



MACKIMMIE TOWER + HUNTER STUDENT COMMONS

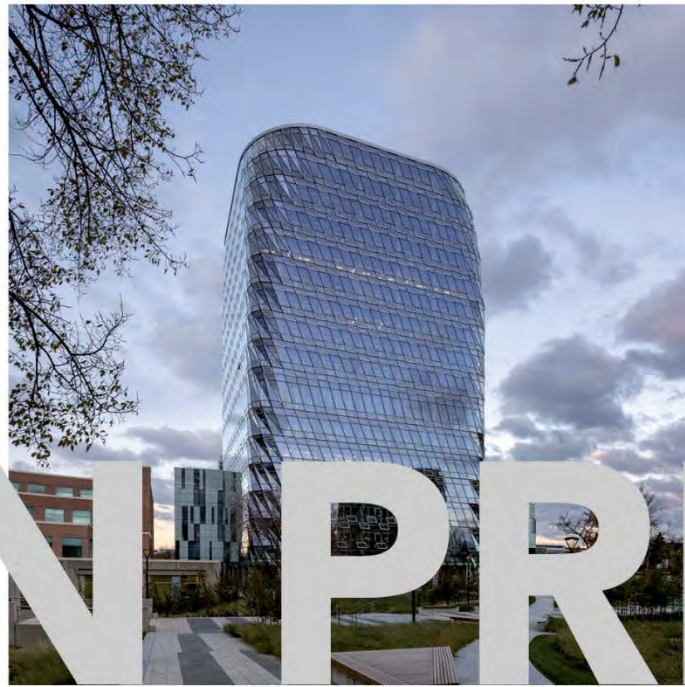
INFRASTRUCTURE PARTNERS CONFERENCE

OCTOBER 7 2024

DIALOG[®]

DESIGN PRINCIPLES

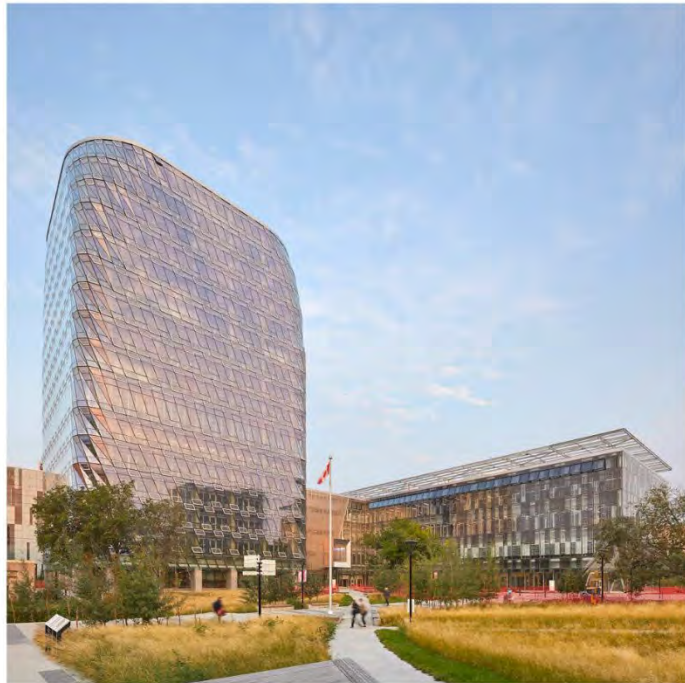
**RADICALLY
SUSTAINABLE**



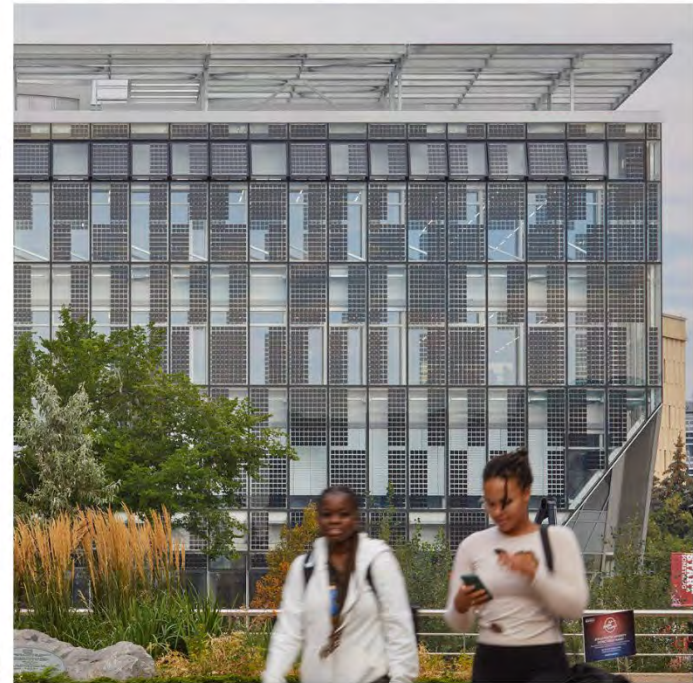
**A NEW HEART
FOR THE
CAMPUS**



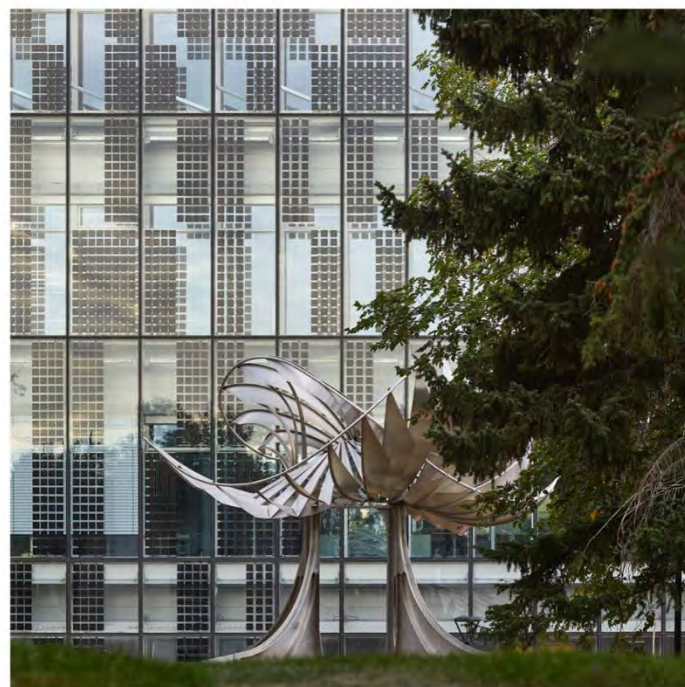
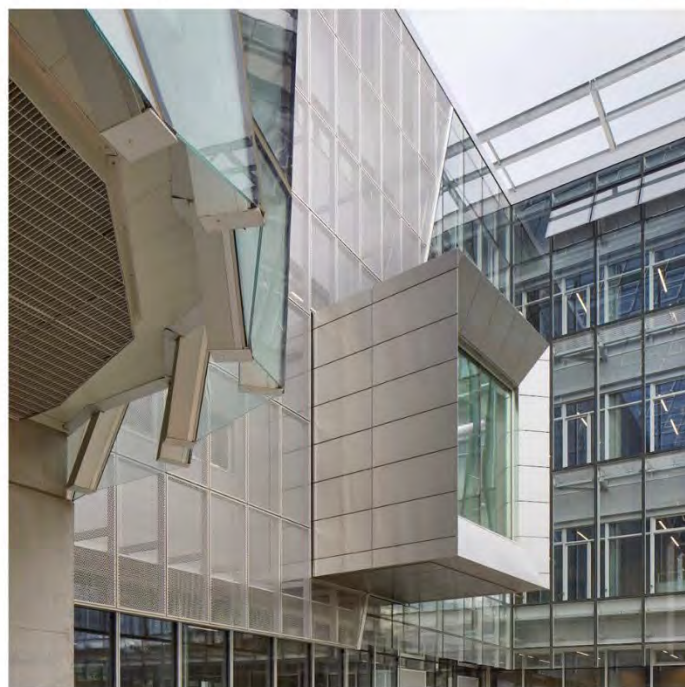
**VISUAL AND
PHYSICAL
POROSITY**



**MULTIPLE
EXPERIENCES**



**SHOWCASE
INNOVATION**



**REINVIGORATE
CAMPUS
IDENTITY**







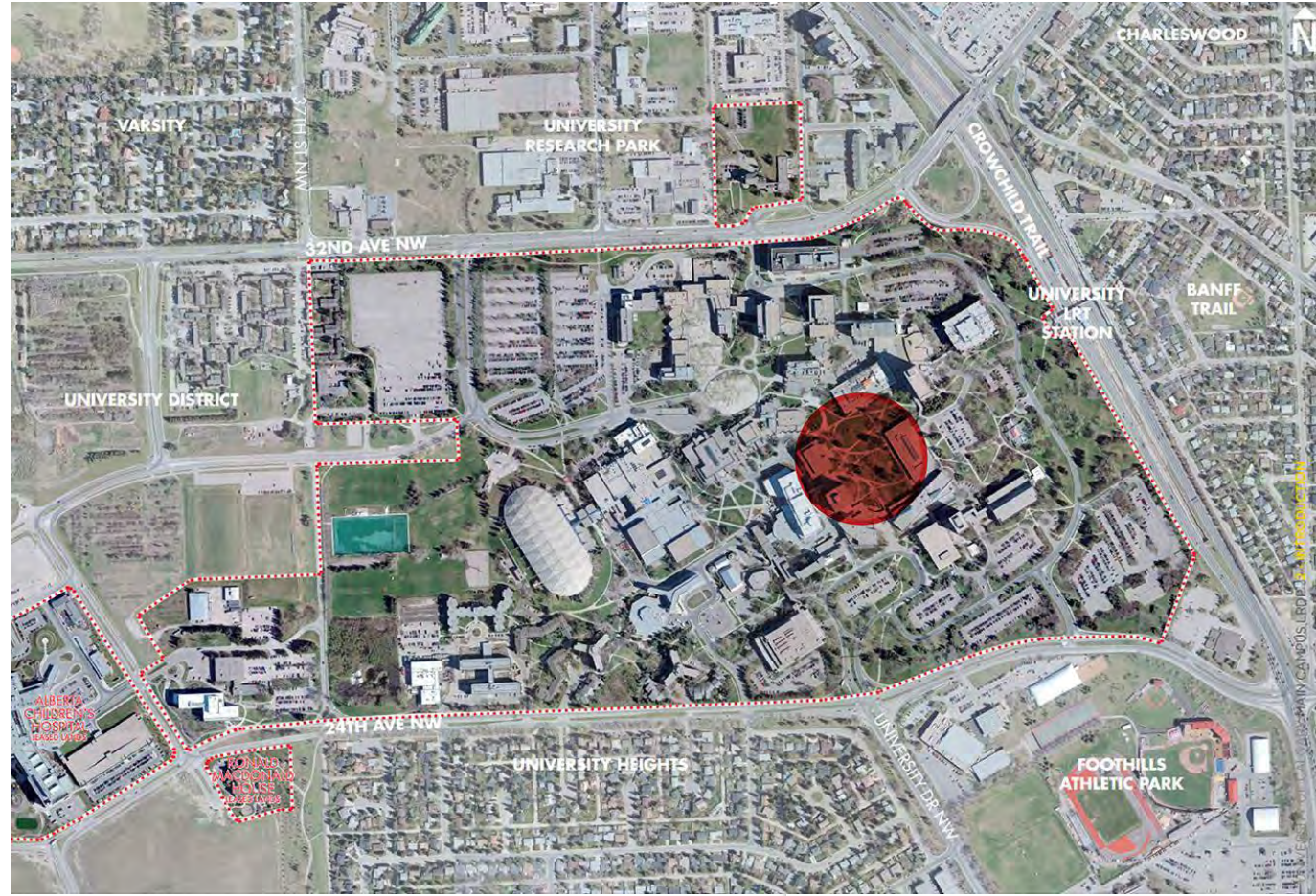


PROJECT DNA = 8000 TONNES of EMBODIED CO₂

2019 CLIMATE ACTION PLAN

The 2019 Climate Action Plan is the University of Calgary's operational roadmap to a carbon neutral campus by 2050, sparking innovation and accelerating the transition to a clean growth economy.





TOWER LINK BLOCK





**ZERO CARBON
BUILDING STANDARD**
Canada Green Building Council®

OPTION 1

Flexible Approach

- Thermal energy demand intensity (TEDI) target
- Energy use intensity (EUI) target

OPTION 2

Passive Design Approach

- Aggressive thermal energy demand intensity (TEDI) target

OPTION 3

Renewable Energy Approach

- Thermal energy demand intensity (TEDI) target
- Zero carbon balance for operational carbon achieved without green power products or carbon offsets

TEDI: The annual heat loss from a building's envelope and ventilation after accounting for all passive heat gains and losses, per unit of modelled floor area.

Option 1:

**TEDI: No Onsite Combustion
OR TEDI Target: 36 kWh/m²/yr**

**EUI: 25% better than NECB 2017
OR EUI Target: 100 kWh/m²/yr**

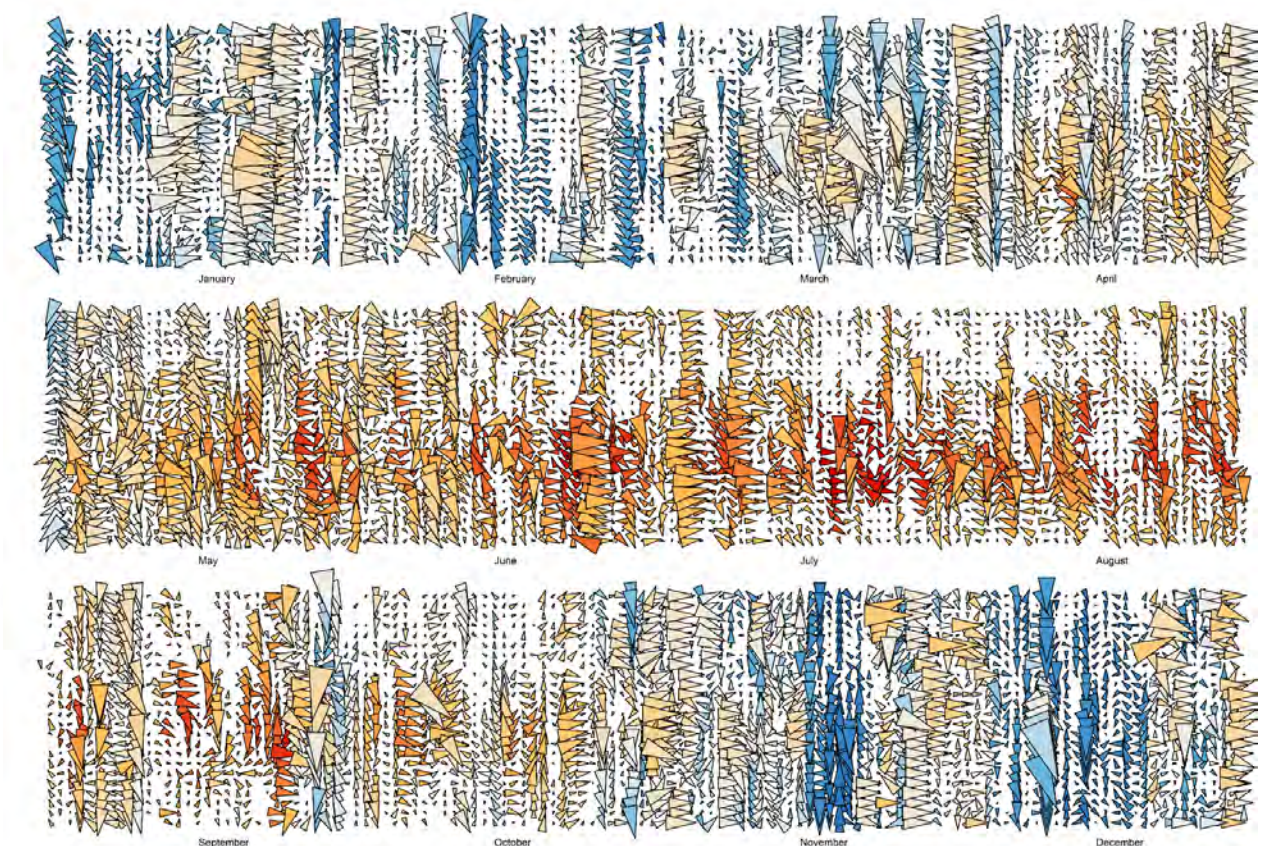
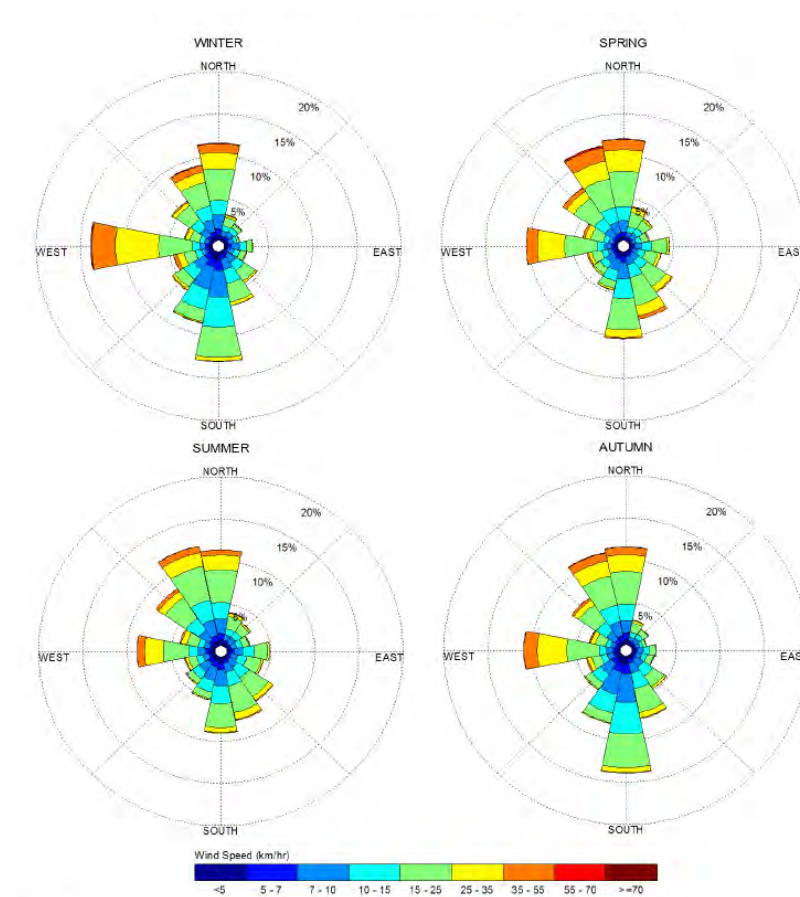
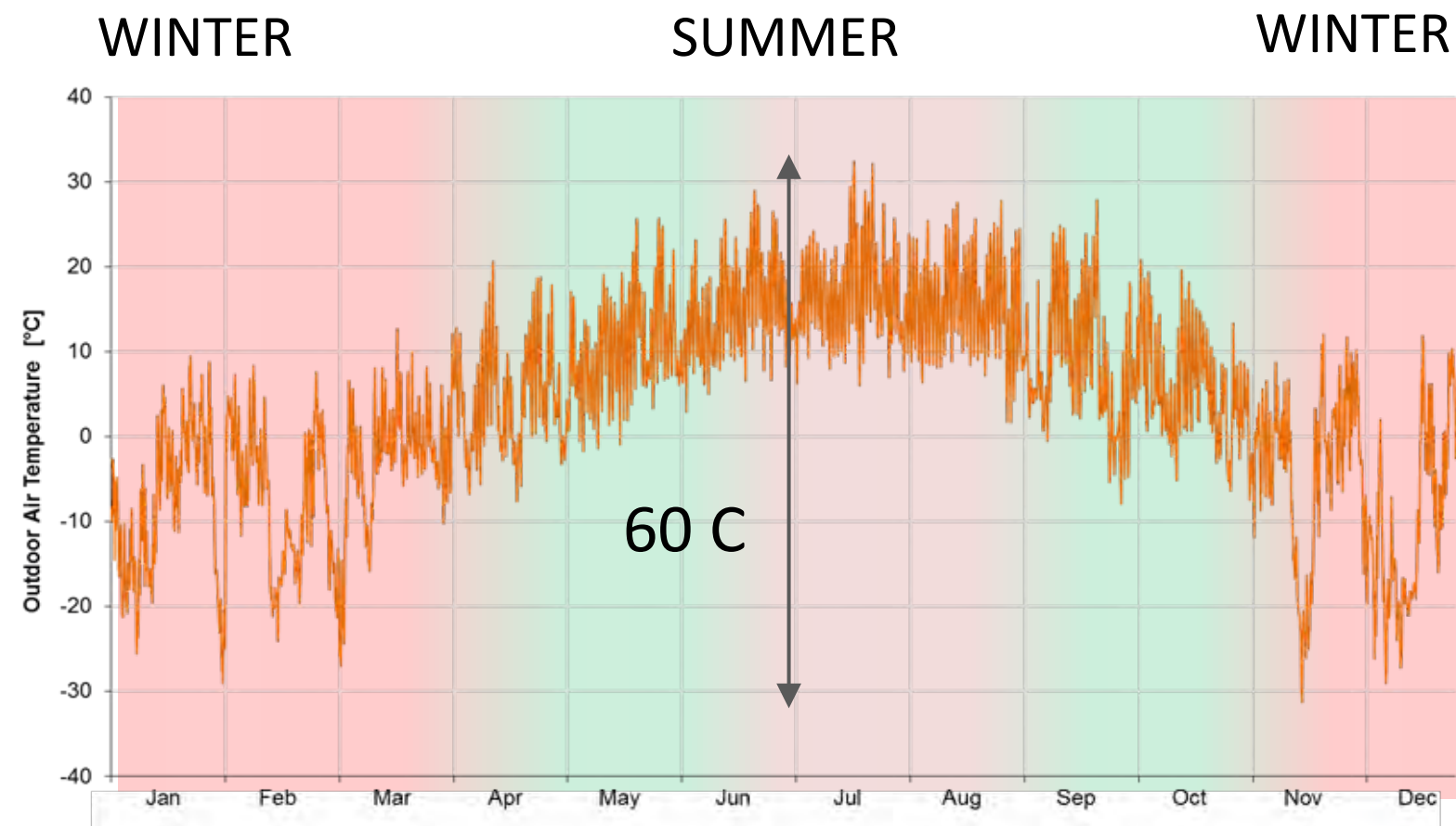
Option 2:

TEDI: TEDI Target: 22 kWh/m²/yr

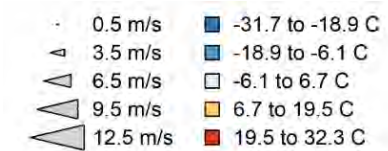
Option 3:

TEDI Target: 36 kWh/m²/yr

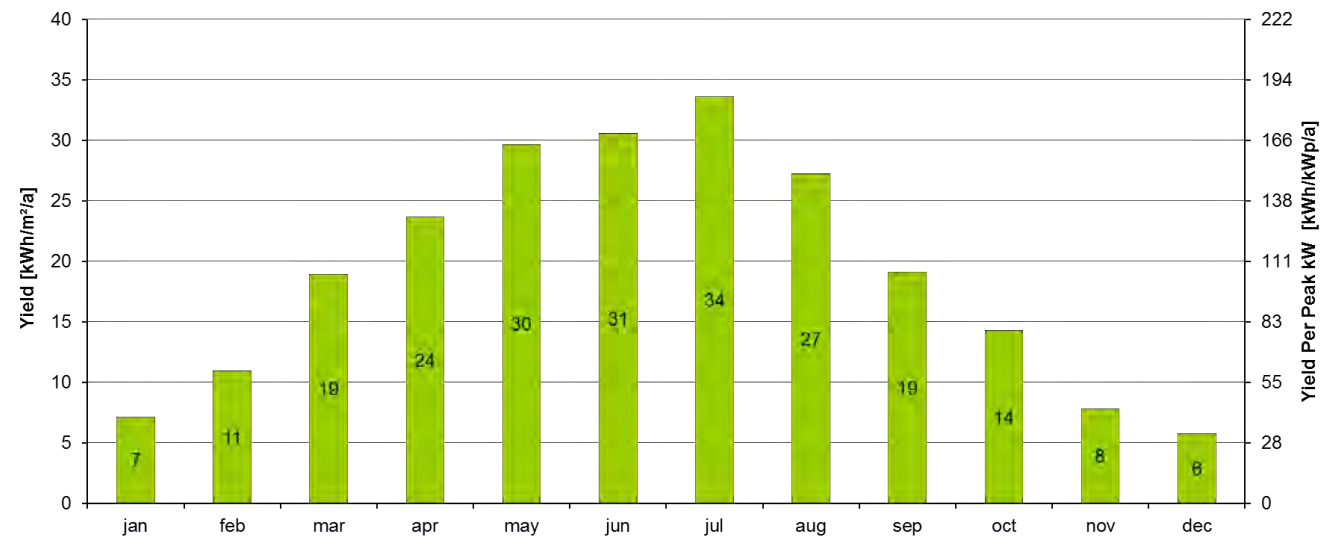
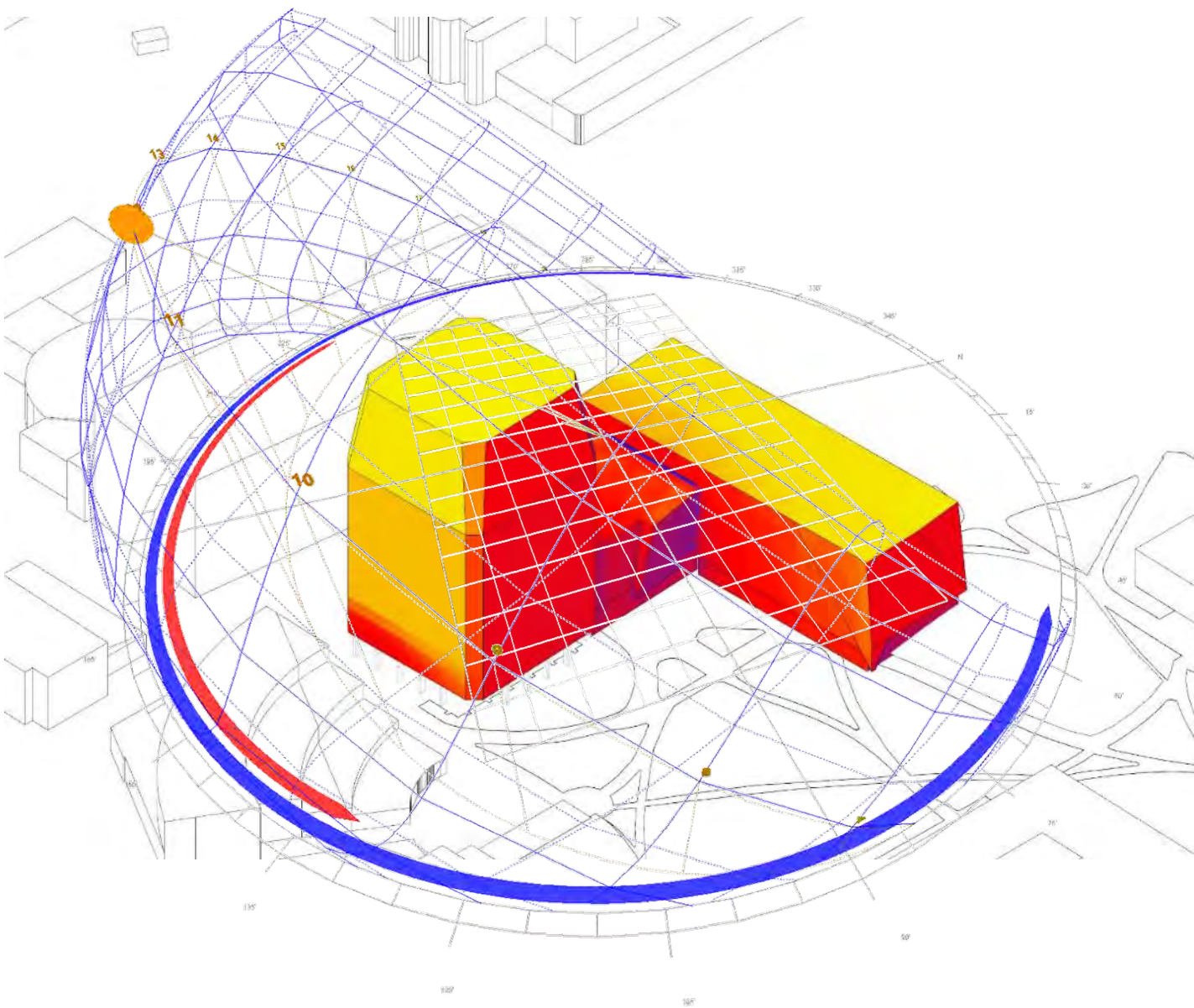
Climate Analysis



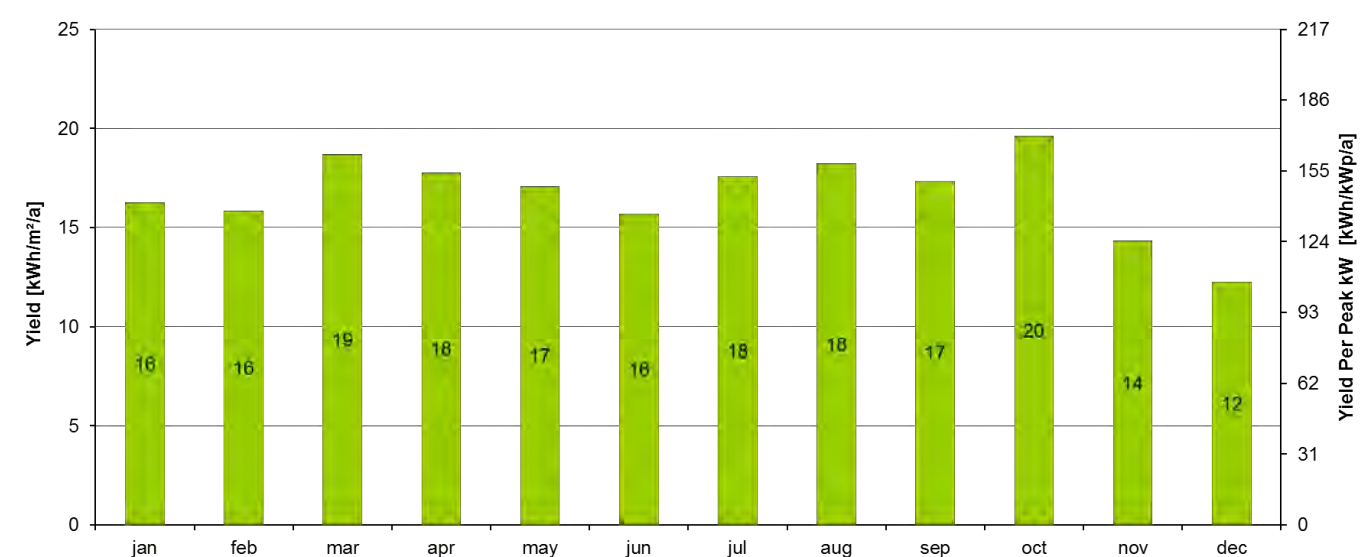
$\Delta T \approx 60 \text{ C}$ Annual Temperature Difference (20-30 C diurnal shift)



Solar Potential



Roof Horizontal
1265 kWh/kW_{peak}

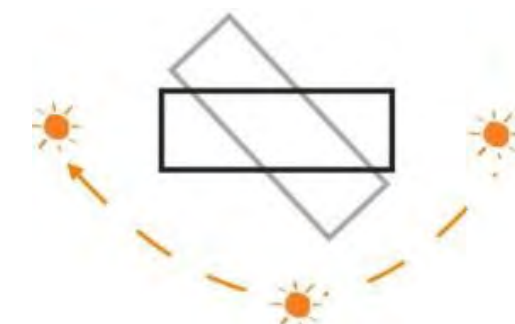


South Façade
1245 kWh/kW_{peak}

Passive Optimization



Building Massing



Building orientation (solar)



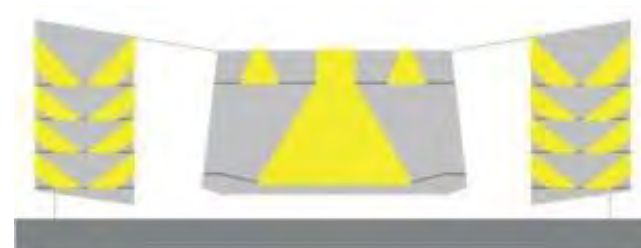
Building orientation (wind)



Open space access



Program distribution

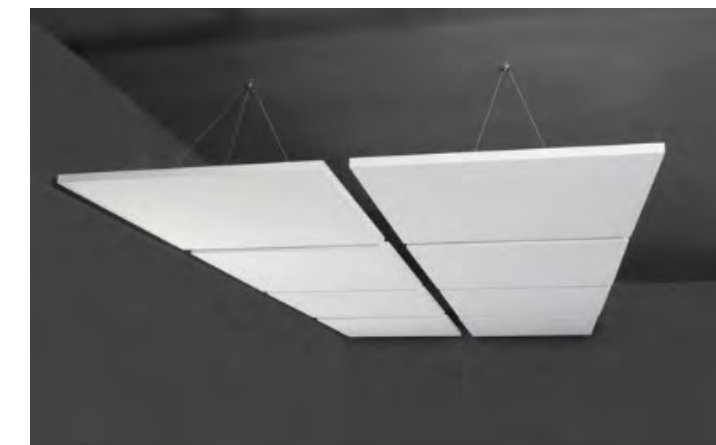


Daylight



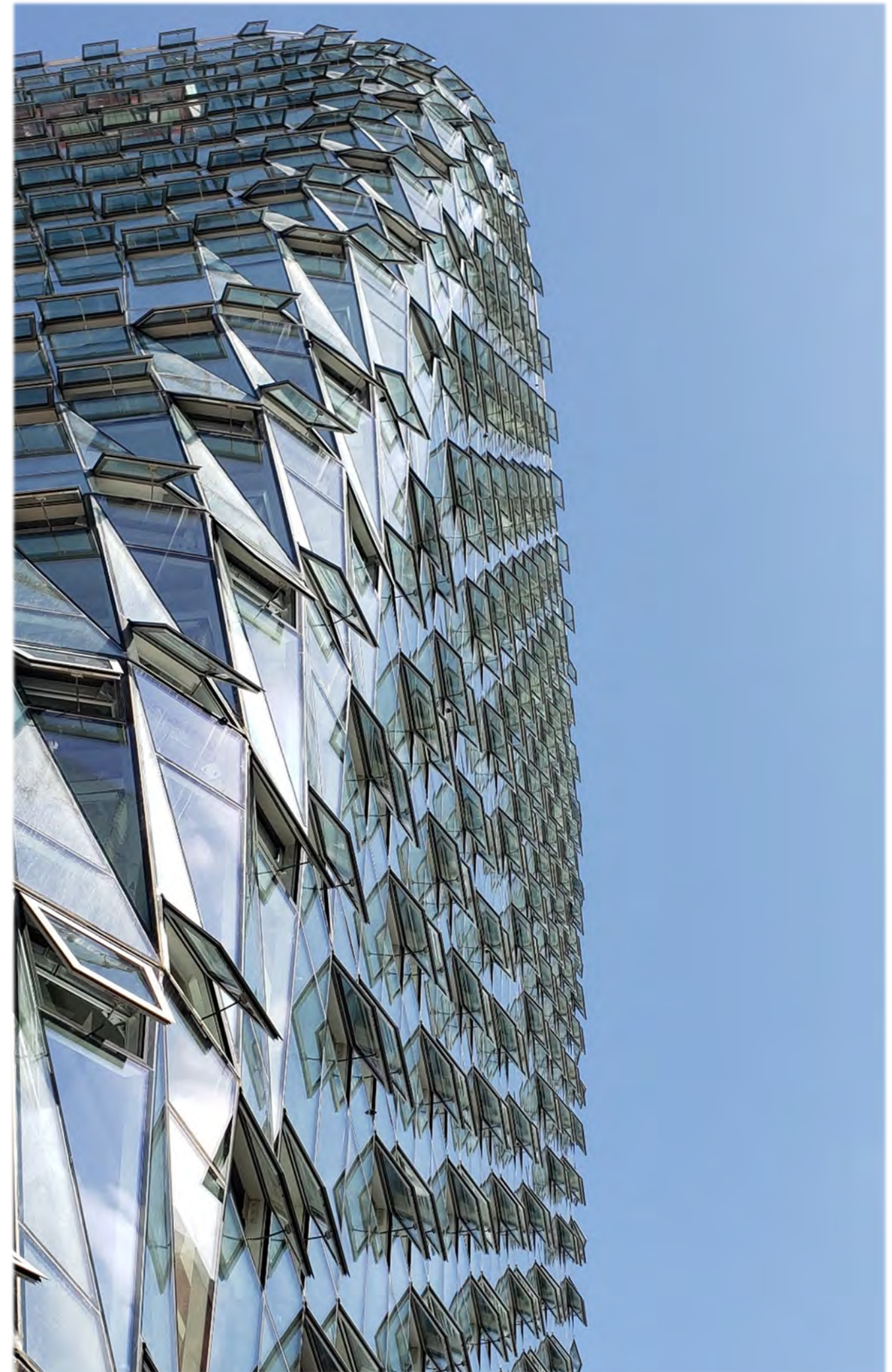
Natural Ventilation

Active Optimization

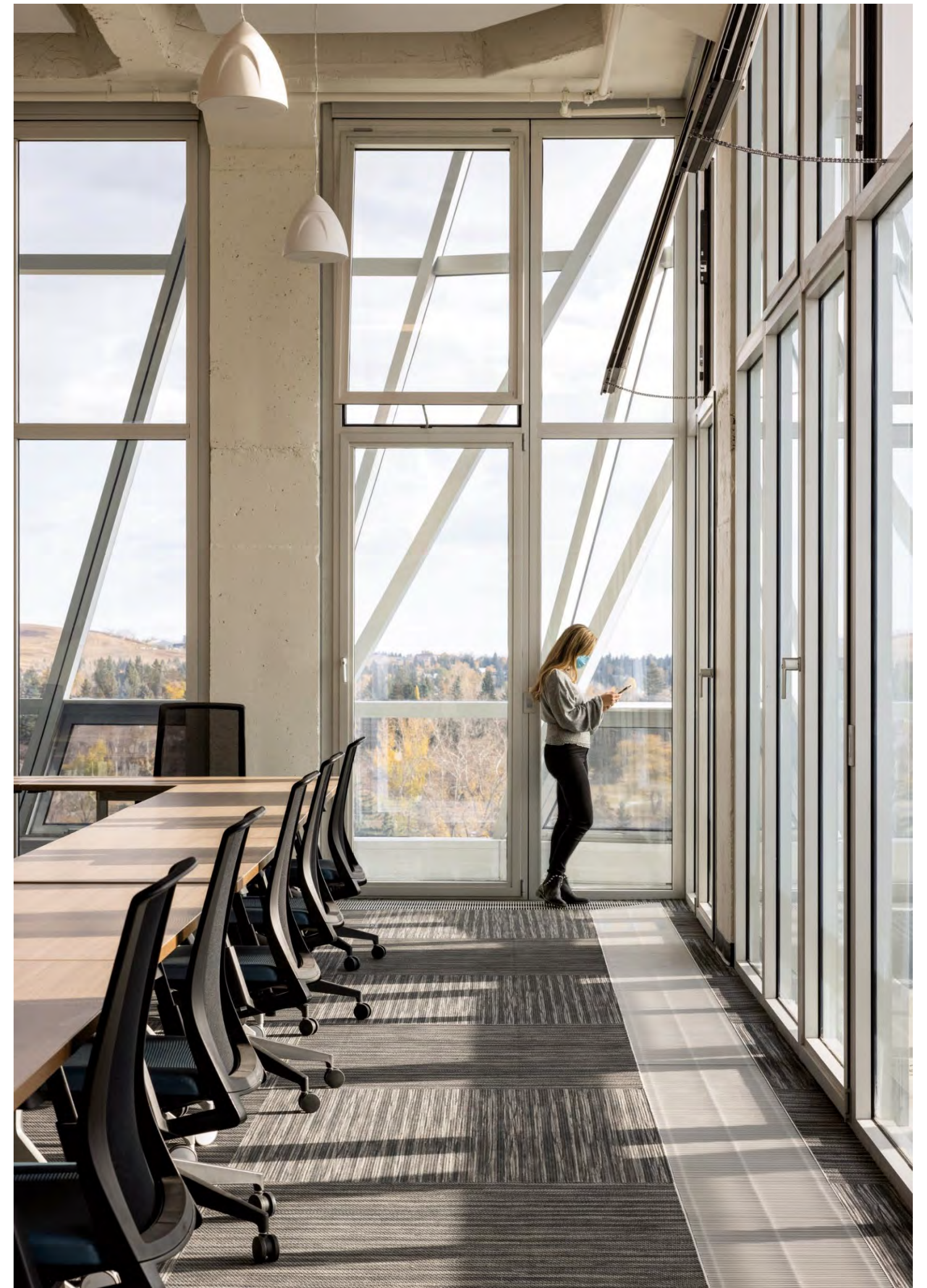


High Performance Systems

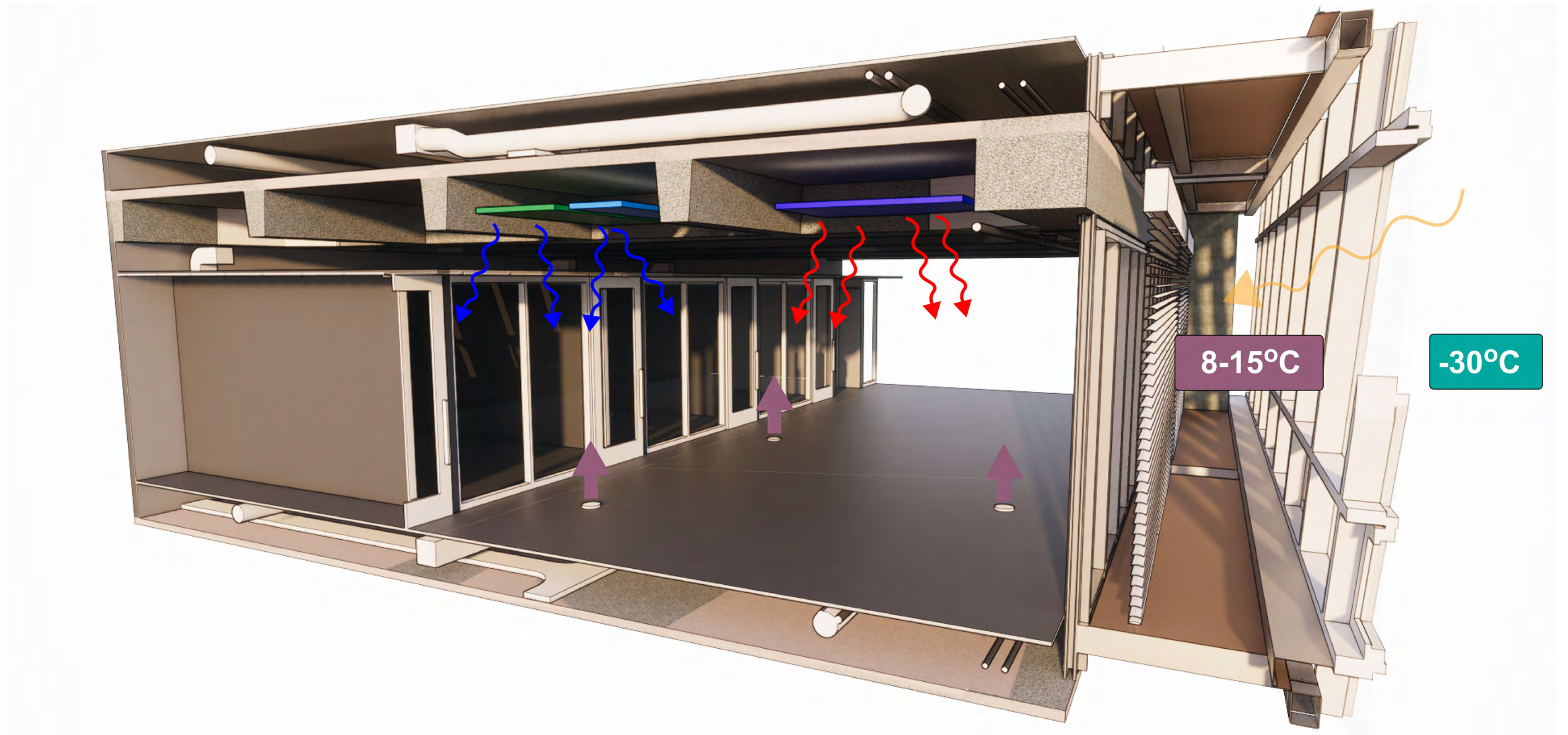
- Rainwater Reuse
- 100% Outside Air Ventilation
- Radiant Heating & Cooling
- Evaporative Cooling
- Natural Ventilation & Night Flush
- Daylighting Controls
- Occupancy Sensors



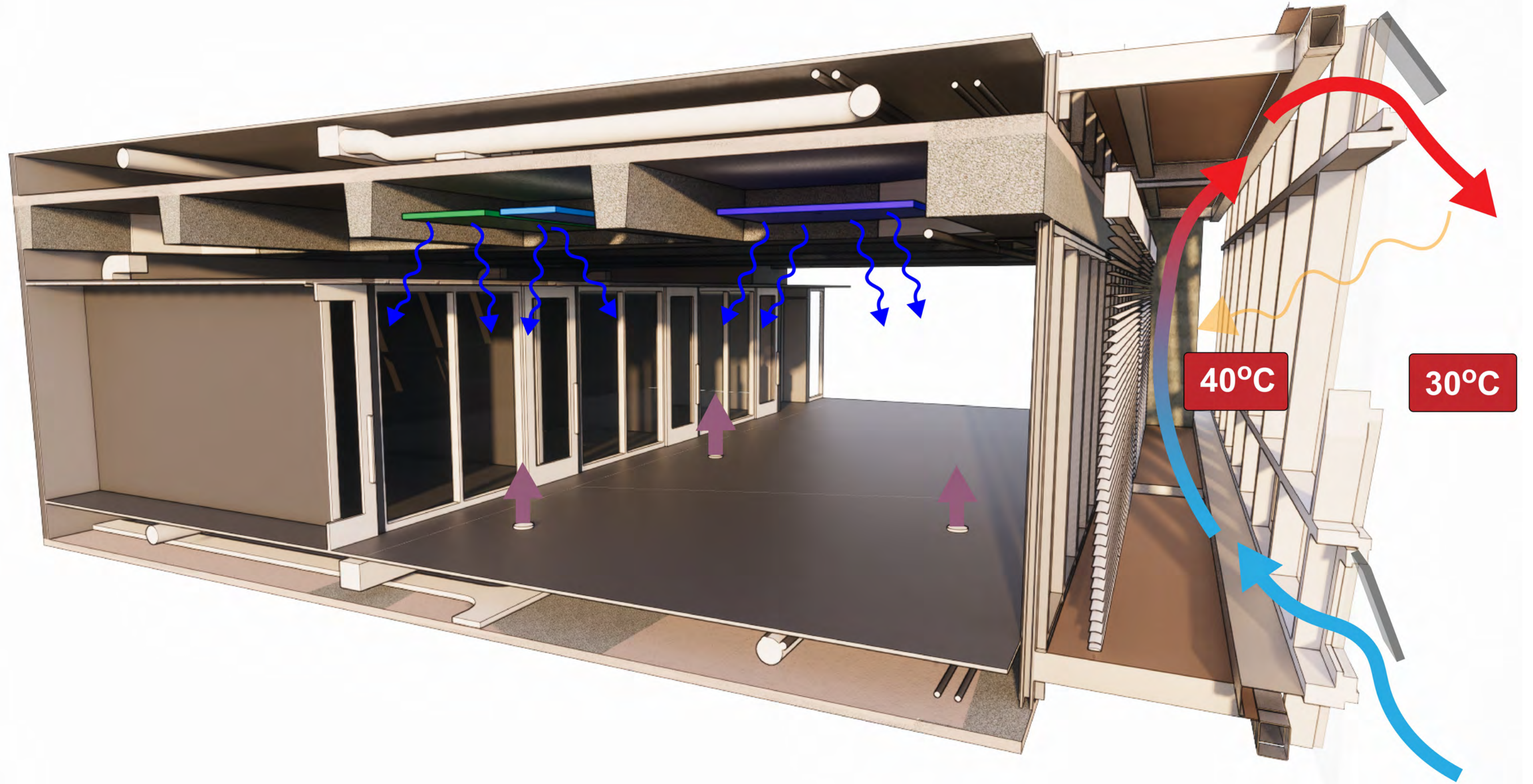
Radiant Heating + Cooling Displacement Ventilation



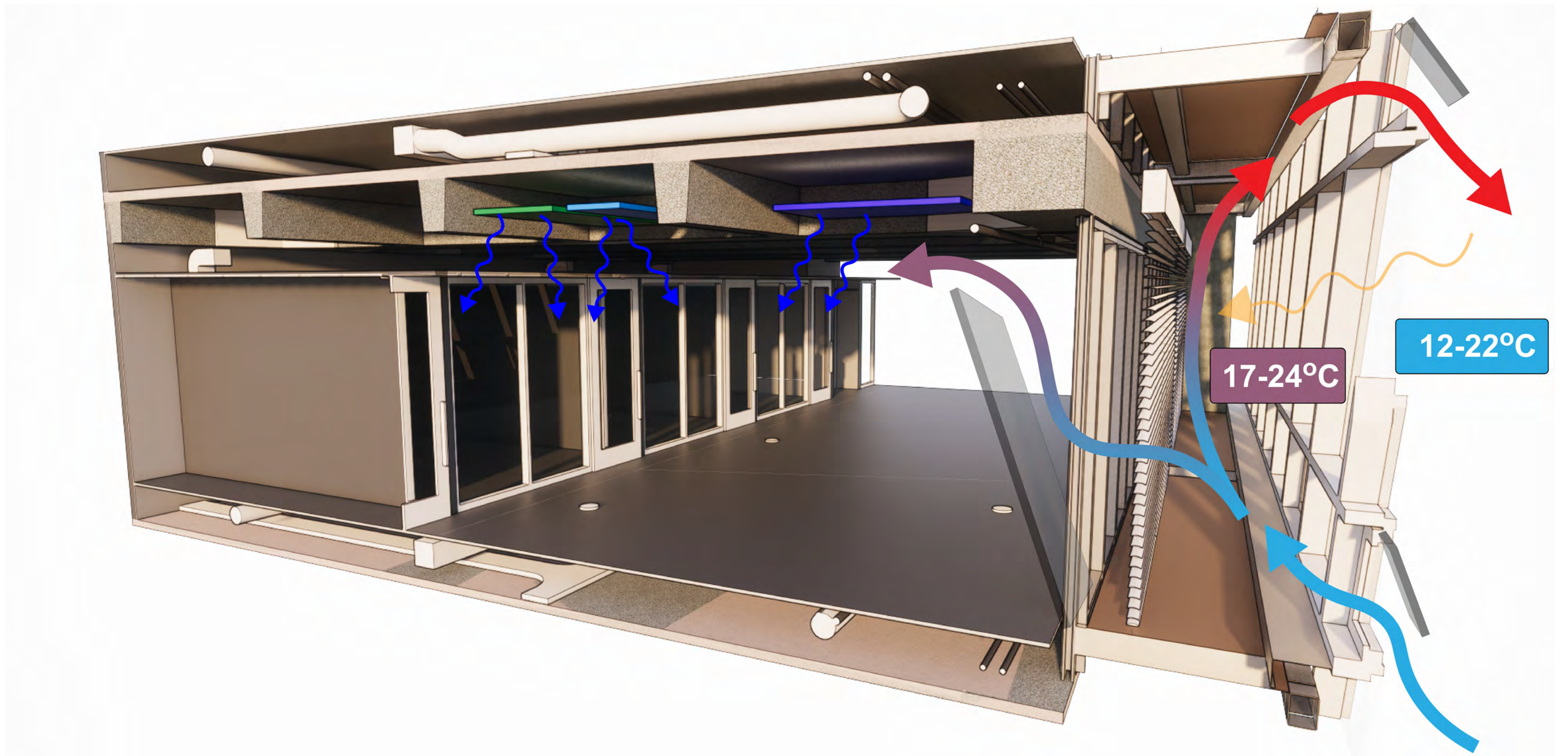
Heating



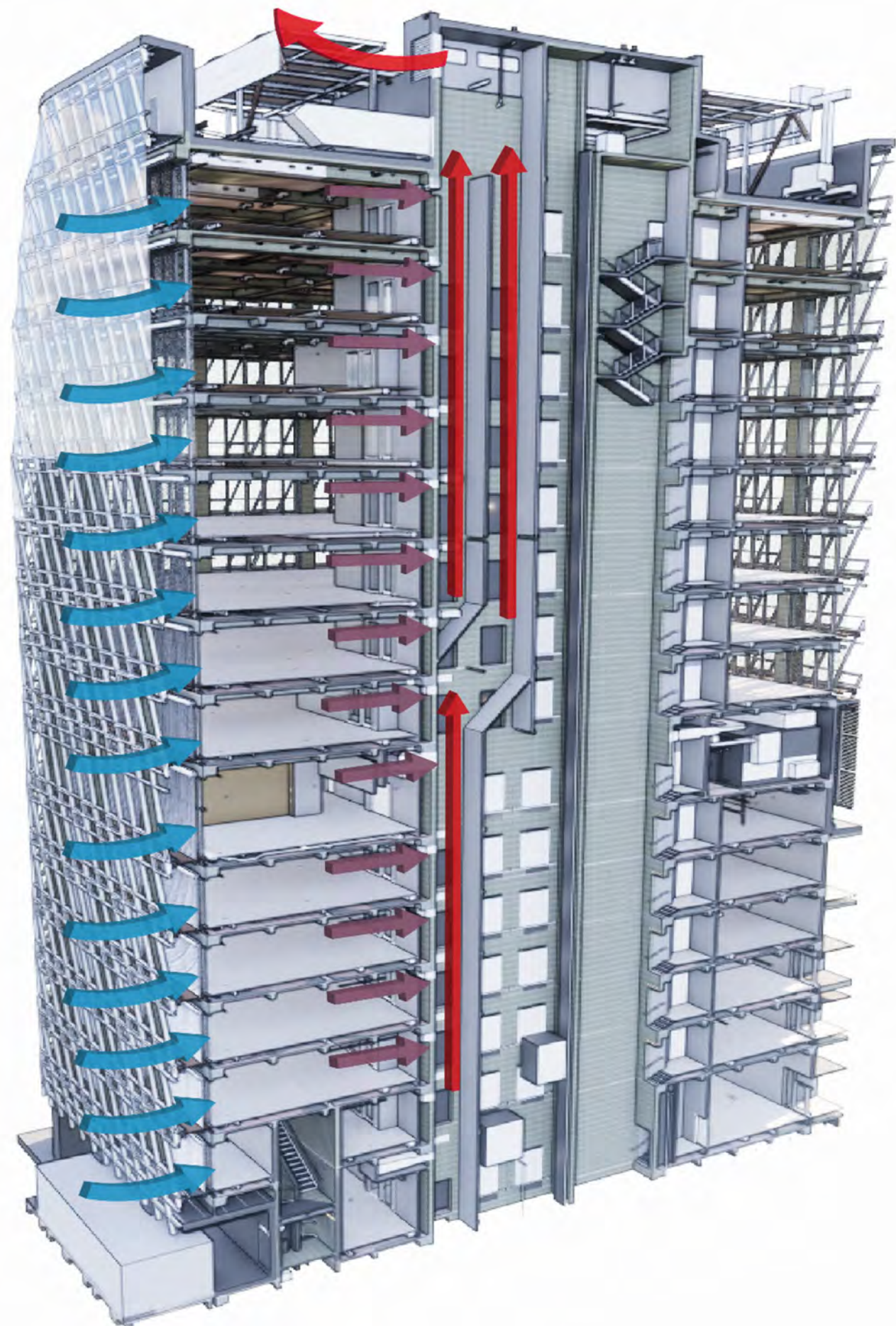
Cooling



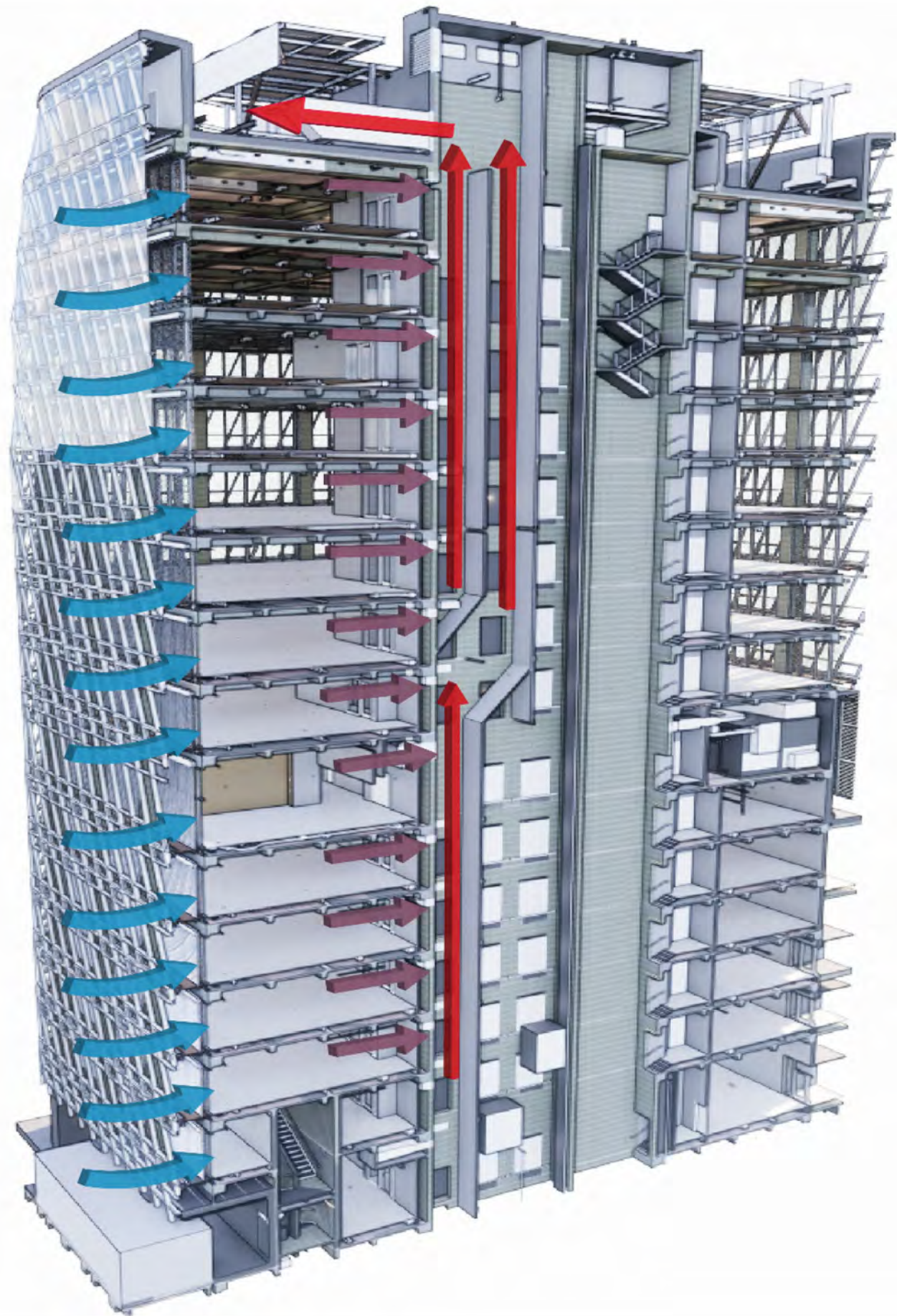
Natural Ventilation



Natural Ventilation

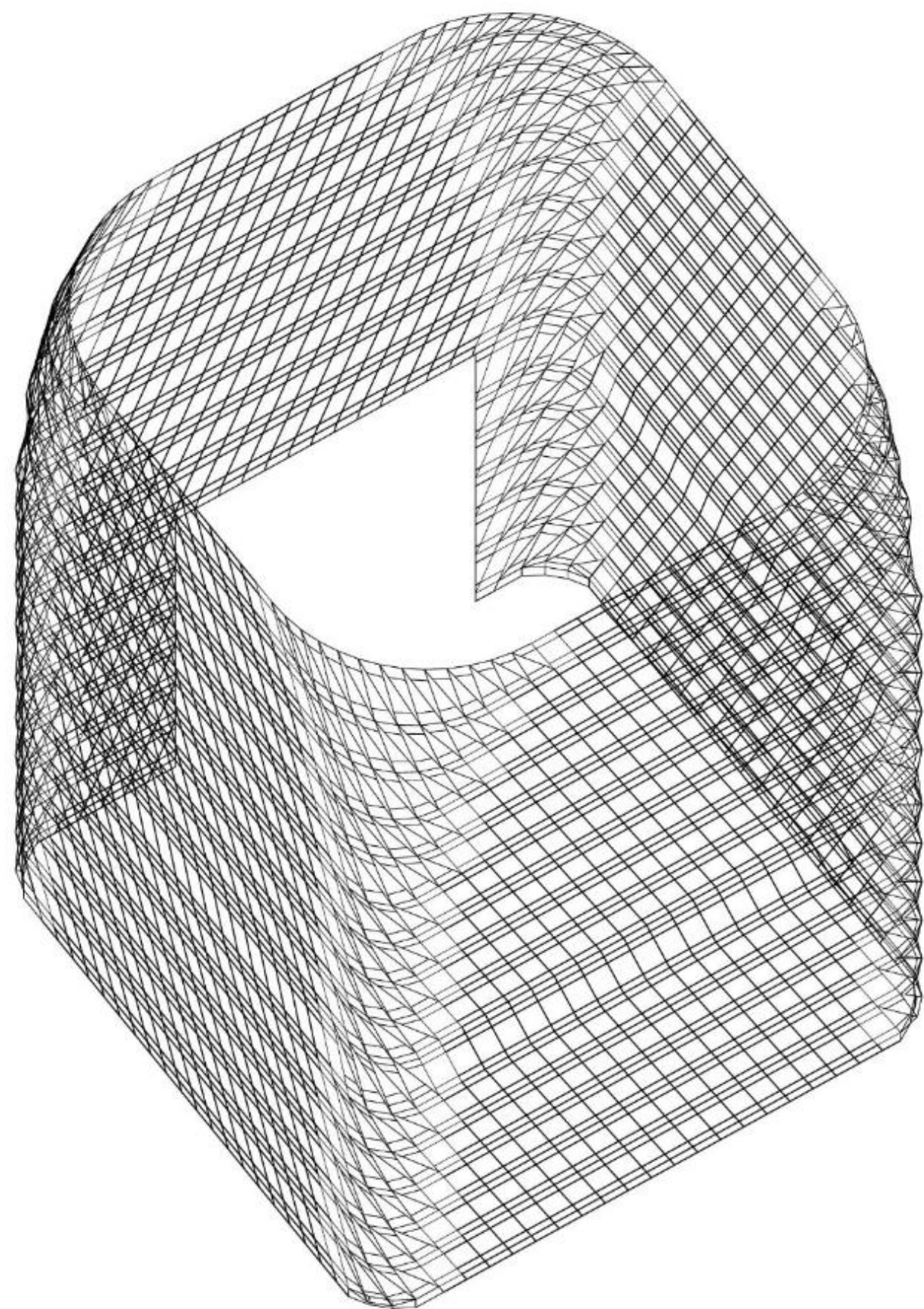
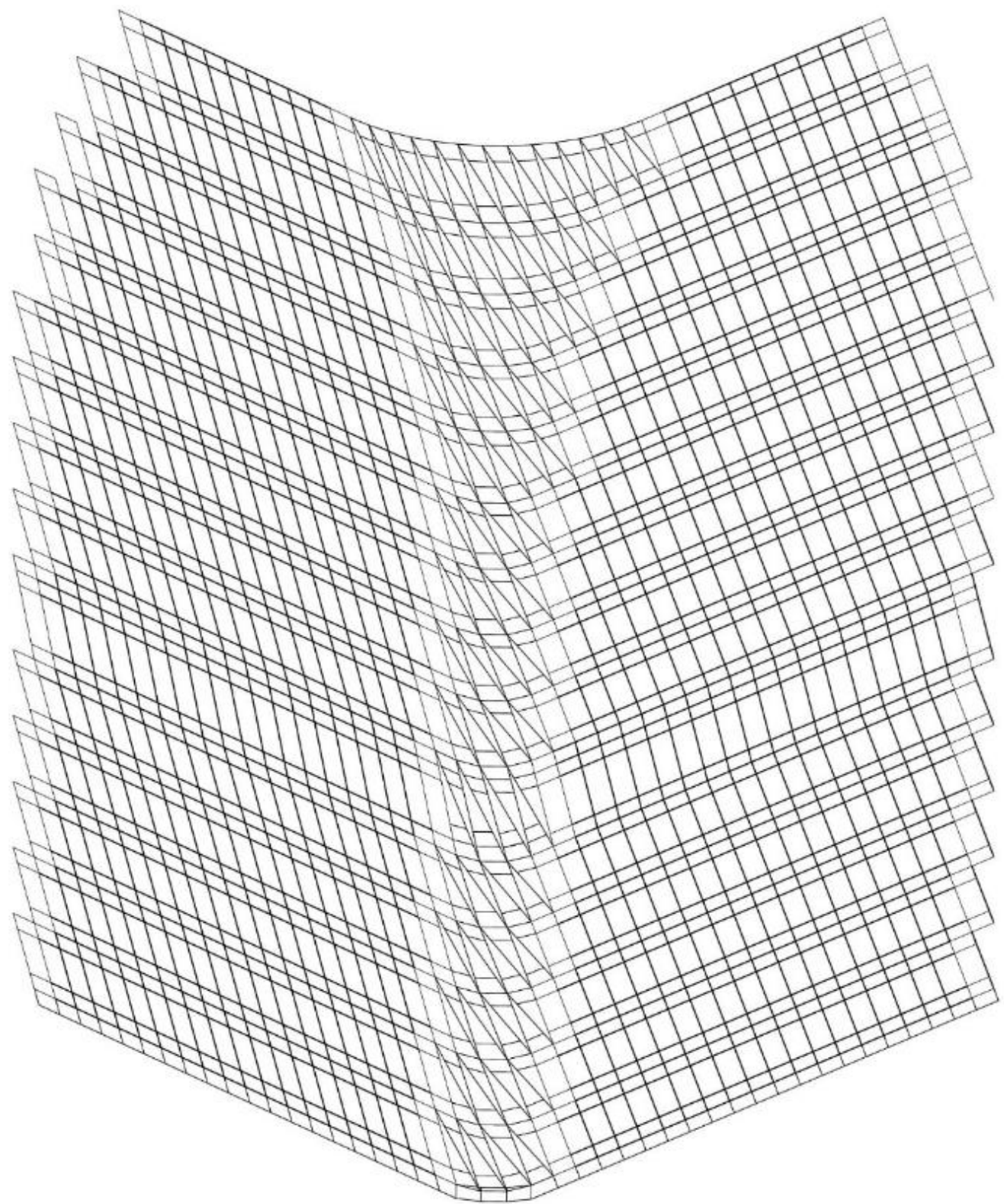


Night Flush Free Cooling





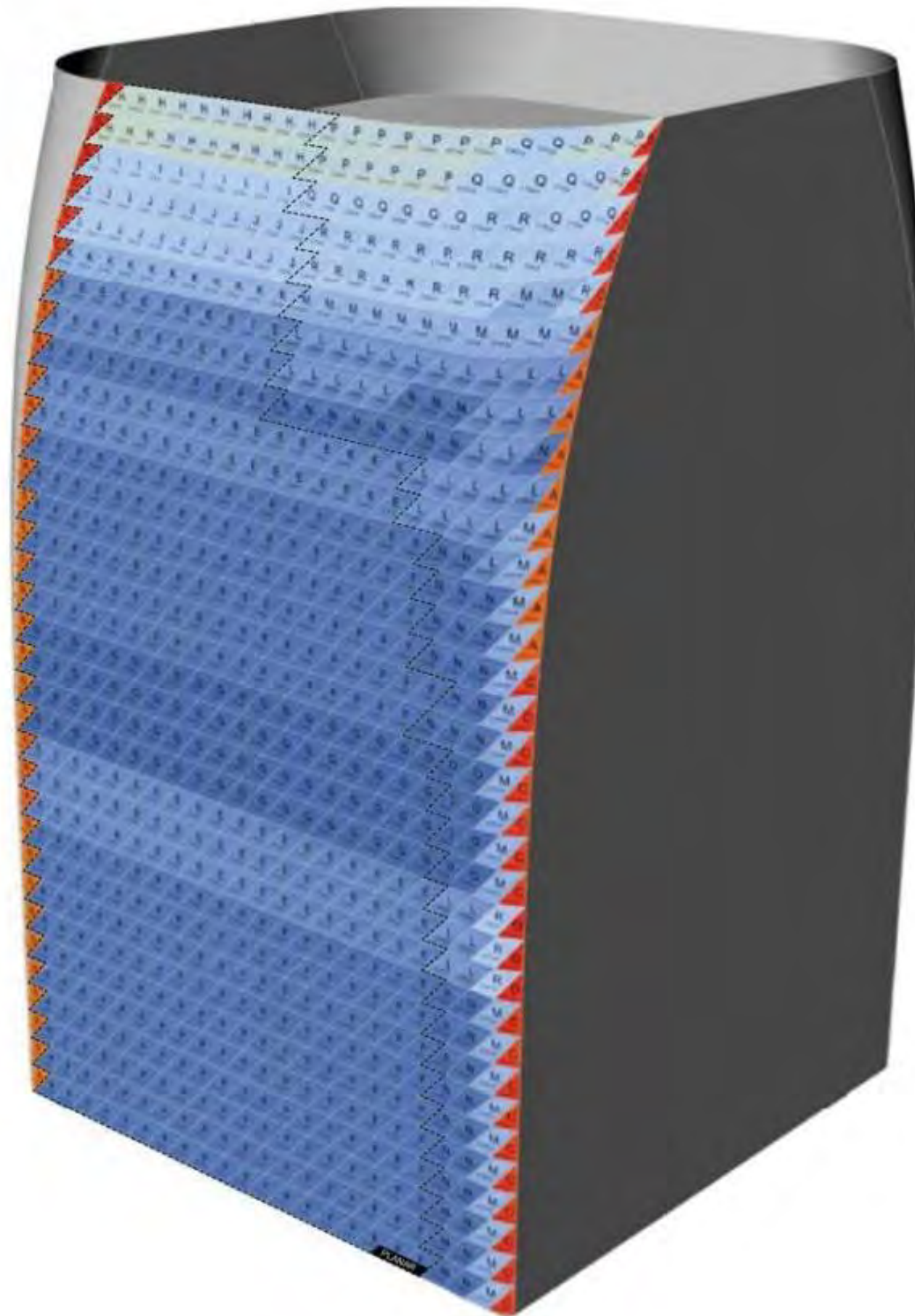




Tower Facade

PANEL OPTIMIZATION

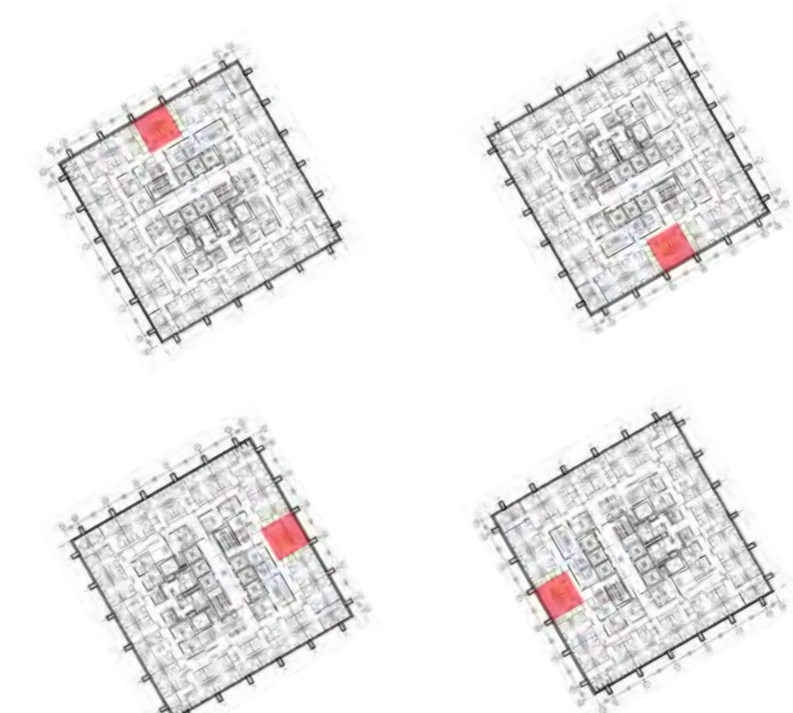
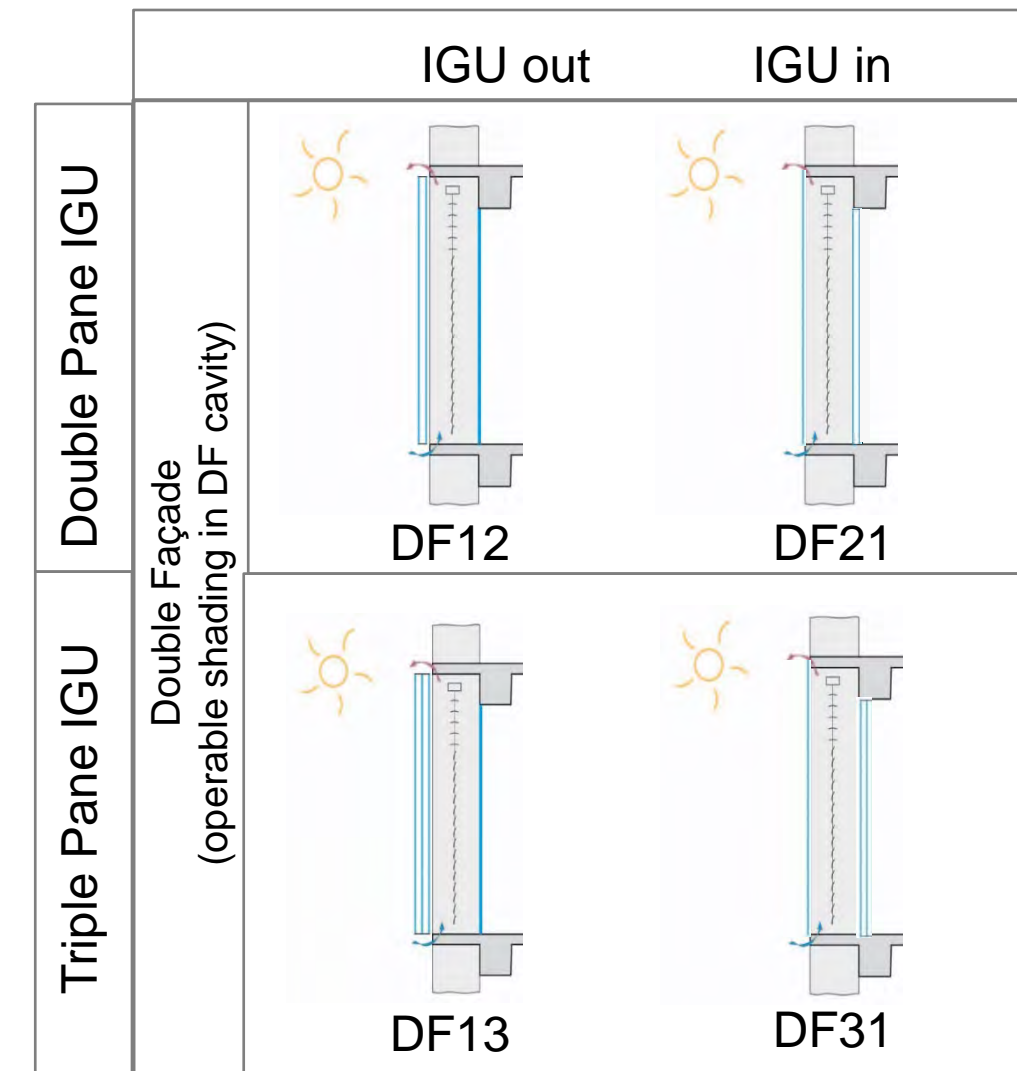
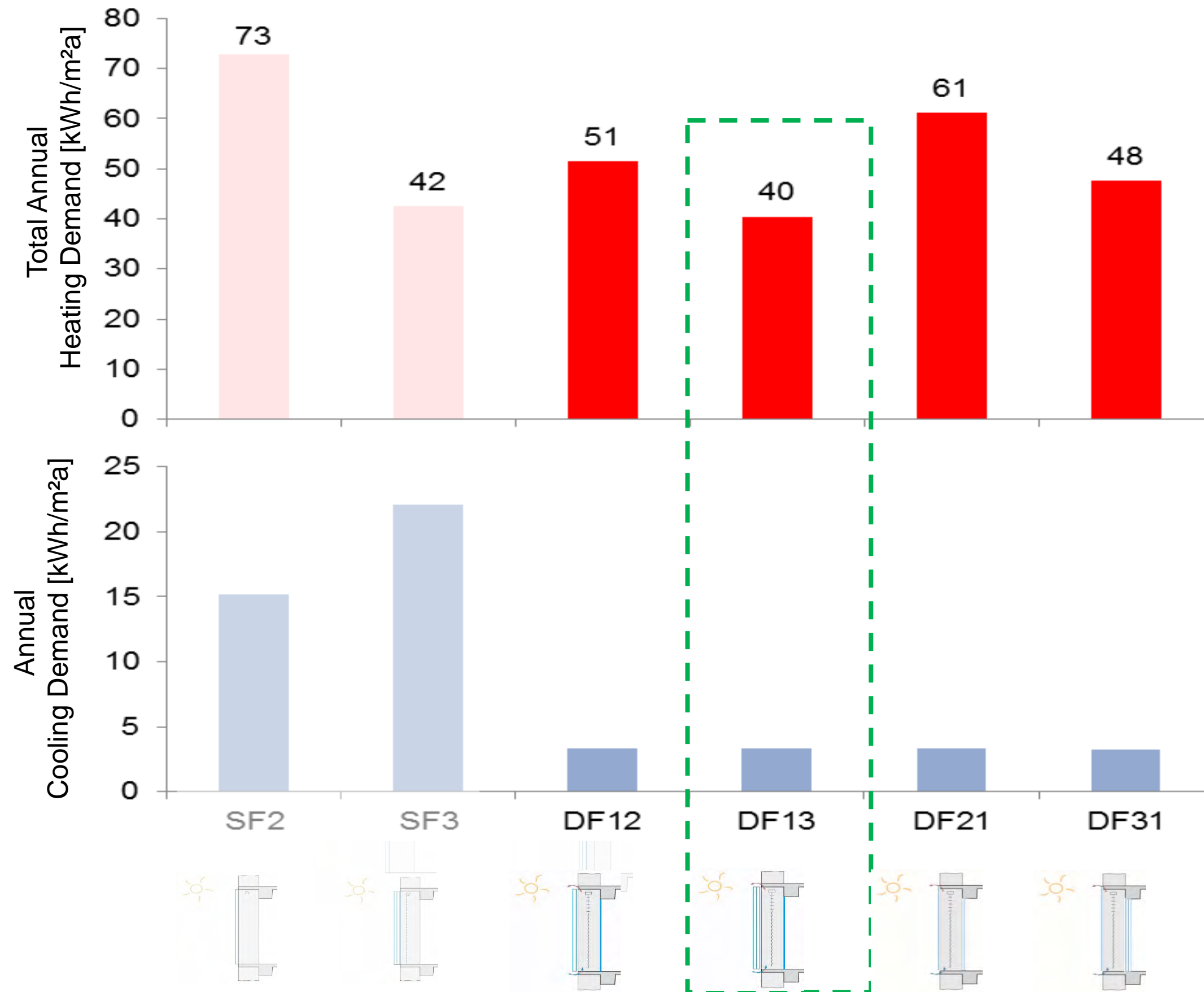
Reduction of the panels to only 18 unique sizes of glass for economics and production.



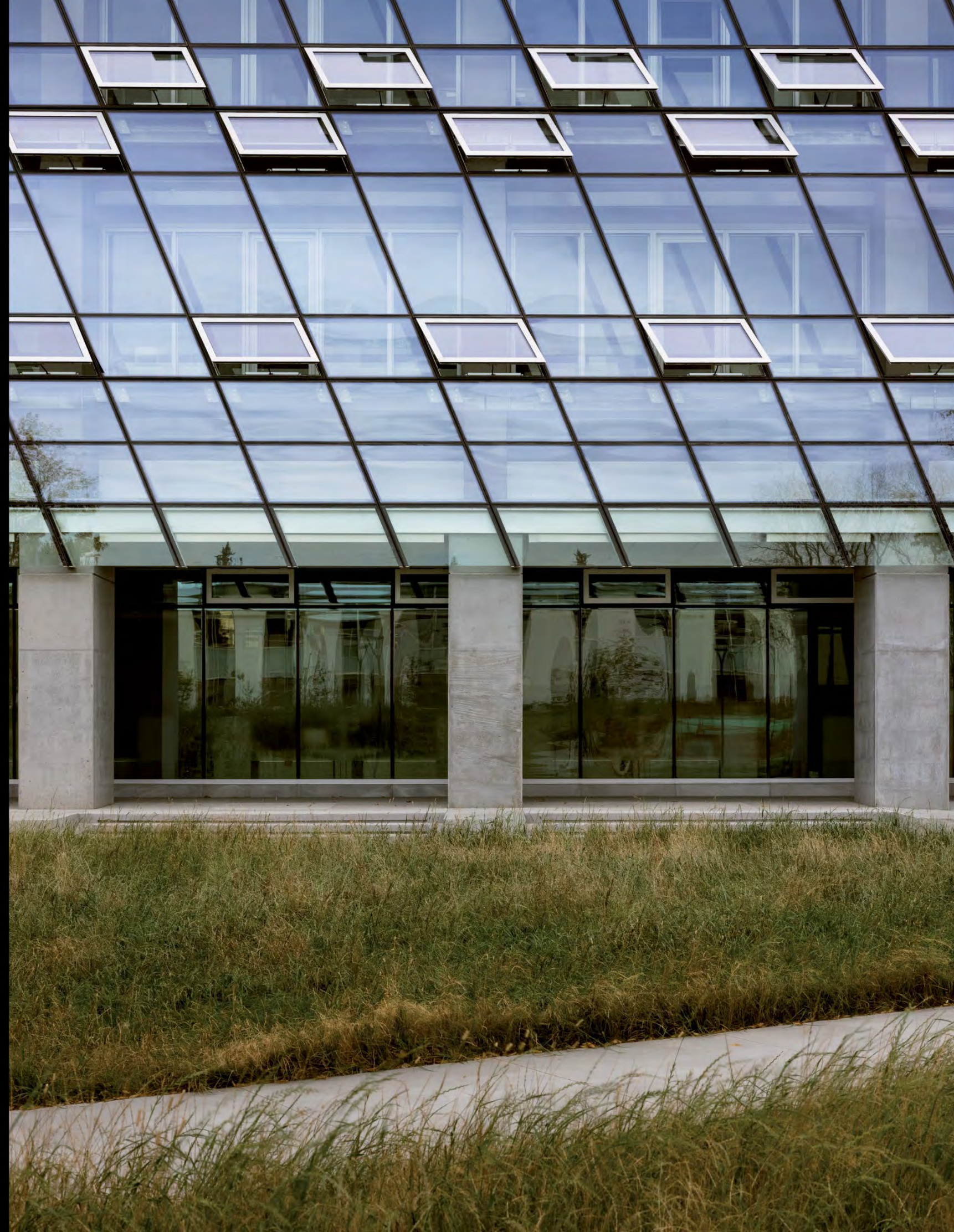
PANEL TYPE	# PANELS	
A	19	
B	18	
C	23	
D	8	TRIANGLES
E	113	
F	310	
G	76	
H	20	
I	10	
J	22	
K	11	
L	37	
M	34	
N	48	PLANAR QUADS
O	8	
P	17	
Q	17	
R	25	
18	816	

x4

Thermal Simulation Tower: Comparison of Façade Options







1968 - 1971



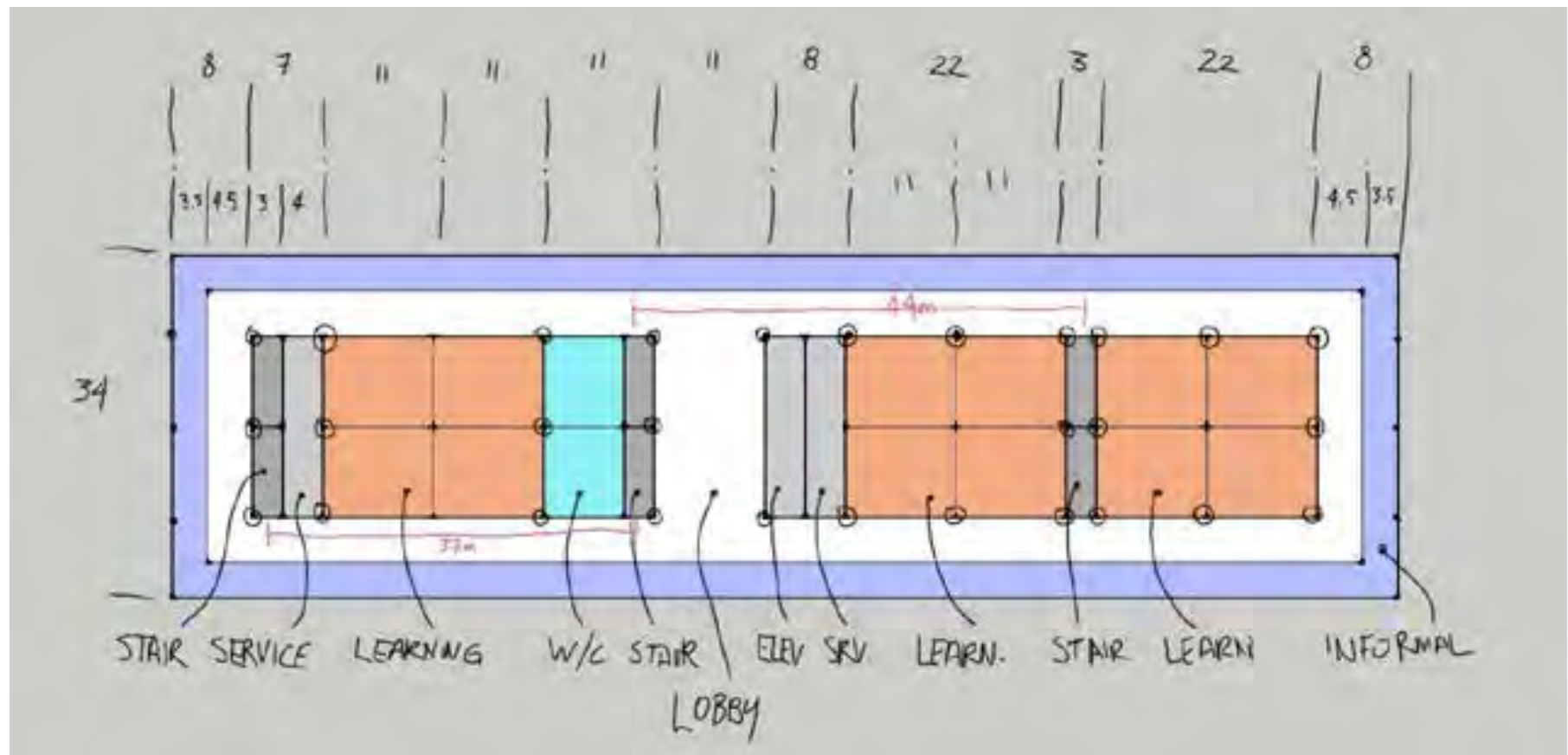
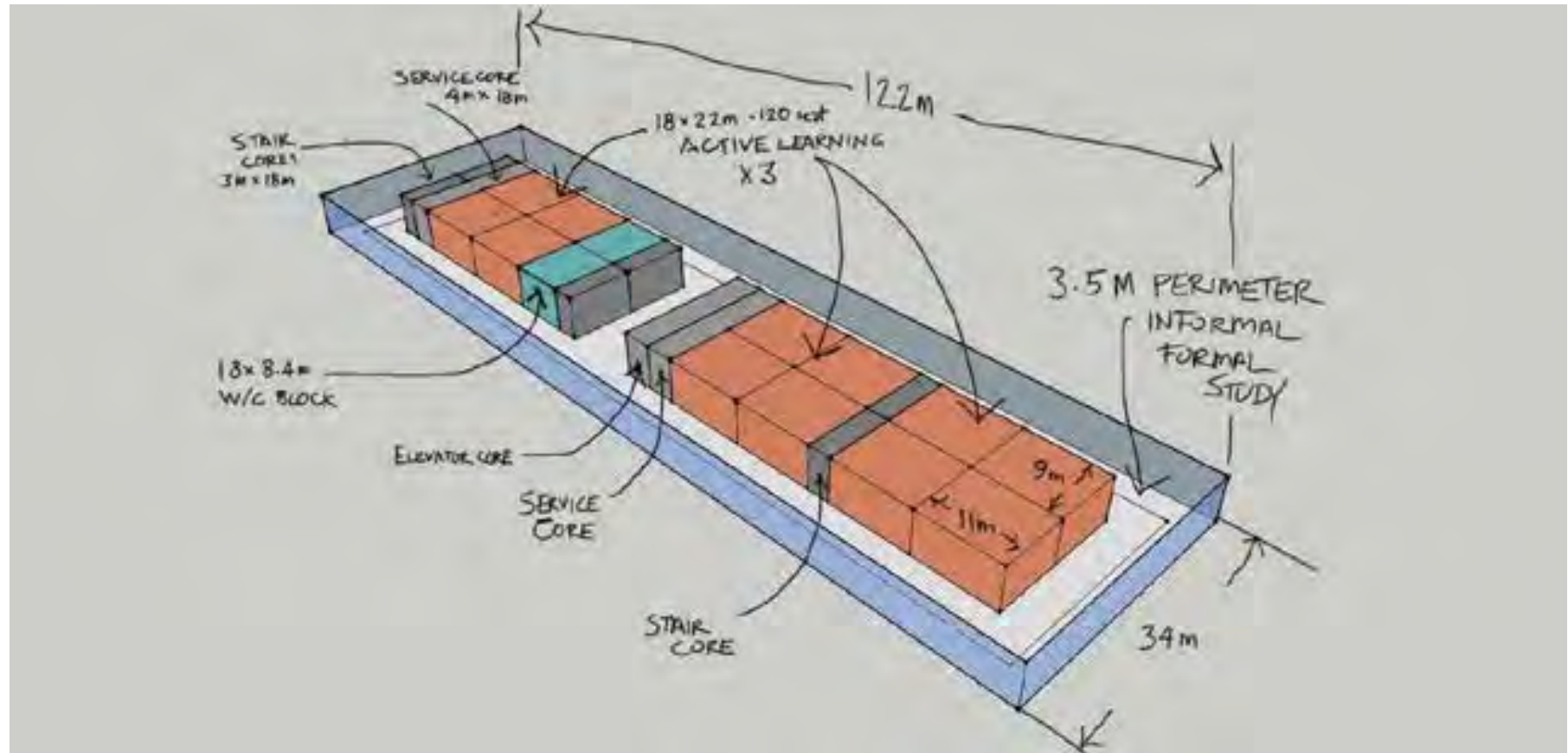
2017



2021



# OF SEATS	TRADITIONAL CLASSROOM 1.85 M ² /PERSON	INTERACTIVE CLASSROOM A 2.4 M ² /PERSON	INTERACTIVE CLASSROOM B 2.6 M ² /PERSON	INTERACTIVE CLASSROOM C 2.8 M ² /PERSON	ACTIVE LEARNING CLASSROOM 3.3 M ² /PERSON
80	12X12 11X14 10X14	14X14 12X16 11.5X17	14.5X14.5 12.5X16.5 12X17.5	17X17 15X19.5 14X21	16X16 14X19 13X20
100	14X14 12X16 11X17	15.5X15.5 13.5X18 13X19	16X16 14X18.5 13X20	17.5X17.5 15X20 14X21.5	18X18 16X20 15X22
120	15X15 13X17 12X18	17X17 15X20 14X21	18X18 15.5X20 14.5X21.5	18X18 16X21 15X22.5	20X20 18X22 17X24



Zero Carbon Balance – How do the PV's support

Tower Roof
150 kW
227 MWh/yr

Block Roof
300 kW
432 MWh/yr

Façade
100 kW
120 MWh/yr

Renewable Energy
Generation

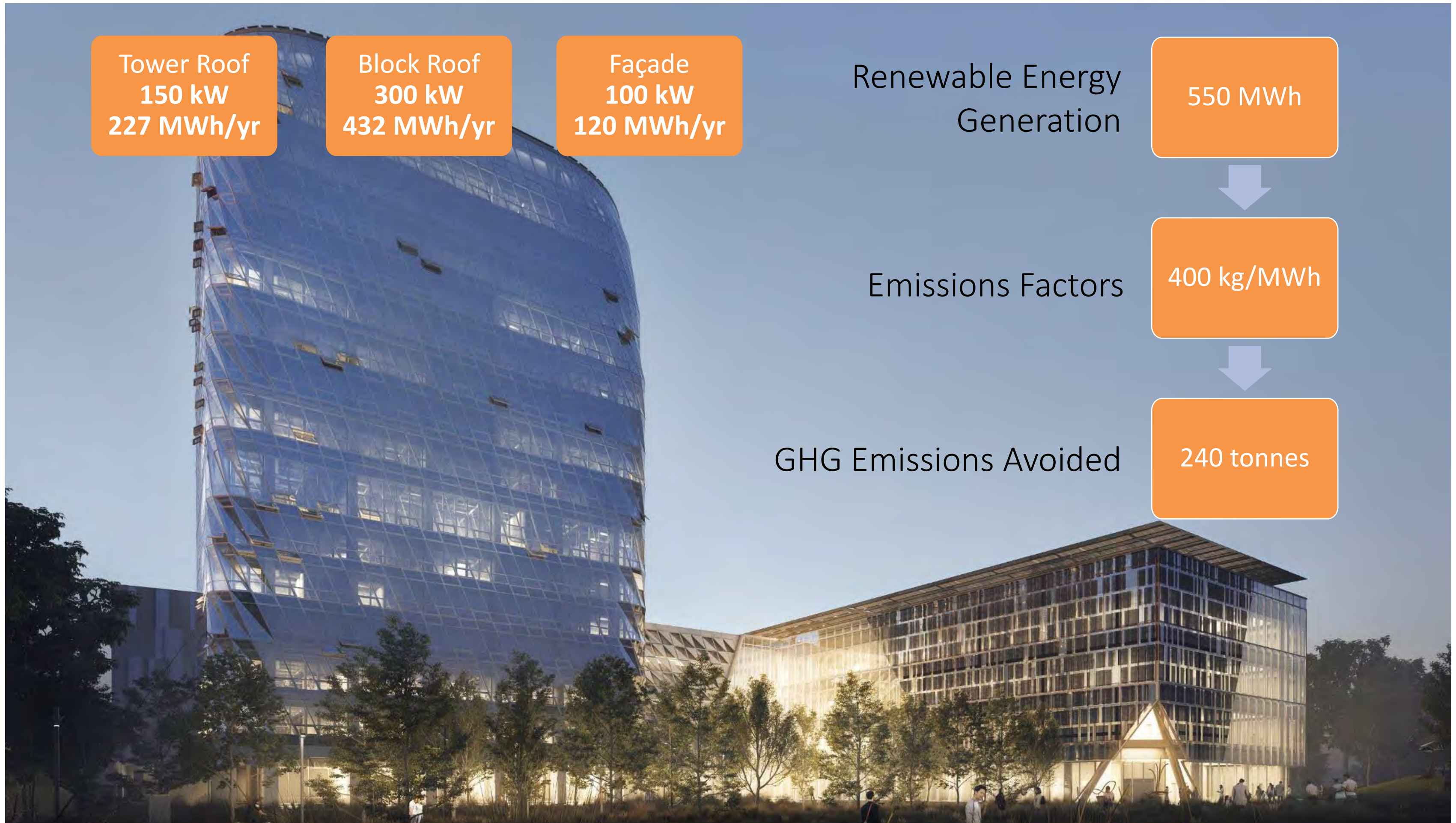
550 MWh

Emissions Factors

400 kg/MWh

GHG Emissions Avoided

240 tonnes



Zero Carbon Targets –CAGBC Pilot program – v 1.0

Energy Use Intensity (EUI)

Original Building
+500 BTU/m²/year

Design Target
75 BTU/m²/year

Thermal Energy Demand Intensity (TEDI) - PREREQUISITE

V1.0 Target:
<36 kWh/m²/year

Design Target
33 kWh/m²/year

Onsite Renewable Energy Generation - PREREQUISITE

V1.0 Target:
>5% of energy

Design Target
>25% of energy

Investment Considerations

- ↑ • Additional investment in envelope and PV
- ↓ • Capital cost savings on mechanical systems + reduced mechanical footprint
- ↓ • Capital cost savings on reuse of existing structure and expedited schedule for retrofit over demolition and build new
- ↓ • Projected 85% reduction in utility costs compared to original complex



...plus benefits to health, wellness, productivity,
staff attraction and retention

...plus enhanced resiliency to climate change
impacts











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THANK YOU