reLoad
Sustainable Design Inc.

Inglewood Campus of Care
100% DD Energy Modelling Report

September 17th, 2021

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EXECUTIVE SUMMARY

reLoad Sustainable Design Inc. has been contracted by ZGF Architects on behalf of Baptist Housing to complete a systems evaluation and provide energy performance consulting for the Inglewood Campus of Care project located in West Vancouver, BC.

This report outlines the summary of the 100% Design Development energy analysis for the Campus and summarizes performance results for all campus buildings energy consumption, carbon emissions, and operational energy cost based on project design strategies for envelope, lighting, and mechanical systems.

The study builds on the system evaluation and energy analysis that was completed during Schematic Design as summarized in "Schematic Design Systems Evaluations Report" (2020-12-04) which provided design direction to the project along with a Life Cycle Cost Analysis study completed by the cost consultant. Further design guidance was provided for the 50% Design Development milestone with updated Campus energy and carbon performance results reflecting design progression, as summarized in the "50% Design Development Energy Modelling Report" (2021-04-08).

The District of West Vancouver, project Authority Having Jurisdiction (AHJ), have set upgraded BC Energy Step Code targets and implemented a Low Carbon Energy System (LCES) requirement for the project. These standards set forth criteria for TEDI, TEUI, and GHGI which must be met for compliance with rezoning requirements.

Three distinct energy models have been updated for the Campus during the 100% Design Development stage:

- One energy model including both the Long-Term Care and Assisted Living (LTC+AL) as these buildings are served by a common plant;
- One energy model including the Affordable Housing (AH), as this is served by its' individual mechanical plant; and
- One energy model including the Independent Living (IL) building as this is served by its' individual mechanical plant.

Technical information reflecting the system design approach is included for envelope performance, internal load structure, ventilation rates, mechanical system, and operational parameters for all three models.

Finally, a summary of energy and operational carbon emissions performance results and findings from the energy modelling process is compared to the AHJ required targets. Based on the 100% Design Development documentation, the implemented design strategies result in compliance with the District's Step Code and LCES criteria.

1 INTRODUCTION

This report outlines the Inglewood Campus of Care building performance based on the 100% Design Development documentation and confirms the results for energy consumption, carbon emissions, and operational energy cost. The systems evaluated in this energy model update are based on the outcome of the strategic design guidance and system evaluation completed during the Schematic Design stage and the 50% Design Development stage.

1.1 Project Overview

Inglewood Campus of Care is a redevelopment project located in West Vancouver, BC, south of the Upper Levels Highway and immediately west of Taylor Way. The current facility on site provides 240 long term care beds and is operated by Baptist Housing. Baptist Housing is looking to redevelop the expanded site with the intent to provide an all-service seniors community including long term care facilities and residential building typologies. The project will provide indoor and outdoor amenities and support services for residents, team members, and visitors.

The project is planned with four separate building typologies to be developed during two phases per the following configuration.

Table 1: Primary Building Information

Building	Phase	Occupants	Nr of Units	Occupancy Class
Long Term Care (LTC)	Phase 1	327	240	B2
Assisted Living (AL)	Phase 2	132	104	B2/B3
Affordable Housing (AH)	Phase 2	268	155	C
Independent Living (IL)	Phase 2	258	200	C

Stakeholders involved in the project include:

- Baptist Housing
- BC Housing
- Vancouver Coastal Health

1.2 Report and Energy Model Revisions Log

This report provides an updated building performance summary based on 100% Design Development drawings and information received between August and September of 2021. The 100% Design Development update is the last milestone submission ahead of the Development Permit application.

Table 2: Progress Update Log

Progress	Issue Date
Opportunities and Challenges - Memo	August 26th, 2020
Systems Evaluation Matrix "Long List"	August 26th, 2020
Climate Adaptation Data - Memo	August 28th, 2020
SD Systems Evaluations - Report	December 4th,2020
50% Design Development - Report	April 8th 2021
100% Design Development - Report	**September 17th, 2021**

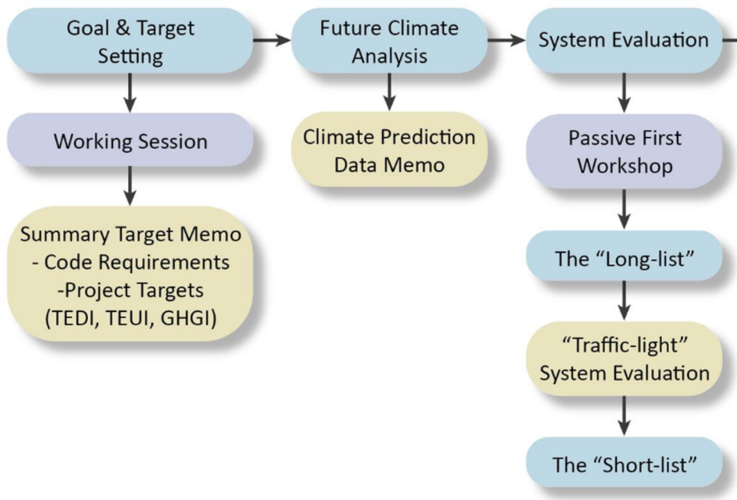

Figure 1: reLoad Scope of Works and Process During SD and DD.

1.3 Reference Documents

- Baptist Housing OPRs (dated April 2020)
- The National Energy Code for Buildings (NECB)
- ASHRAE 62.1-2001 (BCBC minimum ventilation)
- ASHRAE 62.1-2016
- ASHRAE 90.1-2016
- BC Housing Design Guidelines Construction Standards (2019)
- VCH Design Guidelines
- VCH Smart Energy & Water Goals (2020)
- City of Vancouver Energy Modelling Guideline v 2.0 (BC Energy Step Code)
- Building Envelope Thermal Bridging Guide (BETBG)
- BC Hydro Modelling Guideline (January 2019)

2 BULIDING ENERGY CODE REQUIREMENTS AHJ

This project is subject to the District of West Vancouver's (DoWV) Sustainable Buildings Policy and rezoning requirements for building energy use and carbon emissions.

The step code requirements for Inglewood includes the following:

a) Assembly, treatment, and care occupancy (B2 or B3): Step 1 with LCES
b) Residential Occupancy (C): Step 3 with LCES

The definition of LCES per the DoWV includes the following:

a) System seasonal average coefficient of performance >2.0
b) Modelled greenhouse gas intensity (GHGI) less than <3.0 $kgCO_2e/m^2/yr$ for Residential Typology
c) Any natural gas fired peak demand heating equipment is appropriately sized to augment the LCES under peak demand conditions.

It should be noted that a variance to the LCES GHGI target has been discussed with the DoWV for the long-term care facility (LTC+AL) where a more appropriate GHGI target has been proposed for the typology. It is our understanding that the revised target applicable for the long term care facilities is <7.4 $kgCO_2e/m^2$.

2.1 Summary Project Energy Targets

Table 3 summarizes the individual targets of the various stakeholder groups, as well as identifies the design driver for the project as it currently stands. The LCES performance of GHGI **max 3.0 ($kgCO_2e/m^2/yr$) for residential** and **max 7.4 ($kgCO_2e/m^2/yr$) for long-term care** turns out to be the most stringent of the requirements. The OPR stretch-goal of achieving a TEDI of Step 4 or near Step 4 will be required to support the LCES goal.

Table 3: Summary of Energy Targets per Stakeholder Group

Building	Occupancy Class	DoWV	BC Housing	OPR	Design Driver
Long Term Care (LTC)	B2	Step 1 with LCES and GHGI < 7.4	n/a	TEDI Step 4	DoWVs LCES
Assisted Living (AL)	B2 or B3 (TBD)	Step 1 with LCES and GHGI < 7.4	n/a	TEDI Step 4	DoWVs LCES
Affordable Housing (AH)	C	Step 3 with LCES and GHGI < 3.0	Step 3	TEDI Step 4	DoWVs LCES
independent Living (IL)	C	Step 3 with LCES and GHGI < 3.0	n/a	TEDI Step 4	DoWVs LCES

3 FUTURE CLIMATE ANALYSIS

Pacific Climate Impacts Consortium (PCIC) has produced several climate indicators for West Vancouver for the 2020s, 2050s and 2080s[1]. As part of the early master planning stage, reLoad reviewed and summarized the predicted climate change implications for West Vancouver to understand the expected peak temperatures, duration of hot spells, and rainfall intensities, for the project location.

A summary memo of the predicted climate information was issued on August 28th, 2020, to ensure the project team had access to a consistent set of information for the project design. The memo is included as **Appendix B** to this report for reference, with the following key points.

3.1 Temperature

The increase in annual maximum dry-bulb temperature highlights the expected degree of warming climate for the location. Table 4 on the following page indicates the annual maximum dry-bulb temperature.

[1] The 2020s, 2050s and 2080s refer to 30 year time periods for which PCICs climate models are distilled: 2020s (2011-2040), 2050s(2041-2070), 2080s(2071-2100).

Table 4: Summary of Future Temperature Increase

Annual Maximum Temperature (Dry-bulb)	Past (1971-2011)	2050s (2041-2070)	2080s (2071-2100)
Average Prediction	31.8 °C	35.3°C	37.5°C
High Range Prediction	31.8 °C	37.0°C	40.4°C

3.2 Design Temperature for Mechanical Cooling System Sizing

A methodology has been developed by the local health authorities (Fraser Health, Vancouver Coastal Health, PHSA) in collaboration with reLoad (October 2020) for use in the planning and design of health care facilities in BC[2]. Following this methodology results in the following cooling design temperatures to be used for climate change planning, based on 2.5% Dry-bulb (°C) and 2.5% Wet-bulb (°C).

- 2050s Dry-bulb (West Vancouver) = 28.0 + 4.3 = 32.3°C
- 2050s Wet-bulb (West Vancouver) = 19.0 + 4.0 = 23.0°C

To avoid high retrofit costs in the future, the approach for Inglewood is to design the cooling distribution system, but not the actual plant, for the future design temperatures to be able to handle the increase in cooling load expected for the 2050s. The rational is based on the approach that it is not practical to upsize the actual cooling equipment for the 2050s today as the increase in capacity is not yet needed, but rather ensure the infrastructure has the built-in capacity to handle a higher cooling load in the future. As such, the heat pump / cooling towers can be replaced with a larger capacity system at end-of life as needed.

4 BASIS OF 100% DESIGN DEVELOPMENT ENERGY MODELS

The 100% Design Development energy modelling was completed based on the architectural drawing sets provided by ZGF in August 2021. This section outlines what strategies and assumptions were included in the detailed energy models.

4.1 Basis of Energy Model

Design Geometry:	August 12th, 2021 (Design Development progress set)
Software:	IES Virtual Environment, v2019.3.1.0
Climate Zone:	CZ4 (BCBC), HDD (18)-2950
Weather file:	West Vancouver, BC, CWEC 2020s weather file

4.2 Utility Rates and Emission Factors

The following utility rates are used in the energy study.

Table 5: Summary of utility costs and emission rates

Utility Cost		
BC Hydro – Residential Schedule 1101 (April 2020 rates)	Blended rate \$0.11\$/kWh used in model	Up to 1,350 kWh: Step 1 - \$0.0935/kWh > 1,350 kWh: Step 2 - \$0.1403/kWh Rate rider 0% (per BC Hydro)

[2] "*Establishing Design Conditions for Climate Resilient Planning and Design of Health Facilities in British Columbia*", October 2020, v1.0

		GST 5% included
Fortis Natural Gas (October 2020 rates)	Blended rate $9.31/GJ ($0.0335/kWh), used in model	$8.84/GJ, GST 5%, clean levy 0.4% and carbon tax $1.99/GJ included in analysis bended rate.
Emission Factors		
Electricity	11 tCO_2e/GWh	BC Hydro emission rates per BC Energy Step Code Modelling
Natural Gas	185 tCO_2e/GWh	Natural gas emission rates per BC Energy Step Code Modelling

4.3 Model Floor Area

The following building areas are reflected in the energy model. The Model Floor Area (MFA) is used for reporting in the operational energy and carbon intensities.

Table 6: Summary of Model Floor Areas

	LTC-AL	IL	AH	Total
Model GFA (m^2)	40,708	28,440	13,540	82,688
Parking (m^2)	8,194	7,919	2,350	18,463
MFA[3] (m^2)	32,514	20,521	11,190	64,225

Figure 2: 3D Render from Combined Energy Model based on Site geometry (September 2021)

[3] MFA=Modeled Floor Area as per CoV Energy Model Guideline (BC Energy Step Code); excluding parking areas, including all other conditioned, unconditioned or semi-conditioned floor areas. MFA used for TEUI, TEDI and GHGI calculation.

4.4 Envelope

Envelope performance parameters were developed in collaboration with ZGF and RDH (envelope consultants) during Schematic Design to establish a high-performing baseline system that would support meeting the carbon targets. As design has progressed through Design Development, updated envelope parameters reflecting detailed assemblies have been provided by RDH. The following Table 7 summarizes the envelope performance that is included in the energy model.

Table 7: Summary of Envelope Performance for Models

Component	Assumed Envelope Performance SD	Design Envelope Performance DD
Airtightness		
Infiltration Rate	0.1 L/s/m^2 (improved per BC Energy Step Code) For 15 < TEDI < 30 kWh/m^2	0.1 L/s/m^2 (improved per BC Energy Step Code) For 15 < TEDI < 30 kWh/m^2
Glazing and Door Systems		
Punched Window	Double pane low-e glazing, non- metal frame (operable) Uip-0.30 (BTU/F°.hr.ft^2) Usi-1.70 (W/m^2K) SHGC-0.4 (unitless)	Double pane low-e glazing, non- metal frame (operable) Uip-0.25 (BTU/F°.hr.ft2) Usi-1.42 (W/m^2K) SHGC-0.37 (unitless)
Curtain Wall	High performance, thermally broken aluminum frame Uip-0.35 (BTU/F°.hr.ft^2) Usi-2.00 (W/m^2K) SHGC-0.4 (unitless)	High performance, thermally broken aluminum frame Uip-0.30 (BTU/F°.hr.ft2) Usi-1.70 (W/m2K) SHGC-0.37 (unitless)
Commercial Entrance Door	Uip-0.30 (BTU/F°.hr.ft2) Usi-1.70 (W/m2K) SHGC-0.4 (unitless)	Uip-0.33 (BTU/F°.hr.ft^2) Usi-1.87 (W/m^2K)
Emergency Exit Door	Uip-0.30 (BTU/F°.hr.ft2) Usi-1.70 (W/m2K) SHGC-0.4 (unitless)	Uip-0.40 (BTU/F°.hr.ft^2) Usi-2.27 (W/m^2K)
Effective R-values (including impact of thermal bridges)		
Walls Below Grade (conditioned space)	Rip-10 (F°.hr.ft^2/BTU) Rsi-1.76 (m^2·K/W)	LTC - Rip-18.6 (F°.hr.ft^2/BTU) Rsi-3.28 (m^2·K/W)
		AL - Rip-19.2 (F°.hr.ft^2/BTU) Rsi-3.38 (m^2·K/W)
		AH - Rip-14.9 (F°.hr.ft^2/BTU) Rsi-2.62 (m^2·K/W)
		IL - Rip-13.6 (F°.hr.ft^2/BTU) Rsi-2.40 (m^2·K/W)
Walls Above Grade	Rip-15 (F°.hr.ft^2/BTU) Rsi-2.64 (m^2·K/W)	LTC - Rip-13.4 (F°.hr.ft^2/BTU) Rsi-2.36 (m^2·K/W)
		AL - Rip-10.9 (F°.hr.ft2/BTU) Rsi-1.92 (m2·K/W)
		AH - Rip-11.0 (F°.hr.ft^2/BTU) Rsi-1.94 (m^2·K/W)
		IL - Rip-11.8 (F°.hr.ft^2/BTU) Rsi-2.08 (m^2·K/W)

Component	Assumed Envelope Performance SD	Design Envelope Performance DD
Slab on Grade	Perimeter Rip-20 (F°.hr.ft²/BTU) Rsi-3.52 (m²·K/W) for 24" at conditioned space	LTC - Rip-30 (F°.hr.ft²/BTU) Rsi-5.28 (m²·K/W)
		AL - Rip-30 (F°.hr.ft²/BTU) Rsi-5.28 (m²·K/W)
		AH - Rip-30 (F°.hr.ft²/BTU) Rsi-5.28 (m²·K/W)
		IL - Rip-30 (F°.hr.ft²/BTU) Rsi-5.28 (m²·K/W)
Suspended Slab (conditioned space over non-conditioned space)	Rip-20 (F°.hr.ft²/BTU) Rsi-3.52 (m²·K/W)	LTC - Rip-16.6 (F°.hr.ft2/BTU) Rsi-2.92 (m²·K/W)
		AL - Rip-16.3 (F°.hr.ft2/BTU) Rsi-2.87 (m²·K/W)
		AH - Rip-15.1 (F°.hr.ft2/BTU) Rsi-2.66 (m²·K/W)
		IL - Rip-14.9 (F°.hr.ft2/BTU) Rsi-2.62 (m²·K/W)
Exposed Floor/Soffit	Rip-26 (F°.hr.ft²/BTU) Rsi-4.58 (m²·K/W)	LTC - Rip-25 (F°.hr.ft²/BTU) Rsi-4.40 (m²·K/W)
		AL - Rip-25 (F°.hr.ft²/BTU) Rsi-4.40 (m²·K/W)
		AH - Rip-25 (F°.hr.ft²/BTU) Rsi-4.40 (m²·K/W)
		IL - Rip-25 (F°.hr.ft²/BTU) Rsi-4.40 (m²·K/W)
Roof	Rip-40 (F°.hr.ft²/BTU) Rsi-7.04 (m²·K/W)	LTC - Rip-34.8 (F°.hr.ft²/BTU) Rsi-6.13 (m²·K/W)
		AL - Rip-34.8 (F°.hr.ft²/BTU) Rsi-6.13 (m²·K/W)
		AH - Rip-30.8 (F°.hr.ft²/BTU) Rsi-5.42 (m²·K/W)
		IL - Rip-32.1 (F°.hr.ft²/BTU) Rsi-5.65 (m²·K/W)

The percentage window to wall ratios included in the energy model are based on the architectural drawing sets provided by ZGF on August 27, 2021. Glazing has been allocated per room building area according to the percentage WWR values listed in Table 8. The room-by-room glazing position will be reviewed and updated in the energy model to reflect the glazing percentage, orientation, and location as design progresses through CD.

The glazing + frame component of the envelope has the largest heat loss factor despite the modest WWR, refer to Section 5.2. Therefore, the WWR should not vary significantly from those shown in Table 8. Note that changes made to improve views and access to daylight may have a significant impact on the energy and GHGI targets due to shading.

Areas that are 100% glazed can be optimized to reduce glazing area while allowing for high-quality daylighting and "views with a purpose".

Areas where glazing can be further optimized for energy purposes include:

- Stairwells on IL and AH buildings are at 100% WWR for the residential levels – we recommend reducing this to avoid heat loss and stairwell overheating as not occupied space.
- Lobby and amenity space on AH building rooftop are 100% glazed – we recommend reducing this to avoid heat loss and risk for overheating.
- Corridors on AL building are 100% glazed.

Table 8: Summary of Sitewide Window to Wall Ratio (in models)

Building	Building Area	Exterior Envelope Area (m^2)	Window Area (m^2)	WWR (%)
LTC	Common Areas	2113	1056	50%
	Suites	5419	921	17%
	Stairwells	-	-	-
	Level 1	1332	621	47%
AL	Common Areas	636	445	70%
	Suites	2993	528	18%
	Stairwells	-	-	-
	Level 1 and Basement	795	313	39%
AH	Common Areas	535	216	40%
	Suites	5062	1619	32%
	Stairwells	182	102	56%
IL	Common Areas	1345	577	43%
	Suites	9096	2178	24%
	Stairwells	310	173	56%
Total Exterior Wall Above grade		29,818	8,749	29%

4.5 Occupant Internal Load

The following assumptions and diversity schedules were used for the energy analysis. The schedules follow those referenced within the BC Energy Step Code, with some variations to make the consumption profiles more realistic (or conservative) based on expected use of the facilities.

Table 9: Summary of Internal Loads Assumptions

People Internal Loads	Proposed Design			
Space Type	Occupant Density (m^2/person)	Sensible Gain (w/ppl)	Latent Gain (w/ppl)	Description & Diversity Schedule Per NECB 2015
Dwelling Units – AH+IL	25	75	55	Schedule G
Dwelling Units – LTC+AL	25	70	45	Schedule J
Lounge - Residents	10	75	55	Schedule B
Lounge - Staff	10	75	55	Schedule B
Medical Room	20	75	55	Schedule A
Corridor/Elevator Lobbies	100	75	55	diversity 24/7

Dining Area	20	80	80	Schedule B
Main Electrical Room	200	-	-	diversity 24/7
Comms Room	200	-	-	diversity 24/7
Mechanical Room	200	-	-	diversity 24/7
Food Preparation Area	20	80	140	Schedule B
Laundry Room Main	20	80	140	Schedule C
Laundry Room Small	20	80	140	Schedule C
Lobby	10	75	70	diversity 24/7
Locker Room	10	75	70	Schedule A
Office	20	75	55	Schedule A
Stairs	-	-	-	n/a
Storage / Janitor	1000	75	70	Schedule E
Washroom - Residents	30	75	70	Schedule J
Washroom - Staff	30	75	70	Schedule J
Recreation / Fitness	20	80	140	Schedule A
Amenity Rooms	10	75	70	Schedule A
Spa Rooms (massage)	10	75	70	Schedule A
Daycare	7.5	75	70	Schedule A
Parkade - Parking Space	-	-	-	n/a
Café/Retail	10	80	80	Schedule C
Townhall	5.0	75	70	Schedule C
Garbage/Loading	5.0	75	70	Schedule H
Salon	20	75	70	Schedule C

4.6 Lighting and Plug Loads

Preliminary lighting performance assumptions were coordinated with AES Engineering during October 2020 and further in August 2021. No further advancements in lighting design have been made as such the original assumptions stand. In general, the project is planning for integration of ASHRAE 90.1-2016 required occupancy and daylight sensors.

Table 10: Lighting Power Density per Space Type
OS=Occupancy Sensor
DS=Daylight Sensor

Lighting	Proposed Design			Description & Diversity Schedule per NECB 2015 or custom made
Space Type	W/m^2	OS	DS	
Dwelling Units	3.5			Preliminary assumption, based on feedback from AES September 2021
Dwelling Units - LTC	3.5			Preliminary assumption, based on feedback from AES September 2021
Lounge - Residents	15.5	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Lounge - Staff	5.3	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9

Lighting	Proposed Design			Description & Diversity Schedule per NECB 2015 or custom made
Space Type	W/m²	OS	DS	
Medical Room	8.6		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Corridor/Elevator Lobbies	7.9	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Dining Area	17.2		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Main Electrical Room	3.7			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Comms Room	3.7			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Mechanical Room	3.7			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Food Preparation Area	9.1			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Laundry Room Main	3.7		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Laundry Room Small	3.7		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Lobby	17.5			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Locker Room	4.1	x		Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Office	8.0	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Stairs	5.0	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Storage / Janitor	4.0	x		Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Washroom - Residents	8.3	x		Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Washroom - Staff	7.3	x		Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Recreation - ANSI RP-28	15.5			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Amenity Rooms	15.5			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Spa Rooms (massage)	15.5			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Daycare	7.9	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Parkade - Parking Space	1.2	x	x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Café/Retail	5.4		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Townhall	5.4		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9

Lighting	Proposed Design			Description & Diversity Schedule per NECB 2015 or custom made
Space Type	W/m²	OS	DS	
Garbage/Loading	5.0			Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
Salon	7.8		x	Assumed 20% LPD reduction from ASHRAE 90.1-2016 Section 9
External Lighting	LTC/AL: 6kW IL: 4kW AH: 1.5kW			preliminary assumptions

Plug loads are generally based on NECB assumptions (per step code) and in some cases a slight variation to allow for a more "realistic" load profile for the purpose of design guidance. For example, the BC Energy Step Code asks to use a 3kW elevator, whereas 10kW elevators have been used in the energy models until selections are made. Scooter vehicle charging is also included for LTC and AL parking spaces at a total rate of 10kW with assumed charging 6 hrs per day. Electrical room loads have been assumed and details are TBD.

Table 11: Plug-Loads and Elevators

Plug Loads	W/m²	Description & Diversity Schedule Per NECB 2015
Dwelling Units	5	Schedule G
Dwelling Units - LTC	2.5	Schedule J
Lounge - Residents	1	Schedule B
Lounge - Staff	1	Schedule B
Medical Room	7.5	Schedule A
Corridor/Elevator Lobbies	1	diversity 24/7
Dining Area	1	Schedule B
Main Electrical Room	5kW - 10kW	diversity 24/7
Comms Room	5kW	diversity 24/7
Mechanical Room	1	diversity 24/7
Food Preparation Area	10	Schedule B
Laundry Room Main	20	Schedule C
Laundry Room Small	20	Schedule C
Lobby	2.5	diversity 24/7
Locker Room	2.5	Schedule A
Office	7.5	Schedule A
Stairs	0	n/a
Storage / Janitor	0	Schedule E
Washroom - Residents	1	Schedule J
Washroom - Staff	1	Schedule J
Recreation - ANSI RP-28	1	Schedule A

Amenity Rooms	1	Schedule A
Spa Rooms (massage)	2.5	Schedule A
Daycare	5	Schedule A
Parkade - Parking Space	5kW	Scooter vehicle charging - assumption, on 6 hrs per day
Café/Retail	10	Schedule C
Townhall	2.5	Schedule C
Garbage/Loading	0	Schedule H
Salon	10	Schedule C
Elevator Loads	10kW/Elev.	Assumption, BC HYDRO MURB schedule

4.7 Process Loads

Other process loads accounted for in the energy model include the central kitchens and laundry located in LTC (serving also AL) and in IL. Assumptions for gas and power loads have been derived from NREL[4] per the following Table 12.

Table 12: Process Load Assumptions

Preliminary Information		Building			
Process Loads	Unit	LTC	AL	IL	Notes & References
Meals Per Person / Day	nr	3	3	2 IL 1 LL	AH per step code assumptions above per suite, no central kitchen. IL assumes not all tenants eat every meal in kitchen.
Occupants	nr	327	106	263	Design info March 2021 update
Units	nr	240	106	199	Design info August 2021 update
Total meals per day	nr	720	318	400 - 800 (TBD)	Derived from NREL or preliminary information..
Kitchen Gas Load	kW	229	-	127	3.7 equivalent full load hours (per NREL schedules)
Kitchen Electricity Load	kW	103	-	57	5.9 equivalent full load hours (per NREL schedules)
Kitchen Walk in Freezer	kW	3kW/freezer/fridge Assumed 2 per kitchen			7.6 equivalent full load hours (per NREL schedules)
Kitchen HW Load	L/hr	480 litres/hr			Per BCBC Step Code Modelling, allocated residential HW load to central kitchen.
Laundry Power Load	W/m2	Per NECB (Step Code) 20W/m^2 with schedule			Per BCBC Step Code Modelling Guideline
Laundry HW Load	L/h	Preliminary assumption: allocate 20% of HW load from rooms to central laundry.			To align loads with BC Step Code Modelling Guideline

[4] National Renewable Energy Laboratory (NREL) – Commercial Reference Buildings Models of the National Building Stock, Technical Report including energy model assumptions

		Ozone system reduce hot water load in laundry by 75% in LTC/AL + IL.	

4.8 Mechanical System

Table 13 outlines the details of the mechanical system studied for each of the campus buildings. LTC+AL are served by one central heating and cooling plant. IL and AH have their own respective stand-alone system and as such, are listed separately.

Ventilation System:

- LTC+AL: Ventilation is supplied to LTC+AL through ground coupled earth tubes for pre-tempering. High efficiency enthalpy recovery ventilation units are targeting an 80% sensible and 69% latent efficiency, as noted in the mechanical . There is one ERV per building for LTC+AL, serving both the residential suites and common areas. . To improve energy efficiency and reduce the GHGI, the preferred option have been investigated during DD to separate the ERVs to serve suites vs common areas independently, for optimized temperature and air volume control. This will be further studied during Construction Documents stage. The minimum ventilation rates for LTC+AL is 3ACH for suites and 30% over ASHRAE regulated ventilation rates for Common Areas to ensure exceptional indoor air quality.

- IL and AH: Ventilation is supplied to IL and AH suites by high efficiency suite-by-suite HRVs targeting an 85% sensible efficiency and through a central HRV for all common areas. Heat recovery on all suite and common area ventilation air to reduce the load is required in order to meet the TEDI and GHGI targets for these buildings. The minimum ventilation rates are based on code minimums per ASHRAE 62-2001 or per BC Housing Guidelines, whichever is most stringent, with increased rates in corridors to allow for corridor pressurization, final cfm/door TBD.

Humidification:

- LTC+AL: The LTC+AL buildings have gas fired humidification in all occupied spaces, set to a range of 30%-60% RH.

Space Heating/Cooling:

- LTC+AL: The long-term care buildings have fan coil units (FCUs) in all suites providing heating and cooling. The FCUs are Jaga units which have a very low fan power. Common areas are also served by Jaga fan coil units providing both heating and cooling. 24/7 cooling spaces, such as main electrical rooms, IT rooms, and the elevator machine rooms, are also serviced by FCUs to allow for heat recovery year-round. No DX cooling is included in the energy models at this time to maximize heat recovery.

- IL: The IL residential building has FCUs in both residential and common areas for full heating and cooling. 24/7 cooling is also provided by FCUs in main electrical rooms, IT rooms, and the elevator machine room, to allow for heat recovery year-round. Details TBD.

- AH: The AH residential building has suite-by-suite PTAC units with integrated HRVs providing compressor based heating and cooling to each suite and the common areas. The PTAC units operate in an efficient range of COP-3 to COP-4. 24/7 cooling spaces such as electrical room, elevator machine rooms are assumed to be provided through DX cooling units, details TBD.

Plant Heating:

- LTC+AL, IL: The system in both the LTC+AL building as well as for the IL building consists of central air-to-water heat pumps (ASHP) with heat recovery capability providing heating to the hydronic distribution loops. Peak and top up heating is provided by high efficiency condensing boilers. The HW loop temperature distribution will deliver hot water at 100°F - 120°F (38 - 49°C) throughout the building, controlled with OA resets (details TBD). ASHPs are scheduled to turn off when OA< 32°F (0°C), with the exception for modules providing year-round cooling for 24/7 uses.

Plant Cooling:

- LTC+AL, IL: The system in both the LTC+AL building as well as for the IL building consists of central air-to-water heat pumps (ASHP) with heat recovery capability providing cooling to hydronic chilled water loops. The distribution will deliver chilled water at 45 - 55°F (7 - 13°C) throughout the building. All equipment requiring cooling for building conditioning purposes will be piped into these loops. No dedicated DX type cooling system has been accounted for in LTC+ AL or IL at this time in order to maximize degree of hydronic heat recovery.

Domestic Hot Water (DHW):

- LTC+AL and IL: DHW is preheated by the ASHP as first stage, second stage through heat recovery from building heat rejection available also in summer time, and topped up by gas fired boilers. The preheat is expected to provide up to 110°F (43°C) degree water and the top up to 140°F (60°C). Hot water load reduction is achieved through 30% flow reduction over BCBC max rates due to lower flow fixture selection of faucets and shower heads. Central laundry in LTC+AL and IL is equipped with an Ozone system which reduces hot water load by 75-85%. Hot water for kitchen is also preheated locally by kitchen freezer heat rejection.

- AH: DHW is heated by ASHP units located on the rooftop that are able to provide high temperature heating of 140°F (60°C). The equipment is operating with a COP ranging from COP-1.8@ -12°C up to COP-3.9 @32°C. resulting in an annual average COP-2.6 based on preliminary selections. No gas fired backup equipment is included in the 100% DD energy models for AH.

Table 13: Mechanical System Descriptions

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
Hours of Operation	24 hrs, Long Term Care modeled with NECB Schedule J Laundry NECB Schedule C Kitchen NECB Schedule B Common Areas NECB Schedule B or C		24 hrs, Residential modeled with NECB Schedule G Offices NECB Schedule A Daycare NECB Schedule A	24 hrs, Residential modeled with NECB Schedule G and J Laundry NECB Schedule C Kitchen NECB Schedule B Common Areas NECB Schedule B or C	

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
Set points	25 – 28°C Suites 22 – 27°C food preparation / laundry central Classrooms/Amenity Areas/ 22 - 24 °C Offices/Staff Lounge: 21 - 24 °C Mech/Service/ Storage: 16°C Elec/Elevator machine room: 28 °C		Suites 22 – 24°C NECB Schedule G Amenity Areas/Offices: 21 - 24 °C Schedule A Mech/Service/ Storage: 16°C Elec/Elevator machine room: 28°C	Suites 22 – 24°C NECB Schedule G Amenity 21 - 24°C Schedule C Offices: 21 - 24°C Schedule A Mech/Service/ Storage: 16°C Elec/Elevator machine room: 28°C	Using NECB schedules for setpoints to align with BC Energy Step Code targets, for IL and AH.
Min Code OA rates	Residents 3 ACH - suites Common/Other areas +30% ASHRAE Total min OA: 76,900 cfm (36,300 L/s)		62.1-2001 and BC Housing Design Guidelines 49 cfm/studio/1beds 64cfm/two and three beds Amenity/Admin ASHRAE	62.1-2001 and BC Housing Design Guidelines 49 cfm/studio/1beds 64 cfm/two and three beds Total min OA: 19,900 cfm (9,400 L/s)	Continuous exhaust bathroom, balanced flow assumed.
AHUs / MAUs	Earth Tube with ERV (nominal) ERV-1: 21,200 cfm (10,000 L/s) ERV-2: 35,000 cfm (16,500 L/s) ERV-3: 25,000 cfm (11,800 L/s) Modeled with LAT: maximize heat from ERV heating mode. Zone demand for cooling LAT 18C-25C (reset suites) 18C-21C (reset common areas)		Suite by Suite PTAC/HRV units: 272 cfm (128 L/s) total airflow rated out of this min OA rate is 47cfm /85 cfm Corridor MUA: 1,200 cfm (550 L/s), preliminary rate (0.065 cfm/ft2) ~8cfm/door (TBD)	Suite by Suite HRV 50 /65 /100 cfm (25 / 30 / 45 L/s) Common Areas HRV (TBD): Preliminary rate 7,800 cfm (3,700 L/s) Corridor MUA: Preliminary rate 1,700 cfm (0.065 cfm/ft2) ~8cfm/door (TBD)	Preliminary selections provided by mechanical 100% DD report where available. Otherwise based on min OA by ASHRAE / BC Housing.

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
System Fan Power	ERVs: 1.1 W/cfm (2.3 W/L/s) (total supply + exhaust) FCUs: Jaga units 0.09 W/cfm (0.20 W/L/s)		PTAC/HRV 24/7 1.13 W/cfm (OA + Recirc airflow) MUA: 1 W/cfm (prelim assumption)	In-Suite HRV: 50 cfm unit: 0.40 W/cfm 100 cfm unit: 0.7 W/cfm (total supply and exhaust) FCUs: Jaga units 0.09 W/cfm (0.20 W/L/s)	Based on mechanical 100% DD report where info available, or assumption.
Fan Control	ERVs 24/7 DCV in all multi-occupant spaces/common areas. FCUs: 2 speed control.		PTAC/HRV 24/7 constant volume MUA constant volume DCV in offices/amenity areas	HRV 24/7 FCUs: 2 speed control DCV in amenity areas	
Humidification	Humidification ERV-1: 150 lbs/h, 77% eff. ERV-2: 300 lbs/h, 77% eff. ERV-3: 200 lbs/h, 77% eff.		n/a	n/a	Based on mechanical 100% DD report.
Heat recovery	Enthalpy Wheel: ERV-1: 84% sensible, 71% Latent		Suite by Suite HRV integrated in PTAC unit Winter: 89% /86% Summer: 86% /79% efficiency	Suite by Suite HRV 88% efficiency (Zehnder Comfort Air type)	Based on mechanical 100% DD report.
Terminal System Suites	Suites: FCUs for heating and cooling SAT heating: 32°C SAT cooling: 18°C (min)		PTACs with integrated HRV for heating and cooling SAT heating: 30°C 3kW/2.5kW COP_h-4.3 /4.1 SAT cooling: 15°C 2kW/1.7kW COP_c-3.5	FCUs for heating and cooling SAT heating: 30°C SAT cooling: 15°C	

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
Terminal System Other Areas	Common Areas: FCUs for heating and cooling SAT heating: 30°C SAT cooling: 15°C FCU cooling: electrical room/elevator room. Mechanical: electrical UHs (assumed) Stairs: electrical BBrds (assumed)		PTACs with integrated HRV for heating and cooling SAT heating: 30°C 3kW/2.5kW COP_h-4.3 /4.1 SAT cooling: 15°C 2kW/1.7kW COP_c-3.5 DX -cooling: electrical room/elevator room (TBD) Mechanical: electrical UHs (assumed) Stairs: electrical BBrds (assumed)	FCUs for heating and cooling SAT heating: 30°C SAT cooling: 15°C FCU cooling: electrical room/elevator room Mechanical: electrical UHs (assumed) Stairs: electrical BBrds (assumed)	All systems have been auto sized in the energy model until final selections are available.
Kitchen/Laundry	Separate MUAs connected to earth tube, with HW coil MUA Laundry: 8,100 cfm (3,820 L/s) HW coil: 160 kW Supply: 7.9 BHP (5.9 kW) 0.7 W/cfm Exhaust: 0.3 W/cfm MUA Kitchen: Assuming 9,500 cfm (4,500 L/s) Supply and Exhaust (TBD) Fan motor: 0.9 W/cfm (TBD)		No central kitchen/laundry Residential only. Suite kitchen exhaust: 100cfm/unit (47.2 L/s) 1 hr per day	Separate MAU Kitchen with HW/CHW coils, kitchen assuming 9,000 cfm (4,500 L/s) Supply and Exhaust. Residential type laundry only, no separate MUA.	Assumed to operate M-Sun, per initial email on hours. With morning, lunch and dinner exh. fans running 100%, lower rate in between.

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
Parkade Fans	Exhaust Fan: 64,500 cfm 14kW on CO sensors (4hrs per day per ESC) Transfer fans 2 x 5,000 cfm 2 x 1.45 kW BHP	Exhaust Fan: 14,500 cfm 4.3 kW on CO sensors (4hrs per day per ESC) Transfer fans 1 x 4,070 cfm (6,915 L/s) 2 x 1.45 kW BHP	Exhaust: 27,700 cfm on CO sensors (4hrs per day per ESC) 10 kW (sized for 42,600 cfm smoke evac) Transfer fans 3 x 5,000 cfm 3 x 1.45 kW BHP	Exhaust Fan: EF-1: 20,200 cfm on CO sensors (4hrs per day per ESC) 4.5 kW EF-2: 19,000 cfm 4.1 kW EF-3: 26,800 cfm 6.3 kW EF-4: 13,700 cfm 3.15 kW EF-5: 13,600 cfm 3.15 kW Transfer fans 2 x 5,000 cfm 2x 1.45 kW BHP	Exhaust fan volume based on 100% DD mechanical report. Fans operate 4hrs per day per BC Energy Step Code energy modeling guideline.
Below Grade Other Exhaust/Supply Fans	Placeholders Misc. Exh: Assumed 2,500 cfm (1,180 L/s) 0.2W/cfm (0.4 W/L/s) Vestibule Supply Fan: 360 cfm 0.1kW Vestibule Supply Fan: 250 cfm 0.2 kW	Placeholders Misc. Exh: Assumed 2,500 cfm (1,180 L/s) 0.2 W/cfm (0.4 W/L/s) Vestibule Supply Supply Fan 360 cfm 0.1kW	Placeholders Storage Lockers: 1,200 cfm (560 L/s) 0.2W/cfm (0.4 W/L/s) Waste Collection: 1,060 cfm (500 L/s) 0.2 W/cfm (0.4 W/L/s) 24/7hrs Supply Fan 500 cfm 0.1kW	Placeholders Storage Lockers: 1,200 cfm (560 L/s) 0.2 W/cfm (0.4 W/L/s) Waste Collection: 1,060 cfm (500 L/s) 0.2 W/cfm (0.4 W/L/s) Change Rooms: 635 cfm (300 L/s) 0.2 W/cfm (0.4 W/L/s) Bicycle/Scooter storage: 1000 cfm (450 L/s) 0.2 W/cfm (0.4 W/L/s) Vestibule Supply Fan 550 cfm 0.1kW	Intermittent exhausts on timer/sensor assumed to run 6hrs per day. Placeholder assumption until detailed design info available.
PLANT SIDE SYSTEMS					

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
General Description	Central ASHP with heat recovery capabilities. Gas fired condensing high efficiency boilers for peak and top up.		Central DHW condensing hot water heaters.	Central ASHP with heat recovery capabilities. Gas fired condensing high efficiency boilers for peak and top up.	
Heating System	Central ASHP with heat recovery capabilities: 1xNRP-1500: 255 kW capacity 463 kW (heat recovery mode) 2xNRP-2600: 412 kW capacity COPh-2.7 (annual average), in defrost mode COP-1.9 Condensing Boilers 2 x 1,500 MBH (2 x 440 kW) 94% efficiency @120°/80°F (49°/27°C) Fan 1.7kW blower		N/A Refer to terminal system.	Central ASHP with heat recovery capabilities: 1xNRP-1400: 228kW capacity 409 kW (heat recovery mode) 2xNRB-1600: 283kW capacity COPh-2.6 (annual average), in defrost mode COP-1.8 Condensing Boilers 94% efficiency @120/80F (49/27C) 2 x 1,000 MBH (2 x290 kW) Fan 0.3 kW blower	Based on mechanical 100% DD report.
HW Loop	Outdoor air reset (assumed): When OA< (6 °C), SWT=120 °F (49 °C) When OA> (10 °C), SWT=100 °F (39 °C)		N/A	Outdoor air reset (assumed): When OA< (6 °C), SWT=120 °F (49°C) When OA> (10 °C), SWT=100 °F (39 °C)	
HW Pumps	142 W/cfm (301 W/L/s) with VSD (ASHRAE rated)		N/A	142 W/cfm (301 W/L/s) with VSD (ASHRAE rated)	Assumption, until mechanical selections available.

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
Cooling System	ASHP with heat recovery capability: NRP-1500: 118 tons (414 kW), EER-11.24 2xNRP-2600: 193 ton (678 kW) (each), EER-11.8 COPc-4.3 (annual average model)		N/A Refer to terminal system.	ASHP with heat recovery capability: NRP-1400: 105 tons 369 kW EER-11.2 2xNRB-1600: 130 ton (456 kW) (each), EER-11.8 COPc-4.4 (annual average model)	Based on mechanical 100% DD report.
CHW Loop	44 °F (7 °C) Supply 55 °F (13 °C) Return		N/A	44 °F (7 °C) Supply 55 °F (13 °C) Return	
CHW loop pumps	132 W/cfm (279 W/L/s) secondary 33 W/cfm (70 W/L/s) primary (ASHRAE rated)		N/A	132 W/cfm (279 W/L/s) secondary 33 W/cfm (70 W/L/s) primary (ASHRAE rated)	Assumption, until mechanical selections available.
DHW Load	Baseload Per Cov Energy Modeling Guideline v2,0 For Step Code compliance 0.25 gpm/person (0.0016 L/s/person) 30% reduction in flow fixtures vs BCBC Max. Ozone system in Laundry. Salon/Café based on NECB W/occupant Residential: 1,005 L/h Schedule G Laundry: 103 L/h Schedule C Kitchen: 205 L/h Schedule D Salon/Retail: 117 L/h Schedule D		Baseload Per CoV Energy Modeling Guideline v2,0 For Step Code compliance 0.25 gpm/person (0.0016 L/s/person) 30% reduction in flow fixtures vs BCBC Max. Residential: 742 L/h Schedule G	Baseload Per Cov Energy Modeling Guideline v2,0 For Step Code compliance 0.25 gpm/person (0.0016 L/s/person) 30% reduction in flow fixtures vs BCBC Max. Ozone system in Laundry. Residential: 835 L/h Schedule G Laundry: 85 L/h Schedule C Kitchen: 170 L/h Schedule D	BCBC Max flowrates: -Residential Lavatory: 1.5gpm -Residential Sink1.8 gpm -Residential Shower: 2.0 gpm

AIRSIDE HVAC SYSTEMS	LTC	AL	AH	IL	Description
DHW System	Preheat from ASHP and hydronic heat recovery. 75kW (modeled peak) based on DHW load and schedule. Preheat tank + storage tanks 2 x 225 gallon LWT: 110 °F (assumed max) Kitchen freezer heat rejection for preheat. Top up Condensing Gas Water Heater from 110 °F to 140 °F 96% efficiency		AWHP for full DHW capacity COP range COP-1.8 – 3.9 varies with OA temp. Average annual COP-2.6	Preheat from ASHP and hydronic heat recovery. 55kW (modeled peak) based on DHW load and schedule. Preheat + storage LWT: 110 °F (assumed max) Top up Condensing Gas Water Heater from 110 °F to 140 °F 96% efficiency	

4.9 Renewable Energy Systems

A preliminary analysis performed by Teratek studied the potential benefit of incorporating roof mounted solar PV into the Campus plan. While shading would prevent the AH building from being a viable location, both the LTC-AL and IL buildings are fit for solar energy capture. Based on the Teratek analysis, the system is approximated to generate:

- LTC-AL: 137,776 kWh/year per roof. Mounted on two out of three roofs; 275,552 kWh/year.
- IL: 147,096 kWh/year
- The expected payback for this system would be between 11 and 12 years.

For impact on the energy performance metrics, refer to Section 5. It may also be an option to prepare the building for a future installation of PV as funding and technology advance.

4.10 Simulation Results vs Actual Performance

Results from the energy modelling simulations are most appropriate for determining compliance with the BC Energy Step Code and GHGI targets following specific modelling methodologies and requirements. While efforts have been made to adjust assumptions to reflect actual expectations on building operations, actual energy consumption and carbon emissions can differ from these calculations due to a number of variables including, but not limited to:

- variations in occupancy and building operations schedules;
- plug-loads or equipment installed by owner outside of energy model allowances;
- differences between actual weather; and
- the typical meteorological year represented in the climate data file.

5 ENERGY PERFORMANCE RESULTS

The following section summarizes the key performance data for the full campus and subsequently with more details for each building. The combined performance of LTC-AL is shown as they are served by the same mechanical system plant.

5.1 Summary Campus Energy Metrics

Table 14: Summary of Campus Building Energy and Carbon Performance

METRIC	LTC/AL	IL	AH
ENVELOPE+VENT (TEDI)			
TEDI (kWh/m^2) - pre adjust	78	31	20
TEDI (kWh/m^2) - post adjust**	63	29	18
Target TEDI (kWh/m^2)	OPR Step 4 = Max 15 DoWV = n/a	OPR Step 4 = Max 15 DoWV Step 3 = Max 30	OPR Step 4 = Max 15 DoWV Step 3 = Max 30
Meeting Target?	OPR Goal* = Yes DoWV = n/a	OPR Goal* = Yes DoWV = Yes	OPR Goal* = Yes DoWV = Yes
ENERGY CONSUMPTION			
TEUI (kWh/m^2) **	148	83	90
Total (MWh/yr)	4,808	1,720	1,010
Target TEUI (kWh/m^2)	DoWV Step 1 No Max	DoWV Step 3 Max 120	DoWV Step 3 Max 120
Meeting Target?	Yes	Yes	Yes
CARBON EMISSIONS			
tonne CO_2e/yr	185	54	11
kgCO_2e/m^2/yr**	5.7	2.3	1.0
Target GHGI (kgCO_2e/m^2/yr)	7.4	3.0	3.0
Meeting Target?	Yes	Yes	Yes
OPERATIONAL ENERGY COST			
Energy Cost - ($/yr)	$470,975	$173,976	$111,072
Energy Cost – ($/m^2/yr)***	$14.5	$8.5	$9.9
ENERGY COMPLIANCE STATEMENT AHJ			
MEETING AHJ ENERGY & LCES TARGETS?	**YES** STEP 1 + GHGI < 7.4	**YES** STEP 3 + GHGI < 3	**YES** STEP 3 + GHGI < 3

* The OPR TEDI target reflects a modified TEDI based on an "envelope first" principle and is not intended to include the impact of any additional ventilation beyond a typical residential code compliant building or any process driven ventilation. It's the increase in ventilation for infection control/improved IAQ purposes and process ventilation that are driving the reported TEDI up over the max target.

** Post adjusted metric for LTC+AL includes load offset from active heat recovery on a net basis. Post adjusted metric for IL and AH include adjustments due to corridor ventilation (preliminary values) based on the BC Energy Step Code methodology and definitions for residential buildings. Only applied for residential typology, not long-term care.

***Energy cost per m^2 is based on MFA (modelled floor area) which excludes any parking space but include all other gross floor areas.

5.2 Envelope Heat Loss

Figure 3 below shows the relative heat loss annually through the various envelope components. The purpose of the figure is to show a comparison between the components from a thermal performance perspective, and it does not factor in heat gain from internal loads. The weakest link in the envelope from a heating perspective is the exterior glazing + frame system based on the WWR and thermal performance, followed by above grade exterior walls and infiltration. The figure does not include exterior walls or slab on grade for the unconditioned parking areas, but it does include the heat loss impact through the suspended slab between conditioned space and the unconditioned parkade.

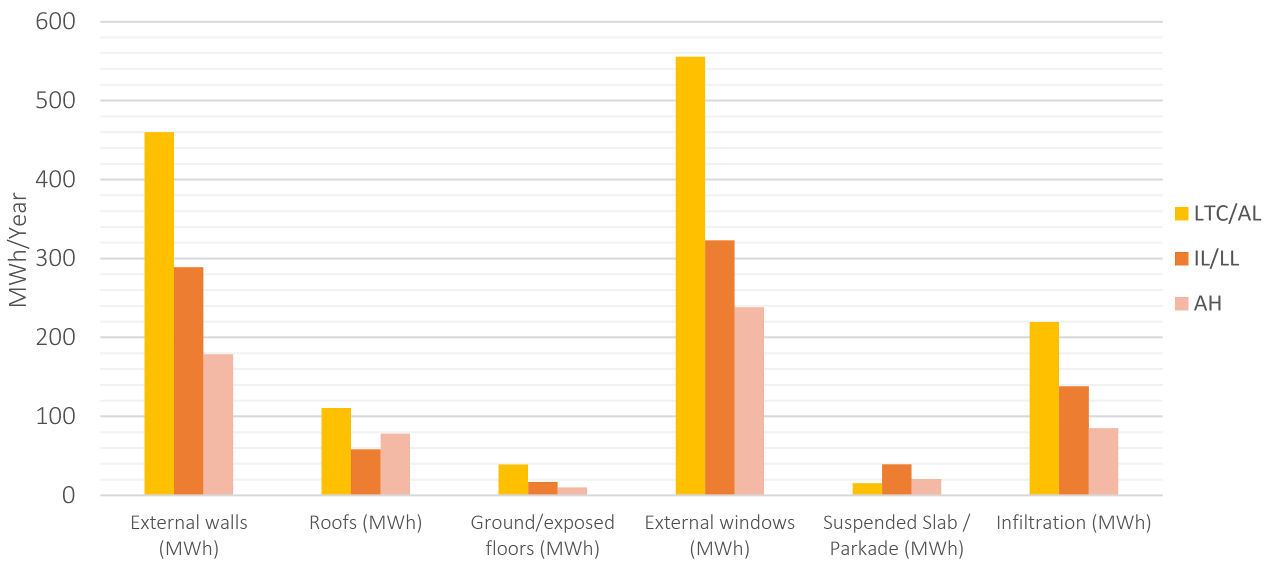

Figure 3: Envelope Heat Loss per Component (MWh/Year and Building)

Table 15, Table 16, and Table 17 summarize details on energy performance and associated carbon emissions and cost per year for each individual building including a breakdown per energy end-use.

5.3 LTC+AL Energy and Carbon Performance

Table 15: LTC-AL Performance by End-use

ENERGY SUMMARY		Long Term Care + Assisted Living (LTC+AL) 100% DD			
Per End-Use	Energy Source	MWh	kWh/m^2	GHGI	$/Yr
Lighting	Electricity	1,173	36	0.40	$129,023
Exterior Lighting	Electricity	31	1	0.01	$3,393
Building Heating Type 1	Natural Gas	174	5	0.99	$5,845
Humidification	Natural Gas	291	9	1.66	$9,755
Building Heating Type 2	Electricity	720	22	0.24	$79,180
Cooling + Heat Rejection	Electricity	142	4	0.05	$15,578
Fans	Electricity	1,056	32	0.36	$116,183

Pumps	Electricity	46	1	0.02	$5,054
DHW Type 1	Natural Gas	89	3	0.50	$2,974
DHW Type 2	Electricity	105	3	0.04	$11,581
Plugloads	Electricity	450	14	0.15	$49,545
Kitchen power	Electricity	190	6	0.06	$20,884
Kitchen gas	Natural Gas	203	6	1.15	$6,803
Elevator	Electricity	138	4	0.05	$15,177
TOTAL (pre-adjustment)		**4,808**	**148**	**5.7**	**$470,975**
Total Electricity		4,051	125	1.4	$445,597
Total Natural Gas		757	23	4.3	$25,378
TOTAL (post-adjustment)		**4,808**	**148**	**5.7**	**$470,975**
MEETING TARGET		n/a	YES	YES	n/a

5.4 IL Energy and Carbon Performance

Table 16: IL Performance by End-use

ENERGY SUMMARY		Residential Rental for Seniors (IL) 100% DD			
Per End-Use	Energy Source	MWh	kWh/m²	GHGI	$/Yr
Lighting	Electricity	453	22	0.24	$49,806
Exterior Lighting	Electricity	21	1	0.01	$2,262
Building Heating Type 1	Natural Gas	38	2	0.34	$1,264
Humidification	Natural Gas	0	0	0.00	$0
Building Heating Type 2	Electricity	275	13	0.15	$30,262
Cooling + Heat Rejection	Electricity	69	3	0.04	$7,630
Fans	Electricity	252	12	0.14	$27,741
Pumps	Electricity	5	0	0.00	$580
DHW Type 1	Natural Gas	88	4	0.79	$2,934
DHW Type 2	Electricity	77	4	0.04	$8,514
Plugloads	Electricity	249	12	0.13	$27,408
Kitchen power	Electricity	73	4	0.04	$8,043
Kitchen gas	Natural Gas	74	4	0.67	$2,474
Elevator	Electricity	46	2	0.02	$5,059
TOTAL (pre-adjustment)		**1,720**	**84**	**2.6**	**$173,976**
Total Electricity		1,521	74	0.8	$167,304
Total Natural Gas		199	10	1.8	$6,671
TOTAL (post-adjustment)		**1,720**	**82**	**2.3**	**$173,976**
MEETING TARGET		n/a	YES	YES	n/a

5.5 AH Energy and Carbon Performance

Table 17: AH Performance by End-use

ENERGY SUMMARY		Affordable Housing (AH) 100% DD			
Per End-Use	Energy Source	MWh	kWh/m²	GHGI	$/Yr
Lighting	Electricity	178	16	0.18	$19,611
Exterior Lighting	Electricity	8	1	0.01	$848
Building Heating Type 1	Natural Gas	0	0	0.00	$0
Humidification	Natural Gas	0	0	0.00	$0
Building Heating Type 2	Electricity	174	16	0.17	$19,117
Cooling + Heat Rejection	Electricity	86	8	0.08	$9,491
Fans	Electricity	229	21	0.23	$25,216
Pumps	Electricity	2	0	0.00	$216
DHW Type 1	Natural Gas	0	0	0.00	$0
DHW Type 2	Electricity	73	7	0.07	$8,058
Plugloads	Electricity	213	19	0.21	$23,455
Kitchen power	Electricity	0	0	0.00	$0
Kitchen gas	Natural Gas	0	0	0.00	$0
Elevator	Electricity	46	4	0.05	$5,059
TOTAL (pre-adjustment)		1,010	90	1.0	$111,072
Total Electricity		1,010	90	1.0	$111,072
Total Natural Gas		0	0	0.0	$0
TOTAL (post-adjustment)		1,010	90	1.0	111,072
MEETING TARGET		n/a	YES	YES	n/a

5.6 Performance with Solar PV Installed

Table 18 summarizes the impact on GHGI and annual costs of installing solar PV arrays (refer to Section 4.9 for details from Teratek analysis).

Table 18: Renewable Energy Generation Summary

Building	No Renewable Energy Generation		With Renewable Energy Generation	
	Adjusted GHGI ($kgCO_{2e}/m^2/yr$)	$/yr	Adjusted GHGI ($kgCO_{2e}/m^2/yr$)	$/yr
LTC-AL	5.7	$470,975	5.6	$455,820
IL	2.3	$173,976	2.2	$157,795
AH	1	$111,072	No PV proposed	No PV proposed

5.7 Observations for Further Discussion

LTC/AL:

- The reported TEDI number for LTC/AL is high due to the 3ACH and +30% increase in ventilation rate supplied continuously to the spaces. The load is significantly reduced through the use of heat recovery wheels; however, it would be improved further if the ERVs were split into two separate units; one supplying the suites, and one supplying the common areas. This will be investigated further during construction documents stage with the mechanical design team.
- Humidification accounts for 30% of the GHGI for LTC/AL. Preliminary equipment selections are noted to have a 77% efficiency rating while 85% efficiency units were discussed earlier on. We recommend reviewing if options exist to specify higher efficiency units >80% efficiency.

IL Building:

- The IL building is very close to the residential Step 3 TEDI criteria of max 30 kWh/m^2. The reason for this is mainly due to the central kitchen which requires make-up air beyond the residential ventilation requirements. Assumptions on the conservative end for the required kitchen exhaust rate has been made at this stage of design and will need confirmation during construction documents stage.
- The corridor ventilation is not supplied through a heat recovery ventilation as initially considered for this building, which contributes to the higher TEDI.
- Stairwells are at close to 100% WWR for the residential levels – we recommend reducing this to avoid heat loss and stairwell overheating.
- Parking area has increased since last energy model iteration. This adds lighting and fan energy consumption with no additional area as part of the MFA (m2), this impacts TEUI and GHGI.
- It was noticed in review of the equipment drawings that there is no cooling coil in corridor ventilation MUA. During a heat wave this means +35C air is being supplied into the building corridors slowly heating up the building from the inside. We recommend considering adding cooling into the corridor MUA.

AH Building:

- Stairwells are at close to 100% WWR for the residential levels – we recommend reducing this to avoid heat loss and stairwell overheating as not occupied space.
- Lobby and amenity space on AH building rooftop are 100% glazed – we recommend reducing this to avoid heat loss and risk for overheating.
- The corridor ventilation is not supplied through a heat recovery ventilation as initially considered for this building, which contributes to the higher TEDI.
- It was noticed in review of the equipment drawings that there is no cooling coil in corridor ventilation MUA. During a heat wave this means +35C air is being supplied into the building corridors slowly heating up the building from the inside. We recommend considering adding cooling into the corridor MUA.

6 CLIMATE RESILIENCE

The project design is using the approach of sizing for the 2050s and planning for the 2080s in order to avoid large retrofit costs in the future while ensuring there is capacity built into the system to meet thermal comfort needs and replace aging equipment with larger capacity equipment over time.

The proposed envelope is also developed with this approach in mind and there is inherent resiliency embedded in the proposed systems approach. The air source heat pumps (ASHP) with FCUs in the suites with full cooling capability ensures that the thermal comfort is achieved for all occupants as the climate warms. An additional benefit is the capability of the ASHPs to recover heat from simultaneous heating and cooling load. As the cooling demand increases, the increased load of heat rejection can be used for either building heating or DHW preheat.

The earth tube systems provide passive tempering of ventilation air for the LTC+AL buildings which saves heating energy in winter and helps to reduce cooling energy in summer. The earth tube itself is an inherent strategy for climate resiliency benefits. The precool effect of the earth tubes on the incoming ventilation air is achieved through heat exchange with the stable ground conditions – and contributes to a considerable reduction in cooling peak kW load for LTC+AL with essentially no maintenance requirements over time for the earth tubes themselves (i.e. buried in ground at time of construction).

7 SYSTEM DIAGRAM

The following system diagram summarizes the key strategies for the LTC+AL systems, also attached as a larger version in Appendix A.

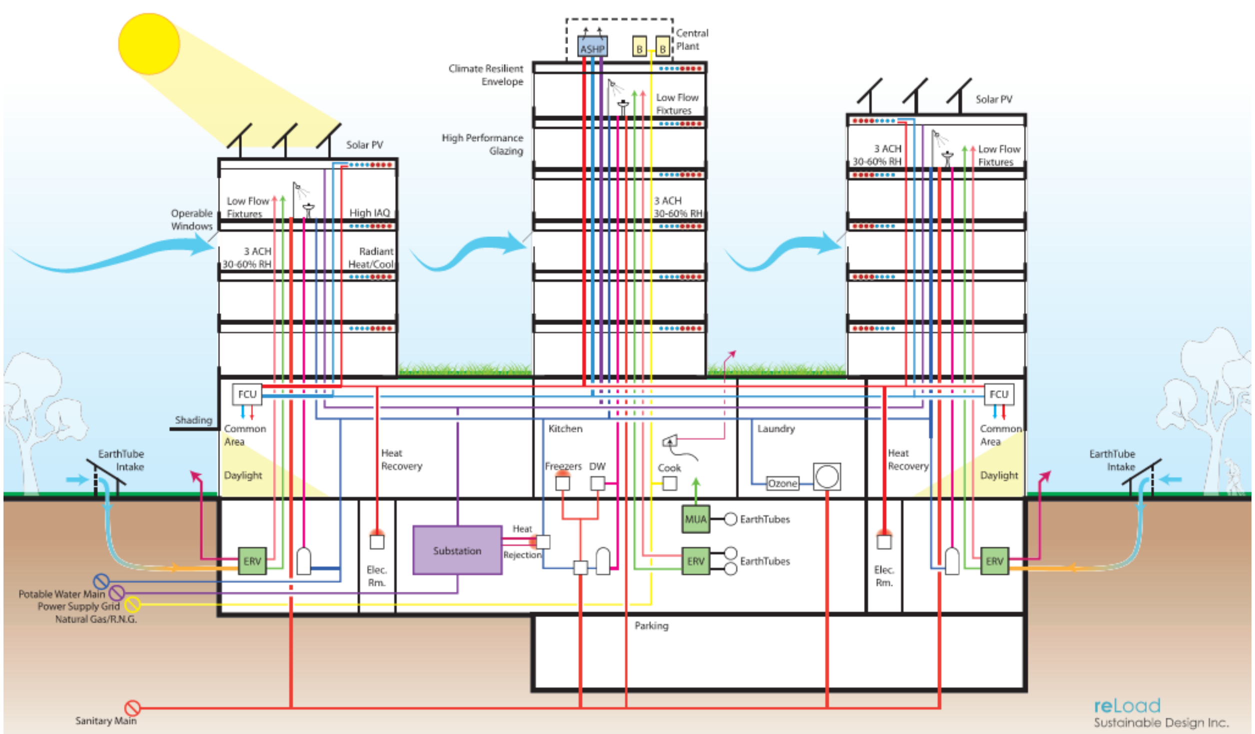

Figure 4: Systems Diagram LTC-AL (refer to Appendix A for enlarged version)

8 NEXT STEPS

The energy results and reporting will be updated next during construction documents phase. The immediate next steps that are scheduled to take place includes:

- Development Permit Application to DoWV
- Continuation of Phase 1 of the project (LTC+AL) into construction documents.
- Develop configuration and control sequence of operation for the ERVs with mechanical design team to optimize operating cost for LTC+AL.
- Investigate options to reduce TEDI in IL building.
- Revisit the 2050s climate resiliency strategy with the architectural and mechanical design team to ensure capacity integration.

It is recommended to have all design parameters as outlined in this report reviewed by the design team for incorporation into project drawings. Any further adjustments to the design are to be reviewed against the energy target.

End of Report

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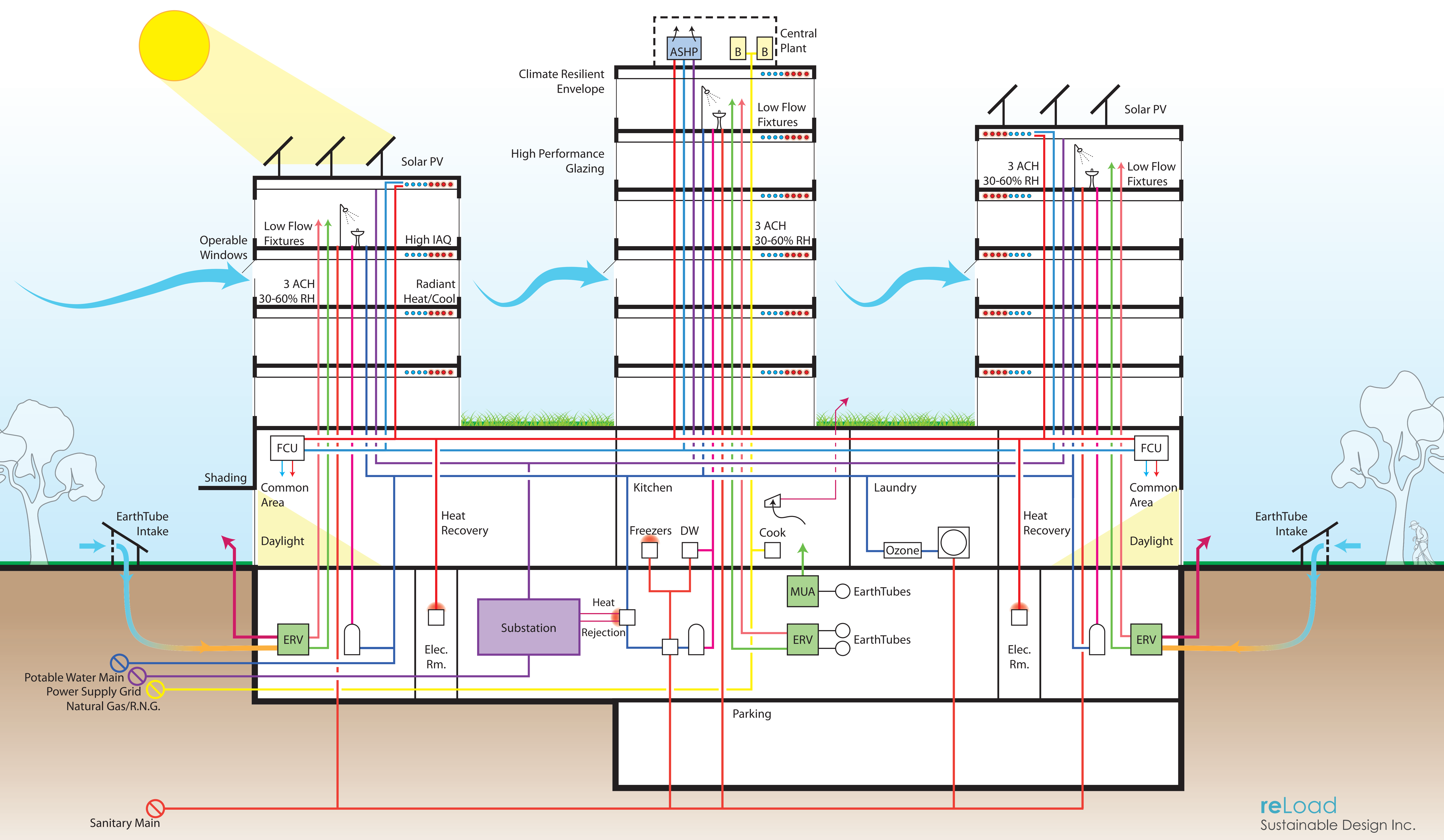
APPENDIX A – SYSTEM DIAGRAM

LTC +AL Building



APPENDIX B – CLIMATE ADAPTATION DATA

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MEMO

Inglewood Campus of Care

To:	ZGF - ING Design Team	Date:	August 28th, 2020
Attn:	Andrew Thomson, Ashleigh Fischer, Iain MacFadyen	Project Name:	Inglewood Campus of Care
From:	Martina Soderlund, P.Eng, reLoad	Project No:	2021_076

RE: Inglewood Campus of Care – Summary of Site Climate Change Predictions (Temperature and Precipitation)

Executive Summary

The memo provides the Inglewood design team a summary of published data sets on climate change predictions to work with their interpretation in a consistent approach; in particular concerning temperature change and cooling capacities to ensure thermal comfort, but also to support early stage conversations around stormwater management and site water retention and re-use opportunities.

The memo lists the most relevant published information (as of August 2020) for application and incorporation into the design of Inglewood.

Temperature

PCIC (Pacific Climate Impacts Consortium) has produced several climate indicators for West Vancouver, for the 2020s, 2050s and 2080s outlined in this memo. The increase in annual maximum dry-bulb temperature highlights the expected degree of warming climate for the location.

Annual Maximum Temperature (DB)	Past (1971-2011)	2050s (2041-2070)	2080s (2071-2100)
Average Prediction	31.8 °C	35.3°C	37.5°C
High Range Prediction	31.8 °C	37.0°C	40.4°C

Design Temperature for Mechanical Cooling System Sizing

A methodology is currently under development by the local health authorities for use in the planning and design of health care facilities in BC which would result in the following cooling design temperatures to be used for climate change planning, based on 2.5% Dry-bulb (°C) and 2.5% Wet-bulb (°C).

- 2050s Dry-bulb (West Vancouver) = 28 + 4.3 = 32.3°C
- 2050s Wet-bulb (West Vancouver) = 19 + 4 = 23°C

It might not be appropriate to size the entire system for the 2080s today, but rather to plan for 2080s in regards to built-in capacity and retrofit timelines, however, this recommendation should be further discussed within the design team to agree on approach.

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Precipitation

Expected changes in total precipitation patterns (include rain and snow) per season are as follows:

- Summer: decrease 16% by 2050s and 23% by 2080s,
- Other seasons: increase, with the largest in autumn 9% by 2050s and 17% by 2080s.

The intensity however of the precipitation events are expected to increase, with implications to consider stormwater management and retention infrastructure on site to avoid flooding and minimize the increased run-off to municipal stormwater infrastructure and nearby Hadden Creek watershed.

Other Considerations

Further items to consider by the design team include the following:

- Hotter, dryer summer = increased wildfire risk, with impact on air quality management and strategies for pollution prevention.
- Filtering requirements and replacement strategies in active ventilation systems to be considered also for longer duration of heat, possibly in combination with wildfire events.

It is recommended that the information in this memo be reviewed by the design team and discussed further. This discussion is essential to establish appropriate climate adaptation strategies to be integrated into the planning and design of the Inglewood Campus of Care today, to meet the needs of the 2050s of the 2080s.

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1. Context

In support of creating a long-term high performing and cost-effective campus of care, climate change projections are recommended to be considered by the design team to plan for adaptation and to build in resiliency in all infrastructure and building systems. To ensure the health and wellbeing of Inglewood's residents and staff for the life of the project, and to reduce expensive retrofits in the future, it is imperative to consider the changing climate over the long term and published data is now publicly available for use in BC.

The main intent of the memo is to provide the Inglewood design team a summary of published data sets to work with their interpretation in a consistent approach; in particular concerning temperature change and cooling capacities to ensure thermal comfort, but also to support early stage conversations around stormwater management and site water retention and re-use opportunities.

The memo lists the most relevant published information (as of August 2020) for application and incorporation into the design of Inglewood. The data sets are referenced from PCIC[1], all references are listed at the end of the memo.

1.1 Climate Scenario References

This memo is focused on the RCP-8.5 (Representative Concentration Pathways) scenario, which considers a 'high emissions' scenario – based on low mitigation of climate change over time. For more information on RCP-8.5 refer to PCIC reports.

2. Climate Projections - Temperatures

PCIC has produced adjusted weather files and several climate indicators for BC weather stations, for the 2020s, 2050s and 2080s – shown in Table 1, next page.

These forecasts project changes which will impact capacity of heating and cooling systems over time to meet occupant comfort, health and wellbeing.

- Predicted daily maximum (indicator 'TXX') shows that by 2050s, the *average* change is +3.5°C and by 2080s the *average* change is +5.7°C compared to the past.
- The predicted *high end* of change show +5.2°C by 2050s and +8.6C by the 2080s compared to the past.

It should be noted that the high scenario of 2050s is close to the average scenario in the 2080s (for TXX). A challenge is to decide what temperature scenario to design for and finding the balance of sizing the system in a way where investments today vs in the future are considered while ensuring comfort over time.

[1] Pacific Climate Impacts Consortium, University of Victoria, (Feb. 2019). Statistically Downscaled Climate Scenarios. Downloaded from https://data.pacificclimate.org/portal/downscaled_gcms/map/ Method: BCCAQ v2, RCP8.5

Table 1: PCIC Data for West Vancouver Temperature Climate Change Indicators[2]

West Vancouver, Weather Station 717840	Past[3]	2020s Change		2050s Change		2080s Change	
		Average	Range[4]	Average	Range	Average	Range
HDD (Heating Degree Days)[5]	2986	-249	(-345 to -154)	-635	(-921 to -439)	-1138	(-1460 to -855)
TNN (°C)[6]	-5.1	0.9	(0.3 to 1.6)	2.1	(1.6 to 2.7)	4	(3.5 to 4.5)
Heating 99.0% (°C)[7]	-2.4	0.9	(0.4 to 1.5)	2	(1.3 to 2.7)	4.1	(3.4 to 4.8)
Heating 97.5% (°C)	-0.7	0.8	(0.3 to 1.2)	1.9	(1.4 to 2.5)	4	(3.2 to 4.6)
Heating (wet-bulb) 99.0% (°C)	-3.9	0.9	(0.4 to 1.4)	2	(1.3 to 2.7)	4.1	(3.4 to 4.7)
Heating (wet-bulb) 97.5% (°C)	-2.2	0.8	(0.3 to 1.2)	1.9	(1.4 to 2.5)	3.9	(3.1 to 4.5)
CDD (Degree Days)[8]	77	41	(16 to 72)	176	(65 to 272)	406	(183 to 628)
CDD10 (Degree Days)[9]	906	144	(71 to 263)	460	(251 to 720)	939	(560 to 1436)
TXX (°C)[10]	31.8	1	(-0.2 to 1.8)	3.5	(1.8 to 5.2)	5.7	(3.1 to 8.6)
Cooling (dry-bulb) 2.5% (°C)[11]	23.4	0.9	(0.4 to 1.6)	3	(1.5 to 4.3)	5.5	(3 to 7.7)
Cooling (wet-bulb) 2.5% (°C)	21.3	0.9	(0.4 to 1.5)	2.8	(1.4 to 4)	5.1	(2.9 to 7.2)

Design temperatures in BCBC are based on historical data and does not (yet) take climate change into account. Section 2.1 below proposes a methodology for how to establish a design temperature using PCICs data, as a suggestion for Inglewood system sizing.

[2] The climate indicators are averaged over 30-year time periods for West Vancouver, BC, referenced as the 2020s (2011-2040), the 2050s (2041-2070) and the 2080s (2071-2100).
[3] 'Past' summarizes data from West Vancouver CWEC 2016 (1971-2011) adjusted baseline and TMY averaged over 1998-2014.
[4] Range of anticipated values (low-high) in the 30-year average for the time period based 10 downscaled climate models (PCIC reference 10th-90th percentiles)
[5] Threshold 18°C
[6] TNN - average annual minimum (of daily minimum temperature) in 10 climate models
[7] Difference to BCBC is that coldest day is influenced also by coldest day outside of January
[8] Threshold 18°C
[9] Threshold 10°C
[10] TXX - average annual maximum (of daily maximum temperature) in 10 climate models
[11] Difference to BCBC is that hottest day is influenced also by the hottest day outside of July

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Tropical nights refer to the number of days in a year when the nighttime low temperature is greater than 20°C. This indicator is important, as a series of hot nights reduces the ability of buildings to cool passively at night, increasing cooling load and energy use during these warmer periods. Tropical nights can also cause heat stress especially in residents sensitive to higher temperatures.

The following Table 2 summarizes predictions in change of number of tropical nights for the Lions Gate Hospital location[12] as a proximate example to the Inglewood site.

Table 2: Tropical Nights (Lions Gate Hospital location)

Indicator	Past (days)	2020s Change (range)	2050s Change (range)	2080s Change (range)
Tropical Nights	0.1	0.8 (0.1 to 1.4)	7 (0.9 to 18)	26 (5 to 57)

2.1 Establishing Design Conditions for Climate Adaptation Planning (Cooling)

The following design temperatures are listed in BCBC 2018 for West Vancouver, per Table 3.

Table 3: West Vancouver Design Temperature (BCBC 2018, Table C-2)

BCBC 2018, Table C-2 West Vancouver	Value
HDD (Heating Degree Days)	2950
Heating (January) 1% (°C)	-9
Heating (January) 2.5% (°C)	-7
Cooling (July) 2.5% Dry-bulb (°C)	28
Cooling (July) 2.5% Wet-bulb (°C)	19

In the absence of National Building Code (and BCBC) published data of design temperatures for future climate, a methodology is currently under development by the local health authorities in collaboration with PCIC, for use in the planning and design of health care facilities in BC.

This approach uses the current BCBC 2018 design temperatures for any location, adjusted with the 2050s highest range of change (90th percentile) for sizing of cooling systems.

Cooling Design Conditions for Climate Adaptation Planning (VCH/FH approach)

2050s Dry-bulb °C = [BCBC 2018 Dry-Bulb] + [2050s highest range of change (90th percentile)]

2050s Wet-bulb °C = [BCBC 2018 Wet-Bulb] + [2050s highest range of change (90th percentile)]

[12] *"Moving Towards Climate Resilient Health Facilities for Vancouver Coastal Health",* Lower Mainland Facilities Management, October 2018.

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For Inglewood, this methodology would result in the following cooling design temperatures to be used for climate change planning.

Cooling Design Conditions for Climate Adaptation Planning – Suggested for Inglewood:

2050s Dry-bulb °C (West Vancouver) = 28 + 4.3 = 32.3°C

2050s Wet-bulb °C (West Vancouver) = 19 + 4 = 23°C

As equipment will be replaced over time and climate change acceleration probably changed, it might not be appropriate to size the entire system for the 2080s today, but rather to plan for 2080s in regards to built-in capacity and retrofit timelines, also system dependent. However, this recommendation should be further discussed within the design team to agree on approach.

2.2 Climate Files for Energy Modeling

We propose to use PCICs future adjusted climate files for energy modeling and thermal comfort analysis for the project to understand the impact of cooling, heating and the energy and carbon balance, and to evaluate the impact of passive strategies on long term operational cost.

Refer to Figure 1 for peak temperatures defined in the adjusted weather files for 2020s, 2050s and 2080s, and to Table 3 for predicted duration of increase in temperature in a year. The adjusted weather files are compared to the current BC Energy Step Code weather file of CWEC 2016.

Similar to the design temperature approach, we suggest using 2050s in energy modeling and thermal comfort modeling for design guidance purposes, but this should be discussed and agreed to by the design team.

2.2.1 Adjusted Weather Files Peak - Temperatures

Figure 1 summarize the peak temperatures from the West Vancouver hourly weather files for the 2020s, 2050s and 2080s, in comparison to the Canadian Weather Year for Energy Calculation (CWEC) 2016 used in energy analysis by current building code.

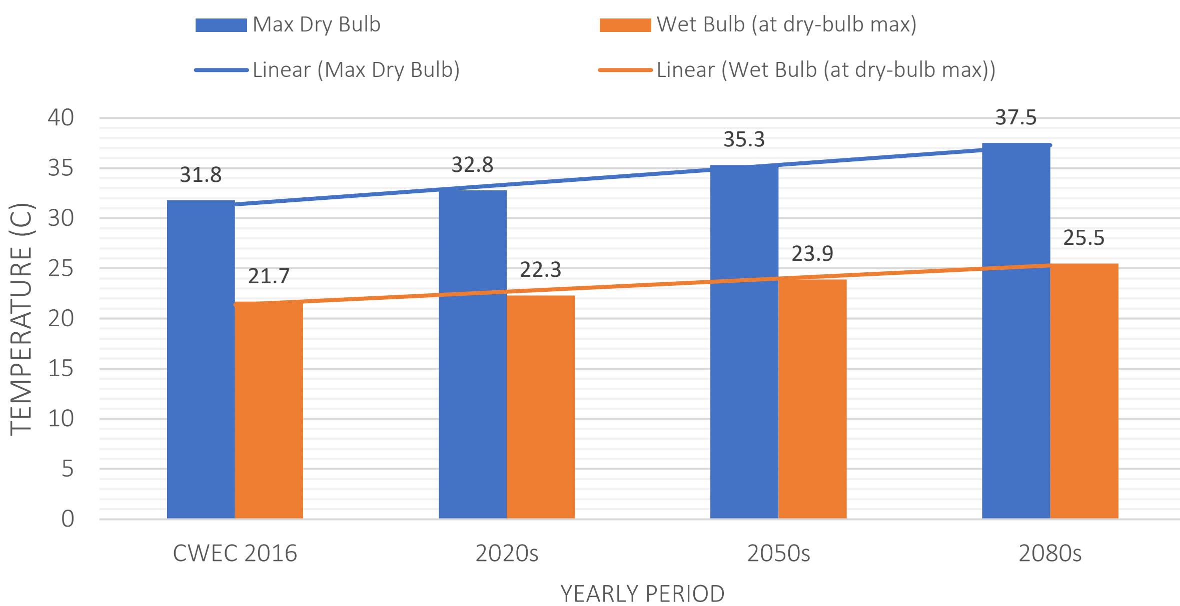

Figure 1: Comparisons and trend for predicted peak temperatures – cooling

2.2.2 Adjusted Weather Files - Duration

The duration of the increased temperatures in the adjusted weather files will be taken to account per the following. As noted, this is important to consider for occupants and staff health and comfort, and to ensure infrastructure and system capacities can maintain over time.

Table 4: Comparisons of hourly weather files, temperature ranges and hours - yearly

Hours in	Past*	West Vancouver **			
Temp Range	CWEC 2016	2020s	2050s	2080s	Unit
24-26 °C	179	240	469	862	hrs
26-28 °C	71	103	245	524	hrs
28-30 °C	27	42	107	291	hrs
30-32 °C	3	13	46	139	hrs
>32 °C	0	2	15	56	hrs

* based on 30 years historical data up to 2014, created by Environment Canada
** from hourly predicted weather files (.epw) provided by PCIC

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3. Climate Projections - Precipitation

The following summarizes information on precipitation. The location of Lions Gate Hospital[13] is used for reference as the closest location to Inglewood per this report.

Expected changes in total precipitation (include rain and snow) patterns per season are as follows, with more details in Table 5.

- Summer: decrease 16% by 2050s and 23% by 2080s,
- Other seasons: increase, with the largest in autumn - 9% by 2050s and 17% by 2080s.

Table 5: Total Seasonal Precipitation (Lions Gate Hospital example)

Season	Past (mm)	2020s Percent Change (range)	2050s Percent Change (range)	2080s Percent Change (range)
Spring	354	2% (-4 to 10)	5% (-4 to 13)	9% (1 to 17)
Summer	168	-8% (-28 to 5)	-16% (-35 to 3)	-23% (-51 to -2)
Autumn	493	2% (-5 to 11)	9% (-2 to 23)	17% (8 to 36)
Winter	572	4% (-2 to 11)	3% (-3 to11)	11% (0 to 24)

The intensity however of the precipitation events are expected to increase, a high-level summary in Table 6.

Table 6: Extreme Precipitation (Lions Gate Hospital example)

Indicator Description	Indicator	Past (mm)	2020s Percent Change (range)	2050s Percent Change (range)	2080s Percent Change (range)
Wettest day of the year precipitation	Rx1day	59	4% (-2 to 13)	8% (-1 to 22)	18% (6 to 28)
Wettest 5-day period of the year precipitation	Rx5day	139	2% (-4 to 14)	7% (-2 to 19)	17% (10 to 27)
Precipitation on wet days	R95p	324	11% (3 to 21)	25% (8 to 51)	49% (28 to 65)
Precipitation on very wet days	R99p	95	12% (-3 to 29)	41% (-1 to 101)	89% (35 to 144)
1-in-20 wettest day	RP20 PR[14]	92	10% (-5 to 32)	12% (-2 to 31)	25% (7 to 37)

[13] referenced from *"Moving Towards Climate Resilient Health Facilities for Vancouver Coastal Health"*, Lower Mainland Facilities Management, October 2018.

[14] 1-in-20 chance (5%) that a 1-day rainfall to this magnitude will fall.

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The implications on stormwater management and retention infrastructure on site should be considered to avoid flooding while also attempt to minimize the increased load on the municipal water supply during the summer time.

4. Other Considerations

There are many layers of climate change to be considered and discussed by the design team, here are a few additional items to consider;

- increased temperatures and dryer summer means predicted increased risk for wildfire events; this impacts air quality management and strategies for pollution prevention.
- air quality concerns are also higher during extreme heat (pollutants from traffic etc increased).
- poor outdoor air quality during extreme heat and wildfire events means the windows in patient rooms and residential units to stay closed; interconnections with HVAC system important.
- filtering requirements and replacement strategies in active ventilation systems to be considered also for longer duration of heat, possibly in combination with wildfire events.

5. References

- *"Climate Projections for Metro Vancouver"*, Metro Vancouver, PCIC, and Pinna http://www.metrovancouver.org/services/air-quality/AirQualityPublications/ClimateProjectionsForMetroVancouver.pdf
- *"Moving Towards Climate Resilient Health Facilities for Vancouver Coastal Health",* Lower Mainland Facilities Management, October 2018. https://bcgreencare.ca/system/files/resource-files/VCH_ClimateReport%2BAppendices_Final_181025.pdf
- *"PCIC Climate Indicators"* for West Vancouver (Weather Station 717840) update June 2020 https://www.pacificclimate.org/data/weather-files
- *CWEC 2016.epw* –weather file based on Environment Canada 30-year historical data.
- Methodology from draft document: "*Establishing Design Conditions for Planning and Design of Climate Resilient Health Care Facilities in BC"* , August 2020 (EES (VCH, PHSA, FH), PCIC and reLoad).

6. Summary

It is recommended that the above summary be reviewed by and discussed with Baptist Housing and the design team to agree on to what degree climate change should be considered in design strategies and financial planning for infrastructure investments, today vs in the future. This discussion is critical to establish appropriate climate adaptation strategies to be integrated into the planning and design of the Inglewood Campus of Care today, to meet the needs of the 2050s and the 2080s.

For any questions or request for further information, don't hesitate to be in touch.

Sincerely,

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