

TOWARDS NET ZERO RENOS

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CASE STUDY



Single detached home achieved Net Zero Ready performance. The reno includes comprehensive envelope improvements, mechanical system upgrades, and solar readiness to significantly enhance efficiency, comfort, durability, and long term operational performance. Resiliency features were also included.

PROJECT PRIORITIES

- Improve efficiency & reliability
- Fire & gird instability resilience
- Demonstrate Alberta NZ affordability
- Improve indoor air-quality
- Improve airtightness, enhance comfort
- Modernize mechanicals & prep for solar

RENOVATOR: Robert Klassen - Livingstone Eco Homes

ENERGY ADVISOR/SERVICE ORGANIZATION: Sol Invictus Energy Services/ Homesol Building Solutions

TARGET: Net Zero Ready Home Renovation

ENERGY REDUCTION: 74.1%

YEAR BUILT: 1972

YEAR RETROFIT COMPLETED: 2025

LOCATION: Crowsnest Pass, Alberta

HOUSE TYPE: Single Detached

SIZE: 1849 sq.ft.

CLIMATE: Zone 7a, 5124 HDD

UPGRADES INCLUDE

Exterior Insulation (2" GPS)

Exterior Insulation on Foundation Wall

Triple Pane Low E Windows

Energy Monitor & Service Upgrade

Slab insulation

Air Source Heat Pump Domestic Water Heater

High Efficiency Gas Furnace

Aerobarrier Air-Sealing

Air-Source Heat Pump & Gas Furnace

Heat Recovery Ventilation

Prepared for Secondary Suite

Critical Load Panels & Generator Ready

Attic Insulation Upgrade

On-site Generation (Roughed In)

Prepared for Future Electrification

Radon Mitigation System



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NET ZERO PLAN

	BEFORE	AFTER
ENERGY CONSUMPTION	163 GJ/year	42 GJ/year
COMFORT	Inconsistent temp's due to drafts, aging furnace, and no cooling. Comfort impacted by outside temps	Internal temp's are more consistent. House is quieter as well.
BUILDING CONDITION	1972 single-story with light wood frame. Aging mechanical systems, very leaky (8.51 ACH).	Insulation added (attic, main walls, foundation & slab). Extensive Air-sealing Triple pane windows. 1.16 ACH.
RENEWABLES	None	None
WALL INSULATION	2x4/R12B/16"OC/HardB	2x4/R12/2.13"GPS/FCB
CEILING INSULATION	2x4/R24B/24"OC-1	R24B/13"BlCell/24OC
FOUNDATION INSULATION	R8	R19 (54%), R19 (24%), R20 (22%)
WINDOWS	D/C/9/M/P/W (U-val=2.89, SHGC=0.66)	Tr2U.91S.18H
VENTILATION	None	65.0% SRE HRV
HEATING	80.0% furnace	3.67 COP air source heat pump, 96.0% afue furnace backup, ENERGY STAR® certified
COOLING	None	3.41 COP air source heat pump
HEAT LOSS & GAIN	HL: 53581 Btu/h, HG: 20232 Btu/h	HL: 18566 Btu/h, HG: 13089 Btu/h
HOT WATER	0.55 EF natural gas conventional tank (pilot)	3.9 UEF heat pump water heater
ELECTRICAL PANEL SIZE	100 A	150 A



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ANNUAL ENERGY USE

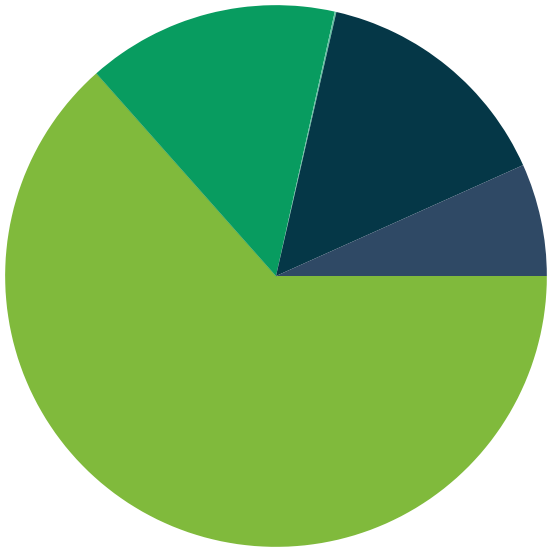
Before Retrofit
163 GJ/ year

Typical New Home
98 GJ/ year

After Retrofit
42 GJ/ year

ENERGY CONSUMPTION BREAKDOWN

BEFORE RENOVATION



AFTER RENOVATION



- Space Heating
- Other Electrical
- Water Heating
- Light and appliances
- Ventilation
- Space Cooling

AS BUILT ENERGY PERFORMANCE

ANNUAL ENERGY SAVINGS	74.1%
GREENHOUSE GAS SAVINGS	-5.42 Tonnes
ESTIMATED COST SAVINGS	$483.78/y

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WHY ARE WE RETROFITTING OUR HOME?

This 1970s home is being retrofitted to improve comfort, energy efficiency and reach Net Zero Ready. Work was done while occupied, adding some complexity. Upgrades include exterior insulation, new attic insulation, better airtightness, new windows and doors, a hybrid heat pump, HRV, radon system and solar readiness. The approach focuses on low cost, repeatable measures suited to rural Alberta homes. Special focus on affordability & repeatability.

WHAT LESSONS DID WE LEARN?

This project showed that pairing a deep energy retrofit with a major renovation boosts resiliency and long term affordability. The upstairs remained intact, allowing air sealing, mechanical reconfiguration and solar ready electrical work on the exterior & basement. A whole home approach, right sized heat pump with backup furnace, improved electrical service and solar readiness created a more efficient, reliable and future ready home.

WHAT ELSE NEEDS TO BE DONE TO GET TO NET ZERO?

We need to Install electric backup for the heat pump. Additional wiring has already been completed in preparation. Gas can then be disconnected from the furnace at a later date. The furnace can still act as the air-handler in conjunction with the HRV to ensure that filtered air is circulated. A a solar system just over 12 kW will provide enough energy to offset electrical consumption.



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PHOTO GALLERY - BEFORE











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PHOTO GALLERY - DURING











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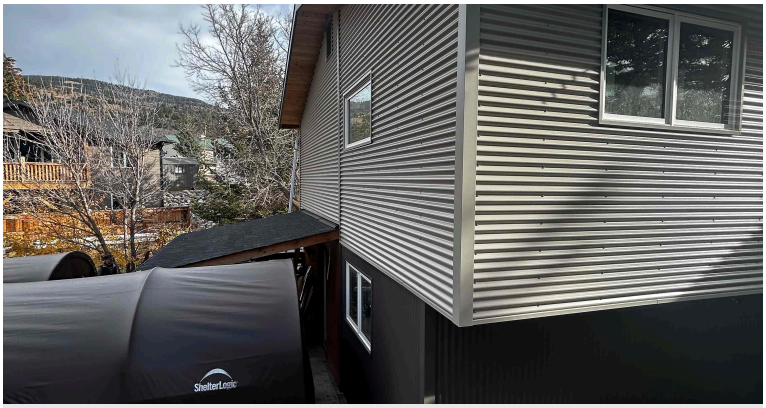
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PHOTO GALLERY - AFTER



HRV, Heat Pump DHW





Exterior Elevation (Side & Rear)



Exterior Elevation (Front)



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TECHNICAL DETAIL 1





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TECHNICAL DETAIL 2



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TECHNICAL DETAIL 3





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TECHNICAL DETAIL 4

Exterior wall

Thermal protection

U = 0,25 W/(m²K)

EnEV Bestand*: U<0,24 W/(m²K)

excellent — insufficient

Moisture proofing

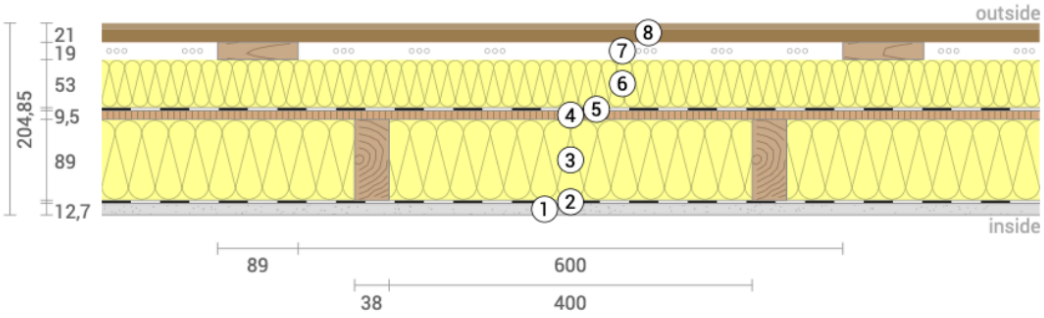
Drying reserve: 178 g/m²a
No condensate

excellent — insufficient

Heat protection

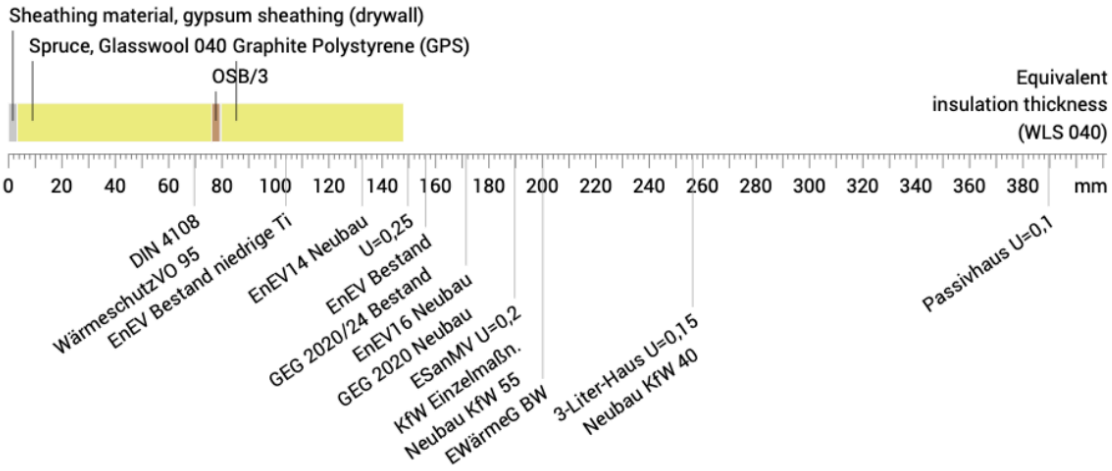
Temperature amplitude damping: 4,5
phase shift: 7,4 h
Thermal capacity inside: 19,6 kJ/m²K

excellent — insufficient



1. Sheathing material, gypsum sheathing (12,7 mm)
2. Polyethylene, high density
3. Glasswool 040 (89 mm)
4. OSB/3 (9,5 mm)
5. pro clima SOLITEX MENTO® 3000
6. Graphite Polystyrene (53 mm)
7. Rear ventilated level (19 mm)
8. Tongue and groove siding (21 mm)

Impact of each layer and comparison to reference values



Wall Assembly Analysis