LDES NATIONAL CONSORTIUM

LDES National Consortium Workshop

Improved Reliability and Resilience Valuation Approaches and Metrics

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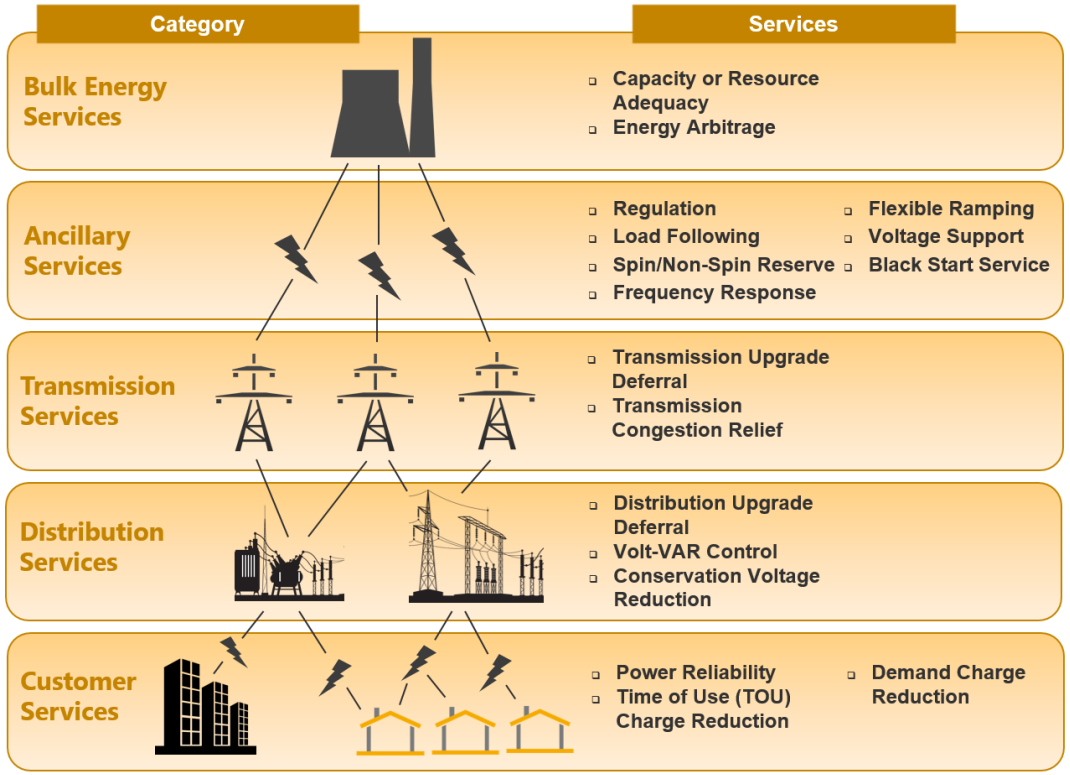
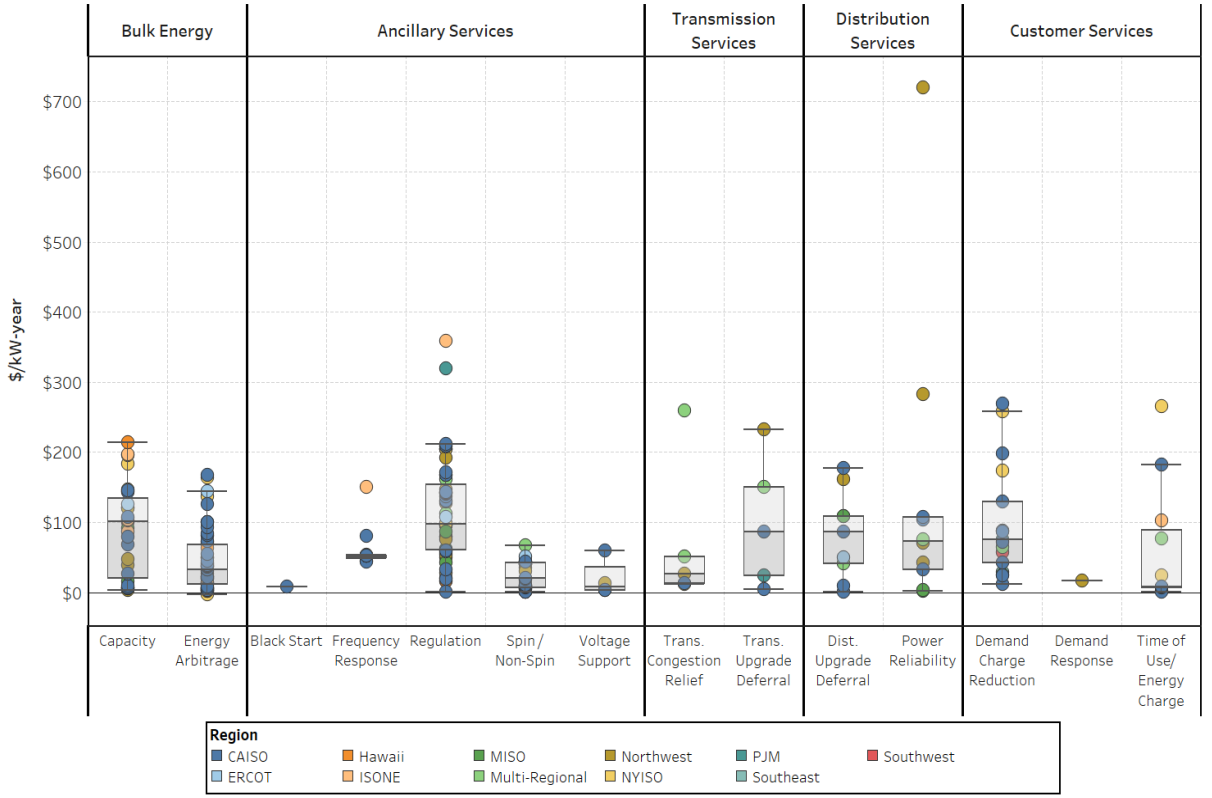
Valuation Taxonomy and Meta-Analysis Results





Source: Balducci, Patrick, Mongird, Kendall, and Weimar, Mark. Understanding the Value of Energy Storage for Power System Reliability and Resilience Applications. Germany: N. p., 2021. Web. https://doi.org/10.1007/s40518-021-00183-7.

Valuing Resilience

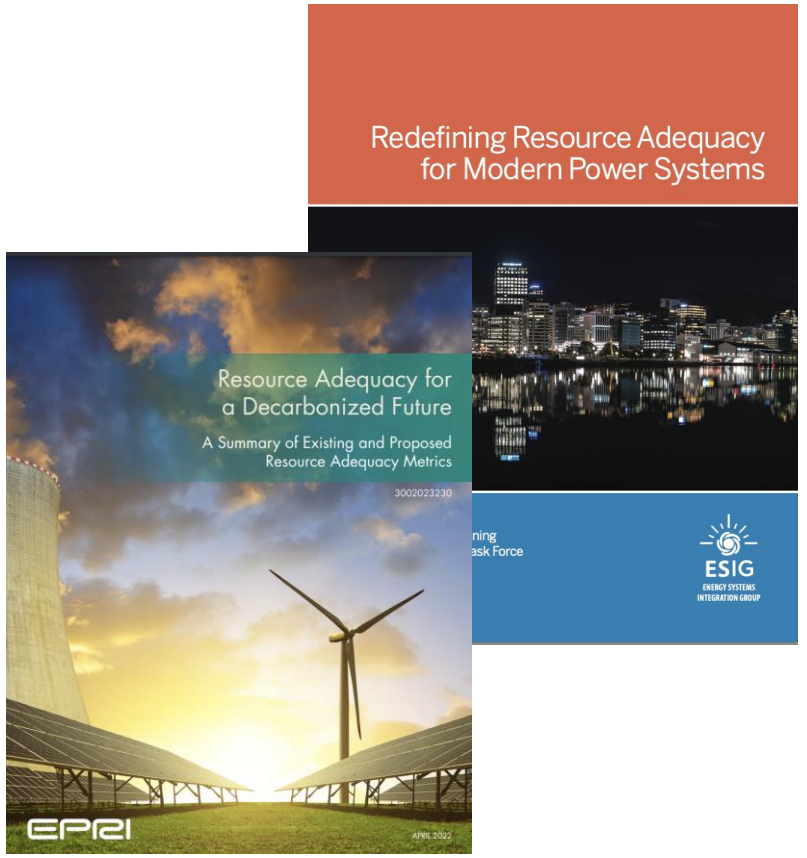
- Energy storage has demonstrated the capacity to enhance grid resilience
- Resilience benefits are poorly defined and generally ignored in energy storage valuation studies
- Resilience benefits are typically evaluated using customer damage functions and interruption cost studies, sometimes evaluated using willingness to pay studies (e.g., contingent valuation method) and input-output analysis
- Resilience value can be embedded in other value streams, including transmission deferral, voltage support, and primary frequency response
- Multi-hazard risk analysis relies on expected value calculations based on probabilistic analysis, while addressing a broad range of hazards and values tied to lost economic productivity, infrastructure damage, and injuries/fatalities is required – annual risk premium approach
- No consensus in the valuation of reliability and resilience

Cost Element	Included in Outage Cost Studies	Included in Resilience Valuation
Value of lost load	☑	☑
Penalties to utilities		↻
Lost energy sales		↻
Surging LMPs	↻	↻
Fatalities, injuries, morbidity	↻	
Infrastructure and property damage	☑	
Business closures and relocations	↻	
Displacement costs	↻	
Direct, indirect, induced effects	☑	

☑ **Often included.**
↻ **Sometimes included.**
Rarely or never included left blank.

New Resource Adequacy Metrics Gaining Support

- **Reliability risk** increasingly driven by weather, not peak demand, complicating reliability planning
- **LOLE** (Loss of Load Expectation, # event days/yr) not sufficient for capturing reliability risks
  - No info about duration or magnitude of events
  - No insight into magnitude of infrequent events
- **New metrics** supported by many industry reports identify shortfall magnitude & duration
  - Inform about infrequent, extreme events
  - **Can guide selection of LDES as a reliability solution**

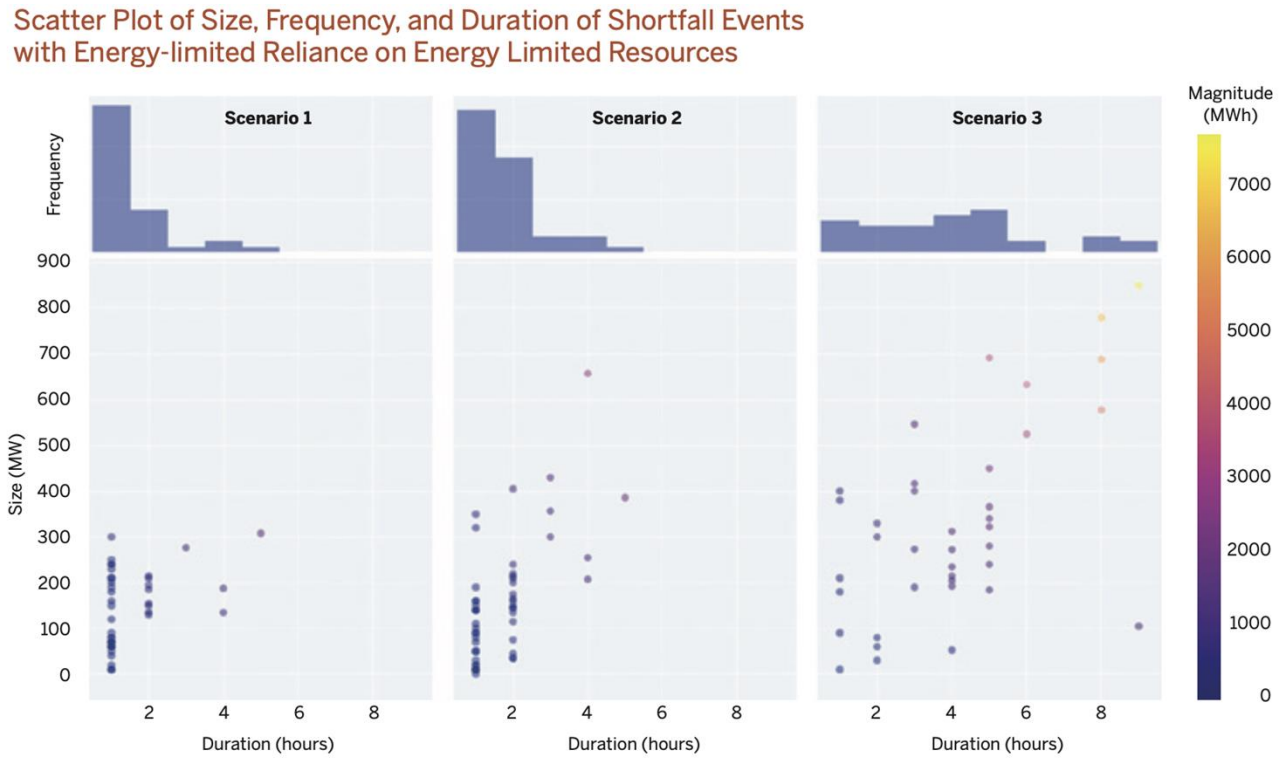


Recent Studies Exploring Adjustments to Traditional Resource Adequacy Approaches

LOLE Can Mask Different Reliability Challenges

- Three portfolios tested against the same weather conditions
- Same LOLE for each scenario
- Different reliability needs
- **Metrics capturing these differences can guide LDES procurement**

Three scenarios with the same LOLE but varied reliability needs



Redefining Resource Adequacy for Modern Power Systems (ESIG, 2021)

Redefining Resource Adequacy Task Force. 2021. Redefining Resource Adequacy for Modern Power Systems. Reston, VA: Energy Systems Integration Group. https://www.esig.energy/reports-briefs

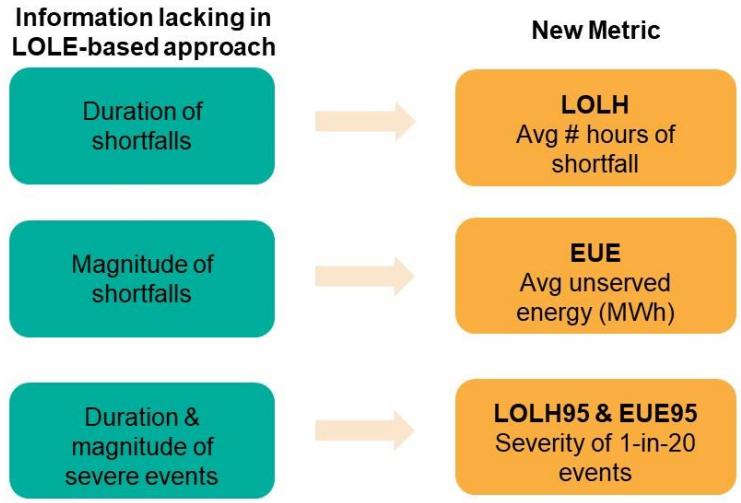
Improved Resource Adequacy Metrics Can Highlight the Role that LDES Can Play in Supporting Reliability

- New metrics can highlight when LDES can meet system reliability needs.
- LDES procurement can be driven by:
  - Longer LOLH and LOLH95:
    System need for longer duration
  - Higher EUE and EUE95:
    System need for larger volumes of stored energy

New metrics provide more granular information for meeting reliability needs.

Event Characteristic	Metric Affected	California Aug 2020	Texas Feb 2021	Difference
Number of Events	LOLEv	2 events	1 event	-50%
Number of Days	LOLE	2 days	3 days	+50%
Number of Hours	LOLH	6 hours	71 hours	+1,083%
Unserved Energy	EUE	2,700 MWh	990,000 MWh	+36,567%
Max Shortfall	-	1,072 MW	20,000+ MW	+1,766%

Beyond 1-day-in-10-years: : Measuring Resource Adequacy for a Grid in Transition. November 29, 2021 by Derek Stenclik - Telos Energy. https://www.esig.energy/beyond-1-day-in-10-years-measuring-resource-adequacy-for-a-grid-in-transition/



New Reliability Metrics Can Guide LDES Procurement

Key Takeaway

- New metrics are better suited to capture reliability risks & identify the role for LDES
  - LOLH and EUE capture the magnitude and duration of events.
  - Longer & larger shortfalls indicate a clear reliability role for LDES

Next Steps

- Utilities should leverage new metrics to pinpoint reliability needs.
- Planners should adjust ELCC calculation methods relying on LOLE to use more informative metrics

Discussion Questions

1. How broadly should we consider costs – i.e., what's logically in and what's out?
2. How do the various approaches for defining value align with the various types of costs?
3. How could we approach designing a program for studying these costs and improving investment planning through their consideration?
4. How will metrics play a role, what should be the focus of this metric development, and how can we use these improved metrics to improve investment planning?