

# MN Study of Utility-controlled, Customer Sited Battery Storage

November 18, 2015

Legislative Energy Commission

Bill Grant, Deputy Commissioner

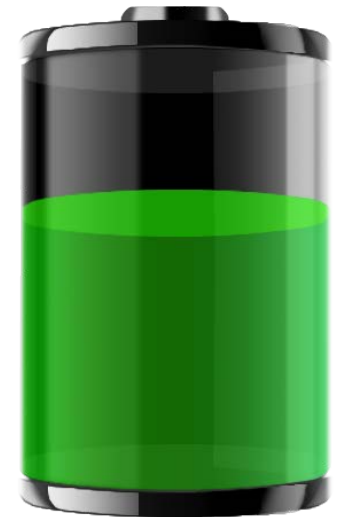
Lise Trudeau, Sr. Engineering Specialist



# Energy Storage Study

Submitted Jan 1, 2014:

- Completed by Strategen Consulting and the Electric Power Research Institute for the Department of Commerce.
- Investigates the potential costs and benefits of installing utility-managed, grid-connected energy storage devices in residential and commercial buildings in Minnesota



# Energy Storage Technologies

## Electro-chemical



(Batteries)

## Mechanical



(Flywheel)

## Bulk Mechanical



(Compressed Air)

## Thermal



(Ice/Hot Water)

## Bulk Gravitational



(Pumped Hydro)

## Transportation



(Electric Vehicles)

# Energy Storage Technologies: Study Scope

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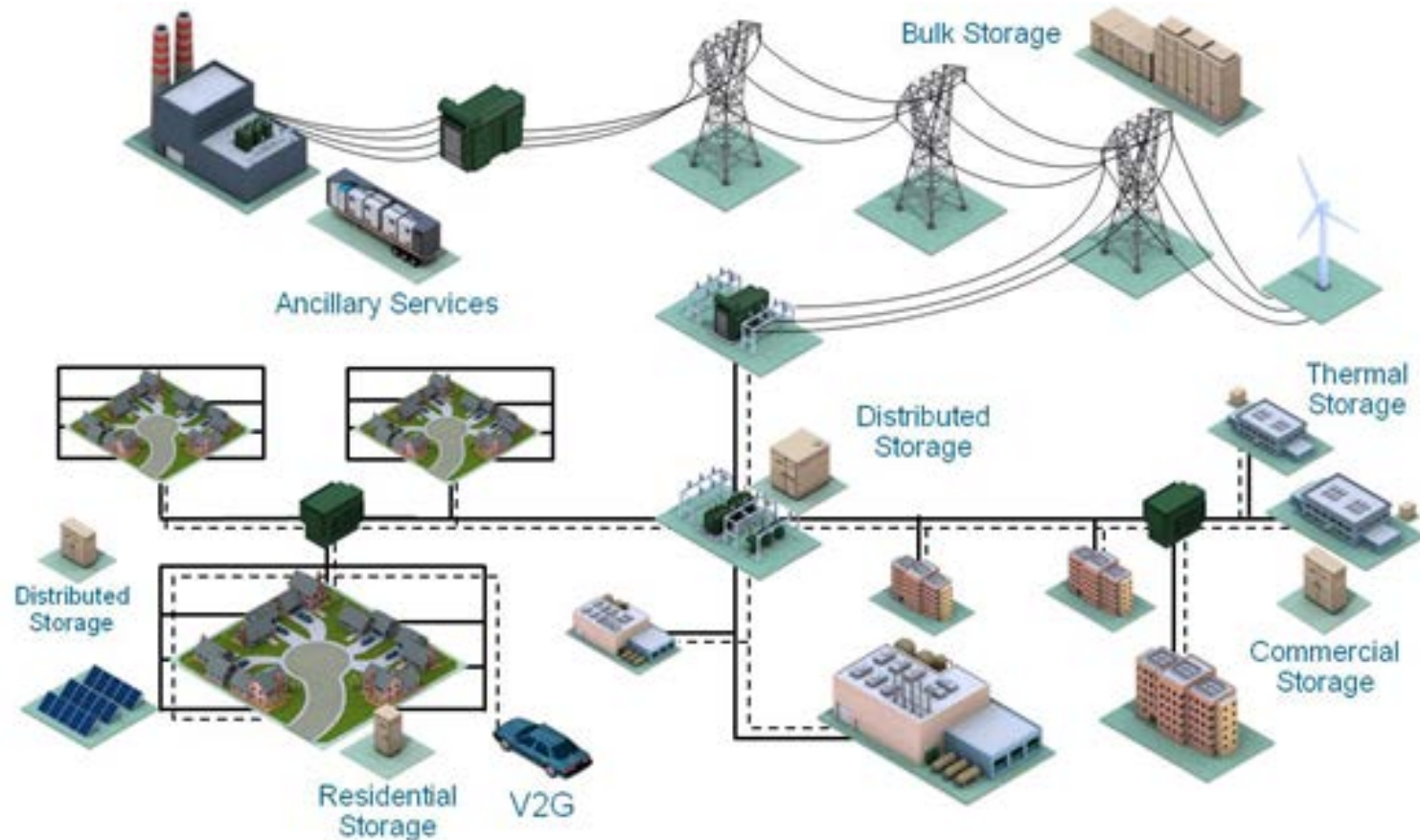
## Transportation



(Electric Vehicles)

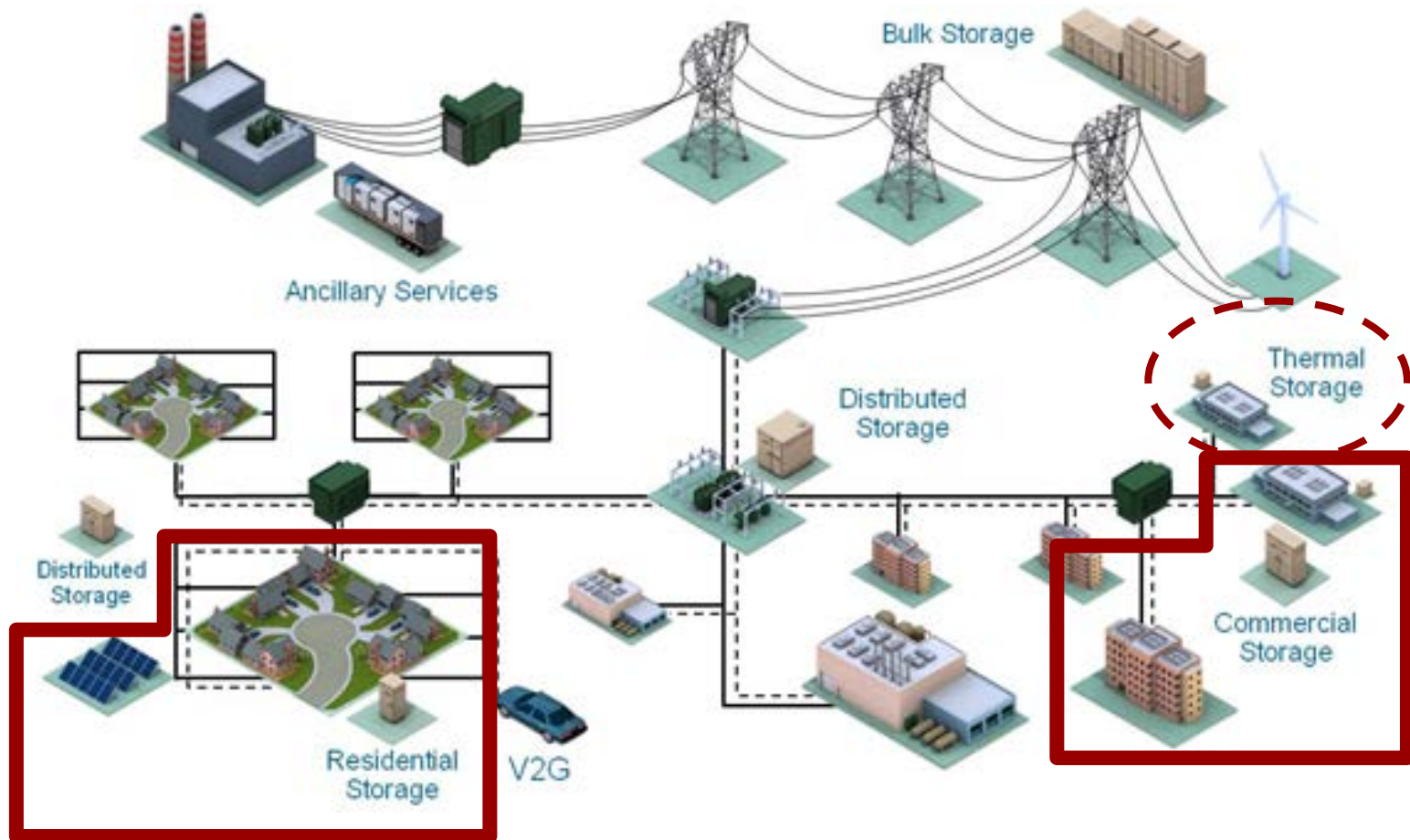
# Energy Storage Roles on the Grid

Energy storage is broad category including diverse technologies and benefits to the electric grid.



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# 2013 MN Energy Storage Study

## Cost-Benefit analysis

Four use-cases modeled:

### **1: Customer controlled for bill savings**

- Reducing peak demand charges;

### **2: Utility controlled for distribution**

- deferring investment in distribution upgrades;
- Improving customer reliability and power quality;

### **3: Utility controlled for distribution and market benefits** (case 2 + MISO market participation)

- Supporting both distribution and transmission grid services

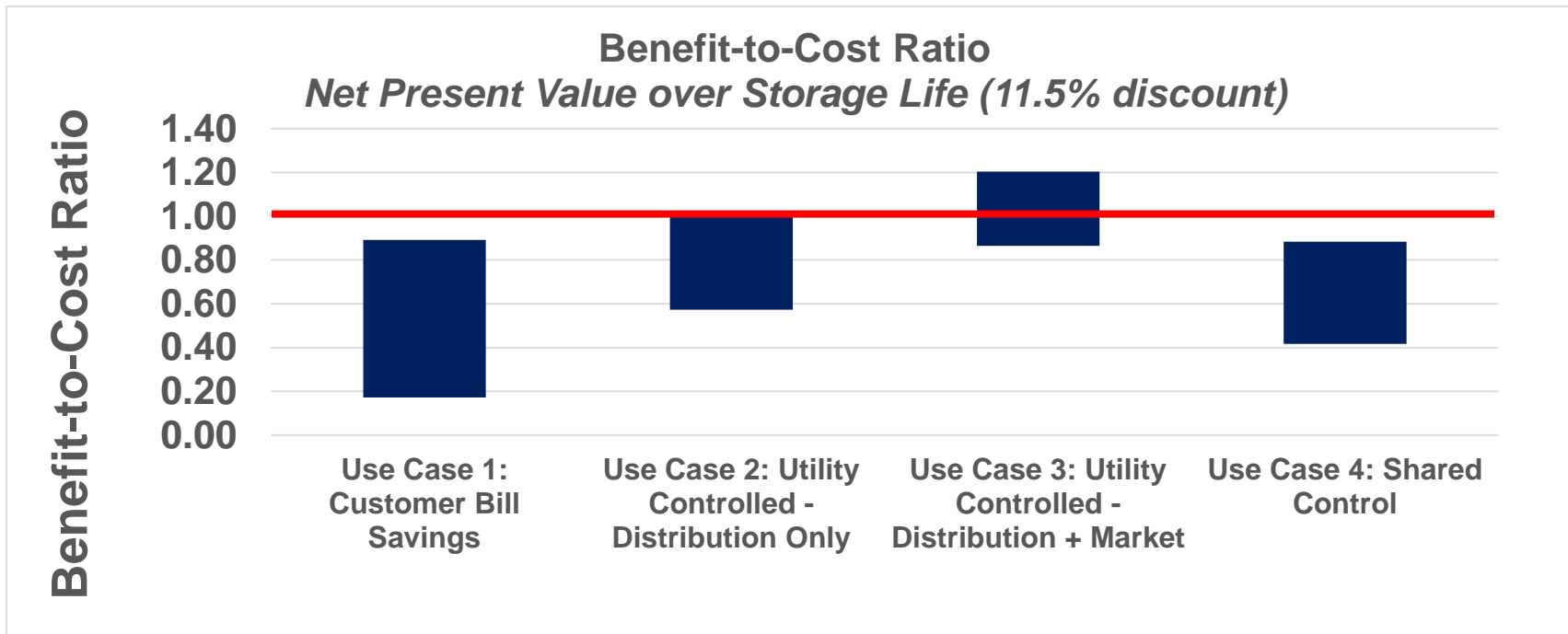
### **4: Shared customer and utility controlled for bill savings and market revenue** (hybrid of 1 & 3)

- Providing additional value for unused storage capacity



# 2013 MN Energy Storage Study

## Key Findings



A benefit to cost ratio greater than one means that the modeled benefits exceed the project costs; in other words, the net present value (NPV) was greater than zero, and for this study had an return (IRR) greater than the 11.5% discount rate



# 2013 MN Energy Storage Study

## Key Findings

- Case 3: Utility-controlled storage with market participation showed the highest benefit to cost ratio by capturing more value streams:
  - Deferral of distribution upgrade cost
  - Participation in MISO market
  - Reduced wear and tear on peaking power plants
  - incentives for energy storage + solar PV

# Opportunity for further study

- Study using site-specific, 15-minute data for various site profiles
- Effect of MISO Ancillary Service market rules
- Declining cost of storage vs. ITC expiration for pairing w/ solar PV
- Combined value streams
  - peak shaving, ancillary services, backup power

# Where could storage add value?

- **Resiliency:** backup for critical infrastructure (water supply & wastewater treatment, grocery stores)
- **Cost:** Demand charge reduction for high peaking customers
- **Emerging market:** Low-carbon microgrids

# Technical Resources

- **Large projects:**
  - Energy Storage Technology Advancement Partnership (ESTAP)
    - Sandia National Labs & CESA
    - Disseminate information (eg. ISO markets)
    - Facilitate partnerships
- **Small projects:**
  - Resilient Power Project
    - Clean Energy Group

# Information Resources

[Energy Storage 101: a quick reference handbook](#),  
U of MN, Energy Transition Lab, July 2015

[White Paper Analysis of Utility-Managed, On-Site Energy Storage in Minnesota](#), Strategen and EPRI for MN Dept of Commerce, Jan 2014

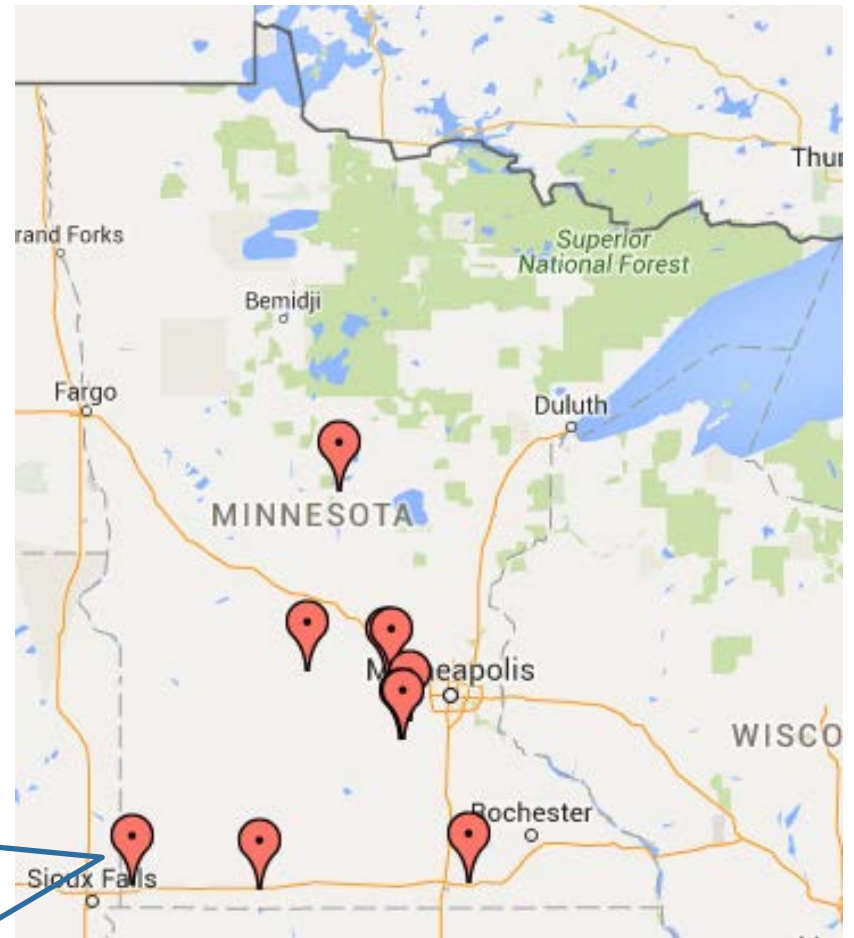
[DOE Global Energy Storage Database](#)

# DOE Energy Storage Database

(1) Sodium-Sulfur Battery: 1,000 kW  
(9) Lead-Acid Batteries: 297 kW  
Total: 1,297 kW



**Xcel Wind-to-Battery Project**  
Luverne, MN 2008  
1,000 kW Sodium Sulfur  
Duration: 7 hour at 1MW



MN Demonstration Projects

# Energy Storage in MN

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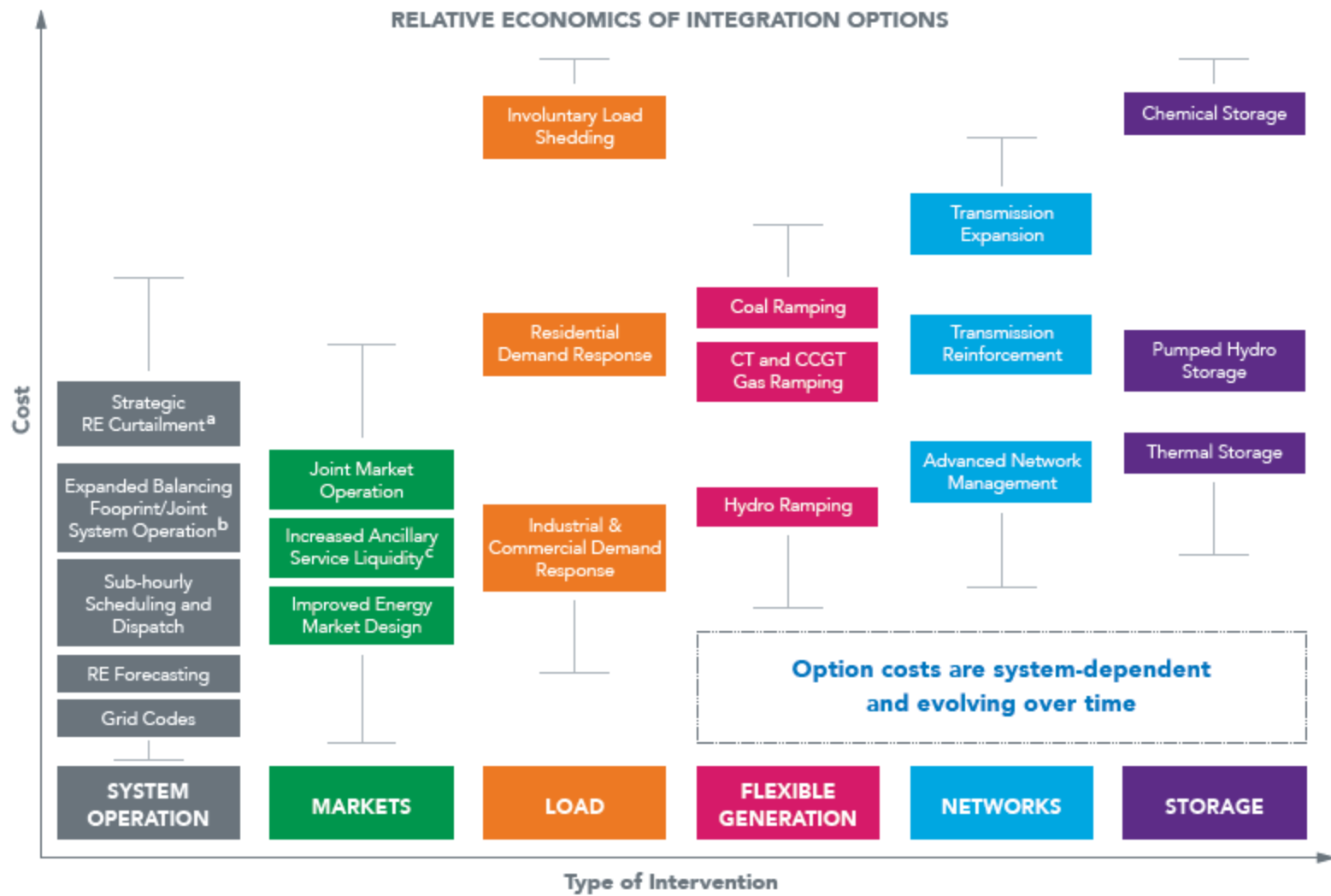


[mn.gov/commerce/energy](https://mn.gov/commerce/energy)

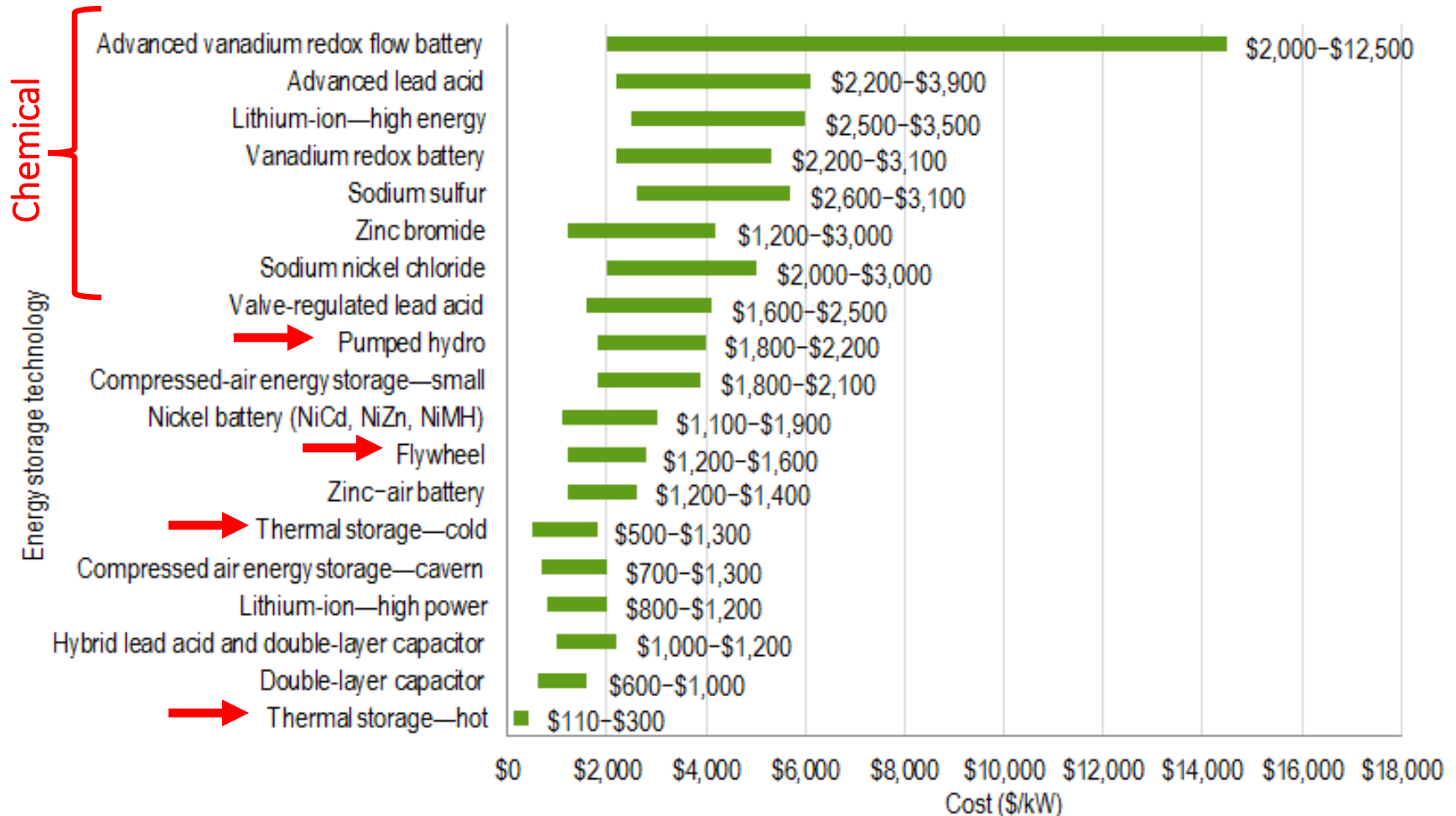
# Additional Resources



# Energy Storage Roles on the Grid



# Energy Storage Technologies



Notes: kW = kilowatt, NiCd = nickel cadmium, NiMH = nickel metal hydride, NiZn = nickel zinc.

© E Source; data from Sandia National Laboratories

# MN Demonstration Projects - Proposed

## Xcel Belle Plaine Battery Project

- 2 MW (6 MWh) Storage + 1 MW Solar PV
- Areas of study:
  - Distribution capacity deferral, Solar PV integration
  - Explore multiple value streams: Volt/Var control, Power Quality, MISO market participation
- Details: 2015 Biennial Report – Distribution Grid Modernization, 10/30/2015, Docket: 15-439