

zeb_x Decarb Lunch Series

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Balancing Whole Life Carbon in BC Step Code Buildings

Mon Nov 24, 2025
12 - 1pm PST
Free Webinar
zeb_x.org



THE UNIVERSITY OF BRITISH COLUMBIA
Campus + Community Planning



reLoad
SUSTAINABLE DESIGN INC





Agenda

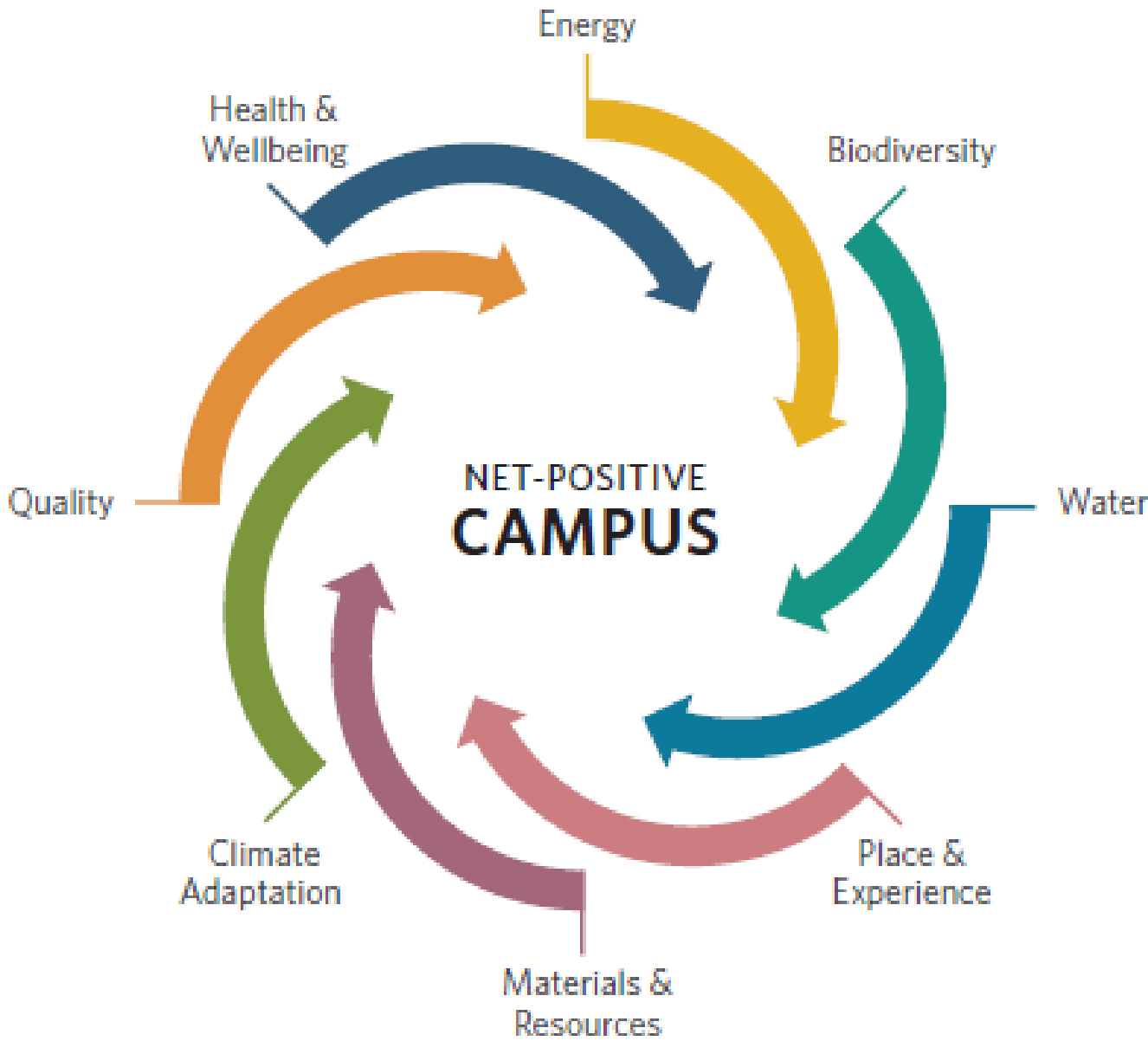
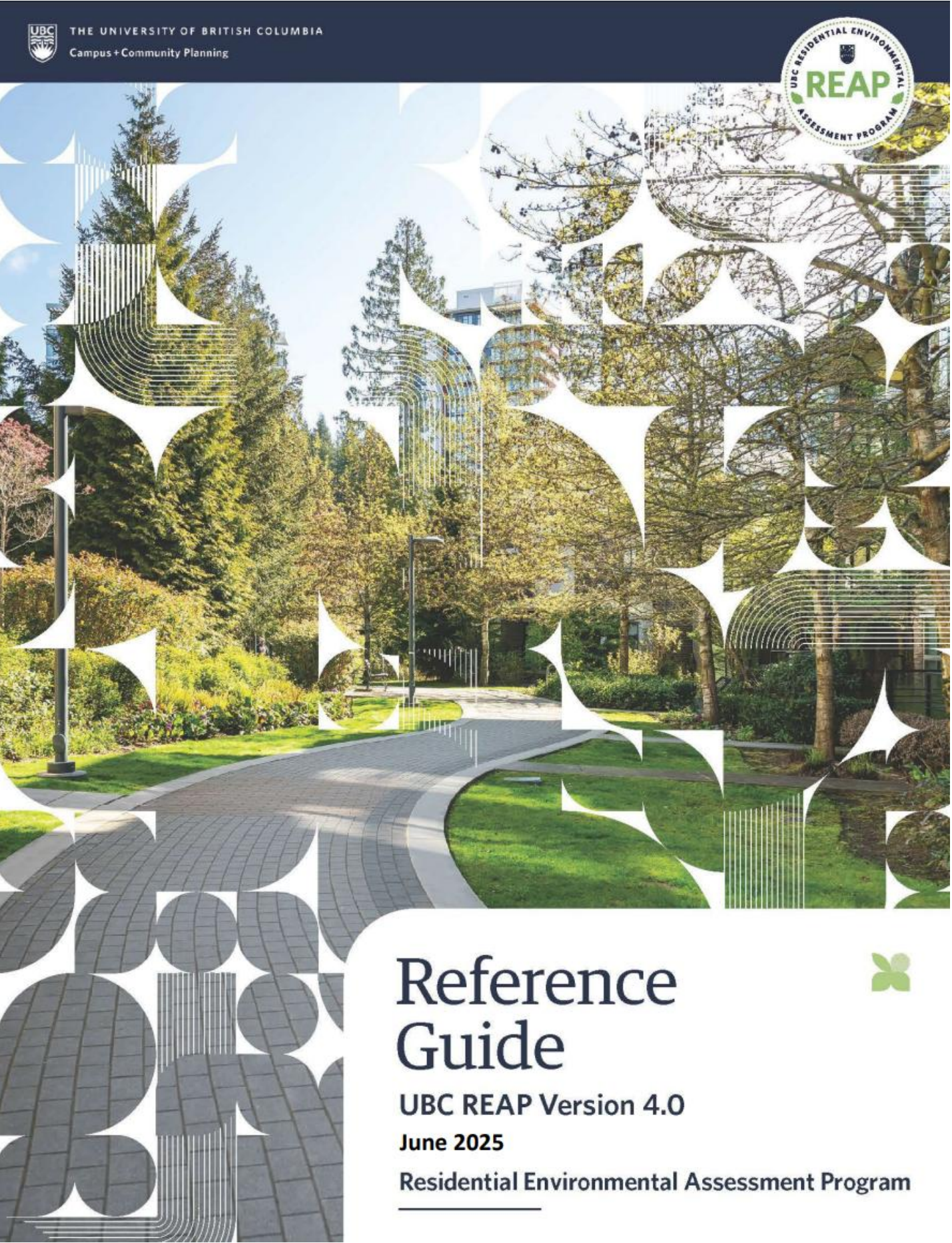
- Background & Context
- Importance of Study vs Current Codes
- Study Orientation
- Study Key Outcomes
- Future Code Impact Considerations
- Questions & Discussion

"City of UBC"



- Growing city of over 17,000
- Sits outside of MV municipal boundaries
- Authority have jurisdiction for building code
- Adopted Energy Step Code 2018 (Step 2)
- Land Use Plan (Land Use Rules) – enables UBC REAP

UBC Residential Environmental Assessment Plan



REAP is UBC's mandatory green building rating system, created to address the unique conditions of neighbourhood growth on UBC's campus

UBC Residential Environmental Assessment Plan

ENERGY & EMISSIONS	
E&E P1: Energy Step Code Compliance (Step 3)	Precondition
E&E P2: Zero Carbon Step Code Compliance (EL-4)	Precondition
MATERIALS AND RESOURCES	
M&R P2: 10% Embodied Carbon Reduction	Precondition

June 2024

June 2025

June 2025

UBC REAP Embodied Carbon Roadmap



Net Zero by 2050 Climate Action Target

Funding support

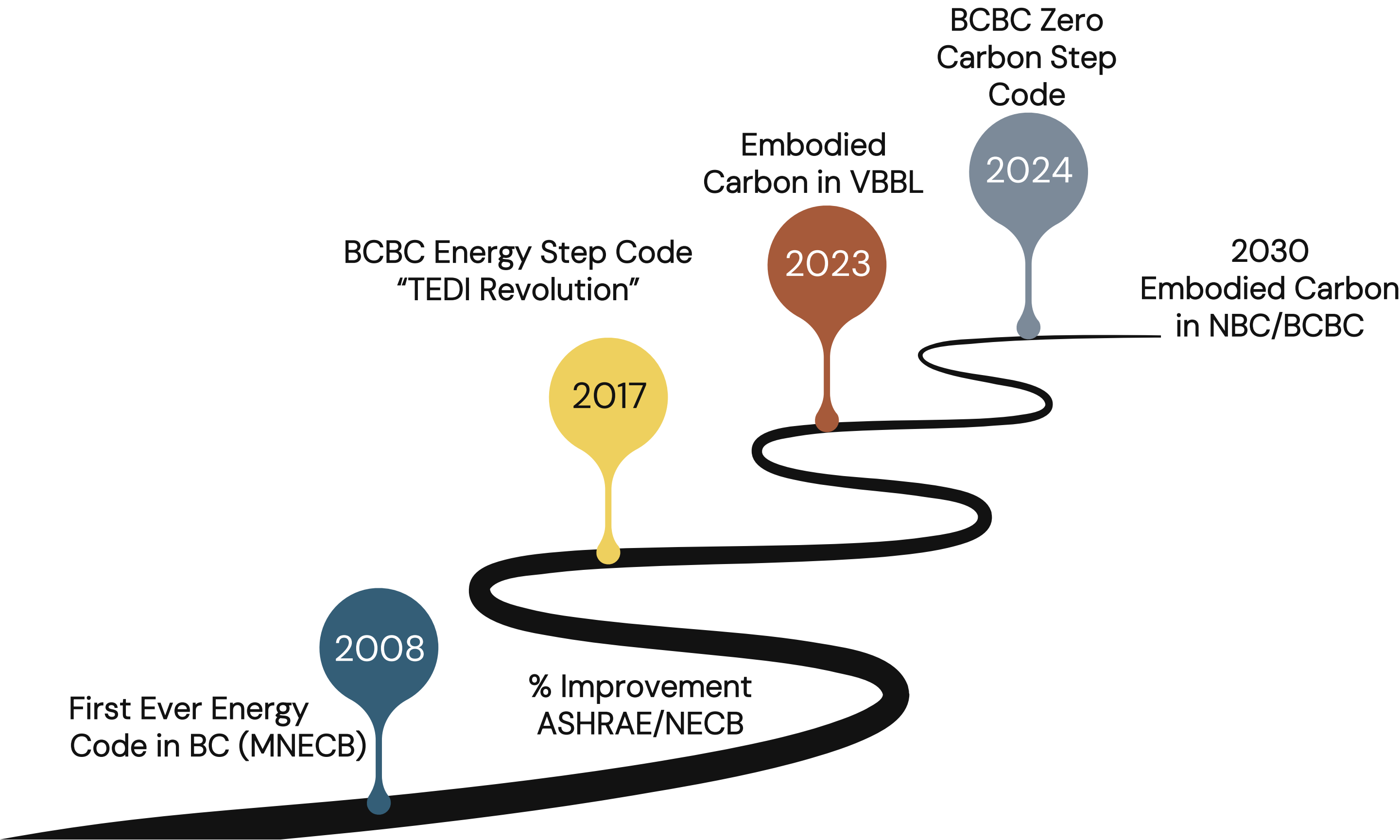


Codes Acceleration Fund



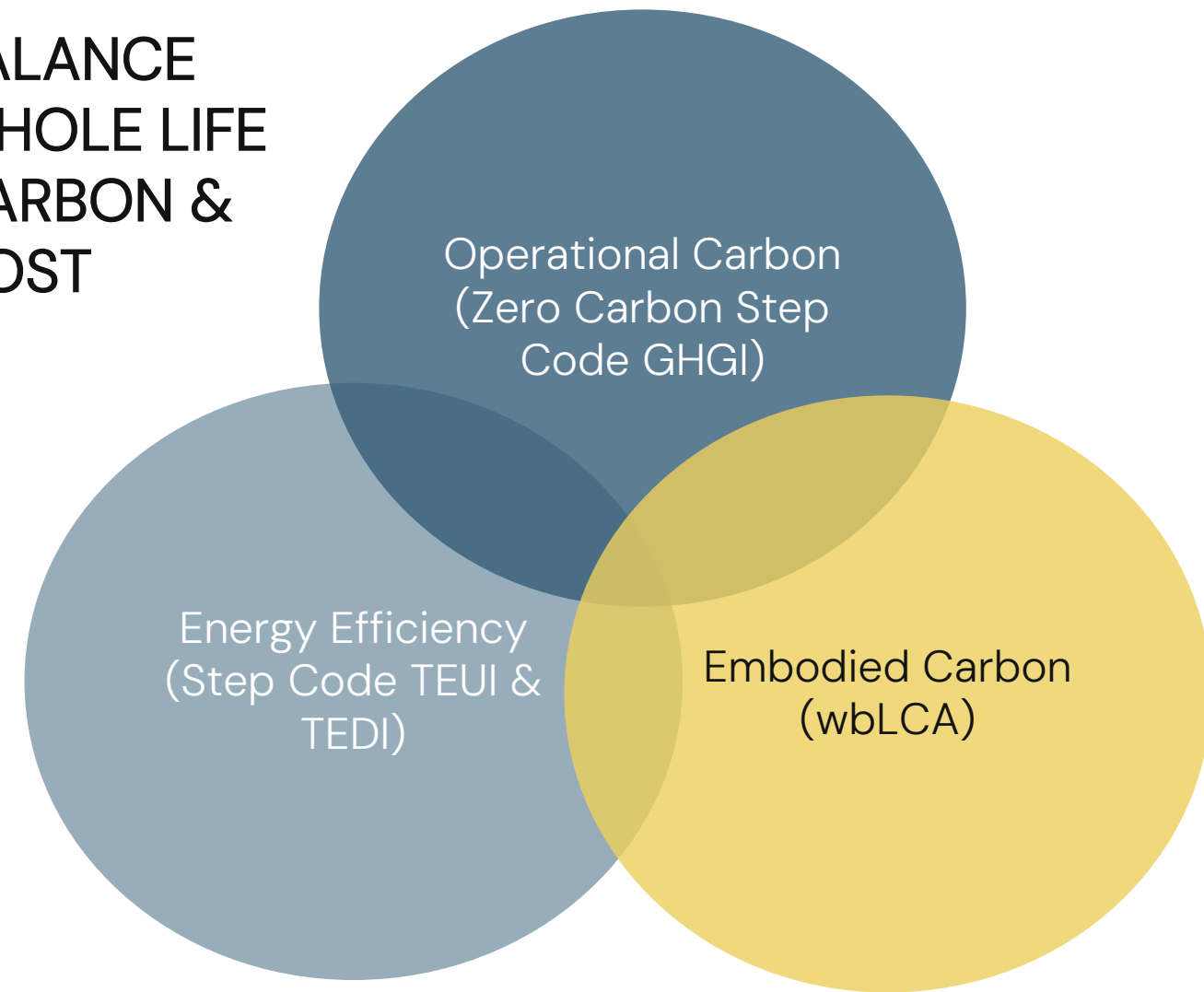
Sustainable Communities Program

Importance of Study in Current Code Landscape



Balancing Building Whole Life Carbon

BALANCE
WHOLE LIFE
CARBON &
COST



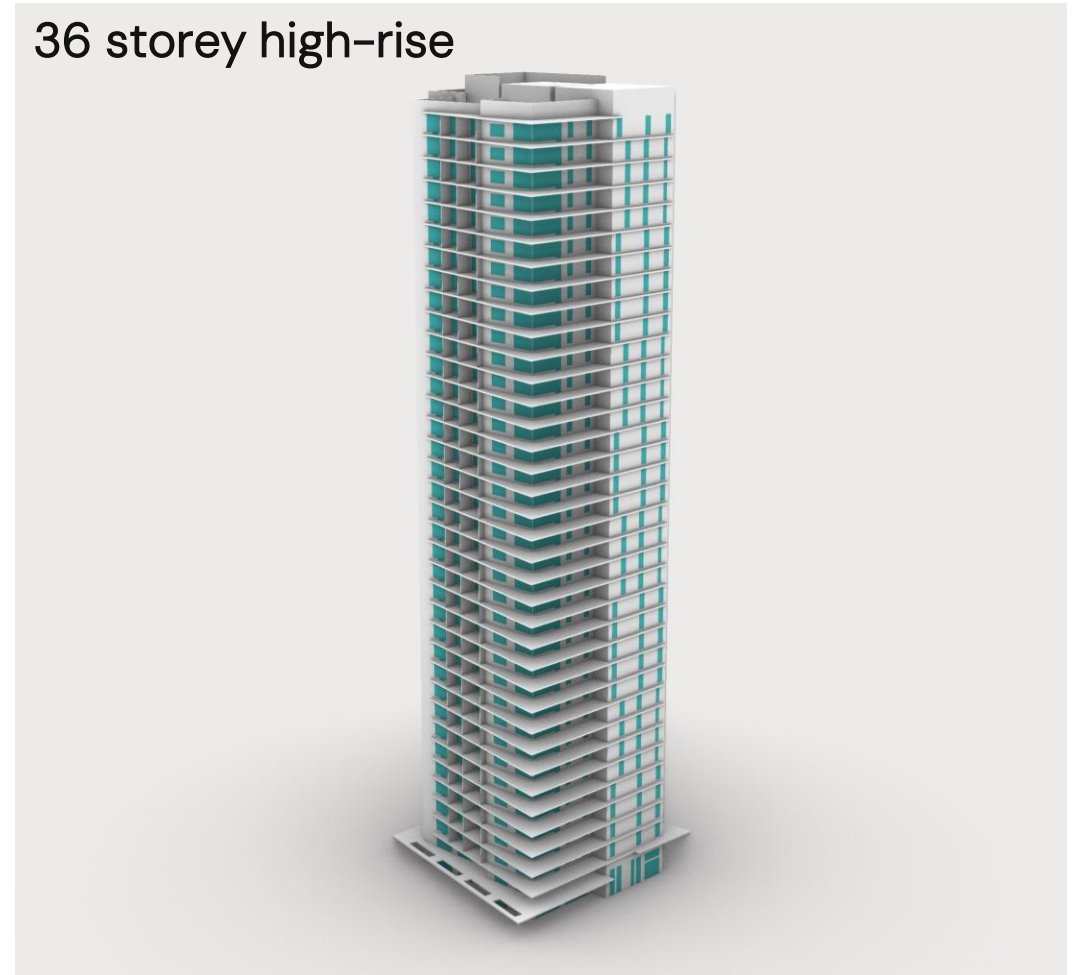
Incremental Cost
(Decision Driver)

- How do we balance performance and practicality and not drive cost up on projects?

6 storey mid-rise



36 storey high-rise





Study Orientation

Team, Approach, & Methodology

Project Team

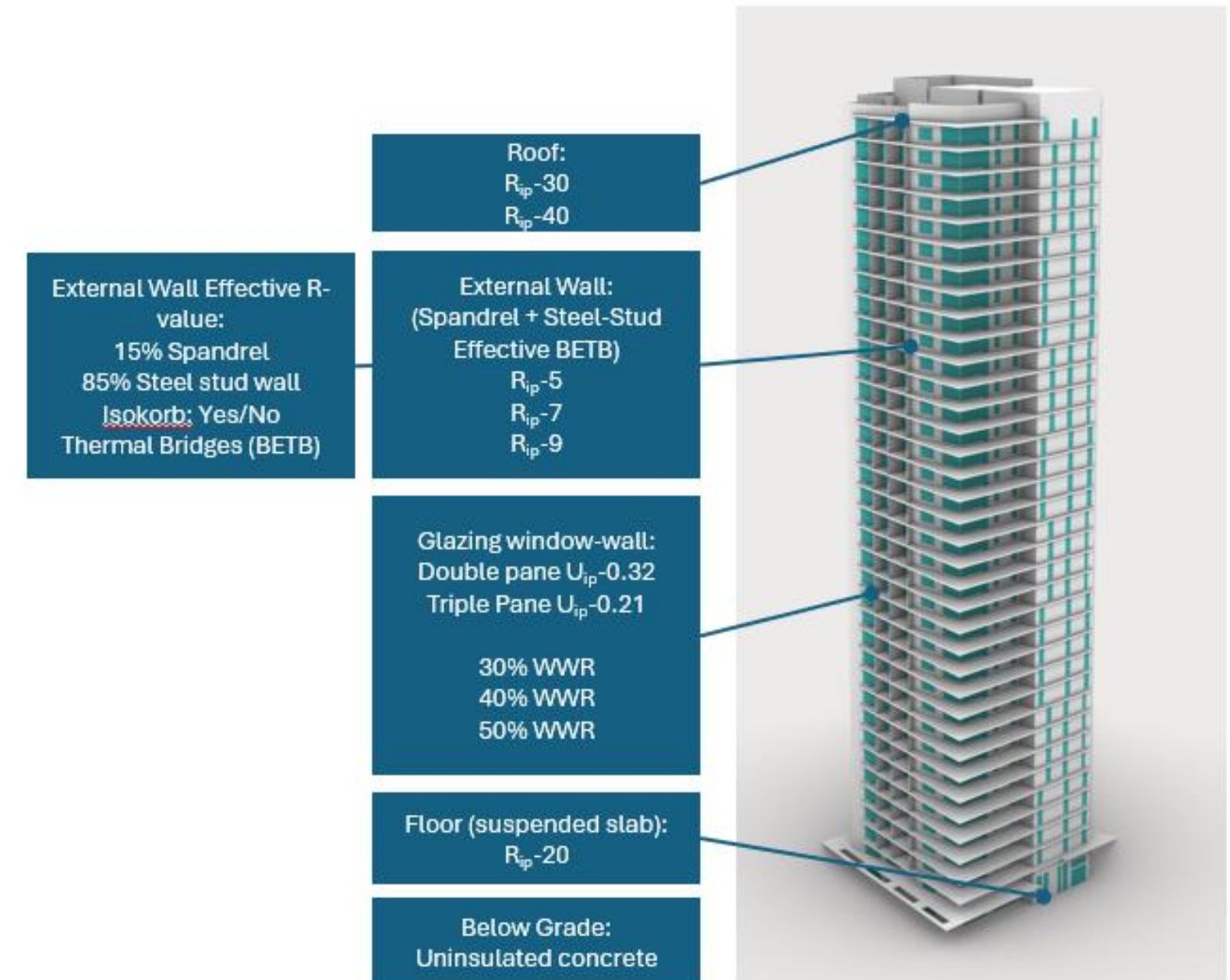
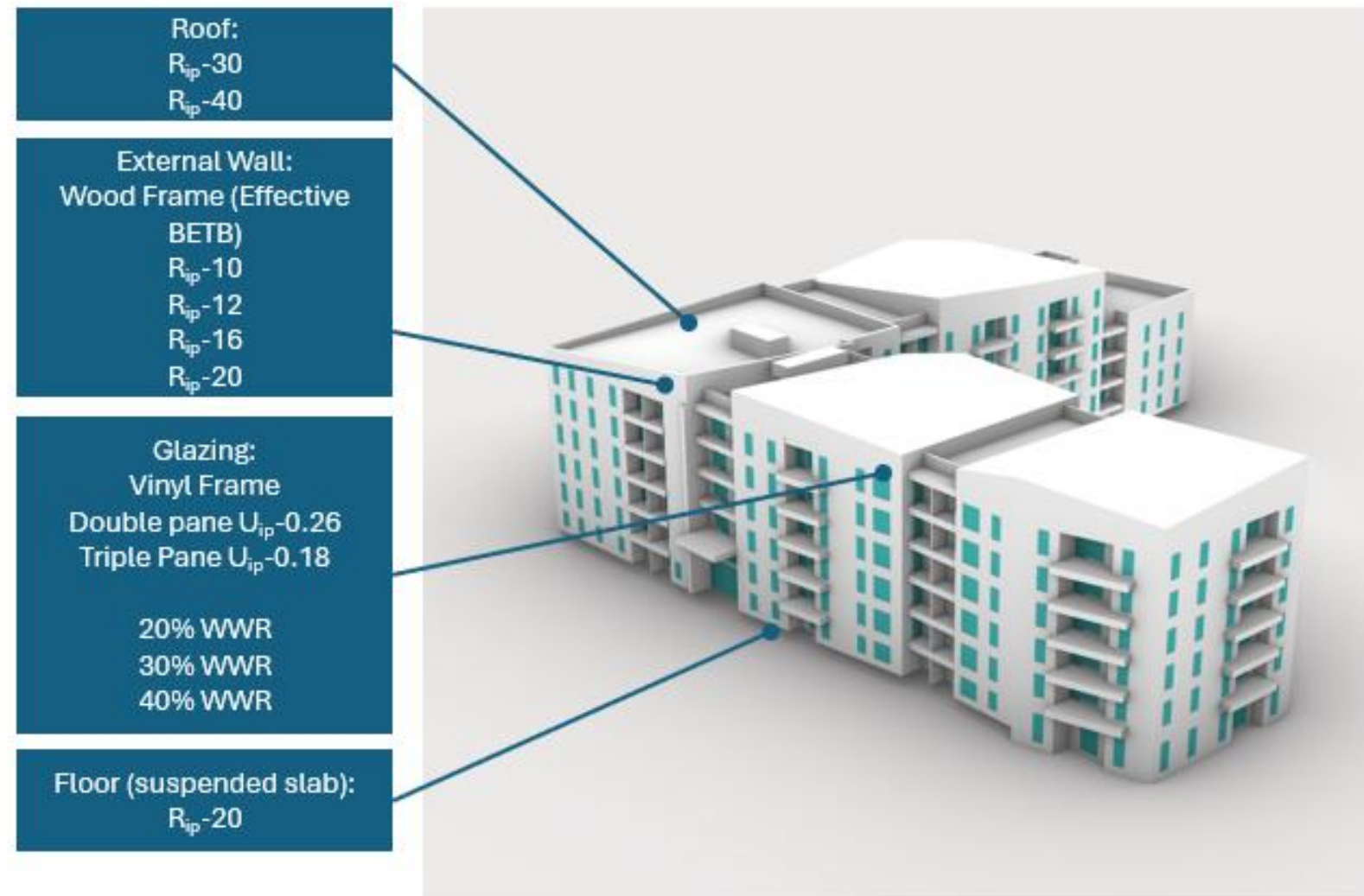


THE UNIVERSITY OF BRITISH COLUMBIA
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Envelope & Fuel Source in Focus

- Thermal performance of envelope (TEDI) drives BC Energy Step Code rating
- How do combinations perform holistically with two fuel sources



Archetype - 6 Storey Wood Frame

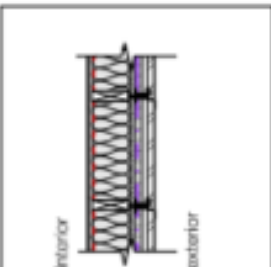
Wall

Hybrid Insulation

1" Outboard insulation with cavity fill

Target Effective
R Value = R10

W1	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.337	Rip-VALUE:	18.85

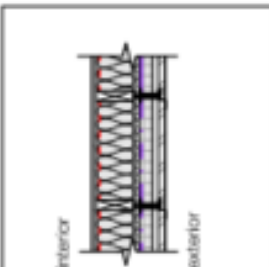


- W1 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 07 21 00 - Fibreglass insulation R19, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 07 21 00 - 25mm rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

2" Outboard insulation with cavity fill

R12

W2	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.295	Rip-VALUE:	19.85

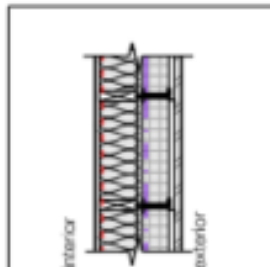


- W2 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 07 21 00 - Fibreglass insulation R19, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 07 21 00 - 50mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

4" Outboard insulation with cavity fill

R16

W3	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.225	Rip-VALUE:	25.24

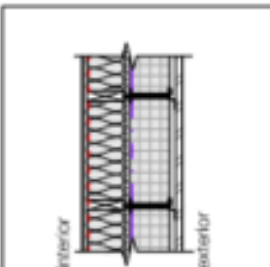


- W3 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 07 21 00 - Fibreglass insulation R19, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 07 21 00 - 100mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

6" Outboard insulation with cavity fill

R20

W4	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.189	Rip-VALUE:	30.94



- W4 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 07 21 00 - Fibreglass insulation R19, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 07 21 00 - 150mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

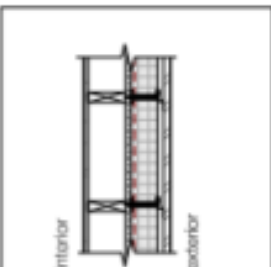
Cavity Insulation + Outboard Insulation 1" to 6"

Outboard Insulation

4" Outboard insulation

R10

W5	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.324	Rip-VALUE:	17.52

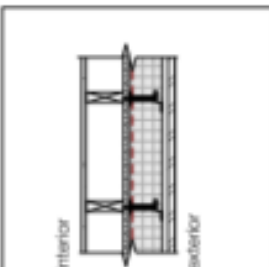


- W5 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Vapour impermeable weather resistant self adhered membrane
 - 07 21 00 - 100mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

5" Outboard insulation

R12

W6	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.278	Rip-VALUE:	20.42

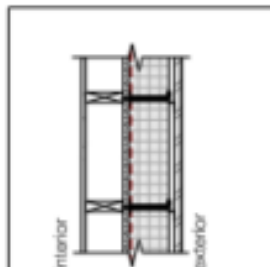


- W6 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Vapour impermeable weather resistant self adhered membrane
 - 07 21 00 - 125mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

6" Outboard insulation

R16

W7	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.245	Rip-VALUE:	23.18

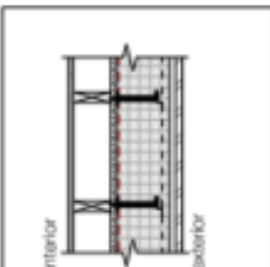


- W7 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Vapour impermeable weather resistant self adhered membrane
 - 07 21 00 - 150mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

8" Outboard insulation

R20

W8	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.200	Rip-VALUE:	28.11



- W8 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Vapour impermeable weather resistant self adhered membrane
 - 07 21 00 - 200mm semi rigid mineral wool exterior wall insulation - R4.2/mch, held in place with stick pins
 - 07 05 43 - Thermal clip with 22mm customized Z-Girt, spacing as required by engineering
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

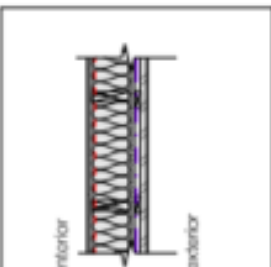
Outboard Only Insulation 4" to 8"

Alternatives

Cavity fill only

R10

W9	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.327	Rip-VALUE:	17.36

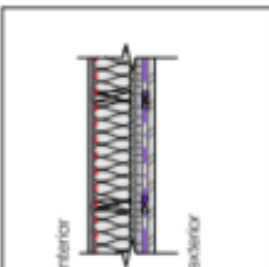


- W9 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent Vapour barrier
 - 06 10 00 - 38 x 140mm wood stud - refer to structural
 - XX XX XX - Hemp fibre batt insulation R3.6/mch, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 06 10 00 - 1x3 treated wood rainscreen @ 400mm c-c
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

22mm Outboard insulation with cavity fill

R12

W10	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.261	Rip-VALUE:	20.20

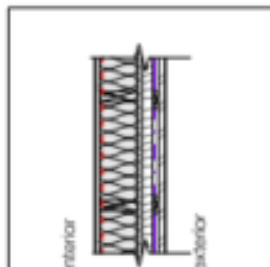


- W10 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent Vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - XX XX XX - Hemp fibre batt insulation R3.6/mch, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - XX XX XX - 22mm wood fibre insulation board - R3.6/mch, held in place with stick pins
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 06 10 00 - 1x3 treated wood rainscreen @ 400mm c-c
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

60mm Outboard insulation with cavity fill

R16

W11	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.230	Rip-VALUE:	24.65

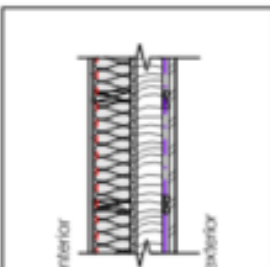


- W11 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent Vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - XX XX XX - Hemp fibre batt insulation R3.6/mch, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - XX XX XX - 60mm wood fibre insulation board - R3.6/mch, held in place with stick pins
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 06 10 00 - 1x3 treated wood rainscreen @ 400mm c-c
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

4" Outboard insulation with cavity fill

R20

W12	Exterior Wall Assembly - Metal Cladding			
	Embodied Carbon / m ² :		?	
	FRR Required:	Not Required	FRR Provided:	Not Required
	STC Required:	Not Required	STC Provided:	Not Required
	Uoi-VALUE [W/m ² K]:	.194	Rip-VALUE:	29.37



- W12 Assembly Components:**
- 09 21 16 - 16mm 'type X' gypsum board
 - 07 25 00 - 10ml intelligent Vapour barrier
 - 06 10 00 - 38 x 140mm wood stud at 400mm c-c - refer to structural
 - XX XX XX - Hemp fibre batt insulation R3.6/mch, fully fill cavity
 - 06 10 00 - 19mm plywood sheathing - refer to structural
 - XX XX XX - 100mm wood fibre insulation board - R3.6/mch, held in place with stick pins
 - 07 27 00 - Semi permeable weather resistant self adhered membrane
 - 06 10 00 - 1x3 treated wood rainscreen @ 400mm c-c
 - 22mm air space / drainage cavity
 - 07 46 00 - Metal Cladding System

Lower Carbon Alternatives: Woodfibre insulation and hybrids

Archetype High Rise – Wall Options



Effective R-value	Reference	Spandrel	Built Up Wall	Isokorb
	Study Option Reference	15% of Opaque Area	85% of Opaque Area	Yes/No
R-5	Option 1	Metal WW 2" insulation	2" Ext. Mineral Wool	No
R-7	Option 2	Metal WW 4" insulation	5" Ext. Mineral Wool	No
	Option 3	Metal WW 4" insulation	3" Ext. Mineral Wool	Yes
	Option 4	Fibreglass WW 4" insulation	4" Ext. Mineral Wool	No
	Option 5	Fibreglass WW 4" insulation	2" Ext. Mineral Wool	Yes
R-9	Option 6	Metal WW 4" insulation	4" PIR 2" Mineral Wool (all Ext.)	Yes
	Option 7	Fibreglass WW 4" insulation	5" Ext. Mineral Wool	Yes
	Option 8	Fibreglass WW 4" insulation	6" Ext. Mineral Wool + Fibreglass Batt	No

Extent of Costing Information

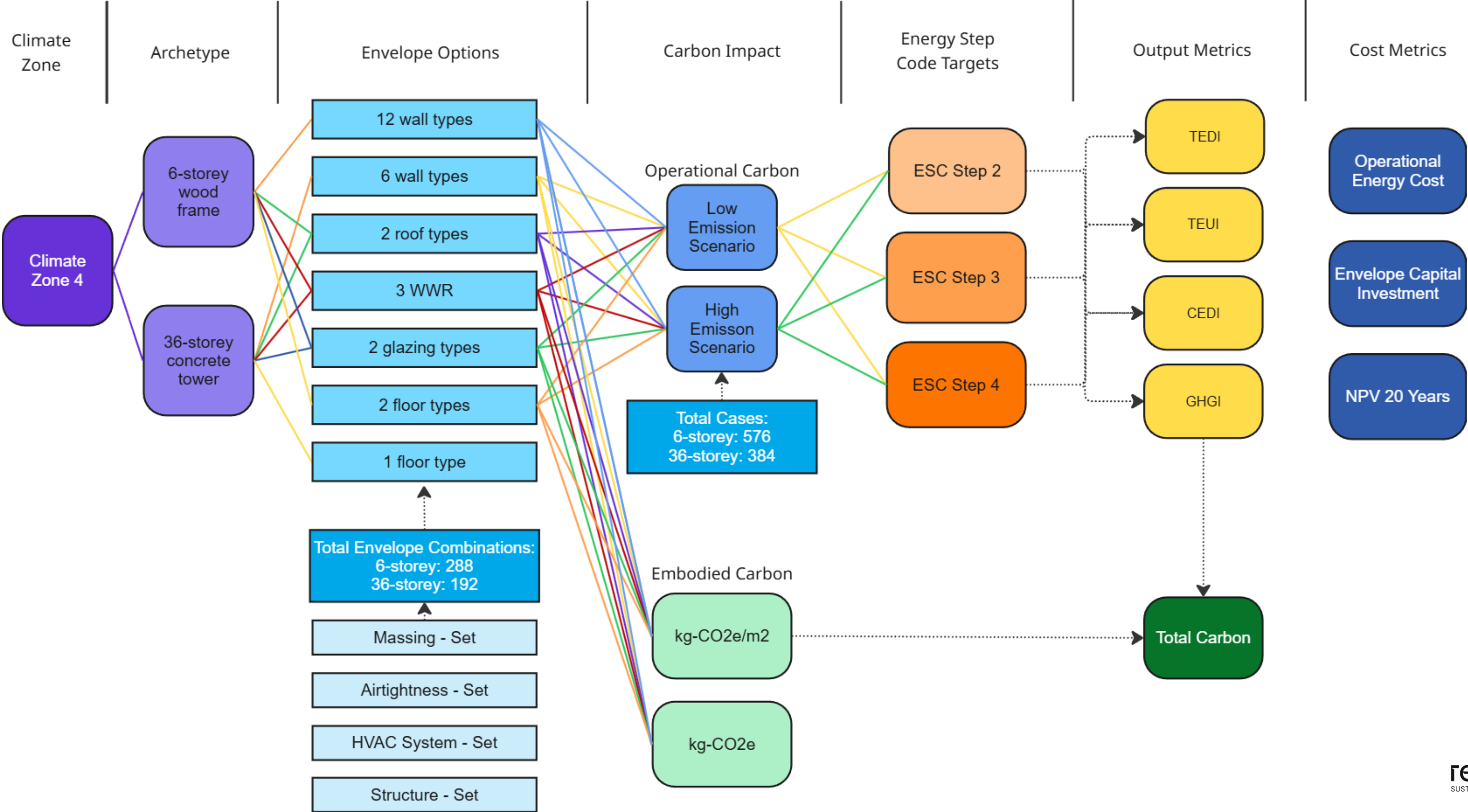
- Incremental differences between assembly packages
- Cost per m² for assembly variations used in models
- NPV over 20-year period
- Altus Group MURB Vancouver average \$/m²

Excluded:

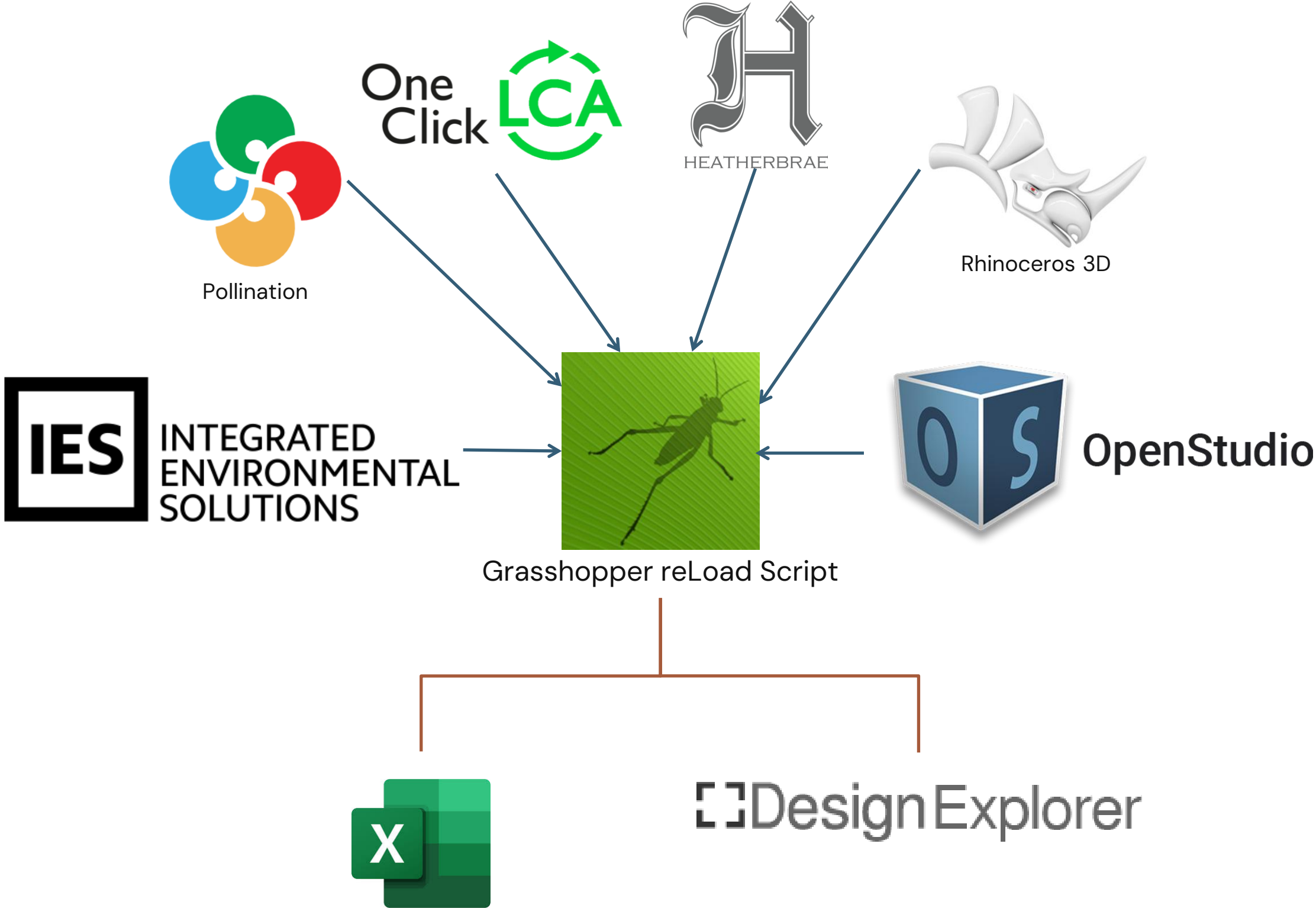
- Maintenance costs/upgrades

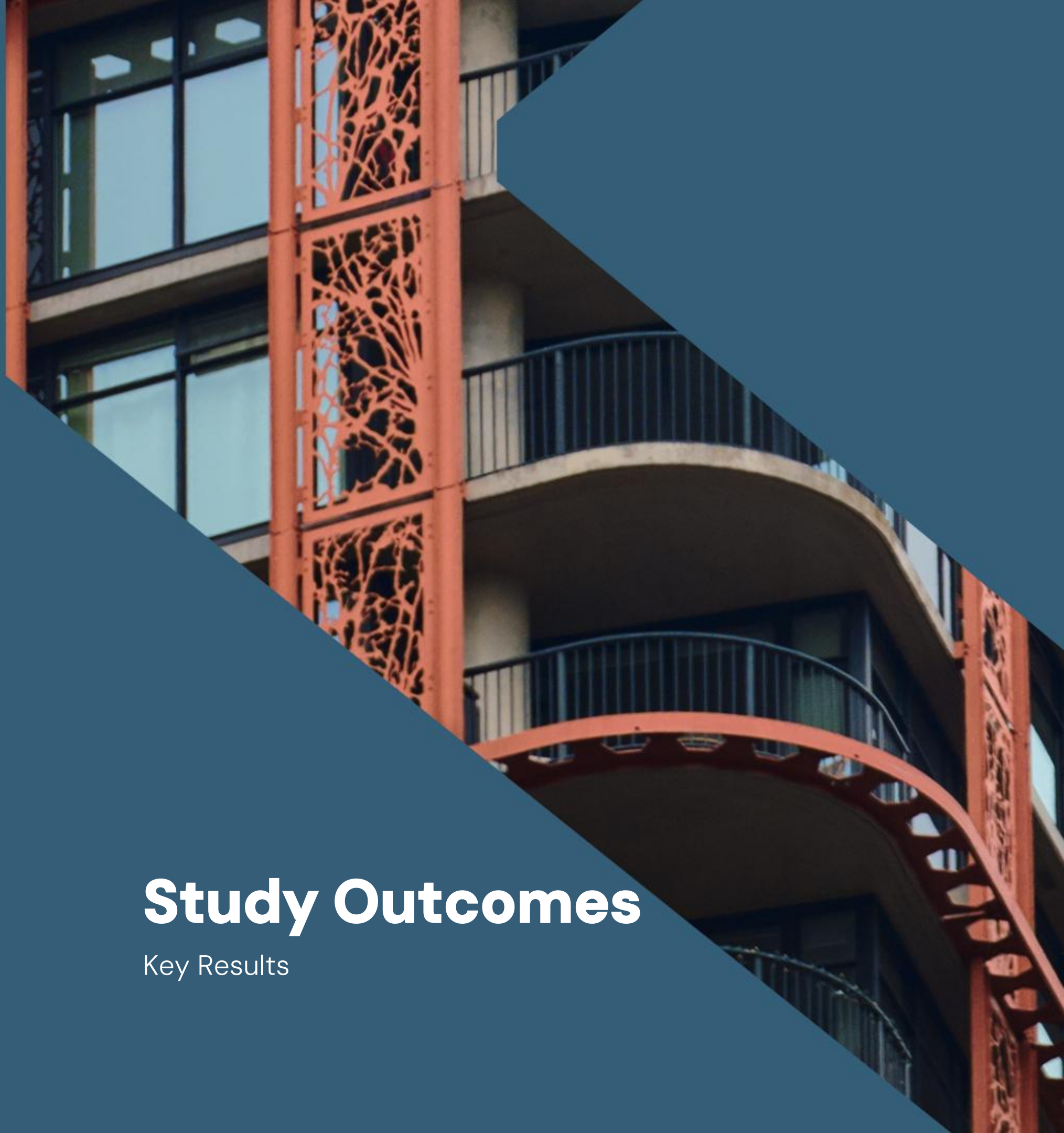


Unique Modelling Approach



Unique Modelling Approach





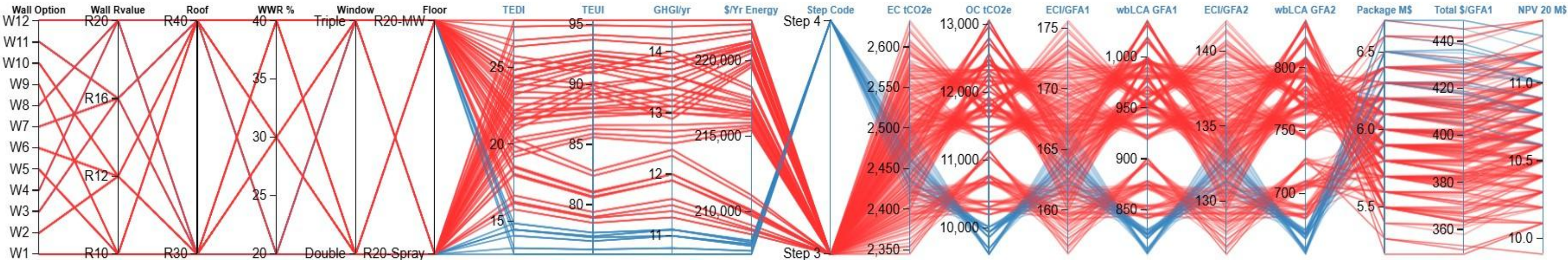
Study Outcomes

Key Results

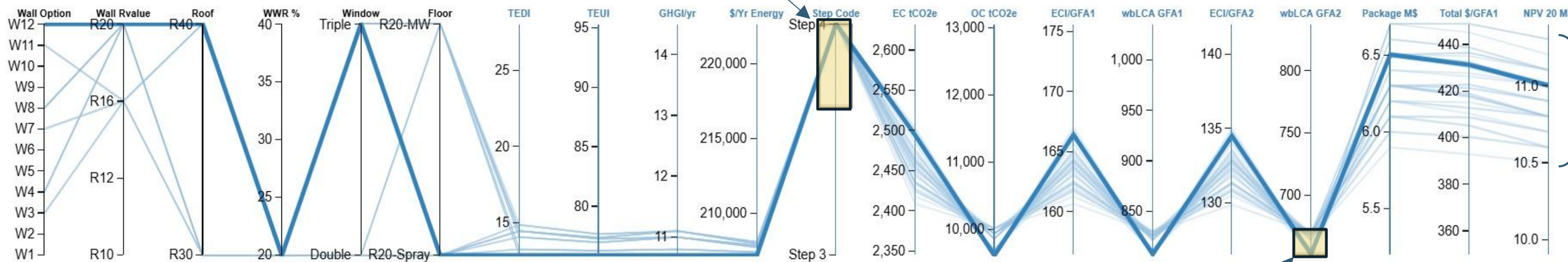
Key Message from Study

- Carbon – Embodied vs. Operational
- How Energy & Zero Carbon Step Code Affects Whole Life Carbon
- Assembly Option Comparisons
- Embodied Carbon vs. TEDI
- Cost Implications

Parametric Modelling Approach



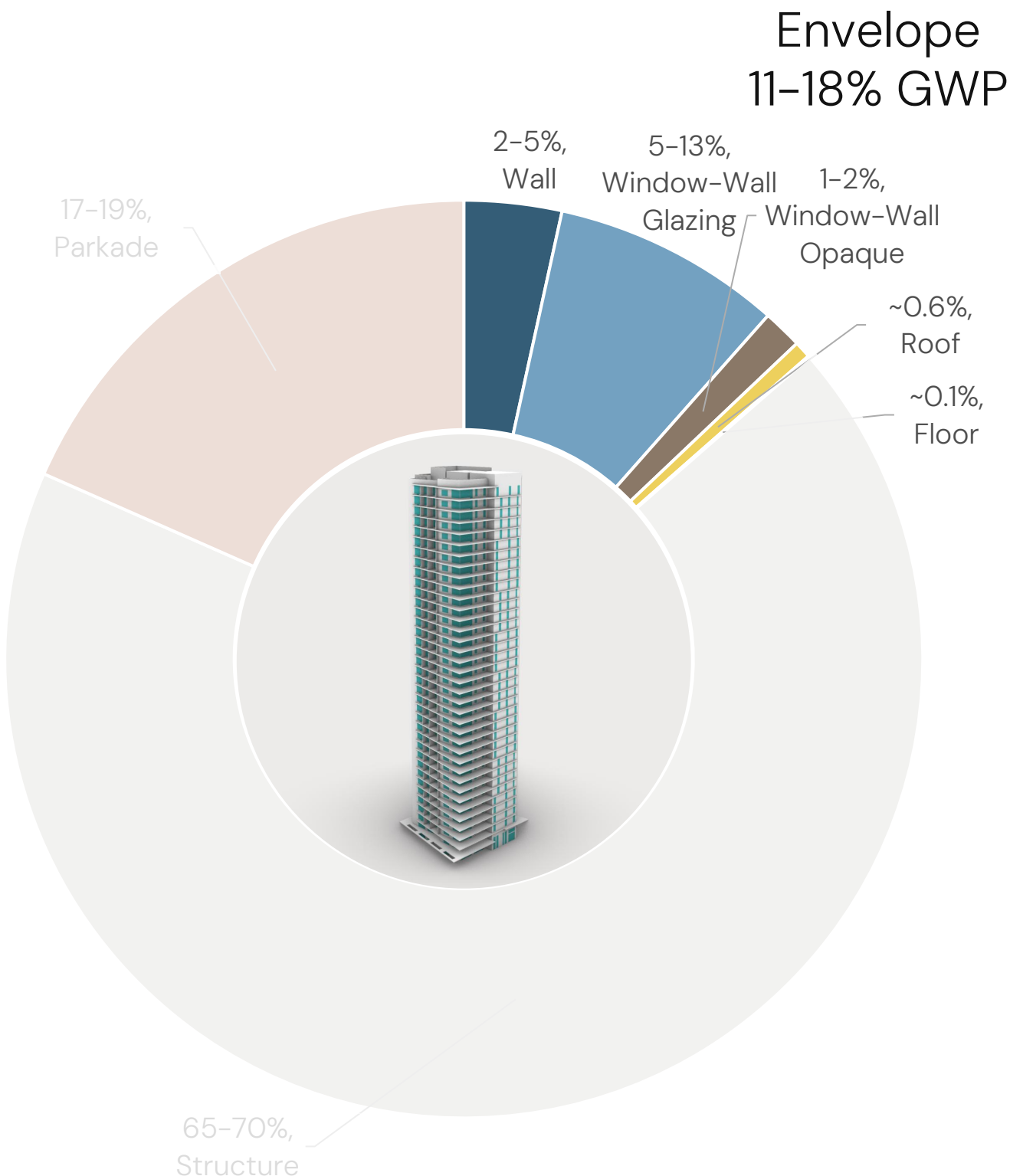
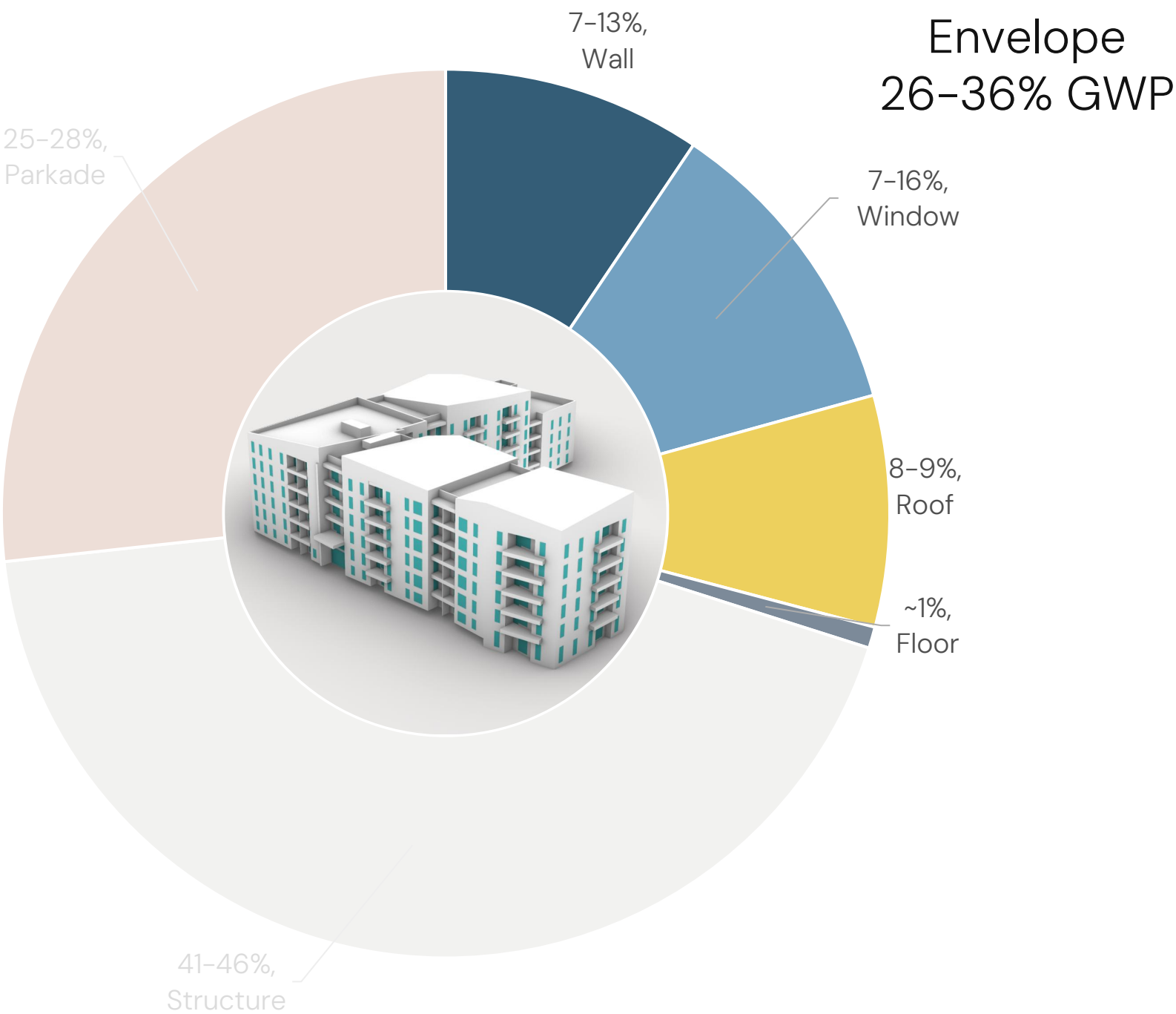
Step 4
Design Solutions



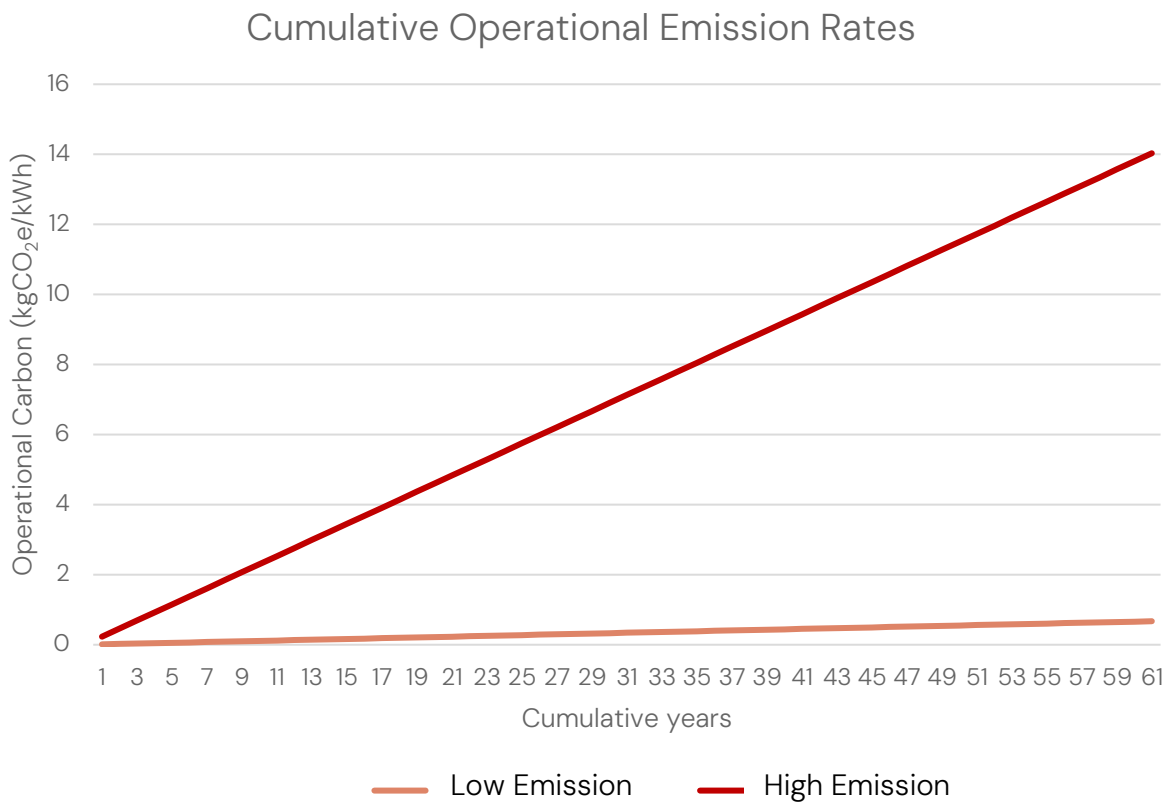
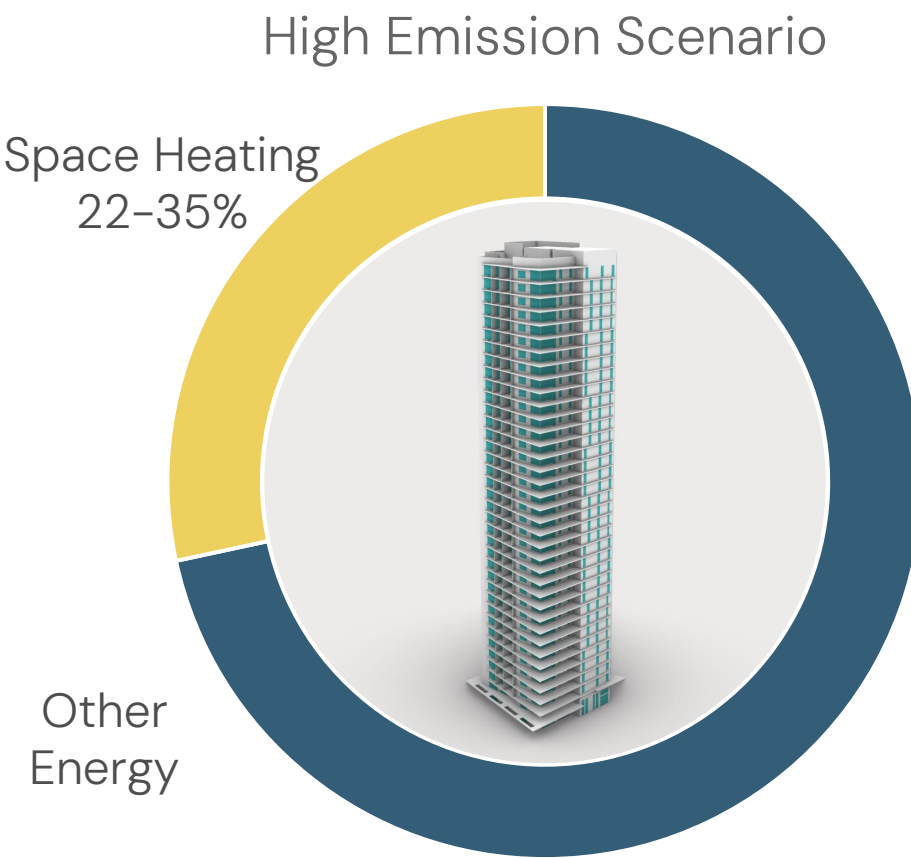
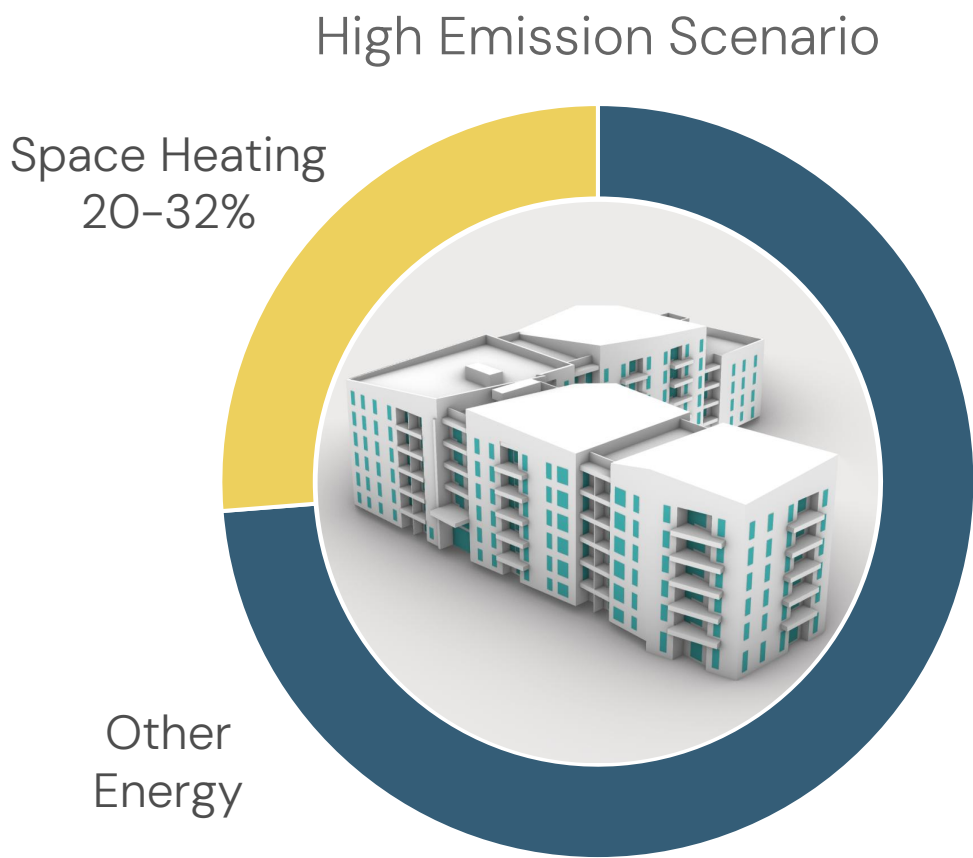
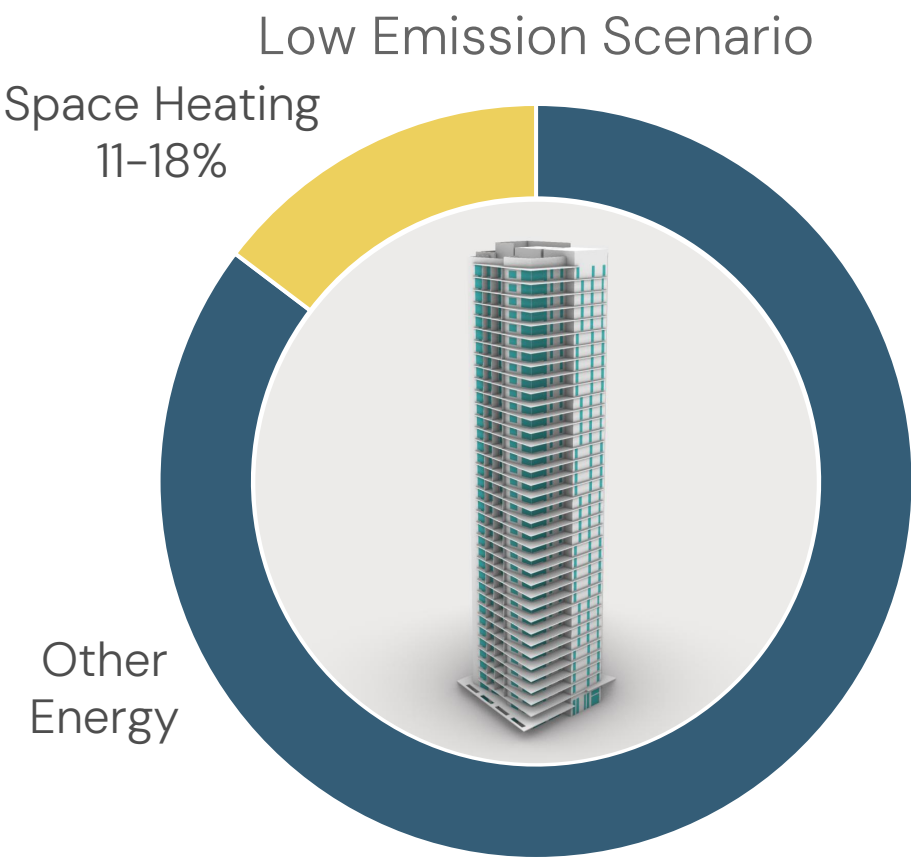
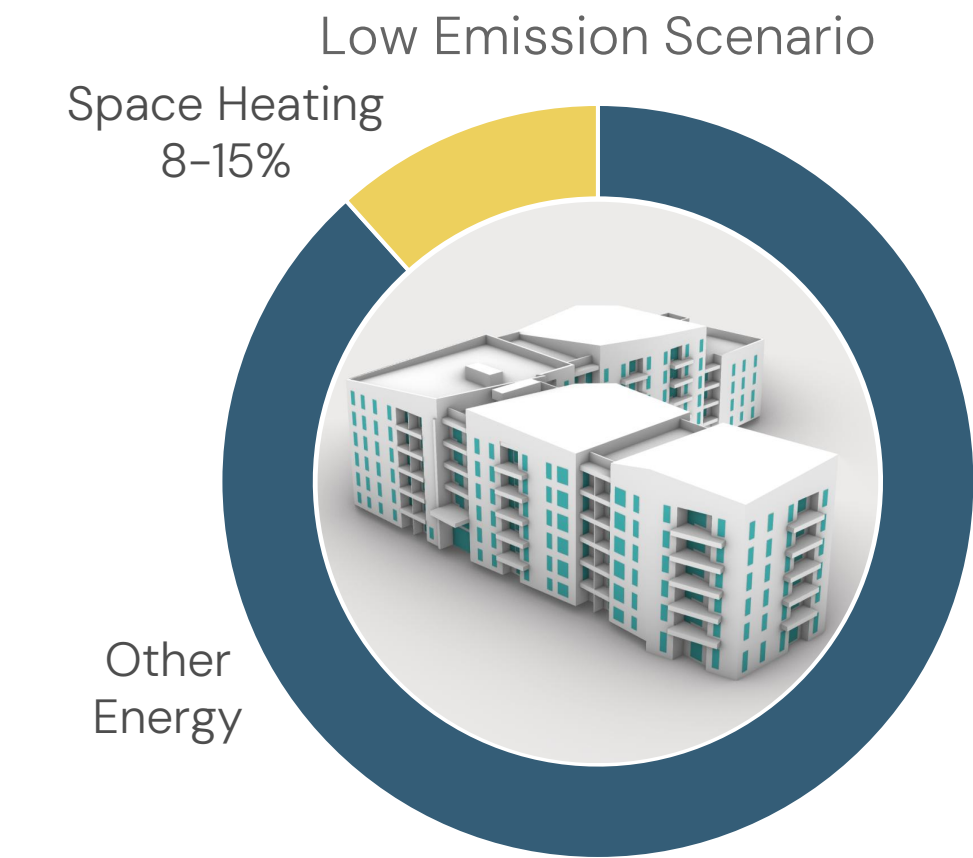
Lowest wbLCA

Opportunities for ~10% reductions in NPV

Embodied Carbon Breakdowns

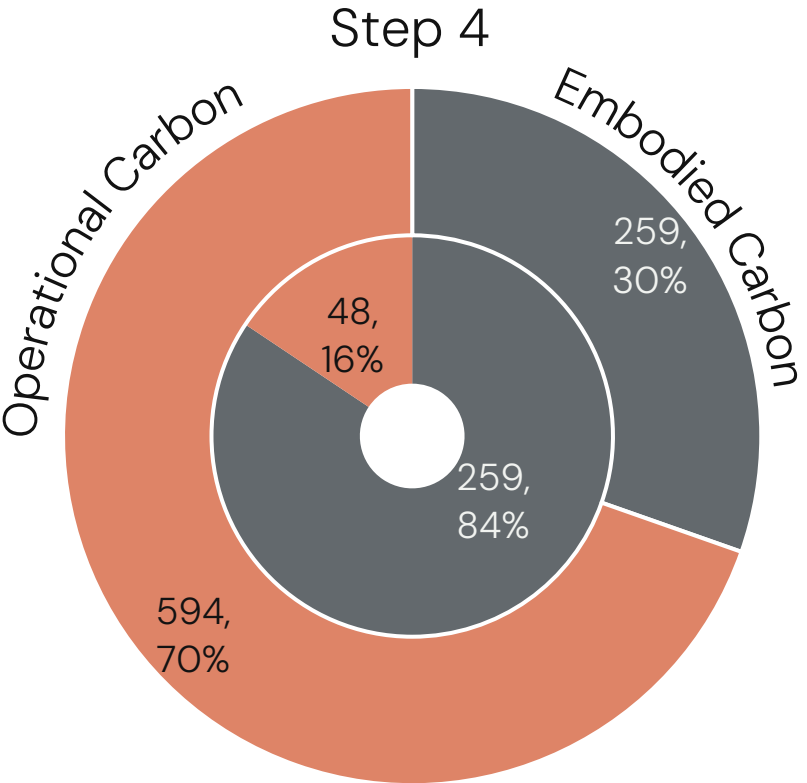
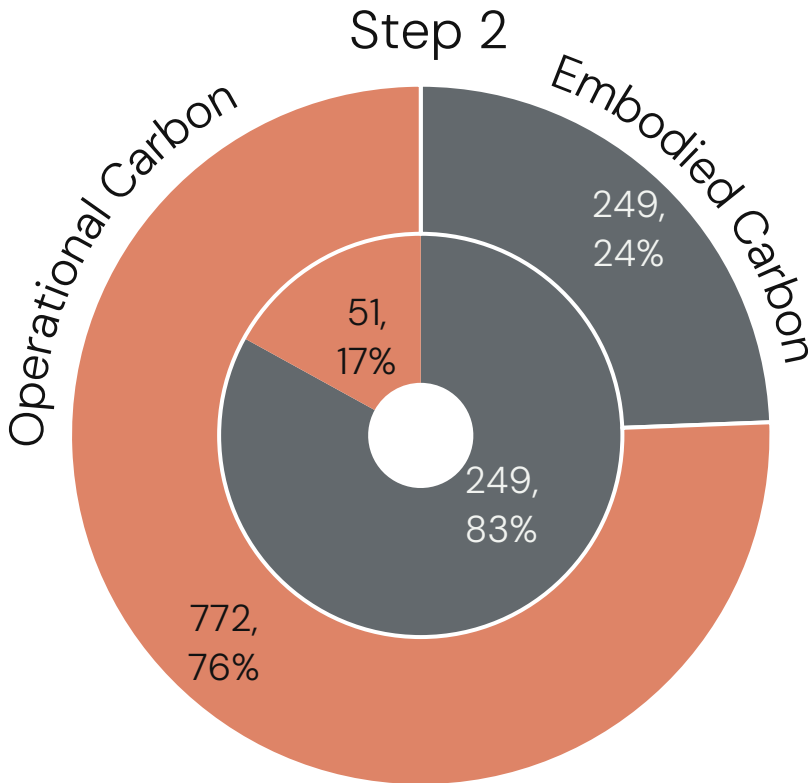
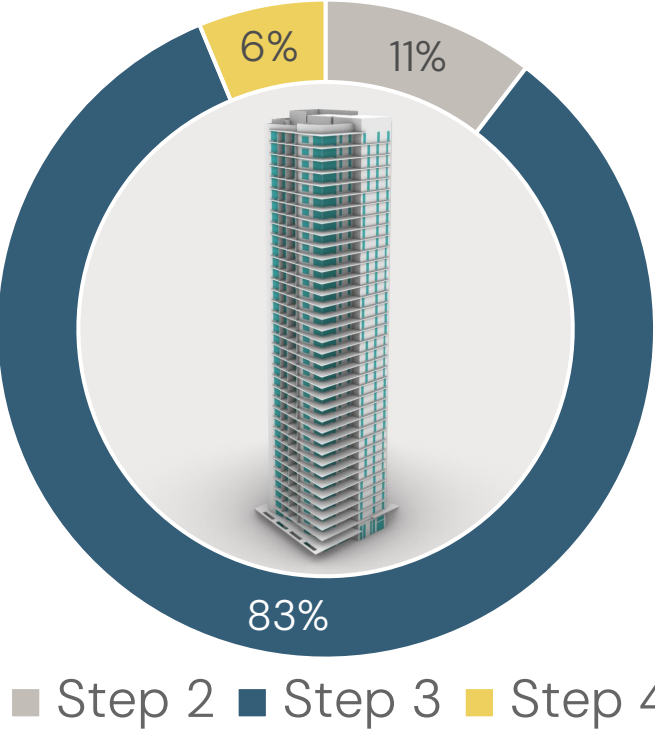


Energy Breakdowns



BC Step Codes vs. Whole-Life Carbon

Breakdown of Total Cases

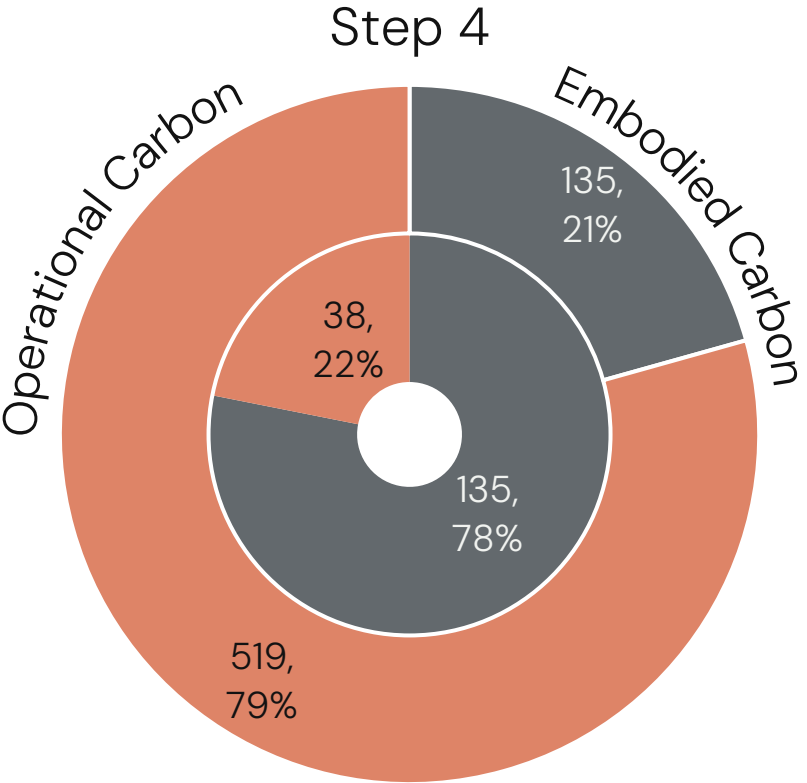
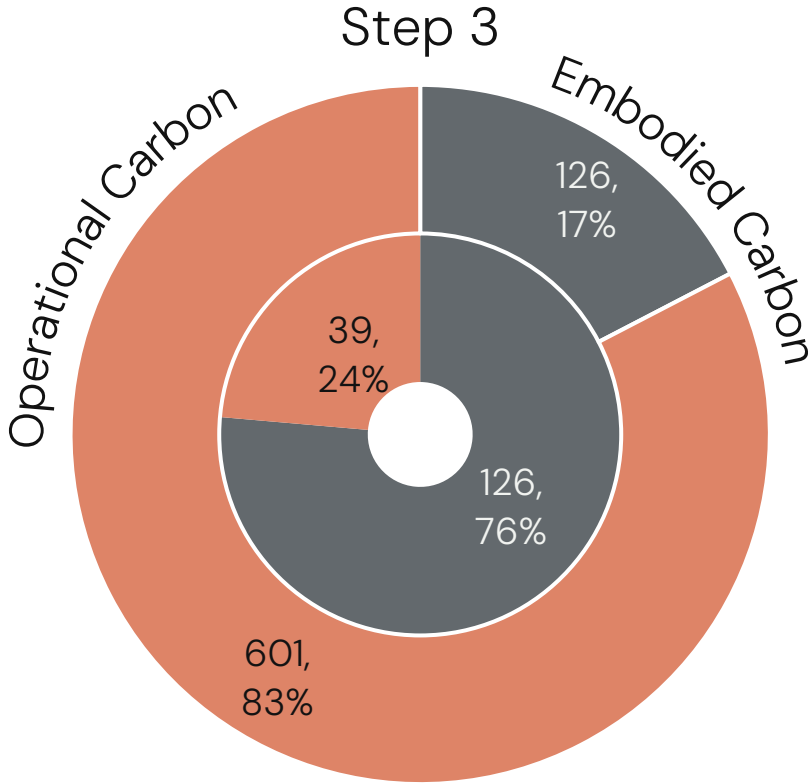
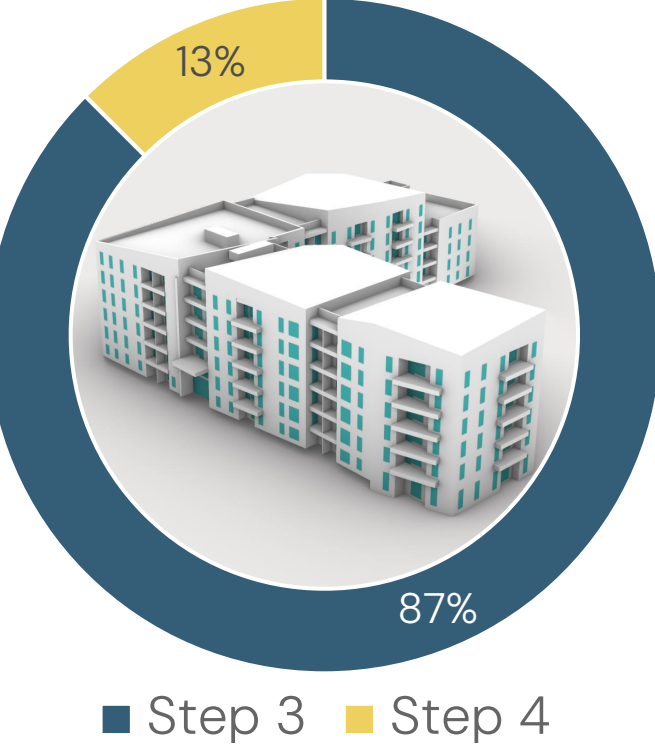


High Emission wbLCA – 1,021 kgCO₂e/BFA
Low Emission wbLCA – 300 kgCO₂e/BFA

Big Savings
Similar

High Emission wbLCA – 853 kgCO₂e/BFA
Low Emission wbLCA – 307 kgCO₂e/BFA

Breakdown of Total Cases



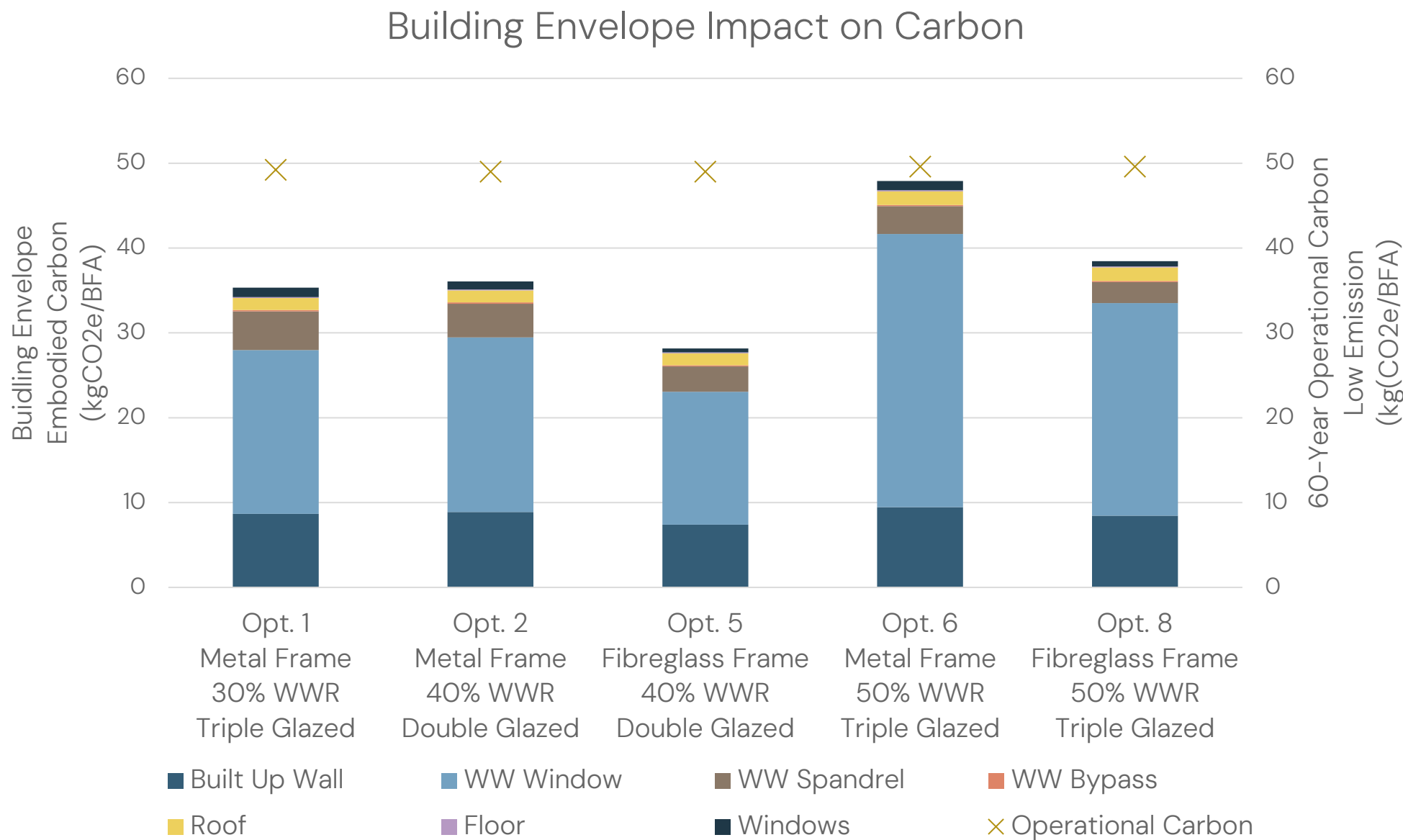
High Emission wbLCA – 727 kgCO₂e/BFA
Low Emission wbLCA – 165 kgCO₂e/BFA

Big Savings
Marginal

High Emission wbLCA – 664 kgCO₂e/BFA
Low Emission wbLCA – 173 kgCO₂e/BFA

High-Rise Assembly Impact Example

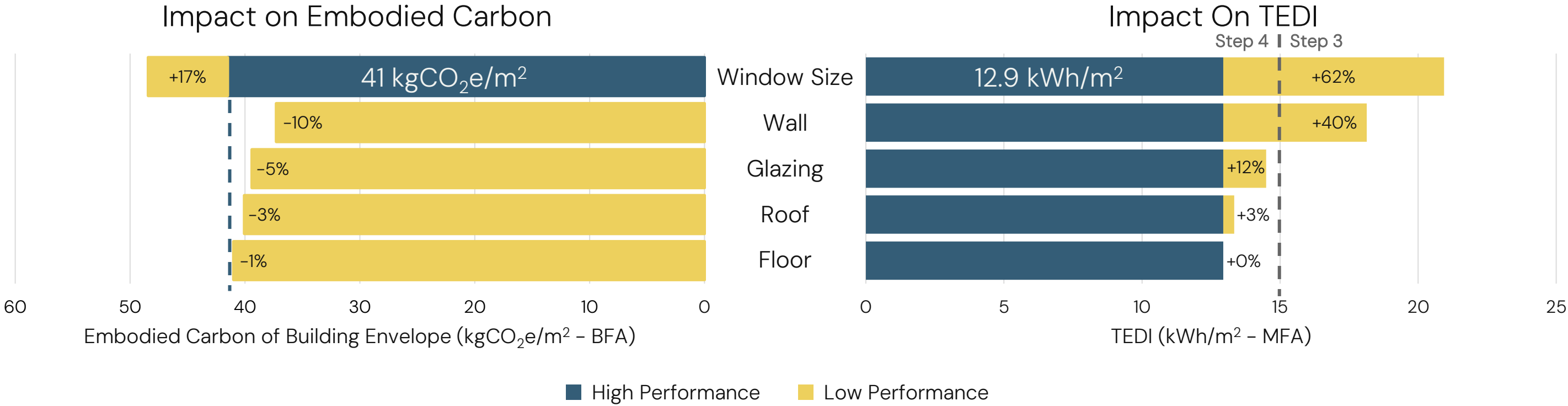
- Fiberglass window-wall offsets inches of built-up wall insulation
- Isokorb reduces embodied carbon slightly but expensive solution
- Embodied carbon heavily influenced by window-wall frame material and WWR for high rise



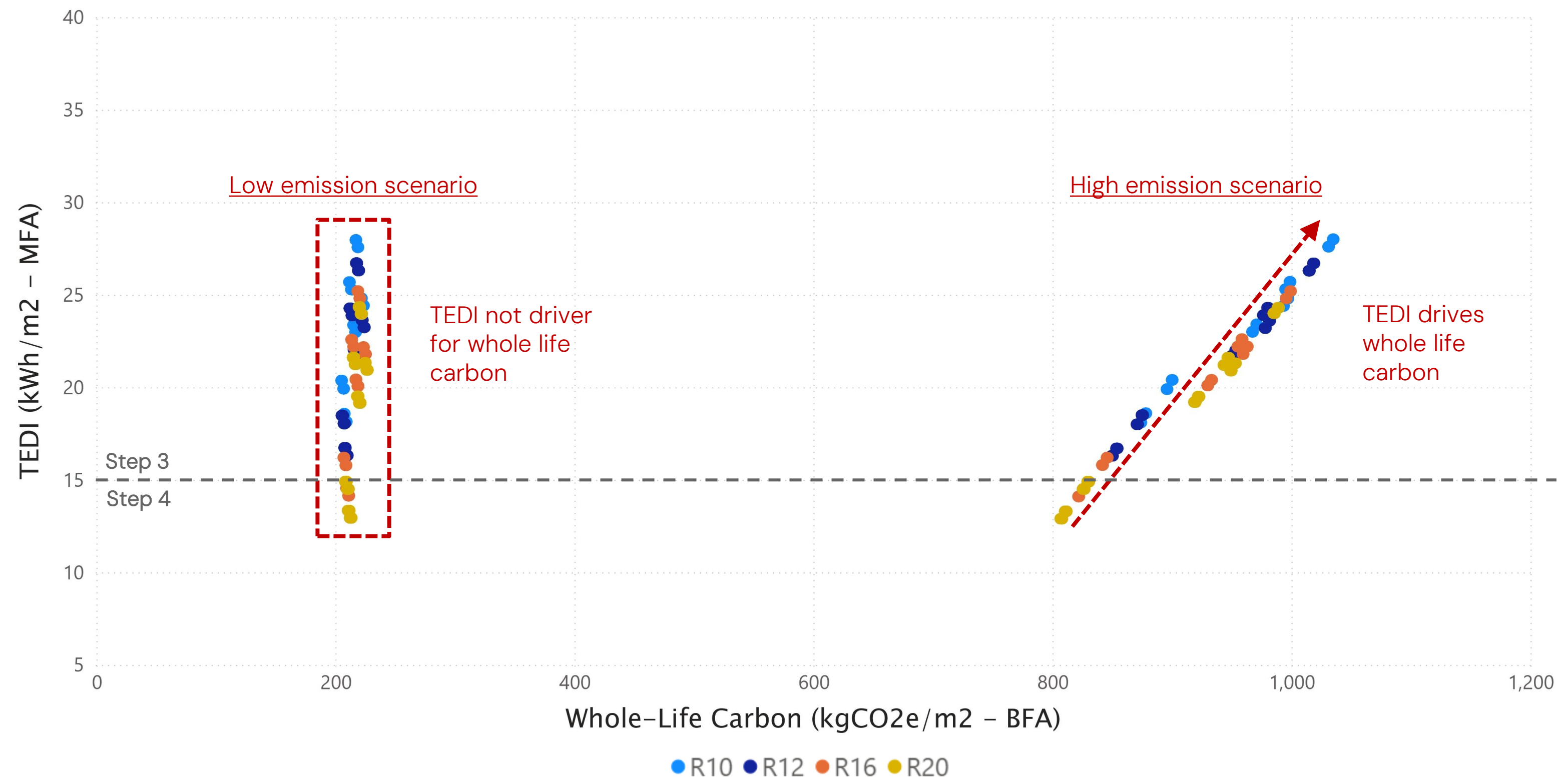
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	Study Option Reference	15% of Opaque Area	85% of Opaque Area	Yes/No
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	Option 2	Metal WW 4" insulation	5" Ext. Mineral Wool	No
R-7	Option 3	Metal WW 4" insulation	3" Ext. Mineral Wool	Yes
	Option 4	Fibreglass WW 4" insulation	4" Ext. Mineral Wool	No
	Option 5	Fibreglass WW 4" insulation	2" Ext. Mineral Wool	Yes
R-9	Option 6	Metal WW 4" insulation	4" PIR 2" Mineral Wool (all Ext.)	Yes
	Option 7	Fibreglass WW 4" insulation	5" Ext. Mineral Wool	Yes
	Option 8	Fibreglass WW 4" insulation	6" Ext. Mineral Wool + Int. Fibreglass Batt	No

Embodied Carbon vs. TEDI – Mid Rise Example

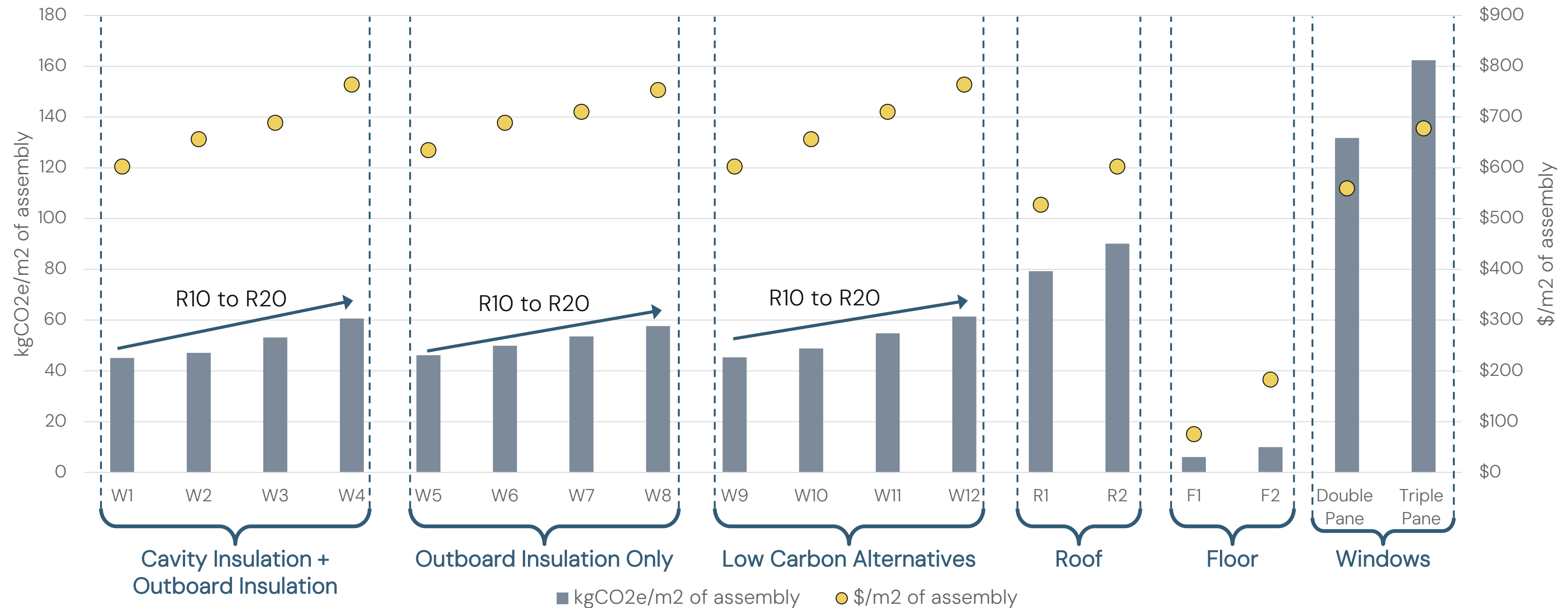
Performance	WWR	Wall	Glazing	Roof	Floor
High	20%	R-20	Triple	R-40	R-20 (Mineral Wool)
	↓	↓	↓	↓	↓
Low	40%	R-10	Double	R-30	R-20 (Spray Foam)



Embodied Carbon Vs. TEDI – Mid Rise Example



Incremental Capital Cost vs. Embodied Carbon – Mid Rise



Highlight Trends

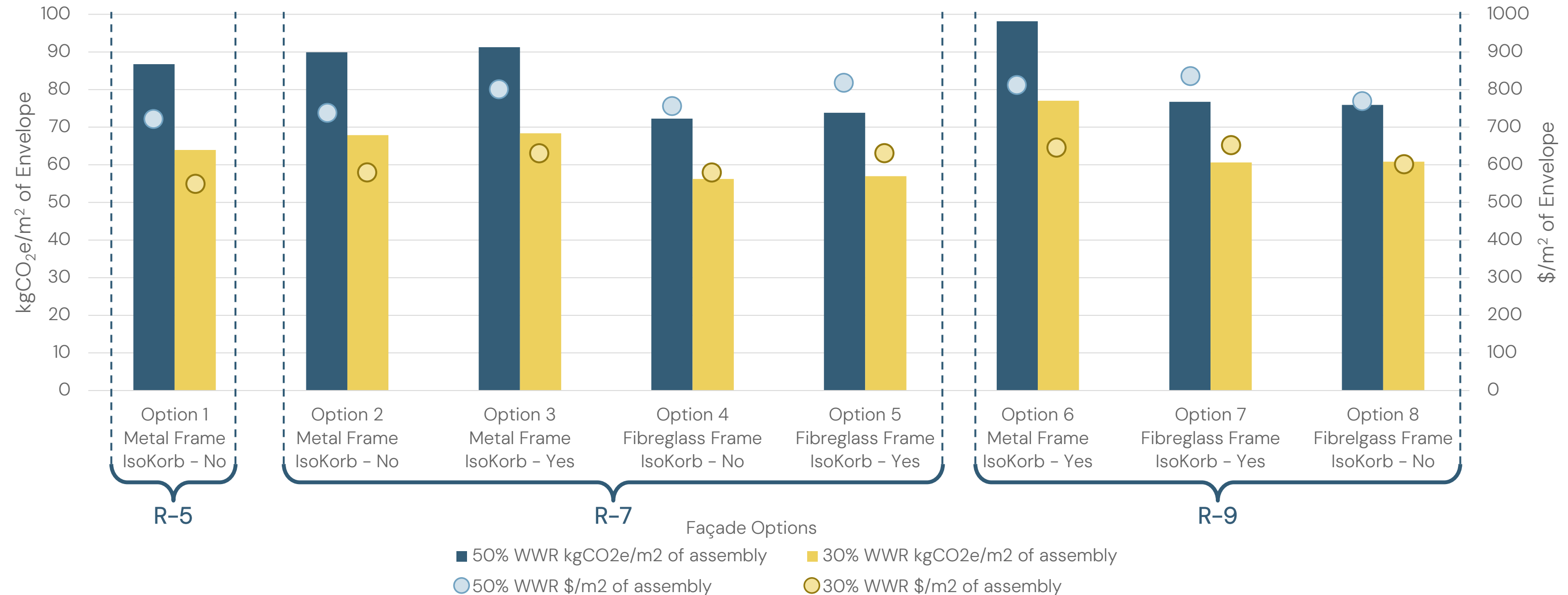
- Increased wall R-value adds embodied carbon and increases cost of envelope
- Glazing systems have much higher embodied carbon vs exterior wall, but cost less
- Step 3 very easy to meet for mid rise, opens door to lower carbon, more cost-effective solutions

Incremental Capital Cost vs. Embodied Carbon – High Rise

Highlight Trends

- Thermal efficiency of fiberglass frame allows for reduction in other thermal measures, leading to carbon & cost reductions
- Both carbon and cost is driven by WWR

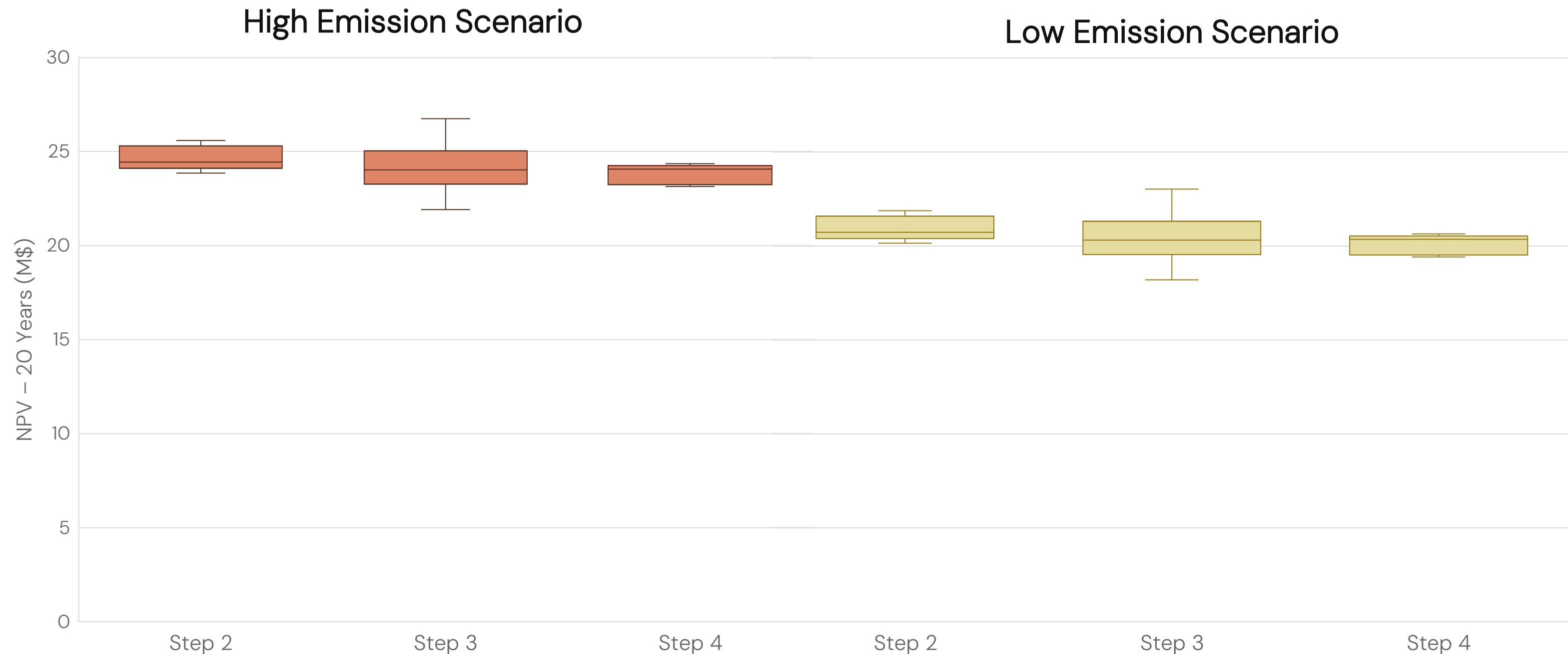
Façade Carbon/Cost Breakdown – Double Glazed, Roof-R30, Floor R-20

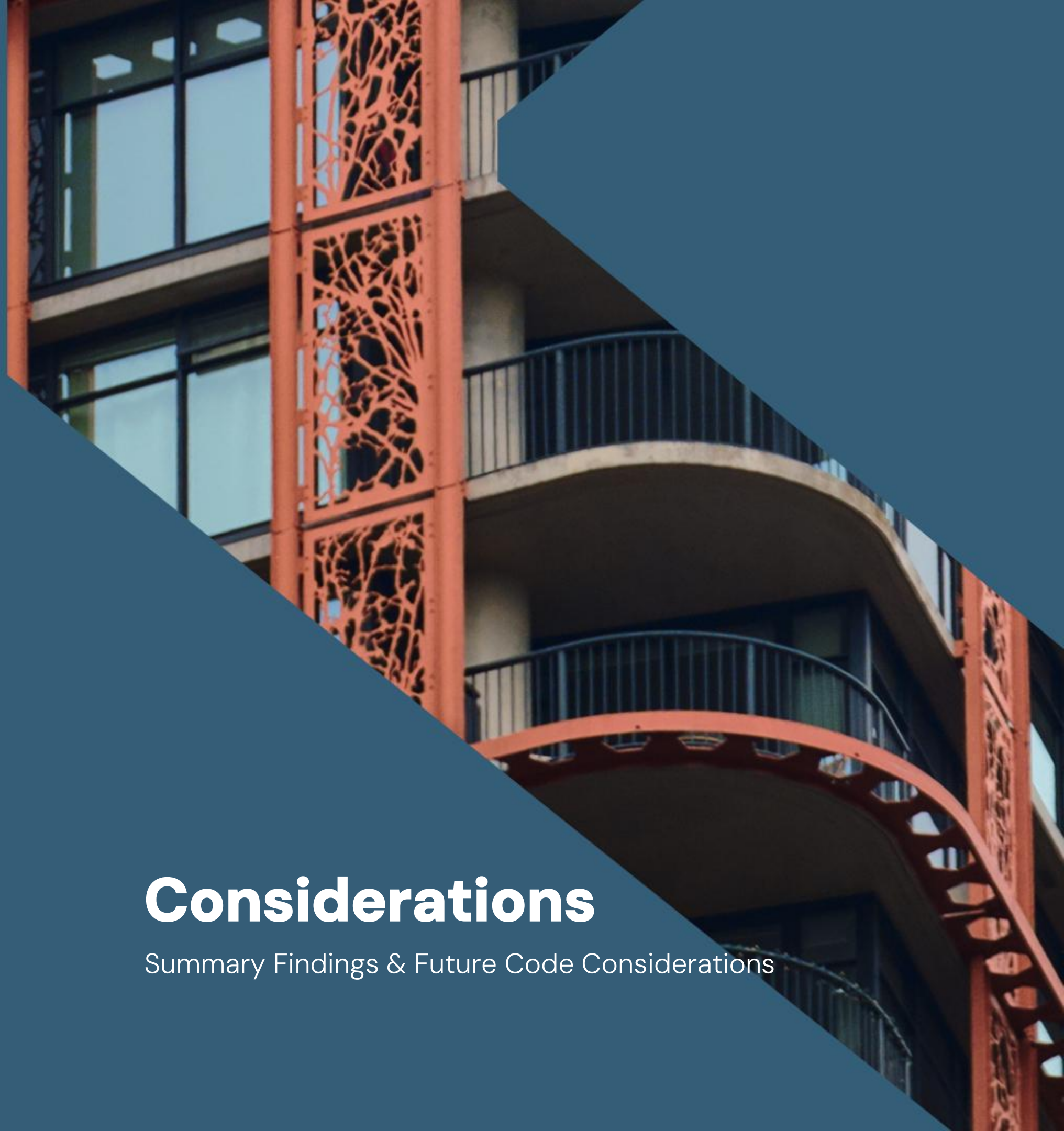


NPV vs. Step Code Level

Highlight trends:

- Higher steps of the Energy Step Code reduce NPV for both fuel source scenarios
- There are Step 3's that outperform Step 4 from an overall cost perspective





Considerations

Summary Findings & Future Code Considerations

Summary

- The thermal envelope accounts for 8–15% of overall construction cost
- The thermal envelope accounts for 11%–36% of total embodied carbon
- There are Step 4 envelope solutions that are more cost-effective vs Step 2 and Step 3
- There are Step 4 envelope solutions that have lower carbon vs Step 2 and Step 3
- With a high emission fuel scenario, Energy Step Code 4 (TEDI) really matters for whole-life carbon
- For low emission fuel scenario (all electric), TEDI is no longer the driver for whole-life carbon

Future Code Impact Considerations

1. Do not compromise on energy efficiency (Low TEUI = Low energy \$)
2. Do not compromise on low operational carbon (EL-4)
3. Consider relaxing TEDI target for EL-4 (all electric)
4. Maintain Step 4 (TEUI and TEDI) for a high emission scenario
5. Consider whole-life carbon compliance pathways in future code



Design flexibility leading to cost savings



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