

# Unlocking Battery Value Streams for Utility Programs

E Source Webinar 3/25/26



# Speaking with you today



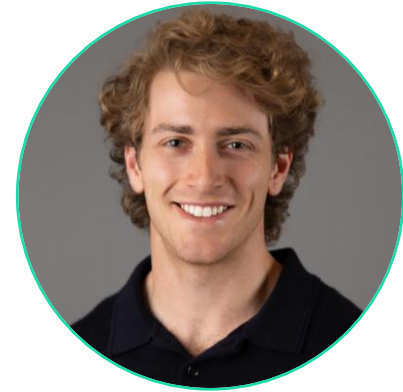
Michael Hartnack

Sr. Director, Customer Energy Solutions



Malcolm Hansell

Analyst, DER Strategy



Ben Campbell

Manager, Battery Research



Bryan Jungers

Principal, Emerging Technologies,  
**Tucson Electric Power**



Kristin Gaspar

Principal Strategy & Planning Consultant,  
Integrated System Planning, **Xcel Energy**

# Agenda

1. Introduction
2. US Battery Market Update and Trends
3. Battery Program Catalog Overview & Value Stream Trends
4. Tucson Electric Power
5. Xcel Energy
6. Q&A

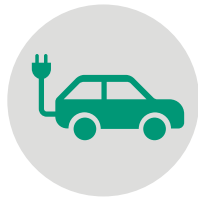
# Market drivers for leveraging advanced load flexibility and battery programs

## Capacity and T&D constraints



Supply retirements and variability, interconnection backlog, aging distribution infrastructure

## Load growth



Hundreds of GW in load growth and capacity shortfalls in most 2030 national scenarios

## Growth in app-based DERs



Unprecedented growth in load-connected, app-based devices (e.g., smart thermostats)

## Energy burden



Rate increases outpacing inflation; 1/6 of customers behind on energy bills

## Policy & market shifts



Increased aggregator activity; opening of DR markets to customers; utility program scale-up

**Drivers position load flexibility and batteries as a low cost and scalable resource to deliver capacity and grid services**

# Battery Market and Technology Update

# Annual US BTM ESS installation forecasts

## Residential

24,000

20,000

16,000

12,000

8,000

4,000

0

2020

2036

## C&I

8,400

7,000

5,600

4,200

2,800

1,400

0

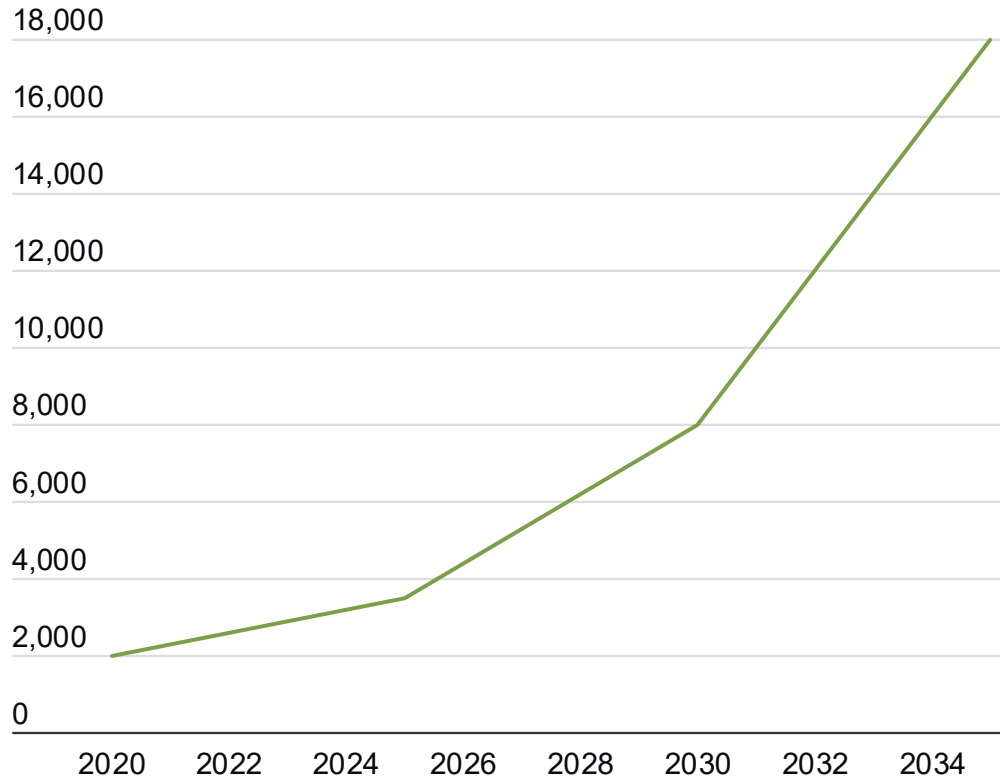
2020

2036

# Better durability will improve incentive value for customers

## Battery cycle life

— Number of cycles to 80% state of health



## Battery cost per cycle

— Cost per cycle

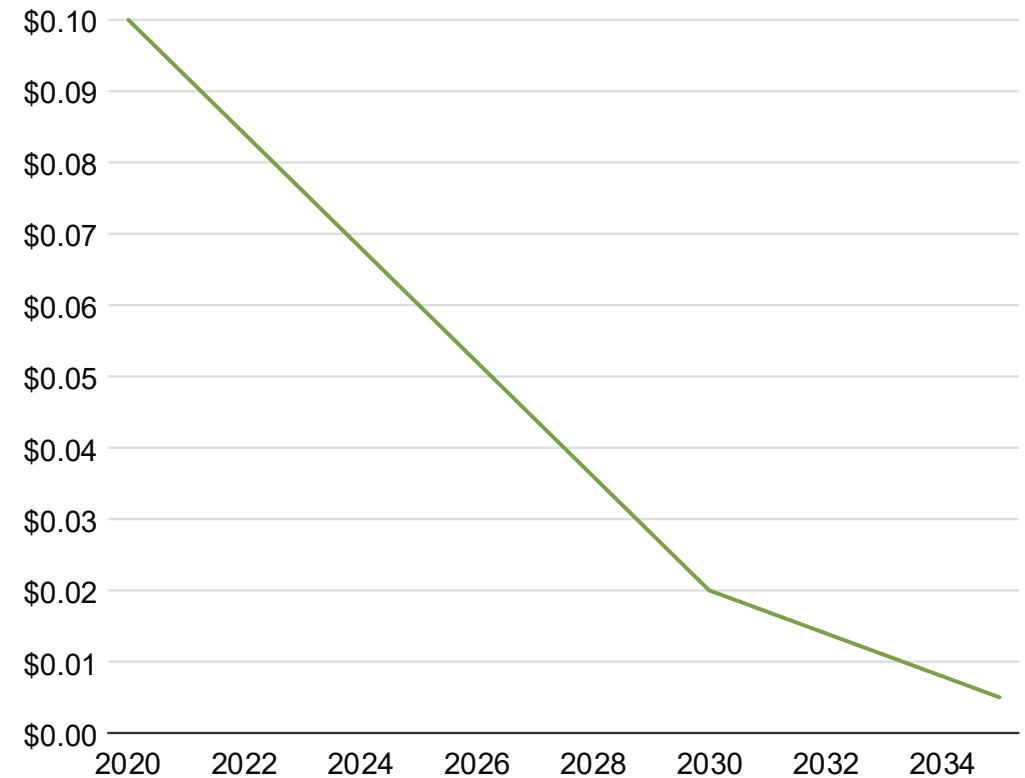


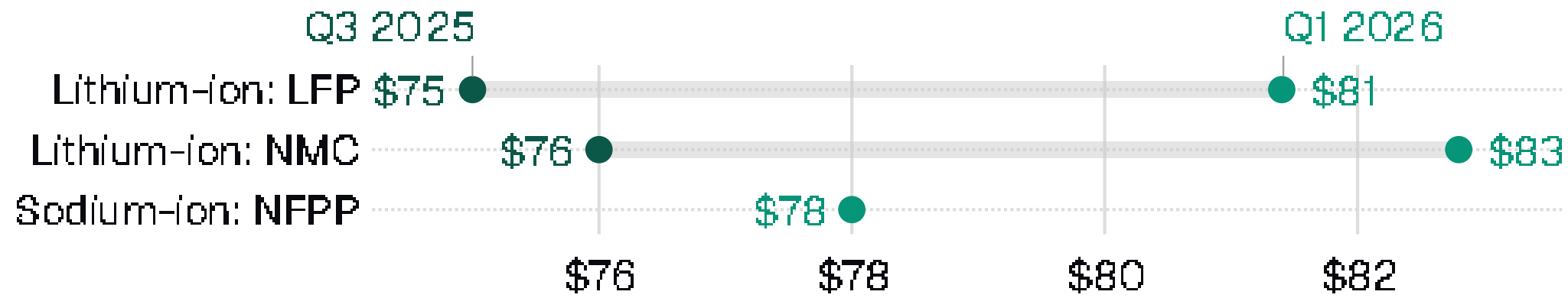
Chart: © E Source

Chart: © E Source

# Rising lithium prices open door for emerging tech

## Battery cell price change

\$/kWh



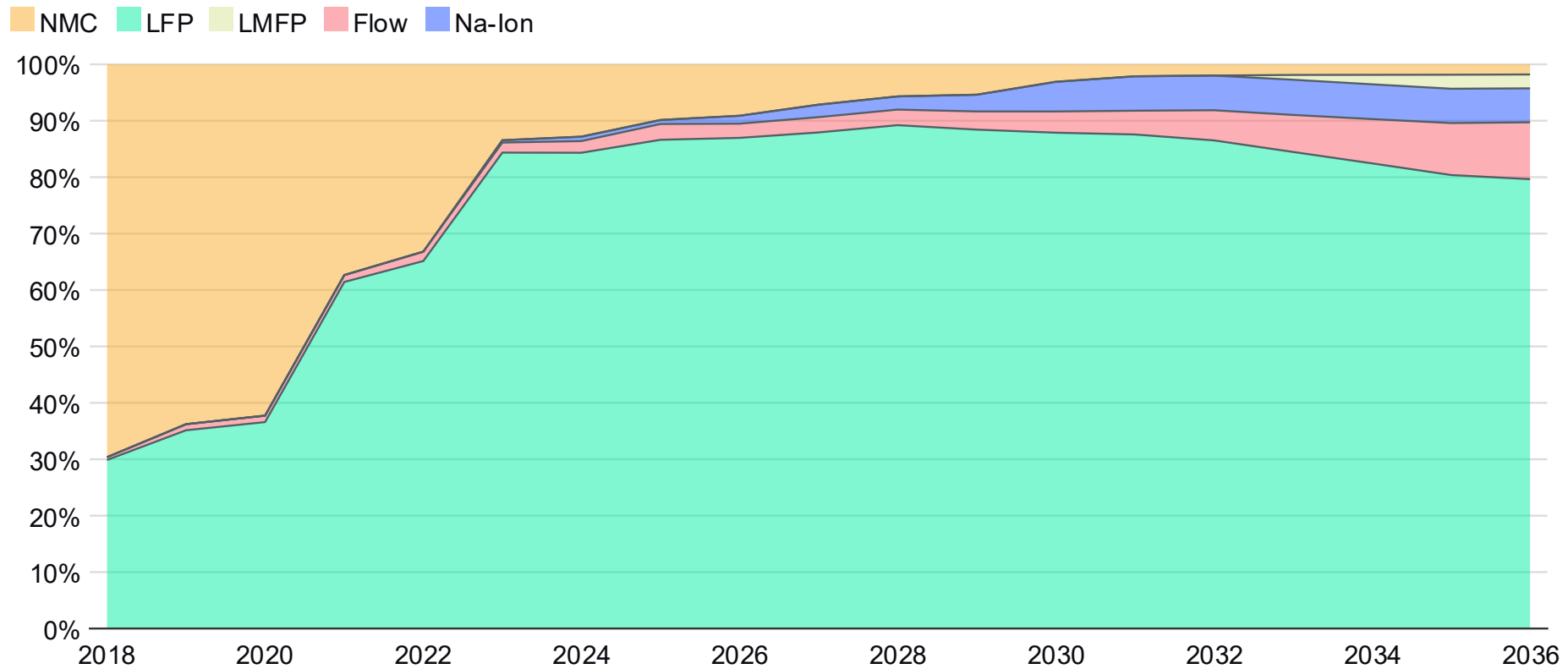
Notes: LFP = Lithium iron phosphate. NMC = Nickel manganese cobalt. NFPP = Sodium ferric pyrophosphate

Source: E Source Battery Cost Model

**As lithium prices rise, the increasing raw-material cost burden on lithium-ion batteries makes sodium-ion chemistries cost competitive.**

# Safety concerns & permitting challenges help emerging chemistries gain traction

## Global ESS market share



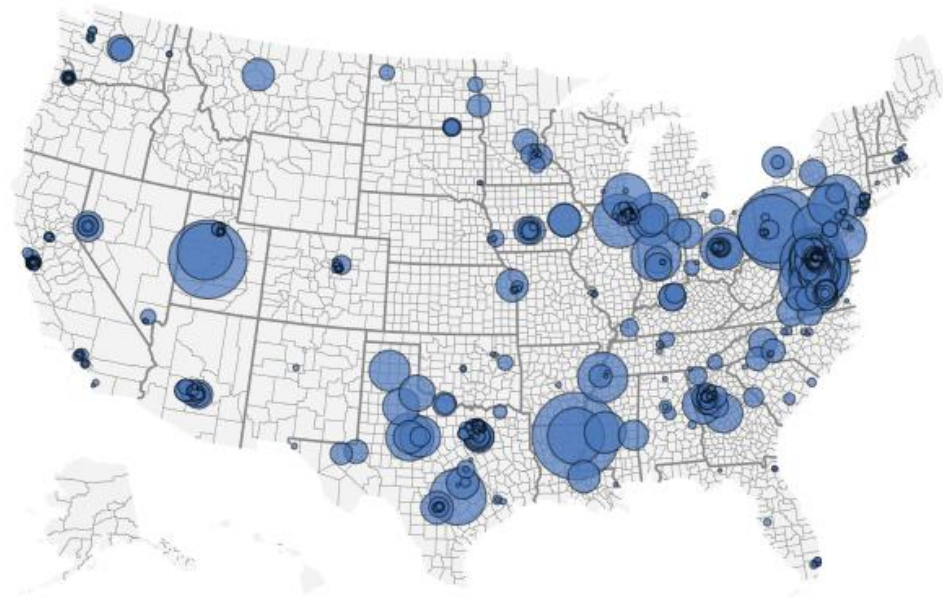
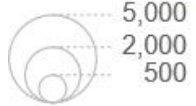
NMC = nickel manganese cobalt; LFP = Lithium iron phosphate; LMFP = Lithium manganese iron phosphate; Na-ion = sodium ion.

Source: E Source

# BTM ESS can directly support data-center load growth

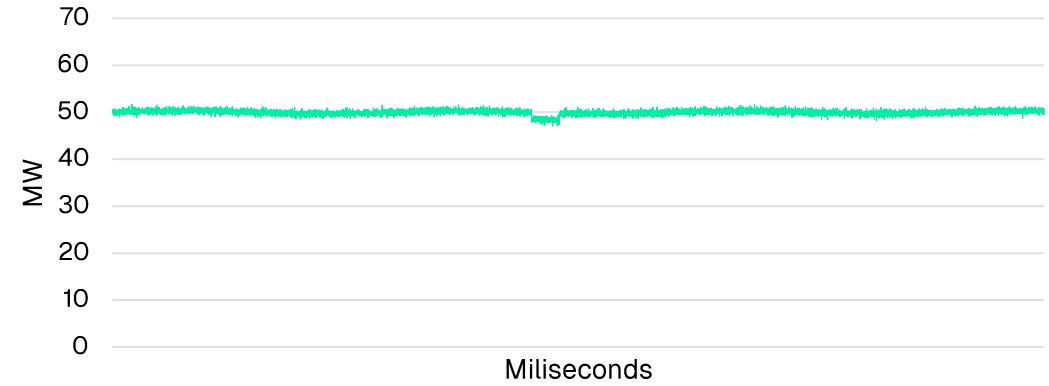
## Data center pipeline to 2036

Nameplate Capacity (MW)

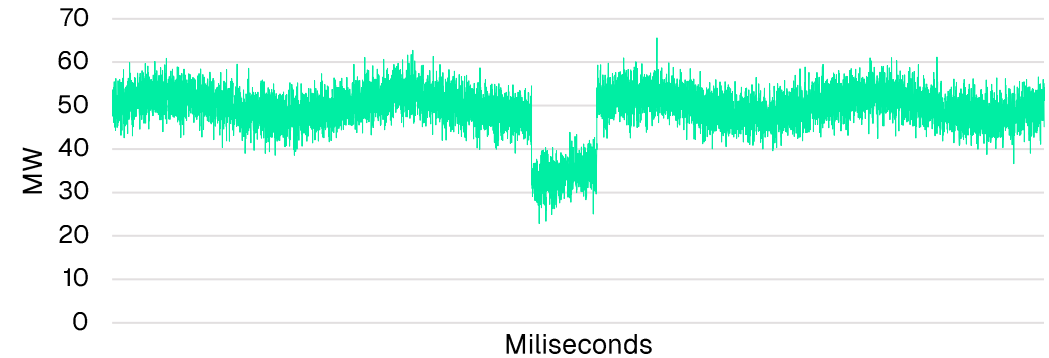


Map: © E Source

## Non-AI workload: 1.5 MW swing



## AI workload: 15 MW swing



Source: E Source, adapted from Google

Recently published: [The evolving role of energy storage systems in AI data center load management](#)

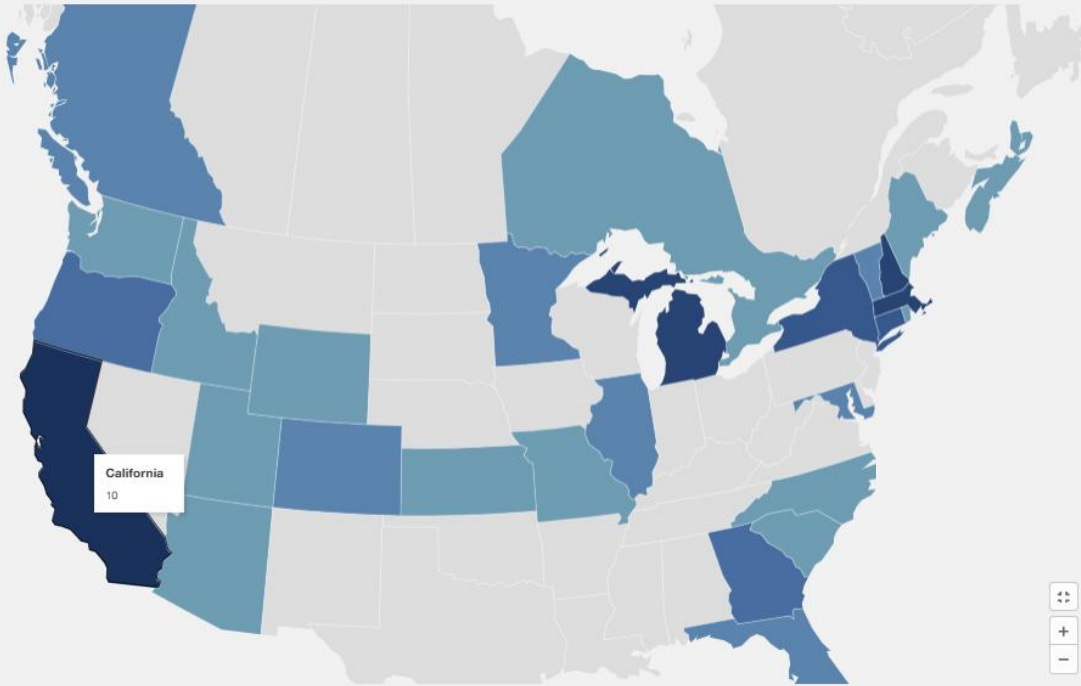
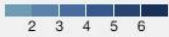
# Battery Program Value Streams

**E Source Research: Malcolm Hansell**

# Active battery storage pilots and programs in the US and Canada

## State and province distribution of battery programs and pilots in the 2025 catalog

California has the most pilots and programs featured in our battery programs and pilots catalog. Our catalog highlights ongoing programs, and it doesn't feature utility-scale programs. Some states not represented in our catalog have had successful pilots which have concluded, such as Nevada.



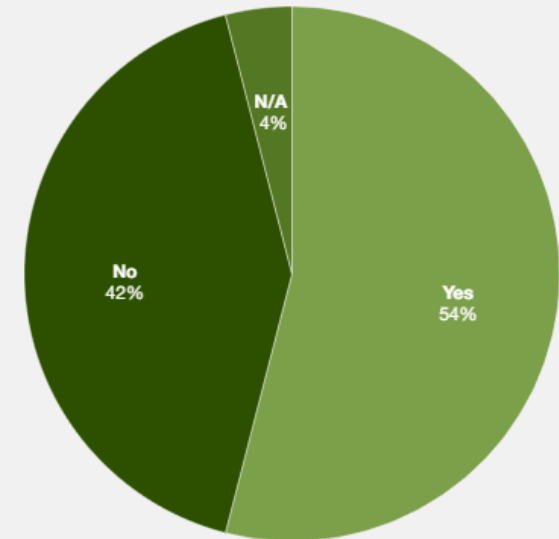
Note: Data from a review of 67 utility battery pilots and programs.

Map: © E Source • Source: 2025 updates for the battery pilots and programs catalog • [Get the data](#)

## Mandatory demand response enrollment for customer battery programs

We looked at the terms and conditions of each program to see if customers are required to participate in demand response. Fifty-four percent of the utility programs we reviewed had demand response participation requirements. For some programs, these requirements consist only of behavioral incentives. Others require customer-sited batteries to be dispatchable by the utility or a third-party DER management system.

■ Yes ■ No ■ N/A

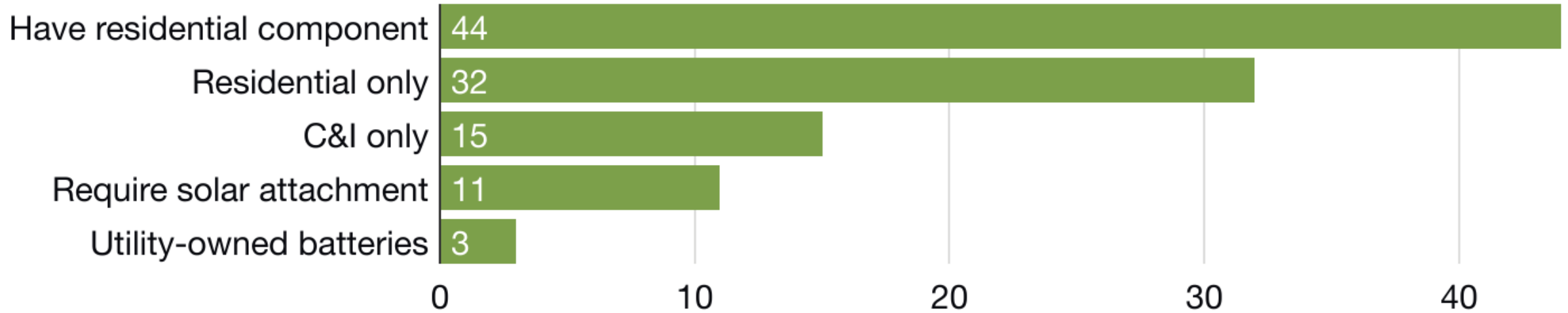


Note: Data from a review of 67 utility battery pilots and programs.

Chart: © E Source • Source: 2025 updates for the battery pilots and programs catalog • [Get the data](#)

# Number of battery programs with various components

Out of 61 programs, most have a residential component. Some require a solar attachment. Only a few programs have utility-owned batteries.



Data from a review of 61 utility battery pilots and programs.

Chart: © E Source • Source: Active battery storage pilots and programs in the US and Canada

[Active battery storage pilots and programs in the US and Canada](#)

# Battery catalog program design features

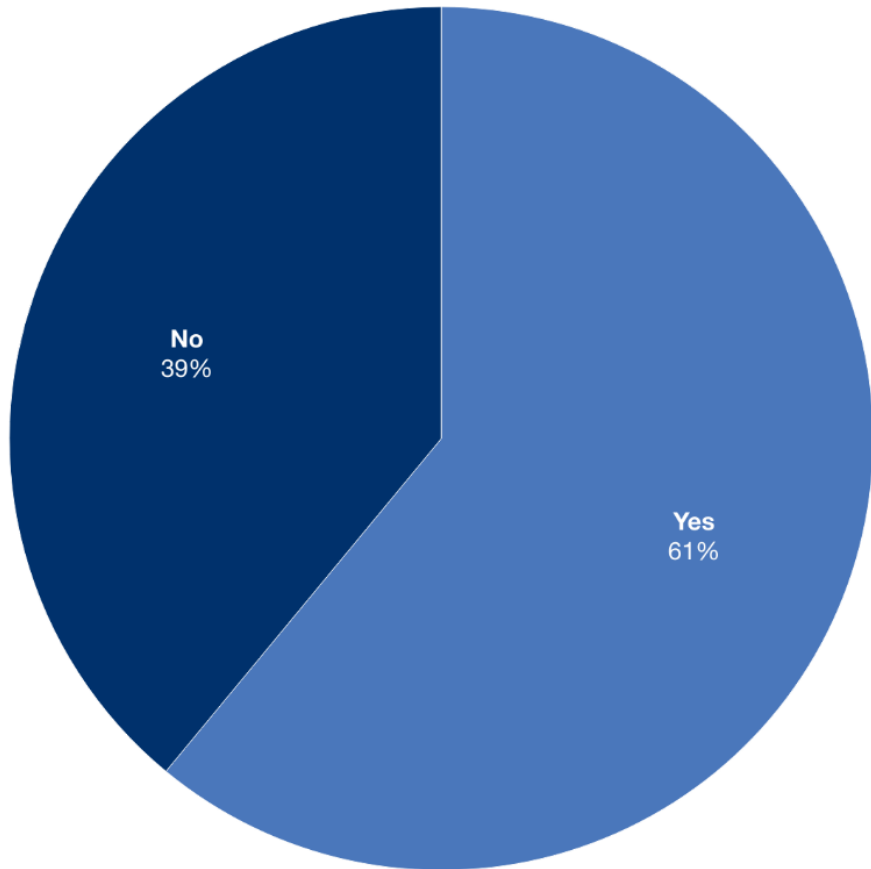
Program Sector	Incentive type	Mean incentive	Event Season	Mean # events	Event length	Opt-out penalties	Dispatch strategy	Primary value stream	Enrolling existing battery owners?
<b>All (n=61)</b>	61% offer upfront, 18% offer performance	\$294/kWh, \$200/kW	Almost always summer	up to 60	2-3 hours on average	Sometimes	Mixed	Peak Load Reduction	Often yes
<b>C&amp;I (n=16)</b>	56% offer upfront, 38% offer performance	\$340/kWh, \$200/kW*	Almost always summer	up to 60	2-4 hours on average	Dependent on shortfall	Direct load control, aggregator or DERMS	Peak Load Reduction	Mixed

[Active battery storage pilots and programs in the US and Canada](#)

## Percentage of battery programs that offer an upfront incentive or rebate

Most programs offer an upfront incentive. The average up-front rebate is \$294/kWh.

■ Yes ■ No



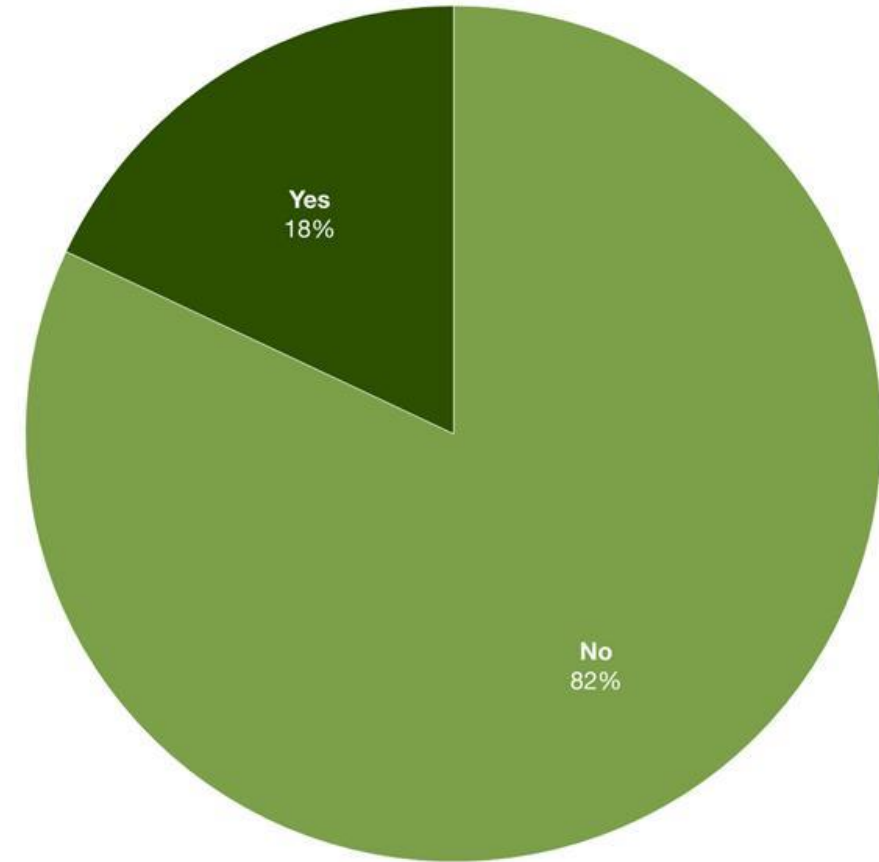
Average up-front rebate is based on the mean of options with ranges, includes base incentives only, and is only for programs with \$/kWh incentives. Data from a review of 61 utility battery pilots and programs.

Chart: © E Source • Source: Active battery storage pilots and programs in the US and Canada

## Percentage of battery programs that offer a performance incentive

Most programs don't offer a performance incentive. Of the programs that do, the average incentive per event is \$200/kW.

■ No ■ Yes

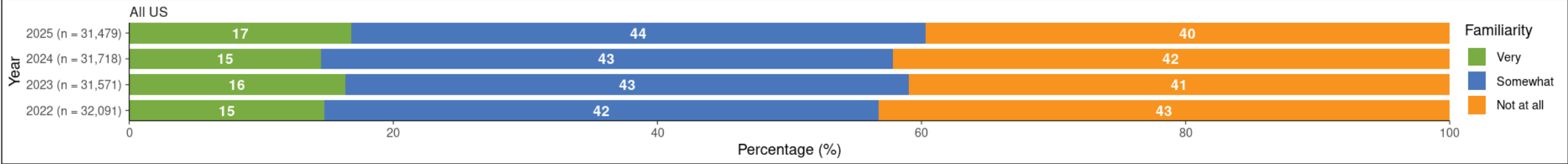


Data from a review of 61 utility battery pilots and programs.

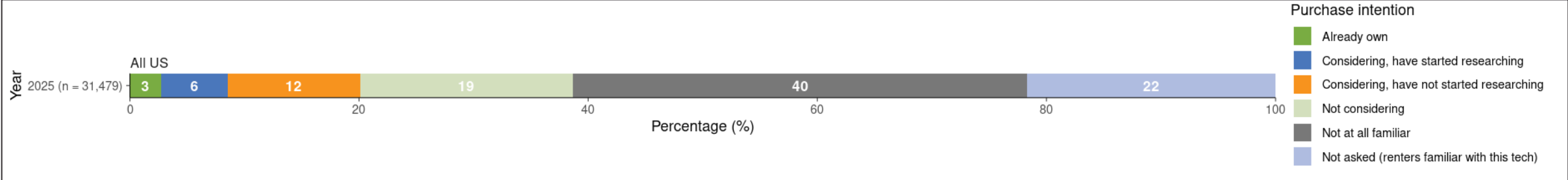
Chart: © E Source • Source: Active battery storage pilots and programs in the US and Canada

# E Source Residential Customer Insights Center

Familiarity with battery storage, all customers:

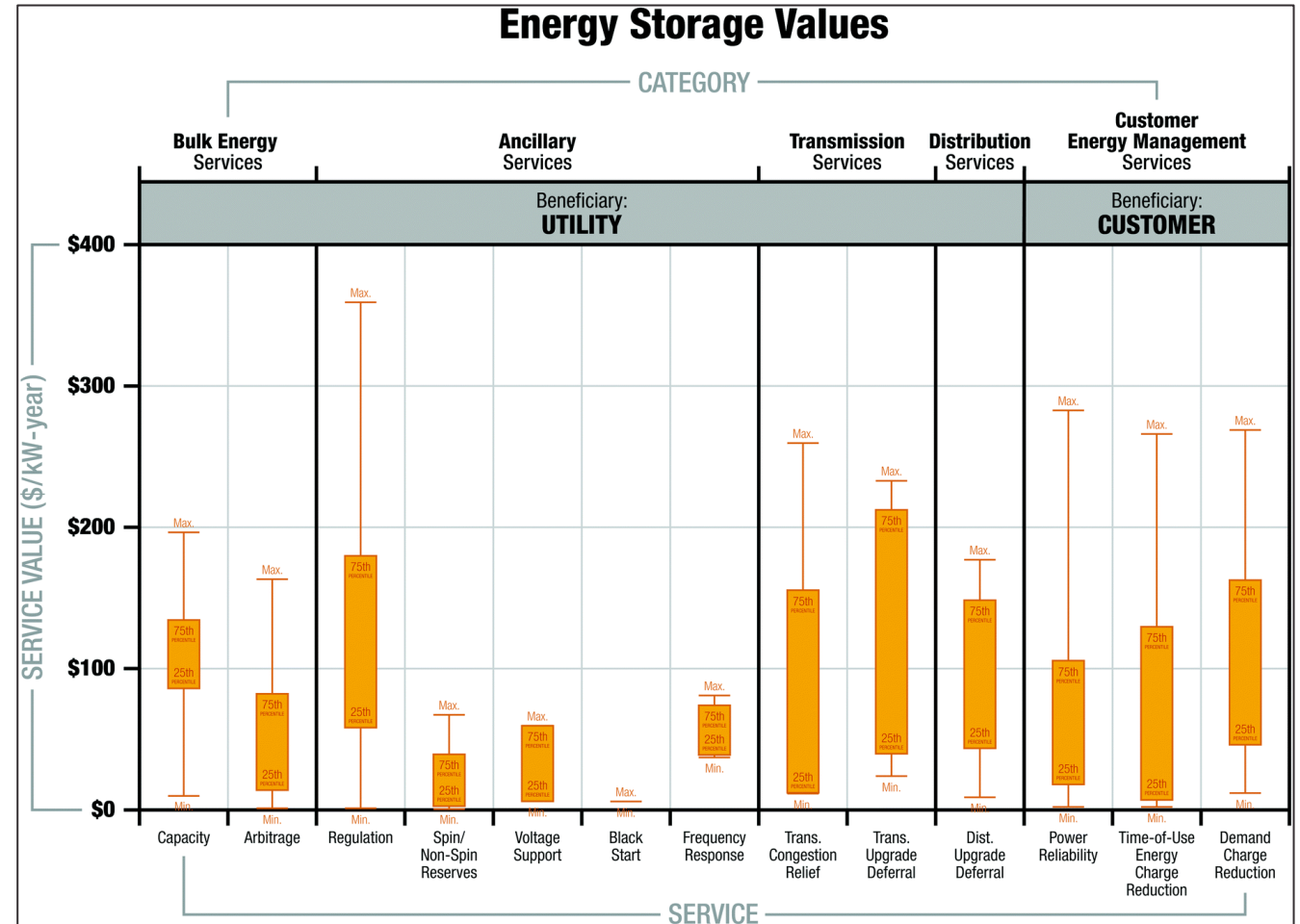


Stage of home battery storage system purchase:



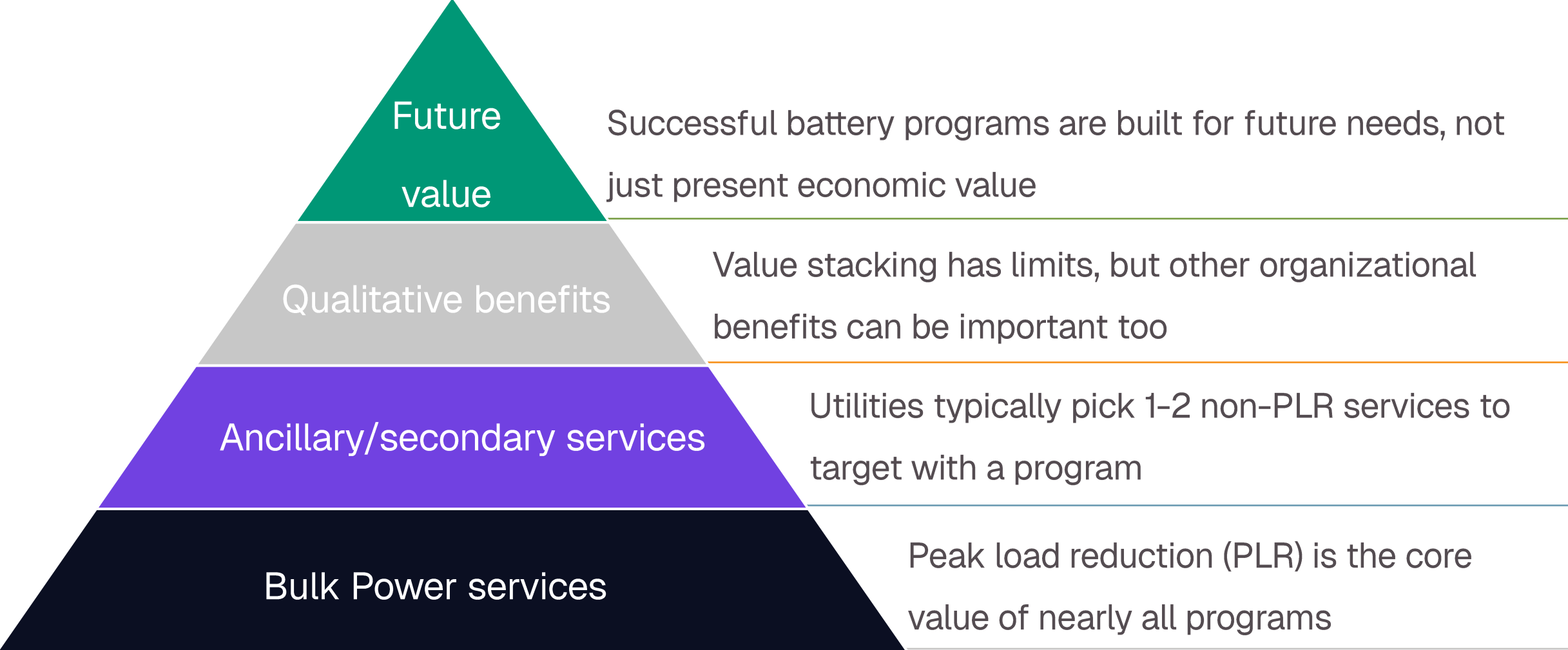
# What value streams are utilities using for battery storage programs?

*BTM batteries can access more possible value streams than utility-scale assets, with the consequence of higher unit costs*



[Assigning value to energy storage systems at multiple points in an electrical grid - Energy & Environmental Science \(RSC Publishing\)](#)

# Battery value stacks have a structured order, just like supply stacks



# Utility program value streams



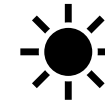
## Peak Load Reduction

Dominant value stream for all programs that provides the bulk of financial benefits.



## Transmission & distribution value

Locational value for congestion relief is explored by many organizations, but only some are starting to find success



## Solar optimization

Reducing grid ramp up period for paired S+S systems, used by Rocky Mountain Power and Xcel Energy



## Ancillary services

Power quality, black start support, and other ancillary services are emerging opportunities



## Resilience

Customer resilience is a focus of most programs, but grid resilience is a feature of fewer, notably Green Mountain Power's programs




## Environmental benefits

Especially for S+S systems, some utilities have quantified greenhouse gas benefits from these programs.

# Diminishing returns on stacking tall...

- Most programs stack <4 value streams
- Logistical and technical constraints
- Some value streams conflict with others; you cannot achieve 100% of all possible benefits



20% of third value stream

65% of second value stream

100% of first value stream

# Tucson Electric Power

**Bryan Jungers**

# Tucson Electric Power

**At Tucson Electric Power (TEP), we strive to be an exceptional energy provider that positively impacts the lives of our employees, customers, and the communities we serve**

- 450,000 Customers in Pima County, AZ
  - Residential: 407,000; Commercial: 40,574; Other: 1,870
- Historic system peak demand = 2.5 GW (*Aug. 2025*)
- Regulated by the Arizona Corporation Commission (ACC)
- 2,375 GWh in DSM portfolio savings from 2005 – 2025
- Spotlight on TEP's residential load flexibility (VPP) programs:
  - *Thermostats* ([Smart Rewards](#)) – >20,000 thermostats and 38 MW in 2025; launched in May 2023
  - *Batteries* ([Energy Storage Rewards](#)) – 166 batteries and 1.32 MW Max Load Shed; Launched August 2025
  - *Managed EVs* – false start in 2025; re-launching 2026



Source: TEP

# Our Battery Journey Began in 2017

Numerous challenges (both technological and philosophical) were encountered. While some were overcome, others remain to address in future implementations

## PROTOCOL ISSUES

1. Proprietary standards still pervasive, introduce complication & potential vendor lock-in
2. Signals limited to set of 4, predefined SIMPLE commands
3. No defined means of cancelling/updating an event
4. OpenADR to API conversion required
5. Some definitions of events still reside with vendors

## DATA ISSUES

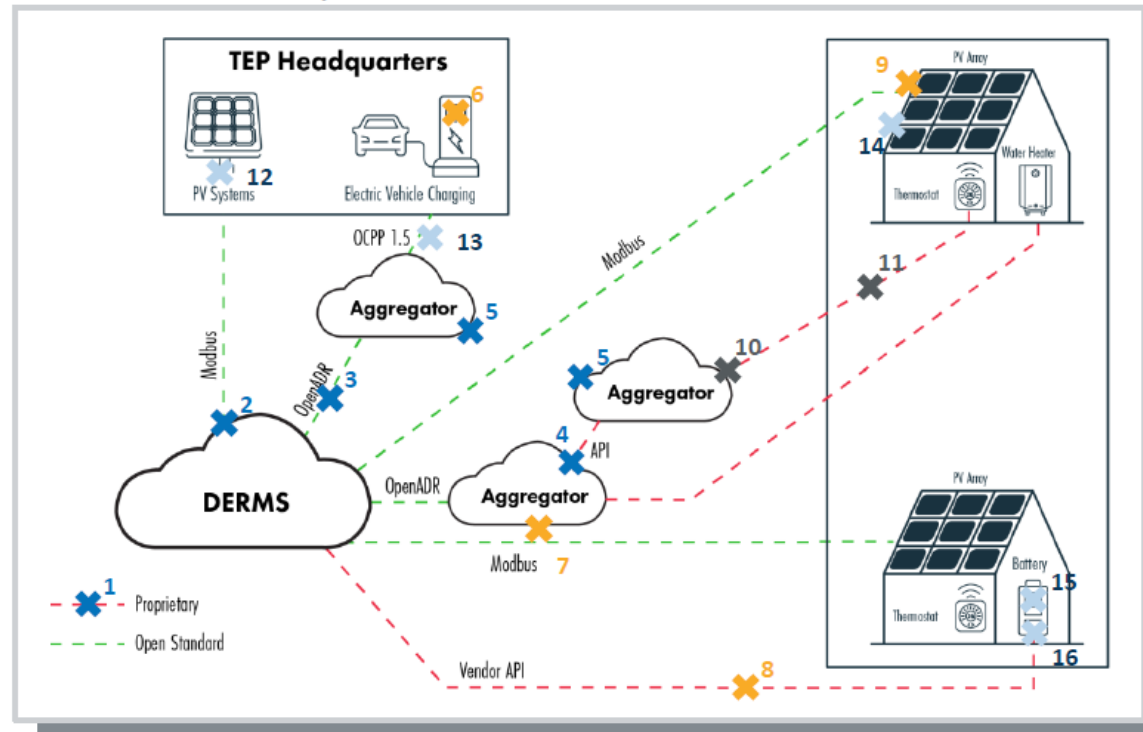
6. No indication of shed event
7. Reports idle shed when should report idle heightened
8. No awareness of device state
9. No DERMS awareness of inverter kVA (real vs. reactive) power limit

## PROCEDURAL ISSUES

10. Alerts sent for every hour of multi-hour event
11. Signals take up to 3 minutes to reach some t-stats

## HARDWARE/SOFTWARE FAILURES

12. Comms/control board failure
13. Cellular link to parking garage frequently breaks
14. Comm board failures
15. Stops dis/charging arbitrarily
16. ECO6 units disconnect permanently if SoC drops too low



## Other Challenges

- Current approach to device connectivity is data-intensive
- Customer comfort impacted by t-stat events
- Contractor education & installation issues

# Aligning to Corporate Strategy

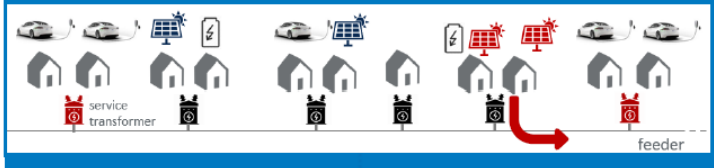
Balancing Customer Demands with Grid Needs Over Time



# Reasons for deploying distributed storage programs

## LOCAL ISSUES

High penetration can overwhelm service transformers, cause reverse power flow, and create power quality issues



transformer overload  
voltage sag

reverse power flow  
high voltage

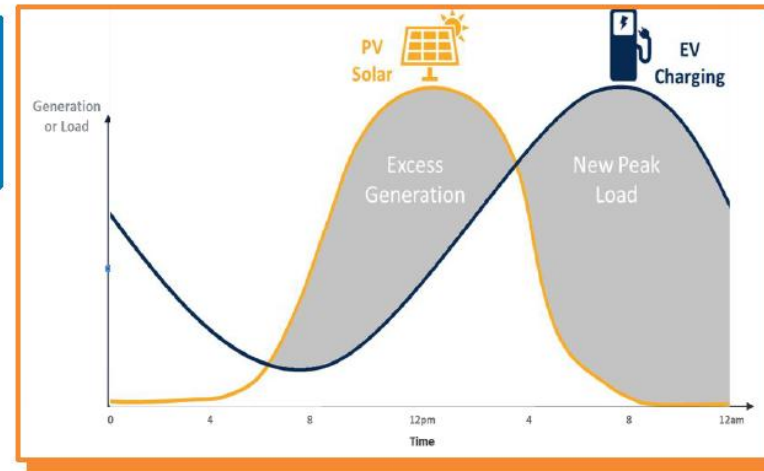


In 2019, 4% of TEP feeders experience these local issues

Source: TEP's Project RAIN w/ EPRI (2019)

## SYSTEM-LEVEL

PV generation is not aligned with new EV load, creating overgeneration mid-day and driving higher system peaks



- ✓ Comply with FERC requirements
- ✓ Bid into (new) regional market
- ✓ Streamline interconnections
- ✓ Enable flexible interconnections
- ✓ Address localized feeder issues
- ✓ Manage t-stat DR event snapback
- ✓ Alleviate distribution congestion
- ✓ Manage peak demand, solar
- ✓ Support electrification initiatives
- ✓ Meet utility load-growth goals
- ✓ Expand customer choice

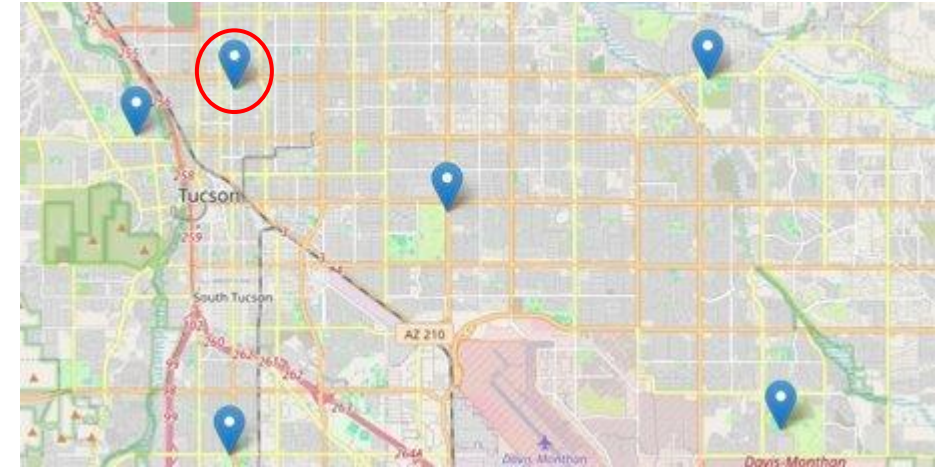
# Program Spotlight - Energy Storage Rewards

## Arizona's First Pay-for-Performance (P4P) Battery Program

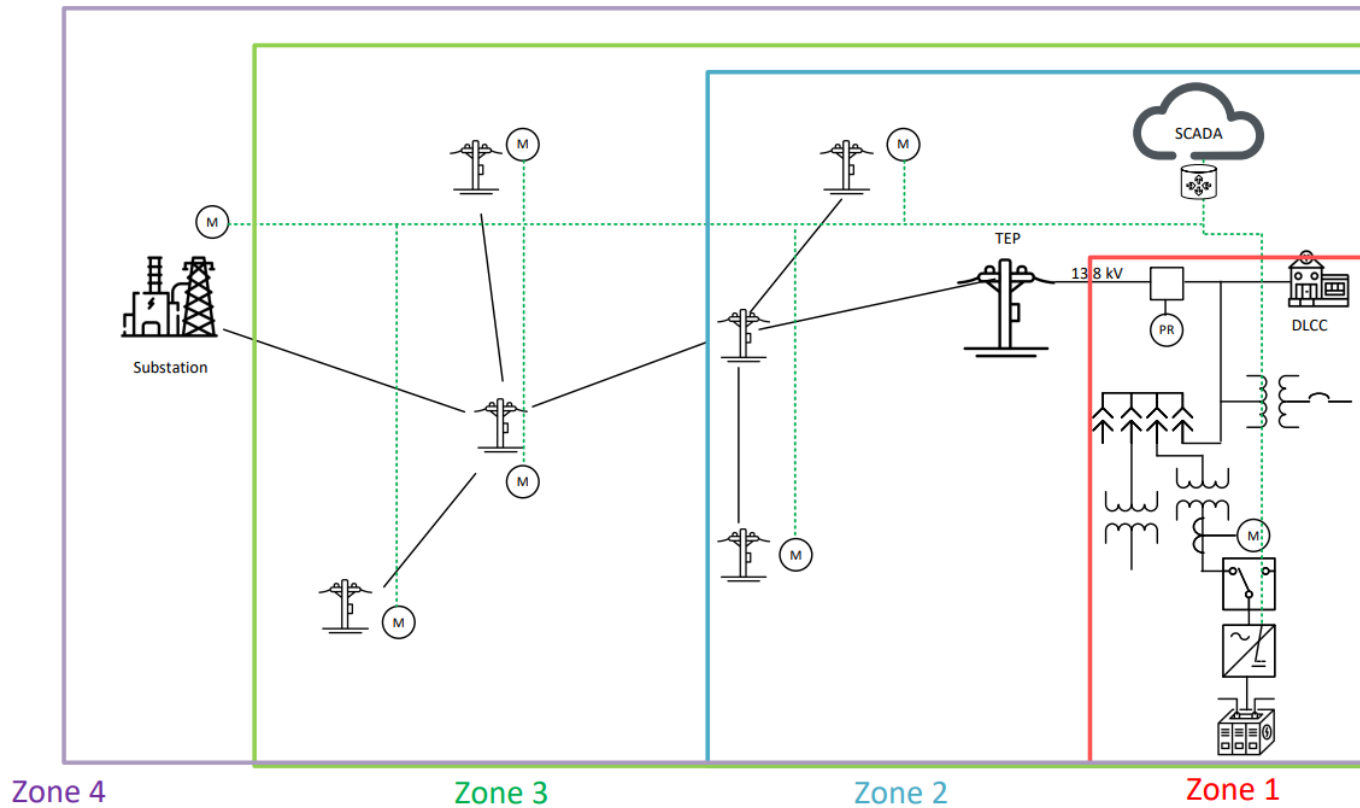
- Bring-your-own-device (BYOD) program open to all TEP Residential Customers with qualifying devices (Tesla, SolarEdge, Enphase)
- Compensates customers for the average kW shared across all events in a season (\$120/kW; summer and winter seasons)
- Call up to 100 winter and summer season events year-round (each event up to 4 hours in length, with day-ahead or day-of notification)
- Overarching Objectives:
  - Enable load flexibility and support grid reliability
  - Enhance customer engagement, value, and affordability
  - Establish learnings for new P4P program design



# Shared-Ownership, Shared-Benefit Microgrids for Extreme Heat Resilience

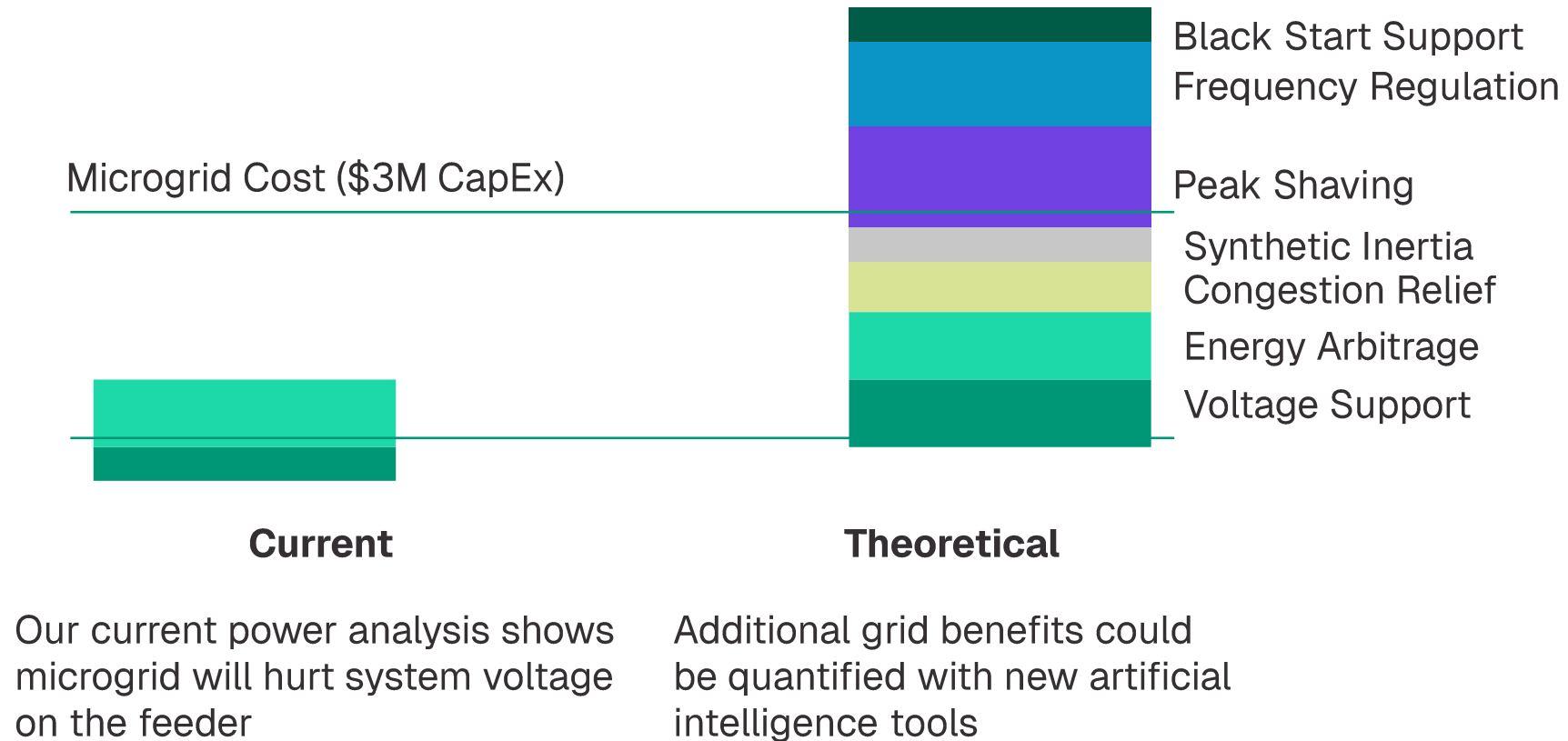


**FTM Benefits**



Source: TEP

# Unlocking grid value streams for the first time



# Xcel Energy

**Kristin Gaspar**

**XCEL ENERGY**

# Distributed Storage Overview

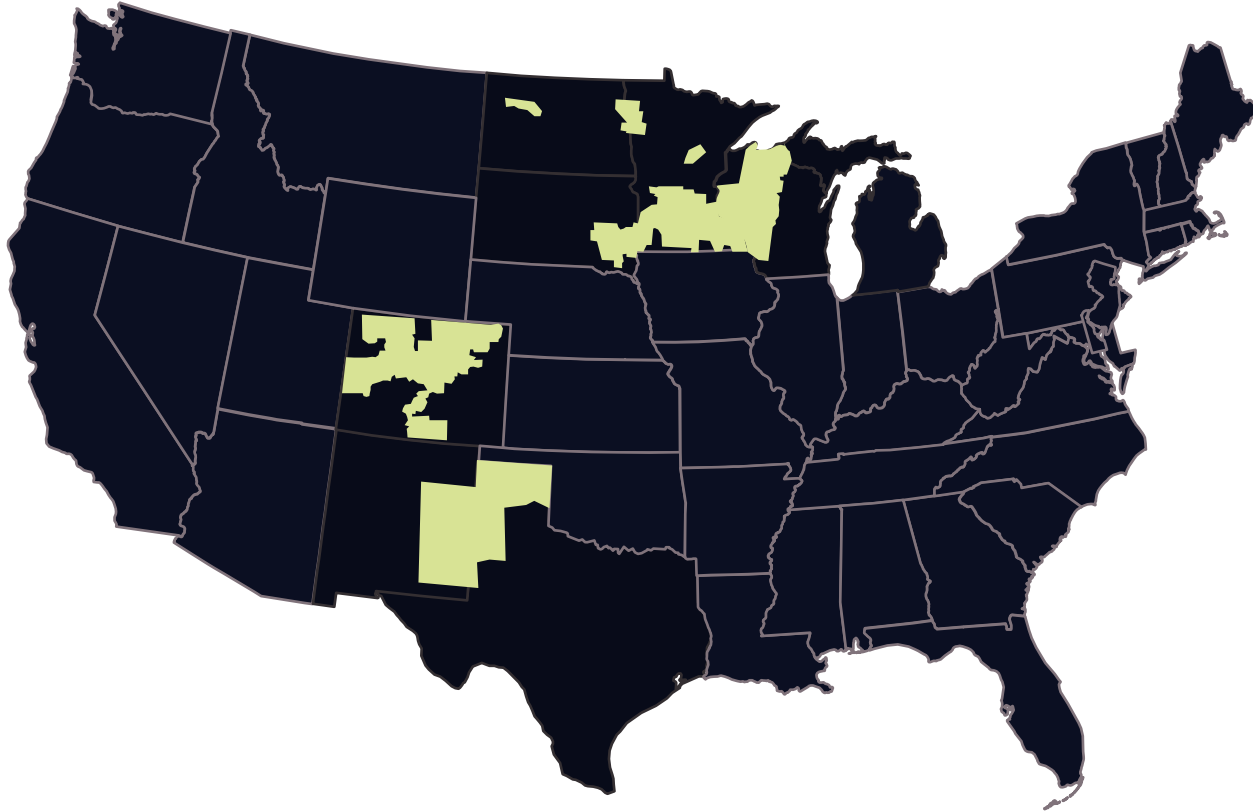
Kristin Gaspar

Principal Strategy & Planning Consultant

Integrated System Planning



# About Xcel Energy



## Serving eight states

**3.9** million electricity customers

**2.2** million natural gas customers

**2 GW** interconnected DER



**125,000** DER installations

## Nationally recognized leader



- Wind energy
- Energy efficiency
- Carbon emissions reductions
- Innovative technology
- Storm restoration

# Xcel Energy's Goal to be a net-zero Energy Provider by 2050

2030

<b>80%</b> lower electric carbon emissions	<b>ELECTRIFICATION- FIRST</b> customer options	<b>NET-ZERO METHANE</b> gas service
		

2035

<b>1.5M</b> EVs enabled by charging infrastructure	<b>20%</b> of fleet converted to EVs
	

2050


<b>ZERO-CARBON</b> electric emissions	<b>NET-ZERO</b> gas service	<b>ZERO-CARBON</b> fuel within 1 mile
		

# Xcel Energy Grid Flexibility and Clean Energy Vision


Decarbonization

Integration of DERs into Distribution System Planning


A net-zero energy provider by 2050

-  100% Carbon-Free Electricity

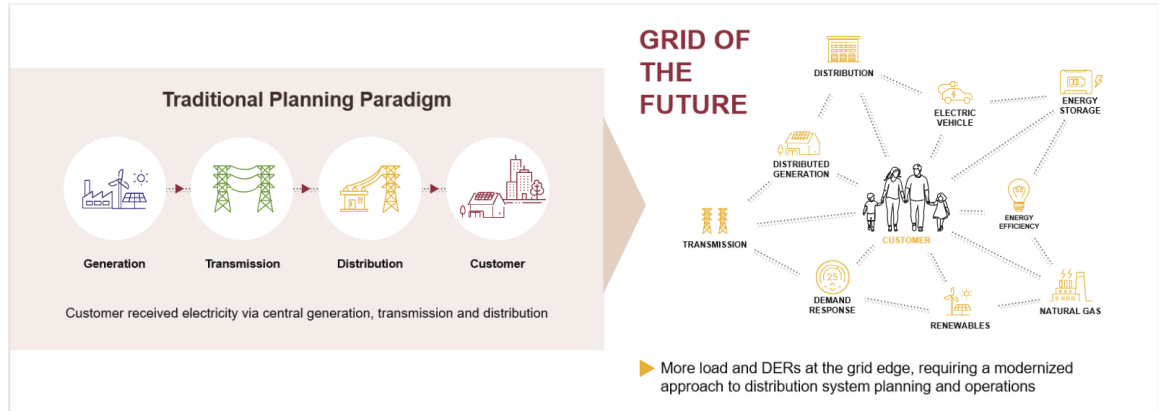
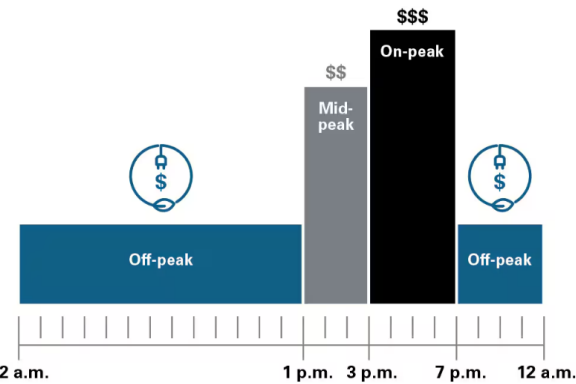
---

-  Net-Zero Natural Gas

---

-  Zero-Carbon Transportation

Daily Demand Response via Rates

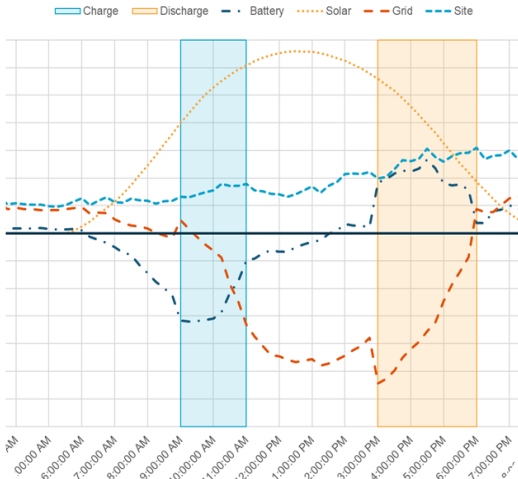


# Xcel Energy BTM Energy Storage Journey

## Foundational & Interconnection

Battery Energy Storage  
Interconnection guidelines

2017



2021

## Pilot & Early DR Value

Residential Battery  
Demand Response  
Pilot

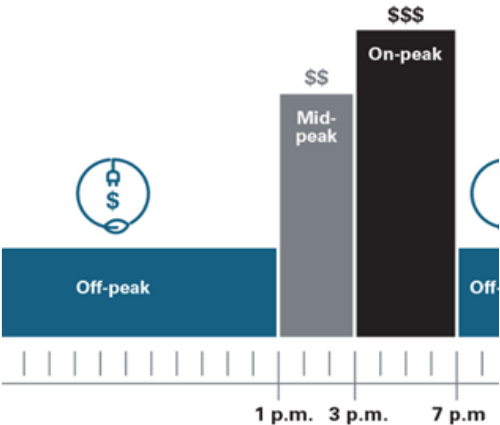
152 pilot batteries →  
2 MW DR potential

## Scaling & Productization

Renewable Battery Connect  
launched requiring battery to  
be 100% charging by solar

~3,500 batteries →  
47 MW nameplate

2023 – FEB 2026



# Xcel Energy Battery Program Evolution

From Insight →

Operations →

Virtual Power Plant

*Learn*

**Pilot**

- \$1,250 upfront payment
- Battery usage patters
- Customer interest and willingness
- OEM software capabilities

*Implement & Scale*

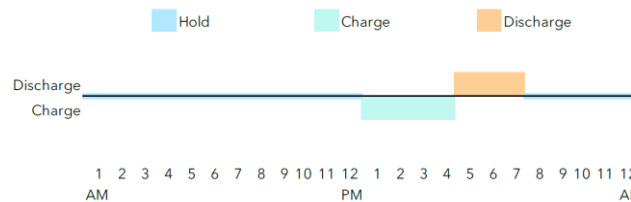
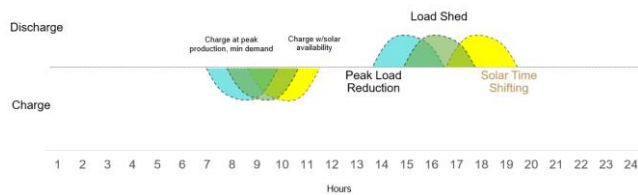
**Program Operations**

- \$/kW upfront + \$100/yr participation payment
- Battery ops and TOU rates
- Bulk grid support use cases
- Bill impact modeling

*Optimize & Monetize*

**Near-Future VPP**

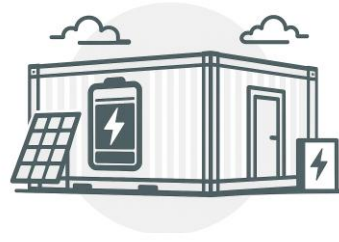
- Pay-for-Performance compensation
- Use cases targeted at constrained feeder
- DERMS capabilities



# Overview of Xcel Grid Serving Distributed Storage/VPP Programs



**Capacity\*Connect  
(DCP – MN)**



**Dispatchable Distributed  
Generation (DDG – CO)**



**Aggregator Virtual Power  
Plant (AVPP – CO)**



**Renewable Battery  
Connect (CO)**

**Primary Use  
Case**

Bulk-System Capacity and Energy; Distribution Benefits for areas where dispatch overlaps

Distribution Load Relief

Bulk System Capacity; Distribution Benefits for areas where peaks overlap

Bulk System Capacity; Piloting locational dispatch

**Asset Types**

Front-of-Meter; battery storage

Front-of-Meter; renewable generation resource co-located with energy storage

Behind-the-Meter; Technology-neutral

Behind-the-Meter; BESS paired with solar PV

**Asset Ownership**

Company-owned assets

Third-party

Third-party; Company

Third-party

**Asset Size**

Larger-scale (1-3 MW)

Larger-scale (750 kW minimum injection capacity)

Minimum of 100 kW per aggregation

Residential

**Dispatch/Event  
Duration**

4 Hours

4 Hours

4 Hours

3 Hours

**Dispatch/Event  
Limitations**

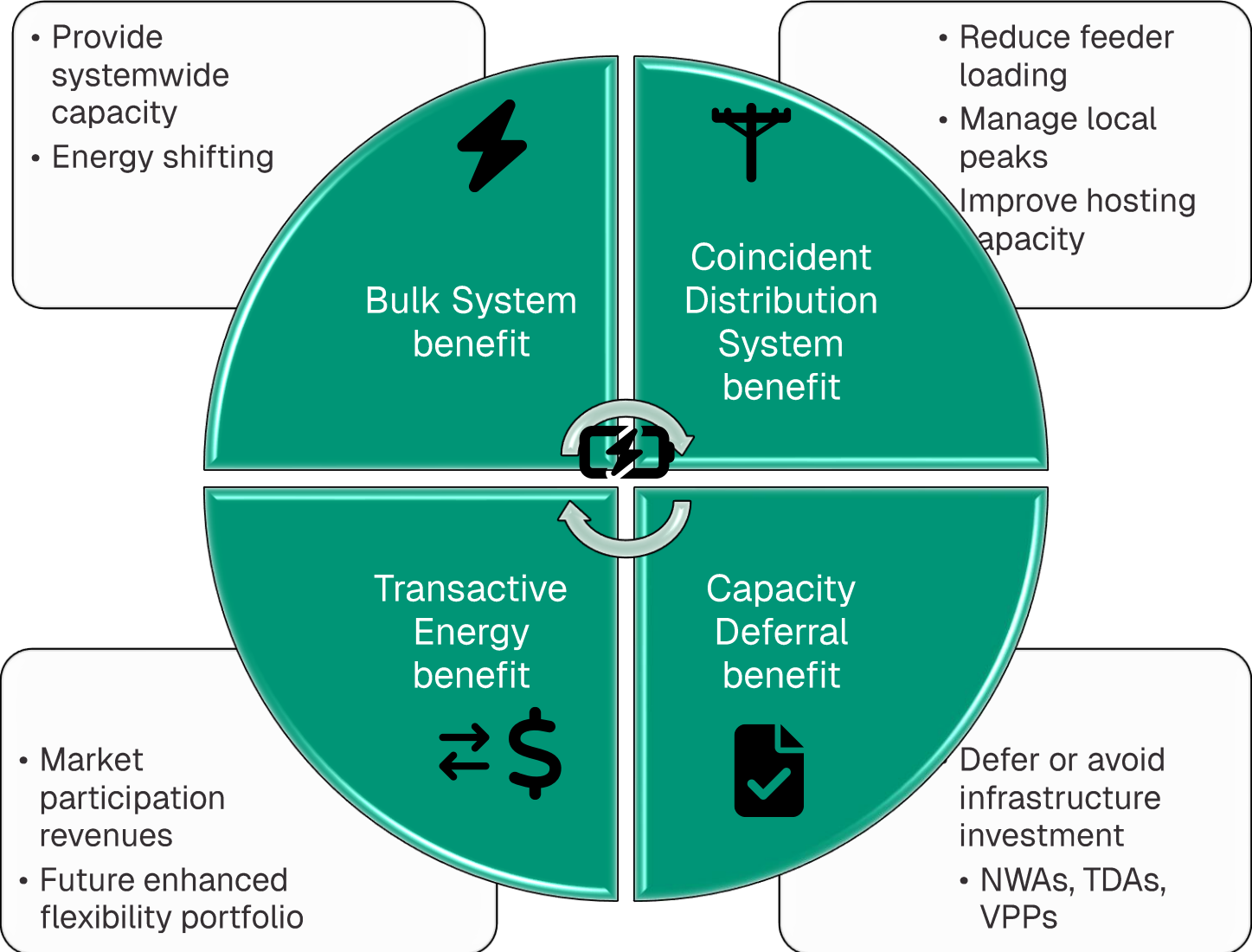
As required by MISO

As defined by schedules

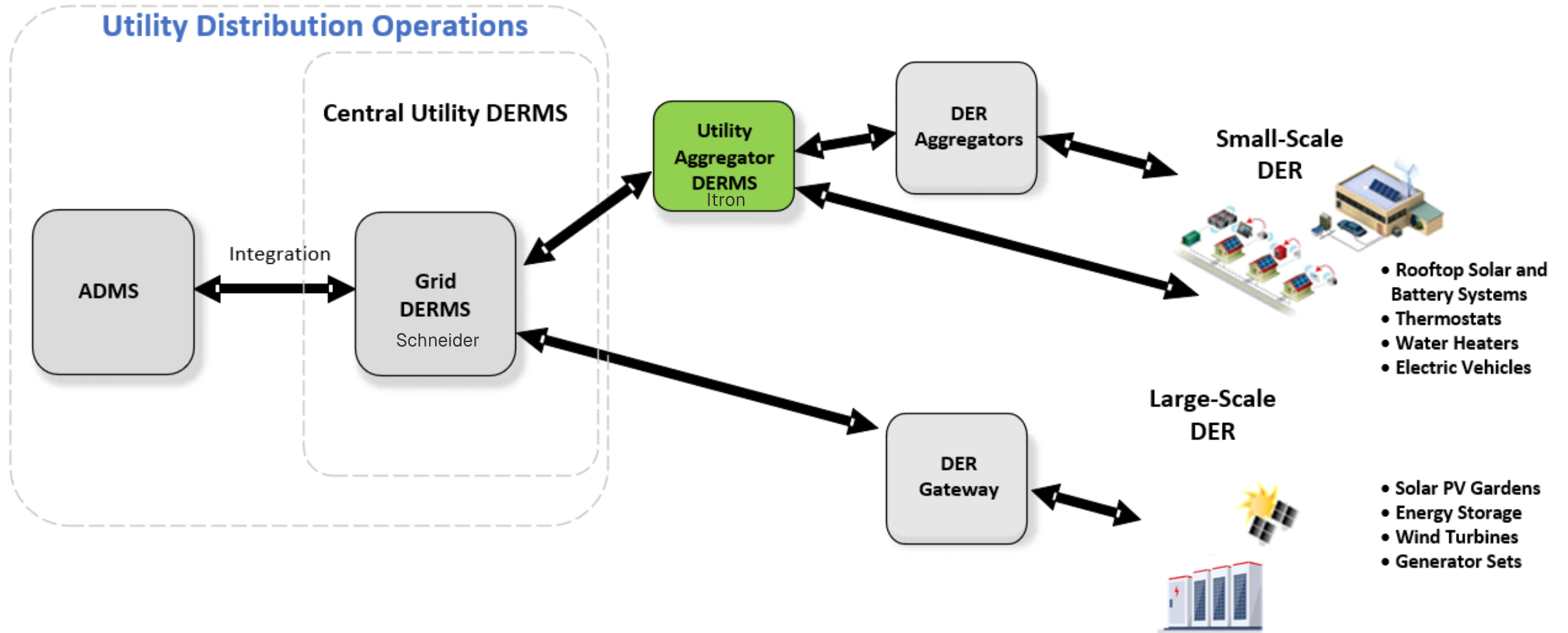
80 Events Per Year

60 Events Per Year

# Distributed storage delivers stacked value across Xcel's system – driven by its primary use case



# Simplified DERMS Architecture – Tech Stack



# Valuation challenge for distributed storage

**The value of distributed storage must be measured by locational grid outcomes, validated through transparent and consistent measurement & verification.**

## Internal Utility M&V

(What we must provide to ourselves)

- Peak reduction at the feeder level during defined constraint windows.
- Load shape modifications showing storage is shifting energy in ways that address the specific constraint (not just kW at one moment)
- Operational risk reduction (e.g., fewer overload alarms, improved voltage profiles)
- Contribution to capital deferral: did storage extend the deferral timeline (e.g., pushing the upgrade year)
- Verification of dispatchability: storage responds consistently at the correct location and time

## Regulatory M&V

(What regulators must see to approve and fund it)

- Clear, repeatable methodology for storage dispatch → constraint reduction → avoided cost impact
- Auditable baselines and event measurement
- Equity and cost allocation visibility: who pays, who benefits, and how locational incentives are set
- Performance certainty and accountability: What happens if storage fails to dispatch? How are penalties structured?
- Consistency with industry M&V standards to ensure comparability across DSM, DER, and storage programs.

# Questions?

# Thank You!



Michael Hartnack

[Michael\\_Hartnack@esource.com](mailto:Michael_Hartnack@esource.com)



Malcolm Hansell

[malcolm\\_hansell@esource.com](mailto:malcolm_hansell@esource.com)



Ben Campbell

[ben\\_campbell@esource.com](mailto:ben_campbell@esource.com)



Bryan Jungers

Principal, Emerging Technologies, Tucson  
Electric Power



Kristin Gaspar

Principal Strategy & Planning Consultant,  
Integrated System Planning