

# Decarb Lunch Series

zebox

## Reframed Initiative: Optimizing Deep Building Retrofits

Fri Mar 8, 2024,  
from 12- 1pm PST  
Free Webinar | [zebox.org](https://zebox.org)

# zeic

ZERO EMISSIONS INNOVATION CENTRE

Building Decarbonization Team



**B2E**



**NearZero**

**BC Retrofit  
ACCELERATOR**



Carbon  
Leadership  
Forum  
**British  
Columbia**

**zeb<sub>x</sub>**



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NearZero: Reaching the Top Step

Watch Later Share

**REACHING THE TOP STEP**

Presented By:

Watch on **cleanBC**

### NearZero: Reaching the Top Step

How are homeowners, builders and designers already reaching the highest step of emission reduction requirements? We found some of them from ZEBx's NearZero program, listen to them here.

Overview

Playbooks & Winners

Is BC Ready for Electrification? B2E w BC Hydro, Sep 2023

Watch Later Share

**B2E Webinar** **BC Hydro Power smart**

**Is BC Ready for Electrification?**

Watch the Event Recorded Sep 29, 2023

Watch on

### Is BC Ready for Electrification? B2E w BC Hydro, Sep 2023

B2E, a program alongside ZEBx and part of the ZEIC family, collaborated with BC Hydro in Sep 2023 to help answer the question 'Is BC Ready for Electrification?'

Overview

B2E Resources

Life Cycle Assess...

Climati chan...

### Life Cycle Assessment Process to Estimate Embodied Carbon in Buildings

From ZEBx's Net-Zero Energy-Ready Playbook Series

Overview

Read This Playbook

Planning Airtight ...

### Planning Airtight Buildings

From ZEBx's Net-Zero Energy-Ready Playbook Series

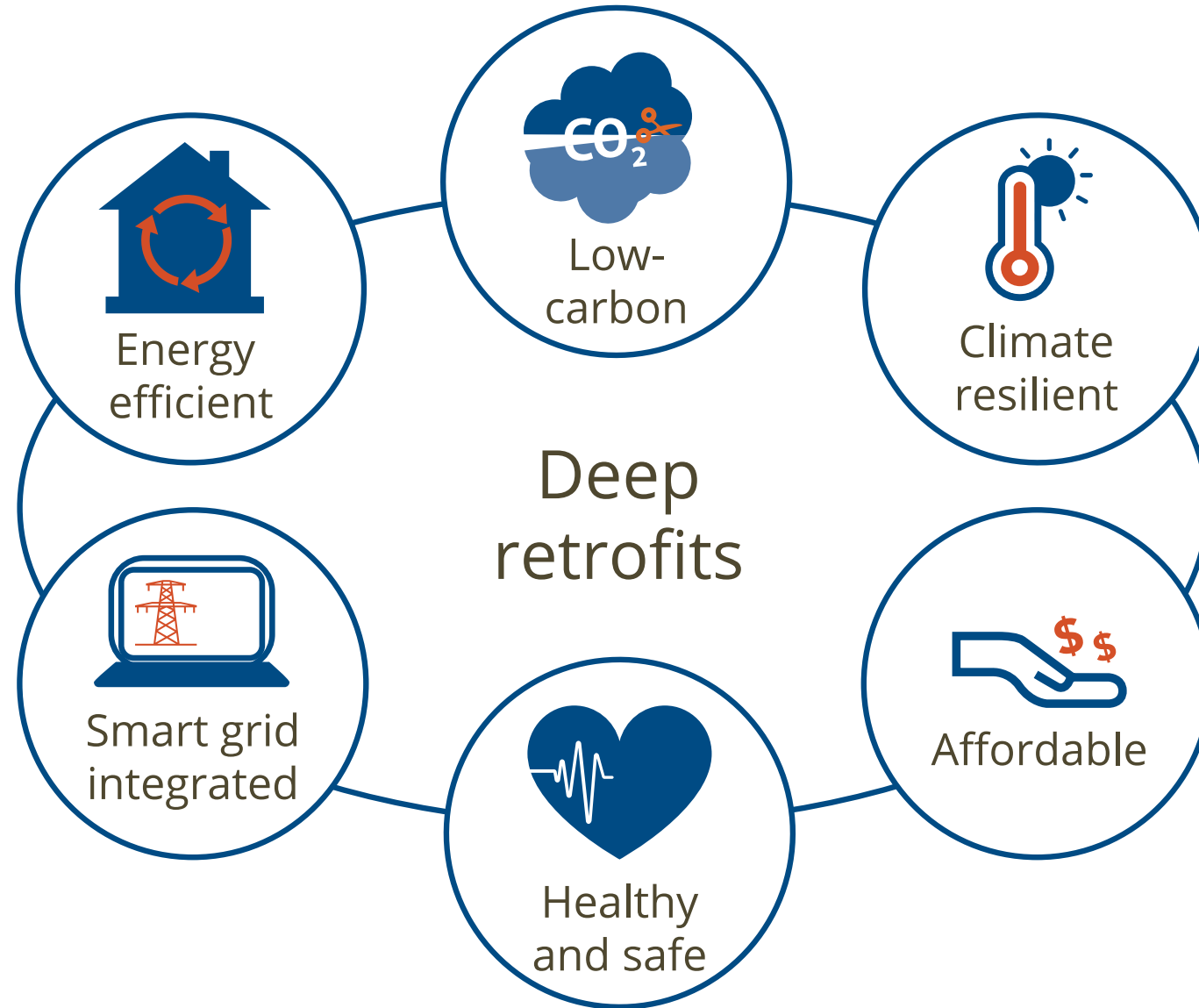
Overview

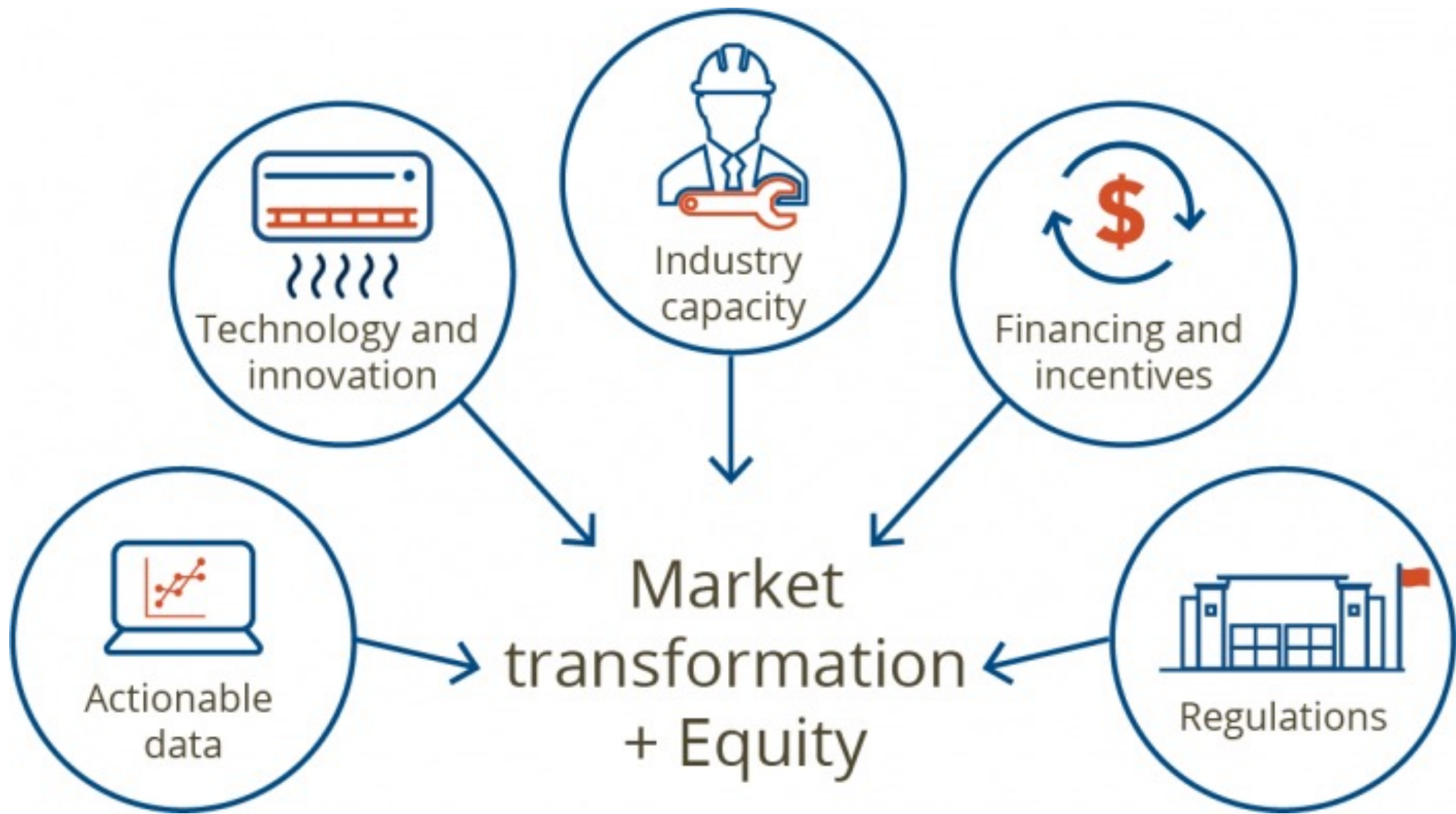
Read This Playbook

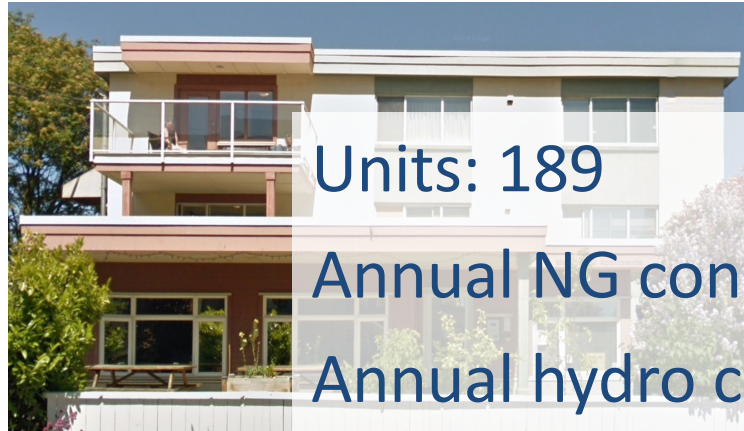
# Decarb Lunch: Reframed Initiative

Betsy Agar, Director  
Buildings  
Pembina Institute

March 8, 2024







Units: 189

Annual NG consumption: >10,000 GJ

Annual hydro consumption: >900 MWh

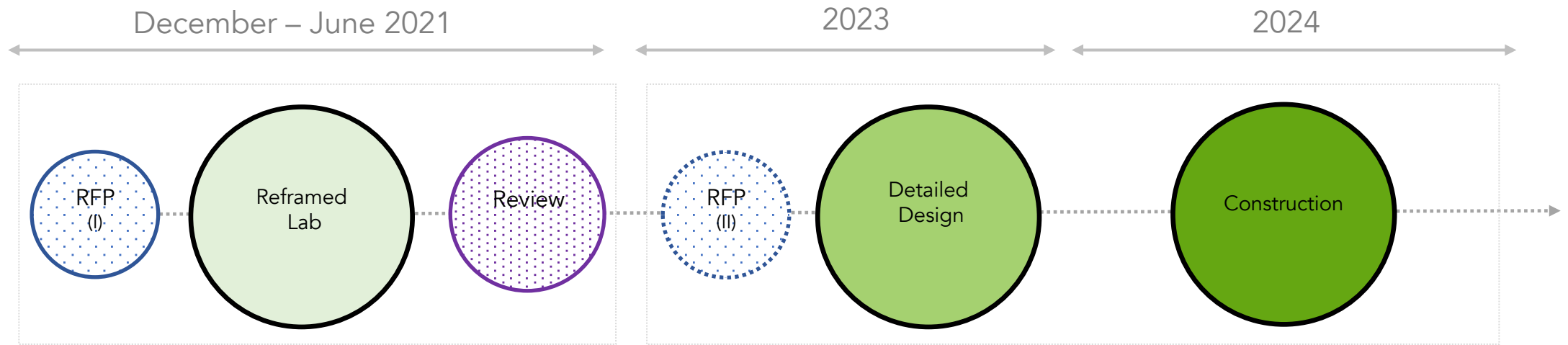
Annual cost: \$190,000CAD

Annual GHGs: 490 tonnes CO<sub>2</sub>e

Overheating, lack of fresh air, and outside noise



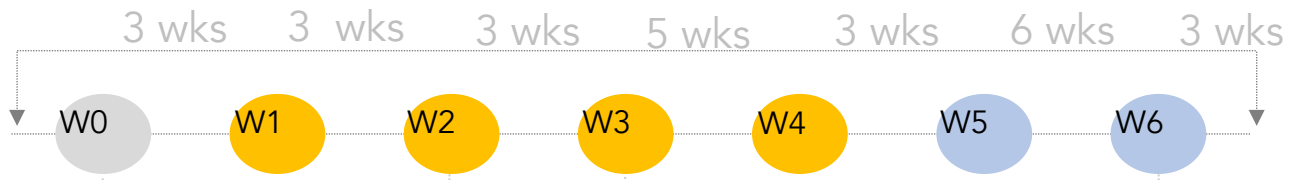
Low-rise, multi-unit residential buildings, wood-framed (except top right)



**Phase I : Exploration**

**Phase II**

**Phase III**



Kick-off meeting

Building exploration

Climate and seismic adaptation & resiliency

Health & wellbeing and embodied carbon

Energy & carbon

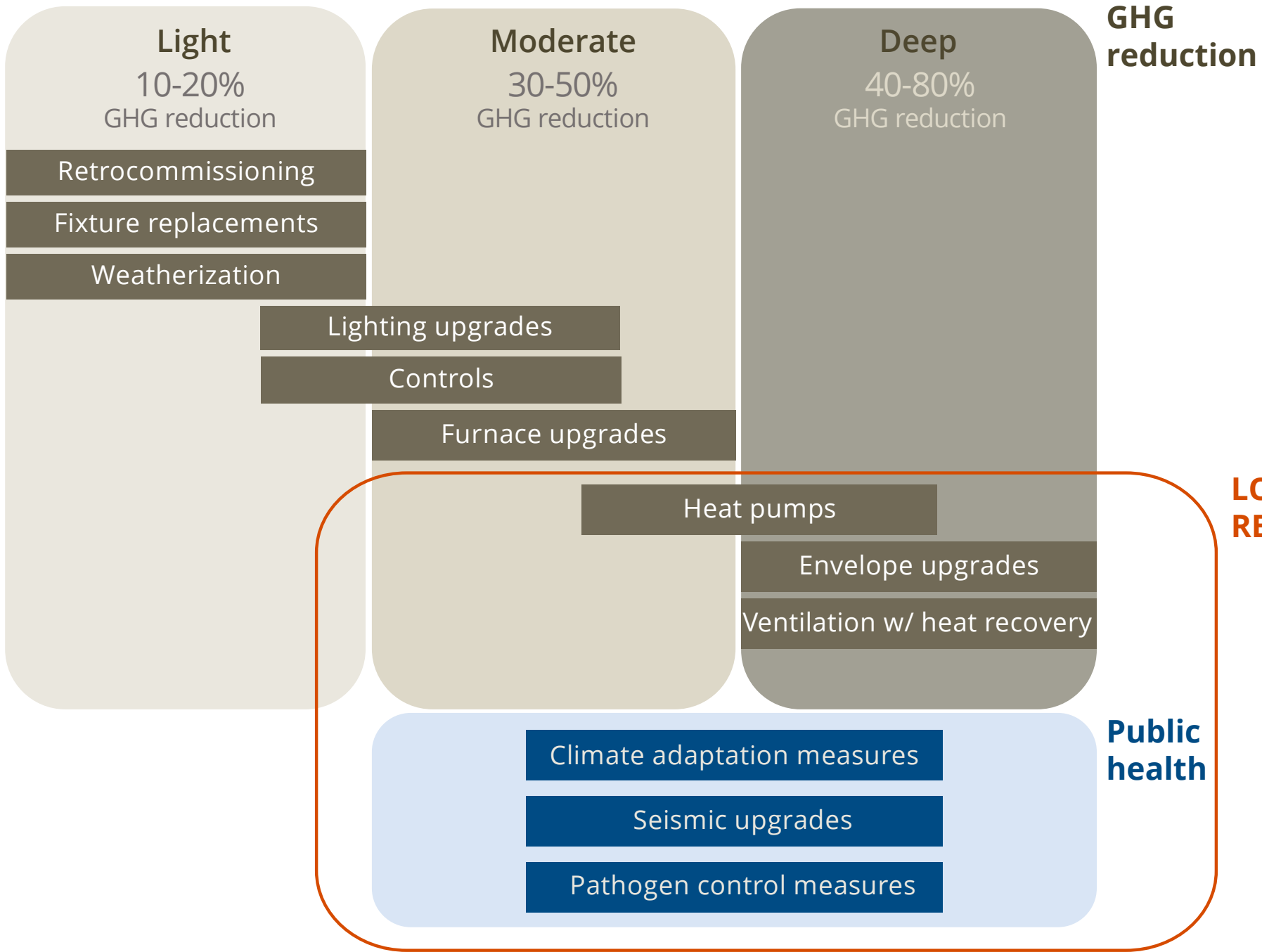
Design workshop 1

Design workshop 2

# Reframed Lab



Examples of building retrofit measures



**LOW-CARBON RESILIENCE**

# Reframed Lab results

Schematic design proposals:

- 58-93% heating energy reductions
- 68-99% carbon emission reductions
- Deep retrofit ~2X baseline retrofit cost at ~\$140,000/unit
- 30-60% embodied carbon from insulation
- ~\$4 recovery costs saved for every \$1 on seismic upgrades

# Reframed Lab learnings

- Deep retrofits start with holistic planning and procurement
- Regulations are needed to send a strong market signal and provide investor confidence
- Low and no cost capital is needed until we reach economies of scale and cost compression
- Cultural shift is needed to value non-energy benefits and define an alternate business model
- Solution-side needs support for training and growth
- Systemic barriers remain in place



**REFRAMED** Partners  
INITIATIVE



# Reframed Initiative: Exploration Lab | Medewiwin Apartments

Decarbonize and reduce GHG emissions

Seek synergies between upgrades

Reduce embodied carbon

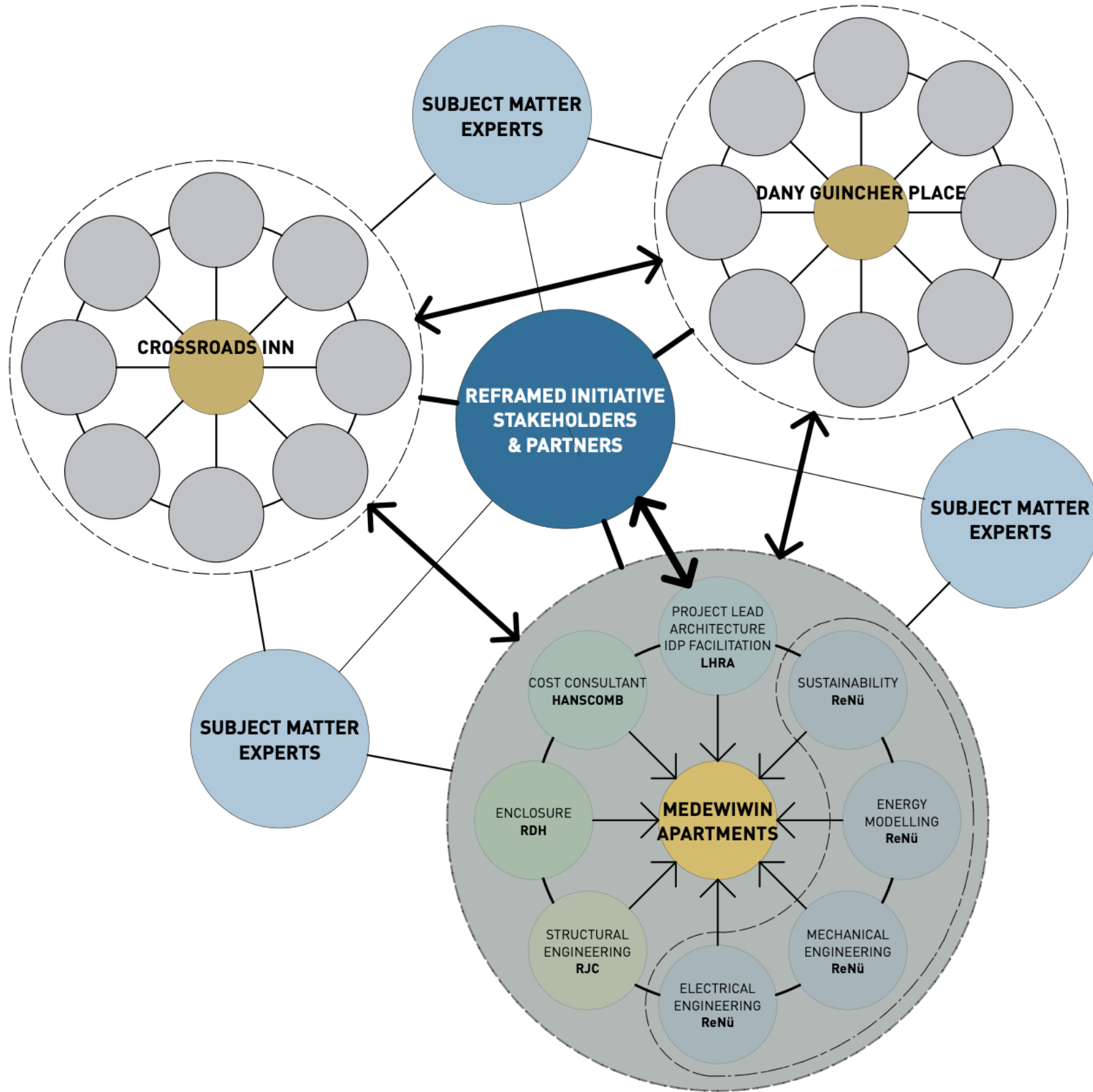
Improve climate resilience

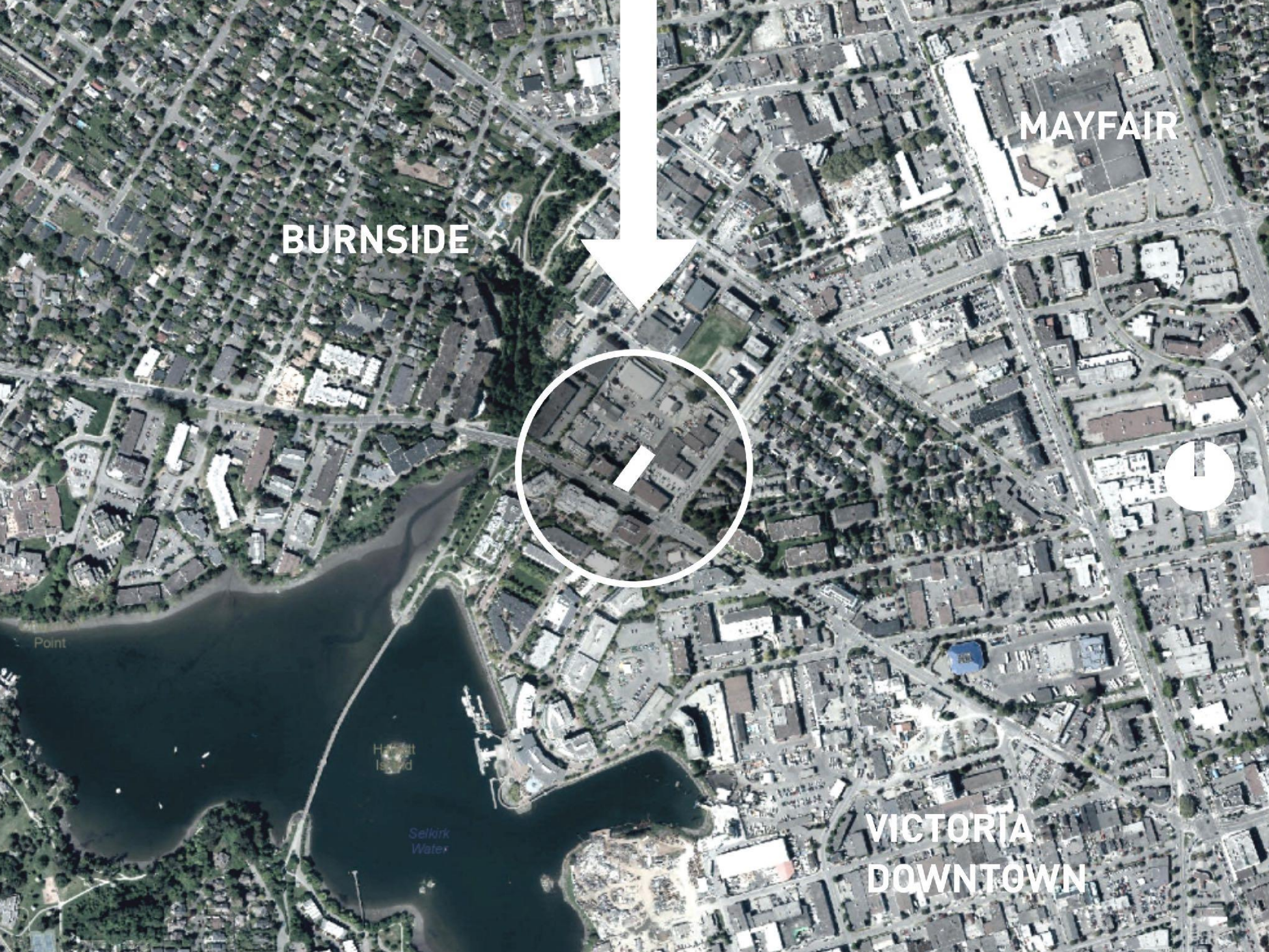
Lower operating costs

Build a prefab opportunity for industry

Improve resident experience

Make a strong business case





**BURNSIDE**

**MAYFAIR**

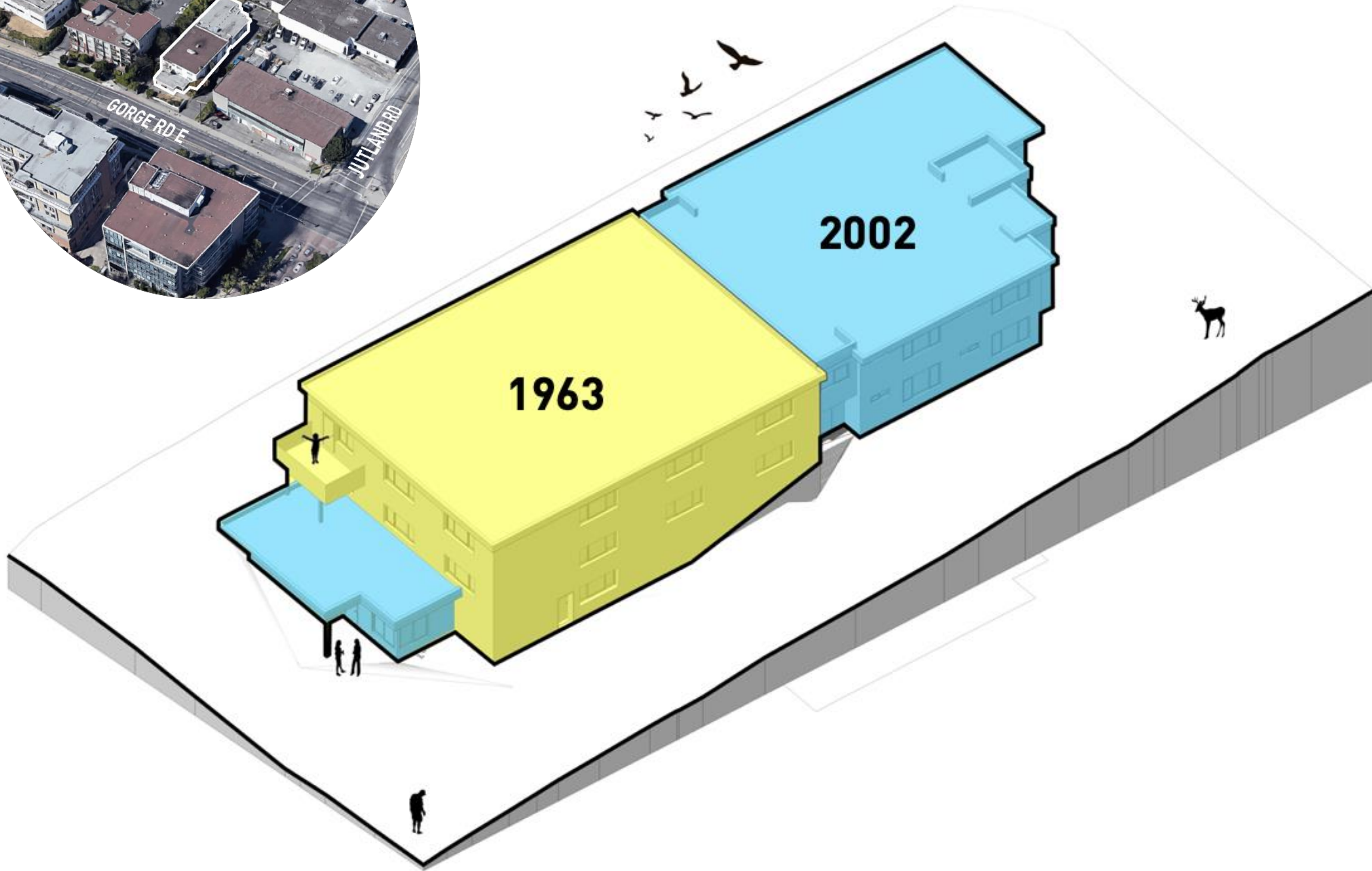
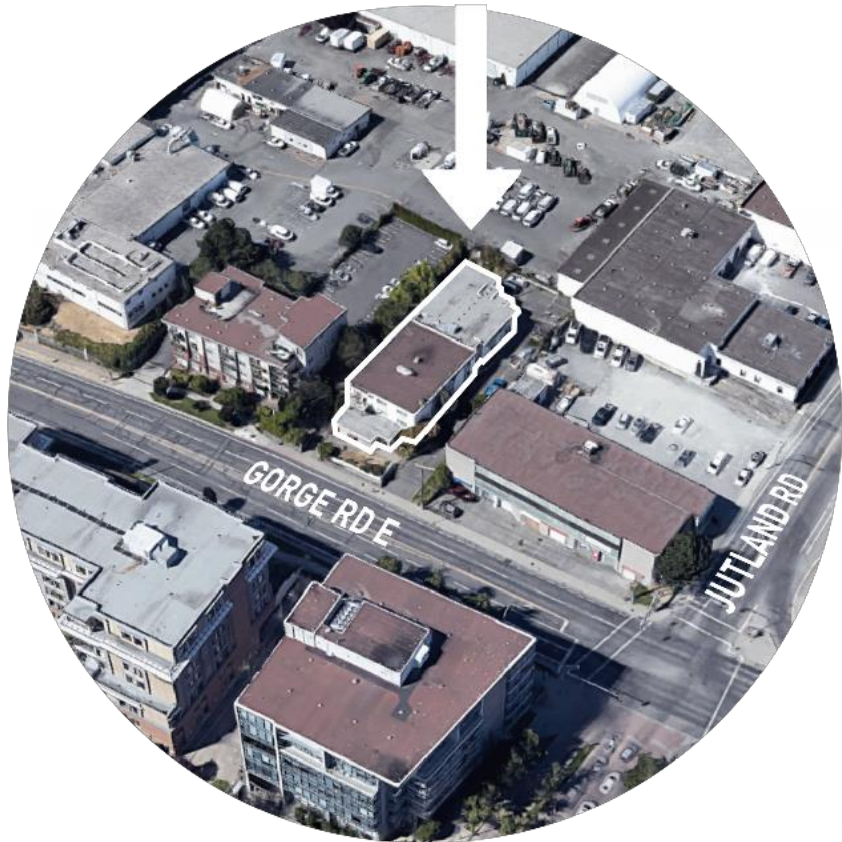


**VICTORIA  
DOWNTOWN**

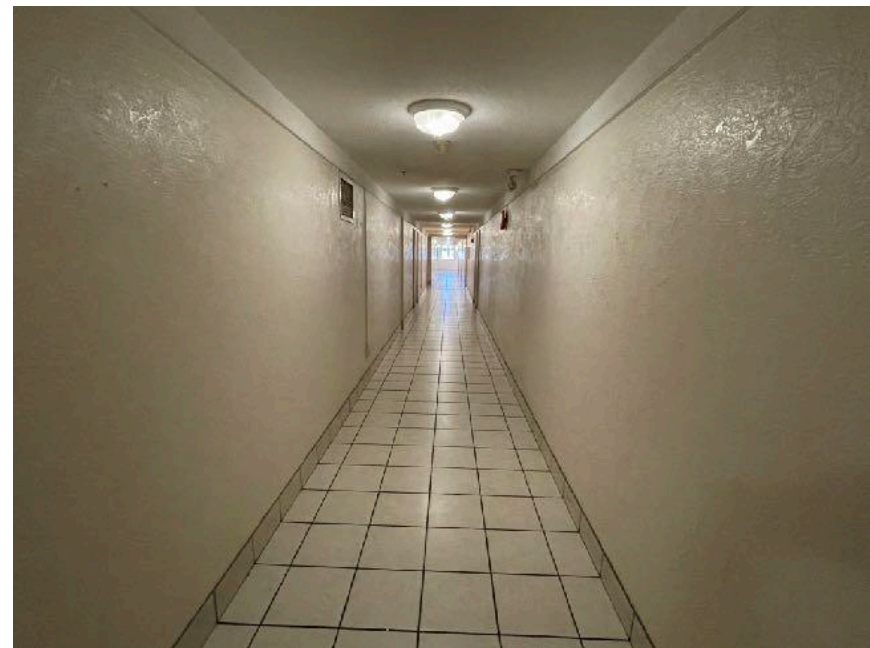
Point

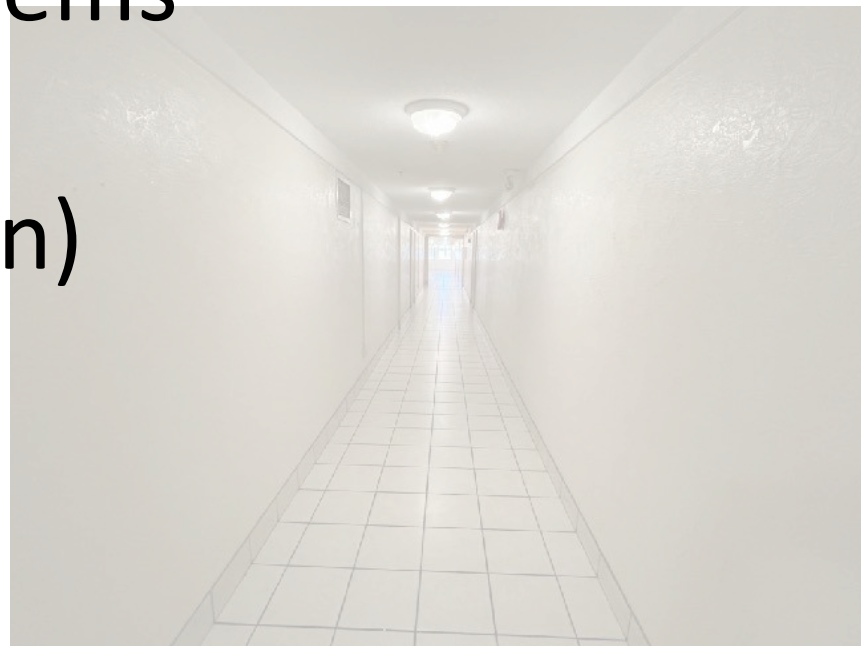
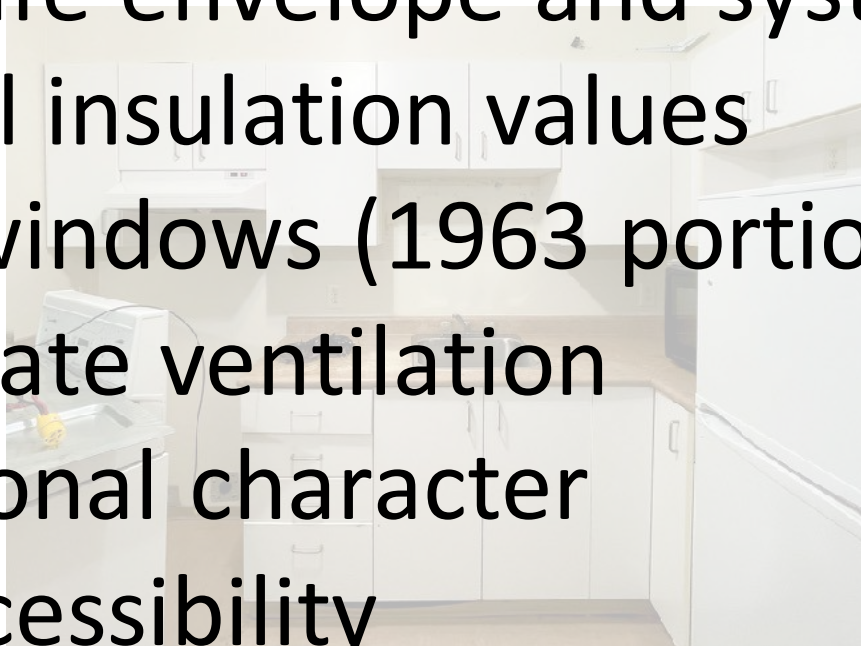
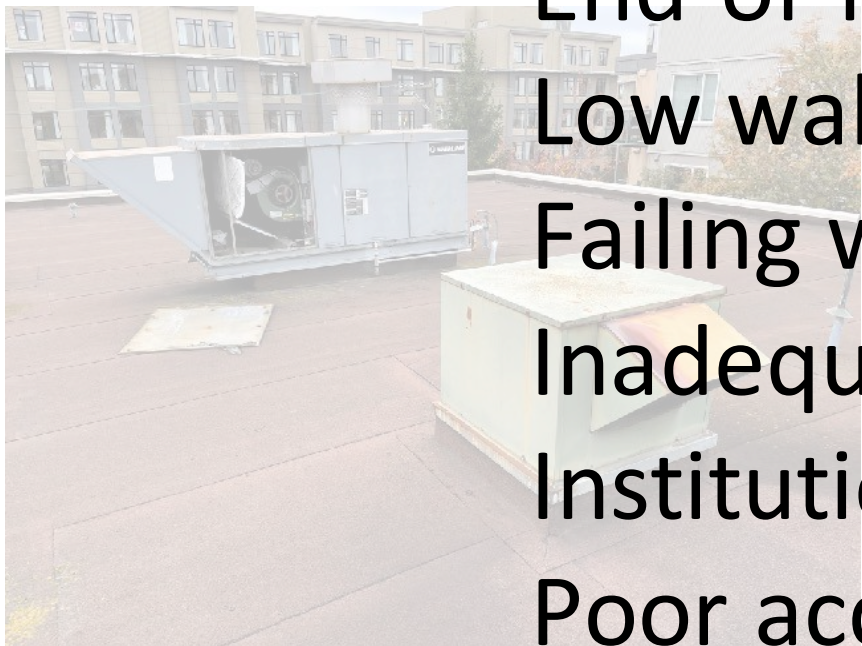
Hart  
Island

Selkirk  
Water

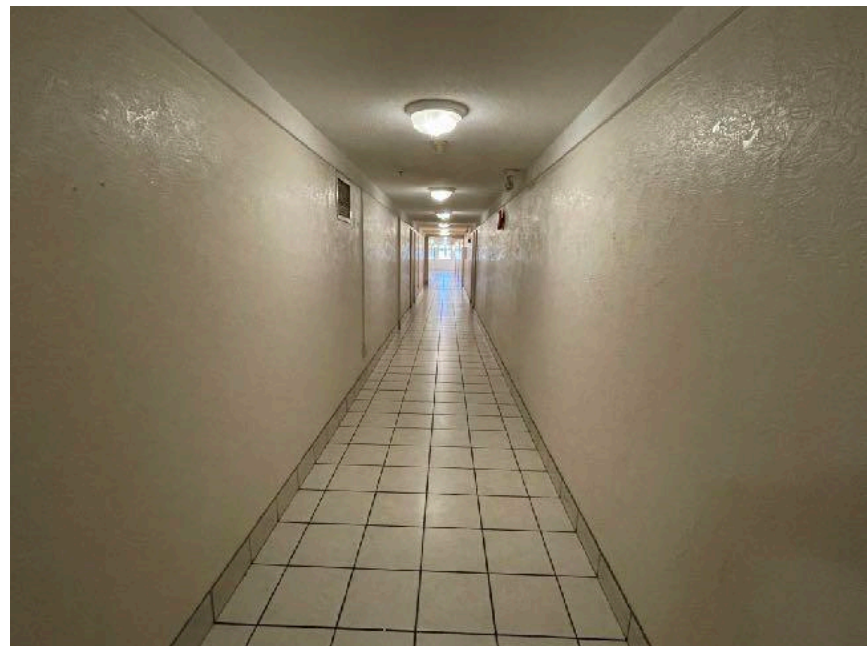




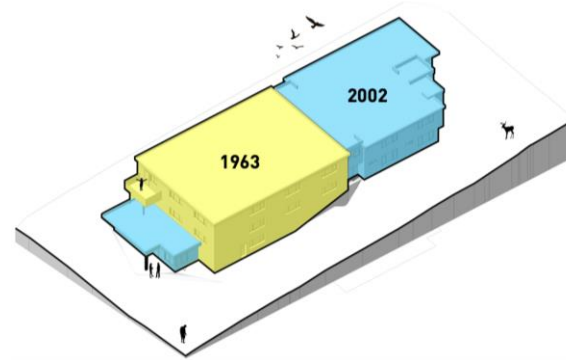




End-of-life envelope and systems  
Low wall insulation values  
Failing windows (1963 portion)  
Inadequate ventilation  
Institutional character  
Poor accessibility



## BASELINE A EXISTING PERFORMANCE



## BASELINE B CURRENT CODE MINIMUM

**ROOF:** R30

**SEISMIC:** STATUS QUO

**WALLS:** STATUS QUO/ COSMETIC

**WINDOWS:** U1.48

**HEATING:** 84% EFF GAS BOILER

**COOLING:** STATUS QUO

**LIGHTING:** STATUS QUO

**ROOF:** STATUS QUO

**SEISMIC:** STATUS QUO

**WALLS:** STATUS QUO/ COSMETIC

**WINDOWS:** STATUS QUO

**VENTILATION:** 91% EFF. GAS MAKEUP AIR UNITS

**HOT WATER:** 95% EFF GAS TANK HEATERS

**RENEWABLE ENERGY:** STATUS QUO

**CRAWLSPACE:** STATUS QUO

## BUNDLE 1

**ROOF:** R30

**SEISMIC:** STATUS QUO

**WALLS:** R20

**WINDOWS:** U1.48

**HEATING:** HYDRONIC INFLOOR HEATING 95% EFF GAS BOILER

**COOLING:** STATUS QUO

**LIGHTING:** LED

**ROOF:** R30

**SEISMIC:** STATUS QUO

**WALLS:** R20

**WINDOWS:** STATUS QUO

**VENTILATION:** 60% EFF HRV 91% EFF. GAS MAKEUP AIR UNITS

**HOT WATER:** 95% EFF GAS TANK HEATERS

**RENEWABLE ENERGY:** STATUS QUO

**CRAWLSPACE:** R20

## BUNDLE 2

**ROOF:** R40

**SEISMIC:** LEVEL 1/ HJ MINIMUM

**WALLS:** R30

**WINDOWS:** U1.48

**HEATING:** AIR-TO-WATER HEAT PUMP (DECENTRALIZED)

**COOLING:** STATUS QUO

**LIGHTING:** LED

**ROOF:** R40

**SEISMIC:** STATUS QUO

**WALLS:** R30

**WINDOWS:** STATUS QUO

**VENTILATION:** 85% SENSIBLE 70% LATENT EFFECTIVE ERV Eclora Ceiling Ducted + ERV

**HOT WATER:** AIR-TO-WATER HEAT PUMP SANCO2 Water Drop Module

**RENEWABLE ENERGY:** STATUS QUO

**CRAWLSPACE:** R20

## BUNDLE 3

**ROOF:** R60

**SEISMIC:** 75% BCBC - LEVEL 3

**WALLS:** R40

**WINDOWS:** U1.02

**HEATING:** AIR SOURCE HEAT PUMP (CENTRALIZED) Daikin REYQ96TJU/ FXAQ07PVJU

**COOLING:** AIR-TO-WATER HEAT PUMP Daikin REYQ96TJU/ FXAQ07PVJU

**LIGHTING:** LED

**ROOF:** R60

**SEISMIC:** STATUS QUO

**WALLS:** R40

**WINDOWS:** U1.02

**VENTILATION:** 85% SENSIBLE 70% LATENT EFFECTIVE ERV TempEff RQ2000

**HOT WATER:** AIR-TO-WATER HEAT PUMP SANCO2 Water Drop Module

**RENEWABLE ENERGY:** STATUS QUO

**CRAWLSPACE:** R20

## BUNDLE 4

**ROOF:** R60

**SEISMIC:** 100% BCBC - POST DISASTER

**WALLS:** R40

**WINDOWS:** U1.02

**HEATING:** AIR SOURCE HEAT PUMP (CENTRALIZED) Daikin REYQ96TJU/ FXAQ07PVJU

**COOLING:** AIR-TO-WATER HEAT PUMP Daikin REYQ96TJU/ FXAQ07PVJU

**LIGHTING:** LED

**ROOF:** R60

**SEISMIC:** STATUS QUO

**WALLS:** R40

**WINDOWS:** U1.02

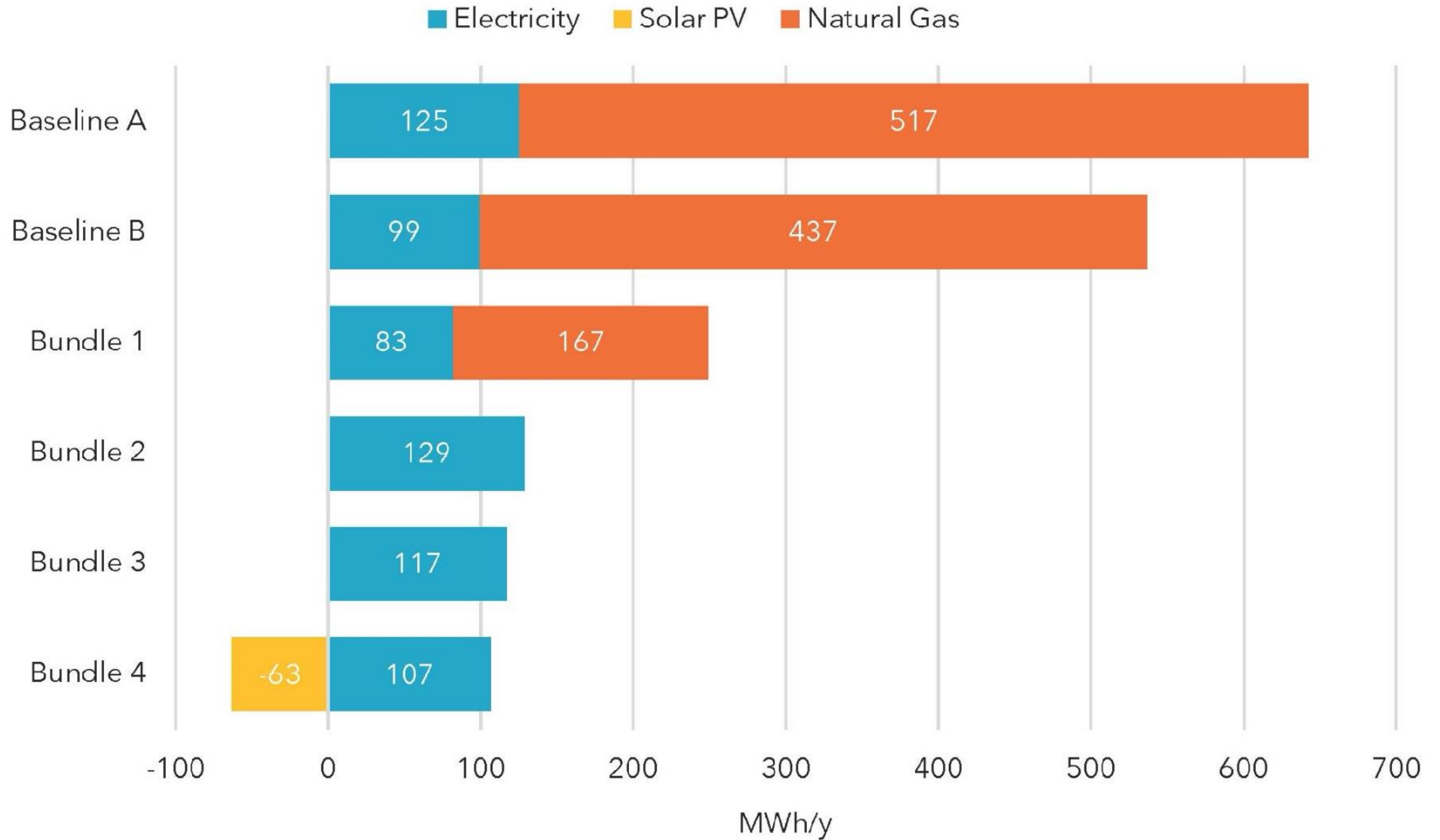
**VENTILATION:** 85% SENSIBLE 70% LATENT EFFECTIVE ERV TempEff RQ2000

**HOT WATER:** AIR-TO-WATER HEAT PUMP + SOLAR PREHEATING SANCO2 Water Drop Module

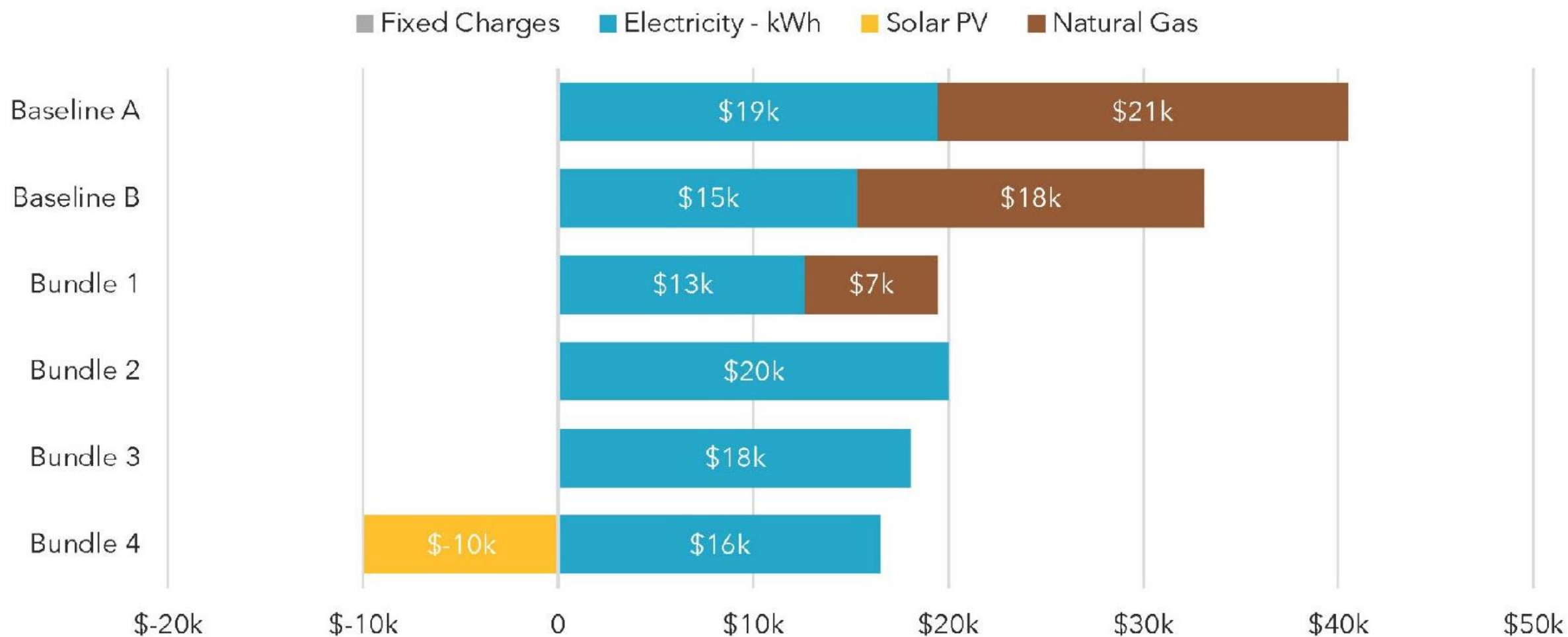
**RENEWABLE ENERGY:** SOLAR PANEL Viessmann Vitossol 200-FM

**CRAWLSPACE:** R20

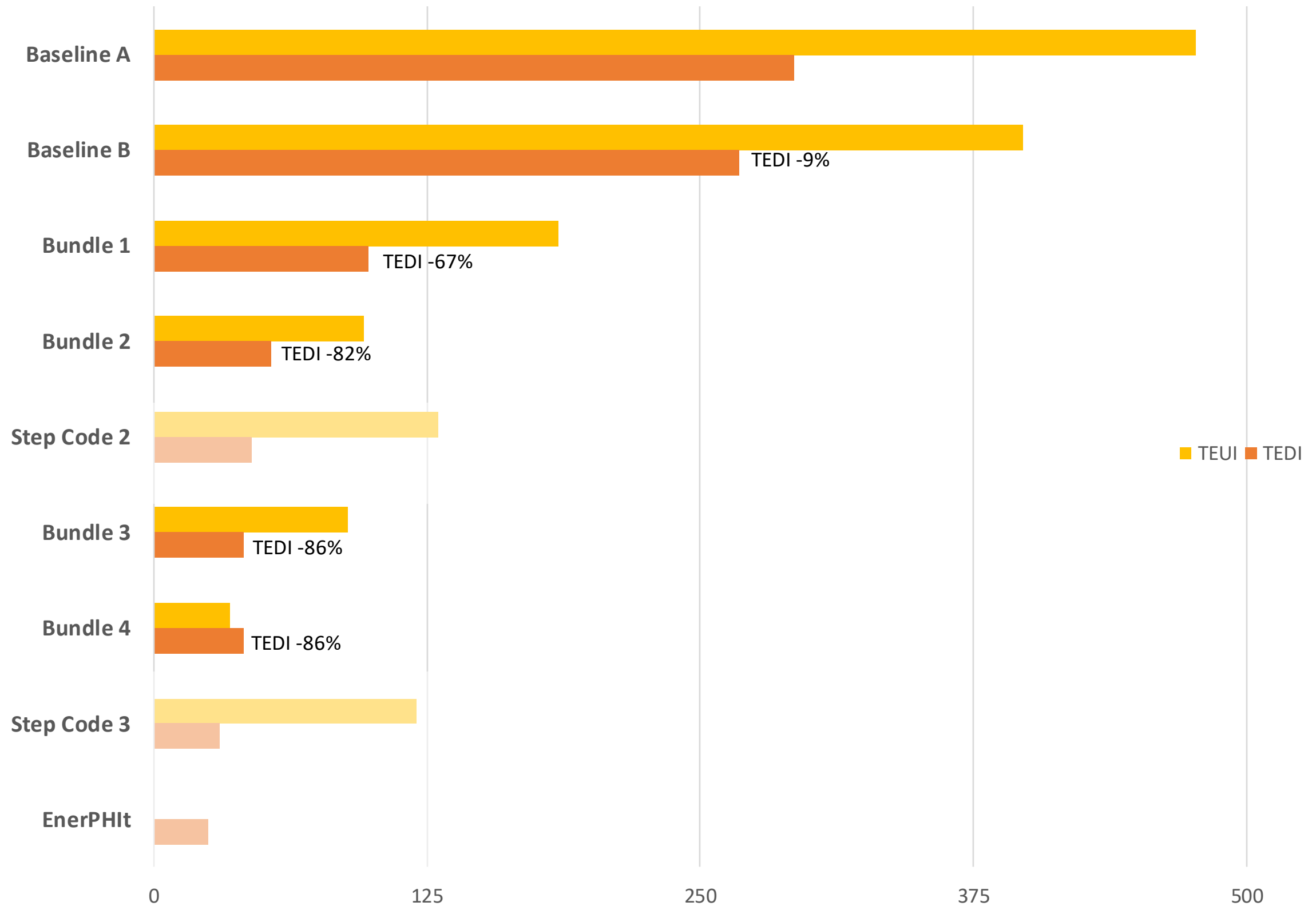
# PROJECTED ANNUAL ENERGY USE



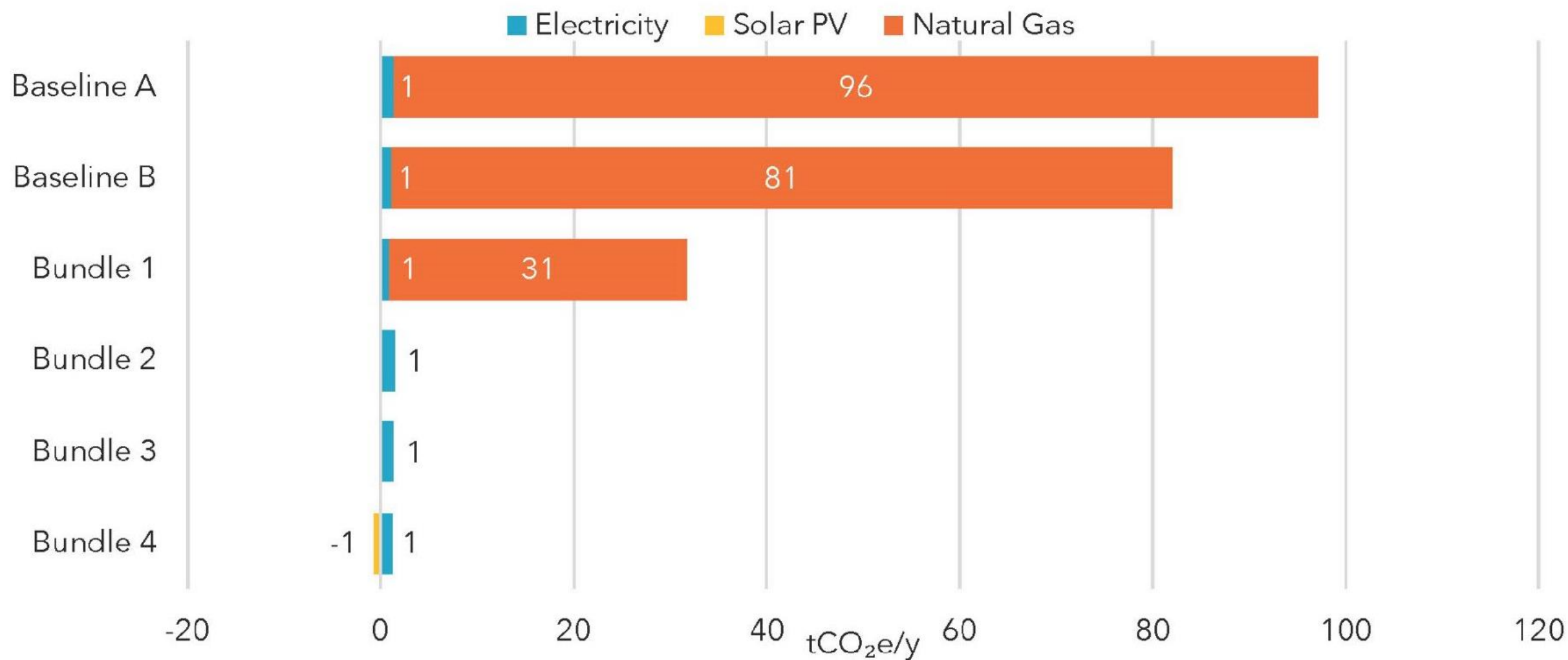
# ANNUAL ENERGY COSTS



# TEDI + TEUI

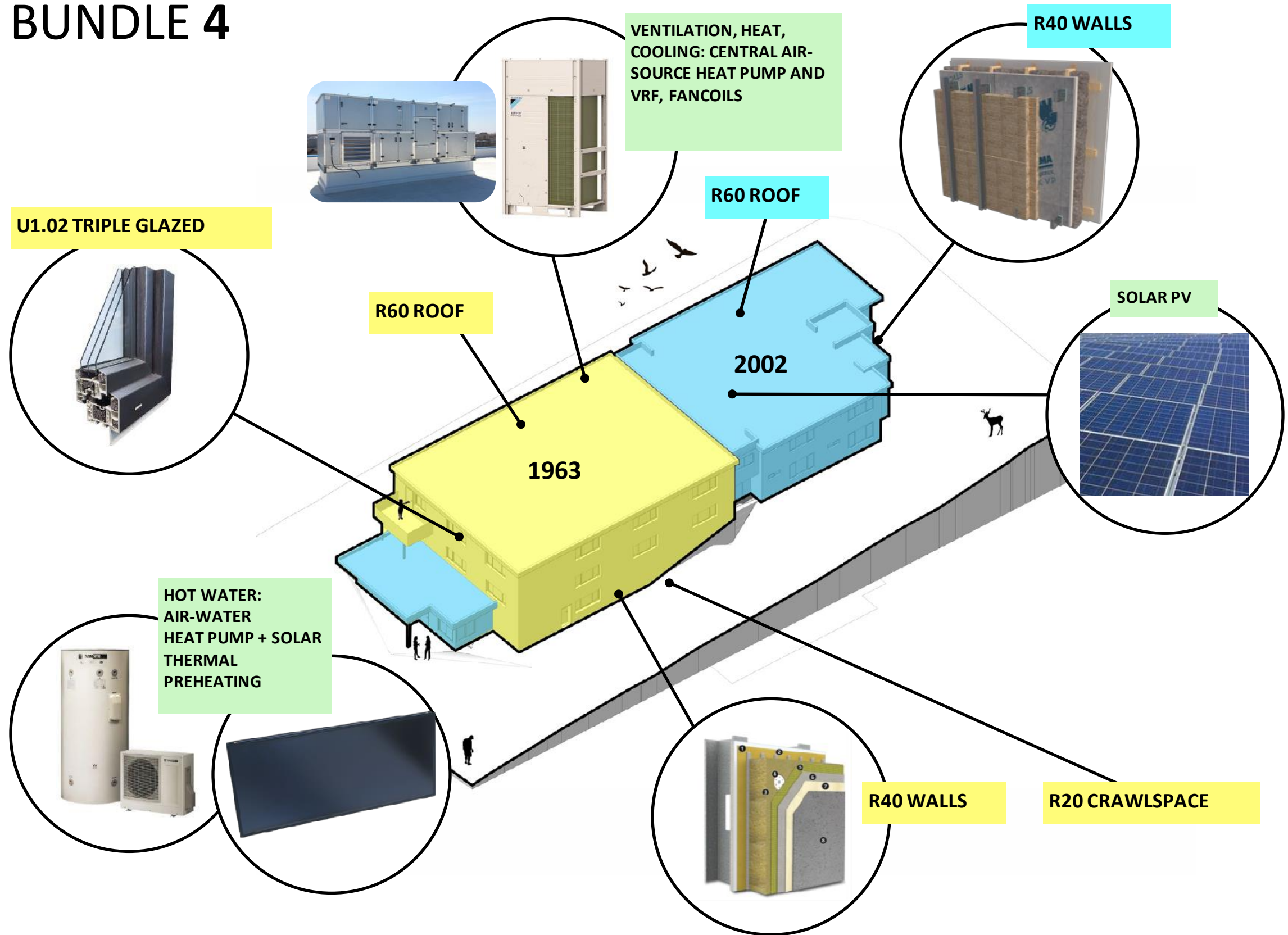


# CARBON EMISSIONS





# BUNDLE 4



# LIFECYCLE COST ANALYSIS

	Capital Costs	O & M	Energy Costs	Cyclical Renewal Costs	Salvage Credits	Total Cost (Present Value)
<b>Baseline A</b>		\$1,262,220	\$88,660	\$343,450	-\$191,330	\$1,503,000
<b>Baseline B</b>	\$1,359,100	\$1,042,590	\$76,020	\$253,090	-\$561,230	\$2,169,570
<b>Bundle 1</b>	\$2,080,800	\$739,250	\$63,910	\$201,350	-\$446,450	\$2,638,860
<b>Bundle 2</b>	\$2,145,300	\$739,250	\$57,070	\$201,350	-\$446,450	\$2,696,520
<b>Bundle 3</b>	\$3,582,400	\$739,250	\$48,500	\$218,600	-\$484,710	\$4,104,040
<b>Bundle 4</b>	\$3,597,700	\$739,250	\$44,630	\$247,360	-\$548,490	\$4,280,450

Discount Rate: 8.0%

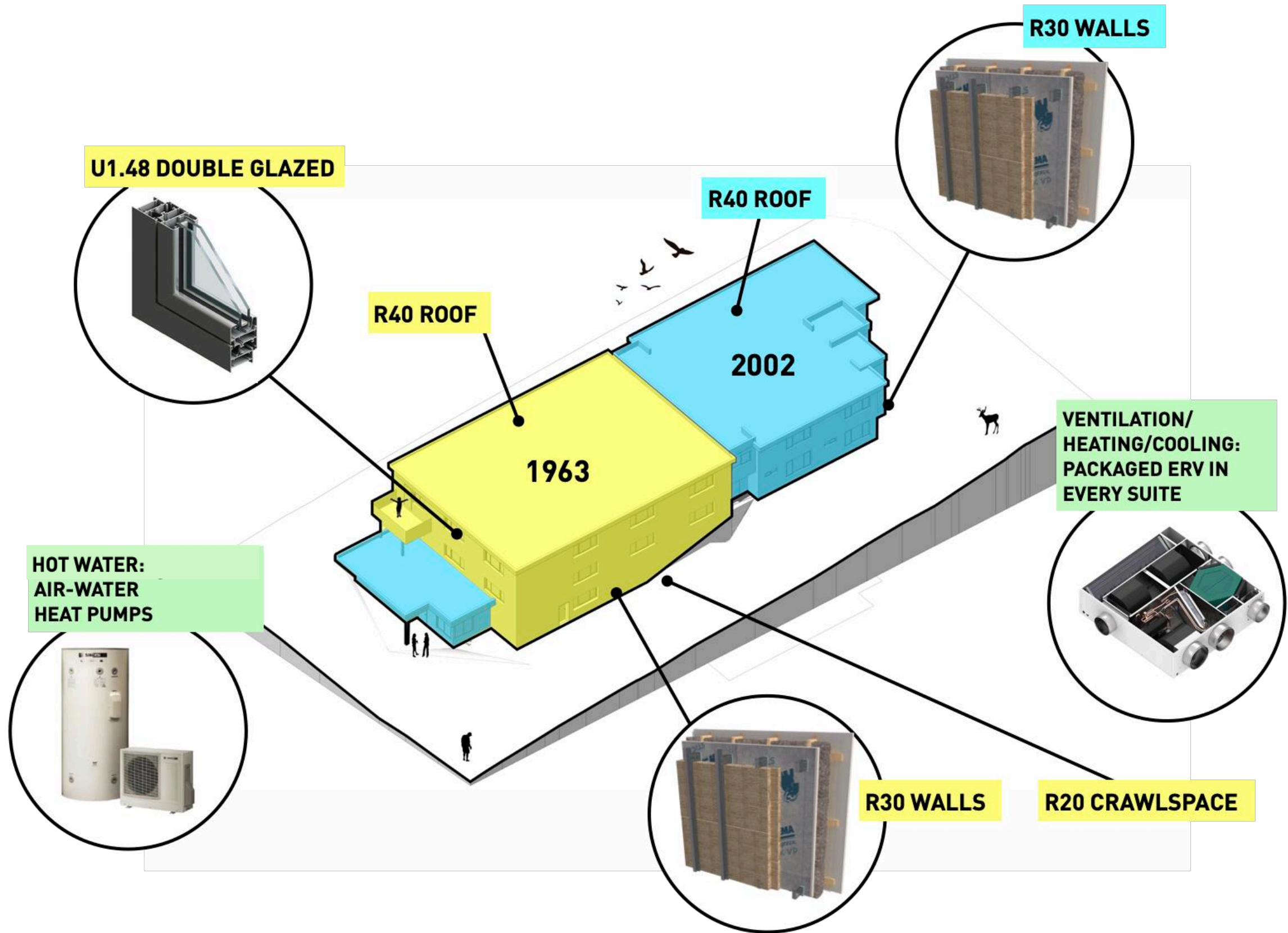
Period of Study: 40 Years

Base Year: 2022

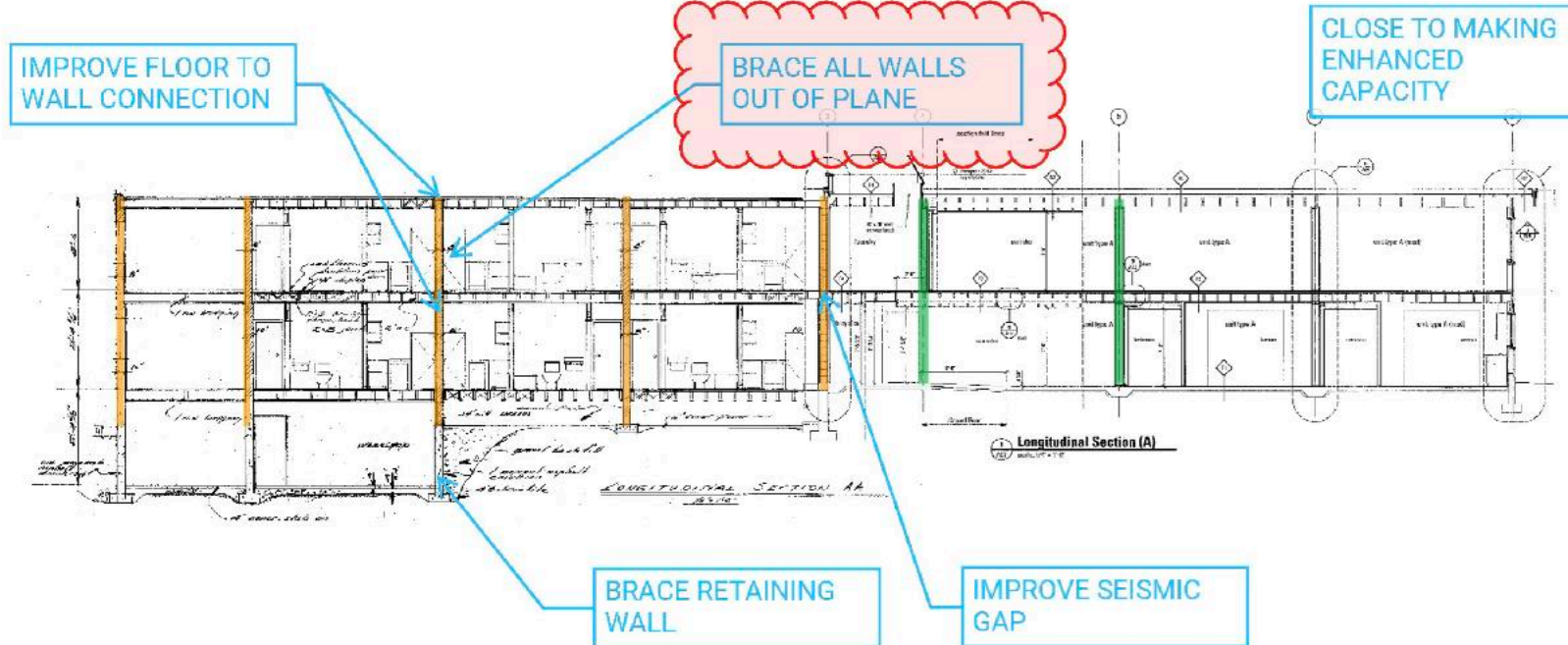
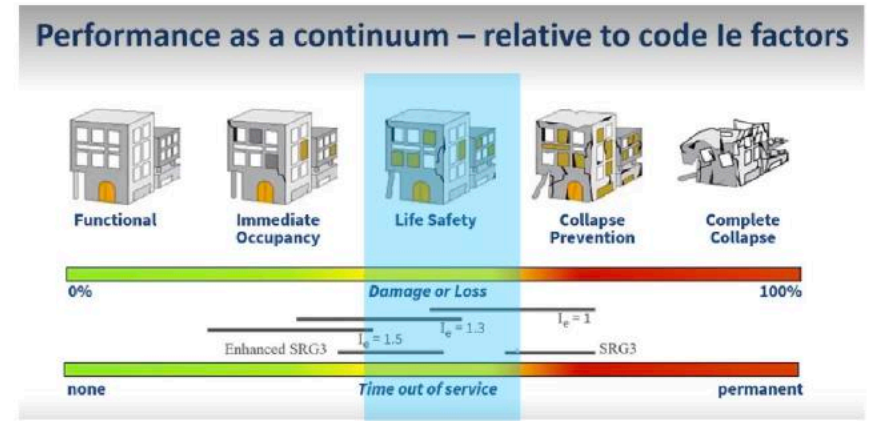
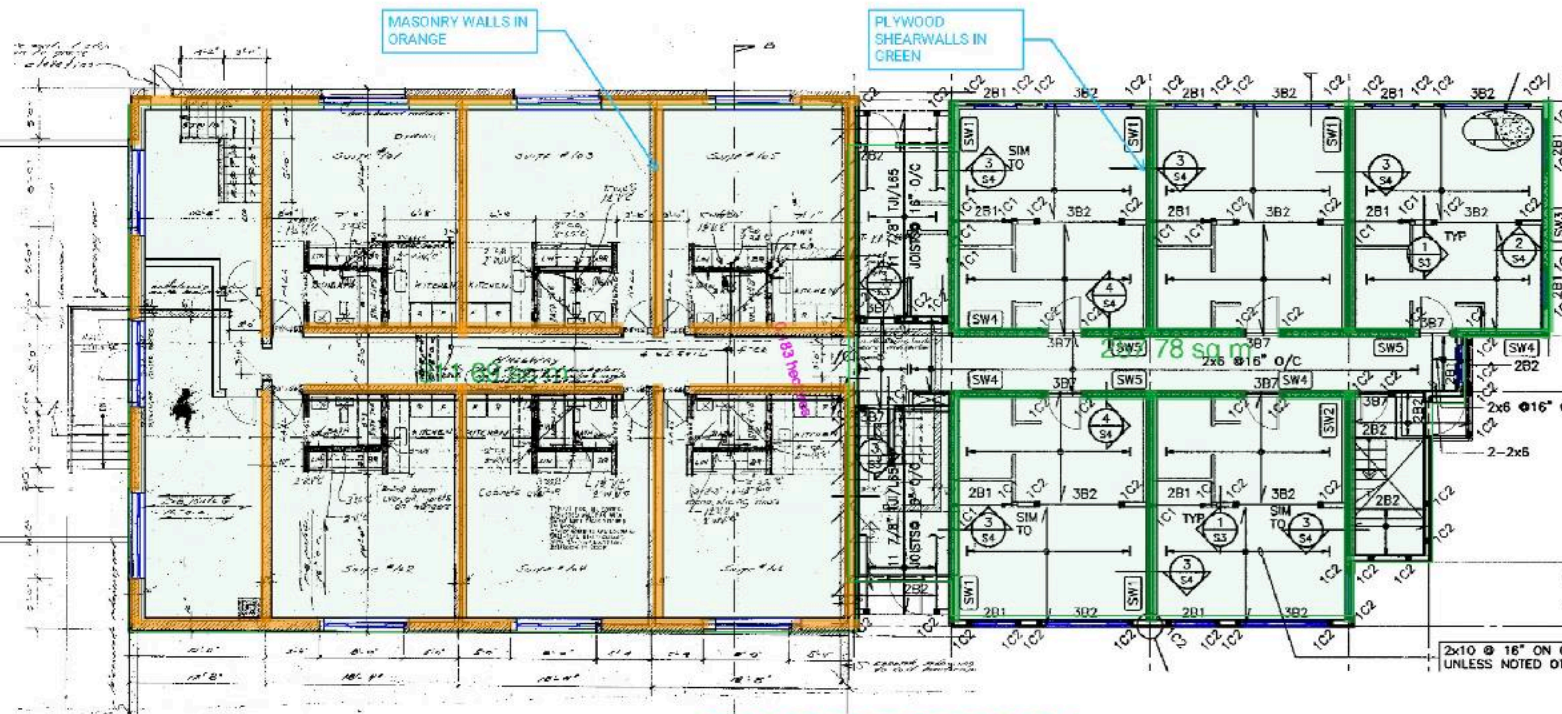
# PROFORMA ANALYSIS

<b>Project Costs</b>		<b>Baseline A</b>	<b>Baseline B</b>	<b>Bundle 1</b>	<b>Bundle 2</b>	<b>Bundle 3</b>	<b>Bundle 4</b>
Direct Project Hard Costs		N/A	\$ 1,359,100	\$ 2,080,800	\$ 2,145,300	\$ 3,582,400	\$ 3,597,700
Project Manager LOC Projects		N/A	\$ 68,000	\$ 104,000	\$ 107,300	\$ 179,100	\$ 179,900
Soft Costs	20.00%	N/A	\$ 271,800	\$ 416,200	\$ 429,100	\$ 716,500	\$ 719,500
Legal/Other Costs	3.00%	N/A	\$ 51,000	\$ 78,000	\$ 80,500	\$ 134,300	\$ 134,900
Interest During Const	6.00%	N/A	\$ 39,400	\$ 60,300	\$ 62,100	\$ 103,800	\$ 104,200
<b>Summary of Project Costs</b>		<b>N/A</b>	<b>\$ 1,789,300</b>	<b>\$ 2,739,300</b>	<b>\$ 2,824,300</b>	<b>\$ 4,716,100</b>	<b>\$ 4,736,200</b>
<i>Assuming 25% of Project Costs as Equity to equate to a 75% Loan to Value Ratio</i>							
<b>Annual Project Renewal Savings</b>		<b>Baseline A</b>	<b>Baseline B</b>	<b>Bundle 1</b>	<b>Bundle 2</b>	<b>Bundle 3</b>	<b>Bundle 4</b>
Annual Operational Savings		N/A	\$ 7,870	\$ 18,740	\$ 18,740	\$ 18,740	\$ 18,740
Annual Energy Savings		N/A	\$ 453	\$ 887	\$ 1,132	\$ 1,439	\$ 1,578
Annual Carbon Tax Savings		N/A	\$ 6,002	\$ 14,458	\$ 15,731	\$ 16,916	\$ 20,837
Annual Cyclical Renewal Savings		N/A	\$ 16,165	\$ 22,225	\$ 22,225	\$ 20,205	\$ 16,837
<b>Annual Stabilized Net Savings</b>		<b>N/A</b>	<b>\$ 30,490</b>	<b>\$ 56,310</b>	<b>\$ 57,828</b>	<b>\$ 57,300</b>	<b>\$ 57,992</b>
Capitalization Rate	2.00%	N/A	\$ 1,524,490	\$ 2,815,506	\$ 2,891,395	\$ 2,865,007	\$ 2,899,615
Return on Investment		N/A	-14.80%	2.78%	2.38%	-39.25%	-38.78%
<b>Whole Life Project Renewal Savings</b>		<b>Baseline A</b>	<b>Baseline B</b>	<b>Bundle 1</b>	<b>Bundle 2</b>	<b>Bundle 3</b>	<b>Bundle 4</b>
Whole Life Operational Savings		N/A	\$ 314,800	\$ 749,600	\$ 749,600	\$ 749,600	\$ 749,600
Whole Life Energy Savings		N/A	\$ 18,120	\$ 35,480	\$ 45,280	\$ 57,560	\$ 63,120
Whole Life Carbon Tax Savings		N/A	\$ 240,072	\$ 578,325	\$ 629,236	\$ 676,646	\$ 833,492
Whole Life Cyclical Renewal Savings		N/A	\$ 646,600	\$ 889,000	\$ 889,000	\$ 808,200	\$ 673,480
<b>Whole Life Stabilized Net Savings</b>		<b>N/A</b>	<b>\$ 1,219,592</b>	<b>\$ 2,252,405</b>	<b>\$ 2,313,116</b>	<b>\$ 2,292,006</b>	<b>\$ 2,319,692</b>
Whole Life Modified IRR		N/A	13.87%	228.90%	227.60%	94.40%	95.91%
<b>Carbon Tax</b>		<b>Baseline A</b>	<b>Baseline B</b>	<b>Bundle 1</b>	<b>Bundle 2</b>	<b>Bundle 3</b>	<b>Bundle 4</b>
Average Annual Carbon Tax		\$ 30,387	\$ 24,385	\$ 15,929	\$ 14,656	\$ 13,471	\$ 9,550
Whole Life Carbon Tax		\$ 1,215,491	\$ 975,419	\$ 637,166	\$ 586,255	\$ 538,845	\$ 381,999
Avg Annual Carbon Tax Savings vs. Base 'A'		\$ -	\$ 6,002	\$ 14,458	\$ 15,731	\$ 16,916	\$ 20,837
Whole Life Carbon Tax Savings vs. Base 'A'		\$ -	\$ 240,072	\$ 578,325	\$ 629,236	\$ 676,646	\$ 833,492

# BUNDLE FINAL RECOMMENDATION



# 100% OF CURRENT CODE BCBC2018



MASONRY SHEARWALL RESULTS

WOOD FRAME SHEARWALL RESULTS

CODE COMP. GIVES 0.67x CAPACITY AT RdRO=1.0

CODE COMPARISON GIVES 1.7x CAPACITY



Project Name  
**MEDEWIWIN REFRAMED**

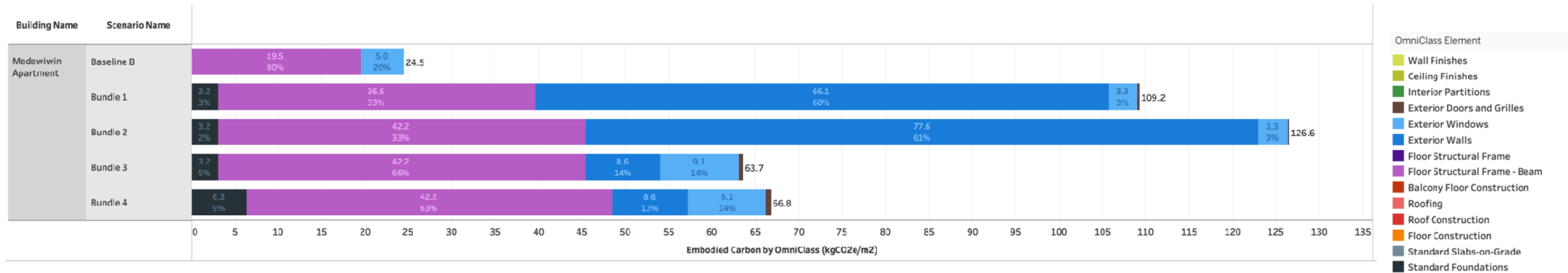
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Dwg. Ref.  
Scale **N.T.S.**  
Date **2022/02/01**  
Project No. **VIC.130432.0003**  
Sketch Number  
**SK-**

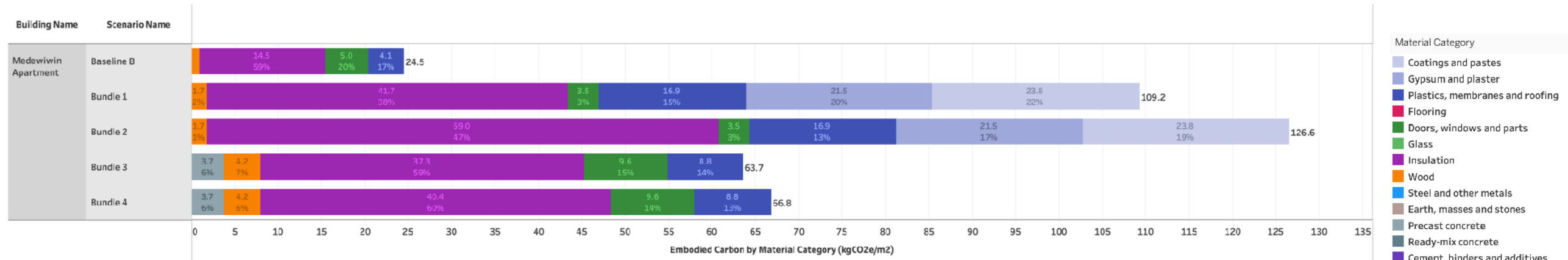
Rev. **00**

# EMBODIED CARBON

## GWP by OmniClass

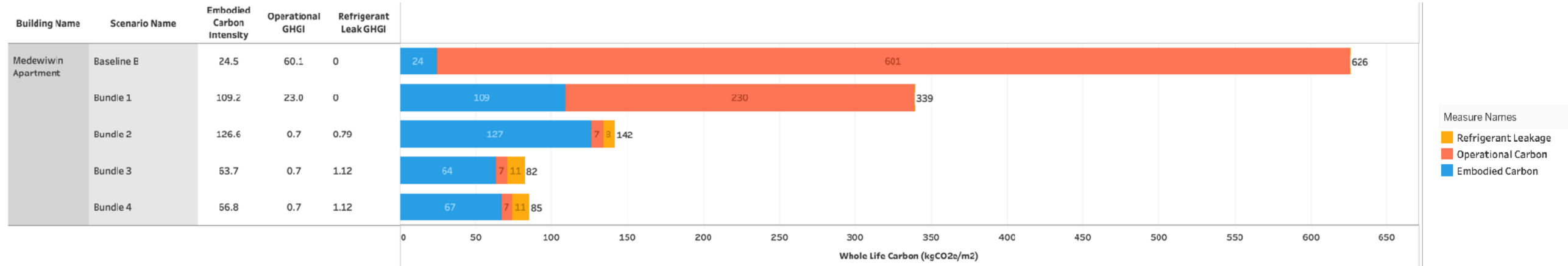


## GWP by Material Type

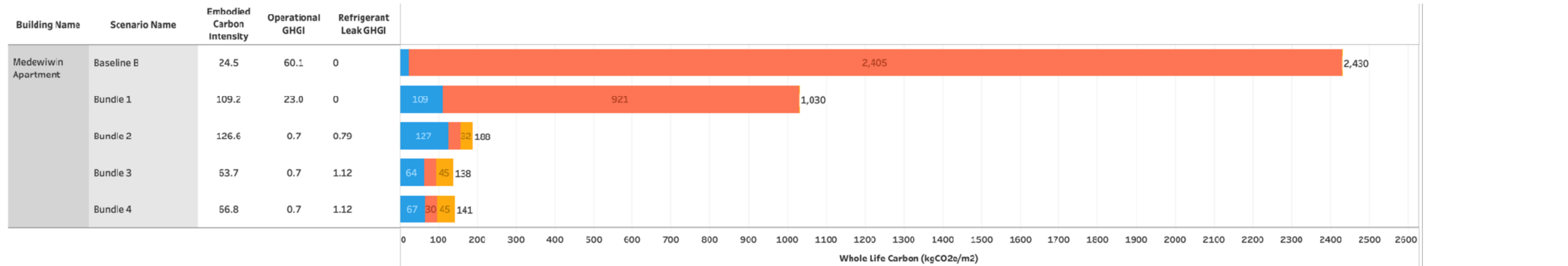


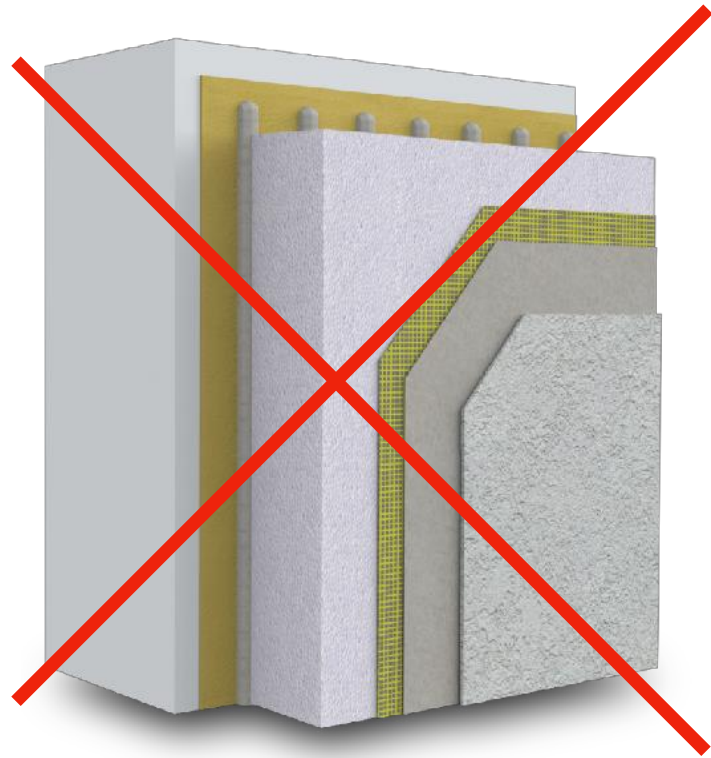
# WHOLE LIFE CARBON

## Whole Life Carbon (10 Years)

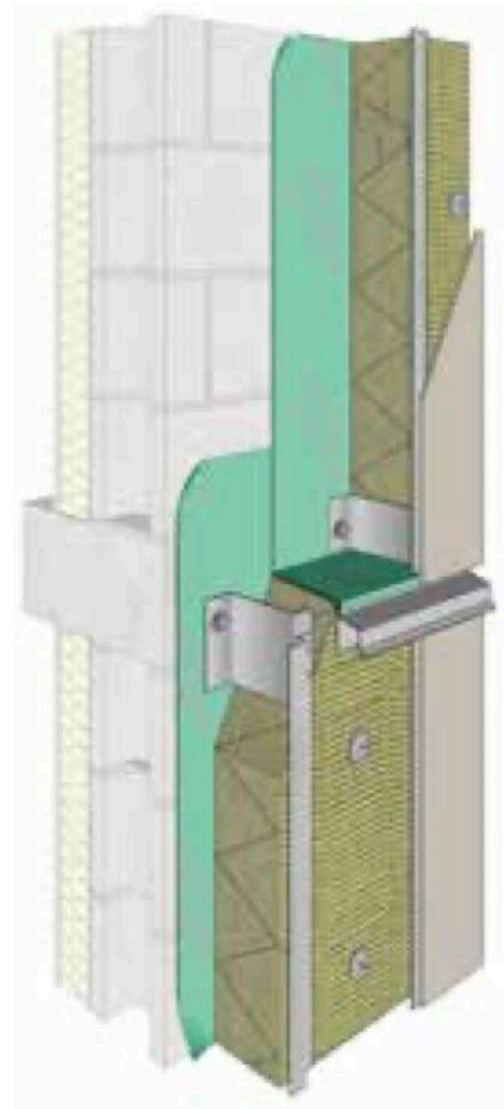


## Whole Life Carbon (40 Years)

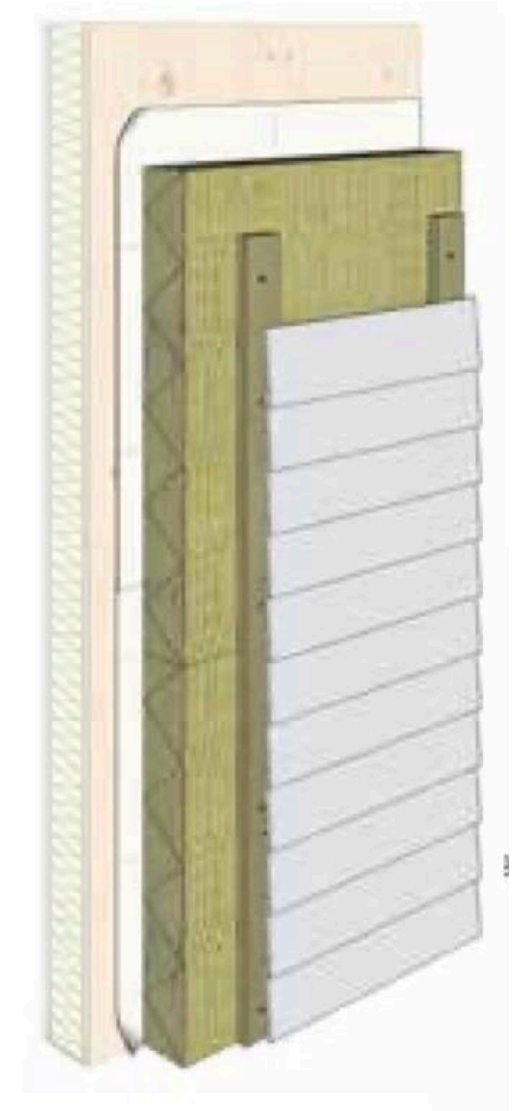




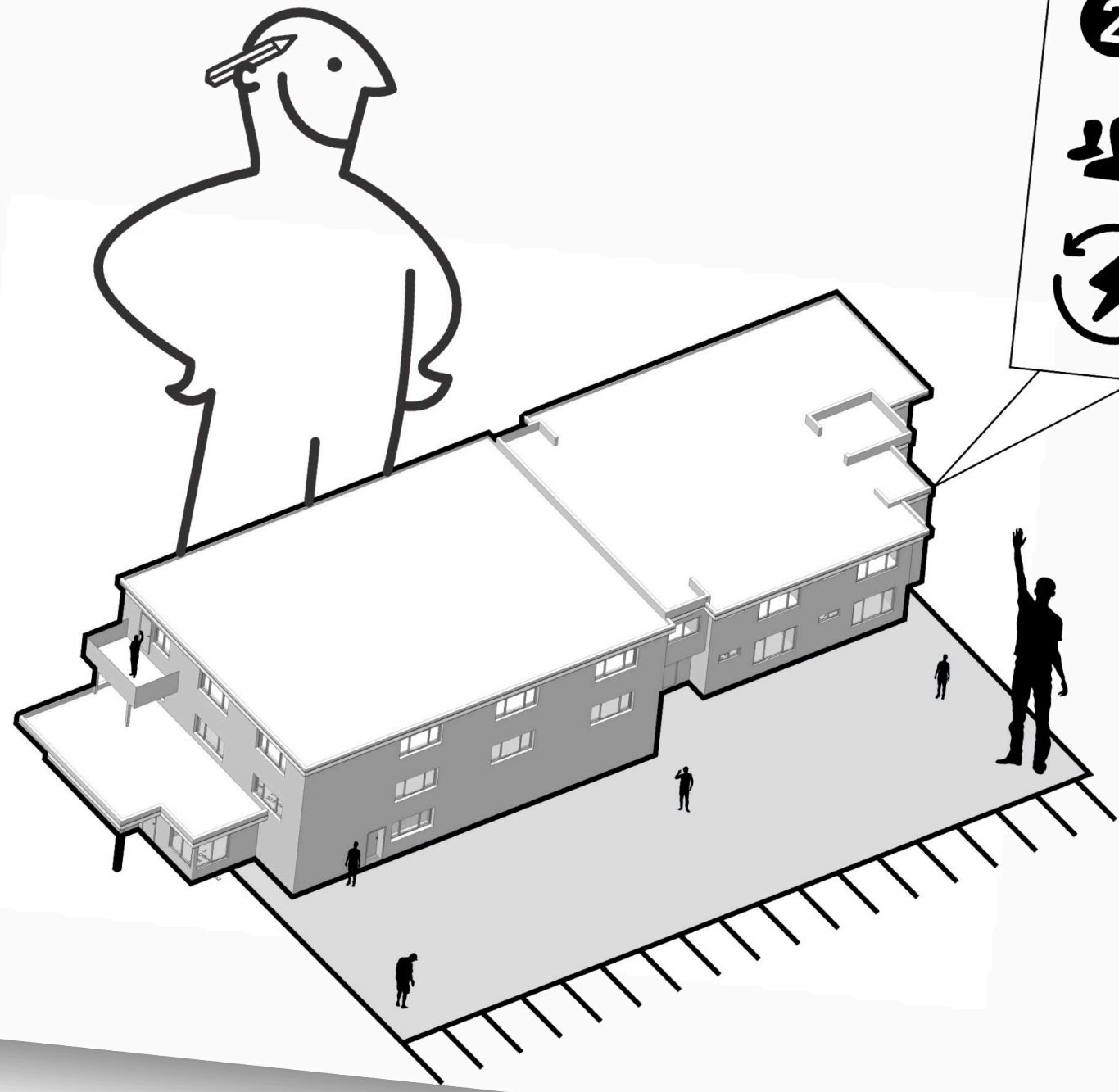
Rejected due to embodied carbon levels



**Proposed overcladding approach**

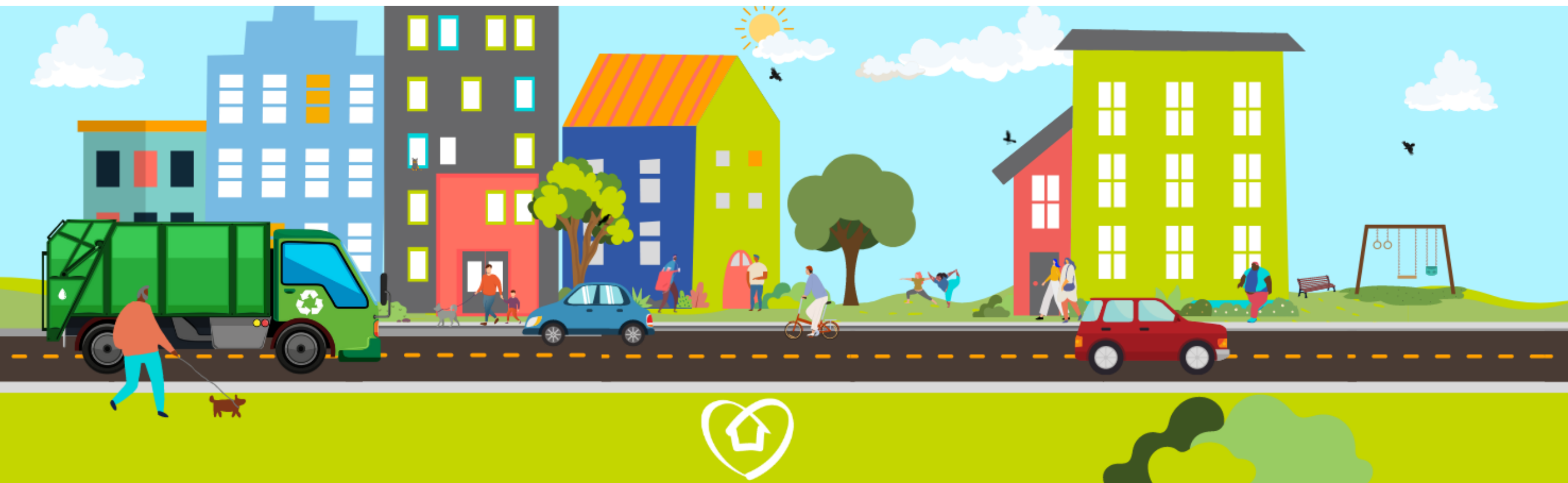






A	B	1
2	3	4

# PACIFICA HOUSING: *Equitable housing in pursuit of thriving communities*



*We acknowledge and honour the Traditional Territory of the Coast Salish Nations whose Territory we operate on, including Songhees Nation, Esquimalt Nation, WSÁNEĆ First Nations, and Snuneymuxw First Nation.*

# PACIFICA HOUSING

## Who We Are

Pacifica Housing is one of Vancouver Island's largest operators and providers of affordable homes and supportive services.

## Our Vision

Equitable housing in pursuit of thriving communities.

## Our Mission

To advance the independence of individuals and families through equitable housing and supportive services.

## Our Values

- 01. Authenticity
- 02. Leadership
- 03. Respect
- 04. Social Justice



**1,446**

homes  
*+88 new homes*



**32**

independent living  
buildings  
*+2 home share buildings*



*being built*

**1**

development  
in progress



**7**

supportive housing buildings  
*+1 supported seniors lodge*



**1**

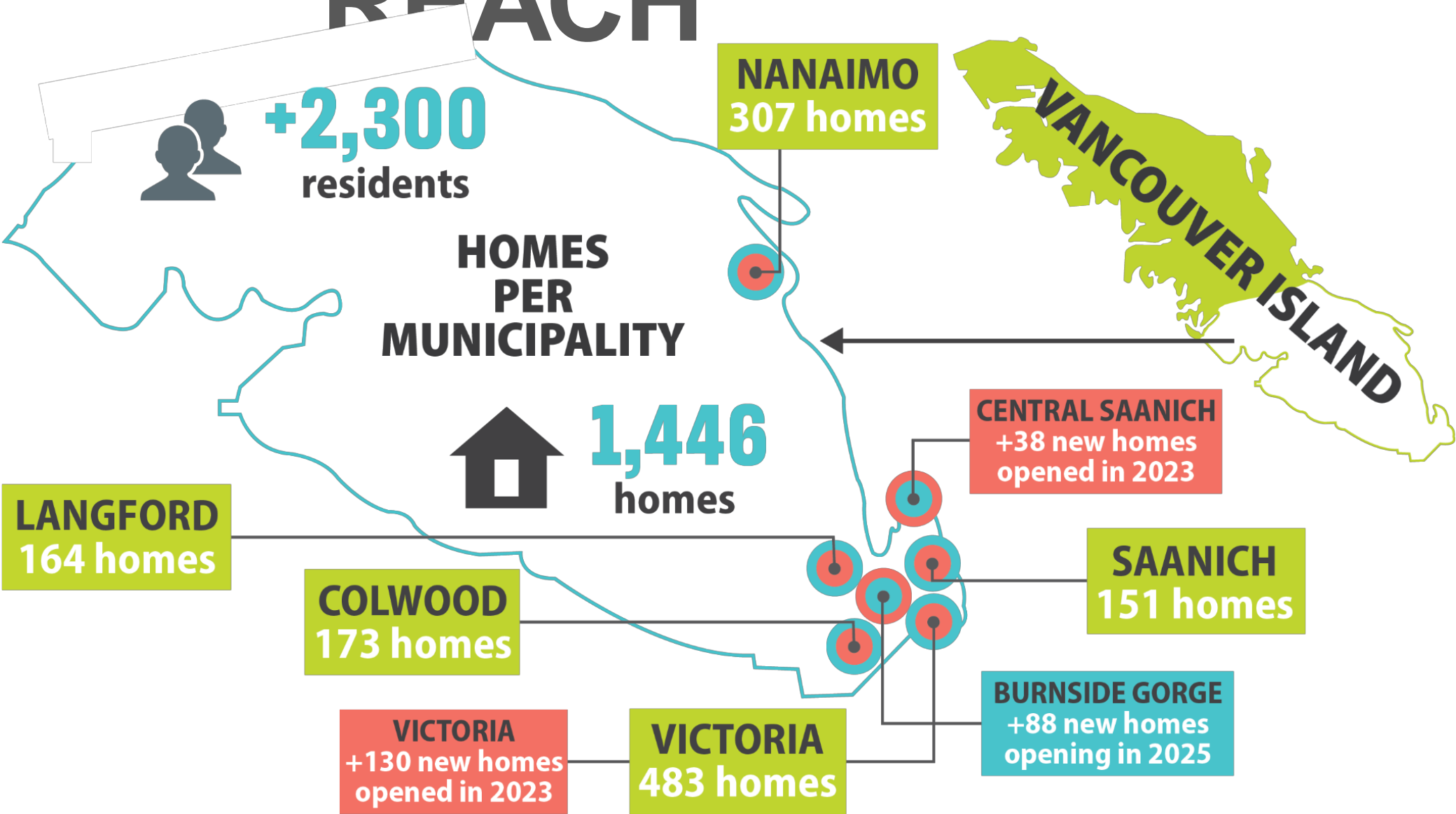
community services  
building (outreach)



**+160**

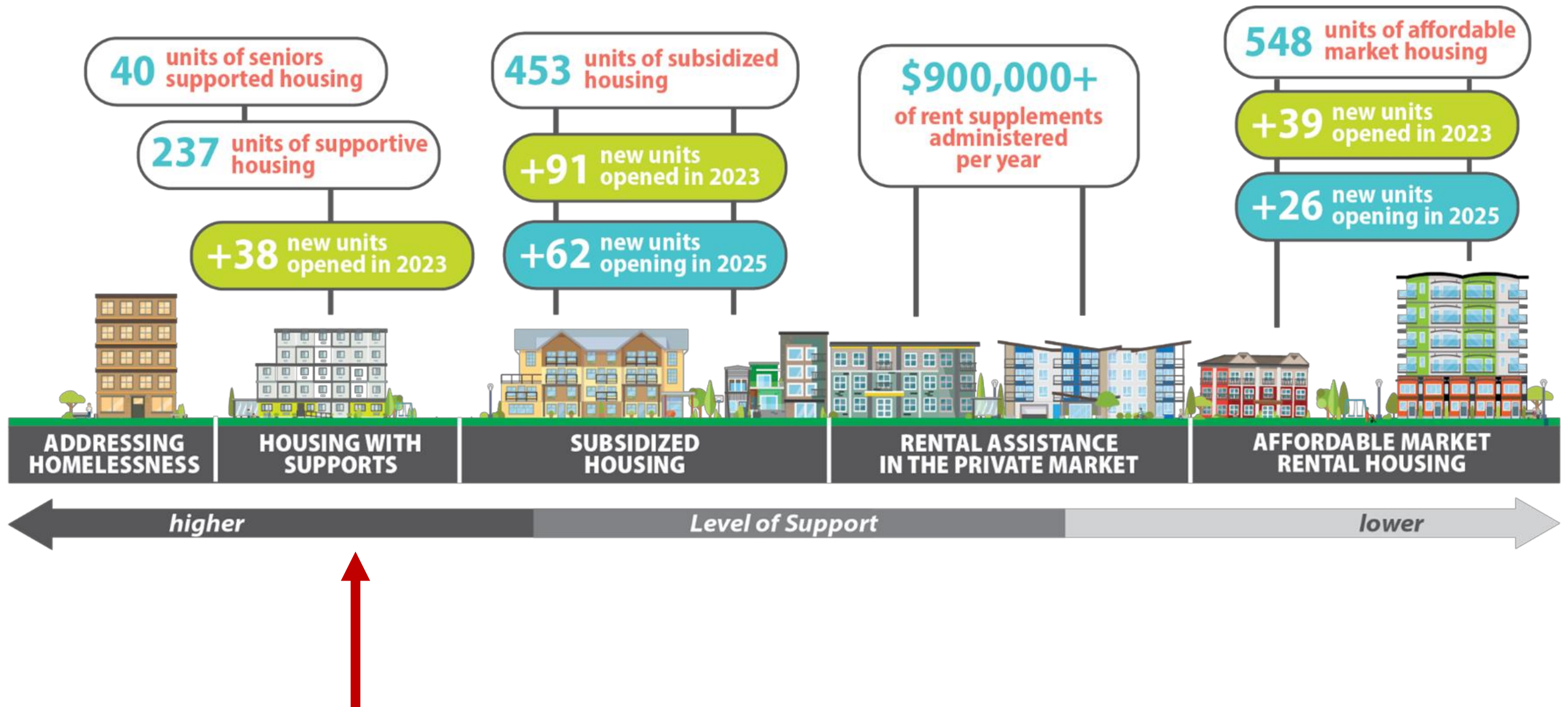
staff  
members

# PACIFICA HOUSING – OUR REACH



# PACIFICA HOUSING

*Equitable housing in pursuit of thriving communities*



## **Pragmatic Considerations**

- Housing a vulnerable population, mostly seniors (45+) with complex histories of trauma, mental and physical health challenges, and current and past addictions
- Some tenants not likely to handle disruption of renovation
- Smoking allowed in units
- Shelter rate rents with BC Housing / Island Health subsidy for operations and support services

## **Successes**

- Clean BC Funding of \$1.64 million (Provincial/Federal)
- BC Housing Capital Renewal Fund commitment
- Project almost to Tender
- Including unit interior renovations and likely also office/common space renovation

## **Pivots**

- Phased relocation → emptying whole building → phased relocation
  - Lack of supportive housing units
- Heat pumps for each unit (no gas fired hydronic heat boiler)
  - Wall-mounted (Innova/GlenAir) vs multi-split VRF vs mini-split
- R-40 roof to R28 (old) and R38 (new); avoiding structural upgrade
- R-30 walls to R26 (old) and R32 (new)
- Centralised hot water: CO2 heat pumps
- No ERVs
- Windows: U-1.2, SHGC-0.22, VT-0.51
- Increased budget to \$4 million ish (but includes unit renovations)





# Deep Building Retrofits: Searching for Synergies

## METRO VANCOUVER HOUSING

Ross Arbo

Housing Technician, Metro Vancouver Housing

ZEBx Decarb Lunch – March 8, 2024

Orbit Link: [add when archiving presentation to Orbit](#)

**metro**vancouver

metrovancover

# Crown Manor



Northeast elevation of Crown Manor

# CROWN MANOR-BACKGROUND

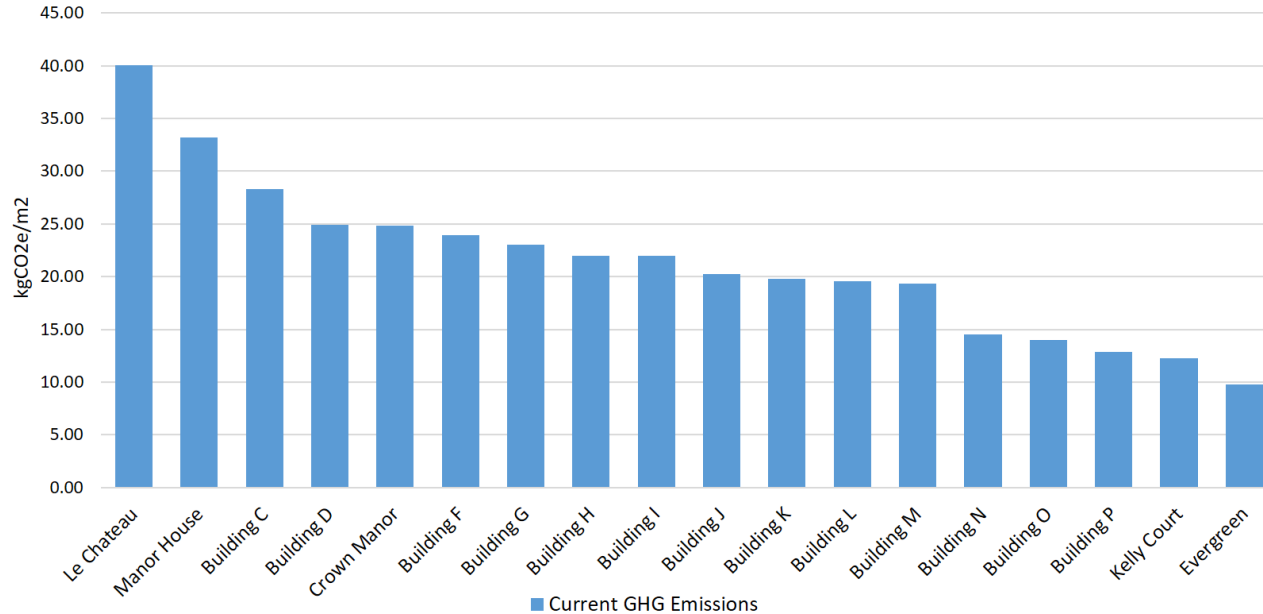
- Located in uptown New Westminster
- Originally constructed in 1964
- Surrounded by similar residential bldg's
- Four-level apartment, 2,050m<sup>2</sup>
- Contains 29 units
- Wood-frame construction
- Aluminum framed windows
- Natural gas DHW and hydronic heating
- Boiler replaced in 2016
- Low-slope roof replaced in 2010



# WHY REFRAMED? WHY CROWN MANOR?

## CURRENT BUILDING BENCHMARKING

MVH GHG Emissions Building Benchmarking



# PEMBINA REFRAMED BUNDLES FOR CROWN MANOR

The targets for consultants to meet were clear in the RFP Document:

- Bundle #1 – Reduce GHG 50% compared to existing building and 30% better than current code requirements
- Bundles #2, 3, & 4 – Reduce GHG 80% of existing while including other Reframed objectives (climate adaptation, seismic upgrades, reducing embodied carbon, improving tenant health/wellbeing, etc.)

# PEMBINA REFRAMED BUNDLES FOR CROWN MANOR

The bundles provided for Crown Manor were.....wanting:

- Bundle #1 - Focus on mechanical upgrades, no BE changes, reduced GHG 52% of existing & 39% of current code
- Bundle #2 – Focus on BE upgrades but retaining existing 95% efficiency gas boiler, reduced GHG 80% & 74% respectively
- Bundle #3 – Same as Bundle 2 but with new electric boiler, reduced GHG 94% & 93% respectively
- Bundle #4 – Same as Bundle 3 but with gas heat pump and fewer BE upgrades, reduced GHG 80% & 75% respectively

# OCCUPIED BUILDINGS

Crown Manor if fully occupied. Some of the suggested seismic and mechanical upgrades would result in extensive and intrusive in-suite work. The project team must understand that these are peoples homes.



Caption here

# SCHEMATIC DESIGN IS DONE, NOW WHAT?

Metro Vancouver's internal schedule:

- **September 2022** – Pembina Reframed complete
- **November 2022** – Negotiate with Consultant team to begin Detailed Design phase
- **March 2023** – Detailed Design complete
- **June 2023** – City approves building permit for project
- **July 2023** – Tender project to General Contractors
- **September 2023** – Contractor mobilizes on site & construction starts...



**NOT SO FAST.....**



Caption here

# OK GO!

**September 2023** – start detailed design

**March 2024** – apply for building permit

**April/May 2024** – Tender for construction

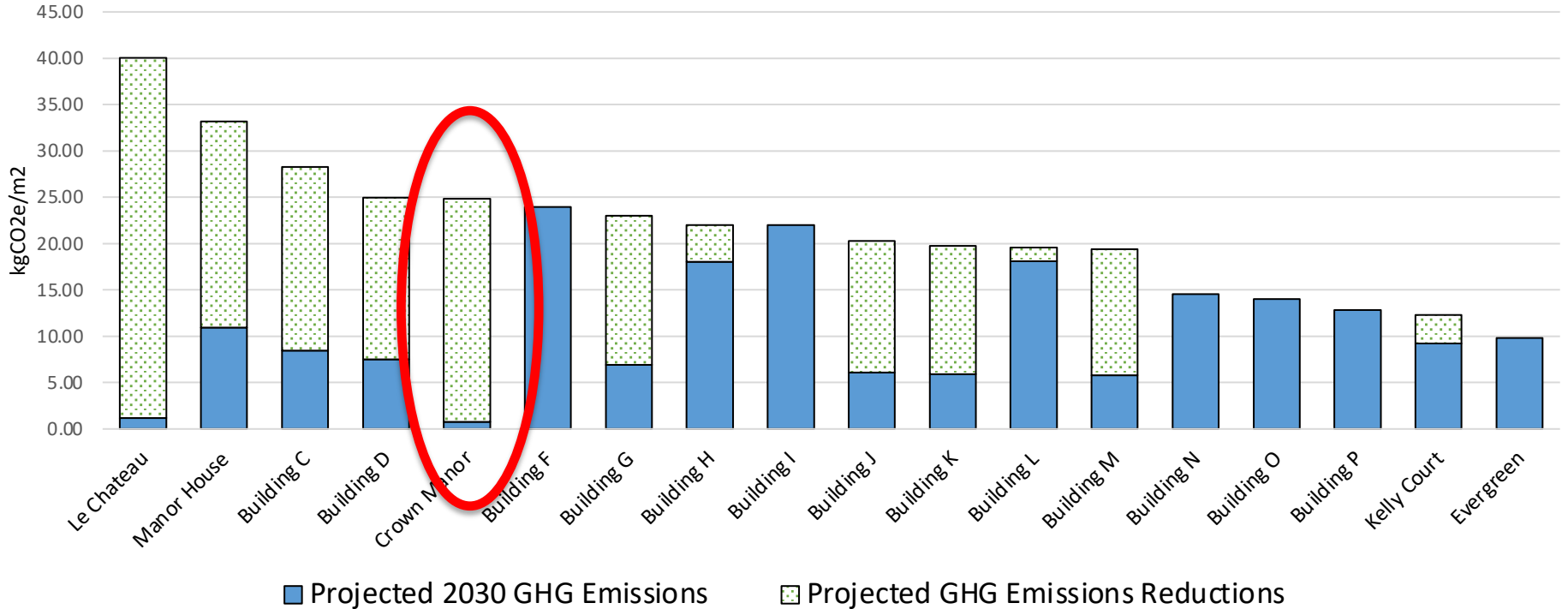
**June 2024** – Construction start



Caption here

# PROJECTED 2030 BUILDING BENCHMARKING

Projected 2030 MVHC Building GHG Emissions



# LESSONS LEARNED

## 2019 METRO VANCOUVER HOUSING 10-YEAR PLAN

### 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.

# THANK YOU!

We want to thank the following people/organizations;

- CleanBC for providing funding for the project!
- The Pembina Institute (Betsy Agar)
- BC Non Profit Housing Association (Ian Cullis)
- ZEBx for shining a light on this project



Questions?

**metrovancouver**  
Together we make our region strong

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