# MAINE ANTIQUE REHAB (80% reduction)

# Sustainability Case Study "Optimization"

By: William Turner

Year-round home, 3,600 $ft^2$, 8,000 degree days

1st Home in Maine & 27th Project to Officially Meet the 1000 Home Challenge!

8-7-15

# Why Is This Relevant?

I did it “wrong”

the first time in 1982-1983

**30 years ago**
**Santa Cruz Presentation 1982**

**Now I hope to meet 1000 Home Challenge 2014-2015?**

# General
# New England Climate Features

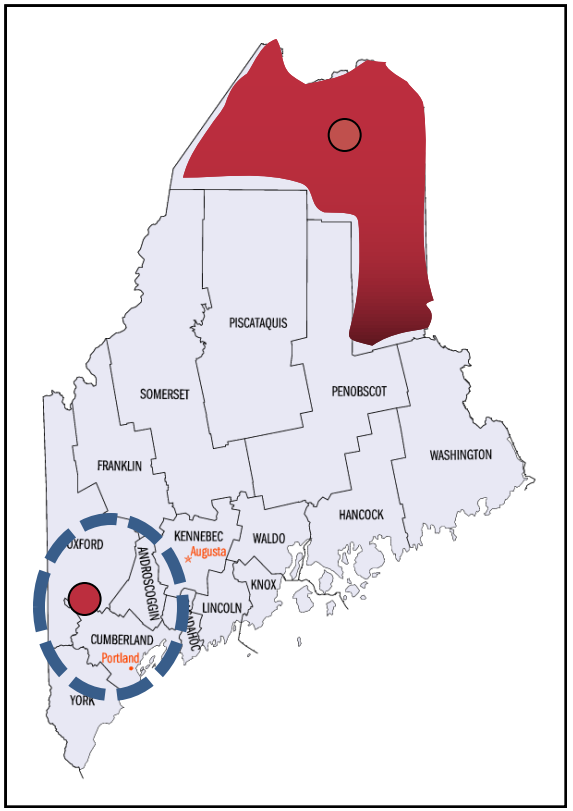
- **Cold & damp**
  - ✓ Supplemental heat for 8 (?) months
- **Hot and humid**
  - ✓ Dehumidification & cooling for 3 (?) months
- **Wind speed & snowfall vary**

# Maine Extreme Climate Features

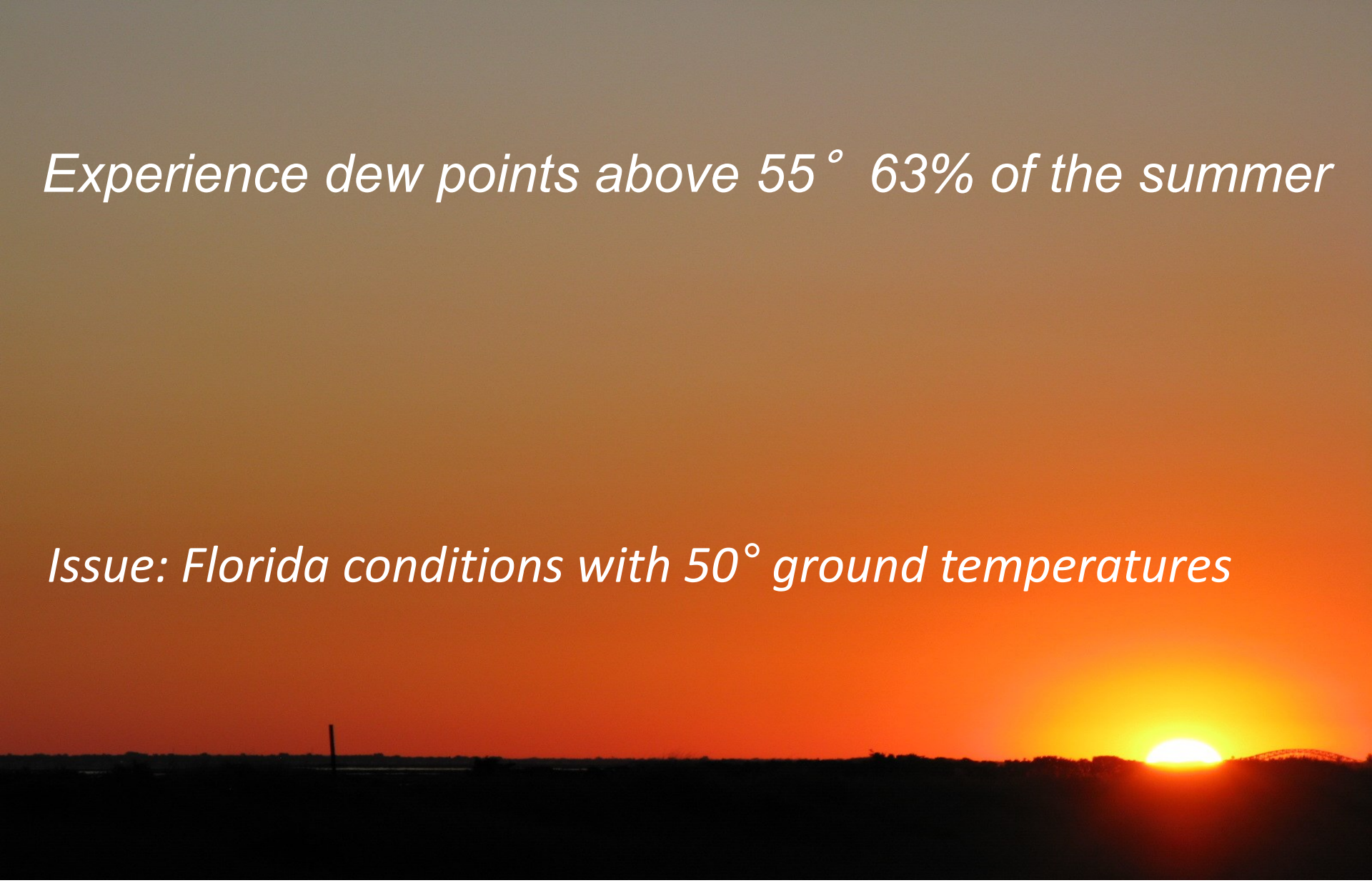
## Range of weather

- ✓ 105º (1911, Bridgton) to
  -50º (2009, Black River)
- ✓ 21” rain in Great Flood of October, 1996
- ✓ 40” to 60” average annual rainfall
- ✓ zones, #6 & #7
  - ✓ Aroostook County and the rest of Maine

*IECC Table 301.1*



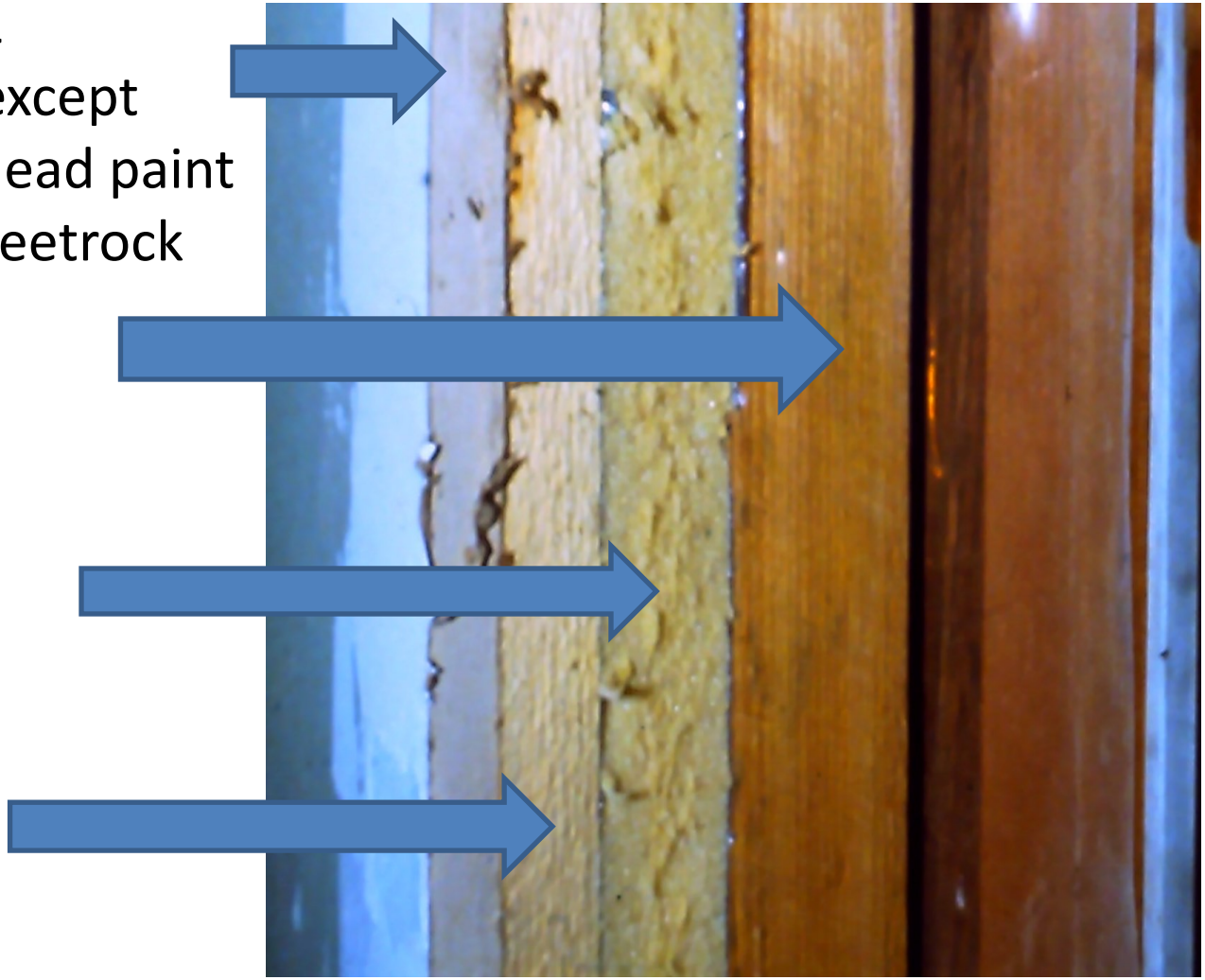

- Not unusual to be -20 ° F with a 30 MPH North Westerly wind, or
- 95° F and dry,
- or have a dew point of 74° F for many hours



# Without indoor humidity control, mold often grows on your organic stuff in Maine

# Decision: Gut from Interior & Reuse Most of Wood Finish

- Gutted inside & re-used wood, except bathrooms & 1 lead paint bedroom got sheetrock
- Added 2 by 2 to 2 by 4
- 6" FG batt & 1" Thermax ™
- ¾" air space



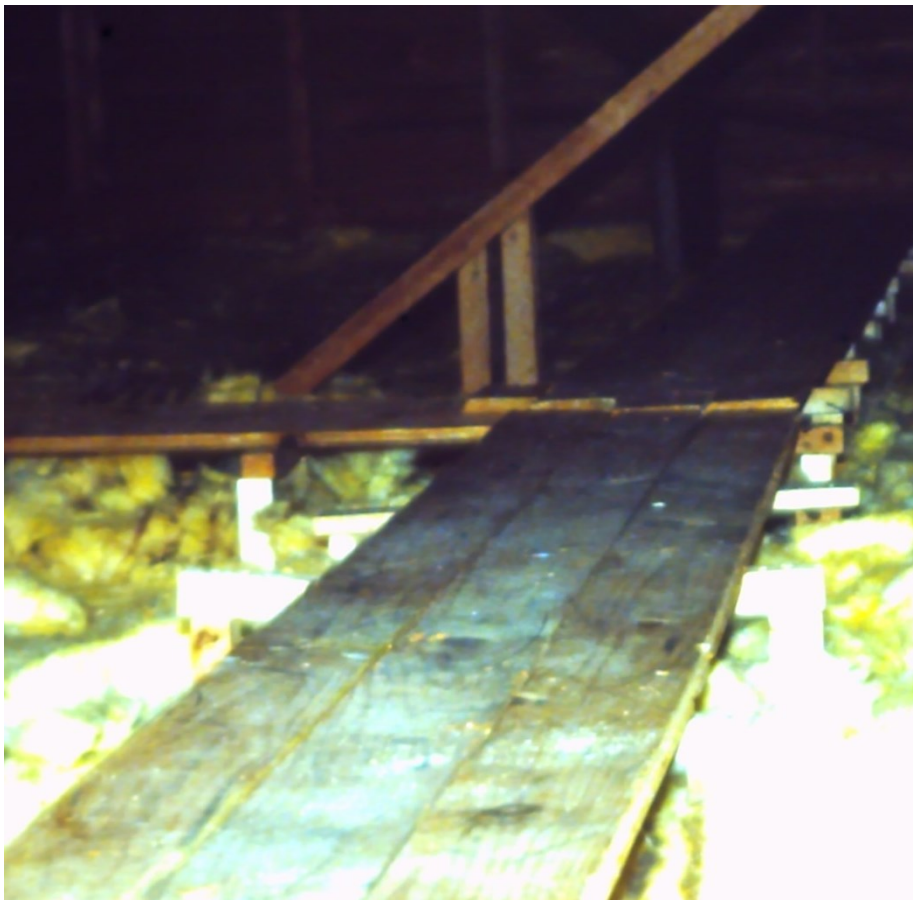
Mistake: 1981 No Effort to Air Seal Joints

# 1981 Blown Cellulose in some unopened cavities

# Restored Interior Finish: Wood & Matched Hard Pine

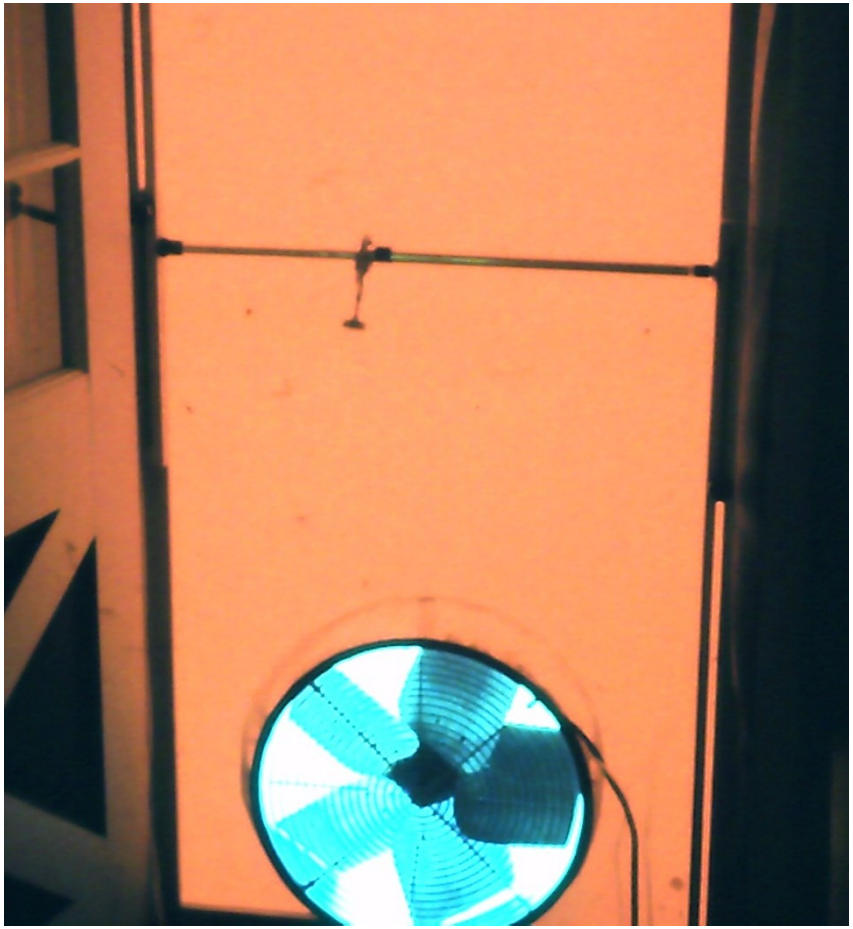
# **Attic:** Foil VB Strips, 12" FG Batts, **Big Mistake**

**In 1981, I listened to "don't make it too tight, a house has to breath", very bad advice.**



# House Was Cold & Drafty With (2) 70,000 BTU Stoves

Called Princeton Energy Partners, David Harrje & Gautam Dutt



# 1982 Attic Air Sealing: removed attic batts to fasten and caulk 6 mil poly on entire attic floor, reinstalled.

**1982 Fix**: Insulated 2 sides (250 $ft^2$) of 30-ton exposed back of fireplace and rock chimney

# **1982 Windows:** 33 French Style, 24 replaced with double hung thermal pane; all windows covered with triple track aluminum storms




14

**1982:** Installed 96 $ft^2$ of Vertical Sunspace (southwest exposure)

**1982 Crawl Space Fix**: Added 3 " or 6" of XPS foam under the FG batts, sealed all joints

# 1882 Complete Crawlspace Isolation

Courtesy of Turner Building Science & Design

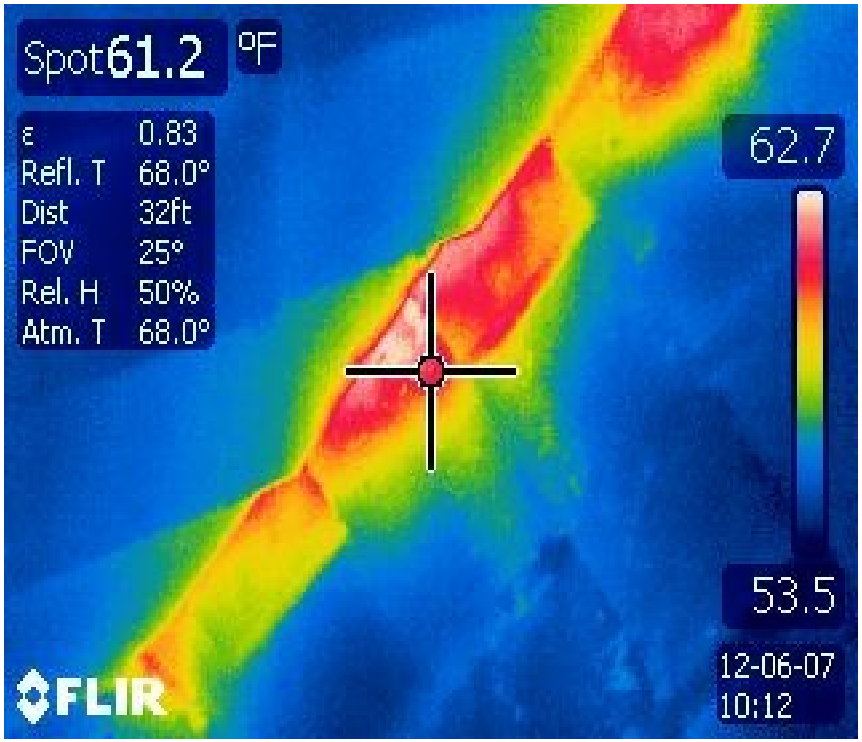
# After Fixes How Did We Do (until 2012)?

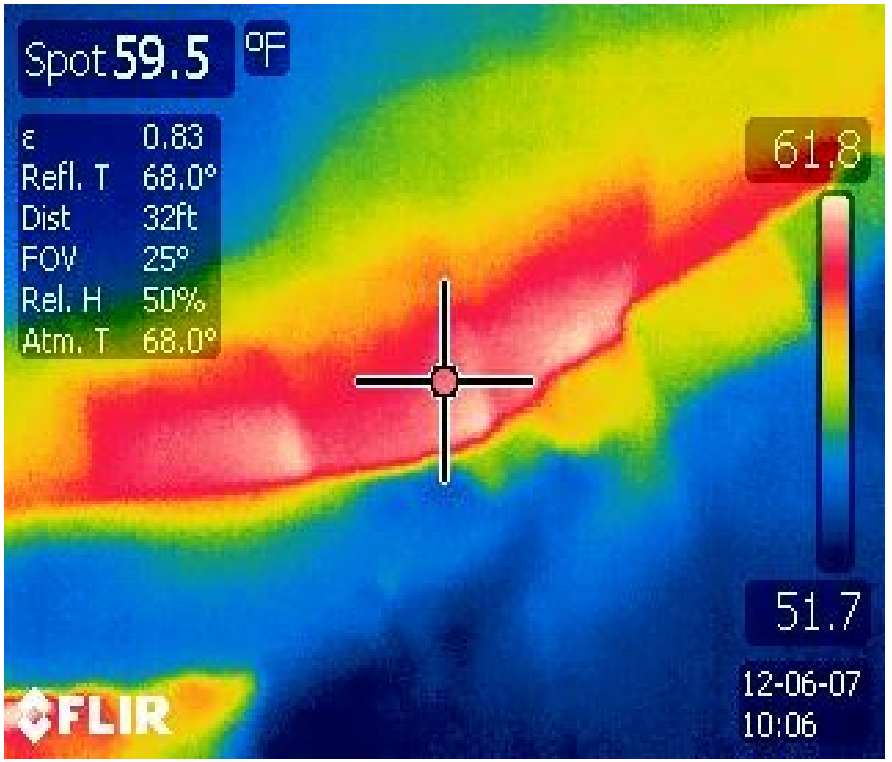
6-7 cords of wood a year & 3/4 tank of oil,
then switched to 100-200 gallons of propane &
always evaporated lots of water on top of wood stoves

# THC inspiration : 2012 Paradigm Shift

1. Wood supplier stop supplying 3 cords a year
2. I new enough now to fix house to use much less energy
3. Major flying squirrel infestation (15) in 1st floor ceiling cavity

# IR Inside Attic: Identified Remaining Major Attic Bypasses (2011-12 winter)




Red & white indicate remaining air leaks inside cold attic at floor, mainly at junctions in framing.

# Interstitial cavity between 1st and 2nd floor accessed for cellulose dense packing, insulation and air sealing

# Interstitial floor space is where flying squirrels were living & commuting at perimeter of space

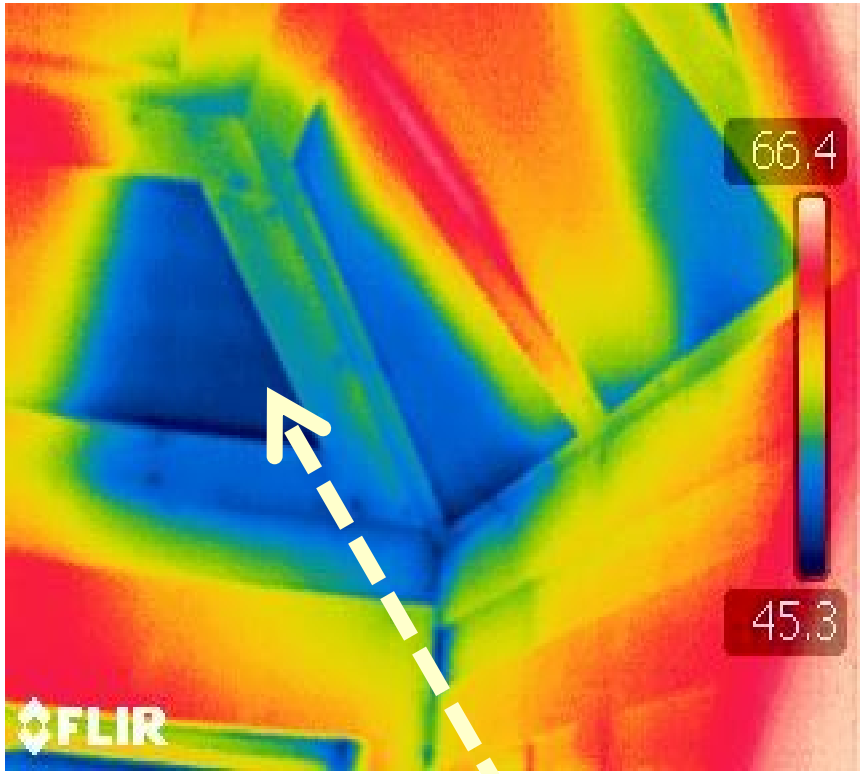
# Air Sealing, Interstitial squirrel cavity between 1st & 2nd floors were accessed for cellulose dense packing

# Interstitial cavity between floors accessed for cellulose dense packing (185 bales added including 18” attic)

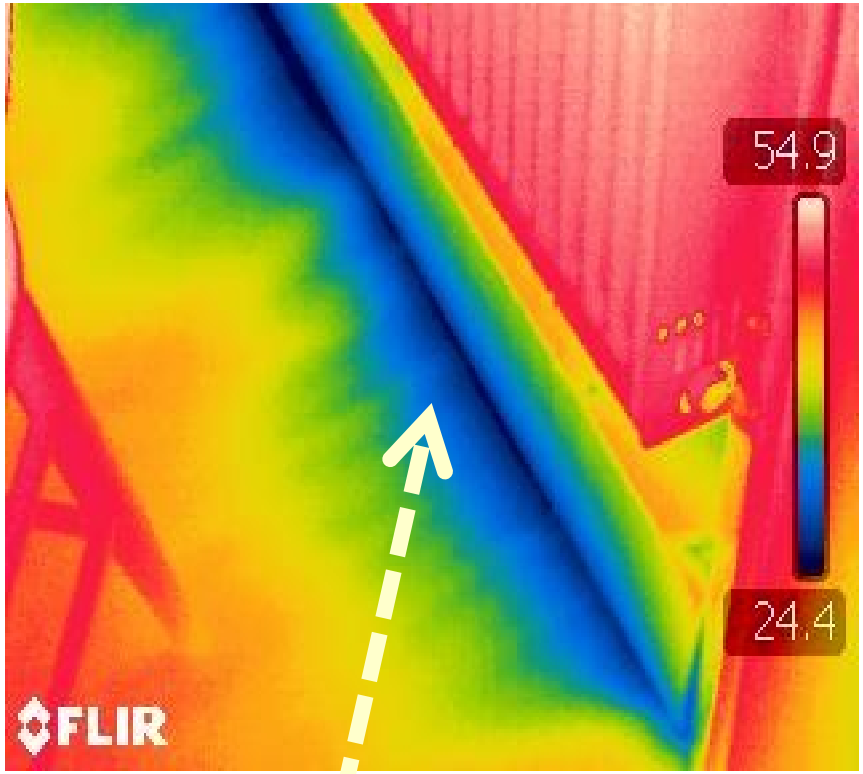
West Side

# Addressed Lead Paint On All Trim

# IR Images Prior Final Dense Pack (Interior)

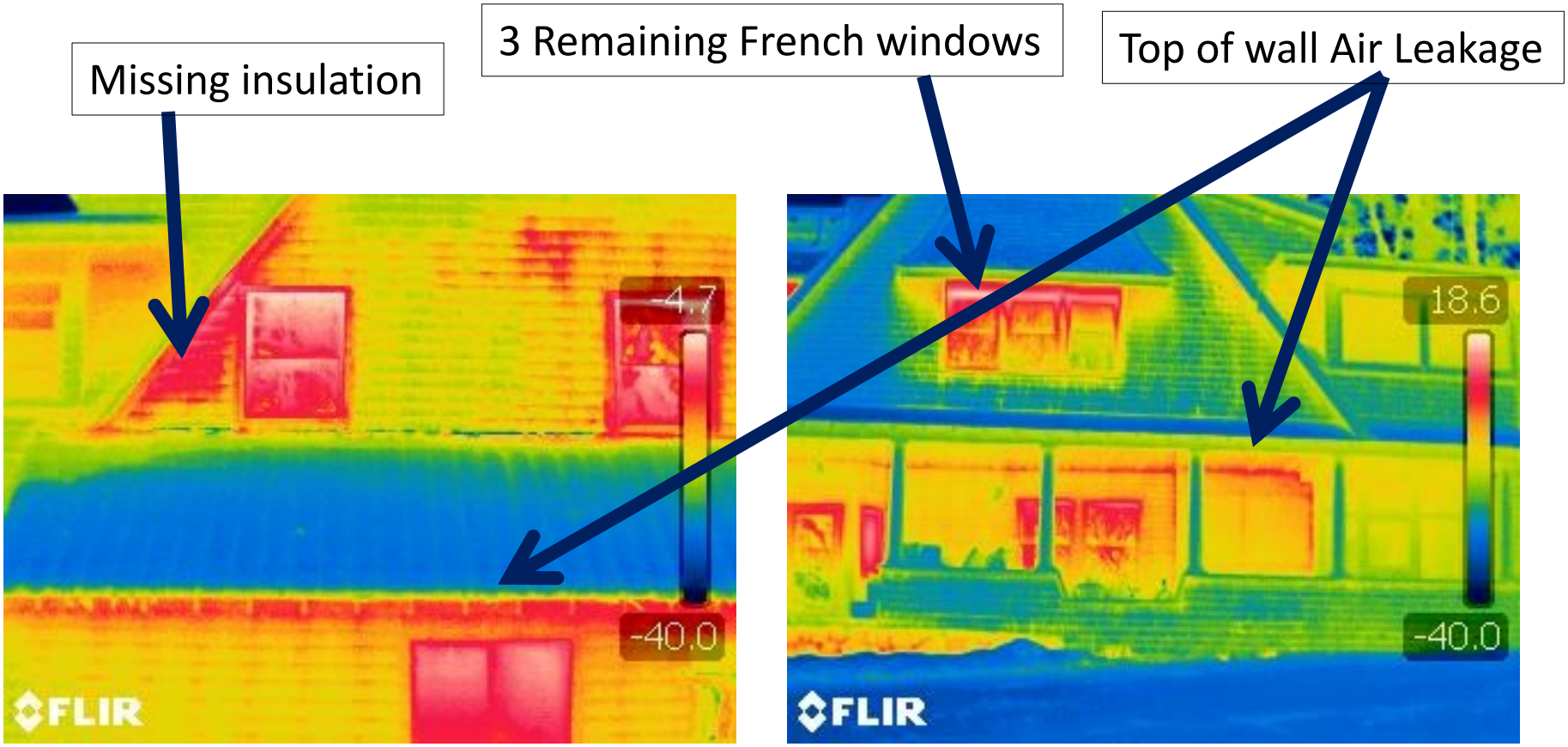



Missed dormer corners




Air leaks at base of wall

# IR Images Prior to Final Dense Pack (Exterior)



# 2nd Dense Pack: First floor walls dense packed into FG batts (25 bales) to air seal walls top & bottom as well as increase R value

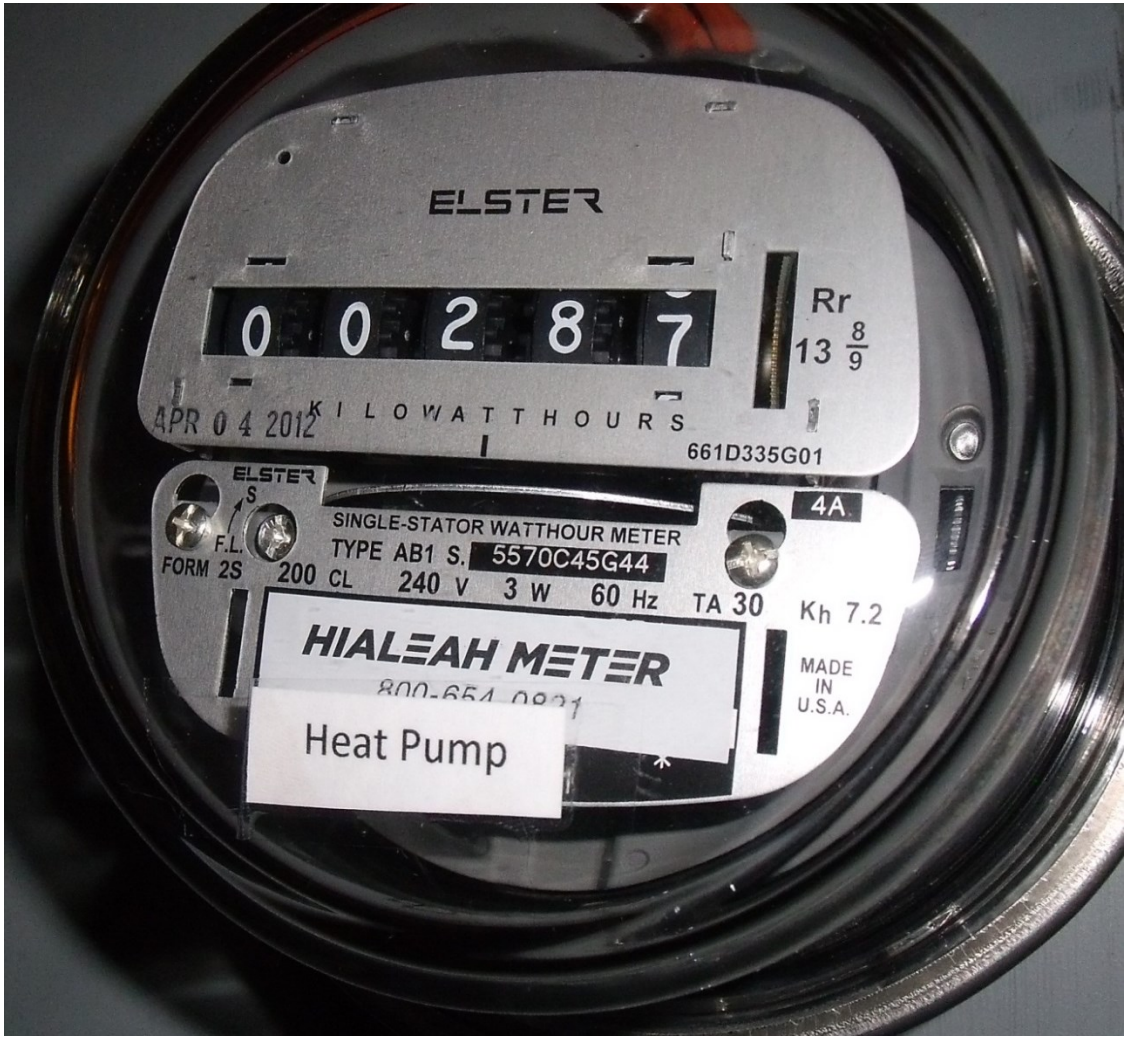
# **2013 1st Ductless Heat Pump**: one DHP serves about 2/3 of home, 1.5 ton

# **Outside Unit** (3 ft. above earth, out of snow, SW exposure)

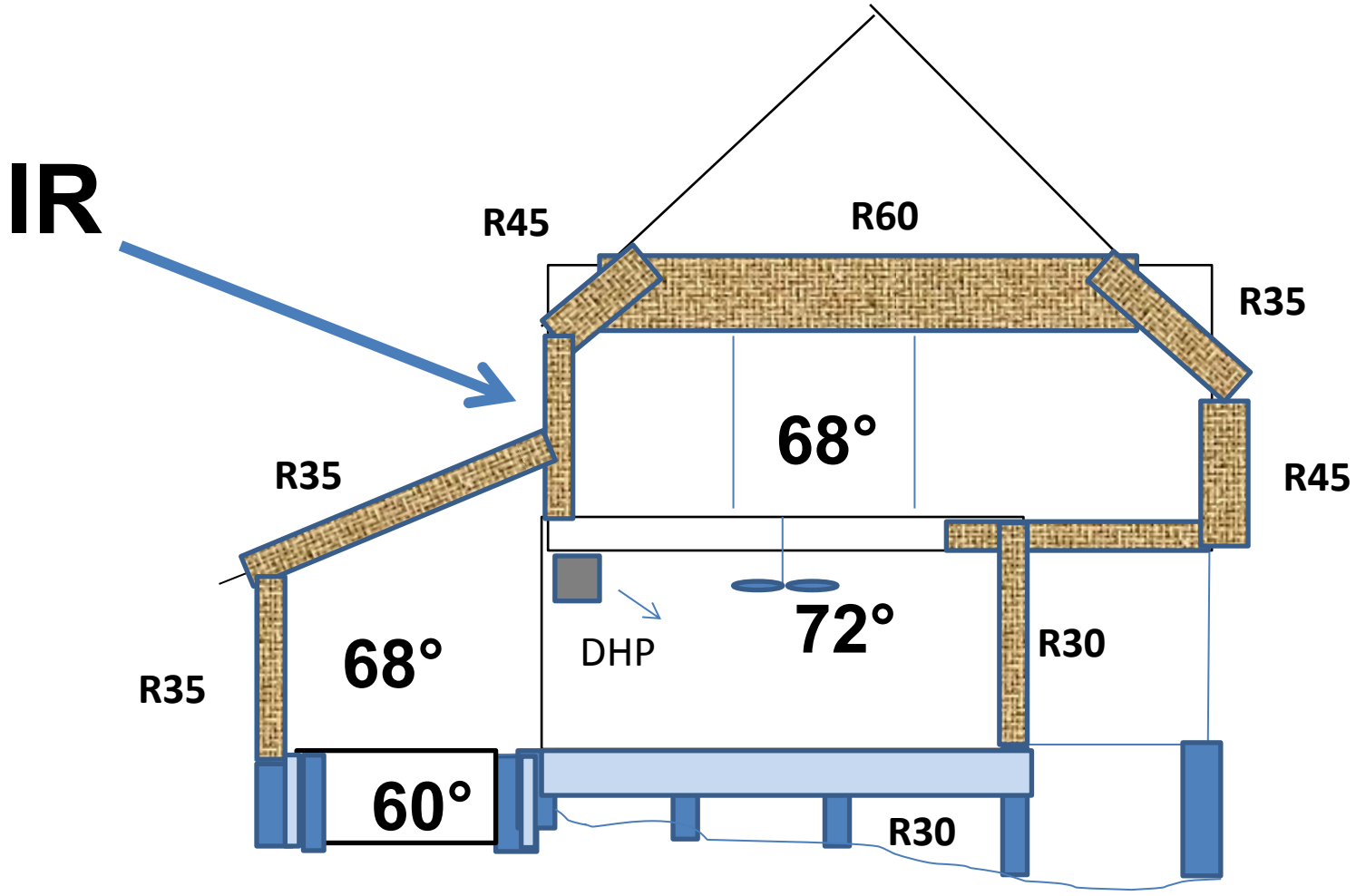
# Inside DHP Unit & Low Wattage Ceiling Fan

# Pleasant Surprise  DHP Sub- Meter $30.00

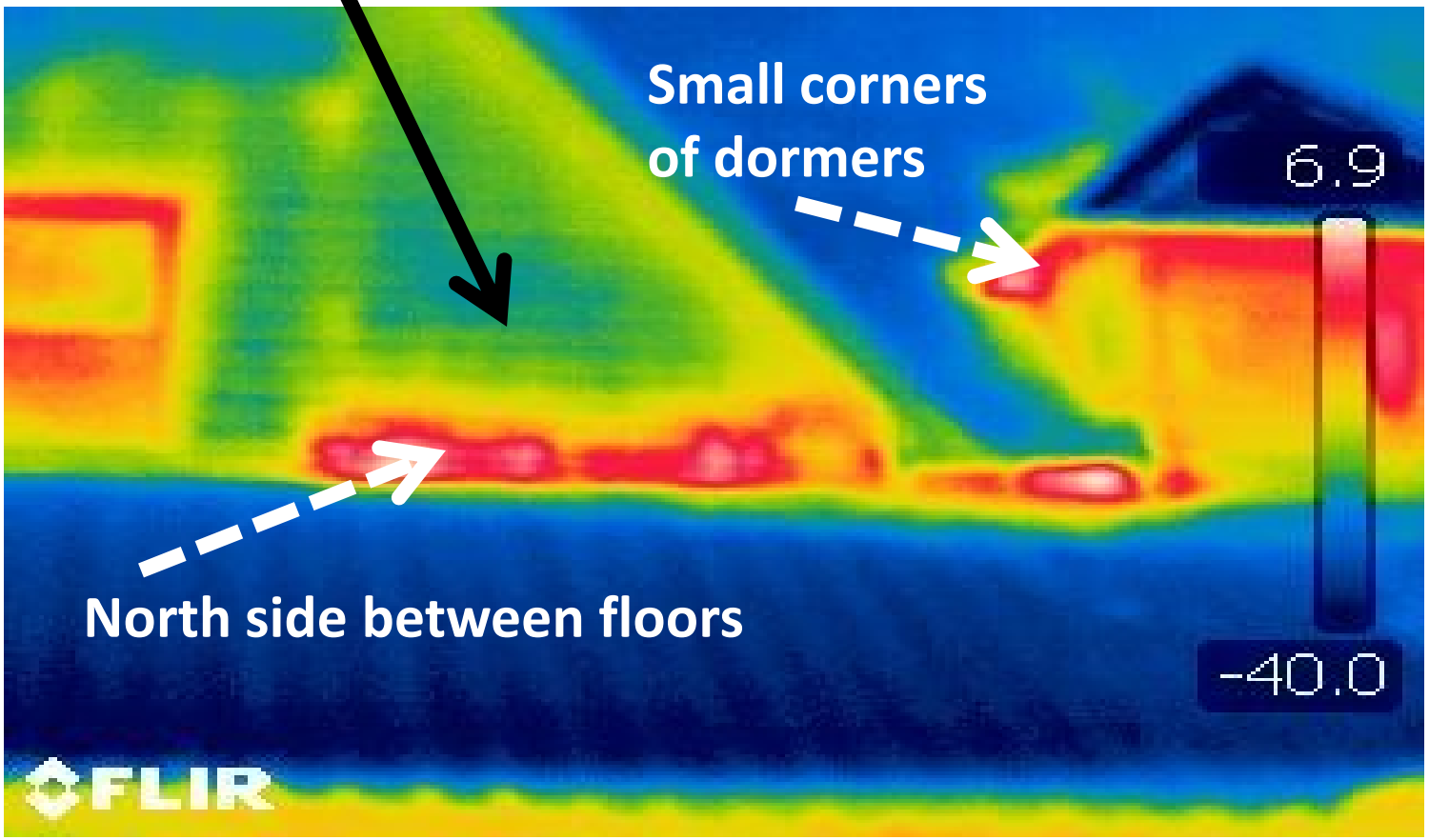
(March 2013 about 0.33 kWh per DD) Cheaper than wood burning.



# Now: Thermal Enclosure Insulation Levels, better comfort



# Remaining Air Leakage Areas Addressed May 2015,



# Current Ventilation Systems (IAQ)

- 2 kitchen exhaust hoods, also 2 bath fan exhausts on de-humidistats (all remote blowers)
- electric clothes driers ducted outdoors
- 1 roof-mounted solar hot air make up air panel on 25% timer 7 AM to 7 PM when 35°-55° outside
- 2 wood stoves without ducted OA
- **Added:** 1 window-mounted 40 cfm supply fan for my bedroom during 30°-60° weather
- 30 year old double hung thermal pane windows

# Blower Door Results & Fuel Use:

**1982** prior to attic VB: not testable — 10+ cords + 200 gal. oil

**2011** prior to dense pack: 12 $ACH_{50}$ — 6 cords
6,675 $CFM_{50}$ + 200 gal. propane

after 1st dense pack: 7 $ACH_{50}$ — 3 cords (8,900 lbs)
5,000 $CFM_{50}$ + 200 gal. propane

after additional dense pack — 1 cord (1,249 lbs)
4,000 $CFM_{50}$ 110 gal. propane
+ two DHP

**2015** To Be Determined

# Reduced Emissions from Cord Wood Heating

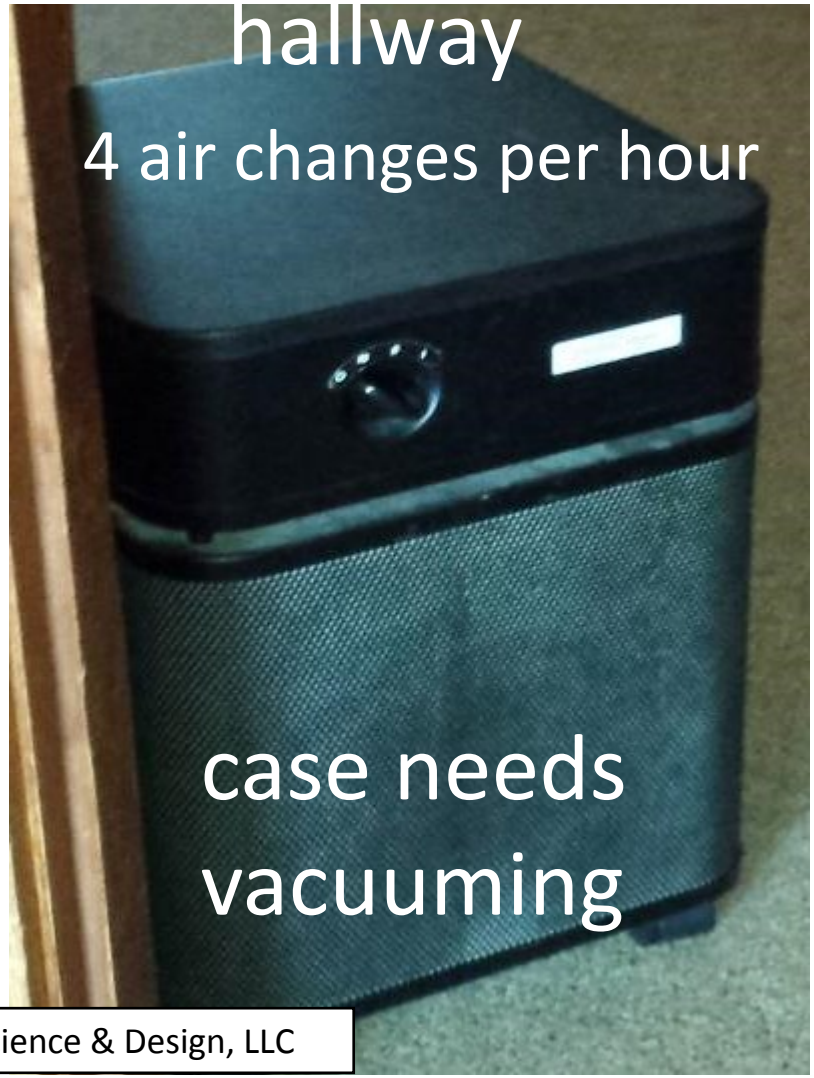
# IAQ

## No Central Air Filter

## Our “Sanctuary”

## Bedroom Areas,

Medium speed = 125 CFM


Courtesy: Turner Building Science & Design, LLC

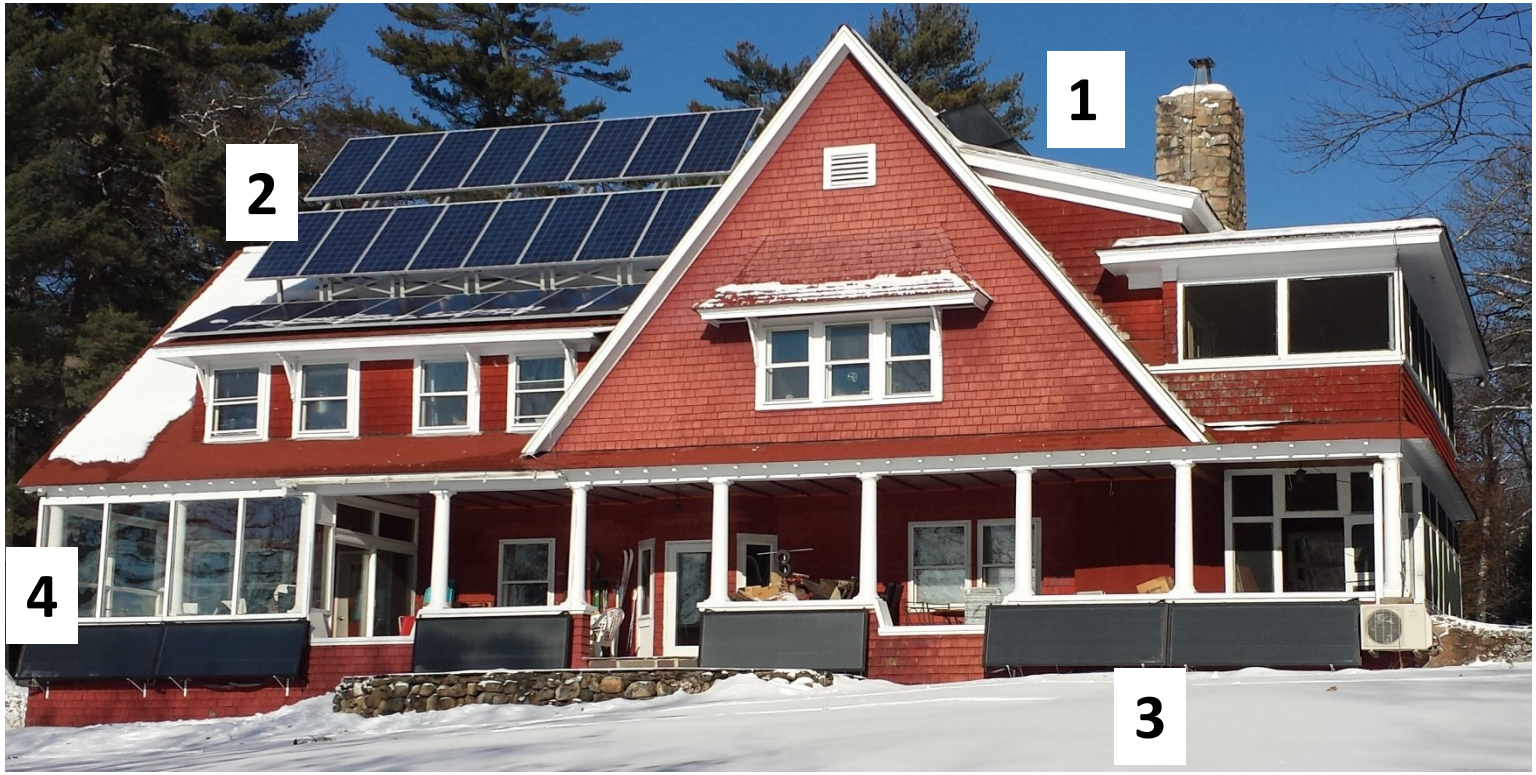
# Thousand Home Challenge: 10 Steps

http://www.thousand homechallenge.com

1. **Assess Needs, Site, Goals, & End Use of Space**
2. **Optimize Enclosures** (reduce heat & cooling load)
3. **Minimize Internal Loads** (lights, appliances, electronics)
4. **Provide Fresh Air**
5. **Control Humidity**
6. **Determine Cooling Needs**
7. **Integrate Hot Water with Other Loads**
8. **Determine Heating Needs**
9. **Integrate Renewables to Address Remaining Loads**
10. **Incorporate Verification, Feedback, & Evaluation**

# Current Renewables 2014

1. 20 $Ft^2$ hot air panel make up air, 40 watt fan
2. Now 7 Kw PV panels
3. 144 $Ft^2$ hot water, 110 gal storage, & fan coil north hall
4. 96 $Ft^2$ passive sunspace (new glass)

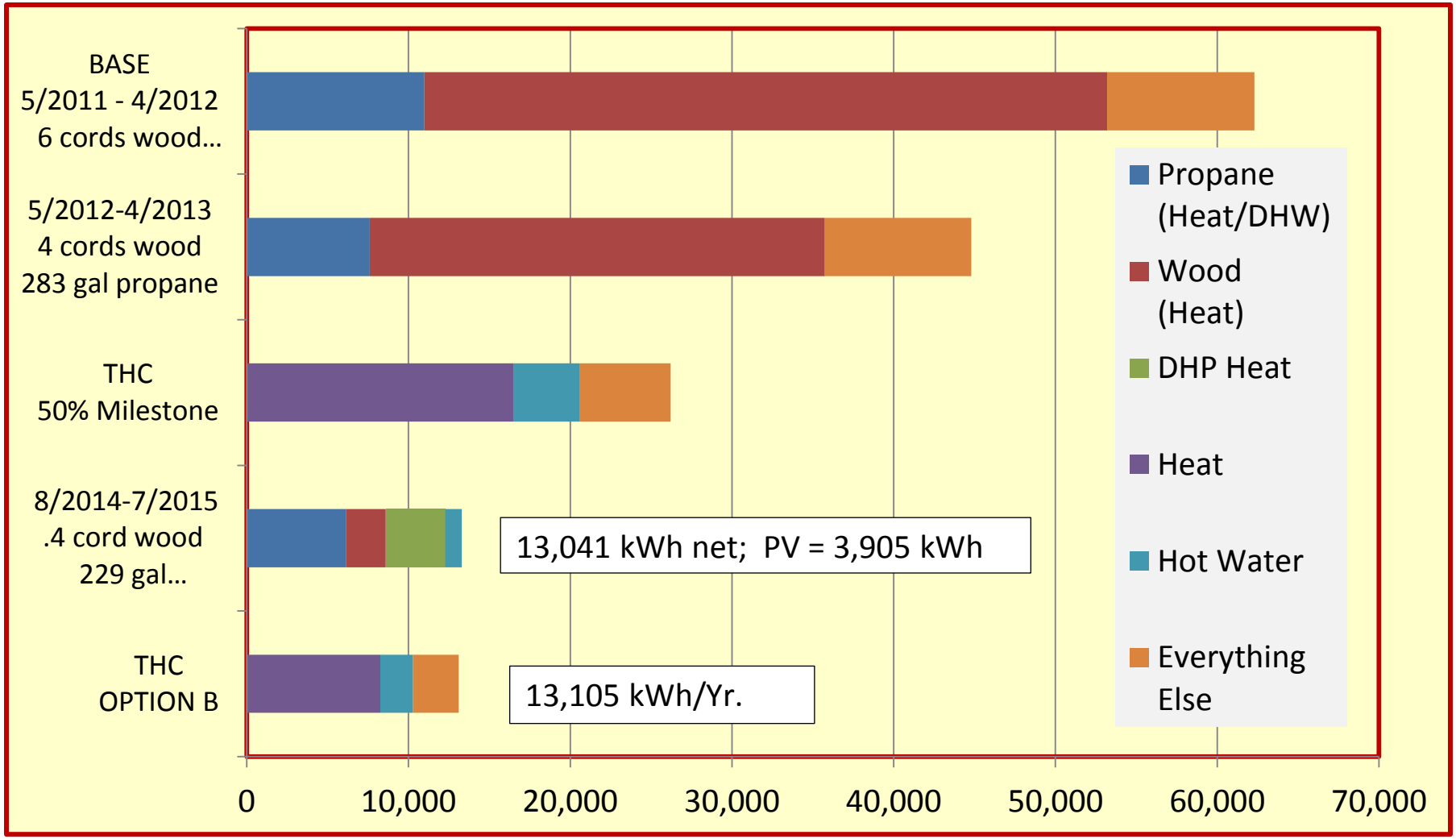


# Current 2015 Investment:

- Fix air binding problem in ground mount Solar DHW **$ 100 done**
- Address north side wall air sealing of air leakage **$ 1,000 done**
- **Also Consider: ??**
  - LED bulbs vs. CFL Not Done $ 250
  - Heat Pump Clothes Drier in Apt. Not Done $1,600
  - Low Use Clothes Washer in Apt. Not Done $ 700
  - Induction Unit 2 Burner Not Done $ 300
  - Condensing Boiler Not Done $4,000
  - 7kW more PV (take tax credit) Scheduled 9/15 $20,000
  - Remove Large Old Pine tree shading PV 9/15 $ TBD
  - **Other Ideas?**

# Household Energy Use Compared with THC Threshold & 50% Milestone

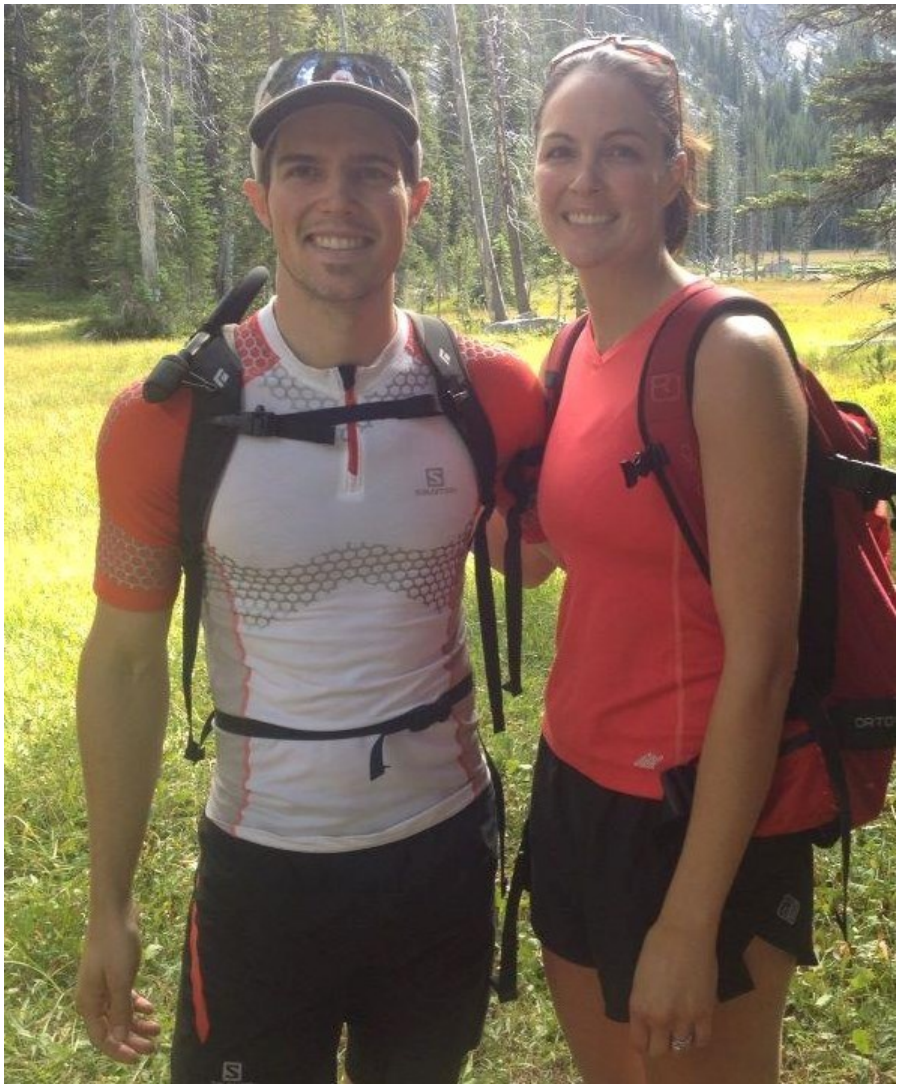
(kWh/year, site energy)




OPTION B Inputs: AUBURN_LEWISTON ME weather station, 7,615 HDD; 3,500 $Ft^2$ FFA; 1.83 households; 3.67 occupants; 30% electric heat

# Thank You

Members of My Family



# And Thank You to

**The 1000 Home Challenge,**
**Curry Caputo, & "Sustainable Structures"**
**dense packers, &**
**Talmage Solar Engineering**

**For information, contact:**

Bill Turner
Turner Building Science & Design, LLC
bturner@turnerbuildingscience.com
www.turnerbuildingscience.com

Case studies on 1000 Home Challenge website
www.thousandhomechallenge.org