



# C Change Summit 2024

Presentation

**Embodied Carbon:**

**The next step in decarbonising  
real estate**

Auditorium



# Welcome and Introductions



**Aleks Smith-Kozłowska**

Director, Research  
Urban Land Institute



**Clemens Brenninkmeijer**

Head of Sustainability  
Redevco



**Arjan Dingste**

Partner/Senior Architect, Lead  
Digital Innovation Global & Lead  
Sustainability Innovation Global  
UNStudio



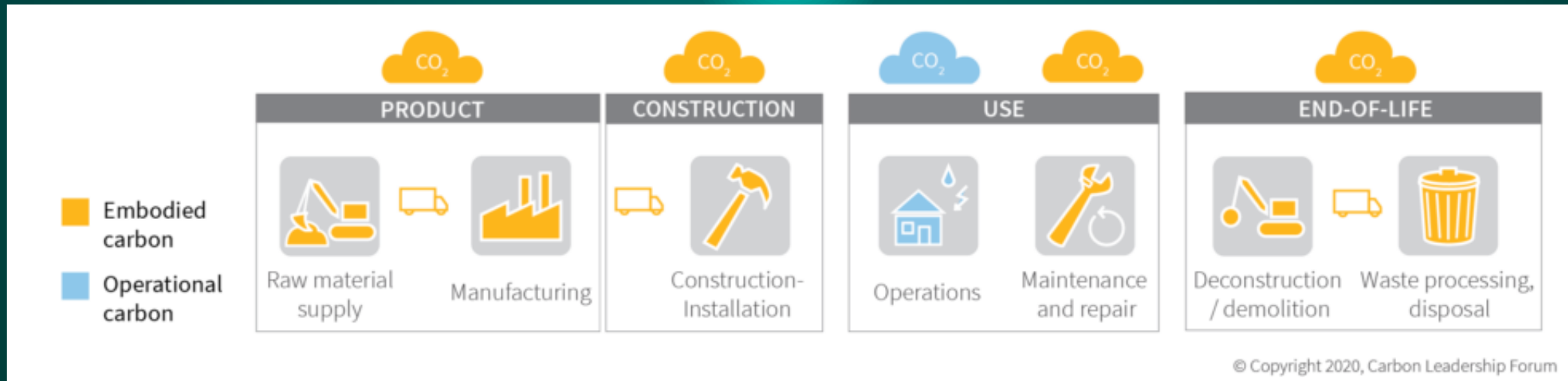
**Andrew Minson**

Director Concrete and  
Sustainable Construction  
Global Cement and Concrete  
Association

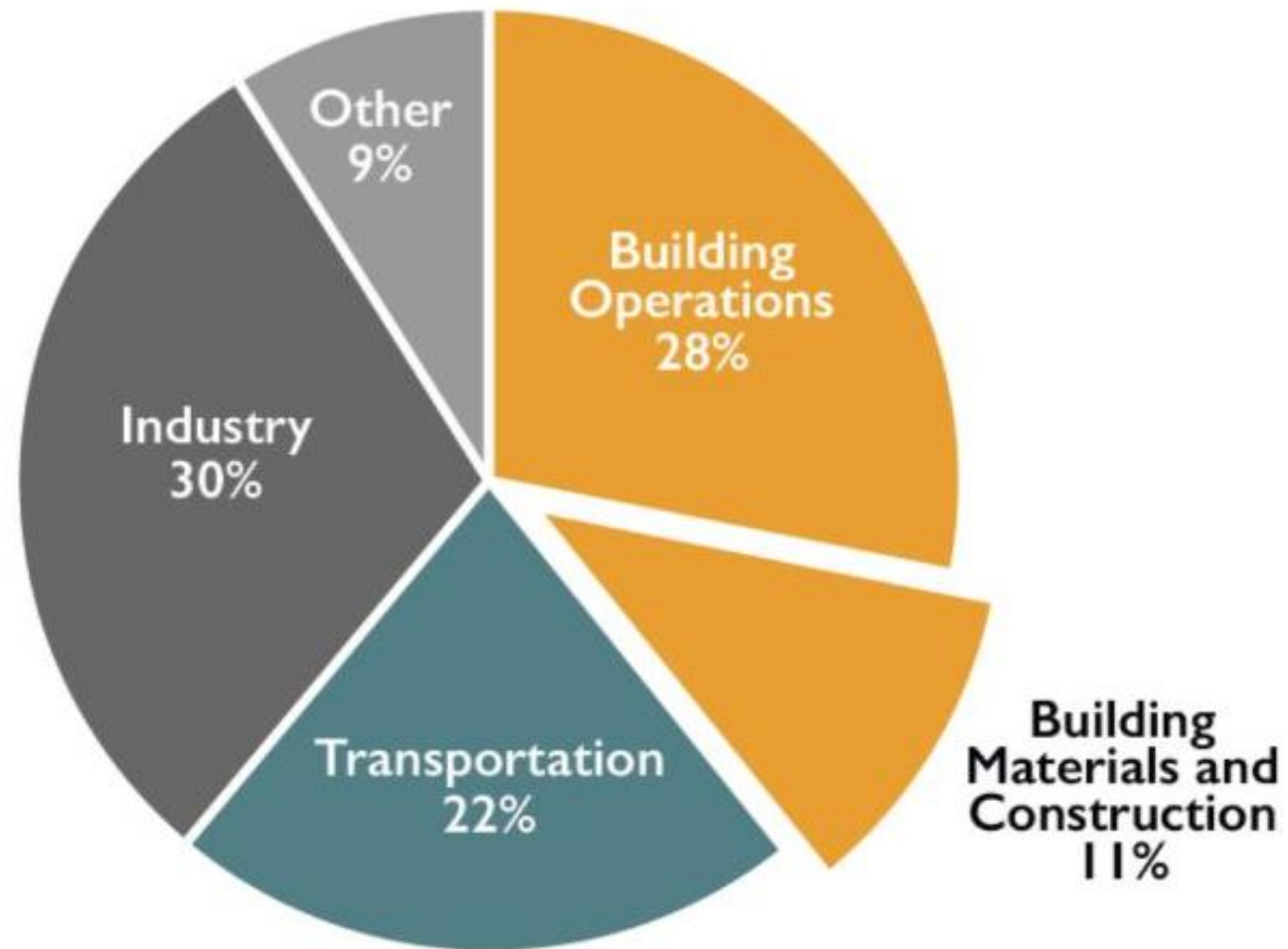
# Quick Definitions

## Embodied carbon:

The greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials.



## Global CO<sub>2</sub> Emissions by Sector



Source: © 2018 2030, Inc. / Architecture 2030. All Rights Reserved. Data Sources: UN Environment Global Status Report 2017; EIA International Energy Outlook 2017

# Embodied vs. Operational

Carbon Emissions from New Construction (U.S.)  
2022 - 2060 Business as Usual Projection

kgCO<sub>2e</sub>  
/m<sup>2</sup>/yr

- Embodied Carbon (Core & Shell)
- Embodied Carbon (Interiors)
- Operational Carbon

Operational Carbon  
(~50% of Total)

Embodied Carbon  
(Interiors)  
(~25% of Total)

Embodied Carbon  
(Core & Shell)  
(~25% of Total)

2020 2025 2030 2035 2040 2045 2050 2055 2060

-37 Years

Sources: U.S. Department of Energy, EIA, Annual Energy Outlook 2020. RESET Project Data.



GIGA © 2022

# Relevant ULI Resources



**The Materials Movement:  
Creating Value with Better  
Building Materials**

[uli.org/materialsmovement](https://uli.org/materialsmovement)



**Carbon Sweet Spot:  
Design Tradeoffs for Embodied and  
Operational Carbon in New Buildings**

[uli.org/carbonsweetspot](https://uli.org/carbonsweetspot)

**Change**

# Drivers of the Materials Movement



Regulations



Green Building  
Certifications



Occupier  
Demand



Enhanced Building  
Value



ESG Investing  
Requirements

# Strategies

Company policies and commitments



Reuse and repurpose

Prioritize material efficiency

Specify and procure  
better products

Minimize waste



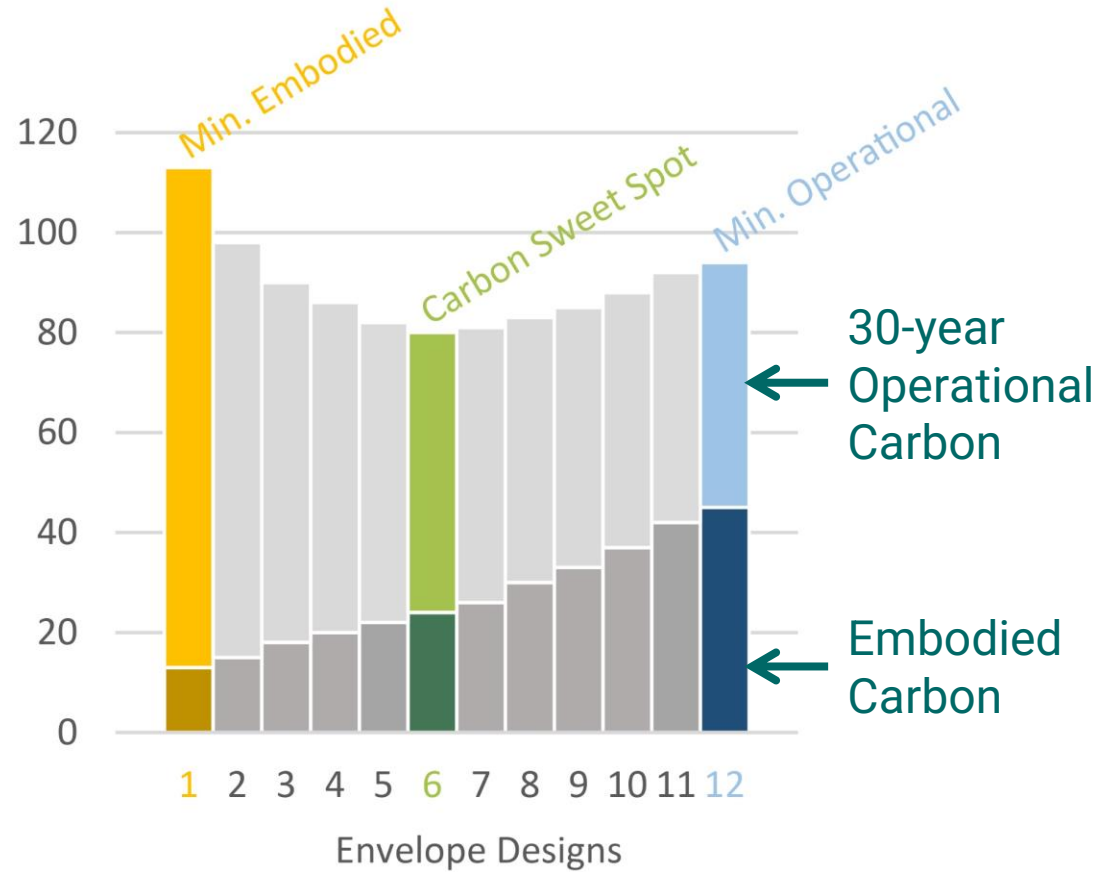
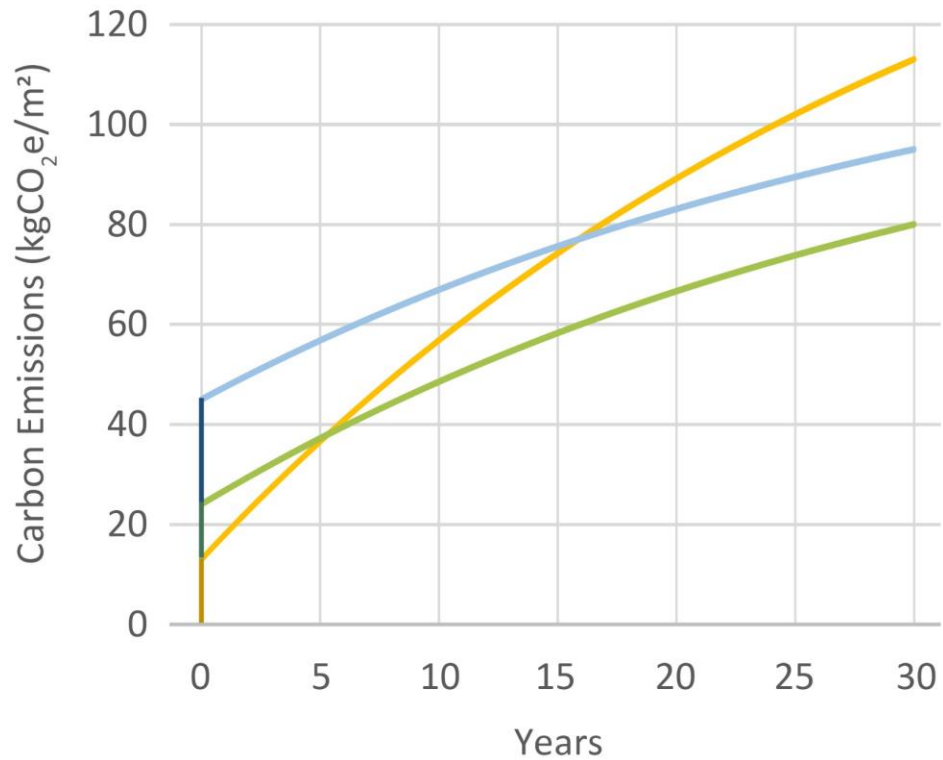
# Case Study – Holbein Gardens



- 1980s Office Building  
Adaptive reuse by Grosvenor
- Retained the brick façade and the concrete structure
- New brickwork designed for disassembly (lime mortar)
- Used 24 tonnes of reclaimed steel
- Cemfree concrete and CLT

Holbein Gardens adaptive reuse project before (left) and after (right)

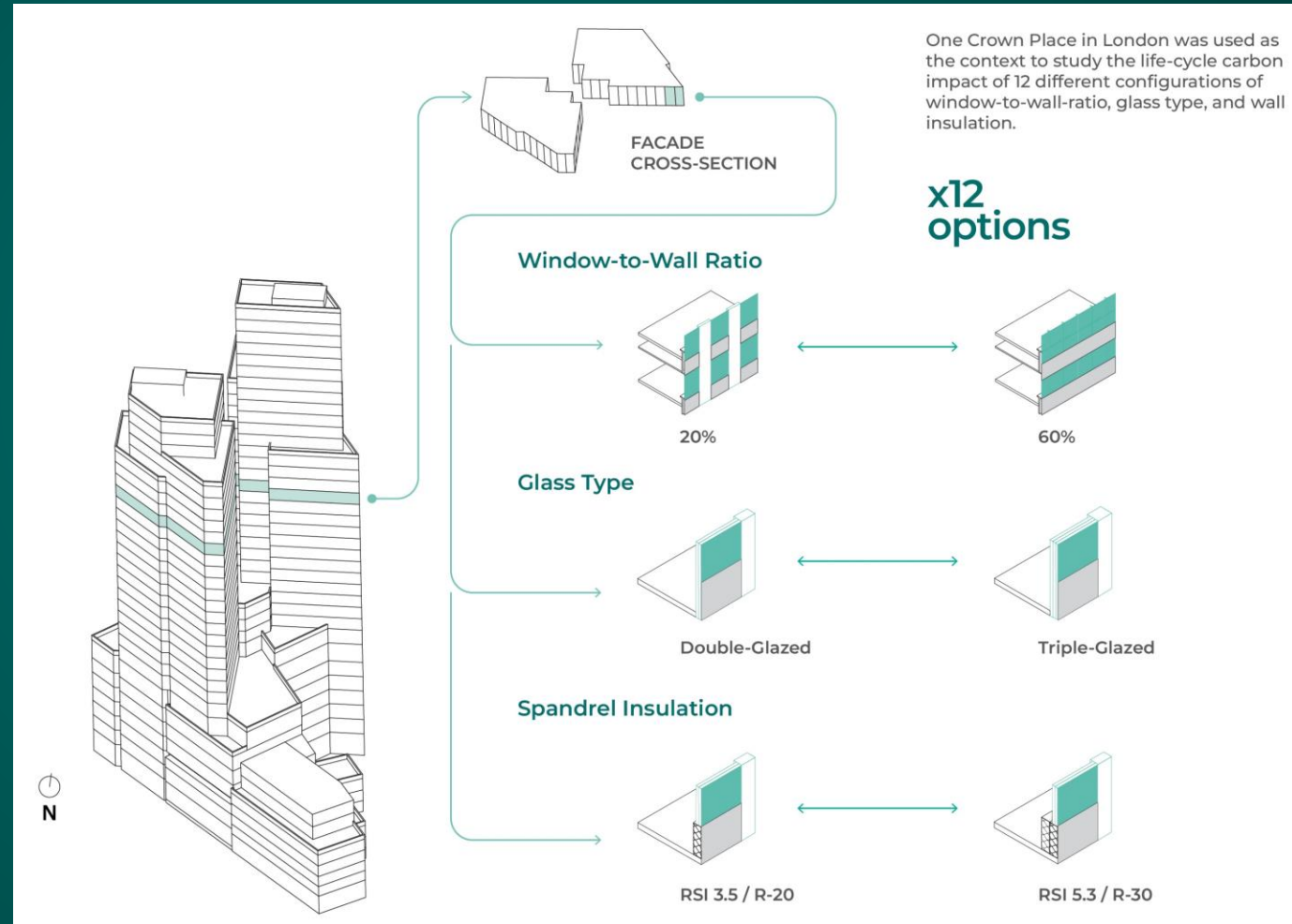
# The “Carbon Sweet Spot”



# Carbon Sweet Spot Analysis Scope

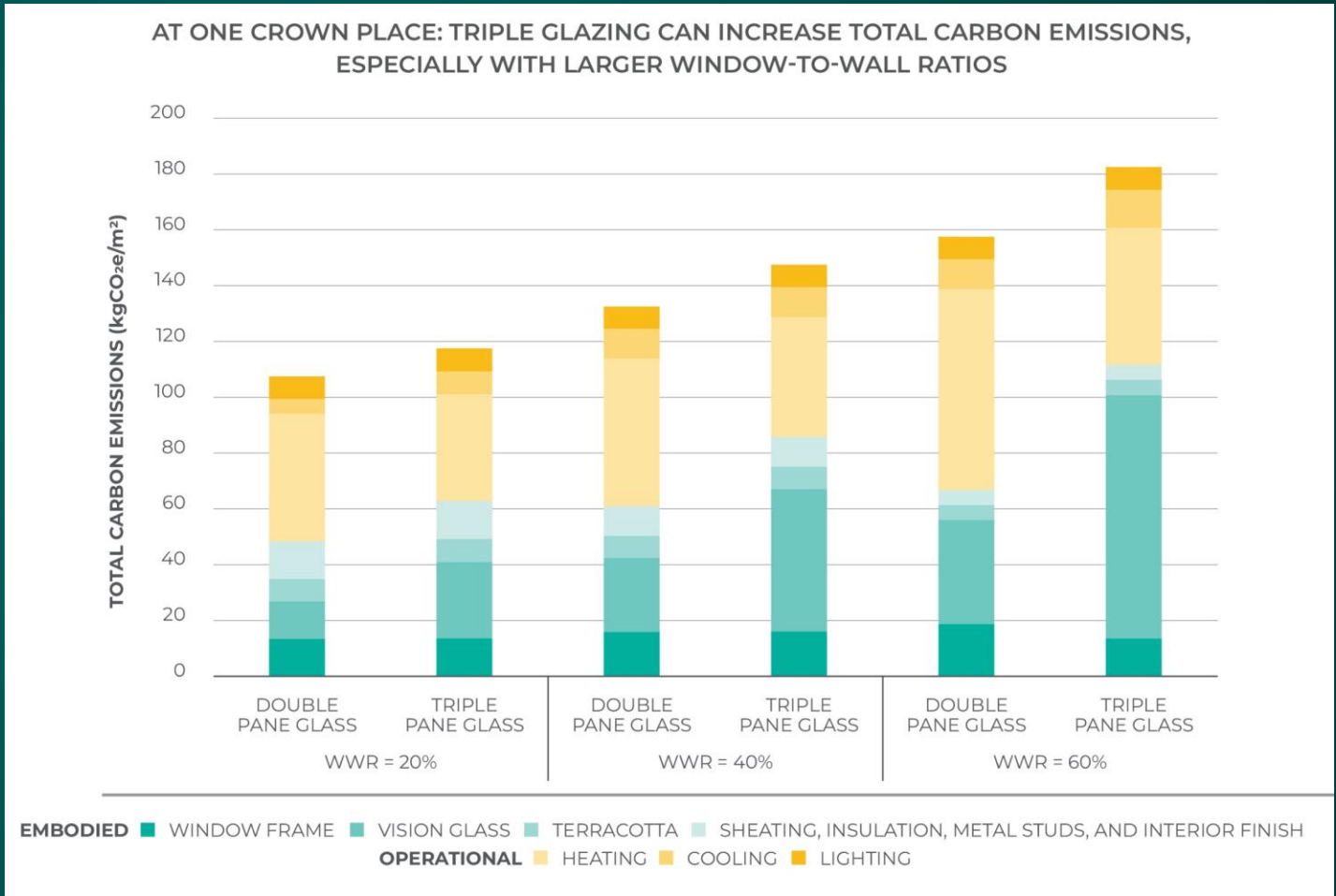


- Facade Parameters Studied:
1. Window-to-wall ratio
  2. Glazing Type
  3. Wall insulation



# Findings – One Crown Place, London

- Window-to-wall ratios (WWR) significantly affected carbon emissions – more so than glazing type
- Triple glazing resulted in more embodied carbon emissions than it saved in operational
- Wall insulation thickness made only a marginal difference to total carbon emissions



# Carbon Sweet Spot - Conclusions

- Consider both operational and embodied carbon when assessing environmental impact of buildings – look for the "**carbon sweet spot**"
- Understand the impact of **local fuel sources** and **decarbonization policy** on tradeoffs
- Read the full report at [uli.org/CarbonSweetSpot](https://uli.org/CarbonSweetSpot)

**cChange**

**UnS**

**UNSTUDIO**

**AMSTERDAM**

**AUSTIN • DUBAI • FRANKFURT**

**HONG KONG • MELBOURNE • SHANGHAI**



born in amsterdam

designing over 35 years since 1989





active in 58 countries

with over 450 passionate employees

we create enhanced connections



in and between cities, buildings and their inhabitants

that have a lasting impact!



# Fighting Embodied Carbon

ULI C-Change Conference

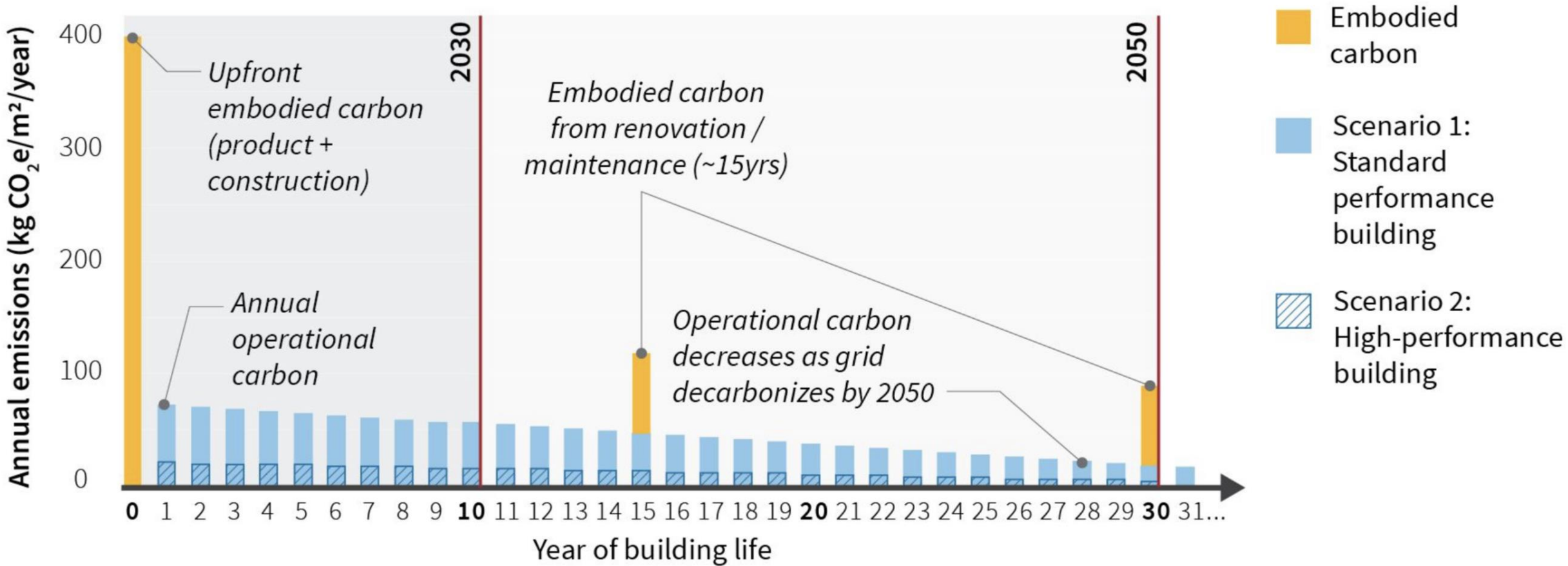
UNSTUDIO



UNSTUDIO

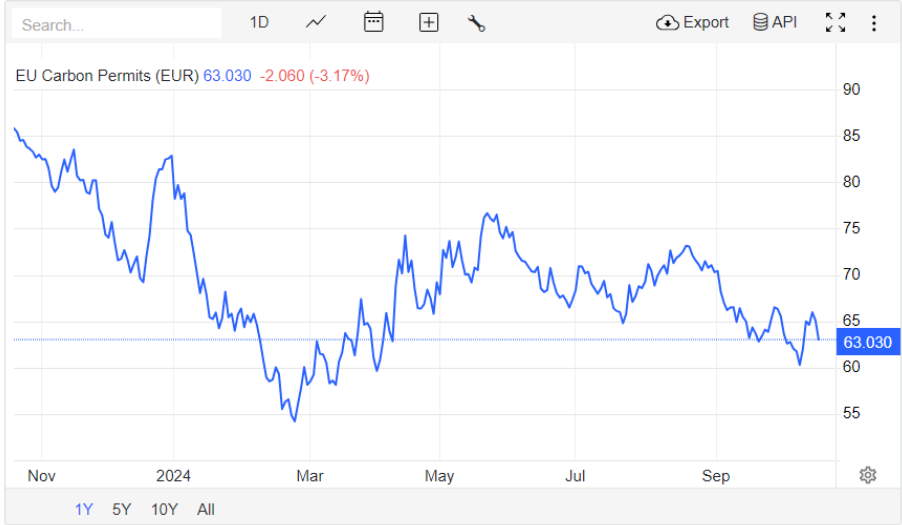
UNSTUDIO

# A Whole Life Carbon Approach

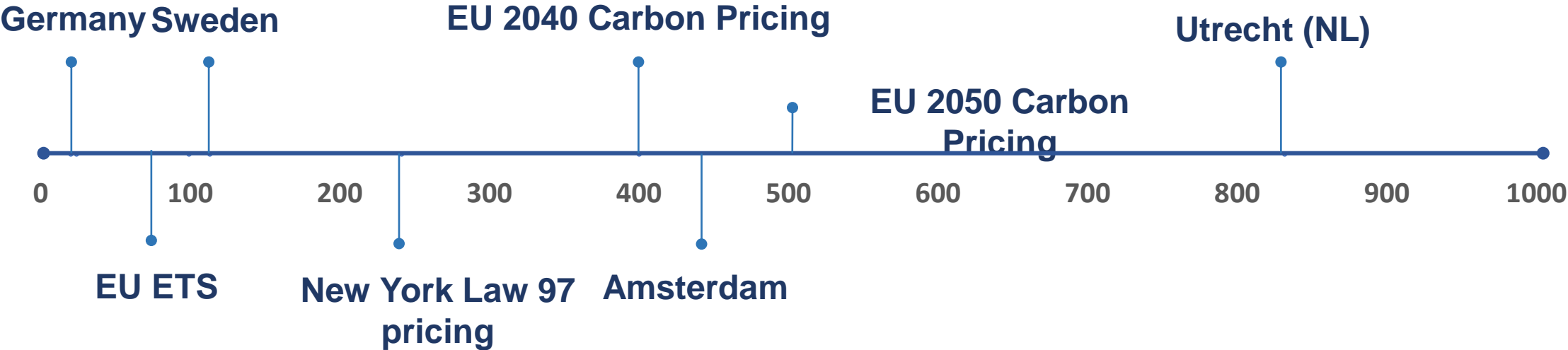


Source : <https://bellona.org/news/climate-change/2023-01-embodied-carbon-101>

# Different Values for Carbon Pricing



## Pricing in € / ton





# Booking.com HQ | BPD

Netherlands, Amsterdam, Mixed-use, 72.500 m2, BREEAM Excelent



# Focus on Human Health & Wellbeing



MATERIALS



AIR



WATER



SOUND



LIGHT



NOURISHMENT



COMMUNITY



MIND

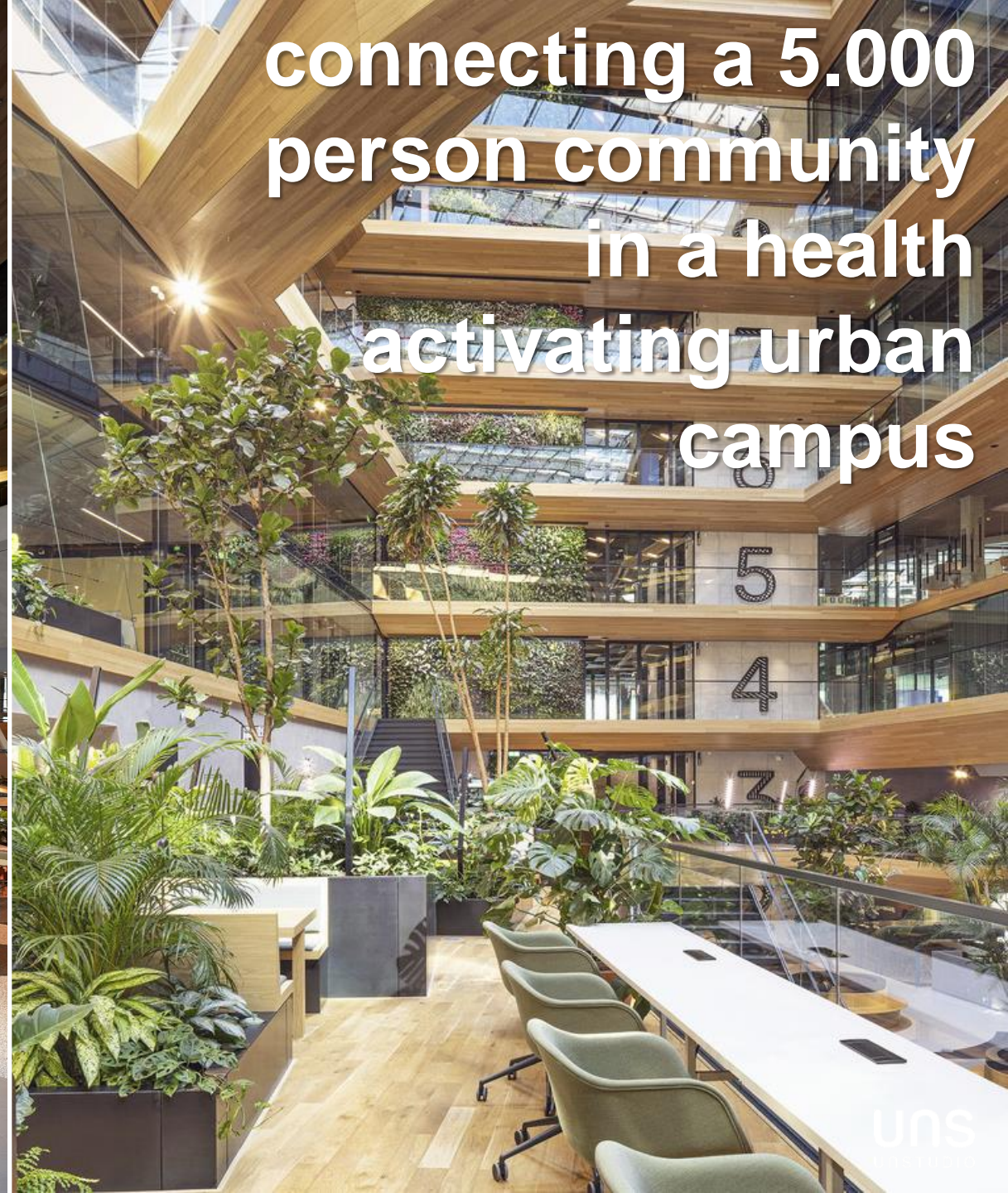


THERMAL COMFORT



MOVEMENT





connecting a 5.000  
person community  
in a health  
activating urban  
campus

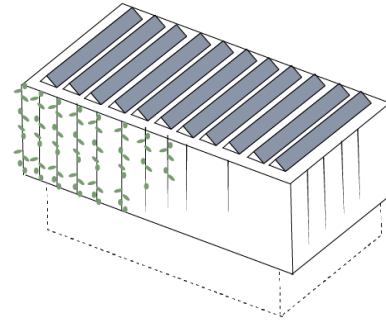
net zero energy &  
human health  
focused design




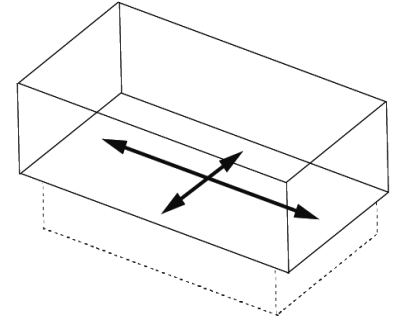
Prix Versailles 2023 winner 'worlds  
most beautiful campus building'

Architizer A+Awards – Voter's Choice -  
Sustainable Cultural/Institutional Building'

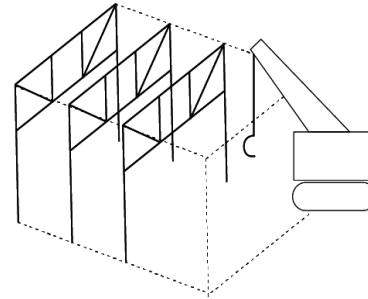
parametrically designed  
for future flexibility and  
end-of-life disassembly



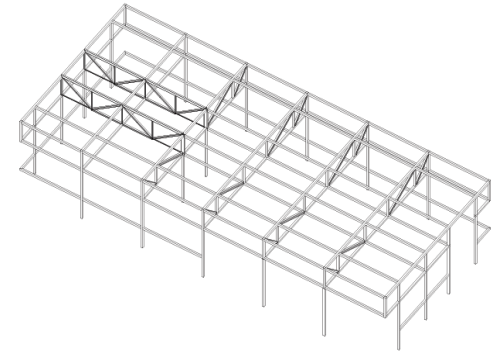
 Green Façade & Energy Roof




 Large Spans for Future Flexibility



 Design For Disassembly



 Parametrically optimized to minimize steel usage

# UNStudio. Tools.

The Platform for development  
of in-house tools for UNStudio

## The AI

PASCAL is the AI Ecosystem for UNStudio. Discover ChatUNS, Imaginarium Creator, Prompt Library, and The Vision—each crafted to streamline our tasks while ensuring utmost security and privacy. Our ecosystem leverages the latest technologies, providing a seamless, safe, and personalized experience.



Early Release [Go to PASCAL](#) →



## The Docs

The Documentation platform for every tool.

Pre-Release [Go to The Docs](#) →



## Modelspace

The online archive of UNStudio Models.

Pre-Release [Go to Modelspace](#) →



## Het Blog!

Updates, inspiration and maybe News

[Go to Het Blog!](#) →



## UNSHub

Explore, collaborate, and drive Research & Innovation

In Production [Go to UNSHub](#) →

UNStudio.Tools is an innovative platform designed exclusively for UNStudio's development of in-house tools. With a wide range of cutting-edge technologies like AI and Carbon Builder, it empowers our architects and designers to create groundbreaking solutions.



## The Carbon Builder

The Framework for Early Stage Carbon Calculation-

[Go to The Carbon Builder](#) →



## Concept Canvas

The platform for the Conceptual Design Process.

[Go to Concept Canvas](#) →



New Chat

The Blueprints

Recent Conversations

July '24

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Uniek Ontsluitingsprincipes for a Vibr

Aanpak voor duurzaam onderwijsgeb

Comprehensive Project Introduction

Process Optimization in Design Phase

Convincing University for Pitch with C

Ju '24

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Verticaal Verbonden Ruimtelijk Lands

Scoring Scenarios Excel Sheet based c

Redesigning Het Voorplein for a Sean

Strategic Plan to Convince Utrecht Ur

Integrated Design and Management

Promoting Health and Well-being in

Enhancing Biodiversity on the UU-Car

Sustainable Renovation Plan for Uniel

OpenUNS 1 Smart, Fast and Flexible Flagship Model

Tone Default: This tone aims for a balance...

Tools Select what tools you want to enhance...



how does the building of the future look like



The building of the future is envisioned to be a harmonious blend of advanced technology, sustainability, and human-centric design. Here are some key features and concepts that are likely to define future buildings:

1. Sustainability

- **Energy Efficiency:** Buildings will incorporate renewable energy sources such as solar panels, wind turbines, and geothermal systems. Energy-efficient designs will minimize consumption through advanced insulation, smart windows, and energy recovery systems.
- **Green Materials:** Use of sustainable, recycled, and locally sourced materials will be prioritized to reduce the carbon footprint.
- **Water Management:** Rainwater harvesting, greywater recycling, and efficient plumbing systems will be standard to conserve water.

2. Smart Technology

- **IoT Integration:** Internet of Things (IoT) devices will be embedded throughout buildings to monitor and control lighting, heating, cooling, and security systems, enhancing efficiency and comfort.
- **Automation:** Smart home and office automation systems will allow for personalized environments, adjusting settings based on occupancy and user preferences.
- **Data Analytics:** Real-time data collection and analysis will optimize building performance and maintenance.

3. Human-Centric Design

- **Well-being:** Design will focus on the physical and mental well-being of occupants, incorporating natural light, ventilation, and biophilic elements like indoor plants and green walls.
- **Flexibility:** Spaces will be adaptable to different uses, with movable walls and modular furniture to accommodate changing needs.
- **Accessibility:** Inclusive design principles will ensure that buildings are accessible to people of all abilities.

4. Resilience

- **Climate Adaptation:** Building design will consider sea level rise and extreme weather conditions and natural disasters, utilizing resilient materials and structural

Regenerate response



Send a message.



# Embodied Carbon Reduction

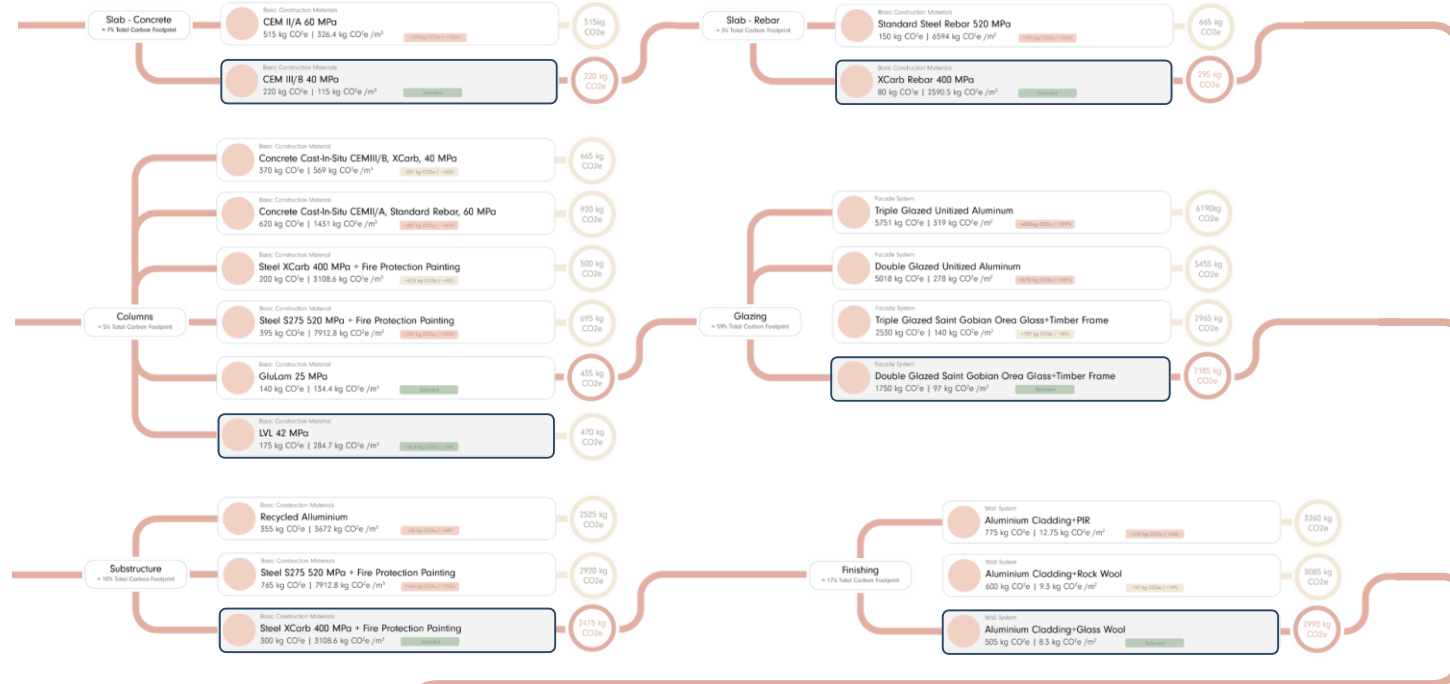
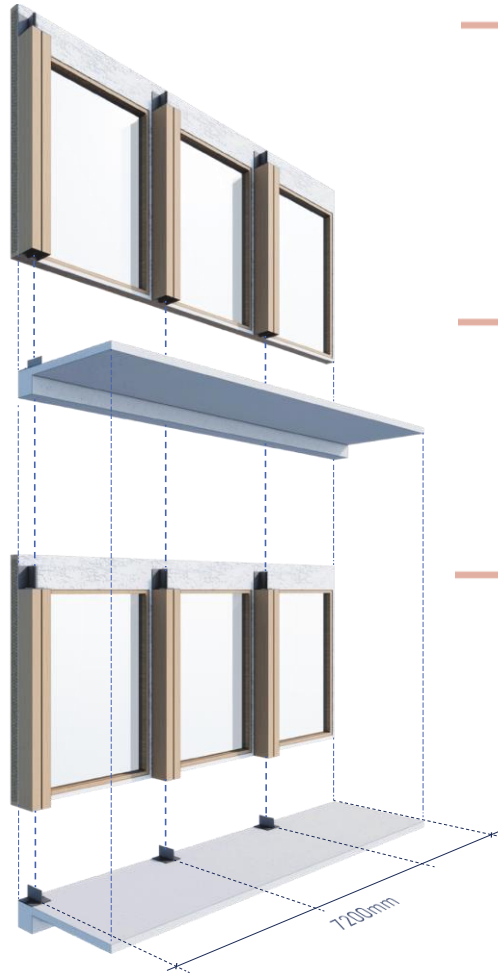


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## THE CARBON STORY

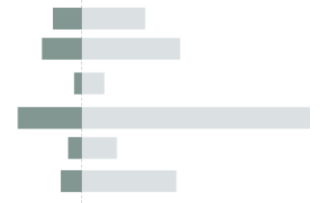
*EARLY DESIGN CARBON CALCULATION*

# Embodied Carbon Reduction: Carbonbuilder



Total Carbon:  
**2980 kg CO2e**

Total Carbon:  
**8550 kg CO2e**



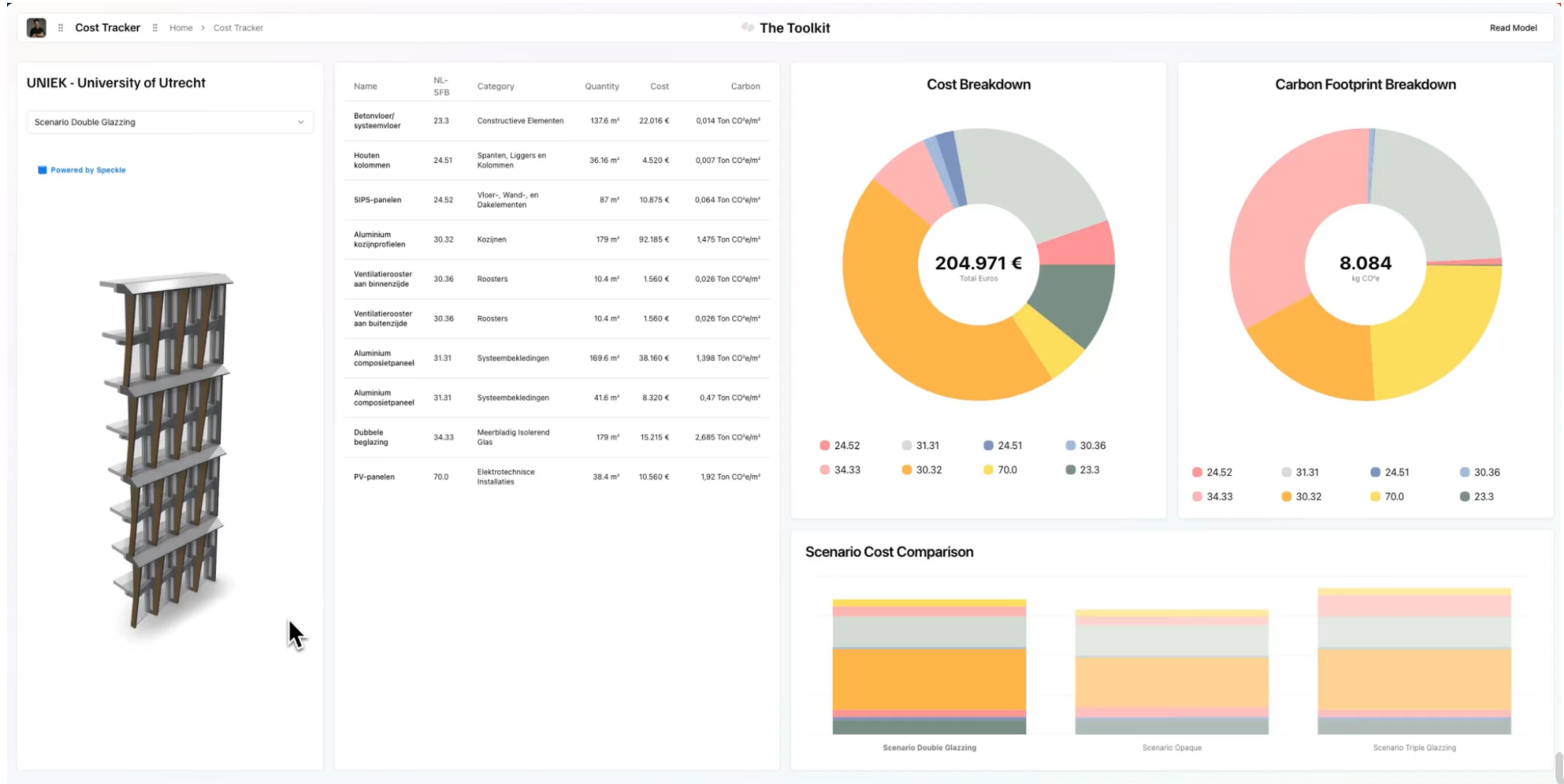
The Selected Roadmap reduces 65% the Carbon Impact in comparison with the Highest Intensity Option

Construction System	Name	Carbon Per Unit	Quantity	Total Carbon (ton CO2e)	Accumulated Carbon
Slab - Concrete	CEM III/B 40 MPa	115	1.894 m <sup>3</sup>	220	220
Slab - Rebar	XCarb Rebar 400 MPa	2590	0.030 m <sup>3</sup>	80	295
Columns	GluLam 25 MPa	135	1.044 m <sup>3</sup>	140	435
Glass	Double Glazed Saint Gobian Orea Glass+Timber Frame	97	18.02 m <sup>2</sup>	1750	2185
Substructure	Steel XCarb 400 MPa + Fire Protection Painting	3110	0.097 m <sup>3</sup>	300	2485
Finishing	Aluminium Cladding+Rock Wool	8.3	60.74 m <sup>2</sup>	505	2990

Selected Roadmap

The selected roadmap reduces the embodied carbon by 65% compared to standard material usage.

# Embodied Carbon Reduction: Carbon Cost analysis





# Method: Carbon Quantity aggregation

	C	D	E	F	G	H	I	J	K	L
	Omschrijving	Description	MT	Eh	Units	Hoew bezeld	ACTIONS	Comm	Carbon Builder?	ASSEMBLY
	HOOFDSTUK A - VOORBEREIDENDE VERKEN & ALGEMEENHEDEN	CHAPTER A - PREPARATORY WORKS & GENERALITIES								
	Inrichting bouwplaats, verloop der werken, voorbereidende werken en algemeenheden	Construction site setup, progress of works, preparatory works, and generalities								
	Hekken	Fencing	VH	Im		320.50	NEEDS ASSEMBLY		YES	FENCING
	Veiligheidsvoorschriften	Safety regulations								
	Verzekering	Insurance								
	Oplevering	Handover								
	Uitvoeringsplan, technische fiches en stalen	Execution plan, technical data sheets, and samples								
	HOOFDSTUK B - RIOLERING	CHAPTER B - SEWAGE								
	Rioleringsbuizen	Sewer pipes								
	Riolering regenwater	Stormwater drainage								
	Ø 110	Ø 110	VH	Im		45.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 110
	Ø 160	Ø 160	VH	Im		40.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 160
	Ø 200	Ø 200	VH	Im		55.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 200
	Ø 250	Ø 250	VH	Im		120.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 250
	Riolering DVA/AFVA	Sewage DVA/AFVA								
	Ø 110	Ø 110	VH	Im		160.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 110
	Ø 125	Ø 125	VH	Im		0.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 125
	Ø 160	Ø 160	VH	Im		65.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 160
	Trekbuizen	Conduit pipes								
	Kabelles trekbuizen Ø 160 SN 8	Kabelles conduit pipes Ø 160 SN 8	VH	Im		20.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 160
	Kabelles trekbuizen Ø 100 SN 8	Kabelles conduit pipes Ø 100 SN 8	VH	Im		20.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 100
	Vaste PVC trekbuizen Ø 200 SN 8	Solid PVC conduit pipes Ø 200 SN 8	VH	Im		20.00	EDS MATERIAL - GEOMETRY		YES	PIPE Ø 200
	Vaste PVC trekbuizen Ø 160 SN 8	Solid PVC conduit pipes Ø 160 SN 8	VH	Im		20.00	EDS MATERIAL - GEOMETRY		YES	PIPE Ø 160
	Trekputten (OPTIE)	Inspection chambers (OPTION)								
	Aansluiting op vastificering van lot infra	Connection to the provisional sewerage of the lot								
	Keuring rioleringsnet + as-built plan	Sewer network inspection + as-built plan								
	HOOFDSTUK C - GRAAFWERK	CHAPTER C - EXCAVATION								
	Grond- en delwerken	Ground and excavation works								
	Aanvullingen met trekzand	Backfilling with crushed sand								
	HOOFDSTUK D - PREFAB BETONVANDEN	CHAPTER D - PREFAB CONCRETE WALLS								
	Geïsoleerde betonnen gevelpanelen afwerking natuurlijk beton kleur	Insulated concrete facade panels finish natural concrete color								
	Geïsoleerde betonnen gevelpanelen dikte 30cm - binnenwand 14cm - PIR 10cm - buitenwand 6cm - index 1b	Insulated concrete facade panels thickness 30cm - inner wall 14cm - PIR 10cm - outer wall 6cm - index 1b	SOG	m2		1057.54	NEEDS ASSEMBLY		YES	FAÇADE PA
	Prefab betongelb geïsoleerd in glad beton - natuurlijk kleur	Prefab concrete plinth insulated in smooth concrete - natural color								
	Betontinten 30x90 U-waarde = 0.22V/m²K	Concrete plinths 30x90 U-value = 0.22V/m²K	SOG	Im		91.50	X		YES	CONCRETE I
	Betonplint bestaande gevel (wachtgevel Carrefour)	Concrete plinth existing facade (waiting facade Carrefour)	SOG	Im		27.75	?		YES	CONCRETE I
	Geprefabriceerde gevelelementen in volle beton voor binnenwanden met plinten inbegrepen - glad beton - natuurlijk kleur	Prefabricated facade elements in solid concrete for interior walls including plinths - smooth concrete - natural color								
	Binnenwanden dikte 15cm REI 120	Interior walls thickness 15cm REI 120	SOG	m2		1681.61	NEEDS ASSEMBLY		YES	CONCRETE I
	Beton panelen 14 cm voor gevel in natuur steen	Concrete panels 14 cm for facade in natural stone	SOG	m2		238.05	X		YES	CONCRETE I
	Mechanische isolatie van geprefabriceerde gevelelementen in volle beton voor bekleding met sandwichpanelen	Mechanical insulation of prefabricated facade elements in solid concrete for cladding with sandwich panels								
	PIR dikte 12cm	PIR thickness 12cm	SOG	m2		142.17	NEEDS ASSEMBLY		YES	INSULATION
	Opdringconsoles aan wand	Brackets to wall								
	Boringen in betonnen wanden of concrete vaults (OPTION)	Drilling in concrete walls or concrete vaults (OPTION)								
	HOOFDSTUK E - DAKDICHTING	CHAPTER E - ROOF SEALING								
	Zelfklevend dampscherm voor steeledek	Self-adhesive vapor barrier for steel deck								
	Dampscherm horizontaal geplaatst voor steeledek	Vapor barrier horizontally placed for steel deck	SOG	m2		4839.60	NEEDS MATERIAL		YES	VAPOR BAR
	Dampscherm verticaal geplaatst voor betonnen wanden	Vapor barrier vertically placed for concrete walls (upstand)	SOG	m2		830.16	NEEDS MATERIAL		YES	VAPOR BAR
TE 4	MINIFRIS : PE dampscherm los gelegd ipv roofing	LOVER PRICE: PE vapor barrier loosely laid instead of roofing vapor barrier - horizontal for steel deck	SOG	m2		4839.60	NEEDS MATERIAL		YES	VAPOR BAR
TE 1	MINIFRIS : PE dampscherm los gelegd ipv roofing	LOVER PRICE: PE vapor barrier loosely laid instead of roofing vapor barrier - vertical for concrete walls (upstand)	SOG	m2		830.16	NEEDS MATERIAL		YES	VAPOR BAR
	Multiple panelen v/BP dikte 22mm ondersteuning horizontale afdichting	Multiple panels v/BP thickness 22mm support for horizontal sealing								plywood panels
	Gebouw	Building	SOG	Im		123.55	?			
	Luiel	Canopy	SOG	Im		242.75	?		YES	
	Houten kepers (lichtstraat)	Wooden battens (skylight)								
	Thermische isolatie van het dak in steeledek	Thermal insulation of the roof on steel deck								Insulation
	Gebouw	Building								
	12 cm PIR horizontaal geplaatst - mechanisch bevestigd	12 cm PIR horizontally placed - mechanically fixed	SOG	m2		4839.60	NEEDS MATERIAL		YES	INSULATION
	8 cm PIR verticaal geplaatst - mechanisch bevestigd op betondek en multiples van gebouw (verticaal & above roof edge)	8 cm PIR vertically placed - mechanically fixed on concrete wall and multiples of building (vertical & above roof edge)	SOG	m2		514.32	NEEDS MATERIAL		YES	INSULATION
	Thermische isolatie van de bovendakse brandmuur in MVV dikte 12cm	Thermal insulation of the above-roof fire wall in MVV thickness 12cm	SOG	m2		329.90	NEEDS MATERIAL		YES	INSULATION
TE 4	MINIFRIS : TPO ipv bitumen horizontaal dakvlak	LOVER PRICE: TPO instead of bitumen horizontal roof	SOG	m2		4839.60	NEEDS MATERIAL		YES	INSULATION
TE 4	MINIFRIS : TPO ipv bitumen verticale opstanden	LOVER PRICE: TPO instead of bitumen vertical upstands	SOG	m2		514.32	NEEDS MATERIAL		YES	INSULATION
TE 4	MINIFRIS : TPO ipv bitumen bekleding brandwand door dak	LOVER PRICE: TPO instead of bitumen cladding fire wall through roof	SOG	m2		329.90	NEEDS MATERIAL		YES	INSULATION
	Opstanden voor koepels, rookluiken en dakdoorvoeren (swelconstructie inbegrepen)	Upstands for domes, smoke hatches, and roof penetrations (including framing)								
	Waterdichte laag (Meerdere lagen)	Watertight layer (Multiple layers)								
	Horizontaal	Horizontal								
	Luiel langs bestaand gebouw	Canopy along existing building	SOG	m2		209.37	NEEDS ASSEMBLY		YES	CANOPY
	Verticaal	Vertical								
	Luiel langs bestaand gebouw	Canopy along existing building	SOG	m2		219.33	NEEDS ASSEMBLY		YES	CANOPY
	Pluvisagstroom- onderdrukstelsysteem (inbegrepen isolatie)	Pluvia system - vacuum system (including insulation)								
	Dakloek & dakventilatie	Flood drain & ventilation								
	Ø110 luiel	Ø110 canopy	SOG	st		11.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 110
	Ø110 ventilatie septische put (geuichte aansluiting op afvoer in de betonkolom)	Ø110 ventilation septic tank (odor-proof connection to downspout in the concrete column)	SOG	st		3.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 110
	Dakwaterafvoeren (bochten en hulpstukken)	Flood downspouts (elbows and fittings)								END OF THE SEWING SYSTEM
	Ø110 ventilatie septische put	Ø110 ventilation septic tank	SOG	Im		18.00	EDS ASSEMBLY - GEOMETRY		YES	PIPE Ø 110

```

import csv
def main():
    # First to call column by headers
    codekey = "codekey"
    descriptionkey = "description"
    unitkey = "ch"
    numberkey = "how bezeld"
    ckey = "Carbon Builder?"
    assemblykey = "ASSEMBLY KEY"

    # Using with-statement to ensure proper handling of the file
    with open(csv_file_path, mode="r") as file:
        # Create a CSV reader
        csv_reader = csv.DictReader(file)

        # Iterate through the CSV rows
        for row in csv_reader:
            # Call values by column header
            c = row[codekey]
            des = row[descriptionkey]
            u = row[unitkey]
            number = row[numberkey]
            cb = row[ckey]
            assembly = row[assemblykey]

            # Convert to float and store
            code.append(c)
            description.append(des)
            units.append(u)

            numbers.append(number)
            carbonBuilder.append(cb)
            assemblyName.append(assembly)

        # Handle the case where conversion to float fails
        print("Could not convert number to a float.")

    # Use indexes to support
    indexes = []
    for i in range(len(carbonBuilder)):
        if carbonBuilder[i] == "YES":
            indexes.append(i)

    # Lists for output
    numbers = []
    units = []
    assemblyName = []
    description = []
    code = []

    for index in indexes:
        numbers.append(numbers[index])
        units.append(units[index])
        assemblyName.append(assemblyName[index])
        description.append(description[index])
        code.append(code[index])

    #***
    units = units
    carbonBuilder = carbonBuilder
    assemblyName = assemblyName
    description = description
    code = code

    #***
    create a dict to store values on a single screen
    mmDict = {}

    mmDict["numbers"] = numbers
    mmDict["units"] = units
    mmDict["assembly"] = assemblyName
    mmDict["description"] = description
    mmDict["code"] = code

    val = str(mmDict)

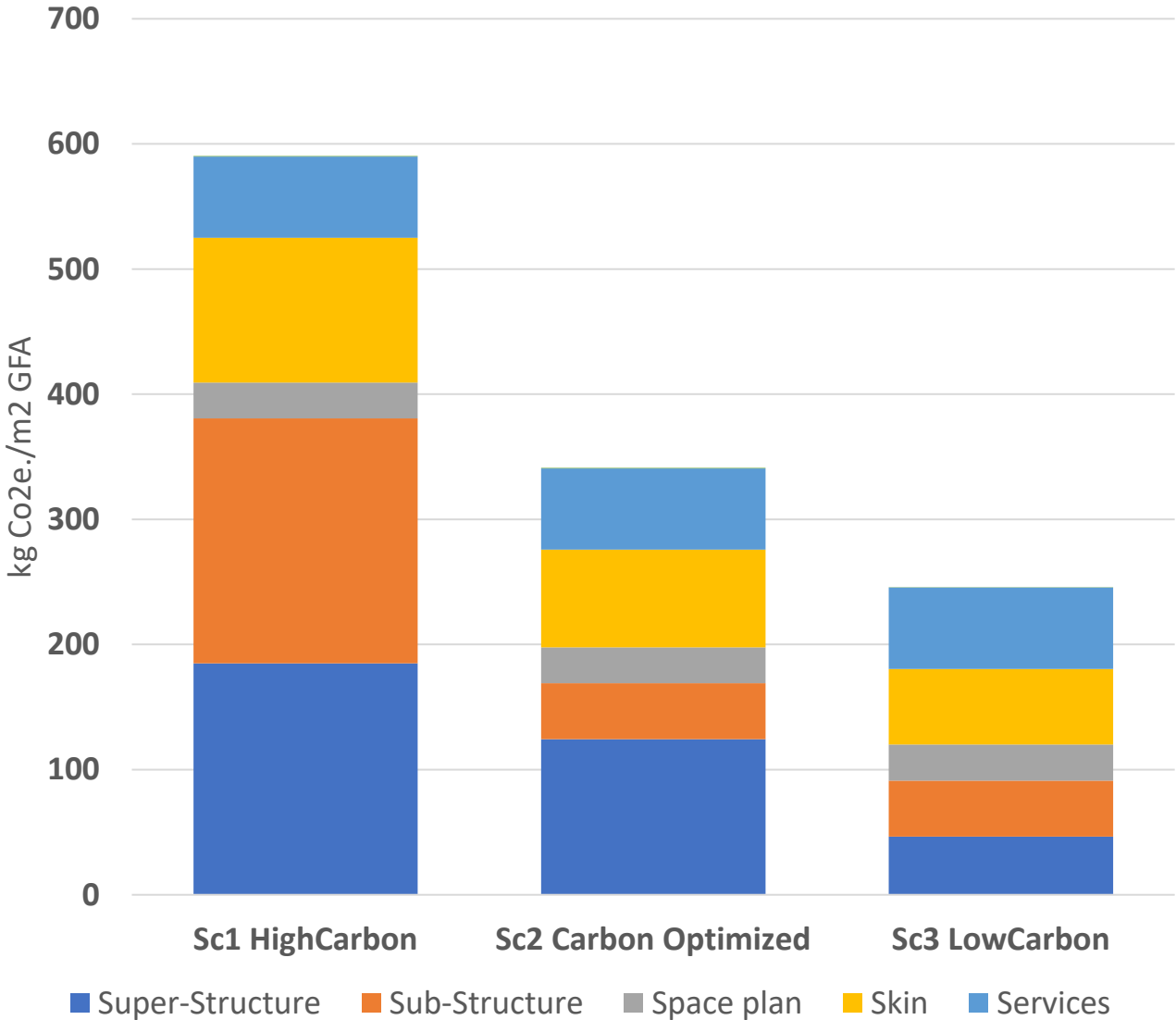
```

-15 KW/m2 operational energy,  
cutting embodied upfront carbon  
down by 50% to 280 kgCO2e/m2

## One Helix | Breakthrough Properties | Astra Zeneca

Netherlands, Amsterdam, Life Science, 4,600 m2, BREEAM Outstanding, Negative Operational Energy Footprint

# Carbon saving scenarios



(Current design)

**High Carbon** : Typical concrete C30/C37 Concrete for Sub and Super Structure, typical structural steel, triple glazing with XPS.

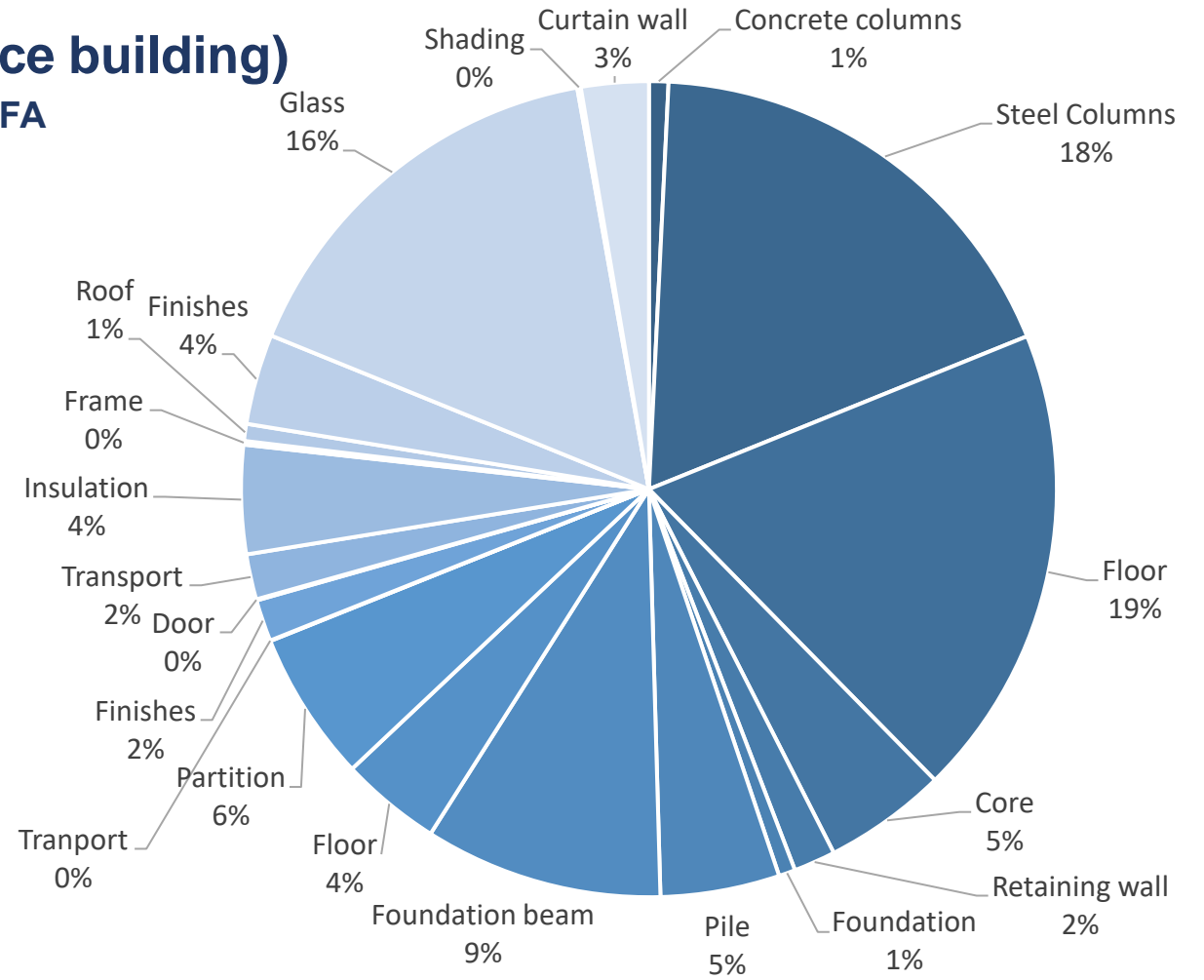
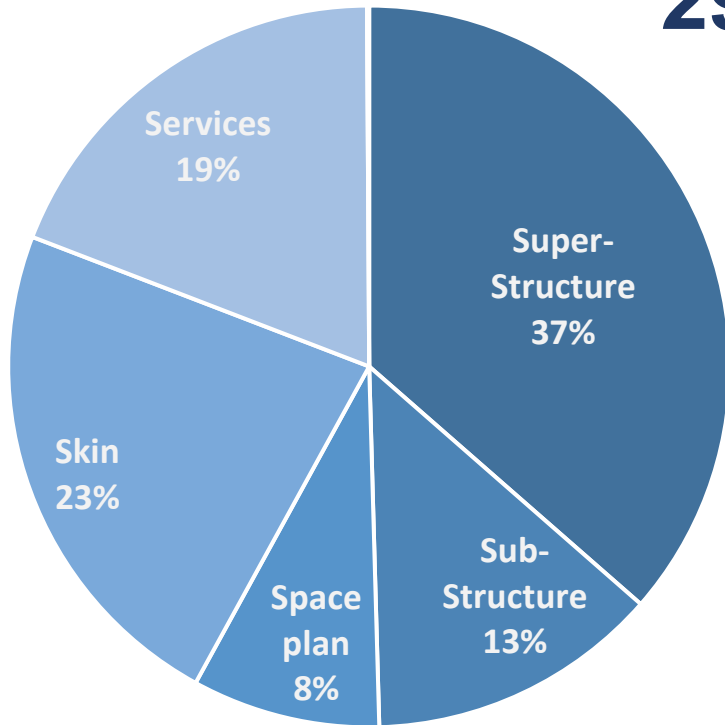
**Optimized Carbon** : Low carb concrete C30/C37 (20% concrete granulate) with XCarb® Structural steel for structure with low carb glass and glass wool.

**Low Carbon**: CLT floor slabs with low carb concrete and XCarb® Structural steel.

# Upfront embodied carbon

## GWP Potential (A1-A5)

**290** (590 reference building)  
kgCo2e/m<sup>2</sup>GFA



Paris Proof Targets	Embodied Carbon Kg CO2-eq. per m2			
New Construction	2021	2030	2040	2050
Office Building	250	158	94	56



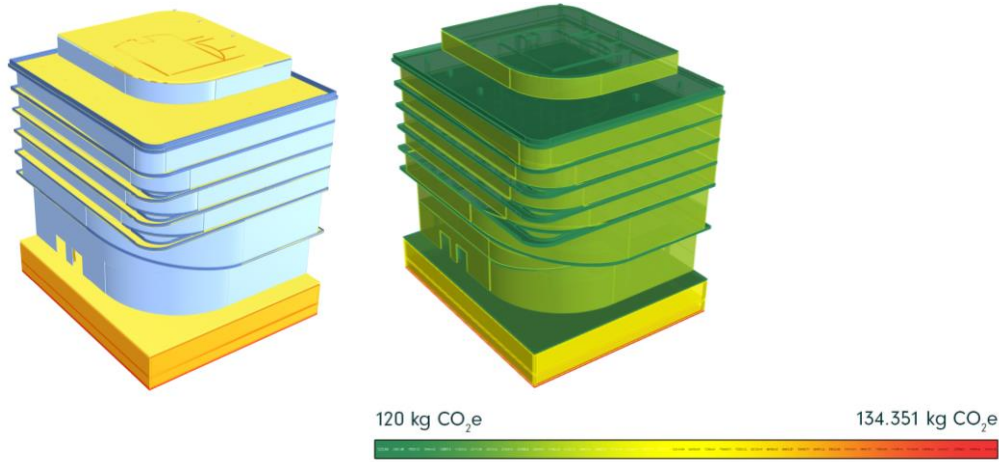


# Kyklos| Atenor & Arņs (Accenture)

Luxembourg, Belval, Office, 11.500 m<sup>2</sup>, A+ EPG (35 KW/m<sup>2</sup>), BREEAM Outstanding, Well Platinum, Low Whole Life Carbon

# Embodied Carbon Reduction Potential

We can potentially reduce Embodied Carbon footprint to a traditional building up to 74% to 113 Kg CO<sub>2</sub>-eq. per m<sup>2</sup>, achieving 2030-2040 goal setting.



Paris Proof Targets	Embodied Carbon Kg CO <sub>2</sub> -eq. per m <sup>2</sup>			
New Construction	2021	2030	2040	2050
Office Building	250	158	94	56

Kyklos: 113.3 Kg CO<sub>2</sub>-eq. per m<sup>2</sup>



## Kyklos

Total Carbon:  
822,6 Ton CO<sub>2</sub>e  
80% of Materials

Approximately 113.3  
Kg CO<sub>2</sub>-eq. per m<sup>2</sup>

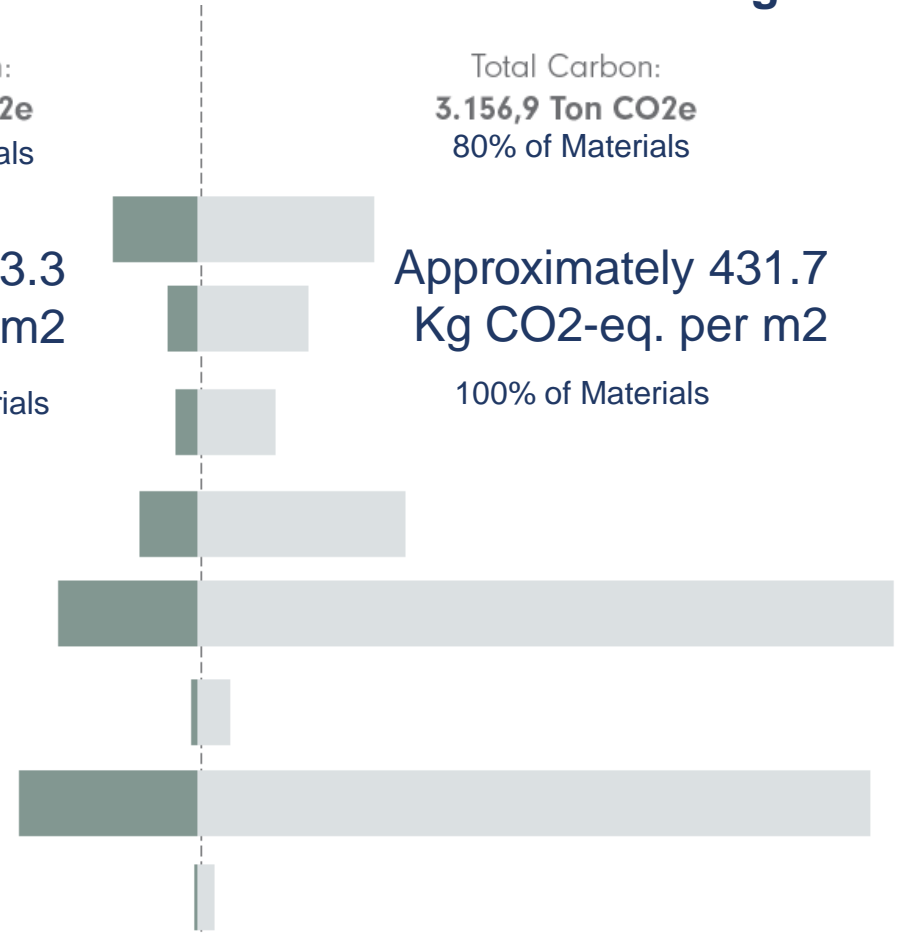
100% of Materials

## Traditional Building

Total Carbon:  
3.156,9 Ton CO<sub>2</sub>e  
80% of Materials

Approximately 431.7  
Kg CO<sub>2</sub>-eq. per m<sup>2</sup>

100% of Materials



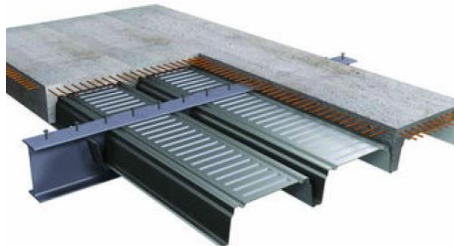
74% reduction in carbon footprint can be achieved compared to benchmark

# Kyklos Floor-system Comparison (Non-Optimized Material Recipes)

Composite floor system  
(wide)  
+ steel beams

Total Weight:  
489.8 kg/m<sup>2</sup>

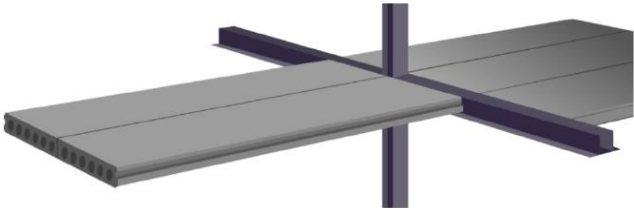
Carbon Footprint:  
219.5 kgCO<sub>2</sub>e/m<sup>2</sup>



Hollow-Core floor system  
+ steel beams

Total Weight:  
308.2 kg/m<sup>2</sup>

Carbon Footprint:  
76.7 kgCO<sub>2</sub>e/m<sup>2</sup>



Composite floor system  
(low)  
+ steel beams

Total Weight:  
389.3 kg/m<sup>2</sup>

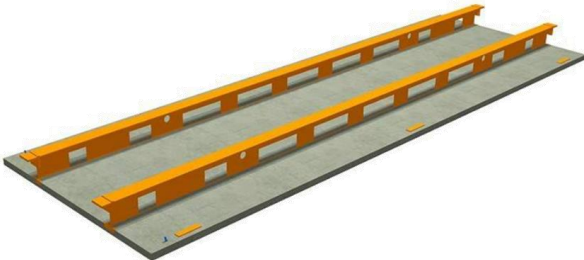
Carbon Footprint:  
152.1 kgCO<sub>2</sub>e/m<sup>2</sup>



Steel concrete hybrid  
+ steel beams

Total Weight:  
306 kg/m<sup>2</sup>

Carbon Footprint:  
144.2 kgCO<sub>2</sub>e/m<sup>2</sup>



# Floor-system Comparison (Optimized Material Recipes)

Composite floor system  
(wide)  
+ steel beams

Total Weight:  
489.8 kg/m<sup>2</sup>

Carbon Footprint:  
51.4 kgCO<sub>2</sub>e/m<sup>2</sup>

Hollow-Core floor system  
+ steel beams

Total Weight:  
308.2 kg/m<sup>2</sup>

Carbon Footprint:  
25.3 kgCO<sub>2</sub>e/m<sup>2</sup>

Composite floor system  
(low)  
+ steel beams

Total Weight:  
389.3 kg/m<sup>2</sup>

Carbon Footprint:  
38.5 kgCO<sub>2</sub>e/m<sup>2</sup>

Steel concrete hybrid  
+ steel beams

Total Weight:  
306 kg/m<sup>2</sup>

Carbon Footprint:  
34.1 kgCO<sub>2</sub>e/m<sup>2</sup>

An architectural rendering of a modern building with a curved facade and a green roof. The building features large glass windows and a prominent curved structure. The scene is set in an urban environment with trees and other buildings in the background. The sky is a clear, light blue.

**From 'worst' to 'best' performing floor-system  
88% reduction of Carbon Footprint per sqm.**

**This is for a 10.000 m<sup>2</sup> building equivalent to what  
1.554 trees absorb on Carbon over a period of 50  
years (buildings assumed life-span)**

**Kyklos| Atenor & Arņs (Accenture)**

Luxembourg, Belval, Office, 11.500 m<sup>2</sup>, BREEAM Outstanding, Well Platinum, Low Whole Life Carbon

**uns**  
UNSTUDIO

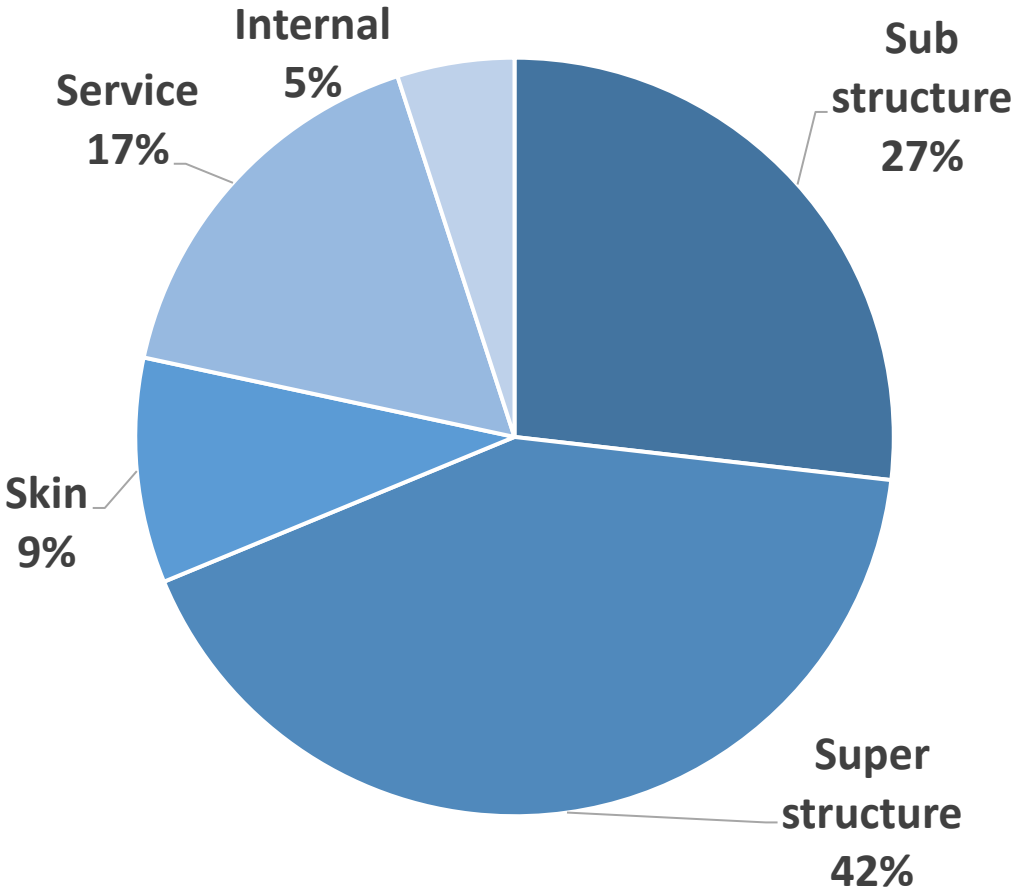


reduce to the  
max: upfront  
carbon in tall  
buildings

## The Bridge Tower

Warsaw, Poland, Office, 55.000 m2, BREEAM Outstanding, WELL Gold.

# Base Case: Upfront (embodied) carbon



GWP Potential (A1-A5)

**786**

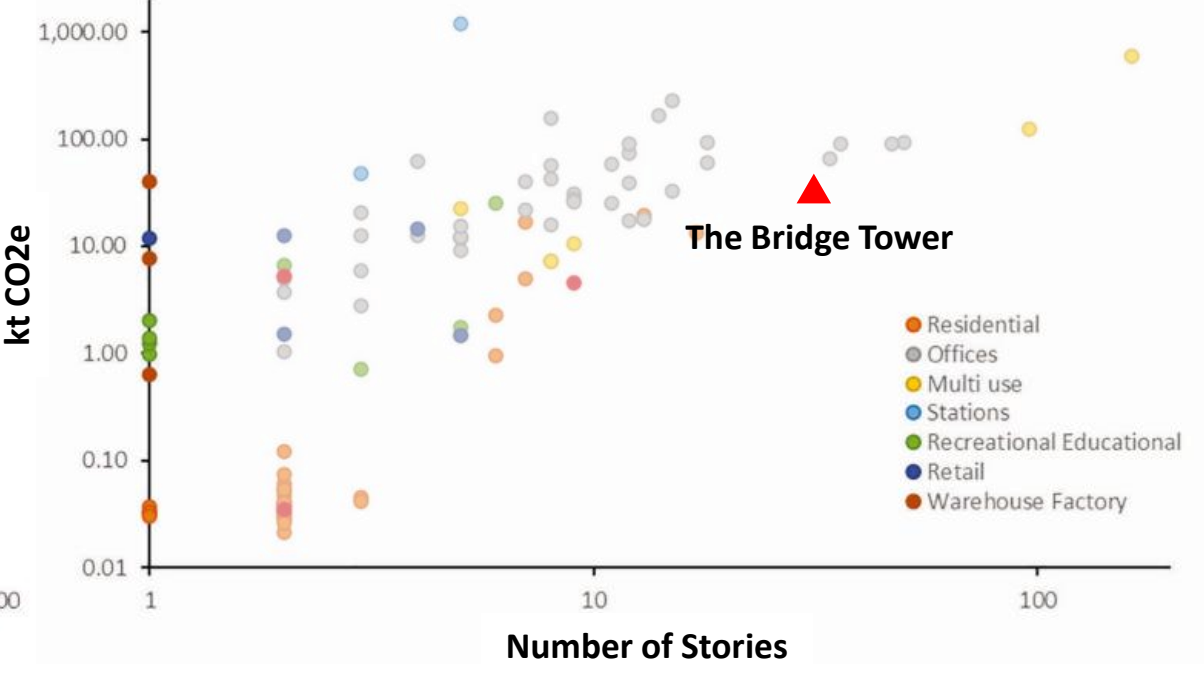
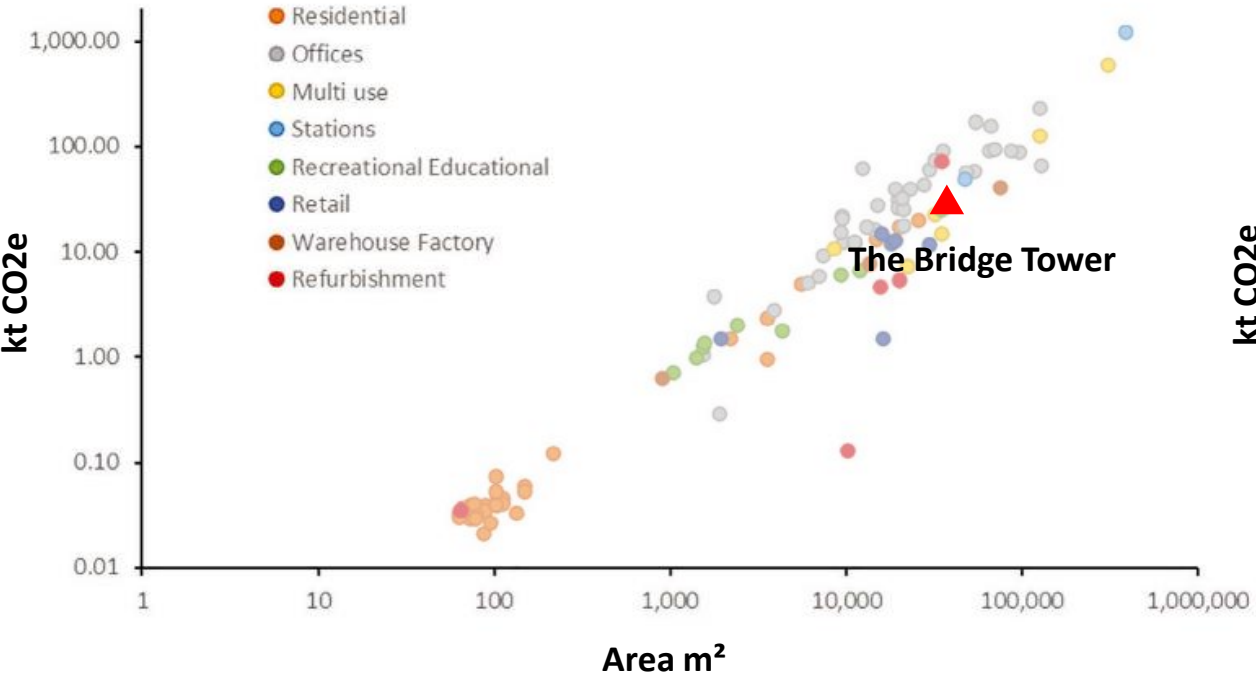
kgCo2e/m<sup>2</sup>GFA

Sub- and Super structure have the largest share, with floors contributing up to 69% of it's Embodied Carbon Footprint.

The number of basement levels (5) significantly impacts the total carbon footprint of the structure.

Concrete, steel, and glazing are major Embodied Carbon Drivers

# Benchmarking the results...



Source: <https://www.istructe.org/ISTRUCTE/media/Public/TSE-Archive/2020/Carbon-footprint-benchmarking-data-for-buildings.pdf>

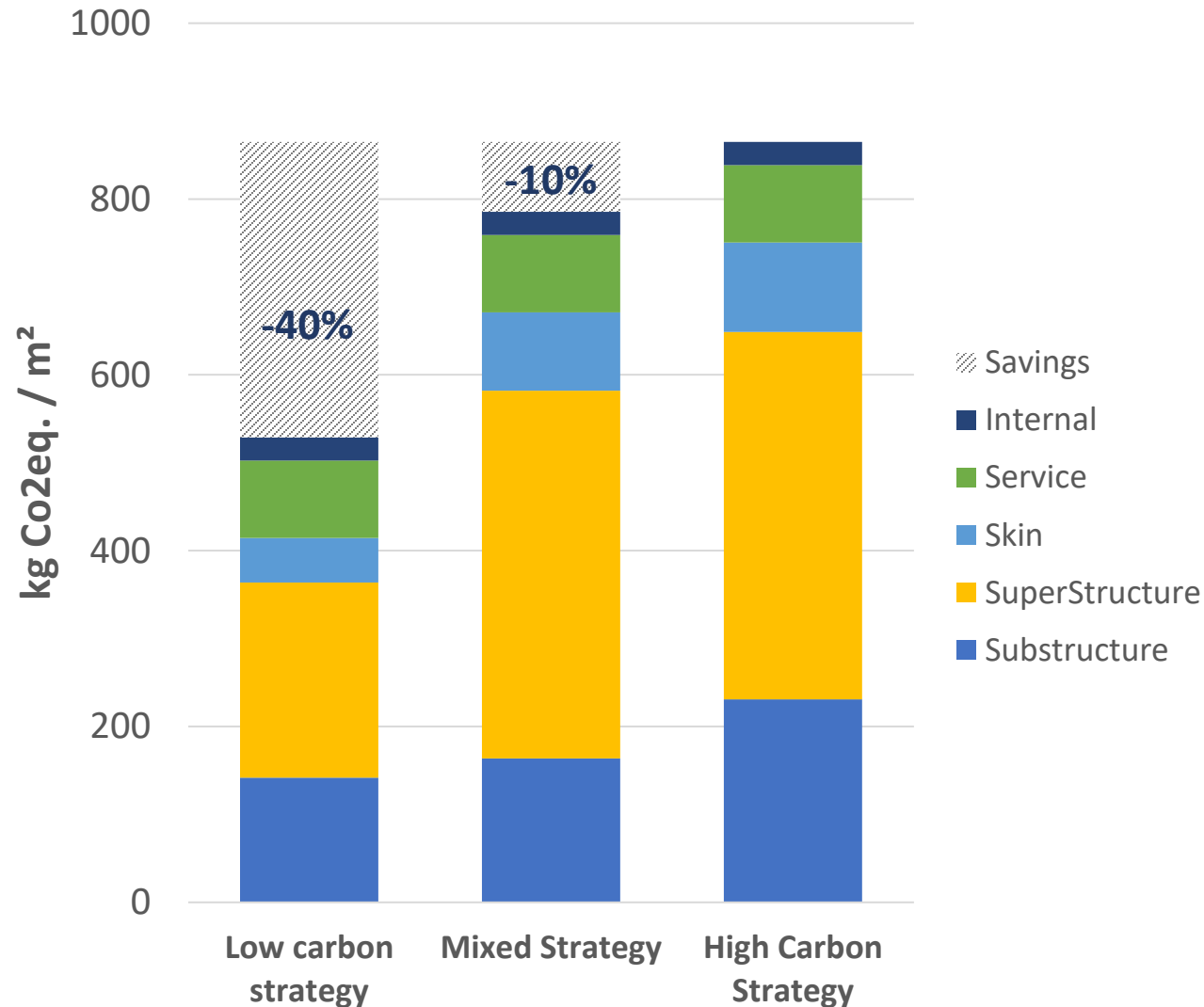


**Upto 20% of the concrete is saved with PT slabs in comparison to the reinforced slabs, saving 2,500 tons of concrete.**

**Equivalent to around 600 Ton of Embodied Carbon**

**Reduced floor thickness allows for an additional office floor within the same skin**

# Carbon saving scenarios



**High carbon strategy uses standard concrete and triple glazing.**

**Mixed strategy employs low-carbon concrete in the basement, achieving 10% savings (Chosen option)**

**Using low-carbon glass and low-carbon concrete can reduce carbon by up to 40%.**

**But low carbon concrete extends construction period by over a year due to the slow curing time of the concrete....**



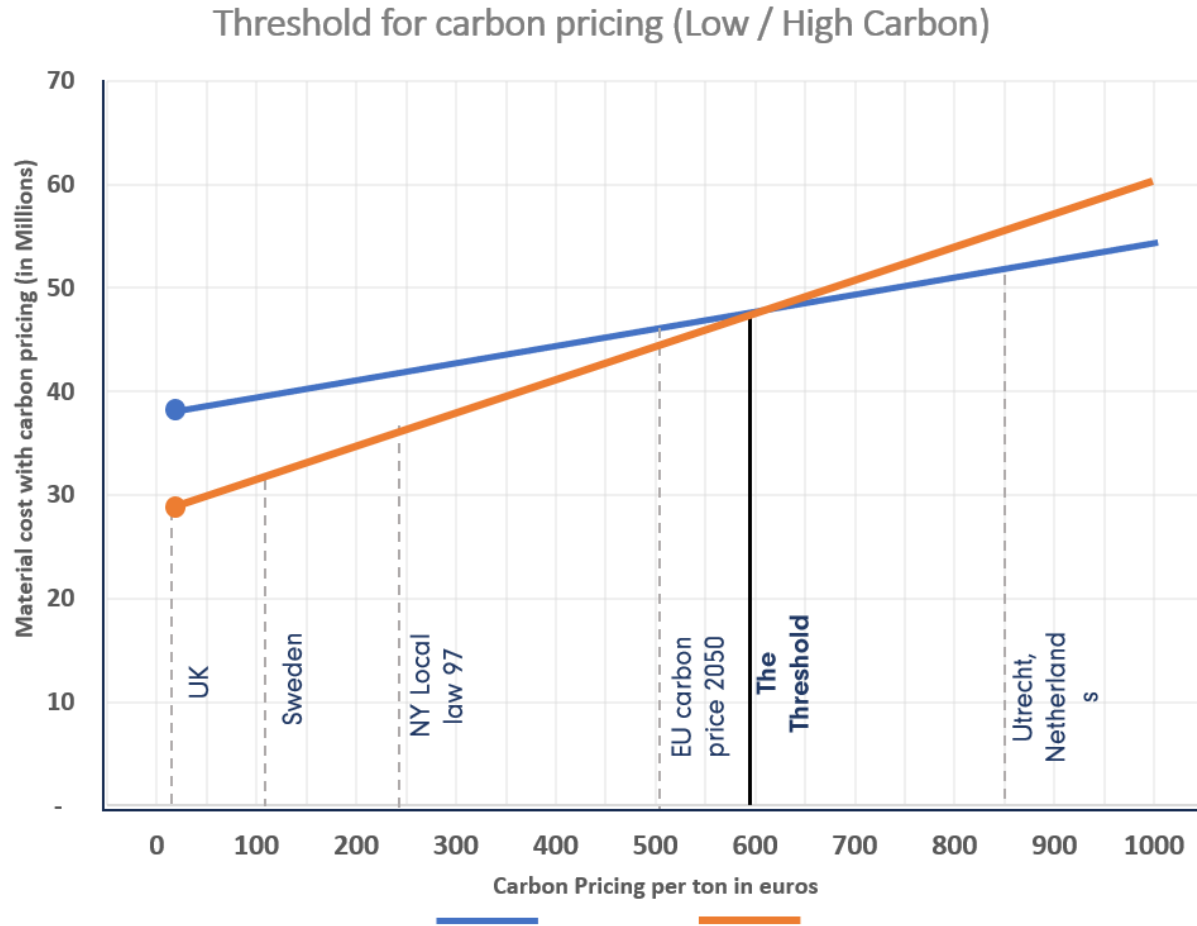
**Transitioning from a 'high' carbon to a mixed carbon strategy already results in a saving of ~ 4,300 tons of carbon**

**This is equivalent to what 2,900 trees capture over a 50-year lifetime.**

**Shifting from high carbon to low carbon achieves an extraordinary savings of 18,500 tons of carbon, similar to planting 12,300 trees over the same period....**

# Threshold of carbon pricing - Present

Carbon Currency – Carbon emission x Carbon pricing per ton in euros



**The initial cost for the low-carbon alternatives are currently more expensive (or too slow....).**

**With rising carbon taxation, the current economical tipping point could move lower**

**Stricter carbon pricing taxation or incentives are needed globally to drive low carbon decisions.**

*\*The low carbon solutions of Steel, Concrete and Glass are 5%-40% more expensive than their standard products.*



**Current Carbon trading values do not validate Low Carbon Strategies**

**With attention significant carbon savings over 50% can be achieved without significant cost increases, even with traditional materials.**

**Strategies include: lightweight (composites), pre-fabrication and low carbon materials**

**Low Carbon Materials will however become more economical.**

**Significant Carbon Taxation or incentives at around EUR can tip the economical balance already today**

**ESG value of Carbon cutting translate however significant more valuable..**



Ing.ir. Arjan Dingsté dipl. Ing. ETH NDS  
Partner / Senior Architect UNStudio  
Lead Digital Innovations & Lead Sustainability Innovations  
a.dingste@unstudio.com

Let's design for a better  
Future!




# Redevco's approach to embodied carbon

ULI C Change Conference  
Barcelona, 17.10.2024

October 2024

# Part of COFRA, a family business for 180+ years



A diversified group of businesses, united by a common ethos to be a Force for Good

Responsible capital

Liveable cities

Feel good Fashion

Clean energy

Sustainable food



# Within the COFRA we focus on liveable cities



## **Our view on cities**

With urbanisation increasing, cities are huge magnets that draw in resources, use them and put waste into the environment. Cities must become resilient and sustainable.

Ultimately, they must make a positive contribution to the health & wellbeing of both people and planet.

## **Our purpose**

We can contribute by creating amazing real estate outcomes for clients. A force for good in the built environment.

# Sustainability ambition

## Built Environment

- Reduce whole life carbon: **Net Zero** by 2040
- Increase onsite **renewable energy** generation
- Implement **climate** adaptation measures

## Natural Environment

- Aim for **biodiversity** net gain
- Responsible **water** management
- Responsible **waste** management

## Social Value

- Provides spaces that meet **local needs**
- Contribute to **placemaking**
- Build strong **relationships** with stakeholders

## Economic Value

- Optimise **capital value** development
- Optimise **rental growth** development
- Minimise structural **vacancy**

Underpinned commitments: 1) highest standards of **health, well being and safety**, and 2) **human rights** and **labour practices**



# Redevco's 'external' commitments

## SBTi



Redevco B.V. commits to reduce absolute scope 1 and 2 GHG emissions 58.5% by 2030 from 2019 base year. Redevco B.V. also commits to reduce absolute scope 3 GHG emissions 46.2% within the same timeframe.

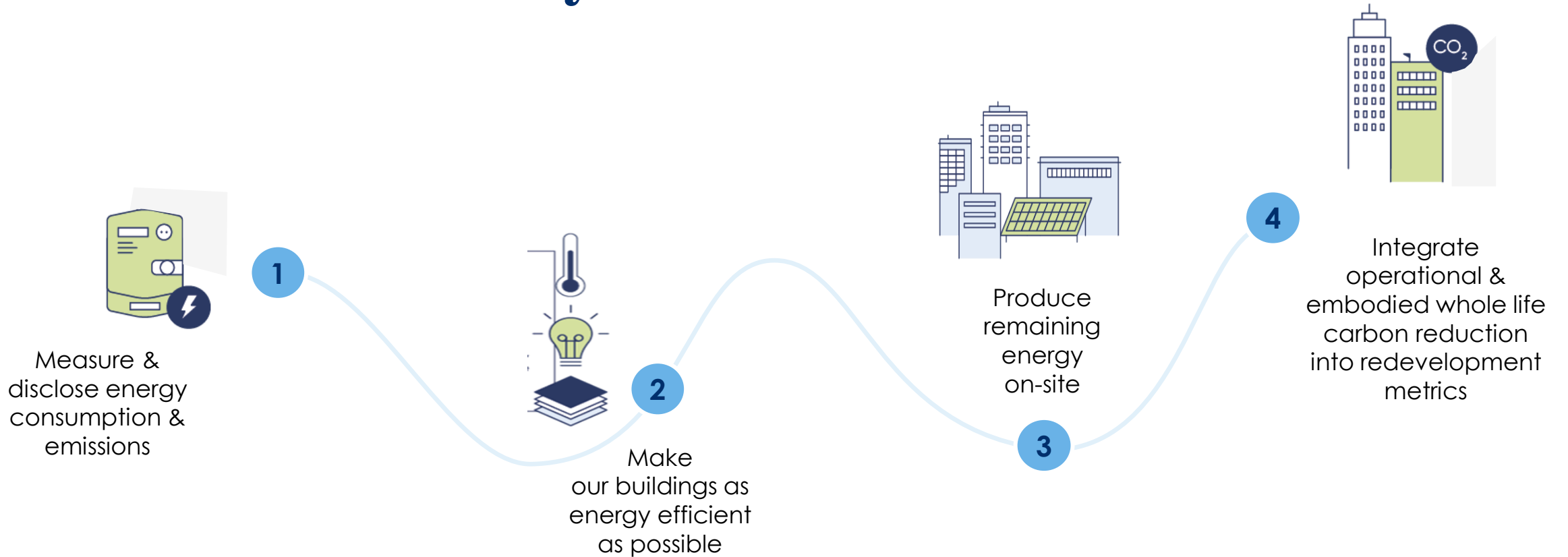
## WorldGBC NZC Buildings Commitment

Redevco commits:

- for assets under direct control (i.e., our own offices and the common areas of our AuM) to reduce (and compensate where necessary) all operational emissions by 2030
- for new developments and major renovations under direct control to reduce and compensate (for residual upfront emissions) embodied carbon emissions by 2030



# Beyond 2030, we have our “Mission 2040” target: Net Zero Carbon by 2040



WE FOLLOW THE DEFINITIONS PROVIDED BY THE WORLD GREEN BUILDING COUNCIL – BUT WANT TO GO FASTER!

# The ingredients of Mission 2040

**2050**  
New buildings, infrastructure and renovations will have **net zero embodied carbon**, and all buildings, including existing buildings, must be **net zero operational carbon**.

**2030**  
New buildings, infrastructure and renovations will have at least **40% less embodied carbon** with significant **upfront carbon** reduction, and all new buildings must be **net zero operational carbon**.

**Net Zero Carbon Buildings Commitment**  
All buildings within direct control to operate at net zero carbon by 2030

**Net Zero Operational Carbon**

**Definition**  
A net zero carbon building is highly energy efficient with all remaining energy from onsite and/or offsite renewable sources

**Guiding Principles**

- 1. Measure and disclose carbon**  
Carbon is the ultimate metric to track, and buildings must achieve an annual operational net zero carbon emissions balance based on metered data
- 2. Reduce energy demand**  
Prioritise energy efficiency to ensure that buildings are performing as efficiently as possible, and not wasting energy
- 3. Generate balance from renewables**  
Supply remaining demand from renewable energy sources, preferably on-site followed by off-site, or from offsets
- 4. Improve verification and rigour**  
Over time, progress to include embodied carbon and other impact areas such as zero water and zero waste

**Net Zero Embodied Carbon**

**Definition**  
A net zero embodied carbon building (new or renovated) or infrastructure asset is highly resource efficient with upfront carbon minimised to the greatest extent possible and all remaining embodied carbon reduced or, as a last resort, offset in order to achieve net zero across the lifecycle.

**Guiding Principles**

- 1. Prevent**  
Avoid embodied carbon from the outset by considering alternative strategies to deliver the desired function
- 2. Reduce and optimise**  
Evaluate each design choice in terms of the upfront carbon reductions and as part of a whole lifecycle approach
- 3. Plan for the future**  
Take steps to avoid future embodied carbon during and at end of life
- 4. Offset**  
As a last resort, offset residual embodied carbon emissions within the project or organisational boundary where possible or if necessary through verified offset schemes





# Guiding principles of net zero embodied carbon

## Prevent

*Avoid embodied carbon from the outset by considering alternative strategies to deliver the desired functions*

## Reduce and Optimise

*Evaluate each design choice in terms of the upfront carbon reductions and as part of a whole lifecycle approach*

## Plan for the Future

*Take steps to avoid future embodied carbon during and at end of life*

## Offset

*As a last resort, offset residual embodied carbon emissions within the project or organisational boundary where possible, or if necessary, through verified offset schemes*

## REDEVCO Sustainable Design Principles \*

- Retrofit first
- Brownfield only
- Scenario modelling (A1-A3) to derive optimal outcome
- Preference for bio-based materials
- Design for disassembly
  - BIM requirement
  - Building passport on completion (e.g., Madaster)
- Footprint of the (re)development only (A1-A5 and C1-C4)



# Whole Life Carbon stages

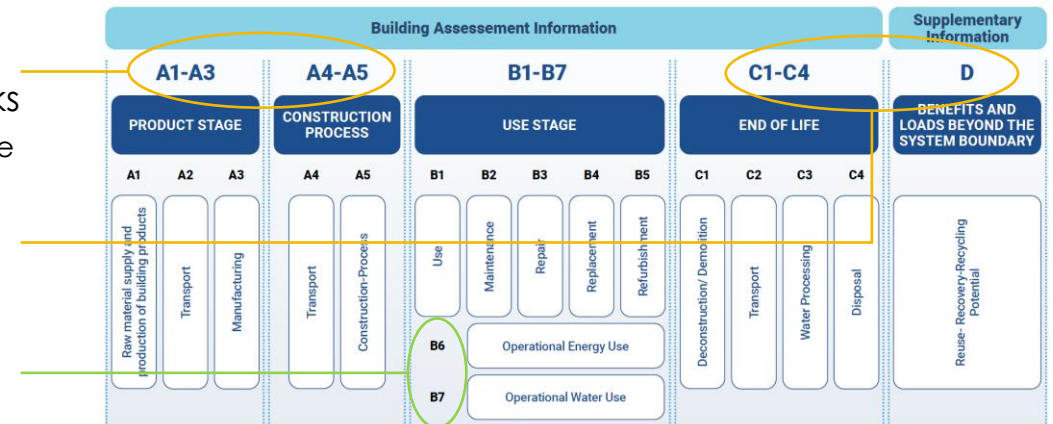
Whole Life Carbon as defined in the EU standard EN 159781 encompasses both the operational carbon of buildings through their use, and the upfront embodied carbon impact of the manufacturing, transportation, construction, as well as end-of-life phases of built assets.

Embodied Carbon boundary includes:

- A1-A5 upfront embodied carbon related to new construction works
  - We include redevelopment of existing assets (any structural works that touch the fabric of the building in question)
- Embodied carbon related to onsite deconstruction works (C1-C4 and D of the current life cycle end)

Already being tracked and monitored by Redevco:

- B6 Operational Energy Use (tenant emissions)
- B7 Operational Water Use



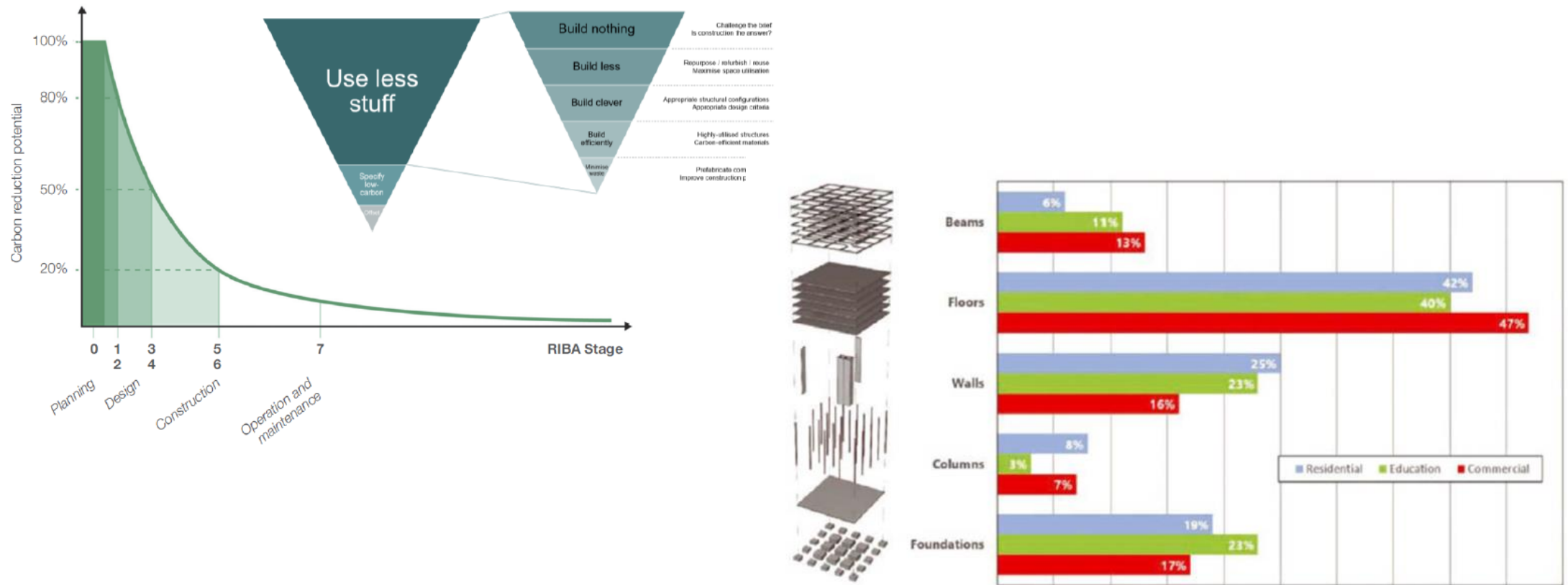
4 POLICY BRIEFING: WHOLE LIFE CARBON REPORTING AND TARGETS

WLCA calculations are becoming the norm for (re)developments and are included as a requirement in our Sustainable Design Brief



## USE LESS STUFF

# Greatest impact at the earliest stages of a project



# Using a NZC design guide to inform deliberate decision-making

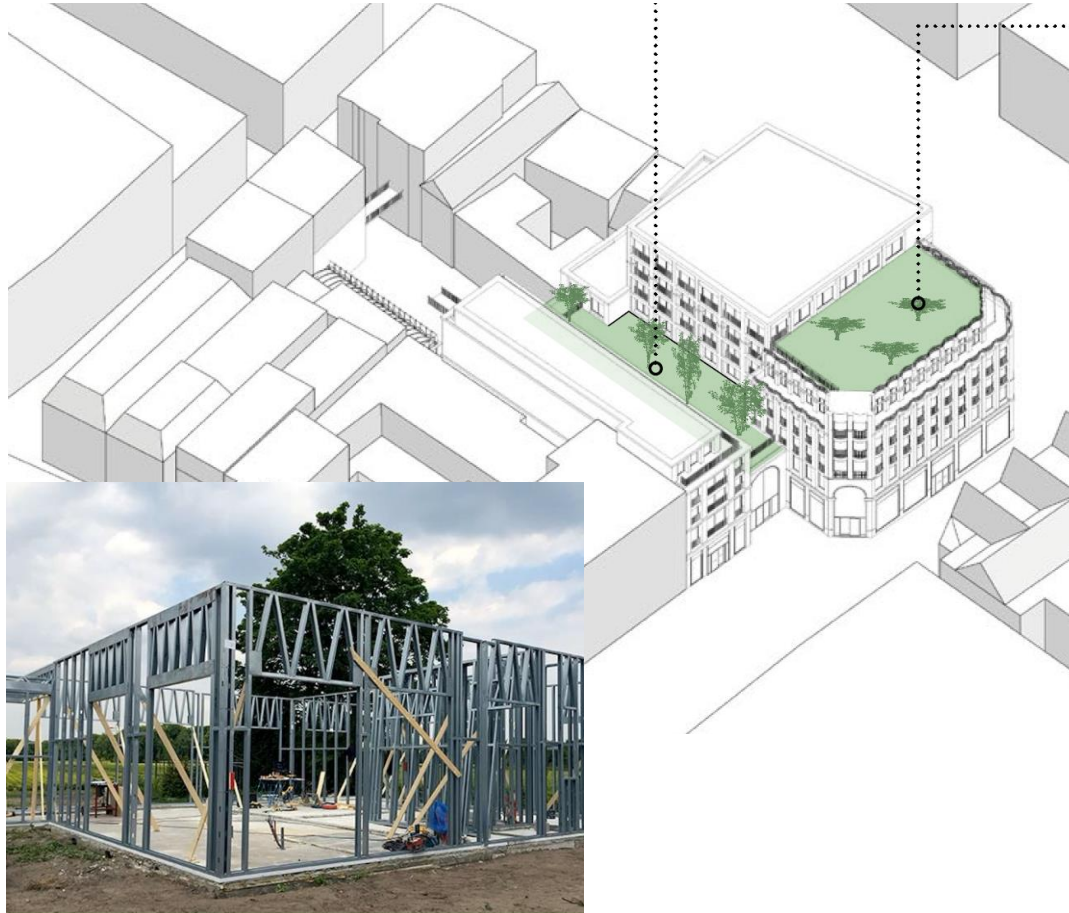
- Steps 1 to 4 are critical elements to the reduction of operational emissions and must be implemented at 'natural moments' in a building's lifecycle (new lease; redevelopment)
- Steps 5 and 6 more relevant at major refurbishment or redevelopment moments to look to the whole lifespan of a building and tackle embodied carbon and scope 3 emissions
- Eliminating fossil fuels as a heating source has significant impact on CO<sub>2</sub> emissions reduction, yet this is also the biggest challenge to convince (retail) tenants to invest in alternatives; less of an issue if we are in control of or responsible for installations
- Focusing on these points more deliberately will drive down the whole life carbon of our AuM



# Case Study: Herestraat, Groningen



# Groningen Herestraat – Planned works



- Demolish 2<sup>nd</sup> and 3<sup>rd</sup> floor
- Strip ground floor and 1<sup>st</sup> floor
- Ground floor and 1<sup>st</sup> floor will remain retail
- Basement will become a public bicycle storage
- Adding 4 floors (2<sup>nd</sup> – 5<sup>th</sup>) with 44 apartments
- Discussion on timber vs. steel (steel frame)
- All electric
- Green roofs (“green street”)
- Biodiversity Net Gain

# Groningen Herestraat – Embodied Carbon Impact

- Our Sustainable Design Brief targets **200 kg CO<sub>2</sub>e/m<sup>2</sup>** for RIBA stages A1-A5
- (Industry average for redevelopment of existing buildings is still ca. 500-600 kg CO<sub>2</sub>e/m<sup>2</sup>)
- This project's LCA calculation shows an upfront embodied carbon of **432 tons CO<sub>2</sub>e**, equating to **155 kg CO<sub>2</sub>e/m<sup>2</sup>**
- Redevco has adopted a carbon price of **€120/ton CO<sub>2</sub>e**
- The internal carbon fee 'charged' to this development is therefore ca. **EUR 52,000.-**

Groningen, Herestraat Upfront Embodied Carbon (A1-A5)	Embodied Carbon ↑ CO <sub>2</sub> e	ICF €120/t	Impact of ICF on Dev Profit	Impact of ICF on Dev IRR
Upfront Embodied Carbon intensity – Current FDP Groningen design score - <b>155</b> kg/m <sup>2</sup>	431.7	€ 51,804	(-1.2%)	(-0.18%)
Upfront Embodied Carbon intensity – Redevco Design Brief budget - <b>200</b> kg/m <sup>2</sup>	557.0	€ 66,844		

- Choosing to retain a significant portion of the existing building and being very deliberate about design choices and recycling and re-using existing materials yields a significantly lower embodied carbon footprint



# Groningen Herestraat – Projected Future State



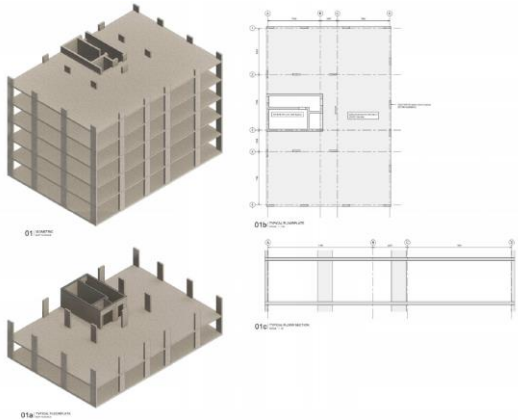


# Case Study: Minerva Way, Glasgow

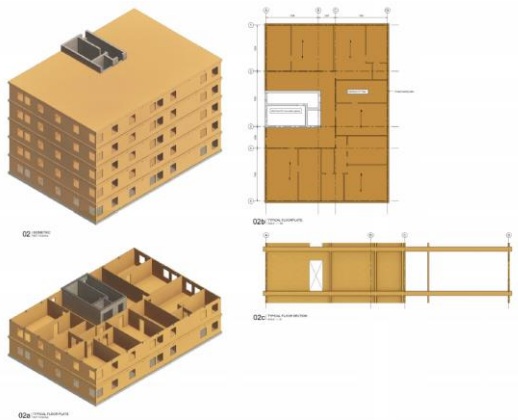


# Modelling exercise on the EC of the structure

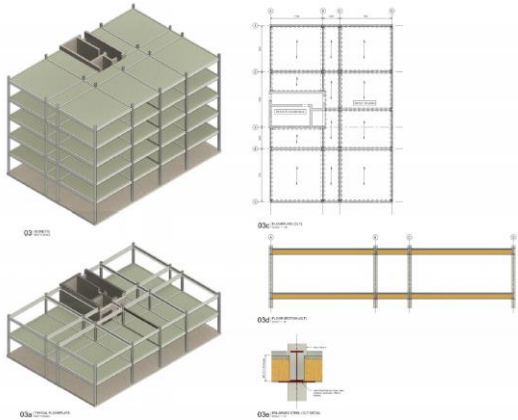
## RC Flat Slabs



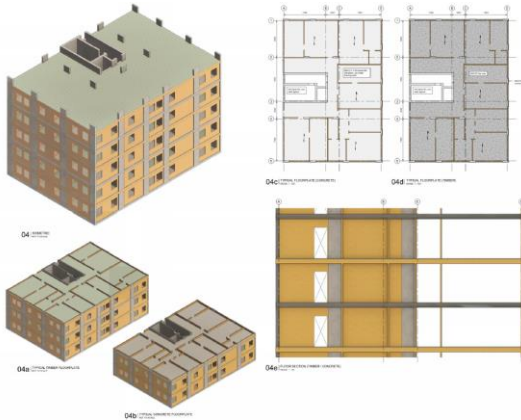
## CLT and bearing walls



## CLT on steel



## CLT on sandwich RC



# Modelling exercise on the EC of the structure

RC Flat Slabs	CLT and bearing walls	CLT on steel	CLT on sandwich RC
A1-A5 absolute: 141 tons CO <sub>2</sub> e A1-A5 intensity: 179 kgCO <sub>2</sub> e/m <sup>2</sup>	A1-A5 absolute: 125 tons CO <sub>2</sub> e A1-A5 intensity: 159 kgCO <sub>2</sub> e/m <sup>2</sup>	A1-A5 absolute: 184 tons CO <sub>2</sub> e A1-A5 intensity: 234 kgCO <sub>2</sub> e/m <sup>2</sup>	A1-A5 absolute: 153 tons CO <sub>2</sub> e A1-A5 intensity: 195 kgCO <sub>2</sub> e/m <sup>2</sup>
Biogenic carbon: 0 tons CO <sub>2</sub> e Biogenic carbon: 0 kg CO <sub>2</sub> e/m <sup>2</sup>	Biogenic carbon: -254 tons CO <sub>2</sub> e Biogenic carbon: -324 kgCO <sub>2</sub> e/m <sup>2</sup>	Biogenic carbon: -180 tons CO <sub>2</sub> e Biogenic carbon: -229 kgCO <sub>2</sub> e/m <sup>2</sup>	Biogenic carbon: -127 tons CO <sub>2</sub> e Biogenic carbon: -162 kgCO <sub>2</sub> e/m <sup>2</sup>
A-C absolute: 155 tons CO <sub>2</sub> e A-C intensity: 198 kgCO <sub>2</sub> e/m <sup>2</sup>	A-C absolute: 135 tons CO <sub>2</sub> e A-C intensity: 172 kgCO <sub>2</sub> e/m <sup>2</sup>	A-C absolute: 193 tons CO <sub>2</sub> e A-C intensity: 246 kgCO <sub>2</sub> e/m <sup>2</sup>	A-C absolute: 167 tons CO <sub>2</sub> e A-C intensity: 213 kgCO <sub>2</sub> e/m <sup>2</sup>
D absolute: 12 tons CO <sub>2</sub> e D intensity: 15 kgCO <sub>2</sub> e/m <sup>2</sup>	D absolute: -80 tons CO <sub>2</sub> e D intensity: -102 kgCO <sub>2</sub> e/m <sup>2</sup>	D absolute: -102 tons CO <sub>2</sub> e D intensity: -130 kgCO <sub>2</sub> e/m <sup>2</sup>	D absolute: -32 tons CO <sub>2</sub> e D intensity: -40 kgCO <sub>2</sub> e/m <sup>2</sup>

N.B. Current UK EPD's and WLC assessment methodologies assume timber is burnt at end-of-life (thereby emitting sequestered CO<sub>2</sub>) which negatively impacts the WLCA...so remain pragmatic w.r.t. LCA tooling and interpretation!



# Performance against Design Brief KPIs

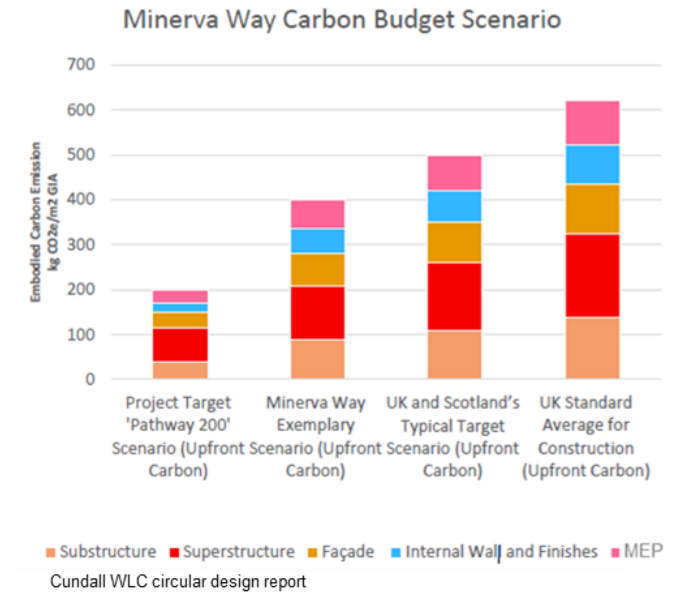
	Current Performance	Redevco's UK Residential Design Brief
Floor average area weighted U-value	0.12 W/m2K	0.15 W/m2K
External wall average area weighted U-value	0.15 W/m2K	0.15 W/m2K
Roof average area weighted U-value	0.09 W/m2K	0.15 W/m2K
Glazing area weighted U-value (including frame)	1.20 W/m2K	1.20 W/m2K
Window g-value	40%	30% - 40%
Window VLT	71%	-
Thermal bridging (γ-value)	0.05 W/m2K	<0.04 W/m2K
Air Permeability (@50Pa)	3 m3/h/m2	2 m3/hr/m2
System type	Exhaust ASHP	No local fossil fuel
Space heating – Heat Pump (COP)	3.3	2.85
Domestic Hot Water (DHW) – Heat Pump (COP)	2.0	2.85
Central AHU maximum specific fan power	0.73 W/l/s - 0.88 W/l/s	1.2 W/l/s
AHU heat recovery	85% – 86%	85%
Energy Use Intensity	41.6 kWh/m2	<41.6 kWh/m2 in line with the Local CRREM 2040 1.5oC scenario for multi-family residential buildings
BREEAM In-Use Assessment Pre-assessment score	Anticipated Outstanding	BREEAM score: ≥85% corresponding to an "Outstanding" BREEAM rating
Home Quality Mark assessment score	4.25 (4.5 -4.75 possible as scheme develops)	≥4
WELL assessment score	Platinum (with operational confirmation required as scheme develops)	Platinum
Embodied carbon	400-450 kg co2/m2	200 kg co2/m2

- Redevco's Sustainable Design Brief was shared with the design team partners at the outset of the project
- Our brief is intentionally aspirational, challenging the team to think out-of-the-box to find workable solutions
- Based on this particular project at this particular stage in the design process, the choices at that moment complied with 15 of 18 KPIs
- The Embodied Carbon (EC) target was not met, although it is still substantially lower than current market averages



# Impact of ICF on returns – Glasgow, Minerva Way

Glasgow, Minerva Way Upfront Embodied Carbon (A1-A5)	Embodied Carbon † CO2e	ICF €120/t	Impact of ICF on Dev Profit	Impact of ICF on Dev IRR
Upfront Embodied Carbon intensity – Current Minerva Way design score - <b>400</b> kg/m2	14,607	€1,752,840	(-3.7%)	(-0.63%)
Upfront Embodied Carbon intensity – Redevco Design Brief budget - <b>200</b> kg/m2	7,304	€876,420		
Upfront Embodied Carbon intensity – UK & Scotland's best practice budget - <b>500</b> kg/m2	18,259	€2,191,050		
Upfront Embodied Carbon intensity – UK standard average budget - <b>620</b> kg/m2	22,677	€2,721,284		



The WLC circular design report compared our current design with 3 other scenarios:

1. The Redevco Design Brief carbon intensity budget of 200 kg/m2 (which appeared beyond reach in this case)
2. The UK & Scotland best practice budget of 500 kg/m2
3. And the UK standard average performance of 620 kg/m2



# Progress made and lessons learned

- Redevelopments have typically yielded 40% improvement in Energy Intensity and Carbon Intensity
- Whilst already impactful – and in line with our CO<sub>2</sub> reduction glidepath modelling – it's not sufficient to really be 'Paris Proof' and be considered resilient to avoid 'stranded asset risk' (carbon perspective)
- We are now challenging our design teams (architects, engineers and consultants) to design for EI performance in line with CRREM 2040 targets – typically representing a 70-80% reduction
- We're now layering in upfront embodied carbon targets too with an internal carbon fee as an incentive to drive deliberate design, materials and construction methodology choices, understanding there may well be trade-offs between embodied carbon choices and future expected operational carbon emissions
- We want to work with partners that are also keen to experiment, to seek out better solutions, to raise the bar, and demonstrate what's possible – and we're convinced it will translate to value



WE FEEL A RESPONSIBILITY TO ACT

## We must act...

- 1.) because it's the right thing to do (and it's an expression of our shareholders' mission)
- 2.) legislation will force us to at some point, as countries live up to their commitments made as part of the Paris Agreement, and efforts are ramped up to transition to a low carbon world



EVEN IN MOMENTS OF ADVERSITY, WE MUST REMAIN CONVINCED  
THAT EVERY LITTLE BIT COUNTS

## What do we want our legacy to be?

We can do better...

We must do better...

We keep learning on the journey...



*"Yes, the planet got destroyed. But for  
a beautiful moment in time we created  
a lot of value for shareholders."*





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**Thank you for your attention.**



# Global Perspectives on Decarbonising the Whole Life Cycle of Concrete

**Dr Andrew Minson**

Director for Concrete and Sustainable Construction, GCCA

DPhil CEng FICE FStructE

Barcelona , October 2024

# GCCA Membership

## Our Members

Asia Cement Corporation  
 Breedon Group  
 BUA Cement  
 Buzzi  
 Cementir Holding  
 Cementos Argos  
 Cementos Moctezuma  
 Cementos Pacasmayo  
 Cementos Progreso  
 CEMEX  
 Cimenterie Nationale  
 Çimsa Cement  
 CNBM  
 CRH  
 Dalmia Cement  
 Dangote  
 Emirates Steel Arkan  
 Fletcher Building  
 GCC  
 Heidelberg Materials  
 Holcim  
 Hima Cement  
 Huaxin Cement  
 JK Cement

JSW Cement  
 Medcem  
 Misr Cement Group  
 Molins  
 Neshor Israel Cement Enterprises  
 Norm Cement  
 Northern Region Cement Company (Saudi Arabia)  
 Orient Cement  
 PT Solusi Bangun Indonesia  
 SCHWENK Zement  
 Secil  
 Siam Cement Group  
 Siam City Cement  
 Taiheiyo Cement  
 Taiwan Cement Corporation  
 TITAN Cement Group  
 TPIPOLENE  
 UltraTech Cement  
 UNACEM  
 Vassiliko Cement  
 Votorantim Cimentos  
 YTL Cement  
 Yura Cement

## National & Regional Association Partners

Asociación de Fabricantes de Cemento Portland – Argentina  
 Asociación de Productores de Cemento – Peru  
 Associação Brasileira de Cimento Portland – Brazil  
 Association of German Cement Manufacturers (VDZ) – Germany  
 Association Professionnelle des Cimentiers – Morocco  
 Betonhuis – Netherlands  
 BIBM – Europe  
 CANACEM – Mexico  
 Canadian Precast Prestressed Concrete Institute  
 Cement Association of Canada  
 Cement Concrete & Aggregates Australia  
 Cement Industry Federation – Australia  
 Cement Manufacturers Association – India  
 Cement Manufacturers Ireland

China Cement Association  
 Concrete NZ – New Zealand  
 European Cement Association (CEMBUREAU)  
 European Federation Concrete Admixtures  
 European Ready Mixed Concrete Organisation  
 Federación Iberoamericana del Hormigón Premezclado – LatAm  
 Federación Interamericana del Cemento (FICEM) – LatAm  
 Japan Cement Association  
 Korea Cement Association  
 Mineral Products Association – United Kingdom  
 National Ready Mixed Concrete Association – USA  
 Portland Cement Association – USA  
 South India Cement Manufacturers Association  
 Thai Cement Manufacturers Association  
 The Spanish Cement Association (Oficemen)  
 Turkish Cement Manufacturers Association (TürkÇimento)

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# Global Perspectives on Decarbonising the Whole Life Cycle of Concrete

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**1** Essential Role of Concrete

**3** Low Carbon Procurement

**2** Global Roadmap

**4** Role of Project Teams

# Essential role of concrete

1

# UN Sustainable Development Goals

UNOPS, a UN agency, has published a report which identified that the built environment supports society in reaching 92% of the 169 targets in the 17 UN SDGs.

This 92% figure derives from consideration of all parts of the built environment: infrastructure (water, waste, energy, transport and digital communications), buildings and facilities.

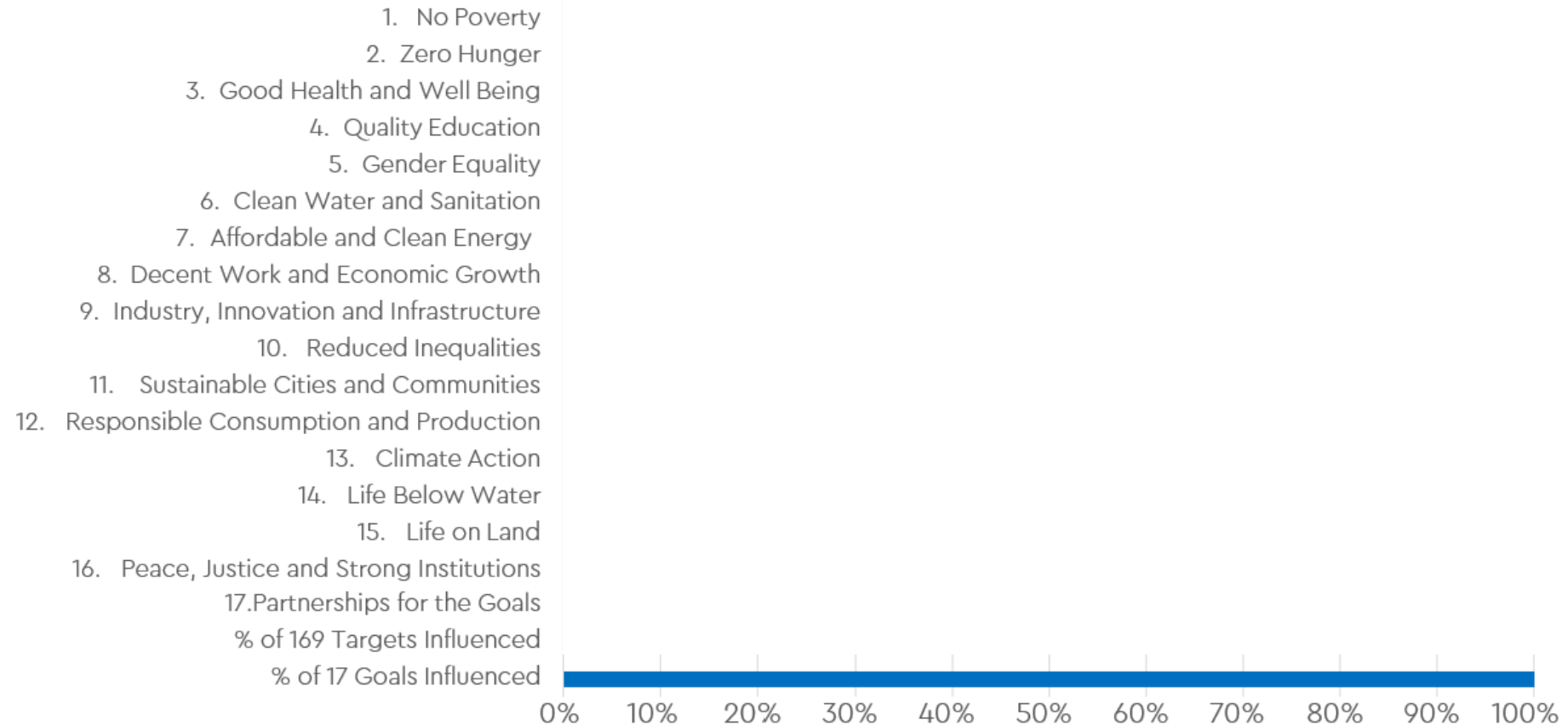


92%

built environment supports society in reaching 92% of the 169 targets

# Positive Role of Concrete in achieving each UN SDGs

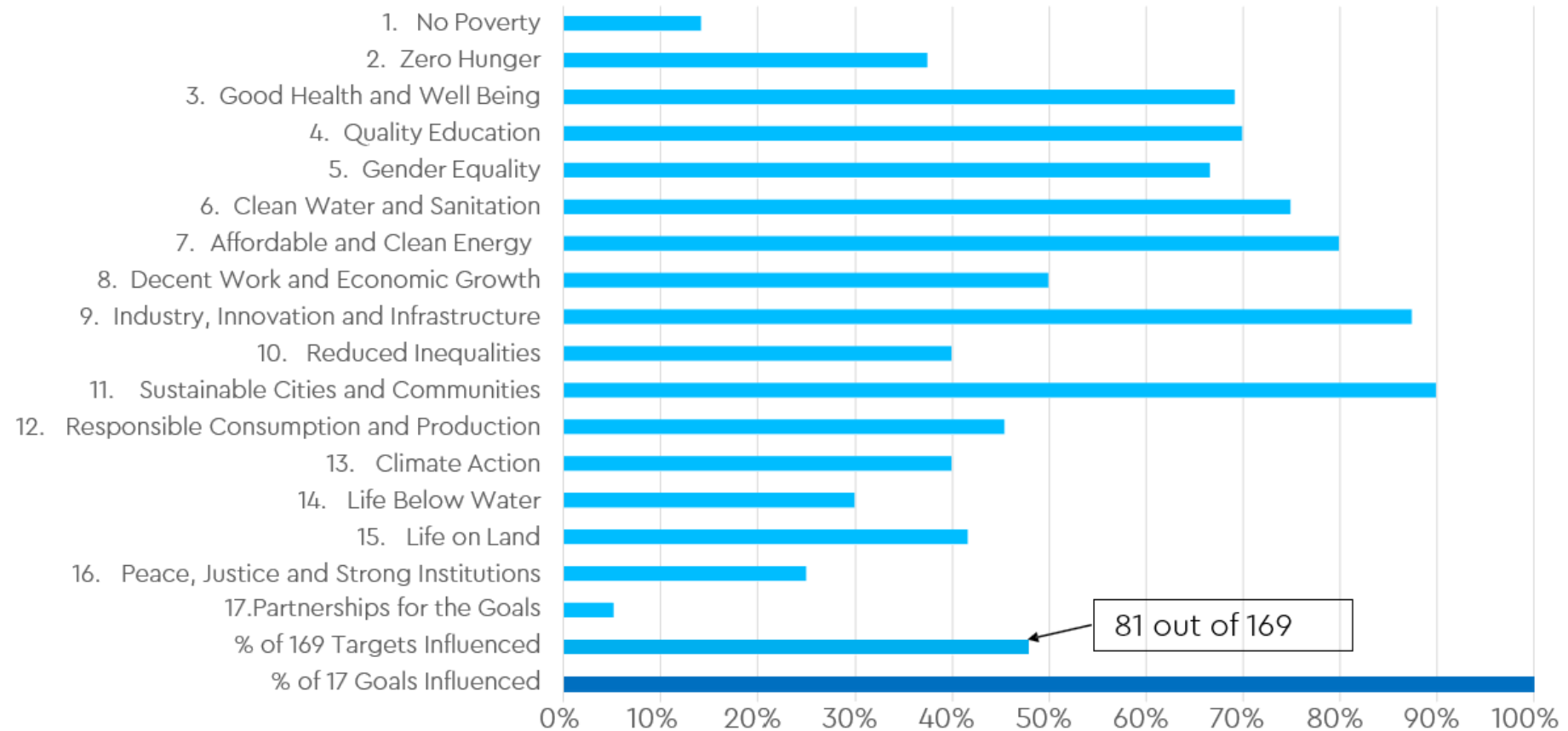
Positive Role of Concrete as % of Targets in each SDG Influenced



Source: Minson A, *The UN Sustainable Development Goals and Concrete*, fib Symposium 2020 , Concrete Structures for Resilient Society pp2237-2244

# Positive Role of Concrete in achieving each UN SDGs

Positive Role of Concrete as % of Targets in each SDG Influenced

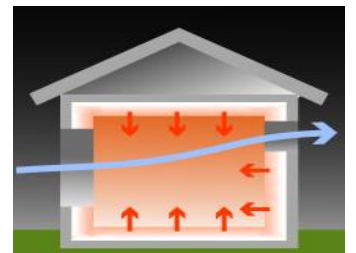
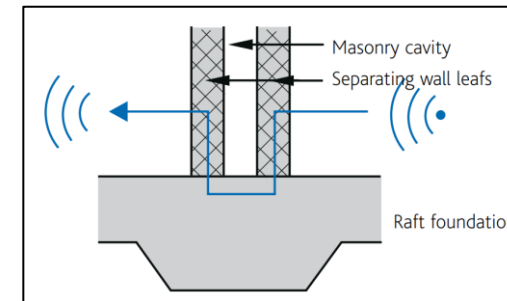


Source: Minson A, *The UN Sustainable Development Goals and Concrete*, fib Symposium 2020, Concrete Structures for Resilient Society pp2237-2244



## Performance benefits of concrete

- Strength
- Durability
- Resilience
- Fire Resistance
- Acoustic performance
- Flood resilience
- Thermal mass





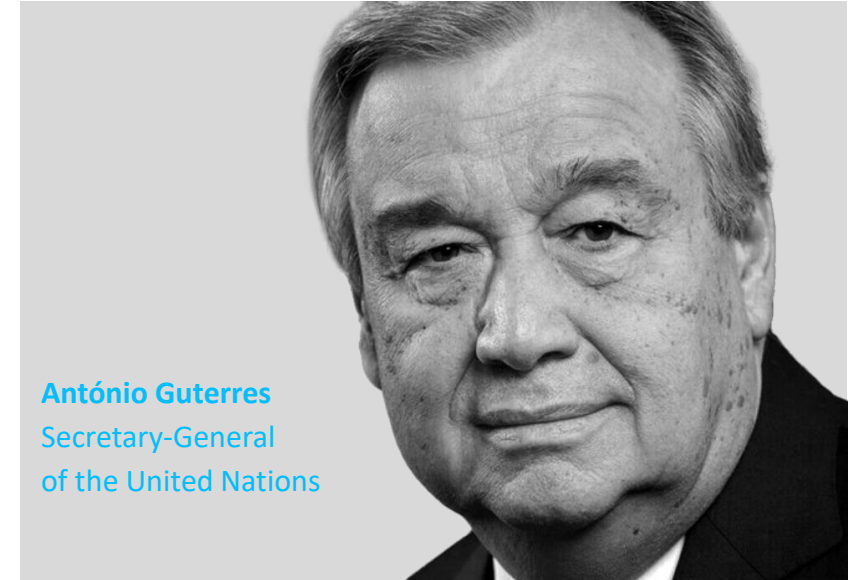
## Concrete is essential... But needs to be decarbonised

“ Three quarters of the infrastructure that will exist in 2050 has yet to be built.

Without credible action now, future generations will have no liveable planet to build upon.

The United Nations stands ready to support you in accelerating the transformation of your industry.

I invite all cement companies to join this vital endeavour.”

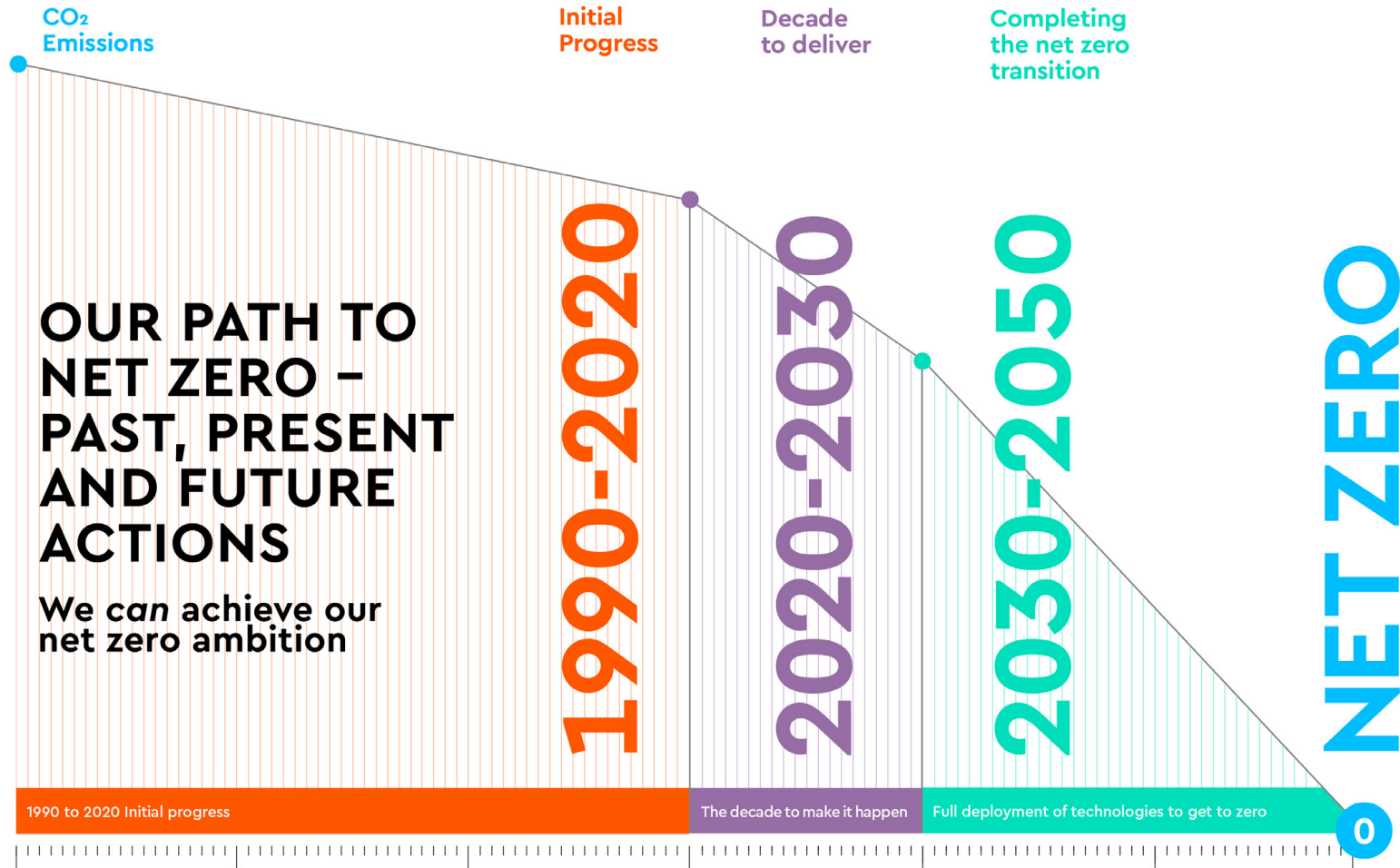


### World's infrastructure needs to 2050



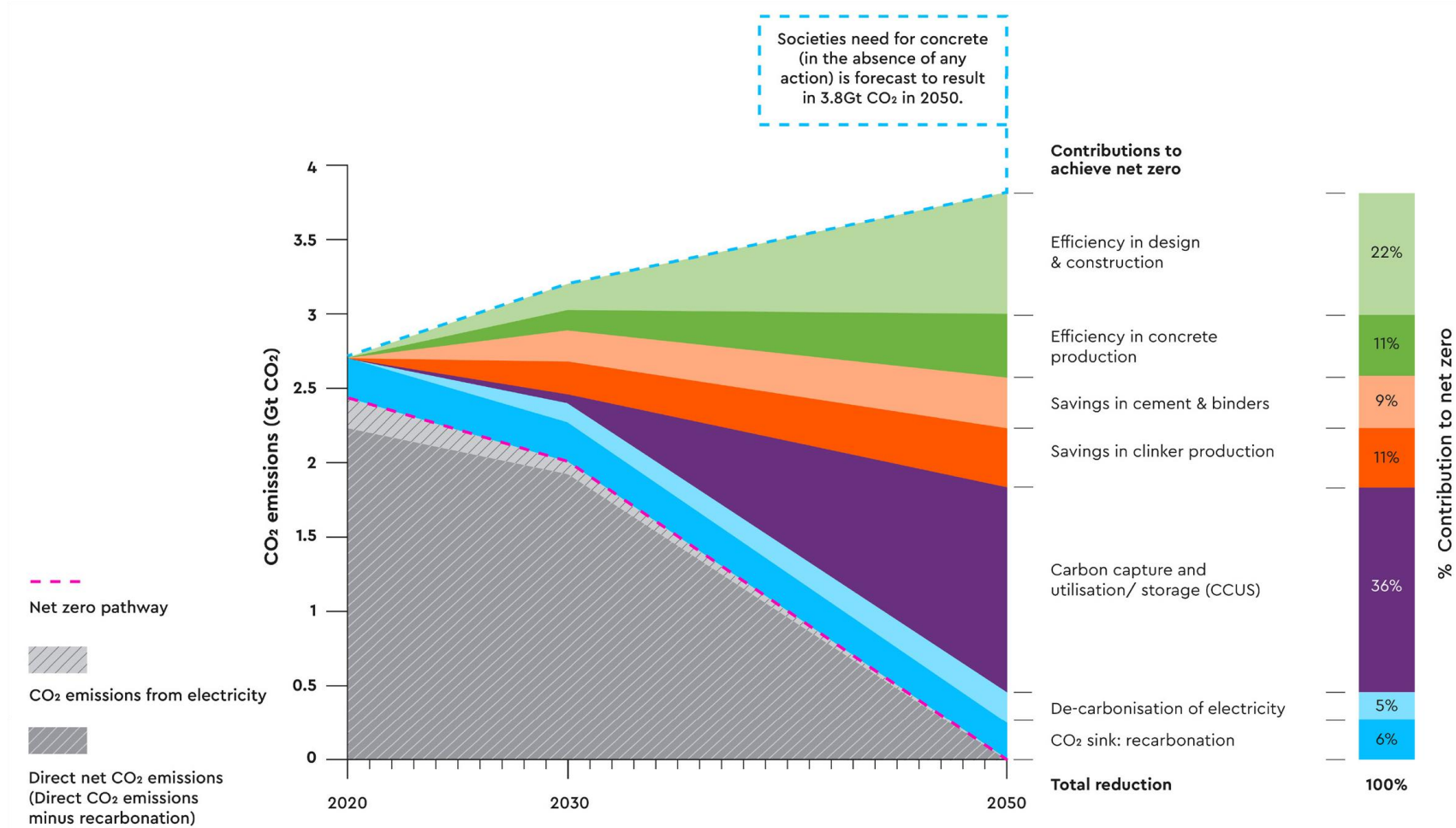
# Global Roadmap to Net Zero

# Global Roadmap to Zero



# Global Roadmap to Zero

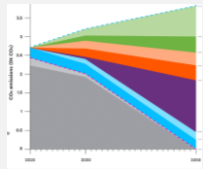
<https://gccassociation.org/cement-industry-net-zero-progress/>



# Country Roadmaps: Accelerator Initiative by GCCA

- GCCA initiative launched March 2022: catalyst for country roadmaps
- Initiative is showing good progress
- A key step in regulatory transition and financing discussion

## KEY DELIVERABLES



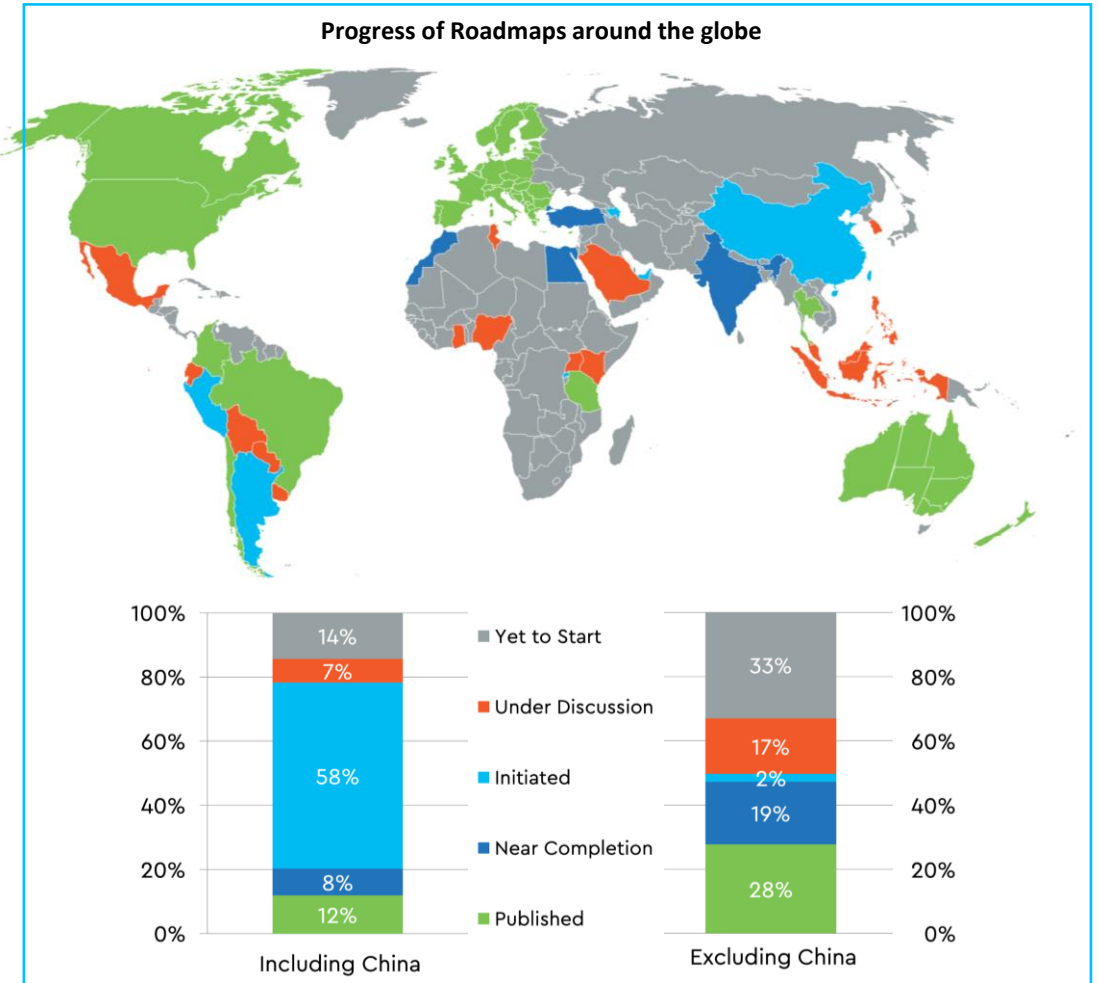
**Roadmap Levers and CO<sub>2</sub> impact**  
Per lever, quantification of potential CO<sub>2</sub> reduction 2030 & 2050



**Policy**  
Per lever, identification of enabling policies



**Lighthouse Projects**  
Per lever, identification of lighthouse projects

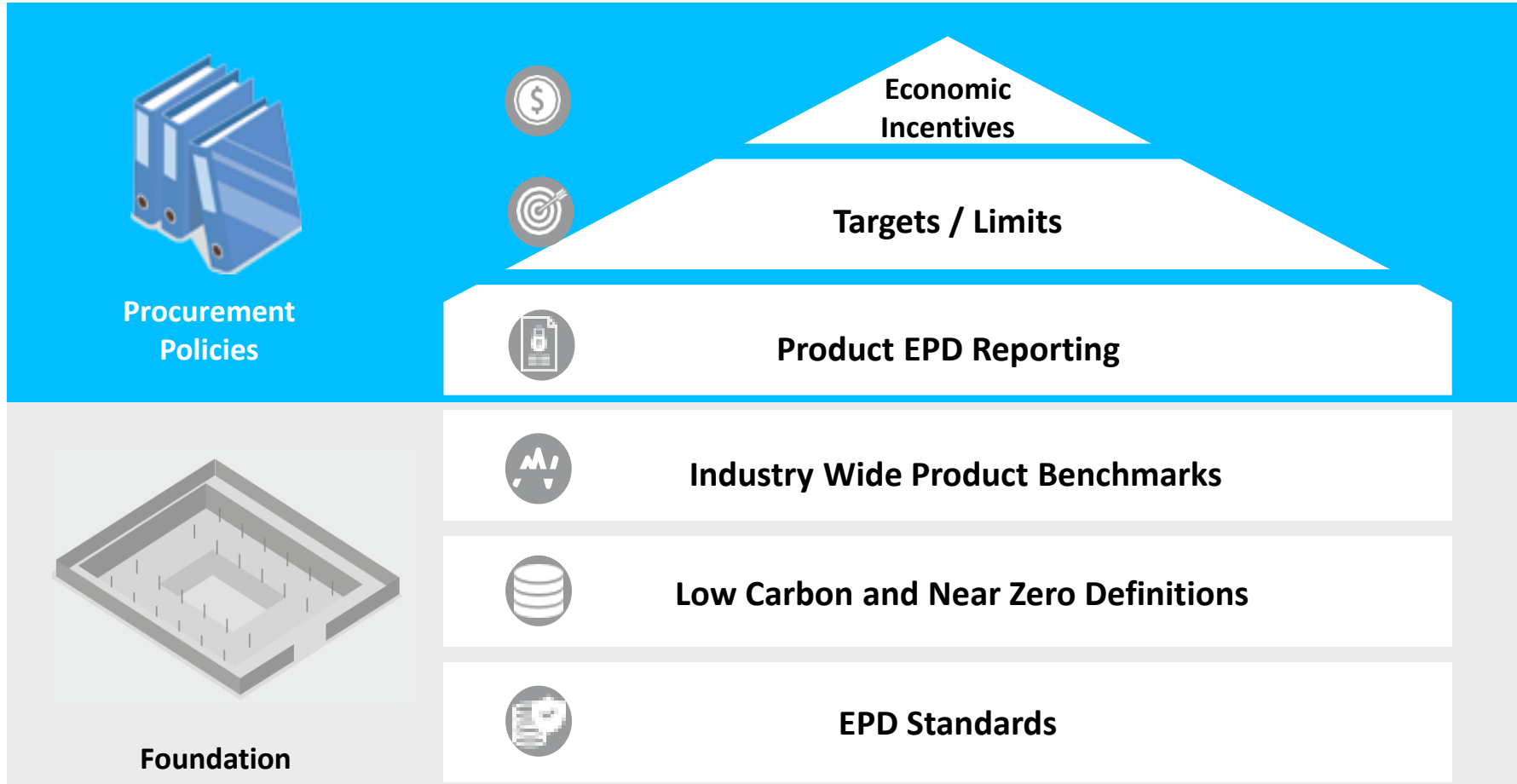


# Low Carbon Procurement

3



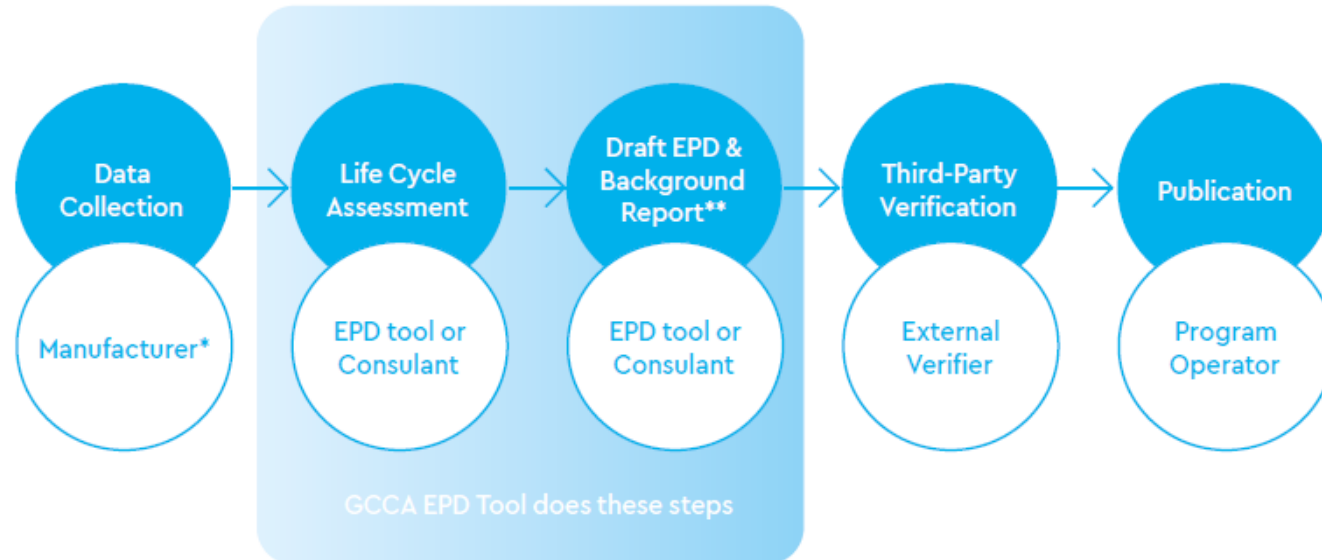
# Low Carbon Procurement



## GCCA EPD Tool

Supports companies to prepare Environmental Product Declarations (EPDs) for cement, concrete, aggregates and precast products.

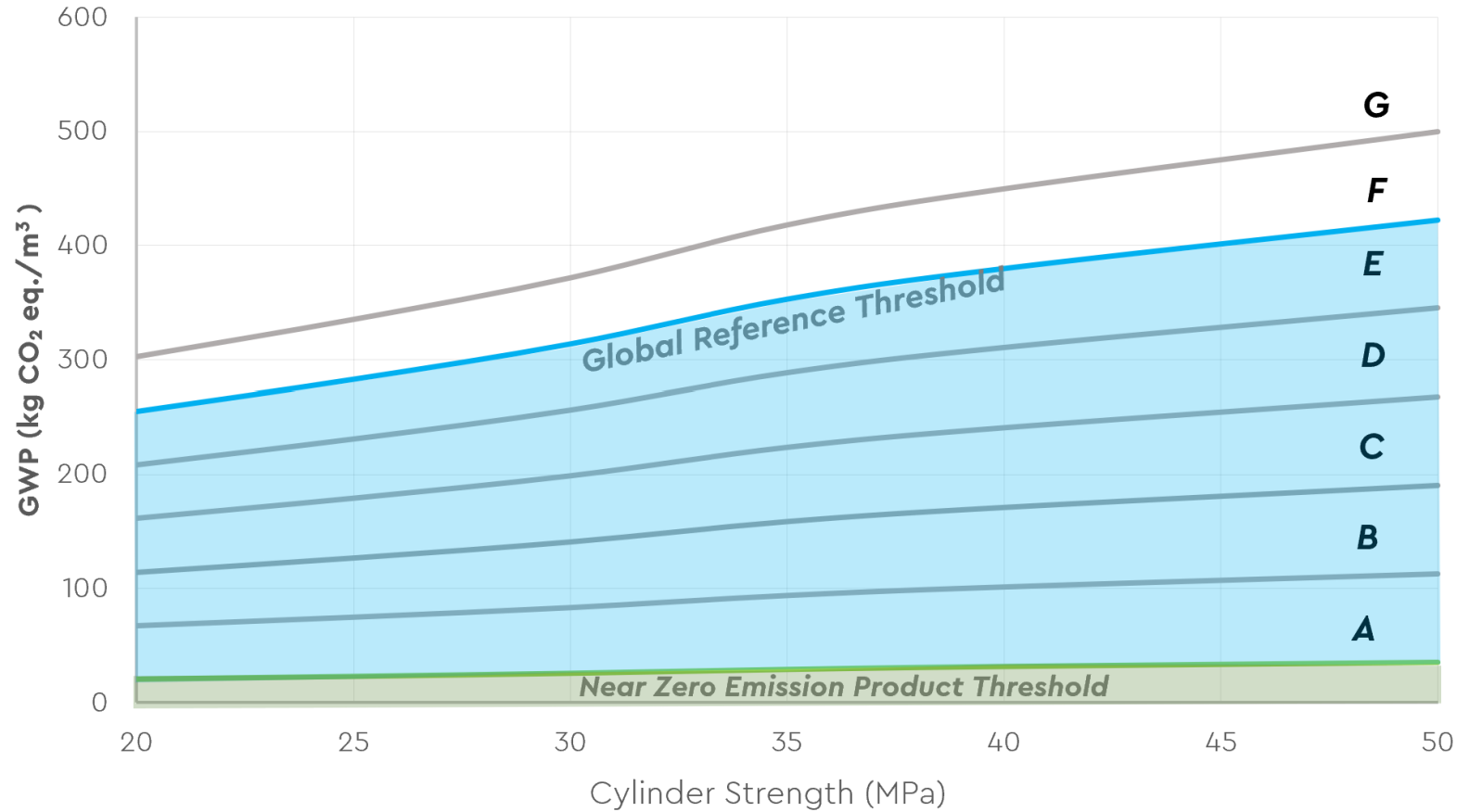
Easy and at a lower cost



*\* The manufacturer manages all stages and liaises with many points of contacts*

*\*\* The background report contains confidential information and is only used by the external verifier*

# GCCA Low Carbon and Near Zero Definitions for Concrete

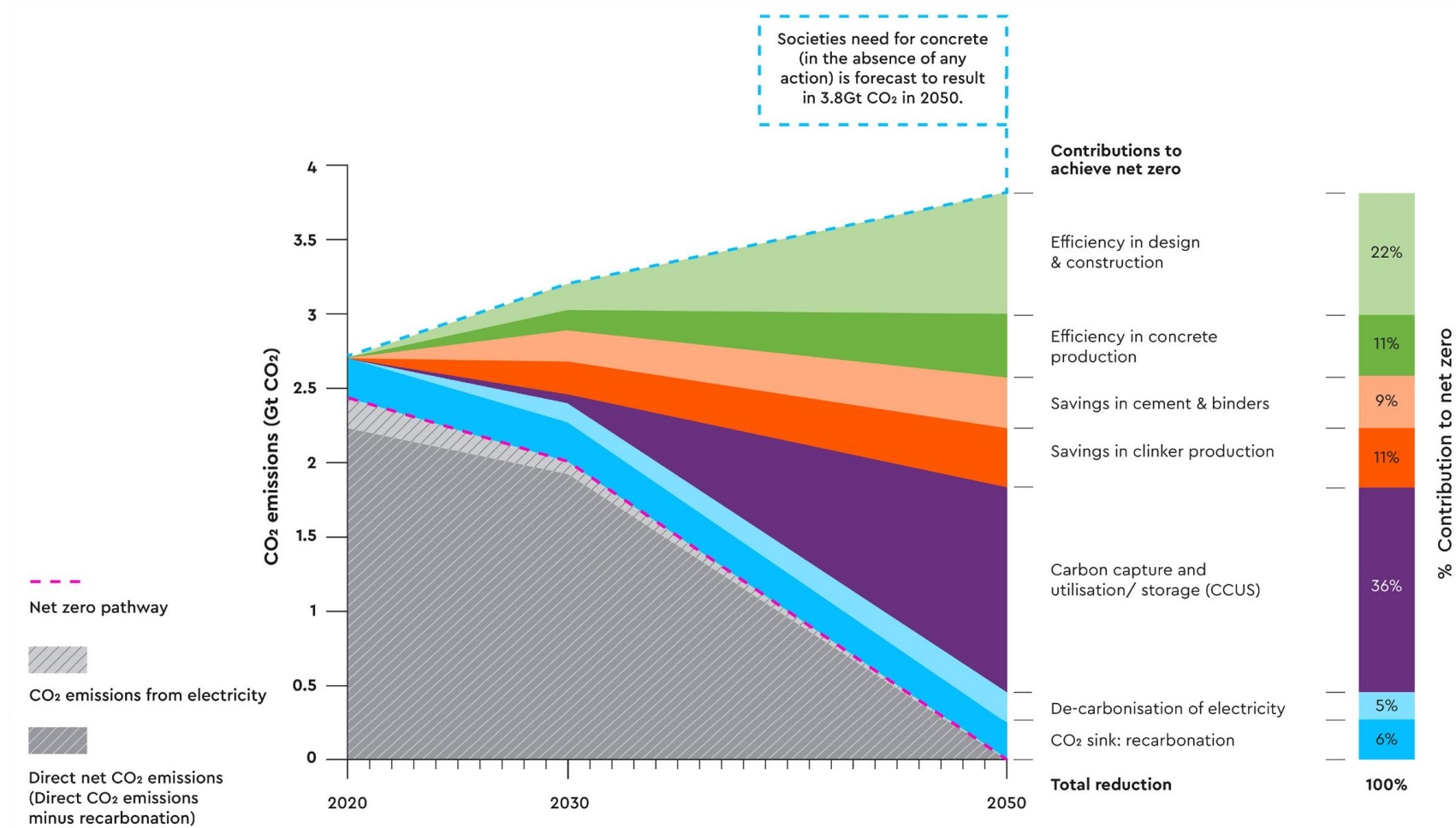


# The role of project teams

4

# Global Roadmap to Zero

<https://gccassociation.org/cement-industry-net-zero-progress/>



Contributions to achieve net zero

Efficiency in design & construction

22%

Efficiency in concrete production

11%

Savings in cement & binders

9%

Savings in clinker production

11%

Carbon capture and utilisation/ storage (CCUS)

36%

De-carbonisation of electricity

5%

CO<sub>2</sub> sink: recarbonation

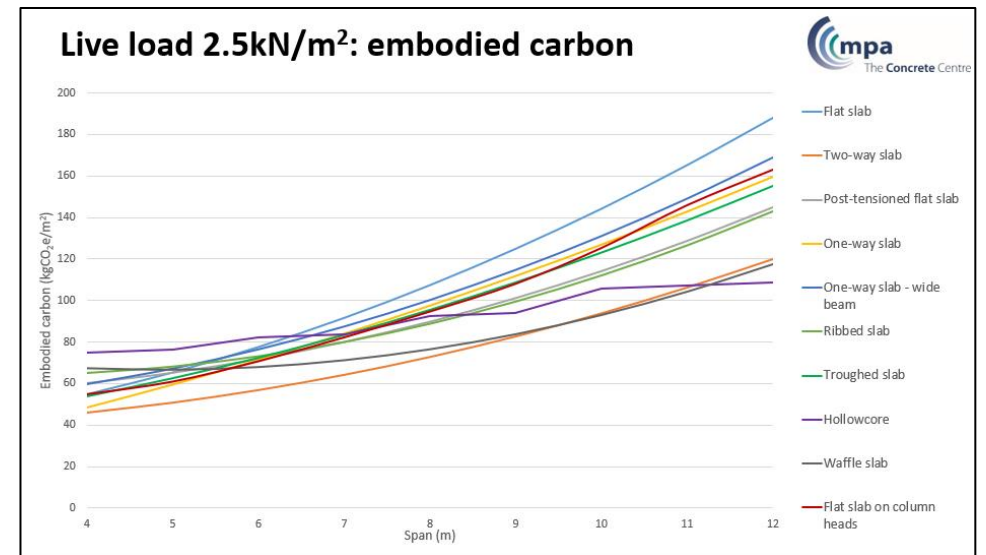
6%

Total reduction

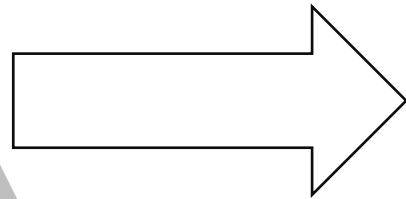
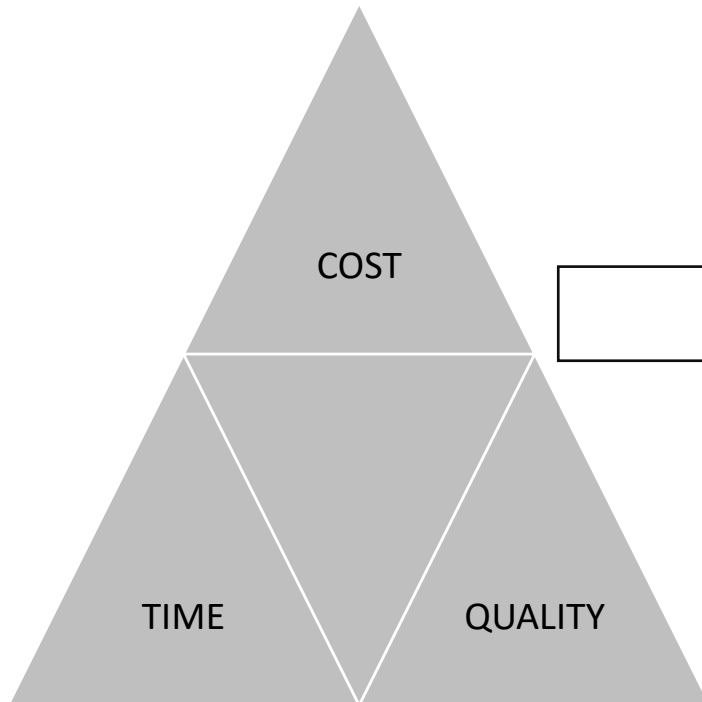
100%

% Contribution to net zero

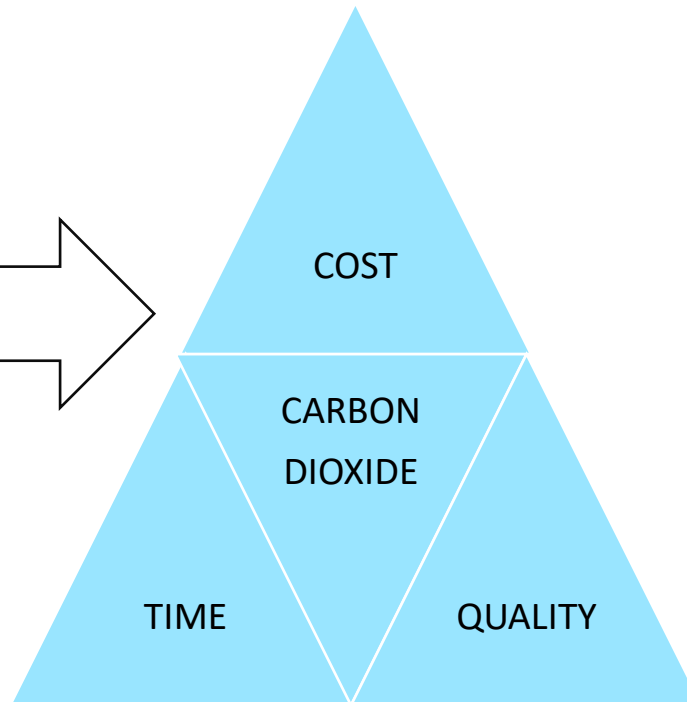
- Client brief to designers to enable optimisation
- Design optimisation
- Construction site efficiencies
- Re-use and lifetime extension



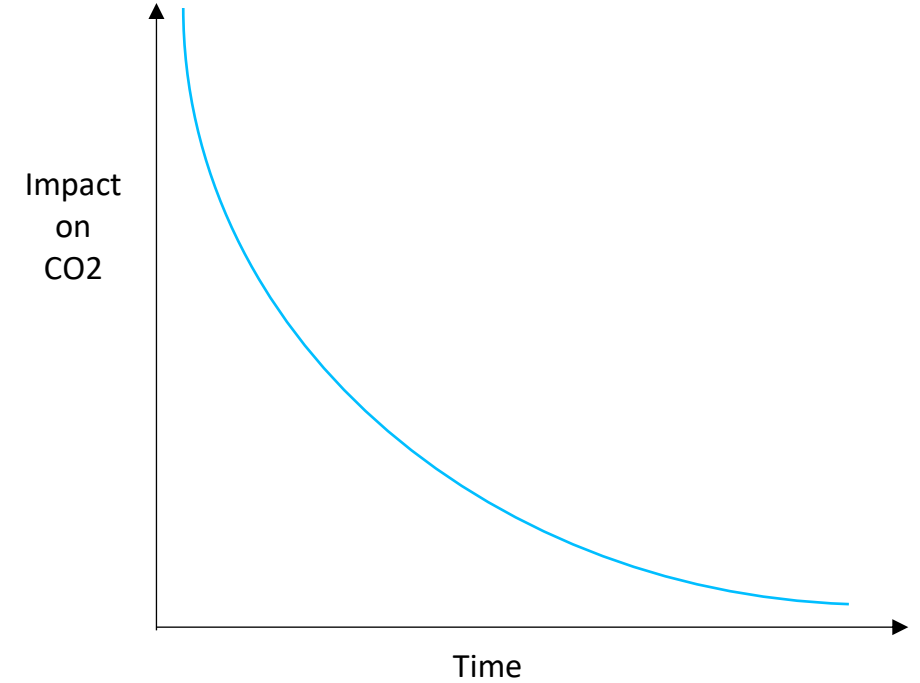
Past/Current



Current/Future



Impact v Project Stage



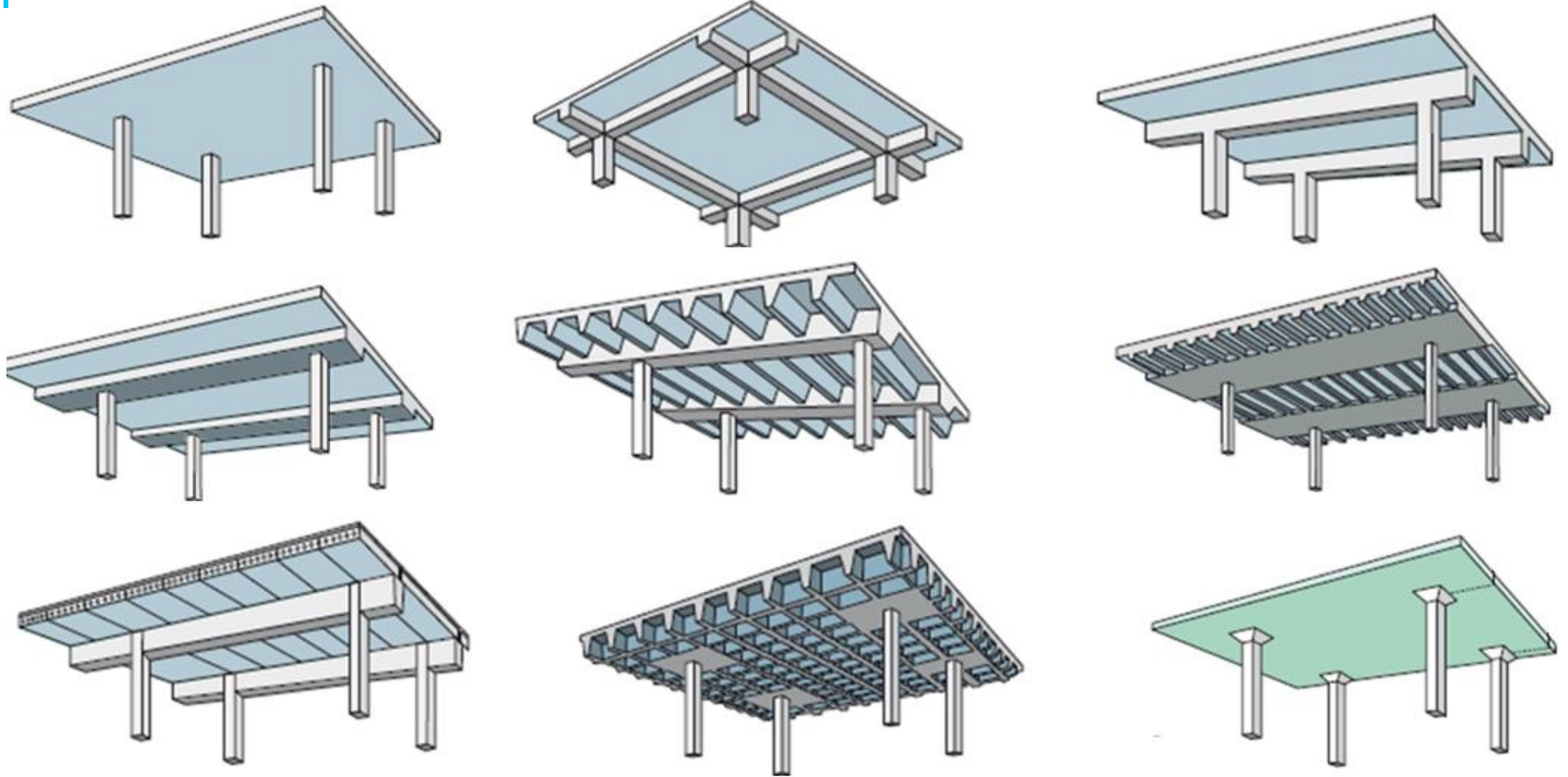
Substage	Description	Lever to reduce concrete construction carbon footprint
Concept	Material Emissions  Choices relevant to construction in all materials	1. Choice of <b>reuse/re purpose</b> of existing
		2. Choice of <b>utilisation of asset(s)</b> (what floor area is actually needed)
		3. Choice/optimisation of <b>building form/massing</b>
		4. Choice of <b>grid sizes</b> to reduce material demand
		5. Choice of <b>loading</b> to reduce material demand
		6. Choice of level of <b>future flexibility/adaptability</b> of structure
		7. Choice of <b>design life</b> – in context of overall material demand over lifetime of this and subsequent project on site
	Avoidance of other emissions	8. Choice of <b>concrete as more than structure</b> – e.g. exposed finish to reduce ceilings, floor and wall finishes (e.g. coloured concrete); exploitation of thermal mass to reduce services
		9. Choice of <b>concrete avoids need for other materials</b> such as fire protection
		10. Choice of <b>concrete avoids long term maintenance and replacement</b>

Legend: Role most able to move lever

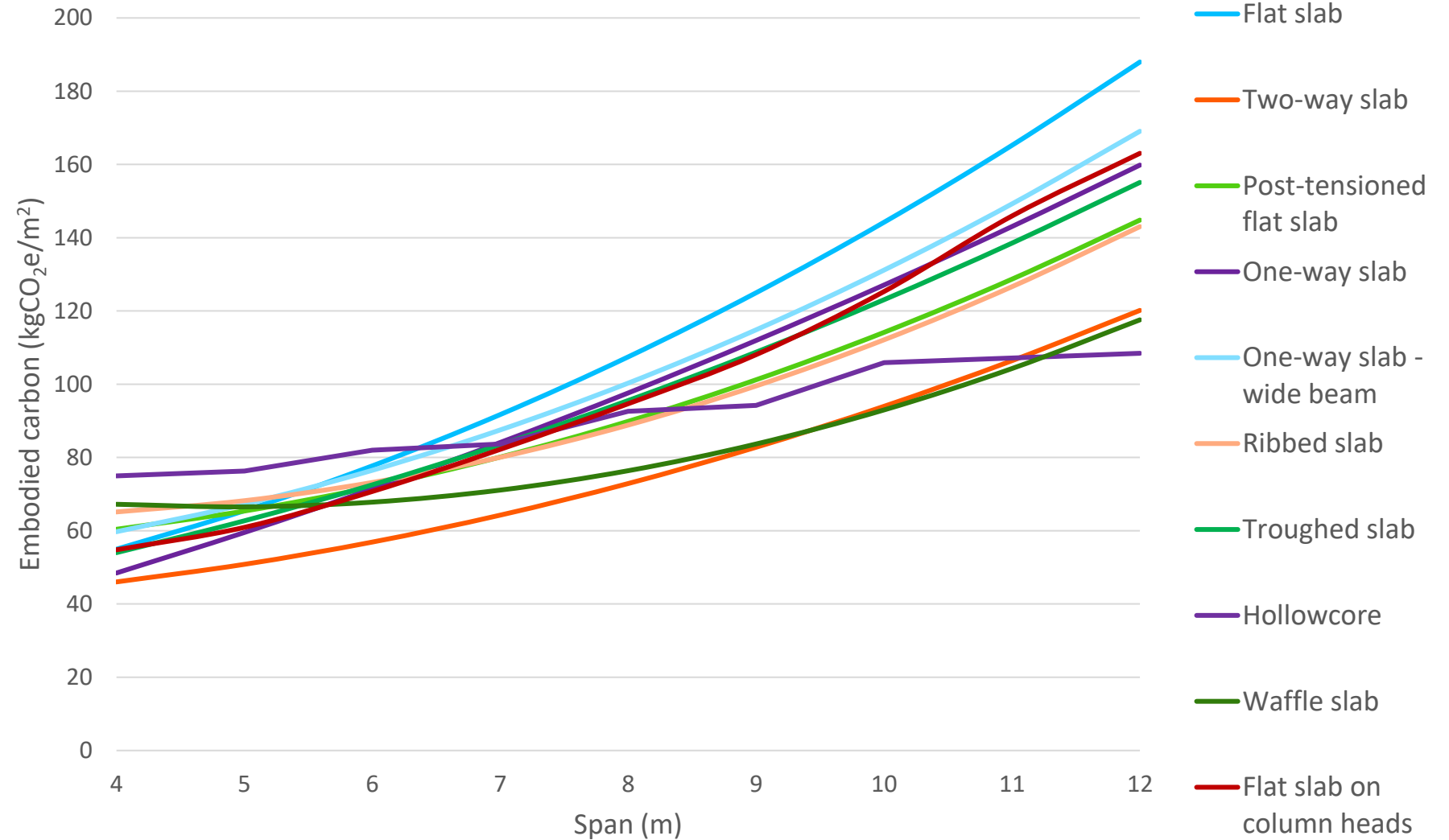
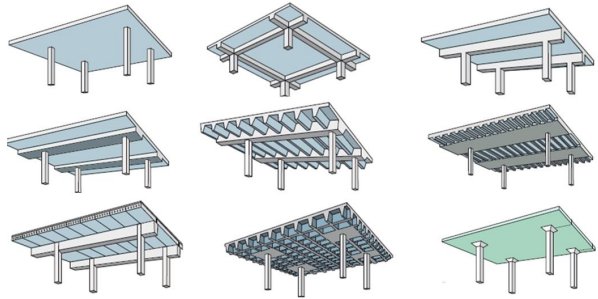
	Client
	Client (designer) or Designer



# Building Example



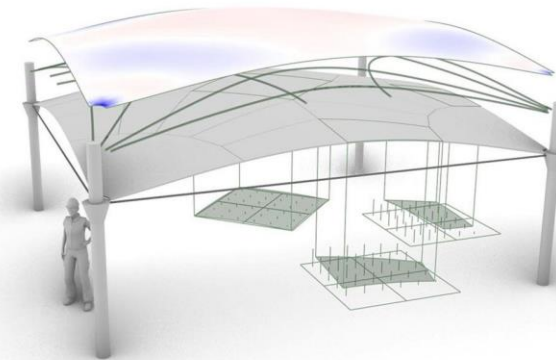
# Building Example



## Thin vaulted floor slab could slash embodied carbon by 60%

Robot-manufactured curved 'thin shell' panels on columns and a raised floor

ACORN (Automating Concrete Construction),  
by Universities of Bath, Cambridge and  
Dundee



Thank you!

Dr. Andrew Minson  
[andrew.minson@gccassociation.org](mailto:andrew.minson@gccassociation.org)