



TOWARDS NET ZERO RENOS



CASE STUDY



This is a 1970's bungalow in SW Ontario. The homeowners are very concerned with greenhouse gas emissions so have already installed solar panels and own electric cars. They would like to do more, but are concerned with air quality (mould) growing in the house and cold spots.

PROJECT PRIORITIES

- Air Quality
- Reducing Greenhouse Gas Emissions
- Comfort

RENOVATOR: Mechanicals done by Waterloo Energy

ENERGY ADVISOR/SERVICE ORGANIZATION: Toby Smith - Building Knowledge, John Vanderhiede - EnergyWerx

TARGET: Net Zero Home Renovation

ENERGY REDUCTION: 81.8%

YEAR BUILT: 1970

YEAR RETROFIT COMPLETED: 2018-2025

LOCATION: Guelph, Ontario

HOUSE TYPE: Single Detached

SIZE: 2695 sq.ft.

CLIMATE: Zone 5, 3449 HDD

UPGRADES INCLUDE

Cathedral / Vault / Flat Ceiling

Above Grade Walls / Garage Wall

Ceiling with Attic Space

Energy Use Monitoring System

Airtightness

Domestic Water Heater

Cooling & Heat Pumps

Removed Gas Fireplace

Replaced Gas Stove with Induction



TOWARDS NET ZERO RENOS



NET ZERO PLAN

BEFORE

ENERGY CONSUMPTION

74 GJ/year

COMFORT

Most of the house was cold, sometimes ice on windows. ACH50 = 3.4

BUILDING CONDITION

Had high radon levels, and mould growth. It's cold and damp in the house. They have no A/C.

RENEWABLES

None

WALL INSULATION

R10 batt

CEILING INSULATION

R51 blown cellulose

FOUNDATION INSULATION

R24 (46%), R11 (44%), R10 (5%), R0 (5%)

WINDOWS

Double glazed (U-val=1.67, SHGC=0.59)

VENTILATION

81.0% SRE HRV

HEATING

95.0% AFUE furnace, ENERGY STAR® certified

COOLING

None

HEAT LOSS & GAIN

HL: 45252 Btu/h, HG: 25170 Btu/h

HOT WATER

0.61 EF natural gas conventional tank (pilot)

AFTER

13 GJ/year

Basement, kitchen, dining room, bedroom, living room are all much more comfortable. ACH=3.8

Ductwork was fixed incl. disconnected duct. HP is being used and can now dehumidify too.

No Change

R5.19/in medium density spray foam + 3" EPS II

R70 Blown Cellulose

R24 (46%), R11 (44%), R10 (10%)

No change

No Change

Panasonic Cold Climate 4 Ton Central Heat Pump HSPF2 7.7

Panasonic Central Heat Pump SEER2 15.6

HL: 23543 Btu/h, HG: 15047 Btu/h

3.7 EF heat pump water heater



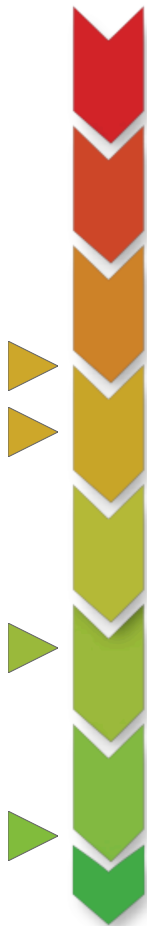
TOWARDS NET ZERO RENOS

ANNUAL ENERGY USE

Before Retrofit
114 GJ/
year
Typical New Home
98 GJ/
year

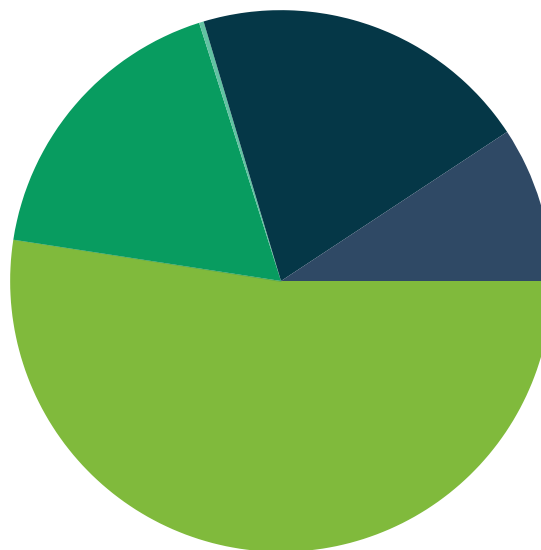
After Retrofit
54 GJ/
year

PV Production
13 GJ/
year



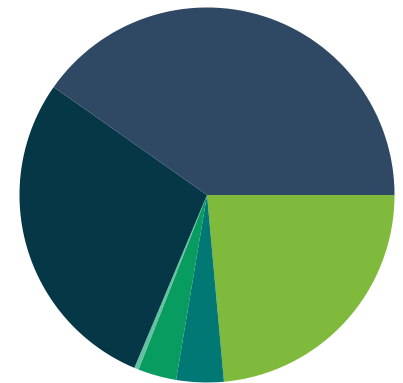
ENERGY CONSUMPTION BREAKDOWN

BEFORE RENOVATION



Space Heating
Other Electrical
Water Heating

AFTER RENOVATION



Light and appliances
Ventilation
Space Cooling

AS BUILT ENERGY PERFORMANCE

ANNUAL ENERGY SAVINGS	81.8%
GREENHOUSE GAS SAVINGS	4.40 Tonnes
ESTIMATED COST SAVINGS	\$113.60/y



TOWARDS NET ZERO RENOS



WHY ARE WE RETROFITTING OUR HOME?

The homeowners want the home to be more comfortable, quieter, and to change conditions for mould growth. Ultimately they want great indoor air quality and as low as possible greenhouse gas emissions. They decided to fix their ductwork, install a heat pump, and continue insulating the basement, cathedral ceiling, and main floor walls.

WHAT LESSONS DID WE LEARN?

A disconnected duct was found leading to about 1/3 of the house so heating and ventilation air was not being delivered. Dampers were closed shut, and the main trunk was increased in size and all ducts sealed. The kitchen and dining room is now much warmer (and cooler in the summer), the bedroom is much more comfortable as a result of the duct improvements. It's hard to find a contractor to do the small jobs.

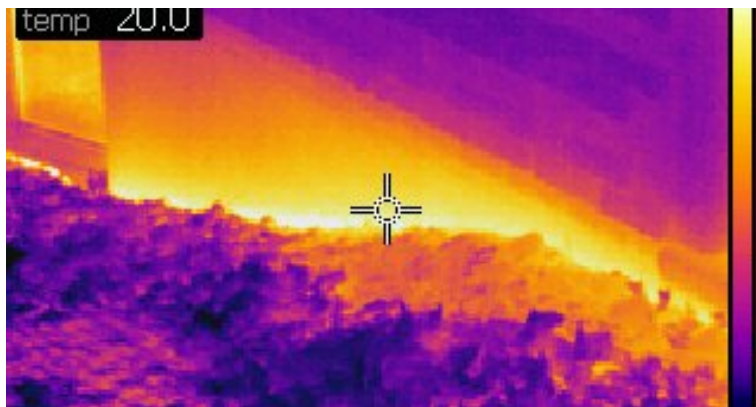
WHAT ELSE NEEDS TO BE DONE TO GET TO NET ZERO?

Wall insulation and windows are being considered, but expensive and difficult to upgrade the brick walls. They are being retrofitted as the rooms are updated. Enclosing the front porch as a solarium is being considered. Additional solar is needed to get the house to Net Zero.



TOWARDS NET ZERO RENOS

PHOTO GALLERY - BEFORE



Heat loss through the basement was high



The front door and ceiling heat loss was high



Customer already had soil gas extraction fan.



TOWARDS NET ZERO RENOS



PHOTO GALLERY - DURING



Measuring duct leakage - results inconclusive with this method.



Checking supply duct flow of all registers to estimate leakage.



Insulation was added to the cathedral ceiling

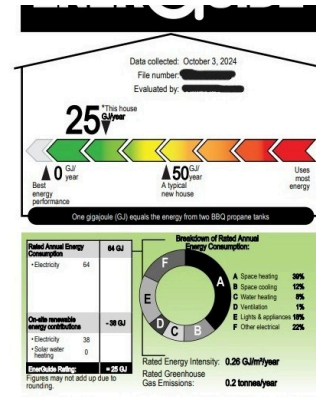


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PHOTO GALLERY - AFTER



The new air source heat pump



Almost at Net Zero energy!



TOWARDS NET ZERO RENOS

TECHNICAL DETAIL 1

701 Maple Duct Flow Measurements

23-Feb-23

Acin Flowfinder

Room	Flow (cfm)	Notes
living room by patio door	39	
living room under window	17	
front entrance right (south)	39	
front entrance left (north)	12	
back bedroom	17	
main bath	35	
front bedroom	67	
basement office right	45	
basement office middle	37	
basement office left	43	
basement bath	35	
basement bedroom ceiling	77	
basement utility back ceiling	57	
basement utility middle ceiling	9	
basement utility fron low	16	
kitchen	36.3	not possible, assumed average
dining	36.3	not possible, assumed average
basement bedroom low wall	36.3	not measured, assumed average
TOTAL MEASURED	545	
TOTAL INCLUDING ESTIMATED	653.9	

TOTAL SYSTEM AIR FLOW (TRUE FLOW)	824
Lost air flow (cfm)	170.1
Duct Leakage (%)	21% AVERAGE FOR NEW HOMES, GOOD FOR EXISTING

Duct flow summary. Flow through the furnace = 824cfm, registers=654, = 21% leakage.



TOWARDS NET ZERO RENOS



TECHNICAL DETAIL 2



Date tested: 2024-02-23
2024-02-23 1:53:0...
Company info
Name: Building Knowledge Canada
Phone: 5196586232
Email: info@buildingknowledge.ca

Tech info
Name:
ID: N/A
Title: HVAC Technical Coordinator
Credentials: RASDT, BCIN

True Flow System Air Flow and Static Pressure Analysis

Air measurements

Total air flow = 824 CFM
Return duct = -0.115 inH₂O
After filter = -0.313 inH₂O
Supply duct = 0.080 inH₂O

System & conditions

System Type: Electric
Orientation: Upflow
Cooling Capacity: 2
Filter Location: InDuct
Cooling Climate Type: Moist
Elevation: 1068 ft

Summary calculations



Flow		412 CFM/ton
TESP		0.393 inH ₂ O
Return Plenum		0.115 inH ₂ O
Filter Drop		0.198 inH ₂ O
Supply Plenum		0.080 inH ₂ O

Summary of Warnings

No warnings.