Energy Conservation Report

51,53,55 & 75 Bradford Street and 20 Checkley Street

BARRIE LAKESHORE DEVELOPMENTS

Barrie, ON

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EXECUTIVE SUMMARY

BARRIE LAKESHORE DEVELOPMENTS has retained EQ Building Performance (EQ) to develop an Energy Conservation Report for the Barrie Waterfront project (the "Proposed Development"). The Proposed Development consists of four residential towers, hotel space, retail space, and associated amenity space. Parking is located within the levels below the development.

The Proposed Development is subject to the energy requirements of the Ontario Building Code Supplementary Standard SB-10. EQ has predicted the energy use, thermal demand, and expected carbon impact of the project in compliance with these requirements, outlined in Table i below. The development team is committed to creating a community in line with OBC performance requirements.

The City of Toronto has created a reference for building energy use, thermal demand, and expected carbon impact for predominant building archetypes – high-rise residential, low-rise residential, retail, and office. As this project falls within these archetypes, the City of Toronto Zero Emissions Building Framework has been used for energy analysis, along with EQ's extensive database of past projects that share similar characteristics.

Energy, thermal demand, and carbon emissions are predicted for OBC compliance and the considered design's estimated level of performance.

Table i - Predicted Energy, Carbon, and Thermal Demand Performance Summary

	OBC SB-10	Considered Upgrades
Total Energy Intensity (ekWh/m^2) – EUI	**190.5**	**169.7**
% Savings vs OBC SB-10	**-**	11%
GHG intensity (kg CO_2e/m^2) – GHGI	**26.1**	**20.0**
% Savings vs OBC SB-10	-	23%
Thermal Energy Demand Intensity (ekWh/m^2) – TEDI	**78.2**	**69.5**
% Savings vs OBC SB-10	-	11%

This report outlines design strategies to achieve each of the presented targets. Advanced measures such as district energy systems and solar PV are outlined for further exploration, however further detailed analysis is outside the scope of this report as it is not expected to be completed at this stage of development. If advanced measures are pursued, they can be explored using the energy model developed for building permit. Design options are also presented to provide enhanced resilience for the Proposed Development and should be evaluated further on a feasibility and cost basis.

The strategies outlined in this report will be evaluated by the design team throughout design development. Using a combination of strategies from the energy strategy report, the Proposed Development will achieve the OBC performance requirements.

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1 INTRODUCTION

The Proposed Development consists of four residential towers, hotel space, retail space, and associated amenity space. Parking is located within the levels below the development. The surrounding area is a mixed use and vibrant community with access to a myriad amenities and services, directly adjacent to the Barrie Waterfront and Marina.

Currently, the project will at a minimum meet OBC SB-10 requirements, but will use this report to explore opportunities for a measures that might be incorporated later on in the design process, as feasible.

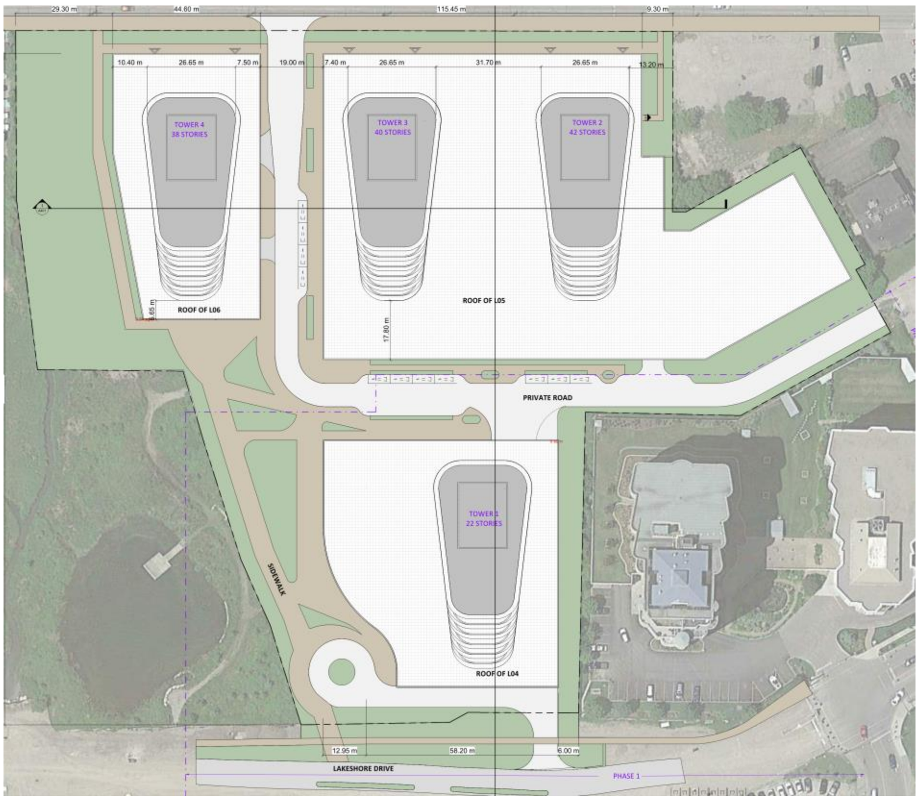


Figure 1. Proposed Project Site Plan

2 PURPOSE

The City of Barrie has developed a number of sustainability policies in order to address climate change, with particular focus on local energy solutions that are efficient, low-carbon, and resilient. For industrial development over 5,000 m^2, commercial building over 2,500 m^2, or a residential development greater than 50 units in a single building, the City of Barrie has recently introduced the requirement for an Energy Conservation Report. The intent of this report is outlined in the *Energy Conservation Report Terms of Reference* and encourages projects to:

- Identify and evaluate opportunities to achieve very low energy use and reduced energy demands
- Consider energy sharing for multi-building developments
- Consider increased resiliency such as strategic back-up power capacity
- Identify innovative solutions to reduce energy consumption

- Explore engaging private investment in energy sharing systems

While all of the strategies discussed are identified during the conceptual stage of the project, they are developed during the detailed phase of the design process in combination with OBC SB-10 performance requirements to inform design.

3 Design Opportunities

3.1 Passive Design Measures

At this point in design, the materiality of the building envelope is still under consideration. Given the nature of the project, precast or spandrel and a moderate window-to-wall ratio were used to predict energy usage in the building. While it is too early in design for envelope interface details to be developed, the project team will carefully consider these details as design progresses. Under current building code requirements, only limited thermal bridging accounting is required to account for major structural elements such as spandrel back-pans, steel studs, and balconies. Current requirements also allow up to 2% of the building envelope major thermal bridges (such as balconies) to be excluded from effective thermal performance calculations. Full thermal bridge accounting introduces new focus on architectural elements that may not have been considered in detail under current building code, including:

- Opaque Wall and Glazing Interfaces
- Interior and Exterior Wall Interfaces
- Slab bypasses
- Balconies
- Parapet and terrace details

By fully accounting for all thermal bridges, a more accurate representation of thermal performance of the envelope can be used in the model, reflecting more accurate energy use estimation. While each project will have different performance values, EQ has completed these calculations on some similar projects. A typical spandrel assembly with insulation in both the back-pan and back-up wall may have a nominal R-20 performance, which would currently be modelled as an effective R-9 with minimal thermal bridging accounting. With full thermal bridges accounted for, this effective performance typically drops closer to R-4; a significant decrease in performance. Considering these details early in design can significantly improve the envelope performance and overall energy performance in a passive way. BC Hydro has developed the *Building Envelope Thermal Bridging Guideline*[1], which is a useful resource to evaluate interface details early in design. This guide shows a number of different approaches to detail the building envelope in order to reduce thermal bridging. While this additional thermal bridging accounting is not currently required in current OBC SB-10 compliance modelling methodology, these calculations are expected to become part of building code and other high performance standards over time, as they are more accurate to the real life performance of the envelope. By

[1]https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/building-envelope-thermal-bridging-guide-1.3.pdf

assessing the building envelope using these advanced accounting techniques and improving upon the affected details, the overall thermal loads will decrease resulting in lower energy demand and emissions.

Full thermal bridging calculations not only better reflect the energy usage in a building, but also give a better representation of the thermal comfort within a space. With a poor performing envelope, the first few feet of a space adjacent to the exterior wall can be unusable due to thermal comfort issues. Improving the performance of the wall can increase occupant comfort significantly and can allow for mechanical equipment to be downsized. Additionally, as interior spaces are better able to maintain their temperature set-points, HVAC run times and system cycling can be reduced leading to increased HVAC system life times. Passive design measures can also effect the resilience of a building. Additional information on this is available in *Section 7 – Energy Resilience* of this report.

In terms of glazing for the project, a product with a low solar heat gain coefficient will be encouraged. This will provide daylight while reducing over-heating in shoulder seasons and cooling loads in the summer. The building is currently targeting a 40% window-to-wall ratio, which will be beneficial.

The orientation of the buildings have been influenced by the nature of the site and the intended uses, limiting opportunities for optimization. Throughout design, the design team will explore options for control of solar gains via external overhangs and shading to limit overheating as appropriate for each building elevation. Electrochromic glazing (glass that tints in response to solar intensity or sun position) can also serve this purpose, while maximizing daylighting and views in the residential spaces. It is expected these measures will have a positive impact on the building cooling and heating loads.

As design progresses and enters building code review, the design team will consider a number of passive design measures. A description of measures for level of performance has outlined below. Cost premiums should be evaluated independently as part of a full feasibility study by the design team.

Minimum Design Suggestions (OBC)

- High performance opaque building envelope, continuous insulation within the assembly (Typical design has little to no continuous insulation)
- Low window to wall ratio - 40% vision (Typical design 40-60% vision)
- 'OK' thermal bridging performance at envelope interfaces (Typical design does not consider these fully)
  - Reduced balconies (<2% of building envelope area)
  - One large window is better than multiple small windows of the same total area
- High performance double glazing with low-e coating (Typical overall performance U-0.40, SHGC 0.35)

Upgraded Design Suggestions (Considered Design)

Design improvements from OBC minimum plus:

- 'Regular' thermal bridging performance at envelope interfaces
    - Enhanced or thermally broken cladding attachments
- Improved infiltration, typically achieved with improved detailing and confirmed with whole building air tightness testing
- Optimization of glazing based on façade orientation

3.2 Active Design Measures

At the current design stage, mechanical systems have been considered only at a conceptual level. Typical design for similar buildings in southern Ontario include a dedicated mechanical heating and cooling via a gas-fired hot water boiler and electric chilled water plant. As design progresses, a preliminary energy model will be developed to evaluate different design opportunities to ensure an optimized active design. During this process, the design team will consider a number of active design measures. A description of measures for each analyzed level of performance have been provided below. Cost premiums should be evaluated independently as part of a full feasibility study by the design team.

OBC Design Suggestions (Typical Design)

- Corridor pressurization ventilation rate –30-60 cfm/suite
- Outdoor air in remaining areas 10-50% higher than ASHRAE 62.1 levels
- Variable speed fans– allows central make up air fans to reduce flows during low activity periods
- Variable speed pumps– allows pumps to vary flow and reduce consumption (Typical)
- Air-side heat recovery – suggest 65% efficiency (for projects with higher WWR ~ 60%)
- Fan coil or water-source heat pump system (Typical)
- SB-10 Lighting power density levels and controls where required
- OBC prescribed flow rates on plumbing fixtures – 8.3 LPM lavatories, 8.3 LPM sinks, 7.6 LPM showers

Premium Design Suggestions (Considered Design)

- Corridor pressurization ventilation rate – 30 cfm/suite
- Outdoor air in remaining areas close to ASHRAE 62.1 levels
- Variable speed fans– allows central make up air fans to reduce flows during low activity periods
- EnergySTAR appliances
- Variable speed pumps– allows pumps to vary flow and reduce consumption

- Air-side heat recovery – suggest 65% efficiency (for projects with higher WWR ~ 60%)
- Fan coil or water-source heat pump system (Typical)
- High-efficiency LED lighting, daylight and occupancy controls – recommend 30% reduction from code in common areas
- 20% reduction in domestic hot water energy use – Recommend low-flow plumbing fixtures for hot water fixtures 5.7 LPM lavatories, 5.7 LPM sinks, 6.8 LPM showers

4 ENERGY ANALYSIS

4.1 ENERGY METRICS

Current energy standards in Ontario use a 'reference' building approach for compliance, comparing the proposed building as designed to a reference building designed with minimum code requirements. This allows buildings to more easily trade off deficient performance in one area with superior performance in others (i.e. a less effective building envelope with higher performance mechanical systems).

The projected energy consumption has been evaluated based on metrics for similar building archetypes in the Zero Emissions Building Framework in Toronto. The intent of evaluating using EUI is to encourage all buildings to meet the same standards of performance regardless of design and helps to easily compare buildings that share similar uses but have different geometries, sizes, and characteristics. In contrast, actual performance may vary dramatically between buildings when using the reference building approach. The Zero Emissions Building Framework proposed the following three targets:

1. **Energy Use Intensity – EUI – ekWh/m^2**: Annual building energy use, divided by conditioned floor area.
2. **Thermal Energy Demand Intensity – TEDI – kWh/m^2**: Annual heating load, divided by the conditioned floor area. TEDI excludes the effects of mechanical efficiencies (e.g. condensing boilers) but does include passive systems such as air heat recovery, solar gains, and internal gains.
3. **Greenhouse Gas Intensity – GHGI – kg CO_2e/m^2**: Annual greenhouse gas emissions, divided by the conditioned floor area. The annual average carbon emission factors currently listed in OBC SB-10 are used for this calculation.

Energy use intensity, thermal energy demand intensity and greenhouse gas intensity will be reviewed and estimated in this report. A reduction in thermal demand will be reflected in a focus on passive design elements and heat recovery options for both heating and cooling use in the analysis below. Because these metrics are not explicitly used for Code compliance, there are improvements that can be made that will not be reflected in a standard OBC SB-10 compliance model. Therefore, the intent is to attempt to quantify the effects of such measures as improved detailing associated with thermal bridging and reduction of hot water use through low-flow plumbing fixtures.

4.2 ENERGY TARGETS

The Development team is committed to creating a community that will meet the levels of energy and GHG emissions set out by the OBC SB-10 requirements. This report will suggest design solutions in order to achieve this performance target and considered upgrades that can help improve energy efficiency, resiliency, and GHG intensity.

Using the Greenhouse Gas Intensity metric, predicted greenhouse gas emissions as well as predicted energy use will be presented. Referencing the Ontario Building Code (OBC), a factor of **0.050 kg CO_2e/kWh** for grid supplied electricity, and **1.899 kg CO_2e/m^3** for natural gas will be applied.

4.3 Predicted Energy Use[2]

The City of Toronto *Zero Emissions Building Framework* outlines sample designs that were used in setting the targets for future versions of the municipal requirements by end use and by building type. This information has been used to predict the energy use of the Proposed Development, and verified against EQ's extensive database of modelled buildings.

Predicted energy use and resulting carbon emissions for each of the two design options is presented in Table 4.

Table 2 - Predicted Energy, Thermal Demand and Carbon Performance

	OBC	**Considered Upgrades**
Electricity - Space Cooling	6.6	6.3
Electricity - Space Heating	2.7	2.9
Electricity - DHW Heating	0.0	0.0
Electricity - Base loads	59.4	54.8
Gas - Space Heating	79.2	70.5
Gas - DHW / Base Loads	42.9	34.8
Total Energy Intensity - (ekWh/m^2)	**190.5**	**169.7**
Total Energy (eMWh)	31,184	27,774
% Savings vs Tier 1	-	11%
GHG intensity (kg CO_2e/m^2)	**26.1**	**20.0**
Total GHGs (tonnes CO_2e)	4,270	3,274
% Savings vs Tier 1	-	23%
Thermal Energy Demand Intensity (ekWh/m^2)	**78.2**	**69.5**
Total Thermal Demand (eMWh)	12,806	11,372
% Savings vs Tier 1	-	11%

The considered upgrades result in an anticipated **11%** reduction in energy use, **23%** reduction in carbon

[2] Detailed calculations are available in the softcopy submission in the excel file provided with submission.

emissions and **11%** reduction in thermal energy demand when compared to anticipated OBC levels of performance.

Improved levels of thermal demand from the considered upgrades are indicative of a strategy focused on **passive design improvements**, in turn reducing heating energy use. For example, one strategy may be to improve the exterior envelope enough so that mechanical equipment can be downsized. The switch to absolute targets requires a shift in how energy performance is measured and requires energy modelling and passive design exploration to happen in a serious way early in design. A focus on heating reduction is evident in Figure 1 and 2.

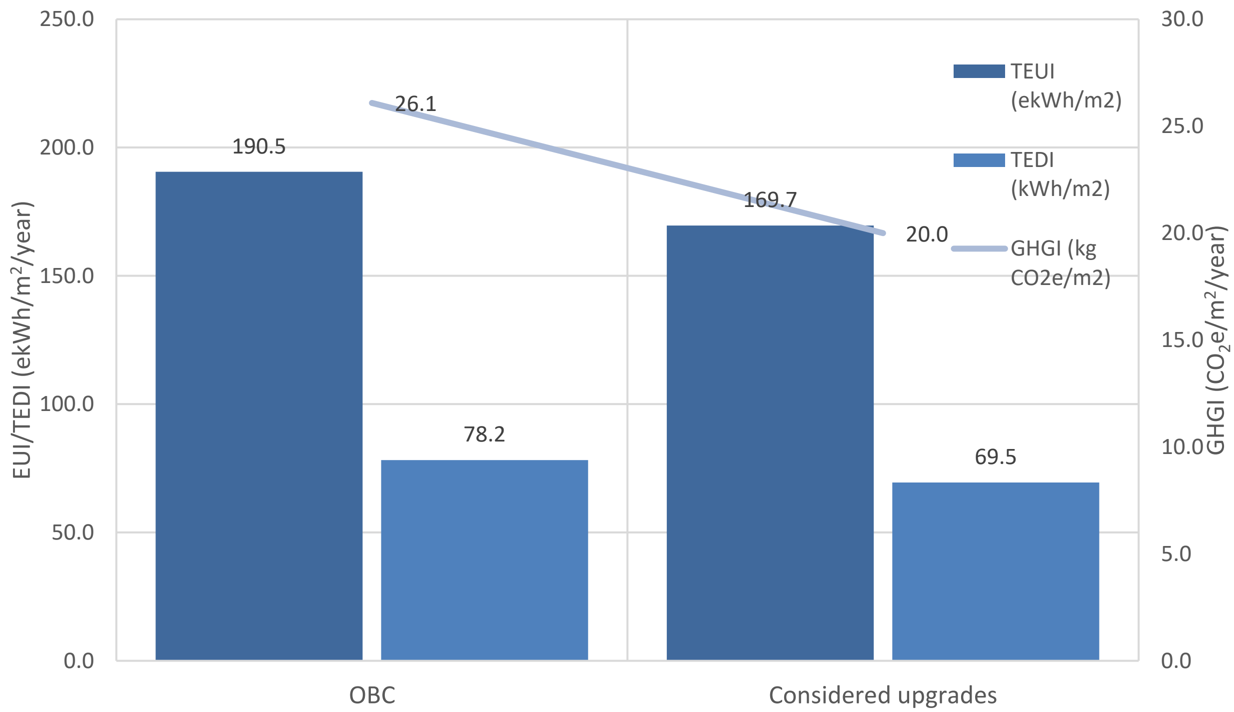


Figure 1 - Predicted Energy, Thermal Demand and Carbon Performance

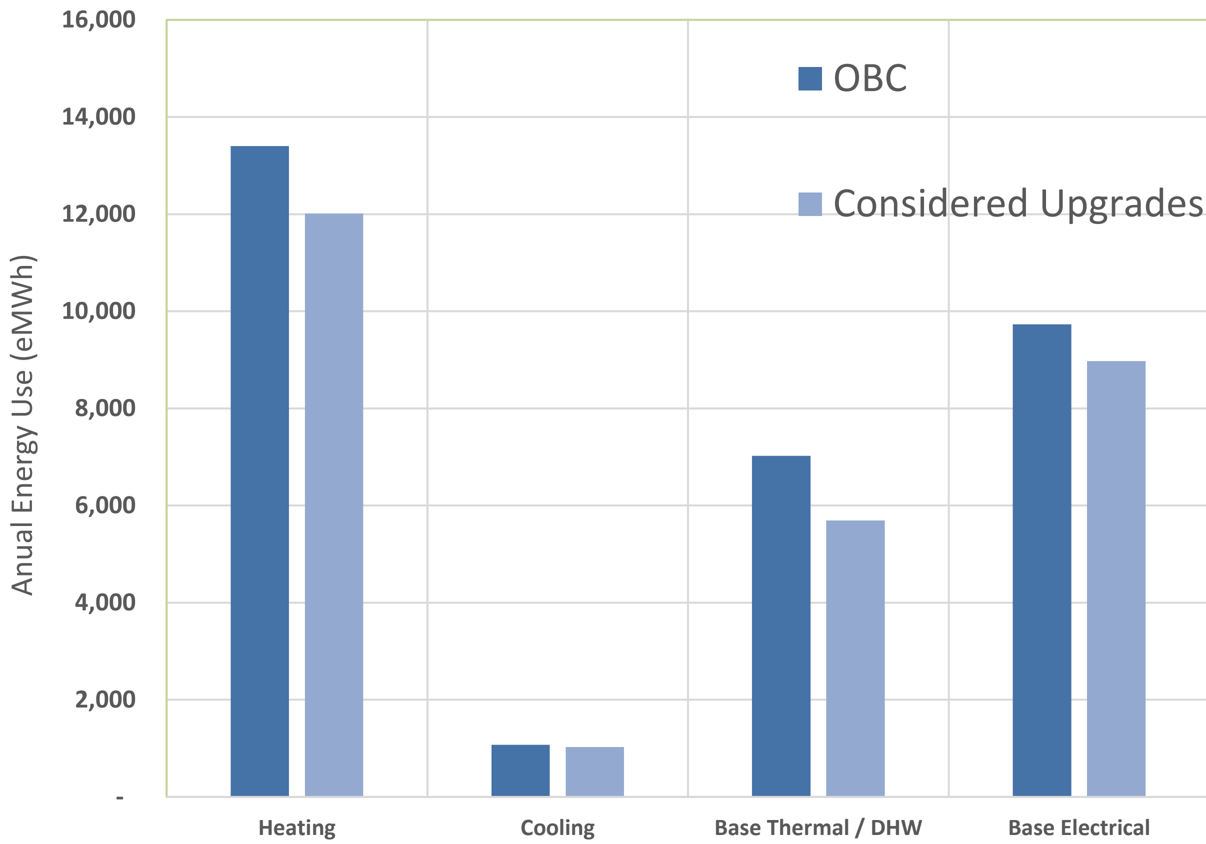


Figure 2 - Predicted Energy Consumption by End-Use

Potential design strategies intended to achieve Code compliance and the considered upgrade design have been presented in Section 2 and Section 3, but are also jointly summarized in Appendix A. It should be noted that designs presented reflect one of many possible design solutions that will be verified and optimized during the energy modeling process.

5 Advanced Energy Solutions

5.1 District Energy Systems

5.1.1 Types of District Energy Systems

At a high level, district energy systems may be categorized as one of two types: **High Temperature** and **Low / Ambient Temperature**.

A **High Temperature** district energy plant provides heating and/or cooling to the building at the temperature required to meet the load, and involves using heat exchangers or coils *within* the building for distribution of heating and cooling, similar to a typical high rise design. This approach is amenable to district technologies such as Deep Lake Water Cooling (DLWC) and central steam or hot water plants, as well as central Combined Heat and Power (CHP) systems.

In comparison, a **Low / Ambient Temperature** district thermal system takes its design philosophy from a water-loop heat pump (WLHP) HVAC system in a high rise residential building. The ambient temperature system relies on heat pumps or VRF units located in the space. These units connect to an ambient temperature (typically 12 to 30°C) distribution loop through which the heat pumps can reject or absorb heat. This approach is amenable to incorporating boreholes at a community level for ground source heat pump technology or low grade solar thermal.

HIGH VS AMBIENT TEMPERATURE DISTRICT THERMAL

HIGH TEMPERATURE LOOP	AMBIENT LOOP
Equipment in building may be minimized (boiler/chiller reduced to a heat exchanger)	Heat pump equipment required in building to generate temperature for space conditioning
Distribution piping requires insulation	No insulation needed / heat exchange with ground encouraged
Heating demand met by gas fired equipment or recovered waste heat	Heating demand met by terminal electric heat pump / VRF, and central gas fired or renewable sources
High temperatures can be augmented by CHP / heat recovery	Low temperatures amenable to ground loops / low grade solar thermal
Separate loops required for heating and cooling	Heating and cooling provided by one loop

The decision to pursue either of these district energy options relies on several factors, including the availability of each type of system, willing partners (e.g. local public/private utilities), space constraints, and project goals.

5.1.2 District Energy Potential

Low carbon thermal energy networks / district energy systems can be an important strategy in greenhouse gas emissions reduction targets. These networks may include options such as deep lake water cooling, biofuels, solar heating or waste heat recovery.

While discussions regarding district energy have not yet taken place, the project should monitor changes in proposed district energy systems to assess any future opportunities to connect to a district energy system.

A detailed energy model and load profile for this site is outside of the scope of this report as it is not expected during this stage. This model can be used by the design team to further explore potential district energy solutions as design progresses. Within the building, connecting to a district system can reduce the amount of space needed on site for mechanical systems, increasing useable GFA for the building, as well as potentially being a more reliable source of heating/cooling compared to a dedicated building plant due to the modular nature of district energy. Connecting to a district energy system can help to achieve significant emissions reductions at a relatively low cost due to economies of scale.

The project team is encouraged to consider connecting to a district system if the opportunity arises. In the meantime, there are ways to design the building to be district energy ready. To prepare for a future district-energy connection, the following key items should be incorporated into building design:

- Install heating and cooling plant equipment on the lower levels for easier integration into a future district system, or provide for a future connection points into the building's thermal piping at ground level
- Provide adequate space at or below ground level for a future energy transfer station
- Provide an easement between the mechanical room and the property line to allow for thermal piping
- Provide two-way pipes placed in the building to carry thermal energy from the district energy network to the section in the building where the future energy transfer station would be located
- Install a low temperature hydronic heating system (e.g. heat pump loop) that is compatible with a district energy system in order to reduce the pipe sized and associated valves, fitting, etc.
- Include provisions for appropriate future thermal energy metering

5.2 Renewable Strategies: Solar PV

Solar PV is rapidly becoming an economically viable strategy for energy generation at the individual building level, thanks to the price reductions in solar panels over the last several years. As such, it is an important design consideration of low carbon buildings. Several developments of all types, including residential, institutional, and commercial have already incorporated PV into their designs or retrofitted existing buildings to take advantage of their long-term economic benefits.

Effective solar PV installations require access to adequate sunlight as well as the space needed to house the panels. This creates constraints for a high rise residential building, typified by a small roof area relative to total conditioned area. There is significant podium space available in the current design, though it is unclear at this stage what the function of that space will be and how it will support the occupants. An alternative to providing solar PV at the time of building would be to incorporate solar ready features so that the building is capable of incorporating PV more easily if the building owner should choose to install at a later date. Solar ready features that could be incorporated into their design include:

- Designate a portion of the roof for future solar PV and/or solar thermal
- Provide adequate structural capacity in the roof
- Install conduit to the roof from the main electrical room to accommodate future systems
- Designate wall area in the electrical rooms or future system controls
- Where possible, place HVAC or other rooftop equipment to avoid shading of future systems
- Consult NREL's Solar Ready Buildings Planning Guide[3]

[3] http://www.nrel.gov/docs/fy10osti/46078.pdf

Given the approximate total roof area of the development, it is estimated that at most **9,690 m^2** may be available for solar energy production considering shading, minimum outdoor amenity areas, and mechanical requirements, resulting in the following levels of production:

Table 3 - Predicted Solar PV Production Potential

System Size (kW)	1,450
System Size (m^2)	9,690
Annual production (kWh)	1,667,500
% of energy requirement (considered upgrades)	2.1 %

If rooftop solar PV is maximized, the potential PV system is predicted to be able to provide **2.1%** of the considered upgrades scenario annual energy consumption. Combining solar production with battery storage would maximize the benefits of a solar array by allowing for load shifting and demand reduction.

6 ENERGY RESILIENCE

With increasing global temperatures, extreme weather events require designs to carefully evaluate back-up power solutions. Typical design intent is to include back-up power via a generator that will supply all emergency (life safety) requirements. Passive design measures such as a relatively low window-wall ratio, high thermal mass elements within the building, and high R-values for the building insulation would assist in maintaining building temperature in the event of heating/cooling system failure.

To increase building resiliency, the project could elect to include back-up power in addition to emergency power on the generator. In general, the difference between these loads is as follows:

Table 4 - Emergency vs. Back-up Power Requirements

	Emergency Power	Back-up Power
Purpose	Minimum life safety requirements (firefighter and evacuation)	Non-life-safety requirements for occupant wellbeing
Duration	2 hours – building code requirement	72 hours – based on federal emergency preparedness guidelines
Loads	Fire pumps, fire elevator, stair pressurization fans, alarm system	Water supply, minimal space heating, power to a common refuge area, domestic booster pumps, additional elevators

Including back-up power on the generator has the potential to increase costs in order to increase the size of the generator, but this can be reduced through the use of a load management system with load selection capability. When the system detects it is no longer in an emergency, it can divert generator resources to back-up power allowing tenants to remain safe and comfortable in their homes during a power outage.

While increasing back-up power capabilities can improve resiliency, passive design is vital to ensuring that occupants are able to stay in the building during a power outage. One typical criteria used in gauging building resilience in buildings is measuring the interior temperature 72 hours and two weeks after a power failure. The better a building is able to maintain its temperature without mechanical conditioning; the longer people will be able to remain in place. The *Zero Emissions Building Framework* analyzed each performance level against these standards. The results are summarized in the Figure below:

Table 5 - Resilience of Various Performance Levels

Tier	72h Power Off Winter Temperature Low (°C)	2 Week Power Off Winter Temperature Low (°C)
OBC SB-10	9.9	0.9
Considered Upgrades	13.5	5.8

As the building envelope improves performance with increased performance (detailed suggestions in Section 3.1), the building is better able to maintain internal temperature in a power outage situation.

Another strategy to improve resilience for residents is to provide an **area of refuge** within the building. The designated space would need to provide minimum levels of heating, cooling, lighting, potable water, and power during power outages for a minimum of 72 hours. This would allow residents to remain in the building during a power outage and to keep warm or cool, store medicine, charge communication devices and share updates. The development team is encouraged to review the *Minimum Backup Power Guidelines for Multi-Unit Residential Buildings*[4] for additional guidance.

Connection to a District Energy System also improves the resilience of the development. District energy improves the reliability and availability of power supply by not depending on the centralized grid. This allows the building to provide energy for both emergency and non-life safety requirements during times when the grid is failing.

7 EMBODIED ENERGY

While the energy used to operate the building is typically discussed throughout design, the energy required to extract, manufacture, and transport a building's materials, as well as the energy used during construction is often forgotten. This is known as embodied energy, and can be a significant amount of energy depending on the materials and methods used in construction. When a building is developed, the materials used (particularly for structure) are discarded in the demolition process which results in the loss of embodied energy. As an example, typical concrete has approximately 1,984,668 MBTU/litre of embodied energy. Comparatively,

[4] https://www.toronto.ca/wp-content/uploads/2017/11/91ca-Minimum-Backup-Power-Guideline-for-MURBs-October-2016.pdf

gasoline has approximately 431,728 MBTU/litre of embodied energy[5]. The is equivalent to 4600 L of gasoline for every liter of concrete poured. Steel or wood both have less embodied energy than concrete and may be a better choice of material depending on the application. In new buildings, as envelope details are improved and more passive house designs are considered, the amount of construction material can increase which would further increase the embodied energy of the building.

It is important to consider a new building's materials and how the embodied energy from the existing site can be salvaged during the early stages of design. The Athena Sustainable Material Institute has produced a free software tool that allows developers, and their consulting team to track the embodied energy associated with their design[6]. Additionally, this tool can be used to improve knowledge of the embodied energy that already exists on site, and help make informed decisions on how to reduce the loss of embodied energy for the project. While outside the scope of this report, the project team is encouraged to use this software during design to stay informed about the energy involved in building the proposed development. The project team is also encouraged to reuse or recycle existing materials on site wherever it is deemed feasible.

8 CONCLUSIONS/RECOMMENDATIONS

Through attention to detail in the envelope selection and construction and mechanical system selection, carbon and energy use minimum OBC performance targets will be achieved utilizing the modelled performance path. Additional measures can be included and, even though modeling conventions do not allow for some of them to be used to achieve compliance, they can contribute to the overall energy efficiency and resilience of the proposed building.

As design progresses, the design team will engage with the energy modelling process to evaluate the design alternatives expressed in this report. The project team is encouraged to explore the feasibility of higher levels of energy and carbon performance, as well as draw on advanced design strategies where feasible to create a truly sustainable development.

Energy predictions in this report are preliminary in nature, and an energy model will be used to fully evaluate the impacts of the recommendations in this report. The design alternatives discussed in this report are recommendations only, and decision to incorporate them into the final design is up to the discretion of the project team.

If the design team chooses to pursue advanced measures such as district energy system connections and solar PV, further detailed analysis above the typical OBC modelling requirements will be needed. Design strategies that would support both of these decisions have been included in this report.

Finally, design options are presented to provide enhanced resilience for the Proposed Development and community, and should be evaluated further on a feasibility and cost basis.

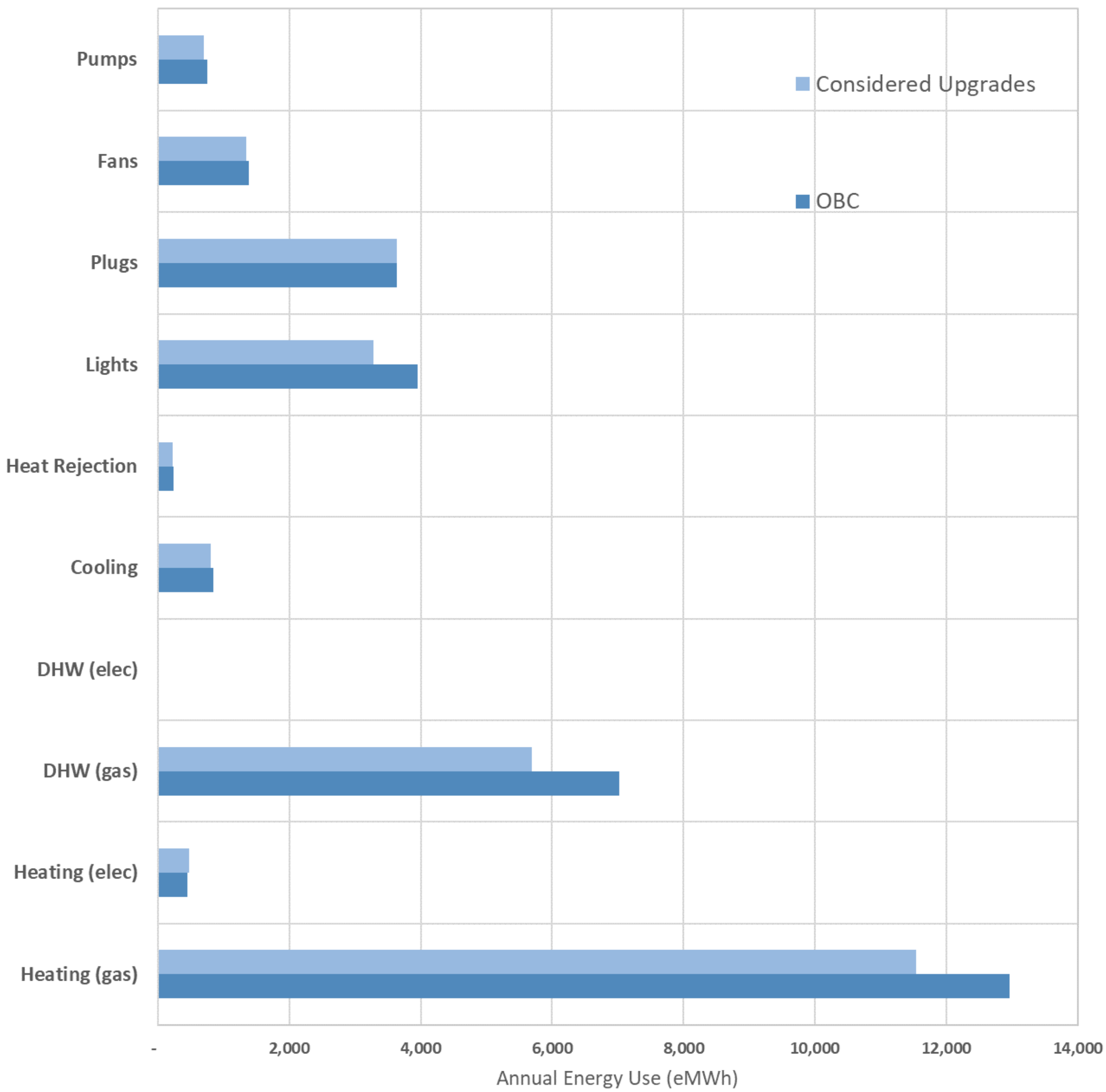
[5] https://www.go-gba.org/embodied-energy/
[6] http://www.athenasmi.org/

APPENDIX A – ENERGY CONSERVATION MEASURES SUMMARY

Energy Conservation Measures	Energy Impact	Cost Impact
BUILDING ENVELOPE – PASSIVE MEASURES		
Opaque Wall –		
Some continuous insulation, reduced balcony area, improved thermal bridges	HIGH	LOW
Vision Wall		
40% vision to wall ratio	MID	LOW
High performance double glazed assembly, thermally broken aluminum frame	MID	LOW
Infiltration – Code defaults assumed, no validation with testing		
Improved air tightness – improved detailing	MID	LOW
MECHANICAL + ELECTRICAL – ACTIVE MEASURES		
Ventilation – 30-60 cfm/suite in corridors, 10-50% above ASHRAE 62.1 in all other areas		
Corridor ventilation - 30 cfm/suite	HIGH	LOW
ASHRAE 62.1 ventilation in other areas	MID-HIGH	LOW
Mechanical System – Fan coil or water-source heat pump, conventional mechanical plant		
EnergySTAR appliances	LOW	LOW
Low-flow plumbing fixtures for hot water fixtures – recommend 5.7-1.9 LPM lavatories, 5.7-3.8 LPM sinks, 6.8 LPM showers	HIGH	LOW
Common Area Lighting – Code maximum lighting power densities, code minimum lighting controls		
30% reduction in lighting power density	MID	LOW
Advanced Design Measures		
District Energy	LOW-HIGH	LOW-MID
On-site Renewable Energy Generation	LOW	HIGH

APPENDIX B – DETAILED EXPECTED ENERGY PERFORMANCE

Barrie Waterfront	OBC	Considered upgrades
Heating Gas (ekWh/m^2)	79.2	70.5
Heating Elec (ekWh/m^2)	2.7	2.9
DHW Gas (ekWh/m^2)	42.9	34.8
DHW Elec (ekWh/m^2)	0.0	0.0
Cooling (ekWh/m^2)	5.1	4.9
Heat Rejection (ekWh/m^2)	1.4	1.4
Lights (ekWh/m^2)	24.2	20.0
Plugs (ekWh/m^2)	22.2	22.2
Fans (ekWh/m^2)	8.5	8.3
Pumps (ekWh/m^2)	4.6	4.3
Electricity - Space Cooling (ekWh/m^2)	6.6	6.3
Electricity - Space Heating (ekWh/m^2)	2.7	2.9
Electricity - DHW Heating (ekWh/m^2)	0.0	0.0
Electricity - Base loads (ekWh/m^2)	59.4	54.8
Gas - Space Heating (ekWh/m^2)	79.2	70.5
Gas - DHW / Base Loads (ekWh/m^2)	42.9	34.8
Gas Use (eMWh)	19,982	17,228
Gas Intensity (ekWh/m^2)	122.1	105.3
Electricity Use (MWh)	11,247	10,474
Electricity Intensity (ekWh/m^2)	68.7	64.0
Total Energy Intensity (ekWh/m^2)	**190.5**	**169.7**
Total Energy (eMWh)	31,184	27,774
% Savings vs OBC	-	11%
GHG intensity (kg CO_2e/m^2)	**26.1**	**20.0**
Total GHGs (tonnes CO_2e)	4,270	3,274
% Savings vs OBC	-	23%
Thermal Energy Demand Intensity (ekWh/m^2)	**78.2**	**69.5**
Total Thermal Demand (eMWh)	12,806	11,372
% Savings vs OBC	-	11%


Pumps
Fans
Plugs
Lights
Heat Rejection
Cooling
DHW (elec)
DHW (gas)
Heating (elec)
Heating (gas)
Considered Upgrades
OBC
-
2,000
4,000
6,000
8,000
10,000
12,000
14,000
Annual Energy Use (eMWh)

APPENDIX C – RESILIENCE CHECKLIST

TORONTO

Checklist - Toronto Green Standards Version 3.0

Resilience Planning New Construction

Why do we need a resilience checklist?

Improving the ability of the buildings to withstand the impacts of climate change and extreme weather is an important step towards creating a more resilient city and to protecting the health, safety and economic well-being of the city's residents and businesses. The aim of this checklist is to summarize the level of resilience planning undertaken for your development project.

What responses will help improve building resilience?

The overall impact of changes in Toronto's climate on the development sector includes: higher risk of flooding events, extreme heat and cold events, and power outages. To reduce the impact of these expected changes, new developments must be constructed in such a way as to mitigate flood events, improve thermal resilience, and extend the duration of back-up power generation.

Flooding Events An increase in the overall volume of precipitation and larger individual storm events create a higher risk of flooding in certain areas of Toronto. The Toronto and Region Conservation Authority (TRCA) provides flood plain mapping resources that help identify flood-prone areas of the city. Toronto Water conducts regular servicing studies, develops and maintains the City's Wet Weather Flow Management policy and guidelines for storm water management, and institutes the City's Basement Flooding Program to ensure residents and businesses are protected from back flow and sewage disruptions.

Extreme Heat & Cold Events The risks associated with the impact of extreme heat and cold events on vulnerable populations is an increasing concern in the City of Toronto. Measures to protect at-risk residents (e.g. the elderly, socially isolated, those with pre-existing illness, and young children) and those without access to air conditioning from excessive heat will therefore be important to include into the design and operation of Toronto's buildings. Higher levels of building energy performance improve passive survivability. Buildings designed with well insulated and sealed building envelopes, lower window-to-wall ratios or other passive building design strategies help to maintain liveable indoor temperatures with less energy and for longer periods of time under power outages during winter or summer.

Power Outages The impact of a warmer climate and more extreme weather events can have an effect on the reliability of our power supply. As temperatures rise, our use of air conditioning also increases, putting stress on the ability of the power grid to deliver electricity. Periods of extreme heat are increasingly leading to brownouts and blackouts, as are events in the fall/winter such as the December 2013 ice storm. Research from past events of this nature has shown that extended back-up power, community energy systems help to reduce both the likelihood and the impact of possible power outages and help communities to recover more quickly from a disruption.

3 1 1 toronto at your service

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Resilience Planning New Construction

A. Modelling Assumptions

For expected changes in climate across the Greater Toronto Area, consult Toronto's Future Weather and Climate Driver Study

Has any enhanced modelling using future climate data been conducted for the building site?

☐ Yes ☐ No If yes, what time period was considered?

What temperature minimums/maximums were considered in building design?

Temperature Low (°C): Temperature High (°C):

What variables were assumed for extreme heat events, if any?

Temperature Max (°C): Duration of events (days):

Frequency (events/year):

What variables were assumed for extreme flooding events, if any?

Daily Rainfall Max (mm): Duration of extreme rainfall events (days):

Frequency (events/year):

Risk Assessment/modelling undertaken (Y/N), method used:

B. Thermal Resilience & Safety

For expected changes in climate across the Greater Toronto Area, consult Toronto's Future Weather and Climate Driver Study

What measures have been taken to reduce the impacts of heat waves?

Building - passive

☐ Higher roof R values
☐ Higher envelope R values
☐ Operable Windows
☐ Window films
☐ Cool/green roof
☐ High albedo envelope materials
☐ External window shading devices
☐ Triple glazed windows
☐ Tenant emergency preparedness guides
☐ Other passive ventilation strategies

Building - active

☐ Indoor refuge area with cooling
☐ Centralized air conditioning
☐ Ceiling fans

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Checklist - Toronto Green Standards Version 3.0

Resilience Planning New Construction

Building - site

- [ ] High albedo landscaping materials
- [ ] Soft landscaping
- [ ] External pools (eg. splash pads)
- [ ] Reduced hardscapes
- [ ] Other building shade structures
- [ ] Use of solar PV as shades
- [ ] Shade trees/shrubs
- [ ] Outdoor shaded amentiy space with seating
- [ ] High albedo hardscapes, including parking lots
- [ ] Other

Has a refuge area with cooling been provided in the building?

- [ ] Yes
- [ ] No

If so, what is the total area? (m^2)

Refuge areas should be a minimum of 93 m^2 (1000 square feet), and/or 0.5m^2/occupant

What critical services are provided?

If not, what is the location of the closest emergency warming or cooling centres during an emergency?

C. Back-up Generation

Consult the City of Toronto's Minimum Backup Power Guidelines for MURBs for additional information on critical services in residential buildings.

Measures have been used to reduce the building's energy demand on the grid?

- [ ] On-site solar PV
- [ ] CHP system
- [ ] On-site solar thermal
- [ ] Ground source heat pump
- [ ] On-site battery storage
- [ ] Microgrid connected
- [ ] District energy ready
- [ ] Smart grid ready
- [ ] Building-integrated windd turbines
- [ ] Other

Describe the Back-up power/emergency generator system selected?

Is storage adequate to provide 72 hours of back-up generation?
- [ ] Yes
- [ ] No

Total storage capacity (kW):

Total back-up generation fuel (units):

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Checklist - Toronto Green Standards Version 3.0

Resilience Planning New Construction

Critical services have been included into back-up power generation calculations?

- [ ] Passenger elevator(s)
- [ ] Security systems
- [ ] Unit space heating
- [ ] Unit space cooling
- [ ] Refuge area cooling
- [ ] Refuge area lighting
- [ ] Refuge area electricity
- [ ] Refuge area heating
- [ ] Sump Pumps
- [ ] Hot water boilers/pumps
- [ ] Domestic water booster pumps
- [ ] Other

D. On-site Flood Mitigation

Is the building in a known flood plain? [ ] Yes [ ] No

List any flood prevention measures used to mitigate the impact of heavy rainfall events and associated risk of flooding within the building:

- [ ] Flood proofed Electrical and HVAC Systems (located above grade or 1st floor)
- [ ] Back-up generator/fuel located above grade or 1st floor
- [ ] Ground floor electrical circuits located in ceiling
- [ ] Waste water back flow prevention
- [ ] Water tight utility conduits
- [ ] Storm water back flow prevention.

List the strategies used to accommodate heavy rainfall events under the Stormwater Retention (Water Balance) section of the TGS:

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Checklist - Toronto Green Standards Version 3.0

Resilience Planning New Construction

E. Manager & Tenant Preparedness

Will building management have access to a vulnerable person's list? ☐ Yes ☐ No

If so, has building management been made aware of the location of the preparedness kit? ☐ Yes ☐ No

What additional resources for emergency preparedness have been made available to building managers, operators, and/or tenants?

Completed By:

Name (First,Last):

Position Title:

Date (yyyy-mm-dd):

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