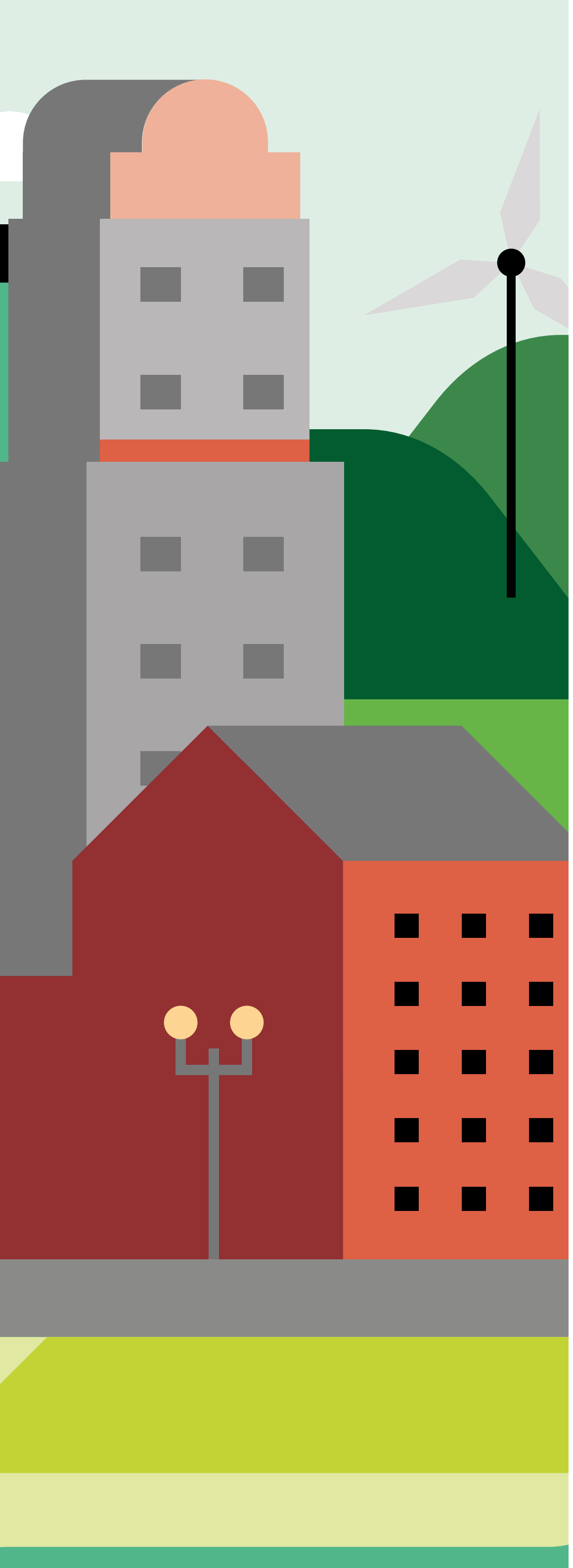
IMPLEMENTATION OF CIRCULARITY, WHOLE LIFE CARBON AND LIFE CYCLE COSTING IN PUBLIC CONSTRUCTION PROJECTS



CONTENTS

INTRODUCTION

Procuring a green building is not like procuring a product such as stationary or uniforms. Each building is bespoke to its site and function. The green performance of a building must first be designed and specified in great detail and the only role of the contractor is to faithfully build this design exactly as specified. If site, design, and exact specification are green the building should be green.

This handbook introduces you to some of the key green indicators that should be applied within the procurement of public construction projects in addition to the energy efficiency requirements in Building regulations TGD Part L. These include Circularity, Whole Life Carbon assessment and Life Cycle Costing. It explains why these are important to integrate in projects, and how there is now a standardised EU approach to the application of the indicators through the EU framework for sustainable buildings: Level(s). This handbook sets out the appropriate level of assessment and how to apply the indicators at each of the stages of the Capital Works Management Framework (CWMF), as well as who should be involved. It provides links to guidance, tools and education available in Ireland and internationally for the application of the indicators.

WHAT IS GREEN PUBLIC PROCUREMENT (GPP)?

Green Public Procurement (GPP) is a process where public authorities seek to source goods, services or works with a reduced environmental impact. The Government of Ireland's annual public sector purchasing accounts for **10%** to **12%** of **Ireland's GDP**, a large part of economic activity and demand.

This provides Ireland's public sector with significant influence to stimulate the provision of more resource-efficient, less polluting goods, services and works within the marketplace.

The public sector has a responsibility to promote green procurement, in order to support Ireland's environmental and wider sustainable development objectives. This duty is highlighted in the **Climate Action Plan (CAP)** 2023 as it states that the public sector will lead by example, embedding climate actions as a central value, **relentlessly** focusing on continuous improvement that **deliver real progress**.

The large impact that the public sector has in relation to implementing circularity is highlighted on a national level in the **Whole of Government Circular Economy Strategy 2022–2023 – Living More, Using Less** strategy and in the **Waste Action Plan for a Circular Economy; Ireland's National Waste Policy 2020–2025**. At an EU level, the **European Green Deal** and the **EU Circular Economy Action Plan** (CEAP) states
the importance of green public procurement in the EUs' aim to achieve their climate neutrality target by 2050 and to halt biodiversity loss.

HOW TO PROCURE A GREEN BUILDING?

In order to procure a green building, it must be designed and specified. The contractor can only deliver what they are contracted to deliver. The building will only be as green as set out in the detail design, information and specification provided in the tender documentation by the procurement team.

This requires collaboration along the entire project timeline as it is not possible to design a green building on an unsustainable site, apply key indicators where not in scope of design fees, the contractor cannot make a green building from an unsustainable design, and the facility manager cannot make an unsustainable building perform.

The targets must be set from the beginning by the sponsoring agency. Everyone along the project time line must be aware of the targets to be achieved through to facility manager. If a site or building needs to be procured then the valuers or property agents must be aware of the targets and site specific issues that will impact performance, including location, transport, embodied carbon resulting from soil conditions or need for parking, resource consumption, waste generation and life cycle costs and this must be reflected in the valuation report.

Ambitious targets set out in this document can only be achieved if design team has integrated them from early concept design so this required integrated design team working. The contractor must be competent to deliver to the performance and quality standards set out in the tender and provide the level of reporting to show compliance with targets. Sufficient information should be provided to the facility manager to operate the building to the set targets and to feedback non-compliance to the sponsoring agency and their team.

Procurer

- Choose a sustainable site
- Develop performance targets for design team
- Develop detail brief + scope of works ensuring fees adequate to cover
- Ensure competency of design team to deliver targets
- Ensure design team is meeting targets at each design review stage

Design Team

- Integrate targets from early concept stage
- Present at each design review stage evidence that project is meeting targets
- Develop sufficient information for contractor to meet targets
- Selection of competent contractor to deliver design meeting targets

Contractor

- Build to quality + performance targets set out in design and specificiation
- Meet environmental targets set out by procurer for construction process itself
- Hand over sufficient information on building to enable it to be operated in line with targets

Facility Manager

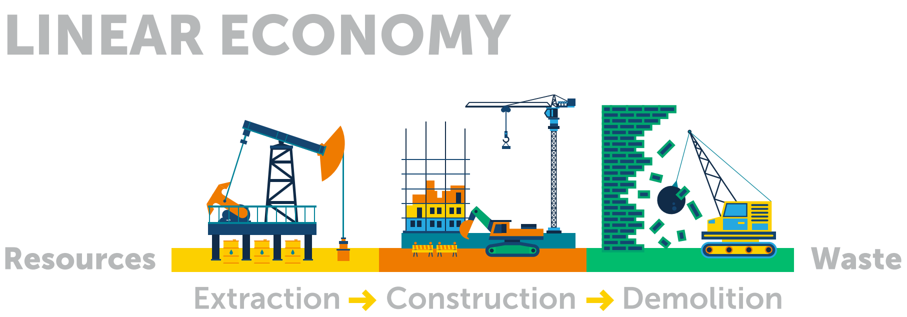
- Ensure that building is operating to the specified performance
- Report back performance to investor/client/design team/contractor
- Work with them to correct non-performance
- Continue to optimise and report performance each year

WHAT IS CIRCULARITY AND WHY IS IT IMPORTANT?

Circularity is the process of keeping materials, that have already been extracted, or harvested to their highest value and reusing these materials rather than disposing of them. In this system there is no waste. Everything flows and copies the regenerative cycles of nature. This system avoids extraction from the Earth's finite resources and reduces carbon emissions.

Over the last number of years, the world at large has been focusing on the journey of switching to renewable energy. However, this only addresses just over half of greenhouse gas emissions.[1] The remaining greenhouse gas emissions come from the fact that we are stuck in a linear economy, and we are constantly extracting from the Earth to make goods. The Circular Economy is the opposite of the linear economy.

Construction is an activity that requires considerable extraction to create the buildings and infrastructure that surround us every day. Extraction of all materials is responsible for 90% of biodiversity loss. Construction is responsible for almost 50% of raw material consumption in Europe.



In the EU, Waste from Construction and Demolition (C&D) activity is the largest waste stream and C&D waste represents one third of all waste. C&D waste is Irelands largest waste stream, and this number is only going to increase due to the large amount of construction projects planned, especially under the Ireland 2040 plan.

The circular economy gives us the tools to tackle climate change and biodiversity loss together. The circular economy transition will bring many additional benefits, including green jobs and economic growth[2].

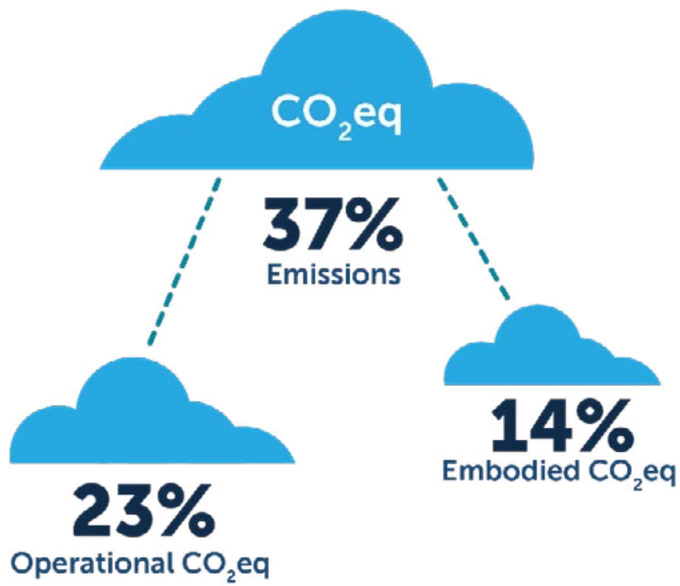
1 https://ellenmacarthurfoundation.org/completing-the-picture
2 The Circular Economy Could Unlock $4.5 trillion of Economic Growth, Finds New Book by Accenture | Accenture

WHOLE LIFE CARBON AND WHY IS IT IMPORTANT?

The construction and built environment sectors account for 37% of Ireland's carbon emissions, equalling those of agriculture. Just under two thirds (23%) of these emissions come from operating buildings but more than a third (14%) comes from the quarrying, from the production of construction materials, transport of materials, construction process, maintenance, repair and disposal of buildings and infrastructure. The carbon modelling work carried out by IGBC and UCD for Building a Zero Carbon Ireland roadmap[3] showed that Ireland would not be able to meet its climate goals by 2030 unless embodied carbon is tackled.

The Government's Climate Action Plan 2023 requires a decrease in embodied carbon in construction materials by 10% by 2025 and a decrease by at least 30% by 2030 for materials produced in and used in Ireland. In older buildings the main cause of emissions is operational energy, but newer buildings with better performance, require greater quantities of materials to achieve this performance.

The production of materials also has a carbon cost known as Embodied Carbon. Cradle to grave thinking allows for building design solutions that seek the optimum balance between embodied carbon and use stage carbon emissions. In particular with embodied carbon, it is important to recognise that buildings are a significant material bank, being a repository for both carbon intensive resources (concrete, steel etc.) and carbon sequestering resources (wood, hemp etc.) over many decades, and so it is important to explore designs that facilitate the future reuse and recycling at the end of the building life.



'Whole Life Carbon' (WLC)

is the total Global Warming Potential (GWP) associated with all life cycle stages of a building including both operational and embodied carbon. It is measured in kg or tonnes of CO_2 equivalent (CO_2 eq).

'Operational Carbon'

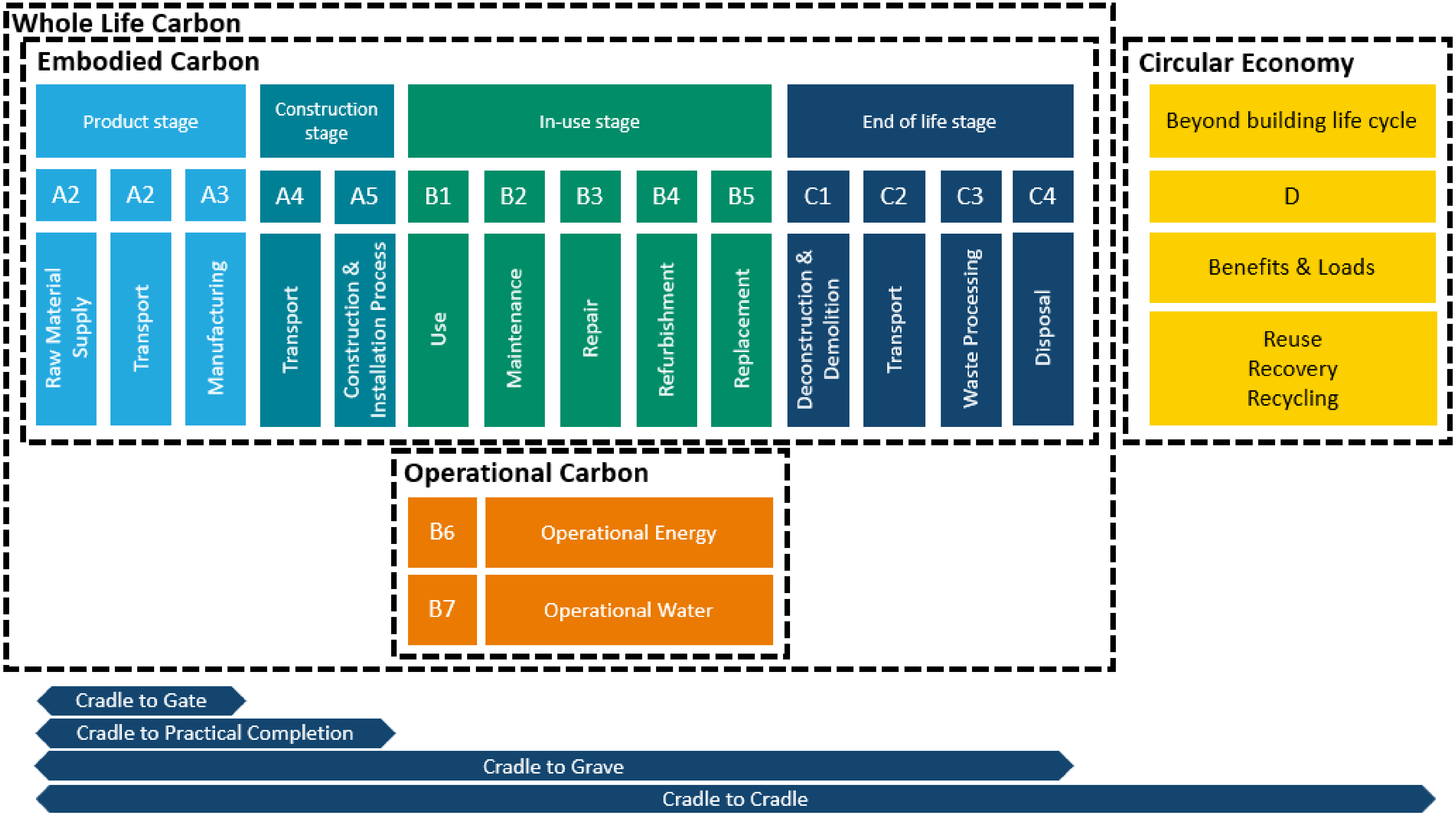
is the GWP associated with operational energy and water use (modules B6 and B7) during the use stage of a building's life cycle.

'Embodied Carbon'

is the GWP associated with the manufacturing and use of all construction materials and products over a building's whole life cycle (50–60 years); cradle to grave (modules A1–A5, B1–B5 and C1–C4).

3 https://www.igbc.ie/building-a-zero-carbon-ireland/

Building Life Cycle stages are defined by EN15978:2011

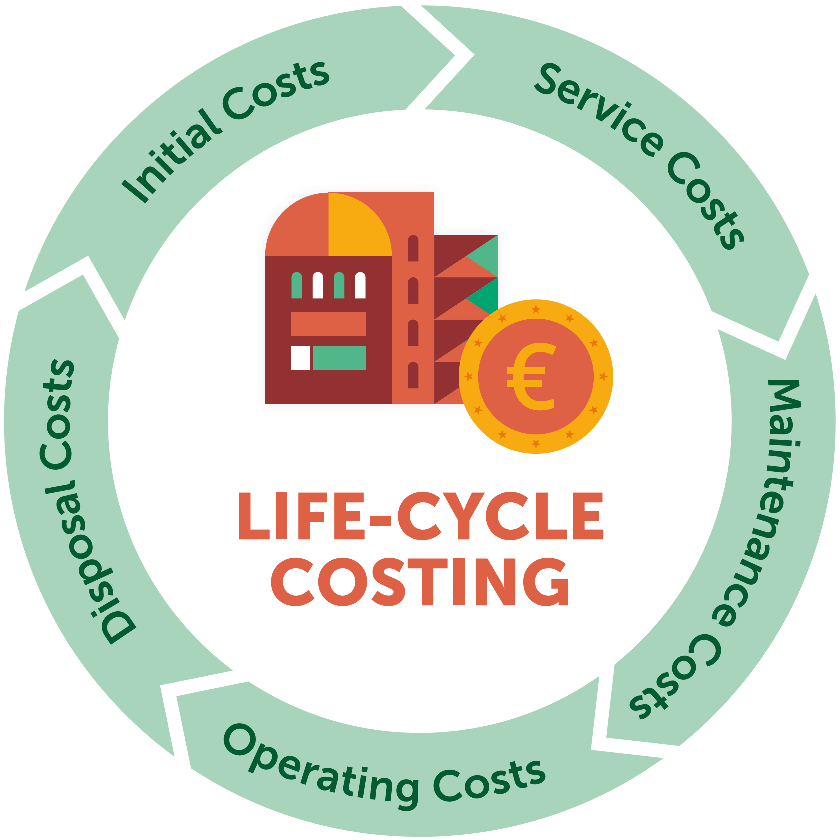


Measuring of WLC of a building gives a clear understanding of the carbon impact of constructing and operating the building. It allows an understanding of long-term post completion considerations such as durability and lifespan.

By making WLC assessment an important consideration in the design of a building, design teams will:

- Reduce the material needs wherever possible
- Optimise the energy performance
- Consider how a building will be deconstructed
- Send a signal up supply chains to material manufacturers that lower carbon products will be preferred. This will assure manufacturers that there is a market for lower carbon solutions and therefore encourage investment in cleaner production processes.

LIFE CYCLE COSTING AND WHY IS IT IMPORTANT?



Life Cycle Cost (LCC) analysis is a methodology for comparing the total cost of a product, structure or system over its entire life cycle. LCC gives a measurement of long-term economic performance of a building taking into account all its life stages. It includes various kinds of cost: the upfront capital costs, maintenance, repair and operation costs, renovation and adaptation costs, and finally demolition and disposal costs. It can also include environmental externalities. By estimating life cycle costs, important information can be provided to investors, asset managers and occupiers.

A life cycle cost perspective encourages clients and designers to consider the relationship between upfront capital costs and use stage costs. They can also provide a more informed basis for understanding future performance, value and liabilities associated with a building. Savings associated with energy and water efficient buildings can be cash-flowed in order to capitalise the value of the savings and reflect this in property valuations and investment decisions.

This may be in comparison with benchmarks of performance in a local market, across a portfolio or the asset performance prior to a major renovation. The development of a medium to long-term maintenance and replacement plan can support more cost-effective management of assets. This can include decisions relating to the service life and durability of key elements and components, as well as predictions of potential future costs and liabilities that may be associated with the early failure of components.

WHAT IS LEVEL(S) AND WHY IS IT IMPORTANT?

Level(s) is an EU initiative that joins up sustainable building thinking across the EU by offering guidance on the key areas of sustainability in the built environment and how to measure them during design and after completion. Level(s) is the first-ever European Commission framework for improving the sustainability of buildings, living by the values of flexibility, resource efficiency, and circularity.

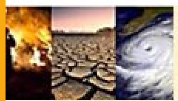
Level(s) is mentioned in key EU Policy related to the built environment including the **Renovation wave, the Circular Economy Action Plan,** the **New European Bauhaus** and the **EU Energy Efficiency Directive**, as a framework for construction and buildings to increase sustainability, and for use in Green Public Procurement. The draft **Energy Performance of Building Directive (EPBD)** will require disclosure of whole life carbon in accordance with the Level(s) framework by 2027 for large new buildings and all new buildings by 2030.

Level(s) is included in national policy documents such as in Irelands' new **National Policy on Architecture** published in 2022 as '**essential in order to make comparable assessments, identify key performance indicators and understand the quality of development and its impact on natural and culturally significant sites**'. The **EPA Green Public Procurement Guidance** for the public sector also references the use of EU Level(s) Framework.

Level(s) is based on six overarching macro-objectives:

1. Greenhouse gas emissions along a building's life cycle
2. Resource efficient and circular material lifecycles
3. Efficient use of water resources
4. Healthy and comfortable spaces
5. Adaptation and resilience
6. Optimised life cycle cost and value

LEVEL(S) KEY INDICATORS

	1	Green house gas emissions along a building's life cycle	1.1 Use stage energy performance	kilowatt hours per square metre per year [kWh/m²/yr]	1.2 Life cycle Global Warming Potential	$kgCO_2$ equivalents per square metre per year				
	2	Resource efficient + circular material	2.1 Bill of quantities	Unit quantities mass + years	2.2 Construction + demolition waste + materials	kg of waste + materials per m²	2.3 Design for adaptability use	Adaptability score	2.4 Design for deconstruction, reuse + recycling	Deconstruction score
	3	Efficient use of water resources	3.1 Use stage water consumption	m³/yr water per occupant						
	4	Healthy + comfortable spaces	4.1 Indoor air quality	Parameters for ventilation, CO_2 + humidity Target list of pollutants: TVOC, formaldehyde, CMR, VOC, LCI ratio, mold, benzene, particulates, radon	4.2 Time outside of thermal comfort range	% of the time out of range during the heating and cooling seasons	4.3 Lighting + visual comfort use	Level 1 check list	4.4 Acoustics + protection against noise	Level 1 checklist
	5	Adaptation + Resilience	5.1 Protection of occupier health + thermal comfort	Projected % time out of range in the years 2030 and 2050 [see also 4.2]	5.2 Increased risk of extreme weather events	Level 1 checklist [under development]	5.3 Increased risk of flood events	Level 1 checklist [under development]		
	6	Optimised life cycle cost and value	6.1 Life cycle costs	Euro per square metre [€/m²/yr]	6.2 Value creation + risk exposure Indoor air quality	Level 1 checklist				

The common Level(s) **framework is organised into three levels**. The **levels provide a choice as to how advanced the reporting on sustainability for the project will be.** The three levels represent the following stages (meaning – levels of detail of design) in the execution of a building project:

Level 1:
The conceptual design for the building project

– the simplest level as it entails early-stage qualitative assessments of the basis for the conceptual design and reporting on the concepts that have or are intended to be applied. This roughly aligns with Stage 1 and part of Stage 2 of the CWMF.

Level 2:
The detailed design and construction performance of the building

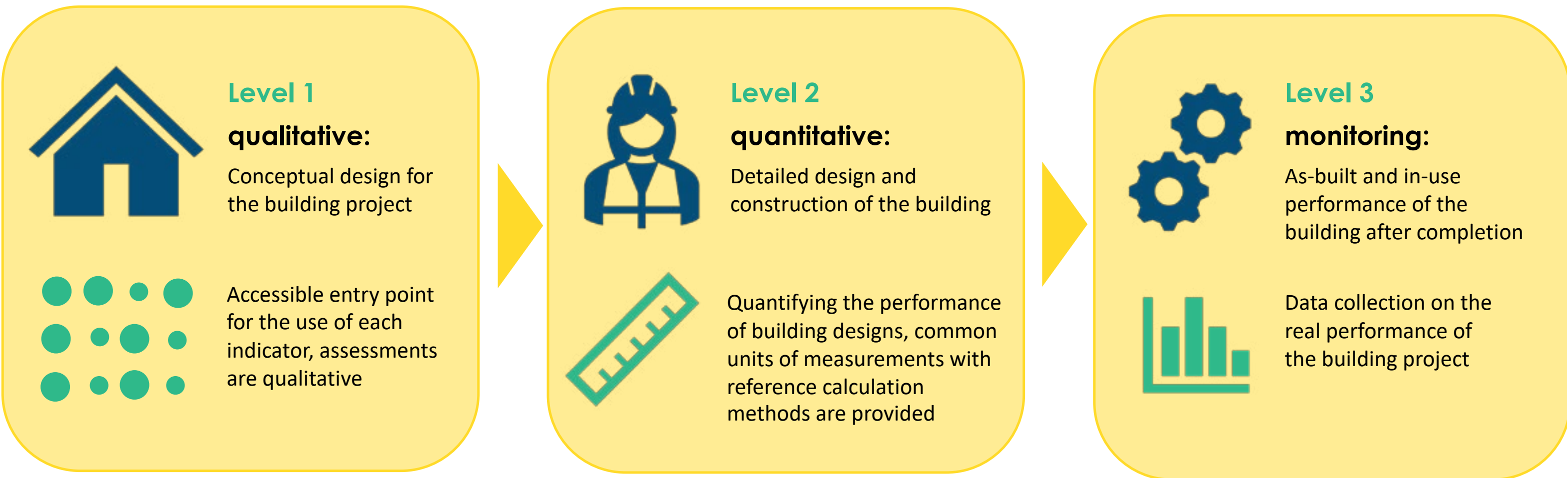
– an intermediate level as it entails the quantitative assessment of the designed performance and monitoring of the construction according to standardised units and methods. This roughly aligns with stage 2–3 of the CWMF.

Level 3:
The as-built and in-use performance of how the building performs after completion and handover to the client

– the most advanced level as it entails the monitoring and surveying of activity both on the construction site and of the completed building and its first occupants as well as the post-occupancy evaluations', with the aim of assessing the performance of the completed building and bringing awareness of the performance gap which could be addressed in repairs and any future developments. This aligns with need for post-occupancy evaluation.

Level(s) Structure

Journey from initial concept design, construction and the reality of the completed building



USING THE LEVEL(S) FRAMEWORK

In order to support the use of the Level(s) framework, the **EU commission has published manuals for each indicator**, which **follow the life cycle of a project from feasibility or early concept design stage through to reporting on the operation of the building**. The first step for the practitioner is to **read the manual** at **https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/412/documents for each indicator/criteria**. It provides checklists or reporting frameworks that can be used at each stage of the project. For example, the Level 1 checklists can be used for reporting on an evaluation of the building even prior to acquisition and at early feasibility and concept stage i.e. Stage 1 of the CWMF.

A summary of each indicator is included in the following pages.
The summary contains:

- What it measures?
- When measurement needs to begin?
  i.e. Ideally needs to be considered before acquisition of land or building.
- What target is proposed?
- When it needs to be applied during the CWMF.
- Who needs to be involved and at what stage?
- How it can be applied. A direct link to the relevant Level(s) manual is provided plus additional guidance. There is also supporting links to other guidance on meeting the targets.
- What tools are available in Ireland or elsewhere to apply the indicator.

The Level(s) Indicators covered in this Handbook

The handbook is focusing on the following Level(s) indicators relating to **Whole Life Carbon**, **Circularity** and **Life Cycle Costing**:

1.1 Life cycle global warming potential

2.1 Bill of Quantities, Materials and Lifespans

2.2 Construction and Demolition waste and materials

2.3 Design for Adaptability and Renovation

2.4 Design for Deconstruction

6.1 Life Cycle Costs

Life cycle Global Warming Potential – Level(s) Indicator 1.2

When to begin:

Ideally assessment should begin prior to land/ building acquisition.

What it measures?:

$KgC0_2eq/m^2$

This indicator measures the greenhouse gas (GHG) emissions associated with the building at different stages along its lifecycle. The unit of measurement is kg CO_2 equivalents per m^2 useful internal floor area for a reference study period of 50 years. The results are to be reported for each lifecycle stage, of which there are four – building production (A), use (B), end of life (C) and additional benefits and impacts beyond the lifecycle (D). The system boundary is 'cradle to grave' as defined by EN 15978, i.e., from the production of building materials to the end of the building's useful life and the subsequent demolition and recovery of the building materials. It measures the building's entire contribution to emissions that contribute towards global warming. This is sometimes referred to as a carbon footprint assessment or whole life carbon (WLC) measurement.

Key to who should be involved at each stage:

SP = Sponsoring Agency, **AP** = Approving Authority, **PTT** = Procurement Technical Team, **A** = Architect, **M&E** = Mechanical and Electrical Consultant, **SE** = Structural Engineers, **QS** = Quantity Surveyor, **LA** = Landscape Architect, **Ecl** = Ecologist, **C** = Contractor, **FM** = Facility, **V** = Valuer

Indicative Targets: New build offices <750kg/CO_2e/m^2, Schools <540kg/CO_2e/m^2, Residential <625kg/CO_2e/m^2 (Based on RIAI Modules A1–A5, B1–B5, C1–C4 climate targets)

When to apply? CWMF	Which Level(s) level?	Who is involved?	Action	Deliverable
Before site acquisition	1	**SP**, **AP**, **PTT**, **V**	Assess ground conditions, requirements for parking or other major ground works likely to impact CO_2e emissions.	Implications for CO_2e should be included in the site assessment report and site valuation.
Stage 1: **Feasibilty**	1	**PTT**, **A**, **SE**, **M&E**, **QS**	Integrated Design meeting – • Define target $KgC0_2eq/m^2$ based on building type and brief. • Use early-stage optioneering design tools appropriate for level.	Initial report setting out various design and structural options • with early stage WLC calculations for each • at least one innovative low carbon option.
Stage 2: **Design i+ii**	1–2	**A**, **SE**, **M&E**, **QS**	• Integrated design team working to develop low carbon design options • Create more detailed inventory of materials using generic data.	Interim stage WLC calculation based on generic data aligns with target.
Stage 2iii: **Tender**	2	**A**, **SE**, **M&E**, **QS**	• Create detailed inventory using ICMS 3 compliant BOQ • Have identified low carbon materials options with product specific data.	• Accurate WLC if building using detailed BOQ to ICMS3 has been created. • WLC meets the specified target and forms part of the contractual performance requirements in tender.
Stage 3: **Construction**	3	**A**, **SE**, **M&E**, **QS**, **C**	Contractor provides accurate quantities and EPD data on any product substitutions and evidence of final use on site.	Final WLC calculation based on actual quantities, transport of materials, on site energy use and other information relevant for full assessment aligns or improves on target.
Stage 4: **Review**	3	**FM**	• Ongoing gathering of data on replacement cycles and repair.	• Report submitted on final calculated WLC results and lessons learnt. • share data with central database to allow development of improved databases and benchmarks.

Additional information and guidance

- **The Level(s) Manual for indicator 1.2** provides guidance on applying it at the different stages of a project. This is available at: https://susproc.jrc.ec.europa.eu/product-bureau/sites/default/files/2021-01/UM3_Indicator_1.2_v1.1_37pp.pdf
  IGBC is working with University of Galway to develop a National Methodology for measurement of Whole life carbon compliant with Level(s) expected to be available in 3rd–4th quarter 2023 which will allow greater comparability for calculations in Ireland.
- **LETI carbon alignment document** sets out guidance on benchmarks for embodied carbon. This is available here: https://www.leti.uk/_files/ugd/252d09_e5865d5fea9044899e5b70e7a88d4663.pdf
  However IGBC and Construct Innovate are developing more accurate benchmarks for different building types in Ireland. This work should be available after 2nd quarter 2024.
- **Whole Life Carbon Hub** provides links to all generic and product specific data available for Ireland and in Europe, information on LCA tools, information videos etc. It will be updated in 2023 with the National methodology and further guidance. It is available here: https://www.igbc.ie/lca/
- **National GWP data for common building materials** such as concrete, brick and steel to understand the carbon emissions involved in the production processes is available at https://www.igbc.ie/generic-data/

What tools can I use?

Tools for calculation

Level 1 tool – Carbon designer for Ireland sponsored by LDA and EPA and developed by One Click LCA is a free early-stage level(s) compliant LCA and optioneering tool allows procurers to set targets at predesign stage and design teams to do early design optioneering and generate reports. It provides typical Irish construction build ups for floors, wall, and roof. The tool is available here: https://www.igbc.ie/carbon-designer-for-ireland/

Level 1–2 tool for structural engineers to optimise structural grid – **The Structural Carbon Tool Version 2 – The Institution of Structural Engineers** (istructe.org), available at https://www.istructe.org/resources/guidance/the-structural-carbon-tool/

Level 2 + 3 tools – One Click LCA,E – Tool, are commercial Level(s) compliant tools which can be linked to BIM tools and allow full LCA to be carried out with full set of EPD datasets for Ireland. Hawkins Brown Revit Plugin allows easy visualisation of carbon hot spots in design.

Tools for Comparing materials

- Materials Pyramid allows easy comparison of relative impact of different materials. This is available at https://www.materialepyramiden.dk/
- EC3 tool is a free tool that can be used for comparing digitised EPD data including from Ireland and is hosted by https://buildingtransparency.org/
- Materials 2050 centralises information on sustainability onto one platform and it's available at https://2050-materials.com/

Resource-efficient + circular material life cycles – Level(s) Ind. 2.1 – 2.4

What does it measure?
It measures four indicators across.

When should it begin?
Application of indicators should begin prior to acquiring site.

The four indicators are:
- **2.1**: Bill of quantities, materials, and lifespans – Unit quantities, mass, and years
- **2.2**: kg of waste and materials per m² total useful floor area
- **2.3**: Adaptability score
- **2.4**: Deconstruction score

Key to who should be involved at each stage:
SP = Sponsoring Agency, **AP** = Approving Authority, **PTT** = Procurement Technical Team, **A** = Architect, **M&E** = Mechanical and Electrical Consultant, **SE** = Structural Engineers, **QS** = Quantity Surveyor, **LA** = Landscape Architect, **Ecl** = Ecologist, **C** = Contractor, **FM** = Facility, **V** = Valuer

Indicative Targets: 70% diversion of waste from landfill

When to apply? CWMF	Which Level(s) level	Who is involved?	Action	Deliverable
Before site acquisition	NA	**SP**, **AP**, **V**	Assess potential to adapt or reuse any existing structures as part of the acquisition and valuation linked to the intended use.	Include recommendations on site assessment report and valuation: • on reuse potential of buildings in site assessment report. • potential waste arising from particular site and potential reuse of resources from site.
Stage 1: **Feasibilty**	1	**PTT**, **A**, **SE**, **M&E**, **QS**	• Initial design team meeting to develop a strategy using early-stage tools and checklists. • Designate a circularity champion and a waste auditor on your team.	A circularity statement setting out strategy for the building against all the key measurables. • Alternative sketches showing how building could be adapted to another future use. • Targets for waste reduction. • Strategy of design for disassembly.
Stage 2: **Design i+ii**	1–2	**A**, **SE**, **M&E**, **QS**	Iterate concept design to take into account the key measurable items using the level(s) checklists.	• Design integrates circularity principles on adaptability, deconstruction, and waste reduction. • Circularity statement is updated with additional detail. • Developed Waste management plan. • Pre demolition audit on any buildings to be demolished.
Stage 2iii: **Tender**	2	**A**, **QS**, **SE**, **M&E**	• Create detailed waste management plan. • Prepare a pre-demolition audit where demolition involved. • implement circularity strategy through technical design and specification.	• Checklist score for adaptability including architectural plans showing alternative change of use. • Score for deconstruction. • detailed ICMS compliant BOQ comparing resource use. • Detailed waste reduction plan included in tender documents.
Stage 3: **Construction**	3	**A**, **C**	Implement • Circularity strategy • waste management on site, including segregation measurement.	Reports on: • different waste streams generated during construction indicator 2.3 in kg/m² per useful area using reporting template. • Information on as built design of disassembly integrated into user manual. • Information on as built design for adaptability integrated into user manuals including eg: spurs for future services etc.
Stage 4: **Review**	3	**FM**	Continue to gather evidence on the operation of the building and levels of resource use.	• Review of project achievements on implementation of circularity reporting against each of the measurable requirements.

Additional information and guidance

- **Manuals for Indicator 2.1–2.**4 which provide a detail checklist of what should be considered at each stage is available here: https:// susproc.jrc. ec.europa.eu/product-bureau/product-groups/412/ documents
- Preparation of BOQ in alignment with ICMS 3 can be found here: https:// icms-coalition.org/
- **EPA Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects**, which includes a template for reporting on waste are available here https://www. epa.ie/publications/circular-economy/resources/CDWasteGuidelines.pdf)
- You may use the **Greater London Authority (GLA) Circular Economy Statement Guidance –Regenerate tool** to aid you in the development of these statements. This is available here: https://www.london.gov.uk/ programmes-strategies/planning/implementing-london-plan/london-plan-guidance/circular-economy-statement-guidance
- **Guidelines for the waste audits before demolition and renovation works of buildings**. These are available here: https://ec.europa.eu/ docsroom/documents/31521/
- **EPA Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects** are available here: https://www.epa.ie/publications/circular-economy/resources/ CDWasteGuidelines.pdf
- Get inspired by existing buildings with circularity principles integrated! Have a look at **Circular Buildings Toolkit** here: https://ce-toolkit.dhub. arup.com/
- The **Southern Waste Region has created circularity checklists for Designers, Quantity Surveyors, Clients, Contractors and Product Manufacturers** that is available at: https://southernwasteregion.ie/ publications
- Read this guide about designing out waste across the entire construction process – **Designing out construction waste – Zero Waste Scotland**, available at https://www.zerowastescotland.org.uk/sites/default/files/ Designing%20Out%20Construction%20Waste%20Guide_0.pdf

What tools can I use?

- The **Regenerate tool** is a free cloud based tool that allows design teams to collaborate at early design stage measuring and scoring the circularity of the building under criteria: design for adaptability; design for deconstruction; circular materials; and resource efficiency. See case study below https://urbanflows.ac.uk/regenerate/
- The **Circular Buildings Toolkit** (arup.com) allows design teams to create a circular toolkit for projects focusing on topics such as build nothing, build for long term value, design for longevity, design for adaptability, design for disassembly, refuse unnecessary components, increase material efficiency, reduce the use of virgin materials, reduce the use of carbon intensive materials and design out hazardous/ polluting materials. This toolkit is available here: https://ce-toolkit.dhub.arup.com/
- Level(s) also provides a more detailed **waste tracking Excel sheet** which can be carried out as an alternative to the simpler EPA waste template. This is available at: https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/412/documents
- **Re-use platform Construction Materials Exchange** (CMEx) developed by the Irish Green Building Council, is a construction material marketplace set up to allow the reuse of construction materials that would otherwise enter the waste stream. It's available here: https://www.igbc.ie/construction-materials-exchange/
- **Construction Waste portal** tool allows design teams to forecast waste, enables efficient procurement and drives best practice within your supply chain. This is available here: https://www.constructionwasteportal.com/
- **BRE SMARTWaste** is an flexible, online-reporting tool that can help manage and reduce waste outputs, impacts and costs. It can be used to prepare, implement and monitor site waste management plans (SWMP). Commercial subscription rates. It's available here: https://www.bresmartsite.com/ insights/

Life Cycle Costs – Level(s) Indicator 6.1

When should it begin?: Assessment begins prior to land/ building acquisition as site specific issues will impact life cycle costs.	The indicator measures all building element costs incurred at each life cycle stage of a project for the reference study period and, if defined by the client, the intended service life. The life cycle stages are presented and explained in the first part of Briefing 1.4 (see Figure 4 in the User Manual 1 document) and the minimum scope of building elements to address is originally provided in Briefings 2.2 and 2.3 (see Table 11 in the User Manual 2 document) as part of the building description. The life cycle stages reflect those used as the basis for the reference standards EN 16627 and ISO 15686-5.
What does it measure?: €/m² /year	These costs will be strongly influenced by the decisions and calculated performance of the following indicators in the Level(s) framework: Use stage primary energy use (1.1), bill of quantities, materials, and lifespans (2.1), efficient use of water resources (3.1).

Key to who should be involved at each stage: **SP** = Sponsoring Agency, **AP** = Approving Authority, **PTT** = Procurement Technical Team, **A** = Architect, **M&E** = Mechanical and Electrical Consultant, **SE** = Structural Engineers, **QS** = Quantity Surveyor, **LA** = Landscape Architect, **Ecl** = Ecologist, **C** = Contractor, **FM** = Facility, **V** = Valuer

Indicative Targets:
No target set yet – to be developed with increase in measurement for Ireland.

When to apply? CWMF	Which Level(s) level	Who is involved?	Action	Deliverable
Before site acquisition	1	**AP**, **SP**, **PTT**, **V**	Evaluate specific site or building conditions that would impact costs for construction and operation.	Site specific issues leading to increased cost over the life time should be reported on and quantified.
Stage 1: **Feasibilty**	1	**A**, **QS**, **SE**	Lead early optioneering on different strategies with design team.	Life Cycle Costing concept design statement.
Stage 2: **Design i+ii**	1–2	**A**, **M&E**, **QS**	Develop more detailed BOQ and life cycle cost plan.	More developed Life Cycle Costing design statement.
Stage 2iii: **Tender**	2	**AP**, **SP**, **PTT**, **A**, **M&E**, **QS**	• Carry out full BOQ • Detailed costings for energy and water. • Detailed information on replacement cycles.	Developed full LCC model accounting for energy water and replacement cycles.
Stage 3: **Construction**	3	**C**, **PTT**, **QS**	Update as built costs on completion.	Report on final total as-built costs.
Stage 4: **Review**	3	**A**, **QS**, **PTT**, **FM**	Gather data and update cost model including, real in use costs, energy, water and maintenance.	• Report on total actual costs of maintenance, energy, and water. • Share data with central government agency such as OGP to allow development of national LCC cost databases.

Additional information and guidance

Level(s) manual 6.2 https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/412/documents

SCSI Guide to Life Cycle Costing https://scsi.ie/scsi-guide-to-life-cycle-costing/

IGBC offer regular training in LCC in conjunction with SCSI. https://www.igbc.ie/events/

Watch TU Dublin lecturer **Dermot Kehillys' YouTube videos on LCC** at: https://www.youtube.com/@dermotkehily4699/videos

What tools can I use?

Level 1 – 2: CRAVEzero provides a full set of free tools, including LCC calculators, LCC case studies to help in the design of high performing buildings at optimised cost Life **Cycle Cost Web Tool Info –** https://www.cravezero.eu/pboard/LCC/LCCInfo.htm

Level 2: One Click LCA – Software used to carry out LCA can also be used to complete LCC at the same time using a ICMS compliant BOQ

CASE STUDY 1 :

Using circularity tools in the design team process.

Generating Circularity Statements for Projects using the Regenerate Tool

Clients:	**Various public and private clients**
Workshop host:	**Irish Green Building Council**
Participants:	**Clients, Architects, Structural engineers, M & E engineers**
Projects:	**Public sector, residential and industrial**
Date of workshops:	**October–December 2021**

Goal

To pilot the use of circularity statements with six design teams working on a range of public and private projects and to explore how collaboration to integrate circularity from early concept stage could work. Circularity statements set out how circularity has been integrated into a project and these are now a requirement for planning approval process in London for buildings over a certain size.

Description

In order to facilitate the process, a free cloud-based circularity tool called Regenerate developed by University of Sheffield was used. In all workshops the key design team members participated, including structural engineer, architect, mechanical and electrical engineer and in some cases the client. This proved essential as each was able to respond to a specific aspect of circularity.

The Regenerate tool proved useful to structure, prompt, challenge and record the approach of the design team in integrating circularity.

The tool focused on the site, itself, including foundations, the structure, building skin, the services, and the space looking at design for adaptability, design for deconstruction, circular material selection and resource efficiency. It challenged each discipline of the design team members to respond on everything from drainage to façade design. This proved important as many of the aspects of circularity had not been considered by the design team before, and this prompted ideas and solutions throughout the workshop.

For example one design team looked at integrating standardised window opening sizes to ensure future adaptability, increasing fire proofing of partitions to facilitate a greater degree of adaptability in the future, another proposed reusing bricks, from a façade demolished on the site for the interior atrium of the new build , and others decided to pilot material passports, decided to avoid secondary finishes in the building, and yet another team decided that building will be prefabricated off site to avoid waste. Many of these strategies would not have been considered otherwise.

Responses were inputted by the design team directly into the tool generating a formatted report which can then be provided to the client.

Conclusion

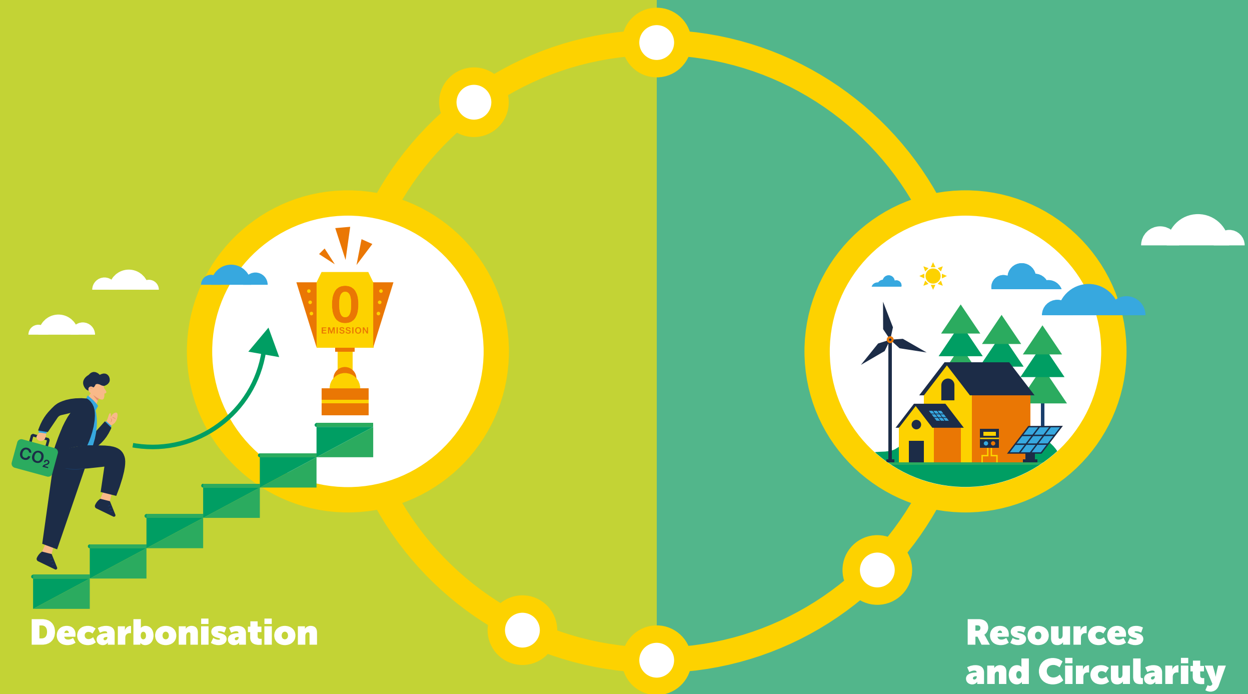
The tool allowed the team to self-assess and score the degree of circularity integrated into the project, however the pilots showed that it was really important to have an experienced team member facilitating and guiding to ensure that these responses are ambitious and substantive, as there was a tendency for some design team members to fall back to describing unambitious and business as usual responses as sufficient to address some questions. The workshops need the members of the design team to bring a positive open mind set and collaborate in an open non defensive way.

While it is essential to start the process at early design stage to ensure opportunities are not missed , it is also essential to revisit the exercise at each subsequent stage of the design process with the full design team, so that the strategies are tracked and iterated with detail as the design develops.

The Design teams found the process very useful. Here are some of the comments received after the workshop.

"The Regenerate tool is very useful to introduce circularity at early design stage."

"The Regenerate tool is a great tool to use to record the projects circular process."



Decarbonisation

New developments, infrastructure, and renovations will have Net Zero embodied carbon, and all buildings, including existing buildings, must be Net Zero operational carbon

Resources and Circularity

A built environment that supports restoration of resources and natural systems within a thriving circular economy

CASE STUDY 2:

Integrating Whole life carbon measurement into the procurement process.

Clients:	**Grangegorman Development Agency (GDA) / TU Dublin**
Architectural Lead:	**Carr Cotter Naessens Architects**
Project:	**FOCAS Research Institute**
Completion Date:	**2020–2021**

Goal:

In order to develop an enduring, adaptable and environmentally responsible building, the Grangegorman Development Agency (GDA) included the requirement that the winning design must demonstrate how the building would meet an embodied carbon target of 600kgCO₂e/m² within the two-stage open Architectural Design Competition.

The carbon requirement was formulated as described in IS-EN-15978. It includes a reduction of embodied carbon by 40% from a baseline set out in the RIAI target. To help make a decision, the jury was advised by technical experts in LCA, Circularity and CLT construction.

Description

The project uses the IS EN-15978 standard and level(s) indicator 1.2 to provide the framework of its LCA. The iterative approach to LCA means decisions can be guided by the latest knowledge on the carbon impact of the design as it evolves.

In order to meet strategic objectives of a net carbon zero horizon for both the Grangegorman site and nationally, performance targets are set for this project. Targets are set for both embodied and operational carbon as elements of whole life carbon. These are complementary to regulatory compliance and are fundamental to the project. The carrying out of Life Cycle Assessments and integrating this into the design process forms part of the complete Design Teams' scope. A Life Cycle Assessor has been appointed as part of the Design Team. The procurement of the LCA role was linked to the Life Cycle Cost and Quantity Surveying Role during procurement. Qualitative assessment around LCA formed a large portion of the award criteria for this linked role and as a result influenced the procurement process emphasising a whole life approach. The Design Team are currently reviewing a number of options around the structural frame which will be reviewed according to a matrix of risks and opportunities including embodied carbon.

The Life Cycle Assessment is being considered as an iterative process used to influence early decision making.

Step 1	Goals definition: develop an enduring, adaptable and environmentally responsible building
Step 2	Choice of indicator: Whole life carbon as defined by IS-EN-15978 and Level(s) indicator 1.2
Step 3	1st stage: selection of 5 teams which will provide a more detailed design
Step 4	Submission of designs
Step 5	2nd stage: selection of the best project by a jury

Conclusion

FOCAS Research Institute project is a leading project regarding the use of LCA in public competition in Ireland. It has introduced carbon indicators in its tender, with the goal of making an enduring, adaptable and environmentally responsible building.

WHAT PRACTICAL STEPS CAN YOU TAKE NOW?

A good way to start your journey right now is to:

- If you are not already a member **join the IGBC** to learn and contribute! Visit: https://www.igbc.ie/membership-account/membership-levels/
- Sign up to the **IGBC Mail Courses – Circular Economy in the Built Environment** at this link: https://www.igbc.ie/events/course-mail-circular-economy-in-the-built-environment-2/
- Sign up to the **IGBC Level(s) Procurement Commitment** here: https://www.igbc.ie/certification/levels-eu-sustainable-buildings-framework/life-levels-commitment/
- Follow the **IGBC roadmap** to building a zero carbon Ireland at this link https://www.igbc.ie/building-a-zero-carbon-ireland/

IGBC
IRISH GREEN BUILDING COUNCIL

The IGBC is a registered charity (RCN 20155568), which was launched in 2011 with the aim of accelerating the transformation of the built environment, related industry and supply chain to one that is sustainable through leadership, research, education, and providing policy input to national and local government. The IGBC is affiliated with the World Green Building Council as an established member. This is a network of over 75 national Green Building Councils worldwide with a total membership of over 27,000 of the most progressive international organisations and businesses making it the largest organisation globally influencing the green building market.

IGBC

IRISH GREEN BUILDING COUNCIL

info@igbc.ie

www.igbc.ie