

Desai Wang

let basics = function

| "hometown" -> ["Xi'an, China"; "Ann Arbor, Michigan"]

| "education" -> ["BArch, Cornell University"; "CompSci Minor"]

| "interests" -> ["sustainable design"; "software development"]



I like...
Mi piace...
我喜欢...



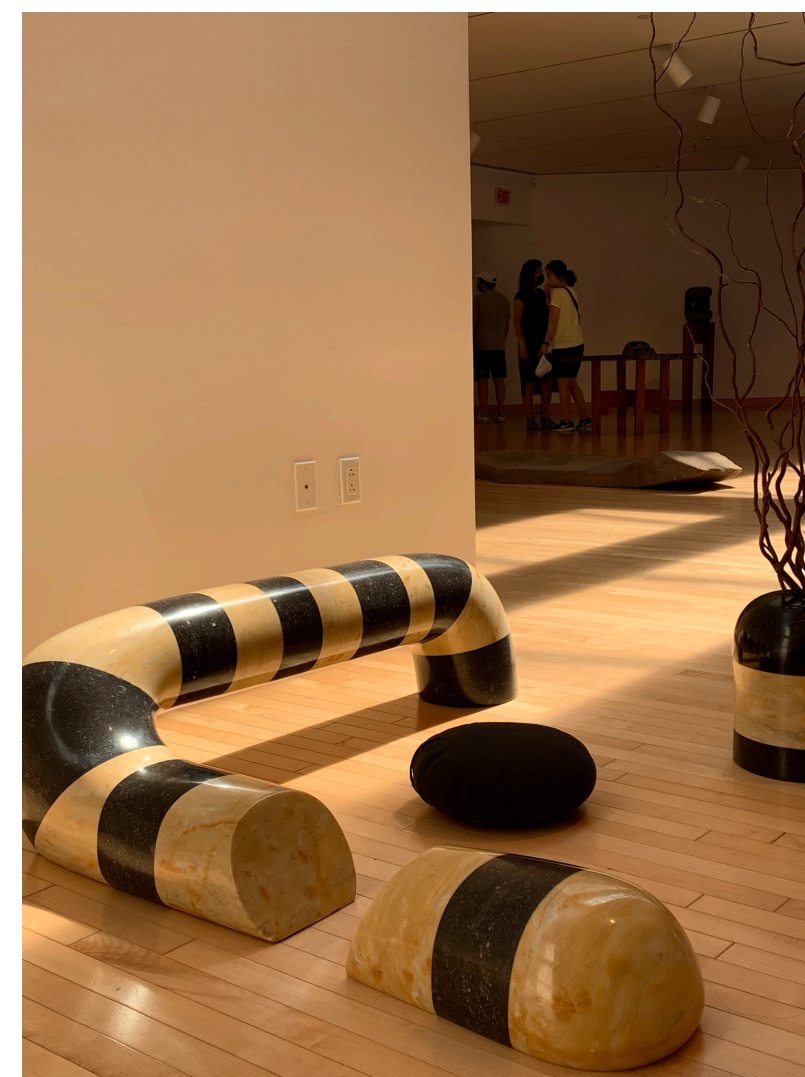
cooking
cucinare
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baking
infornare
烘焙

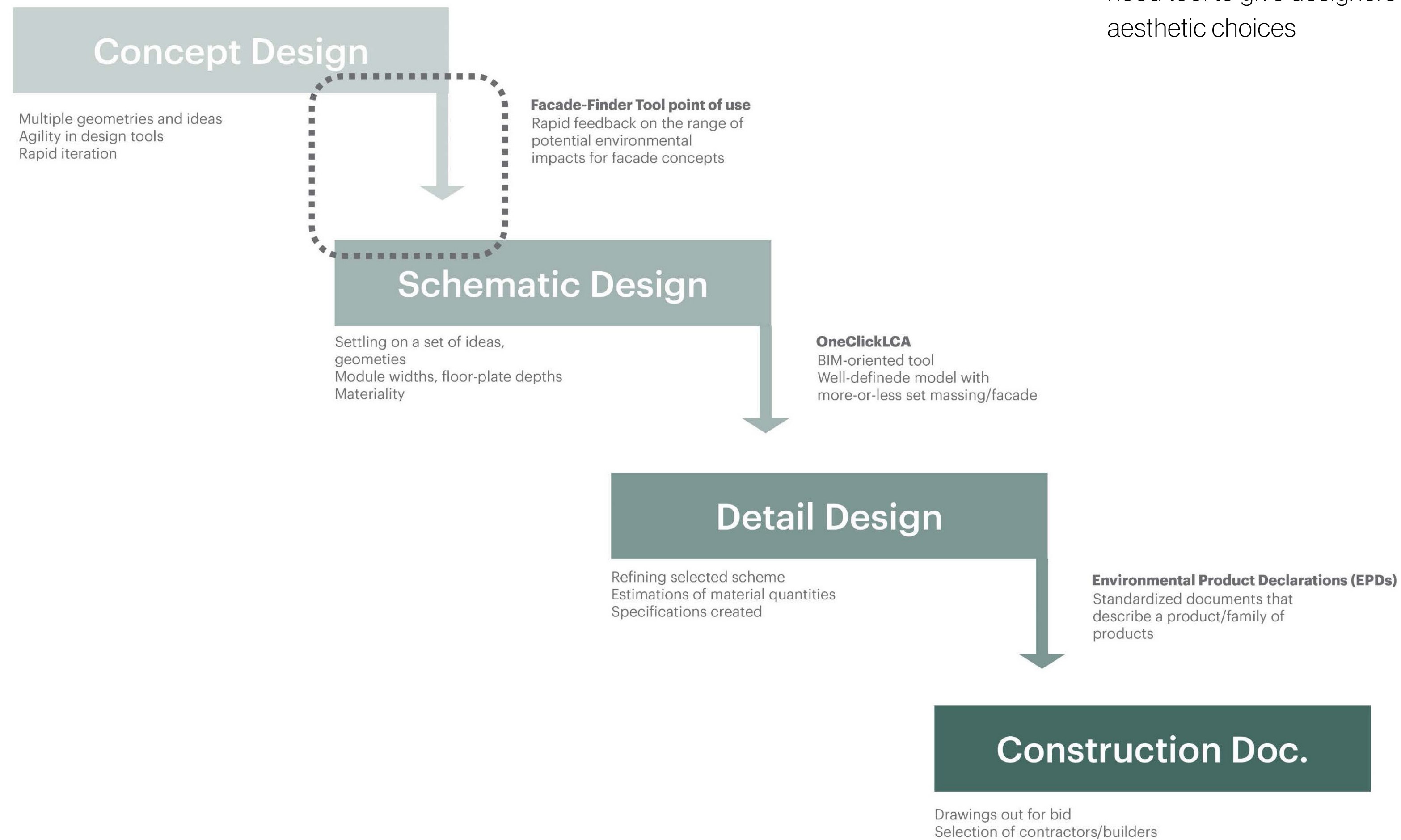


running
correre
跑步



museums
musei
博物馆

Carbon Analysis



Motivation:

LCA needs to be integrated with design!

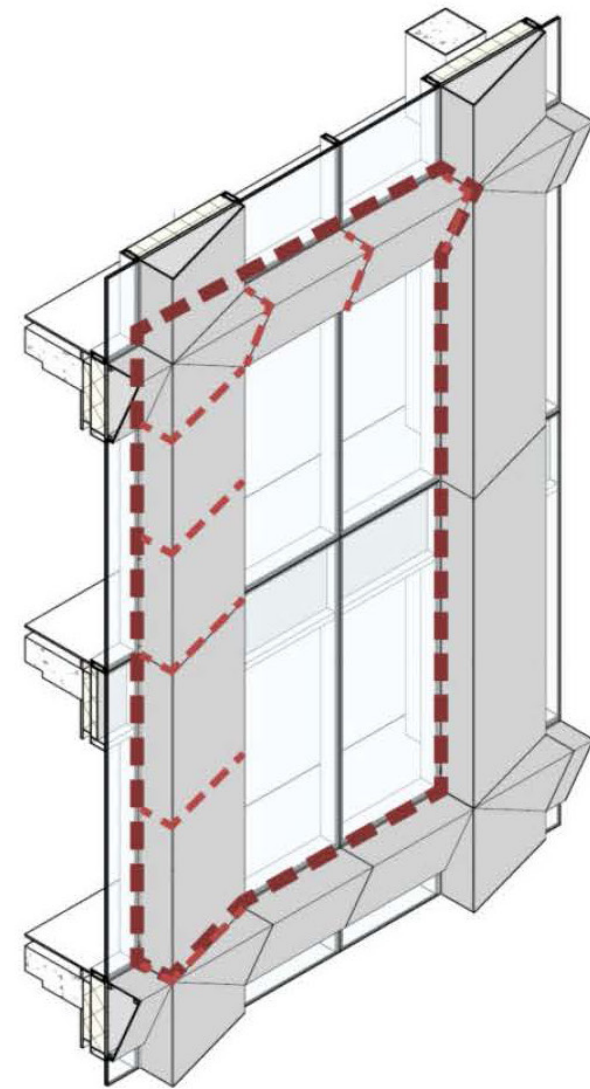
- early stage design offers most opportunities for embodied carbon reduction
- need tool to give designers feedback about aesthetic choices

Tool Development

Early Stage Design Choices

- generalized parameters instead of specific products
- interface to visualize and compare options

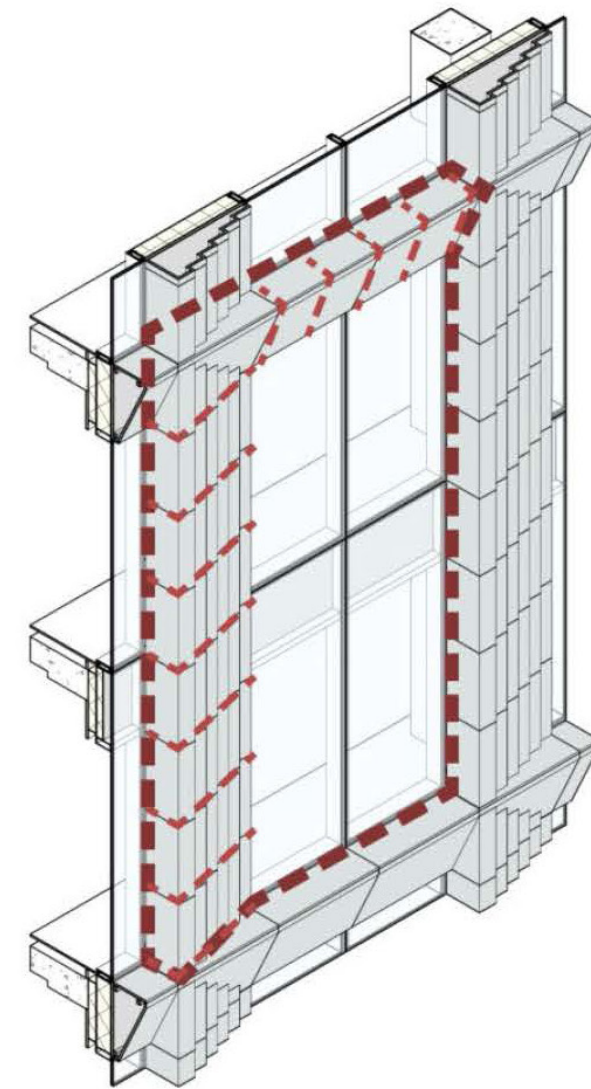
Aluminum panel



Cladding thickness: 3mm
Cladding Panel weight: 4.9 kg/m²
Cladding Support: x8 Aluminum
Frames + Fixings

Embodied Carbon:
231 kgCO₂e/sqm

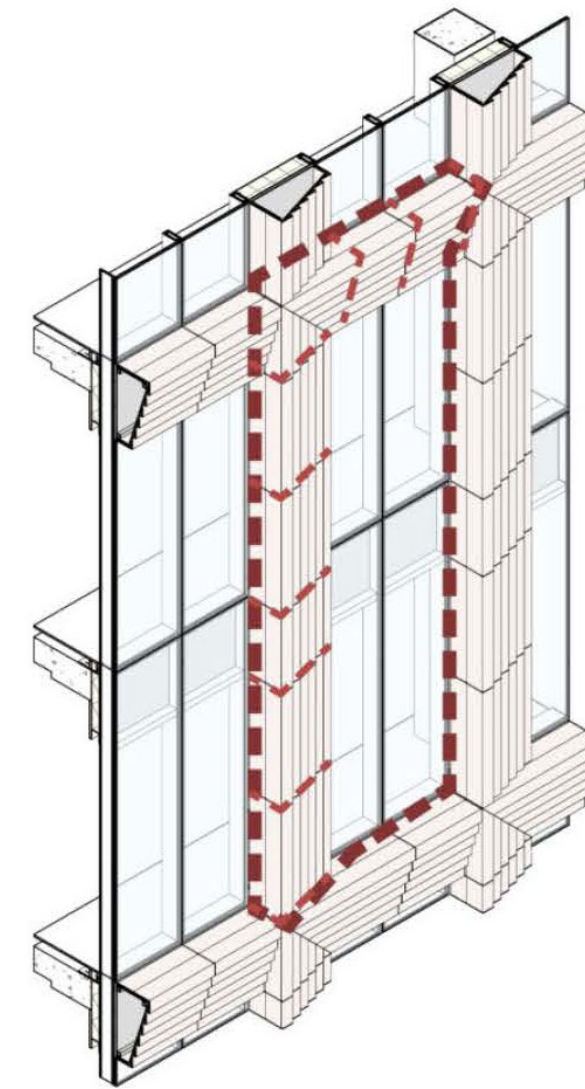
Natural Stone



Cladding thickness: 30mm
Cladding Panel weight: 44.7 kg/m²
Cladding Support: x13 Aluminum
Frames + Fixings

Embodied Carbon:
226 kgCO₂e/sqm

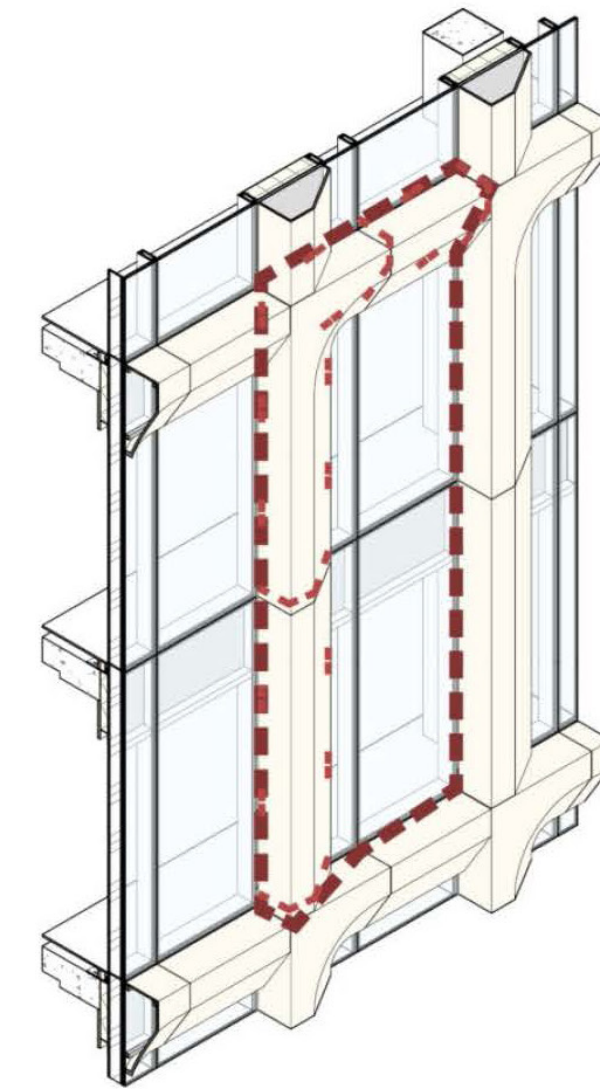
Terracotta



Cladding thickness: 40mm hollow extrusion
Cladding Panel weight: 31.7 kg/m²
Cladding Support: x9 Aluminum Frames +
Fixings

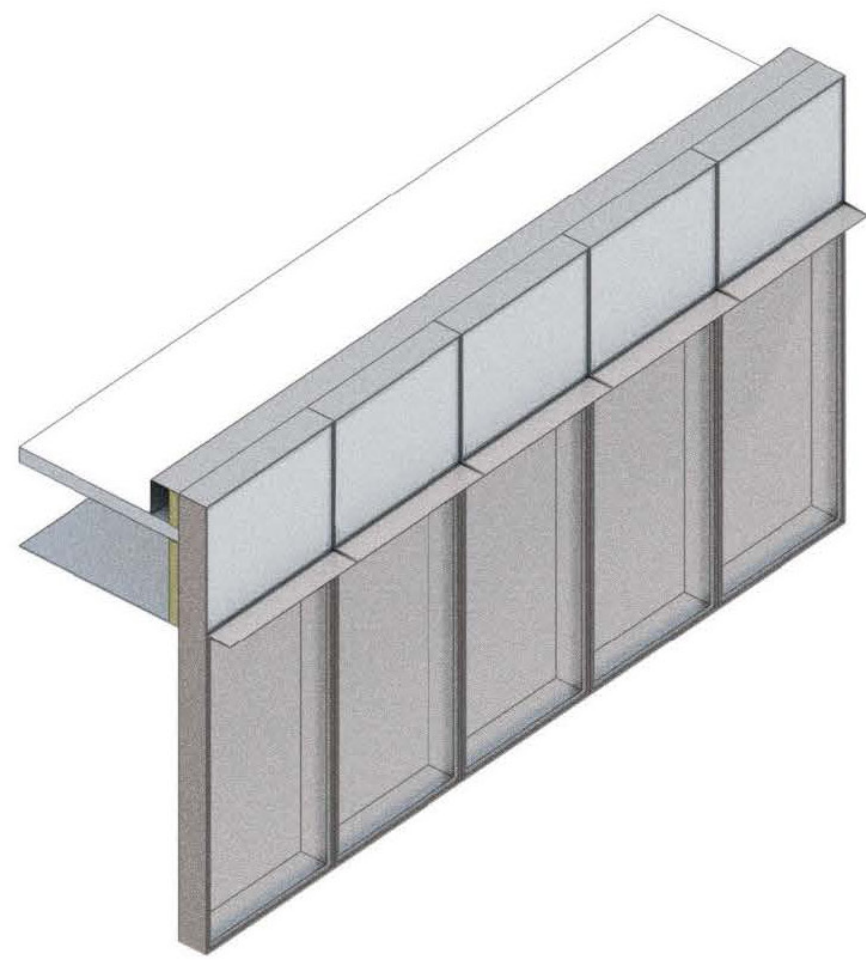
Embodied Carbon:
223 kgCO₂e/sqm

UHPC



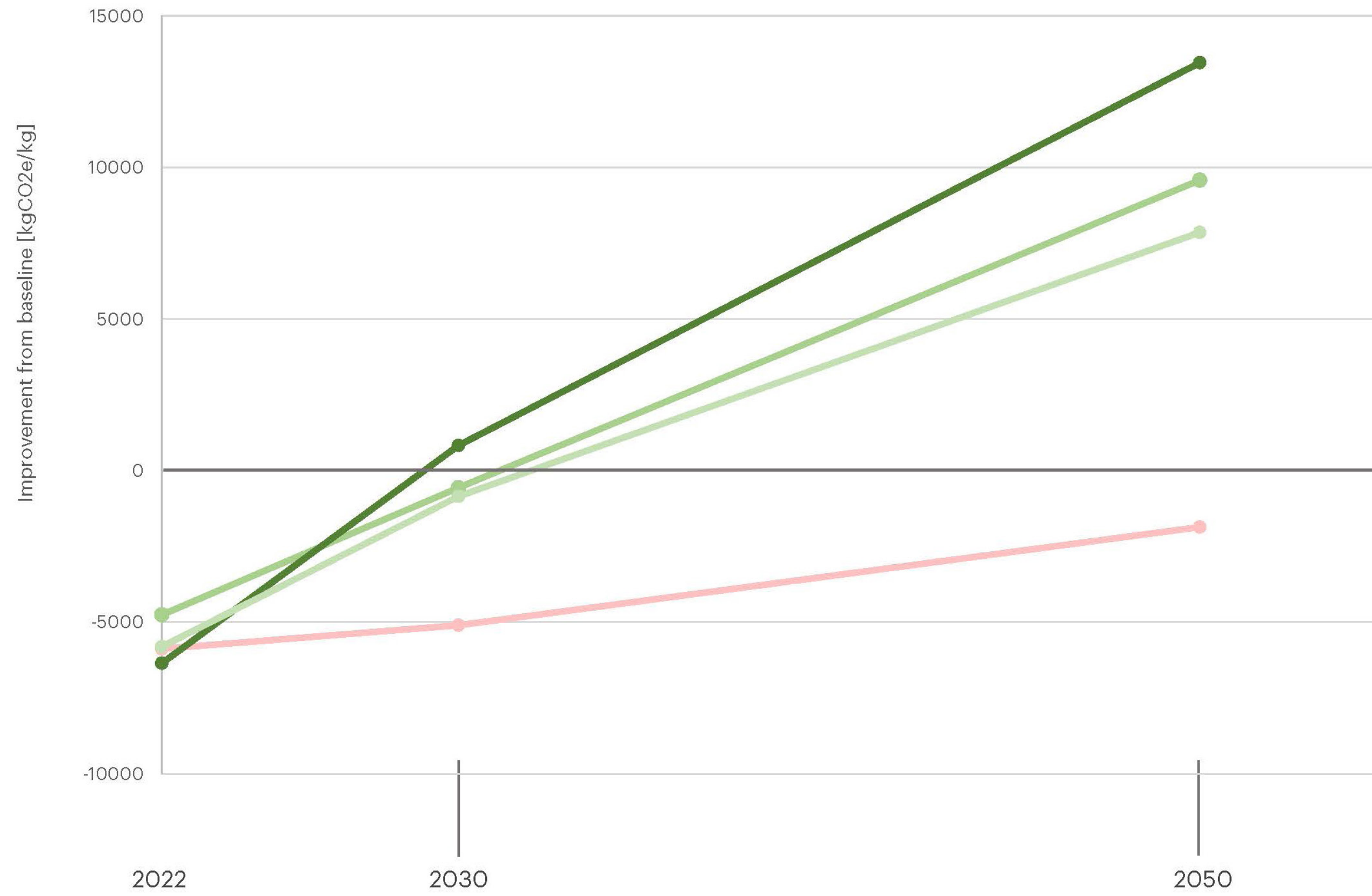
Cladding thickness: 30mm
Cladding Panel weight: 37.1 kg/m²
Cladding Support: Fixings

Embodied Carbon:
204 kgCO₂e/sqm

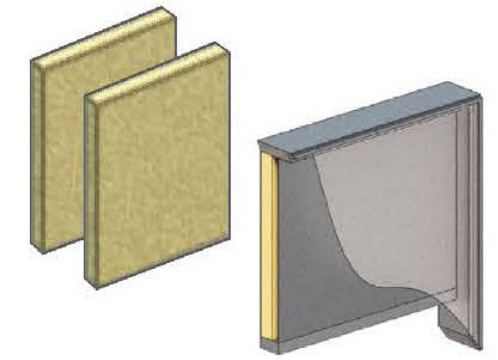


Baseline Module

Payoffs of different facade upgrades



Dense horizontal shading:
Save 13452 kgCO2e by 2050



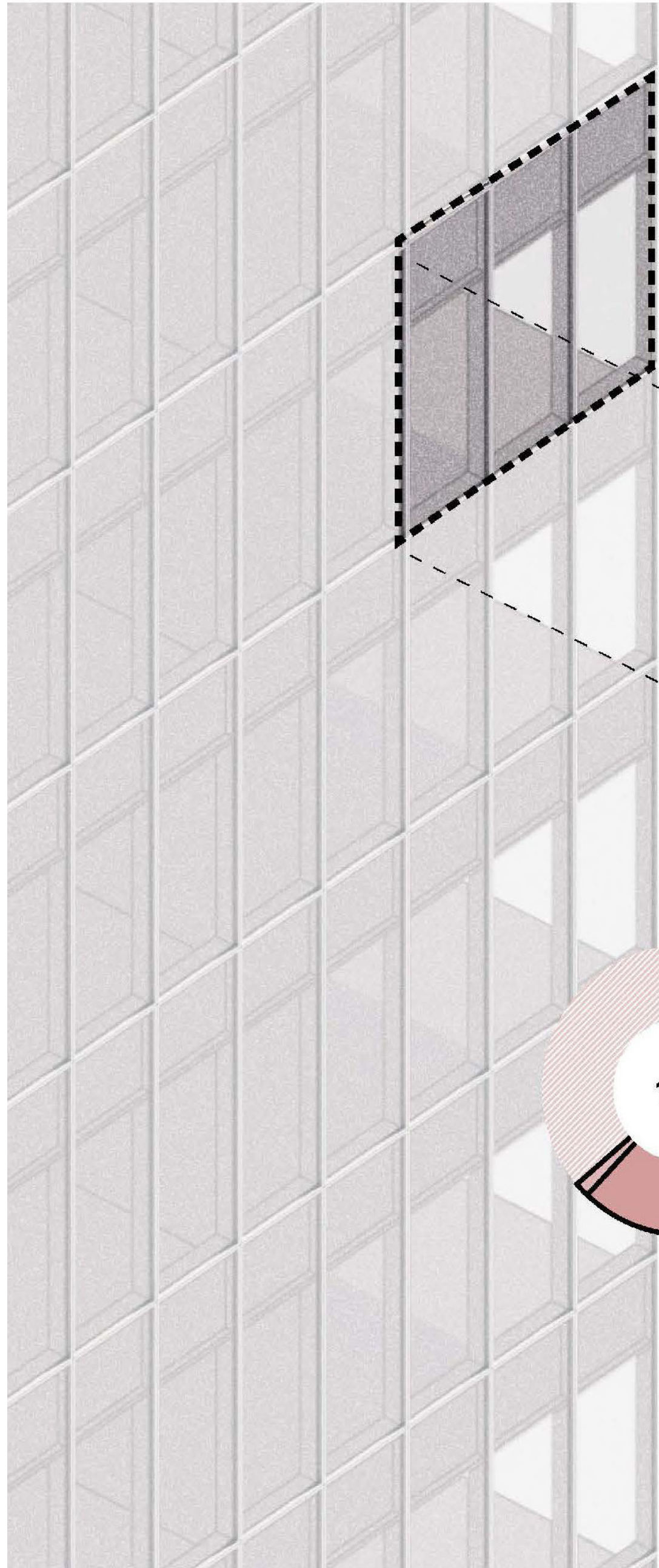
Extra insulation:
Save 9574 kgCO2e by 2050



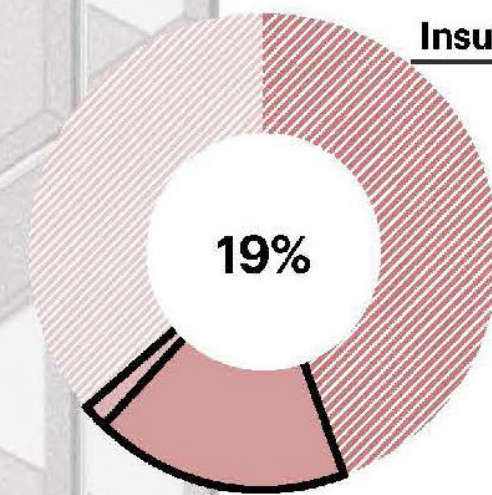
Triple-pane glazing:
Save 7854 kgCO2e by 2050



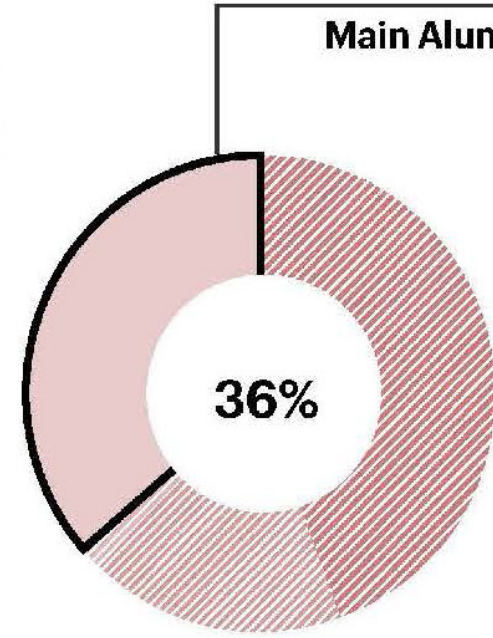
Vertical fins:
Spend 1867 kgCO2e by 2050



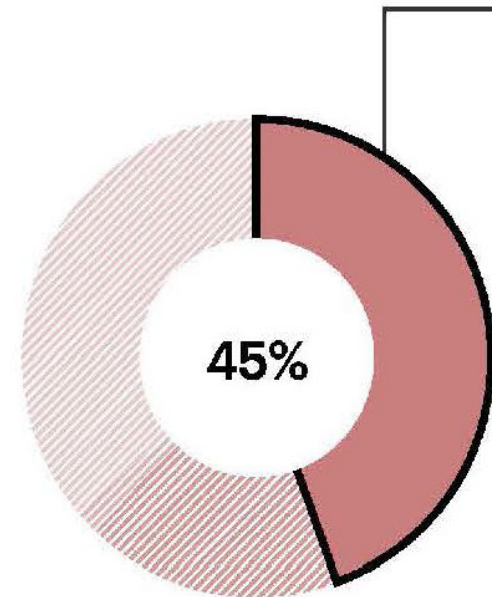
> Glass and Aluminium Curtain Wall



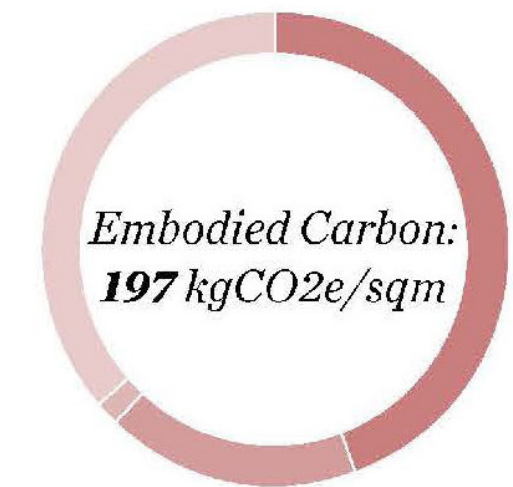
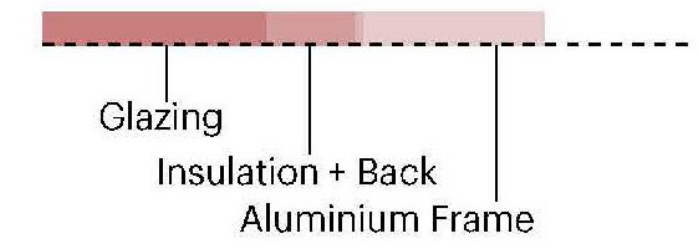
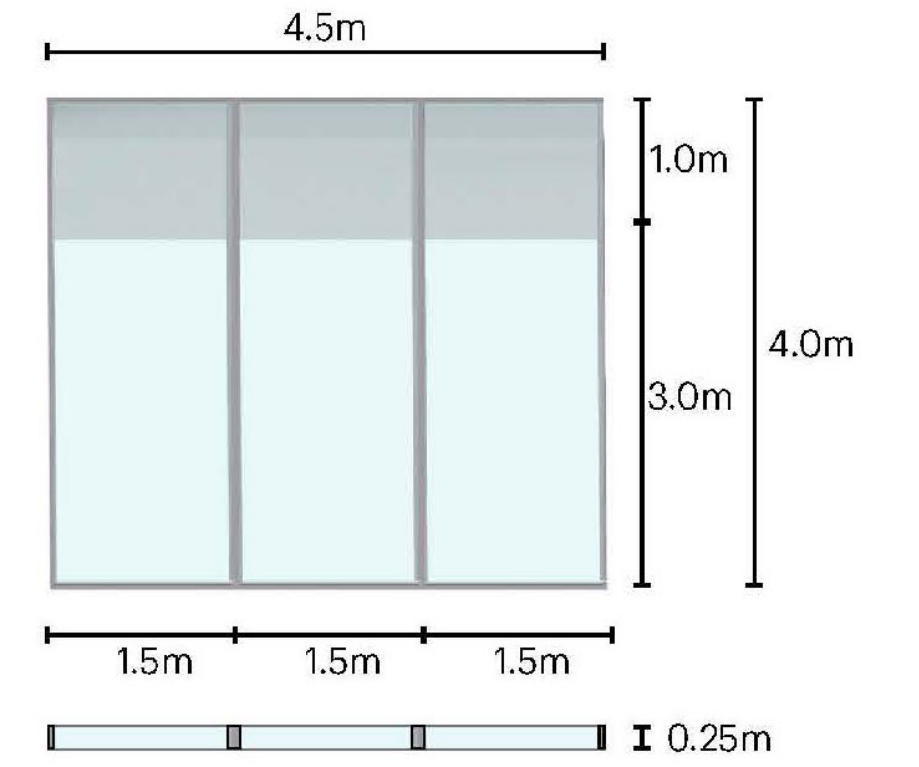
Insulation + Back Panels

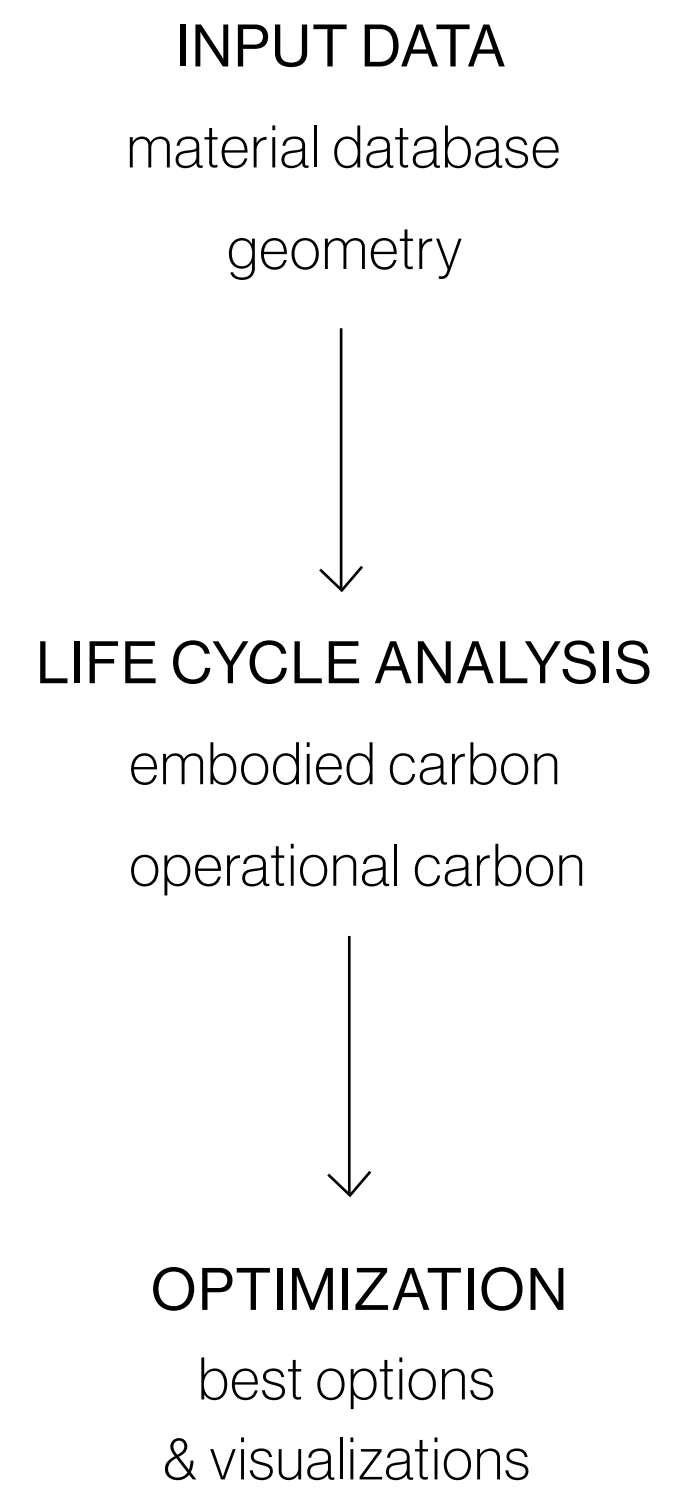


Main Aluminium Frame

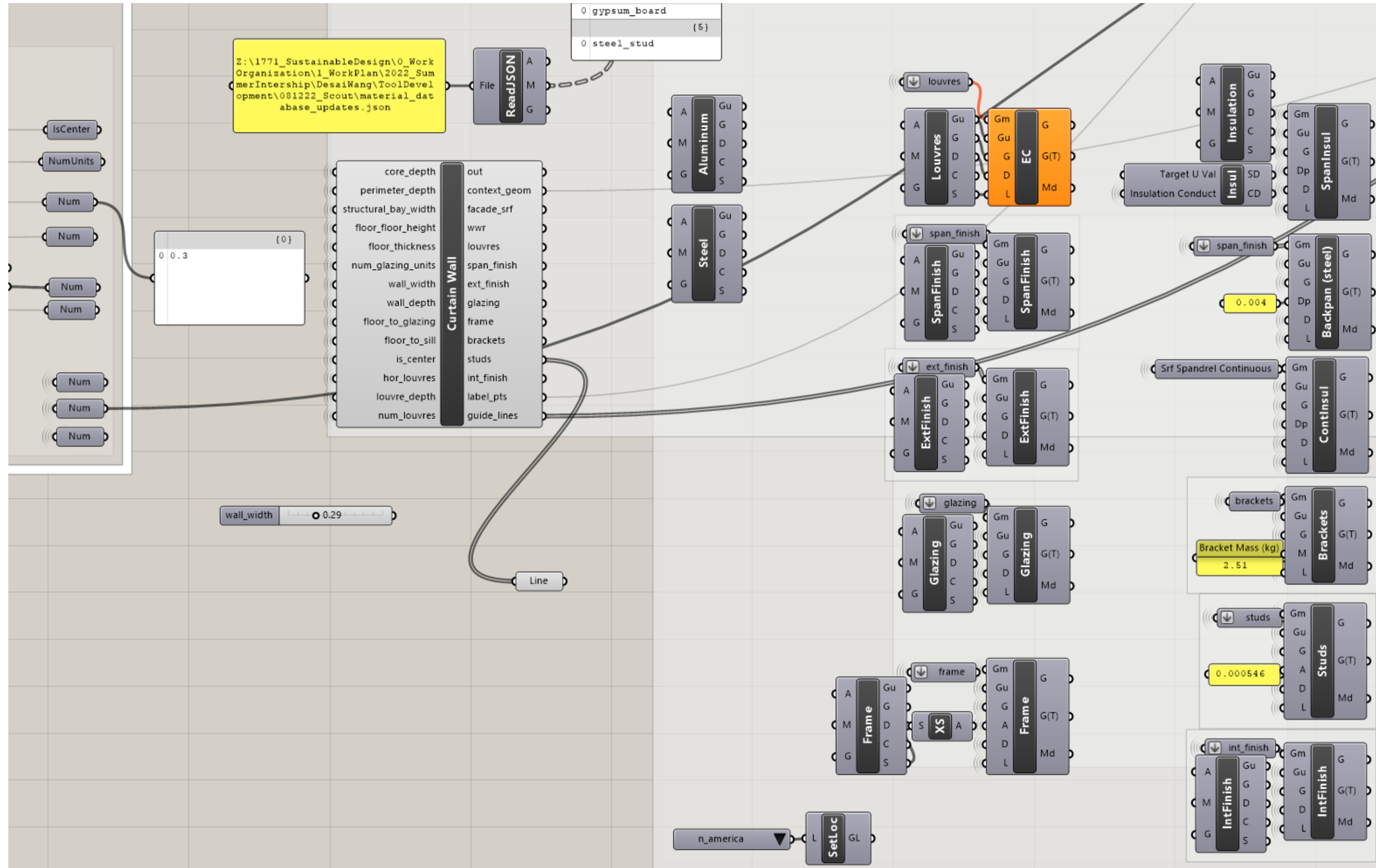


Glazing Unit





Grasshopper



```

Script Editor
Script component: Curtain Wall
49
50
51 private void RunScript(double core_depth, double perimeter_depth, double structural_bay_width, double floor_floor_height, double floor_thickness, int num
52
53 //last update: 081122
54
55 //base point and vectors (currently using default xyz, and not parameterized into script)
56 Point3d origin = new Point3d(0, 0, 0);
57 Vector3d z_unit = new Vector3d(0, 0, 1);
58 Vector3d y_unit = new Vector3d(0, 1, 0);
59 Vector3d x_unit = Vector3d.CrossProduct(z_unit, y_unit);
60
61 //double floor_thickness = floor_floor_height - floor_ceil_height;
62 double floor_ceil_height = floor_floor_height + floor_thickness;
63
64 //create floor slabs based on depth (= core_depth + perimeter depth), width and height, offset by floor_floor_height
65 Plane bpl = new Plane(origin, z_unit);
66 BoundingBox bounding_b = new BoundingBox(origin, new Point3d(structural_bay_width, core_depth + perimeter_depth, floor_thickness));
67 BoundingBox context_b = new BoundingBox(origin, new Point3d(4 * structural_bay_width, core_depth + perimeter_depth, floor_thickness));
68
69 //legacy for creating single floor modules
70 Box base_b = new Box(bounding_b);
71 // Box top_b = new Box(base_b);
72 // top_b.Transform(Transform.Translation(0, 0, floor_floor_height));
73
74 Box base_b = new Box(context_b);
75 Box top_b = new Box(base_b);
76 base_b.Transform(Transform.Translation(-3 * structural_bay_width, 0, 0));
77 top_b.Transform(Transform.Translation(-3 * structural_bay_width, 0, floor_floor_height));
78
79 Brep p0_b = context_b.ToBrep();
80 p0_b.Transform(Transform.Translation(-3 * structural_bay_width, 0.05, 0)); //0.05 offset so geom doesn't clash in vis
81 Brep n1_b = p0_b.DuplicateBrep();
82 n1_b.Transform(Transform.Translation(0, 0, -floor_floor_height));
83
84 Brep p1_b = p0_b.DuplicateBrep();
85 p1_b.Transform(Transform.Translation(0, 0, floor_floor_height));
86 Brep p2_b = p1_b.DuplicateBrep();
87 p2_b.Transform(Transform.Translation(0, 0, floor_floor_height));
88 Brep p3_b = p2_b.DuplicateBrep();
89 p3_b.Transform(Transform.Translation(0, 0, floor_floor_height));
90
91 List<Brep> b_list = new List<Brep>(); //holds slabs in context geometry
92 b_list.Add(n1_b);
93 b_list.Add(p0_b);
94 b_list.Add(p1_b);
95 b_list.Add(p2_b);
96 b_list.Add(p3_b);
97
98 //create glazing system for WindowWall
99
100 //initialize line and srf lists
101 double glazing_unit_width = structural_bay_width / num_glazing_units;
102 List<Line> WallLines = new List<Line>();
103 List<Line> WindowLines = new List<Line>();
104 List<Line> UnitFrame = new List<Line>();
105 List<Line> Cassette = new List<Line>();
106 List<Line> Studs = new List<Line>();
107
108 List<Point3d> LouvresPts = new List<Point3d>();
109 List<Point3d> LouvreStuds = new List<Point3d>();
110 List<Point3d> AnchorBracketPts = new List<Point3d>();
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Web UI

The image displays a web-based user interface for a facade design tool. On the left, a dark-themed 'Inputs' panel is open, showing five sliders and a 'Metrics' section. The sliders are: 'Module Width' (range 1.5 to 3.8), 'Module is centered?' (range 'not centered' to 'centered'), 'Wall Width' (range 0.3 to 0.9), 'Floor-Sill Distance' (range 0.8 to 0.7), and 'Shading Type' (range 0 to 3). The 'Metrics' section includes a toggle for 'Component Embodied Carbon' (6123.3 kgCO2e) and a color-coded progress bar from 25 to 3888. A line graph at the bottom of the panel shows 'Total Carbon Emissions' and 'Assembly Option' over time. The main area features a 3D perspective view of a building facade with a grid of windows. A cutaway section reveals the internal structure of a window module, with labels for 'Int Finish', 'Studs', 'Continuous Insul', 'Brackete', 'Backpan', 'Spandrel Insul', 'Frame', 'Glazing', 'Ext Finish', 'Spandrel Finish', and 'Louvers'. The 'Scout v 0.14.0' logo is in the bottom right corner.

Inputs

model: 18

Module Width: 1.5 to 3.0

Module is centered?: not centered to centered

Wall Width: 0.3 to 0.9

Floor-Sill Distance: 0.0 to 0.7

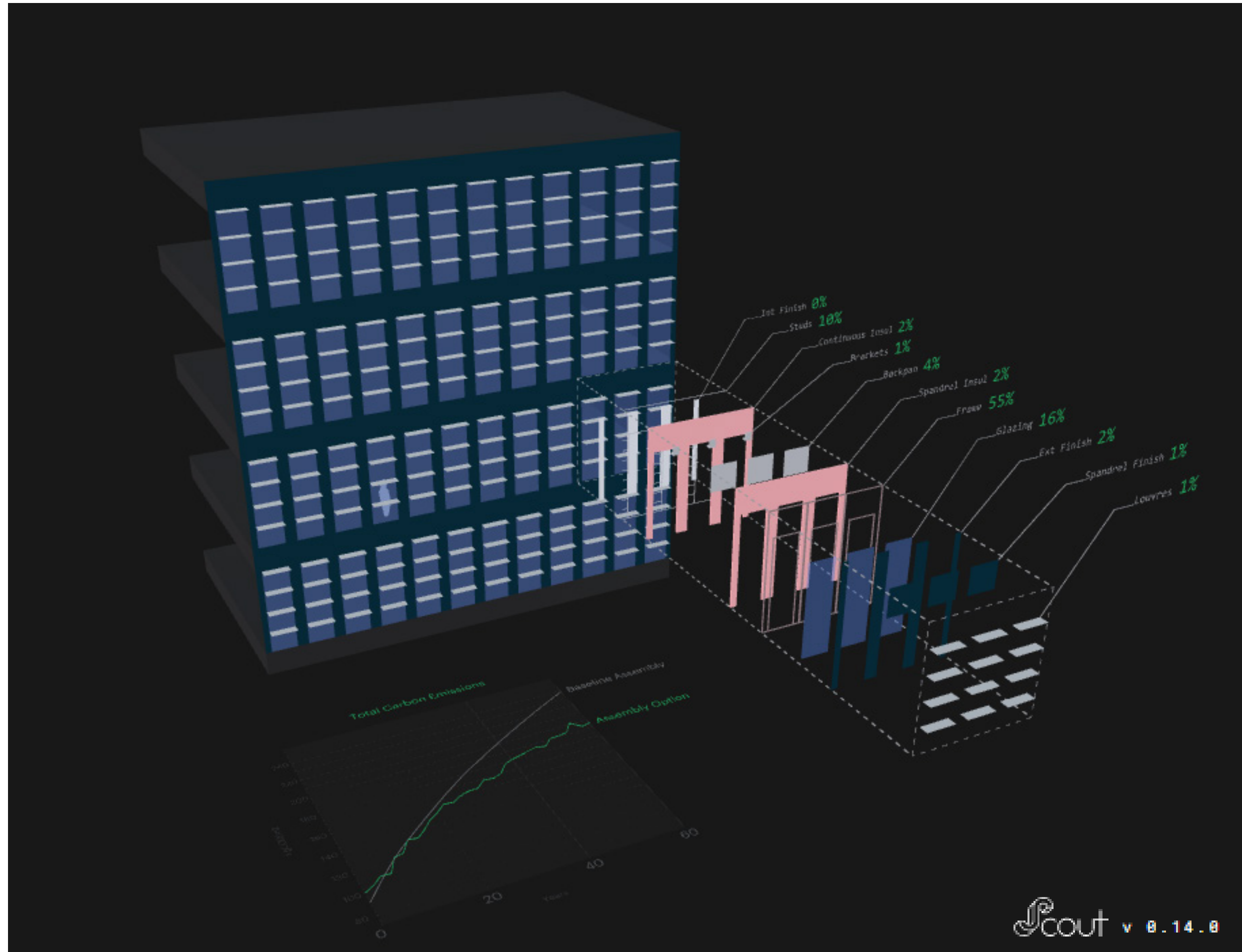
Shading Type: 0 to 3

Metrics

Component Embodied Carbon: 4516.3 kgCO2e

25 to 3000

The global warming potential (GWP) of the production processes for all the materials (A1-A3) as they are found in a facade.



Thanks!



Carlos + Luc
Benjamin
Eric

EP + UI

KPF