

7th Annual North American Passive House Conference
September 27-30, 2012 Denver CO

HAWKINS HOUSE: THE REAL COSTS AND LESSONS LEARNED

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Passive House Institute US

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Session Learning Objectives:

- Understand the design implications of the cost Passive House over Code built homes
- Learn the cost comparisons between Passive House and Code built homes
- Learn the results of the monitoring data
- Understand the lessons learned on the construction of the first Passive House in a cold climate

Hawkins House – Halifax, NS



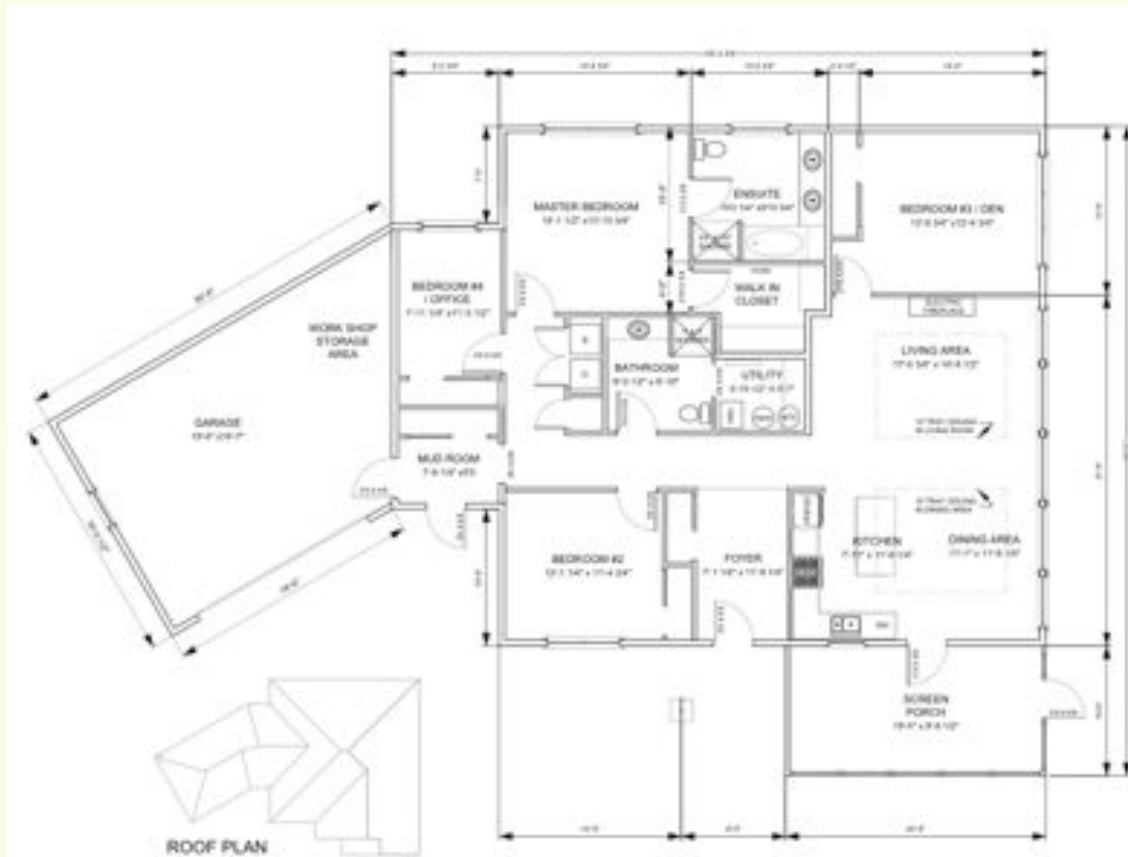
Design Objectives

- Match with Local Residential Vernacular
- Targeting Passive House Standard
- Targeting LEED for Homes Gold Certification
- Implementing Lifetime for Homes Aging in Place Standards
- Utilizing locally available building materials
- Cost control
- Market acceptance



Design Strategies

- Reduce site disturbance
- Simple, compact building shape
- Centralize plumbing and HRV
- Maximize solar gain
- Daytime living space to the south
- Garage to the north
- Also design to accessibility/aging in place guidelines



Building Summary: 1645 SF

- 1-storey new construction
- Concrete foundation, wood frame structure
- Passive House and LEED For Homes Gold certification
- Tested at 0.46ACH air tightness
- Using local and resource-efficient materials



Engineered Slab on Grade Foundation

- 8" EPS center of slab
- 8" vertical perimeter insulation



Double Wall Construction

2 x4 load bearing interior wall with roxul batt insulation

12" I-joist exterior wall with dense packed blown in cellulose



Roof Construction

- Standard roof trusses with 24" raised heel
- 28" blown in cellulose



American Doors/Canadian Windows



THERMA TRU
DOORS

accurate
dorwin



Air Sealing



Heating and Domestic Hot Water

- ETS (Electric Thermal Storage) and electric baseboards
- ETS qualifies for NSPI Time of Use program
- Cooled with manual night ventilation only
- Simple, low maintenance system for the homeowner
- Thermal Solar provides 50% of hot water needs



LEED Features

- Protection of the natural habitat on the site
- Sustainable landscape plan
- Exceptional energy efficiency
- Building durability strategies
- Improved indoor air quality
- LED and CFL lighting
- Local and recycled materials
- Low VOC glues, paints and caulking
- Low flow toilets and faucets
- Construction waste management



Accessibility/ Aging in Place Features

- Wide hallways
- Levered handles on windows, doors, faucets and cabinets
- Right height toilets
- Lower light switches and raise plug heights
- One floor living with no thresholds between rooms
- Accessible sill on entry door from garage
- Adequate space in bathrooms for wheelchair or walker



Incremental Cost Analysis

Objectives

- Provide verified cost numbers
- Establish first step in a more thorough post-construction analysis of the project
- Develop tools to talk to policy makers
 - Interest in shifting costs from equipment to labour
 - Use tools that are already in use

Costing Methodology

- 1) Receipt/accounting review
- 2) Construction manager estimates
- 3) RSMeans CostWorks Data
- 4) Local sub-contractor estimates
- 5) In-office estimates using local material suppliers
- 6) Derived from previously verified costs

Base Case House

Modelled as Nova Scotia Code Compliant House

Walls	R-24
Attic	R-40
Slab	R-10
Ventilation	HRV
Windows	Double Glazed, Low-E Argon Equal Glazing All Directions Same Glazing Area/Equal Distribution
Doors	Steel Polystyrene
Heating	Oil Furnace 85% AFUE / Electric Infloor Radiant
DHW	Electric Tank
ACH	2.5 ACH50

Incremental Costs

Incremental Costs by Component		
	Oil Furnace Base Case	Infloor Electric Radiant Base Case
Foundation	\$4,705.48	\$4,705.48
Wall Assembly	\$6,225.57	\$6,225.57
Attic	\$2,460.26	\$2,460.26
Ventilation	\$3,449.90	\$3,449.90
Windows	\$1,804.00	\$1,804.00
Doors	\$3,358.45	\$3,358.45
Air Sealing	\$3,427.37	\$3,427.37
Heating	(\$4,025.00)	(\$12,025.00)
DHW	\$5,290.00	\$5,290.00
<i>Incremental Costs</i>	<i>\$26,696.03</i>	<i>\$18,696.03</i>
Rebates	(\$10,837.00)	(\$10,837.00)
Total Cost Increase	\$15,859.03	\$7,859.03

Energy Modelling Results

Projected Energy Consumption and Costs

	Passive House	Code House Oil	Code House Infloor
Heating	1256.40 kWh/year	874.43 litres of oil/year	7449.50 kWh/year
Domestic Hot Water	3237.50 kWh/year	5228.30 kWh/year	5228.30 kWh/year
Ventilation	382.70 kWh/year	657.00 kWh/year	657.00 kWh/year
<i>Total Consumption</i>	<i>4876.60 kWh/year</i>	<i>15302.91 ekWh/year</i>	<i>13334.80 kWh/year</i>
Projected Annual Costs	\$651.51	\$1,695.68	\$1,781.53
	Over Code Oil	Over Code Infloor	
Projected Annual Savings	\$1,044.17	\$1,130.02	
Oil Price (\$/L)	\$1.04		
Electricity Price (\$/kWh)	\$0.13		

Financial Analysis

	With Rebates		Without Rebates	
	Oil Furnace Base Case	Infloor Electric Base Case	Oil Furnace Base Case	Infloor Electric Base Case
Incremental Cost	\$15,859.03	\$7,859.03	\$26,696.03	\$18,696.03
Discount Rate	5.00%	5.00%	5.00%	5.00%
Time period	25	25	25	25
Annual Savings	\$1,044.17	\$1,130.02	\$1,044.17	\$1,130.02
Utility Price Increase (UPI)	2.50%	2.50%	2.50%	2.50%
Equivalent Annual Cost (EAC)	(\$1,125.24)	(\$557.62)	(\$1,894.15)	(\$1,326.53)
Simple Payback	15.19	6.95	25.57	16.54
Net Present Value (NPV)	\$3,041.49	\$12,595.39	-\$7,795.51	\$1,758.39

	With Rebates		Without Rebates	
	Oil Furnace Base Case	Infloor Electric Base Case	Oil Furnace Base Case	Infloor Electric Base Case
Incremental Cost	\$15,859.03	\$7,859.03	\$26,696.03	\$18,696.03
Discount Rate	3.75%	3.75%	3.75%	3.75%
Time period	25	25	25	25
Annual Savings	\$1,044.17	\$1,130.02	\$1,044.17	\$1,130.02
Utility Price Increase (UPI)	2.50%	2.50%	2.50%	2.50%
Equivalent Annual Cost (EAC)	(\$988.52)	(\$489.87)	(\$1,664.01)	(\$1,165.36)
Simple Payback	15.19	6.95	25.57	16.54
Net Present Value (NPV)	\$5,978.82	\$15,774.21	-\$4,858.18	\$4,937.21

PH vs Actual Energy Use (annual)

	PH Requirement	PHPP Calculated	Actual
Heat Load	2292.5	2170.2	1847.0
Site Energy	6792.4	6749.4	7753.0

Notes: Based on TFA= 152.8m²

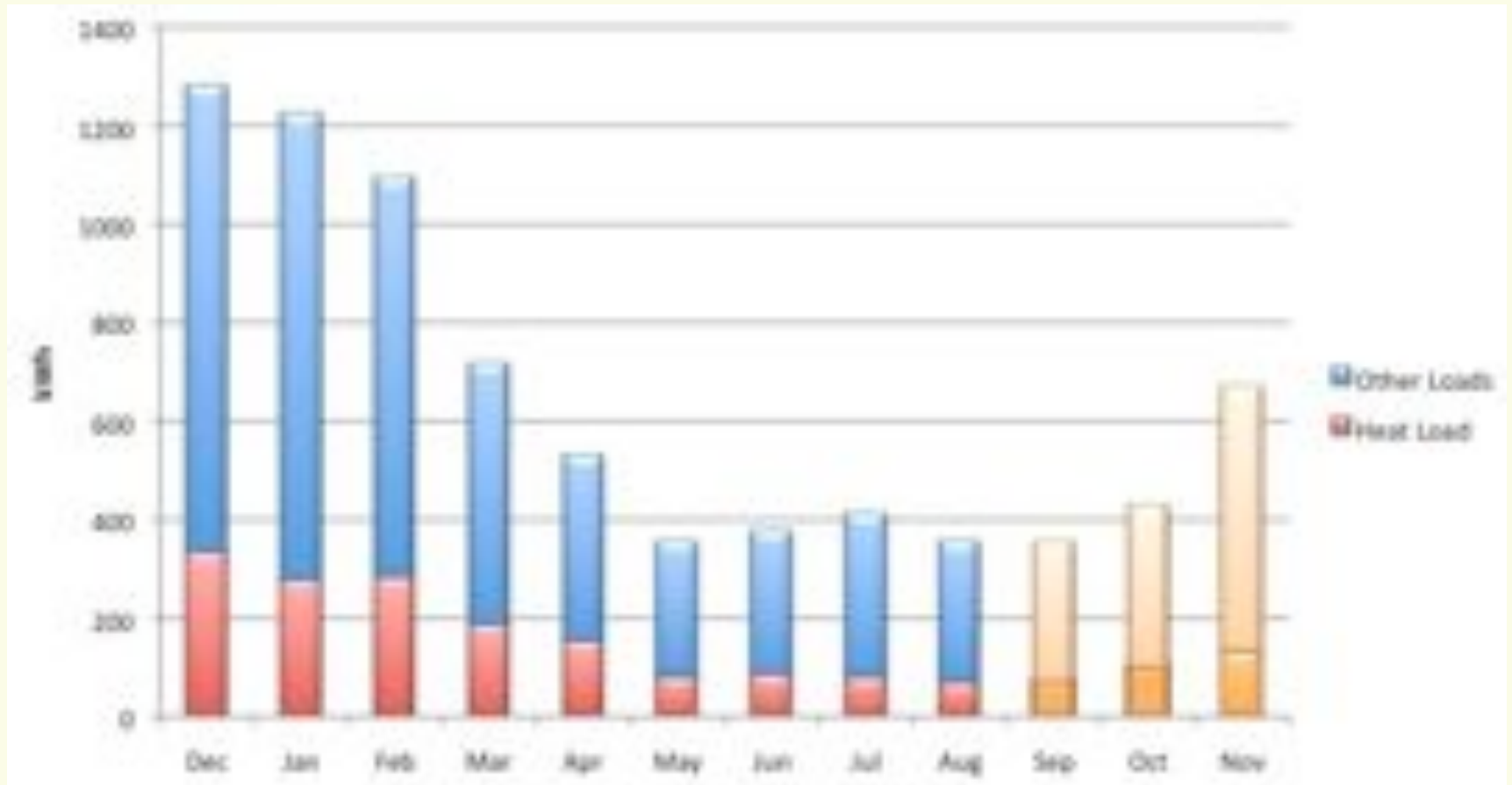
Actual based on homeowner's power bills

Sept and Oct estimated to calculate annual totals

Heat system controls required adjustment after monitoring

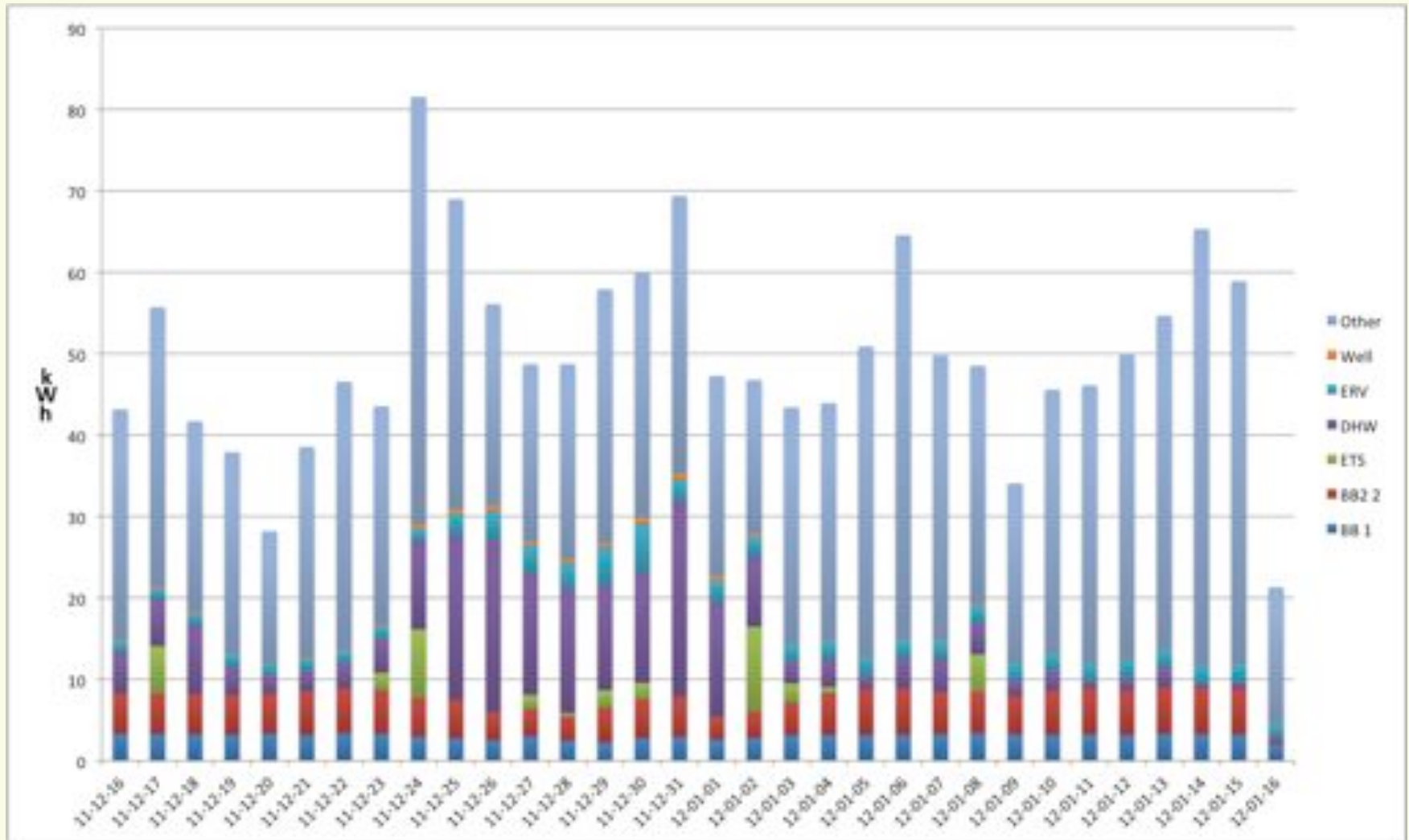
User plug loads reduced after monitoring

Monthly Monitoring Summary



Note: Sept, Oct, and Nov months estimated for the remainder of the year

Monitoring Results – Dec. 2011



Lessons Learned

Smart design is critical to cost effectiveness.

- Reducing the footprint
- Simplifying the shape of the building envelope
- Optimizing the window design
- Centralizing plumbing
- Planning for ventilation ducting



Lessons Learned

- The trades won't thoroughly read the drawings, onsite explanations and supervision are required.
- Establishing collaboration between the consultants and the trades is invaluable. You need them all engaged in onsite troubleshooting.
- The simple step of introducing and connecting subtrades to each other helps bridge the usual lack of cooperation between trades.



Lessons Learned

- Standard construction task scheduling can change, making it hard to bridge smoothly between subtrades.
- Thinking through the schedule of tasks and reassigning tasks to a trade that normally does not handle these tasks is sometimes necessary.



Lessons Learned

- A report of a suitable material or product from another project will not necessarily perform in your climate.



Lessons Learned

- Regular quality assurance inspections are critical.
- Finding issues early and before they are covered in saves \$\$ and time.
- Testing air tightness at critical points in construction is the main tool to support QA.
- Thermal imaging to insure the quality of the insulation installation is key.



Further Information

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