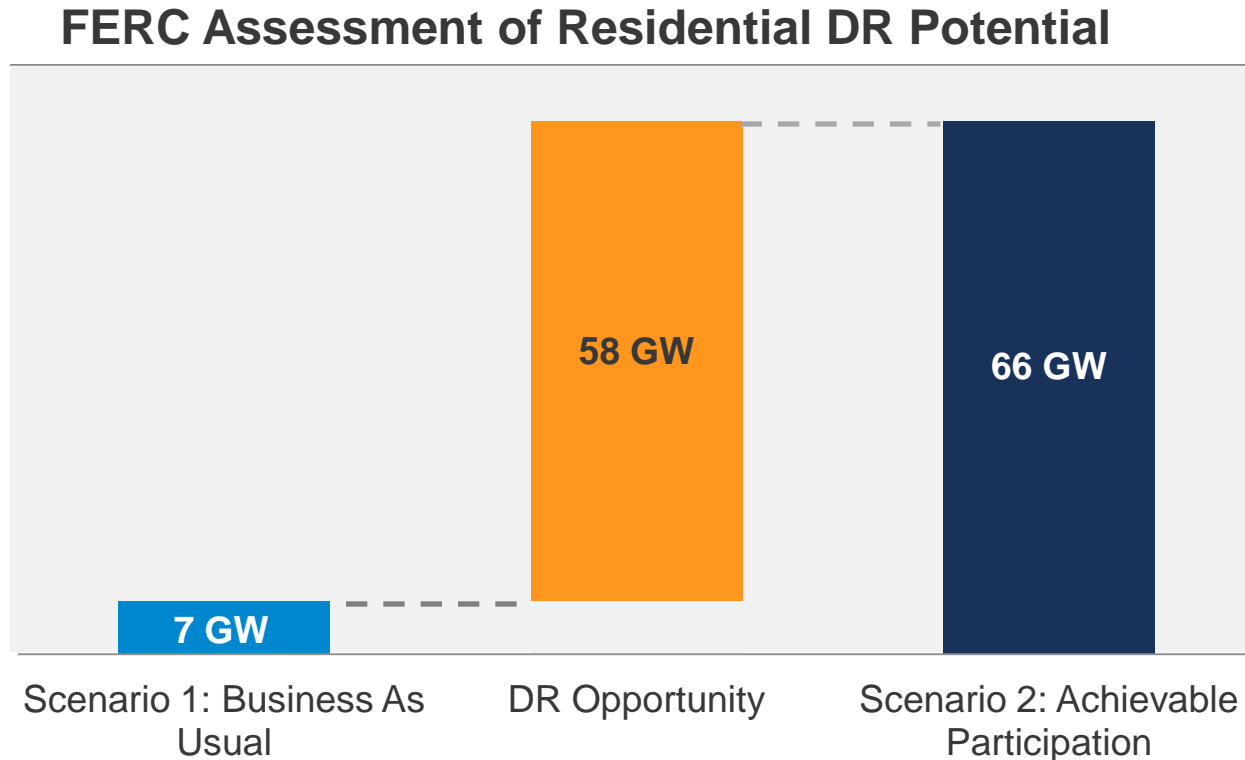


Behavioral Demand Response



Residential customers: An untapped demand response resource



Utilities are on track to reach only 10% of residential DR potential

Legacy technologies are difficult to scale

Traditional Direct Load Control

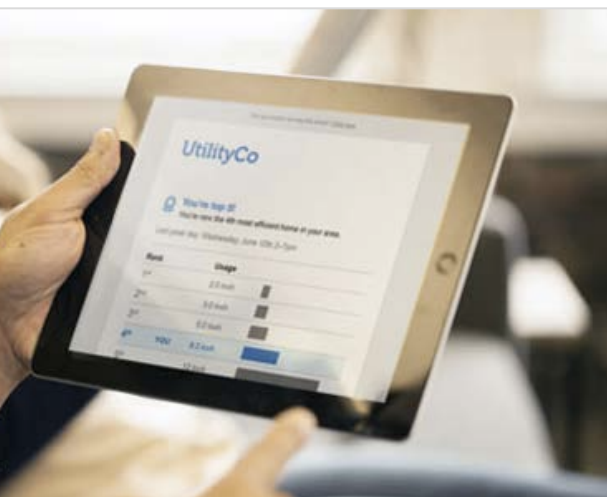


Challenges

- » Historically low participation leaves 70%-95% of **customers unengaged**
- » Hardware focused programs are **costly** and take years to reach scale
- » Neglected customer experience leads to **low satisfaction** and churn
- » Hardware-centric platforms lead to **technology lock-in**

Behavioral Demand Response: 150k Homes, 3 Utilities

Peak day notification



- » Targeted communication
- » Channel of choice
- » Opt-out program design

Personalized adjustments



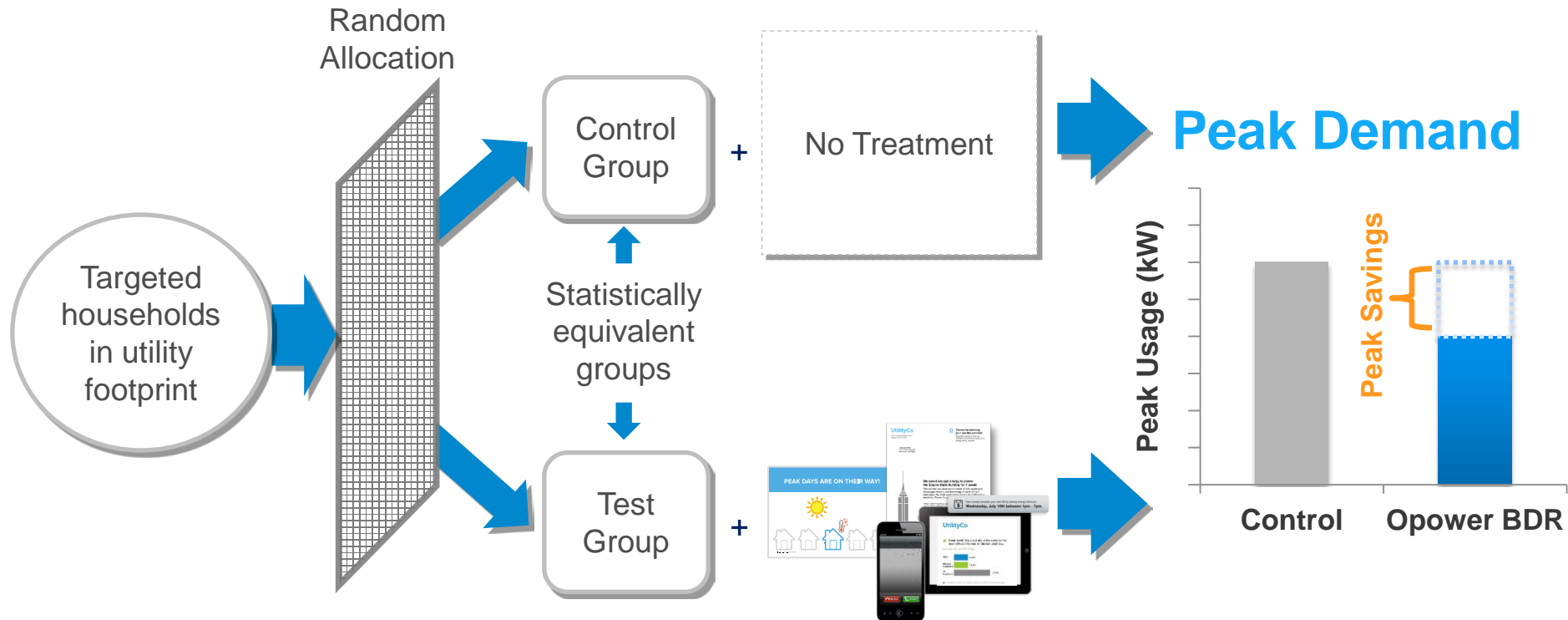
- » Large-scale engagement
- » Access to more kW
- » Highly accurate EM&V

Post-event feedback



- » Immediate feedback
- » Highly personalized results
- » Ongoing encouragement

Randomized Controlled Trial (RCT) ensures accurate measurement of load impact



Large-Scale Data Analysis

- » Follows experimental design blueprint
- » Clearly isolates impact of BDR
- » Follows NAPEE guidelines
- » Endorsed by ACEEE, DOE
- » Used in PUC filings in dozens of states

M&V: RCT Design + Regression Estimation

Measures difference in treatment and control usage during event hours conditional on:



Recent hourly customer usage

Usage during event hours in the same day of the week in four weeks prior to BDR season



Hourly usage in the same month last year (when available)

Usage during event hours in the same day of the week of the same month last year



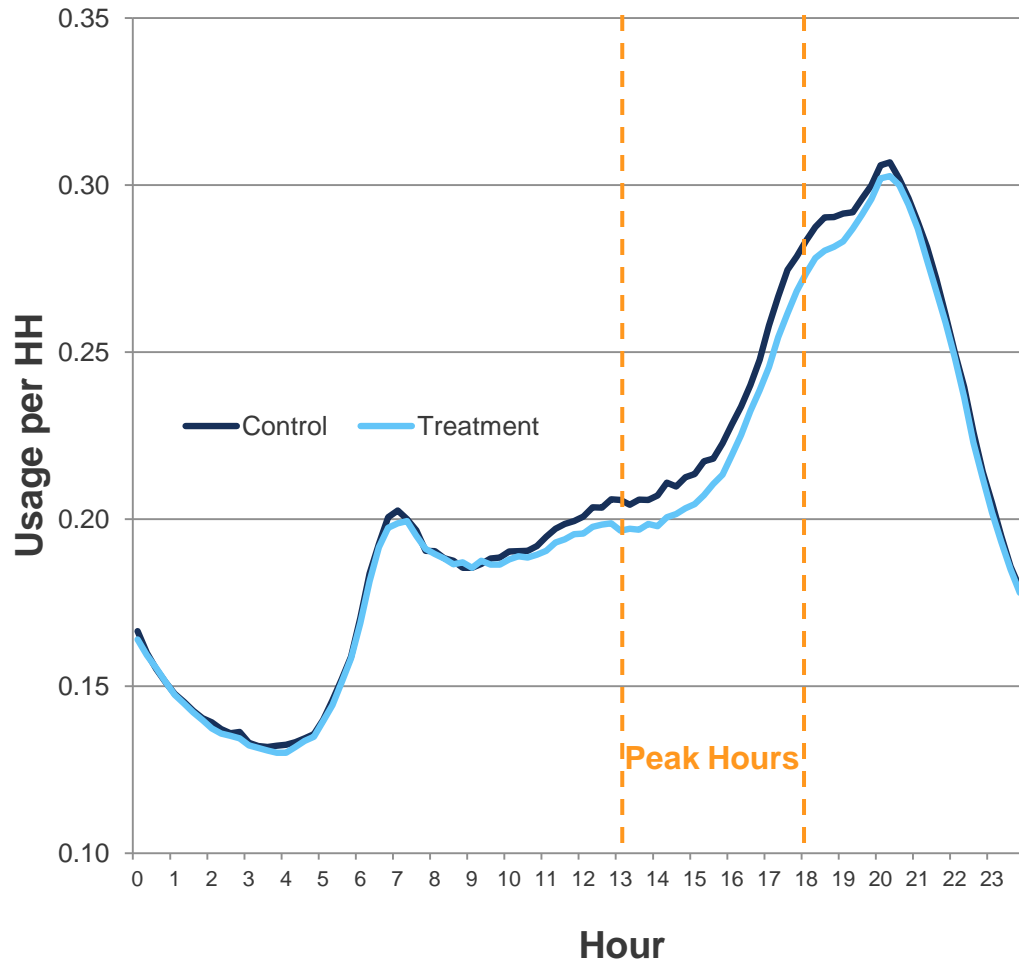
Average seasonal usage

Average summer, winter, and annual usage in the year prior to the BDR season

Sensitivity Analysis: Ensure results robust to alternate specifications

Result:

Significant load reduction during peak hours

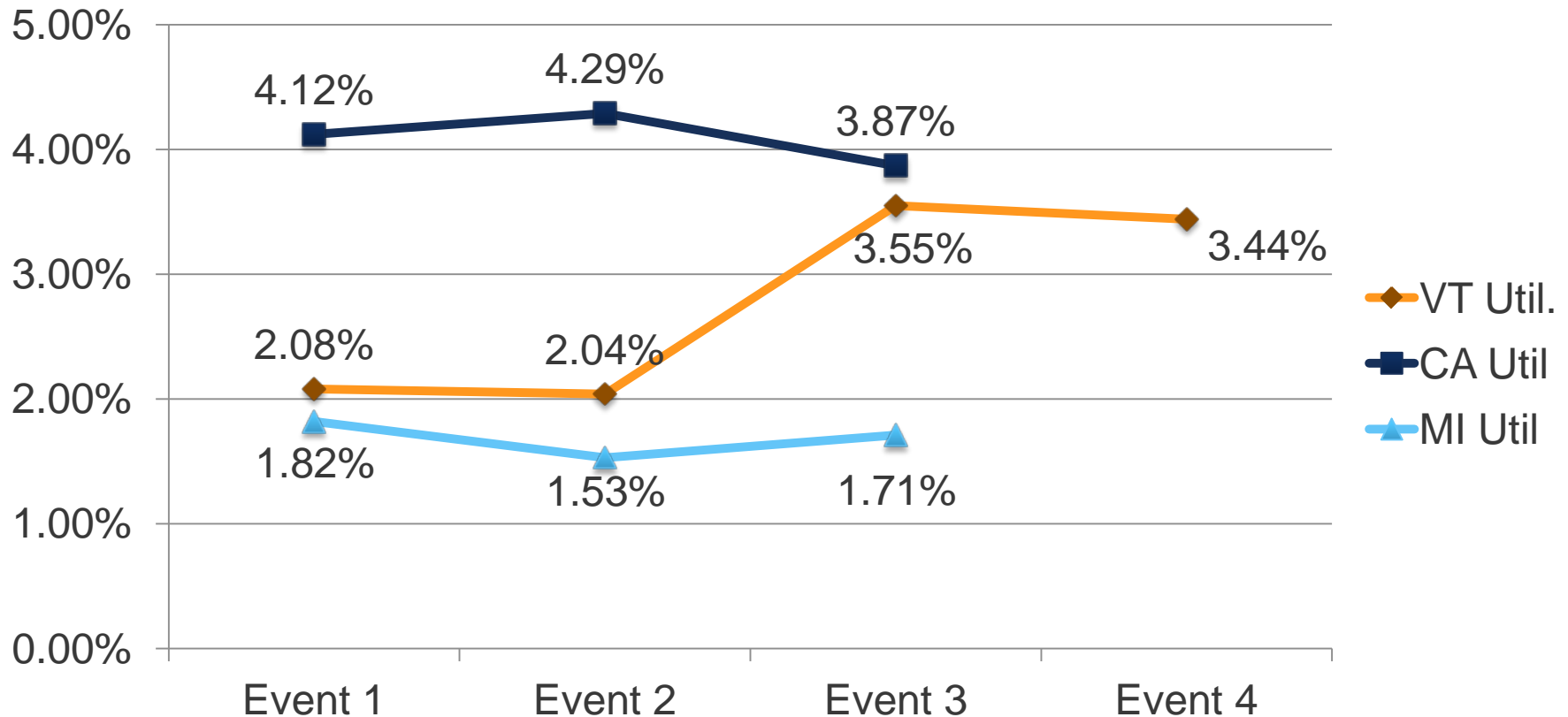


Performance across 10 events:

- » **3%** avg. peak reduction
- » **5.04%** max. peak reduction

Result:

Consistent savings across events



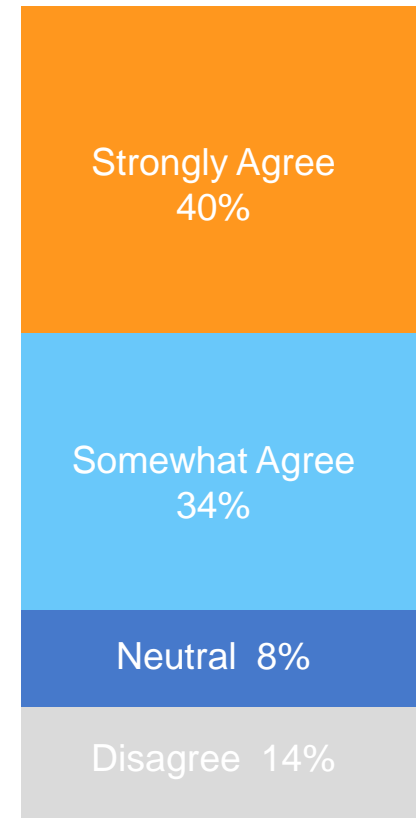
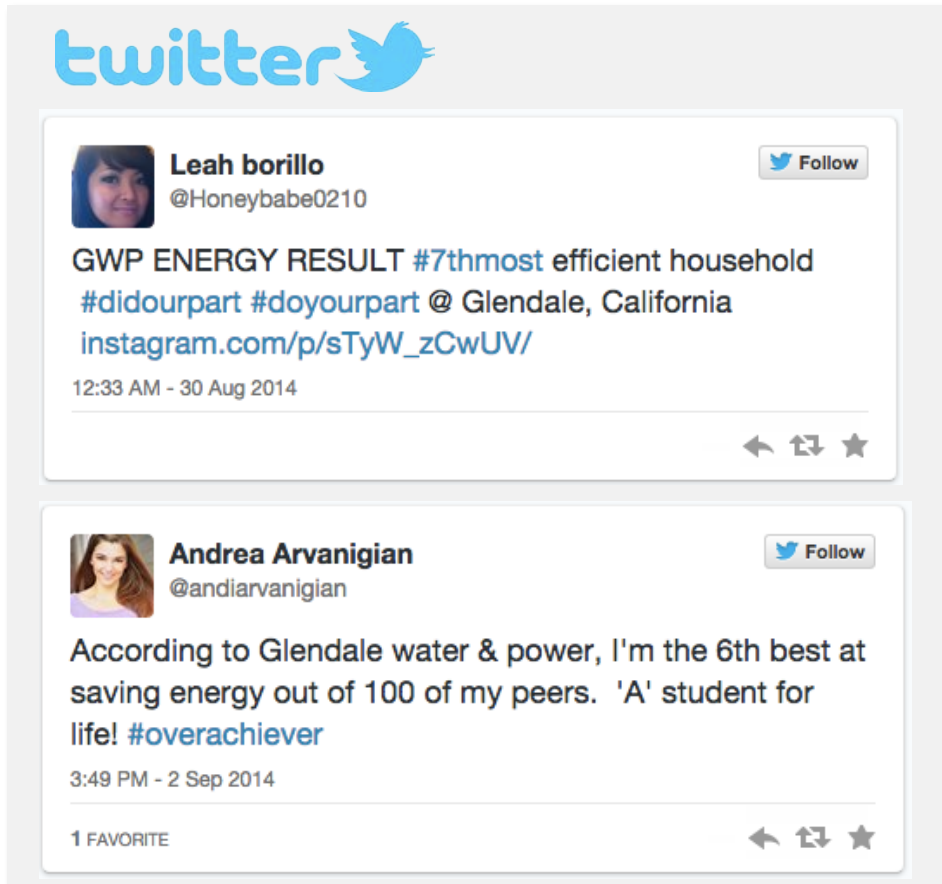
Incentive-based (rebates) program at BGE yielded ~5% savings

Result:

Measurable savings, engaged customers

Can Demand Response be engaging?

“I am satisfied with the peak energy days program”

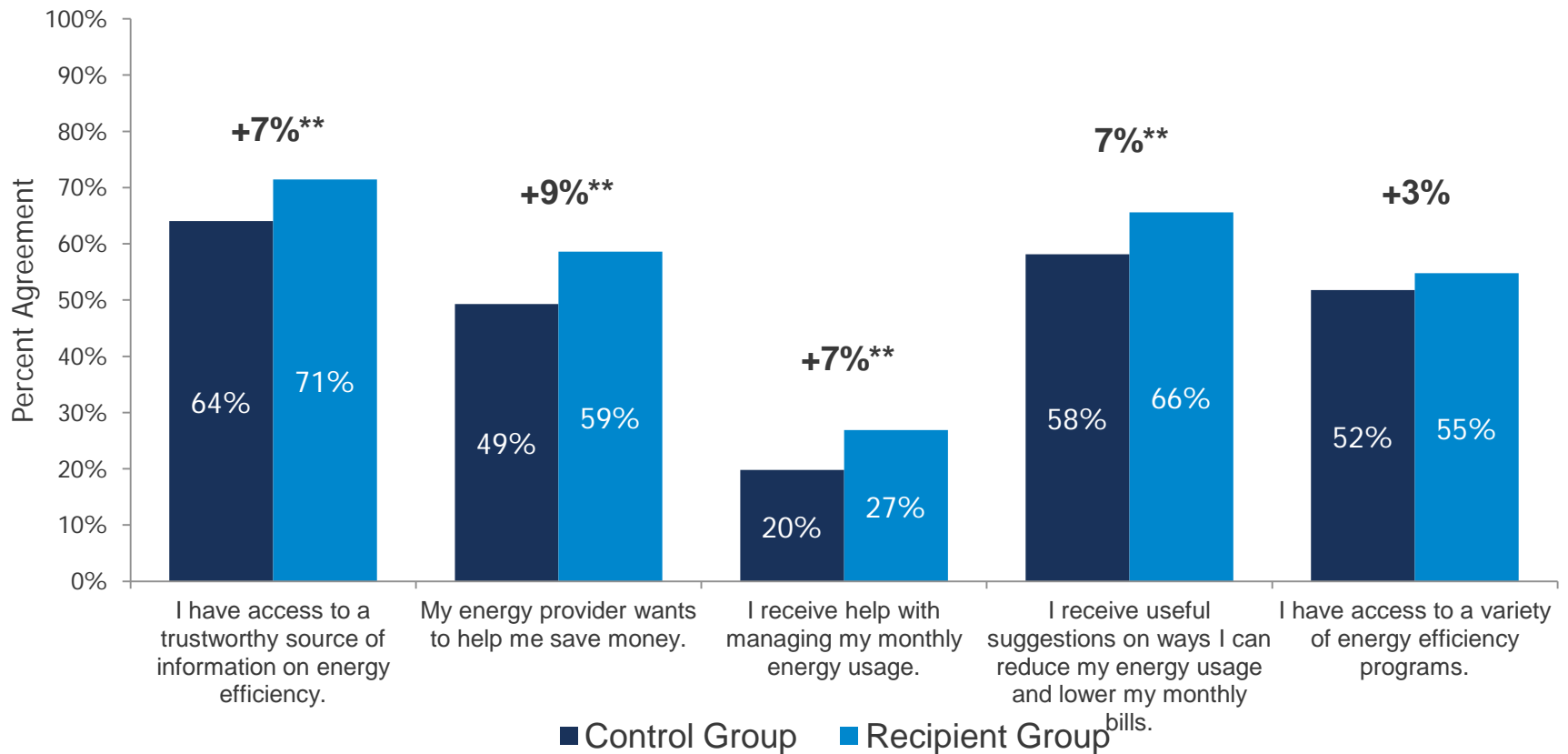


Result:

Measurable savings, engaged customers

Impact on Customer Relationship Metrics

(689 Treatment and 288 Control – 5 Point Scale, Top 2 Box)



**95% significant difference

*90% significant difference

Opportunity: What would 3% deliver across 500k homes?

Behavioral Demand Response



 = 20,000 Homes

Key Outcomes (500k HH utility)



100% Participation



45 MW



1,575 MWh



2.1 TRC | 1.9 RIM

Assumptions: 3.0% Peak Savings, 3.0 kW/Home Demand, 5 Events * 7 Hours, \$70 Avoided Cost per kW