CIBSE TM65: Embodied carbon of building services equipment

How to use it in ANZ

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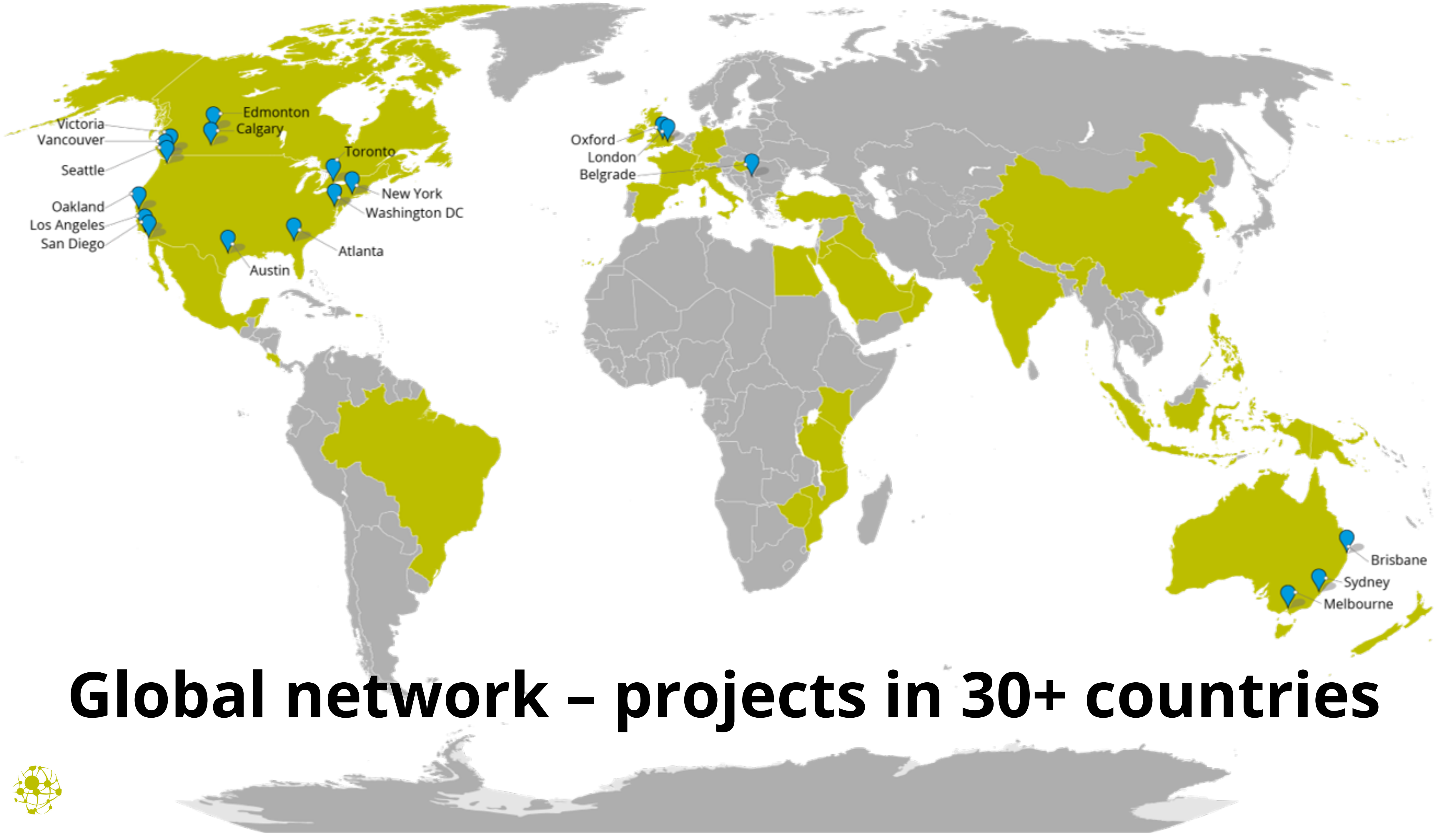
INTEGRAL

Acknowledgment



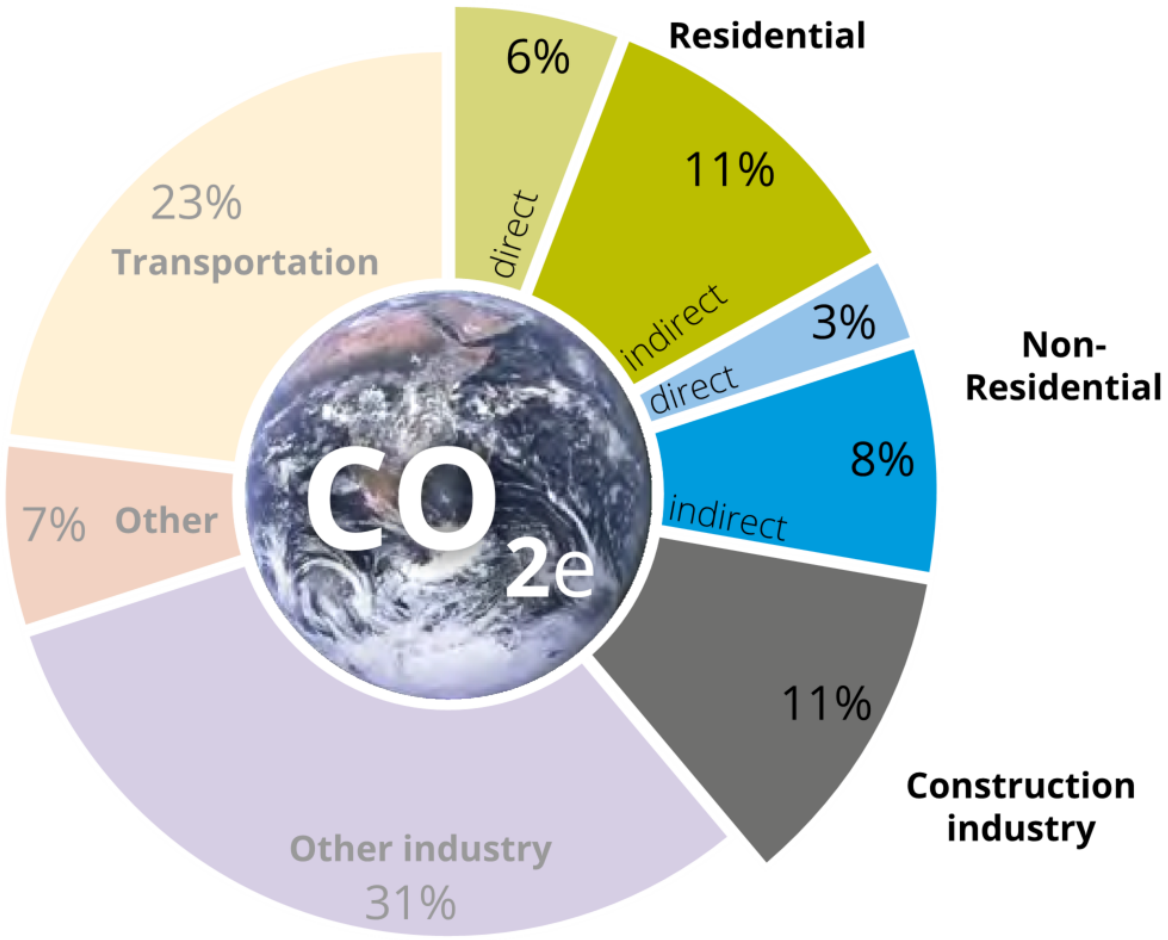
Global network – projects in 30+ countries

Agenda

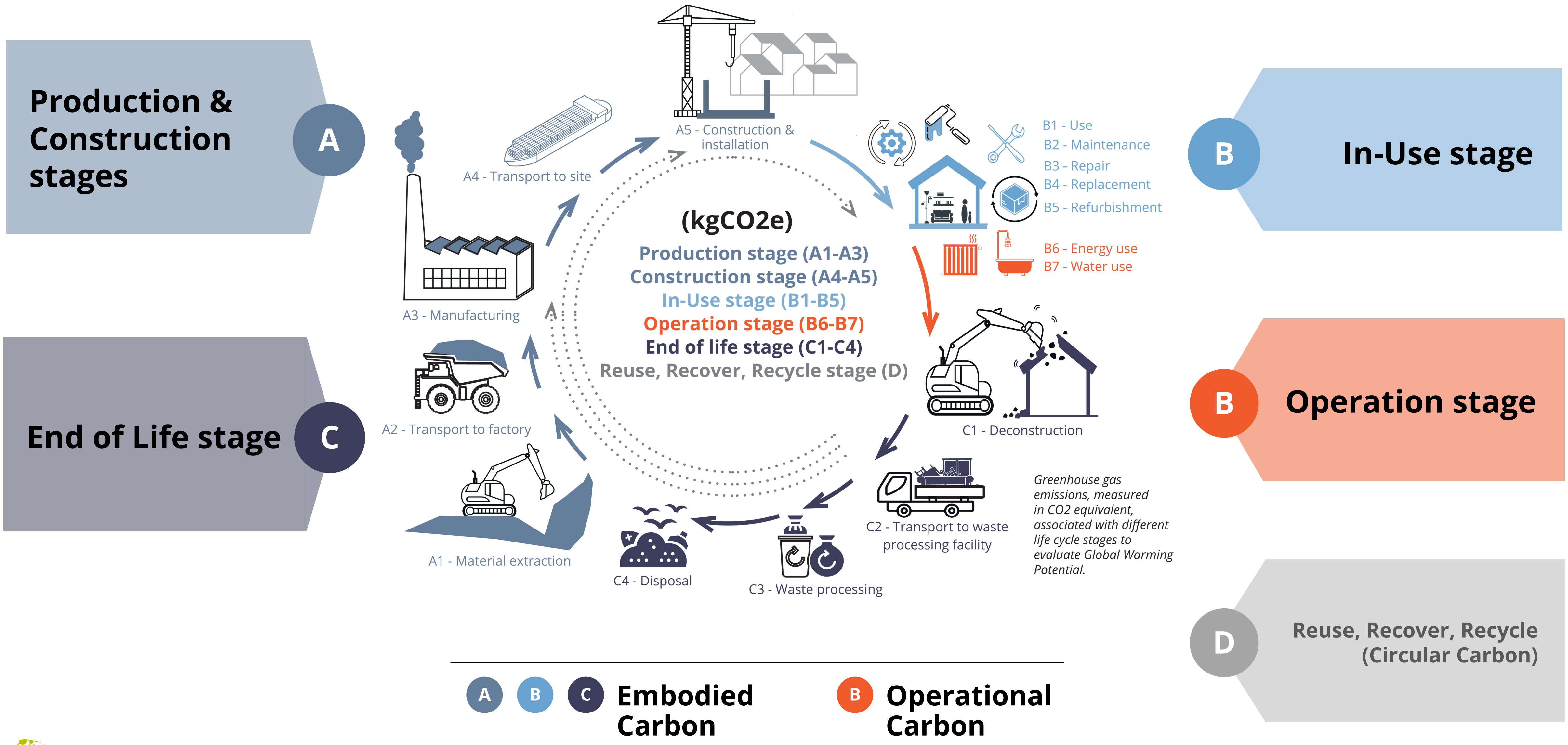
- What is the problem?
- CIBSE TM65
- System-level carbon impacts
- How to use TM65 in ANZ
- Next steps
- Wrap-up (key takeaways)

What is the problem?

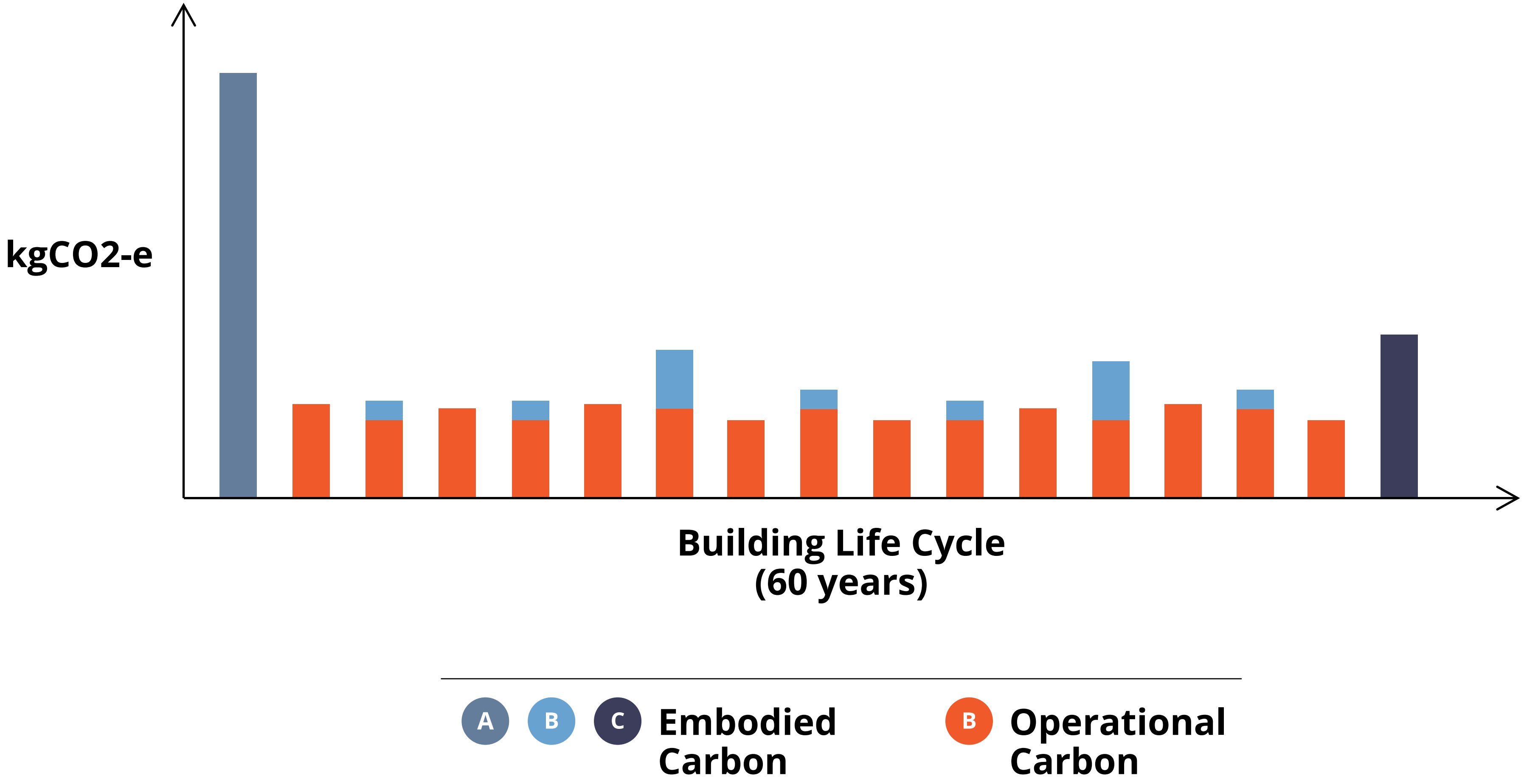
Buildings have a major impact on global carbon emissions



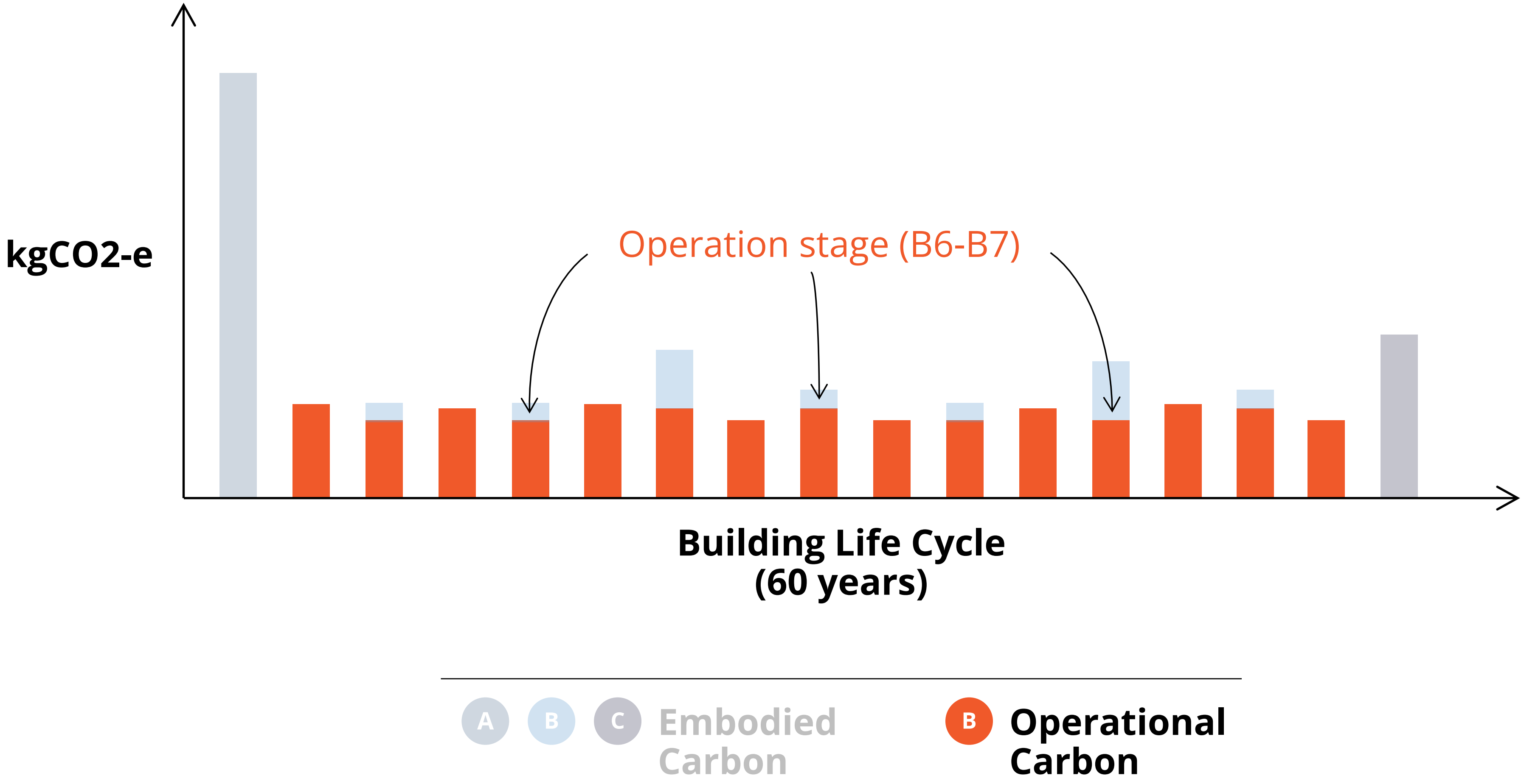
A Whole Life Carbon approach



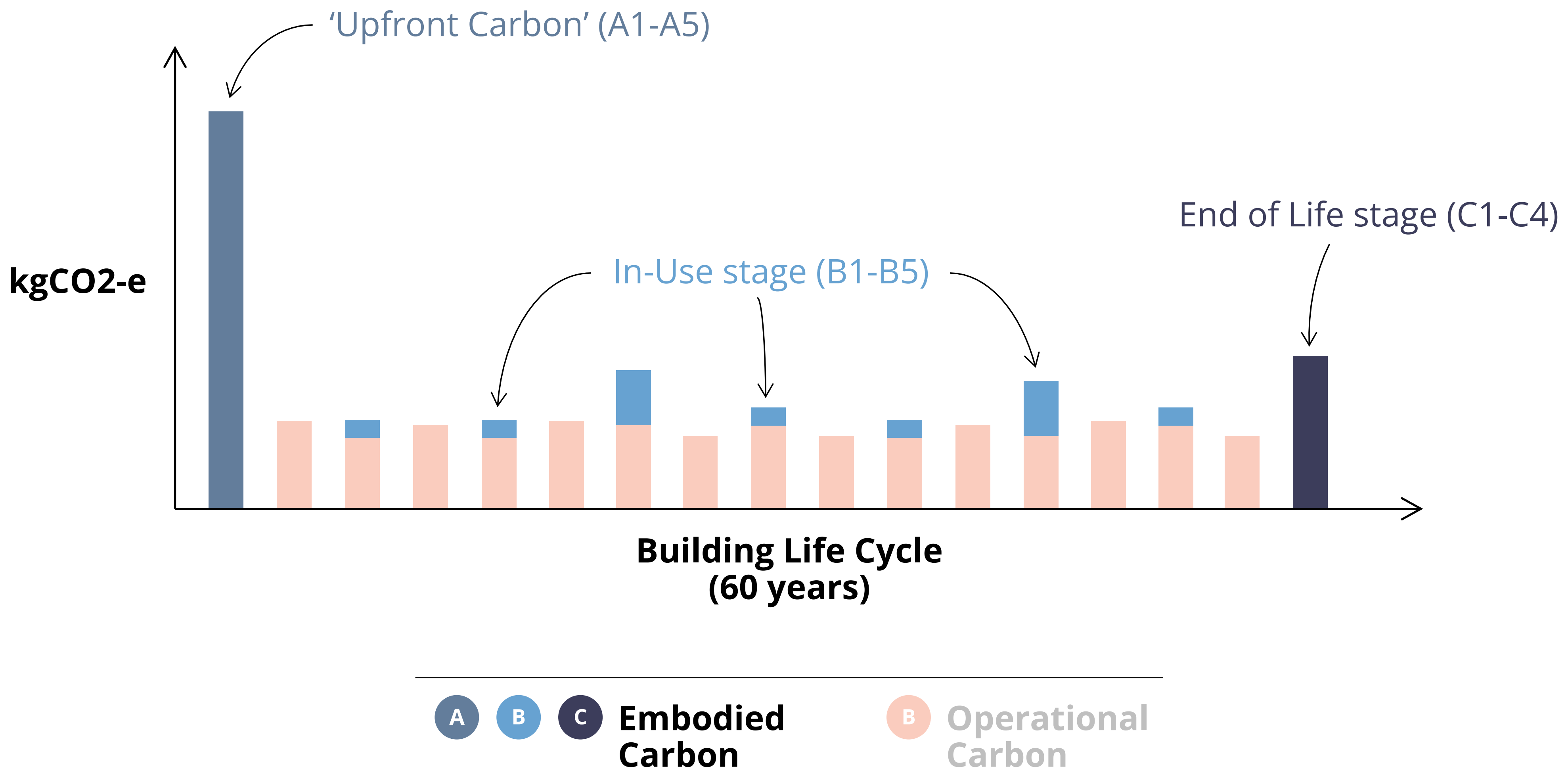
A Whole Life Carbon approach



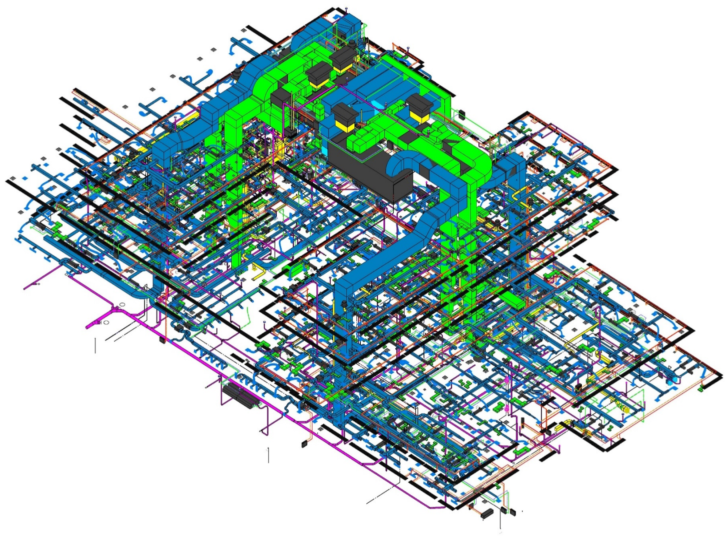
A Whole Life Carbon approach



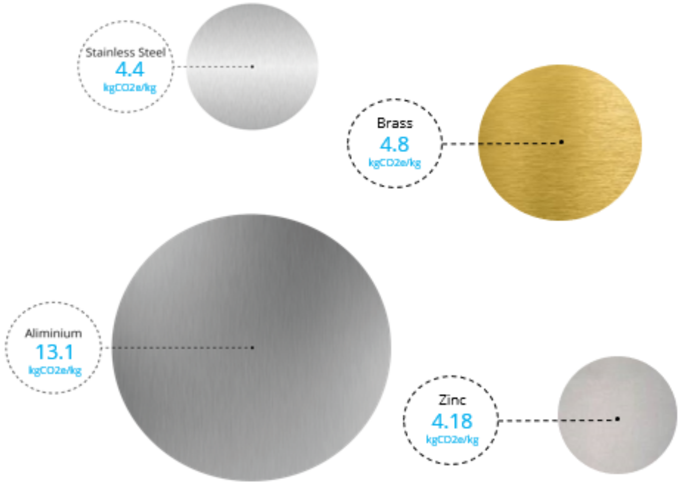
A Whole Life Carbon approach



Services are high impact



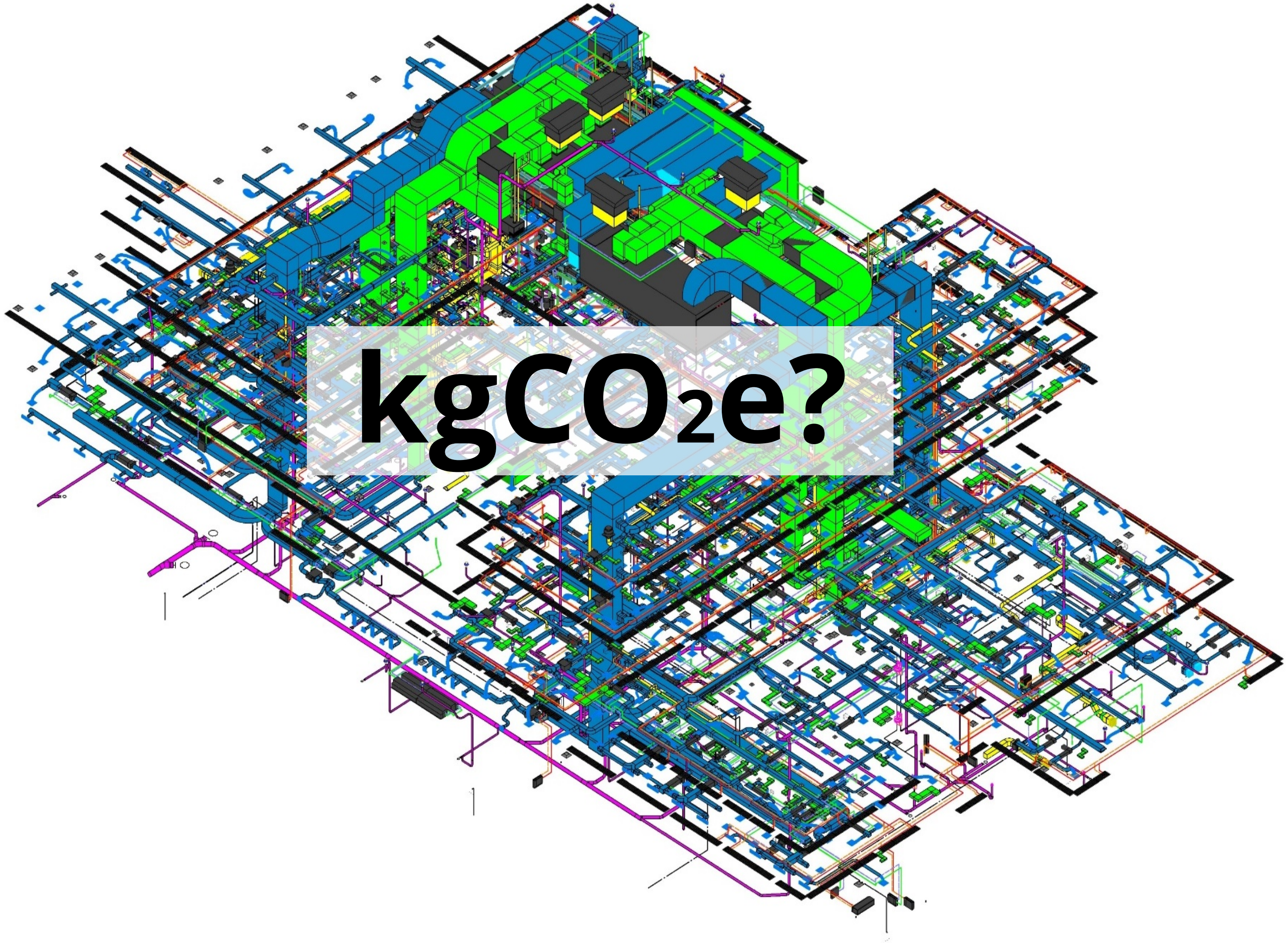
Lots of 'Stuff'



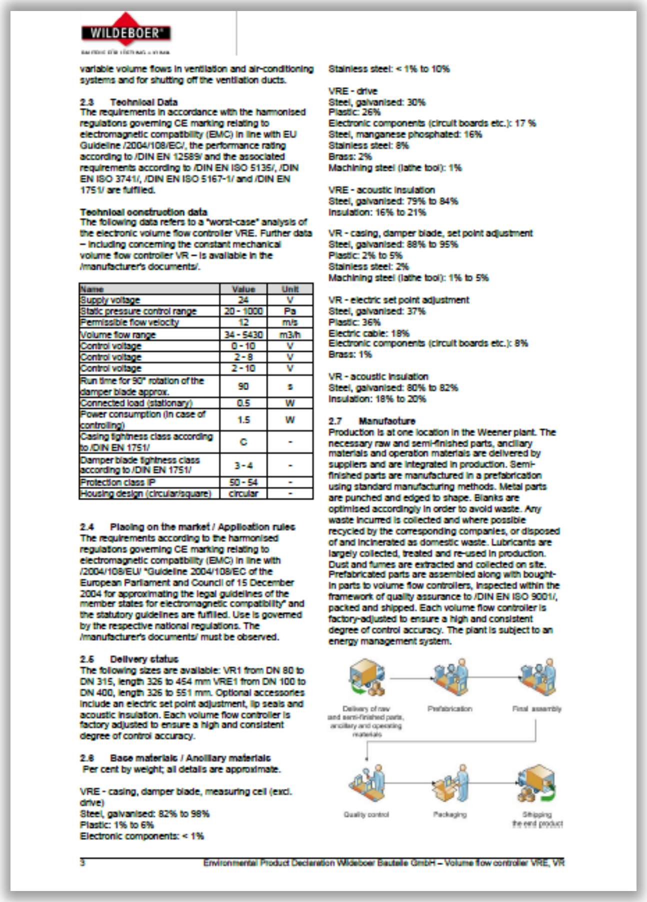
High Impact Materials

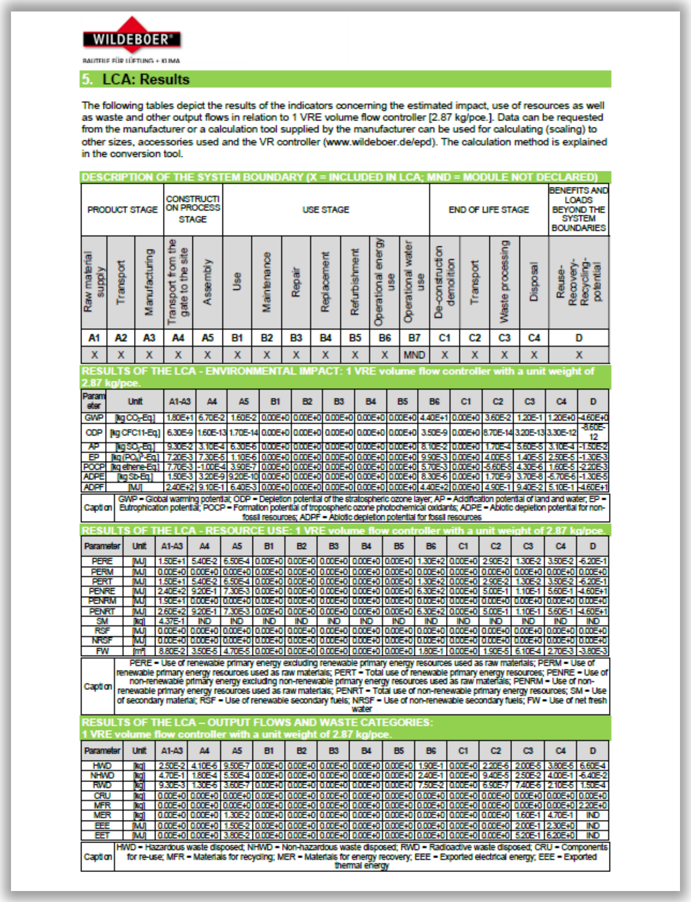
High Replacement Rates

Knowledge gap



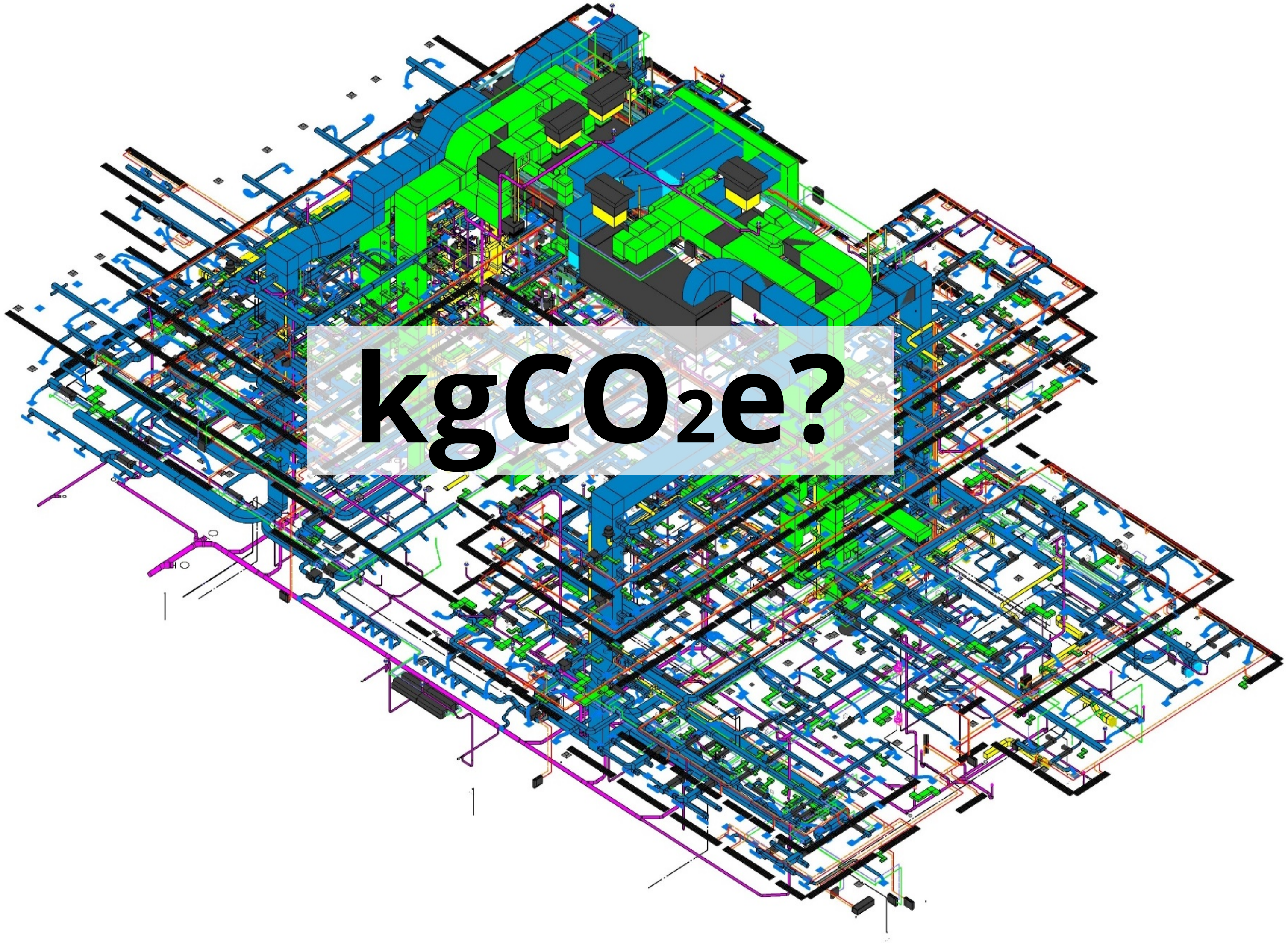
Environmental Product Declarations





An EPD provides a standard way to disclose environmental impacts about a product throughout its lifecycle, using a rigorous, consistent, third party reviewed methodology.

TM65 is here to help!



CIBSE TM65

What is TM 65?

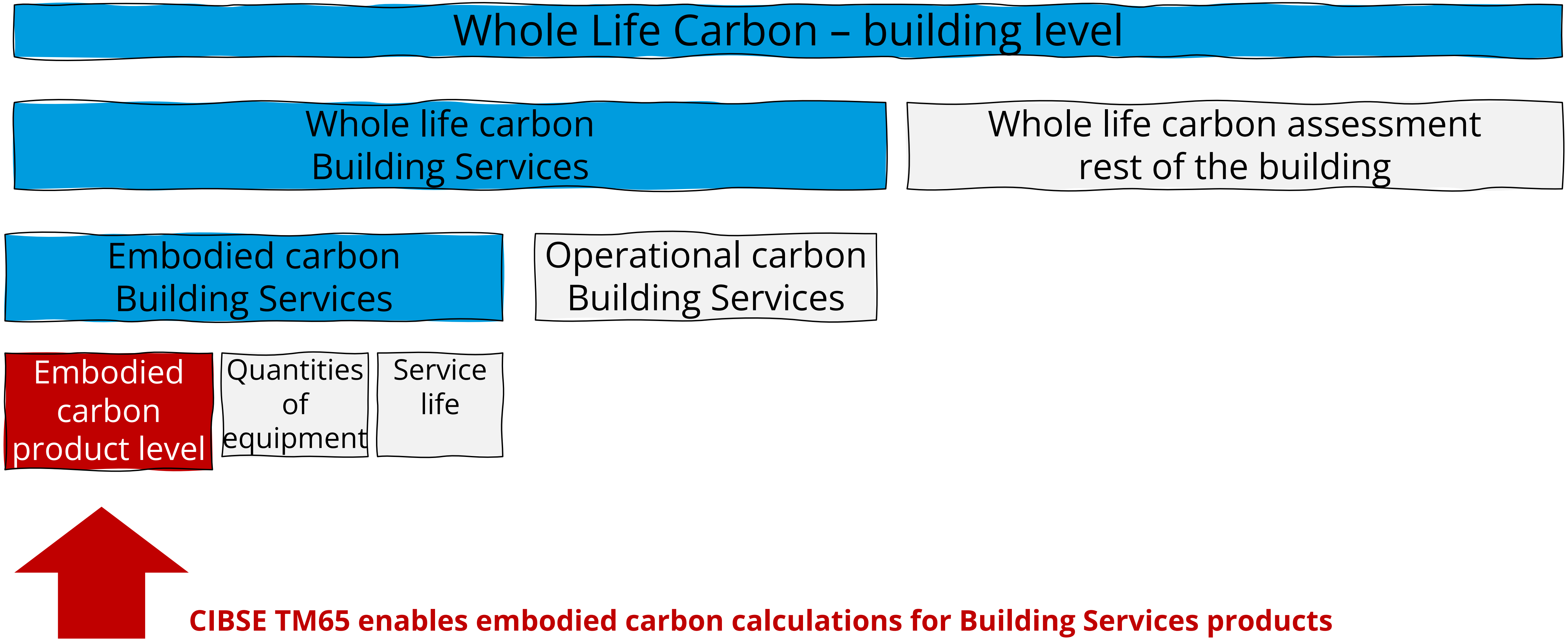
What TM65 **is**

- A method for estimating embodied carbon in building services equipment
- A first step to promote transparency in the industry
- A reporting methodology
- A set of rules to allow the production of comparable carbon metrics
- A simple, replicable, standardised methodology

What TM65 **isn't**

- A detailed Life Cycle Assessment (LCA) at system level
- An Environmental Product Declaration (EPD)
- A peer reviewed certification
- An exhaustive assessment of the materials in a product
- A detailed and holistic assessment of all environmental impacts of a product (embodied carbon only)

How the TM65 fits into building Whole Life Carbon assessment



TM65 - process

Data collection	Calculations	Reporting
	Embodied carbon of MEP product	
Manufacturer form	**CIBSE TM65 methods**	**Results format**
Section A filled in →	Basic calculation →	Result form 1
Section A & B filled in →	Mid level calculation →	Result form 2

TM65 – method comparison

	'Basic' calculation	'Mid level' calculation	EPD
Easy	● ● ● ○	● ● ○ ○	● ○ ○ ○
Manufacturer involvement	● ○ ○ ○	● ● ● ○	● ● ● ●
Detailed	● ● ○ ○	● ● ● ○	● ● ● ●

TM65 versus EPD

Table 4.1 Comparison of the life cycle stage modules needing to be calculated and the type of information required per life cycle stage module for the two calculation methods and an EPD

Preliminary information	'Basic' calculation	'Mid-level' calculation	BS EN 15804+A2 compliant EPD*
Capacity of equipment/size	Mandatory	Mandatory	Mandatory
Product service life (years)	Mandatory	Mandatory	Optional
Refrigerant used, GWP, charge (kg)	Mandatory	Mandatory	Mandatory

Stage	Module	'Basic' calculation	'Mid-level' calculation	BS EN 15804+A2 compliant EPD*
	A1 (material extraction)	Mandatory	Mandatory	Mandatory
	A2 (transport to factory)		Mandatory	Mandatory
A	A3 (manufacturing)	Scale-up factor	Mandatory	Mandatory
	A4 (transport to site)		Mandatory	Optional
	A5 (installation)	—	—	Optional
	B1 (use)	Mandatory for refrigerant based system	Mandatory for refrigerant based system	Optional
	B2 (maintenance)	Scale-up factor	Optional	Optional
	B3 (repair)	Mandatory	Mandatory	Optional
B	B4 (replacement)	—	—	Optional
	B5 (refurbishment)	—	—	Optional
	B6 (operational energy)	—	—	Optional
	B7 (operational water)	—	—	Optional
	C1 (deconstruction)	Mandatory for refrigerant based system	Mandatory for refrigerant based system	
C	C2 (transport)		Mandatory	Mandatory
	C3 (waste processing)	Scale-up factor		
	C4 (disposal)		Mandatory	
D	D (reuse, recover, recycle)	—	—	

* Compliant with BS EN 15804:2012+A2:2019, therefore modules C and D are mandatory whereas they are optional for BS EN 15804:2012+A1:2013

Legend:

Mandatory: calculations are mandatory for this life cycle stage module

Optional: calculations are optional for this life cycle stage module

Scale-up factor: life cycle stage module included through a scale-up factor

— Not included in calculation

Type of information needed for the calculations:

- Manufacturer product-specific information
- Product generic assumption unless manufacturer information available
- Product generic assumption
- Scale-up factor based on product complexity (no manufacturer information needed)
- Not included in the calculation, therefore no information needed

More detailed information can be found in Appendix C.

TM65 – manufacturer form

Data collection

Manufacturer form

Section A

Capacity of equipment/size
Product service life (year)
Product weight (kg)
Material composition breakdown (95%)
Refrigerant used + charge (kg)
Components replaced over service life

Essential information
to carry any CIBSE TM65 calculations

Section B

Final assembly factory location
Final assembly factory energy use (kWh)
Factories from supply chain location

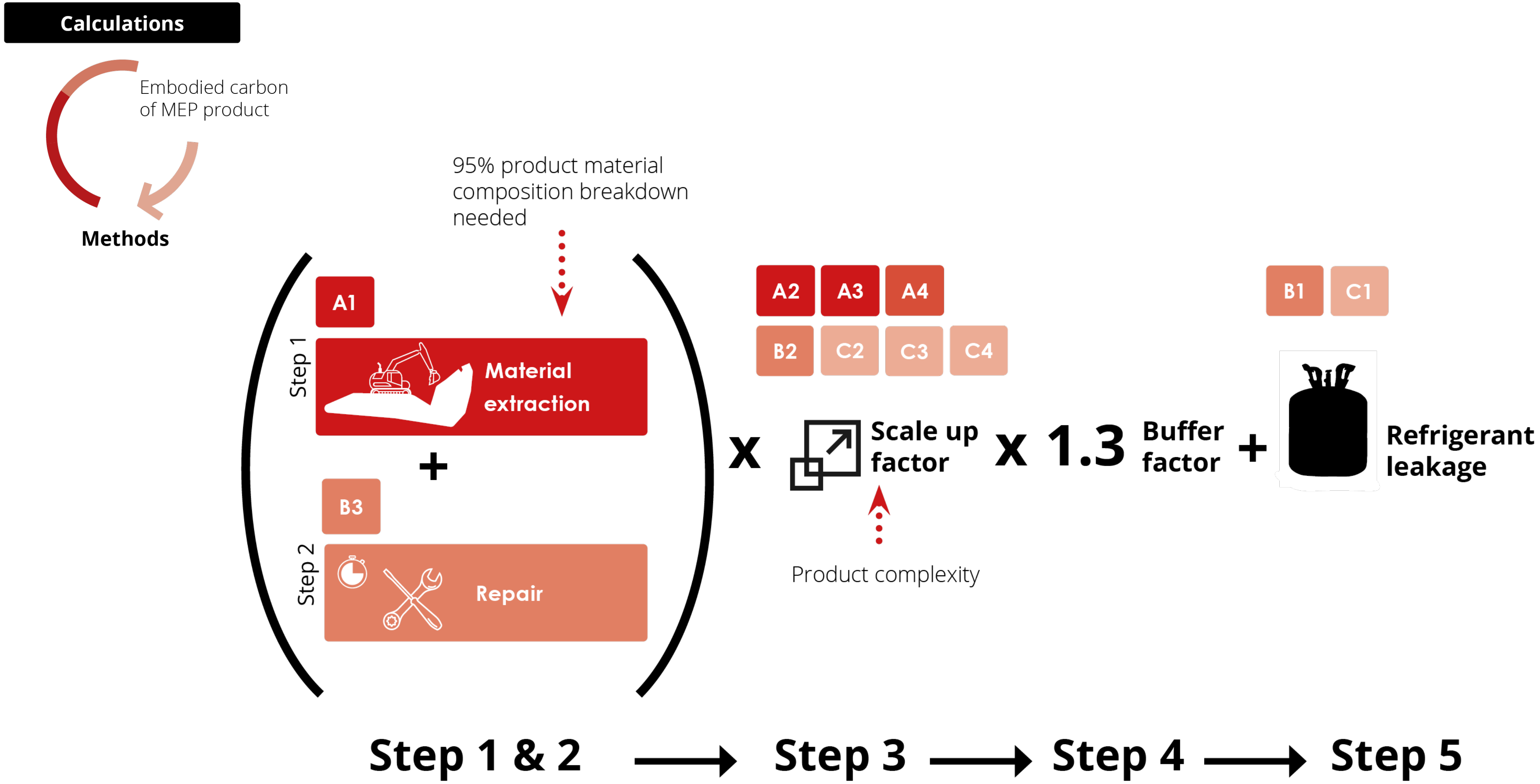
Supplementary information
needed for Mid Level calculations

Section C

Operational efficiency of product
Annual waste output at final assembly factory (kg)
Annual water consumption at final assembly factory (m3)
Renewable energy onsite factory (kWh)
% product reused, recovered or recycled
Maintenance recommendations
Warranty (years)
Ownership mode

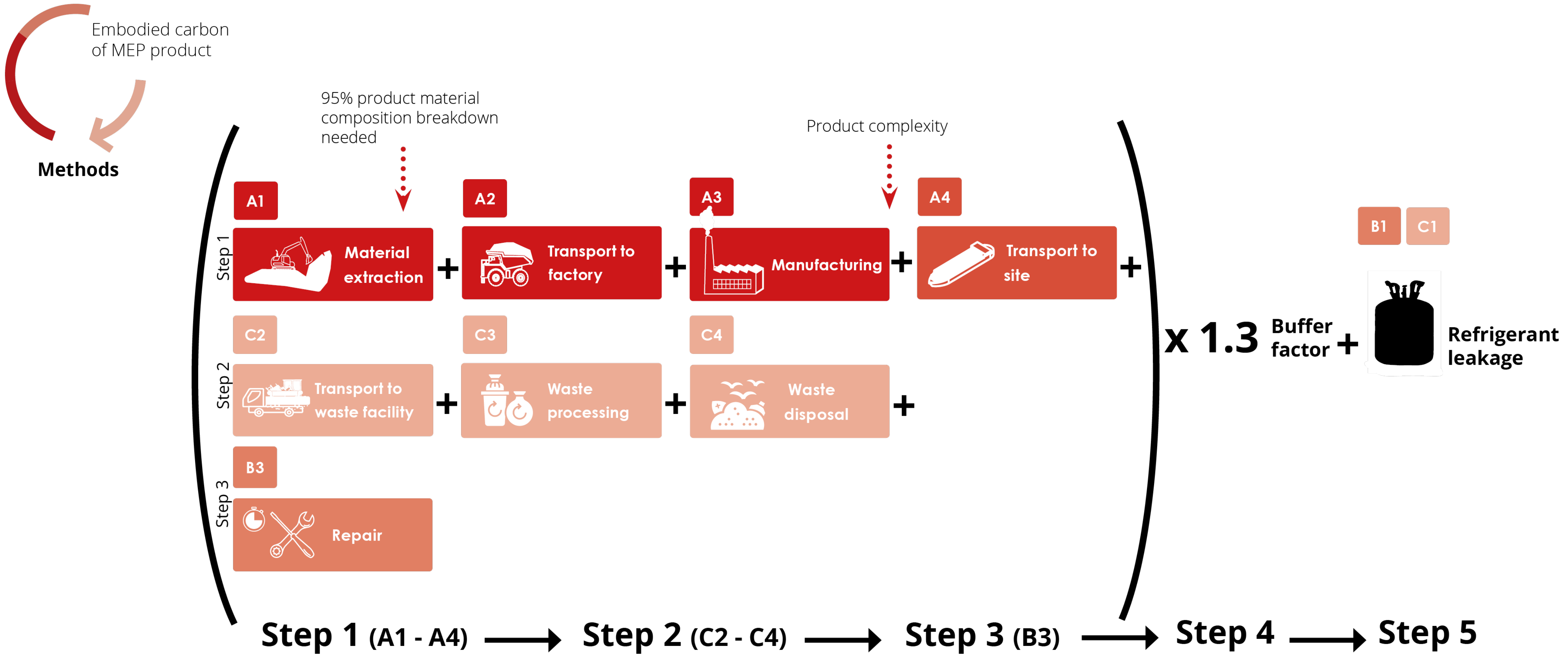
Optional information
for development of the next CIBSE TM65

TM65 – basic calculation method



TM65 – mid-level calculation method

Calculations



TM65 – reporting results

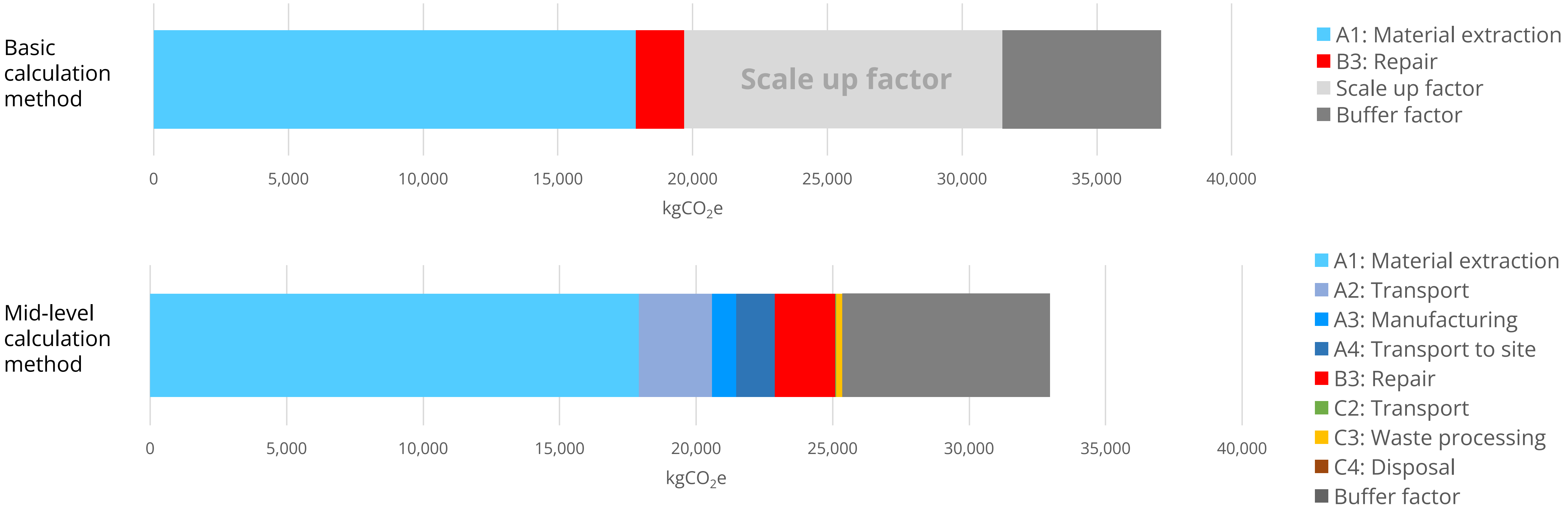
Reporting

Results format

Basic calculation		Notes/source
Date of assessment	dd/mm/yy	
Name of assessor and assessor organisation	A N Other	
Contact details of assessor	A N Other	
Product information		
Type of product	Heat pump	
Capacity/size of equipment (kW; m^3; litres; etc.)	100 kW	
Product weight (kg)	1000 kg	
Material % breakdown for at least 95% of the product weight? (Y/N)	Y	
Product service life (years)	15	
If refrigerant based, type of refrigerant used and GWP	R410a (GWP = 2088)	
Refrigerant charge (kg)	35 kg	
Product complexity category	3	
GWP results (kg CO_2e) — without refrigerant leakage		
A1: Material extraction (original product)	5319	
A1: Material extraction (components that are replaced in B3)	532	
A1–A4, B3, C2–C4: Total embodied carbon with scale-up and buffer factors (excluding refrigerant leakage)	12,170	
GWP result (kg CO_2e) — refrigerant leakage only		
B1 (refrigerant leakage during use) + C1 (refrigerant leakage end of life)	45,310	
GWP result with 'basic' calculation method (kg CO_2e) — total		
Result of 'basic' calculation	**57,479**	
Assumptions		
A1: Material carbon coefficient source		TM65 assumptions
B1: Refrigerant annual leakage rate (%)	4%	Type 2 (TM65 Table 4.13)
C1: Refrigerant end of life recovery rate (%)	98%	Type 2 (TM65 Table 4.13)
B3: Materials replaced as part of repair (%)	10%	As per TM65 Step 2.1
Details		
Please provide any relevant details		

Mid-level calculation		Notes/source
Date of assessment	dd/mm/yy	
Name of assessor and assessor organisation	A N Other	
Contact details of assessor	A N Other	
Product information		
Type of product	Heat pump	
Capacity of equipment/size (kW; m^3; litres; etc.)	100 kW	
Product weight (kg)	1000	
Material % breakdown for at least 95% of the product weight? (Y/N)	Y	
Service life of the product (years)	15	
If refrigerant based, type of refrigerant used	R410a (GWP = 2088)	
Refrigerant charge (kg)	35	
Energy consumption of the factory per unit of product	200 kW·h	
Location of manufacture	France, Europe	
Product complexity category	3	
GWP results (kg CO_2e) breakdown		
A1: Material extraction	5319	TM65 assumptions
A2: Transport	792	TM65 assumptions
A3: Manufacturing	272	TM65 assumptions (Europe)
A4: Transport to site	198	TM65 assumptions
A5: Construction	n/a	
B1: Use	43,848	TM65 leakage type 2
B2: Maintenance (if information given by manufacturer)	n/a	
B3: Repair	666	TM65 assumptions
B4: Replacement	n/a	
B5: Refurbishment	n/a	
B6: Operational energy	n/a	
B7: Operational water	n/a	
C1: Deconstruction	1462	TM65 leakage type 2
C2: Transport	13	
C3: Waste processing	68	
C4: Disposal	3	TM65 assumptions
GWP results (kg CO_2e) — without refrigerant leakage		
A1–C4 (excluding B1, C1)	7331	
A1–C4 with buffer factor (excluding B1, C1)	9531	
GWP result (kg CO_2e) — only refrigerant leakage		
B1 (refrigerant leakage during use) + C1 (refrigerant leakage end of life)	45,310	
GWP result with 'mid-level calculation' method (kg CO_2e) — total		
Result of 'mid-level calculation'	54,840	
Assumptions		
B1: Refrigerant annual leakage rate (%)	4%	TM65 leakage type 2
C1: Refrigerant end of life recovery rate (%)	98%	TM65 leakage type 2
B3: Materials replaced as part of repair (%)	10%	TM65 assumptions
C4: Percentage of product going to landfill (%)	30%	TM65 assumptions
Details		
Please provide any relevant details		

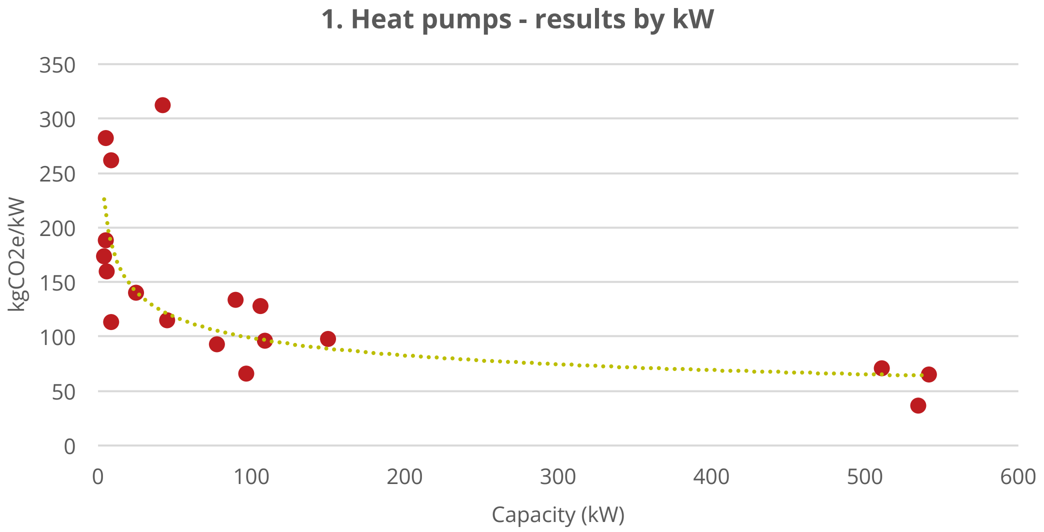
TM65 – 542 kW heat pump example

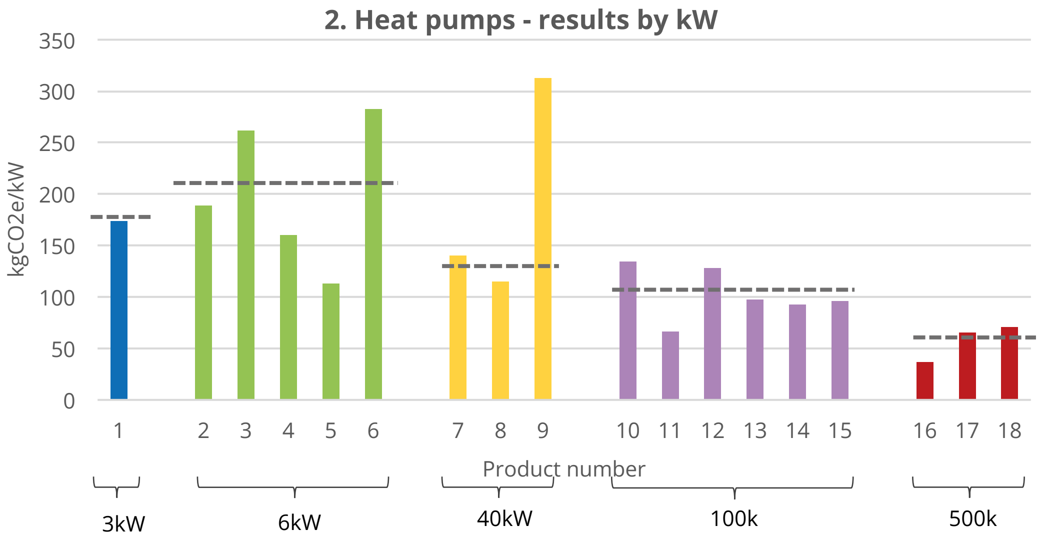


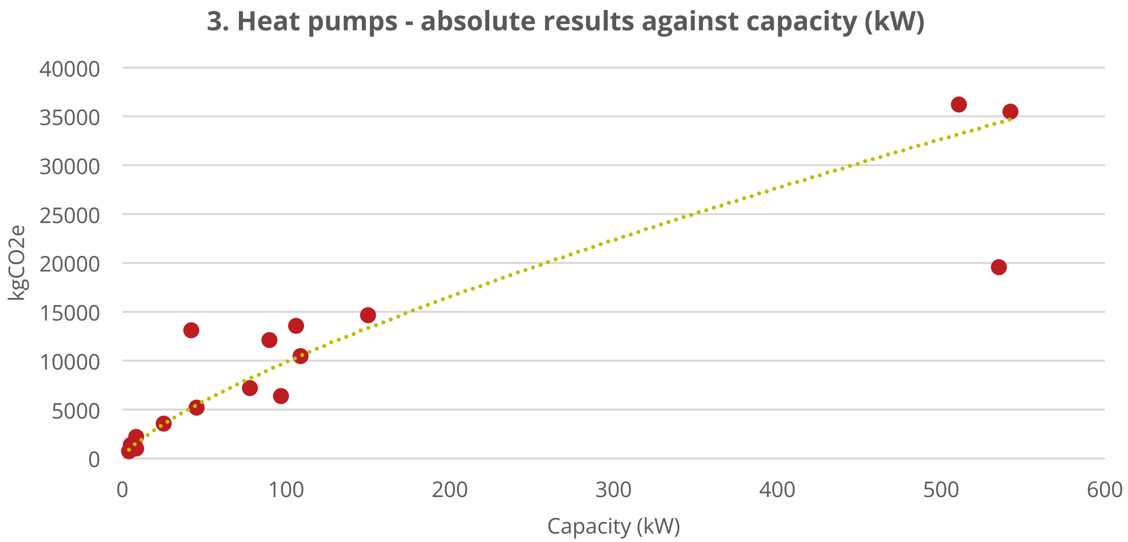
System-level assessment

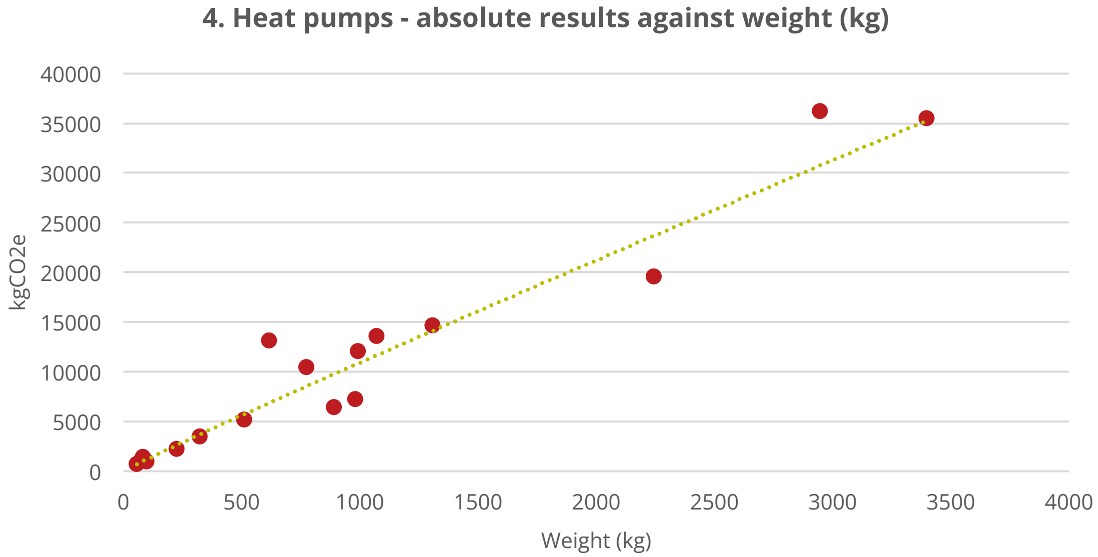
TM65.1: Embodied carbon of building services: residential heating

Heat Pumps

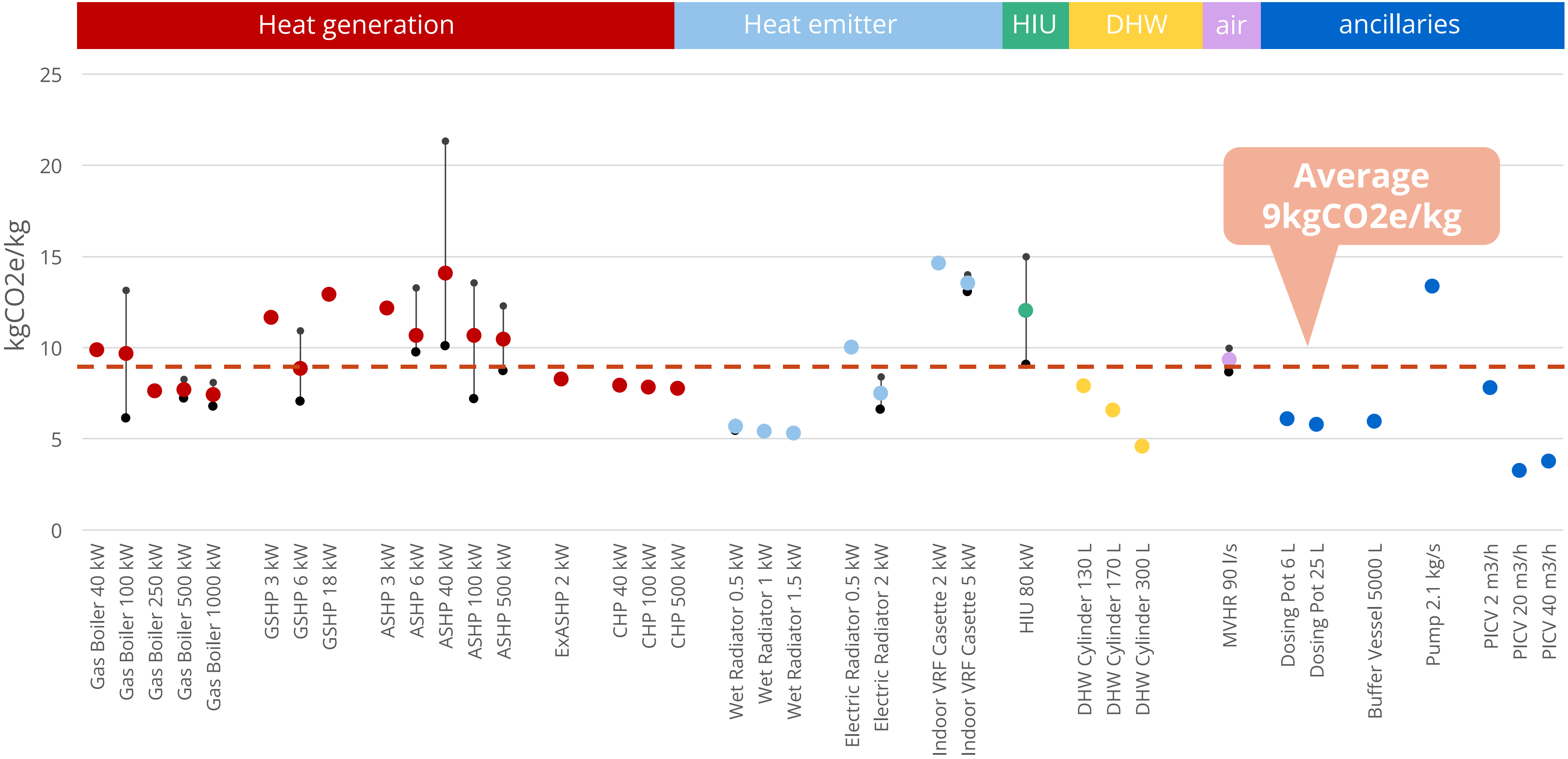

1. Heat pumps - results by kW
kgCO2e/kW
350
300
250
200
150
100
50
0
0
100
200
300
400
500
600
Capacity (kW)


2. Heat pumps - results by kW
kgCO2e/kW
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Product number
3kW
6kW
40kW
100k
500k

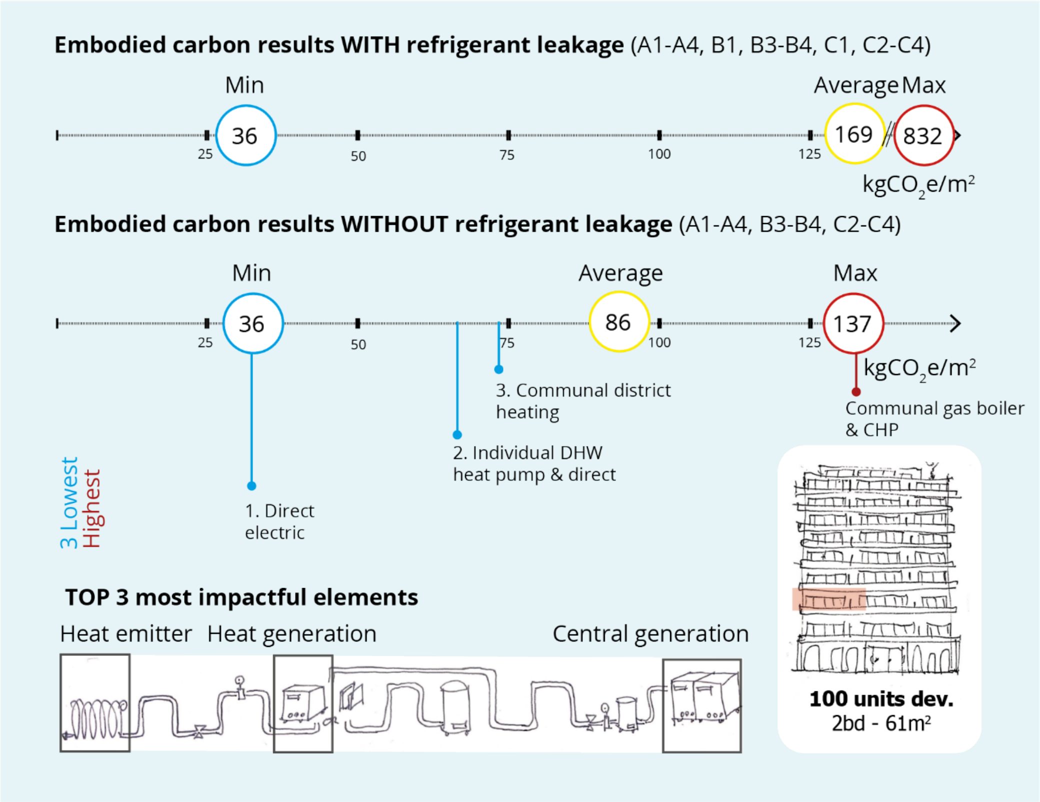

3. Heat pumps - absolute results against capacity (kW)
kgCO2e
40000
35000
30000
25000
20000
15000
10000
5000
0
0
100
200
300
400
500
600
Capacity (kW)

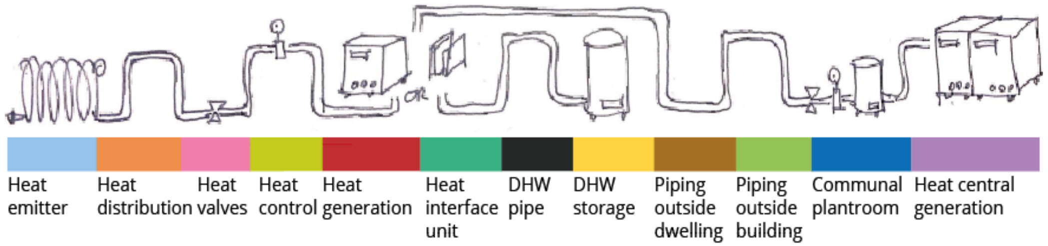

4. Heat pumps - absolute results against weight (kg)
kgCO2e
40000
35000
30000
25000
20000
15000
10000
5000
0
0
500
1000
1500
2000
2500
3000
3500
4000
Weight (kg)

Products findings – Average kgCO2e/kg

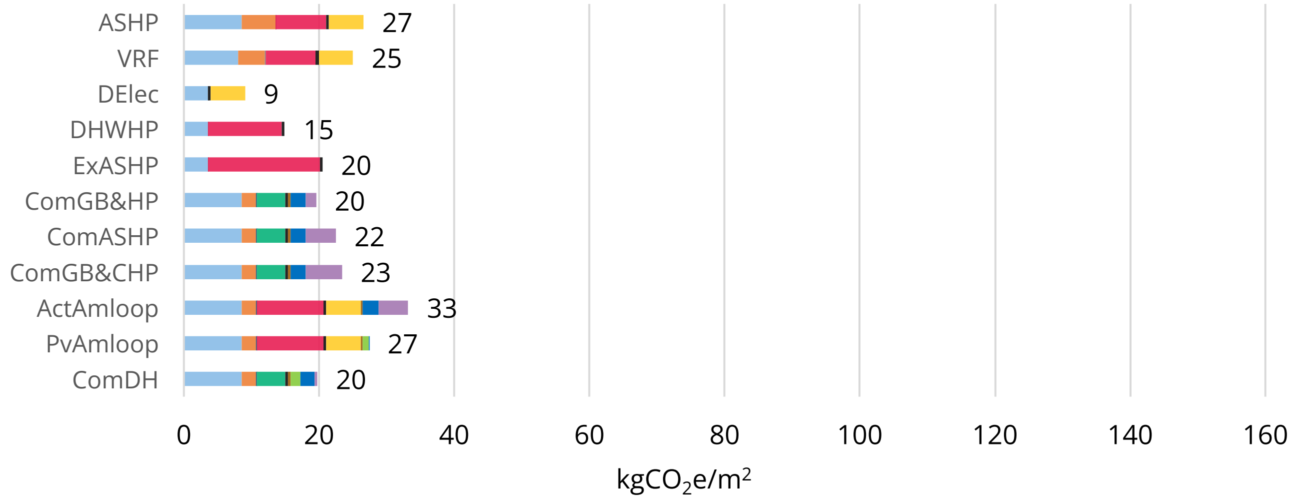


Results - 100 apartment scheme

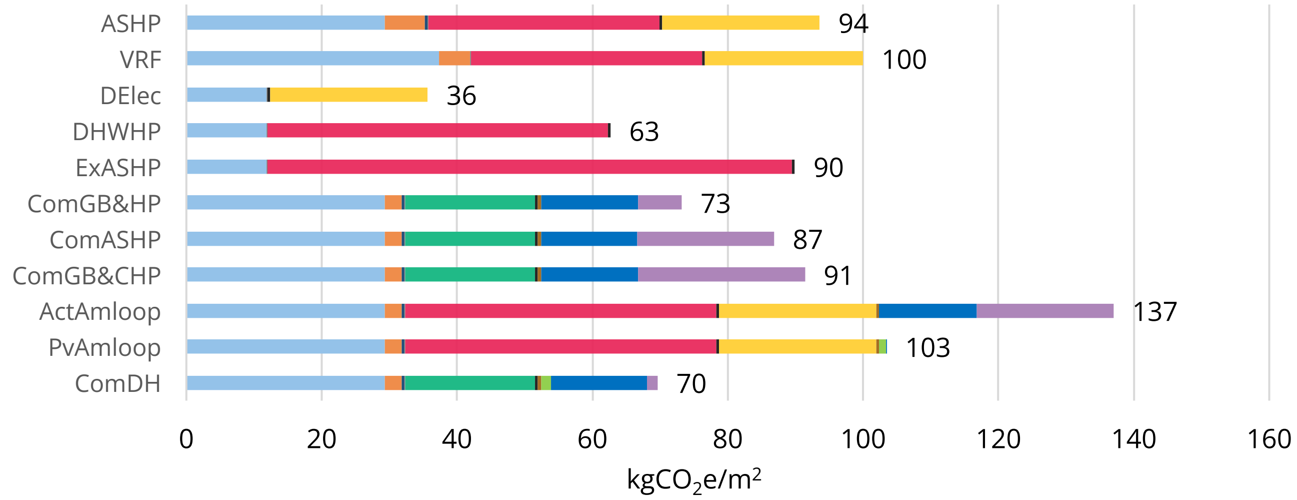




100 Units Residential Development: Upfront Embodied Carbon (A1-A4) in kgCO2e/m2



100 Units Residential Development: Embodied carbon (A1-A4,B3-B4,C2-C4) excluding refrigerant leakage in kgCO2e/m2



How to use in ANZ

TM65 ANZ addendum working group

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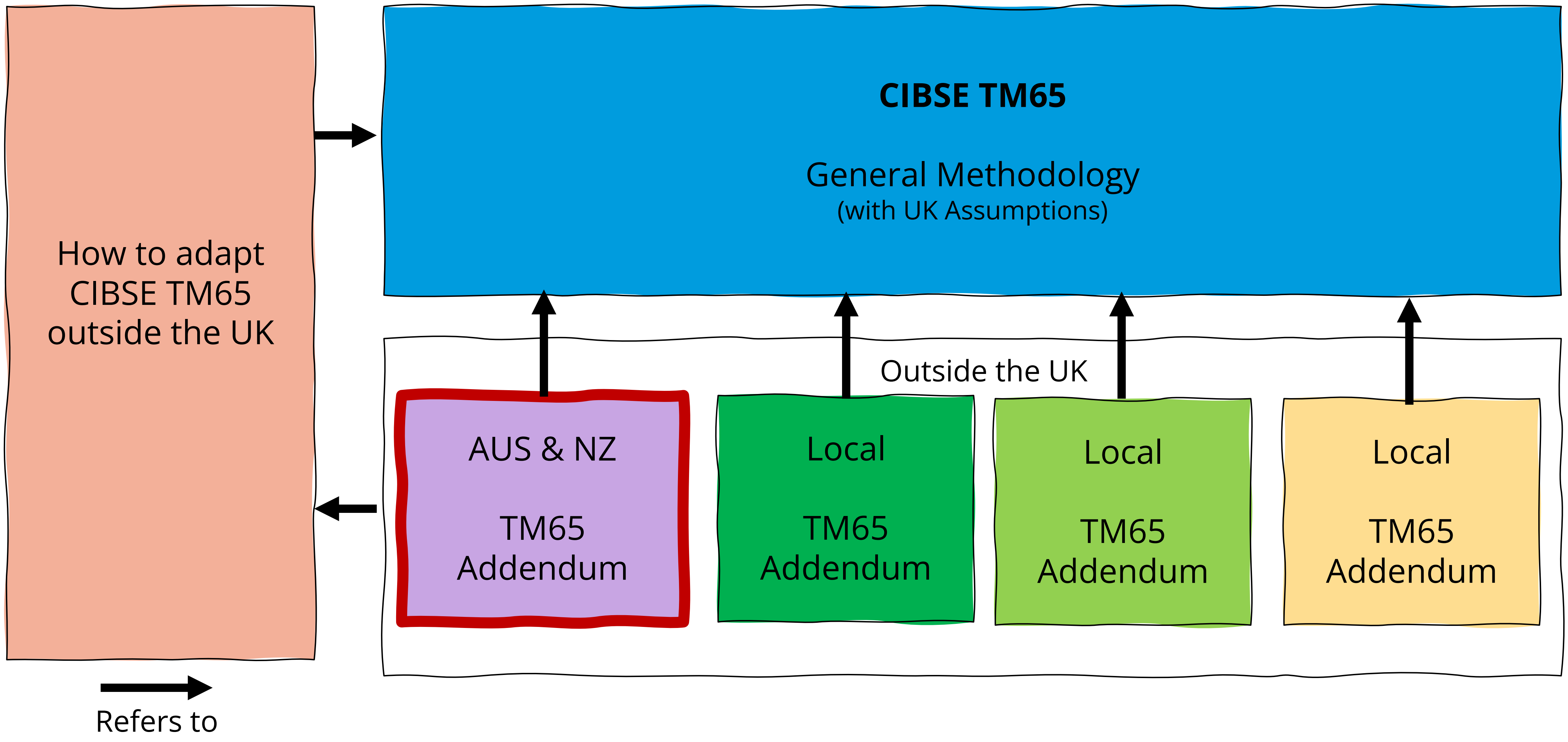
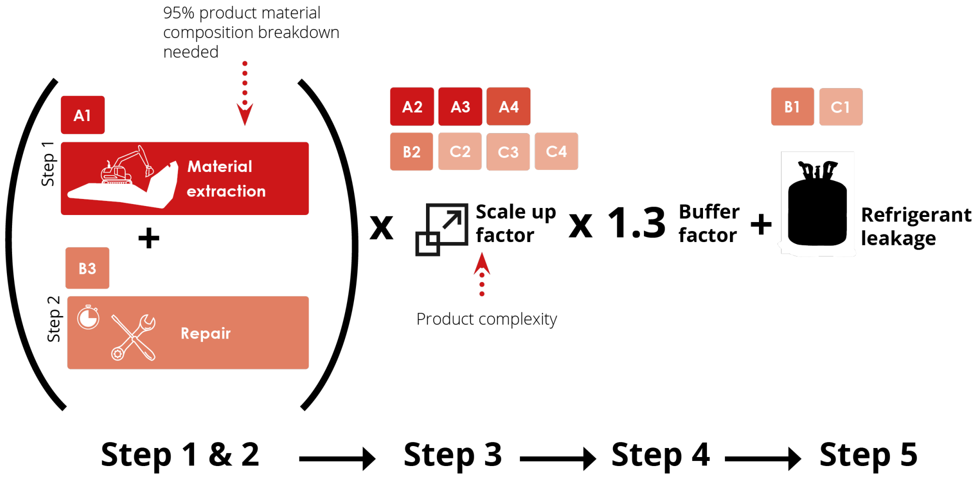
TM65 ANZ Addendum



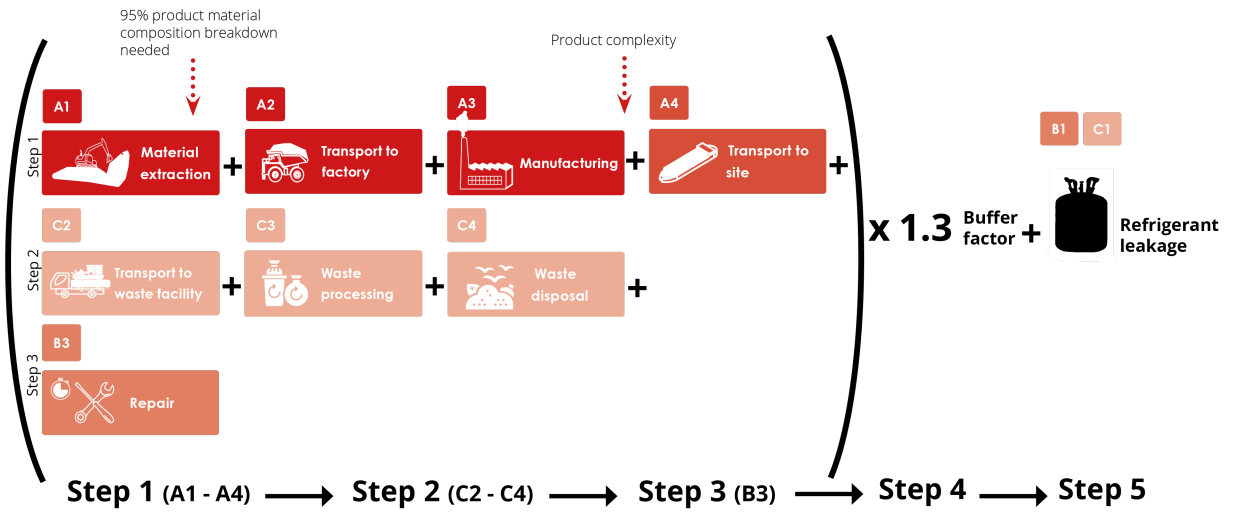
TM 65 basic method in ANZ – local assumptions

1. Refrigerant leakage scenarios

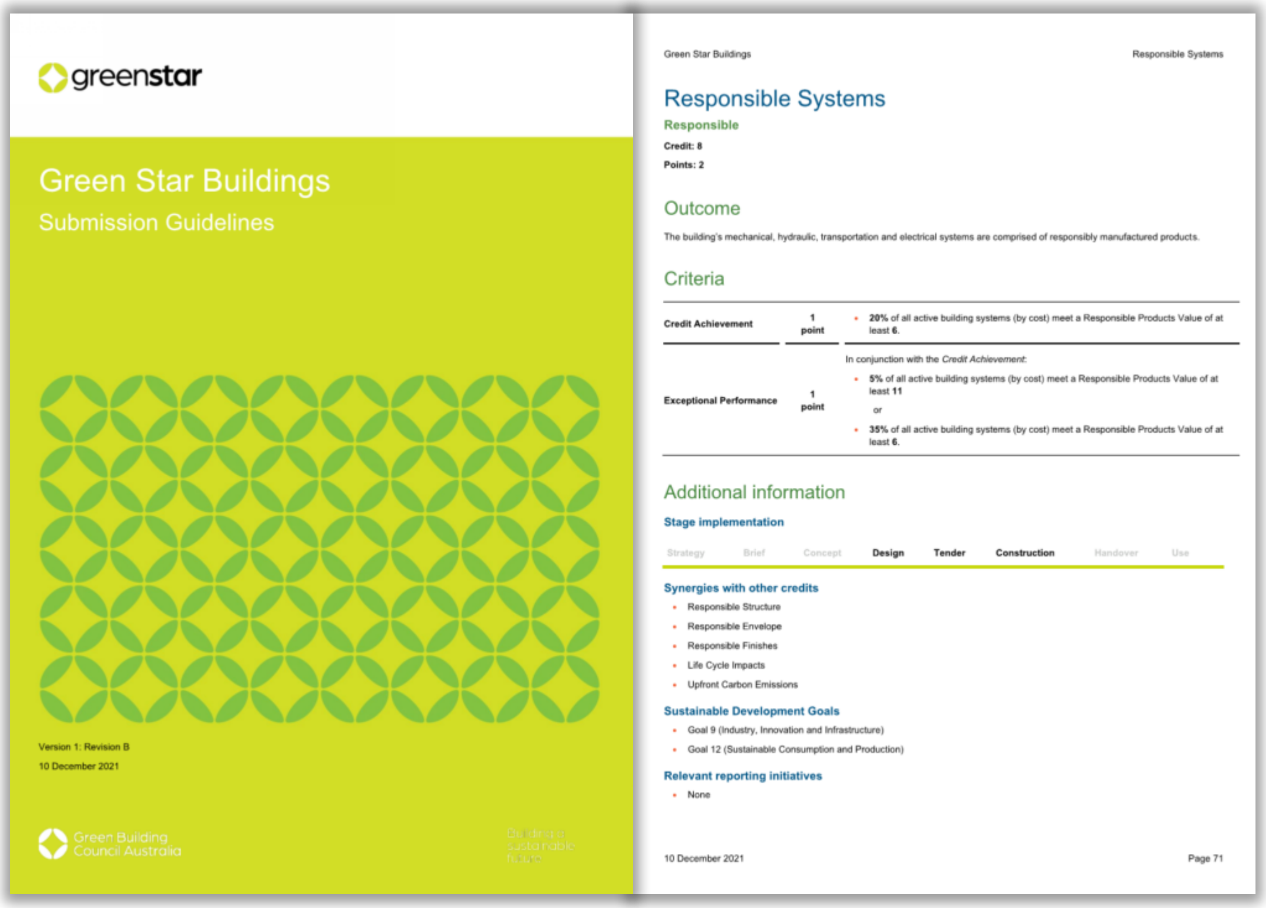


TM 65 mid-level method in ANZ – local assumptions

1. Carbon factors for transport (A2 – transport to factory, A4 -transport to site) are updated to 2021
2. Detailed carbon factors for electricity (A3 – manufacturing) to reflect regional factors in Australia and New Zealand
3. Local carbon factor for gas (A3 – manufacturing) to reflect regional factor in Australia and New Zealand
4. Local transport scenarios (A4 – transport to site)
5. Refrigerant leakage scenarios (B1 – use, C1 – Deconstruction) as per the basic calculation
6. Local carbon factor for landfill (C4 – disposal)



Green Star Responsible Systems


greenstar

Green Star Buildings
Submission Guidelines

Version 1: Revision B
10 December 2021

Green Building Council Australia

Green Star Buildings | Responsible Systems

Responsible Systems

Responsible

Credit: 8

Points: 2

Outcome

The building's mechanical, hydraulic, transportation and electrical systems are comprised of responsibly manufactured products.

Criteria

Credit Achievement	**1 point**	• **20%** of all active building systems (by cost) meet a Responsible Products Value of at least **6**.
Exceptional Performance	**1 point**	In conjunction with the *Credit Achievement*: • **5%** of all active building systems (by cost) meet a Responsible Products Value of at least **11** or • **35%** of all active building systems (by cost) meet a Responsible Products Value of at least **6**.

Additional information

Stage implementation

Strategy | Brief | Concept | **Design** | **Tender** | **Construction** | Handover | Use

Synergies with other credits

- Responsible Structure
- Responsible Envelope
- Responsible Finishes
- Life Cycle Impacts
- Upfront Carbon Emissions

Sustainable Development Goals

- Goal 9 (Industry, Innovation and Infrastructure)
- Goal 12 (Sustainable Consumption and Production)

Relevant reporting initiatives

- None

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CIBSE TM65 next steps

CIBSE TM65 ANZ – web-based tool

CIBSE TM65.2 – Embodied carbon of HVAC strategies in offices (UK)

TECHNICAL MEMORANDUM OF EMBODIED CARBON OF HVAC SYSTEMS IN OFFICES

CIBSE TM65 ANZ Addendum

Wrap-up

TM65 Key Takeaways

- We need to understand, measure and reduce embodied carbon
- Building Services equipment is a ‘grey area’
- TM65 provides a methodology to benchmark equipment and establish industry averages when EPDs are not available
- Rules-of-thumb can be created for system types to help inform early engineering decisions and make embodied carbon a key design driver
- TM65 is a stepping stone… we hope that it encourages the Building Services equipment supply chain to adopt formal EPDs
- TM65 ANZ addendum will be released to industry this Spring

Thank you ;)