

Overview of Need for Flexibility



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Reliability & Resilience Through the Transition



A Decarbonized Grid must be more reliable and resilient as the grid becomes more dynamic, decentralized, and inverter-based in the context of changing climate and other hazards.

RESOURCE ADEQUACY

Additional resources to meet energy needs for resiliency to extreme future scenarios

DELIVERY ADEQUACY

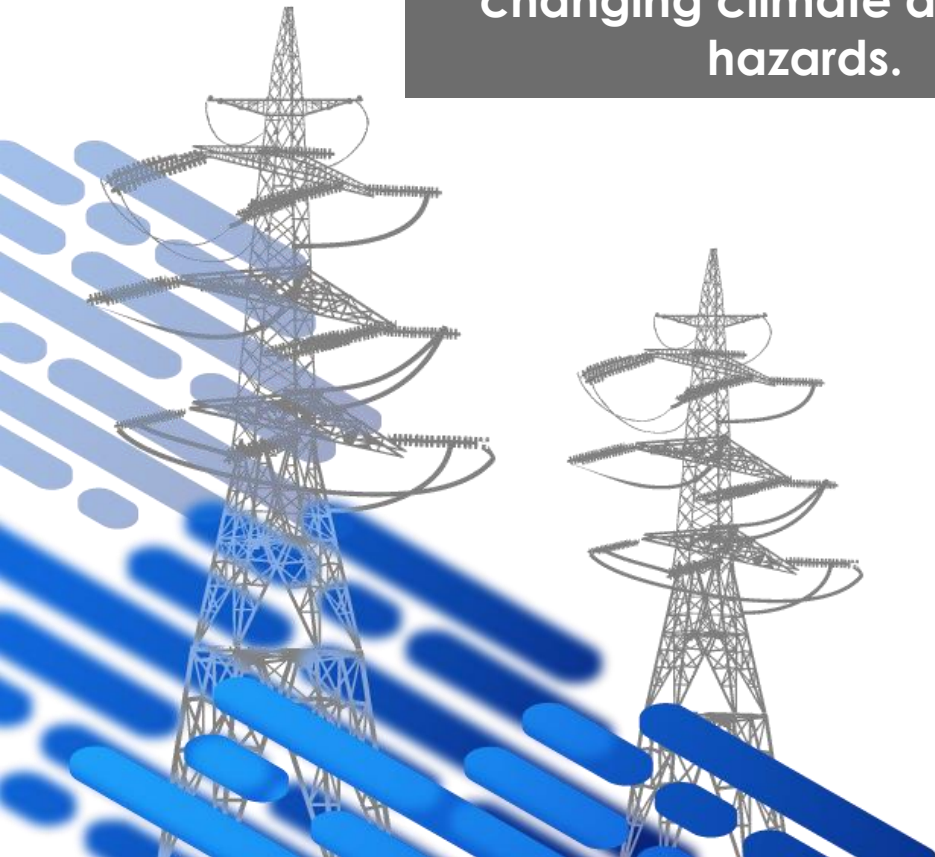
Regional T&D capacity to integrate renewables and DER and serve increased electrification demand

BALANCING AND FLEXIBILITY

Flexibility resources and operating reserves to manage variability and uncertainty

GRID STABILITY

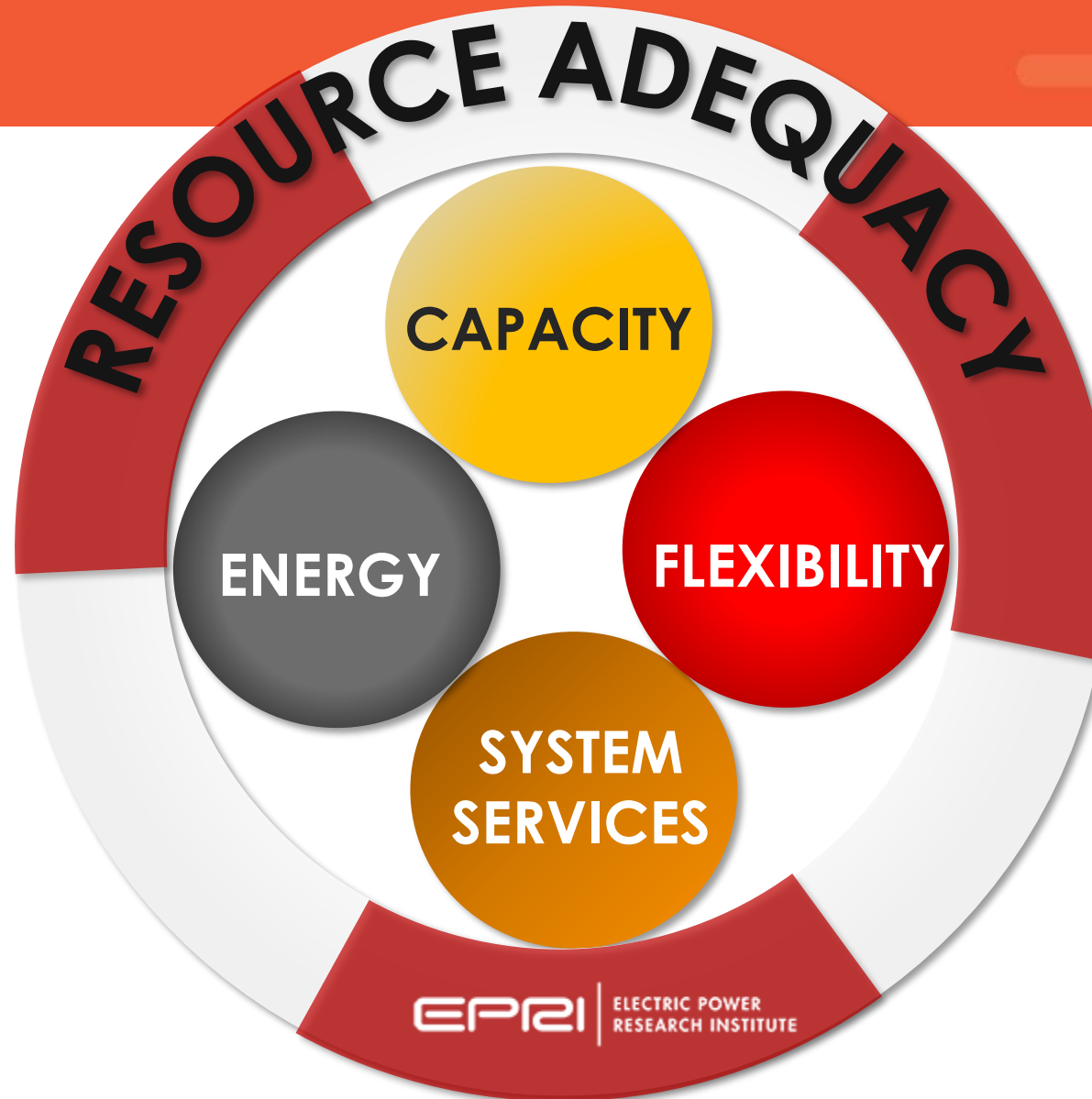
Resources and controls to maintain frequency and voltage for much faster dynamic system



What does it mean to have adequate resources?



An adequate supply fleet is not just the installed MW in the ground. The capacity must have energy to sustain during critical time periods, flexibility to accommodate condition changes, and sufficient reliability services to provide when necessary

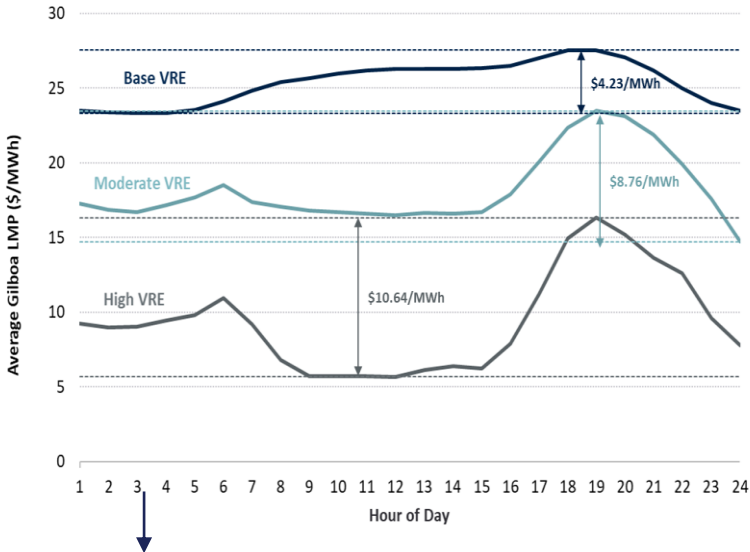


Flexibility Will Become More Valuable

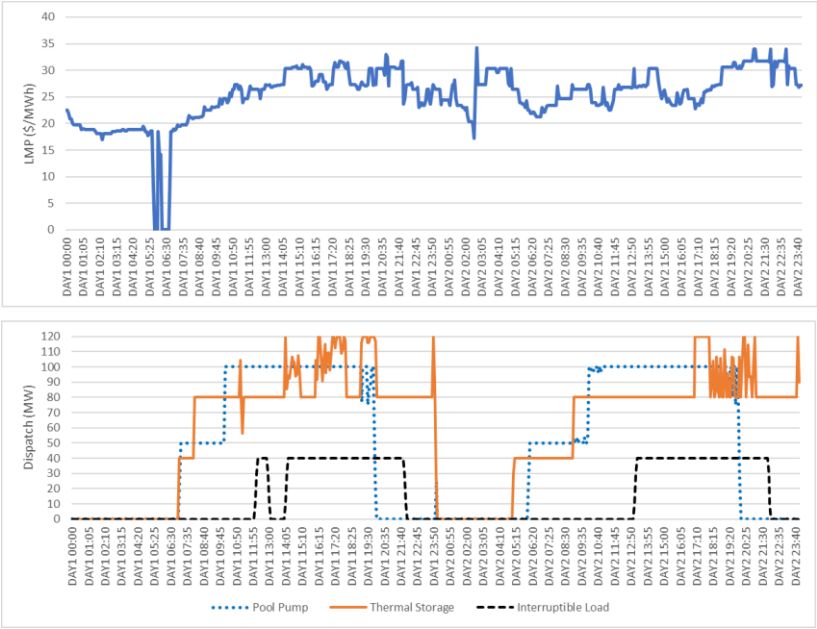
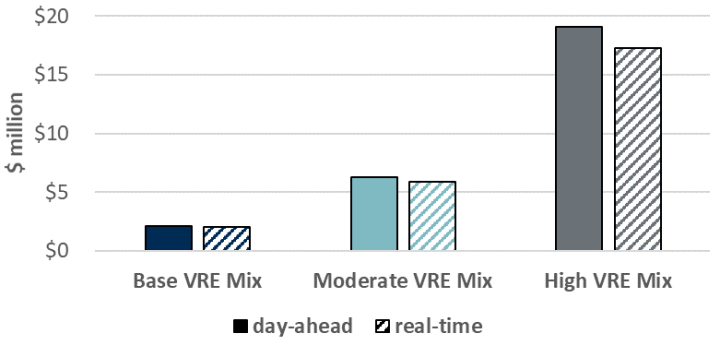


- Flexibility/ramping needs
- Reliability and Economics

Flexibility from traditional and emerging resources becomes more valuable



Total system cost savings from Gilboa PSH plant



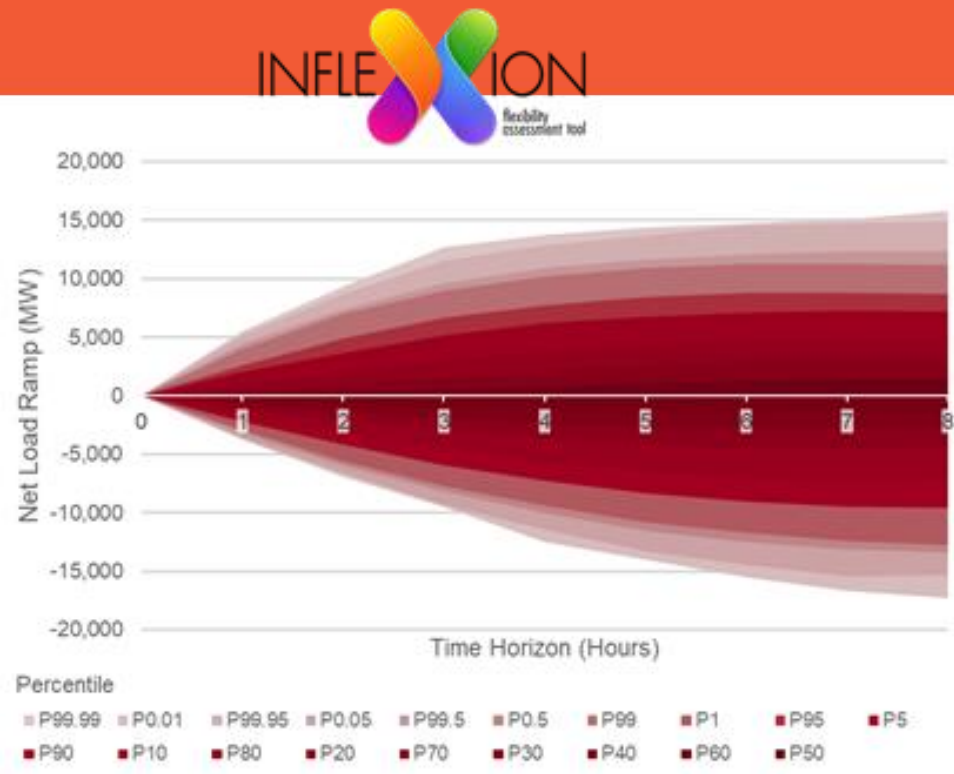
Need to consider potential trade offs as emerging resources provide flexibility

Items	Base Case (without DR)	Study 1 (PG-M)	Study 2 (ES-M)
Total operating cost	\$86 M	\$82 M (↓ 4.6%)	\$84 M (↓ 2.8%)
Balancing Violation (MWh)	25.8	20.3	1.6
No. of Intervals with Balancing Violation	3	3	1

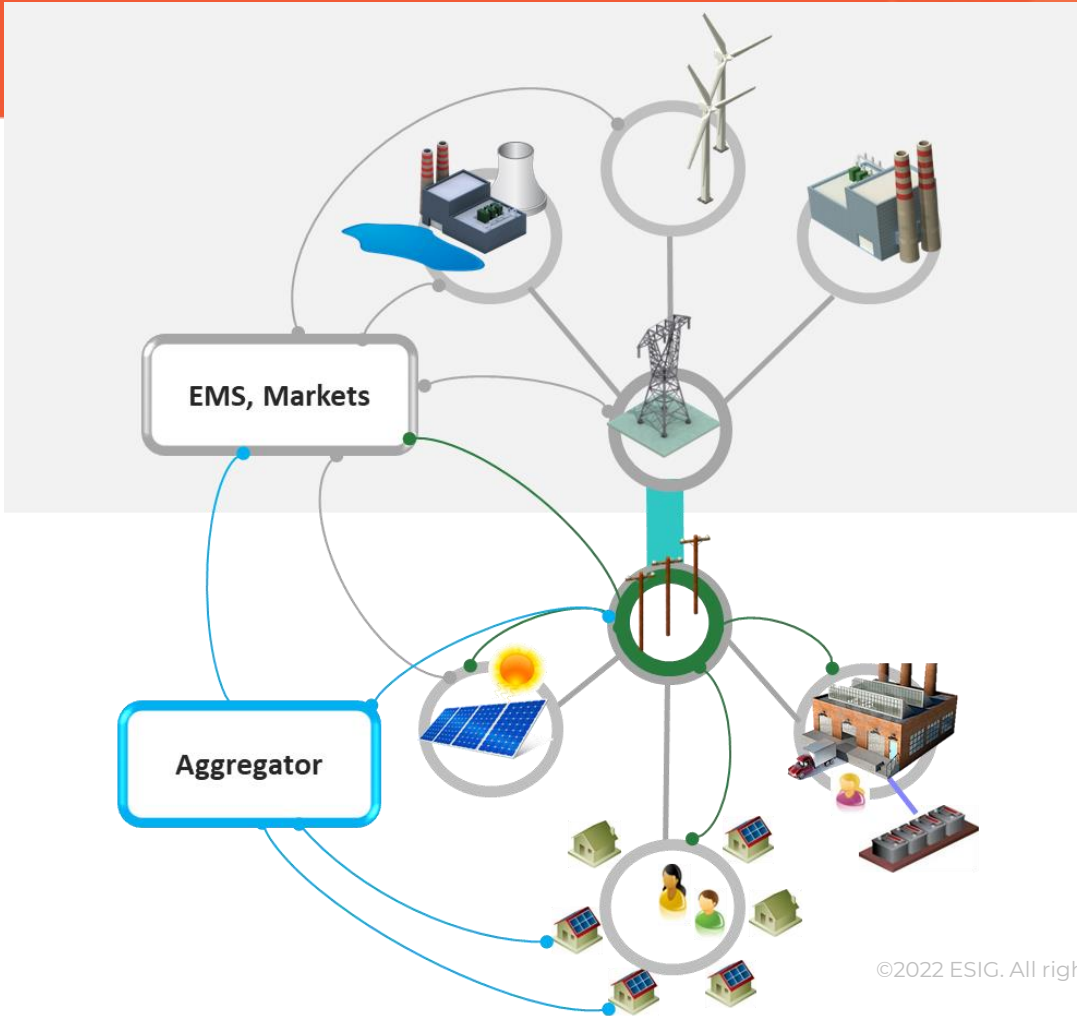
From EPRI, “Predicting Unique Market Pumped Storage Significance (PUMPSS) – Final Project Report”, Forthcoming, 2022

From EPRI, “Flexible Demand Response Modeling and System Analysis of Impacts”, 3002024552, June 2022

Flexibility – measuring needs and obtaining services



Need to be able to assess what is needed, and then get it from emerging and existing resources



Distributed Resources for Grid Flexibility



↑
**2030:
200
GW**
Flexible
Load
**2020:
60
GW**

Smart and Fast
Charging of EV



Enabling Higher
Penetration of
EV/Solar/DER



Grid-Integrated
Energy Storage



Vehicle-to-Grid
System Resource



Connected, Smart
Demand-
Responsive Load



2020 Brattle study estimates potential U.S 2030 load flexibility at 200 GW – 20% of peak load.

- **Initially expected as a source of demand side flex**
 - *Production of hydrogen through electrolyzers with clean electricity*
 - *Use in other industries as a feedstock to decarbonize there*
 - *Pockets may develop with unidirectional flexibility to make use of renewables and then be used from system side at other times*
- **Fuels can be produced away from where they are needed and transported**
 - *Requires consistent accounting of carbon costs/emissions*
 - *Could produce in places with high wind/solar potential (e.g. MENA, Australia, etc.)*
 - *Imported into places with less resources but suitable H₂ networks*
 - US – currently has 1, 600 miles of hydrogen pipelines, 320,000 circuit miles of gas transmission
 - *Will also impact markets – price formation, energy, capacity, etc.*

ENTSO-E has formulated recommendations for policymakers on:

› The new roles of hydrogen

Hydrogen is a tool for reaching decarbonisation targets and not an end in itself

› Where we are now and the next steps towards bigger hydrogen

The business case to use hydrogen in an electricity system operation support function does not currently exist

› Planning and operating hydrogen in 'one system of systems'

A unified system perspective (one system view) is necessary

ENTSO-E, Nov 2021 [\(link\)](#)

Green hydrogen now cheaper than blue in Middle East, but still way more expensive in Europe

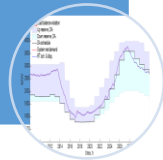


See recent ESIG Flexibility Resources Report ([link](#)) and ongoing TF

Mechanisms to Incentivize Flexibility

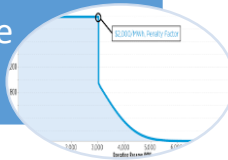
Reduce costs and improve reliability with intelligence

Forecasted Reserve Requirements



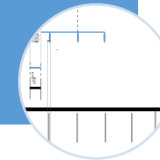
Value reserve above minimum requirements

Operating Reserve Demand Curve



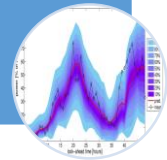
Price opportunity costs of ramp

Multi-interval settlement



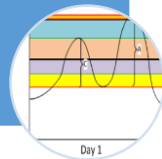
Represent uncertainty explicitly

Stochastic models, smart reserve



Make sure flexibility is built in the first place

Forward Flexible Capacity Attribute Procurement



Let demand provide flexibility

Real-time pricing, retail alignment and automation



Transparency leads to innovation

Price Formation



Reduce uncertainty directly

Enhanced Forecasting



The image features a blue-tinted background with a photograph of four professionals (three men and one woman) in business attire. Overlaid on this is the EPRI 50th Anniversary logo. The logo consists of the letters 'EPRI' in white, followed by a large '50' in a bright cyan color. The '5' and '0' are stylized with arrowheads at their ends, pointing right and left respectively. A small 'th' in white is positioned to the right of the '0'.

EPRI 50th

ANNIVERSARY

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