1

2

The Opportunity:
Prefabricated Exterior Energy Retrofits

Traditional deep energy retrofits are slow, expensive, disruptive and rare.

Can a standardized, industrialized, prefabricated approach enable a leap in deep energy retrofit?

NRCan's PEER R&D Project (2016-2022)

Goal: panelized building envelope retrofit solutions

Main research question:

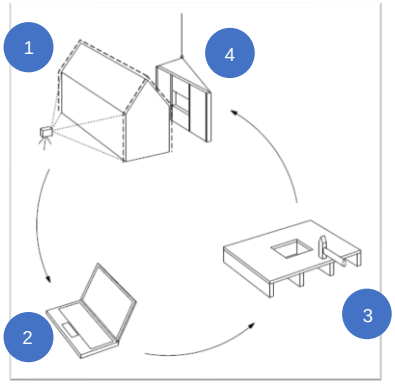
Can prefabrication enable faster, more cost effective and less disruptive deep retrofits?

R&D Activities:

1. Building capture guidance
2. Panel prototyping
3. Building science implications

2

What is a prefabricated retrofit?



1. Scanning or measuring building (building capture)
2. Panel design
3. Off-site fabrication
4. Panel installation

Ottawa Community Housing Pilot completed in 2021.

4 units, 3 bedrooms each
Built in 1960
7200$ in utilities annually
18 tons of CO2 emitted annually

4 units, 3 bedrooms each
Renewed in 2020
Net-Zero Energy annually
0 tons of CO2 emitted annually
Tenants in-suite during retrofit

3

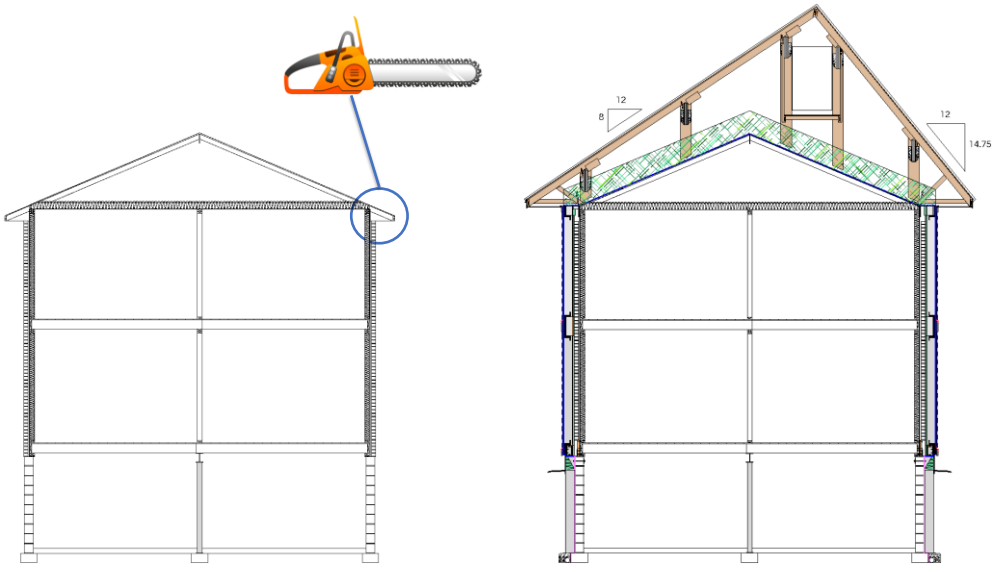
PEER Pilots

PEER Proof-of-Concept Pilot
Ottawa, ON
Units: 1
Net-Zero Ready
Completed 2017
Monitoring Ongoing

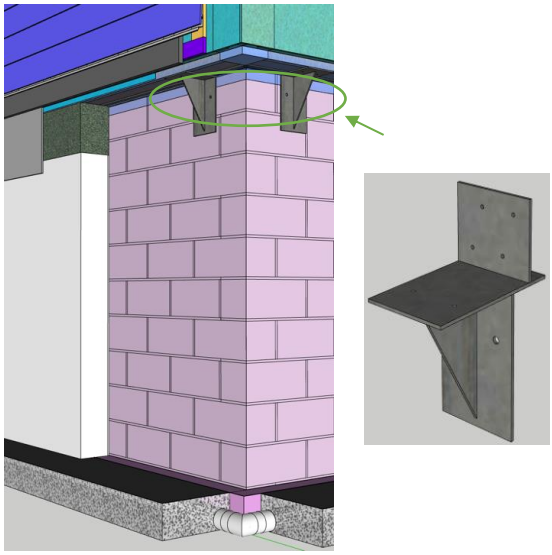
Sundance Housing Co-Op
Edmonton, AB
Units: 59
Net-Zero Ready
Construction Underway

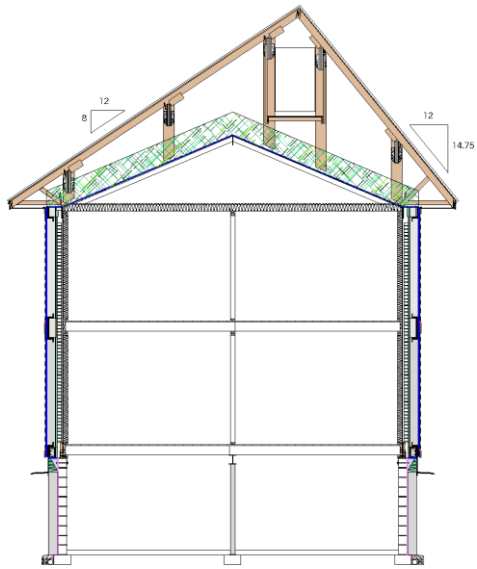
Ottawa Community Housing
Ottawa, ON
Units: 4
Net-Zero Energy
Construction Complete
Monitoring Underway

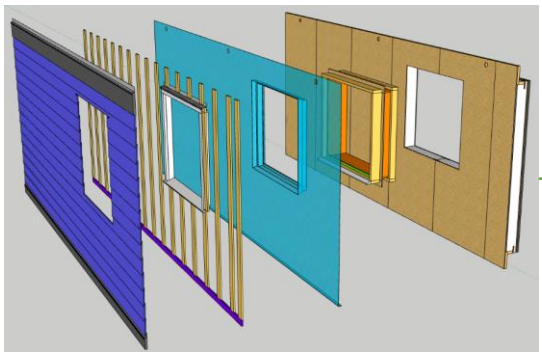
5

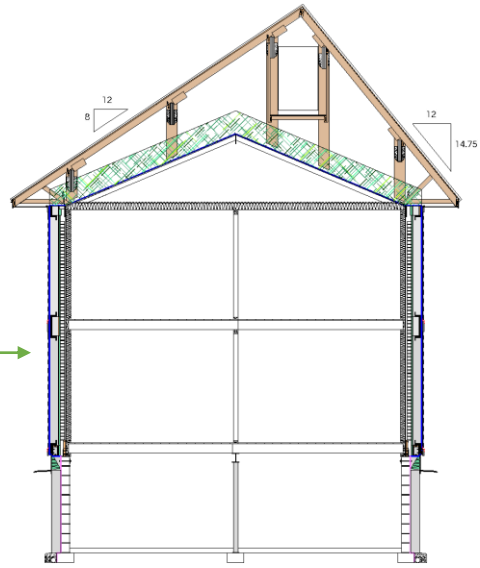


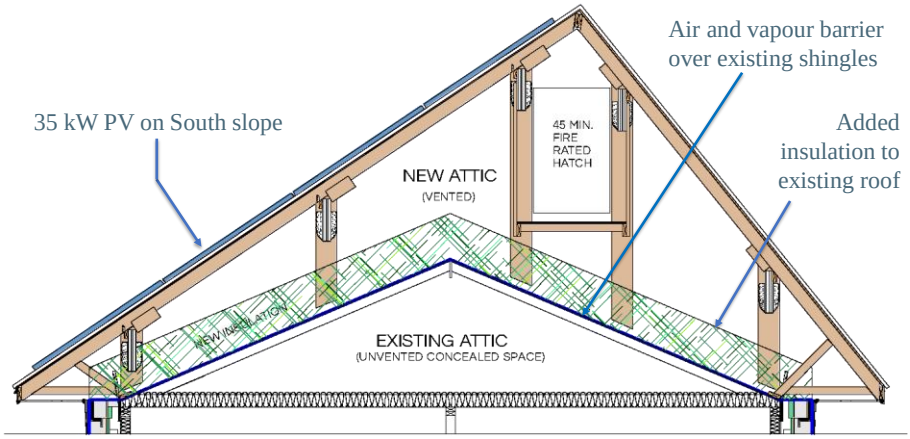
Before After




12
8
12
14.75



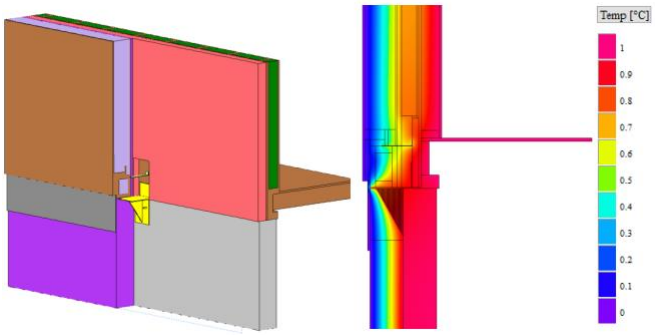

12
8
12
14.75



Thermal Bridging Analysis

Modelled in Heat 3

- Point Bridges: Chi (X) – values
  - 32 Brackets
- Linear Bridges: Psi (Ψ) – values
  - Vertical panel joint
  - Horizontal panel joint
  - Window installation
  - Base of wall transition
  - Top of wall transition



Chi Value: 0.05 W/K

26

Mechanical Upgrade

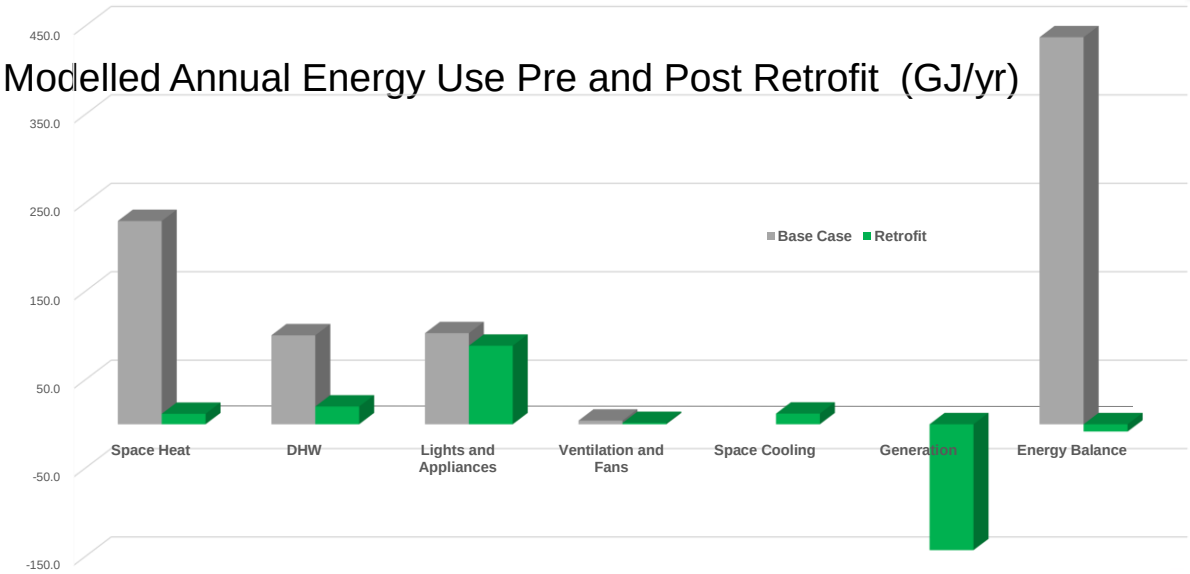
Natural Gas vs. Heat Pump & ERV

27

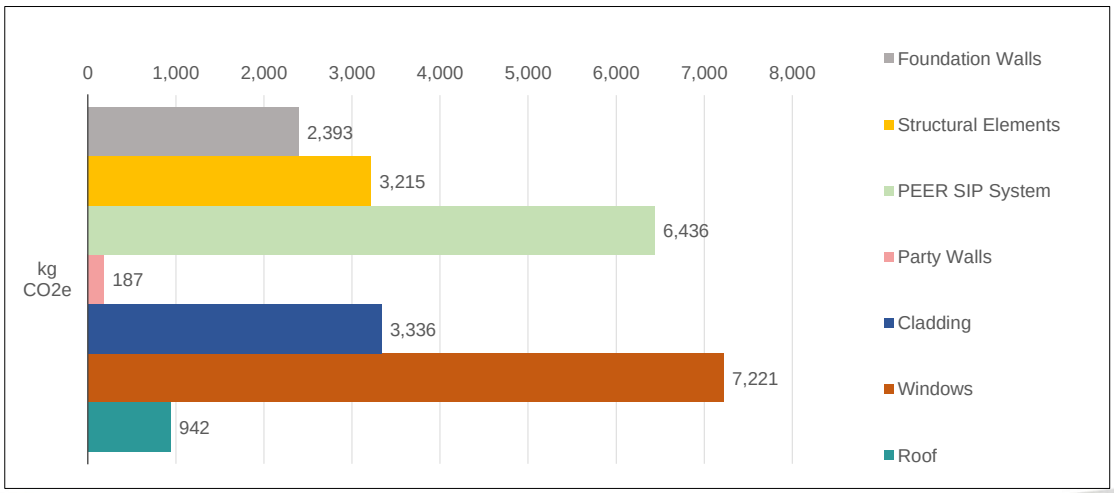
Electrical Upgrade

Type	Manufacturer	Model	Quantity
Module	Canadian Solar Inc.	CS1H-335MS (HiDM)	104
Inverter	SolarEdge Technologies Inc.	SE7600H-US	4

Modelled Annual Energy Use Pre and Post Retrofit (GJ/yr)



Material Carbon Emissions (kg CO_2e) *(as designed)*



Fabrication Facilities

OCH Panel Shop

- 32’ x 32’ x 12’ high
- Concrete Slab
- 2x20’ Container Storage
- 10’ x 18’ Rolling Table

Successes

- Panel fabrication
- Panel installation
- Below grade work
- Monitored performance

Challenges

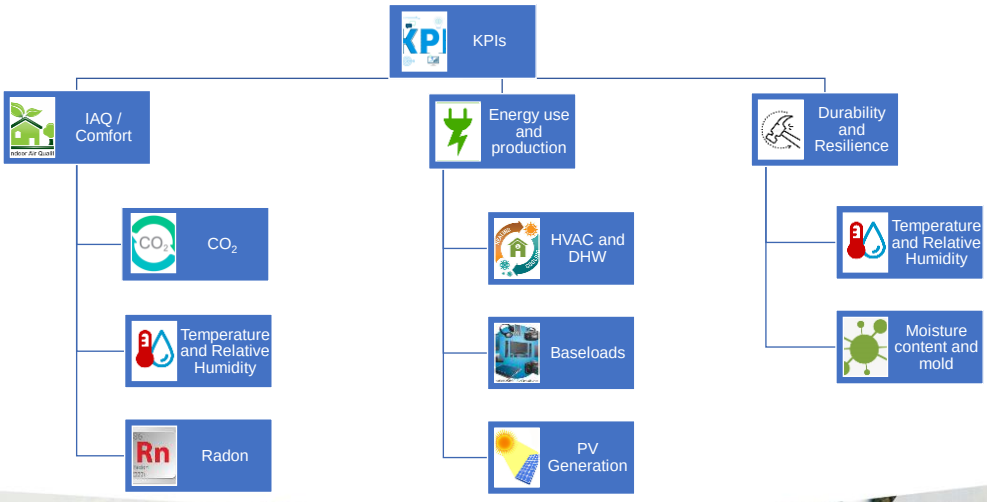
- Overall construction took much longer than planned
- Retaining the brick
- Windows installed on site
- Overroof design intent vs reality
- Airsealing

Costs

- Construction: ~$290k / unit
- Design: ~$37k / unit
- Capital (panel shop and telehandler): ~$38k / unit

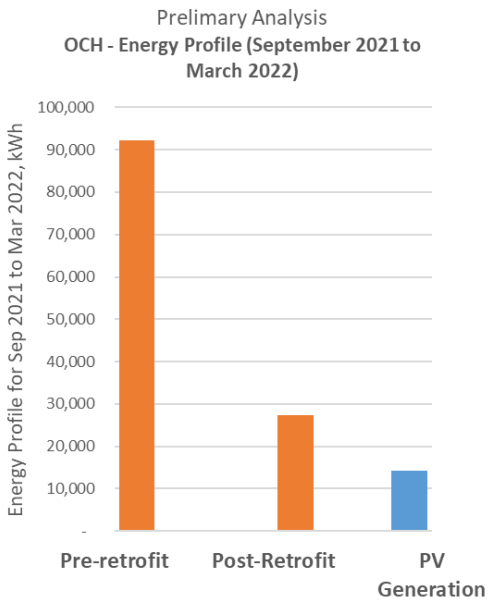
- Wall panel cost normalized: ~$90/ft2

Monitoring Plan: Key Performance Indicators



Preliminary Energy Analysis

September 2021 - March 2022



Energy savings to date:

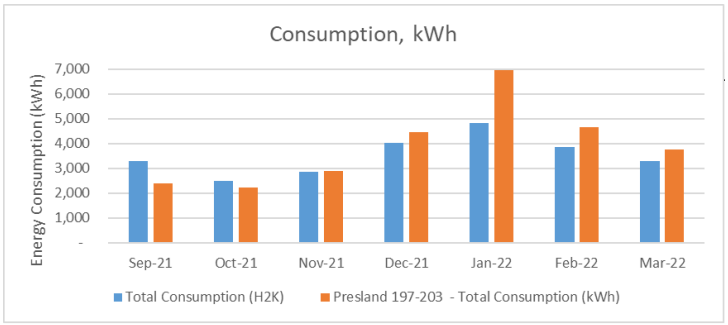
- Space heating reduction - **75%**
- Net energy use reduction - **86%**

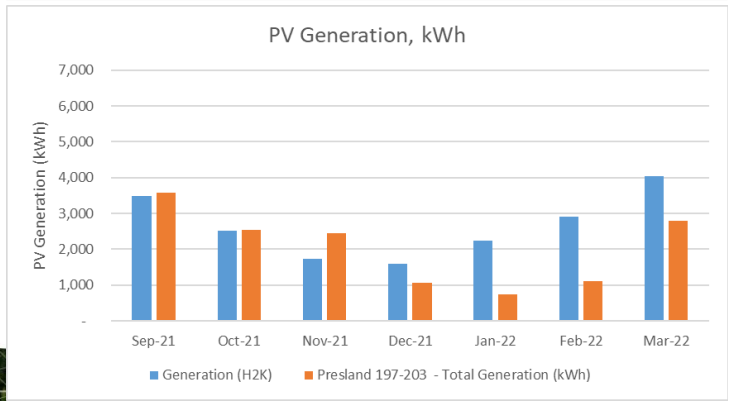
Discrepancies:

- *One heat pump not functioning as expected*
- *Social housing sees occupancy than typical*
- *Occupants still regularly using windows for ventilation*
- *Window installation deficiencies*

Preliminary Energy Analysis

September 2021 - March 2022





Modelled

Monitored

Notes:

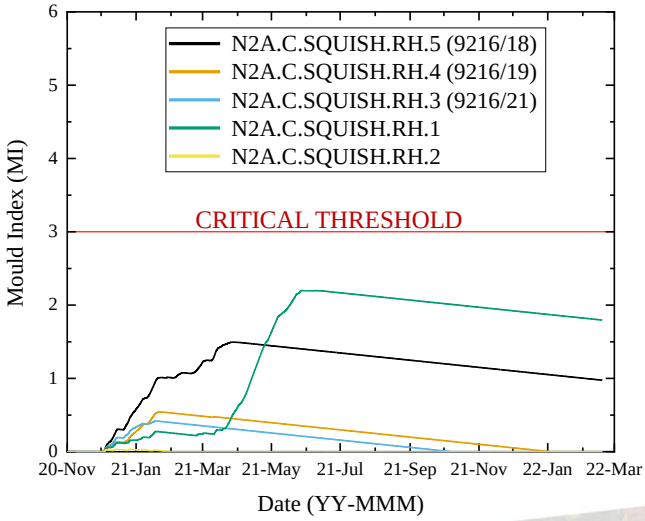
- cursory weather normalization for HOT2000 estimates
- 'as-is' energy consumption data

Durability Indicators

Mold Potential

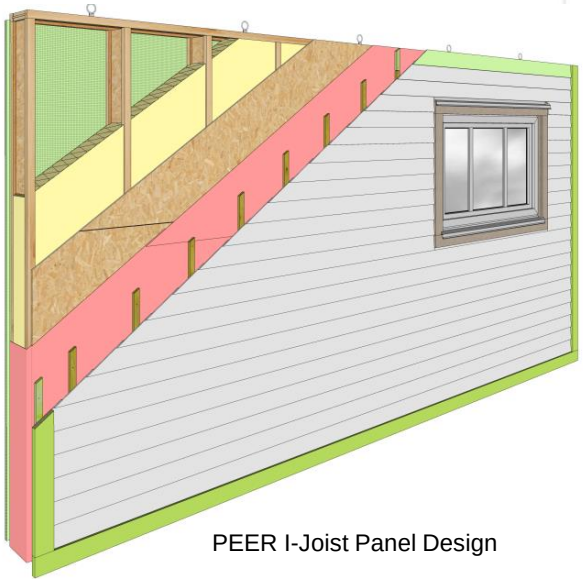
North Wall

- Mold Index:
  - relationship to predict mold growth potential for different materials
  - Range of values between [0,6] depending on growth coverage.
  - ASHRAE Standard establishes design threshold of 3 (visually detectable)
- Great trends to date
  - Increase during the initial period
  - But low RH and warmer T conditions have put the mold potential into decay



5 Panel Designs

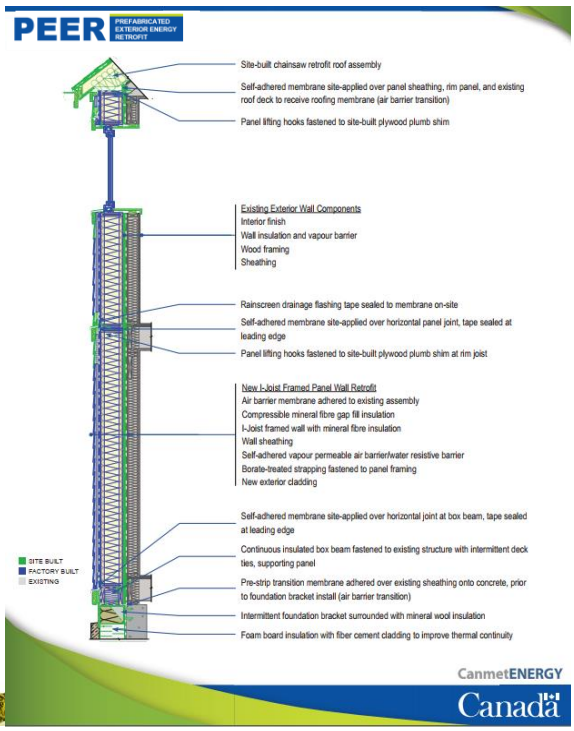
- SIPs / Nailbase
- Light woodframe standoff
- I-Joist framed
- EIFS



PEER I-Joist Panel Design

Panel Prototypes and Design Guide

- 5 panel prototypes developed to date
- Design Guide in development
  - Building capture
  - Design
  - Fabrication
  - Installation
  - Project delivery



Future outlook and Opportunities

- Low carbon panel designs and testing
- Adapt process and panel designs for MURBs / Commercial
- Design tools to streamline Scan to BIM to shop drawings
- Construction and fabrication methods and tech transfer
- Labelling / certification

Thanks!

For more info, please visit:

- nrcan.gc.ca/energy/efficiency/data-research-and-insights-energy-efficiency/housing-innovation/peer-prefabricated-exterior-energy-retrofit/19406

Mark Carver, CanmetENERGY Mark.Carver@Canada.ca

Special thanks to:
Dan Dicaire and Keith Gagnier, Ottawa Community Housing
Jeff Armstrong, Cold Climate Building
Peter Amerongen, Butterwick Construction
Graham Finch and Daniel Calero, RDH