Bringing It All Together:
Design and Evaluation Innovations in the Alameda County Residential Behavior Pilot

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HOME ENERGY ANALYTICS

What does BKi do?

- BKi is an Oakland consultant firm that specializes in program design, implementation, and data analysis for:
  - **energy efficiency**
  - **water conservation**
  - alternative fuel transportation
  - carbon sequestration

Alameda County Behavior Pilot program design: Program partners

STOPWASTE
at home • at work • at school

BAY AREA Regional Energy Network

HOME ENERGY ANALYTICS

ENERGY • ECONOMICS • ENVIRONMENT

GREENPRO network

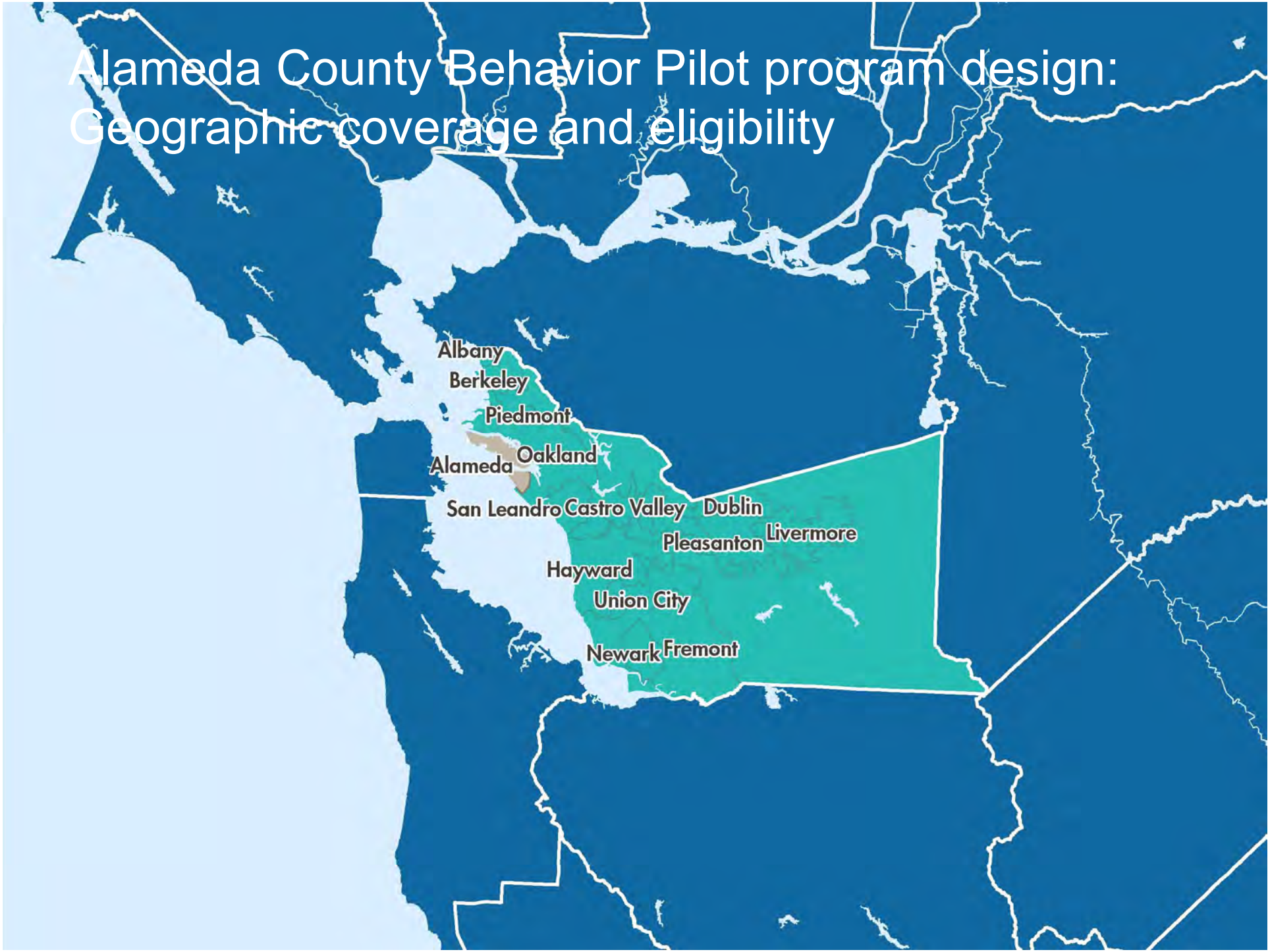
Alameda County Behavior Pilot program: Design summary and key innovations

1. Help participants save energy by providing automated, custom electricity and natural gas use feedback based on their SmartMeter data.
2. Use sophisticated energy analysis algorithms to disaggregate each participant's energy use into major load categories.
3. Tailor the intervention based on the participant's existing energy use patterns.

Alameda County Behavior Pilot program: Summary of savings

kWh	Therms
7.4%	13.0%
38 kWh/mo	5.0 therms/mo

Alameda County Behavior Pilot program design: Geographic coverage and eligibility



Alameda County Behavior Pilot program design: Behavior feedback mechanisms

- Cognition
  - Education (user-friendly display of energy use trends; breakdown of energy use by load; custom recommendations based on actual use; participant engagement; energy "sleuthing")
- Calculus
  - Asynchronous feedback (bimonthly reports showing hourly/daily energy use)
  - Incentives (display of energy costs over time; translating kWh + therms to $ savings)
  - Goal-setting and commitment
- Social interaction
  - Similar homes comparison (including load disaggregation comparison)

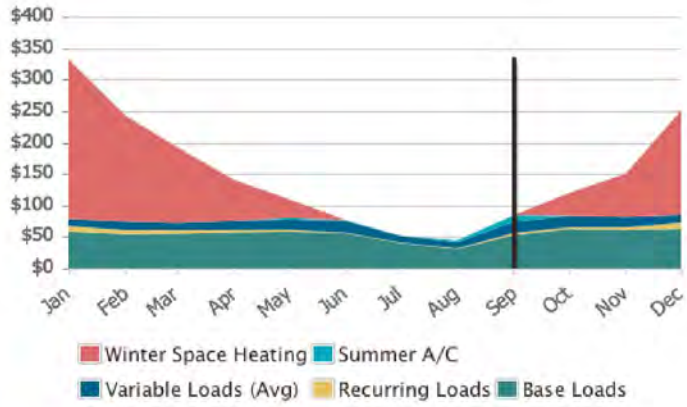
Alameda County Behavior Pilot program design: Energy use categories

- **Base loads** (electricity & natural gas)
  - Anything that is using electricity in your home *all the time*, such as electronics in stand-by mode like game consoles, desktop computers, or charging/idle laptops.
- **Recurring loads** (electricity)
  - Anything that comes on at *the same time every day* with a clear usage pattern, such as exterior lights on timers.
- **Variable loads** (electricity & natural gas)
  - Anything that *you turn on at will* such as switching on lights, using your dishwasher, the microwave, doing laundry, and watching TV.
- **Cooling** (electricity)
  - Loads associated with *cooling* a home (correlated with local CDD)
- **Space heating** (electricity & natural gas)
  - Loads associated with heating a home (correlated with local HDD)

Alameda County Behavior Pilot program design: Participant categories

Program	Sorting criteria	Intervention	# participants
High HVAC	4 BTU/sqft/CDD or 8 BTU/sqft/HDD and bills >$1,500/year	• Bimonthly emails with load disaggregations and custom recommendations • Referral to Home Upgrade Advisors	67
High Plug Load	Non-HVAC electricity use > 4,000 kWh/year	• Bimonthly emails… • BKi follow up by phone to identify custom actions (35 participants)	84
Low Energy	Energy bills < $800/year	• Bimonthly emails… • Messaging to encourage ongoing efficiency	57
And the rest	None of the above	• Bimonthly emails…	91

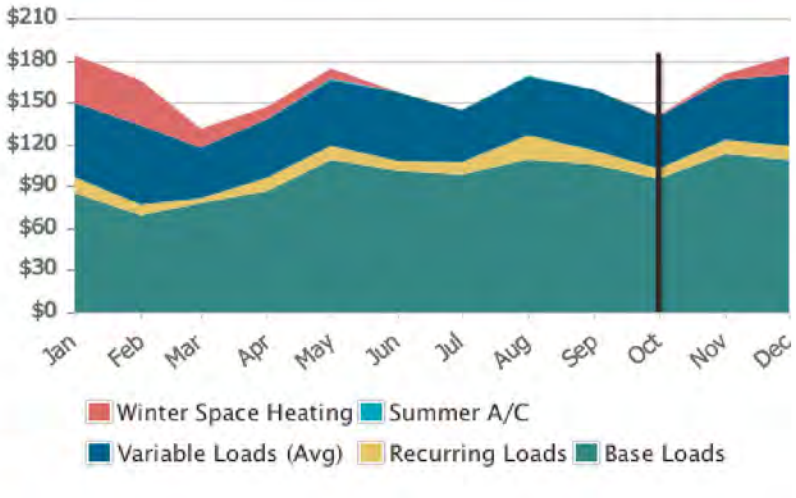
Why is load disaggregation important?

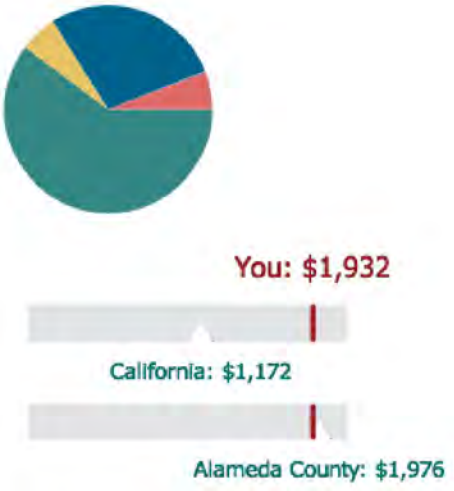


Similar annual energy bills ($)

BUT

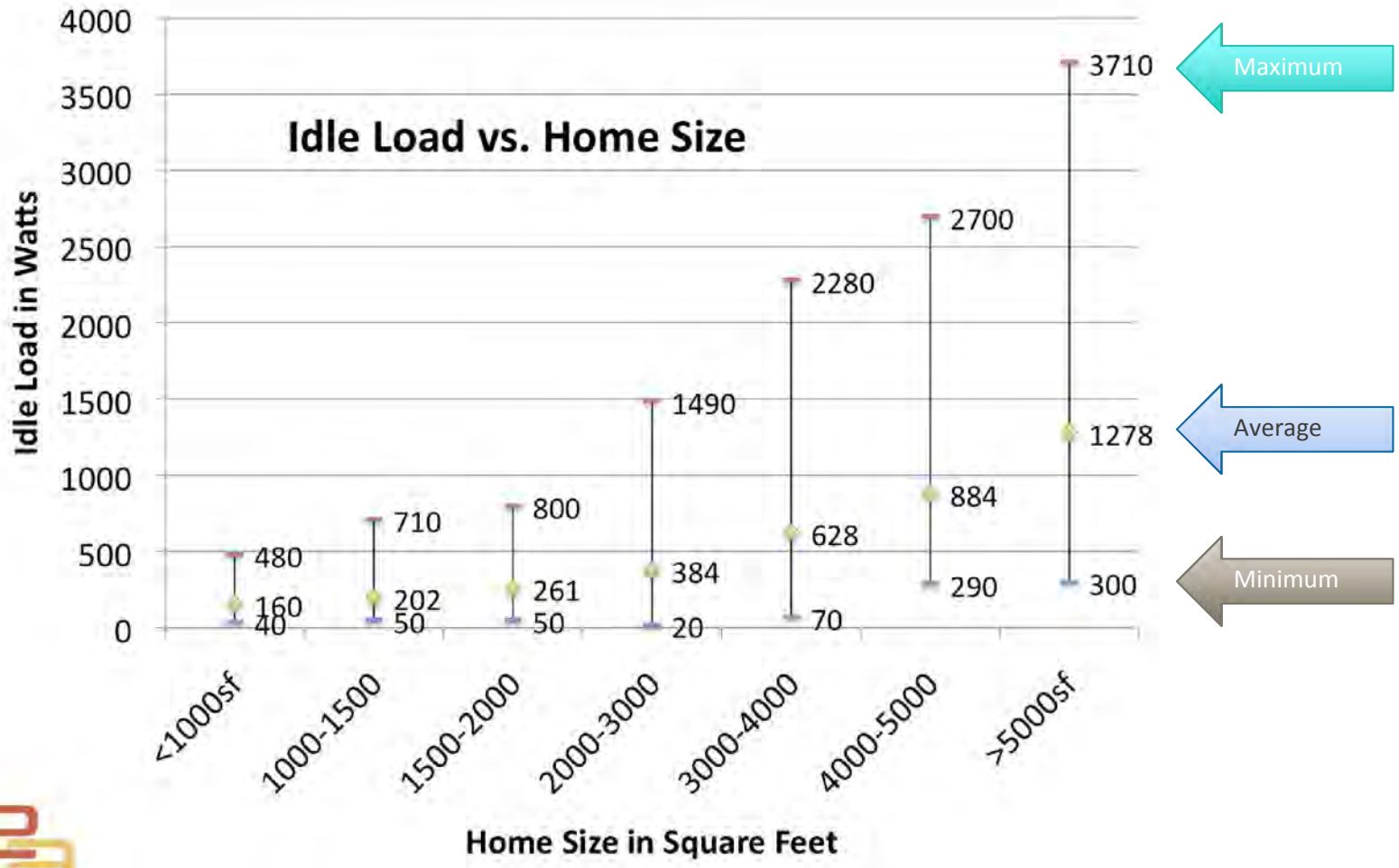
Different consumption patterns





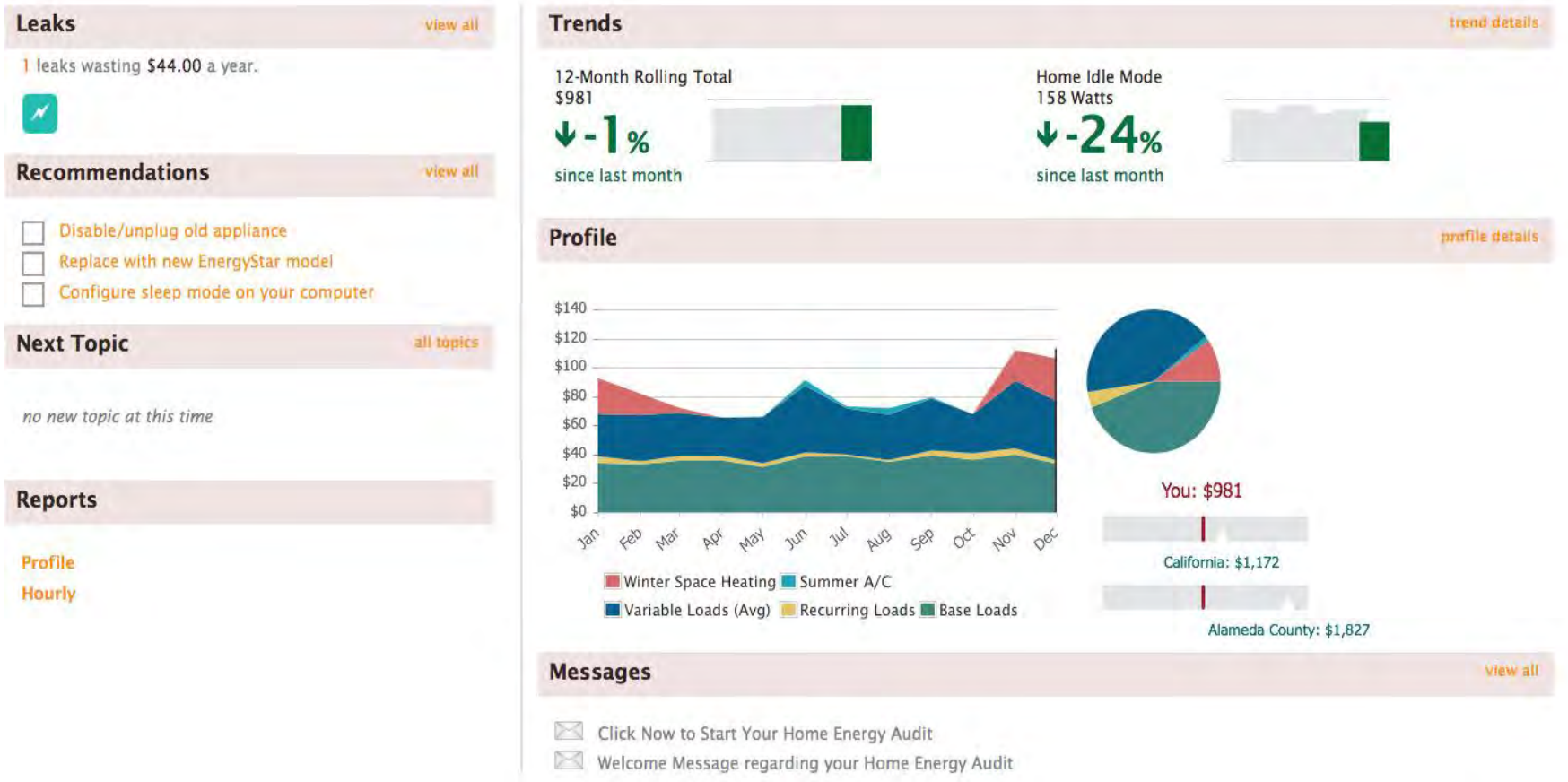
HOME ENERGY ANALYTICS

Why is custom messaging about loads important?



HOME ENERGY ANALYTICS

Home Energy Profile example



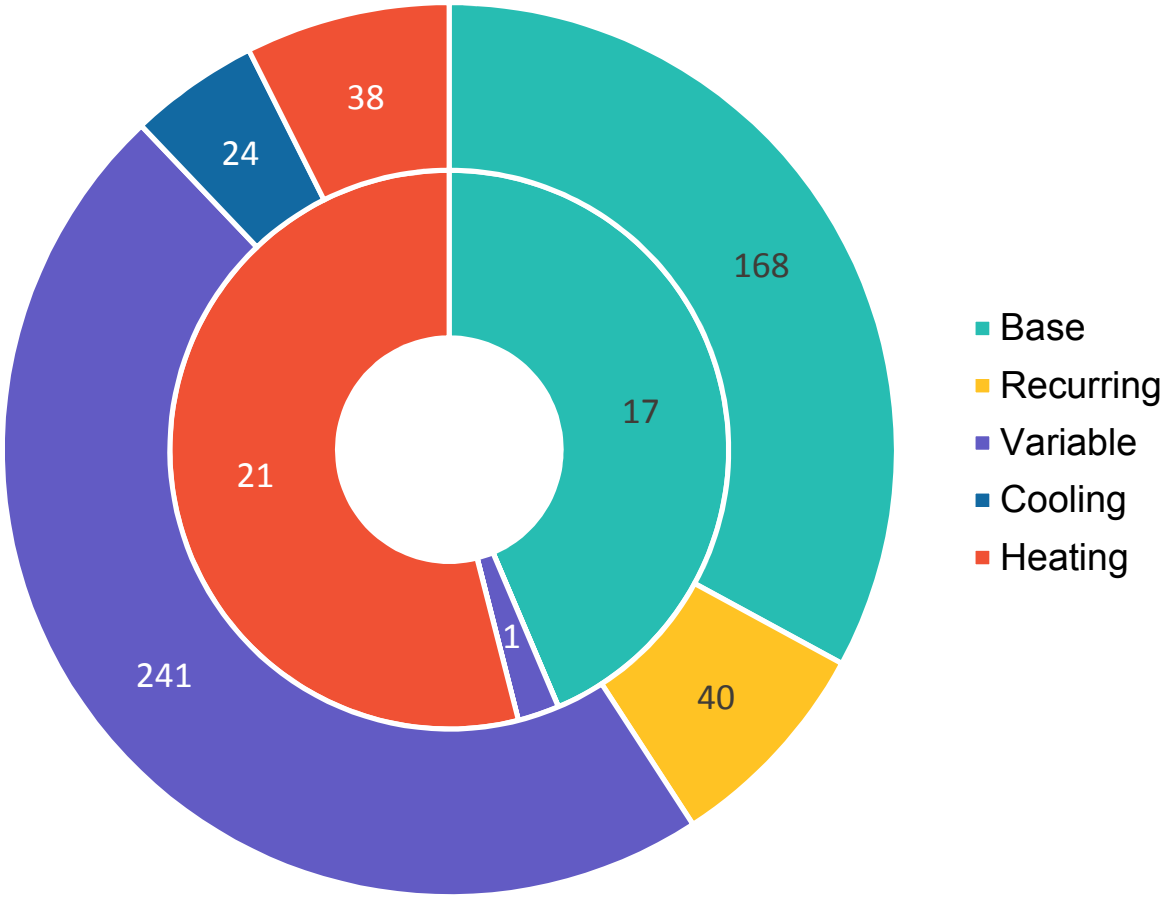
Results + Interpretations: Program-wide savings and average savings per participant

Bill $	kWh	Therms	MMBTU
6.6%	7.4%	13.0%	11.3%
$9.34/mo	38 kWh/mo	5.0 therms/mo	0.63 MMBTU/mo

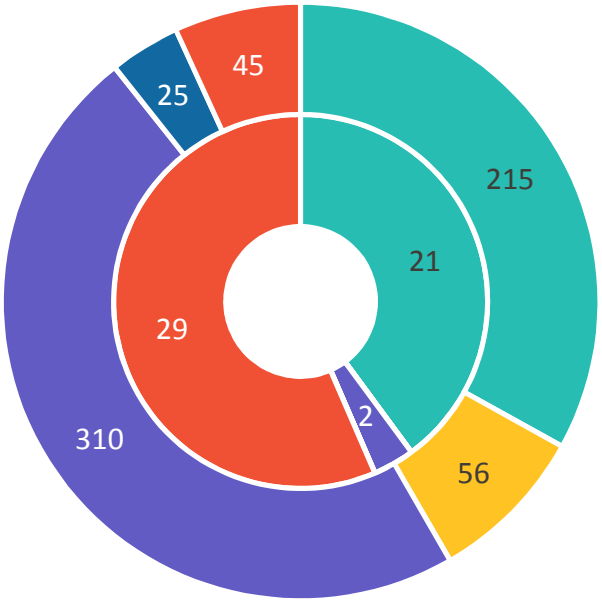
Results + Interpretations: Pre-registration energy use

Outer donut:
kWh/month
Total: 511

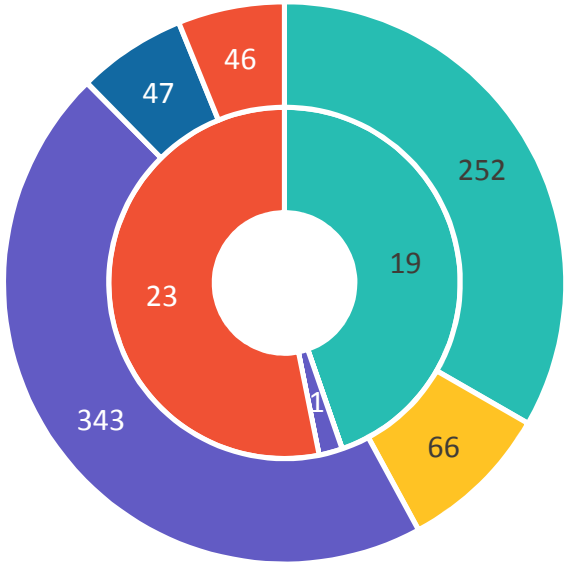
Inner donut:
Therms/month
Total: 39



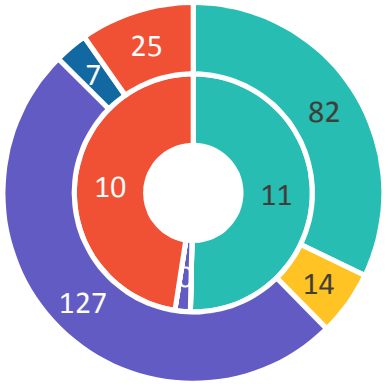
Results + Interpretations: Pre-registration energy use by program



High HVAC
651 kWh/mo
52 therms/mo
7.4 MMBTU/mo

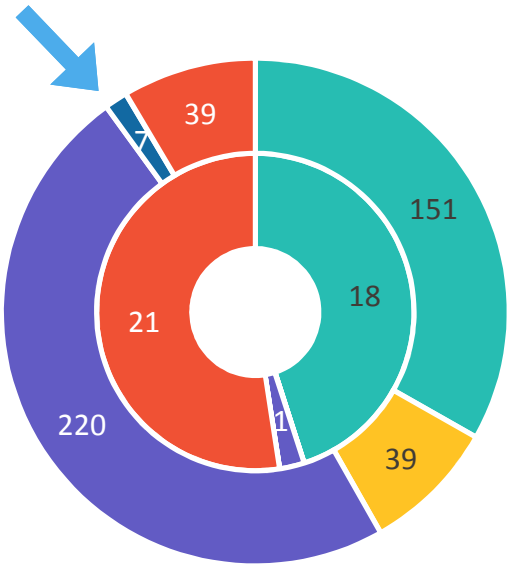


High Plug
755 kWh/mo
43 therms/mo
6.9 MMBTU/mo

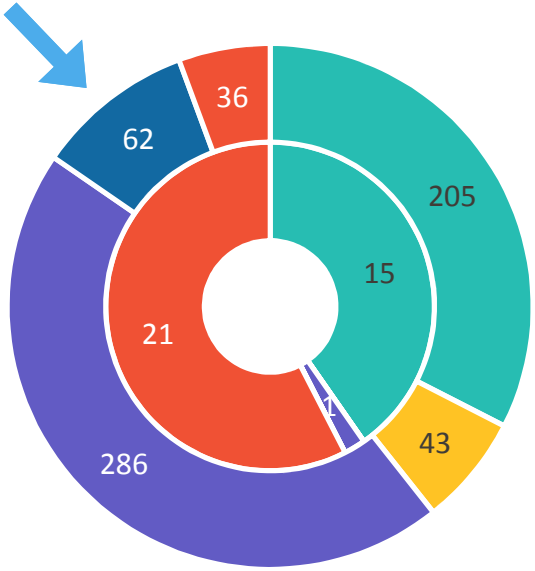


Low Energy
255 kWh/mo
21 therms/mo
3.0 MMBTU/mo

Results + Interpretations: Pre-registration energy use by climate zone

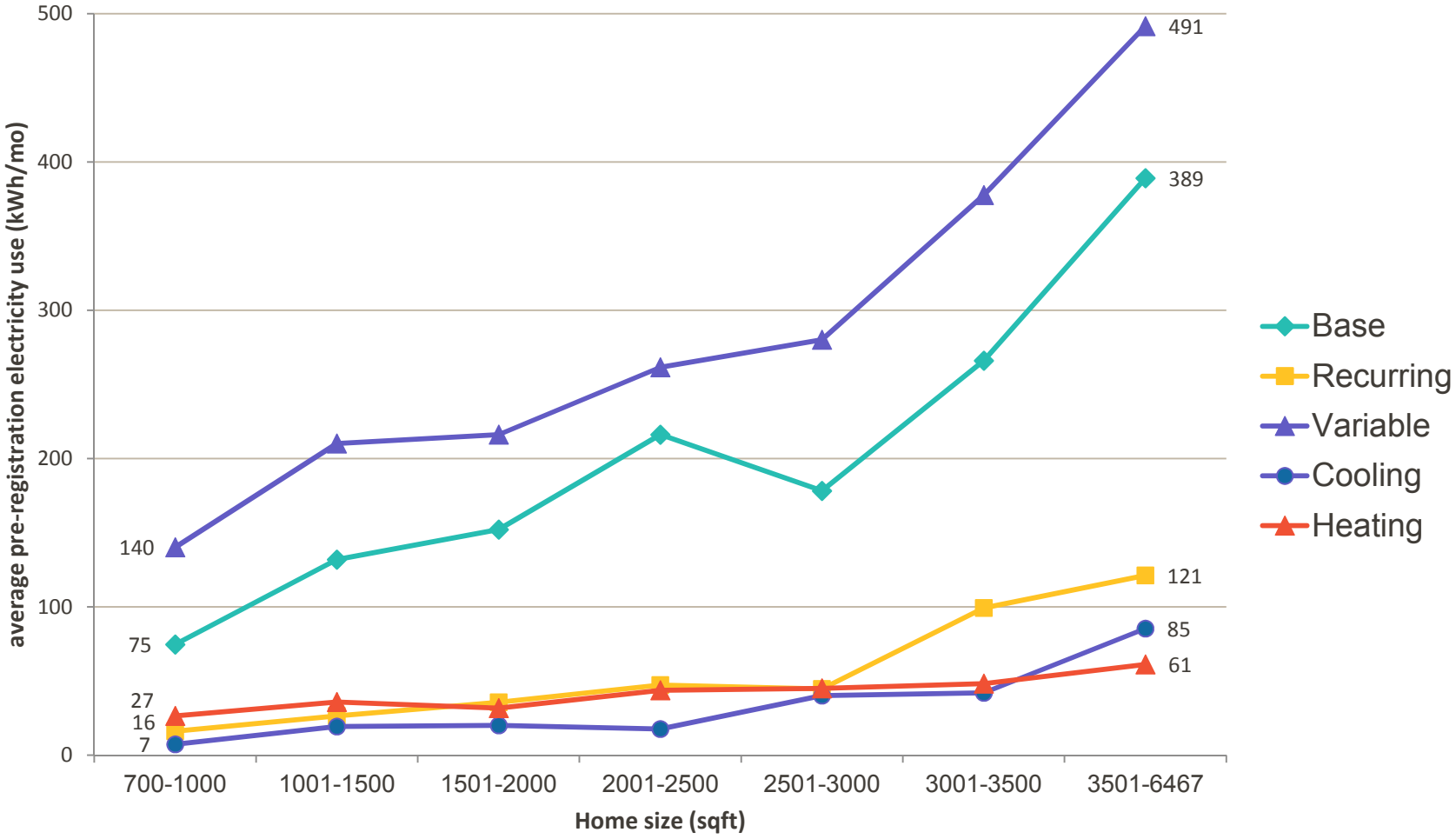


CZ3 (coast)
456 kWh/mo
40 therms/mo
5.6 MMBTU/mo

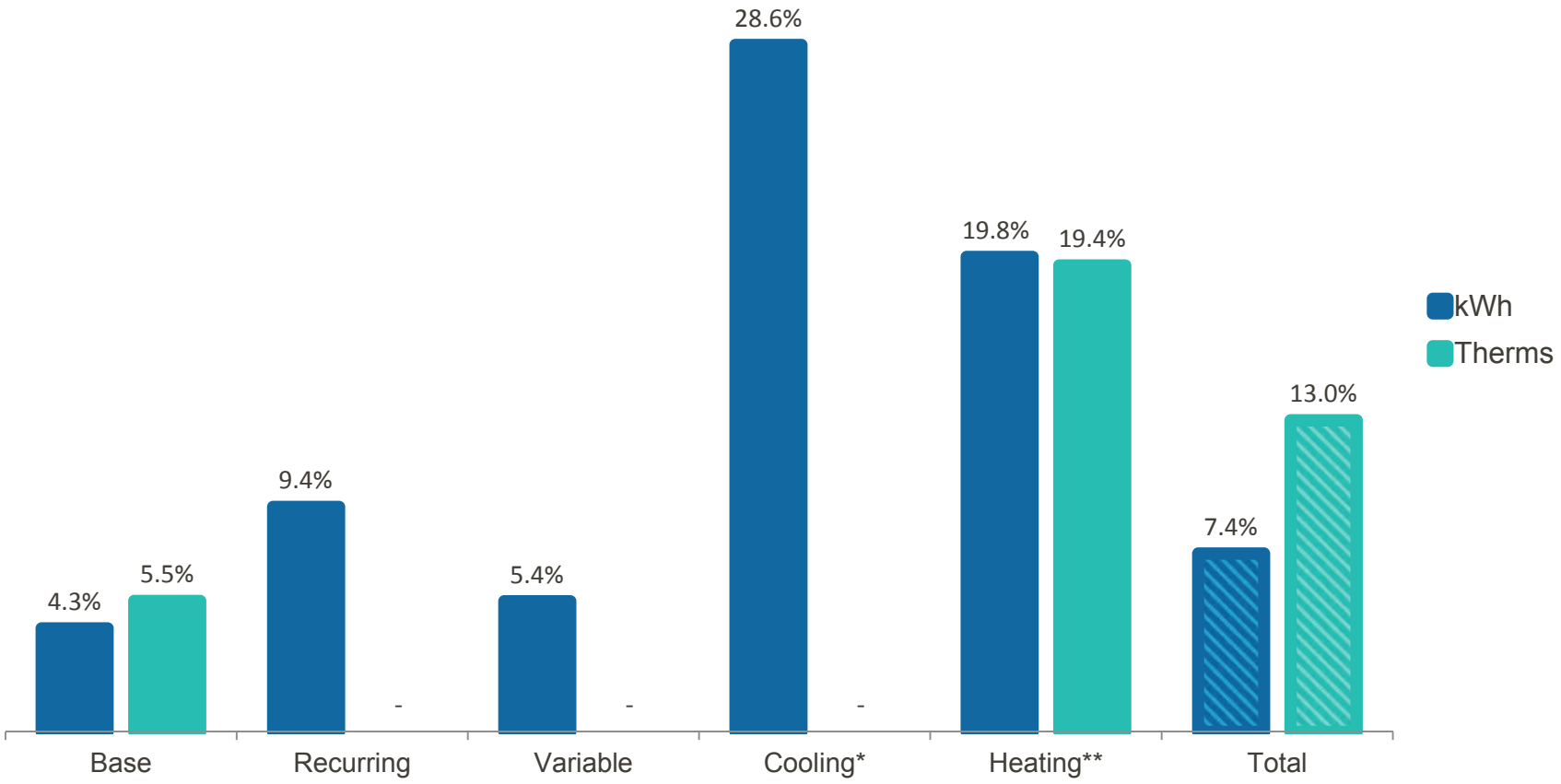


CZ12 (inland)
632 kWh/mo
37 therms/mo
5.9 MMBTU/mo

Results + Interpretations: Pre-registration electricity use by home size



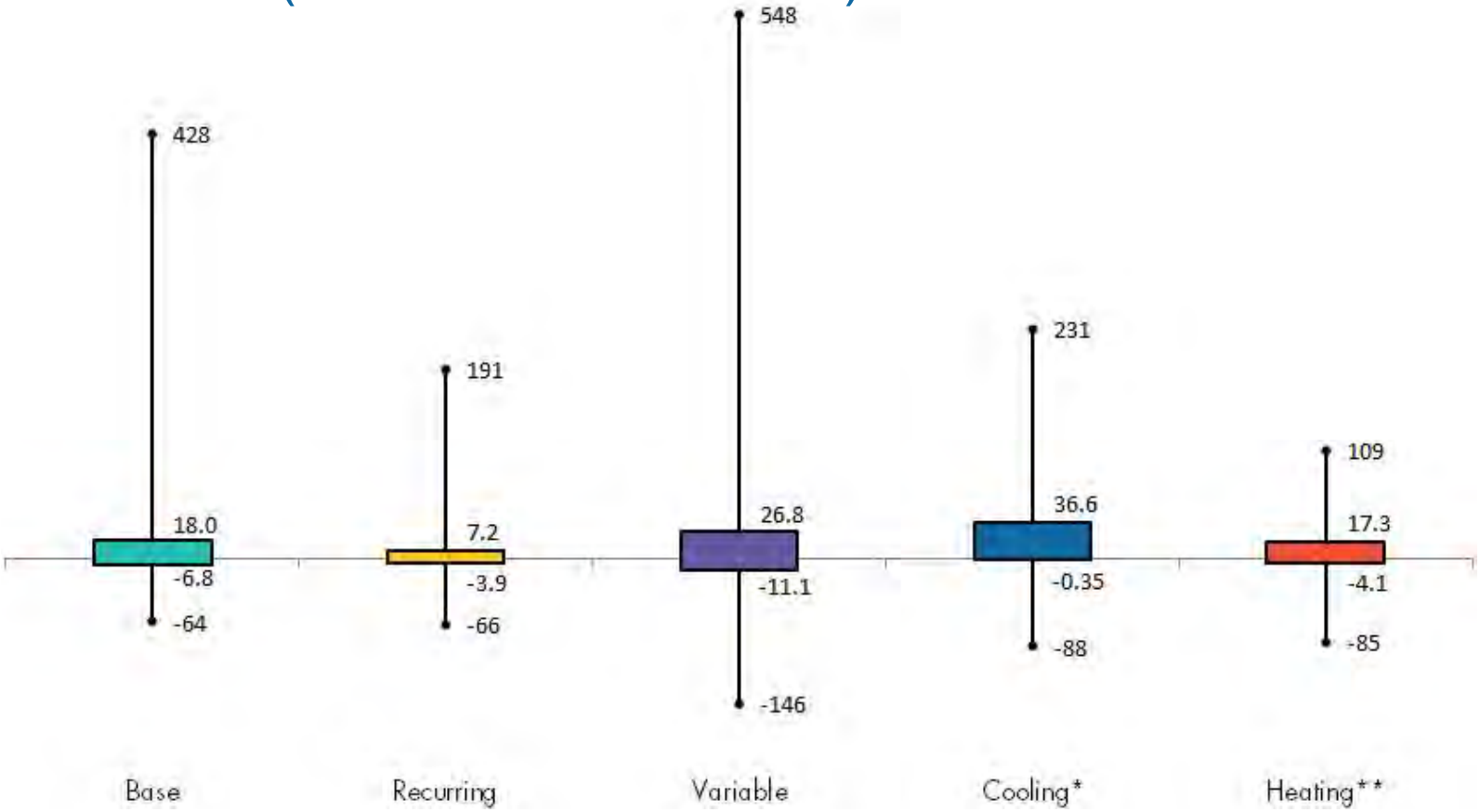
Results + Interpretations: % savings by load



* Among participants with average ≥25 kWh/mo in Cooling
** Among participants with average ≥10 kWh/mo in Heating and/or ≥5 Therms/mo in Heating

Results + Interpretations: Variation in savings

Showing minimum, 25th percentile, 75th percentile, and maximum (all values in kWh/mo)



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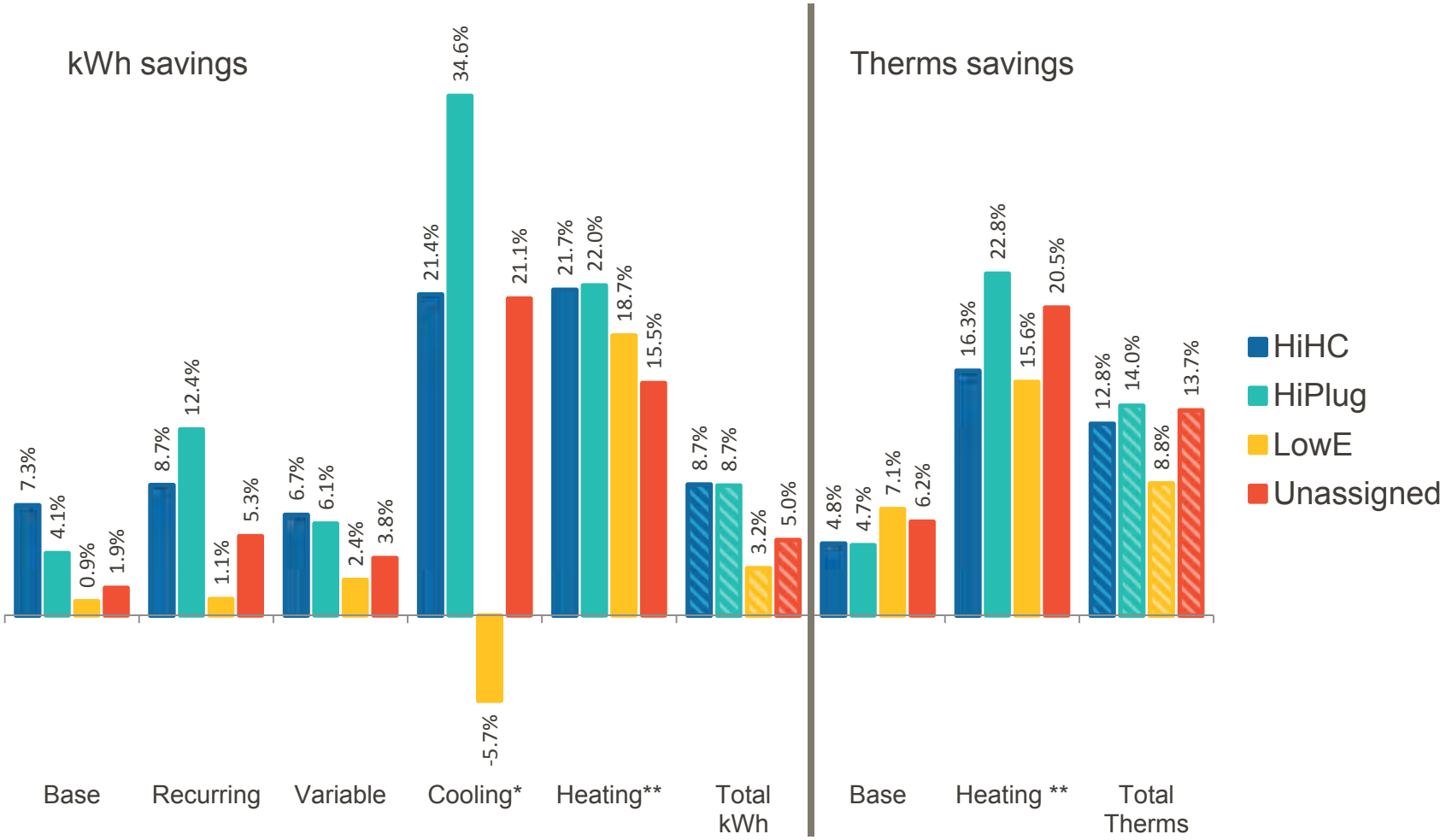
Results + Interpretations: % savings by program

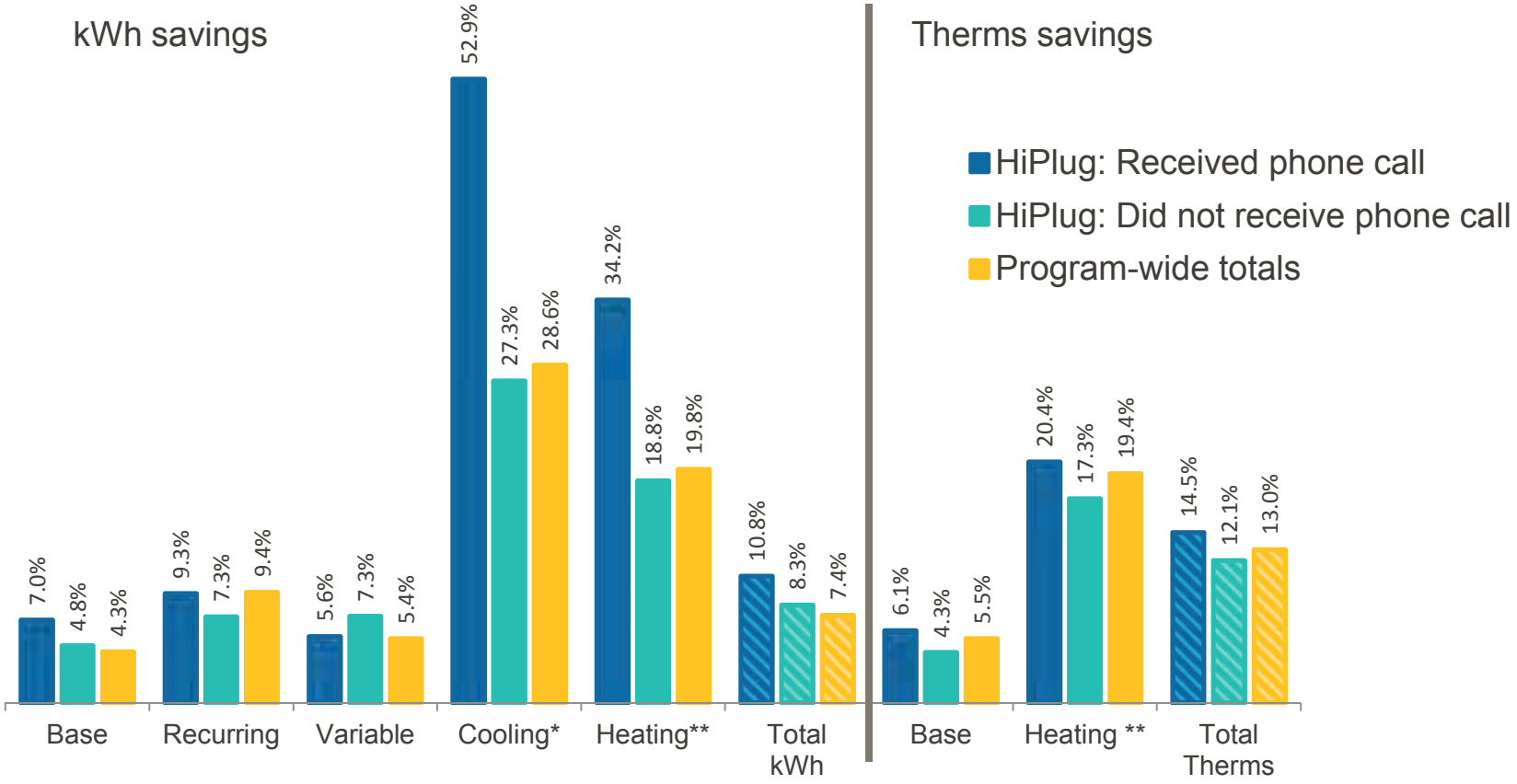


* Among participants with pre-reg average ≥25 kWh/mo in Cooling

** Among participants with pre-reg average ≥10 kWh/mo in Heating and/or ≥5 Therms/mo in Heating

Results + Interpretations: % savings by phone calls

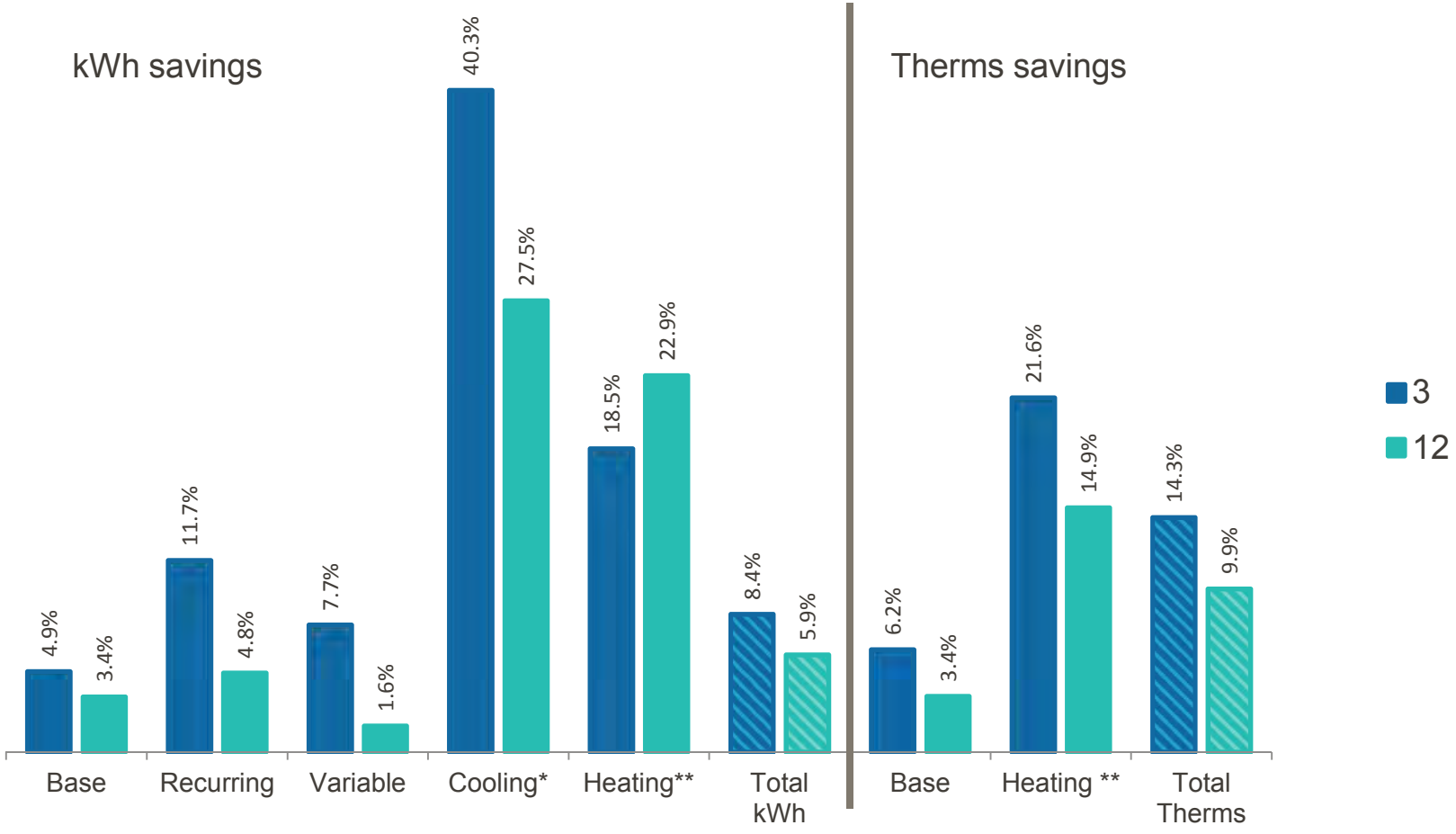
Among users meeting High Plug criteria before cutoff date



* Among participants with pre-reg average ≥25 kWh/mo in Cooling

** Among participants with pre-reg average ≥10 kWh/mo in Heating and/or ≥5 Therms/mo in Heating

Results + Interpretations: % savings by climate zone



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Next steps

- Collect more data!
  - We need to measure persistence of savings after a year or more, with and without continuation of the bimonthly feedback
- Explore savings among those who added equipment upgrades
  - Survey respondents to see which customers installed physical measures in addition to taking behavior-only steps
- Compare control group
  - Participants are self-selected (though pre-upgrade use similar to local averages)

Questions?

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