Net Zero New Design & Tender:

North East Scarborough Community Recreation & Child Care Centre

TORONTO

Agenda

1. Land Acknowledgement
2. Introductions
3. Net Zero / TGS Version 4
4. Project Background
5. Presentation by Perkins&Will
6. Question & Answers

Land Acknowledgement for Toronto

We acknowledge the land we are meeting on is the traditional territory of many nations including the Mississaugas of the Credit, the Anishnabeg, the Chippewa, the Haudenosaunee and the Wendat peoples and is now home to many diverse First Nations, Inuit and Métis peoples. We also acknowledge that Toronto is covered by Treaty 13 with the Mississaugas of the Credit.

Introductions

Host:

Gaby Kalapos, Clean Air Partnership

Panelists:

- Dejan Skoric, City of Toronto
- Mario Pecchia, City of Toronto
- Zeina Elali, Perkins&Will

Net Zero / TGS Version 4

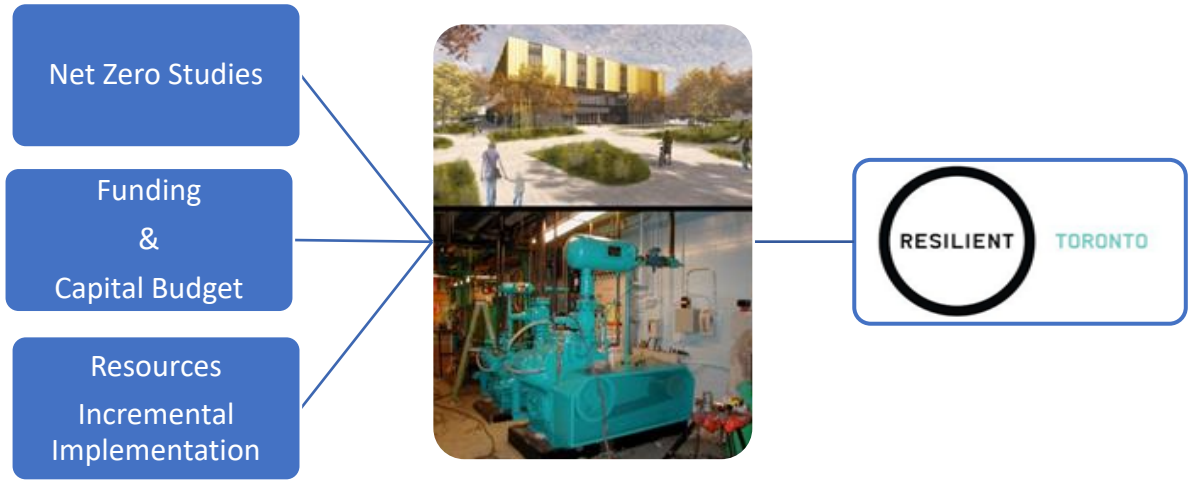
TORONTO

Net Zero by 2040

On December 15, 2021, City Council adopted the TransformTO Net Zero Strategy, an ambitious strategy to reduce community-wide greenhouse gas (GHG) emissions in Toronto to net zero by 2040 – 10 years earlier than initially proposed

Leading by Example

"All City Agency, Corporation and Division-owned new developments are designed and constructed to applicable Toronto Green Standard (TGS) Version 4 standard achieving zero carbon emissions, beginning in May 2022"

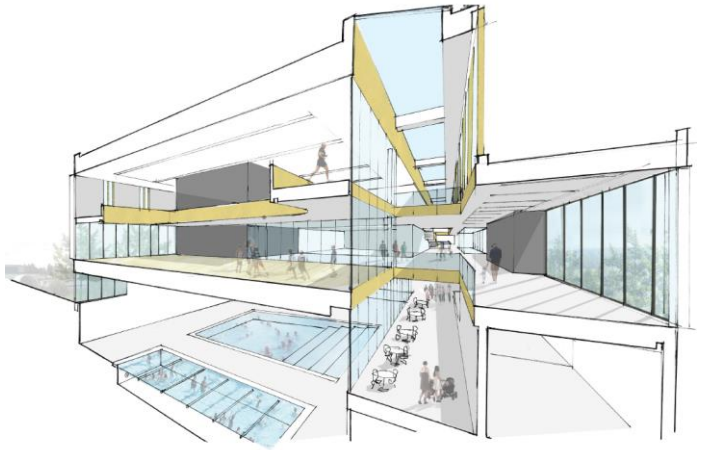


Background

- Importance of Council Decision
- The original RFP scope of work did not include Net Zero requirements, included only TGS Tier 2 design
- Timing
  - Project had advanced to design development
- Project paused as result of Council direction
  - Report to council for additional funding for the study
  - Tender was delayed
- Undertake feasibility study
  - Assessed & recommended suitable option
  - Report back to council for additional project funding

Background continued

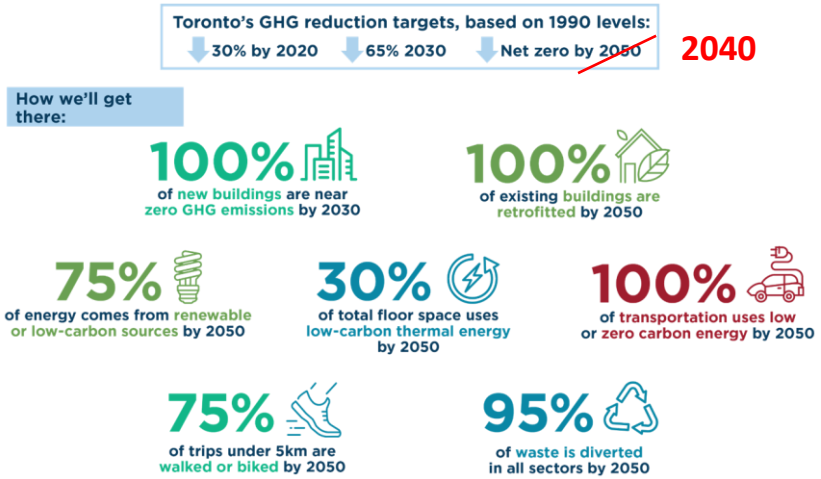
- Project was tendered during a volatile hyper inflation period in the construction market (COVID 19, supply chain issues, risk averse costing)
- Final project cost including net zero: $86.3million (8-12% net zero components)
- Bids received exceed initial cost estimates due to:
  - Inflation from time of costing to bidding
  - Busy market
  - Extraordinarily high costs in steel and concrete
- Value engineering was not an option
- Recommendation to award with an increased budget was advanced to council and approved



Tender Process

- General Contractor evaluation criteria included experience in constructing high performance low carbon buildings (e.g. LEED) capable of achieving zero carbon buildings
- 5 firms participated in the pre-qualifying process
- 4 firms was invited to the tender process - lowest bid, Aquicon, won the contract
- No specialty subs were pre-qualified
- Construction started April 2022

Lessons learned



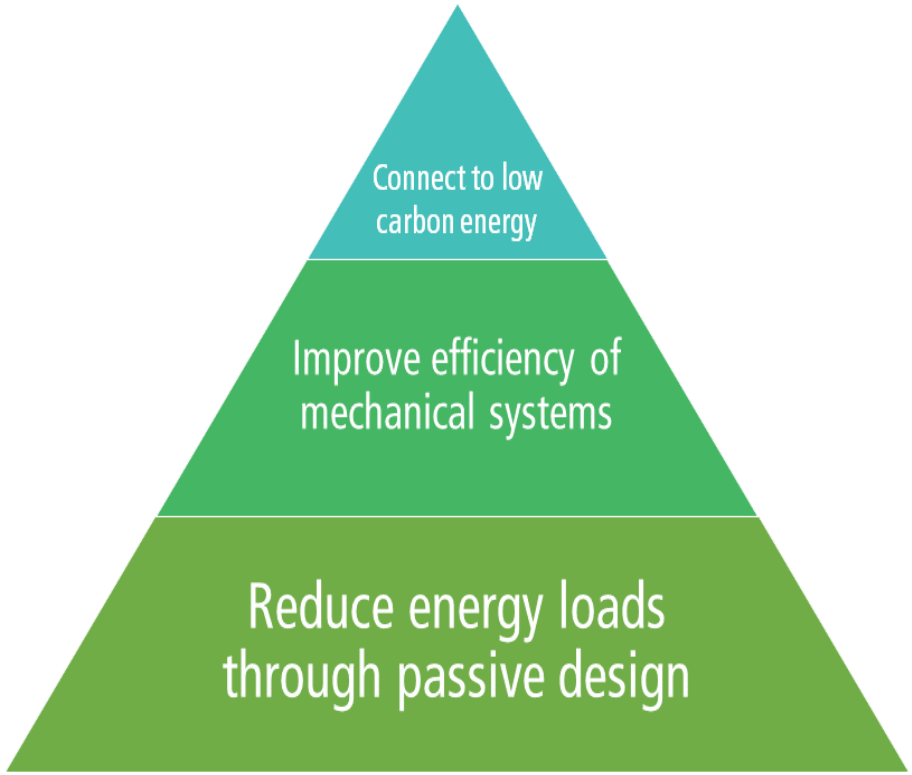
- Pivoting results in increased costs
- Net Zero is the path forward. Budget for net zero initiatives for new projects as early as possible to avoid additional re-design or retrofit costs to get to net zero.
- Implementing net zero will necessitate moving away from fossil fuels
- On-site renewable energy will help mitigate potential of electricity cost increases
- Additional staff within Parks Development and Capital Projects, and Community Recreation will be required, trained in the use of new systems and methods in order to achieve the Council/Corporate direction

Recommendations for RFP stage

- RFP for Architect must specify a Net Zero Emissions Building
- Specify passive design principles in scope of work
- Specify net zero energy goal: site to generate as much on-site renewable energy as it uses
- Require air tightness testing
- Require embedded carbon accounting

Additional recommendations:

- Require that the design meets the CaGBC's Zero Carbon Standard
- Require third party commissioning, and monitoring and verification



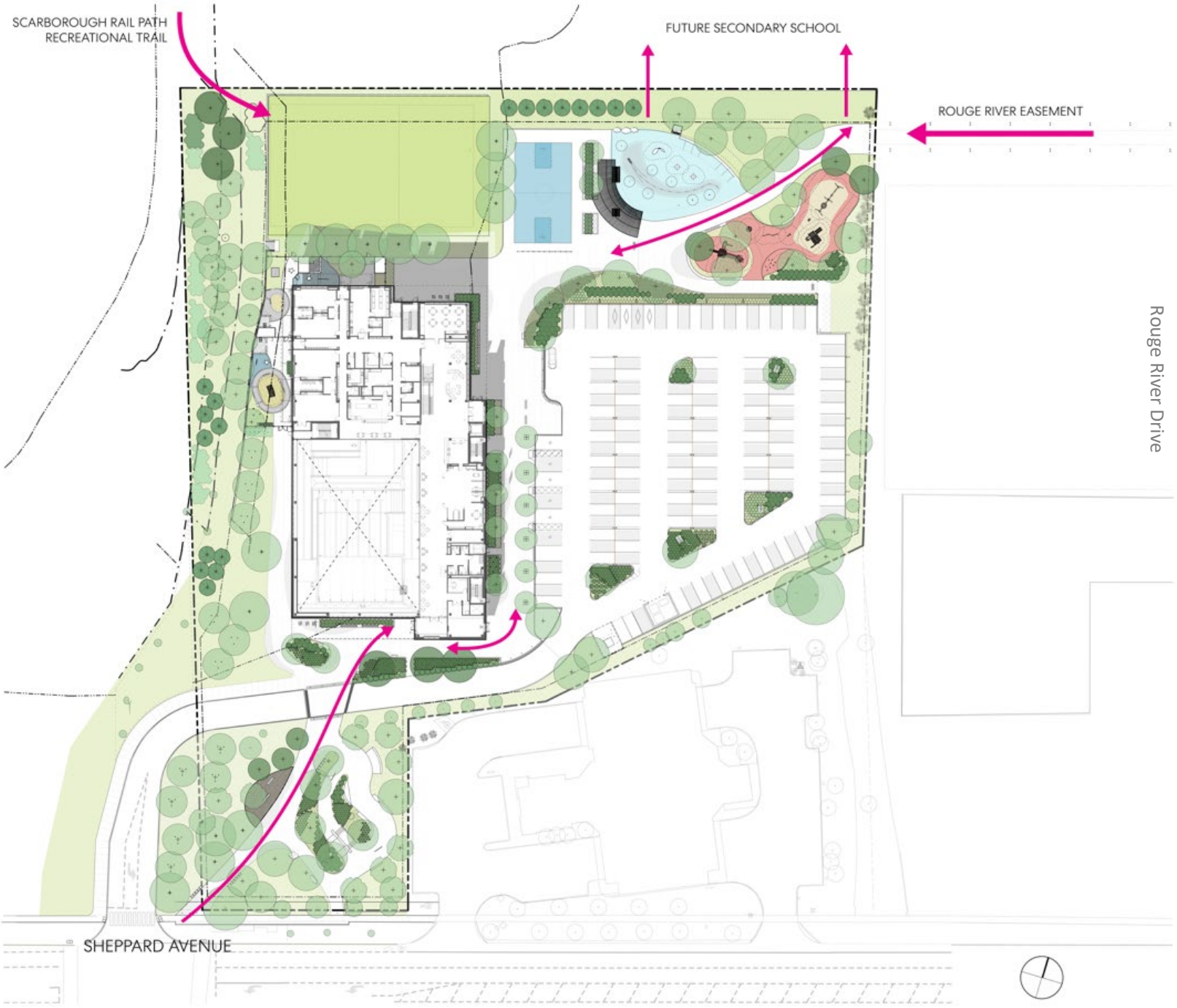
Questions & Answers

Design Overview

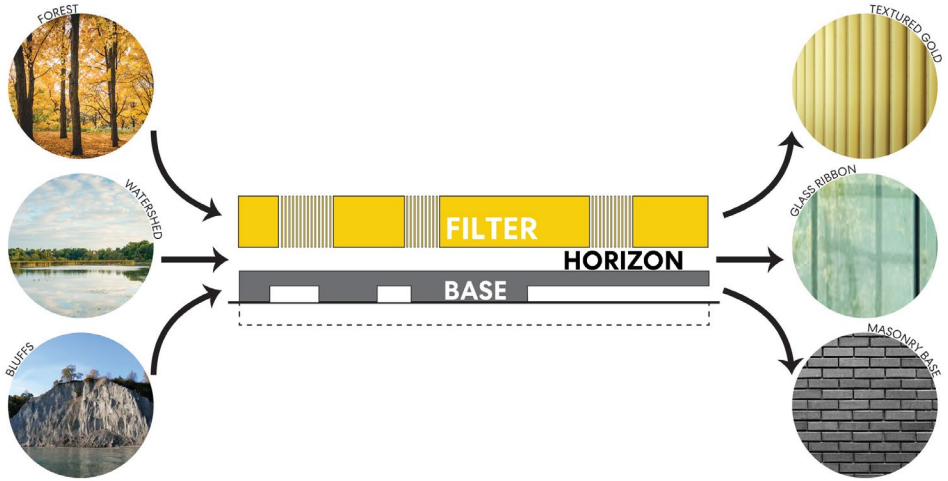
Perkins&Will

Smith + Andersen

footprint



- 8450 SHEPPARD AVE E
- Gross Area 8683 m²
- Under construction (Aquicon)
- Completion ~ Fall 2024


FOREST
WATERSHED
BLUFFS
FILTER
HORIZON
BASE
TEXTURED GOLD
GLASS RIBBON
MASONRY BASE

Perkins&Will

Whole Life Cycle Carbon Analysis

Northeast Scarborough Community Centre

What is Carbon Associated with Buildings?

Image Credit: Skanka

Embodied Carbon

Manufacture, transport and installation of construction materials

Operational Carbon

Building energy consumption

What is Carbon Associated with Buildings?

Image Credit: Skanka

Embodied Carbon

Manufacture, transport and installation of construction materials

Operational Carbon

Building energy consumption

Measures Summary Matrix

	Technologies & Measures	Energy Savings**	TEUI (kWh/m²)	GHGI*** (kg/m²)
	TGS Compliant Base Design	-	306	37
Passive Design	A2.1: Envelope Improvement – Walls R25	0.3%	305	36.9
	A2.2: Envelope Improvement – Roofs R55	0.3%	305	36.9
	A2.3 : Envelope Improvement – Triple Glazing (U-0.2)	2.6%	298	35.8
	A2.4: Fins Shading			
	A3: Airtightness Improvement by 50%	3.6%	295	35.8
Active Systems	M1.1: Geothermal Heat Pump*	30.4%	213	10.7
	M1.2: Geothermal Heat Pump with backup Electric Boiler	27%	223	11.2
	M2: Air Source Heat Pump	30.4%	213	10.7
	M3: Hybrid Air Source & Geothermal Heat Pump			Expl
	M4: Push and Pull System	-18%	361	53.3
	M5: Pool Covers	5%	291	36.8
	M6: Earth Tubes	3%	293	36
	M7: Bio Mass Boilers	-7%	340	7
	M9: Improve Heat Recovery Efficiency to 85% (except pool)	1.6%	301	36.9
	M10: Drain Heat Recovery	8.2%	281	32.8
Renewable Energy	E1.1: Photovoltaic and Thermal (PVT) (Roof Area)	23%	245	28.5
	E1.2a: Bifacial PV Panels (Roof Area)	6.2%	287	36.3
	E1.2b: Bifacial PV Panels (Parking Area)	14.3%	262	34.9
	E1.3 BIPV on South Façade Glazing	2%	300	36.9

Design Options Summary

NZEE Construction Cost Premium: 8%-12%

NZEE Strategies:
- Enhanced Building Envelope (6.8% energy savings)
- Air Source Heat Pumps (30.4% savings)
- 85% Heat Recovery Efficiency (1.6% savings)
- Drain Heat Recovery (8.2% savings)

Renewable Energy:
- PVT Roof Panels (23%)
- Bifacial PV Parking Canopy (14.3%)
- 1300 m2 of PV @ north (8.7%)
- BIPV on South Façade (2%)

Designs	TEUI (kWh/m²)	GHGI* (kg/m²)
TGS Compliant Base Design: Toronto Green Standard, Version 3 - Tier 2	306	37
RESPONSE TO COUNCIL MOTION: Net Zero Energy & Emissions Design	0	0
OPTION 1: Design Optimized for 20 Year Payback	187	27.5
OPTION 2: Near Net Zero Design Optimized for 30 Year Payback	94.3	4.7

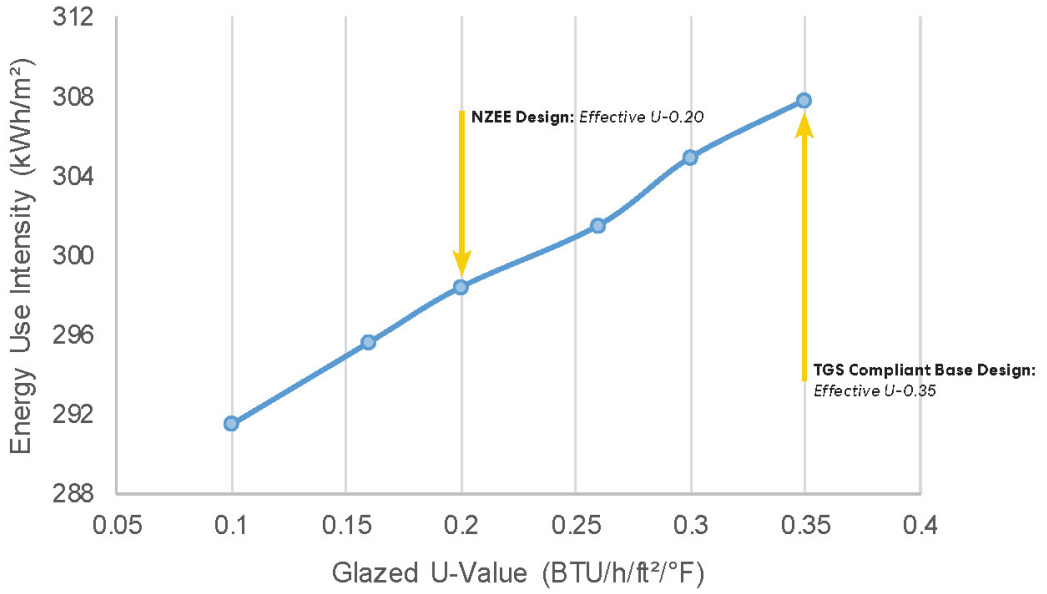
Passive Strategies: Enhanced Envelope

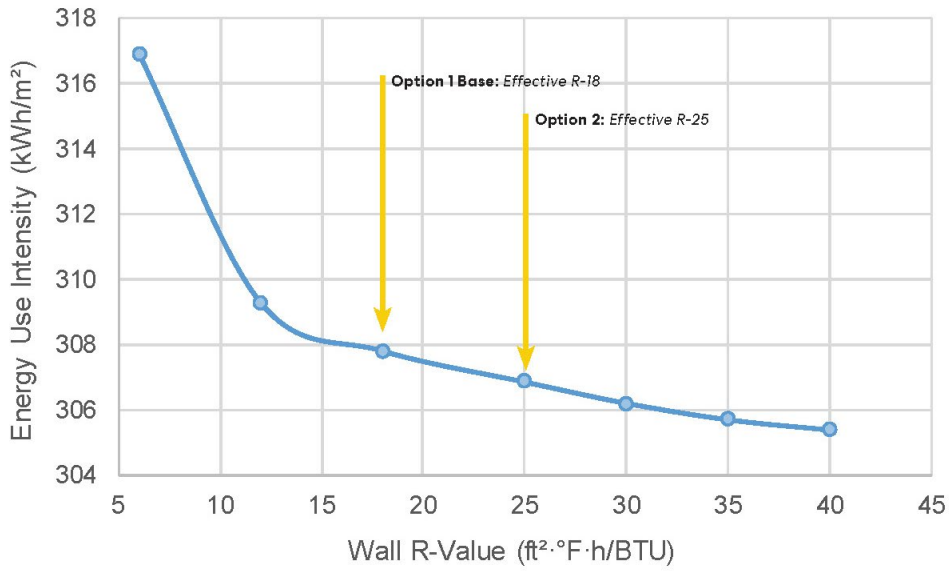
Capital Construction Cost Premium : 8% to 10% premium over conventional wall, roof and glazing.

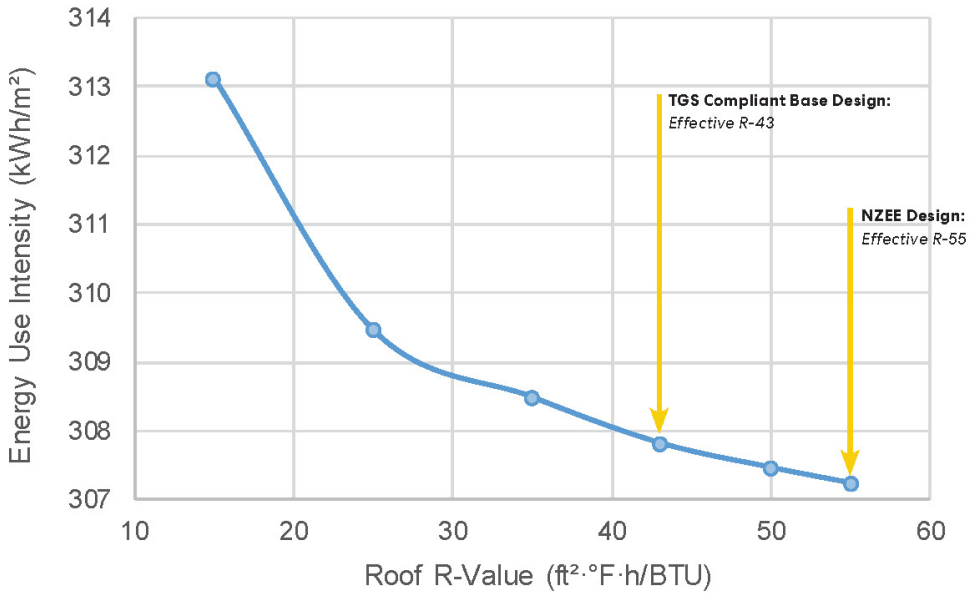
- Wall Improvement (R25) = 20% of premium
- Roof improvement (R55) = 15% of premium
- Triple Glazing = 65% of premium
- Air Tightness = 2% of premium

Energy Savings: 6.8%

- Wall Improvement = 0.3%
- Roof improvement = 0.3%
- Triple Glazing = 2.6%
- Air Tightness = 3.6%



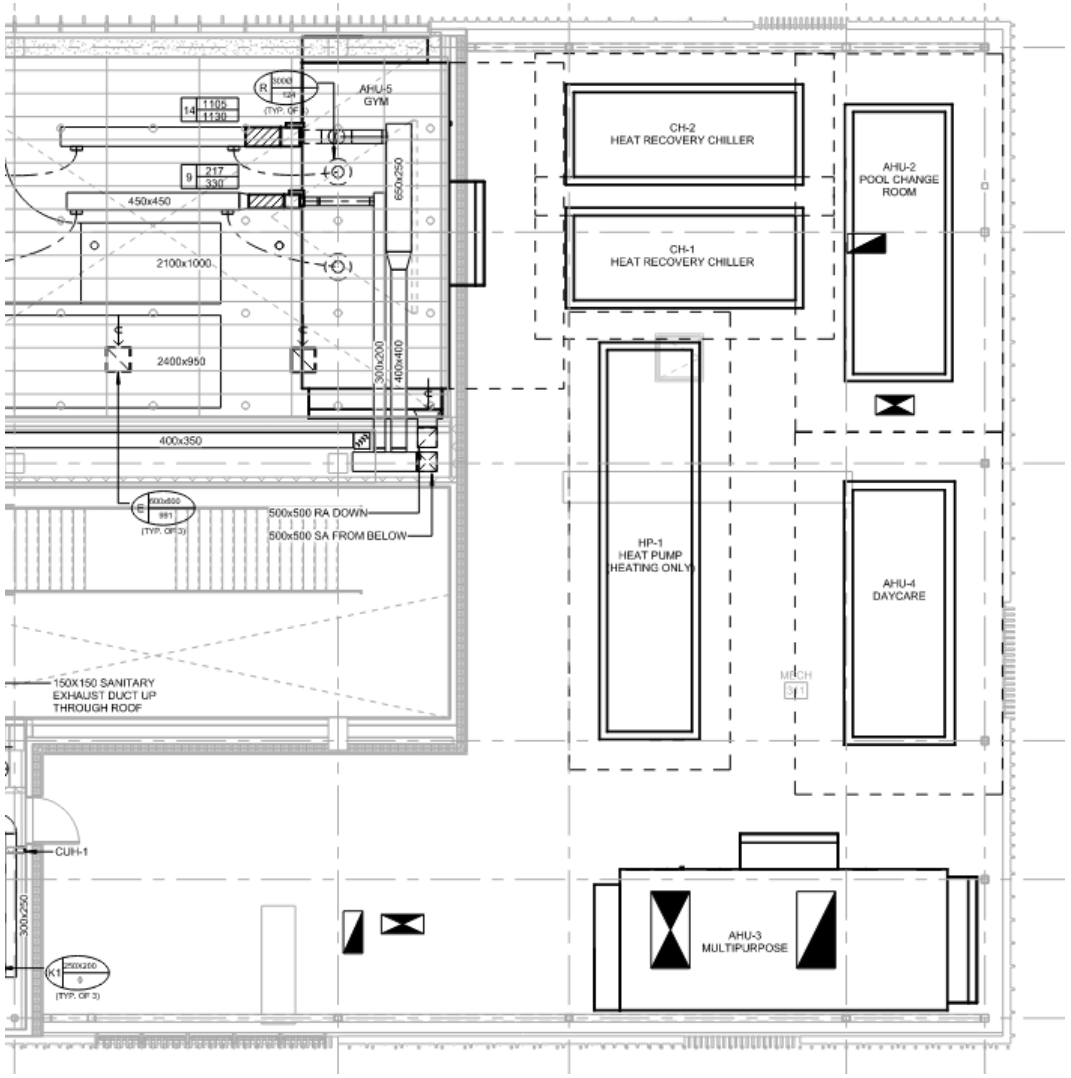




Active Systems: Air Source Heat Pumps

Capital Cost : 2-3% of Div 3-33 cost

Energy Savings: ~ 30.4%



In Progress Roof Mech Well Layout

Strategy M9: 85% Heat Recovery Efficiency

Capital Cost: ~0.5% of Div 3-33 cost

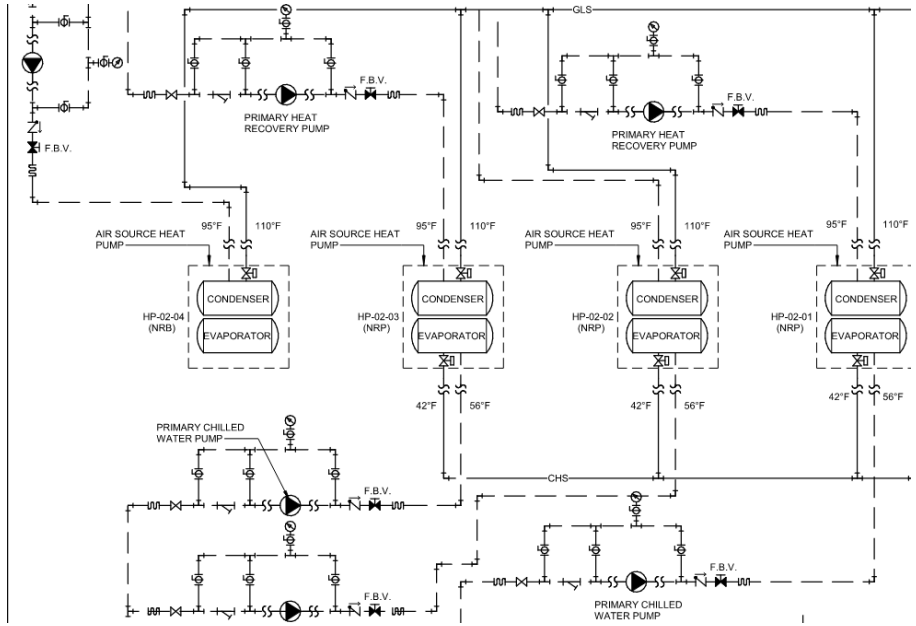
Energy Savings: ~1.6%

Strategy M10: Drain Heat Recovery

Capital Cost: 0.8% of Div 3-33 cost

Energy Savings: ~8.2%

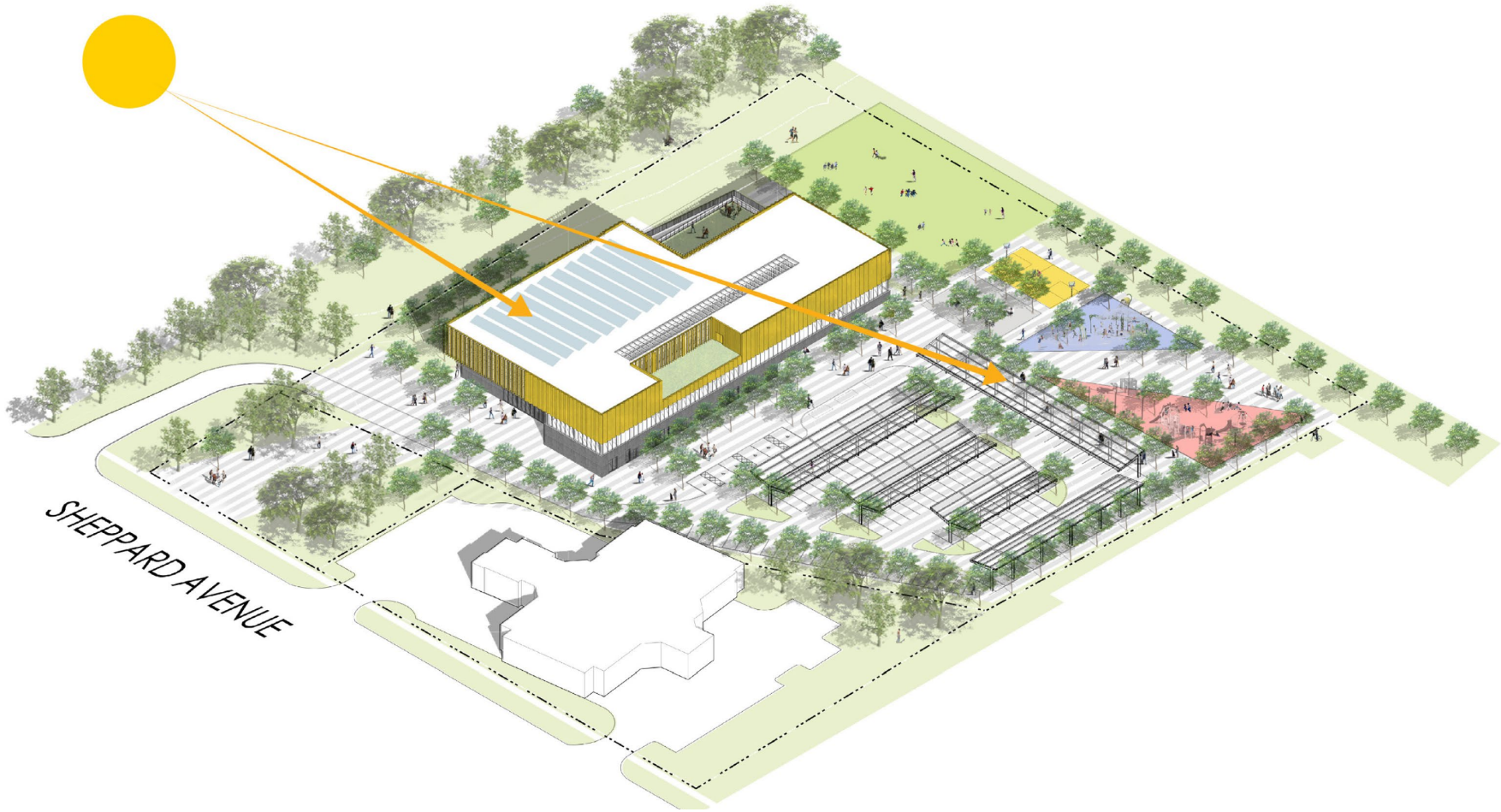
- Drain heat recovery system designed to operate continuously to transfer heat from outgoing warm pool drainage water to incoming domestic cold pool fill water.



Strategy E1.1: PVT Roof Panels

1. Roof PVT (Photovoltaics Thermal Hybrid) Panels:

Solar cogeneration system generating electricity and heat simultaneously



Capital Cost: ~1% of Div 3-33 cost

Energy Savings: ~23%

- 460 PVT Panels, 315W rated

Configuration	Configuration	Annual Energy Generation
DualSun Spring Hybrid Solar Panel (PVT)	Rated 315W Hybrid Solar Panels (PVT), Tilt 10 degrees, 460 panels	Electricity Generation: 176,010 kWh
		Thermal Generation: 349,753 kWh

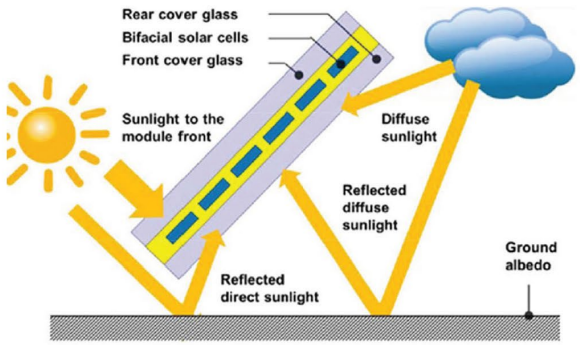
NZEE Progress Update

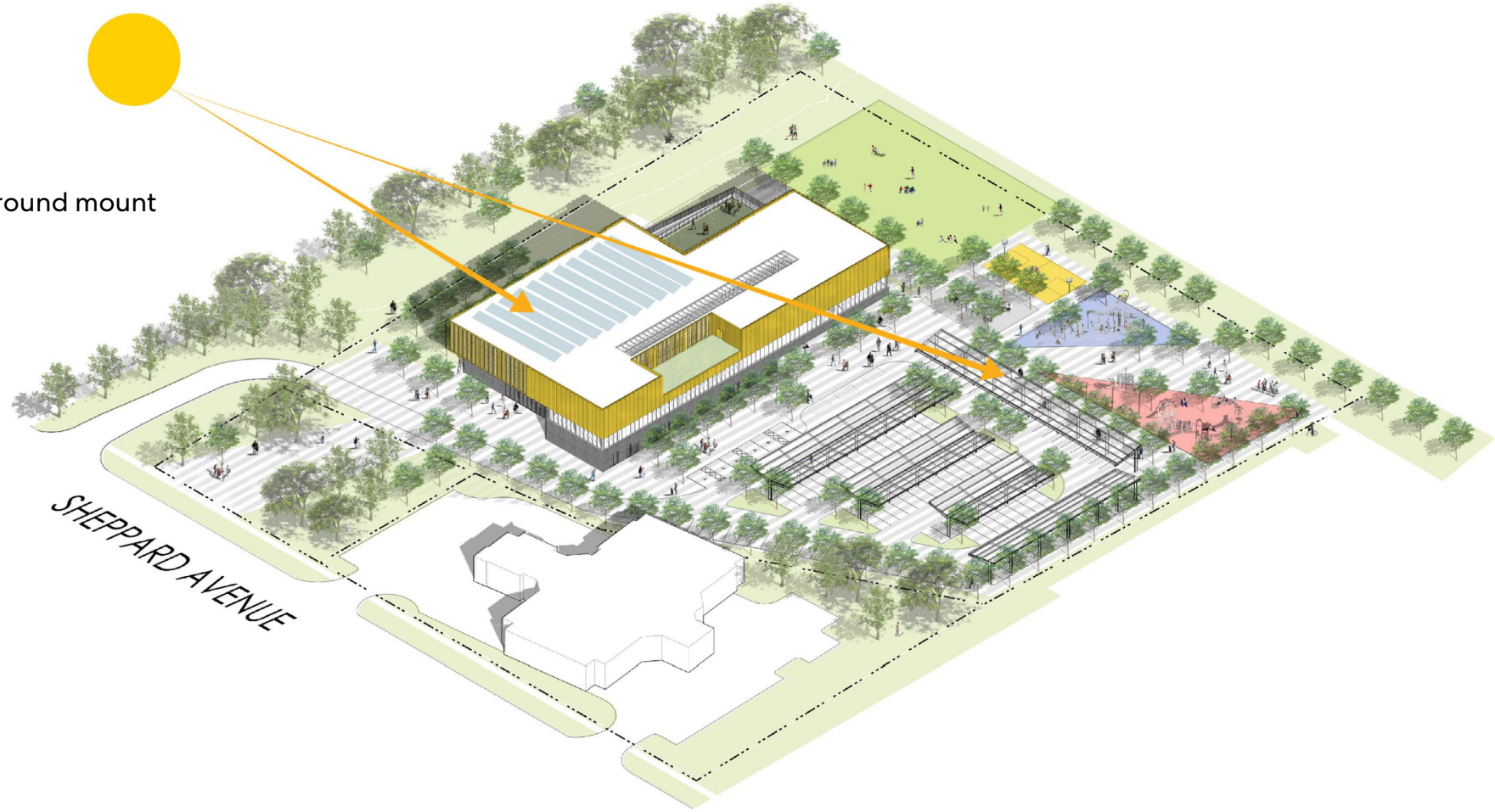
Strategy E1.2b: Bifacial PV Parking Panels

Capital Cost: ~3% of Div 3-33 cost

Energy Savings: 23% (Annual generation: 747,000 kWh)

- Parking lot canopy PV panels:
  - 820 panels, Coverage: 1640 m^2
  - Annual generation: 414,787kWh
- North site edge PV panels:
  - 600 panels, Coverage: 1200 m^2
  - Annual generation: 325,914kWh (ground mount installation)





2. Bifacial PV Parking Lot Canopy:

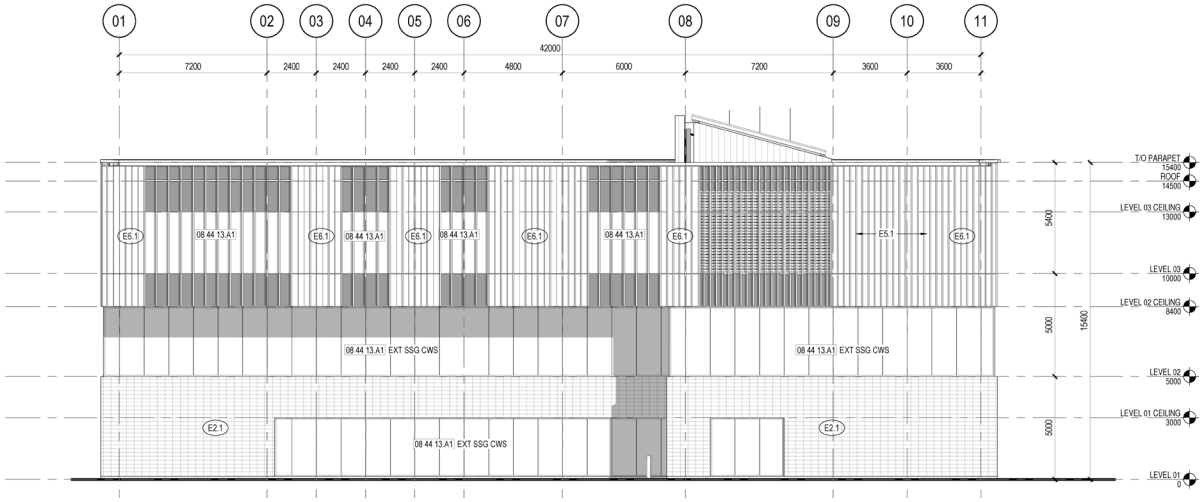
PV modules located on both sides of PV panel to increase overall power production per panel

Strategy E1.3: BIPV on South Façade Glazing

Capital Cost: ~0.5% of Div 3-33 cost

Energy Savings: 2% (152 panels, Annual Generation: 35,600kWh)

- 250 panels BIPV (onyx spandrel) to be applied on south and west façade spandrel panels
- Annual generation: 65,716kWh



South Elevation

West Elevation

Onyx Spandrel PV

Strategy: Airtightness Enhancements & Testing

City's responsibilities:

- Engage a Commissioning Authority
- Third party verification (TGS Verifier / CaGBC Zero Carbon Building)
- Retain Air tightness testing company

GHG 4.3 Air Tightness Testing

Conduct a whole-building Air Tightness Test to improve the quality and airtightness of the building envelope.

Best practice for envelope air tightness testing:

- Leakage testing to max 1.0 L/s-m² @ 75 Pa
- Integration of construction phase testing requirements into specifications (incl Building Envelope Coordinator with min experience & Passivehouse credentials)

Image Credit: Skanka

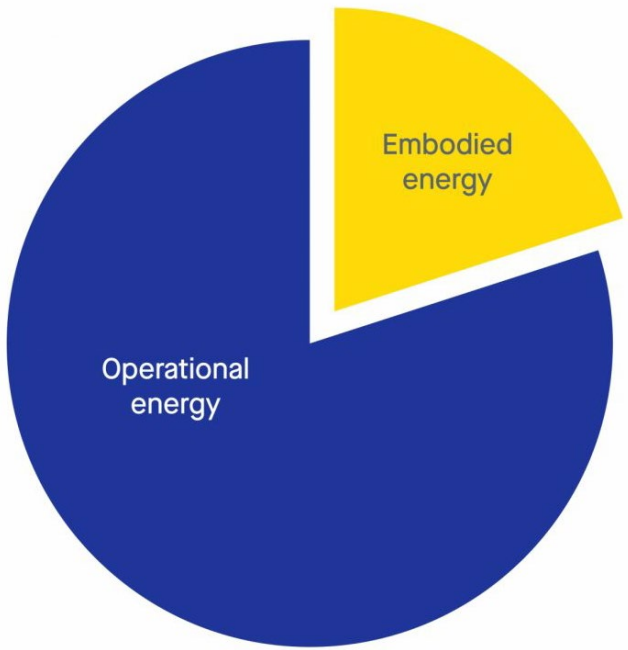
Embodied Carbon

Manufacture, transport and
installation of construction materials

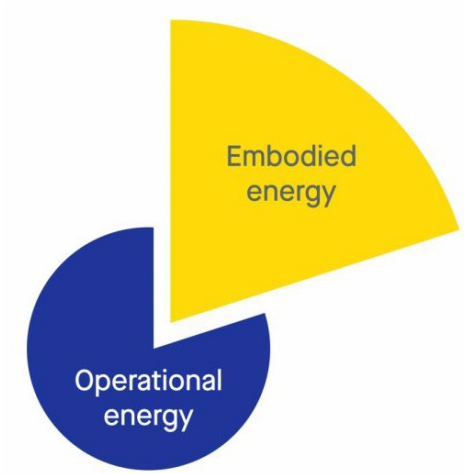
Operational Carbon

Building energy consumption

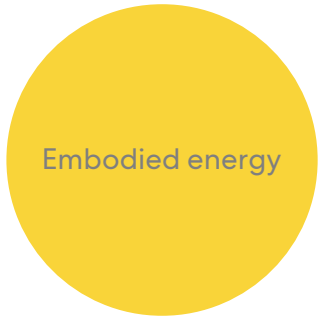
Why is Embodied Carbon Important?



Typical Building



High Performance Building



Net Zero Energy and Emissions Building

What is included in the Analysis?

All envelope and structural elements per CaGBC, including:

Structural

- Footings
- Foundations
- Structural floors and ceilings
  (not including finishes)
- Stairs

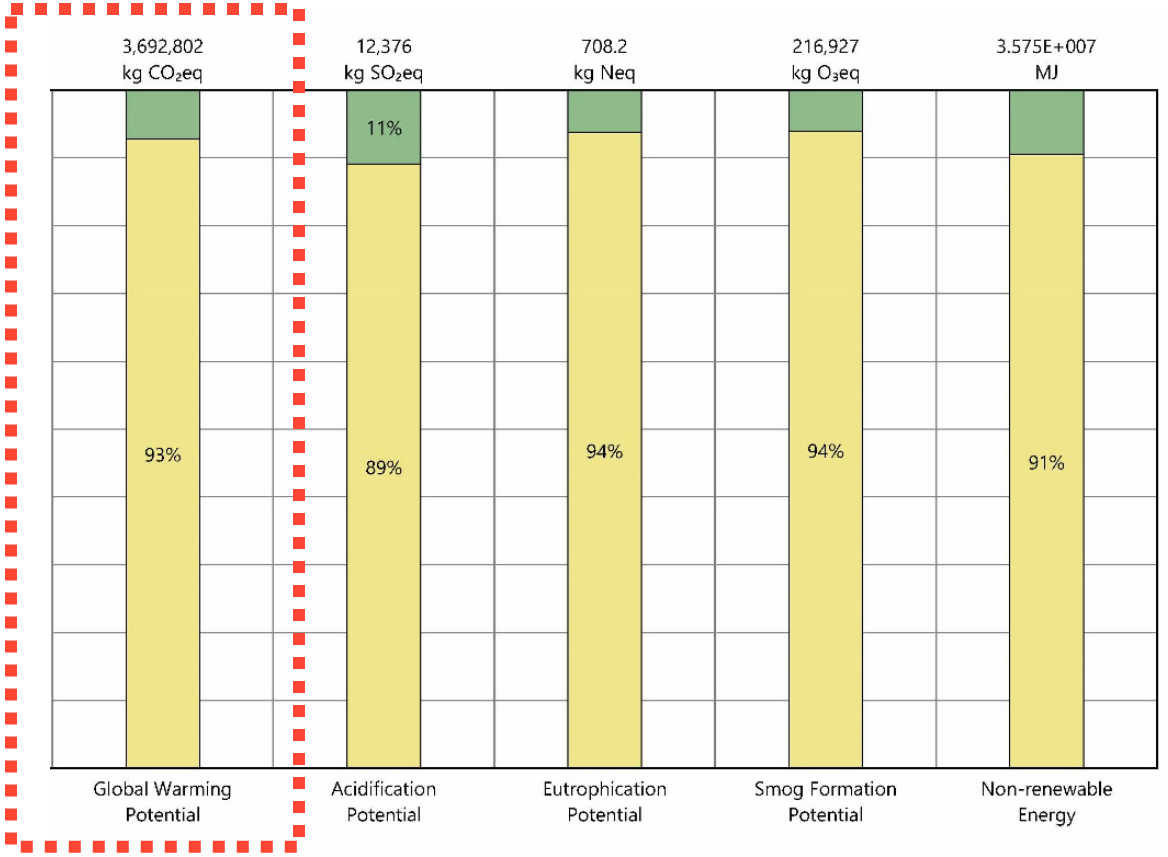
Architectural

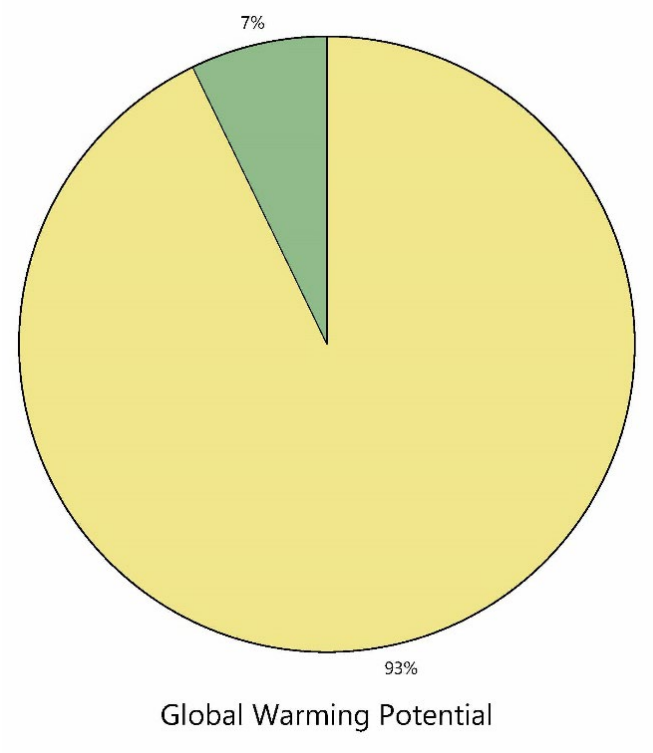
- Complete structural wall assemblies
  (from cladding to interior finishes, including basement)
- Roof assemblies

Components	Baseline GWP (kgCO2eq)	Proposed GWP (kgCO2eq)	Reduction
20 – 25 MPa concrete	390,408.87	220,716.62	43%
30 MPa concrete	1,015,763.25	553,220.14	46%
35 MPa concrete	2,216,283.46	1,207,380.13	46%
Remaining structural components	1,619,395.24	1,619,395.24	0%
Architectural materials	1,493,498.33	1,493,498.33	0%
		Total reduction	**24%**

Too late to impact envelope by study start

Results, Structural





Total Embodied Carbon

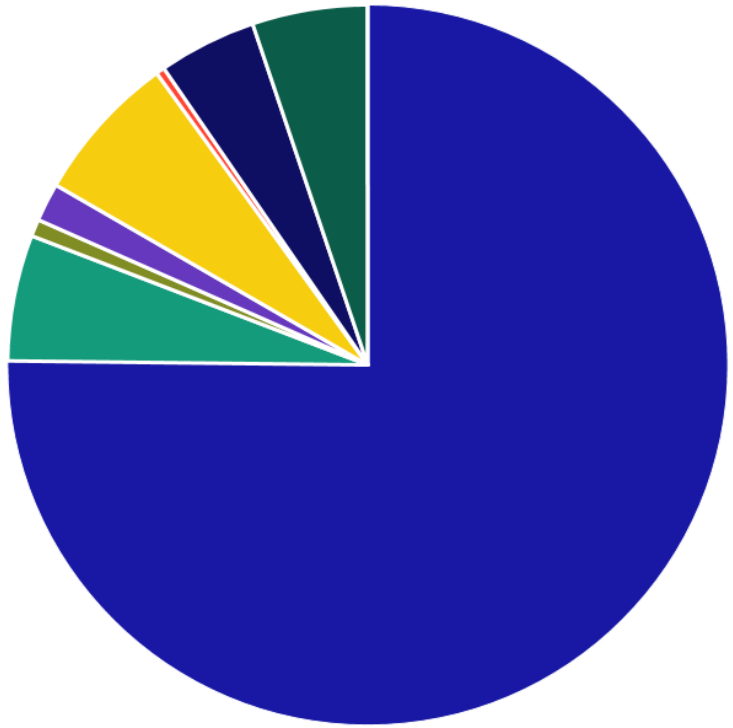
Northeast Scarborough:

526 kgCO2eq/m^2
(without reductions implemented)

Then 24% reduction to 400

Typical Community Centres:

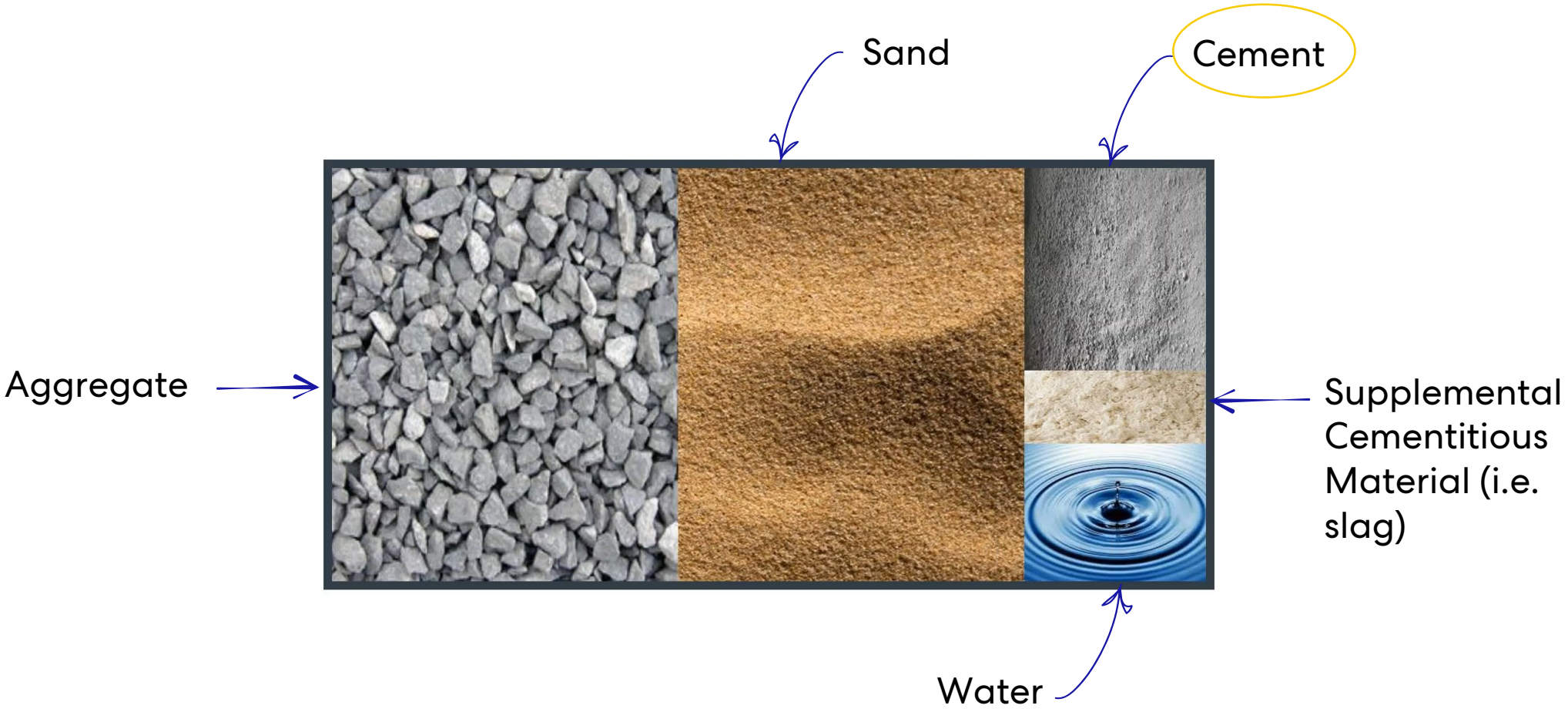
~605 kgCO2eq/m2*



1 ■ Structure - Concrete
■ Architectural - Concrete
■ Architectural - Metals
■ Architectural - Thermal and Moisture Protection
■ Architectural - Finishes

2 ■ Structure - Metals
■ Architectural - Masonry
■ Architectural - Wood
■ Architectural - Openings and Glazing

Concrete, by weight

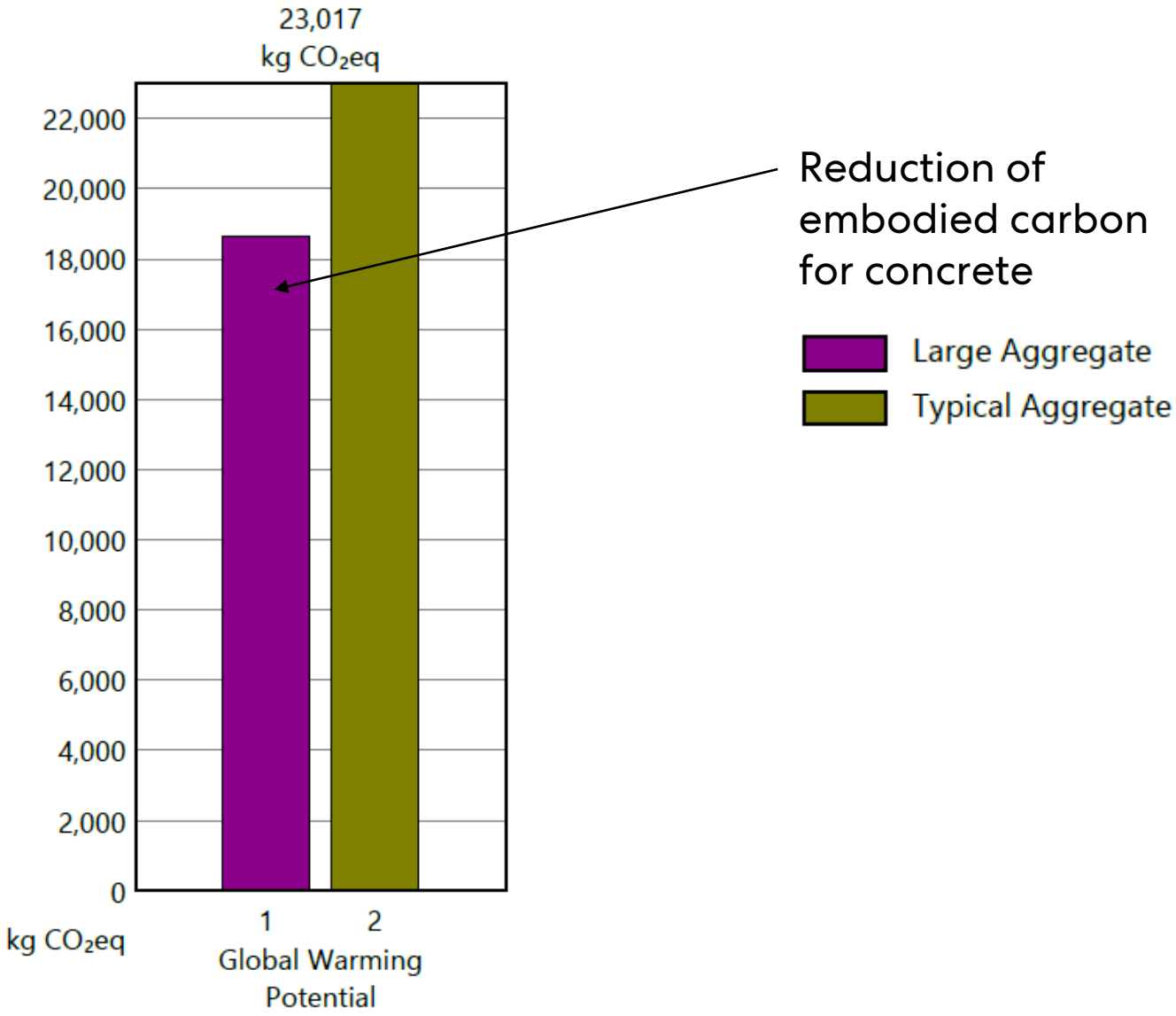


Concrete, by embodied CO2

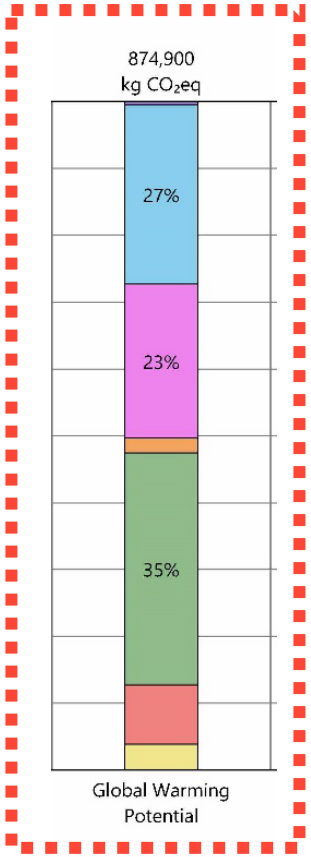
Carbon Reductions, Concrete - Aggregate

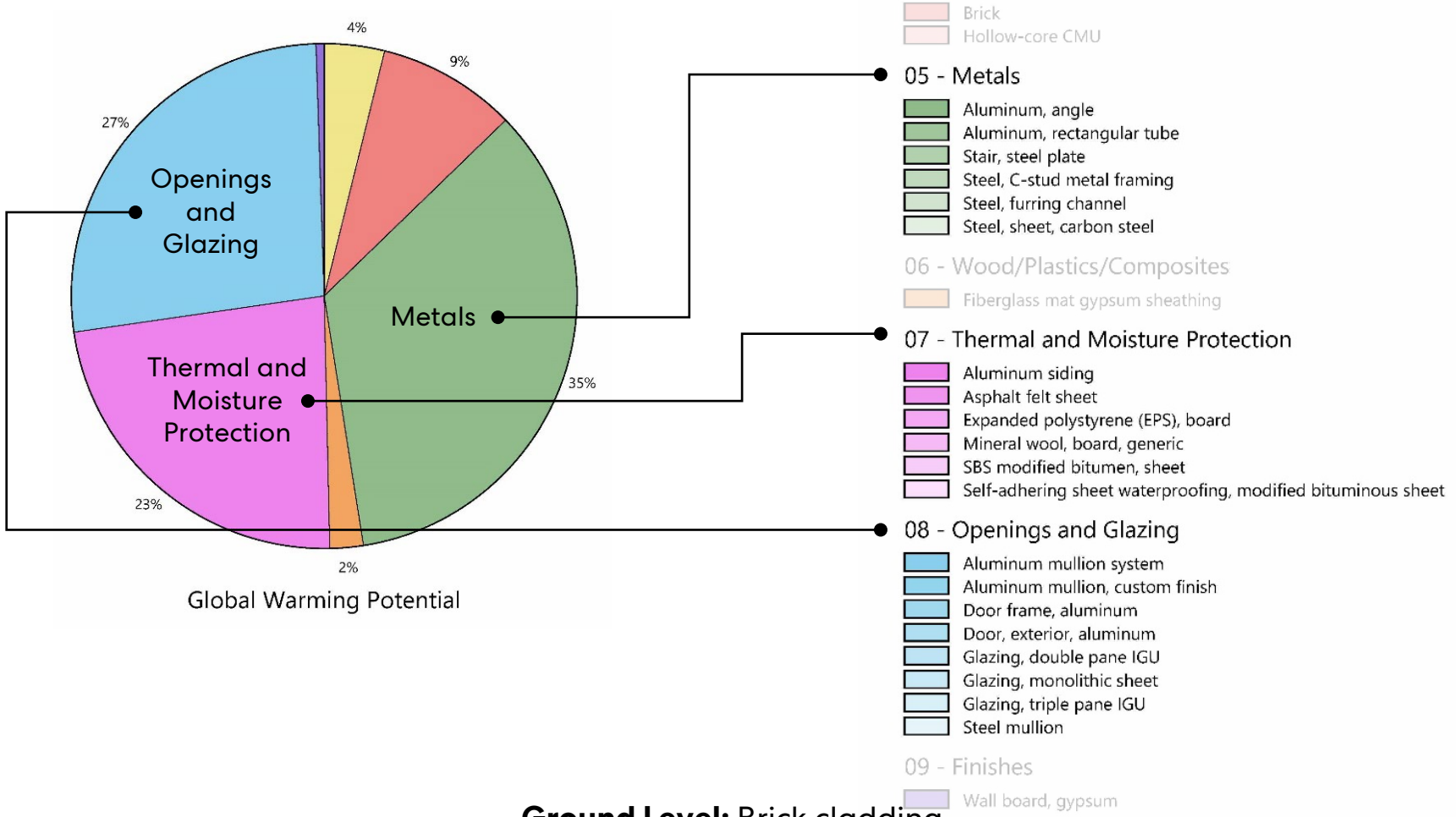
Some strategies:

- Reduce cement content by 10% = ~10% reduction
- increase aggregate (whether in size or by quantity) by 10% =~10% reduction
- Substitute GU with GUL (Portland Limestone Cement) =~10% reduction



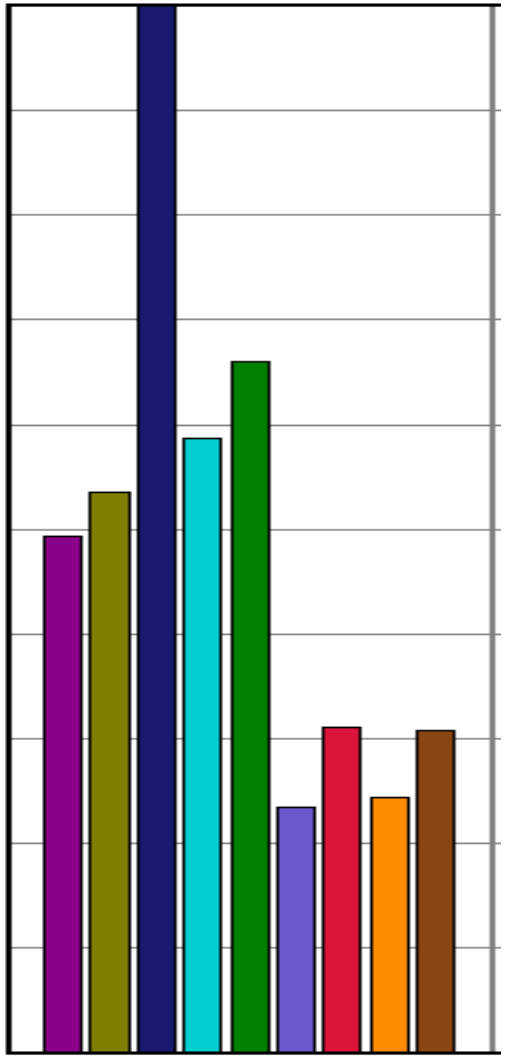
Results, Architectural





Ground Level: Brick cladding
Second Level: Curtain wall and spandrel , triple glazing
Third Level: Painted Gold Aluminum Corrugated Panel Cladding

General Façade Study



Legend

Design Options

- 40mm Stone
- 90mm ACMU
- 90mm Brick
- 90mm Concrete Panel
- ACM
- Insulation and AVB
- Limestone Veneer
- Porcelain Panel
- Prefinished Metal Siding

Specifying steel that is fabricated from an electric arc furnace (EAF) instead of basic oxygen furnace (BOF):

EAF

- Average 93% recycled content (can be up to 100%)
- Same performance
- EAFs are powered by electricity rather than natural gas (+ coal, depending on location!), can be powered by renewable energy sources
- Produce less than half as much CO2 as BOF
- Used for hot rolled shapes (wide-flange members, angles, rebar)

BOF

- Average 25% recycled content
- Burns natural gas (+ coal, depending on location!)
- Virgin steel can have an embodied carbon footprint that is 5x greater than recycled steel
- Used for hollow structural shapes (HSS) and metal deck

DESIGN PHASE LESSONS LEARNED

- Make decisions around targets as early as possible
- Enable timely decision-making by providing full and clear picture of cost and lifecycle impacts
- Set up multi-disciplinary brainstorming session ~~early~~ at start of design
- Develop SD energy model for initial benchmarking and testing
- Assess technical and operational potential of key strategies early in design

Questions?

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