



Energy Storage Summit

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MN Department of Commerce

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Energy Storage

- Initial study & future opportunities
- Energy storage: a pathway to 10% solar?
- Energy storage & resource planning

Energy Storage Study

- Investigated potential costs and benefits of installing energy storage devices:
 - utility-managed
 - grid-connected
 - residential and commercial buildings
 - in Minnesota



Where could storage add value?

- Energy assurance
- Affordability
- Economic efficiency and reliability



MN **SOLAR** PATHWAYS

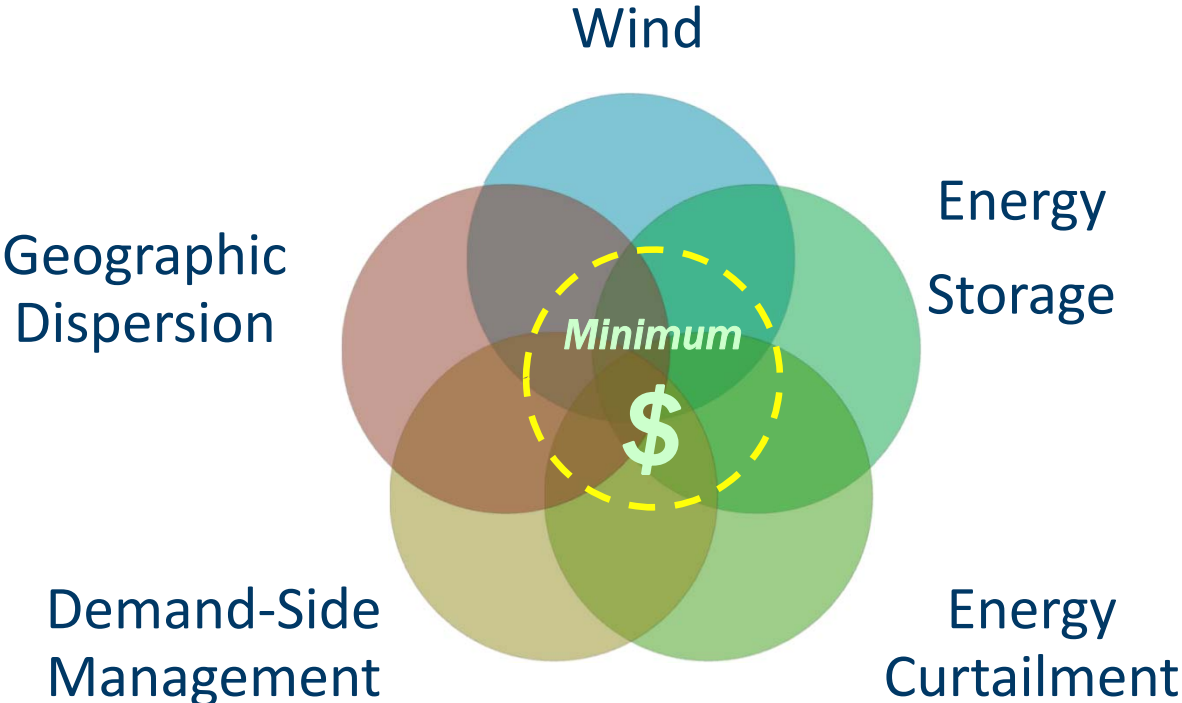
Storage: Pathway to 10% solar?

Scenario-based technical analysis

Evaluate technical and economic potential for technologies to complement solar in future high penetration scenarios



Portfolio of Technologies Considered



Energy Storage Technologies

Electro-chemical



(Batteries)

Mechanical



(Flywheel)

Bulk Mechanical



(Compressed Air)

Thermal



(Ice/Hot Water)

Bulk Gravitational



(Pumped Hydro)

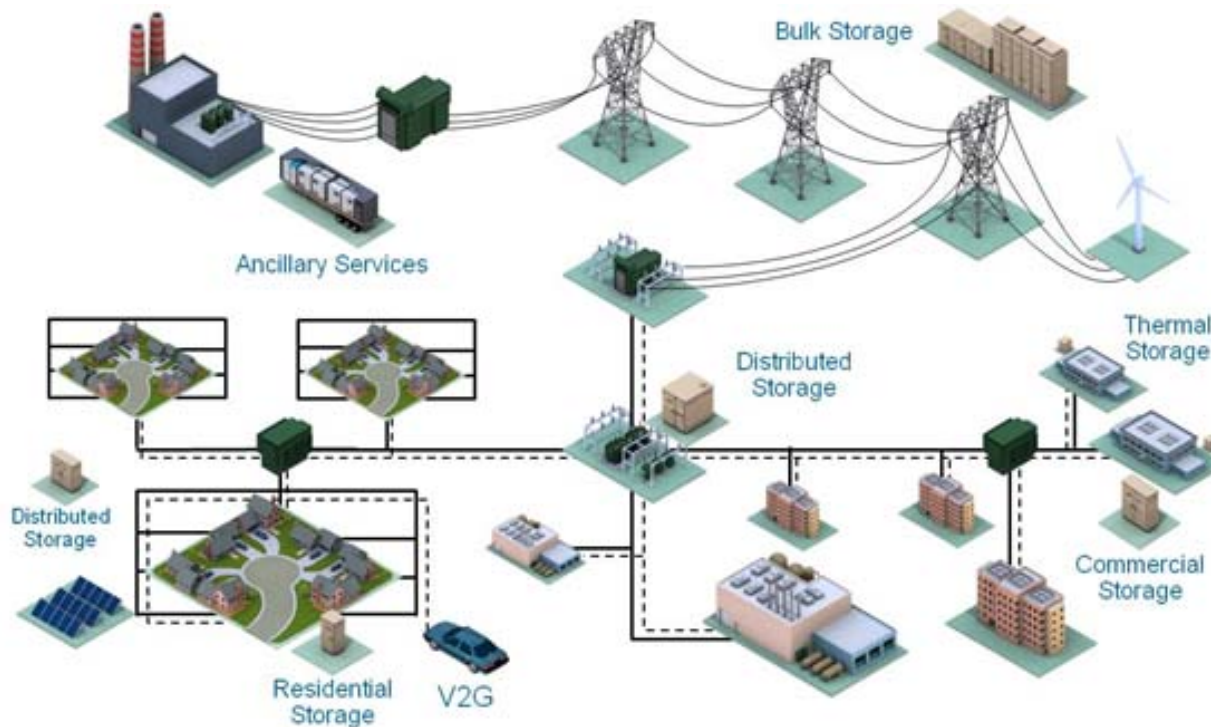
Transportation



(Electric Vehicles)

Energy Storage Roles on the Grid

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



DOE Energy Storage Database

Existing:

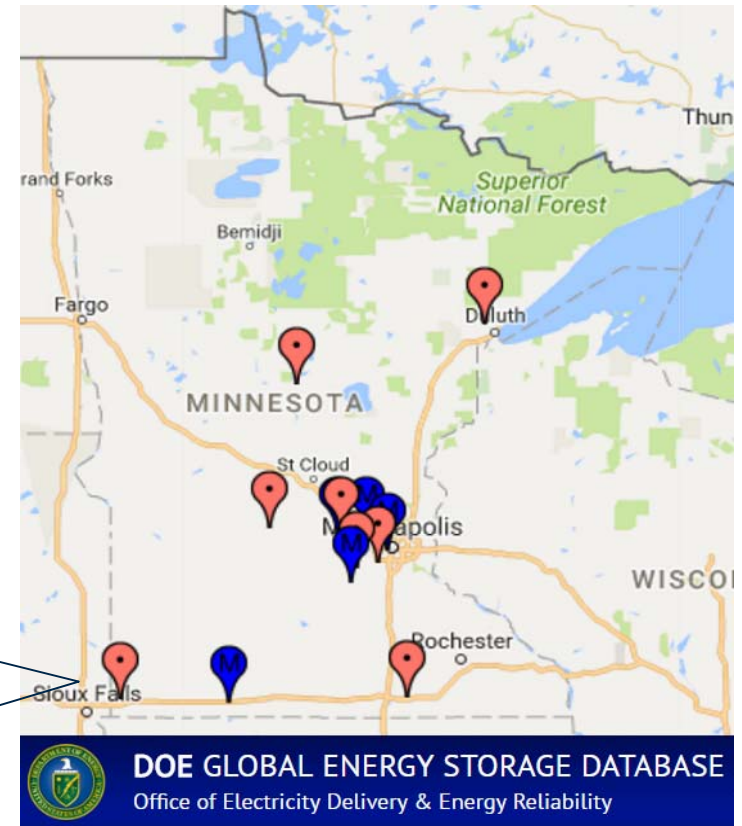
(1) Sodium-Sulfur Battery: 1.000 MW
(12) Other Batteries: 0.465 MW
Total: 1.465 MW



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

Proposed:

Connexus
Solar + Storage:
20.0 MW



Energy Storage in Resource Planning & Acquisition

- Types of storage that are already used in resource planning
 - Thermal storage → load shaping
 - Wind + hydro curtailment → hydro storage



Energy Storage and Resource Planning

- Provides peaking services
- Creates increase in demand during demand during off-peak
- Creates increase in supply during on-peak
- Might bid against traditional peaking units
- Benefits include flexibility & no environmental costs
- Need to consider what (marginal) resource is displaced

Summary

- There are future opportunities for study
- Energy storage is one pathway being explored to help meet a 10% solar future
- Energy storage has a place in resource planning

Thank You!

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