1637 Bathurst
Energy Model Report

Prepared by:

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REG Project Number:
3015-17

Date:
December 5, 2019

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Revision Log

#	Date	Description
1.0	December 5, 2019	SPA submission

Signatures

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1.0 INTRODUCTION

1.1 OVERVIEW

This report presents the results of the energy model for the multi-unit residential development at 1637 Bathurst in Toronto, ON. For the purposes of applying to Tier 1 of the Toronto Green Standard: Version 3 the energy model was simulated with IES-VE v2019.1.0.0 to determine compliance with ASHRAE 90.1 – 2013, as amended by Division 3, Chapter 2 of the supplementary standard SB-10. Compliance requires the design team to demonstrate that the Proposed building does not exceed the Budget building, as described by the prescriptive requirements of the standards, in any of the following 4 criteria:

- Total building annual energy consumption: 15% minimum reduction
- Total building annual carbon dioxide equivalent emissions
- Total building peak electricity demand in the summer
- Total building peak electricity demand in the winter

1.2 MODEL INPUT

The footprint space distribution, building massing and envelope performance were based on architectural drawings and schematic design. The interior lighting power densities were assumed from previous similar projects. The HVAC and service hot water systems were based on the mechanical schematic design, or product literature where necessary. The energy simulations for the Proposed and Budget buildings were prepared using the Energy Cost Budget Method, described in Chapter 11 of the ASHRAE standard 90.1 – 2013. See Appendix B-2 for a detailed table of energy model inputs.

A summary of the key energy performance parameters of the Proposed building is given below:

Walls

- Metal stud wall with cavity and outboard insulation. Targeting effective R20

Windows (Fenestration and door to wall ratio (FDWR) = 45%)

- Double glazed, argon filled, Low E windows with thermally broken aluminum frames. Targeting project average effective: U-Factor = 0.40, Solar Heat Gain Coefficient (SHGC) = 0.35

Roof

- Concrete slab with continuous insulation. Targeting effective R25

Exposed Floor (Soffit)

- Concrete slab with continuous insulation. Targeting effective R15

Lighting

- Low lighting power densities in common areas. Assumed 15% reduction compared to SB-10: Table SB 9.5.1-2017 maximum prescriptive values.

HVAC

- Air source variable refrigerant flow system with variable speed fan coils (50% min. flow) for amenity areas and dwelling units. EER_C = 13.0, COP_H = 3.5
- Remote HRVs for dwelling units to deliver outdoor air based on bathroom count. Sensible effectiveness = 65%
    - 1 bathroom: High flow (2 hours per day) = 100 cfm, low flow (22 hours per day) = 50 cfm
    - 2 bathrooms: High flow (2 hours per day) = 150 cfm, low flow (22 hours per day) = 75 cfm
- Condensing, natural gas-fired (Thermal efficiency = 90%) and DX cooled (EER_C = 11.0), constant volume make-up air unit to deliver 30 cfm per door to corridors, ASHRAE 62.1 – 2010 outdoor air rates to amenity/service areas, and pressurize vestibules to 0.81 CFM/ft^2
- 2 x condensing natural gas fired boilers for service water heating. 5:1 turndown, 95% thermal efficiency. Storage tanks with 2’’ jacket insulation
- 15% reduction in hot water demand

Energy model inputs based on schematic design, best practice or previous similar projects. Confirmation required by design team for future iterations of energy model report

The simulated geometry of the building is shown in Figure 1.

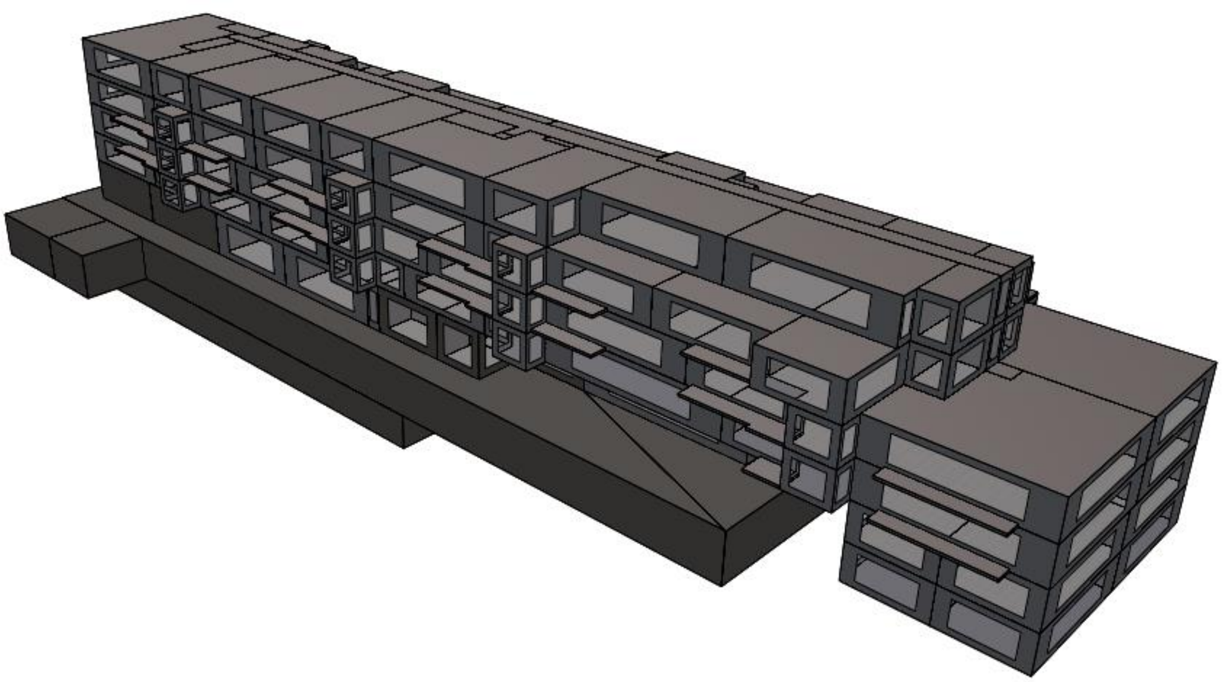
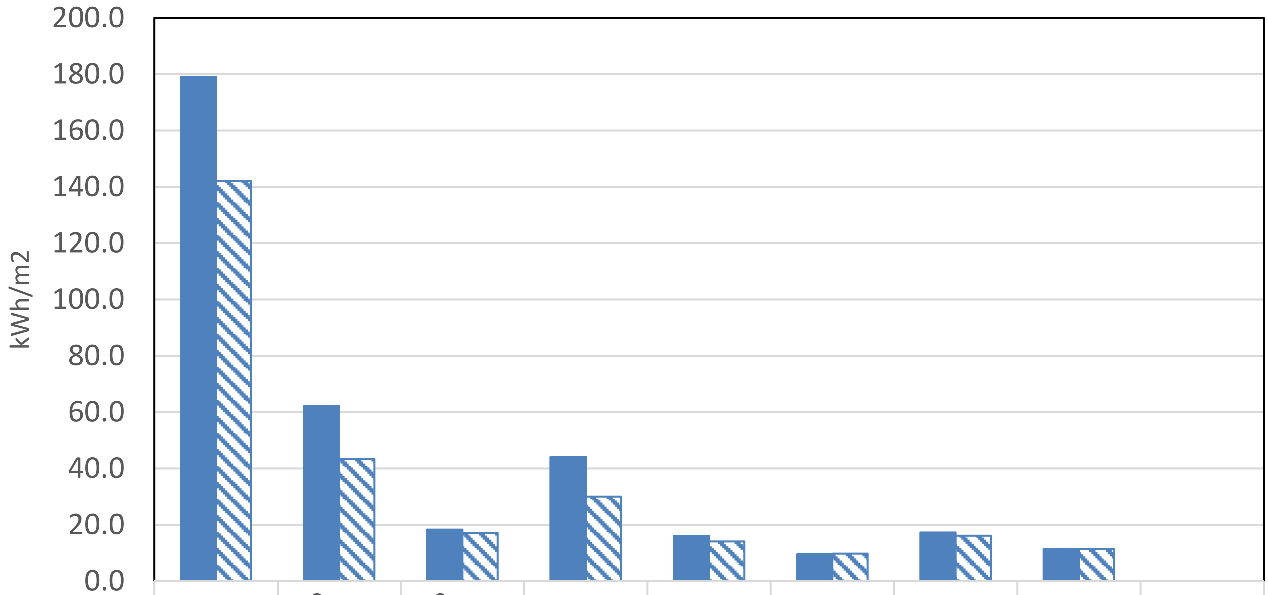


Figure 1: Simulated building geometry

2.0 RESULTS

2.1 ANNUAL ENERGY CONSUMPTION

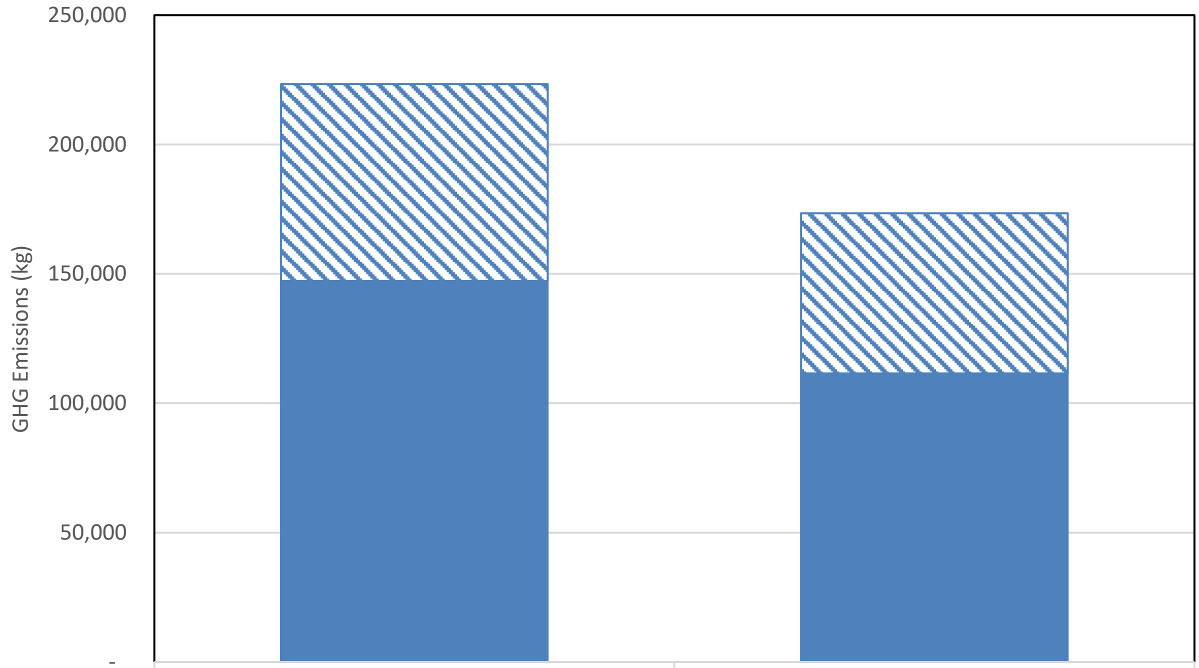


	Total	Space Heat (Elec.)	Space Heat (Gas)	Hot Water	Vent. Fans	Space Cool	Interior Lights	Misc. Equip.	Pumps & Aux.
Budget	179.1	62.3	18.3	44.1	16.1	9.5	17.3	11.4	0.1
Proposed	142.2	43.5	17.2	30.0	14.1	9.8	16.2	11.4	0.0

Figure 2: Annual energy use intensity by end use

The results indicate that the Proposed design was **20.6% more energy efficient** than the Budget design and met the 15% target for Toronto Green Standard Tier 1. Figure 2 shows the energy use breakdown by end use for the Proposed and Budget buildings. Large amounts of energy savings in hot water consumption, due to the assumed low flow plumbing fixtures and condensing service hot water heating, compounded with smaller amounts of energy savings from heat recovery ventilation and the VRF system with variable speed fan coils to result in an overall 20.6% increase in energy efficiency over the Budget design.

2.2 ANNUAL GREENHOUSE GAS EMISSIONS

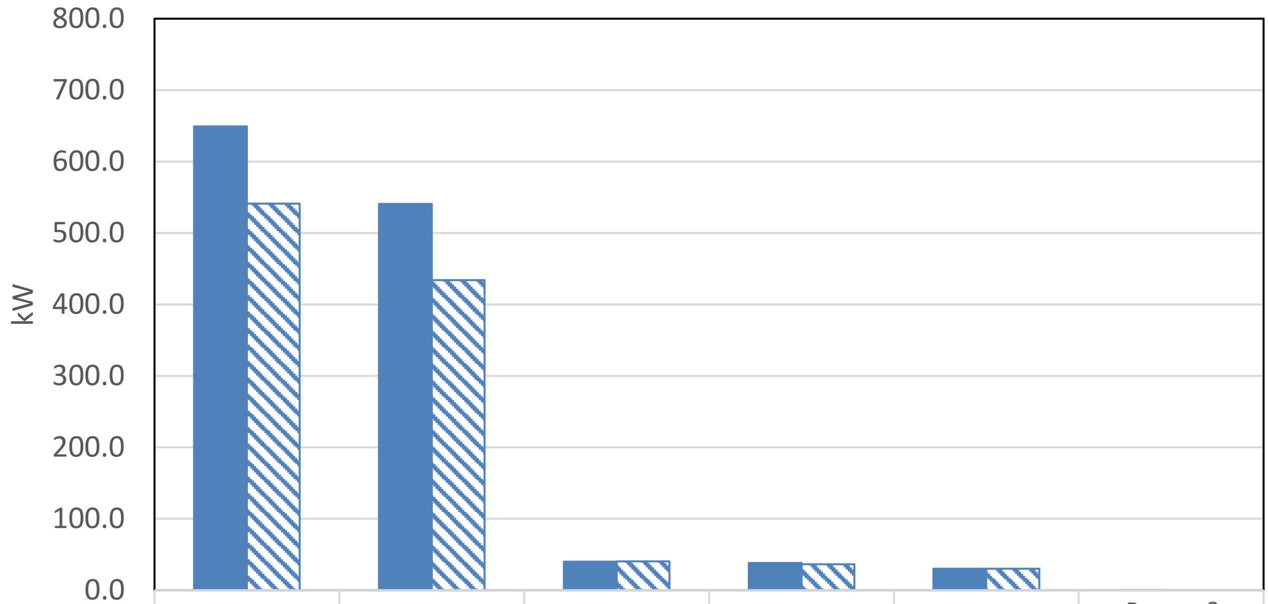


	Budget	Proposed
Electricity	76,109	61,899
Gas	147,250	111,547

Figure 3: Annual greenhouse gas emissions in kg of $CO2_e$ by energy source

With emissions factors obtained from Table 1.1.2.2. of SB-10 Ch. 1 Div. 3, Figure 3 shows that the Proposed design was able to demonstrate an overall **22.4% reduction** in greenhouse gas emissions. Electricity per unit of energy is considered to be a much cleaner fuel source in Ontario, thereby reducing the impact of electrical energy end uses to overall emissions. Even though electricity reductions were achieved, the majority of the overall emissions reductions were demonstrated by natural gas savings, through the assumed reduction in hot water demand and condensing service hot water heating boilers.

2.3 PEAK ELECTRICAL DEMAND (WINTER)

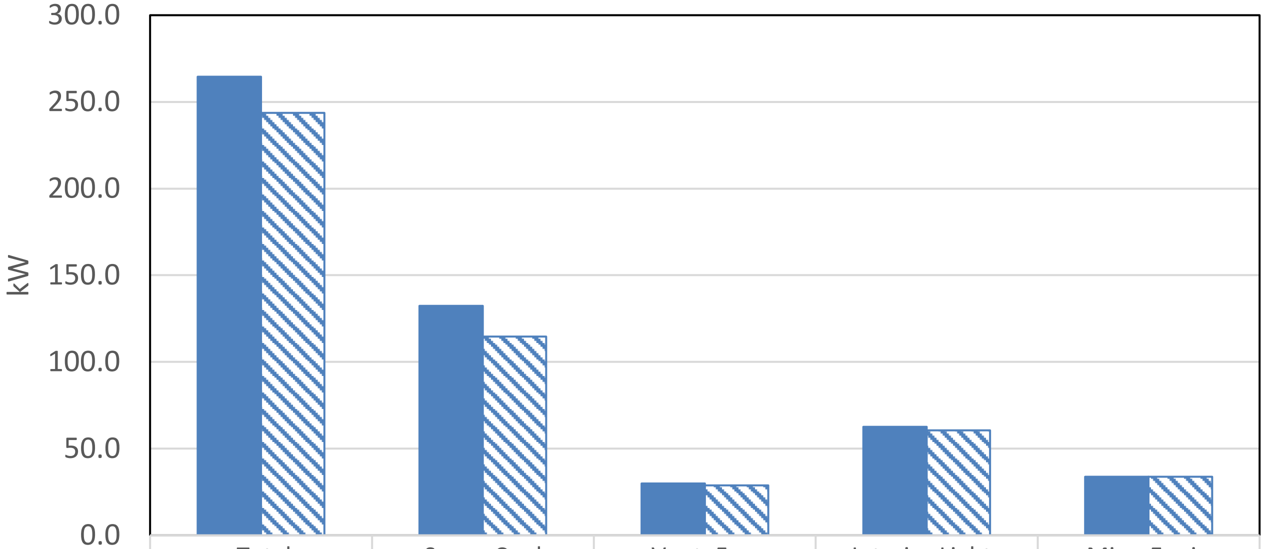


	Total	Space Heat	Vent. Fans	Interior Lights	Misc. Equip.	Pumps & Aux.
Budget	649.1	540.7	39.9	38.1	30.0	0.4
Proposed	541.1	434.0	40.4	36.7	30.0	0.0

Figure 4: Peak electrical demand by end use in the winter

Figure 4 shows that Proposed building had a peak electrical demand on December 20th at 7:30 AM, **16.7% lower** than that of the Budget building. There is a substantial heating load on December 20th based on the -4°F outdoor air temperature simulated in the weather file. The Proposed design was shown to be able to use heat pump heating (at reduced capacity), while the Budget building as per the prescriptive requirements of Energy Cost Budget Method from chapter 11 of ASHRAE 90.1, uses backup electric resistance below an outdoor air temperature of 40°F. The VRF's heating efficiency at these cold temperatures is the main reason the Proposed design was able to reduce peak electrical demand in the winter by over 100 kW.

2.4 PEAK ELECTRICAL DEMAND (SUMMER)



	Total	Space Cool	Vent. Fans	Interior Lights	Misc. Equip.
Budget	264.5	132.3	29.9	62.6	33.9
Proposed	243.7	114.6	28.8	60.7	33.9

Figure 5: Peak electrical demand by end use in the summer

Figure 5 shows that Proposed building had a peak electrical demand on August 1st at 6:30 PM, **7.9% lower** than that of the Budget building. Building summer peak conditions are primarily influenced by the amount of power required for cooling and fans. Despite slightly larger windows, increasing the Proposed building's solar gains, the highly effective VRF system and the ability of the fan coils to modulate fan speeds was shown to reduce peak electrical demand relative to the Budget building, in addition to small peak savings as a result of the low wattage lighting assumptions.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The results have shown that the Proposed design meets the energy, emissions and winter/summer peak electrical demand requirements of the Toronto Green Standard Version 3 Tier 1 as followed:

- 20.6% less annual energy consumption
- 22.4% less annual greenhouse gas emissions
- 16.7% decreased peak electrical demand in the winter
- 7.9% decreased peak electrical demand in the summer

The Toronto Green Standard compliance forms can be found in the Appendix.

It is the responsibility of the design team to review the energy model inputs to ensure that they are consistent with the intended design.

NOTE: While all efforts have been made to produce an accurate estimation of annual energy consumption, software limitations, as-constructed design parameters, actual building operation and maintenance may result in substantially different energy consumption than the results presented in this report. This report has been produced to demonstrate compliance with the applicable energy code and shall not be used as a contract document for tendering or pricing.

Appendix A-2

Better Building Partnership-Toronto Green Standard Energy Efficiency Report

APPENDIX-A2 (Relative Performance Targets Pathway)
Better Buildings Partnership
TORONTO GREEN STANDARD
Energy Efficiency Report

PROJECT INFORMATION:

Project Address:	**64-86 Bathurst**
SPA Number:	
Date(dd-mm-yyyy):	**05-12-2019**
Building Type:	**Low Rise Multi-Unit Residential Building**
Total Modeled GFA (m^2):	**13,044.63**
Energy Simulation Software Used:	**IES-VE v2019.1.0.0**

Energy Modeller Information:

Company Name: **Reinbold Engineering Group** Contact Person: **Richard Outtrim**
email: Routtrim@reg-eng.com Telephone # **403-313-7523**

Architect Information:

Company Name: **WZMH Architects** Contact Person: **Len Abelman**
email: Labelman@mzmh.com Telephone # **416-961-4111 (346)**

Select Reference Code Compliance Path: **OBC SB-10 (2017) Division 3 Chapter 2 - ASHRAE 90.1-2013**

	Reference Building						Proposed Building						Energy Savings			
Energy End Use	Electrical Annual Consumption (kWh)	Natural Gas Annual Consumption (kWh)	EUI kWh/m^2	GHGI[a] $kgCO^2e/m^2$	Peak Demand Summer kW	Peak Demand Winter kW	Electrical Annual Consumption (kWh)	Natural Gas Annual Consumption (kWh)	Energy Use Intensity (kWh/m^2)	GHGI[a] $kgCO^2e/m^2$	Peak Demand Summer kW	Peak Demand Winter kW	Peak Demand Summer kW	Peak Demand Winter kW	Total Annual Consumption (kWh)	Energy Efficiency above Base Case %
Lights	226,024.20		17.33				210,696.00		16.15						15,328.20	
Misc.Equipment	148,597.60		11.39				148,597.60		11.39						0.00	
Space Heating	812,651.80	238,831.90	80.61				567,141.70	224,811.90	60.71						259,530.10	
Space Cooling	124,179.00		9.52				120,549.10		9.24						3,629.90	
Heat Reject			0.00				6,954.40		0.53						-6,954.40	
Pumps	1,258.10		0.10						0.00						1,258.10	
Fans	209,470.30		16.06				184,033.50		14.11						25,436.80	
Service Hot Water	575,350.00		44.11					391,956.50	30.05						183,393.50	
Others			0.00						0.00						0.00	
Totals	**2,097,531.00**	**238,831.90**	**179.11**	**11.35**	**264.5**	**649.1**	**1,237,972.30**	**616,768.40**	**142.18**	**13.30**	**243.7**	**541.1**	**20.8**	**108.0**	**481,622.20**	**20.6%**

a. GHGI is automatically calculated using the emission factor extracted from SB10 (0.05kg of CO^2 /kWh Electric & 1.899kg of CO^2 /m^3 Nat. gas). ($1m^3$ = 10.5ekWh)
b. TEDI value require input. See Energy Terms of Reference and Energy Modeling Guideline V3 for TEDI definition. Supporting calculation required to review TEDI value.

Total Annual Heat Demand for TEDI (kWh) 1,138,119.40

TEDI[b] (kWh/m^2) **87.2**

Please see Appendix-C for the calculation

I herby certify that the energy demand and consumption are properly representative of the Energy Modelling Report submitted for the above project.

Energy Modeller Name: **Richard Outtrim M.A.Sc., P.Eng, BEMP**

Signature: Digitally signed by Richard Outtrim Date: 2019.12.05 08:16:54-07'00'

Architect Name: Len Abelman- WZMH Architects

Signature:

Appendix B-2

Better Building Partnership-Toronto Green Standard Energy Modelling Simulation Summary Report

Project name:	1637 Bathurst	**Date:**	December 5, 2019
Project number:	3015-17	**Location:**	Toronto, ON
Rating System:	Toronto Green Standard Version 3	**Heating Degree Days:**	3520
Baseline:	SB-10 Div. 3 Ch. 2 (ASHRAE 90.1 - 2013)	**Climate Zone:**	5A

Design Parameters Description / Name	Proposed Building	Reference the relevant plans, drawings or reports
Schedules:	NECB Schedules for Occupancy, Lighting and Misc Loads	Energy model assumption
Space Use Classification	Multi-unit residential building	
Conditioned Floor Area (m2)	12,604	Archictectural drawings
Total Floor Area (m2)	13,045	Archictectural drawings
Window Wall Ratio		
Gross Wall Area (m2)	5,342	Archictectural drawings
Window Wall Ratio	45.0%	Archictectural schematic design
Skylight Roof Ratio		
Gross Roof Area (m2)	2,599	Archictectural drawings
Skylight Area (m2)	0	Archictectural drawings
Skylight Roof Ratio	0.0%	Archictectural drawings

Passive Design Strategies/Elements:	
None	

	Design Parameters Description / Name	Budget Building	Proposed Building	Reference the relevant plans, drawings or reports
Envelope	Walls	Steel framed: U = 0.050	Targeting R20	Archictectural schematic design
	Window	Metal framing (fixed): U = 0.38, SHGC = 0.40 Metal framing (operable): U = 0.45, SHGC = 0.40 Assumed 1:4, operable to fixed Max. FDWR = 40%	Average: U-Factor = 0.40 SHGC = 0.35 FDWR = 45%	Archictectural schematic design
	Roof	Insulation entirely above deck: U = 0.029	Targeting R25	Archictectural schematic design
	Below Grade Roofs	Insulation entirely above deck (Semi Heated): U = 0.057	R0.78: Uninsulated concrete	Archictectural schematic design
	Exposed Floor (Soffit)	Mass floor: U = 0.046	Targeting R15	Archictectural schematic design Envelope Summary
	Below Grade Walls	Below Grade Wall (Semi-Heated): C = 0.119 Below Grade Wall (Residential): C = 0.067	Uninsulated concrete (C-Factor = 1.14)	Archictectural schematic design
	Slab on Grade	Unheated (Residential): F-Factor = 0.459	Uninsulated concrete (F-Factor = 0.73)	Archictectural schematic design
	Infiltration	0.05 cfm/ft2 vertical surface area	0.05 cfm/ft2 vertical surface area	City of Toronto *Energy Efficiency Report Submission & Modelling Guidelines*
Lighting	Workshop	12.3 W/m2	15% reduction in lighting power density	Energy model assumption
	Multi-Purpose	11.5 W/m2		
	Lobby (other)	10.8 W/m2		
	Lobby (Elevator)	7.3 W/m2		
	Corridor (other)	7.1 W/m2		
	Storage Rooms	6.8 W/m2		
	Stairway	6.2 W/m2		
	Loading Dock, Interior	6.2 W/m2		
	Electrical/Mechanical Rooms	4.6 W/m2		
	Storage Garage, Interior	1.5 W/m2		
	Dwelling Units	7.3 W/m2	7.3 W/m2	ASHRAE default OBC SB-10: Table SB 9.5.1-2017
Plug Loads	Workshop	10.0 W/m2	10.0 W/m2	Default: NECB 2015: Tables A-8.4.3.2.(2)-A/B
	Dwelling Units	5.0 W/m2	5.0 W/m2	
	Electrical/Mechanical, Multi-Purpose, Lobbies, Storage	1.0 W/m2	1.0 W/m2	
	Stairways, Corridors, Parking, Loading Dock	0 W/m2	0 W/m2	
Other	Emissions Factors	Similar to proposed	Natural Gas: 1.899 kgCO2e/m3 Electricity: 0.05 kgCO2e/kWh	OBC SB-10: Table 1.1.2.2.

	Design Parameters Description / Name	Budget Building	Proposed Building	Reference the relevant plans, drawings or reports
HVAC Equipment	Parking Area, Interior (EF only)	Similar to proposed	Exhaust fans to cycle based on CO sensor. Average equivalent of 4h/day operating time.	Mechanical schematic design
	Dwelling Units (VRF + HRV)	System 8: Packaged terminal heat pumps, with DX cooling and single speed fans. Electric resistance auxiliary heat when OA temperate below 40 degF. EERC = 10.0, COPH = 3.0	Air-source VRF system with variable speed fan coils (50% min. flow) and remote HRVs. EERC = 13, COPH = 3.8. See Heat Recovery for ventilation.	Mechanical schematic design
	Amenity: Multi-Purpose, Gym (VRF + CMUA)	System 8: Packaged terminal heat pumps, with DX cooling and single speed fans. Electric resistance auxiliary heat when OA temperate below 40 degF. EERC = 10.0, COPH = 3.0	Air-source VRF system with variable speed fan coils (50% min. flow). EERC = 13, COPH = 3.8. See CMUA for ventilation.	Mechanical schematic design
	Corridor Pressurization (CMUA)	System 10: Packaged terminal air conditioner with single speed fan and hot-water fossil fuel boiler. See Heating Plant for hot water loop. EERC = 12.2	Natural gas-fired and DX cooled, constant volume make-up air unit to provide 30 cfm per door, ASHRAE 62.1 OA rates to amenity, and pressurize lobbies to 0.81 cfm/ft2. EER = 11.0, thermal efficiency = 90%.	Mechanical schematic design Energy model assumption
	CACF Room (EMUA)	System 8: Packaged terminal heat pump with single speed fan, no cooling. Electric resistance auxiliary heat when OA temperate below 40 degF. COPH = 3.0	Constant volume electric mini make up air unit	Mechanical schematic design
	Fans	Fan power allowances: EF/TF: 0.49 W/CFM CMUA: 0.72 W/CFM EMUA: 0.54 W/CFM PTHP (VRFs): 0.64 W/CFM PTHP (EUHs): 0.54 W/CFM Exhaust and OA flow rates and fan power similar to proposed	EF/TF: 0.40 W/CFM CMUA: 0.75 W/CFM EMUA: 0.80 W/CFM VRFs: Average 0.40 W/CFM EUHs: Average 0.20 W/CFM	Mechanical schematic design Energy model assumption
	Lobbies, Exit Stairways, Electrical/Mechanical (EUHs)	System 8: Packaged terminal heat pumps with single speed fans, no cooling. Electric resistance auxiliary heat when OA temperate below 40 degF. COPH = 3.0	Electric, constant volume unit heaters.	Mechanical schematic design

	Design Parameters Description / Name	Budget Building	Proposed Building	Reference the relevant plans, drawings or reports
HVAC Equipment	Heating Plant	Natural draft boiler, 300 MBH < Capacity > 600 MBH: 3:1 turndown ratio, thermal efficiency 90%	None.	Mechanical schematic design
	Pumps	Hot Water (19 W/gpm) Pumps exceeding 7.5 kW required to have VSD	None.	ASHRAE default: Table 11.5.2-1 f
	Heat Recovery Ventilation	VRFs and CMUA exempt under clause 6.5.6.1.8	Residential HRVs to run on high for 2 hour/day Sensible effectiveness = 65%, Exh/Sup. Power = 0.50 W/cfm 1 bathroom: High: 100 cfm, Low: 50 cfm 2 bathroom: High: 150 cfm, Low: 75 cfm	Mechanical schematic design
Domestic Hot Water	Residential DHW	Similar size as proposed. 3:1 turndown, thermal efficiency 80% Storage tanks with R2.2 insulation	Condensing natural gas-fired boiler, 5:1 turndown, thermal efficiency = 95%. 2 x 500 gal storage tanks with 2" jacket insulation	Mechanical schematic design
		Lavatory Faucets, 8.35 LPM Shower Heads, 7.6 LPM Residential load 500 W/occ, 247 occupants Multi-Purpose load 45 W/occ, 40 occupants	15% reduction in hot water demand Residential load 425 W/occ, 247 occupants Multi-Purpose load 38.3 W/occ, 40 occupants	Mechanical schematic design

Appendix C
Better Building Partnership-Toronto Green Standard Thermal Energy Demand Intensity (TEDI) Documentation

APPENDIX-C

Better Buildings Partnership - Toronto Green Standard

Thermal Energy Demand Intensity (TEDI) Documentation

Date(dd-mm-yyyy):	05-12-2019
Project Name and Address:	1637 Bathurst (64-86 Bathurst)

Peak Heating Load

The peak heating load of the building considers energy gained or lost due to envelope conduction, internal gains, and air infiltration. Outside air ventilation loads are excluded.

eQUEST: The peak heating load of the building can be found in the LS-C report under Total Load, Heating Load

IES: Using VistaPro to look at the Room Heating Loads (.htg file), sum the "Space conditioning sensible" variable for all rooms in the model.

EnergyPlus: In 'Output Reporting - Output:Table:Summary Reports' field in the idf file of the EnergyPlus model, add the report 'Facility Component Load Summary', and find the report after simulation. Use the 'Grand Total' in the column of 'Total [W]' of the table 'Estimated Heating Peak Load Components'.

Total Peak Heating Load (kW):	**446.00**	Notes / Source

Provide a complete summary of the annual space heating energy delivered to the building spaces.

Hydronic Space Heating

The space heating energy provided by all hydronic loops in the model is summed to determine a total hydronic heating load.

eQUEST: The space heating load for each loop can be found in Report PS-D under Coil Load, Sum

IES: Using VistaPro to look at the HVAC network, select the "HWL space heating load" variable for each loop under Waterside: Hot water loops

EnergyPlus: in the 'Energy Meters - Annual and Peak Values - Other' report, use the 'Plant Loop Heating Demand: Facility' maximum value [W].

Modelled Hydronic Loop Name	Space Heating Load (GJ)	Notes / Source
Total Hydronic Heating Load (GJ)	**0.00**	

Direct Space Heating (e.g. Furnace, Direct Fire, Electric Resistance, Unit Heater, Force Flow)

The space heating energy provided by all direct heat sources in the model is summed to determine a total direct space heating load.

eQUEST: The space heating load for each heat source can be found by running an hourly report for each applicable system under Variable Type: HVAC Systems, 'Total Central/Zone Heat Coil Output' or by reviewing the SV-A report as applicable.

IES: Using VistaPro to look at the HVAC network, select the "GHS space heating load" variable for each heat source under Plant equipment: Generic Heat Sources

EnergyPlus: in the 'HVAC Sizing Summary - Zone Sensible Heating' report, use 'Calculated Design Load'.

Modelled Heat Source Name	Space Heating Load (GJ)	Notes / Source
CMUA Furnace	937.54	
Electric Resistance	217.29	
Total Direct Space Heating Load (GJ)	**1,154.83**	

Heat Pump Heating

The space heating energy provided by all heat pumps in the model is summed to determine a total heat pump heating load.

eQUEST: The space heating load for each heat pump can be found by running an hourly report for each applicable system under Variable Type: HVAC Systems, 'Total Central/Zone Heat Coil Output' or by reviewing the SV-A report as applicable.

IES: Using VistaPro to look at the HVAC network, select the "HTL heating load" variable for each loop under Waterside: Heat transfer loops

EnergyPlus: in the 'HVAC Sizing Summary - Zone Sensible Heating' report, use 'Calculated Design Load'.

Modelled Heat Pump Name	Space Heating Load (GJ)	Notes / Source
VRF	2,938.80	
Total Heat Pump Heating Load (GJ)	**2,938.80**	

Gross Floor Area (m2)	13,044.63
Total Heating Load (GJ)	4,093.63
TEDI (kWh/m2)	**87.17**