Construct Innovate
Built Environment Research Ireland

IBCI Building Control Conference, 13th -14th March, Sligo

Ireland's National Research Centre for Construction Technology and Innovation

Making Ireland a global research and innovation leader for sustainable construction and built environment technology

www.constructinnovate.ie

Prof Jamie Goggins
Director, Construct Innovate

Ollscoil na Gaillimhe University of Galway · Trinity College Dublin, Coláiste na Tríonóide, Baile Átha Cliath, The University of Dublin · UCD Dublin · UCC University College Cork, Ireland, Coláiste na hOllscoile Corcaigh · IGBC Irish Green Building Council · DTU Dublin · ATU · SETU South East Technological University · Technology Centre, Enterprise Ireland, IDA Ireland Supported

Outline

Overview of Construct Innovate

Whole life carbon of buildings

Example of other activities in Construct Innovate

Construct Innovate
Built Environment Research Ireland

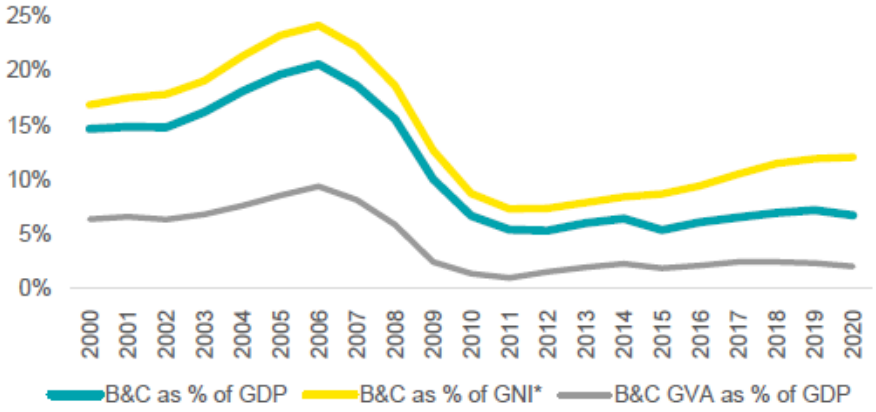
Challenges for the sector

Cyclical nature

Fragmented sector

Low productivity

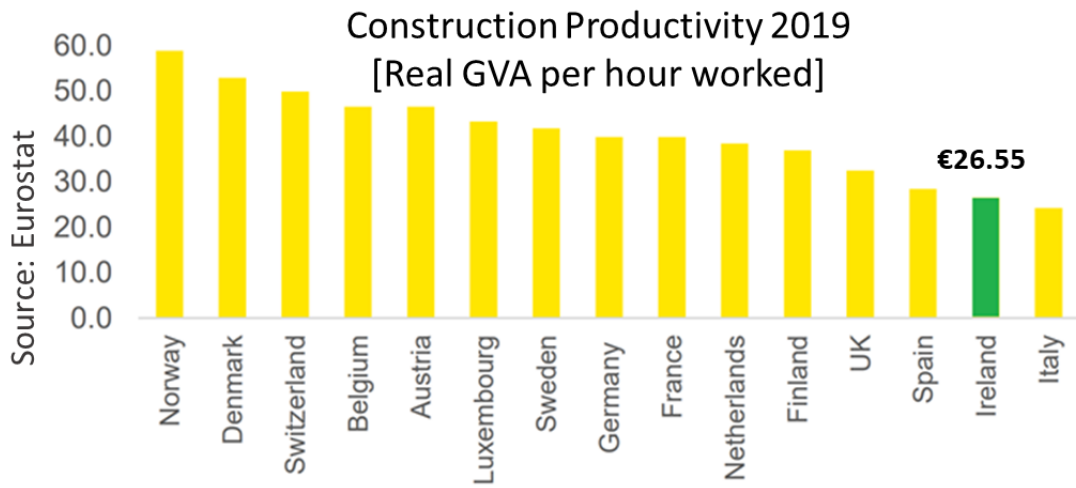
Figure 7: Building and Construction Output as % of GDP and GNI* and GVA as % of GDP



Source: CSO

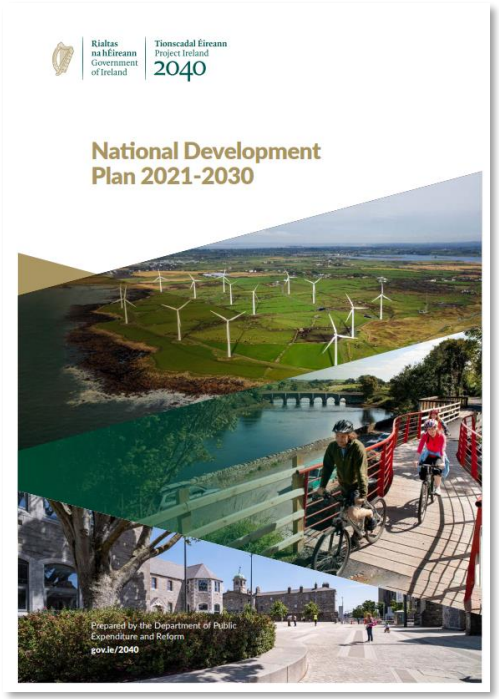
92.8% of companies employ <6 people

99.6% of companies employ <50 people

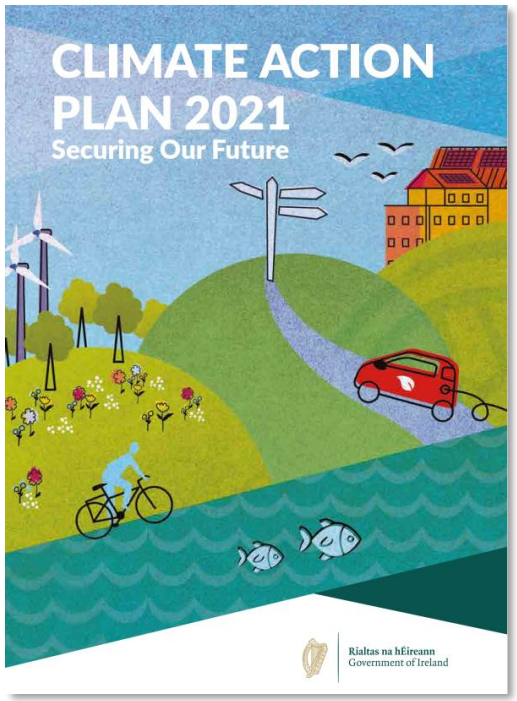


Construct Innovate
Built Environment Research Ireland

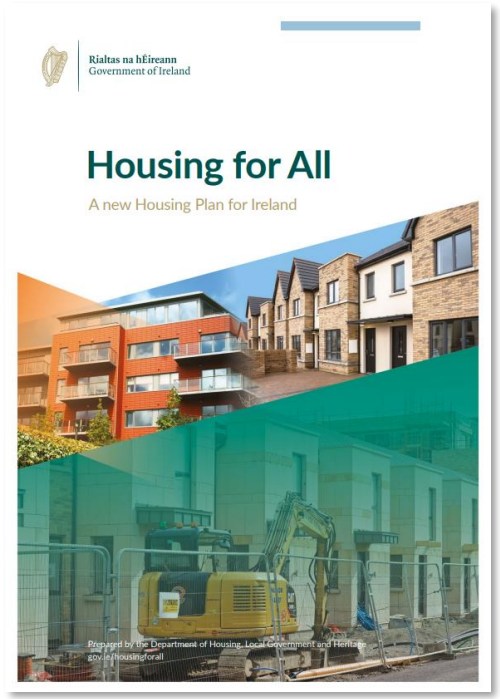
Background



€165 billion
2021 - 2030



Low carbon materials & technologies in construction and renovation



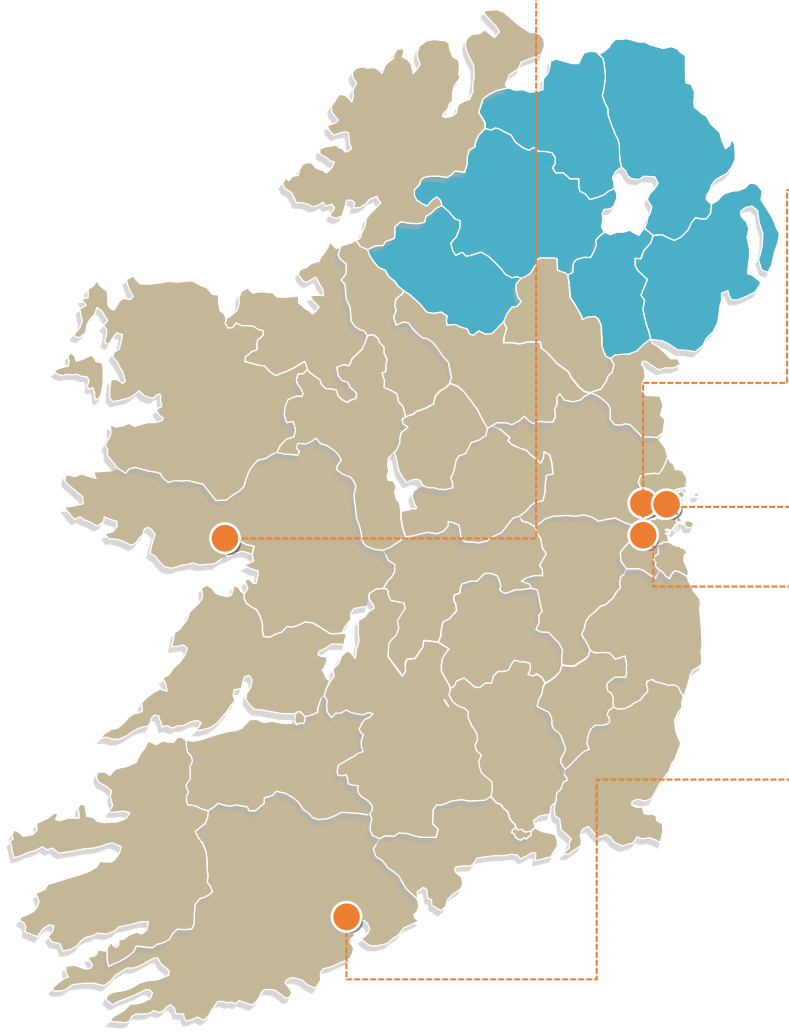
33,000 new homes each year 2021 - 2030

Enterprise Ireland Strategy 2022-2024

Construct Innovate
Built Environment Research Ireland

Construct Innovate

Vision to make Ireland a global research & innovation leader for sustainable construction and built environment technology



University of Galway

Ollscoil na Gaillimhe University of Galway

Trinity College Dublin

Trinity College | Coláiste na Tríonóide The University of Dublin

TU Dublin

DUBLIN Technological University Dublin

University College Dublin

UCD Dublin University College Dublin Ireland's Global University

University College Cork

UCC Coláiste na hOllscoile Corcaigh University College Cork, Ireland

Irish Green Building Council

- >300 organisations nationwide
- Cross-disciplinary network
- Construction & built environment
- Entire value chain

IGBC Irish Green Building Council

Construct Innovate
Built Environment Research Ireland

Mission

Construct Innovate

Construct Innovate brings together the whole value chain in construction and the built environment by driving the transition towards a modern, sustainable sector through the active engagement of our Members and Stakeholders in Research & Innovation.

Value proposition

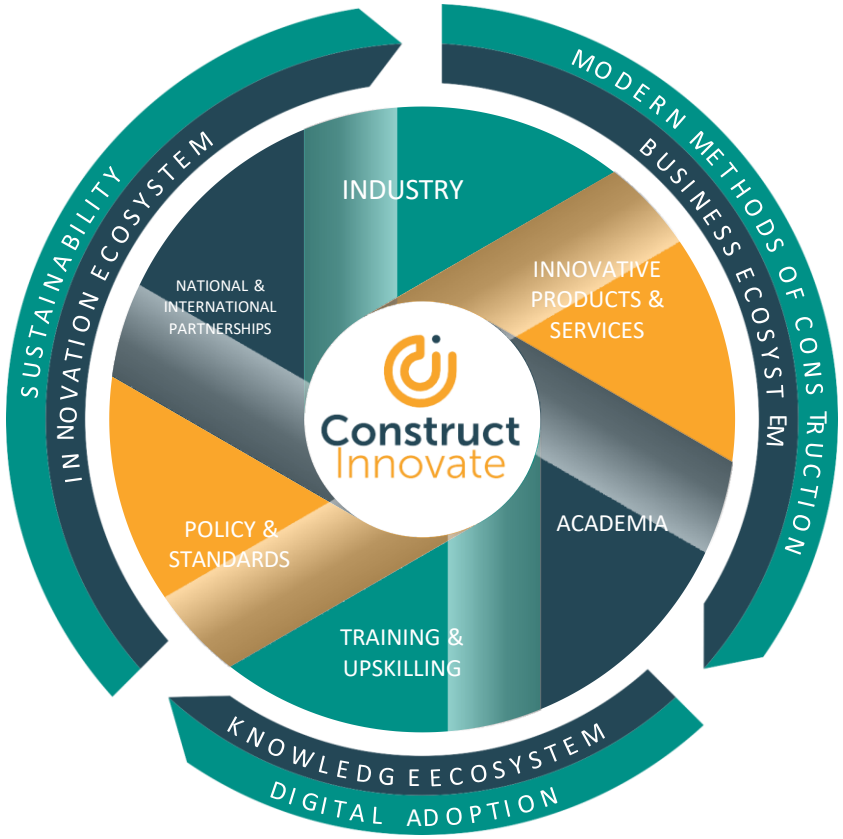
Our Values

Collaboration | Agility of Operation | Transparency | Ethics

Construct Innovate is:

- An Industry led center for all
- An enabler of collaboration
- A facilitator & funder of world class research
- Enabling Research Programmes steered to maximise value for all members
- An effective platform for communication while providing opportunities for networking across the value chain
- Providing open source information, widely shared
- Providing opportunities for companies to go on their own research journey and break down barriers in adopting innovative approaches.

RPO Members



The interface between academia and industry in the Irish construction & built environment ecosystem facilitating industry's transition through impactful research and innovation.

RPO Members

Ollscoil na Gaillimhe University of Galway

IGBC Irish Green Building Council

University College Dublin An Coláiste Ollscoile, Baile Átha Cliath

Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin

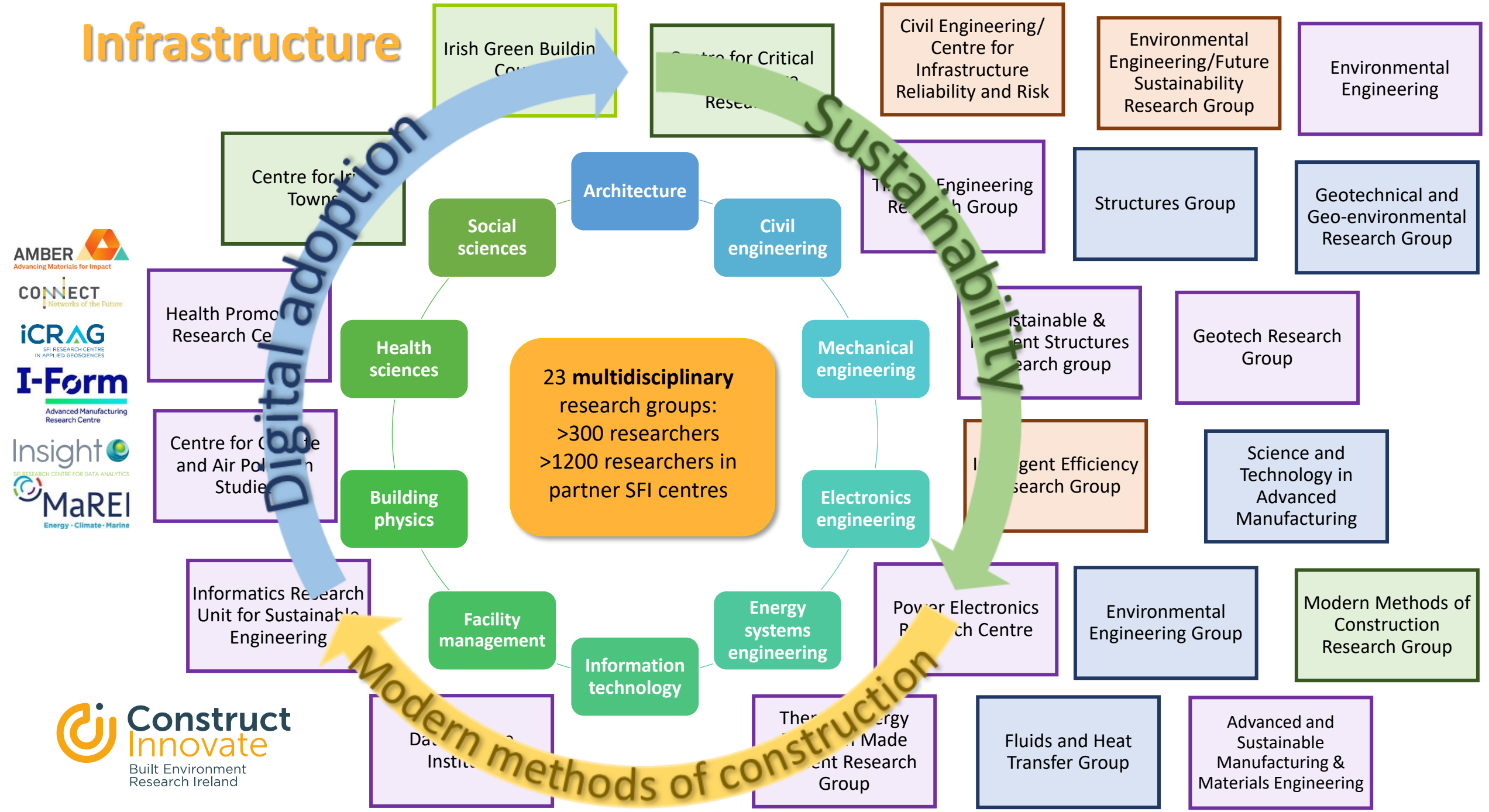
UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

TU Dublin Ollscoil Teicneolaíochta Bhaile Átha Cliath Technological University Dublin

ATU Ollscoil Teicneolaíochta an Atlantaigh Atlantic Technological University

SETU Ollscoil Teicneolaíochta an Oirdheiscirt South East Technological University

Infrastructure



Associate members

2023 Annual Report

Year 1 Summary in Numbers

Construct Innovate
Built Environment Research Ireland

Whole Life Carbon of Buildings

Construct Innovate
Built Environment Research Ireland

IBCI Building Control Conference 2012 | Athlone, 28-29 March 2012

Sustainability and Embodied Energy (and Carbon) in Buildings

Dr Jamie Goggins | Lecturer in Civil Engineering

Affiliations:

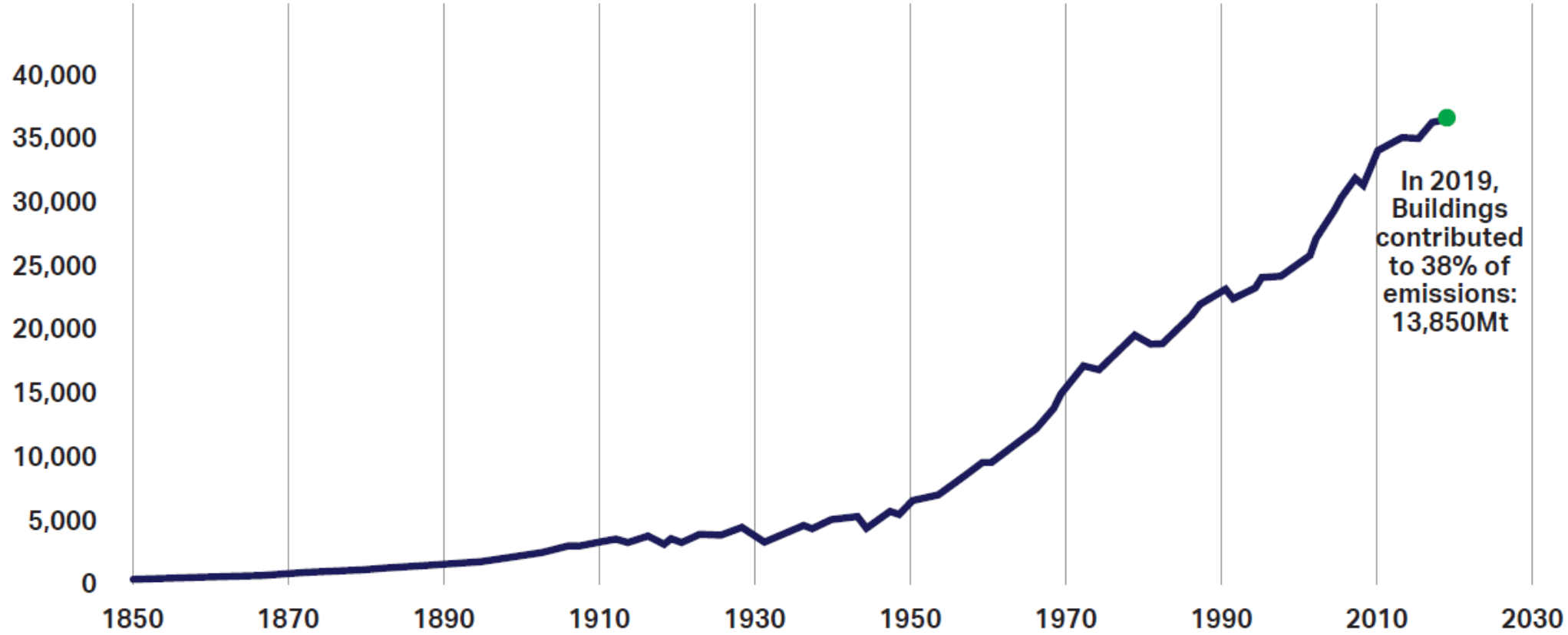
College of Engineering & Informatics, NUI Galway
Ryan Institute for Environment, Marine & Energy Research

Energy in Buildings - Sustainability

- What is a sustainable solution?
- Sustainability – Embodied energy and embodied carbon as indicators
- Why should embodied energy and embodied carbon be considered?
- Material choice
  - Concrete and cements
  - Steel
  - Timber
- Case study
- Summary

Carbon Emissions in Building Sector

Global Annual CO_2 Emissions (Mt)



Construct Innovate
Built Environment Research Ireland

Ref: WBCSD and ARUP, Net-zero buildings: Where do we stand?, World Business Council for Sustainable Development & ARUP, 2021.

IBCI Building Control Conference 2012 | Athlone, 28-29 March 2012

Sustainability and Embodied Energy (and Carbon) in Buildings

Dr Jamie Goggins | Lecturer in Civil Engineering

Affiliations:

College of Engineering & Informatics, NUI Galway
Ryan Institute for Environment, Marine & Energy Research

Energy in Buildings - Sustainability

- What is a sustainable solution?
- Sustainability – Embodied energy and embodied carbon as indicators
- Why should embodied energy and embodied carbon be considered?
- Material choice
  - Concrete and cements
  - Steel
  - Timber
- Case study
- Summary

Life Cycle Assessment-Standards

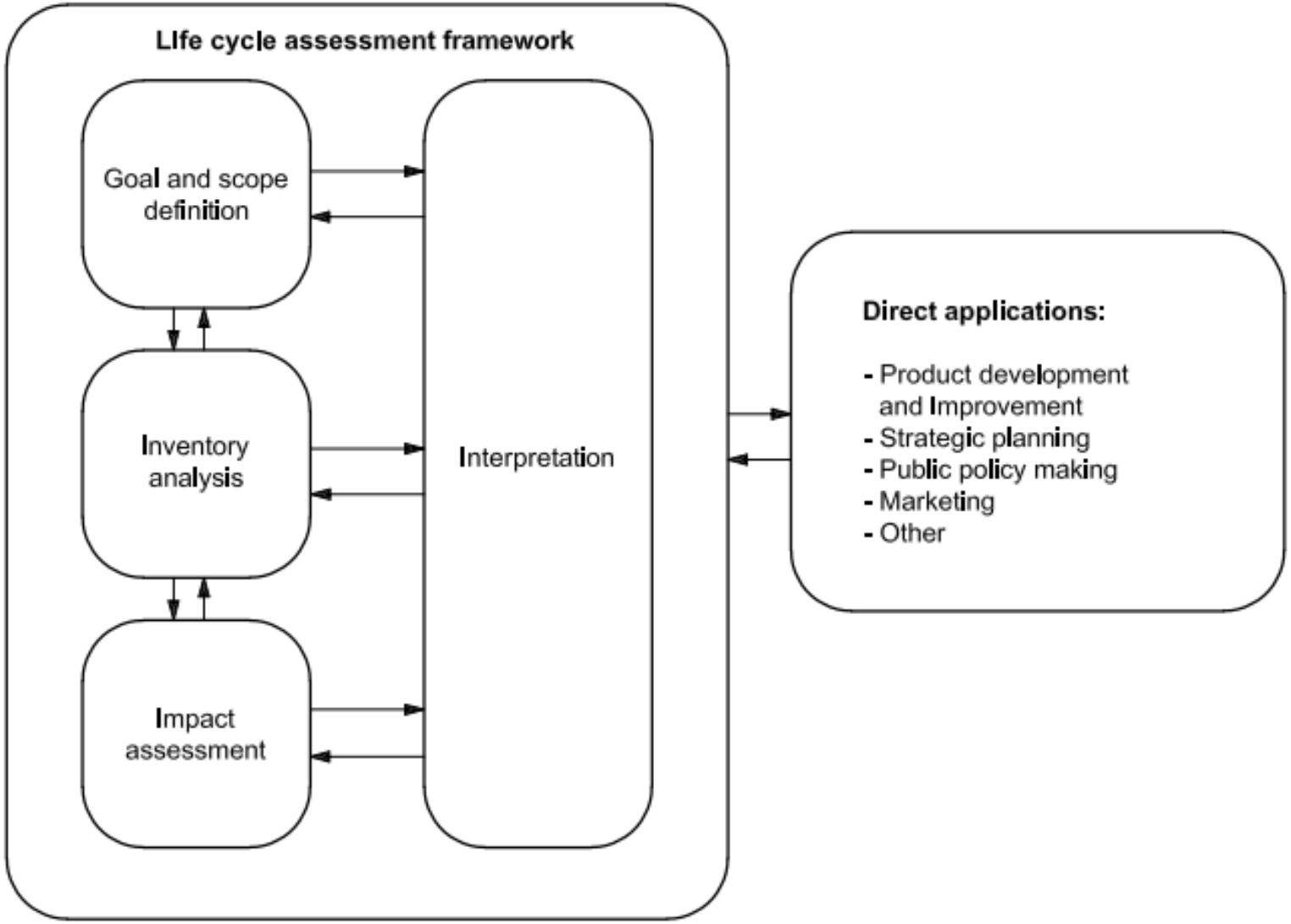
INTERNATIONAL STANDARD

ISO 14040

Second edition
2006-07-01

Environmental management — Life cycle assessment — Principles and framework

Management environnemental — Analyse du cycle de vie — Principes et cadre

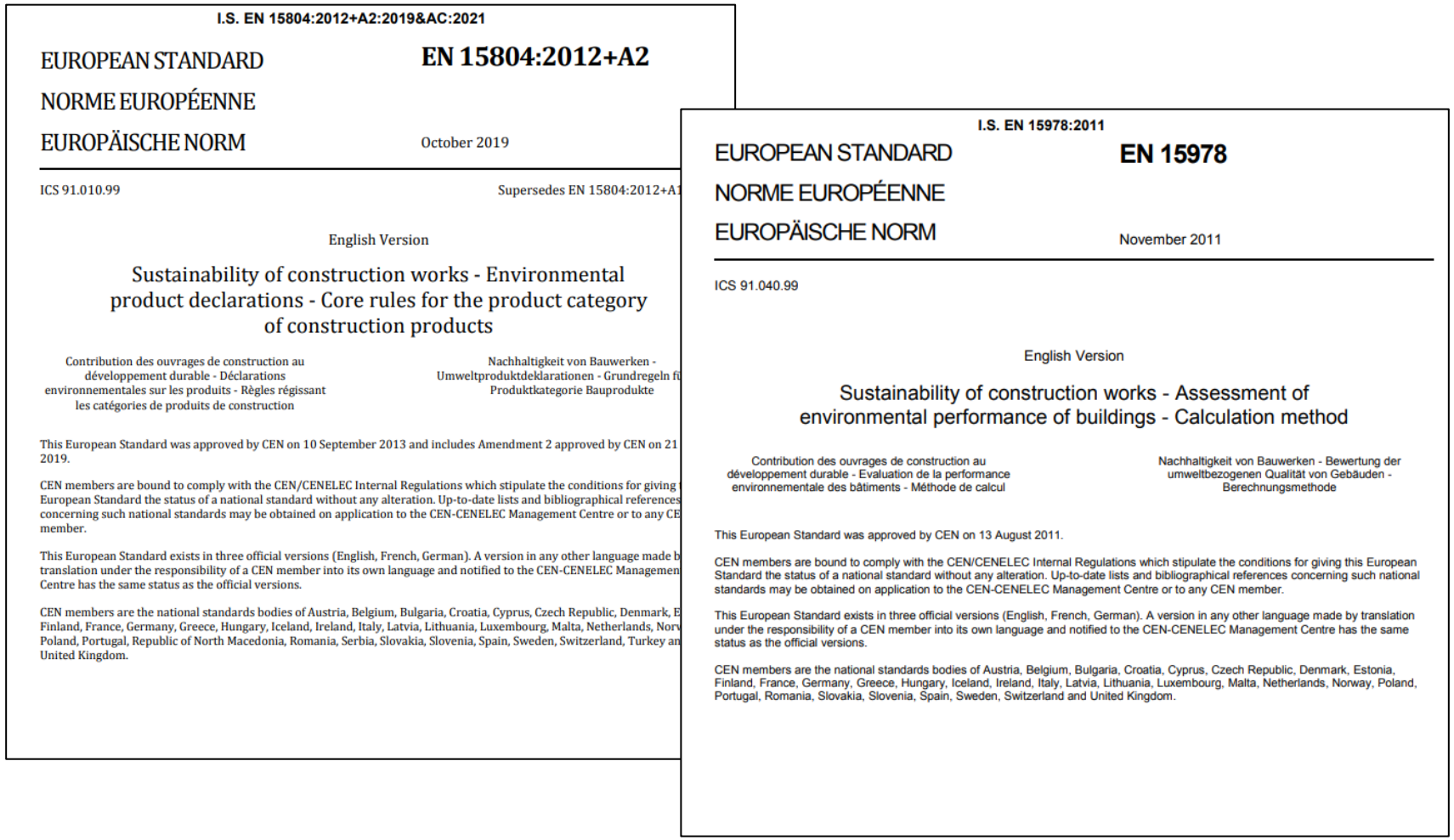


Construct Innovate
Built Environment Research Ireland

Ref: The International Standards Organisation, Environmental management — Life cycle assessment — Principles and framework, Iso 14040. 2006 (2006) 1–28.

Life Cycle Assessment Standards

EPD IRELAND
THE ENVIRONMENTAL PRODUCT DECLARATION PROGRAMME



I.S. EN 15804:2012+A2:2019&AC:2021

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 15804:2012+A2

October 2019

ICS 91.010.99

Supersedes EN 15804:2012+A1

English Version

Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

Contribution des ouvrages de construction au développement durable - Déclarations environnementales sur les produits - Règles régissant les catégories de produits de construction

Nachhaltigkeit von Bauwerken - Umweltproduktdeklarationen - Grundregeln fü Produktkategorie Bauprodukte

This European Standard was approved by CEN on 10 September 2013 and includes Amendment 2 approved by CEN on 21 2019.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving t European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CE member.

This European Standard exists in three official versions (English, French, German). A version in any other language made b translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Managemen Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, E Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norv Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey an United Kingdom.

I.S. EN 15978:2011

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 15978

November 2011

ICS 91.040.99

English Version

Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method

Contribution des ouvrages de construction au développement durable - Evaluation de la performance environnementale des bâtiments - Méthode de calcul

Nachhaltigkeit von Bauwerken - Bewertung der umweltbezogenen Qualität von Gebäuden - Berechnungsmethode

This European Standard was approved by CEN on 13 August 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

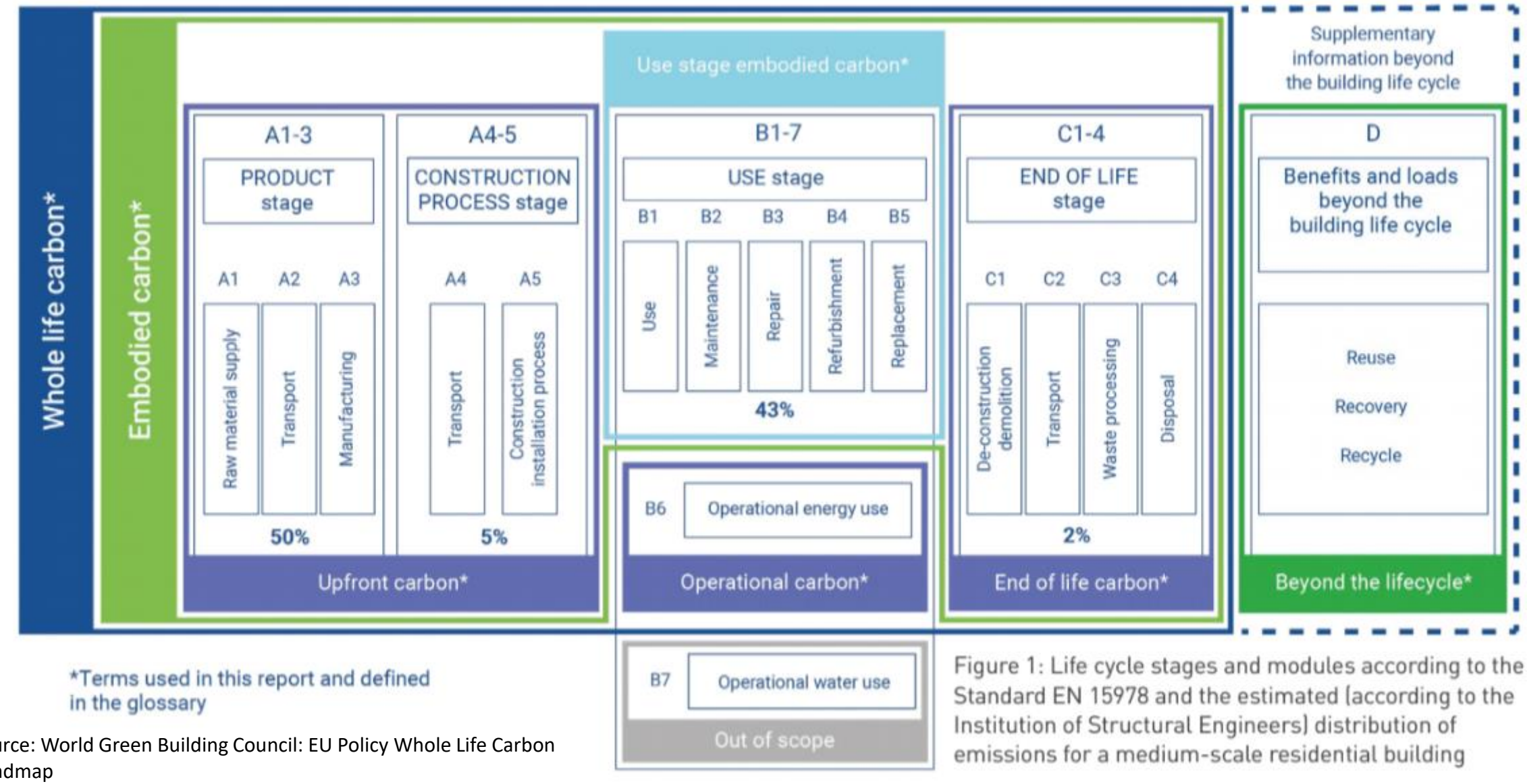
Construct Innovate
Built Environment Research Ireland

Ref: NSAI, I.S EN 15804:2012 Sustainability of construction works-Core rules for the product category of construction products, National Standards Authority of Ireland, 2013.

NSAI, I.S EN 15978:2011 Sustainability of construction works-Assessment of environmental performance of buildings-Calculation method, National Standards Authority of Ireland, 2011.

Whole Lifecycle Carbon (WLC)

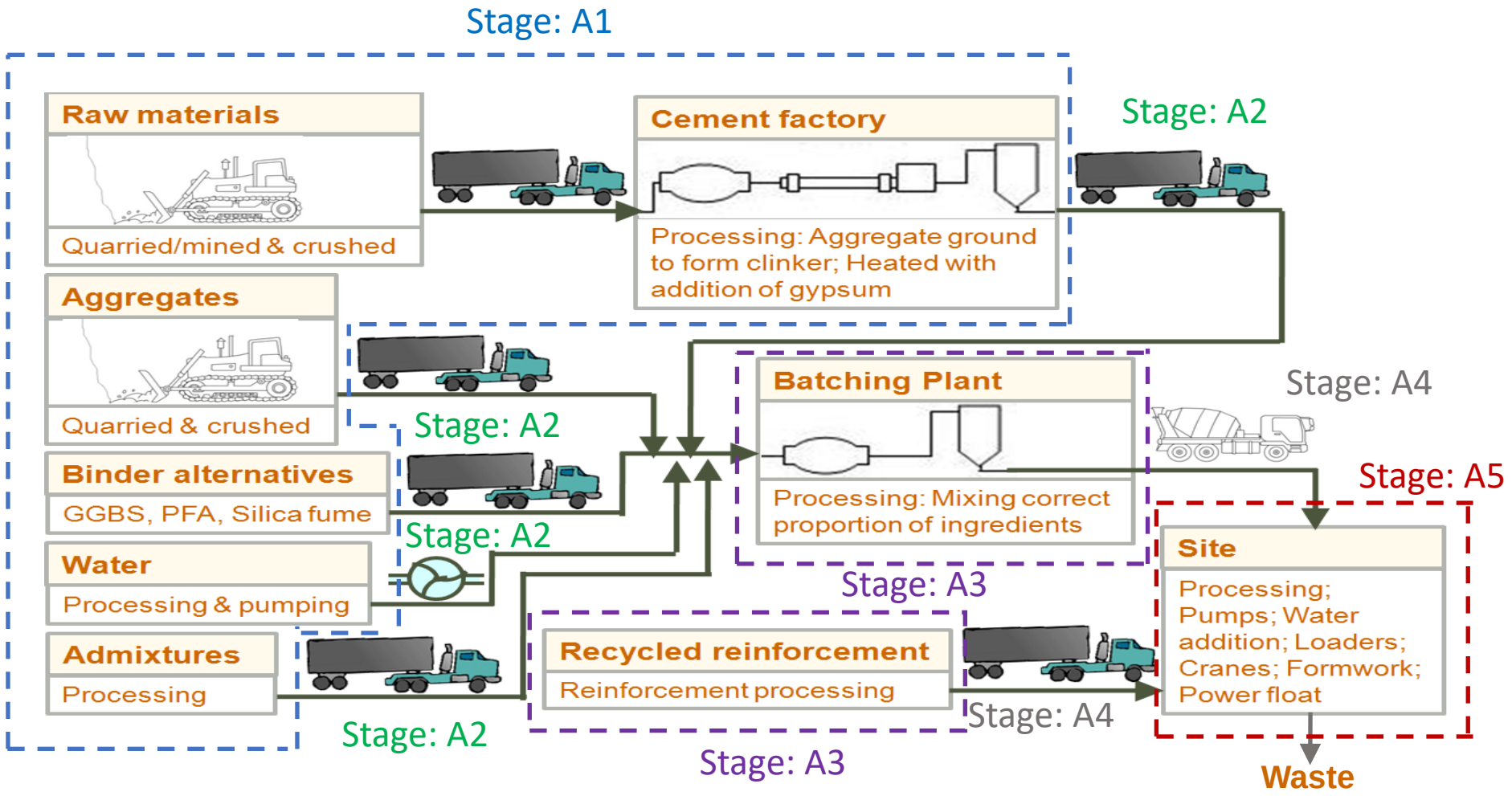
Construct Innovate
Built Environment Research Ireland



*Terms used in this report and defined in the glossary

Figure 1: Life cycle stages and modules according to the Standard EN 15978 and the estimated (according to the Institution of Structural Engineers) distribution of emissions for a medium-scale residential building

Source: World Green Building Council: EU Policy Whole Life Carbon Roadmap


Stage: A1
Raw materials
Quarried/mined & crushed
Cement factory
Processing: Aggregate ground to form clinker; Heated with addition of gypsum
Stage: A2
Aggregates
Quarried & crushed
Stage: A2
Batching Plant
Processing: Mixing correct proportion of ingredients
Stage: A4
Stage: A5
Binder alternatives
GGBS, PFA, Silica fume
Stage: A2
Water
Processing & pumping
Stage: A3
Site
Processing; Pumps; Water addition; Loaders; Cranes; Formwork; Power float
Admixtures
Processing
Stage: A2
Recycled reinforcement
Reinforcement processing
Stage: A4
Stage: A3
Waste

EPD IRELAND

THE ENVIRONMENTAL PRODUCT DECLARATION PROGRAMME

Construct Innovate
Built Environment Research Ireland

Environmental Product Declarations (EPD) are a standardised way of providing data about the environmental impacts of a product through the product life cycle using EN 15804.

Environmental Impact Indicators

- Global Warming Potential (GWP)
- Acidification (AP)
- Eutrophication (EP)
- Stratospheric Ozone Depletion Potential (ODP)
- Photochemical Ozone Creation Potential (POCP)
- Abiotic depletion

IBCI Building Control Conference 2012 | Athlone, 28-29 March 2012

Sustainability and Embodied Energy (and Carbon) in Buildings

Dr Jamie Goggins | Lecturer in Civil Engineering

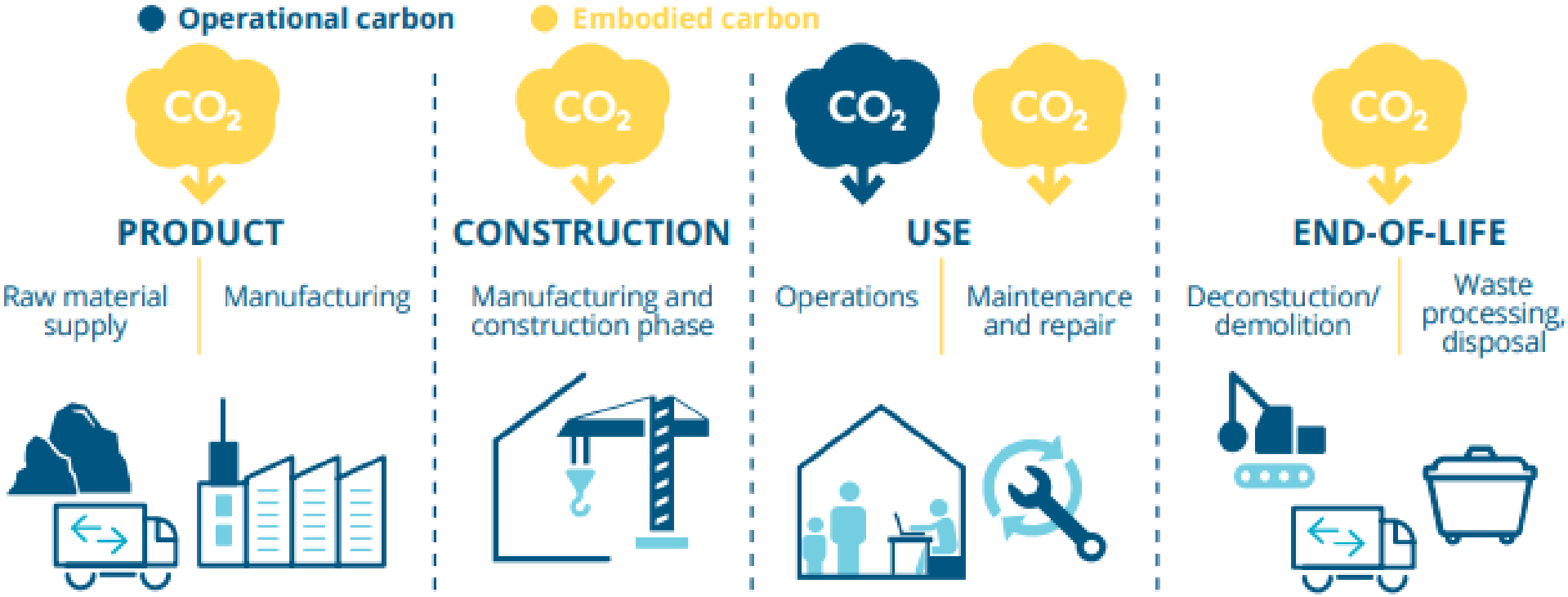
Affiliations:

College of Engineering & Informatics, NUI Galway
Ryan Institute for Environment, Marine & Energy Research

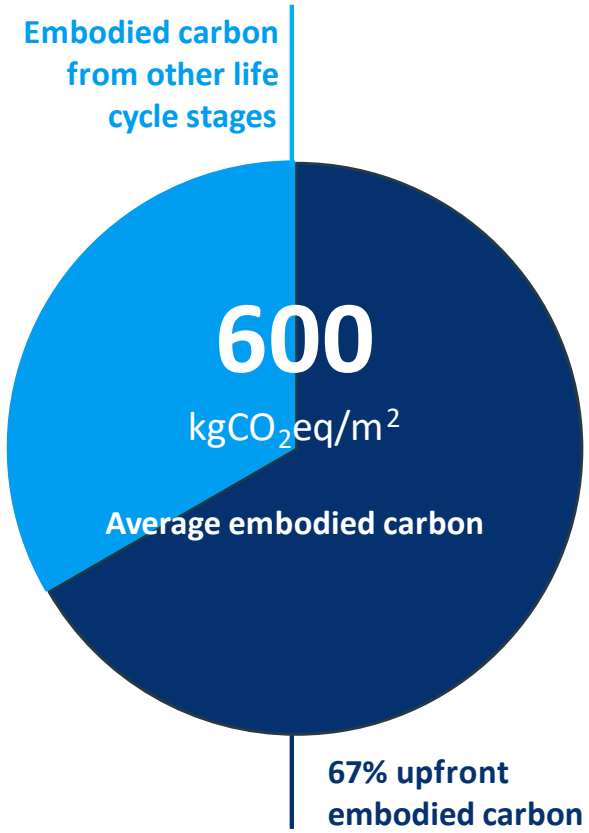
Energy in Buildings - Sustainability

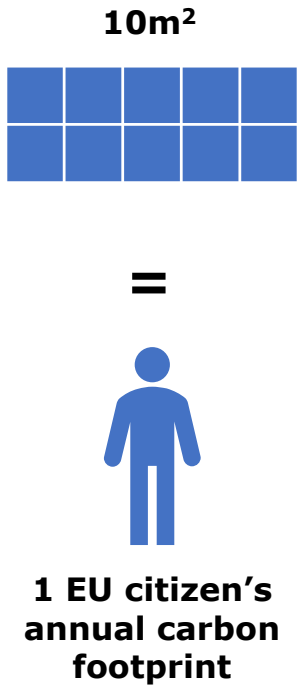
- What is a sustainable solution?
- Sustainability – Embodied energy and embodied carbon as indicators
- Why should embodied energy and embodied carbon be considered?
- Material choice
  - Concrete and cements
  - Steel
  - Timber
- Case study
- Summary

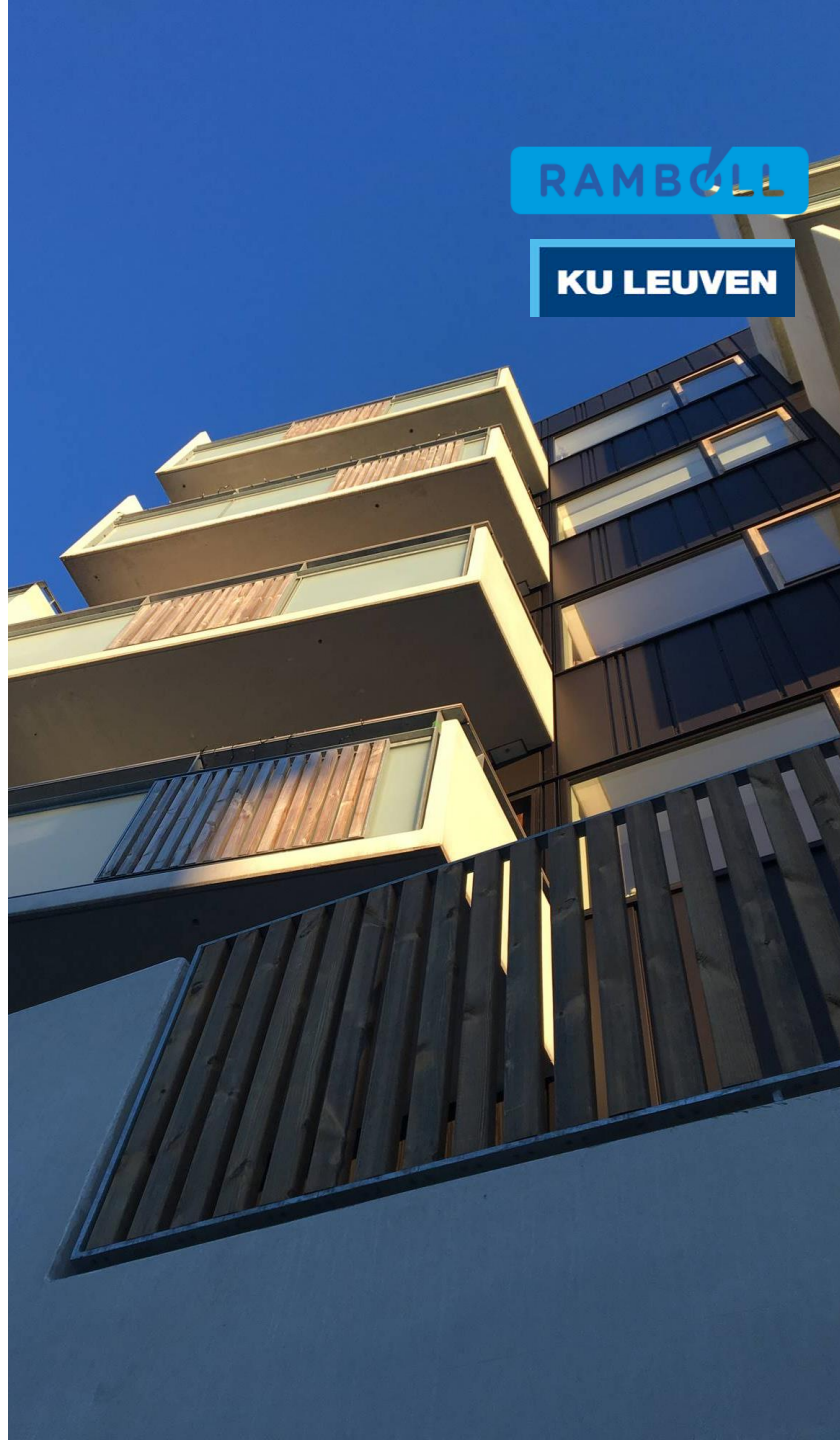
Whole Lifecycle Carbon (WLC) perspective on emissions



Embodied carbon of new buildings: 2/3 of WLC occur as upfront carbon spike



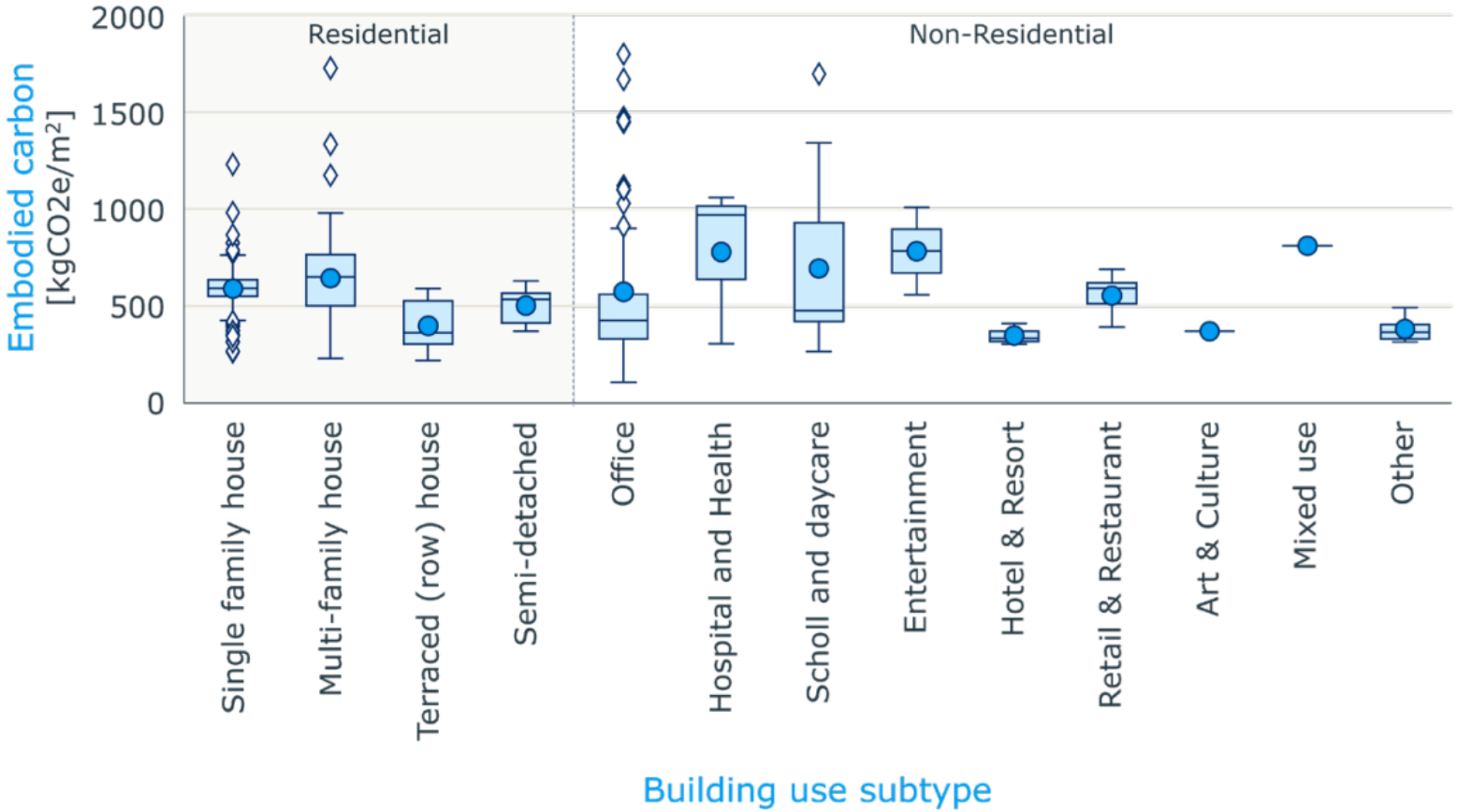




Building Life Cycle Data

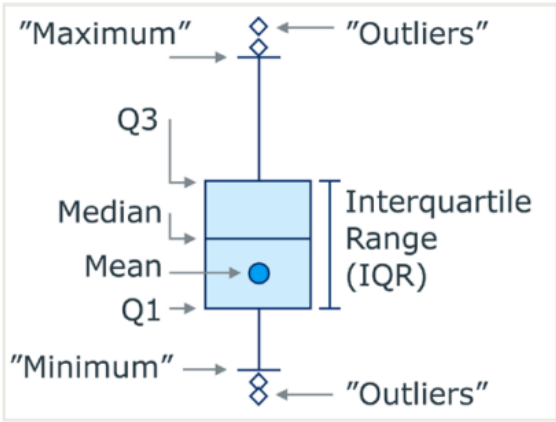
Embodied carbon per m^2 floor area

By building use subtype for EU-ECB data, harmonized values



Infobox

How to read a boxplot?



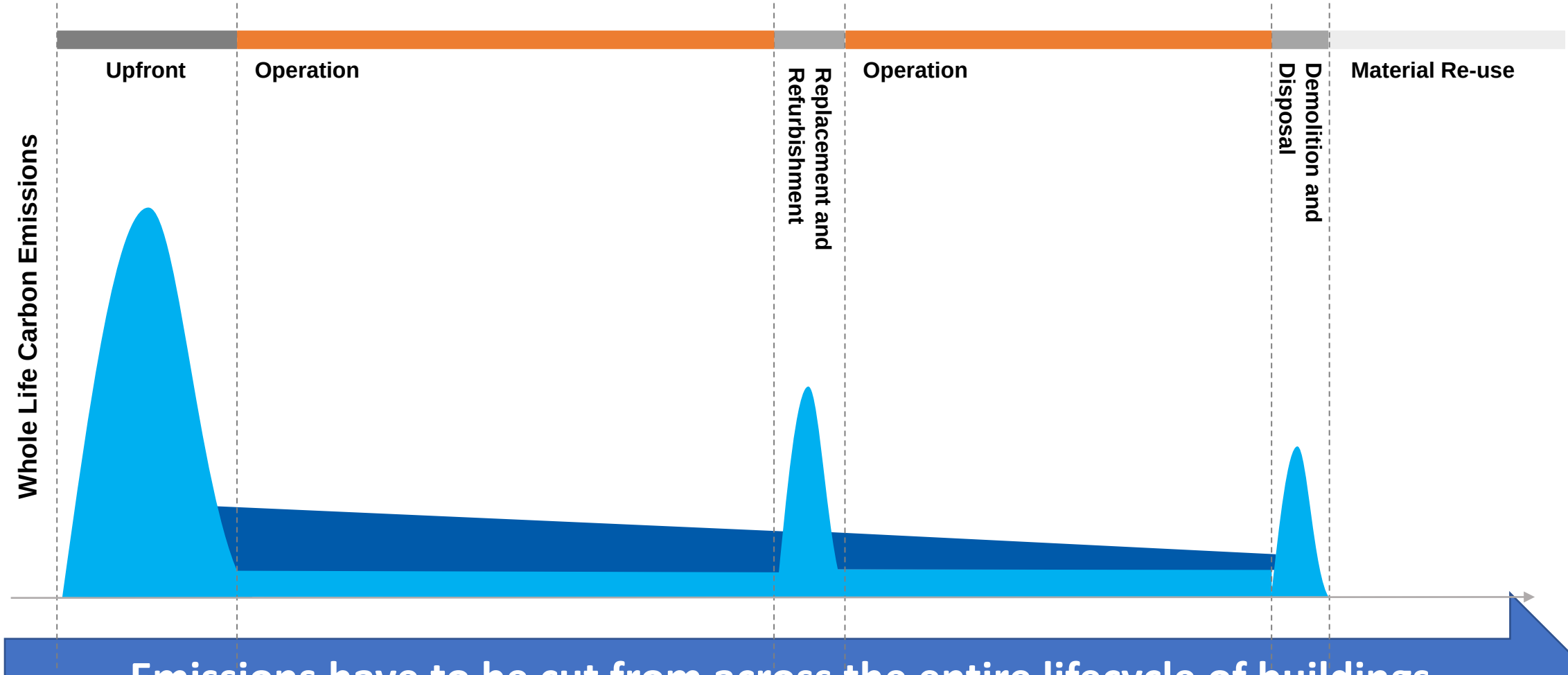
Where:

- Q1 = 25th percentile
- Q3 = 75th percentile
- IQR = Q3-Q1
- "Maximum" <= (Q3 + 1.5* IQR)
- "Minimum" >= (Q1 - 1.5* IQR)
- "Outliers" = Extreme values

Construct Innovate
Built Environment Research Ireland

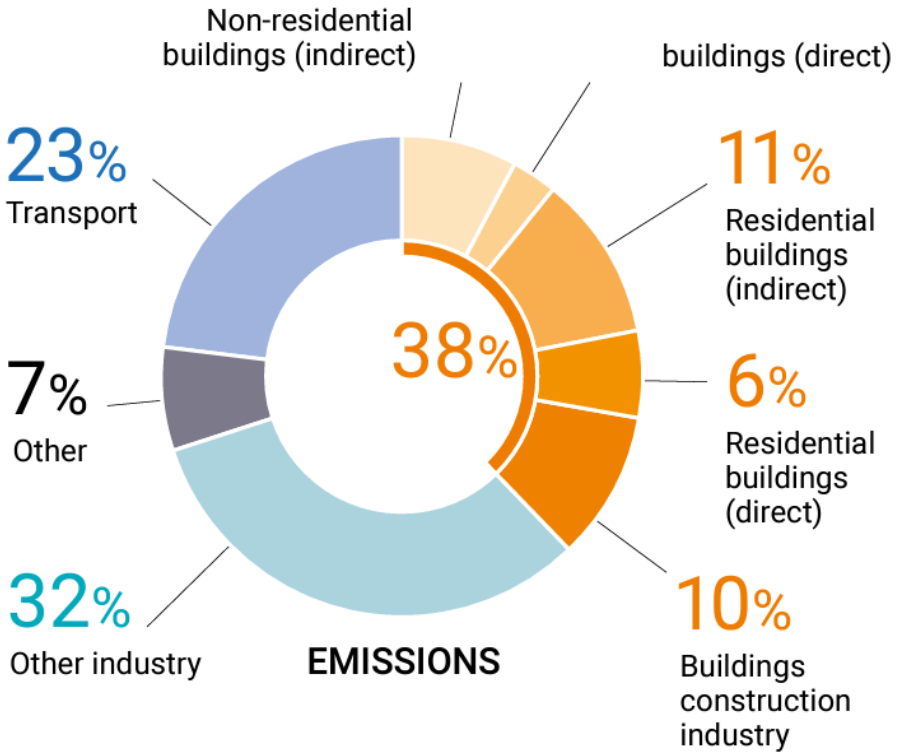
Building lifecycle emissions

Construct Innovate
Built Environment Research Ireland



Carbon Emissions in Building Sector

IEA Building Operation and Construction Emissions Estimates, 2019



	2019 (MtCO2)	Share
Buildings use phase	**9953**	
Coal	496	9% direct emissions
Oil	939	
Natural gas	1663	
Electricity and heat	6855	19% indirect emissions
Buildings construction	**130**	**10% indirect buildings and construction value chain emissions**
Construction energy use	130	
Material manufacturing	**3430**	
Cement- and steel- manufacturing for construction	2038	
Other	1391	
Buildings and construction value chain	**13512**	**38% of total energy related emissions**

Construct Innovate
Built Environment Research Ireland

Ref: WBCSD and ARUP, Net-zero buildings: Where do we stand?, World Business Council for Sustainable Development & ARUP, 2021.
IEA, Energy Technology Perspectives 2020, International Energy Agency, 2020.
UN Environment and International Energy Agency, Towards a zero-emission, efficient, and resilient buildings and construction sector, 2017. www.globalabc.org

EU and Member States' General Approach on Whole Lifecycle Carbon (WLC) in buildings

An incremental approach:

1. First step - Requiring assessment and reporting

2. Second step – setting targets and limit values

1 First step - Requiring assessment and reporting

Already in policy initiatives

Level(s) is European Framework for sustainable buildings and is the basis on which to bring **whole life carbon** into building policy.

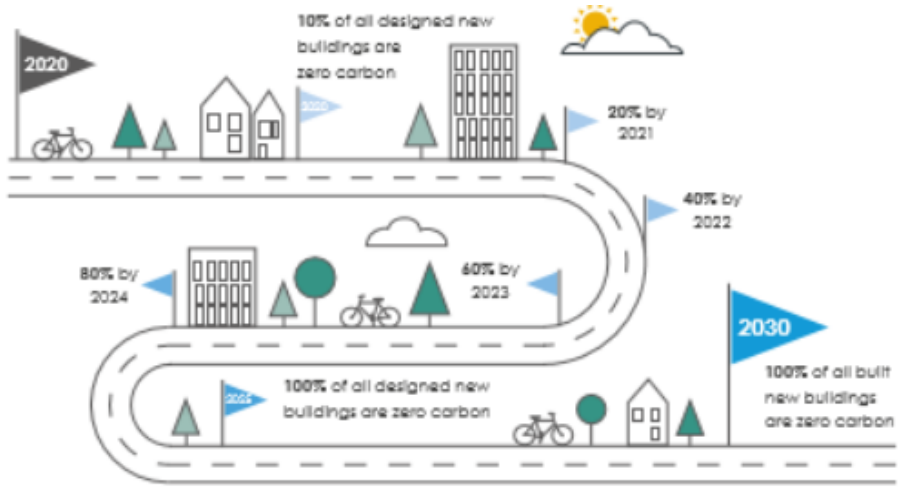
Directives & Regulations

- **Sustainable Finance Taxonomy** – large (>5000m2) new constructions are required to disclose WLC as of January 2022
- **Energy Performance of Buildings Directive recast** – WLC disclosure requirements from 2027 onwards
- **Construction Products Regulation** review – information requirements on the products' environmental footprint

Spread knowledge and build market capacity
Generation of data
Soft reduction of whole life carbon

https://environment.ec.europa.eu/topics/circular-economy/levels_en

2 Setting targets and limit values



Reference: LETI CEDG

Benchmarking
Limit Values

- Already being developed by EU COM (DG ENV, together with DG Grow):
  - Roadmap for reduction of whole life carbon
    - ✓ Quantified targets, with milestones up to 2050
    - ✓ Embodied and operational carbon
    - ✓ Not a list of policy recommendations

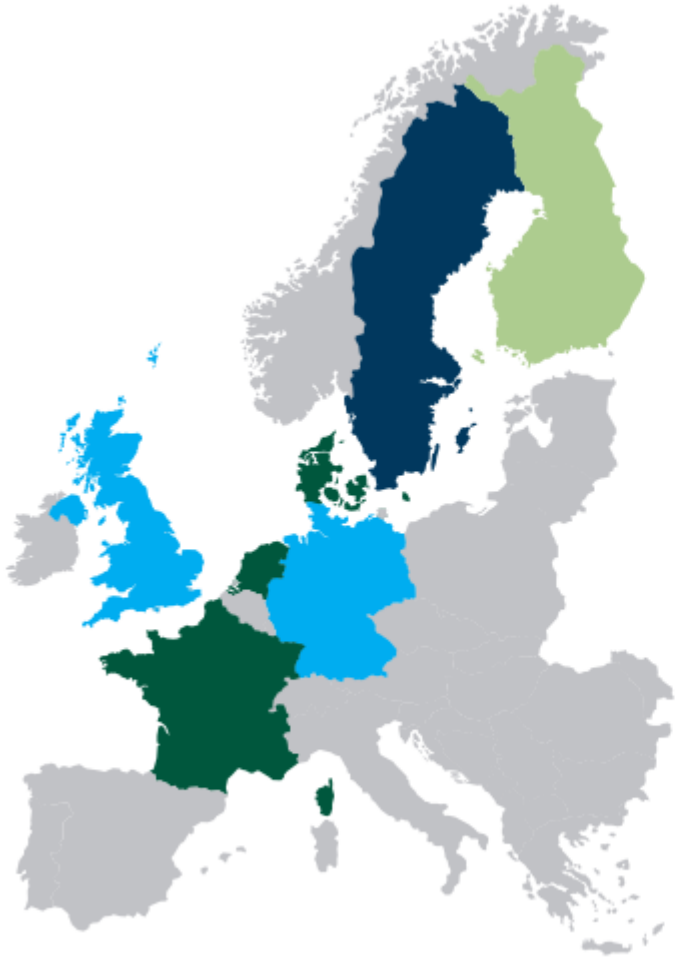
➢ Bringing together expertise and initiatives - inspired by frontrunners – engage across the EU

Based on this methodology, by 1 January 2027, Member States will have to produce roadmap containing minimum values on the total WLC of all new buildings and set targets for new buildings from 2030.

Construct Innovate
Built Environment Research Ireland

WLC: Leading EU Member States

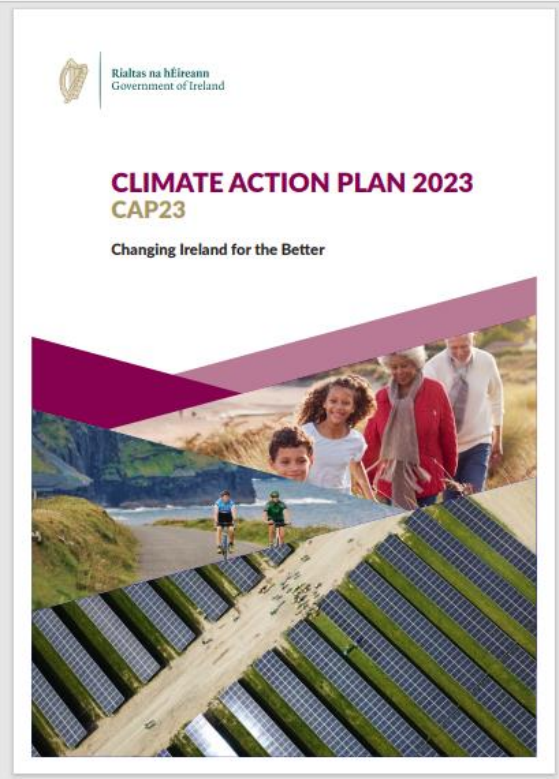
- Netherlands (2012: Documentation – 2018: limit value)
- France (2021)
- Switzerland (2022)
- Norway (2022)
- Denmark (2022)
- Finland (2023)



- WLC legislation with limit values in force or agreed
- Reporting obligation in force, limit values to be proposed
- WLC legislation proposed
- Other non-legislative LCA requirements in place (e.g. for public buildings or for public fund applications)

Source:

Life Cycle Carbon – Climate Action Plan 2023 - Ireland

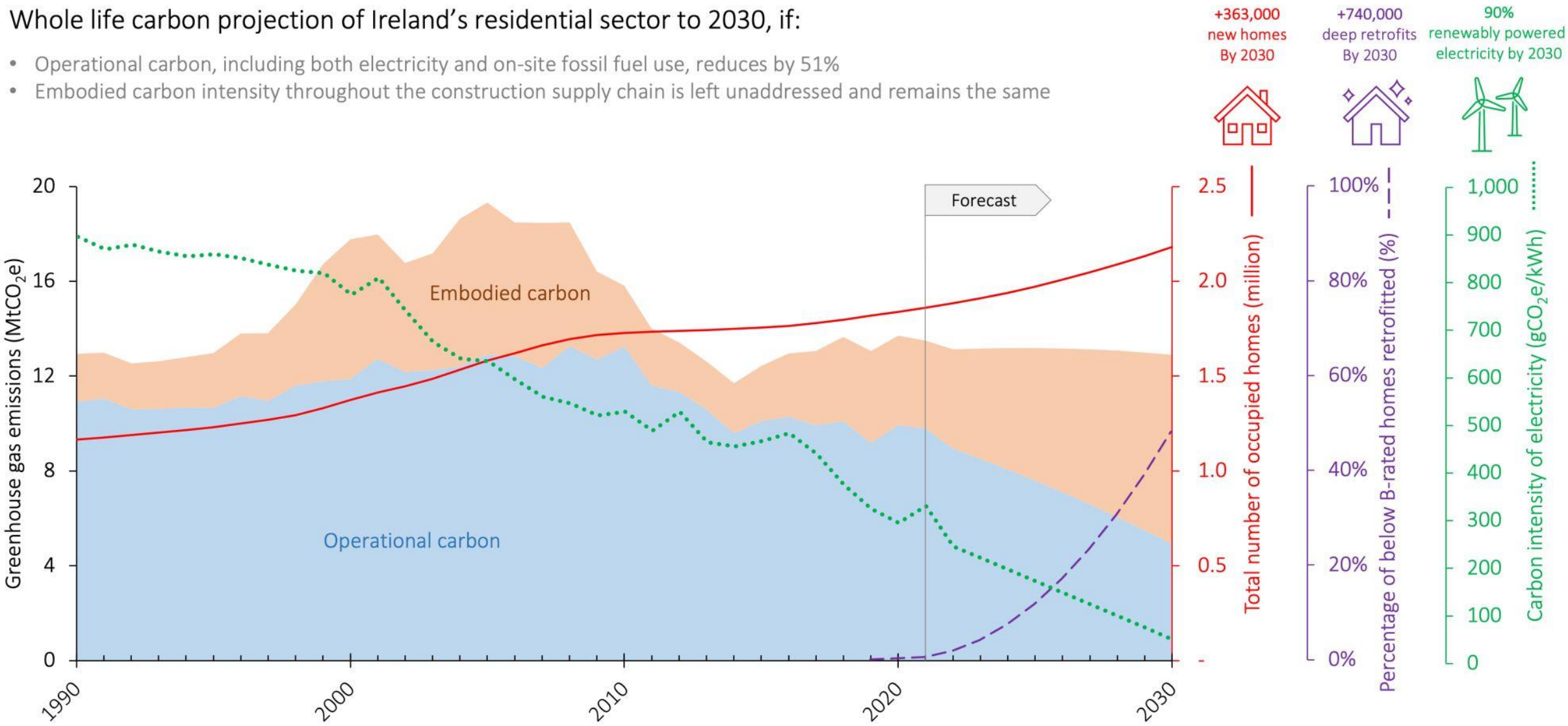


Measure	2023 Actions	2024 Actions	2025 Actions
Reduction in Embodied Carbon in Construction Materials for Industry	Publish a report on actions to decrease embodied carbon in the whole life-cycle of construction materials	Continue implementation of recommended actions from report to align with sectoral targets	SEAI: Commence developing an embodied carbon building rating calculation methodology taking account of CPR (where available) and EPBD
	Identify case study which highlights suitability and opportunities for alternative construction materials		
Leading by Example Reduction in Embodied Carbon in Construction Materials for the Public Sector	Prepare and submit to Government a public procurement policy to facilitate public bodies incorporating the principle of low carbon construction methods and materials and whole life-cycle analysis approaches in all publicly procured projects	Implement the policy through the Office of Government Procurement	Implement the policy through the Office of Government Procurement
	Specify low carbon construction methods and low carbon cement material as far as practicable for directly procured or supported construction projects from 2023	Public Bodies: Specify low carbon construction methods and low carbon cement material as far as practicable for directly procured or supported construction projects	Public Bodies: Specify low carbon construction methods and low carbon cement material as far as practicable for directly procured or supported construction projects
	Publish new Green Public Procurement Strategy and Action Plan, identifying an appropriate monitoring and reporting protocol that includes the monitoring of the implementation of low carbon construction in public tenders and grant schemes	Implementation of GPP Strategy and Action Plan	Implementation of GPP Strategy and Action Plan.

Construct Innovate
Built Environment Research Ireland

Whole life carbon projection of Ireland's residential sector to 2030, if:

- Operational carbon, including both electricity and on-site fossil fuel use, reduces by 51%
- Embodied carbon intensity throughout the construction supply chain is left unaddressed and remains the same



Hegarty & Kinnane (2023)

BUILDING A ZERO CARBON IRELAND

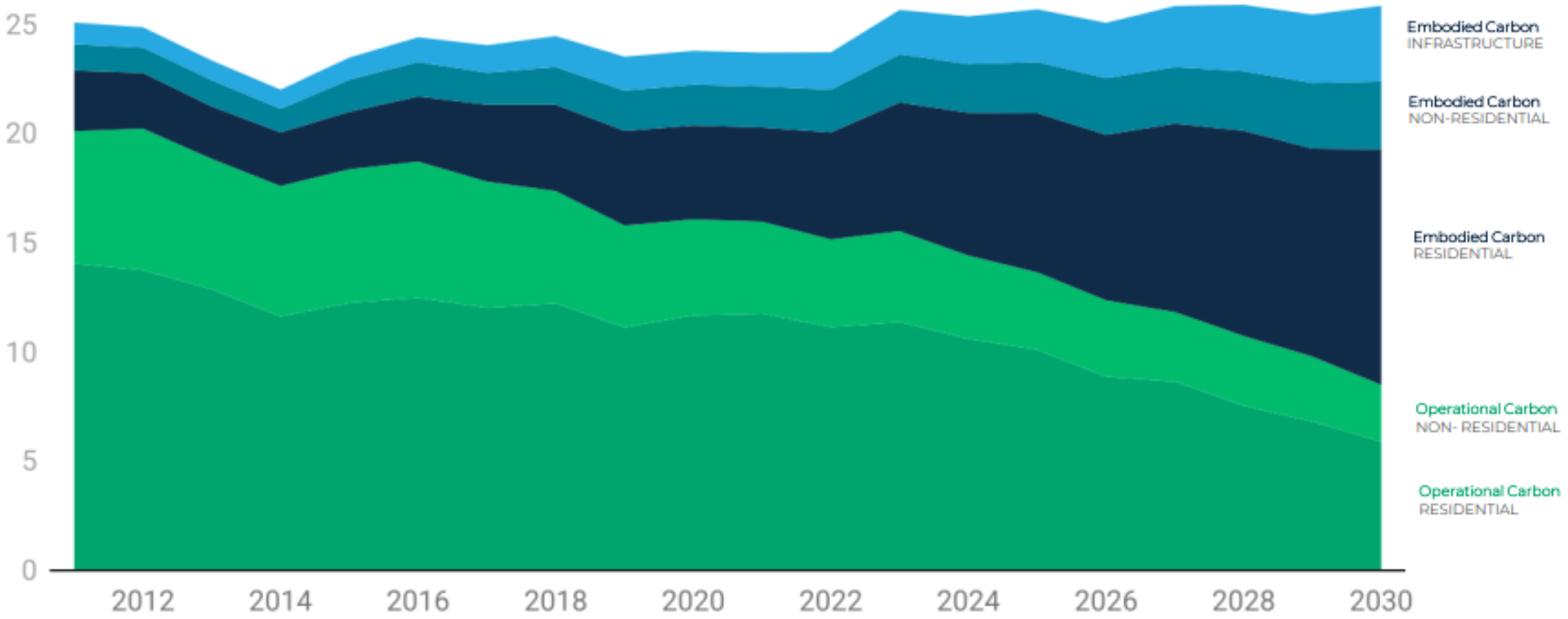
A Roadmap to decarbonise Ireland's
Built Environment across its Whole Life Cycle

#BUILDINGLIFE

IGBC
IRISH GREEN BUILDING COUNCIL

https://www.igbc.ie/wp-content/uploads/2022/10/Building-Zero-Carbon-Ireland.pdf

Construct Innovate
Built Environment Research Ireland



Source: https://www.igbc.ie/wp-content/uploads/2022/10/Building-Zero-Carbon-Ireland.pdf

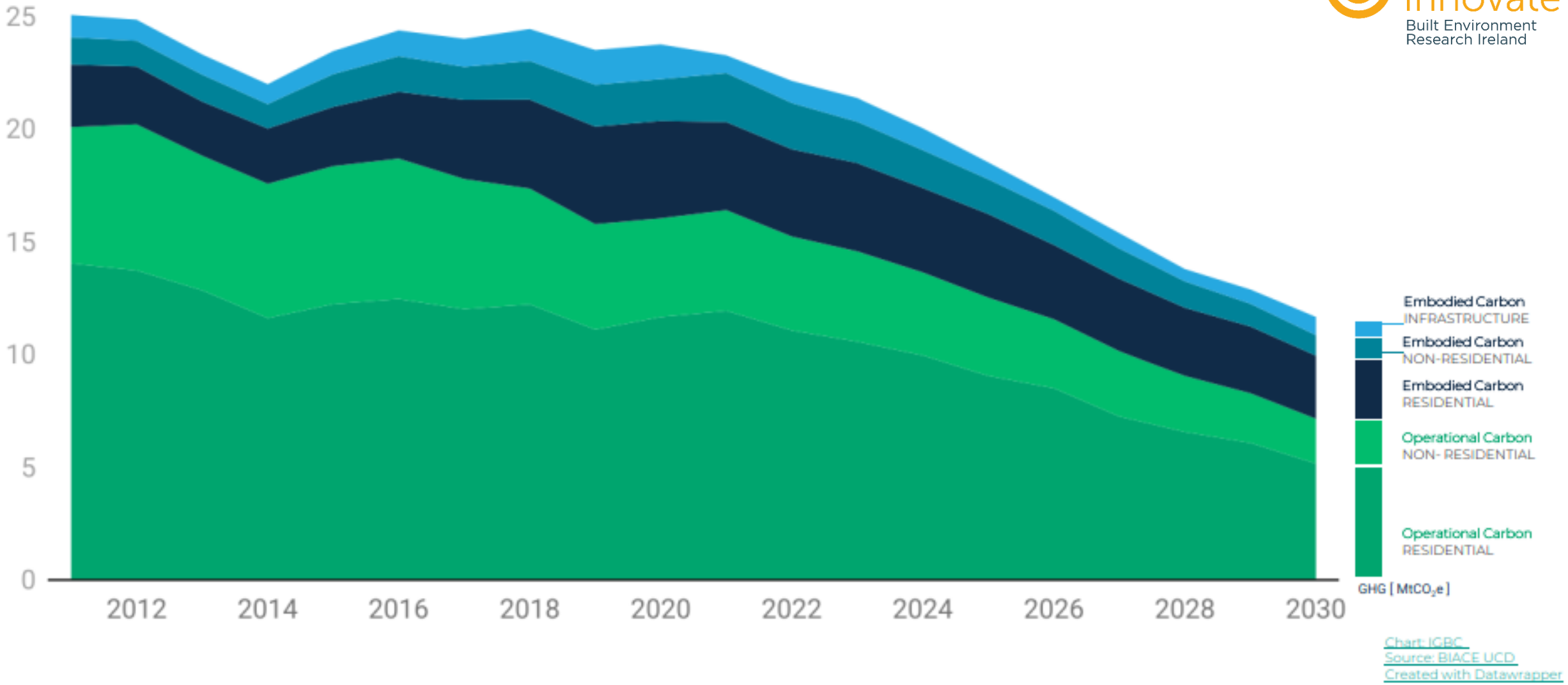
Chart: IGBC
Source: RIACE UCD
Created with Datawrapper

IGBC IRISH GREEN BUILDING COUNCIL

Business as Usual: Embodied Carbon (EC) will double

WORLD GREEN BUILDING COUNCIL

BPIE



Source: https://www.igbc.ie/wp-content/uploads/2022/10/Building-Zero-Carbon-Ireland.pdf

IBCI Building Control Conference 2012 | Athlone, 28-29 March 2012

Sustainability and Embodied Energy (and Carbon) in Buildings

Dr Jamie Goggins | Lecturer in Civil Engineering

Affiliations:

College of Engineering & Informatics, NUI Galway
Ryan Institute for Environment, Marine & Energy Research

Energy in Buildings - Sustainability

- What is a sustainable solution?
- Sustainability – Embodied energy and embodied carbon as indicators
- Why should embodied energy and embodied carbon be considered?
- Material choice
  - Concrete and cements
  - Steel
  - Timber
- Case study
- Summary

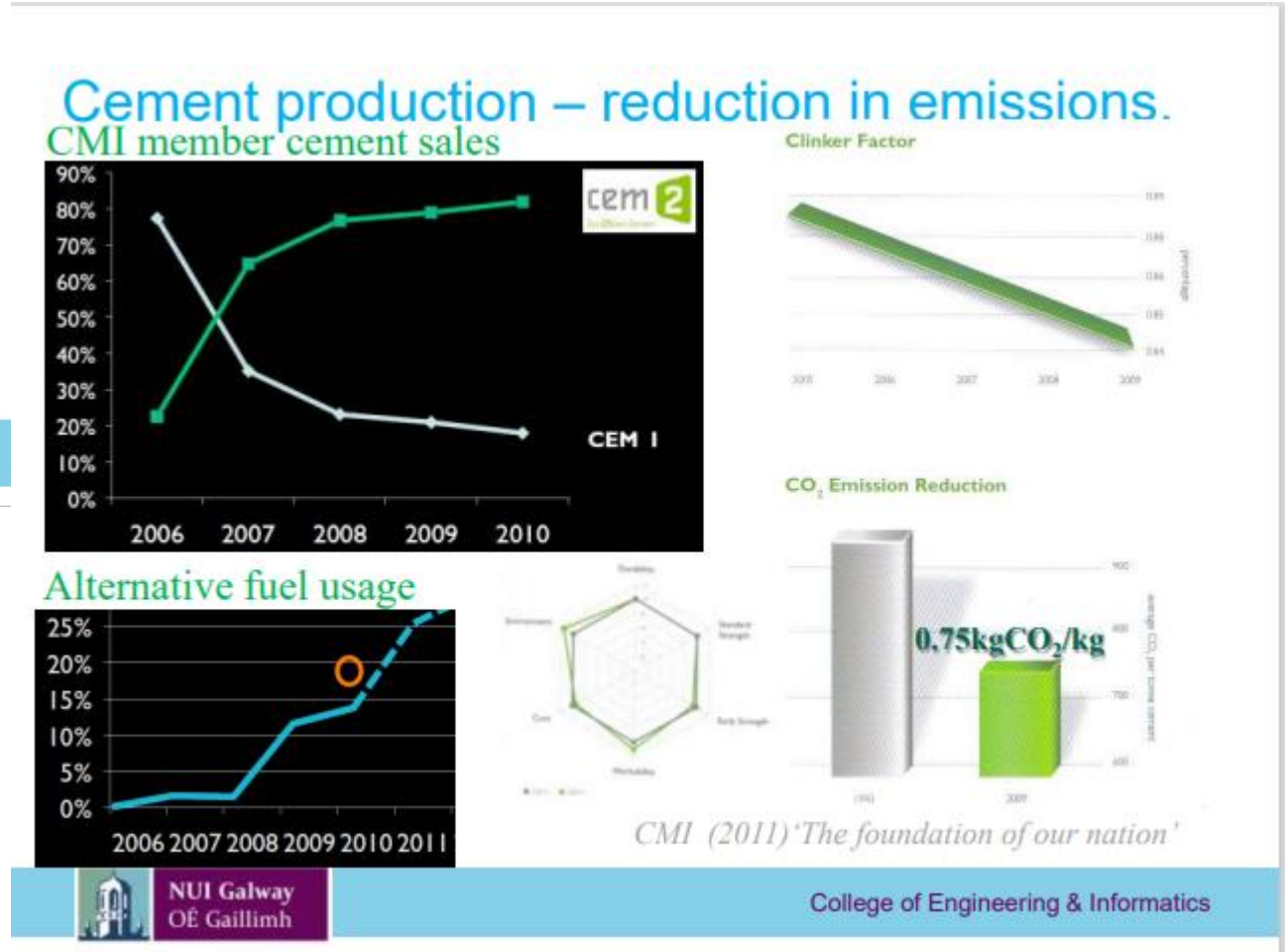
IBCI Building Control Conference 2012 | Athlone, 28-29 March 2012

Sustainability and Embodied Energy (and Carbon) in Buildings

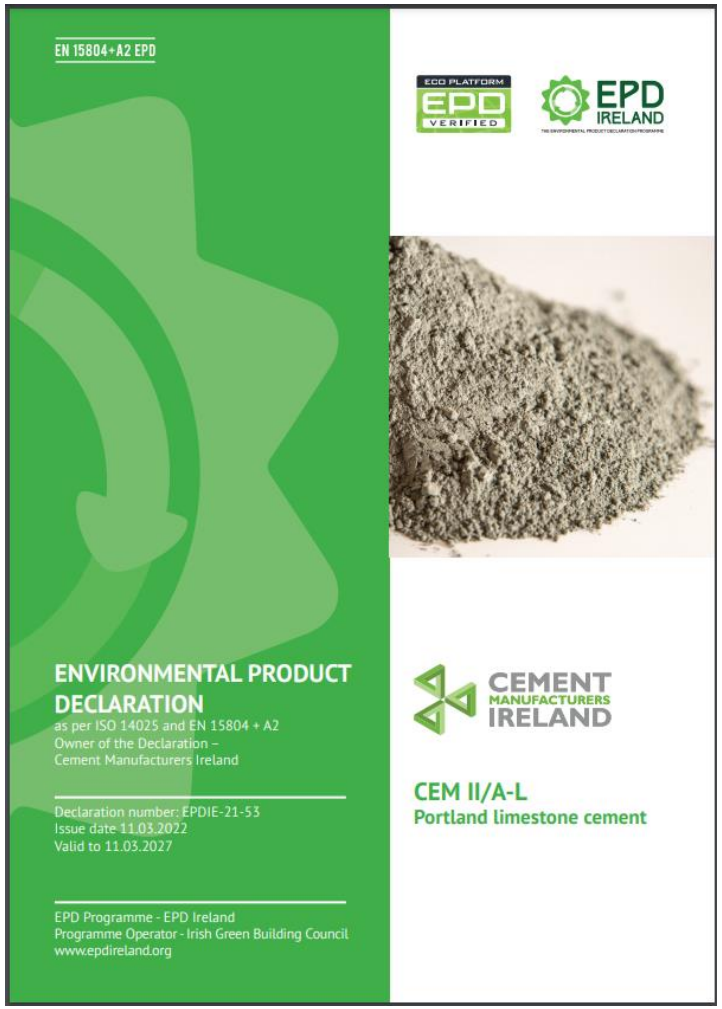
Dr Jamie Goggins | Lecturer in Civil Engineering

Affiliations:

College of Engineering & Informatics, NUI Galway
Ryan Institute for Environment, Marine & Energy Research



Latest values for cement in Ireland



CEM I Portland Cement –
GWP of 0.763kgCO_2eq/kg of cement

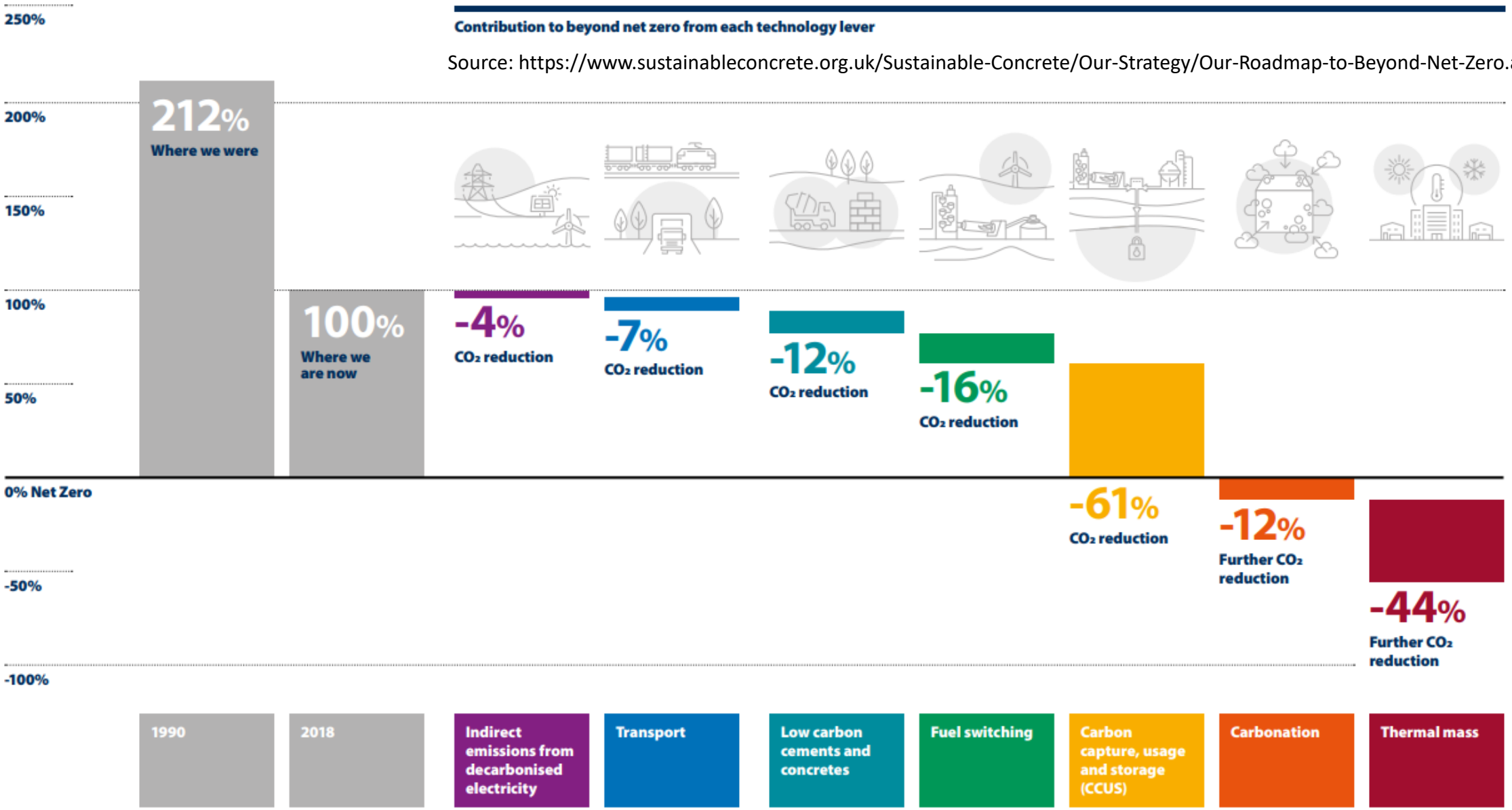
CEM II/A-L Portland Limestone Cement –
GWP of 0.698kgCO_2eq/kg of cement

https://www.ibec.ie/connect-and-learn/industries/construction-property-and-engineering/cement-manufacturers-ireland/sustainability

UK Concrete and Cement Industry Roadmap to Beyond Net Zero

Construct Innovate
Built Environment Research Ireland

Source: https://www.sustainableconcrete.org.uk/Sustainable-Concrete/Our-Strategy/Our-Roadmap-to-Beyond-Net-Zero.aspx



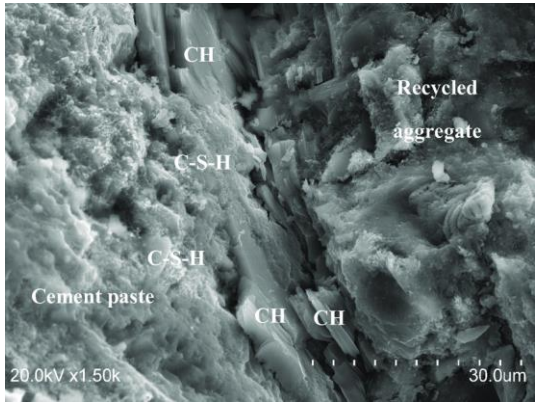
Choice of materials and systems

Construct Innovate
Built Environment Research Ireland

Low-carbon materials

Low-carbon construction materials

Circular Economy



Recycled concrete paste back into concrete

Embedding other waste products into concrete

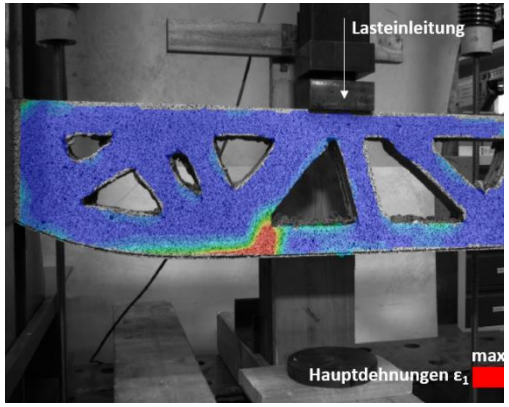
Inject CO_2 into fresh concrete, where it converts to a solid mineral, calcium carbonate (CaCO3) (e.g. CarbonCure®).

Optimise material usage

Minimise waste

Only use material where needed

Design for manufacture, disassembly and reuse



Parametric modelling, optimisation of use of material

Durability of materials: extend life

IBCI Building Control Conference 2012 | Athlone, 28-29 March 2012

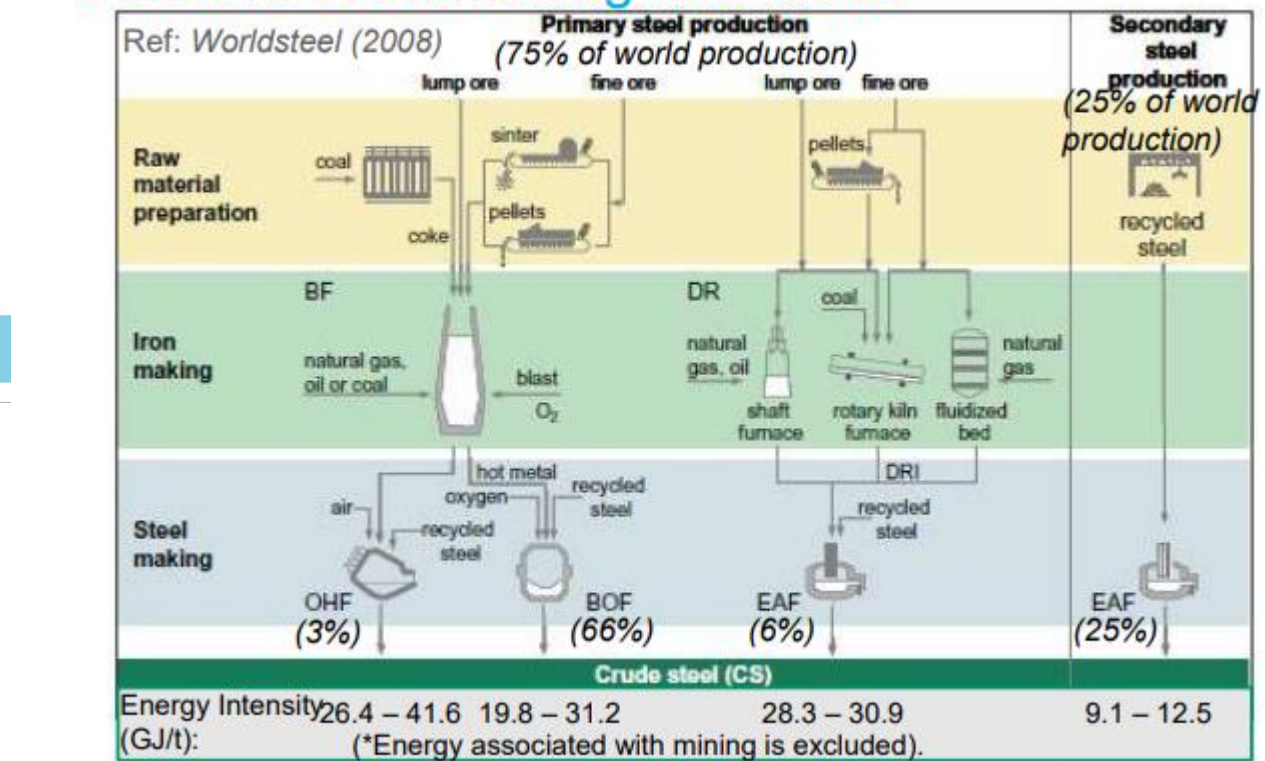
Sustainability and Embodied Energy (and Carbon) in Buildings

Dr Jamie Goggins | Lecturer in Civil Engineering

Affiliations:

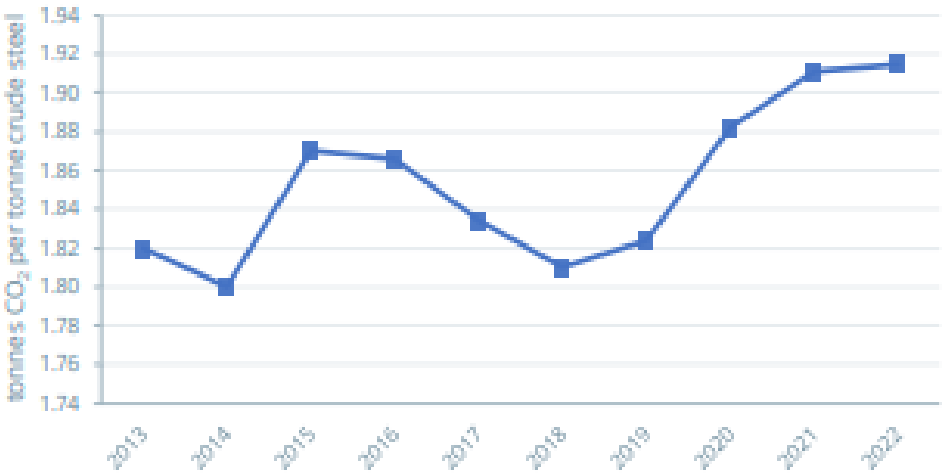
College of Engineering & Informatics, NUI Galway
Ryan Institute for Environment, Marine & Energy Research

Iron and Steel making flow chart

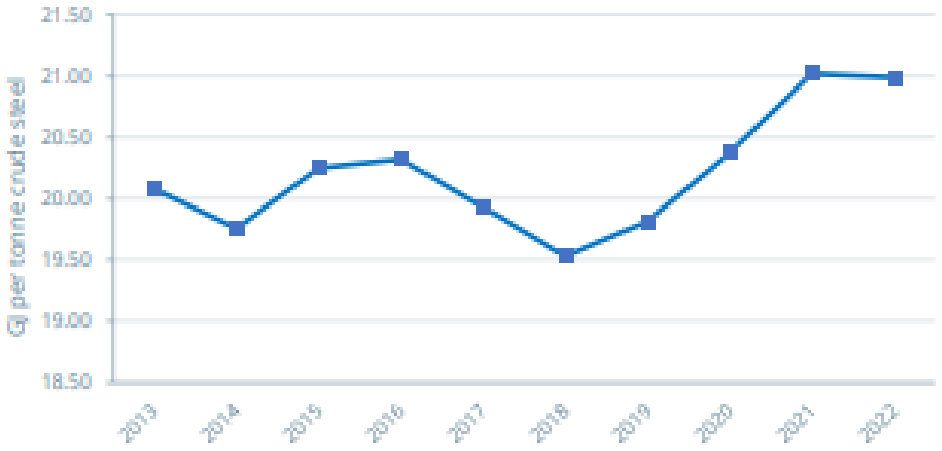


Embodied carbon and energy of world steel production

1. CO_2 emissions intensity



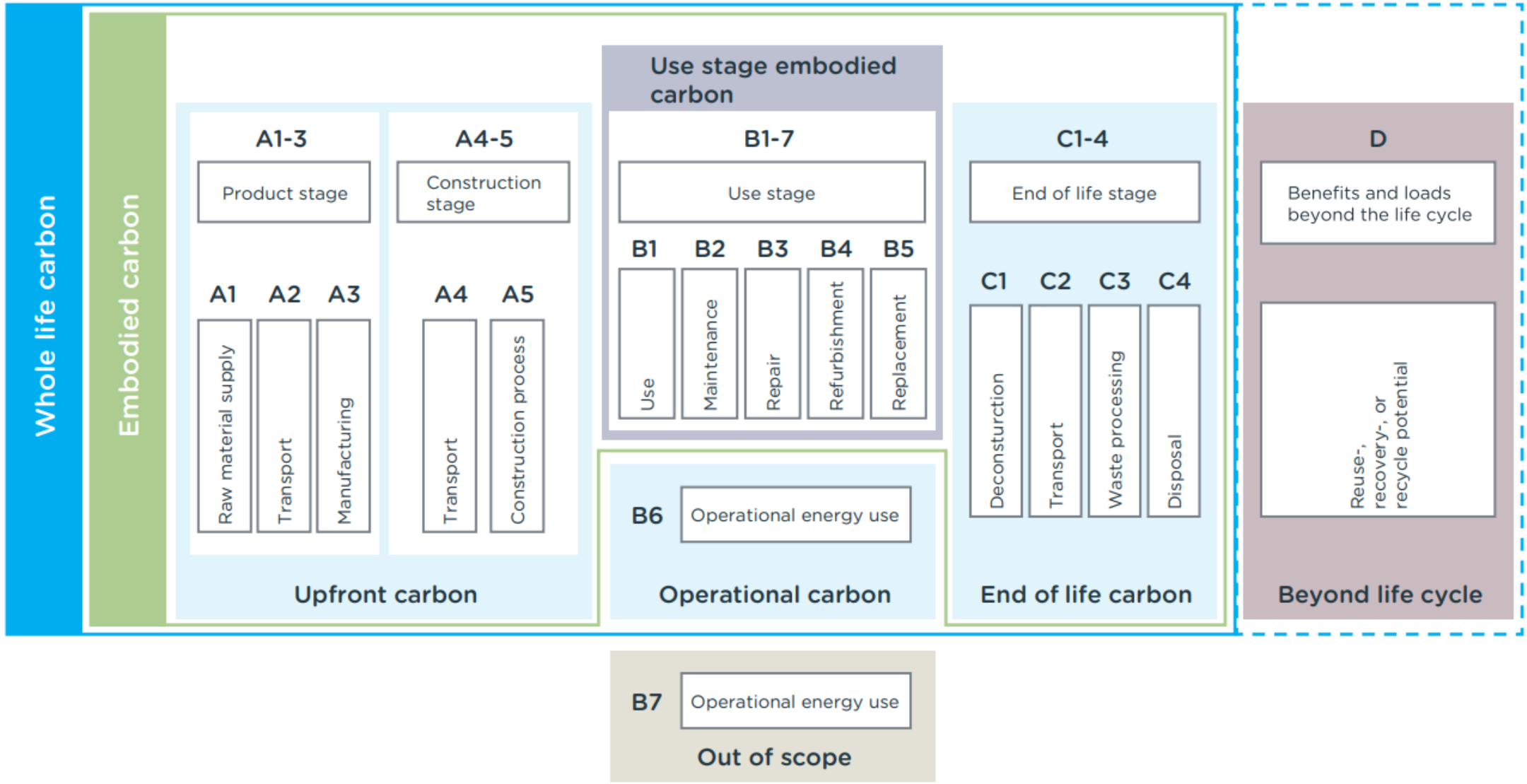
2. Energy intensity



https://worldsteel.org/wp-content/uploads/Sustainability-indicators-report-2023.pdf

Whole Life Carbon of Buildings

Building Life Cycle



EPBD recast and Construction Product Regulations

European Commission	Life-cycle Global Warming Potential' (GWP) calculation using **Level(s) from 2030 for all new buildings** and from **2027 for all new buildings with floor area above 2000m²**. **No targets for WLC reductions set in this revision**.
Council of the European Union	Maintains requirement on **WLC reporting.** Authorises **national 'methods'** to be used for reporting as an alternative to Level(s). Member States can decide not to disclose GWP if building permit already exists by the date of WLC requirement.
European Parliament	Deadline for **WLC reporting** for all new buildings brought forward to **2027.** Delegated act to set out a harmonised EU WLC reporting framework by end of 2025. Based on this methodology, by 2027, Member States will have to produce roadmap containing minimum values on the total WLC of all new buildings and set **targets for new buildings from 2030**.

Construct Innovate
Built Environment Research Ireland

Climate Action Plan

Action	198	Develop an embodied carbon building rating calculation methodology			
Steps Necessary for Delivery		**Proposed Output**	**Timeline**	**Lead**	**Key Stakeholders**
Examine life cycle analysis and embodied carbon emissions in buildings to compare the use of sustainable materials		Publication of Life Cycle Analysis report	Q2 2023	SEAI	DECC, DHLGH
Design a calculation methodology for the overall embodied carbon emissions in buildings using typical construction materials		Standard Calculation Methodology	Q2 2024	SEAI	DECC, SEAI, IGBC, RIAI, NSAI, DHLGH, EPA
Develop a database of all construction materials and their embodied carbon emissions		Database developed subject to review of Construction Products Regulation	Q3 2024	SEAI	DECC, SEAI, IGBC, RIAI, NSAI, DHLGH, EPA
Publish a draft embodied carbon emission building Rating scheme, similar to the existing Building Energy Rating system		Embodied Carbon Rating System	Q2 2025	SEAI	DECC, SEAI, IGBC, RIAI, NSAI, DHLGH, EPA
Publish software to calculate embodied carbon emissions in buildings		Software Release	Q4 2025	SEAI	DECC, SEAI, IGBC, RIAI, NSAI, DHLGH, EPA

Construct Innovate
Built Environment Research Ireland

Purpose

To create a methodology for measuring Whole Life Carbon in Irish buildings in line with Action 198 of the CAP.

To discover our baseline today so we fully understand the emissions associated with current building practice across a building's lifecycle.

To set targets to lower these emissions and provide tools and advice on how this can be done.

Construct Innovate
Built Environment Research Ireland

Why THIS methodology?

So we can aggregate assessments to understand what typical looks like today

To do this, assessments must be done consistently – meaning the same scope (what to include),

consistent assumptions on:

- the impact of materials (A1-3),
- transport distance and type (A4),
- on site wastage(A5),
- replacement cycles (B4),
- the grid in the future (B6),
- end of life (C1-4).

So that any two projects are comparable

Open source, no licence required, national, transparent and free to anyone

Methodology

Level(s) provides a materials scope and some assumptions

- This outlines everything we need to include to consistently produce results we can compare;
  - across projects
  - across companies and organisations
  - across the EU
  - against Green Financing objectives (the Green Deal/Taxonomy)

Methodology

NSAI Standards

Irish Standard
I.S. EN 15978:2011

Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method

European Commission

JRC TECHNICAL REPORTS

Level(s) – A common EU framework of core sustainability indicators for office and residential buildings

User manual 2: Setting up a project to use the Level(s) common framework

(Publication version 1.1)

Nicholas Dodd, Shane Donatello, Mauro Cordella (JRC, Unit B.5)

January 2021

Construct Innovate
Built Environment Research Ireland

Macro-objective		Definition
Macro-objective 1 **Greenhouse gas and air pollutant emissions along a buildings life cycle**		Minimise the total greenhouse gas emissions along a buildings life cycle[1], from cradle to grave, with a focus on emissions from building operational energy use and embodied energy.
Macro-objective 2: **Resource efficient and circular material life cycles**		Optimise the building design, engineering and form in order to support lean and circular flows, extend long-term material utility and reduce significant environmental impacts.
Macro-objective 3: **Efficient use of water resources**		Make efficient use of water resources, particularly in areas of identified long-term or projected water stress.
Macro-objective 4: **Healthy and comfortable spaces**		Create buildings that are comfortable, attractive and productive to live and work in, and which protect human health.
Macro-objective 5: **Adaptation and resilience to climate change**		Futureproof building performance against projected future changes in the climate, in order to protect occupier health and comfort and to minimise long-term risks to property values and investments.
Macro-objective 6: **Optimised life cycle cost and value**		Optimise the life cycle cost and value of buildings to reflect the potential for long-term performance improvement, inclusive of acquisition, operation, maintenance, refurbishment, disposal and end of life.

Methodology

Physical scope of a new-build assessment:

Foundations (substructure)	Piles
	Basements
	Retaining walls
Load bearing structural frame	Frame (beams, columns and slabs),
	Upper floors
	External walls
	Balconies
Non-load bearing elements	Ground floor slab
	Internal walls, Partitions and doors,
	Stairs and ramps
Facades	External wall systems
	Cladding and shading devices,
	Façade openings (including windows and external doors),
	External paints, coatings, renders
Roof	Structure
	Weatherproofing
Parking facilities	Above and underground (within the curtilage of the building and servicing the building occupiers)
Fittings and furnishings	Sanitary fittings,
	Cupboards, Wardrobes and worktops (where provided in residential property),
	Ceilings
	Wall and ceiling finishes
	Floor coverings and finishes

In-built lighting system	Light fittings,
	Control systems and Sensors
Energy system	Heating plant and distribution
	Cooling plant and distribution
	Electricity generation and distribution
Ventilation system	Air handling units
	Ductwork and distribution
Sanitary systems	Cold water distribution
	Hot water distribution
	Water treatment systems
	Drainage system
Other systems	Lifts and escalators
	Firefighting installations,
	Communication and security installations
	Telecoms and data installations
External Works	
Drainage systems	Drainage system
Utilities	Connections and diversions,
	Substations and equipment
Landscaping	Paving and other hard surfacing,
	Fencing, Railings, Walls

Source: Level(s) indicator 1.2 – Lifecycle GWP

- Generic Product data
- EPDs
- Energy data
- Completeness
- Consistency

Construct Innovate
Built Environment Research Ireland

Methodology

	A	B	C	D	E	F	G	H	I	J	K
1											
2	**Bill of quantities organised by the main building parts and elements** *Fictive entries have been added below for illustration purposes, please delete any information in the green or yellow cells before starting*								**Building floor area (m2)**		**2500**
3	**Tier 1 building element**	**Tier 2 building element**	**Tier 3 building element**	**Optional further description of the product/material being purchased**	**Bill of Quantities (number of units)**	**Unit**	**Conversion factor (kg/unit)**	**TOTAL (kg)**	**Cost €/unit**	**Cost €/kg**	**TOTAL cost €**
5	Shell	Foundations_substructure	Piles	Reinforced concrete pile foundations with rebar at 130kg/m3	100	m3	2600	260000	150.0	0.1	15000
6	Shell	Foundations_substructure	Basements	Concrete basement floor (0.3 x 150m2) with rebar at 120kg/m3	55	m3	2400	132000	135.0	0.1	7425
7	Shell	Foundations_substructure	Basements	Ceramic tiled basement surface	150	m2	20	3000	15.0	0.8	2250
8	Shell	Foundations_substructure	Retaining walls	Reinforced concrete retaining walls with rebar at 120kg/m3	160	m3	2400	384000	120.0	0.1	19200
9	Shell	Loadbearing_structural_frame	Frame (beams, columns and slabs)	Reinforced concrete slabs and columns with rebar at 120kg/m3	900	m3	2400	2160000	125.0	0.1	112500
10	Shell	Loadbearing_structural_frame	Upper floors	Pretensioned hollow-core concrete slabs produced offsite (20m x 1.2m x 0.3m)	50	pieces	5600	280000	175.0	0.0	8750
11	Shell	Facades	External wall systems, cladding and shading devices	Full length glass curtain walling on an aluminium frame	3000	m2	22	66000	80.0	3.6	240000
12	Core	Fittings_and_furnishings	Floor coverings and finishes	Laminate flooring with foamed plastic underlay	2500	m2	7.5	18750	12.0	1.6	30000

Construct Innovate
Built Environment Research Ireland

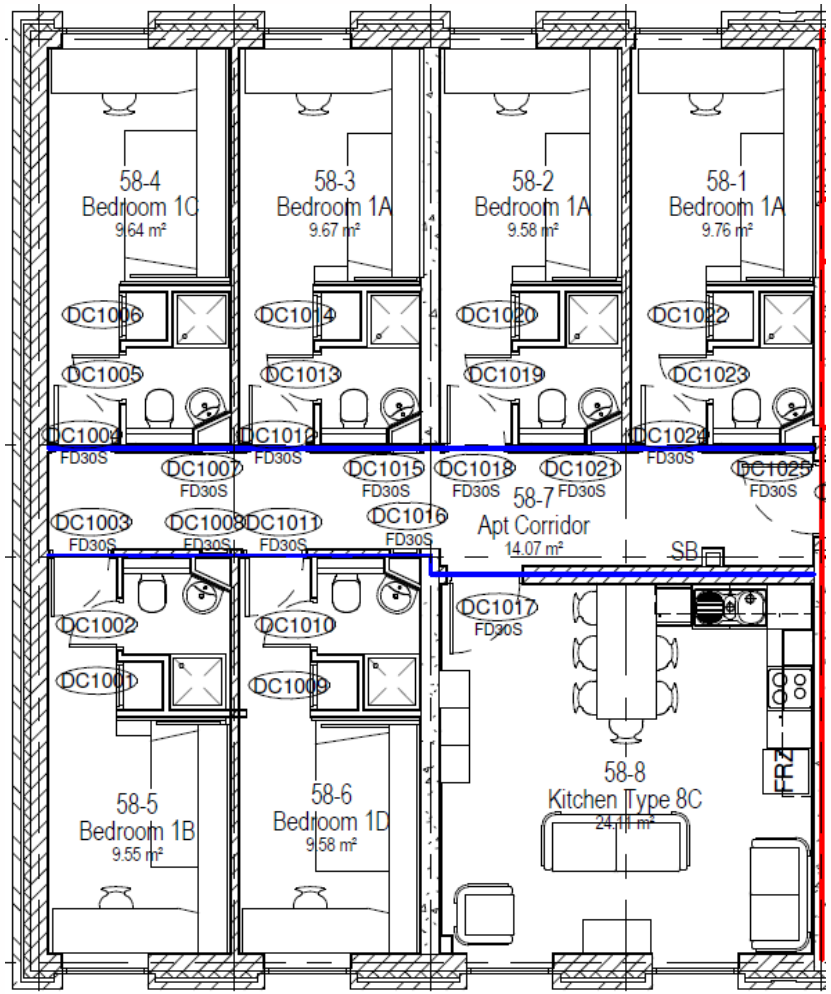
Methodology

It is envisaged that the final methodology will be adopted by the SEAI as the single method for measuring the carbon impact of all new and renovation projects in Ireland.

It will drive awareness that this is now being measured, and what gets measured gets managed, sending a signal up supply chains that lower carbon products will be preferred.

Construct Innovate
Built Environment Research Ireland

Case Study Building: Student Accommodation



- 429 bed spaces grouped in apartments of five or six bedrooms with shared kitchen, dining and living rooms.
- Four distinct buildings containing 4 storeys each.
- Total gross floor area of 12,801 m^2

Construct Innovate
Built Environment Research Ireland

Embodied Carbon Results: Sample data sheet

STUDENT APARTMENT BLOCK

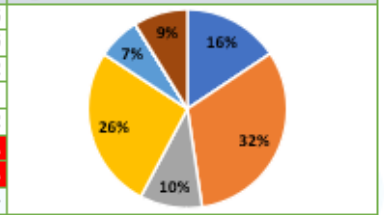
INDICATE

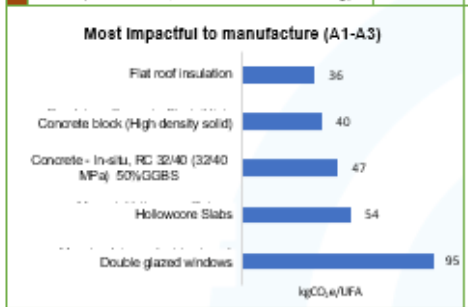
Building Information	
Sector	Residential
Type of Building	Apartment Building
Year of Completion	2018
Usable Floor Area (UFA)	12,801m²
Brief Description	Student apartments, complete and occupied.

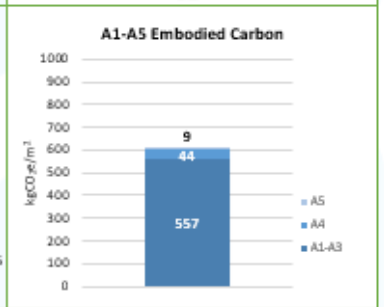
LCA Information			
Completeness of Level(s) scope	61%	Data Quality	66%

LCA Results

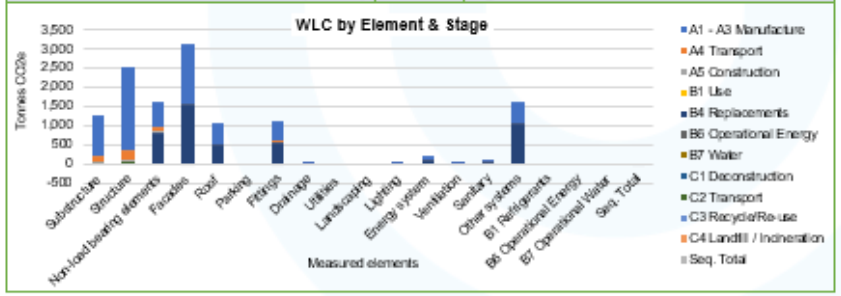
Upfront Carbon (A1-A5)	609	kgCO₂e/m²
Foundations (Substructure)	95	
Load bearing structural frame	195	
Non-load bearing elements	62	
Facades & Roof	161	
Fittings and furnishings	42	
Drainage Systems & Utilities	NDA	
Landscaping & Parking	NDA	
MEP (Mechanical, Electrical and Plumbing)	54	







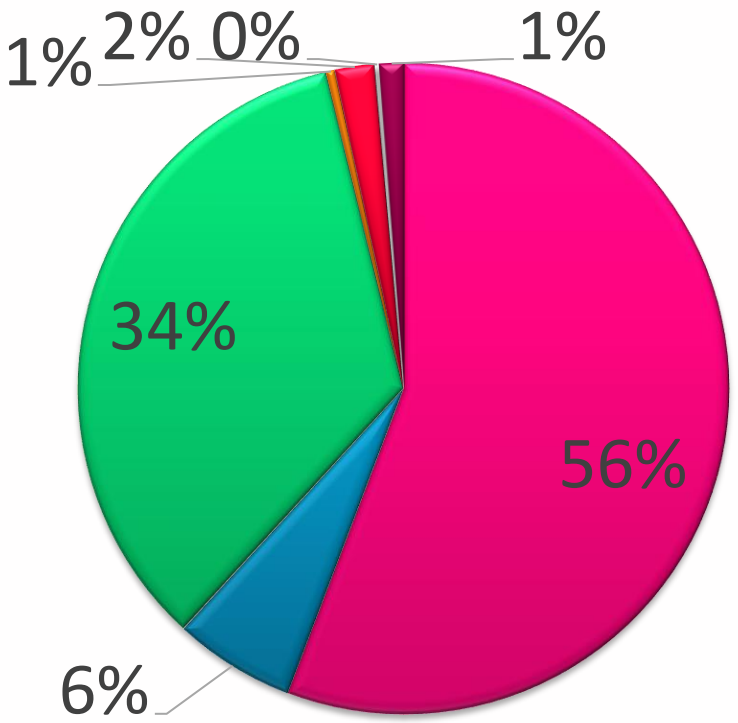
Whole-Life Embodied Carbon (WLEC)	991	kgCO₂e/m²



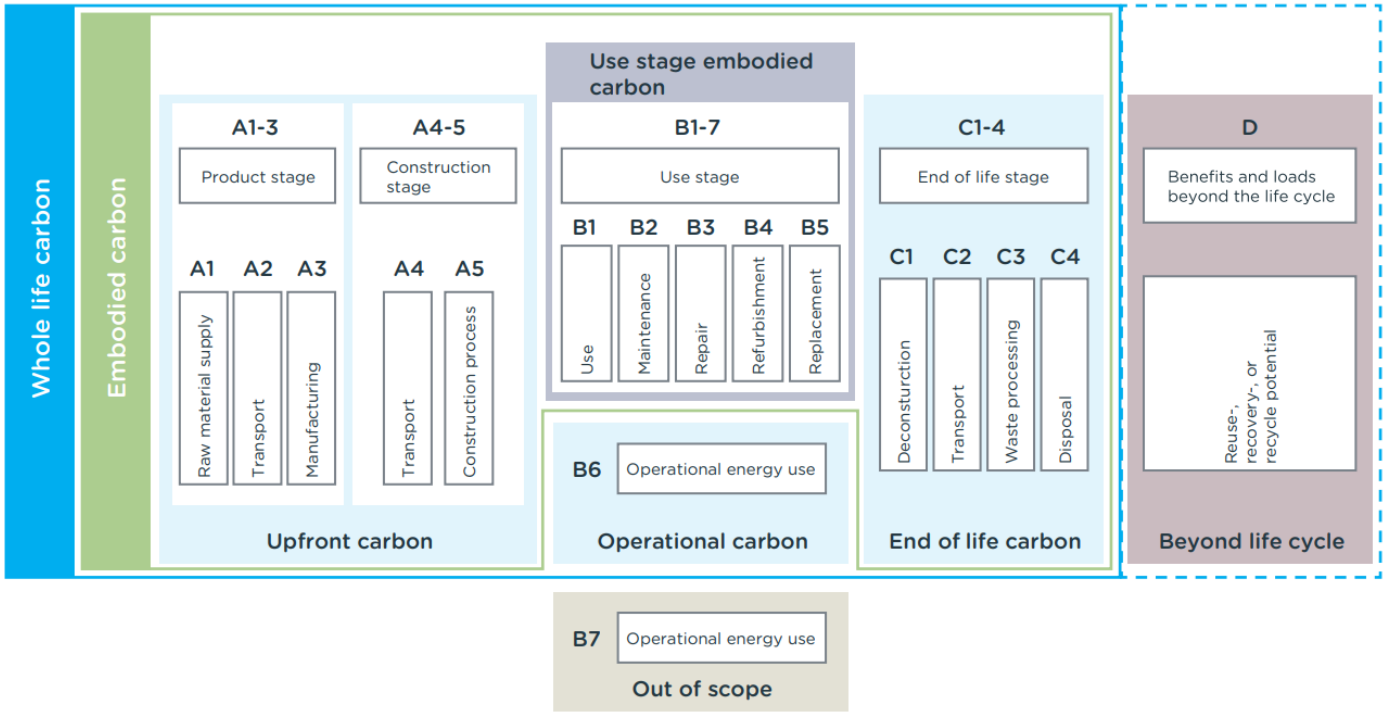
NDA: No data available.

Construct Innovate
Built Environment Research Ireland

Embodied Carbon Results: Student accommodation

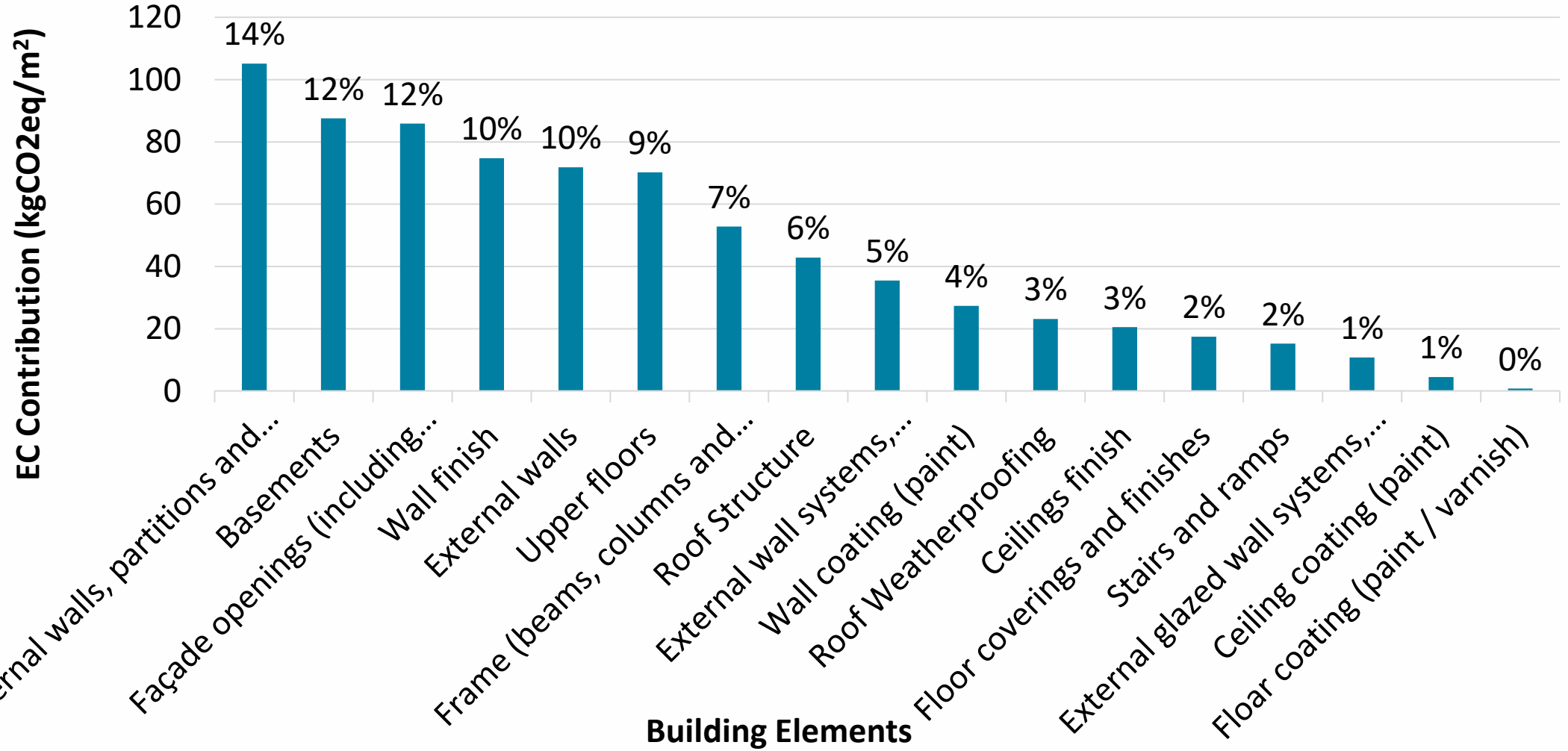


A1 - A3 A4 B4 C1 C2 C3 C4



Construct Innovate
Built Environment Research Ireland

Embodied Carbon Results: Student accommodation



Construct Innovate
Built Environment Research Ireland

Embodied Carbon Results: Sample data sheet

PRIMARY SCHOOL

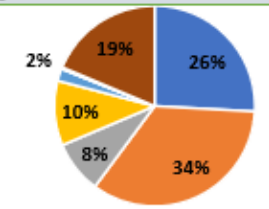
INDICATE

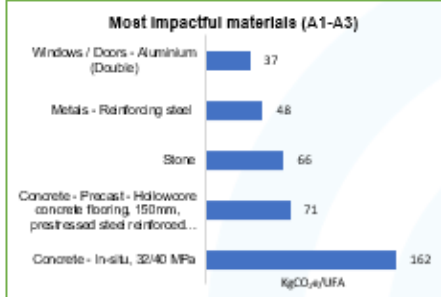
Building Information	
Sector	Non-residential
Type of Building	School
Year of Completion	2024
Usable Floor Area (UFA)	5,000m²
Brief Description	NDA.

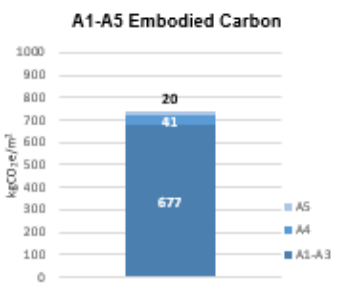
LCA Information			
Completeness of Level(s) scope	71%	Data Quality	47%

LCA Results

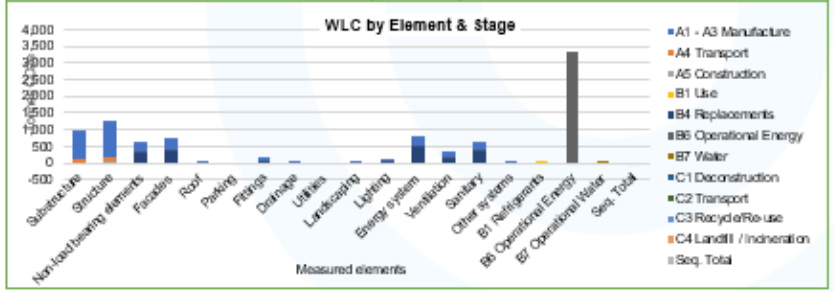
Upfront Carbon (A1-A5)	738	$kgCO_2e/m^2$
Foundations (Substructure)	191	
Load bearing structural frame	253	
Non-load bearing elements	62	
Facades & Roof	77	
Fittings and furnishings	15	
Drainage Systems & Utilities	NDA	
Landscaping & Parking	2	
MEP (Mechanical, Electrical and Plumbing)	138	







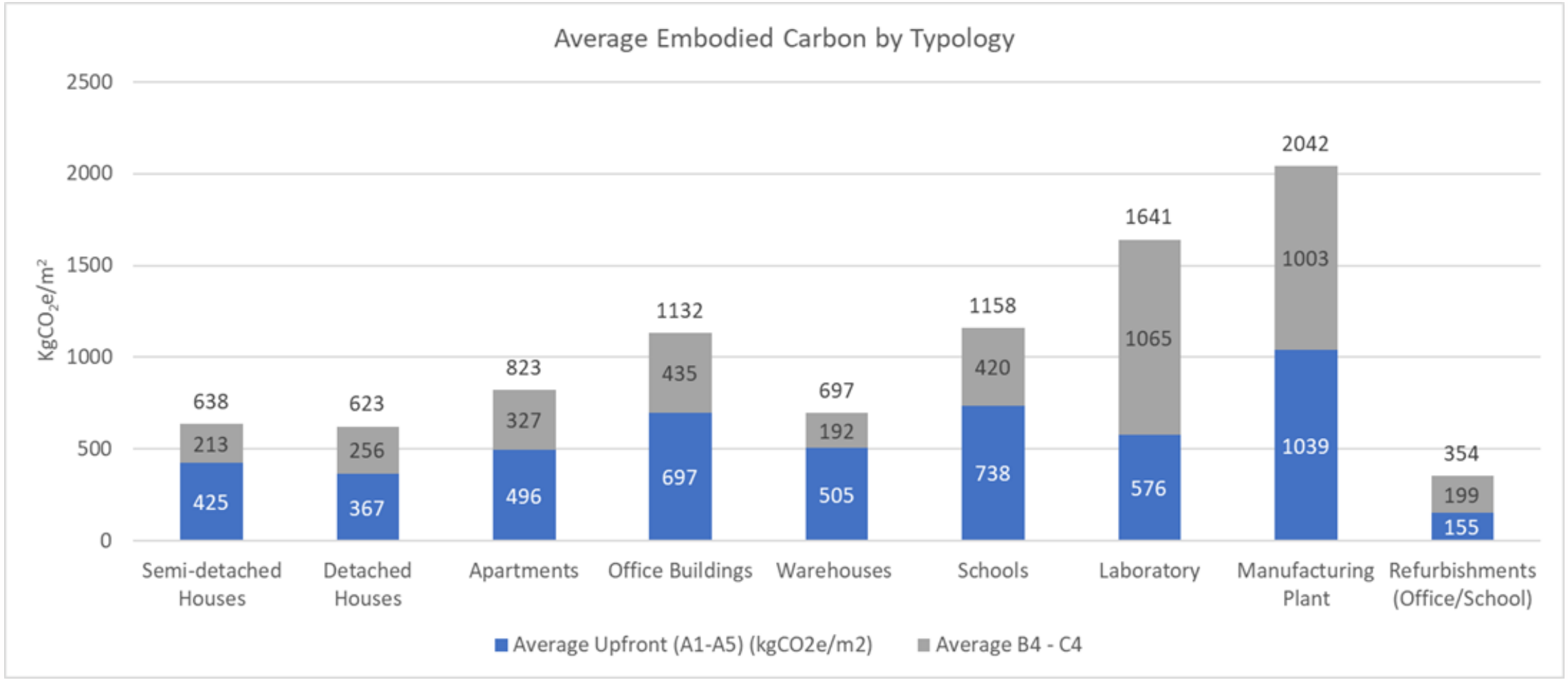
Whole-Life Embodied Carbon (WLEC)	1,158	$kgCO_2e/m^2$



NDA: No data available.

Construct Innovate
Built Environment Research Ireland

Embodied Carbon Results



Construct Innovate
Built Environment Research Ireland

Example of other initiatives in Construct Innovate

Construct Innovate Reports

Construct Innovate
Built Environment Research Ireland

Construct Innovate: Monitoring performance of buildings

Comhairle Cathrach na Gaillimhe
Galway City Council

LoRaWAN

Construct Innovate
Built Environment Research Ireland

Building Level	Room Level	Occupants
Heating Energy Consumption	Temperature	Socio-Demographics
Aggregated Electricity Consumption	Relative Humidity	
Appliance sub-metering	Carbon Dioxide	
Cooking sub-metering	Motion	
Lighting sub-metering	Brightness	
Renewable electricity		

150+ homes on real-time monitoring platform

Construct Innovate: Monitoring performance of buildings

LDA
Ghníomhaireacht Forbartha Talún
Land Development Agency

LoRaWAN

- **Building Level**
  - Heating Energy Consumption
  - Aggregated Electricity Consumption
  - Appliance sub-metering
  - Cooking sub-metering
  - Lighting sub-metering
  - Renewable electricity
- **Room Level**
  - Temperature
  - Relative Humidity
  - Carbon Dioxide
  - Motion
  - Brightness
- **Occupants**
  - Socio-Demographics

150+ homes on real-time monitoring platform

Construct Innovate
Built Environment Research Ireland

Research Programme – DHLGH projects

Project Name - Lead
Creation of standardised design details for MMC builds - open access to test data (Structure, Fire, Energy and Sound) to create Building Regulation-compliant standardised details for wall, floor and roof build-ups. → Dr Daniel McCrum
Durability of Dense Aggregate Concrete masonry units in Irish structures - Assessment of performance in future anticipated. → Prof. Alan O'Connor
A study to evaluate alternative methods of remediation of buildings damaged by defective concrete blocks. → Dr Myra Lydon
A study on the feasibility of indigenous test facilities to support testing of construction products and diagnosis of buildings affected to support standards development and compliance on-site (including MMC).. → Prof. Jamie Goggins & Dr Magdalena Hajdukiewicz
Ageing population and universal access – Building Regulations compliance assessment of UD Homes. → Dr Thomas Grey
Report into the Reuse of existing buildings (including traditional buildings). → Pat Barry
A study on the effectiveness of the Technical Guidance Document J (TGD J) provisions regarding the locations of flue outlets for solid fuel burning appliances and their effectiveness at preventing smoke particles re-entering the dwelling or neighbouring dwellings. → Dr John Gallagher

Research Programme – industry led

Industry Led Research Programmes

AIMday®

Academic Industry Meeting Day is a workshop model where 'challenge questions' (problems!) from industry are discussed with academic researchers from relevant university disciplines.

Thematic Working groups formed by stakeholders e.g. RPOs, Industry Members, Universities, Professional Bodies, Government Agencies, etc.

First Member - Led Working Groups

1. Sustainable Concrete and Cements
2. Modern Methods of Construction (MMC)
3. Mass Timber Construction
4. Materials & Technology Testing
5. Innovative Materials & Technology Adoption
6. Whole Lifecycle Carbon (WLC) Accounting
7. Lean Construction & Digital Tools
8. Socioeconomic analysis of sustainable construction
9. Overheating in Irish Dwellings

Research Programme – industry led

Industry Led Research Programmes

- Construct Innovate announced its very first Seed Fund call on 2nd October 2023.
- The Seed Fund call aimed to promote collaborative, impactful projects, initiated by industry that can support organisations in the Irish construction sector with their organisational and sectoral challenges and opportunities for innovation through research.
- The Seed Fund was open to Construct Innovate members only and for projects up to €50,000.

Skills and Training: Construct Innovate Webinars Series

(recordings available)

- **Sustainability planning in construction**
  - Sustainability Planning (19th September 2023)
  - Retrofitting Our Buildings (26th September 2023)
  - Passive House Design (3rd October 2023)
  - Design and Operation of Façade Systems (10th October 2023)
  - Sustainable Transport (17th October 2023)
  - Circular Economy (24th October 2023)
  - Heritage, Culture, Communities and Sustainability (31st October 2023)

- **Digital construction technologies**
  - Digital Adoption in the Construction Industry (7th November 2023)
  - Digital Platforms (14th November 2023)
  - Artificial Intelligence, Virtual and Augmented Reality and 3D Scanning (21st November 2023)
  - Digital Project Delivery (28th November 2023)
  - Simulation for Better Performance (5th December 2023)
  - Digital Buildings and Communities (12th December 2023)

Construct Innovate
Built Environment Research Ireland

- **Modern Methods of Construction (MMC)**
  - Introduction to MMC (16th January 2024)
  - Designing homes for MMC (23rd January 2024)
  - Housing for All delivery: The perspective from light-gauge steel MMC manufacturers (30th January 2024)
  - Design considerations for MMC (6th February 2024)
  - Housing for All delivery: The perspective from timber MMC manufacturers (13th February 2024)
  - Housing for All delivery: The perspective from concrete MMC manufacturers (20th February 2024)
  - MMC case studies from water and wastewater industry (27th February 2024)
  - MMC applications in schools and commercial buildings (5th Mar 24)
  - MMC: offsite manufacture to onsite construction (12th March 2024)

- **Innovation & Entrepreneurship**
  - Innovation in the construction sector (19th March 2024)
  - Innovation & entrepreneurship as a concept (26th March 2024)
  - Innovation case studies (2nd April 2024)
  - Innovation strategies in the construction and built environment (9th April 2024)
  - R&D tax incentives and credits (16th April 2024)
  - Investment opportunities to allow my company to innovate (23rd April 2024)

Skills and Training: Postgraduate Diploma

Postgraduate Diploma

Ollscoil na Gaillimhe
University of Galway

- Postgraduate Diploma in Construction Innovation
- One Year Part-time course
- Hybrid delivery
- 90% Fee funded through HCI Pillar 1
- Year 1 started September 2023
- Aims to equip participants with key knowledge and skills needed to develop sustainable technology solutions to the challenges facing the construction and built environment sector in Ireland and elsewhere

- https://www.universityofgalway.ie/courses/taught-postgraduate-courses/construction-innovation.html

Skills and Training: Work Ready Graduate Programme

Construct Innovate

Graduate Development Programme

To be launched in September 2024, the programme aims to:

- Provide current and relevant training and industrial experience to recent graduates thus upskilling them to current industry market requirements
- Link these individuals with suitable companies with whom they can work on research projects
- Provide a new pool of industry relevant RDI individuals that can ‘hit the ground running’ in SMEs and address the skills and absorptive capacity gaps that are prevalent in companies

Construct Innovate
Built Environment Research Ireland

Ireland's National Research Centre for Construction Technology and Innovation

Making Ireland a global research and innovation leader for sustainable construction and built environment technology

www.constructinnovate.ie

Ollscoil na Gaillimhe University of Galway
Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin
UCD Dublin
UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh
IGBC Irish Green Building Council
DTU Dublin
ATU
SETU Ollscoil Teicneolaíochta an Oirdheiscirt South East Technological University
Technology Centre Enterprise Ireland IDA Ireland Supported