SITE & LOCATION

Greater Toronto Area

Lake Ontario

1. Newmarket
2. Aurora
3. Richmond Hill
SITE PLAN

Site area: 325 hectares
Building Area: 41,660 ft² (3,870 m²)
OUR VISION

Present

Proposed

Future
**Design Goals Set & Achieved**

- **Net-0 Operational & Lifetime Carbon**
- **Net-0 Energy**
- **Net-0 Water**
- **Disassembly & Reassembly**
- **Occupant Health & Wellbeing**
- **Educate**
- **Circular Economy**
- **Minimal Impact on land & Positive Community Contribution**
EXTERIOR DESIGN

- West Façade
  - WWR: 28%

- East Façade
  - WWR: 29%

- South Façade
  - WWR: 33%

- North Façade
  - WWR: 7%

Materials:
- Vertical Wood Siding
- Transparent Glass
- Mirrored Exterior Finish

Architectural Façades:
- Vertical Wood Siding
- Transparent Glass
- Mirrored Exterior Finish
BUILDING PROGRAM PRINCIPLE

Introduction
Architecture
Engineering
Energy Performance
Durability and Resilience
Embodied Environmental Impact
Comfort and Environmental Quality
Occupant Experience
Integrated Performance
Market Analysis
Conclusion
Interior Renders

Ground floor multi-purpose conference hall

Ground floor service room and main staircase

View from second floor main staircase

View of green wall from second floor
INTERIOR RENDERS

View of second floor private offices

View from fourth floor open workstations

View of third floor open workstations

View from top of fourth floor main staircase
**STRUCTURE**

Concrete Precast Panel cores

Glue-Laminated Timber (GLT) Beams

Glue-Laminated Timber (GLT) Columns

Timber Concrete Composite (TCC) floors

Concrete Piles
Panelized Modular Envelope Construction

SOUTH ELEVATION

EAST ELEVATION

NORTH ELEVATION

WEST ELEVATION
## Envelope Control Layers

**Roof R-value**: 45 ft²°F·h/BTU (RSI VALUE: 8 m²K/W)

**Wall R-value**: 47 ft²°F·h/BTU (RSI VALUE: 8.3 m²K/W)

**Window R-value**: 7 ft²°F·h/BTU (U VALUE: 0.8 W/m²K)

**Ground Floor R-value**: 46 ft²°F·h/BTU (RSI VALUE: 8.2 m²K/W)
HVAC SYSTEMS SIMULATED THROUGH OPEN STUDIO

Energy Use Intensity of Proposed Model vs. Alternative HVAC systems

- DOAS+ERV+ASHPs+VRF
- DOAS+FAN COIL CHILLER WITH CENTRAL ASHPs
- DOAS + FCU
- GSHP DOAS
- DOAS+WSHP+GSHP
# Building Energy Simulation

A baseline represents a typical modern building. (EUI before renewables).

Target EUI is 20 based on an 82% reduction.

<table>
<thead>
<tr>
<th>Source EUI</th>
<th>Conversion Factor 1</th>
<th>Conversion Factor 1.96</th>
<th>Solar Decathlon Requirement</th>
<th>Toronto Green Standard (TGS) Tier 4 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 kBu/tf² (62 kWh/m²)</td>
<td>39 kBu/tf² (123 kWh/m²)</td>
<td>96 kBu/tf² (303 kWh/m²)</td>
<td>—</td>
</tr>
<tr>
<td>Site EUI</td>
<td>20 kBu/tf² (62 kWh/m²)</td>
<td>—</td>
<td>20.4 kBu/tf² (65 kWh/m²)</td>
<td>—</td>
</tr>
<tr>
<td>TEDI</td>
<td>4.4 kBu/tf² (14 kWh/m²)</td>
<td>—</td>
<td>4.7 kBu/tf² (15 kWh/m²)</td>
<td>—</td>
</tr>
<tr>
<td>GHGI</td>
<td>0.5 lbCO₂e/ft² (2.2 kgCO₂/m²)</td>
<td>—</td>
<td>0.91 lbCO₂e/ft² (4 kgCO₂/m²)</td>
<td>—</td>
</tr>
</tbody>
</table>

### Building Summary

- **Location**: Vaughan, ON
- **Uses**: Office
- **Size**: 33,262 sq.ft (100.0%)

### Results

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Your Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUI % Reduction from Baseline</td>
<td>0%</td>
<td>82%</td>
</tr>
<tr>
<td>Zero Score</td>
<td>100</td>
<td>19</td>
</tr>
<tr>
<td>Site EUI (kBtu/yr)</td>
<td>107</td>
<td>20</td>
</tr>
<tr>
<td>Source EUI (kBtu/yr)</td>
<td>167</td>
<td>31</td>
</tr>
</tbody>
</table>
SIMULATION RESULTS

Energy Use Breakdown

- 11% Space Heating
- 12% Space Cooling
- 24% Lighting
- 15% Equipment
- 6% Fans
- 11% Miscellaneous
- 3% Water Heating

Plug Load Densities:
0.28 W/ft² (3.0 W/m²)

Lighting Power Densities:
0.5 W/ft² (5.4 W/m²)
Renewable Energy Generation

Energy Performance

- Architecture
- Engineering
- Energy Performance
- Durability and Resilience
- Embodied Environmental Impact
- Comfort and Environmental Quality
- Occupant Experience
- Integrated Performance
- Market Analysis
- Conclusion
## Annual Production

<table>
<thead>
<tr>
<th>Production (MWh)</th>
<th>Production (Kbtu/hr)</th>
<th>Tilt</th>
<th>Number of PV Panels</th>
<th>Power (kw)</th>
<th>Power (Kbtu)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Top</td>
<td>85</td>
<td>38°</td>
<td>124</td>
<td>70</td>
<td>239</td>
<td>Canadian Solar</td>
</tr>
<tr>
<td>Carport</td>
<td>252</td>
<td>0°</td>
<td>400</td>
<td>228</td>
<td>778</td>
<td>Canadian Solar</td>
</tr>
<tr>
<td>Shading</td>
<td>19</td>
<td>0°</td>
<td>60</td>
<td>70</td>
<td>239</td>
<td>Solaronix</td>
</tr>
<tr>
<td>Total</td>
<td>356</td>
<td></td>
<td></td>
<td>357</td>
<td>1,217,031</td>
<td></td>
</tr>
</tbody>
</table>

| EUI after Renewables | - 45.6 kwh/m² | - 14.5 kbtu/hr ft² | Net positive |

---

**Electricity Production (on-site) Vs. Energy Consumption**

- **Annual Solar Production (Kbtu/h):** 1,217,031
- **Annual Building Consumption (Kbtu/h):** 701,308

**Solar Energy generation Vs. Building energy demand**

- **Solar Production (Kbtu/h):**
  - January: 20,000
  - February: 40,000
  - March: 60,000
  - April: 80,000
  - May: 100,000
  - June: 120,000
  - July: 140,000
  - August: 160,000
  - September: 180,000
  - October: 200,000
  - November: 220,000
  - December: 240,000

- **TRCA Building Usage (Kbtu/h):**
  - January: 1,200,000
  - February: 1,250,000
  - March: 1,300,000
  - April: 1,350,000
  - May: 1,400,000
  - June: 1,450,000
  - July: 1,500,000
  - August: 1,550,000
  - September: 1,600,000
  - October: 1,650,000
  - November: 1,700,000
  - December: 1,750,000

**Net positive**
Self Sustaining Building - Net-O Energy & Water

<table>
<thead>
<tr>
<th>Total Greywater Demand (Washroom + Irrigation)</th>
<th>Total potable water demand (Kitchen+Dishwasher+ showers+ Washroom Sinks)</th>
<th>Rooftop Collection</th>
<th>Underground Wells</th>
<th>Total annual water demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>392 m$^3$/yr</td>
<td>692 m$^3$/yr</td>
<td>643 m$^3$/yr</td>
<td></td>
<td>1,084 m$^3$/yr</td>
</tr>
<tr>
<td>103,555 gal./yr</td>
<td>182,807 gal./yr</td>
<td>169,863 gal./yr</td>
<td></td>
<td>286,363 gal./yr</td>
</tr>
<tr>
<td>Filtered using Filter 2</td>
<td>Filtered using Filter 1</td>
<td>Filtered using Filter 2</td>
<td>Filtered using Filter 1</td>
<td></td>
</tr>
</tbody>
</table>

Table: Potable and non-potable water demand of the building

Water Generating systems
ELEVATED BUILDING STRUCTURE

DISASSEMBLY & REASSEMBLY

Unique QR code “tag” for all materials

Elevated 15 inches from the ground since the site is a possible future flood plain
GLOBAL WARMING: CRADLE TO GRAVE

Cradle to grave (A1-A4, B4-B5, C1-C4) | kg CO₂e/m²
--- | ---
(< 130) | A
(130-250) | B
(250-370) | C
(370-490) | D
(490-610) | E
(610-730) | F
(> 730) | G

Material Recovered | 88.7%
Mgmn | 11.3%
Renewable | 26.8%
Recycled | 10.8%
Reused | 51.1%

Material Returned | 67.4%
Reuse as material | 34.5%
Recycling | 0.3%
Downcycling 1/2 | 64.3%
Use as energy 1/2 | 0.9%
Disposal | 0%

Building Circularity | 78%
GLOBAL WARMING: RESOURCE TYPE

• Biogenic carbon storage value (Mass Timber) = 810,971 kg CO₂e (sequestering carbon)
• NET-Zero Energy Building = Zero Operational Carbon = Lifetime NET-Zero Carbon Building
AIR PURIFICATION - NATURAL VENTILATION & BIOPHILIC COMPONENTS

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A combination of natural ventilation and stack effect is demonstrated in the diagram. The green wall is a key component, and plants such as the Peace Lily, Boston Fern, and English Ivy are used to enhance the biophilic environment.

Cold Air

Warm Air

Natural Ventilation + Stack Effect
DAYLIGHTING

Spatial Daylight Autonomy (sDA)

Illuminance (lux)

Ground floor

Second floor

Third floor

Fourth floor

37.9% sDA
69.6% sDA
53.0% sDA
69.4% sDA

6.4% lux
412 lux
7.2% lux
412 lux

507 lux
542 lux
628 lux
920 lux
ARTIFICIAL CIRCADIAN LIGHTING

5000K LED A19 Light Bulbs

Slim Circadian LED Downlight

Circadian Zirc™ LEDs CZ4DR

FROVI Task Light

Circadian Zirc™ LEDs CZMX4UD

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Occupant Experience
INTEGRATED DESIGN PROCESS

Design Goals

Architect

Energy Modelling Lead

Project Manager

Building Envelope Lead

Renewable Energy & HVAC Lead

Integrated Performance

Market Analysis

Conclusion

Introduction

Architecture

Engineering

Energy Performance

Durability and Resilience

Embodied Environmental Impact

Comfort and Environmental Quality

Occupant Experience
• The cost is **10,436,930 USD** (251 USD/sq.ft - 316 CAD/sq.ft)
• Including energy efficient strategies, renewables and biophilic components.
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THANK YOU!

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