Greater Consideration of Energy in Adequacy Assessment

NARUC-ESIG Seminar

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What is Resource Adequacy (RA)?

Basic Definition

A measure of the ability of a power system to meet the electric power and energy requirements of its customers within acceptable technical limits, taking into account scheduled and unscheduled outages of system components.

Source: CIGRE, “The Future of Reliability,” Tech. Brochure No 715, 2018

RA aims to assess whether a system has the mix of resources to meet projected demand at various timeframes

- Includes both supply side and demand side resources
- Assessed for different timeframes: seasonal, annual, X years out

How is RA measured?

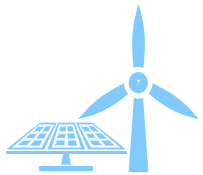
RA assessments range in complexity

Planning reserve margin & simple analyses

- PRM calculated for one or more “peak” load periods
- Can include aspects of reliability through forced outage rates (FOR, EFOR, EFORd) and loss-of-load metrics

Statistical or probabilistic approaches

- Can aggregate in ways to capture severity, duration, etc.
- Measure frequency, size and/or duration of expected outages for a range of projected conditions

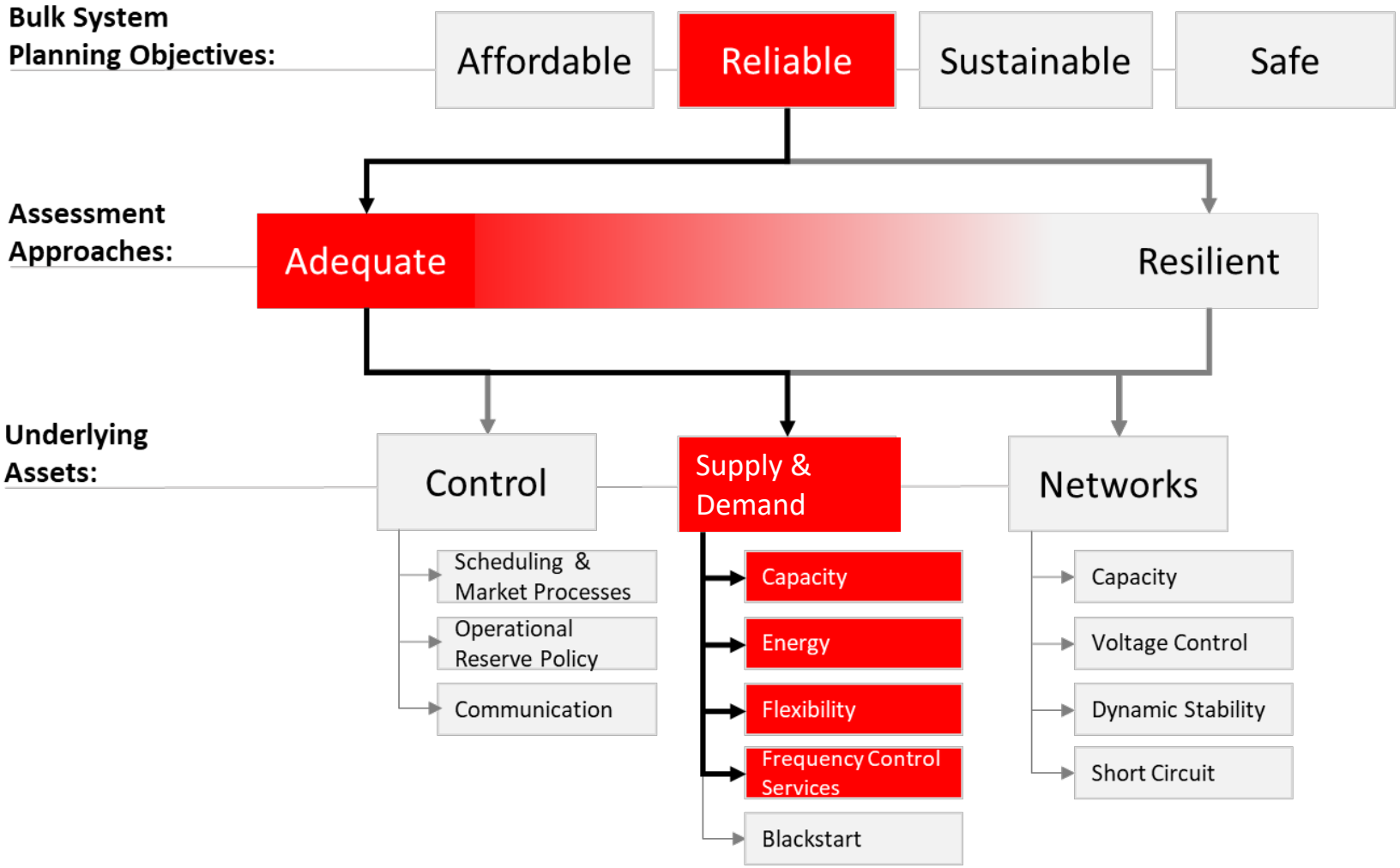


Incorporating unique attributes

- Resources like renewables and DR spurred new metrics such as effective load carrying capability (ELCC)
- Other methods can assess the needed flexibility in a fleet

Variety of commercial tools in use to assess RA

What is the scope of adequacy assessment?



Adequate

Philosophy: Determine the expected performance of a system over the range of foreseeable conditions.

Assessment Metrics:
Expected frequency, duration, energy lost margins, pass/fail tests

Resilient

Philosophy: Identify how a system anticipates, absorbs, adapts to, and/or rapidly recovers from extreme scenarios

Assessment Metrics:
An array of case specific metrics that can include load and energy not served.

Feb. 2021 Polar Vortex: RA Improvements Indicated

Historic Winter Peak Demand

- 10 GW (13%) > prior winter peak
- 10% > extreme winter plan level

Unprecedented Supply Outages

- ≈50% of supply capacity unavailable
- Equipment and fuel supply limits
- Common-mode failures across systems

Load Shed to Prevent Blackout

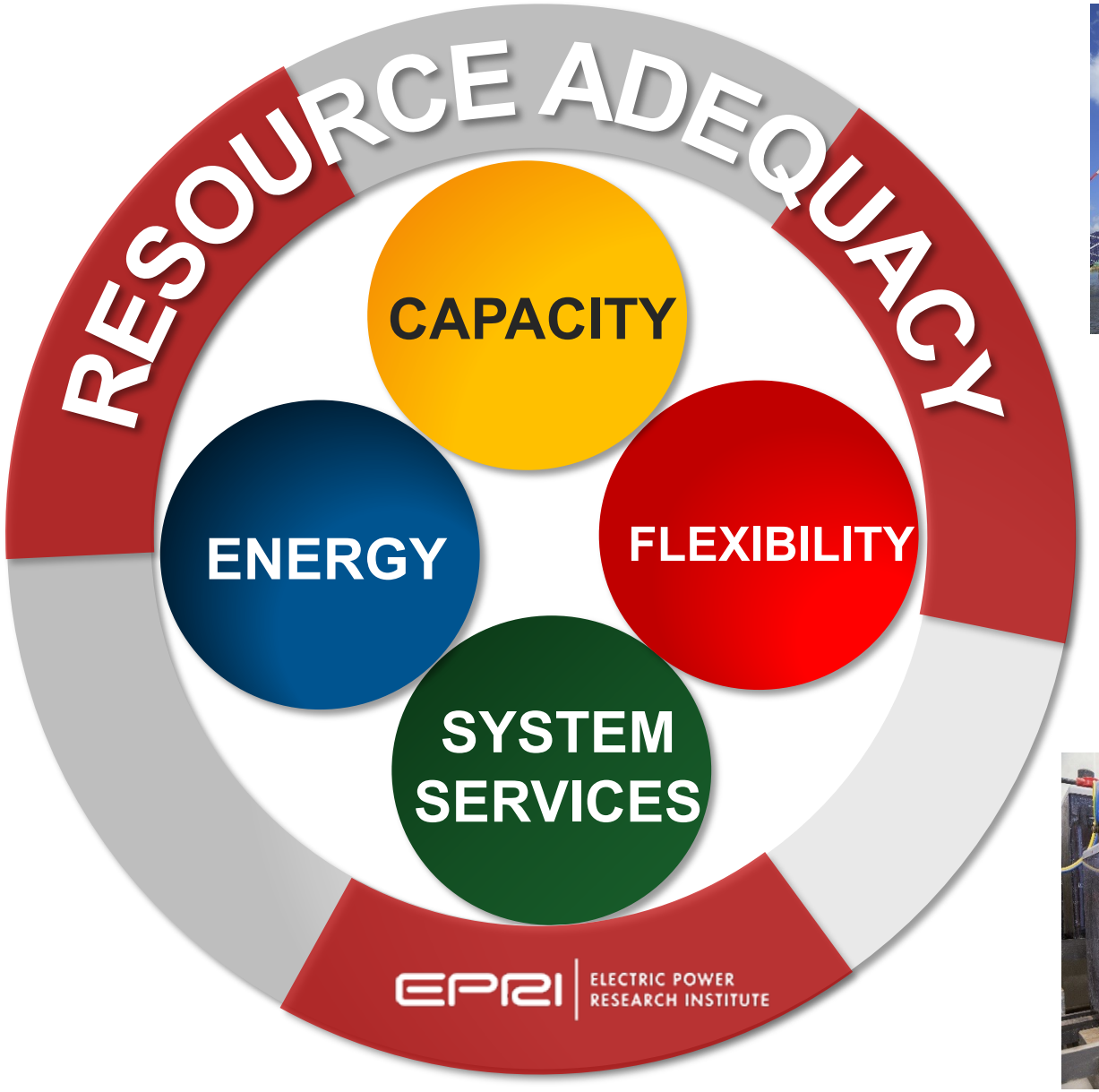
- ERCOT shed an estimated 800 GWh
- SPP, MISO, and Cenace also shed load

- Scenario planning includes future trends (climate, et. al.)
- Metrics reflect magnitude and duration of events
- Design criteria reflect future system consequences
- Resource performance in future context considered
- Impacts of interdependent systems considered

RA assessment methods and tools must evolve to ensure resiliency.

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



Moving towards energy adequacy

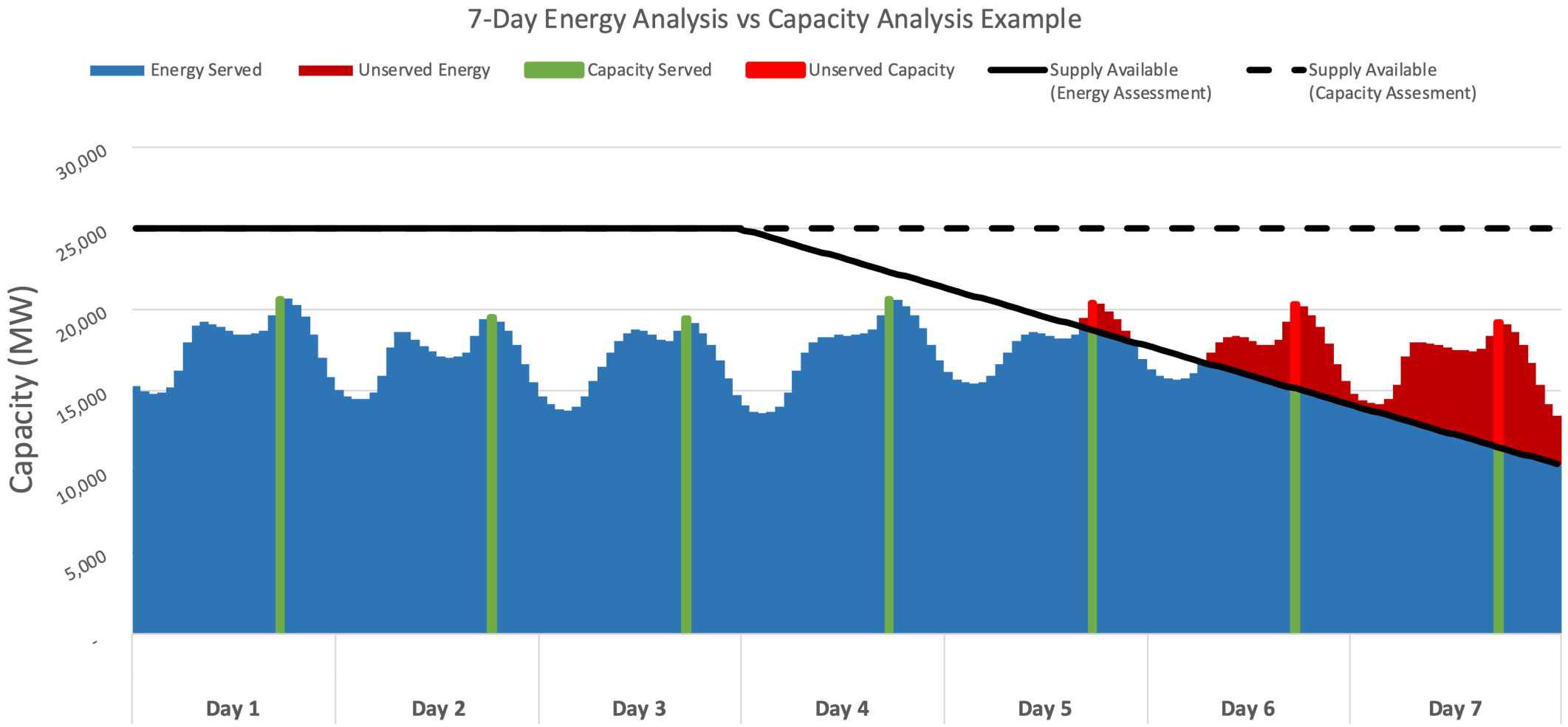
Five Phases of Resource Adequacy and Capacity Accreditation (Source: ESIG)

1. Nameplate capacity of resources
2. Expected capacity available at time of *peak load*
3. Expected capacity available at time of peak *net* load
4. Expected capacity available at time of high *risk*
5. Expected capacity *and energy* available from resources during periods of high risk

With increased energy storage on the system, it will help to further differentiate between capacity shortfalls and energy shortfalls

TELOS ENERGY

Capacity vs Energy

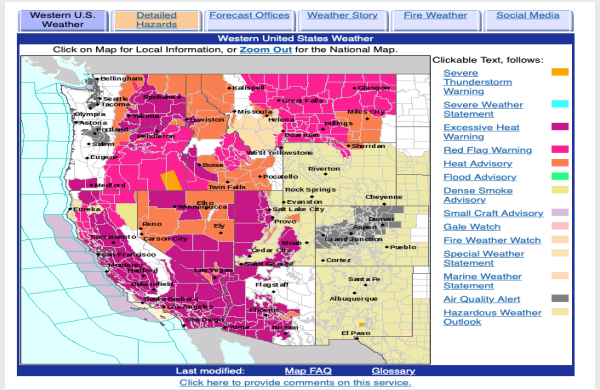


Energy Assessment considers linkages across time (from NERC ERATF white paper)

Scenario Analysis and Data– Key Questions/Topics

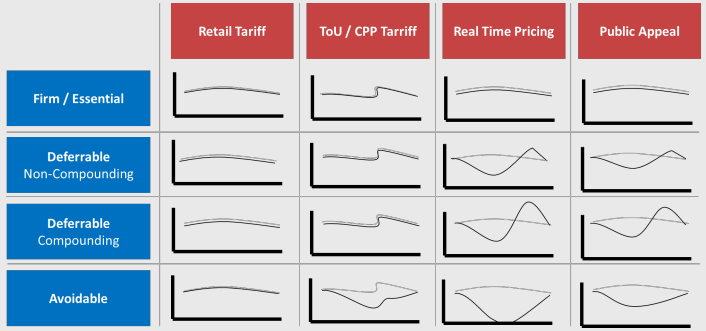
Long Term Scenarios

- Load forecasting
- Consistent scenarios for tech adoption
- Consideration of climate



Operational Scenarios

- Extreme weather events
- Chronology and range of operational outcomes
- Representation of markets



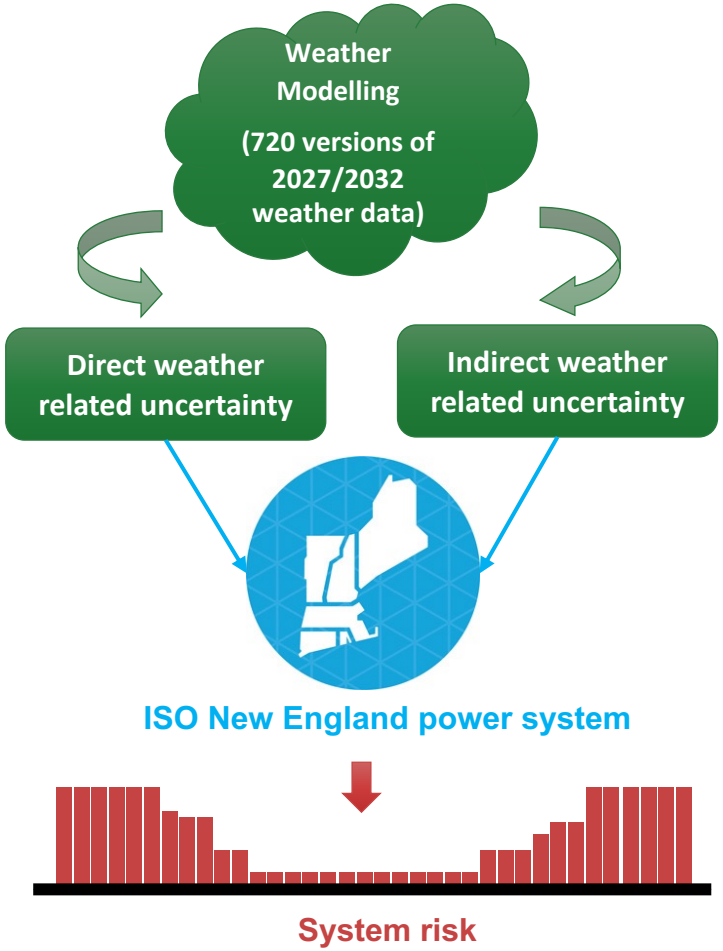
Data

- Costs and performance
- Customer behavior
- Tools to parameterize models

Are we studying the right conditions using the right data?

How to identify risk for future system? Risk modeling

- **Goal:** Search the weather data set and identify discrete (extreme) weather events that are potentially stressful to the power system from an availability of energy perspective
- Risk screening model will quantify the relationship between weather and the power system
  - Direct weather related uncertainty – e.g., *wind output is a function of wind speed at the site*
  - Indirect weather related uncertainty – e.g., *gas plant fuel supply is a function of heating demand that is a function of weather*



More detail at:
https://www.iso-ne.com/committees/key-projects/operational-impacts-of-extreme-weather-events/

Being developed with ISO-NE and made open source through RA Initiative/READi

Stress Test Study Approach

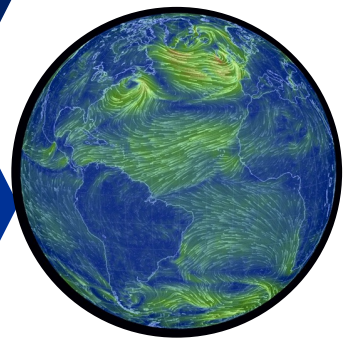
High Level Overview

Power System Information
e.g. generators, demand

Weather Data
Historical & Climate Model

Asset Risk Profiles
e.g. normal operating ranges

Project Future Weather
Historical weather overlaid on climate model projections



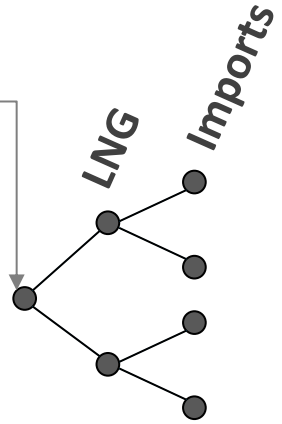
Identify High Risk Events
Screen weather for periods of potential high risk

Cold Snap

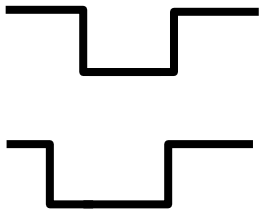
Severe Storm

Heatwave

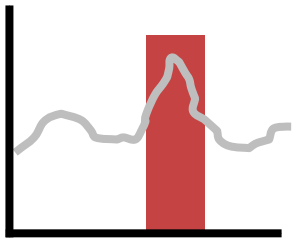
Event Scenarios
Identify potential non-weather scenarios



Weather Dependent Outages
Simulate outages of thermal plant

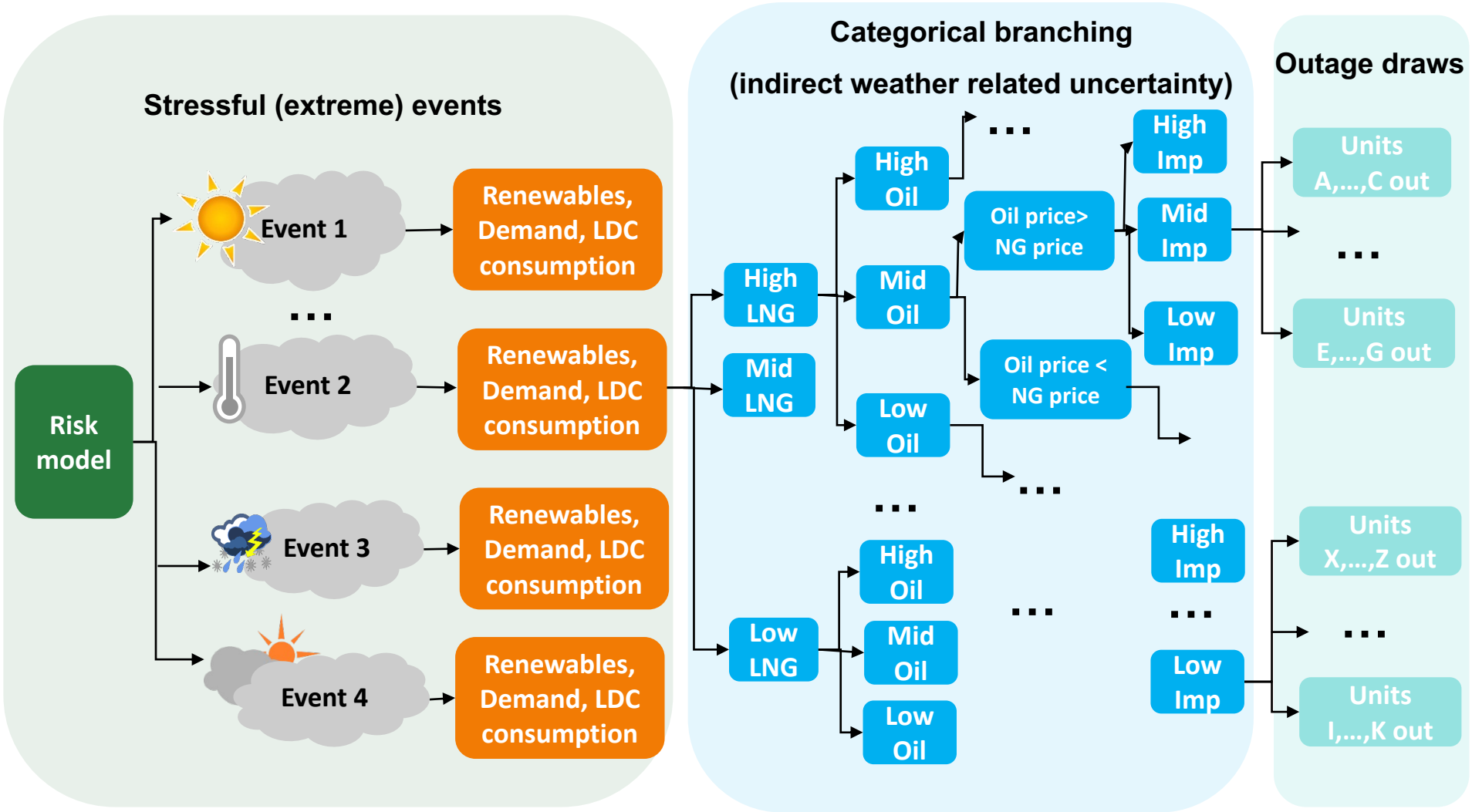


Operational Simulation
Simulate how the system operates through events



Source: https://gcaptain.com/earth-weather-visualized/

Scenario Trees Enable Incorporation of Indirect-Weather Related Uncertainty and Random Outage Realizations



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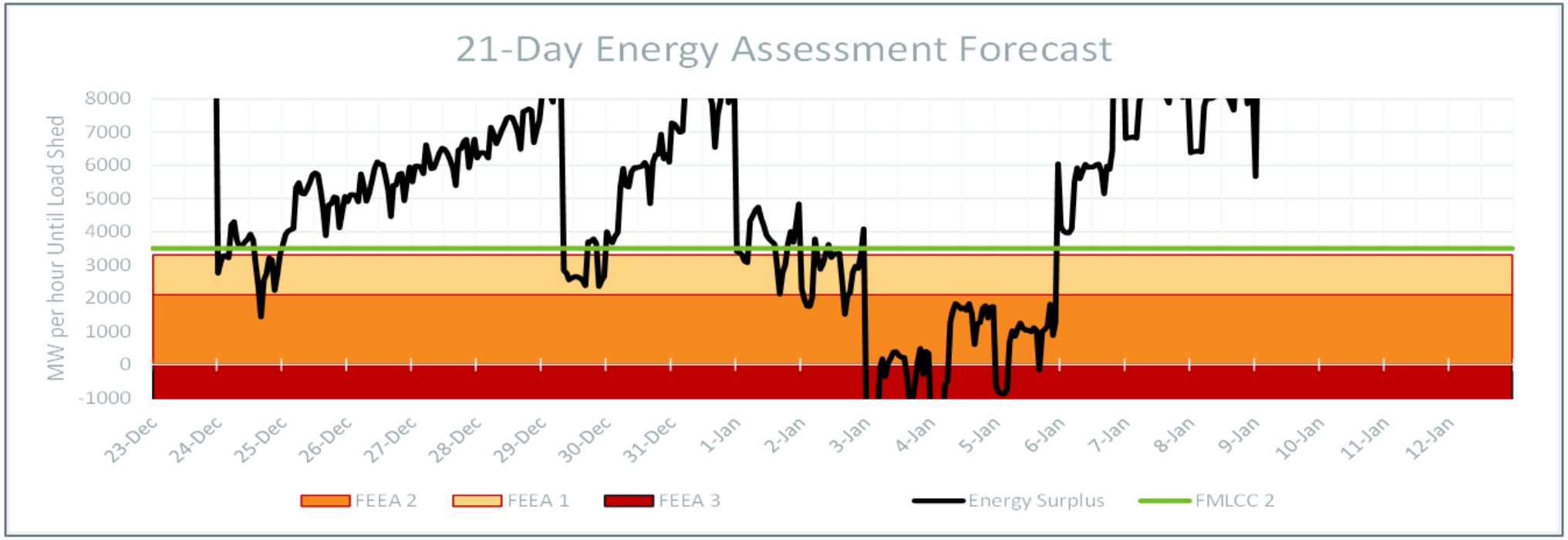
Use of data in ISO-NE example

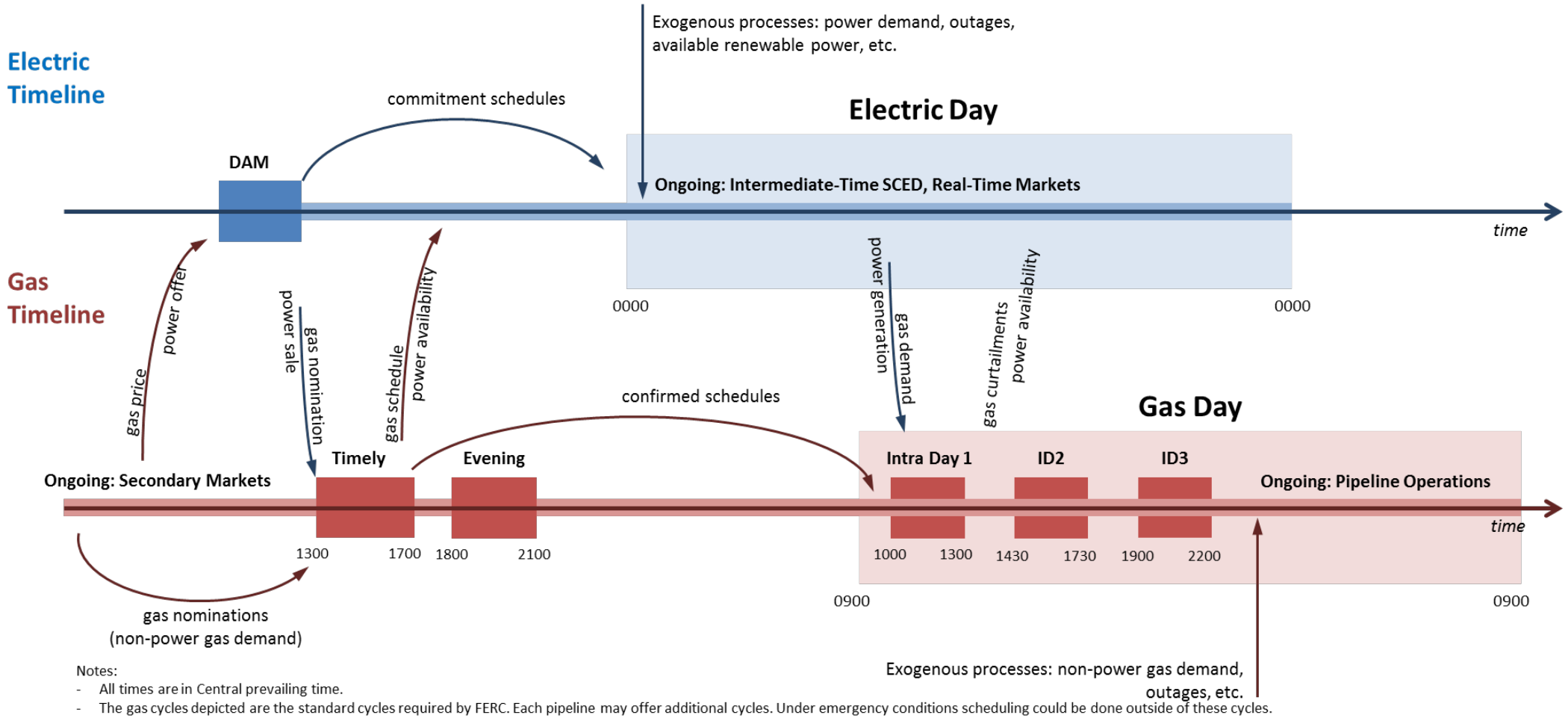


*The figure above is an illustration of a 21-day energy assessment forecast

- For each scenario evaluated by the 21-day energy assessment, results will include:
  - Energy surplus (as depicted by the black curve in the figure above)
  - Load shed, quantity (MW) and duration (as depicted by periods where the black curve dips into the red shaded area)
  - OP-4 actions, quantity (MW) and duration (as depicted by periods where the black curve dips into the yellow or orange shaded area)
  - Load shed and OP-4 action statistics can be calculated based on the outcomes of many scenarios

From April 19, 2023 | NEPOOL Reliability Committee meeting presentation by ISO-NE

Gas / Electric Coordination

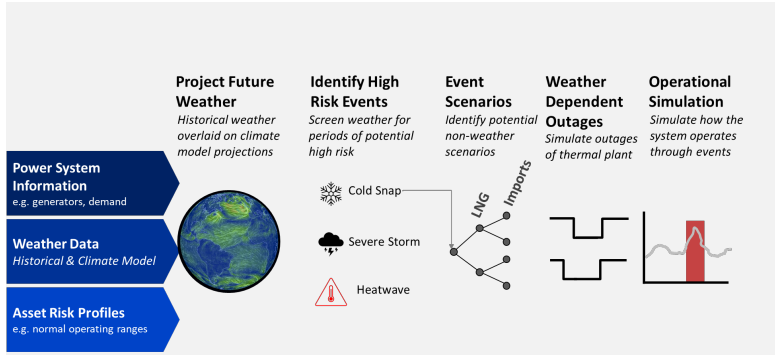


Notes:
- All times are in Central prevailing time.
- The gas cycles depicted are the standard cycles required by FERC. Each pipeline may offer additional cycles. Under emergency conditions scheduling could be done outside of these cycles.

Source: Rudkevich, et al., "Market based Intraday Coordination of Electric and Natural Gas System Operation," HICCS 2018.

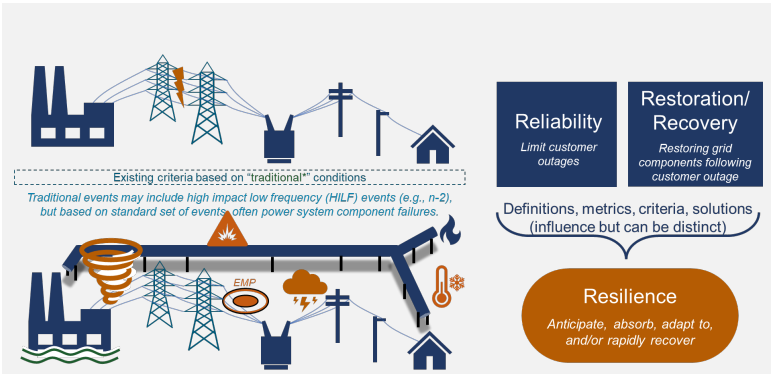
Natural gas and electric power market interactions need restructuring to remove operational inefficiency

Bulk System Supply Resilience Research



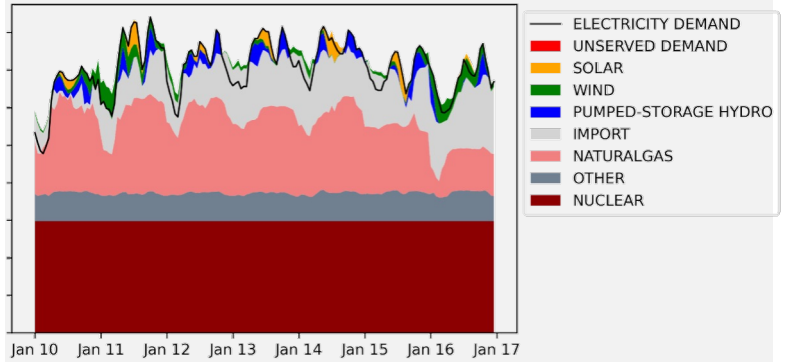
Adequacy Stress Tests

- Devising and testing method to identify stress test conditions
- Integrating common mode failure
- Expanding to integrated investment approach



Supply Resilience Whitepaper

- Gap analysis
- Identified main gaps:
  - RA
  - Gas-Electric Coordination
  - Fuel Security



Gas – Electric Coordination

- Testing gas-electric tools and scenarios
- Developing guidance and understanding of modelling approaches and future requirements
- Addressing data gap for Gas-Electric studies

Activities focused on developing framework on tools for bulk system supply resilience analysis

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