Retrofit – the future depends on it

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UNIVERSITY OF ALASKA FAIRBANKS

International Arctic Research Center

Attic:

R 60 polyurethane
+ fiberglass

2x4 walls:

R 11 fiberglass,
6mil VB

Original 2 pane windows

Cathedral ceiling roof:

R 11 cold roof, fiberglass batts, some foam

Cantilever:

R 40 polyurethane

House characteristics

- Built: 1978
- Location: near Campbell Tract
- Living space: 1,351 sqft, Garage: 257 sqft
- S-facing windows: 0
- Window / wall: 10%
- Energy Rating: 4 Star + (84.1 points)
- Air leakage: 79 sqin (1,562 CFM @ 50Pa)
- Heat: Natural gas boiler, baseboard heat, no ducting
- Electricity: 8.4kW solar array (>½ energy for home and vehicle)

AIR SEALING & VENTILATION

- ✓ Taped vapor-open air-barrier outside of old T1-11 siding
- ✓ Decentralized heat recovery ventilation system

INSULATION

- ✓ Cathedral Roof: >7” polyurethane with 1.5” gap
- ✓ Walls: + R 24 of vapor-open insulation

towards net zero

WINDOWS & DOORS

- ✓ Triple pane for opening windows, U=0.16
- ✓ R14 insulating glass units, U=0.058
- ✓ Codel 100% fiberglass doors, triple lock

HEATING

- ✓ 3 tons soapstone masonry heater
- ✓ ~3 cords firewood/year

Cathedral ceiling roof

7”
polyurethane

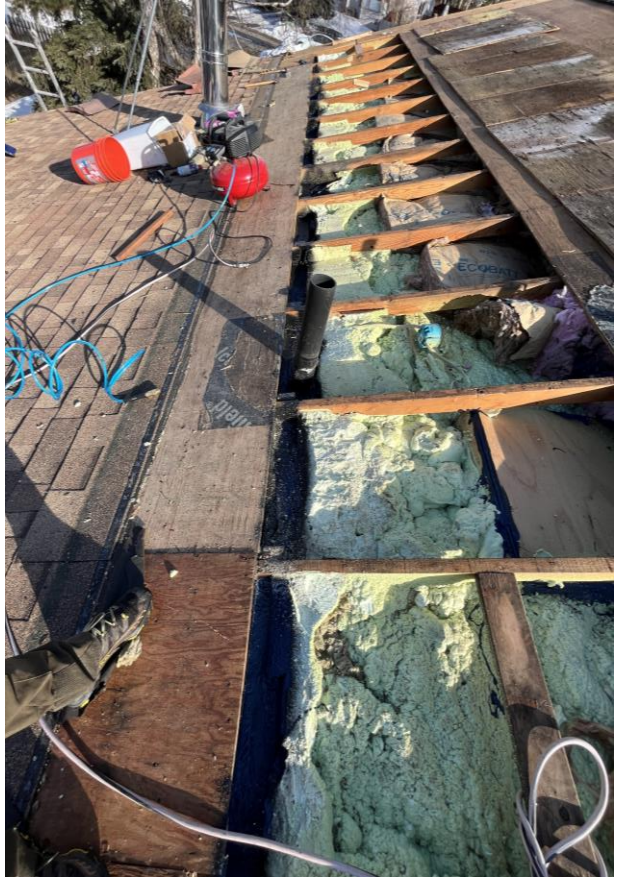
1.5”
air gap

2 years later

DON’T forget

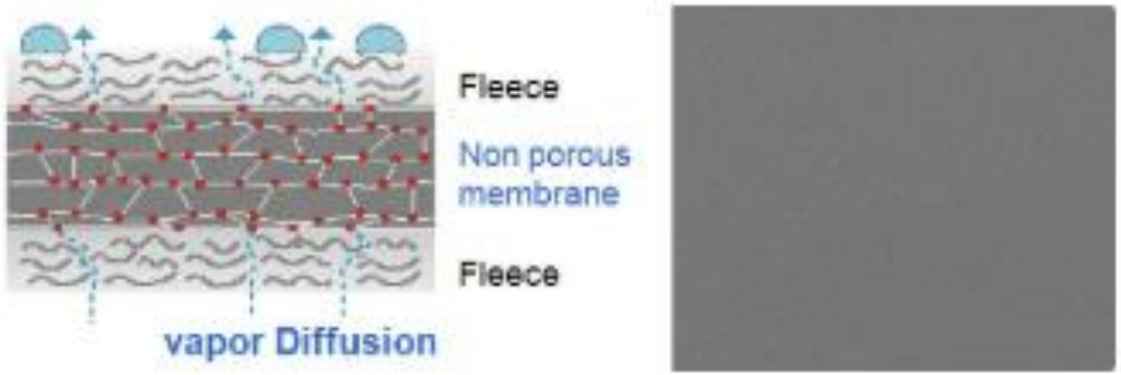
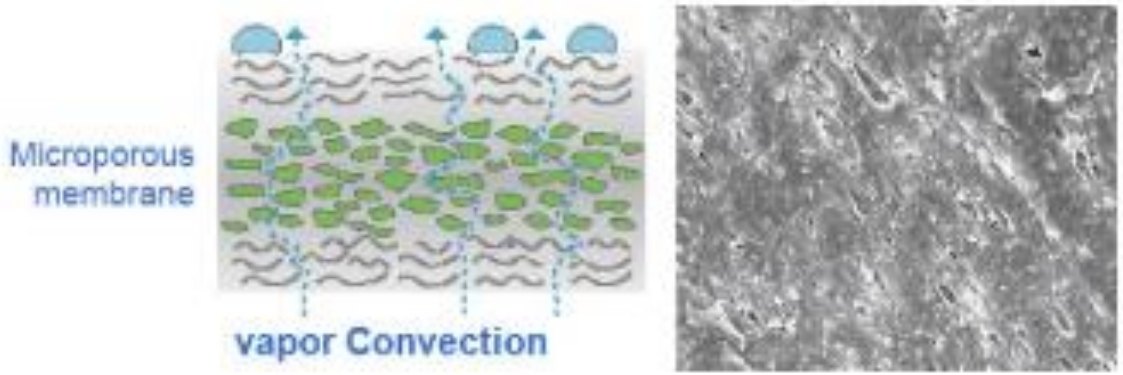
TOP PLATE

air sealing
&
insulating



Air sealing

top plate

Thermoplastic Elastomer Ether Ester (TEEE) membrane	Conventional Water-resistive barrier (Tyvek)
Actively vapor open Diffusion driven Non-porous	Vapor open Convection driven Porous
 microscope view	 microscope view

Permeability:	38 perms
Waterproofness:	33ft column
Airtightness:	0.00004 cfm/sqft
Layers:	3 (less prone to tearing)

Permeability:	54 perms
Waterproofness:	1ft column
Airtightness:	0.004 cfm/sqft
Layers:	1

Source: 475 Building Supply

Air sealing

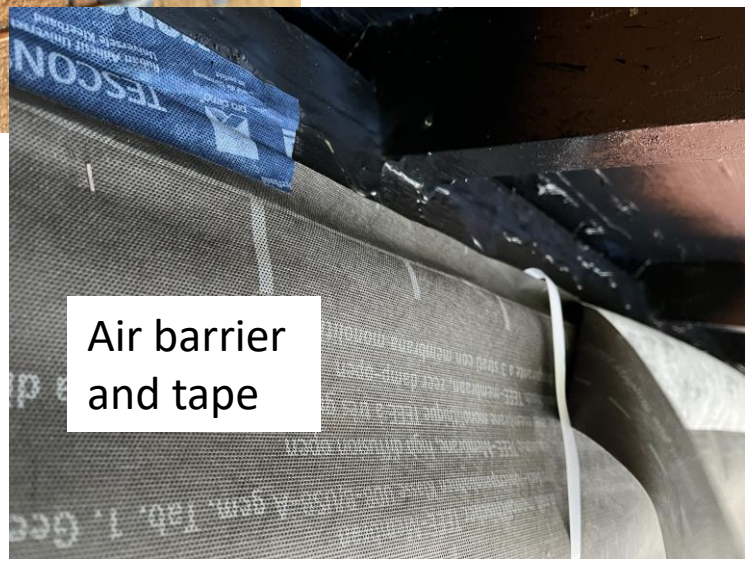
soffit vents

top plates

Step 1

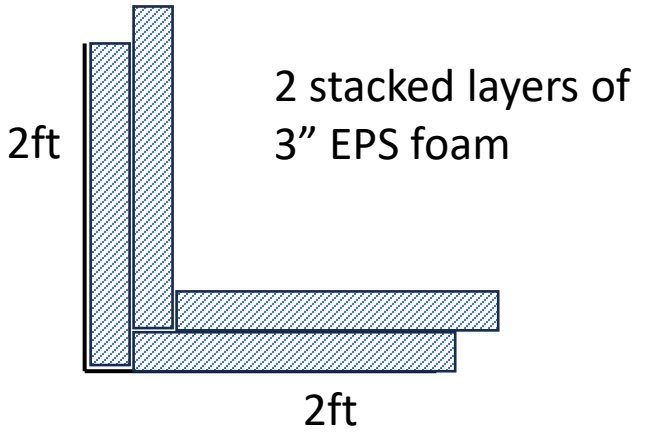
Step 2

Step 3



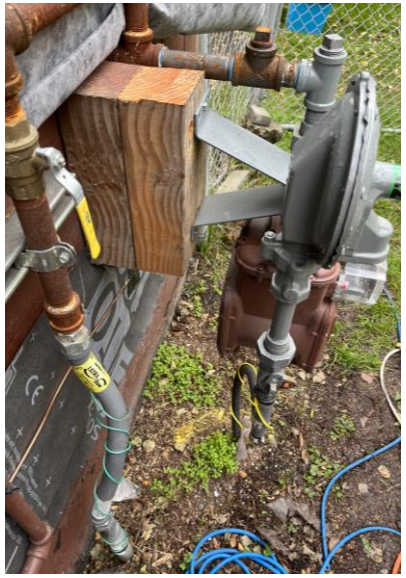
Insulation

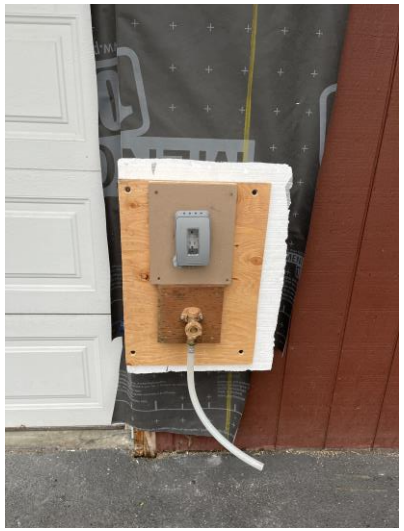
frost protection below grade



Insulation

moving wall penetrations





Electric service upgrade
- 200 Amp
- wiring to 8.4kW solar array

REMOTE WALL

COLD CLIMATE
HOUSING RESEARCH CENTER

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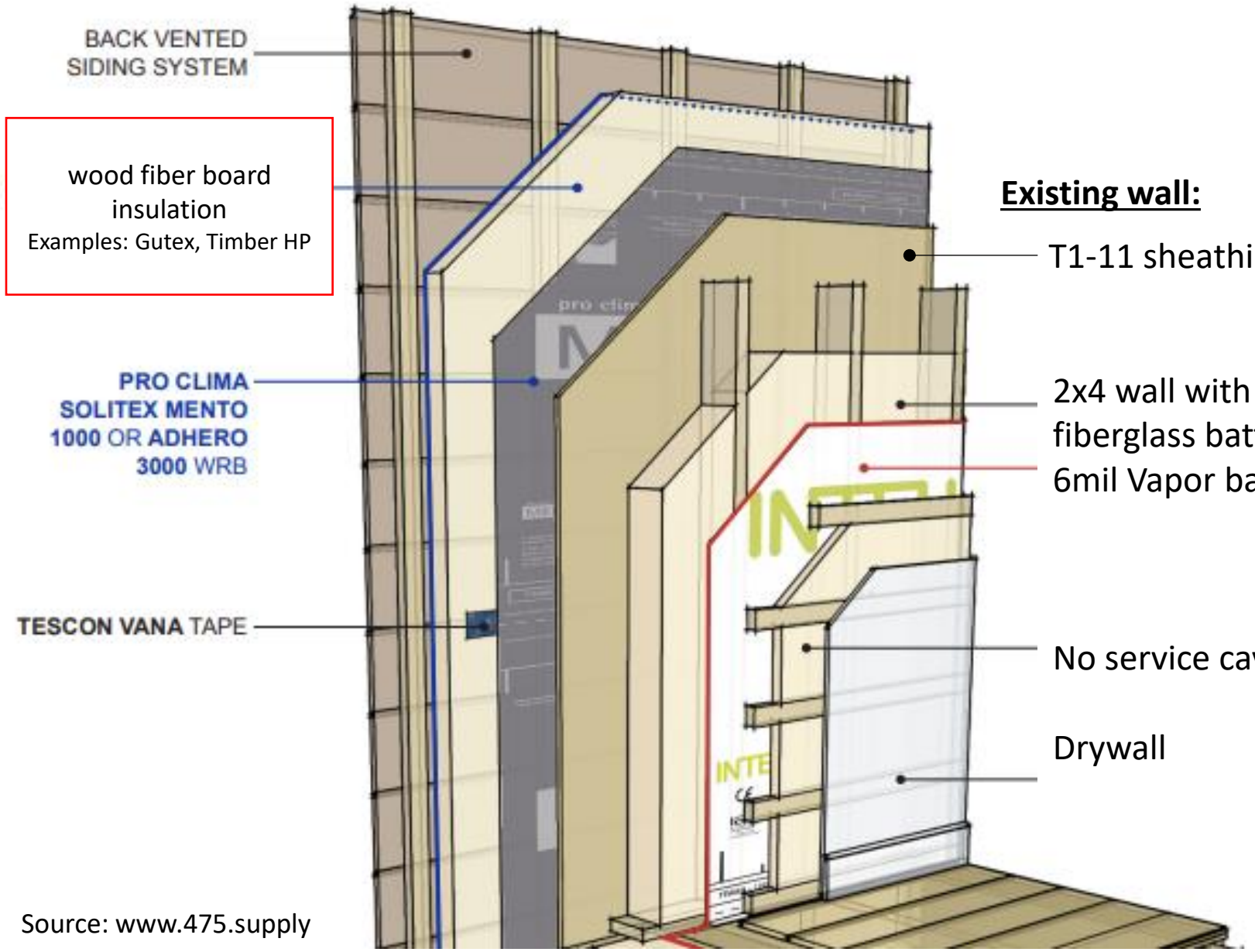
REMOTE Walls

One of the greatest challenges of building in a cold climate is managing moisture in the building envelope. That's because of a familiar concept called vapor drive, in which water seeks to go from a more concentrated state to a less concentrated state. What does this mean for your building?

Smart Enclosure System

diffusion / vapor open

minimizes thermal bridging



Source: www.475.supply

Wood fiber insulation:
- 32 perms
- sequestered carbon
- ~100% recycled wood fiber, paraffin (wax)
- NO health concerns
- Use saw to cut

vs.

Rockwool Comfortboard (2x4ft):
- 30 perms
- Formaldehyde
- Energy intensive to produce
- Not a recycled product
- Use breadknife to cut


Window RO moved out by thickness of 1st layer of insulation
Cut EPS 6” lower than shown to allow for D1 and pavement to garage entry


Keep track of wall layout for screws later attaching furring strips
2 stacked layers of 3” Rockwool Comfortboard, adding R24


Increased size of attic vent
bird screen
Vertically aligned furring strips allow airflow behind siding

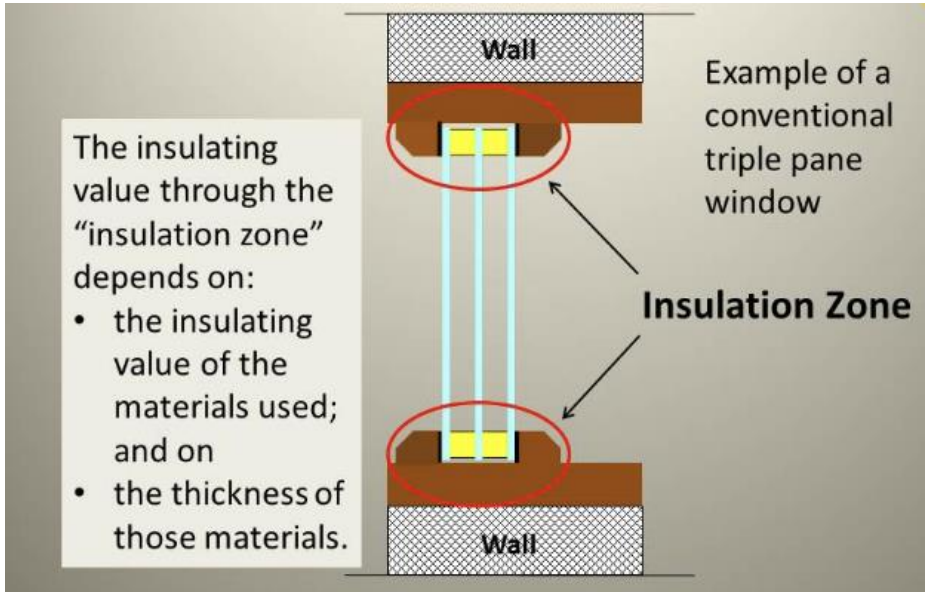
Windows

- Strap anchors instead of nail fins
- No foam!
- Rockwool & taped
- 2nd layer of insulation **overlaps** window-RO-gap by 1 inch

Windows

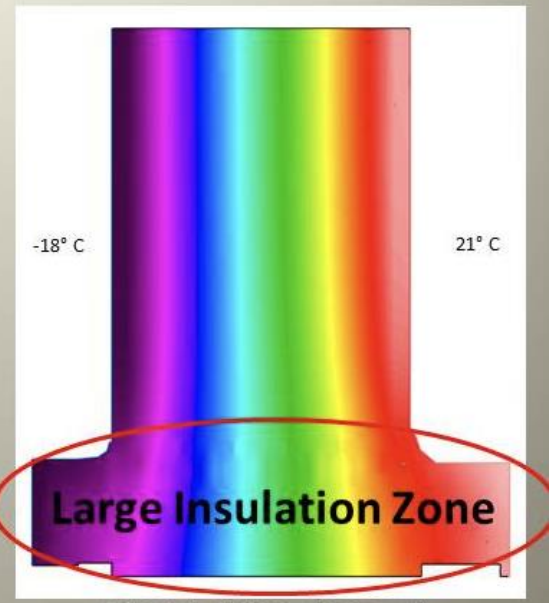
insulation overlap at the window-RO-gap increases critical insulation zone with conventional windows

Conventional window



Insulated Glass Unit

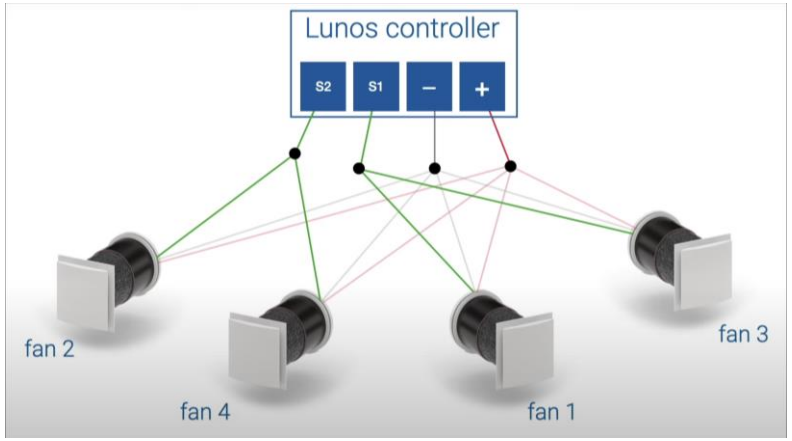
- The very warm interior surface of the glass unit is almost a uniform 18° C, as indicated by the red shading
- The exterior surface of the glass unit is an extremely cold -18° C (same as outside temperature)
- LiteZone™ achieves very high overall window R-values because of its large "insulation zone"



Simulated Infrared Image of LiteZone™ film layered glass unit and frame

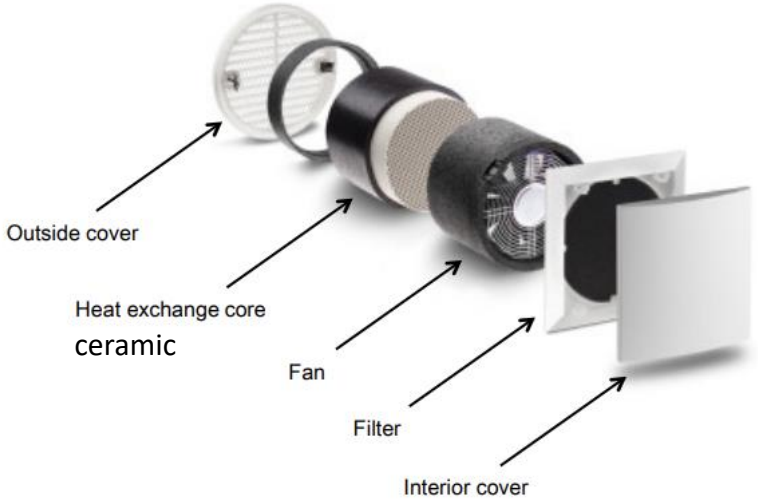
Source: LiteZone.ca

Decentralized heat recovery ventilation



- 12V
- working in pairs
- one controller

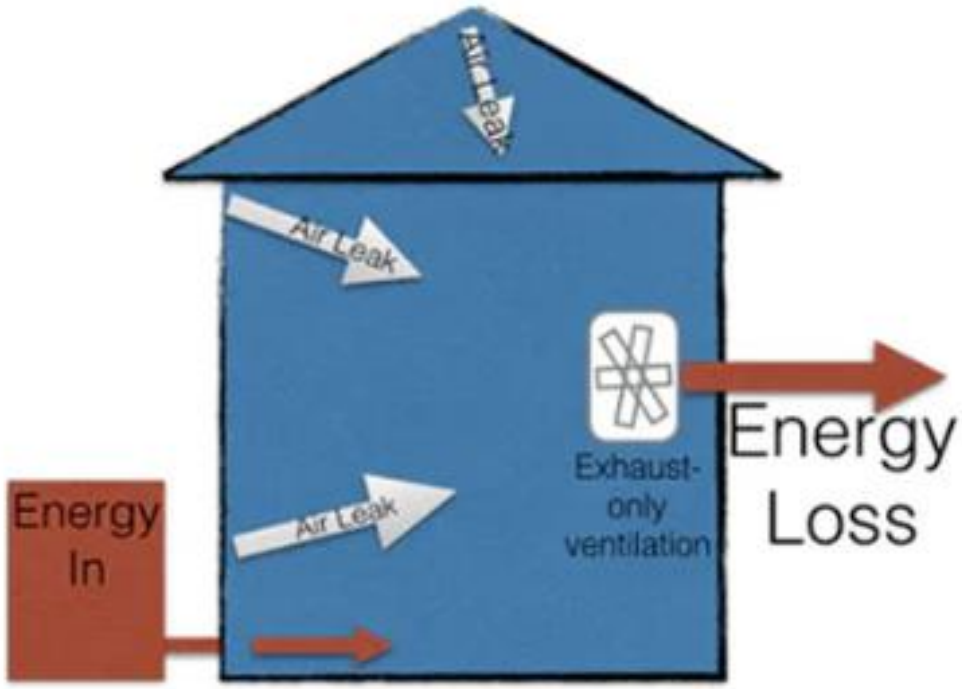
Easy penetrations – easy maintenance



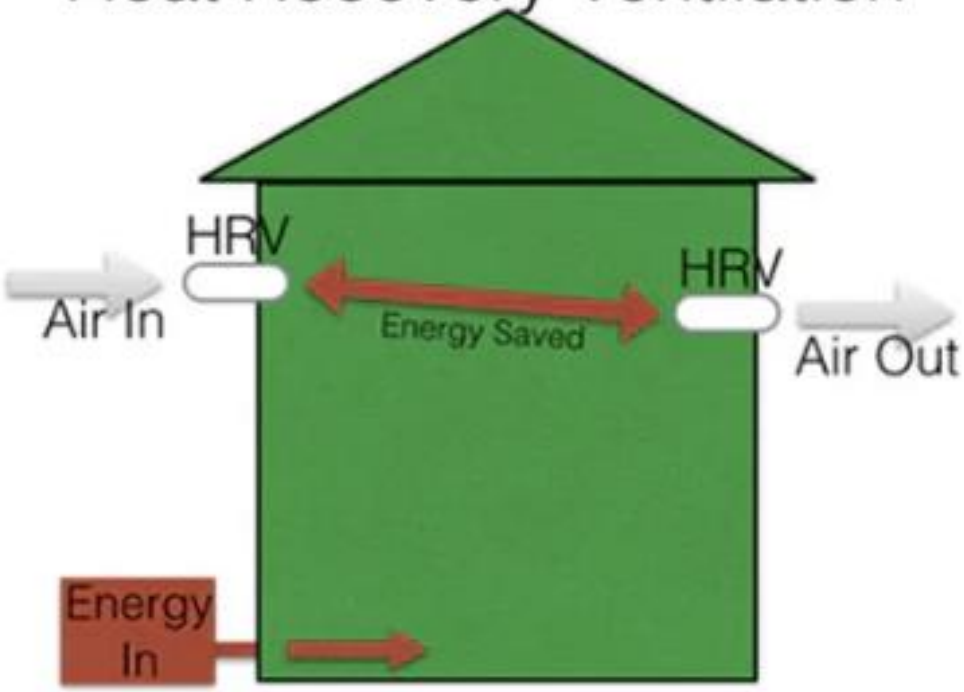
- Passive heat exchange
- Whisper noise (18 decibels)
- MERV 13 filter (wildfire)
- 89% efficient
- 10, 15, or 20 ft^2/min

Source: www.475.supply

Exhaust-Only Ventilation



Balanced & Decentralized Heat Recovery Ventilation



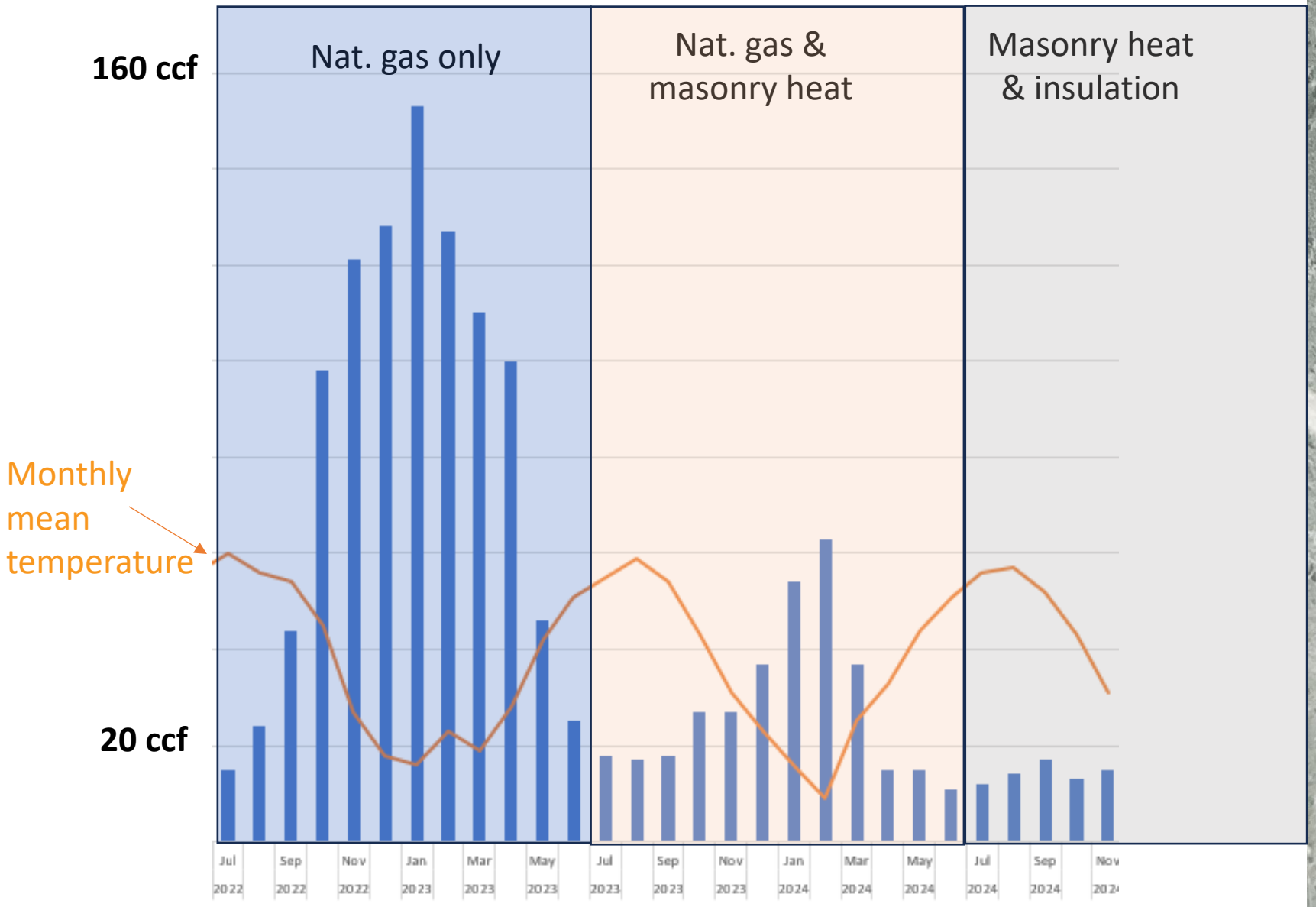
Source: 475.supply

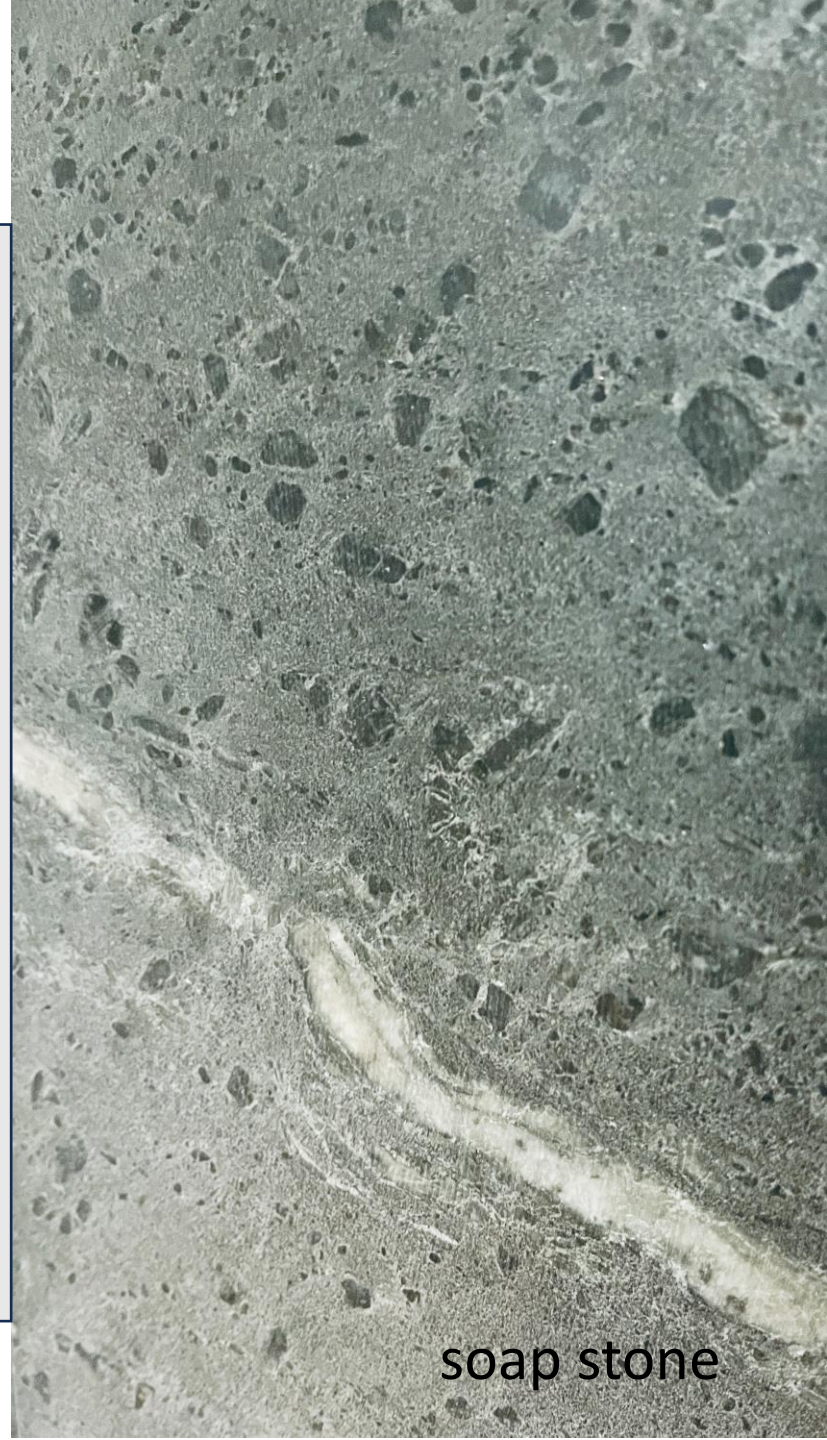
Heating

- Foundation in cellar
- Concrete pedestal
- Slab with exterior air intake
- Electricity hook up

Natural gas consumption

house temp = 70° F





Material costs

Description	Cost	% of total
Insulation	$15k	28%
Windows and doors	$15k	28%
New siding	$12k	22%
Heat recovery ventilation	$9k	17%
Air sealing	$3k	6%

Add ~50% miscellaneous materials: total ~$80k
Not included: labor, masonry heater, 200Amp electrical upgrade

Acknowledgments

- Mark Houston, The Comforts of Home
- Floris Keverling, 475 High Perf. Building Supply
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- Tory Dugan

Thank you

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