
Behavioral Energy Usage Segments Help Explain EE Program Savings Rates

OP@WER

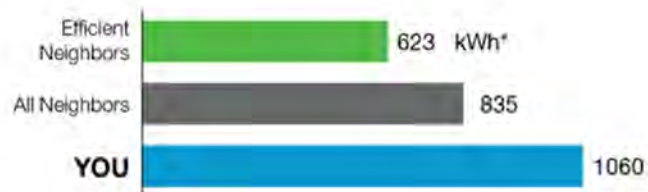
ORACLE®

Agenda

- 1 Opower background
- 2 Machine learning to segment households by energy usage
- 3 EE savings behavioral insights

Opower's Home Energy Report

Last Month Neighbor Comparison | You used **27% MORE** electricity than your neighbors.



How You're Doing:

You used more than average.

Turn over for easy ways to save

* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

Who are your Neighbors?

All Neighbors

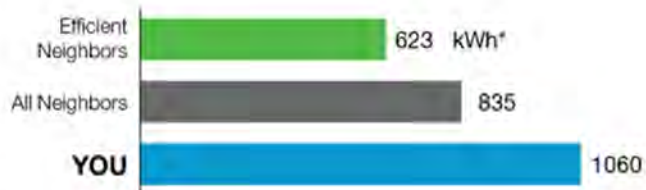
Approximately 100 occupied, nearby homes that are similar in size to yours (avg 890.39 sq ft) and have electric heat.

Efficient Neighbors

The lowest electricity-use 20% of all neighbors.

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Normative comparison

Who are your Neighbors?

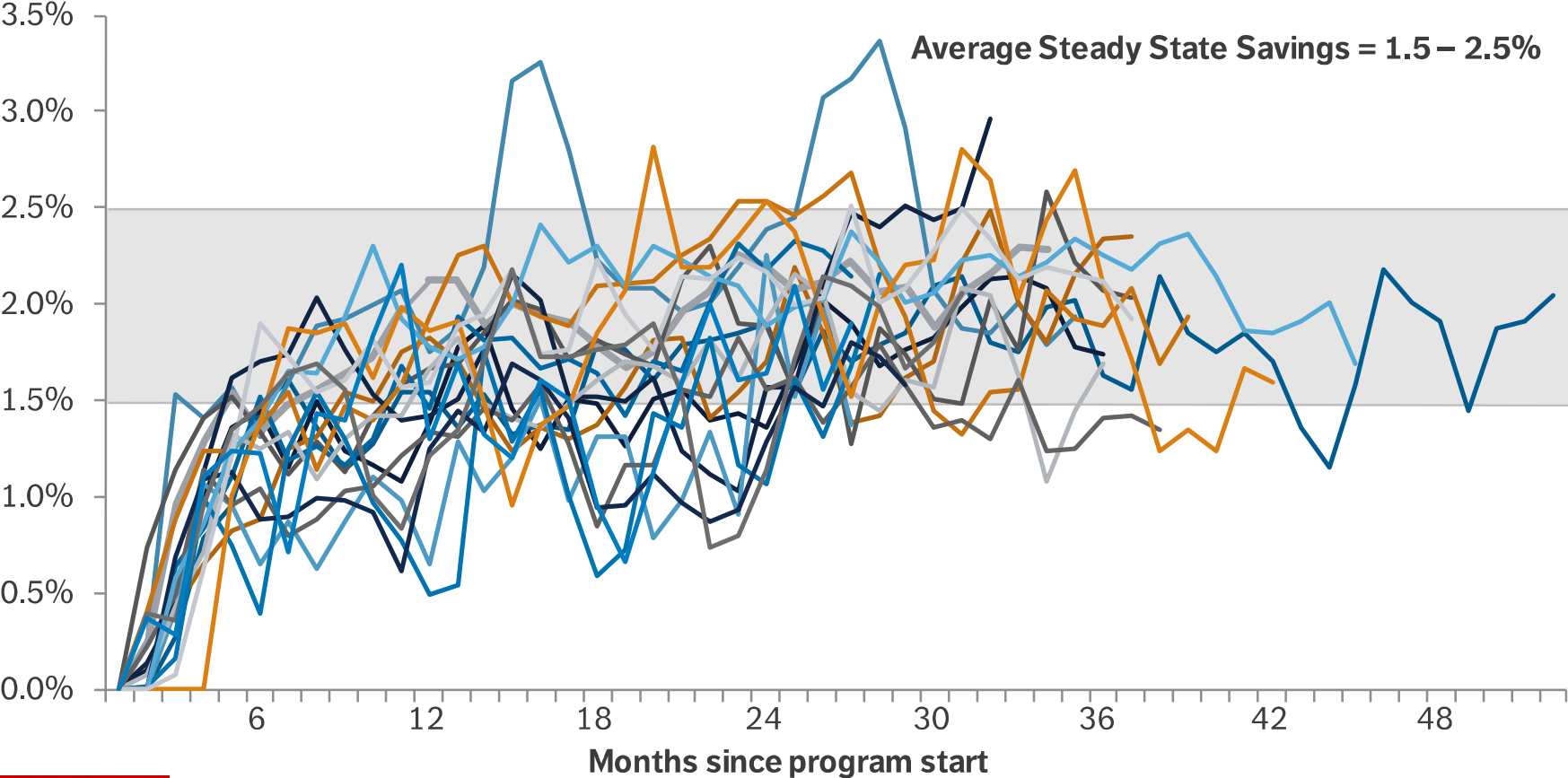
All Neighbors

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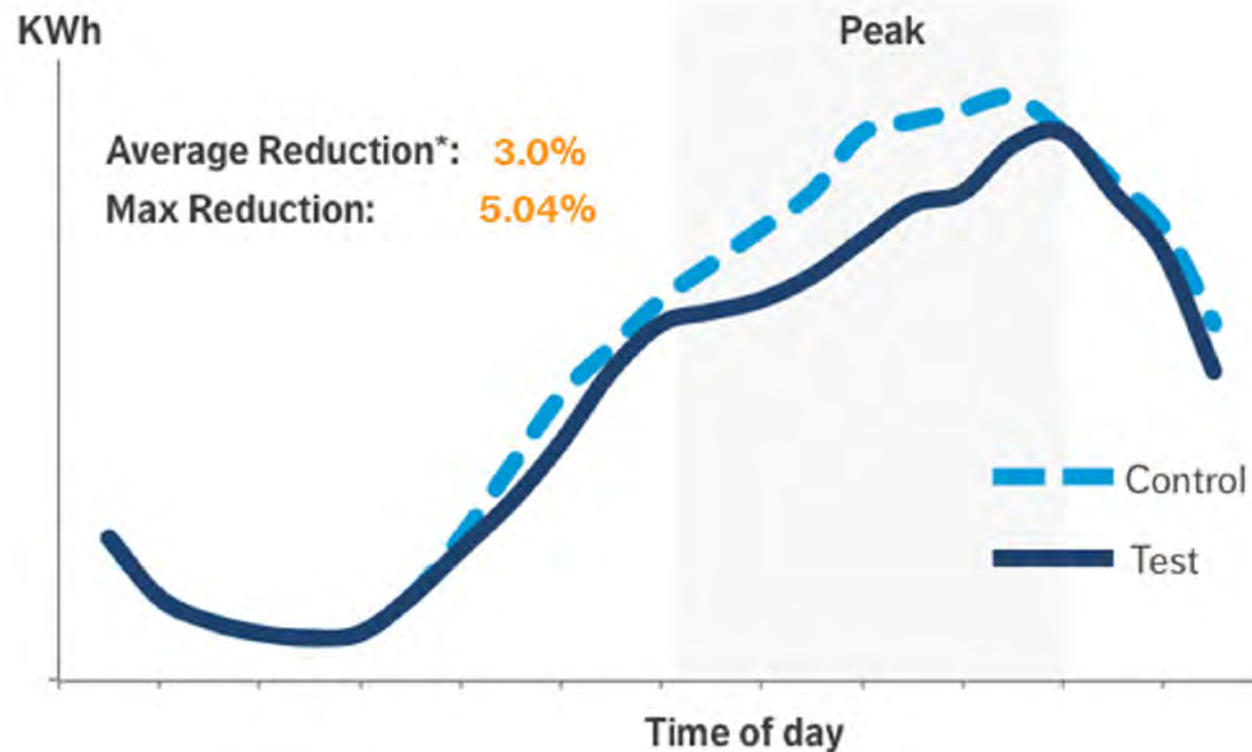
Efficient Neighbors

The lowest electricity-use 20% of all neighbors.

Generates predictable and verified electricity savings



Behavioral Demand Response product reduces peak usage, without a device or price

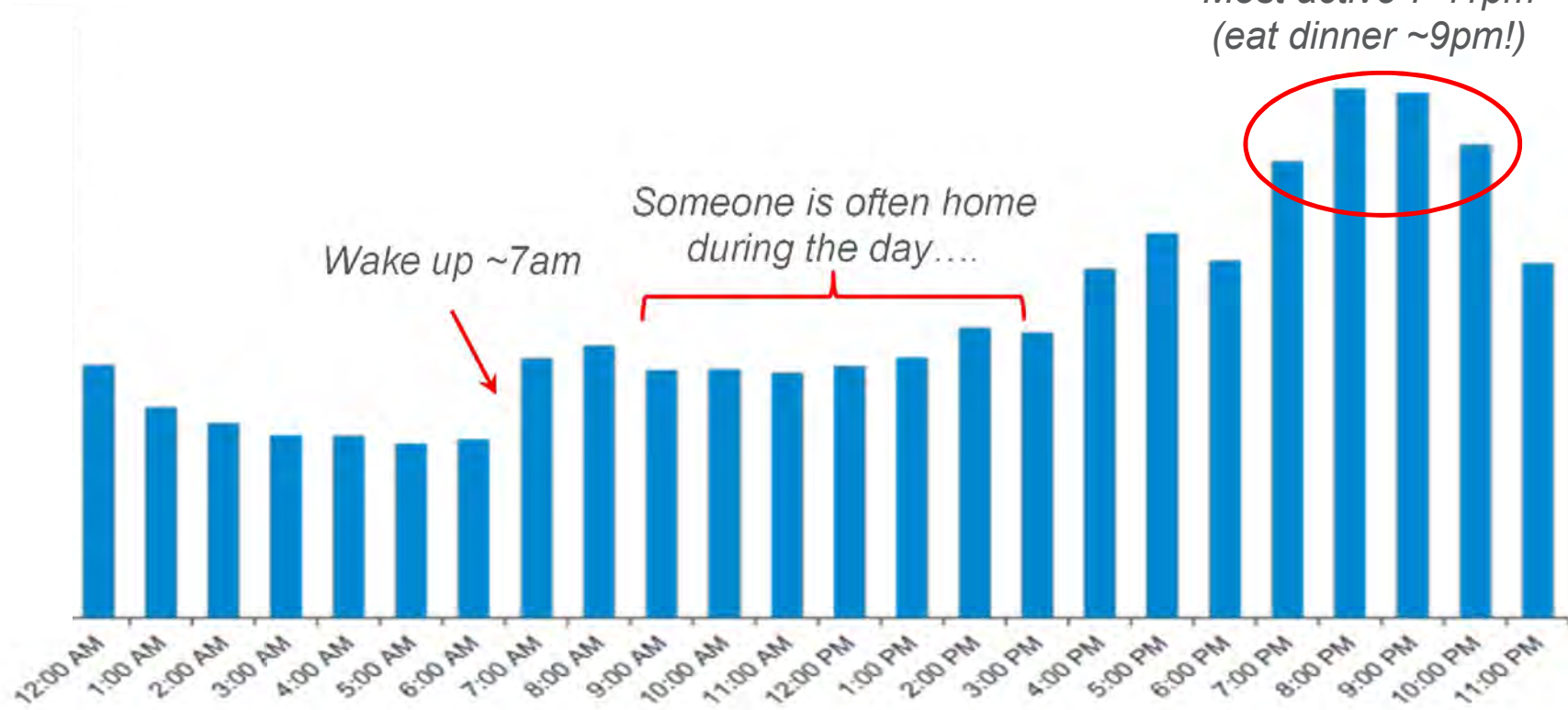


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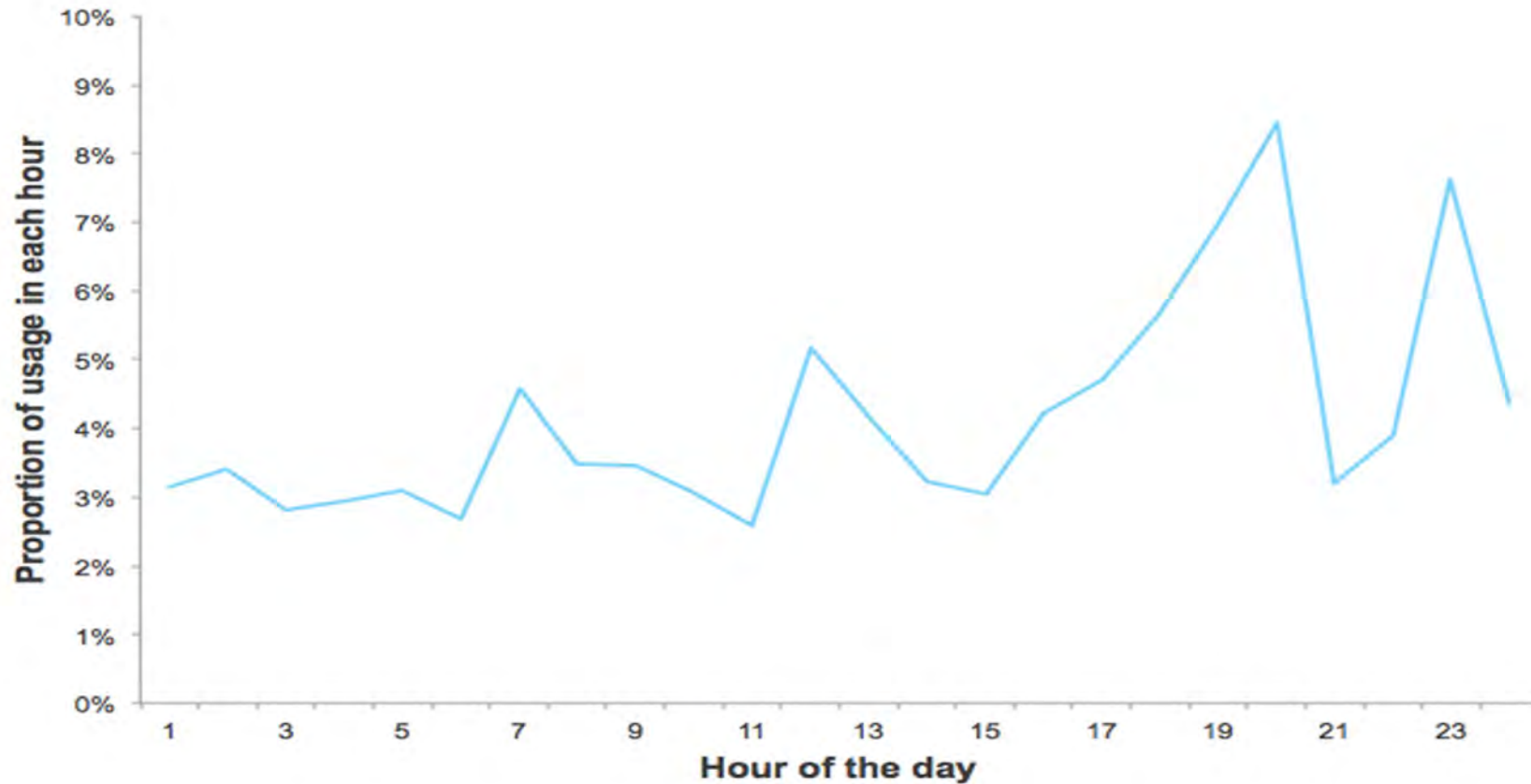
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Hourly data opens a window into how Matt lives

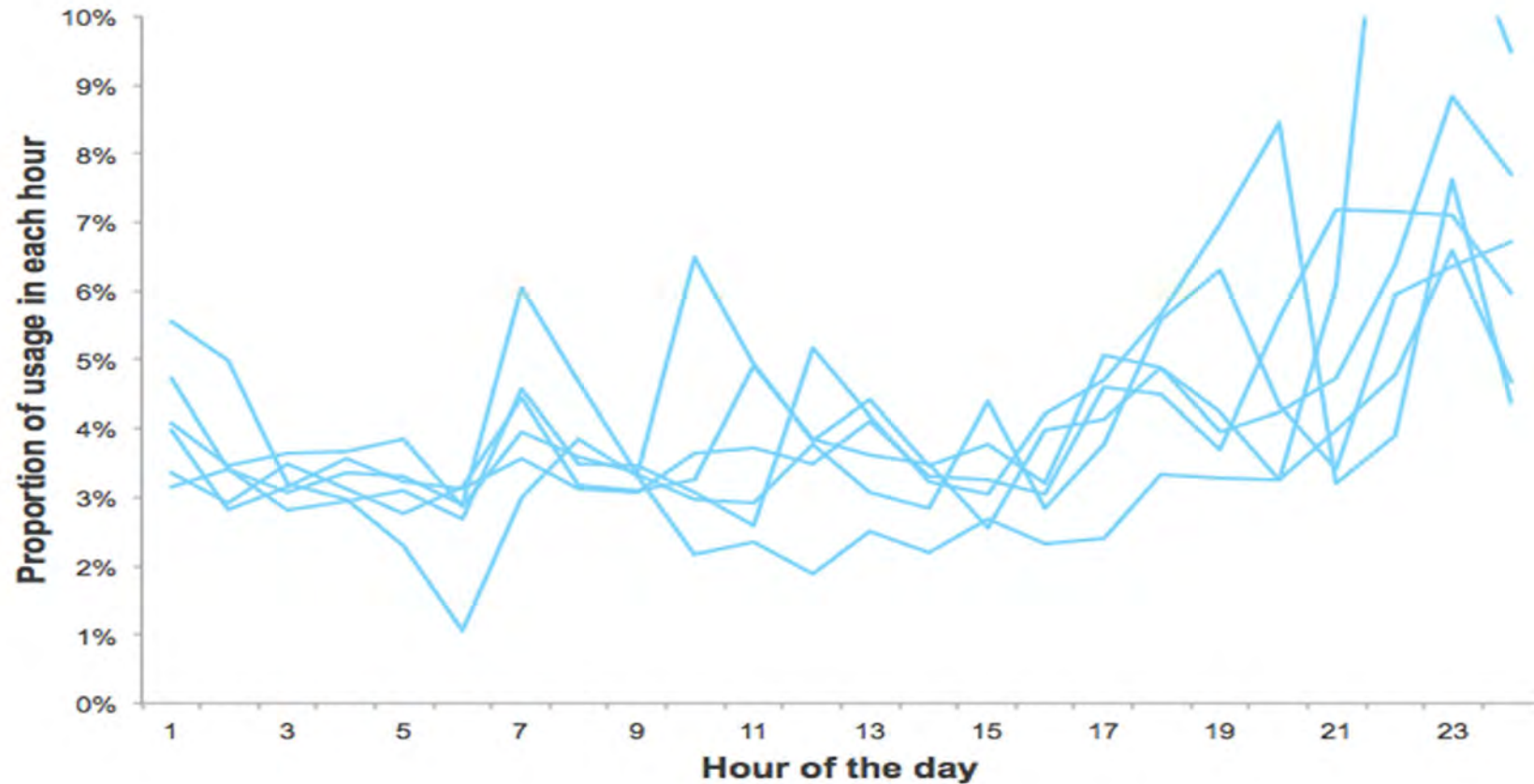
Most active 7-11pm
(eat dinner ~9pm!)



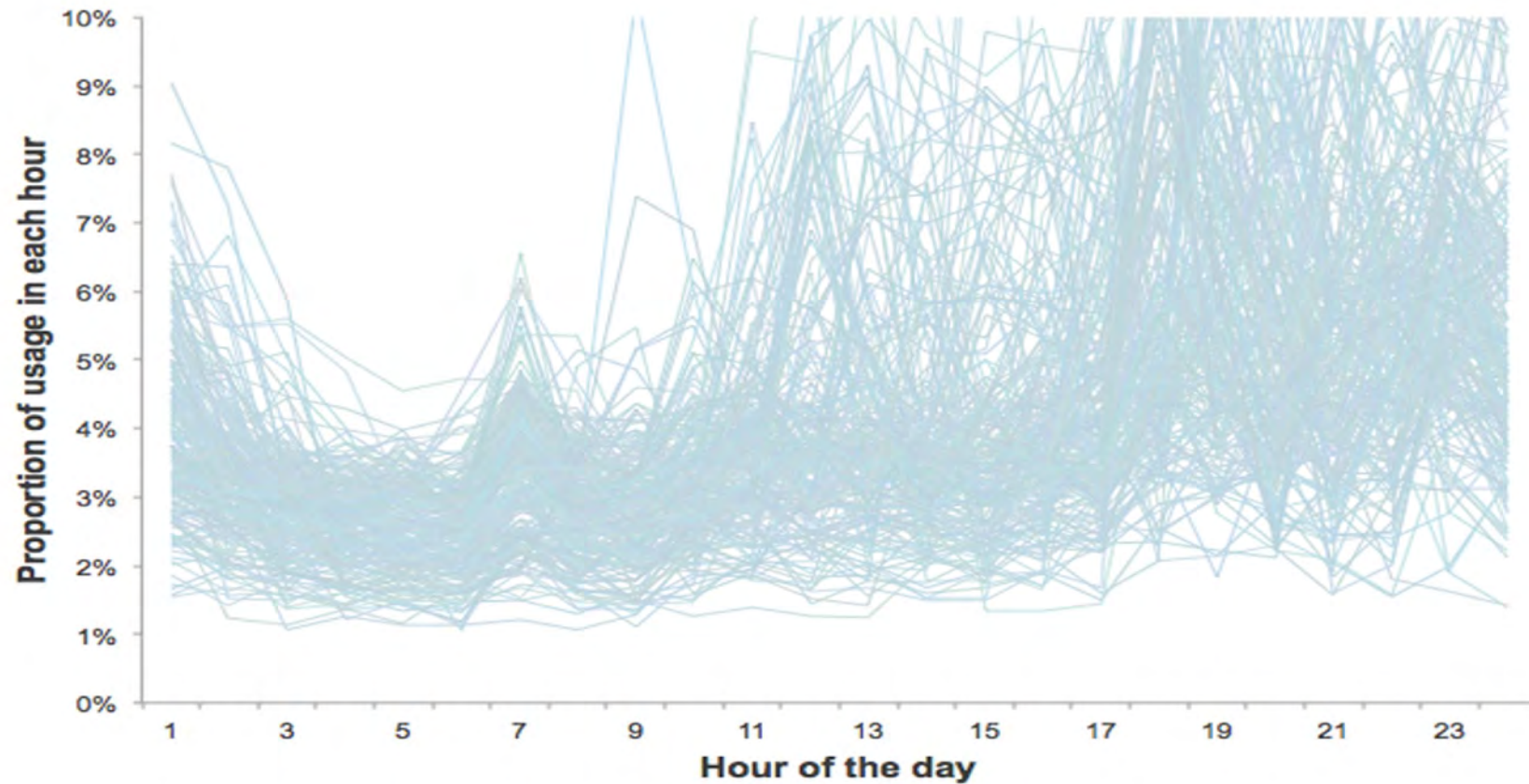
But, one day of data only tells us so much about a customer



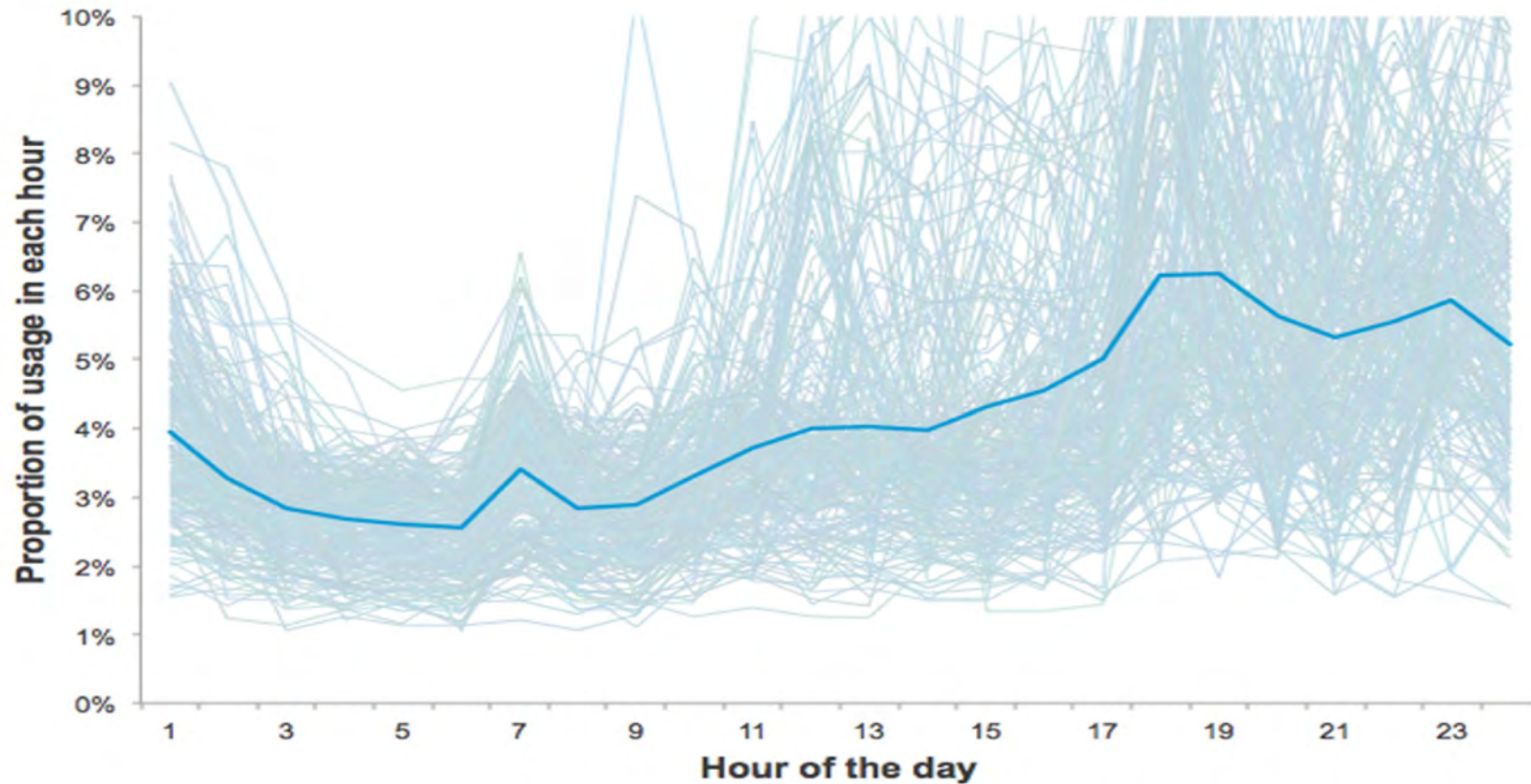
And every day isn't exactly the same, so there's a lot of noise in the data



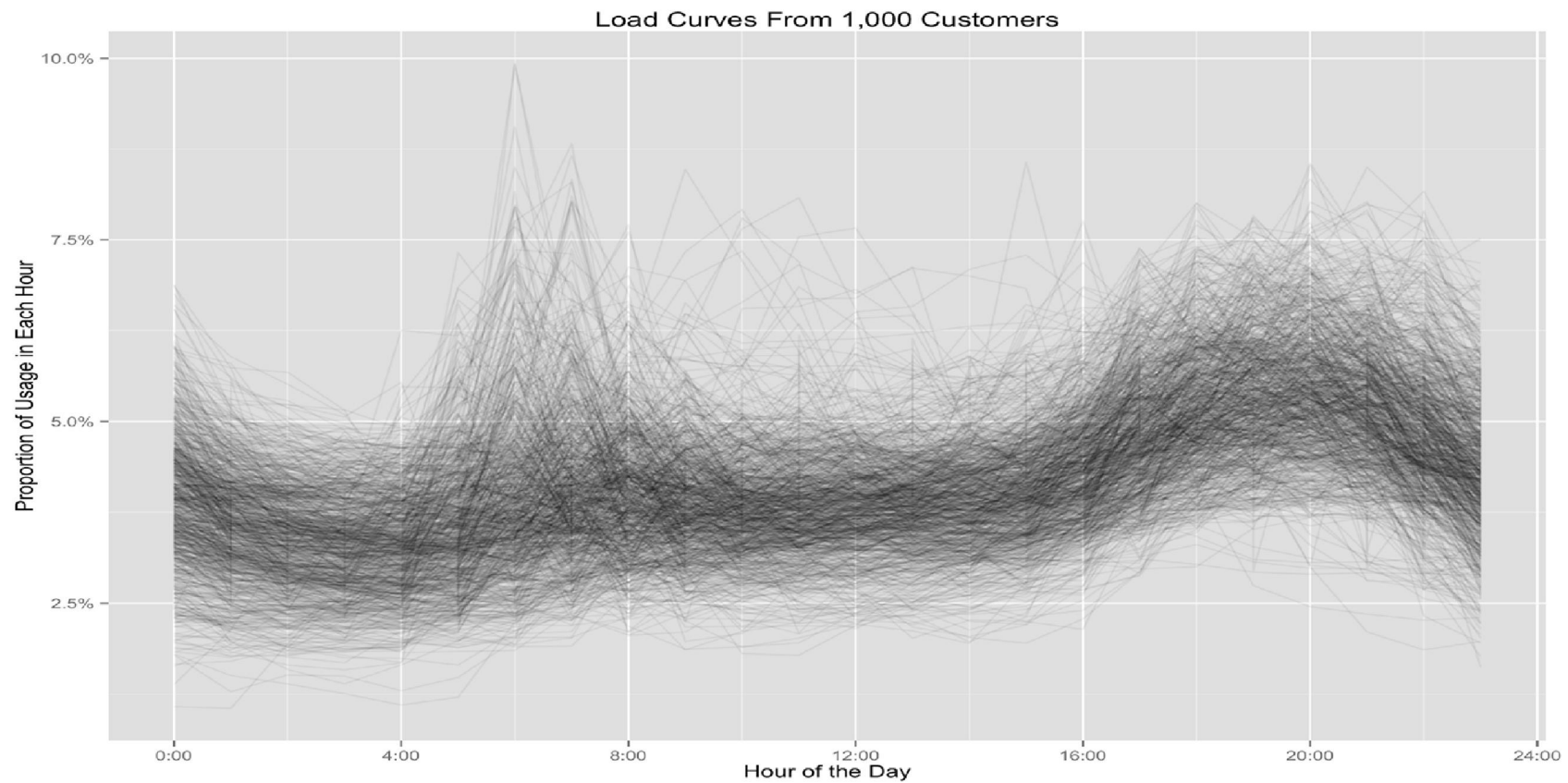
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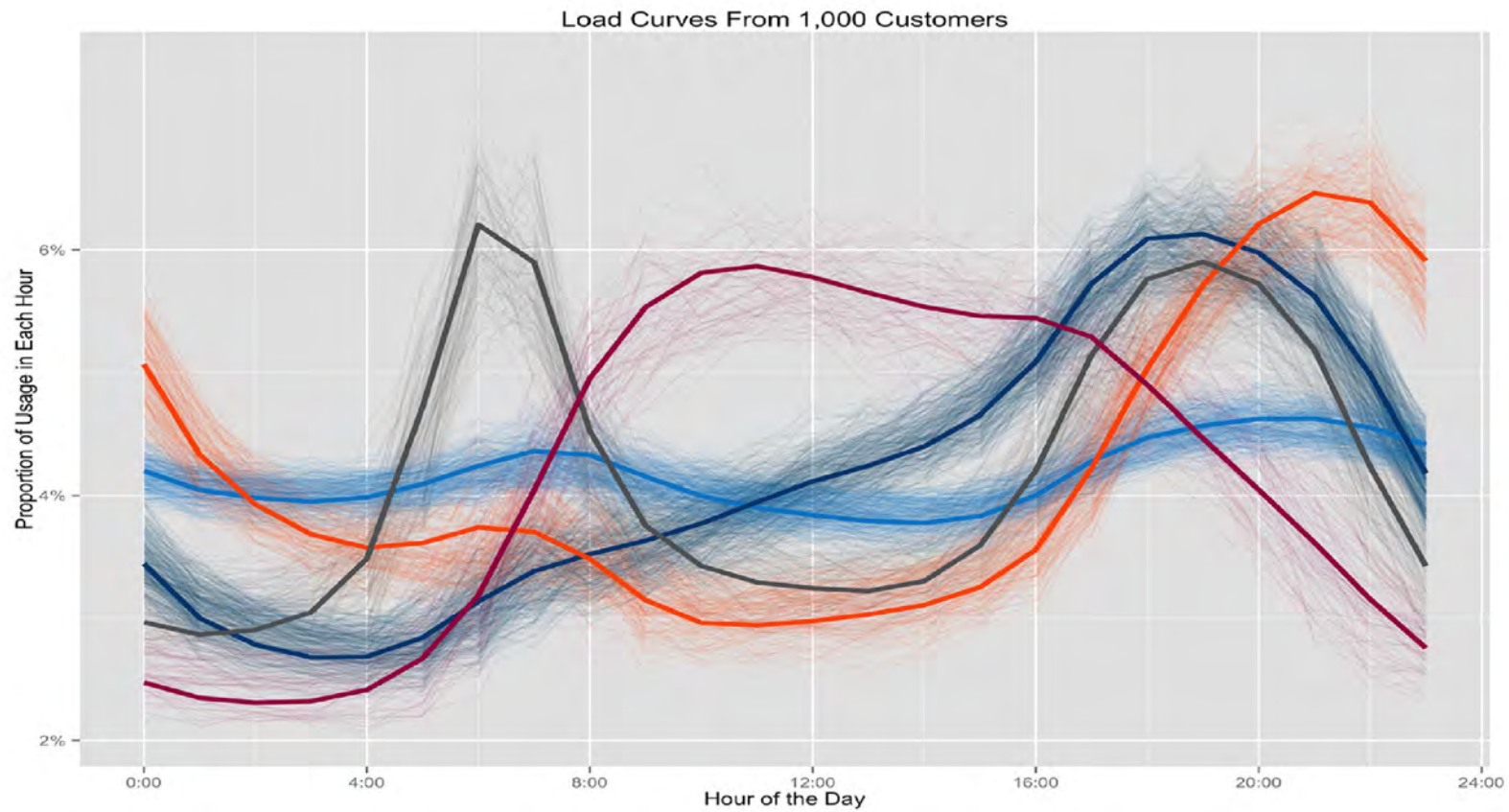
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When we look at all customers, how do we make this meaningful?



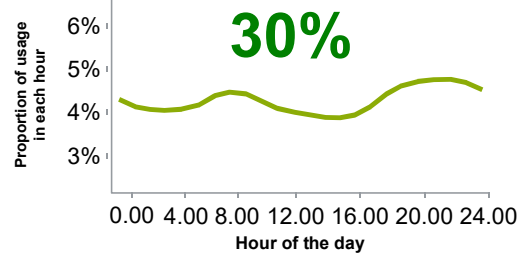
By finding signal in the noise



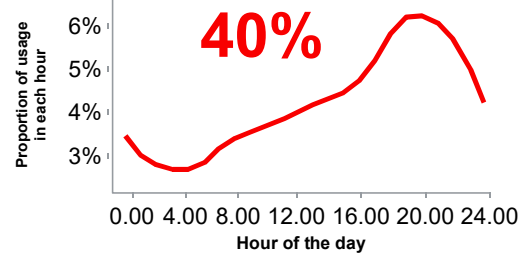
Smith et al 2012. A Simple Way to Use Interval Data to Segment Residential Customers for Energy Efficiency and Demand Response Program Targeting. ACEEE.

AMI load archetypes allow us to segment customers by their behavior

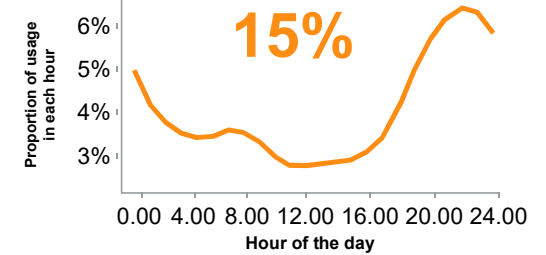
Steady Eddies



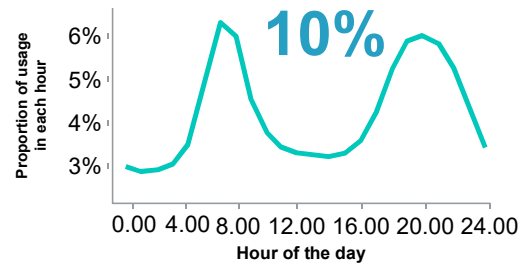
Evening Peakers



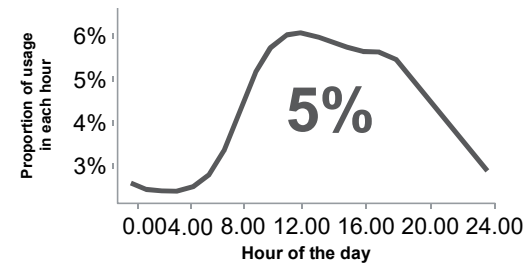
Night Owls



Twin Peaks



Daytimers



Knowing this enables us do better segmentation and targeting for programs

This is an alert from UtilityCo:

Tomorrow, Wednesday, August 18th is a peak day. From **2:00 PM to 7:00 PM** join UtilityCo customers by reducing your electric use. Simple ways to save on peak days include postponing dishwashing and other large appliance use until the peak day is over. Thank you for helping us save! To opt out of phone alerts, press 9. You may also reach us at 1-800-800-8000.



UtilityCo

Please join your neighbors in reducing energy use on Wednesday afternoon, **August 18th from 2–7pm.**

1 You used **MORE** than similar homes on the last peak day.

Last peak day: Wednesday, June 12th 2–7pm

Category	Usage (kWh)
Efficient Neighbors	2 kWh
All Neighbors	5 kWh
YOU	10 kWh

All Neighbors: Average. 100 occupied nearby homes that are similar size to yours.
Efficient Neighbors: The most efficient 20 percent from the All Neighbors group.

What is a peak day?
During hot days when demand is high, energy can seem expensive. By using less energy during peak days you can help keep costs down for everyone.

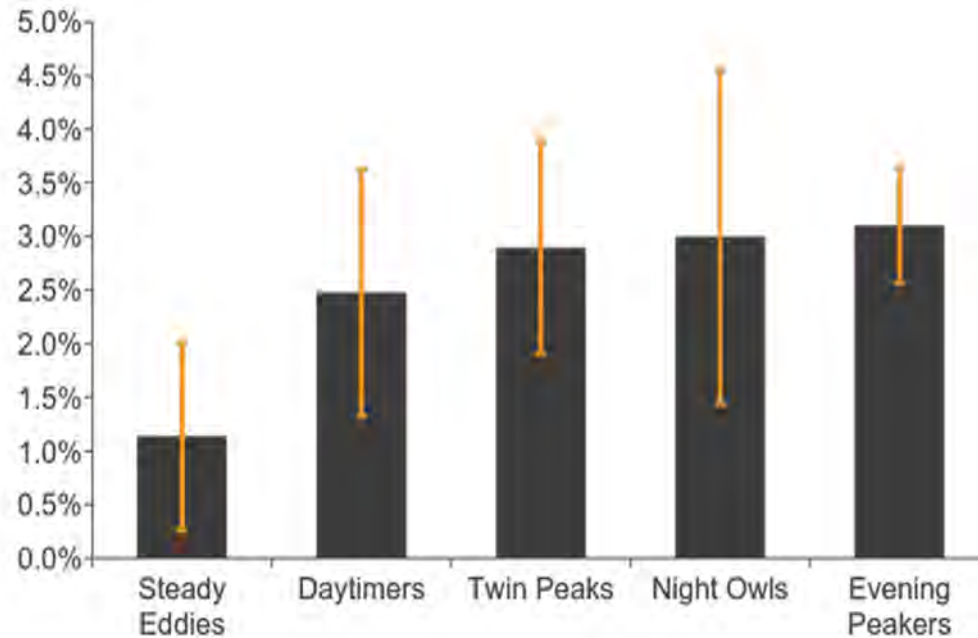
Ways to save on peak days

- Before you leave the house**
Adjust your thermostat a few degrees
Pinterest yr brunch cardigan hashtag blue bottle, put a bird on it swag. Schilz umami kogi banh mi, next level craft beer yr forage Portland church-key.
- While you're at home**
Delay large appliance use until after peak hours
Pinterest yr brunch cardigan hashtag blue bottle, put a bird on it swag. Schilz umami kogi banh mi, next level craft beer yr forage Portland church-key.
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FirstName LastName
Acct # ****-XXXX
Unsubscribe from these emails
Utility Name, 1811 Fort Meyer Drive, Suite 702, Arlington, VA 22208

Knowing this enables us do better segmentation and targeting for programs

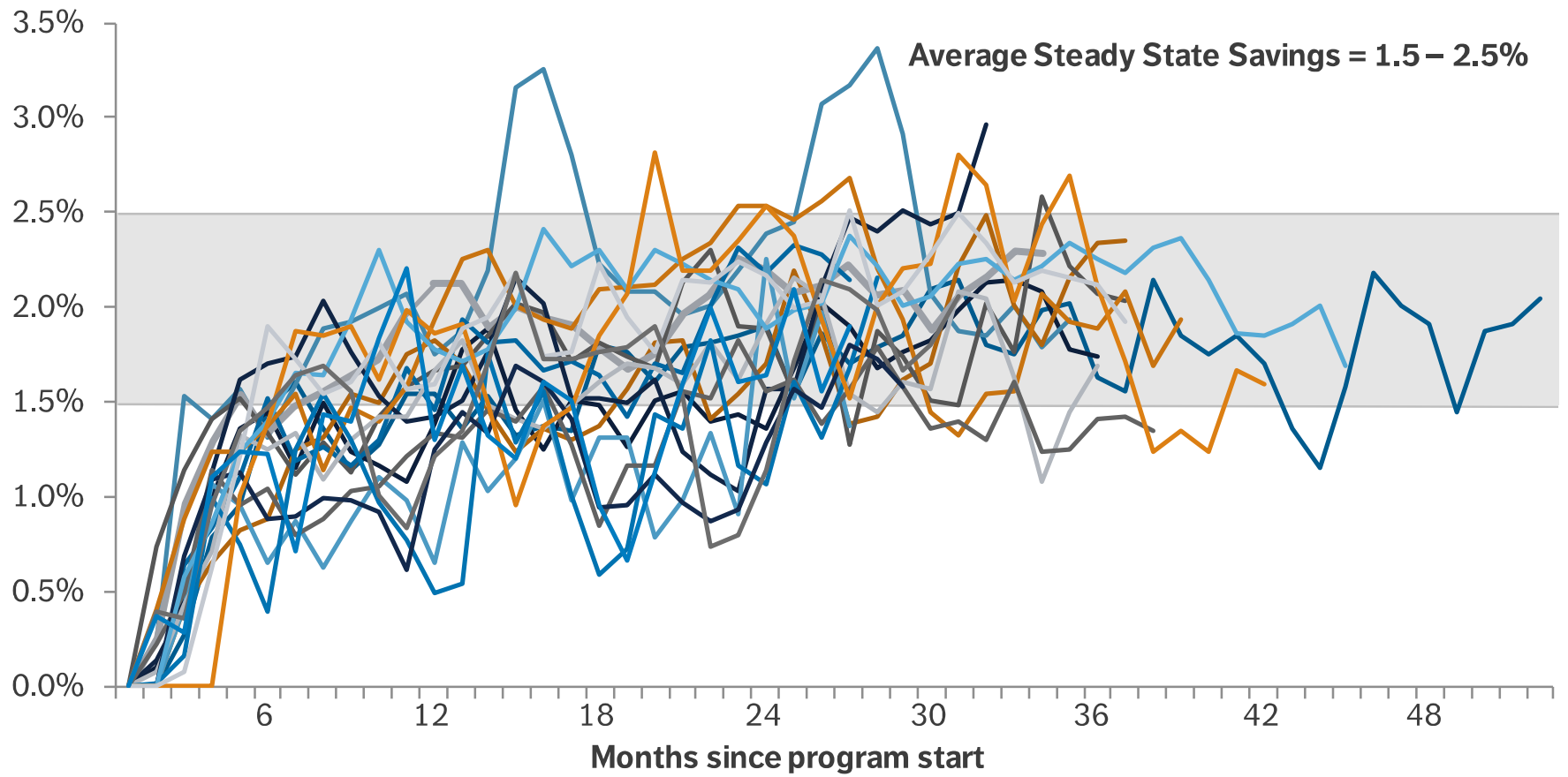
BDR Peak Reduction % by Archetype



Average peak savings results normalized by average energy usage

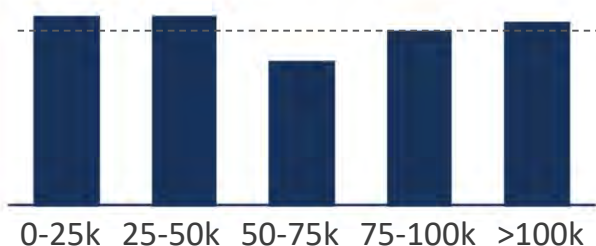
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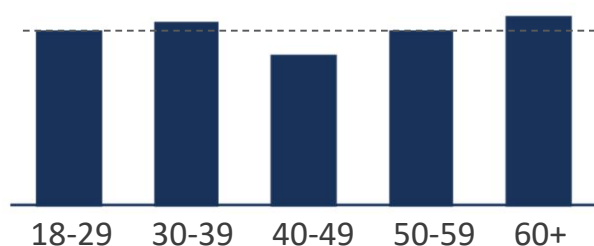


What types of customers save the most?

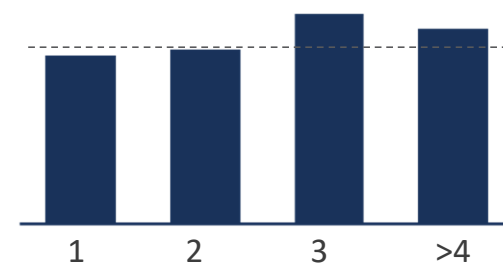
Energy savings by income



Energy savings by age



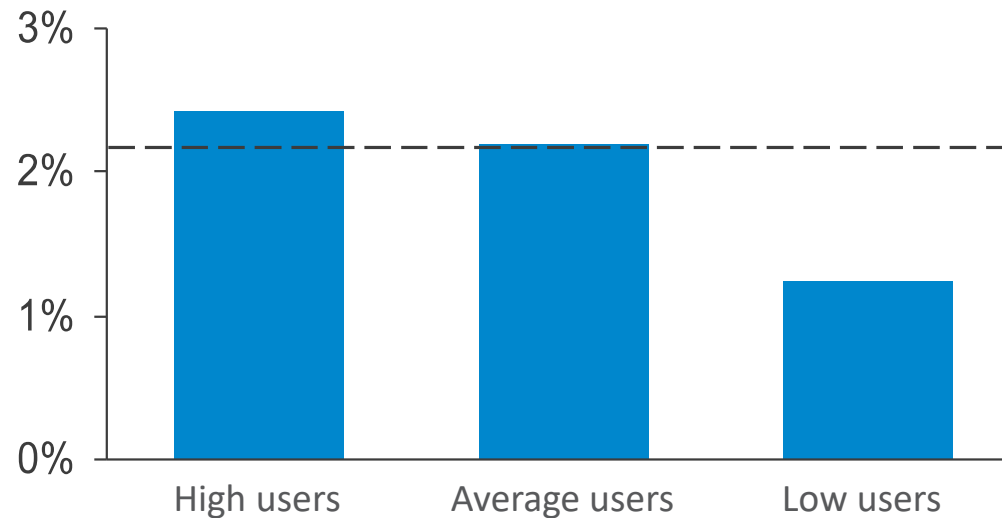
Energy savings by # of residents



Demographics and household characteristics do not predict EE savings

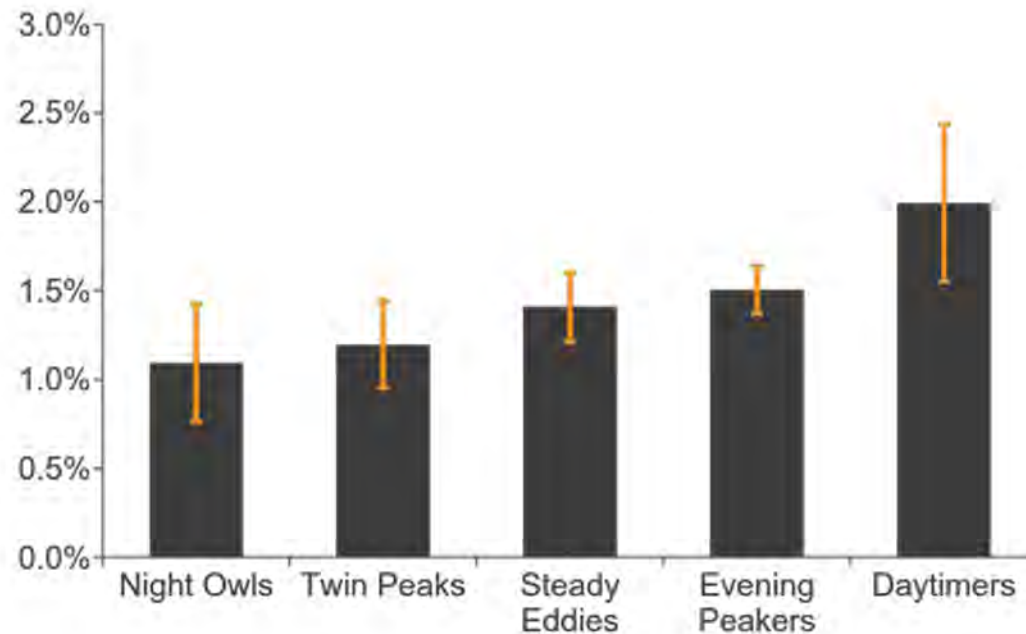
To date, the only factor predictive of savings has been how much energy customers use

Energy savings % by energy usage



...but, surprisingly, load profile archetypes also predict savings

EE Savings % by Archetype

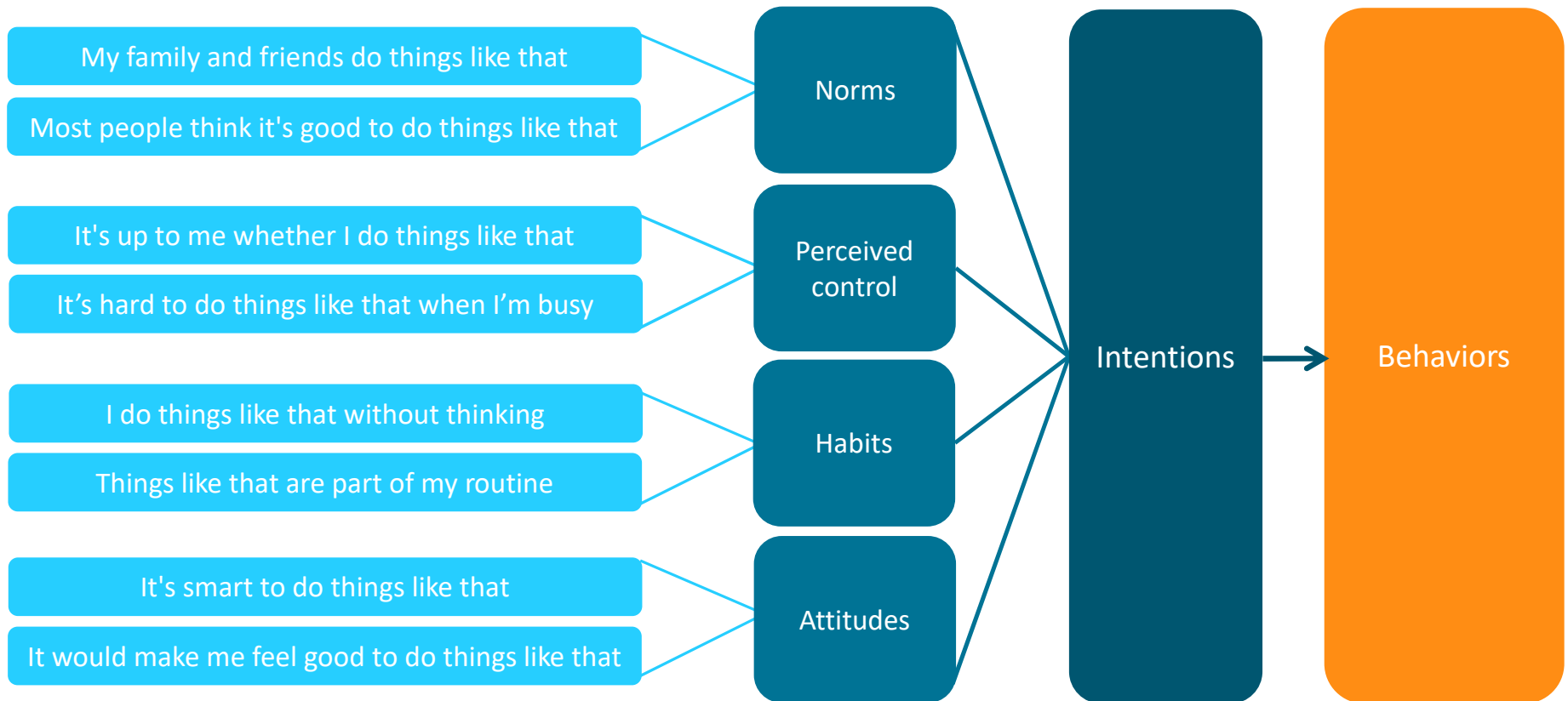


Average savings results normalized by average energy usage

WHY do customers with different archetypes save at different rates?

- Surveyed 600 AMI customers at one utility to investigate behavioral motivations
- Applied the Theory of Planned Behavior
 - What beliefs do customers hold about energy efficiency that could motivate intention to save energy?
 - Norms
 - Control
 - Habits
 - Attitudes
 - Do customers intend to modify their behavior to save energy?
 - Self-reported intention to save energy

Theory of Planned Behavior Model



Which customer attribute is most strongly correlated with energy savings beliefs and intentions?

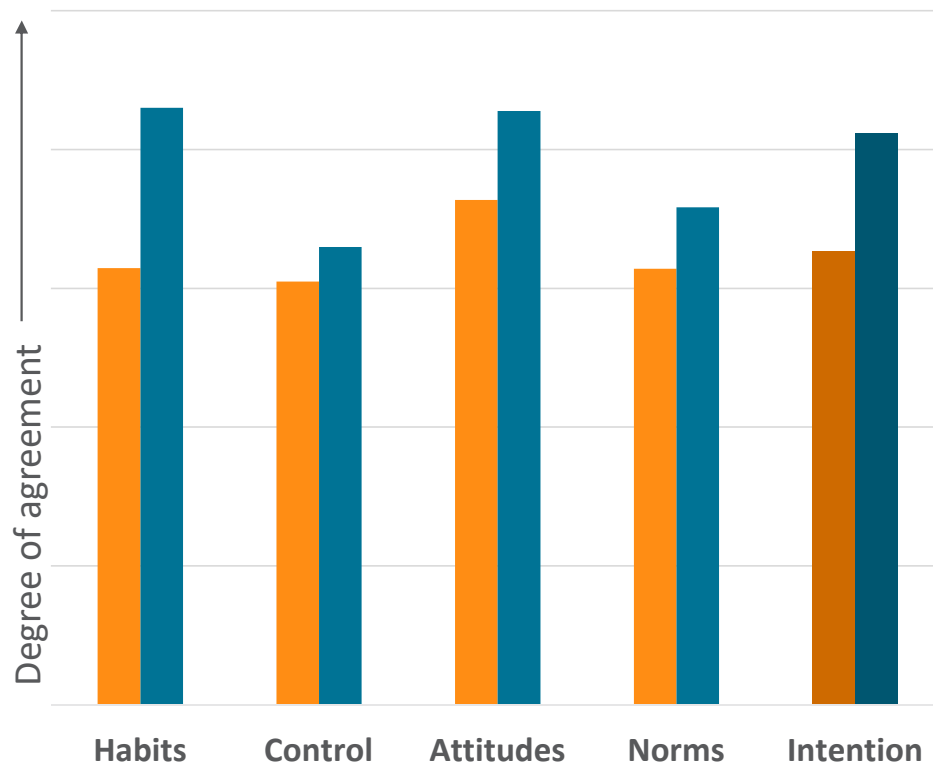
- Demographic characteristics
 - Education
 - Income
- Household characteristics
 - Living square footage
 - Heat type
 - AC type
- Program participation
 - Receives Opower Home Energy Reports
- Energy Usage
 - Average annual usage
 - Average winter usage
 - Load Profile Archetype

Which customer attribute is most strongly correlated with energy savings beliefs and intentions?

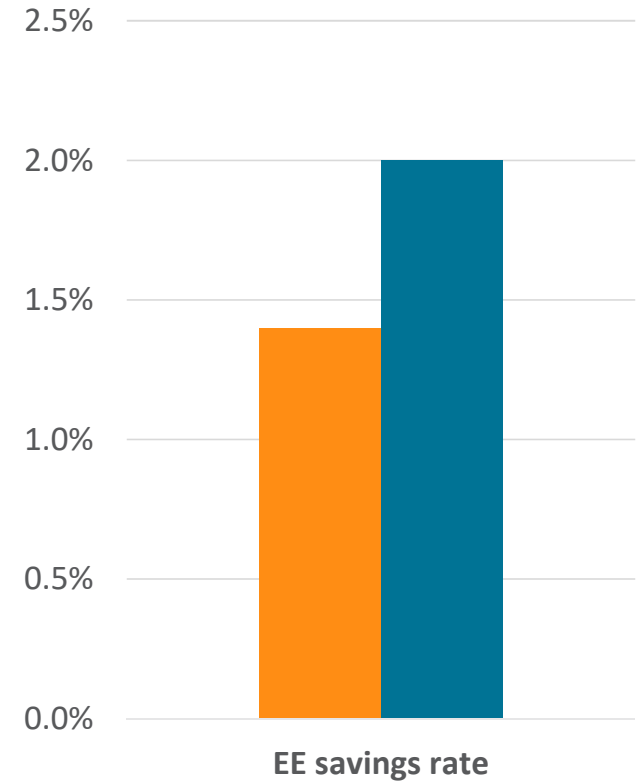
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 - **Load Profile Archetype**

Survey responses and energy savings tell a coherent story

Survey responses by Load Profile Archetype



Savings rate from HERs



■ Steady Eddies ■ Daytimers

Means in both charts adjusted for covariates

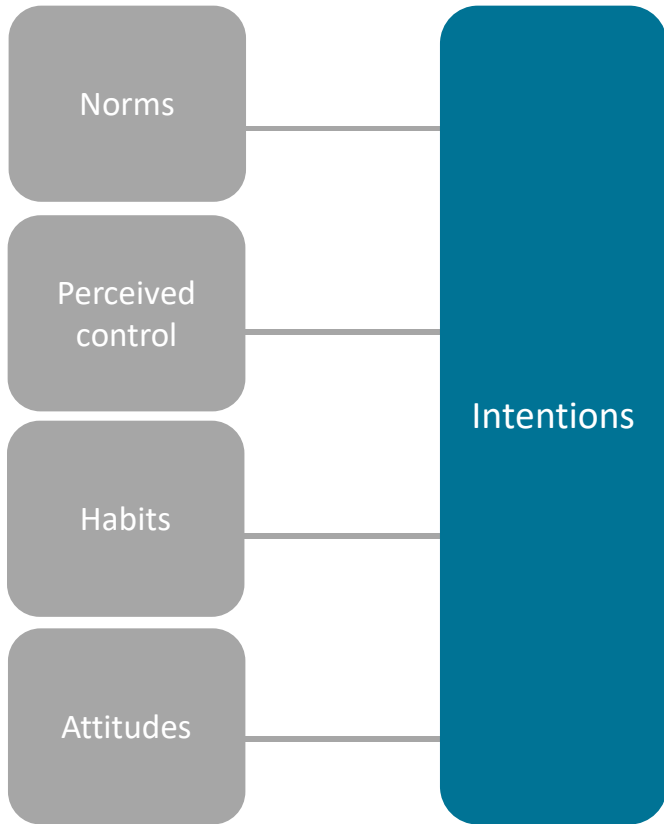
Could we boost energy savings by tailoring messaging to behavioral segments?

- Option 1: Segment based on behavioral survey responses
 - PRO: Precise, customer-level knowledge of attitudes
 - CON: Prohibitively expensive to measure directly

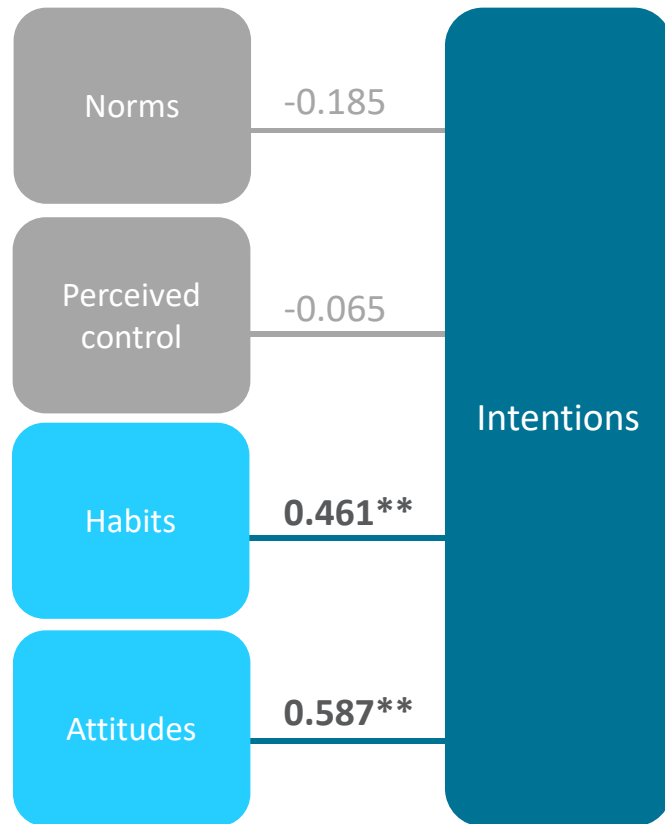
Could we boost energy savings by tailoring messaging to behavioral segments?

- Option 1: Segment based on behavioral survey responses
 - PRO: Precise, customer-level knowledge of attitudes
 - CON: Prohibitively expensive to measure directly
- Option 2: Segment based on Load Profile Archetypes
 - PRO: Inexpensive to calculate for AMI customers
 - CON: Blunt tool aimed at attitudes by proxy

Daytimers

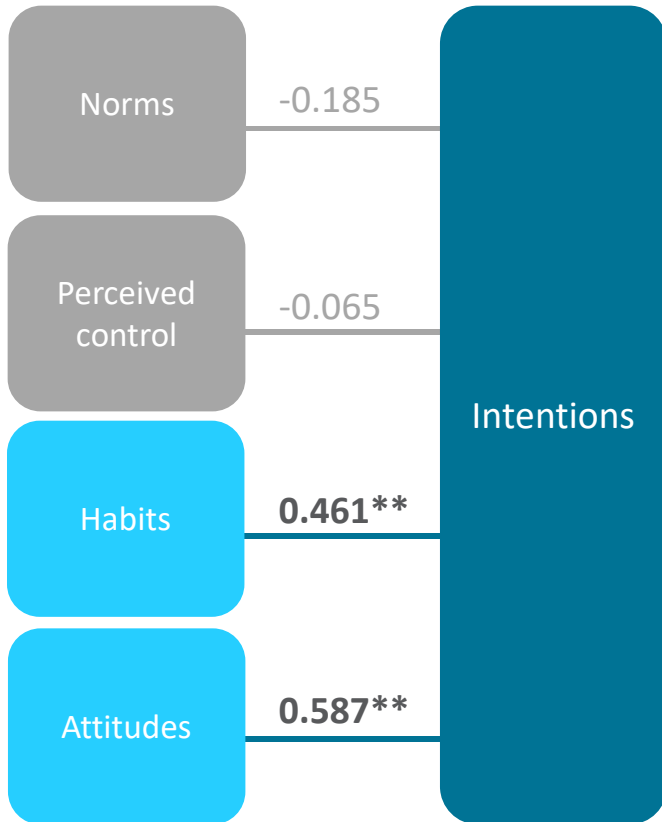


Daytimers

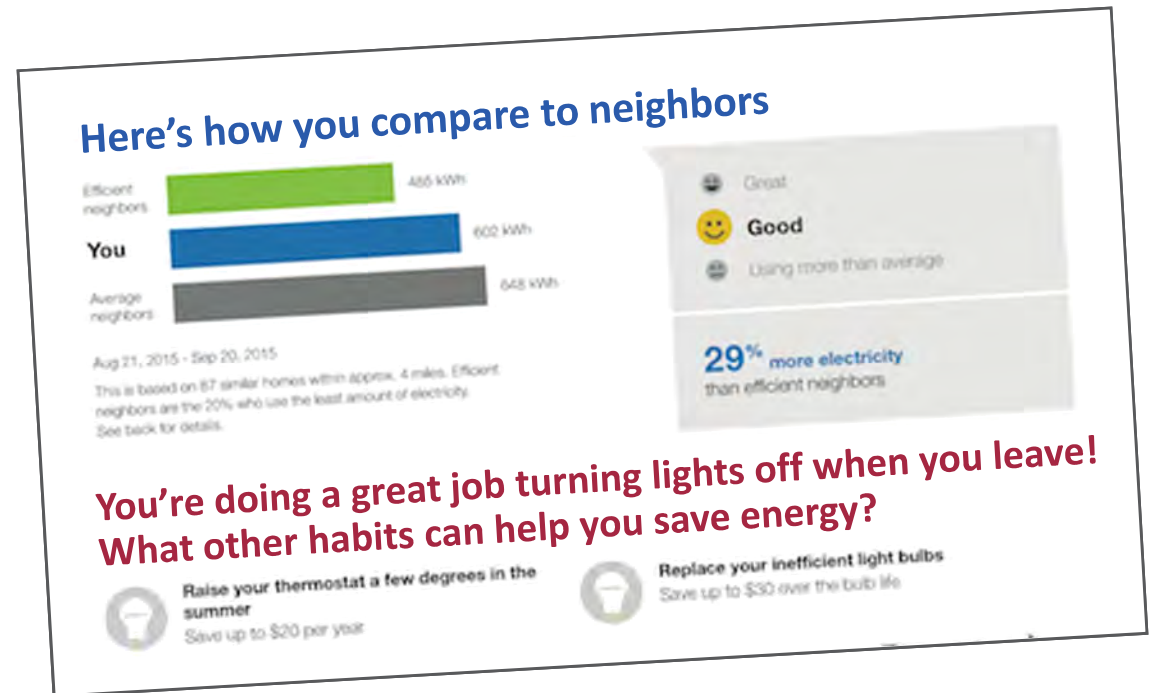


- For Daytimers, strong **Habits** and **Attitudes** are most predictive of intention to save
- Could Daytimers' strong 2.0% EE savings rate be boosted further by sending messaging tailored to these dimensions?

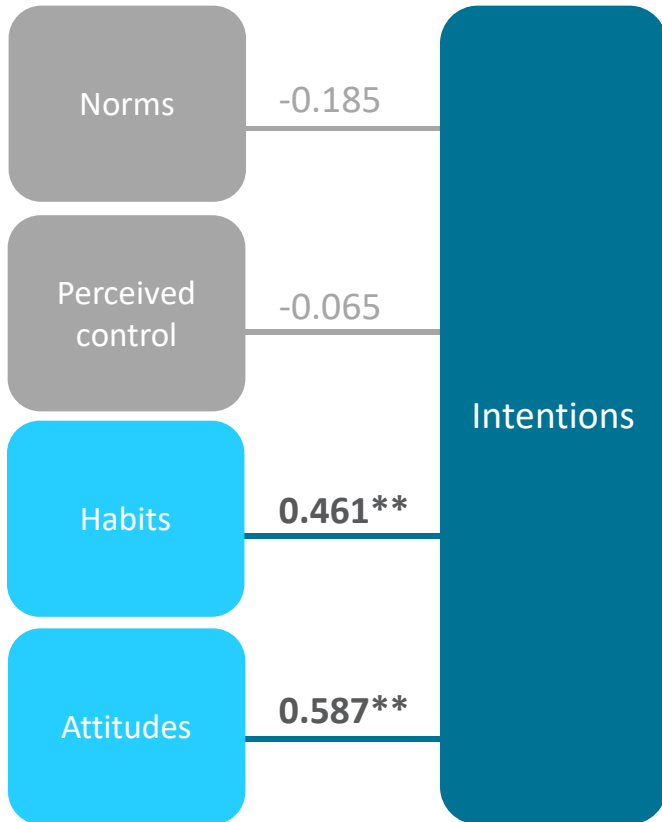
Daytimers



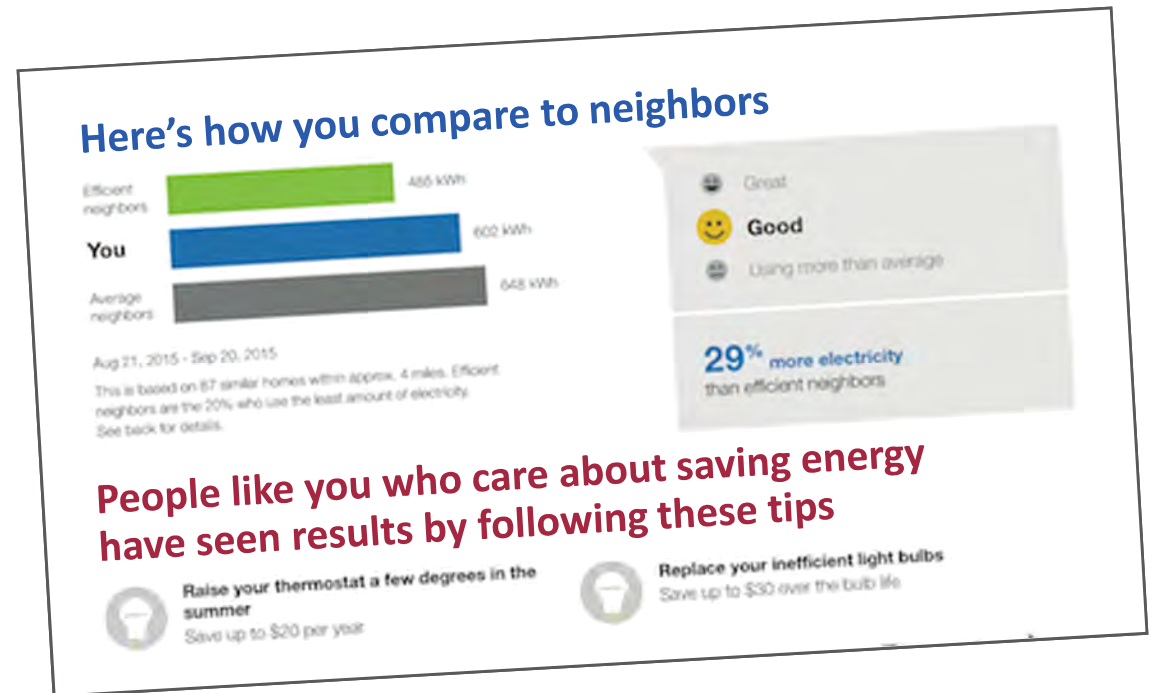
- For Daytimers, strong **Habits** and **Attitudes** are most predictive of intention to save
- Could Daytimers' strong 2.0% EE savings rate be boosted further by sending messaging tailored to Habits?



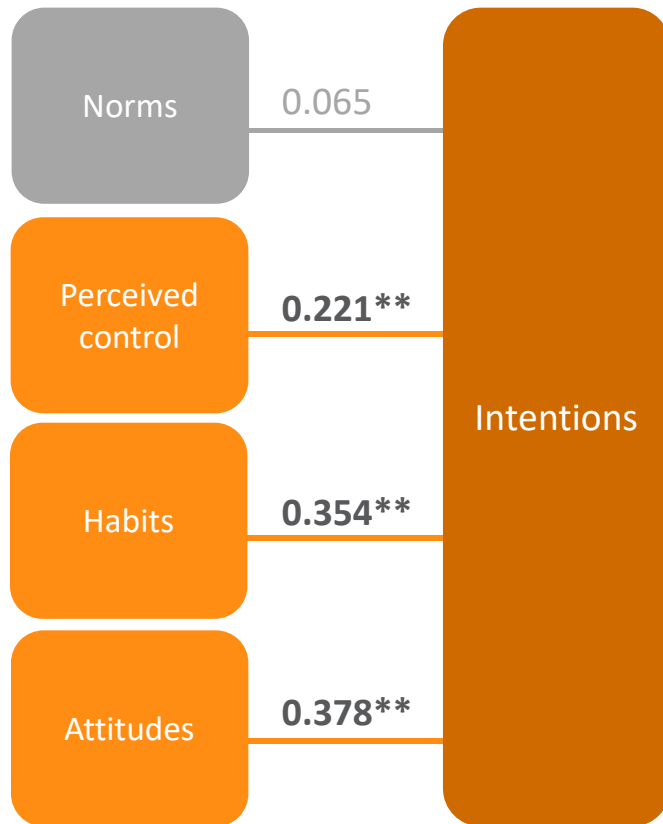
Daytimers



- For Daytimers, strong **Habits** and **Attitudes** are most predictive of intention to save
- Could Daytimers' strong 2.0% EE savings rate be boosted further by sending messaging tailored to Attitudes?

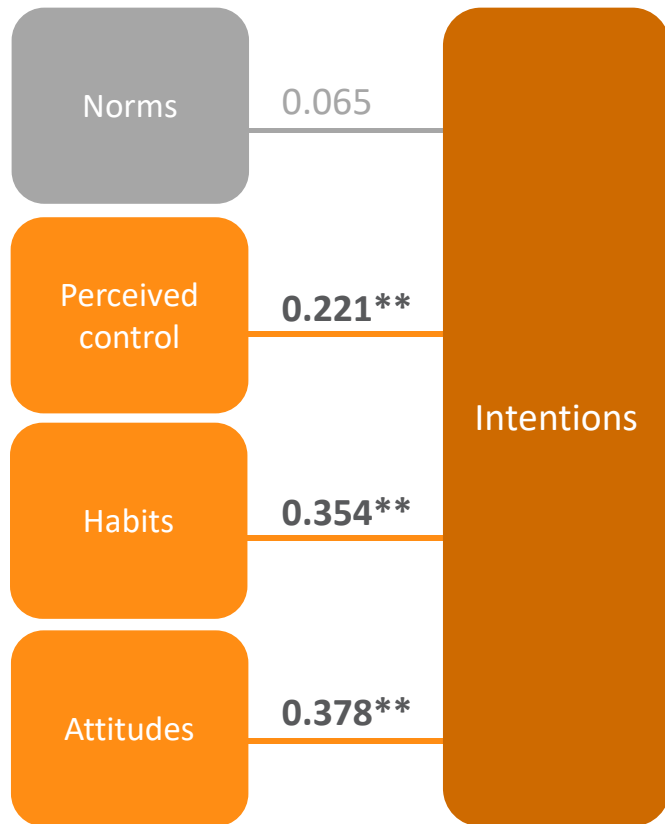


Steady Eddies

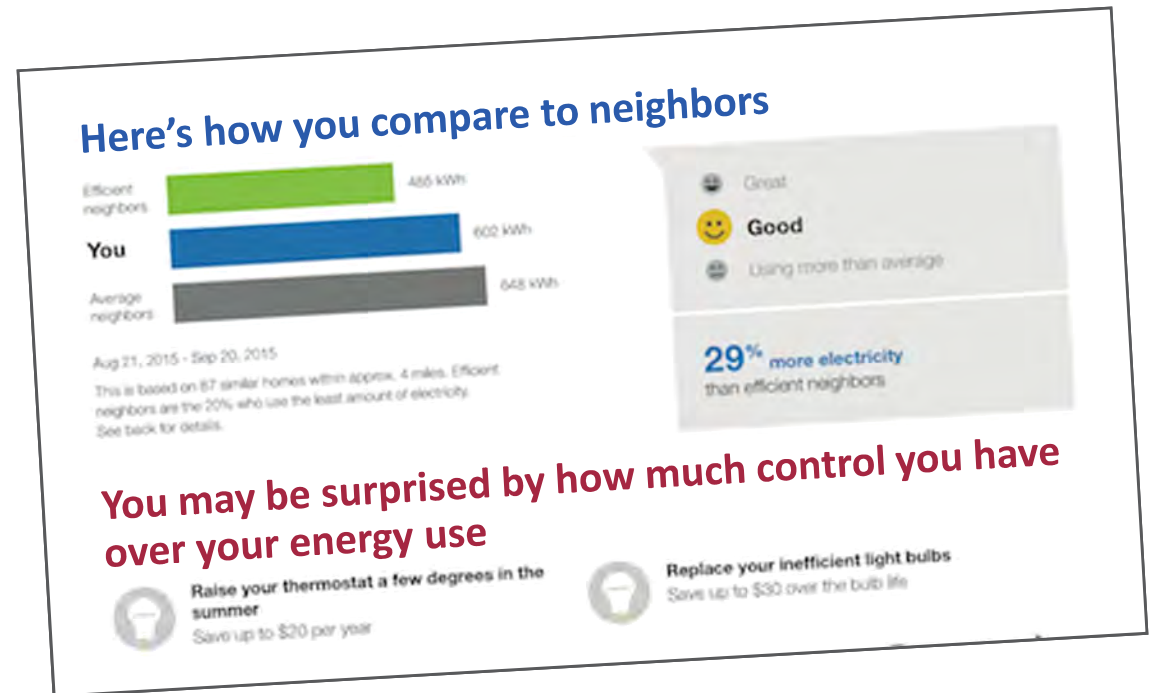


- For Steady Eddies, **Perceived Control** is also predictive of intention to save
- Could Steady Eddies' lower 1.4% EE savings rate be boosted further by sending messaging tailored to Control?

Steady Eddies



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- Could Steady Eddies' lower 1.4% EE savings rate be boosted further by sending messaging tailored to Control?

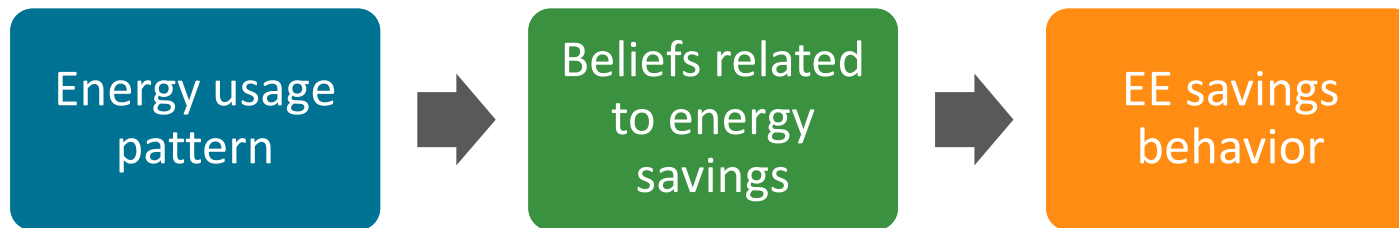


Open question: What does this relationship tell us about energy savings behavior?

- What is the *causal* relationship between customers' beliefs about EE, what time of day they use energy, and EE savings?

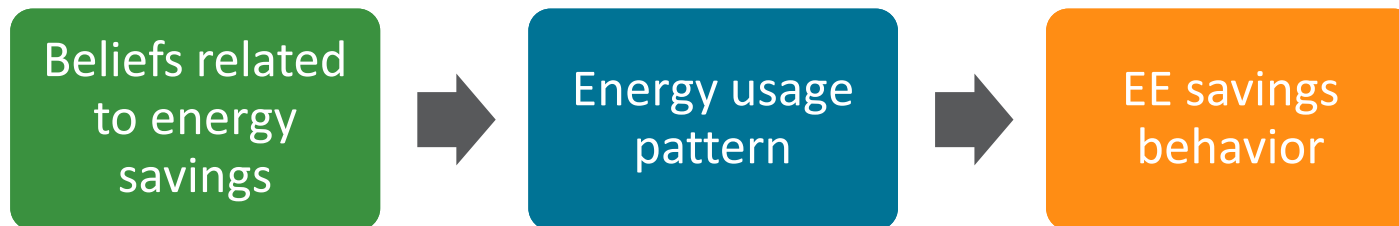
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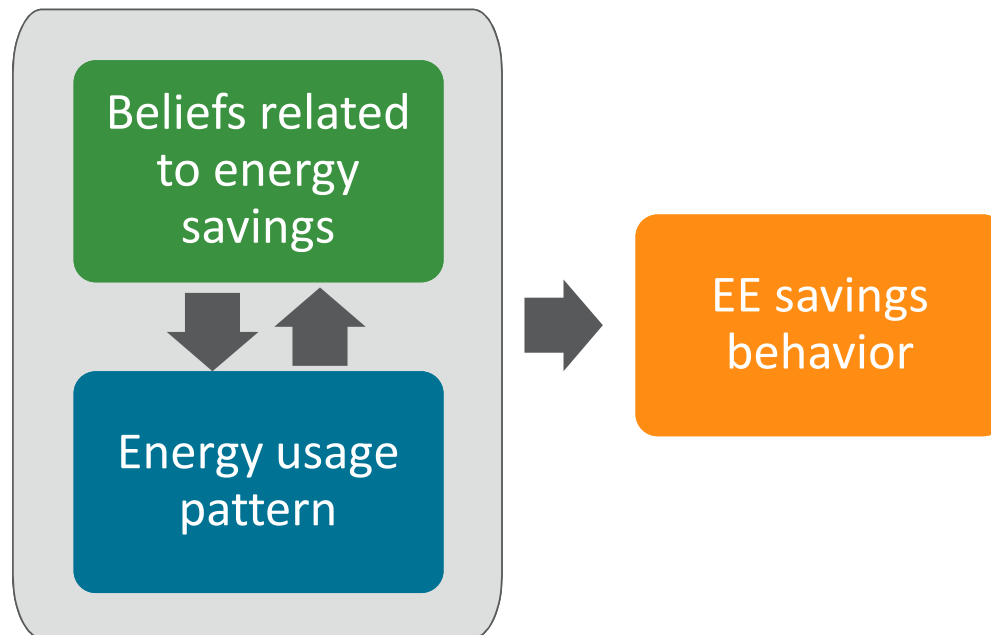
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Thank you

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