



Energy Storage for Integrating Wind

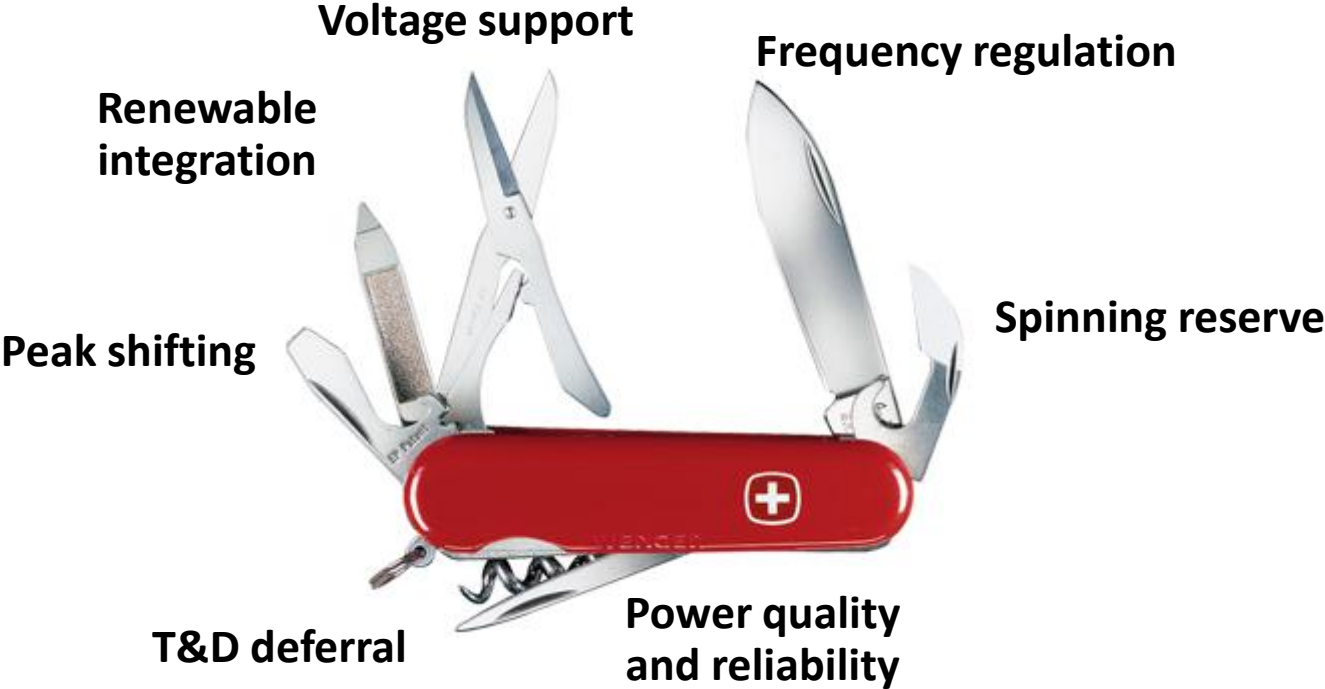
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UMass Lowell Wind Energy Research Workshop

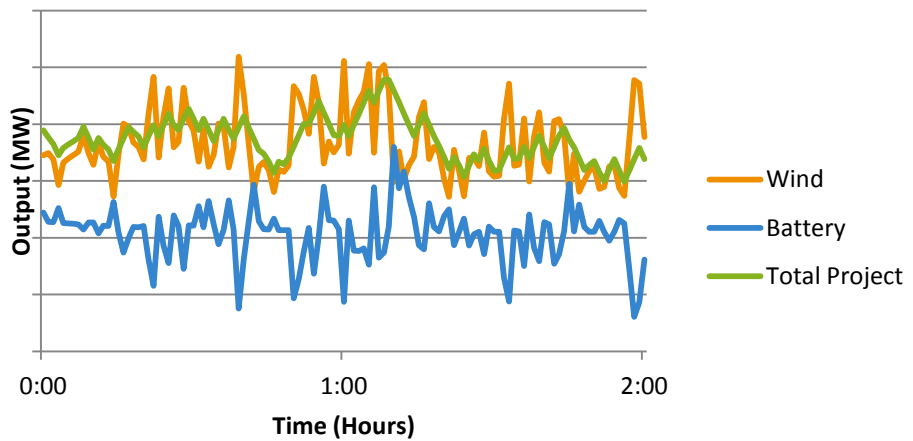
Energy Storage is a Multifunctional Tool



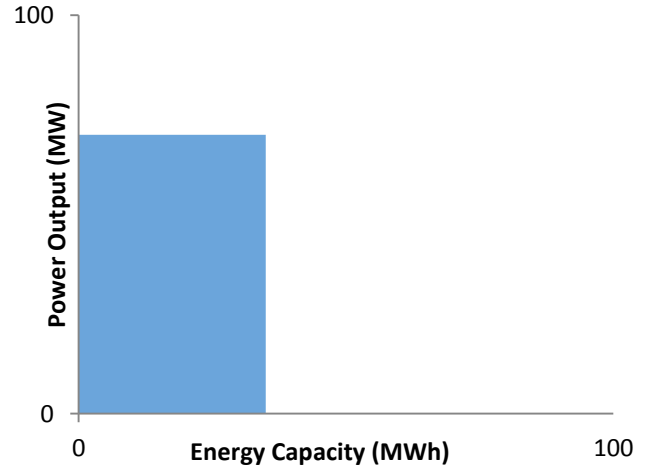
Renewable Ramp Management

Absorb sudden changes in wind farm output

Wind Project Output

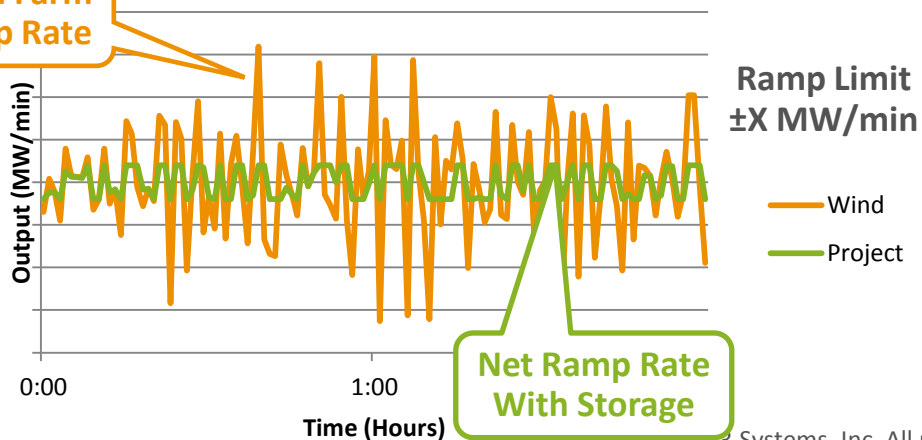


Storage System Sizing

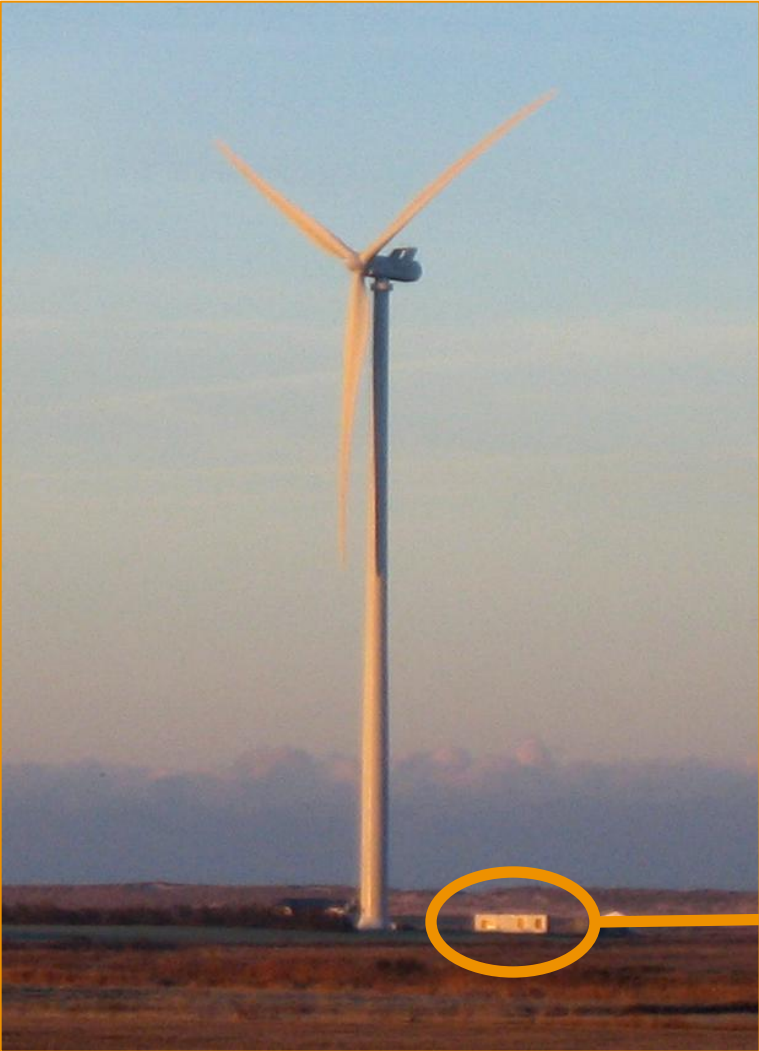


Wind Project Ramp Rate

Wind Farm Ramp Rate



Renewable Ramp Management: Denmark



Multiple Uses: Tehachapi Storage Project

- Customer: Southern California Edison
- Location: Tehachapi Windfarm
 - + California's largest wind resource
 - + Wind development potential driving grid infrastructure upgrades and expansion
 - + 2nd largest wind park in the world
 - 660MW installed / ~5,000 turbines
- System
 - + 8MW – 4 hour (32MW-hour) GBS system
 - World's largest Li-ion battery system when complete
 - + Dynamic 4-Quadrant PCS/Grid Interface
 - + A123 Prismatic Cells
 - + Installation / Operation 2012
 - + 13 Targeted Operational Uses – Individually and Stacked



Multiple Uses: Tehachapi Storage Project

- Transmission-Related Uses
 - + Voltage Support & Grid Stabilization
 - + Demonstrate a decreased in transmission losses
 - + Demonstrate how the system can defer transmission investment
 - + Optimize Size and Cost of Renewable Energy-Related transmission

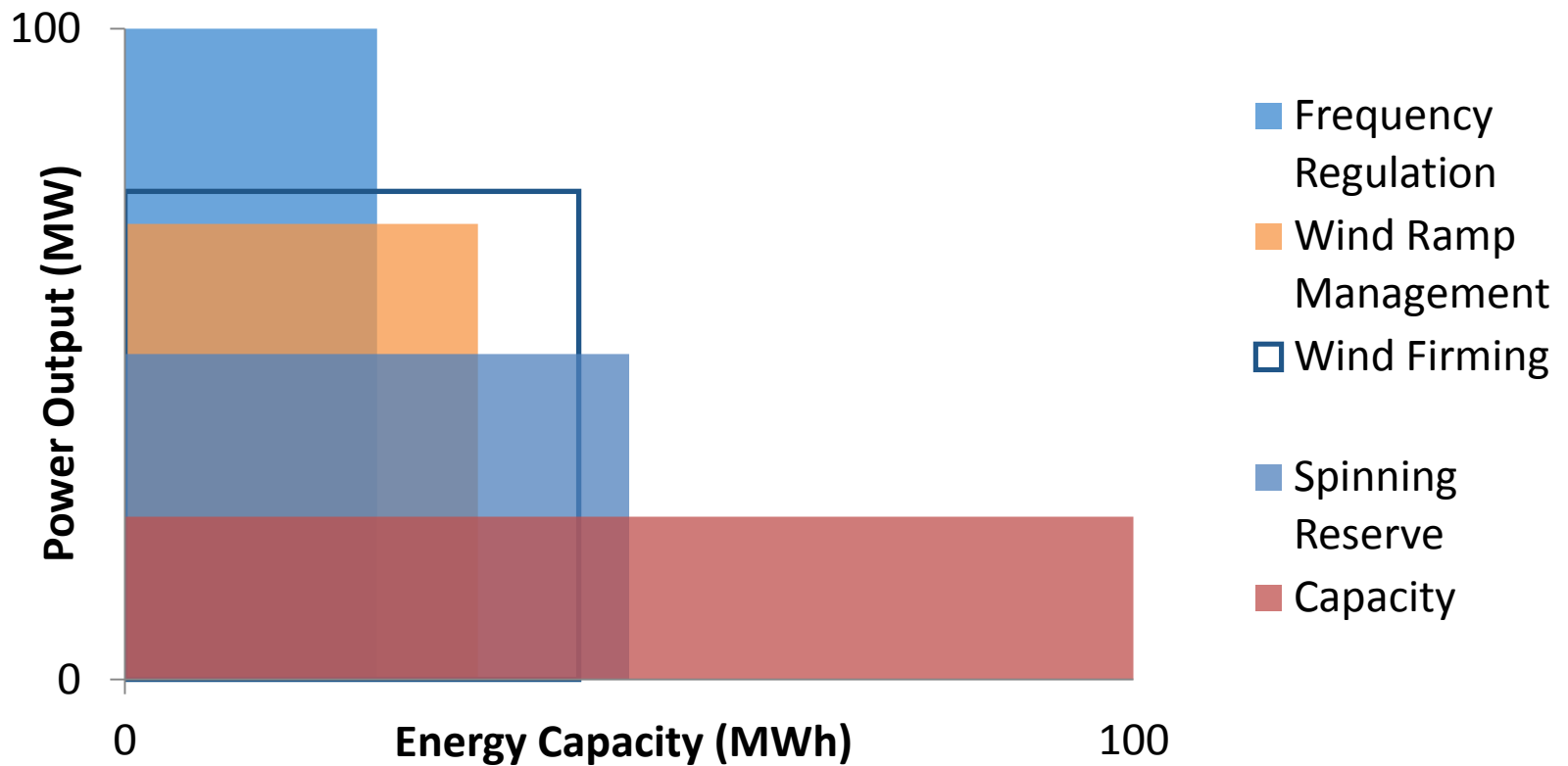
- System-Related Uses
 - + Provide System Capacity and Resource Adequacy
 - + Black Start
 - + Wind Firming

- ISO Market-Related Uses
 - + Frequency Regulation
 - + Spinning and Non-Spinning Reserves
 - + Ramp Management
 - + Energy Price Arbitrage



Diverse System Needs...

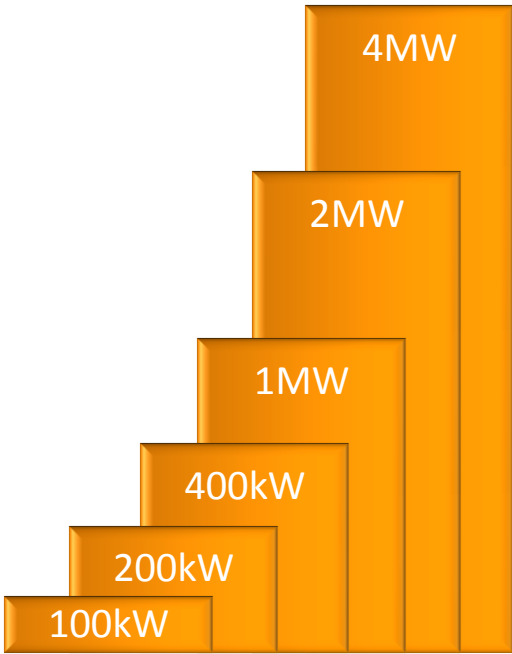
Storage System Sizing



...Need a Flexible Product Architecture...

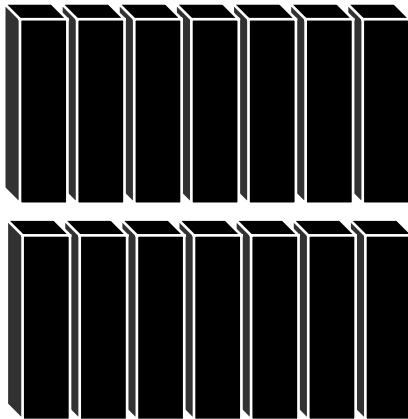
More Power:

Choose Inverter Size



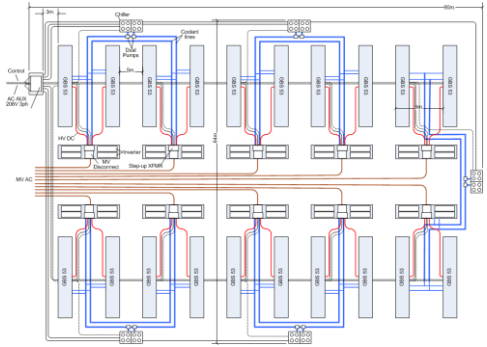
More Energy:

Select Number of Racks



Scalability:

Add Containers



...and A123 Provides Solutions Worldwide

Over 40MW in service today

