



Heating with an Air-Source Heat Pump in Vermont

VECAN – December 7, 2013

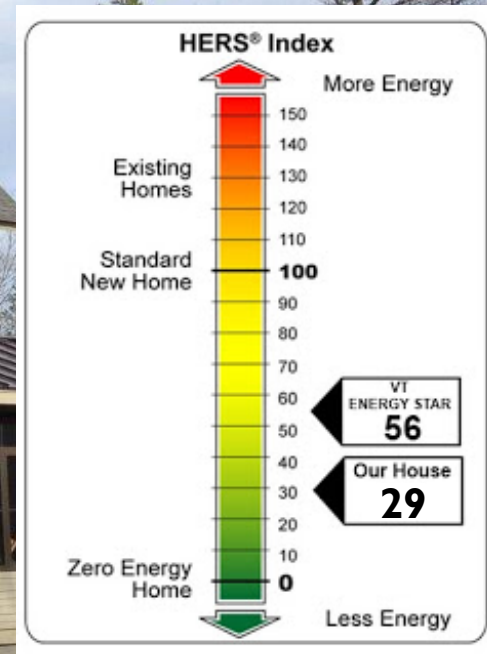
Kallock House



Kallock House

Awards:

- 2012 Efficiency Vermont Better Buildings by Design: Innovative Residential New Construction
- 2013 Vermont Green Building Network: Greenest Residential
- 29 HERS Rating



Construction Details

Square Feet	2,348 sqft gross, 2,000 sqft net
Wall Insulation	R-60 dense pack cellulose
Attic Insulation	R-104 blown-in cellulose
Under Foundation	R-54 high density foam
Foundation Walls	R-43 spray foam, high density foam
Windows	Fibertec triple pane, low-e, SHGC 0.61, U-Value 0.21
Glazing	N 24%, E 11%, S 58% , W 7%
Infiltration	0.7 ACH50 (~0.047 ACH)

Mechanical Systems

Annual Loads

Heating 6.57 kBTU/ft²/yr

Cooling 0.17 kBTU/ft²/yr

Mechanical Ventilation

Zehnder ComfoAir 350 with ComfoFond ground loop

Hot Water

Sunward Solar Thermal 80 gal preheat to electric resistance water heater

Heating Cooling

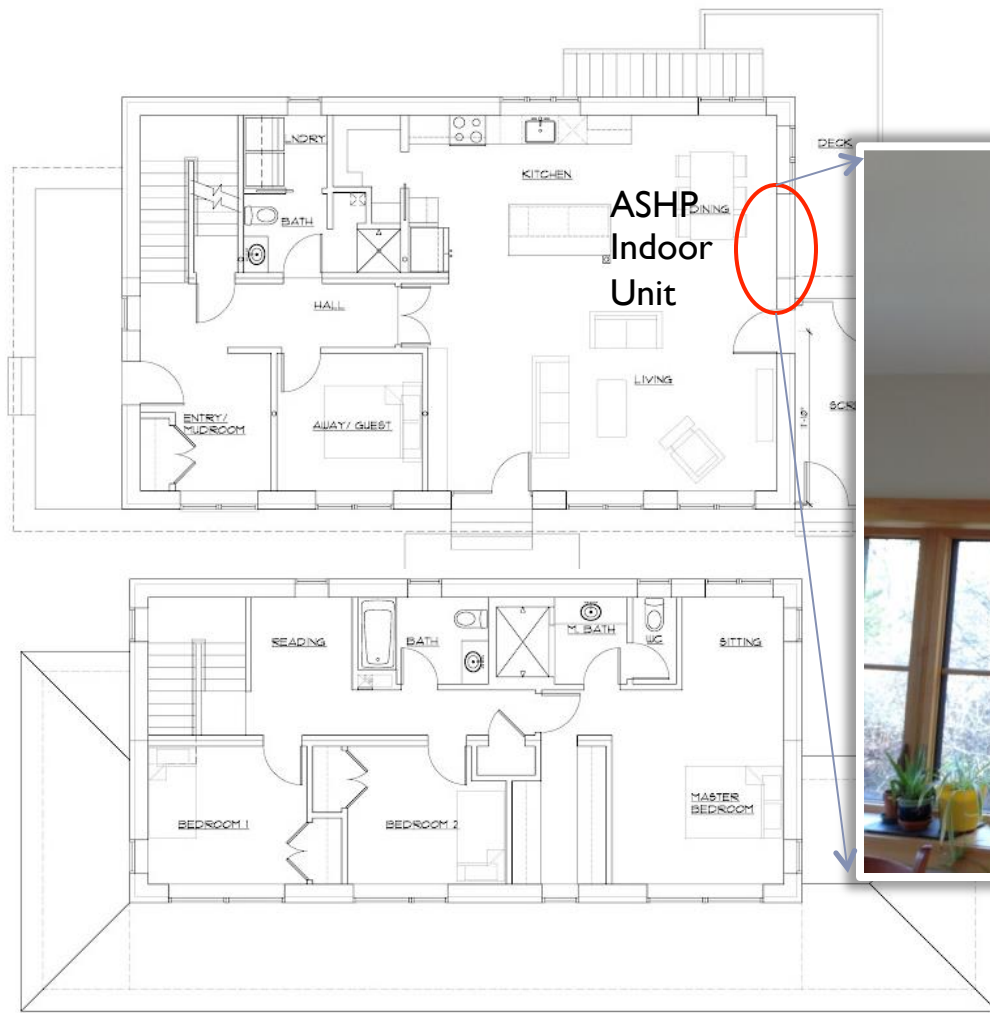
Mitsubishi Air Source Heat Pump (FEI8)

Mitsubishi Hyper Heat FE18

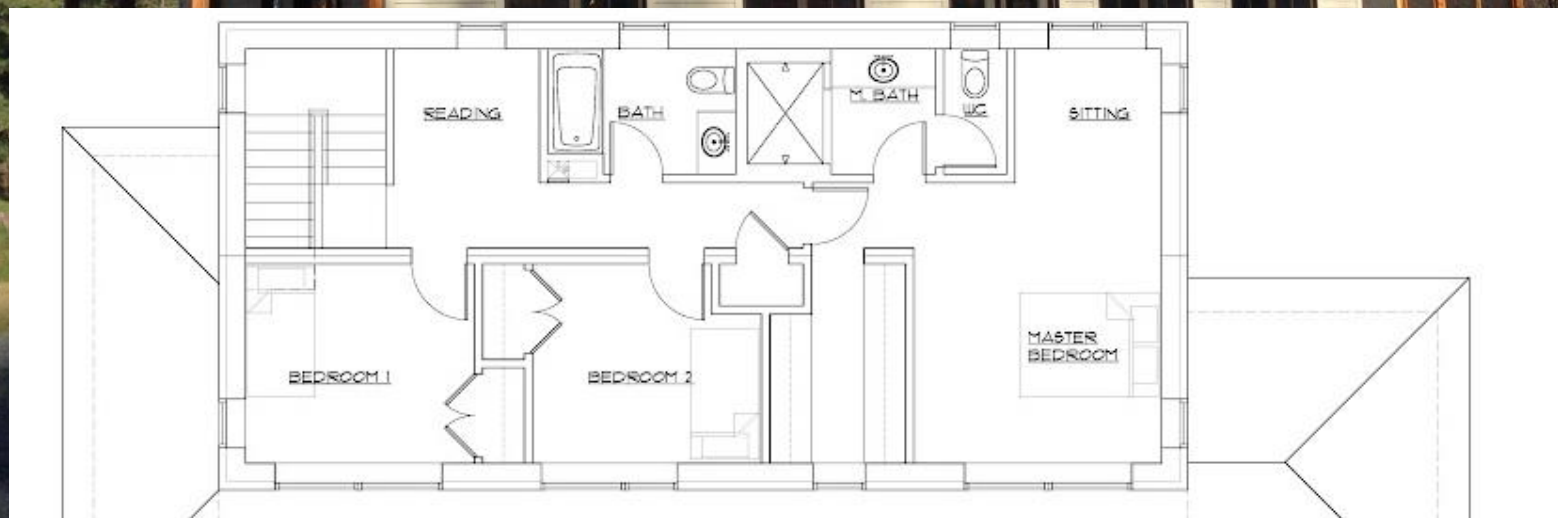
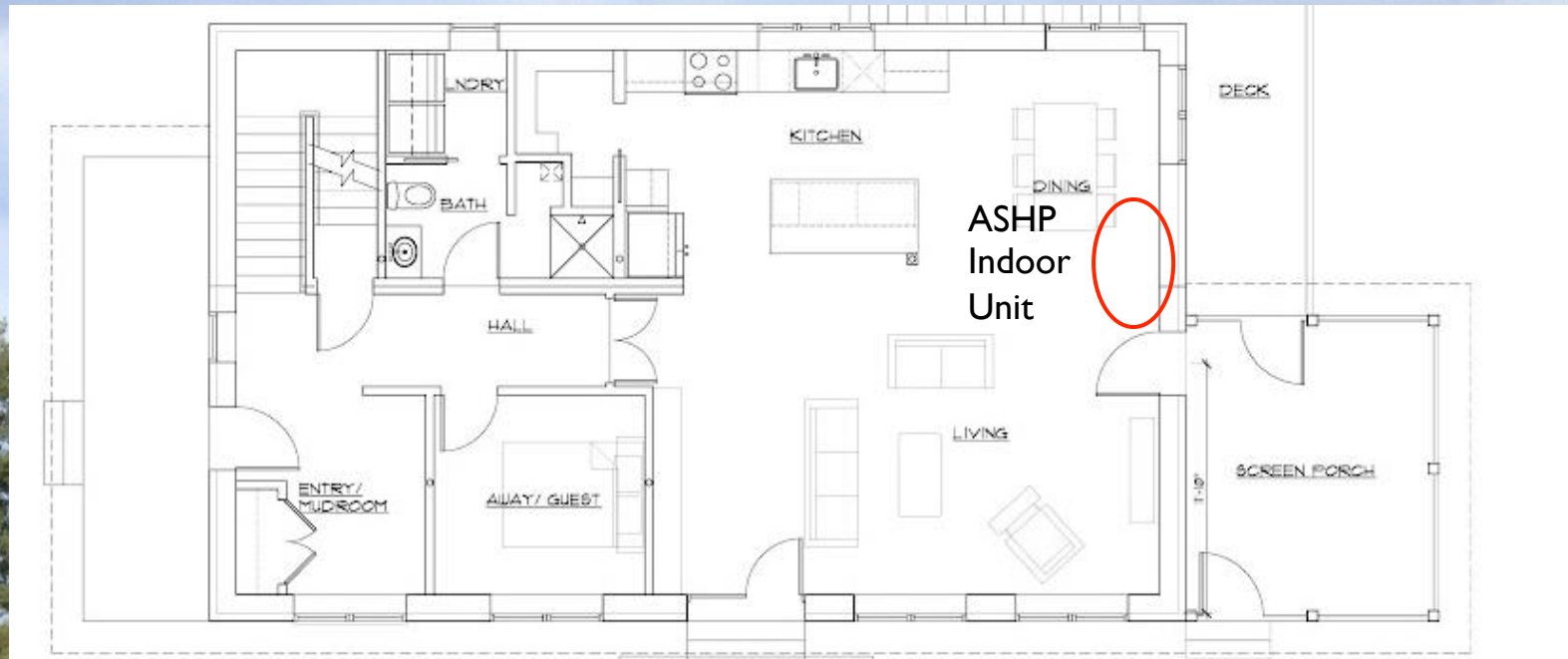
Model Name	Indoor Unit		MSZ-FE18NA
	Outdoor Unit		MUZ-FE18NA
Cooling	Rated Capacity	Btu/h	18,000
	Capacity Range	Btu/h	8,200-25,200
	Total Input	W	1,270 (570-2,280)
	Energy Efficiency	SEER	20.2
	Moisture Removal	Pints/h	2.7
	Sensible Heat Factor		0.84
Heating at 47° F *2	Rated Capacity	Btu/h	21,600
	Capacity Range	Btu/h	7,500-29,700
	Total Input	W	1,540 (520-2,420)
	HSPF (IV)	Btu/h/W	10.3
	COP		4.11
Heating at 17° F *3	Rated Capacity	Btu/h	11,700
	Rated Total Input	W	2,180
	Maximum Capacity	Btu/h	19,300
	COP		2.77
Heating at 5° F	Maximum Capacity	Btu/h	21,600



Floor Plans

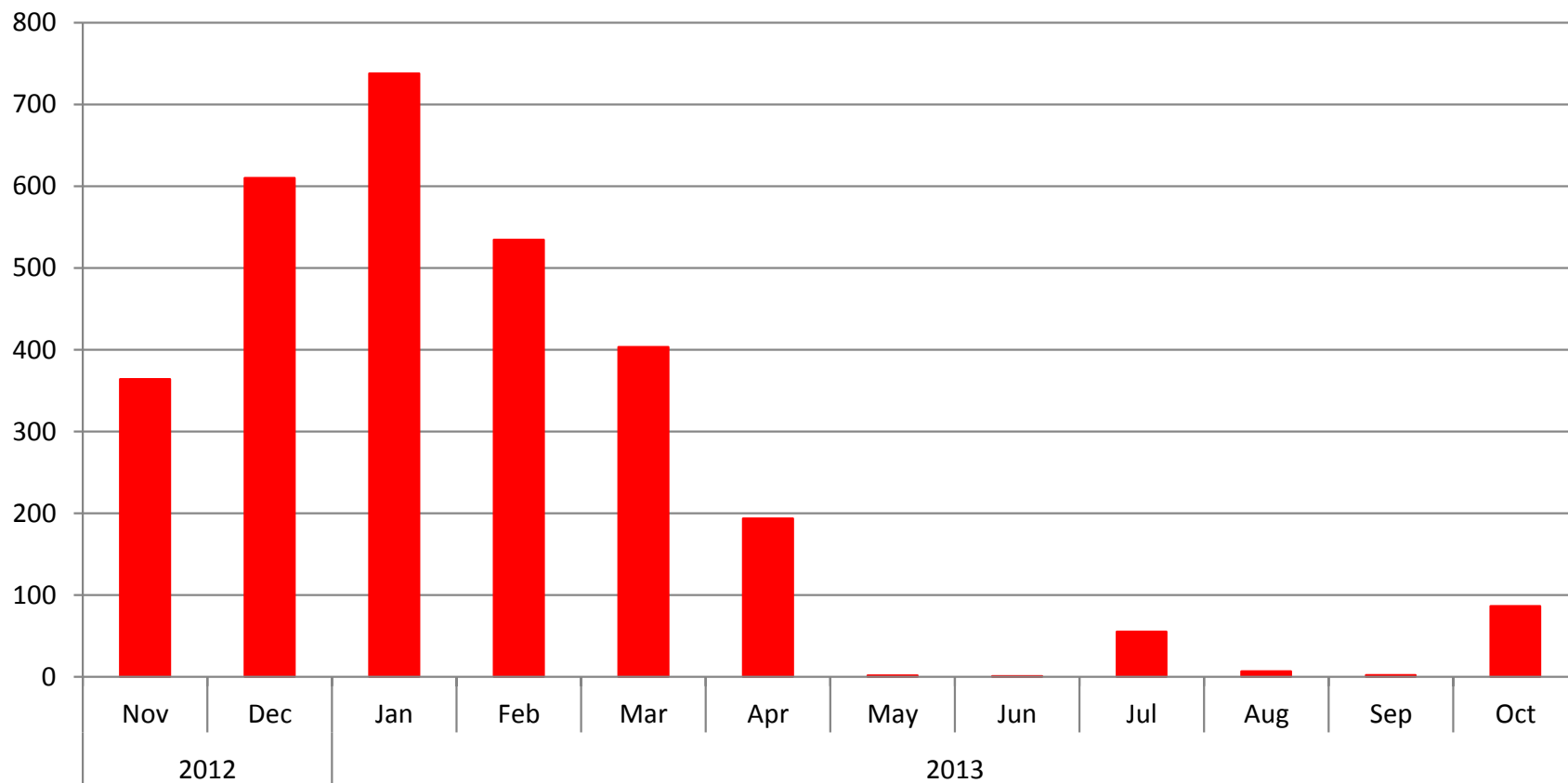


Floor Plans



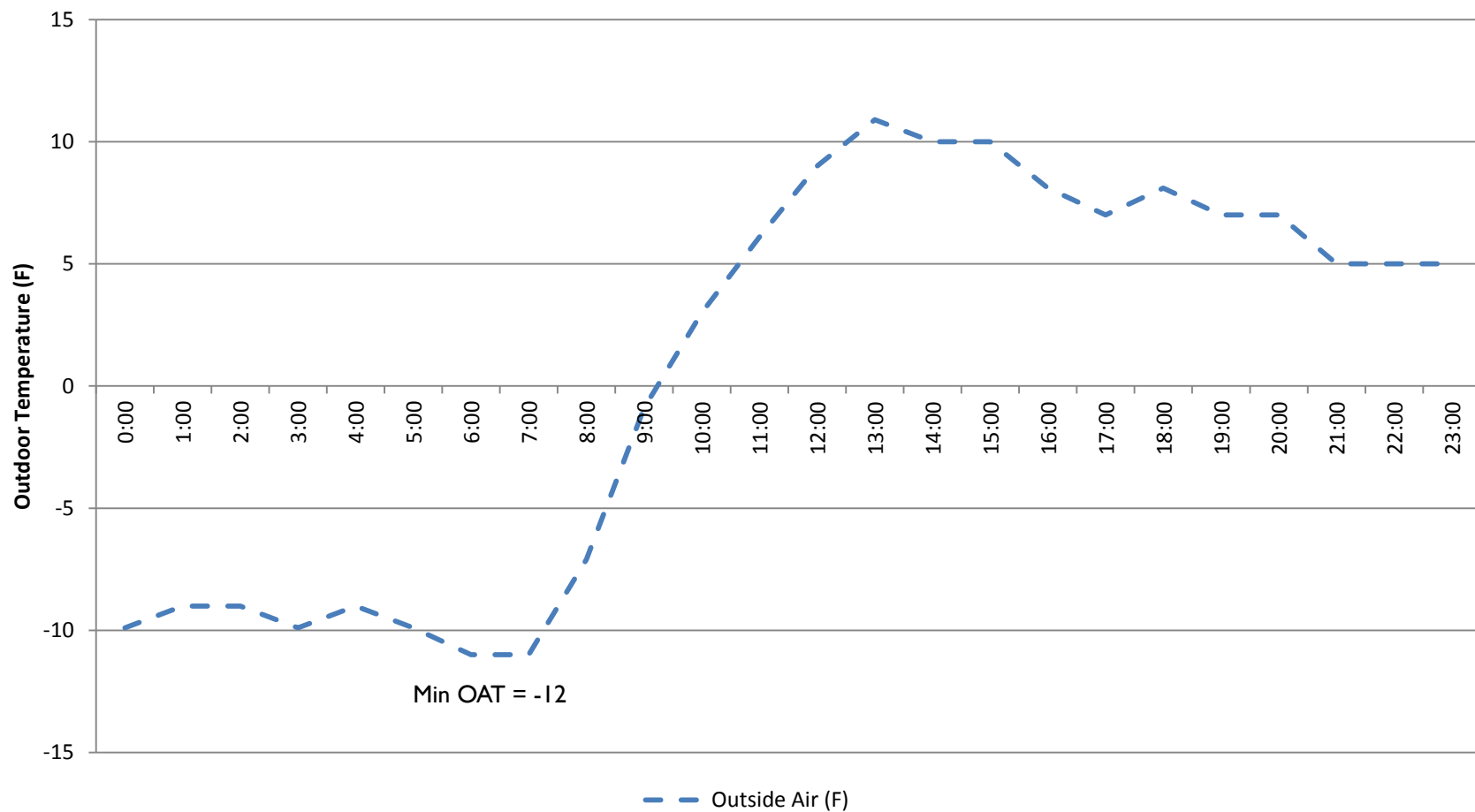
Monthly Heat Pump Use

**12 Month Heat Pump Energy
3,000 kWh (\$420)**



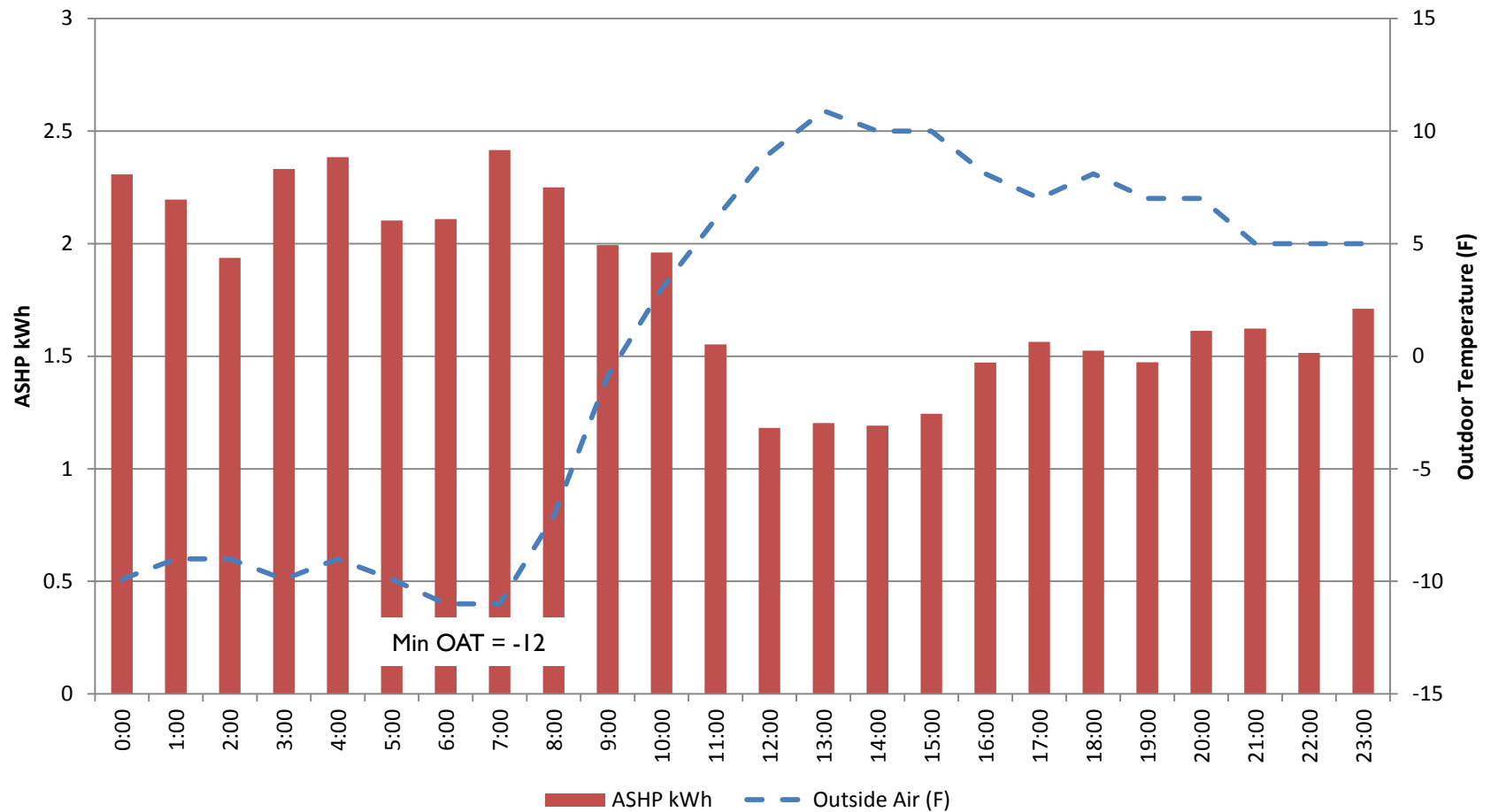
Cold Weather Performance

January 24, 2013



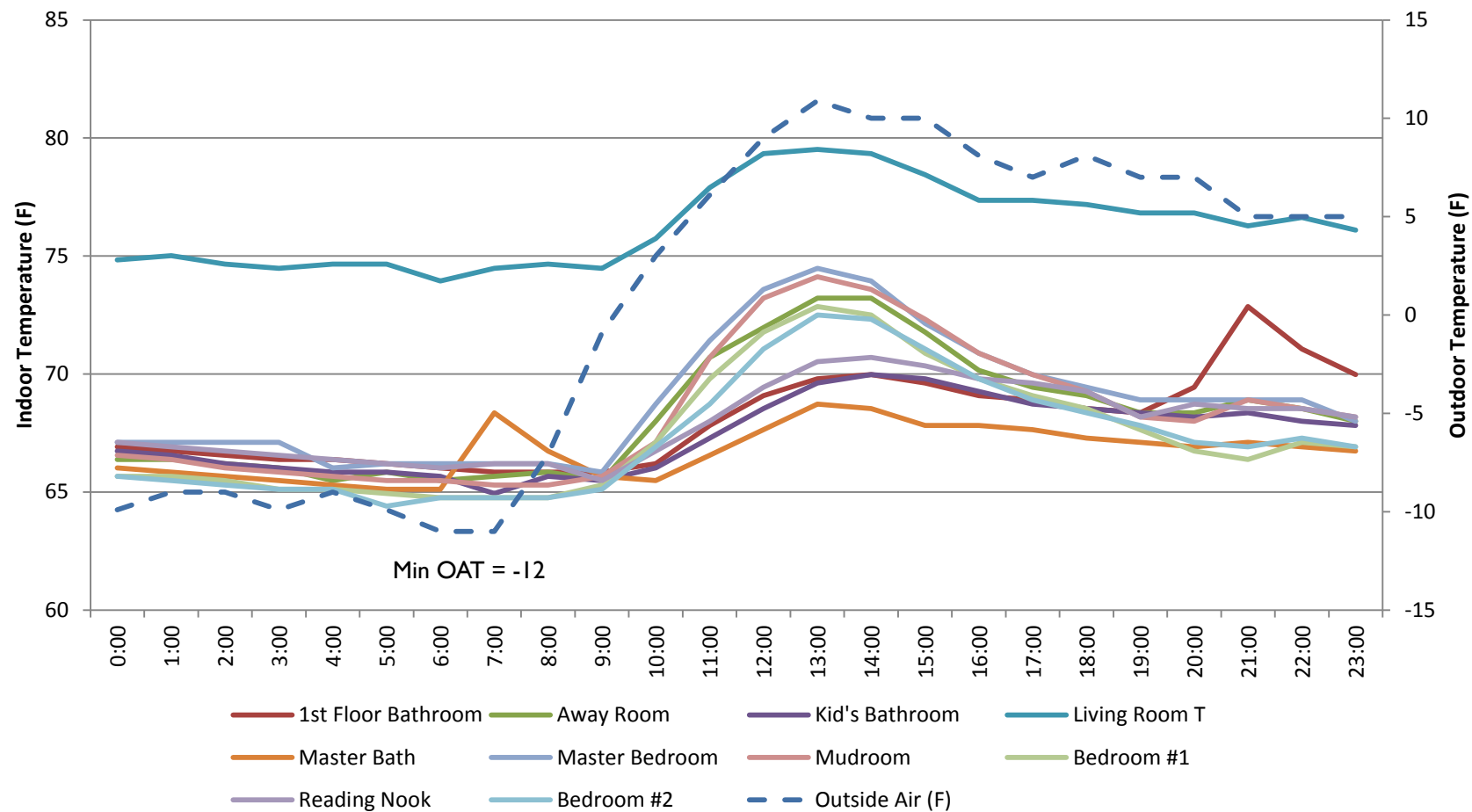
Cold Weather Performance

January 24, 2013



Cold Weather Performance

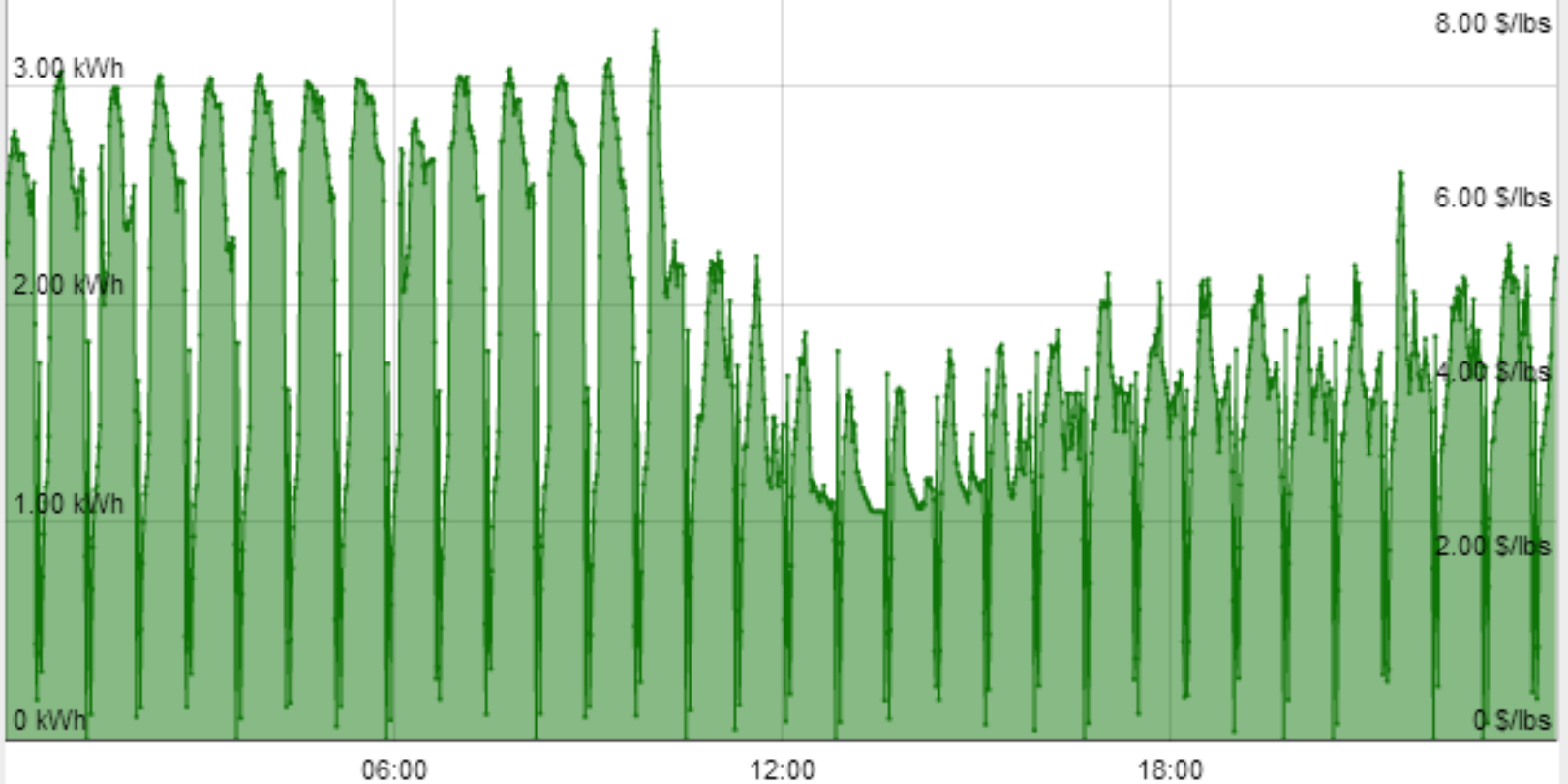
January 24, 2013



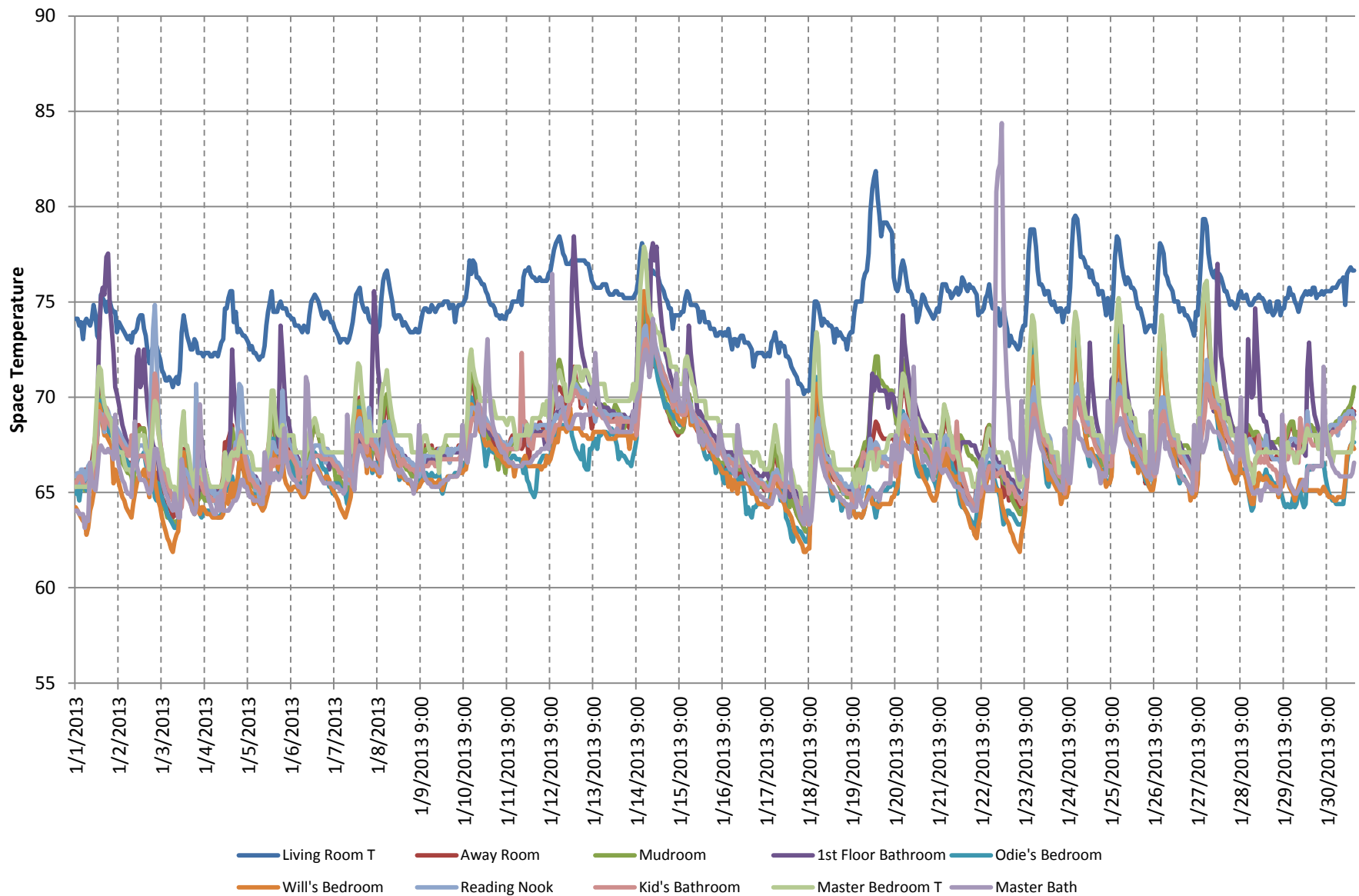
Cold Weather Performance

2013 ► January ► 24

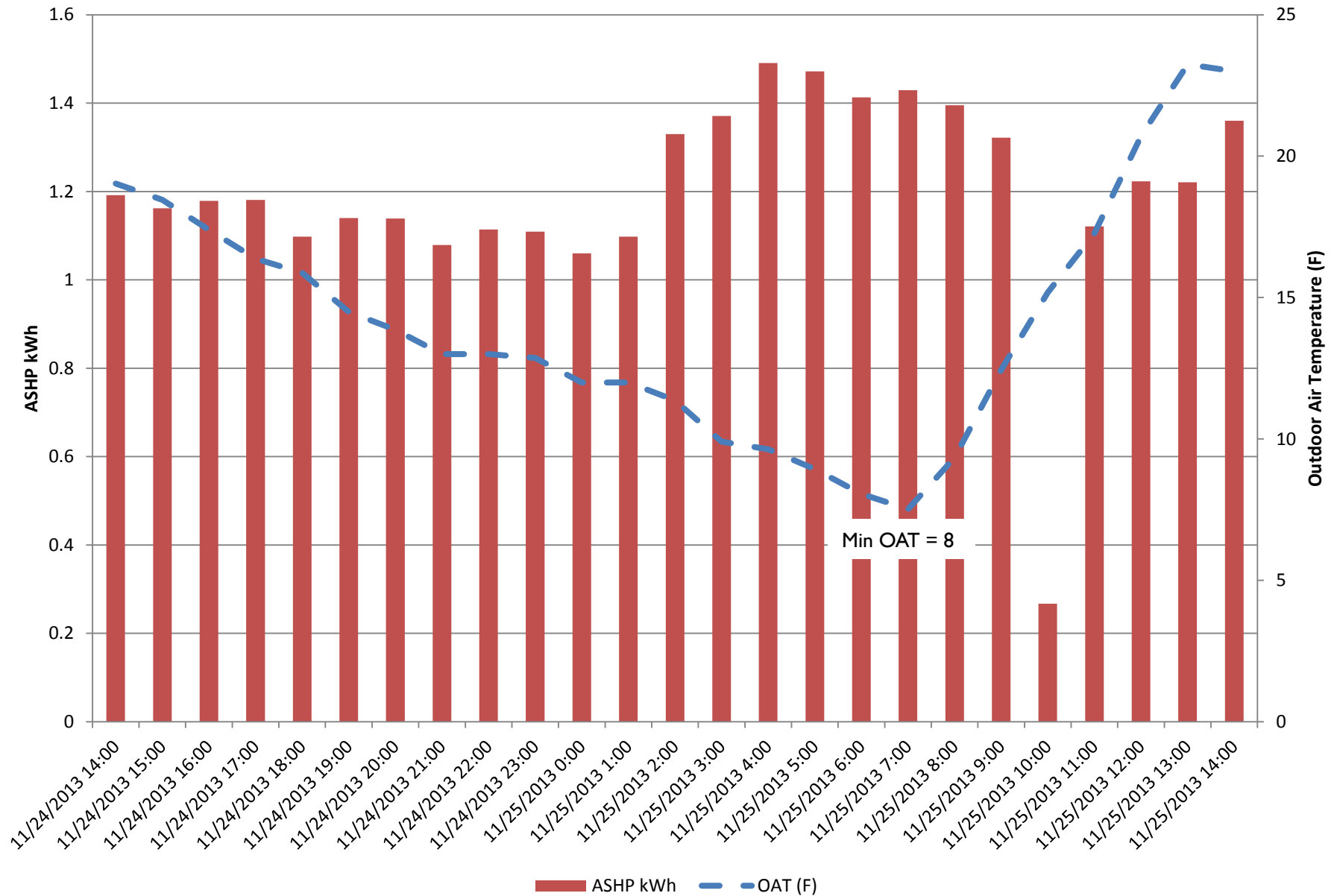
00:00 - 23:59



January 2013



November 24-25, 2013



November 24-25, 2013

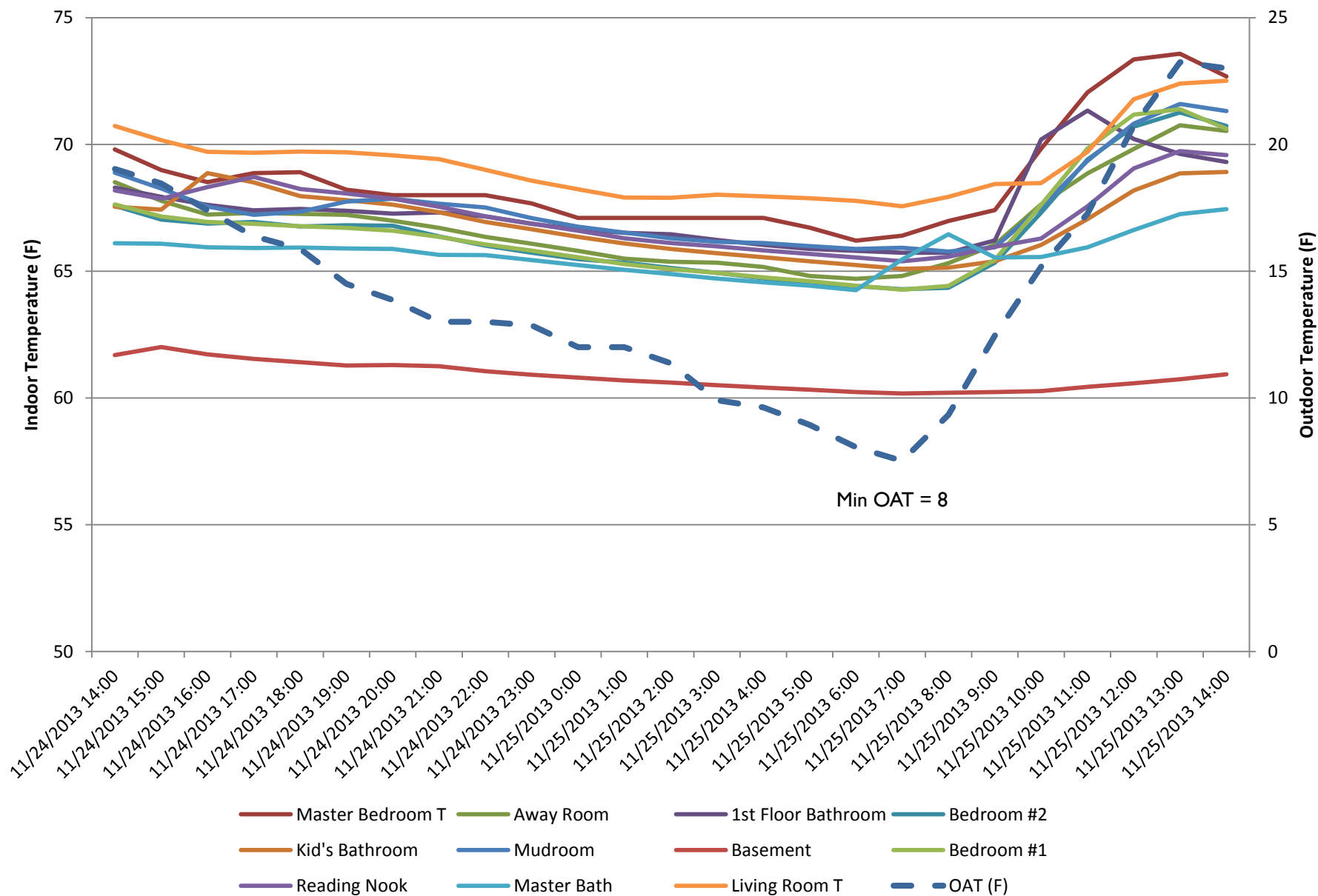
Indoor Temperature (F)

Outdoor Temperature (F)

Min OAT = 8

Legend:

- Master Bedroom T
- Kid's Bathroom
- Reading Nook
- Away Room
- Mudroom
- Master Bath
- 1st Floor Bathroom
- Basement
- Living Room T
- Bedroom #1
- Bedroom #2
- OAT (F)



Lessons Learned

- Air Source Heat Pumps works well in Vermont
- Heating capacity is maintained $< 0^{\circ}\text{F}$
- Monitoring performance may identify issues
- Air distribution range is limited – need to use multiple indoor fan units (1st & 2nd Floor)

Questions?



Contact Info:

Bill Kallock

bill.kallock@gmail.com