149 DUNLOP STREET EAST, BARRIE

ENERGY CONSERVATION REPORT FOR SITE PLAN APPLICATION

April 5th, 2023

Prepared For Dunlop Developments

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ECOVERT

City File No. D28-011-2022

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1. Executive Summary

ECOVERT is undertaking an Energy Conservation Report in support of a Site Plan Application for a mixed use commercial residential development located at 149 Dunlop Street East, Barrie. The proposed development is comprised of a single 25-storey mixed use building. The development has 3 underground parking areas, and 2 floors dedicated for commercial use. The total gross floor area of the new development is 15,223.51m^2.

The City of Barrie's Energy Conservation Report applies to new developments including industrial buildings over 5,000 m^2, commercial buildings over 2,500 m^2, and residential buildings with over 50 units. The energy conservation report is intended to act as a roadmap that helps achieve the City of Barrie's energy consumption and carbon reduction targets. The report helps designers and developers identify at the earliest opportunity, options to integrate local energy conservation measures that are efficient, low carbon, and resilient [1] .

ECOVERT used the IES-VE simulation software to create energy performance results for an SB10 reference model, an energy efficient model, and a low-carbon enhanced performance model, each with unique energy conservation measures. The energy performance results from each of the three models and their respective energy conservation measures were compared and discussed in the analysis section. This analysis includes passive and active design measures along with on-site energy solution opportunities and other feasible low-carbon energy options.

With the support of the modelling analysis, ECOVERT has identified a recommended set of energy conservation measures that will provide the best opportunity for the 149 Dunlop Street East project to achieve a low-carbon high performance design. This set of energy conservation measures and the resulting high-performance design is very attainable and aligns perfectly with the City of Barrie's plan to move towards energy consumption and carbon reduction targets.

***Figure 1** – 149 Dunlop Street East (Courtesy of Scott Shields Architects Inc.)*

2. Introduction

The City of Barrie is calling for strong action to meet the Federal emissions targets for both 2030 and 2050. Producing near zero emissions in new and existing buildings is one of the key strategies of Barrie's Community Energy and Greenhouse Gas Reduction Plan [2]. This Energy Conservation Report is an example of how these energy and carbon reduction goals can be achieved. The purpose of this Energy Conservation Report is to identify opportunities for developments to integrate local energy solutions that are efficient, low carbon, and resilient [1]. An Energy Conservation Report completed in the early design stages can not only maximize the potential for energy conservation measures (ECMs), but it can pave the way for other developments to follow suit and help contribute to a greener City of Barrie.

- The Energy Conservation Report must complete the following four requirements to successfully provide the development with an achievable low-carbon proposed design [1]:
- Identify both passive and active design opportunities to reduce energy use and demand.
- Identify any opportunities for on-site and off-site low-carbon energy solutions (ex. rooftop PV).
- Compare energy savings of proposed design with included ECMs to the same building constructed with minimum Ontario Building Code standards.
- Use comparative analysis to suggest a preferred scenario with ECM recommendations.

The result of this Energy Conservation Report will guide the 149 Dunlop Street East development to a proposed design that can take full advantage of the energy and carbon reduction opportunities available.

3. Project Description

The 149 Dunlop Street East project is comprised of a single 25-storey residential building. The development has 3 underground parking areas, and 2 floors that are partially dedicated for commercial use. The total gross floor area of the new development is 15,223,51 m^2.

Where model inputs are unavailable, assumptions were made which are clearly outlined in this document. Key model inputs are shown in Section 4. Energy analysis is conducted using IES VE 2022 Feature Pack 1 V2022.1.0.0 [2]. Figure 2 shows the energy model's geometry built in IES VE. Please note that colors used to show the geometry do not represent the actual color of the material designed by the architect.

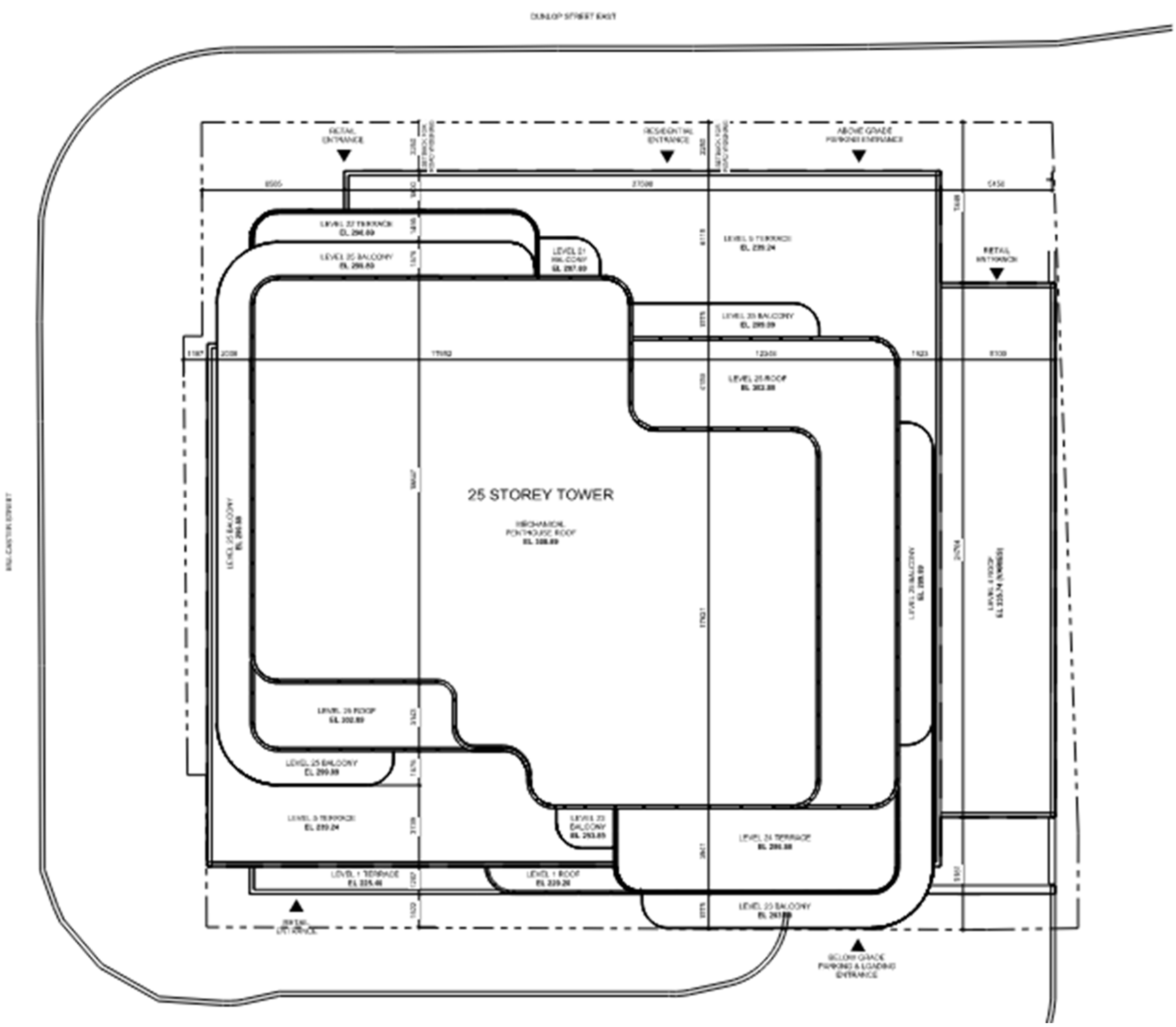

***Figure 2** – 149 Dunlop Street East–Site Plan (Courtesy of Scott Shields Architects Inc.)*

4. Methodology

ECOVERT created 3 different model scenarios for the 149 Dunlop Street East project using the IES-VE simulation software under Barrie's weather file. The three model scenarios created include an SB10 reference model, an energy efficient model, and a low-carbon advanced performance model. The three different sets of energy performance results differ relative to their incorporated energy conservation measures.

- The SB10 equivalent model was created without any incorporated energy conservation measures and demonstrates minimum compliance with the Canadian National Energy Code for Buildings (NECB 2015) as modified by Supplementary Standard SB-10 2017 Division 3 Chapter 3.
- The energy efficient model was created to demonstrate how the 149 Dunlop Street East project would perform with minor energy conservation measure upgrades above a typical development
- The low-carbon advanced performance model represents the most feasible option for the 149 Dunlop Street East project to reach a low-carbon design. This high-performance model utilizes passive and active energy conservation measures to achieve a cost-effective low carbon emissions design. The incorporated energy conservation measures and results for each model scenario will be discussed in further detail in the analysis.

ECOVERT categorizes the energy conservation measures proposed based on the type of measure (passive or active) per archetype. Developers and designers are encouraged to incorporate these energy conservation measures in their design. As the project evolves based on the actual design a more representative energy model should be developed for the site plan approval and building permit. CO2 emission factors are assumed to be 0.05 kgCo2e/kWh of electricity and 1.899 kgCo2e/m3 of natural as per Table 1.1.2.2. of MMA supplementary Standard SB-10 [3]. The energy cost analysis is based on the assumed virtual rates of 0.151$/kWh of electricity and 0.024$/kWh of natural gas.

5. Near Zero Emissions Analysis

This Energy Conservation Report will identify how the development can achieve a design with near zero carbon emissions. As briefly discussed in the introduction, Barrie is pushing towards near zero emissions for all new and existing developments which will help achieve community energy and carbon reduction targets [2]. Near zero emissions involves striving to bring developments as close to zero carbon design as possible. To add perspective, fully achieving zero carbon design includes producing the amount of energy equivalent to the amount of carbon that is consumed by the development. Thus, in order to achieve a near zero emissions design under cost and environmental constraints (local electric carbon density, site area, solar access, etc.), the load on the building is first minimized, followed by providing passive solutions (envelope upgrades) to meet the building energy demand, then addressing the remaining demand with active solutions (mechanical systems). The potential passive and active energy conservation measures and energy solutions for the 149 Dunlop Street East project will be broken down in the analysis that follows.

5.1 SB10 EQUIVALENT MODEL

ECOVERT uses the high-rise MURB archetype incorporating conventional, commonly adopted mechanical and building envelope systems which fulfills the minimum requirements of the project to meet NECB 2015 as modified by Supplementary Standard SB-10 2017 Division 3 Chapter 3. Detailed building characteristics are shown in Appendix A. Figure 3 below shows the performance of the SB10 equivalent model.

SB10 Reference Model	
	Energy (MWh)
Heating	2,117
Cooling & Heat Rejection	153
Interior Lighting	455
Fans	314
Pumps	107
SHW	982
Receptacle	350
Elevators	75
Total Electricity	**1,455**
Total Gas	**3,099**
Total Energy Consumption	**4,554**

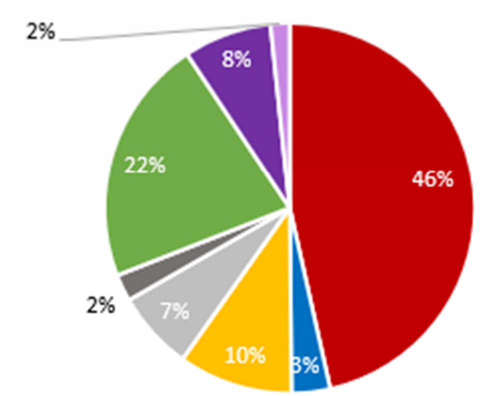

Figure 3 *– SB10 Equivalent model results*

5.2 ENERGY EFFICIENT MODEL

Passive Design:

The following passive design solutions are incorporated over the SB10 equivalent Model:

- Double pane argon filled curtain wall with aluminum framing and low-e surface 2 (U-2.24, SHGC 0.4)
- Opaque Wall - Podium: Exterior and Interior insulated steel stud effective R-value: 13.2
- Roof effective R-value: 31
- Overall R-Value: 5.2

Active Design:

The following active design solutions are incorporated over the SB10 equivalent Model:

- Plant:
    - Heating Boilers: condensing, 95% efficient
    - Cooling: Magnetic Bearing centrifugal chiller (COP-6.5), induced draft cooling tower with VSD fan
- HVAC
    - Suites: 4-pipe fan-coil integrated with in-suite ERV's, Electronically Commutated (EC) motor on 2-speed fans (75% sensible/ 65% latent recovery efficiency)
    - Other Regular Occupied Areas: 4-pipe fan-coil, ECM 2-speed fans, Lobby/Amenities with heat recovery (75% sensible/ 65% latent recovery efficiency)
    - Corridor MUA: Hydronic rooftop MUA unit, 30 cfm/suite ventilation
- DHW
    - Gas fired: Condensing, 95% efficient

Energy Efficient Model	
	Energy (MWh)
Heating	1,848
Cooling & Heat Rejection	140
Interior Lighting	415
Fans	296
Pumps	27
SHW	619
Receptacle	317
Elevators	75
Total Electricity	**1,271**
Total Gas	**2,467**
Total Energy Consumption	**3,738**

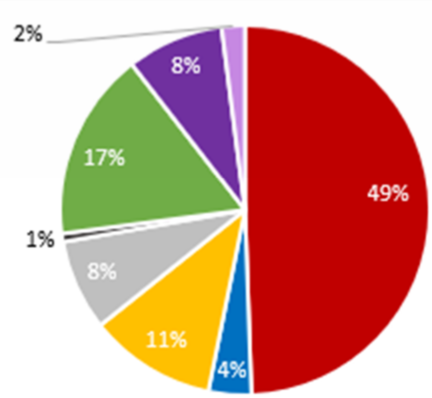

Figure 4 *– Energy efficient model results*

5.3 LOW-CARBON ENCHANCED PERFORMANCE MODEL

Passive Design:

The following passive design solutions are incorporated over the Energy Efficient Model:

- Hybrid window wall (I.G), Glazing USI-1.7, SHGC-0.28 (low solar gain, low e coatings on side 2 and 4 (ITO) with 8% operators in pultruded fiberglass in lieu of aluminum operators)
- Opaque Wall: Podium thermal performance increase to effective R-value: 22
- 40% WWR
- Overall R-value: 6.3

Active Design:

- The following active design solutions are incorporated over the Energy Efficient Model:
- Variable capacity corridor pressurization (15 cfm/suite ventilation)
- In-suite ERV improved to 81% sensible recovery and 75% latent recovery efficiency
- Distributed ground source heat pumps integrated with in-suite ERVs

Low-Carbon Enhanced Performance Model	
	Energy (MWh)
Heating	424
Cooling & Heat Rejection	183
Interior Lighting	415
Fans	226
Pumps	83
SHW	619
Receptacle	317
Elevators	75
Total Electricity	**1,299**
Total Gas	**1,042**
Total Energy Consumption	**2,342**

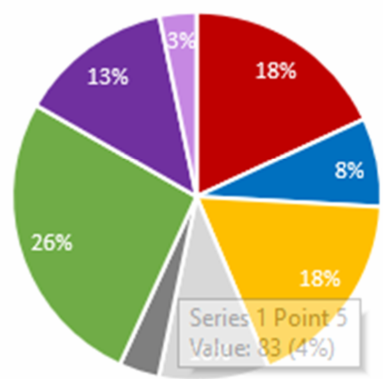

***Figure 5** – Low-carbon enhanced performance model results*

5.4 LOW-CARBON ENCHANCED PERFORMANCE MODEL

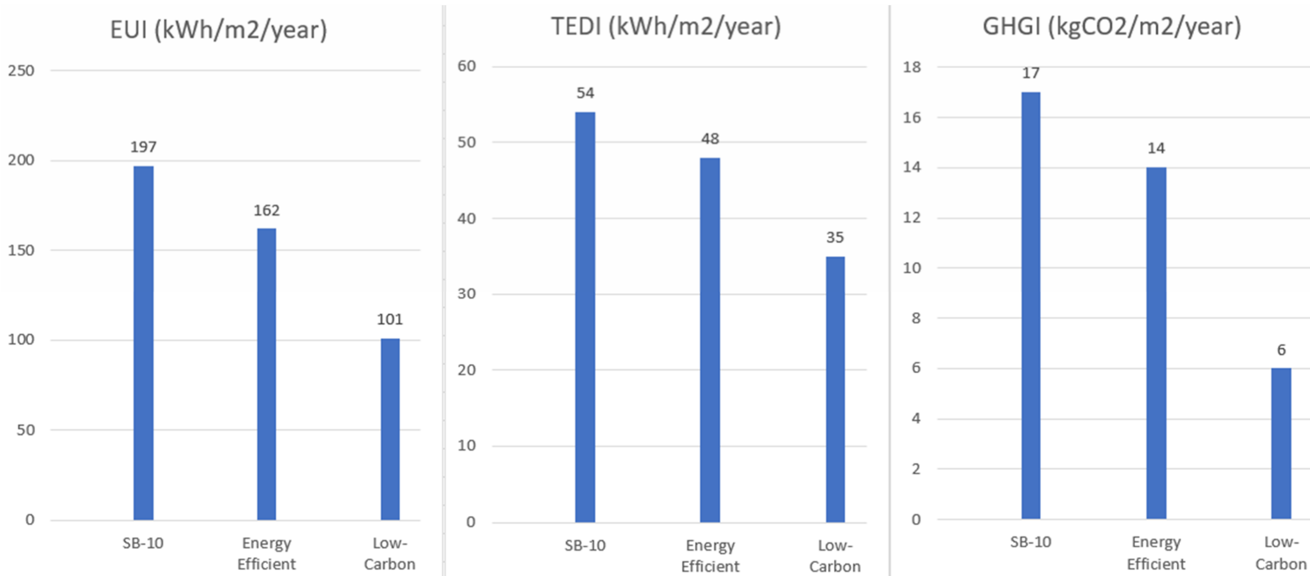

Figure 6 *– Intensities comparison*

	SB10 Equivalent	Energy Efficient	Low-Carbon
	Proposed Development Overall Analysis		
Total Electricity (MWh/year)	1,455	1,271	1,299
Total Gas (MWh/year)	3,099	2,467	1,042
Total Energy (MWh/year)	4,554	3,738	2,342
Total Energy Cost ($/year)	334,782	289,121	312,291
Peak Electricity (kW)	435	405	595
	Proposed Development Intensities		
EUI (kWh/m^2/year)	197	162	101
TEDI (kWh/m^2/year)	54	48	35
GHGI (kgCO2/m^2/year)	17	14	6

Table 1 *– Energy and electricity consumption metrics for each model*

6. Low-Carbon Solutions

6.1 SOLAR ENERGY

Solar photovoltaic (PV) panels generate electricity by capturing energy from solar radiation. They are becoming increasingly economically viable for generating energy on-site due to reduced costs over the last several years, and as such are an important design consideration for low carbon and net zero buildings. Many developments, including residential, institutional, and commercial, utilize solar PV in their designs to take advantage of the long-term economic benefits they provide.

To optimize the feasibility of solar energy on site, a suitable location for a solar array must be available. Such a location needs to have a clear, shade free view due east to west through south to take advantage of the highest amount of available direct sunlight throughout the year. Therefore, it is important for a development to have a sizeable flat roof area or south-facing sloped roof in order to take full advantage of the solar energy resource.

The non-amenity rooftop area on top of the 25-storey 149 Dunlop Street East project is around 505m^2. Considering an inclination angle of 25° facing due south and 60% available roof area with an output of 0.15 kW/m^2 it is estimated that the development can harness over 58,083kWh of electricity annually. The results are summarized in Table 2, and in Figure 7 the the location of the proposed PV panels is shown.

January	*kWh*	2,724
February	*kWh*	3,640
March	*kWh*	5,821
April	*kWh*	6,171
May	*kWh*	6,510
June	*kWh*	6.235
July	*kWh*	6,571
August	*kWh*	6,320
September	*kWh*	5,369
October	*kWh*	3,773
November	*kWh*	2,703
December	*kWh*	2,246
TOTAL	*kWh*	**58,083**

Table 2 *– Monthly and annual solar PV energy output (kWh)*

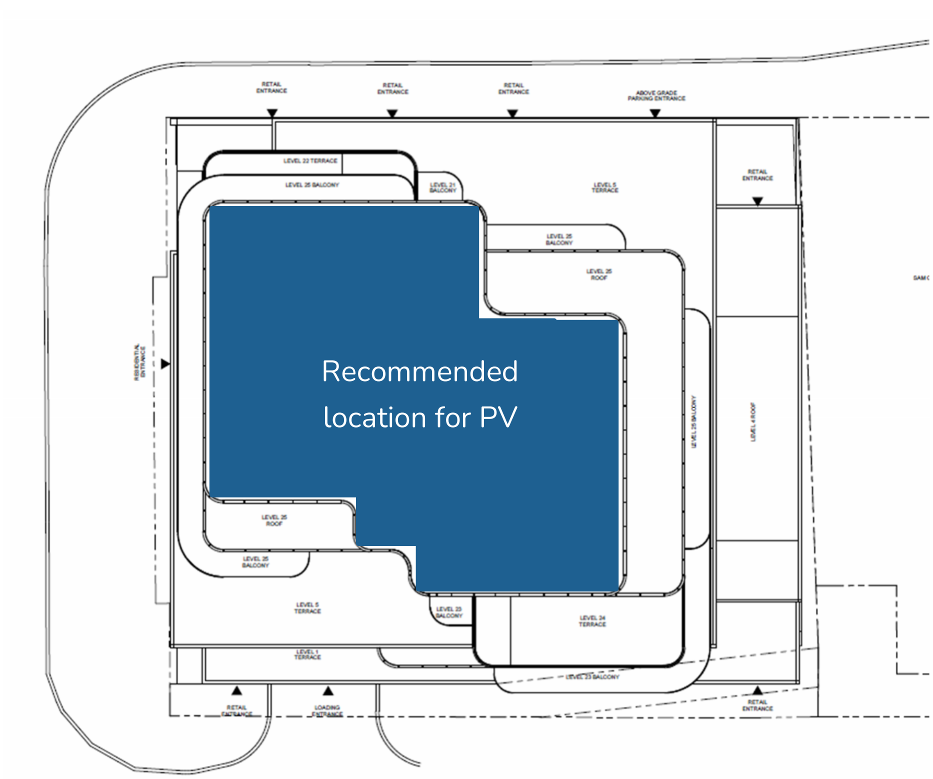

Figure 7 *– Recommended location for solar PV panels on the rooftop*

6.2 OTHER LOW CARBON TECHNOLOGIES

Other low and zero carbon technologies that may be considered an option for the site include:

Ground Source Heat Pumps - A piping network uses the mass of the earth to improve the performance of a vapor compression refrigeration cycle which can heat in winter and cool in summer. Solar Thermal - Rooftop mounted solar energy collectors capture the suns thermal energy. These are usually used to offset the heating of domestic hot water loads in buildings.

Wind - Wind turbines are a large-scale renewable energy technology – generally requiring open, unobstructed topography in order to best capture the winds energy resources. Wind turbines can be situated in an urban setting to generate renewable electricity locally, but this is usually less cost effective as efficiencies are reduced.

Solar Wall – This passive solution to reduces thermal energy demand though preheating outdoor air. A solar collector is heated by solar radiation and outdoor air is drawn through or across the collectors in the heating season. Increased fan power is required to overcome the resistance of the collector, however, significant reduction in heating load can be achieved.

Cogeneration / Trigeneration - A gas fired engine is used to locally generate electricity, allowing waste heat to be used to offset space and water heating. Biomass fueled CHP is a renewable source alternative to natural gas. In addition, an absorption chiller can be added to provide cooling (tri-generation). A properly designed CHP plant can be twice as efficient as a typical fossil fuel power plant, converting up to 80% of the energy from input fuel into electricity and useful heat. This technology is suspected to be suitable due to the scale of the development and amount of waste heat being produced from the predominantly cooled buildings. Further investigation is required to determine the feasibility and benefit of a cogeneration/trigeneration system.

TABS (Thermally Active Building Systems) – TABS leverage the diurnal exterior environmental conditions and thermal inertia inherent to the building to preheat/precool building thermal mass in order to reduce conditioning load. Cool nighttime air can be used to precool building thermal mass in the summer to reduce the cooling load during the day, and daytime solar radiation can be collected through glazing to preheat building thermal mass in the winter to reduce the heating load at night.

Off-site Renewable Energy Procurement – Aside from on-site renewable technologies, any development may procure off-site renewable energy generation credits to offset their carbon footprint.

7. Energy Resilience

It is important to identify opportunities for backup power systems that will improve the resilience of buildings to area-wide power outages. This includes meeting all emergency power (life safety) requirements, as well as providing for 72 hours (at a minimum):

- Domestic water (hot and cold)
- Elevator service
- Space heating, lighting and receptacle power to the central common area/amenity space/lobby, where applicable

The current design intent for the proposed development is to include back-up power via generators that will supply all emergency life safety requirements. Passive design measures such as high thermal mass elements within the building, and high R-values for the building insulation will assist in maintaining building temperature in the event of mechanical system failure.

Diesel generators are more common than natural gas generators as they are significantly cheaper and smaller in size. Additionally, natural gas generators above 350kW have difficulty meeting the 15 second maximum time allowance for life safety equipment to come back on. This issue could be addressed with multiple or twin generators.

The benefits of natural gas generators are lower NOX emissions, as well as a constantly available fuel supply that does not have to be manually delivered.

The distribution and sizing of the backup systems will need to consider Ministry of Environment and Climate Change requirements for NOX emissions. Typically, the generators must be located at higher levels, such as a penthouse, to satisfy the emissions requirements.

The development will take several years to be fully realized and will likely be in operation for more than 40 years. As such, selected strategies should be sufficiently robust to meet the needs of today, while flexible enough to adapt to future uncertainties.

The team should consider design solutions that allow the buildings systems to be adapted to future climatic conditions such as:

- Ability to add shading devices in the future;
- Design high performance enclosures with low window-to-wall ratios to improve the thermal comfort and passive survivability of the building;
- Thermal breaks at balconies;
- Improved building airtightness.

8. Recommendations and Conclusions

The analysis of the energy efficient model scenario for the 149 Dunlop Street East project shows that using conventional, commonly adopted mechanical and envelope systems with a few basic upgrades can achieve a high-performing design. Furthermore, by implementing both passive and active energy conservation measures, as demonstrated in the low-carbon enhanced performance model scenario, the 149 Dunlop Street East project can move closer to a "near zero emissions" development and align with Barrie's energy and carbon reduction targets. Below is a table summarizing the recommended energy conservation measures for the 149 Dunlop Street East project, each of which were included in the low-carbon enhanced performance model scenario that was analyzed above.

Recommended ECM's	
Passive Design	**Active Design**
Window Performance improved from USI 2.24 SHGC 0.4 to USI-1.7 SHGC 0.28	Geo exchange field – Distributed ground source heat pump with heating COP of 4.2; Cooling EER of 16
Podium wall improved from effective R-13.2 to R-22	In-suite ERV improved to 81% sensible recovery and 81% latent recovery efficiency
WWR reduced from 90.5% to 40%	Corridor Pressurization reduced from 30cfm/door to 15 cfm/door

Table 3 *– Recommended ECM's*

As the design progresses, the design team should engage with the energy modelling process to evaluate the design alternatives expressed in this report to help optimize building design. Therefore, there will be further opportunity for exploring approaches for ambitious energy performance as the building design is advanced (which is the most appropriate point to make such decisions). It should be noted that nothing in the proposed package would preclude the potential to do this at a later stage.

Advanced measures such as, CHP, solar PV, solar air heating, and solar thermal could be undertaken on this project but further analysis outside the scope of this report would be required. As these alternatives are explored and design progresses, the proposed development is also encouraged to consider pursuing full net zero or zero carbon design to maximize the energy savings potential moving forwards. Making efforts to pursue these stringent building codes can improve the environmental image of the development and simultaneously blaze a trail for other developments to follow suit in contributing to Barrie's community energy and carbon reduction targets.

9. Disclaimer

As used in this disclaimer, “Ecovert,” “us” or “we” refers to Ecovert, its related or affiliated partnerships or corporations, and their respective directors, officers, shareholders, partners, agents and employees.

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10. References

[1] City of Barrier Energy Conservation and Efficiency Terms of Reference:
https://www.barrie.ca/City%20Hall/Planning-and-Development/Documents/Energy%20Conservation%20and%20Efficiency.pdf

[2] City of Barrie – Community Energy & Greenhouse Gas Reduction Plan
https://www.buildingbarrie.ca/communityenergy

[3] MMA Supplementary Standard SB-10: Energy Efficiency Requirements (2017)

11. Appendix A

Location	149 Dunlop Street East, Barrie, ON
Climate Zone	Z6 – HDD: 4380
Weather File	CAN_ON_EGBERT-CS_611E001_CWEC.epw
Schedules	Units: NECB schedule G I Amenities: NECB schedule B I Corridor and parking lighting: ON continuously
Occupancy	Units: 25 m²/person I Amenities: 5 m²/person

	SB10 Equivalent Model	Energy Efficient Model	Low-Carbon Advanced Performance Model
	Envelope		
Window Wall Ratio	65%	48%	40%
Podium Wall RSI (R_{imp})	Effective 0.7 (4)	Effective 2.32 (13.2)	Effective 3.87 (22)
Tower Wall RSI (R_{imp})	Effective 0.7 (4)	Effective 1.53 (8.7)	Effective 1.53 (8.7)
Roof RSI (R_{imp})	Effective 6.41 (36.4)	Effective 5.46 (31.0)	Effective 5.46 (31.0)
Window USI (U_{imp})	Overall, 1.9 (0.33)	Overall, 2.24 (0.4)	Overall, 1.70 (0.3)
Window SHGC	0.4	0.4	0.28
Infiltration	0.25 l/s.m² of façade @ 5 Pascal	0.25 l/s.m² of façade @ 5 Pascal	0.25 l/s.m² of façade @ 5 Pascal
	Internal Loads		
Receptacle	Suite: 5.0W/m² I Amenities: 1.0W/m²	Suite: 5.0W/m² I Amenities: 1.0W/m²	Suite: 5.0W/m² I Amenities: 1.0W/m²
Lighting	Suite: 5.0W/m² I Lobby: 10.8W/m² Amenities: 11.5W/m² Corridor: 7.1W/m²	Suite: 5.0W/m² I Lobby: 9.2W/m² Amenities: 9.8W/m² Corridor: 6.0W/m²	Suite: 5.0W/m² I Lobby: 9.2W/m² Amenities: 9.8W/m² Corridor: 6.0W/m²
Service Hot Water (W/occ)	Residential: 500 I Amenities: 60	Residential: 500 I Amenities: 60 (reduced 37% for low flow fixtures)	Residential: 500 I Amenities: 60 (reduced 37% for low flow fixtures)
Ventilation	Suite: per ASHRAE 62.1-2010 Corridor: 30 cfm/door	Suite: per ASHRAE 62.1-2010 Corridor: 30 cfm/door	Suite: per ASHRAE 62.1-2010 Corridor: 15 cfm/door
	Mechanical HVAC		
HVAC System	Suites: 4-pipe FC & ERVs Amenities: NECB System 3 (single zone packaged rooftop unit with baseboard heating)	Suites: 4-pipe FC & ERVs Amenities: 4-pipe FC, ECM 2spd fans, ERV Corridor: Hydronic rooftop MUA	Suites: *GSHP & ERV* heating COP of 4.2; Cooling EER of 16; Heating loop delta T: 10F; Cooling loop delta T: 12F; Building Side Heating Entering Temp: 48F; Building Side Cool Entering ⁰F: 88 Amenities: GSHP & ERV Corridor: Hydronic rooftop MAU
Heat Recovery	N/A	75% eff.	81% eff.
Fans	ERV: 0.5W/cfm I Fan coils: 0.3W/cfm MUA: 0.5 W/cfm	ERV: 0.5W/cfm I Fan coils: 0.3W/cfm MUA: 0.5 W/cfm	ERV: 0.5W/cfm I HP: 0.3W/cfm MUA: 0.5 W/cfm
Ventilation Effectiveness	0.8	0.8	1
	Plant		
Heating	Condensing boiler, 90% eff.	Condensing boiler, 95% eff.	Geothermal
Cooling	Centrifugal water-cooled chiller, induced draft cooling tower with constant speed, COP 6.3	Magnetic bearing centrifugal chiller, induced draft cooling tower with VSD, COP 6.6	Geothermal
Pumps	Constant speed pumps	VSD on all pumps	VSD on all pumps
Service Hot Water	Condensing boiler 90% eff.	Condensing boiler 95% eff.	Condensing boiler 95% eff.