



Whole Life Carbon in Construction: What You Need to Know

27th Feb 2025

Dr Craig Jones & Edwin Lowe

circularecology.com

Contents

- Introduction
- What is embodied carbon?
- What is a whole life carbon assessment?
- How do you measure the whole life embodied carbon of a project?
- What data can product manufacturers and suppliers provide?
- Which standards should you adhere to?
- How to obtain BREEAM Mat 01 LCA credits
 - Crucial deadlines for securing these credits
- Understanding the London Plan's WLCA requirements
- How WLCA can help to achieve Net Zero Carbon Buildings
- Q&A

Speakers



Dr Craig Jones

Managing Director

- *20 years experience embodied carbon*
- *Original author ICE Database*



Edwin Lowe

Delivery Manager

- *8 years experience in the construction sector*
- *Worked for contractors, infrastructure clients and in consulting*

Circular Ecology – Introduction



Environmental consultancy, founded in 2013

Offer a range environmental services:

- Whole Life Carbon Assessments for Construction Projects
- Organisational Carbon Footprints, Scope 1, 2 & 3
- Product Carbon Footprints
- Life Cycle Assessments (LCA)
- Net Zero Carbon Strategy
- Carbon Footprint Database (library) Development
- Verification and Peer Review
- Online E-Learning Training Courses
- Carbon Offsetting and Tree Planting



Our Mission Statement

***“Making a difference together
Towards a more sustainable future”***

Five Core Values:



Impactful



Community



Quality



Ethical



Continuous Improvement

Scaling Carbon Reduction Initiative (SCRI)

- Launch of our **Scaling Carbon Reductions Initiative (SCRI)**
 - A key part of our purpose is **to release impactful work, to enable scalable carbon reductions**
 - We will be diverting a specified amount from some of our sales into the SCRI
 - Funds will be used to **develop free carbon footprint data, tools and resources**
 - Publication of an annual impact report disclosing the amount raised and use of funds
 - <https://circularecology.com/scaling-carbon-reductions-initiative.html>



Scaling Carbon Reduction Initiative (SCRI)

Products that make a contribution to our **Scaling Carbon Reductions Initiative (SCRI)**

- **e-learning training courses**

- Intro to carbon footprinting
- Intro to Life Cycle Assessment
- Embodied carbon in construction
- [under development] Sustainability 101 training course
- <https://circularecology.com/training.html>

66.67% of ex. VAT training course sales diverted to help update ICE Database until June 25

- **Carbon offset credits** - £1 ex. VAT per tCO₂e offset

- <https://circularecology.com/product-category/carbon-offset>

- **Tree planting packs**

- Recently added to our website online store
- 25% diverted (exchange rate dependant)

e-Learning Training Courses – Breakdown

Carbon Footprinting

- Intro
- 10 Topics
- 3 Quizzes
- Final Test

Life Cycle Assessment (LCA)

- Intro
- 7 Parts
- 15 Topics
- 4 Quizzes
- Final Test

Embodied Carbon in Construction

- Intro
- 4 Parts
- 26 Topics
- 10 Quizzes
- Final Test

Introduction to Embodied Carbon & Whole Life Carbon Assessment

The Beginning - The Cradle

- Carbon Life Cycle Assessment Starts at the Cradle
- All inputs must be traced back to **The Cradle....**



From the Cradle...



Material Refining

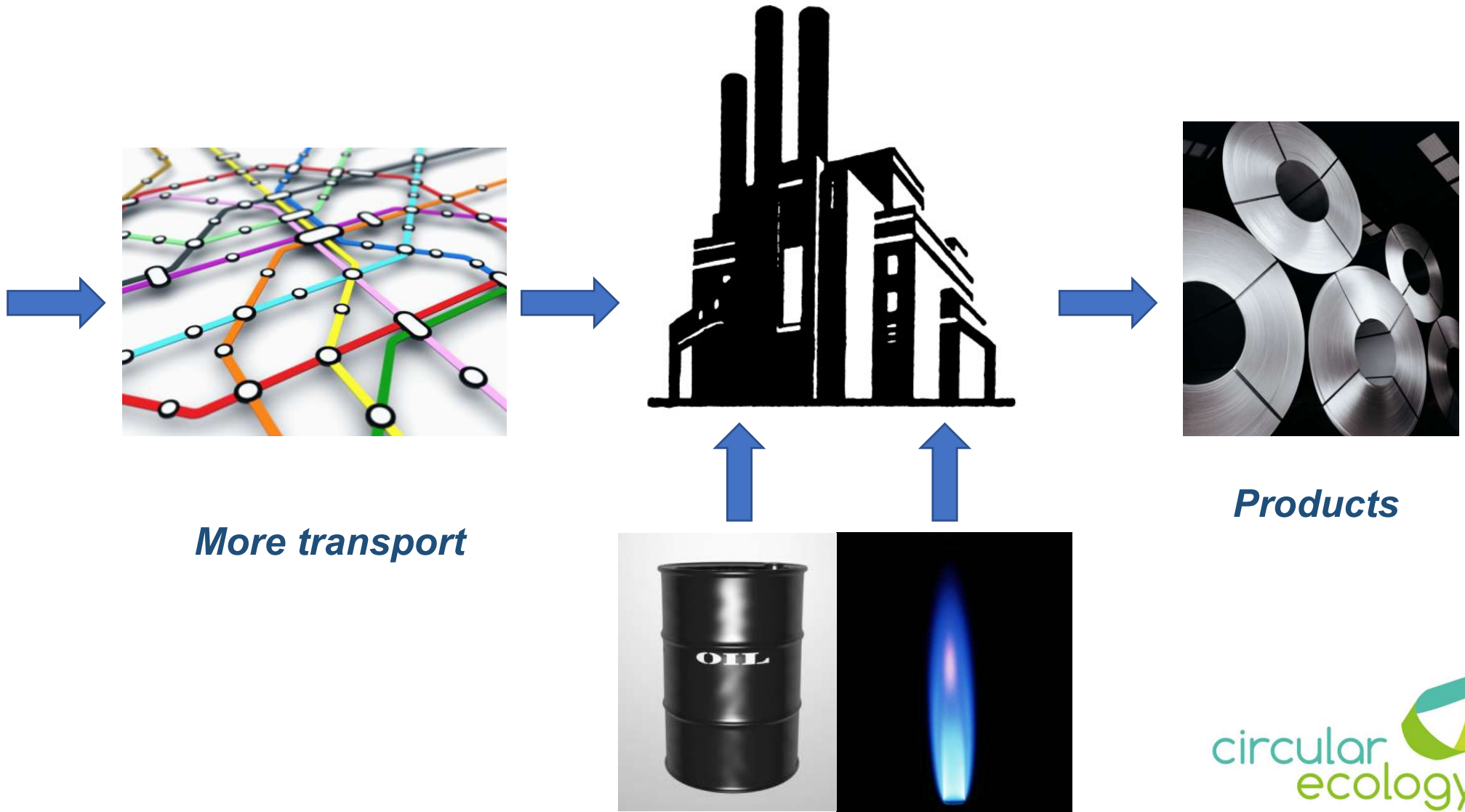


***The Cradle =
The earth, or ground***

Transport

From the Cradle....to (Factory) Gate

Factories: Fabrication, assembly...etc



More transport

Products

...and to (Construction) Site



Construction Site



Packaging

Distribution

....On-Site Carbon



Power



Assembly Activities

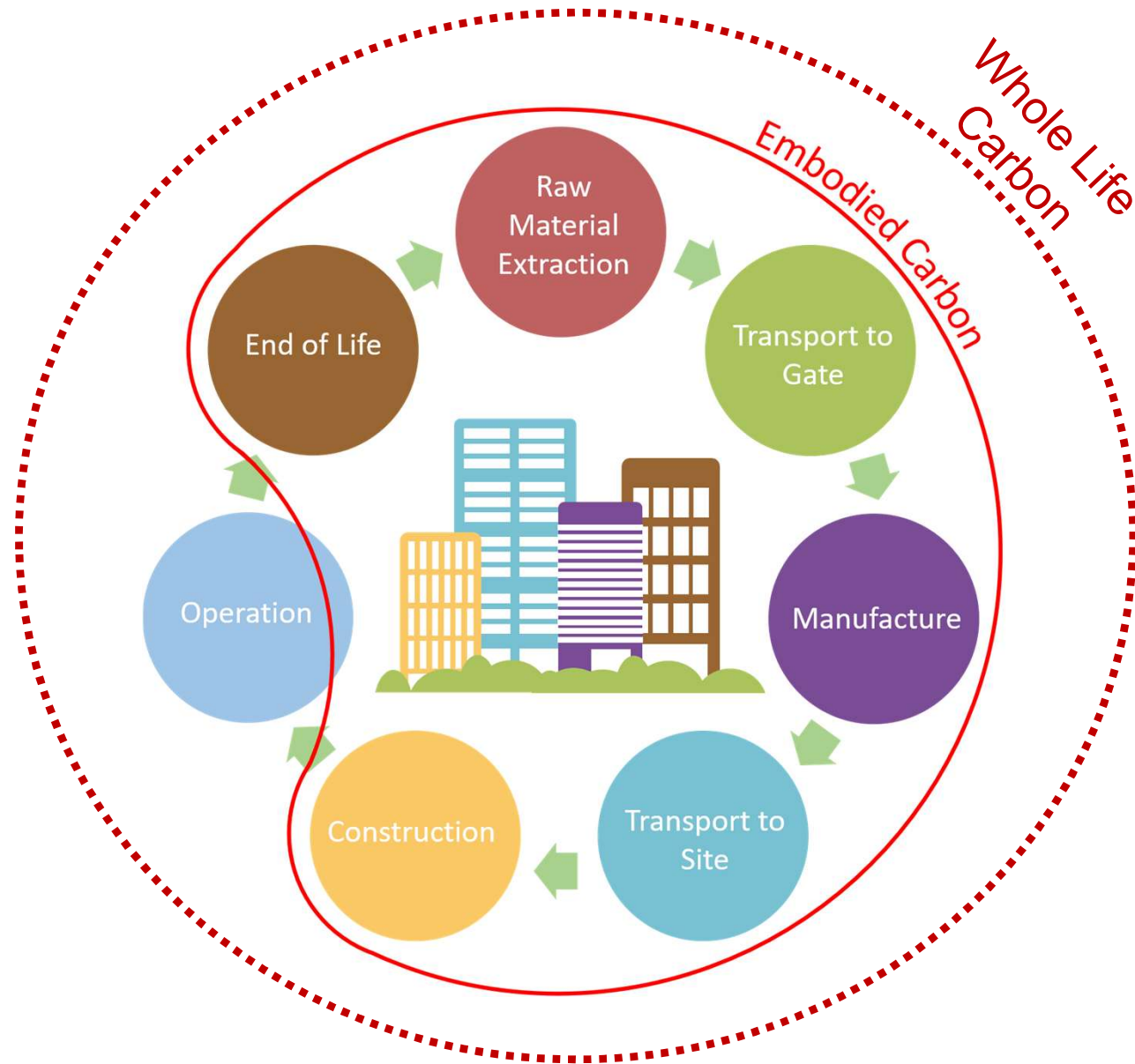


*Waste =
embodied carbon of waste
+ waste management*

The Life Cycle of a Building

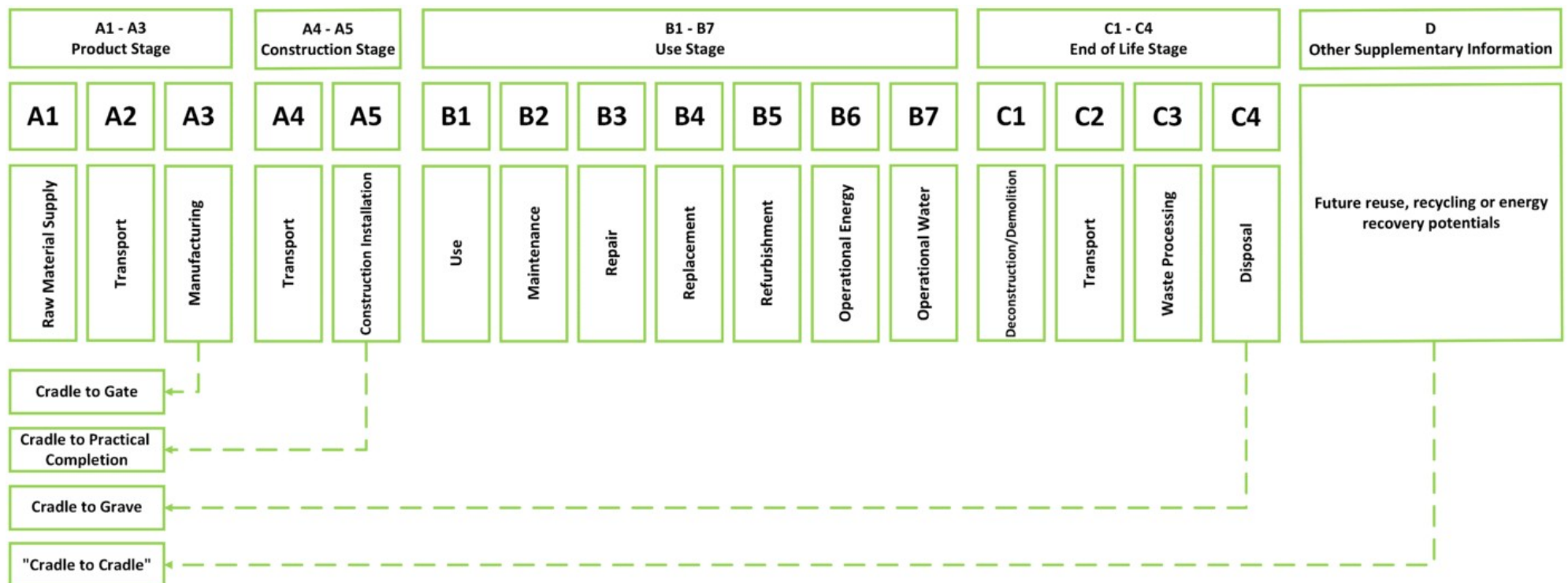


The Life Cycle of a Building



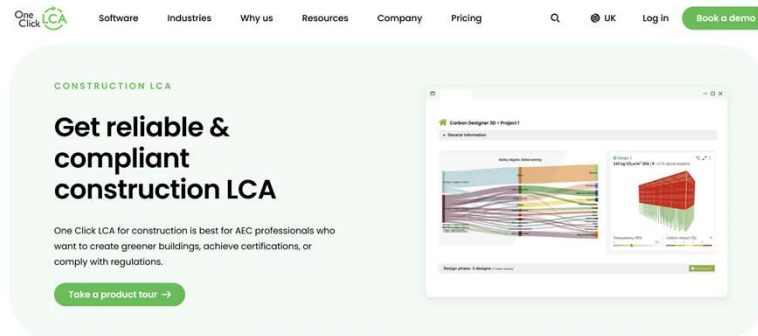
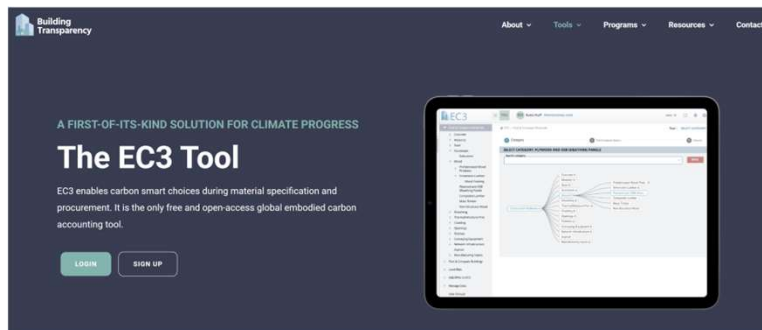
Life Cycle Modules

- Modules A, B, C and D define life cycle stages
- Originally defined in European standards EN15804 / EN 15978 series
- But these Modules are now used extensively around the world



How Do You Measure Whole Life Carbon?

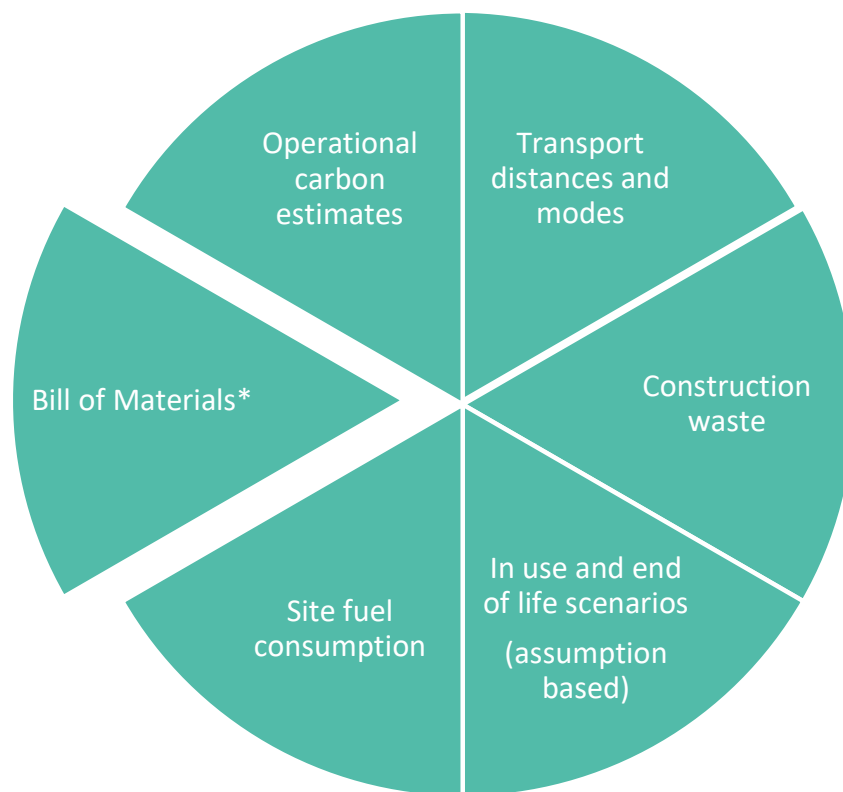
- Assessments can be undertaken through modelling in Excel
 - Using generic data such as the ICE Database and supplier specific carbon factors
 - However, it requires complex excel models and a lot of data
- Therefore, most people now use specialist Whole Life Carbon software and tools, e.g.
 - OneClick LCA (paid) - <https://oneclicklca.com/en-gb/>
 - EC3 (free) - <https://www.buildingtransparency.org/tools/ec3/>



Whole Life Carbon Tools

- There are also many tools for specific types of buildings, or parts of the building:
 - IStructE - The Structural Carbon Tool
 - www.istructe.org/resources/guidance/the-structural-carbon-tool/
 - Cerclos (eTool)
 - <https://cerclos.com/products/etool/>
 - Tally (revit based)
 - <https://choosetally.com/>
 - AECB Embodied Carbon Calculator
 - <https://aecb.net/product/aecb-embodied-carbon-calculator-stand-alone-version-and-first-years-subscription/>
 - RSSB (rail sector cloud-based tool)
 - <https://www.rssb.co.uk/sustainability/net-zero-carbon-rail/rail-carbon-tool>


What Data is Needed for WLC?



* Either Bill of Quantities (BoQ) or access to a good Revit Model plus design drawings and specs

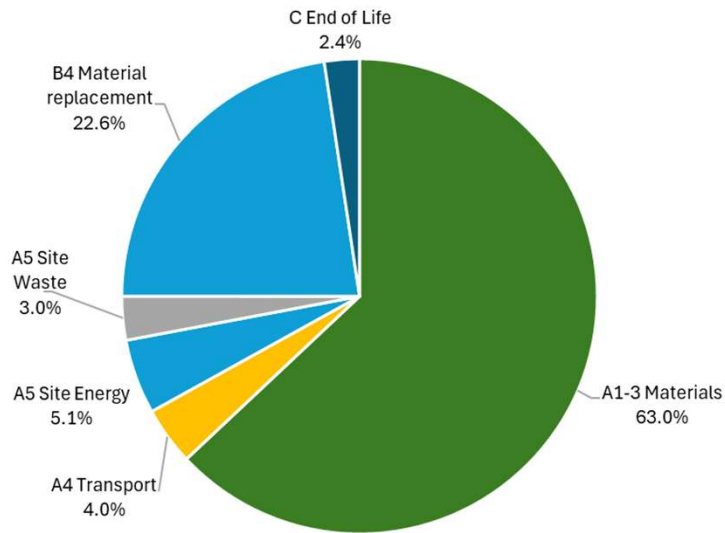
The ICE Database

- An **embodied carbon database (A1-3)** for building materials
 - First version 2005 released by Dr Craig Jones and Professor Geoff Hammond, University of Bath
- Data for over 200 materials
- Over 50,000 worldwide users
- ICE V4.0 Released by Circular Ecology in Dec 2024
- **Over 750 unique organisations registered to use ICE v4.0 within 60 days of launch**
- Excel version free to download from www.circularecology.com/ice-database.html

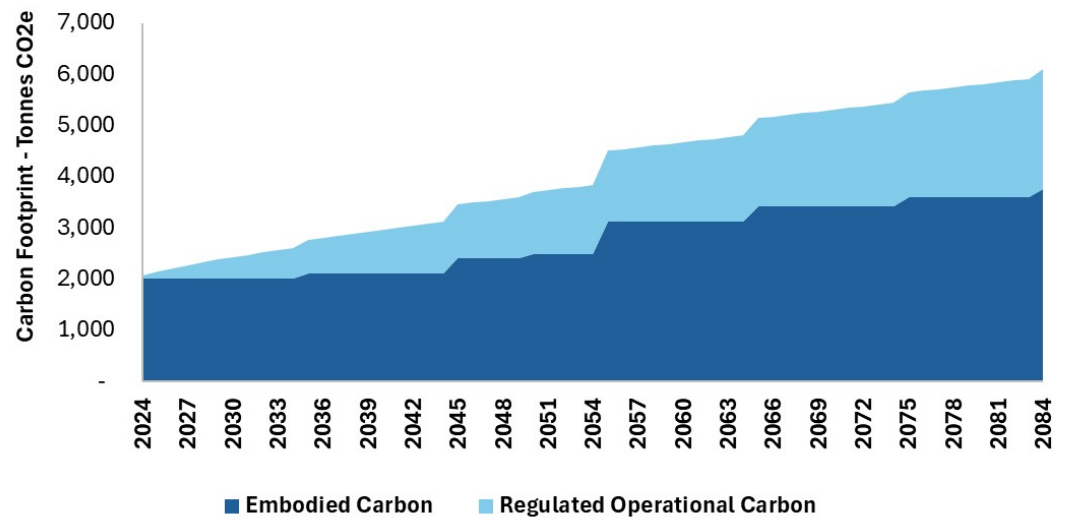
ICE (Inventory of Carbon & Energy)	
<i>All authors are listed alphabetically</i>	
Current Authors:	Circular Ecology*
Affiliation:	
<small>*corresponding author. Contact details: http://www.circularecology.com/contact.html</small>	
Version Control	
Version:	Advanced
Version Number:	V4.0 - Dec 2024
<small>This version is valid for a period of 3 years from the above date. After which it will expire and the data shall not be used.</small>	
<small>Users are required to Register for Permission to use the data for Non-educational Use. Registration is Free. Use the link below and fill in the form on the webpage.</small>	
Is this version still valid?	Check link below, to see if a newer version is available.
Register for permission to use the data for non educational use and to check if this copy is up to date at:	http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html

Whole Life Carbon Assessment Results

Whole Life Embodied Carbon Breakdown



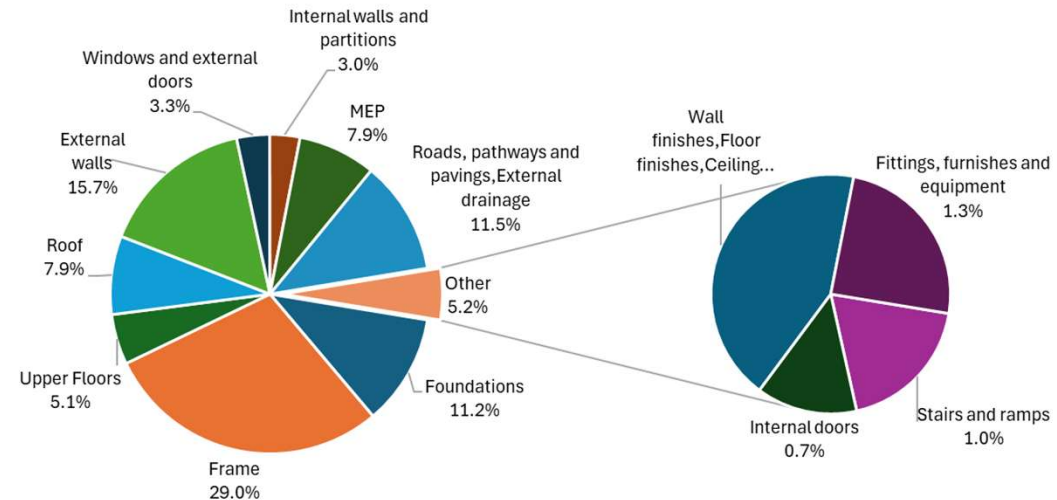
Whole Life Carbon Results



Whole Life Carbon Assessment Results

Building Component	Sub-Component	Embodied Carbon - Excluding Biogenic Carbon (kgCO2e)
0.1 Toxic Mat	Toxic material treatment	-
0.2 Demolition	Major demolition work	-
0.3 Supports	Temporary supports	-
0.4 Groundworks	Specialist groundworks	-
0.5 Diversion	Temporary diversion works	-
1 Substructure	Foundations	251,478
2 Superstructure	Frame	648,753
2 Superstructure	Upper Floors	113,979
2 Superstructure	Roof	177,615
2 Superstructure	Stairs and ramps	21,987
2 Superstructure	External walls	352,178
2 Superstructure	Windows and external doors	74,859
2 Superstructure	Internal walls and partitions	68,159
2 Superstructure	Internal doors	15,879
3 Internal finishes	Wall finishes, Floor finishes, Ceiling finishes	49,865
4 Fittings, furnishes and equipment	Fittings, furnishes and equipment	28,497
5 Services (MEP)	MEP	176,548
6 Prefabricated buildings and building units	prefab	-
7 Work to existing buildings	Works to existing buildings	-
8 External Works	Roads, pathways and pavings, External drainage	256,789

Embodied Carbon Breakdown of Materials

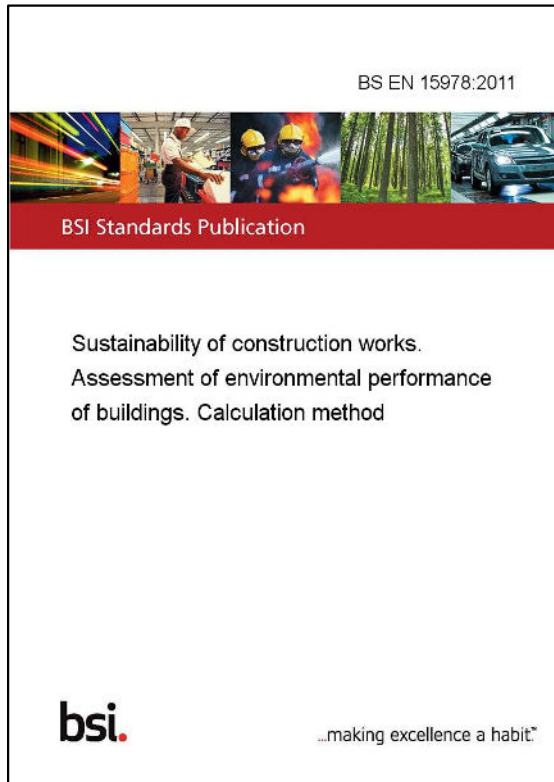


Whole Life Carbon Assessment

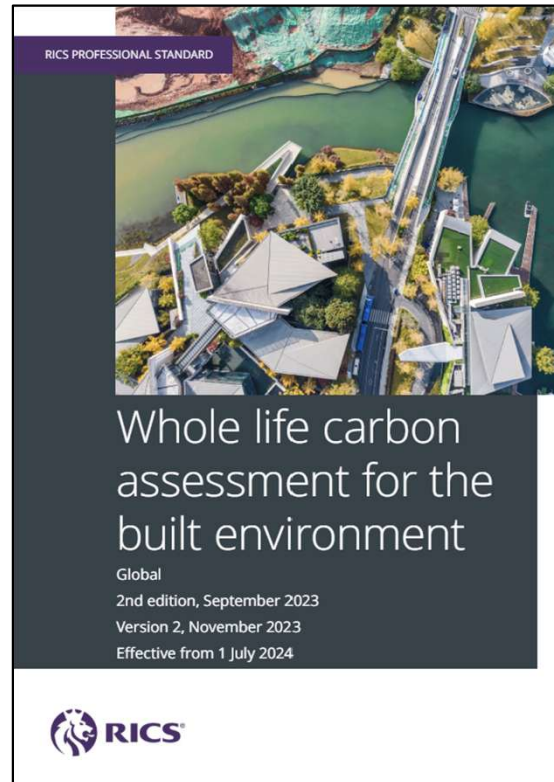
- What about operational carbon?
 - Operational carbon assessment has often been a separate assessment
 - Often using the regulated energy emissions (e.g. Part L building energy calcs)
 - With the results integrated into the Whole Life Carbon Assessment
 - However, there is increased movement to more predictive operational energy modelling
 - Such as CIBSE TM54 encouraged in the RICS 23 WLC Method
- How long does an assessment take?
 - As assessment can be completed in a few weeks
 - However, most detailed assessments span months
 - For example, over the construction timeline of the project
 - Which should ideally include interaction with the design teams to find carbon reduction measures
- What methods or standards should be followed? ...

Whole Life Carbon Standards

What Standards Should Be Adhered To?



BS EN 15978:2011



RICS Professional Standard – Whole
life carbon assessment for the built
environment -
2nd Edition



PAS 2080:2023 – Carbon
management in buildings and
infrastructure

Tips for Ensuring Compliance



Ensure use of reputable WLC calculation tools



Seek third party validation of assessments



Ensure a clear scope and boundary



Maintain an audit trail and detail any assumptions



Undertake specific whole life carbon training courses

Certification Schemes Considering WLC



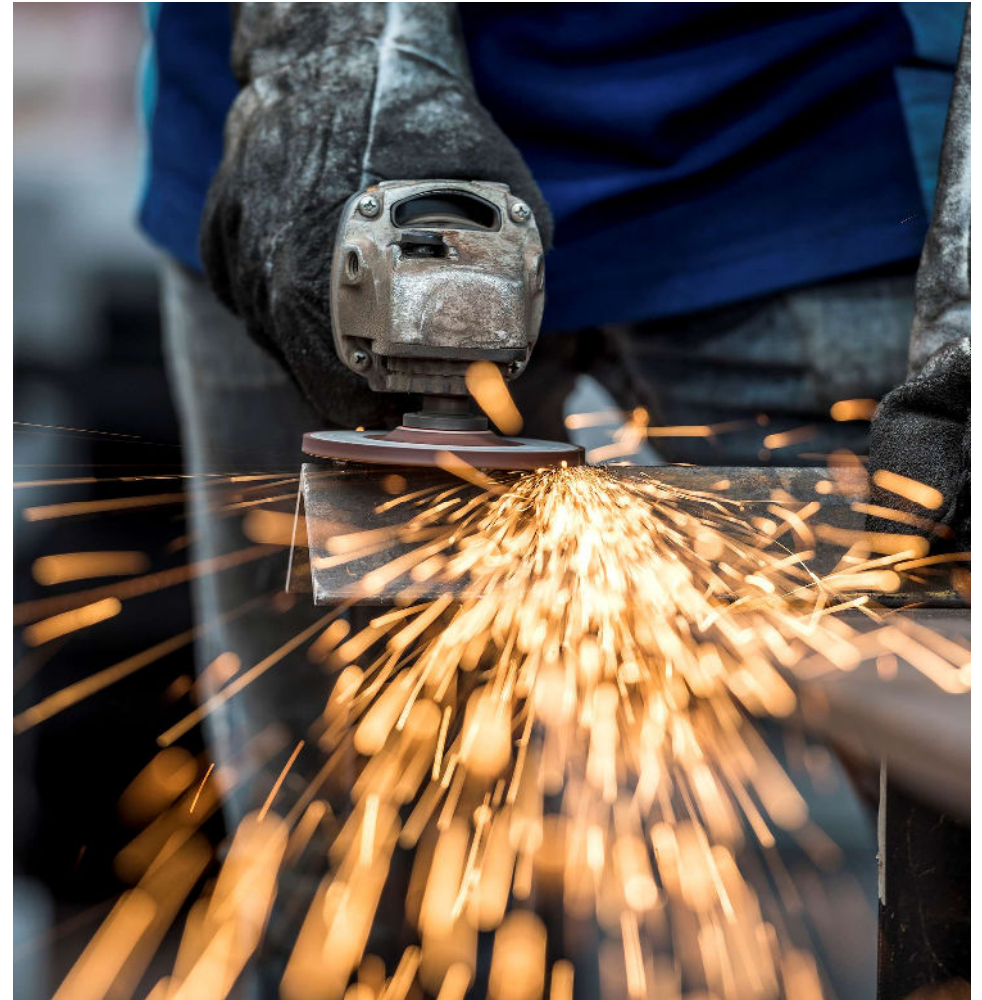
BREEAM[®]



What Data Can Suppliers and Manufacturers Provide?

What Data Can Suppliers and Manufacturers Provide About Their Products?

- Embodied carbon data: Cradle to (factory) gate
 1. Raw material extraction & use of recycled materials
 2. Transport to site of manufacture
 3. Energy consumed in manufacturing process
- Other data includes material quantities, composition and product service life
- Usually in the form of an EPD or Product Carbon Assessment compliant with EN15804 + A2



Environmental Product Declarations (EPD)

- **Environmental Product Declarations (EPDs)** are short documents usually provided by a product manufacturer
- EPDs show the results of a Life Cycle Assessment, and contain information on the impact of a material or product over a certain lifespan
- A wide range of impact categories are included (not only carbon)

bre

Statement of Verification
BREG EN EPD No.: **000247**
ECO EPD Ref. No. 0000823
This is to verify that the **Environmental Product Declaration** provided by: **Xtratherm UK Ltd** is in accordance with the requirements of: **EN 15804:2012+A1:2013** and **BRE Global Scheme Document SD207**

Issue 1

BRE Global Verified
EPD

This declaration is for: **Phenolic Insulation Product**

Company Address
Park Road
Holmewood
Chesterfield
S42 5UY

Xtratherm
More than insulation

Signed for BRE Global Ltd
Operator
Date of first issue
01 February 2019

Laura Critien
Operator
Date of this issue
01 February 2019

Expiry Date
01 February 2023

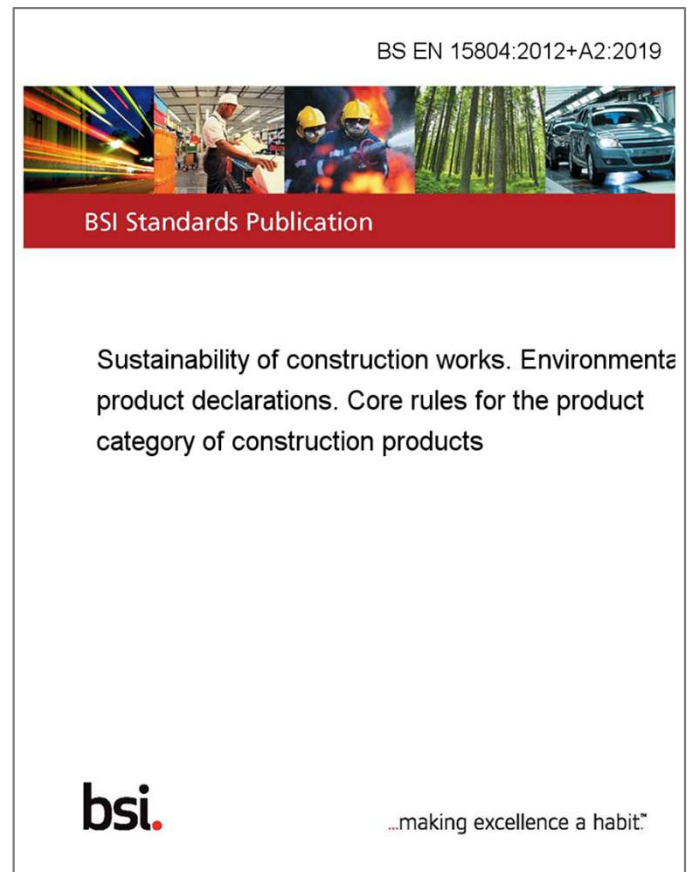
BRE Global Verified
EPD

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What Standards Should Be Adhered To?

- **EN15804 + A2 – Sustainability of construction works – Environmental product declarations - Core rules for the product category of construction products**



Why Is This Data Useful?



Helps improve accuracy of WLC assessments



Can inform low carbon decision making (e.g., comparison of multiple products with similar function)



Assists with identification of carbon hotspots to inform where best to focus efforts

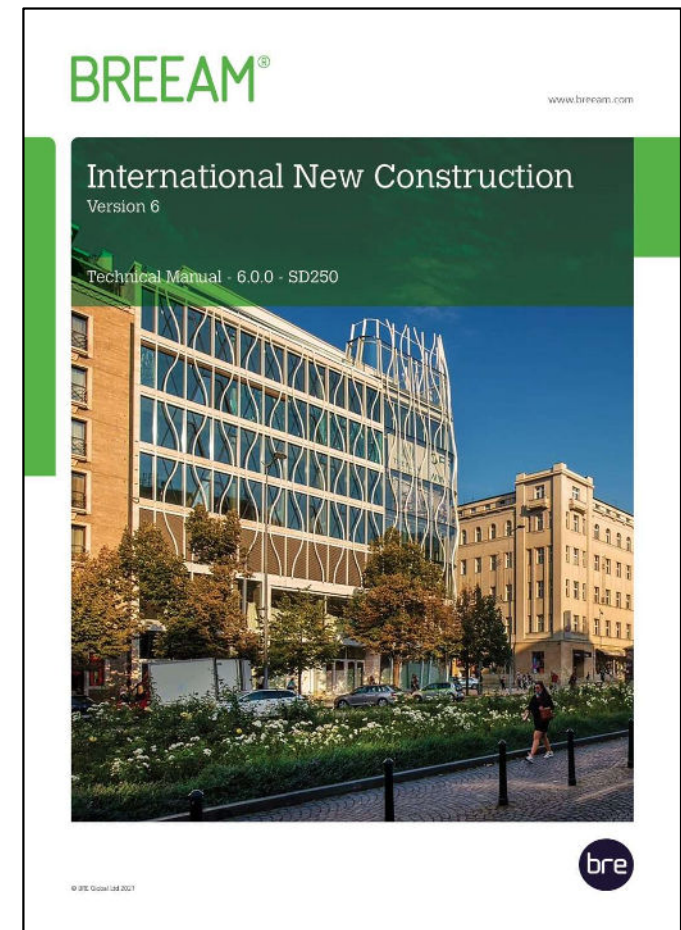


RICS Edition 2 requires use of EPDs where appropriate, some certification schemes give credits for their use

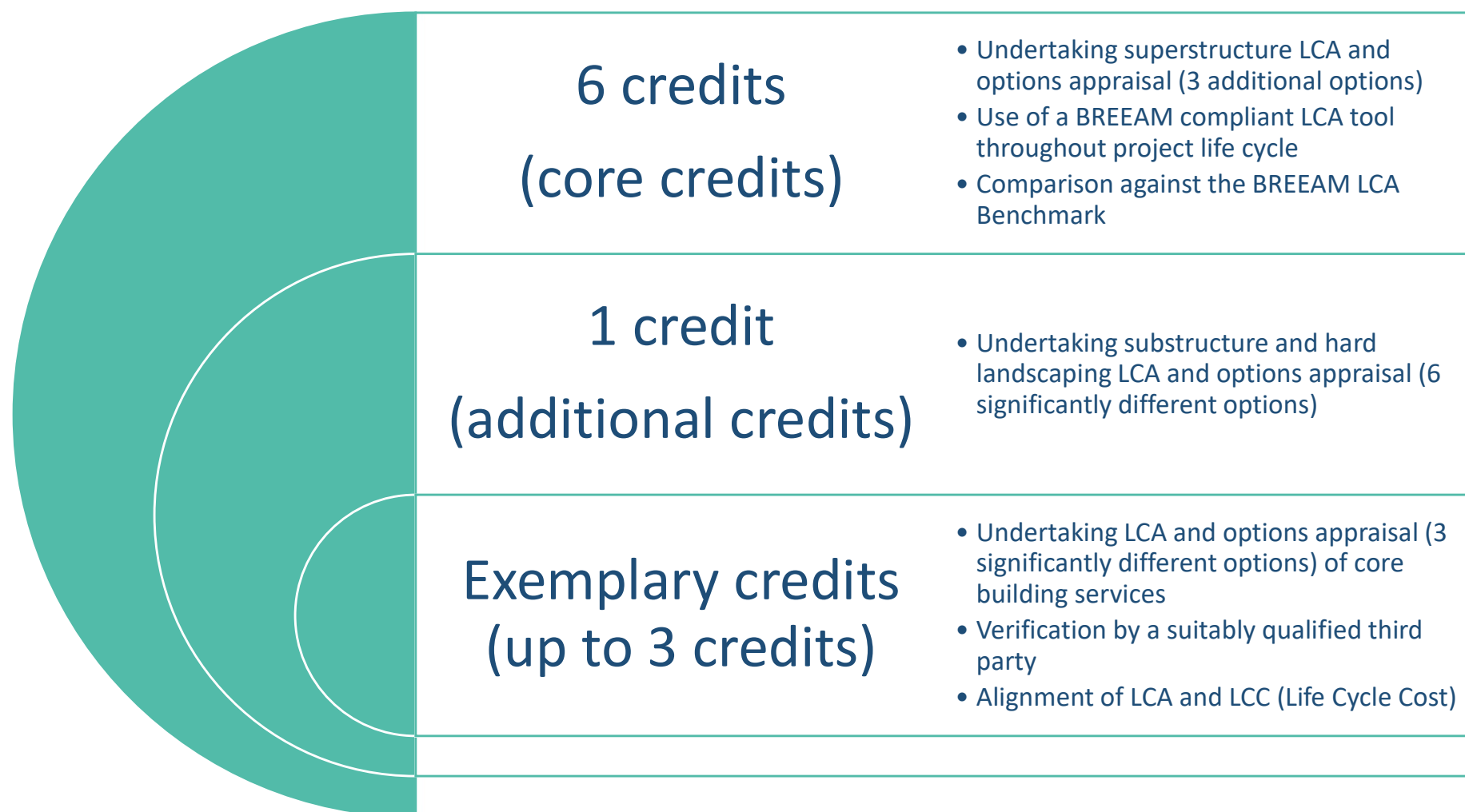
BREEAM Mat 01 LCA Credits

BREEAM Mat 01

- Credits are available for undertaking WLC – contributing to overall BREEAM rating
- Mat 01 Life Cycle Assessment (LCA) is designed to assess and drive design decisions which reduce the environmental impacts of a construction project
- Mat 01 covers range of lifecycle impacts (not just Global Warming Potential)
- Only recognised tools should be used to conduct the LCA
- “Significantly different design options” are required to be assessed against each other



Mat 01 Available Credits



Mat 01 Building Element Coverage

- Coverage is limited to a range of key building elements

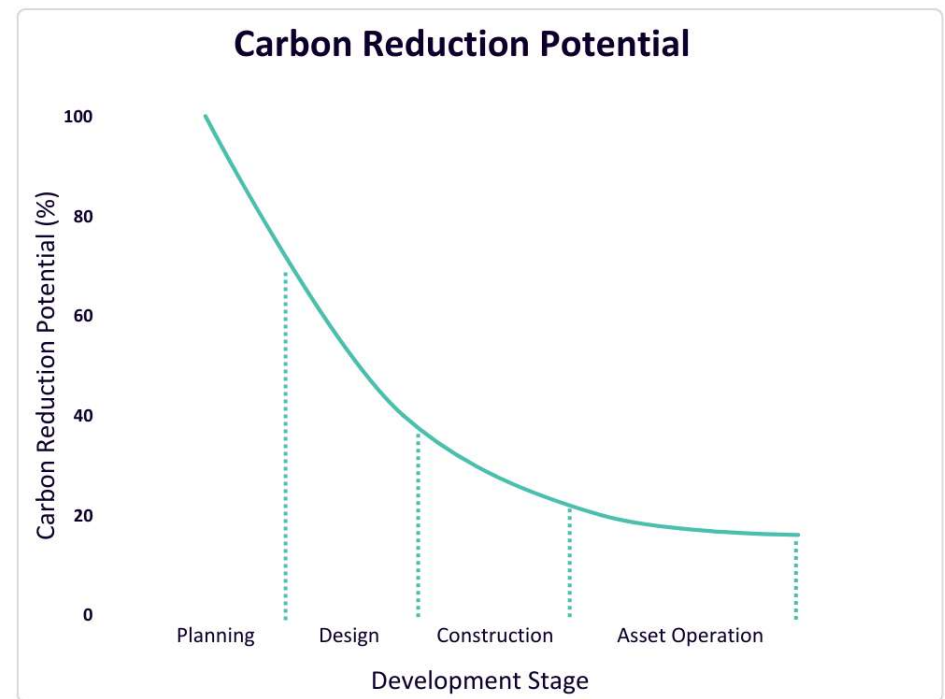
Level 1 Group element	Level 2 Element	Level 3 Sub-element
2. Superstructure	1. Frame	<ol style="list-style-type: none"> 1. Steel frames 2. Space decks 3. Concrete casings to steel frames 4. Concrete frames 5. Timber frames 6. Other frame systems
	2. Upper floors	<ol style="list-style-type: none"> 1. Floors
	3. Roof	<ol style="list-style-type: none"> 1. Roof structure 2. Roof coverings 3. Specialist roof systems

Level 1 Group element	Level 2 Element	Level 3 Sub-element
		<ol style="list-style-type: none"> 5. Rooflights, skylights and openings
	4. Stairs and ramps	<ol style="list-style-type: none"> 1. Stair or ramp structures
	5. External walls	<ol style="list-style-type: none"> 1. External enclosing walls above ground floor level 2. External enclosing walls below ground level 3. Solar or rain screening
	6. Windows and external doors	<ol style="list-style-type: none"> 1. External windows
	7. Internal Walls and Partitions	<ol style="list-style-type: none"> 1. Walls and partitions (Education only)

Mat 01 Considerations

- Conducted at RIBA Stage 2 (Concept Design)
- Credits also available for further assessment at RIBA Stage 4 (Technical Design)
- Mat 01 assessments can be undertaken by specialists including consultants and architects
- Assessments can be produced in as little as 1-2 weeks, but 4-6 weeks is more appropriate

Concept Design Assessment must be submitted to BRE **prior** to detailed planning assessment – otherwise many credits can be missed out on



Recreation of graphic from UK Government Infrastructure Carbon Review

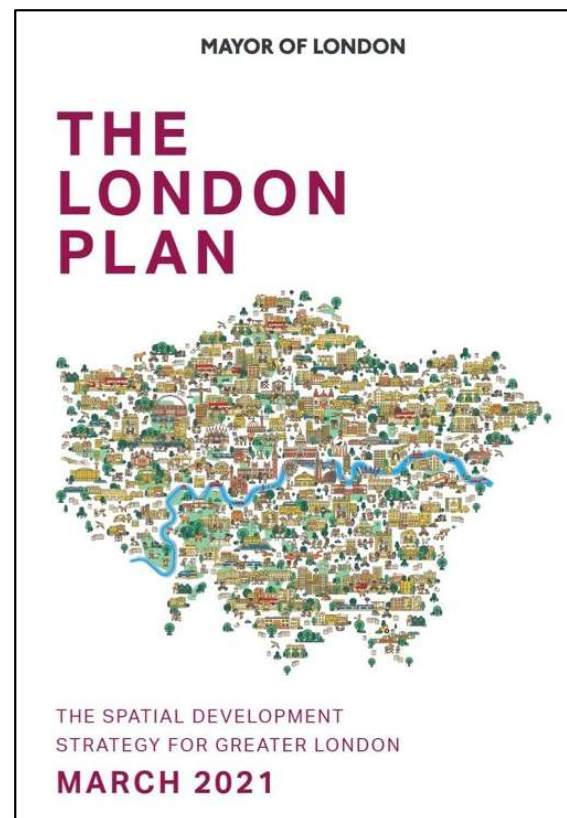
Whole Life Carbon in the London Plan

London Plan Whole Life Carbon

“Whole life-cycle carbon emission assessments are therefore required for development proposals referable to the Mayor.”

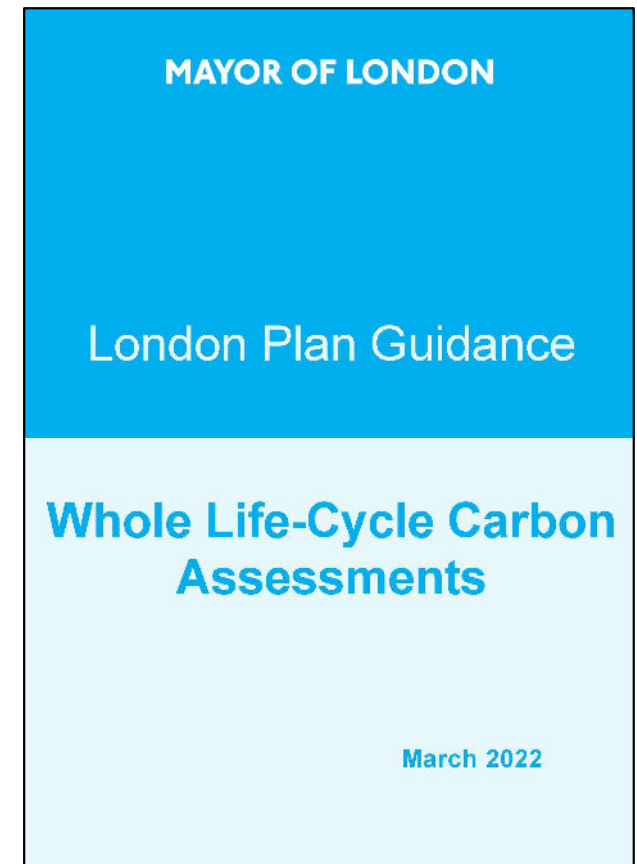
“Major non-referable development should calculate unregulated emissions and are encouraged to undertake whole life-cycle carbon assessments.”

The London Plan, 2021, Chapter 9 Sustainable Infrastructure



London Plan Guidance

- Based on BS 15978:2011 and RICS WLC Edition 2 – with some specific deviations:
 - Specific reporting requirement for operational carbon
 - All life-cycle modules (A-D) to be reported – including pre-construction demolition (A5.1)
 - Quantification of “key” carbon reduction actions
 - Infrastructure projects can be required to complete WLC, but are recommended to align with PAS 2080



Stages of London Plan WLC

Pre-application Stage

- Provide brief outline details of the proposal
- Confirm details of, or otherwise outline justification of exclusion of, range of carbon reduction measures
- Estimation of emissions associated with any pre-construction demolition

Outline or Detailed Planning Stage

- Estimation of total Whole Lifecycle Carbon Emissions for each lifecycle module
- Completion of Material Quantities and End of Life Scenarios (in line with details provided in the project's Circular Economy Statement)

Post-Construction Stage

- Assessment based on actual materials, products and systems used
- Comparison of post-construction stage assessment with planning stage assessment and details of any deviations
- Comparison with GLA's benchmark values for the building type and summary of good practices and lessons learned

Benchmark Values

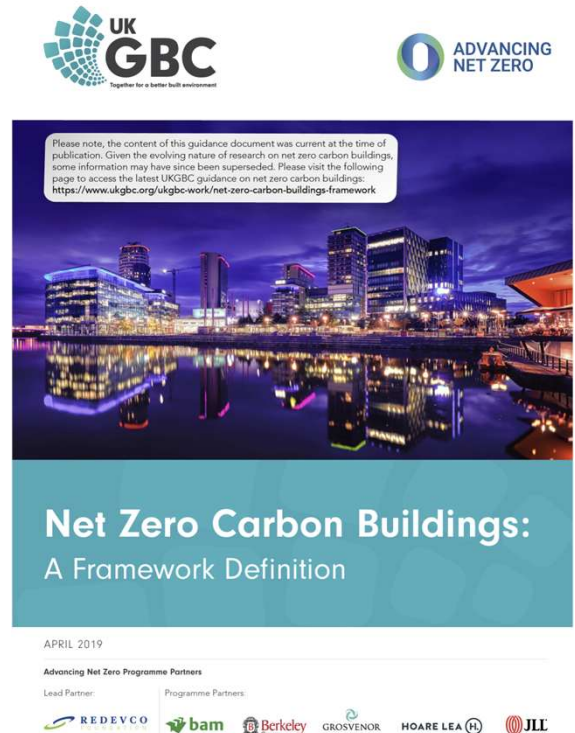
WLC benchmark	A1-A5	B-C (excl B6 & B7)	A-C (excl B6 & B7)
Offices	<950	<450	<1400
Residential	<850	<350	<1200
Schools, Universities etc.	<750	<250	<1000
Retail	<850	<200	<1050
Aspirational WLC benchmark	A1-A5	B-C (excl B6 & B7)	A-C (excl B6 & B7)
Offices	<600	<370	<970
Residential	<500	<300	<800
Schools, Universities etc.	<500	<175	<675
Retail	<550	<140	<690

* All benchmark values in kg CO₂e/m²

How Can Whole Life Carbon Help with Net Zero Carbon Buildings

The Rise of Net Zero Carbon Buildings

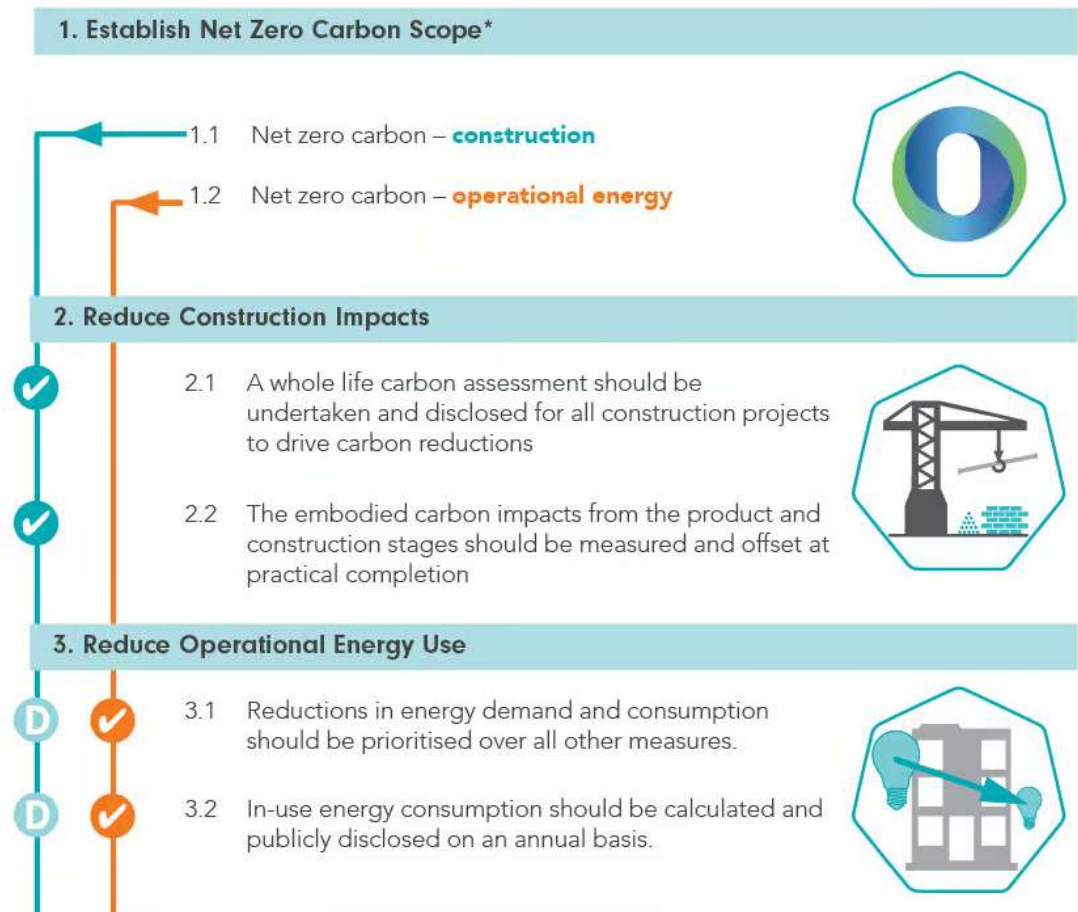
- UK GBC Net Zero Carbon Framework set the foundation for NZC buildings
- First released in 2019
- They also released guidance on:
 - Levels of performance
 - Renewable energy procurement
 - Carbon offsetting good practice guidance
- Now being overtaken by development of UK NZC Standard
- But it was an important standard for development of NZC Buildings



Achieving a Net Zero Carbon Building

UKGBC framework could achieve either:

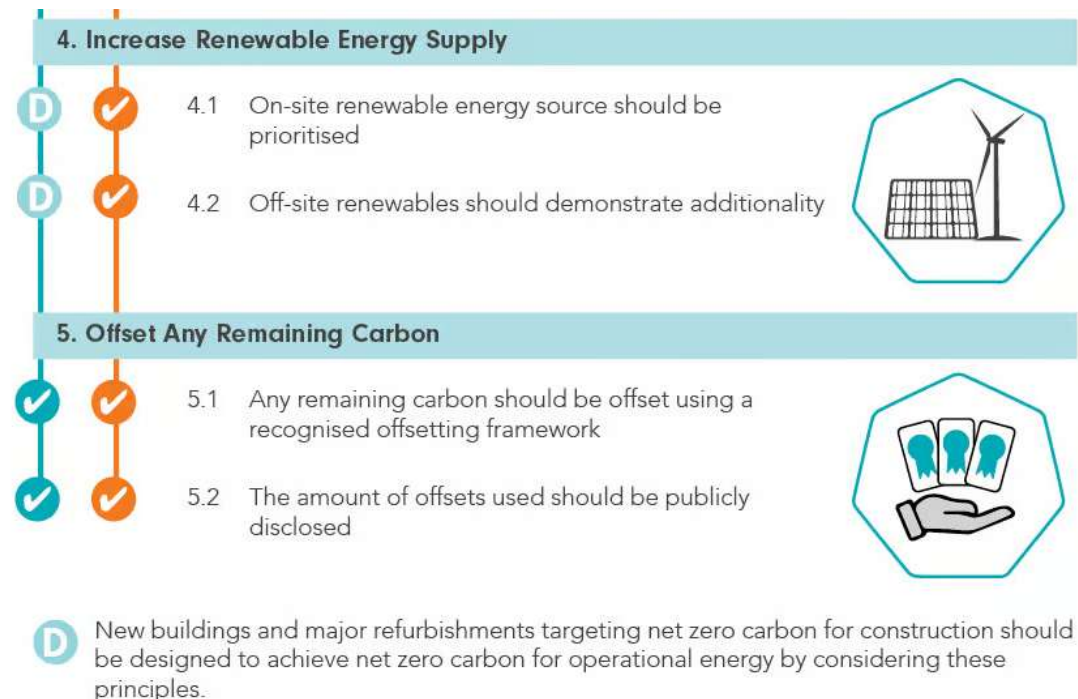
- **NZC Construction:** Embodied carbon
- **NZC Operations:** In-use energy
- **Embodied carbon reduction needed to achieve NZC Construction**
- **Also need to reduce operational energy demand**
- **Measure and disclose in-use energy annually to achieve NZC Operations**



Source: UKGBC

Achieving a Net Zero Carbon Building

- Prioritise **on-site renewables**
- **Off-site renewables** allowed when demonstrating additionality
- Publicly disclose **offsets** used
- NZC Construction to **reduce embodied carbon**, then **offset residual emissions**
- NZC offsets serve as a contingency measure to **supplement renewable energy sources** if they fall short of meeting the building's **annual energy requirements**



Source: UKGBC

UK Net Zero Carbon Buildings Standard

- **UK Net Zero Carbon Standard was launched in pilot phase Sept 24**
- Builds upon the same principles as UKGBC standard
- **UK GBC framework is being retired**
- UK GBC Standard doesn't currently allow Net Zero Construction (embodied carbon)
 - Although have indicated that these requirements may be developed in the future
- **UK NZC Standard is starting pilot testing soon on real projects**

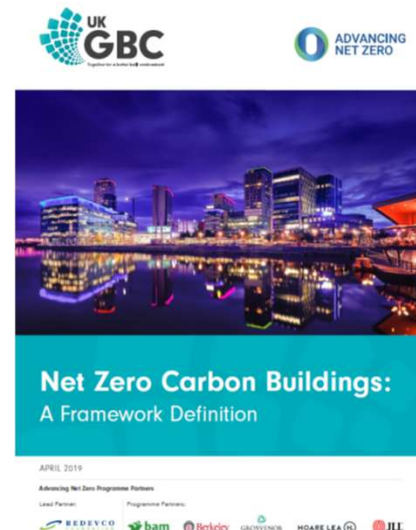
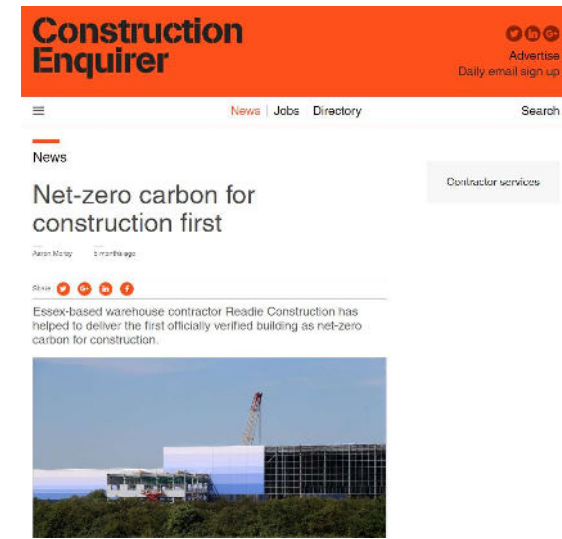


Net Zero Carbon Buildings

- There is also a Net Zero Carbon Buildings standard from the International Living Future Institute
- **Whole Life Carbon assessments help with the requirements of any of these NZC building standards**
 - Target lower embodied and whole life carbon emissions
 - Reduce embodied carbon
 - Measure residual embodied carbon
 - As-built embodied carbon evidence
 - Project operational carbon emissions over the lifetime

World's First UKGBC Net Zero Carbon Building

- **GLP Magnitude – Net Zero Carbon Construction**
 - **Logistics centre - 29,183 m² GIA**
 - **First building verified to UKGBC as Net Zero Construction (Embodied carbon)**
- **Circular Ecology:**
 - **Measured embodied carbon**
 - **Advised on carbon reduction**
 - **Took through the Net Zero Carbon verification process**
 - **Provided the carbon offsets - 11,735 tCO₂e**
- Example news:
 - <https://www.constructionenquirer.com/2020/08/25/net-zero-carbon-for-construction-first/>



Summary

Summary

- **Embodied carbon is the carbon footprint of making, handling and installing materials or products**
- Whole Life Carbon Assessment can help to quantify the **carbon emissions released from construction projects over their life cycle**
 - A1-3 – cradle to gate
 - A1-5 – cradle to practical completion
 - A-C – cradle to grave (e.g. over 60 years)
- Whole life carbon assessments can **help to get BREEAM Mat 01 LCA credits**
 - **It's really important to not miss the Stage 2 credits deadline**
 - Submit to BRE before a detailed planning application has been submitted
- **There are increasing requirements from policy and legislation, such as the London Plan**
- **Whole Life Carbon Assessments are required for any development that wants to achieve Net Zero Carbon**

Next Webinars

- We are planning a **webinar series across 2025**
- Next webinars:
 - **Organisational Carbon Footprinting** – March 13th
 - ICE Database Insights webinar series – coming soon
- **Keep an eye on our networks** for more information
 - Website - circularecology.com
 - LinkedIn - linkedin.com/company/circular-ecology

Q&A

Please use the Q&A interface to ask any questions....

Thank you for watching

Sign up to our newsletter for monthly updates

<https://circularecology.com/newsletter.html>