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127th Annual Meeting

Staff Subcommittees on Electricity & Electric Reliability

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Maintaining Grid Reliability While Change and More Change Keeps Coming: Why policymakers should care about the evolving grid; and What exactly are those 'reliability' impacts that States are supposed to consider when crafting CPP compliance plans!?!

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Moderators: **Pat Poli, Chair Staff Subcommittee on Electric Reliability**
Kim Jones, Chair Staff Subcommittee on Electricity

Todd Lucas: ***General Manager Bulk Power Operations for Southern Company, Chair NERC's Essential Reliability Services Task Force (ERSTF)***

Dan Woodfin: ***Director of System Operations, ERCOT***

Tom Coleman: ***Director of Reliability Assessments, NERC***

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Todd Lucas: ***General Manager Bulk Power Operations for Southern Company,***
Chair NERC's Essential Reliability Services Task Force (ERSTF)

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Essential Reliability Services Task Force (ERSTF)

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November 8, 2015

RELIABILITY | ACCOUNTABILITY




Transformation of the Electric Grid

- The evolving resource mix represents a fundamental shift in the operational characteristics of the power system.
- Essential Reliability characteristics of the grid must be maintained.
  - Voltage control
  - Frequency support
  - Load/resource balancing (Ramping Capability)
- In 2014, NERC established the Essential Reliability Services Task Force (ERSTF) to develop a means to assess the impacts on these essential reliability characteristics.
- ERSTF recommendations and technical report expected to be finalized in December 2015.

Policy Considerations

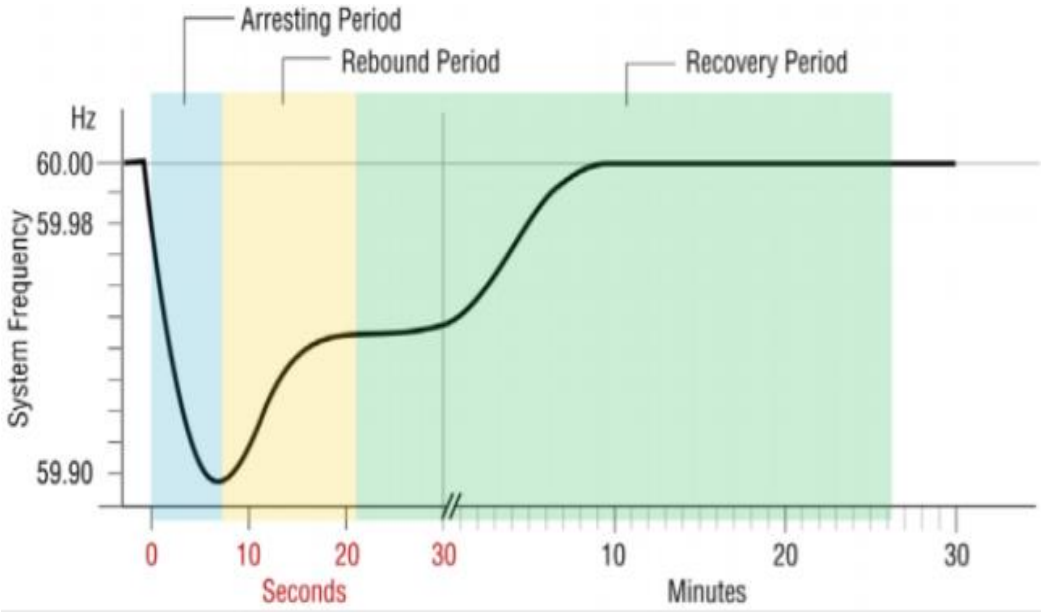
- Policy decisions have a direct influence on resource mix choices and can affect the reliability of the electric grid.
- Engineering analysis in the planning and design phases are required for system operators to have flexibility to meet real-time reliability needs.
- Policies should encourage the proper planning and support the necessary flexibility to maintain reliability.
- NERC ERS efforts are intended to inform policy makers of the reliability considerations associated with the changing resource mix.

Voltage Control

- Maintaining system voltage is critical to reliability.
  - Voltage must be controlled to protect system reliability in both normal operations and following a disturbance.
  - Voltage issues tend to be local in nature, such as in sub-areas of the transmission and distribution systems.
  - Reactive power is needed to keep electricity flowing and maintain necessary voltage levels.
  - Today, large rotating generators inherently provide reactive power. As these resources are replaced by more dispersed variable resources, special attention is needed to ensure reactive power needs are met.

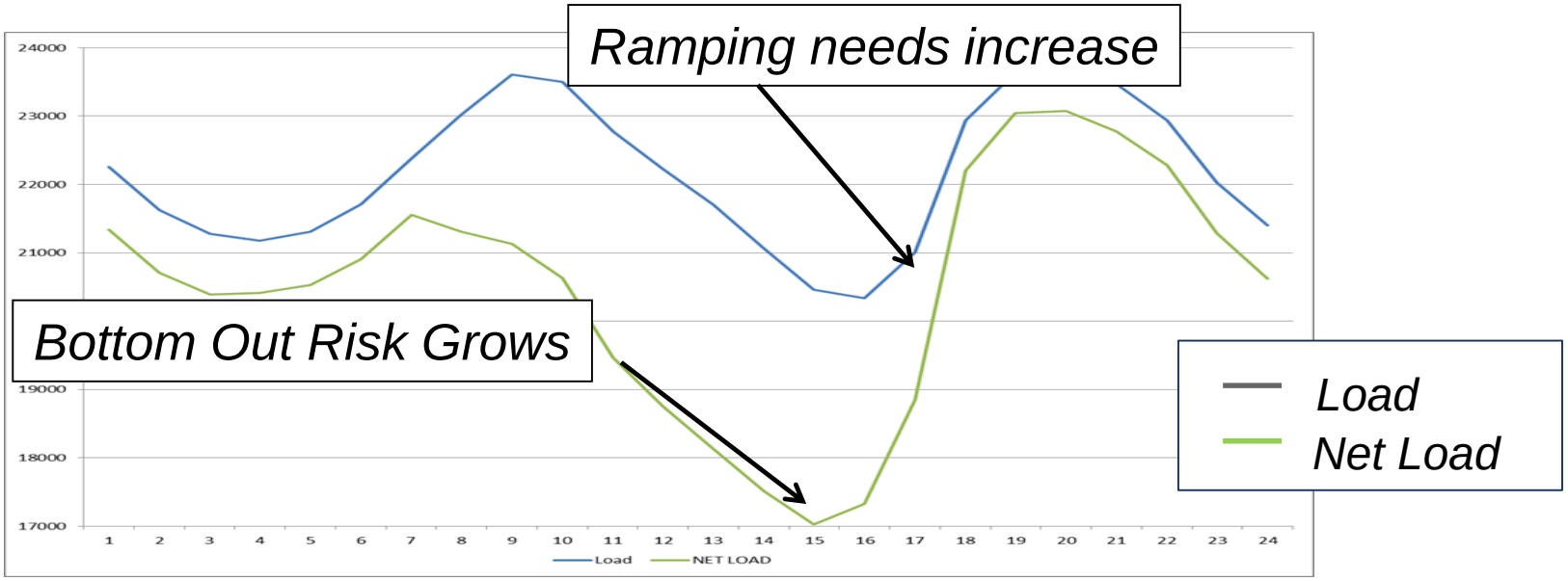
Frequency Support

- The electric grid is designed to operate within tight tolerances around 60 hertz (Hz).
- Deviations can result in damage to equipment or loss of load.
- It is critical to maintain and restore frequency after a disturbance such as the loss of generation.



Load/Resource Balancing

- Adequate ramping capability (ability to match load and generation at all times) is necessary to maintain system frequency.
- Changes to the generation mix or the system operator's ability to adjust resource output can impact the ability of the operator to keep the system in balance.



Impacts of Distributed Energy Resources

- Distributed Energy Resources (DERs) are becoming a significant element of net load on distribution systems in a few areas of North America.
- DERs impact transfer of power between distribution and the bulk system.
- DERs can impact the bulk power system and must be coordinated with overall grid operations.
- Lack of coordination could exacerbate a disturbance such as a frequency excursion or a voltage deviation.

ERSTF Recommendations

- Trending historical and forecasting future levels of key reliability characteristics.
  - System inertia and overall frequency response
  - System reactive capability
  - System ramping needs
- New resources should have the capability to support voltage and frequency. Ensuring these capabilities are present in the future resource mix is prudent and necessary.
- NERC should further examine impacts of the interaction between distributed energy resources and the bulk power system.

Summary

- Evolving generation resource mix represents a fundamental shift in the operational characteristics of the power system.
- Policy decisions have a direct influence on resource mix changes and affect the reliability of the electric grid.
- Planning and analysis is necessary to ensure reliable and economic operation of the bulk power system.
- ERSTF recommendations provide a means to assess trends and engineer solutions to ensure reliability is maintained.

Questions and Answers

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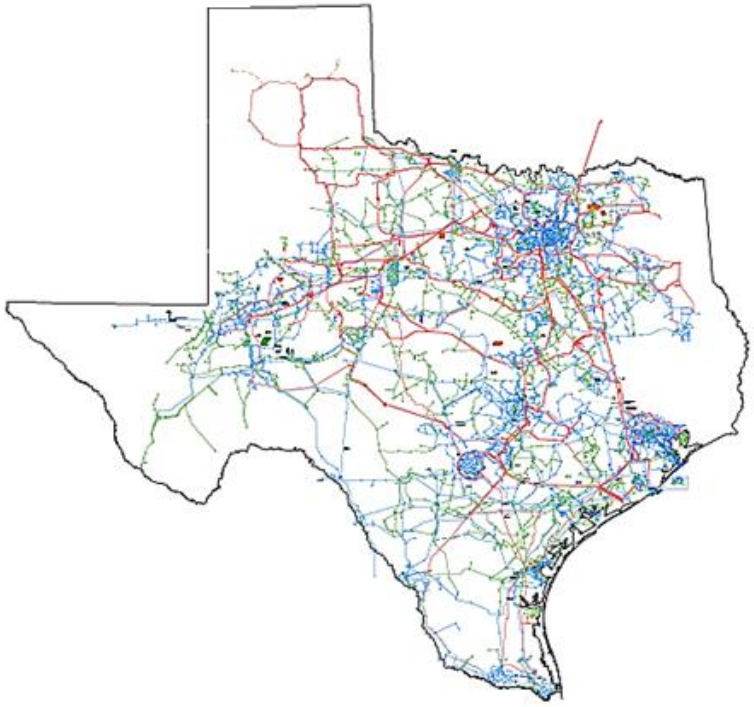
Dan Woodfin: ***Director of System Operations, ERCOT***

Overview of the ERCOT Future Ancillary Services Initiative

Dan Woodfin
Director, System Operations

NARUC Staff Subcommittee on Electric Reliability
November 8, 2015

ERCOT



ERCOT Region

The interconnected electrical system serving most of Texas, with limited external connections

- 90% of Texas electric load; 75% of Texas land
- 69,621 MW peak demand (set August 10, 2015)
- More than 46,500 miles of transmission lines
- 550+ generation units
- External connections only through five direct current ties (1100MW total)

ERCOT Inc.

The Texas Legislature restructured the Texas electric market in 1999 and assigned ERCOT four primary responsibilities:

- Maintaining System Reliability
- Ensuring Open Access to Transmission
- Facilitating of Competitive Retail Market
- Facilitating Competitive Wholesale Market

ERCOT is regulated by the Texas Public Utility Commission with oversight by the Texas Legislature

ERCOT is not a market participant and does not own generation or transmission/distribution wires

Background on Ancillary Services (AS)

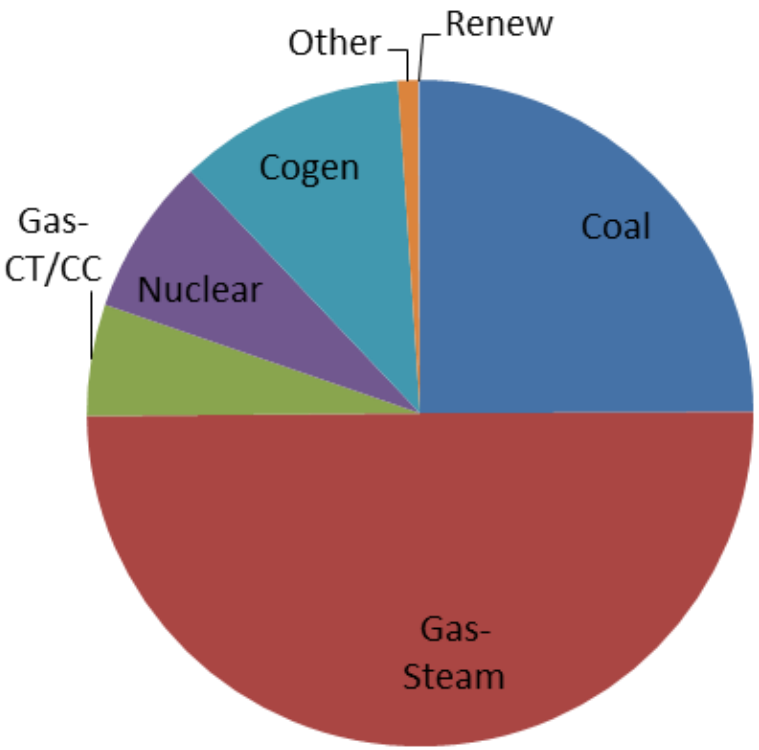
- A fundamental role of system operations is to maintain frequency close to 60 Hz
  - Accomplished by constantly balancing generation and load
- Load and generation are constantly changing, requiring continual rebalancing, due to:
  - Daily load patterns
  - Instantaneous load variation
  - Changes in intermittent generation output
  - Generators tripping offline
- Requires sufficient resources on-line, or able to be brought on-line in a timely manner, with appropriate characteristics to provide this continual rebalancing

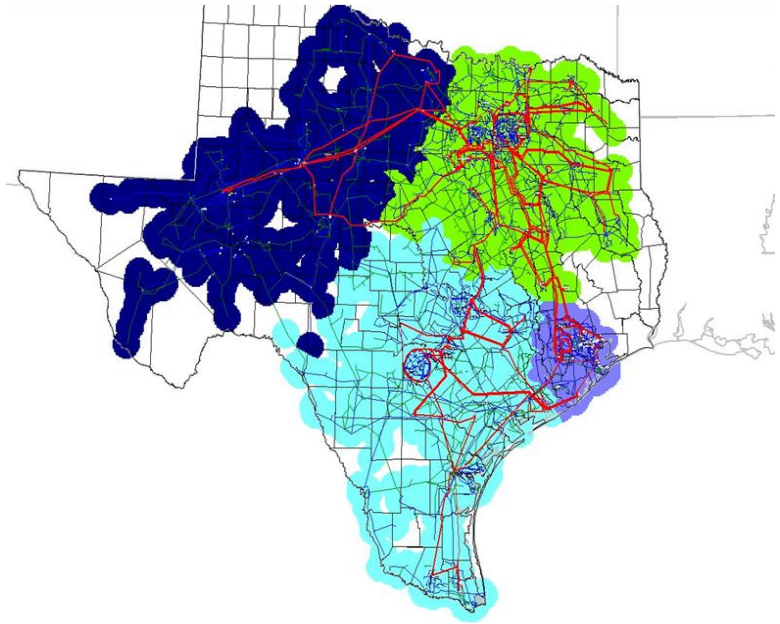
“Ancillary” Services

- The balancing of generation and load is generally accomplished through the real-time energy market
  - Market commitment of generation
  - Periodic economic dispatch of generation to match load (currently, 5 minutes)
- This process alone does not ensure that sufficient resources with appropriate characteristics are available
  - Additional mechanisms, which are “ancillary” to the energy market, are needed to help maintain balance
  - Ancillary Services ensure that ERCOT can balance any additional variability that is not covered by the energy market

History of Current AS Framework

Installed Capacity by Unit Type

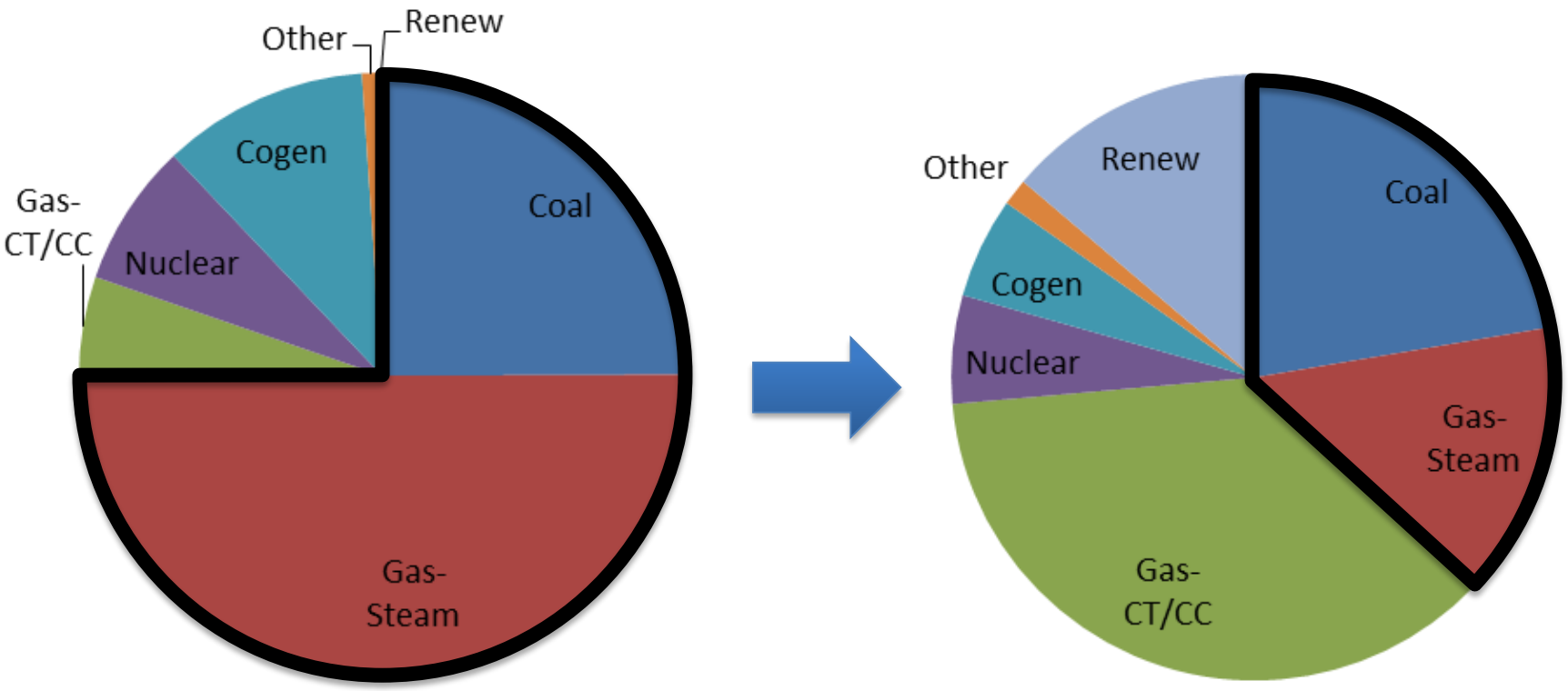




This is the world for which the current set of Ancillary Services was designed in the late 1990s

Changing Resource Mix

Installed Capacity by Unit Type



Late 1990s

2015

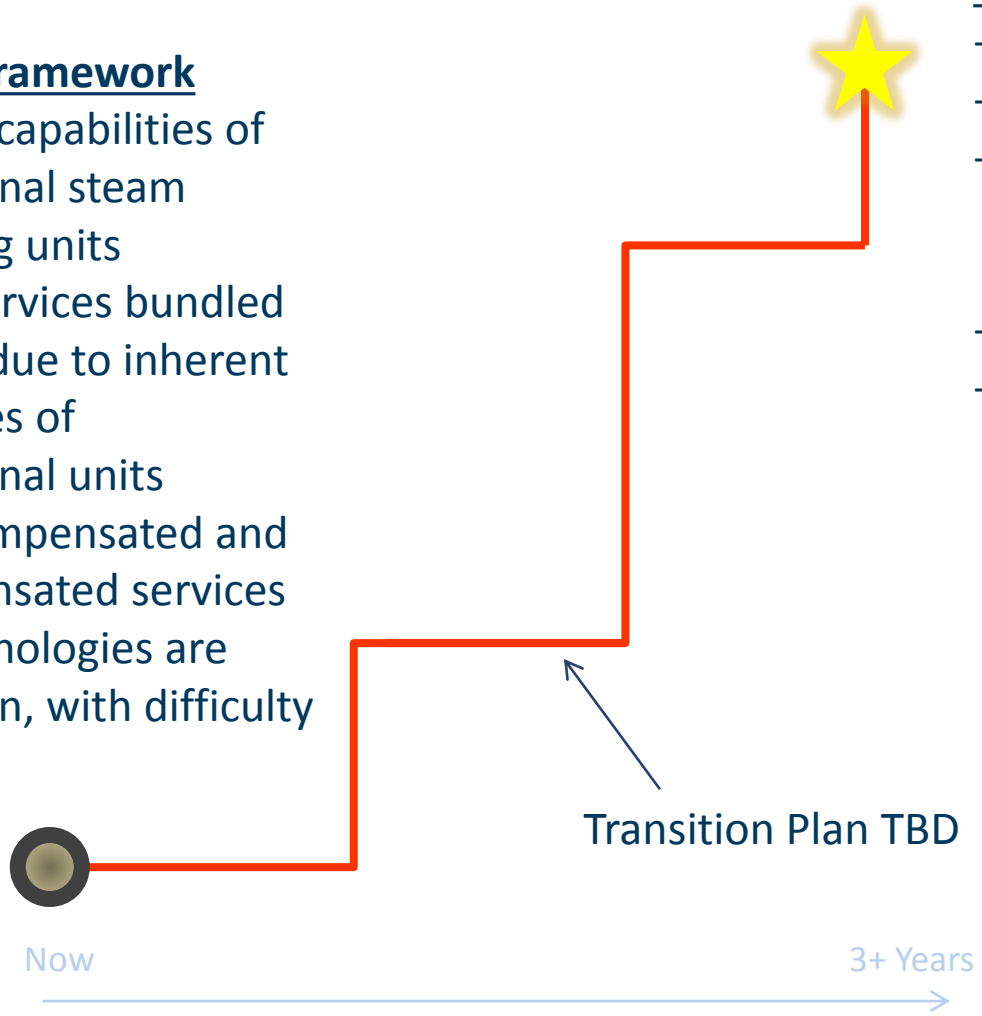
Goal of Redesign Effort

Current AS Framework

- Based on capabilities of conventional steam generating units
- Unique services bundled together due to inherent capabilities of conventional units
- Mix of compensated and uncompensated services
- New technologies are cobbled on, with difficulty

Future AS Framework

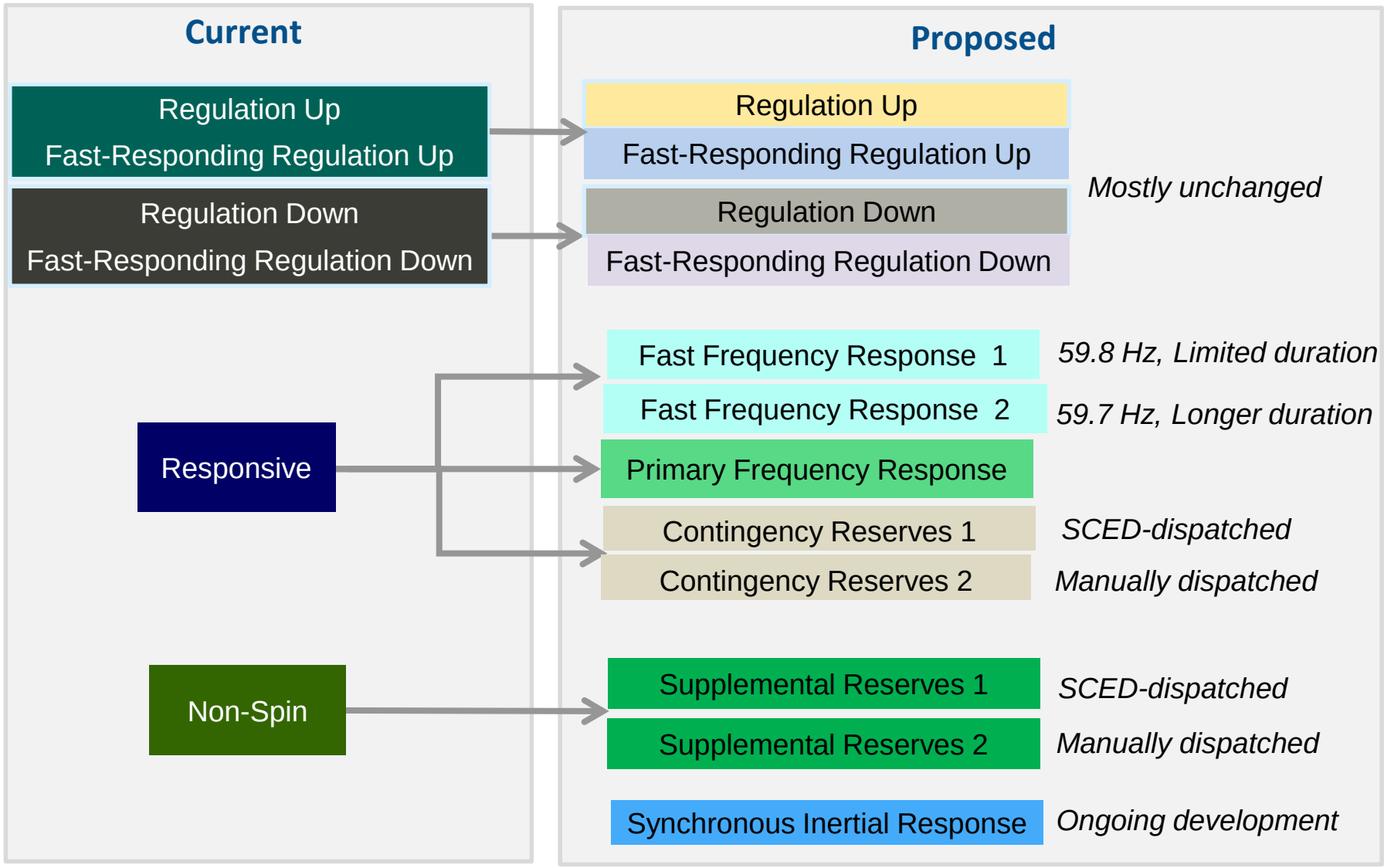
- Technology neutral
- Market-based
- Based on fundamental needs of the system, not resource characteristics
- Unbundled services
- Flexible for new technologies



Drivers for New Ancillary Service Framework

- Align the AS framework with the changing technical needs of the ERCOT System
- Remove barriers to entry for new resource types that could meet the fundamental requirements for AS
- Improve the efficiency in AS procurement

Proposed Future Ancillary Services



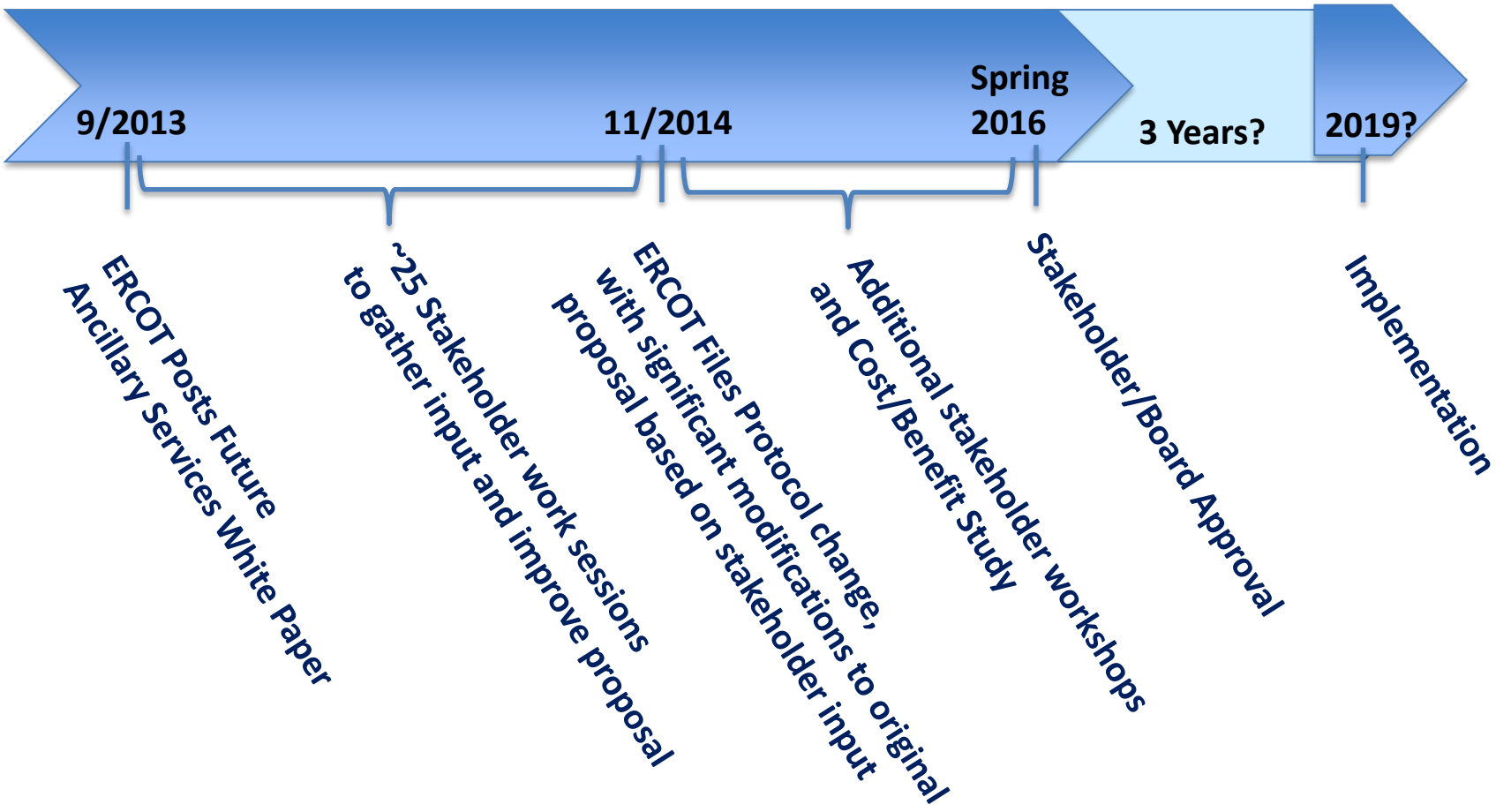
Example: Frequency Response Resources

	Case1	Case2	Case3	Case4	Case5	Case6	Case7	Case8	Case9	Case10	Case11	Case12
FFR/PFR	2.2:1	2.0:1	1.5:1	1.4:1	1.3:1	1.25:1	1.13:1	1.08:1	1:1	1.0:1	1:1	1:1
Net load Level(GW)	15-20	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	60-65
Inertia (GW·s)	239	271	304	354	403	459	511	556	593	631	664	700
PFR needed (no FFR)	5200	4700	3750	3370	3100	3040	2640	2640	2240	2280	2140	2140

	Case1	Case2	Case3	Case4	Case5	Case6	Case7	Case8	Case9	Case10	Case11	Case12
FFR/PFR	2.2:1	2.0:1	1.5:1	1.4:1	1.3:1	1.25:1	1.13:1	1.08:1	1:1	1:1	1:1	1:1
PFR Min	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240
FFR needed with PFR Min	1800	1696	1641	1511	1431	1440	1239	1296	1000	1040	900	900
Combined Total	3040	2936	2881	2751	2671	2680	2479	2536	2240	2280	2140	2140

PFR – Primary Frequency Response
FFR – Fast Frequency Response

FAS Timeline



Future dates are tentative

Cost/Benefit Assessment (CBA)

- ERCOT has engaged Brattle to perform CBA of FAS
- Analysis will be quantitative and qualitative
- Will look at several scenarios:

	Near Term	Long Term with Business as Usual Resources		Long Term with Resources Facilitated by FAST	
Environ. Regs:	**Current Trends**	**Current Trends**	**Stringent**	**Current Trends**	**Stringent**
Current Framework	√	√	√	N/A	N/A
FAST Framework	√	√	√	√	√

- Brattle presentation on the CBA is posted and will be presented to ERCOT stakeholders tomorrow (11/9/15)

Synchronous Inertia Service (SIR)

- Not initially included in Protocol change
- Holding series of workshops to flesh out details
- Separate service should be more efficient way to get inertia than by Reliability Unit Commitment or by procuring additional PFR to commit additional synchronous generation
  - Unbundles provision of synchronous inertia from requirements for PFR
- Workshops will also look at whether “super-fast” FFR could lower need for inertia service

Why Go FAS?

- Specifies a holistic set of distinct Ancillary Services needed to meet the changing technical needs of the ERCOT System
- Provides efficient, market-based procurement process to obtain these services
- Provides a coordinated transition to meet these needs instead of a piecemeal approach

For more information:
WWW.ERCOT.COM/COMMITTEES/OTHER/FAST

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Tom Coleman: ***Director of Reliability Assessments, NERC***

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Reliability Considerations for Clean Power Plan Development

Thomas H Coleman
Director, Reliability Assessment
November 8, 2015

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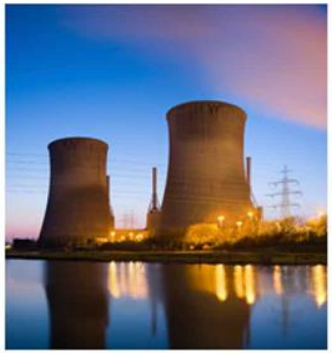
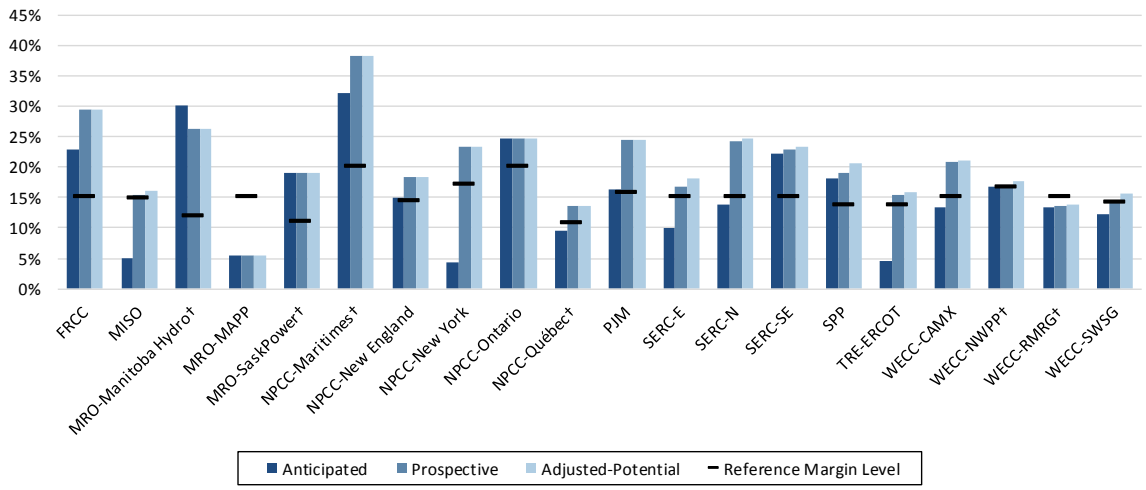


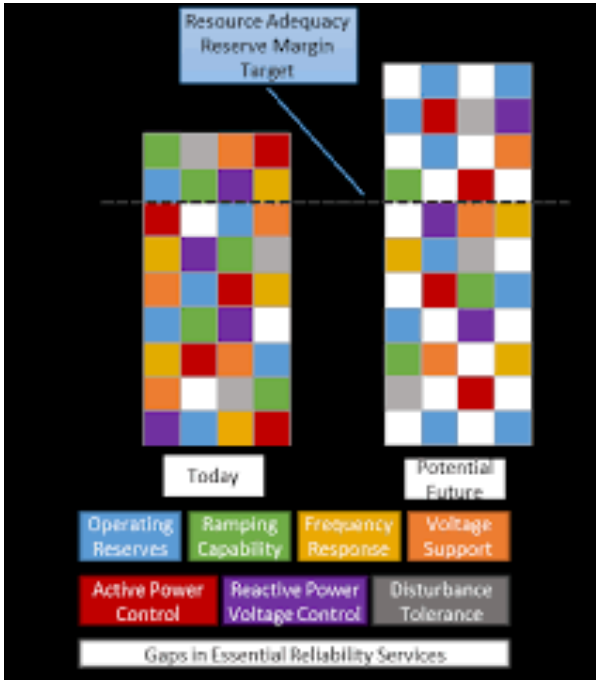
Reserve Margins

- Reference Margin Levels have historically been set at a level that accommodates for a one-event-in-ten-years generation inadequacy in a particular area where it has been set.
- With an impending changing resource mix, reserve margins must be re-examined.



Essential Reliability Services

- Essential Reliability Services are critical to support BPS reliability.
- With more distribution-centric resources, the amount of control needed to maintain reliability, must be maintained.



Trading

- The EPA has provided for the possibility of a robust trading system around Emission Reduction Credits.
- Uncertainty remains regarding development of ERC market.

Unit Cycling and Capacity Factors

- The CPP implementation can potentially result in a change in the operating characteristics and run times of existing generating units.
- Coal units may be cycled more, and natural gas units are projected to have increased capacity factors.

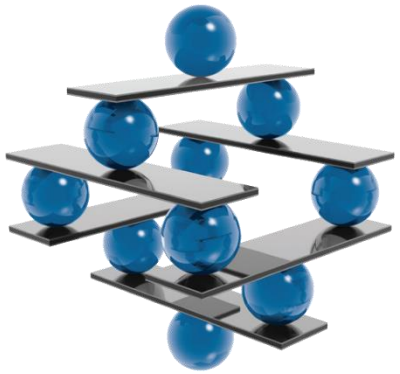
Energy Efficiency

- The EPA removed Energy Efficiency as a building block in determining the Best System of Emission Reduction (BSER).
- The EPA also envisions that energy efficiency will grow dramatically and be a very large part of a state's ability to comply with the CPP.

Source: EMG

RTO/ISO/State Coordination

- Many states have multiple ISOs within them and many RTOs traverse multiple states.
- This broadens the complexities as states develop their plans.
- The roles of planning agencies should be clearly defined and communication at the state level, regional level and across ISOs and RTOs is paramount as states work toward compliance.



Comparing and Contrasting

- Electric systems both domestically and internationally have seen significant shifts in resource portfolios in recent history.
- While states should consider some of the planning involved with these other transformations, these other systems are not necessarily proxies for what could actually happen in another system.

Reliability Safety Valve

- In the final rule, the RSV applies to individual sources when there is an unanticipated conflict between plan requirements for an EGU and maintaining electric reliability.
- In developing their plans, states should consider the scope of the RSV and other tools to help assure reliability.

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