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ENERGY STRATEGY REPORT

4050 Yonge Street, Toronto

January 20, 2020

Prepared for:
City of Toronto (Metro Hall)
Environment & Energy Division
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1 EXECUTIVE SUMMARY

Opportunities to reduce energy usage, minimize greenhouse gas emissions, and enhance operational resiliency have been investigated as part of the early planning phase of this new 35-storey hotel and residential development.

As an infill development, the orientation and massing of the building has been planned to optimize the use of the available site area. Hotel rooms and residential suites have been arranged (to the extent possible) to take advantage of views and passive solar gains in the winter. Furthermore, fenestration details are being developed to strike a balance between occupant needs and energy performance. Window performance criteria (i.e. U-value and SHGC) will be tuned to improve occupant comfort and enhance overall building energy performance.

Recommended energy performance characteristics for the design of the building are outlined in Section 3 of this report under the following headings: Building Envelope, Interior Lighting Loads, Interior Plug & Process Loads, HVAC Systems, Service Water Heating Systems, Exterior Lighting Loads, and Exterior Plug & Process Loads. These recommendations have been based on preliminary "block modeling" results (presented in Section 4 of this report) and have been developed as a first step toward meeting OBC / TGS v3 Tier I minimum energy performance thresholds. The resulting "Design Baseline" version of the Proposed Building (i.e. an OBC / TGS v3 TIER I COMPLIANT SCENARIO) is presented as the starting point for further design development.

It is anticipated that this project will demonstrate compliance with TGS Tier I minimum energy performance thresholds following the Absolute Performance Targets compliance path. Therefore, the Proposed Building will be required to meet or exceed the performance targets for energy use intensity (EUI), thermal energy demand intensity (TEDI), and greenhouse gas intensity (GHGI). The early compliance calculations done for this report are based on the TGS requirements that were in force as of the date of the preliminary "block modeling" results (refer to Section 4 of this report). Formal compliance will need to be verified for TGS and OBC – please refer to separate Energy Modeling Reports for additional information.

Opportunities to achieve TGS Tier II (or higher Tier levels of the TGS) may be reviewed at a later date. The project team will gather information about TGS requirements as they relate to this project and will consider all input.

Other potential opportunities for the development (such as shared energy infrastructure, renewable energy system implementation, and back-up power systems exceeding OBC requirements) continue to be investigated.

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2 INTRODUCTION

2.1 Purpose

The purpose of this Energy Strategy Report is to identify opportunities to integrate innovative energy solutions into the project to help reduce energy usage, minimize greenhouse gas emissions, and enhance operational resiliency over the long term. The findings of this report are preliminary in nature, but are intended to introduce viable design options to the project team for thoughtful consideration. This early work will inform more detailed energy analyses including those prepared for the TGS Building Energy Modeling Report (at the time of Site Plan Control Application) and those prepared for the OBC Building Energy Modeling Report (at the time of Building Permit Application).

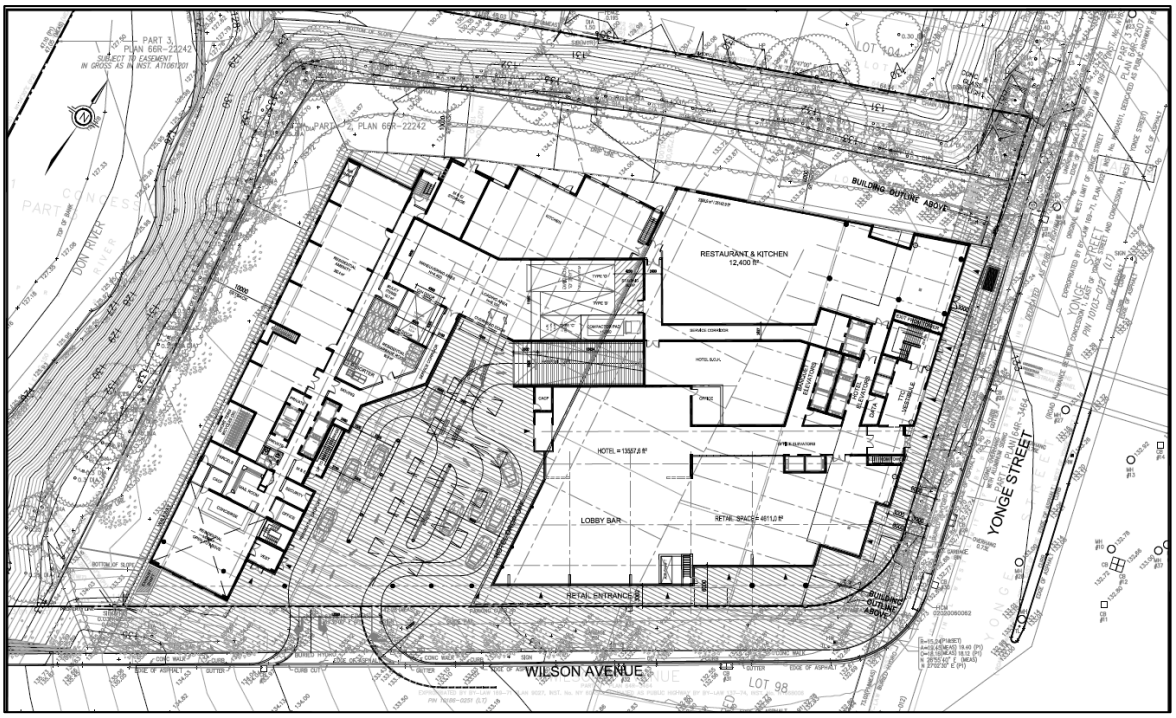
2.2 Scope

This Energy Strategy Report applies to the new development project known as:

- 4050 Yonge Street, Toronto, Ontario

The project consists of a new, double-tower hotel and residential development with a total above-grade modeled floor area of 71,841 m^2. The building is comprised primarily of hotel rooms and residential suites, but it also includes a restaurant, meeting rooms, office, and a bar. The project also includes five levels of underground parking.

A site plan is shown below:



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2.3 Objectives

The main objectives of this Energy Strategy Report are:

- to ensure opportunities to make use of existing or proposed ***shared energy infrastructure*** (such as district energy systems) are investigated during the early planning phase of the new development,
- to ensure opportunities to take advantage of ***passive solar design strategies*** are investigated during the early planning phase of the new development,
- to ensure opportunities to incorporate ***enhanced energy conservation and energy efficiency measures*** within and around the building are investigated during the early planning phase of the new development,
- to ensure opportunities to incorporate ***renewable energy systems*** on or around the building are investigated during the early planning phase of the new development, and
- to ensure opportunities to incorporate ***strategic back-up power systems*** for the building are investigated during the early planning phase of the new development.

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3 RECOMMENDED ENERGY PERFORMANCE CHARACTERISTICS

This project is required to meet the minimum energy performance thresholds specified by the OBC and TGS Tier I. To demonstrate compliance with the TGS thresholds, the modeled energy performance of the "Proposed Building" will be compared to absolute performance targets for EUI, TEDI, and GHGI.

To demonstrate compliance with the OBC thresholds, the modeled energy performance of the "Proposed Building" will be compared to the modeled energy performance of a "Reference Building". The energy performance characteristics of the Reference Building are defined by: ANSI/ASHRAE/IES Standard 90.1-2013 "Energy Standard for Buildings Except Low-Rise Residential Buildings" as modified by Chapter 2 of Division 3.

Recommended energy performance characteristics for the design of the Proposed Building are outlined in the following subsections. These recommendations are based on our preliminary assessment of project context, early project drawings, and overall design intent and may change as more details about the project emerge. The version of the Proposed Building described below (i.e. an OBC / TGS v3 TIER I COMPLIANT SCENARIO) is referred to as the "Design Baseline" building.

Note: The project is located in an area served by both "grid" electricity (from Toronto Hydro-Electric System Limited) and "piped" natural gas (from Enbridge Gas Distribution Inc.). "Design Baseline" systems have been established assuming that these two services are the only available energy infrastructure.

3.1 Building Envelope

- roofs ≥ R-35 [(h·ft^2·F) / Btu]
- walls ≥ R-20 [(h·ft^2·F) / Btu]
- exposed floors ≥ R-15 [(h·ft^2·F) / Btu]
- slab-on-grade floors ≥ R-10 [(h·ft^2·F) / Btu]
- heated slab-on-grade floors (if applicable) ≥ R-15 [(h·ft^2·F) / Btu]
- windows (assembly) ≤ U-0.35 [Btu / (h·ft^2·F)] and SHGC ~0.32
- window-to-wall ratio < 50% for each elevation (i.e. North, South, East, West)

Note: All envelope performance values are expressed as overall assembly "effective" values (i.e. the values include the effects of thermal bridging resulting from studs, girts, frames, etc.).

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3.2 Interior Lighting Loads

- reduce hotel guest room lighting power density to ≤ 0.30 W/ft^2 and utilize occupancy/vacancy lighting controls
- reduce residential suite lighting power density to ≤ 0.30 W/ft^2 where lighting is provided:
- reduce all amenity/common area lighting power densities [design to the following LPDs: Meeting Room = 0.86 W/ft^2, Prefunction = 0.86 W/ft^2, Bar/Lounge = 0.74 W/ft^2, Dining = 0.57 W/ft^2, Office = 0.80 W/ft^2, Corridor = 0.48 W/ft^2, Lobby = 0.85 W/ft^2]
- reduce underground parking lighting power density to ≤ 0.11 W/ft^2
- utilize occupancy/vacancy lighting controls in all common and service areas and garage (controls per ASHRAE 90.1-2013 as a minimum)
- utilize daylighting controls in common areas that have access to adequate natural daylight (controls per ASHRAE 90.1-2013 as a minimum)

3.3 Interior Plug & Process Loads

- select ENERGY STAR certified kitchen and laundry appliances and equipment
- select regenerative drive elevators
- identify and improve efficiency of atypical process loads (e.g. swimming pool heating)

3.4 HVAC Systems

- ventilation: provide mechanical ventilation in accordance with OBC / ASHRAE 62 requirements, however do not exceed OBC / ASHRAE 62 ventilation flow rates by more than 5%
- ventilation: provide compartmentalized guest rooms and residential suites with a dedicated air-to-air energy recovery ventilation unit for each suite (i.e. utilize ERVs with both sensible and latent heat recovery, specify a minimum sensible heat-recovery effectiveness of 70% at 0° C); similar air-to-air energy recovery ventilation for remaining building areas (meeting rooms, bars, dining rooms, gym, corridors, lobby, etc.)
- ventilation: ERV total fan power ≤ 0.85 W/cfm at operating conditions
- heating system: four-pipe fan coil units with three speed fan control (i.e. low for "fan only" ventilation operation, medium for heating mode, and high for cooling mode), electronically commutated fan motors

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(i.e. total fan power ≤ 0.25 W/cfm at operating conditions), and high-efficiency (>95%) condensing NG boiler plant with VFD pumps and load reset on supply temperature

- cooling system: four-pipe fan coil units (as above) served by high-efficiency chiller plant (water-cooled, magnetic-bearing, VSD centrifugal chillers) with VFD cooling tower fans and VFD pumps
- control system: 5-2 programmable thermostats in each residential unit that allow for programming of "fan only" ventilation operation, heating setpoints, and cooling setpoints

3.5 Service Water Heating Systems

- low-flow showerheads (5.7 LPM)
- low-flow kitchen faucets (1.9 LPM)
- low-flow lavatory faucets (1.9 LPM)
- high-efficiency (>95%) condensing NG service water heating plant

3.6 Exterior Lighting Loads

- design for total installed lighting power densities ≤ 50% of ASHRAE 90.1-2013 allowances

3.7 Exterior Plug & Process Loads

- identify and improve efficiency of atypical process loads (e.g. snow melting, car charging, etc.)

3.8 Mandatory Provisions of ASHRAE 90.1-2013

- A/M/E designers to comply with Mandatory Provisions of ASHRAE 90.1-2013

Note: ASHRAE 90.1-2013 Mandatory Provisions forms are to be completed by the A/M/E designers and submitted with the Building Energy Modeling Report.

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4 "DESIGN BASELINE" BUILDING PERFORMANCE

The following table summarizes preliminary "block modeling" results for the "Design Baseline" building to illustrate projected building energy performance for an OBC / TGS TIER I COMPLIANT SCENARIO:

END USE	ENERGY RESOURCE	EUI [ekWh/m^2/year]	ENERGY USE [ekWh/year]	PERCENT OF TOTAL [%]
Lighting	ELEC	17.5	1,255,798	14.5%
Plug & Process Loads	ELEC + NG	18.6	1,336,138	15.4%
Space Heating	NG	48.9	3,513,070	40.6%
Space Cooling	ELEC	5.6	402,728	4.7%
Pumps & Auxiliary	ELEC	5.0	357,167	4.1%
Fans	ELEC	8.1	583,656	6.7%
Service Water Heating	NG	16.3	1,169,949	13.5%
Exterior Loads	ELEC	0.5	32,406	0.4%
TOTAL	**ELEC + NG**	**120.4**	**8,650,912**	**100.0%**

Note: "Design Baseline" building performance characteristics are described in Section 3 of this report.

For comparison, the average EUI of a typical existing high-rise residential building in Ontario is approximately 300 ekWh/m^2 (depending on usage patterns, etc.). Therefore, it is estimated that this building would show a savings of >50% relative to a typical existing mid-rise residential building.

Note: This building has been modeled using very limited design information. Many assumptions have been made regarding design details (such as equipment performance ratings, controls systems used, and detailed operating parameters). These energy performance numbers will change as more design information becomes available.

Note: The results presented in this report are not predictions of actual energy consumption. Real world experience will differ from modeled energy performance for many reasons including (but not limited to) variations in building occupancy and operating patterns, equipment setup and maintenance, unexpected weather conditions, inaccurate modeling assumptions, modeling simplifications, and energy uses not modeled.

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5 OPPORTUNITIES TO IMPROVE PERFORMANCE

This project will consider many opportunities to improve energy performance beyond the minimum requirements specified by OBC / TGS Tier I. Additionally, the project team is looking at ways to enhance the operational resiliency of the project, from an energy perspective. These concepts are under review and will continue to be evaluated on a case-by-case basis considering all project factors including project budget and cost/benefit analysis.

Based on our preliminary assessment of project context, early project drawings, and overall design intent – the following subsections summarize the status of each of the 5 key areas of investigation covered by this report.

5.1 Shared Energy Infrastructure

Opportunities for shared energy infrastructure have been discussed. Opportunities for waste heat recovery from/to adjacent sites do not appear to be compelling, and a shared central plant (i.e. a district energy system) does not fit the development model envisioned for this project. If a specific, viable, and financially beneficial opportunity is found, it will be thoughtfully considered during the detailed design phase of the project.

5.2 Passive Solar Design Strategies

Opportunities to incorporate passive solar design strategies are being implemented as part of the architectural design of the building. The placement of windows and window performance criteria are being carefully considered. Window performance criteria (i.e. U-value and SHGC) will be tuned during detailed design to improve occupant comfort and enhance overall building energy performance.

5.3 Enhanced Energy Conservation and Energy Efficiency Measures

Opportunities for enhanced energy conservation and energy efficiency measures will be evaluated as the design progresses. For example, the project team may investigate the costs and the potential benefits of achieving TGS Tier II (or higher Tier levels of the TGS). To achieve enhance performance, the following items should be investigated:

- upgrades to the building envelope (insulation values, window performance)
- further enhancements to lighting systems
- advanced mechanical systems
- advanced control systems (e.g. override control for residential units to include "suite kill switch" to turn off all lighting and non-essential loads)

Note: The potential development charge rebate for the project if TGS Tier II were achieved is uncertain at this time. The project team will continue to gather information about TGS Tier II and make a final decision about pursing it at a later date.

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5.4 Renewable Energy Systems

Opportunities to incorporate renewable energy systems have been contemplated. The most appropriate solution would be a solar photovoltaic (PV) system installed on the roof (and/or possibly the south façades) of the project.

The size, shape, and location of the building limits the feasibility of implementing a very large solar installation. However, as an example, we have investigated the size of PV system that would be required to produce approximately 5% of the (modeled) total annual energy consumption of the building (since this is the minimum amount that would make the building eligible for ZERO CARBON BUILDING CERTIFICATION).

Based on the information currently available about the project, we expect that a PV system with a 360 kWp installed capacity would be necessary to produce ~5% of the (modeled) total annual energy consumption of the building. A PV system of this capacity would require approximately 1,800 m^2 of solar panel area (assuming high efficiency modules were used). We would recommend installing a portion of the PV on the roof, and a portion of the south façade (or it could all be installed on the south façade).

A concept design and additional detailed analyses (including a shading analysis and a financial analysis) would be required before making a decision about proceeding with a PV system on this building. Design implications and costing will continue to be evaluated as the project moves into the next design phase.

5.5 Strategic Back-Up Power Systems

Back-up power is planned for life safety systems in the building, per the requirements of the Ontario Building Code. Emergency lighting, elevators, sump pumps, garage exhaust fans, the fire alarm system, and fire pumps will be fed from natural gas generator(s). Since natural gas will be used as the fuel (instead of diesel), the run time of the generator(s) will be virtually unlimited during an emergency situation. Additionally, the design team will look at options to provide heating and cooling to designated common areas in the event of a prolonged power outage. This will be evaluated in detail during the detailed design phase.

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6 CONCLUSIONS AND RECOMMENDATIONS

This project can comply with the minimum energy performance thresholds specified by the OBC / TGS Tier I by implementing good engineering design and adhering to the recommended energy performance characteristics for "Design Baseline" building systems (as described in Section 3). Additional detailed recommendations may be required as the design progresses.

There may be significant benefits associated with reaching the TGS Tier II performance level (including a significant development charge rebate). It is recommended that the project team continue investigating the costs and the potential benefits of achieving TGS Tier II.

Refined and more detailed energy analyses are required to confirm performance. Further work is required to prepare Building Energy Modeling Reports to help document compliance with the OBC and TGS and to reach enhanced levels of energy performance (possibly TGS Tier II).

Opportunities for shared energy infrastructure will continue to be investigated in the detailed design phase. However, heat recovery from/to adjacent sites does not appear economically feasible and a shared central plant does not fit the development model envisioned for this project.

Renewable energy system implementation will continue to be contemplated as part of an investigation into ZERO CARBON BUILDING CERTIFICATION. It is too early to tell if it will be pursued at this time.

Back-up power for this project will be provided by natural gas generators to provide virtually unlimited operation during an emergency situation. Additionally, the design team is committed to looking at options to provide heating and cooling to designated common areas in the event of a prolonged power outage.