PURPOSE

The Queensway & Fordhouse Boulevard Development

Net Zero Emissions Strategy Study

1370443 Ontario Limited c/o RSM Canada

November 27, 2024

Project No. 23089A

HEALTHY · LOW CARBON · CIRCULAR

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1 | Introduction

1.1 Purpose

a) This Net Zero Emissions Strategy (NZES) has been prepared at the request of 1370443 Ontario Limited c/o RSM Canada, in support of an Official Plan Amendment and Rezoning application for The Queensway & Fordhouse Boulevard mixed-use development in Etobicoke.

b) The purpose of the NZES is to identify early opportunities to reduce energy demand and carbon emissions and increase resilience to climate change.

c) The Strategy satisfies the requirements of the City of Toronto Rezoning Application Submission.

d) The intended use and limitations for this report are described in our proposal dated May 17, 2023.

1.2 Site Context and Key Development Features

a) 21,536 m^2 development site in Etobicoke bordered by The Queensway, Fordhouse Boulevard, and adjacent parcels.

b) Total development GFA 131,424 m^2

c) Bldg A: 30 floors, 342 units, 28,713 m^2

d) Bldg B: 35 floors, 449 units, 31,671 m^2

e) Bldg C: 40 floors, 504 units, 34,561 m^2

f) Bldg D: 45 floors, 524 units, 36,478 m^2

g) Parking: 583 spaces

1.3 Methodology

a) We assessed 3 energy and carbon performance scenarios as required by City's Terms of Reference:
   - TGS v4 Tier 1 (Mandatory for all new development projects in the City of Toronto)
   - TGS v4 Tier 2 (Voluntary, expected to be mandatory in 2025)
   - TGS v4 Tier 3 (Voluntary, expected to be mandatory in 2028)

b) Energy and Carbon Performance Targets of each TGS Tier are presented on the next page.

c) We assessed the impact of zoning design decisions made to date and identified initial design pathways for achieving each performance scenario based on engineering judgement and experience with similar projects.

d) We did not assess additional TGS requirements for air quality, water, ecology and solid waste.

1.4 Toronto Green Standard v4 Performance Targets

The TGS uses 4 energy and carbon performance metrics, with progressive thresholds for each Tier (targets are maximum limits; lower is better). The targets for each Tier are:

PERFORMANCE METRIC	TIER 1	TIER 2	TIER 3
Thermal Energy Demand Intensity (kWh/m^2/yr)	50	30	15
Energy Use Intensity (kWh/m^2/yr)	135	100	75
Operational GHG Emissions Intensity (kgCO_2/m^2/yr)	15	10	5
Embodied GHG Emissions Intensity (kgCO_2/m^2)	None	350	250

Thermal Energy Demand Intensity (TEDI): total annual heating demand for envelope and ventilation loads per GFA.

Energy Use Intensity (EUI): total annual building energy use per GFA.

Operational GHG Emissions Intensity (GHGI): carbon emissions of total energy used for each fuel type per GFA.

Embodied GHG Emissions Intensity (ECI): carbon emissions associated with extraction & manufacturing, and construction of materials used for the building structure and envelope per GFA (also referred to as Upfront Carbon).

1.4 Toronto Green Standard v4 Performance Targets

Building A includes non-residential spaces that make up more than 10% of total GFA.

The TGS uses area-weighted, mixed use performance targets for these cases; based on Building A's space mix, the TGS performance targets are 3-7% lower than shown on the previous table.

This does not impact our recommendations (i.e. the same design strategies apply to all buildings).

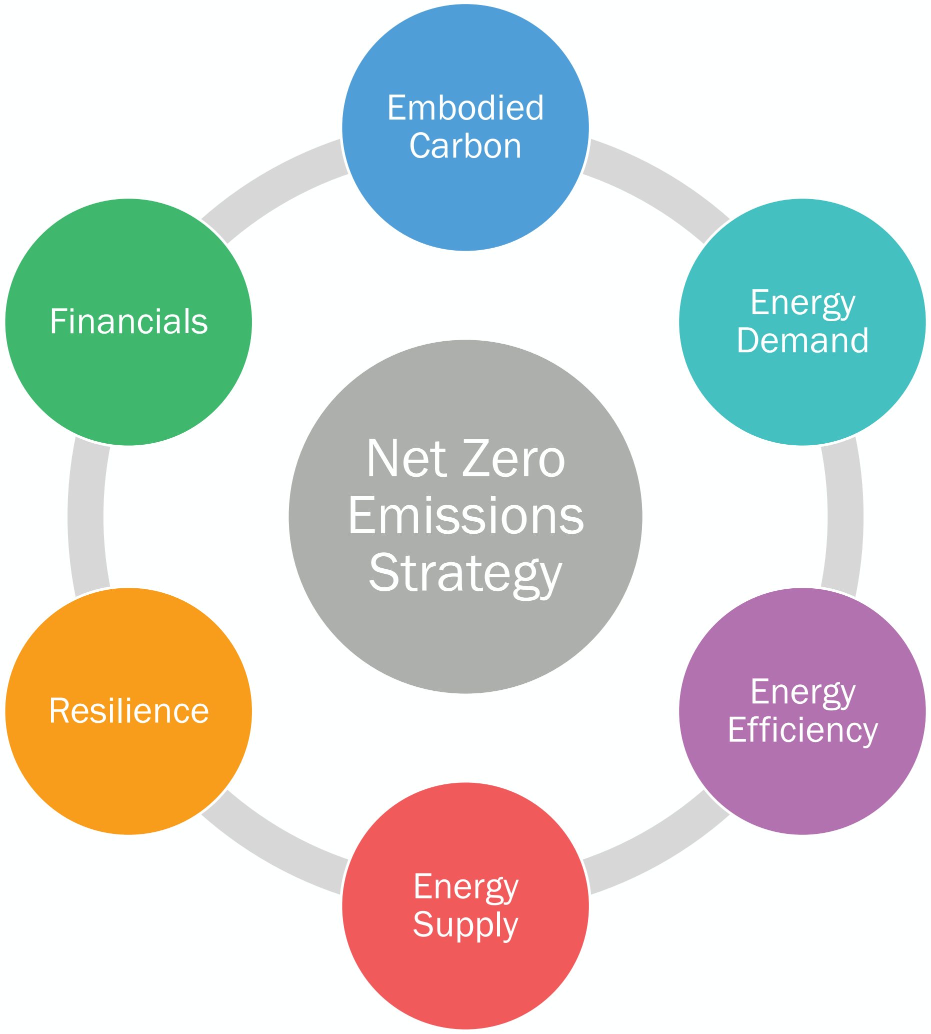
2 | Design Approach

2.1 Focus Areas for NZE Strategy

a) The overall Net Zero Emissions Strategy includes 6 focus areas.

b) Achieving cost-optimal, high-performance outcomes requires consideration and holistic integration of all 6 focus areas.

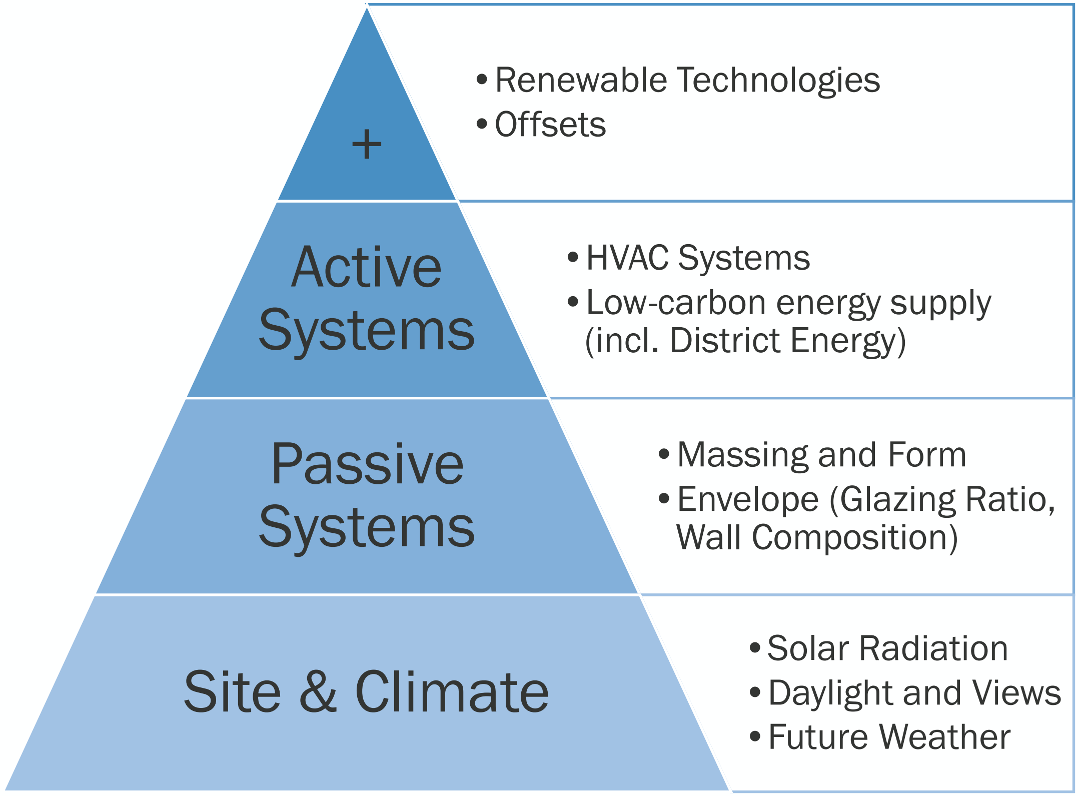
c) The key take-aways presented in Chapter 3 of this Study are organized according to these focus areas.



2.2 Operational Energy and Carbon

a) Because design features and building systems interact with each other, there are many **pathways** to achieving the performance targets of each TGS scenario.

b) The most cost-effective pathway to higher performance requires consideration of site, climate, and passive systems during the conceptual stages of projects, followed by iterative design & analysis optimization that is supported by robust performance simulations and costing tools.



2.2 Operational Energy and Carbon

The expected impact of key design parameters on Operational Performance is:

DESIGN PARAMETER	TEDI	EUI	GHGI
Massing Complexity(VFAR)	Moderate	Low	Low
Glazing Ratio	High	Moderate	Low
Glazing Performance	High	Moderate	Low
Wall Performance	Moderate	Low	Low
Airtightness	Moderate	Low	Low
Corridor Pressurization	High	Moderate	Low
HVAC Systems	N/A	High	High
Ventilation Heat Recovery	High	Moderate	Moderate
HVAC Plant	N/A	High	High
Lighting	N/A	High	Low
Appliances	N/A	High	Low
Domestic Hot Water	N/A	High	High

More effort and focus should be directed to key design parameters with High expected impact for each performance metric.

2.3 Embodied Carbon

The expected impact of key design parameters on Embodied Carbon is:

DESIGN PARAMETER	EMBODIED CARBON
Below-Grade Parking	High
Transfer Slabs	High
Structural Grid Alignment	Moderate
Shear Walls	Moderate
Material Efficiency	Moderate
Local Materials	Moderate
Recycled Materials	Low
Concrete Mix Design	High
Envelope Insulation	Low
Glazing Ratio	Low
Cladding Materials	Moderate

More effort and focus should be directed to key design parameters with High expected impact for each performance metric.

3 | Initial Moves and Opportunities

3.1 Reducing Embodied Carbon

a) Embodied Carbon (associated with extraction & manufacturing, construction and disposal of building materials) can account for 25-35% of total life cycle emissions of buildings designed to achieve TGS v4 Tier 1 performance (and up to 60% of those designed to Tier 3). Concrete, steel, aluminum and glass are typically the biggest contributors to embodied carbon.

b) The two levels of below-grade parking and structural transfer elements like slabs and beams that are expected to transfer loads from the below-grade structural grid to above-grade ones, typically result in higher embodied carbon emissions. Based on the current massing, we estimate the embodied carbon is approx. 375-400 kg CO_2e/m^2.

c) Reducing embodied carbon emissions to achieve Tiers 2 and 3 requires more optimized structural design and low-carbon materials.

d) We recommend performing a detailed Life Cycle Analysis during SPA when more details about structural and envelope systems will be available.

3.2 Reducing Energy Demand

a) Thermal Energy Demand (TEDI) is driven by envelope performance and ventilation and pressurization loads. Reducing Thermal Demand can reduce energy use and operational emissions, increase thermal resilience and improve occupant thermal comfort.

b) The impacts of current massing moves on TEDI are mixed:

- Positive impact due to simple rectangular massing, few recessed balconies and moderate façade articulation. Façade articulation is expressed as the ratio of vertical wall area to gross floor area or VFAR; estimated at approx. 0.45-0.5 (lower is better).
- Negative impact due to north-south building orientation with taller buildings to the south (shading buildings to the north and reducing beneficial solar gains in the winter).

c) Mechanical design strategies for achieving Tier 1 TEDI include limiting corridor pressurization to under 20 cfm/suite and incorporating ventilation heat recovery with at least 75% effectiveness.

3.2 Reducing Energy Demand

d) TGS Tier 1 is still likely possible with double-glazing, but glazing ratio must be maintained below 40% and the basis of design should be panelized wall systems, not conventional window-wall.

e) Achieving TGS v4 Tier 2 and 3 TEDI will likely require the following (in addition to Tier 1 measures):

- Reduced glazing ratio (below 40%)
- Triple glazing.
- Reducing corridor pressurization flow below 15 CFM/suite.
- Centralized or semi-centralized heat recovery (80%+ effectiveness).
- Reduced thermal bridging of transition elements like slab edges, parapets and window-to-wall interfaces.
- Improved air-tightness.

3.3 Improving Energy Efficiency

a) A central mechanical plant with a small air source heat pump in additional to boilers is likely sufficient to achieve TGS v4 Tier 1.

b) Achieving TGS v4 Tier 2 and 3 EUI will likely require the following (in addition to Tier 1 measures):

- Energy Star certified appliances.
- Full replacement of conventional natural gas heating with low carbon options.
- Introduction of low-carbon energy generation technologies like solar PV panels.

3.4 Decarbonizing Energy Supply – Thermal

a) Decarbonizing the thermal energy supply is the most important step in reducing operational carbon emissions.

b) There is a sewer line running along Fordhouse Blvd. which has sufficient heating capacity to provide the new development with recovered waste heat (5MW total or approx. 38 W/m^2).

c) The City of Toronto identified a potential district energy site at Kipling Ave & Norseman Street about 2 km to the north but this is likely too far to connect to.

d) The use of geo-exchange or air source heat pumps would reduce operational carbon emissions below TGS Tier 3 levels, if sized to satisfy 100% of heating loads. TGS Tier 1 and 2 levels of emissions could be achieved if these technologies are sized to satisfy part of the load.

e) Full electrification can also unlock potential financial incentives like CMHC and improve market recognition through 3rd party Certification like the CaGBC Zero Carbon Design Standard.

3.4 Decarbonizing Energy Supply – Thermal

f) Buildings designed with any fossil fuels, should be made Zero Carbon Ready by developing and implementing a Transition Plan (away from fossil fuels).

g) We recommend performing life cycle costing of the proposed energy systems.

h) To achieve a future Transition, consider the following during initial design stages:

- Design the heating and cooling plant to allow for future electrification, including designing low temperature heating systems.
- Size electrical systems to allow for full electric heating.
- Leave space and structural capacity for new equipment.
- Speak to Toronto Hydro about current and future plans for electrical distribution system design.
- Install metering and monitoring equipment to optimize controls and inform sizing and design of future equipment.

3.5 Decarbonizing Energy Supply – Renewables

a) The site has good solar access due to surrounding low-rise buildings and the QEW highway corridor immediately south of the site (there will be no tall building directly south of the site which might block solar access).

b) However, the North-South orientation of the towers will reduce solar access for Buildings A-C.

c) The roof of each tower may be able to support a small 35-45 kW PV array, sufficient to provide approx. 1% of each tower's annual energy use (assuming Tier 1 performance).

d) The roof on each tower is currently dedicated to green roof space. It is possible to use roof space for both a green roof and photovoltaics but coordination would be required to maintain viability of the plants.

e) Building D may be a good candidate for Building Integrated Photovoltaic (BIPV) due to unimpeded solar access on its south facade.

f) We can complete a detailed solar generation study at a later stage if desired.

3.6 Increasing Resilience

a) Toronto's recent weather is warmer and more extreme compared to historical patterns (and design temperatures used to design HVAC systems) and this trend is expected to continue and intensify.

b) Resilience is the ability to withstand and recover from sudden shocks (i.e., floods, area-wide power outages) and chronic stresses (i.e., increasing temperatures). Resilience can be achieved through active measures (back-up power) or passive measures (massing/envelope).

c) Passive Survivability is the ability of a building to maintain indoor temperatures during a power outages, allowing occupants to shelter in place.

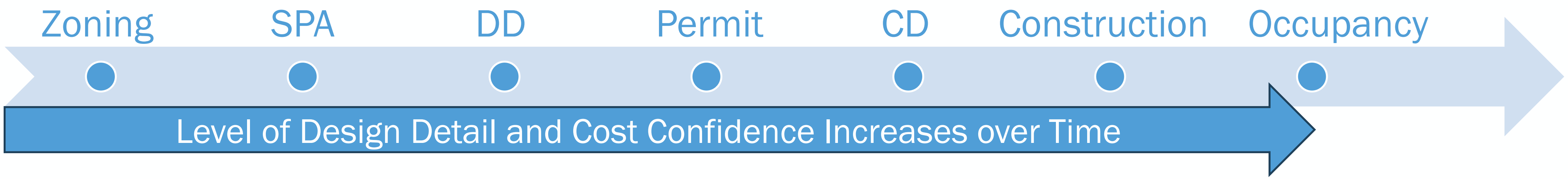
3.6 Increasing Resilience

d) Consider these tactics to further increase resilience and passive survivability:

- Design HVAC systems based on future weather predictions (including allocating sufficient physical space and electrical and structural capacity).
- Backup power for non-life safety loads including sump pumps and domestic water booster pumps, ideally for 72 hours or more.
- Design an indoor common space to act as a refuge area where residents can gather to stay comfortable, charge cell phones, access internet, safely store medicine and basic food necessities, access potable water and toilets, and prepare food.
- Designing louvres or fins on the west façade to keep the sun out during problematic later afternoon periods.
- Managing current and future climate risks such as flooding and heat waves (consider locating critical equipment above-grade).

3.7 Delivering Cost Effectiveness

a) The level of design detail and cost confidence increases over time.



b) Most developers require higher degrees of confidence the further design departs from business-as-usual.

c) Inspiring confidence in costing to pursue higher levels of performance requires a higher level of design detail, earlier in the project, when decisions are made that set the project on a particular performance path.

d) Front-loading the analysis and design coordination of key decisions about envelope and energy supply can inspire more confidence and unlock cost-optimal pathways to higher performance.

3.7 Delivering Cost Effectiveness

e) Projects that pursue TGS v4 Tier 2 or 3 are eligible for a Development Charge rebate.

f) Typically, the rebate amount is less than the capital cost premium required to achieve Tier 2 or 3, however, cost-optimization opportunities should be explored further, including partnering with 3rd party energy supply providers, which can reduce upfront investment by amortizing cost capital costs of low-carbon systems over 20–30-year terms.

g) Lifecycle Cost Analysis can be completed later.

4 | Performance Outcomes

4.1 Outline Specifications for Each Tier

DESIGN PARAMETER	RECOMMENDED PERFORMANCE OF EACH DESIGN PARAMETER		
	To Achieve Tier 1	To Achieve Tier 2	To Achieve Tier 3
Glazing Ratio	40-45%	35-40%	30-35%
Glazing Performance	Double glazing U-value 0.3	Triple glazing U-value 0.20	Triple glazing U-value 0.14
Wall Performance	R-10 to R-15	R-15 to R-20	R-20 to R-25
Airtightness	2.0 - 1.0 $L/s/m^2$	1.0-0.5 $L/s/m^2$	0.5 $L/s/m^2$
Corridor Pressurization	15-20 CFM/suite	10-15 CFM/suite	0.3 $L/s/m^2$
HVAC Plant	Small Air-Source Heat Pump + Boilers	Large Air-Source or Geo-Source + Boilers	100% Air Source or Geo-Source
HVAC Systems	Fan-coil or heat pump	Fan-coil or heat pump	Fan-coil or heat pump or VRF
Heat Recovery	75%	80%	85%
Domestic Hot Water	Low-flow fixture	Ultra low-flow fixture	Ultra low-flow fixture
Materials (Embodied Carbon)	N/A	Low-carbon concrete Recycled steel Low-carbon cladding (not available locally)	Likely unachievable

4.2 Energy and Energy Cost Estimates

The table below estimates total development performance under each TGS Tier:

	TGS V4 TIER 1	TGS V4 TIER 2	TGS V4 TIER 3
Energy			
Total Energy Use Intensity (ekWh/m^2/yr)	135	100	75
Total Energy (eMWh/yr)	17,742	13,142	9,857
% Savings over Tier 1	-	**26%**	**44%**
Thermal Energy Demand Intensity			
Thermal Energy Demand Intensity (ekWh/m^2/yr)	50	30	15
Thermal Energy Demand (eMWh/yr)	6,571	3,943	1,971
% Savings over Tier 1	-	**40%**	**70%**
Energy Costs*			
Based on today's utility rates	$1.27/sf	$1.31/sf	$1.36/sf
Based on escalating cost of emitting carbon (2040)	$1.40/sf	$1.38/sf	$1.36/sf

* Energy cost estimates are based on end use breakdowns representative of typical high-rise residential buildings. These estimates are based on modelled designs prepared for regulatory and certification purposes, and do not represent predictions of future operating costs.

4.3 Carbon Emissions Estimates

The table below estimates total development performance under each TGS Tier:

	TGS V4 TIER 1	TGS V4 TIER 2	TGS V4 TIER 3
Embodied Carbon			
Greenhouse Gas Emissions Intensity ($kgCO_2eq/m^2$)	385*	350	250
Total Greenhouse Gas Emissions (tonnes CO_2eq)	60,707	55,188	39,420
% Savings over Tier 1	-	**9%**	**35%**
Operational Carbon			
Greenhouse Gas Emissions Intensity ($kgCO_2eq/m^2/yr$)	15	10	5
Total Greenhouse Gas Emissions (tonnes CO_2eq/yr)	1,971	1,314	657
% Savings over Tier 1	-	**33%**	**67%**
Whole-Life Carbon			
Embodied + 60 Years of Operational Emissions per m^2	1,285	950	550
% Savings over Tier 1		**26%**	**57%**

* TGS v4 does not stipulate a maximum embodied carbon intensity for Tier 1. Typical GTA residential buildings emit 300-350 kg/m2 of embodied carbon. Proposed development is estimated at 385 kg/m^2 due to two levels of below-grade parking and transfer elements.

5 | Next Steps

5 Next Steps

We recommend the following approach as the project moves into later stages of development:

ZBA Compliance

- Prepare Net Zero Emissions Strategy (NZES).

Completed

SPA Compliance

- Prepare TGS Tier 1 SPA Energy Model and TGS Checklists (based on our prescriptive design recommendations).

Optimization

- Build on the SPA work to decide what level of performance you want to achieve by engaging in integrated design, analysis and costing.

Implementation

- Steward the Sustainability Vision and optimize downstream design decisions.

5 Next Steps

Specifically, we recommend:

a) Assess the current development proforma to understand the baseline investment assumptions and the associated design strategies to determine the likely level of attainable performance (i.e. does the current design meet the proforma and desired level of sustainability performance?).

b) Estimate the costs of specific design considerations and technologies.

c) Consider potential sources of funding including new procurement models.

d) Evaluate the business case for higher levels of performance, pursuing TGS Tier 2 and beyond.

e) Analyze and optimize cost-effective pathways to higher performance, utilizing tools like parametric analysis.

f) Implement, track, verify & monitor the agreed-upon strategies during future design phases.

PURPOSE

Go Farther Faster With Purpose.

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