

Decarb Lunch Series

zebx

 **BC Hydro**
Power smart

 **CITY OF
VANCOUVER**

From Net-Zero Energy to Near-Zero Emissions

Fri Oct 29, 2021,
from 12- 1pm PDT
Free Webinar | zebx.org

 **BC HOUSING**

Music: Morning in Waiting – Ambient Solle

Zero Emissions Building Plan

2016

RR-2

POLICY REPORT DEVELOPMENT AND BUILDING

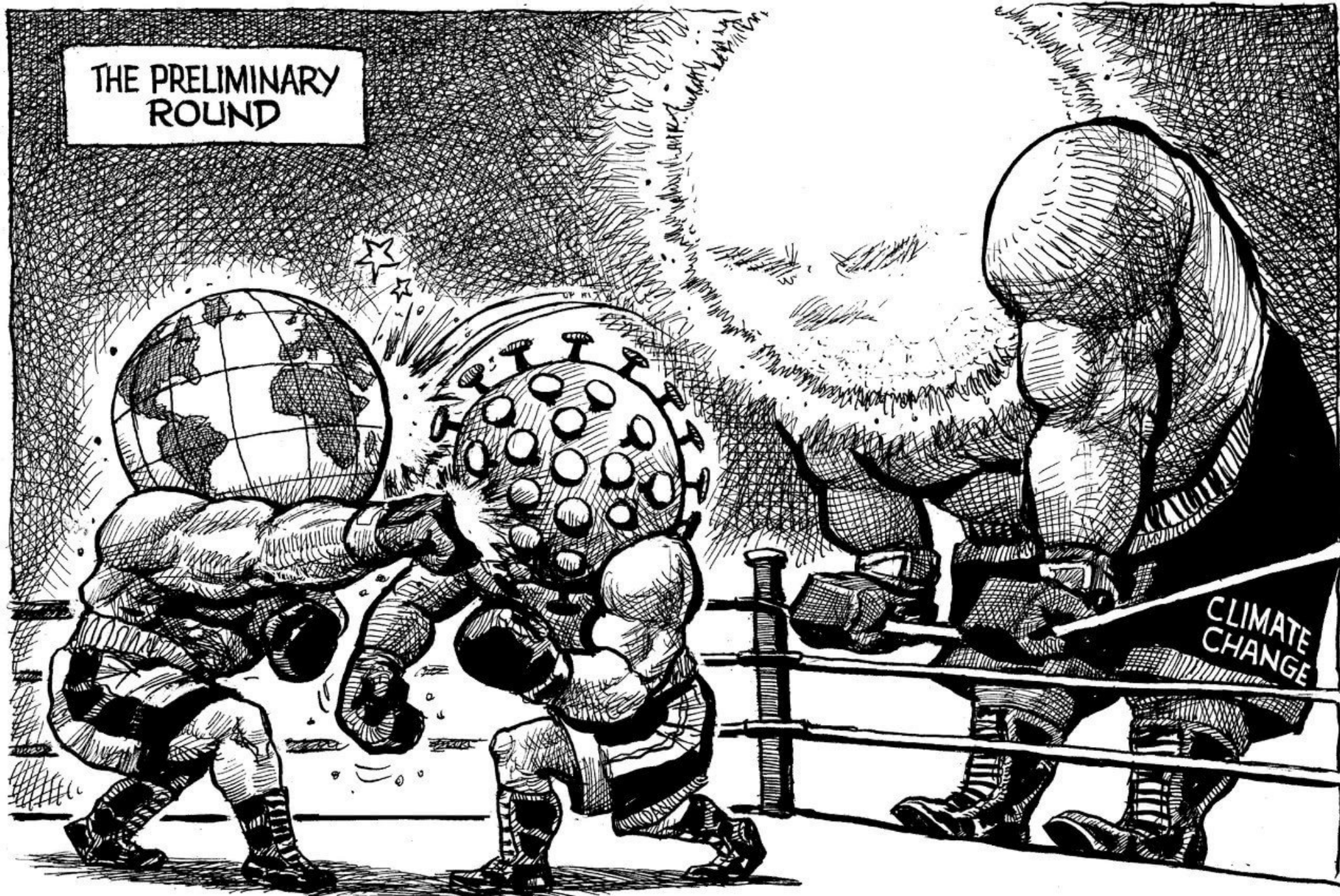
Report Date: July 5, 2016
Contact: Sean Pander
Contact No.: 604.871.6542
RTS No.: 11195
VanRIMS No.: 08-2000-20
Meeting Date: July 12, 2016

TO: Vancouver City Council
FROM: Green Building Manager, Sustainability Group
SUBJECT: Zero Emissions Building Plan

RECOMMENDATION

- A. THAT Council approve the Zero Emissions Building Plan (attached as Appendix A) and adopt a target to reduce emissions from new buildings by 90% as compared to 2007 by 2025 and to achieve zero emissions for all new buildings by 2030 including intermediary time-stepped GHG emission and thermal energy demand targets as described in the Plan.
- B. THAT Council direct staff to report back with specific recommendations to reflect the first step of these limits in the Rezoning Policy for Green Buildings and Vancouver's Building Bylaw along with any synergistic updates to Neighbourhood Energy connection requirements by Q1 2017.
- C. THAT Council direct staff to build all new City-owned and Vancouver Affordable Housing Agency (VAHA) projects to be Certified to the Passive House standard or alternate zero emission building standard, and use only low carbon fuel sources, in lieu of certifying to LEED Gold unless it is deemed unviable by Real Estate and Facilities Management, or VAHA respectively, in collaboration with Sustainability and report back with recommendations for a Zero Emissions Policy for New Buildings for all City-owned and VAHA building projects by 2018.
- D. THAT Council direct staff, in consultation with industry, to develop a three year, \$1.625 million Zero Emissions Home Program for detached and row houses (\$325K in 2017 from the Climate Action Rebate Incentive Program Reserve, \$650K in 2018 and \$650K in 2019 from a funding source to be determined and reported back to Council), and report back to Council with specific recommendations for tools to catalyze leading builders to demonstrate cost effective approaches to building zero emissions homes by 2017.

F. THAT Council approves in principle \$700,000 over three years (\$300K in 2017, \$200K in 2018, and \$200K in 2019 from the City's 2017 Innovation Fund, subject to Council approval of the 2017 Innovation Fund budget) towards establishing a non-governmental Zero Emissions Building Centre of Excellence with the mission to facilitate the compilation and dissemination of the knowledge and skills required to design, permit, build and operate zero emission buildings in BC, and direct staff to engage partners, secure matching funding, consult with stakeholders and report back with recommendations for implementation in 2017.



COLLABORATE

Accelerate Solutions



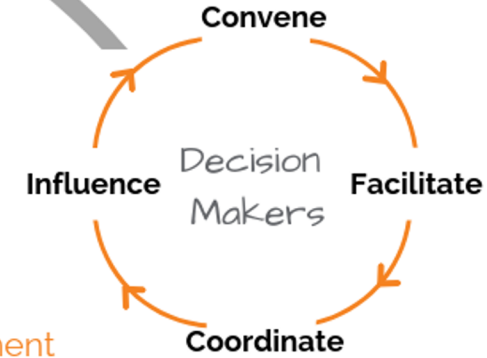
Designers
Builders
Academia
Developers
Manufacturers

zebx

"connecting industry to solutions"

~~ADVANCE~~ ACCELERATE

Remove Barriers &
Identify Opportunities



Government
Global Experts
Mission-Aligned Organizations
Industry Associations

SCALE

Build Capacity



Season 1 Episode 5

Recorded at Past Event: Jul 22 @ 12:00 pm – 1:00 pm

The Builders Have Spoken: The Cost of High-Performance Construction



▶ 0:00 / 53:32



Overview

In our June Decarb Lunch, we presented ZEBx's [in-depth analysis](#) of construction costs for high-performance multi-unit residential buildings in BC. Of the seven buildings in the study, two all-electric, Step 4 buildings were constructed for well under the average cost of similar code-minimum residential buildings in the area. Both buildings were constructed by developer/builders: [Vidorra Developments](#) and [Highstreet Ventures](#). How did they achieve this impressive result? Was it the fact that they are developer/builders? Do they have some special recipe for constructability or cost-effective high-performance building development?

The July 2021 was a collaboration with the Pacific Region [UDI](#).

CASE STUDY

zeb^x
NET-ZERO ENERGY READY BUILDINGS

cleanBC
BETTER BUILDINGS

NET-ZERO ENERGY-READY
CHALLENGE

WINNERS SERIES

Supporting, promoting and
celebrating the design and
construction of net-zero
energy-ready buildings

825 Pacific Street

Net-Zero Energy-Ready Challenge Winners Series
Sep 2021



NearZero.ca

A green initiative sponsored by the City of Vancouver and CleanBC to gather data and encourage the construction of more high-performance homes.

PROJECT BROUGHT TO YOU BY:

PASSIVEHOUSE
CANADA Build better.
Feel better.

 CITY OF
VANCOUVER

 **GREENEST**
CITY

zebx
ZERO EMISSIONS BUILDING EXCHANGE

cleanBC
our nature. our power. our future.

[Home](#)

[About NearZero](#)

[Overview](#)

[Requirements](#)

[Deliverables](#)

[Compensation](#)

[ZEBx](#)

[Register](#)

Deep Emissions Retrofit Dialogue

zeb^x

 **BC Hydro**
Power smart

 **CITY OF
VANCOUVER**

Series

**Deep Emissions
Retrofits of Homes:
How to Get it Right**

**Tue, Oct 26, 2021
from 12.30pm - 2.30 pm PDT
Free webinar | zeb.org**



**HOME PERFORMANCE
STAKEHOLDER COUNCIL**

Be part of it first.

Join the **Building to Electrification
Coalition launch event**

Sep 29, 2021

11am- 12pm PDT

Free Webinar

Building zobx Electrification

Photo: Brayden Law on Unsplash



B2E

**Building to
Electrification
Coalition**

A Building Electrification Road Map for British Columbia

5 CORE STRATEGIES

STRATEGY	OBJECTIVE
Create Market Demand	<ul style="list-style-type: none">• Demonstrate provincial leadership through messaging and market signals• Raise level of consumer awareness about the benefits of electrification• Require building GHG performance data reporting and disclosure• Set a minimum energy performance standard of co-efficient of performance (COP) >1 by 2035 for space and water heating equipment
Improve Cost Competitiveness	<ul style="list-style-type: none">• Reduce equipment and whole building capital costs• Level the playing field between natural gas and electric operational costs• Reduce electricity connection and system upgrade fees• Address housing affordability and building electrification• Reduce transactional costs for consumers
Address Systemic Barriers	<ul style="list-style-type: none">• Reflect high efficiency features more accurately in property appraisals• Reduce landlords' legal barriers to undertake electrification retrofits• Ensure buildings connected to district energy systems can decarbonize• Improve access to capital• Reduce permitting complexity and time for new heat pump systems
Expand Industry Capacity	<ul style="list-style-type: none">• Expand electrification sales force• Improve building electrification awareness, coordination, and advocacy• Build industry knowledge, experience, and competence• Expand the use of trade certifications and energy performance guidelines• Support growth in the number of people in the building electrification trades sector
Increase Available Technologies	<ul style="list-style-type: none">• Support the development of building and equipment standards• Accelerate the certification of promising new technologies• Support the introduction of certified technologies• Expand the market in North American for building electrification

Buildings account for 11% of total emissions in B.C., but 30% to 60% of total emissions for many B.C. municipalities.

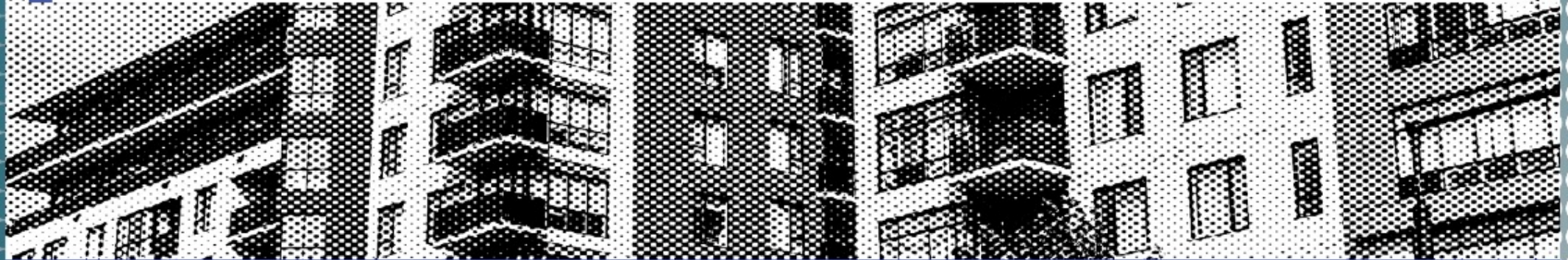
Electrification is recognized by all levels of government as a critical strategy for decarbonizing BC's building sector.

B2E Newsletter Launch



Apply for B2E Membership

Read & Subscribe to the B2E Newsletter



POLL 1

Tell us about yourself!

Three-part anonymous poll





What's Happening at BC Housing?

WHO WE ARE

BC Housing develops, manages and administers a wide range of subsidized housing options across the province. We work with the ministry responsible for housing to address critical gaps across the housing continuum, which range from emergency shelter and rent assistance in the private market to affordable home ownership. We also license residential builders, administer owner builder authorizations and carry out research and education that benefits the residential construction industry and consumers

Reframed Lab



In cooperation with Pembina, BCNPHA, BC Housing, City of Vancouver, and Metro Vancouver Housing

A six-month lab to design deep retrofit solutions, each working on a different building with support from their peers and experts on climate change, energy, and health

Intent to create deep retrofit solutions that can be delivered at scale affordably

Twin Towers – Near Enerphit

Twin Towers project, North Vancouver

Full building envelope retrofit and fuel switch

Final project expected to achieve 90% GHG reduction



~200 new construction projects

About half of these will meet Step Code 3 or greater

GHGI Targets

Four Passive House Projects



Station Avenue, Langford
Step Code 4; GHGI ~1kgCO₂/m²

What is MBAR?

- Mobilizing **B**uilding **A**daptation and **R**esilience
- Multi-year, multi- stakeholder knowledge- & capacity- building project
- Focused on climate change adaptation and disaster resilience for housing
- Pilot projects

MBAR aims to:

- **Stabilize communities** during a natural disaster
- Building owners and occupants **better protect investments & adapt to climate change stressors and shocks**, such that *no one is stressed beyond their ability to cope*




RESOURCES

MBAR Program

 bchousing.org/mbar
 mbar@bchousing.org

Building Smart

 bchousing.org/research-centre/learning-centre/building-smart

Contact Info

 kpедerson@bchousing.org

Construction Standards and Guidelines

 <https://www.bchousing.org/partner-services/asset-management-redevelopment/construction-standards>



METRO VANCOUVER HOUSING CORPORATION

WORKSHOP #1 PROCEEDINGS

NET ZERO STUDY FOR WELCHER AVE MULTI - FAMILY RESIDENTIAL DEVELOPMENT



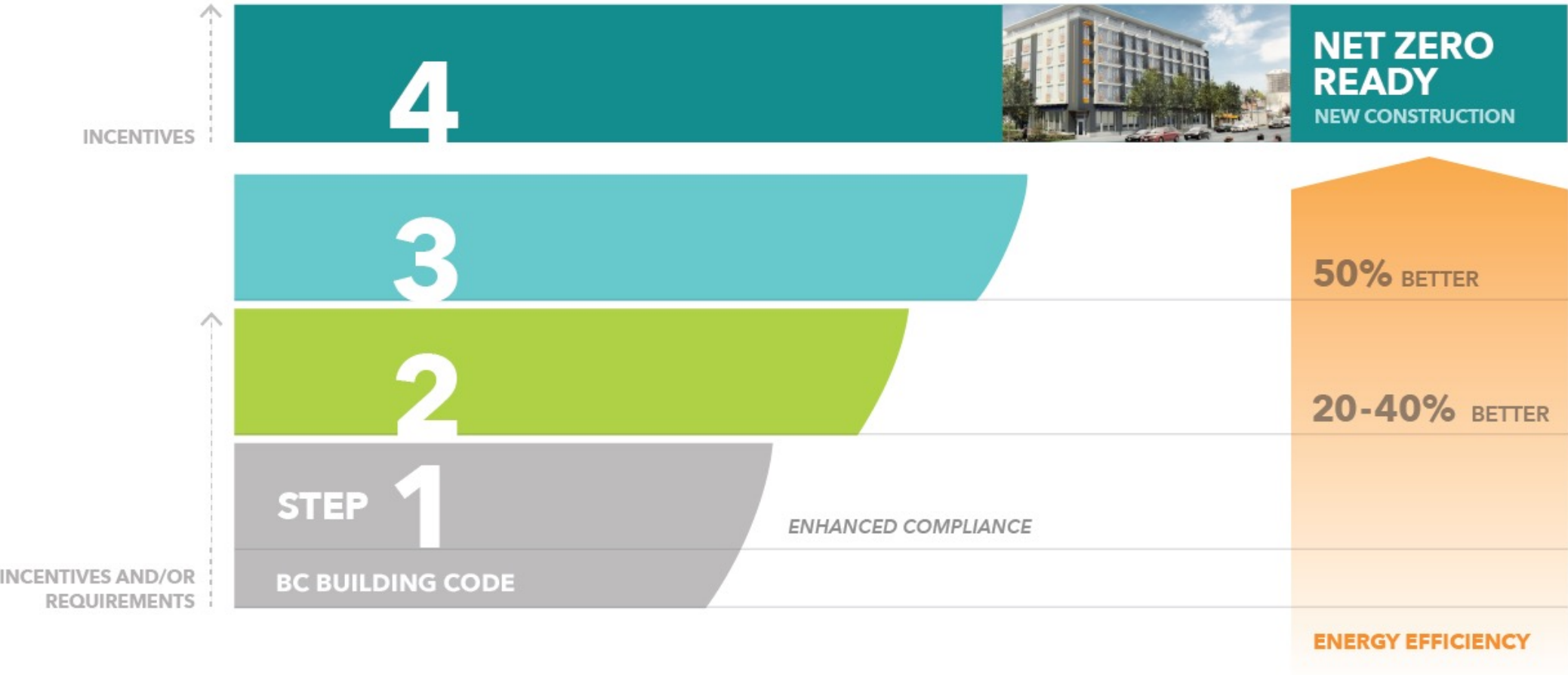
cleanBC
our nature. our power. **our future.**

Roadmap to 2030

PATHWAY TO 2032: **PART 3 (WOOD-FRAME RESIDENTIAL)**

2017

2032



Roadmap to 2030

- **New requirements to make all new buildings net-zero emissions by 2030**
- Increased energy efficiency requirements, including a requirement that after 2030, or earlier where feasible, all new space and water heating equipment sold and installed in B.C. will be at least 100% efficient, significantly reducing emissions compared to current combustion technology
- Updated regulations to shift the focus of utility-funded efficiency programs from conventional gas-fired heating equipment such as furnaces and boilers, to building-envelope improvements and heat pumps
- A greenhouse gas emissions cap that will require gas utilities to undertake activities and invest in technologies to further lower GHG emissions from the fossil natural gas used to heat homes and buildings and power some of our industries
- A nation leading adoption of zero-emission vehicles with 90% ZEVs by 2030 and 100% by 2035
- A commitment to increase the price on carbon pollution to meet or exceed the federal benchmark, with supports for people and businesses
- Requirements for new industry projects to have enforceable plans to reach net-zero emissions by 2050
- Stronger regulations that will nearly eliminate industrial methane emissions by 2035

POLL 1

What did you tell us about yourself?





Welcher Affordable Housing – Netzero Feasibility Study

METRO VANCOUVER HOUSING

Leigh Rollins, P.Eng

Project Engineer, Housing Maintenance and Capital Projects

metrovancouver

METRO VANCOUVER HOUSING – WHO WE ARE



1914 GVS&DD

GREATER VANCOUVER
Sewerage and Drainage District

18 member jurisdictions
35 Directors
1 non-voting Commissioner

1924 GVWD

GREATER VANCOUVER
Water District

20 member jurisdictions
37 Directors
1 non-voting Commissioner

metrovanouver

1974 MVHC

METRO VANCOUVER
Housing Corporation

23 member jurisdictions
40 Directors

1967 MVRD

METRO VANCOUVER
Regional District

23 member jurisdictions
40 Directors

Metro Vancouver Housing Portfolio

67%
TOWNHOMES



33%
APARTMENT
BUILDINGS



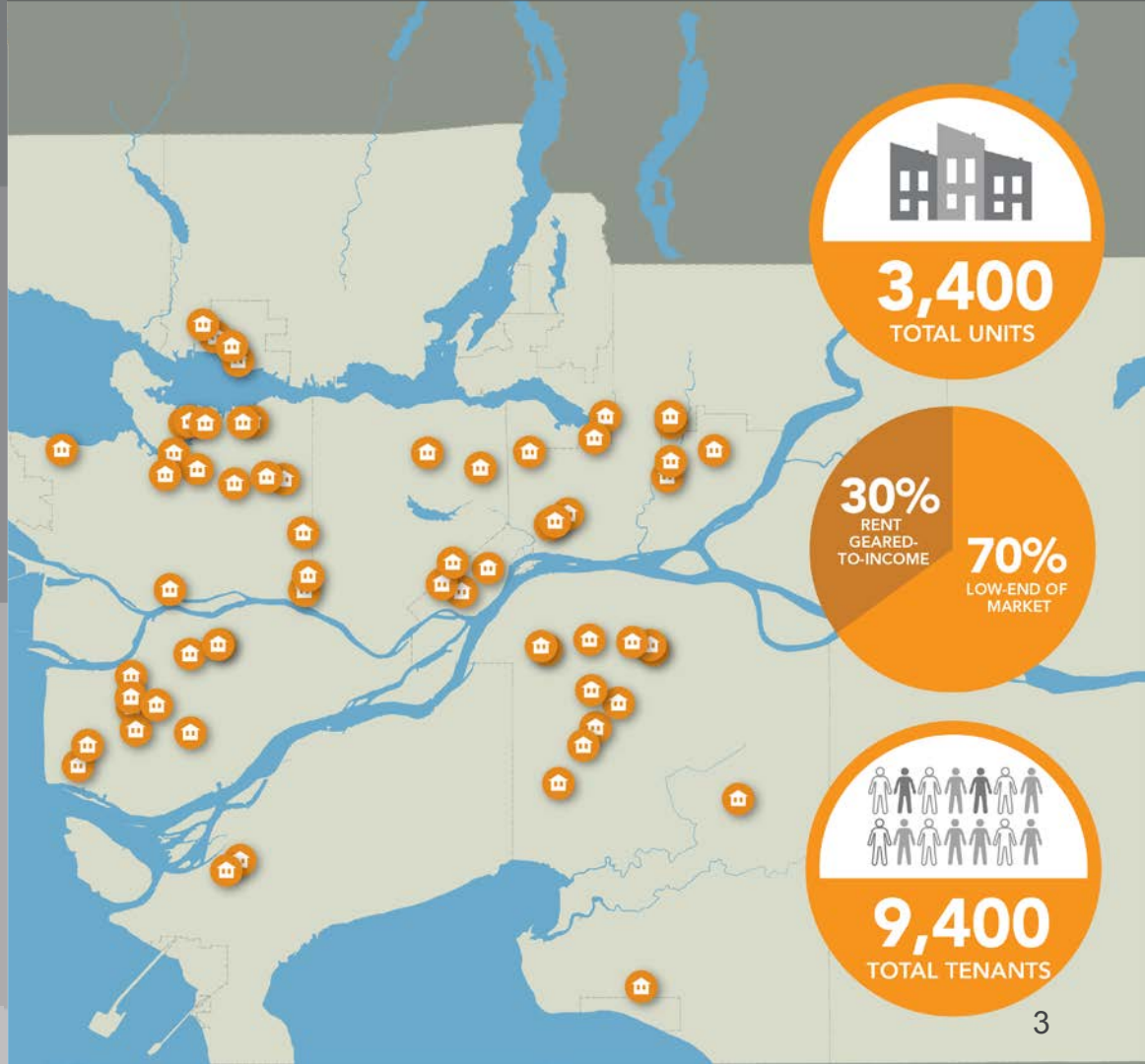
metrovancover

0 – 1 BDRM
18%

2 BDRM
41%

3 BDRM
40%

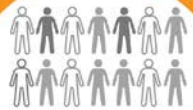
4 BDRM 1%



3,400
TOTAL UNITS

30%
RENT
GEARED-
TO-INCOME

70%
LOW-END OF
MARKET



9,400
TOTAL TENANTS

METRO VANCOUVER HOUSING 10-YEAR PLAN



10 YEAR PLAN TARGETS

Targets

🎯 Mixed-income

Maintain at least 30% of our portfolio as Rent-Geared-to-Income to support a range of affordability needs and ensure long-term financial sustainability.

🎯 Diverse housing types

Maintain at least 70% of portfolio as 2-bedroom units or larger to support family-friendly housing and provide a mix of unit sizes to allow flexibility and suit a range of needs.

🎯 Energy Efficient

Reduce energy consumption by 25% for major rehabilitations, such as building envelope upgrades, and for new construction (from 2015 National Energy Code for Buildings).



🎯 Low emission

Reduce GHG emissions in housing portfolio by 45% (from 2010 levels) over the next 10 years to work towards the region's goal of being carbon neutral by 2050.

🎯 Well-maintained

Maintain a portfolio-wide Facility Condition Index at or below 20% over the next 10 years to support safe and healthy homes for existing tenants.

🎯 Age-friendly

Work towards 20% of units as adaptable or fully accessible to support people of all ages and abilities.

🎯 Growth

Increase housing portfolio with 1,350 new and redeveloped units approved over the next 10 years.

METRO VANCOUVER POLICIES

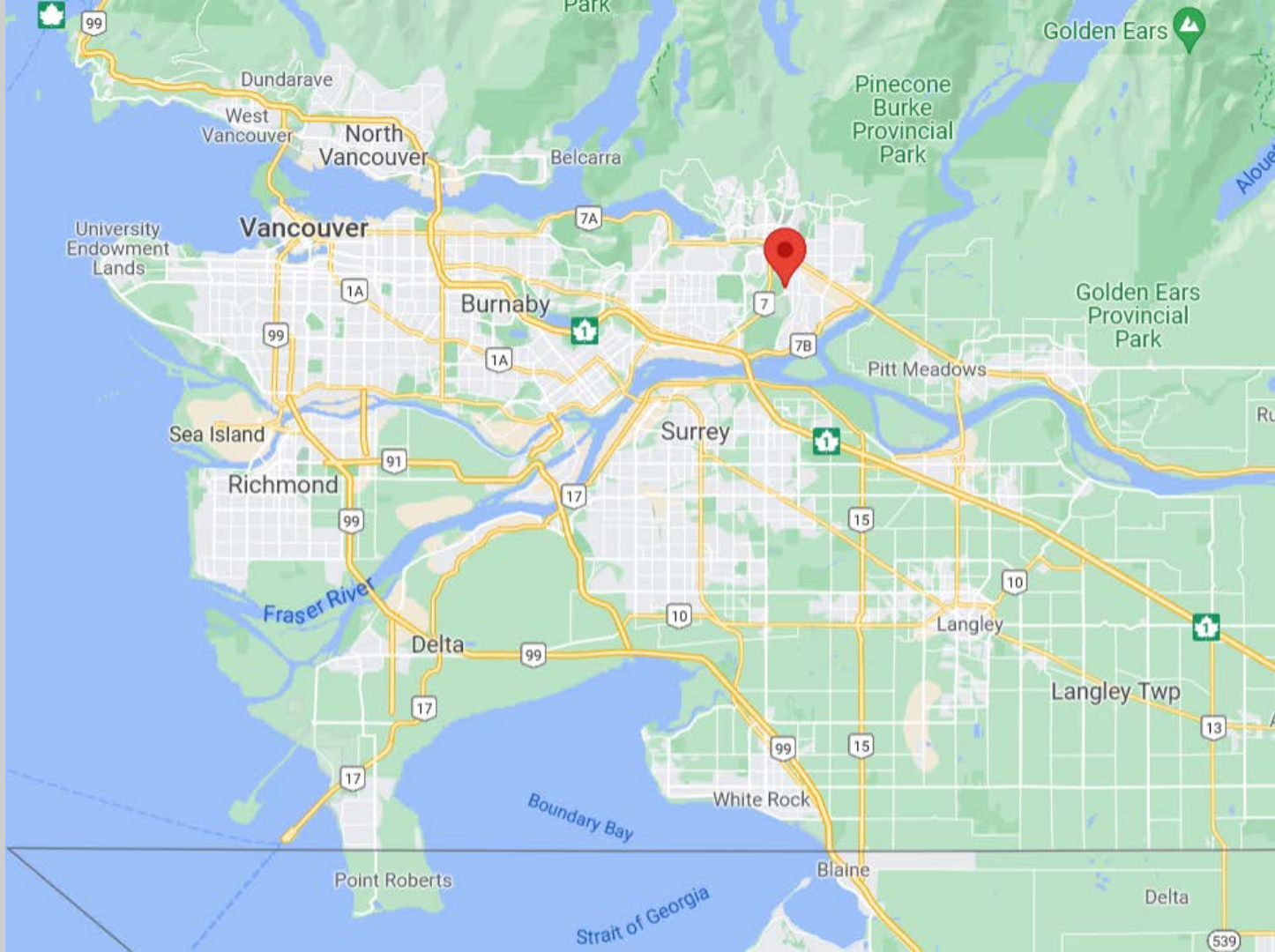
- Energy Management Policy (2014)
- Carbon Price Policy (2017)
- Sustainable Infrastructure and Buildings Policy (2018)



THE PROJECT

Welcher Ave
Port Coquitlam

metrovancouver



THE PROJECT

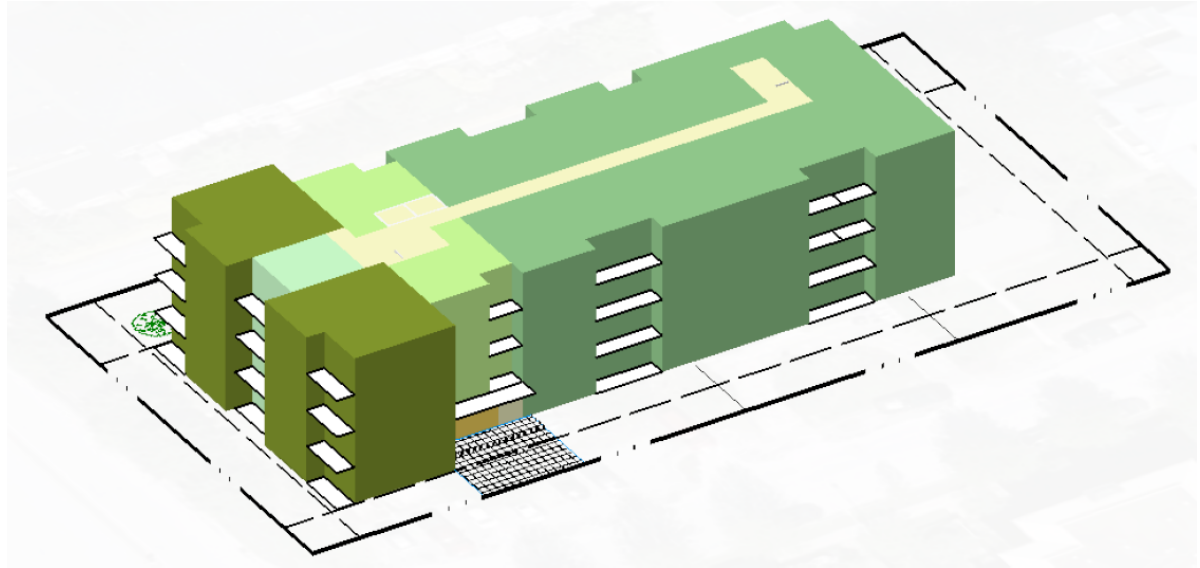


ORIGINAL CONCEPT

50-unit wood frame

4-storey over single
level parkade

GFA: 4,000 m²



REVISED CONCEPT

63-unit wood frame

5-storey over single
level parkade

GFA: 5,900 m²



PARTNERSHIPS



PARTNERSHIPS



Building BC: Community Housing Fund Affordability

- 30% of units – Affordable Market
- 50% of units – Rent Geared to Income (RGI)
- 20% of unit – Deep Subsidy

PARTNERSHIPS



Building BC: Community Housing Fund Energy Use Design

- BC Housing Construction Guidelines
- Step Code 4

PARTNERSHIPS



Commercial New Construction Program

- Up to \$15,000 grant for study
- Capital incentives up to \$500,000
- Based on lifetime reduction of CO₂e

PARTNERSHIPS

Federation of Canadian Municipalities – Green Municipal Fund



Sustainable Affordable Housing (SAH):

- For municipally owned or non-profit entities
- Incentives for improvements
 - Environmental
 - Economic
 - Social



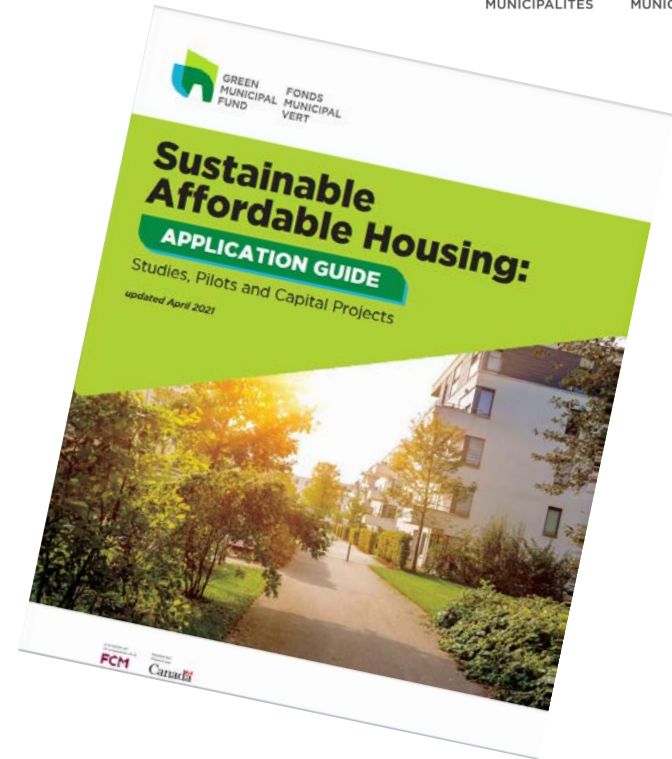
PARTNERSHIPS

Federation of Canadian Municipalities – Green Municipal Fund



Sustainable Affordable Housing (SAH):

- **Study**
 - Grant for up to 50% of eligible costs up to \$175k
- **Capital Project – New Build**
 - Financing up to 20% of project costs
 - 50% grant, 50% loan



PERFORMANCE TARGETS

FCM



Step Code 4

BC Housing CHF



Step Code 3 - Baseline

Port Coquitlam

MV Policy



PATHWAY TO 2032: PART 3 (WOOD-FRAME RESIDENTIAL)



NETZERO FEASIBILITY STUDY - ENERGY

Net Zero Energy

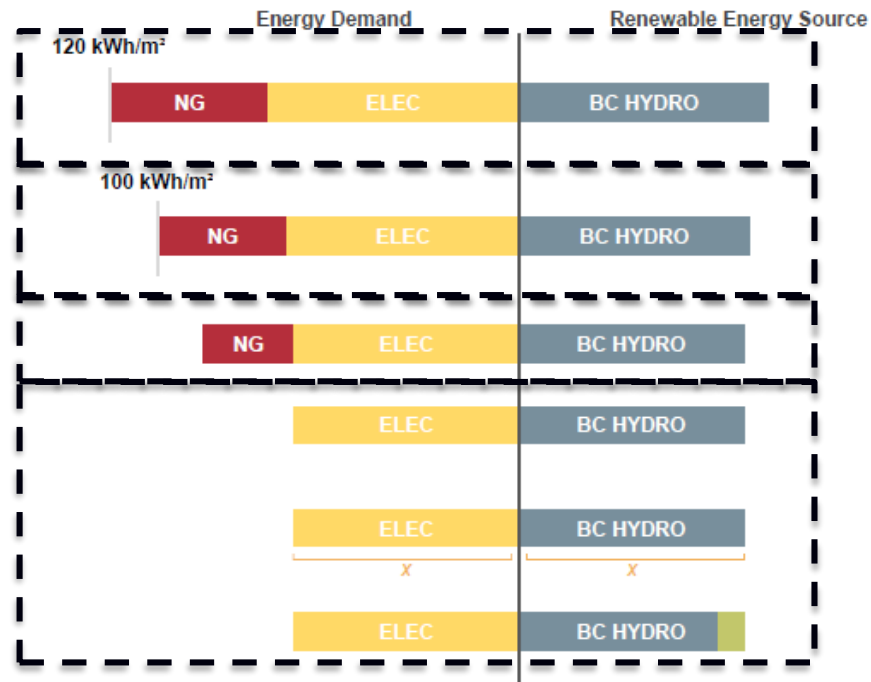
MINIMUM STANDARD FOR MVHC
Step Code 3 EUI target of 120 kWh/m²/yr

WELCHER AT CURRENT DESIGN
Step Code 4 EUI target of 100 kWh/m²/yr
BC Housing GHGI target of 5.5.



NET ZERO ENERGY
100% of energy demand met by renewable sources

NET ZERO ENERGY + ON-SITE RENEWABLES
Offset non-renewable portion of electric grid demand with on-site PV



NETZERO FEASIBILITY STUDY - CARBON

Net Zero Operational Carbon

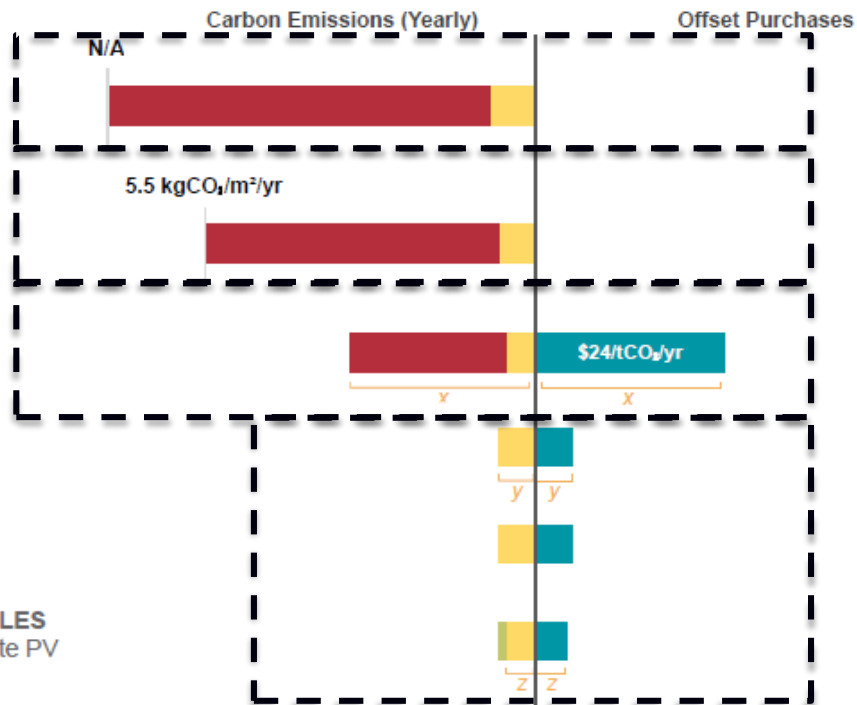
MINIMUM STANDARD FOR MVHC
No current target for carbon emissions

WELCHER AT CURRENT DESIGN
Step Code 4 EUI target of 100 kWh/m²/yr
BC Housing GHGI target of 5.5.



NET ZERO OPERATIONAL CARBON
100% of energy demand met by BC Hydro Grid

NET ZERO OPERATIONAL CARBON + ON-SITE RENEWABLES
Offset non-renewable portion of electric grid demand with on-site PV



NETZERO FEASIBILITY STUDY - RESULT

Basis of Design	Net Construction Cost (\$/ft ²)	% Increase from baseline
Step 3 (120 EUI) - Baseline	\$320	-
Step 4 (100 EUI)	\$384	20%
Net Zero Energy Ready (60 EUI)	\$396	24%
Net Zero Energy Ready + PV (52 EUI)	\$398	24%

KEY TAKEAWAYS:

1. Netzero Energy Ready – difficult to achieve on a typical multifamily site
2. Best value for EUI / GHG improvements - Mechanical
3. Diminishing return on enclosure improvements beyond typical Step 4 design
4. User behavior – lots of potential



Questions

metrovancouver
Together we make our region strong

FROM NET-ZERO ENERGY TO NEAR-ZERO EMISSIONS

Local Practice Architecture + Design



PROJECT BASELINES AND NET ZERO STUDY

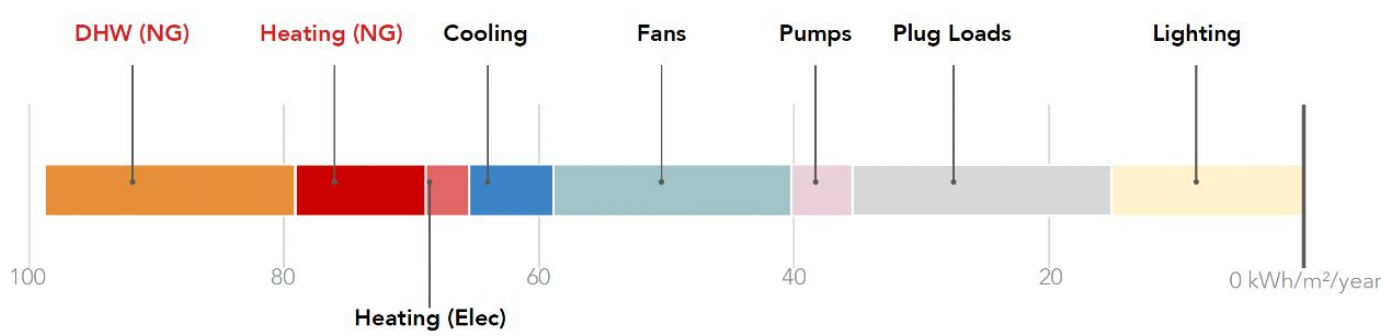
Minimum requirement MVHC + Port Coquitlam: Step 3

Baseline requirements March 2020

Minimum requirement BC Housing: Step 4

Welcher Step 4 design at 50% CD:

EUI: 96.9 kWh/m² TEDI: 13.3 kWh/m²



- | | |
|--------------------------------|---|
| Envelope | 6" stud wall w/ mineral wool, 8" semi-rigid insulation on exterior, Passive House performance windows |
| Heating / Cooling | Fan coil units for heating and cooling |
| Heating / Cooling Plant | Hydronic system using ASHP with 2 backup natural gas boilers |
| Domestic Hot Water | 3 natural gas boilers |
| Ventilation | 87% efficient HRV, natural gas Make-up Air Unit for corridor pressurization |
| Other Measures | Sub-metering all utilities |

Net Zero Study Target: Net Zero Energy Ready

WELCHER AVE
NET ZERO STUDY

PROJECT
TRAJECTORY

MIN. REQUIREMENT
BC STEP CODE 3

WELCHER AVE
BC STEP CODE 4

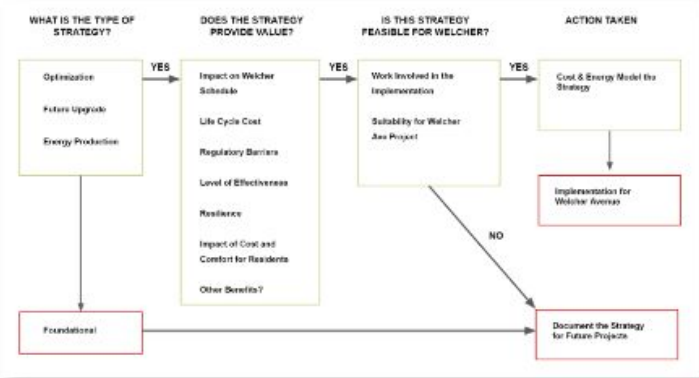
WELCHER AVE
NET ZERO ENERGY READY
& FULL ELECTRIFICATION

SCOPE OF NET ZERO STUDY

3 STAKEHOLDER WORKSHOPS



37 DIFFERENT STRATEGIES ANALYZED



18 STRATEGIES IMPLEMENTED INTO DESIGN

NET ZERO RESULTS					
Type	Energy Conservation Measure	Energy Reduction Potential (kWh/m ² /year)	GHG Reduction Potential (tCO ₂ e/m ² /year)	Costs (Cost/Measure)	LCC Payback (Years)
Envelope	High performance glazing	2.2	0.1	\$12,000	14-18 years
Envelope	High performance secondary glazing	0.1	0.01	\$10,000	\$1,940
Envelope	High performance windows to Balconies	0.1	0.01	\$4,900	14-18 years
Envelope	High performance insulation	0.2	0.01	\$24,700	14-18 years
Envelope	High performance roof insulation	0.2	0.01	\$14,600	14-18 years
Mechanical	Variable speed air conditioning	14.2	0.5	\$100,000	14-18 years
Mechanical	Variable speed HVAC system	0.1	0.01	\$10,000	14-18 years
Mechanical	High performance VAV system	0.1	0.01	\$24,000	\$1,940
Mechanical	Variable speed fan and gas boiler system	1.1	0.01	\$10,000	\$1,940
Mechanical	Make-up air system on kitchen exhaust	0.1	0.01	\$10,000	\$1,940
Electrical	Optimised lighting system	0.1	0.01	\$4,900	\$1,940
Electrical	Smart lighting	0.1	0.01	\$4,900	\$1,940
Electrical	Energy Star Appliances	0.1	0.01	\$4,900	\$1,940
Electrical	Energy Star Appliances	0.1	0.01	\$4,900	\$1,940
Electrical	Energy efficient elevator	0.1	0.01	\$10,000	14-18 years
Water	Water saving fixtures	0.1	0.01	\$10,000	\$1,940
Water	Water saving fixtures	0.1	0.01	\$10,000	\$1,940
Water	Water saving fixtures	0.1	0.01	\$10,000	\$1,940
Water	Water saving fixtures	0.1	0.01	\$10,000	\$1,940
Water	Water saving fixtures	0.1	0.01	\$10,000	\$1,940

FINAL REPORT



ROCKY POINT
ENGINEERING LTD.

FCM
FEDERATION OF CANADIAN MUNICIPALITIES
FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

local.

BC Hydro
Power smart

zeb
ZERO EMISSIONS BUILDING EXCHANGE

BC HOUSING

bty

metrovanancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

BCIT

ZERO ENERGY BUILDINGS LEARNING CENTRE

CITY OF
PORT
COQUITLAM

RDIH
BUILDING
SCIENCE

o.m.

PEMBINA
institute

KEY CONSIDERATIONS IN TACKLING AFFORDABLE HOUSING

MVHC GUIDING PRINCIPLES

Social: Support tenant well-being through quality housing and community building

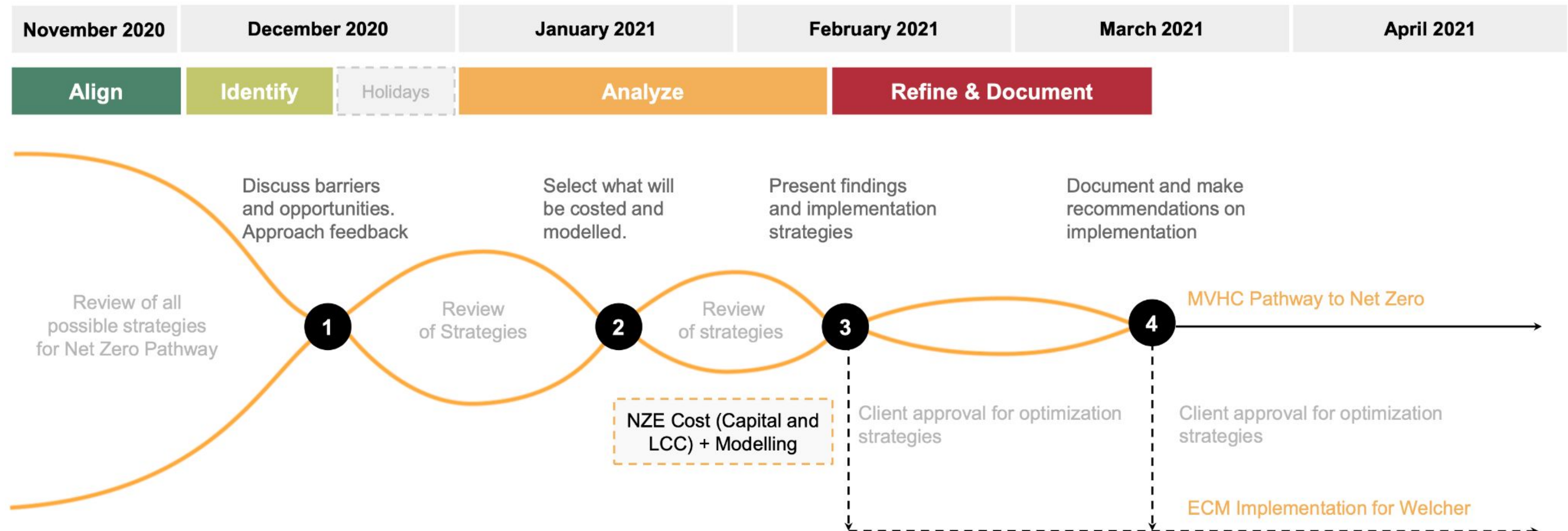
Financial: Ensure long-term affordability through financial sustainability

Environmental: Strive to enhance environmental and energy sustainability

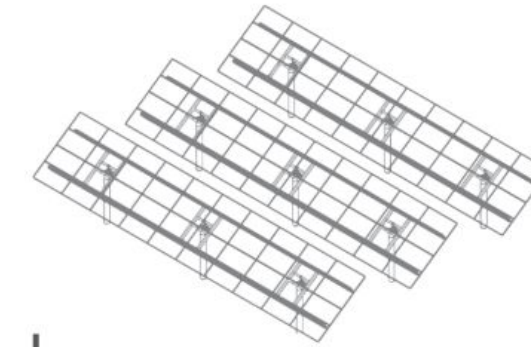
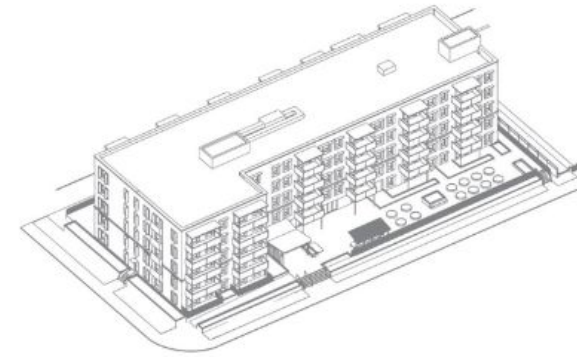


STUDY PARAMETERS

1. REDUCE ENERGY USAGE AND USE RENEWABLE ENERGY
2. CONSIDER LIFE CYCLE COSTING FOR HOLISTIC PICTURE
3. ENSURE POSITIVE IMPACTS ON TENANTS FOR COMFORT, OPERATION AND AFFORDABILITY



INITIAL APPROACH



TYPICAL LOW-RISE MURB
No Target

171 kWh/m² per year*

WELCHER
Target: 100 kWh/m²

93-100 kWh/m² per year**

NET ZERO ENERGY FOR WELCHER
Target: Building gives back as much energy it takes from grid.



1

OPTIMIZE BUILDING PERFORMANCE

- Improve performance of building components, systems, and envelope as much as possible.

2

INSTALL RENEWABLE ENERGY ON SITE

- PV system estimated to generate maximum of 100,000 kWh/year.***

3

INSTALL RENEWABLE ENERGY OFF SITE

- Adopt the concept of scale-jumping as a NZE strategy.
- Produce remaining energy demand off-site on other buildings and sites in MV portfolio.

* Energy Consumption in Low-Rise Multi-Family Residential Buildings in British Columbia - RDH (May 2017)

** Based on energy modelling done for Welcher Ave - RDH (June, 2020) and current estimates for EUI by RDH

*** According to Welcher Integrated Design Workshop Five - Part 2 - Energy & Systems Review - O'M (May 2020)

DEFINING NET ZERO

LESS DIFFICULT TO ACHIEVE

MORE DIFFICULT TO ACHIEVE

NET ZERO ENERGY READY (CHBA, BC ENERGY STEP CODE)

- Fossil fuels permitted
- Renewable energy system designed to allow for Net Zero Energy but not installed

ZERO EMISSIONS BUILDING (CoV)

- Limited fossil fuels (GHGI < 4.5)
- Passive House or equivalent

ZERO EMISSIONS BUILDING (CoV, AFTER 2025)

- Limited fossil fuels (GHGI < 4.5)
- Passive House or equivalent

ZERO CARBON (CoV)

- Limited fossil fuels (GHGI < 4.5)
- Passive House or equivalent

ZERO CARBON (CaGBC)

- Fossil fuels permitted
- Net Zero operational carbon (through owned renewable energy, green power purchases, or carbon offset purchases)

NET ZERO ENERGY (CHBA, BC ENERGY STEP CODE)

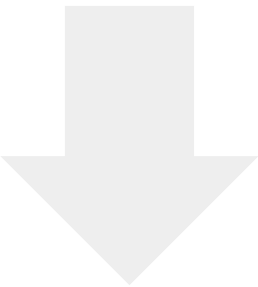
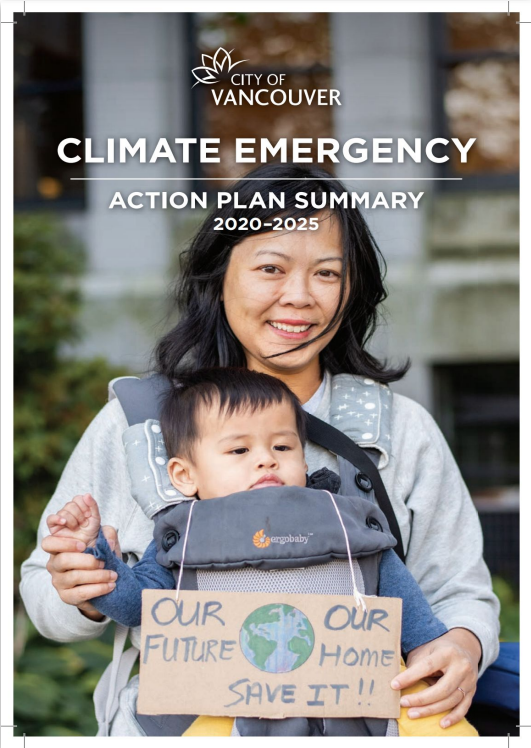
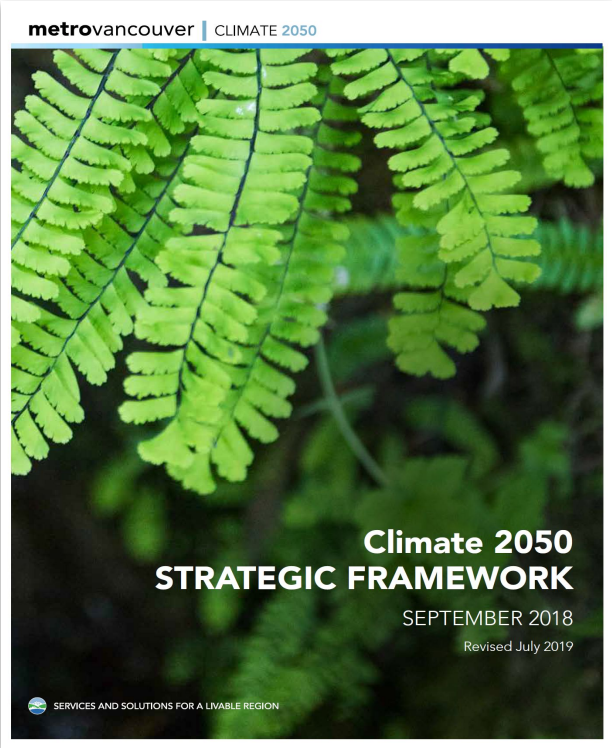
- Fossil fuels permitted
- All energy demand met by renewable energy generated onsite

NET ZERO ENERGY (ILFI)

- No fossil fuels permitted
- All energy demand met by renewable energy generated onsite or nearby

FROM NET ZERO ENERGY TO NET ZERO CARBON

MV REGION



CARBON NEUTRAL BY 2050

RENEWABLE ENERGY CONSIDERED



OFF-SITE: BC HYDRO

Carbon Intensity: **0.011** kgCO₂eq/kWh*

- Hydro electricity production is considered at least 93%** renewable.
- Climate change will put strain on capacity and distribution.



ON-SITE: PV PANELS

Carbon Intensity: **0.120** kgCO₂eq/kWh***

- Energy intensive process to produce.
- Sourcing PV produced in regions with clean grids preferable.

NOTE:
*Clean infrastructure royalty credit program - Government of BC (2018)
**New Act powers B.C. forward with clean energy and jobs - BC Hydro (2010).
***How sustainable is PV solar power - Low-tech Magazine (n.d.) Embodied carbon over 30 year life span, assuming production in China and similar climate to Germany

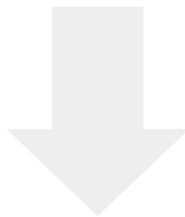
DEFINING THE NET ZERO STUDY

MINIMUM STANDARD FOR MVHC

Step Code 3 EUI target: 120 kWh/m²/yr

WELCHER AT CURRENT DESIGN

Step Code 4 EUI target: 100 kWh/m²/yr
BC Housing GHGI target: 5.5 kgCO₂e/m²/yr

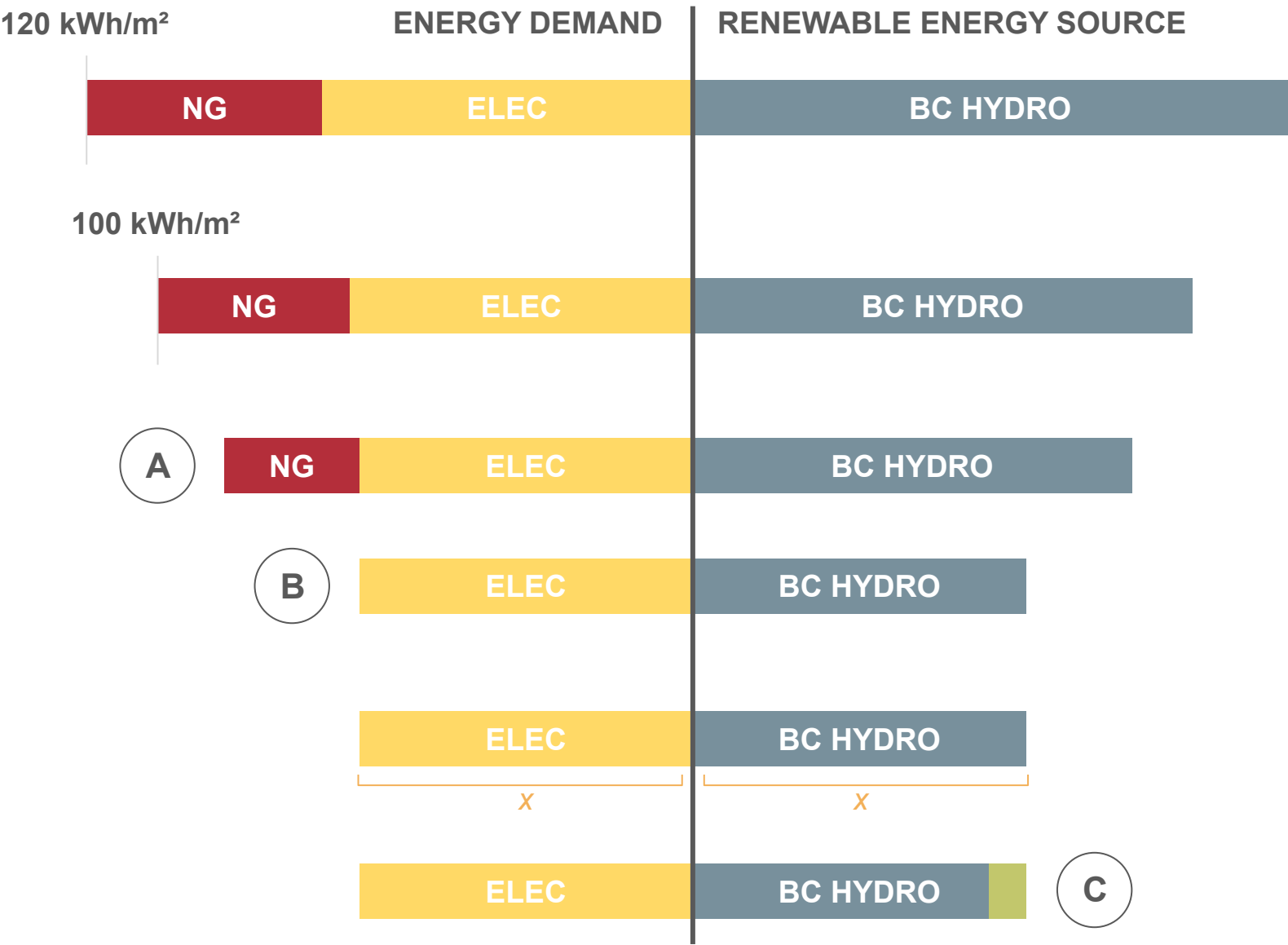


NET ZERO ENERGY

100% of energy demand met by renewable sources

NET ZERO ENERGY + ON-SITE RENEWABLES

Offset non-renewable portion of electric grid demand with on-site PV



A

OPTIMIZE BUILDING PERFORMANCE

- Reduce the demand for energy to reduce energy cost impacts to tenants when switching to electric.

B

ELIMINATE NON-RENEWABLE ENERGY (ELECTRIFICATION)

- Allow for the full electrification of the building either at construction or a simple transition later in the building life.

C

ON-SITE PV SIZED TO THE NON-RENEWABLE PART OF GRID

- BC Hydro is **93-96%** renewable.
- Size on-site PV to meet 4-7% of electrical demand.



NATURAL GAS



ELECTRICITY

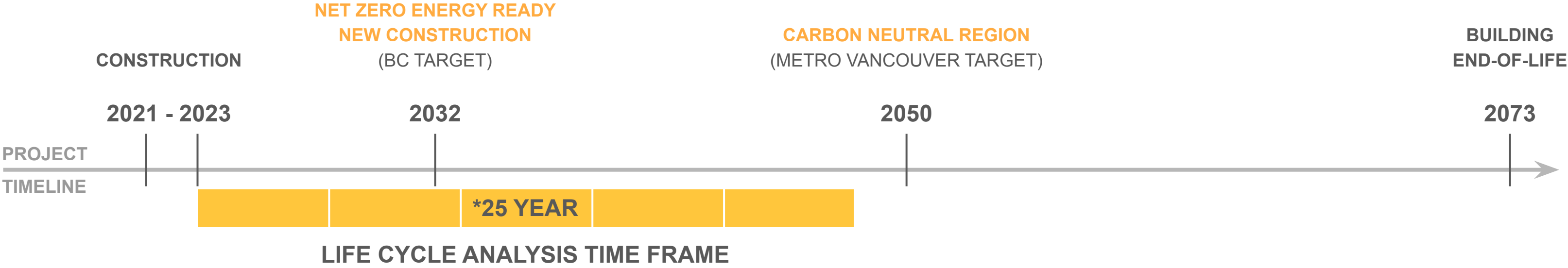


ONSITE RENEWABLES (PV)



BC HYDRO GRID

LIFE CYCLE COST TIMELINE AND PARAMETERS



Life Cycle Costing Assumptions Include:

- Maintenance (2.0% escalation)
- Replacement (2.0% escalation)
- Natural Gas Consumption (3.0% escalation)
- Electricity Usage (3.0% escalation)
- NPV Discount Rate (3.5% escalation)

*Life cycle period set to 25 years to avoid larger inaccuracies and assumptions that can result from longer analysis periods

ENERGY CONSERVING STRATEGIES (ENVELOPE)

ENVELOPE FIRST

Low life cycle cost, passive

Envelope upgrades had low to negative life cycle cost premium due to little to no maintenance or replacement costs

Strategies not implemented

Type	Energy Conserving Measure	EUI Reduction (kWh/m²/year)	GHGI Reduction (kgCO2eq/m²/ year)	Capital Cost Premium	LCC Premium
Envelope	Airtightness 0.4 ACH50	2.2	0.4	\$72,500	(\$-18,030)
Envelope	PH curtain walls at amenity space	0.1	<0.1	\$12,000	\$1,360
Envelope	Upgrade steel exit doors to fiberglass	0.1	<0.1	\$4,900	(\$-830)
Envelope	Increase core wall insulation	0.2	<0.1	\$24,100	(\$-830)
Envelope	Increase core floor insulation	0.2	<0.1	\$3,400	(\$-1,000)
Envelope	PH Certified Windows	0.3	<0.1	\$133,600	\$9,740
Envelope	Punched Windows at Amenity Space	0.3	<0.1	(\$-3,200)	(\$-1,250)
Envelope	Increased roof insulation	0.1	<0.1	\$43,800	(\$-830)
Envelope	Reduce thermal bridging at ground floor slab (Schöck System)	0.7	<0.1	\$121,500	(\$-6,240)
Envelope	Increased size of shading devices	0.1	<0.1	\$12,200	\$8,160
Envelope	Switch South facade shades to operable	<0.1	<0.1	\$173,900	\$143,420
Envelope	Recirculating kitchen hood fans	N/A	N/A	\$217,400	N/A
Envelope	Air Admittance Valves (AAV) for plumbing stacks	N/A	N/A	\$11,500	N/A

ENERGY CONSERVING STRATEGIES (MECHANICAL)

DHW HEAT PANELS

Combined systems for high savings

High energy savings modelled by utilizing hydronic heating system infrastructure in domestic hot water production

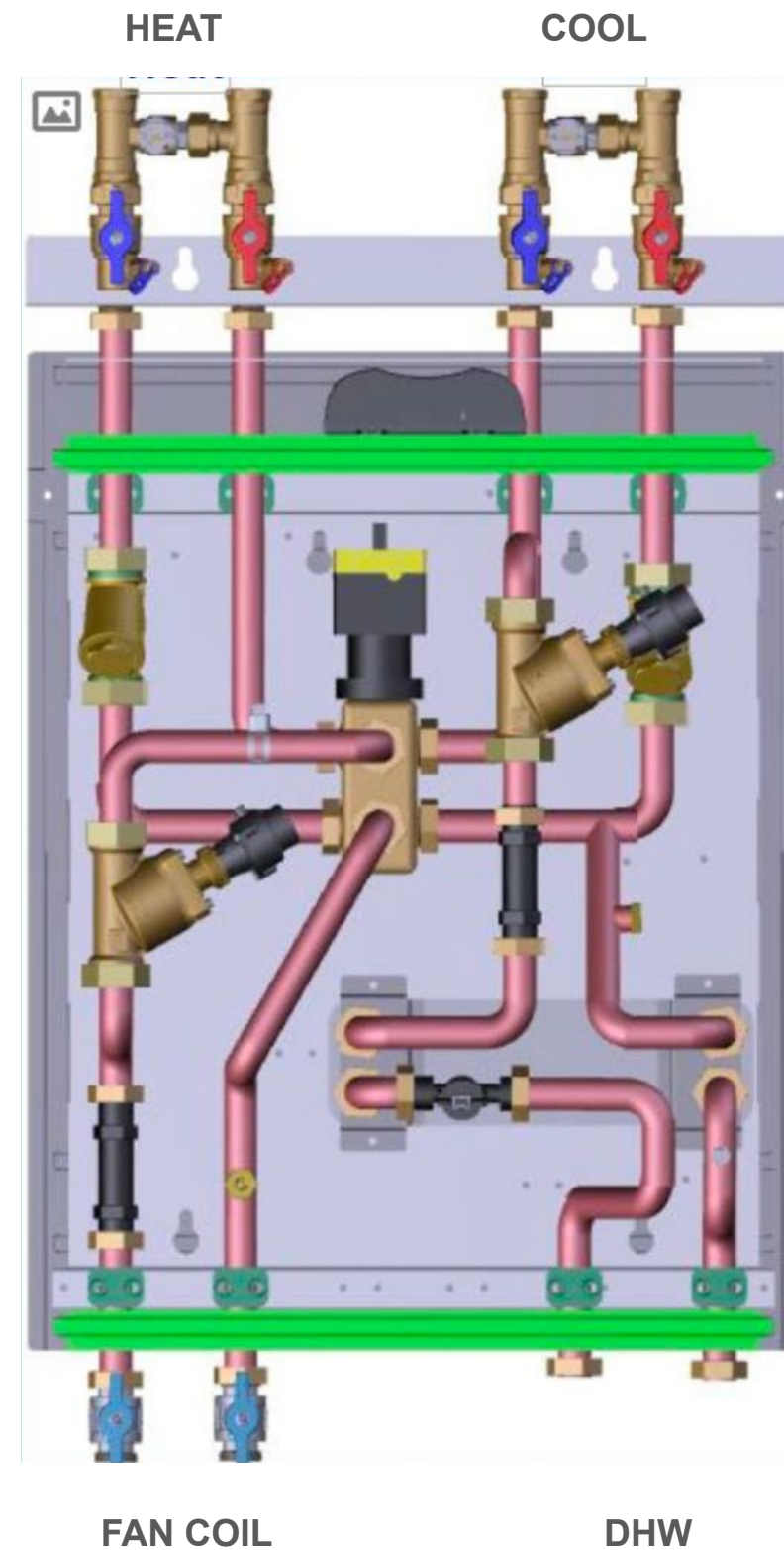
Strategies not implemented

Type	Energy Conserving Measure	EUI Reduction (kWh/m²/year)	GHGI Reduction (kgCO2eq/m²/ year)	Capital Cost Premium	LCC Premium
Mechanical	In-suite on-demand DHW heat panels	14.6	2.97	\$106,400	(\$-20,790)
Mechanical	Low velocity HRV system	3.6	0.1	\$23,000	(\$-107,870)
Mechanical	Heat pump sizing to 90% peak	5.4	1.7	\$234,600	\$184,930
Mechanical	Switch backup natural gas boilers to electric	1.6	2.23	\$120,800	\$124,960
Mechanical	Make-up air tempered via hydronic system	<0.1	<0.1	\$9,800	\$16,790
Mechanical	Discharge HRV exhaust to the ASHP	0.1	<0.1	\$13,800	\$71,670
Mechanical	SHARC wastewater heat recovery system	0.9	0.2	\$230,000	\$189,870
Mechanical	Hybrid Geoexchange/ASHP Central Plant	9.8	2.1	\$184,100	\$76,520
Mechanical	Supply and remove air as needed to maintain required pressurization via the HRV	<0.1	<0.1	N/A	N/A
Mechanical	Switch primary gas backup boiler to electric (Hybrid gas/electric backup boiler system)	1.2	1.67	\$60,400	\$62,480
Mechanical	Replace HRV with 95% efficient unit	3.0	0.56	\$62,100	\$16,550

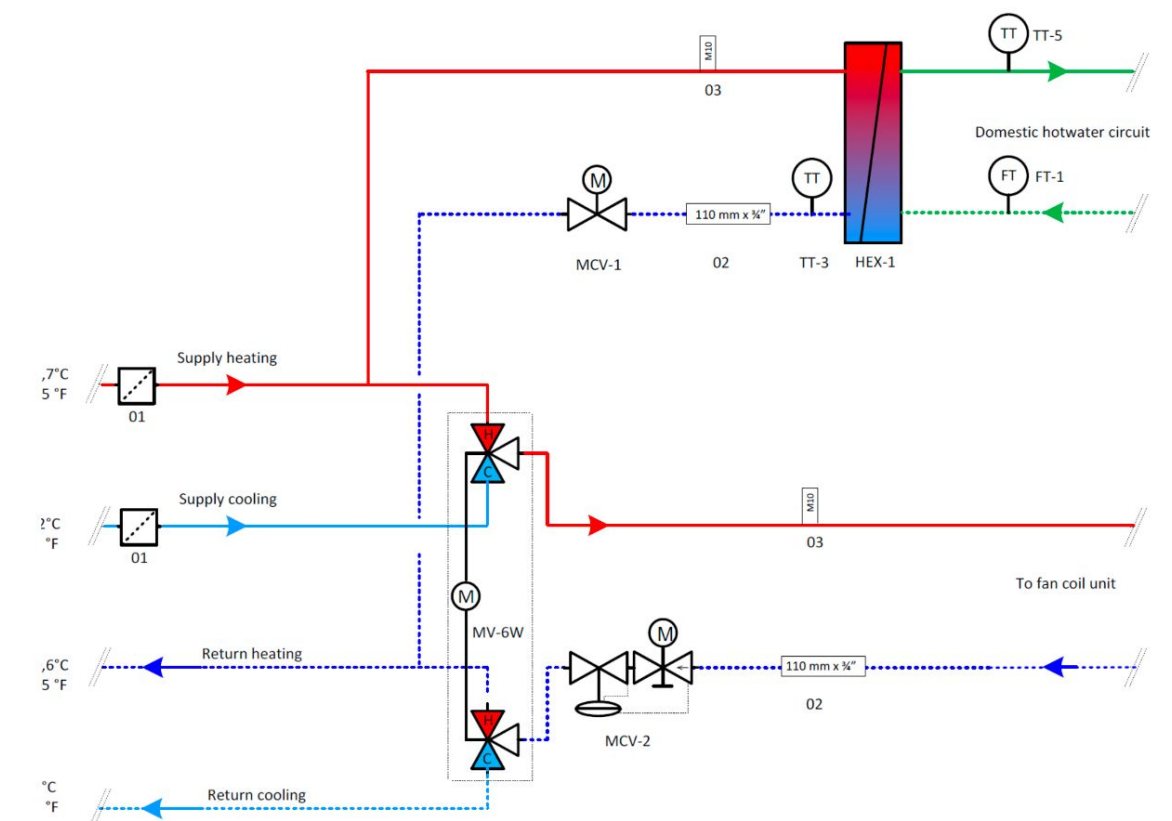
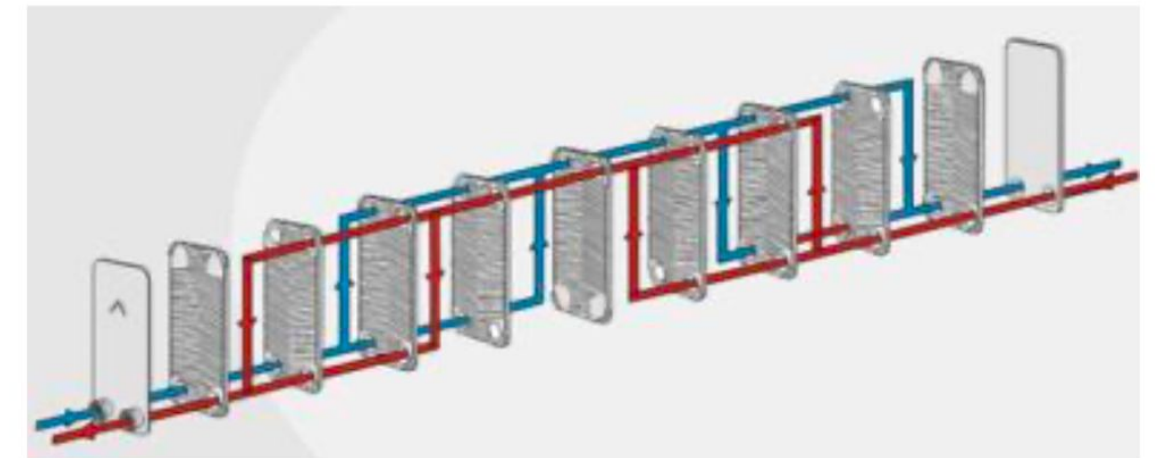
IN-SUITE PANELS FOR DHW, COOLING, AND HEATING DISTRIBUTION

IN-SUITE HEAT PANEL

- Welcher Step 4 design included typical 140°F DHW system with natural gas boilers and recirculation system
- In-suite heat panels produce on-demand 115°F DHW by exchanging heat from the 120°F hydronic system
- The on-demand system removes the need for DHW storage and recirculation
- Rejected heat from the hydronic cooling system can be captured and used to directly heat domestic hot water
- Technology is widely used in other areas, but new to North America



2-pass plate heat-exchanger to meet the temperatures for the combined Heat & Cooling station



ENERGY CONSERVING STRATEGIES (ELECTRICAL)

OPTIMIZING

Significant optimization possible

Largest impact for the project’s operational carbon was moving to an all electric building

Type	Energy Conserving Measure	EUI Reduction (kWh/m²/year)	GHGI Reduction (kgCO2eq/m²/year)	Capital Cost Premium	LCC Premium
Electrical	Optimize exterior lighting 10%	0.6	<0.1	\$6,400	\$3,740
Electrical	Smart Outlets	0.6	<0.1	\$64,100	\$43,390
Electrical	Energy Star Appliances	20% based suite plug load reduction	N/A	N/A	N/A
Electrical	Energy efficient elevator	1.6	<0.1	\$115,000	(\$-9,300)

ENERGY CONSERVING STRATEGIES (USER BEHAVIOUR)

USER BEHAVIOUR

Designing to affect change

- Studies show that sub-metering utilities significantly reduce usage
- Physical display dashboards have been observed to have little value
- Cost of utilities have a big impact
- “Instant” feedback of usage can help tenants to reduce in key areas

Strategy not implemented

Type	Energy Conserving Measure	EUI Reduction (kWh/m²/year)	GHGI Reduction (kgCO2eq/m²/year)	Capital Cost Premium	LCC Premium
User Behaviour	Programmable set-point limits (night time set backs)	2.6	0.43	\$57,500	\$59,500
User Behaviour	Sub-Metering and Smart-Metering (DHW heating energy use)	2.6	0.45	\$40,300	\$15,290
User Behaviour	Smart-Metering of Electricity Consumption	4% lighting and plug load reduction	N/A	N/A	N/A
User Behaviour	Tenant Education/Engagement	2% lighting and plug load reduction	N/A	N/A	N/A
User Behaviour	In-suite physical dashboards + Building lobby physical dashboard	N/A	N/A	N/A	N/A

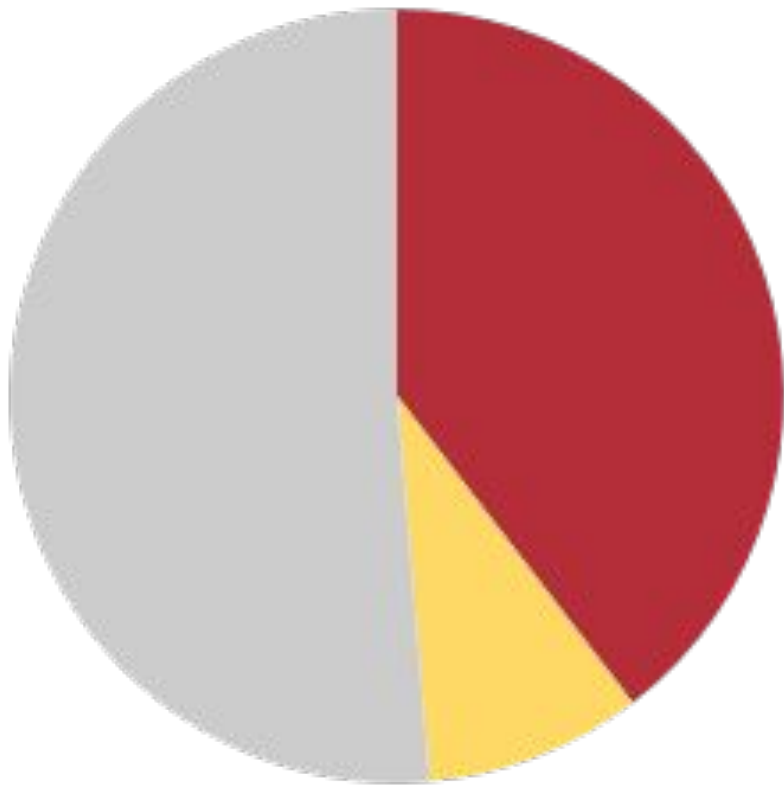
SUMMARY OF RESULTS



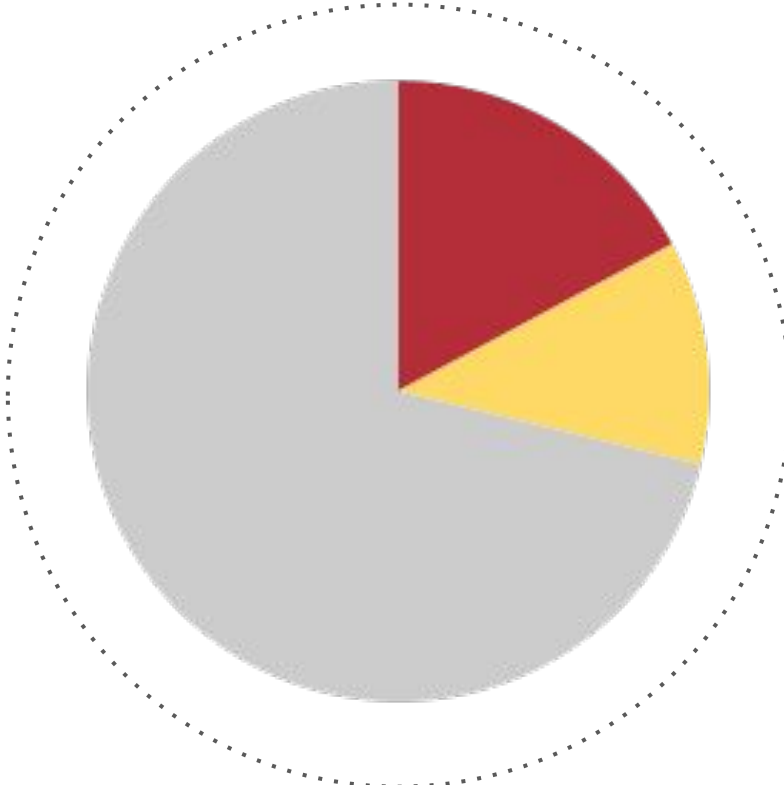
NOTE:
*Capital Cost based on current cost estimate before current optimization. Gross construction costs in June 2021 dollars (includes contractor mark ups, but not contingencies and escalations). This information is shown for a general comparison between designs. The cost provided for Step 3 is a generic cost provided by quantity surveyor based on recent experience with similar projects near the project location. The Step 3 design was never fully costed. Also to consider are some site specific issues factoring into project costs, including a fully waterproofed foundation and unique offsite works. The tendering process is ongoing. A construction contract has not yet been awarded.

HOLISTIC CARBON PICTURE

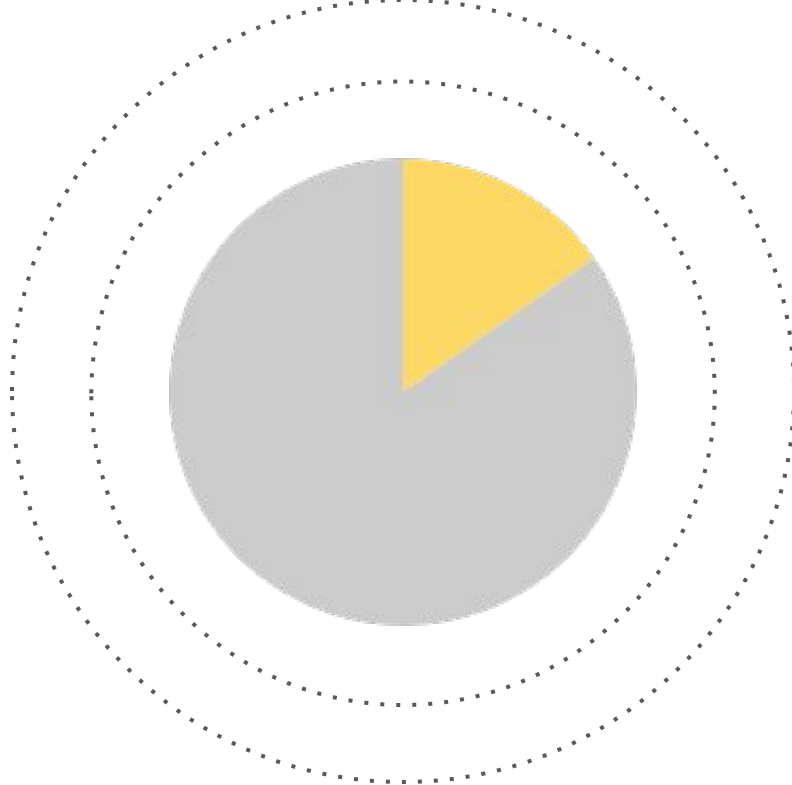
Total Carbon Emissions
(50 years)



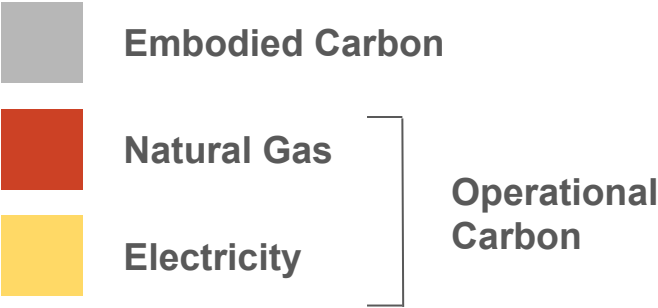
Step Code 3



Step Code 4



Implemented
Optimization

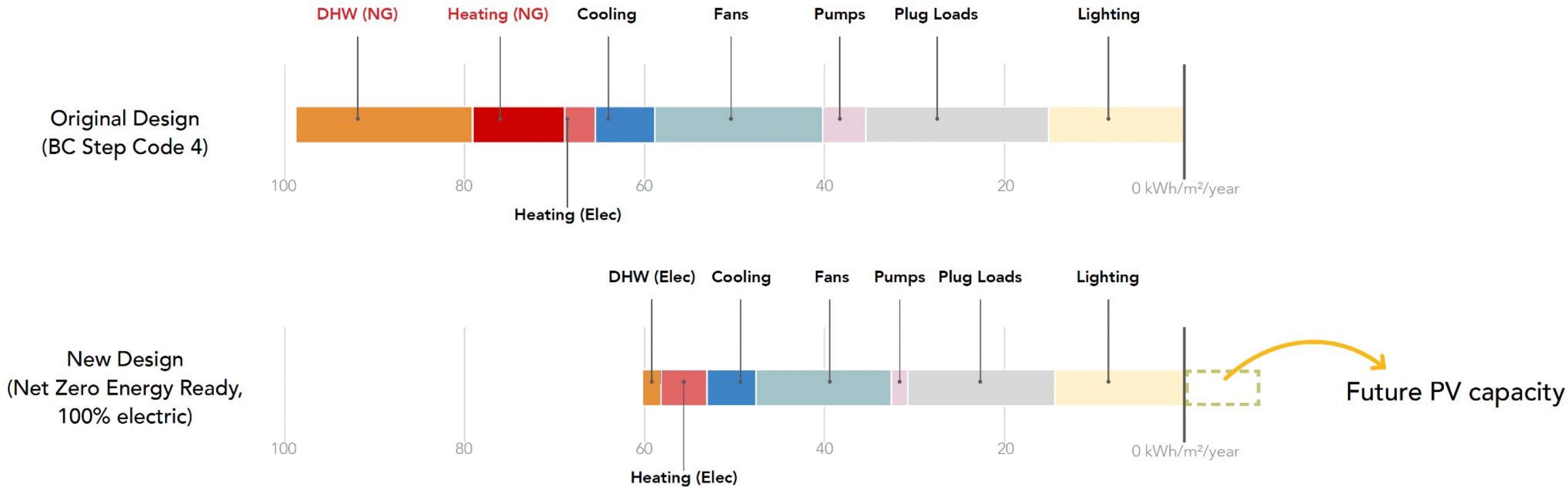


NET ZERO ENERGY READY

ENERGY PERFORMANCE RESULTS

Target	EUI (kWh/m ² /year)	GHGI (kgCO ₂ eq/m ² /year)
Minimum Project Requirement, BC Step Code 3	120	N/A
Original Project Target, Step Code 4 & BC Housing req. for GHGI	100	5.5
Welcher Ave, Step Code 4	96.9	5.4
Welcher Ave, Net Zero Energy Ready	60.3 (62.4)*	0.7

*Without the effect of smart metering on lighting/plug loads and tenant education/engagement on lighting/plug loads.



LESSONS LEARNED

1. **ELIMINATE FOSSIL FUELS**
2. **REDUCE ENERGY DEMAND**
3. **OPTIMIZE ON-SITE/OFF SITE LOW CARBON ENERGY SOURCES**

FUTURE ROOFTOP PV SYSTEM + ELECTRIFICATION

- Maximum capacity for 104 PV panels (~13% of building energy demand)
- PV panels have a higher embodied carbon than the regional grid
- Recommended as a future upgrade with future low-carbon technology

ELIMINATE ALL NATURAL GAS

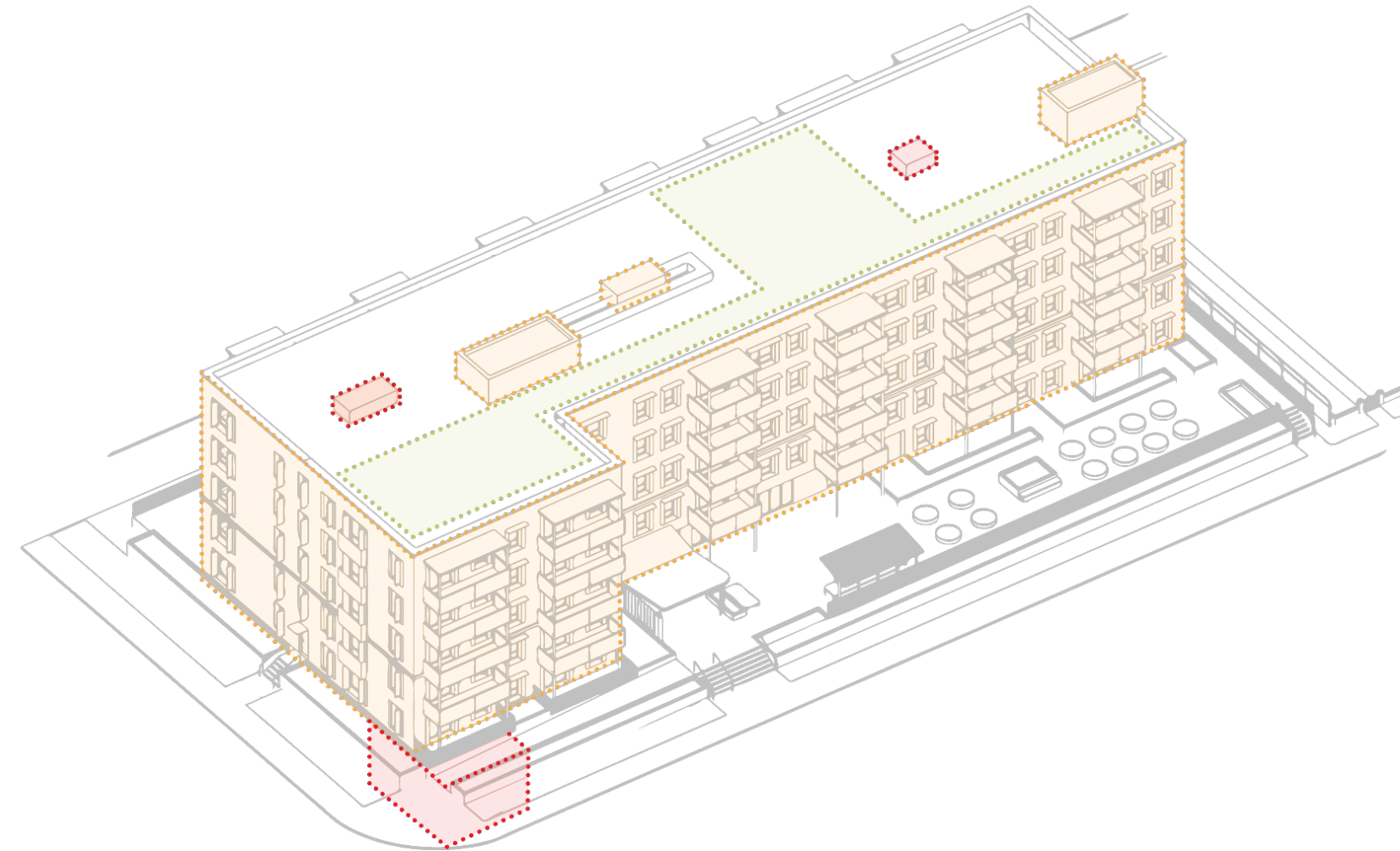
- Replace the heating/cooling natural gas back-up boilers with electric
- Temper make-up air using hydronic system

INCREASE ASHP CAPACITY

- Size for 90% peak capacity
- Reduce reliance on back-up boiler system

INSUITE ON-DEMAND DHW

- Eliminate natural gas DHW boilers and storage
- In-suite heat-exchangers to heat DHW and Fan Coil Units with ASHP-powered hydronic system



TENANT BEHAVIOUR

- Sub-metering all utilities
- Smart-metering electricity, heating & DHW
- Smart outlets
- Programmable set points for space heating/cooling
- Tenant education

SYSTEMS REFINEMENT

- Lower velocity HRV system
- Exterior lighting reductions
- Energy star appliances
- Energy efficient elevators

ENVELOPE UPGRADES

- Targeting 0.4 ACH50 airtightness
- Increase below-grade core insulation
- PH exit doors
- PH curtain walls at amenity space

