REPORT

189 SUMMERSET DRIVE, BLOCK 76

ENERGY CONSERVATION REPORT

PROJECT #2206145
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SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained by Stateview Homes to prepare an energy strategy report for the 189 Summerset Drive, Block 76 development in Barrie, Ontario. The development consists of a multi-unit residential building with below grade parking (see Figure 1). The proposed total gross building area (including parking) is 14,591 m^2.

This report was completed to support the Site Plan Approval submission, as required by the City of Barrie (Reference Link 1). RWDI has explored how differing energy efficiency strategies may be of benefit to the project. The intent of this exploration is to provide strategic energy options for the project at an early stage, and to identify the steps that should be explored to reduce energy use.

This report should act as a roadmap towards enhanced levels of performance. Particular focus was placed on achieving an energy consumption 20% and 50% below an SB-10 Baseline for total building energy use. In addition to energy saving strategies, this report has provided recommendations on how to implement climate resilient design to account for the expected changes in the local climate.

This energy conservation report identifies a number of interesting opportunities that will continue to be explored by the project team. However, pursuit of opportunities will need to be balanced with the risks of implementing non-traditional development solutions. As such, the implementation of identified opportunities will likely require a collaborative effort between the developers of this project and the City to de-risk the less-conventional development solutions.

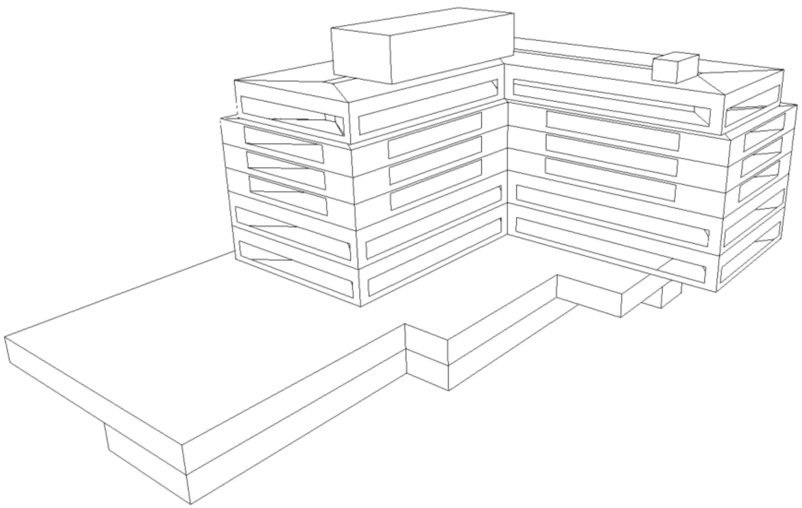

Figure 1: Energy Model Image of proposed Block 76 project

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1. INTRODUCTION

1.1 PLANNING FOR A SUSTAINABLE FUTURE

More than ever before, climate change and greenhouse gas (GHG) emissions are a priority on the agenda at all levels of government in Canada. The City of Barrie has indicated that an Energy Conservation Report be submitted for new developments showing scenarios that can achieve improved performance as compared to a code-complaint building.

The motivation for producing this conservation report is province-wide. For example, in 2019 buildings in Ontario were responsible for 38.6 million tonnes of equivalent carbon emissions (CO_2e), as reported in Canada's National Inventory Report on GHGs (Reference Link 2). This represents 24% of the Province's GHG emission inventory and quantifies the important role that buildings will play in Ontario's goal to reduce carbon emissions.

Further, based on Toronto data natural gas consumption in buildings accounts for 94% of building emissions (see Figure 2). The link between a low-energy development and a low-carbon development is both the efficiency of the building and the GHG intensity (i.e., CO_2e/kWh) of the fuels consumed. Over the next 20 years in Ontario, the GHG intensity of natural gas is projected to be 2.3 times that of electricity as a result of electricity being generated primarily using non-GHG emitting energy sources.

This energy strategy report explores opportunities for the proposed development to reduce its energy use and GHG emissions. The focus on carbon will be balanced, however, by the economic challenge presented by the fuel-cost disparity: the cost of electricity is currently over five times greater than that of natural gas.

Beyond GHG emissions, it is important to consider that buildings designed today will have to accommodate an alternative climate future. Renewable energy and climate resilience will have to become part of the design process.

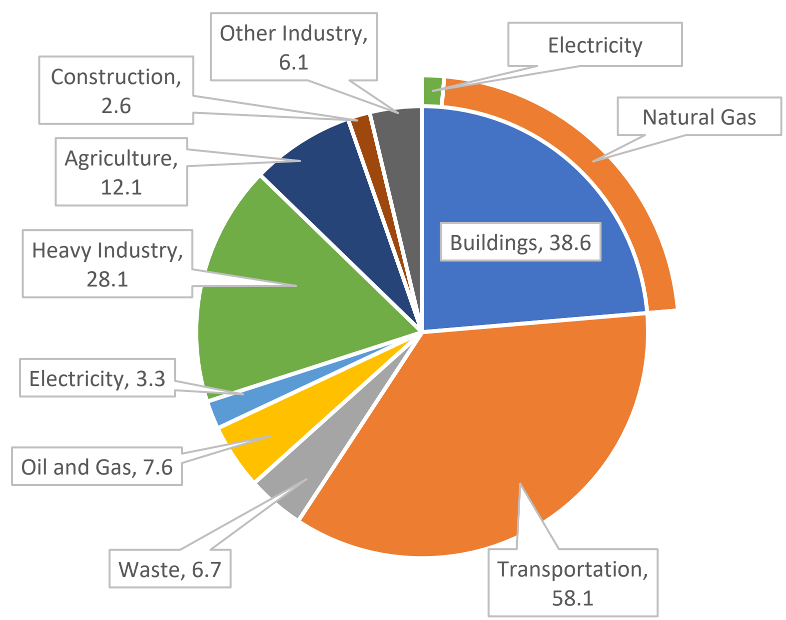


Figure 2: Ontario GHG Emissions in 2019 (in million tonnes CO_2e)

1.2 BUILDING PERFORMANCE METRICS

There are three metrics commonly used to indicate a building's absolute energy performance, detailed below:

- **Total energy use intensity (TEUI)**: This metric measures the energy consumed by the building each year (in ekWh) normalized by the conditioned floor area (in m^2). A lower TEUI indicates a more energy efficient building.
- **Thermal energy demand intensity (TEDI):** This metric measures the annual heating energy required for a building to maintain a stable, pre-defined interior temperature (in kWh) normalized by the conditioned floor area (in m^2). A lower TEDI is achieved by designing a high-performance building envelope and using energy recovery ventilation units.
- **Greenhouse gas intensity (GHGI):** This metric looks at the annual GHG emissions of a building (in kg CO_2e) based on the current-year fuel-specific emission factors, normalized by the conditioned floor area (in m^2). This metric encourages the use of highly efficient, lower-carbon emitting fuels.

By reducing each of these intensities, developments can reduce utility costs and associated GHG emissions. Many standards, including the Toronto Green Standard (Reference Link 3), identify absolute targets for each performance metric based on building type (e.g., High Rise Residential, Mid Rise Residential, Commercial Office, or Commercial Retail). For this project, no specific targets were requested by the City, but this report investigates designs that can achieve TEUI reductions of 20% and 50% as compared to an SB-10 Baseline. The overall energy performance targets for this development have been determined using an IES energy model based on preliminary building drawings and site statistics. The energy performance metrics of the Sb-10 code compliant building are shown in Table 1.

Table 1: SB-10 Energy Performance Targets for the 189 Summerset Drive Development

Performance Metric	Target
TEUI (ekWh/m^2)	350
TEDI (kWh/m^2)	103.4
GHGI (kg CO_2e/m^2)	51

2. PROJECT ANALYSIS

2.1 ENERGY CALCULATION METHODOLOGY

The following key steps were applied by RWDI in preparing this energy conservation report:

1. **Develop an IES energy model** representative of the proposed project. The proposed development is comprised of the following building space types, as shown in Figure 3:
    1. Residential and Corridors
    2. Mechanical Penthouse
    3. Underground Parking
2. **Identify Energy Conservation Measures (ECMs)** that should be considered for the project to achieve three levels of performance:
    - I. Baseline Performance – SB-10 compliance;
    - II. 20% better than baseline; and
    - III. 50% better than baseline.

    Quantify the impact of these ECMs on site-wide energy and greenhouse gas emissions.
3. **Consider low-carbon opportunities for the project,** including on-site renewable energy and district thermal energy networks.
4. **Make recommendations based on the results of the analysis.**

This report was prepared using the preliminary density and built form concepts from the 'BEA Condo Towns Statistics' dated May 2022. RWDI has used the energy modelling tool IES Virtual Environment 2022 to develop this analysis. A summary of the energy modeling inputs can be reviewed in Appendix A.

Note that "actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this standard, changes in energy rates between design of the building and occupancy, and precision of the calculation tool." [ASHRAE 90.1 - 2016, 11.2 Informative Note].

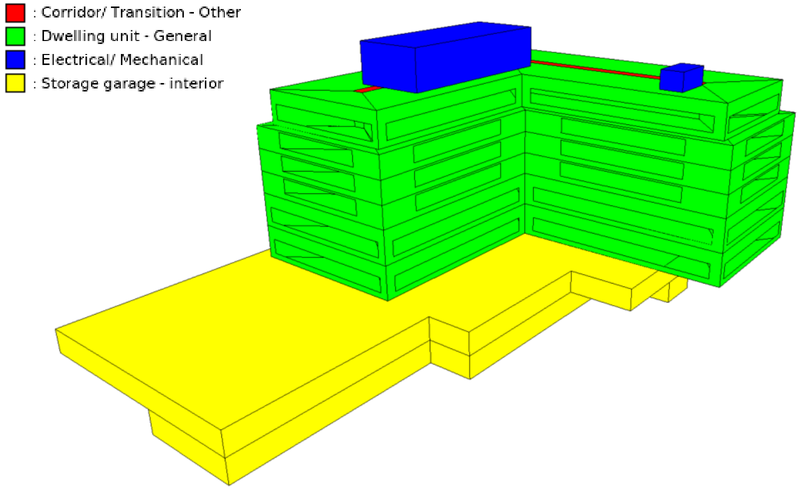


Figure 3: Project Geometry with Modelled Archetypes

2.2 PACKAGE 1 – 20% REDUCTION: ENERGY CONSERVATION MEASURES AND RESULTS

In support of its current development application, a path has been identified to reduce TEUI by 20% relative to a SB-10 Baseline. A package of design strategies and energy conservation measures has been employed in the energy model to achieve this performance. The energy conservation measures included in this package have been selected to prioritize low-cost upgrades and best practice design in Ontario. The results for each performance metric for this package are shown in Figure 4.

The key strategies in this package are:

1. Use in-suite ventilation paired with heat recovery ventilation units with 65% sensible effectiveness to provide pre-conditioned fresh air to residential suites.
2. Specify high-performance mechanical plant equipment including condensing boilers, a variable frequency drive centrifugal chiller, and a cooling tower with variable speed drive fan.

This package results in a TEUI reduction of 21% relative to the baseline, while simultaneously reducing GHGI by 19% and TEDI by 18%.

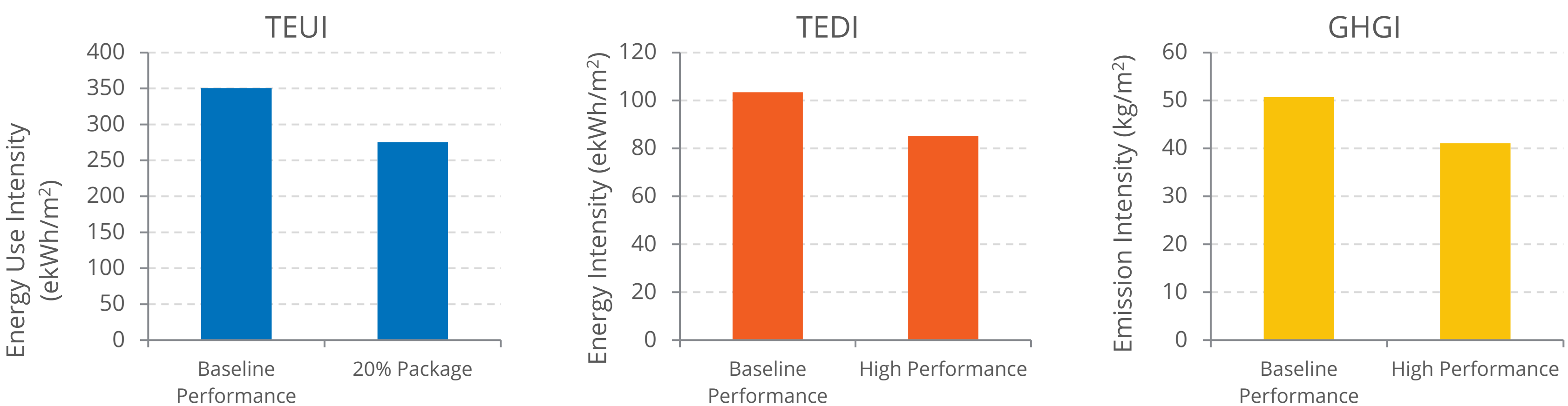


Figure 4: 20% Reduction Package Results

2.3 PACKAGE 2 – 50% REDUCTION: ENERGY CONSERVATION MEASURES AND RESULTS

Additional performance improvements were analyzed to demonstrate a potential path to reducing TEUI by 50% relative to the SB-10 Baseline. The results for each of the building performance metrics based on this proposed performance package are shown in Figure 5, below.

The key strategies in this package are:

1. Implement heat pump water heaters for domestic hot water heating.
2. Improve the windows to a USI-2.0 construction.
3. Improve the roof to an R-40 construction.
4. Upgrade the residential in-suite ventilation units to ERV with 75% sensible and 70% latent effectiveness.

This package results in a TEUI reduction of 47% relative to the baseline, while simultaneously reducing GHGI by 62% and TEDI by 26%.

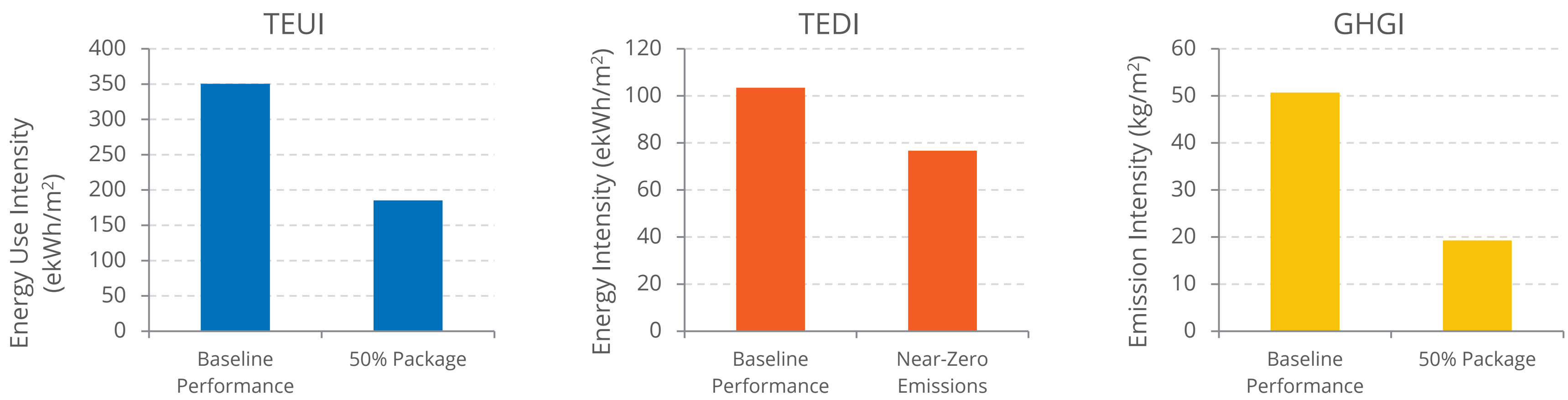


Figure 5: 50% Reduction Package Results

2.4 FINANCIAL PROJECTIONS

Improved energy efficiency packages often offer operational cost savings that must be balanced against increased upfront costs. To begin assessing this balance, annual operating costs that account for changes from electricity, natural gas, and carbon pricing and emission factors (Reference Link 4) were estimated for a 20-year period. Electricity and natural gas prices were assumed to escalate at 3% per year, and carbon prices followed the Federal framework (Reference Link 5) to 2030 and then were assumed constant. The results are shown in Figure 6.

As shown in Figure 6, both improved packages offer costs savings compared to the baseline in each year. At the onset of the project, the 20% Package and 50% Package offer 26% and 20% annual cost-savings relative to the baseline, respectively. In the 20th year, these savings are 25% and 23%, respectively. The increase in savings over the 20-year period for the 50% Package occurs because the carbon cost over the lifetime of the project increases. For example, in the baseline the carbon cost is 10% in the first year and increases to 19% in the 20th year. However, since the 50% Package uses an electric heat pump water heater instead of a gas boiler, the high cost of electricity compared to natural gas results in an increase in operating cost from the 20% Package to the 50% Package.

While this assessment is preliminary, it supports that both improved performance packages will consistently offer energy and carbon cost savings as compared to the baseline. In addition, since we conservatively assumed carbon pricing remains flat from 2030, systems that minimize carbon will offer further savings if prices escalate.

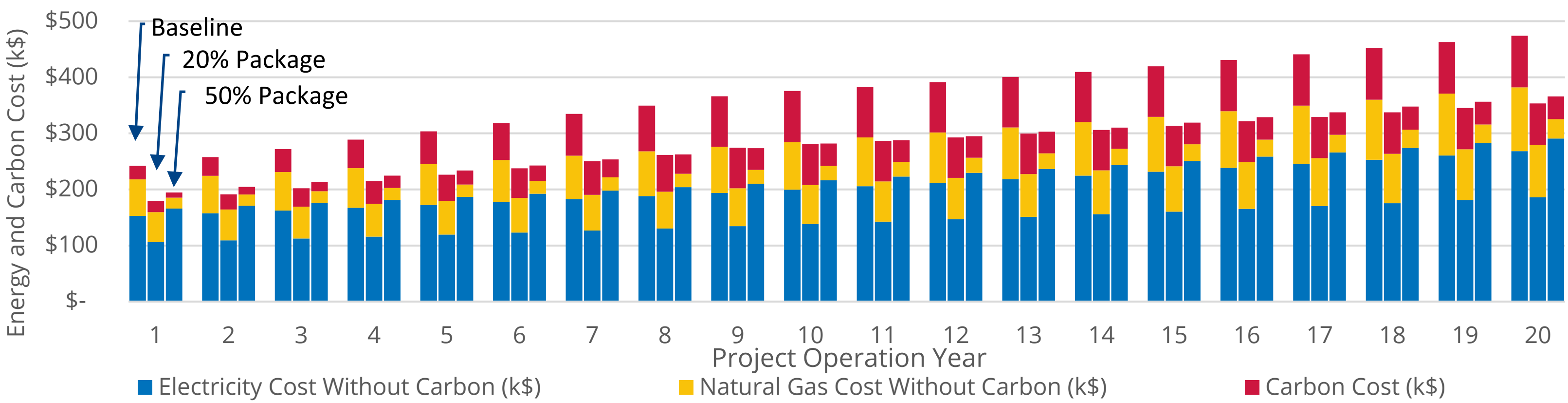


Figure 6: Operating Cost Projections

2.5 ENERGY AND EMISSIONS PROJECTIONS

The results from the energy conservation and demand management strategies presented in Sections 2.2 to 2.3 are visualized on the following pages. The detailed assumptions used for each package are listed in Appendix A.

The energy use intensity (EUI) of each ECM package is shown broken down by end-use for the building in Figure 7. As shown in Figure 7, the 20% Package and 50% Package offer total EUI savings of 21% and 47%, respectively, which are primarily from reduced heating energy use through improved building system efficiency.

Given the disparity in emissions for electricity and natural gas, a similar breakdown for GHG emissions for each end use is shown in Figure 8 to illustrate emissions reductions. In this analysis, projected 20-year average GHG emission intensities for each fuel source were used instead of the SB-10 requirements used for the baseline analysis. As shown in Figure 8, using the 20% Package and 50% Package offer emission reductions of 20% and 57%, respectively, which are a result of reduced energy consumption for both packages, and fuel shifting for the 50% Package.

Visualizations of the analysis results are shown in Figure 9, broken down by space type. Table 2 summarizes other outputs.

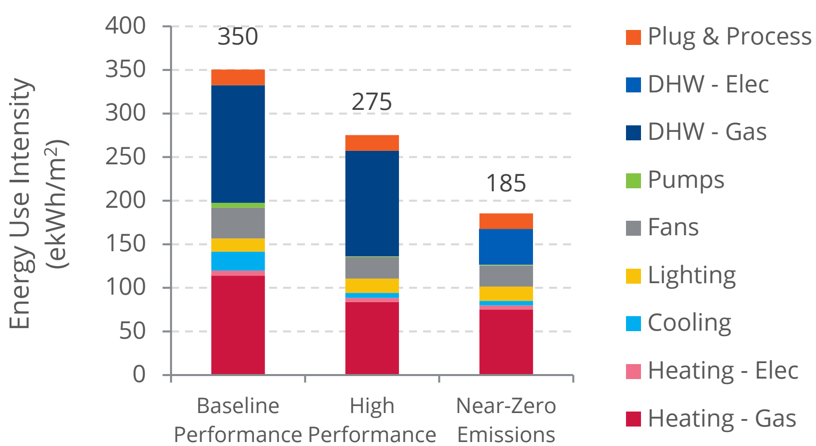


Figure 7: Energy End-Use Breakdown

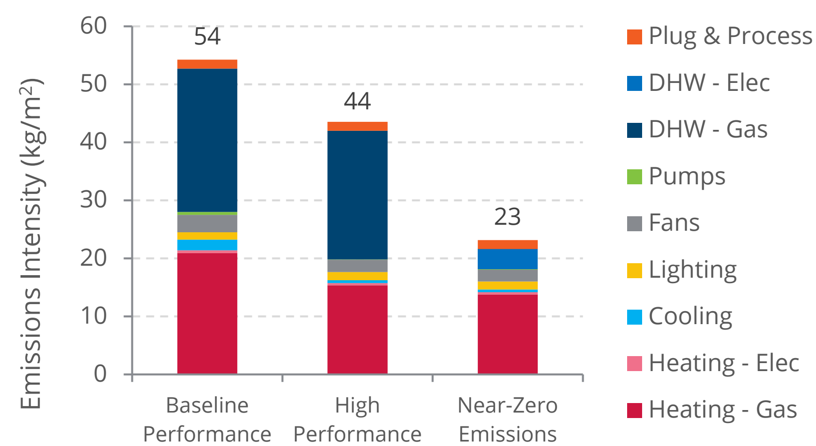
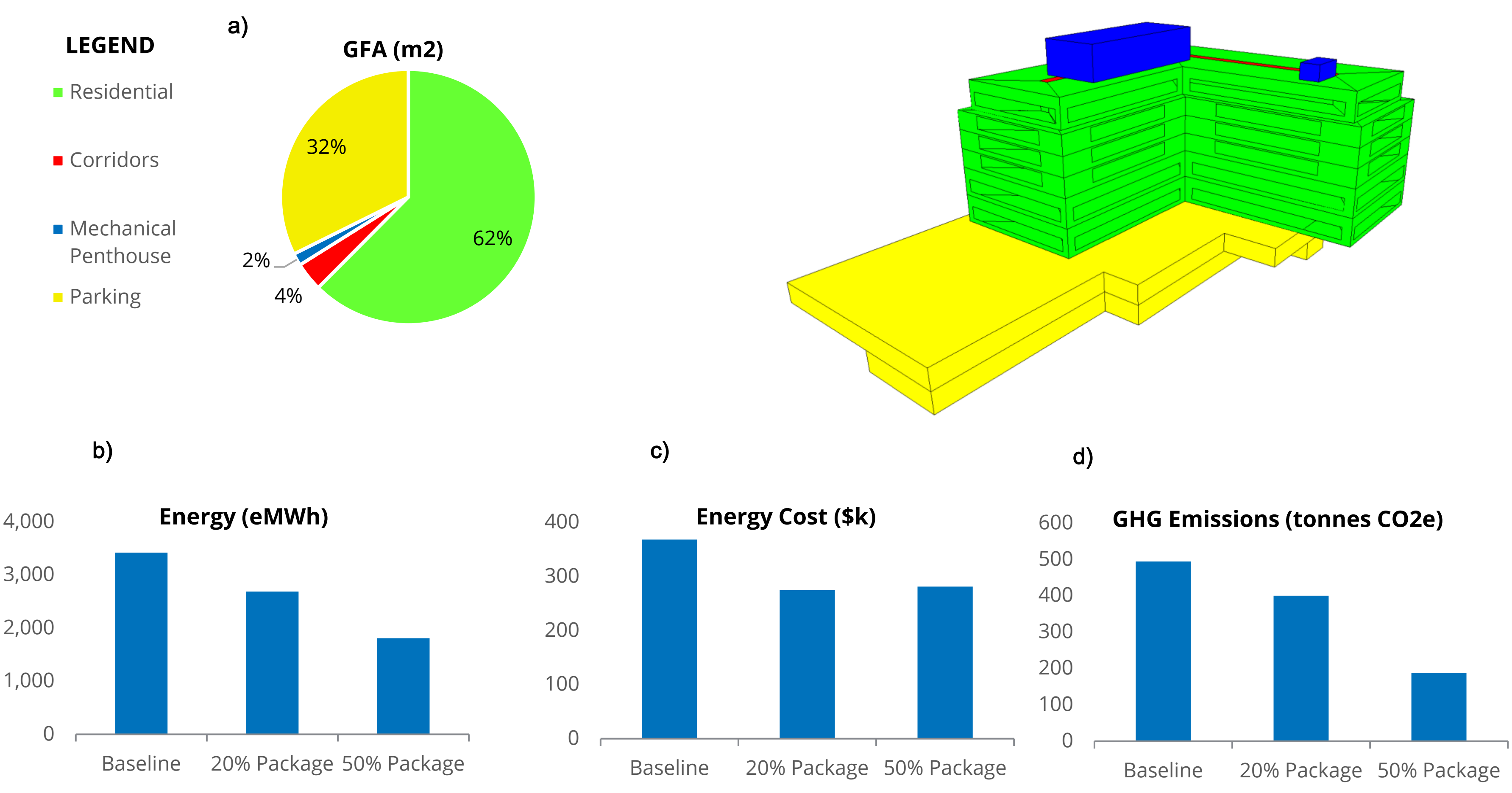


Figure 8: Projected Emission Intensity End-Use Breakdown

2.6 SUMMARY OF RESULTS

Figure 9: a) Breakdown of Development Site Gross Floor Area by Archetype, b) Energy Results, c) Energy Cost Results, d) GHG Emissions Results



2. PROJECT ANALYSIS

2.6 SUMMARY OF RESULTS

Table 2: Site-level Performance Results

Performance Metric	Unit	Baseline Performance	20% Package	50% Package
Total Energy	ekWh	3,418,400	2,685,200	1,807,700
TEUI	ekWh/m^2/yr	350	275	185
Energy Savings	%	--	21%	47%
TEDI	kWh/m^2/yr	103	85	77
TEDI Savings	%	--	18%	26%
Current-Year Electricity Emission Factor	kg CO_2e/kWh		0.05	
Current-Year Natural Gas Emission Factor	kg CO_2e/kWh		0.183	
GHGI	kg CO_2e/m^2	51	41	19
GHGI Savings	%	--	19%	62%
Energy Cost	$	368,000	275,000	281,000
Energy Cost Savings	%	--	25%	24%

3.1 ON-SITE RENEWABLES

After reducing the total energy consumption of the development by 47% as compared to the Baseline Design in the 50% Package, this energy strategy now considers the application of renewables to offset the remaining energy use.

Rooftop solar photovoltaic (PV) potential was explored using the National Renewable Energy Laboratory's (NREL) PVWatts Calculator (Reference Link 6). Given the early design stage of this project, which we assume allows for the prioritization of PV mounting on rooftops, the analysis assumed that 70% of building and mechanical penthouse roofs are availableor PV mounting, resulting in an array size of 2,262 m^2 (Figure 10). Using site-specific solar radiation information and the PVWatts calculator, it was estimated that 545 MWh of energy could be generated on-site annually. While this generation is significant, it would only offset 30% of the 50% Package modelled total energy use (1,807,700 kWh) and is therefore insufficient to reach a net-zero level of performance using on-site renewable generation. Therefore, off-site renewables are discussed next.

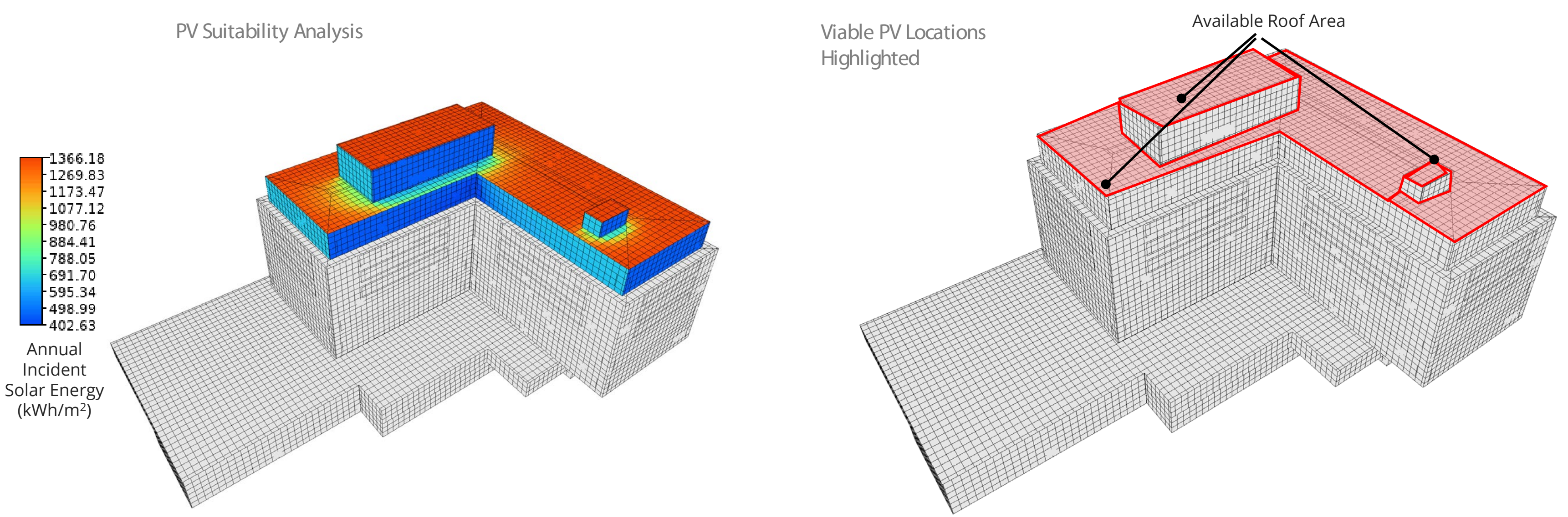


Figure10: Solarradiationpotentialon the building

3.2 OFF-SITE RENEWABLES

Although on-site solar PV generation will not generate sufficient energy for the development to reach a net-zero level of performance, off-site carbon offset strategies could also be considered.

The area of solar generation that would be required to fully offset the energy requirement and carbon emissions of the development can be determined by comparing the PV system size to the total energy requirement of the building.

The PVWatts calculator results for on-site solar PV suggest an annual generation potential of 241 kWh/m^2 in the Barrie climate. The quantity of solar PV required to offset the remaining energy consumption of the 50% Package model (1,262,462 kWh) can then be calculated by dividing the remaining energy consumption by the generation potential. This equates to a solar PV system area of 5,238 m^2.

This is not an insignificant area, and it would not likely be feasible to install this much solar capacity in downtown Barrie as the area is comparable to existing solar farms in rural Ontario. An example of such a solar farm is presented in Figure 11. Developments like this could consider taking advantage of Ontario's abundant rural areas where large-scale solar farms are possible to achieve a net-zero carbon level for the project through off-site solar generation. At present, however, there are minimal incentives to encourage developments to consider such large-scale strategies, making their pursuit unlikely to be feasible.

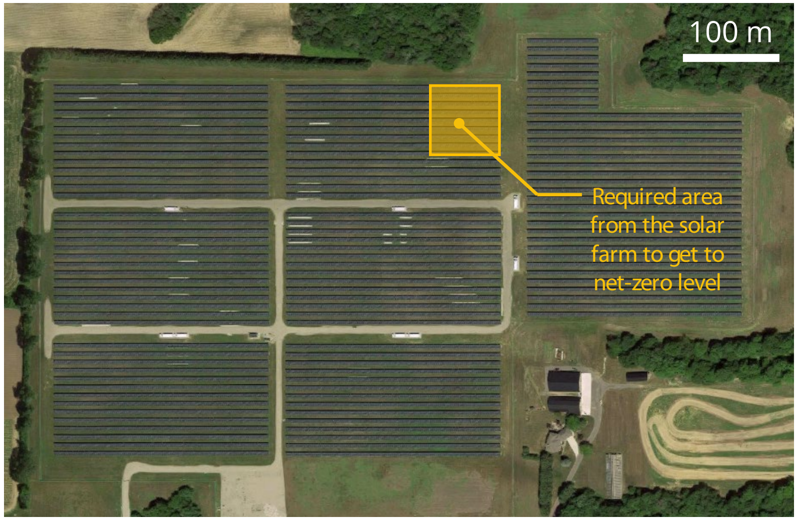


Figure 11: The area of off-site generation required by the development (yellow rectangle) overlaid on the Silvercreek Solar Park, found near Aylmer Ontario **(image Courtesy of Google Earth©).**

3.3 DISTRICT ENERGY & CHP

District energy systems (DES) use a centralized plant to generate and distribute energy for many buildings, in the form of thermal energy for heating and cooling, and/or electricity. By collaborating, a group of buildings can find an economy of scale that may provide the following benefits:

1. Increased efficiency at the plant level;
2. Reduced energy consumption by sharing waste thermal energy between buildings with different load profiles;
3. Potential reduction in capital costs;
4. Streamlined maintenance and future equipment upgrades with one central plant instead of several smaller plants;
5. Reduced mechanical space requirements within each building, allowing for increased useful area, and
6. Flexibility to divide energy generation across a number of energy sources, and add future capacity as required.

A review of public resources did not indicate that there are any existing district systems in Barrie. However, given that townhomes are also planned as part of this development, a new district system that connects the townhomes and the central building could be constructed to achieve the benefits listed above.

A list of common systems that could be integrated into a future district system for this development is given below, with pros and cons provided:

Technology	Pros	Cons
Boilers	• Widely available and well understood • Natural gas is a low-cost fuel option	• The GHG intensity of natural gas is higher than for electricity • Biofuels may lack availability
Chillers	• Widely available and well understood	• Requires separate heating source (as compared to an ASHP)
Air Source Heat Pumps	• Widely available and well understood • Can provide heating and cooling	• Electricity can be more expensive than natural gas for heating • At low outdoor temperatures, system capacity and efficiency can diminish
Ground Source Heat Pumps	• High year-round efficiency • Lower operating cost compared to ASHP	• High installation cost • Seasonal thermal balance must be maintained • Space for borehole field is required
Sewage Heat Recovery	• Source of free heat that can improve system efficiency • Design at early development stage can improve economics	• Added maintenance associated with the solids separation system • Relatively new technology
Thermal Storage	• Can offset peak loads and associated charges • Can reduce equipment capacity requirements	• Careful analysis and control is needed to ensure efficiency operation

3.4 LOW-CARBON TRANSPORTATION

Electric Vehicles (EVs) can offer significant reductions in CO_2e emissions as compared to conventional internal combustion vehicles, especially in Ontario given the low CO_2 intensity of Ontario's electricity. As shown in Figure 12 for multiple EV types, CO_2e emissions per kilometer can be reduced by approximately 95% for a vehicle of the same type (e.g., full-sized sedan), which exemplifies the importance of adopting EVs on a societal level.

Given recent and future increases in EV adoption, it is critical to consider infrastructure to support EVs at the building level. This infrastructure typically comes in the form of charging stations, and both current and future building standards in Ontario are mandating the inclusion of this infrastructure. For example, in the mandatory tier of TGS V4 (Tier 1) , at least 25% of parking spaces in residential buildings must have adjacent energized outlets that support level 2 EV charging (208-240 VAC with 40-amp breakers) and 100% of spaces must permit the future installation of energized outlets (e.g., installation of empty cable raceways).

While these targets may seem ambitious, a study carried out by The Atmospheric Fund (TAF) showed that current EV adoption targets in Ontario will result in 75% of building residents facing significant barrier to adopting EVs if only 25% of spaces are equipped with EV charging infrastructure (Reference Link 7). TAF also found that the cost of installing EV infrastructure during building construction was an order of magnitude lower than installing it as a retrofit. Therefore, and in line with requirements set in jurisdictions such as Richmond and Vancouver BC, considering the installation of EV infrastructure at 100% of parking spaces is recommended.

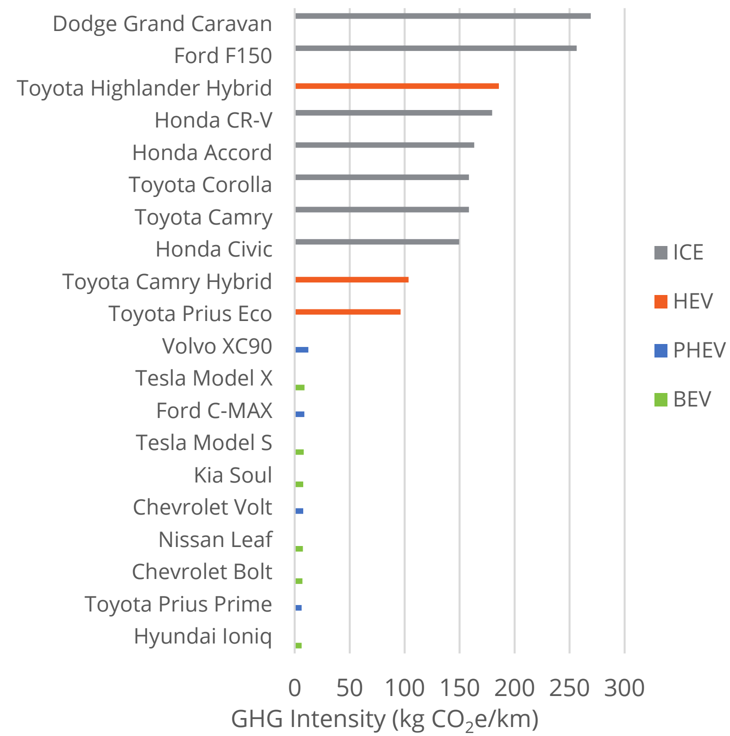


Figure 12: GHG Intensities of Internal Combustion Engine (ICE) Vehicles, Hybrid Electric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), and Battery Electric Vehicles (BEV) (Reference Link 8)

4. RESILIENCY

4.1 CLIMATE CHANGE

Historically, Southern Ontario has been considered to have a heating-dominated climate, with Barrie for example, categorized in ASHRAE Climate Zone 6. In the last 20 years, however, Ontario's climate has changed – the number of annual heating degree days (HDDs) has reduced. As a result, in the near future Barrie may transition to ASHRAE Climate Zone 5.

Further, a study by the City of Toronto, the *Future Weather and Climate Driver Study,* predicts that climate change will continue to present a new set of challenges to building developments in Ontario (Reference Link 9). Some of the climatic changes include:

- Increased temperatures throughout the year. This means both an increased number of Cooling Degree Days above 18°C, and an increased frequency and duration of heat waves;
- Increased temperatures throughout the year will also result in a decreased number of Heating Degree Days below 18°C;
- Increased intensity of major rain events; and
- Increased frequency of freeze-thaw events.

As the annual HDDs are forecasted to decrease, Barrie could potentially also shift into ASHRAE Climate Zone 4. For example, the historical and forecasted heating degree days for Toronto Pearson International Airport are is shown in Figure 13, showing the shift from Climate Zone 6 to Climate Zone 4.

A study by RWDI demonstrated that as the climate changes, controlling summer overheating will become increasingly important for occupant comfort in Southern Ontario's buildings (Reference Link 10). Designing modular mechanical systems to allow for future increased cooling capacity can help alleviate the increased risk of overheating and occupant discomfort.

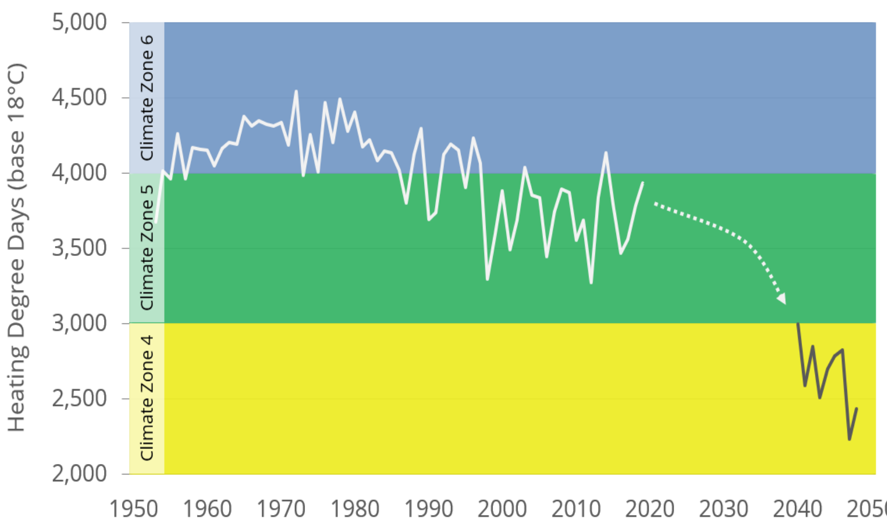


Figure 13: Historical and Forecasted Heating Degree Days at Toronto Pearson International Airport

4.2 DESIGN CONSIDERATIONS

According to the Resilient Design Institute, "resilient design" is the intentional design of buildings, landscapes, communities, and regions in order to respond to natural and man-made disasters and disturbances, as well as long-term changes resulting from climate change, including sea level rise, increased frequency of heat waves, and regional drought (Reference Link 11).

To better the prepare for the forecasted changes to Southern Ontario's climate, this project's team will be encouraged to consider:

- Back-up power systems, which are suggested to provide at least 72 hours of support for: domestic water (hot & cold), elevator service, space heating, lighting and receptacle power.
- Design solutions that allow the buildings systems to be adapted to future climatic conditions. Examples could include: the ability to add shading devices at a future date, or additional system cooling capacity.
- Enclosure strategies like low window to wall ratios, thermal breaks at balconies, airtightness, and operable windows to improve the thermal comfort and passive survivability of the building.
- Building materials selected for durability during flooding events, and buildings designed to operate despite water incursion from major rain events, forecasted to become more frequent (shown in Figure 14).

Working resiliency in the design and equipment selection inevitably has an impact on the cost of the building. As a result, it is important to consider the business case for resiliency and how to recoup the investment. This could encompass:

- Higher perceived value because of the resilient features and the ability to market these;
- Lower operating costs from thermal envelope improvements;
- Reduced insurance premiums; and
- Increased safety.

Figure 14: Flooding of Downtown Toronto Streets in 2013 (Courtesy of user:Eastmain Public Domain)

5. CONCLUSIONS AND RECOMMENDATIONS

1. The 20% energy reduction package requires that in-suite ventilation heat recovery be used along with high-efficiency mechanical systems. This package offers a GHG emission reduction of 19% and an operating cost reduction of 25% compared to the baseline. Additional modelling will be required as the design progresses to ensure continued alignment with these performance metrics.

2. The 50% energy reduction package requires window and roof improvements, high-efficiency mechanical systems, improved suite ventilation energy recovery, and a heat pump water heater be implemented. This package offers a GHG emission reduction of 62% and an operating cost reduction of 24% compared to the baseline. Additional modelling will be required as the design progresses to ensure continued alignment with these performance metrics.

3. A detailed financial analysis is recommended to determine the preferred scenario based on the two proposed packages. While our proposed packages demonstrate the project's potential to meet the target, and offer notable annual energy and carbon cost reductions, especially as carbon prices increase, careful balancing against initial cost is required to overcome the cost disparity between natural gas and electricity. An investigation into potential financial incentives for these packages, including partial development charge refunds, grants, loans and other financial supports, and savings associated with the reclaim of mechanical spaces when applying district systems is recommended as part of this analysis.

4. Energy conservation measures related to occupant behavior can have significant impact on the building energy use, but are challenging to predict in an energy model. These measures, including suite-level thermal sub-metering and kill switches near exits, can have greater marketability because of their visibility and direct link to the residents' utility bills. These visible measures give occupants better control of their utility bills and over the use of their space.

6. REFERENCE LINKS

1. Barrie Site Plan Approval Process: https://www.barrie.ca/City%20Hall/Planning-and-Development/Pages/Development-Review-Process.aspx#
2. Canada's National Inventory Report on GHGs : https://publications.gc.ca/collections/collection_2021/eccc/En81-4-2019-3-eng.pdf
3. City of Toronto Zero Emissions Buildings Framework: https://www.toronto.ca/wp-content/uploads/2017/11/9875-Zero-Emissions-Buildings-Framework-Report.pdf
4. Ontario Emission Factor Projections: https://taf.ca/wp-content/uploads/2021/11/20211116_TAF_Emissions-Factors-Guidelines.pdf
5. Federal Carbon Pricing Framework: https://www.canada.ca/en/environment-climate-change/news/2020/12/a-healthy-environment-and-a-healthy-economy.html
6. National Renewable Energy Lab (NREL) PVWatts Calculator: http://pvwatts.nrel.gov/
7. TAF Feedback on TGS v4: https://taf.ca/wp-content/uploads/2021/06/Toronto-GDS-v.4-Recommendations.pdf
8. GHG Intensity of Different Vehicles: https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2018/market-snapshot-how-much-co2-do-electric-vehicles-hybrids-gasoline-vehicles-emit.html
9. Toronto's Future Weather and Climate Driver Study: https://www.toronto.ca/legdocs/mmis/2012/pe/bgrd/backgroundfile-51653.pdf
10. RWDI White Paper "Modelling Weather Futures": https://rwdi.com/assets/factsheets/Modelling-weather-futures.pdf
11. Resilient Design Institute: http://www.resilientdesign.org/

APPENDIX A

SUMMARY OF ENERGY MODEL INPUTS

APPENDIX A

SUMMARY OF PRIMARY ENERGY MODEL INPUTS

The primary energy model inputs for the **High-Rise Residential Building** are shown below:

Modelled Area | Description	9,753 m² Residential + Conditioned Mechanical Penthouse | 4,837 m² Parking
Location | Climate	Barrie, Ontario | Barrie CWEC (Climate Zone 6)
Primary Space Types	Residential, Corridors, Parking
Occupancy Schedule	NECB Schedule G
Set Points	Residential: Heating Set Point 22°C, Set Back 18°C | Cooling Set Point 24°C, Parking: Heating Set Point N/A, Cooling Set Point N/A
Fuel Emissions Intensities	Electricity = 0.050 kg/kWh | Natural Gas = 0.1832 kg/kWh

	20% Improvement Package	**50% Improvement Package**
TEDI (kWh/m²)	85	77
TEUI (kWh/m²)	275	185
GHGI (kg CO2e/m²)	41	19
Envelope		
Typical Exterior Wall Performance	RSI-1.76 (R-10.0)	RSI-1.76 (R-10.0)
Typical Roof Performance	RSI-5.35 (R-31)	**RSI-7.0 (R-40)**
Gross Window to Wall Ratio	40%	40%
Glazing Performance	USI-2.2 (U-0.39) | SHGC 0.40	**USI-2.0 (U-0.35) | SHGC 0.40**
Infiltration Rate	0.25 L/s-m² of façade and roof	0.25 L/s-m² of façade and roof
System Level – Residential		
Primary HVAC Type	DOAS 4-Pipe Fan Coil with In-Suite Ventilation	DOAS 4-Pipe Fan Coil with In-Suite Ventilation
Airside Energy Recovery	65% Sensible, 0% Latent	**75% Sensible, 70% Latent**
Heating	Hydronic Coils | Electric Preheat to -5ºC	Hydronic Coils | Electric Preheat to -5ºC
Cooling	Hydronic Coils	Hydronic Coils
Outdoor Air Rates	ASHRAE 62.1	ASHRAE 62.1
Fan Power (W/CFM)	Ventilation: 1 | FC: 0.5 (multi-speed)	Ventilation: 1 | FC: 0.5 (multi-speed)
System Level – Corridors		
Primary HVAC Type	DOAS 4-Pipe Fan Coil with Centralized Ventilation	DOAS 4-Pipe Fan Coil with Centralized Ventilation
Airside Energy Recovery	N/A	N/A
Heating	Hydronic Coils	Hydronic Coils
Cooling	Hydronic Coils	Hydronic Coils
Outdoor Air Rates (per Corridor)	14 L/s per door	14 L/s per door
Fan Power (W/CFM)	Ventilation: 1 | FC: 0.5 (multi-speed)	Ventilation: 1 | FC: 0.5 (multi-speed)
System Level – Parking		
Primary HVAC Type	Single Zone Fan Coil, Heating Only	Single Zone Fan Coil, Heating Only
Airside Energy Recovery	N/A	N/A
Heating	Hydronic Coils	Hydronic Coils
Outdoor Air Rates	ASHRAE 62.1	ASHRAE 62.1
Fan Power (W/CFM)	Ventilation: 1 | FC: 0.5 (multi-speed)	Ventilation: 1 | FC: 0.5 (multi-speed)
Plant Level		
Space Heating Efficiency	Condensing boiler: 95% Rated Efficiency	Condensing boiler: 95% Rated Efficiency
Space Cooling Performance	VFD Centrifugal Chiller: Rated COP 6.5 Cooling tower with VSD speed fan	VFD Centrifugal Chiller: Rated COP 6.5 Cooling tower with VSD speed fan
DHW Efficiency	Condensing boiler: 95% seasonal	**Heat Pump Water Heater with Seasonal COP of 2.8**
Space Level		
Occupant Density (m²/person)	Res: 25 | Corridor: 100 | Parking: 1000	Res: 25 | Corridor: 100 | Parking: 1000
Equipment Load	Res: 5.0 | Corridor: 0 | Parking: 0	Res: 5.0 | Corridor: 0 | Parking: 0
Lighting Power Density (W/m²)	Res: 5.0 | Corridor: 5.8 | Parking: 1.5	Res: 5.0 | Corridor: 5.8 | Parking: 1.5
DHW Fixture Flow Rates (L/h/person)	Res: 8.57 | Corridor: 0 | Parking: 0	Res: 8.57 | Corridor: 0 | Parking: 0