

PASSIVE HOUSE

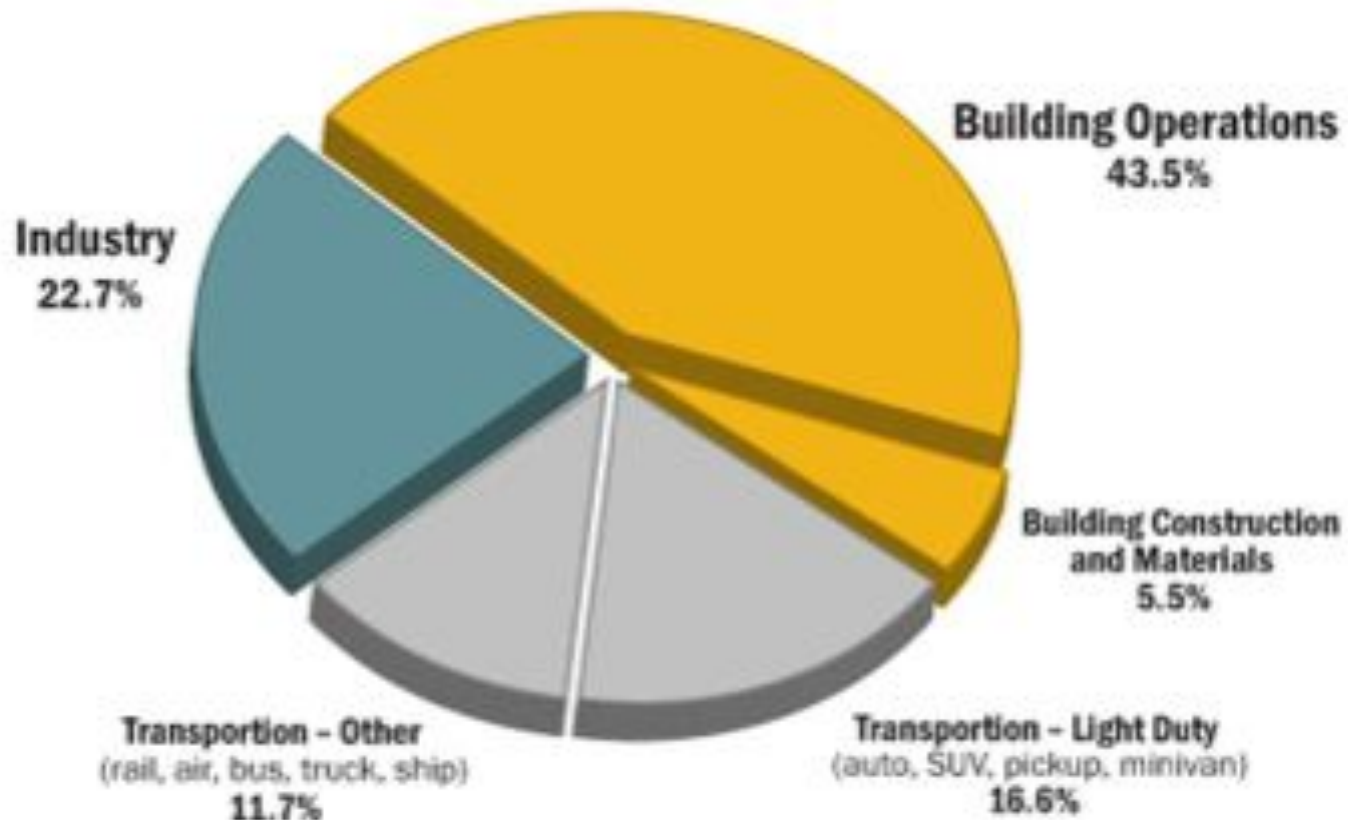
An Introduction to the Most Energy Efficient Homes in the World

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Eco Houses of Vermont, LLC

How much energy does a house use?



U.S. Energy Consumption by Sector

Source: ©2010 2030, Inc. / Architecture 2030. All Rights Reserved.
Data Source: U.S. Energy Information Administration (2009)

Vt State Comprehensive Energy Plan



- Recommends that 100% of new homes built in 2030 be Net Zero Houses.
- 30% of all new homes built to Net Zero by 2020.

Net Zero Goal: Two paths



Big Leaky House



40+ panels to get to Net Zero

Net Zero Goal and PH



Reasonable Sized PH

+



A few PV panels

Home Building Energy Triangle

It's the Recycling Triangle for Home Energy

1st Reduce Load



3rd Use fossil fuels sparingly if needed

2nd Use as many as you can renewables

How does it relate to other programs?

Energy Efficient Housing Concepts in the US:

Vermont Energy Code (RBES): required for all new construction

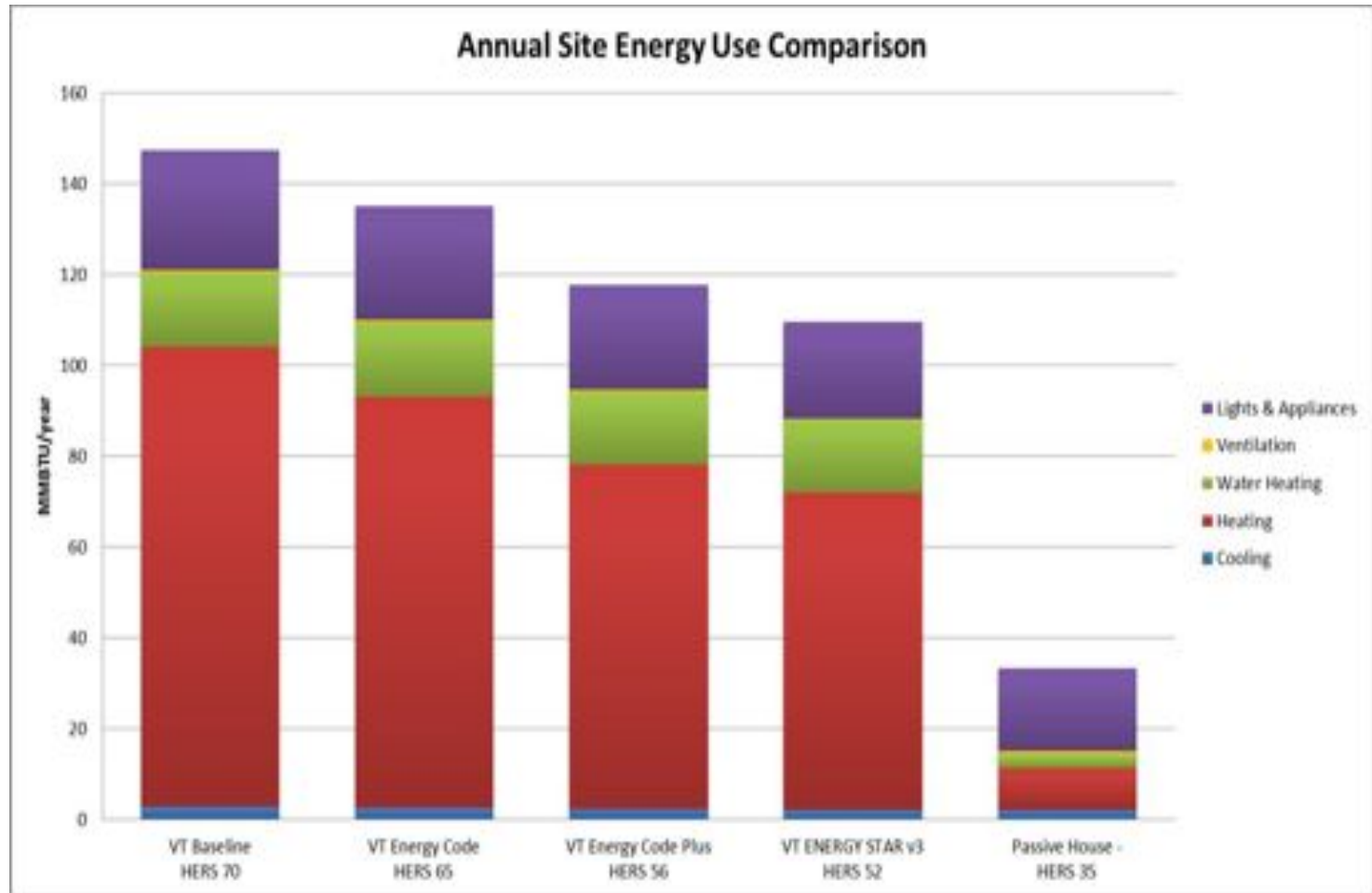
Energy Star 3.0: DoE Program (30% more efficient than Code)

Building America: DoE super energy savings Program (15% better than EStar)

Passive House: 90% more efficient than Code
 70% more efficient than Energy Star
 55% more efficient than Building America

Costs only max. of 15% more to build

Energy Usage Comparison



Passive House Results

- **90% reduction** in heating and cooling loads when compared to Code
- **70%-80% reduction** in total energy demand
- Superior **indoor air quality**
- Occupant **comfort**
- Lower annual energy costs
- **Smaller carbon footprint**

People say PH is expensive



Results from actual houses in Vermont:

Higher construction costs (10% to 15%)

Doesn't cost more! Monthly savings from Day 1.

Much higher quality construction means more durable and therefore a better value over time.

What are we talking about?

What is the payback on a marble counter top?



Passive House Costs

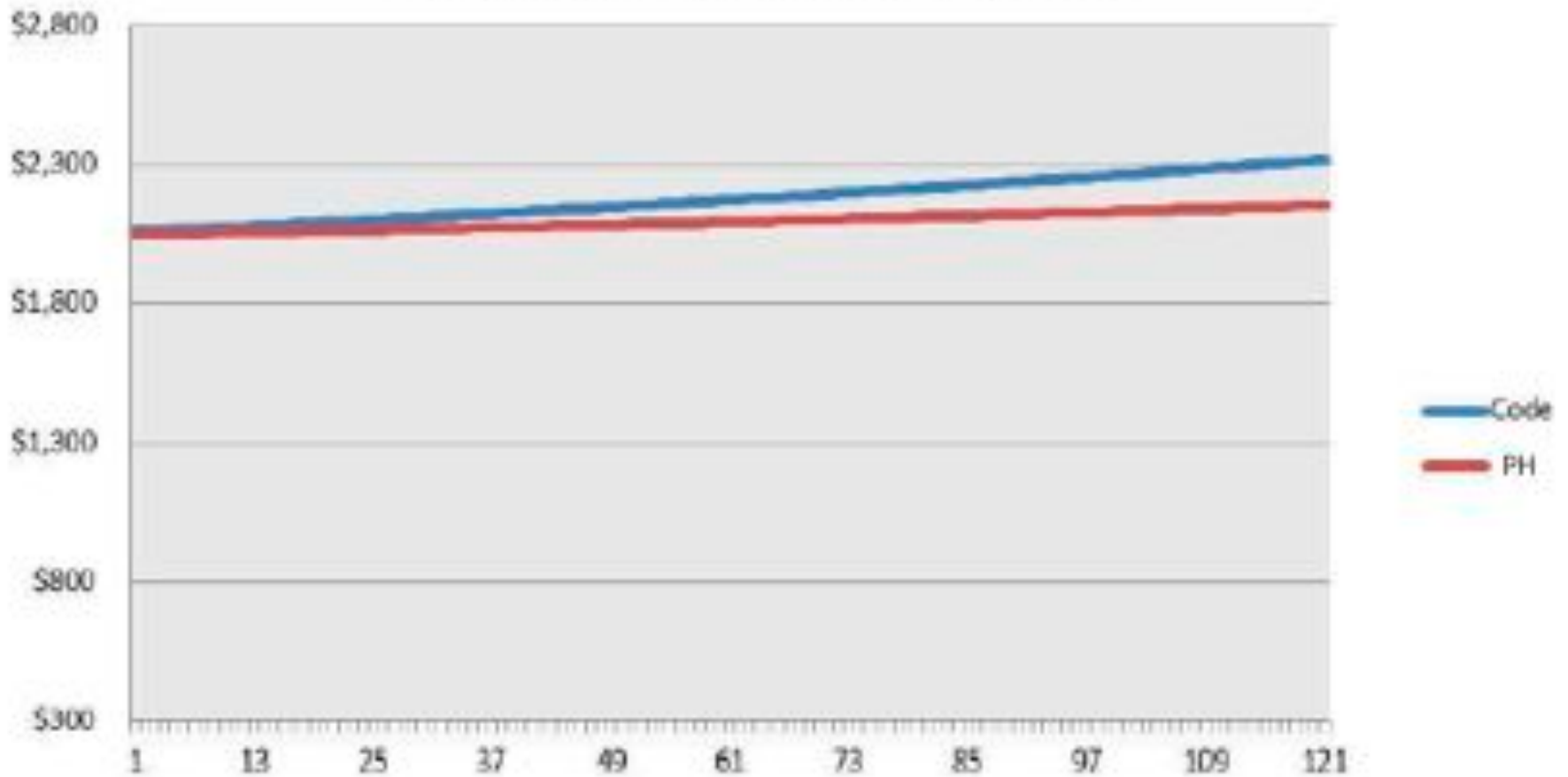
Costs up to 15% more to build than conventional construction

Saves 90% on Heating and Cooling Bills



Cost Analysis

Monthly housing cost over time



Vermont Case Study: HfH Charlotte

1,050 sq. feet interior space



Vermont Case Study: HfH Charlotte



Vermont Case Study: HfH Charlotte



EAST ELEVATION



NORTH ELEVATION

Vermont Case Study: HfH Charlotte

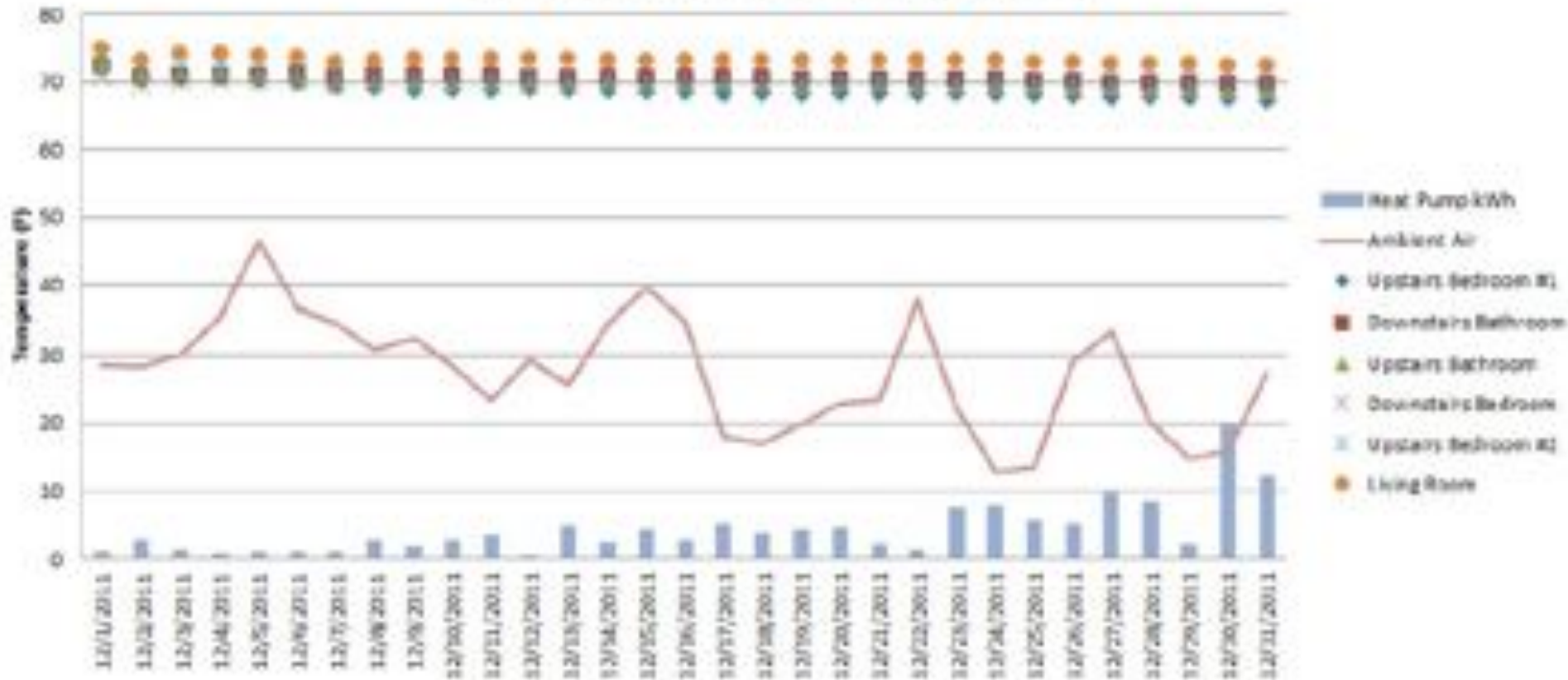


Vermont Case Study: Mechanicals

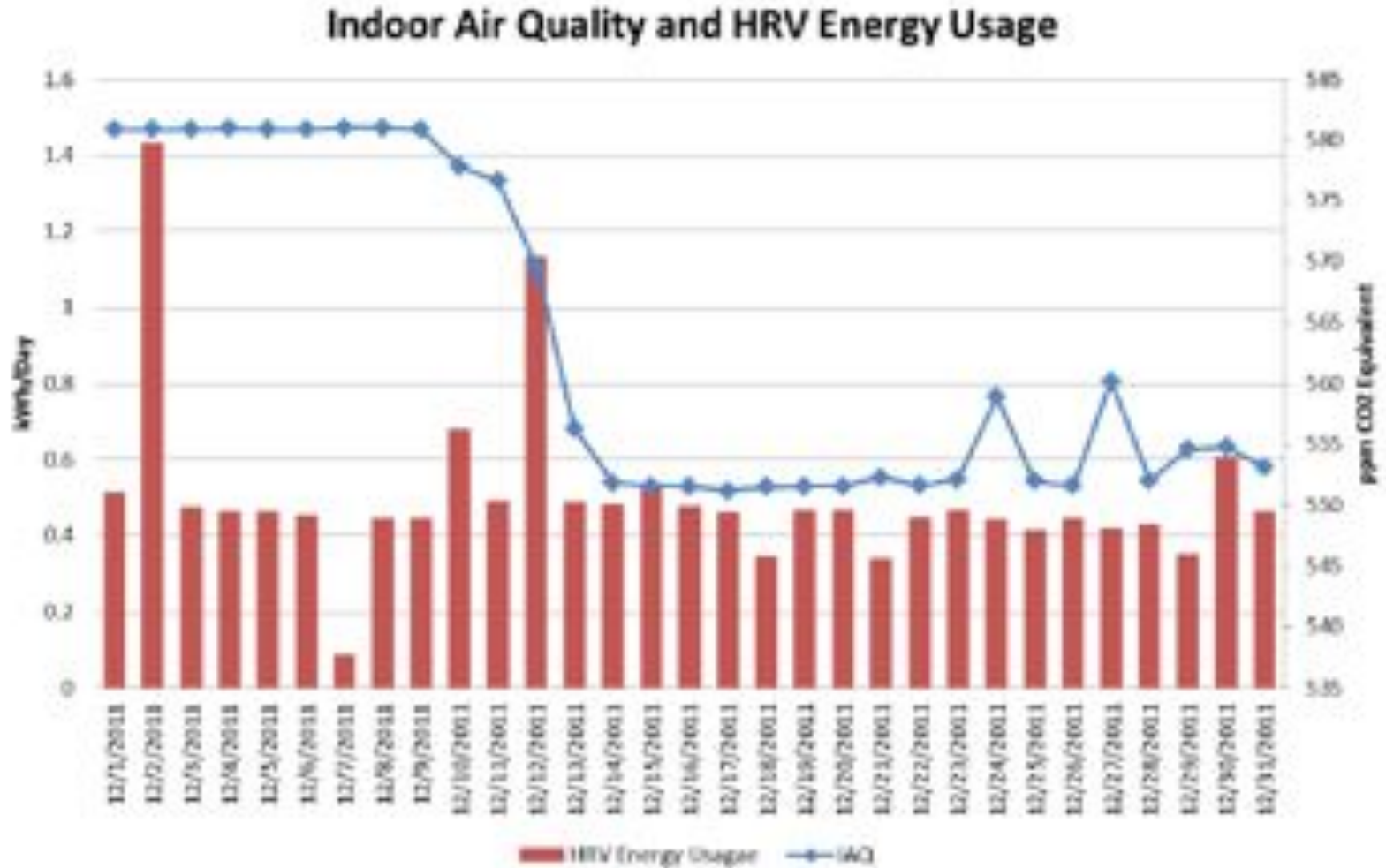


Vermont Case Study: Sensor Data

Temperature Variation with Point Source Heating & Heat Pump Energy Usage (135kWh)



Vermont Case Study: HVR Data



Vermont Case Study: Monthly Utility Bills

Monthly Utility Costs - Low Load #1
Average Monthly Cost - \$67



Includes Heating, Hot Water, Cooking, Lighting and all appliances.

Passive House Second Home

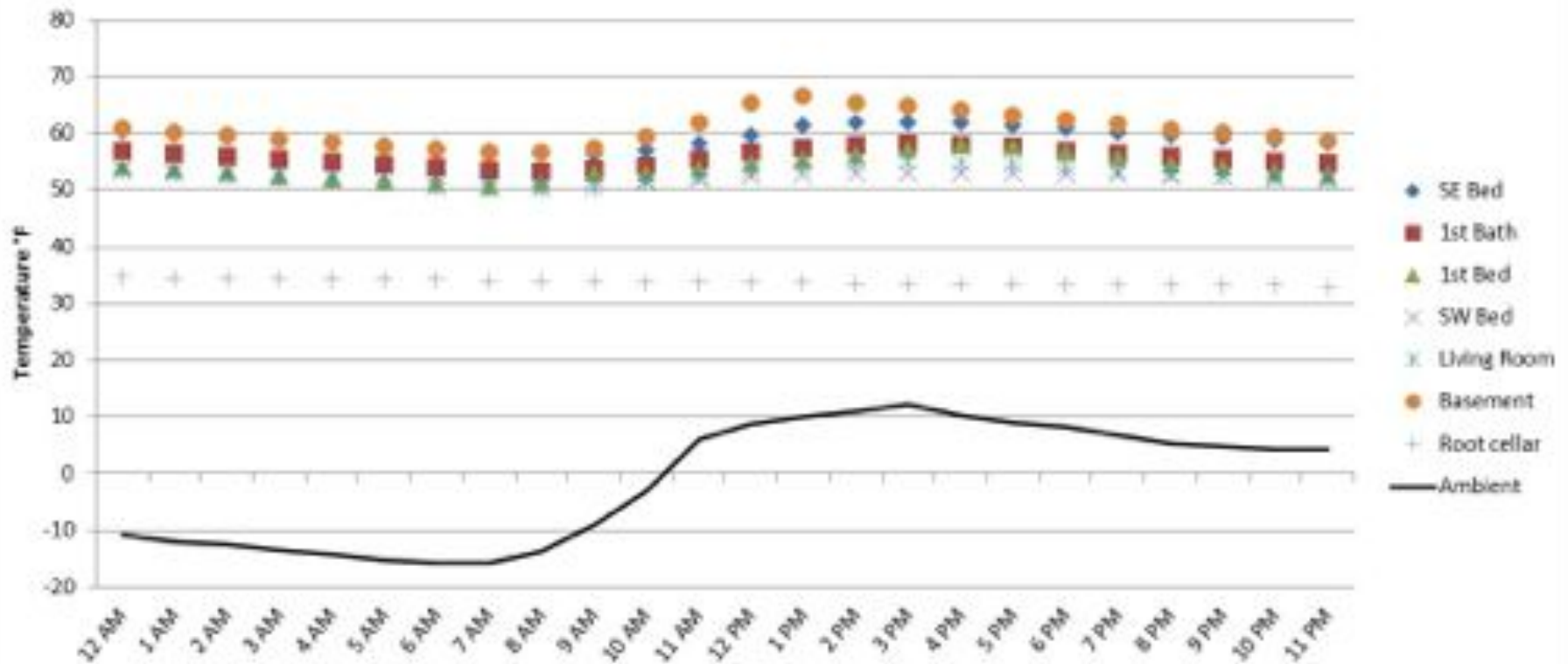


Passive House Second Home Performance

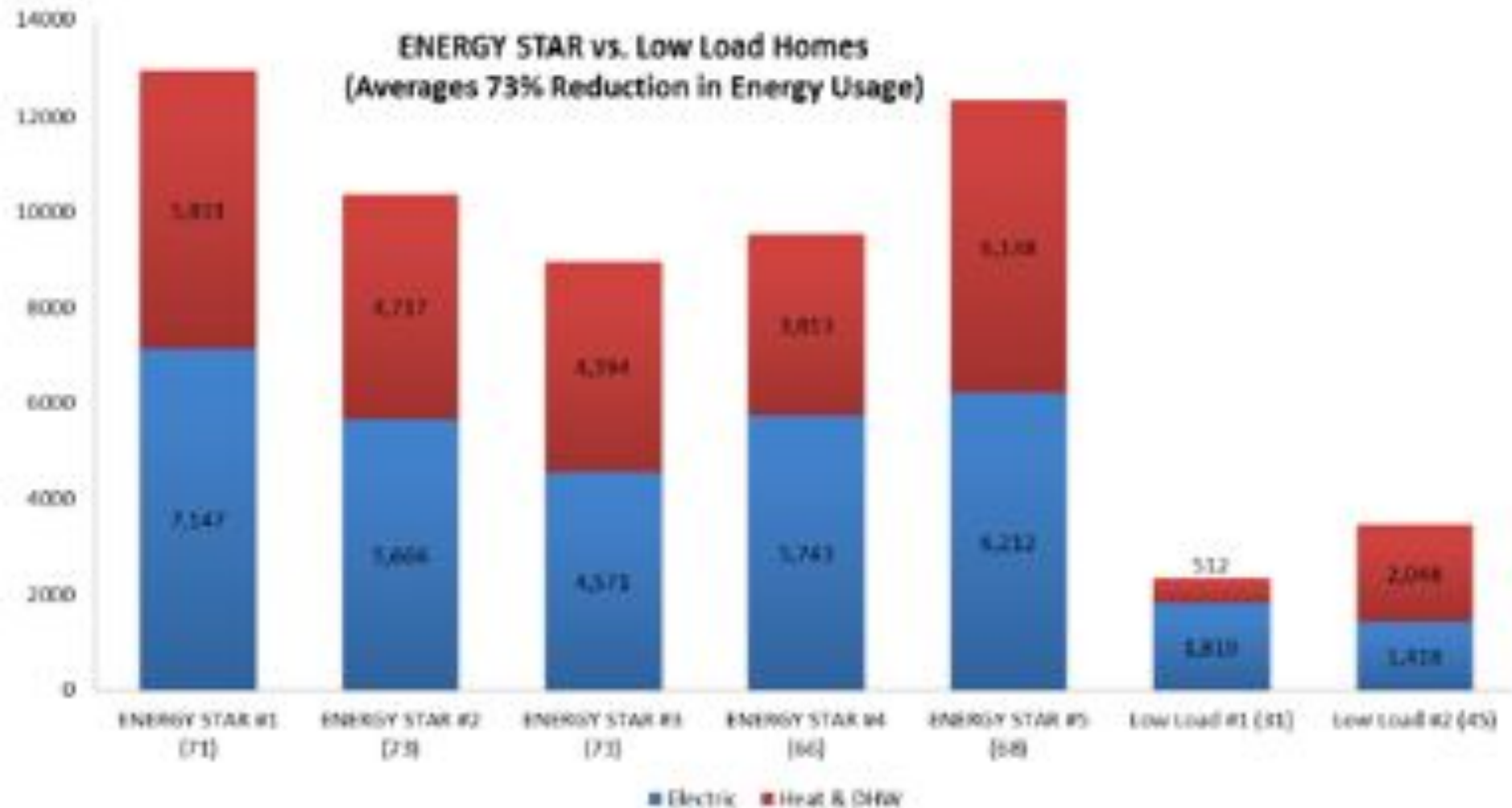
Space Temperatures with Heating and HRV Energy Usage

Residence G, Jan 24, 2013

Electric Radiant Heat: 0 kWh; HRV: 1 kWh



Passive House Performance Comparison to Energy Star



What Do Passive Houses Look Like?



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What Do Passive Houses Look Like?



Conclusion



Passive House

- High quality home
- Healthier living environment
- Slightly more expensive to build
- Payback in 3 – 7 years (depending on price rise)
- Monthly cost is the same from day one!
- 90% cheaper to live in (heating/cooling bills)
- High resale value expected
- Zero energy home easily attainable with PH