ENERGY STRATEGY REPORT
683-685 Warden Avenue
Scarborough

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Prepared for:

Choice Properties Limited Partnership
22 St Clair Avenue East,
Suite 700
Toronto, ON M4T 2S5

Prepared by:
Pratus Group

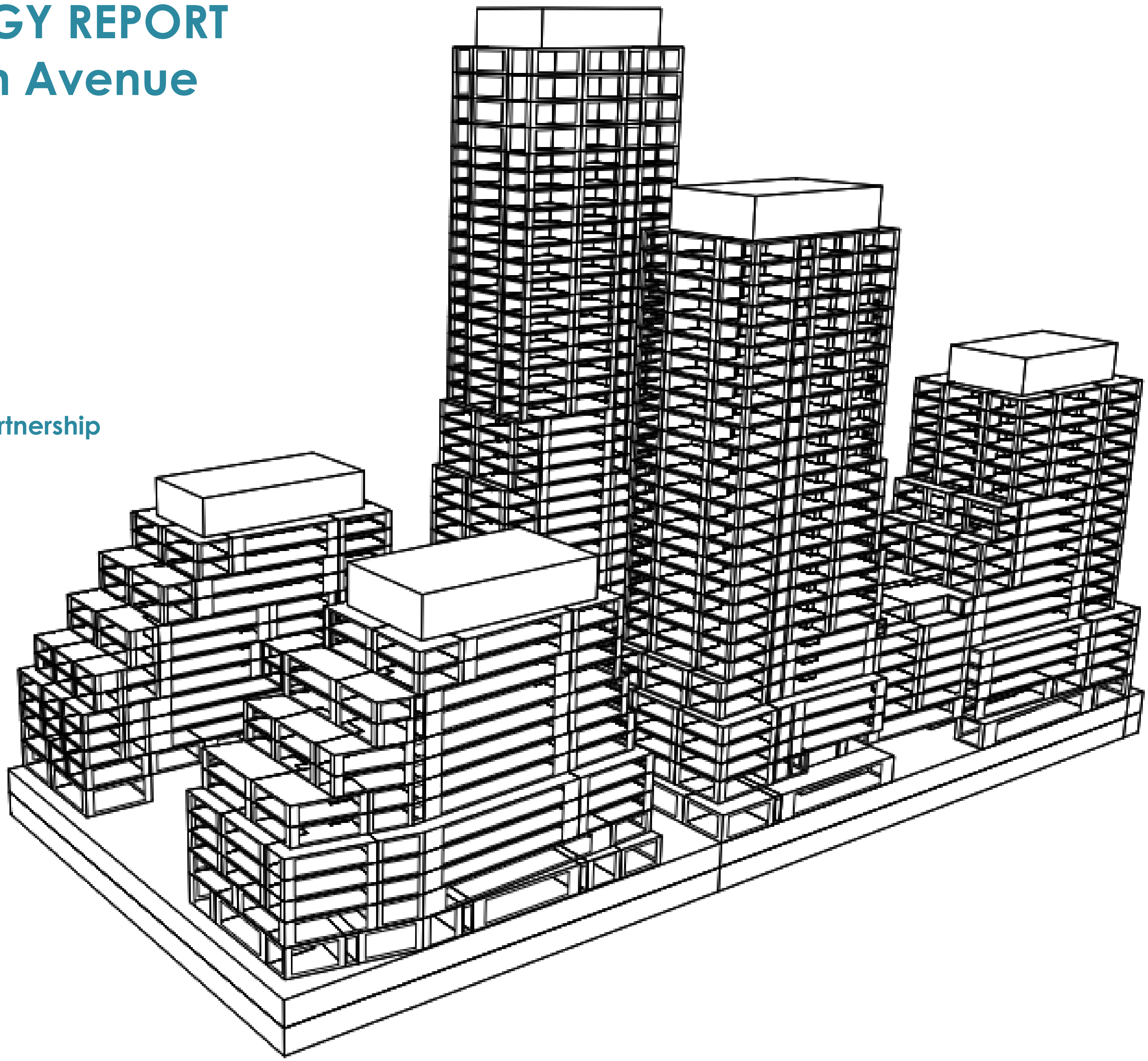


Table of Contents

1 EXECUTIVE SUMMARY

The following Energy Strategy Report summarizes the analysis and results of the energy conservation measures considered for the proposed 683-685 Warden Avenue mixed-use community development project. The 2.6-hectate site, located at 68-3685 Warden Avenue. Choice Properties Limited Partnership (Choice) is proposing six development blocks (Block A through Block F). The total gross floor area of the proposed development will be 121,003 m^2 including 993.0 m^2 of commercial space. A total of 1,519 units are proposed distributed between six mid-rise and high-rise towers.

Pratus Group has been retained by Choice to identify opportunities for integrating local energy solutions that are efficient, low carbon and resilient into the proposed project's design. The results of which have been summarized in the following Energy Strategy report for 685 Warden Avenue. The energy conservation strategies analyzed have been done so in accordance with the City of Toronto's Energy Strategy Terms of Reference. The analysis completed as a part of this report is the first step and will serve to inform subsequent design decisions that will be reflected in the Toronto Green Standard Design Development Stage Energy Report.

2 LIMITATIONS

This report has been prepared for Choice to inform and investigate energy strategy for the 685 Warden Avenue project. The analysis and the results present modelled performance metrics (TEUI, TEDI and GHGI) for the proposed building design in comparison to performance limits of TGS and OBC SB-10. The calculations are applicable only for determining compliance with OBC SB-10, Toronto Green Standard v3 requirements and for option comparison. They are not predictions of actual energy use or costs of the proposed design after construction.

Actual experience will differ from these calculations due to the variations such as occupancy, building operation and maintenance, weather, energy use not covered by energy standard, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.

3 INTRODUCTION

The purpose of this Energy Strategy Report is to explore and identify opportunities to integrate efficient, low carbon, resilient, and local energy solutions for the proposed development. The analysis completed as a part of this report is the first step in this process; it will inform subsequent design decisions that will be reflected in the Toronto Green Standard Design Development Stage Energy Report.

This Energy Strategy Report fulfills the City of Toronto's requirement that apply to all new developments including residential, non-residential and mixed use with:

- A total gross floor area of 20,000 m^2 or more; or
- Are located within a Community Energy Plan area approved by Council

In association with the following application types:

- Official Plan Amendment;
- Zoning By-Law Amendment; or
- Plan of Submission

As per the City of Toronto's Energy Strategy Terms of Reference, the Energy Strategy is intended to contribute to achieving the City's objectives to reduce energy consumption and GHG emissions and become more resilient.

The Official Plan policy 3.4.18 states that "innovative energy producing options, sustainable design and construction practices ... will be supported and encouraged in new development … through: d) advanced energy conservation and efficiency technologies and processes that contribute towards an energy neutral built environment".

Undertaking an Energy Strategy at the application stage for a Plan of Subdivision, Official Plan or Zoning Bylaw Amendment facilitates the following key outcomes:

- Opportunity to site buildings to take advantage of existing or proposed energy infrastructure, energy capture and/or solar orientation at the conceptual design stage.
- Consideration of potential energy sharing for multi-building development and/or neighboring existing/proposed developments.
- Consideration of opportunities to increase resiliency such as strategic back-up power capacity (for multi-unit residential buildings).
- Identification of innovative solutions to reduce energy consumption in new construction and retrofit of existing buildings (if part of new development).
- Exploration of potential to attract private investment in energy sharing systems.

Pratus Group has been retained to provide the analysis required for the Energy Strategy report for 685 Warden Avenue.

4 BACKGROUND

Figure 1: Architectural Render of 685 Warden Avenue Development

4.1 PROPOSED DEVELOPMENT

Choice is proposing to develop a mixed-used, commercial- residential development on the vacant land located at 685 Warden Avenue located in Toronto, Ontario. The site is estimated to be 2.6 hectares in size.

The proposed development will introduce a network of public roads to subdivide the large site into six appropriately sized development blocks (Blocks A through F). In total, 121,003 m^2 are proposed, including 993.0 m^2 of non-residential uses. A total of 1,519 units are distributed through high-rise towers. Building heights range for 13 storeys on towers A and up to 36 storeys on tower C.

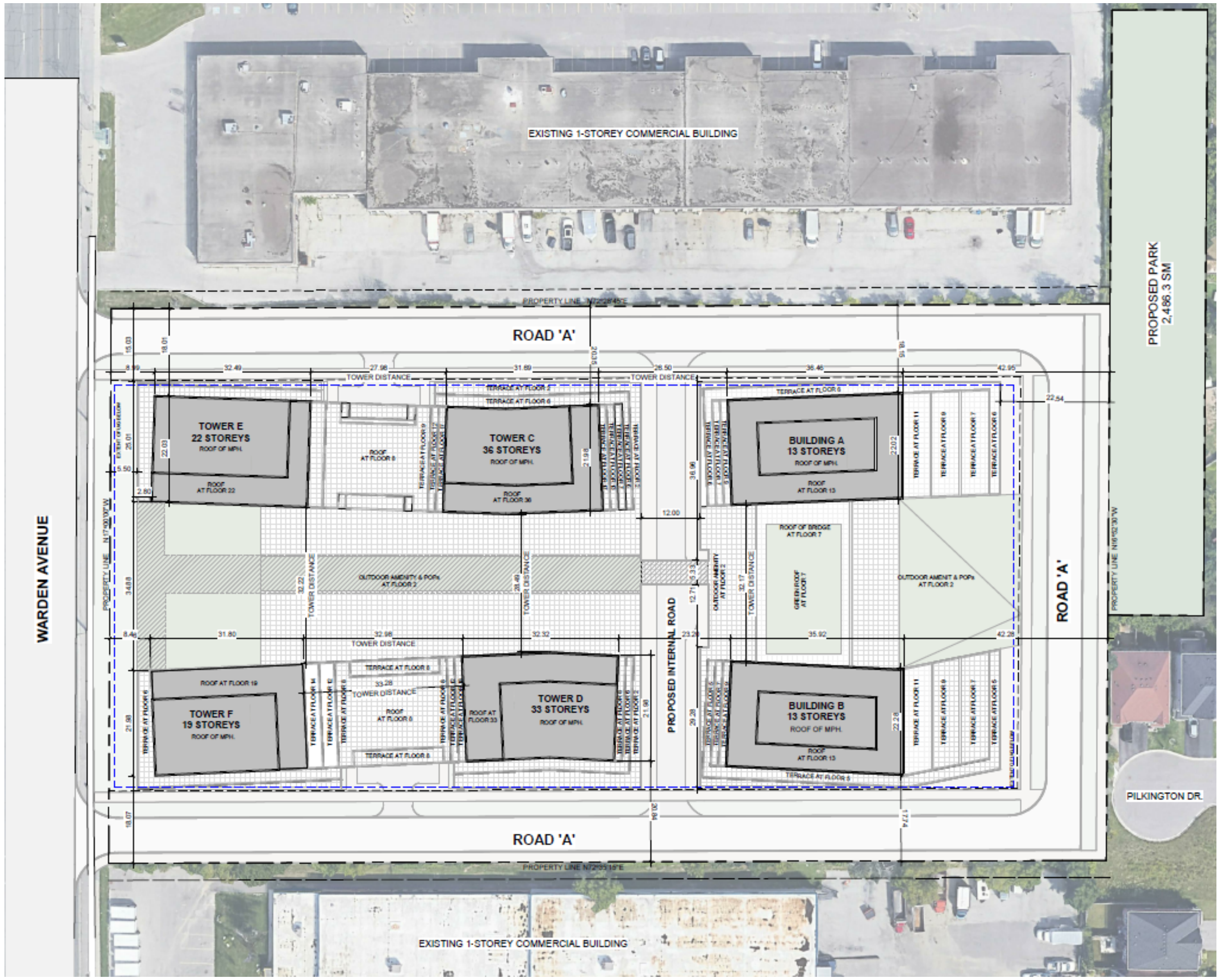


Figure 2: 685 Warden Avenue Site Plan

4.2 NEIGHBORHOOD

The site is located at 685 Warden avenue in the south west area of Scarborough, within the City of Toronto. The site is bounded by commercial uses to the North and South, low-rise residentials to the East and Warden Woods and Gus Harris Trail to the West.

Figure 3: Existing Site (Source: Urban Design Guidelines & Block Context Plan)

The proposed development will transition the site from a vacant land to a mixed-used commercial-residential properties with a network of public streets and walkable areas.

The current site is transit-oriented as it is well served by the existing Toronto Transit Commission (TTC) Warden Station (Line 2 Bloor-Danforth Subway Line) as well as bus network with 2 bus routes (69 and 135) within walking distance.

4.3 ENERGY ENVIRONMENT

The site is serviced by Toronto Hydro for electricity, Enbridge for natural gas, and by the City of Toronto for domestic potable water. The Time-of-Use rates are summarized in Figure 4. For the purposes of this report the IESO average price of $13.97/kWh for November 2020 is used combined with the Toronto Hydro demand rate of $14.8/kW.

TOU period	Hours	Price
On-peak	Weekdays from 7 a.m. to 11 a.m. and 5 p.m. to 7 p.m.	21.7¢ per kWh
Mid-peak	Weekdays from 11 a.m. to 5 p.m.	15.0¢ per kWh
Off-peak	Weekdays from 7 p.m. to 7 a.m. and all day weekends and holidays	10.5¢ per kWh

Figure 4: Toronto Hydro Time-of-Use Rates effective November 1

The natural gas rates are summarized in Table 1 below:

Enbridge Rates	
Total	**cents/m^3**
First 500 m^3	28.2069
Next 1,050 m^3	26.0951
Next 4,500 m^3	24.6163
Next 7,000 m3	23.6661
Next 15,250 m^3	23.2437
All Over 28,300 m^3	23.1379

Table 1: Enbridge Gas Rates

A price on carbon pollution is an essential part of Canada's plan to fight climate change and grow the economy. It is one of the most efficient ways to reduce greenhouse gas emissions and stimulate investments in clean technologies. It creates incentives for individuals, households, and businesses to choose cleaner energy options.

As part of Canada's plan, provinces and territories have the flexibility to maintain or develop a carbon pollution pricing system that works for their circumstances, provided it meets federal benchmark stringency requirements. To ensure carbon pollution pricing applies throughout Canada, the federal backstop carbon pollution pricing system applies in whole or in part in any province or territory that requests it or that does not have a pricing system in place that aligns with the federal benchmark stringency requirements. The federal backstop is in place in Ontario.

As part of this program, a carbon charge applies to fossil fuels sold in Ontario, including natural gas. On April 1, 2020, the federal carbon charge for natural gas increased to 5.87 cents per cubic metre (m^3). This charge will increase annually each April. In April 2021, the charge has increased to 7.83 cents per cubic metre. Pricing changes year over year are summarized in Table 2.

Table 2: Federal Carbon Charge Rates for Natural Gas

2019 – 2022 Federal Carbon Charge Rates for Marketable Natural Gas		
Year	$/ tCO^2e	cents/m^3
2019	$20	3.91
2020	$30	5.87
2021	$40	7.83
2022	$50	9.79

In December 2020 the government announced that the carbon charge rate will rise to $170 per tonne by 2030. This will have a significant impact on the cost of using natural gas in buildings and should be considered when designing future buildings. The current blended gas rate is around 24 cent/m^3 with 5.87 cents of that charge being carbon tax. At $170/ton, the carbon tax on a m^3 of gas will increase to 33.3 cents. This will more than double the cost of natural gas by 2030.

4.4 CARBON

4.4.1 Federal and Provincial Targets

Reducing carbon emissions is a priority for the City of Toronto and the mandate for Energy Strategy Reporting is a part of the process in meeting this objective. Reducing carbon emissions at the municipal level aligns with the broader provincial and federal carbon reduction targets and commitments. Canada has committed to reducing Green House Gas (GHG) emissions to 30% below 2005 levels by 2030 in an effort to limit global climate warming below the 1.5°C degree threshold established by the Paris Agreement in 2015.

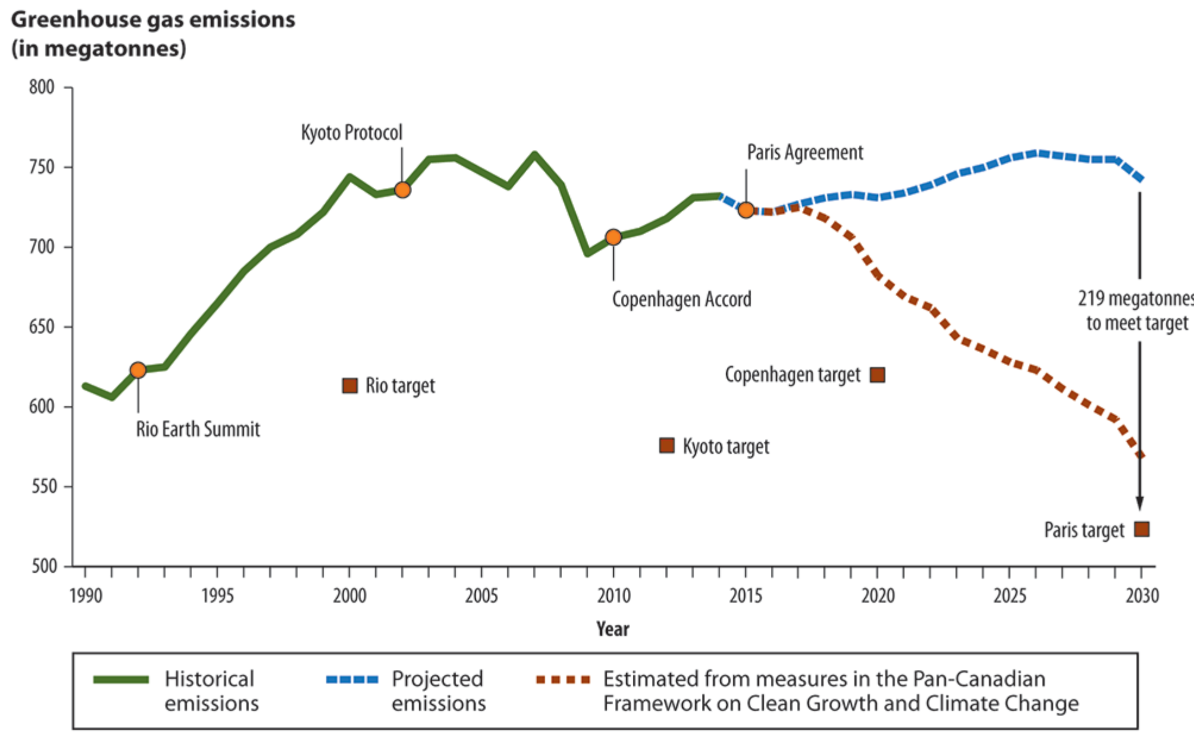


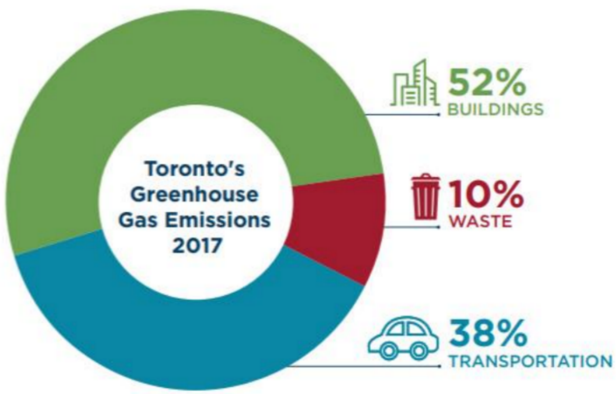
Figure 5: Canada's GHG Reduction Commitment and Progress (Office of the Auditor General of Canada)

Carbon reduction is very closely tied to energy use reduction; higher annual energy use results in a higher annual carbon emission factor associated with the project. Energy source mix, not just overall energy use, contributes to the carbon emission profile of the project. Electricity, natural gas, oil, etc. have difference emissions factors associated with them.

In November 2018, the province of Ontario released their new climate plan with a framework to meet the Paris Agreement commitments. The new plan involves regulation of large emitters, invectives for green innovation and investment.

The Federal Government of Canada's goals exceed those of the Paris Agreement and target a net 80% reduction in emissions by 2050 from 2005 levels. The planned actions to reach these goals have been outlined in the Canada's Pan-Canadian Framework on Clean Growth and Climate Change released in 2016. A federal carbon pricing system is a large part of this outlined plan but has faced opposition from several provinces including Ontario. As a result, the federal government announced in 2018 that it will impose the federal carbon pricing backstopping plan on five of the country's 13 provinces and territories in 2019, including Ontario. Federal and provincial developments in carbon and emission limitations should be kept in mind when thinking about future large-scale developments in the province.

4.4.2 Municipal Targets



Toronto has an ambitious climate action strategy, TransformTO, which lays out a set of long-term, low-carbon goals and strategies to reduce local greenhouse gas emissions and improve our health, grow our economy, and improve social equity. On October 2, 2019 City Council voted unanimously to declare a climate emergency and accelerate efforts to mitigate and adapt to climate change, adopting a stronger emissions reduction target of net zero by 2050 or sooner.

Toronto's greenhouse gas (GHG) emissions reduction targets, based on 1990 levels:

- 30 per cent by 2020
- 65 per cent by 2030
- Net zero by 2050, or sooner

The Toronto Green Standard is Toronto's sustainable design requirements for new private and city-owned developments. The Standard consists of tiers (Tiers 1 to 4) of performance measures with supporting guidelines that promote sustainable site and building design. Tier 1 of the Toronto Green Standard is a mandatory requirement of the planning approval process.

Financial incentives are offered through the Development Charge Refund Program Version 3 or Version 2 for planning applications that meet higher level voluntary standards in Tiers 2 to 4. The current version of the Toronto Green Standard is a tool for moving new development in the right direction with respect to the City's emissions targets. The current version of the TGS, version 3.0, outlines a number of absolute targets for planned developments based on the archetype building they belong to. The majority of the 685 Warden Avenue site will fall under the 'Mixed Use Buildings' building type. The current targets for TGS v3.0 are outlined in Figure 6.

The Toronto Green Standard is an evolving standard which aims to push the development industry to building near-net zero emissions buildings in line with the City's goals. The TGS requirements increment regularly with increasing levels of stringency. In May 2022, version 4.0 of the TGS will become mandatory for all projects applying for Site Plan Approval. It is anticipated that the mandatory TGS v4.0 Tier 1 energy targets will be set at the current TGS v3.0 Tier 2 targets. The 685 Warden site is a phased project and will have a number of blocks applying under the TGS v4.0 or

Building Type	Total Energy Use Intensity (KWh/m^2)		Thermal Energy Demand Intensity (KWh/m^2)		Greenhouse Gas Intensity (kg/m^2)	
	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
Multi-unit Residential Buildings (≥4 Storeys)	170	135	70	50	20	15
Multi-unit Residential Buildings (≤ 6 Storeys)	165	130	65	40	20	15
Commercial Office Buildings	175	130	70	30	20	15
Commercial Retail Buildings	170	120	60	40	20	10
Mixed Use Buildings (90% residential, 5% retail, 5% commercial)	170	134	70	49	20	15
All Other Building Types	Tier 1: ≥15 per cent improvement above SB-10, 2017 Tier 2: ≥25 per cent improvement above SB-10, 2017					

Figure 6: TGS v3.0 Absolute Targets

later versions. Choice is committed to meeting the TGS Tier 1 requirements of the TGS version applicable at the time of SPA. It is anticipated that the first phase of the 685 Warden development will be submitted in the summer of 2022, when TGS v4.0 will be in effect. As a result, the phase will be required to mee the Tier 1 requirements of TGS v4.0, which will be TEUI of 134 kW/m^2 , a TEDI of 49 kW/m^2 and a GHGI of 15 kW/m^2.

In 2017, buildings made up 52% of all the carbon emissions in Toronto. The current TGS v3.0 carbon reduction strategies will not result in the City meeting it's 2050 targets. Under the business-as-planned scenario there will be an 8.7 MT gap. The City has identified that improved building energy efficiency can account for 3.86 MT of this shortfall. As a part of this strategy, buildings currently being planned must achieve high levels of energy efficiency and use low-carbon technologies.

By 2030, Toronto will have to construct new buildings in a way that drastically reduces their energy need and virtually eliminates their carbon emissions. The 685 Warden development is a phased development which could have buildings constructed after 2030. It is critical to consider low-carbon technologies at this stage to meet our Municipal carbon reduction targets.

5 CHOICE PROPERTIES LIMITED PARTNERSHIP SUSTAINABILITY STRATEGY

Choice is committed to conducting their business in a manner that is respectful to the environment and the communities in which they operate in. This includes improving operational efficiency at their properties by utilizing technologies that support their environmental commitment, where commercially reasonable.

Choice has been exploring the feasibility of achieving Tier 2 of the Toronto Green Standard for their new developments in Toronto. This includes investigating efficient envelope design, low-carbon systems, and district energy. The 685 Warden project presents an opportunity to continue Choice's commitment to their sustainability goals.

6 ENERGY PERFORMANCE

Pratus Group has used IES VE 2021, an hourly energy simulation tool, to prepare the analysis for this report.

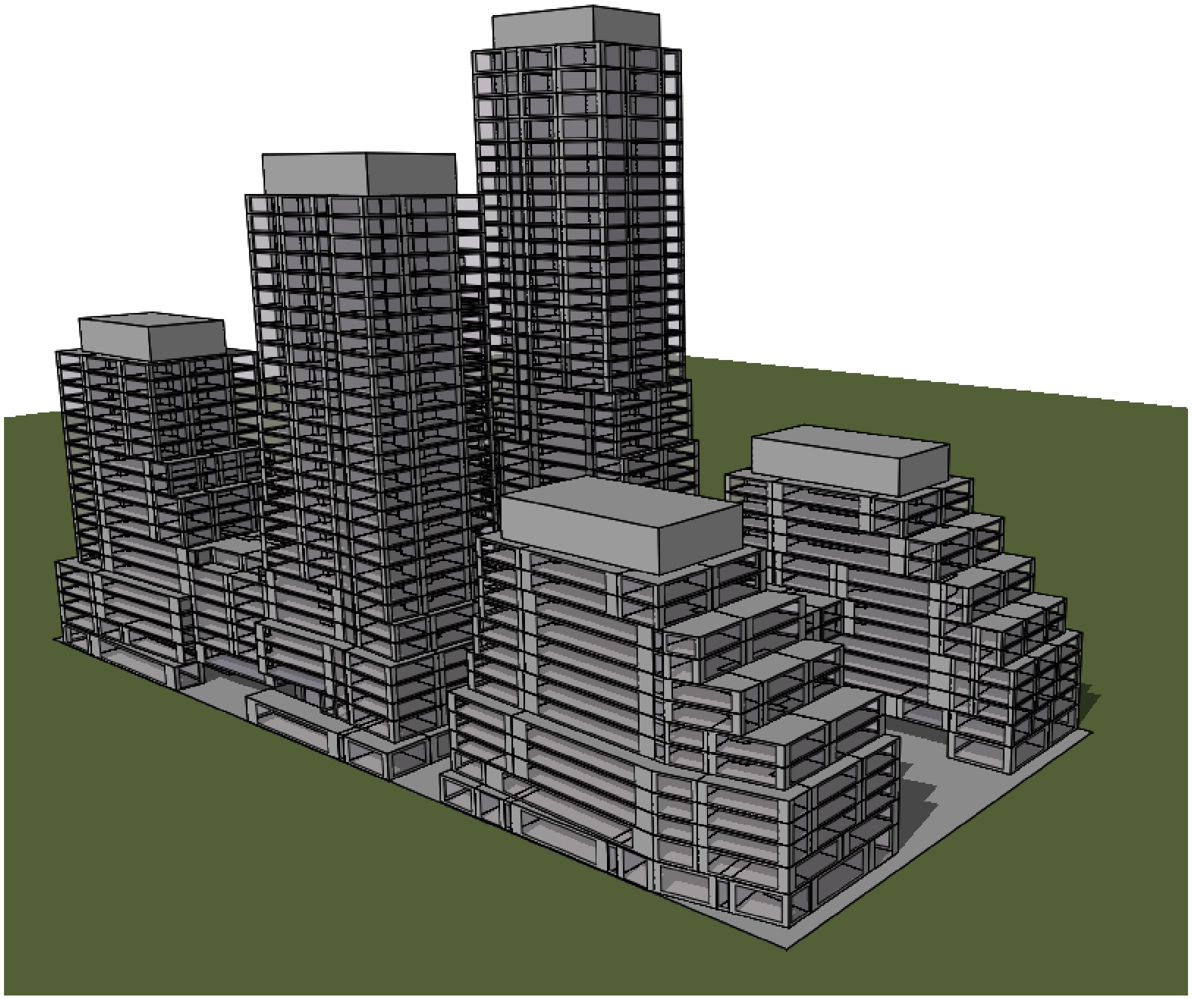


Figure 7: Representation of the proposed development in IES VE 2019

Various metrics are used to evaluate energy performance for a project. The ones that will be discussed in this report are summarized below:

TEUI: Total Energy Use Intensity is the sum of all energy used on site (i.e. electricity, natural gas, and district heating and cooling), minus all Site Renewable Energy Generation, and divided by the Modelled Floor Area. TEUI is reported in kWh/m²/year.

TEDI: Thermal Energy Demand Intensity is the annual heating delivered to the building for space conditioning and conditioning of ventilation air. Measured with modelling software, this is the amount of heating energy delivered to the project that is outputted from any and all types of heating equipment, per unit of modelled floor area. TEDI is reported in kWh/m²/year.

GHGI: Green House Gas Intensity is the total greenhouse gas emissions associated with the use of all energy utilities on site on a per area basis, using the emissions factors in Section 3.3 of this guideline. GHGI shall be reported in kg eCO2/m²/year.

In Toronto, these metrics are analyzed in relation to the targets outlined in the Toronto Green Standard (TGS). Targets are unique to each building archetype. The proposed development is most closely aligned with the Mixed-Use Building Archetype. This archetype's TEUI, TEDI and GHGI targets are highlighted in Figure 8. TGS Tier 1 requirements are mandatory for all buildings and Tiers 2-4 are voluntary targets which, should they be achieved, have development charge rebates associated with them. The project will be subject to, at minimum, the current Tier 2 thresholds as TGS v4.0 will be in effect during Site Plan Application.

Building Type	**Total Energy Use Intensity (KWh/m²)**		**Thermal Energy Demand Intensity (KWh/m²)**		**Greenhouse Gas Intensity (kg/m²)**	
	Tier 1	**Tier 2**	**Tier 1**	**Tier 2**	**Tier 1**	**Tier 2**
Multi-unit Residential Buildings (≥4 Storeys)	170	135	70	50	20	15
Multi-unit Residential Buildings (≤ 6 Storeys)	165	130	65	40	20	15
Commercial Office Buildings	175	130	70	30	20	15
Commercial Retail Buildings	170	120	60	40	20	10
Mixed Use Buildings (90% residential, 5% retail, 5% commercial)	170	134	70	49	20	15

Figure 8: TGS v3.0 Performance Targets

Note that the above benchmarks are only valid for Toronto Green Standard Version 3. In May 2022, TGS v3 will be replaced by version 4 and Tier 2 energy targets of version 3 will become mandatory Tier 1 targets for all building archetypes. As per analysis, 685 Warden will be complying with Tier 1 requirements of TGS version in effect during the Site Plan Application submission. The first phase of the proposed development is anticipated to initially submit after May 2022; TGS v4.0 will be in effect at that point in time. Refer to energy modelling parameters discussed in Appendix A to review pathway to meet Tier 2 and higher requirements of TGS v4.0. At this stage, the timeline of further phase Site Plan Applications are unknown.

6.1 BASE CASE/TIER 1

During the analysis required for the Energy Strategy Report, it is important to establish a baseline or reference scenario for the proposed development. At this very early design stage, only preliminary architectural drawings and rendering are available to describe the development. Currently mechanical and electrical design documents have not been prepared.

The baseline case selected for the purpose of this analysis is a building architecturally identical to the proposed development and meets the minimum requirements of the current Ontario building code energy regulations as outlined in SB-10 2017 and Toronto Green Standard v4.0 Tier 1 requirements. The Tier 1 requirements of TGS v4.0, which will be TEUI of 134 kW/m^2 , a TEDI of 49 kW/m^2 and a GHGI of 15 kW/m^2.The design characteristics of this Baseline building and the subsequent improved scenarios are summarized in Appendix A.

The proposed development's Baseline Case energy performance is summarized in Figure 10. The Total Energy Use Intensity (TEUI) for this scenario is **134 ekWh/m^2**. The associated Thermal Energy Demand Intensity (TEDI) is **39 kWh/m^2** and the Green House Gas Intensity (GHGI) is **15 ekg/m^2**. These performance metrics meet the minimum requirements of the Toronto Green Standard v4.0 through the absolute performance pathway. The proposed development's shows **25.6 %** energy use savings over a building built to the minimums of OBC SB-10.

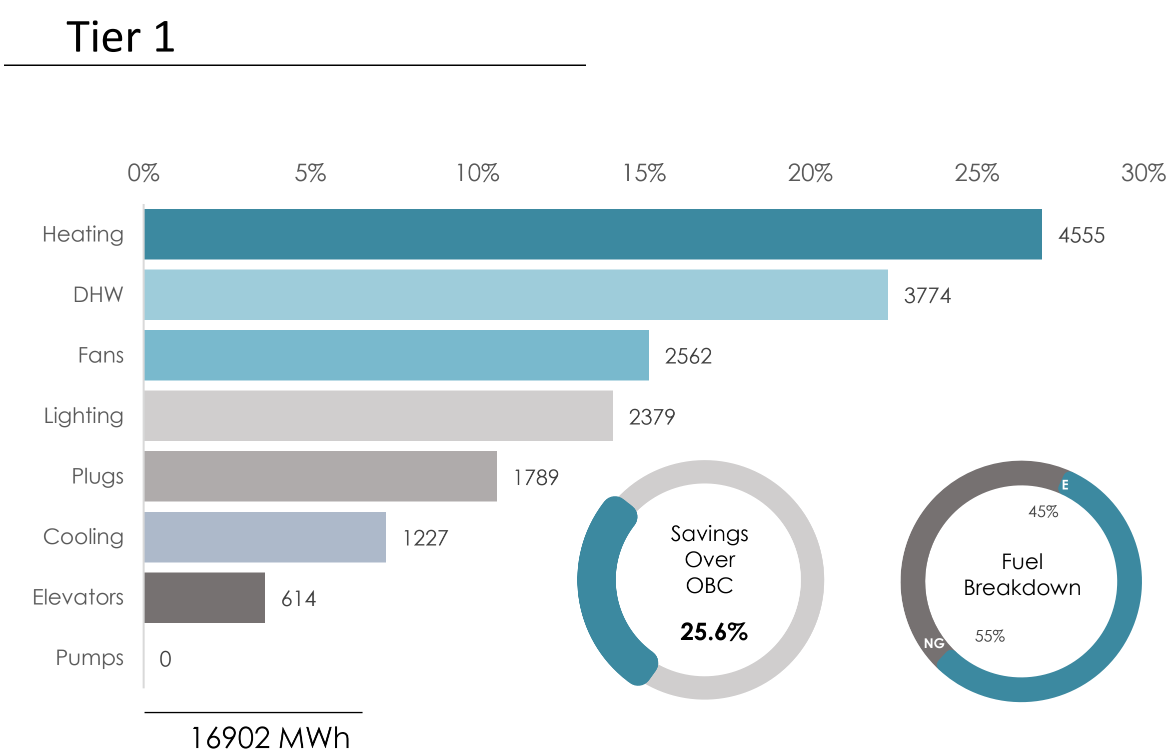


Figure 9: Baseline Annual Energy Use by End Use

6.2 OBC SB-10 REFERENCE

The baseline is compared to the OBC SB-10 performance for the same development. The OBC SB-10 reference case is limited to 40% glazing and as a result, the heating energy use is lower. The proposed development's OBC SB-10 Reference Case energy performance is summarized in Figure 11. The Total Energy Use Intensity (TEUI) for this scenario is **181 ekWh/m²**. The associated Thermal Energy Demand Intensity (TEDI) is **38 kWh/m²** and the Green House Gas Intensity (GHGI) is **21 ekg/m²**.

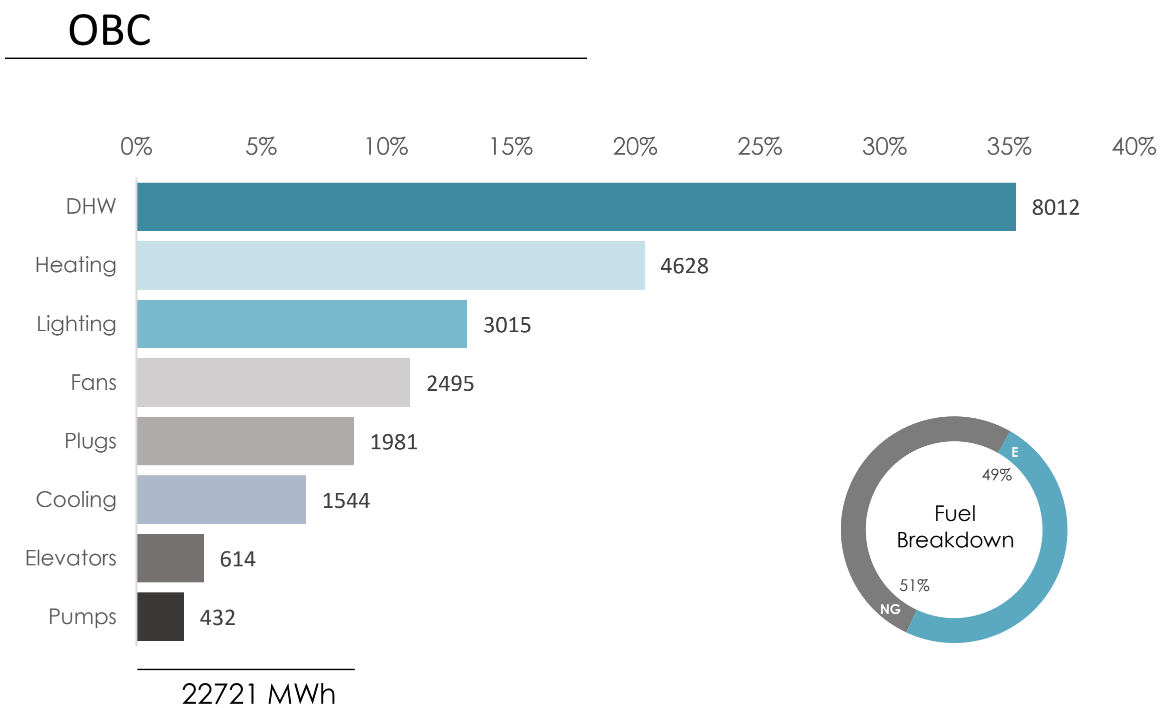


Figure 10: OBC SB-10 Annual Energy Use by End Use

6.3 ENERGY CONSERVATION OPPORTUNITIES/TGS TIER 2

The proposed development's Baseline Case presents significant opportunities for energy opportunities, specifically on the heating side. Options for meeting the voluntary Toronto Green Standard v4.0 Tier 2 are explored.

TGS Tier 2 targets are absolute targets for TEUI, TEDI and GHGI. The TGS v4.0 Tier 2 targets are anticipates to be a TEUI of 100 kWh/m^2, TEDI of 29 kWh/m^2 and GHGI of 10 kg/ m^2. The achievement of these requires HVAC and envelope improvement. The main change includes shifting from a water-loop heat pump system with boilers and fluid cooler to an air-source variable refrigerant flow (VRF) and electrifying the domestic hot water system. Energy recovery effectiveness is also increased. The HVAC change is combined with improved glazing and improve opaque wall to reduce the TEDI. The Total Energy Use Intensity (TEUI) for this scenario is **99 ekWh/m^2**. The associated Thermal Energy Demand Intensity (TEDI) is **29 kWh/m^2** and the Green House Gas Intensity (GHGI) is **5 ekg/m^2**. The proposed development's shows **45.2 %** energy use savings over a building built to the minimums of OBC SB-10.

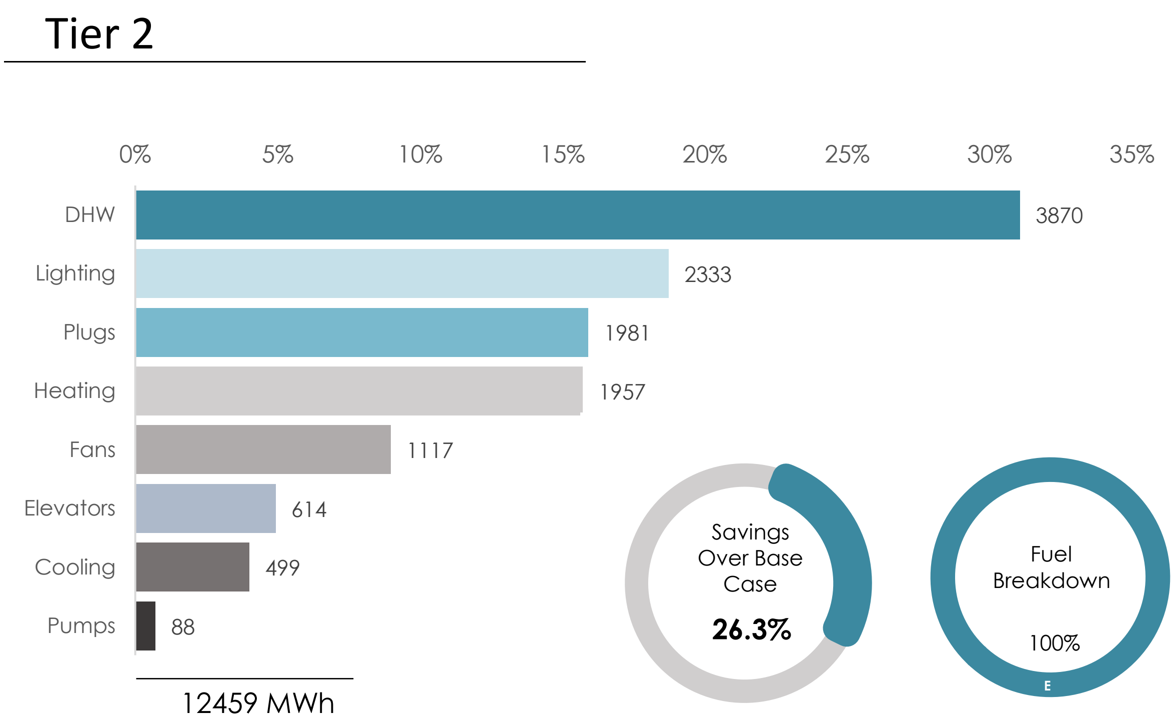


Figure 11: TGS Tier 2 Scenario Annual Energy Use by End Use

6.4 TOWARDS NET-ZERO

The pathway to achieving Net-Zero, whether Net-Zero Carbon or Net-Zero Energy, looks very similar.

Net-Zero Carbon centers around achieving a zero-carbon balance through on-site and off-site renewable, carbon free energy sources while eliminating on-site combustion of fossil fuels. The energy mix of natural gas and electricity has a large impact on this target.

Net-Zero Energy focuses on meeting a net-zero energy balance and is independent of fuel source.

The first step is to reduce project energy loads; this includes improving the building envelope to minimize the heating and cooling requirements, reducing lighting loads through smart design and daylighting or occupancy sensors, reducing ventilation to only provide what is required, optimizing orientation and massing, etc.

Once the loads are reduced, the next step is to meet those loads in an efficient manner. This includes having an efficient HVAC system, efficient lighting technologies, energy recovery, etc. Once the loads have been reduced and met in the most efficient way, it is time to consider meeting the rest of the energy requirements through on-site or off-site renewable resources such as solar or wind generation.

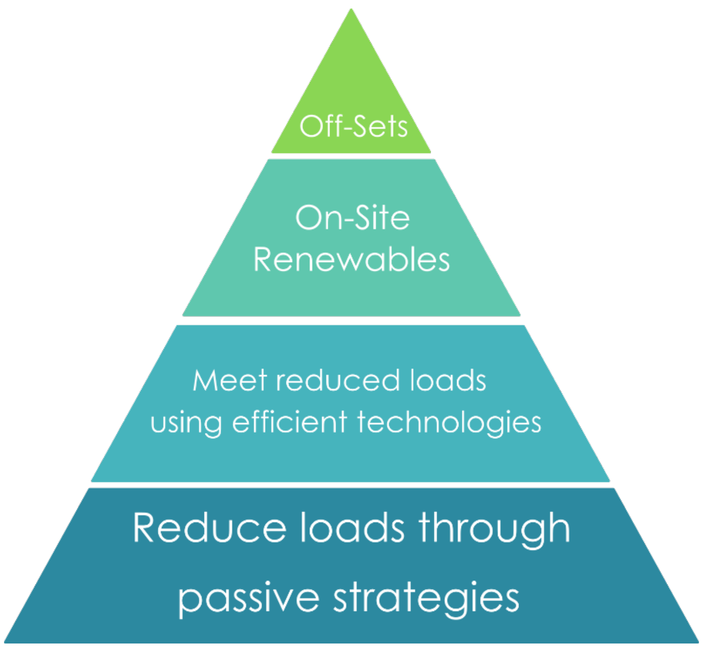


Figure 12: Net-Zero Design Pyramid

A scenario which sets the project on the path to Net-Zero was explored for the proposed 685 Warden development. This involves significant improvements in the building envelope and HVAC systems. Keeping carbon emissions in mind, an HVAC and DHW system which uses electricity was preferred over a gas combustion one.

Approaching Net Zero

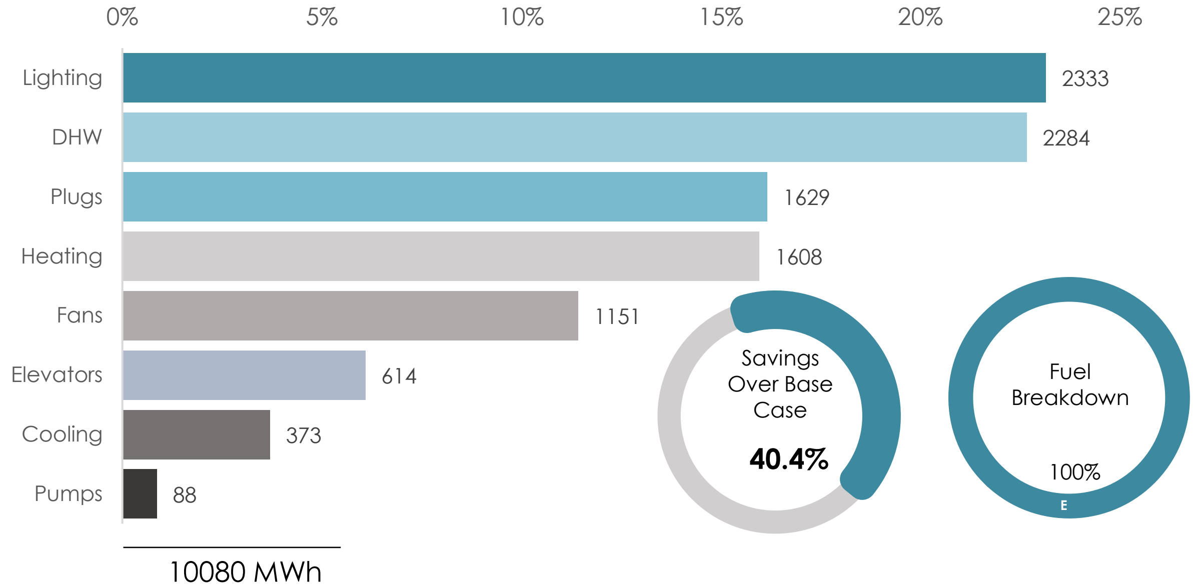


Figure 13: Net-Zero Design Scenario Annual Energy Use by End Use

The Total Energy Use Intensity (TEUI) for this scenario is **80 ekWh/m²**. The associated Thermal Energy Demand Intensity (TEDI) is **21 kWh/m²** and the GHGI is **4 ekg/m²**. The proposed development's shows **55.8 %** energy use savings over a building built to the minimums of OBC SB-10 and **40.4%** better than the Tier 1 scenario.

This performance comes short of meeting the current Tier 4 requirements or future Tier 3 requirements. However, the performance would meet the current energy requirements of the Canada Green Building's Council's Zero Carbon Building Standard by meeting the TEDI and energy performance requirements. Meeting current Tier 4 targets is challenging for a high-rise multi-unit residential mixed-use building, largely due to the high ventilation requirements of MURBS and constructability challenges for high performance envelope elements on high-rise MURBs. As technologies evolve to meet the increased energy requirements of energy codes, these barriers will be overcome.

The summary of the energy metrics for the four scenarios is presented in Table 2.

Scenario	TEUI	TEDI	GHGI
Baseline/Tier 1	134	39	15
OBC Reference	181	38	21
TGS Tier 2	99	29	5
Approaching Net Zero	80	21	4

Table 3: Summary of Scenarios

7 THERMAL BRIDGING

Heating is one of the largest components of energy use in commercial, institutional, and residential buildings in Ontario. Building envelope thermal performance is a critical consideration for reducing space heating loads and will be an increasingly important factor as we move towards near net-zero emissions buildings.

As of January 2020, Bulletin 2 of the Toronto Green Standard (TGS) V3 requires all Mid to High Rise and Non-residential buildings to include impact of thermal bridging on the proposed building façade. Therefore, the importance of selecting high performing architectural details during site plan application (SPA) is imperative to ensuring that a high performing building is constructed.

Thermal bridging is a key player in the overall performance of the building envelope that is often overlooked. Thermal bridges occur in an assembly when there is a highly conductive material that by-passes the insulation layers. This creates a pathway that allows significant amounts of undesirable heat transfer occur and it can greatly affect the overall thermal performance of an assembly. A poor building envelope will increase the demand on the mechanical system which will drive up the annual energy consumption. Careful selection of architectural details can substantially improve thermal performance as we will see in the example below.

The following is an example showing the thermal characteristics of a standard curtain wall assembly with increasing back pan insulation.

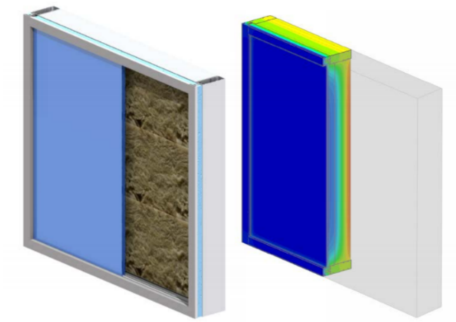


Figure 15: Example Detail of Standard Curtain Wall

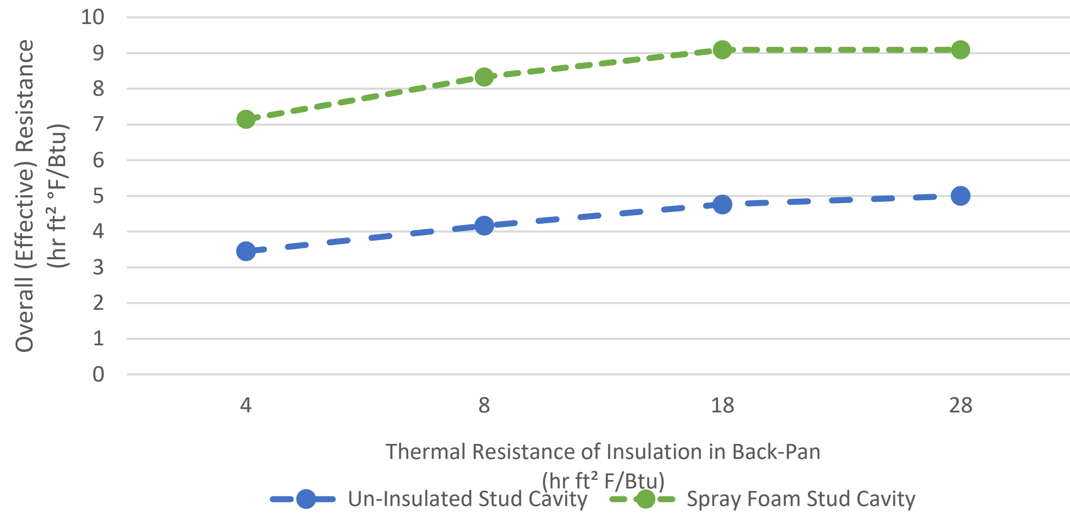


Figure 14: Diminishing Rate of Return of Spandrel Section Overall Thermal Performance

As seen in Figure 14, the minimal performance gain with increasing insulation shows that the heat is flowing around the insulation through the frame. Therefore, adding additional insulation in the back pan to non-thermally broken assemblies only has slight improvements on the overall assembly performance.

Pratus Group conducted a façade thermal bridging analysis of a 39-storey MURB high rise tower in downtown Toronto. Figure 16 shows a high-level impact of each detail on the overall envelope performance. The nominal insulation for this project was R25+. The overall envelope performance decreases as each of the thermal bridging effects are accounted for.

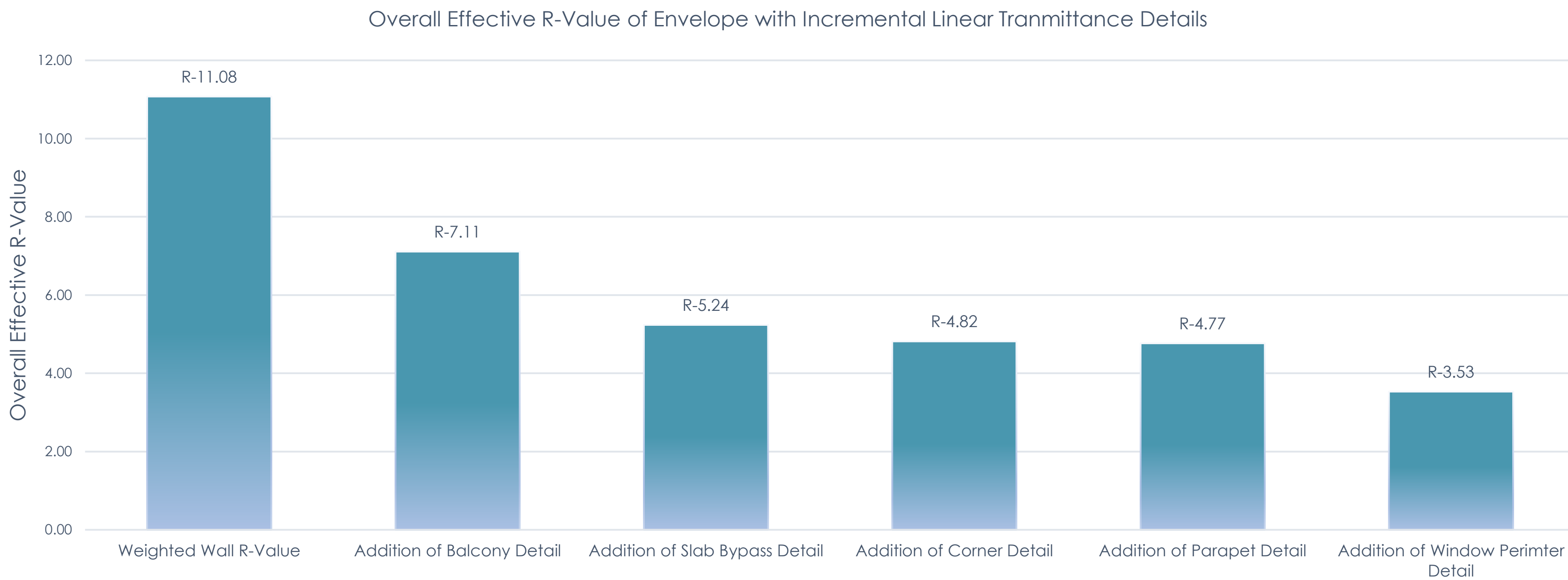


Figure 16: Effect of individual details on the overall envelope thermal performance

As the building considered in this study is a high rise MURB, the details that occur in the largest numbers are the slab balcony, slab bypass and window wall interface assemblies. These details are shown to have the highest impact on the overall thermal performance of the envelope. Accounting for the effects from each detail reduces the **R-11.8** opaque wall assembly to **R-3.53** effective, a **68%** decrease. Due to the large impact on envelope performance from the thermal bridges, especially the key details listed above, the importance of reviewing the thermal characteristics of each assembly prior to selection cannot be overstated.

7.1 RENEWABLES AND LOW-CARBON OPTIONS

7.1.1 On-Site Solutions

7.1.1.1 Solar PV

An annual analysis of the total available solar energy for the building was performed. The findings are visually summarized in Figure 17. From this, the penthouse roofs appear to be the optimal locations for on-site solar generation. These locations are not shaded by adjacent buildings or structures and therefore shading will not hinder the generation capacity.

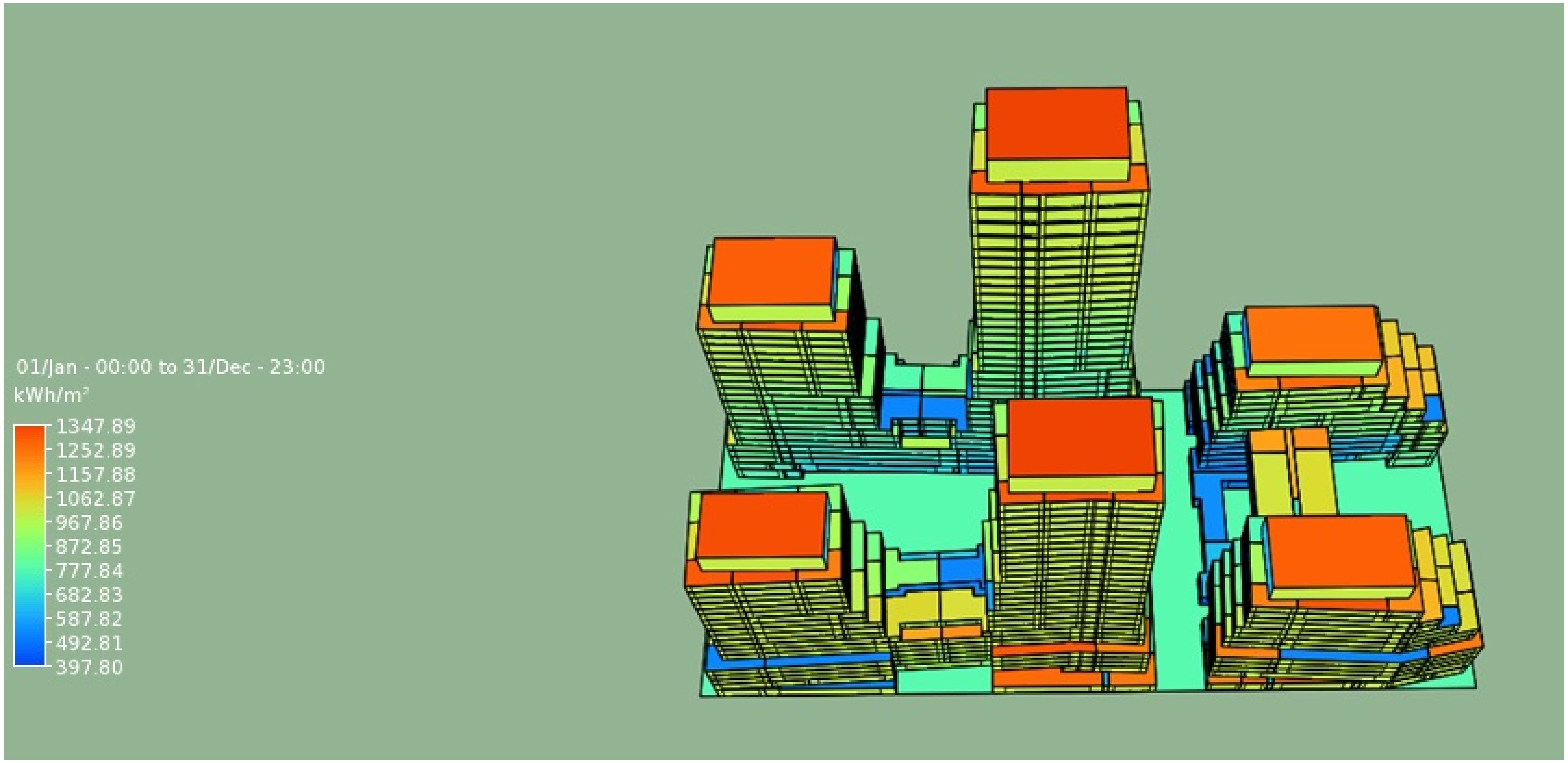


Figure 17: Annual Solar Energy Analysis - View from North

The annual solar generation potential for the site was analyzed considering 90% of the penthouse roof area is covered with solar PV panels, about **26,296 ft²**. Based on the IES VE 2021 analysis, this would generate **575,273 kWh** of electricity annual. This represents approximately **5.7%** of the building's annual energy usage for the 'Approaching Net Zero' scenario. As a reference, to achieve the Canada Green Building Council's Zero-Carbon Building certification as project would have to produce a minimum of 5% of its annual energy use through low-carbon on-site generation.

7.1.1.2 *Ground Source Heat Exchange*

Ground Source Heat Exchange does not provide electricity generation on site but rather an opportunity to connect the building's HVAC to a low-carbon renewable system. Using the ground as a heat source in the heating season and a heat sink during the cooling season would allow for an HVAC system that uses far less energy than a conventional heat pump system. Conventional heat pump systems rely on combustion and electricity to meet the heating/cooling needs to the building and therefore have a greater carbon impact.

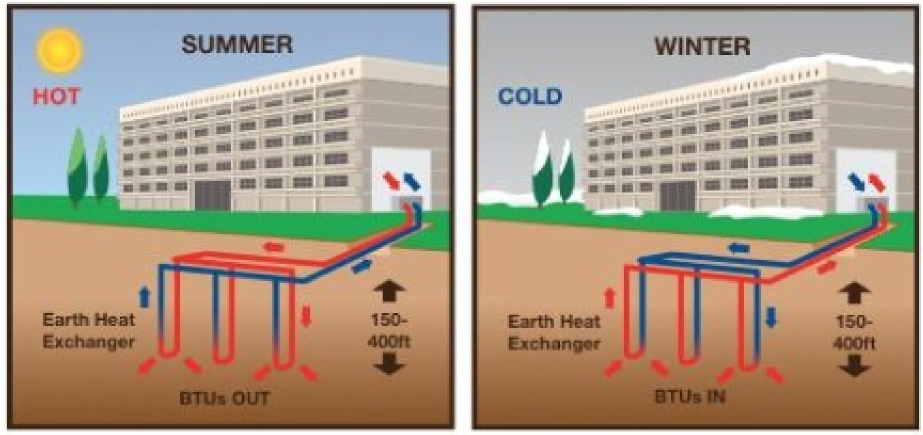


Figure 18: Ground Source Heat Exchanger Illustration (Source: cleantechnica.com)

This system involves drilling deep into the ground (300 ft +) and circulating fluid through the tubes to reject or extract heat from the ground which remains as a relatively constant temperature throughout the year. Further investigation on this system would be required to get approximate the available on-site capacity and the benefit for the project.

An analysis of addition geothermal to the Tier 2 scenarios was conducted. The Total Energy Use Intensity (TEUI) for this scenario is **96 ekWh/m²**. The associated Thermal Energy Demand Intensity (TEDI) is **29 kWh/m²** and the GHGI is **5 ekg/m².**

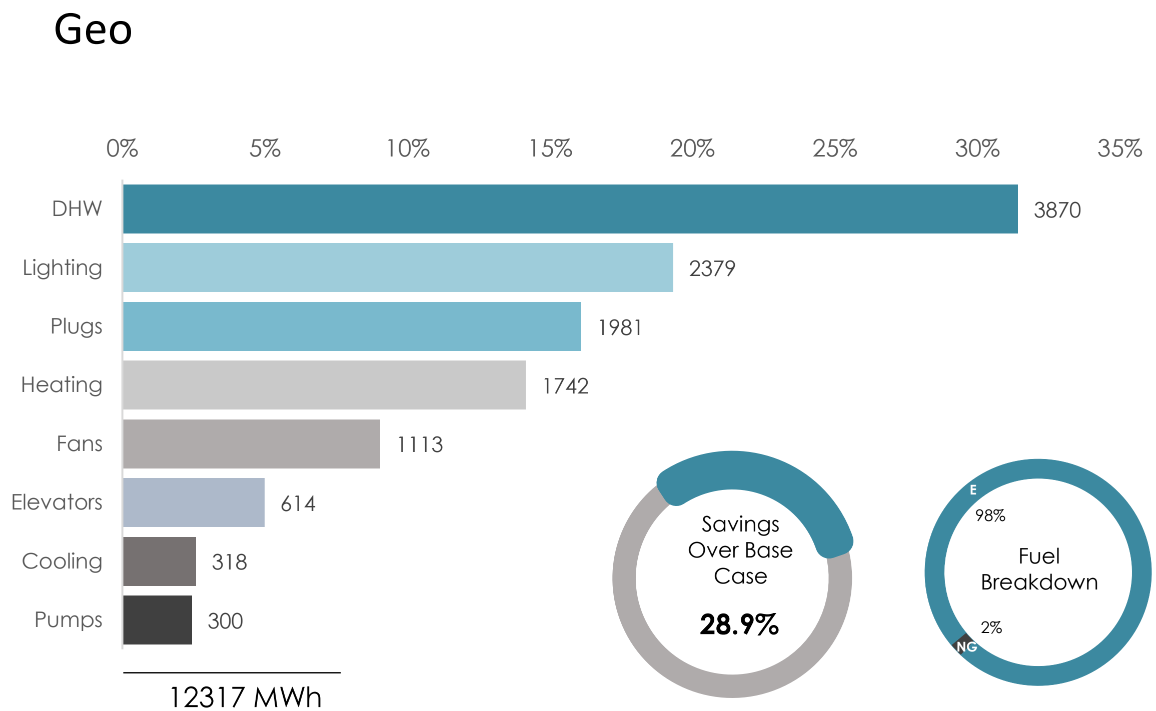


Figure 19: Ground Source Design Scenario Annual Energy Use by End Use

7.1.2 *Off-Site Solutions*

Although on-site solar and energy generation capacity may be limited for the proposed project, off-site solutions can also be considered to achieve net-zero energy and net-zero carbon goals.

If the project were interested in meeting 100% of the annual energy use through solar generation, the total area of solar panels would have to be approximately **460,742 ft²**. The area, compared to the building size, is shown in Figure 20.

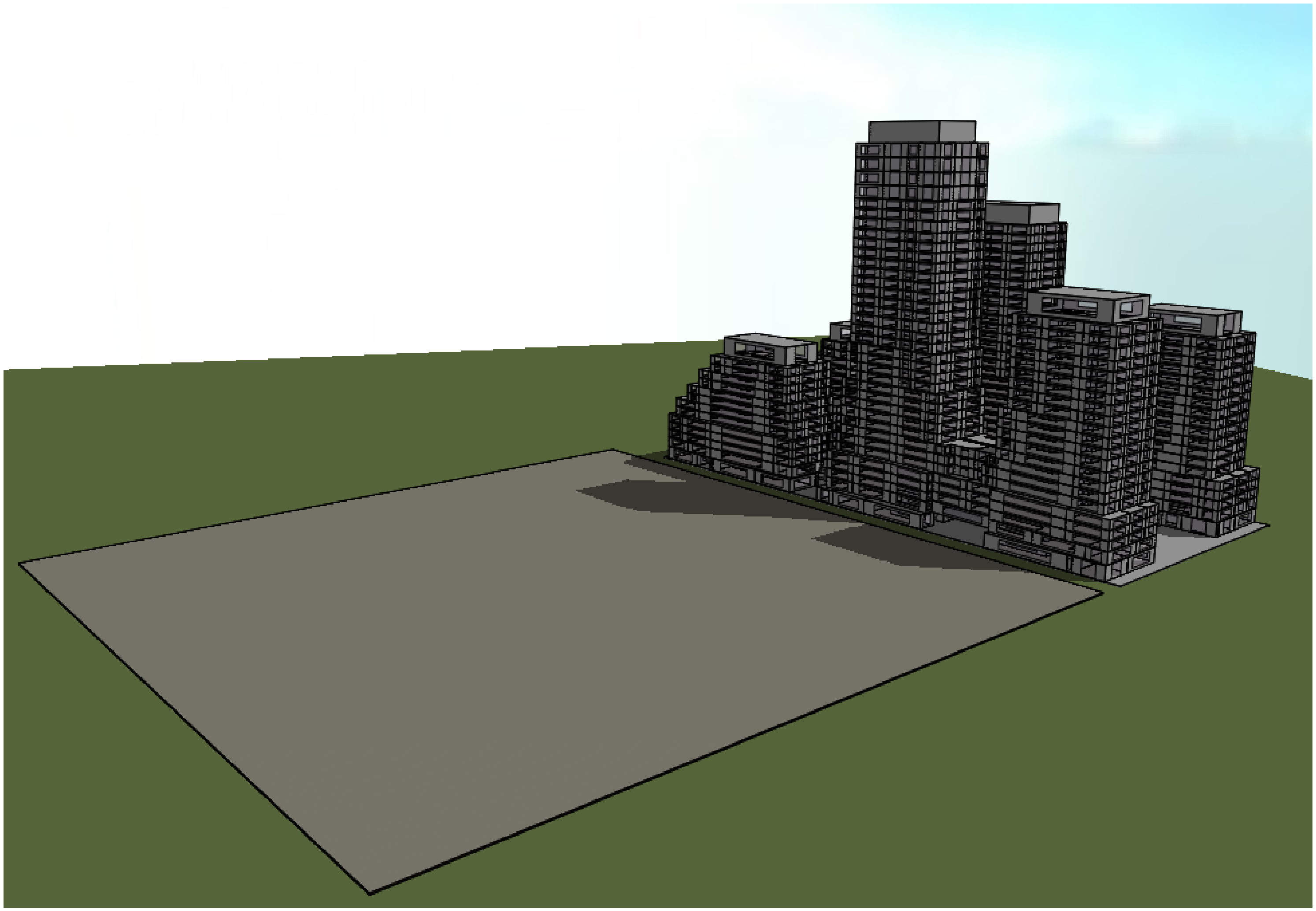


Figure 20: PV for 100% of the Annual Energy Use

8 DISTRICT ENERGY

The City of Toronto has identified district energy systems (DES) as an important opportunity to reduce GHG emissions from new and existing buildings while also reducing the demands on the energy infrastructure. The City seeks to:

- Connect new buildings to DES where it is already established or in the process of development
- Design new buildings to be district energy ready where future DES opportunities exist
- Provide opportunities for existing buildings to connect to future DES

DES is a thermal energy distribution strategy for multiple buildings at a development or neighborhood scale. A DES consists of a heating and/or cooling center, and a thermal network of pipes connecting groups of buildings. The central equipment can include low-carbon technologies such as lake water cooling, ground source heat exchangers (GSHX) and combined heat and power (CHP).

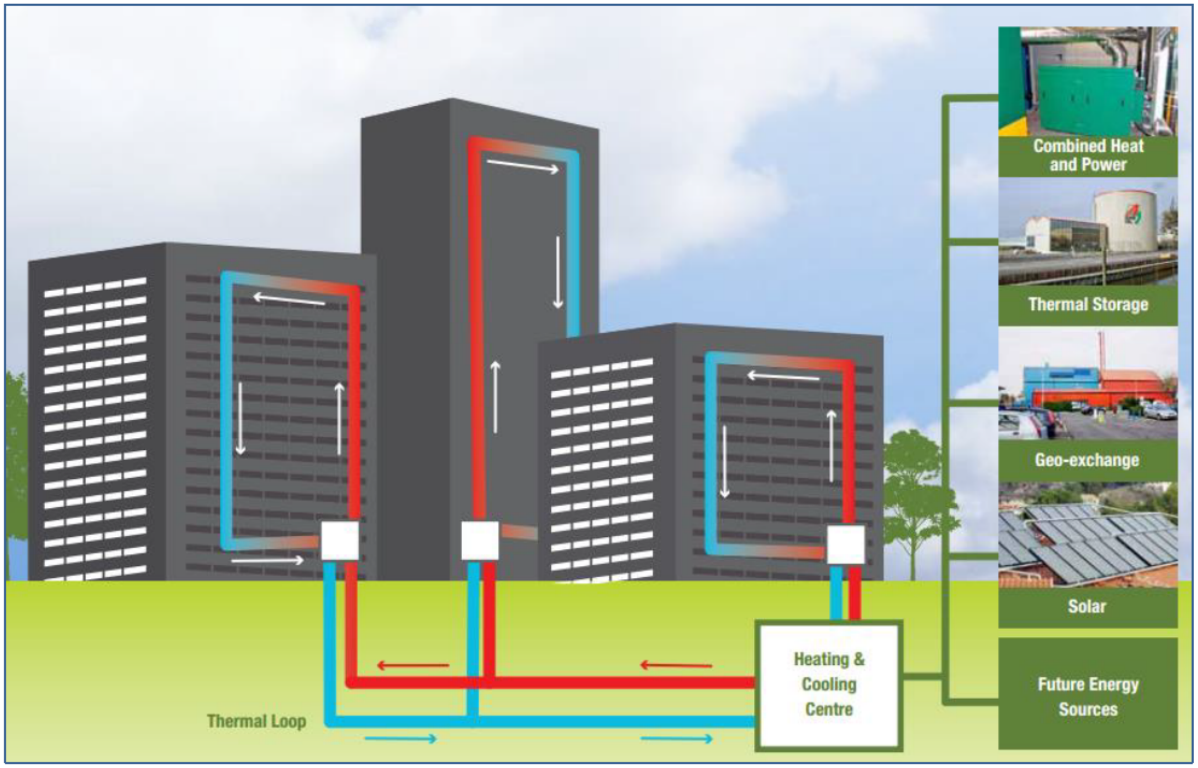


Figure 21: Illustration of DES (DE Ready Guideline, City of Toronto))

District energy systems create the economies of scale and energy sharing opportunities necessary to integrate local, low-carbon sources required to achieve large-scale, cost-effective GHG reductions.

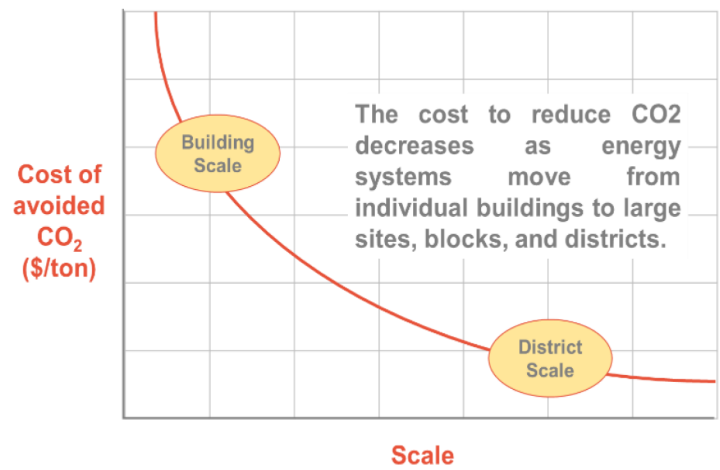


Figure 22: CO2 avoidance cost at building vs. district scale (DE Ready Guide, City of Toronto)

For the purpose of discussion, the following is explored:

To be district energy ready, the following guidelines are presented:

- Provide adequate space required for future equipment and thermal piping
- Design building mechanical systems to be compatible with a future district energy service, including the following features:
  - Hydronic system with large temperature differentials
  - Variable volume flow with variable speed pumps
  - Two-way controls valves on terminal equipment
  - Return water temperature kept to a minimum
- For multi-building developments, design a single, slightly larger mechanical room in one building and connect other buildings through a thermal energy distribution network.

8.1 DES AT 685 WARDEN AVENUE

The size and use mix of the proposed development at 685 Warden Avenue makes the project a good candidate for creating a common central plant for the development, effectively creating a district energy system.

8.1.1 Energy Impact

Centralizing the mechanical equipment may allow for better energy sharing and part load performance than having individual mechanical plants. This is most notable for systems which use a central loop allowing energy sharing such as Water-Loop Heat Pump (WLHP) systems or Water-Source Variable Refrigerant Flow (WS VRF) systems. Additionally, centralizing the plant may allow opportunities for ground source energy to be incorporated on a centralized scale with one bore-hole field being shared by the entire development. These measures have the opportunity to reduce the energy consumption of the central equipment when compared to having individual mechanical plants.

8.1.2 Design Impact

Locating the mechanical equipment in a central location to serve the entire development may have an impact on the use of space which is typically devoted to mechanical equipment such as the mechanical penthouse. Pending necessary approvals, the mechanical penthouse areas may be reallocated to leasable or saleable space, providing a financial incentive for the owner. Additionally, having a common plant may occupy less total area than four or more building mechanical plants. The size and mix use of the proposed development at 685 Warden Avenue makes the project a good candidate for creating a common central plant for the development, effectively creating a district energy system. A central plant will have an impact on the phasing of the project which will need to be carefully considered.

8.1.3 Resources

The City of Toronto has developed a set of guidelines (DESIGN GUIDELINE FOR DISTRICT ENERGY-READY BUILDINGS, October 2016) for building developers and owners, architects, and engineers support the design of buildings that are ready for connection to a district energy system.

A number of companies provide district energy design, construction and financing. These include:

- Creative Energy
- Enwave Energy Corporation
- FVB Energy

685 Warden Avenue can explore the opportunity for a District Energy System for this development by engaging one of these providers for further analysis.

9 RESILIENCY

The City of Toronto has identified improving resiliency as a primary goal and is working to improve its resilience to the physical, social, and economic challenges of the 21st century. The City is working with the global 100 Resilient Cities Network (100RC) and locally the strategy is being led by Toronto's Resiliency Office and Chief Resilience Officer.

100RC defines urban resilience as "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience."

On a building and development level, response to shocks is a priority for addressing resiliency. Toronto's key shocks are identified as:

Urban flooding

Heat waves

Blizzards/cold snap

Interruption to energy supply

Infrastructure failure

Public health emergencies

Cyber attacks

Toronto's condo and apartment towers, housing a large number of the population, are a key part of the overall resilience of the City. Events such as heat waves, ice storms, rain events and resulting power disruptions means that residence may be relying on the passive and adaptive features of their dwelling for long periods of time.

When considering resilience, it is important to take note of our changing climatic conditions and the impacts that climate change will have on future weather patterns. In 2011 the City of Toronto published Toronto's Future Weather and Climate Study. This study predicts a significant increase in the number of high degree heat days, the frequency of heat waves, and the magnitude of rainfall events.

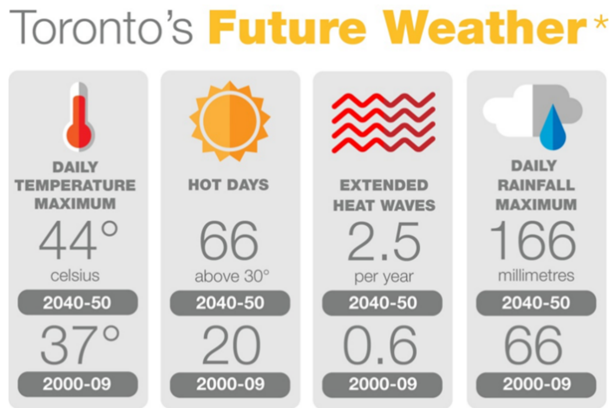


Figure 23: Summary of Toronto's Future Weather and Climate Study

It is not only important to consider resilience measures to meet the energy and stormwater needs of the development under current conditions, but also worthwhile to consider future needs based on forecasted values as a result of climate change. By designing today to meet the predicted needs of the future building owners can safeguard their assets and the individuals who occupy them.

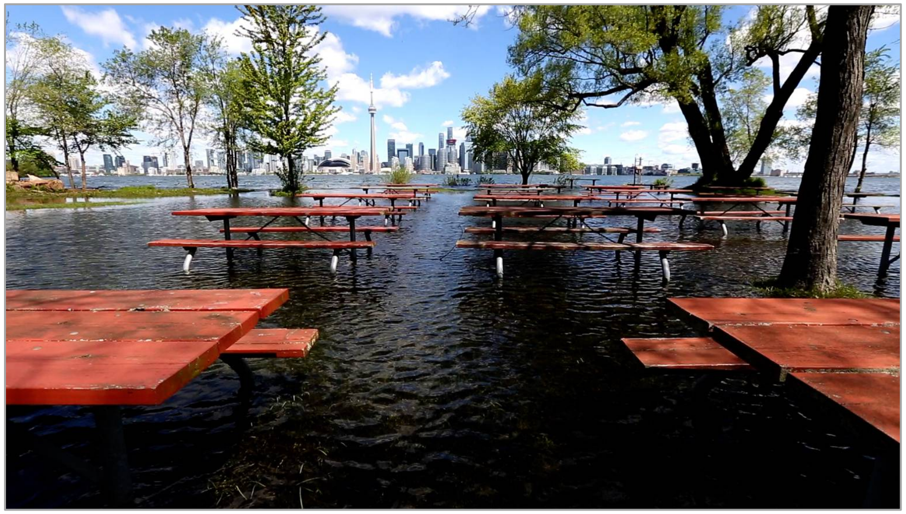


Figure 26: Toronto Island Flooding

A number of design considerations can be taken when designing with resiliency in mind. These include:

- Using future climactic data to inform building design, including weather extremes
- Designing for thermal resiliency by reducing TEDI
- Passive ventilation strategies
- Tenant and occupant emergency preparedness guides
- Indoor refuge areas (heating and/or cooling)
- Ceiling fans
- Shade trees/shrubs
- External pools
- Reduces hardscape
- On-site power including solar PV, solar thermal, battery storage, CHP systems, GSHX, etc.
- Flood proofed electrical, HVAC and back-up generation systems (above 1st floor)

Further design guidelines and considerations can be found in the checklist for Toronto Green Standard v3.0 Resilience Planning New Construction.

10 FUNDING SOURCES

A number of funding options are available for project which are looking to exceed the minimum energy performance standards of the OBC SB-10 and Toronto Green Standard v3.0 Tier 2.

10.1 ENBRIDGE SAVINGS BY DESIGN

Savings by Design is a green building initiative administered by Enbridge Gas Distribution. The program aids builders/developers to design and construct buildings with improved energy performance, with a target of at least a 15% improvement over the current Ontario Building Code. The Savings by Design program provides industry professional design support and financial incentives during design, construction and commissioning stages of a project.

The SBD program is divided into three stages. The first is a visioning session with the project owner to discuss the objectives and goals of the project and establish where additional design consultation may be required. The second stage occurs following the completion of Schematic Design. At this time the SBD program will facilitate a one-day Integrated Design Process (IDP) workshop including design team members, industry design specialist, and energy modelling experts. Outside design specialists will be selected based on the desired outcomes from the visioning session. The costs associated with facilitating the workshop, the attendance of outside design professionals, and the day-of real time energy modelling are all covered by the program. Stage three is the administration of incentive funds directly to the project owner. Funds are approved in two parts, $15,000 for projects who have verified their design meets a 15% improvement over the current Ontario Building Code, and an additional $15,000 for projects who commission their buildings.

10.2 TORONTO GREEN STANDARD V3.0 TIER 2 AND ABOVE

The Toronto Green Standard is the City of Toronto's sustainable design requirement for new private and public developments. The Toronto Green Standard (TGS) is a tiered set of performance measures with supporting guidelines that promote sustainable site and building design. Tier 1 of the TGS is mandatory and Tiers 2 to 4 are higher level voluntary standards that offer financial incentives.

Site Plan Applications submitted on or after May 1, 2018 are required to meet Version 3 of the Toronto Green Standard. Tier 1 performance measures must be met, with compliance being confirmed through the planning approval process. Applications pursuing the voluntary Toronto Green Standard Version 3 Development Charge refund program must achieve at minimum the Tier 2 program requirements in addition to Tier 1. Projects pursuing TGS Tier 2 or higher require post-construction verification.

Under the Toronto Green Standard compliance is addressed through five (5) impact categories:

1. Air Quality
2. Energy Efficiency, GHG & Resilience
3. Water Balance, Quality & Efficiency
4. Ecology
5. Solid Waste

Project pursuing Tier 2 must meet all performance measures in the 'Core' development categories and in addition select three 'Optional' performance measures from any of the categories listed below. Projects that meet the Tier 2 requirements are eligible for the Development Charge Refund program. Development charge rebates are issued in accordance with Development Charges By-law 515-2018: https://www.toronto.ca/legdocs/bylaws/2018/law0515.pdf

Tier 1 compliance is verified through Site Plan Approvals. Tier 2, 3 and 4 are third-party verified, including a construction review, and certified by prequalified consultants. The TGS Tier 2 Core performance measures for TGV v3.0 are the following:

- Urban Heat Island Reduction: At-Grade
- Energy Systems
- Commissioning & Reporting
- Stormwater Retention & Reuse
- Water efficiency
- Light Pollution
- Construction Waste Management

A preliminary calculation for the Development Charge Refund for the 685 Warden Avenue project indicates that the refund would be in the amount of $ 4,187,856 at today's rebate rates.

10.3 CMHC – RENTAL CONSTRUCTION FINANCING INITIATIVE

Another source of funding to be considered is the Canada Mortgage and Housing Corporation's (CMHC) Rental Construction Financing initiative (RCFi). This initiative is available to projects that are either, purpose built residential rental, or of mixed use between residential rental and non-residential, that offer affordable residential rents, accessible units, greater energy efficiency and reduced greenhouse gas emissions.

The CMHC rental construction financing provides low cost funding to eligible borrowers during the riskiest phases of product development such as during construction though to stabilized operations. CHMC mortgage loan insurance is included and provides access to preferred interest rates lowering borrowing costs for the refinancing of multi-unit residential properties and facilitates renewals throughout the life of the mortgage. The program is designed to support sustainable apartment projects in areas where there is a need for additional rental supply. Totaling $13.75 billion in available loans, the initiative is open from 2017 through to the end of 2027.

In order to be eligible, the project must decrease energy use and greenhouse gas emissions 15% below the 2015 National Energy Code for Buildings or the 2015 National Building Code at minimum in addition to fulfilling various affordability and accessibility criteria.

11 CONCLUSIONS AND RECOMMENDATIONS

The project has many opportunities for energy, carbon and energy cost reductions. The current baseline meets the minimum requirements of the Toronto Green Standard Tier 1 however, implementing a number of identified strategies will aid the project in achieving advanced sustainable design goals.

The Toronto Green Standard Tier 2 targets for this project are achievable with additional consideration surrounding improving the building envelope. Higher energy performance goals such as TGS Tier 3+, Net-Zero Energy and Net-Zero Carbon are achievable with further efficiency improvements such as Air Source VRF systems, triple glazing, improved energy recovery and by incorporating off-site energy generation resources.

It is recommended that Tier 2 exploration is considered as the project moves through design factoring in the strategies described in this report and the potential DC Refunds identified.

The project is not located on an identified district energy node. It is recommended to design the project with provisions for future DES readiness should a district energy network extend to the site in the future. It is recommended that the owner engages a district energy and ground source provider to evaluate the opportunity for an island district energy system for this site.

Lastly, resiliency continues to have an ever-increasing influence on development, particularly residential developments. Future weather conditions and extreme climate events present a significant potential risk to property owners and occupants. Safeguarding assets today by designing for resiliency helps mitigate climate change risks, fuel security threats, and infrastructure damage predicted as a result of our changing weather patterns. Designing with resiliency in mind is highly recommended. It is recommended to provide backup power systems for emergency power and life safety requirements for a minimum of 72 hours.

APPENDIX A

Energy Modelling Parameters

Proposed Design Model Characteristics

General

Location	685 Warden Avenue	
Simulation Weather File	Toronto City Centre CWEC 2016	
Climate Zone	Table 1.3.1.1 SB-10 Zone 5	
Modeling Software	IESVE 2021	
Building Area	Modelled Area	125,815 m²
Number of Stories Above Ground	36 stories above ground with 2 stories of underground parking	
Building Type	Mixed-Use (Commercial and Multi Unit Residential)	
	Residential	7 days a week ,24 hours a day (As per NECB 2015 Operating Schedule G)
	Amenity	7 days a week, 123 hours/week (As per NECB 2015 Operating Schedule B)
	Commercial	7 days a week, 94 hours/week (As per NECB 2015 Operating Schedule C)
	(the above and all other schedules as per TGS v3- Energy Efficiency Report Submission & Modelling Guidelines- Revision 1 – October 2020)	

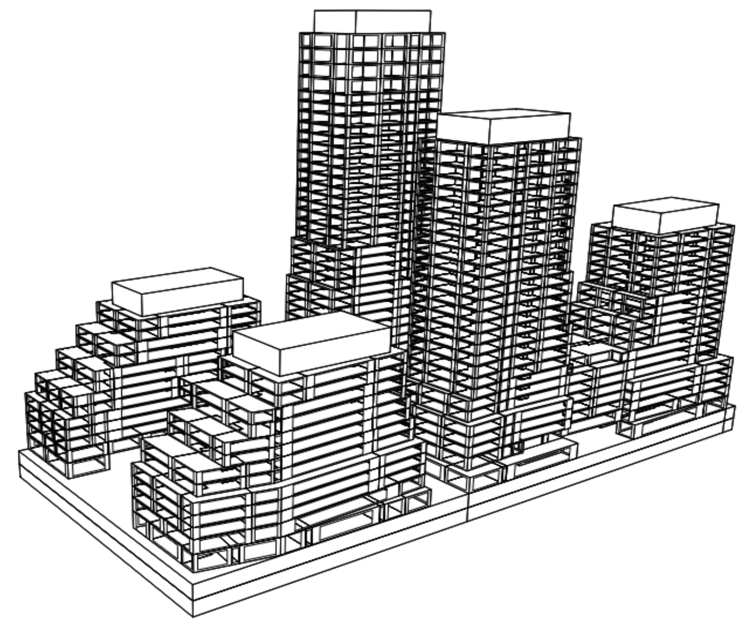


Figure 1: North-East view of 685 Warden Avenue

Envelope Performance

Opaque Envelope

Wall Type	OBC SB-10 Reference		TGS v3.0 Tier 1		TGS v3.0 Tier 2		Approaching Net Zero		Ground Source Heat Exchange	
	Description	**R-IP**	**Description**	**R-IP**	**Description**	**R-IP**	**Description**	**R-IP**	**Description**	**R-IP**
Roof	As per code Insulation entire above deck	R-34.5	Same as code	R-34.5	Same as code	R-34.5	Same as code	R-34.5	Same as code	R-34.5
Vertical Wall	As per code Steel framed	R-20	Targeting overall R-value of 12	R-16	Targeting overall R-value of 20	R-20	Targeting overall R-value of 20	R-20	Targeting overall R-value of 20	R-20
Below Grade Wall	Uninsulated (Unheated Garage)	N/A	Uninsulated (Unheated Garage)	N/A	Uninsulated (Unheated Garage)	N/A	Uninsulated (Unheated Garage)	N/A	Uninsulated (Unheated Garage)	N/A
Floor Above Garage	Mass Floor	R-16.4 ci	Mass Floor	R-16.4 ci	Mass Floor	R-16.4 ci	Mass Floor	R-16.4 ci	Mass Floor	R-16.4 ci

Fenestration

Wall Type	OBC SB-10 Reference			TGS v3.0 Tier 1			TGS v3.0 Tier 2			Approaching Net Zero			Ground Source Heat Exchange		
Aluminium framed Windows	As per code Metal framing: Fixed	**U-IP**	0.38	Double Glazing	**U-IP**	0.33	Double Glazing with Low E Coating in Hybrid Aluminum Frames	**U-IP**	0.28	Triple Glazing with Low E Coating.	**U-IP**	0.22	Double Glazing with Low E Coating in Hybrid Aluminum Frames	**U-IP**	0.28
		SHGC	0.40		**SHGC**	0.40		**SHGC**	0.40		**SHGC**	0.30		**SHGC**	0.40
Percentage Glazing	40%			60%			40%			30%			40%		
Infiltration	(0.05 cfm/ft2) of total above grade envelope surface area (roofs, exterior walls, and windows, exposed floors), flow varied with windspeed as per PNNL-18898 guideline			(0.05 cfm/ft2) of total above grade envelope surface area (roofs, exterior walls, and windows, exposed floors), flow varied with windspeed as per PNNL-18898 guideline			25% better than code			50% better than code			25% better than code		

Mechanical Systems															
	OBC SB-10 Reference			TGS v3.0 Tier 1			TGS v3.0 Tier 2			Approaching Net Zero			Ground Source Heat Exchange		
System Description	**System 6 - Water-Source Heat Pump (WLHP)**	Serving	Residential suites, amenity and retail	**Water Loop Heat Pumps (WLHP)**	Serving	Residential suites, amenity and retail	**Variable Refrigerant Flow Unit (VRF)**	Serving	Residential suites, amenity and retail	**Variable Refrigerant Flow Unit (VRF)**	Serving	Residential suites, amenity and retail	**Ground Source and Water Loop Heat Pumps (GSHP & WLHP)**	Serving	Residential suites, amenity and retail
		Description	Distributed water-loop heat pump with condenser loop which is served by boilers and fluid cooler. Ventillation provided in-suite ERVs.		Description	Distributed water-loop heat pump with condenser loop which is served by condensing boilers and fluid cooler. Ventillation provided in-suite ERVs.		Description	Air Source (Variable Refrigerant Flow)VRF Systems. Ventillation provided in-suite ERVs.		Description	Air Source (Variable Refrigerant Flow)VRF Systems. Ventillation provided in-suite ERVs.		Description	Water Course VRF connected to a central condenser loop which is served by a ground-source heat exchanger.
		Efficiency	Heat Pumps: 12.2 EER for cooling COP 4.2 for heating ERVs: 55% sensible/55% latent No ERVs for emenity and retail		Efficiency	Heat Pumps: 16 EER for cooling COP 5 for heating ERVs: 73% sensible/60% latent		Efficiency	Heating COP: 4.2 Cooling COP: 4.4 ERV: 73% sensible/60% latent		Efficiency	Heating COP: 4.2 Cooling COP: 4.4 Fresh Air from Central ERV with 80% effectiveness.		Efficiency	Heating COP: 5.1 Cooling COP: 5.5 ERV: 73% sensible/60% latent
		Fan Power	As per ASHRAE 90.1-2013		Fan Power	40 W/ERV; 1 unit per suite 0.2 W/cfm serving VRF units (EC motors on fans)		Fan Power	40 W/ERV; 1 unit per suite 0.2 W/cfm serving VRF units (EC motors on fans)		Fan Power	0.2 W/cfm serving VRF units (EC motors on fans)		Fan Power	40 W/ERV; 1 unit per suite 0.2 W/cfm serving VRF units (EC motors on fans)
System Description (continued)	**System 11 - Packaged Rooftop Air Conditioner**	Serving	Corridors	**Make-Up Air Unit (MUA)**	Serving	Corridors	**Make-Up Air Unit (MUA)**	Serving	Corridors	**Make-Up Air Unit (MUA)**	Serving	Corridors	**Make-Up Air Unit (MUA)**	Serving	Corridors
		Description	DX Cooling Coil and Furnace Heating		Description	DX Cooling Coil and Hydronic Heating from condensing boiler		Description	Air Source HP		Description	Central ERV supplying		Description	Air Source HP
		Efficiency	80% furnace EER 9.8		Efficiency	90% furnace EER 11		Efficiency	ASHP with COP of 4.2 at rating condition.		Efficiency	ASHP with COP of 4.2 at rating condition.		Efficiency	ASHP with COP of 4.2 at rating condition.
		Fan Power	Supply fan power as per code		Fan Power	0.7 W/cfm		Fan Power	0.7 W/cfm main supply fan with VFD.		Fan Power	0.7 W/cfm main supply fan with VFD.		Fan Power	0.7 W/cfm main supply fan.
	System 11 - Packaged Rooftop Air Conditioner	Serving	Storage and M&E rooms	**Hydronic Unit Heater (UH)**	Serving	Storage and M&E rooms	**Electronic Unit Heater (UH)**	Serving	Storage and M&E rooms	**Electronic Unit Heater (UH)**	Serving	Storage and M&E rooms	**Hydronic Unit Heater (UH)**	Serving	Storage and M&E rooms
		Description	Gas fired at 80%		Description	Gas fired at 80%		Description	Equipped with electric resistance coil		Description	Equipped with electric resistance coil		Description	Equipped with hot water coil
		Fan Power	As per code		Fan Power	0.3 W/cfm		Fan Power	0.3 W/cfm		Fan Power	0.3 W/cfm		Fan Power	0.3 W/cfm

Fan Control	Office, Amenity and Commercial	Runs as per corresponding HVAC schedule
	Common Spaces	Ventilation fans run continuously with nightime set-back during the night
	Residential suites	Zone level fan and ERV fans run together
	Parkade	Runs 4 hours per day
	Commercial	1,219 cfm, Demand Control Ventillation for Tier 2 +
	Amenity Spaces	17,513 cfm, Demand Control Ventillation for Tier 2 +
	Residential Suites	50 cfm/suite continuous with 100cfm boost 2hrs/day
	Common Spaces	OBC: 76,900,140 cfm (50 cfm/door) Tier 1: 76,900,140 cfm (50 cfm/door) ramping down to 50% between 10 pm and 8 am Tier 2+1: 46,140 cfm (30 cfm/door)ramping down to 50% between 10 pm and 8 am Approching Net Zero: corridor OA at ASHRAE 62.1 2016 levels

	Space Type	**Heating (deg. F)**		**Cooling (deg. F)**	
		Occupied	Unoccupied	Occupied	Unoccupied
Indoor Design Temperature	Office	71.6	64.4	75.2	99
	Common Spaces	71.6	64.4	75.2	75.2
	Commercial	71.6	64.4	75.2	99
	Residential Suites	71.6	64.4	75.2	75.2
	Storage and M&E Rooms	55	55	55	55
	Parkade	NA	NA	NA	NA
Heating/Cooling Supply Air Temperature	Heating	90°F			
	Cooling	55°F			

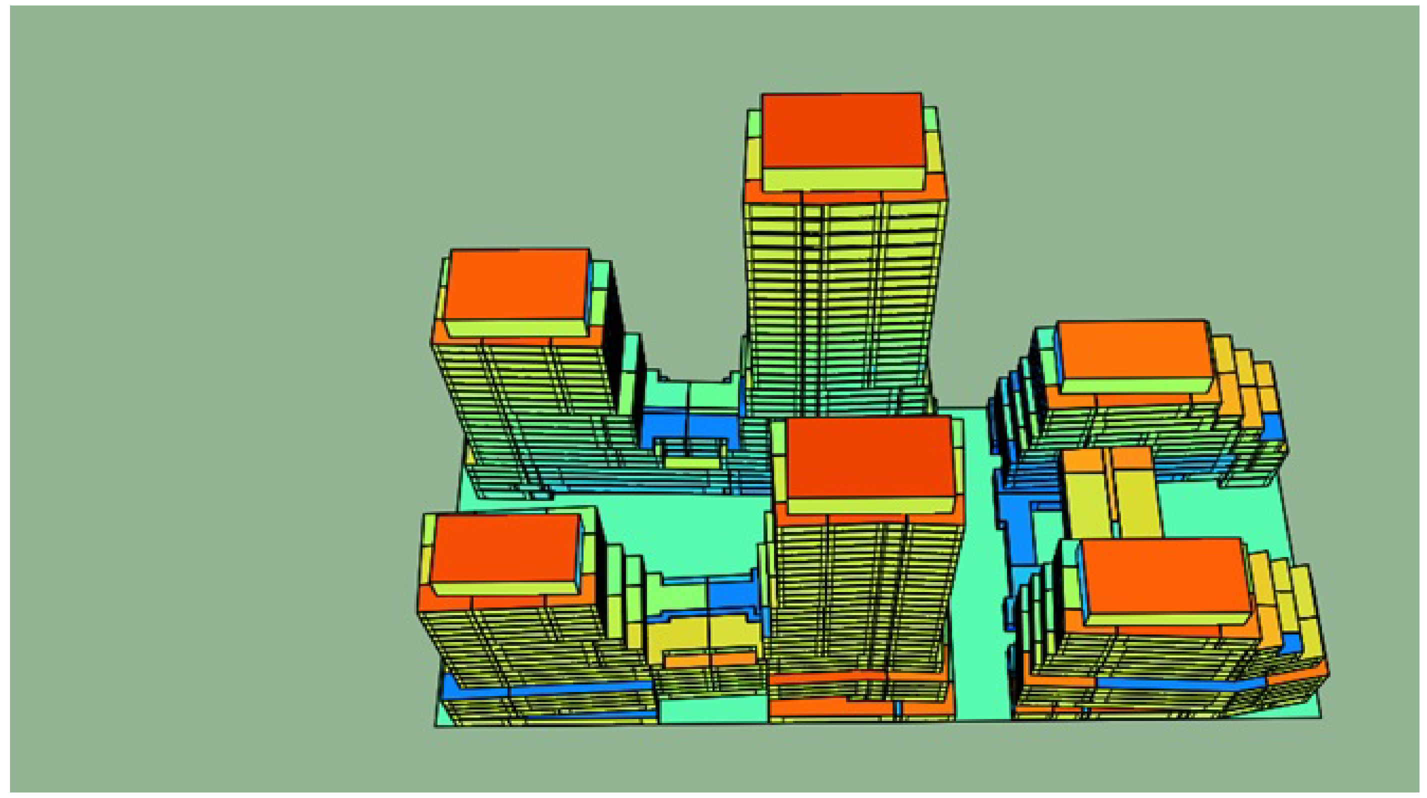


Figure 2: Solar Energy Visualization

Central Plant

Hot Water Loop	**OBC SB-10 Reference**		**TGS v3.0 Tier 1**		**TGS v3.0 Tier 2**		**Approaching Net Zero**		**Ground Source Heat Exchange**	
Heat Transfer Loop Water Loop	Description	2 Natural Gas Fired Boilers Fluid Cooler	Description	2 Natural Gas Fired Boilers Fluid Cooler	Description	NA	Description	NA	Description	NA
	Efficiency	90% boiler Fluid Cooler as per ASHRAE 90.1 2013	Efficiency	96% boiler Fluid Cooler as per ASHRAE 90.1 2013 VSD pumps and fans	Efficiency		Efficiency		Efficiency	NA
Ground Source Heat Transfer Loop	Description	NA	Description	NA	Description	NA	Description	NA	Description	Ground Source Heat Exhanger Size for 60% of peak heating load Gas Condensing Boilers Fluid Cooler
	Efficiency		Efficiency		Efficiency		Efficiency		Efficiency	96% boiler Fluid Cooler as per ASHRAE 90.1 2013 VSD pump
Domestic Hot Water	DHW Heater	Gas-fired DHW heaters; 80% efficient	DHW Heater	Gas-fired condensing DHW heaters; 96% efficient	DHW Heater	Electric DHW heaters	DHW Heater	ASHP DHW Heaters	DHW Heater	Electric DHW heater
	Fixture Type	As per NECB	Fixture Type	Low Flow	Fixture Type	Low Flow	Fixture Type	Low Flow	Fixture Type	Low Flow
	Lavatory Faucet	8.35 LPM	Lavatory Faucet	4.56 LPM	Lavatory Faucet	4.56 LPM	Lavatory Faucet	4.56 LPM	Lavatory Faucet	4.56 LPM
	Showerhead	7.60 LPM	Showerhead	5.70 LPM	Showerhead	5.70 LPM	Showerhead	5.70 LPM	Showerhead	5.70 LPM
	Kitchen Faucet	8.35 LPM	Kitchen Faucet	5.70 LPM	Kitchen Faucet	4.56 LPM	Kitchen Faucet	4.56 LPM	Kitchen Faucet	5.70 LPM

Internal Loads							
Lighting Power Density (LPD)	Space Type		OBC SB-10 Reference LPD W/m^2	TGS v3.0 Tier 1 LPD W/m^2	TGS v3.0 Tier 2 LPD W/m^2	Approaching Net Zero LPD W/m^2	Ground Source Heat Exchange LPD W/m^2
	Common Spaces (including corridors, lobbies, stairwells, public washrooms etc.)		7.3 W/m^2	4 W/m^2 20% better than baseline	4 W/m^2 20% better than baseline	4 W/m^2 20% better than baseline	4 W/m^2 20% better than baseline
	Residential Suites		5 W/m^2	5 W/m^2	5 W/m^2	5 W/m^2	5 W/m^2
	Amenity Spaces		11.5 W/m^2	9.2 W/m^2 20% better than baseline	9.2 W/m^2 20% better than baseline	9.2 W/m^2 20% better than baseline	9.2 W/m^2 20% better than baseline
	Retail/ Commercial Spaces		13.1 W/m^2	10.5 W/m^2 20% better than baseline	10.5 W/m^2 20% better than baseline	10.5 W/m^2 20% better than baseline	10.5 W/m^2 20% better than baseline
	Parking		1.5 W/m^2	1.5 W/m^2	1.5 W/m^2	1.5 W/m^2	1.5 W/m^2
Lighting Controls	Same as ASHRAE 90.1-2013 Table 9.6.1						
External Lighting	Peak Watts	5 kW					
	Schedule	Photocell control					
Process Loads	Suites	OBC: 5 W/m^2 Tier 1+: 4.5 W/m2 Energy Star Appliances Approaching Net Zero Option: 4.1 W/m2 including Energy STAR appliances and ventless heat pump dryers					
	Other Space Types	As per NECB Space type internal load (Table A-8.4.3.2. (2)-B)					
	Elevators	3 per building with 18.5 kW/motor on elevator schedule (As per BC Hydro modelling guide)					
	Parkade Exhaust	0.75 cfm per ft; 0.3 W/cfm					
Occupancy	NECB Defaults for space type						