Long Duration Energy Storage

Potential Roles & Value

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Critical Consumer Issues Forum
March 2, 2022



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Generation Profile



Response Time



Round-Trip Efficiency



Marginal Cost



Combination of factors impacts energy supply decisions

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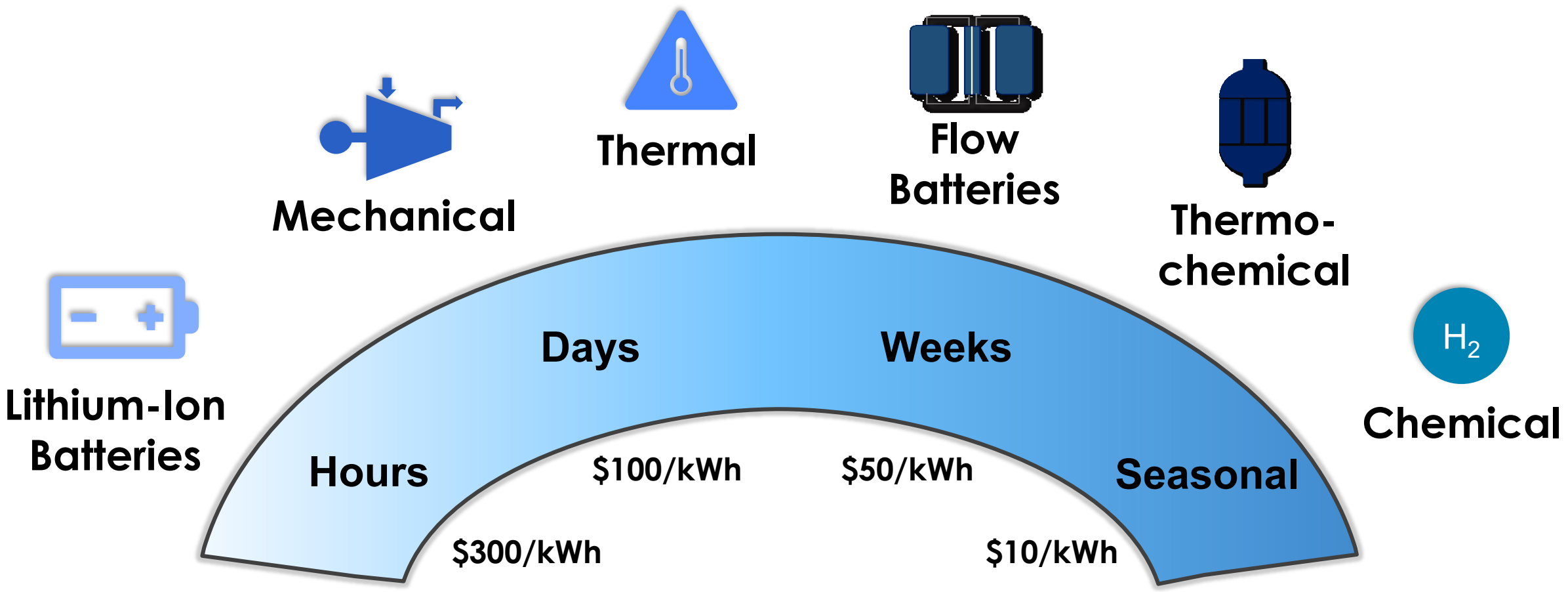
Energy Storage Spectrum

More than 100 different technologies



A range of energy storage technologies will be needed

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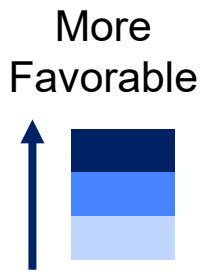
Energy Storage Comparison



	Li-Ion Batteries	Pumped Hydro	Thermal	Mechanical	Chemical
Cost of Storage					
Duration					
Efficiency (AC-AC)					
Environmental					
Footprint					
Inertia					
Maturity					
O&M					
Response Time					
Safety					
Scalability					
Startup Time					

No energy storage technology is one-size-fits-all

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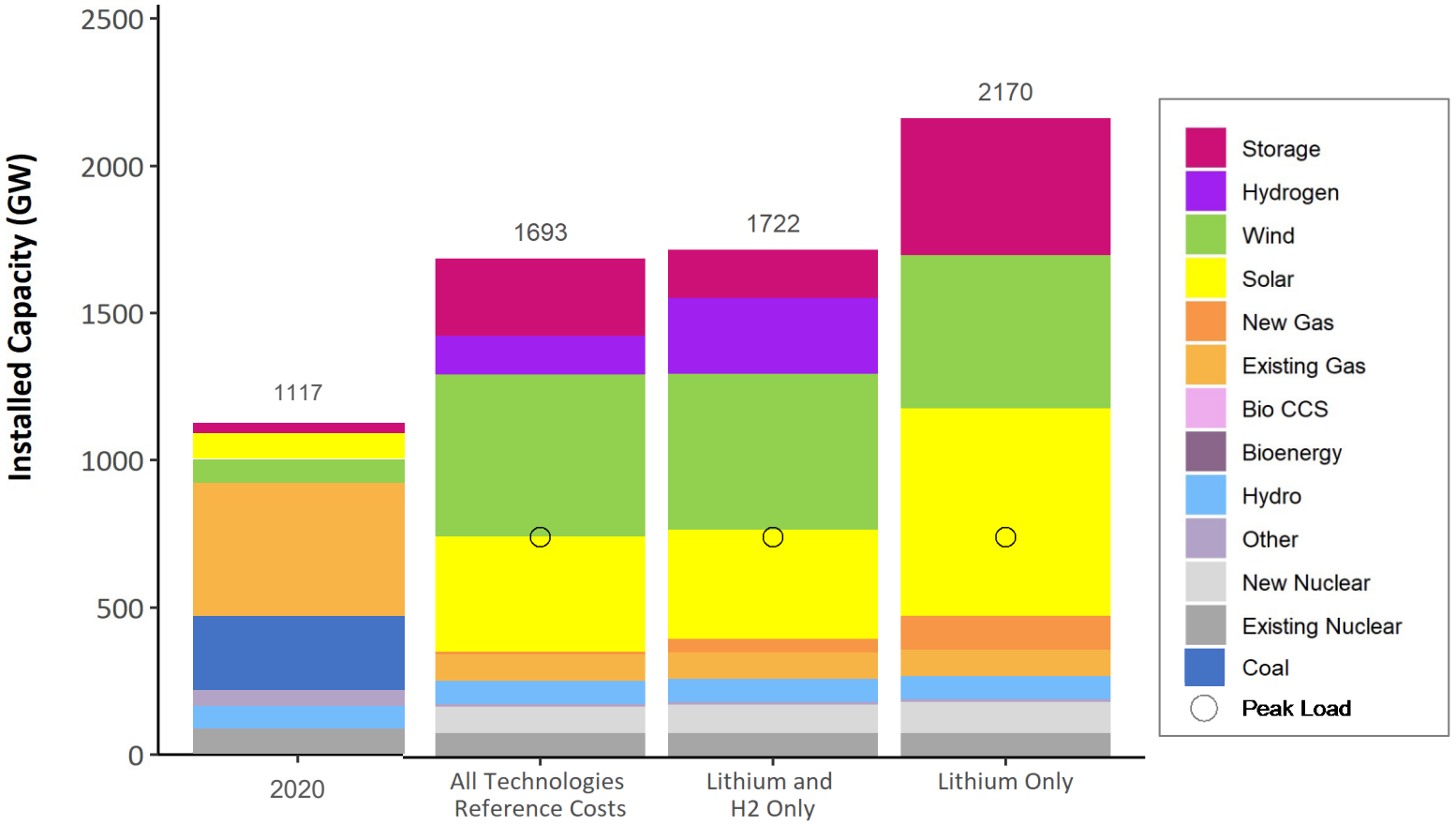
Limiting Options Alters Investments

US-REGEN
Regional Economy, GHG, and Energy

EPRI Report
3002021099

2035 Carbon-Free Scenario

CAPACITY



- Mid- and long-duration energy storage deployed in restrictive carbon-free scenario
- Li-ion batteries did not deploy beyond 10 hours
- Total capacity increased by 28% when only Li-ion batteries were considered

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Advanced Demand Efficiency

Critical Consumer Issues Forum

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March 2, 2022

Agenda

ICF Overview

Advanced Technology

Utilizing Technology for Customer Programs

ICF Overview

A Growing, Global Company Since 1969

Global professional, **technology and marketing services** firm since 1969

More than **8,000** People

Headquartered in Fairfax, Virginia with:



75+ Offices

53% Female Leaders and Gender Pay Equity

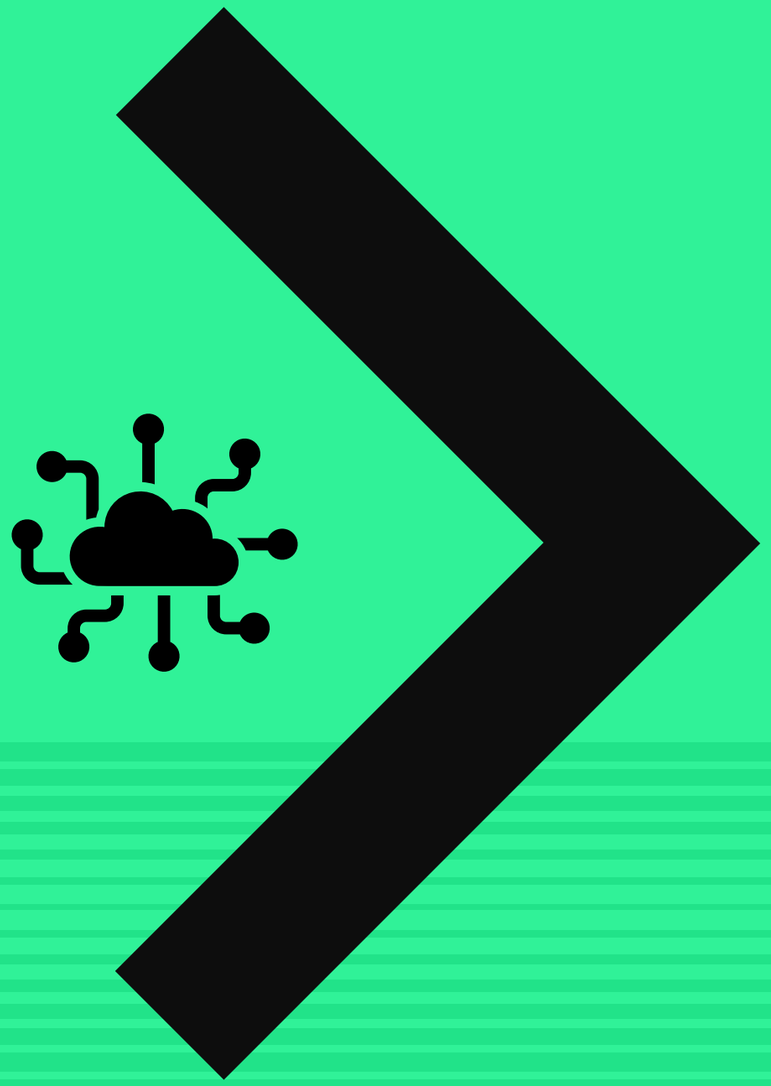
80 Homelands

$1.51B In annual revenue

70+ Languages

ICF's US Demand Side Management Implementation Footprint





Advanced Technology

A Complex Confluence of Trends



Industry Macro Trends

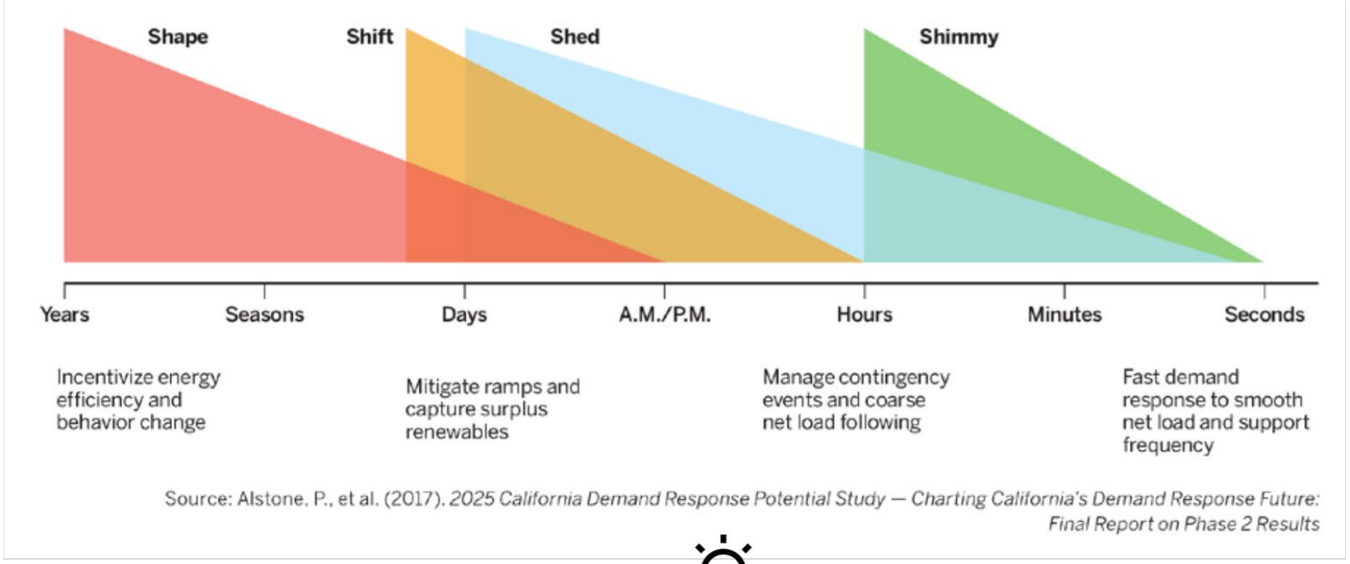
- Decarbonization
- Negative load growth
- Focus on cost minimization
- Shift in utility regulatory models
- Grid parity
- Search for new products/services
- Expansion of the definition of “utility system” to new technologies/locations
- Increasing customer supplier & technology choice
- Attacks on utility value proposition

EE Micro Trends

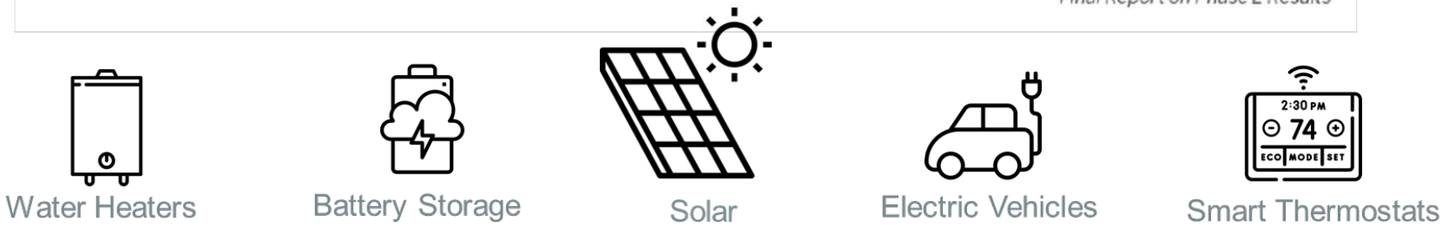
- Demand for customer engagement
- Design Thinking
- Stricter codes and standards
- Shifting regulatory and legislative policy
- Declines in technology cost
- Worsening avoided cost fundamentals
- Interest in flexible load shapes
- Growing locational value
- Saturation of EE technologies/programs
- Changes in cost recovery & incentives
- Increasing pay for performance/capital

Advanced Technology – The Convergence of Technology and Customer Solutions

- EE and DR are converging – shaping load is becoming more important that passive kWh savings, especially in light of electrification
- Conventional EE is facing challenges due to increasing codes and standards and lower avoided costs
- Grid technologies are allowing more visibility and control over end use technologies
- Issues of resiliency, equity and inclusion and GHG reductions are all taking on increasing importance
- The role of the customer as a grid resource is an increasingly important, but challenging piece of the equation



Source: Alstone, P., et al. (2017). *2025 California Demand Response Potential Study — Charting California's Demand Response Future: Final Report on Phase 2 Results*



Top 10 Emerging Technologies

Short Term - 1 to 3 Years

Market Ready

- Heat Pump Clothes Dryers
- Smart Residential Outlets
- Insulated Vinyl Siding
- Ducted Variable-Speed Split Heat Pumps
- CO_2 Heat Pump Water Heaters
- Low-GWP, High Efficiency Heat Pump and Air Conditioners

Medium Term - 3 to 5 Years

Extensive Assessment

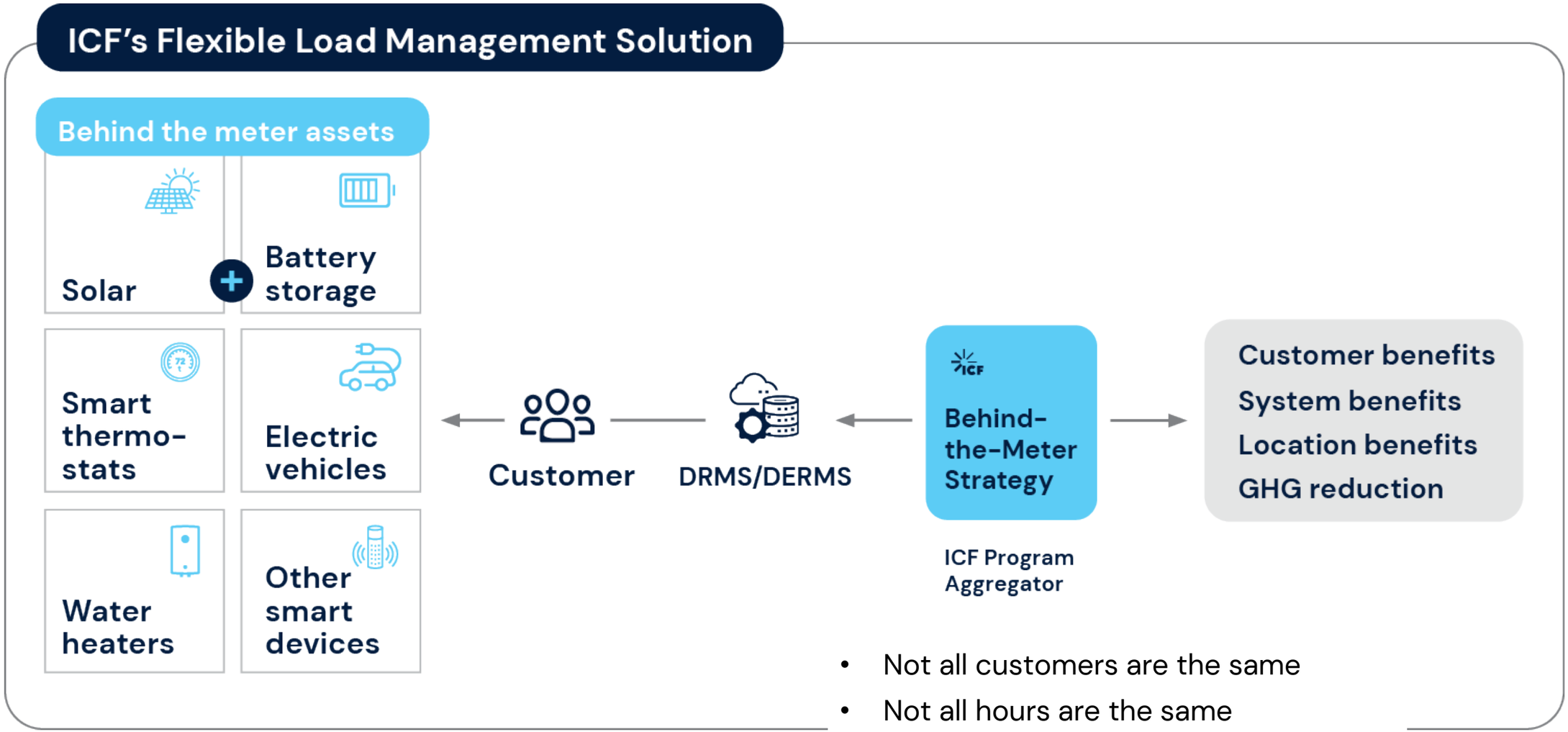
- Aerogel Insulated Double Glazed Windows
- Heat Recovery Cloth Dryers

Long -Term

Concept Validated

- Ultrasonic Cloth Dryers
- Residential Water-Cooled Condenser

Advanced Control Strategies



- Not all customers are the same
- Not all hours are the same
- Not all devices and behind-the-meter assets have the same value



Customer Programs

Customers as a Grid Resource

Additional Renewable Generation, Distributed Generation and DERs on the grid require additional grid flexibility

Demand-side flexibility refers to programs or capabilities in the electricity demand sectors (buildings, transportation, and industry) that enable or encourage end-users to alter their consumption with the aim of improving the efficiency and/or reliability of the power system.[1]

Different customers bring different benefits at different times

All customers are valuable and targeting varying benefits is important

Deeper understandings of when customers bring value allow for better management and retention of customers in programs

1. *Operational Analysis of U.S. Power Systems with Increased Electrification and Demand-Side Flexibility. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-79094.*

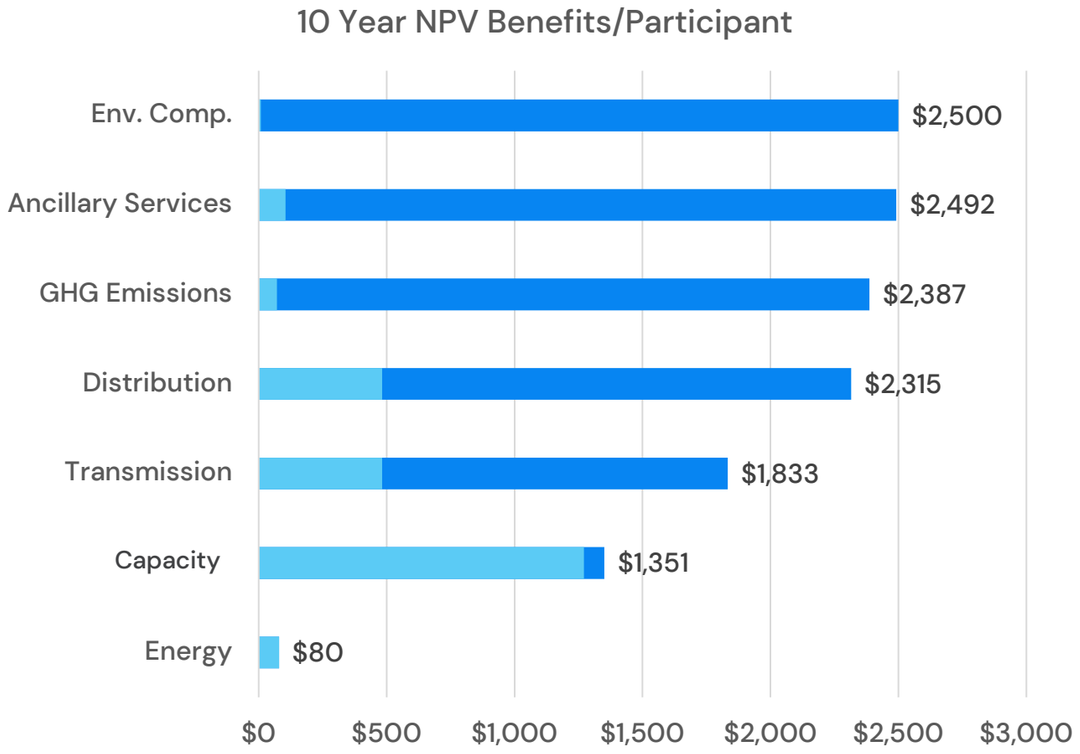
Design of the Smart Thermostat Management Pilot

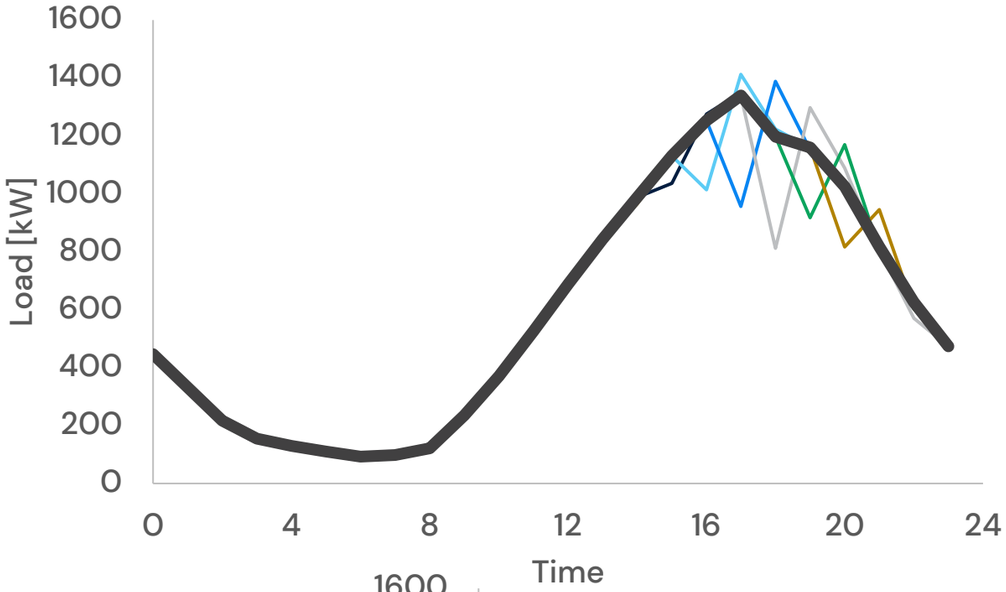


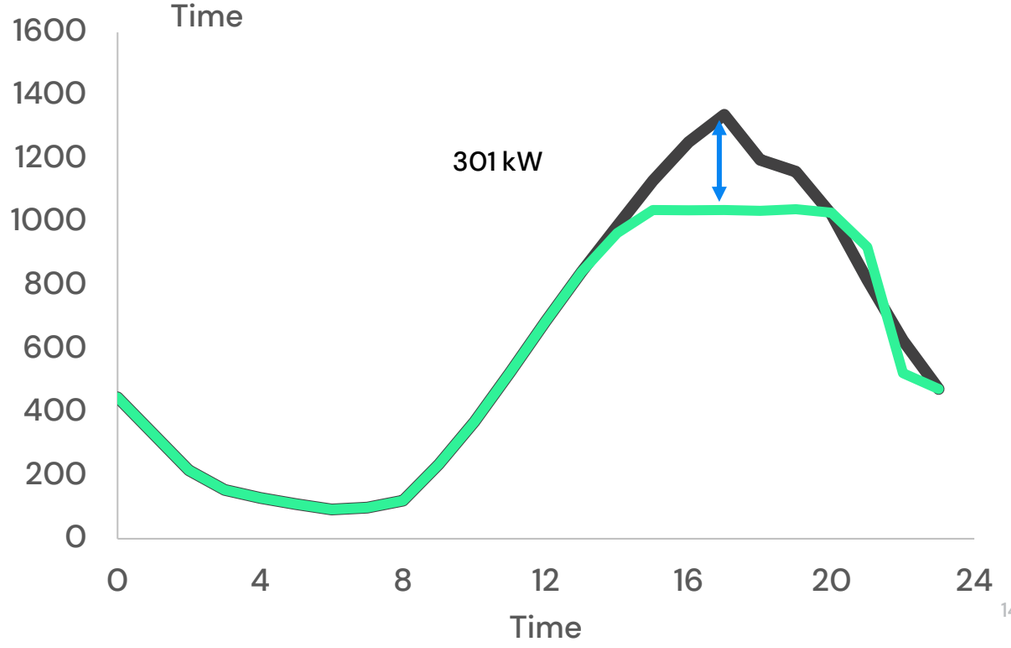
1. Manage already installed smart thermostats in sub-hourly increments based on wholesale price signals across the year (e.g. top 5% of hours - ensure customer comfort not impacted)
2. Can be add on to DR program - thermostats controlled across the year, but also for peak events
3. Machine learning through advanced EM&V to dynamically assign cohorts of customers for when they bring the most value
4. Compare results to current energy savings recognized by EE programs and capacity savings from traditional DR programs
5. Use data driven approach to customer recruitment and savings evaluation (AMI data and historic member participation in EE programs to identify best customers to recruit)

Aggregating Participant Cohort Dispatches

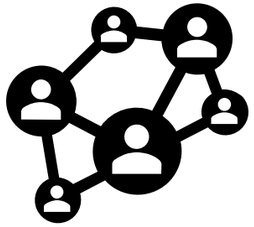
Potential 10 Year NPV Benefits of $2,500/Participant







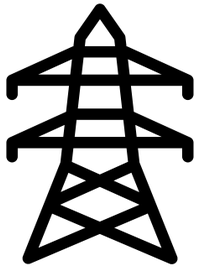
Conclusions



Connectiveness of advanced technologies will allow for additional flexible load management to increase reliability, resilience, efficiency, and decarbonization efforts

A targeted approach to utilizing these technologies is important so that the maximum value can be extracted without impacting customer daily operations (e.g. comfort, fully charging EV)





A variety of technologies and resources being managed in an elegant and thoughtful manner can create meaningful aggregate contributions to grid reliability, resiliency, efficiency, and decarbonization

Let’s get started.

For questions regarding this presentation, please contact:

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