# Overview of Need for Flexibility

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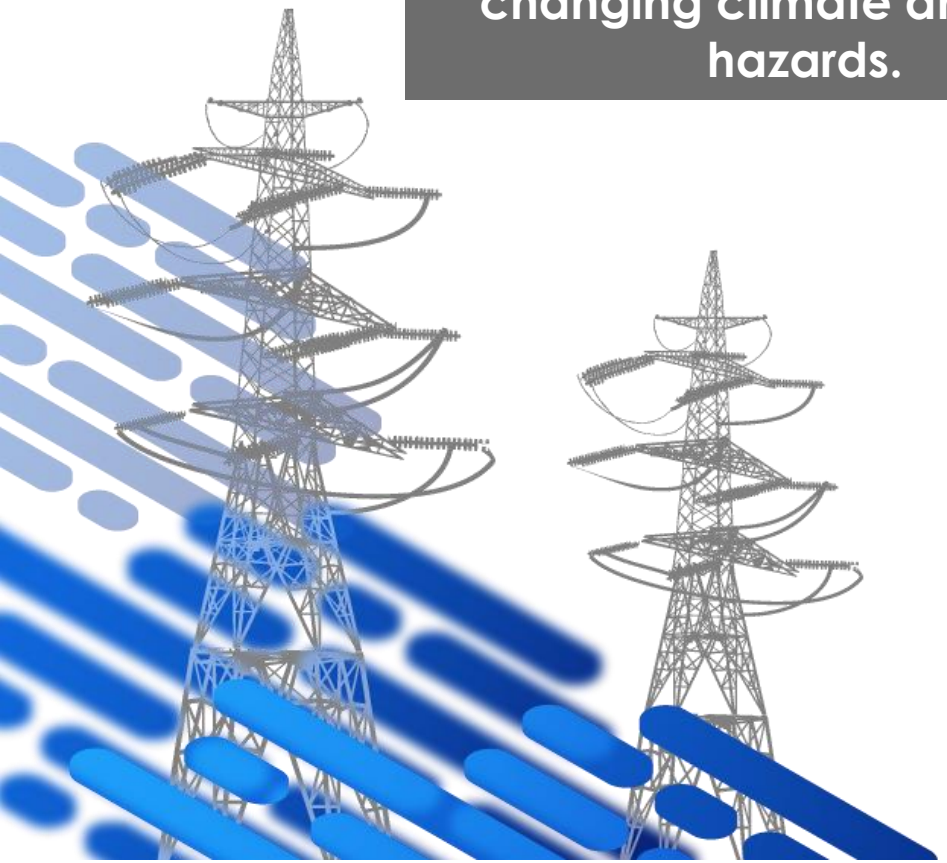
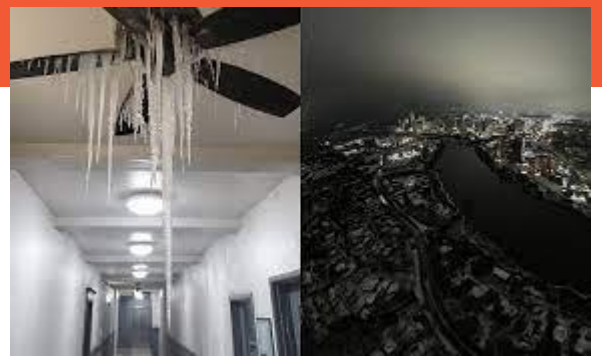
# Reliability & Resilience Through the Transition

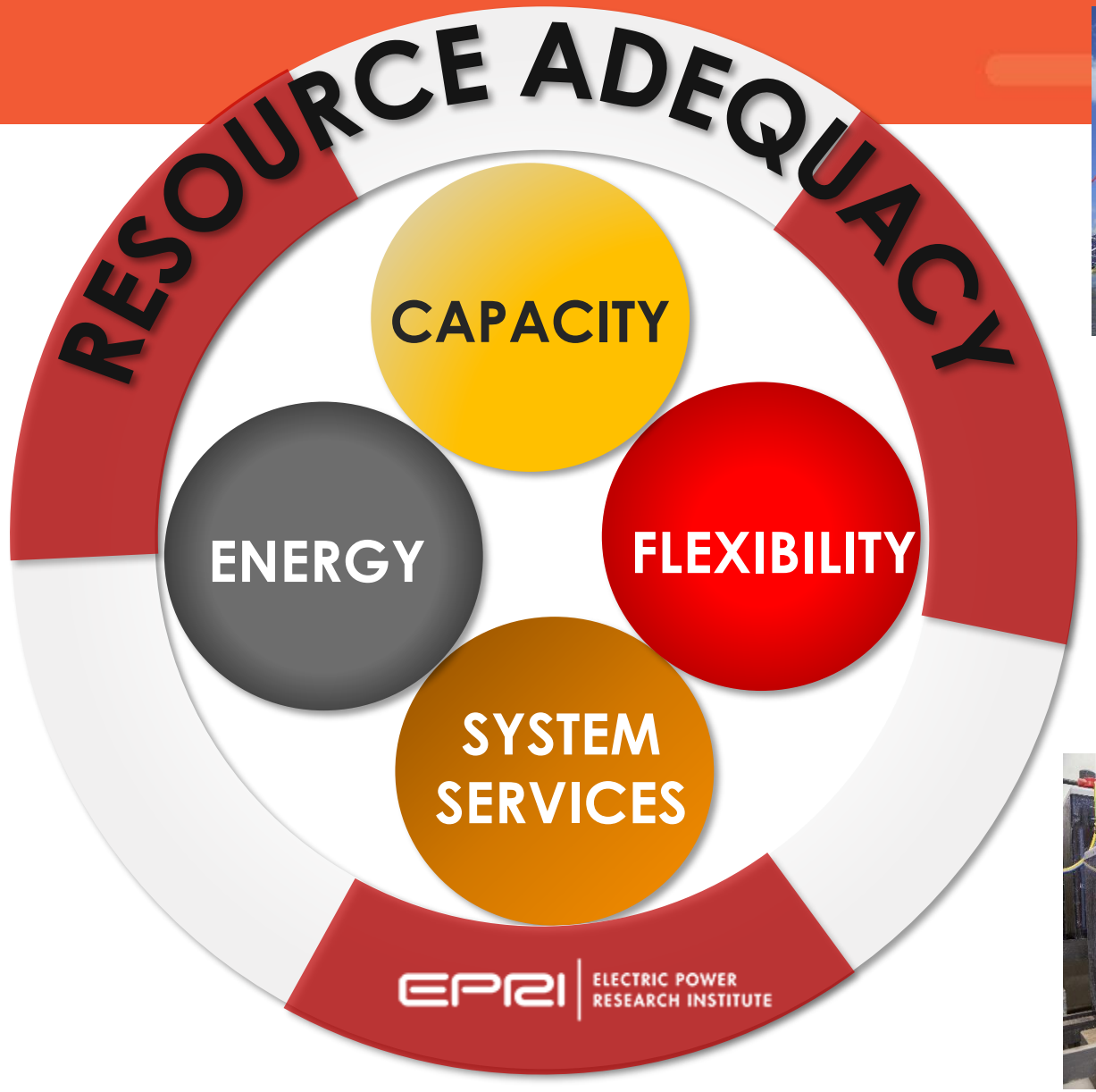
**A Decarbonized Grid must be more reliable and resilient as the grid becomes more dynamic, decentralized, and inverter-based in the context of changing climate and other hazards.**



| RESOURCE ADEQUACY | DELIVERY ADEQUACY |
|---|---|
| Additional resources to meet energy needs for resiliency to extreme future scenarios | Regional T&D capacity to integrate renewables and DER and serve increased electrification demand |
| **BALANCING AND FLEXIBILITY** | **GRID STABILITY** |
| Flexibility resources and operating reserves to manage variability and uncertainty | Resources and controls to maintain frequency and voltage for much faster dynamic system |

# What does it mean to have adequate resources?





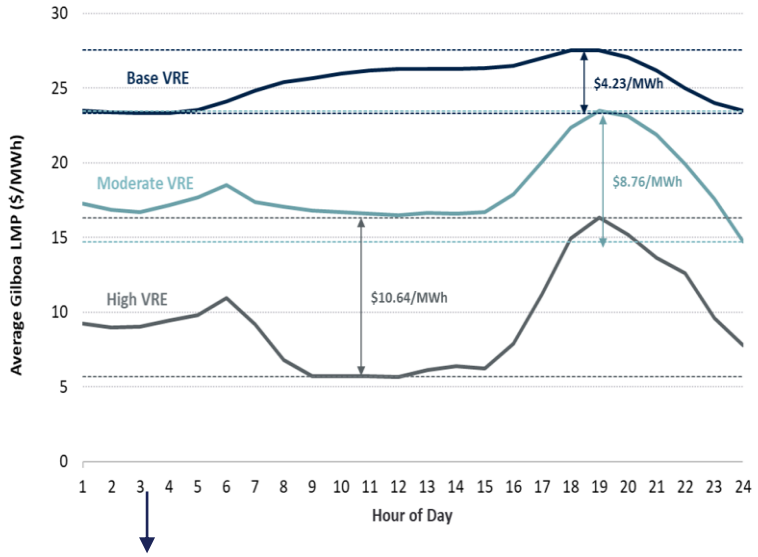

***An adequate supply fleet is not just the installed MW in the ground. The capacity must have energy to sustain during critical time periods, flexibility to accommodate condition changes, and sufficient reliability services to provide when necessary***

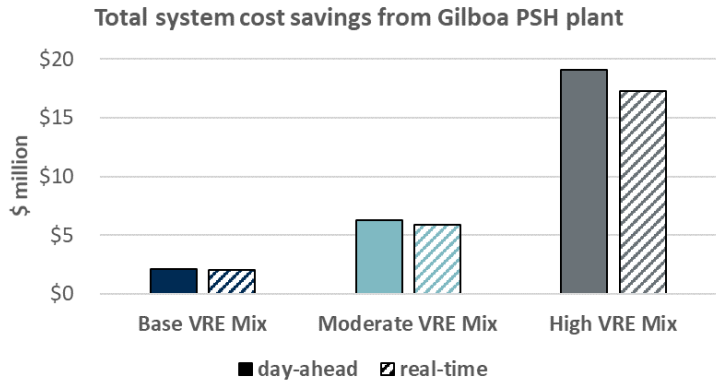

www.epri.com/resource-adequacy

# Flexibility Will Become More Valuable

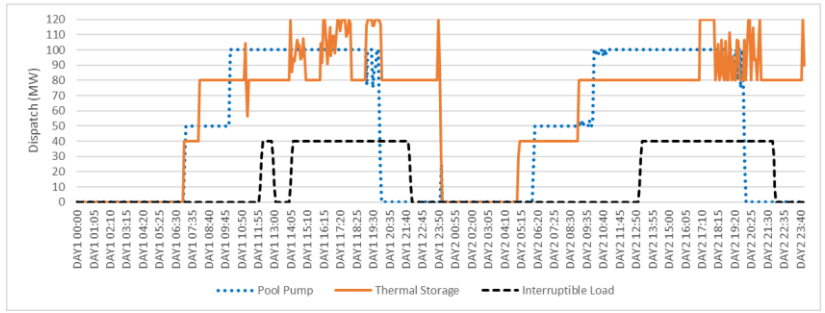
- **Flexibility/ramping needs**
- **Reliability and Economics**

Flexibility from traditional and emerging resources becomes more valuable




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

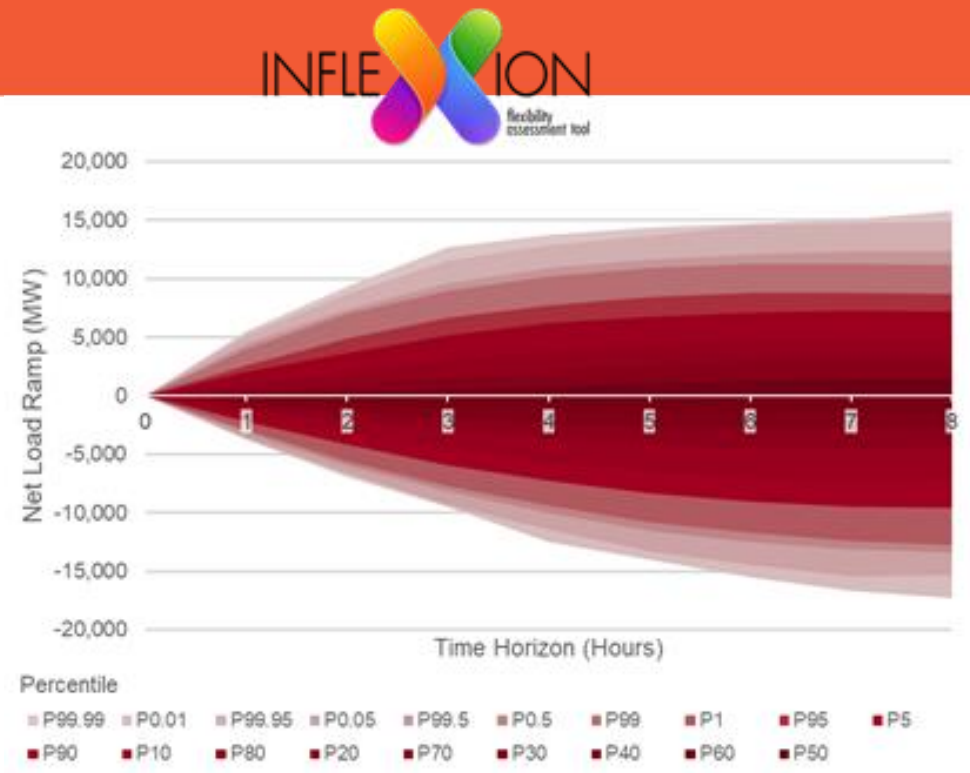



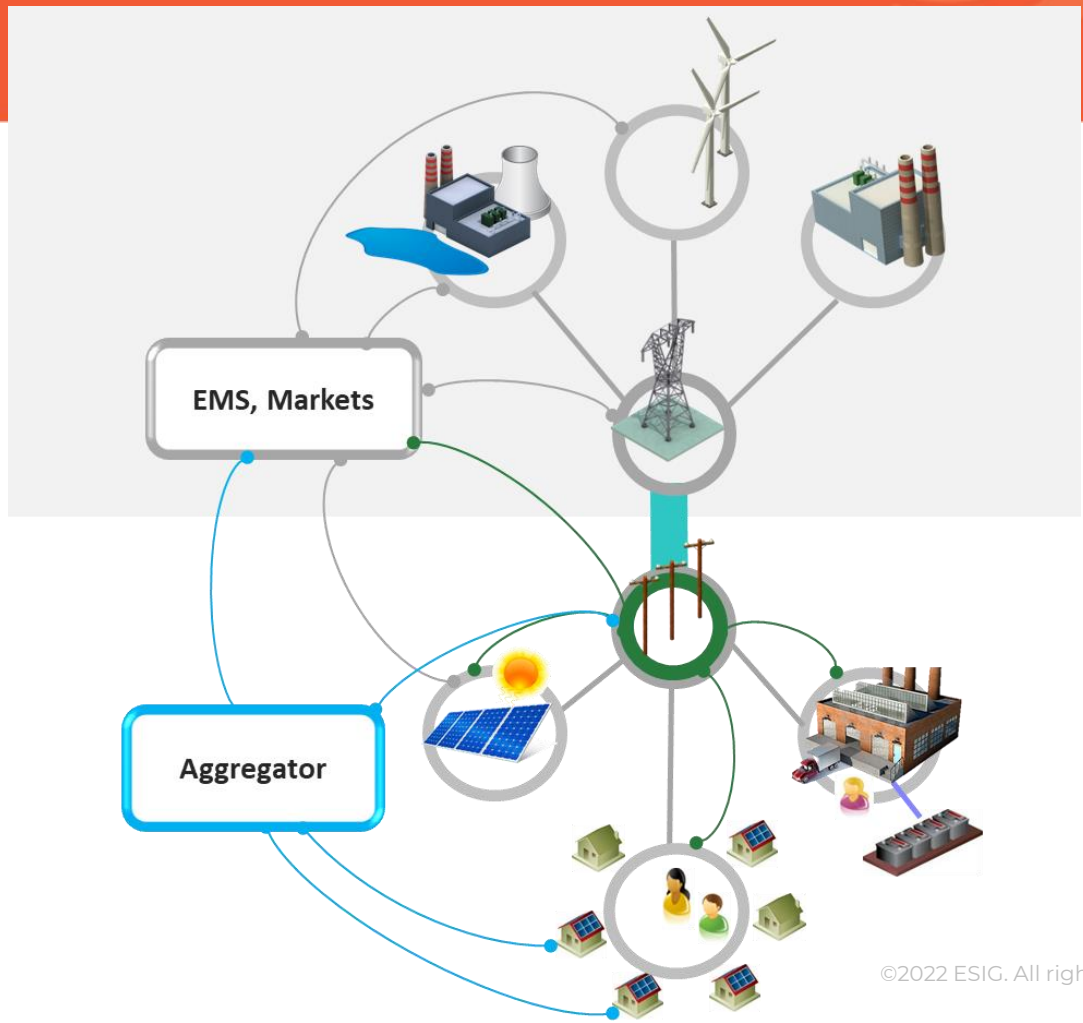

Need to consider potential trade offs as emerging resources provide flexibility

| 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, "*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.**

# Flexibility from hydrogen

- **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 $H_2$ 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**

RECHARGE
Global news and intelligence for the Energy Transition

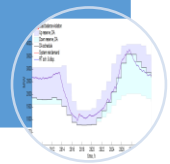


See recent ESIG Flexibility Resources Report (link) and ongoing TF

# Mechanisms to Incentivize Flexibility

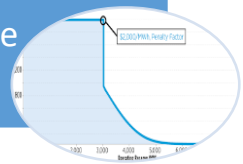
Reduce costs and improve reliability with intelligence

Forecasted Reserve Requirements



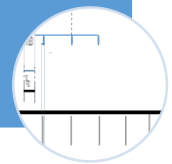
Value reserve above minimum requirements

Operating Reserve Demand Curve



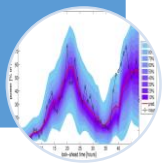
Price opportunity costs of ramp

Multi-interval settlement



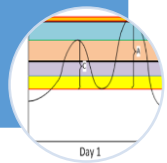
Represent uncertainty explicitly

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





*EPRI comments, Modernizing Electricity Market Design Docket No. AD21-10-000, March 2022*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