BATTERY PILOT DESIGN: TAPPING INTO UNDER-UTILIZED FLEXIBLE RESOURCES

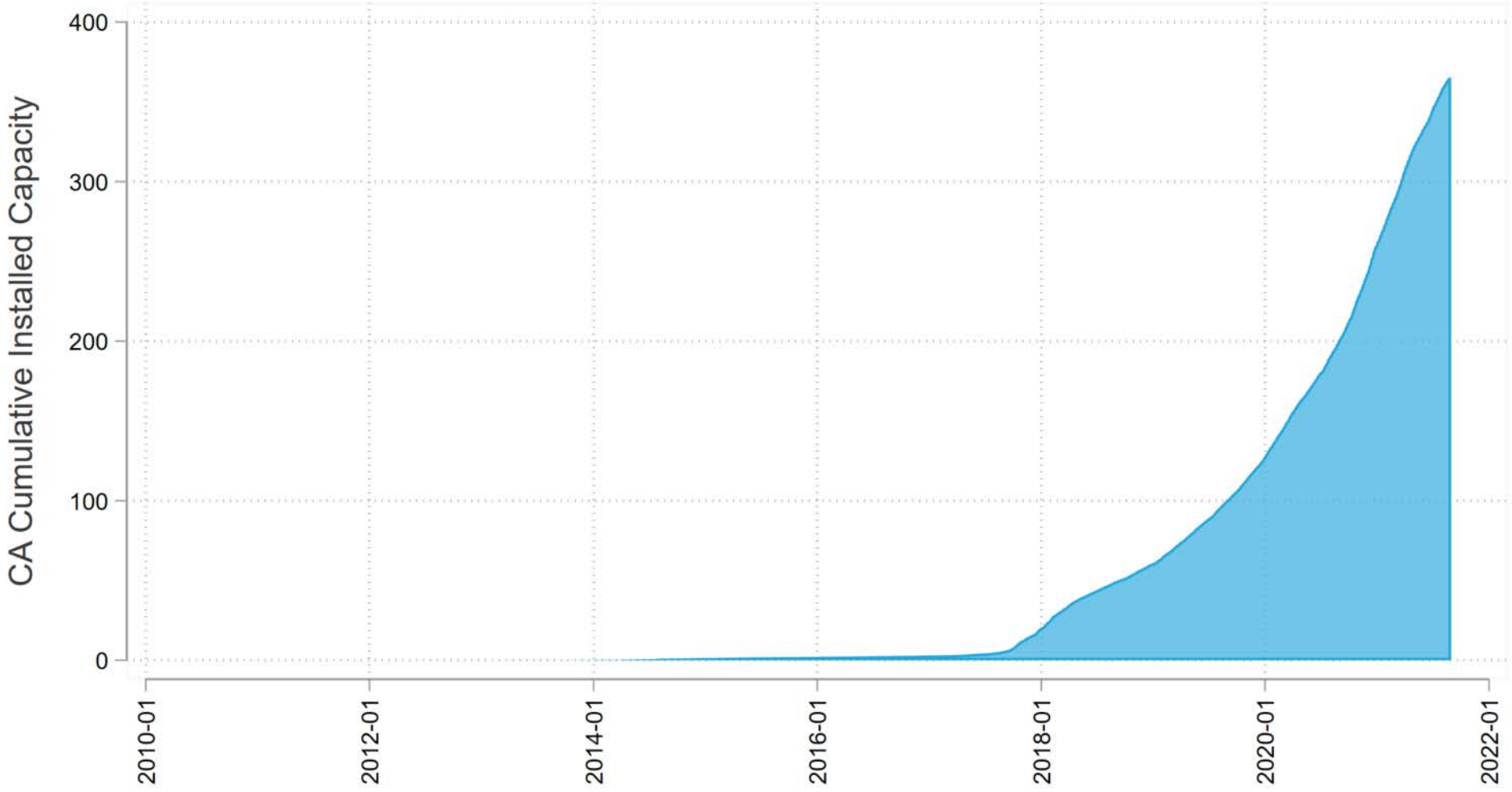
Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

AEIC/WLRA FALL 2021 CONFERENCE, OCTOBER 28, 2021

TODAY'S PRESENTATION

- Background
- Key research questions
- Study design

THERE HAS BEEN A LARGE INCREASE IN INSTALLED RESIDENTIAL STORAGE CAPACITY OVER THE LAST 5 YEARS*



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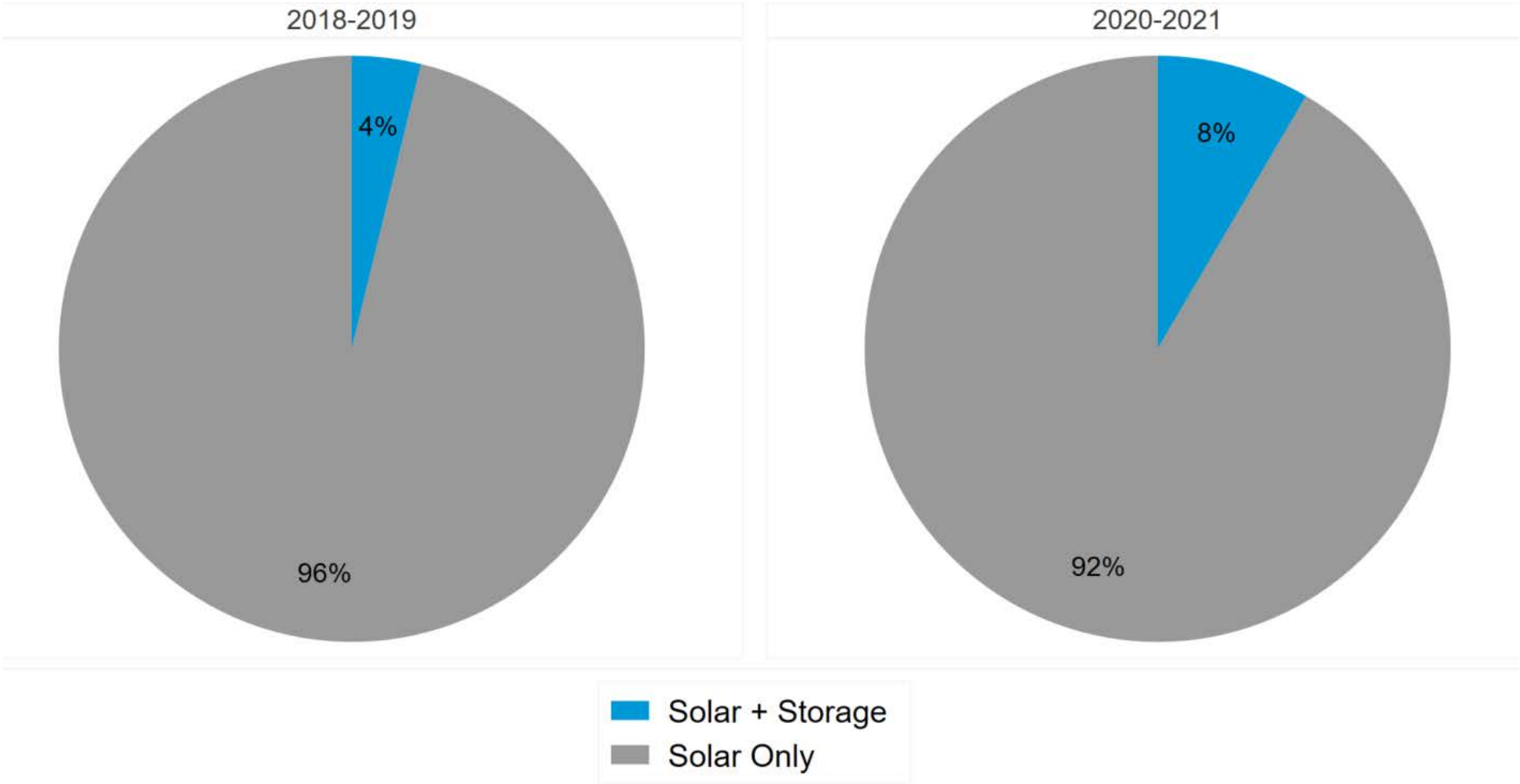
* Graph based on CA installations

THE % OF SOLAR SITES BEING PAIRED WITH STORAGE IS INCREASING*



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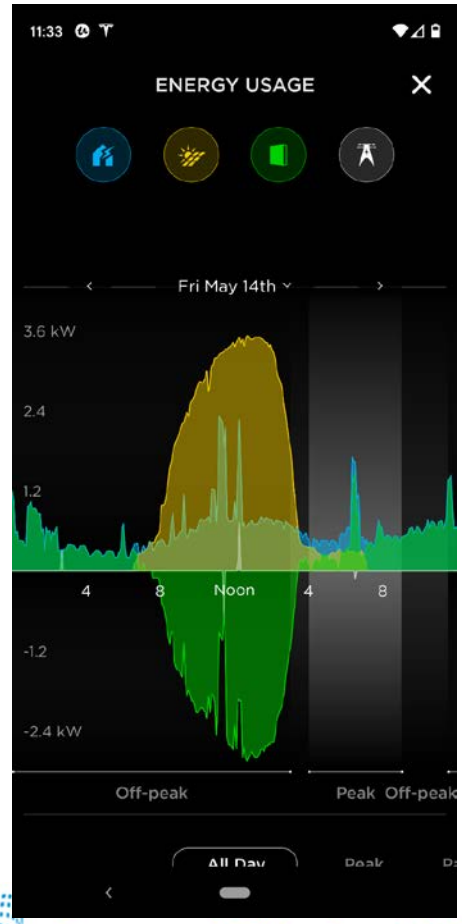
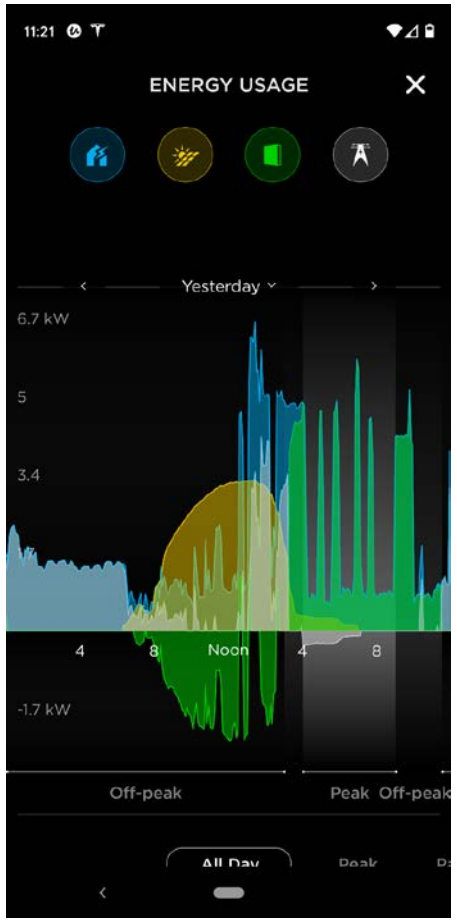
* Graph based on CA installations

HOW IS BEHIND THE METER BATTERY STORAGE BEING USED? (SAMPLE BATTERIES – SELECTED DAYS)

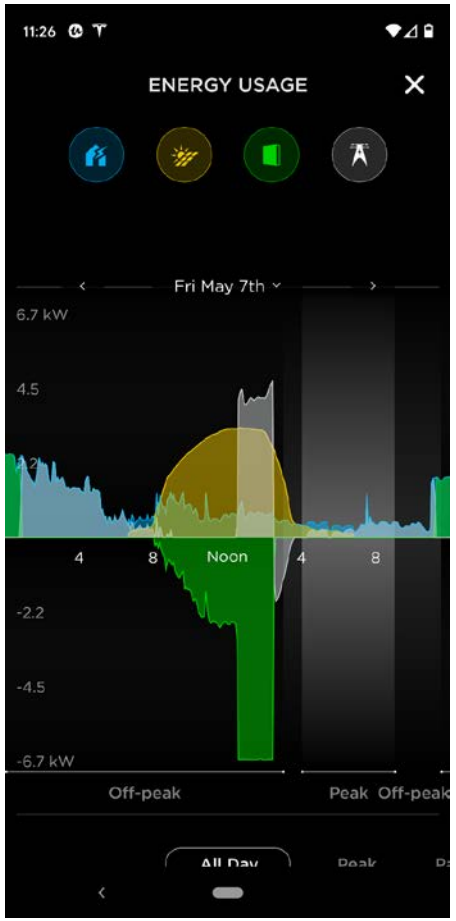
Off-Grid



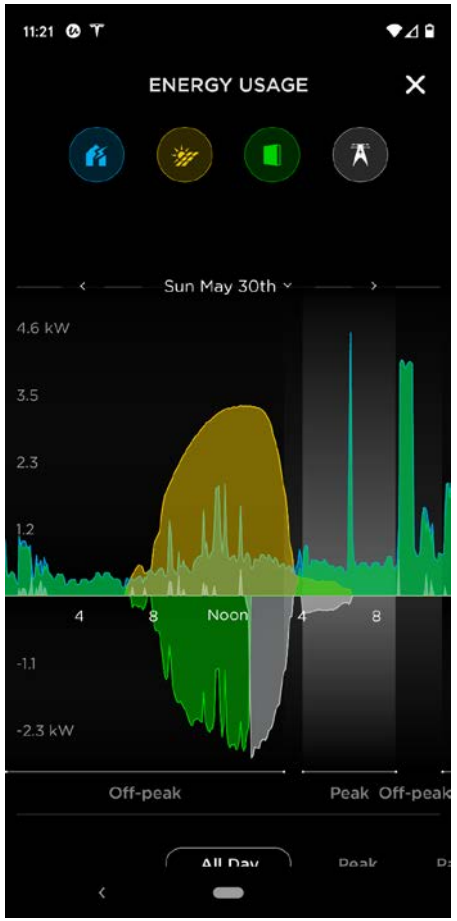
Charge off-peak



Fully charge mid-day



Contribute to the ramp



- Batteries are absorbing customer solar generation and helping meet customer loads
- They are not being used to meet grid needs
- They typically charge as soon as solar production ramps up
- They don't always solve ramping needs because they often reach full capacity mid-day to early afternoon
- They rarely export to the grid

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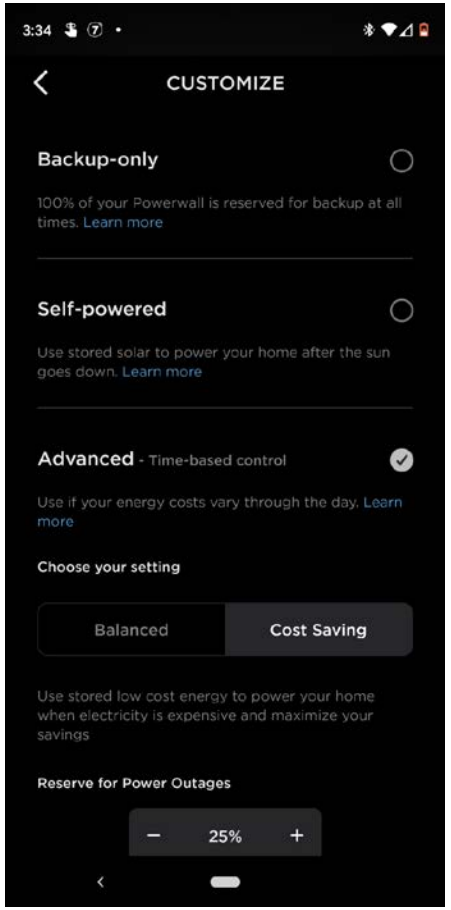
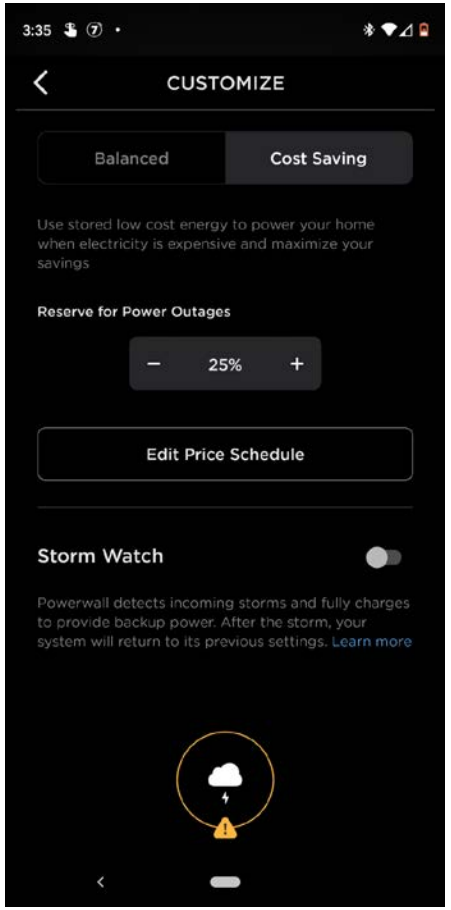
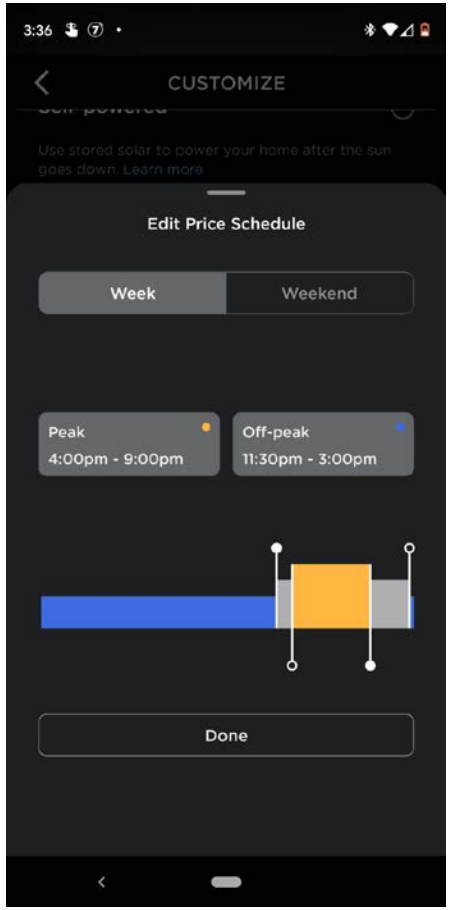
THE CUSTOMER BATTERY SETTINGS OPTIONS MATTER AND VARY BY PROVIDER







- Tesla main modes
  - Back-up only
  - Self-powered
  - Time of use balanced
  - Time of use cost saving
- Time of use only works if the user edits the price schedule
- % Reserved for power outages
- Storm-watch

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PHASE I KEY RESEARCH QUESTIONS

What are the enrollment rates for existing battery storage?

How do incentive levels and amount of outreach affect participation rates for existing battery owners?

What are the enrollment rates for solar intercepts (battery storage offered to sites installing solar)?

How are battery storage customers using the storage on their own?

- What are the settings? Back-up only, self-powered, or time based response?
- How much power do people reserve for backup?
- What are typical charge and discharge patterns?
- How well does their "natural battery use" with grid needs? What is the untapped value
- Do the use patterns vary by rate type, solar-ownership, EV ownership?

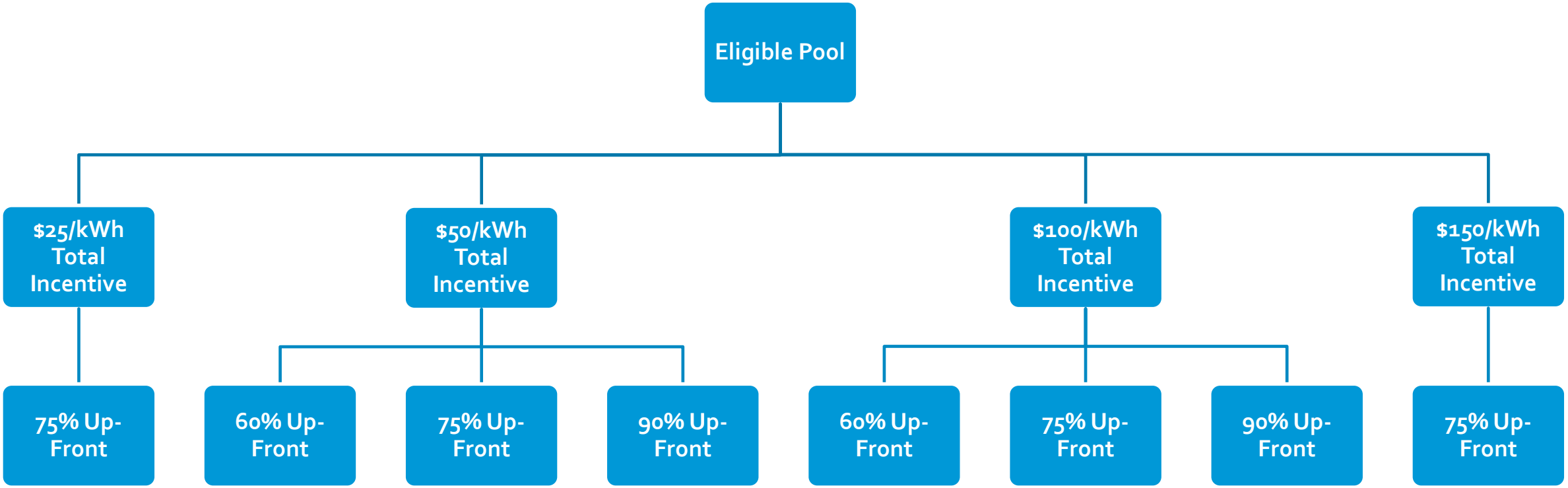
What are the load changes associated with:

- TOU
- RTP
- Event based response
- Load shaping events

PHASE II KEY RESEARCH QUESTIONS

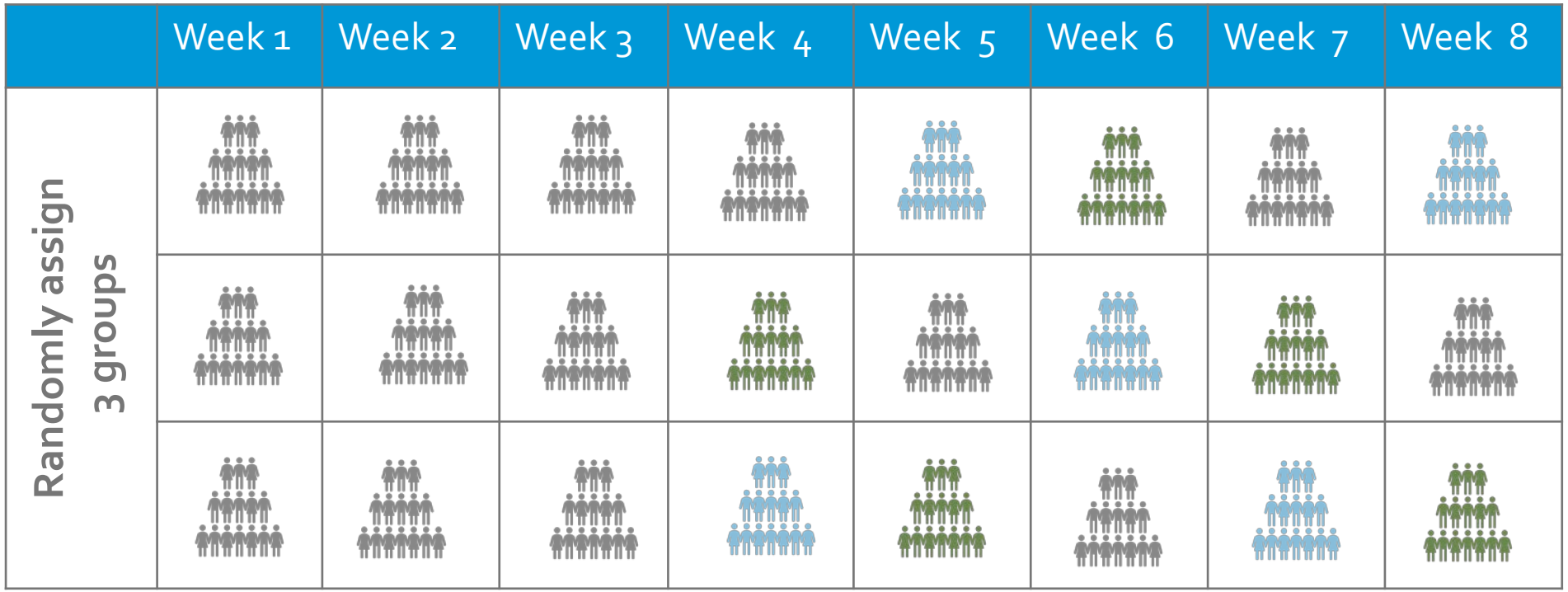
- How quickly do the batteries respond (latency) to external instructions?
- Can we feed specific discharge (e.g., T&D load relief) and or charge shapes (e.g., load building) to the batteries?
- Are the batteries able to respond to over/under frequency and voltage?
- What use cases can be stacked realistically?
- What baseline methods, if any, should be used?
- How effective are existing algorithms?
- Is the technology ready for a program?
- What is the optimal design and cost-effectiveness of a battery storage program?

STUDY ENROLLMENT DESIGN TESTS



STUDY DESIGN – PHASE I

Phase I Sample Baseline Period – Assess Data & Implement Pricing



Control TOU RTP

- How are customers using storage on their own?
- What are the load changes associated with TOU?
- What are the load changes associated with RTP?

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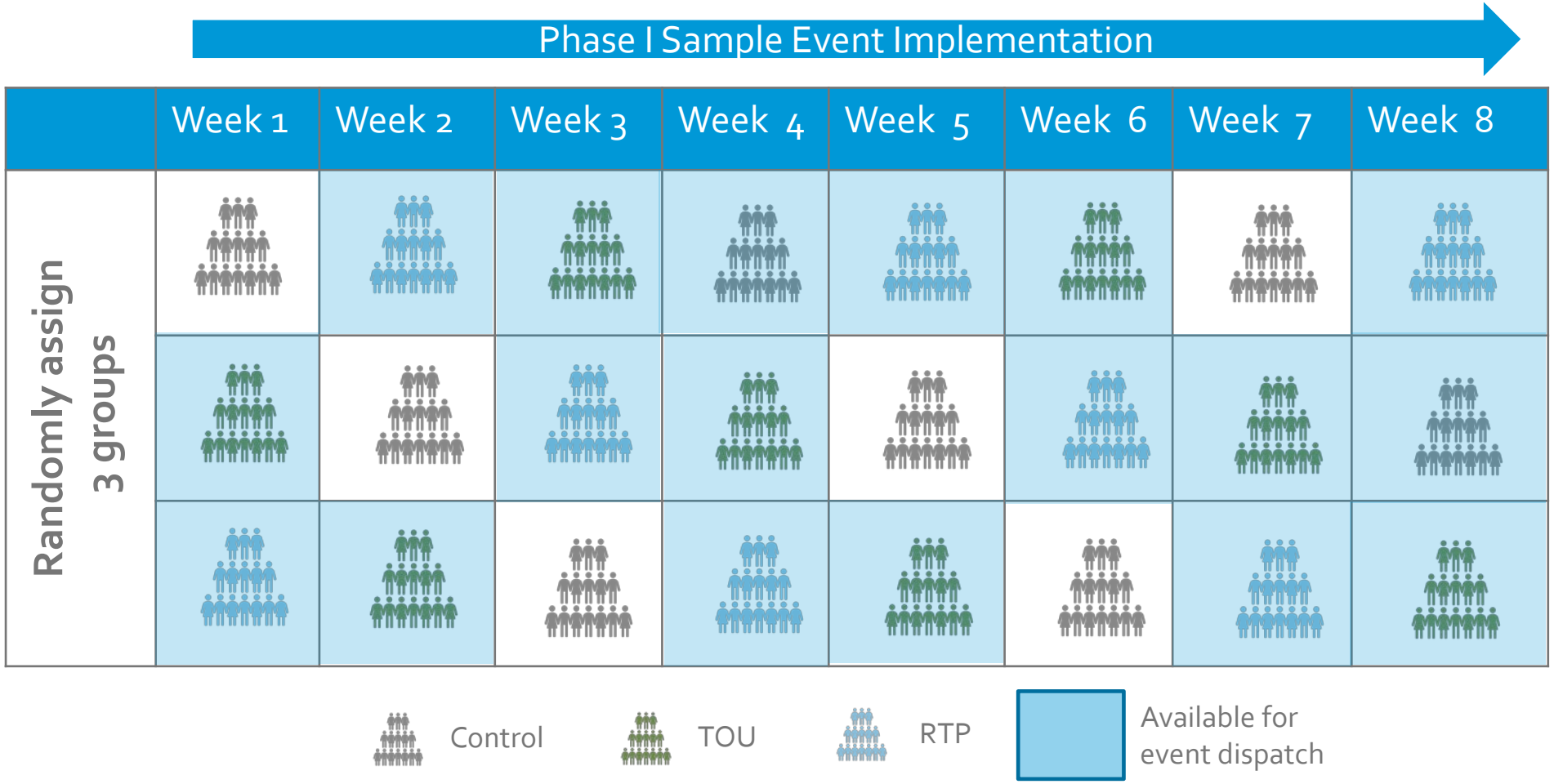
STUDY DESIGN – PHASE I



- What are the load changes associated with:
  - Event only - e.g., give us what you can from 4 hours, starting at 5 pm
  - Load modifying event – provide a utility specified discharge (or charge shape)

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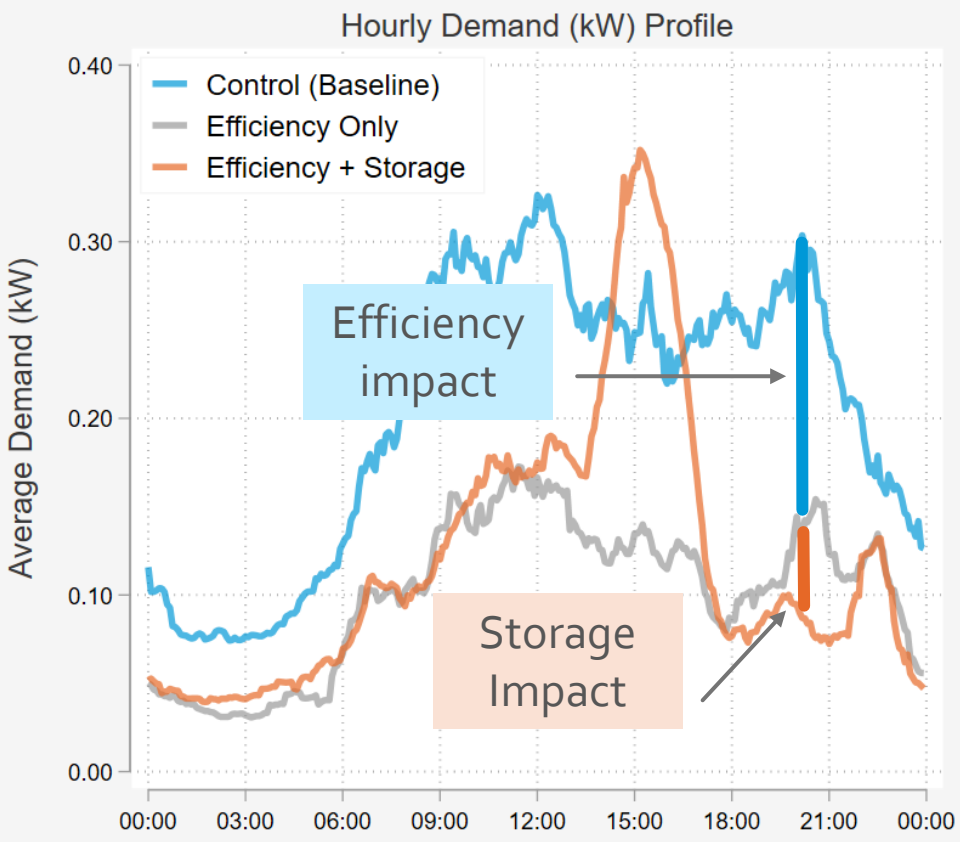
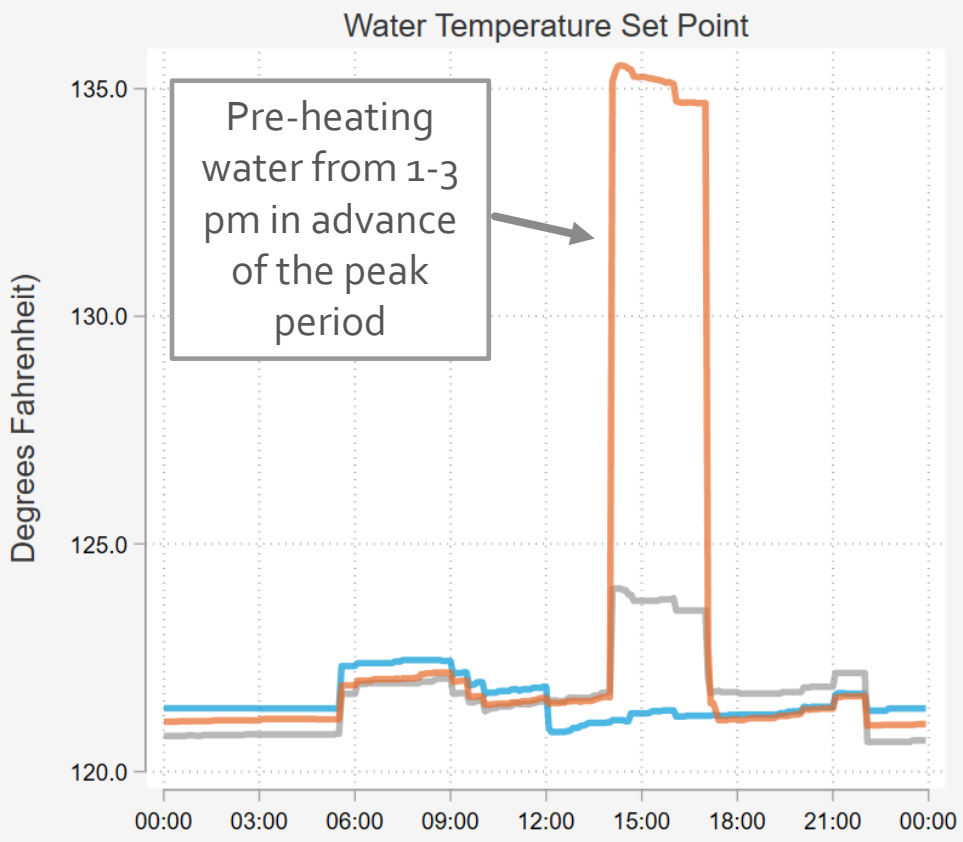
EXAMPLE OF THE STUDY DESIGN: HEAT PUMP WATER HEATERS

Efficiency 0.15 kW per unit (4-9 pm)
+
Storage 0.03 kW per unit (4-9 pm)





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OPERATIONS PLAN – WHAT TO TEST

Event Type	Advance notice	Event duration	Event start	Weather conditions	Season	Day of week
Block reduction (discharge)	24 hours	15 minutes	12:00 PM	Very hot	Winter	Weekday
Load reduction shape (discharge)	6 hours	1 hour	1:00 PM	Hot	Summer	Weekend
Zero building use (discharge)	3 hour	2 hours	2:00 PM	Moderate	Shoulder	
Block load building (charge)	1 hour	3 hours	3:00 PM	Cloudy/rainy		
Load building shape (charge)	10 min	4 hours	4:00 PM			
Absorb solar peak (charge)	0 min	5 hours	5:00 PM			
		6 hours	6:00 PM			
		7 hours	7:00 PM			

WHAT AN EVENT OPERATION PLAN MAY LOOK LIKE

Phase	Event No	Test Element	Event Type	Advance notice	Event start	Event duration	Weather conditions	Season	Day of Week
Phase I (First 6 months)	Base	Base	Block reduction (discharge)	24 hours	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	2	Advance notice	Block reduction (discharge)	***6 hours***	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	3	Advance notice	Block reduction (discharge)	***3 hour***	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	4	Advance notice	Block reduction (discharge)	***1 hour***	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	5	Event duration	Block reduction (discharge)	24 hours	4:00 PM	***2 hours***	Not Tested	Not Tested	Not Tested
	6	Event duration	Block reduction (discharge)	24 hours	4:00 PM	***6 hours***	Not Tested	Not Tested	Not Tested
	7	Event start	Block reduction (discharge)	24 hours	***2:00 PM***	4 hours	Not Tested	Not Tested	Not Tested
	8	Event start	Block reduction (discharge)	24 hours	***6:00 PM***	4 hours	Not Tested	Not Tested	Not Tested
	9	Event Type	***Load reduction shape (discharge)***	24 hours	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	10	Advance notice	Load reduction shape (discharge)	***6 hours***	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	11	Advance notice	Load reduction shape (discharge)	***3 hour***	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	12	Advance notice	Load reduction shape (discharge)	***1 hour***	4:00 PM	4 hours	Not Tested	Not Tested	Not Tested
	13	Event duration	Load reduction shape (discharge)	24 hours	4:00 PM	***2 hours***	Not Tested	Not Tested	Not Tested
	14	Event duration	Load reduction shape (discharge)	24 hours	4:00 PM	***6 hours***	Not Tested	Not Tested	Not Tested
	15	Event start	Load reduction shape (discharge)	24 hours	***2:00 PM***	4 hours	Not Tested	Not Tested	Not Tested
	16	Event start	Load reduction shape (discharge)	24 hours	***6:00 PM***	4 hours	Not Tested	Not Tested	Not Tested

QUESTIONS?

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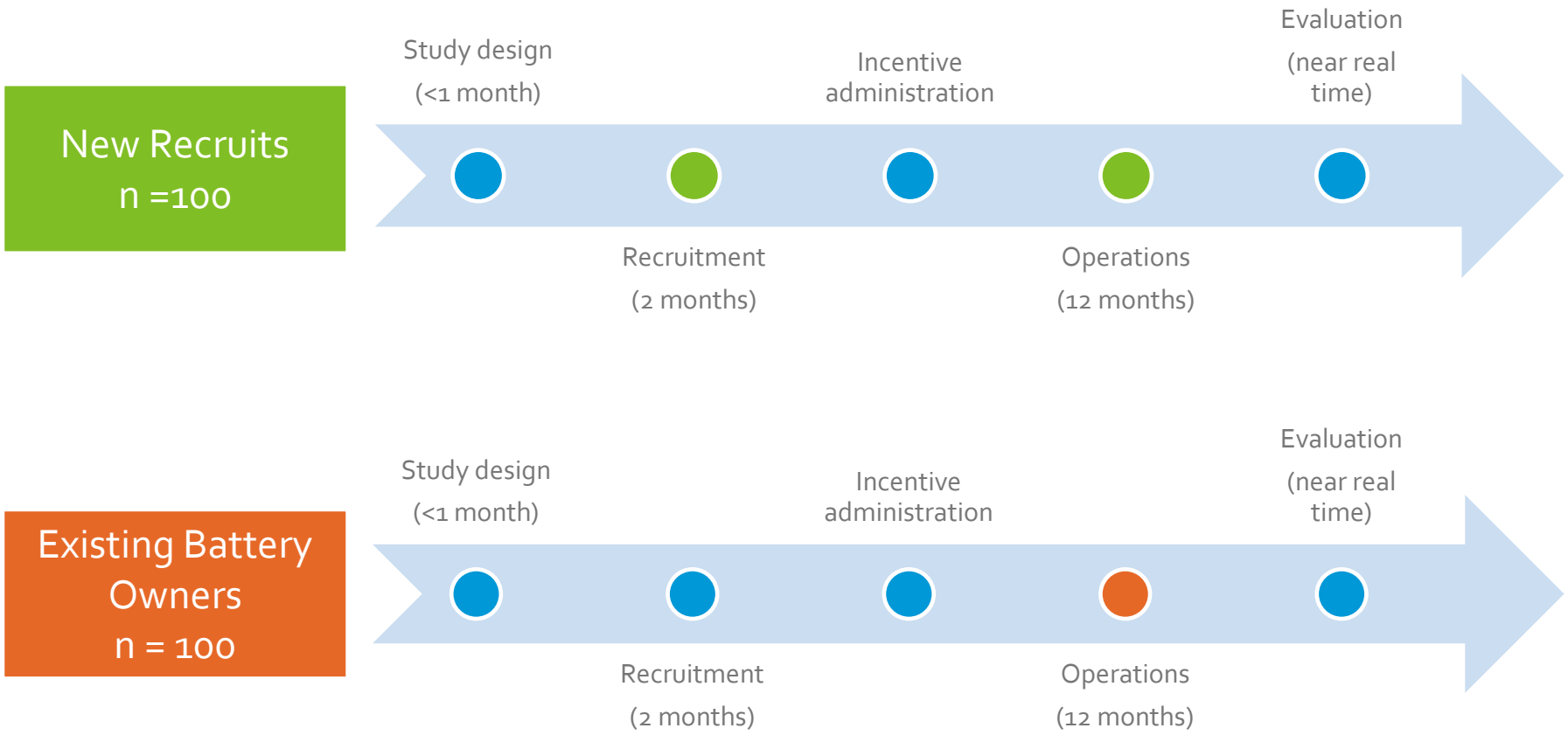
ADDITIONAL SLIDES

STUDY GOALS

- Determine if battery storage is ready to be added to future residential pilot programs and provide:
  - **Reliable load reduction** – ability to deliver the amount of load reduction that is promised
  - **Meaningful load reduction** –when and how battery storage can provide value to the grid in DR programs
  - **Cost-effectiveness** – ensure DR Programs remain cost effective with battery storage
- Assess additional grid services that batteries can provide, including:
  - **Speed of response** –the speed of distributed battery storage response
  - **Load building** – the ability to increase minimum load and thus decrease ramping capacity needs and increase hosting capacity
- Increase number of customers with battery storage participating in DR programs:
  - Identify how to remove significant barriers for DER aggregators and their customers to use battery storage when participating in DR programs

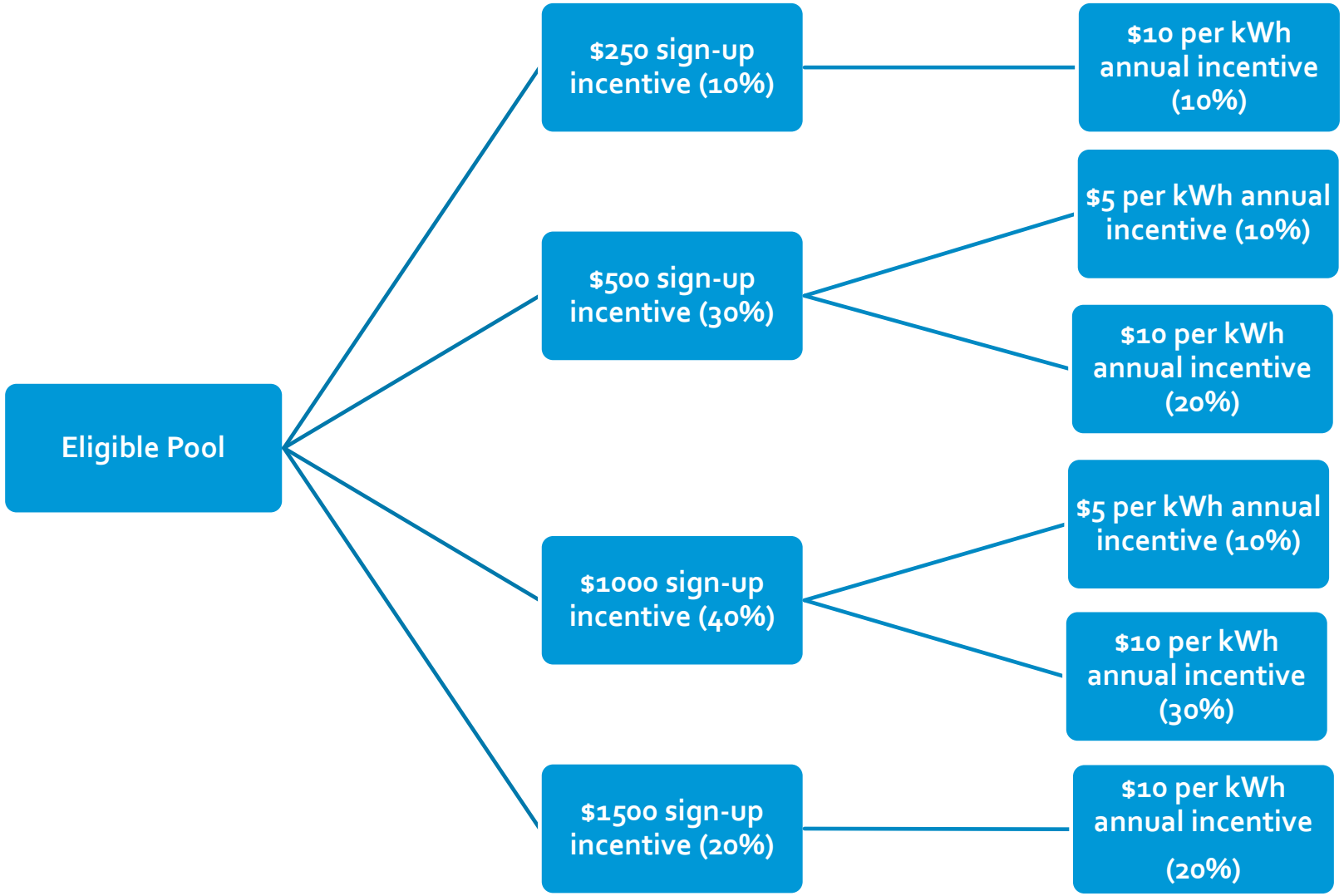
BACKGROUND AND OVERVIEW



Program design elements

- TOU
- RTP signals
- Event based DR
- Load shaping events
- Ancillary services
  - Contingency reserves
  - Frequency regulation
  - Under frequency/voltage relays

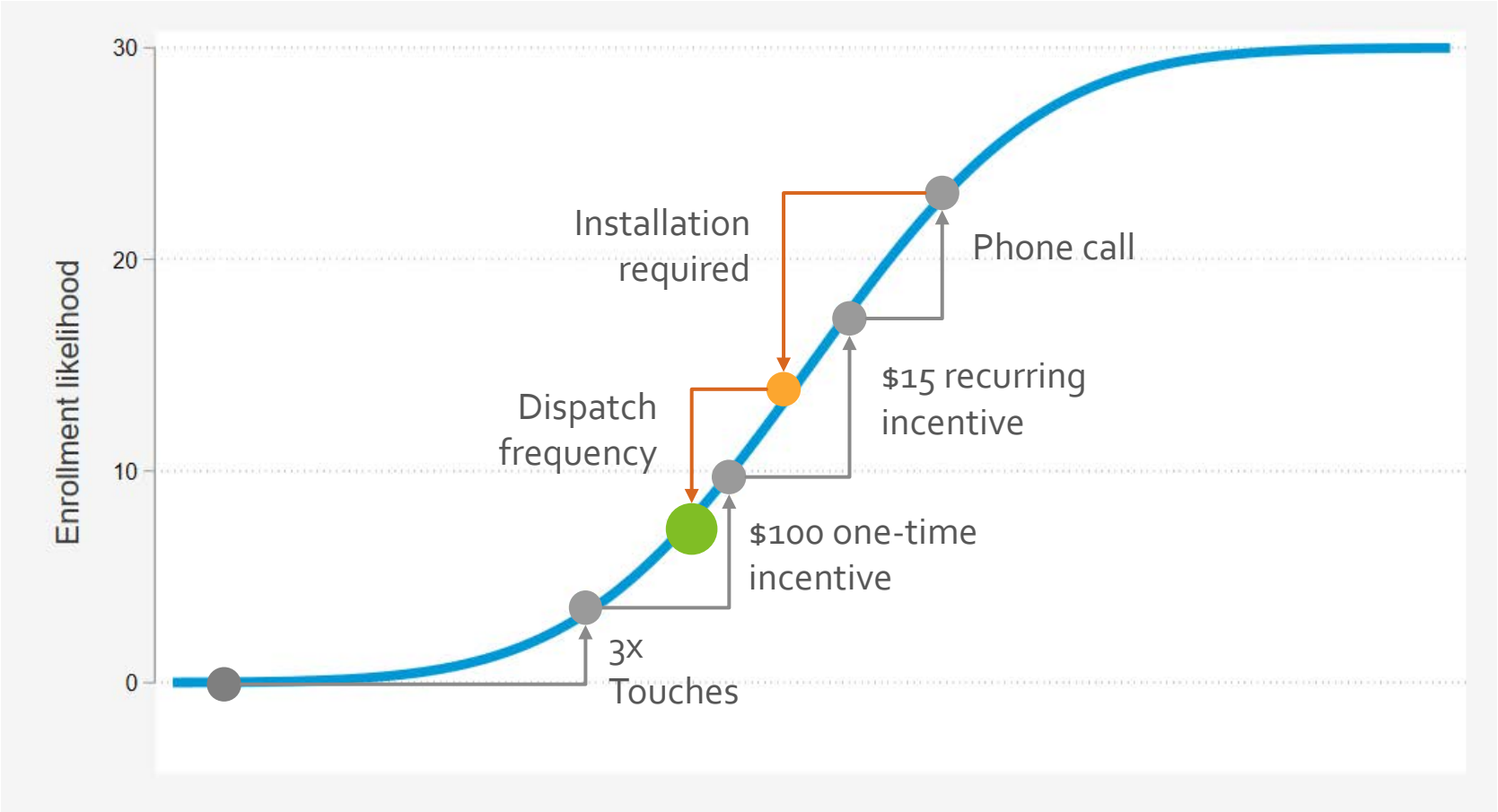
STUDY DESIGN ENROLLMENT TESTS



ESTIMATING THE IMPACTS OF OUTREACH & INCENTIVE

Marketing, incentives, and program characteristics affect the likelihood of adoption

- Avg. Customer
- ↑ 3x touches
- ↑ $100 one-time incentive
- ↑ $15 recurring incentive
- ↑ Phone call
- ↓ Installation required
- ↓ Dispatch frequency



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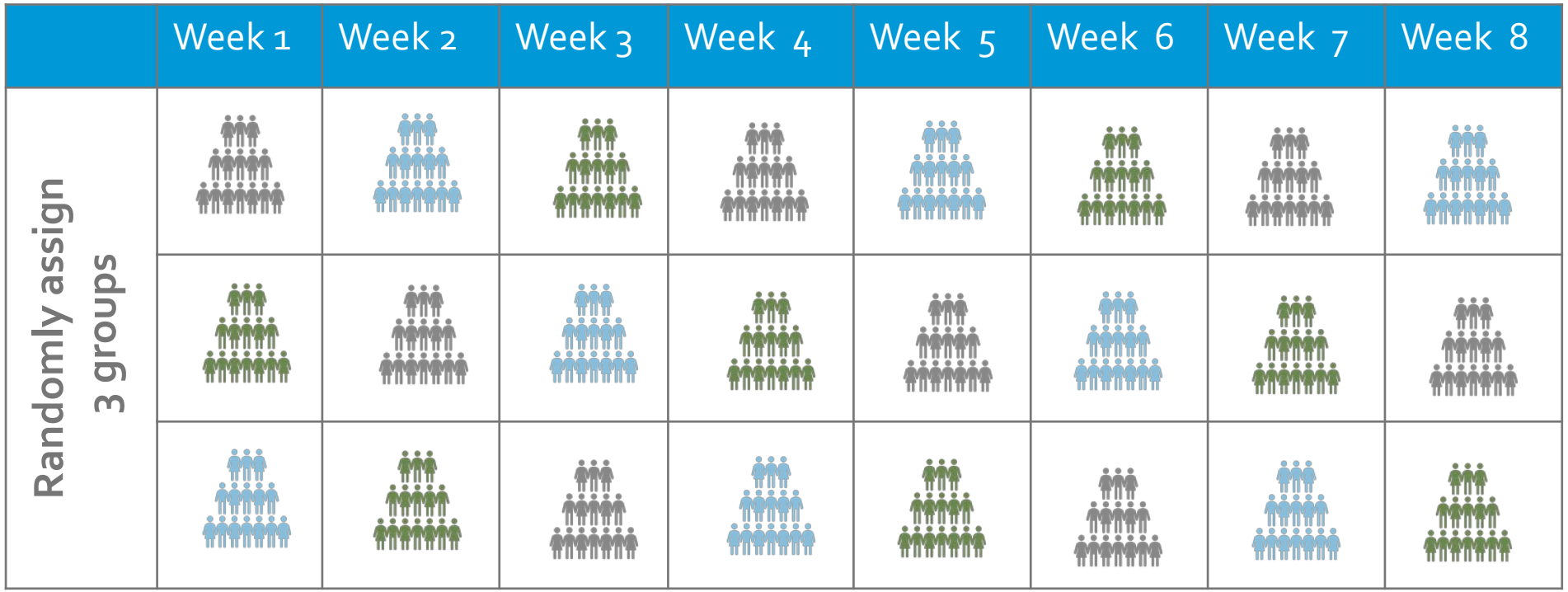
STUDY DESIGN – PHASE II

Phase II Advanced Controls



Control TOU RTP

- How quickly do the batteries respond (latency) to external instructions?
- Contingency reserves
- Regulation
- Battery performance for over/under frequency and voltage

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