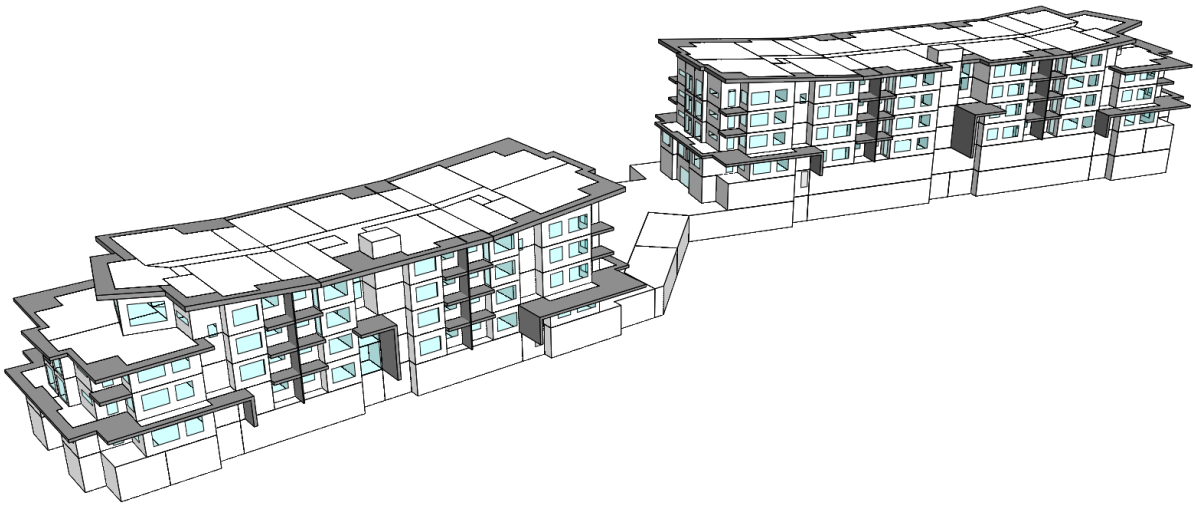
19036 Parcel A – 1340 & 1360 Mt Fee Road

Energy Model Report

NECB 2015 for CMHC

12/22/2021 Rev 0

FOCAL ENGINEERING



Prepared by:
Focal Engineering Inc.
467 John Street
Victoria, BC, V8T 5H1
250-516-6088

Prepared for:
Whistler 2020 Development Corporation
604-938-4278

Revision History

Revision Number	Date	Description
0	12/22/2021	Initial report issue

Table of Contents

1 INTRODUCTION

The Parcel A project is a new construction mixed-use residential project to be built at 1340 & 1360 Mt Fee Road in Whistler, British Columbia. The project consists of 2 4-story, wood-framed residential buildings containing 100 suites total with shared below-grade parking levels. Key building characteristics are summarized in Table 1.

Table 1: Key Building Characteristics

Parameter	Value	Notes
Authority Having Jurisdiction (AHJ)	Resort Municipality of Whistler	
Climate Zone	6 (4000 < HDD < 5000)	Per BCBC 2018 and NECB 2015
Project Floor Area (m^2)	9,139	Excluding parkade area
Area Use Category	Residential, Part 3	
# Residential Suites	100	
Parking Area (m^2)	3,915	

This report summarizes the energy model for this project for the purposes of demonstrating percentage improvement vs the National Energy Code for Buildings (NECB) 2015 as an eligibility requirement for the Canadian Mortgage and Housing Corporation (CMHC) Green Home program. This program requires the project demonstrate at least 20% energy and greenhouse gas emissions savings over an NECB 2015 reference building design, as the current applicable building code under the BCBC. The project has been designed to meet the Step 3 of the BC Energy Step Code as required by the AHJ.

2 METHODOLOGY

The project was simulated using IES-VE 2018 building performance simulation software for the purpose of NECB 2015 energy comparison at Tender drawing design. Two models, a proposed and a reference building, were simulated for this purpose with both sets of inputs and results provided in this report. The NECB 2015 proposed model closely follows the methodology of the proposed Step Code model, issued at building permit, with a few differences.

2.1 Information References

The following codes and standards have been referenced for this report:

- BC Building Code (BCBC) 2018
- National Energy Code of Canada for Buildings (NECB) 2015
- EGBC Professional Practice Guidelines – Whole Building Energy Modelling Services (V1.0)

The following project specific documentation was referenced for the energy model inputs with additional information obtained in discussion with the consultants, post-BP addendums, and design revisions. The model was based on the following drawings sets:

- Architectural drawing set, issued for Tender by Murdoch & Company, November 9, 2020
- Mechanical drawing set, issued for BP by CADA and Associates Consulting, September 4, 2020
- Electrical drawing set, issued for BP by CADA and Associates Consulting, September 4, 2020

2.2 Climate

The *Whistler-Nesters CWEC 2016* file was used for weather data for the model simulation as the nearest, appropriate representative location. Table 2 summarizes the CWEC 2016 climate file alongside BCBC design conditions.

Table 2. Climate Data

	Heating Degree Days 18°C	Climate File Max	Climate File Min	Winter Design (1%)	Summer Design (2.5%) (db/wb)
BCBC Design	4180	---	---	-20 °C	30/20 °C
CWEC 2016 Climate File	4351	37.2	-15.6	---	---

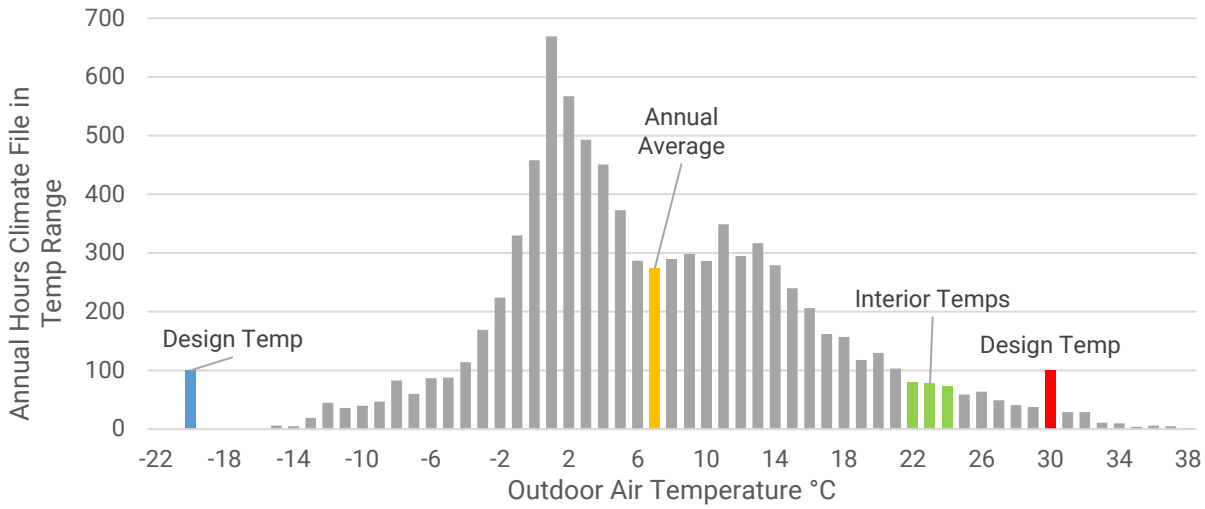


Figure 1. Weather File Temperature Distribution

The climate in Whistler covers a wide range of temperatures requiring high performance envelope and mechanical systems to reduce heating loads and an effective passive cooling strategy to managing thermal comfort through the summer.

2.3 Site and Geometry

The project site is located at 1251 Cheakamus Lake Road in Whistler, BC. Building geometry was modelled in detail based on architectural drawings including shading from overhangs, balconies, and privacy screens. External shading devices are not modelled in the reference building following NECB Part 8 requirements.

Located in the Whistler Valley the site has mountains to the west and east which limit direct daylight hours. A shading mask representing site lines to the mountains surrounding the site was created and included in the model. True North is 65° west of plan north.

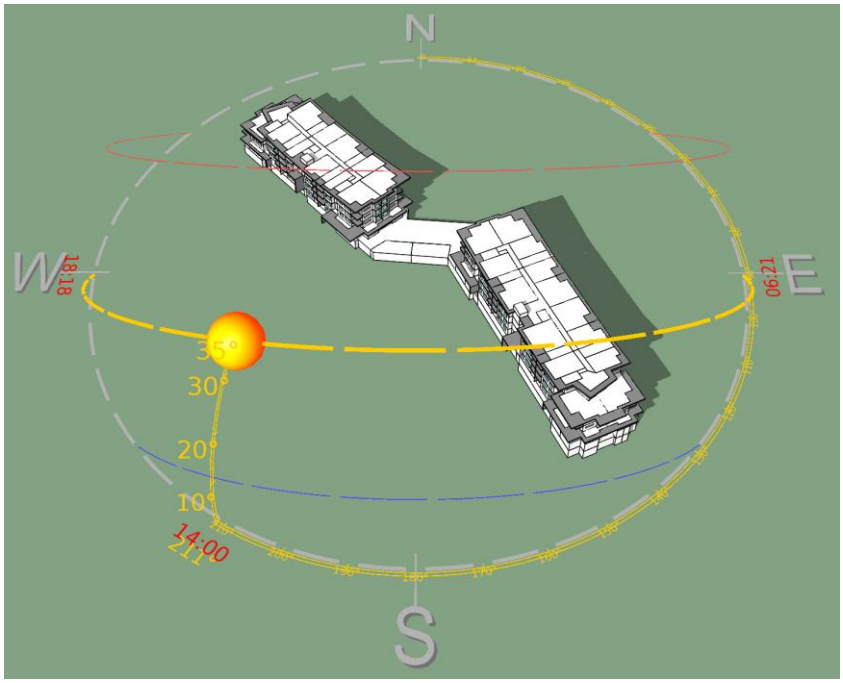


Figure 2. Proposed Energy Model – Orientation

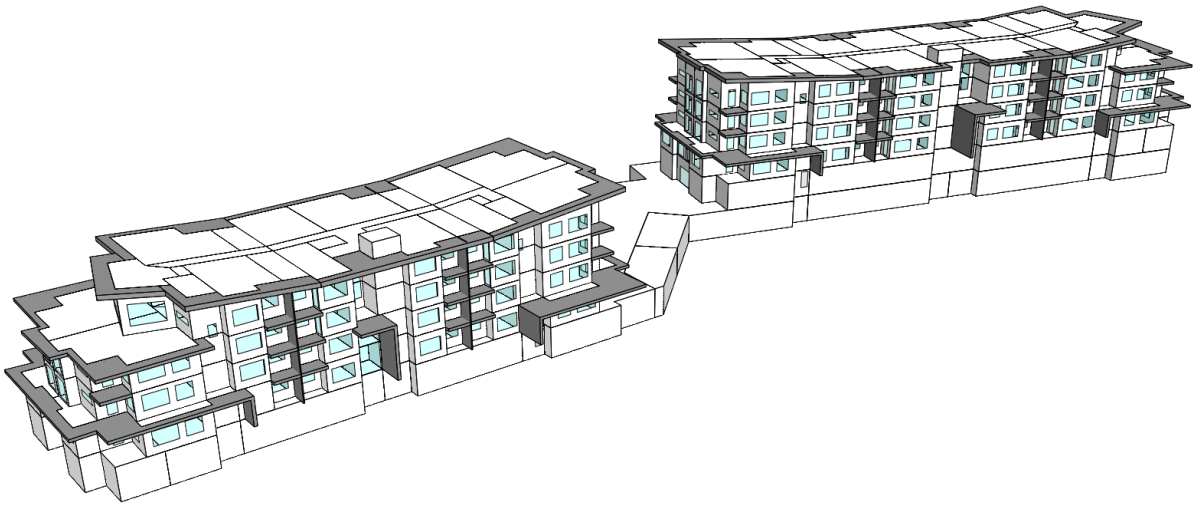


Figure 3. Proposed Energy Model – Southwest Perspective

3 MODEL INPUTS

The project uses a variety of high-performance building strategies to achieve compliance with the project's performance requirements. A detailed Model Inputs Summary is included in Appendix A1; key features are summarized in Table 3.

Table 3. Key Inputs

Building Envelope	Inputs	
	Proposed Model	**Reference Model**
Air Tightness (infiltration)	0.38 L/s/m^2 of vertical façade continuous at operating pressure modelled, 0.25 L/s/m² above grade envelope per NECB part 8. Equivalent to a tested air tightness of 1.67 L/s/m^2 above grade enclosure area at a testing pressure of 75 Pa.	Same as proposed
Exterior Wall W3.X	U_{SI} 0.221 W/m²K (R_{IP} 25.7 ft²°F/(Btu/hr)) 2x6 framed wall with rainscreen, R22 glass fibre in cavity. 1.5" of exterior mineral wool insulation, R4/inch.	U_{SI} 0.247 W/m²K (R_{IP} 23.0 ft²°F/(Btu/hr)) NECB CZ6 prescriptive exterior wall.
Insulated Floor Over Parkade F4	U_{SI} 0.233 W/m²K (R_{IP} 24.4 ft²°F/(Btu/hr)) Suspended slab parkade ceiling under conditioned space. 5" spray insulation below, 1.5" EPS rigid insulation above slab, vinyl plank finish.	U_{SI} 0.310 W/m²K (R_{IP} 31.0 ft²°F/(Btu/hr)) NECB CZ6 prescriptive floor.
Roof Assemblies R1 and R2	U_{SI} 0.155 W/m²K (R_{IP} 36.6 ft²°F/(Btu/hr)) 6" continuous polyiso insulation above roof deck	U_{SI} 0.183 W/m²K (R_{IP} 31.0 ft²°F/(Btu/hr)) NECB CZ6 prescriptive roof.

Glazing	U_{SI} 0.90 W/m²K SHGC 0.26 (fixed) U_{SI} 1.02 W/m²K SHGC 0.23 (operable) U_{SI} 1.02 W/m²K SHGC 0.20 (doors) Vinyl framed, triple glazed, low-e coating, windows. 22% fenestration and door to wall ratio (FDWR).	U_{SI} 2.20 W/m²K NECB CZ6 prescriptive windows. Same SHGCs as proposed. 39% FDWR (per NECB 3.2.1.4).

Mechanical	**Input**	
	Proposed Model	**Reference Model**
Suites	In-suite HRVs providing continuous ventilation with 67% sensible recovery efficiency on exhaust air. In-suite electric baseboard space heating.	System 1 HVAC per NECB table 8.4.4.7-A: Direct ventilation with no heat recovery configured as in proposed, electric baseboard heating. Same ventilation rates and schedule as proposed. No heat recovery ventilation.
Corridors	Corridors pressurized with makeup air units with electric resistance coils tempering outdoor supply air.	Same system, air flow rates, and operation as proposed.
Parkade	Hydronic unit heaters throughout parking providing freeze protection, served by gas fired boilers. Hydronic snow melt system served by gas-fired boiler.	System 4 HVAC system per NECB, hydronic baseboard heating for anti-freeze served by gas fired boiler. Same snow melt system as proposed.
Domestic hot water	Occupant DHW loads per NECB by space type. DHW low-grade heating water provided by Cheakamus Crossing District Energy System (annual average COP 2.8), top-up heat to 60°C from 95% gas -boilers on site.	Same loads as proposed. Two 83% efficient natural gas boilers. Natural draft.

Electrical	Input	
	Proposed Model	**Reference Model**
Lighting Power Density (LPD, building avg.)	3.8 W/m^2	4.4 W/m^2
Plug Load Density (building avg.)	4.1 W/m^2	Same as proposed

3.1 Infiltration and Airtightness

The air leakage rate in both models is based on the NECB value of 0.25 L/s/m² of above grade envelope enclosure at operating volume. This corresponds to a modelled infiltration rate of 0.38 L/s/m² of vertical façade area at operating pressure and an air leakage value of 1.67 L/s/m^2 of enclosure area at 75 Pa. For details, other metrics and rates, see Appendix A2. Note that this is a modelling value set by the NECB and the project is targeting a more airtight design based on previous project experience as outlined in Appendix A2 and the BP Step Code energy model. However, the NECB 2015 does not allow credit for airtightness and so the prescribed infiltration rate is used in both proposed and reference models.

3.2 Lighting Power

Proposed lighting power was modelled for each space, using information from electrical BP lighting plans. Fixture powers were referenced from the BP schedules for common spaces and based on a lighting package from the architect for residential space, except for suites which are modelled with a LPD of 5 W/m² per NECB section 8.4.4.5-2. Exterior lighting was calculated from takeoffs of the drawings and is modelled with a photosensor controller for operation schedule.

Reference model lighting powers were determined based on space use types and NECB section 4.2.

4 RESULTS

4.1 Summary

Table 4 gives a summary of the energy model results. Emissions factors for electricity and natural gas from the City of Vancouver Energy Modelling Guidelines have been references for BC Hydro and Fortis BC utilities.

Table 4. Energy Model Results Summary

Parameter	Proposed Building	NECB 2015 Reference Building	Savings (%)
Annual Energy (MWh)	1258.9	1900.3	34%
Annual GHG (tons CO_{2e})	60.4	129.6	53%

The proposed design meets and exceeds the 20% savings over the building code base design threshold of the CMHC Green Homes program. The results for energy and GHG both models with relative savings indicated are shown Figure 4 with colours corresponding to end uses as described in section 0. The NECB unmet load hour requirement is met by both models.

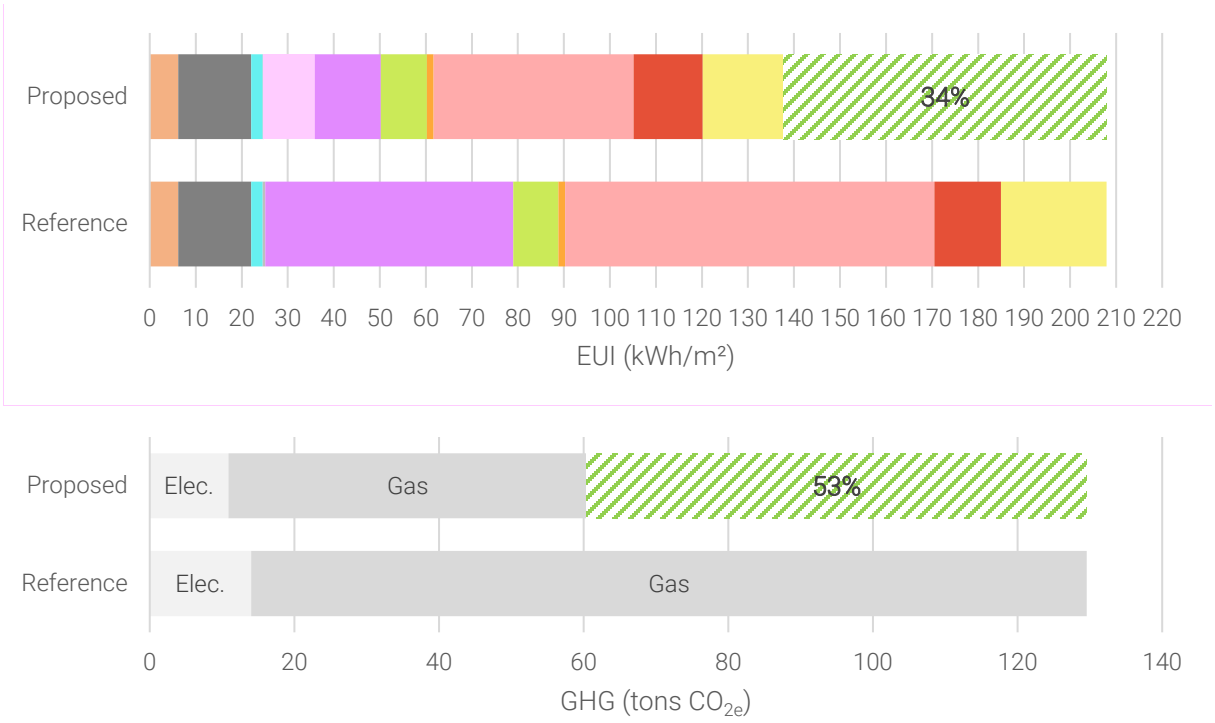


Figure 4. NECB Energy Model Results

4.2 Energy-End Use Breakdown

While the results in Table 4 indicate that the proposed design will meet the energy and GHG savings requirements, the energy end-use breakdown in Table 5 provides an indication of how much energy will be used annually by each system within the building and where savings are found.

Table 5: Energy End-Use Breakdown

	End-Use Category	Proposed Energy (MWh)	Reference Energy (MWh)	Savings (%)
	Interior Lighting	209.7	160.6	23%
	Heating - Gas	132.5	137.2	-4%
	Heating - Elec	733.1	397.7	46%
	Pumps	13.1	13.1	0%
	Fans	90.1	91.6	-2%
	Service Water Heating – Gas	491.9	130.5	73%
	Service Water Heating – Elec	0.0	101.5	0%
	Exterior Lighting	5.3	2.2	59%
	Elevators	23.2	23.2	0%
	Plug and Process	144.5	144.5	0%
	Snow Melt – Gas	56.7	56.7	0%
	Total Electricity (MWh)	991.2	1275.8	22%
	Total Natural Gas (MWh)	267.7	624.5	57%
	Total Energy (MWh)	**1258.9**	**1900.3**	**34%**
	Total GHG (tons CO_{2e})	**60.4**	**129.6**	**53%**

Heating energy is a significant source of energy savings due to the high-performance envelope assemblies, in particular the windows, and the use of heat recovery ventilation. Due to the high emissions rate of gas versus electricity, the proposed building also demonstrates significant GHG savings the low-grade water connection to the District Energy System. Lighting savings from the efficient LED design also provide notable electricity savings.

4.3 Actual Operation vs Energy Model

The purpose of the energy modelling summarized in this report is intended for the purposes of evaluating a design against an NECB reference building design. In order to compare against the NECB reference, many modelling methodologies and inputs are prescribed and must be followed. While many of these inputs are realistic, there are many uncertainties that cannot be know at this time, that will impact actual performance. As a result, the results are considered to only be a reasonable approximation of the actual building energy use. A useful analogy is fuel efficiency ratings of vehicles. Ratings are determined under specific conditions to allow for useful comparisons, actual fuel economy will depend on many factors that vary with user.

5 CLOSING

The NECB 2015 energy modelling has been completed for Parcel A project based on the Building Permit and Tender phase design. The project as designed demonstrates 34% energy savings and 53% GHG savings over the NECB 2015 reference building design thus meeting the CMHC Green Home requirement of 20% savings.

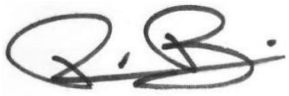
Should you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Modelled by:

Danny Taylor, CHPC
Senior Energy Modeller
250.516.6088 x3 | danny@focaleng.com

Reviewed by:



Riley Beise, P.Eng., BEMP, CPHD
Principal | Building Performance Engineer
250.661.3817 | riley@focaleng.com

December 22, 2021
Permit to practice no:
1001572

APPENDIX A1

DETAILED MODEL INPUTS SUMMARY

Energy Model Inputs Summary

General

Project	19036 Whistler Parcel A	
Project Description	2 Buildings; 4-storey residential rentals with below grade parking	
Modelled floor area [m²]	9139	
Location	Whistler, BC	
Orientation	True North is 65° W of Plan North	
Weather File	Whistler-Nesters CWEC 2016	
Climate Zone	NECB Climate Zone 6 (4000 < HDD < 5000)	
Heating Degree Days	4180 HDD 18°C	
Design Temperatures	Heating (1%)	-20°C
	Cooling (DB/WB (2.5%))	30/20°C
Software	IES VE 2018	
Model Purpose	NECB 2015 Part 8 performance model for CMHC requirements	

Internal Gains & Miscellaneous

Space Types	Lighting W/m²		Plug Loads	Occupants	Schedules
	Proposed	Reference	W/m²	m²/Occ	
Corridor	4.9	7.1	0.0	100	NECB G (lights 24/7)
Mechanical/Electrical	7.6	4.6	1.0	200	NECB E
Stairway	6.2	7.4	0.0	200	NECB G (lights 24/7)
Garbage/Recycling	2.7	6.8	1.0	100	NECB E
Storage/Janitor	6.1	6.8	1.0	100	NECB E
Parkade	0.9	2.1	0.0	1000	NECB H
Suites	5.0	5.0	5.0	1/bedroom +1	NECB G
Total Building	3.8	4.4	4.1	309	
Savings vs Reference	14%				

Lighting Notes	Proposed lighting information based lighting design and fixture schedule, Electrical BP set Sept 4, 2020 except suites which are modelled the same as reference design per NECB 8.4.3.4-1. Reference lighting powers determined per space use type per NECB table 4.2.1.16.	
Plug Load Notes	Plug load power densities determined per space use type referencing NECB table A-8.4.3.2.(2)-A.	
Occupant Notes	Occupant densities determined per space use type referencing NECB table A-8.4.3.2.(2)-A except in suites which are 1 occupant per suite plus an additional occupant per bedroom.	
Lighting Controls	Proposed	Reference
Daylight Controls	No daylight lighting controls in model.	Same as proposed, no daylighting required or included in modelling.
Occupancy Sensors	Occupancy sensors accounted for per 8.4.3.5-3 for spaces as design per 4.3.2.10.	Occupancy sensors accounted for per 8.4.4.5-3 for spaces with requirements per 4.2.2 and 4.3..2.10.

Misc. Loads	Proposed	Reference	
Exterior Lighting kW	0.44	1.08	Proposed load based on lighting plans from Electrical BP set Sept 4, 2020. Reference lighting allowance per NECB 4.2.3. Operating on a photocell sensor, same schedule in both models.
Elevator Power kW (each)	3.0	3.0	2 elevators, operating on the same NECB G equipment schedule suites. Based on City of Vancouver Energy Modeling Guidelines and NECB 8.4.2.7.

Building Envelope

	Proposed			Reference		
Air Tightness						
Infiltration	0.25 L/s/m² above grade envelope area per NECB 8.4.3.3-3, equal to 0.38 L/s/m² vertical facade for project geometry. Corresponds to a tested air leakage rate of 1.67 L/s/m² whole building enclosure at a testing pressure of 75 Pa. See Airtightness calculation in Appendix A2 for details.			Same as proposed (8.4.4.3-6)		
Above Grade Walls						
Wood-Framed Exterior Wall W3.X	Description	2x6 studs @ 406 o.c. with R22 Batt infill, 1.5" R4/inch external mineral wool insulation.		Description	Prescriptive NECB exterior wall performance for reference model.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020 and Focal calculation		Source	NECB 2015 Table 3.2.2.2 CZ6	
	Usi	0.221	W/m²K	Usi	0.247	W/m²K
	Rip	25.7	ft²°F/(Btu/hr)	Rip	23.0	ft²°F/(Btu/hr)
Below Grade Walls						
Parkade Wall W1	Description	8" uninsulated concrete wall in parkade area adjacent to ground conditions. Effective performance account for ground contact modeled in software.		Description	Unconditioned space, modelled same as proposed.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020		Source	Same as proposed.	
	Usi	0.694	W/m²K	Usi	0.694	W/m²K
	Rip	8.2	ft²°F/(Btu/hr)	Rip	8.2	ft²°F/(Btu/hr)
Exterior Floors						
Deck Suspended Slab F3	Description	Suspended concrete slab with 2" XPS Insulation.		Description	Prescriptive NECB floor performance for reference model.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020		Source	NECB 2015 Table 3.2.2.2 CZ6	
	Usi	0.376	W/m²K	Usi	0.183	W/m²K
	Rip	15.1	ft²°F/(Btu/hr)	Rip	31.0	ft²°F/(Btu/hr)

Insulated Parkade Ceiling F4	Description	Suspended slab parkade ceiling under conditioned space. Reinforced concrete with 5" R20 Mineral Batt Insulation, 1.5" R6 EPS and 1.5" concrete topping.		Description	Prescriptive NECB floor performance for reference model.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020		Source	NECB 2015 Table 3.2.2.2 CZ6	
	Usi	0.233	W/m²K	Usi	0.183	W/m²K
	Rip	24.4	ft²°F/(Btu/hr)	Rip	31.0	ft²°F/(Btu/hr)
Parkade Floor F1	Description	300 mm uninsulated concrete slab on grade floor. Performance adjusted for ground adjacency conditions and slab geometry in modelling software.		Description	Uninsulated slab, modelled same as proposed as assembly at unconditioned space.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020		Source	NECB 3.2.3.3-1 and proposed design	
	Usi	0.173	W/m²K	Usi	0.173	W/m²K
	Rip	32.8	ft²°F/(Btu/hr)	Rip	32.8	ft²°F/(Btu/hr)
Roofs						
Typical Roof R1, R2	Description	Insulation above deck, 6" polyiso continuous insulation		Description	Prescriptive NECB roof performance for reference model.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020		Source	NECB 2015 Table 3.2.2.2 CZ6	
	Usi	0.155	W/m²K	Usi	0.183	W/m²K
	Rip	36.6	ft²°F/(Btu/hr)	Rip	31.0	ft²°F/(Btu/hr)
Split Insulation Roof R4	Description	Sloped poly iso, minimum 1" over TJI roof with 8" spray foam insulation.		Description	Prescriptive NECB roof performance for reference model.	
	Source	Assembly schedule, architectural issue for tender, Nov 9, 2020		Source	NECB 2015 Table 3.2.2.2 CZ6	
	Usi	0.134	W/m²K	Usi	0.183	W/m²K
	Rip	42.5	ft²°F/(Btu/hr)	Rip	31.0	ft²°F/(Btu/hr)
Glazing						
Fixed Windows	Description	Innotech triple glazed fixed frame windows with Defender 76DS glazing.		Description	Prescriptive NECB window performance for reference model.	
	Source	Innotech project shop drawings		Source	NECB 2015 Table 3.2.2.3 CZ6	
	Usi	0.90	W/m²K	Usi	2.2	W/m²K
	Uip	0.16	(Btu/hr)/ft²°F	Uip	0.39	(Btu/hr)/ft²°F
	SHGC	0.26		SHGC	0.26	

Operable Windows	Description	Innotech triple operable tilt-and-turn glazed windows with Defender 76DS glazing.		Description	Prescriptive NECB window performance for reference model.		
	Source	Innotech project shop drawings		Source	NECB 2015 Table 3.2.2.3 CZ6		
	Usi	1.02	W/m²K	Usi	2.2	W/m²K	
	Uip	0.18	(Btu/hr)/ft²°F	Uip	0.39	(Btu/hr)/ft²°F	
	SHGC	0.23		SHGC	0.23		
Outswing Glazed Doors	Description	Innotech triple glazed outswing doors with Defender 76DS glazing.		Description	Prescriptive NECB window performance for reference model.		
	Source	Innotech project shop drawings		Source	NECB 2015 Table 3.2.2.3 CZ6		
	Usi	1.02	W/m²K	Usi	2.2	W/m²K	
	Uip	0.18	(Btu/hr)/ft²°F	Uip	0.39	(Btu/hr)/ft²°F	
	SHGC	0.20		SHGC	0.20		
Natural Ventilation							
Operable Windows	Simulated ideal occupant window operation of windows using IES VE Macroflo module. Operable windows side hung, maximum opening angle 20°. Windows modulate from closed at 23.5°C to max open at 24.5°C. Maximum opening modulates with outdoor air temperature to prevent over-cooling in shoulder seasons when simulating at a 10 minute time step. Max opening modulates from 0% at 12°C to 100% at 16°C				No operable window passive cooling modeled.		

Fenestration Area	Exposure	Gross Wall Area m²	Window Area m²	FDWR %	Exposure	Gross Wall Area m²	Window Area m²	FDWR %
Fenstration and Door to Wall Ratio (FDWR)	North	1142	250	22%	North	1142	447	39%
	East	1253	285	23%	East	1253	510	41%
	South	1081	227	21%	South	1081	406	38%
	West	1194	251	21%	West	1194	449	38%
	Total	4670	1013	22%	Total	4670	1812	39%

Notes	Reference opening areas scaled to meet maximum permitted under NECB 3.2.1.4 per 8.4.4.3-3 modelling requirements.	
Shading		
Adjacent Buildings	No signficant adjacent buildings shading.	Modeled same as proposed
Landscape	Horizon profile included in model to provide impact of site location in the valley.	Modeled same as proposed
Building Shades	Some self-shading from balconies and privacy screens modelled. Roof overhangs provide additional shading on top floors.	No external shading devices modelled in reference building per 8.4.4.3-4.
Notes		
Effective Performance Opaque Construction	All performance values are overall effective, including effects of thermal bridging by structural framing and air films	
Effective Performance Fenestration	All glazing performance is total fenestration system performance including frame and air film resistance, calculated in accordance with NFRC 100.	
Units	Usi values given are W/m²K, Rsi values are given in m²K/W/m² Uip values given in (Btu/hr)/ft²°F, Rip values given in ft²°F/(Btu/hr) SHGC is solar heat gain coefficient (dimensionless), VLT is visual light transmittance (dimensionless)	

Mechanical (Proposed)		
Suites		
Description	Input	Suites are ventilated with individual in-suite HRVs and heated with electric baseboards. No mechanical cooling is included in the design.
	Source	Mechanical BP set, Sept 4. 2020, NECB 2015, BCBC 2018
Ventilation	Input	Continuous ventilation provided by a Fantech FIT 120E ERV per unit. 14 L/s/suite for studios and 1-bedroom units 21 L/s/suite for 2 and 3-bedroom units 67.2% and 66.3% effective sensible recovery efficiencies at 14 and 21 L/s operating volumes based on performance information from manufacturer. 55 % latent heat recovery. 82 W rated fan power consumption at 31 L/s
Heating	Input	In-suite electric baseboard heating. 1.1 kW to 4.4 kW total heating capacity per suite. 22°C setpoint, 18°C nighttime setback (NECB G setpoint schedule).
Cooling	Input	No cooling included in the design and none modelled per NECB 8.4.3.1-4a
Range Hoods	Input	Suites equipped with kitchen range hoods modelled to run for 2 hours, twice per day. 50 L/s flow rate, 20 W fan power. Makeup air for operation is assumed from general infiltration and corridor transfer air following BC Step Code energy modelling methodology.
Corridors		
Description	Input	Corridors are pressurized with electric makeup air units providing continuous tempered air.
	Source	Mechanical BP set, Sept 4. 2020
Ventilation	Input	42.5 L/s per floor corridor pressurization with additional ventilation to common entry spaces on parking levels. 370 L/s total continuous ventilation to building A, 620 L/s to building B. 750 W (1 HP) fan motor power at rated 944 L/s (2000 cfm) supply flow volume.
Heating	Input	44 kW capacity electric heating coil per MUA unit tempering outdoor air to 18°C. Supplemental 0.3 kW electric baseboard heaters in spaces for additional space heating.

Misc. spaces		
Description	Input	Mechanical and electric rooms equipped with exhaust fans operating on a reverse acting thermostat for 24°C setpoint. Laundry rooms and parkade storage spaces exhausted with fans on manual or timing exhaust fans, modelled as running for 2 hours per day. Ancillary spaces throughout building heated with electric baseboards.
	Source	Mechanical BP set, Sept 4. 2020
Exhaust	Input	Parkade garabage/recycling rooms are continuously exhausted, rates up to 840 L/s, 0.37 kW (0.5 HP) fan motor powers.
Heating	Input	Parkade stairwell entrances are heated with electric force flow heaters maintaining spaces above 18°C. 2.0 kW heating capacity per unit, estimated 220 L/s supply flow, 66 W fan power.
Cooling	Input	Electrical rooms are cooled with ductless wall mounted fan coil units maintaining spaces below 24°C. 7.0 to 17.3 kW cooling capacity, L/s supply flow, xx W fan power.
Parkade		
Description	Input	Parkade levels served by supply, transfer, and exhaust fans. Gas-fired unit heaters throughout parking provide freeze protection
	Source	Mechanical BP set, Sept 4. 2020
Air systems	Input	Supply, transfer, and exhaust fans running in sequence intermittantly on CO sensor controls, estimated as 4 hrs total per day modelled. 25,000 L/s total supply/exhaust flow, 21.75 kW combined fan motor size. 10,600 L/s total transfer air flow capacity, 2.3 kW combined fan motor size.
Heating	Input	Gas fired unit heaters maintain spaces above 5°C throughout the winter. Up to 117 kW (400 MBH) units, 89% efficient.
Snow Melt	Input	A 400 MBH capacity, 95% efficient condensing boiler system servers a 50% glycol heating loop providing snow melt to a section of the parkade entrance ramp during the snow season. Roughly a 185 m² ramp area is served, modelled with the surface temperature maintained above 1°C.
Domestic Hot Water		
Load	Input	Loads and schedule by space type by occupant per NECB.
	Source	NECB table A-8.4.3.2.(2), BC Plumbing Code 2018 Div B table 2.2.10.6, BCH Design Guidelines
DHW Heating Equipment	Input	Cheakamus Crossing District Energy System serves SHW heating with low grade water (to 43°C) for system preheat. Average system annual COP of 2.8 as reported in the January 2017 Energy Study Report completed by DEC Engineering. 2, 95% efficient gas-fired boilers provide topup heat to 60°C.
	Source	Mechanical BP set, Sept 4. 2020

Mechanical (Reference)

Suites		
Description	Input	NECB 2015 System 1: constant volume direct ventilation and electric baseboard heating.
	Source	NECB 8.4.4.7
Ventilation	Input	Same continuous ventilation rates as in proposed, direct ventilation No ventilation heat recovery modelled per 8.4.4.19 and 5.2.10. Fan power calculated per zone per 8.4.4.18, 1.6 W/L/s modelled as a single fan per suite.
Heating	Input	Electric baseboard heating sized to meet loads per suite plus 30% oversizing per 8.4.4.8-1. Same setpoints and schedules as proposed model.
Cooling	Input	No cooling modelled in reference model as in proposed per 8.4.4.1-5
Range Hoods	Input	Modelled the same as the proposed building per A-8.4.4.17.1
Corridors		
Description	Input	As ancillary spaces to the residential areas systems for these spaces are System 1: constant volume fan, and electric baseboard heating. No mechanical cooling as in proposed.
	Source	NECB 2015 8.4.4.7, table 8.4.4.7-A note 2
Ventilation	Input	Same outdoor air rates and schedules as proposed. Ventilation by constant-speed fan, power use per 8.4.4.18, 1.6 W/L/s.
Heating	Input	Electric baseboard space heating, size to meet space loads plus 30% oversizing factor. Same setpoints and schedules as proposed. Electric resistance pre-heating of outdoor air, sized for loads plus 30% controls and configuration the same as in proposed per table 8.4.4.7-B note 2.

Misc. Spaces		
Description	Input	As ancillary spaces to the residential areas systems for these spaces are System 1: constant volume fan, unitary air-conditioning (where cooling designed) and electric baseboard heating (where heating designed). Corresponds to spaces listed in "Misc. Spaces" for proposed design inputs. No ventilation to spaces as in proposed.
	Source	NECB 2015 8.4.4.7, table 8.4.4.7-A note 2
Exhaust	Input	Exhaust fans schedule, volume, and power modelled the same as proposed.
Heating	Input	Electric baseboard heating, size to meet space loads plus 30% oversizing factor where force flow heaters installed in proposed. Same setpoints and schedules as proposed.
Cooling	Input	Air cooled DX system conditioning electrical rooms, size to meet space loads plus 10% oversizing factor (8.4.4.8). SEER 15 performance per table 5.2.12.1. Supply flow sized for 11K on peak cooling loads and specific fan power 1.6 W/L/s per system per 8.4.4.18. Same setpoints and schedules as proposed.
Parkade		
Exhaust	Input	Parkade fans schedules, volumes, and powers modelled the same as proposed.
	Source	NECB 2015 A-8.4.4.17.(1)
Heating	Input	Per NECB System 4 (table 8.4.4.7-A and B) Hydronic baseboard system providing freeze protection operating same as in proposed. Hydronic system served by 83% efficient (table 6.2.2.1) boiler, part load curve per 8.4.4.21-A.
	Source	NECB 2015 tables 8.4.4.7-A and B
Snow Melt	Input	Modelled the same as the proposed building as a miscellaneous load per 8.4.2.7-1d.
Domestic Hot Water		
Load	Input	Same loads as determined by space use types as proposed model, no savings claimed for low-flow fixtures in reference modelling.
	Source	NECB table A-8.4.3.2.(2)
DHW Heating Equipment	Input	2, 83% efficient gas-fired DHW heaters serving the proposed pre-heat and top-up heat portions of the proposed design, respectively, per 8.4.4.6. and 8.4.4.20
	Source	NECB 2015 table 6.2.2.1, 8.4.4.6, 8.4.4.20, 8.4.4.21

APPENDIX A2

AIR TIGHTNESS AND INFILTRATION CALCULATIONS

Whole Building Airtightness and Infiltration Calculation

19036 Parcel A

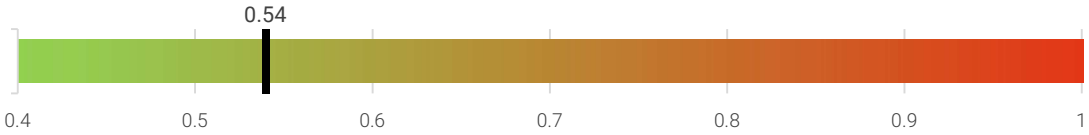
This calculation correlates airtightness target & testing leakage rates with energy model infiltration rates for a given project. Note that while the project has a target design air leakage rate, a different value is modelled following the Part 8 modelling of the NECB 2015 for CMHC requirements.

Project Geometry within Air Barrier		
Roof	2,374	m²
Below Grade Wall	0	m²
Above Grade Façade	4,670	m²
Ground Contact Floor	0	m²
Exposed Floor	2,362	m²
Total Floor Area	**8,641**	**m²**
Modelled Floor Area (for comparison)	0	m²
Total Volume	26,055	m³
Total Above Grade Envelope	9,406	m²
Total Enclosure	**9,406**	**m²**
Total Enclosure to Floor Area Ratio	1.09	

Not including parkade spaces outside of air barrier.

Vertical Façade to floor Area Ratio (VFAR)

The ratio between vertical façade area and floor area is a key metric for Step Code projects, with lower values performing better. Increased façade area equates to greater heat loss through higher infiltration rates and increased envelope area. A high VFAR can make it more challenging to meet floor area based performance targets such as Thermal Energy Demand Intensity (TEDI) of the BC Energy Step Code.



Whole Building Air Tightness Leakage and Energy Model Infiltration Rates

Target air leakage test rates and energy model infiltration rates are shown below for this project's specific geometry. Examples from standards are shown as reference points.

Air Tightness Levels	Enclosure Air Leakage Rate		Energy Model Infiltration Rate
	L/s/m² of Total Encl. at 75 Pa	ACH at 50 Pa	L/s/m² Façade at operating pressure
VBBL, BC Housing test limit, EALR (2.0 L/s/m² at 75 Pa)	2.00	2.00	0.45
NECB 2015 Part 8 (model rate, 0.25 L/s/m² of above grade envelope)	1.67	1.67	0.38
City of Vancouver EM Guidelines Default (0.20 L/s/m² façade)	0.89	0.89	0.20
Passive House (0.6 ACH at 50 Pa)	0.60	0.60	0.14
Project Design Target	1.10	1.10	0.25
CMHC/NECB 2015 Modelled Infiltration Rate	**1.67**	**1.67**	**0.38**