

# Net Zero Energy Ready Home in Dillingham, Alaska

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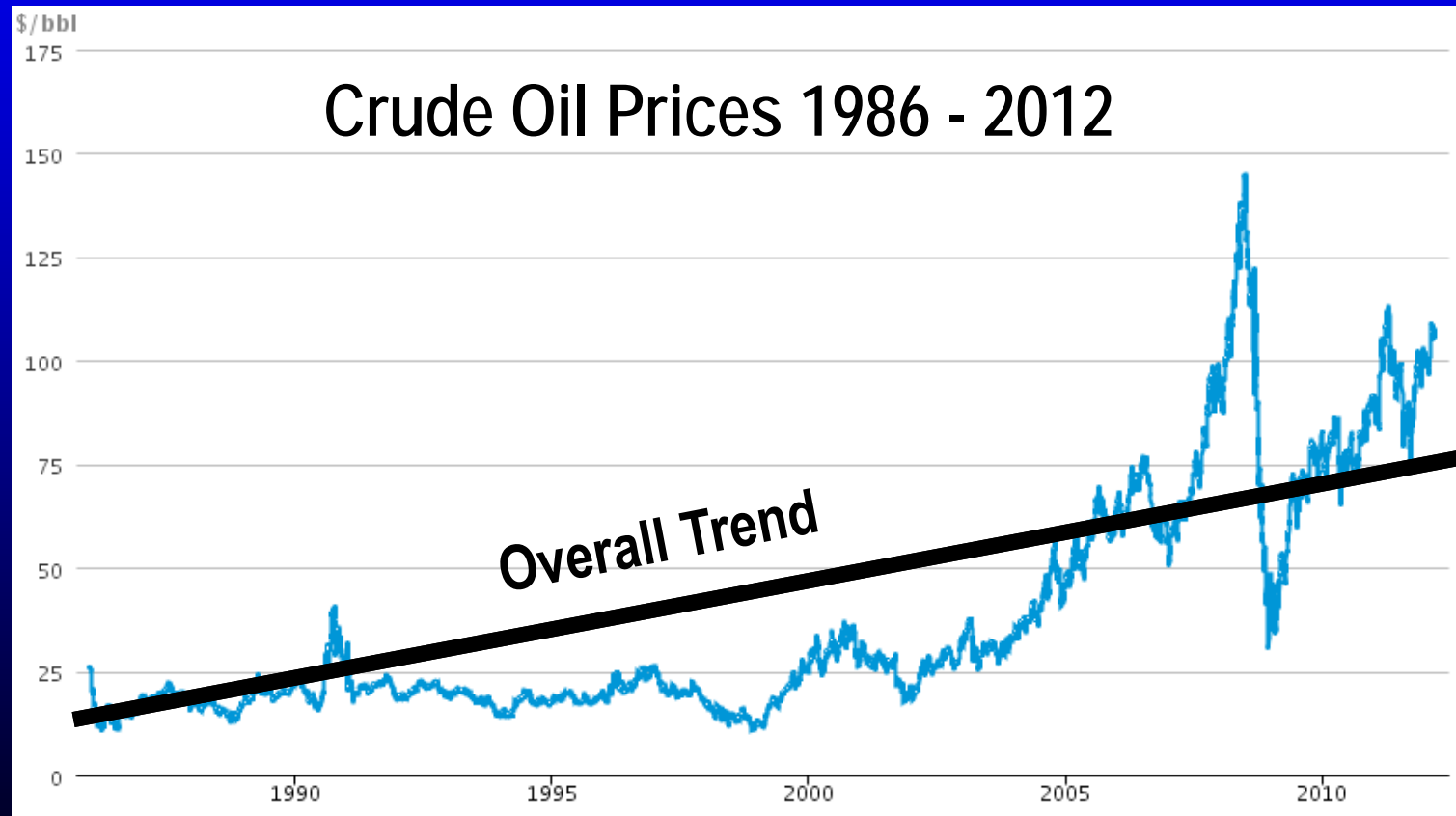
# Disclaimers

- I am a scientist/engineer, but not a builder
- Data analysis not fully completed



# Reasons for energy efficient homes

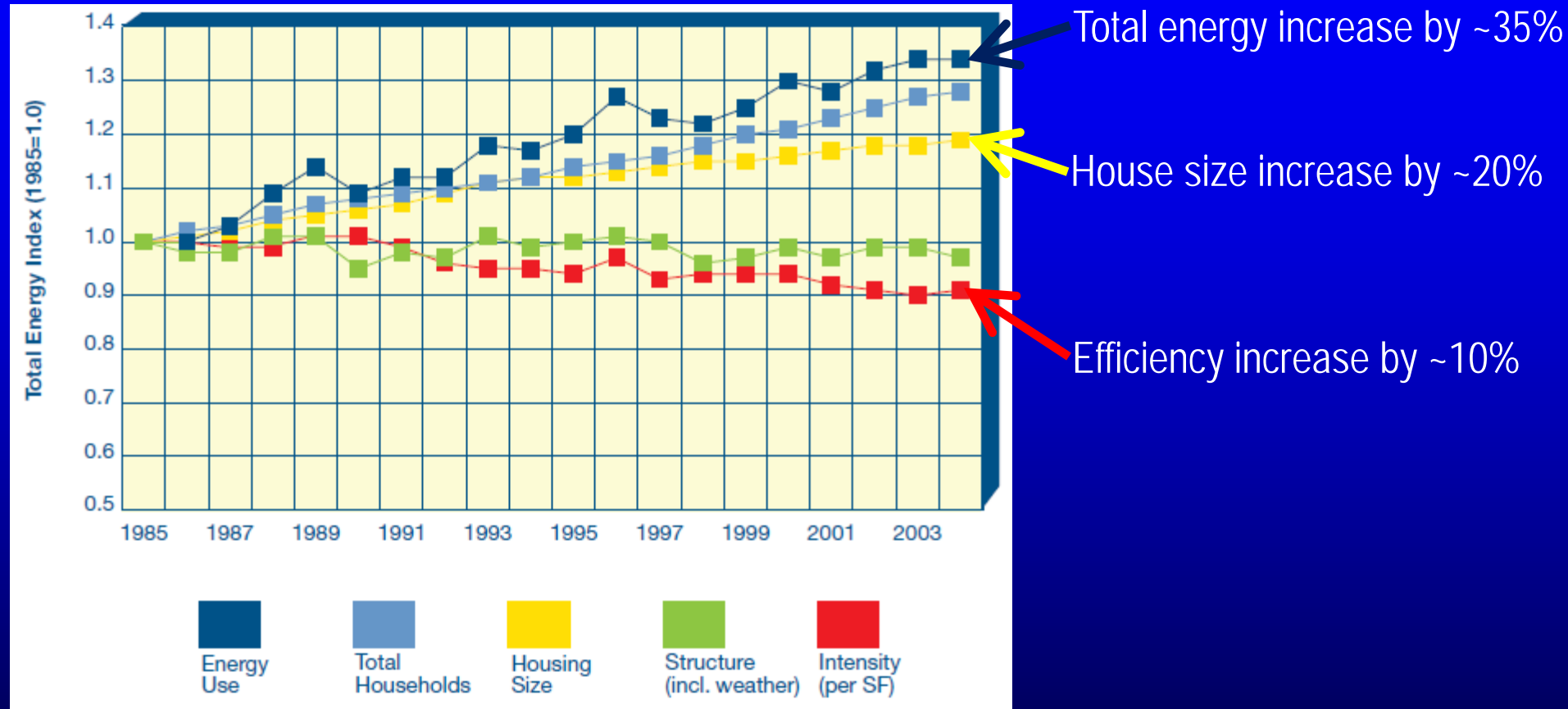
- Reduce energy use (save money, environment, etc.)
- Increase value of your house
- Get ready for the long-term future



Source: Energy Information Administration ([www.eia.gov](http://www.eia.gov))

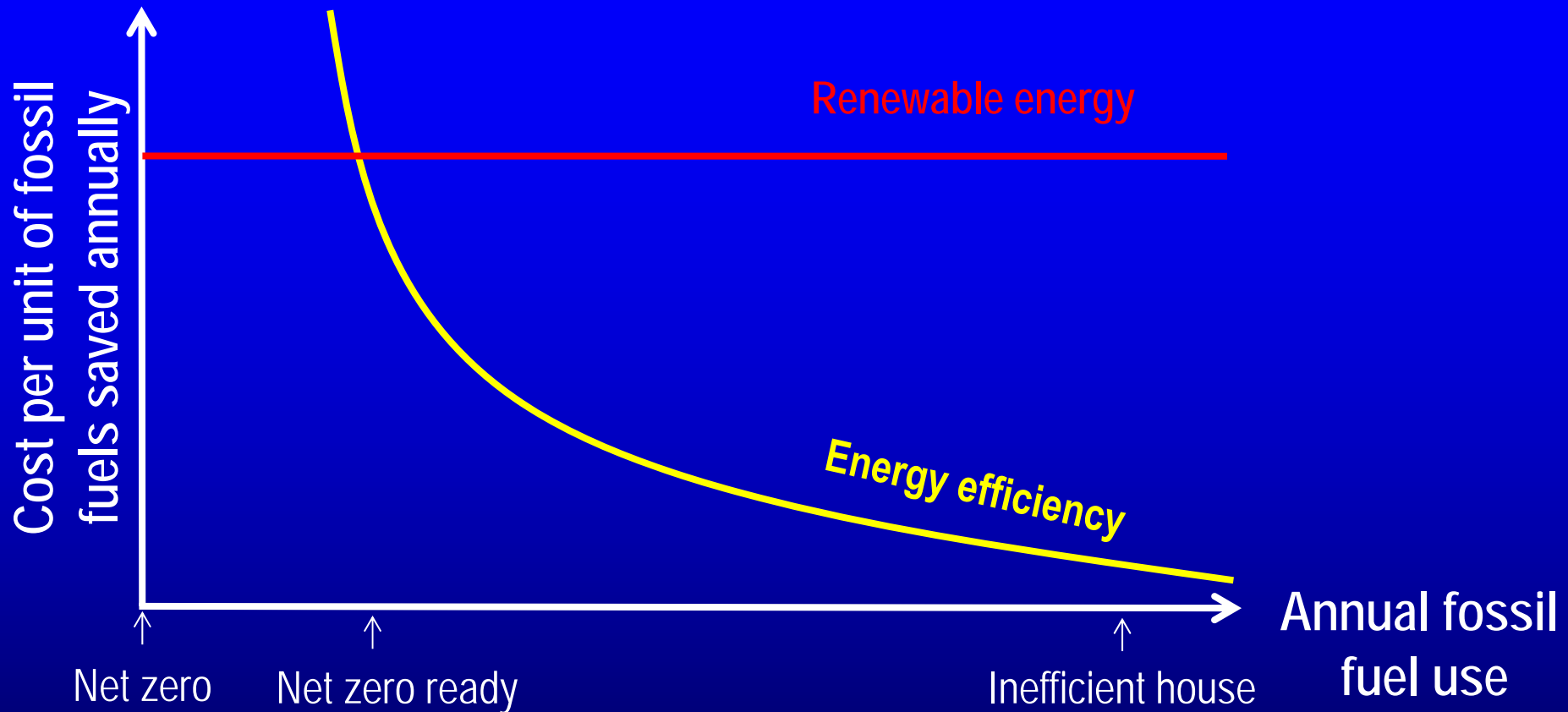
# Is efficiency the only factor?

Trends in Residential Sector (Source: US DOE)



What good does it do to increase the energy efficiency of homes if it is outweighed by escalations in their size?

# Net zero energy house – how to get there?



## Why possibly stop at net zero ready?

- Wait for renewable energy to get better and/or cheaper
- For some types of renewable energy, community-scale systems more beneficial than residential-scale

# Our house – basic characteristics

Outside dimensions: 24'x24'

Wall thickness: 28"

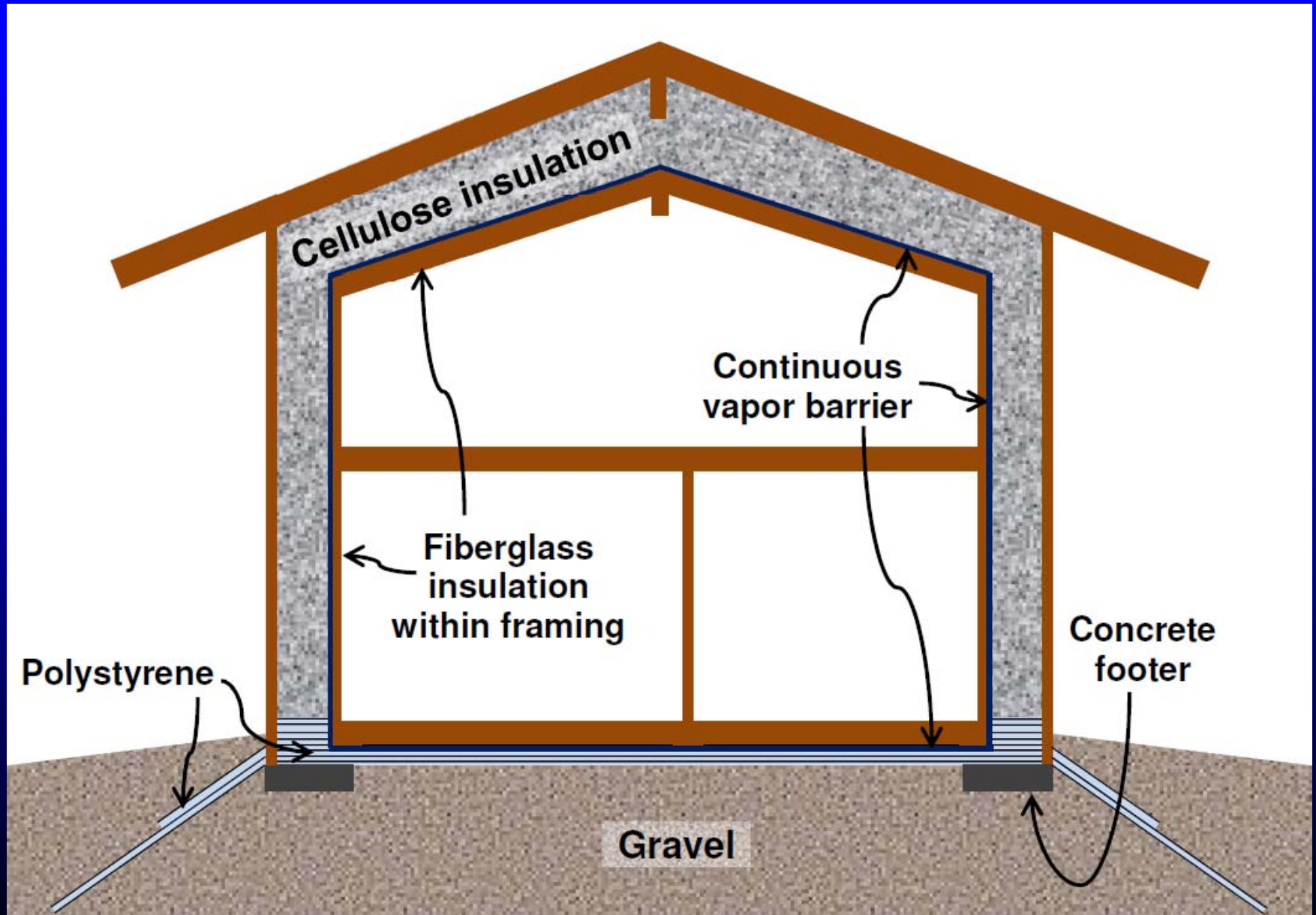
Stories: 1.5

Inside: 590 sf, 2 bedrooms, 1 bathroom





# Keep it simple!



# Our house – energy features (approximate values)

- Largely (but not completely) based on the Passive House standard
- Walls: R-90; Ceiling: R-140; Floor: R-35 + R-20 outside along perimeter
- Design heating load (@ -22 F) of 1.4 kW
- Air-tightness: <0.1 ACH @ 50 Pa





# Our house – energy features – Cont'd

- Triple-pane, argon-filled, double low-e, fiberglass-frame windows
- Heat Recovery Ventilator (HRV)
- Heat pump water heater
- Low-flow plumbing fixtures
- ENERGY STAR appliances
- Entirely electric (no oil, no propane, no wood)







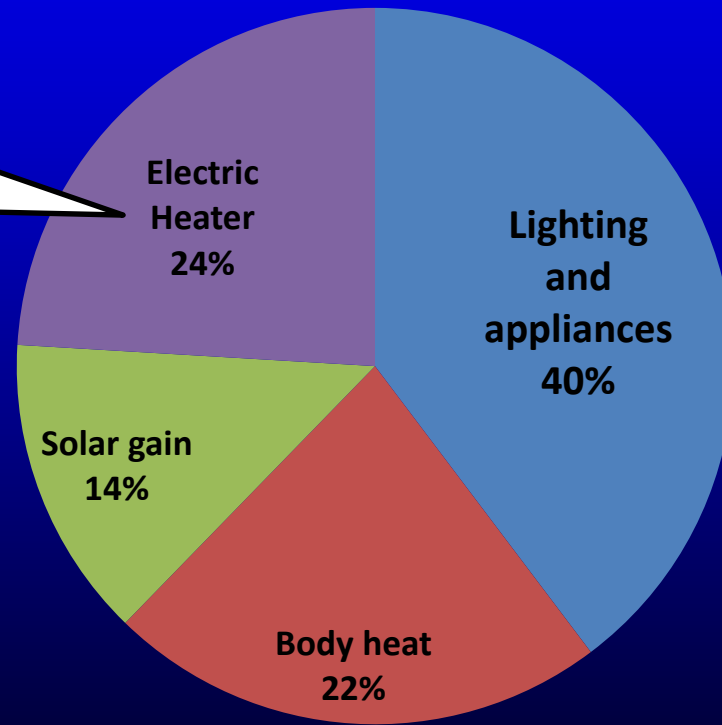




# Where is the heat coming from?

Total annual heat demand:  
4,650 kWh (100%)

1,116 kWh  
or  
3,808 kBtu  
or  
35 gal if heated with oil

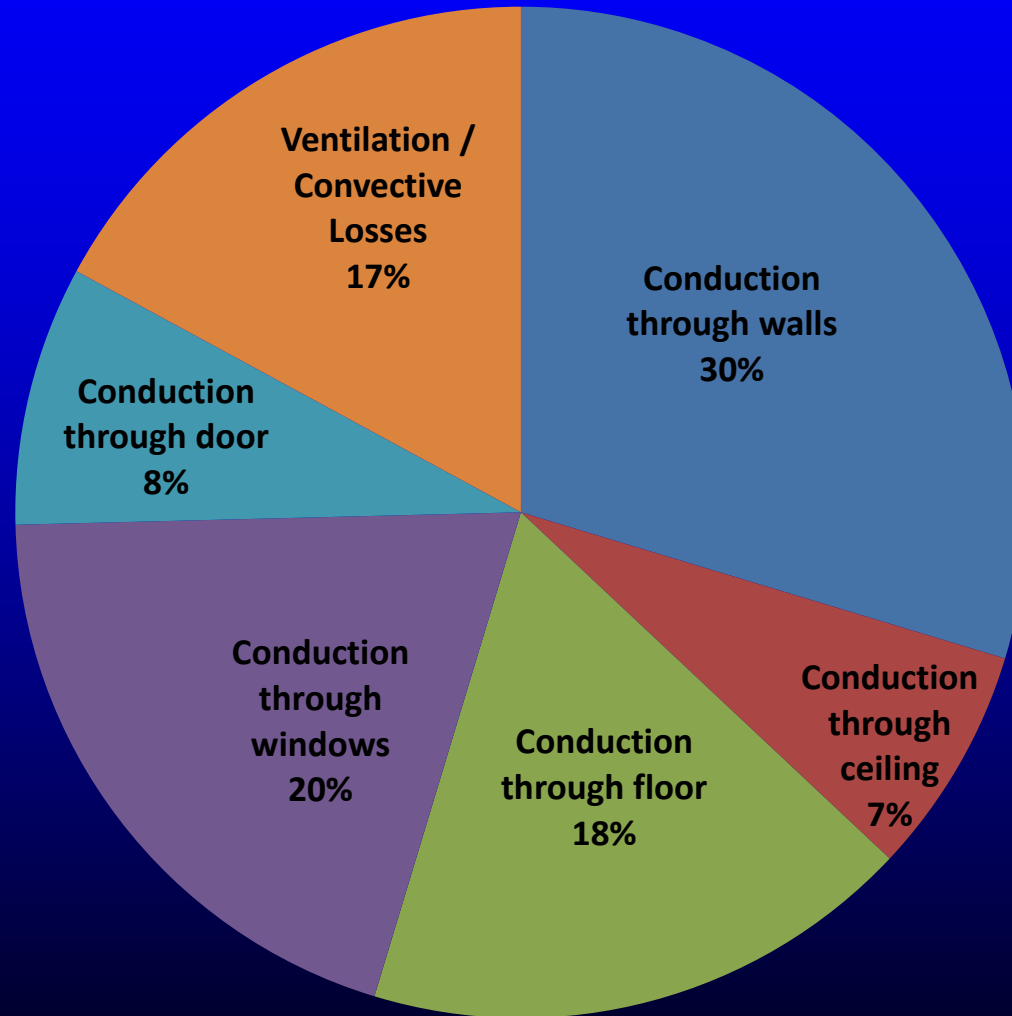


## Consideration:

Use air-source heat pump  
instead of an electric heater?

# Where is the heat going?

Total heat loss proportions

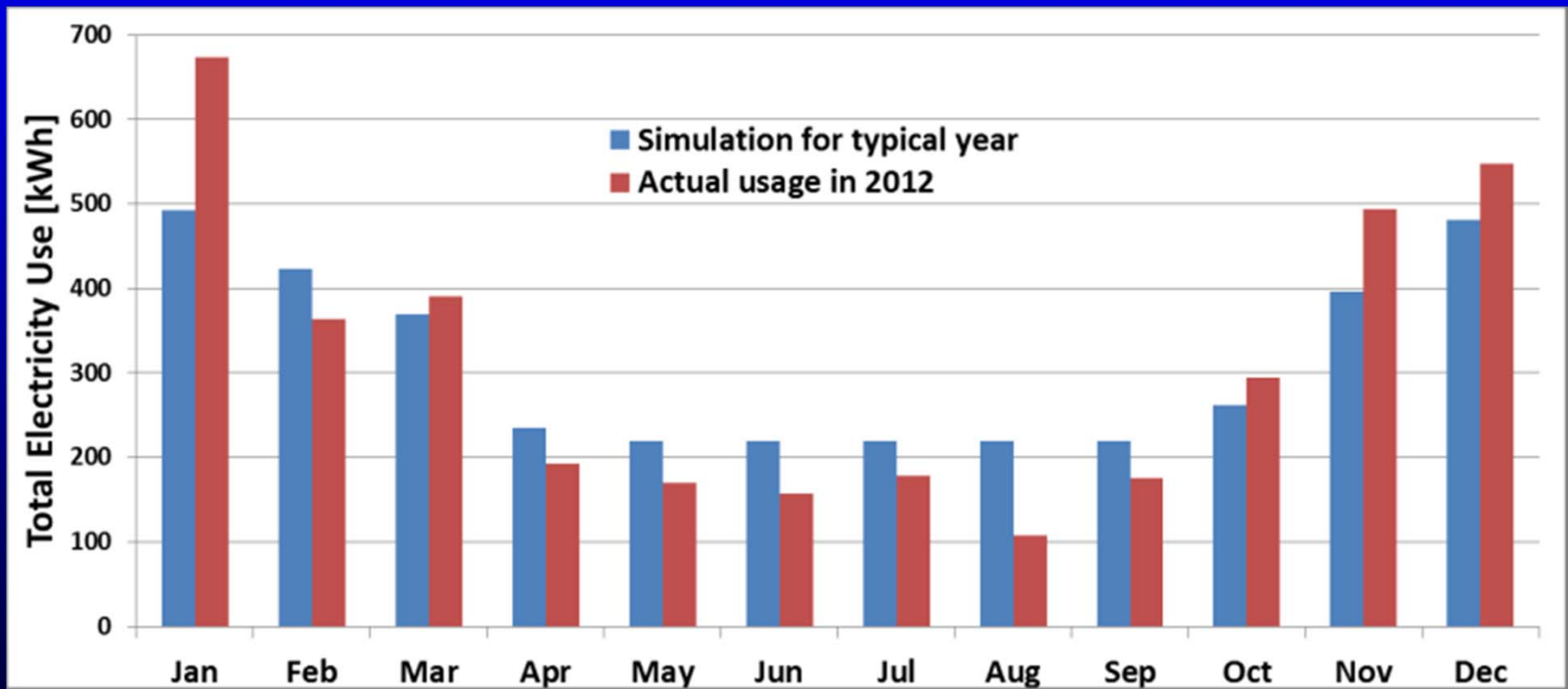




# Total annual electricity use

Based on simulation for typical year: 3,760 kWh

Total electricity actually used in 2012: 3,744 kWh



# Annual energy cost

	Electricity	Heating fuel	Total
Average house in Dillingham	(5,930 kWh) \$1,270	(700 gal of oil) \$4,200	\$5,470
Our house	(3,760 kWh) \$900	None	\$900

Notes:

\$0.17/kWh (after PCE) plus service fees

\$6 per gallon

700 gallon of oil per year is average for rural Alaska; data for Dillingham not available

# Material cost

Category	Cost	What is included
Land and gravel	\$42,900	Land, gravel, well, sewage system
Unequipped building	\$54,400	Foundation, roof, windows and door, walls (siding to sheetrock), insulation
HRV and accessories	\$1,300	HRV, weather hoods, ducts
Space heating system	\$400	Electric wall heater
Water heating system	\$1,900	Heat pump water heater
Plumbing and electrical	\$8,800	Rough plumbing and electrical, pressure tank, water softener, lighting
Interiors	\$59,800	Kitchen, flooring, plumbing fixtures, appliances, interior doors
<b>Total</b>	<b>\$169,500</b>	

Labor cost: ???

# 2013 Experiment

## Heating with an air-source heat pump



Results still unknown

# Conclusion



# Credits

## Individuals:

William Donaldson  
Gorden Isaacs  
Chet Chambers  
Fergus Hickling  
Dave Northup  
Mike Favors  
Dagen Nelson  
Kent Winship  
Jack Brown  
Tran Smyth  
Mike Davis  
Todd & Michele Radenbaugh  
Paul Liedberg  
Rick Lind  
Bryan Reed  
Jiri Marsik  
Russell Nelson  
Anthony Jett  
and many others ...

## Organizations:

UAF Bristol Bay Campus  
Alaska Building Science Network  
Cold Climate Housing Research Center  
Bristol Bay Housing Authority

**THANK YOU!**



# For more information

Go to the web

[energy-alaska.wikidot.com/nzer-dillingham](http://energy-alaska.wikidot.com/nzer-dillingham)