

# Northwest Ductless Heat Pump Project



## Current & Future DHP Performance Evaluations

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# Evaluating Ductless Heat Pumps

## ■ Regional goals

- Provide insight to implement promising Technology
- Develop a measure that can transcend weatherization for electric resistance homes

## ■ Provide understanding of DHP technology and the determinants of energy savings

- Review occupant behavior as it interacts with DHPs
- Assess DHP control strategies and their impacts on total savings
- Assess the cooling impact on various parts of the region

# Current Methodology

- Select a sample which is representative of the PNW climates
  - Willamette, Puget Sound: random sample
  - Inland Empire, Boise/Twin Falls, Western Montana & Eastern Idaho: Engineering Sample
- Use a metering approach for assessing performance
  - Quad metering using HOBO, U-30 Technology
  - Adapt to allow in situ measure of Heat Pump COP
- Develop a billing analysis appropriate for evaluating a baseline heating consumption
- Provide a market assessment based on interviews with customers, utilities, NEEA and installers
- Provide a cost effectiveness analysis that incorporates all the data

# BPA Pre-Pilot, Monmouth

- 14 homes with installed DHP, single zone, single compressor.
  - 11 Monmouth, 2 Moses Lake, 1 Tacoma
- Savings measured in 13 homes, over 40% space heat savings (on average)
  - Total savings of 4442 kWh
  - Large variation and a small sample

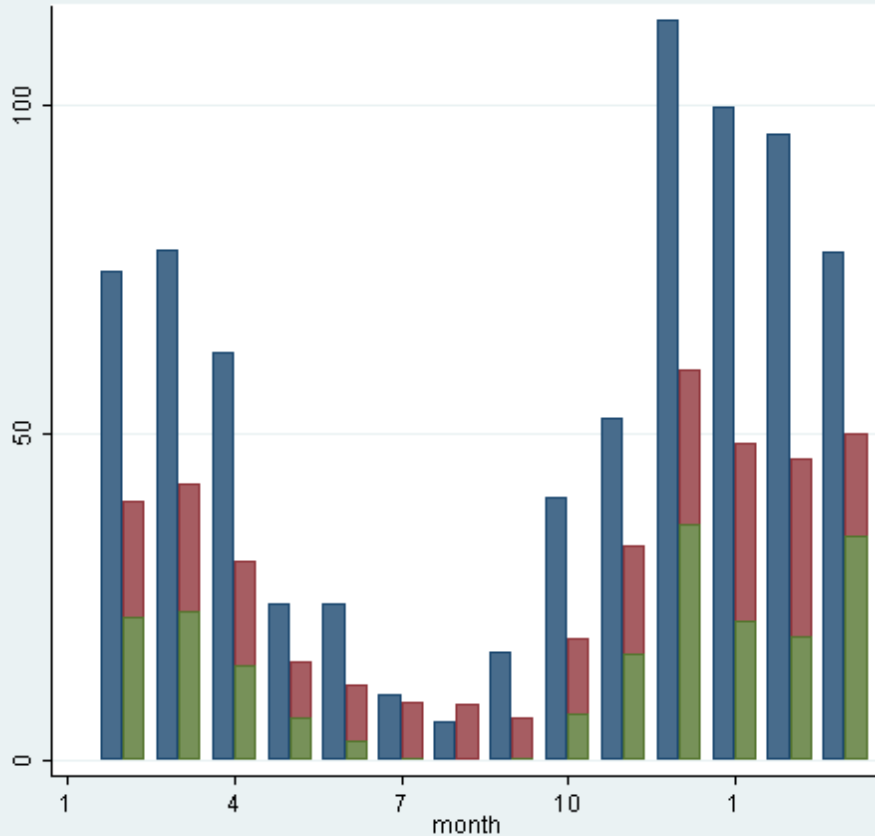
# Monmouth Analysis

Case	Pre-Bills	Submetered	Savings
Monmouth 1	9917	6802	3115
Monmouth 2	4011	2356	1655
Monmouth 3		4557	
Monmouth 4	12513	8893	3620
Monmouth 5	5669	3952	1717
Monmouth 6	17701	8081	9620
Monmouth 7	7018	5050	1968
Monmouth 8	18561	10052	8509
Monmouth 9	5264	3797	1467
Monmouth 10	24253	7246	17007
Monmouth 11	5391	2420	2971
MosesLake 1	4308	3540	768
MosesLake 2	10384	6902	3482
Tacoma 1	4103	2259	1844
<b>Average(of 13)</b>	<b>10400</b>	<b>5537</b>	<b>4442</b>
<b>Average (of 11)</b>	<b>9930</b>	<b>5488</b>	<b>4863</b>

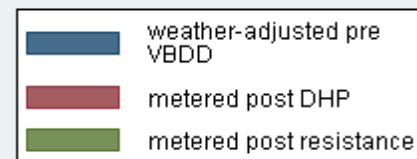
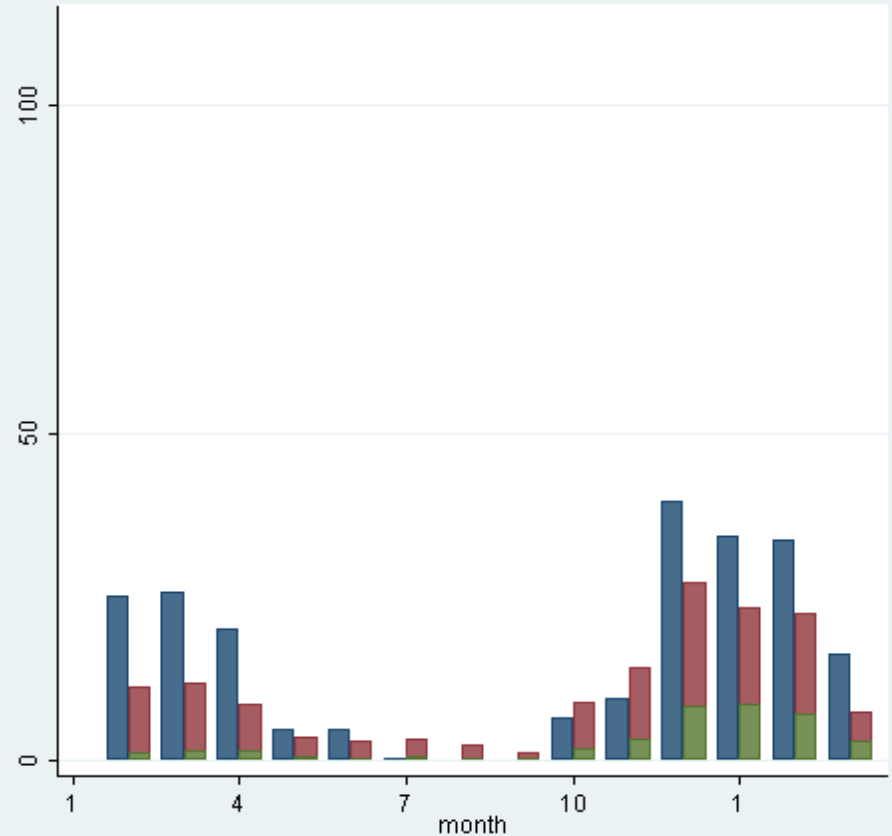
# Monmouth sites kwh/day heating energy

submetered "post" year compared with weather-adjusted "pre" VBDD billing reg estimates

Monmouth\_8

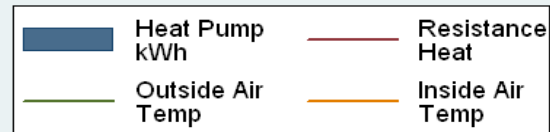
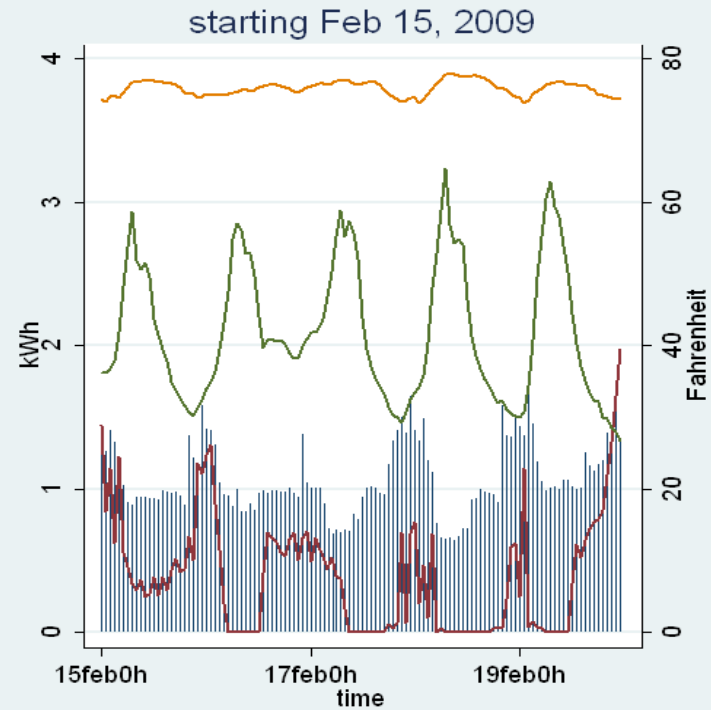
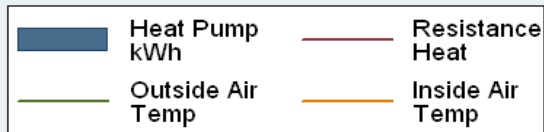
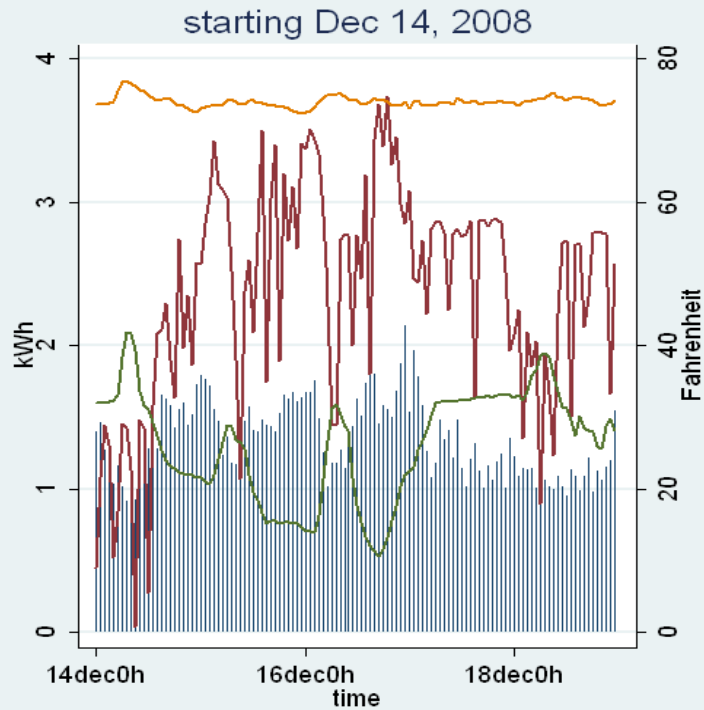


Monmouth\_9



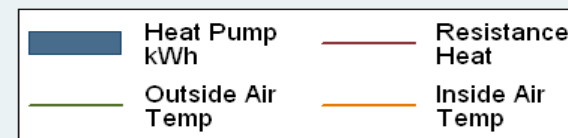
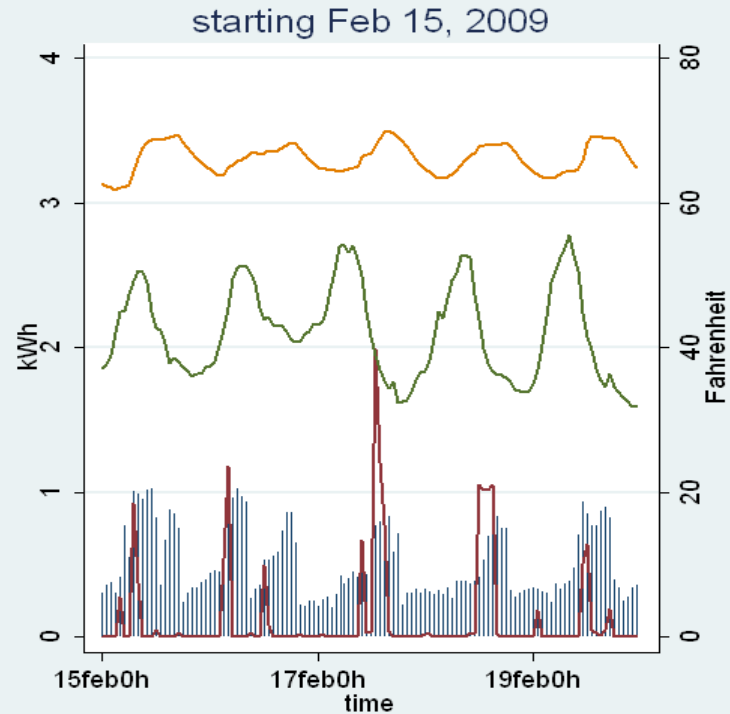
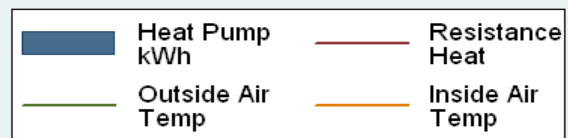
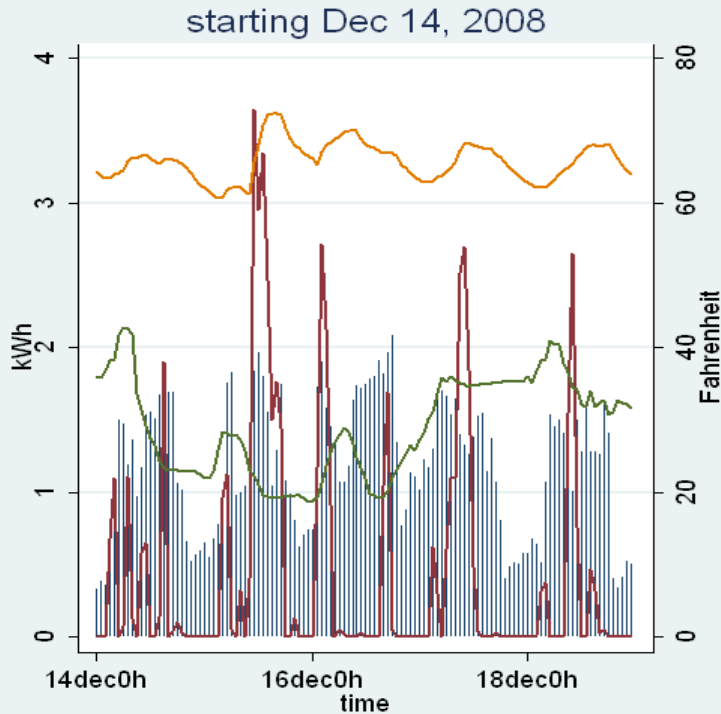
# Comparison, Two Winter Weeks

## Monmouth site 8 Hourly Usage over two 5-day intervals



# Comparison, two winter weeks

## Monmouth site 9 Hourly Usage over two 5-day intervals

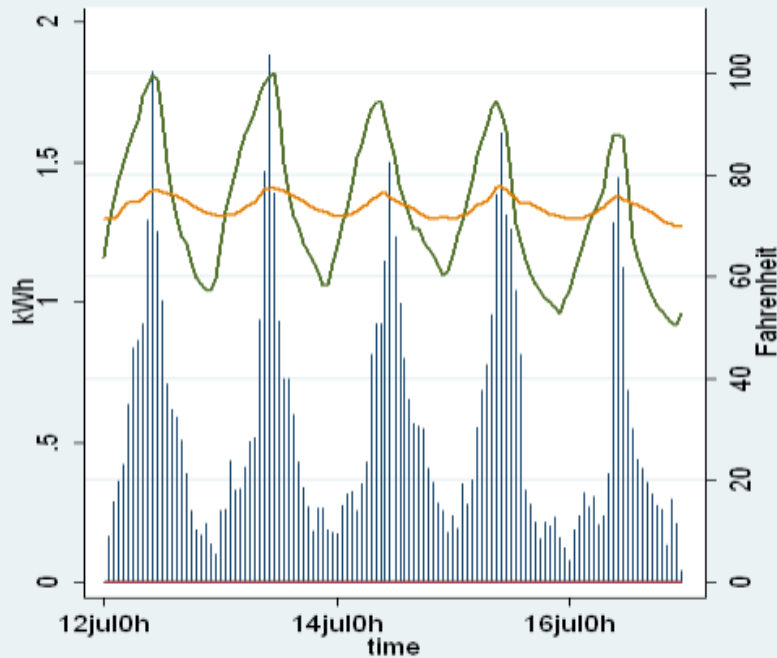


# Monmouth Cooling Offset

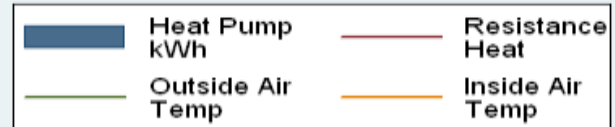
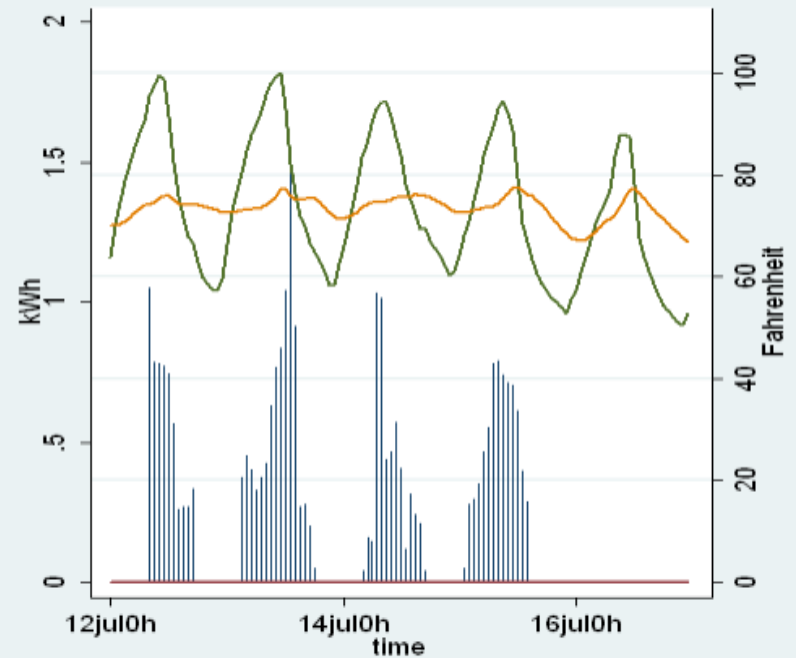
- Analysis assumed cooling if temperature was above 65°
- Cooling was calculated in base load to correspond the existing cooling equipment
- Very minor offsets were apparent in the very mild year (2008)
- No real evidence of substantial cool increase during cooling months

# Sites compared over 5 days starting July 12, 2008

## Monmouth 8



## Monmouth 9



# Monmouth Lessons

- Characteristics and full bill record is important
- Occupant previous cooling behavior and supplemental heating behavior should be available
- A signal to identify cooling in the DHP very important
- Use of sub-metered data without a sub-metered base case is workable
- Savings vary from 30-70 percent of heating load
- Average Savings 45%

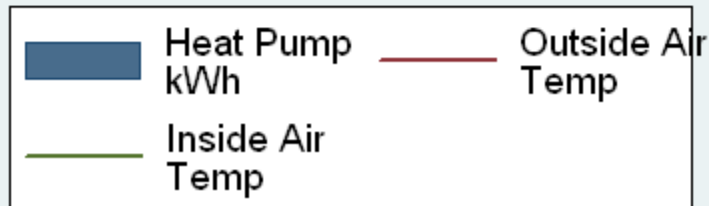
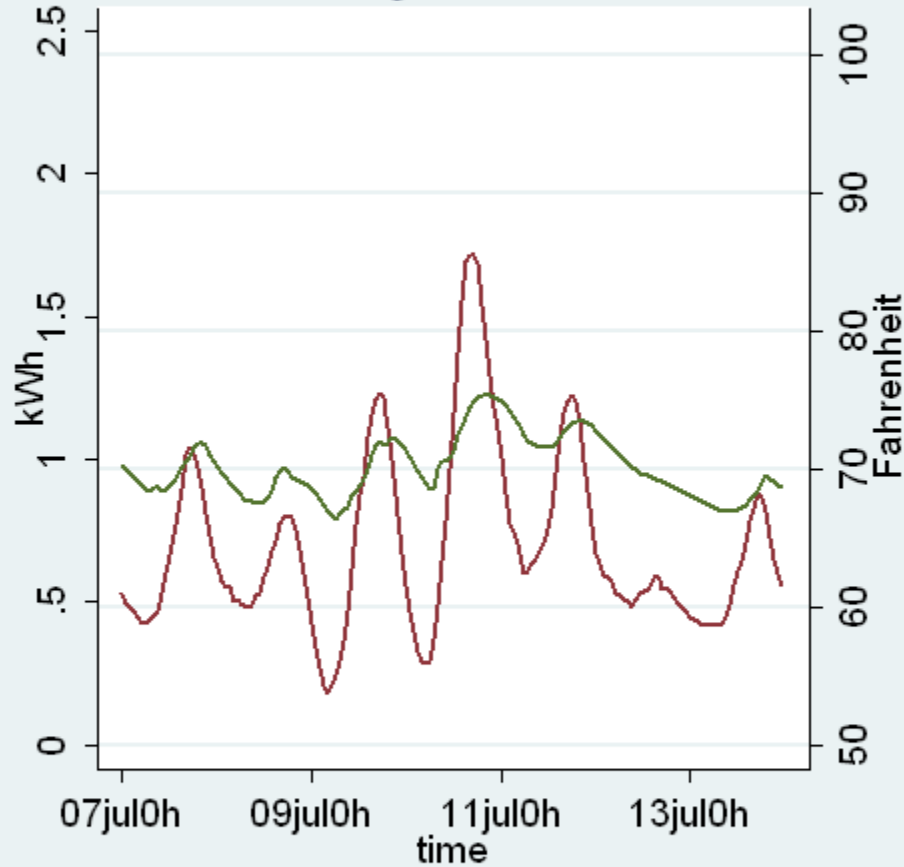
# Current Data Summaries for Summer Operation

- Summer 2009 very hot with a substantial cooling load
- Several comparisons made between cooler summer weeks and the Portland “heat storm,” July 25-31
- Two different heat pumps are shown here a large Mitsubishi and a small Fujitsu.
  - The Mitsubishi used in the initial runs two years ago (HSPF 8.2 EER 8.8)
  - The Fujitsu released in mid 2008 (HSPF 10.0 EER 10.4)

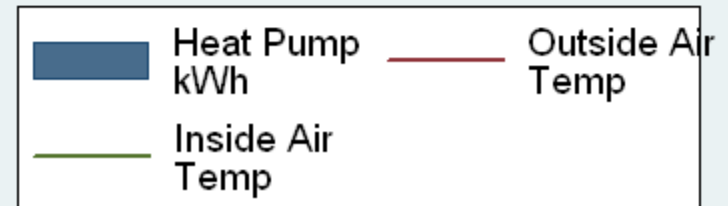
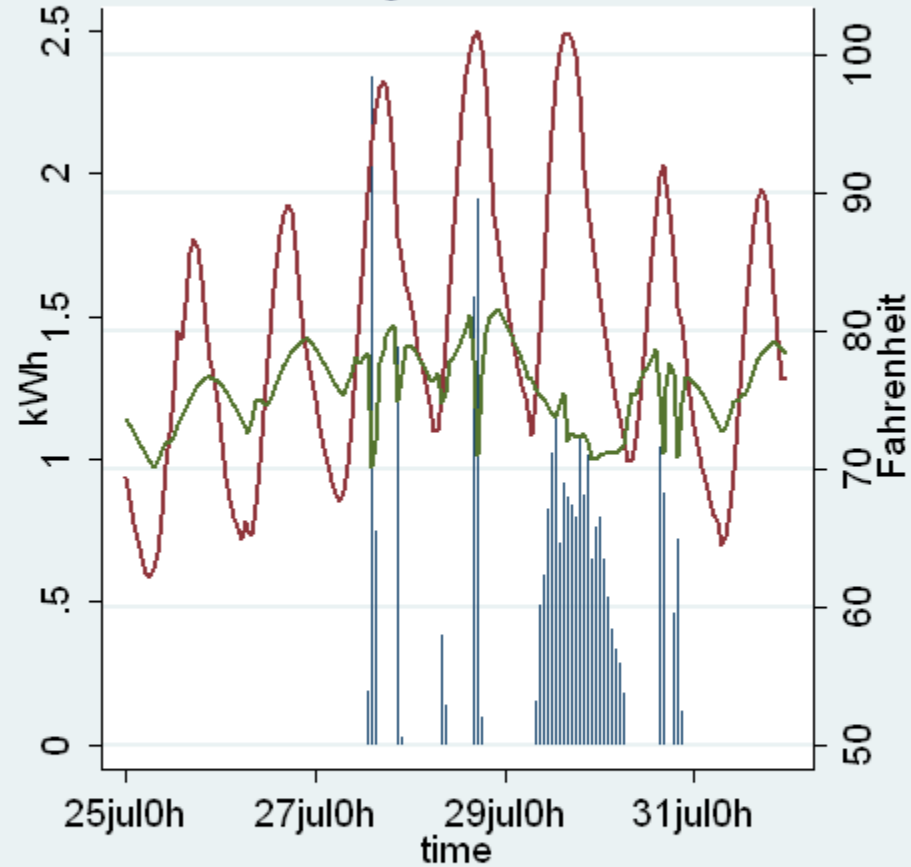
# hourly DHP usage over two 7-day intervals

logger id 2329708

starting Jul 7, 2009



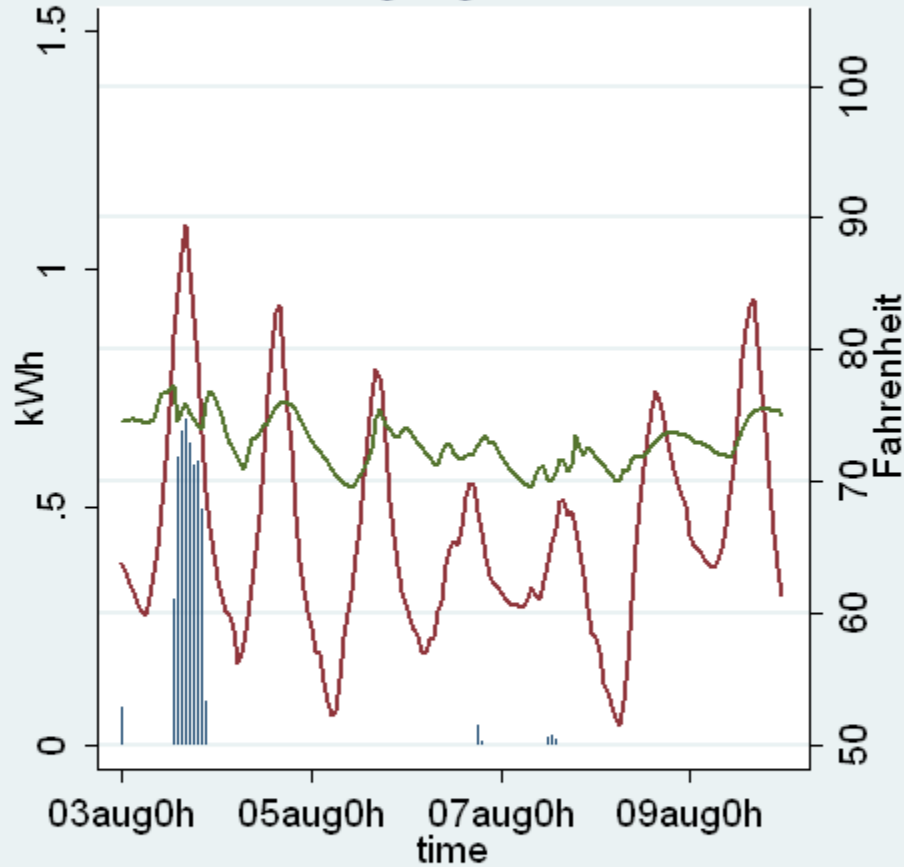
starting Jul 25, 2009



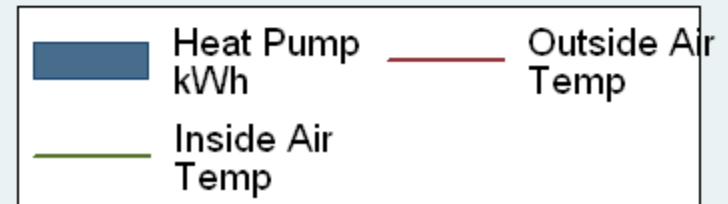
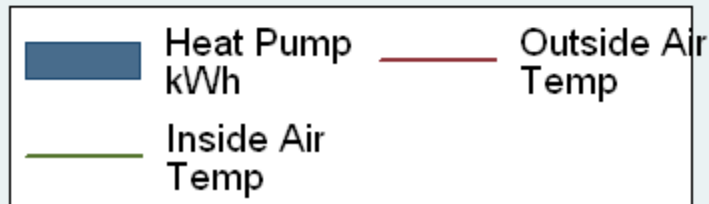
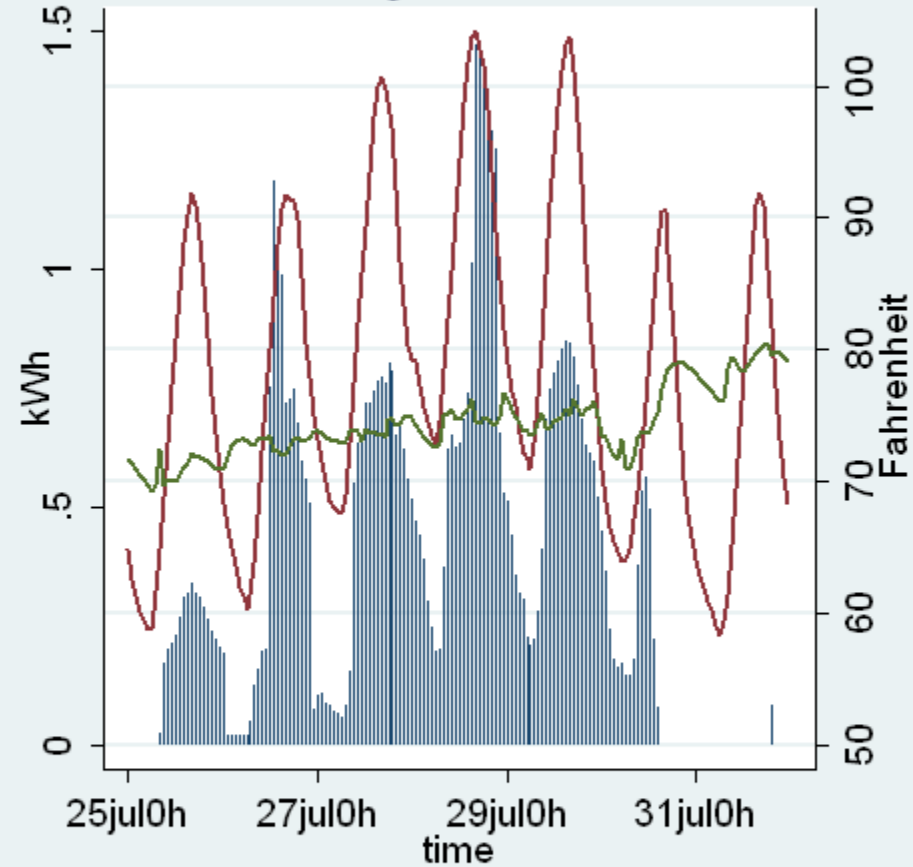
# hourly DHP usage over two 7-day intervals

logger id 2329728

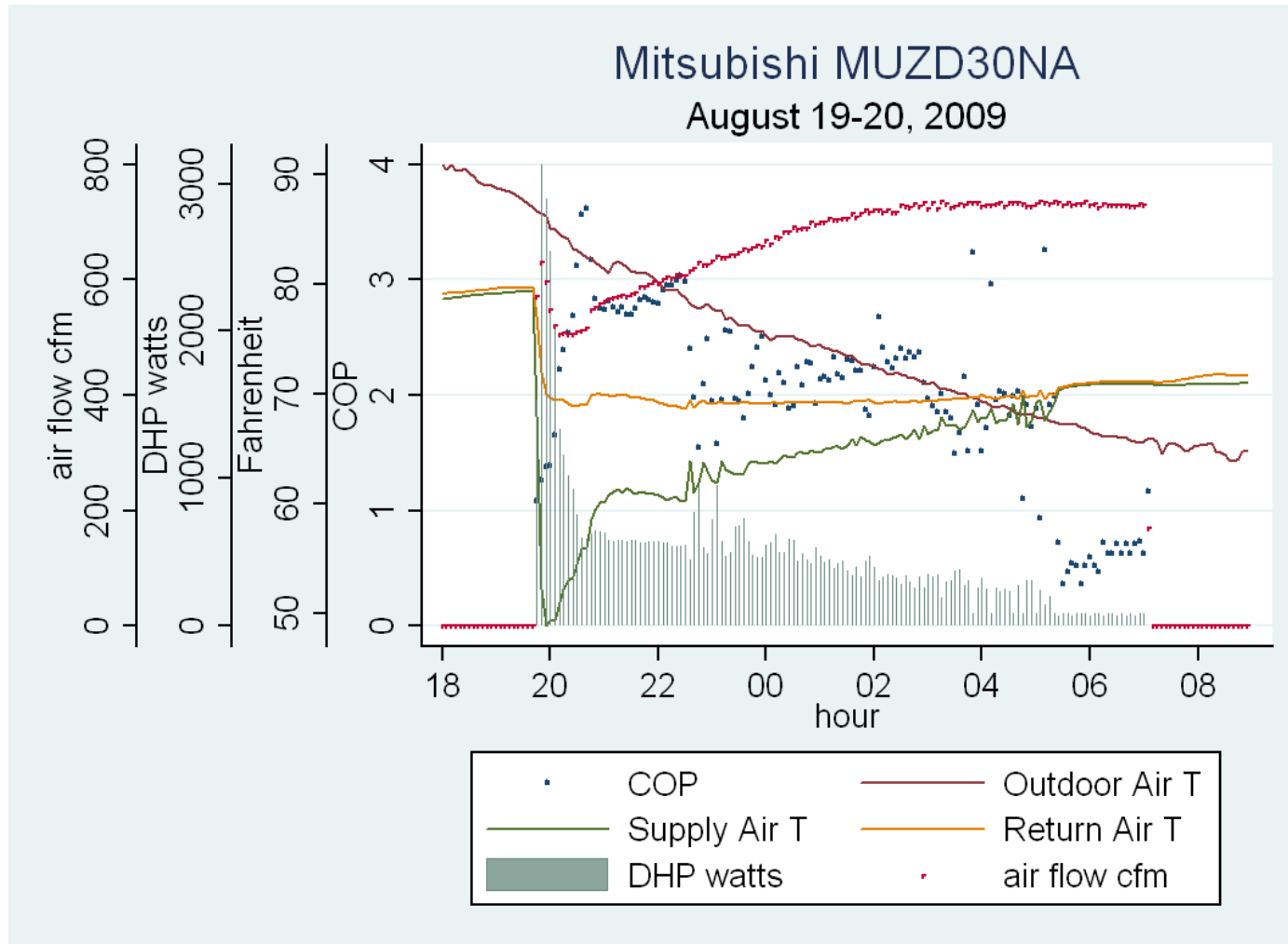
starting Aug 3, 2009



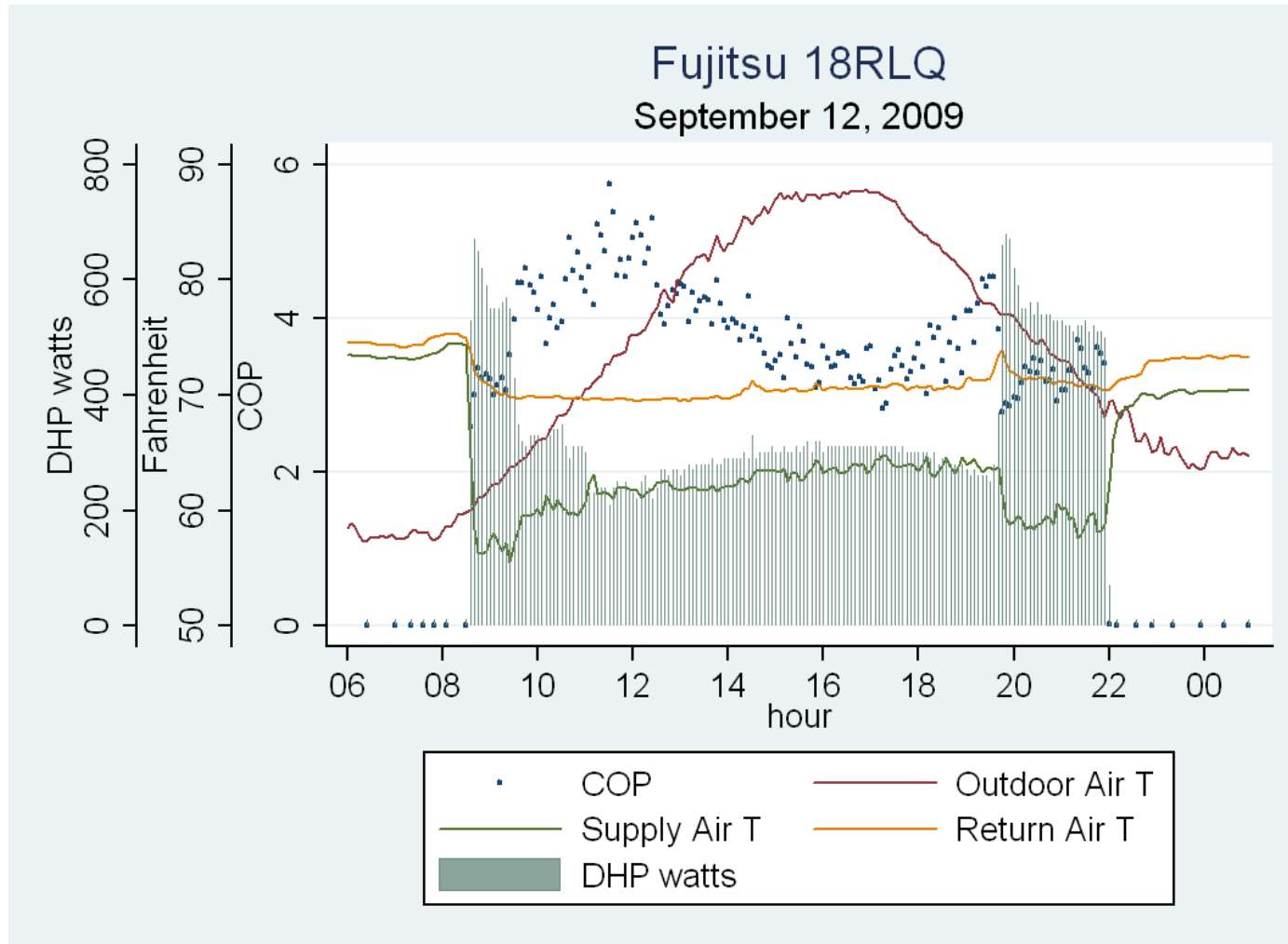
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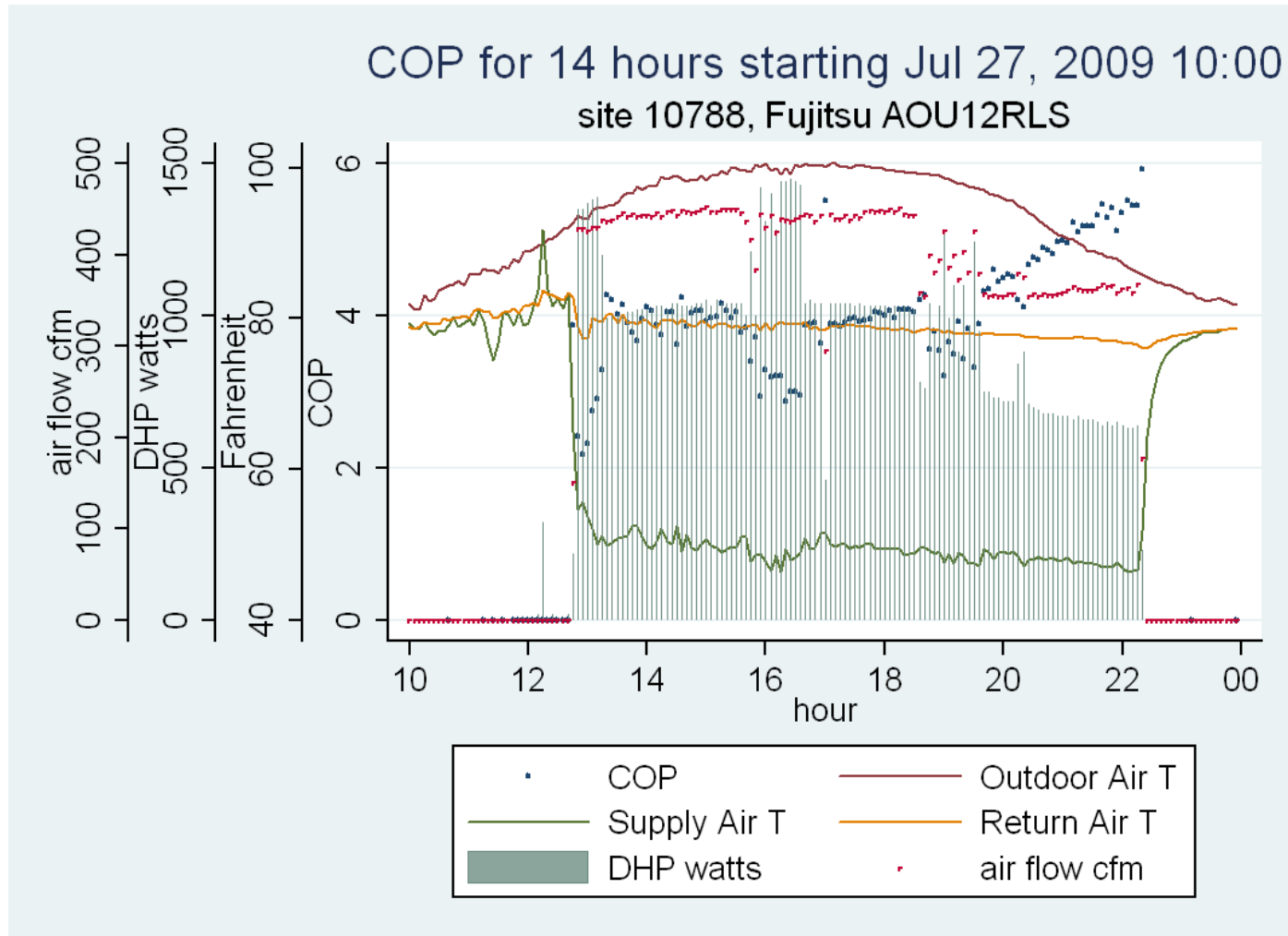
# Older Unit, Thrifty Customer



# Newer Unit, More Aggressive Set-Points

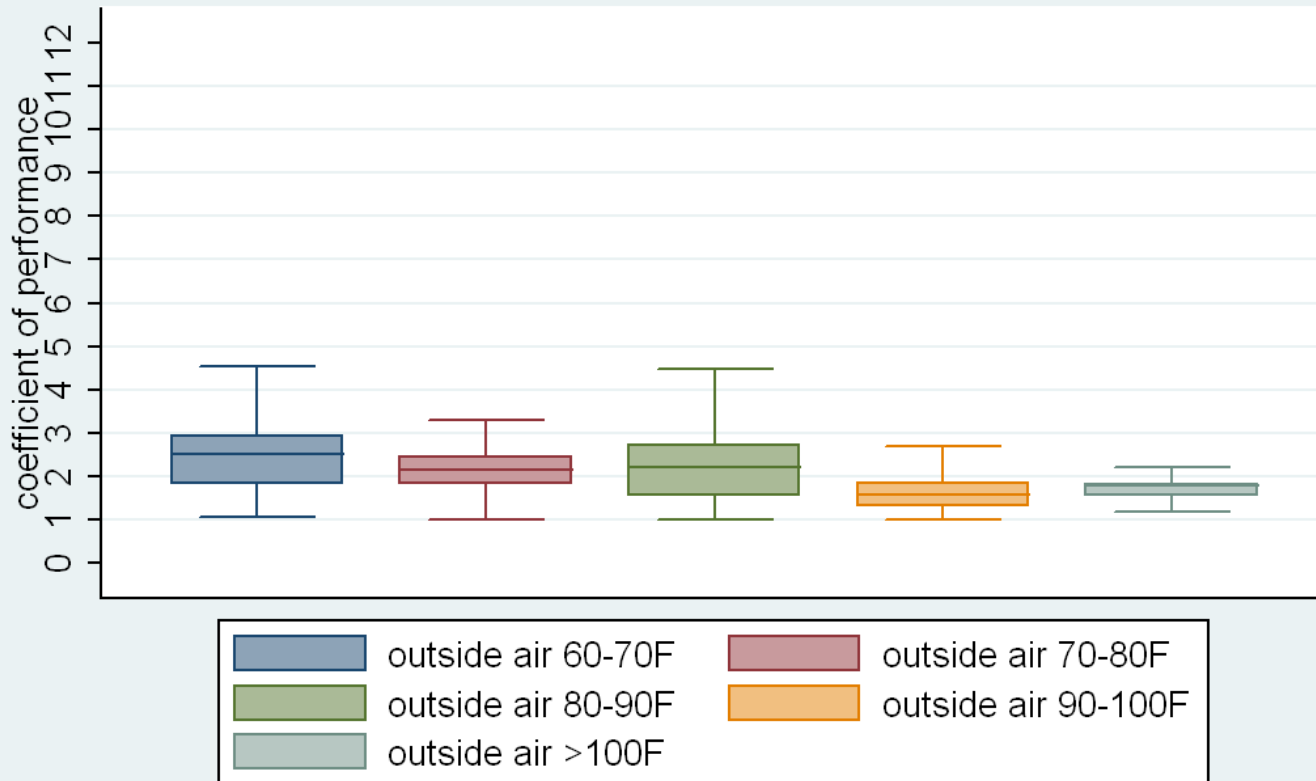


# Newest Unit, More Aggressive Set-Point



# 2006 Model, EER: 8.8

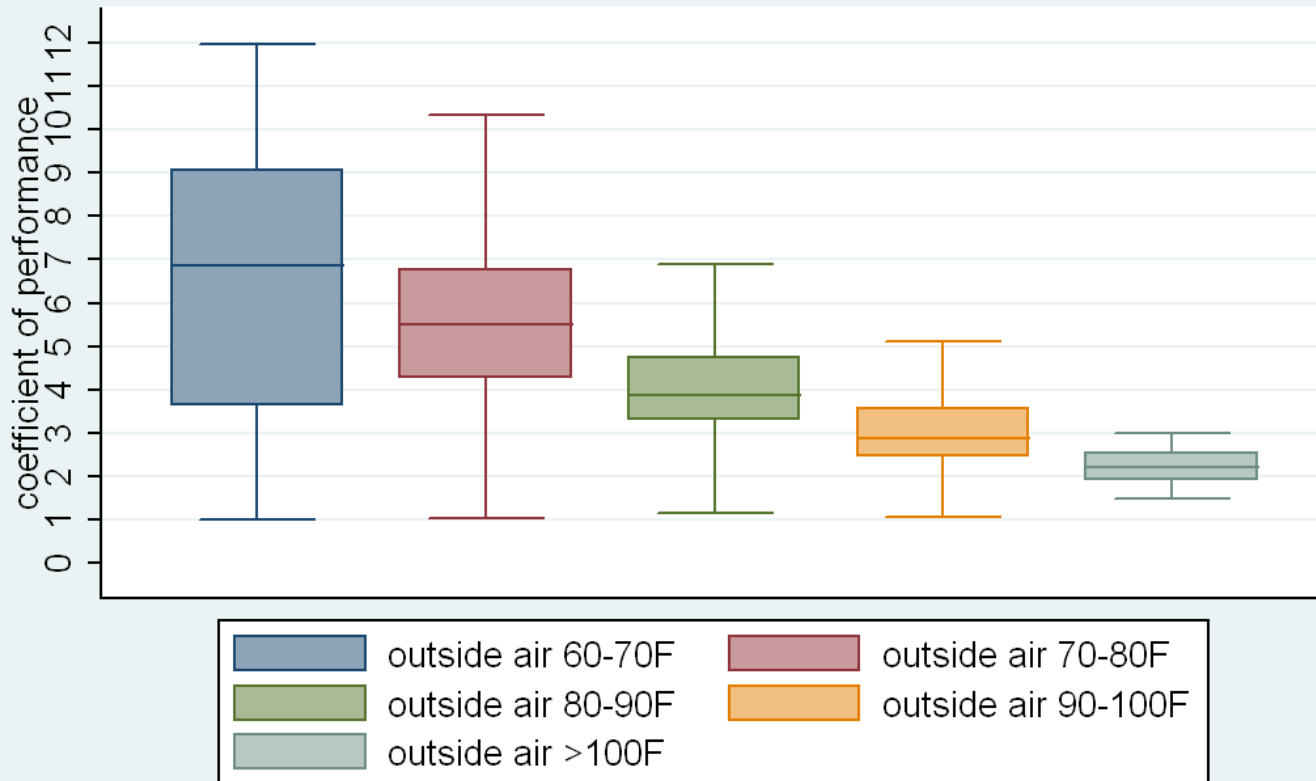
COP with different outside air temperatures (pruned data)  
Mitsubishi MUZD30NA



excludes outside values

# 2008 Model, EER: 10.4

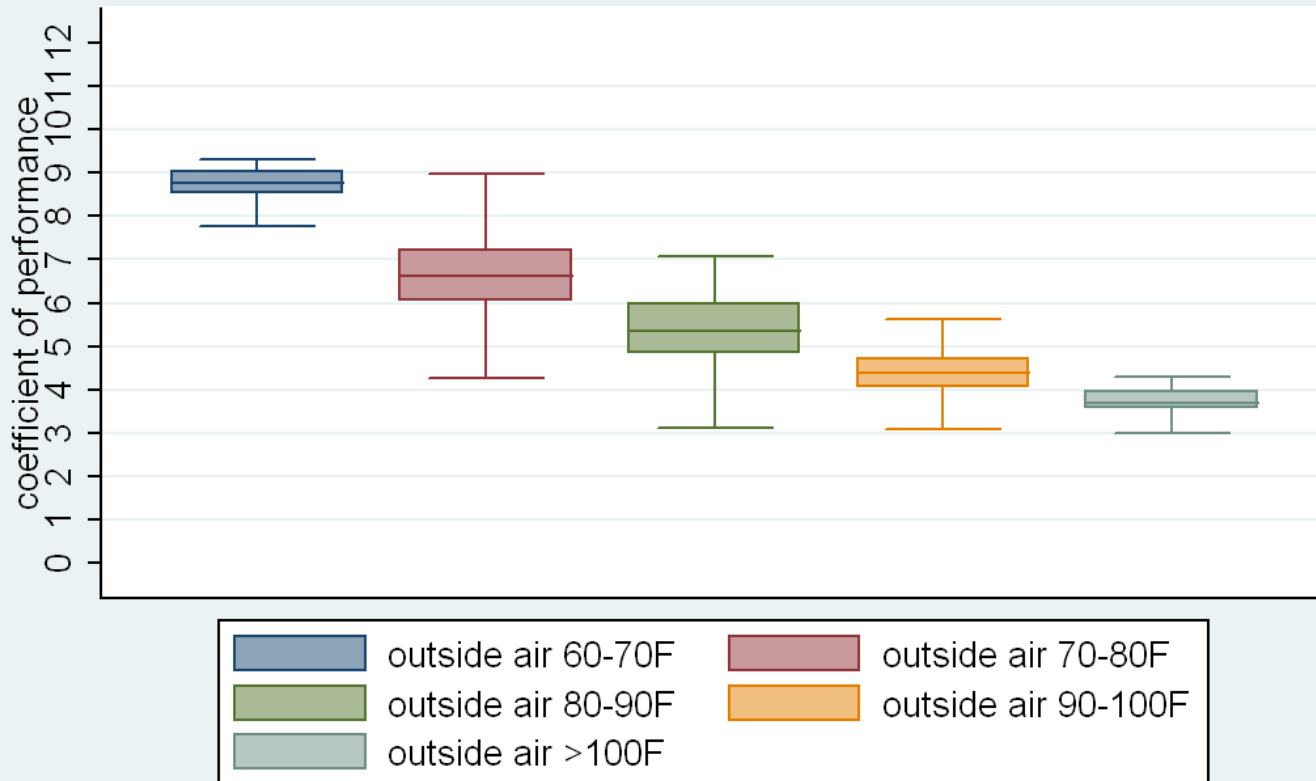
COP with different outside air temperatures (pruned data)  
Fujitsu 18RLQ



excludes outside values

# 2009 Model, EER: 12.8

COP with different outside air temperatures (pruned data)  
Fujitsu 12RLS



excludes outside values

# Regional DHP Impact Evaluation

- Complete metering in the Eastern Blocs in October and November
  - Develop up to 25 additional COP sites, at least 15 in colder zones
  - Complete at least a year of data collection by the end of 2010
  - Complete analysis of metered data third quarter 2011
- Develop billing analysis on all participants 2011
- Complete cost effectiveness analysis and develop deemed savings procedures (using SEEM) 2011
- Market progress reports 2010 and 2011
- Final Report first Quarter 2012