

Heat Pump Water Heating in Multifamily Buildings



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ACEEE Hot Water Forum
2017

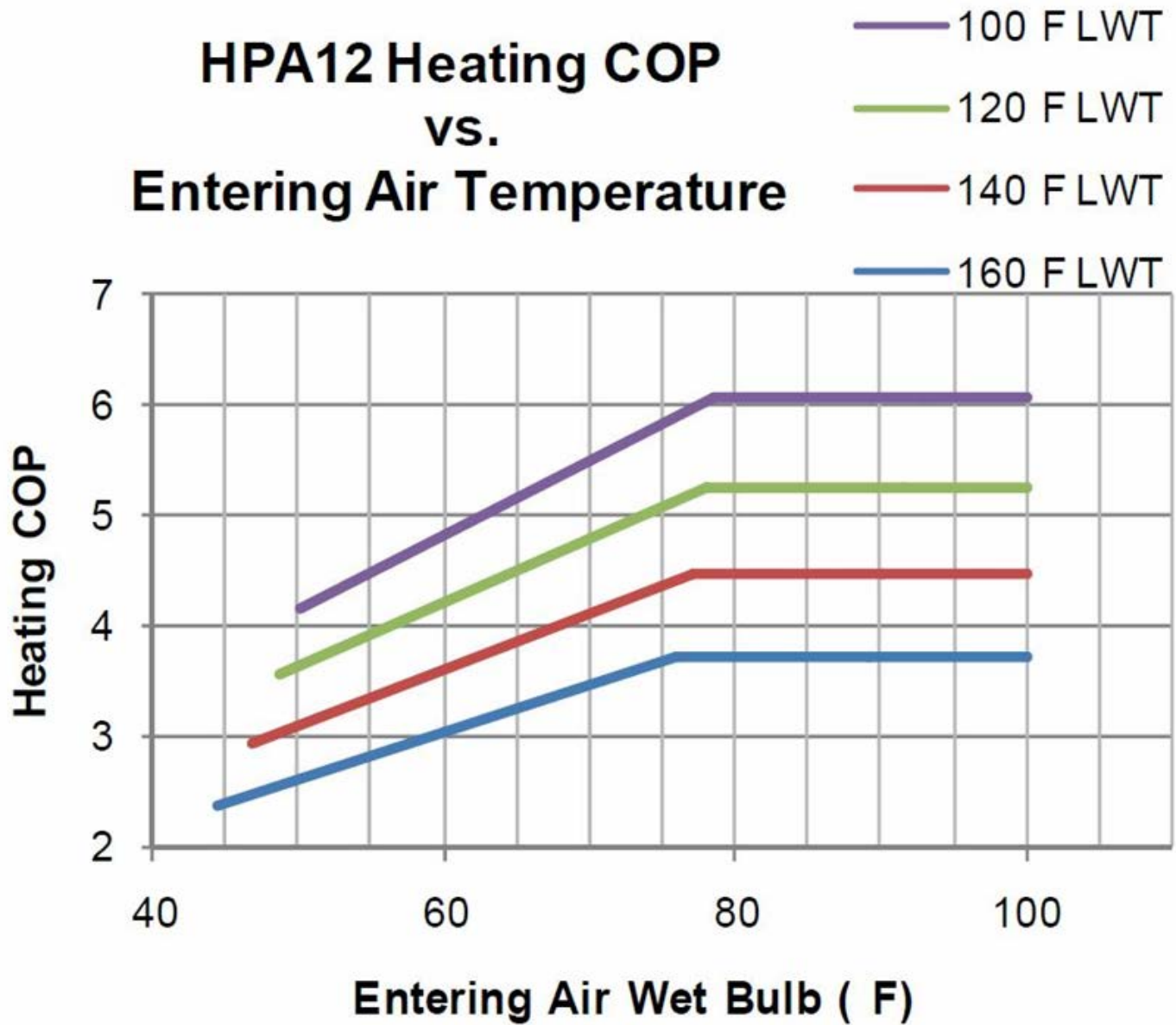
Presentation Objectives

- Results and Lessons Learned from RCC Pilot Project
- Solar Assist Heat Pumps
- Waste Water Heat Pumps

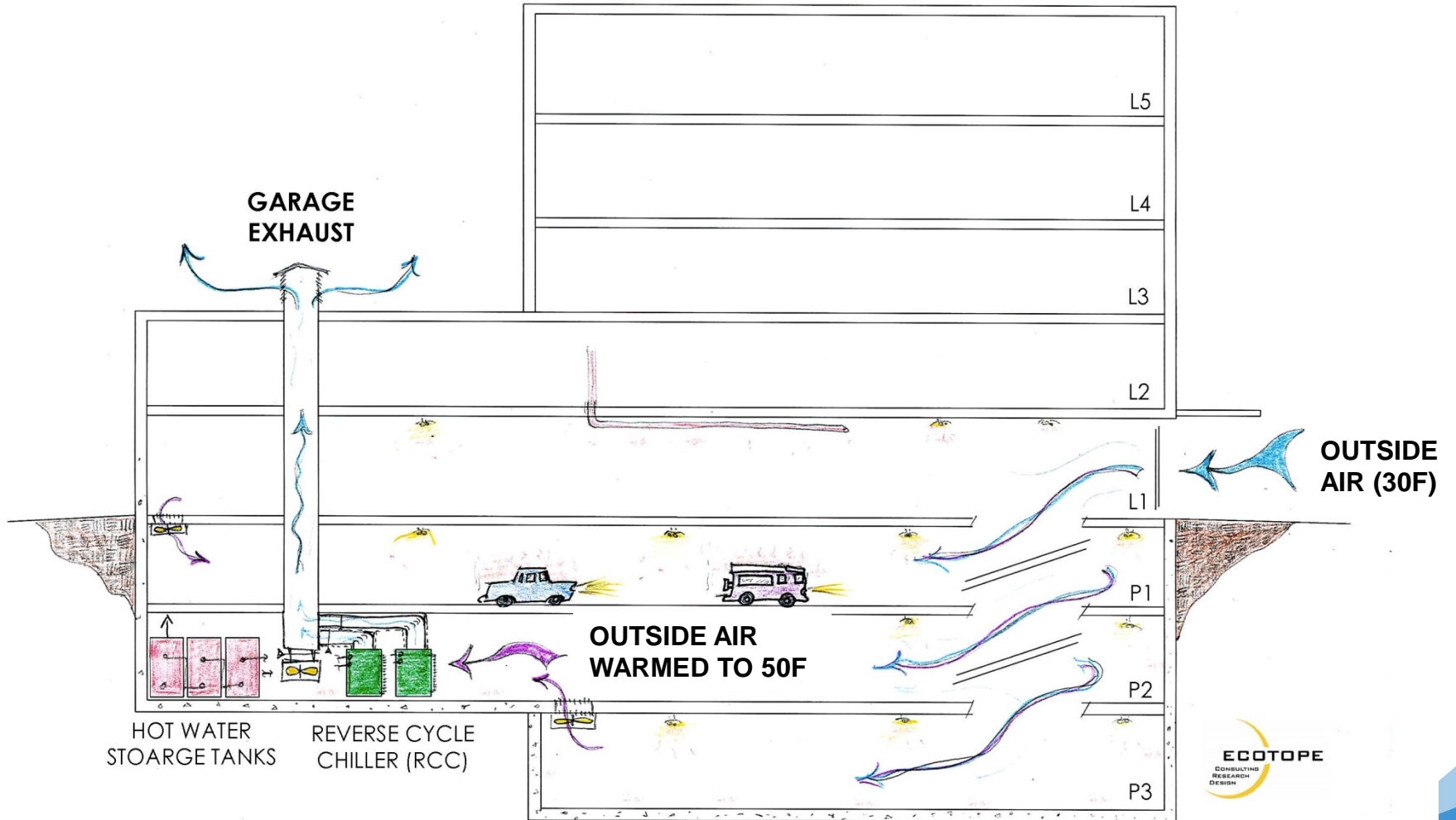
Reverse Cycle Chiller (RCC)



HPA12 Heating COP vs. Entering Air Temperature

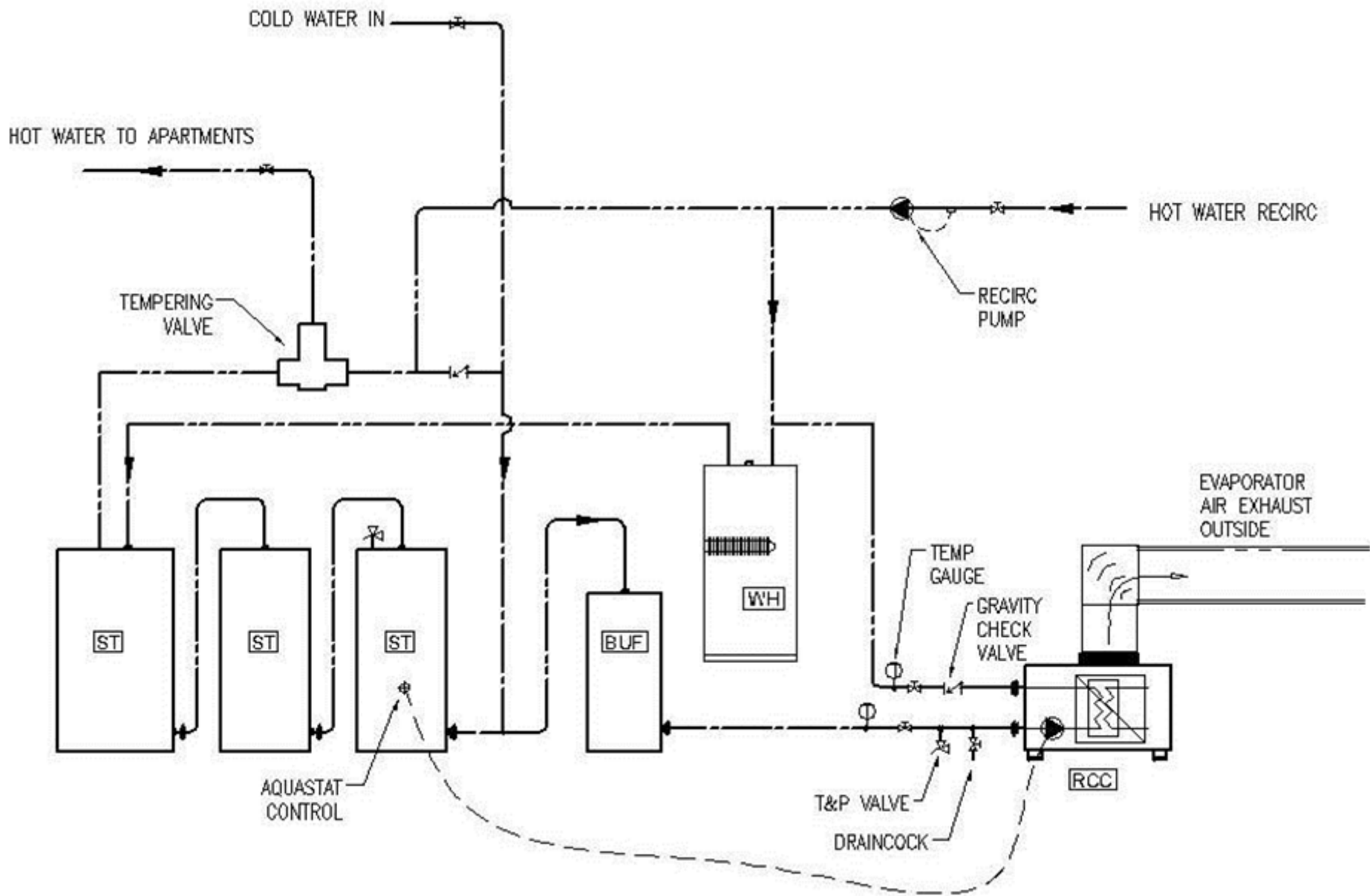


RCC Schematic



Sunset Electric, Stackhouse, Stream



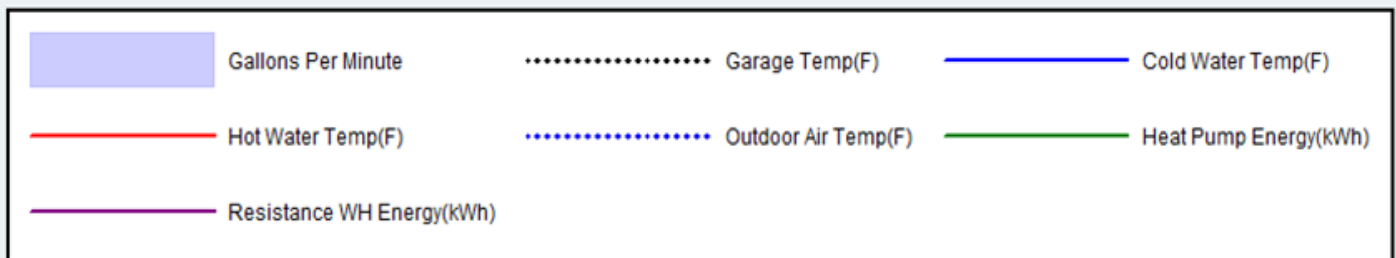
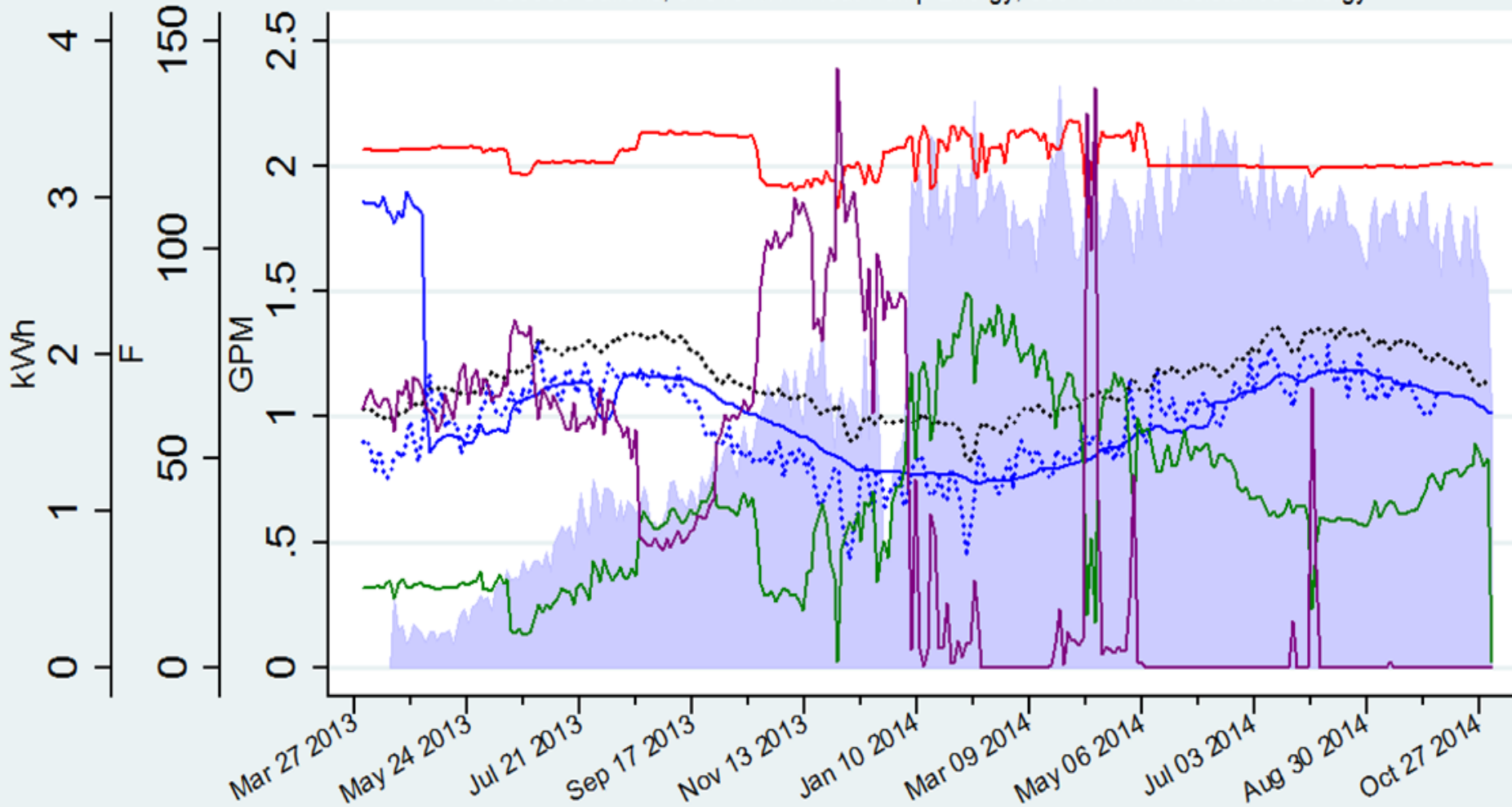


Stream Uptown



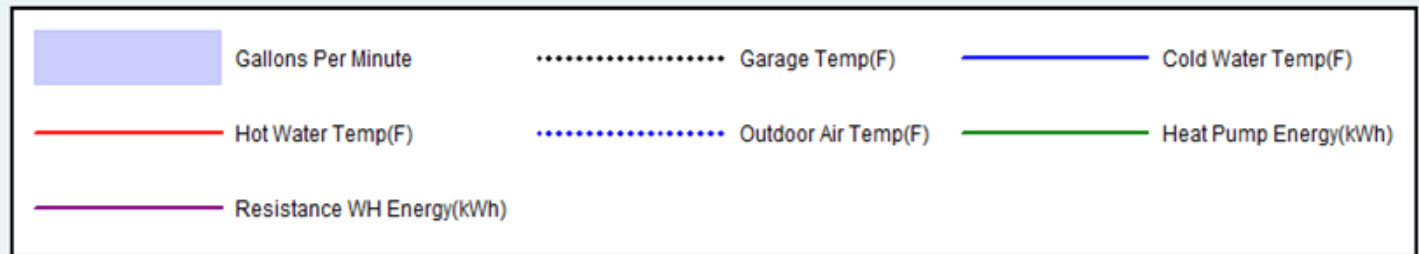
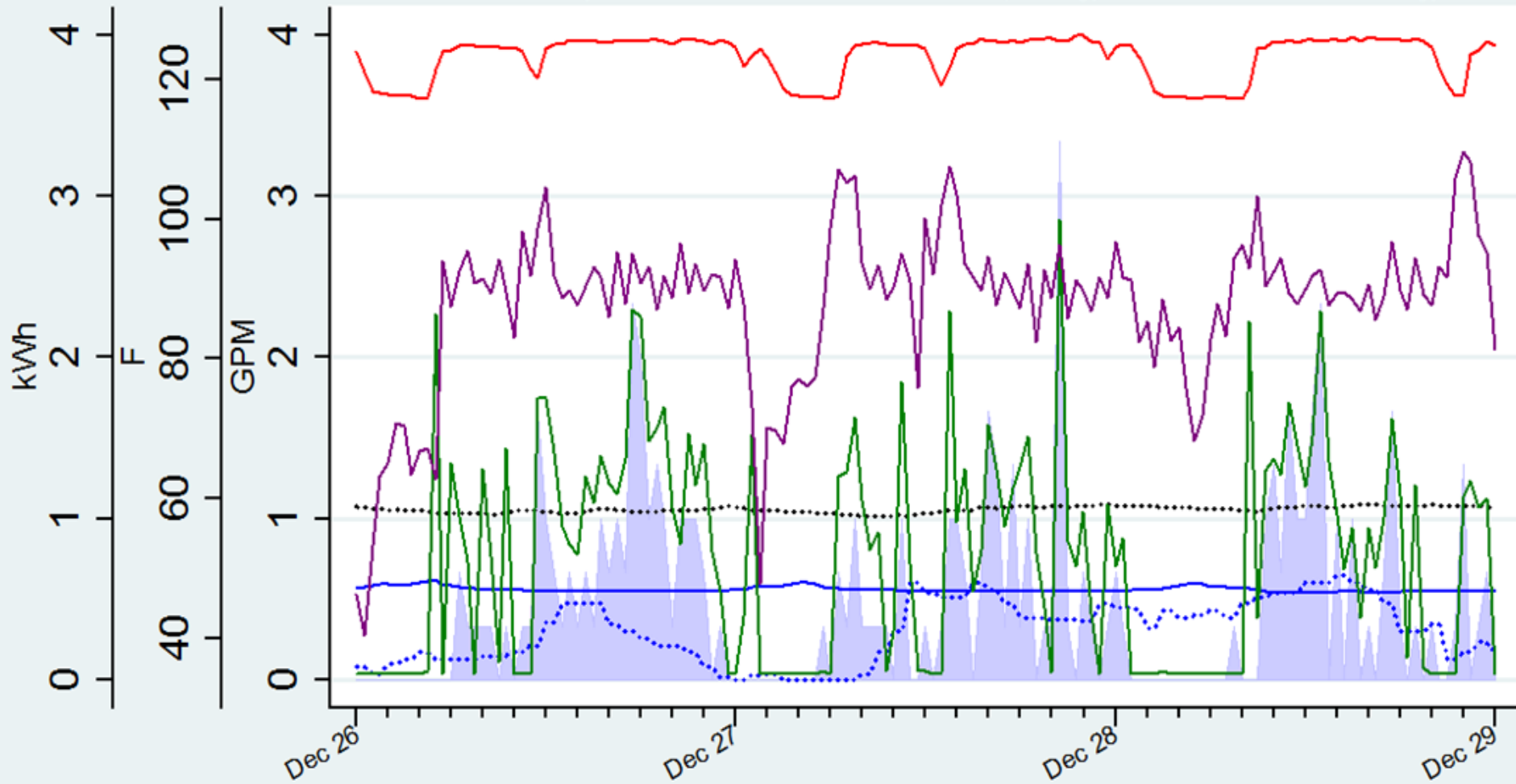
580 days starting from April 1, 2013

1059590 Gallons, 87818 kWh Heat Pump Energy, 80945 kWh Resistance Energy



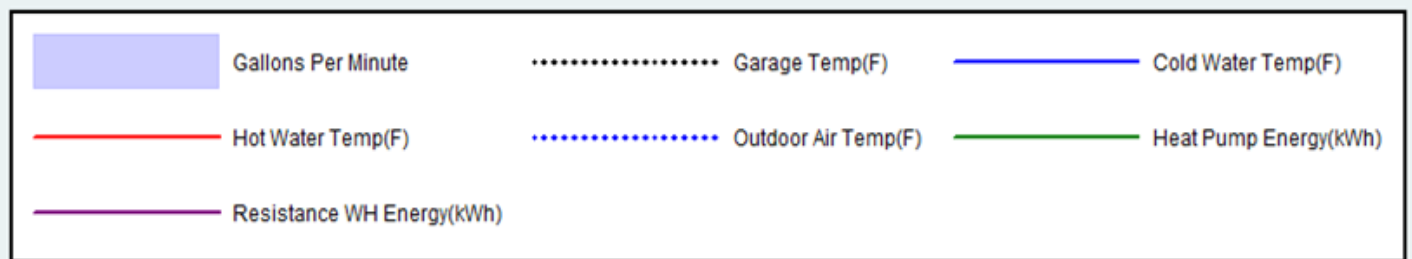
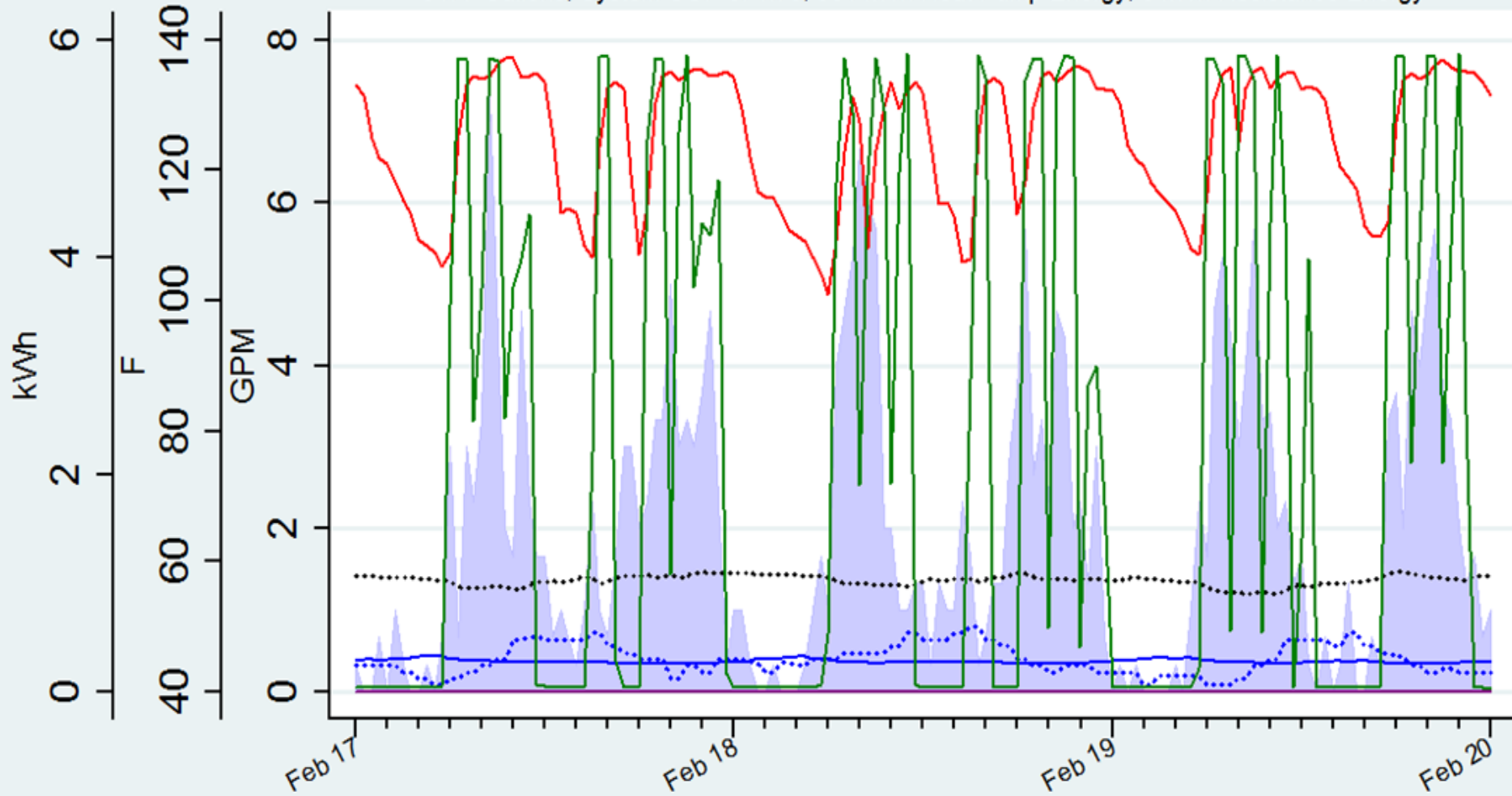
3 days starting from December 26, 2013

1940 Gallons, System COP of .28, 327 kWh Heat Pump Energy, 1007 kWh Resistance Energy



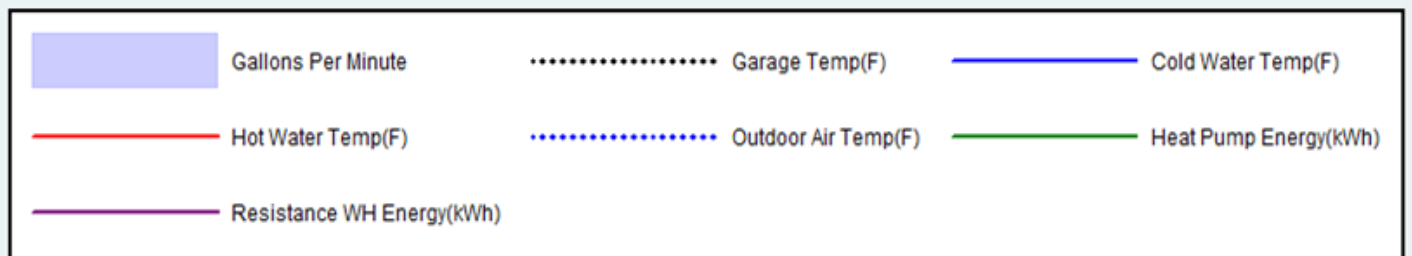
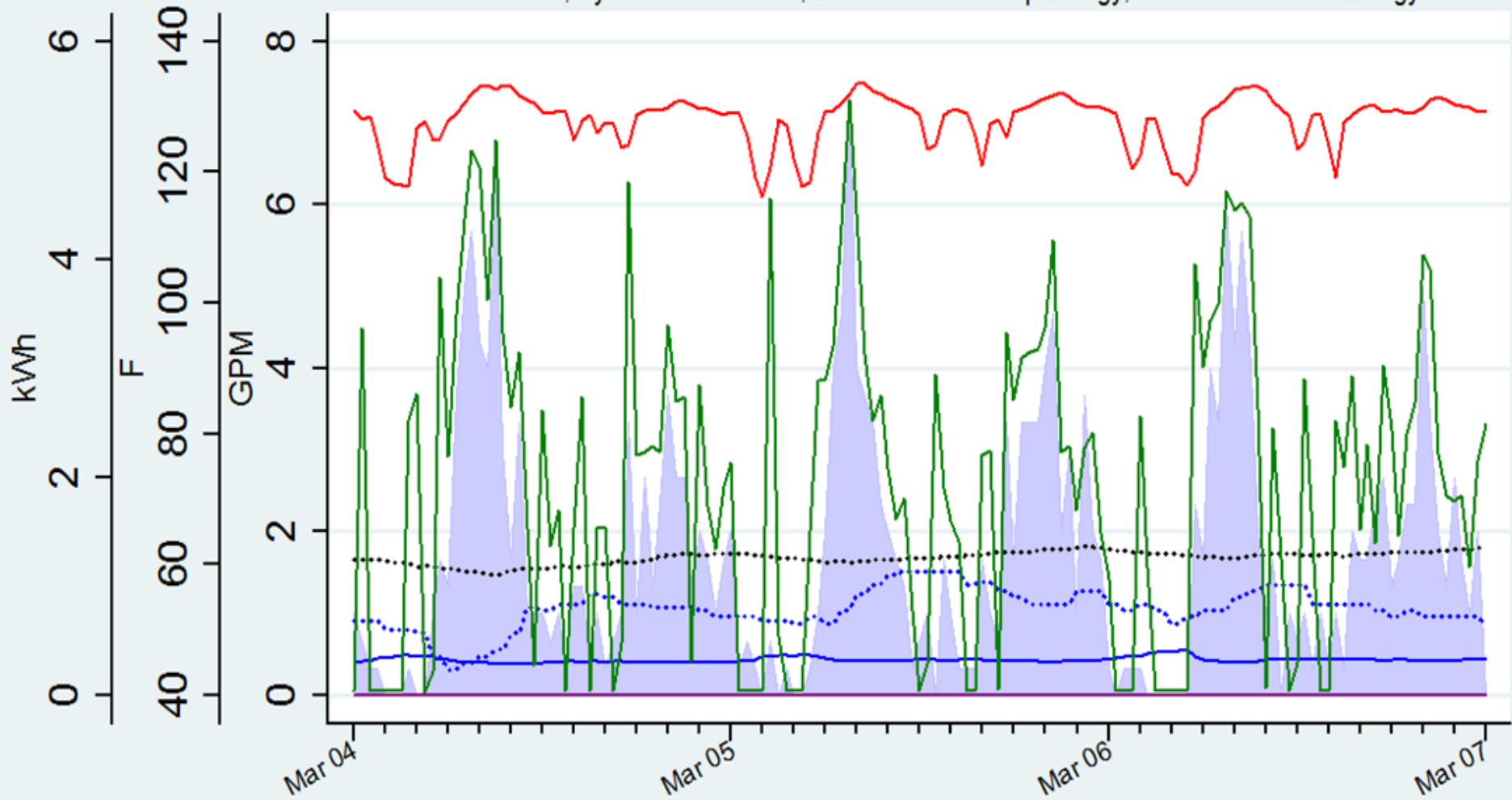
3 days starting from February 17, 2014

8477 Gallons, System COP of 1.75, 961 kWh Heat Pump Energy, 0 kWh Resistance Energy



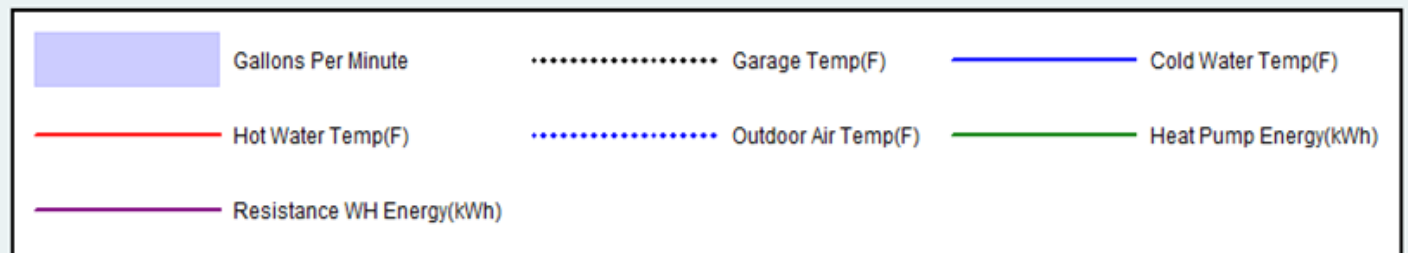
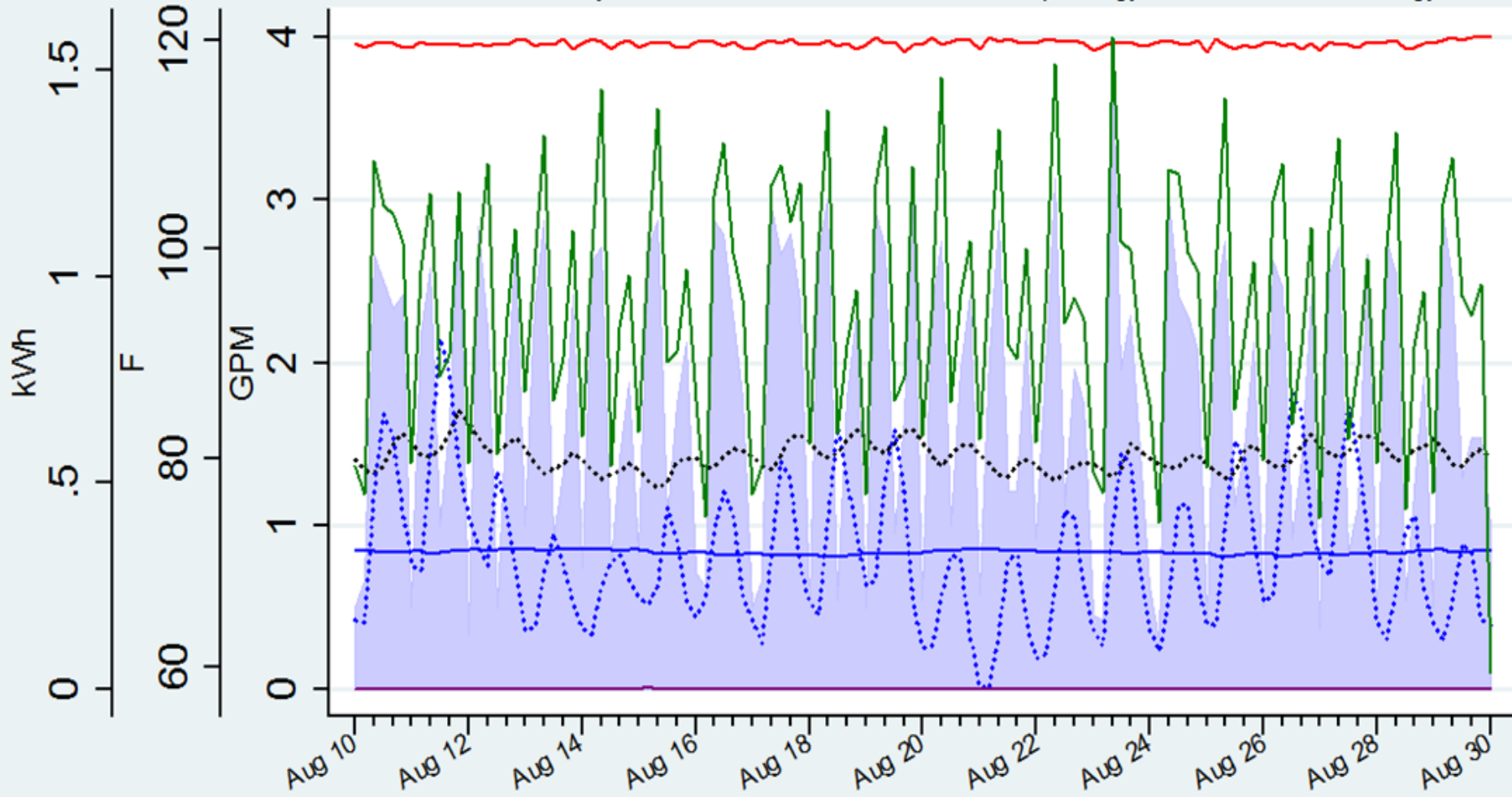
3 days starting from March 4, 2014

7493 Gallons, System COP of 1.78, 854 kWh Heat Pump Energy, 0 kWh Resistance Energy



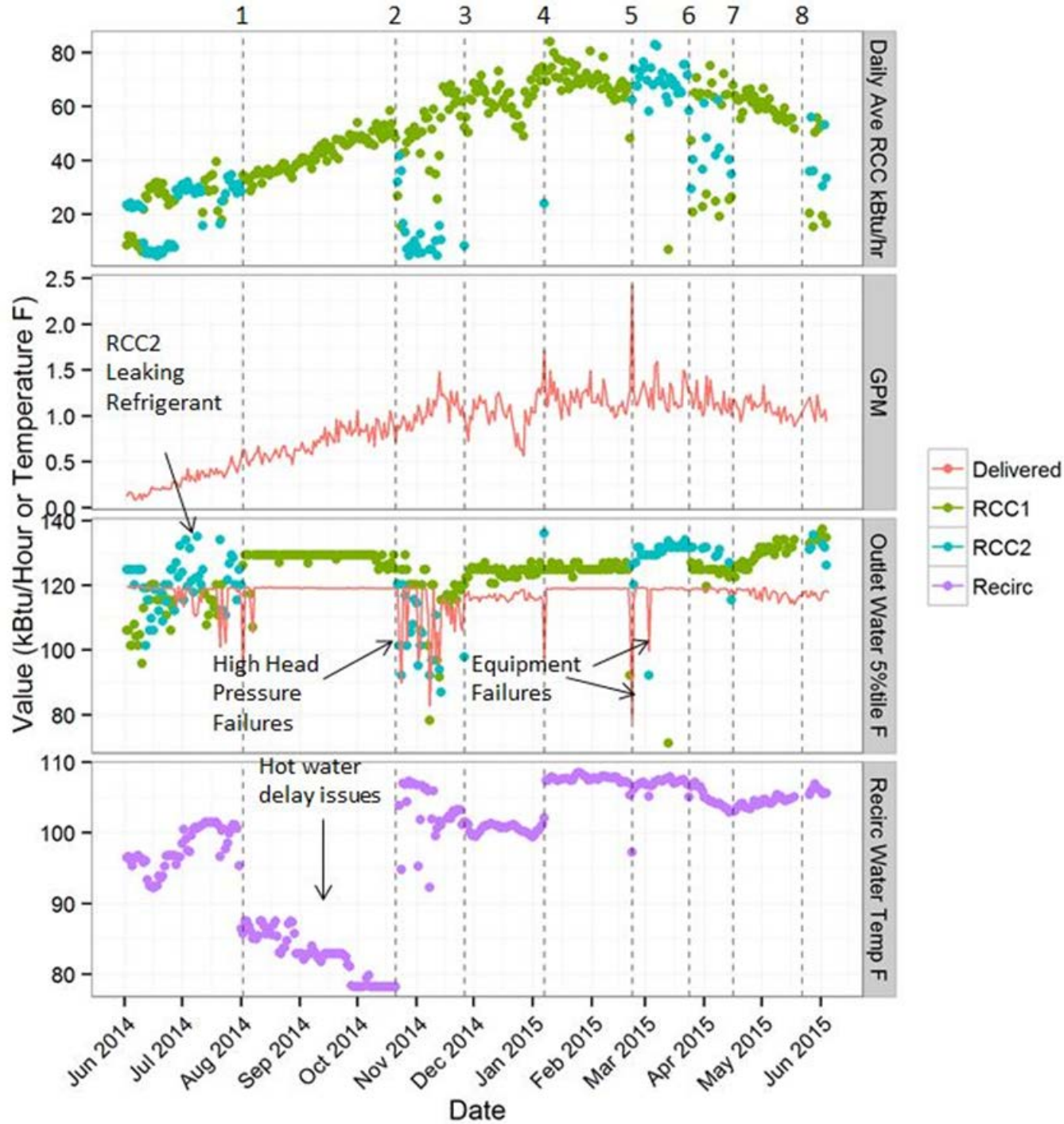
20 days starting from August 10, 2014

51271 Gallons, System COP of 2.26, 2687 kWh Heat Pump Energy, 0 kWh Resistance Energy



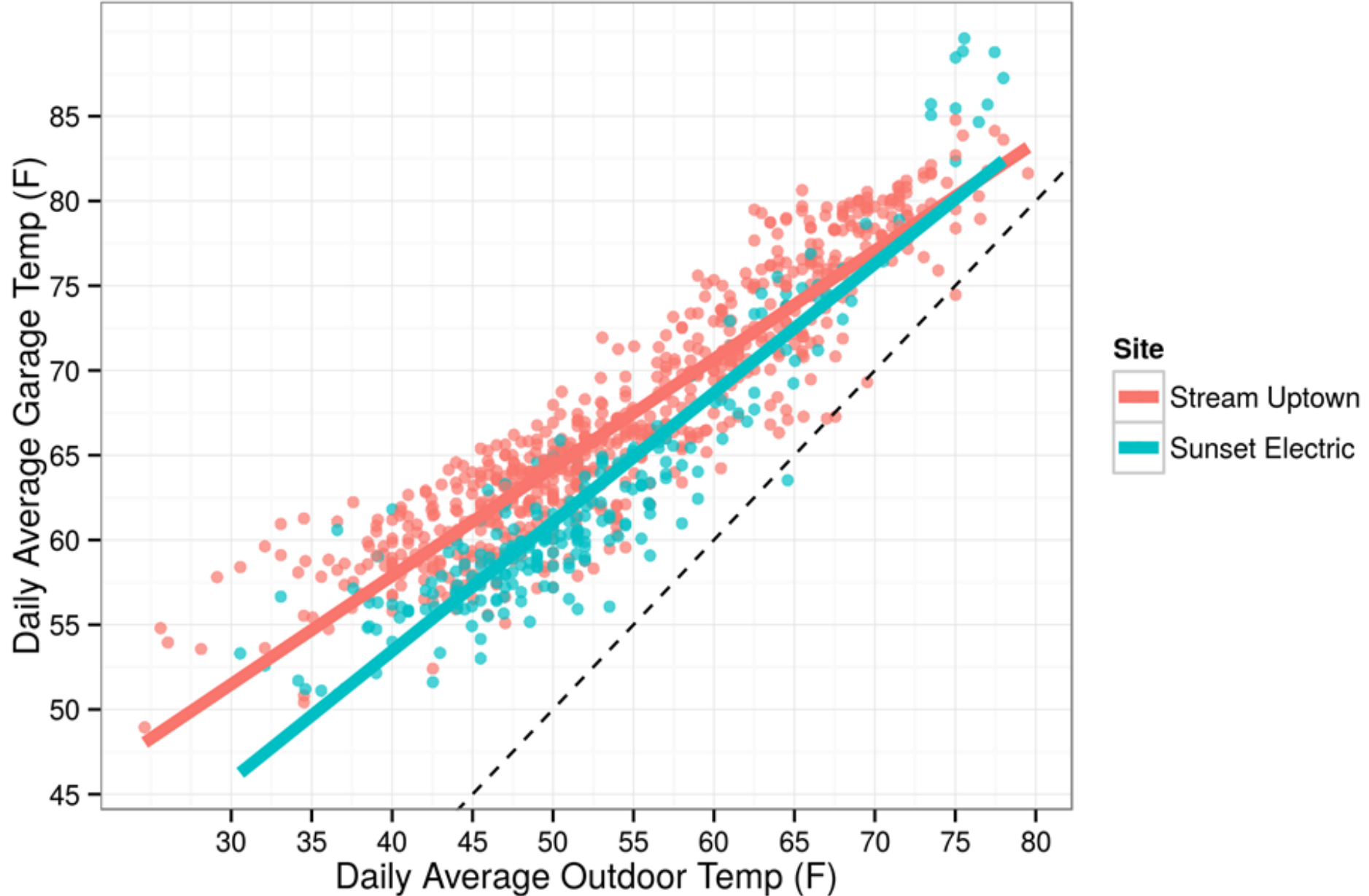
Sunset Electric





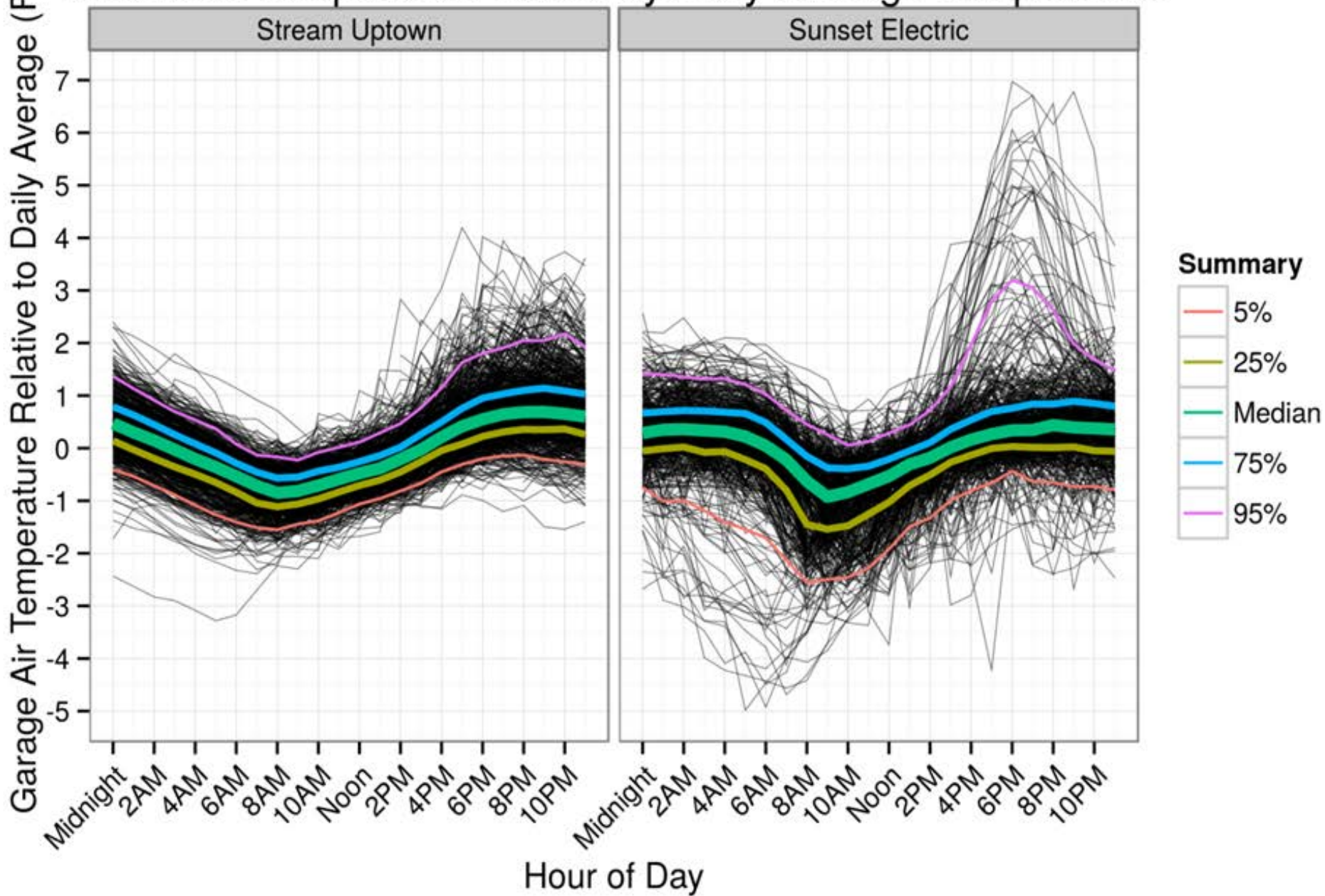
Daily Garage Air Temp by Outdoor Air Temp

Dashed Line as 1-1



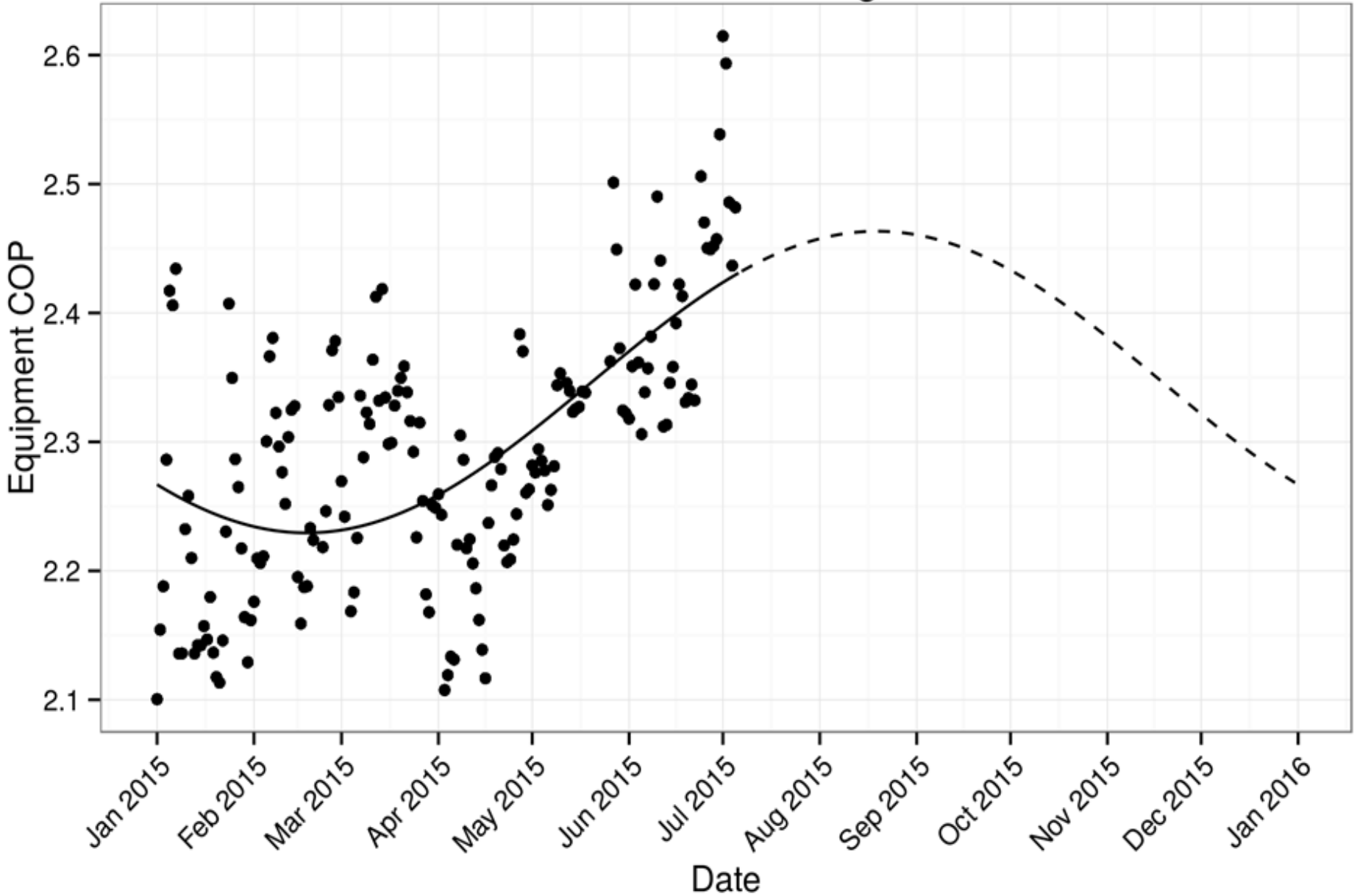
Garage Temperature Diurnal Pattern

Measured Temperature scaled by Daily Average Temperature



Sunset Electric RCC Equipment COP - Measured and Projected

Estimated Annual Average = 2.35



Summary of System Performance Information

Measure	Range	Stream	Sunset
Apartments		118	92
Occupants		140	110
Garage Temp °F	Average	66	63
	High (99%)	81	83
	Low (1%)	53	50
Hot Water	Average	19	13
Gal/Person/Day	High (95%)	23	18
	Low (5%)	16	-
RCC COP	Average	2.8*	2.4
	High	-	2.5
	Low	-	2.2
Losses	kBtu / year	200,000	210,000
	Average %	30%*	44%
RCC Energy Use		262,000**	210,000

*Estimate based on manufacturer's data.

**Excluding periods of electric resistance operation.

Some Key Lessons Learned

1. Storage/Distribution/Circulation losses are **HUGE**

- Focus on minimizing distribution piping
- Super-Insulate hot water distribution piping
- Consider heat trace cable in lieu of recirculation



Some Key Lessons Learned

2. Standard Older ASHRAE Sizing Method is Way Over-Sized.

Look to 2015 Applications Handbook Table 7, “Low Usage” method.

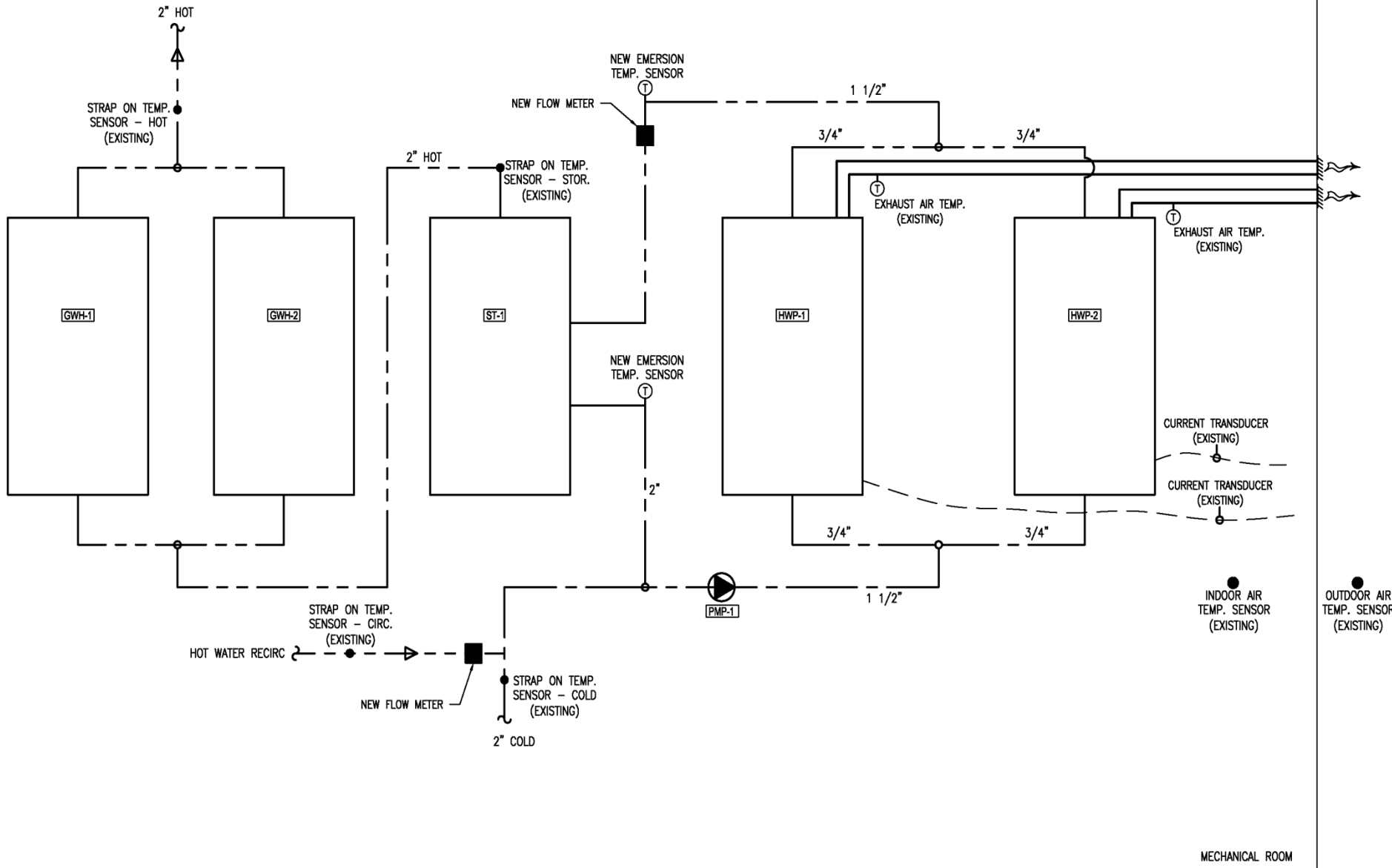
Some Key Lessons Learned

3. M&V Data Critical to understanding new technologies.



What if There is No Parking Garage?



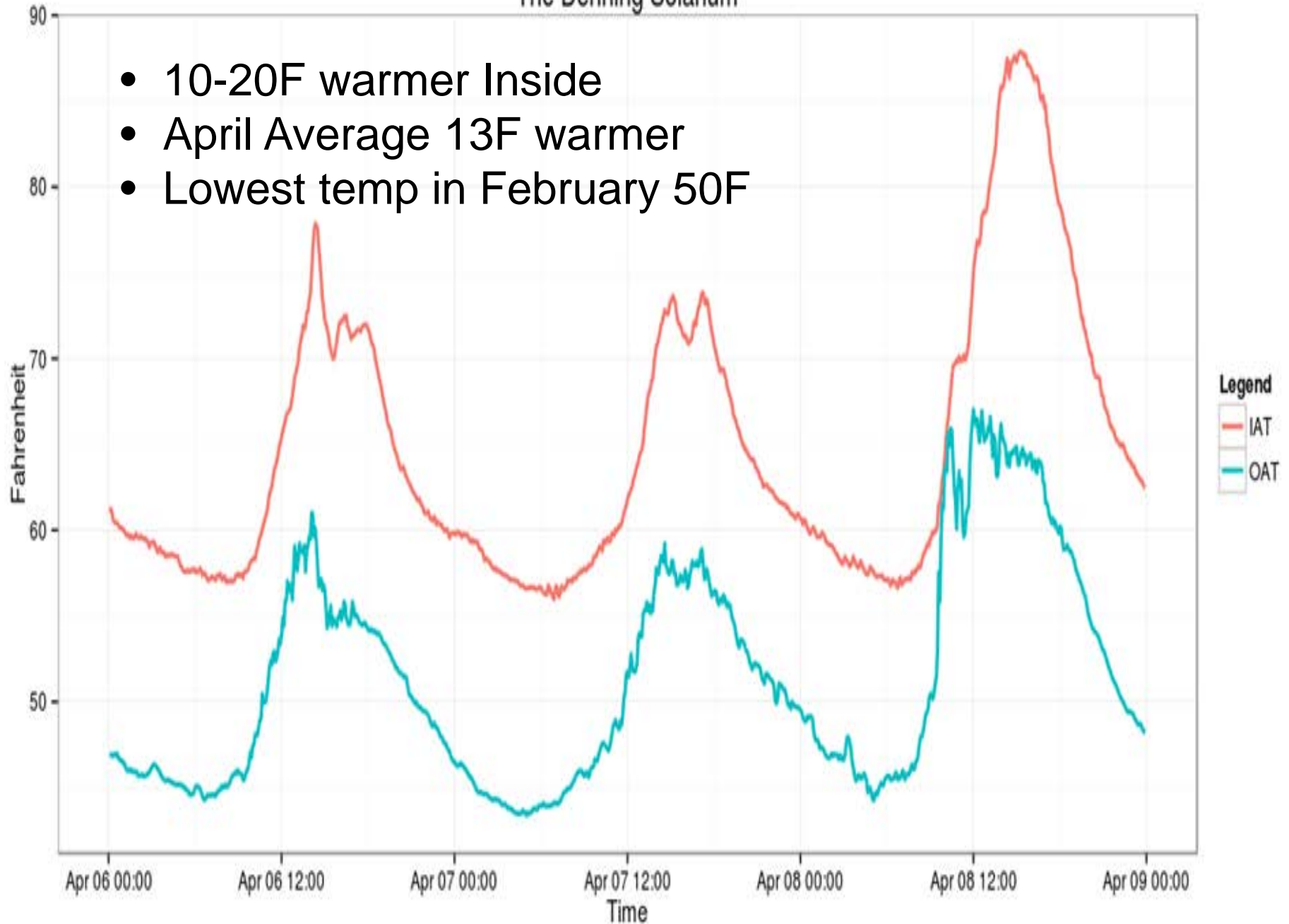


1 SCHEMATIC OF MEASUREMENT AND VERIFICATION DETAILS AT THE DENNING APARTMENTS

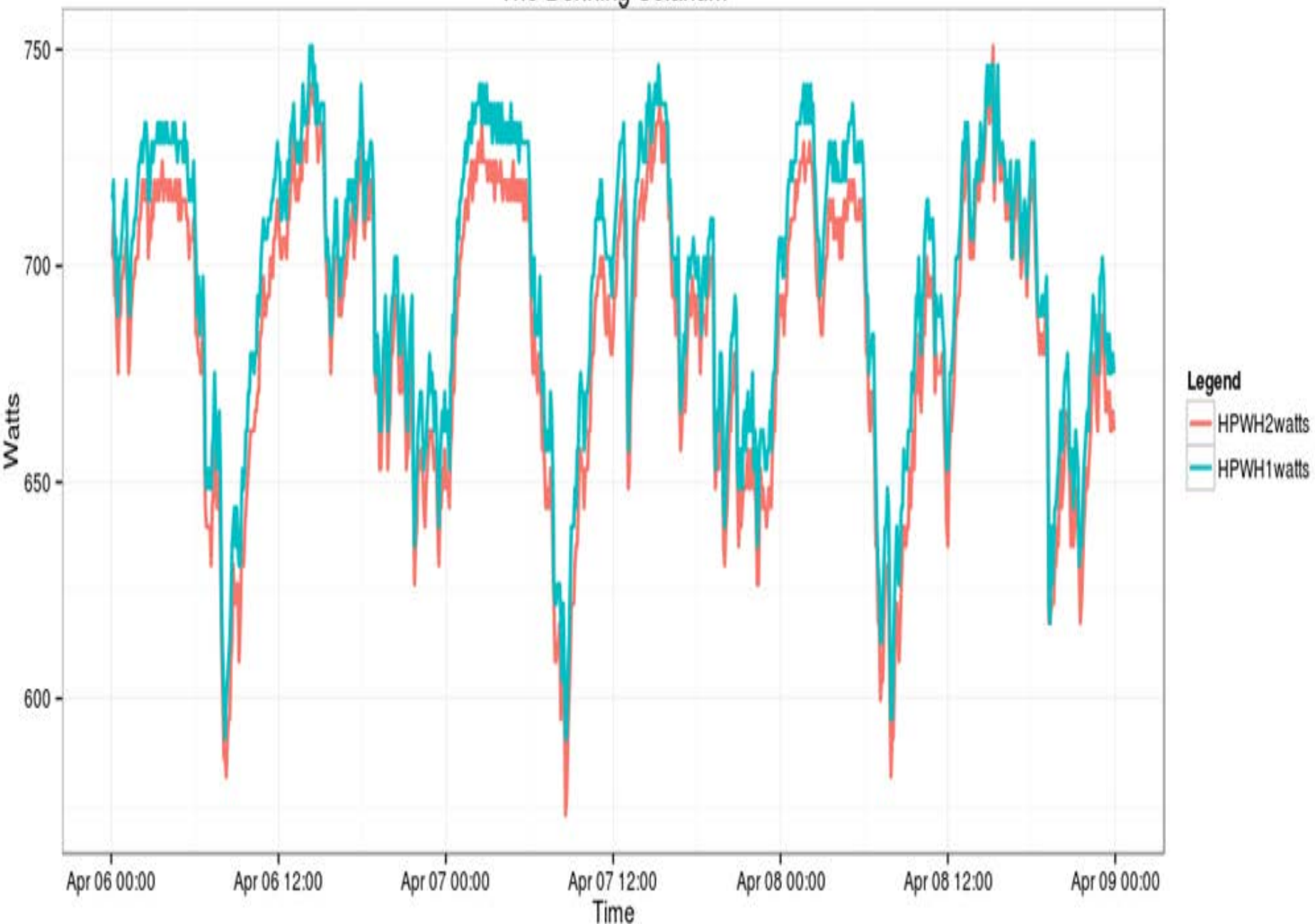
SCALE: NONE

The Denning Solarium

- 10-20F warmer Inside
- April Average 13F warmer
- Lowest temp in February 50F

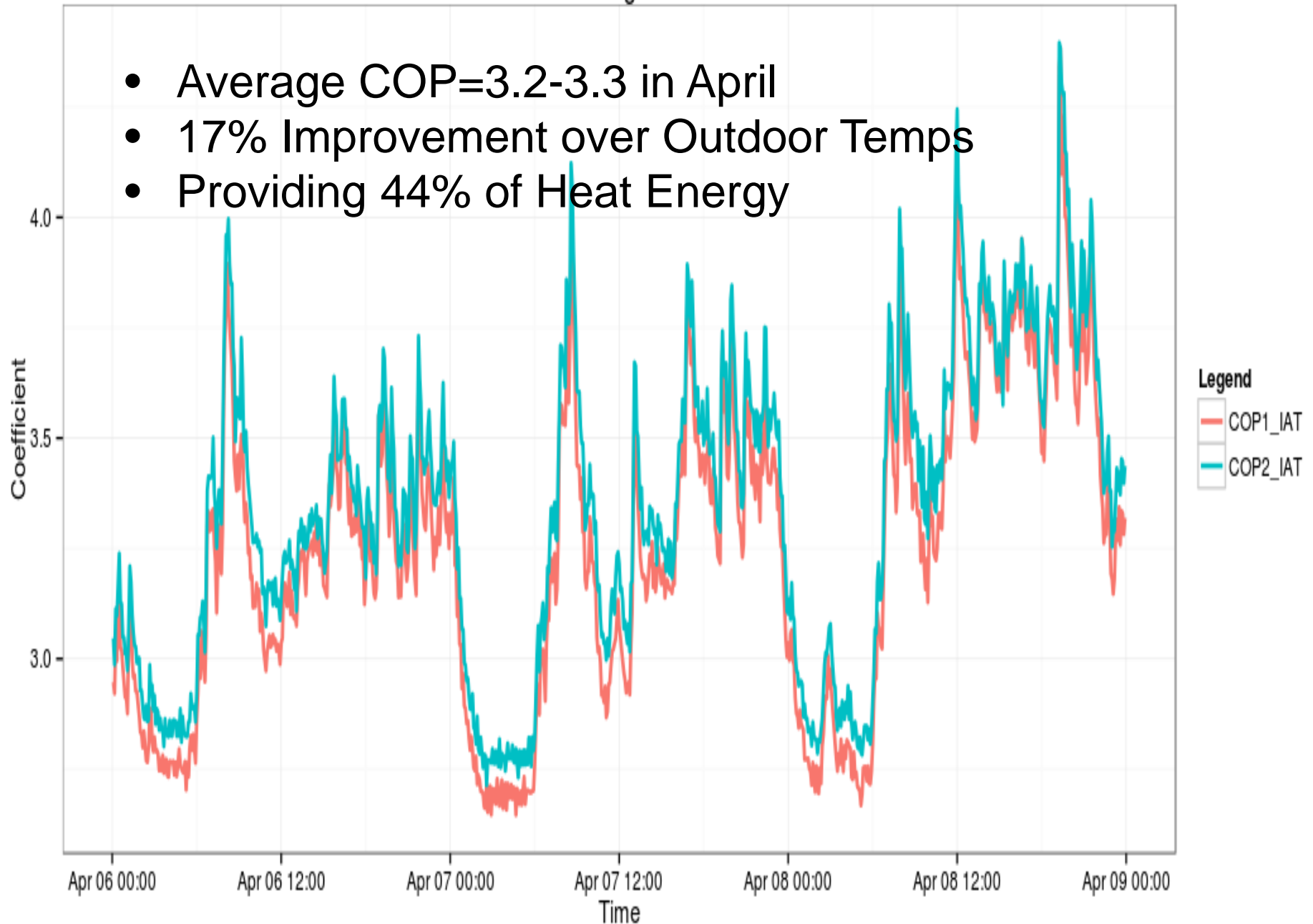


The Denning Solarium



The Denning Solarium

- Average COP=3.2-3.3 in April
- 17% Improvement over Outdoor Temps
- Providing 44% of Heat Energy



R410a – Split Systems



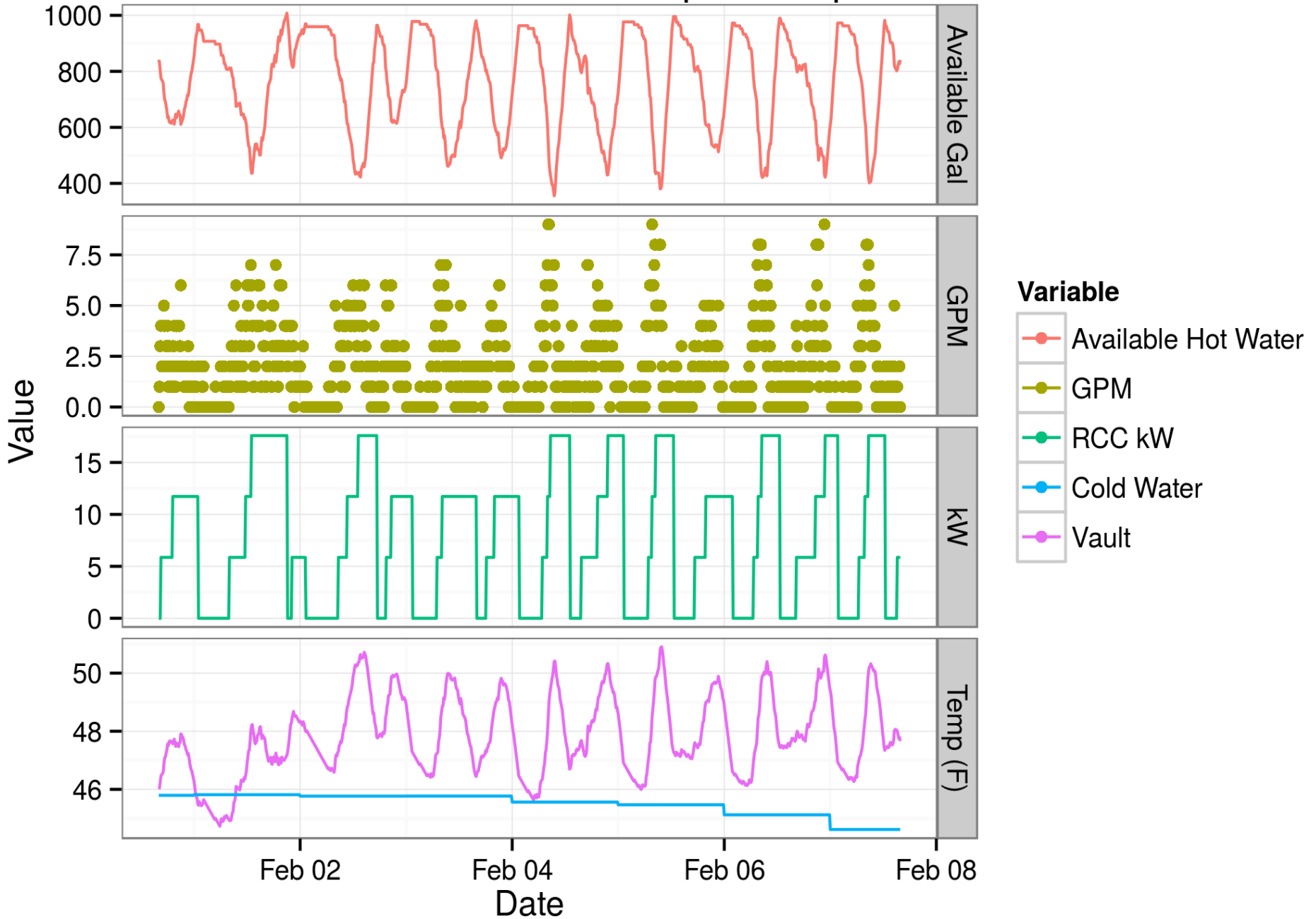
Waste Water – The Ultimate Source



Waste Water Heat Pump



WWHP Fake Data - Stream Uptown Inputs



Questions?

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