A Net Zero Recreation Facility: What is it? Is it Possible? Is it Afforable

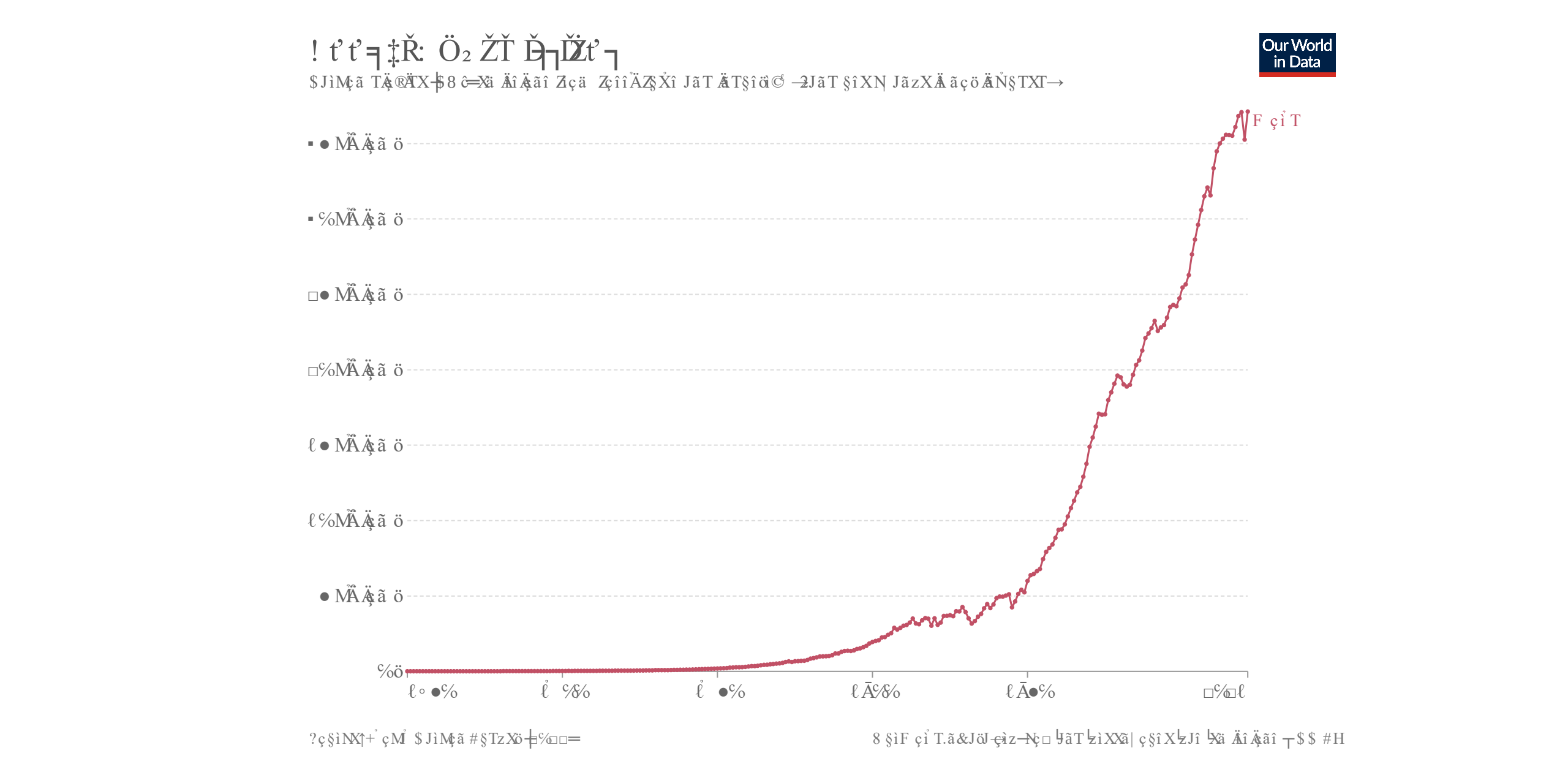
presenters

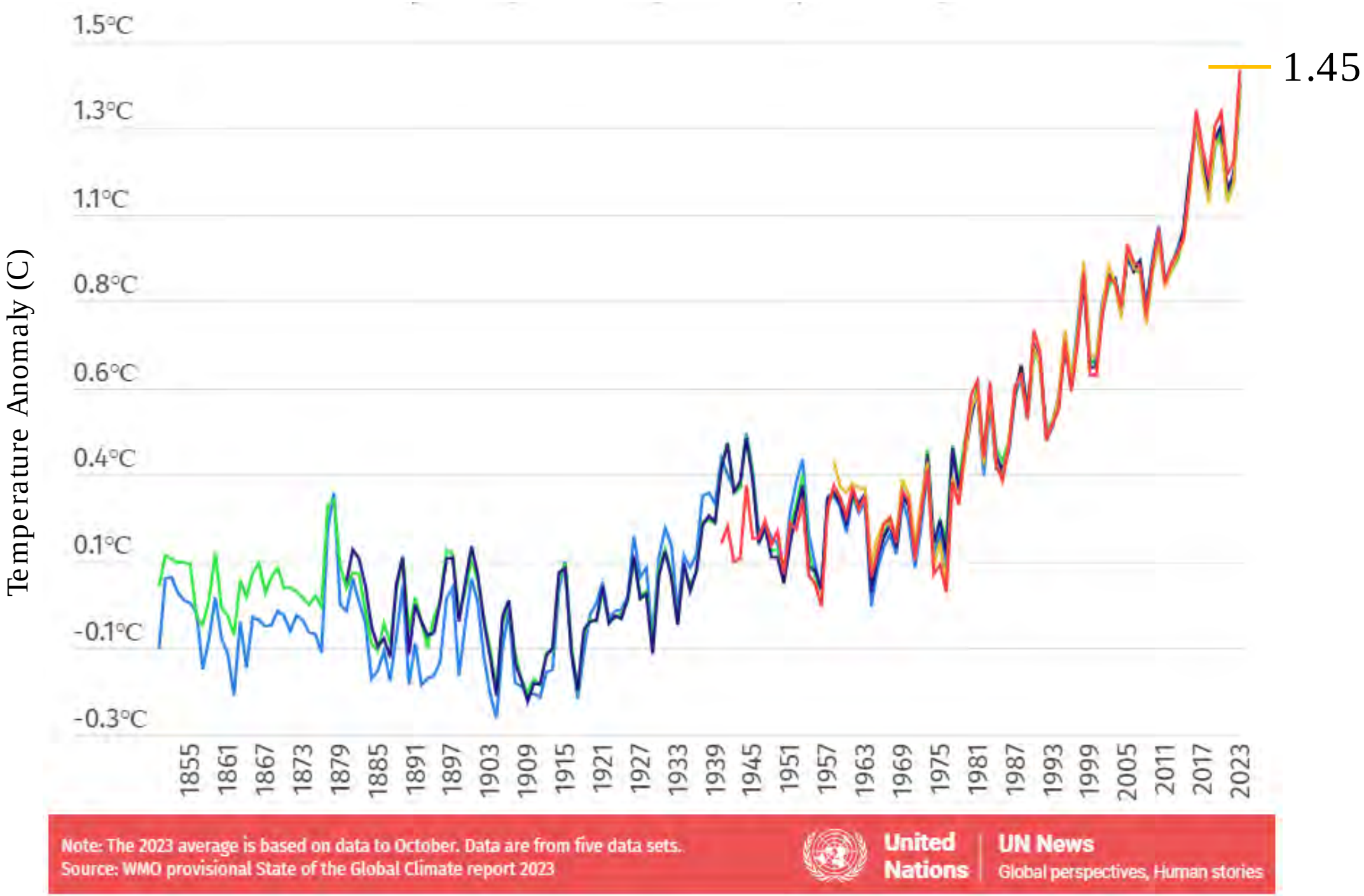
Peter Duckworth-Pilkington
sustainable design lead HDR

Robert Cesnik, ARCHITECT AIBC, MRAIC, LEED AP BD+C
Civic Principal HDR

Benjamin Ellah
Sr. Mech. Technologist Stantec

net zero…why should we care


Our World in Data
F çỉ T
▪ ● MẪÄçã ö
▪ %MẪÄçã ö
□● MẪÄçã ö
□%MẪÄçã ö
ℓ● MẪÄçã ö
ℓ%MẪÄçã ö
● MẪÄçã ö
%ö
ℓ◦ ●%
ℓ %&%
ℓ ●%
ℓĀ%&%
ℓĀ●%
□%□ℓ


Temperature Anomaly (C)
1.5°C
1.3°C
1.1°C
0.8°C
0.6°C
0.4°C
0.1°C
-0.1°C
-0.3°C
1.45
1855
1861
1867
1873
1879
1885
1891
1897
1903
1909
1915
1921
1927
1933
1939
1945
1951
1957
1963
1969
1975
1981
1987
1993
1999
2005
2011
2017
2023
Note: The 2023 average is based on data to October. Data are from five data sets.
Source: WMO provisional State of the Global Climate report 2023
United Nations
UN News
Global perspectives, Human stories


1.1°C
Adobe Stock

GLOBAL CARBON BUDGET 2011-2020

Global Carbon Project

TOTAL EMISSIONS

38.8 (±2.9)

ATMOSPHERIC CO_2 GROWTH RATE

18.7 (±0.07)

TOTAL SINKS

21.7 (±2.7)

34.8 (±1.8)

4.0 (±2.6)

11.4 (±2.2)

10.3 (± 1.5)

Fossil fuels and industry

Land Use Change

Land sink

Ocean sink

EMISSIONS AND SINKS

In billion-tons CO_2 per year (Pg CO_2 / yr), average 2011-2020

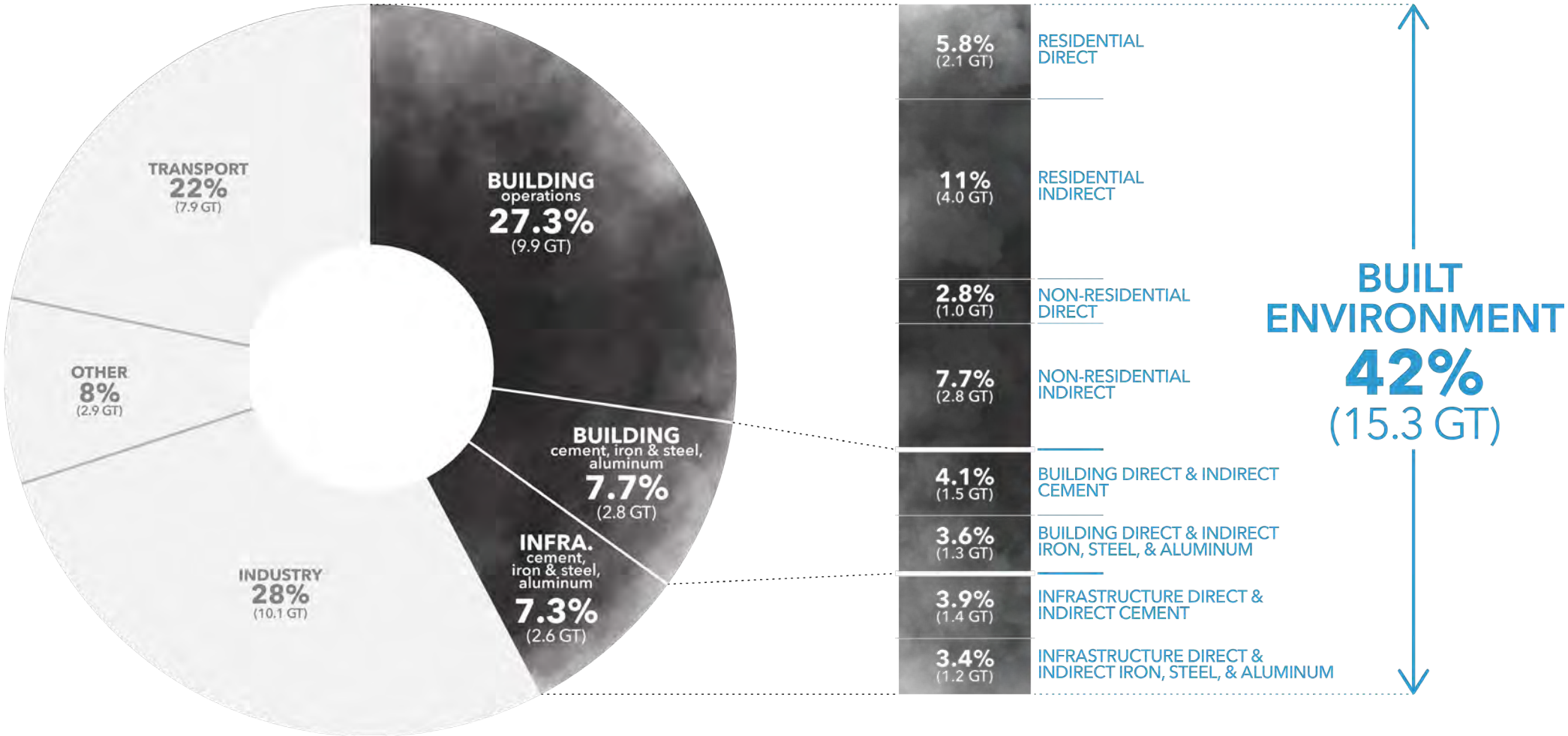
Anthropogenic emissions

Sinks of anthropogenic emissions

GLOBAL CARBON PROJECT

FONDATION BNP PARIBAS

TOTAL ANNUAL GLOBAL CO_2 EMISSIONS
Direct & Indirect Energy & Process Emissions (36.3 GT)



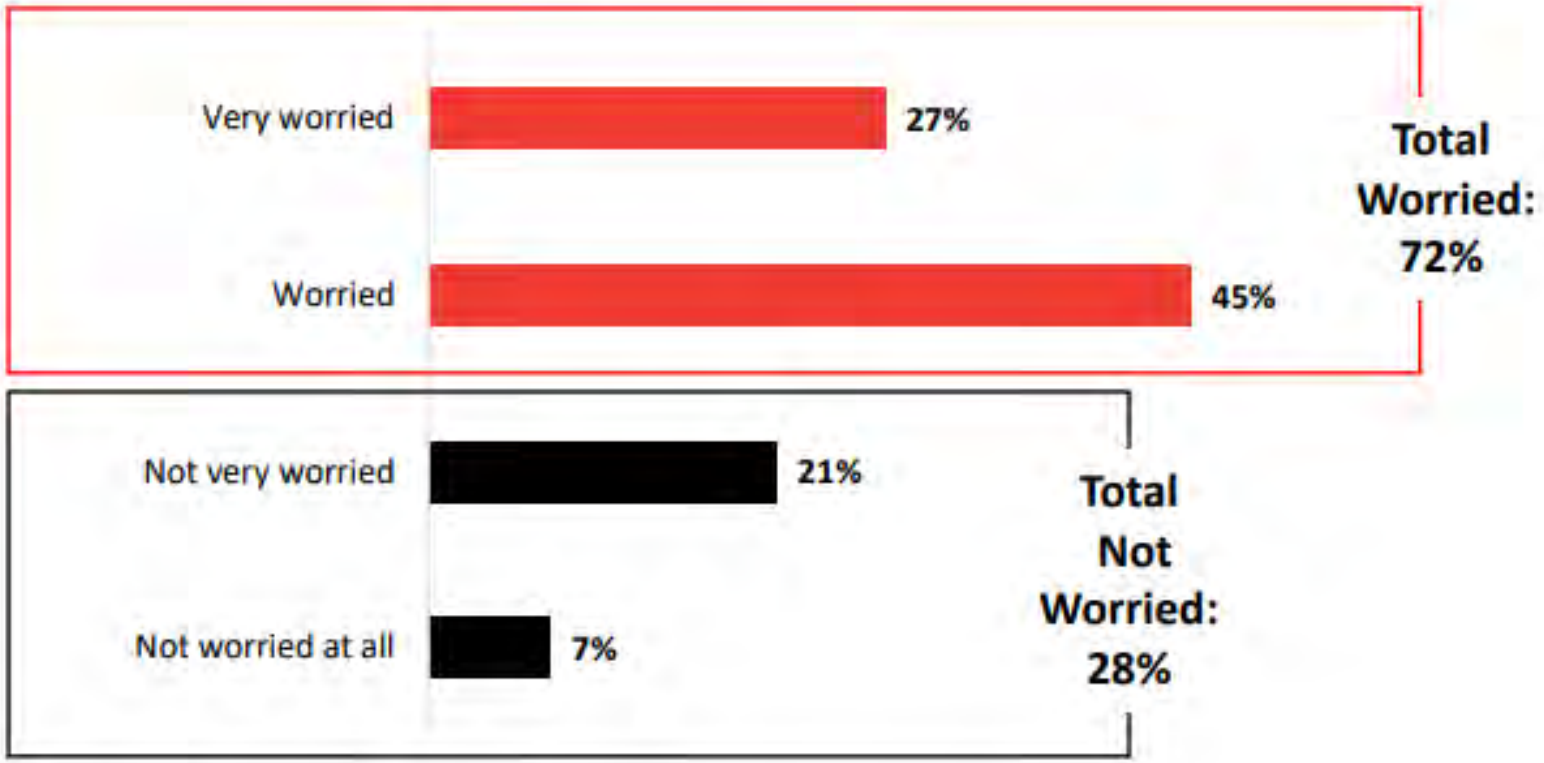
Analysis & Aggregation by Architecture 2030 using data sources from IEA & Statista.

also, people care…

Worries About Climate Change

Q2. To what extent are you worried about climate change?

Base: All respondents (n=1,526)



costsÑ

The Physical Costs of Climate Change to Canada

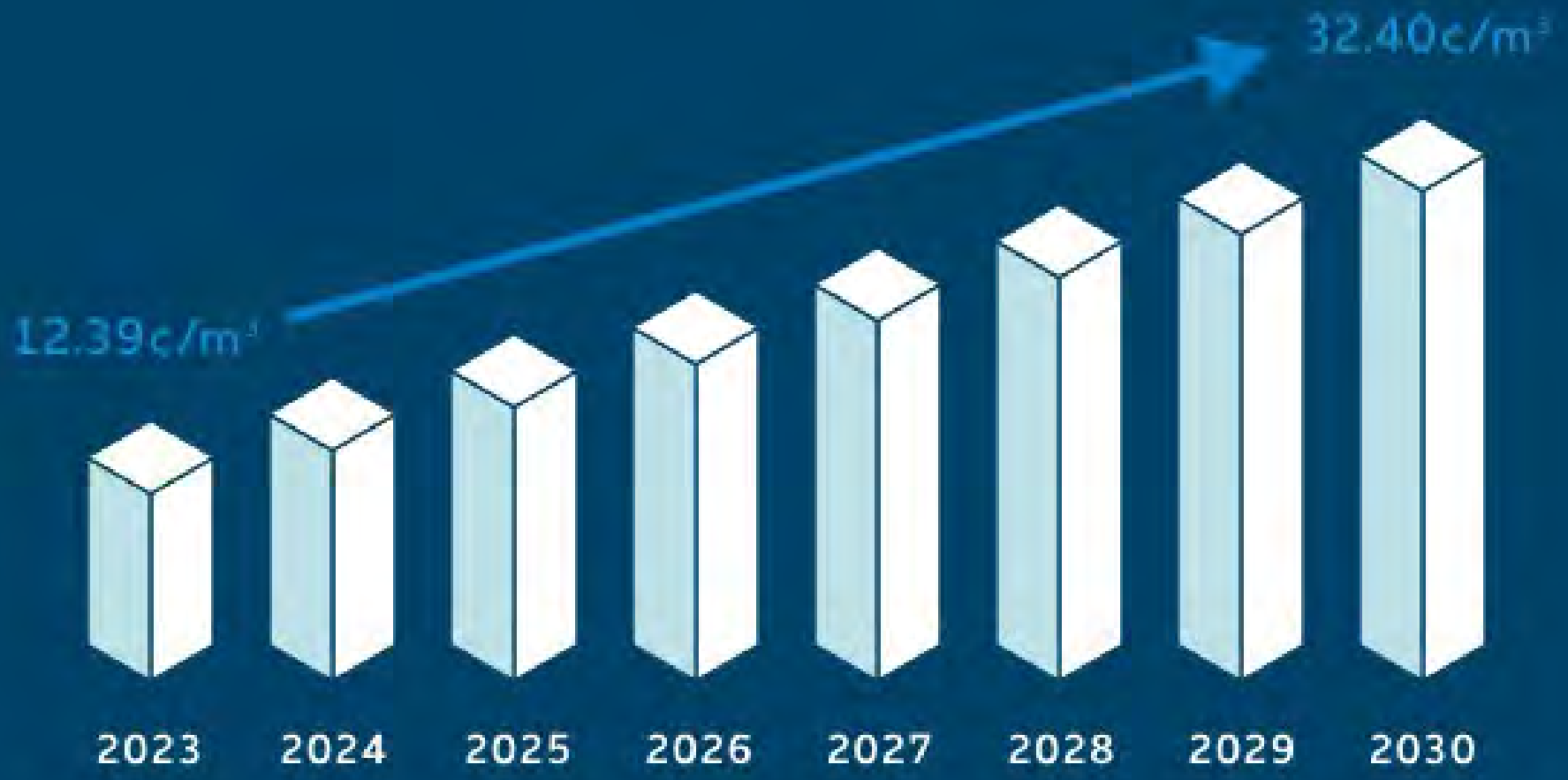
(Cumulative total by 2100 in $billions)

Institute for Sustainable Finance

2°C	$2,772.78
3°C	$3,635.65
4°C	$4,794.57
5°C	$5,520.06

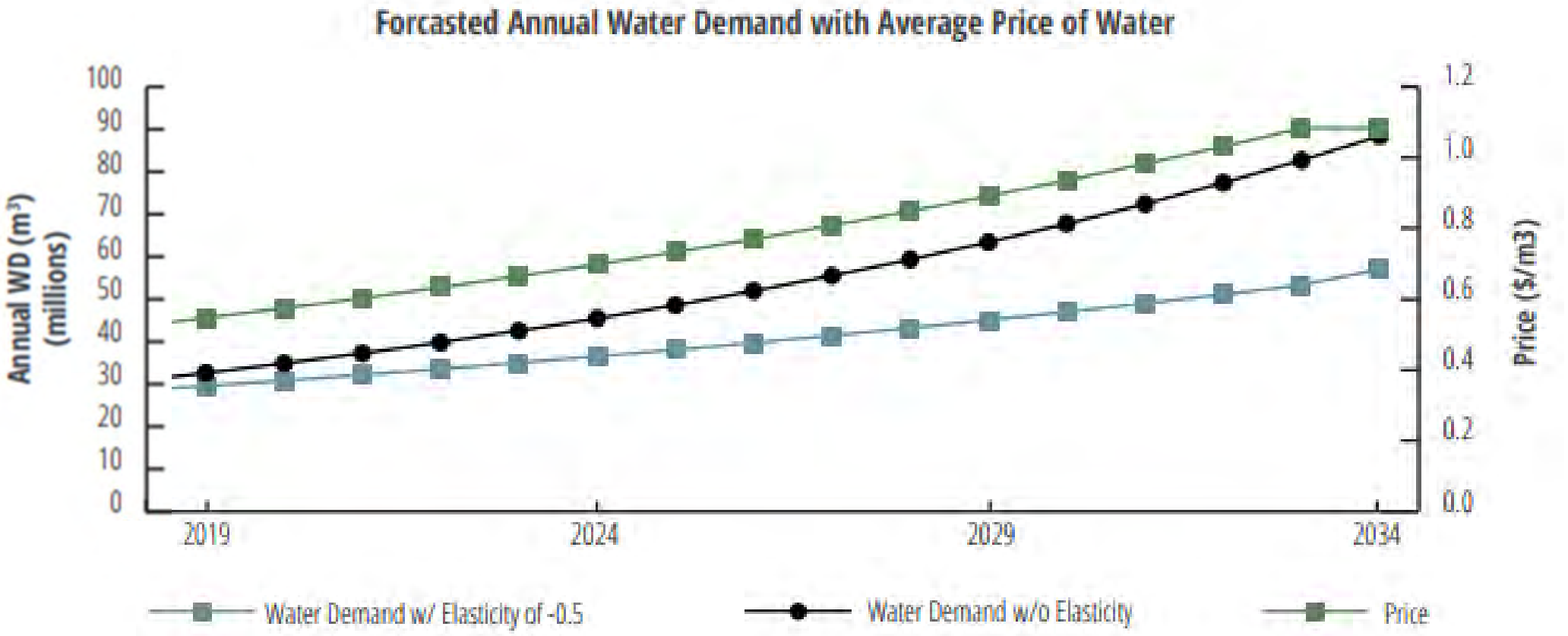
Source: Institute for Sustainable Finance, The Physical Cost of Climate Change: A Canadian Perspective, 2022

energy costs…



natural gas prices are expected to double by 2030 …

water costs...



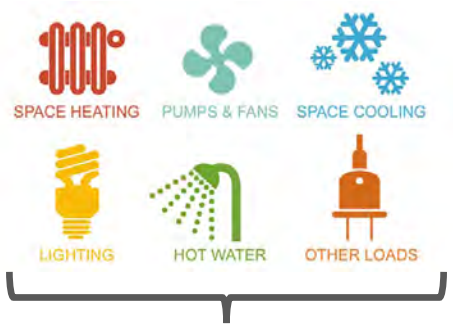
EXTENDING MUNICIPAL WATER DEMAND FORECASTING CAPACITIES STEVEN RENZETTI AND DIANE DUPONT, BROCK UNIVERSITY Published September 2015

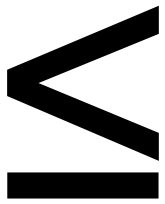
...catalysis for local development

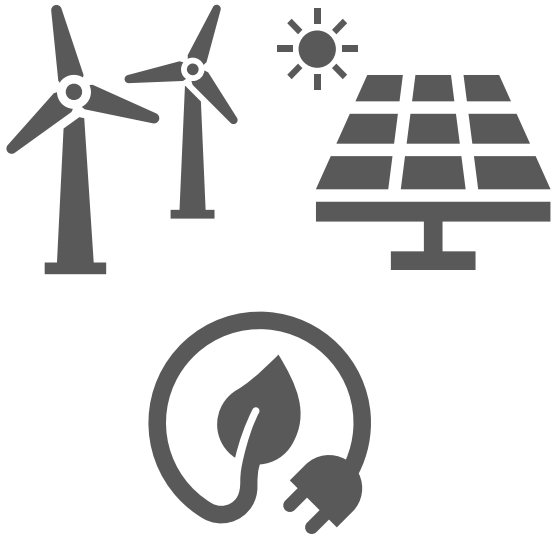
...community resilience

net zero what is it

Net Zero Energy Building: a highly energy efficient building that produces onsite, or procures, renewable energy equal to its energy use.



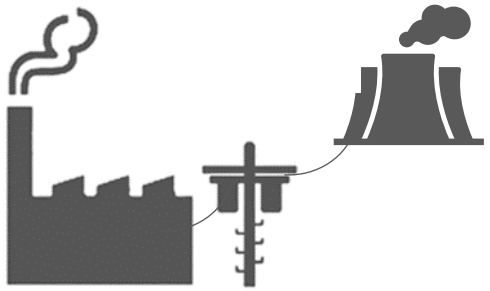




Building Energy Use is less than or equal to Renewable Generation

Solar/ Wind/ Biomass/ Geothermal

Zero Carbon Building (ZCB) or Net Zero Carbon Building: a highly energy efficient building that eliminates operational and embodied GHG emissions, bringing them as close to zero as possible and reabsorbing, or offsetting, the equivalent of any remaining emissions.



natural gas
refrigerant gases
grid emissions
embodied carbon

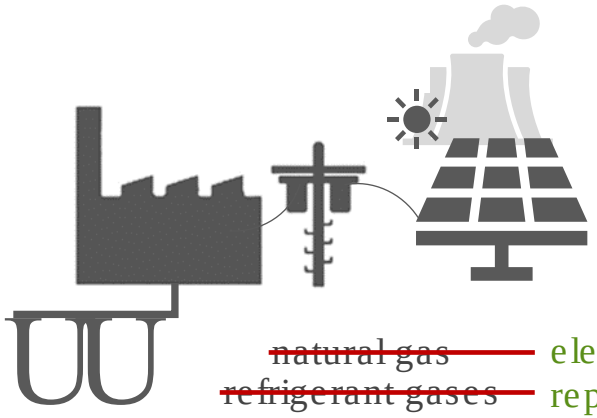
Building Emissions

is less than or equal to

offset high with low carbon energy
planting
biomaterials
purchased offsets

Carbon Offset/ Sequestration

Net Zero Carbon Ready Building: a building that in the short-term emits net carbon, however, includes a costed credible transition plan to eliminates operational and embodied GHG emissions over time.



~~natural gas~~ electrify
~~refrigerant gases~~ replace
~~grid emissions~~ disconnect
embodied carbon

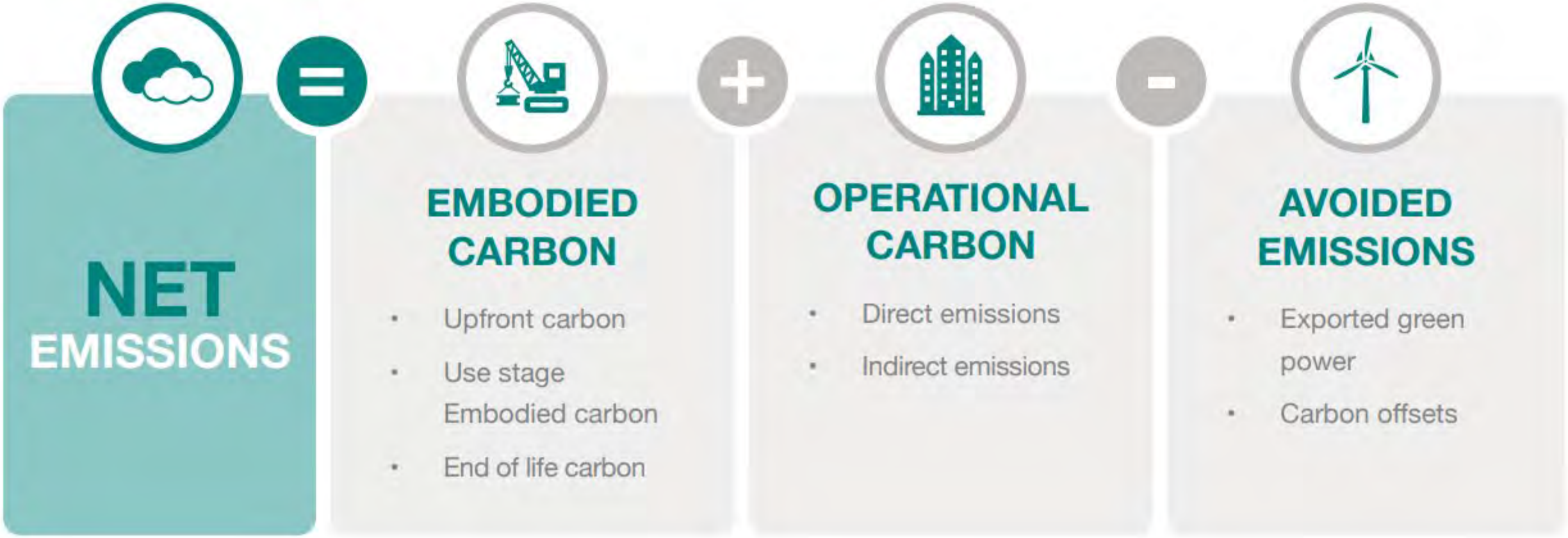
Building Emissions

is greater than but there is a **plan to be less** than or equal to

offset high with low carbon energy
planting
biomaterials
purchased offsets

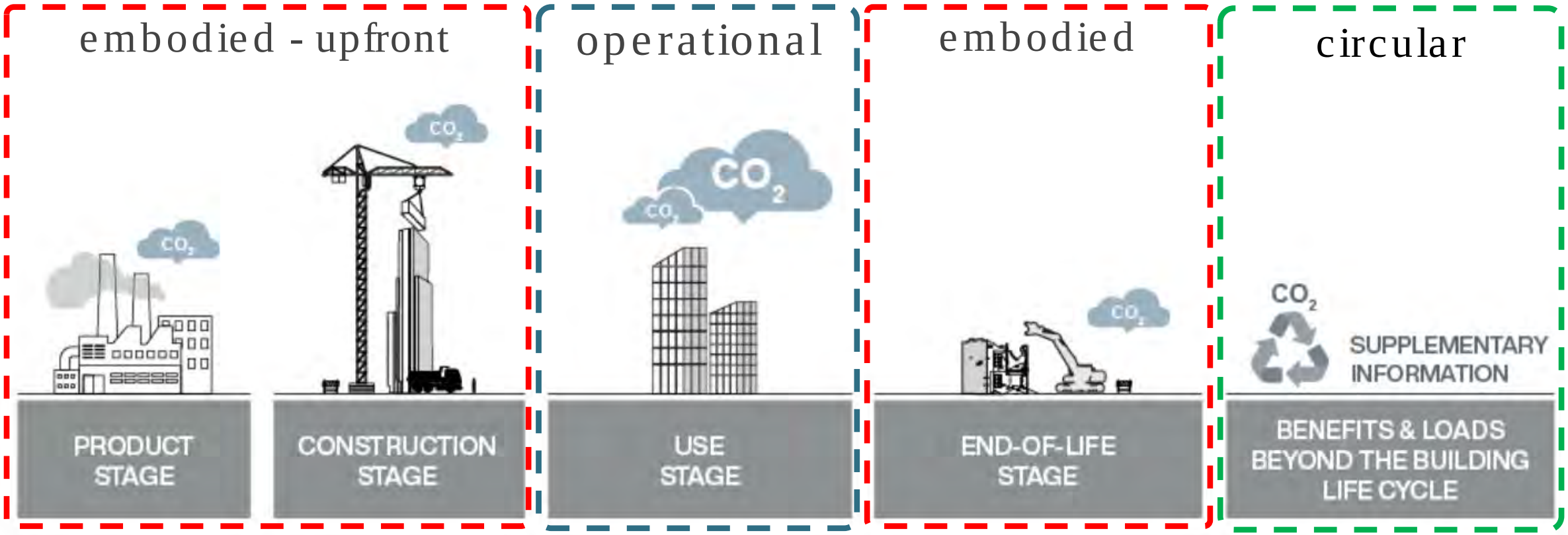
Carbon Offset/ Sequestration

Zero Carbon Balance: when the net emissions associated with embodied carbon, operational carbon and avoided emissions are zero, or less, over the life of a building (typ. 40 to 60 years)



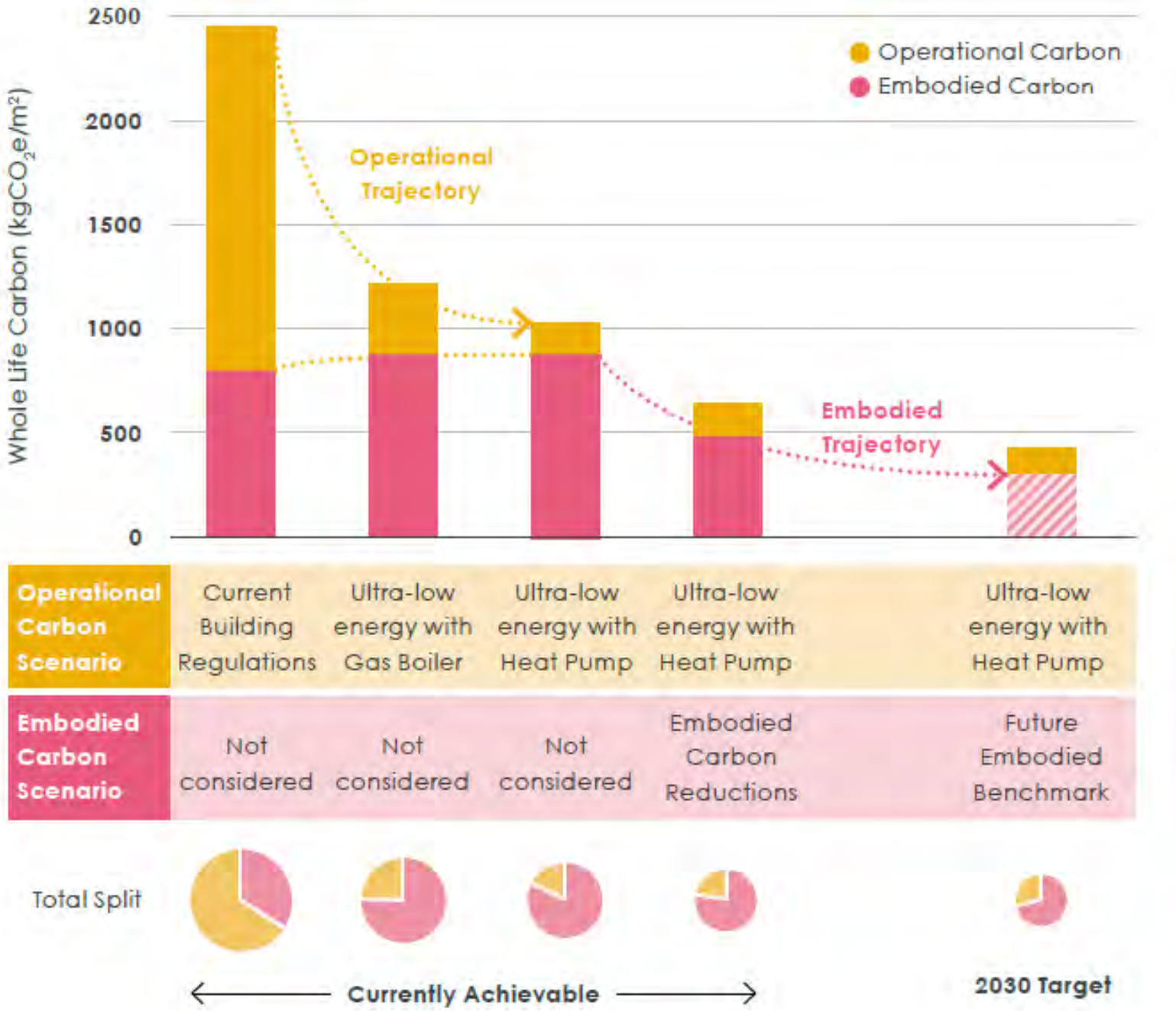
CaGBC ZCB Standard v3

Carbon Emissions Types



Operational Carbon: refers to the emissions associated with building energy use, as well as refrigerant leakages during normal building operations.

Embodied Carbon: GHG emissions associated with the extraction, processing, transportation, construction, operation and eventual disposal of a construction material and construction processes throughout the whole lifecycle of a building



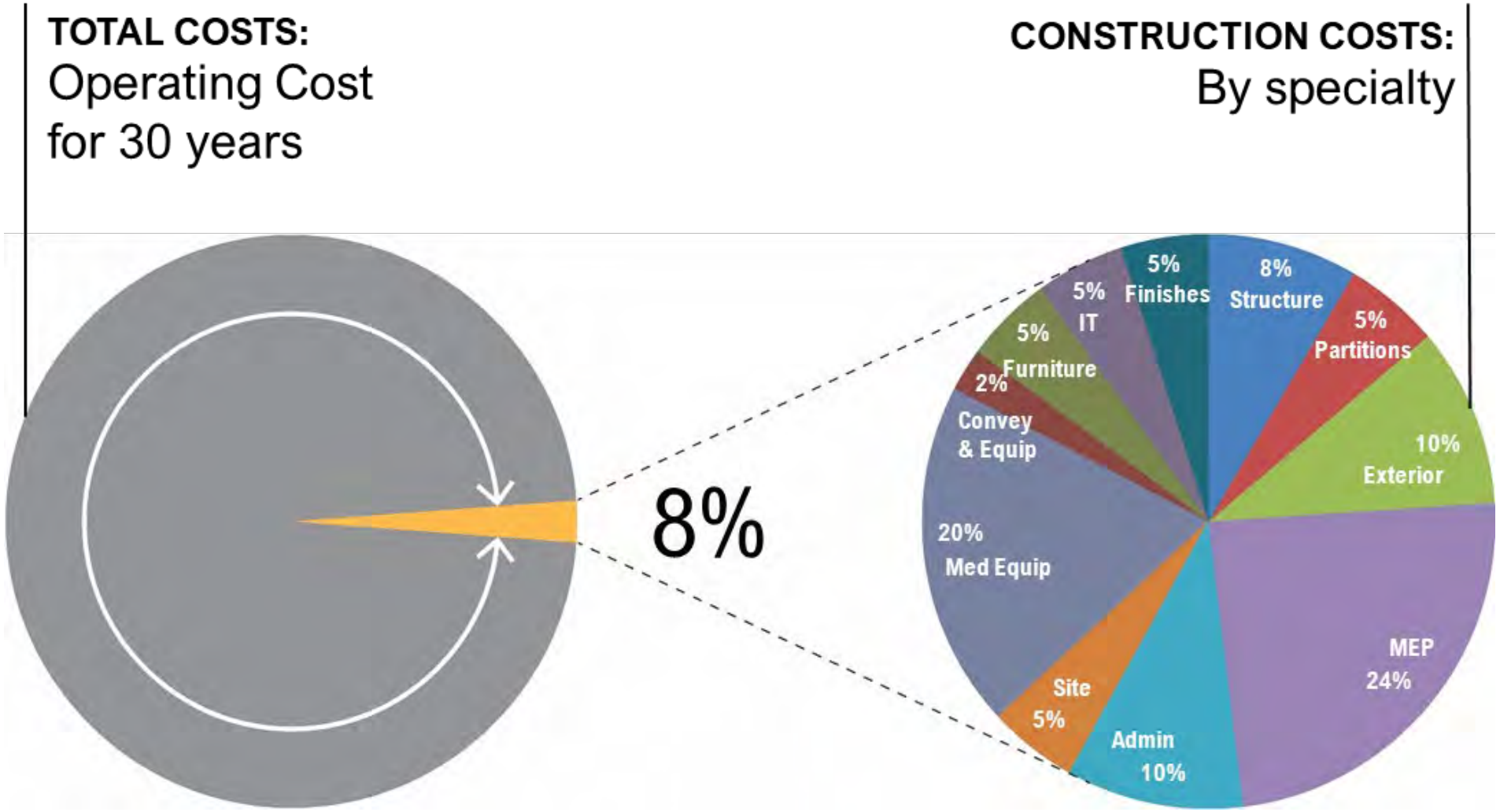
Credit: London Energy Transformation Initiative (LETI)

how can we get to net zero?

1. Play the Long Game

- Budget for the Cost of Ownership (Capital and Operational)
- Complete a Life Cycle Cost Assessment
- Invest in energy/ operational carbon reductions
- Set Capital and Operational budgets accordingly

The Cost of Ownership…



2. Do the Homework

- Know what is working and not working in your facilities
- Complete Energy Audits and set benchmarks
- Share with others to develop best practices
- Provide the data to consultants

3. Set the Standard

- Provide clear and measurable goals for consultants for
  - Energy (eg 25 % below NECB 2020
  - Operational and Embodied Carbon (eg Net Zero -30%)
  - Climate resilience
  - ROI/ NPV
  - Commissioning/ M+V
  - After completion
- Required IDP, LCCA, and LCA
- Consider 3rd Party Verification

4. Be Part of the Solution

- Be prepared to be involved and make facility staff available
- Participate in the LCCA and business case
- Participate in the Integrated Design Process

5. Focus on Low Cost/ Low Risk

1. Building Orientation and Location
2. Building Less
3. Start with Passive (hp envelope)
4. Efficiency (controls/ vfd/ energy recovery)
5. Electrification (heat pumps)
6. Renewables (PV, biomass, geoexchange/ geothermal)

6. Measure to Improve

- Collect the data for Commissioning and M+V teams
- Use calibrated energy models
- Celebrate the successes learn from the challanges

Canfor Leisure Pool Prince George

2023

85% GHG reduction

- Orientation
- HP Envelope
- Controls
- Heat Recovery
- Mass Timber
- Biomass DE

Steveston CC Richmond

Anticipated 2025

Net Zero Ready

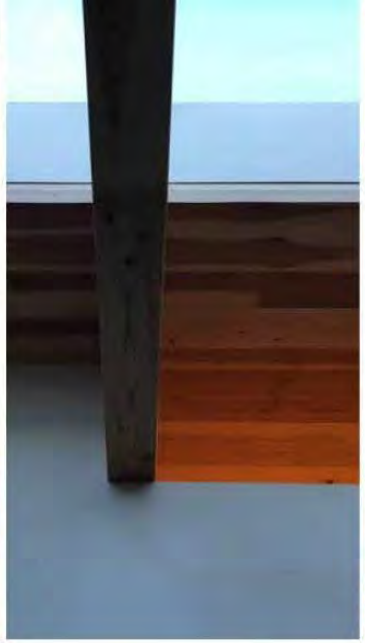
- Orientation
- HP Envelope
- Controls
- Heat Recovery
- Mass Timber
- Air Source HP
- Solar Ready Roof

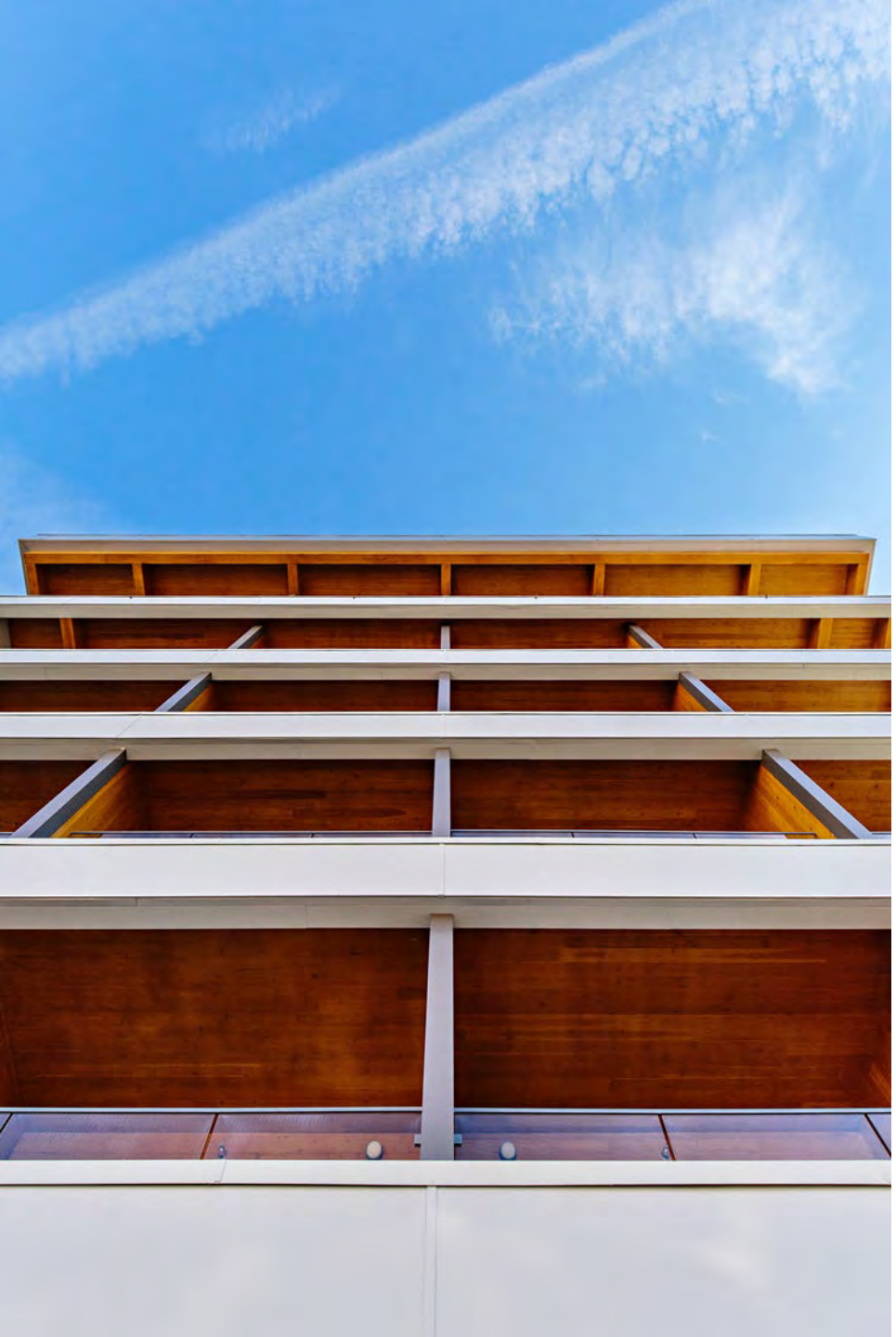
A Net Zero Recreation Facility

Why not Mass Timber?

Robert Cesnik, ARCHITECT AIBC, MRAIC, LEED AP BD+C
Civic Principal HDR

2003- 2010	BEVANDA ARCHITECTURE INC
2010- 2015	CEI ARCHITECTURE PLANNING INTERIORS
2015 - CURRENT	**HDR ARCHITECTURE ASSOCIATES, INC.**





Cost Neutral: In IPD delivery and public tender, we have achieved cost neutrality through holistic consideration of material, finishes and schedule.

Speed of Construction: Flexibility. Easily modified on site and produces little waste. Prefabricated panels manufactured off site.

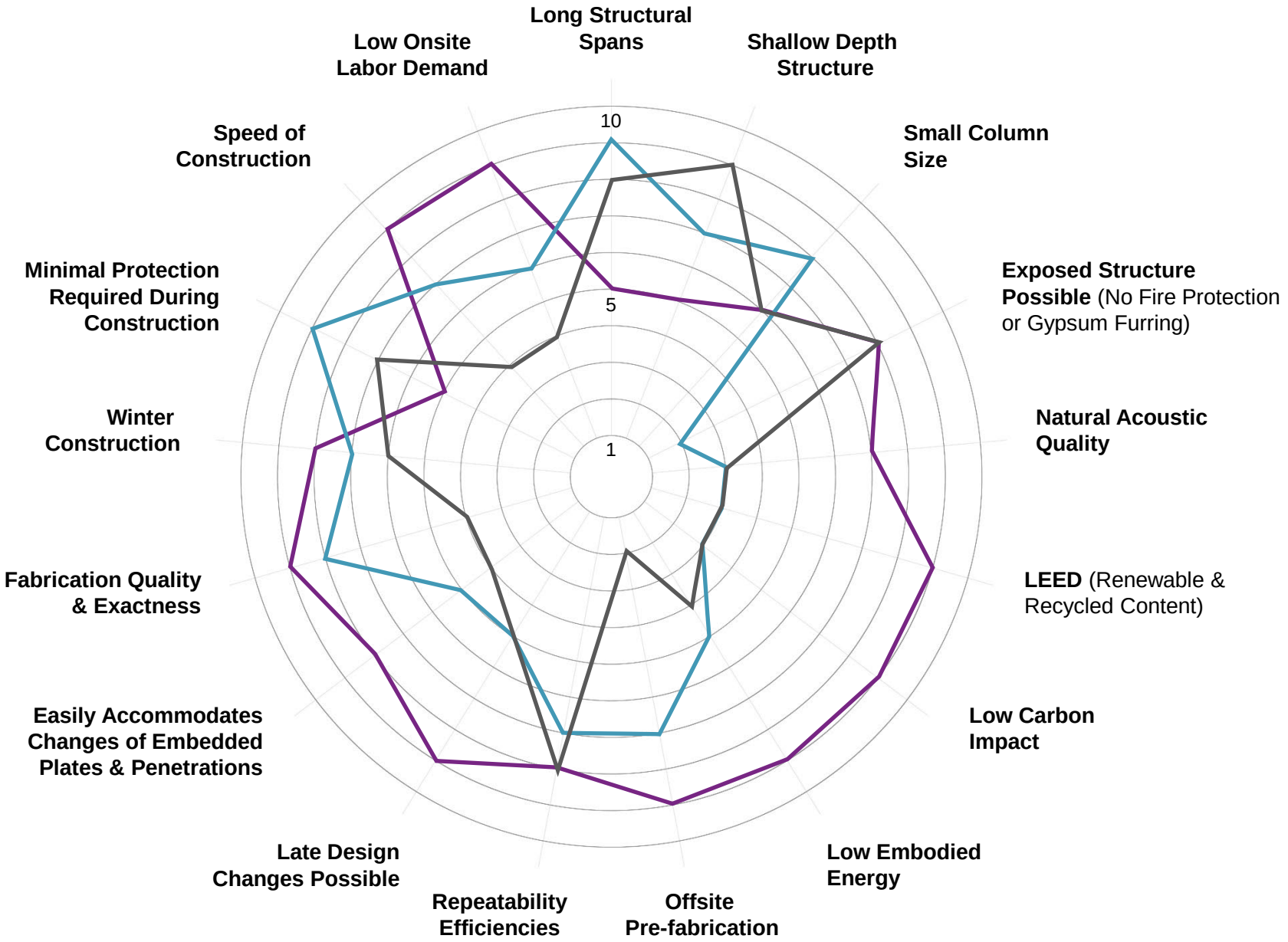
Environmental Impact: 100 percent renewable carbon-sequestering resource.

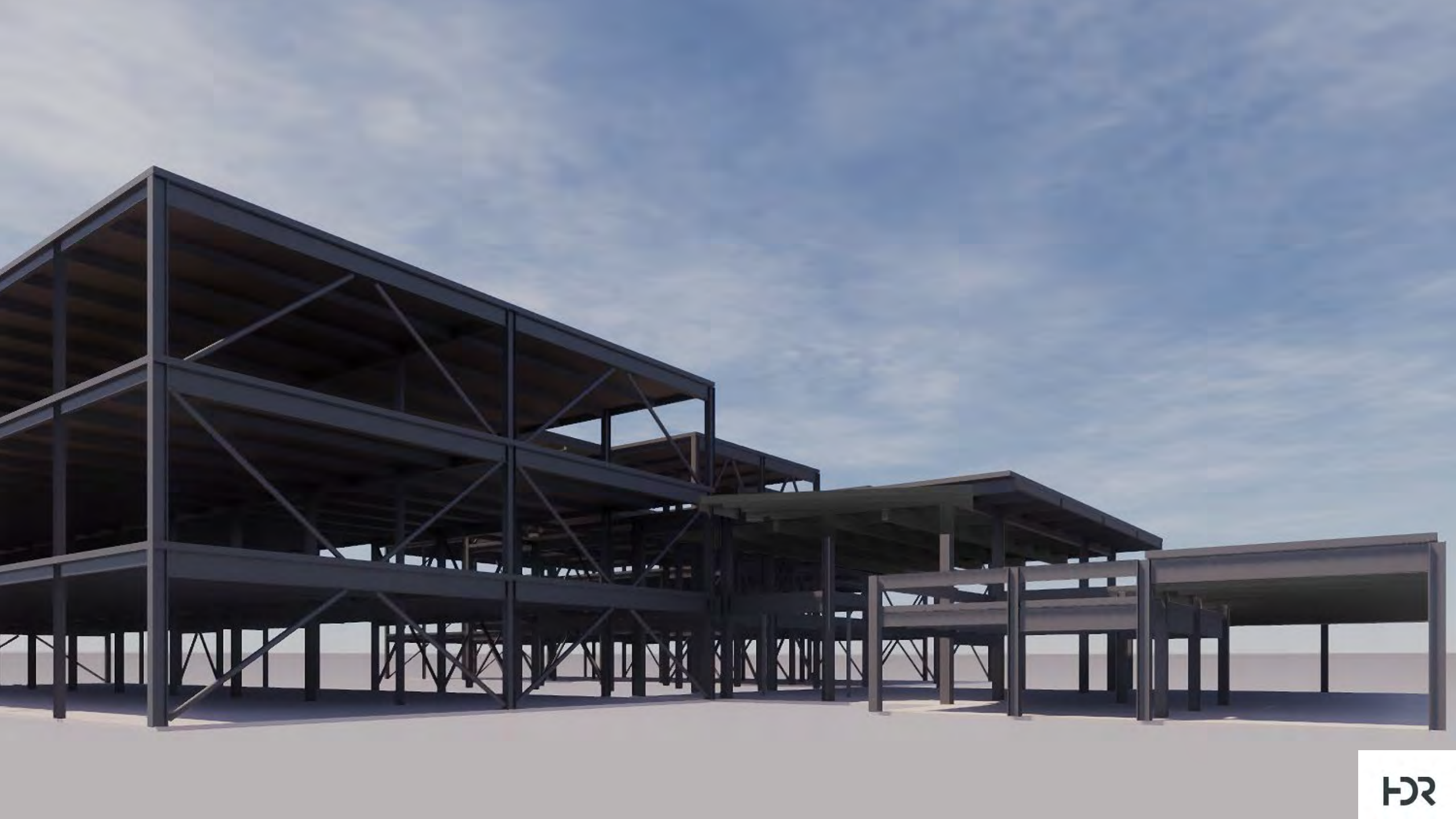
Safety and Performance: In the event of a fire, char allows wood structure to be insulated from the fire. Seismic resilience. High humidity environments: corrosion resistance.

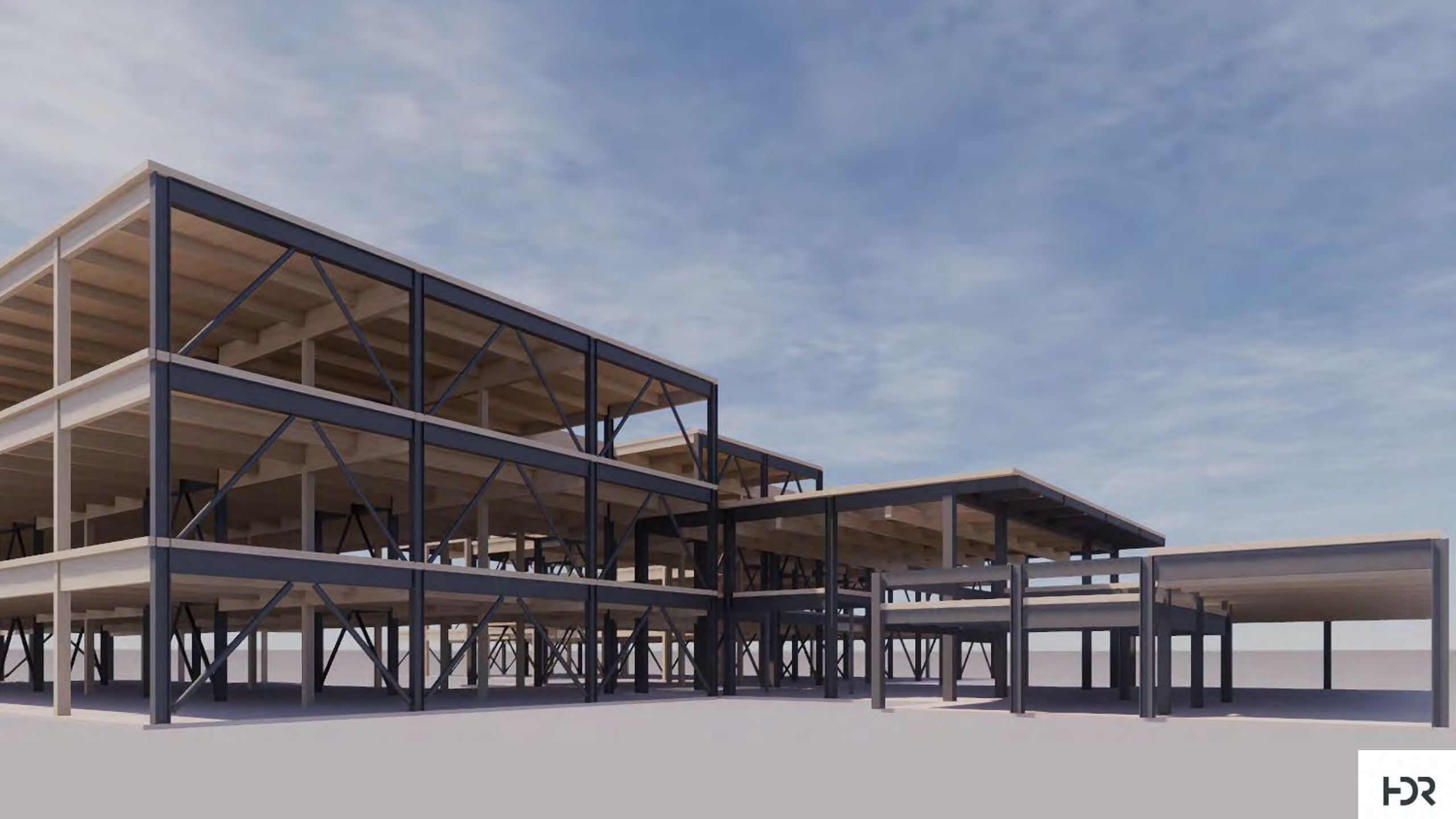
Reduced Structural Weight: Saves on foundation > materials, time & cost.

Thermal Performance: Wood's natural insulating properties = strong thermal performance.

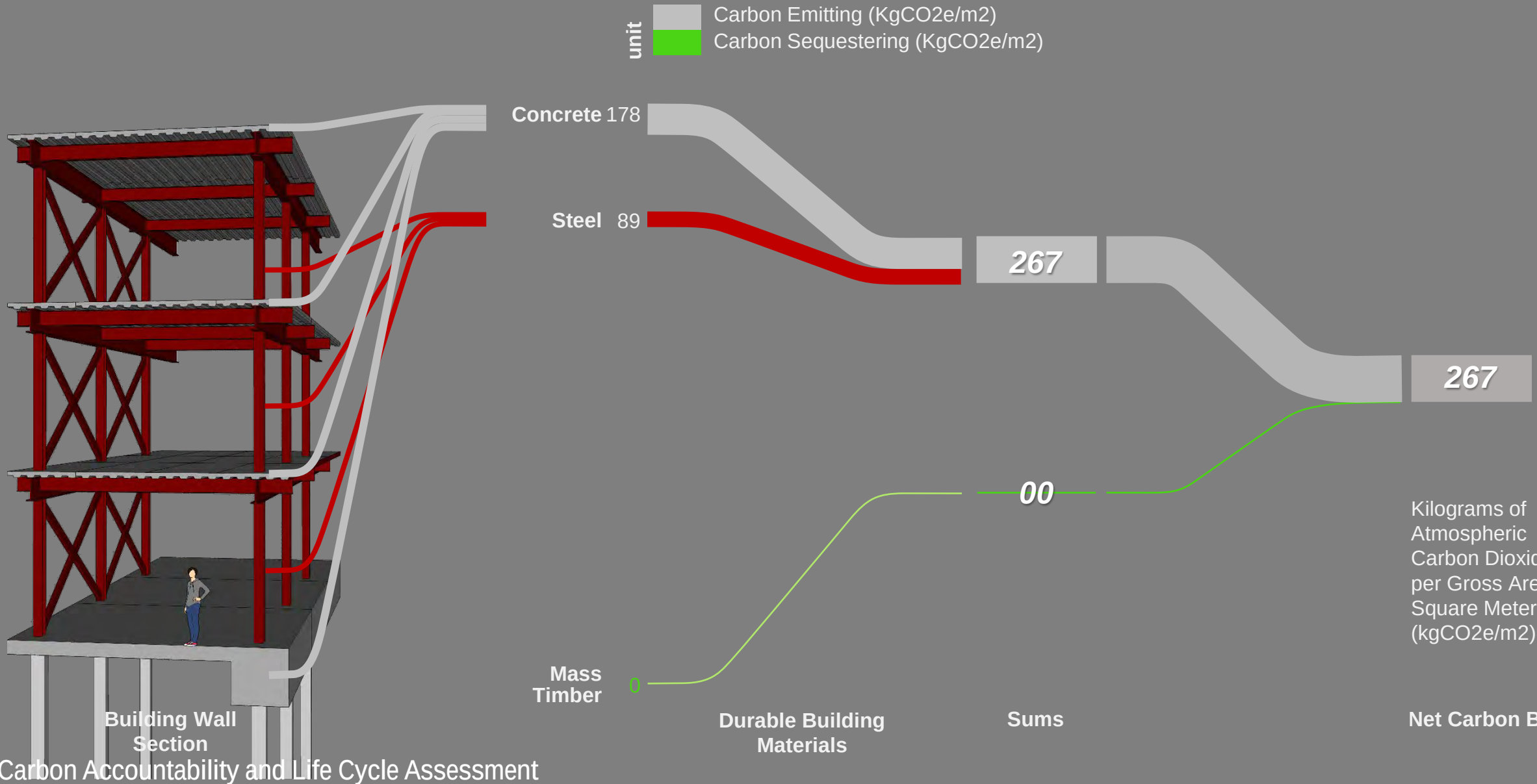
Biophilic Design Benefits: Exposure to natural elements = good. Raw material is fully finished.


Long Structural Spans
Shallow Depth Structure
Small Column Size
Exposed Structure Possible (No Fire Protection or Gypsum Furring)
Natural Acoustic Quality
LEED (Renewable & Recycled Content)
Low Carbon Impact
Low Embodied Energy
Offsite Pre-fabrication
Repeatability Efficiencies
Late Design Changes Possible
Easily Accommodates Changes of Embedded Plates & Penetrations
Fabrication Quality & Exactness
Winter Construction
Minimal Protection Required During Construction
Speed of Construction
Low Onsite Labor Demand
10
5
1
Mass Timber
Steel
Concrete



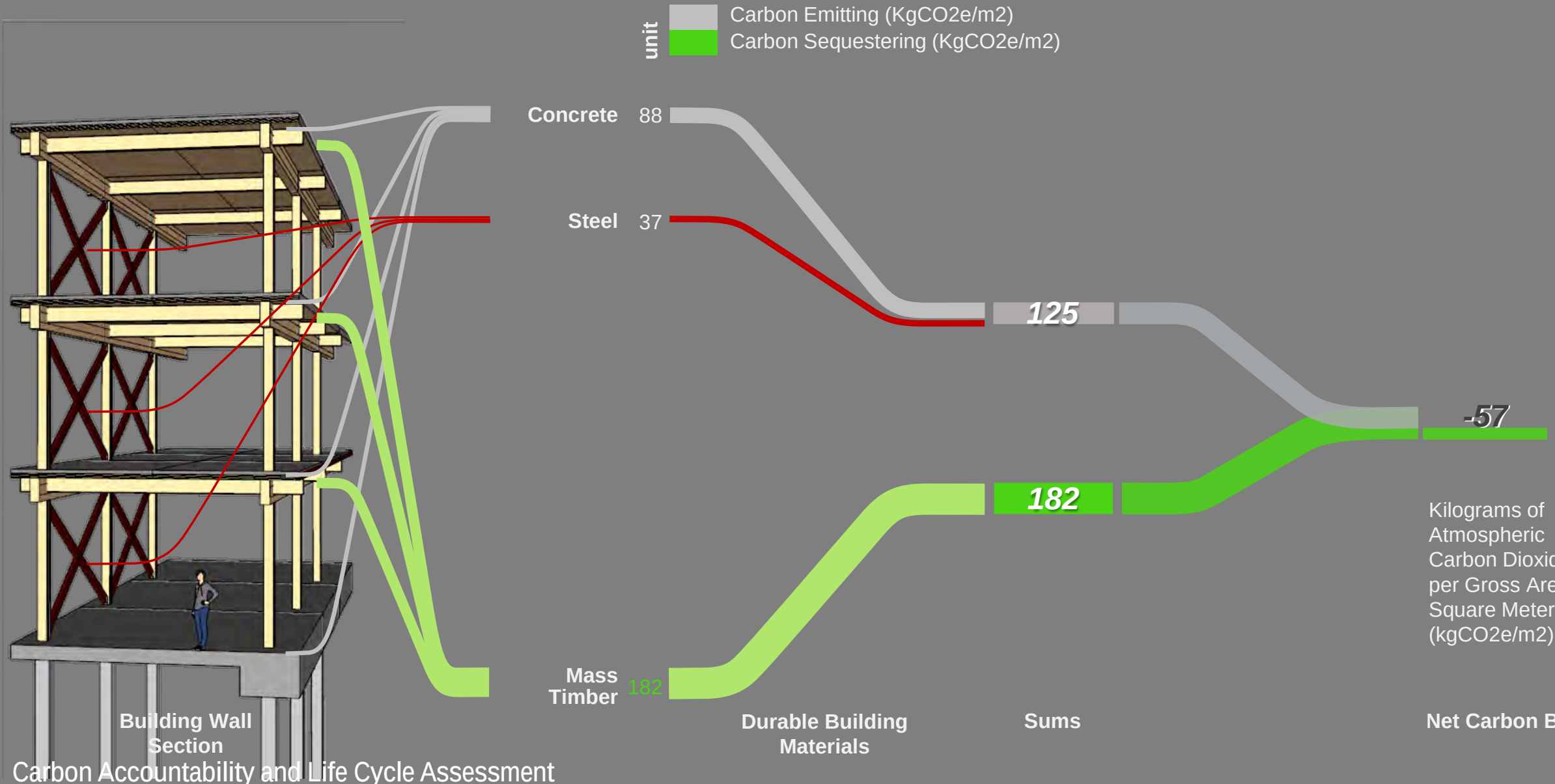


BASE BUILDING CARBON BALANCE (SCHEDULE A1-A5+D)



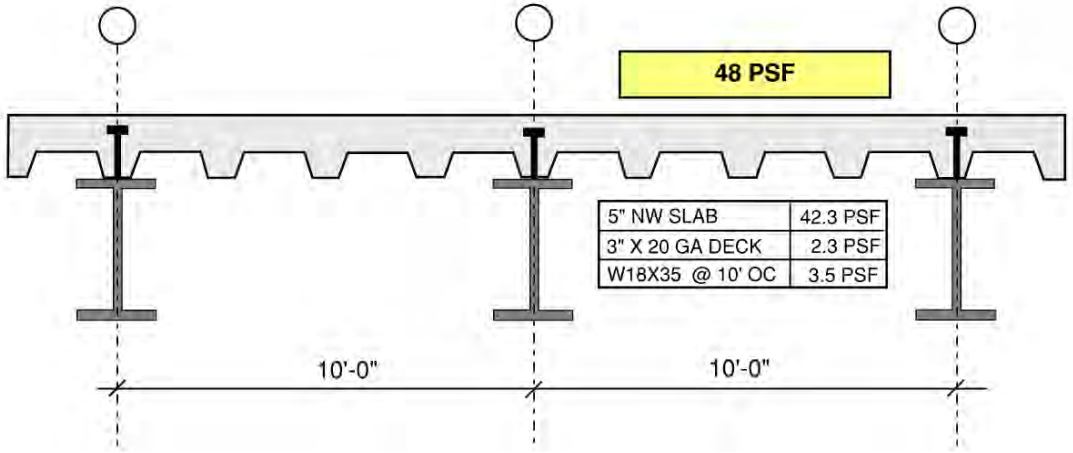
Carbon Accountability and Life Cycle Assessment

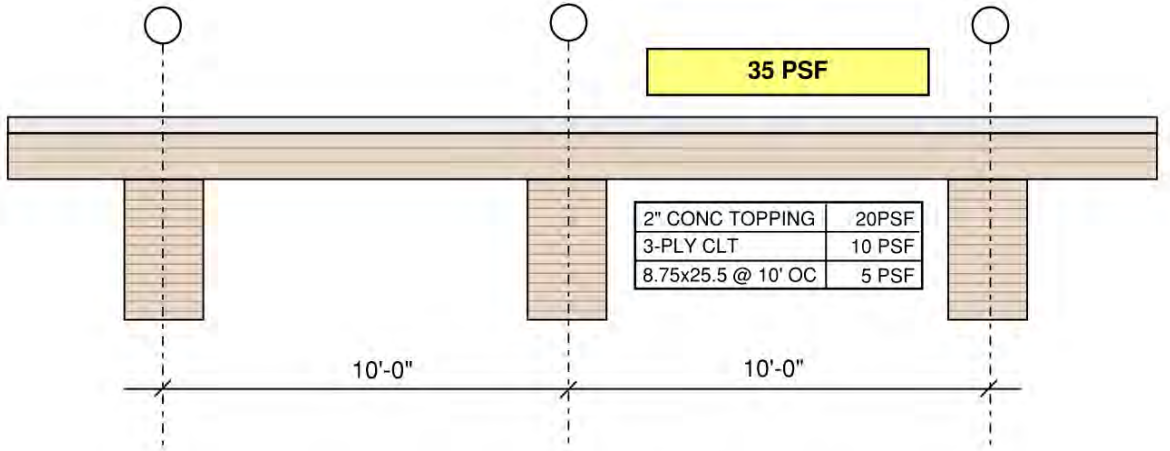
MASS TIMBER CARBON BALANCE (SCHEDULE A1-A5 + D)



Carbon Accountability and Life Cycle Assessment

Structural Framing

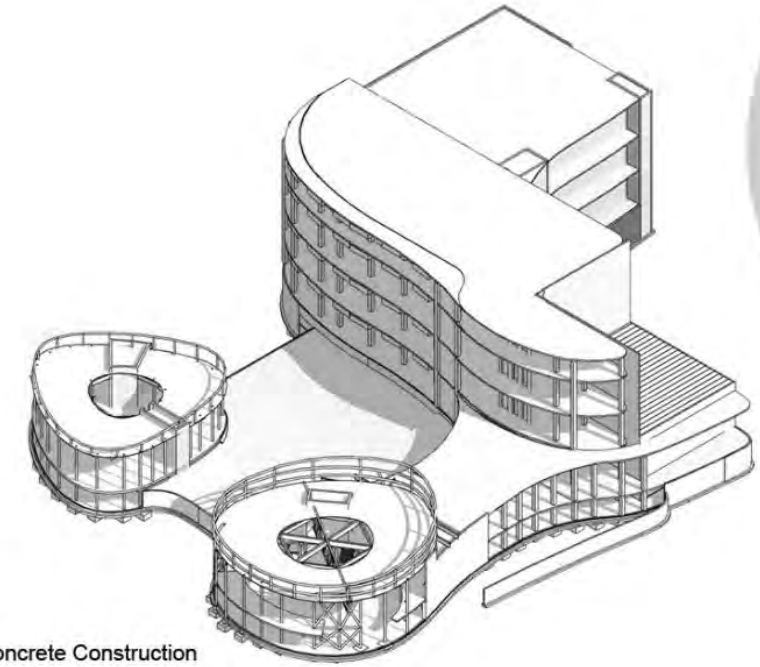




EMBODIED CARBON REDUCTION USING MASS TIMBER HYBRID CONSTRUCTION

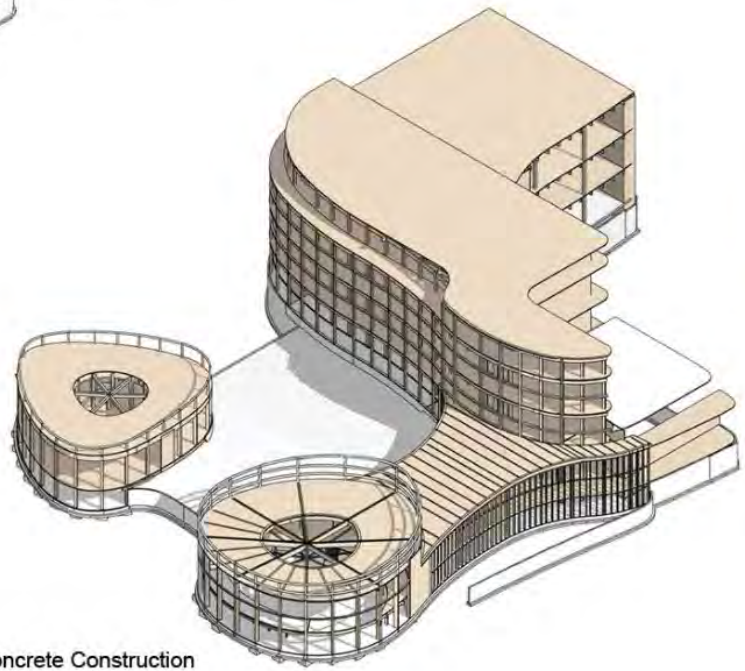
32%
reduction of global warming potential

Equivalent to
7,383,775 miles
driven by an average passenger vehicle



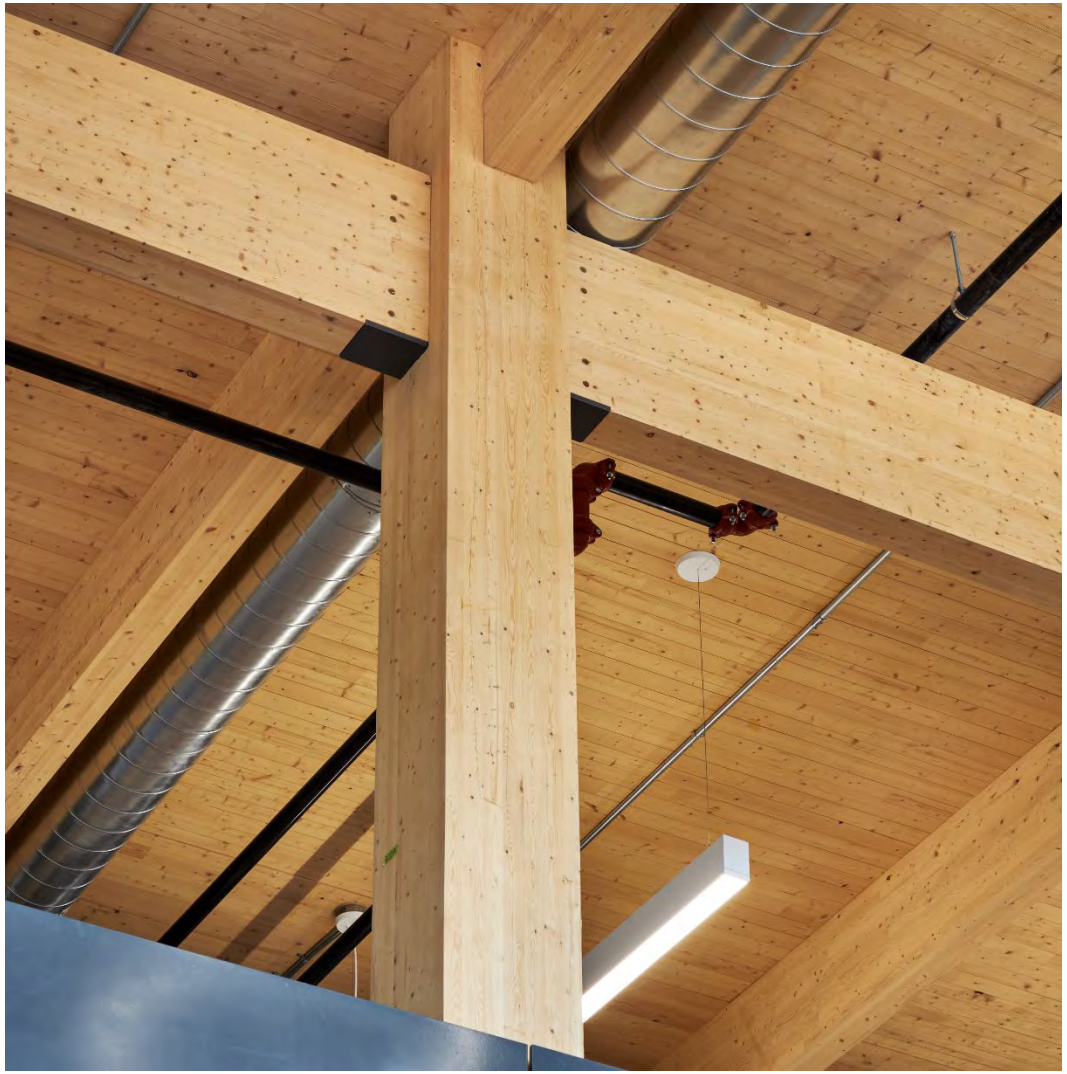
Steel + Concrete Construction

9234
metric tons of
CO_2
Equivalent



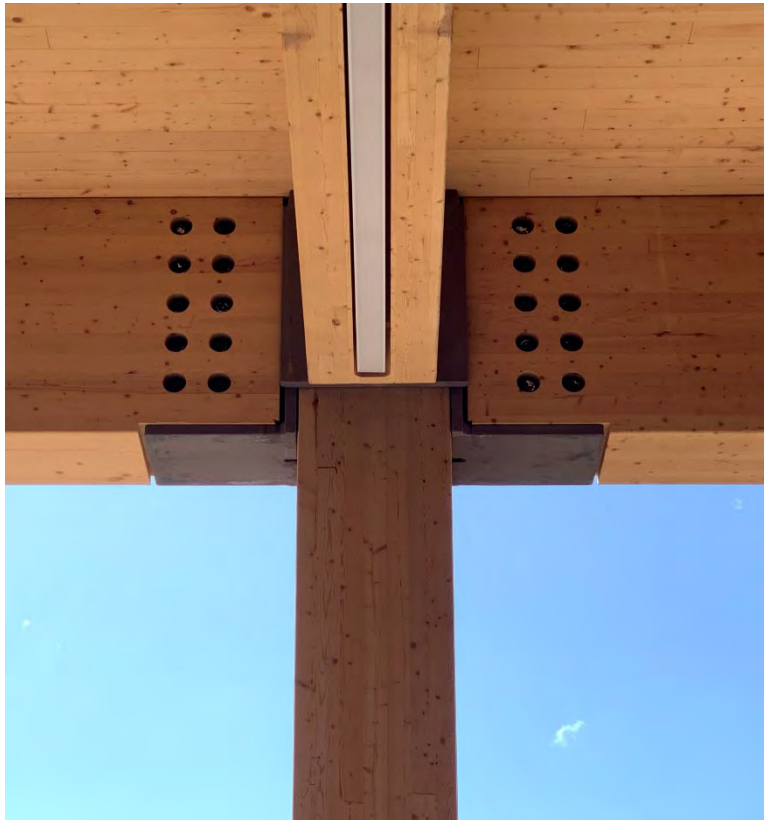
Mass Timber + Steel + Concrete Construction

6296
metric tons of
CO_2
Equivalent



Integration

between



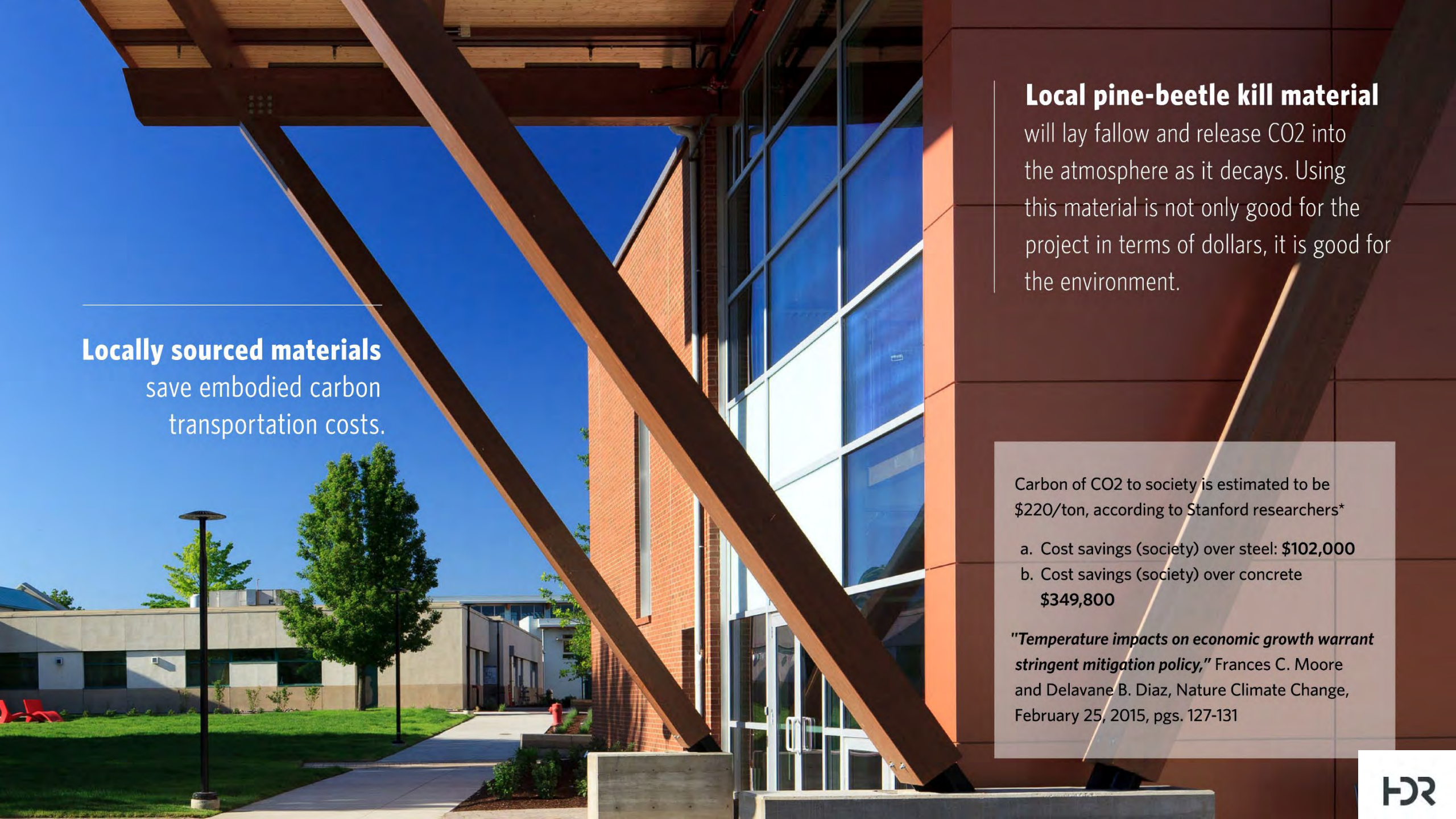
among

below

Jim Pattison Centre of Excellence

Penticton, BC

2011



Locally sourced materials
save embodied carbon transportation costs.

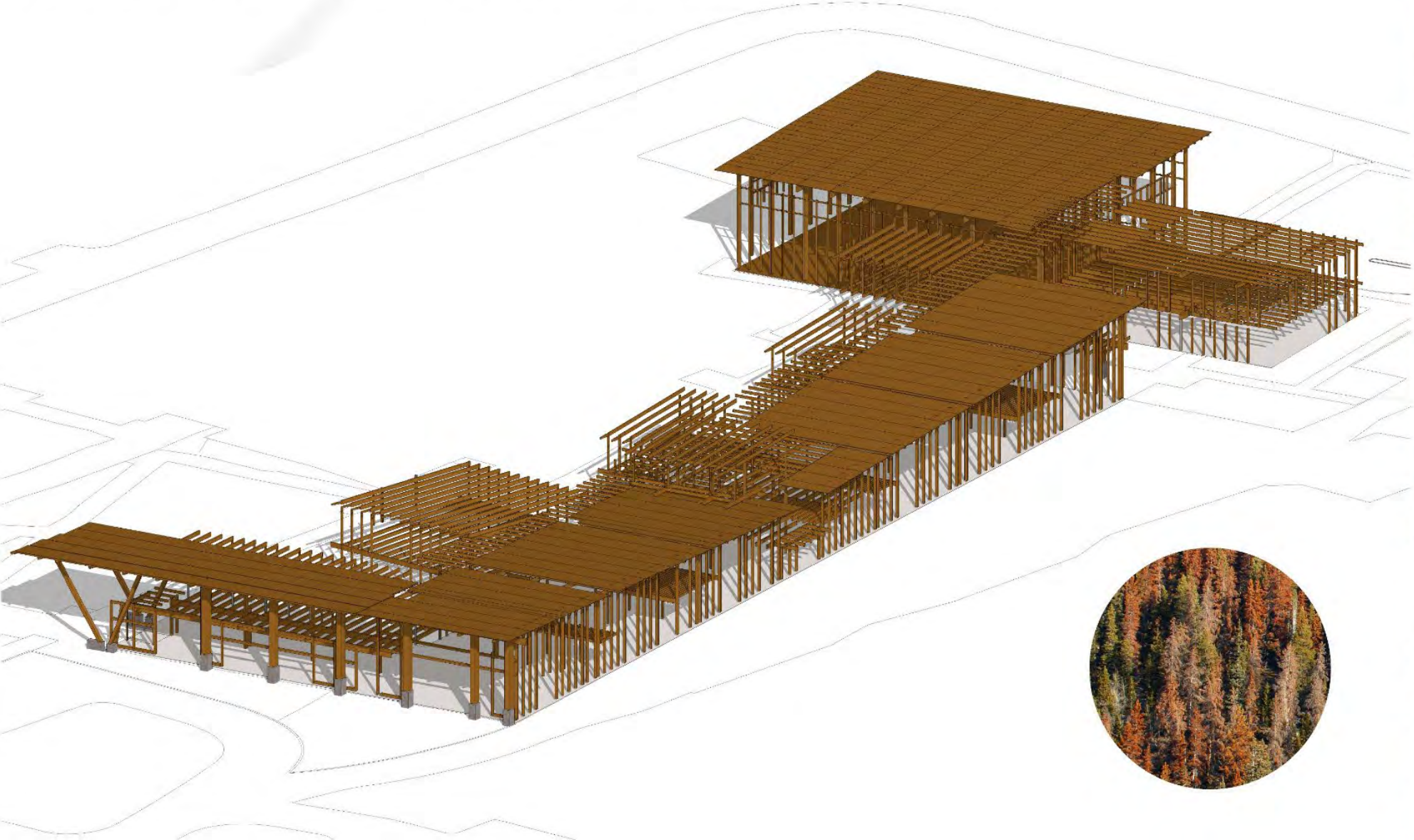
Local pine-beetle kill material
will lay fallow and release CO2 into the atmosphere as it decays. Using this material is not only good for the project in terms of dollars, it is good for the environment.

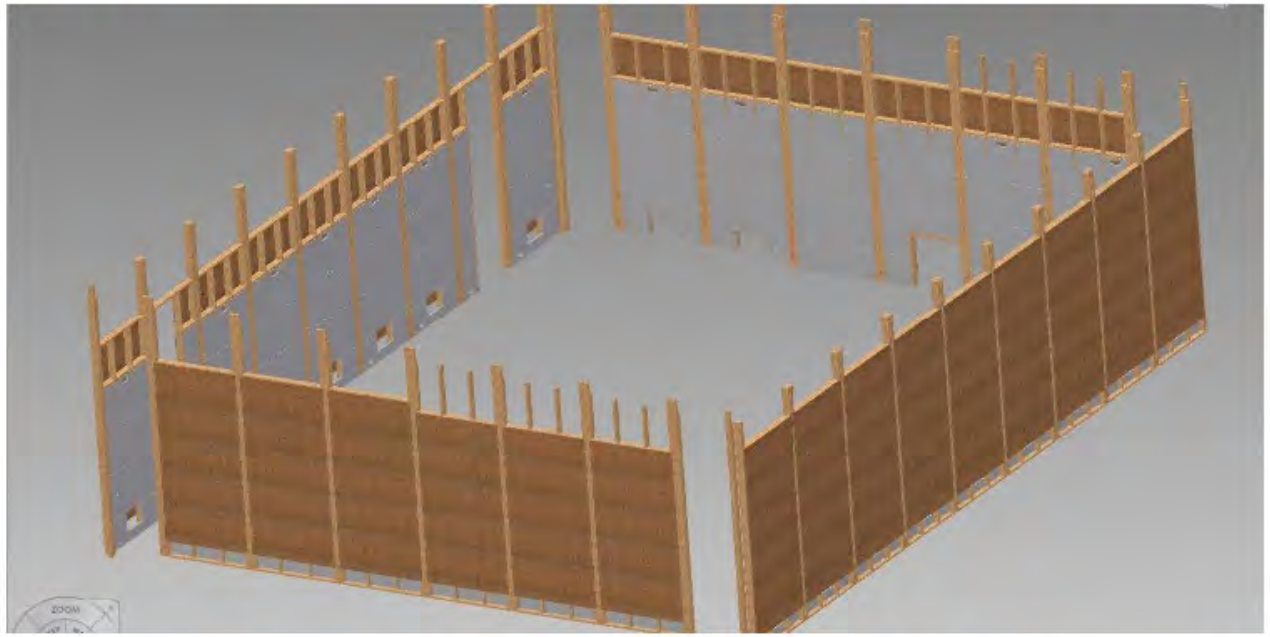
Carbon of CO2 to society is estimated to be $220/ton, according to Stanford researchers*

a. Cost savings (society) over steel: **$102,000**
b. Cost savings (society) over concrete **$349,800**

"Temperature impacts on economic growth warrant stringent mitigation policy," Frances C. Moore and Delavane B. Diaz, Nature Climate Change, February 25, 2015, pgs. 127-131

DEMOUNTABLE HEAVY TIMBER CONSTRUCTION



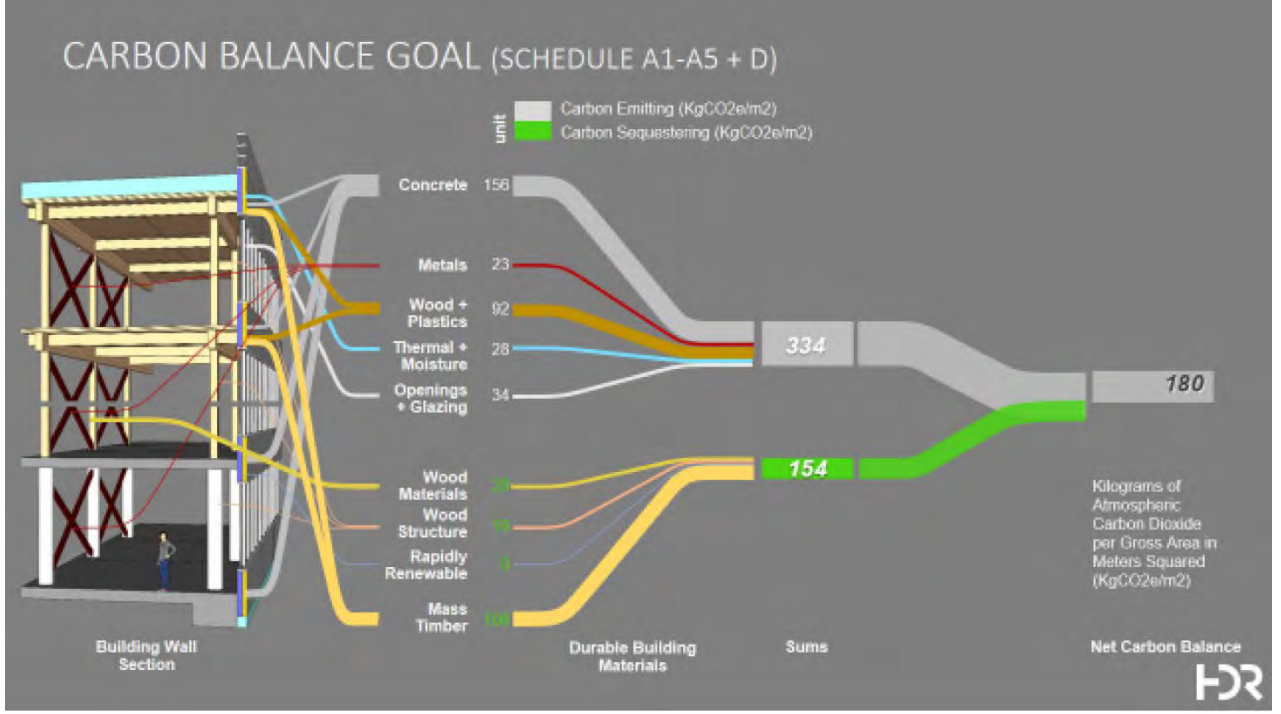


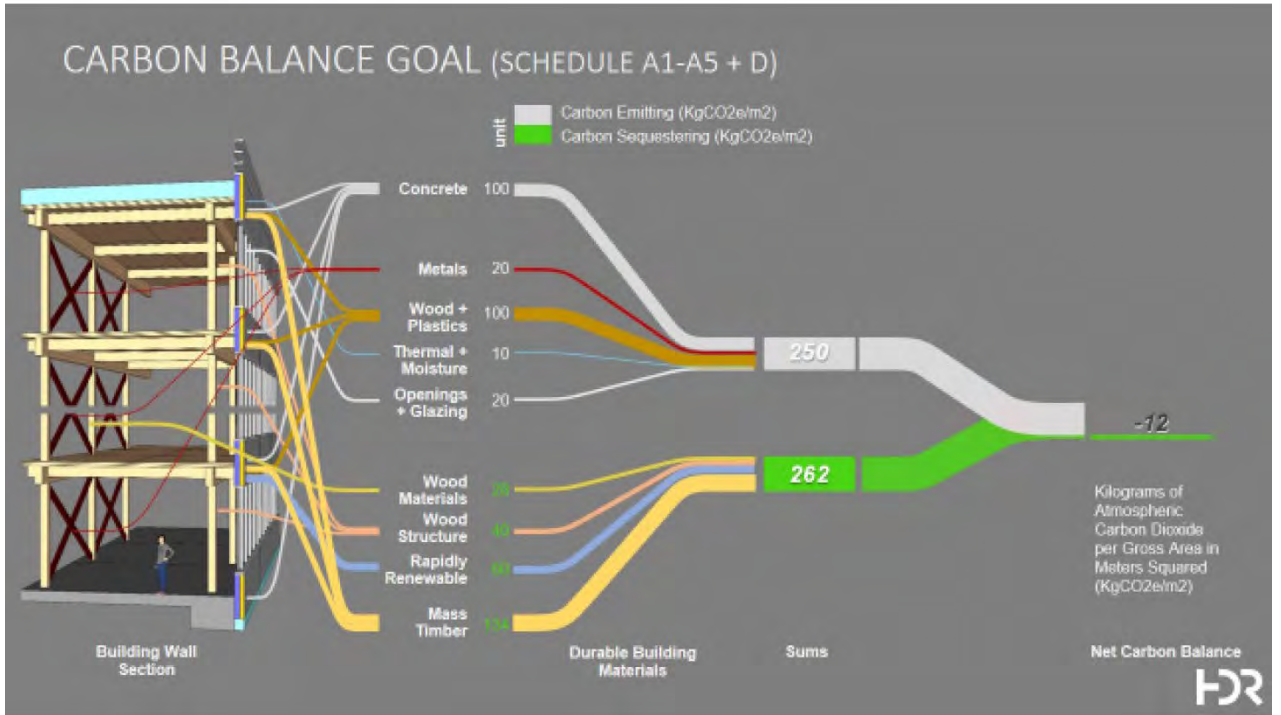
Composite mass timber panels with integrated radiant /MEP systems

Penticton Lakeside Resort

Penticton, BC

2018





Opportunities:

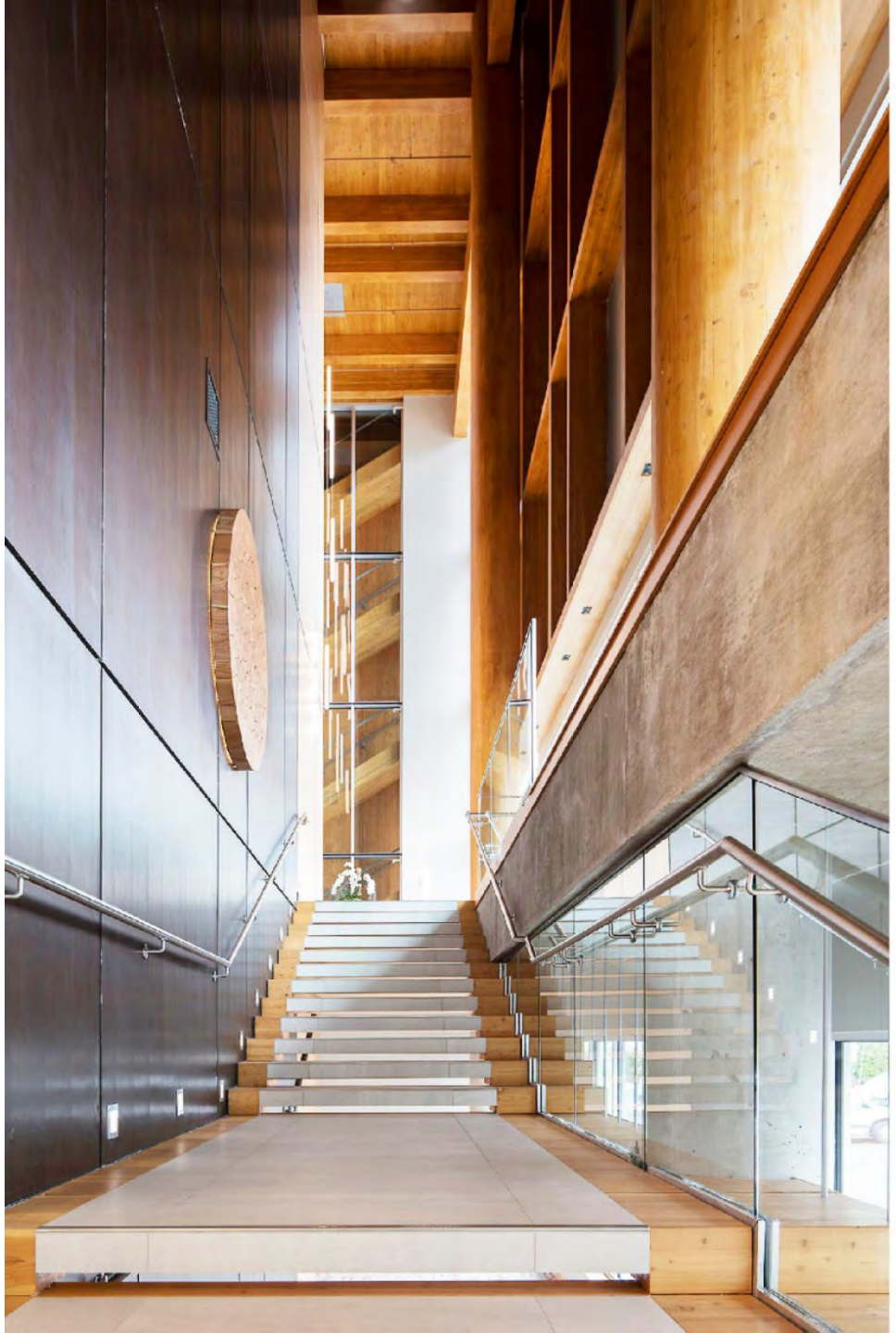
1. Speed of Construction
2. Environmental benefit
3. Structure as finish
4. Platform during construction
5. Reduced Structural weight
6. Marketing Opportunity

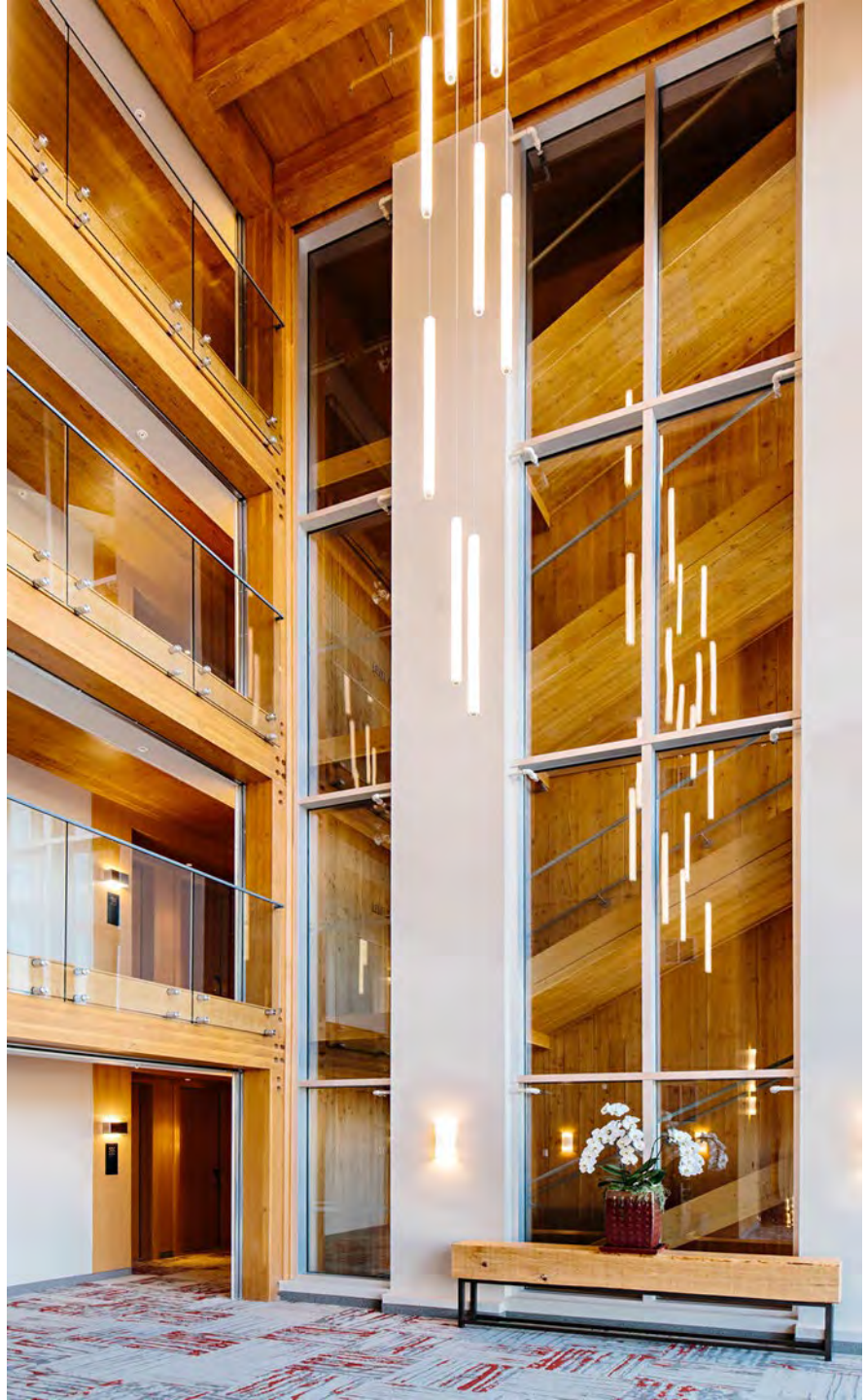
Challenges:

1. Acoustic challenges
2. Fire Considerations
3. Qualified General Contractor and Consultants
4. Expansion and Contraction
5. Municipal approval process.

WEST WING 2018
PENTICTON BC

HDR





Lake Cowichan Sports Arena

Lake Cowichan, Vancouver Island, BC

2010

Aldergrove Community Centre

Langley, BC

2018


3 8"

Delbrook Community Recreation Centre

North Vancouver, BC
2017

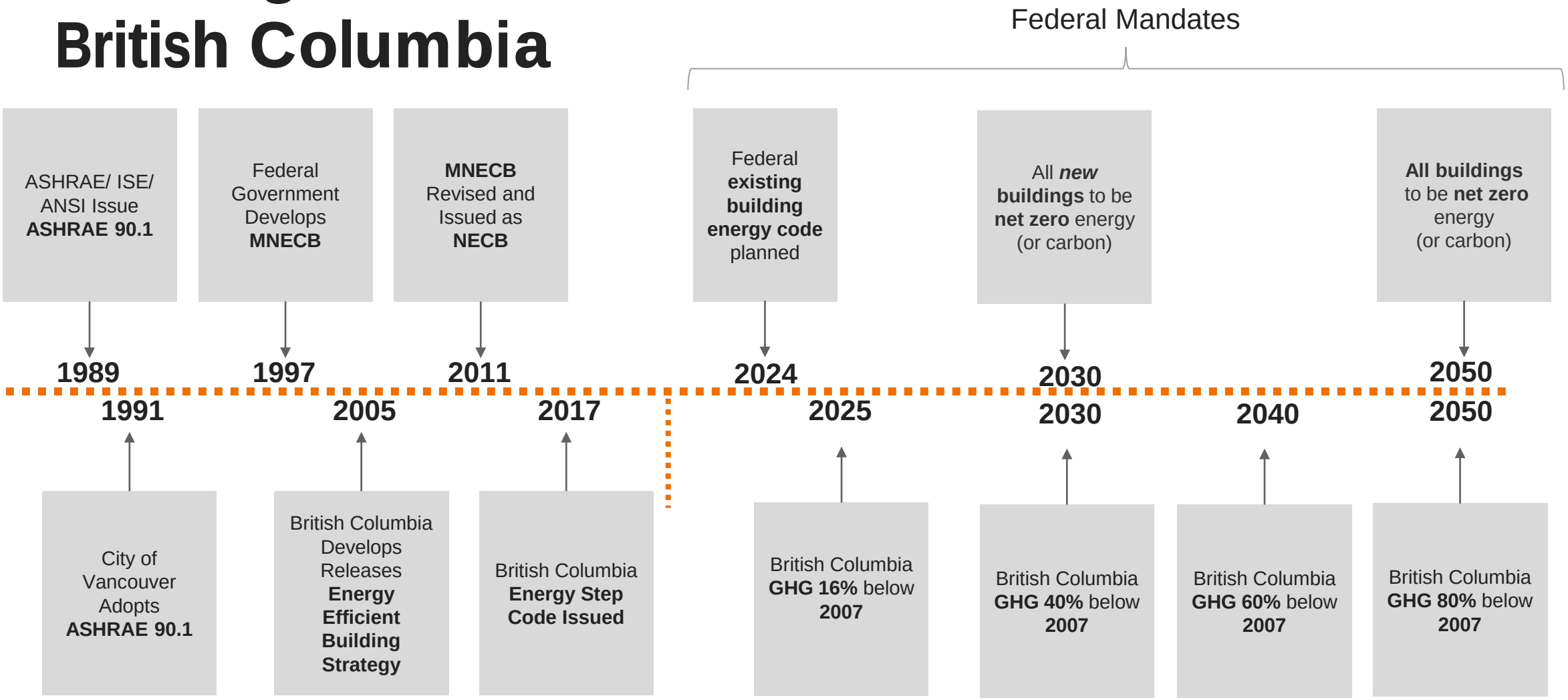

RECEPTION

West Fraser Centre,
Quesnel, BC
2017

Armstrong-Spallumcheen Arena, *Armstrong, BC*
2005

Paul Reynolds Community Centre, *St. John's, NL*
2013

Building Performance in British Columbia



WHAT WE KNOW TO BE TRUE

- 450+ Recreation Buildings in BC
- 4500+ Recreation Buildings Canada
- All Carbon Zero by 2050
- It Can Be Done

Canada Games Aquatic Centre Kamloops

Existing Building
21% Energy Reduction
36% GHG reduction

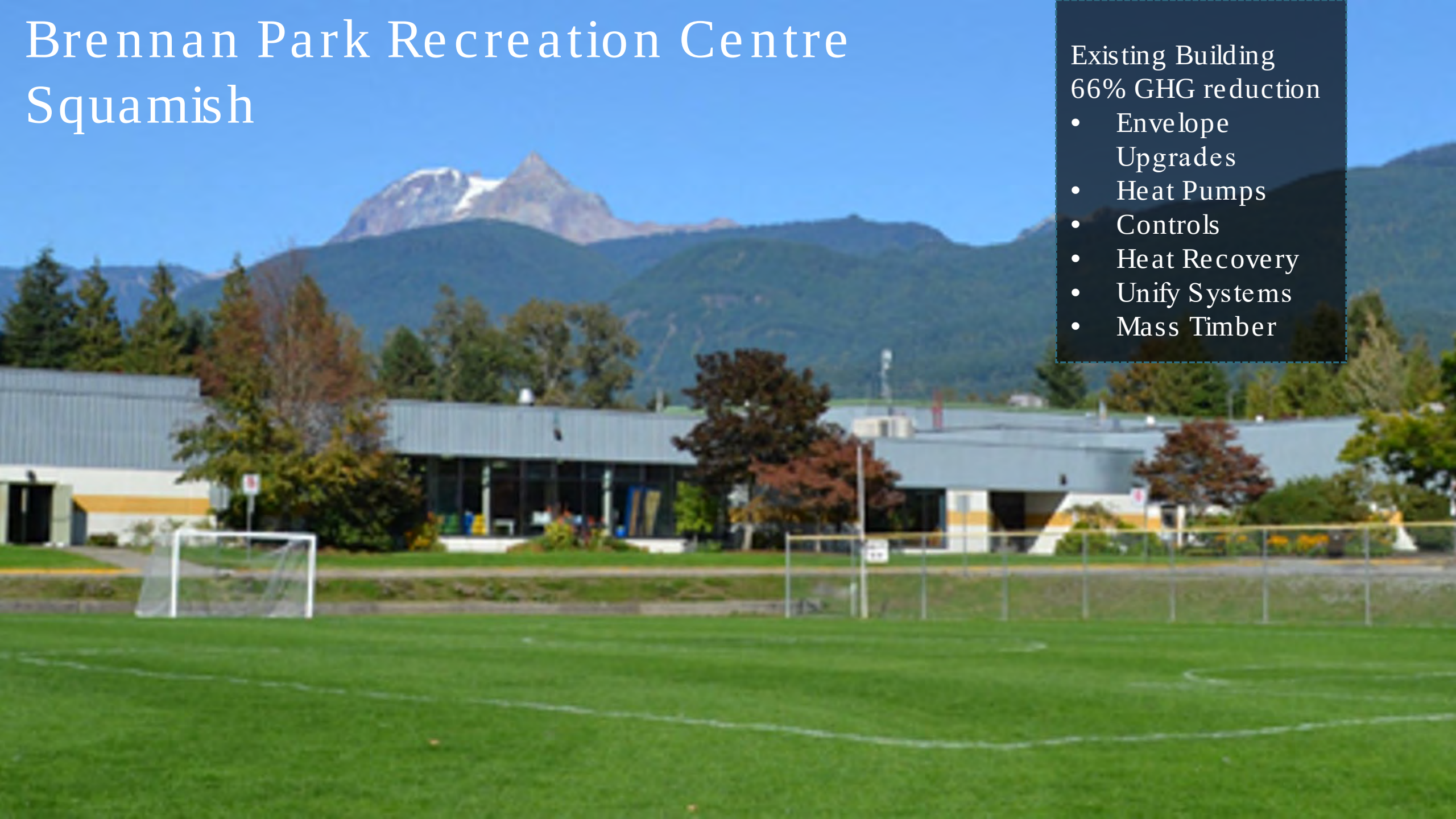
- Envelope Upgrades
- Heat Pumps
- Controls
- Heat Recovery

Bear Creek Athletic Centre
Surrey

Structural Reuse

- Minimal Space Conditioning

Brennan Park Recreation Centre Squamish



Existing Building
66% GHG reduction

- Envelope Upgrades
- Heat Pumps
- Controls
- Heat Recovery
- Unify Systems
- Mass Timber

Northwest Community Centre
Oshawa

Net-Zero Carbon

- Mass Timber
- Heat Pumps
- Controls
- Heat Recovery
- Unify Systems
- Mass Timber

Rotary Park Pool

Oshawa

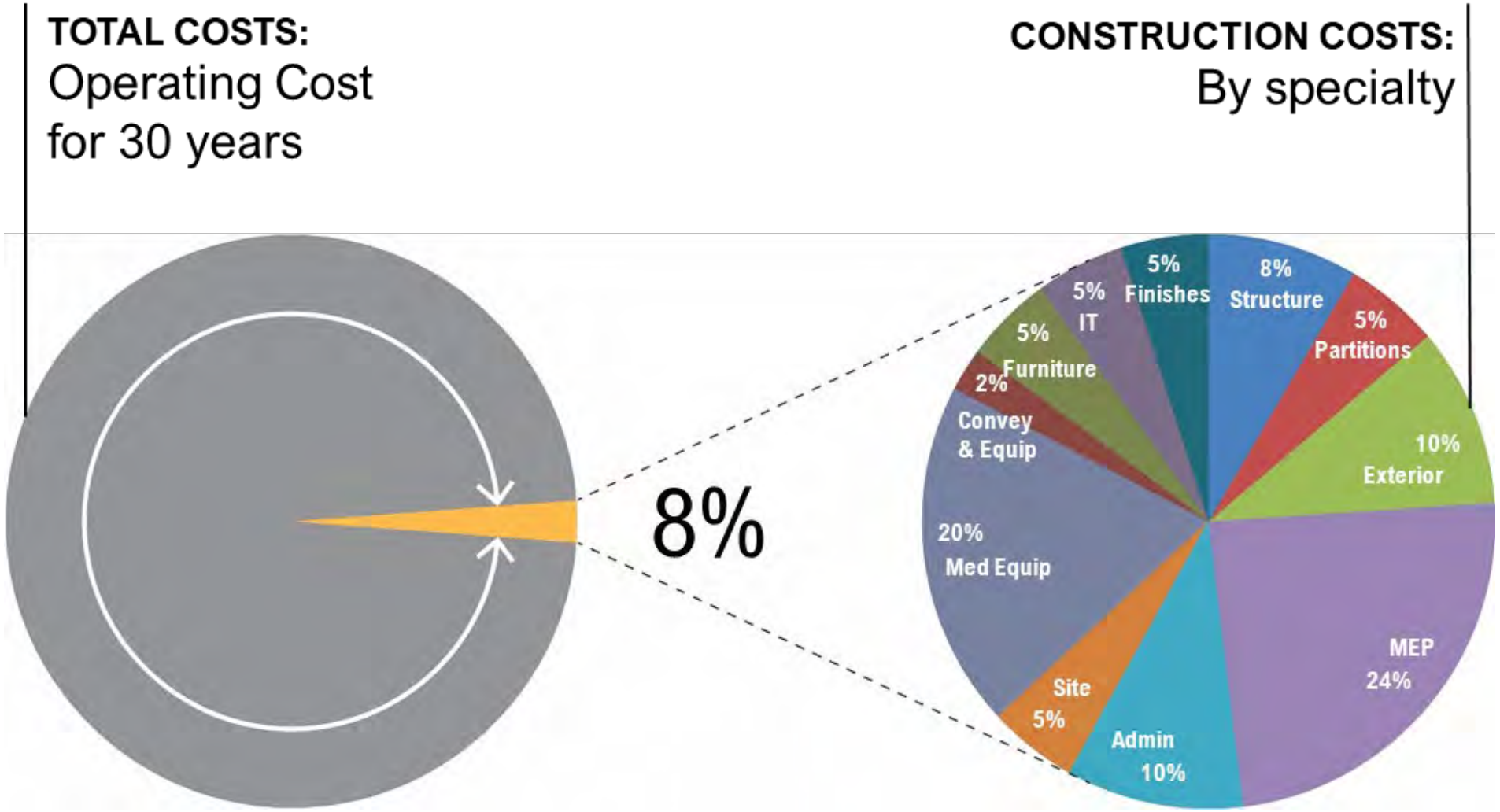
- Summer Operation
- Heat Pump Pool Heating
- Electric Domestic Water

how can we get to net zero?

1. Play the Long Game

- Budget for the Cost of Ownership (Capital and Operational)
- Complete a Life Cycle Cost Assessment
- Invest in energy/ operational carbon reductions
- Set Capital and Operational budgets accordingly

The Cost of Ownership…



2. Do the Homework

- Know what is working and not working in your facilities
- Complete Energy Audits and set benchmarks
- Share with others to develop best practices
- Provide the data to consultants

3. Set the Standard

- Provide clear and measurable goals for consultants for
  - Energy (eg 25 % below NECB 2020
  - Operational and Embodied Carbon (eg Net Zero -30%)
  - Climate resilience
  - ROI/ NPV
  - Commissioning/ M+V
  - After completion
- Required IDP, LCCA, and LCA
- Consider 3rd Party Verification

4. Be Part of the Solution

- Be prepared to be involved and make facility staff available
- Participate in the LCCA and business case
- Participate in the Integrated Design Process

5. Focus on Low Cost/ Low Risk

1. Building Orientation and Location
2. Building Less
3. Start with Passive (hp envelope)
4. Efficiency (controls/ vfd/ energy recovery)
5. Electrification (heat pumps)
6. Renewables (PV, biomass, geoexchange/ geothermal)

6. Measure to Improve

- Collect the data for Commissioning and M+V teams
- Use calibrated energy models
- Celebrate the successes learn from the challenges