NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Perspectives on Clean Power Plan Implications

NERC Reliability Assessments

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RELIABILITY | ACCOUNTABILITY



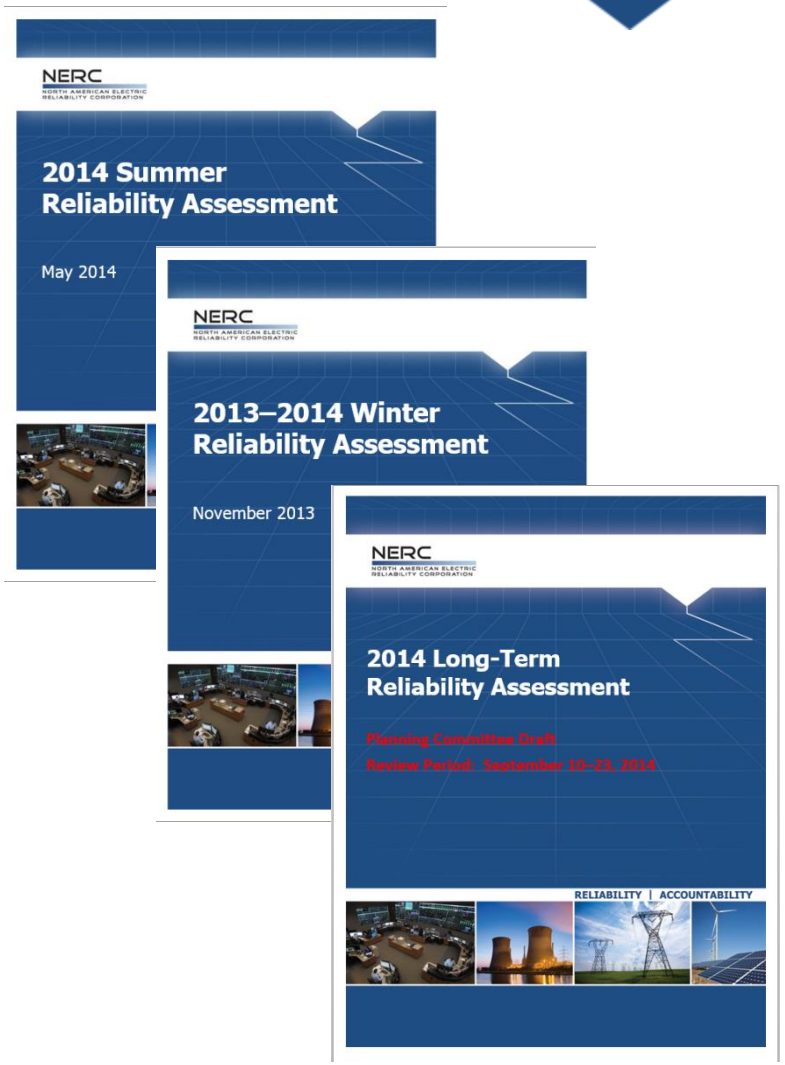

About NERC: Mission

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

- Reliability
  - Resource Adequacy
  - Operating Reliability
- Transmission adequacy
- Demand forecasts
- Demand-Side Resources
- Regional coordination
- Awareness and certainty
- Key issues - emerging trends
  - Technical challenges
  - Evolving market practices
  - System elements/dynamics
  - Potential legislation/regulation



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NERC Assessment Areas

System Dynamic Character is Changing

- Retirement/displacement of conventional generation
  - Variable energy resources
  - Rapid penetration of electronically-coupled resources
- Essential Reliability Services
  - Reduced inertia
  - Frequency Response
  - Voltage Support
  - Ramping and flexibility needs
- Rapid penetration of new loads
- System controls and protection coordination
- Modeling and simulation constraints
- Increasing interface with distribution-centric resources

CPP Overview

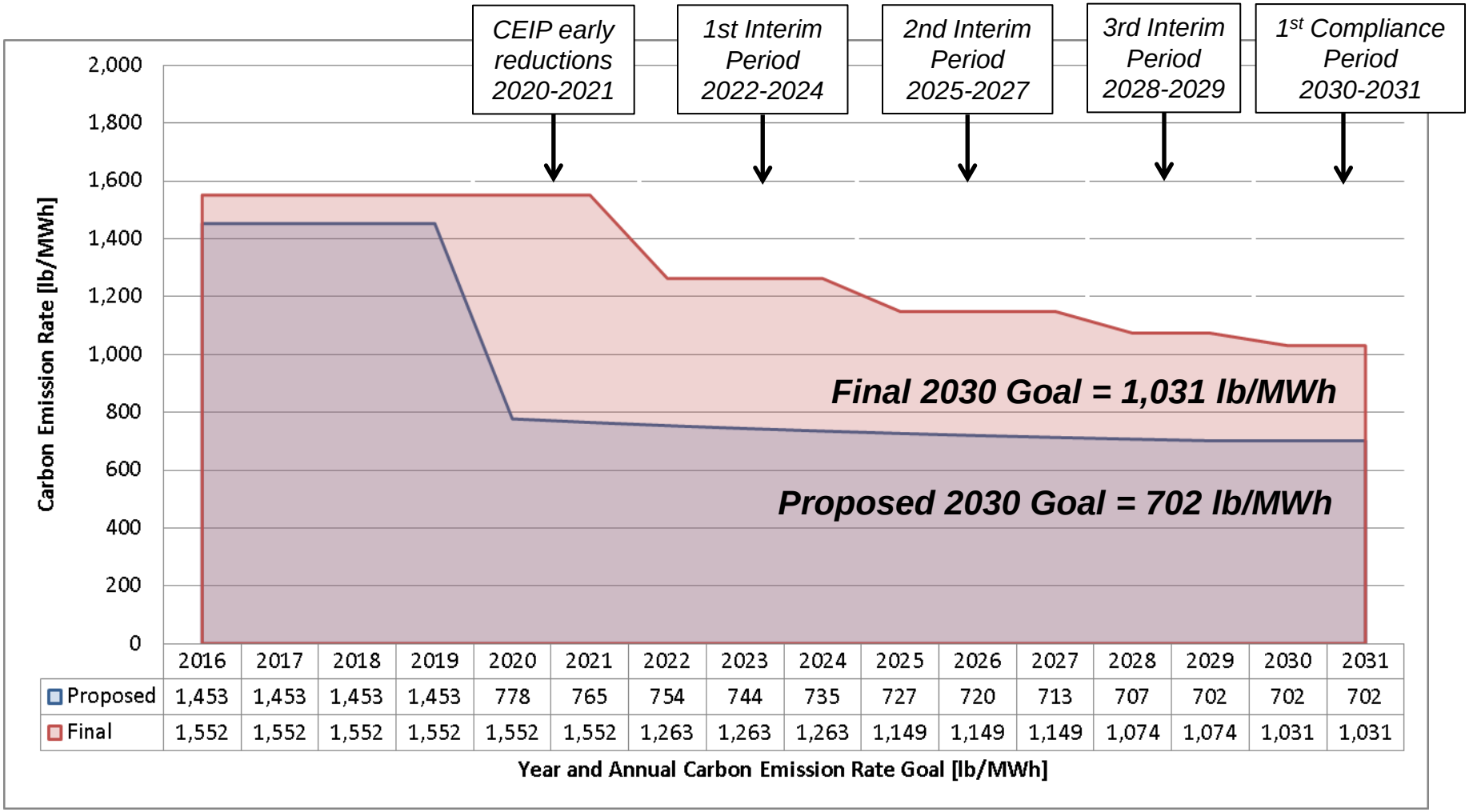
- The final rule extended compliance to

  2022 from 2020
- Increased total reduction from 30% to

  32% of 2005 levels
- Envisions Significant Increase in Renewables and Energy Efficiency – Clean Energy Incentive Plan
- Trading is projected by EPA to be a large mitigating factor for attainment of compliance goals

Example of Envisioned Glide Slope

Example: Arizona

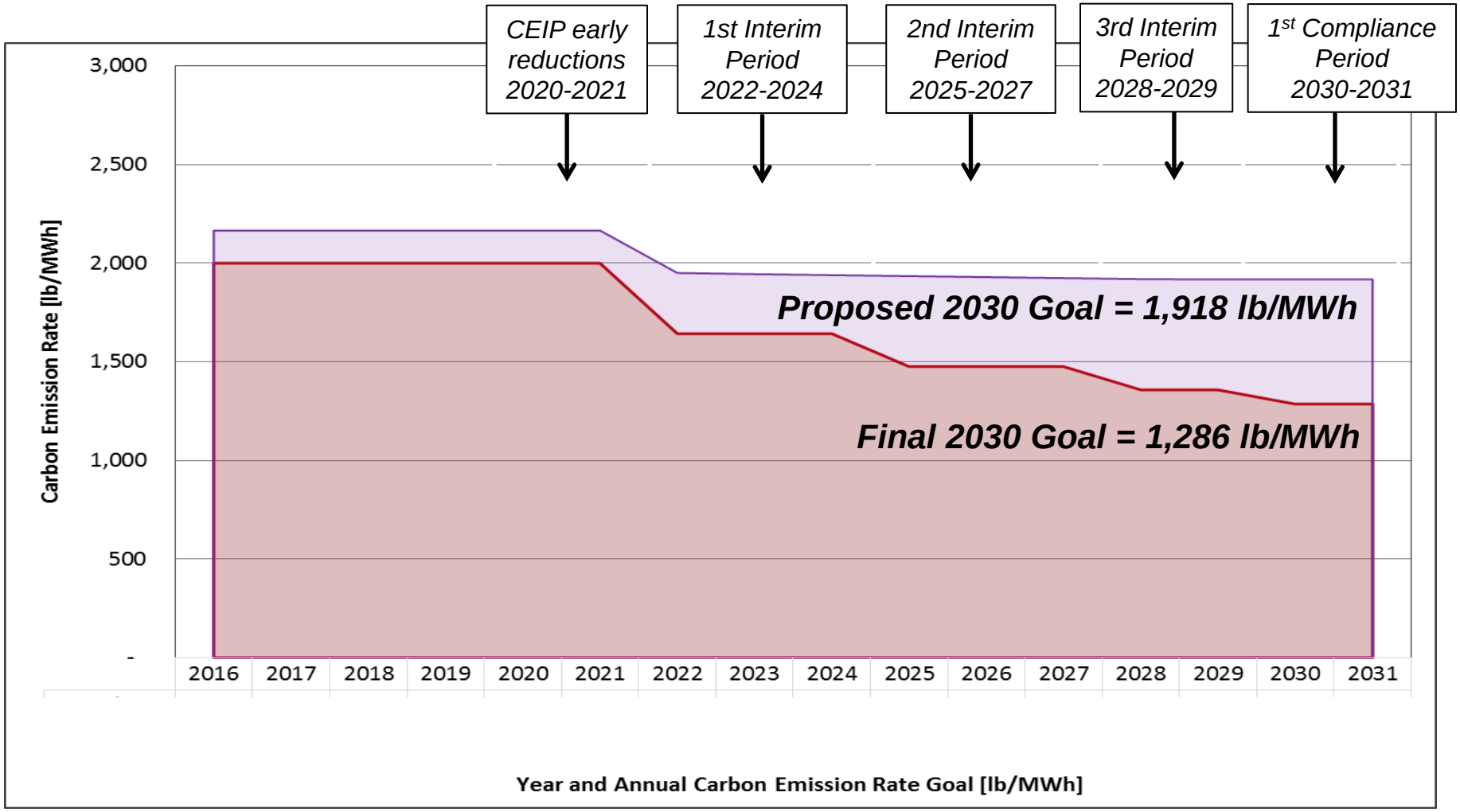


	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Proposed	1,453	1,453	1,453	1,453	778	765	754	744	735	727	720	713	707	702	702	702
Final	1,552	1,552	1,552	1,552	1,552	1,552	1,263	1,263	1,263	1,149	1,149	1,149	1,074	1,074	1,031	1,031

Source: Salt River Project

Example of Envisioned Glide Slope

Example: Kentucky



Reliability Provisions

- States required to demonstrate its consideration of reliability
- Mechanism for states to seek a revision to its plan for unanticipated and significant reliability challenges
- Reliability safety valve to address unanticipated or other extraordinary circumstances

NERC CPP Phase II

- Assessment looking at potential reliability impacts of CPP Final Rule
- Developed through collaboration with stakeholders to inform policy discussions and highlight potential risks to BPS reliability
- Provides range of resource adequacy evaluations based on several potential cases using different models
- Provides framework for more granular studies at the state and regional level

Planning Committee Advisory Group

- Formed to advise NERC on assessment scope and goals
- Representation
  - All NERC Regions
  - ISO\RTOs and Planning Coordinators
  - IPPs and Renewable Energy Producers
  - Trade Organizations
  - Power Marketers
  - Consultants
  - Canadian Representation
- Sub-group formed to author the recommendations document
- Work with modelers to develop scenarios and assumptions

CPP Phase II Scenarios

Reference Case	• No CPP
Constrained Interstate Trading	• Intrastate trading develops, interstate constrained
Full Trading	• Full intrastate and interstate trading
High Renewables	• High penetration of renewables
Nuclear retirements	• Accelerated retirement of nuclear units

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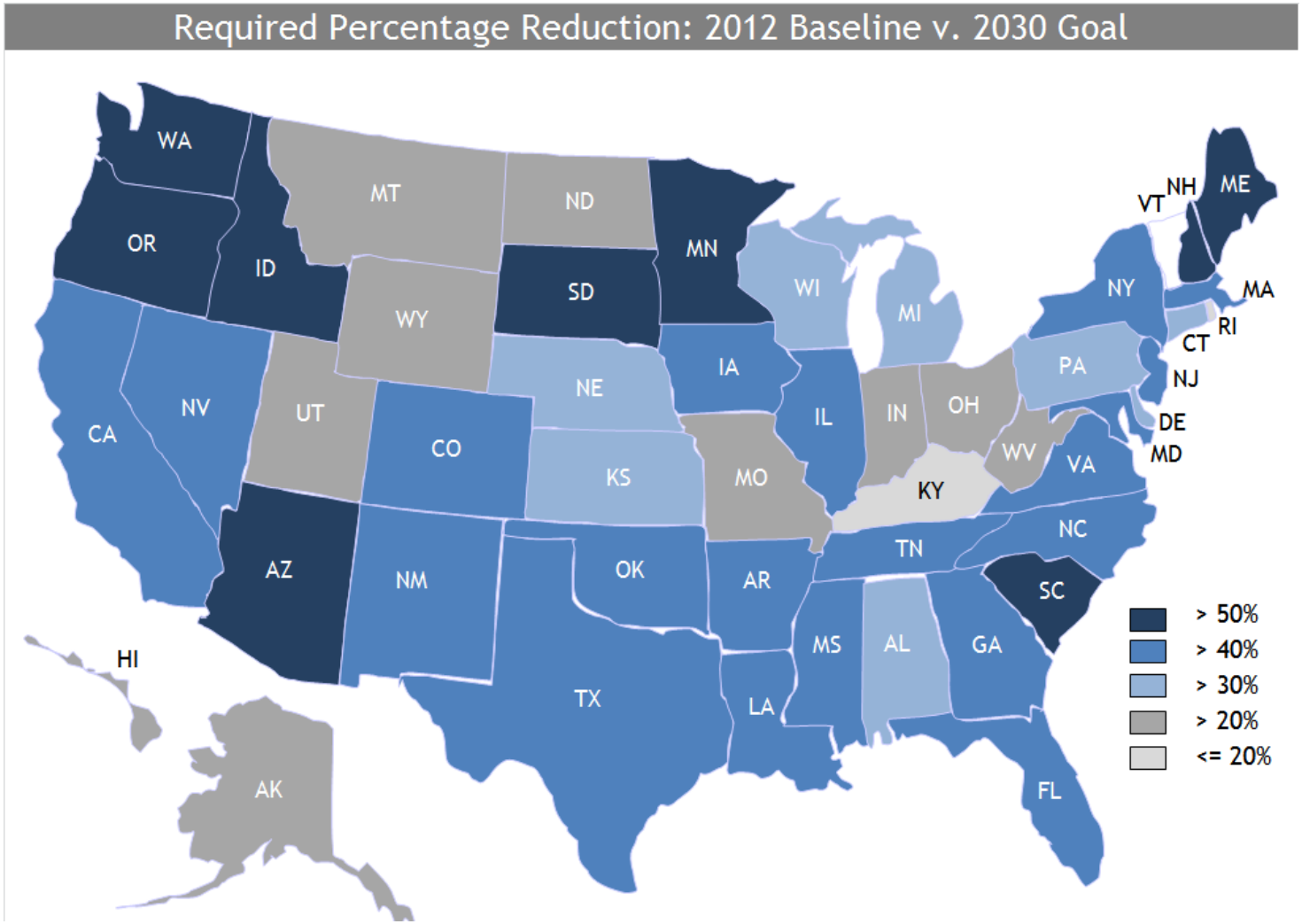
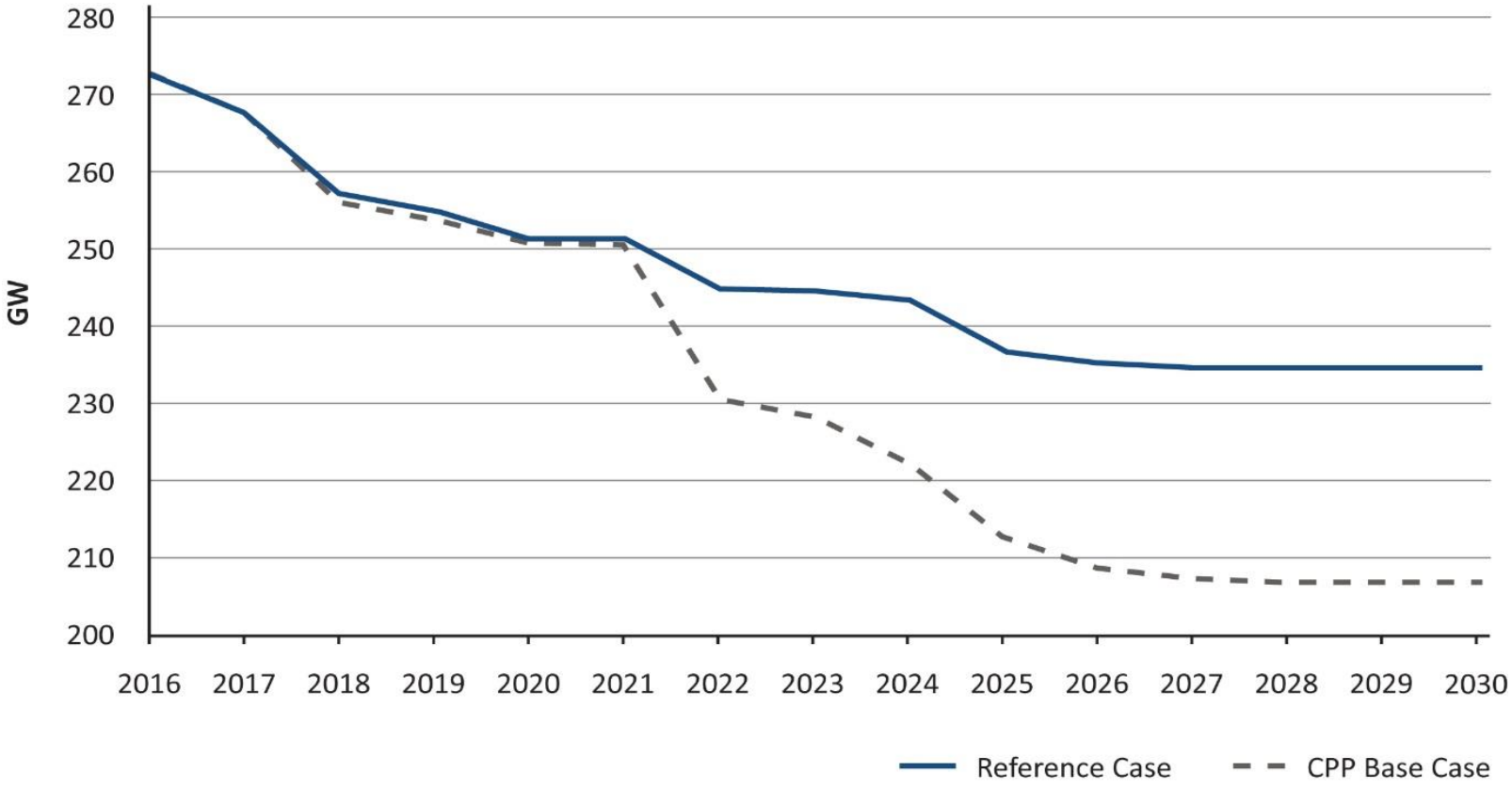
Emissions Reductions by State



Expected Coal Capacity Decline

Coal capacity decline by up to 27 GWs



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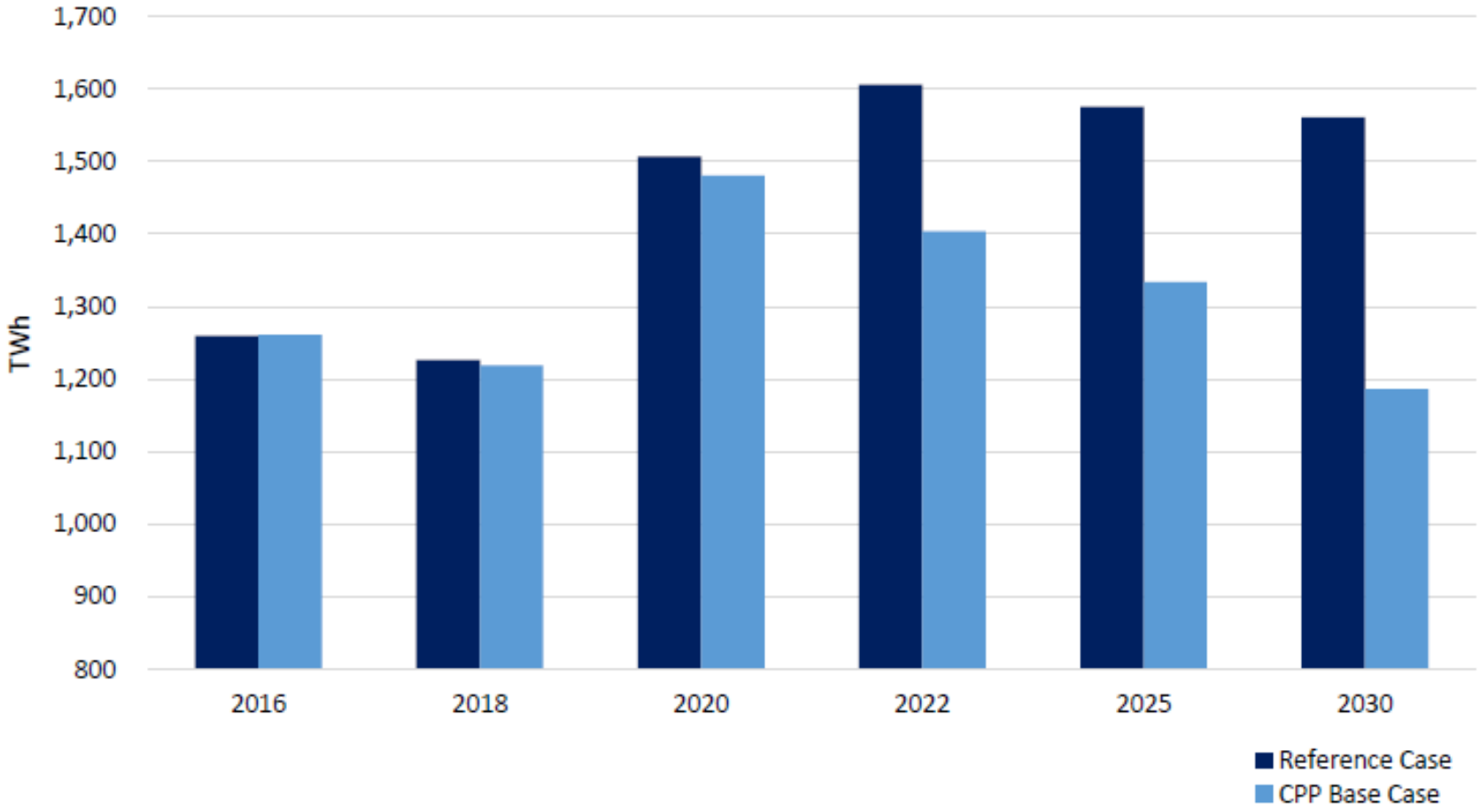
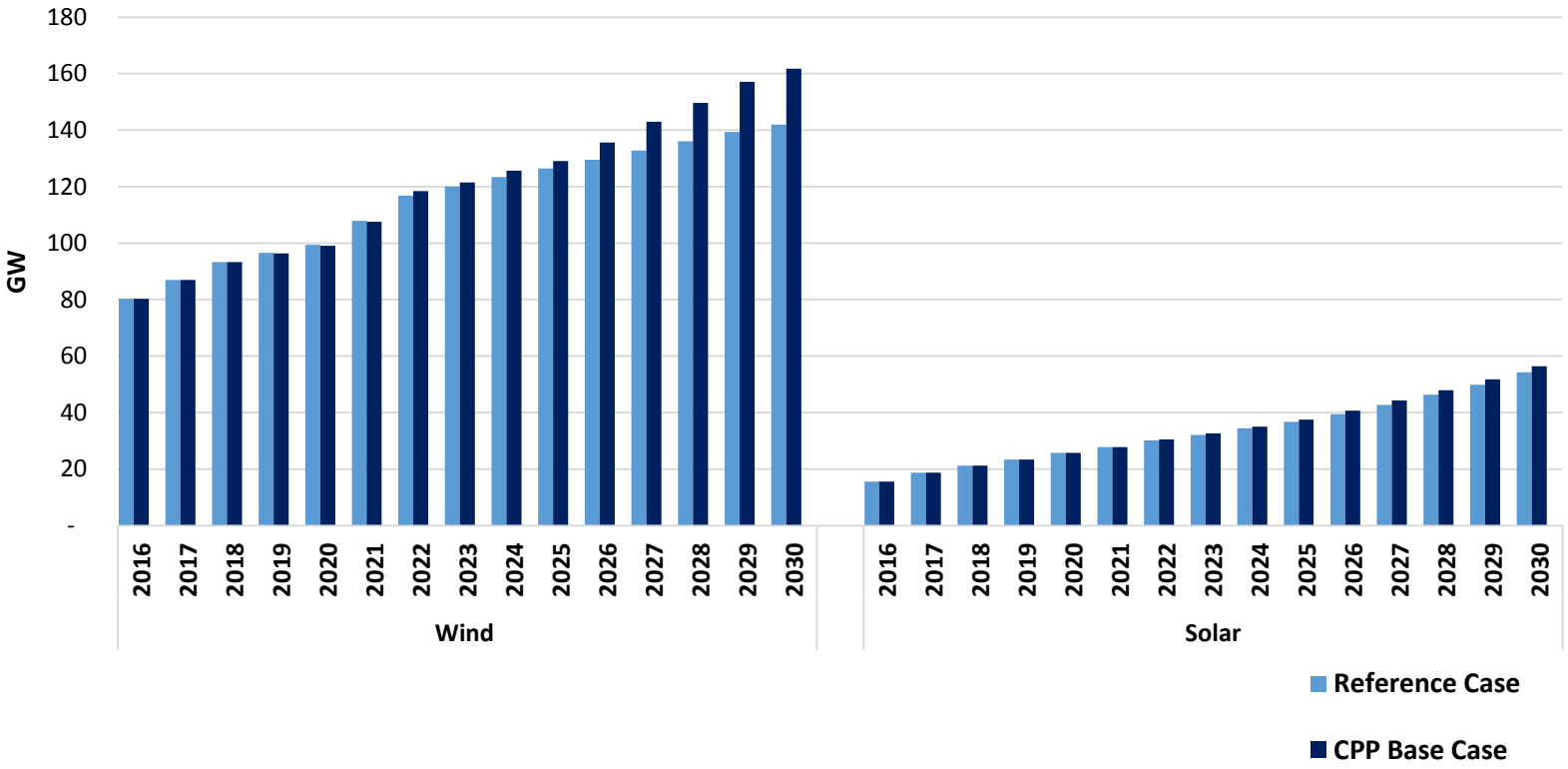
Coal Generation (TWh) Declines



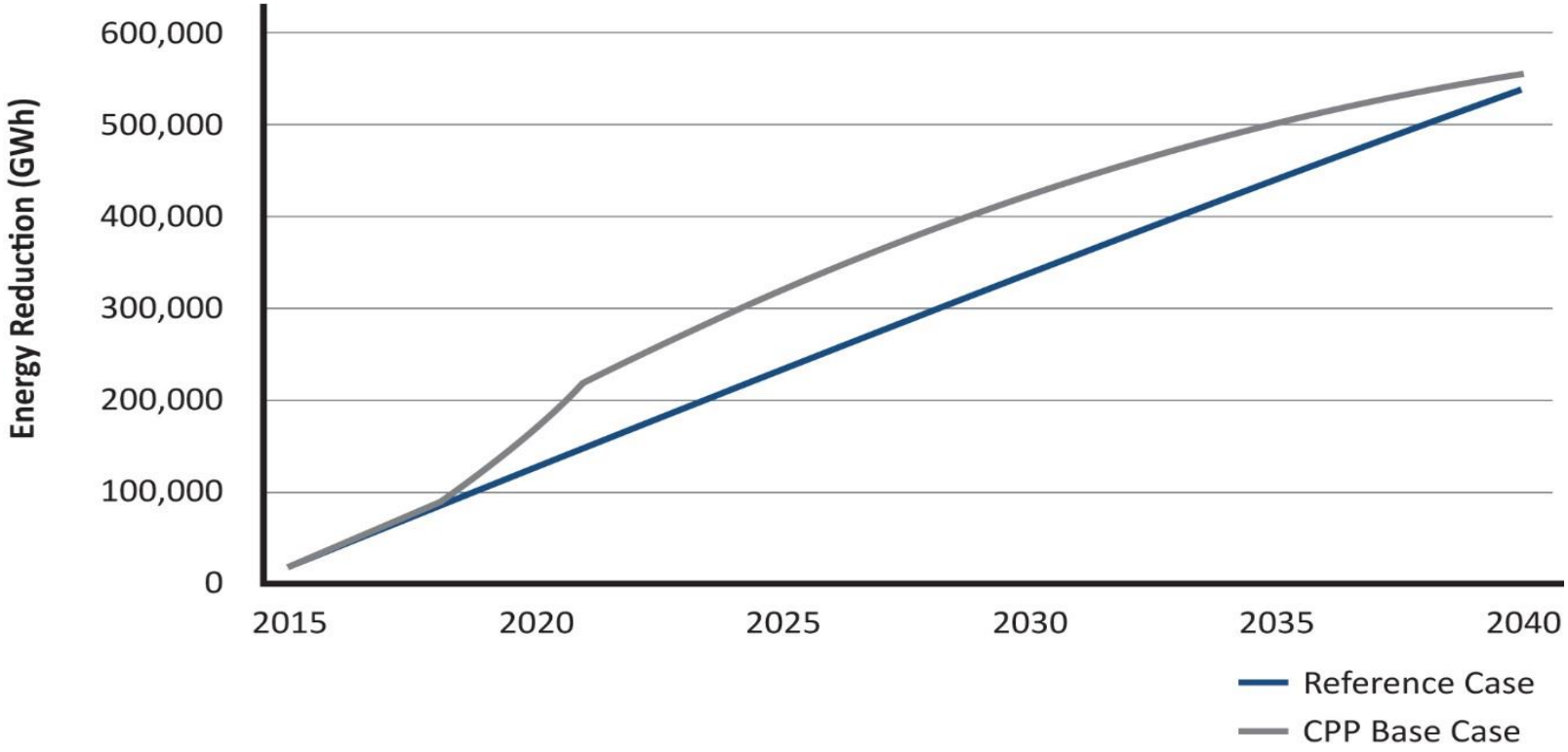
Large Amount of Renewable Integration

Tax credits and renewable portfolio standards drive renewables

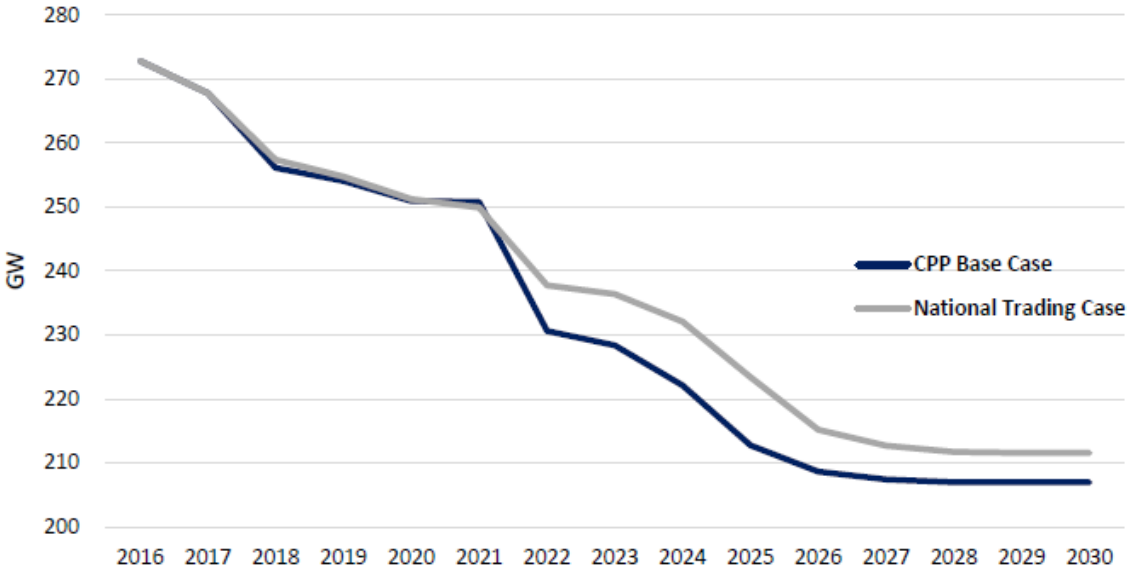


Demand Growth

Annual energy demand growth is expected to flatten

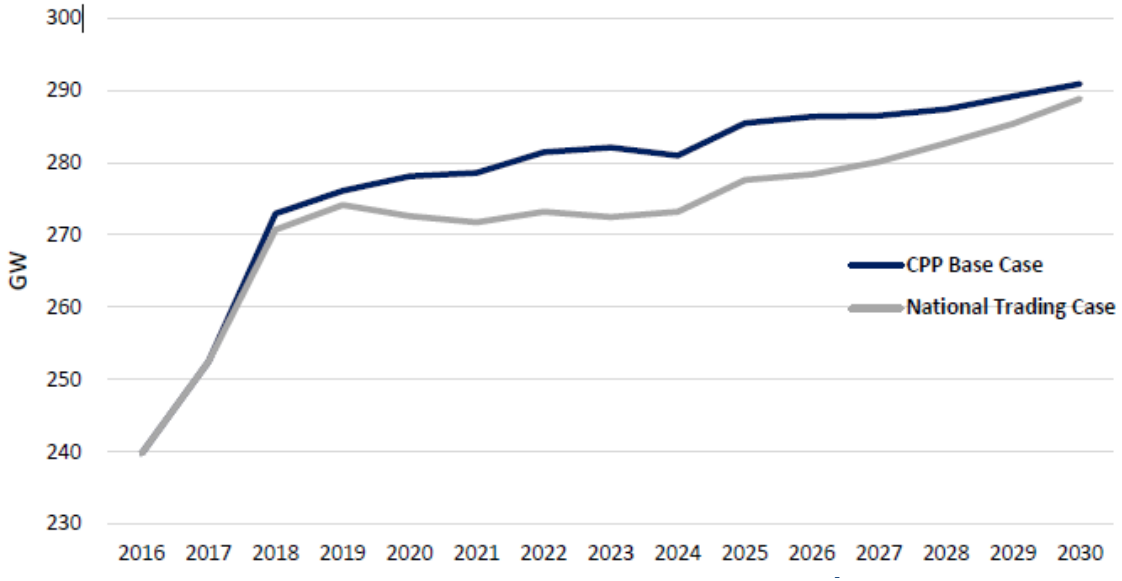


National Trading Impacts Coal Retirements and Gas Additions

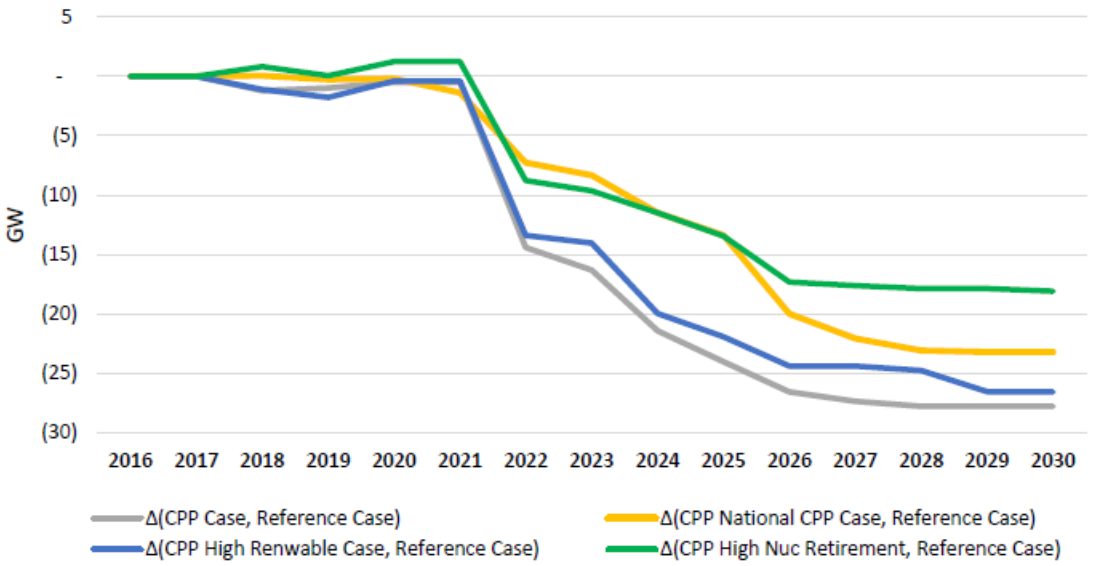


Coal Capacity

CCGT Capacity



Scenario Cases Compared to Reference Case



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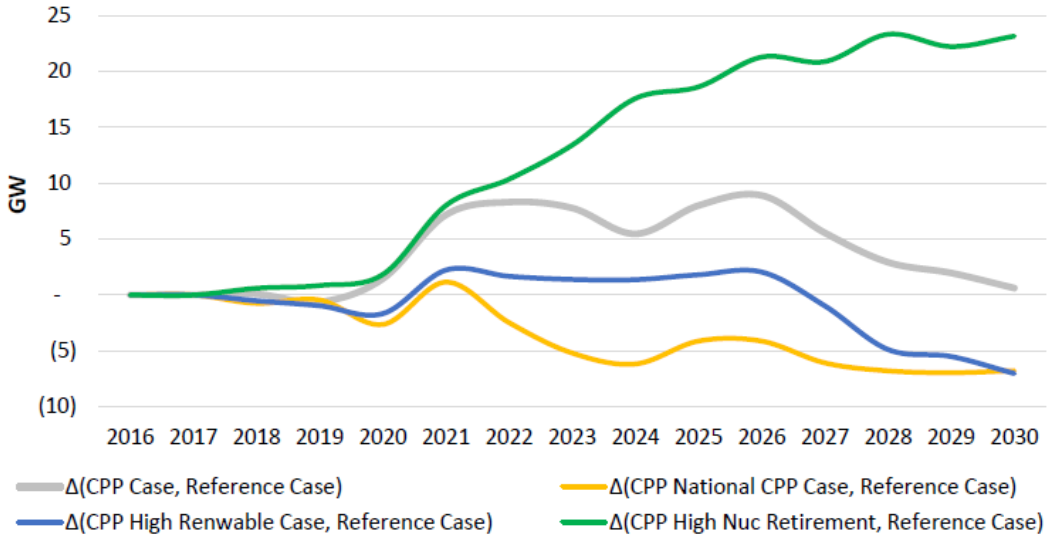
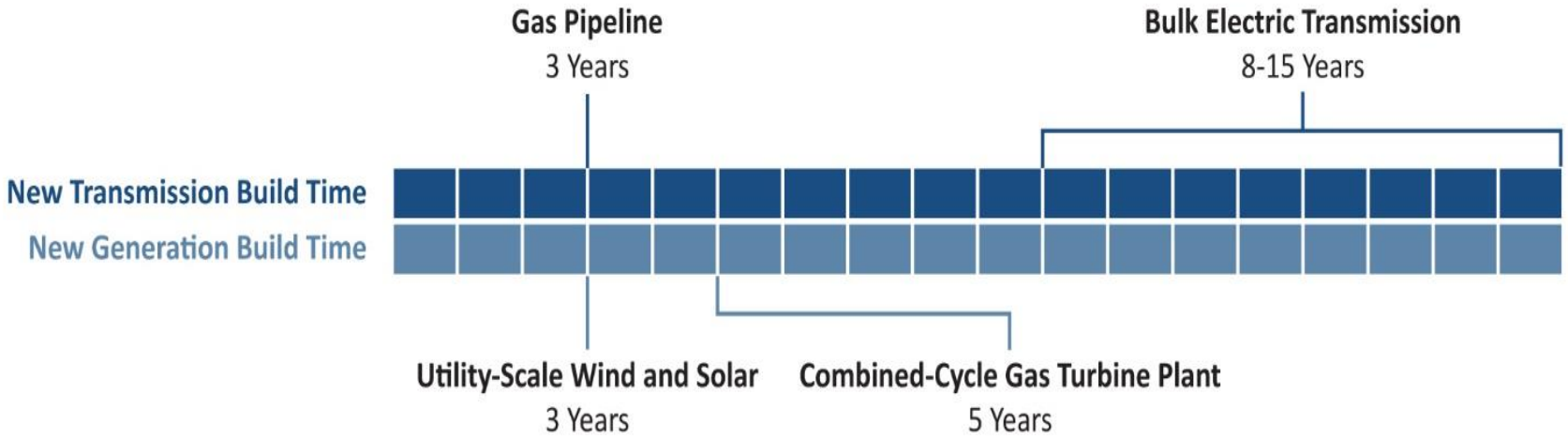


Planning

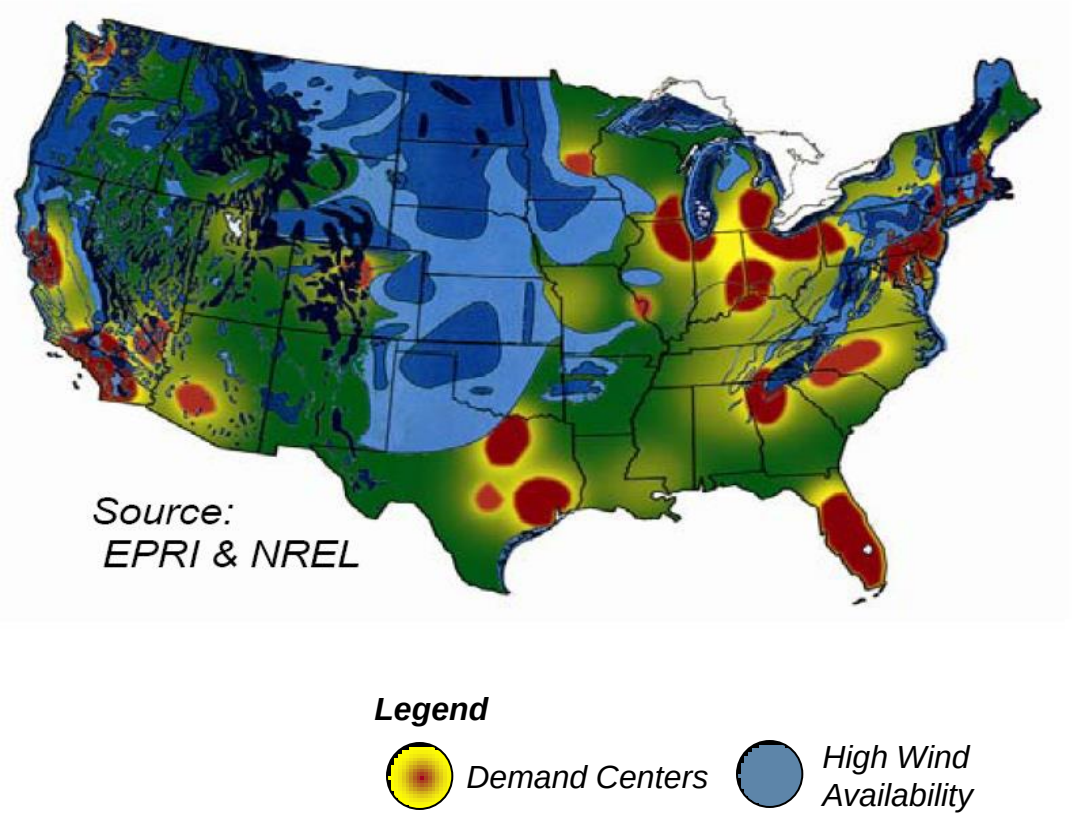
Planning should already be under way due to the need for new transmission and natural gas pipeline infrastructure



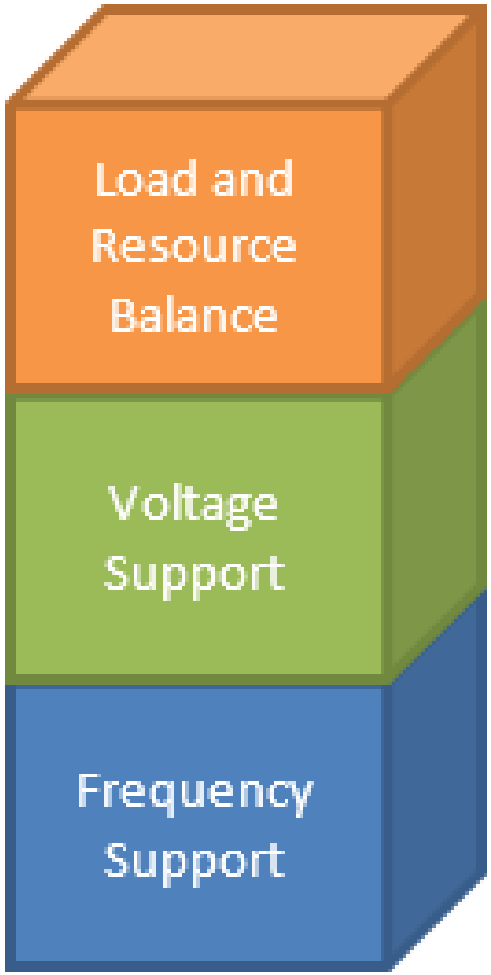
Need for Transmission

*High levels of variable generation will require **significant transmission additions** and reinforcements.*

- Interconnect variable energy resources in remote areas
- Smooth the variable generation output across a broad geographical region
- Deliver ramping capability and ancillary services
- Construct/site/permit transmission to deliver power across long distances

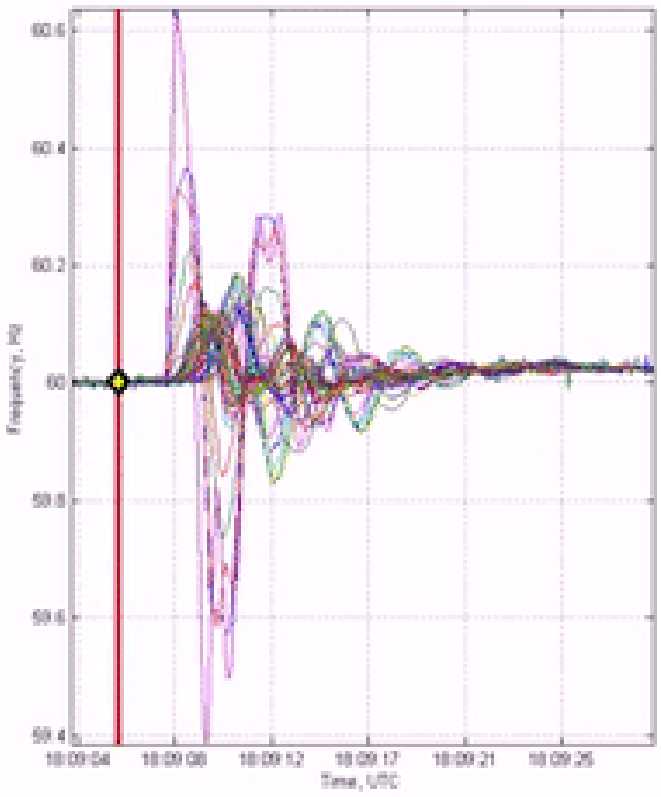


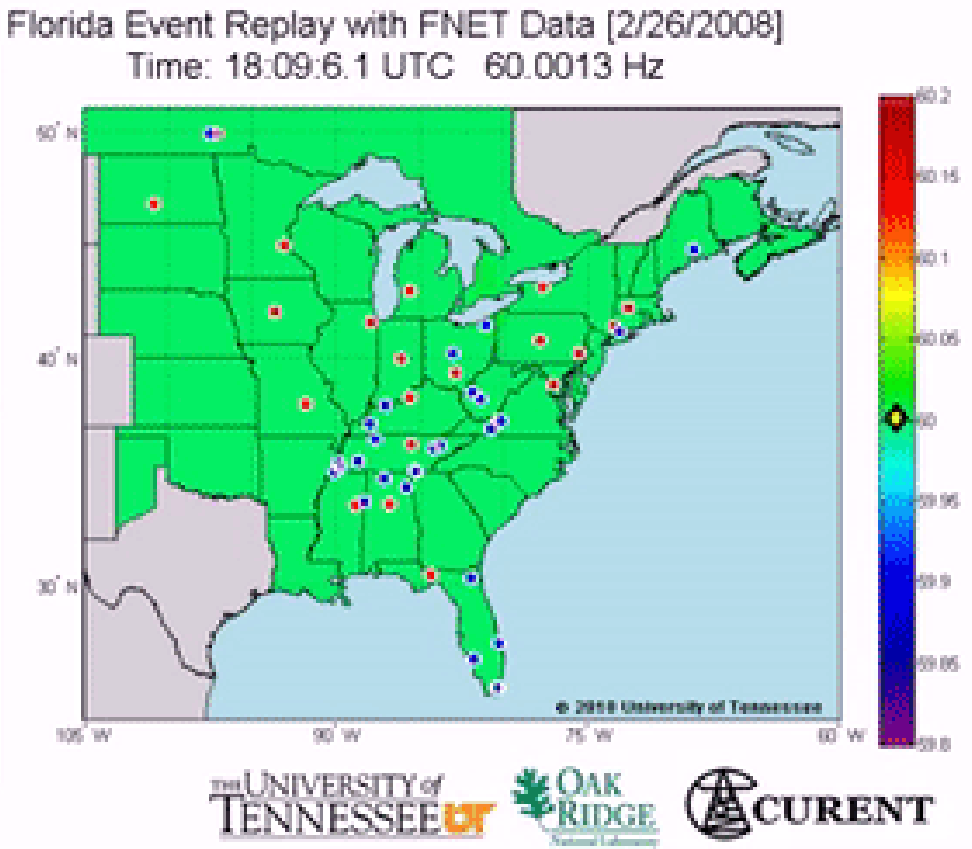
Essential Reliability Services: Fundamentals



- "Building blocks" of physical capabilities
- Accentuated by resource changes
- Not all MWs are equal
- Some partly covered through ancillary services
- Inherently provided by synchronous/conventional generation, but can be synthetically provided by DR, batteries, and inverters

Frequency Excursion – Interconnection-wide Phenomena





Proactively Resolve Reliability Concerns

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
- Solution sets for maintaining reliability can come from:
  - Market tools and rules
  - New technology integration
  - Standards or requirements
- Unresolved cost implications can impede solutions from materializing

Recommendations and Guidance to State Plan Developers

- Address roles and responsibilities of planning agencies and reliability authorities
  - NERC Planning Coordinators and Transmission Planners
- Maintain adequate Essential Reliability Services
  - Needed for the reliability operation of the Bulk-Power System
- Address future characteristics of resources
  - Cycling, availability, environmentally constrained dispatch, etc
- Early identification of additional infrastructure needs for natural gas transportation and assurance
- Identify changes to Reserve Margins needed for supply adequacy

Recommendations and Guidance to State Plan Developers

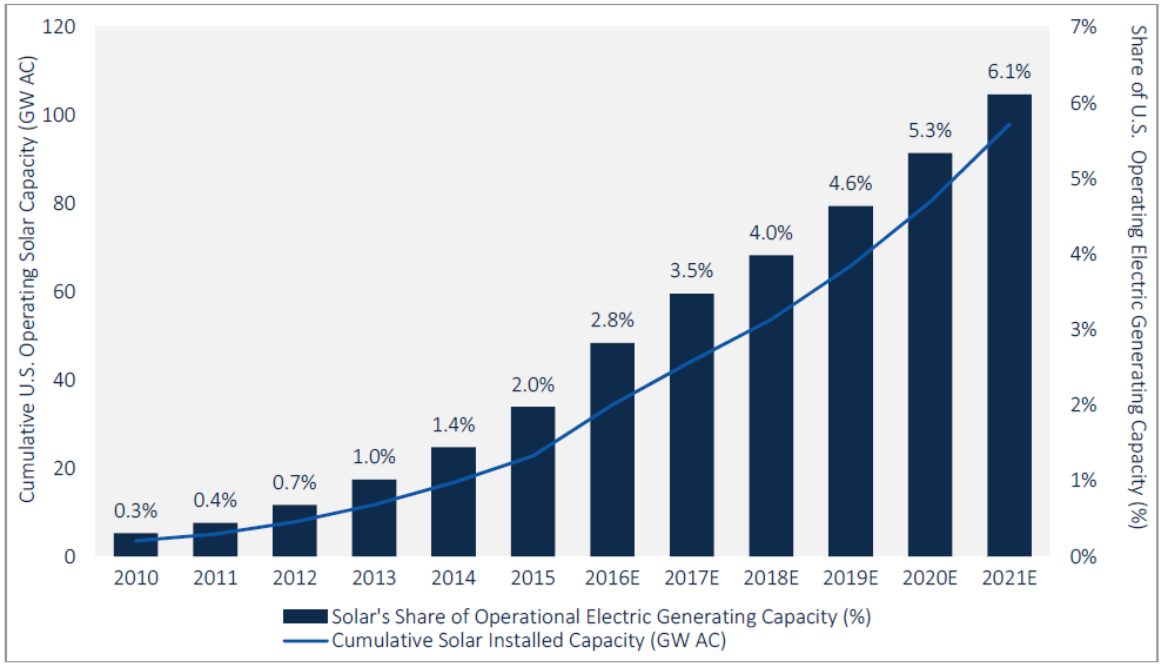
- Emphasize implications of the reliability assurance provisions
- Lessons learned from other systems that have experienced significant resource shifts (e.g., Ontario)
- Address implications of increased distributed resources and control challenges
- Discuss potential options for solutions, including technologies that can support reliability

2015LTRA
#3: Reliability Trends and Emerging Issues

Reliability Finding #3: Operators and planners face uncertainty with increased levels of distributed energy resources and new technologies

- Distributed energy resources (DERs) are contributing to changing characteristics and control strategies in grid operations.
- NERC has established a task force focused on examination of reliability impacts of large amounts of DER on the BPS.

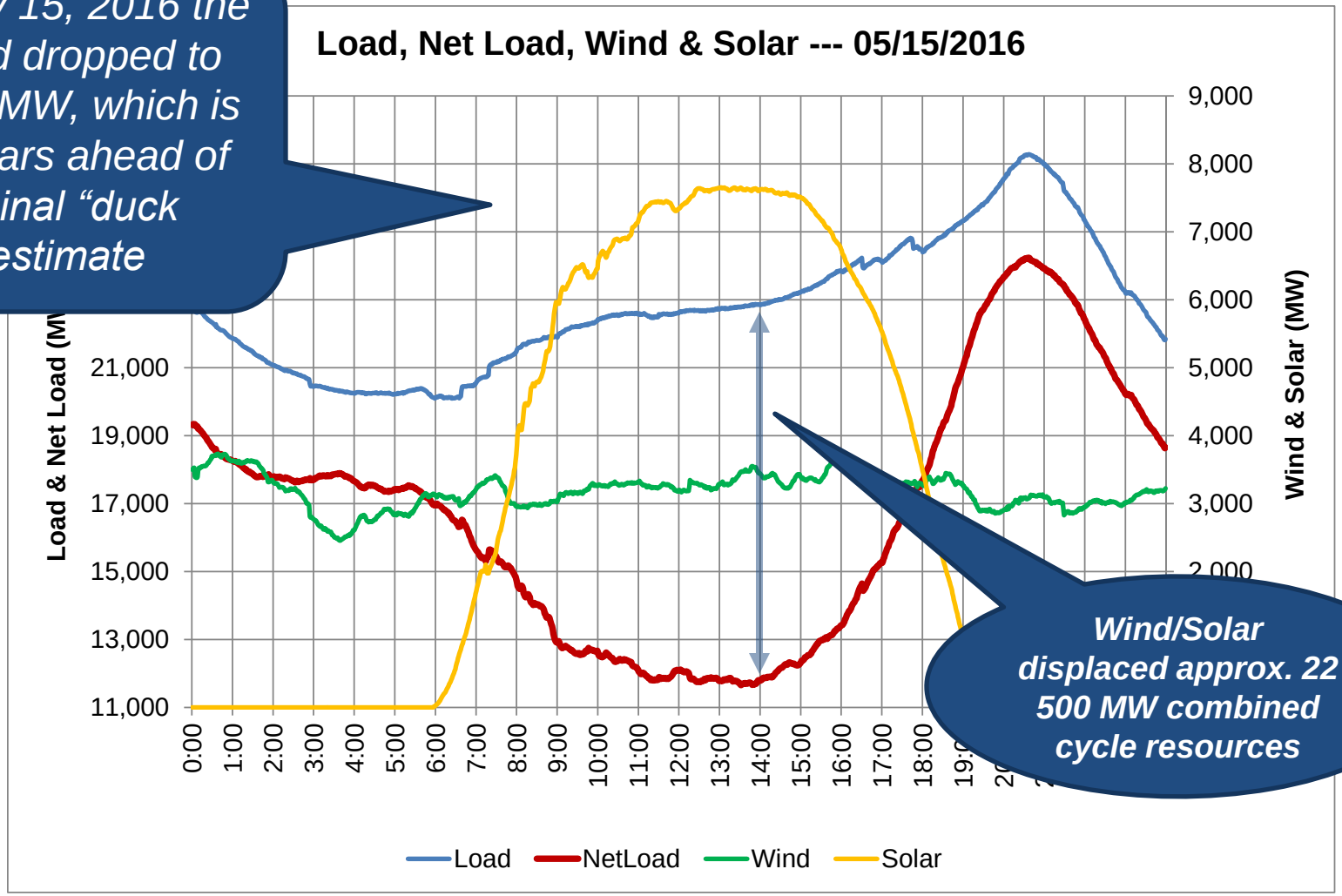
Cumulative Solar Installed Capacity in U.S. Since 2010 compared to Total Installed Capacity



Source: GTM Research (solar); FERC (historical non-solar figures); EIA (projected non-solar figures)

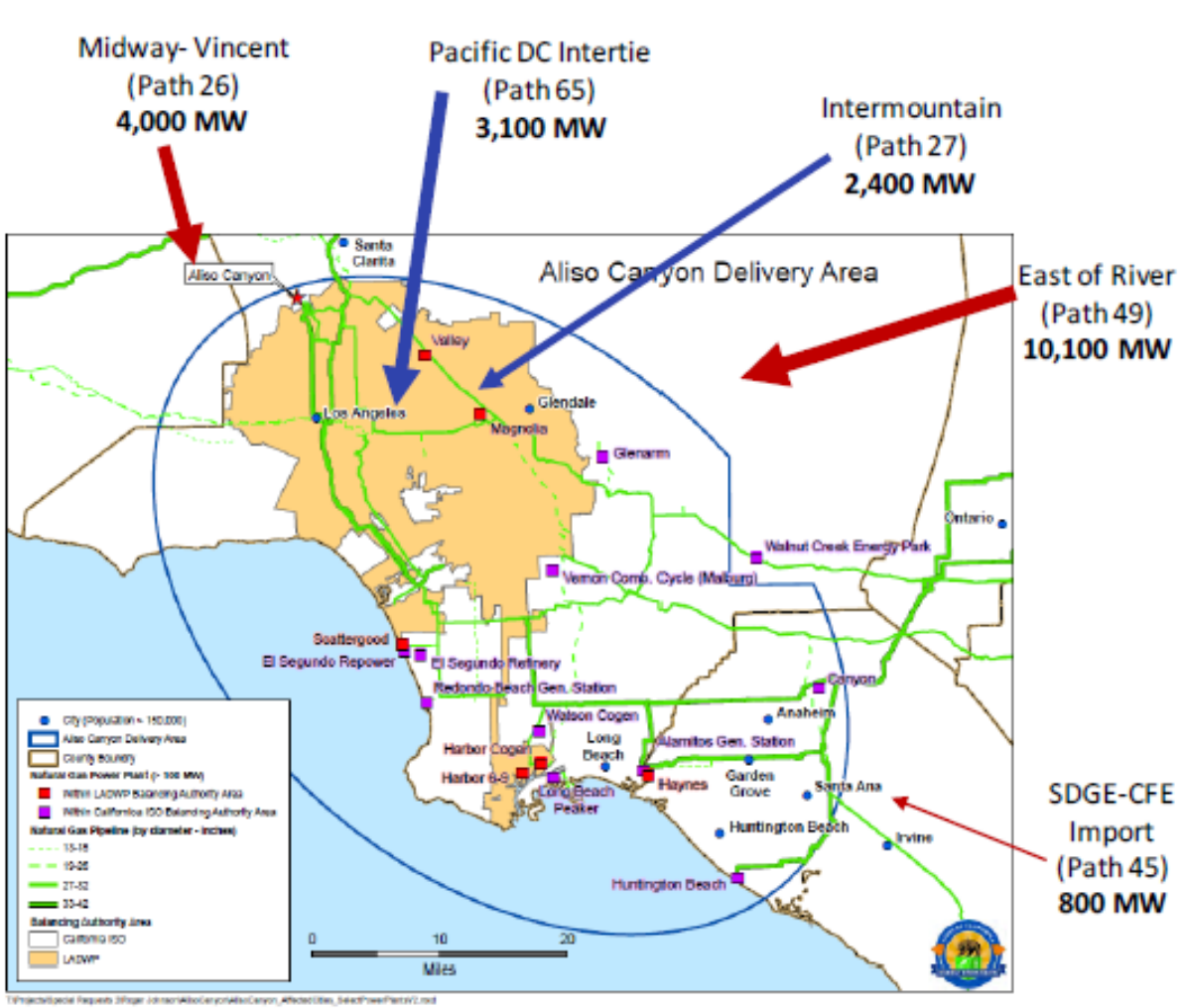
The Future is Now

*On May 15, 2016 the net-load dropped to 11,663 MW, which is **four** years ahead of the original "duck curve" estimate*



Wind/Solar displaced approx. 22 500 MW combined cycle resources

Aliso Canyon: LA Basin Power Supply



Potential Impacted Generation

LA Basin:

- 9,800 MW natural gas generation
- ~95% of total local capacity

Rest of Southern California:

- >15,000 MW natural gas generation

Maximum Import Capacity

- 5,500 MW DC capacity
- 14,900 MW AC capacity
- 20,400 MW total*

* Typically limited to 17,000 - 18,000 MW

Remaining Uncertainties

- What will the Federal Plan look like?
- Mass versus Rate
- Parallels to previous regulations?
- Uncertainty with neighboring state plans and available transfers
- Energy efficiency expectations
- Timing and location of retirements
- Robustness of trading
- Legal impediments
- Transmission-level impacts
- Market sensitive information sharing

Closing Remarks

- Profound changes occurring on the BPS—resources and policies
- Lots of uncertainty in the future
  - nuclear, carbon, natural gas, climate trends, transmission
- New system behaviors and characteristics require new measurements for reliability
- Emerging reliability issues bring new technical (and political) challenges
- Must carefully balance costs and benefits
- Changes occurring irrespective of CPP
- NERC is well positioned to study, evaluate, and assess the reliability of the Bulk Power System

Questions and Answers