RIBA SUSTAINABLE OUTCOMES GUIDE

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Foreword

In June 2019 the RIBA joined the global declaration of an environmental and climate emergency. In the same week, the UK government announced a new law to bring greenhouse gas emissions to net zero by 2050. In September 2019 we launched the RIBA 2030 Climate Challenge and in this new guide, we provide our members to tools to fortify their position as leaders of sustainable outcomes.

As a practitioner and educator, I am a champion of sustainable architecture. As architects we are guardians of the built environment. We are equipped thanks to our education and continuing professional development with the tools to combine strategic ideas with performance and regulation, choice of material, construction and technology – from initiation to occupancy and use.

Architects committed to sustainable design face many barriers that need to be navigated dexterously. Building regulations do not reflect the reality of buildings in use and hamper architects striving for better than the minimum. I believe we must re-construct our profession as the leaders of sustainable design teams if we are to combat climate change and meet the UK climate targets and our ethical responsibilities.

This guide will help you describe the DNA of a sustainable project, using clear and measurable targets across the triple bottom line of sustainability – environmental, social, and economic. I look forward to hearing your feedback as architects take the lead in defining and demonstrating contemporary sustainable professionalism.

Alan Jones, RIBA President 2019-21

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Preface

“rely on renewable energy flows that are always there whether we use them or not, such as, sun, wind and vegetation: on energy income, not depletable energy capital”
Amor Lovins

I have been concerned about climate change since the late 1980s. Throughout my career I have sought to research, teach and create an architecture that is not only beautiful but inherently sustainable. And on some occasions where the project team are completely aligned, sustainable outcomes have resulted. The theory and principles of zero whole life carbon buildings, I believe, is now understood by many in our profession, but unfortunately this view is not shared by everyone and in the wider construction industry. Throughout my career I have encountered a multitude of reasons why sustainability can’t be fully achieved, not least its perceived negative impact on the aesthetic preferences of some in our profession. This business as usual approach is not good enough and has to change.

I am privileged to be writing and contributing to all the latest RIBA sustainable guides in my role as Chair of the Sustainable Futures Group. The SFG is a group of architects and other built environment professionals that are committed to define and guide the construction industry to a sustainable future. Their support and that of the RIBA executive team have been invaluable in writing this guide and turning our ideas into policy and then actions. The RIBA 2030 Challenge is the first step in a radical shift in the profession towards delivering a sustainable future. We will not stop with this current series of guides, and our agenda will now move onto sustainable CPD, Architectural Curriculum, Knowledge Hubs, and raising the sustainable bar in the architectural awards.

The Declaration of a Climate and Ecology Disaster by the RIBA and others this year is the change in attitude that I hope will clear away the last remaining barriers. This is our last chance to avert a climate disaster. We must act now.

Gary Clark
December 2019

Introduction

In June 2019, the RIBA Council declared a climate and ecological emergency and approved all key recommendations of its Ethics and Sustainability Commission, the independent advisory board set up to help the RIBA fulfil its commitment to the UN Global Compact and the 17 UN Sustainable Development Goals. To help implement these recommendations, this guide defines a concise measurable set of core sustainable outcomes and associated metrics that correspond to key UN SDGs. It complements the RIBA Plan of Work 2020 Sustainability Strategy and the RIBA Plan for Use Guide.

An outcomes-based design approach will help resolve the now well-known gaps between design intent and in-use performance across a range of metrics and deliver real and lasting reductions in carbon emissions by reinforcing the feedback loop between briefing and outcomes. It complements mandatory requirements under Government Soft Landings, for UK and devolved governments to carry out post-occupancy evaluation (POE) on all centrally funded public buildings and education projects, with the aim to reduce energy and running costs, and enhance health and wellbeing.

However, it is increasingly clear that delivery of POE studies in general is patchy and the lessons learnt have not been consistently embedded into the knowledge and processes of the construction industry. The operational performance gap must be urgently addressed if the UK is to meet its current net zero carbon target by 2050. Performance gaps also affect user experience of buildings including comfort: virtuous cycles of continuous improvement can be achieved by planning for use, managing expectations during design and construction, more effective handovers, fine tuning buildings after completion, and integrating the lessons learnt from completed buildings into the next generation of projects.

While the recurring lessons learnt from poor in-use performance are understood by some, they are not being consistently applied across the entire profession and construction industry. We also need to seek restorative and regenerative sustainable solutions that put people first; and promote sufficiency and re-use as a guiding principle by asking: do we really need this?

The RIBA Sustainable Outcomes Guide crystallises targets that need to be achieved, with an aggressive timeline to delivery by 2030 for new and refurbished buildings, and an absolute backstop of 2050 for most existing buildings. The RIBA urges all architects to embrace these and act on them. The time for greenwash and vague targets is over: with the declared climate emergency, it is the duty of all architects and the construction industry to act now and lead the transition to a sustainable future that delivers the UN Sustainable Goals.

UN Sustainable Development Goals and RIBA Sustainable Outcomes

In the UN Sustainable Development Goals in Practice (RIBA 2017) explained the ways in which architects and architecture can contribute to supporting all seventeen UN SDGs. In this guide the RIBA has identified eight sustainable outcomes that all buildings contribute to. These sustainable outcomes are clear, measurable, realistic, and transparent between expectations and outcomes. They avoid long checklists and unnecessary complexity and address the triple bottom line definition of sustainability – balancing social, environmental, and economic value. They can be used not just by architects but the wider construction industry and its clients.

The RIBA's eight sustainable outcomes build on previous environmental performance indicators for construction, not least those of the Movement for Innovation in 2001. Not all the UN SDGs are covered, because many of these apply at Government policy level, and beyond the remit of an individual built project.

Diagram 1: UN Sustainable Design Goals Outcomes Map, Gary Clark

This Guide outlines the key performance metrics and design principles that architects and project teams need to follow. Its aim is not to set up another sustainable assessment method, but to clarify the absolute targets for a sustainable future.

While there can be no sustainable future without stopping – and ideally reversing – the build-up of carbon in the atmosphere, other environmental, social and ecomomic strategies must also be addressed. It is no longer enough just to mitigate ill-effects, opportuities for restoration and regeneration must also be taken forward, and holistically. We must also be alert to unintended consquences, and able to identify and mitigate any emerging problems at the earliest opportunity.

For each outcome described, this Guide outlines the key performance metric and a set of design principles that architects and project teams should follow. This approach gives design teams the creative flexibility to use the sustainable assessment methods and modelling tools they prefer to achieve the outcomes and targets chosen. If the principles are not considered holistically at an early stage, there may be unintended consequences and a sustainable outcome is unlikely to be fully realised.

The RIBA requires performance metrics to be independently measured and verified in use by recognised Post Occupancy Evaluation (POE) tools. We cannot continue to allow the use of predicted outcomes as the absolute measure of success if we are serious in delivering a step change in sustainability.

Diagram 2: RIBA Sustainable Outcomes, Gary Clark

RIBA Sustainable Outcomes

Environmental Sustainability | Social Sustainability | Whole Life Net Carbon | Economic Sustainability

	Whole Life Net Carbon			Economic Sustainability				
Outcome	Net Zero Operational Carbon	Net Zero Embodied Carbon	Sustainable Water Cycle	Sustainable Connectivity & Transport	Sustainable Land Use & Ecology	Good Health & Wellbeing	Sustainable Communities & Social Value	Sustainable Life Cycle Cost
Metric	$kWh/m^2/y$ $kgCO_2e/m^2/y$	TCO_2e Embodied	Litre/person/year Potable water	$kgCO_2e$/km/per occupant	Species added Enhancement	Various Metrics	Various Metrics	£/m^2 value
Principles	1. Prioritise deep retrofit of existing buildings 2. Prioritise Fabric First principles for building form and envelope 3. Fine tune internal environment with efficient mechanical systems 4. Provide responsive local controls 5. Specify ultra low energy sufficient appliances 6. Specify ultra low energy sufficient IT 7. Prioritise maximum use of onsite renewables appropriate to context 8. Demonstrate additionality of offsite renewables 9. Offset remaining carbon through recognized scheme	1. Prioritise building re-use 2. Carry out whole life carbon analysis of building elements. 3. Prioritise ethical and responsible sourcing of all materials 4. Prioritise low embodied carbon and healthy materials 5. Minimise materials with high embodied energy impacts 6. Target Zero construction waste diverted to landfill 7. Promote use of local natural materials 8. Consider modular off-site construction systems 9. Detailing to be Long life and robust 10. Design building for disassembly and the circular economy 11. Offset remaining carbon emissions through recognized scheme	1. Provide Low flow fittings and appliances 2. Provide Waterless appliances where possible 3. Provide Leak detection 4. Provide Rainwater and greywater recycling and attenuation but consider operational implications of complex systems 5. Provide on-site black water cleansing and recycling if viable 6. Create Sustainable Urban Drainage that supports natural aquatic habitats and human amenity	1. Create comprehensive green transport plan including digital connectivity 2. Prioritise high quality Digital Connectivity to avoid need for unnecessary travel 3. Prioritise site selection with good proximity to public transport 4. Provide high quality pedestrian links to local amenities 5. Provide end of journey provision for active travel runners and cyclists (showers, dry lockers etc) 6. Provide infrastructure for electric vehicles as a priority 7. Provide car sharing spaces 8. Provide suitable onsite personal storage	1. Leave a site in better 'regenerative' ecological condition than before development. 2. Prioritise Building and site re-use 3. Prioritise Brownfield site selection 4. Carry out sustainable remediation of site pollution 5. Retain existing natural features 6. Create mixed use development with density appropriate to local context 7. Create a range of green spaces (green roofs, vertical greening, pocket parks, green corridors) 8. Create habitats that enhance bio-diversity 9. Create 'productive' 10. landscapes for urban food production 11. Zero local pollution from the development	1. Provide spaces with strong visual connection to outside 2. Provide responsive local controls eg. opening windows, or local control 3. Design spaces with appropriate occupant density for activity 4. Design spaces with good indoor air quality 5. Design spaces with good indoor daylighting, lighting and glare control 6. Design spaces to adaptive thermal comfort standards 7. Design spaces with good acoustic comfort 8. Design spaces that are inclusive and universal accessible 9. Prioritise active circulation routes-e.g. stairs, cycling provision, walking routes etc 10. Provide indoor and outdoor planted spaces	1. Prioritise placemaking that expresses identity and territory 2. Create secure places for privacy 3. Create places for social interaction 4. Create vibrant mixed use places 5. Provide high quality permeable links to social amenities 6. Provide High quality pedestrian public realm 7. Create inclusive Places for community interaction 8. Create Secure Places with overlooking views	1. Carry out whole life cycle analysis of key building systems 2. Carry out Soft Landings Graduated to Handover and aftercare 3. Measure energy costs 4. Measure management and maintenance costs 5. Measure overall running costs 6. Measure added value of occupant health and wellbeing 7. Measure added value of sustainable outcomes of building
	Performance Verification: Publicly disclose energy use and carbon emissions	*Construction Verification:* Construction measurement and offset	*Performance Verification:* Measure potable water usage in operation	*Performance Verification:* Post Occupancy Evaluation occupant survey	*Construction Verification:* Measure bio-diversity enhancement in use	*Performance Verification:* Post Occupancy Evaluation	*Performance Verification:* Post Occupancy Evaluation questionnaire	*Performance Verification:* Measure operational running costs

The fundamental aim of RIBA Sustainable Outcomes is to distil the complexity of sustainable architectural design into a set of measurable and manageable outcomes that architectural practices can use on a daily basis on projects of all scales.

- In addition to building environmental sustainability outcomes, they include social sustainability in terms of Health and Wellbeing and economic sustainability in terms of Operational Cost
- They are measurable by common industry accepted methods of building evaluation
- They align with requirements of the UK Government's Ministry of Housing Communities and Local Government (MHCLG) and the Treasury's Green Book
- They are rigorous and robust, built on cutting edge knowledge in the field, and expressed in interdisciplinary global language of research to encourage engagement across industry and academia, across disciplines and cultures.

Diagram 2 illustrates the various levels of an outcomes-based approach and how they relate to the triple bottom line of sustainable development.

Each outcome is clearly stated with the associated key performance metric, set of design principles and verification requirement; and classified under its respective environmental, social, economic or multiple category. For simplicity, a single key performance metric is shown for each outcome. However, some outcomes are highly complex and require subsidiary but complementary metrics to produce a rounded picture. For example, indoor health includes air quality, daylighting and other environmental variables.

It is also important to highlight that the outcomes should not be seen as separate silos, and instead are inextricably cross-linked. For example, Net Zero Operational Carbon and Net Zero Embodied Carbon should be seen as twin targets under the concept or Whole Life Net Carbon as defined by the UKGBC Net Zero Carbon Buildings: A Framework Definition (2019) and reported using the RICS Whole life carbon assessment for the built environment (2017). Whole Life Carbon will be discussed in greater detail later in the guide.

RIBA Sustainable Outcomes Metrics

1 Net Zero Operational Carbon Dioxide emissions, (kWh/m^2/y and kgCO_{2e}/m^2/year)

The carbon dioxide produced as a result of the production and use of the energy from fossil fuels consumed for the day-to-day operation of the building or structure, including Low/zero carbon renewable energy technologies both on- and off-site, plus recognised offset schemes where essential.

As principally defined by *CIBSE TM 54 Evaluating Operational Energy Use of Buildings at Design Stage, 2013*, or Passivhaus PPHP.

Target – Net Zero for new buildings and retrofit buildings

2 Net Zero Embodied Carbon Dioxide (kWh/m^2/y and kgCO_2e/floor area m^2)

The carbon dioxide produced from the energy used in the extraction, fabrication and transportation from place of origin of the materials used in the construction, including recognised carbon offset schemes.

As principally defined by *RICS Whole Life Carbon Assessment for Built Environment, 2017.*

Target – Net Zero for new buildings and retrofit buildings including offsetting

3 Sustainable Water Cycle (m^3/person/year)

Analogous to operational carbon dioxide, the amount of mains water used in the operation of the building including the offset by use of greywater or recycled water to reduce mains water consumption.

As principally modelled by *England and Wales building regulations water calculator*

Target – To achieve 40% reduction in potable water use per person per day

4 Sustainable Connectivity and Transport (kgCO_2e per km per person per annum)

The purpose of this outcome is to measure the resultant carbon impact of the travel of occupants and visitors to and from site or building to a local transport hub or local retail and community facilities.

As principally defined by *BREEAM 2018 Transport Credits.*

Target – To achieve net zero carbon emissions per person per day

5 Sustainable Land Use and Bio-diversity (increase in new flora or fauna species on site)

The intention is that this outcome should be used as a measure of actions taken to maintain, protect and improving the flora and fauna on site.

As principally defined by *BREEAM 2018 bio-diversity credits, Urban Green Factor, London Plan.*

Target – To achieve net positive species impact and 0.3-0.4 urban green factor on all new sites

6 Good Health and Wellbeing (various metrics)

This outcome includes key variables of internal occupant health and well-being, including Indoor Air Quality, Daylight, overheating, acoustic comfort, responsive controls, and physical contact to outside.

As principally defined by CIBSE TM 40, 52, and 59, Good Homes Alliance overheating guidance and/or *WELL Building Standard v2 Preconditions, 2019.*

Target – To achieve good indoor health metrics as per 2030 challenge, including CIBSE TM 40, TM 59 Overheating Avoidance

7 Sustainable Communities and Social Value (various metrics)

The intention of this outcome is to measure the positive impacts of good placemaking on a local community.

As principally defined by *RIBA Social Value Toolkit, 2019.*

8 Sustainable Life Cycle Cost (£/m²)

The ensure a holistic outcome with regards to economic sustainability, the intention is to use Government Soft Landings requirement for measuring operational costs of buildings.

As principally defined by *ICMS Global Consistency in Presenting Construction and Other Life Cycle Costs, 2019.*

Diagram 3: RIBA Core Sustainable Outcomes Target, Gary Clark

The RIBA 2030 Climate Challenge

In response to its declaration of a climate emergency, the RIBA has set the architectural profession a challenge of achieving the following reductions as soon as possible:

1. Reducing operational energy demand and carbon by at least 75%, before offsetting
2. Reducing embodied carbon by 50-70% before offsite renewables offsetting
3. Reduce potable water use by 40%
4. Achieve all core health targets (as set out below).

This challenge focuses on the three environmental sustainability outcomes that all new or refurbished buildings contribute to: energy use, embodied carbon and water use with an overall aim to target net zero whole life carbon emissions (or better) by 2030 at the latest.

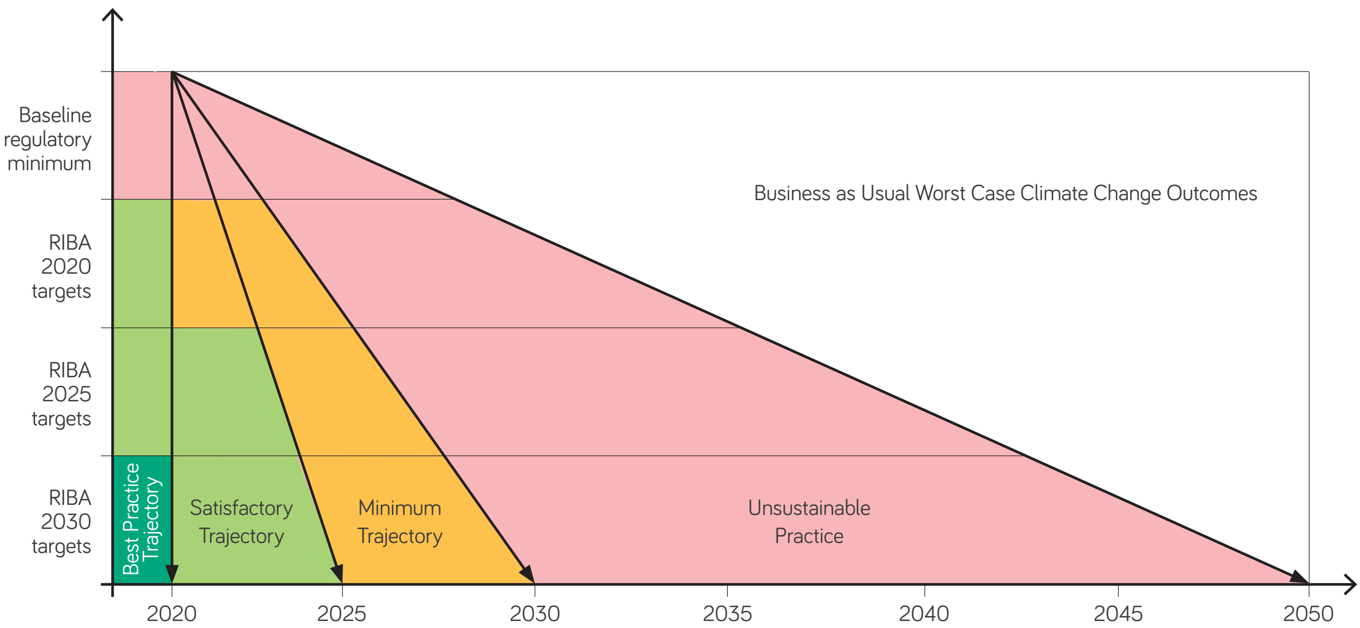

Diagram 4: RIBA 2030 Climate Challenge Trajectories

We believe that net zero whole life carbon could be achieved in urban areas when taking into account offsite renewable generation and certified woodland offsetting, and in lower density areas without offsetting.

The following sections discuss specific measures and targets, outcome by outcome. We recognise targets will need tailoring by sector, building type and use, region and so on. The RIBA will develop metrics with other professional bodies including RICS and CIBSE. However, we cannot wait for the perfect benchmark to be developed, and would rather urge project teams to aim for a percentage reduction of the current best practice benchmark and to help develop sector benchmarks in the future.

The targets shown in the following Sections take account of the latest recommendations from the Green Construction Board committees on operational carbon and on materials and waste; and consultation with a number of professional bodies and the RIBA Sustainable Futures Group. We believe these targets are stretching yet realistic, and a vital first step to achieve a net zero carbon UK by 2050. Diagram 4 shows RIBA targets for offices and residential.

To assist in the realistic prediction of the operational energy target and avoiding the performance gap, the RIBA would recommend the use of CIBSE TM54 or other comparable design for performance methods. It is important to report the energy use by fuel use and include the full breakdown of regulated and unregulated energy use.

Similarly, the RIBA would also recommend using embodied carbon assessment tools that embody all RICS whole life carbon modules A, B, and C to ensure consistency and equivalence of measurement.

RIBA 2030 Climate Challenge target metrics for domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	146 kWh/m² /y (Ofgem benchmark)	< 105 kWh/m²/y	< 70 kWh/m²/y	< 0 to 35 kWh/m²/y	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1000 $kgCO_2e/m^2$ (M4i benchmark)	< 600 $kgCO_2e/m^2$	< 450 $kgCO_2e/m^2$	< 300 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day	125 l/p/day (Building Regulations England and Wales)	< 110 l/p/day	< 95 l/p/day	< 75 l/p/day	CIBSE Guide G

RIBA 2030 Climate Challenge target metrics for non-domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	225 kWh/m²/y DEC D rated (CIBSE TM46 benchmark)	< 170 kWh/m²/y DEC C rating	< 110 kWh/m²/y DEC B rating	< 0 to 55 kWh/m²/y DEC A rating	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1100 $kgCO_2e/m^2$ (M4i benchmark)	< 800 $kgCO_2e/m^2$	< 650 $kgCO_2e/m^2$	< 500 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day	>16 l/p/day (CIRA W11 benchmark)	< 16 l/p/day	< 13 l/p/day	< 10 l/p/day	CIBSE Guide G

RIBA 2030 Climate Challenge target metrics for all buildings

Best Practice Health Metrics		References
Overheating	25-28 °C maximum for 1% of occupied hours	CIBSE TM52, CIBSE TM59
Daylighting	> 2% av. daylight factor, 0.4 uniformity	CIBSE LG10
CO_2 levels	< 900 ppm	CIBSE TM40
Total VOCs	< 0.3 mg/m³)	Approved Document F
Formaldehyde	< 0.1 mg/m³)	BREEAM

Diagram 5: RIBA 2030 Climate Challenge Office and Domestic Targets

Sustainability Assessment Tools

Diagram 6 shows some widely used sustainability assessment and POE methods. This guide does not seek to reinvent or supplant these, but to identify commonalities between them.

Tools should be chosen for the quality of insight and feedback they provide to inform briefing and design in the early stages, expectations management as a project proceeds, and performance assessment and remedial interventions once a building is used. They should be as simple as possible, only providing feedback that will be used. Complex statistical outputs may make results difficult to interpret, confusing designers and building operators. If all tools available were used on a single project, there would be duplication, contradictions, too much data, and increased risk of spurious correlations between supposed cause and effect. It is best to keep outcome metrics simple and the input data good and reliable.

This Guide defines the most important outcomes only and gives project teams flexibility to choose the sustainability assessment and certification methods that best suit the project and the client.

	Zero Operational Carbon	Zero Embodied Carbon	Sustainable Water Cycle	Sustainable Connectivity and Transport	Sustainable Land use and Bio-diversity	Good Health and Wellbeing	Sustainable Cities and Communities	Sustainable Life Cycle Cost	Measurement in use
BREEAM	●	●	●	●	●	●	●		optional
BUS Methodology						●			yes
CIBSE TM22	●								yes
CIBSE TM 54 and 59	●								yes
CIC Design Quality Indicators						●			yes
Greenstar *(Australia)*	●	●	●	●	●	●	●		optional
BRE Home Quality Mark	●	●	●		●	●	●		optional
LEED	●	●	●	●	●	●	●	●	optional
Living Building Challenge	●	●	●	●	●	●	●	●	yes
Leesman Index						●			yes
NABERS *(Australia)*	●		●			●			yes
Passivhaus	●					●			yes
RIBA Social Value Toolkit							●	●	yes
WELL Building Standard						●			yes
Process Tools to ensure the delivery of outcomes									
RIBA Plan for Use	●	●	●	●	●	●		●	yes
Soft Landings	●	●	●	●	●	●		●	yes

Diagram 6: Sustainability Tools Table

To close the performance gap and deliver consistent levels of sustainable outcomes we can no longer rely solely on predicted values: in-use performance must be measured and verified consistently and accurately.

BREEAM and LEED are the most widely used sustainability assessment methods and have fundamentally raised the understanding and integration of sustainable design and technologies. In addition, the BRE and the International WELL Building Institute™ (IWBI™) are collaborating to promote health and wellbeing in design, construction and operation of buildings and fit-outs, internationally. The document, Assessing Health and Wellbeing in Buildings, has been written to assist those who wishing to obtain both a BREEAM and WELL certification.

BREEAM 2018 has taken an important step to close the performance gap by awarding credits for verification of energy use using CIBSE TM54 and post occupancy user surveys.

Using the Metrics

The techniques and metrics must be kept under continuous review throughout a project. This will help to maintain the "golden thread" from client and design intent to operational reality, as identified in the Soft Landings Framework and the Hackitt Report. See the Sustainability Strategy in the RIBA Plan of Work 2020 Overview and RIBA Plan for Use Guide for stage specific tasks related to the sustainable outcomes metrics.

Post Occupancy Evaluation

Post Occupancy Evaluation during Stage 6 and 7 of the RIBA Plan of Work is critical to optimising in-use performance. While the original 1963 Plan of Work included Stage M – Feedback, it was woefully underused and removed in 1972. This cannot continue, so the RIBA now requires all architects to promote POE to clients as a core service.

As discussed in the Plan for Use Guide, the RIBA identifies a graduated approach to POE from:

Level 1 – **Light Touch Review**, to obtain rapid feedback on performance and occupant satisfaction and to identify opportunities for fine-tuning. With the assistance of other design and building team members, the Architect will ideally do this during RIBA Stage 6, by the end of the 12-month defects period. Some independent input is desirable but not essential.

Level 2- **Diagnostic Assessment**, normally by independent evaluators during Year 2 of occupation, to verify performance and review any issues discovered, including those identified at Level 1.

Level 3- **Detailed (Forensic) Investigations,** if necessary by independent evaluators, to identify and where possible resolve any significant and persistent performance issues. These can start at any time, but should ideally be completed by the end of Year 3.

Building Performance Evaluation methods available for use in POE cover a wide range of outcomes and metrics. Widely used in the UK are the CIBSE TM22 energy assessment method and the BUS Methodology occupant satisfaction survey. Both were developed and used as prototypes for major studies of offices in the 1980s and codified in the 1990s. Together with walk-through surveys, spot checks using hand-held instruments, and informal discussions with occupants and management, they were applied in the twenty "Probe" POE studies, published between 1995 and 2002. In 2001-15, they were used in Innovate UK's £ 8 million Building Performance Evaluation studies.

Another tool that has been used extensively in the UK is the RIBA Higher Education Design Quality Forum Method (2000). Available at: https://www.hedqf.org/wp-content/uploads/2019/02/2000_HEDQF_Post_Occupancy_Review_of.pdf

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Soft Landings

Soft Landings was created by Mark Way Chair of RMJM for their projects for the University of Cambridge in the early 1990s with essential support from the university's Director of Estates David Adamson. Since then it has been developed over many years by principally Rod Bunn, Bill Bordass, and BSRIA to help the client and design team deliver better outcomes without being prescriptive. Soft Landings is not an alternative or competition to the aforementioned sustainability methods and tools. Instead it is the framework on which the other tools can more comfortably sit, and travel further because of the commitment to BPE, graduated handover, and post-completion follow-through (including POE) that Soft Landings requires.

There are 12 core principles of Soft Landings:

1. Adopt the entire process
2. Provide Leadership
3. Set Roles and Responsibilities
4. Ensure Continuity
5. Commit to Aftercare
6. Share Risk and Responsibility
7. Use Feedback to Inform Design
8. Focus on Operational Outcomes
9. Involve the Building Operators
10. Involve the End Users
11. Set Performance Targets
12. Communicate and Inform

These principles inherently ask the project team to consider the following for any of the sustainable outcomes as described within this guide:

- Work collaboratively and with a no blame culture
- Benchmarking at the inception of the project
- Design with the end operational outcomes in mind, however they are expressed
- Regularly reality-check and risk assess progress on operational outcomes throughout procurement.
- Explain the design intent to the users before handover and support them thereafter
- Support the building operators and end-users within the first year of handover
- Carry out periodic POE, share the lessons learned and use them to make improvements.

The RIBA believes that the most consistent tools in delivering sustainable outcomes are those that share a common requirement to measure actual in use performance before attaining certification. We believe that irrespective of any sustainability assessment method chosen, it would be important that the principles of Soft landings are adhered to, or ideally to formally follow the Soft Landings framework. The combination of measurement and verification method together with a softer more collaborative approach, we believe, is more powerful than using a single approach alone.

The RIBA Plan for Use discusses Soft Landings in greater detail, but in summary we would suggest that project teams use the following combination of steps to ensure that better outcomes are achieved.

Step 1 Define sustainable outcomes during briefing

Step 2 Use one (or more) of the sustainability certification tools to ensure compliance

Step 3 Adopt the Soft Landings Principles as a basis for reality-checking outcomes and handover building

Step 4 Verify sustainable outcomes through POE

Diagram 7: RIBA Plan of Work Soft Landings Outcomes

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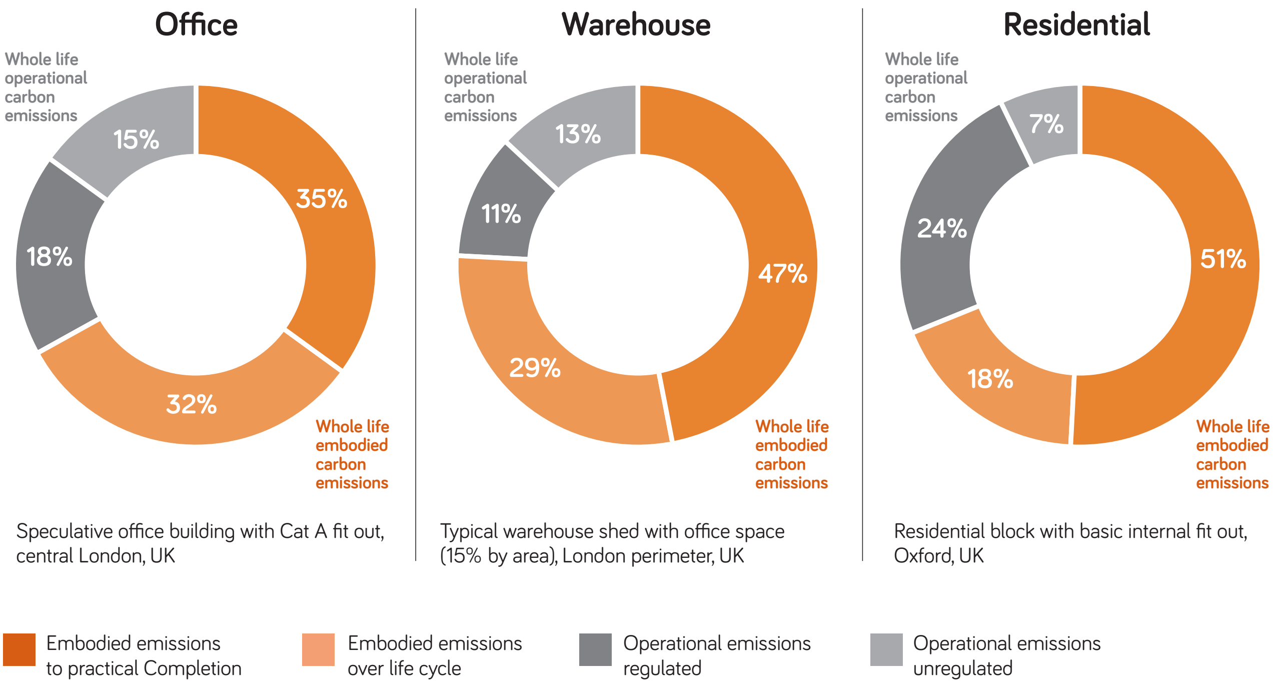
Available at: https://www.bsria.com/uk/product/XBYWwn/how_to_procure_soft_landings_specification_and_supporting_guidance_for_clients_consultants_and_contractors_bg_452014_a15d25e1/

Whole Life Carbon

The RIBA believes that all new buildings need to achieve net zero whole life carbon by 2030, so that as an industry we can help limit climate change to 1.5°C above pre-industrial levels by the end of the century. For this to be possible the RIBA recognises that the industry will need the knowledge, skills and experience to be able to deliver net zero buildings within the next few years so that buildings that are completed in 2030 meet this target.

The UKGBC Net Zero Framework also states that while operational energy reduction is a key priority, whole life carbon costs and benefits over the life of the building need to be assessed too. Otherwise, there may be unintended consequences, e.g. over-sophisticated systems that save less carbon than they embody. Whole Life Carbon assessment (sometimes referred to as Life Cycle Assessment or LCA) describes the combined impacts of both operational and embodied emissions over a building's entire life and its ultimate disposal. The aim is to minimise overall carbon emissions by optimising resource efficiency over a building's entire life cycle, for example optimising the relationship between facade design, structural design and environmental servicing.



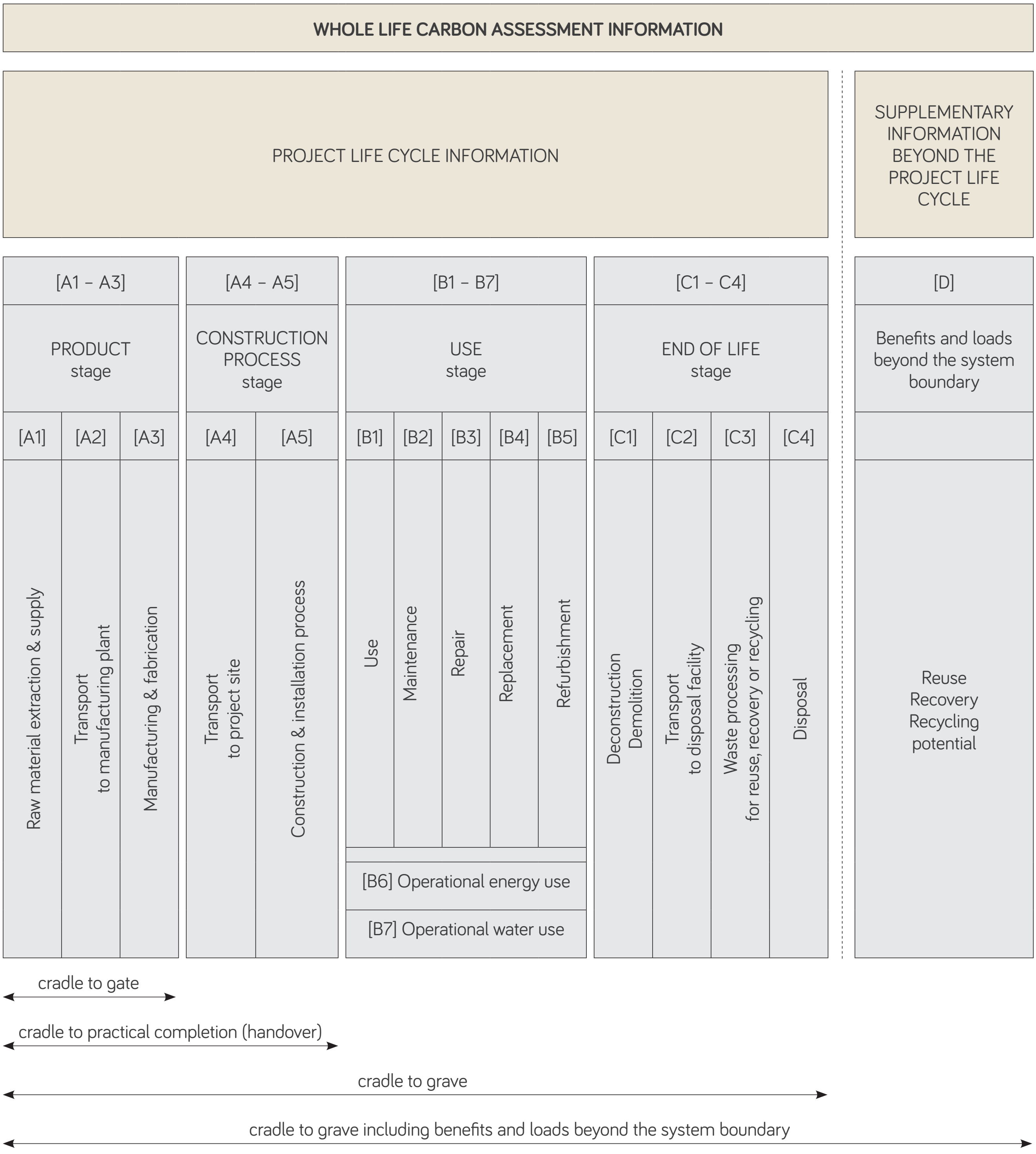
Pie charts illustrating indicative relationships between operational and embodied carbon emissions for three building typologies. The whole life figures have been calculated in line with the modular structure (modules A-C) of BSEN15978 as detailed in RICS PS., i.e. over a 60 years life cycle. Operational and embodied emissions are as estimated at design stage. Grid decarbonisation applied to emissions due to electricity consumption over the life of the building in accordance with the slow progression scenario in National Grid Future Energy Scenarios 2015. Diagrams: Sturgis Carbon Profiling/ RICS.

Diagram 8: Whole Life Carbon Charts of Building Types, Simon Sturgis

Other benefits of a WLC assessment include optimising maintenance and replacement cycles, and future proofing asset value against future climate change.

The British Standard BS EN 15978:2011 sets out the overall principles of embodied and whole life carbon measurement in the built environment. BS EN 15978 covers the assessment of the environmental performance of buildings, while the associated BS EN 15804:2012 covers the environmental performance of individual products. Ideally these two standards should be read together. Other relevant standards are: PAS 2050, PAS 2080 and the ISO 14000 series.

In November 2017 RICS published "*Whole life carbon assessment for the built environment*" – a Professional Statement (the highest form of RICS guidance, both mandatory and regulated by the RICS. It is the recommended methodology for undertaking carbon assessments, brings increased consistency to reporting, aligns with BS EN 15978 and provides a reporting structure and practical guidance for calculating lifetime embodied and operational emissions. It can be applied to all types of built assets, including buildings and infrastructure and covers new and existing assets including refurbishment, retrofit and fit-out projects.



Modular reporting structure of BS EN 15978 as used in RICS PS
Module A: Product and Construction stages; Module B: In use; Module C: End of Life; Module D: potential benefits through reuse or recycling.

Diagram 9: Whole Life Carbon BS EN 15978 Modular Reporting Structure

Design and Verification Tools

WLC methodology is already embedded in many sustainable assessment and verification tools, including the UKGBC Net Zero Carbon Buildings: A Framework Definition, (2019), which provides detail on the background to Whole Life Carbon, and a clear list of design priorities in order to achieve Net Zero – starting with passive first principles and ending with offsite renewables and embodied carbon offsetting.

The UKGBC framework acknowledges the need for more accuracy and reliability in reporting embodied carbon of materials and products e.g. "a further scope for net zero whole life carbon will be developed in the future" and "Net zero whole life carbon is not proposed as an approach at present due to current limitations in the reporting of carbon from the maintenance, repair, refurbishment and end-of-life stages of a building's lifecycle. Instead, project teams are encouraged to aim for net zero carbon in construction A1-A5 (new buildings and major refurbishments) and for operational energy B6 (existing buildings), until greater familiarity with whole life carbon impacts has been achieved."

Steps to Achieving a Net Zero Carbon Building

1. **Establish Net Zero Carbon Scope**
   - 1.1 Net zero carbon – construction
   - 1.2 Net zero carbon – operational energy
2. **Reduce Construction Impacts**
   - 2.1 A whole life carbon assessment should be undertaken and disclosed for all construction projects to drive carbon reductions
   - 2.2 The embodied carbon impacts from the product and construction stages should be measured and offset at practical completion
3. **Reduce Operational Energy Use**
   - 3.1 Reductions in energy demand and consumption should be prioritised over all other measures.
   - 3.2 In-use energy consumption should be calculated and publicly disclosed on an annual basis.
4. **Increase Renewable Energy Supply**
   - 4.1 On-site renewable energy source should be prioritised
   - 4.2 Off-site renewables should demonstrate additionality
5. **Offset Any Remaining Carbon**
   - 5.1 Any remaining carbon should be offset using a recognised offsetting framework
   - 5.2 The amount of offsets used should be publicly disclosed

Diagram 10: Steps to achieve Zero Carbon, UKGBC 2019

BREEAM 2018 (Mat01 category) has increased the focus on the life cycle impacts of construction products on the environment. It requires a minimum of two life cycle assessments for embodied carbon and life cycle carbon, at RIBA Stages 2 and 4.

The latest draft of the proposed new London Plan includes the requirement that referable buildings undertake a WLC assessment using a nationally recognised methodology, with the London Mayor's Environment Strategy of May 2018 making explicit reference to the RICS Professional Statement.

WLC thinking should start at the outset of a project: **RIBA Stages 0** (Strategic Definition) and **Stage 1** (Preparation and Briefing). The Brief should include the proposed scope of assessment in line with the RICS Professional Statement *'Whole Life Carbon assessment for the built environment' 2017.*

During **RIBA Stages 2** (Concept Design) and **Stage 3** (Spatial Coordination), WLC considerations such as climate change, future flexibility, operational performance, intended design life and durability, material optimisation, deconstruction and disposal are all relevant to concept development. WLC analysis of design options for major built systems (structure, cladding, mechanical services etc.) and the relationship with the building's proposed environmental performance should be undertaken. It is worth noting that BREEAM 2018 Mat01 requires Stage 2 engagement with embodied carbon thinking.

During **RIBA Stage 3** a WLC assessment should be prepared using the material descriptions and quantities in the cost plan, and the anticipated energy use over the building's life. This indicative baseline carbon budget should be updated with actual material/product choices and the evolving environmental strategy as the project progresses. Reporting should be both as totals (tCO_2e), and more usefully for comparative purposes as intensity ($kgCO_2e/m^2$). The WLC assessment can be synchronised with any life cycle costing analysis undertaken for BREEAM Man 02. A table of detailed design options and their respective impacts on the carbon budget should be prepared to enable the design team to choose low carbon and preferably cost neutral options. Circular Economic potential can be given a carbon value referencing Module D of the RICS Professional Statement – though this is not strictly part of a building's life cycle emissions. With some authorities, WLC evaluations can contribute to the Planning Submission's Environmental Impact Assessment.

During **RIBA Stage 4** (Technical Design) the low carbon options and strategies need to be fully incorporated into drawings and specification for tender and procurement. The process needs to be tailored to engage with the supply chain, but not increase tender prices. It is important that the tender documentation ensures that competing contractors understand the WLC requirements, the goals and process of delivering and monitoring carbon reductions during construction.

For **RIBA Stage 5** (Manufacturing and Construction) the actual carbon impacts of the construction process need to be monitored against the Stage 3 carbon budget taking into account any evolution of the scheme during tender and procurement. It is recommended that reporting intervals of 3-6 months during construction helps ensure delivery of the project requirements.

For **RIBA Stage 6** (Handover) should include a post practical completion final review of the asset information, with a final assessment of the WLC impacts of the completed project – which should be included within the buliding manual. Light touch post occupancy evaluation might include a more thorough account of operational carbon use.

RIBA Stage 7 (Use) Any post-occupancy evaluation (POE) process should take account of all WLC impacts. This should include the actual performance of the building's environmental systems; the fabric's physical performance with respect to durability and fitness for purpose; and an assessment of the maintenance regimes for both.

In conclusion, WLC assessment has traction in the industry, and is proposed in the new London Plan. The UKGBC Framework suggests that net zero operational and net zero construction emissions are adopted as twin objectives in the design process. Operational energy predictions should use techniques such Passivhaus PHPP and CIBSE TM54, that predict actual in-use energy requirements; and not the compliance modelling that has been commonplace.

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Net Zero Operational Carbon

Introduction

Forty percent of global carbon emissions come from powering our buildings and cities. The urgency of reducing these makes a Net Zero Operational Carbon Outcome a critical construction industry target, and we consider net zero operational carbon is achievable now with offsetting.

Operational energy, from the meter, is the key indicator of the operational efficiency of a building and should be clearly understood by the project team outside of the use of renewable energy sources. There are four key steps in the reduction of operational energy and carbon within a building:

1. **Passive First**
   Use form, fabric and landscape to optimise ambient lighting, heating, cooling and ventilation
   - Location, orientation, massing, protection and shading
   - Windows, daylighting, ventilation, solar and acoustic control
   - Insulation, airtightness and thermal mass
2. **Fine-tune, with gentle engineering**
   Use efficient and well-integrated mechanical and electrical systems and user-friendly controls
   - Lighting systems, with effective
   - Ventilation systems, both natural and mechanical.
   - Heating, cooling heat storage and heat recovery systems
   - Responsive system and room controls, with good user interfaces
3. **Incorporate on-site renewables**
   Use low and zero carbon (LZC) technologies to minimise energy purchases and carbon emissions. Consider:
   - Building Integrated photovoltaic and solar hot water panels
   - Ground, water and air source heat pumps and opportunities for heat recovery
   - Heat and electricity storage, to improve load management and demands on mains supplies
   - Local opportunities for wind and water power and for community systems
4. **Make the building and its systems usable and manageable**
   Avoid designing buildings that prove too complicated to look after, frustrating occupants and wasting energy. Consider:
   - Start a dialogue in Stage 1 about how the building and its systems will be used and managed
   - Write and regularly update a narrative about this. Put the final version in the Log Book
   - Design for usability and manageability, testing ideas with occupier representatives
   - Identify who will operate the building as early as possible. Make sure I see the point from either way – note below.
   - Don't leave controls – and particularly their user interfaces – to the engineers. Architects need to understand where best to put them and how they are supposed to work
   - If possible involve the future building users and managers to review the designs, ideally in mock-ups and with samples of the proposed user interfaces
   - Plan for commissioning, including seasonal commissioning and fine tuning during Year 1

In most dense urban locations, it will be challenging to achieve net zero emissions on site. The RIBA supports the UKGBC net zero framework, which allows offsite renewables such as wind farms and certified woodland offsetting to be used to achieve net zero operational carbon.

It is important to calculate and consider the energy use of a building first (by energy source too) and then the resultant carbon emissions. The energy analysis gives a better understanding of a building's performance, which carbon can obscure, particularly given the variability of the conversion factors.

The London Energy Transformation Initiative has created a simple one page guide on ten key components of net zero buildings, available at: https://www.leti.london/

Targets

The RIBA believes that to tackle absolute carbon emissions from UK building stock, new domestic and non-domestic buildings will have to significantly reduce energy in use from current best practice targets such as CIBSE TM46 for non-domestic buildings. For domestic buildings, the Passivhaus heating demand target is a good target, and through this process electrical and primary energy requirements can be reduced substantially. Renewables can also be added, when using Passivhaus Plus and Premium.

However, new buildings only account for 1% of the total UK building stock annually, so the existing building stock will need to be improved substantially if the built environment is to achieve net zero operational carbon by 2050. The RIBA promotes strategies and policies for the incremental retrofit of the existing building stock to reduce energy use and emissions, however we recognise that this will be challenging giving the physical and financial constraints of retrofitting existing buildings. We therefore support the use of the UKBC Net Zero Framework principles of maximising the energy efficiency of the existing building first (which could be at least 50% of total operational energy), and then applying renewables and offsetting schemes to achieve net zero.

Key Design Principles

The key design principles that should be followed through all stages of the RIBA Plan of Work 2020 are below, with the emphasis on energy efficiency measures before renewables or offsetting are considered:

1. Prioritise retrofit of existing buildings
2. Prioritise Fabric First principles for building form and envelope
3. Fine tune internal environment with efficient mechanical systems
4. Provide responsive local controls
5. Specify ultra-low energy appliances
6. Specify ultra-low energy IT
7. Prioritise maximum use of onsite renewables appropriate to context
8. Demonstrate additionality of offsite renewables
9. Offset remaining carbon through a recognised scheme

It is important to avoid unintended consequences in the rush to reduce energy and carbon emissions. For example, the diesel car policy has created a significant health impacts due to particulates and oxides of nitrogen; while insulated and airtight buildings without appropriate windows, shading, ventilation and passive cooling strategies can suffer overheating and moisture-related problems.

Design Tools

The performance gap in operational energy is now well recognised. For example, predicted energy from **SBEM Part L2** and in UK EPC ratings bears very little relation to actual energy use: it covers only “regulated” energy use, and uses standard operational assumptions that seldom match real-life situations. This gap is inherent in Part L, making it solely a compliance tool.

The construction industry must also predict and then measure operational energy consistently. The RIBA urges all architects to support the use of CIBSE TM 54 method, which uses real world benchmarking data to allow operational energy use, targets and assumptions to be estimated at an early stage and tracked through all stages of the Plan of Work. The Passivhaus methodology and PPHP calculator is an alternative assessment system that has also proven to deliver class leading levels of operational energy performance.

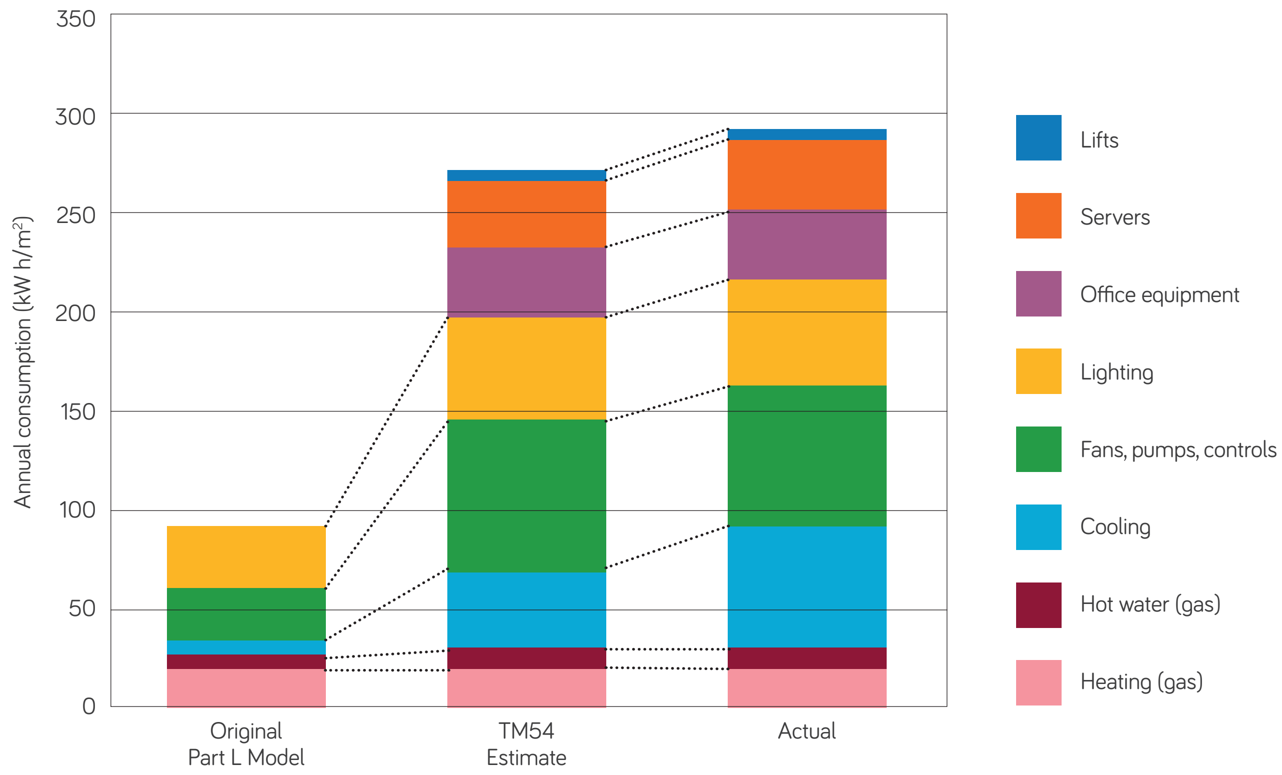

Diagram 11: Part L model versus TM54 estimate versus actual, Source CIBSE

The Passivhaus method and PPHP Modelling is a different approach to TM54 which includes a number of benefits:

- Clear targets and guidance
- Robust Process
- Educated supply chain
- Detailed case studies
- Independent Verification & Certification

The success of Passivhaus in consistently delivering a step change in energy reduction. In Australia, similar benefits have come from NABERS Commitment Agreements, particularly for landlord's services – "the Base Building" in rented multi-tenanted offices. A UK derivative of NABERS, *DfP – Design for Performance,* is now available for UK offices; with other sectors to be added in due course. See www.betterbuildingspartnership.co.uk/node/360 .

Design and Certification Tools

BREEAM 2018 has many credits related to operational energy use, including:

- Ene 01 Reduction of emissions
- Ene 02 Energy monitoring
- Ene 03 External lighting
- Ene 04 Low and zero carbon technologies
- Ene 05 Energy efficient cold storage
- Ene 06 Energy efficient transportation systems
- Ene 07 Energy efficient laboratory systems
- Ene 08 Energy efficient equipment

Performance in use Verification

Key tools for measuring and reporting in-use energy are CIBSE TM22 (Non-domestic) and DOMEARM (domestic) which both employ a rigorous approach to analysing metered data and checking equipment loads. The CIBSE TM22 method has been used since the 1990s, when it was used to collect and organise in-use benchmarking data for ECON 19, Energy Use in Offices (1991, revised 1997).

There are nine principle end uses for energy in office buildings relating to building services or occupiers' equipment.

End uses (building services):

- heating and hot water – by gas or oil
- cooling – including chillers, packaged airconditioning equipment, condensers and cooling towers
- fans, pumps and controls
- humidification – though rare, is spreading in mechanically ventilated and air-conditioned buildings
- lighting of the treated area.

End uses (occupiers' equipment):

- office equipment – excluding vending machines, local kitchens or equipment in dedicated rooms (eg computer suites and print rooms)
- catering – including vending machines, kettles, dishwashers etc, and sometimes catering kitchens, shown in type 4 only
- other electricity – including lifts, print rooms, and energy use outside the measured treated area, for instance by plant room or exterior lighting
- computer and communications rooms – including air-conditioning of their dedicated suites. Energy use depends on the amount of equipment installed and can be substantial.

Diagram 12: Energy Uses in Offices, Source ECON 19, 1997

The ECON 19 benchmarks, while in need of updating, nevertheless remain relevant today. For example, operational energy use data from case studies in the recent Innovate Building Performance Evaluation Programme (2011-15) is broadly comparable with the 1997 "good practice" benchmarks. However, while the regulated loads (particularly from heating) have reduced significantly over the years, this has been matched by increases in electricity use – particularly from electronic equipment.

In 2019, CIBSE has launched a new operational energy benchmarking website. This still includes the ECON 19 values, but for some sectors it shows more recent data – particularly that collected for public sector buildings in the database of Display Energy Certificates, DECs – in terms of statistical distributions.

CarbonBuzz is an RIBA CIBSE platform for benchmarking and tracking energy use in projects from design to operation. It was developed to encourage users to go beyond Part L compliance, refine design estimates to account for additional energy loads in-use, and put both predicted and metered data side by side with each other. Having lost government funding, the RIBA and CIBSE are pursuing options to capture the predicted and actual operational energy use, including breakdown by end use.

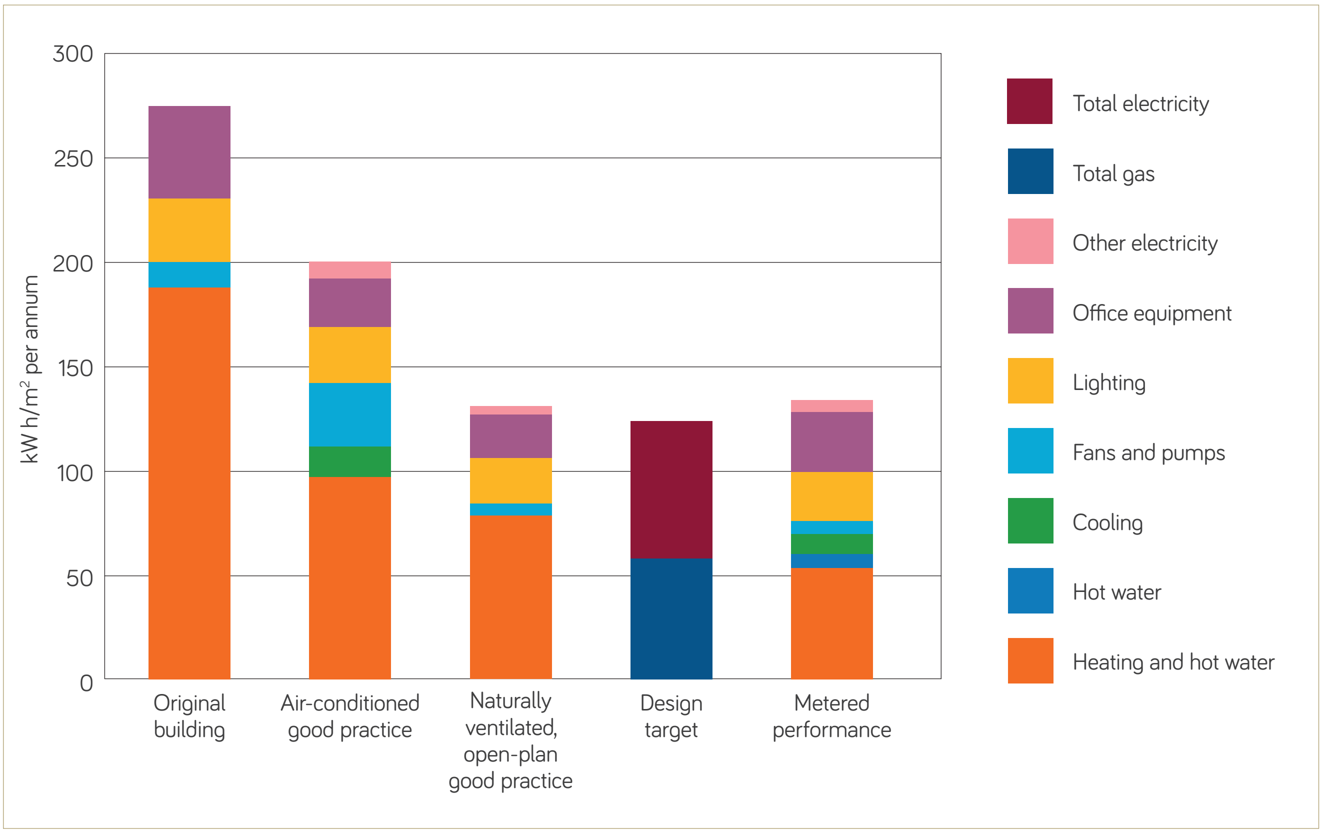

Diagram 13: Operational Energy use of Elizabeth II Court, Hampshire County Council, Bennetts Associates, Source Roderic Bunn for the Carbon Trust

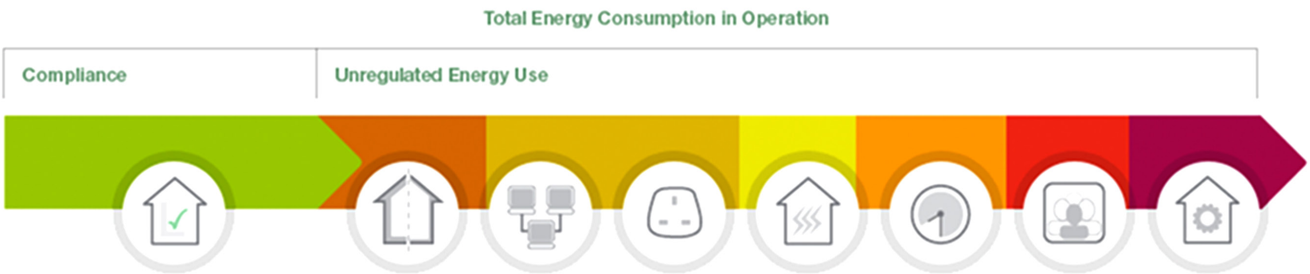

Diagram 14: The Performance Gap, RIBA/CIBSE CarbonBuzz

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TM54: Evaluating operational energy performance of buildings at the design stage, CIBSE (2013). Available at: https://www.cibse.org/Knowledge/knowledge-items/detail?id=a0q20000008I7f7AAC

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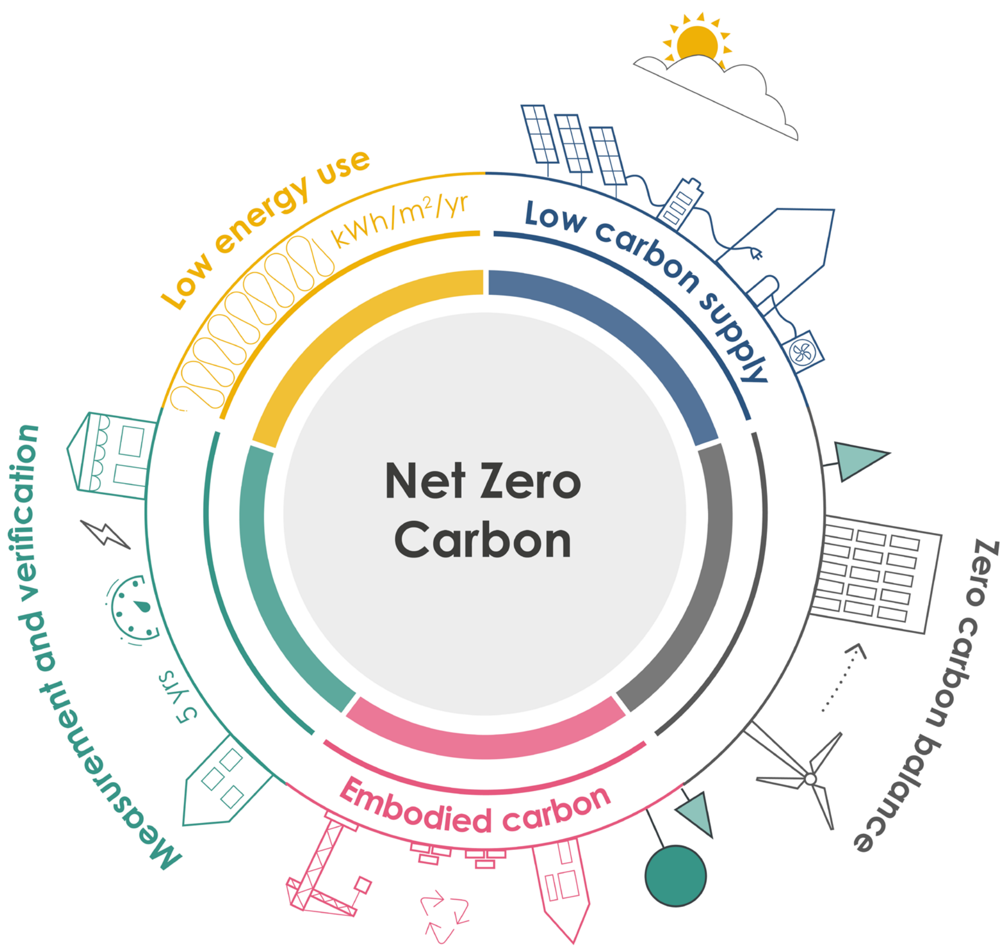

Diagram 15: Requirements for Net Zero Operational Carbon Building, LETI 2019

Net Zero Embodied Carbon

Introduction

Embodied carbon emissions are generated from the processes associated with sourcing materials, fabricating them into products and systems, transporting them to site and assembling them into a building. They also include the emissions due to maintenance, repair and replacement, as well as final demolition and disposal. Embodied carbon emissions from construction and over the buildings service life (often taken as 60 years) are significant, and in exceptional low carbon DEC A-rated or Passivhaus projects, often represent more than 50-70% of the lifetime emissions of a new building. Embodied carbon emissions are considered as supply chain emissions and reported in carbon dioxide equivalent (CO_2e).

Embodied carbon assessments provide a better understanding of the sourcing and processing of materials and products; an understanding of long-term post completion considerations such as maintenance, durability, adaptability, and also making plain the carbon savings value of retaining existing built fabric. Embodied assessments also help quantify the carbon impacts of procurement choices, construction methods (e.g. off-site vs on-site), waste mitigation and disposal, and circular economic considerations.

Reducing embodied emissions is directly related to resource efficiency and manifests itself in several ways – a more efficient supply chain for example, the use of recycled content reducing costs, improved durability leading to longer life with less maintenance and replacement.

In creating our buildings and infrastructure for a sustainable future, we not only have to consider reducing embodied energy, but we have to create robust and resilient solutions to a future of extreme weather events. Within this outcome the RIBA urges architects and the construction industry to model and test construction systems for a future climate, using future climate models such as UKCIP.

An extensive global survey of embodied energy benchmarks per building type are outlined below. The aim is to significantly reduce the embodied carbon of buildings by at least 50-70% before offsetting.

Target

The target is to achieve net zero embodied carbon emissions for new buildings including offsetting. This target also implies zero construction waste.

The M4i benchmarks from the early 2000s are still relevant today as a starting benchmark for different sectors.

Embodied CO_2 for Various Building Type

Building Type	Benchmark Scores ($kgCO_2/m^2$)				
	Best	25%	50%	75%	Worst
Offices	500	650	800	950	1100
Domestic Dwellings	300	360	630	815	1000
Retail	600	720	900	1075	1500
Hospitals	750	875	1030	1265	1500
Education	500	640	857	975	1000

Note: these are estimates based on calculations using typical specification for each of the building types, therefore in the graphical representation these are shown as a continuum rather than segment as for measured values. Intermediate values are simply the quarter points between the minimum and maximum values.

Diagram 16: M4i KPI Benchmarks (cradle to grave) from early 2000's

The RIBA 2030 Challenge suggests achieving a 50-70% reduction in embodied energy as soon as possible, with a backstop of 2030, before offsetting by certified renewable generation and or woodland regeneration schemes.

The Living Building Challenge from the USA requires project teams to calculate and minimise the embodied energy of the materials used in the construction of the project and then offset residual carbon emissions through recognised offsetting schemes.

Key Design Principles

The key design principles to achieve a zero embodied energy target are prioritised below:

1. Prioritise building re-use
2. Carry out whole life carbon analysis of all building elements.
3. Prioritise ethical and responsbile sourcing of all materials
4. Priortise low embodied carbon and healthy materials
5. Minimise materials with high embodied energy impacts
6. Target Zero construction waste diverted to landfill
7. Promote use of local natural materials
8. Consider modular off-site construction systems
9. Detailing to be Long life and robust
10. Design building for disassembly and the circular economy
11. Offset remaining carbon emissions through recognized scheme

Design and Certification Tools

As mentioned in Whole Life Carbon section the key design and certification tools include the Living Building Challenge 3.1- Imperative 11 Embodied Carbon Footprint and BREEAM 2018 has several credits related to embodied carbon including:

- Mat 01 Life cycle impact
- Mat 02 Hard landscaping and boundary protection
- Mat 03 Responsible sourcing of materials
- Mat 04 Insulation
- Mat 05 Designing for durability and resilience
- Mat 06 Material efficiency
- Man 03 Responsible construction practice – direct
- Wst 01 Construction waste management
- Wst 02 Recycled aggregates
- Wst 03 Operational waste
- Wst 04 Speculative floor and ceiling finishes
- Wst 05 Adaptation to climate change
- Wst 06 Functional adaptability

Key References

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Sustainable Water Cycle

Introduction

The water cycle is one of the most critical and immediate outcomes that needs to be addressed in some regions of the world today. This critical situation is highly likely to be widespread in the future due to climate change, and therefore our buildings and infrastructure not only have to save water but be more resilient to future extreme weather events such as storms and flooding.

This outcome promotes a decentralised building level approach to alleviate the pressure on national water supply and drainage infrastructure.

The overall aim is to significantly reduce potable water use to a locally sustainable level, which will vary dramatically between regions and watershed zones. This is principally achieved by first reducing water usage by behaviour, low water appliances and better leak detection. Secondly, we need greater use of recycled rainwater and waste water which in turn reduces potable water use for non-drinking purposes.

The combined effects of greater reduction and recycling results in less waste water discharge to local systems, and less surface water run off to manageable levels, and in turn less new infrastructure. The UK and devolved environmental protection agencies have strict run off to match pre-development rates and in some instances are reducing that by 20%.

Finally, the aim is to revitalise and express natural water courses that were polluted and often built over, and to use creatively within our sustainable developments to create new habitats and community amenity (refer to Sustainable Land-use and Ecology, and Good Social Value outcomes).

Targets

The principal target is to reduce potable water use by 60% to more sustainable levels – UK target of **below 60 litres per person per day for domestic buildings, and 6l/p/per day for non-domestic buildings.**

This is exemplary level of water use as defined by BREEAM 2018.

Key Design Principles

The key design principles to deliver this outcome area below and focus on reducing water use and recycling water within a development to lessen the impact on local utilities and bring life to our local water courses.

1. Provide Low flow fittings and appliances
2. Provide Waterless appliances where possible
3. Provide Leak detection
4. Provide rainwater recycling and attenuation. Consider greywater recycling
5. Provide on-site reed bed black water cleansing and recycling if practicable
6. Create Sustainable Urban Drainage that supports natural aquatic habitats

It is important to consider the unintended consequences of significantly reduced water targets such as

- High maintenance requirements of grey water recycling
- Difficulty of flushing low flow toilets (efficient design or vacuum systems should be considered)
- Consider impact on Victorian sewage system of low water use

Design Tools

The principal design criteria in the UK are the Planning and regulatory requirement in UK. In particular, Part G of the England and Wales Building Regulations have comprehensive calculators to predict potable water use.

These regulations can be supplemented by a number of sustainable assessment methods that promote best practice, such as BREEAM, LEED, Greenstar and Liveable Buildings Challenge from the United States.

In particular, BREEAM 2018 has a number of credits related to water use, these include:

- Wat 01 Water consumption 5 credits
- Wat 02 Water monitoring 1 credit
- Wat 03 Water leak detection 2 credits
- Wat 04 Water efficient equipment
- Pol 03 Flood and surface water management

Performance in Use Verification

For the simplest verification, water meters can be used and these should all be accurate within 5%. The potable water use of a residential building can also be measured and calculated using BS 8542:2011

Key References

BS EN 806-2:2005: Specifications for installations inside buildings conveying water for human consumption. Design, British Standards Institute (2005).
Available at: https://shop.bsigroup.com/ProductDetail/?pid=000000000030011044

BS 8558:2015 Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806, British Standards Institute (2015).
Available at: https://shop.bsigroup.com/ProductDetail/?pid=000000000030299695

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Available at: https://shop.bsigroup.com/ProductDetail/?pid=000000000030218884

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Available at: https://www.gov.uk/government/publications/sanitation-hot-water-safety-and-water-efficiency-approved-document-g

Sustainable Connectivity and Transport

Introduction

Transport operational carbon emissions account for approximately 25% of total UK emissions, which is the second highest after buildings, so we therefore have to work closely with our engineering partners in this sector to reduce emissions to net zero by 2050.

There are significant improvements being made to electric vehicles with 2040 being the current UK target for the switch over, with other countries, notably Netherlands and Norway, banning the combustion engine by 2025. These targets are welcome aspirations, but Norway has significant hydro power to provide the clean energy required for such a step change. The question is – how do we power all these new vehicles without a corresponding increase in renewable energy?

The RIBA believes that reducing carbon emissions associated with transport should also consider reducing the need for travel in the first instance. This outcome promotes a greater digital and physical connectivity of our villages, towns and cities, which in turn will significantly reduce the need to travel in the first instance and to reduce the length of travel time. Finally, our buildings and infrastructure has to support the future widespread use of electric and/or hydrogen vehicles.

Targets

The target is to achieve net zero carbon emissions for transport by 2050.

To support this target this outcome promotes the need to measure, manage and reduce the kgCO_2/per person/per year of the occupants to the net zero target. (i.e. well within the personal annual carbon budget of approximately 1 TonneCO_2/per person/per year)

Design Principles

The key design principles to deliver this outcome area outlined below and focus on reducing the need for local travel and its duration by promoting alternative transport, together with a mixed-use sustainable development approach:

1. Create comprehensive green transport plan including digital connectivity
2. Prioritise high quality Digital Connectivity to avoid need for unnecessary travel
3. Prioritise site selection with good proximity to public transport
4. Provide high quality pedestrian and cycle links to local amenities
5. Provide end of journey provision for active travel runners and cyclists (showers, dry lockers etc)
6. Provide infrastructure for electric vehicles as a priority
7. Provide car sharing spaces
8. Provide suitable onsite personal storage

Design Tools

This outcome is subject to strict planning requirements in the UK and Devolved Governments. Current best practice guidance can be found in BREEAM, Institute of Civil Engineers, and research led organisations such as Liveable Cities.

BREEAM 2018 has two sections and a number of credits related to sustainable transport use, these include:

- Tra 01 Transport assessment and travel plan
- Tra 02 Sustainable transport measures

Performance in Use Verification

We recognise that this metric is generally outside an architect's remit, but we would encourage clients to measure, manage and reduce their transport related carbon emissions as part of their CSR or scope 3 science-based targets. Small scale domestic projects could also employ transport carbon footprint calculators such as http://www.footprintcalculator.org/

The Institution of Civil Engineers has formed a working group that is translating the UNSDGs into project-level indicators, to find compelling ways for engineers to consistently measure SDG impact across infrastructure projects or programme. This has started by collecting existing research on sustainable measurement tools for infrastructure at: https://www.ice.org.uk/knowledge-and-resources/sustainability-route-map/measuring-monitoring-and-reporting

Key References

Supplementary Planning Guidance on Sustainable Transport, Various local authorities

Sustainability Route Map, Institution of Civil Engineers (2019).
Available at: https://www.ice.org.uk/knowledge-and-resources/sustainability-route-map

Sustainable Land Use and Bio-Diversity

Introduction

Global and UK biodiversity is declining at an alarming rate, while at the same time the pressure to expand our built environment to create more homes is growing. This outcome therefore aims to avoid development on sensitive and ecologically rich landscapes and to make the best use of previously inhabited sites for development.

The RIBA believes that a sustainable development fundamentally implies a significant increase and enhancement of bio-diversity on a site compared to its footprint before development. This also means creating a productive landscape that is capable of food production as well as creating habitats for wildlife.

In addition, increasing biodiversity and the urban greening factor can address the urban heat island effect of cities, as outlined in the London Plan.

Targets

The key targets of this outcome are to:

- **significantly enhance the local flora and fauna** post development compared to pre-development
- **urban greening factor of 0.3 for non-domestic and 0.4 for residential developments**

Key Design Principles

The key design principles aims to reduce development on ecologically rich sites, make the best use of previously inhabited sites, protect existing wildlife and make it ecologically richer and productive.

1. Leave a site in better 'regenerative' ecological condition than before development.
2. Prioritise building and site re-use
3. Prioritise brownfield site selection
4. Carry out sustainable remediation of site pollution
5. Retain existing natural features
6. Create mixed use development with density appropriate to local context
7. Create a range of green spaces (green roofs, vertical greening, pocket parks, green corridors)
8. Create habitats that enhance bio-diversity
9. Create 'productive' landscapes for urban food production
10. Zero local pollution from the development

Design Tools

The UK and Devolved Governments are mandated to protect and enhance local ecology. Consultation with a local ecologist early in the design process is essential to a good outcome, and a prerequisite for BREEAM. Additional best practice guidance is contained within BREEAM 2018 and BREEAM for Communities, and in particular the Living Building Challenge.

BREEAM

BREEAM 2018 has a significant number of credits related to sustainable land use, these include:

- LE 01 Site selection
- LE 02 Ecological value of site and protection of ecological features
- LE 03 Minimising impact on existing site ecology
- LE 04 Enhancing site ecology
- LE 05 Long term impact on biodiversity
- Pol 01 Impact of refrigerants
- Pol 02 NOx emissions
- Pol 03 Surface water run off
- Pol 04 Reduction of night time light pollution
- Pol 05 Reduction of noise pollution

Performance in Use Verification

The RIBA recommends that a registered ecologist is appointed to carry out field measurements of local ecology to ascertain health and diversity outcomes in use.

Key References

Supplementary Planning Guidance on Biodiversity, Various local authorities

Plant Health Resources, Landscape Institute (2016).
Available at: https://www.landscapeinstitute.org/technical-resource/plant-health-resources/

Good Health and Wellbeing

Introduction

This primarily relates to the indoor health, visual, aural and thermal comfort, and occupant wellbeing. No single metric can measure the successful achievement of this outcome: it requires a core set of objective and subjective metrics.

Adrian Leaman and Bill Bordass during 40 years of post-occupancy research have identified 6 'killer' variables that significantly impact user satisfaction, these include:

1. **density**
2. **comfort,** including personal control
3. **responsiveness to need,** including comfort (from 1), but a host of other ways in which needs should be met effectively
4. **ventilation type,** which also encompasses attributes such as size, building depth and other allometric properties (i.e. how size affects shape, volume, services etc.)
5. **workgroups** and their layout in the space plan
6. **design intent** and how this is communicated to users and occupants.

The human and economic benefits of this outcome have been increasingly recognised in recent years, in particular, through the work of Usable Buildings Trust, BREEAM, UKGBC, and recently the WELL Building Institute.

A key unintended consequence of focusing narrowly on heat loss reduction in domestic buildings is increased overheating in dwellings especially with good insulation and air-tightness, inadequate or insecure natural ventilation, too much glass, too little indoor thermal mass and sometimes heat recovery systems that cannot be by-passed. This illustrates the importance of considering sustainability holistically: achieving net zero carbon must not be to the detriment of occupant health.

Targets

Post occupancy research has identified a number of metrics that are measurable and commonly part of a detailed project brief during RIBA stage 1.

Many of these metrics can be modelled using dynamic simulation software such as IES during Stage 2 to 4, and measured in use by physical measurement and the BUS methodology during Stage 7.

The RIBA therefore define the core 'building related' metrics for health and wellbeing as:

Health Outcome	Metrics	References
Good Occupant Density	M^2 per person appropriate to building type	BCO, DfE, HQM
Good Personal Control	Time of response	Usable Buildings Trust
Good Indoor Air Quality	CO_2, CO, NOX, PM2.5, PM10, Mould, VOC	CIBSE TM40, WELL v2
Good Thermal Comfort	°C	CIBSE TM59
Good Visual Comfort	average daylight factor with uniformity 0.4)	CIBSE
Good Aural Comfort	Reverberation time and Noise Rating NR appropriate to use	
Physical contact to Nature	Open window within 7m Biophilia- contact to views, Places, Plants, Natural Materials	BREEAM, WELL

Diagram 17: Core health metrics, RIBA

All of the above metrics can be measured in use, as discussed in CIBSE TM 40, and TM 59. They are also contained in a number of sustainable assessment methods to varying degrees, such as WELL-Building Standard v2, BREEAM, LEED, and the Living Building Challenge.

The Target is to successfully deliver all core building related metrics.

Key Design Principles

The key design principles that should be achieved through all stages of the Plan of Work 2.0 include:

1. Provide spaces with strong visual connection to outside
2. Provide responsive local controls e.g. opening windows, or local control of HVAC systems.
3. Design spaces with appropriate occupant density for activity
4. Design spaces with good indoor air quality
5. Design spaces with good indoor daylighting, lighting and glare control
6. Design spaces to adaptive thermal comfort standards
7. Design spaces with good acoustic comfort
8. Design spaces that are inclusive and universal accessible
9. Prioritise active circulation routes, e.g. stairs, cycling provision, and walking routes
10. Provide indoor and outdoor planted spaces

Design Tools

The concept of wellbeing and wellness has gained global popularity in recent years. A number of design tools are available to assist the design team from Stage 1 to Stage 6.

BREEAM has contained credits related to Health and Wellbeing since its inception and the latest BREEAM 2018 version has identified the following relevant credits to target during the design process:

- Hea 01 Visual comfort.
- Hea 02 Indoor air quality
- Hea 03 Thermal comfort
- Hea 04 Water quality
- Hea 05a Acoustic performance
- Hea 05b Acoustic performance
- Hea 06 Safe access
- Hea 07 Minimising the potential damage of natural hazards
- Hea 08 Private spaceHea 07

The WELL Building Standard is growing in popularity in the UK and globally and defines wellness across ten concepts: Air, Water, Nourishment, Light, Movement, Thermal Comfort, Sound, Materials, Mind, Community and Innovation

The IWBI has recently released Well-Building Standard 2.0. The standard goes beyond fixed building related elements into operational and organisational issues such as food, exercise, and human resources.

Design Quality Indicators

In addition to the design tools above, Design Quality Indicators can be used to track the delivery of functionality outcomes that support Health, Comfort and Wellbeing of occupants, including:

- Space Density Effectiveness (m^2 per person-BCO Guide)
- Toilets (male, female, disabled, gender neutral).
- Meeting rooms (number, size, location and type)
- Storage Spaces (number, size, location)
- Catering Facilities (number, size, location)
- Range of indoor and outdoor green spaces

Performance in Use Verification

In addition to the in-use measurement of indoor air quality metrics, there are a number of POE tools that measure occupant satisfaction, the principal methods include the following:

- The BUS Methodology occupant questionnaire Survey
- University of Califiornia Berkeley CBE Survey
- The Guide to Post Occupancy Evaluation, HFCE/ AUDE/University of Westminster, 2006
- Leesman Index.

The BUS methodology, with its eleven indicators, is a tried and tested way to understand the overall perceptions of the user. It has been used as core POE in the UK for over thirty years, including the Government-funded Innovate UK Building Performance Evaluation studies, completed and published in 2015. The BUS methodology.

Diagram 18: Example of BUS output results, © BUS Methodology 2019

Key References

Building Knowledge: Pathways to Post Occupancy Evaluation, RIBA (2016).
Available at: https://www.architecture.com/knowledge-and-resources/resources-landing-page/post-occupancy-evaluation

TM40 Health Issues and Wellbeing in Building Services, CIBSE (2019).
Available at: https://www.cibse.org/Knowledge/CIBSE-TM/TM40-2019-Health-Issues-and-Wellbeing-in-Building-Services

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Available at: http://www.smg.ac.uk/documents/POEBrochureFinal06.pdf

Occupant Satisfaction Survey, BUS Methodology (2019).
Available at: https://busmethodology.org.uk/index.html

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Available at: https://www.usablebuildings.co.uk/UsableBuildings/Unprotected/KillerVariables2016v6SingleSpacing.pdf

Post Occupancy Evaluation and Building Performance Evaluation Primer, RIBA Publication, 2016.
Available at: https://www.architecture.com/knowledge-and-resources/resources-landing-page/post-occupancy-evaluation

Well Building Standard V2, International WELL Building Institute (2018)
Available at: https://www.wellcertified.com/

Ventilation: Approved Document F: Building regulation in England for the ventilation requirements to maintain indoor air quality, Crown Copyright (2013).
Available at: https://www.gov.uk/government/publications/ventilation-approved-document-f

Sustainable Communities and Social Value

Introduction

This outcome relates to the social impact of a development on the end users and the wider community. The ultimate goal for this outcome is to create places for people that support not only basic needs of security, shelter, and health, but to enhance individual and social wellbeing, and community identity.

Since the advent of the UK Social Value Act 2012, Social Value has been gaining traction as a requirement of procurement, contracts and planning in the public sector, commonly expressed through the creation of jobs, training and apprenticeships through construction.

The Social Value Toolkit for Architecture (RIBA, 2019) has been developed to demonstrate and evaluate the impact of design on people and communities so these can be considered as social value benefits in policy and procurement. It is a bottom-up initiative developed by a group of UK researchers in architecture practices (notably Assael Architecture, Atkins and HTA Design LLP) with the University of Reading, ARUP, New Economics Foundation, Hatch Regeneris, Triangle Consulting and MHCLG. It is conceived as a clip on to other systems such as the BUS survey. It takes the form of a library of POE questions developed out of wellbeing research and considerable consultation. These have been piloted but will remain in evolution as the SVT expands its attention from housing and communities into other fields.

Whilst it is recognised that quantitative outcomes should always be accompanied by qualitative narrative and context, the SVT uses monetary terms so it can be included in economic models. It uses Social Return on Investment (SROI) financial proxies, a method that is gaining traction in UK local authorities and across the globe. The SROI process can be an intense project specific process or – as with the SVT – used to develop broad brush indicators and metrics, which will be refined as the body of research aiming to reduce the social performance gap grows. Whilst the Social Value of the supply chain has long been a concern of the construction industry, it is time that architects recognise the social value lifecycle implications of their design and specification choices.

High level outcomes for the SVT are:

1. Freedom
2. Connecting
3. Active Lifestyles
4. Positive Emotions

With additional questions relating to Participation, where relevant.

Targets

The SVT includes a library of questions to be used in housing situations across a variety of sectors and scales. The team is identifying a set of key questions on high-level outcomes above that are readily monetisable using current proxies (e.g. the HACT Social Value Bank), which are combined person by person, year by year. Questions are also included about how much these outcomes are attributable to the design of the project. Examples include:

1. I feel in control of my life – currently valued at £15,894 a year by the HACT Social Value Bank.
2. I talk to neighbours regularly – currently valued at £4,511 by HACT.
3. I feel a sense of belonging in my neighbourhood – currently valued at £3,753 by HACT.
4. I am able to take frequent mild exercise – currently valued at £3,537 by HACT.
5. I am active in a tenant's group – currently valued at £8,116 by HACT.

The RIBA will publish the SVT in early 2020, including a series of POE questions with monetisable outcomes. The HACT Social Value Bank is available online at https://www.hact.org.uk/social-value-bank

Design Principles

The key design principles for this outcome focus on greater permeability, external social spaces, and mixed-use developments:

1. Prioritise placemaking that expresses identity and territory
2. Create secure places for privacy
3. Create places for social interaction
4. Create vibrant mixed-use places
5. Provide high quality permeable links to social amenities
6. Provide High quality pedestrian public realm
7. Create inclusive places for community interaction
8. Create secure places with overlooking views

Design Tools

UK Green Building Council, (2019), Driving social value in new development: options for local authorities, https://www.ukgbc.org/wp-content/uploads/2019/03/UKGBC-Driving-social-value-in-new-development-Options-for-local-authorities-1.pdf

In addition, there are significant planning regulations related to this issue within the UK and devolved governments which will be the primary guide for the emerging design.

BREEAM for Communities has also been specifically developed to help the industry design consistently create better places, and has a number of credits related to placemaking and social value, these include:

Category	Aim	Weighting
Governance	Promotes community involvement in decisions affecting the design, construction, operation and long-term stewardship of the development.	9.30%
Social and economic wellbeing	Local economy: To create a healthy economy (employment opportunities and thriving business).	14.80%
	Social wellbeing: To ensure a socially cohesive community.	17.10%
	Environmental conditions: To minimise the impacts of environmental conditions on the health and wellbeing of occupants.	10.80%
Resource and energy	Addresses the sustainable use of natural resources and the reduction of carbon emissions.	21.60%
Land use and ecology	Encourages sustainable land use and ecological enhancement.	12.60%
Transport and movement	Addresses the design and provision of transport and movement infrastructure to encourage the use of sustainable modes of transport.	13.80%
Each of the forty assessment issues has an individual weighting and a variable number of credits. This means that the value of credits varies depending on the weighting of the assessment issue. The following tables outline the individual weightings for each assessment issue and the value of each credit in that assessment issue.		

Diagram 19: Categories and Weightings BREEAM for Communities, BRE

Well Community Standard

The WELL Community Standard aims to impact individuals not just within the walls of their home or workplace, but throughout the public spaces where they spend their time. A WELL community is designed to support health and wellbeing across all aspects and areas of community life. The vision for a WELL community is inclusive, integrated and resilient, with a strong community identity fostering high levels of social interaction and engagement. Resources in a WELL community—natural, human and technological—are used effectively, equally and responsibly to meet the community's current and future needs and priorities.

https://v2.wellcertified.com/community/en/overview

Performance in use Verification

A core part of the RIBA Social Value Toolkit is its social value questionnaire which is designed to be used as part of a wider post occupancy evaluation of the development.

Key References

Social Value Toolkit for Architecture, Flora Samuel, University of Reading, RIBA (2020)

'**Applying Social Return on Investment (SROI) to the Built Environment',** Kelly J. Watson and Tim Whitley, (2017), Building Research and Information, 45, 8, pp.875-891.
https://doi.org/10.1080/09613218.2016.1223486

Social Value Bank, HACT and Daniel Fujiwara (2018).
Available at: https://www.hact.org.uk/social-value-bank

Sustainable Life Cycle Cost

Introduction

Life cycle costs play a pivotal role in the financial management of construction projects around the world. They allow critical decisions to be made regarding the relative importance of capital and longer-term costs, which ultimately impact asset performance, longevity, disaster resilience and sustainability. In the context of climate change, there is growing evidence of unsustainable levels of running costs in buildings with highly complex services: their resilience in extreme future climates is also questionable. The insurance industry will need to respond to a building's resilience and ability to withstand climate change.

There is also compelling evidence of the significant economic benefits of low carbon and healthy buildings, not of all of which is anecdotal. The Urban Land Institute carried out a theoretical exercise of the potential savings of LEED Platinum buildings in the States in 2005 which even then would total $60/square foot savings (over 20 years). In Australia a good NABERS rating has also been shown to increase the value and lettability of office buildings (see graph below). Studies such as this are scarce, but a growing number of leading UK developers are at the forefront of defining the economic value of sustainability. See also the UKGBC Capturing the Value of Sustainability report, 2018.

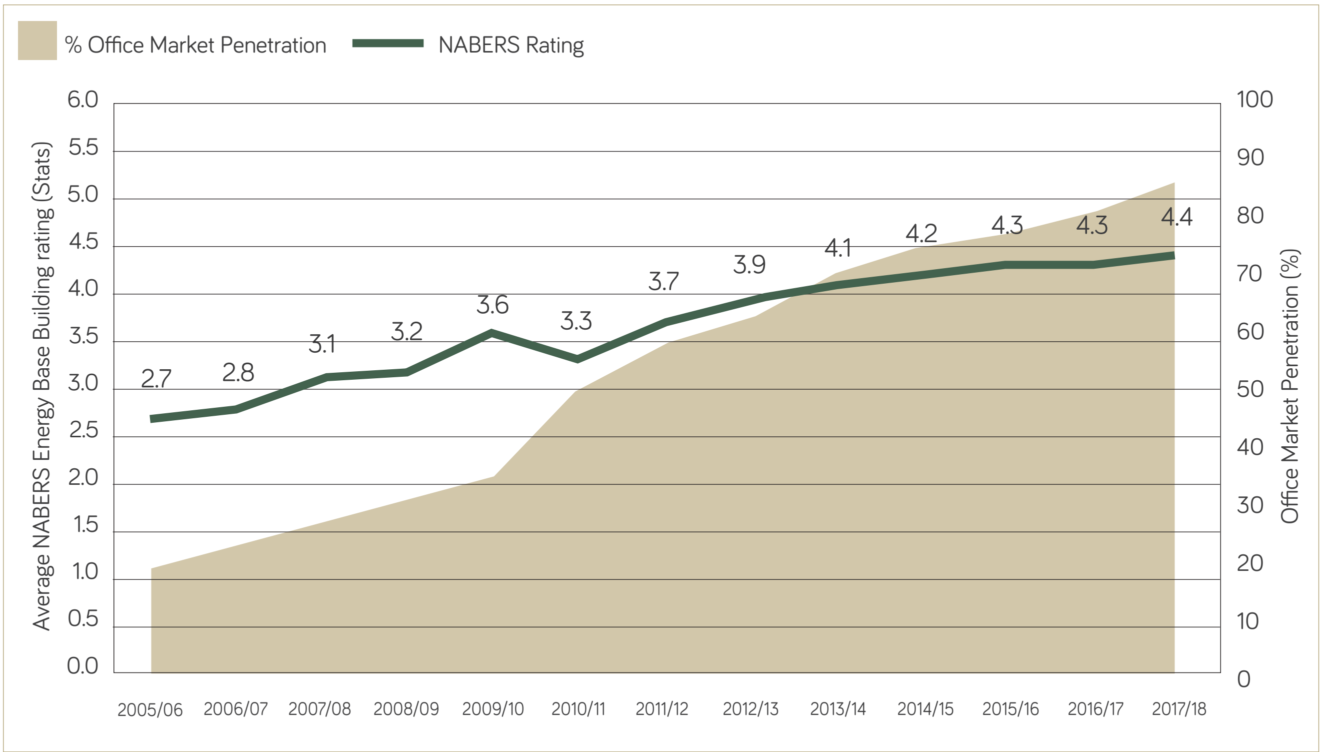

Diagram 20: Chart highlighting average NABERS Energy Base Building ratings and office market penetration over time, Better Buildings Partnership, 2019

This outcome seeks to design for use, and align capex and opex budgets which in turn unlocks whole life value over the life of the building.

The RIBA Plan for Use guide discusses the relationship between design and operation in greater depth.

Targets

The target for this outcome is to **measure and benchmark the operational running costs of a building in use as per £/m²** using ICMS Life Cycle method of measurement. And **compare this to the return on investment value created by the project**, including rental value, building value, and social value as described in the previous section.

Key Design Principles

The key design principles for this outcome as discussed above is to align Capital expenditure with Operational expenditure budgets to ensure sustainable whole life value decisions are made:

1. Carry out whole life cycle analysis of key building systems
2. Carry out Soft Landings or RIBA Plan for Use processes
3. Measure energy costs
4. Measure management and maintenance costs
5. Measure overall running costs
6. Measure added value of occupant health and wellbeing
7. Measure added value of sustainable outcomes of building

Design Tools

The principal method for measuring whole life value is set out in the International Construction Measurement Standards (ICMS) Life Cycle Method of measurement. ICMS are principles-based international standards that set out how to report, group and classify construction project costs in a structured and logical form.

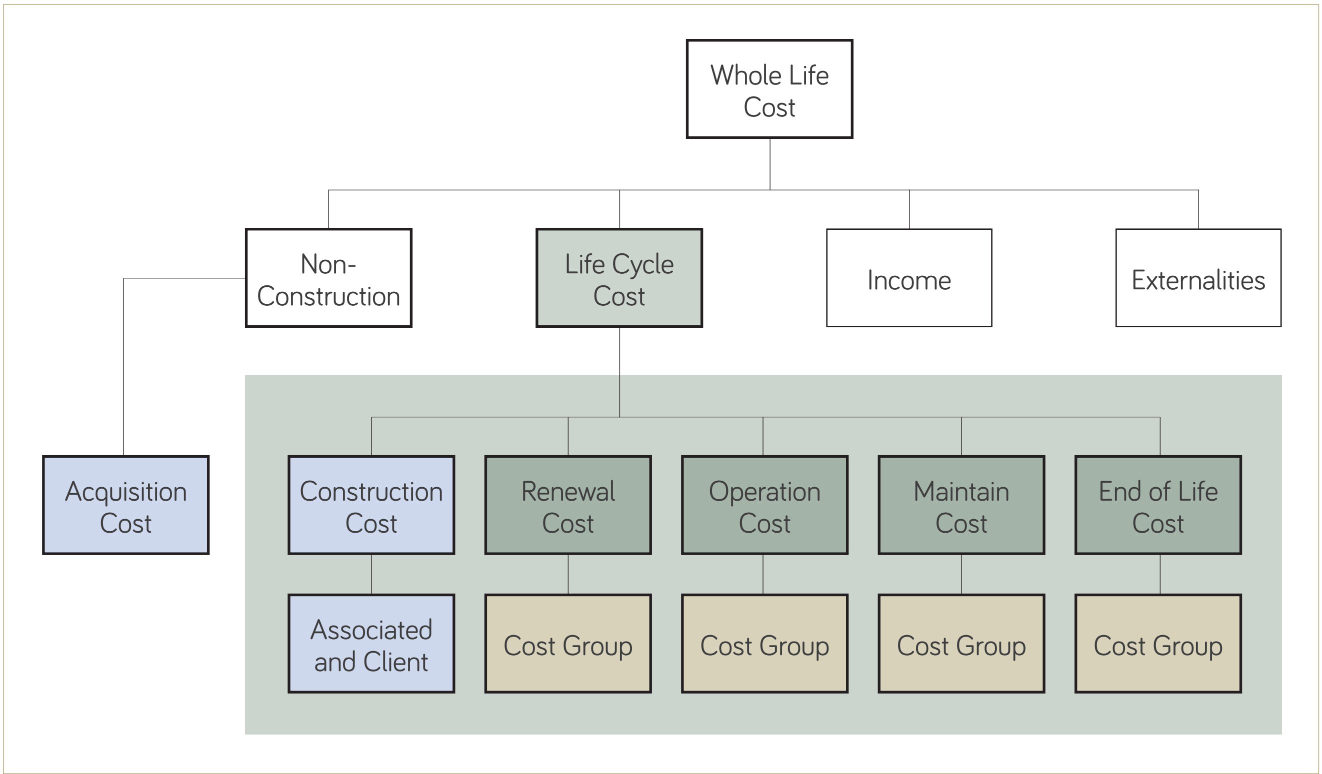

Diagram 21: ICMS Life Cycle Cost Method of Measurement

To assist architects and the project team deliver better outcomes, the RIBA recommend following the RIBA Plan for Use Strategy and adopting the Soft Landings Framework when possible. Please refer to the **RIBA Plan for Use** for further detailed guidance.

BREEAM

In addition to the above design tools, BREEAM 2018 has a number of credits related to life cycle operational value, which include:

- Man 01 Project brief and design 4 credits
- Man 02 Life cycle cost and service life planning
- Man 03 Responsible construction practices
- Man 04 Commissioning and handover
- Man 05 Aftercare

Performance in Use Verification

The RIBA would recommend using ICMS methods to measure the running costs of buildings and to benchmark these against best practice exemplars to help fine-tune their buildings and to inform future projects.

Key References

ICMS: Global Consistency in Presenting Construction and Other Life Cycle Costs, International Construction Measurement Standards Coalition (2019).
Available at: https://icms-coalition.org/

Conclusion

The RIBA is committed to demonstrate leadership in delivering the UN Sustainable Development Goals, and closing the performance gap to deliver agreed sustainability performance. This guide has sought to clarify the DNA of a sustainable project, by identifying a core set of sustainable outcomes that can also contribute significantly to the UK 2050 commitment on climate change, to limit the global temperature increase to 1.5 C.

The ten key recommendations to deliver sustainable outcomes are:

1. Commit to RIBA 2030 Challenge
2. Use core sustainable outcomes through all stages of the RIBA Plan of Work
3. Commit to performance in use verification
4. Deliver net zero operational carbon as soon as practical, or by 2030 at the latest.
5. Deliver all other sustainable outcomes as soon as possible
6. Use appropriate sustainability assessment tools during the design process that promote in-use performance verification
7. Follow the Soft Landings Principles or Methodology to create a collaborative and outcomes focused project ethos to deliver better outcomes
8. Commit to completing a 'Light Touch POE at the end of Stage 6
9. If required, carry out level 2 or 3 POE on projects post completion during Stage 7
10. Encourage the client and the design team to commit to disclose outcomes performance data

The RIBA policy of POE and disclosure of operational data is vital to ensure that lessons learnt are shared with the wider industry. Disclosure of data has been proven to create a competitive edge to deliver continuously improving outcomes in line with competitors, as shown by the work of NABERS in Australia. Comparison of performance data is also important to develop more accurate benchmarks, as illustrated by the BUS Methodology. These refined benchmarks help to improve briefing, allow projects to understand their relative performance, and allow the construction industry to speed up the process of delivering better and more specific outcomes.

In response to the declaration of a climate emergency, the RIBA 2030 Challenge is a stark message to our profession and others about the immediate targets that must be met if we are to achieve a net zero carbon future by 2050. We believe that these 2030 targets are realistic, and the case studies contained within this Guide demonstrate that some aspects of this future are being achieved now.

We have reached a critical moment in human history. In 2018, we emitted 38 Billion Tonnes of CO_2 – around twice the theoretical carrying capacity of the Earth. Humankind must therefore live within the means of Earth and reduce CO_2 emissions drastically as soon as possible or face the worst case scenarios set out by the International Panel on Climate Change

Since the built environment is responsible for 40% of these emissions, it is our professional and ethical duty to lead and deliver this sustainable future. We must act now.

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