



Vermont
Energy Investment
Corporation

Measuring
Energy Savings
When it Counts:
How Smart Grid Data and
Open-Source Analytics
Can Lead to
Savings Load-Shapes

Ethan Goldman
October 2015

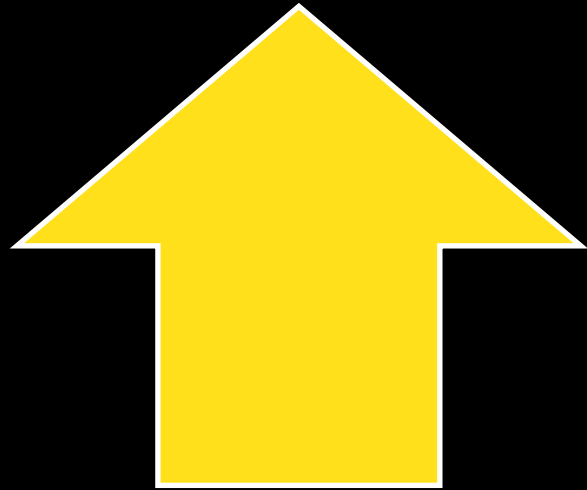
About VEIC



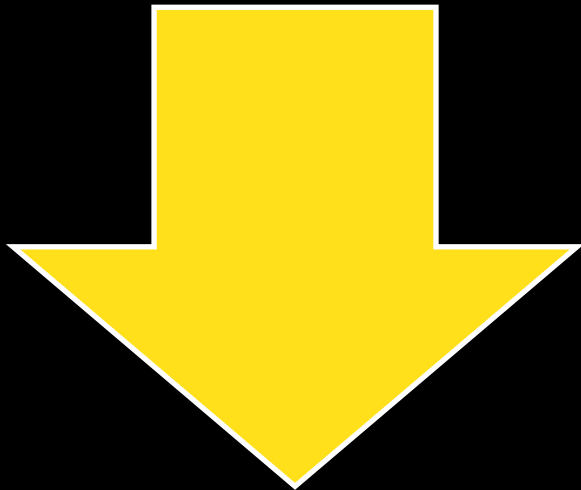
- Nonprofit founded in 1986
- Designs, delivers, and evaluates energy efficiency, transportation, and renewable energy programs nationwide
- 300+ employees
- Locations: VT, DC, OH, NJ

www.veic.org

Why Measure Savings?

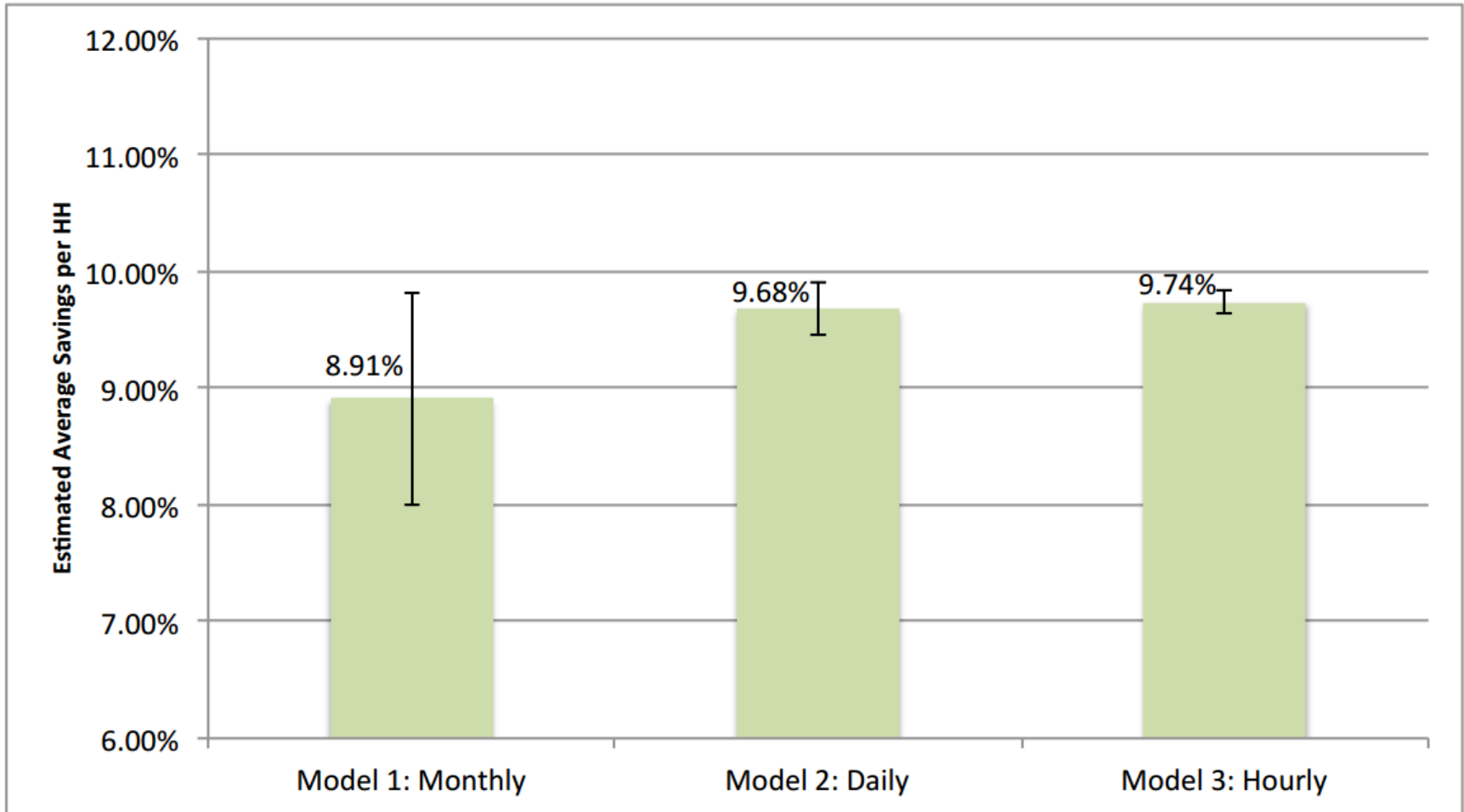


Project-Based
Savings



Deemed
Savings

What Does AMI Get Us?

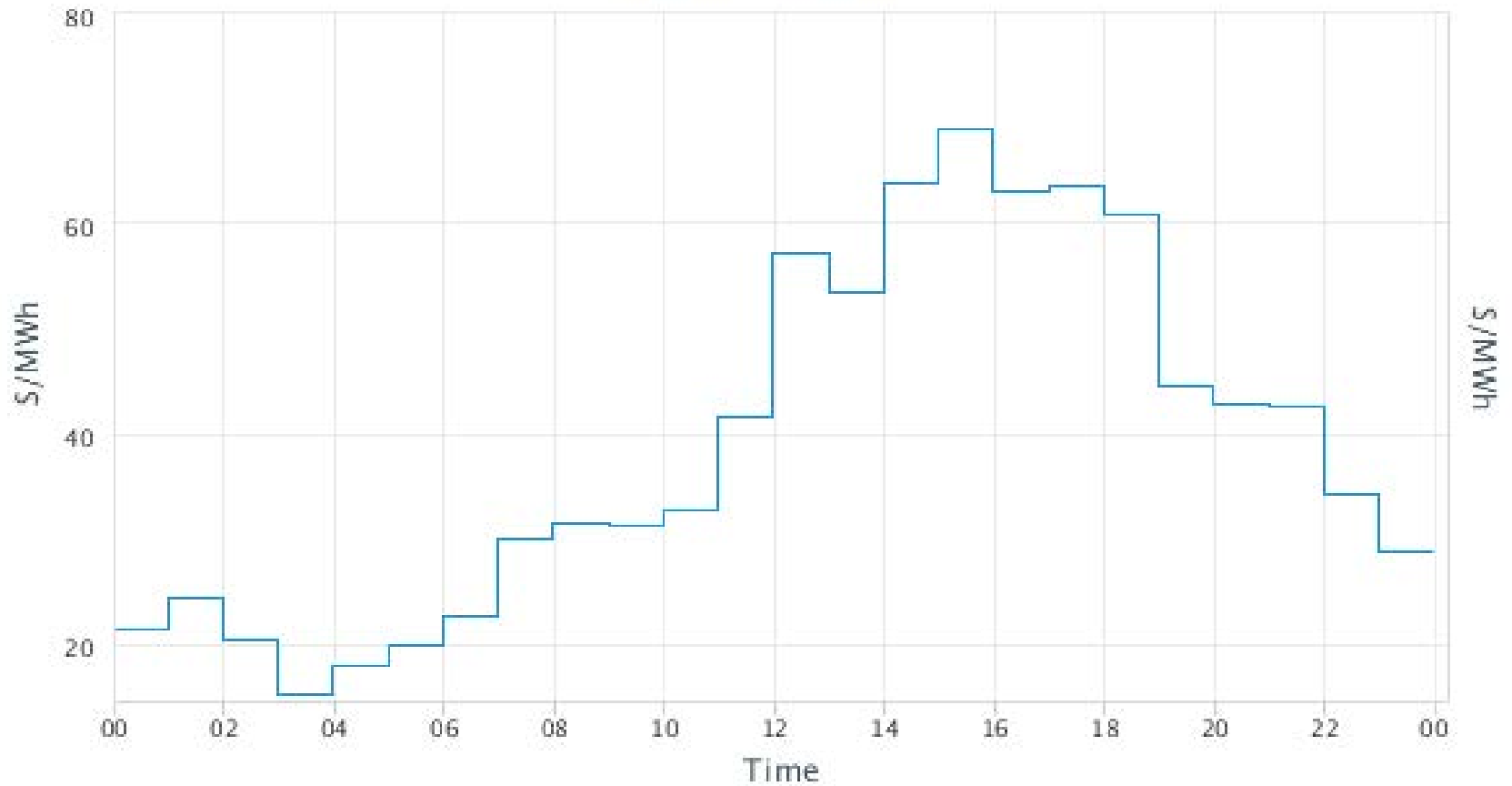


Cornwell and Grover, *Is More Always Better? A Comparison of Billing Regression Results Using Monthly, Daily and Hourly AMI Data*, Long Beach, California: International Energy Program Evaluation Conference, August 2015.

A Negawatt Saved is a Negawatt Earned

Hourly LMP Graph

Date: 07/28/2015

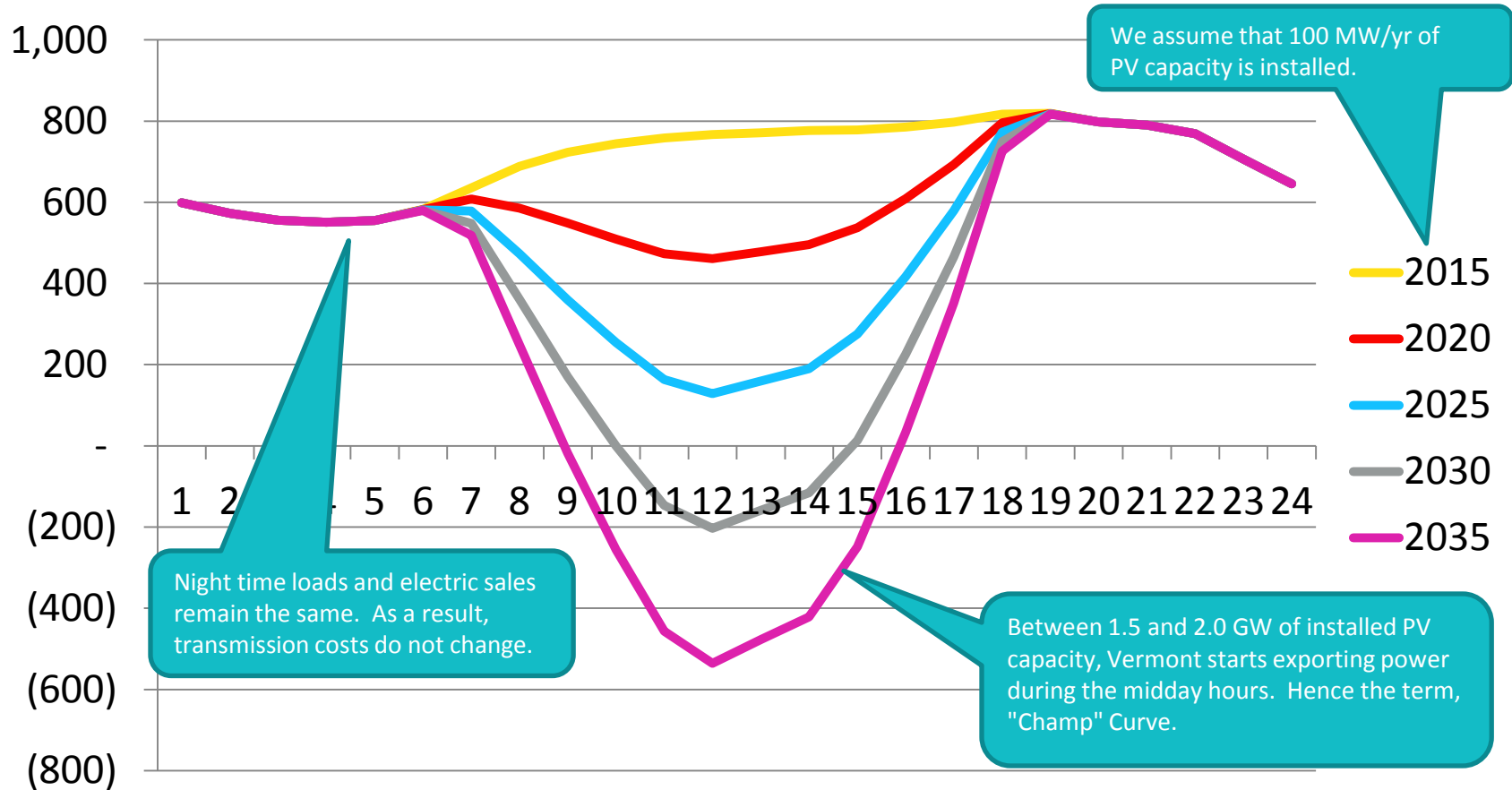


Is “Champ” Real?



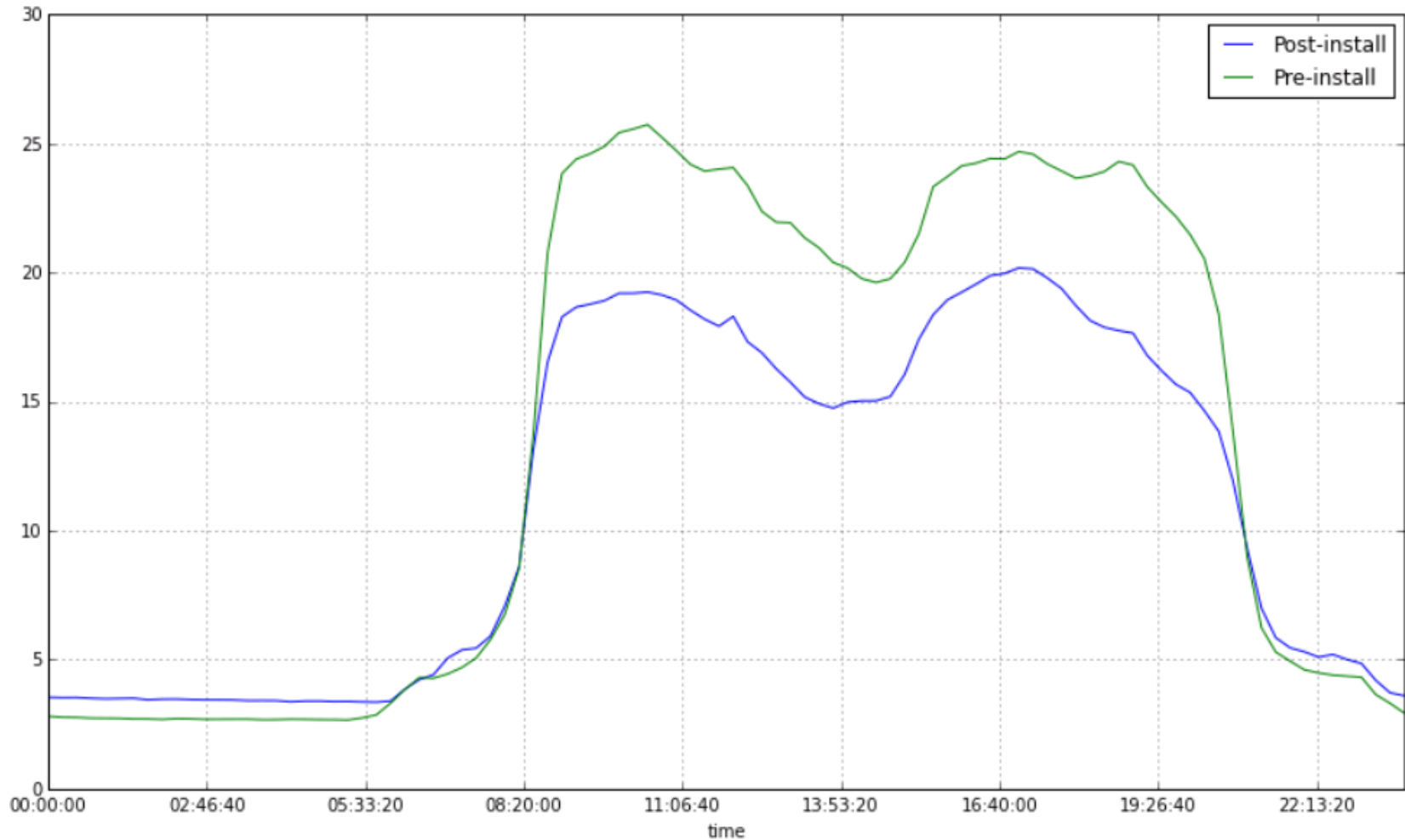
Vermont's July-average "Champ Curve"

1 GW of net-metered PV in 2025
2 GW of net-metered PV in 2035

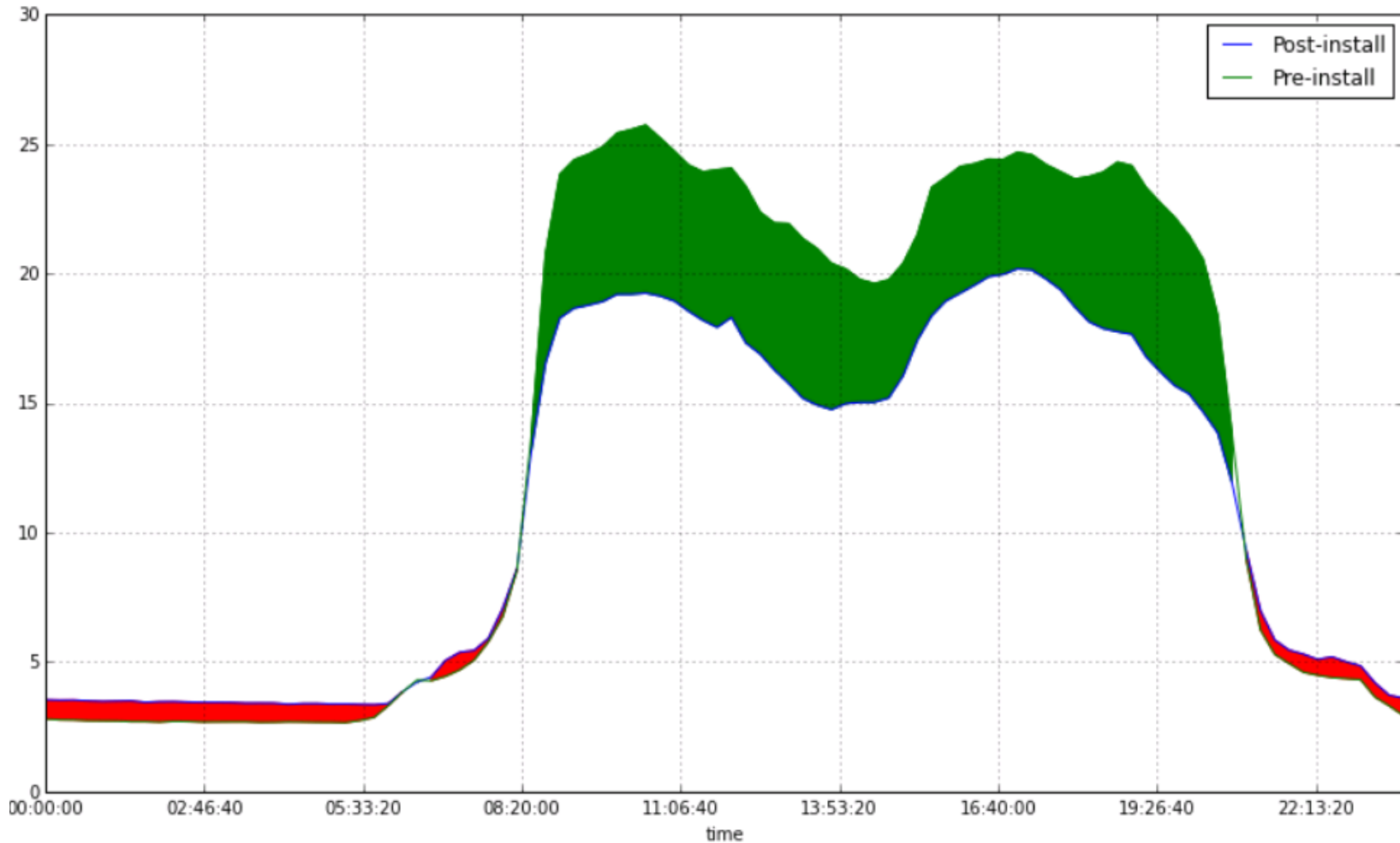


From Solar Market Pathways "Barriers and Integration" brief, thanks to Shawn Enterline and Green Mountain Power

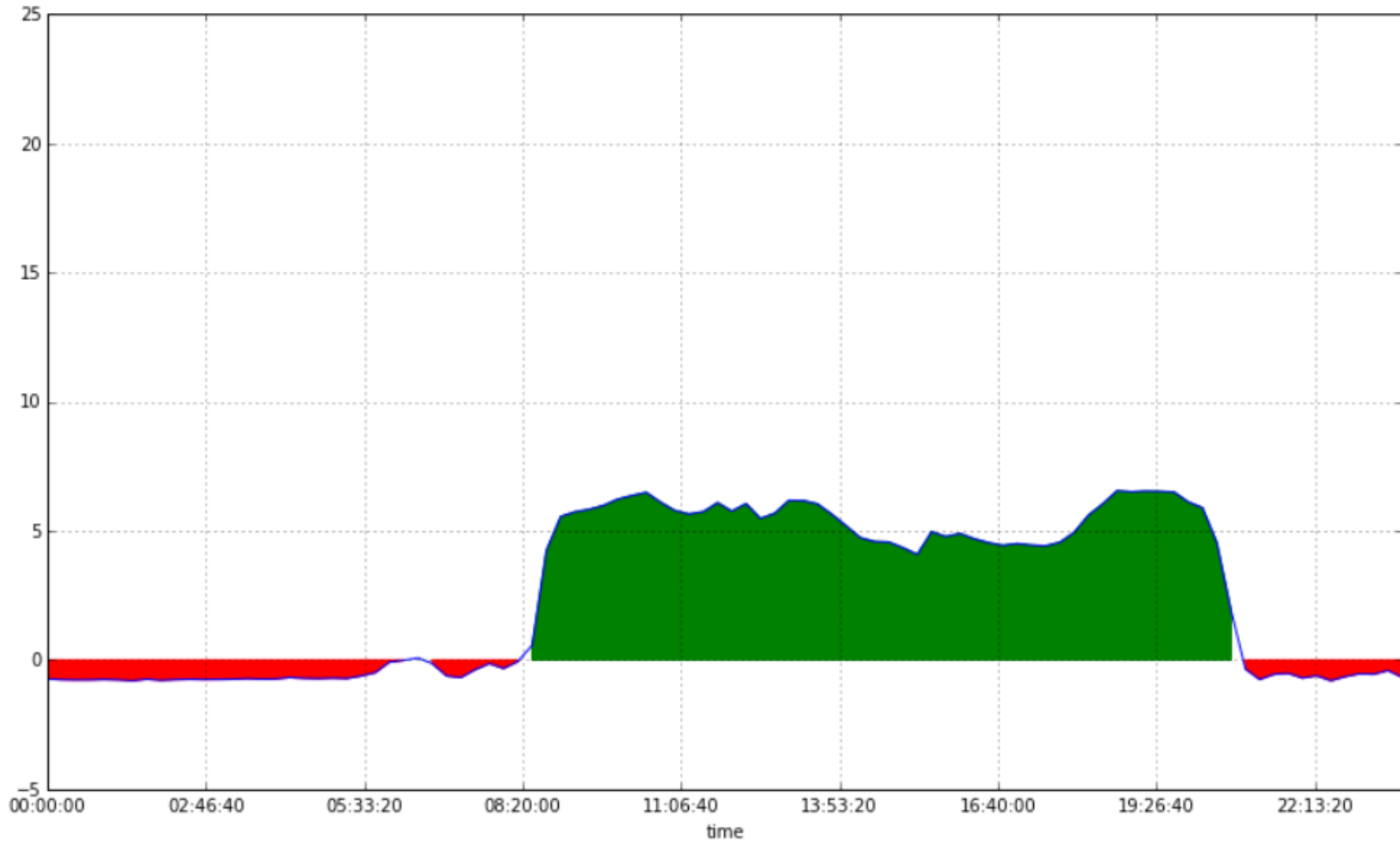
Pre- and post-efficiency load-shape



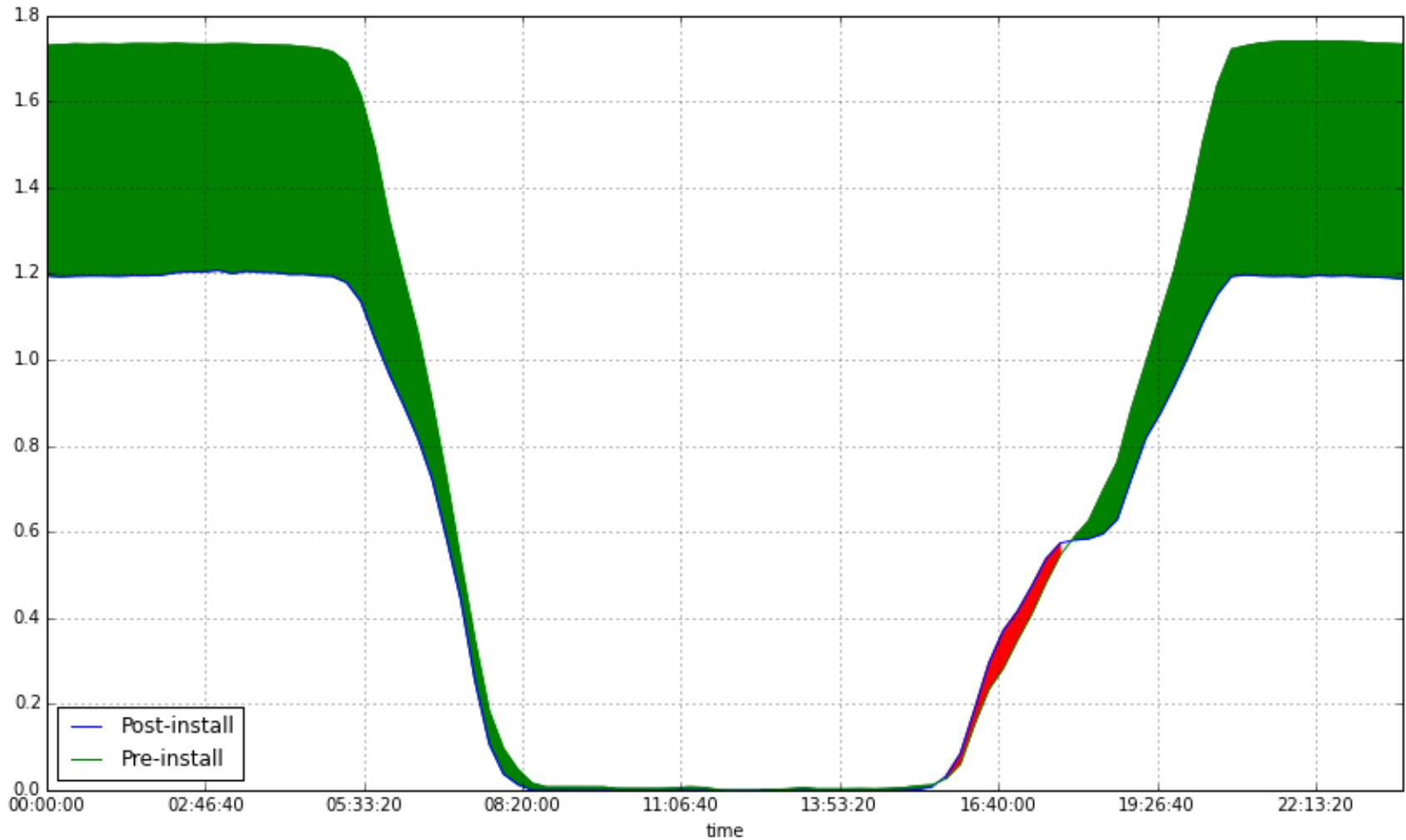
Pre- and post-efficiency load-shape



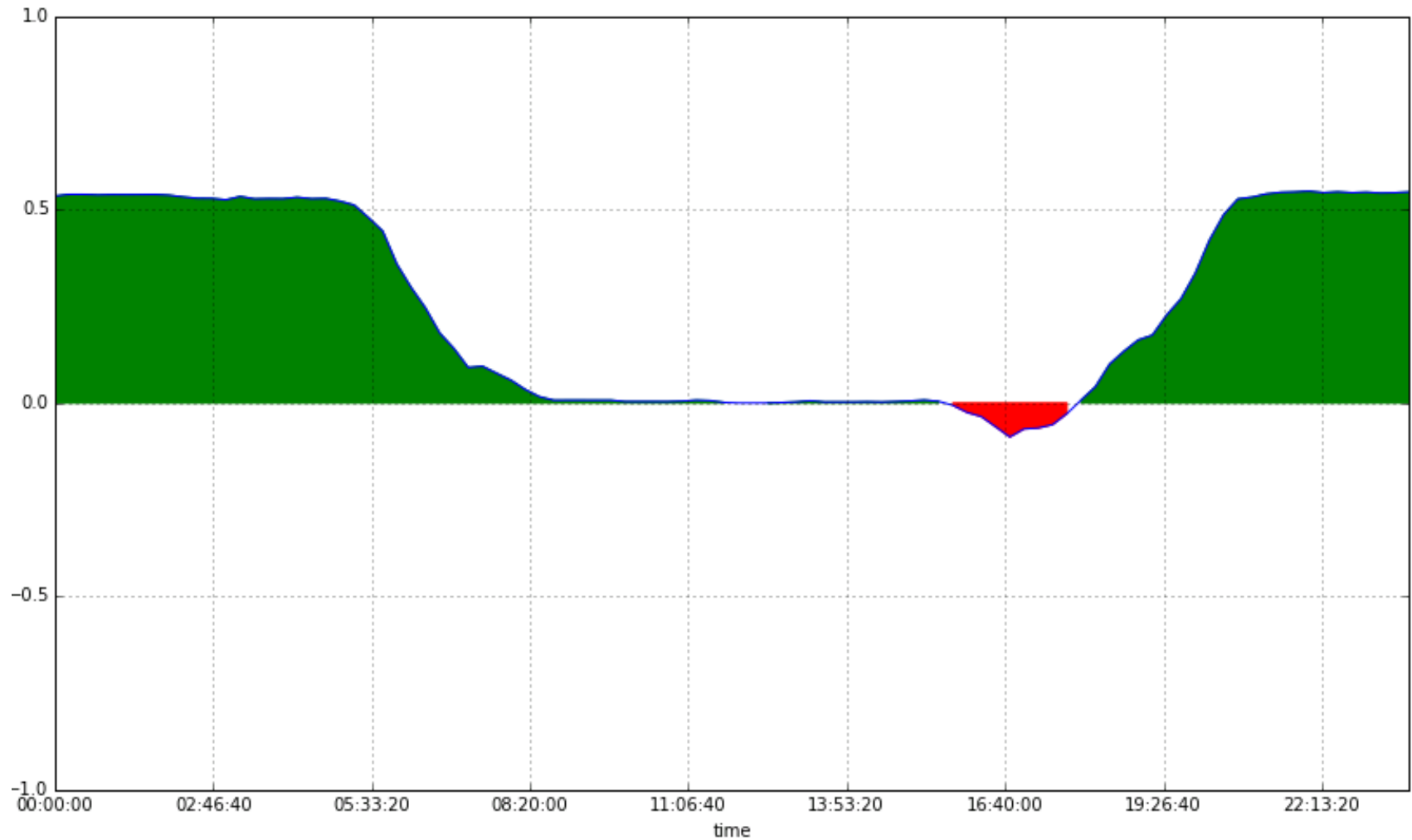
Pre- and post-efficiency savings-shape



Pre- and Post-efficiency Load-shape

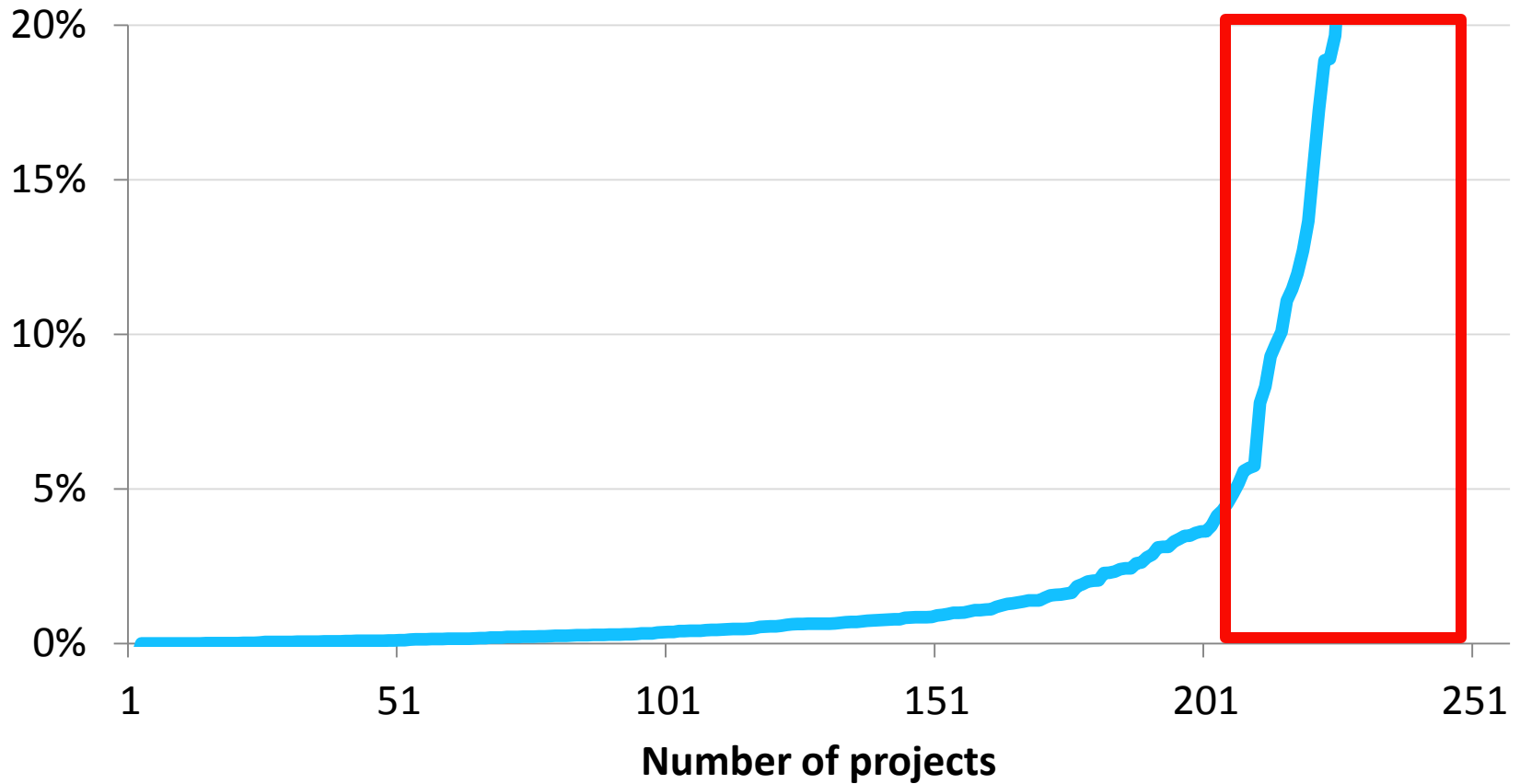


Pre- and Post-efficiency Savings-shape

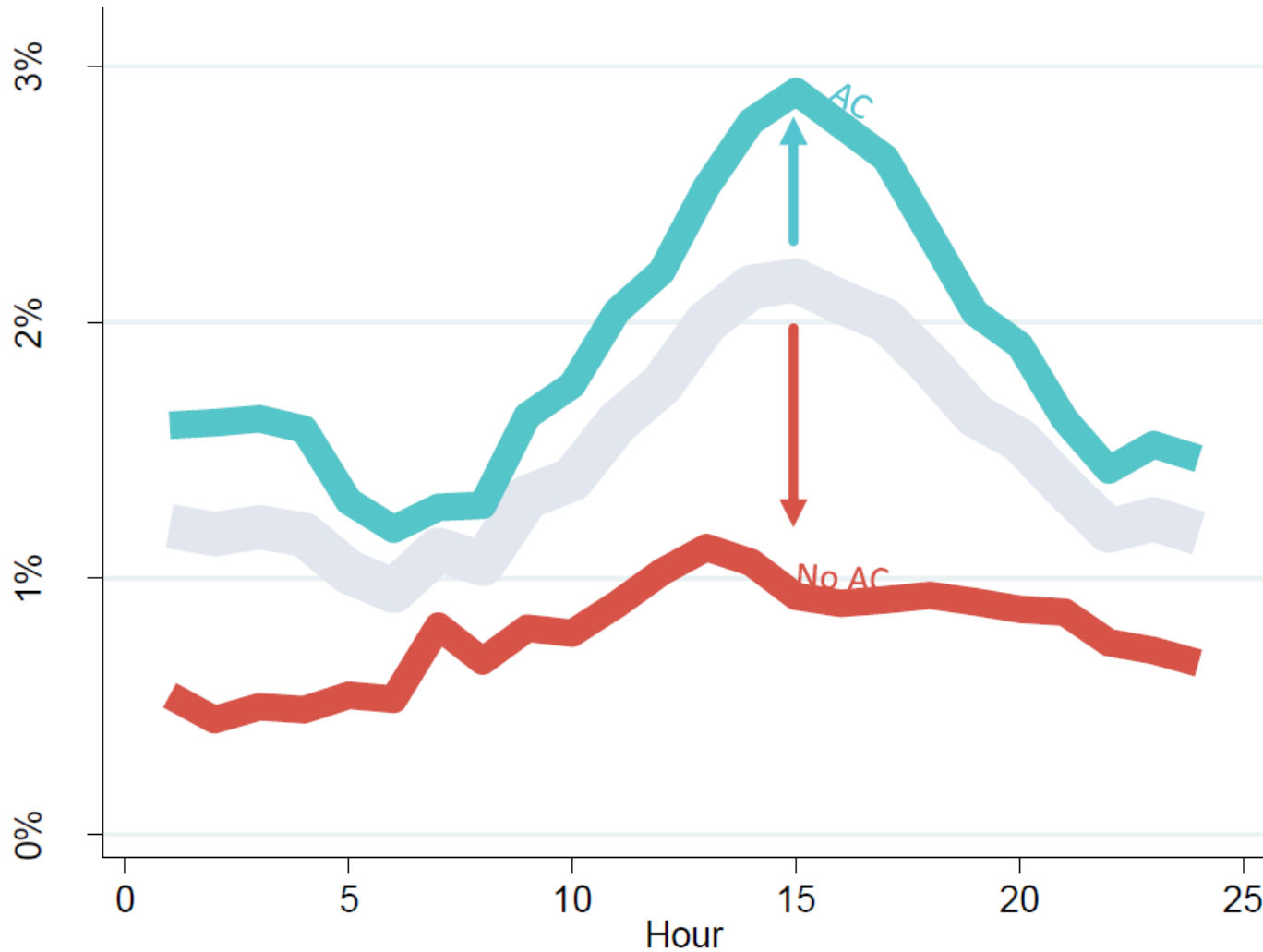


Getting Lost in the Noise

Savings as a Percent of Bill



Savings from Behavior Programs

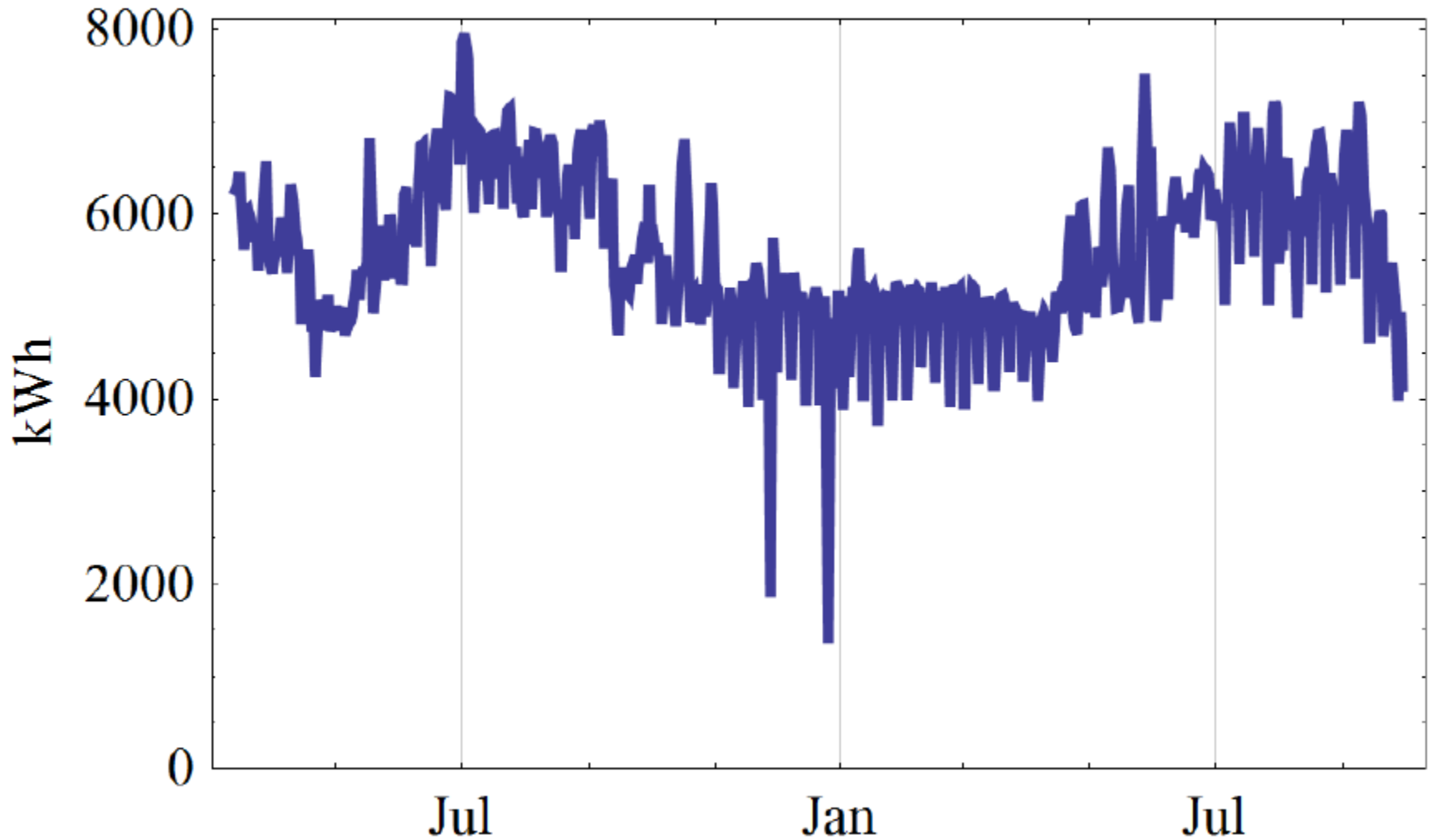


Todd et al. 2013, *Insights from Smart Meters: Focus on Home Energy Report Programs*

There's No Accounting for the Weather

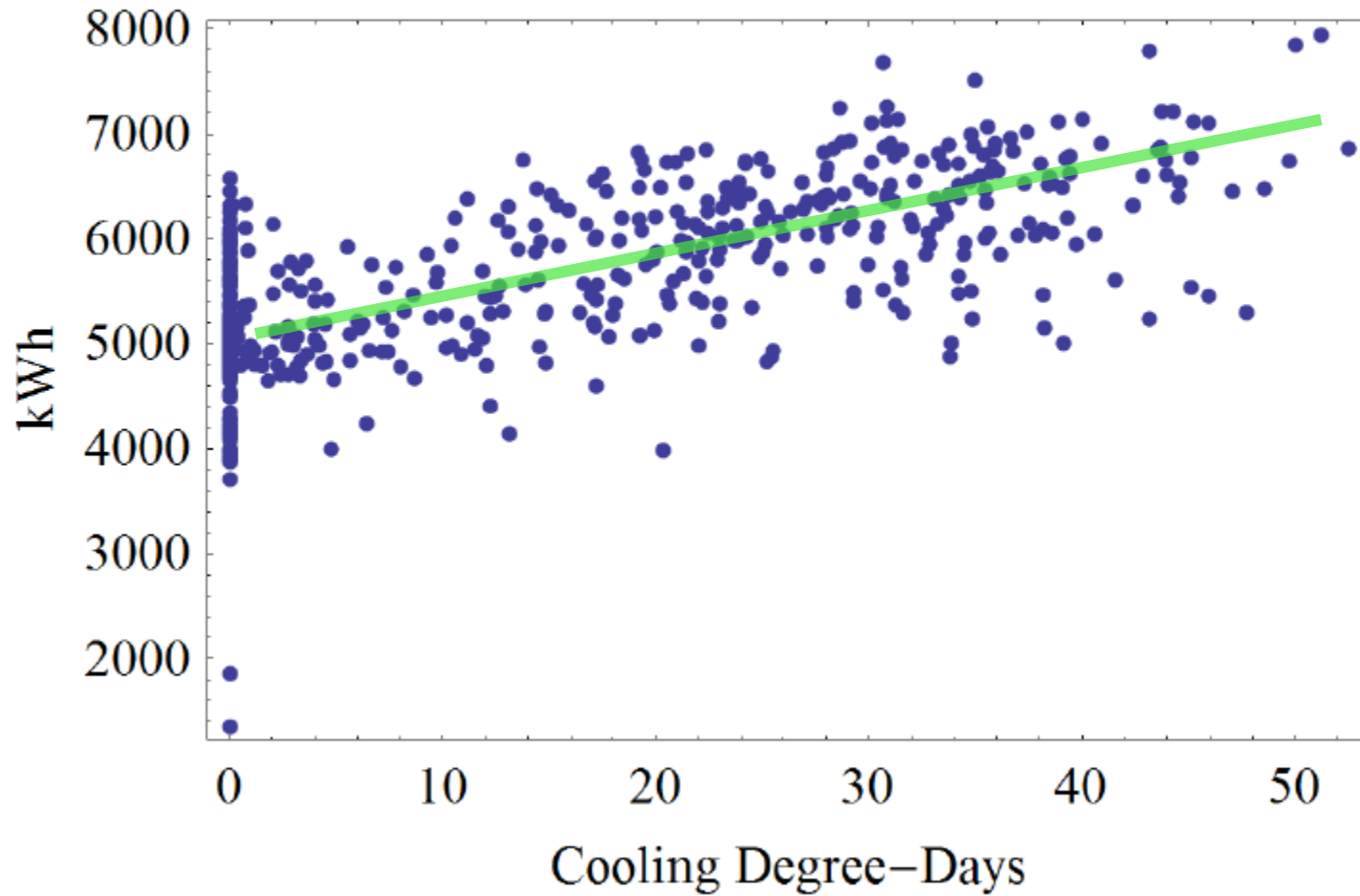


Single Building Model

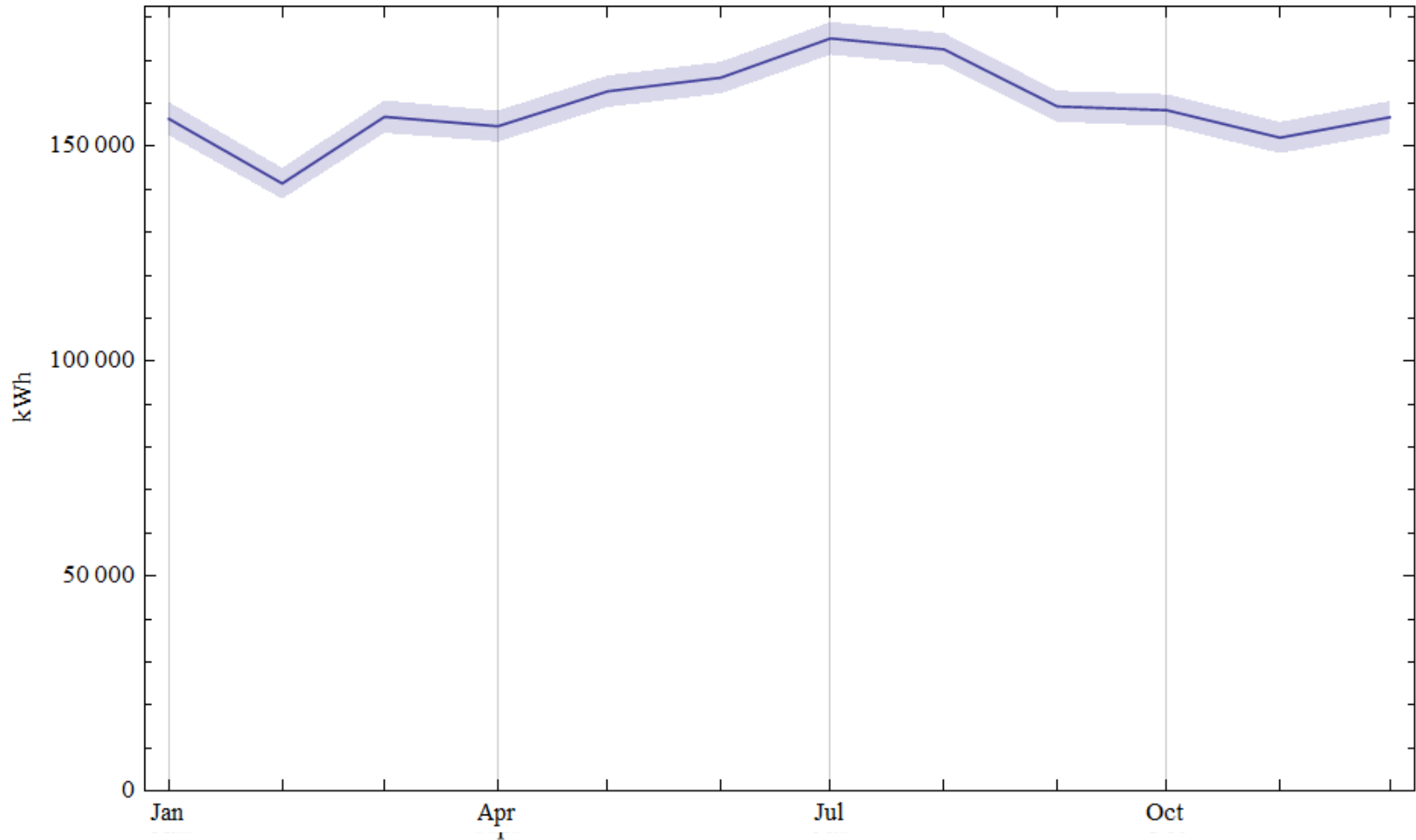


Weather Regression

Billed Energy vs. Cooling Load

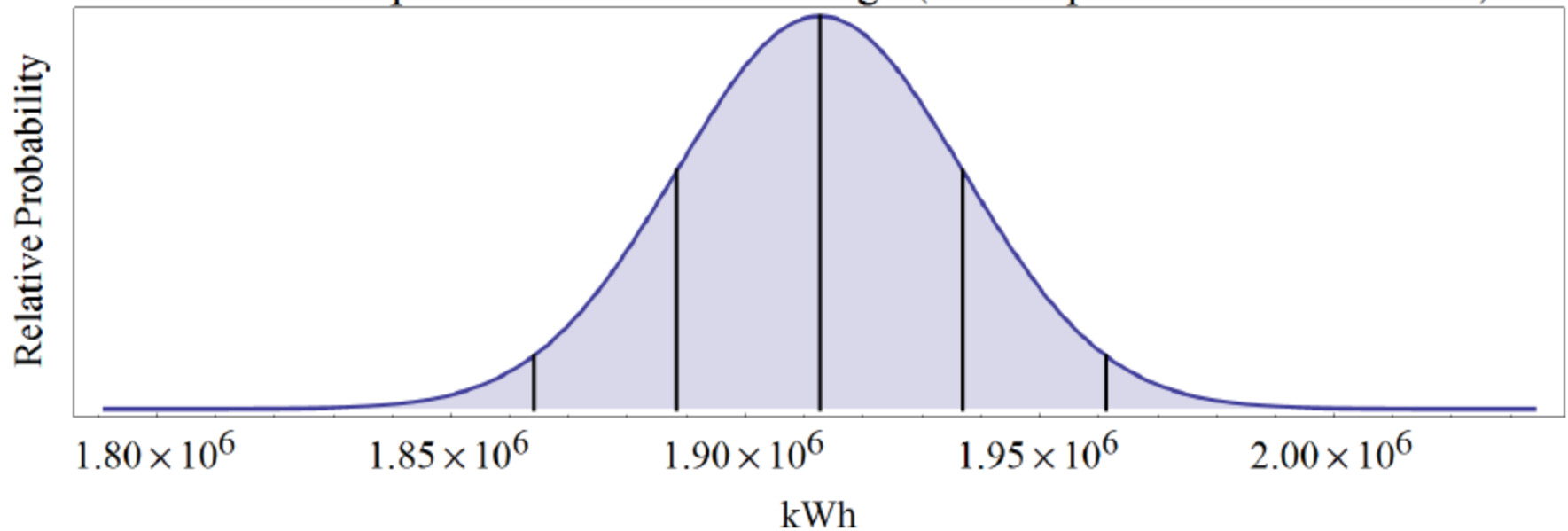


Single Building Model

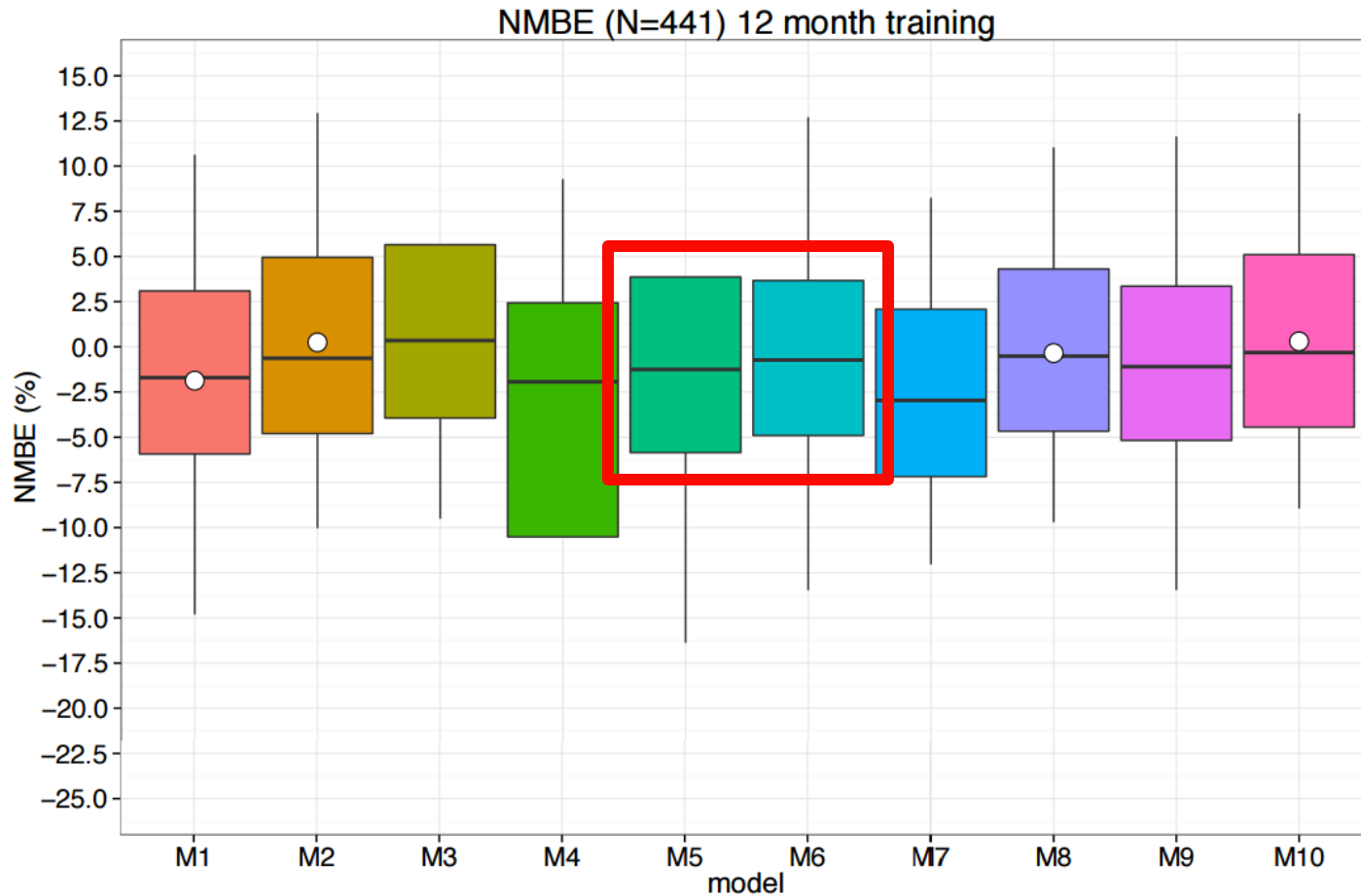


Single Building Model

Bell curve of predicted normalized usage (i.e. the prediction distribution).

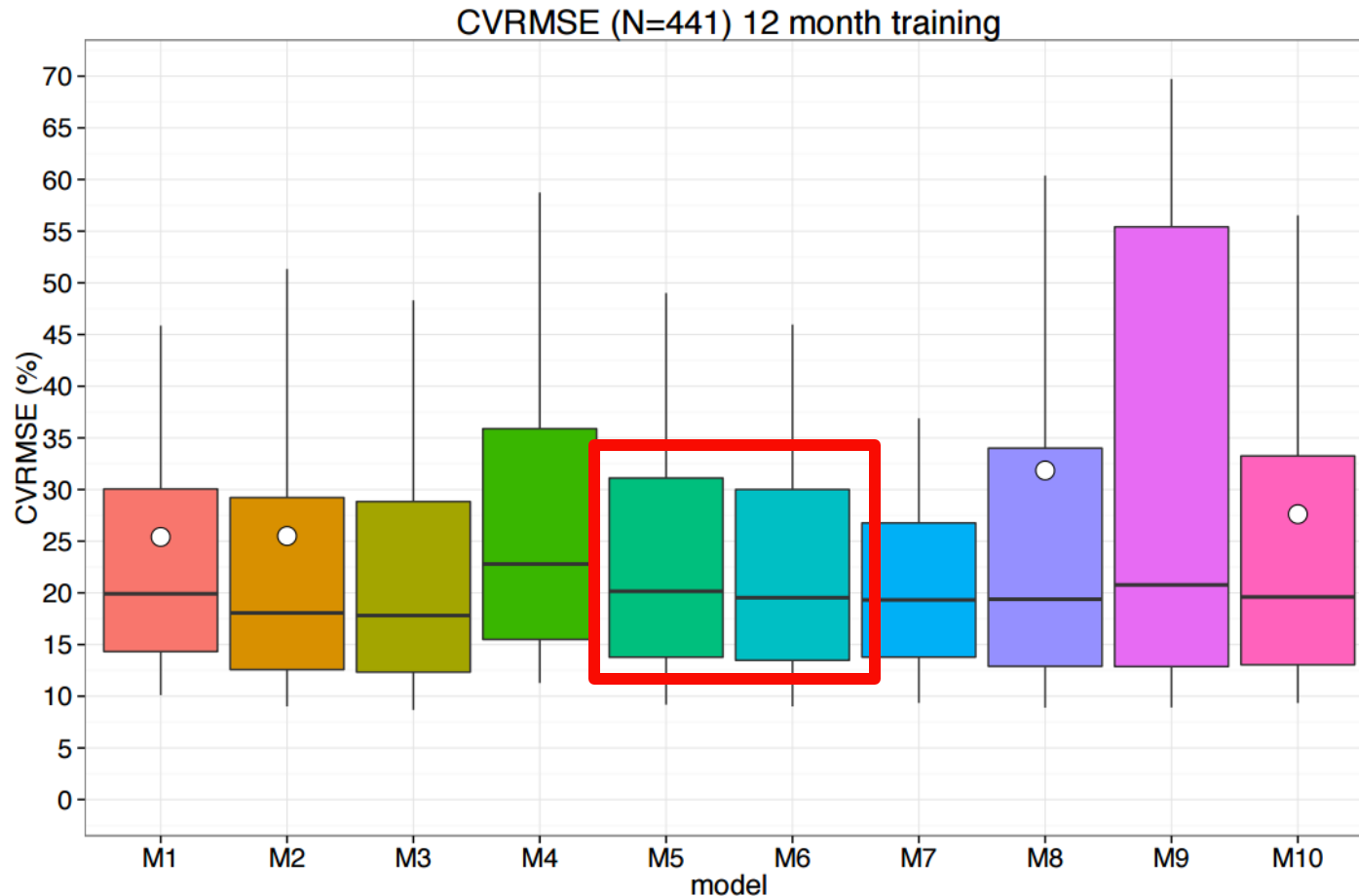


Prediction Accuracy of Different Models



Granderson, Jessica, Samir Touzani, Claudine Custodio, Michael Sohn, and Samuel Fernandes. *Assessment of Automated Measurement and Verification (M&V) Methods*, Edited by David Jump. Berkeley: LBNL, 2015.

Variation of 15-Minute Loadshapes



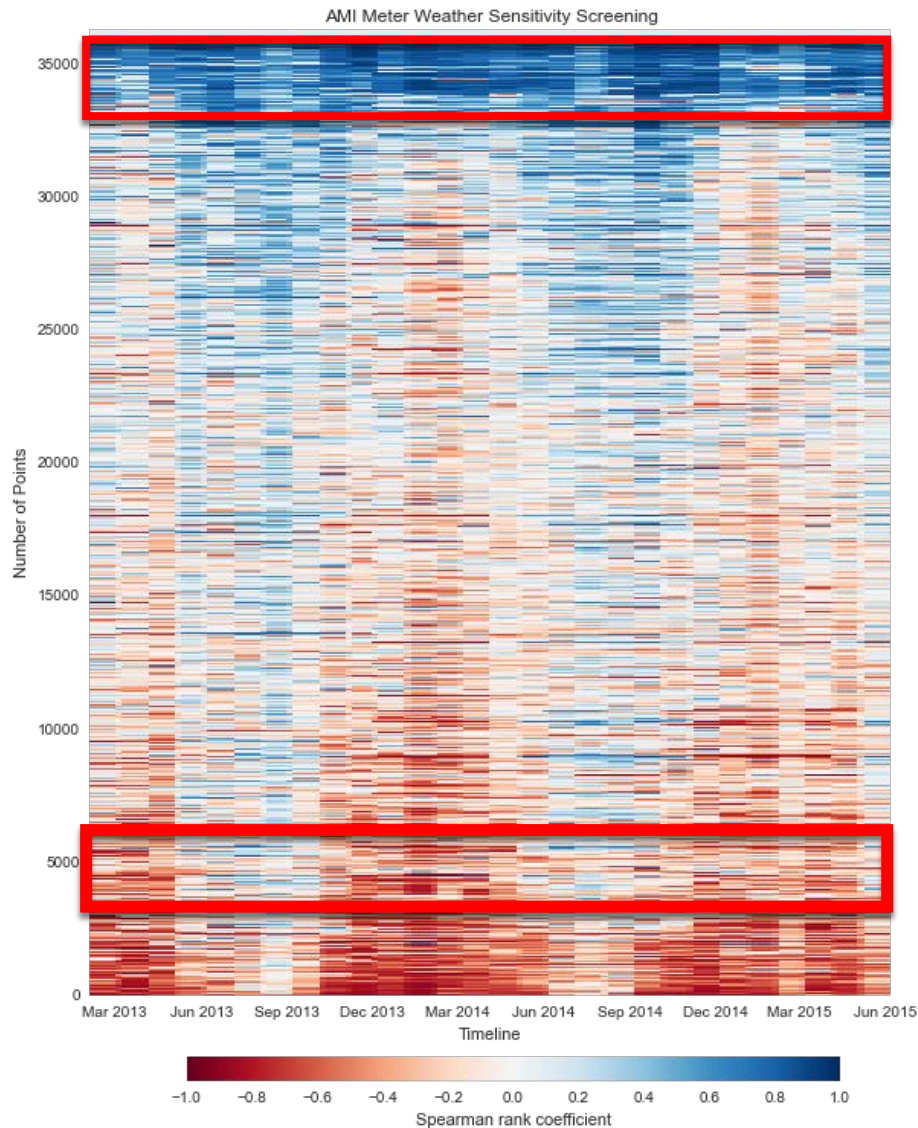
Granderson, Jessica, Samir Touzani, Claudine Custodio, Michael Sohn, and Samuel Fernandes. *Assessment of Automated Measurement and Verification (M&V) Methods*, Edited by David Jump. Berkeley: LBNL, 2015.

What the Heck Does That Even Mean?

Smart meter data helps to measure savings.

It may still not be good enough.

Looking for the Biggest Needles



Strongly cooling sensitive

Strongly heating sensitive

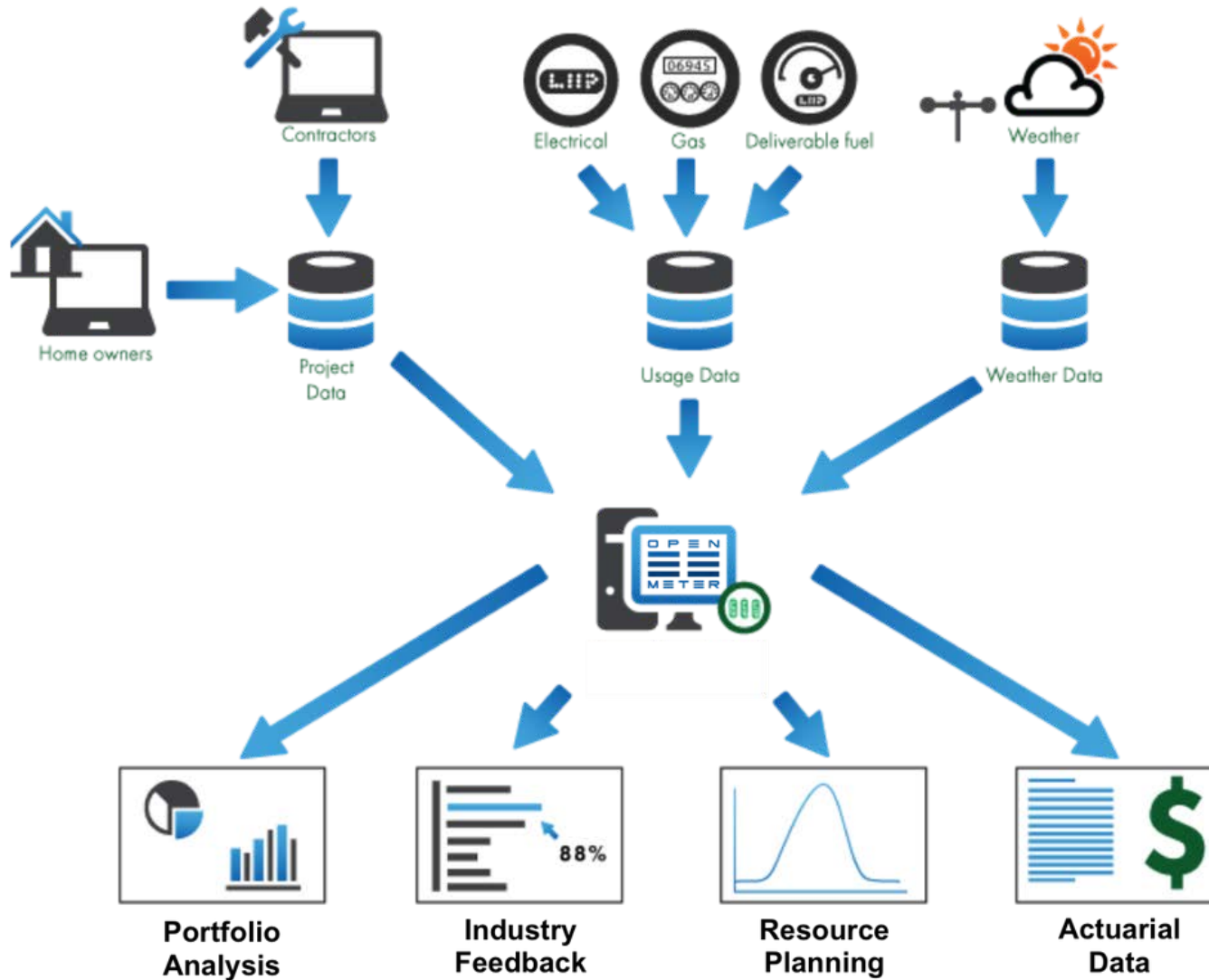
Billions and Billions of Connected Devices



Automating Savings for Each Project



Open Energy Efficiency Meter



Questions?

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