NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

2013 Special Reliability Assessment:

Maintaining Bulk Power System Reliability While Integrating VER

ND PSC Symposium
January 22, 2014
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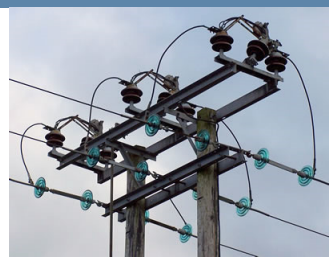
RELIABILITY | ACCOUNTABILITY

About NERC: Mission

To ensure the reliability of the North American bulk power system



- Develop and enforce reliability standards
- Assess current and future reliability
- Analyze system events and recommend improved practices
- Encourage active participation by all stakeholders
- Accountable as ERO to regulators in the United States (FERC) and Canada (NEB and provincial governments)

NERC Reliability Assessments

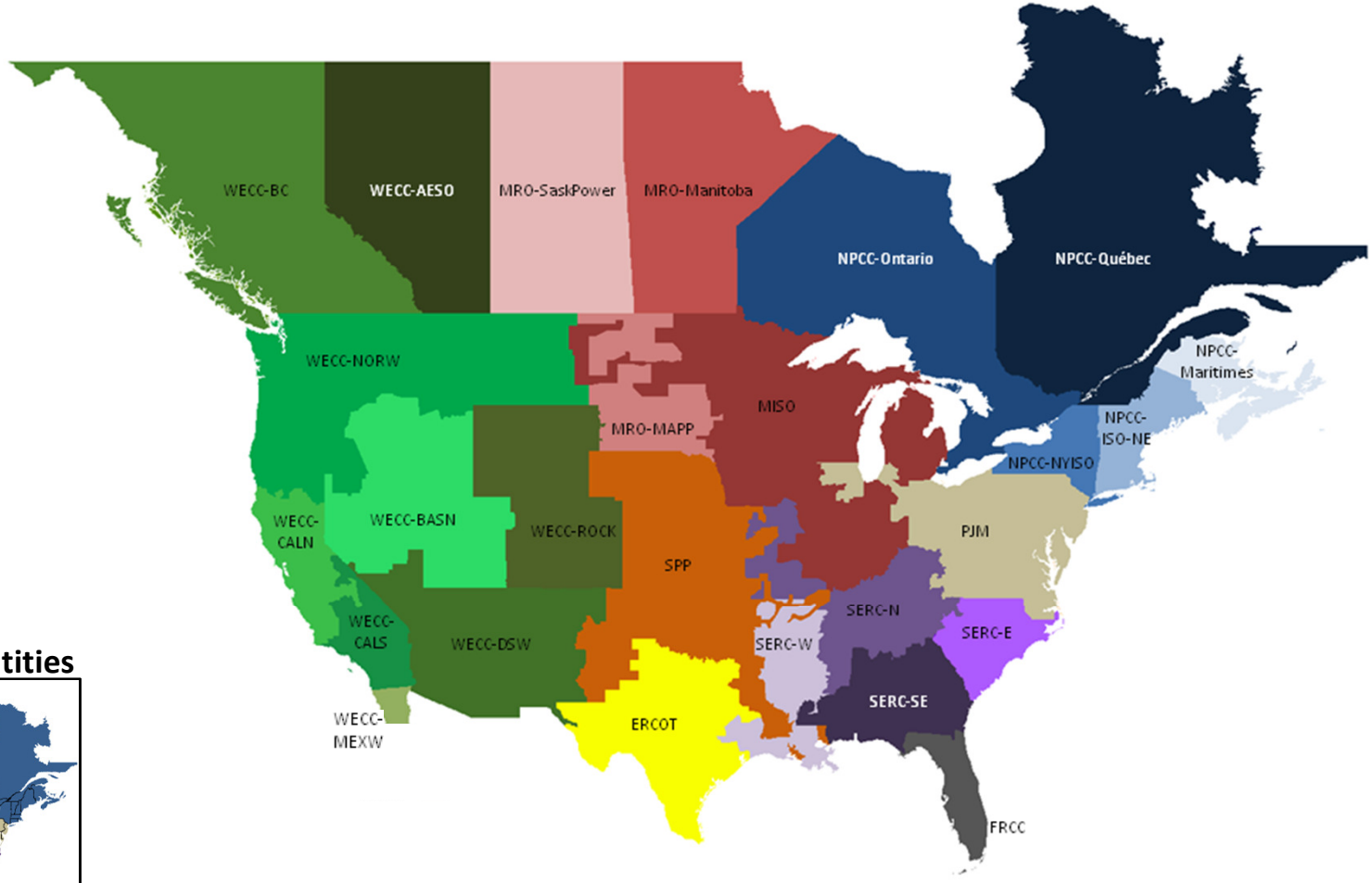
Long-Term Assessment	Provide a technical platform for important policy discussions on technical challenges facing the interconnected North American bulk power system
Seasonal Assessments	Identify and report on the electric industry's preparations to manage potential seasonal issues for both the winter and the summer
Special and Scenario Assessments	As emerging risks and potential impacts to reliability are identified, special assessments are performed to provide additional insights about the range and specific aspects of these challenges and make recommendations

NERC Reliability Assessments

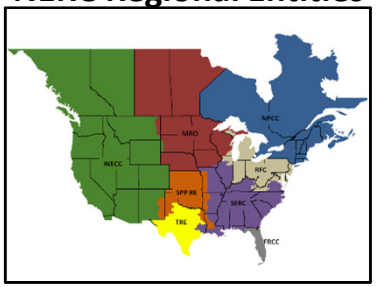
- Peak demand forecasts
- Resource adequacy
- Transmission adequacy
- Key issues - emerging trends
  - Technical challenges
  - Evolving market practices
  - System elements/dynamics
  - Potential legislation/regulation
- Regional self-assessment
- Ad-hoc special Assessments

NERC Assessment Areas

NERC Assessment Area: The footprint of a single Planning Coordinator, or group of Planning Coordinators



NERC Regional Entities



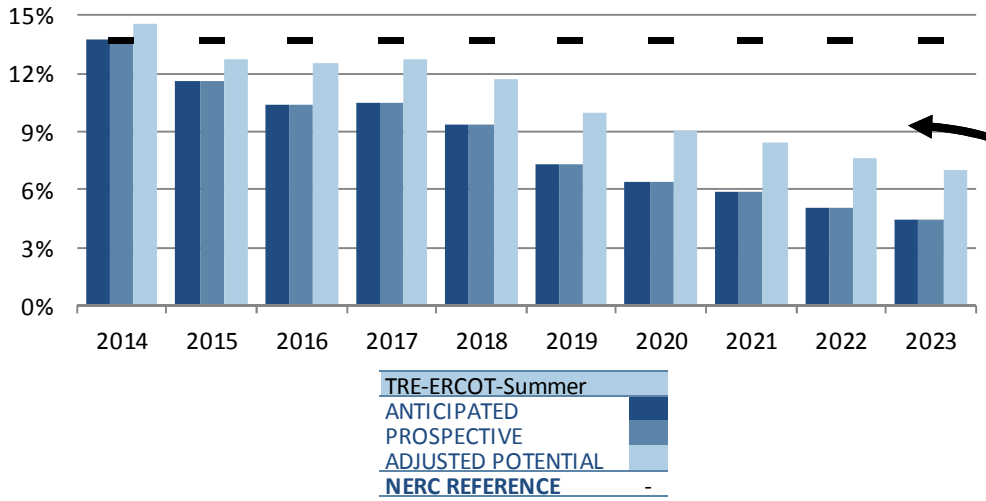
Long-Term Reliability Challenges and Emerging Issues

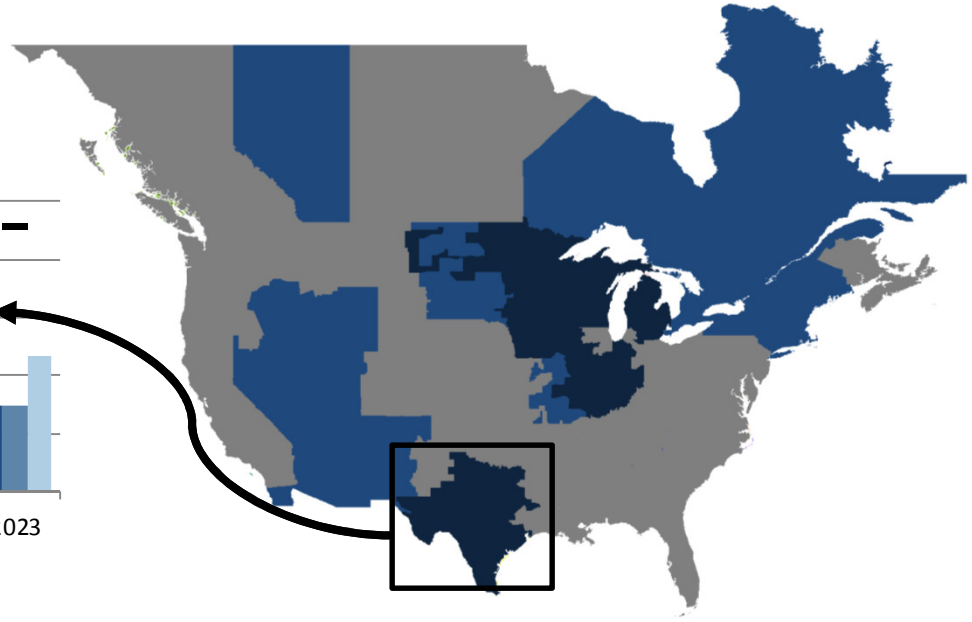
1. Resource Adequacy Assessments in TRE-ERCOT and MISO Fall Below Planning Reserve Margin Targets.
2. High Levels of Variable Generation May Present Operational and Planning Challenges.
3. Fossil-Fired Retirements and Coordination of Outages for Environmental Control Retrofits Continue to Present Challenges.
4. Increased Dependence on Natural Gas for Electric Power Will Require New Planning and Operating Practices.
5. Increased Use of Demand-Side Management Creates More Uncertainty for System Planners and Operators.
6. Nuclear Generation Retirements and Long-Term Outages Reduce Flexibility and Present Potential Reliability Challenges.

Areas with Insufficient Anticipated Reserve Margins

2023

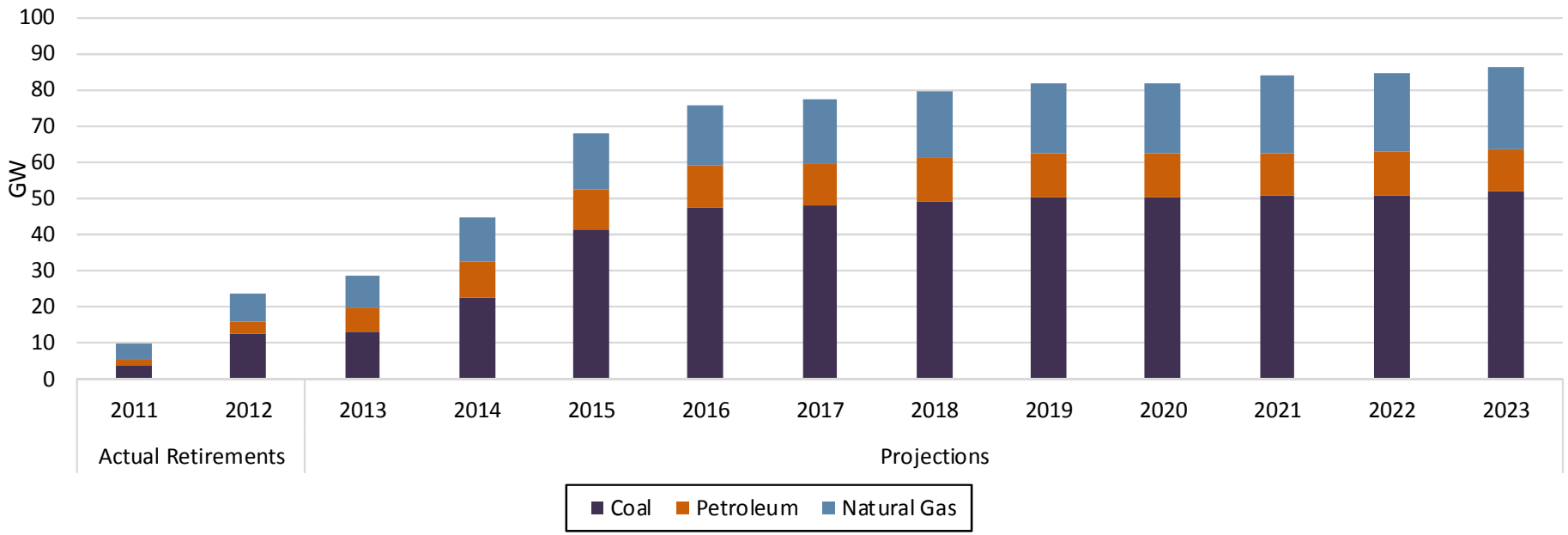
ERCOT Planning Reserve Margins





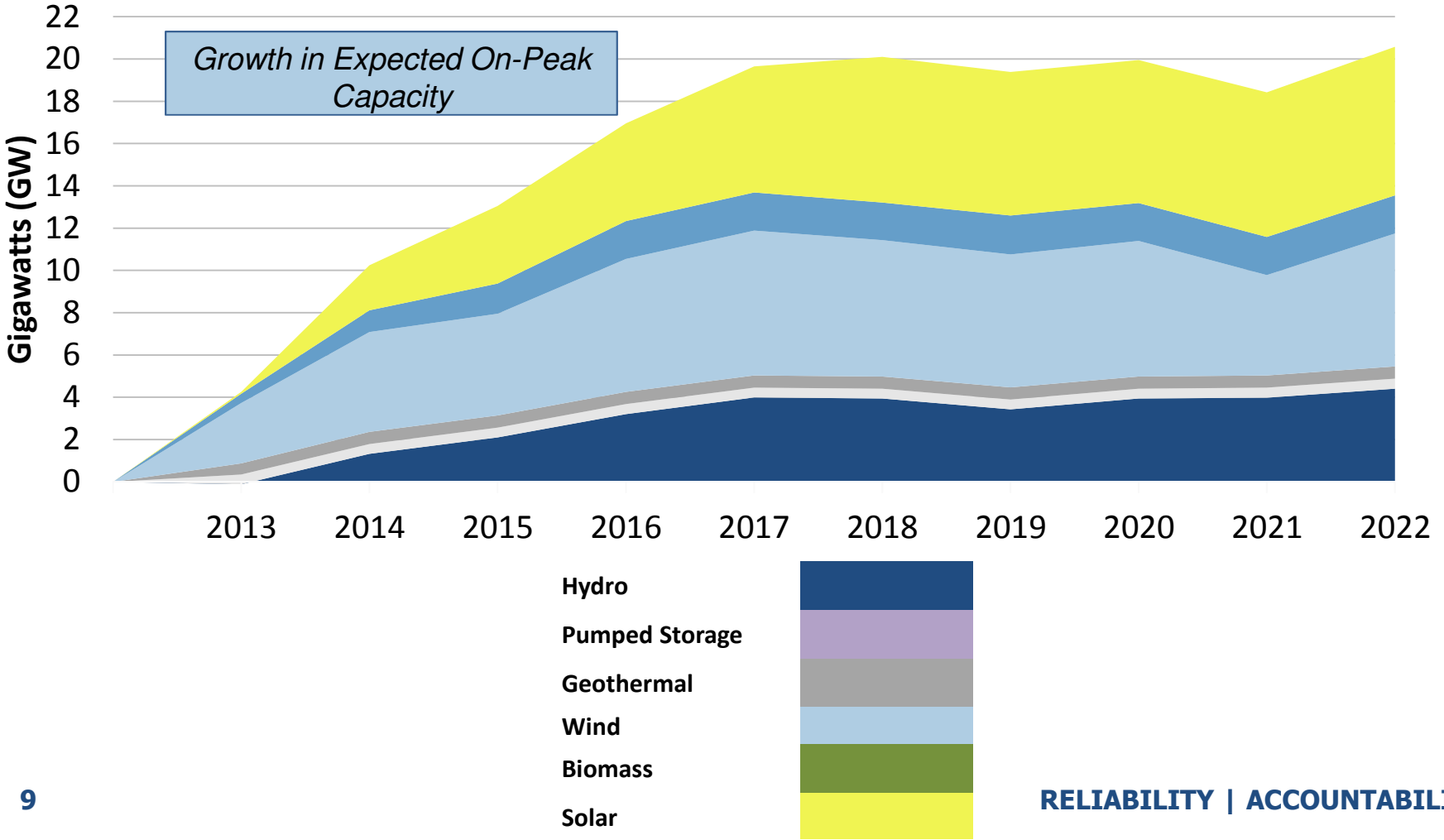
Fossil-Fired Retirements and Retrofits

- 23.4 GW of fossil-fired units retired in 2011 and 2012.
- Additionally, 62.8 GW of fossil-fired generation (39.3 GW of coal, 8.3 GW of petroleum, and 15.2 GW of natural gas) will be removed from the on-peak generation mix between 2013 and 2023.



Key Finding: Change in Resource Mix

New Renewable/Variable Resources Introduce New System Planning and Operational Challenges



Joint NERC-CAISO Effort

- Objectives
  - Describe unique challenges in California
  - Identify the reliability challenges given increases in VERs
  - Determine system needs and requirements
  - Promote the recommendations from the NERC IVGTF
    - Highlight CAISO action based on IVGTF guidance
    - Validate that actions are addressing key reliability gaps
    - Offer recommendations on residual gap to others
  - Understand implications to the Western Interconnections

Unique Challenges for CAISO…

- ISO's unique operating challenges
- VERs build out to meet 33% RPS by 2020
- ISO 2010 FERC Filing for VERs interconnection requirements
- NERC/ISO recommended characteristics VER should provide
- The ISO's plans for integrating renewables
- Partners to reliably integrate high levels of renewables

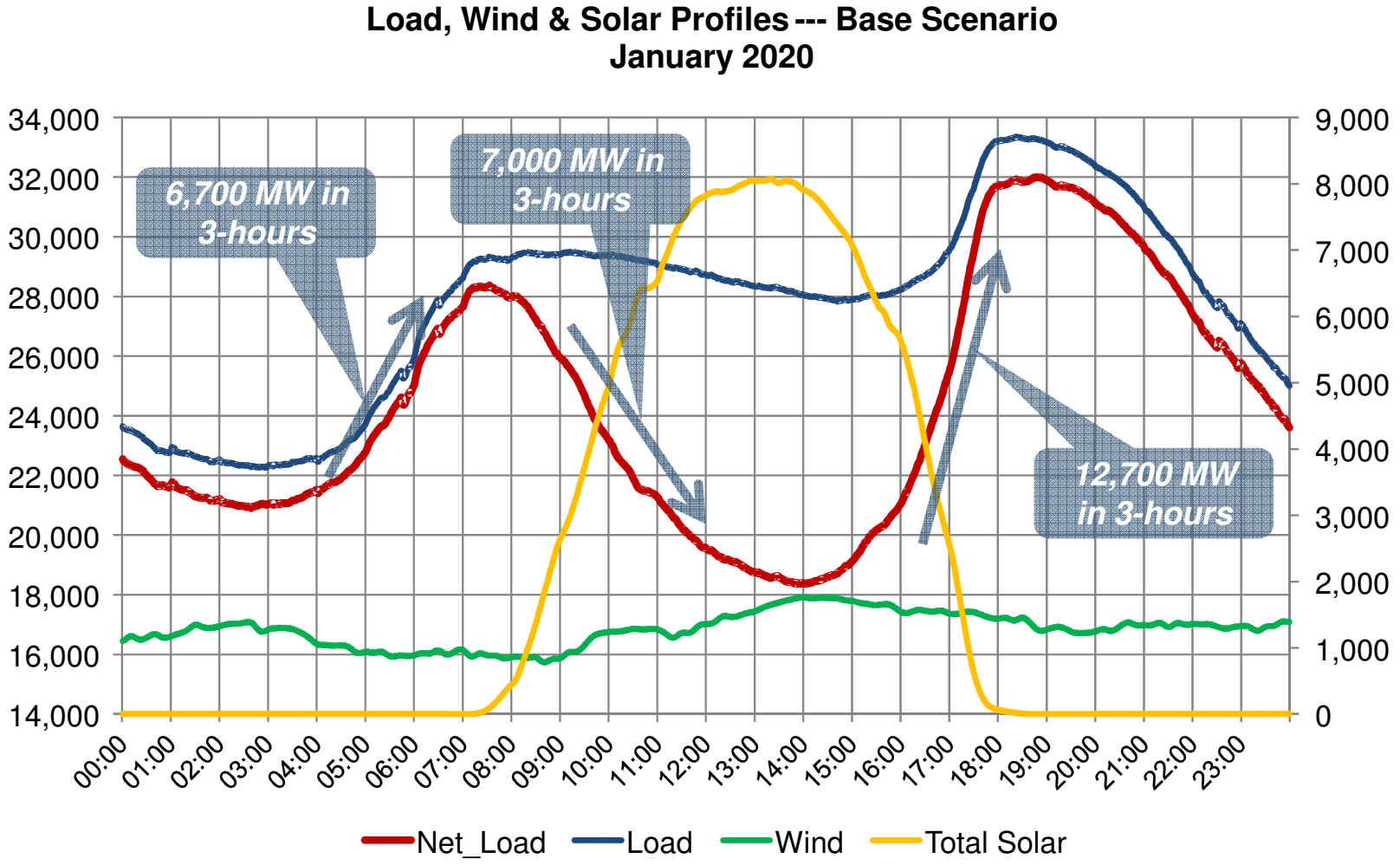
…Driven by Success of State Initiatives and Environmental Policies

- Greenhouse gas reductions to 1990 levels by 2020
  - Limits on availability of air emission credits for replacement generation
- 33% of load served by renewable generation by 2020
- Possibly 12,000 MW of distributed generation by 2020
- Less predictable load patterns – rooftop solar, electric vehicles, and smart grid
- Scheduled phase out of once-through cooling in coastal power plants
- Delta bay plan managing water flow affecting hydro availability

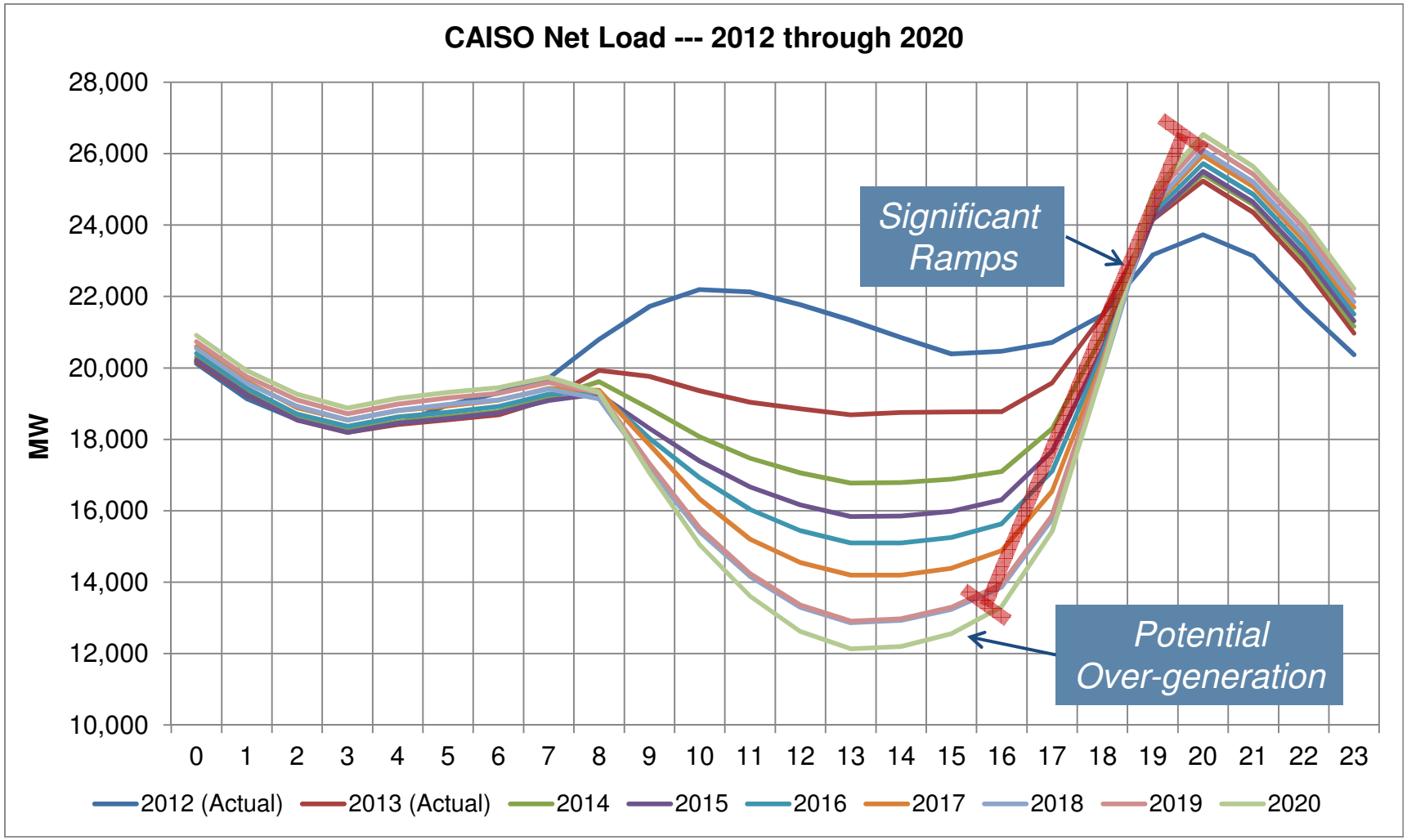
Summary of Future Grid Operations to Manage a More Complex Grid

- Increased requirements for regulation up and down
- Need to manage increased intra-hour flexibility and multiple hour ramps, daily
  - Approx. 3,000 MW of intra-hour load-following
  - Approx. 13,000 MW of continuous up-ramp within a 3 hour time period (almost double current up-ramps)
- Non-dispatchable resources serving load varies between 12,000 MW to 14,000 MW based on maximum capability of resources
- Increased instances of over-generation conditions
- Need to comply with a frequency response obligation following a disturbance (Compliance with BAL-003-1)
- Impact of DER resources on the BES is still not fully understood

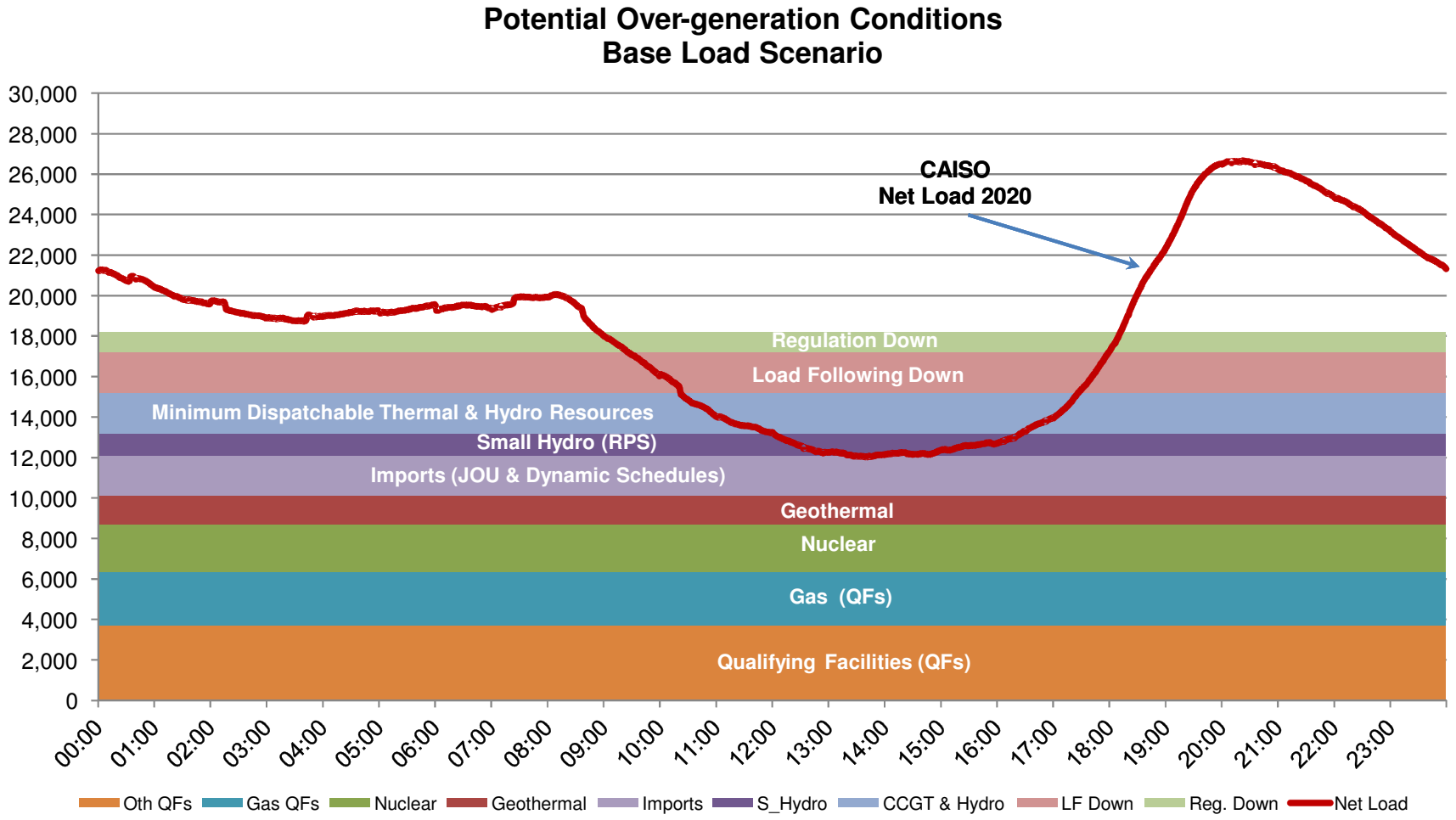
The Need For Flexibility: A Future, Not a Scenario



Non-Summer Months - Net Load Pattern Changes Significantly Starting in 2014



Non-Flexible Supply Creates Dispatch Issues and Potential Over-Generation Conditions



Operating Reliability Characteristics

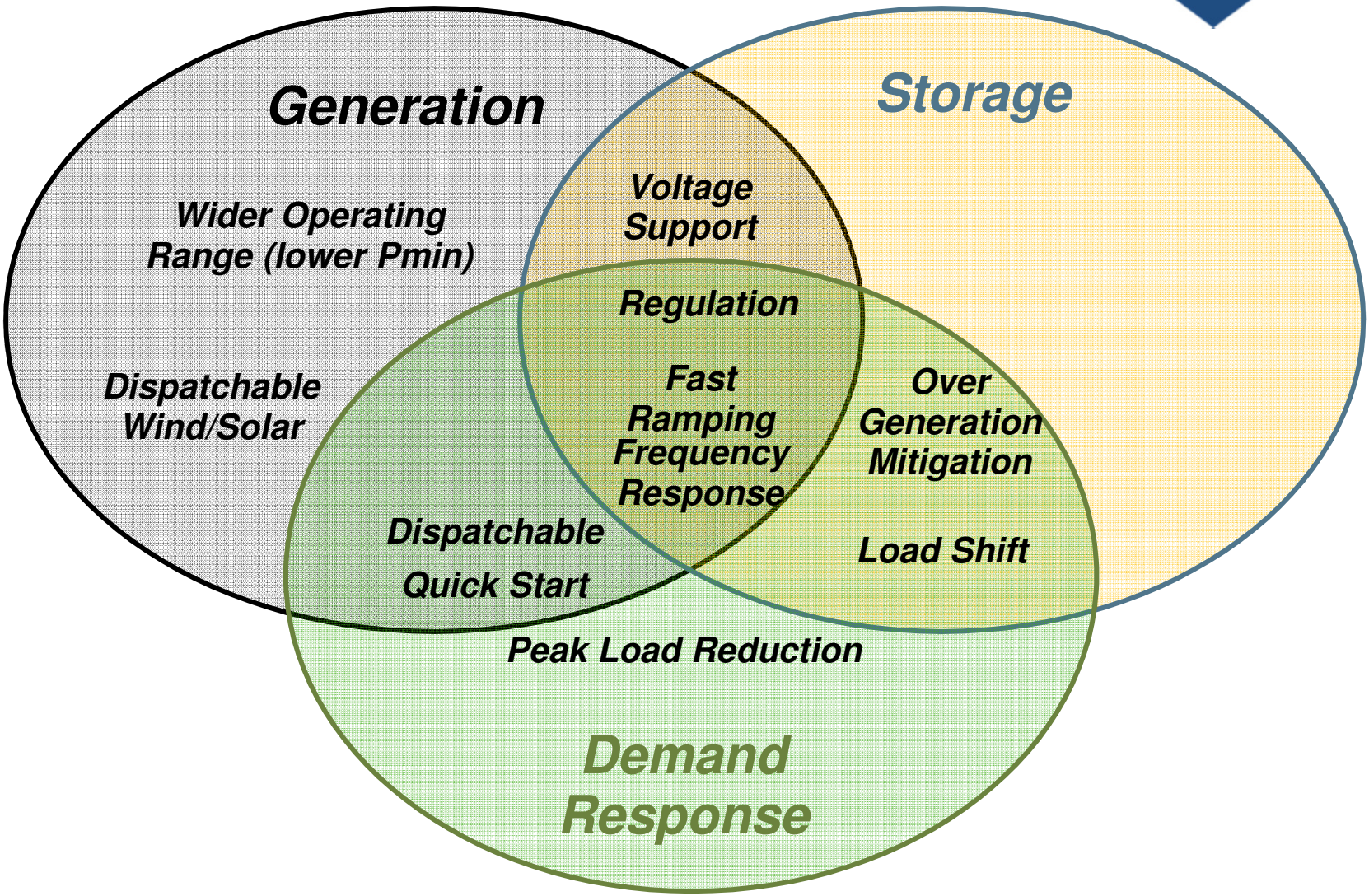
- Four essential characteristics needed from resources to enable a stable and reliable BPS:
  - Capability to provide reactive power support;
  - Capability to increase or reduce energy output automatically, in response to system frequency;
  - Ability to limit power production as needed for the promotion of reliability; and
  - Capability to provide inertial response.
- CAISO to require VERs to contribute to essential BPS reliability services

Market Enhancements Help the Integration of Variable Resources

CAISO Market Enhancements

- Active flexible capacity procurement
- Dynamic transfers
- Lower bid floor to incentivize economic curtailment
- Pay-for-performance regulation
- FERC 764, intra-hour scheduling
- Proposed enhancements to the California Public Utilities Commission's (CPUC) resource adequacy program
- Energy Imbalance Market (Regional Coordination)
- Dispatchable VERs
- Reliability Tools
  - Load Following Requirement Tool
  - Regulation Prediction Tool
  - VER Forecast Improvements

All of the Above Solution, Including Regional Coordination



Conclusions

- As an electric system approaches a significant penetration in variable resources
  - essential reliability services will be strained
  - technical aspects of the evolving resource mix must be given due consideration at state, federal, and provincial level
  - solutions sets for maintaining reliability can come from:
    - Market tools and rules
    - New technology integration
    - Standards or requirements
  - unresolved cost implications can impede solution sets

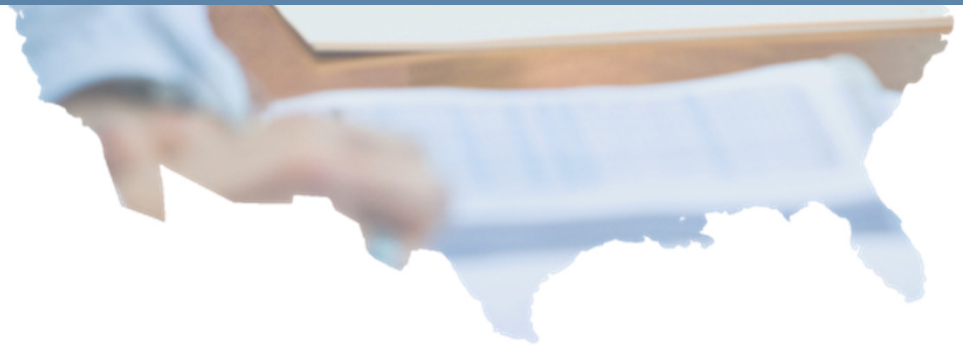
Fossil-Fired Retirements and Coordination of Outages for Environmental Control Retrofits

- U.S. Environmental Regulations:
  - Mercury and Air Toxics Standards (MATS)
  - Clean Air Act (Section 111)
  - Best Available Retrofit Technology (BART)
  - Clean Air Interstate Rule (CAIR)
  - Coal Combustion Residuals Disposal (CCDR)
  - Clean Water Act (Section 316(b))
- Important considerations:
  - Combined impacts of existing and future regulations
  - Replacement generation's contribution to reliability
  - Timeline for new transmission
  - Market implications

Other Challenges

- Mid-Continent Independent System Operator (MISO) Reliability Plan
- Aging Workforce
- Load Forecasting Uncertainty
- Smart Grid
- Change in System Behavior and Composition of System Load
- Transmission Siting, Permitting, and Right-of-Way Issues
- Aging Infrastructure
- Region/Interconnection-wide Modeling
- Potential Operational Risks Associated with Interaction of Special Protection Systems/Remedial Action Schemes
- Global Supply Chains and Fuel Reliability
- Coordinated Cyber or Physical Attacks on Electricity Infrastructure

Questions and Answers



Additional Information

- **NERC Reports on Accommodating High Levels of Variable Generation:**
  - DRAFT Joint NERC-CAISO Special Reliability Assessment: Maintaining Bulk Power System Reliability While Integrating Variable Energy Resources to Meet Renewable Portfolio Standards
  - Interconnection Requirements for Variable Generation, NERC, September 2012
  - Potential Bulk System Reliability Impacts of Distributed Resources
  - Methods to Model and Calculate Capacity Contributions of Variable Generation for Resource Adequacy Planning
  - Ancillary Service and Balancing Authority Area Solutions to Integrate Variable Generation
  - Operating Practices, Procedures, and Tools
  - Potential Reliability Impacts of Emerging Flexible Resources
  - Variable Generation Power Forecasting for Operations
  - Standard Models for Variable Generation
  - Flexibility Requirements and Potential Metrics for Variable Generation
- **NERC Reports on Accommodating and Increased Dependency on Natural Gas**
  - Primer (Phase I)
  - Vulnerability Assessment (Phase II)
- **NERC Reliability Assessments (Long-Term and Seasonal)**
  - http://www.nerc.com/pa/RAPA/ra/Pages/default.aspx