



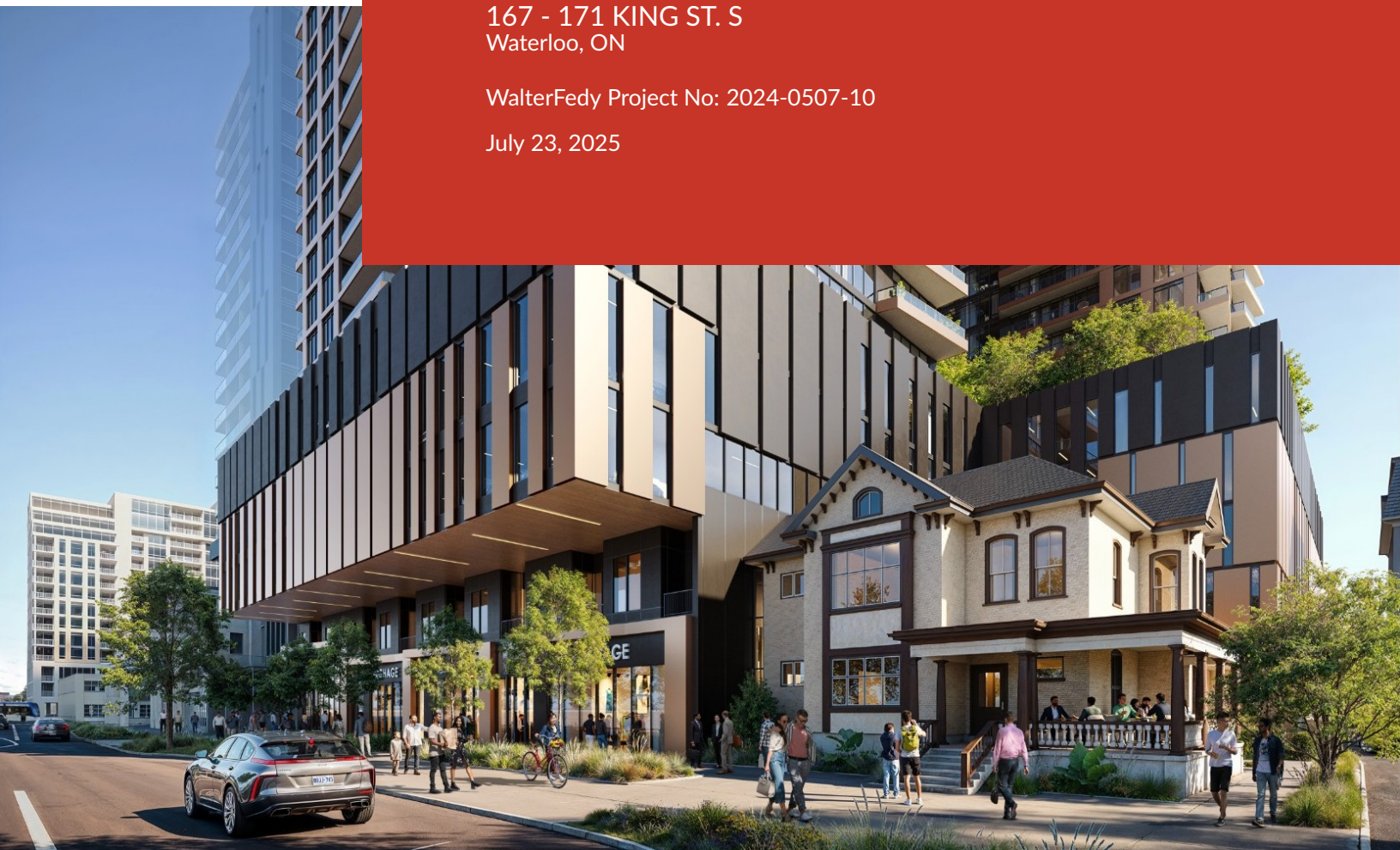
ENERGY STRATEGY STUDY

VANMAR DEVELOPMENTS INC.

167 - 171 KING ST. S
Waterloo, ON

WalterFedy Project No: 2024-0507-10

July 23, 2025



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1 INTRODUCTION

1.1 Background

WalterFedy was engaged by VanMar Developments Inc. in support of the proposed development of the site and as part of a complete Zoning By-law Amendment submission. The intent of this Energy Strategy Study is to comply with the City of Waterloo's Energy Study requirements. The Energy Strategy will evaluate various energy conservation measures (ECMs) and identify combinations of measures that would in theory achieve the savings outlined in the Terms of Reference. Energy and carbon impacts will be analyzed for the following three scenarios;

- **Building Code Baseline.** The path followed for this analysis is ASHRAE Standard 90.1-2013 as modified by OBC SB-10.
- **High Performance** where Total Energy Use Intensity (TEUI) is reduced by 30%, Thermal Energy Demand Intensity (TEDI) is reduced by 30%, and Greenhouse Gas Emissions Intensity (GHGI) is reduced by 50%, all relative to the current Building Code.
- **High Performance Net-Zero Ready Performance** where Total Energy Use Intensity (TEUI) is reduced by 60%, Thermal Energy Demand Intensity (TEDI) is reduced by 60%, and Greenhouse Gas Emissions Intensity (GHGI) is reduced by 90%, all relative to the current Building Code

1.2 Scope of work

A brief summary is as follows.

- Obtain site development information.
- Develop SB-10 baseline energy model.
- Analyze various ECMs to quantify approximate project cost, energy use, greenhouse gas (GHG) emissions, utility cost, and cost-benefit.
- A set of ECMs to be included in the proposed facility.
- Compare proposed scenarios with baseline scenario.
- Develop draft report compliant with City of Waterloo Energy Strategy requirements.
- Review draft report with VanMar Developments Inc. and other stakeholders.
- Revise report based on feedback and provide final version.

1.3 Contact information

Contact information for WalterFedy (the Consultant) and VanMar Developments Inc. (the Client) is provided in Table 1.

Table 1: Contact information

Description	Consultant	Client
Organization	WalterFedy	VanMar Developments Inc.
Address	Suite 111, 675 Queen St South	145 Goddard Crescent
Location	Kitchener, ON	Cambridge, ON
Postal code	N2M 1A1	N3H 4R6
Contact name	Patrick Darby	Jordan Zekveld
Credentials	P.Eng., CEM, CMVP, LEED AP	PQS, GSC, LEED AP
Title	Senior Energy Engineer	Director of Preconstruction
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Email	pdarby@walterfedy.com	jordan.zekveld@vanmaron.com

2 FACILITY DESCRIPTION

2.1 Facility overview

An overview of 167 - 171 King St. S is provided in Table 2.

Table 2: Facility overview

Description	Unit	Value
Name	[-]	167 - 171 King St. S
Address	[-]	167 - 171 King St. S
Location	[-]	Waterloo, ON
Type	[-]	Mixed use
Dwelling units	[-]	834
Gross floor area	[m2]	53,788
Gross floor area	[ft2]	578,970

A top-down view of the potential site layout for 167 - 171 King St. S is provided in Figure 1.

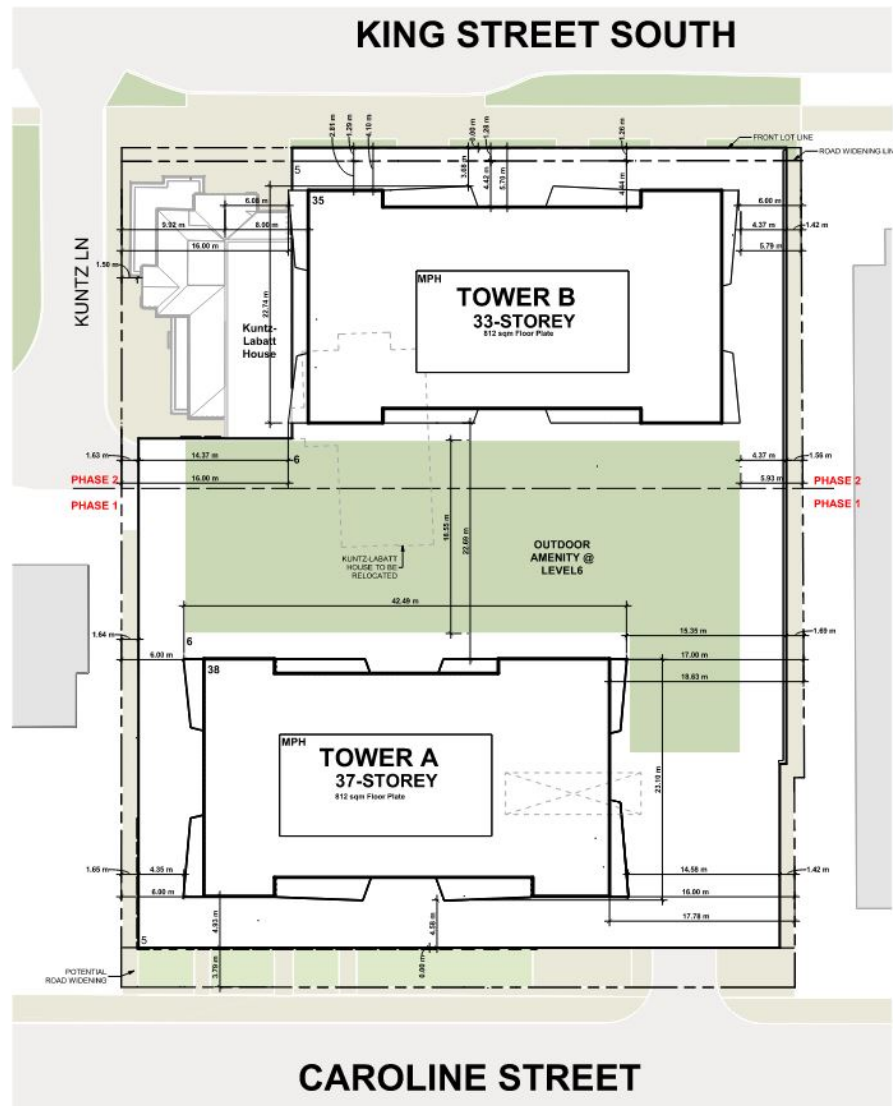


Figure 1: 167 - 171 King St. S aerial view

A conceptual design was provided by VanMar Developments Inc., with the facility consisting of:

- A 5 storey podium.
- A 31 storey tower (Tower A)
- A 27 storey tower (Tower B)

Additional design assumptions are as follows.

Envelope

The envelope thermal properties are compliant with OBC SB10 2024.

- Roof R value of R35
- Wall R value of R20
- Window assembly U-value of 2.15 W/m²/K
- Glass door assembly U-value of 3.48 W/m²/K

- Infiltration rate of 0.35 L/s/m² of envelope area (assumed).

It should be noted that the baseline considers an envelope design with a 40% window-to-wall ratio to meet the prescriptive requirements of OBC SB10.

Lighting

Lighting for the baseline model is assumed to be fluorescent throughout the facility.

Table 3: Lighting systems summary

Space name	Floor area of space	Light power density	Data source
-	[m ²]	[W/m ²]	-
Whole building	53,788	7.3	SB10 2024

Water fixtures

Typical flow rates are assumed for all water fixtures.

Table 4: Water fixture summary

Serves	Flow	Volume	Data source
-	[gpm]	[gpc]	-
Washroom faucets	1.5	-	Assumed.
Kitchen faucets	1.5	-	Assumed.
Showers	2.5	-	Assumed.
Toilets	-	1.6	Assumed.

Heating

Heating throughout the facility is provided by a hot water loop which is served by a natural gas fired boiler.

Domestic hot water is served by a central DHW boiler system.

Table 5: Heating systems summary

Serves	Utility	Efficiency	Data source
-	-	[decimal]	-
Domestic hot water	Natural gas	0.90	OBC SB10 2024
Hot water heating	Natural gas	0.90	OBC SB10 2024

Cooling

Space cooling is provided by a chilled water loop. The chilled water loop is cooled by a central water cooled chiller with a cooling tower.

Table 6: Cooling systems summary

Serves	Utility	Efficiency	Data source
-	-	[decimal]	-
Chiller	Electricity	3	Assumed
Cooling tower	Electricity	25	Assumed

Water distribution

Pump sizes for chilled water, hot water, condenser water, and domestic hot water are listed in the table below. All of these pumps are assumed to be equipped with VFDs, with the exception of the DHW recirculation pump.

Table 7: Water distribution systems summary

Tag	Serves	Motor output	Motor output	Data source
-	-	[kW]	[hp]	-
CHW	Chilled water pump	29.8	40	Assumed
CW	Condenser loop pump	29.8	40	Assumed
HW	Hot water pump	29.8	40	Assumed
DHW	DHW recirculation	1.5	2	Assumed

Air distribution

The baseline model considers a 4-pipe fan coil system, complete with hot water and chilled water coils. Each suite (834 in total) is equipped with a fan coil unit as well as a heat recovery ventilator (HRV) that is tied into the washroom exhaust. Fan coil units are assumed to operate when there is a call for either heating or cooling, while the HRVs are assumed to operate 24/7.

Both Towers A and B are assumed to each have a makeup air unit to provide pressurization to corridors. These units are assumed to operate 24/7.

Table 8: Air distribution systems summary

Serves	Air flow	Motor output	Motor output	Data source
-	[cfm]	[kW]	[hp]	-
Tower A makeup air	9,000	7.457	10.00	Assumed
Tower B makeup air	8,000	7.457	10.00	Assumed
Fan Coils (typical of 834)	500	0.249	0.33	Assumed
Heat recovery ventilators (typical of 834)	50	0.093	0.12	Assumed

3 METHODOLOGY AND ASSUMPTIONS

3.1 Energy model development methodology

The utility use profile was developed from an hourly analysis, spanning one year, of the following energy systems. The analysis was completed using the programming language called R and reflects the existing conditions of the facility as documented in Section 2.

1. **Hourly utility use profiles.** An hourly utility use profile for each utility was developed according to the following methodology.

- (a) *Utilities and end uses.* Hourly utility use profiles developed through this analysis were assigned to both utilities and end uses. The utilities and end uses that were modeled are summarized in Table 9.

Table 9: Utility and end use summary and definitions

Utility	End use	Definition of end use
Electricity	Cooling	Cooling energy use.
	Equipment	Equipment energy use.
	Fans	Fan motor energy use.
	Heat rejection	Energy use by heat rejection equipment (e.g. cooling towers).
	Lights	Lighting energy use.
	Pumps	Pump motor energy use.
Natural gas	DHW heat	Domestic hot water heating energy use.
	Space heat	Space heating energy use.
	Ventilation heat	Ventilation air heating energy use.
Water	Faucets	Faucet water use.
	Showers	Shower water use.
	Toilets	Toilet flushing water use.

- (b) *Weather data.* Hourly weather data was obtained for Waterloo, ON and used to construct the energy model.
 - (c) *Facility spaces.* Facility spaces were grouped according to activities in the spaces and HVAC systems serving them. The thermal characteristics of the exterior building envelope components for the facility were assumed based on findings from reviewing existing facility conditions and documentation. Thermal loads within each space were calculated based on assumed space temperature and humidity setpoints, hourly weather data, and activities in the space that affect thermal conditions (e.g. lighting or equipment that generates heat).
 - (d) *Primary systems.* Primary systems are defined as systems whose utility use can be predicted independent from other systems; examples include lighting, equipment (e.g. office and process equipment), pumps, etc. The hourly utility demand of primary systems was modeled based on assumed time-of-day operating schedules, peak power input and average loads relative to the peak power input. Peak power input was estimated from assumptions documented throughout Section 2, including lighting power or power density, nameplate horsepower of motors, etc.
 - (e) *HVAC systems.* HVAC system energy use was modeled based on hourly weather data and space condition setpoints defined for the various spaces. The analysis also accounted for system-specific ventilation controls and activities and primary systems that have thermal influences on spaces (e.g. occupancy, lighting, equipment, processes that add heat to spaces). The analysis quantified hourly energy use of fans, heating (e.g. sensible, humidification, reheat) and cooling (e.g. sensible, dehumidification).
2. **End use analysis.** An end use analysis of each utility was completed. Since the hourly utility use profiles already track the hourly utility use by each end use, the end use analysis involved summarizing data from

the hourly utility use profiles to obtain yearly utility use by each end use. Results were presented in Section 3.3.

3.2 Monthly utility use profiles

Monthly utility use profiles for each modeled utility are presented in Figure 2.

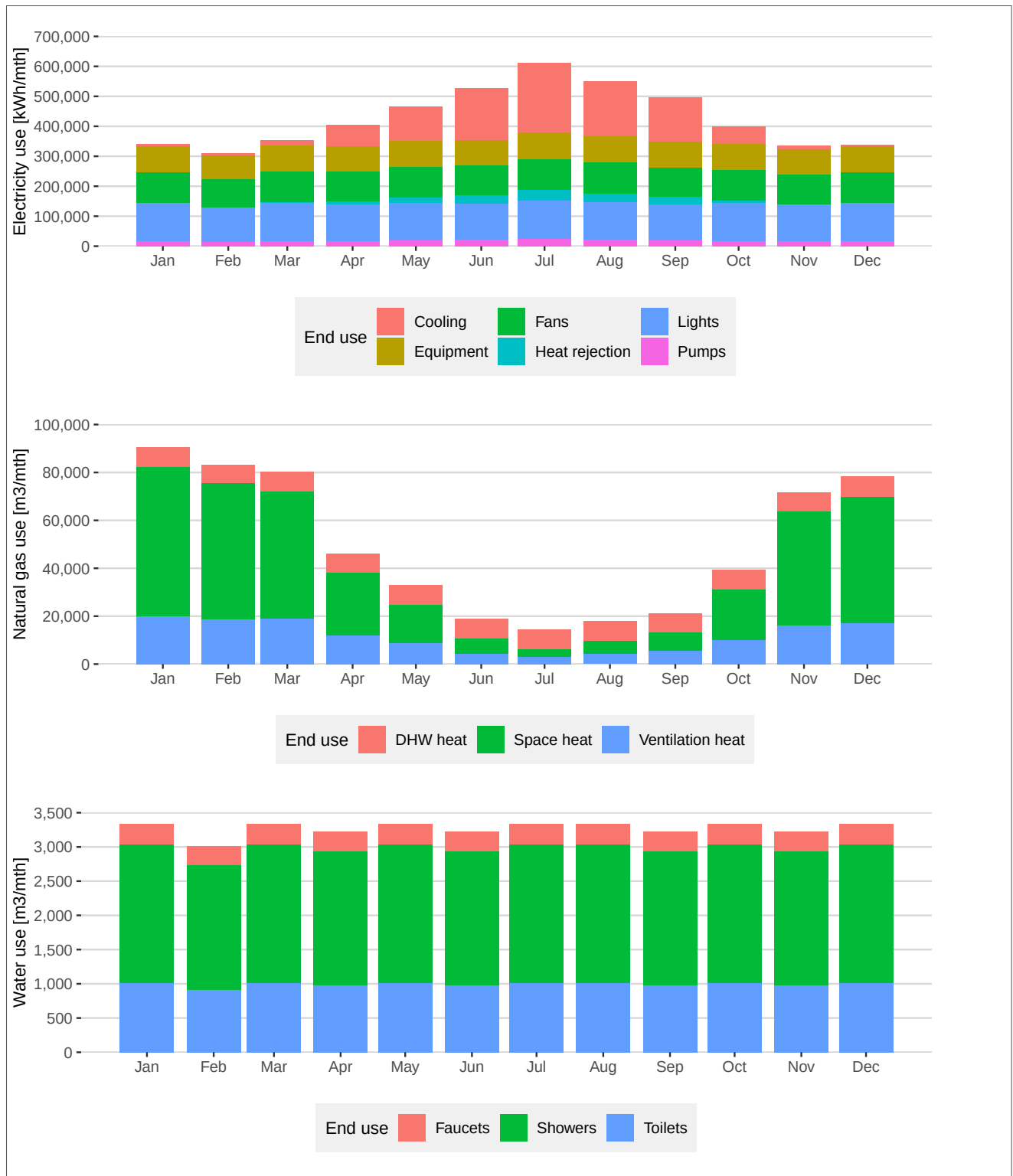


Figure 2: Monthly utility use profiles for each modeled utility

3.3 End use analysis

Electricity

The yearly electricity end use breakdown calculated by the energy model is plotted in Figure 3. See Table 9 for end use definitions.

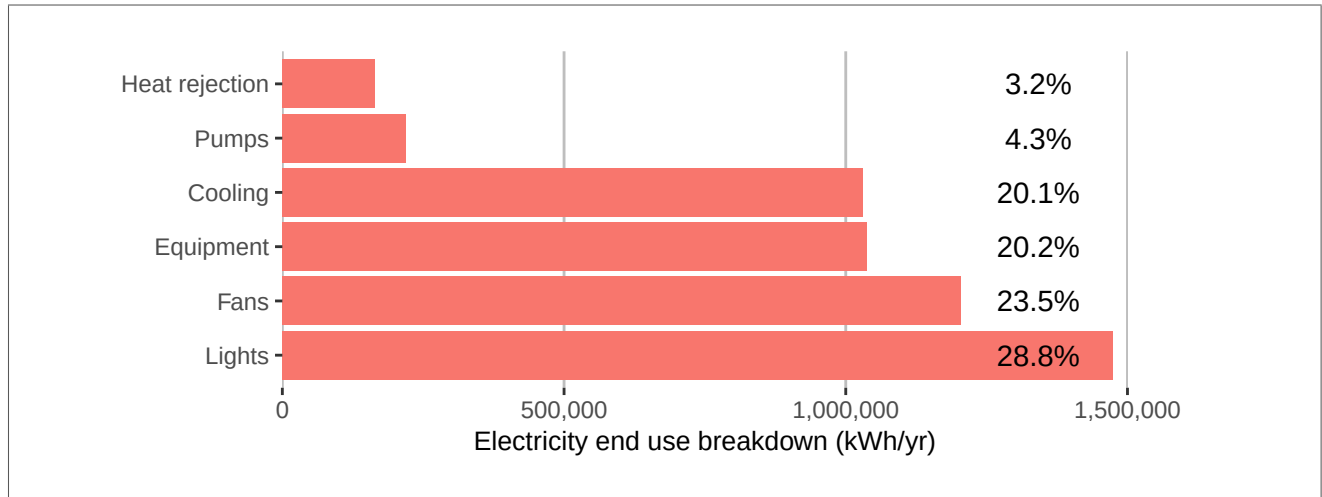


Figure 3: Electricity end use breakdown (calculated by energy model)

Natural gas

The yearly natural gas end use breakdown calculated by the energy model is plotted in Figure 4. See Table 9 for end use definitions.

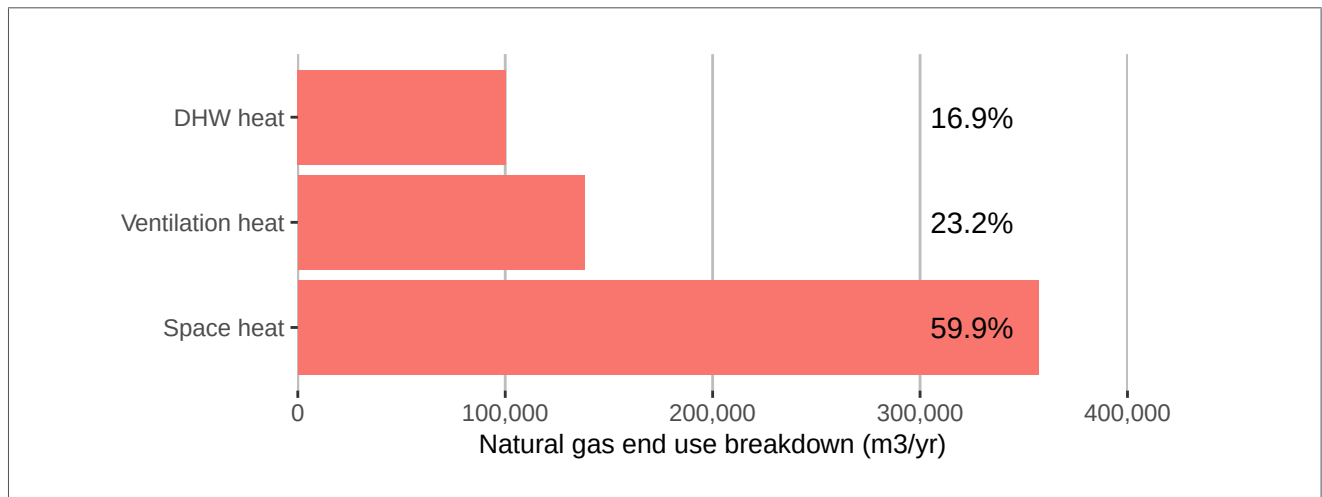


Figure 4: Natural gas end use breakdown (calculated by energy model)

4 MEASURE ANALYSIS

The analysis is intended to present a variety of measures that VanMar Developments Inc. can take to increase the energy and carbon performance of the proposed development. The objective of each measure presented is to reduce greenhouse gas emissions directly or indirectly produced by activities at the site. In addition, the measures presented are in direct response to the Energy Strategy requirements provided by the City of Waterloo.

4.1 Measure analysis summary

The following sections outlines potential measures that can be undertaken as steps to reduce the facility's overall annual energy consumption and GHG emissions. Each measure is presented conceptually, outlining the expected impacts on electricity, natural gas use, and GHG emissions.

Table 10: Measure summary

Measure	Recommendation	TEUI reduction	TEDI reduction	GHG reduction
Air-source VRF	Provide heating and cooling through an air-source VRF system. Note, this measure is presented as an option to reduce the absolute GHG emissions of the facility. As such, it is compared with the baseline four-pipe fan-coil system (SB-10 procedures would require the baseline building to be redefined and remodeled as packaged terminal heat pump (for residence) and packaged rooftop heat pump (for office); however, in this analysis, baseline systems are maintained as four-pipe fan-coil). It should also be noted that this measure should be considered as theoretical, intended to present what is required to comply with the High Performance and Net-Zero Ready Performance scenarios, as it would cause significant changes to the conceptual design and would severely impact the cost and practicality of the project.	36.3	0.0	67.8
Demand control ventilation	Provide demand control ventilation such that the suite ERVs are programmed to only operate when occupancy is detected or in-suite CO2 levels exceed certain threshold.	7.5	9.3	8.7
Night temperature setbacks	Reduce overnight heating setpoints and raise overnight cooling setpoints in suites and common spaces. Note that this measure will be difficult to implement to due individual tenant controls and potential comfort issues. This measure should be considered as a theoretical step to reaching the targets of the Net-Zero Ready Performance scenario.	2.3	1.4	1.7
Central ERV	Provide central energy recovery ventilation in place of the makeup air units. Exhaust from each suite will be centrally ducted to rooftop ERVs. This measure will ensure that all ventilation air is tempered through energy recovery, greatly reducing the ventilation heating load. It should be noted that this measure should be considered as theoretical, intended to present what is required to comply with the High Performance and Net-Zero Ready Performance scenarios, as it would cause significant changes to the conceptual design and would severely impact the cost and practicality of the project.	12.7	23.0	19.7
Domestic hot water heat pump	Provide an air source heat pump to provide domestic hot water heating. It should be noted that this measure should be considered as theoretical, intended to present what is required to comply with the High Performance and Net-Zero Ready Performance scenarios, as it would cause significant changes to the conceptual design and would severely impact the cost and practicality of the project.	6.9	0.0	13.6

Table 11: Measure summary

Measure	Recommendation	TEUI reduction	TEDI reduction	GHG reduction
LED lighting	Provide LED lighting fixtures throughout the facility.	3.63	-3.67	-1.21
Low flow water fixtures	Provide low flow hand washing faucets and shower heads.	3.59	6.51	5.58
Roof insulation enhancement	Provide roof insulation with an effective thermal resistance of R60.	0.16	0.32	0.30
Wall insulation enhancement	Provide wall insulation with an effective thermal resistance of R40.	1.36	2.64	2.26
Triple glazed windows	Provide triple pane windows with an assembly U value of 1 W/m ² /K. It should be noted that this measure should be considered as theoretical, intended to present what is required to comply with the High Performance and Net-Zero Ready Performance scenarios, as it would cause significant changes to the conceptual design and would severely impact the cost and practicality of the project.	7.80	15.31	12.89
90% WWR	Based on the conceptual design of the facility, a 90% window-to-wall ratio is assumed. This is in contrast to the OBC SB10 baseline which considers a 40% window-to-wall ratio.	-22.39	-17.73	-19.22
10% WWR	Reduce the window-to-wall ratio to 10%. This would cause significant changes to the conceptual design and would not meet the intent of the design, and should only be considered as a theoretical measure intended to present what is required to comply with the Net-Zero Ready Performance scenario.	11.53	9.86	10.47
Infiltration mitigation	Mitigate infiltration through the envelope through the use of spray-foam insulation and provision of sealing adhesive materials at construction transitions; as an alternative to adhesive, spray air-barriers (e.g. AeroBarrier) may be applied. Perform building leakage testing in accordance with ASTM E779 (this testing is necessary to account for the energy-savings associated with this measure under SB-10).	3.44	6.60	5.58
Solar PV	Provide rooftop solar PV. This measure assumed that 100% of the tower roof area can be used for solar PV. It should also be noted that this measure should be considered as theoretical, intended to present what is required to comply with the Net-Zero Ready Performance scenarios, as it would cause significant changes to the conceptual design and would severely impact the cost and practicality of the project.	1.18	0.00	0.38

Scenario composition

Groups of energy conservation measures, known as scenarios, were composed with the intent to achieve the targets outlined by VanMar Developments Inc.. Table 12 defines the scenarios that were analyzed.

Table 12: Scenario composition

Measure	High Performance	Net-Zero Performance
Air-source VRF	Yes	Yes
Demand control ventilation	Yes	Yes
Night temperature setbacks	No	Yes
Central ERV	Yes	Yes
Domestic hot water heat pump	Yes	Yes
LED lighting	Yes	Yes
Low flow water fixtures	Yes	Yes
Roof insulation enhancement	No	Yes
Wall insulation enhancement	No	Yes
Triple glazed windows	Yes	Yes
90% WWR	Yes	No
10% WWR	No	Yes
Infiltration mitigation	Yes	Yes
Solar PV	No	Yes

4.2 Scenario analysis results

The following sections outlines the results of the scenario analysis regarding the key metrics outlined by VanMar Developments Inc..

Table 13: Measure summary

Scenario	TEUI (ekWh/m2)	TEUI reduction (%)	TEDI (ekWh/m2)	TEDI reduction (%)	GHGI (kgCO2e/m2)	GHGI reduction (%)
Baseline	212	0	105	0	24.7	0
High Performance	117	45	59	44	4.5	82
Net-Zero Performance	67	69	39	63	2.5	90

4.3 Scenario analysis summary

Given the current conceptual design of the facility, meeting the Net-Zero Performance target of 60% TEDI reduction from the OBC baseline is very difficult. OBC SB10 prescriptive requirements state that the facility window-to-wall ratio may be no greater than 40%. Based on the conceptual design, the window-to-wall ratio used in the analysis for the proposed scenarios is 90%. Given the large window area of the proposed facility, there is no combination of the suggested energy conservation measures that are able to achieve the TEDI target without theoretical measures being analyzed as well. Measures are considered theoretical as they are either difficult to implement or would cause significant changes to the conceptual design. These measures have been highlighted in Table 10 and 11 and only been analyzed to present what would be required in theory to achieve the targets stated in the Net-Zero Ready Performance scenario.

4.4 Additional energy and carbon considerations

Additional criteria and considerations are listed below which have impacts on the carbon and energy performance of the facility and should be considered in the subsequent design phases.

- **Thermal bridging** will contribute significantly to the TEDI of the proposed facility. VanMar Developments Inc. should consider thermally broken balconies and window frames in order to reduce thermal bridging.
- **Embodied carbon** of materials and construction will contribute to the climate impact of the facility. The bulk of the embodied carbon content will stem from the likely use of steel framing and concrete. VanMar Developments Inc. should consider specifying steel with high (90%+) recycled content as well as low embodied carbon with high fly ash or slag content.
- **Thermal energy storage**, in the form of an ice battery, can be implemented to reduce peak cooling loads. Ice can be produced overnight by the cooling system when cooling loads are at their lowest, and thermal energy stored can be used to cool facility during the day. This will allow for a smaller chiller to be purchased, reducing capital costs. Additional electricity savings can be realized through the reduction of peak electricity consumption, and the electrical service size can be reduced.
- **Green roof.** Green roofs are able to further enhance energy efficiency by providing insulation, while serving as a local carbon sink. Additional benefits including the management of stormwater by reducing runoff and filtering pollutants, improved building aesthetics, promotion of biodiversity, and creation of spaces for relaxation. However, challenges such as high initial costs, potential water leakage, structural load considerations, and ongoing maintenance requirements must be addressed for successful implementation.
- **Battery energy storage system.** BESS should be considered for optimal operational carbon results. The benefits of BESS include energy resilience in the case of emergencies and the capability to maximize solar PV output.

4.5 Climate resiliency

Each of the recommended energy conservation measures will contribute to the climate resiliency of the facility. Different measure types and their impacts on resilience are noted below.

- **Improved controls and load reduction** measures such as demand control ventilation of energy recovery will increase the building's resiliency as temperatures rise and prolonged heat waves occur at greater frequency. During periods of extreme temperature, heating and cooling equipment is required to operate at or near capacity for increased operating times, contributing to higher thermal energy demand and wear on equipment, and in some cases may not have the capacity to maintain design output temperatures. With DCV and energy recovery the ventilation rates and associated thermal loads are reduced, which will increase the likelihood of maintaining comfortable thermal conditions during more frequent extreme weather events.
- **Increased thermal resistance** of the envelope will improve the climate resiliency of the building as the additional insulation and enhanced materials will reduce heat loss from the building in extreme cold and heat gain to the building in extreme heat. This will allow the building to maintain stable indoor air temperatures

in extreme heat/cold scenarios. Additionally, the higher quality envelope materials will increase durability against storms, heavy rain, and wind.

- **Solar PV** can enhance the climate resiliency of the building by generating on-site energy in cases of energy disruptions in extreme weather events. Coupling on-site electricity generation with a **Battery energy storage system** will optimize the facility's ability to provide back up power to critical system in the event of a power outage.

5 RECOMMENDATION

In order to improve the facilities climate resiliency, reduce its climate impact to be aligned with the City of Waterloo's goals, as well as reduce annual utility costs and improve the appeal of the facility for potential residents, it is recommended that VanMar Developments Inc. consider implementing the energy conservation measures in the **High performance scenario** while considering financial feasibility and limiting changes to the conceptual design.

6 END