The state of demand flexibility programs and rates

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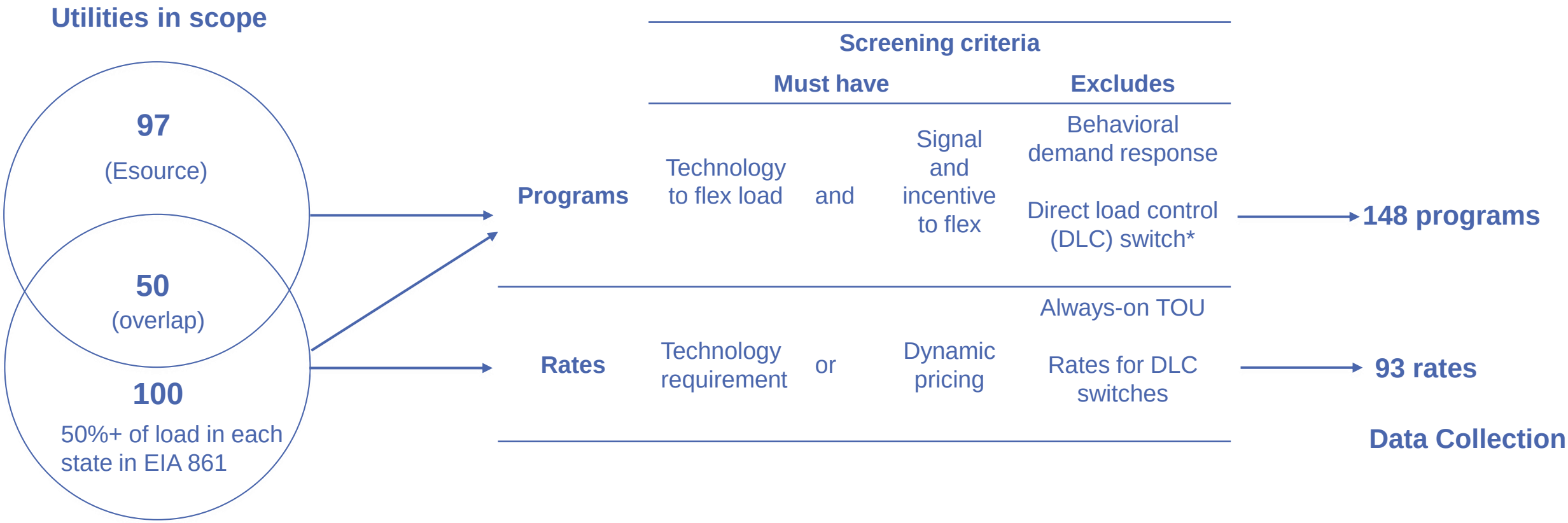
Overview

- Motivations and goals
- Data collection
- Program characteristics
- Rate characteristics
- Program and rate outcomes

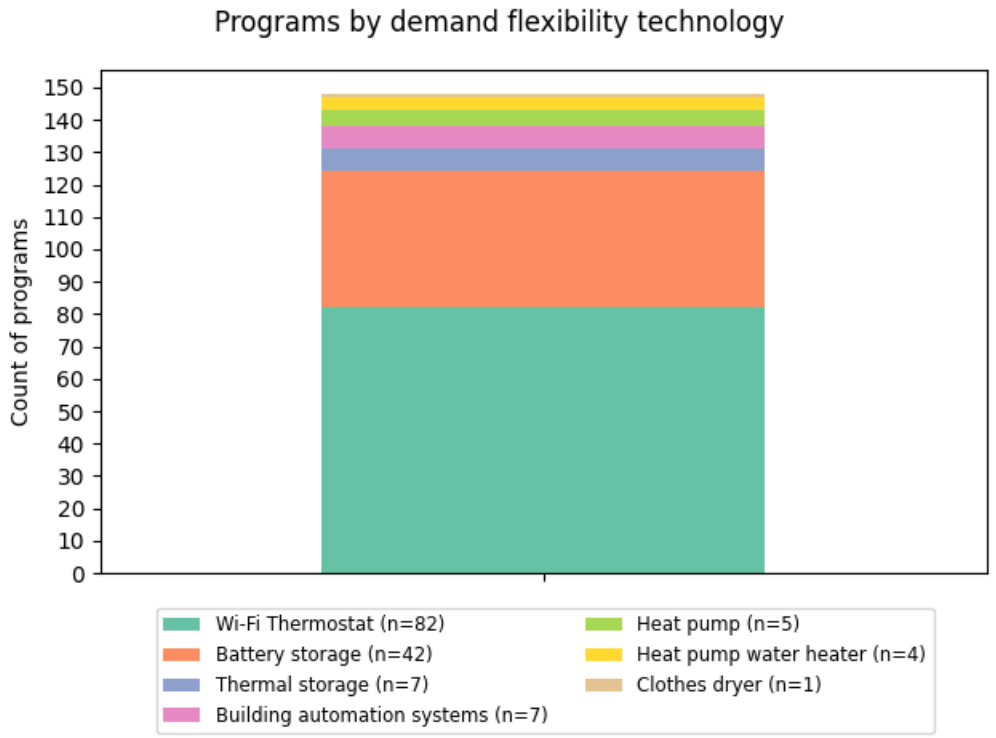
Motivations and goals

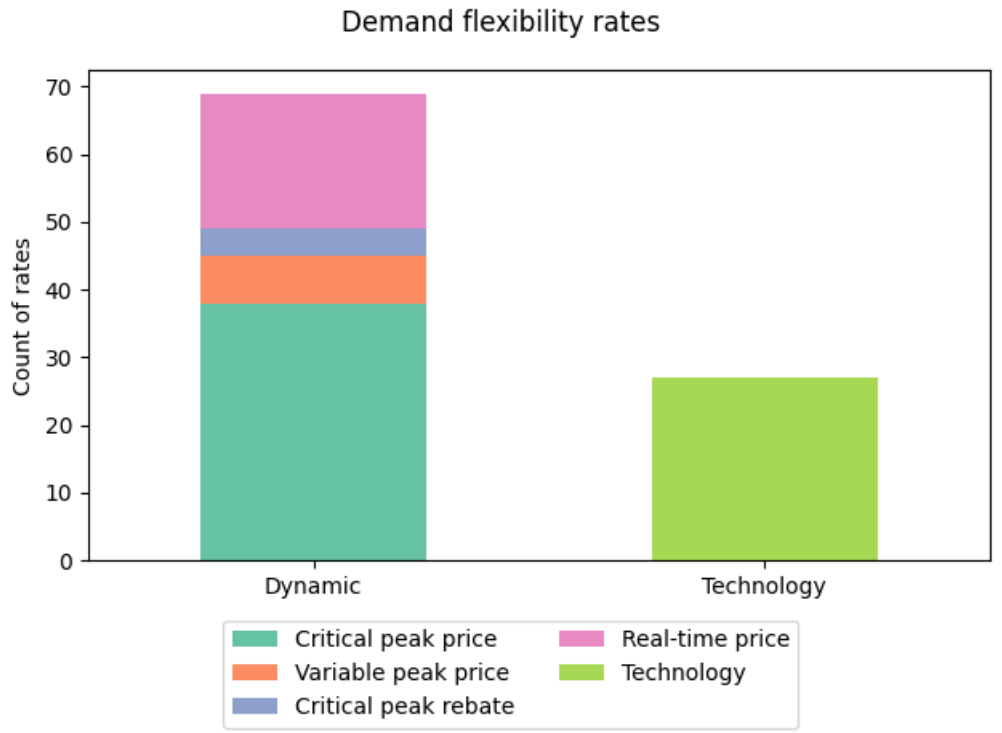
- By shedding or shifting load, demand flexibility can:
  - Can reduce carbon emissions and electricity costs.
  - Support the integration of renewable energy.
- But, there is a lack of data on programs and rates that promote demand flexibility.
- Data could support policy makers and regulators by informing:
  - Demand flexibility goals
  - Program design
- We address this gap by providing foundational data on demand flexibility programs and rates, including:
  - Event structure
  - Incentive types and amounts
  - Enrollment and participation
  - Program spending and demand savings

We identified 148 programs and 93 rates for data collection



Overview of programs and rates in dataset

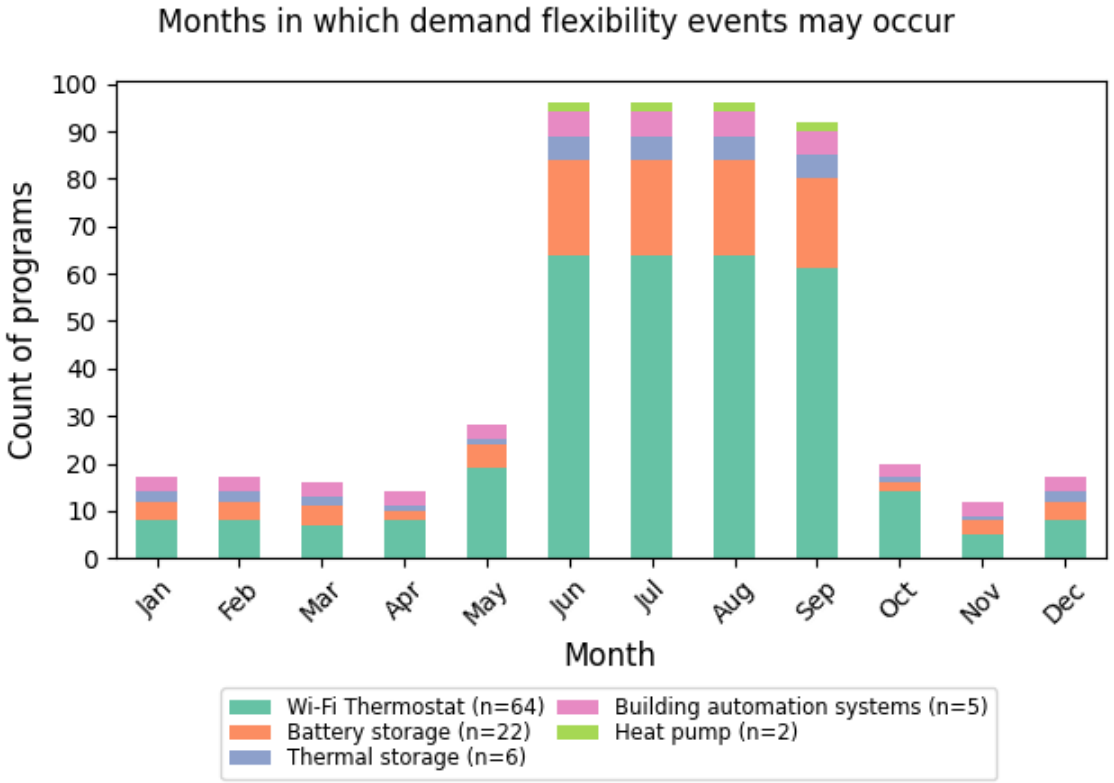




- Programs come from 38 states and Washington D.C and rates come from 26 states.
- Wi-Fi thermostats and batteries accounted for 84% of programs.
- Demand flexibility rates were a mix of dynamic rates and time-of-use rates with technology requirements.

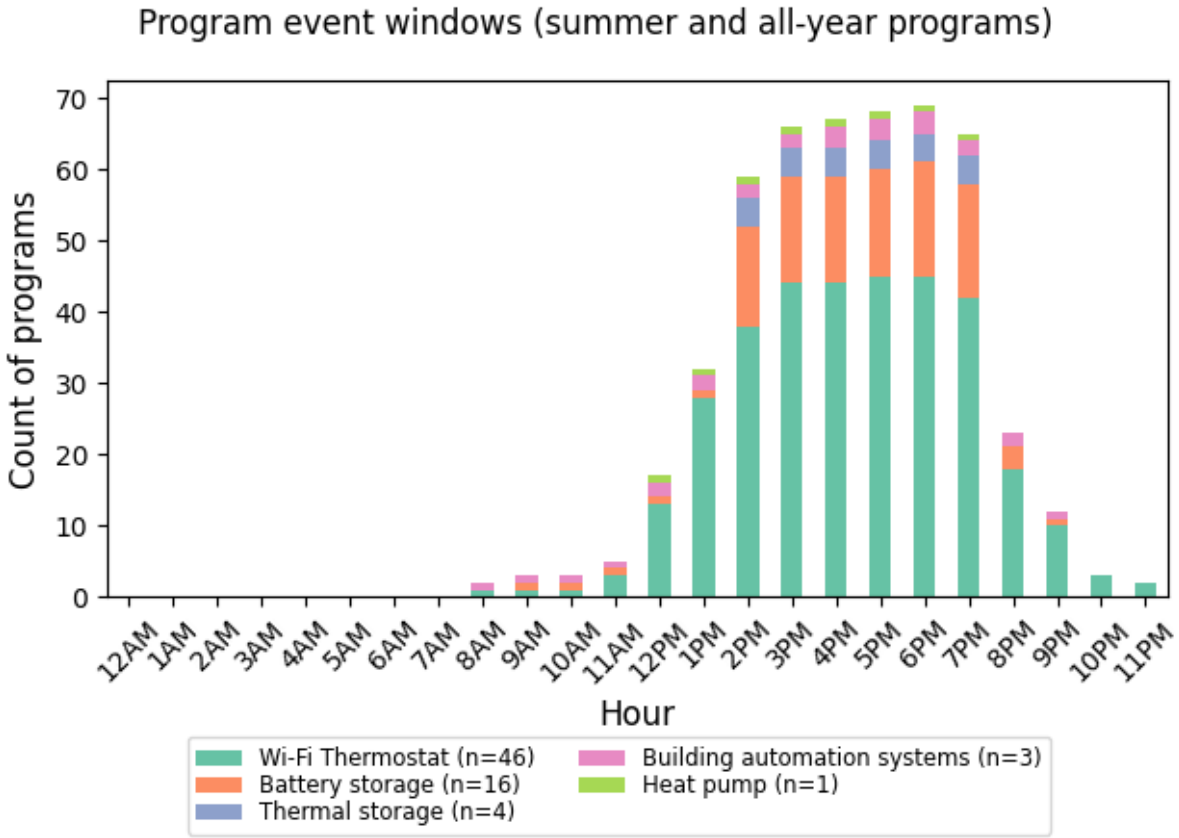
Program characteristics

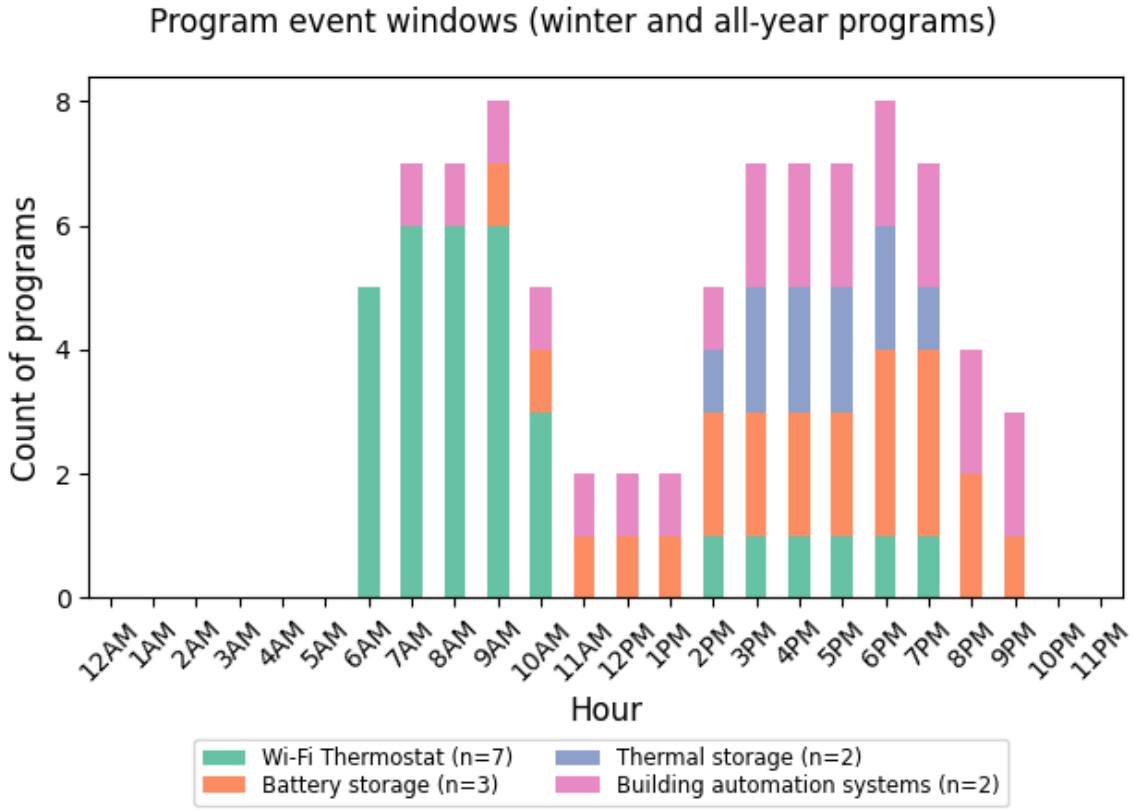
Demand flexibility programs largely operate in the summer



- 56 of 64 Wi-Fi thermostat and 18 of 22 battery programs operate in *summers only*.
- 8 winter Wi-Fi thermostat programs operate in *summer and winter*.
  - 5 are in southern states with high levels of electric space heating.

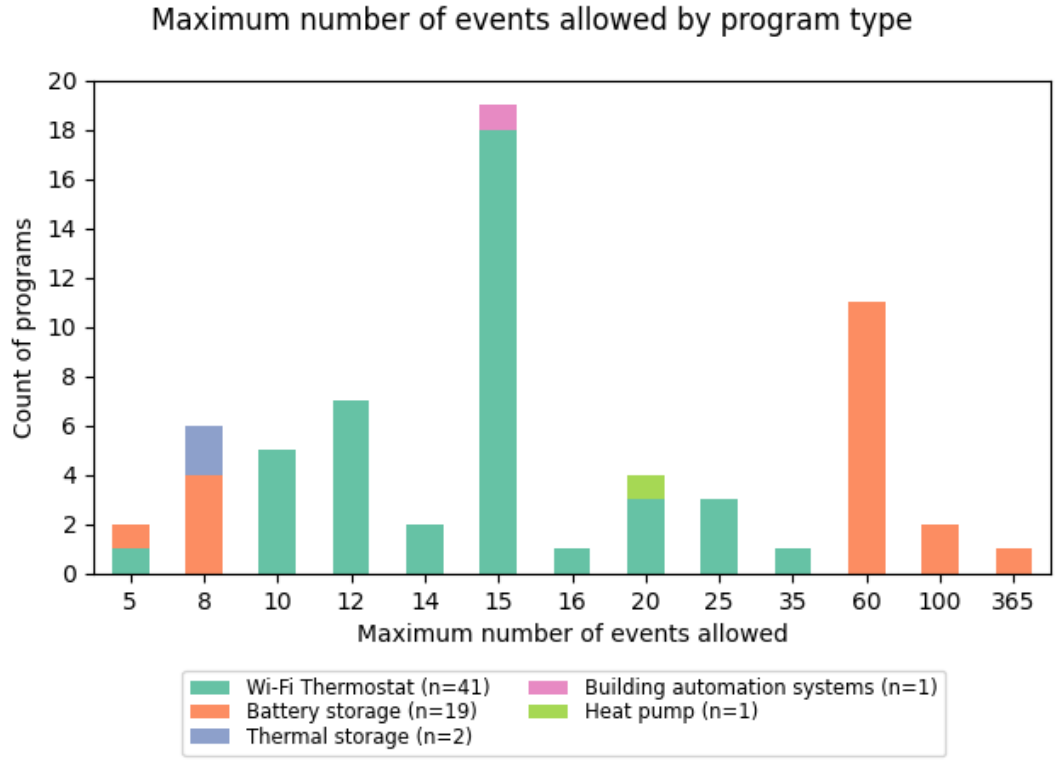
Summer program event windows align with cooling-driven peaks

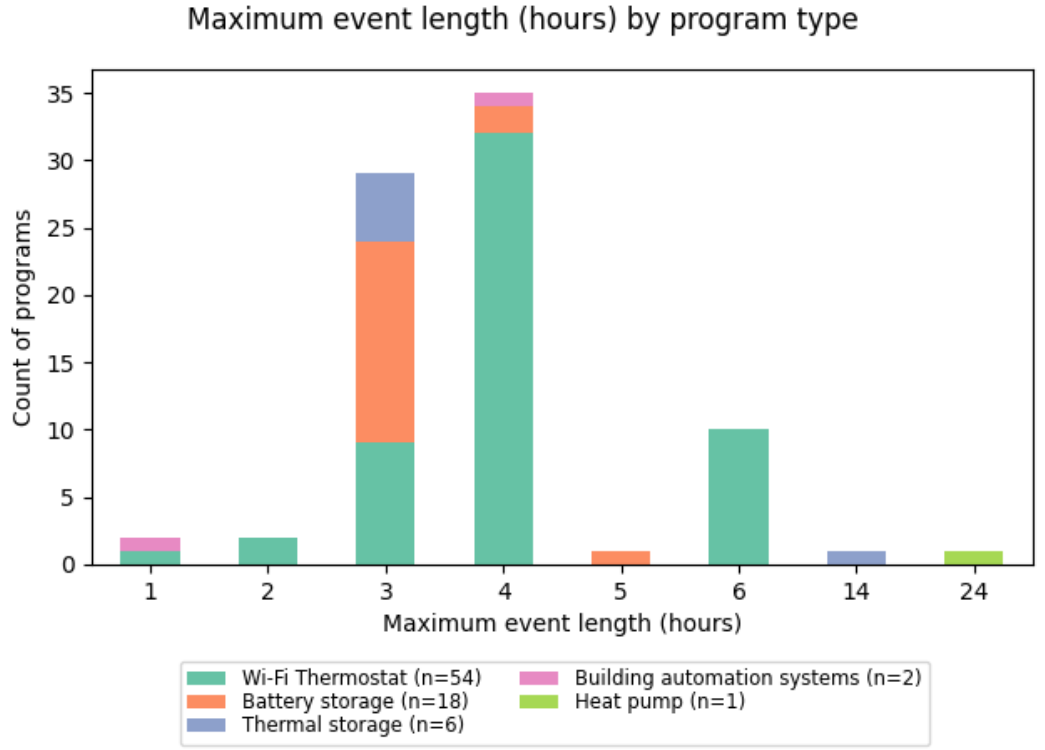




- Summer event windows typically straddle afternoons and early evenings.
- Winter hours vary by technology, with Wi-Fi thermostat programs generally targeting morning hours.

Maximum number of events allowed and event length vary by program type

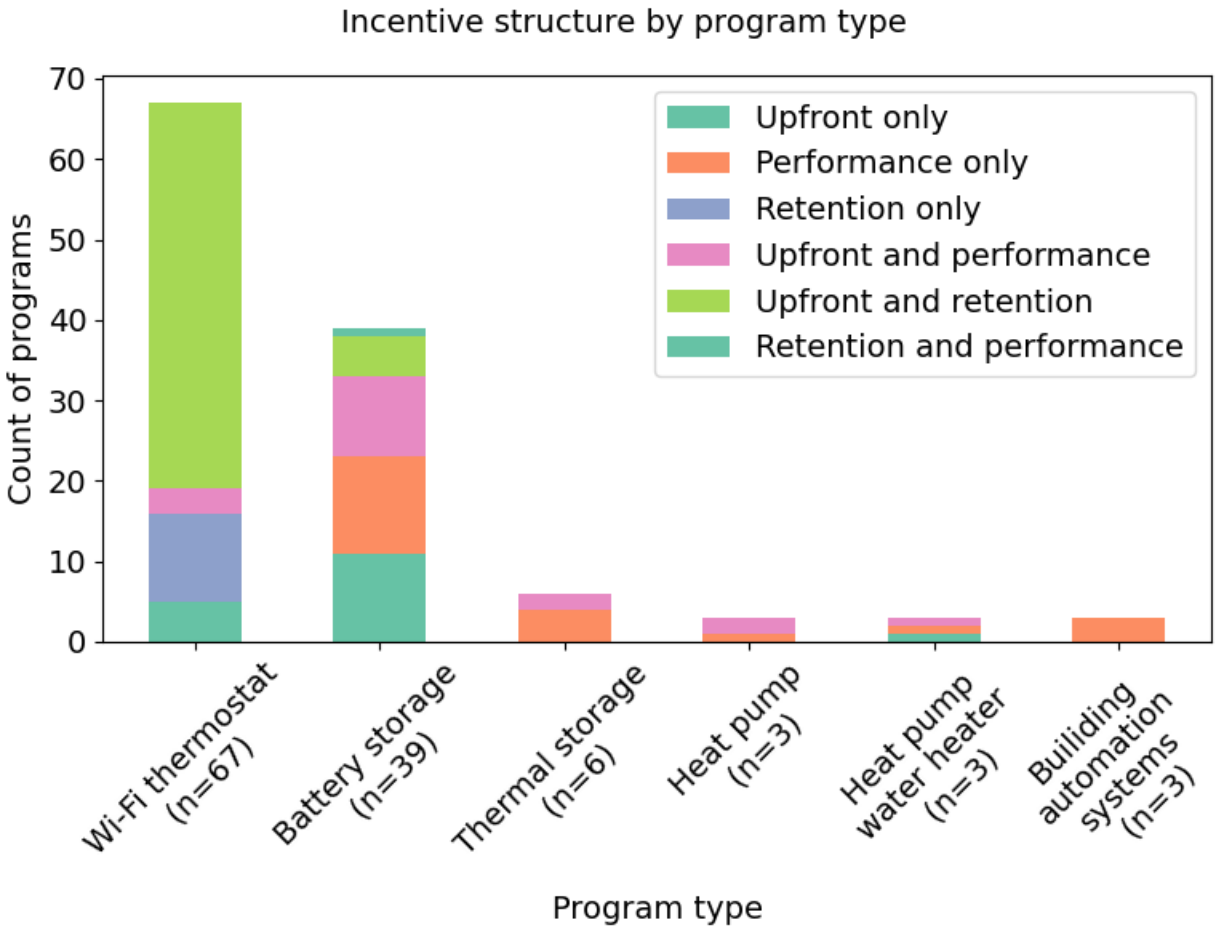




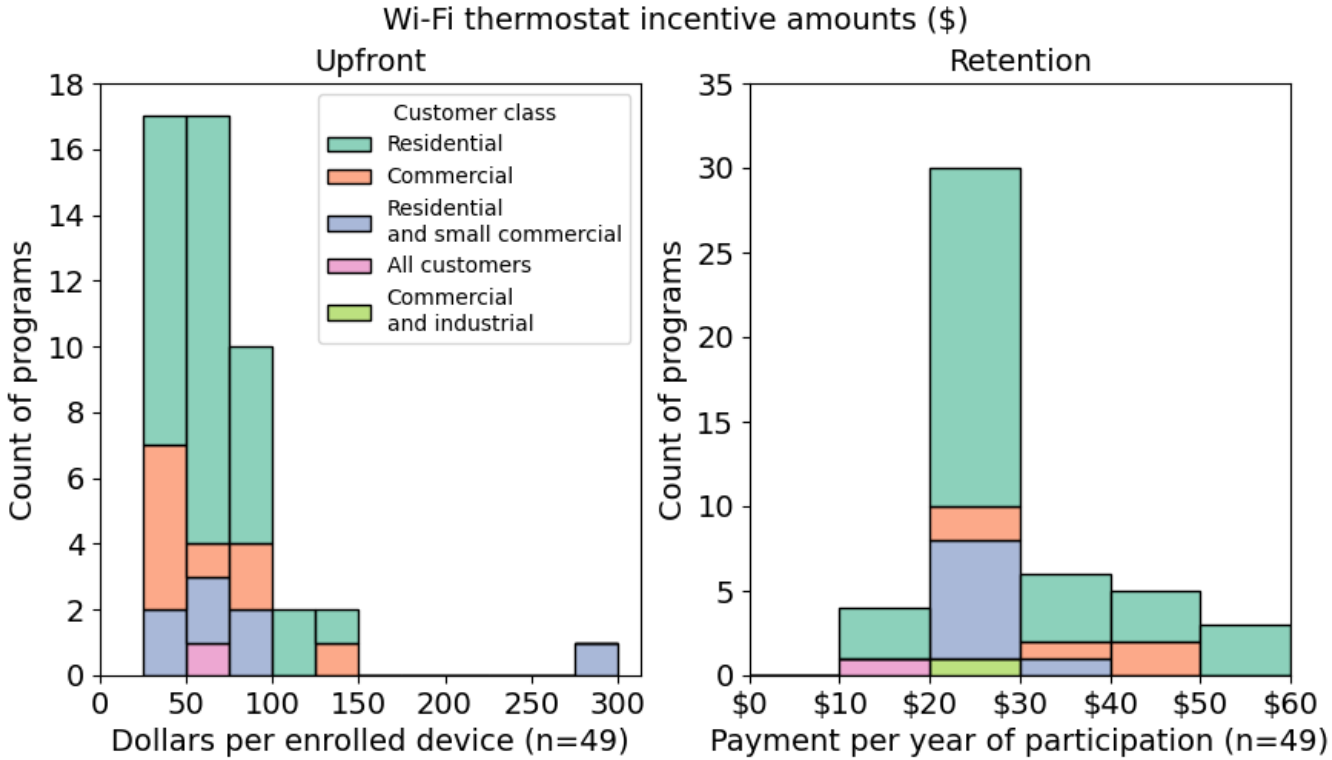
- Battery programs generally allow for more events than Wi-Fi thermostat programs do.
  - Thermal comfort impacts of Wi-Fi thermostat events likely creates a trade-off between event frequency and enrollment.
- Wi-Fi thermostats have slightly longer median max event length (4 hours) than batteries (3 hours).
- We found little data on the actual number of events.

Incentive structure varies by program type

- **Upfront** incentives drive *technology adoption and program enrollment*.
  - E.g. thermostat rebate, $ per kW installed battery capacity.
- **Retention** incentives *encourage continued enrollment.*
  - E.g. $ per thermostat enrolled or $ per kW committed battery capacity per year.
- **Performance** incentives promote *energy and demand reductions.*
  - E.g. $ per average kW of battery capacity provided across multiple events.
- Wi-Fi thermostat programs generally have both upfront and retention incentives.



Thermostat incentive amounts



- Upfront incentives are typically under $100 per enrolled device.
- Retention incentives are generally smaller than upfront incentives.

Battery program details

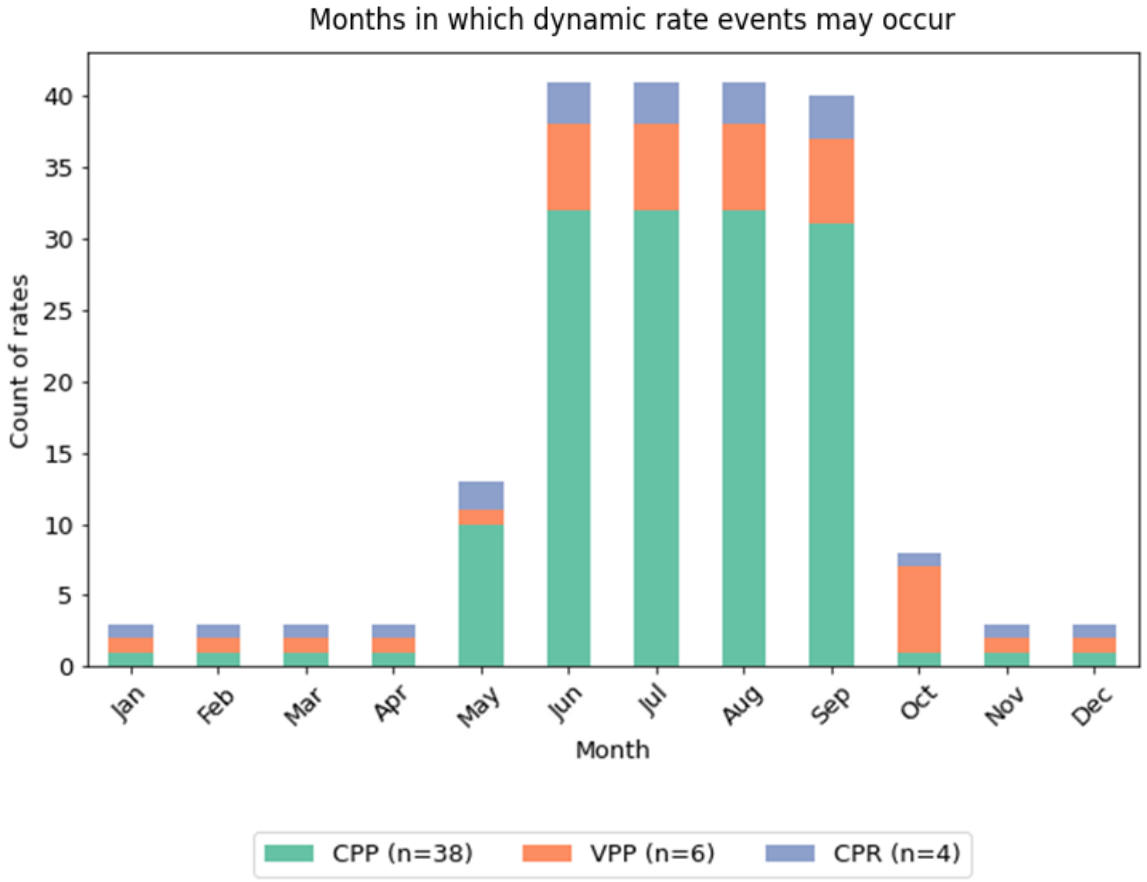
- Programs generally involve customer ownership of batteries (39 of 42 programs) as opposed to utility ownership.

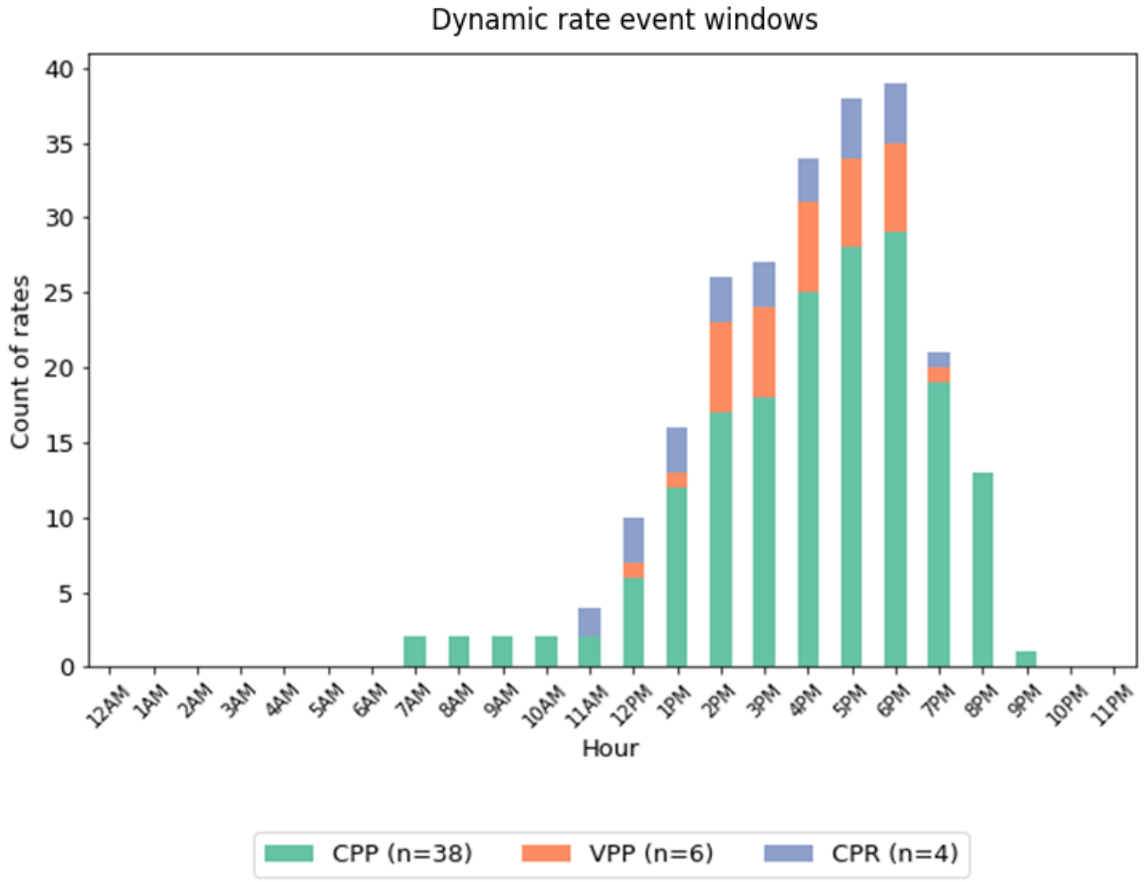
- They also tend to allow:
  - Stand-alone systems (19 of 22 programs with reported data).
  - Grid charging (17 of 21 programs with reported data).

- Battery programs may balance grid needs with participant needs for back-up power.
  - 14 of 42 have rules on the level of capacity available for control (e.g. minimum or maximum).
    - Minimum levels imply utilities want a certain level of load to control.
    - Maximum levels enable customer resiliency during outages.
  - 10 of 42 programs do not allow discharges ahead of forecasted major storms.

Rate characteristics

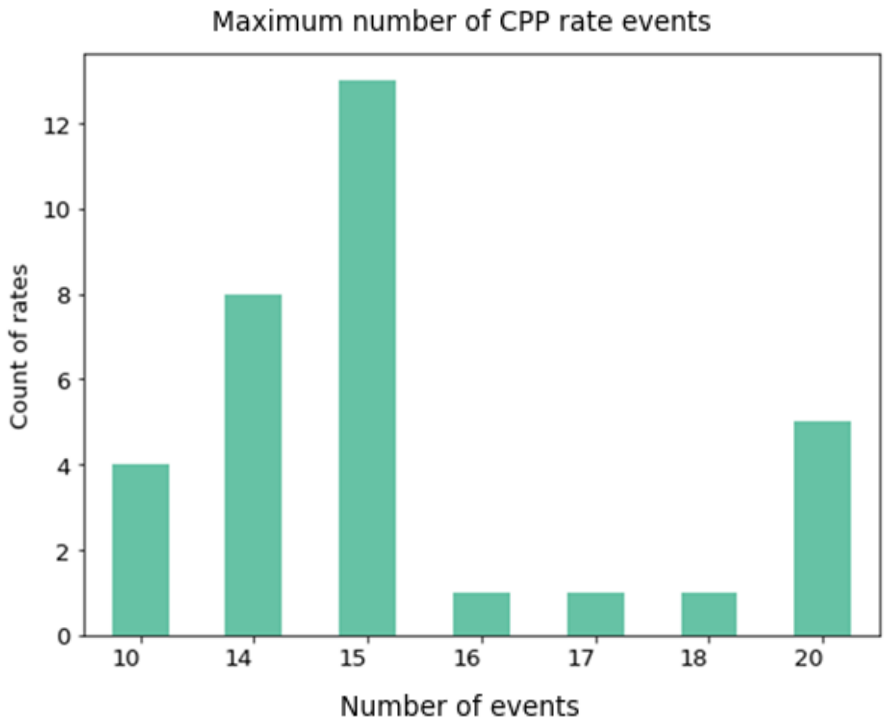
Dynamic rate events generally occur in summer afternoons and evenings

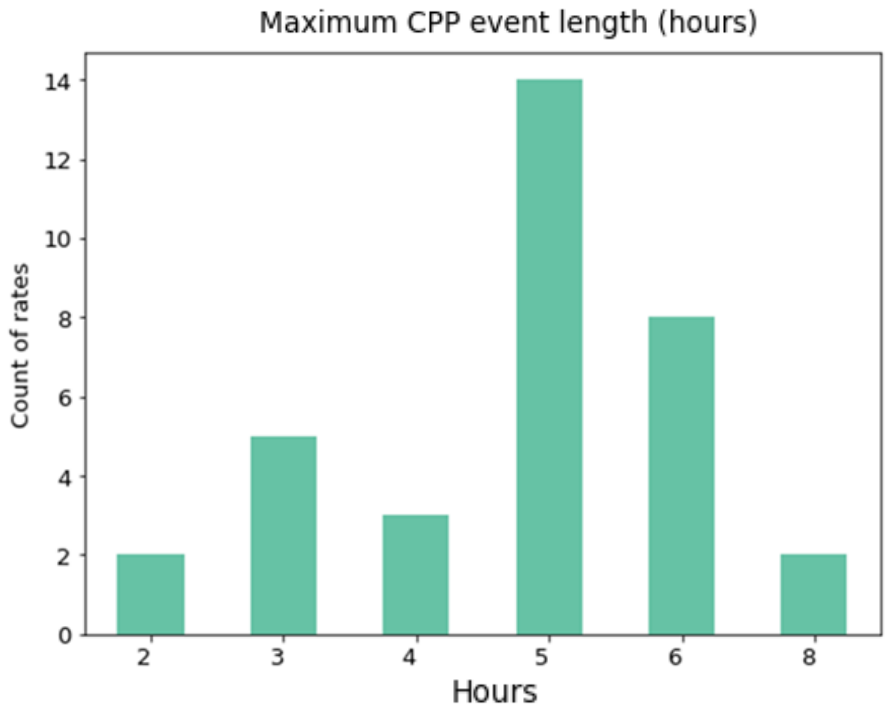




- As with demand flexibility programs, dynamic rate events focus on summer afternoons and early evenings.

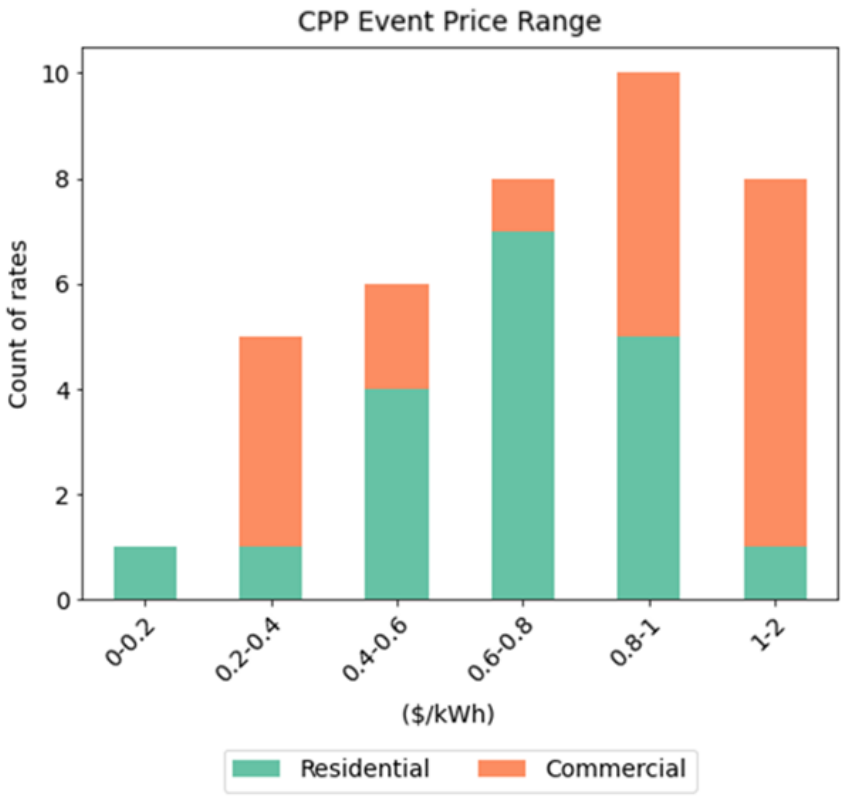
CPP events have similar limits as Wi-Fi thermostat programs

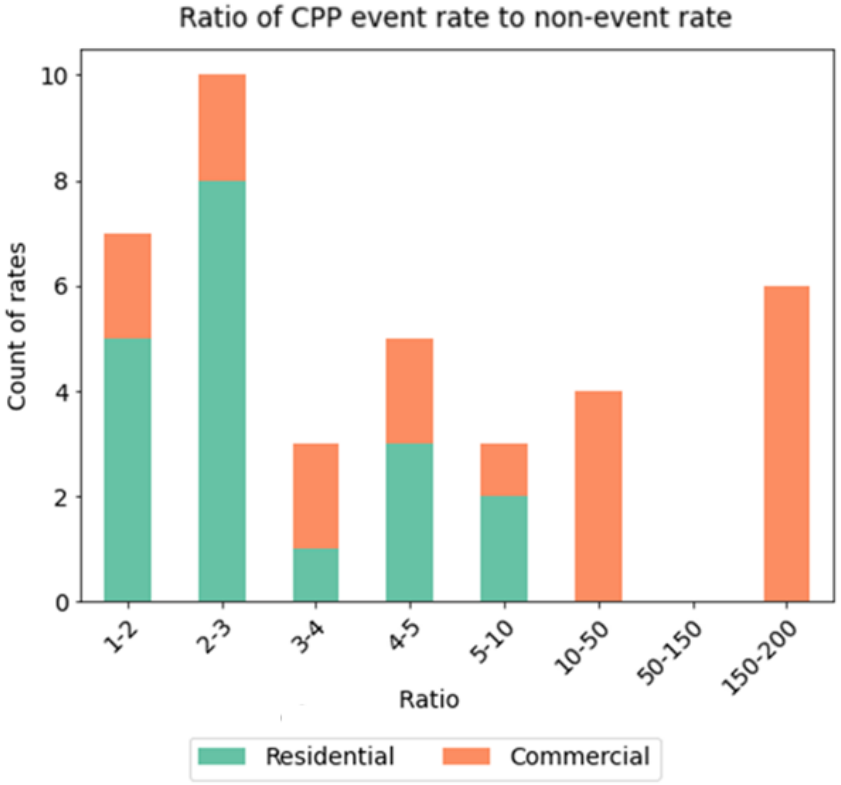




- The median CPP rate and Wi-Fi thermostat program both have at most 15 events.
- The median CPP rate has slightly longer max event length (5 hours) than median Wi-Fi thermostat program (4 hours).

CPP event prices and event-to-non-event price ratios have wide variation





- CPP event prices range from $0.1/kWh to $1.44/kWh.
- Commercial CPP rates have higher event-to-non-event rate ratios than residential CPP rates.
  - Notably, the CPP rate with highest ratio (~180:1) has demand charge and lower volumetric rate.

Program and rate outcomes

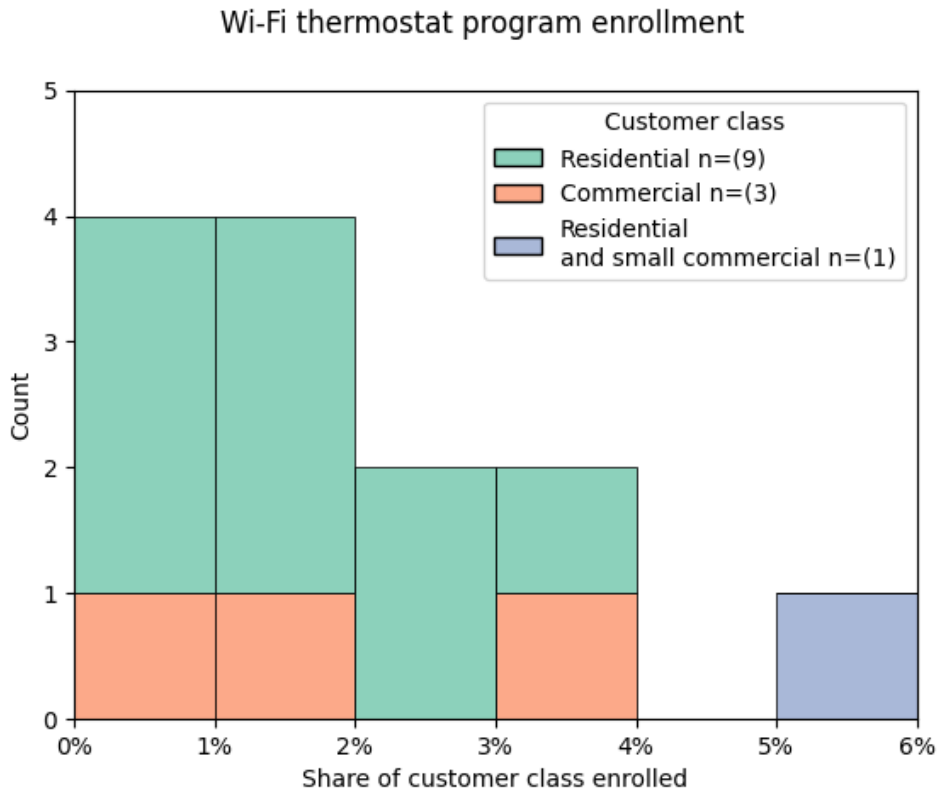
Data on program outcomes was sparse for all program and rate types

- Of the 148 programs in our dataset:
  - 27 had enrollment data
  - 13 had participation data
  - 31 reported demand reductions
  - 21 reported program spending

- We found no data on enrollment or demand reductions in demand flexibility rates.

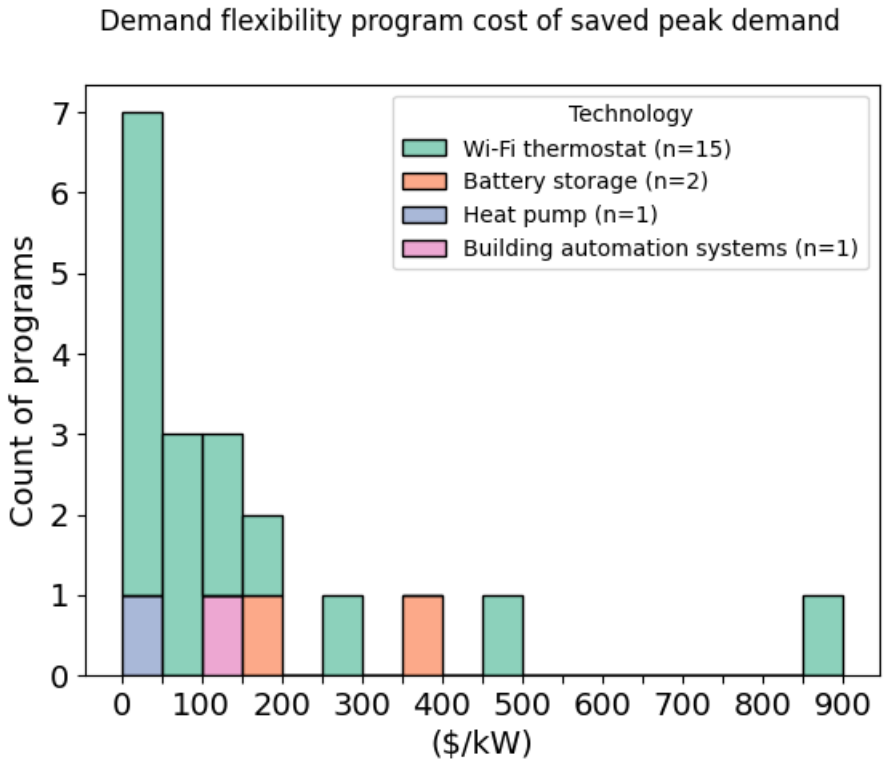
- Lack of data results from:
  - Lack of reporting
  - Reporting lag
  - Aggregation of outcomes with other programs

Wi-Fi thermostat enrollment varies amongst studied programs



- We normalized Wi-Fi thermostat enrollment by the number of customers in the customer class(es) the programs served.
  - Enrollment rates ranged from 0.1% to 5.7%.

Wi-Fi thermostats have a low cost of saved peak demand



- We calculated the first year cost of saved peak demand for programs with reported demand savings and spending.
- Studied Wi-Fi thermostat programs provide a low-cost demand resource.
  - Savings-weighted average cost of saved peak demand is $39/kW.

Key takeaways

- Demand flexibility programs and rates are available in most states.
  - Wi-Fi thermostat and battery programs are most common in our dataset.
- Most demand flexibility rates are dynamic rates that vary prices based on grid conditions.
  - Critical peak pricing rates are most common dynamic rate (among those studied)
- Demand flexibility programs and rates generally target summer afternoons and early evenings.
- Incentive structure varies by demand flexibility program type.
- Data on program and rate outcomes (e.g enrollment or demand savings) is lacking.
  - Improved reporting could enable more analysis.

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