FCBS CARBON

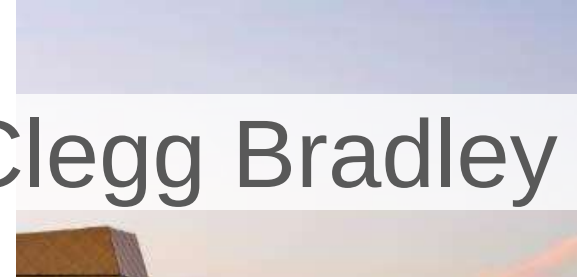
Understanding carbon from the outset

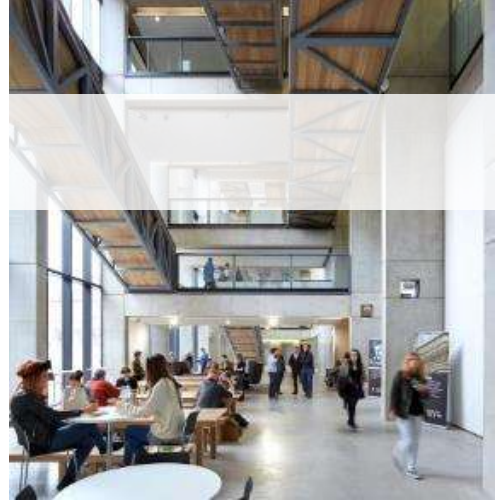
An introduction to **FCBS CARBON**

SPACES Virtual Conference

17 June 2021

Feilden Clegg Bradley Studios






AJ100 Client Choice Award

RIBA Stirling Prize

Queen's Award for Sustainable Development

54RIBA

5 RIBA Sustainability

32 Civic Trust Awards

1 Civic Trust Special Award for Education

3 Civic Trust Special Awards for Sustainability

16 Housing Design Awards

1 Europa Nostra Award for Conservation

10 Architect of the Year Awards

3 AJ100 Sustainable Practice of the Year Awards

2 New London Architecture Awards

4 Building Awards

5 Building Construction Industry Awards

Architects Declare

11 Commitments to mitigate climate change

FCBStudios a founding signatory

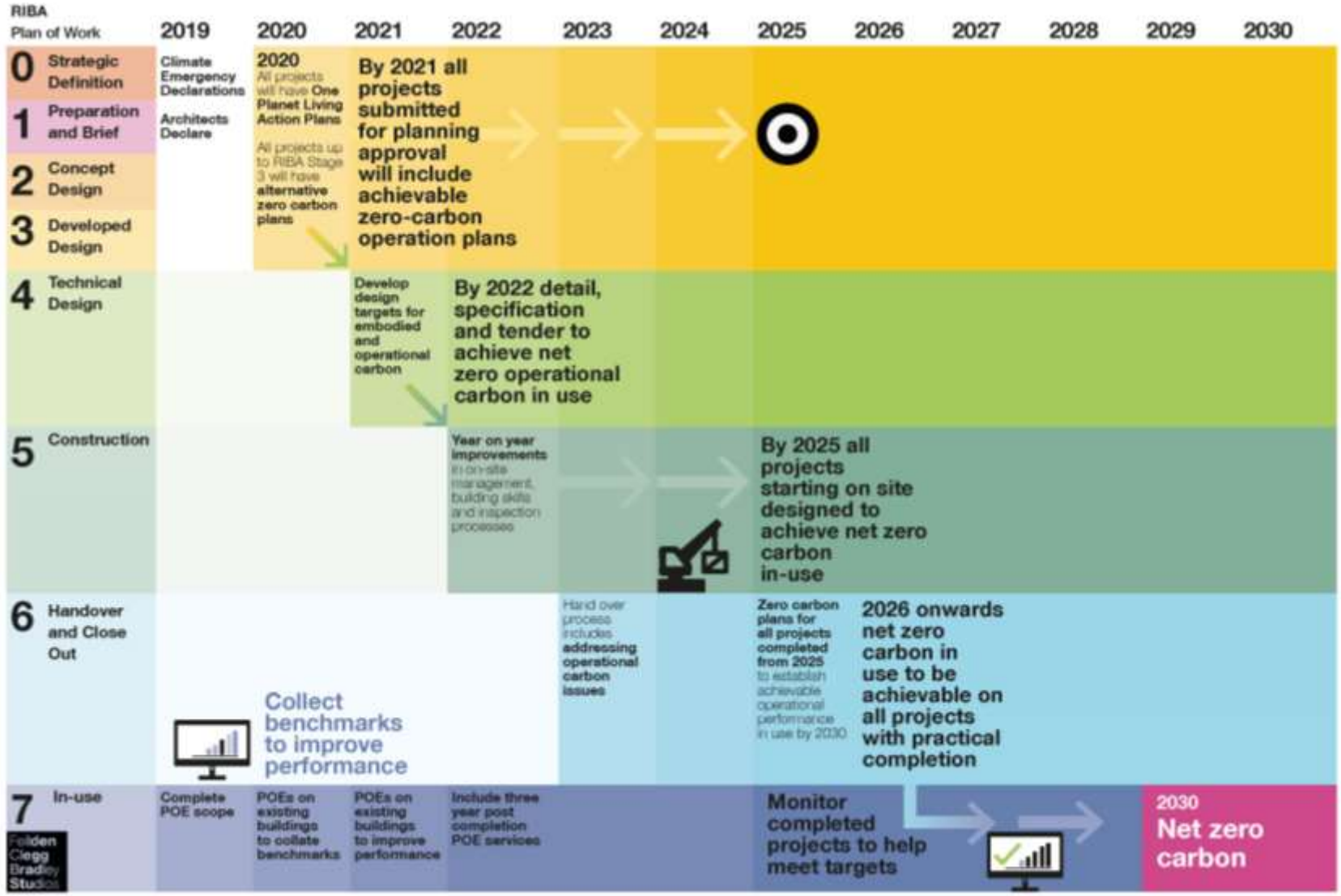
950+ have signed up

A commitment to share knowledge

https://www.architectsdeclare.com/

Contents

FCBStudios' Route to Zero Carbon



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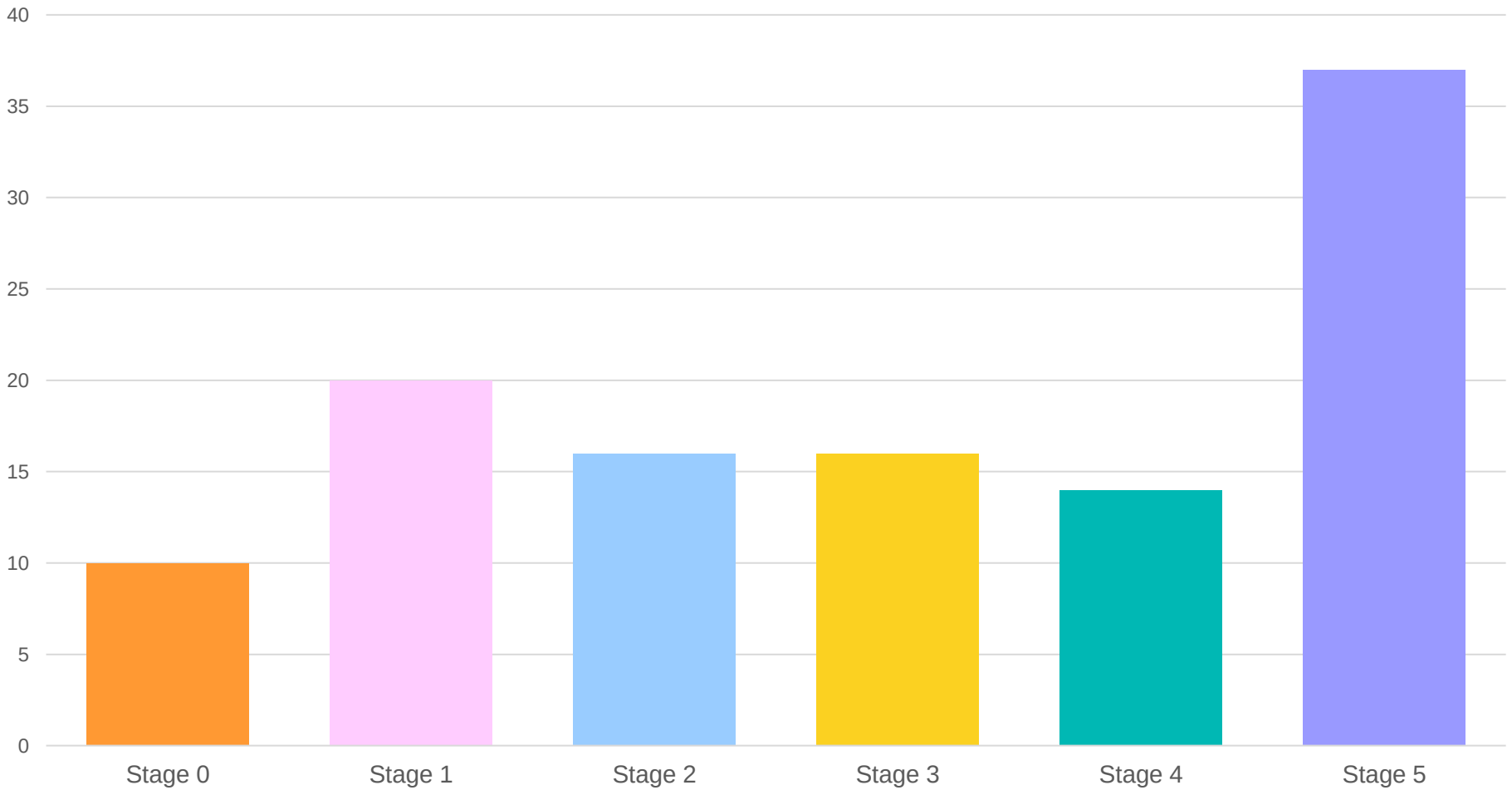
Scale of FCBStudios



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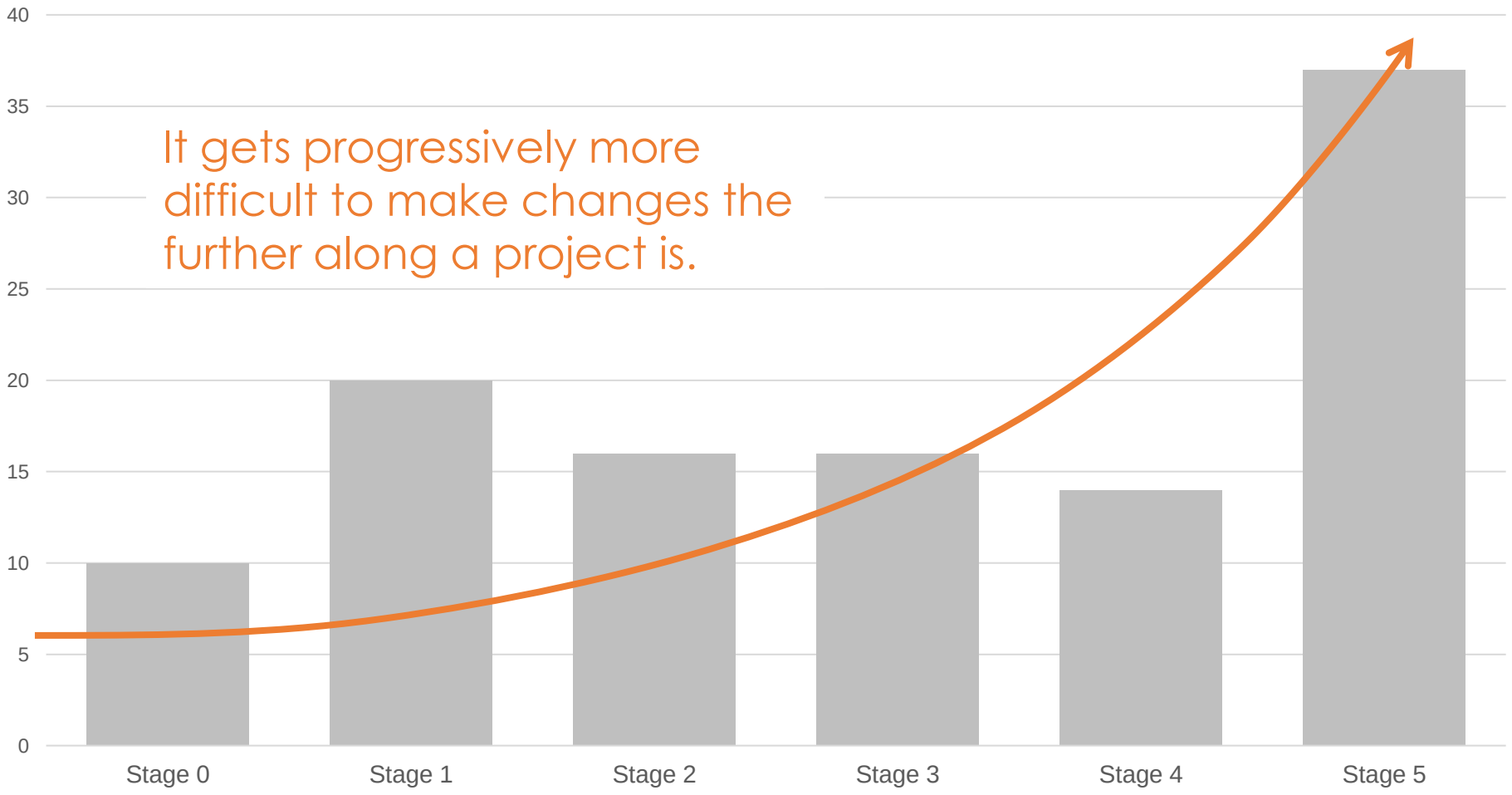
When to make changes?



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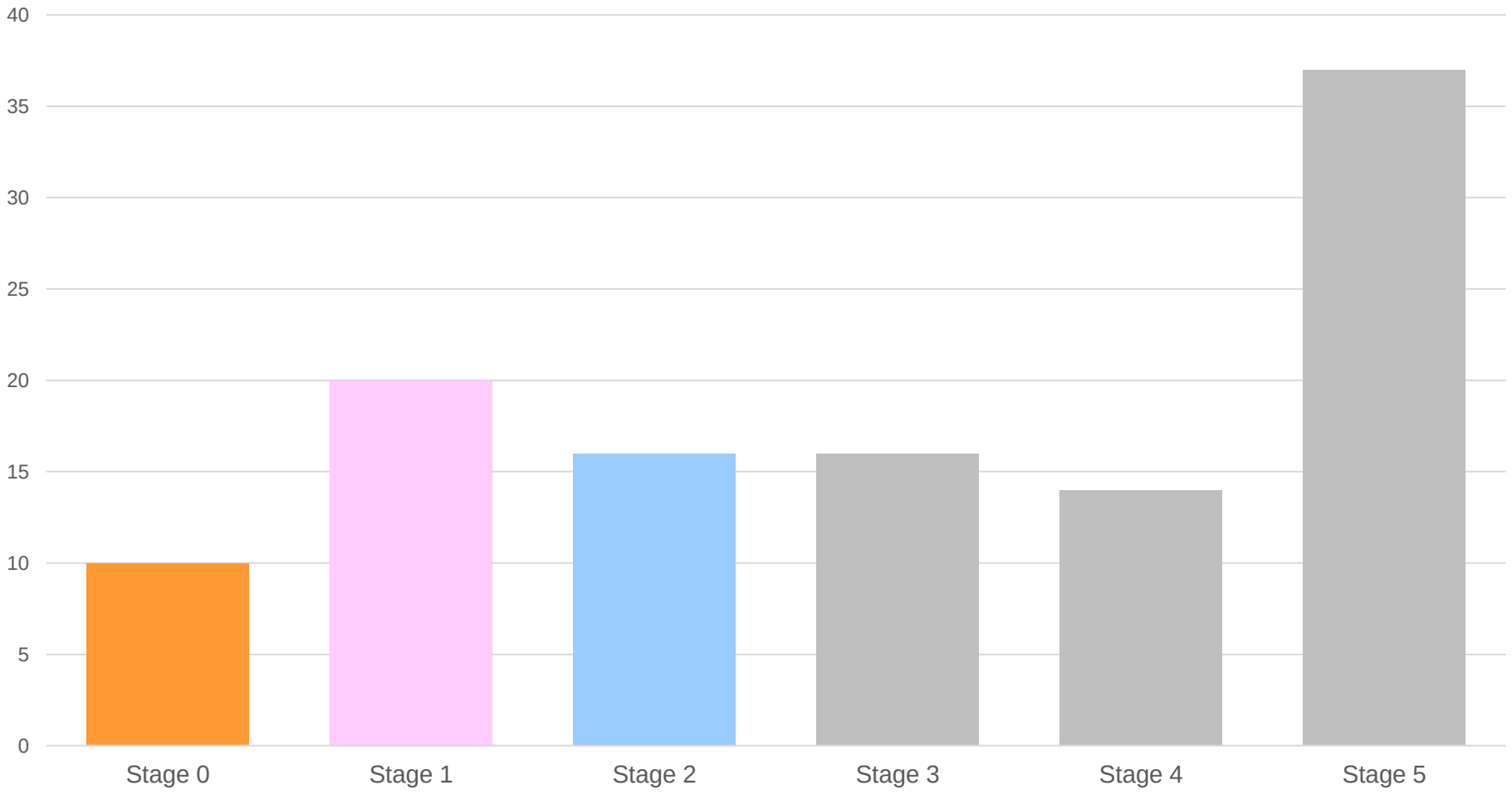
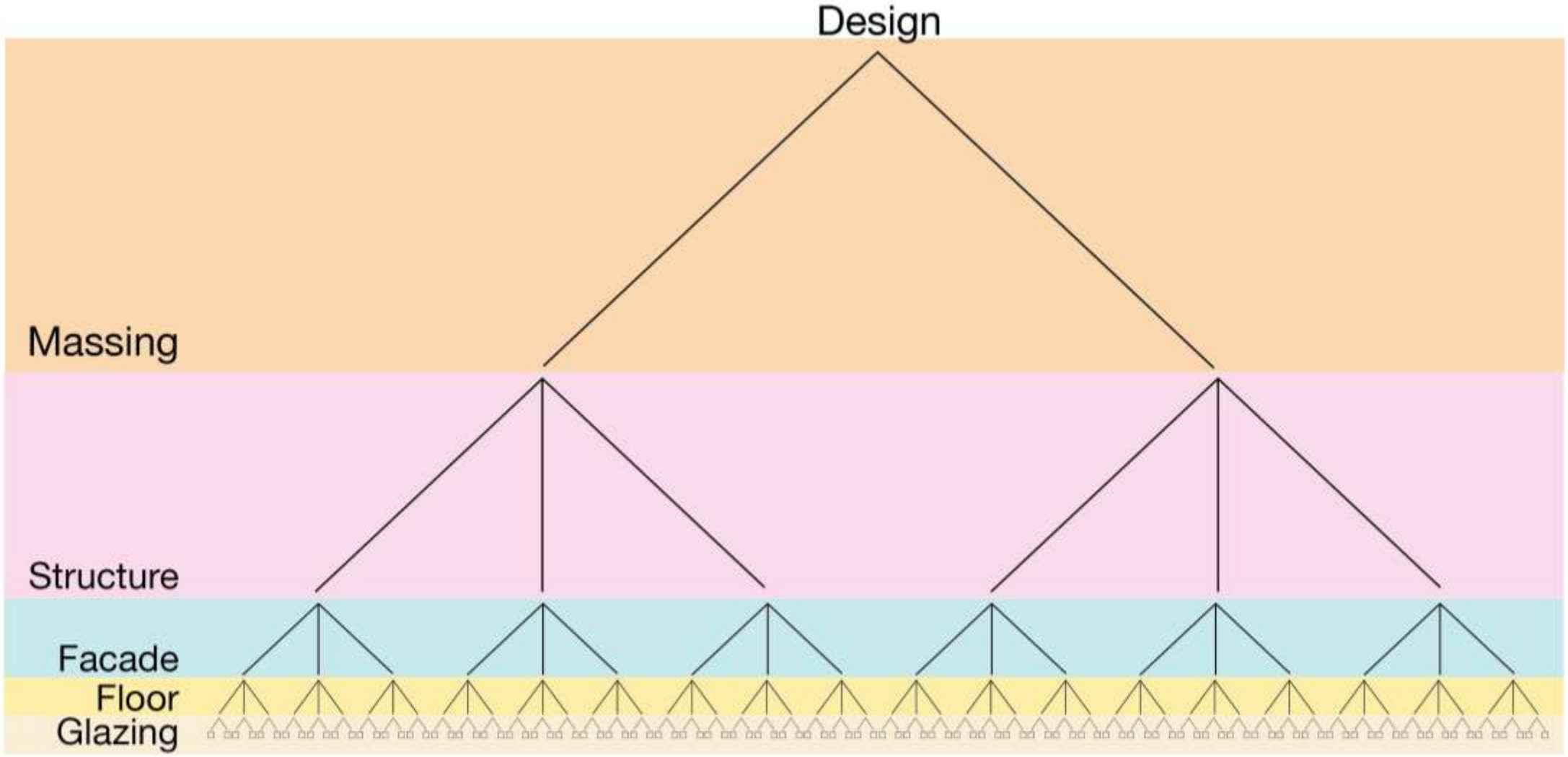


Design Iteration



108 design iterations

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FCBS CARBON Approach

Building an accurate Whole Life Carbon model requires a detailed **bill of materials**.

But as designers we need to know the impact of our decisions quickly and BoMs are time consuming.

Instead, we have a library of **standard construction build-ups** that we apply to an **algorithmically described building**.

The role of **FCBS CARBON**

We developed a tool:

- To record the details of our projects
- To estimate the whole life of our projects
- To understand how our buildings emit carbon

We're focusing on those early stages, where the biggest decisions can be made.

It's currently based in excel so there are few barriers to adoption.

We need to understand **direction** & **magnitude** at the early stages, keeping carbon in the discussion.

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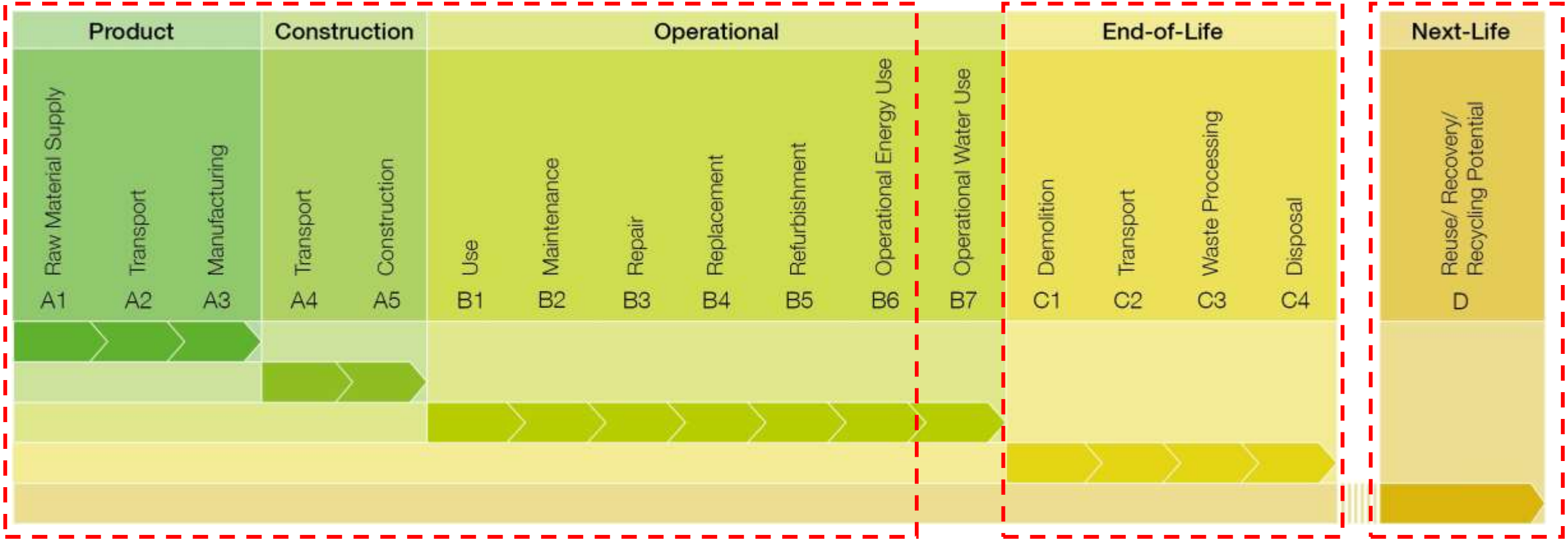
An early stage **Whole Life Carbon** model



LCA modules included in FCBS CARBON

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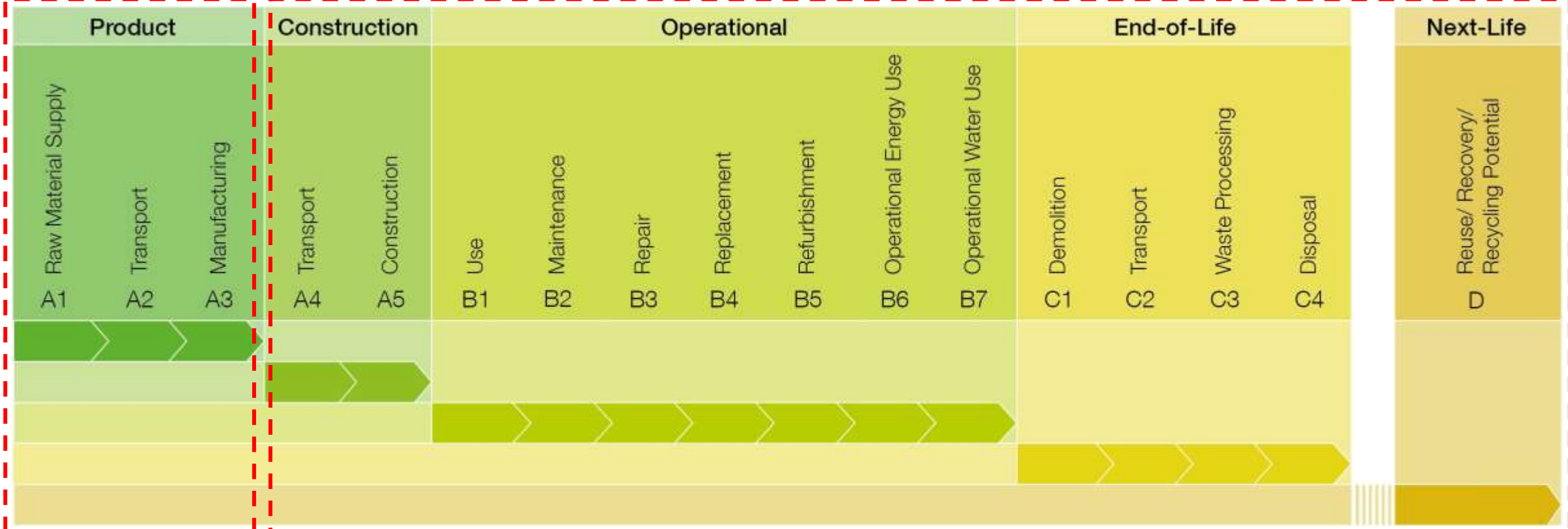
An early stage **Whole Life Carbon** model



From the ICE database and EPDs

Estimated as percentage uplifts on A1-A3 based on LETI ECP

FCBS CARBON predictions could up as well as down...

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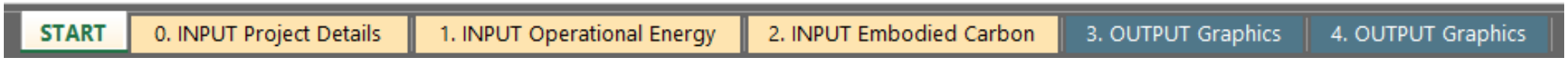
FCBS CARBON Structure

Three **input** pages:

0. Project Details
1. Operational Energy
2. Embodied Carbon

Two **output** pages:

3. Overview
4. Detailed



Boxes in **yellow** are inputs.

Boxes in **dark blue/grey** are calculated.

0. **Input** Project Details

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Project Number:	Example Project
Project Name:	0.7 Test
Building Name:	Example Building
Stage:	0
* **Est. Year of project completion:**	2024
* **Sector:**	Housing
* **Sub-sector:**	Multi-family (6 - 15 storeys)
* **GIA:**	3500
Assessment date:	17/07/2020
Asssessment completed by:	JT

* Required for sheet calculations

Stated environmental objectives:
What are the drivers and aims of the assessment?

A page to capture global variables and also record other sustainability aspirations.

These global variables must be set otherwise it will generate errors.

There is space for an image if needed.

1. **Input** Operational Energy

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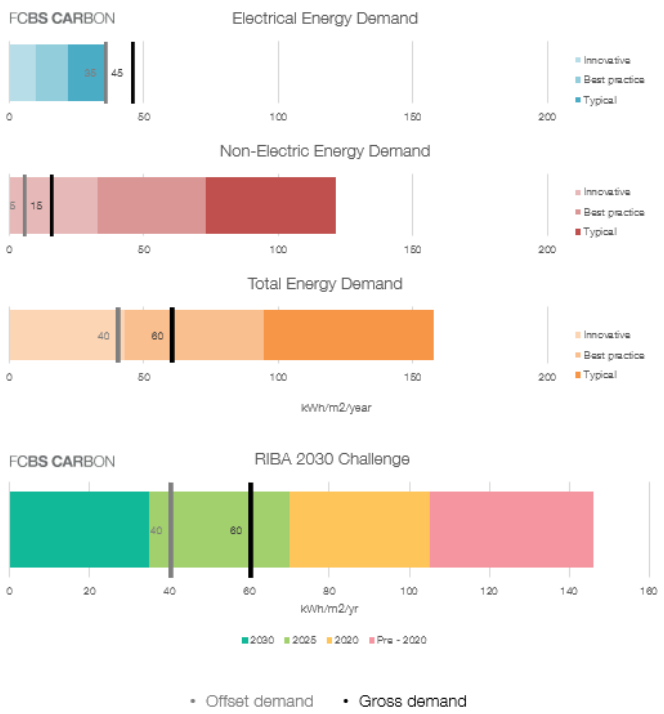
Building Details					
Supplied on 0. INPUT Project Details					
Building Name	Example Building				
Sector	Housing				
Sub-sector	Multi-family (6 - 15 storeys)				
GIA	3500 m2				
Subsector Benchmarks					
	kWh/m2/yr				
	Typical	Best Practice	Innovative	Pioneering	
Electrical energy	36	22	10	0	
Non-electric energy	121	73	33	0	
Total energy	158	95	43	0	
User inputs required					
Calculation methodology:	Estimate				
Regulated energy use - electrical					
Space heating		kWh/m2/yr			
Hot water		kWh/m2/yr			
Cooling		kWh/m2/yr			
Fans and pumps		kWh/m2/yr			
Lighting		kWh/m2/yr			
Other	35	kWh/m2/yr			
Total	35	kWh/m2/yr			
Regulated energy use - non-electric					
Heating	15	kWh/m2/yr			
Hot water		kWh/m2/yr			
Other		kWh/m2/yr			
Total	15	kWh/m2/yr			
Anticipated unregulated energy use - electrical					
Computers		kWh/m2/yr			
Server rooms		kWh/m2/yr			
Appliances		kWh/m2/yr			
Other	10	kWh/m2/yr			
Total	10	kWh/m2/yr			
Anticipated unregulated energy use - non-electic					
Cooking		kWh/m2/yr			
Other		kWh/m2/yr			
Total	0	kWh/m2/yr			
Power generation					
Electrical	10	kWh/m2/yr			
Non-electric (solar thermal et	10	kWh/m2/yr			
Total	20	kWh/m2/yr			

FCBS CARBON



BETA V0.8

The operational energy pages requires manual input.

It provides sector benchmarks to help guide your expected energy usage.

If you have a break-down of energy uses, great! But if you don't just put in the headline figures.

The graphs on the right will update with the gross and net energy usage.

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2. **Input** Embodied Carbon

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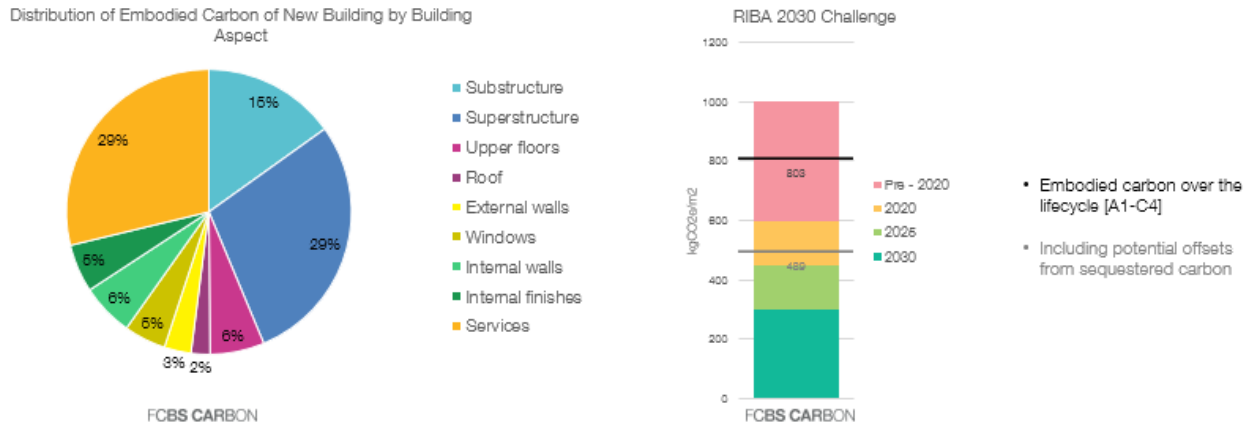
FCBS CARBON

Building Details		
Supplied on 0. INPUT Project Details		
Building Name	Example Building	
Sector	Housing	
Sub-sector	Multi-family (6 - 15 storeys)	
GIA	3500	m2
Associated with selected sub-sector		
Grid size	6	m
Partitions factor	1	
RIBA 2030 Challenge Category	Domestic	
Imposed floor load	1.5	kN/m2
User inputs required		
Building perimeter	90	m
Building footprint	500	m2
Building width	20	m
Floor-to-floor height	3.5	m
No. storeys ground & above	6	
No. storeys below ground	1	
Glazing ratio	30	%



Building Aspect	Building Element	Material	Existing fabric?	Age if existing?	Adjustment Factor (%)	Component Life (years)	Designed for disassembly?	Estimated Quantity	Units	Life cycle embodied carbon estimate A - C (kgCO2e/m2)	A1 - A3 Biogenic carbon (sequestered kgCO2e/m2)	Potential benefits beyond the system boundary D (kgCO2e/m2)	Assumptions	Notes
Substructure	Piles	RC 32/40 (50kg/m3 rein	New			80	No	224.8	m3	34.7	0.0	0.0	15 m depth, 600 mm diameter, 500 kN per pile	
Substructure	Pile caps	RC 32/40 (200kg/m3 re	New			80	No	15.8	m3	3.3	0.0	0.0	0.75 x 2 x 1.5 m caps	
Substructure	Capping beams	RC 32/40 (200kg/m3 re	New			80	No	40.5	m3	8.5	0.0	0.0	750 x 600 mm beam sections	
Substructure	Basement walls	RC 32/40 (125kg/m3 rei	New			80	No	252.0	m3	46.0	0.0	0.0	800 mm wall thickness	
Substructure	Lowest floor slab	RC 32/40 (150kg/m3 rei	New			80	No	150.0	m3	28.8	0.0	0.0	300 mm slab thickness	
Superstructure	Core structure	Precast RC 32/40 (100k	New			80	No	222.2	m3	42.7	0.0	0.0	200 mm wall thickness	
Superstructure	Columns	Steel	New			80	No	6.5	m3	43.6	0.0	0.0	UC 254 x 254	
Superstructure	Beams	Steel	New			80	No	10.8	m3	72.4	0.0	0.0	UB 533 x 210	
Superstructure	Secondary beams	Steel	New			80	No	10.5	m3	70.9	0.0	0.0	75% of material in primary beam	
Upper floors	Floor slab	CLT	New			80	No	600.0	m3	49.6	-140.4	0.0	200 mm slab thickness	
Roof	Roof	CLT	New			80	No	100.0	m3	8.3	-23.4	0.0	200 mm slab thickness	
Roof	Roof insulation	Rockwool	New			30	No	125.0	m3	7.2	0.0	0.0	250 mm insulation thickness	
Roof	Roof finishes	Asphalt (Mastic)	New			30	No	500.0	m2	1.7	0.0	0.0	20 mm thickness	
External walls	Facade	Timber	New			40	No	1323.0	m2	5.4	-12.2	0.0	See "Build-ups" sheet	
External walls	Wall insulation	Rockwool	New			30	No	330.8	m3	19.1	0.0	0.0	250 mm insulation thickness	
Windows	Glazing	Double Glazing	New			40	No	6.1	m3	18.4	0.0	0.0	Two panes of 6 mm glass	
Windows	Window frames	Al/Timber Composite	New			40	No	2126.3	m	19.8	-2.7	0.0	See "Build-ups" sheet	
Internal walls	Partitions	CLT	New			80	No	578.8	m3	47.8	-135.4	0.0	120 mm wall thickness	
Internal finishes	Ceilings	Exposed Soffit	New			80	No	3500.0	m2	0.0	0.0	0.0	None	
Internal finishes	Floors	Carpet	New		70%	20	No	3500.0	m2	26.4	0.0	0.0	12 mm carpet thickness	
Internal finishes	Floors	Vinyl	New		20%	20	No	3500.0	m2	10.2	0.0	0.0	3 mm vinyl thickness	
Internal finishes	Floors	Stoneware tile	New		10%	20	No	3500.0	m2	7.2	0.0	0.0	10 mm tile thickness	
Services	Services	Medium	New			20	No	3500.0	m2	231.0	0.0	0.0	60 kgCO2e/m2 flat rate estimate	
								0		0.0	0.0	0.0		
								0		0.0	0.0	0.0		
								0		0.0	0.0	0.0		

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2. **Input** Embodied Carbon

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FCBS CARBON

Building Details		
Supplied on 0. INPUT Project Details		
Building Name	Example Building	
Sector	Housing	
Sub-sector	Multi-family (6 - 15 storeys)	
GIA	3500	m2
Associated with selected sub-sector		
Grid size	6	m
Partitions factor	1	
RIBA 2030 Challenge Category	Domestic	
Imposed floor load	1.5	kN/m2
User inputs required		
Building perimeter	90	m
Building footprint	500	m2
Building width	20	m
Floor-to-floor height	3.5	m
No. storeys ground & above	6	
No. storeys below ground	1	
Glazing ratio	30	%

The top blue/grey section includes the global parameters from 0. Input, and sector specific assumptions.

The yellow boxes are your specific design:

1. Perimeter
2. Footprint
3. Width
4. Floor to Floor Height
5. Storeys above ground
6. Storeys below ground
7. Glazing Ratio

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2. **Input** Embodied Carbon

The first three columns are where the material/constructions are assigned to building elements.

The next five columns enable the materials to be tailored further, including lifespan, tagging existing elements, and those designed for disassembly.

The blue/grey cells show the calculated data and some of the underlying assumptions.

Building Aspect	Building Element	Material	Existing fabric?	Age if existing?	Adjustment Factor (%)	Component Life (years)	Designed for disassembly?	Estimated Quantity	Units	Life cycle embodied carbon estimate A - C (kgCO2e/m2)	A1 - A3 Biogenic carbon (sequestered kgCO2e/m2)	Potential benefits beyond the system boundary D (kgCO2e/m2)	Assumptions	Notes
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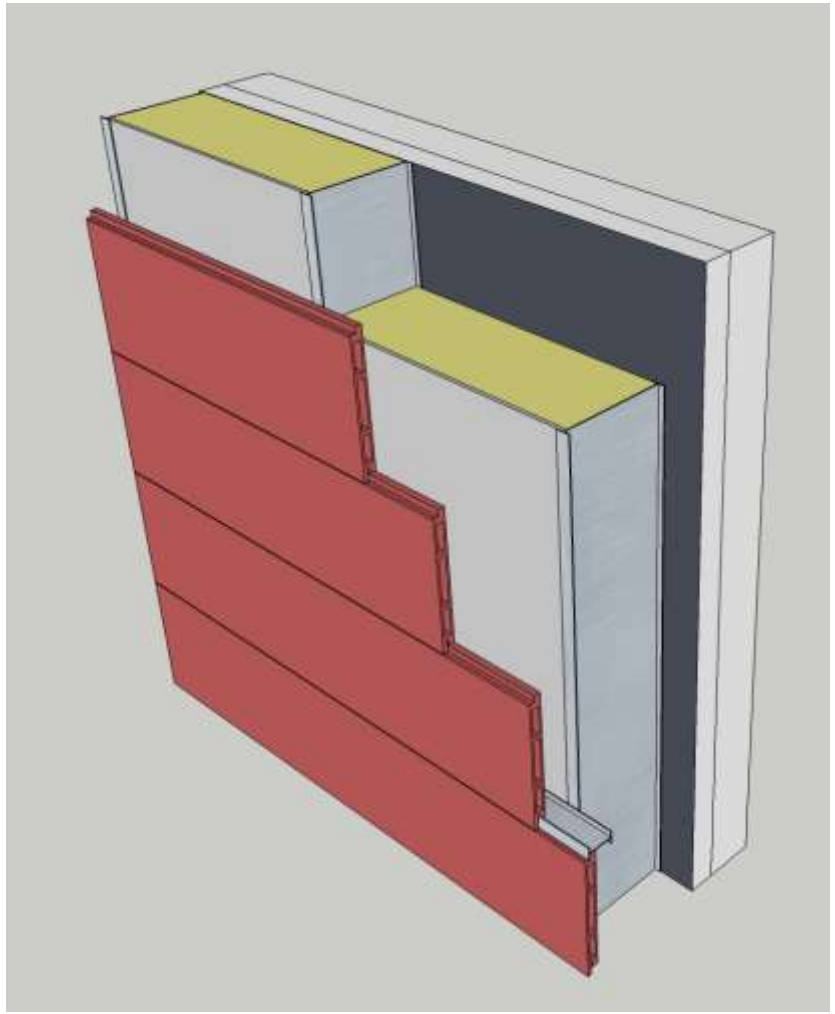
Substructure	Capping beams	RC 32/40 (200kg/m3 re	New			80	No	40.5	m3	8.5	0.0	0.0	750 x 600 mm beam sections	
Substructure	Basement walls	RC 32/40 (125kg/m3 rei	New			80	No	252.0	m3	46.0	0.0	0.0	800 mm wall thickness	
Substructure	Lowest floor slab	RC 32/40 (150kg/m3 rei	New			80	No	150.0	m3	28.8	0.0	0.0	300 mm slab thickness	
Superstructure	Core structure	Precast RC 32/40 (100k	New			80	No	222.2	m3	42.7	0.0	0.0	200 mm wall thickness	
Superstructure	Columns	Steel	New			80	No	6.5	m3	43.6	0.0	0.0	UC 254 x 254	
Superstructure	Beams	Steel	New			80	No	10.8	m3	72.4	0.0	0.0	UB 533 x 210	
Superstructure	Secondary beams	Steel	New			80	No	10.5	m3	70.9	0.0	0.0	75% of material in primary beam	
Upper floors	Floor slab	CLT	New			80	No	600.0	m3	49.6	-140.4	0.0	200 mm slab thickness	
Roof	Roof	CLT	New			80	No	100.0	m3	8.3	-23.4	0.0	200 mm slab thickness	
Roof	Roof insulation	Rockwool	New			30	No	125.0	m3	7.2	0.0	0.0	250 mm insulation thickness	
Roof	Roof finishes	Asphalt (Mastic)	New			30	No	500.0	m2	1.7	0.0	0.0	20 mm thickness	
External walls	Facade	Timber	New			40	No	1323.0	m2	5.4	-12.2	0.0	See "Build-ups" sheet	
External walls	Wall insulation	Rockwool	New			30	No	330.8	m3	19.1	0.0	0.0	250 mm insulation thickness	
Windows	Glazing	Double Glazing	New			40	No	6.1	m3	18.4	0.0	0.0	Two panes of 6 mm glass	
Windows	Window frames	Al/Timber Composite	New			40	No	2126.3	m	19.8	-2.7	0.0	See "Build-ups" sheet	
Internal walls	Partitions	CLT	New			80	No	578.8	m3	47.8	-135.4	0.0	120 mm wall thickness	
Internal finishes	Ceilings	Exposed Soffit	New			80	No	3500.0	m2	0.0	0.0	0.0	None	
Internal finishes	Floors	Carpet	New		70%	20	No	3500.0	m2	26.4	0.0	0.0	12 mm carpet thickness	
Internal finishes	Floors	Vinyl	New		20%	20	No	3500.0	m2	10.2	0.0	0.0	3 mm vinyl thickness	
Internal finishes	Floors	Stoneware tile	New		10%	20	No	3500.0	m2	7.2	0.0	0.0	10 mm tile thickness	
Services	Services	Medium	New			20	No	3500.0	m2	231.0	0.0	0.0	60 kgCO2e/m2 flat rate estimate	
								0		0.0	0.0	0.0		
								0		0.0	0.0	0.0		
								0		0.0	0.0	0.0		

Curated Components and Materials



Based on previous projects and discussion with consultants and manufacturers, we've created a list of common materials and elements for each building aspect.

These are then modelled using the ICE database where appropriate, or EPDs for certain materials.

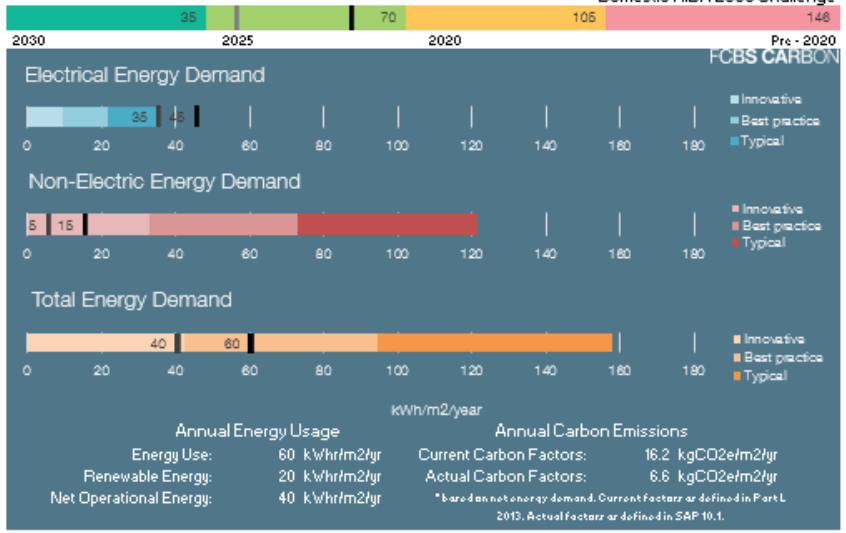
The components may be different to how you would design that element, so do look at the assumptions column.

Interaction of Elements and Parameters

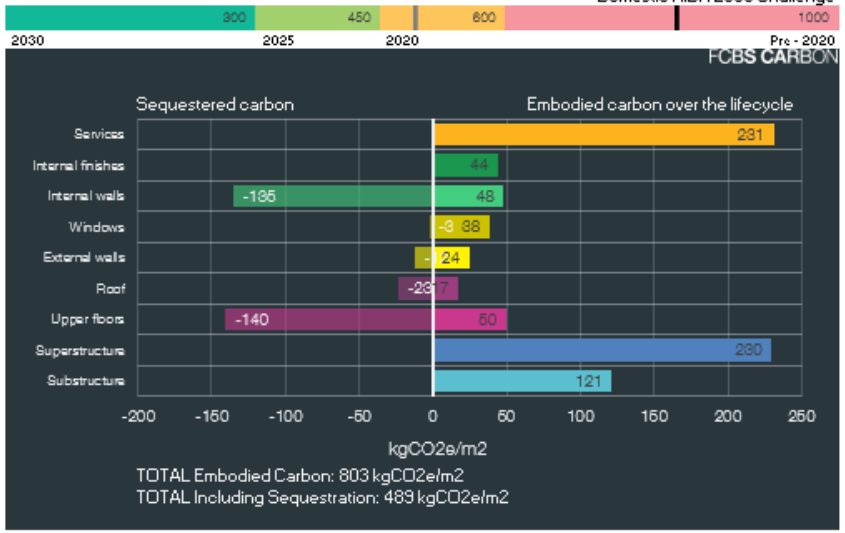
	Piles	Pile caps	Raft	Capping beams	Basement walls	Lowest floor	Core structure	Columns	Beams	Secondary beams	Floor slab	Joisted floors	Roof	Roof finishes	Roof insulation	Facade	Wall insulation	Glazing	Window frames	Partitions	Ceilings	Floors	Services
GIA											X	X								X	X	X	X
Perimeter				X	X				X							X	X	X	X				
Footprint		X	X			X	X	X	X	X	X	X	X	X	X								
Width		X						X															
Floor-to-floor height					X		X	X								X	X	X	X				
No. storeys ground & above							X	X	X	X						X	X	X	X				
No. storeys below ground					X		X	X	X	X													
Glazing ratio																X	X	X	X				
Grid size		X					X	X	X														
Building load	X																						
Partitions factor																				X			

3. **Outputs** – Main Output

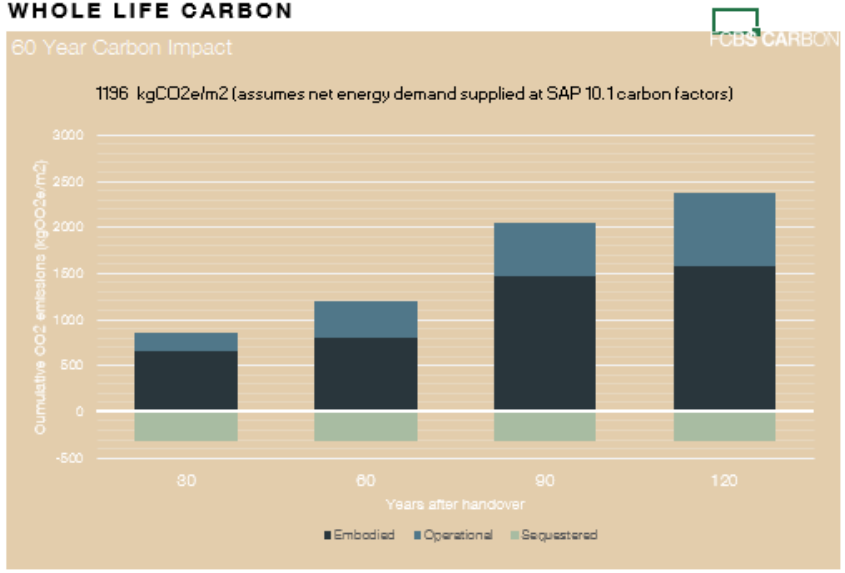
OPERATIONAL ENERGY



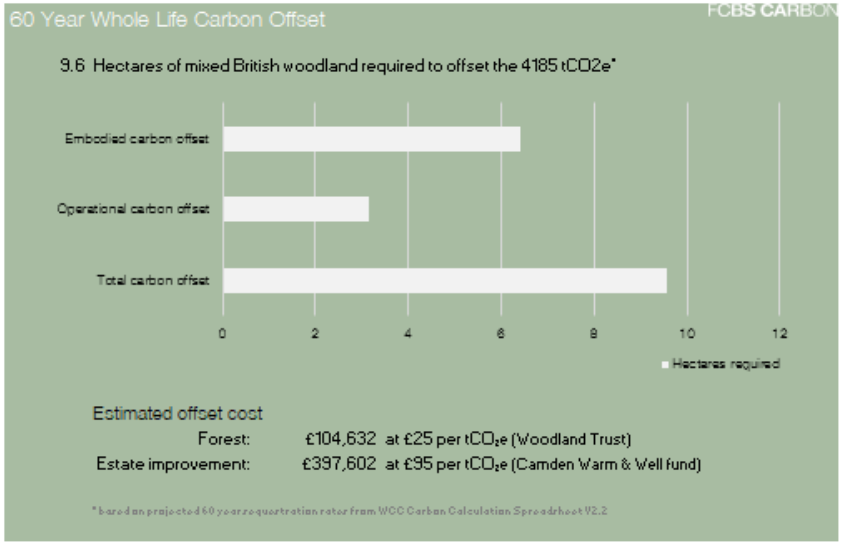
LIFECYCLE EMBODIED CARBON



WHOLE LIFE CARBON



OFFSET CARBON



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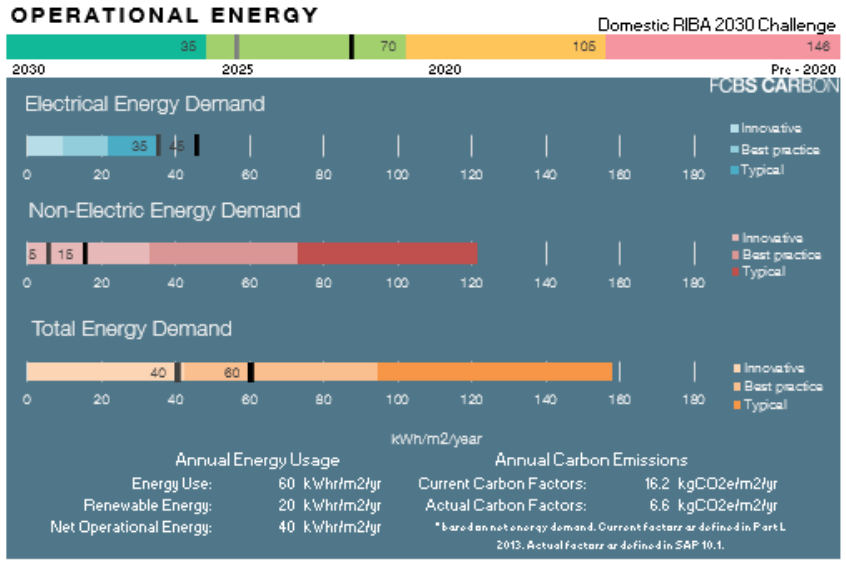
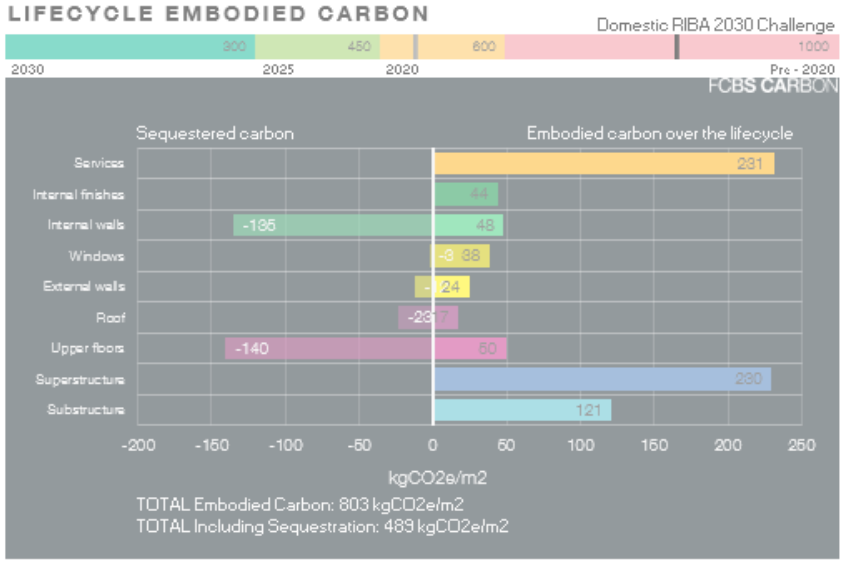
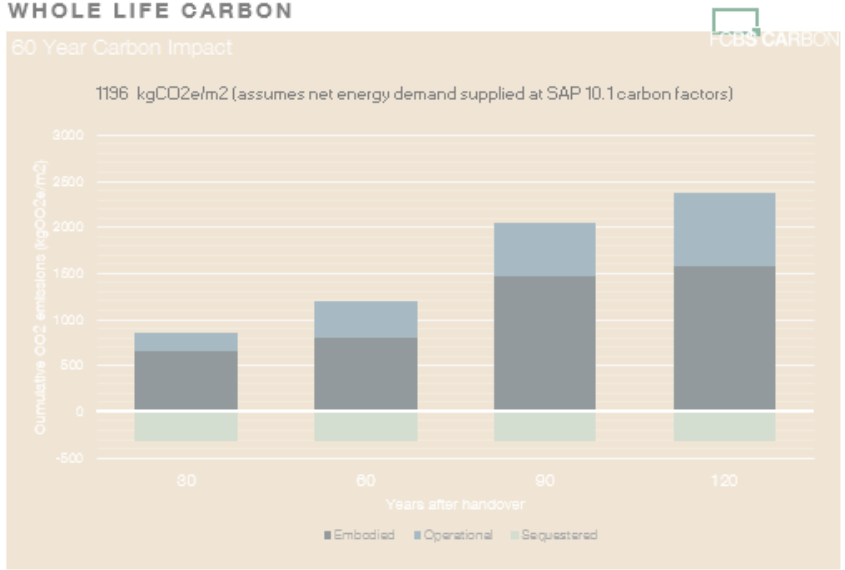
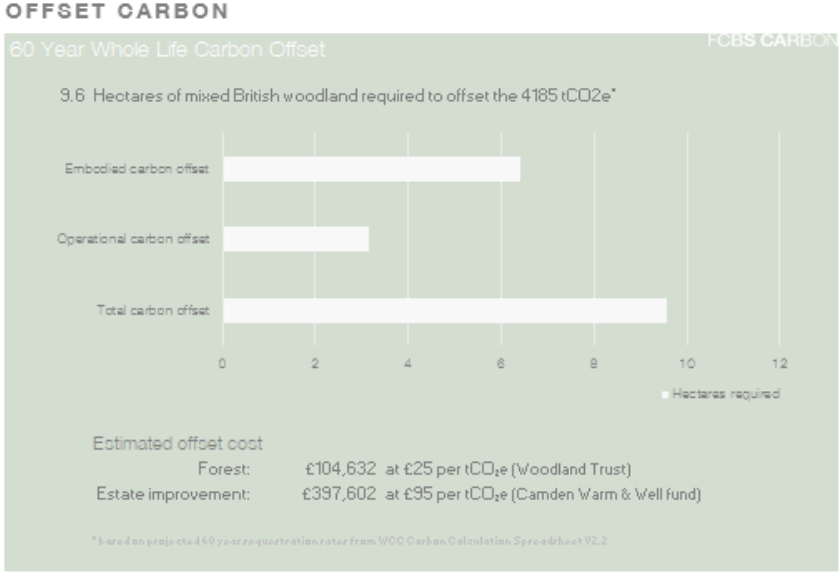
3. **Outputs** – Main Output





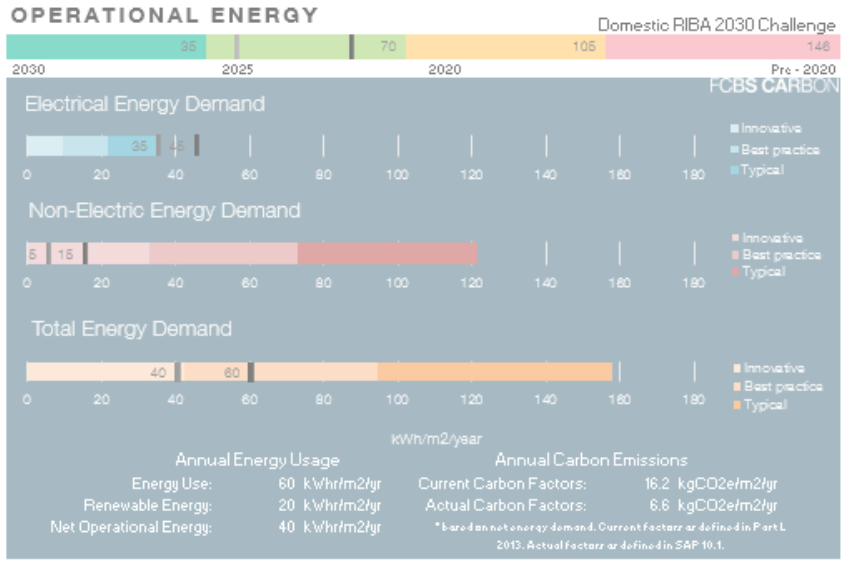


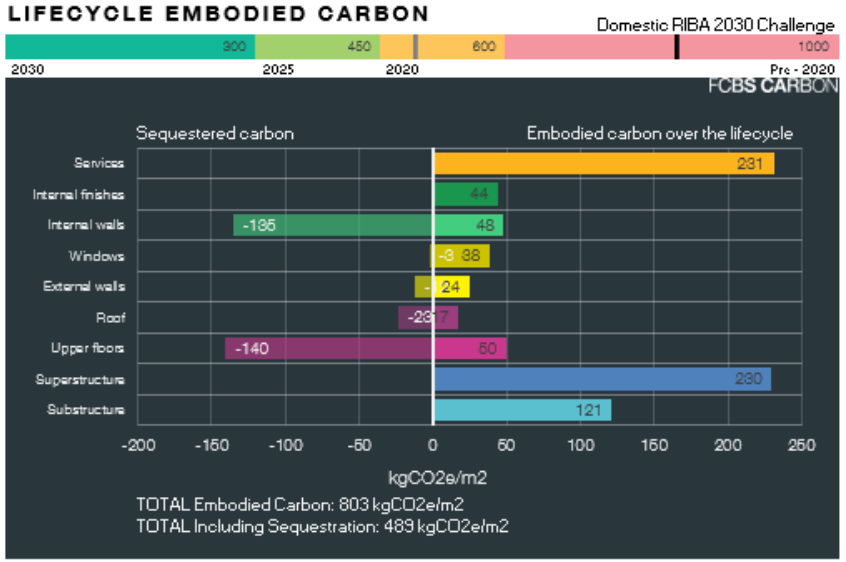


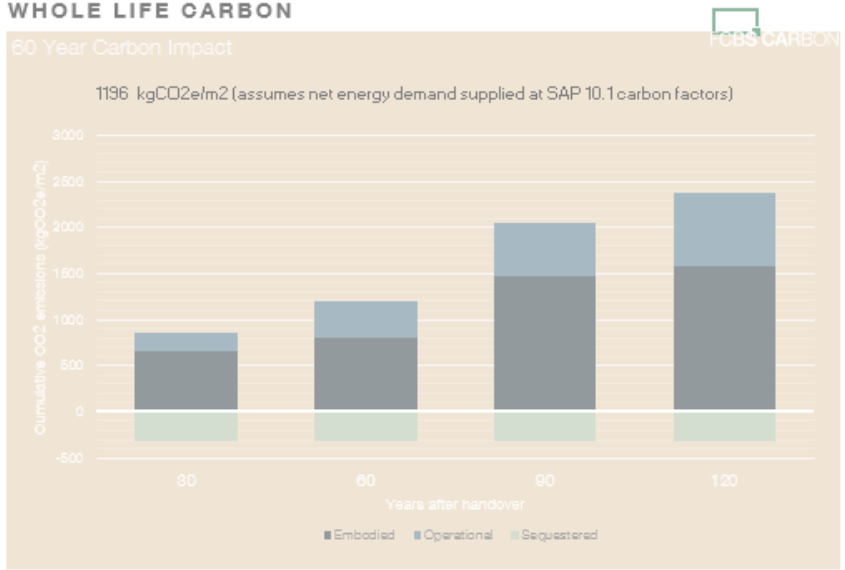
Operational figures are shown as net and gross lines on the charts, enabling comparison with LETI/RIBA/etc. targets.

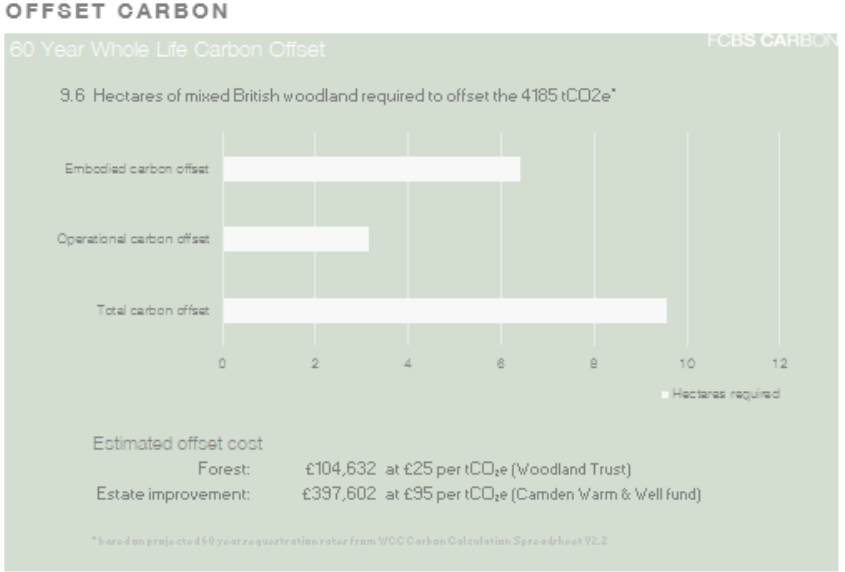
FCBS CARBON

3. **Outputs** – Main Output





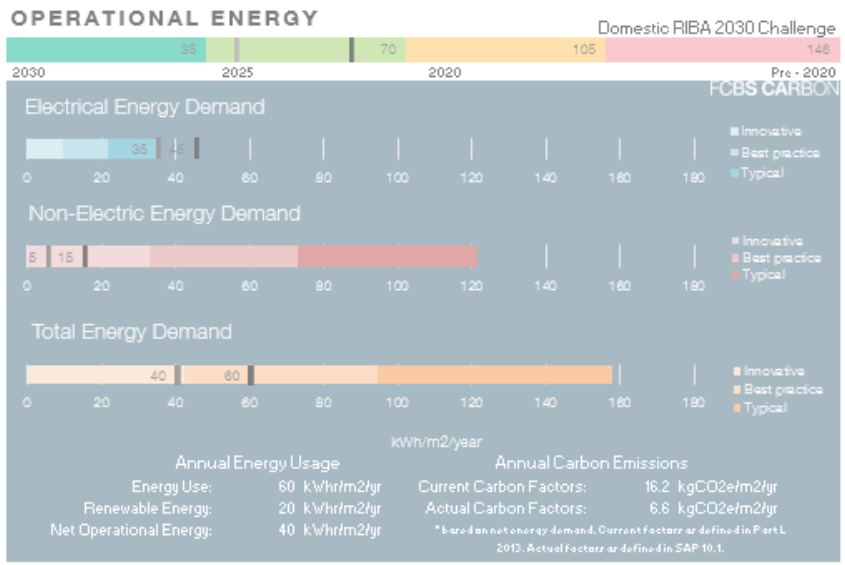


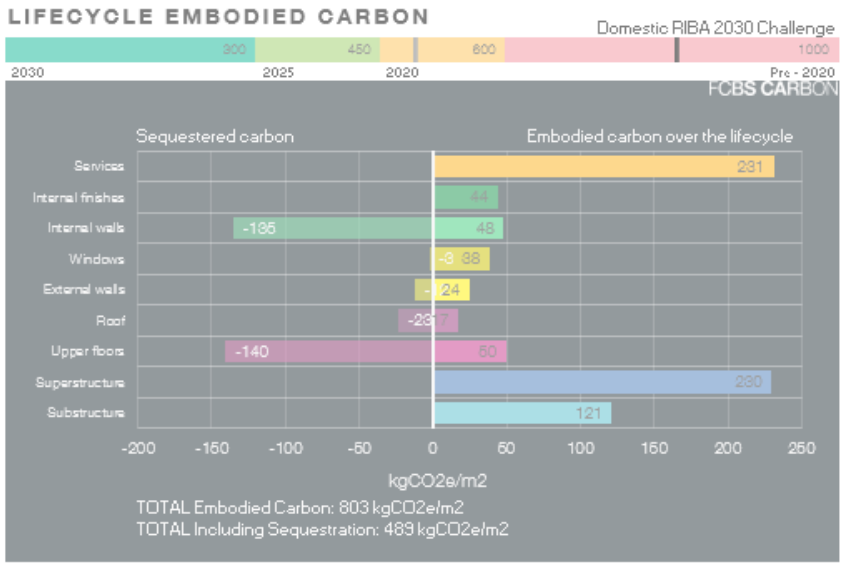


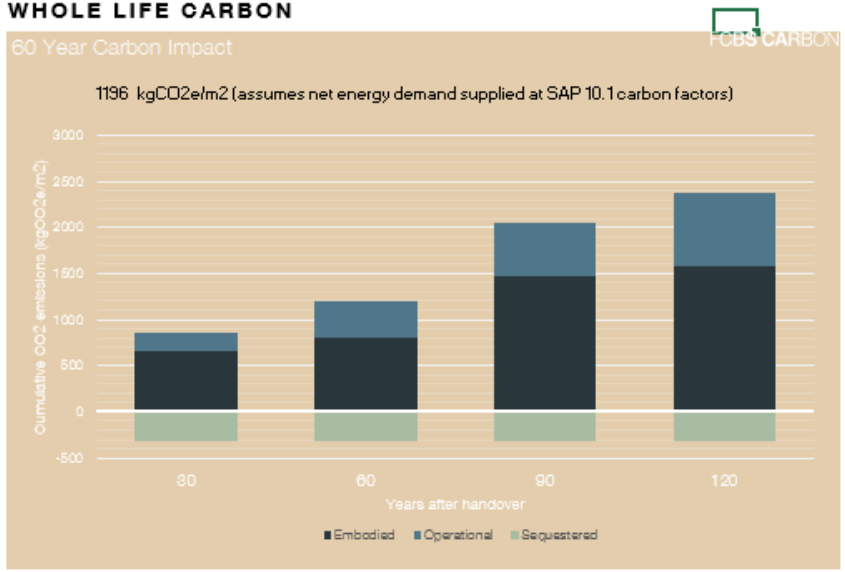
Embodied Carbon figures broken down by building aspect (modules A1-B5 & C1-4) for a 60 year period.

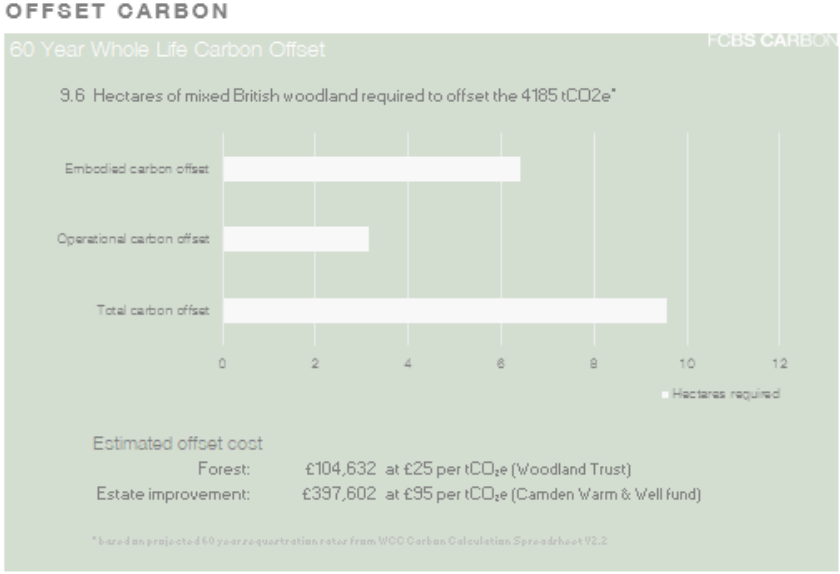
FCBS CARBON

3. **Outputs** – Main Output







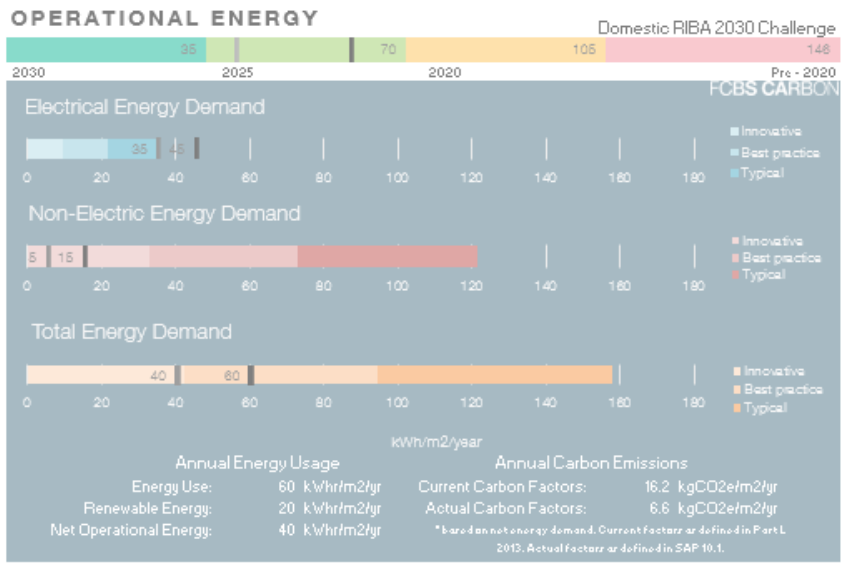


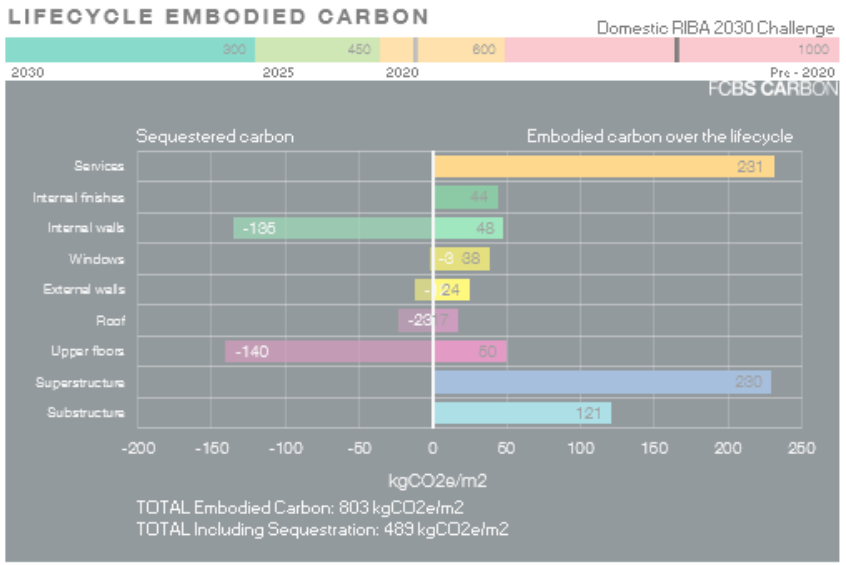
Whole life carbon, with sequestered shown separately.

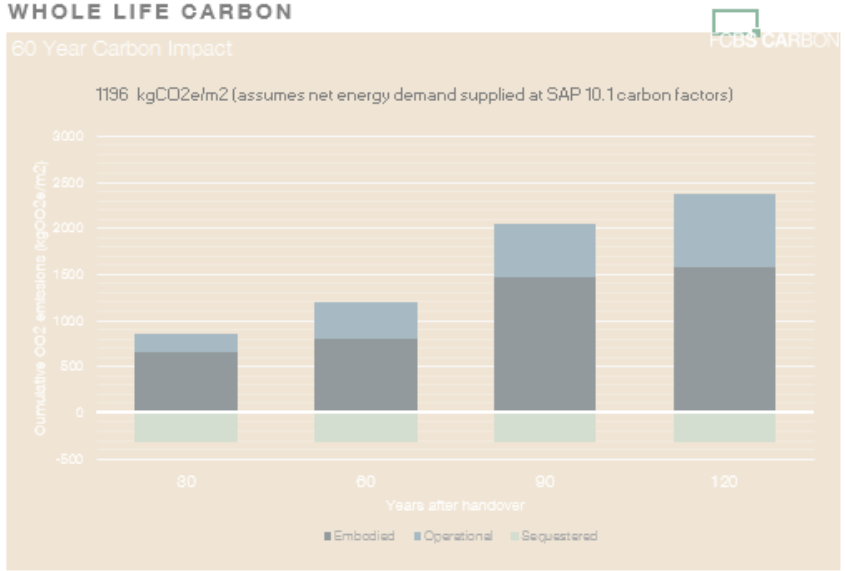
The figure given is the 60 year total, including any onsite renewables, but not sequestration.

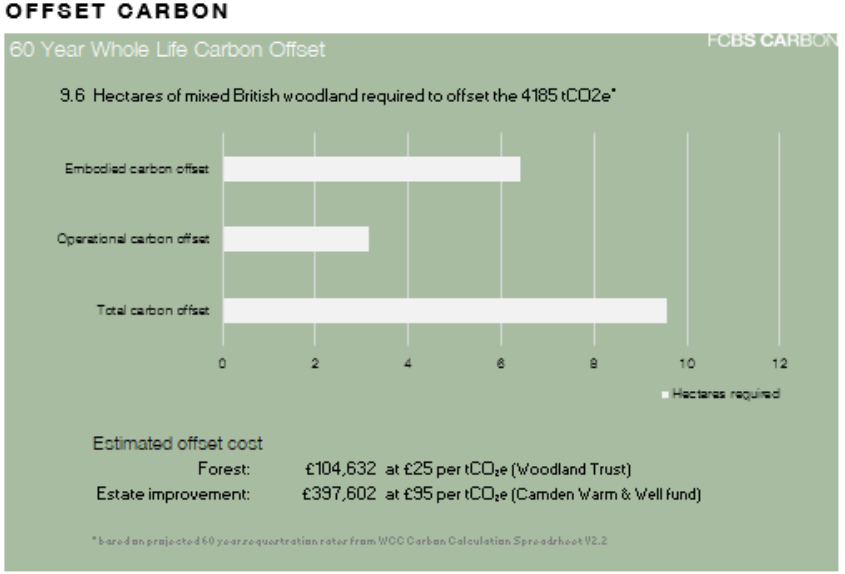
FCBS CARBON

3. **Outputs** – Main Output







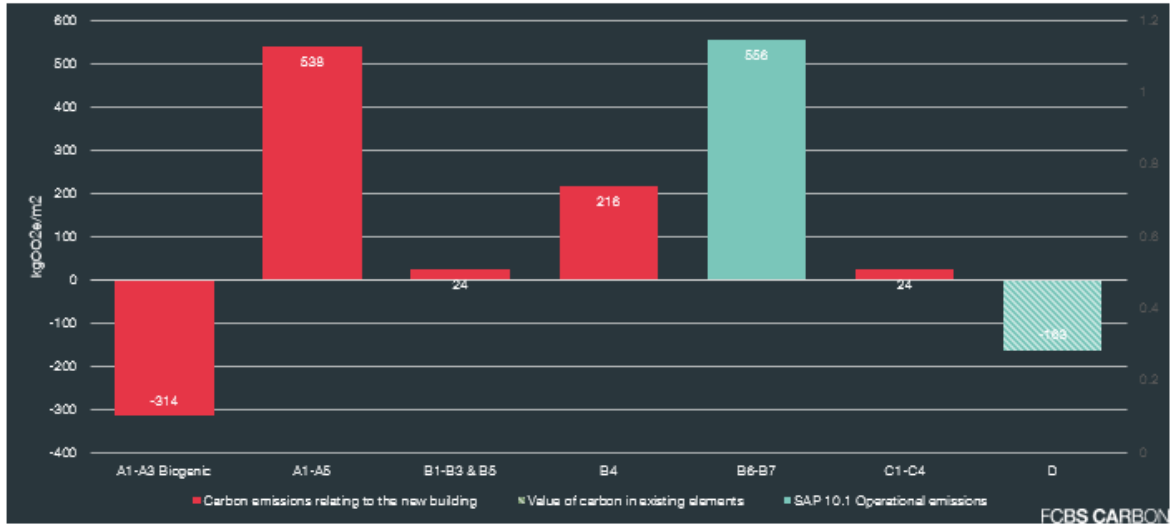


Indicative offsetting methods, including trees and Camden retrofit program.

FCBS CARBON

4. **Outputs** – Detail Output

CARBON IMPACT OVER THE LIFE CYCLE AND POTENTIAL BENEFITS

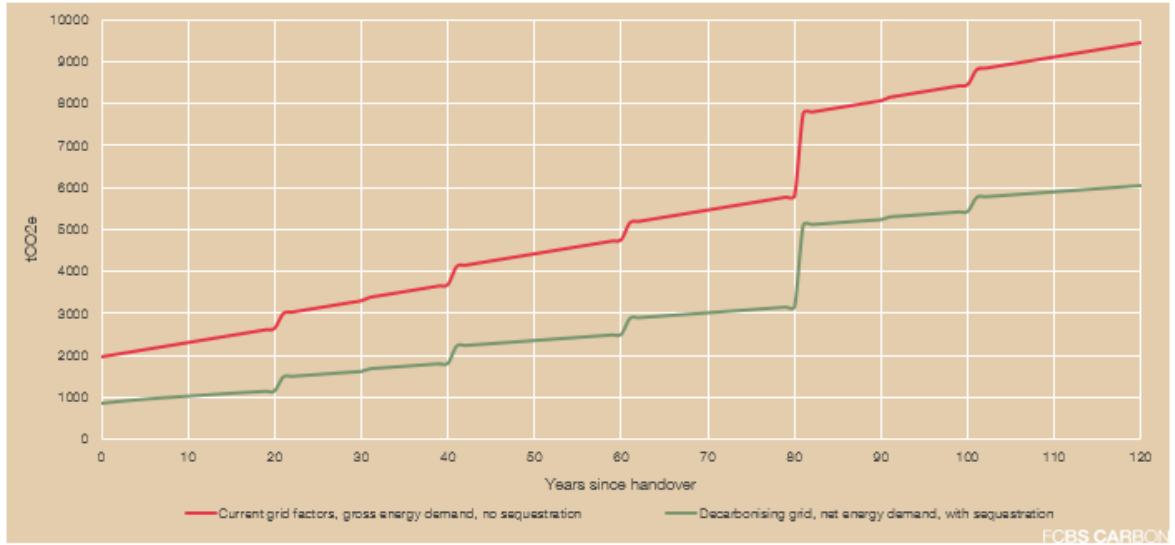


NOTES

Term	Definition	Value (kgCO2e/m2)	
Embodied carbon to practical completion	Comprises stages A1-A5	538	
Embodied carbon over the life cycle	Comprises stages A1-A5, B1-B5, C1-C4	803	
Whole life carbon	Comprises stages A, B & C, with module D reported separately	A, B & C	D
		1359	-163

N.B. These totals consider emissions incurred over the life of the current building. The value of carbon in existing elements is therefore not included in the total, but is displayed for information. Biogenic carbon has been excluded from these totals to provide clarity on the unavoidable emissions arising from material use. Operational emissions consider gross demand, as opposed to net demand on 3. OUTPUT. Module D represents potential benefits from the reuse of elements designed for deconstruction, including continued lock-in of biogenic carbon, alongside projected operational savings from on-site generation.

WHOLE LIFE CARBON IMPACT



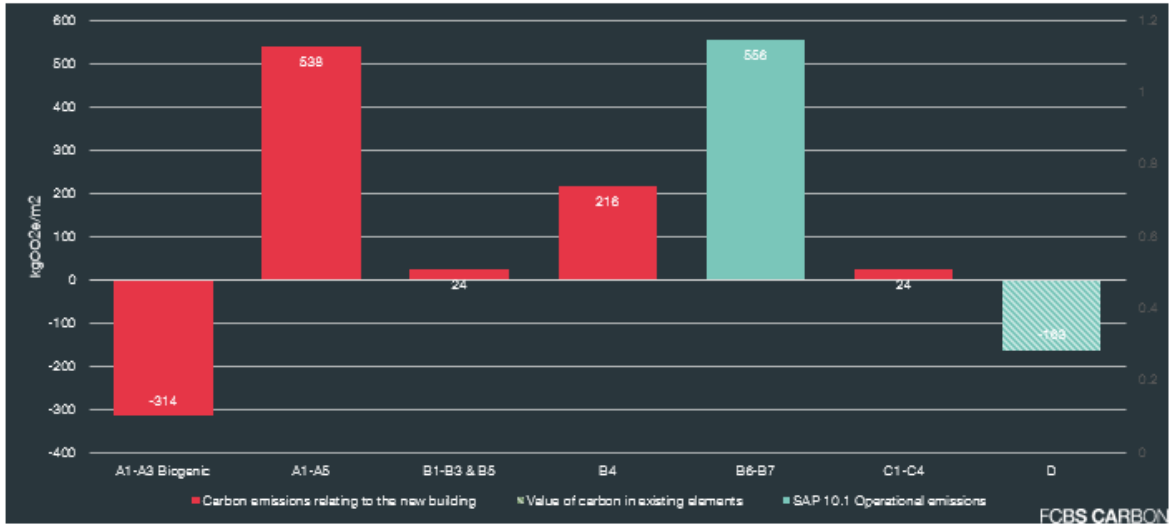
NOTES

End of life emissions [C1-C4] have been applied at year zero such that reading the graph at any time point will include them. The red line represents the estimate reported elsewhere on this sheet.

FCBS CARBON

4. **Outputs** – Detail Output

CARBON IMPACT OVER THE LIFE CYCLE AND POTENTIAL BENEFITS



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		1359	-163

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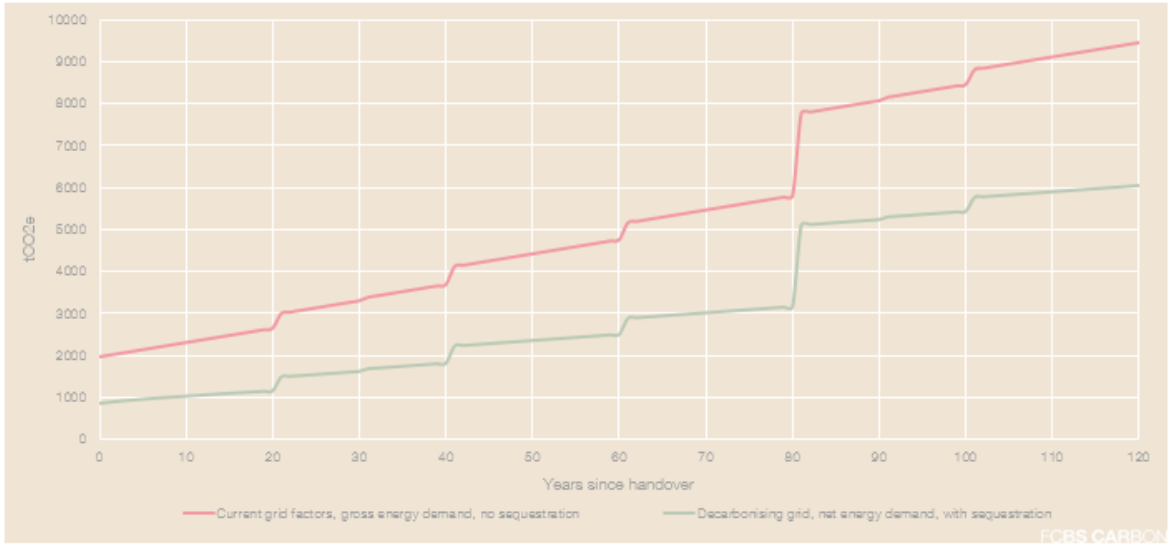
WHOLE LIFE CARBON IMPACT



NOTES

End of life emissions [C1-C4] have been applied at year zero such that reading the graph at any time point will include them. The red line represents the estimate reported elsewhere on this sheet.

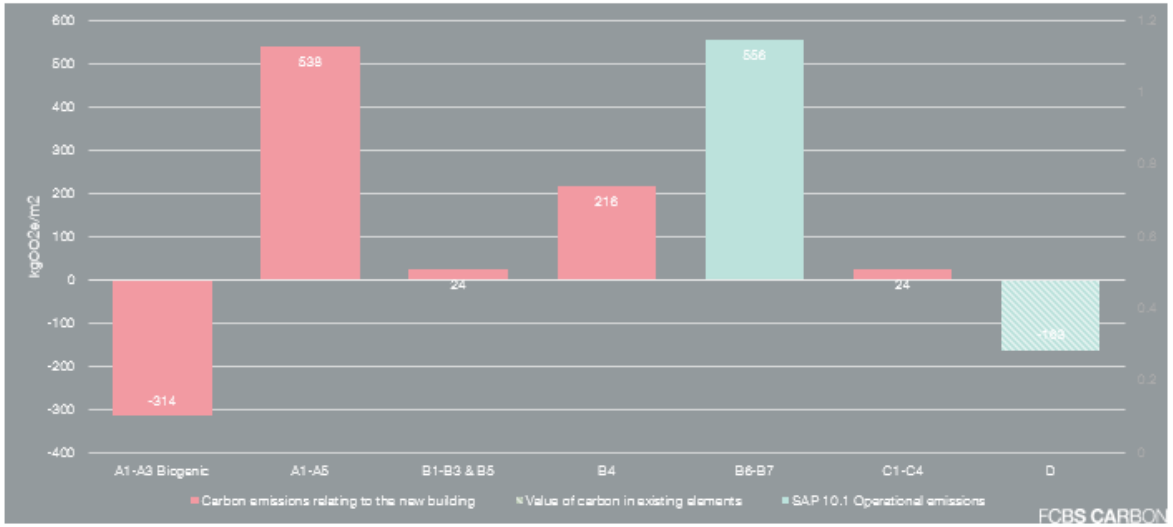
A chart showing the carbon emissions by LCA module, including elements that have been reused.

Modelled over 60 years.

FCBS CARBON

4. **Outputs** – Detail Output

CARBON IMPACT OVER THE LIFE CYCLE AND POTENTIAL BENEFITS



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Whole life carbon	Comprises stages A, B & C, with module D reported separately	A, B & C: 1359	D: -163

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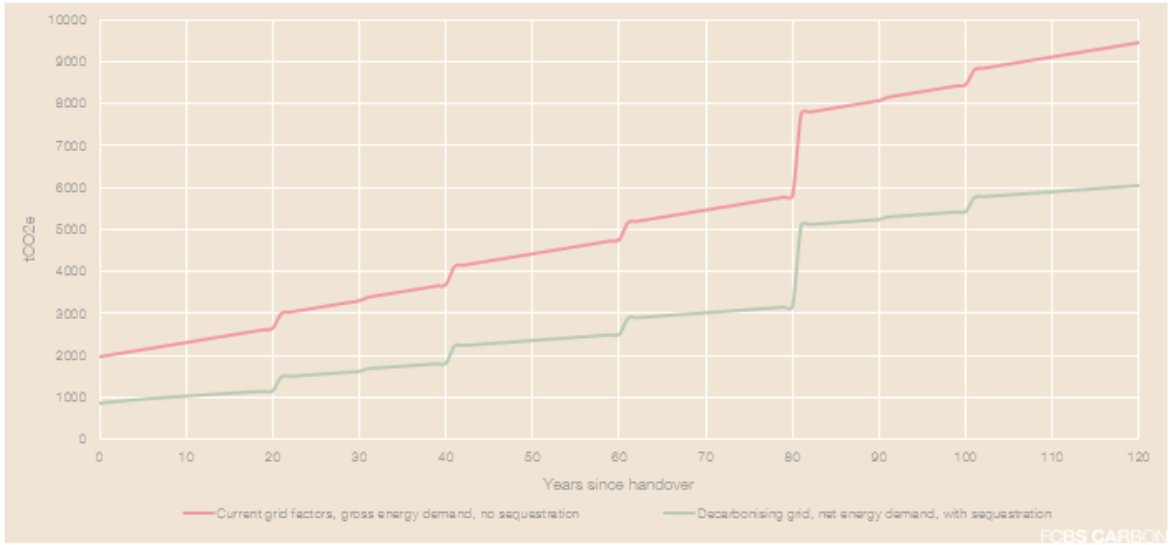
WHOLE LIFE CARBON IMPACT



NOTES

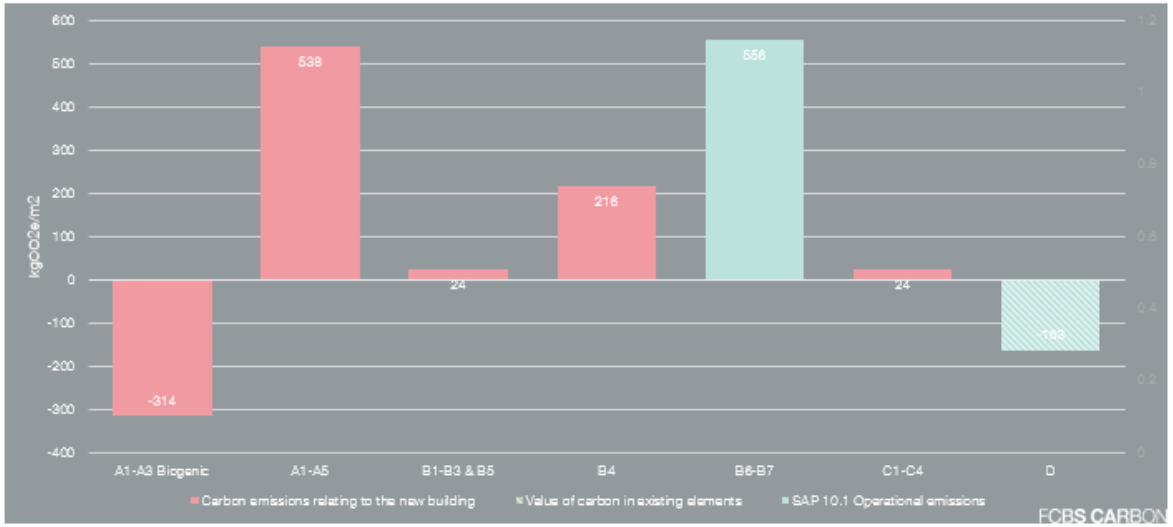
End of life emissions [C1-C4] have been applied at year zero such that reading the graph at any time point will include them. The red line represents the estimate reported elsewhere on this sheet.

Detailed breakdowns of the contributions by each module for ease of reference.

FCBS CARBON

4. **Outputs** – Detail Output

CARBON IMPACT OVER THE LIFE CYCLE AND POTENTIAL BENEFITS



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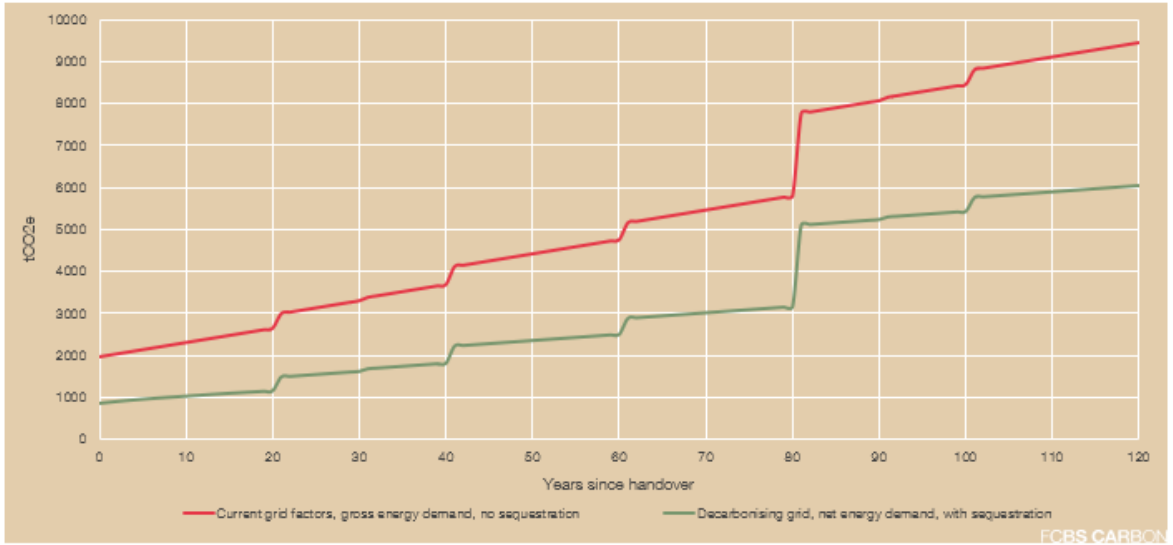
WHOLE LIFE CARBON IMPACT



NOTES

End of life emissions [C1-C4] have been applied at year zero such that reading the graph at any time point will include them. The red line represents the estimate reported elsewhere on this sheet.

Two lines are shown, representing best and worst cases.
Red line shows no sequestration, no renewables, and a static carbon factor for energy.

Green line include sequestration, renewables, and future emission scenarios.

Note C1-4 is included in year 0 to enable WLC to be read at any year.

FCBS CARBON

Demonstration of FCBS CARBON

Inputting data into the tool and making changes

FCBS CARBON

Q&A

FCBS CARBON

https://fcbstudios.com/fcbscarbon

Thank you

Please send feedback to:

joe.jack.williams@fcbstudios.com

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