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BUILDING TECHNOLOGIES OFFICE

Hood River Passive House

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Washington State University
Extension Energy Program, BA-PIRC

January 2014

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Hood River Passive House

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Unless otherwise noted, all figures were created by BA-PIRC.

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Definitions

ACH_{50}	Air changes per hour at 50 Pascals
BA	Building America
BA-PIRC	Building America Partnership for Improved Residential Construction
BEoptE+	Building Energy Optimization
CO_2	Carbon dioxide
DHW	Domestic hot water
HRV	Heat recovery ventilator
HVAC	Heating, ventilation, and air conditioning
IECC	International Energy Conservation Code
NEEA	Northwest Energy Efficiency Alliance
PHPP	Passive House Planning Package
SIP	Structurally insulated panel

Executive Summary

The Washington State University Energy Program, as a Building America Partnership for Improved Residential Construction (BA-PIRC) team member, has been working with builders in the marine and cold climates of the Pacific Northwest for more than 20 years to develop exceptionally efficient residential construction practices. The Hood River Passive House Project was developed by Root Design Build of Hood River, Oregon, using the Passive House Planning Package (PHPP) to meet all of the requirements for certification under the European Passive House standards (Passive House Institute US 2007).

The Passive House design approach has been gaining momentum among residential designers for custom homes. BEoptE+ modeling (NREL 2013) indicates that these designs may actually exceed the goal of the U.S. Department of Energy BA program to "reduce home energy use by 30%-50% (compared to 2009 energy codes for new homes)." The project was initiated in 2009 but market conditions delayed final completion until the third quarter of 2012. The project did not involve BA-PIRC input in the design process; it was initiated to evaluate the output of the Passive House design process as supported by Passive House Institute US in North America.

This is the final report of the project, which documents:

- Test results (blower door and tracer gas testing and on-site confirmation of as-built characteristics)
- Twelve months of monitoring (electrical billing data, energy end uses, and interior environmental conditions)
- Final construction costs.

The results of PHPP and BEoptE+ modeling of the project are reviewed and compared to monitored energy performance. The design includes high R-value building assemblies, extremely tight construction, high performance doors and windows, solar thermal domestic hot water (DHW), heat recovery ventilation, movable external shutters, and a high performance ductless mini-split heat pump.

Monitoring the energy performance of the home shows that the ultra-high performance building enclosure produces excellent performance and significantly reduces space conditioning energy use. Coupled with a high performance space conditioning appliance, monitored heating and cooling site energy use was reduced by 75% below the estimated use for a similar sized home meeting the 2009 International Energy Conservation Code in climate zone 5. Total site energy consumption with the enhanced enclosure and additional measures (DHW, lighting, refrigeration, and other appliance efficiencies) was less than 5,000 kWh/year.

Cost analysis indicates that many of the measures implemented in this project did not meet the BA standard for cost neutrality. The ductless mini-split heat pump, lighting, and advanced air leakage control were the most cost-effective measures. The future challenge will be to value engineer the performance levels observed here using production-based practices at a significantly lower cost.

Figure 1. Hood River Passive House architect's rendering

1 Project Description

1.1 Introduction

The Hood River Passive House Project was developed by Root Design Build of Hood River, Oregon, using the Passive House Planning Package (PHPP) to meet all of the requirements for certification under the European Passive House standards. The Passive House design approach has been gaining momentum among residential designers for custom homes. BEoptE+ modeling indicates that these designs may actually exceed the goal of the U.S. Department of Energy Building America (BA) program to "reduce home energy use by 30%-50% (compared to 2009 energy codes for new homes)."

The Passive House performance standards are summarized in Table 1. The project did not involve Building America Partnership for Improved Residential Construction (BA-PIRC) input in the design process; it was initiated to evaluate the output of Passive House design process as supported by Passive House Institute US in North America.

Table 1. Passive House Performance Requirements

Measure	Requirement
Space Heating Demand	< 4.75 kBtu/ft^2-yr
Space Cooling Demand	< 4.75 kBtu/ft^2-yr
Total Source Energy	< 38.0 kBtu/ft^2-yr
Mean Ambient Radiant Interior Surface Temperatures	> 68^{o}F
Frequency of Overheating (> 77^{o}F)	< 10% of time
Ventilation	Heat recovery
Air Changes per Hour at 50 Pascals (ACH_{50})	< 0.60

1.2 Background

In 2009, Passive House Institute US conducted training in Portland, Oregon and Seattle, Washington. This training, attended by approximately 60 architects, contractors, and mechanical engineers, stimulated a number of projects in the region, including the Hood River project. As the project developed, BA-PIRC facilitated the acquisition of materials to enhance the project, including procuring windows and doors from Internorm in Austria. Because of financing constraints and other market conditions, the project moved slowly and was not completed until the third quarter of 2012. The home has been occupied since October 2012.

Figure 2. Hood River Passive House near completion

Modeled predictions compare well with the measured performance of completed Passive Houses, as verified by research in Europe conducted by the Cost Efficient Passive Houses as European Standards project and monitoring of early Passive House projects in the United States for BA (Stecher and Allison 2012). Production builders have been reluctant, however, to embrace measures required to meet Passive House standards based on assumed costs and the often nontraditional approaches used for space conditioning. Design assistance was not provided by the BA team on this project. BA-PIRC, with team member Washington State University Energy Program, approached this project as an opportunity to evaluate the Passive House design approach and process outcomes, document home performance, track costs, and determine obstacles to moving the Passive House into a cost-effective production environment.

1.3 Climate

The Hood River Passive House is located near the east entrance to the Columbia River Gorge in climate zone 5 dry. Climate data are shown in Table 2.

Table 2. Climate Data

Heating Degree Days$_{65}$	5,499
Cooling Degree Days$_{70}$	88
Annual Precipitation	30.0 in.

1.4 Contact Information

Table 3. Contact Information

Team Contact	Company	Phone	Email
V J Jovanovic	Root Design Build	503-515-6478	vj@rootdesignbuild.com
David Hales	Washington State University Energy Program	509-443-4355	halesd@energy.wsu.edu

Hood River Passive House is located at 4070 Belmont Dr., Hood River, OR 97031.

2 Building Characteristics

The Hood River Passive House project is a 2,004 ft^2 (1,674 ft^2 as defined in PHPP analysis), two-story house built on a slab-on-grade. Additional characteristics are provided in Table 4.

Table 4. Hood River Passive House Characteristics

Measure	2009 IECC[a] Climate Zone 5	Hood River Passive House
Walls R-Value	20	50.5[b]
Slab-on-Grade R-Value	10	43.5[b]
Ceiling R-Value	49	76.6[b]
Heat Pump Heating Season Performance Factor/Seasonal Energy Efficiency Ratio	7.7/13	11/22
DHW Electrical Energy Factor	.87	Solar thermal
Ventilation	ASHRAE 62.2	HRV
Windows U-Value	0.32	0.09[b]
Doors U-Value	0.32	0.13[b]
Air Sealing	7.0 ACH_{50}	0.3 ACH_{50} tested
Shading	Not required	Moveable exterior
Lighting	40% compact fluorescent lamps	100% compact fluorescent lamps + light-emitting diodes

[a] International Energy Conservation Code (ICC 2009)
[b] Values as derived in PHPP

The high R-value walls were achieved with 8-in. structurally insulated panels (SIPs) covered with an additional 4 in. of expanded polystyrene sheathing. The vaulted ceilings are 12-in. SIPs with an additional 4 in. of expanded polystyrene sheathing. There are 9 in. of expanded polystyrene under the entire slab and at the perimeter. All of the fenestration is from Internorm in Austria with U-values as prequalified by Passivhaus Institut but that do not necessarily equal published values derived from standardized test methods.

Domestic hot water (DHW) is provided by a solar thermal system with electric resistance backup. Heating, ventilation, and air conditioning (HVAC) is provided by a single-head high performance ductless mini-split heat pump with electric resistance baseboards as backup and a heat recovery ventilator (HRV) set up to meet ASHRAE 62.2 2010. Shading to protect against overheating is provided by a system of movable exterior panels (under construction at the time of this report).

3 Modeling

Modeling was done using BEoptE+ 1.2 and the 2007 U.S. version of PHPP. Table 5 shows the breakout of modeled source energy end uses for the BA benchmark and the Hood River House as derived in BEoptE+ and PHPP. The project has a Home Energy Rating System index of 40.

Table 5. BEoptE+ Versus PHPP Modeled Source Energy

Source Energy Use (MMBtu/yr)	BA Benchmark From BEoptE+	BEoptE+ Hood River House	PHPP Hood River House
Heating	46.2	1.0	5.0
Cooling	8.4	7.3	4.8
Hot Water	40.9	6.4	2.8
Large Appliances	26.0	12.1	8.6
Lighting	19.6	12.7	2.4
Ventilation Fan	1.6	2.8	4.2
HVAC Fan	8.3	0.9	0.7
Miscellaneous	39.2	38.8	8.6
Total	190.2	82.0	37.1

BEoptE+ modeling predicts a 57% reduction in whole-house source energy use. PHPP indicates an 80% source energy reduction from the BA benchmark as modeled in BEoptE+ (see Figure 3 and Figure 4). The large discrepancy is mostly associated with assumptions about modeling miscellaneous loads, but significant variations are also seen in lighting, DHW, and cooling. Some of the cooling difference may be a result of the inability of BEoptE+ to directly model the exterior movable shading included in the project. For BEoptE+ modeling, interior shading was assumed with no shading in winter and 80% shading in summer. BEoptE+ models cooling hourly but PHHP does not. There are also different assumptions on internal gains.

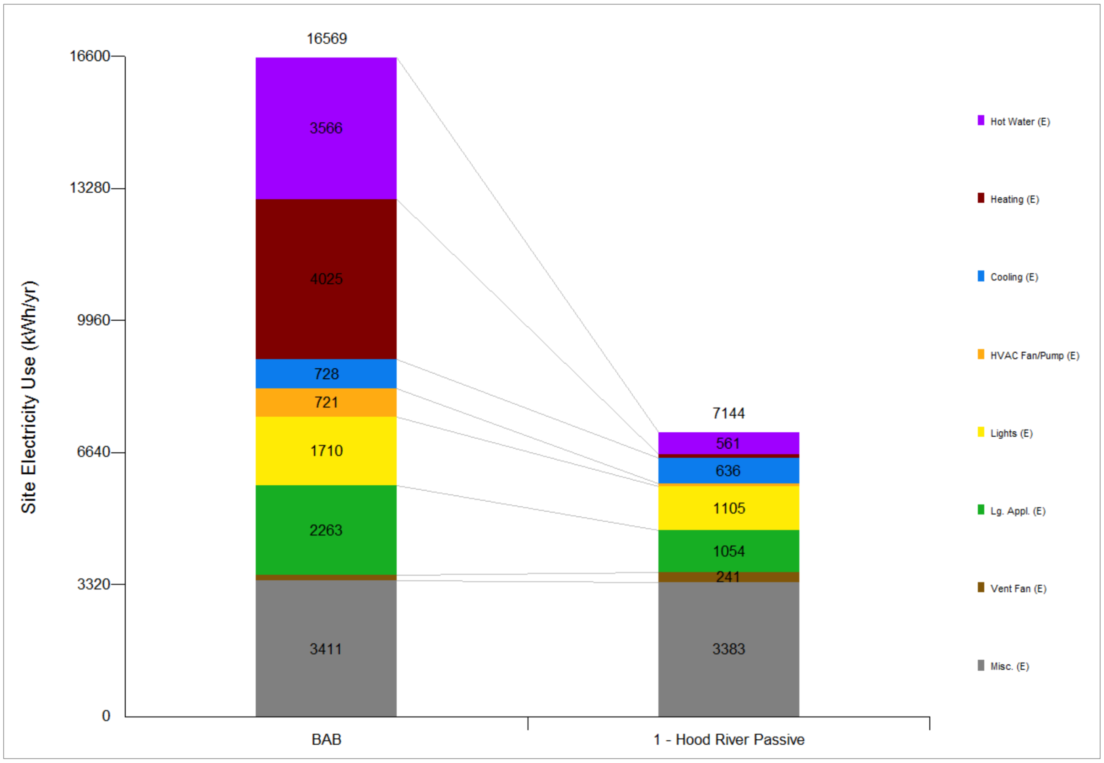

Figure 3. Hood River Passive House site energy from BEoptE+ modeling

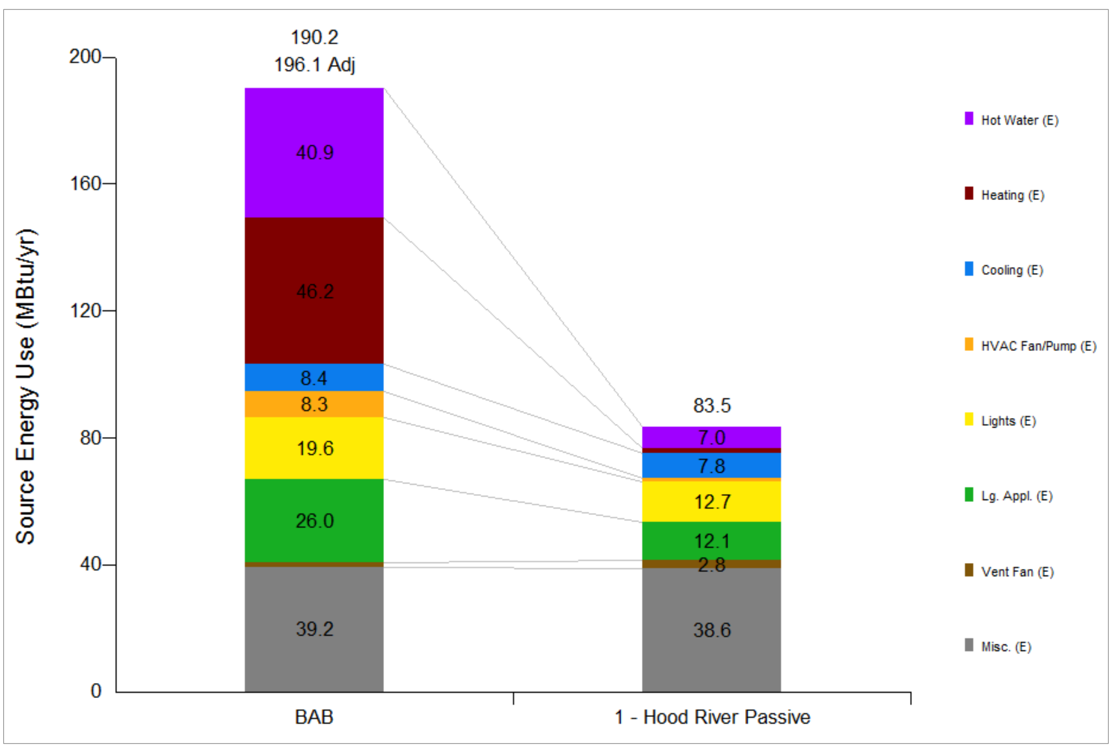

Figure 4. Hood River Passive House source energy from BEoptE+ modeling

4 Monitoring

Table 6 shows electrical utility bills during occupancy, from November 2012 through September 2013. See Appendix B for a comparison to other similar homes in the utilities service area.

Table 6. Electrical Utility Billing Data

Date	Days	kWh/day	kWh	Ave Temp	HDD_{65}	Charge
12/11/2012	32	20	631	43	704	$68.09
1/14/2013	34	23	768	33	1088	$81.39
2/13/2013	30	21	622	38	810	$68.79
3/11/2013	26	16	409	43	572	$48.74
4/10/2013	30	11	343	50	450	$42.53
5/8/2013	28	11	300	55	280	$38.51
6/10/2013	33	12	394	59	198	$48.91
7/10/2013	29	12	356	71	0	$44.20
8/12/2013	33	9	289	76	0	$37.77
9/9/2013	28	10	272	74	0	$36.16
10/8/2013	29	10	285	64	30	$37.25
11/6/2013	29	9	270	50	305	$35.87
Totals	361	13.7	4939	54.7	4102	$588.21

Major electrical loads were monitored at the electrical service panel and logged with a HOBO U-30 with an Ethernet connection for daily data access. Monitored loads included total service, mini-split heat pump, electric resistance backup heat, DHW electric resistance backup, and electric cooking. Table 7 shows the break out of energy end uses based on monitored use compared to modeled results for the house built to the 2009 IECC.

Table 7. Energy End Uses

Item	2009 IECC Model	Hood River Passive House
Annual Total Site Energy (kWh)	16,569	4,987
Space Conditioning (kWh)	5,474	1,343 total 1,092 heat pump 251 electric resistance
Utility DHW (kWh)	3,509	672
All Other Loads (kWh)	7,586	3,156
Site Energy Reduction Below 2009 IECC	0%	68.8%

The use of a Metrima SVM F2 flow meter to determine hot water use and calculate a solar fraction for the solar DHW system failed. Based on performance analysis of other solar DHW systems in the region, a 50% solar fraction would be typical.

HOBO H08 environmental loggers were used to collect hourly data on temperature and relative humidity at six locations: master bedroom, master bath, guest bedroom, main living area, family room/study, and northern exposure outdoor ambient conditions. Figure 5 shows a 24-hour temperature plot for January 1, 2013, a typical cold winter day. Appendix A has the complete dataset.

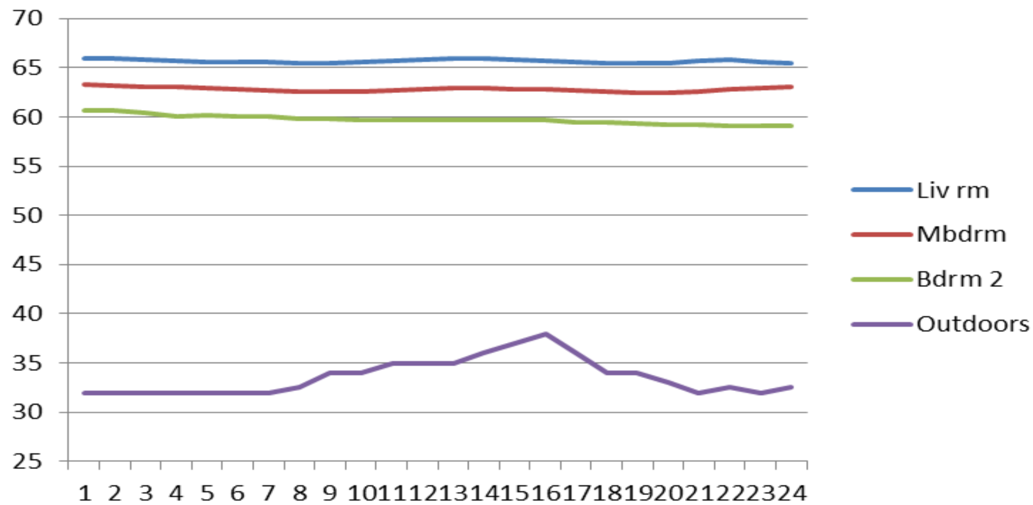

Figure 5. Hourly temperature plot for January 1, 2013

Figure 6 shows the averaged interior relative humidity.

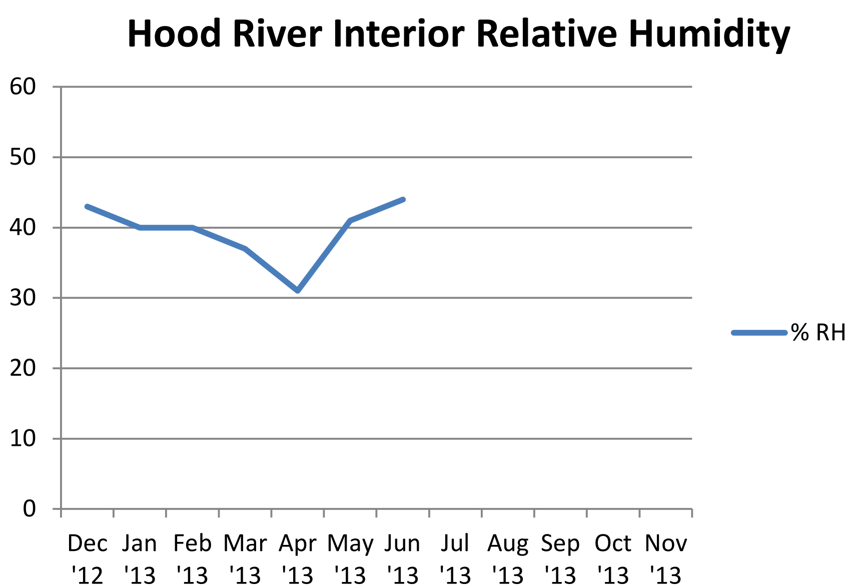

Figure 6. Monthly average relative humidity

The Northwest Energy Efficiency Alliance (NEEA) ventilation study also monitored performance of the ventilation system under a variety of operating conditions (NEEA 2013). Temperature, relative humidity, and carbon dioxide (CO_2) levels were logged at three different locations: main living area, master bedroom, and guest bedroom. Figure 7 summarizes monitored environmental data at 15-minute intervals in the main living area from January 31, 2013 through May 16, 2013. Spikes in CO_2 correspond to different operating conditions imposed on the ventilation system during the ventilation study (i.e., system on/off, interior doors open/closed).

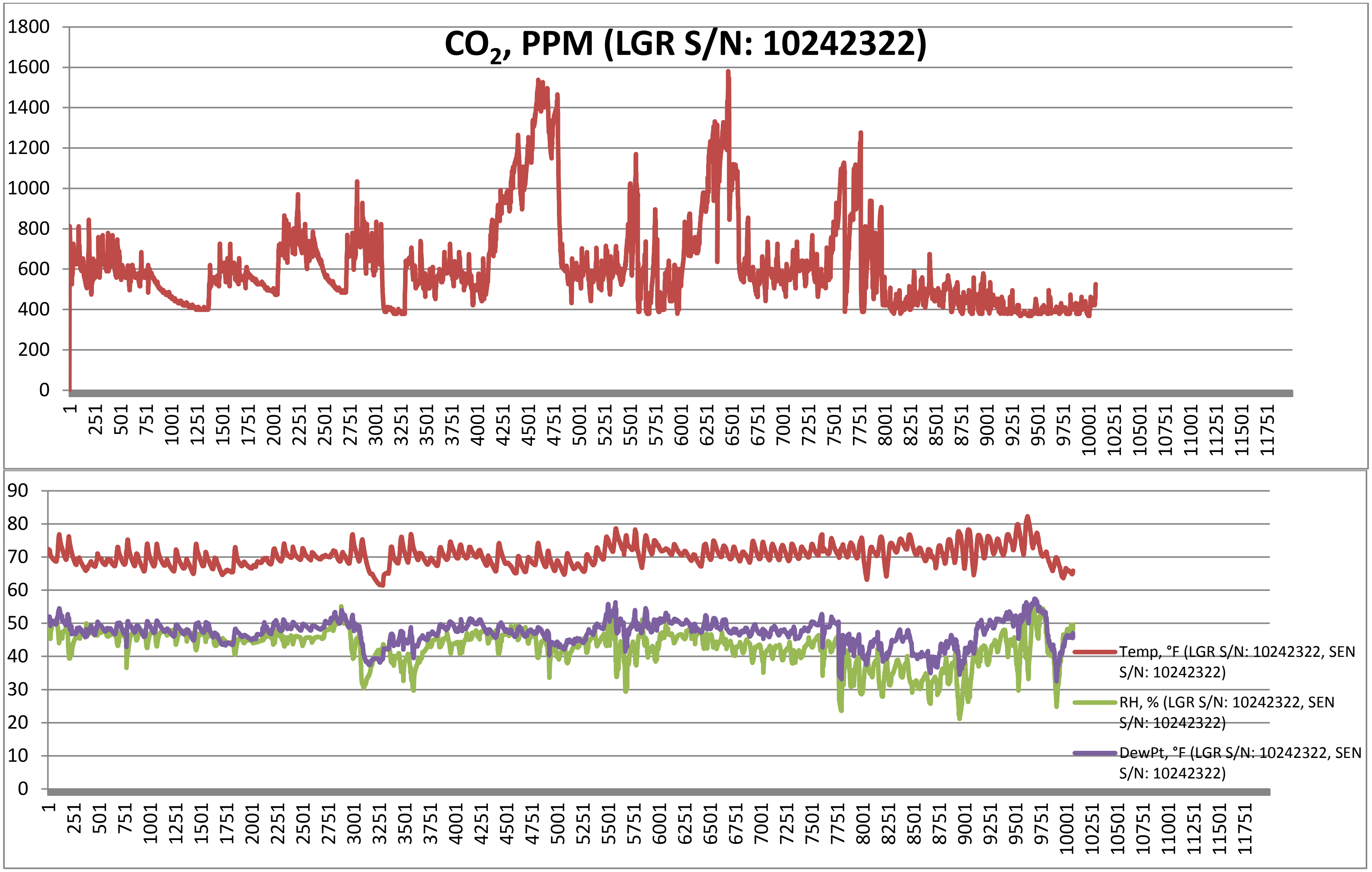

Figure 7. Environmental conditions, main living area

5 Analysis

5.1 Costs

Comparisons between Passive House design development using PHPP and modeling with BEoptE+ and other simulation programs suggest some fairly large discrepancies. See Table 5 for a comparison of the BEoptE+ modeling of the Hood River house and PHPP.

Some confusion may exist because of differences in definitions. PHPP uses different conventions for determining conditioned floor area and house volume. PHPP measures floor area from the interior surface of exterior walls; only counts a percentage of storage, utility, and stair floor area; and subtracts the volume of interior walls and floor cavities from the house volume. The net effect is that the PHPP values for energy use per square foot and ACH must all be reduced for comparison to BEoptE+ and other simulations. As shown in Table 4, the researchers attempted to make these adjustments by normalizing the area and volume values to those used in BEoptE+.

BEoptE+ modeling and design optimization probably would have resulted in a different structure driven by construction cost considerations. BEoptE+ modeling suggests that the home is over-glazed, but this may be a result of the inability of BEoptE+ to model the exterior shading. This is seen in the relatively high cooling energy predicted by BEoptE+ as indicated in Table 5. The Passive House process using PHPP is driven by design performance, not construction costs.

Figure 8 shows the on-site electrical energy savings associated with individual measures based on BEoptE+ modeling. For the modeling, each measure is treated individually as if it were the only measure applied to the base case design (2009 IECC). This approach does not show possible interactive effects between measures that influence the total package performance (i.e., a better enclosure reduces the savings from improved HVAC efficiencies but may reduce equipment costs by allowing downsized systems). The approach does help identify the relative importance of different measures. Additional air sealing has a much larger impact than adding additional insulation to the roof, for example, as seen in Table 8.

Using the modeled savings shown in Figure 8 and measure cost data supplied by the builder as compared to baseline measure costs from the BEoptE+ cost library, incremental measure costs were calculated and are displayed in Table 8. Assuming \$0.10/kWh for electricity and a 3% discount rate over 30 years for a typical mortgage, the present values of the electrical savings were calculated for each measure. Comparing the 30-year present value of savings for each measure to the measure's incremental cost provides a gauge of the affordability of the measure.

Only the lighting and the DHP show cost neutrality or better within the expected measure life. Advanced air leakage control has a 30-year present value close to its measure cost, but the overall package is far from cost neutrality.

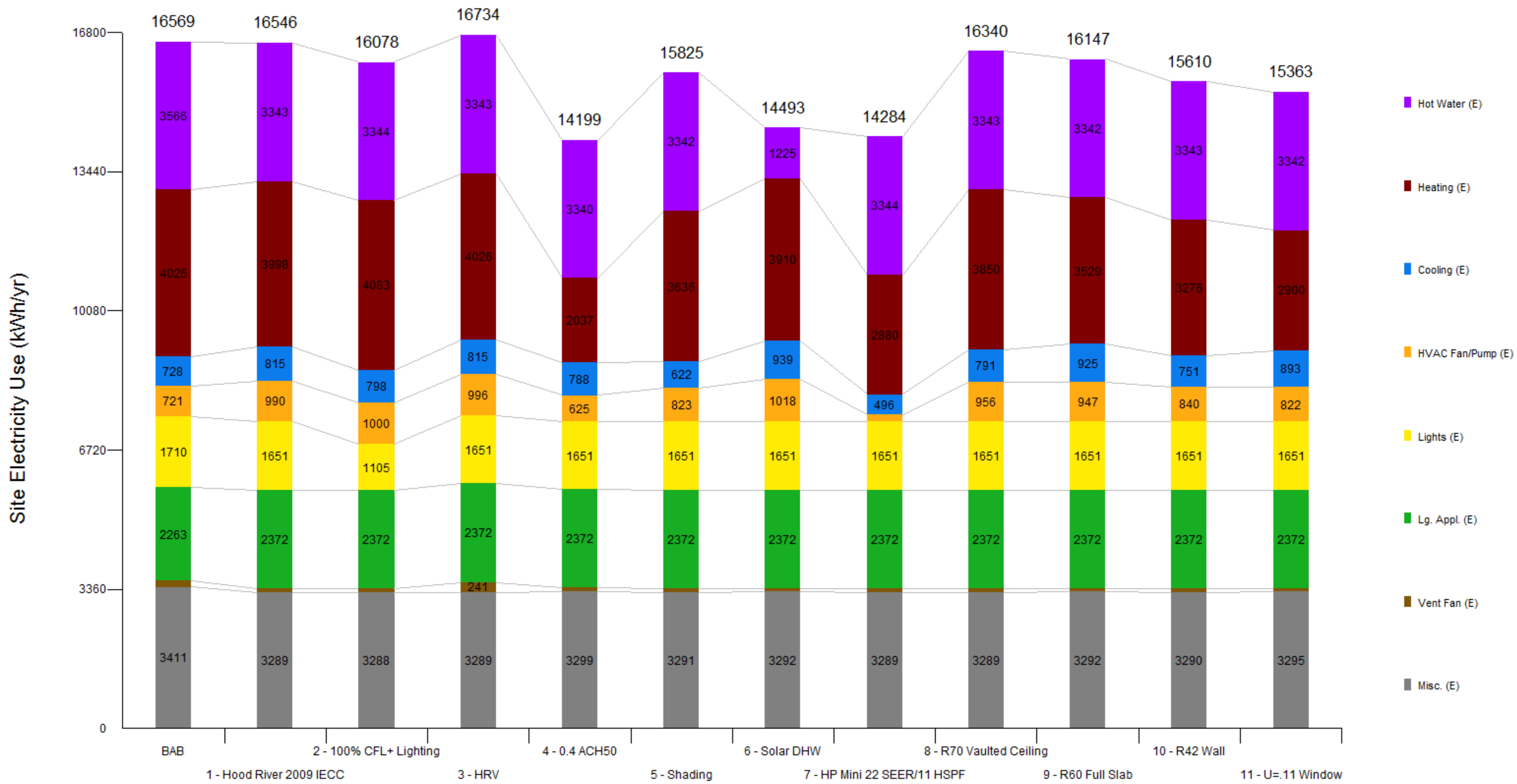

Figure 8. Hood River Passive House modeled energy use by measure

Table 8. Cost Analysis of Individual Measures

Measure	2009 IECC	Baseline Measure Cost	Hood River Passive House	Passive House Measure Cost	Savings kWh/yr[a]	Present Value of Electrical Savings[b]	Incremental Measure Cost As Reported
Walls R-Value	20	$3.52/ft^2	43.5	$9.41/ft^2	959	$1,879.68	$18,000
Slab-on-Grade R-Value	10	$2,218	50.5	$7,480	422	$827.14	$5,262
Ceiling R-Value	49	$2.55/ft^2	76.6	$10.68/ft^2	229	$448.85	$10,975
Heat Pump Heating Season Performance Factor/Seasonal Energy Efficiency Ratio	7.7/13	$2,285	11/22	$3,750	2,285	$4,478.70	$1,465
Water Heating	EF = 0.87	$258	Solar thermal	$9,748	2,076	$4,069.05	$9,490
Ventilation	ASHRAE 62.2	$463	HRV	$1,850	-188	($368.49)	$1,387
Windows U-value	0.32	$24.30/ft^2	0.09	$35.60/ft^2	1,206	$2,363.81	$6,650
Air Sealing	7.0 ACH_{50}	$0.00/ft^2	0.4 ACH_{50}	$2.40/ft^2	2,370	$4,645.30	$4,800
Lighting[c]	40%	$0.05/ft^2	100%	$0.08/ft^2	491	$962.38	$60
Shading	Not required		Movable exterior		744	$1,458.27	$5,000
All Measures					9,425	$18,473.42	$63,089[d]

[a] Savings modeled as first measure in all cases.
[b] Assumes $0.10 kWh and 3% discount rate over 30 years.
[c] Percentage of lighting fixtures using compact fluorescent lamps or light-emitting diodes.
[d] Additional savings may be anticipated in the package analysis for equipment downsizing and if central forced air ducts are assumed in the base case and eliminated from the project house.

5.2 Energy Performance

Monitoring has shown that the Passive House is exhibiting excellent energy performance. The 12 months of available data provided in Table 6 total 4,939 kWh for site energy consumption. Extrapolating these data for 4 additional days based on an average seasonal consumption of 12 kWh/day projects total annual site energy consumption of 4,987 kWh. As seen in Appendix B, total consumption is 66% below similar homes in the utility service area and represents a 75.9% reduction below modeled performance for the BA benchmark.

Most significantly for the Passive House design approach, total space conditioning site energy was monitored at 1,343 kWh. Using the Passive House metrics for conditioned space, this equals

4.58 kBtu/ft^2-yr—well below the design target of 4.75 kBtu/ft^2-yr from Table 1. This also represents a 75.5% reduction in the space conditioning load from the BA benchmark.

The total site energy consumption of 4,987 kWh represents 45.9 MMBtu of source energy, or 27.4 kBtu/ft^2-yr—again below the Passive House design target of 38 Btu/ft^2-yr and a 75.9% reduction from the BA benchmark.

Table 9 compares the monitored results in Table 7 with the modeled predictions in Table 5 after adjusting for source energy versus site energy.

Table 9. Modeled Versus Monitored Performance

<table>
<tr><th>Source Energy Use (MMBtu/yr)</th><th>Monitored Use Hood River House</th><th>BEoptE+ Hood River House</th><th>PHPP Hood River House</th></tr>
<tr><td>Heating</td><td rowspan="2">12.4</td><td>1.0</td><td>5.0</td></tr>
<tr><td>Cooling</td><td>7.3</td><td>4.8</td></tr>
<tr><td>Hot Water</td><td>6.2</td><td>6.4</td><td>2.8</td></tr>
<tr><td>Large Appliances</td><td rowspan="5">29.1</td><td>12.1</td><td>8.6</td></tr>
<tr><td>Lighting</td><td>12.7</td><td>2.4</td></tr>
<tr><td>Vent Fan</td><td>2.8</td><td>4.2</td></tr>
<tr><td>HVAC Fan</td><td>0.9</td><td></td></tr>
<tr><td>Miscellaneous</td><td>38.8</td><td>8.6</td></tr>
<tr><td>Total</td><td>47.6</td><td>82.0</td><td>37.1</td></tr>
</table>

5.3 Comfort

The extremely low design loads and the nontraditional space conditioning systems employed to meet them have raised concerns about overall comfort in ultra-high performance homes. Often lost in a discussion of Passive House design is the requirement to meet a mean ambient radiant interior surface temperature of 68°F. The use of PHPP is intended to assure that this condition is met. Possible overheating is also an issue driven by increased sensitivity to solar and internal gains that is also addressed in the PHPP design process.

The Hood River project has an open design with interior doors only to the bedrooms, bathrooms, and utility area. Primary space conditioning is provided by a ductless mini-split heat pump with a single head mounted on the east wall of the main living area on the ground floor. Zonal electric resistance heating in the bedrooms and bathrooms provides a backup during extreme design conditions. Some mixing is provided by the continuous operation of the HRV.

As seen in Table 7, 18.7% (but only 251 kWh) of the space conditioning energy was consumed by the zonal electric resistance heaters. Factoring in the efficiency of the heat pump, this represents only about 6.5% of the heating load.

Figure 5 plots the hourly indoor temperatures for three areas for January 1, 2013, one of the colder days of the last heating season. While the set points appear relatively low, the temperatures in each zone appear very stable.

Appendix A shows the temperatures in five different zones in the house and the outside ambient temperature. A drop in temperatures is seen from January 5 through January 21, when the occupants were on vacation and the HVAC systems were off. Even without heat, none of the zones dropped below 50°F during over 2 weeks of wintertime conditions. Daily spikes in daytime temperatures are also apparent from solar gain and are most significant in the main living area and the upstairs study (the areas with the most glazing). The normally unoccupied guest bedroom shows the widest range of temperatures, which correlates with the fact that the door is often closed and resistance heat is rarely used, suggesting that such areas would not be comfortable at all times without some supplemental heat.

5.4 Air Leakage

As part of a supplemental study on ventilation performance in very tight homes, a CO_2 tracer gas decay was conducted on the site in May 2013. The house was seeded with CO_2 to about 5,000 parts per million and the decay was recorded with the house considered as one zone and with the ventilation system off and then on (see Figure 9). The decay was logged at 1-minute intervals using a PP Systems, WMA-4 CO_2 Analyzer. By determining the slope of the best fit exponential decay curve for the logged data, it is possible to determine the actual ACH rate for the house under the test conditions. Table 10 shows the results for the Hood River House.

The ventilation study work was funded by the NEEA and the results for the Hood River site were taken from prepublication analysis (NEEA 2013).

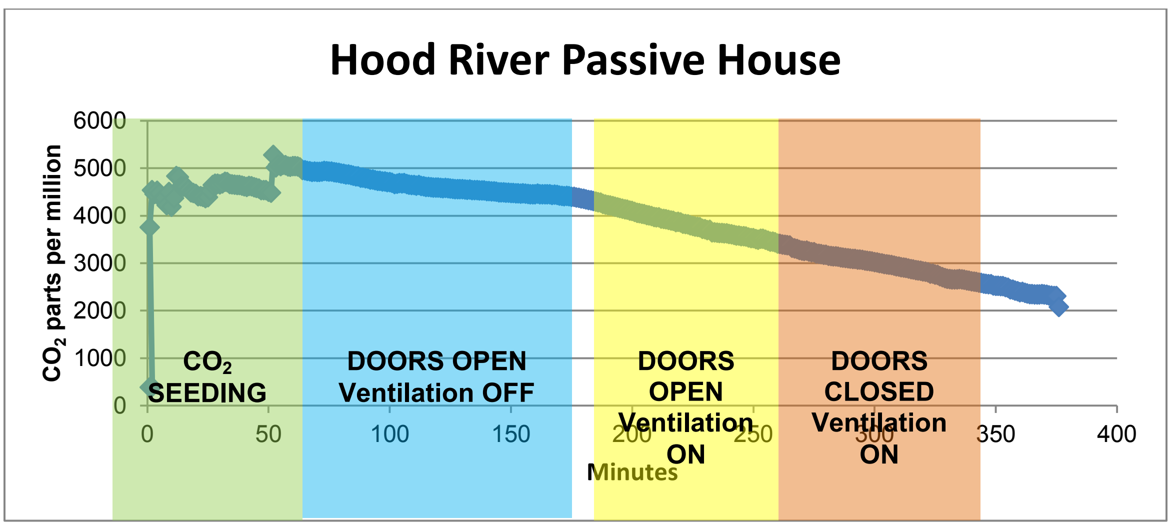

Figure 9. Tracer gas decay

Table 10. Hood River ACH Rates From Tracer Decays

House Operation	ACH	R^2
Ventilation Off/Interior Doors Open	0.07	0.953
Ventilation On/Interior Doors Open	0.20	0.997
Ventilation On/Interior Doors Closed	0.26	0.992

6 Conclusion

Both modeling and monitoring indicate the Passive House design approach can produce the level of performance needed in the building enclosure to meet BA goals for new construction homes. As a design process, the Passive House process produces an extremely high performance design rooted in proven building science applicable to climate zones in the Pacific Northwest. The process as seen here does not ensure meeting the cost benefit goals of BA but, rather, appears driven by noneconomic forces (such as the desire to do the right thing). The challenge is to adapt measures to the production building environment while finding significant cost reductions and optimizing measure cost versus the cost of renewable energy generation.

The ductless mini-split heat pump is well suited to provide space conditioning in the low load environment of a Passive House design. Even with an open floor plan and some mixing with the continuous operation of an HRV, a single-head system fails to meet the comfort requirements of all the zones especially when doors are closed, further limiting distribution. A small amount of zonal electrical resistance heat can make up the deficit at a relatively low cost.

Occupant behavior plays a significant role in overall energy use. Set points, setbacks, utilization of the heat pump versus zonal electric heat, and proper utilization of operable shading all impact the space conditioning load and require occupant education for maximum benefit.

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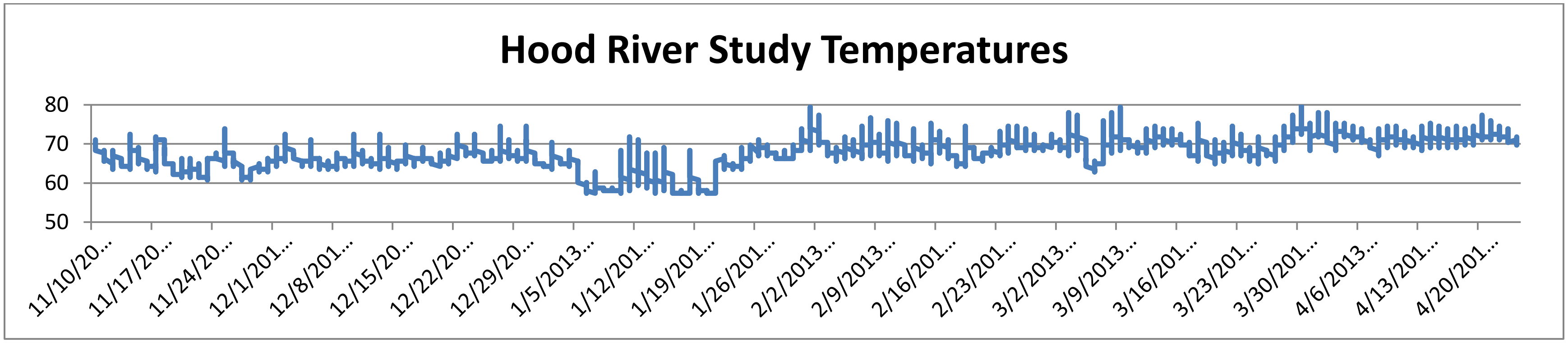
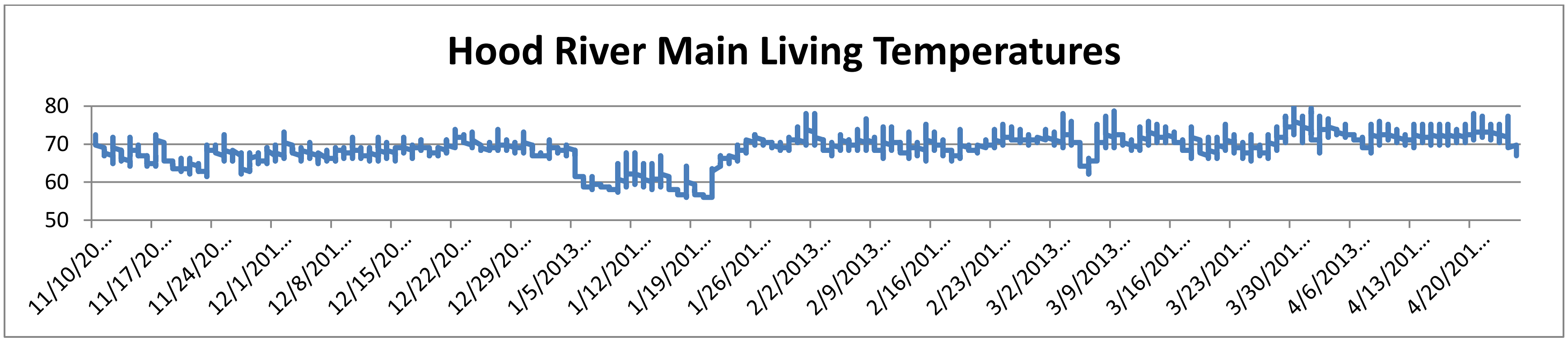
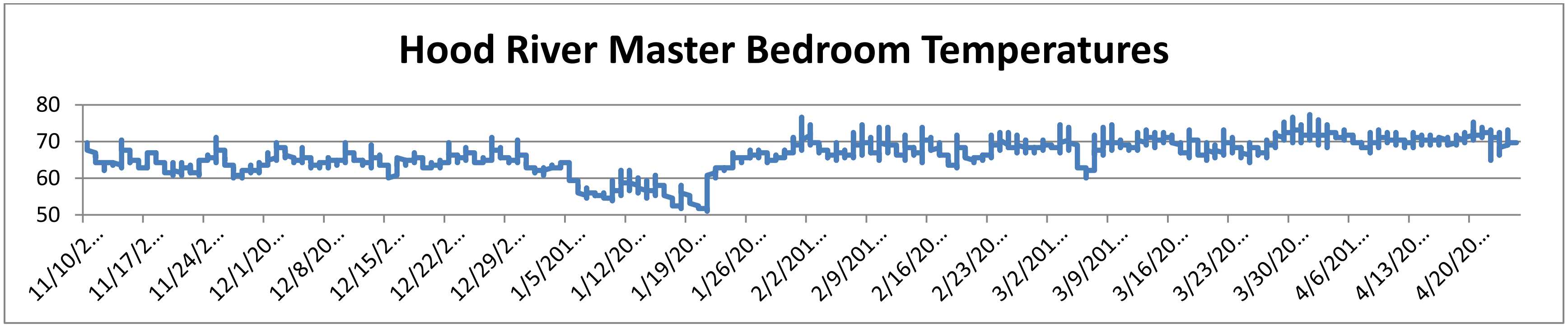
Appendix A: Environmental Data






Hood River Master Bedroom Temperatures
80
70
60
50
11/10/2...
11/17/2...
11/24/2...
12/1/20...
12/8/20...
12/15/2...
12/22/2...
12/29/2...
1/5/201...
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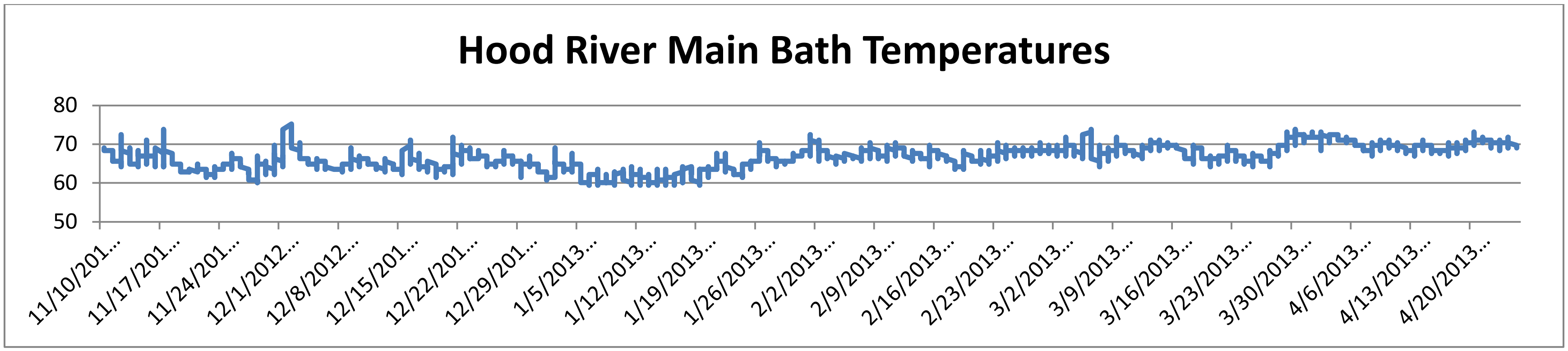
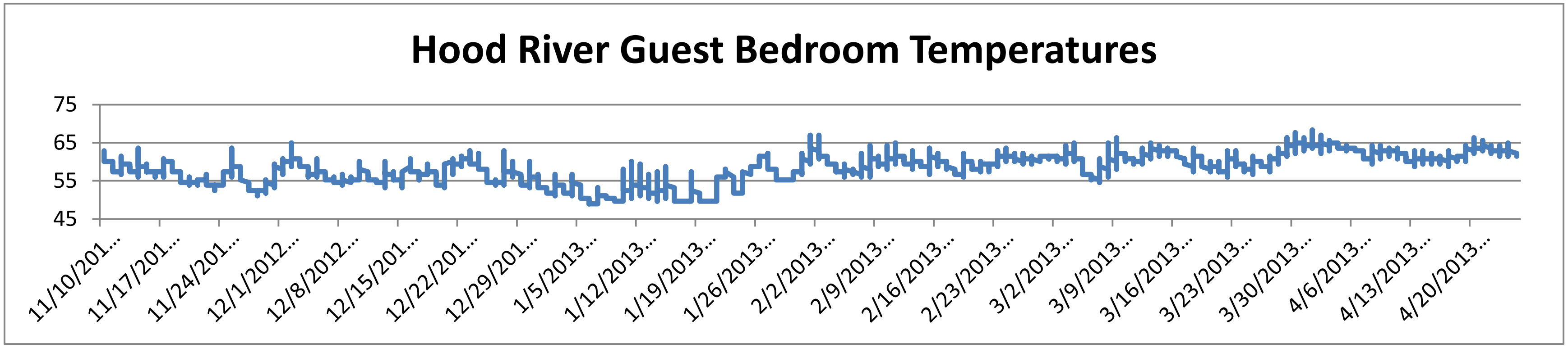
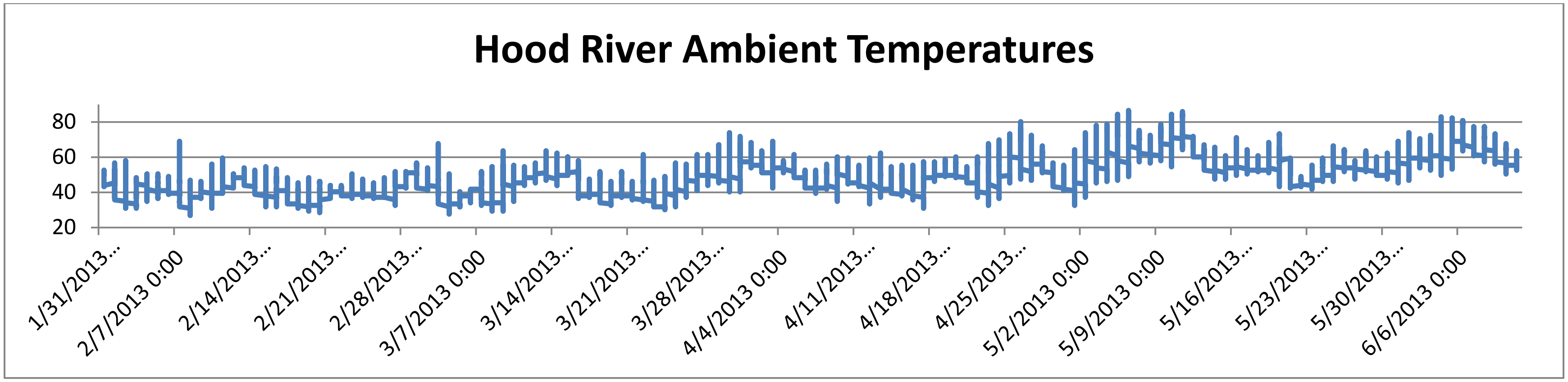
1/26/20...
2/2/201...
2/9/201...
2/16/20...
2/23/20...
3/2/201...
3/9/201...
3/16/20...
3/23/20...
3/30/20...
4/6/201...
4/13/20...
4/20/20...


Hood River Main Bath Temperatures
80
70
60
50
11/10/201...
11/17/201...
11/24/201...
12/1/2012...
12/8/2012...
12/15/201...
12/22/201...
12/29/201...
1/5/2013...
1/12/2013...
1/19/2013...
1/26/2013...
2/2/2013...
2/9/2013...
2/16/2013...
2/23/2013...
3/2/2013...
3/9/2013...
3/16/2013...
3/23/2013...
3/30/2013...
4/6/2013...
4/13/2013...
4/20/2013...


Hood River Guest Bedroom Temperatures
75
65
55
45
11/10/201...
11/17/201...
11/24/201...
12/1/2012...
12/8/2012...
12/15/201...
12/22/201...
12/29/201...
1/5/2013...
1/12/2013...
1/19/2013...
1/26/2013...
2/2/2013...
2/9/2013...
2/16/2013...
2/23/2013...
3/2/2013...
3/9/2013...
3/16/2013...
3/23/2013...
3/30/2013...
4/6/2013...
4/13/2013...
4/20/2013...


Hood River Ambient Temperatures
80
60
40
20
1/31/2013...
2/7/2013 0:00
2/14/2013...
2/21/2013...
2/28/2013...
3/7/2013 0:00
3/14/2013...
3/21/2013...
3/28/2013...
4/4/2013 0:00
4/11/2013...
4/18/2013...
4/25/2013...
5/2/2013 0:00
5/9/2013 0:00
5/16/2013...
5/23/2013...
5/30/2013...
6/6/2013 0:00

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Appendix B: Utility Energy Report

PACIFIC POWER

In collaboration with **Energy Trust of Oregon**
421 SW Oak St., Suite 300 • Portland, OR 97204

Personal Energy Report
Account number:
Report period: 08/13/13–09/09/13

This report gives you context on your energy use to help you make smart energy-saving decisions.

For a full list of smart purchases to help you save energy at home, including cash incentives from Energy Trust of Oregon, visit:

energytrust.org/wattsmart

**************AUTO**3-DIGIT 970
SLOBODANKA JOVANOVIC
4070 BELMONT DR
HOOD RIVER OR 97031-7706

Last Month Household Comparison

You used **44% less** electricity than efficient similar homes.

* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

How you're doing:

- **GREAT** ☺☺
- Good ☺
- More than average

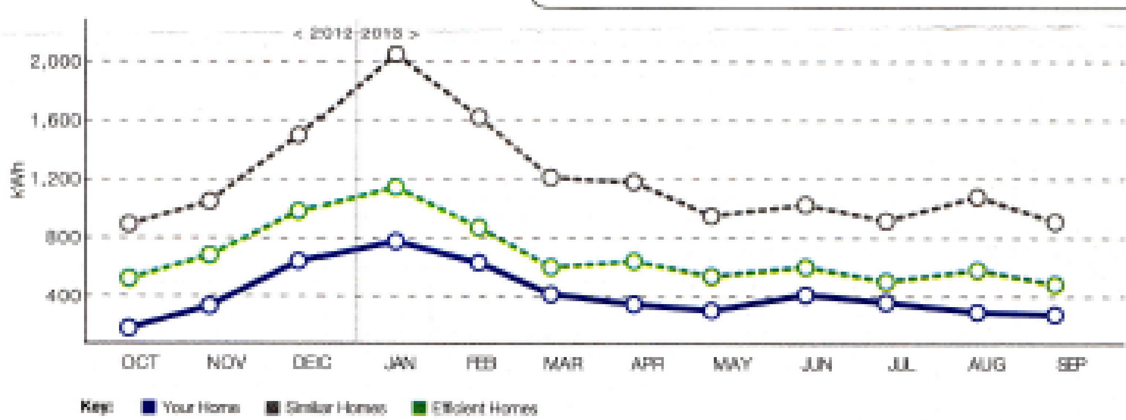
Which Homes are Compared?

Similar Homes: Approximately 100 occupied, nearby homes that are similar in size to yours (avg 2,053 sq ft) and have electric heat

Efficient Homes: The most efficient 20 percent of similar homes

Last 12 Months Household Comparison

You used **66% less** electricity than similar homes.
This saves you about **$496** per year.



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Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post-consumer waste.