Impact Evaluation for BGE's Winter SEP Pilot 2011

Load Analysis and Settlement
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July 28, 2011

Outline

1. Research Questions
2. Overview of the Winter SEP 2011
3. Load Impact Results
    1. Price Only Impacts
    2. Incremental Impacts due to Technology
    3. Summary
4. Program Satisfaction
5. Conclusion
6. Appendix

Winter Employee SEP Pilot
Research Questions

- The goal of the Winter SEP Pilot is to understand:
  - Peak load impact in response to pricing incentive
  - Incremental peak load impact attributed to setting back PR thermostats and shutting off PR water heater switches
    - During event hours, PR water heaters are shut off completely and thermostats are set back 1-4 degrees, if applicable.
- Additional questions:
  - How does the peak load impact vary in response to different degrees of thermostat setbacks?
  - After the critical event ends, to what extent does the backup resistance heat come on and offset the peak load impact attributed to the program?

Overview of Winter SEP Pilot

- The Winter SEP Pilot was run from January 24th to March 31st 2011.
  - 10 critical events were called, 6 were 6-10 AM and 4 were 5-9 PM.
  - The last PM event was removed due to mild weather

Event Time	Date	Temp Setback of the TS	Peak WTHI
AM (6-10 am)	1/27/2011	1	40.2
	2/4/2011	2	35.09
	2/9/2011	2	32.73
	2/11/2011	3	29.8
	2/23/2011	4	33.21
	3/3/2011	4	35.3
PM (17-21pm)	2/3/2011	1	38.84
	2/10/2011	3	33.86
	2/22/2011	3	40.2
	~~3/25/2011 (removed)~~	~~5~~	

  - This presentation focuses on results from the AM model based on a larger amount of data. PM results can be found in Appendix.

Overview of the Winter SEP Pilot Participants

- The Pilot recruited 101 BGE employees and featured 4 treatment groups

Program ID	Treatment	# Participants
E1	PTR + Thermostat	29
E2	PTR + Thermostat + Water Heater	45
E3	PTR + Water Heater	12
E4	PTR only	15

Total=101

- Tariff code distribution

Tariff Code	Rate Schedule	#Participants
42	RH	51
45	RLH	14
142	RH with supplier	30
145	RLH with supplier	6

Winter Pilot vs. Previous Summer Pilots

- How does the design of the Winter Pilot differ from earlier summer pilots?
  - The Winter Pilot was limited to BGE employees who have electric heating and heat pumps as their primary heating source, therefore this sample is not representative of the general residential population or its electric heating subclass
  - Two treatment cells, PTR only and PTR + WH, have very few participants (15 and 12).
  - Customers on TOU rates and with suppliers are disproportionally represented in the winter sample.
  - There was no control group recruited and no pre-treatment data available for the Winter Pilot. Some post-pilot data are available and being used in additional analysis.
  - In the winter participants can override temperature setbacks at the Tstat without being detected; in the summer participants can only call or go online to override A/C cycling.
  - In winter, when the outside temperature is low enough and the customer adjusts their heat pump Tstat setting up after a critical event, the high-use backup resistance heat might come on and offset the peak load reduction during the critical peak hours.

- ***The results of the impact analysis of this Winter Pilot should be viewed with caution due to the sample's small dataset and unrepresentative nature as well as lack of a control group and pre-pilot data***

Load Response due to Price

Step 1: Price Elasticity for Customers (N = 101)

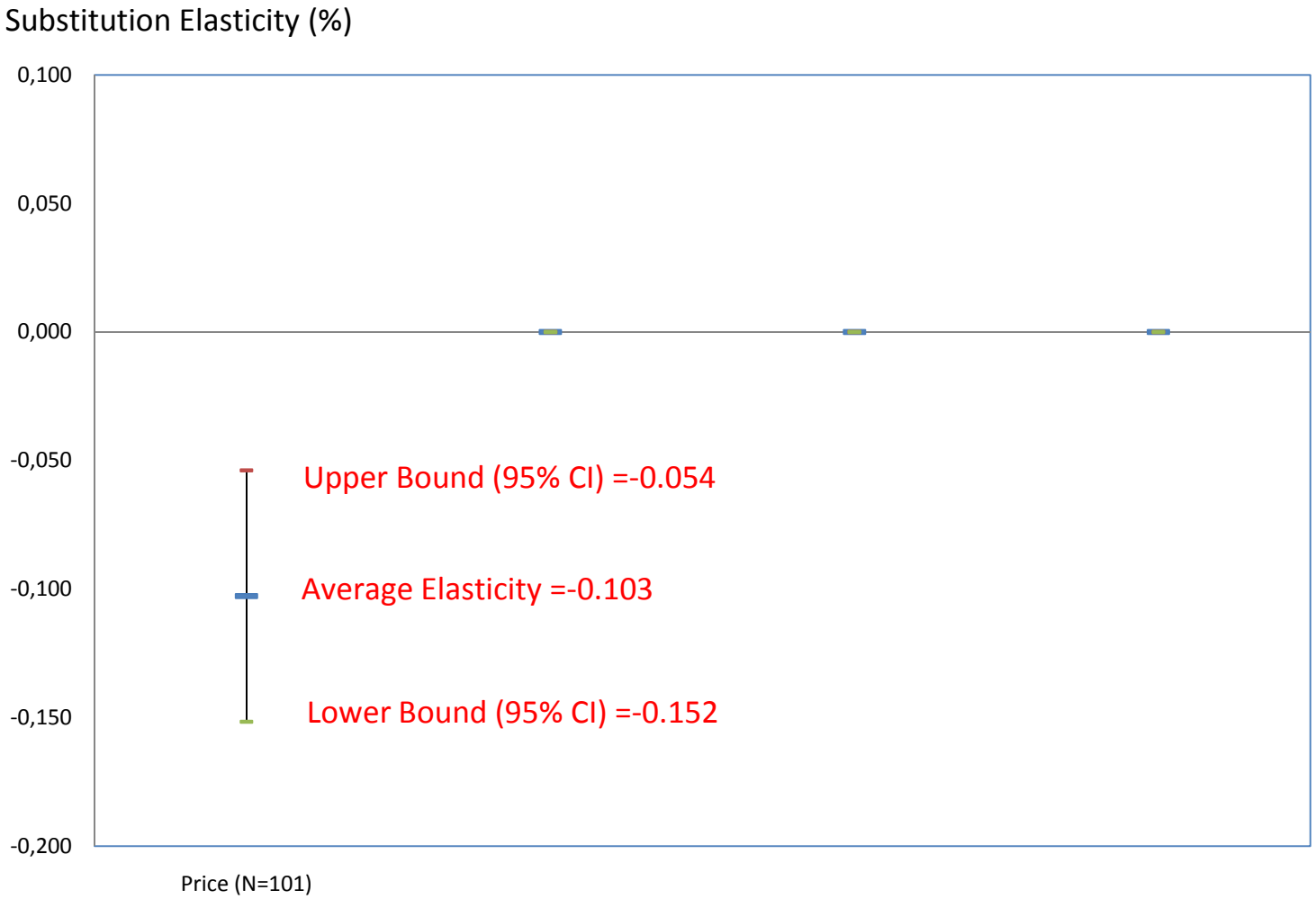
1. Estimate daily and substitution elasticities to represent customer price responsiveness. Elasticity is defined as the X% change in kWh in response to 1% change in price.

   A. Substitution elasticity reflects how peak-to-off-peak load ratio changes in response to changes in peak-to-off-peak price ratio.
      - Result: AM substitution elasticity = -0.103

   B. Daily elasticity reflects how daily load changes in response to changes in daily price.
      - Result: AM daily elasticity = 0

Load Response due to Price

Step 1: Price Elasticity for Customers (N = 101)



Load Response due to Price

Step 2: PRISM Model(N = 101)

2. PRISM: This model is run to determine the impacts
   A. Inputs
      - Elasticity results
      - Existing and critical peak rates
      - Weather dependent control group load profile (RH and RLH load research samples – not a true control group for the sample)

   B. Outputs
      - % load impact for peak and off-peak periods
      - % change in monthly consumption

   C. Results:
      - Average hourly impact for AM event hours= -16.43%

Incremental Load Response due to Technology

Step 3: Incremental Price Elasticity for TS, WH, TS+WH (N = 29, 12, 45)

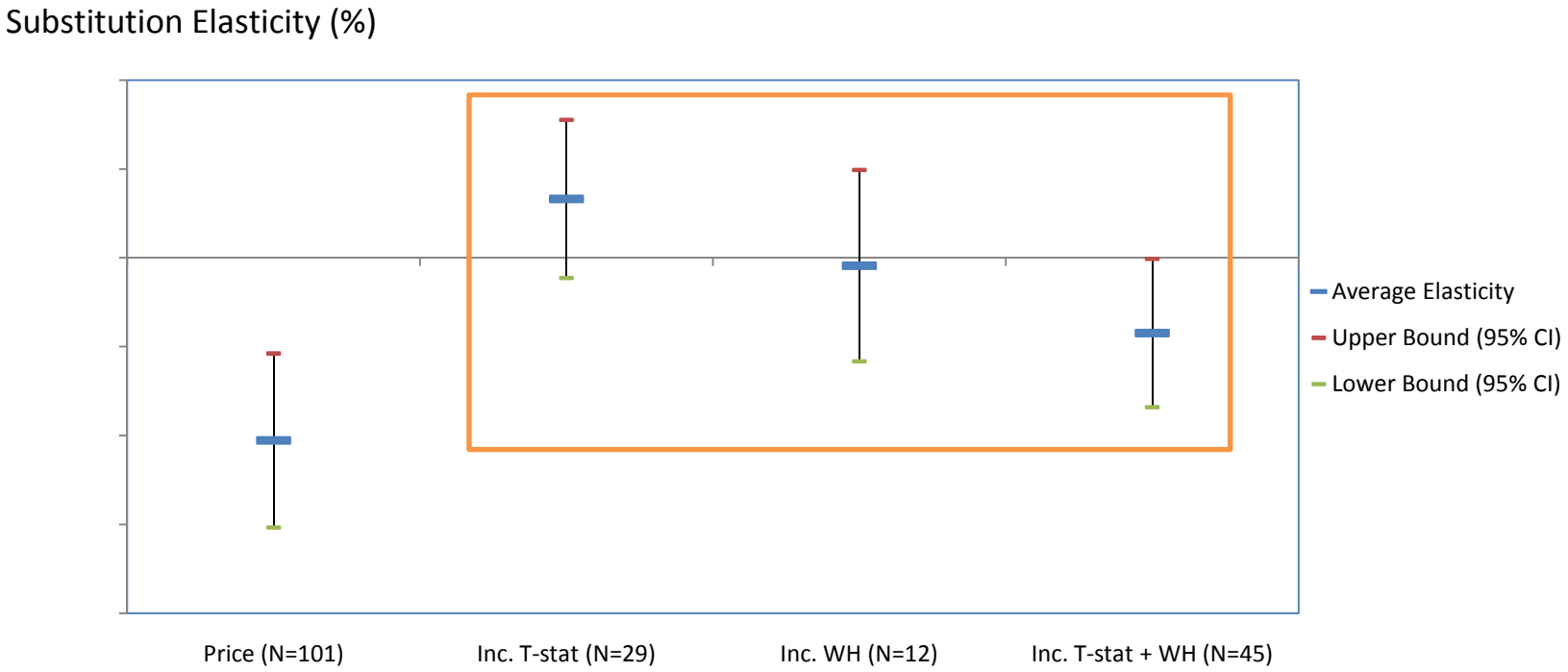
1. Estimate incremental substitution and daily elasticity by adding variables for each technology to the elasticity models

Program	Average Incremental Substitution Elasticity
Inc. T-stat (N=29)	0.033
Inc. WH (N=12)	-0.004
Inc. T-stat + WH (N=45)	-0.042

Incremental Load Response due to Technology

Step 3: Incremental Price Elasticity for TS, WH, TS+WH (N = 29, 12, 45)

2. When taking into consideration of the spread of the estimated elasticity, we found for TS and WH, the average incremental substitution elasticity can't be significantly distinguished from zero. Thus for these two cells we accept that the incremental substitution elasticity is equal to zero.



Incremental Load Response due to Technology

Step 3: Incremental Price Elasticity for TS, WH, TS+WH (N = 29, 12, 45)

3. This step results in three treatment cells with the same substitution elasticity.

Program	Inc. substitution elasticity significantly different from 0?*	Inc. substitution elasticity due to technology	Substitution Elasticity
PTR (N=101)	-	-	-0.103
PTR +T-stat (N=29)	No	0	-0.103
PTR + WH (N=12)	No	0	-0.103
PTR + T-stat + WH (N=45)	Yes	-0.042	-0.145

*: Yes indicates that the estimate for average substitution elasticity is significantly different from zero with confidence level at 95%, no otherwise.

Incremental Load Response due to Technology

Step 4: PRISM Model (N = 29, 12, 45)

- Based on elasticity results and other inputs, the PRISM model simulates the kWh impacts for each of the treatment cells.

Program	% Average Hourly Impact for Event hours	
	Winter Pilot 2011	Summer Pilot 2010*
PTR	-16.43%	-25.07%
PTR +T-stat	-16.43%	-32.90%
PTR + WH	-16.43%	-
PTR + T-stat + WH	-27.47%	-

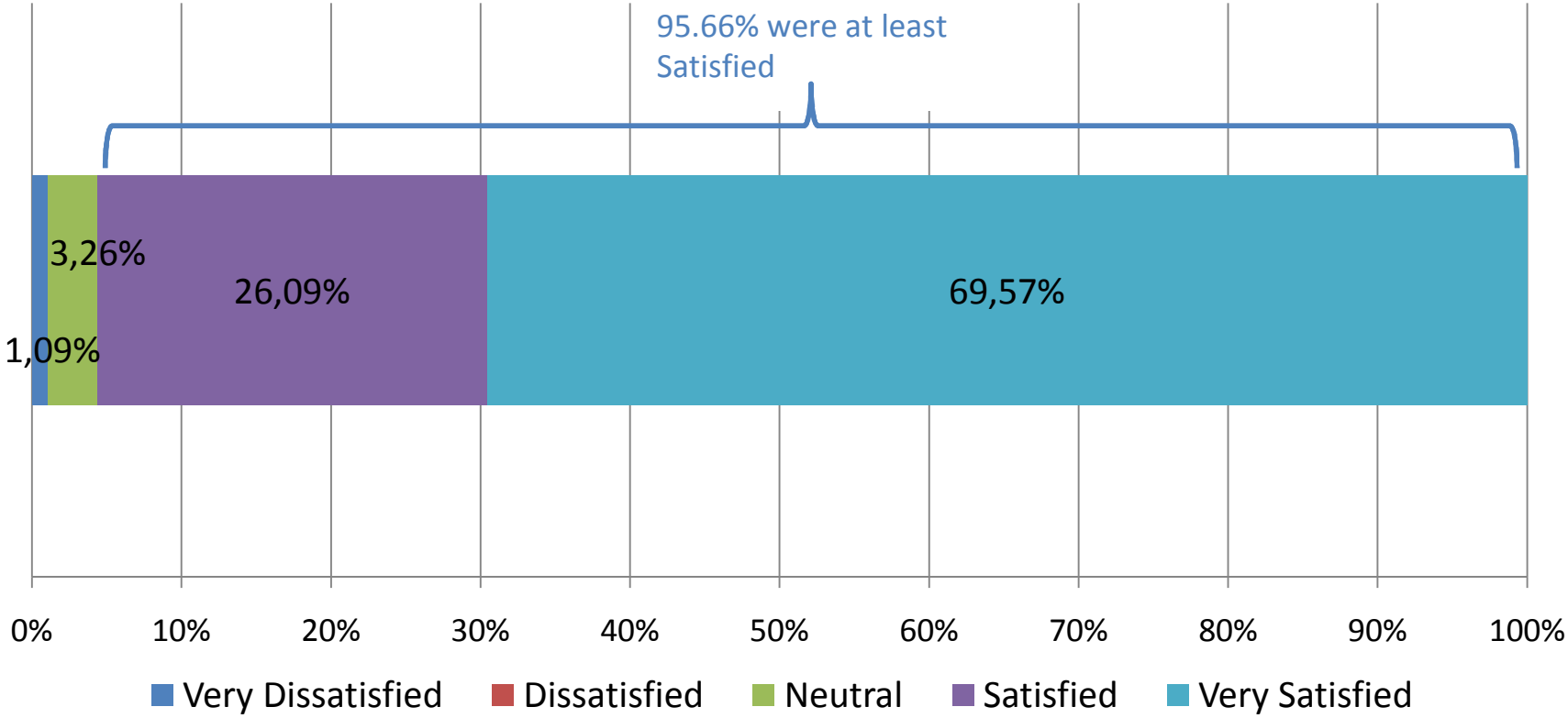
*: The Summer Pilot 2010 impacts are based on Brattle Report 2010.

Summary

- Analysis suggests:
- In the AM, for PTR+TS+WH, the average hourly impact during the event hours is 27.5%, while the average hourly impact for the other three treatment cells is 16.4%.
- In the PM, for PTR, PTR+WH and PTR+TS+WH, the average hourly impact during the event hours is 21.4%, while the average hourly impact for PTR+TS is 7%.
- Caveats:
- In both AM and PM, we found statistically indistinguishable impacts for three out of four cells.
  - The statistically indistinguishable results may be caused by the small sample sizes, which lead to insufficient statistical power to tease out the impact of one cell from that of another.
- PTR+TS has less impact than other cells. This could be due to participants manually adjusting the temperature.

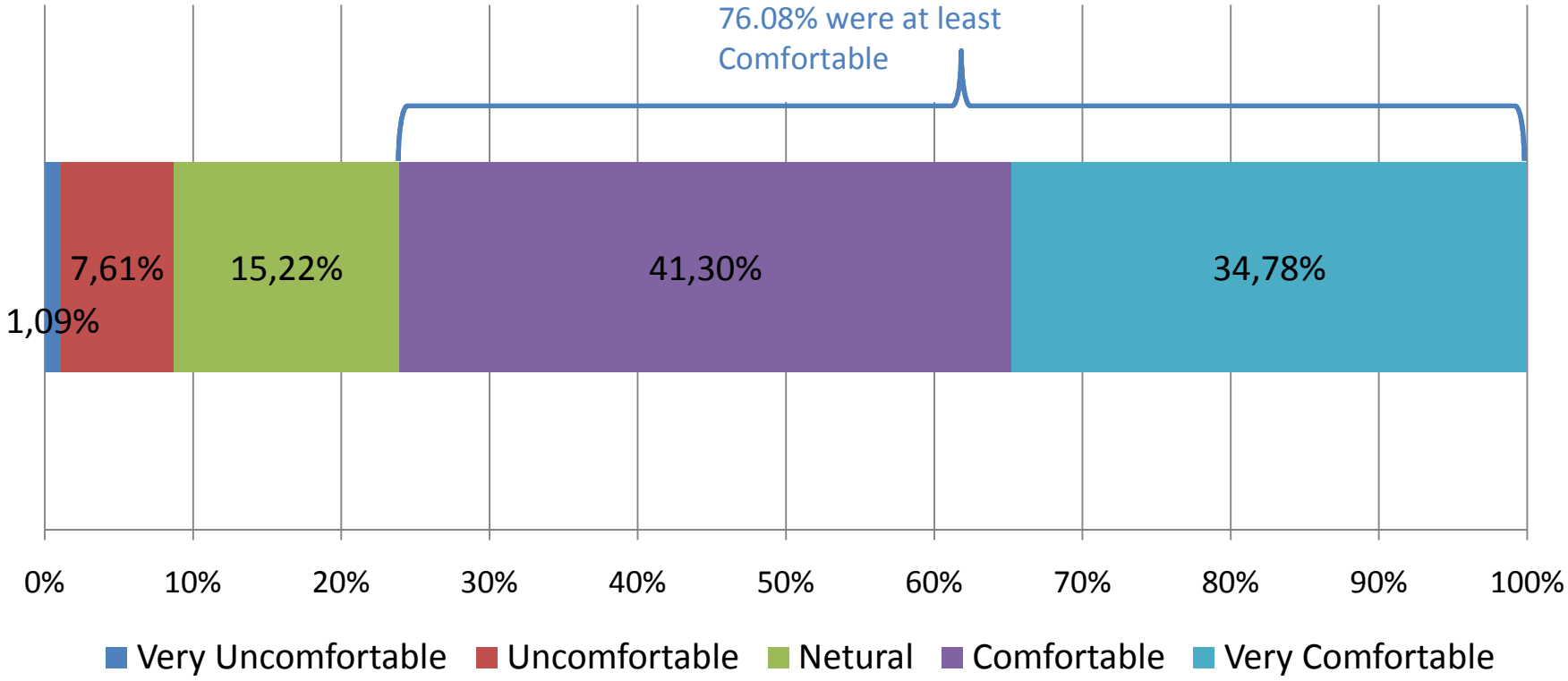
Participant Satisfaction

On a scale of 1 to 5, where 1 is "Very Dissatisfied" and 5 is "Very Satisfied", please rate your overall experience with the Smart Energy Pricing Winter Pilot program. (13 respondents)



Participant Comfort Level

On a scale of 1 to 5, where 1 is "Very Uncomfortable" and 5 is "Very Comfortable," after making behavior adjustments, please rate the comfort level of your home during the Critical Peak Days that were called.



What customers said when asked if they would participate again…

- “Program was very easy to follow, and I was seeing immediate savings which encourage me to be participate even more in the program. More than happy in participation and wished for more participation days.”
- “I adjusted my usage and even lowered the heat addition degrees knowing that at certain times of the day the house is empty and no one felt the temperature change. The monetary rebates encouraged me to reduce usage. this program was a huge success in my book!”
- “I found the pilot program easy to live with, and the changes to our lifestyle were minimal.”
- “I was amazed and very satisfied with the cost savings from the program.”
- “I would participate again because the program is relatively transparent and easy to override. While you are encouraged to save energy, it is not forced and we are still able to have things like hot water available if needed. I would be much more hesitant to participate if a hot water heater cutoff was required.”
- “The amount of effort on our part (my wife and I) was minimal, and we weren't being asked to do anything too extreme. So the savings was worth it. I'd do it again.”

Conclusion

- Load Impacts
- In the AM, the average hourly impact varies from 16.4% to 27.5% by cell.
- In the PM, the average hourly impact varies from 7% to 21.4% by cell.

- Program Satisfaction
- The participants are mostly satisfied and would like to engage in SEP again in the future.

Appendix A

PM results

Load Response due to Price

Step 1: Price Elasticity for Customers (N = 101)

1. Estimate daily and substitution elasticities to represent customer price responsiveness. Elasticity is defined as the X% change in kWh in response to 1% change in price.

   A. Substitution elasticity reflects how peak-to-off-peak load ratio changes in response to changes in peak-to-off-peak price ratio.
      - Result: PM substitution elasticity = -0.131

   B. Daily elasticity reflects how daily load changes in response to changes in daily price.
      - Result: PM daily elasticity = 0

Load Response due to Price
Step 2: PRISM Model (N = 101)

2. PRISM: This model is run to determine the impacts
   A. Inputs
      - Elasticity results
      - Existing and critical peak rates
      - Weather dependent control group load profile (RH and RLH load research samples – not a true control group for the sample)

   B. Outputs
      - % load impact for peak and off-peak periods
      - % change in monthly consumption

   C. Results:
      - Average hourly impact for PM event hours= -21.38%

Incremental Load Response due to Technology

Step 3: Incremental Price Elasticity for TS, WH, TS+WH (N = 29, 12, 45)

- As the average incremental substitution elasticity for T-stat+WH and WH can't be significantly distinguished from zero, we accept the incremental substitution elasticity equal to zero.
  - This step results in three treatment cells with the same substitution elasticity.

Program	Inc. substitution elasticity significantly different from 0?*	Inc. substitution elasticity due to technology	Substitution Elasticity
PTR	-	-	-0.131
PTR +T-stat	Yes	0.09	-0.041
PTR + WH	No	0	-0.131
PTR + T-stat + WH	No	0	-0.131

*: Yes indicates that the estimate for average substitution elasticity is significantly different from zero with confidence level at 95%, no otherwise.

Incremental Load Response due to Technology

Step 4: PRISM Model (N = 29, 12, 45)

- Based on elasticity results and other inputs, the PRISM model simulates the kWh impacts for each of the treatment cells.

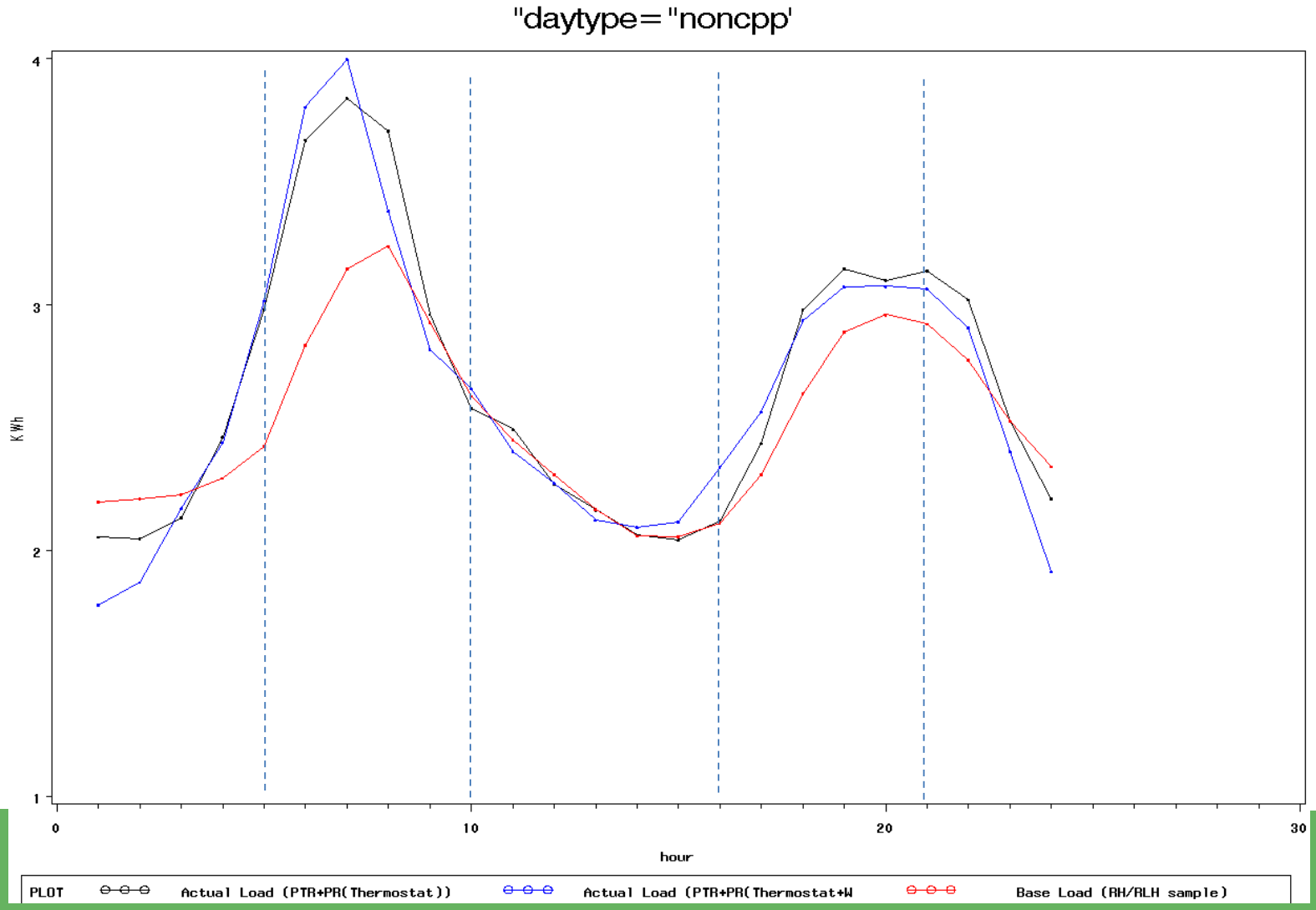
Program	% peak impact	Peak Impact in KWh
PTR	-21.38%	-0.769
PTR +T-stat	-7.05%	-0.253
PTR + WH	-21.38%	-0. 769
PTR + T-stat + WH	-21.38%	-0. 769

Appendix B

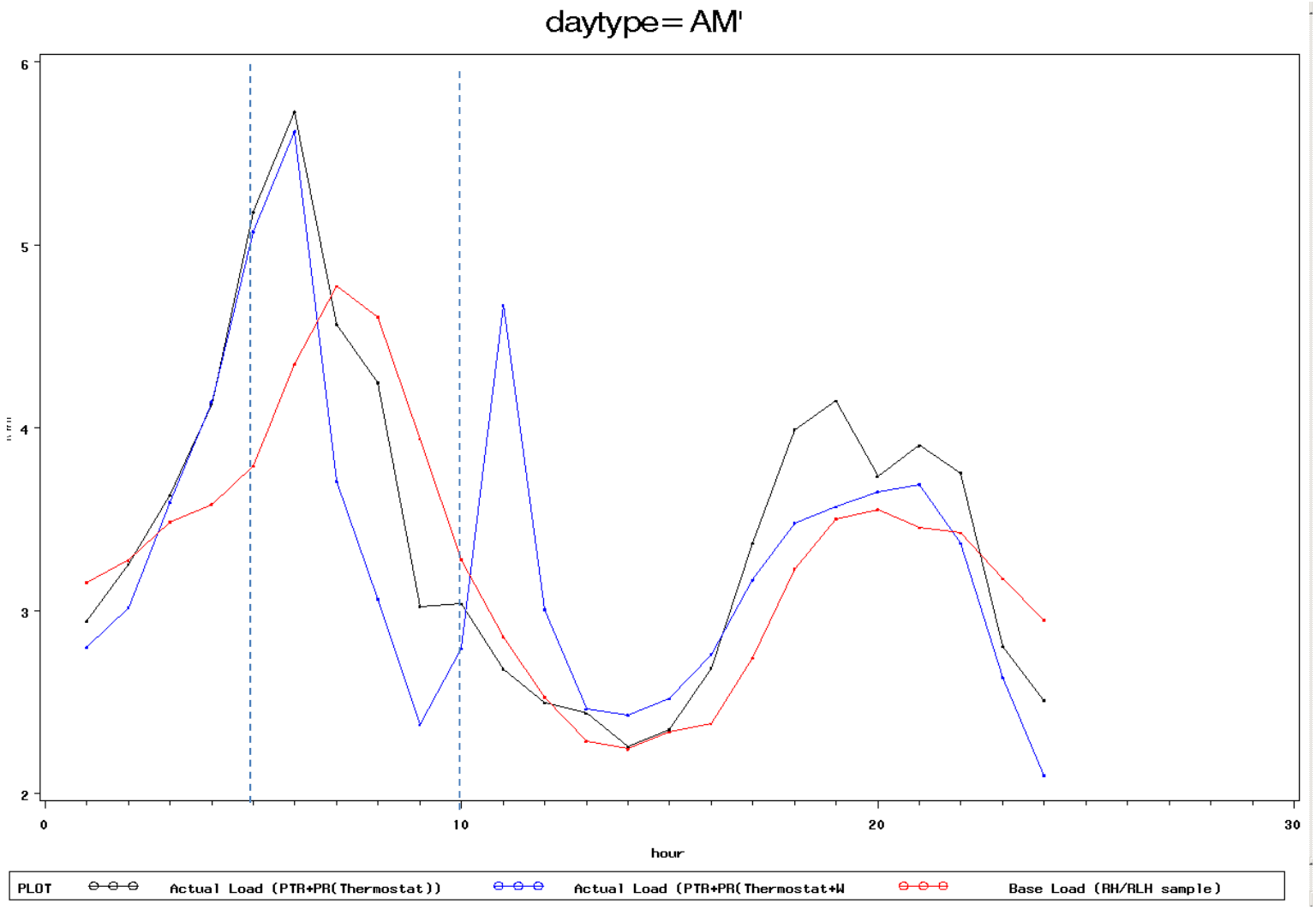
Load Impact Graphs

Load Shape: 1. Thermostat (E1) & Thermostat+Water Heater (E2)

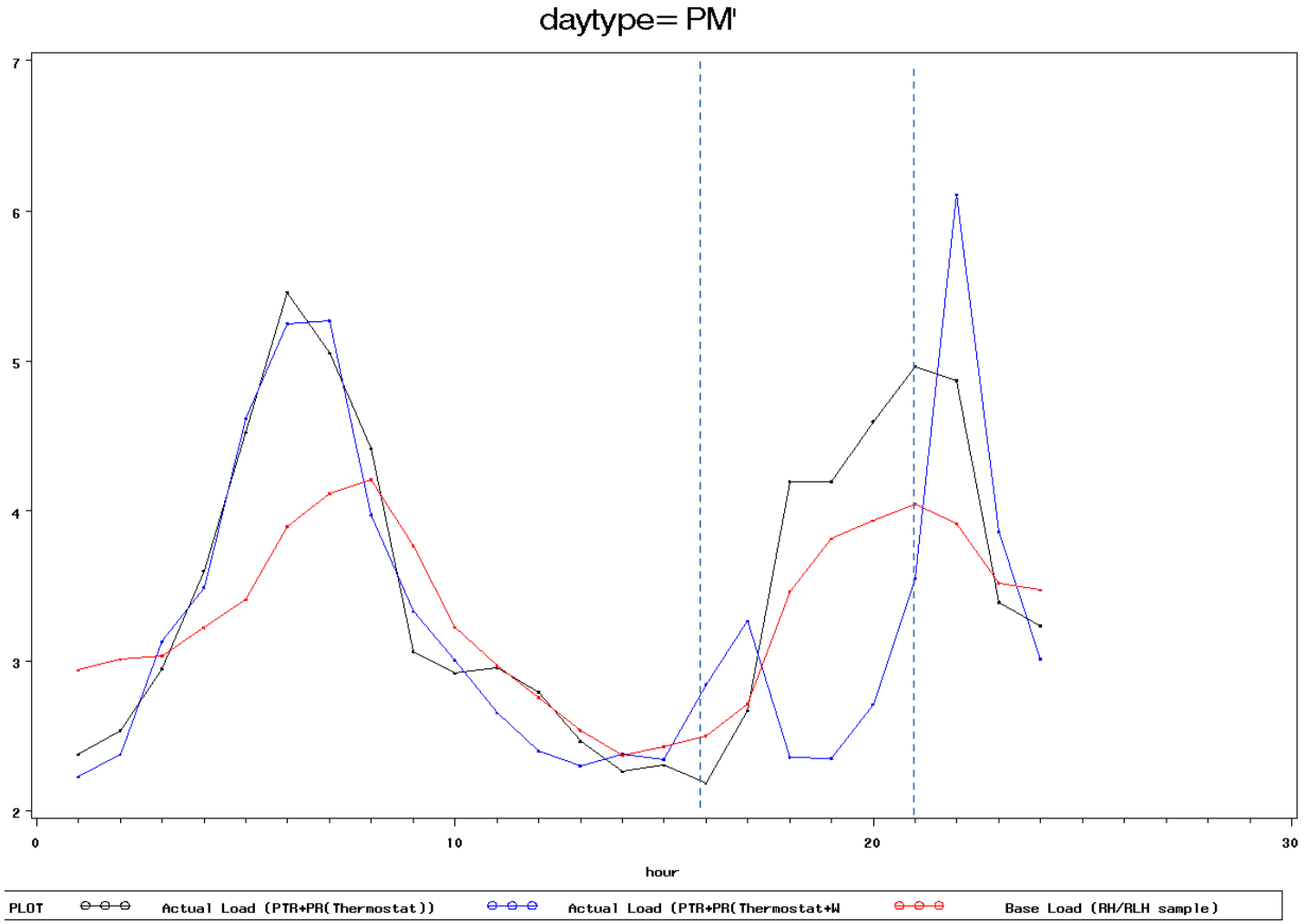
Non CPP Day Actual vs. Base Load



AM CPP Day Actual vs. Base Load

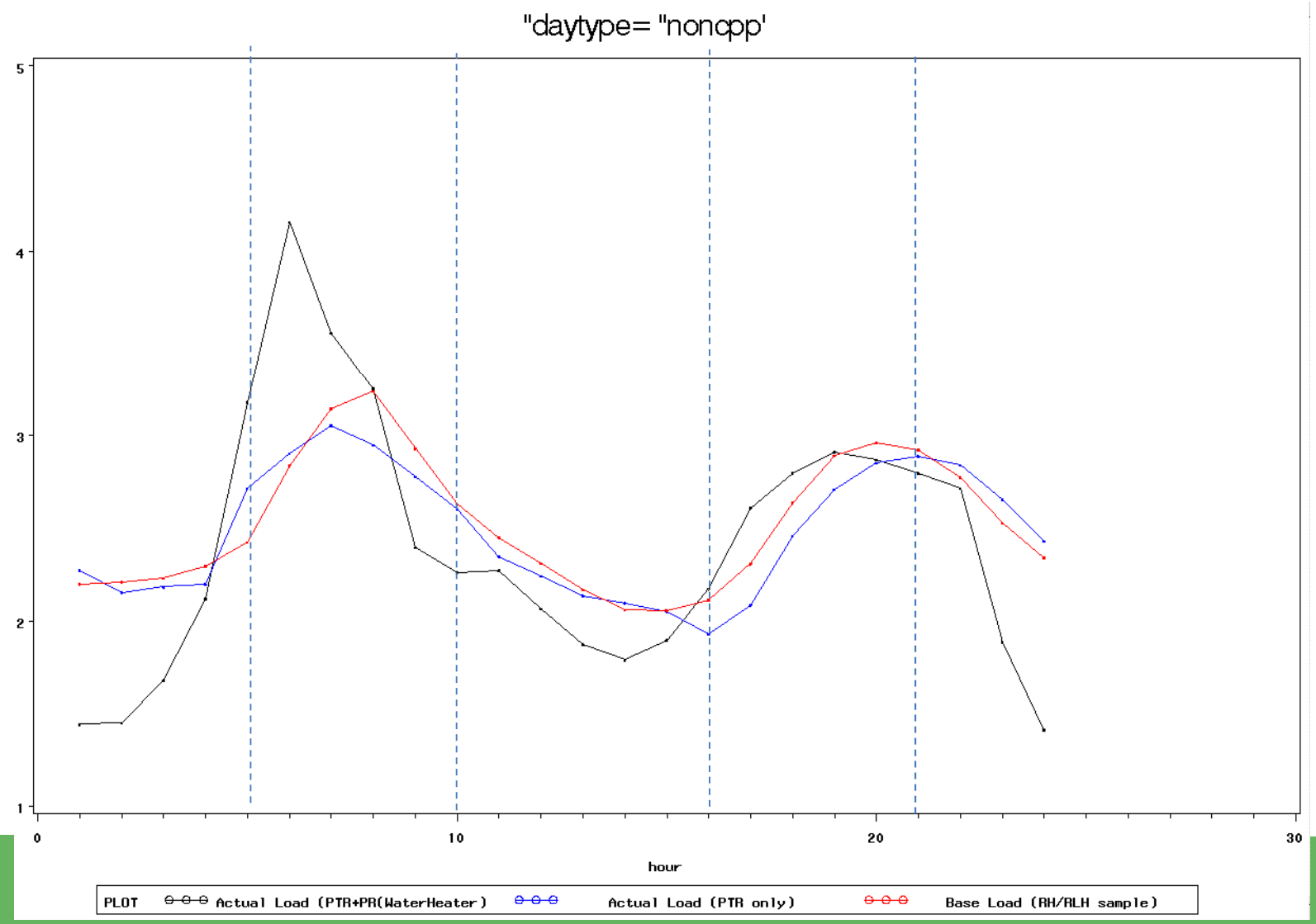


PM CPP Day Actual vs. Base Load

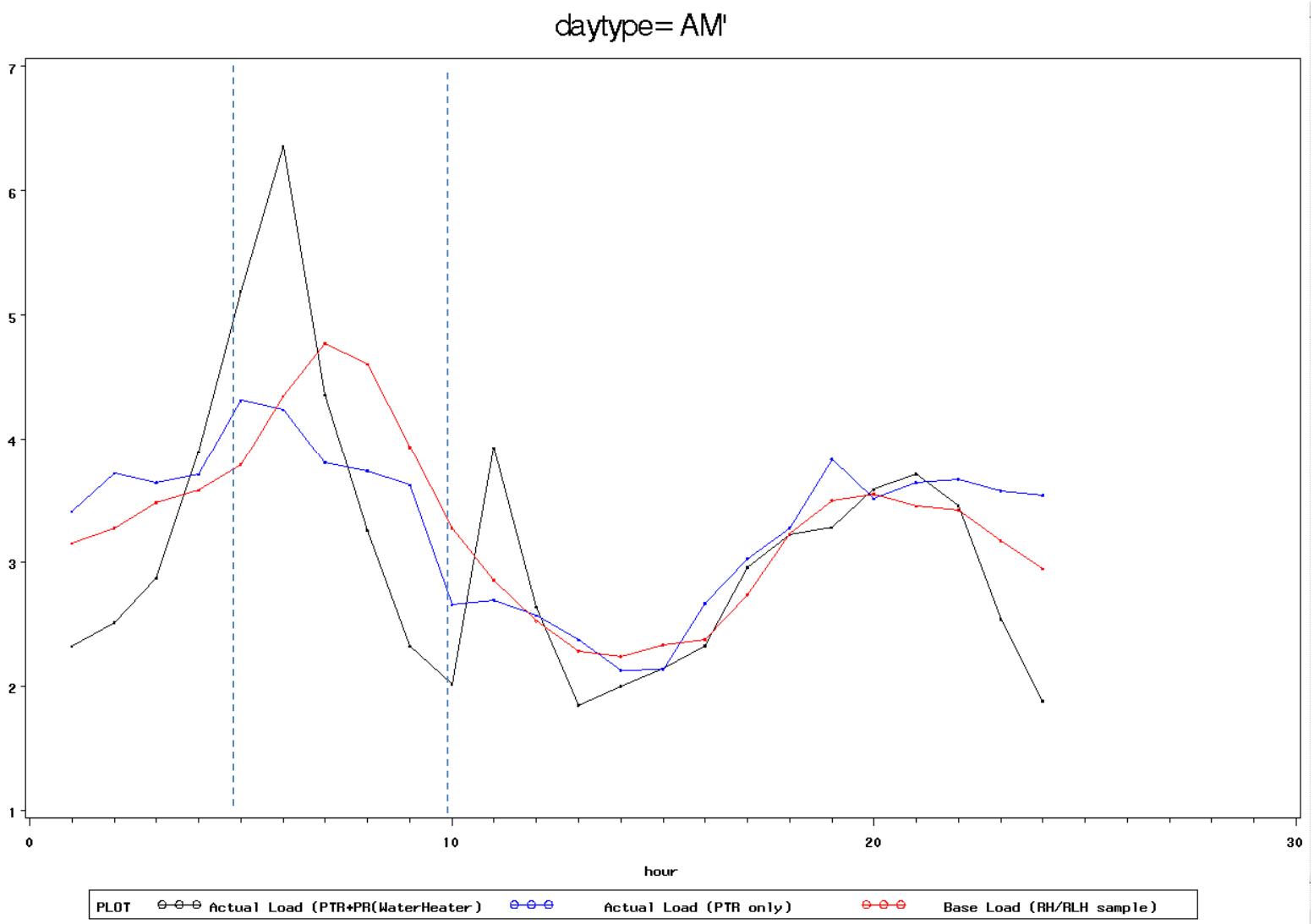


Load Shape: 2. Water Heater (E3) & PTR only (E4)

Non CPP Day Actual vs. Base Load



AM CPP Day Actual vs. Base Load



PM CPP Day Actual vs. Base Load