# Net Zero New Construction Design:

## Western North York Community Centre

TORONTO

# Agenda

1. Land Acknowledgement
2. Introductions:
    1. City of Toronto
    2. MJMA
3. Net Zero / TGS Version 4
4. Presentation by MJMA
5. 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:**

**Dorothy Chao**
Senior Energy Consultant, Energy & Environment Division, City of Toronto

**Panelists:**

**Cheryl Aleong-Spry**
Senior Project Co-Ordinator, Parks, Forestry & Recreation, City of Toronto

**Ted Watson**
Partner, MJMA Architecture & Design

**Jeanne Ng**
Principal, MJMA Architecture & Design

# Net Zero / TGS Version 4

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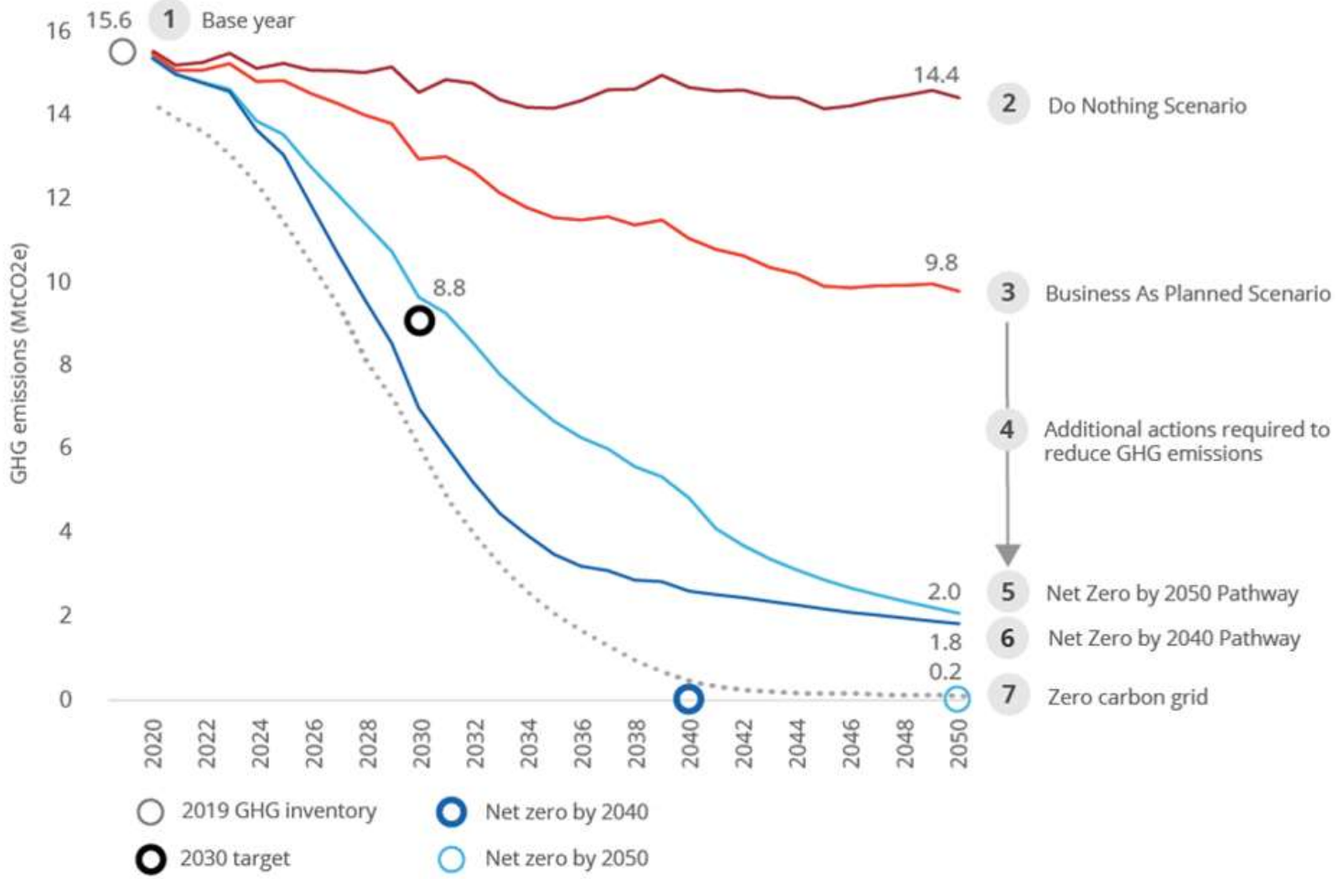
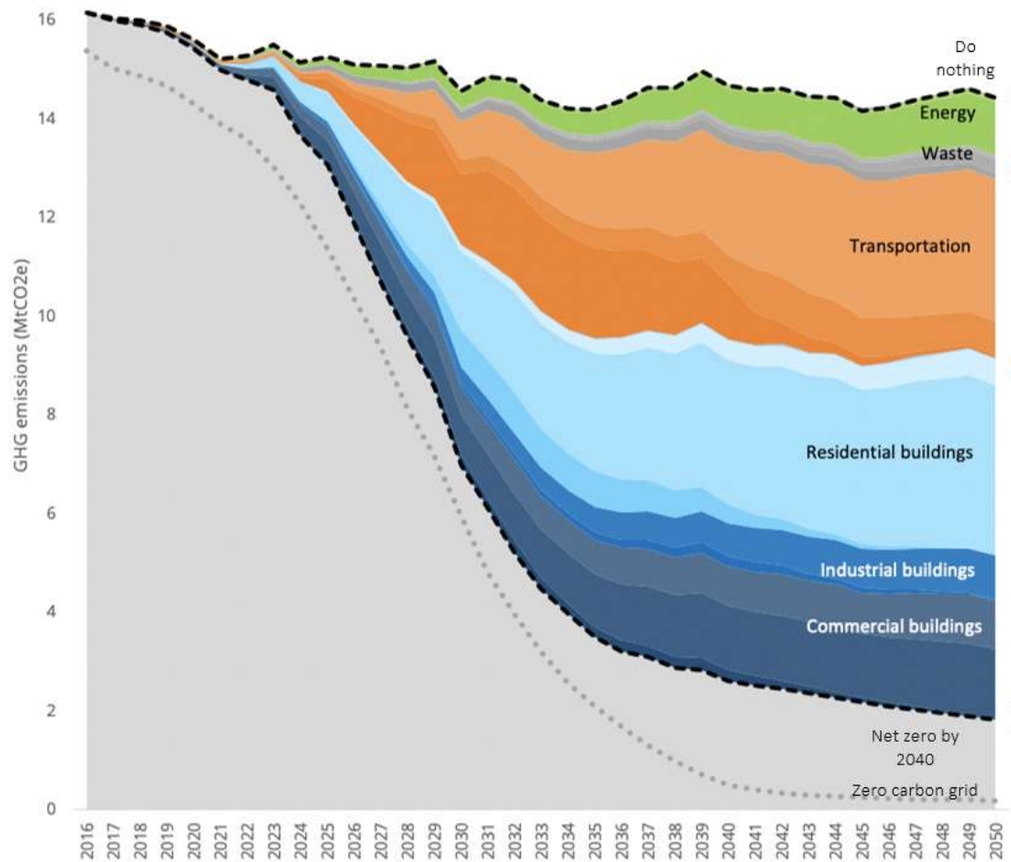
# Net Zero by 2040

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

# Net Zero by 2040



# A Path to Net Zero: Actions by Sector




**Renewable Energy**
- Solar PV & District Energy
- Renewable Natural Gas from waste
- Energy storage

**Sustainable transport**
- Electrify personal vehicles
- Electrify & enhance transit
- Promote active transportation

**Low Carbon Buildings**
- Residential retrofits & fuel switch
- Commercial retrofits & fuel switch
- Industrial retrofits & fuel switch
- Accelerated TGS for commercial & residential

**Grid decarbonisation**

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# Leading by Example

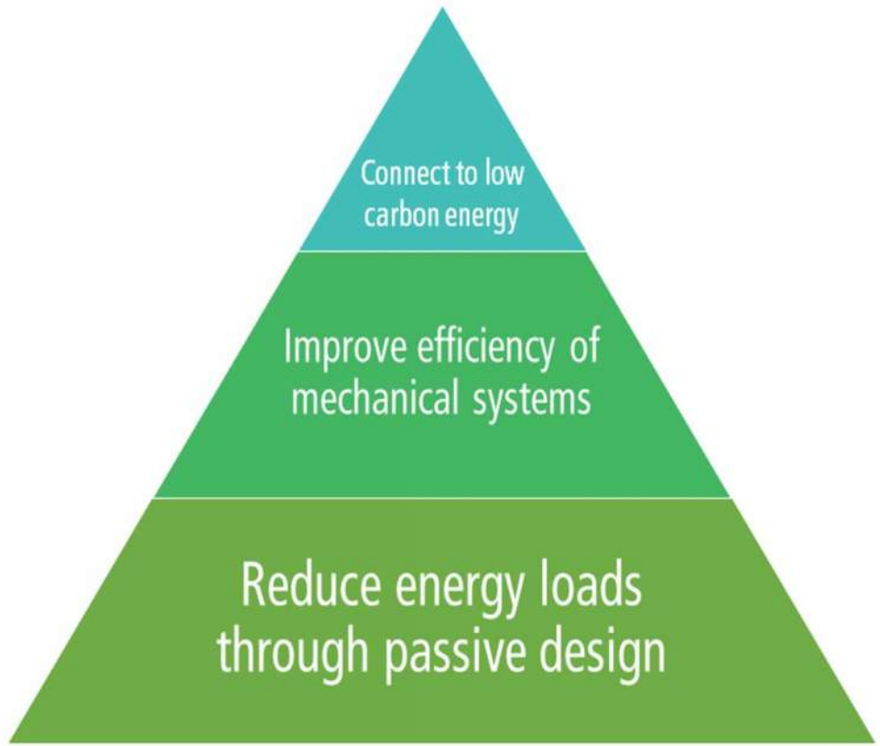
“All City Agency, Corporation and Division-owned new developments are designed and constructed to applicable Toronto Green Standard (TGS) Version 4 standard achieving zero carbon emissions, beginning in May 2022”

# Recommendations

- 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



# Western North York Community Centre

60 Starview Lane, Toronto

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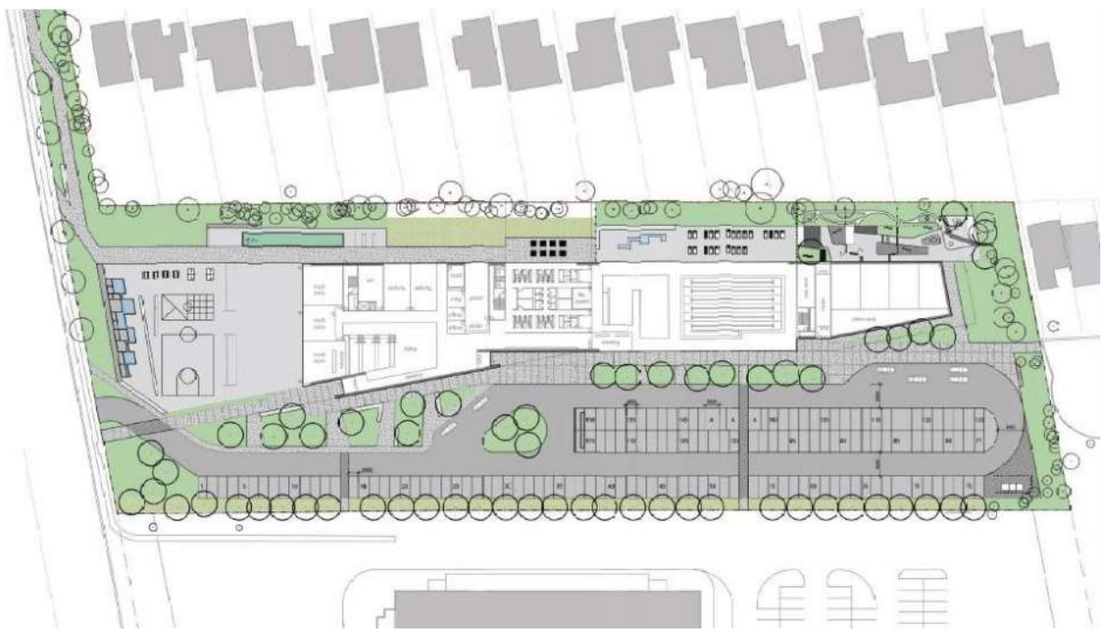
# Project Challenges and Solutions

## 1. Site

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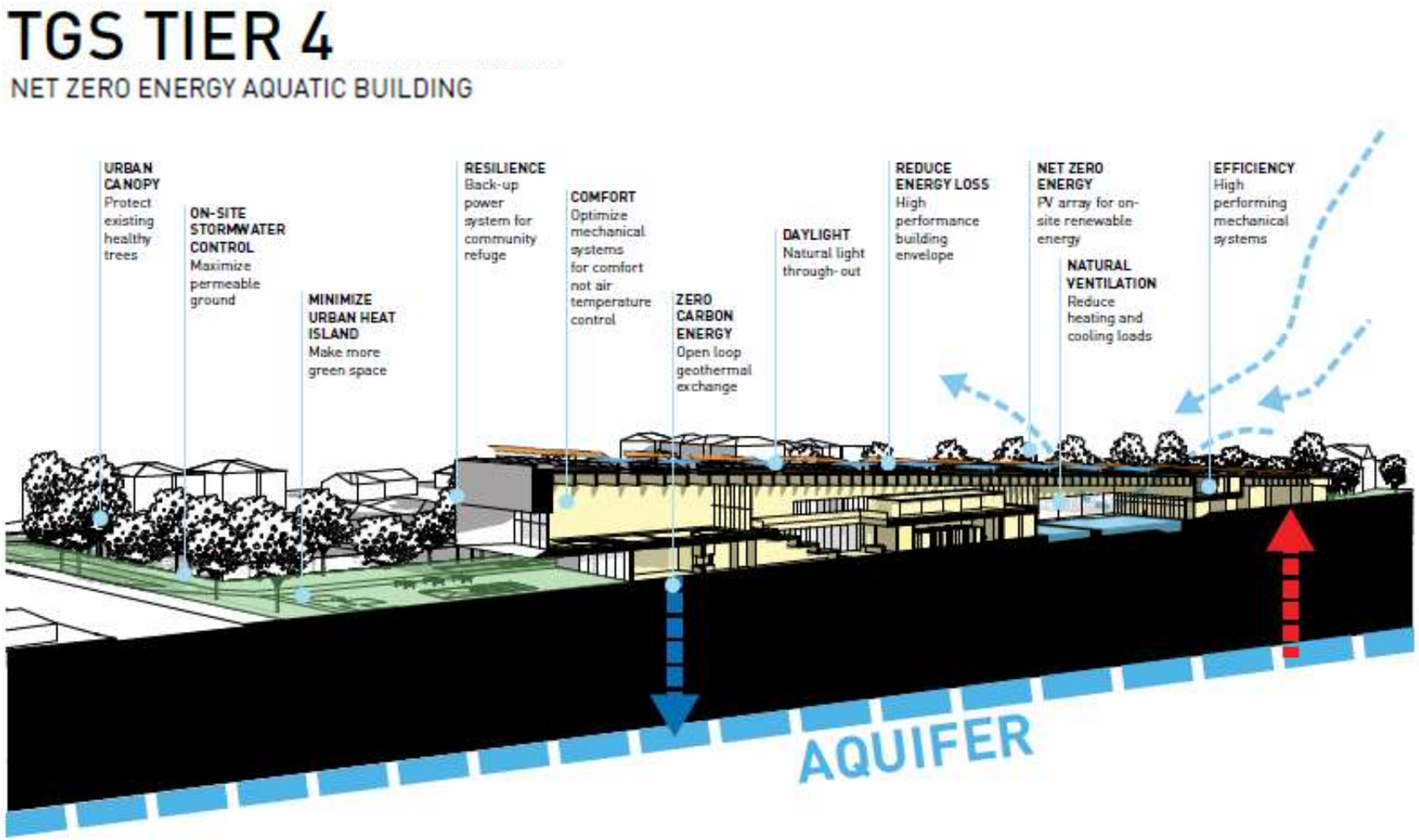
# Project Challenges and Solutions

## 2. Sustainable Targets

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# Project Challenges and Solutions

## 3. Public Engagement




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# Project Challenges and Solutions
## 4. Construction Budget

- Original construction budget was $34 million.
- To assist in the funding for the Net Zero Energy Feasibility Studies, the City applied for the Green Municipal Fund (GMF) offered through the Federation of Canadian Municipalities (FCM) and received grant approval.
- Based on the Class ‘C’ Cost Estimate, budget was insufficient to achieve the required TGS Version 3, Tier 2 requirements to meet Site Plan Approval, in addition to the targeted TGS Version 3,Tier 4.
- The Class ‘B’ Cost Estimates confirmed that due to COVID 19 and the unstable market and material shortages and supply, prices have exponentially increased and more funding would be required.

# Lessons Learnt

The Three “C”s

- Collaboration
- Communication
- Courage

# CASE STUDY
# Western North York Community Centre

Toronto, Ontario – MJMA Architecture & Design

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# MJMA Architecture & Design

## +30 Years Community Recreation


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Footprint

Smith + Andersen

EMC GROUP LIMITED

BORTOLOTTO
architecture + interior design

MJMA
ARCHITECTURE & DESIGN

Blackwell
Structural Engineers

SALAS O'BRIEN

CFMS
CONSULTING INC.

RDH

Autocase

SUTHEY HOLLER

CBER
CANADIAN BIOMASS ENERGY RESEARCH LTD
envint Consulting

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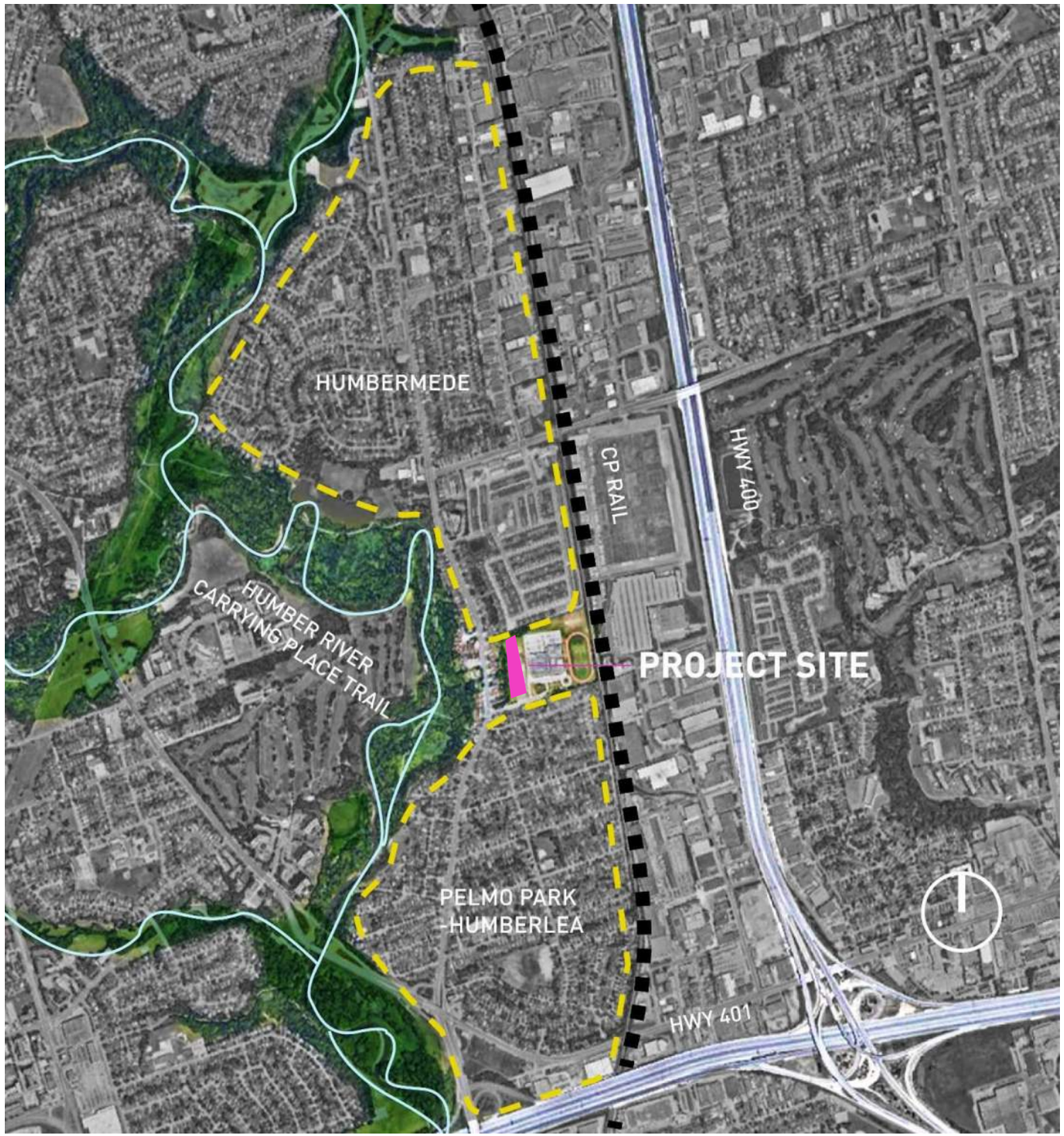
RDH

ha/f research studio

VCT GROUP

MANTLE
DEVELOPMENTS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PALACES FOR THE PEOPLE
HOW SOCIAL INFRASTRUCTURE CAN HELP FIGHT INEQUALITY, POLARIZATION, AND THE DECLINE OF CIVIC LIFE
EXTRA LIBRIS
ERIC KLINENBERG
"A BRILLIANT AND IMPORTANT BOOK."
—ARLIE RUSSELL HOCHSCHILD, AUTHOR OF STRANGERS IN THEIR OWN LAND
CP RAIL
PROJECT SITE
WESTON ROAD
STARVIEW LANE
HUMBER RIVER TRAIL
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# SITE IS CONSTRAINED RELATIVE TO PROPOSED PROGRAM

PROGRAM AREA
78,000 SF

PARKING

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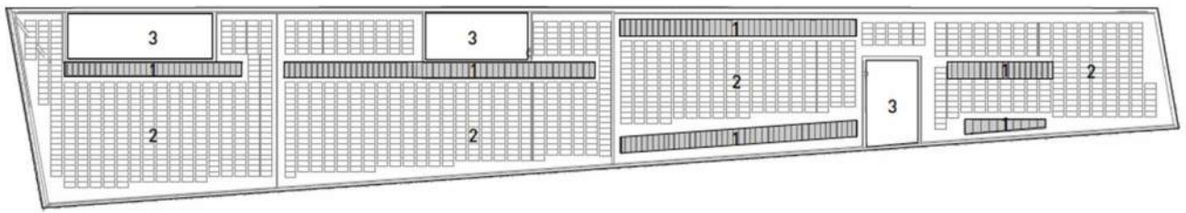
# Plans

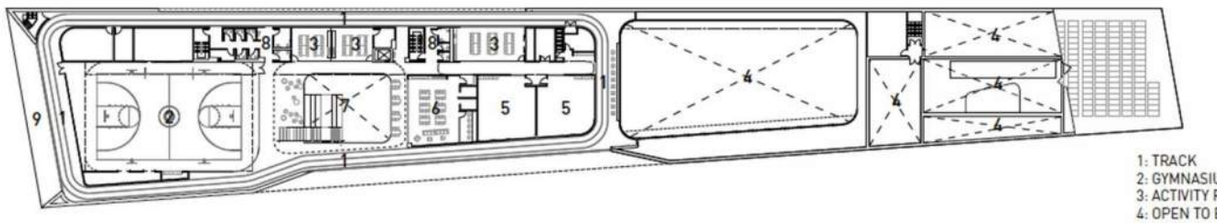
- Gym
- Aquatics
- Track
- Fitness Studios
- Community Spaces
- Childcare

USING DAYLIGHT TO
ORGANIZE MAJOR SPACES



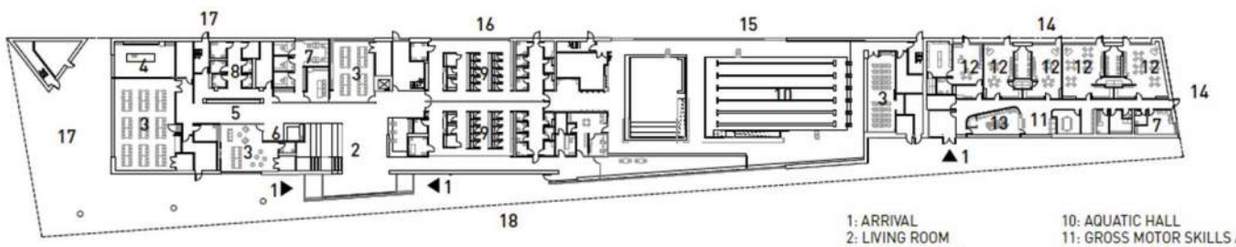
ROOF PLAN

1: SKYLIGHT
2: ROOFTOP PV SYSTEM
3: MECHANICAL WELL



SECOND LEVEL PLAN

1: TRACK
2: GYMNASIUM
3: ACTIVITY ROOM
4: OPEN TO BELOW
5: STUDIO
6: GAMING GARAGE
7: LIVING ROOM
8: ALL GENDER W/C
9: FITNESS TERRACE



GROUND LEVEL PLAN

1: ARRIVAL
2: LIVING ROOM
3: ACTIVITY ROOM
4: COMMUNITY KITCHEN
5: COMMUNITY GALLERY
6: COMMUNITY-RUN SERVERY
7: ADMINISTRATION
8: ALL GENDER W/C
9: UNIVERSAL CHANGEROOM
10: AQUATIC HALL
11: GROSS MOTOR SKILLS AREA
12: CHILDCARE PLAYROOM
13: OPEN KITCHEN
14: CHILDCARE PLAYGROUND
15: AQUATIC PATIO
16: GARDEN
17: ACTIVITY PATIO
18: COMMUNITY PROMENADE

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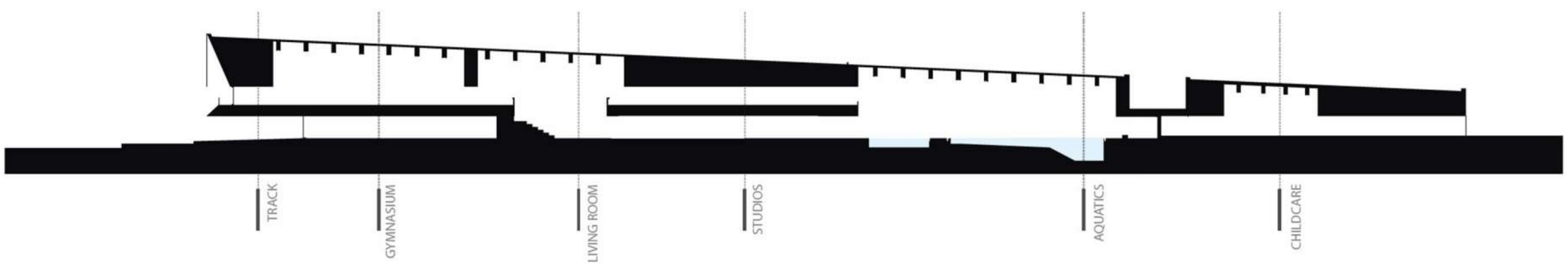
# Building Sections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# Setting Priorities




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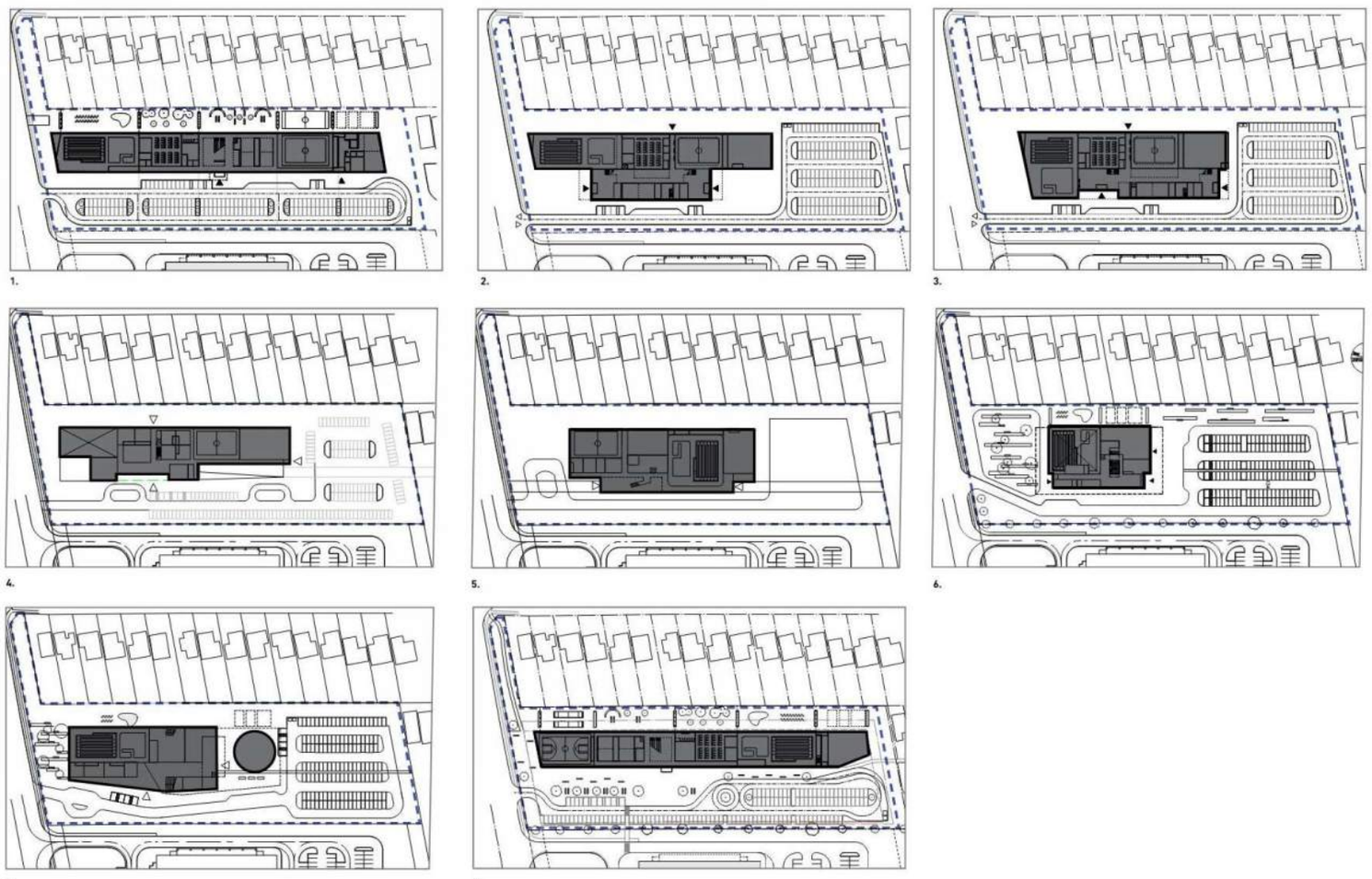
# Site Plan Studies

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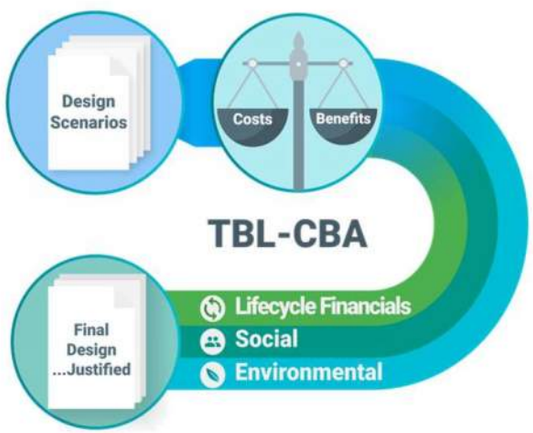
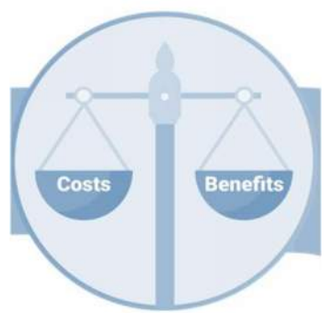
# Triple Bottom Line / Net Present Value

Autocase




- Capital Costs ($)
- Operating Costs ($)
- Maintenance Costs ($)
- Disposal Costs ($)




**Life Cycle Cost**
- Capital Savings
- O&M Savings (inc.subsidies)
- ↓ Energy costs
- Additional Revenue

**Soft Dollar Savings**
- ↑ Property value
- ↑ Rental premiums

**Non-Cash Performance**
- ↑ Productivity
- ↑ Tenant health
- ↓ Absenteeism

**Social & Environmental**
- ↓ Heat island effect
- ↓ Flood risk
- ↓ Local air pollution
- ↓ Carbon emissions
- ↑ Social value of water
- ↑ Water quality

Total Costs ($) | Discounting (%) | Total Benefits ($)

Net Present Value ($)

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# Site Plan Comparisons

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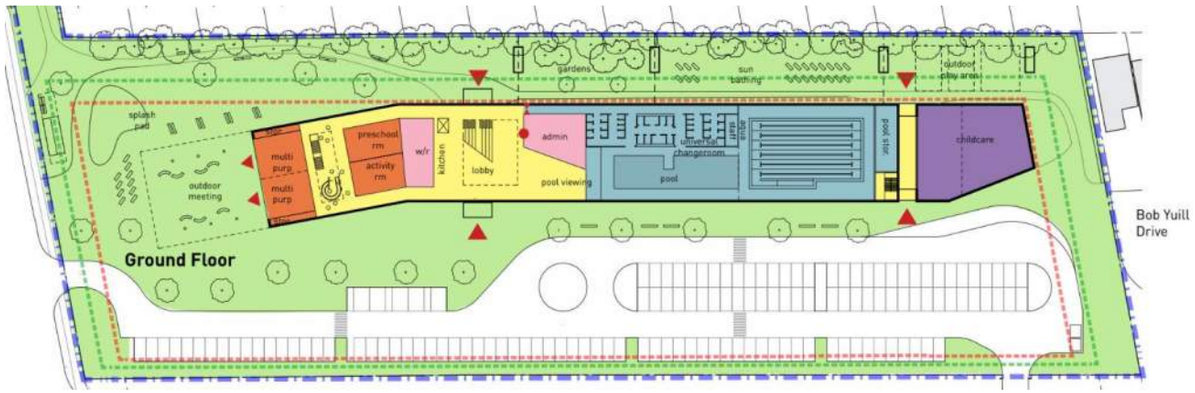


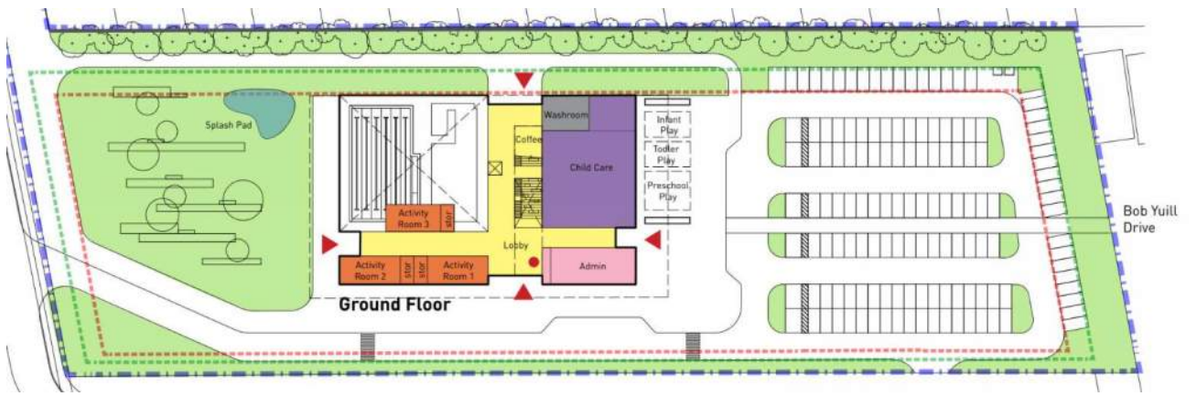


**Three Aspects of Site Comparison**:

Rainwater Capture Potential

Outdoor Recreation Offerings

Green Space/Hard Scape Comparison

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# Analysis Outcome

Autocase

| Crank vs Cube TBL-NPV Comparison | | | | |
|---|---|---|---|---|
| **Category** | **Impact Name** | **Mean Value** | **Low** | **High** |
| Financial | Financial Savings from Water | $1,408 | $1,408 | $1,408 |
| Social | Flood Risk | $15,261 | $15,261 | $15,261 |
| Social | Property Value | $1,376,478 | $1,373,843 | $1,379,051 |
| Social | Recreational Value | $30,404 | $23,426 | $44,194 |
| Social | Heat Island Effect | $21,070 | $11,172 | $31,162 |
| Environmental | Water Quality | $4,424 | $4,424 | $4,424 |
| Environmental | Social Value of Water | $254 | $254 | $254 |
| Environmental | Air Pollution Reduced by Vegetation | $9,327 | $6,772 | $12,104 |
| Financial Benefit | | **$1,408** | **$1,408** | **$1,408** |
| Social Benefit | | **$1,443,213** | **$1,423,702** | **$1,469,667** |
| Environmental Benefit | | **$14,005** | **$11,450** | **$16,782** |
| **Total TBL-NPV** | | **$1,458,626** | **$1,436,559** | **$1,487,857** |

## Comparative Analysis

- Preliminary values based on conceptual design options
- TBL-NPV analysis over 40 years of operation
- Large difference in property value uplift driving the comparison
- “Cranked” Bar performs better across all metrics considered
- Pollution reduction driving the environmental difference

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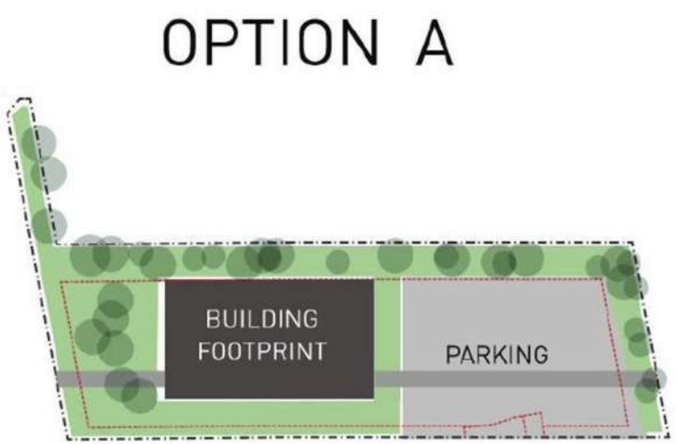
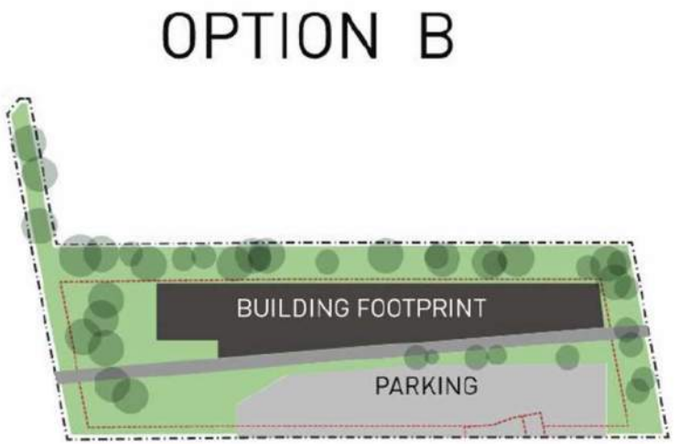
# Site Plan Outcome




PREFERRED OPTION

- **CONNECTS** pedestrian paths and provides visual connection through site
- **OPTIMIZES** usable green space
- **INCREASES** potential roof area for renewable energy systems
- **ENABLES** natural ventilation

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Weston Rd
Pylon Signage
Existing Residential
Outdoor Amenity Space
Child Care Playground
Western North York Community Centre
Forecourt
Starview Lane
Promenade
A
B
C
D
E
Multi-Sports Court
Parking 119 parking
7 accessible parking, 5 nursery, 37 school
St.Basil - The - Great College School
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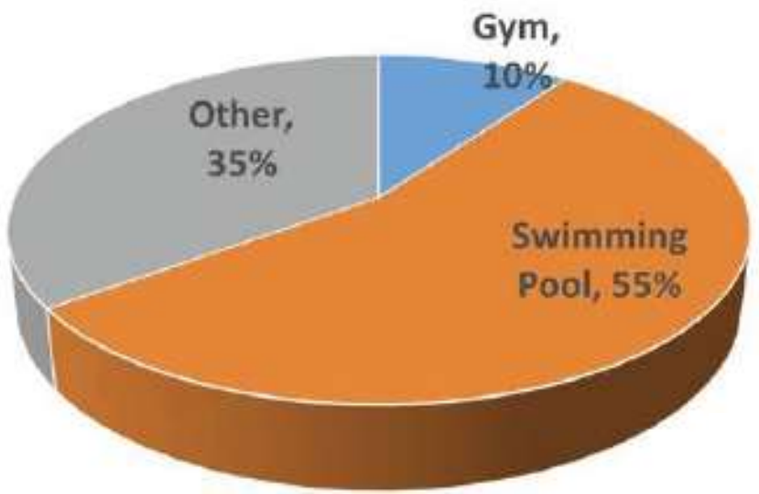
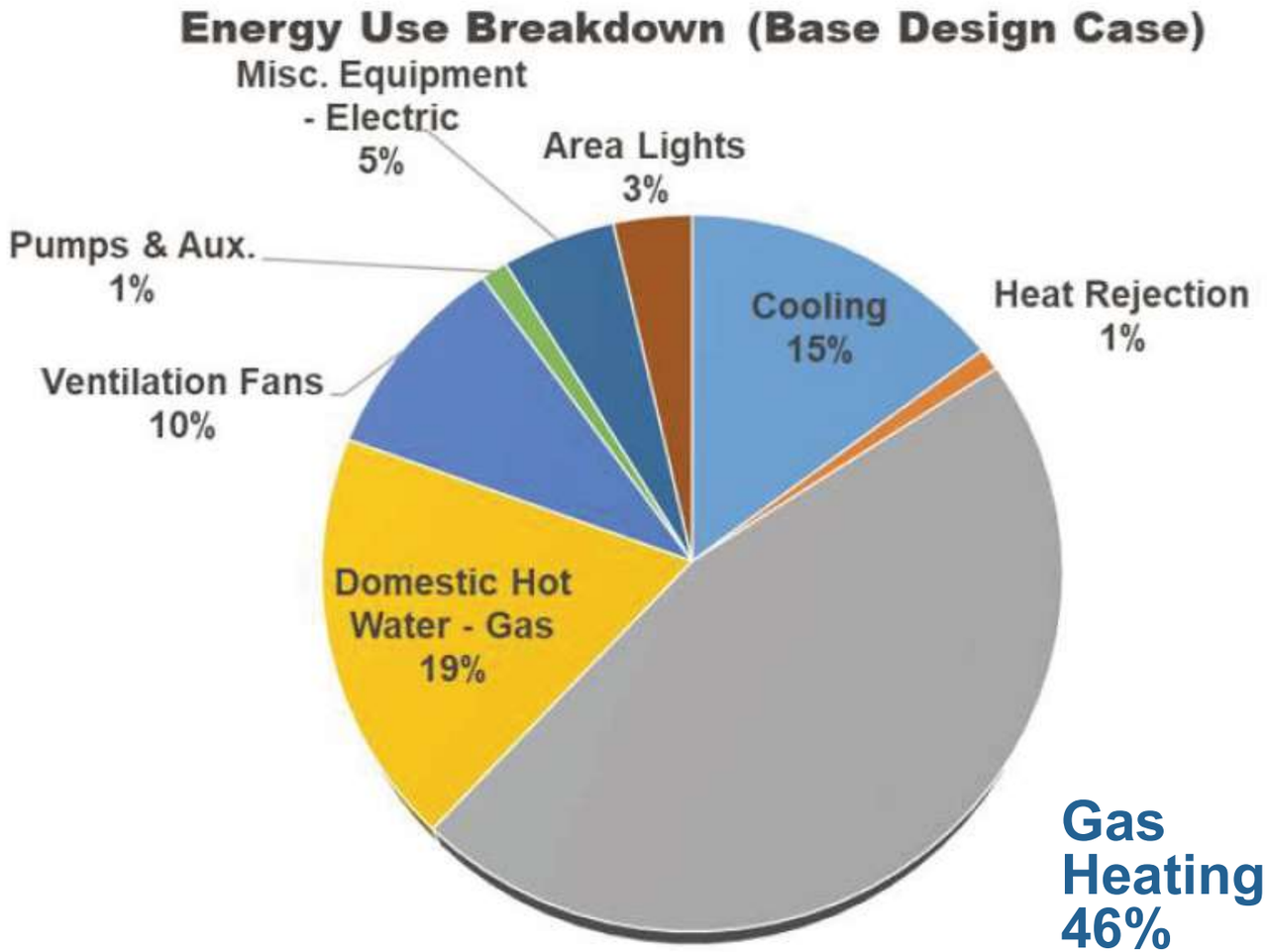
# The Challenge




**Swimming Pool 55%**




**Gas Heating 46%**

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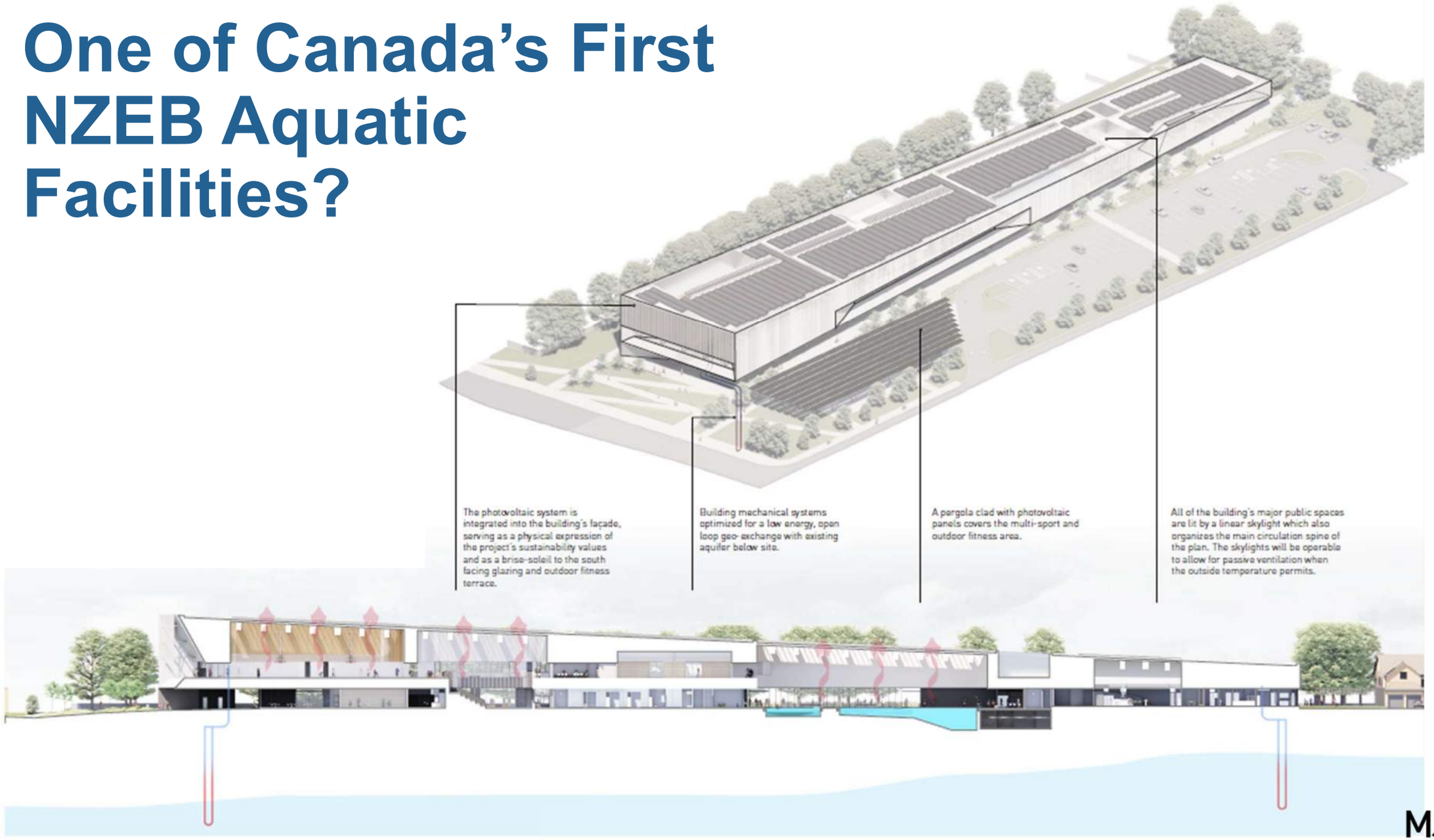
# One of Canada's First NZEB Aquatic Facilities?

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# System Strategies

## Footprint

| Design Options or Improvements | | Energy Savings** | TEUI (kWh/m²) | TEDI (kWh/m²) | GHGI*** (kg/m²) |
|---|---|---|---|---|---|
| Base Design (Current) | BASE CASE | 24.87% | 345.2 | 93.2 | 43.7 |
| Airtightness Improvement | 3.2% | 28.07% | 330.9 | 80.5 | 43.2 |
| Geothermal Heat Pump* | 30.94% | 59.01% | 190 | 93.2 | 7.6 |
| Push and Pull System | 6.49% | 31.36% | 316.2 | 92.2 | 40.6 |
| Natural Ventilation | 3.81% | 28.68% | 327.7 | 91.6 | 44.3 |
| Heat Recovery on All AHUs | 13.2% | 38.07% | 286.1 | 37.8 | 32.6 |
| Solar Thermal Collector (Full Roof) | 15.3% | 40.17% | 276.7 | 93.2 | 33.8 |

**All of building's ventilation cooling, heating and domestic hot water load has been shifted to the geothermal system.*
*** The energy savings are compared to the OBC-SB10 reference building*
**** Using Energy Star Portfolio Manager Greenhouse gas emission factors*

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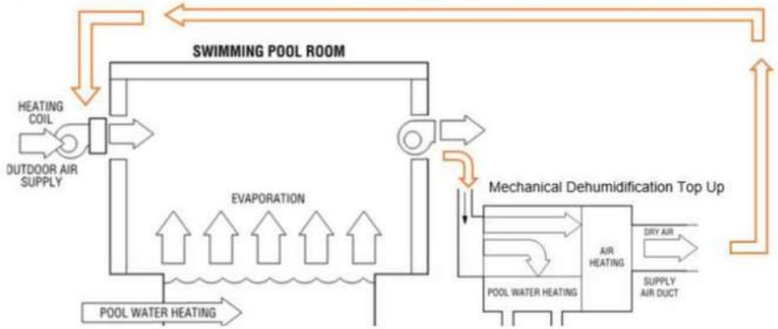
# Airtightness

| | Passive House | WNYCC CaGBC Zero Carbon |
|---|---|---|
| **Air leakage** | 0.6ACH at 50 Pa | Recommended 0.175 l/s $m^2$ façade, similar level as passive house |

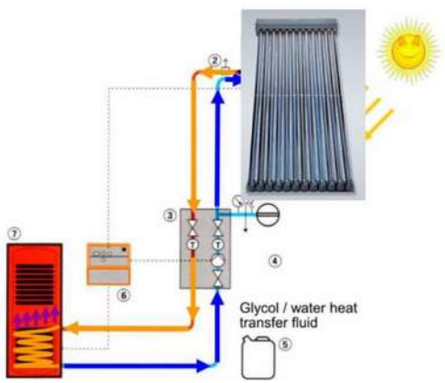
- 30% improvement from ASHRAE 90.1-2013
- Air barrier system commission required
- Air tightness tests

# Push and Pull System

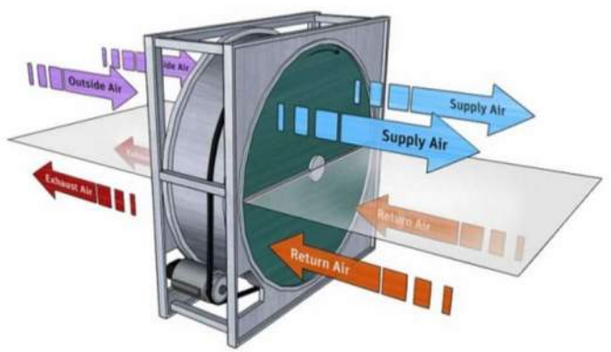



# Solar Thermal Collector

| Configuration | Annual Energy Generation |
|---|---|
| 800 Collectors (2400 $m^2$ Total collector area)<br>Roof coverage: 69%<br>Total system area: 3700 $m^2$<br>Rated at 100% of DHW Peak Demand: 221 kW<br>30° Tilt facing South | 430,000 kWh |




# Heat Recovery on all AHUs

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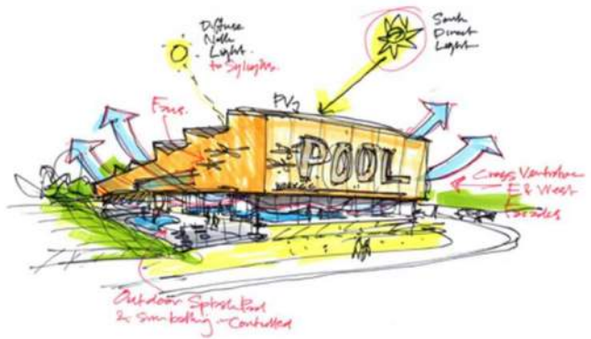
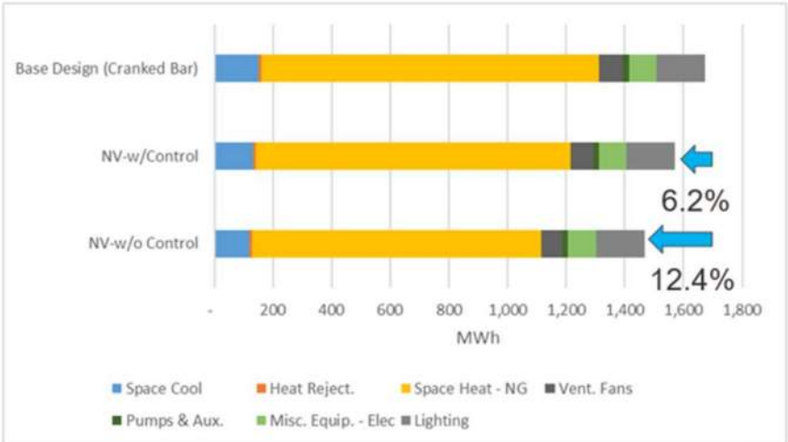
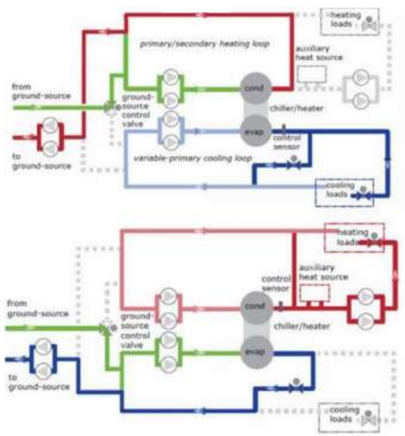
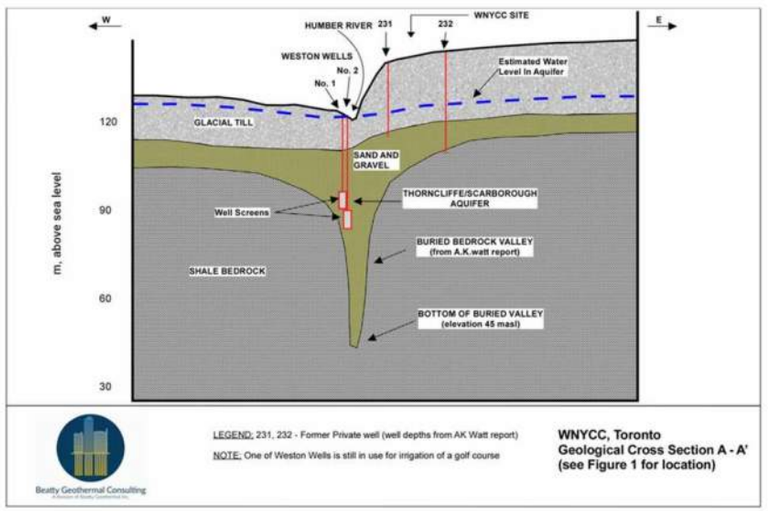
# Natural Ventilation




# Geothermal System

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# PV Studies

VCT GROUP


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# Alternative Energy Sources: Biomass

SUTHEY HOLLER

CBER
CANADIAN BIOMASS ENERGY RESEARCH LTD

envint Consulting

Figure 12 Containerized wood pellet boiler with silo store


*Photo source: Fink Machine; Drawing: CBER Ltd*

Figure 13 Underground boiler plant with walking floor wood chip store

*Picture courtesy of Viessmann*

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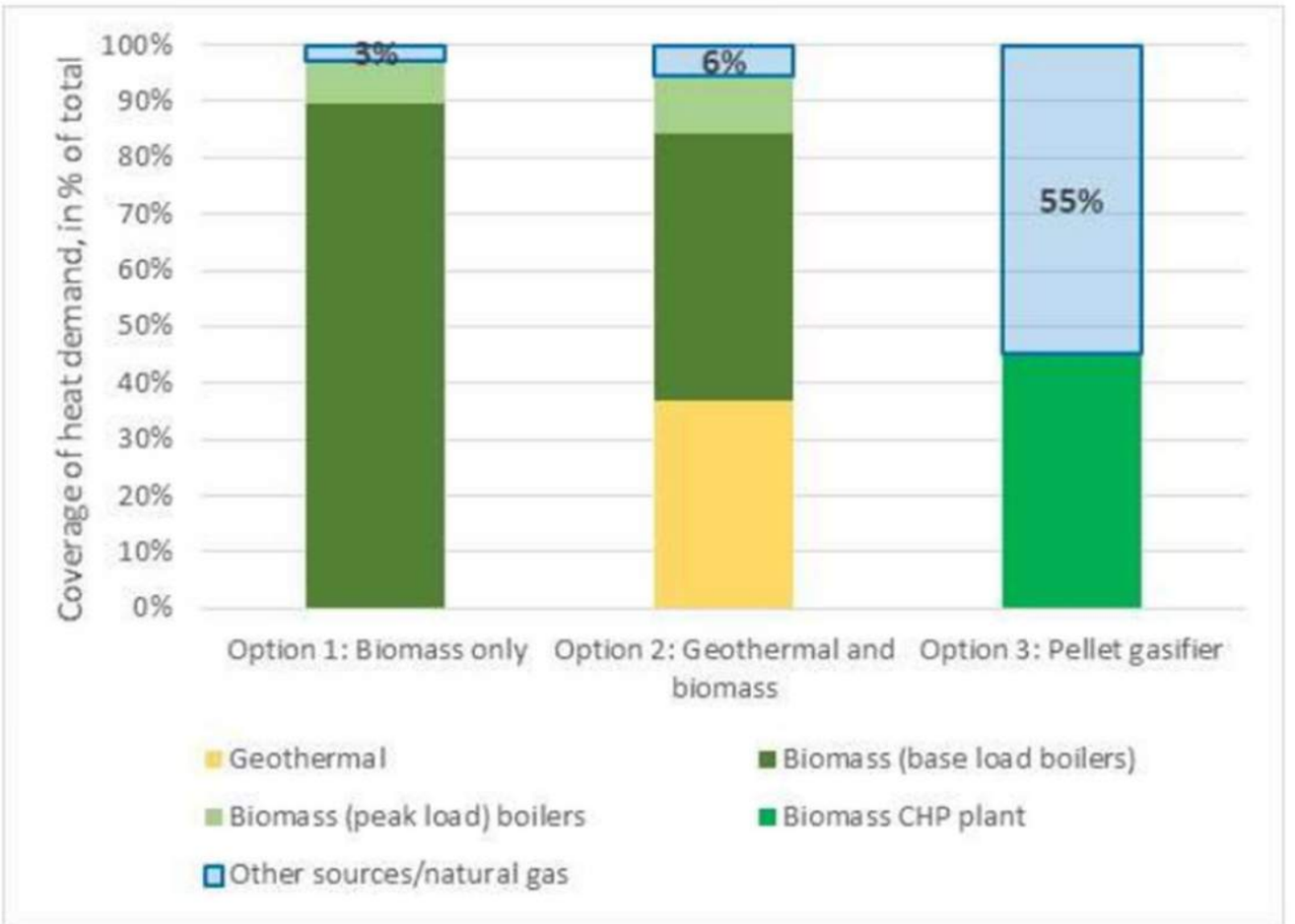
# Alternative Energy Sources: Biomass

Figure 9 Coverage of WNYCC's heat demand by various heat sources



# Alternative Energy Sources: Biomass

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# Alternative Energy Sources: Biomass

**Take-Aways**

- Biomass energy has potential for buildings of this type
- Considering energy and electrical loads alone, a biomass CHP with a pellet boiler could replace the geo-exchange and PV system currently being designed for this project
- Steady and reliable source of biomass is critical and is challenging in the Toronto area – reliable biomass fuel market does not exist
- Operations of a biomass combined heat and power plant (CHP) requires a highly trained technician and a strict fuel specification
- Spatial considerations required for delivery and storage of biomass can limit feasibility

# Energy Modelling

## Footprint

| | TEUI<br>TOTAL ENERGY UTILIZATION INDEX<br>kWh/m2 | TEDI<br>THERMAL ENERGY DEMAND INTENSITY<br>kWh/m2 | GHGI<br>GREENHOUSE GAS INTENSITY<br>kg/m2 |
|---|---|---|---|
| **SUSTAINABILITY TARGETS** | 0 | TBD | 0 |
| **BASE DESIGN CASE:**<br>TGS V3 TIER 2<br>MORE THEN 25% IMPROVEMENT ABOVE ONTARIO BUILDING CODE (SB-10 2017) | 335 | 182 | 47 |
| **NET ZERO ENERGY BUILDING DESIGN**<br>**STEP 1: LOWER TEDI AND TEUI WITH DESIGN**<br>MINIMIZE ENERGY USE WITH BUILDING DESIGN BY EMPLOYING THE FOLLOWING DESIGN STRATEGIES AND SYSTEMS:<br>• IMPROVED BUILDING ENVELOPE AIR TIGHTNESS<br>• ULTRA HIGH PERFORMING THERMAL ENVELOPE<br>• GEOTHERMAL HEAT PUMP SYSTEM<br>• POOL HEAT RECOVERY AND DEHUMIDIFIER<br>• NATURAL VENTILATION FOR LOBBY AND MEETING ROOMS<br>• HEAT RECOVERY IN ALL AIR HANDLING UNITS<br>• POOL COVERS<br>• SLAB HEATING<br>• DRAIN HEAT RECOVERY | 120 | 112 | 0 |
| **STEP 2: ACHIEVE TGS V3 TIER 4 WITH CaGBC ZERO CARBON STANDARDS**<br>PURCHASE 800 kW OF OFF-SITE RENEWABLE ENERGY | 120 | 112 | 0 |
| **STEP 3: ACHIEVE NET ZERO ENERGY BUILDING STANDARDS**<br>INSTALL PV PANELS ONSITE TO OFFSET ENERGY CONSUMPTION | 0 | 112 | 0 |

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# Next Steps:
# Net Zero Carbon

## ZERO CARBON BUILDING CERTIFICATION

The South End Community Centre is aiming to achieve certification under the ZCB-Design v2 pathway. The design proposes to adopt Option 1 - Flexible Approach in meeting the Energy Requirements. The design is currently modeled to be 33% better than a National Energy Code of Canada for Buildings 2017 (NECB-2017) reference building in terms of annual energy consumption.

As currently modelled, the design is not meeting the TEDI requirements for any of the three paths for energy requirement. Both Option 1 and Option 3 require a TEDI of 34 kWh/m² while Option 2 would require a TEDI of 24 kWh/m².

## TEDI CHALLENGE

At the time of the Savings By Design workshop, the TEDI for the South End Community Centre was modelled at 97 kWh/m².

The current reference building modelled to NECB-2017 has a TEDI of 93.6 kWh/m².

The proposed design is currently modelled with a TEDI of 62 kWh/m².

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**TEDI**
**62 kwh/m2/yr**

Canada Green Building Council
*Every Building Greener*
Conseil du bâtiment durable du Canada
*Verdir tous les bâtiments*

Brian Fountain
S+A Footprint
1100 – 100 Sheppard Ave. East
Toronto ON M2N 6N5

Brian,

This letter is to confirm that the South End Community Center (SECC) in Guelph, Ontario has been granted an allowance to the Thermal Energy Demand Intensity (TEDI) target in the ZCB-Design v2 Standard. The project must use the flexible approach to energy efficiency and achieve the required site energy use intensity that is 25% better than NECB 2017. The ruling issued by the Zero Carbon Steering Committee (ZCSC) was:

"The South End Community Centre may demonstrate compliance with the TEDI target by achieving a TEDI of 62 kwh/m2 (which represents a 34% reduction in TEDI compared to a NECB 2017 reference building). The project team must report the TEDI for the entire building, the envelope TEDI, and the TEDI reduction compared to a NECB 2017 reference building when they submit for certification. The project team must also provide complete details on the scenario chosen, and additional information on each of the better options and why they were not feasible for this project."

In order to satisfy this ruling, the applicant must submit the following when submitting for certification:

1) A copy of this letter
2) A copy of the SECC TEDI Allowance request PDF submitted during this process.
3) Final information about the scenario chosen (such as the exact variation of Scenario 6).
4) Additional information explaining why the better performing scenarios were not practical.
5) The percent reduction in TEDI compared to a NECB 2017 baseline building, as well as the TEDI value for the entire building, and the envelope only TEDI. The TEDI for the entire building must match the allowance request of 62 kWh/m2/year or better.

Thank you,

Fin MacDonald
Manager, Zero Carbon Building Program

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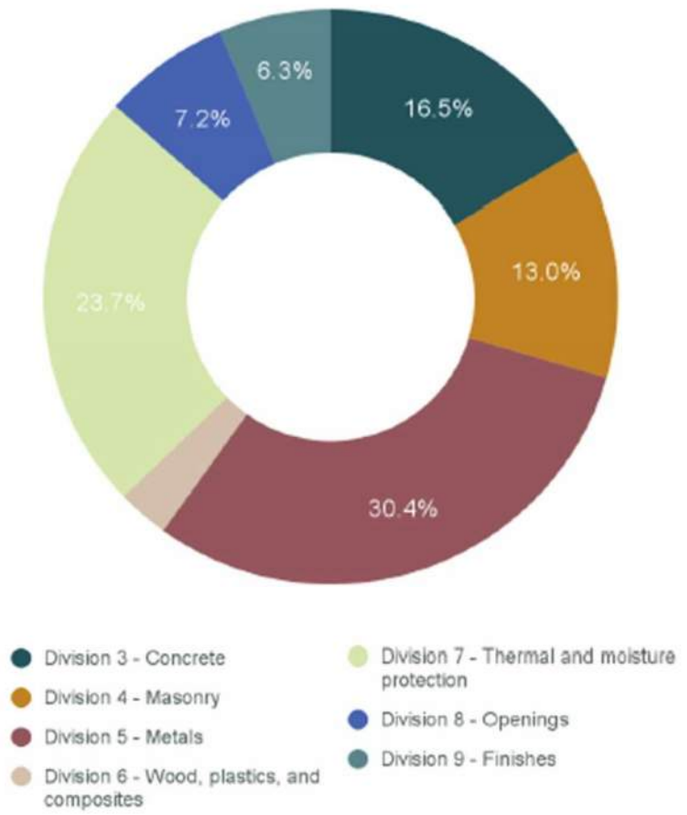
# Embodied Carbon Study

ha/f research studio MANTLE DEVELOPMENTS

2. Embodied Carbon Breakdown



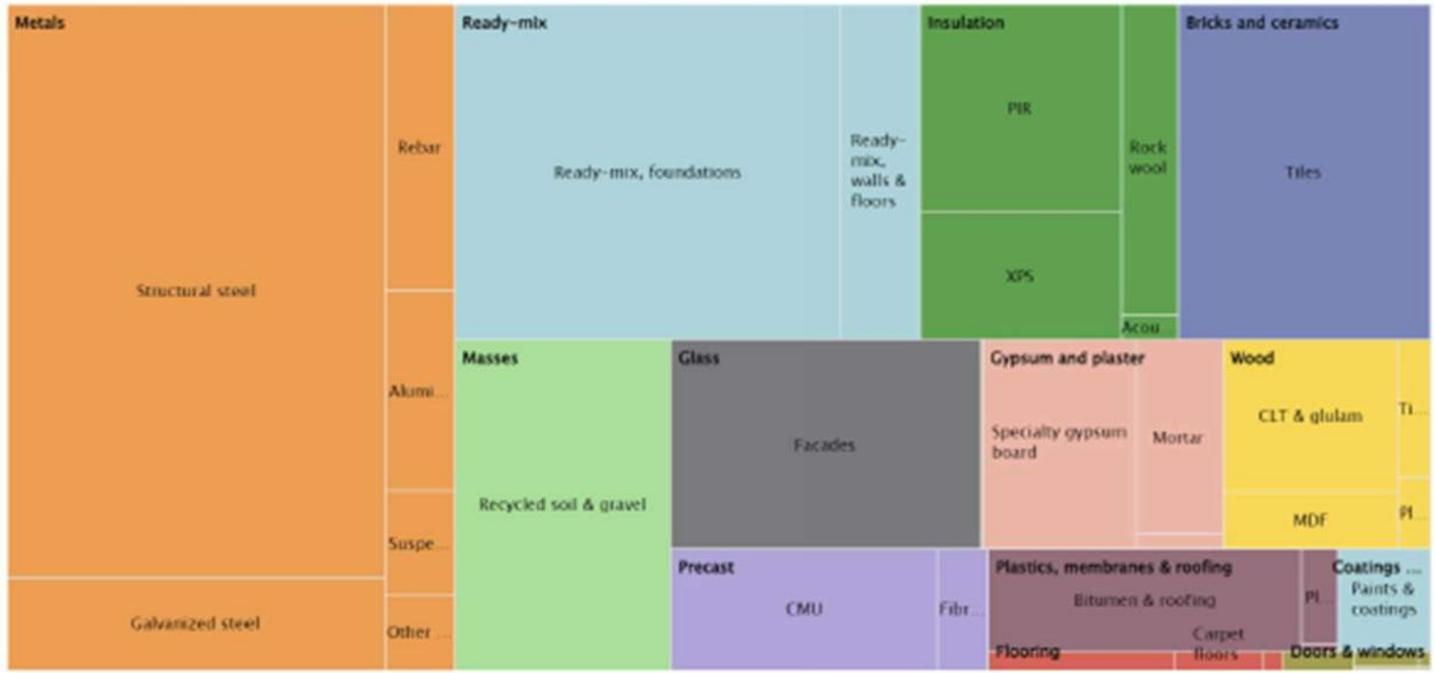




Figure 9 - Embodied Carbon by Material Category and Subcategory (OneClick LCA)

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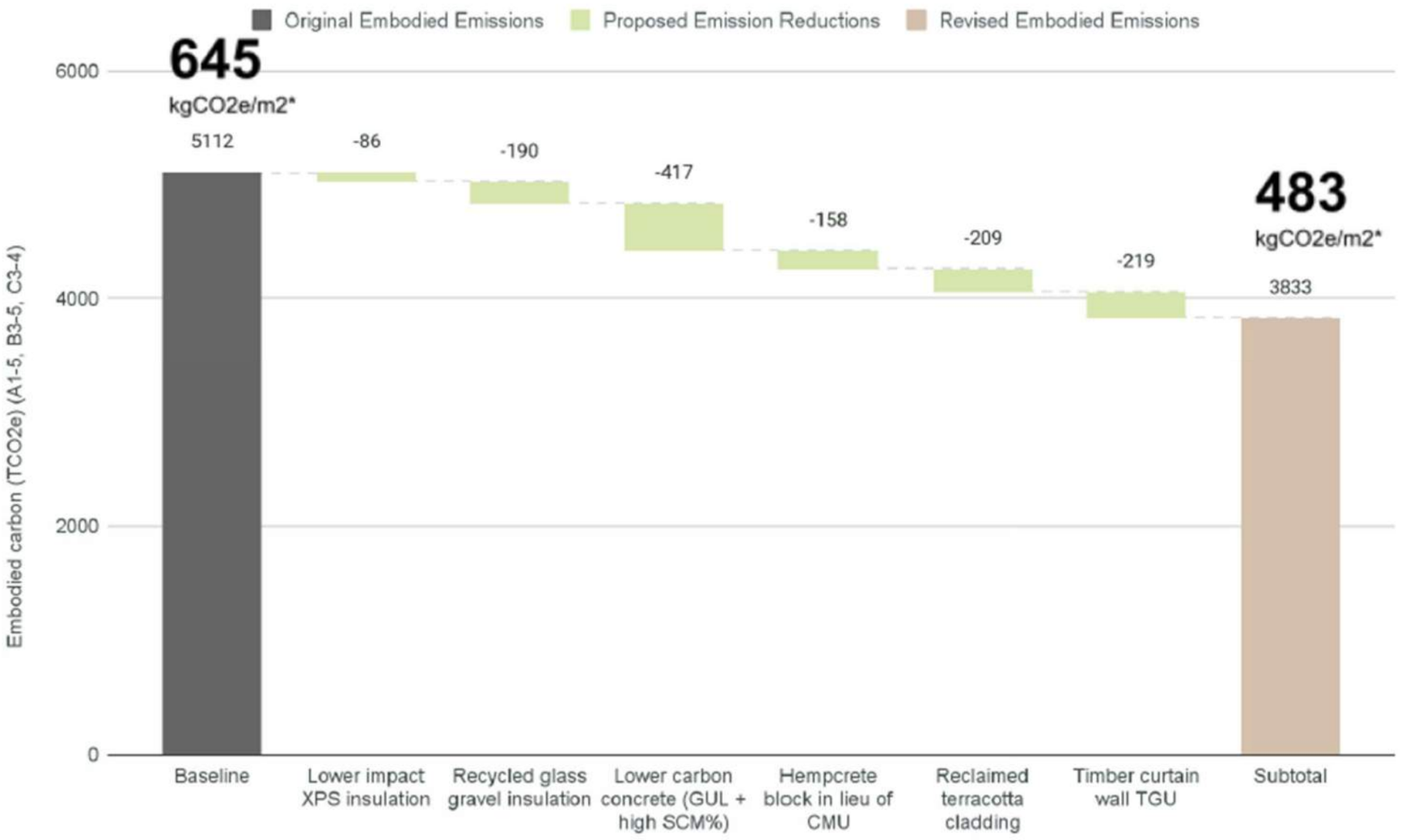
# Embodied Carbon Study

ha/f research studio MANTLE DEVELOPMENTS

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# Net Zero Take-Aways

1. Clear direction from the Client
2. Solution is different depending on Place
3. Integrated Design Team
4. Appropriate Fees
5. Client Involvement is Essential – Operator Buy-in
6. Dynamic and Quickly Evolving Time


Thank
You
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# Questions & Answers

Thank you for attending!

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