Energy Strategy Report: Bloor & Dundas, Toronto, ON

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EXECUTIVE SUMMARY

The Proposed Development at 2280 Dundas St W includes 7 new construction buildings totaling approximately 1,696,844 gross ft² (157,642 square meters). The proposal includes 1,923 new residential units in buildings ranging from 5 to 38 stories. The proposal is mixed use containing ground floor retail, commercial office space, below ground parking, and open park space. The project currently aims to meet Toronto Green Standard (TGS) Version 4 Tier 1 as a minimum performance goal, but the developer, Choice Properties Limited Partnership (Choice), will endeavor to explore opportunity to meet higher performance goals. Choice has secured Steven Winter Associates (SWA) to complete an Energy Strategy Report of the proposed development at Bloor & Dundas to explore the viability of the Toronto Green Standard Version 4 Tier 1, 2, and 3, complete an assessment of embodied carbon, identify opportunities to improve climate resiliency, and provide recommendations for meeting higher tiers of the Toronto Green Standard.

SWA has evaluated the site energy use intensity (EUI), thermal energy demand intensity (TEDI), and greenhouse gas intensity (GHGI) associated with TGS Version 4 Tier 1, 2, and 3. For each tier predictive energy modeling has been completed, building system and performance upgrades have been identified, and capital cost premiums with net operating costs were calculated. The following table outlines the major findings of the energy modeling effort.

Table 1. Predicted EUI, TEDI, GHGI, Capital Cost, and Operating Cost for TGS Tier 1, 2, & 3.

	TGS V4 Tier 1	TGS V4 Tier 2	TGS V4 Tier 3
Total Energy Use Intensity (kWh/m²)	102.0 - 128.6	78.8 – 96.7	52.5 - 72.6
Thermal Energy Demand Intensity (kWh/m²)	31.3 - 40.7	24.3 - 30.0	5.7 - 8.6
Greenhouse Gas Intensity ($kgCO_2/m^2$)	9.6 - 13.1	4.8 - 8.7	1.6 - 2.2
Capital Cost ($/ m²)*	$4,304	$4,389	$4,492
Capital Cost Premium (%)*	-	2%	4.4%
Operating Cost ($/ m²) 30-year life cycle	$214	$195	$172

*The estimated capital cost premiums are based on available data today, and are subject to change from construction price escalation.

As part of this study SWA has evaluated the development charge refunds available if the project were to pursue TGS Tier 2 or higher. SWA estimates that the project could be eligible for an estimated **$6,275,419** in development charge refunds based on the current Toronto Green Standard Program guidelines and Schedule C TO CH.415 ART I Development Charges Table, Tier 2, 3 and 4 CAP (effective November 1, 2021). This schedule and the Toronto Green Standard Version 4 program guidelines are subject to change. If the project team chooses to pursue Toronto Green Standard Tier 2 or higher the partial development charge refunds will help offset the additional capital costs associated with building design upgrades.

Embodied carbon for the proposed development was also assessed using the Canadian Green Building Council's Embodied Carbon Reporting Template. The results indicate that the development as currently designed includes 120,452,593 kgCO²eq of embodied carbon; however, this report identifies opportunities to reduce embodied carbon to 78,166,155 kgCO²eq, a reduction of 42,286,438 kgCO²eq or a 35% reduction in embodied carbon.

This report also evaluates the application of advanced design measures and technologies such as district energy systems (DES), solar photovoltaics & batteries, combined heat and power, ground source geo-exchange, and heat pumps. This project does not have the opportunity to connect to an existing district energy system, but the project is of an appropriate scale to consider an on-site high temperature or low/ambient temperature DES. Both DES technologies, and their applications are discussed in the body of this report. Further, Passive Design Strategies in combination with Back-up Power Technologies such as solar photovoltaics & batteries, and combined heat and power have also been assessed to improve and promote Climate Resiliency. Section 3 of this report outlines the strategies and technologies that can be deployed at Bloor and Dundas to promote Climate Resiliency.

Please refer to the following body of this report for further discussion of these analyses.

ABOUT STEVEN WINTER ASSOCIATES

Steven Winter Associate's (SWA) core business includes sustainability, energy efficiency, and accessibility consulting. With 50 years of experience in building science research, SWA has applied and tested energy efficiency strategies in various modeling software and confirmed energy performance in existing buildings. SWA has modeled and analyzed hundreds of millions of square feet of commercial, residential, and institutional space in energy modeling programs such as eQuest, OpenStudio and EnergyPlus. We also use system specific software such as THERM and WUFI to evaluate envelope systems, and have one of the largest portfolios of large Passive House buildings. Our background in research, coupled with our hands-on building science credentials, allows SWA to provide unique insight for the project team to leverage for energy efficient and cost-effective design solutions.

ENERGY MODELING

The predictive energy modeling developed for this report aligns with the Toronto Green Standard Energy Modeling Guidelines; however, As-built actual energy use after construction may vary from the predicted energy use cited in this report due to annual changes in weather, building occupancy patterns, as well as operation and maintenance practices.

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INTRODUCTION

The Proposed Development includes 7 new construction buildings totaling approximately 1,696,844 gross ft² (157,642 square meters). The proposal includes 1,923 new residential units in buildings ranging from 5 to 38 stories, please refer to table 2 below. The mixed use project includes ground floor retail, commercial office space, below ground parking, and open park space – please refer to the site plan in Figure 1 below

Table 2 – Bloor and Dundas site planning building matrix

Building	Gross Area m²	Residential Units
Building 1	42,618	557
Building 2	29,583	410
Building 3	31,155	220
Building 4	23,198	338
Building 5	13,641	177
Building 6	5,655	80
Building 7	11,792	141
Total	**157,642**	**1,923**

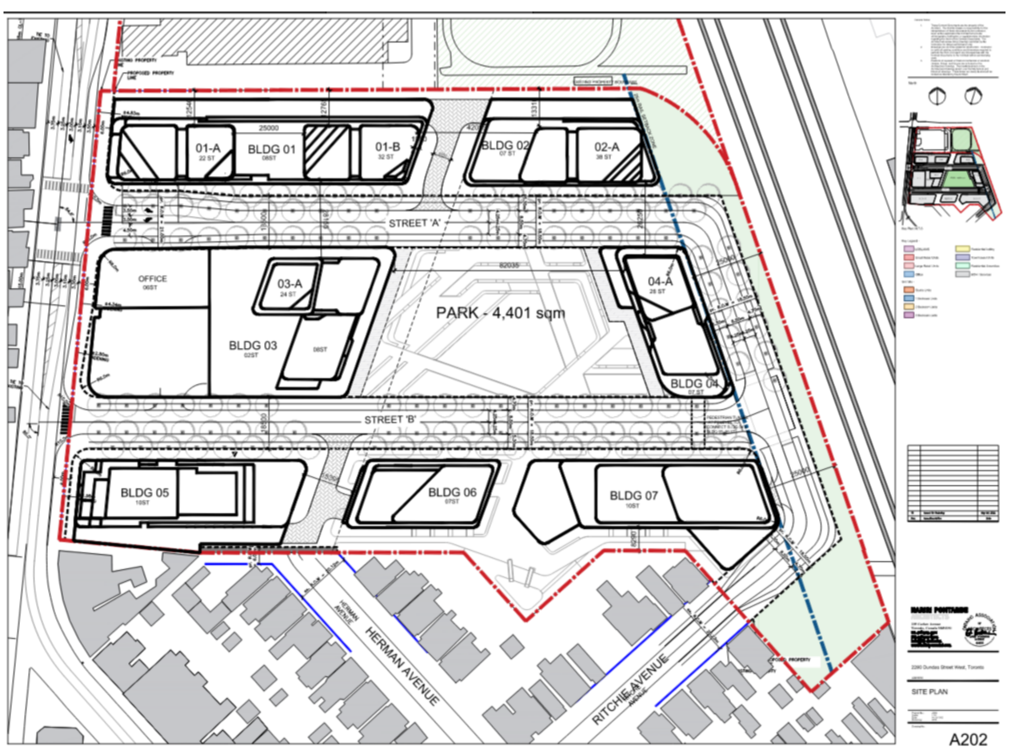

Figure 1. Bloor & Dundas project site plan diagram.

NET ZERO OPERATIONAL EMISSIONS

For each of the seven buildings in the development, SWA has prepared a simple box energy simulation to explore feasibility of TGS v4 Tier 1, Tier 2, and Tier 3 performance in terms of total energy use intensity (TEUI), thermal energy demand intensity (TEDI), and greenhouse gas intensity (GHGI). In collaboration with the design team, SWA has identified opportunities to reduce building TEDI, GHGI, and TEUI through passive design strategies as well as high efficiency space conditioning and service water heater equipment. Three design packages, outlined in the Table below, were evaluated. Energy simulation results show that these packages would result in Tier 1, Tier 2, and Tier 3 compliance, respectively, for each metric.

The simple box analyses were performed with eQuest v3.65 energy simulation software. eQUEST is fully-featured dynamic simulation tool for computing the various energy flows in a building during a typical meteorological year. The software produces whole-building, hourly energy simulation results and allows for parametric evaluation of Energy Conservation Measures (ECMs).

Table 3. Energy Modeling Inputs and ECMs for Tier 1, 2, & 3.

Component	Energy Modeling Input		
	Tier 1	**Tier 2**	**Tier 3**
Heating & Cooling	Water Source Heat Pumps Cooling Efficiency: 12.5 EER Heating Efficiency: 4.0 COP Supply Fan power: 0.42 W/CFM Plant Equipment: Condensing Boiler, 95% Et Cooling Tower with Two Speed Fan	Variable Refrigerant Flow Heat Pumps Cooling Efficiency: 13.6 EER Heating Efficiency: 3.2 COP Supply Fan power: 0.42 W/CFM	Geothermal with Water Sourced VRFs Cooling Efficiency: 12.5 EER Heating Efficiency: 4 COP Supply Fan power: 0.42 W/CFM
Ventilation	Individual ERVs 60% efficiency OA Flow rates modeled per ASHRAE 62.1	Individual ERVs 75% efficiency OA Flow rates modeled per ASHRAE 62.1	Individual ERVs 84% efficiency OA Flow rates modeled per ASHRAE 62.1
Envelope: Roof	R-30 c.i.	R-30 c.i.	R-50 c.i.
Envelope: Opaque Wall	Steel-Frame with Continuous Exterior & Cavity Insulation	Steel-Frame with Continuous Exterior & Cavity Insulation	Steel-Frame with Continuous Exterior & Cavity Insulation

	Average U-0.052-0.057	Average U-0.052-0.057	U-0.030
Envelope: Fenestration	40% Window-to-Wall Ratio Punched Windows Metal Framing, Double Pane: U-0.30 / SHGC-0.30 No external shading devices	30% Window-to-Wall Ratio Punched Windows Metal Framing, Double Pane: U-0.30 / SHGC-0.30 No external shading devices	30% Window-to-Wall Ratio Punched Windows Metal Framing, Triple Pane: U-0.14 / SHGC-0.30 No external shading devices
Envelope: Balconies	30% units with balconies 10 LF / Balcony Typical	30% units with balconies 10 LF / Balcony Typical	0% units with balconies 10 LF / Balcony Typical
Low Flow Plumbing Fixtures	Bathroom: 1.0 gpm Kitchen: 1.5 gpm Showerhead: 2.0 gpm	Bathroom: 1.0 gpm Kitchen: 1.5 gpm Showerhead: 2.0 gpm	Bathroom: 1.0 gpm Kitchen: 1.5 gpm Showerhead: 2.0 gpm
DHW System	Central Gas Storage, 80% Et	Central Gas Storage, 96% Et	Water to Water Heat Pump, 2.5 COP
Plug Loads	ENERGY STAR refrigerators, dishwashers, and in-unit laundry Electric Stoves and Dryers	ENERGY STAR refrigerators, dishwashers, and in-unit laundry Electric Stoves and Dryers	ENERGY STAR refrigerators, dishwashers, and in-unit laundry Electric Stoves and Dryers
Interior Lighting	Residential: 4.95 W/SM (0.46 W/SF) Offices: 10.6 W/SM (0.98 W/SF) Retail: 15.5 W/SM (1.44 W/SF) Garage: 2.1 W/SM (0.20 W/SF)	Residential: 3.44 W/SM (0.32 W/SF) Offices: 8.4 W/SM (0.78 W/SF) Retail: 7.4 W/SM (0.69 W/SF) Garage: 1.5 W/SM (0.14 W/SF)	Residential: 3.44 W/SM (0.32 W/SF) Offices: 8.4 W/SM (0.78 W/SF) Retail: 7.4 W/SM (0.69 W/SF) Garage: 1.5 W/SM (0.14 W/SF)
Garage Exhaust	Demand controlled	Demand controlled	Demand controlled
Infiltration	0.4 cfm/ sf @ 75PA	0.16 cfm/ sf @ 75PA	0.08 cfm/ sf @ 75PA
Setpoints	Heating: 22°C/18°C Setback Cooling: 24°C	Heating: 22°C/18°C Setback Cooling: 24°C	Heating: 22°C/18°C Setback Cooling: 24°C

Schedules	Occupancy, Plug Load, Lighting, Heating, and Cooling Schedules per TGS v4 Energy Modeling Guidelines	Occupancy, Plug Load, Lighting, Heating, and Cooling Schedules per TGS v4 Energy Modeling Guidelines	Occupancy, Plug Load, Lighting, Heating, and Cooling Schedules per TGS v4 Energy Modeling Guidelines
Shading	No external shading devices	No external shading devices	No external shading devices

TEUI AND TEDI REDUCTION EVALUATION

For High Rise Multifamily Residential Buildings and Mixed-Use Buildings, TEDI and TEUI targets are defined by the Toronto Green Standard Version 4 as outlined below.

Table 4. TEDI and TEUI targets as defined by the Toronto Green Standard Version 4.

Type	Scenario	Annual Targets	
		EUI (kwh/m^2)	TEDI (kWh/m^2)
High Rise Multi Unit Residential Building	TGS v4 T1	135	50
	TGS v4 T2	100	30
	TGS v4 T3	75	15
Mixed-Use	TGS v4 T1	132	43
	TGS v4 T2	99	27
	TGS v4 T3	71	15

TEDI and TEUI reduction opportunities were considered and evaluated for each building. SWA explored options for high performance enclosure design, infiltration reduction, plug load and lighting power reduction, heat pump service water heating, ground source heating and cooling, and improved ventilation efficiency.

Detailed energy analysis results are indicated the tables below. These projections correspond to design conditions indicated in the Energy Modeling Inputs Table above.

Table 5. Modeled TEDI for buildings 1 to 7.

Thermal Energy Demand Intensity (TEDI), kwh/m^2				
	Tier1	Tier2	Tier3	Result
Target, HR MURB, kwh/m2	50	30	15	
Target, Mixed-Use, kwh/m2	43	27	15	
Building 1	34.8	27.9	9.2	Complies
Building 2	31.3	26.8	8.6	Complies

Building 3	35.1	27.8	7.4	Complies
Building 4	34.0	24.3	5.7	Complies
Building 5	33.4	26.8	8.0	Complies
Building 6	40.7	30.0	8.6	Complies
Building 7	35.6	27.3	8.0	Complies

Table 6. Modeled EUI for buildings 1 to 7.

Total Energy Use Intensity (TEUI), kwh/m²				
	Tier1	Tier2	Tier3	Result
Target, HR MURB, kwh/m2	135	100	75	
Target, Mixed-Use, kwh/m2	132	99	71	
Building 1	102.0	78.8	52.5	Complies
Building 2	124.2	93.6	55.3	Complies
Building 3	126.5	95.4	72.6	Complies
Building 4	128.6	96.7	65.9	Complies
Building 5	121.4	93.4	66.2	Complies
Building 6	124.2	89.4	69.9	Complies
Building 7	123.7	94.8	64.2	Complies

GHGI REDUCTION EVALUATION

For High Rise Multifamily Residential Buildings and Mixed-Use Buildings, GHGI targets are defined by the Toronto Green Standard Version 4 as outlined below.

Table 7. GHGI targets as defined by the Toronto Green Standard Version 4.

Type	Scenario	Annual Targets
		GHG ($kgCO^2$ e/m^2)
High Rise Multi Unit Residential Building	TGS v4 T1	15
	TGS v4 T2	10
	TGS v4 T3	5
Mixed-Use	TGS v4 T1	14
	TGS v4 T2	9
	TGS v4 T3	4

GHG reduction opportunities were considered and evaluated for each building. In addition to passive design opportunities to lower carbon intensity, SWA explored all-electric, highly efficient heating and cooling systems, heat pump water heaters, electric in-unit appliances, and unit-by-unit energy recovery ventilation.

Detailed energy analysis results are indicated the table below. These projections correspond to design conditions indicated in the Energy Modeling Inputs Table above

Table 8. Modeled GHGI for buildings 1 to 7.

Green House Gas Intensity (GHGI), kgCO^2 e/m^2				
	Tier1	Tier2	Tier3	Result
Target, HR MURB, kgCO^2 e/m^2	15	10	5	
Target, Mixed-Use, kgCO^2 e/m^2	14	9	4	
Building 1	9.6	4.8	1.6	Complies
Building 2	12.6	7.7	1.7	Complies
Building 3	10.4	5.4	2.2	Complies
Building 4	13.1	8.7	2	Complies
Building 5	11.8	7.8	2	Complies
Building 6	11.7	6.4	2.1	Complies
Building 7	11.9	7.5	1.9	Complies

DISTRICT ENERGY SYSTEMS EVALUATION

Applicants proposing a total gross floor area of 100,000 square meters or more are required to evaluate the development of an on-site district energy system (DES). The Proposed Development contains 161,848 gross square meters across 7 new buildings. As such, the evaluation of a DES is required to be included in the Energy Strategy Report.

DES has been identified as a key component of Toronto's climate action plan, helping reduce emissions from buildings and reach the goal of net zero by 2040. DES are designed to distribute thermal energy at the site and neighborhood scale, and can service the heating and cooling needs of multiple buildings in a development. DES can provide opportunities to substantially reduce greenhouse gas emissions when utilizing low grade heat sinks/sources instead of fossil fuels, such as ground sourced geo-exchange, solar thermal energy, sewer heat energy recovery, or deep lake water cooling. Connection can provide additional economic benefits. For example, a DES can reduce the amount of space dedicated for mechanical rooms in each building and increase the amount of space allocated for residential or commercial leasing.

The proximity of the project site to an existing DES has been evaluated using the City of Toronto's Design Guidelines for District Energy Ready Buildings. Based on the District Energy Node Scan it has been determined that the project site is not located near any existing, new, or potential nodes for DES development, as shown in Figure 2 below. As such, connection to an existing DES node at this time is not feasible, but future development of DES nodes in the area should be monitored as the project planning progresses. However, given the size and scale of the proposed development at

Bloor & Dundas the project itself may be a good candidate for an isolated DES that operates independently of existing DES nodes in Toronto, but the application of this technology must be investigated further as the design progresses.

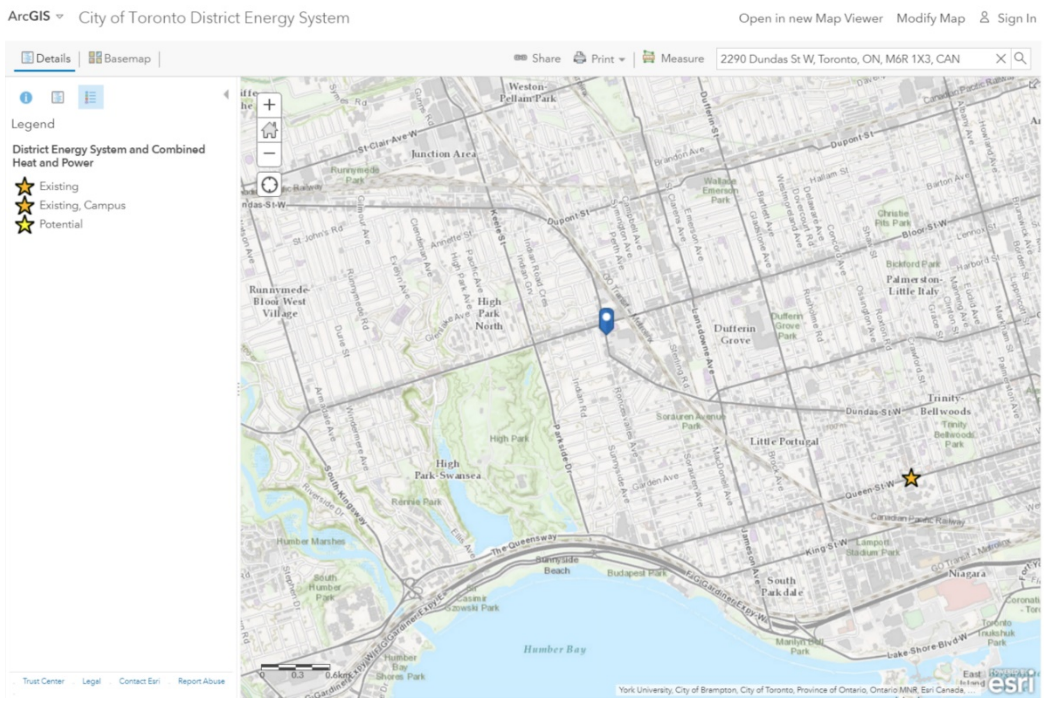

Figure 2. Project site location shown in relation to DES nodes.

DES can be broadly categorized as either a high temperature system or a low temperature system. High temperature systems separately circulate both high temperature and low temperature water to each building using a site network of insulated piping. A heat exchanger within each building services separate loops for hot and cold water, and space heating and cooling is typically provided by fan coil units. Because this system relies on the distribution of hot and cold water at the temperature required to meeting the heating and cooling loads it is best aligned with central heating technologies such as combined heat and power, hot water plants, and steam plants, which most often utilize natural gas as their fuel source, and cooling technologies such as deep lake water cooling.

In contrast, a low temperature DES combines several low-grade heat sources and sinks though a network of piping. A single loop of piping circulates low to ambient temperature water using a site network of uninsulated piping. A single water loop is installed in each building, and heating and cooling is provided by distributed terminal heat pumps. The heat pumps reject heat to the ambient loop for cooling, and extract heat from the ambient loop to provide heating. Because these systems rely on the distribution of low to ambient temperature water combined with heat pumps they are best aligned with low grade sources/sinks such as a site wide geo-exchange field, a wastewater or sewer heat recovery plant, and low-grade heat recovery from commercial areas. Further, a low temperature DES is appropriate for large scale developments that have a mixed-use program with simultaneous heating and cooling needs. The Bloor and Dundas project site includes a commercial grocery store, a commercial retail space, commercial office space, community space, and a large residential program. As such, it is anticipated that there will be simultaneous demand for heating and cooling.

Based on current energy modeling for Bloor & Dundas a DES is not required to meet TGS Tier 1. However, the evaluation of a low temperature DES should be considered by the project team if pursuing higher performance goals such as Toronto Green Standard Version 4, Tier 2 or 3 that have more stringent site EUI and site GHGI requirements. However, if Tier 1 is pursued as the performance goal and a DES is not included in the design, the project site and buildings can be future proofed to prepare for future installation of a DES. Per the City of Toronto's Design Guideline for District Energy-Ready Buildings it is recommended that the following key items are included to ensure that a future connection to a DES is possible:

- Locate mechanical rooms and heating and cooling equipment on the lower floors of the buildings to allow for future integration of a DES
- Provide an easement between the mechanical room and the property line to allow for thermal piping
- Include two-way pipes in the building to carry the thermal energy from the district energy network to the section in the building where the future energy transfer station will be located
- Install a low temperature hydronic heating and cooling system that is compatible with a district energy system

BUILDING LIFECYCLE CARBON ASSESSMENT

MATERIAL EMISSIONS ASSESSMENT: EMBODIED CARBON

This section discusses the sustainability measures integrated into the proposed project relating to the Greenhouse Gas (GHG) emissions of construction materials. A building lifecycle carbon assessment of the structure and envelope per the Canada Green Building Council (CaGBC) Zero Carbon Building Standard illustrates the projected carbon footprint before operations.

The lifecycle assessment tool used was One Click LCA, a lifecycle assessment cloud software, in compliance with EN 15978, EN 15804, ISO 14040, ISO 14044, and ISO 21929. The LCA datasets are compliant with EN 15804 or ISO 14040/14044.

These standards set equivalent methods of comparing building lifecycle carbon assessments. The type and quantity of materials significantly influence the carbon emissions of the built environment. Reducing the amount of material and waste generated during construction starts during design and is a cost-savings opportunity.

The proposed project is exploring several ways to reduce building lifecycle carbon. The assessment for the proposed project kept the total GSF/GSM, function, orientation, and whole wall u-value equivalent for both baseline and design cases. The results of this analysis indicate that the development as currently designed includes 120,452,593 $kgCO^2eq$ of embodied carbon; however, this report identifies opportunities to reduce embodied carbon to 78,166,155 $kgCO^2eq$, a reduction of 42,286,438 $kgCO^2eq$ or a 35% reduction in embodied carbon. Reductions in embodied carbon can be achieved primarily through careful selection of concrete. The emissions from manufacturing concrete are the most significant embodied carbon source, and the main environmental impact associated with concrete stems from its cement.

Although cement makes up only 10 percent of the concrete mix, it is responsible for over 80 to 90 percent of concrete's embodied carbon. Cement production involves heating a mixture of limestone, silica, alumina, and gypsum to 1,400-2,500 degrees Celsius. The heat-intensive process often uses fossil fuels, but the chemical reaction also generates significant CO_2.

RECOMMENDATIONS

This subsection intends to give high-level guidance to the team. The appropriate certified design and quality control will review and approve all recommendations and plans.

Initial research indicates several Lafarge cement manufacturing plants in the Toronto area may offer eco-friendly concrete mixes and product specific Environmental Product Declarations (EPD).

Require early coordination between the design team and contractor to discuss central goals. For example, add Performance-based specifications for concrete in bid documents:

"Supply concrete mixtures such that the total Global Warming Potential (GWP) of all concrete on the project is at least 30% lower than the CO_2 equivalents set by the industry average impact category datasets, as defined by the National Ready Mix Concrete Association (NRMCA) regional mix EPD datasets, as well as the impact category information reported within mill-specific EPDs or from mix design information from competing bidders."

It is essential to communicate carbon reduction goals throughout the project. For concrete, this is especially important because there are so many parameters and criteria for concrete mixtures. The Consultant suggest following NRMCA recommendations, for example,

- Ensure reducing embodied carbon remains a top priority throughout the project and is communicated to the owner, contractor, and product suppliers.
- Set a carbon budget for the total concrete used on the project using this tool.
- Invite the contractor and manufacturer to collaborate during the early design process.
- Pre-bid meetings - can be opportunities to communicate carbon reduction goals for all products to all potential bidders. Add carbon performance criteria to the bid process.

Optimize concrete volume:

- The first sustainable solution is to design an efficient structural system.
- Size appropriately without oversizing.
- Use LCA to calculate carbon for structural and architectural elements quickly.

Set targets for carbon:

- Set carbon footprint limits for total concrete, not individual CLASSES of concrete. The intent is to leave room for contractors and manufacturers to innovate.
- Do an LCA and set a carbon budget for all concrete on the building. It's still necessary to know each mix design's carbon footprint to form a carbon budget for the installation.
- Many concrete companies have published EPD data for concrete, and most will be willing to post for a project. NRMCA has published a cradle-to-gate LCA for ready-mixed concrete and regional, Industry-Wide (IW), EPD's for many concrete mixtures.
- Often concrete requiring high early strength should be limited to around 30% replacement of fly ash or slag. Concrete that does not need early age strength, such as footings, basement walls, and even some vertical elements such as columns and shear walls, could have as much as 70% fly ash/slag and be tested at 56 or 90 days instead of 28 days.
- High volume SCMs mixed can be identified from the industry-wide EPD or published product-specific EPDs from region.

Further exploration is needed to investigate the following:

- Use of Portland Limestone Cement (sometimes called general-use limestone cement) instead of the regular Portland Cement. In this type of mix, limestone replaces some of the cement. This substitution has no significant structural implications and can lead to a 10 percent reduction in Global Warming Potential (GWP).
- Reduce the amount of cement in concrete to significantly reduce the concrete's overall embodied carbon. Cement replacements like Supplemental Cement Materials (SCMs), e.g., fly ash or blast furnace slag, can substitute for cement. Mixes with high-fly ash content can slow curing time in cold weather. However, there are standard methods to deal with the situation, such as using insulated construction blankets.
- Other design strategies such as using post-tensioned slabs or voided concrete—such as hollow-core slabs, waffle slabs, or bubble-deck systems—may also help reduce the overall amount of concrete in a structural system.
- Consider a steel grade for concrete reinforcing that reduces the total amount of material needed for the structure.

MATERIAL EMISSIONS ASSESSMENT: EXISTING BUILDING

There are several existing low-rise buildings on the site. The site includes four one-storey buildings comprised of approximately 12,830 sq. meters of retail gross floor (leasable) area. These retail buildings are organized in a suburban "strip mall" style, surrounded by supporting surface parking. Its addresses include 2264, 2280, 2288, and 2290 Dundas Street West. Existing retail tenants include Loblaws, LCBO, Kal Tire, Pizza Nova, Coffee Time; and, a three-storey office building with approximately 4,168 sq. meters of office gross floor area. The address is 2238 Dundas Street West. The site also includes a three-storey residential building with eight (8) residential units. At this time, there is no opportunity to recover materials from the existing buildings on the site.

CLIMATE RESILIENT BUILDINGS

Version 4 of the Toronto Green Standard has made improving building resiliency a primary goal. A resilient building is one that can easily adapt to a changing climate, by mitigating the acute risks associated with extreme weather events and adapt to the long-term chronic risks associated with climate change. The Toronto Green Standard Resiliency checklist has identified three major risks that all buildings will face as our climate changes:

- **Extreme Heat & Cold Events**: The risks associated with the impact of extreme heat and cold events on vulnerable populations is an increasing concern in the City of Toronto. Measures to protect at-risk residents (e.g., the elderly, socially isolated, those with pre-existing illness, and young children) and those without access to air conditioning from excessive heat will therefore be important to include into the design and operation of Toronto's buildings. Higher levels of building energy performance improve passive survivability. Buildings designed with well insulated and sealed building envelopes, lower window-to-wall ratios or other passive building design strategies help to maintain livable indoor temperatures with less energy and for longer periods of time under power outages during winter or summer.
- **Power Outages:** The impact of a warmer climate and more extreme weather events can have an effect on the reliability of the power supply. As temperatures rise, our use of air conditioning also increases, putting stress on the ability of the power grid to deliver electricity. Periods of extreme heat are increasingly leading to brownouts and blackouts, as are events in the fall/winter such as the December 2013 ice storm. Research from past events of this nature has shown that extended backup power and community energy systems help to reduce both the likelihood and the impact of possible power outages, and help communities to recover more quickly from a disruption.
- **Flooding Events:** An increase in the overall volume of precipitation and larger individual storm events create a higher risk of flooding in certain areas of Toronto. The Toronto and Region Conservation Authority (TRCA) provides flood plain mapping resources that help identify flood prone areas of the city. Toronto Water conducts regular servicing studies, develops and maintains the City's Wet Weather Flow Management policy and guidelines for storm water management, and institutes the City's Basement Flooding Program to ensure residents and businesses are protected from back flow and sewage disruptions.

PASSIVE DESIGN STRATEGIES AND CLIMATE CHANGE RESILIENCE

To mitigate the major risks identified by the City of Toronto and design a climate resilient building both passive and active measures must be considered. Passive building design measures such as an airtight, well insulated building enclosure with an optimized window to wall ratio and SHGC must be considered for any building pursuing climate resiliency as a goal. These passive design measures that focus on the building enclosure design first help to improve resiliency to extreme heat and cold events by providing a more stable interior temperature 72 hours after a power outage, while also reducing energy demand and the burden on active backup power systems. TGS Tier 3 will provide the highest performance enclosure and will offer the best passive climate resiliency strategy, when partnered with appropriate backup power systems.

The following Passive Design Strategies should be considered to promote climate resiliency, and mitigate the risks associated with extreme heat events, cold events, and power outages:

Table 9. Passive Design Strategies and Climate Resiliency Benefits.

Passive Design Strategies	Climate Resiliency Benefit

Continuous insulation & Thermal bridge free Construction	Continuous insulation and thermal bridge free construction reduces heat transmission losses and gains during extreme heat or cold events, allowing a building to maintain comfortable interior temperatures for a prolonged period of time. Additionally, continuous insulation and thermal bridge free construction reduces the heating or cooling demand during an extreme heat or cold events, allowing the back-up power systems to run longer or cover more loads.
High performance windows & optimized window to wall ratio	As the climate gets warmer, an optimized window to wall ratio combined with a low SHGC and solar shading strategies will help mitigate overheating in interior spaces and limit cooling loads in the building.
Airtight building enclosure	Reduced air infiltration through the enclosure reduces heat transmission losses/gains during extreme heat or cold events, allowing a building to maintain comfortable interior temperatures for a prolonged period of time. It lowers the heating or cooling demand during an extreme heat or cold event allowing the back-up power systems to run longer or cover more loads. Climate change may result in decreased outdoor air quality and reducing unmitigated air infiltration through the enclosure will help control and improve indoor air quality during smog events or even wildfires.
Balanced mechanical ventilation with heat recovery included	A mechanical ventilation system with heat recovery reduces ventilation heat losses/gains during extreme heat or cold events, allowing a building to maintain comfortable interior temperatures for a prolonged period of time. The balanced ventilation system combined with a very low air infiltration rate ensures that the breathing air is not coming from unknown locations, such as through the building assembly where it may carry pollutants into the breathing zone.
Efficient common area and dwelling unit LED lighting with controls	LED light fixtures and controls reduce lighting energy demand and are measures that better utilize the back-up energy required to operate them during a power outage.

Low flow domestic hot water fixtures and an efficient domestic hot water distribution system	Low flow domestic hot water (DHW) fixtures and an efficient DHW distribution system reduce DHW energy demand and better utilize the backup energy required to provide DHW during a power outage.

Figure 3 outlines the Passive Design Strategies that should be considered to promote climate resiliency in a residential project such as Bloor & Dundas to help mitigate the risks associated with extreme heat events, cold events, and power outages.

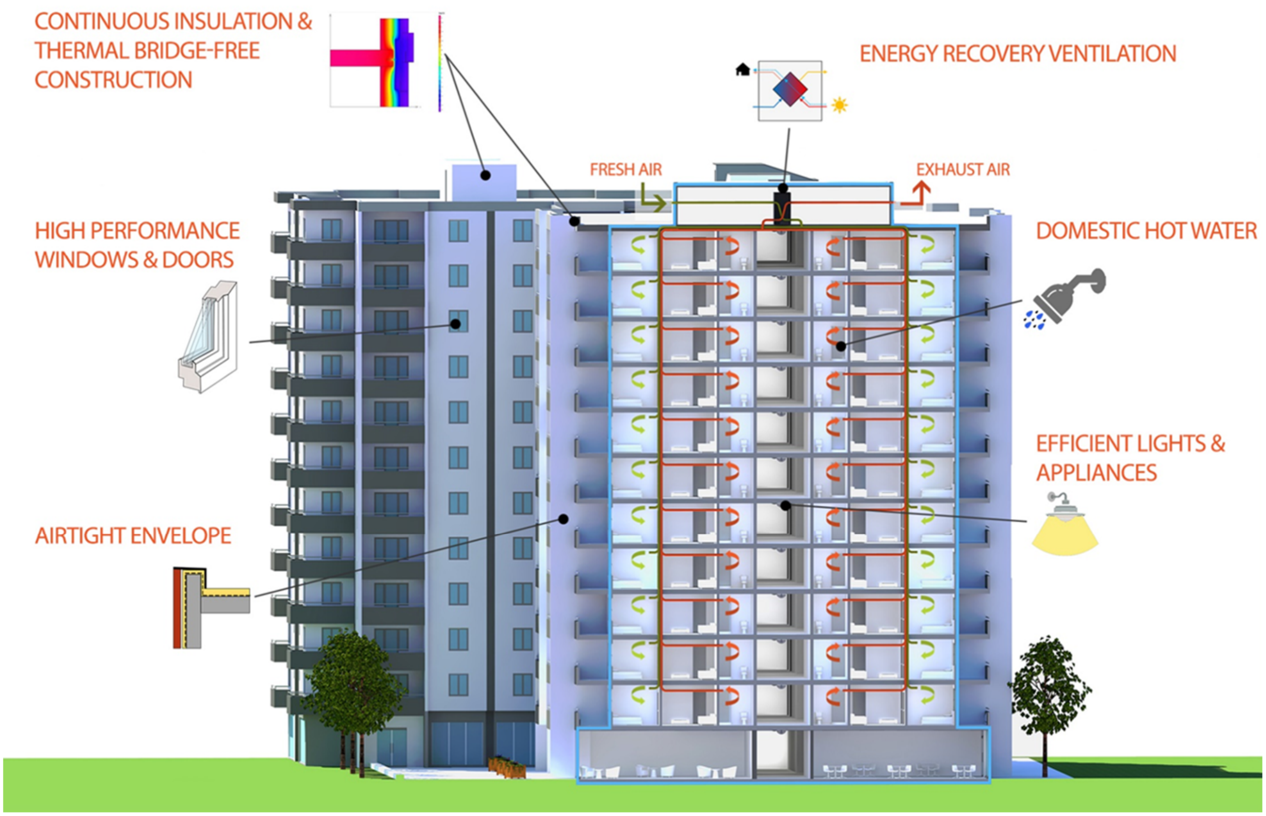

Figure 3. Passive Design Strategies that should be considered to promote climate resiliency.

The passive design measures listed in this report provide a more stable interior temperature 72 hours after a power outage. The impact of Passive Design strategies on interior temperature can be seen for Tier 1 and 3 below. Tier 3 buildings have the most robust building enclosure and the most stable interior temperature 72 hours after a winter power outage.

Table 10. Estimated lowest interior temperature 72 hours after power outage for Tier 1 and Tier 3 building design.

TGS Version 4 Tier	Lowest Interior temperature 72 hours after power outage (winter) (°C)	Highest Interior temperature 72 hours after power outage (summer) (°C)
Tier 1	15.5	28.2
Tier 3	20.5	28.7

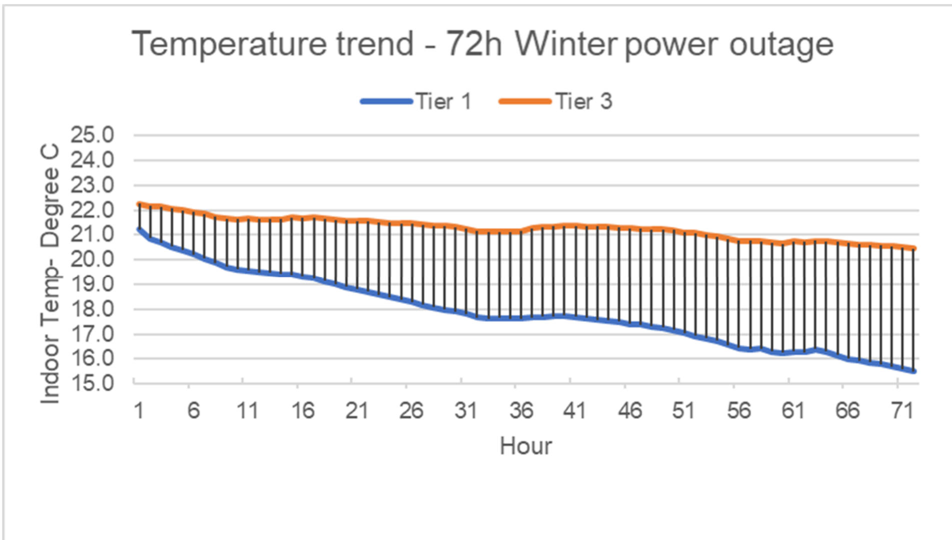

Figure 4. Estimated interior temperature 72 hours after a winter power outage for a Tier 1 and 3 building

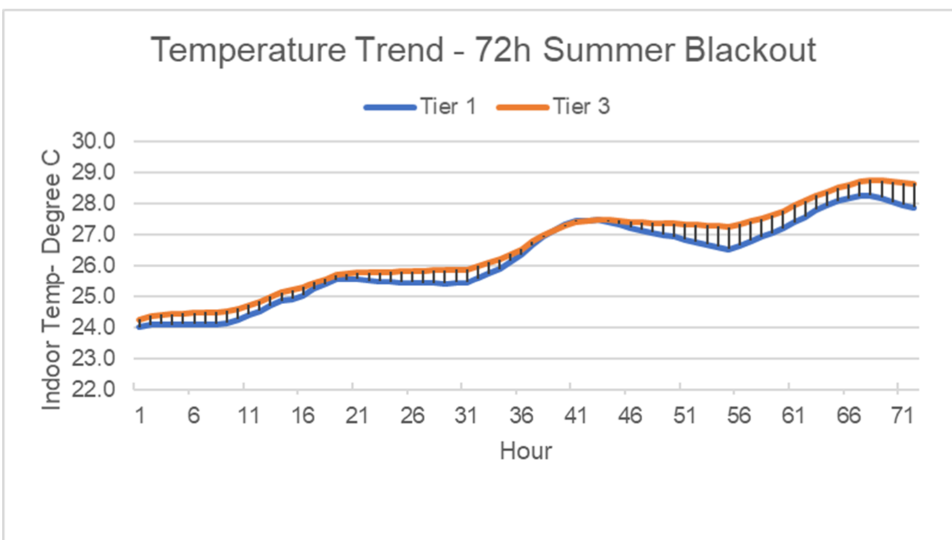

Figure 5. Estimated interior temperature 72 hours after a summer power outage for a Tier 1 and 3 building

BACKUP POWER SYSTEMS AND CLIMATE CHANGE RESILIENCE

Options for backup power systems were evaluated, which can make the Bloor & Dundas development more resilient during power outages. There is a growing concern regarding livability in Toronto during times of power outages. Extreme weather events combined with decaying and over-burdened electrical grids make it more important for residents to shelter in place in their homes. Installing backup power requires an owner to prioritize loads as backup power systems are not typically designed to keep a full building running at 100% of its normal operations. These systems are sized to cover what is needed to support residents sheltering in place—providing basic needs for health and safety, with comfort as an optional addition. The traditional solution for backup power has been the installation of emergency generators. However, Combined heat and power (CHP) systems and solar photovoltaics with battery systems are newer technologies that can provide backup power. As such, alternatives to emergency generators are worth investigating for numerous reasons.

COMBINED HEAT AND POWER (CHP)

CHP is the cogeneration of electricity and heat from an engine or turbine unit. Fuel drives a generator, and heat is harvested before being exhausted outdoors. Heat captured from a CHP plant can be used for a variety of end-uses, from domestic hot water to heating, and even cooling applications if coupled with an absorption chiller.

Common CHP systems in multifamily applications use natural gas as their fuel source. Economics are driven largely by the spread in cost between the gas burned by the plant, and the cost of the offset grid-purchased electricity. These economics tend to be most favorable in areas where electricity prices are high, and larger buildings concentrate the electric and thermal loads that CHP can offset.nA CHP unit must have *black start* capabilities, which includes a small onboard battery-powered starting system, in order to operate as a source of backup power. The unit must be capable of operating independently of the utility grid.

CHP systems are commonly integrated with the building domestic hot water plant and storage. Adding battery energy storage to this design allows for greater coverage of elevators, cyclical pumps, and other variable emergency power loads with high in-rush current demands and rapid power demands. These large load spikes can be difficult to cover with CHP in high rise buildings where the most economically sensible CHP sizing is often too small to operate large elevator motors and house pumps. However there is significant downtime when these loads are not being drawn. Battery energy storage has not typically been used within the multifamily market, so this is an emerging concept.

PV BATTERY SYSTEM

Standard solar photovoltaic panels (PV) produce electricity by converting solar radiation into direct current power using semiconductors that exhibit the photovoltaic effect. The direct conversion of sunlight to electricity occurs without any moving parts or environmental emissions during operation. PV must be located thoughtfully during installation in order to maximize generation. The panels will lose performance dramatically if shaded, and should be oriented towards the sun. In Toronto the best fixed orientation for an array is within 45 degrees of south and with a 10-60 degree tilt above horizontal.

PV provides savings by reducing the amount of electricity a property needs to pull from the grid. Electricity is generated on-site whenever the sun is shining on the panels. In periods where sunshine is unavailable, such as during cloudy days or at night, PV system production halts. It is during these times that batteries are used, as they store excess energy to maintain power through an outage or during poor sunlight conditions. PV is a proven and supported technology for creating on-site electricity, but it does not function as a robust backup power source or effective peak demand shaving system unless coupled with the correct inverters and significant battery banks.

There are several options for battery bank design, but there are very few examples of these systems in grid-tied multifamily buildings. Lead-acid batteries are a mature technology for other applications, and lithium-ion batteries are developing as a next generation solution. Lead acid batteries have a lower up-front cost compared to lithium, but they have shorter lifetimes, are temperature-sensitive, and flooded lead acid models require significant maintenance.

TRADITIONAL BACKUP GENERATORS

Natural gas generators are recommended when alternative systems are not cost-effective or possible given logistical constraints. Natural gas generators are recommended over diesel when service is available, due to their ability to run continuously without interruptible deliveries. The natural gas grid is very robust, and is more likely to be functional than a truck fuel delivery route during an emergency. Natural gas generators also burn cleaner fuel, with reduced emissions compared to liquid fuel generators. Natural gas generators are available in any size and can be selected to match emergency power loads including pumps and elevators relatively easily.

There are many hurdles to adopting new technologies, some real and some imagined or outdated. The following table provides a summary of many of the common decision making factors when adopting one of the three technologies described in this paper.

Table 11. Backup power systems pros, cons, and misconceptions.

Technology	Pros	Cons	Misconceptions
CHP	Combined heat and power (CHP) systems provide electric and thermal energy to a site, producing operating cost savings year-round. Many CHP units can be common-vented with other boilers, utilizing the existing flue.	Maintenance costs can be high and regular servicing is vital. Gas pressure may need to be higher than is delivered, so a gas booster pump may be needed. Space is needed for hot water storage.	*"CHP is a new technology that is untested."* In reality CHP has seen large market uptake. *"CHP systems can be sized based on the electrical demand at a building."* The economics of CHP hinge on being able to use both the electricity and the heat produced. Effective design must take into

	CHP units are available for indoor or outdoor installation.	Buildings need suitable electric and thermal loads. CHP (without batteries) is usually not able to meet elevator and large motor emergency power needs in very tall multifamily buildings without being oversized for building thermal loads.	account thermal loads as well as demand.
PV-Battery	Energy storage batteries can be charged by the grid or by PV systems. There are no moving parts, so less maintenance. PV is a decades old technology that is tested and accepted.	Pairing PV with batteries is an uncommon solution for emergency power applications. PV panels require unshaded outdoor space, which can be difficult in dense cities.	*"Solar panels are prohibitively expensive."* Costs have come down significantly in the past few years.
Gas Generator	May be used to participate in demand response events. Can be purchased in any size to fit any building loads.	Standalone generators do not provide a direct source of energy savings to a building. Generators must be tested and maintained frequently.	*"A generator is the cheapest option for backup power."* Generators have low first costs, but maintenance is labor intensive and there is limited option for revenue generation with a generator.

PRIORITIZING EMERGENCY BACKUP LOADS

The Urban Green Council's Building Resiliency Task Force has proposed the following as a hierarchy for prioritizing backup power loads. The loads connected to an emergency backup power source will determine the size of the power source, driving cost and feasibility of the project. Backup power loads have diverse needs for power and current draws, creating challenges for sizing standby solutions. This is generally easier to do with natural gas fired equipment due to the high energy density of the fuel, and will require more attention if other technologies from this report are used.

Starting with Tier 1, the loads below are organized by types of electrical equipment that should be given the highest priority for backup power coverage. Any code-required standby loads take precedence over this list, such as providing elevator power in multifamily buildings. Note that installation of backup power requires wiring of all emergency loads to dedicated emergency panels. These are the electrical panels that will be energized by the backup power source during a grid outage.

Tier 1: Egress

1. Exit signs and egress illumination

Tier 2: Extended life safety

1. Fire alarm and smoke/carbon dioxide detectors (battery backup instead of generator)
2. Common corridor and stairwell lighting
3. Essential security equipment such as electric locks
4. Fuel pump systems for generators

Tier 3: Water

5. Sump and sewage ejector pumps
6. Domestic water booster pumps

Tier 4: Parking Egress

7. Parking egress (lifts and lighting)

Tier 5: Convenience power for building occupants

8. Charging stations equipped with current meters
9. Community room

Tier 6: Small critical heating loads

10. When possible, heating systems and all ancillary equipment required to generate and distribute heat for space conditioning. This may include control panels, burners, boilers, circulators, condensate pumps, vacuum pumps, gas boosters, fuel pumps, combustion air dampers and fans, and inducer fans.
11. Domestic hot water equipment and all ancillary equipment required to generate and distribute domestic hot water. This may include control panels, burners, boilers, recirculation pumps, gas boosters, fuel pumps, and inducer fans.

Tier 7: Improved habitability

12. Elevator car operation
13. One convenience receptacle in living units, such as for refrigeration
14. Air conditioning
15. Main telecommunications room

SUMMARY OF BEST PRACTICES

Although natural gas generators are the most commonly installed backup power solutions for multifamily buildings, there are many applications and technologies for alternative sources of backup power. There are a combination of mature technologies and emerging alternatives to choose from listed in this report. Given the risks associated with climate change and the increasing likelihood of extreme weather events, a robust back up power system in combination with passive design strategies is essential for powering loads beyond life safety requirements for at least 72 hours.

LOCATION OF CRITICAL EQUIPMENT

Critical equipment will be located such that building operations are not disrupted during extreme weather events. The Toronto and Region Conservation Authority (TRCA) flood plain map was assessed to determine if the project is located within a flood plain, and if critical HVAC, DHW, and backup power equipment located on the ground floor would be at risk from flooding events. The project location is not in a regulatory flood plain, please refer to Figure 6 below. The location of the project site outside of a registered flood plain provides flexibility in the location of critical HVAC, DHW, and backup power equipment. However, location of mechanical rooms at or near the ground floor provides some advantages if connecting to a DES.

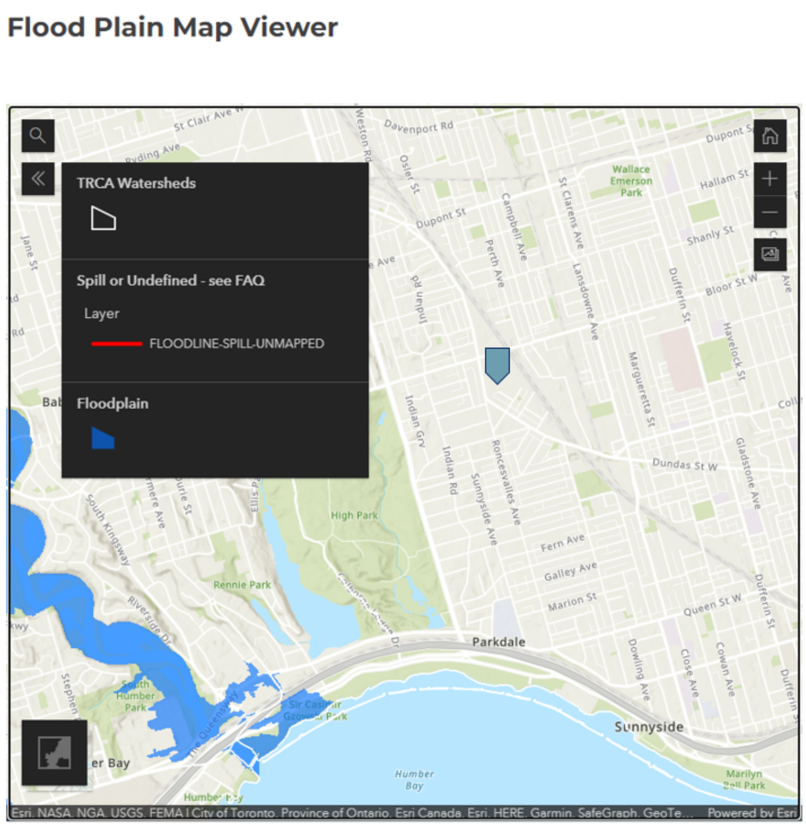

Figure 6. TRCA flood plain mapping tool and project site location shown.

FUTURE-PROOFING HVAC

The City of Toronto has produced a research paper investigating the potential impact of climate change on the city. The *Toronto Future Weather and Climate Driver Study* concludes that Toronto will see hotter summers, an extended cooling season, and milder winters. This report projects an average winter temperature increase of 5.7°C and a projected average summer temperature increase of 3.8°C by 2040. This shift in climate profile will lead to lower building heating demands, higher building cooling demands, and an extended cooling season SWA estimates that the number of days where cooling is required may increase by 31% in a 2040 climate scenario. The heating and cooling system designed today could be sized with a higher cooling capacity to adapt to higher peak cooling loads in the future. To estimate the additional cooling capacity that might be needed in a 2040 climate SWA developed a future climate scenario energy model case study. The current TGS models were updated and the climate file was changed from climate zone 6 to climate zone 4, the difference in additional required cooling capacity was estimated. The higher performing Tier 2 and Tier 3 buildings require less cooling capacity in today's 2022 climate scenario, when compared to a Tier 1 building, because of the improved enclosure. Further, in a 2040 climate scenario all performance tiers require 5.0 to 7.7% additional cooling capacity, but the Tier 3 building requires a comparatively smaller increase to cooling capacity because of the robust enclosure - please see summary table below:

Table 12. Additional cooling capacity required for a future 2040 climate zone modeling scenario.

TGS Version 4 Tier	Incremental Cooling Capacity required in 2022 Toronto Climate Zone 6 (kBtu/hr)	Incremental Cooling Capacity Required in 2040 Toronto Climate Zone 4 (kBtu/hr)
Tier 1	Base line	7.7%
Tier 2	-19%	7.7%
Tier 3	- 30%	5.0%

ANALYSIS, PREFERRED SCENARIO, AND RECOMMENDATIONS

DEVELOPMENT CHARGE REFUNDS

Compliance with Toronto Green Standard Version 4 Tier 2 or Tier 3 will make the project eligible for a partial refund of development charges. SWA estimates that the project can be eligible for approximately **$6,275,419** in development charge refunds, based on the current Toronto Green Standard Program Guidelines, Schedule C TO CH.415 ART I Development Charges Table, Tier 2, 3 and 4 CAP (effective November 1, 2021), current building design, and unit mix. Please refer to their table below for a summary of development charge refunds based on site unit mix. If the project chooses to pursue Toronto Green Standard Tier 2 or higher the partial development charge refunds will help offset the additional capital costs associated with building design upgrades. The project team is encouraged to pursue a full Tier 2 and/or Tier 3 Feasibility study.

Table 13. Tier 2 Development Charge Refund estimates based on site unit mix

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	30	$4,477	$134,313
Apartment 2+ Bedroom*	776	$3,522	$2,733,382
Apartment 1 Bedroom & Bachelor*	1139	$2,402	$2,736,493
Non-Residential Use**	16,480	$40.73	$671,230
			$6,275,419

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Note that while the project is currently estimated to receive up to **$6,275,419** in development charge refunds this estimate is based on the current Toronto Green Standard Program guidelines and Schedule C TO CH.415 ART I Development Charges Table, Tier 2, 3 and 4 CAP (effective November 1, 2021) - This schedule and the Toronto Green Standard Version 4 program guidelines are subject to change.

PREFERRED SCENARIO, AND RECOMMENDATIONS

Below are the calculated EUI range, TEDI range, GHGI range, Capital Cost Premium, and 30-year operating cost estimates. At this time TGS Tier 1 is the preferred performance goal for the proposed development. The current design aligns with 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. This report has identified many opportunities for EUI, TEDI, GHGI, embodied carbon, and operational cost reductions that could help the project achieve TGS Tier 2 or 3. It is recommended that these opportunities are continually assessed as the design progresses.

TGS Tier 2 is attainable with modest improvements to the building enclosure and heating/cooling system. TGS Tier 3 is attainable with more substantial improvements to the building enclosure, triple pane windows, increased HVAC efficiencies, fuel switching for DHW equipment, and an improved lighting design. While TGS Tier 3 offers the lowest EUI, TEDI, GHGI, and operating cost and is best aligned with climate resiliency strategies by including a robust enclosure and passive design strategies it also requires the highest upfront capital cost with an estimated capital cost premium of 4.4%. In contrast TGS Tier 2 has an estimated capital cost premium of 2%. It is recommended that the opportunity to meet TGS Tier 2 is continually assessed throughout the design process as this would both improve building performance and make the project eligible for an estimated **$6,275,419** in development charge refunds.

Table 14. Predicted EUI, TEDI, GHGI, Capital Cost, and Operating Cost for TGS Tier 1, 2, & 3.

	TGS V4 Tier 1	TGS V4 Tier 2	TGS V4 Tier 3
Total Energy Use Intensity (kWh/m^2)	102.0 - 128.6	78.8 – 96.7	52.5 - 72.6
Thermal Energy Demand Intensity (kWh/m^2)	31.3 - 40.7	24.3 - 30.0	5.7 - 8.6
Greenhouse Gas Intensity ($kgCO_2/m^2$)	9.6 - 13.1	4.8 - 8.7	1.6 - 2.2
Capital Cost ($/ m²)*	$4,304	$4,389	$4,492
Capital Cost Premium (%)*	-	2%	4.4%
Operating Cost ($/ m²) 30-year life cycle	$214	$195	$172

*The estimated capital cost premiums are based on available data today, and are subject to change from construction price escalation.

Embodied carbon for the proposed development was also assessed using the Canadian Green Building Council's Embodied Carbon Reporting Template. The results indicate that the development as currently designed includes 120,452,593 $kgCO^2eq$ of embodied carbon; however, this report identifies opportunities to reduce embodied carbon to 78,166,155 $kgCO^2eq$, a reduction of 42,286,438 $kgCO^2eq$ or a 35% reduction in embodied carbon. It is recommended that the concrete selected for the building structure is carefully selected to reduce the embodied carbon associate with the proposed development.

This project does not have the opportunity to connect to an existing district energy system, but the project is of an appropriate scale to consider an on-site high temperature or low/ambient temperature DES. A DES is not required to meet TGS Tier 1, however, it is recommended that DES technology be considered moving forward in combination with the higher performance goals of TGS Tier 2, and 3. Further, Passive Design Strategies in combination with Back-up Power Technologies such as solar photovoltaics & batteries, and combined heat and power should be considered to promote Climate Resiliency. The changing climate and the more severe weather events that are associated create risk for building occupants and owners that can be mitigated with these design measures. It is recommended that the opportunity to meet TGS Tier 2 is continually assessed throughout the design process as TGS Tier 2 includes additional climate resiliency strategies that will help prepare the buildings for the risks associated with climate change.

APPENDIX

APPENDIX ITEM 1: ENERGY MODEL OUTPUTS

Building 1

Tier 1

Bloor Building One_2022-5-27 DOE-2.2-48y 6/13/2022 17:03:12 BDL RUN 1

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	591046.	0.	799931.	251260.	391714.	11507.	413230.	181526.	0.	0.	0.	0.	2640209.
FM1 NATURAL-GAS THERM	0.	0.	0.	32398.	0.	0.	0.	0.	0.	0.	30023.	0.	62421.

TOTAL ELECTRICITY 2640209. KWH 5.146 KWH /SQFT-YR GROSS-AREA 5.146 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 62421. THERM 0.122 THERM /SQFT-YR GROSS-AREA 0.122 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 6.88
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 603

Tier 2

Bloor Building One_2022-5-27 DOE-2.2-48y 6/13/2022 17:08:29 BDL RUN 4

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	576157.	0.	723456.	495240.	284451.	0.	840.	637522.	0.	39398.	0.	0.	2757060.
FM1 NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	25027.	0.	25027.

TOTAL ELECTRICITY 2757060. KWH 5.374 KWH /SQFT-YR GROSS-AREA 5.374 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 25027. THERM 0.049 THERM /SQFT-YR GROSS-AREA 0.049 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.06
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 5

Tier 3

Bloor Building One_2022-5-27 DOE-2.2-48y 6/14/2022 11:57:02 BDL RUN 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	413732.	0.	732765.	80300.	249676.	106393.	225213.	270152.	0.	0.	263840.	0.	2342071.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 2342071. KWH 4.565 KWH /SQFT-YR GROSS-AREA 4.565 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 1.84
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 1
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 160

Building 2

Tier 1

Bloor Building Two_2022-5-17 DOE-2.2-48y 6/13/2022 17:23:10 BDL RUN 2

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	456521.	0.	632434.	172665.	386445.	10090.	336984.	126636.	0.	0.	0.	0.	2121775.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	22505.	0.	0.	0.	0.	0.	0.	46786.	0.	69291.

TOTAL ELECTRICITY 2121775. KWH 5.543 KWH /SQFT-YR GROSS-AREA 5.543 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 69291. THERM 0.181 THERM /SQFT-YR GROSS-AREA 0.181 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 12.56
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 1100

Tier 2

Bloor Building Two_2022-5-17 DOE-2.2-48y 6/13/2022 17:19:21 BDL RUN 2

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	318411.	0.	579080.	380295.	298951.	0.	1070.	533217.	0.	30102.	0.	0.	2141129.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	38979.	0.	38979.

TOTAL ELECTRICITY 2141129. KWH 5.594 KWH /SQFT-YR GROSS-AREA 5.594 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 38979. THERM 0.102 THERM /SQFT-YR GROSS-AREA 0.102 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.05
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 4

Tier 3

Bloor Building Two_2022-5-17 DOE-2.2-48y 6/14/2022 12:01:32 BDL RUN 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	319565.	0.	579080.	57552.	216961.	80939.	273389.	193492.	0.	0.	227311.	0.	1948290.
FM1 NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 1948290. KWH 5.090 KWH /SQFT-YR GROSS-AREA 5.090 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 6.39
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 560

Building 3

Tier 1

Bloor Building Three_2022-5-19 DOE-2.2-48y 6/13/2022 17:42:07 BDL RUN 1

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	875203.	0.	1234908.	222505.	362294.	13072.	332743.	118034.	0.	0.	0.	0.	3158754.
FM1 NATURAL-GAS THERM	0.	0.	0.	30594.	0.	0.	0.	0.	0.	0.	27832.	0.	58426.

TOTAL ELECTRICITY 3158754. KWH 6.334 KWH /SQFT-YR GROSS-AREA 6.334 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 58426. THERM 0.117 THERM /SQFT-YR GROSS-AREA 0.117 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 7.85
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 688

Tier 2

Bloor Building Three_2022-5-19 DOE-2.2-48y 6/13/2022 17:38:28 BDL RUN 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1	ELECTRICITY KWH	720713.	0.	1197207.	464704.	261781.	0.	12187.	500411.	0.	35100.	0.	0.	3192102.
FM1	NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	23179.	0.	23179.

TOTAL ELECTRICITY 3192102. KWH 6.401 KWH /SQFT-YR GROSS-AREA 6.401 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 23179. THERM 0.046 THERM /SQFT-YR GROSS-AREA 0.046 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.13
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 11

Tier 3

Bloor Building Three_2022-5-19 DOE-2.2-48y 6/14/2022 12:11:54 BDL RUN 2

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1	ELECTRICITY KWH	715968.	0.	1197207.	58790.	219309.	89792.	295027.	136058.	0.	0.	245157.	0.	2957311.
FM1	NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 2957311. KWH 5.930 KWH /SQFT-YR GROSS-AREA 5.930 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 1.92
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 168

Building 4

Tier 1

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1	ELECTRICITY KWH	260023.	0.	411156.	142337.	333974.	7992.	239514.	155040.	0.	0.	0.	0.	1550035.
FM1	NATURAL-GAS THERM	0.	0.	0.	15547.	0.	0.	0.	0.	0.	0.	31211.	0.	46758.

TOTAL ELECTRICITY 1550035. KWH 5.870 KWH /SQFT-YR GROSS-AREA 5.870 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 46758. THERM 0.177 THERM /SQFT-YR GROSS-AREA 0.177 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 1.00
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 88

Tier 2

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	182016.	0.	374416.	207597.	200400.	0.	397.	336759.	0.	18292.	0.	0.	1319876.
FM1 NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	30343.	0.	30343.

TOTAL ELECTRICITY 1319876. KWH 4.998 KWH /SQFT-YR GROSS-AREA 4.998 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 30343. THERM 0.115 THERM /SQFT-YR GROSS-AREA 0.115 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.03
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 3

Tier 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	182016.	0.	374416.	26987.	240211.	35252.	4702.	82731.	0.	0.	306265.	0.	1252580.
EM2- ELECTRICITY KWH	0.	0.	0.	0.	0.	0.	255947.	0.	0.	0.	0.	0.	255947.
FM1 NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 1508528. KWH 5.712 KWH /SQFT-YR GROSS-AREA 5.712 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.59
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 4
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 48

Building 5

Tier 1

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY	KWH	201420.	0.	274105.	93867.	194088.	4027.	158905.	102782.	0.	0.	0.	0.	1029195.
FM1 NATURAL-GAS	THERM	0.	0.	0.	9718.	0.	0.	0.	0.	0.	0.	17984.	0.	27703.

TOTAL ELECTRICITY 1029195. KWH 5.354 KWH /SQFT-YR GROSS-AREA 5.354 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 27703. THERM 0.144 THERM /SQFT-YR GROSS-AREA 0.144 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 1.10
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 96

Tier 2

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY	KWH	140995.	0.	249558.	162000.	122696.	0.	257.	230730.	0.	13447.	0.	0.	919683.
FM1 NATURAL-GAS	THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	17482.	0.	17482.

TOTAL ELECTRICITY 919683. KWH 4.784 KWH /SQFT-YR GROSS-AREA 4.784 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 17482. THERM 0.091 THERM /SQFT-YR GROSS-AREA 0.091 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.02
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 2

Tier 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY	KWH	140995.	0.	249558.	26185.	143229.	21562.	2803.	62930.	0.	0.	176742.	0.	824004.
EM2- ELECTRICITY	KWH	0.	0.	0.	0.	0.	0.	185590.	0.	0.	0.	0.	0.	185590.
FM1 NATURAL-GAS	THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 1009594. KWH 5.252 KWH /SQFT-YR GROSS-AREA 5.252 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.56
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 21
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 28

Building 6

Tier 1

REPORT- BEPU Building Utility Performance — WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	88316.	0.	122745.	49702.	94121.	2326.	72573.	46757.	0.	0.	0.	0.	476539.
FM1 NATURAL-GAS THERM	0.	0.	0.	5750.	0.	0.	0.	0.	0.	0.	6007.	0.	11757.

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TOTAL ELECTRICITY    476539. KWH       5.661 KWH     /SQFT-YR GROSS-AREA    5.661 KWH     /SQFT-YR NET-AREA
TOTAL NATURAL-GAS     11757. THERM     0.140 THERM   /SQFT-YR GROSS-AREA    0.140 THERM   /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE =  1.12
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED                =  0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE                =     0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE                =    98
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Tier 2

REPORT- BEPU Building Utility Performance — WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY KWH	61821.	0.	112020.	80452.	59313.	0.	104.	112939.	0.	6882.	0.	0.	433532.
FM1 NATURAL-GAS THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5767.	0.	5767.

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TOTAL ELECTRICITY    433532. KWH       5.150 KWH     /SQFT-YR GROSS-AREA    5.150 KWH     /SQFT-YR NET-AREA
TOTAL NATURAL-GAS      5767. THERM     0.069 THERM   /SQFT-YR GROSS-AREA    0.069 THERM   /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE =  0.03
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED                =  0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE                =     0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE                =     3
```

Tier 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	61821.	0.	112020.	12895.	69376.	10399.	1318.	37987.	0.	0.	58267.	0.	364084.
EM2- ELECTRICITY													
KWH	0.	0.	0.	0.	0.	0.	103254.	0.	0.	0.	0.	0.	103254.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 467338. KWH 5.552 KWH /SQFT-YR GROSS-AREA 5.552 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.35
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 29
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 2

Building 7

Tier 1

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	180505.	0.	241124.	88657.	177060.	3835.	145103.	94595.	0.	0.	0.	0.	930881.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	9684.	0.	0.	0.	0.	0.	0.	14868.	0.	24552.

TOTAL ELECTRICITY 930881. KWH 5.449 KWH /SQFT-YR GROSS-AREA 5.449 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 24552. THERM 0.144 THERM /SQFT-YR GROSS-AREA 0.144 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.60
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 53

Tier 2

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY	KWH	126354.	0.	219591.	175193.	109197.	0.	212.	201105.	0.	17188.	0.	0.	848842.
FM1 NATURAL-GAS	THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	14385.	0.	14385.

TOTAL ELECTRICITY 848842. KWH 4.969 KWH /SQFT-YR GROSS-AREA 4.969 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 14385. THERM 0.084 THERM /SQFT-YR GROSS-AREA 0.084 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.08
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 7

Tier 3

REPORT- BEPU Building Utility Performance WEATHER FILE- EPW Toronto Pearson

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY	KWH	126354.	0.	219591.	22615.	126339.	18895.	2506.	51327.	0.	0.	145311.	0.	712937.
EM2- ELECTRICITY	KWH	0.	0.	0.	0.	0.	0.	149161.	0.	0.	0.	0.	0.	149161.
FM1 NATURAL-GAS	THERM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL ELECTRICITY 862098. KWH 5.047 KWH /SQFT-YR GROSS-AREA 5.047 KWH /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.56
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 14
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 35

APPENDIX ITEM 2: DEVELOPMENT CHARGE REFUND SUMMARY

The following tables provide an individual breakdown of estimated development charge refunds per building. Note that while the project is currently estimated to receive up to $6,275,419 in development charge refunds this estimate is based on the current Toronto Green Standard Program guidelines and Schedule C TO CH.415 ART I Development Charges Table, Tier 2, 3 and 4 CAP (effective November 1, 2021). This schedule and the Toronto Green Standard program guidelines are subject to change.

Building 1 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	0	$4,477	$0
Apartment 2+ Bedroom*	238	$3,522	$838,331
Apartment 1 Bedroom & Bachelor*	320	$2,402	$768,813
Non-Residential Use**	2,100	$40.73	$85,533
			$1,692,677

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Building 2 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	7	$4,477	$31,340
Apartment 2+ Bedroom*	170	$3,522	$598,808
Apartment 1 Bedroom & Bachelor*	253	$2,402	$607,843
			$1,237,990

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Building 3 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	0	$4,477	$0
Apartment 2+ Bedroom*	100	$3,522	$352,240
Apartment 1 Bedroom & Bachelor*	152	$2,402	$365,186

Non-Residential Use**	12,625	$40.73	$514,216
			$1,231,642

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Building 4 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	4	$4,477	$17,908
Apartment 2+ Bedroom*	122	$3,522	$429,733
Apartment 1 Bedroom & Bachelor*	186	$2,402	$446,872
Non-Residential Use**	480	$40.73	$19,550
			$914,064

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Building 5 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	0	$4,477	$0
Apartment 2+ Bedroom*	69	$3,522	$243,046
Apartment 1 Bedroom & Bachelor*	108	$2,402	$259,474
Non-Residential Use**	1275	$40.73	$51,931
			$554,451

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Building 6 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	8	$4,477	$35,817
Apartment 2+ Bedroom*	22	$3,522	$77,493

Apartment 1 Bedroom & Bachelor*	31	$2,402	$74,479
			$187,788

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

Building 7 Tier 2, or Tier 3 Development Charge Refund estimates based on building unit mix.

Unit Type	Quantity	2021 Development Charge Refund Rates	Total Development Charge Refund Estimate
Multiples	11	$4,477	$49,248
Apartment 2+ Bedroom*	55	$3,522	$193,732
Apartment 1 Bedroom & Bachelor*	89	$2,402	$213,826
			$456,806

**Unit type and naming defined by City of Toronto By-law 515-2018*
***Per square meter ground floor area*

APPENDIX ITEM 3: CAPITAL COST & OPERATION COST ASSESSMENT

General Project Parameters		
Analysis Period	*Time period*	30
Year of analysis	*Current Year*	2020
Year of Occupancy	*Year of operation*	2025
Area	*sf.*	1,944,701
Building Type	*Commercial/ Residential*	RESIDENTIAL
Utility Rates	*Electricity ($/kWh)*	$ 0.13
	Natural Gas ($/Therm)	$ 0.92

Option	**Tier 1**	**Tier2**	**Tier3**
Description	Base Design to meet Tier 1 performance criteria.	Design enhancement to meet Tier 2 requirements	Design to meet Tier 3 requirements. Aligns with Passive house design criteria.
Initial Cost only	**$ 777,880,400**	**$ 793,247,308**	**$ 812,015,061**
Recurring fuel cost	**$ 38,656,218**	**$ 35,315,362**	**$ 31,126,550**

Initial Costs + Replacement costs			
Option	**Tier 1**	**Tier2**	**Tier3**
Component 1 type	Base cost (-) minus Mechanical & DHW- $400/ sf.	Base cost (-) minus Mechanical & DHW- $400/ sf.	Base cost (-) minus Mechanical & DHW- $400/ sf.
Component 1 cost	**$ 709,695,294**	**$ 709,695,294**	**$ 709,695,294**
Component 2 type	HVAC- WSHP systems	HVAC- VRF systems	HVAC- GSHP systems
Component 2 cost	**$ 68,064,535**	**$ 81,677,442**	**$ 81,677,442**
Component 3 type	ERV- included in Base costs	ERV efficiency improvement	ERV efficiency improvement
Component 3 cost	**$ -**	**$ 1,018,791**	**$ 1,967,562**

Component 4 type	Gas DHW - condensing Boiler	Gas DHW - condensing Boiler	Water - Water HP - DHW
Component 4 cost	$ 120,571	$ 120,571	$ 233,452
Component 5 type	Above Grade wall & Roof (Included in base cost)	Same as Tier 1	PH- improved insulation cost" 6" addl insulation Wall + R-20 Roof
Component 5 cost	$ -	$ -	$ 6,157,482
Component 6 type	Air tightness (Included in base cost)	Same as Tier 1	Air tightness detailing + testing - Incremental cost
Component 6 cost	$ -	$ -	$ 2,341,406
Component 7 type	Windows (Included in Base cost	Same as Tier 1	Window Improvement-Incremental cost
Component 7 cost	$ -	$ -	$ 9,207,214
Component 7 type	Balcony construction (included in Base cost)	Balcony Thermal bridge detail-Incremental cost	Balcony Thermal bridge detail-Incremental cost
Component 7 cost	$ -	$ 735,210	$ 735,210
Cumulative Recurring fuel costs *(from energy model)*			
Option	**Tier 1**	**Tier2**	**Tier3**
Utility type	Elec	Elec	Elec
Units of consumption	kWh	kWh	kWh
Annual Consumption	11,905,944	11,622,890	11,095,227
Annual Utility cost	$ 1,547,773	$ 1,510,976	$ 1,442,380
Life Cycle Utility cost	$ 33,400,935	$ 32,606,856	$ 31,126,550

Utility type	NtGas	NtGas	NtGas
Units of consumption	therm	therm	therm
Annual Consumption	301059	155162	0
Annual Utility cost	$ 276,739	$ 142,628	$ -
Life Cycle Utility cost	$ 5,255,283	$ 2,708,506	$ -

Zero Carbon Building Version 2
Embodied Carbon Reporting Template

Bloor & Dundas, Ontario, Canada
Special Planning Area (SPA) Application
6/10/2022

INTRODUCTION

The purpose of this reporting template is to outline the information that is required to be submitted in the embodied carbon report that is required for ZCB-Design v2 certification. Projects may complete this template or provide a custom report that meets the information needs specified herein.

Projects pursuing ZCB-Performance v2 certification that complete a retrofit of structural or envelope materials in the performance year must also use this template to guide the reporting of embodied carbon associated with the retrofit project.

GENERAL INFORMATION

Please provide the following general information about the project.	
Project Name	Bloor and Dundas SPA Submission Support
Embodied Carbon Assessor	Kai Starn, LEED AP, CPHC
Firm	Steven Winter Associates
Date of Assessment Completion	6/13/2022
Software & Version Number	One Click LCA
Project Life	☒ 60 year
Assessment Timing (check all that apply)	☐ Schematic Design ☐ Design Development ☐ Construction Documents
Please confirm that the analysis includes all structural and envelope components ("mandatory materials") by checking the applicable boxes to the right.	☒ Footings and foundations ☒ Complete structural wall assemblies (cladding to finish) ☒ Structural floors and ceilings (no finishes) ☒ Slab on grade ☒ Roof assemblies ☒ Stairs ☒ Parking structure (not including surface parking)
Please list any additional materials that are included at the applicant's discretion.	The project used estimated material quantities using the One Click LCA Carbon Designer to generate a simple lifecycle carbon assessment.

CARBON EMISSIONS FOR EACH LIFE CYCLE STAGE

Provide the following breakdown by life-cycle stage. If the software used does not provide values for every stage, leave the missing ones blank.

Life-cycle Stage				Carbon Emissions from Mandatory Materials (kg CO_2e)	Carbon Emissions from Optional Materials (kg CO_2e)
Upfront	Product	A1	Raw Material Supply	90,717,968	50,968,131
		A2	Transport (to factory)		
		A3	Manufacturing		
	Construction	A4	Transport (to site)	21,414,292	21,422,981
		A5	Construction & Installation	4,674,472	3,048,071
			Total Upfront Carbon	**116,806,732**	**75,439,184**
Use		B1	Use	0	0
		B2	Maintenance	0	0
		B3	Repair	0	0
		B4	Replacement	901,084	901,084
		B5	Refurbishment		
			Total Use Stage Embodied Carbon	**901,084**	**901,084**
End of Life		C1	Demolition	2,744,777	1,825,887
		C2	Transport (to disposal)		
		C3	Waste Processing		
		C4	Disposal		
			Total End of Life Carbon	**2,744,777**	**1,825,887**
Optional, does not need to be offset:					
Beyond the Life-cycle		D	Reuse		
		D	Recycling		
		D	Energy Recovery		
			Total Beyond the Life-cycle Carbon	**Not assessed**	**Not assessed**

Contribution Analysis

Please provide a contribution analysis, broken out to the best of your ability by either material type or building assembly type. The list must include the top 10 contributing items at a minimum (concrete can only count as one, although multiple mix types can be listed separately).	
Material or Building Assembly	**Carbon Emissions (kg CO_2e)**
Concrete 4000 psi, ready mix, foundations & internal walls	53,811,000
Concrete, 30MPa ready mix, walls floors	19,666,000
Reinforcement steel (rebar)	5,105,000
Concrete, 40MPa ready mix, columns, beams, pilings	4,055,000
Insulating Glass Unit	2,978,672
Steel stud framing for drywall	1,154,000
XPS insulation	1,191,000
Gypsum plaster board	822,000
Cement mortar	512,000
Clay brick	277,000
Oriented strand board (OSB)	142,000
Insulation, glass wool board, high density	88,000

Reduction Measures Considered

Please provide a list of embodied carbon reduction measures considered, as well as the associated embodied carbon reduction potential of each.	
Description of Embodied Carbon Reduction Measure	**Reduction Potential (kg CO_2e)**
Ready-mix concrete, 25MPa (3626 psi), ECOPact Prime RMPS25N511X (Lafarge - Eastern Canada, Burlington plant)	20,957,000
Ready-mix concrete, 30MPa Industry Average Benchmark (CRMCA)	6,455,000
Ready-mix concrete, 35 Mpa (5076 psi), 56 days	6,212,000

Impact and Innovation - 20% Reduction in Embodied Carbon

ZCB-Design projects pursuing the Impact and Innovation strategy of demonstrating an embodied carbon reduction of at least 20% must provide the following information.

Please provide a summary description of the embodied carbon reduction measures that were implemented.
Ready mix concrete is the largest contributing material to global warming. Performance-based specifications targeting at minimum 40% reduction in concrete kCO_2e for the entire project could achieve a 35% in building life-cycle carbon footprint. Additionally, there are opportunities to replace materials such as XPS, gypsum plaster board, and insulating glass units with lower carbon materials.

Please explain how the baseline building and the proposed building have equivalent operational energy use, floor area, functional space use, and building shape/orientation.
The life-cycle assessment is carried out with One Click LCA, a life-cycle assessment cloud software, in compliancy with EN 15978, EN 15804, ISO 14040, ISO 14044 and ISO 21929. The LCA datasets are compliant with EN 15804 or ISO 14040/14044. The total GSF, function, orientation and whole wall u-value are equivalent for both baseline and design case.

Please provide a summary of the embodied carbon reductions achieved.							
Life-cycle Stage					Baseline (kg CO_2e)	Proposed (kg CO_2e)	Percent Reduction
Upfront	Product	A1 A2 A3	Raw Material Supply Transport (to factory) Manufacturing		90,717,968	50,968,132	44%
	Construction	A4	Transport (to site)		21,414,292	21,422,981.10	0%
		A5	Construction & Installation		9,348,945.89	6,096,143	35%
			Total Upfront Carbon		**116,806,732**	**75,439,184**	**35%**
Use		B1	Use		0	0	
		B2	Maintenance		0	0	
		B3	Repair		0	0	
		B4 B5	Replacement Refurbishment		901,084	901,084	
			Total Use Stage Embodied Carbon		**901,084**	**901,084**	**0%**
End of Life		C1 C2 C3 C4	Demolition Transport (to disposal) Waste Processing Disposal		2,744,777	1,825,887	
			Total End of Life Carbon		**2,744,777**	**1,825,887**	**33%**

Impact and Innovation - Net Upfront Carbon Emissions Equal to or Less Than Zero

ZCB-Design projects pursuing the Impact and Innovation strategy of demonstrating upfront carbon emissions equal to or less than zero must provide the following information.

Please provide a description of any strategies for carbon storage (sequestration) in the building materials and provide the associated reduction in upfront carbon emissions (life-cycle stages A1-A5).		
Description of Carbon Storing Material	**Amount of Material (kg)**	**Carbon Storage (kg CO_2e)**
Not applicable		

Please provide the upfront carbon demonstrating it is less than or equal to zero.		
Upfront Carbon (kg CO_2e)	**Total Carbon Storage (kg CO_2e)**	**Net Upfront Carbon (kg CO_2e)**
NA		