



Evaluation of PG&E's Two-year Behavioral Demand Response Study

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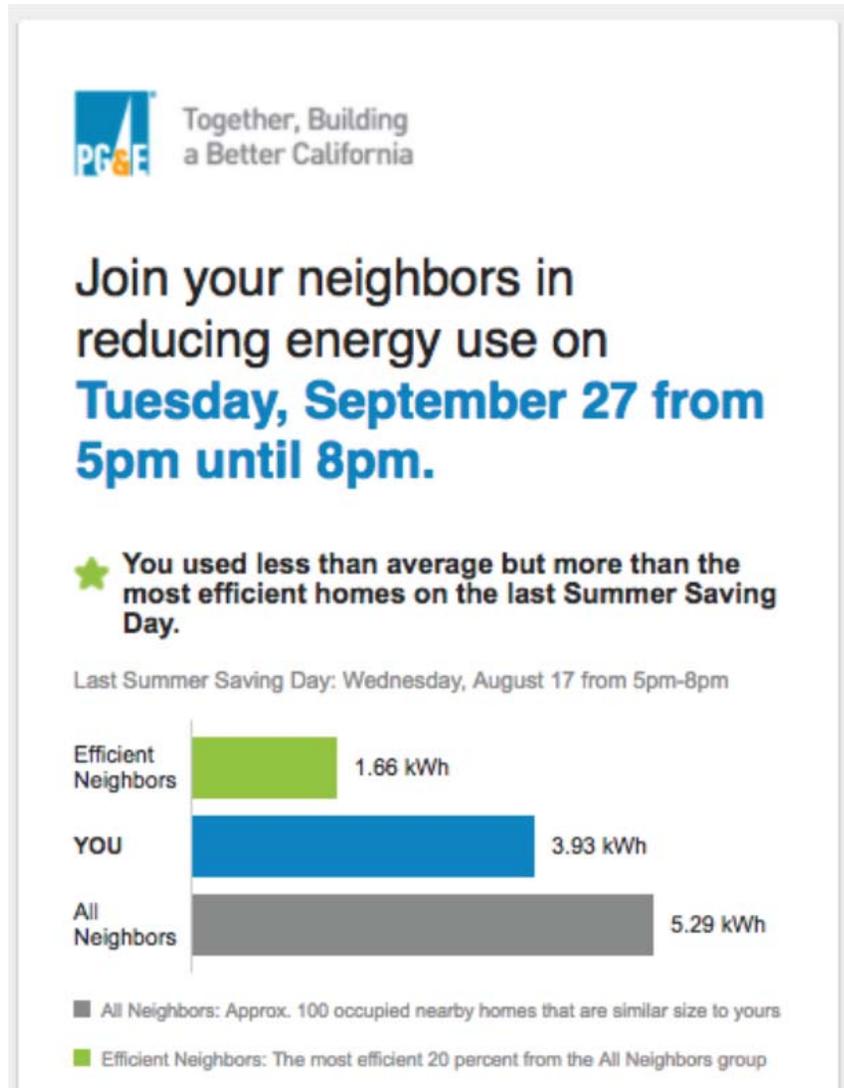
Background on PG&E's two-year BDR study

- Primary objective was to **assess the impact** of Behavioral Demand Response (BDR) on residential peak usage on “Summer Saving Days”
- Part of PG&E's Demand Response **Transmission and Distribution Pilot**
 - Targeted residential customers served by 31 substations within PG&E's system
 - Identified as high priority areas for reducing peak loads

What is BDR?

- Pre/post-event **communications** and social comparisons specifically aimed at reducing usage on event days
- **No** financial incentives or installation of technology
- Implemented by **Opower**, which also implements the PG&E Home Energy Reports (HER) program
- Fundamental concepts are similar to HER program, with the key difference being that BDR is **designed to target only a few hours** on days when demand is high

BDR Communications



- **Pre-Season Letter:** Opt-out enrollment
- **Event notification:** Day prior 65% IVR, 17% email, 18% both
- **Post event feedback:** within 4-7 days on how well they did compared to neighbors

Answers to several key research questions for YEAR TWO

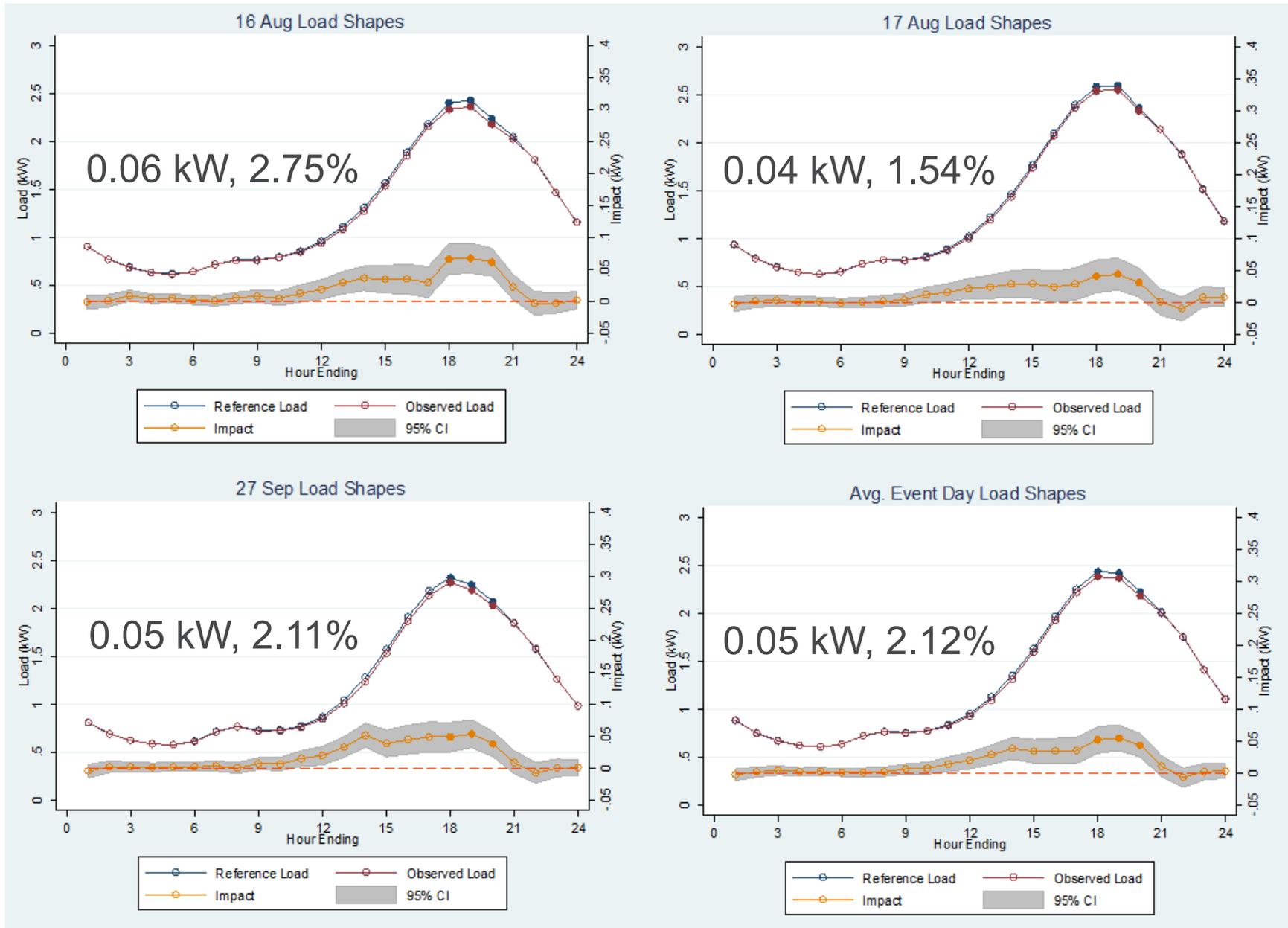
- **PRIMARY:** Do the **impacts persist** for customers enrolled for two summers?
- Do customers follow the **same patterns** as year one?
- How do customers respond on **consecutive event days**?
- Do the impacts “**spill over**” to non-Summer Saving Days?
- How do the impacts vary across **types of customers**?
- How do the impacts compare for customers who do and do not also receive **HERs**?
- What are the **key takeaways and recommendations** for utilities?

Program design expanded 2015 population

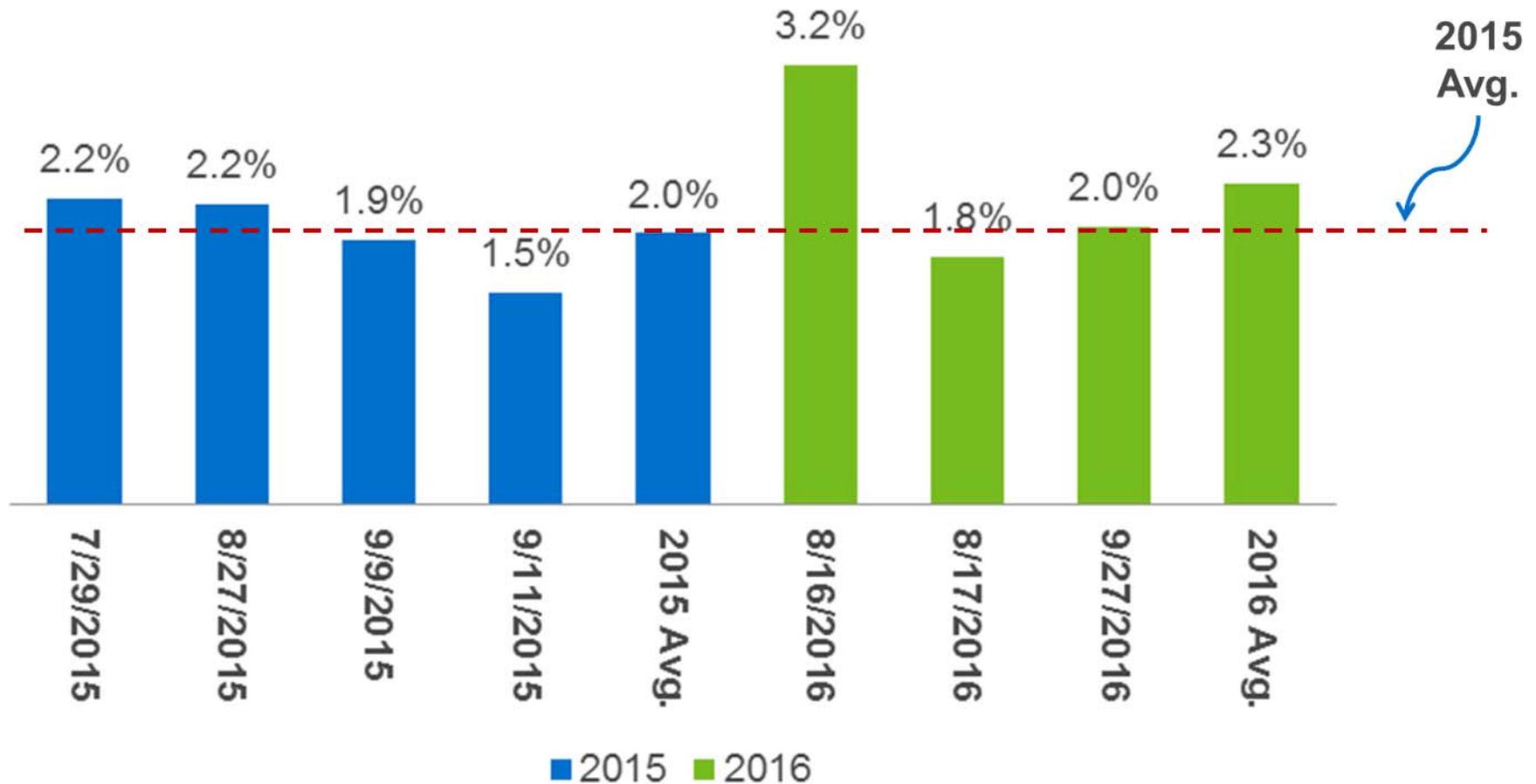
Randomized controlled trial (RCT) with large samples was used to conclusively answer the research questions

Cohort	Assignment	HER Recipients	HER Control Customers	Total
2015	BDR Treatment	30,200	9,800	40,000
	BDR Control	26,400	8,500	34,900
	Total	56,600	18,300	74,900
2016	BDR Treatment	11,474	3,526	15,000
	BDR Control	9,497	3,003	12,500
	Total	20,971	6,529	27,500
Total	BDR Treatment	41,674	13,326	55,000
	BDR Control	35,897	11,503	47,400
	Total	77,571	24,829	102,400

BDR impact was similar across three Summer Saving Days in 2016

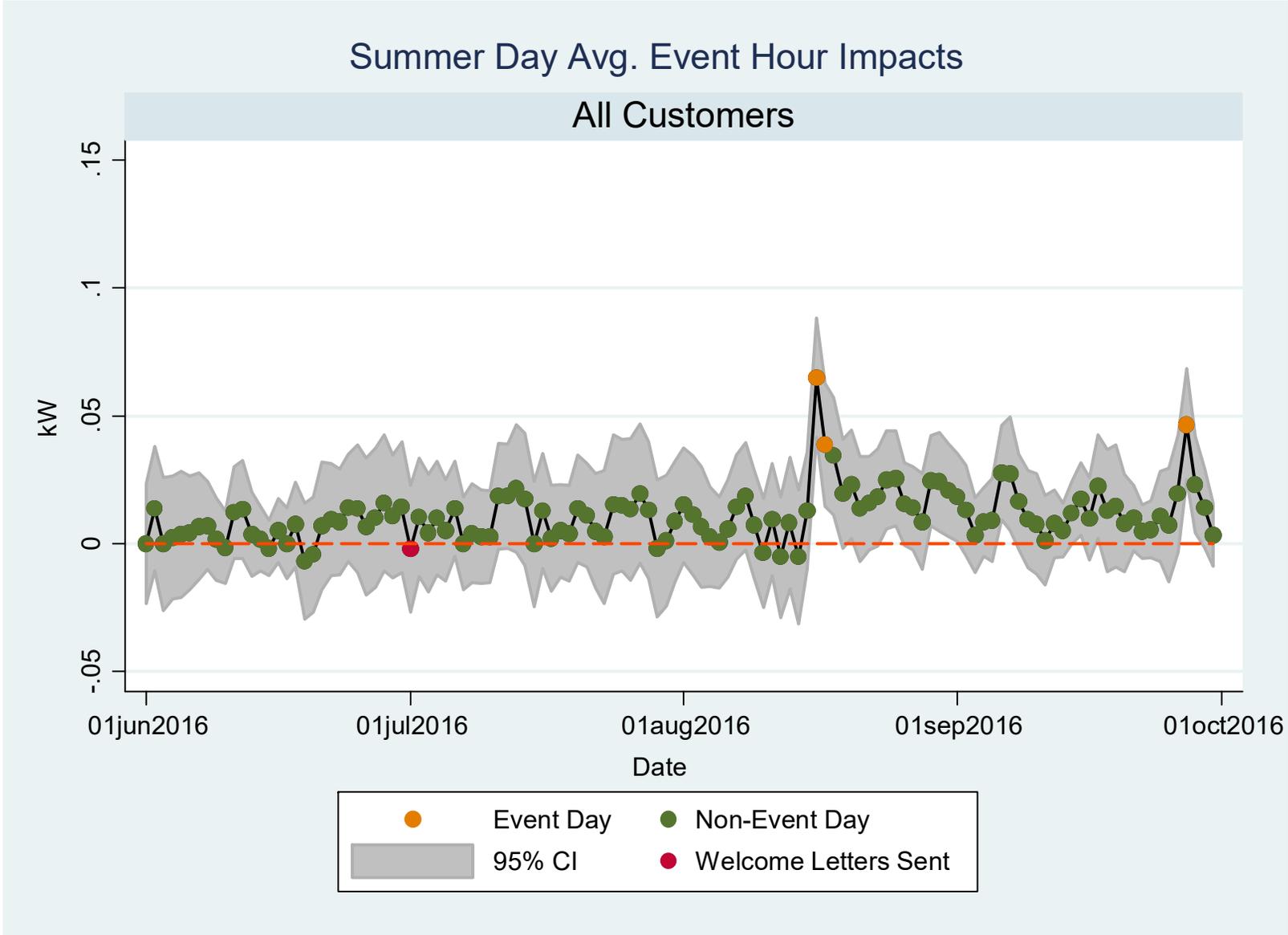


BDR impacts sustained or increased for two-year participants

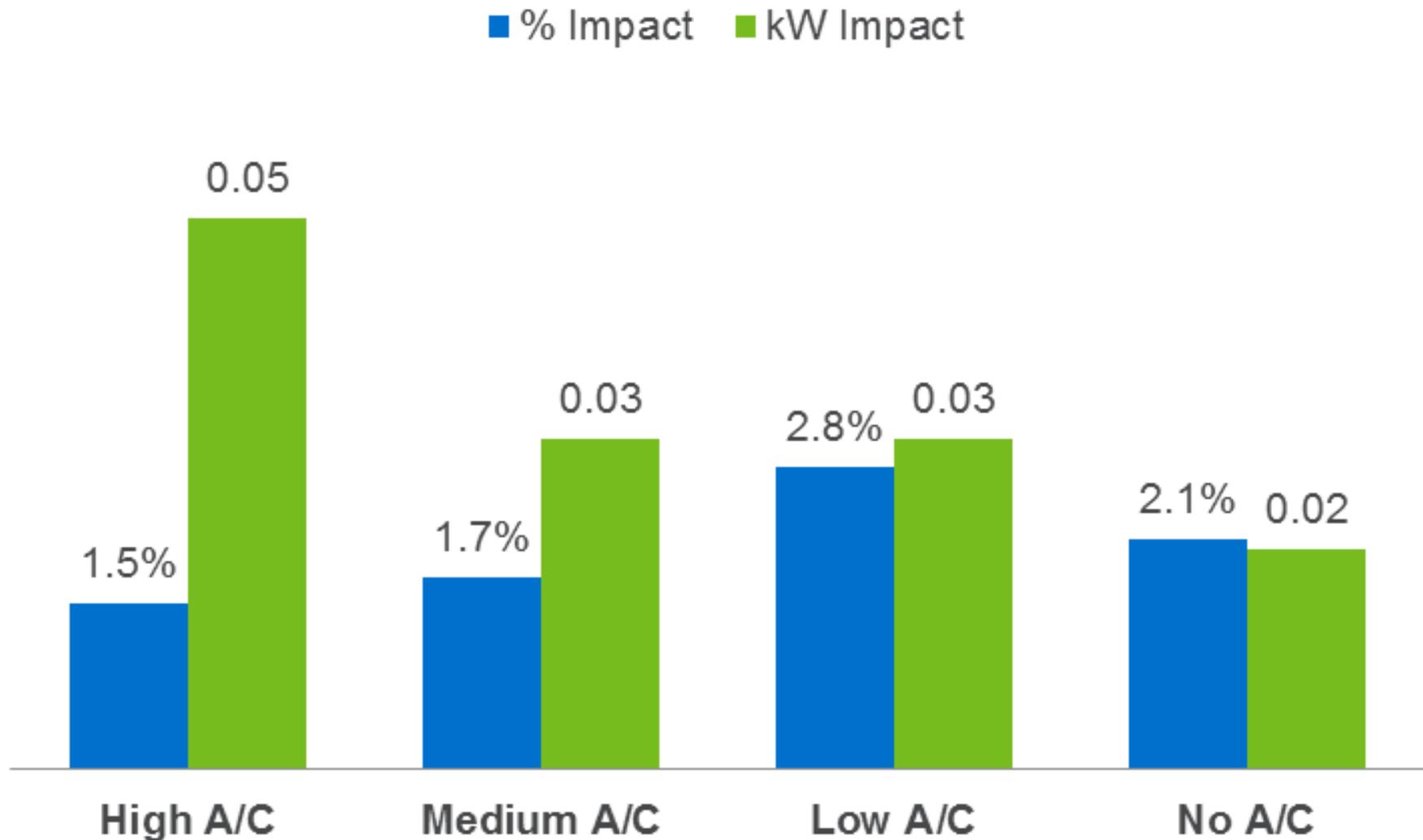


Note: Temperatures were significantly lower for the 2016 events as compared to the 2015 events. Persistent customers experienced event period temperatures of 88.7 °F in 2016 on average, which is 5.5 degrees cooler than that of the average 2015 event (94.2 °F).

BDR impacts spill over to non-event days, particularly the day after events



High A/C usage = higher BDR actual load reduction but lower impacts in overall percentage

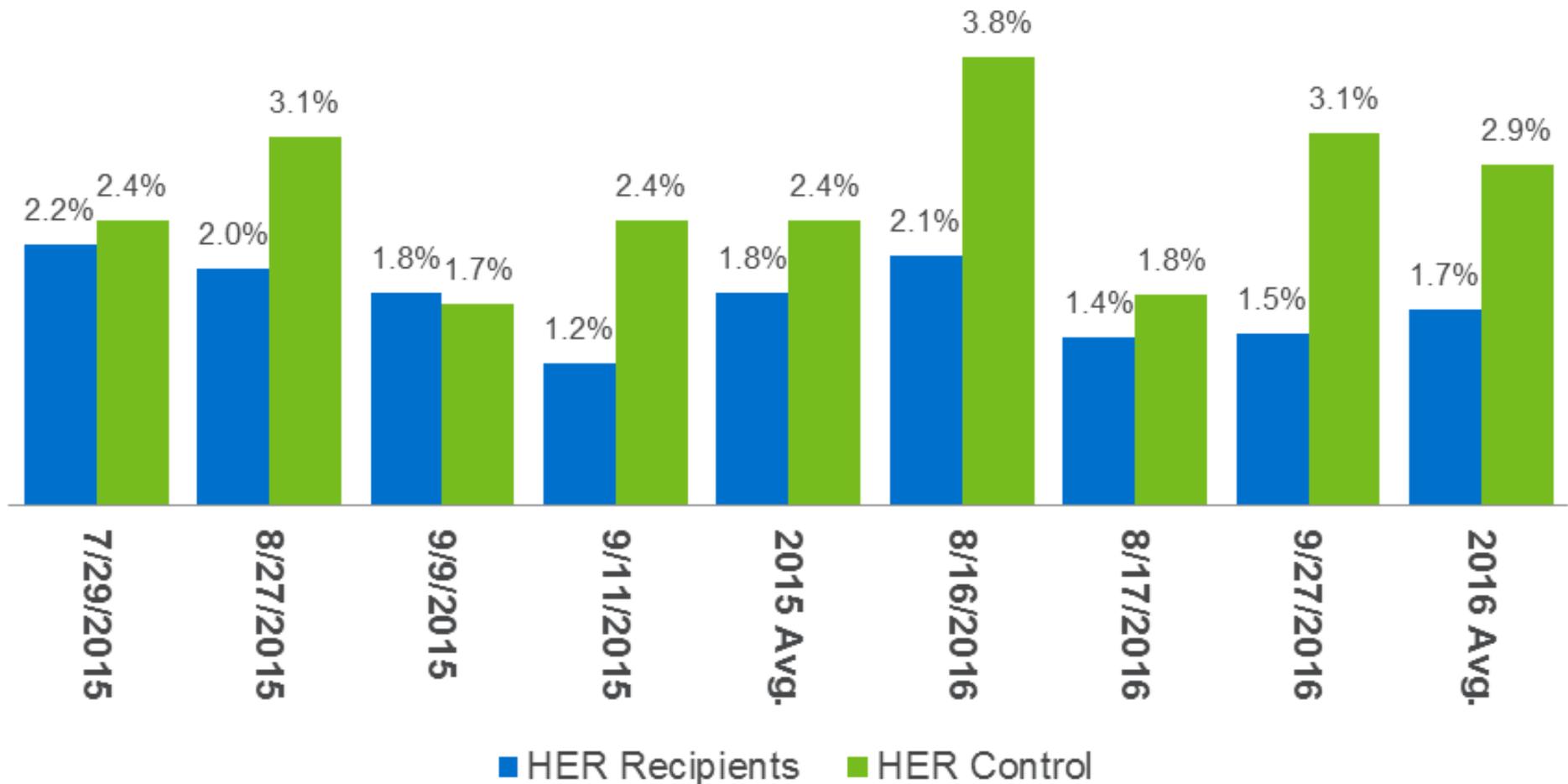


Notification type did not affect performance

Delivery Channel	Accounts	Reference Load (kW)	Observed Load (kW)	Impact (kW)	Aggregate Impact (MW)	Percent Impact (%)
IVR Only	31,725	2.23	2.18	0.05	1.59	2.25%
Email Only or Email + IVR	17,404	2.60	2.54	0.06	0.98	2.17%

- Approximately 65% of study participants received the event notification by automated phone call (IVR) the day before
- Aggregate impacts were significantly higher among IVR only customers

HER recipients do perform but not as much as non-HER



Key takeaways for utilities from PG&E's two-year BDR study

- BDR produced **small (2%) reductions** in residential peak period energy consumption that persisted over two years with varying event temperature conditions
- If aggregated over a large number of customers, these small impacts (0.04 to 0.06 kW) **can result in sizeable reductions** during critical hours (5 to 8 PM in the summer)
- BDR can be **launched relatively quickly** in targeted areas if needed
- However, BDR currently requires **notice more than 24 hours** in advance of each event, which may not be applicable to many situations in which peak load reductions are required

Recommendations for utilities from PG&E's two-year BDR study

- **Avoid consecutive event days**
 - Customers don't perform as well the second day
 - Haven't received feedback on first day yet
 - Alternative option is to give notification for multi-day events instead
- **Target High A/C usage customers and non-HER recipients**
 - Non-HER delivered higher impacts
 - HER recipients are either desensitized to contact or have already implemented some energy savings measures in response to receiving HER communications
- **Reduce costs and keep it simple**
 - Email is easier, quicker and cheaper
 - TCPA restricts use of cell phones and customers with landline phones on decline
 - Consider eliminating normative comparisons



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