ELECTRIC POWER RESEARCH INSTITUTE

The Future of the Electric Grid and the Role of Storage

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Beyond Lithium Ion IX
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Together…Shaping the Future of Electricity

EPRI's Mission

Advancing safe, reliable, affordable, and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation.

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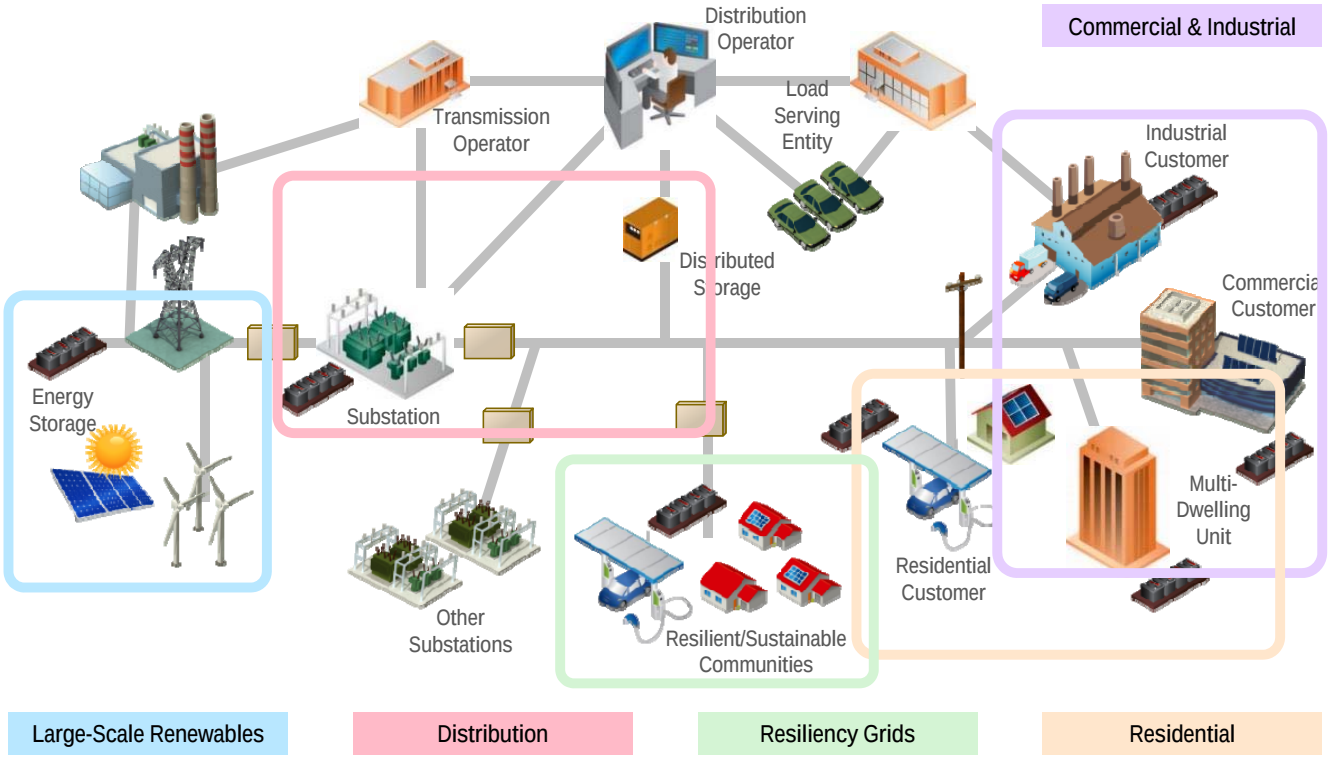
How Utilities think about storage



Better cost and performance information
and experience with the technology will help

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Storage Can Provide Several Potential Services

Grid Domain	Services Possible with Storage
Market	Resource Adequacy (Firm capacity)
	Resource Adequacy (Ramping)
	Energy (Time-shifting / Arbitrage)
	Frequency Regulation
	Spinning Reserve
	Non-spinning Reserve
Transmission	Upgrade Deferral / Avoidance
	Energy Loss Reduction
	Voltage Support
Distribution	Upgrade Deferral / Avoidance
	Energy Loss Reduction
	Voltage Control / Power Quality
Consumer	Reliability/Resiliency
	Demand Charge Reduction

Utility and market services can create a path to monetize benefits

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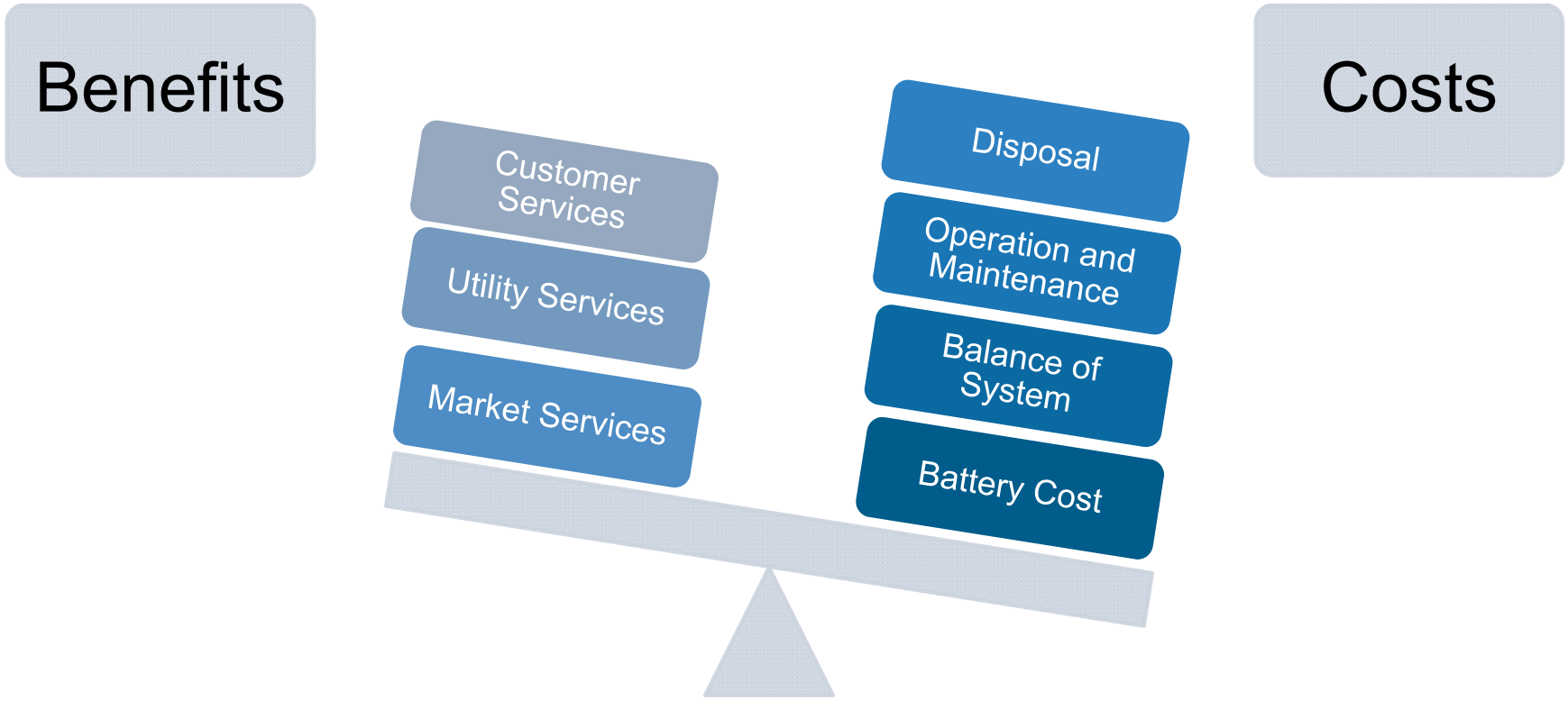
Challenge of Balancing the Costs and Benefits of Storage



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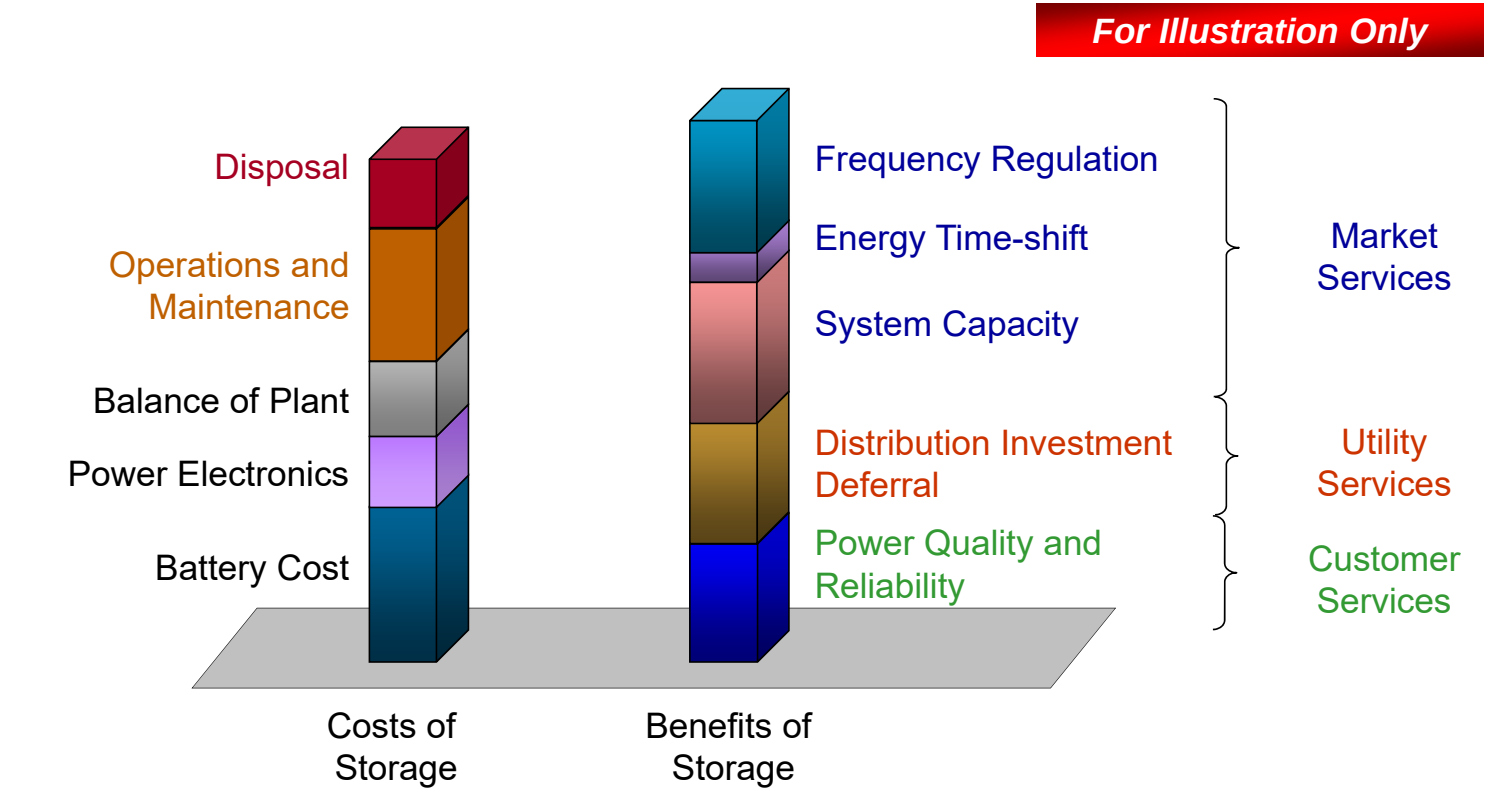
Analyzing the Value of Storage



Developing a business case usually requires stacking multiple benefits

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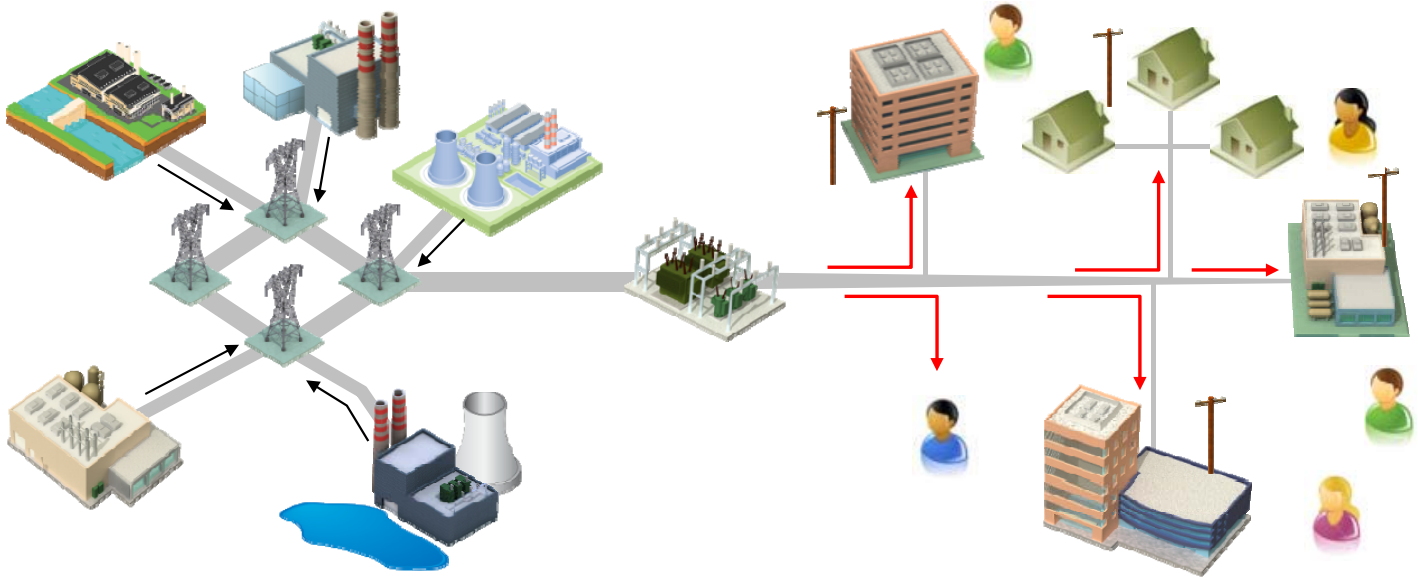
Today's Power System



Generation → Delivery → Customer

One-Way Power Flow from Dispatchable Resources to Meet Forecasted Loads

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Storage on the Grid Today

Pumped Hydro (Taum Sauk) 400 MW 3520 MWh

Lithium ion (Tehachapi) SCE 32 MWh

Sodium Sulfur Battery 2 MW 12MWh

Flywheels 20 MW 5MWh

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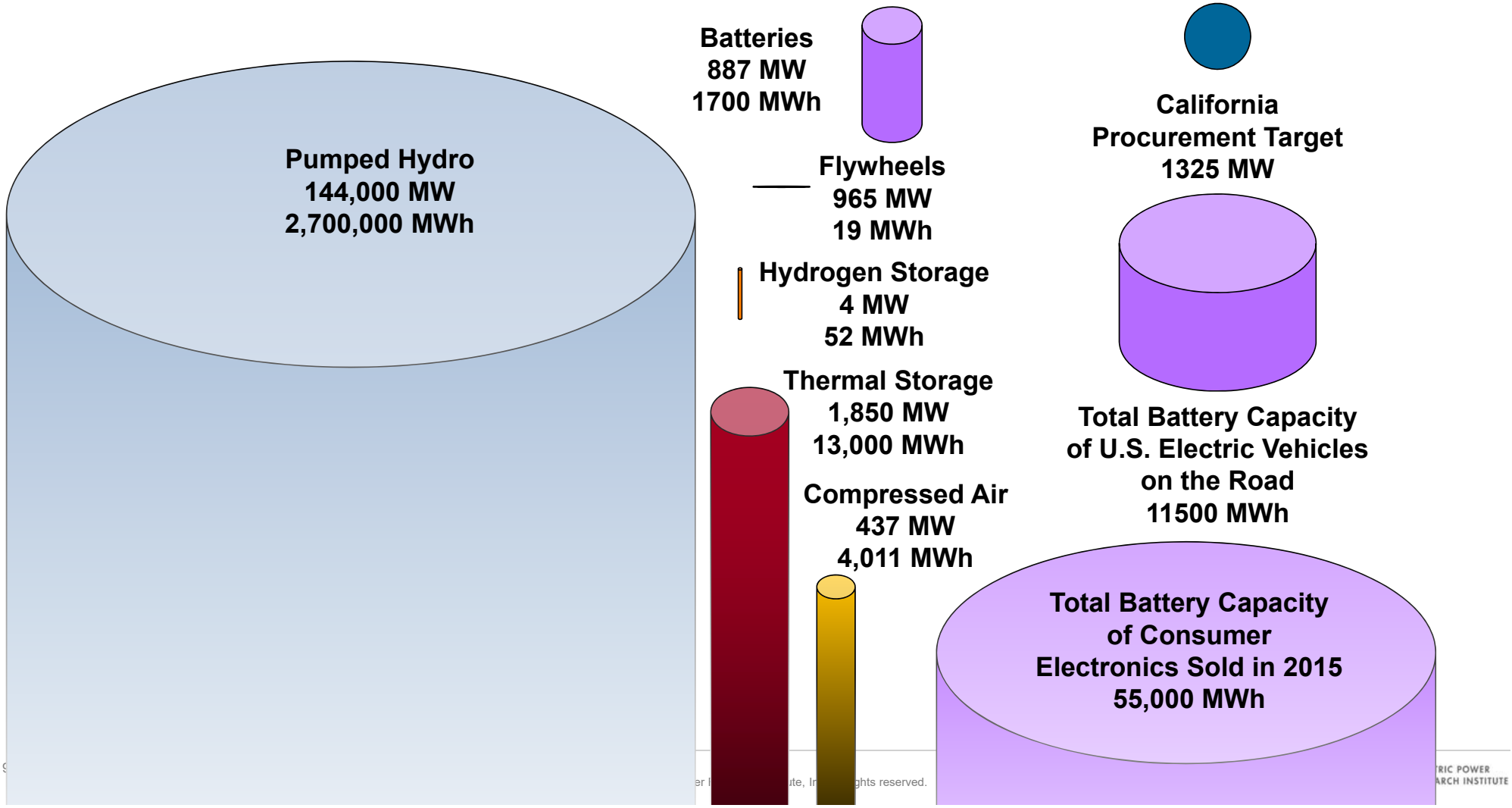
Total Deployed Grid Storage Worldwide, January 2016



Other Storage Pushes

- Storage legislation has arrived in California, Puerto Rico, New York, New Jersey…
  - Creates incentives for customer-sited storage, owned by 3rd parties
  - Motivated by renewables integration as well as economic opportunity
- Regulators are evaluating the participation of storage on the grid
  - FERC Rulings 755, 784, 792 open new doors for storage in electricity markets
  - PJM and other markets have created special market products such as Reg D, targeted for storage
  - California has mandated 1.325 GW of utility energy storage by 2020

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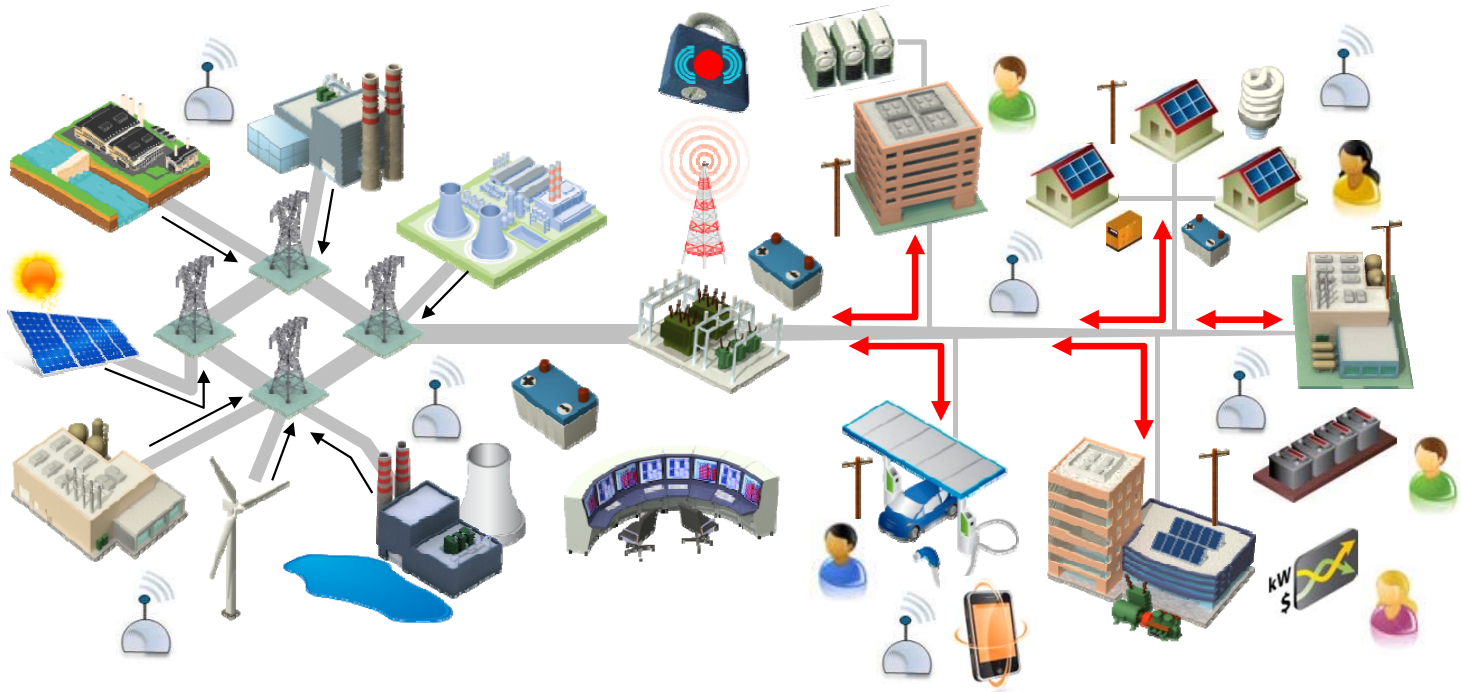
Transformation of the Power System



An Interconnected Power System Balancing Forecasted Resources with Dispatchable Loads

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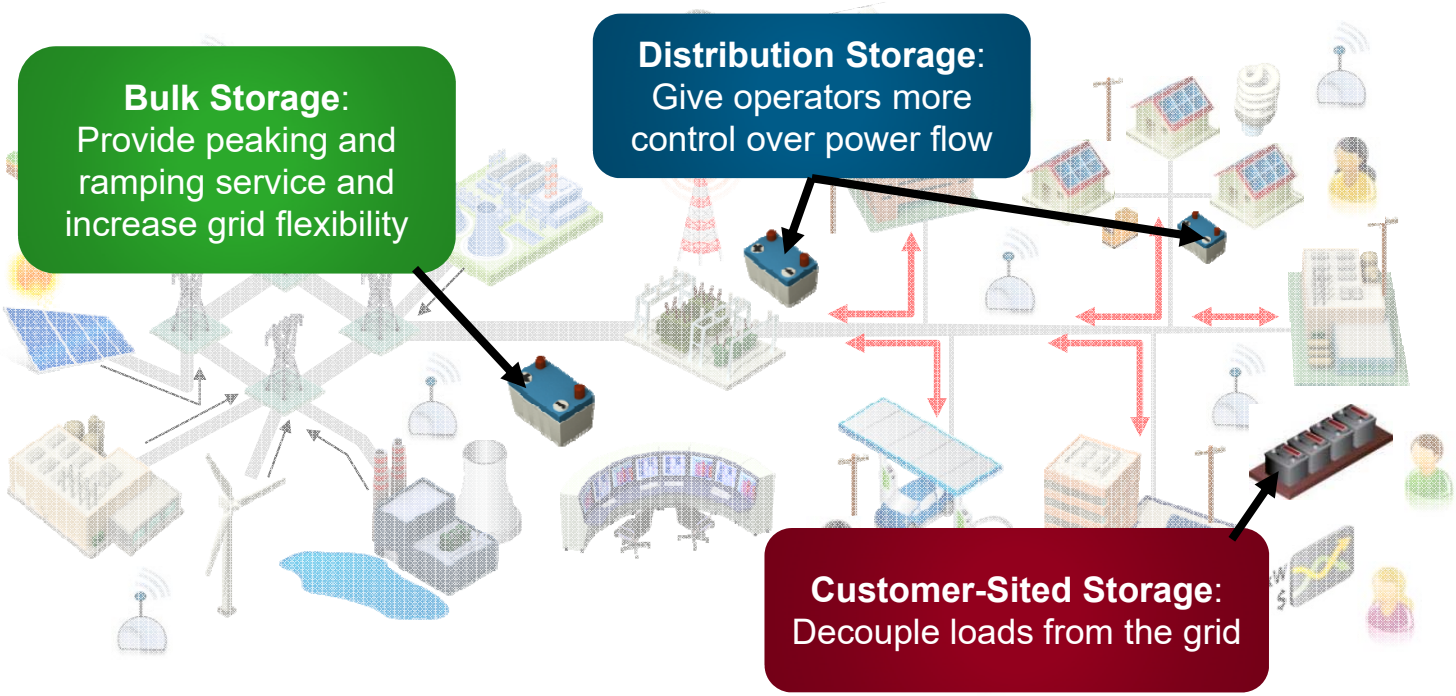
Energy Storage in Future Power Systems



Energy storage can play key roles across the grid by moving energy through time and delivery location

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Role for Storage… how do we get there

402kW/282kWh; Sodium Nickel; Duke Energy

250kW/1MWh; Lead- Carbon; PNM Resources

25kW/50kWh; Lithium Ion; Microgrid – SDG&E

9MVA/32Wh; Lithium Ion; Wind – SCE

36 MW ESS West Virginia

2 MW ESS California

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Utility Customers need more than a battery

They need a complete Storage System

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Including, but not limited to…

- Fully-integrated product
- Proven commitment to system safety (for the integrated product!)
- Established track record of reliability (for the integrated product!)
- Clear acceptance of product responsibility
- Use of common, widely-accepted approaches
- Turnkey installation and commissioning
- Warranted performance
- Long-term maintenance contracts

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What do beyond lithium ion technologies need to succeed?

Lower Cost	Increased Performance	Better Efficiency
• Initial Cost • Operating Cost • Life Cycle Cost	• Cycle Life • Calendar Life	• Operating Efficiency • Standby Efficiency

Systems
Designed with SAFETY and Operation in mind
Reliability is Critical to Utilities

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Today's Key Takeaways

Energy storage is part of an on-going transformation of the grid: By creating a system for inventory in a just-in-time supply chain, storage can radically transform the electric power enterprise, especially when linked to other technologies such as renewables and smart.

Several drivers are making storage an attractive opportunity right now: Newer and better storage technologies, falling costs, and enabling policy are coming together to create a highly favorable environment for learning about storage

Utilities are well-suited to take the lead in storage investment: While initial investments in energy storage have been focused on market applications, storage integrated into transmission and distribution systems and used for multiple applications provides the greatest benefit-cost potential

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