



# **Integrating Probabilistic Forecasts into the Energy Management System (EMS) and Market Management System (MMS) Software**

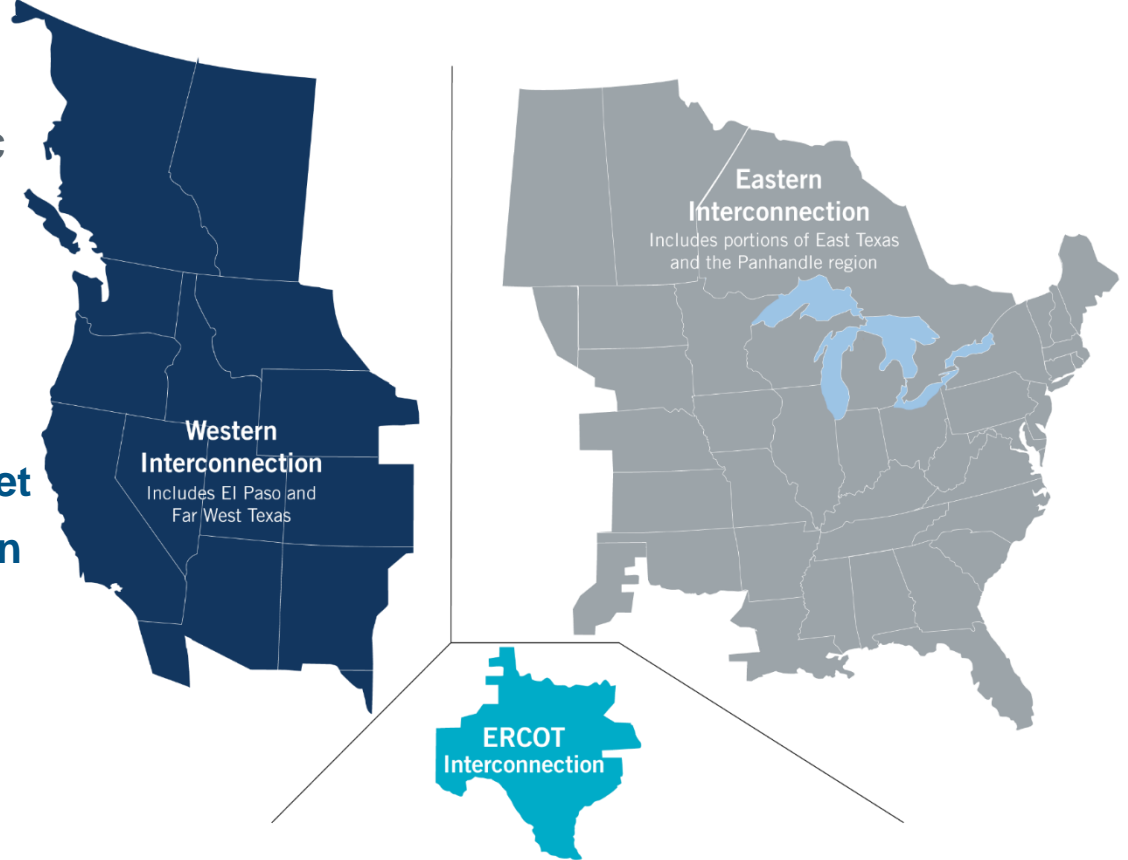
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ERCOT

# What is ERCOT?

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

- **System Reliability**
- **Competitive Wholesale Market**
- **Open Access to Transmission**
- **Competitive Retail Market**



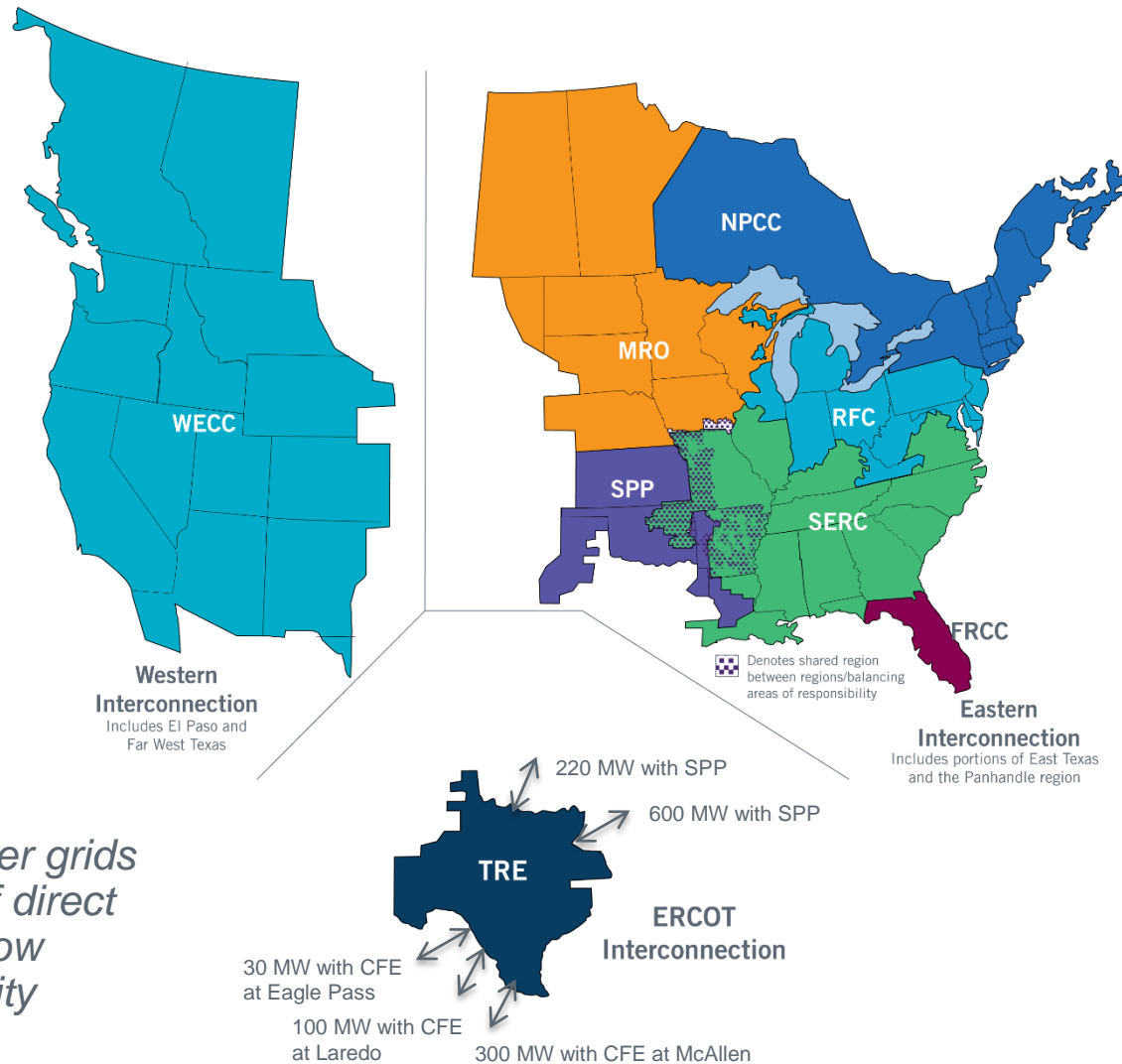
ERCOT is a nonprofit organization and regulated by the Public Utility Commission of Texas, with oversight by the Texas Legislature.

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

# The ERCOT Region

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

- 90% of Texas electric load; 75% of Texas land
- 71,110 MW peak, August 11, 2016
- More than 46,500 miles of transmission lines
- 570+ generation units



*ERCOT connections to other grids are limited to ~1250 MW of direct current (DC) ties, which allow control over flow of electricity*

# Current Records

## Peak Demand Record: 71,110 megawatts (MW)

- Aug. 11, 2016, 4-5 p.m.

## Weekend Record: 66,921 MW

- Sunday, Aug. 7, 2016, 5-6 p.m.

## Winter Peak Record: 59,650 MW

- Jan. 6, 2017, 6-7 p.m.

## Wind Generation Records (instantaneous)

- Output: 16,141 MW
  - March 31, 2017, 8:56 p.m.
- Penetration (load served): 50%
  - March 23, 2017, 3:50 a.m.
  - Total Load = 28,780 MW

## Recent Monthly Peak Demand Records

### 2017

- January: 59,650 MW (Jan. 6, 6-7 p.m.)

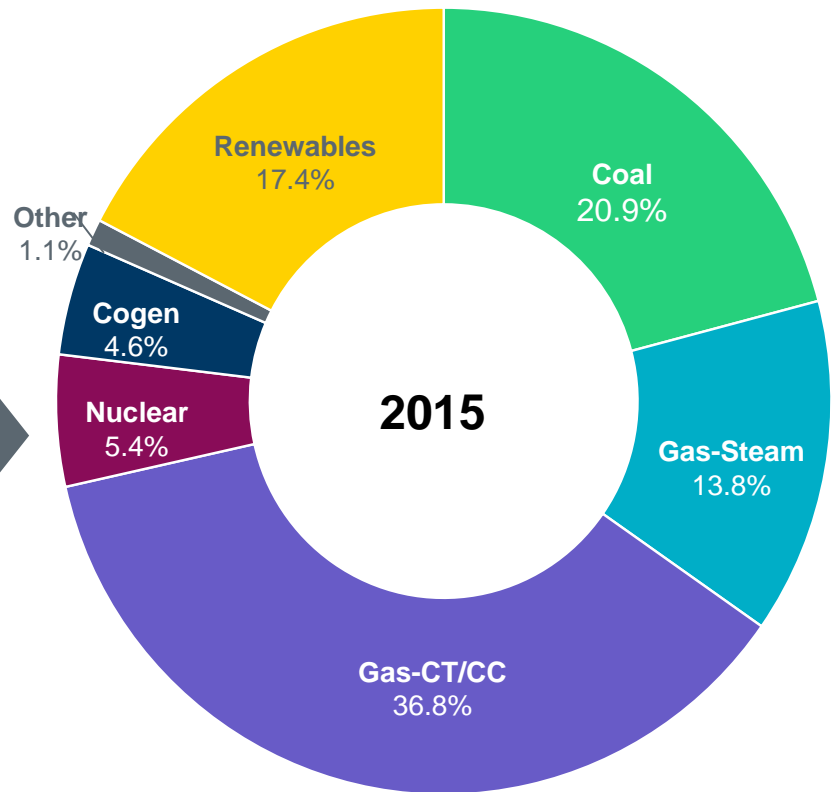
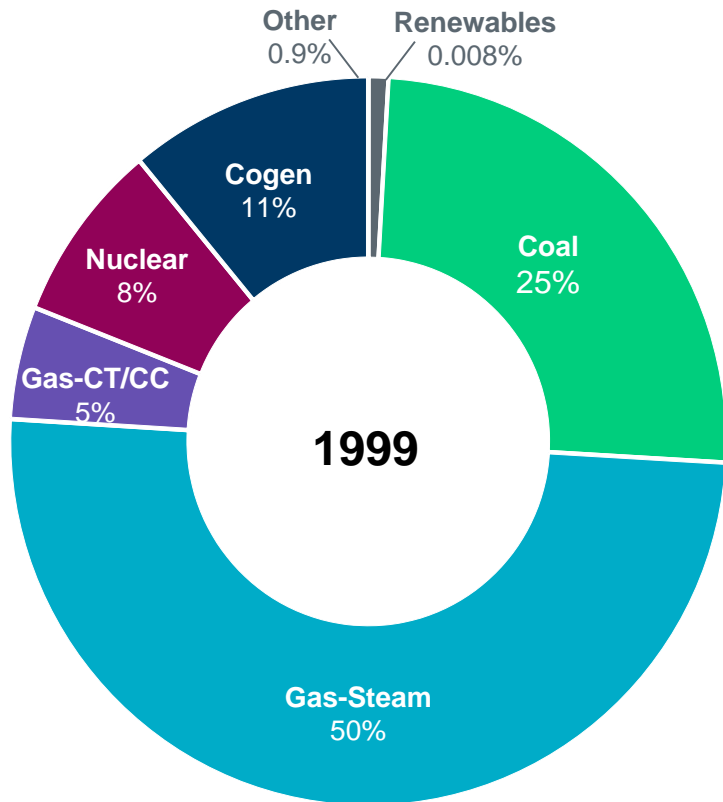
### 2016

- August: 71,110 MW  
(*All-time record*)
- September: 66,949 MW (Sept. 19, 4-5 p.m.)
- October: 59,864 MW (Oct. 5, 4-5 p.m.)
- December: 57,932 MW (Dec. 19, 7-8 a.m.)

### 2015

- July: 67,650 MW (July 30, 4-5 p.m.)

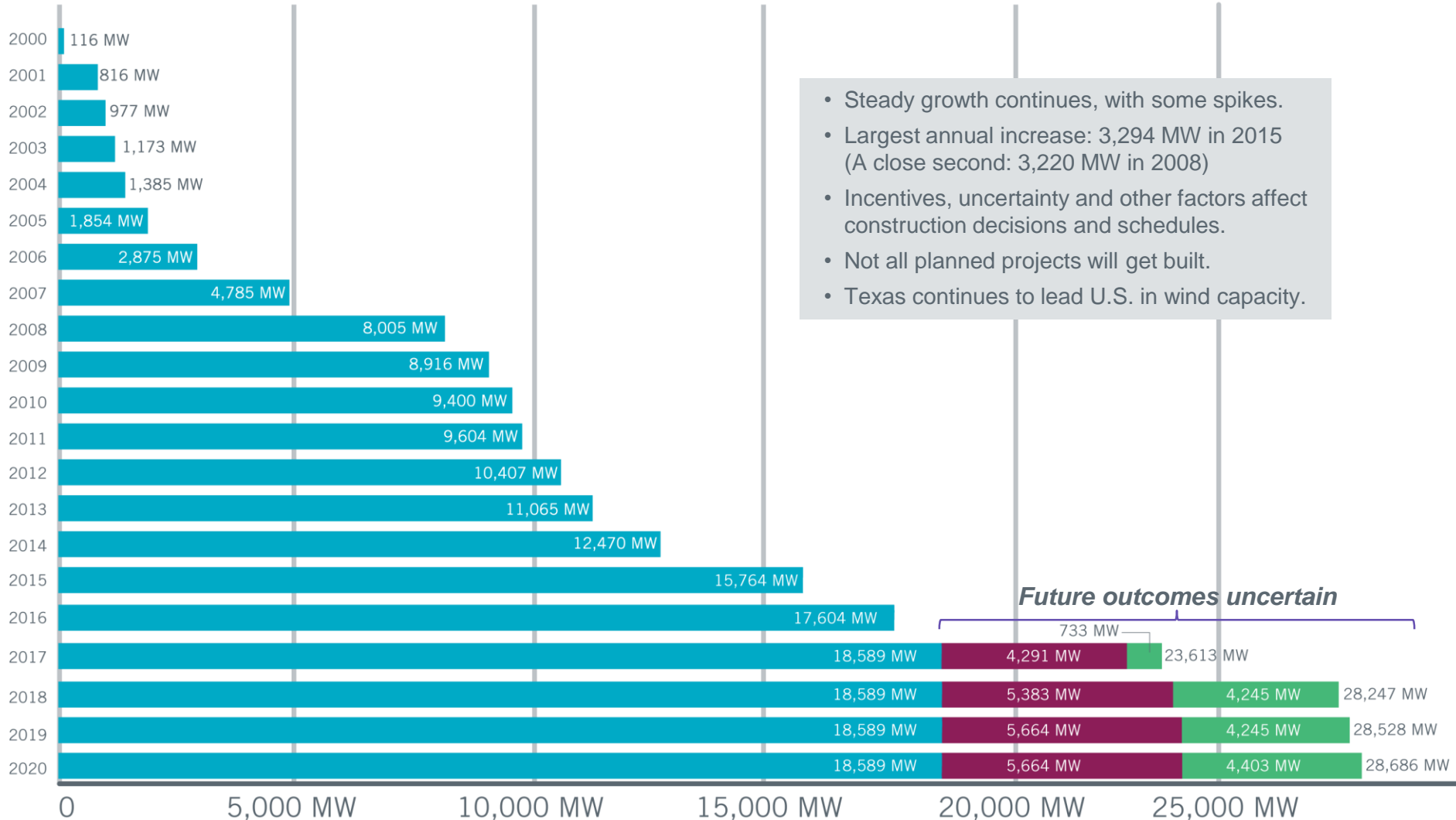
# Changing Resource Mix – Installed Capacity



# Wind Generation Capacity (March 2017)

ERCOT Wind Installations by Year  
(through April 1, 2017)

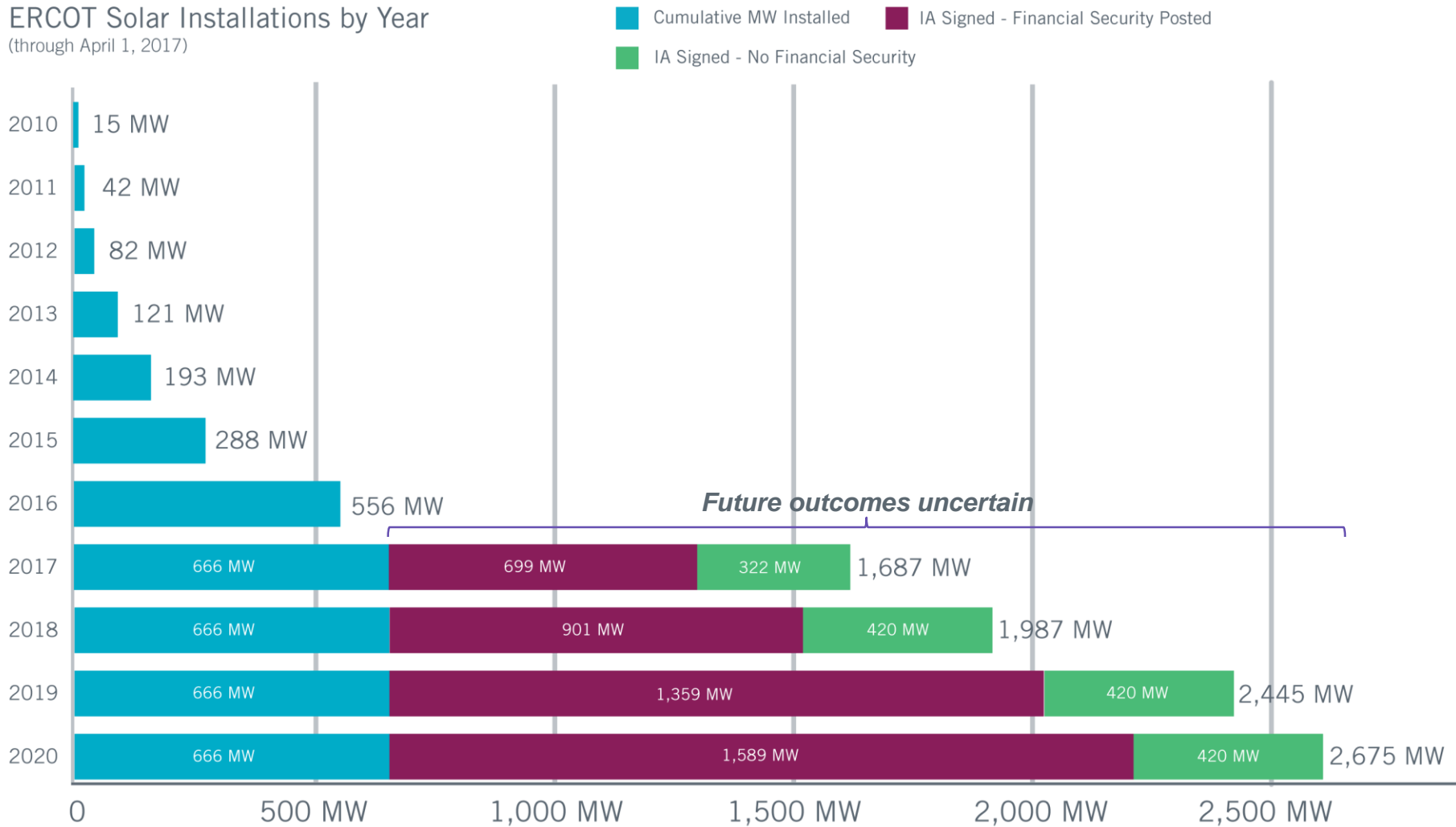
■ Cumulative MW Installed ■ Cumulative Planned (Signed Interconnection Agreement with Financial Security) ■ IA Signed - No Financial Security



- Steady growth continues, with some spikes.
- Largest annual increase: 3,294 MW in 2015 (A close second: 3,220 MW in 2008)
- Incentives, uncertainty and other factors affect construction decisions and schedules.
- Not all planned projects will get built.
- Texas continues to lead U.S. in wind capacity.

# Utility Scale Solar Generation Capacity (March 2017)

ERCOT Solar Installations by Year  
(through April 1, 2017)



The data presented here is based upon the latest registration data provided to ERCOT by the resource owners and can change without notice. Any capacity changes will be reflected in current and subsequent years' totals. Scheduling delays will also be reflected in the planned projects as that information is received. This chart reflects planned units in the calendar year of submission rather than installations by peak of year shown.

# Reliability Risk Desk

- To meet ERCOT's strategic goal of adapting to the changing resource mix, staffing for a new desk in Control Room was approved in 2016-17 budget
- Initial tools, procedures, staffing and training has been completed and new desk went live on 1/30/2017.

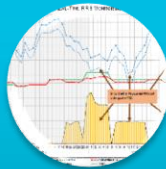


# Reliability Risk Desk Goals

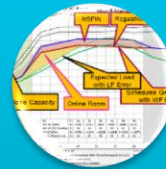
- Facilitate improved accuracy of renewable forecasts
  - Promote improved telemetry performance from wind/solar plants
  - Perform forecast adjustments during icing and other extreme weather events
- Maintain sufficient frequency responsive reserves
  - Confirm critical level of inertia is online
  - Ensure frequency responsive capacity is available to cover actual inertia conditions
- Maintain sufficient temporally available capacity to cover remaining forecast errors and net load ramps



1. Renewable Forecast  
and Extreme Weather  
Monitoring



2. Inertia Monitoring  
and RRS Sufficiency



3. Forecast Error Risk  
and NSRS Sufficiency



4. Intra-Hour Resource  
Monitoring

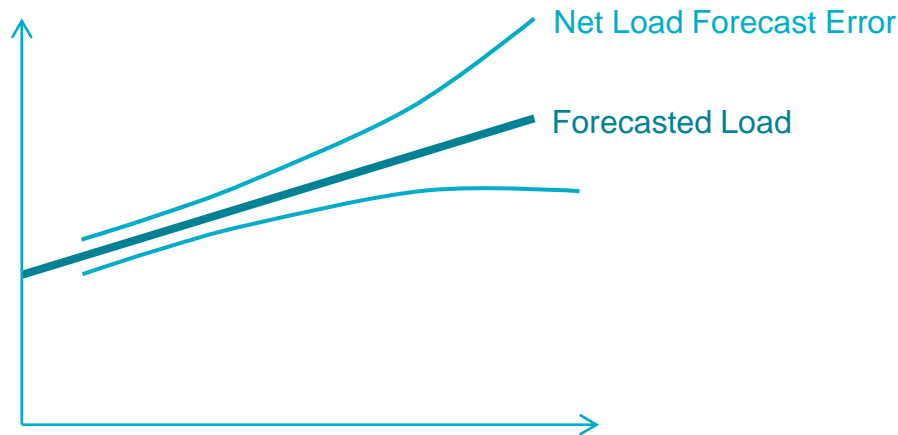
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# INTEGRATING PROBABILISTIC FORECASTS INTO THE ENERGY MANAGEMENT SYSTEM (EMS) AND MARKET MANAGEMENT SYSTEM (MMS) SOFTWARE

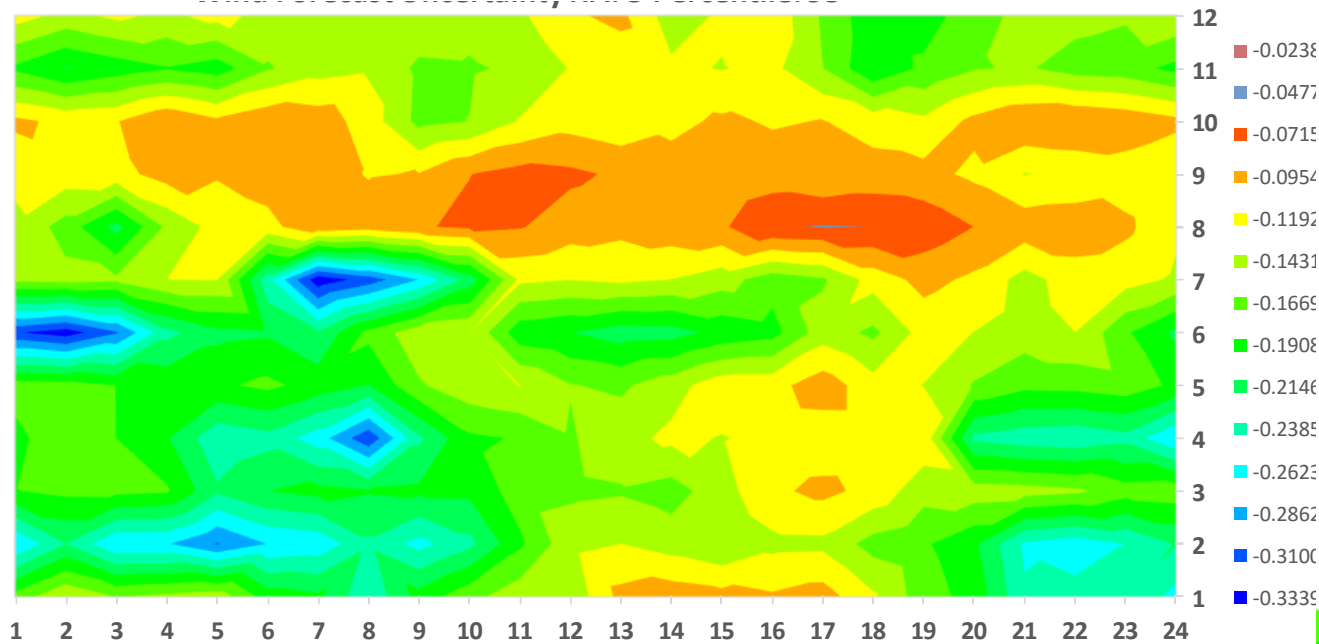
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# Forecast Risk & NSRS Sufficiency Monitoring

- Reliability Risk Desk will:
  - Monitor the adequacy of scheduled resources (COPs) to cover the forecasted Load, ramp, and the uncertainty around the Load and renewable forecasts for the next 6 hours and identify hours with insufficiency
  - Retain sufficient NSRS in every hour to cover the higher of:
    - the current level of net load ramp risk or
    - the amount that will be needed, based on currently expected operating conditions, to restore frequency and recover contingency reserves

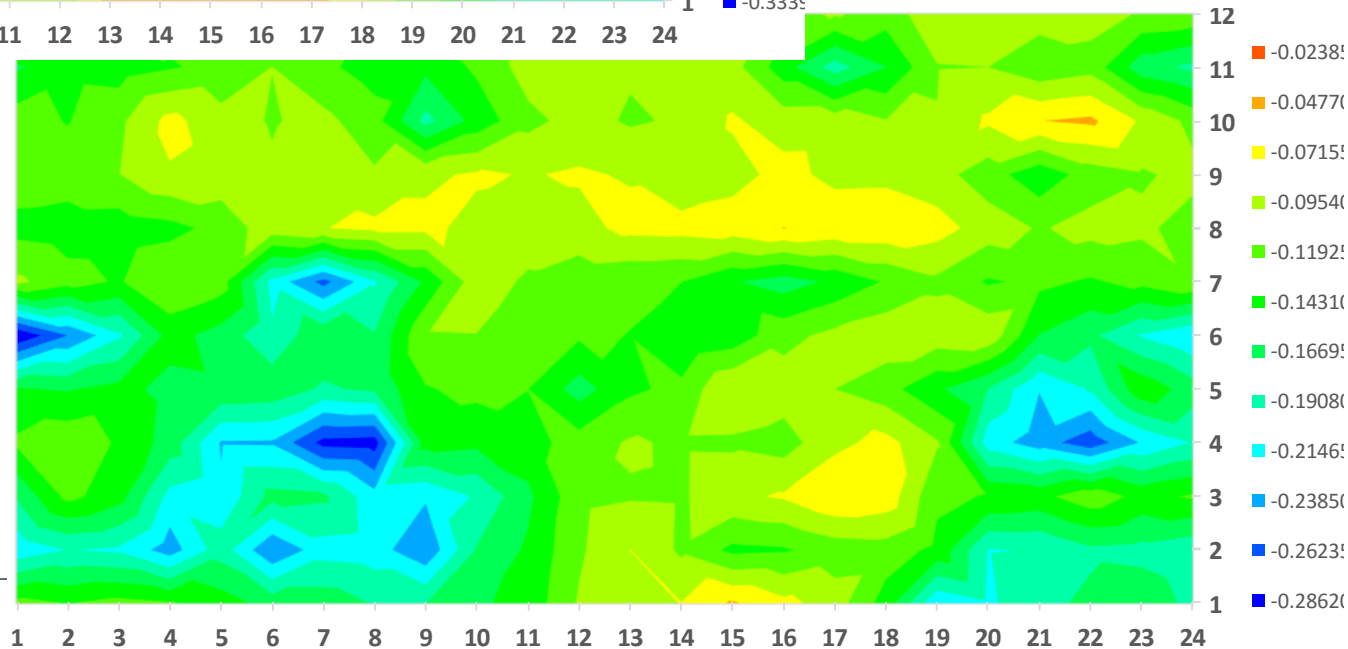


# Uncertainty/Error of Wind Forecast

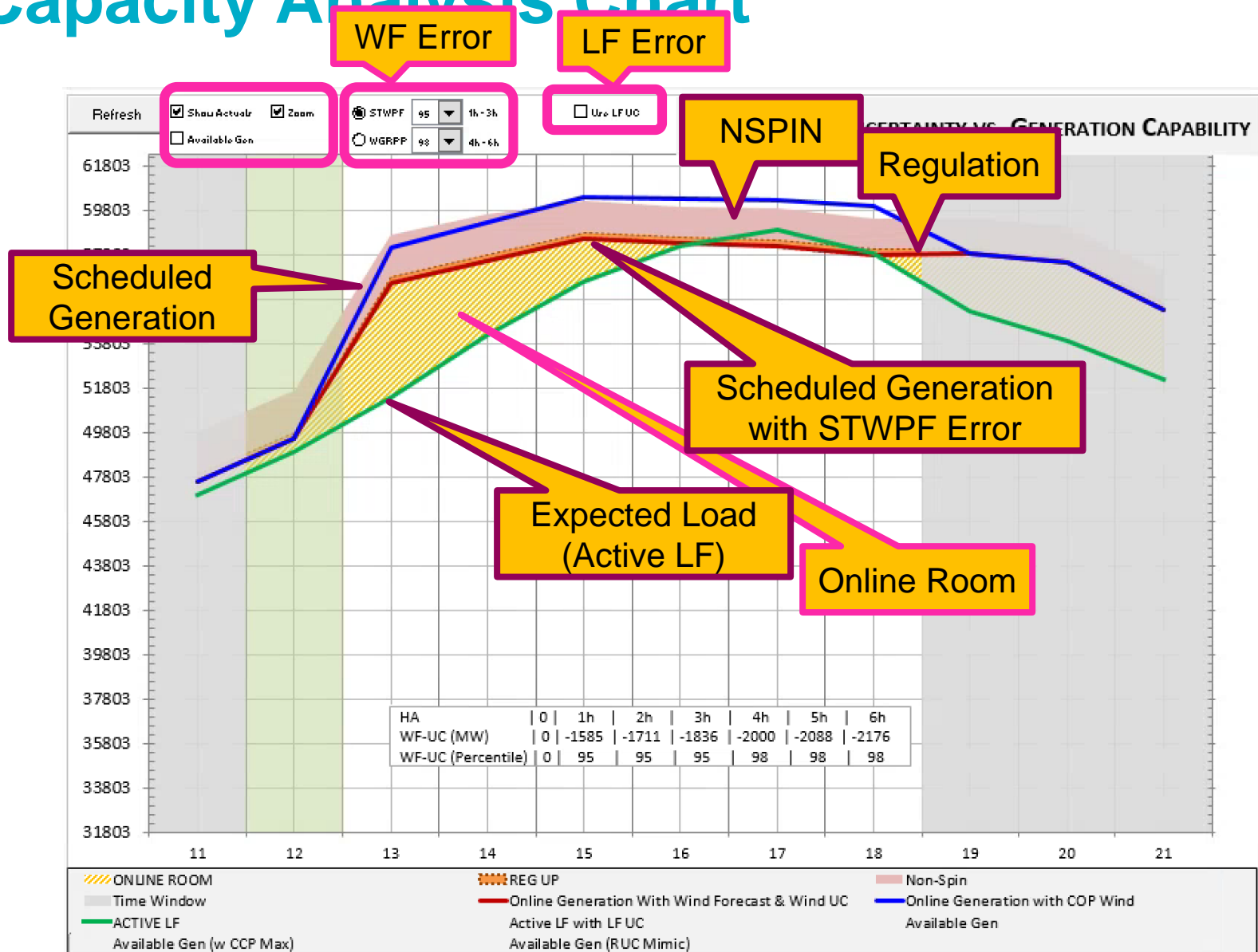


**5 Hour Ahead Wind  
Forecast uncertainty**

**1 Hour Ahead Wind  
Forecast uncertainty**

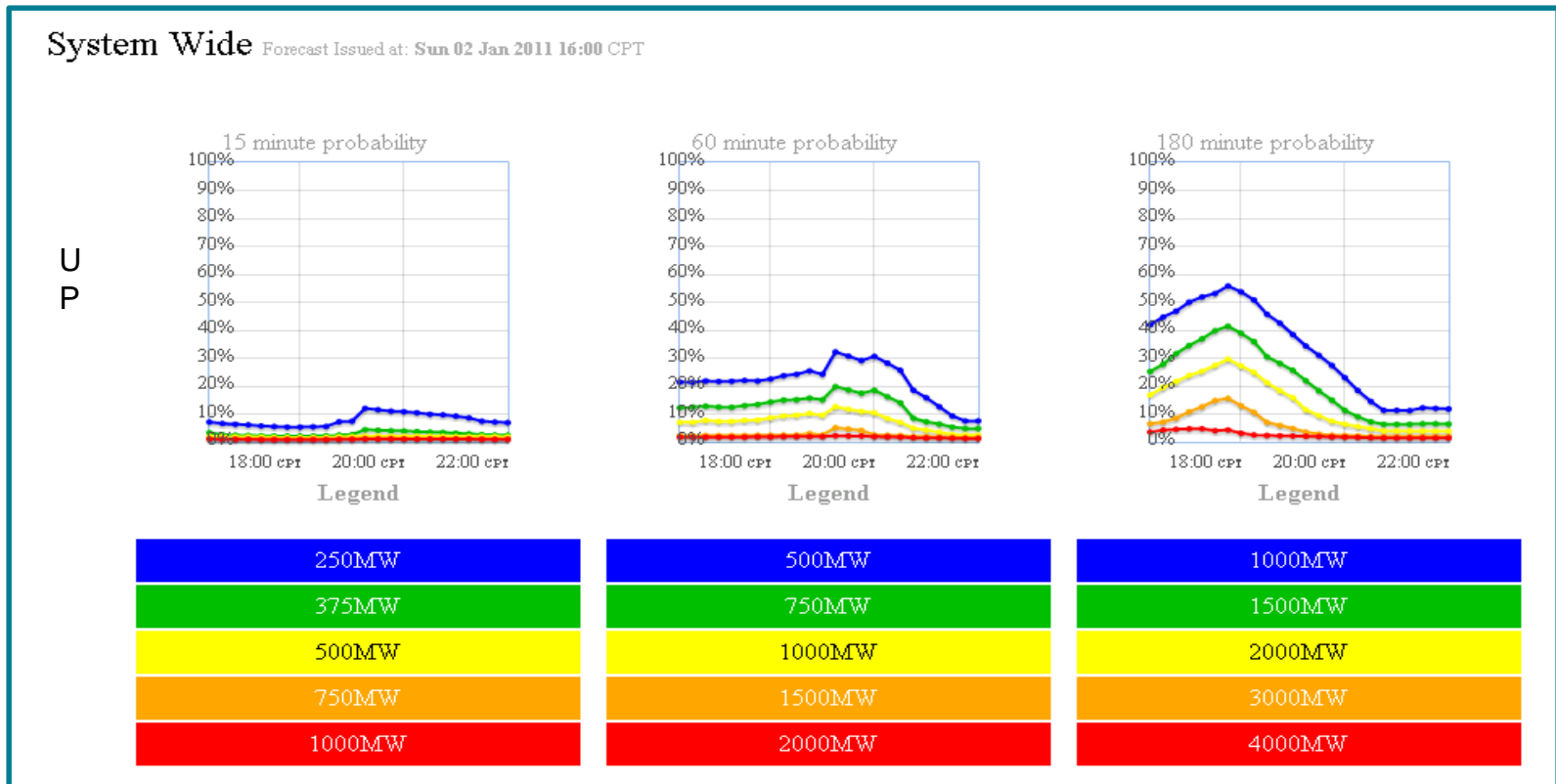


# Capacity Analysis Chart



# ERCOT Large Ramp Alert System (ELRAS)

- The main focus of ELRAS is to provide the probabilities of Wind Power ramp events of various MW changes over various time frames
  - The far right graph shows that there is a 30% chance of the wind output changing by 2000 MW or more between 18:00 and 21:00
  - Information is provided for both the system and region levels

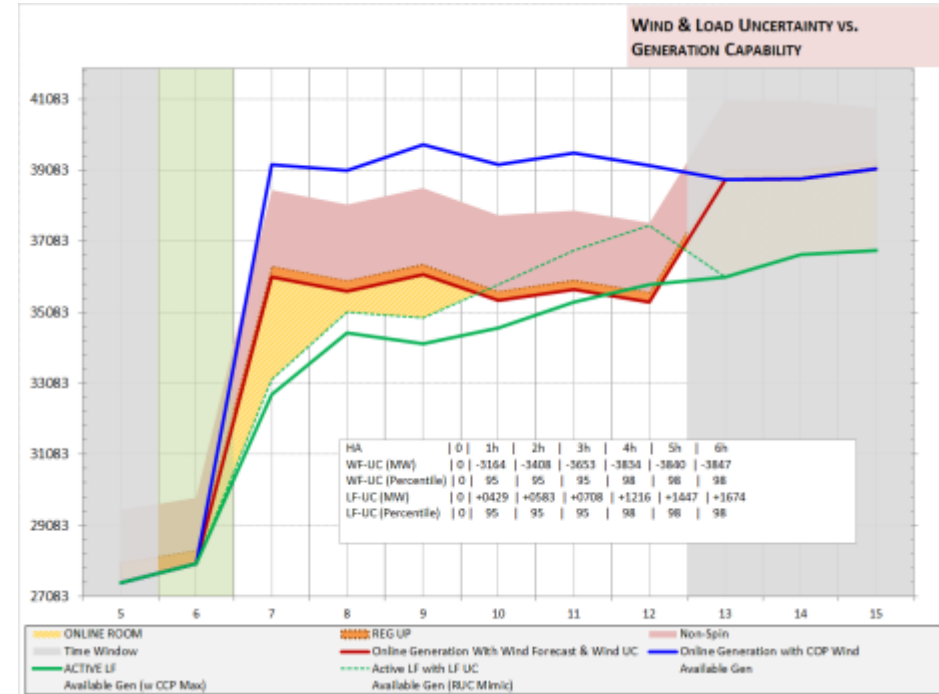
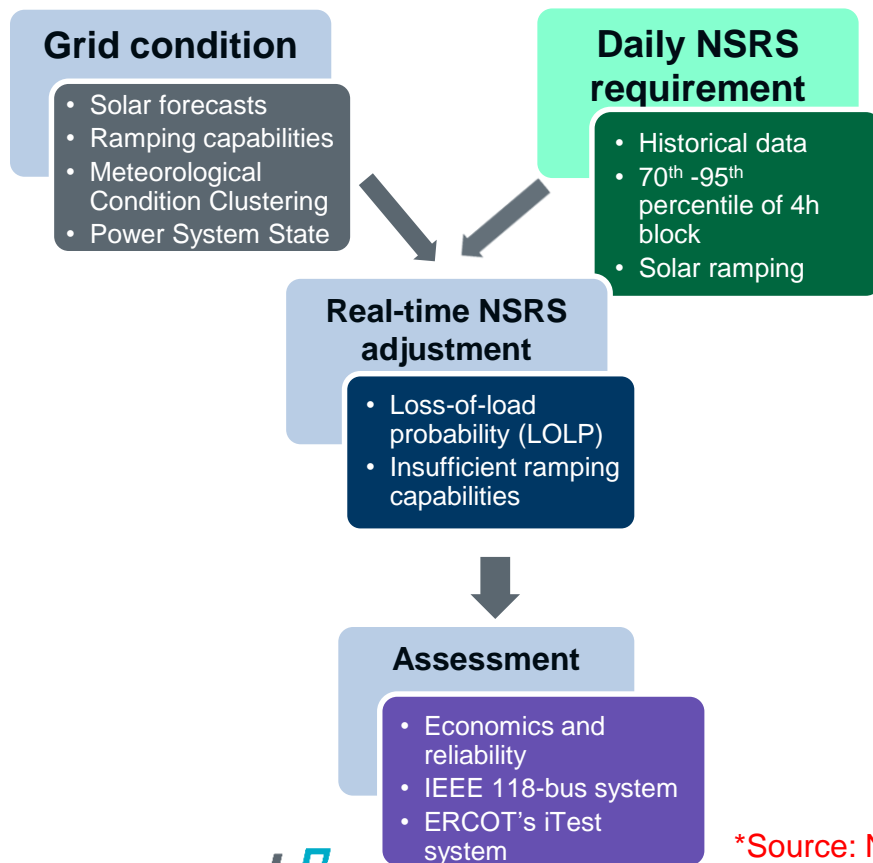


# Planned Forecasting Enhancements

- Integrating probabilistic wind forecasts into look ahead capacity availability assessments
  - ERCOT currently monitors the adequacy of scheduled resources (COPs) to cover the forecasted Load, ramp, and the uncertainty around the Load and renewable forecasts for the next 6 hours and identify hours with insufficiency.
  - This analyses utilizes historic forecast error as a metric of uncertainty.
  - ERCOT's Large Ramp Alert System (ELRAS) has the ability to track various probabilistic wind power forecasts and probabilistic 15m/60m/180min wind ramp forecasts.
  - In an effort to include a more realistic wind generation uncertainty (that is based on expected weather and not just history), ERCOT is looking to integrate the probabilistic forecasts from ELRAS into its capacity availability assessment tools.

# Adaptive Reserves (Under Consideration)

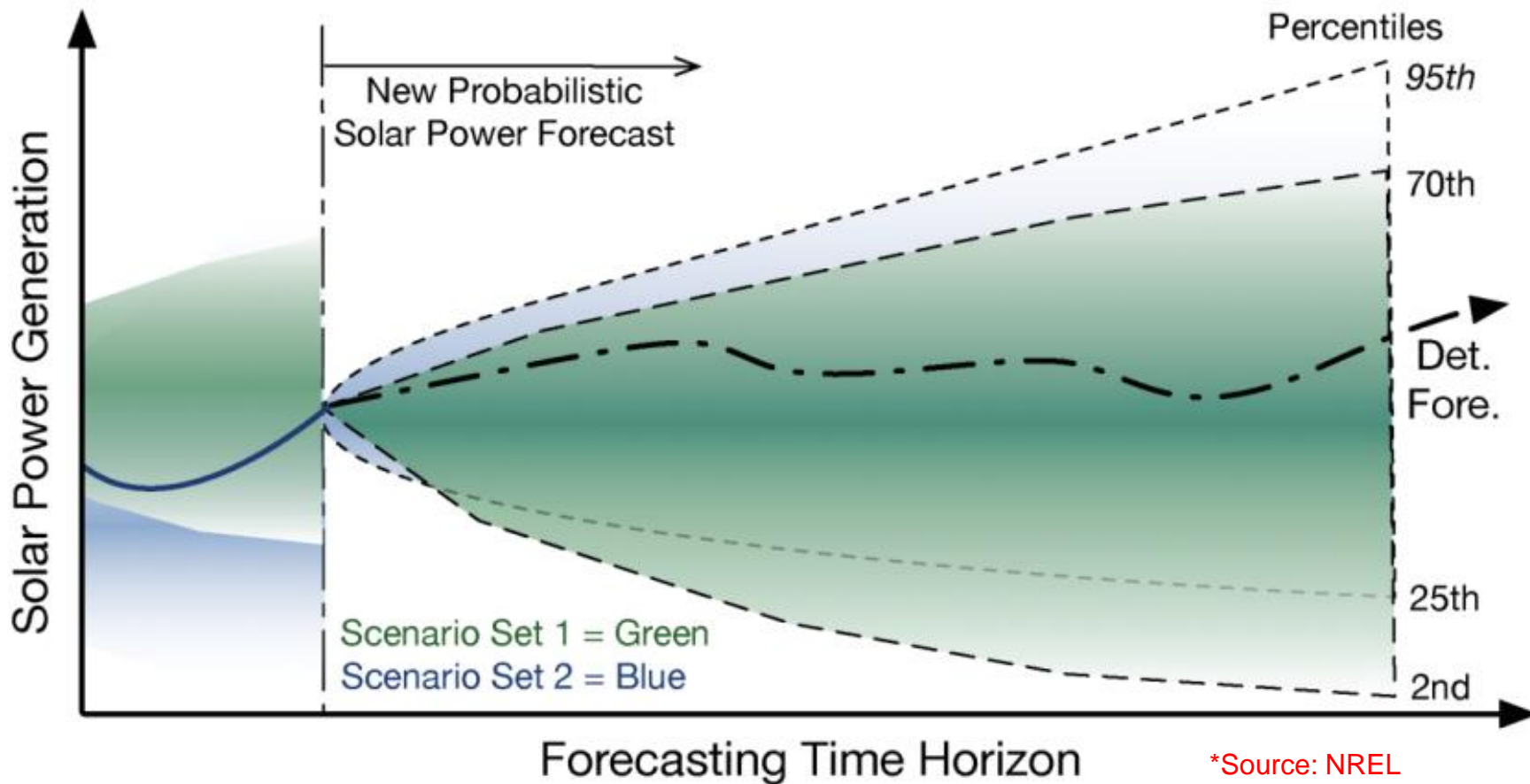
- Update Non-Spinning Reserve Service (NSRS) on a daily basis based on historical data, solar forecast, and power system state forecast.
- Values assessed using online tool for determining loss-of-load-probability (LOLP) and ramping capabilities.



\*Source: NREL



# Risk-Parity Dispatch (Under Consideration)



## Advantages:

- Explicitly incorporates probabilistic information into dispatch process.
- Reduced solve time compared to full stochastic dispatch.
- Takes into account both the meteorological and power system states.
- Does not produce overly conservative solutions such as robust dispatch.

# Planned Forecasting Enhancements

- Extreme Weather integrated Wind Forecast
  - In an effort to improve situational awareness, ERCOT is working to acquire new forecasting methods that will predict the potential for icing along with amount of wind generation capacity that will be impacted.

# Ongoing Questions

- As renewable penetration increases, do we have to change the way forecasts are measured?
  - Do we need to rethink what is a “**GOOD**” forecast?
  - Should our error metrics change? Is there a need for something entirely new?
- Do we alter the way we operate?
  - Do we manually override more in tight situations?
  - What probabilities create actions?

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# DISCUSSION & QUESTIONS

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