Frequency Response and Ancillary Services in ERCOT

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Outline

- ERCOT Background
- Primary Frequency Response in ERCOT
- Ancillary Service Products in ERCOT
- Need for Faster Frequency Response
- New AS Products in 2020 and 2022
- Frequency Response from Curtailed Resources

ERCOT Background

Peak Demand: 74,531 MW*

- August 12, 2019, 4-5 p.m

Solar Generation

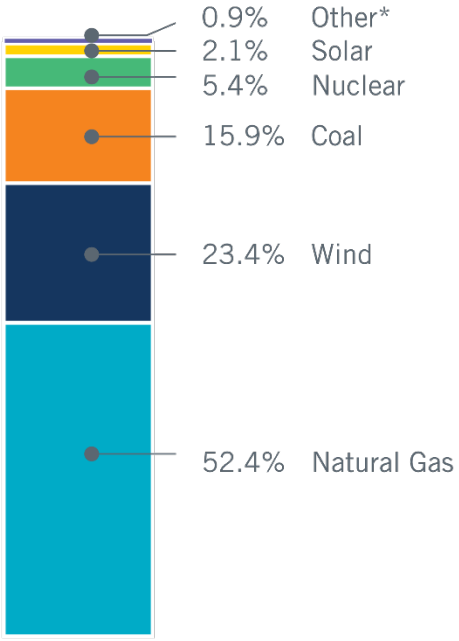
- Installed Capacity >1.8 GW

Wind Generation

- Installed Capacity >22 GW
- Output Record: 19,672 MW
  - Jan. 21, 2019, 7:19 p.m.
- Penetration Record (load served): 56.16%
  - January 19, 2019, 3:10 a.m.
  - Total MW Served by Wind = 17,406 MW

2019 Generation Capacity

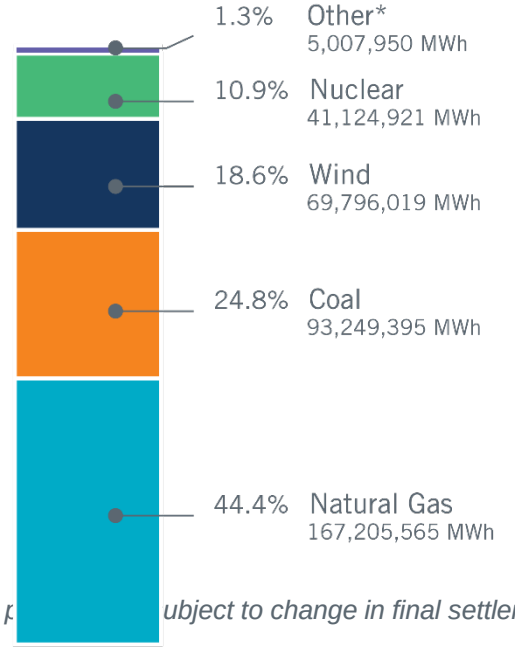
*Includes hydro, storage and biomass



2018 Energy Use

376 billion kilowatt-hours of energy used in 2018, a 5 percent increase compared to 2017.

*Includes solar, hydro, petroleum coke, biomass, landfill gas, distillate fuel oil, net DC-tie and Block Load Transfer imports/exports and an adjustment for wholesale storage load.

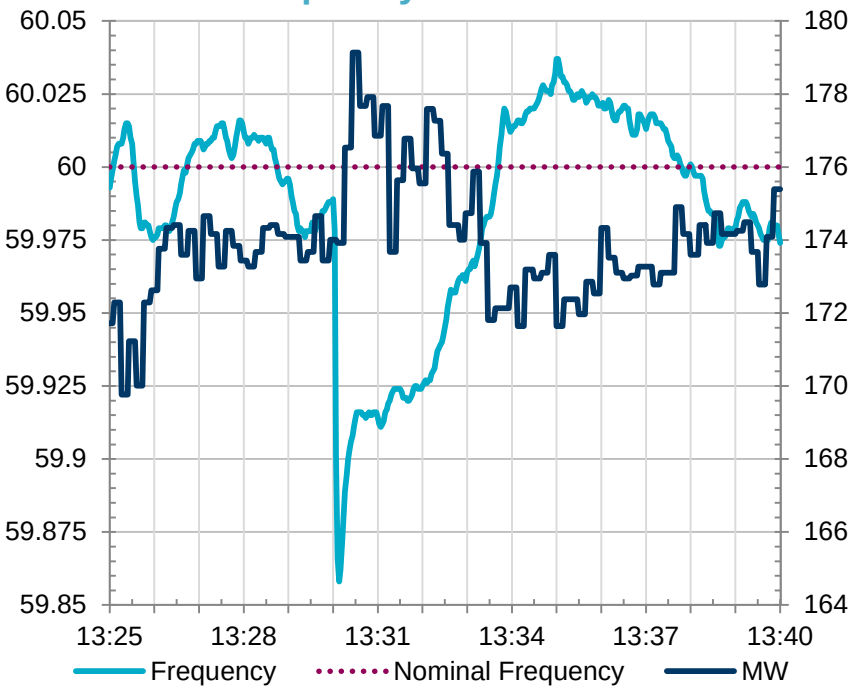


*New records are subject to change in final settlement

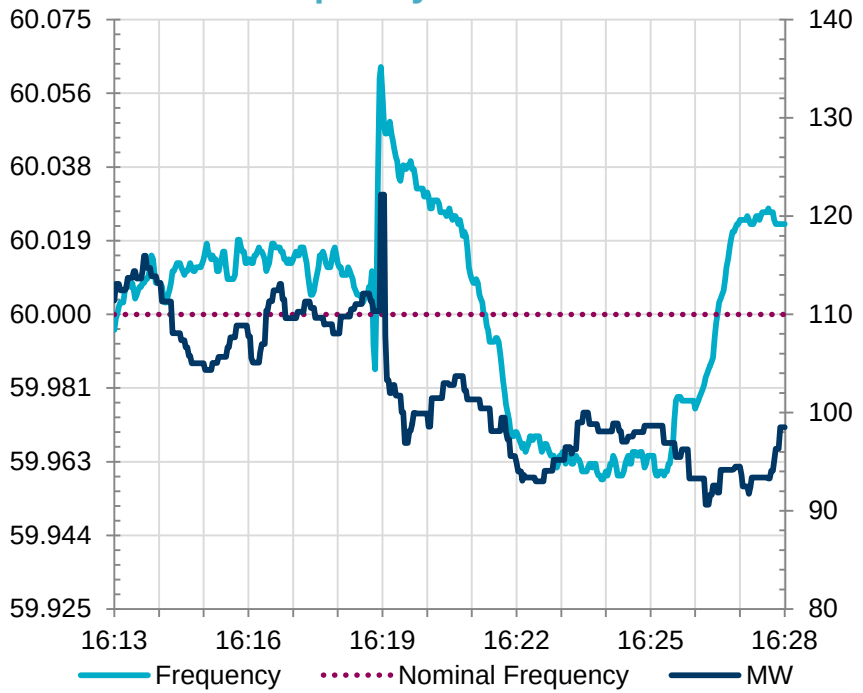
“Governor-like” response from Wind and Solar, 2012

- Requirement for all wind and solar resources with interconnection agreements after 2008 to provide a “governor-like” response;
- To date, about 2000 MW of older plants are exempt;
- In 2016 the deadband for **all** generation changed to from 36 to 17 mHz

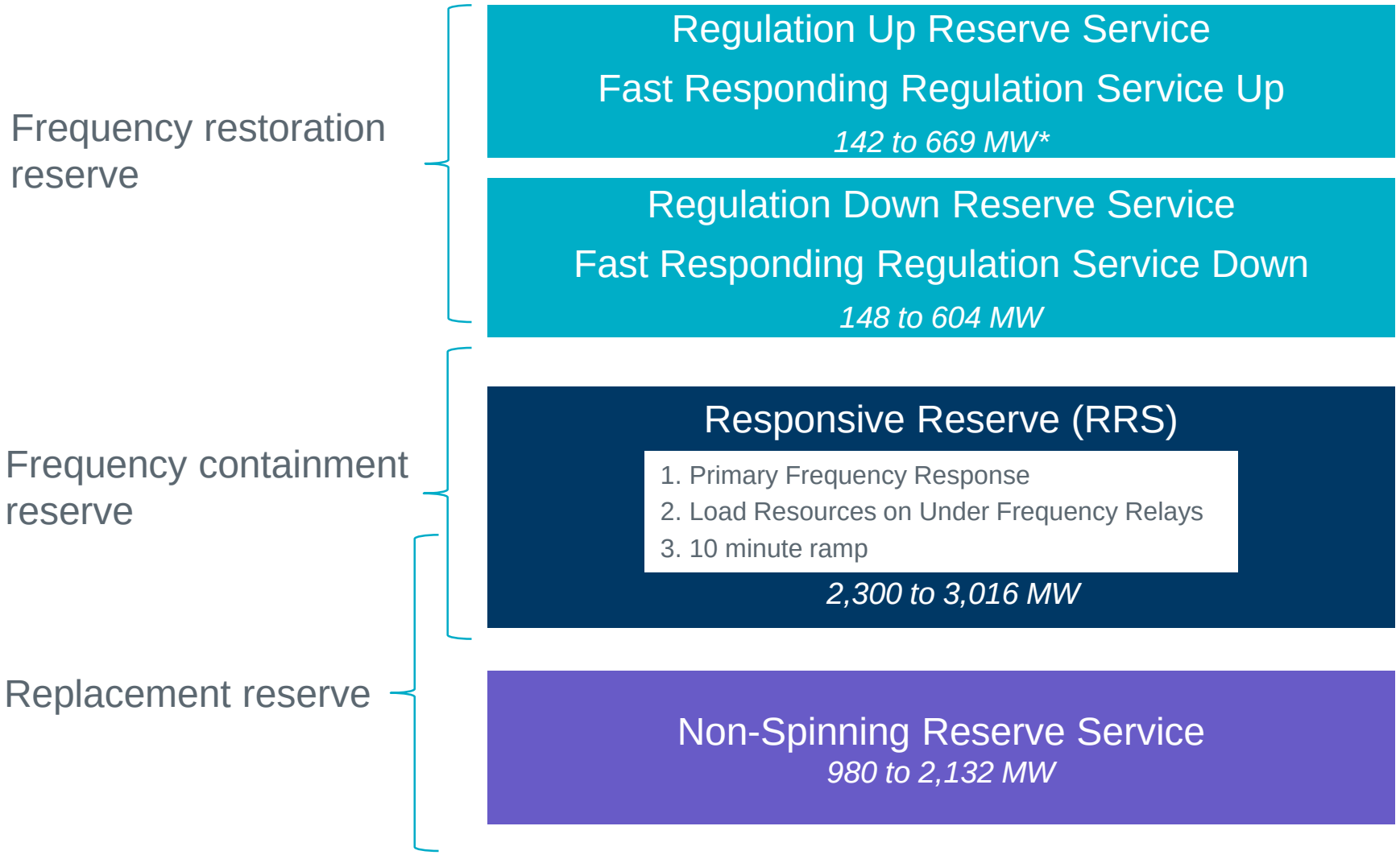
Wind Resource Response to Low Frequency 07/13/2016



Wind Resource Response to High Frequency 08/25/2015



Existing Ancillary Services



*The numbers are showing 2019 AS amounts

Need for Faster Response

- Declining inertia calls for faster frequency response, to arrest frequency after generation trip events fast enough, before it reaches UFLS
- Faster response also allows to decrease critical inertia
- Too much of fast response may cause frequency overshoot and delay primary frequency response
- Load Resources very effective but unwilling to deploy too often and once deployed are unavailable for 3 hours
- New technologies are capable of faster response <0.5s, indifferent to the frequency of deployments, can be restored sooner

Revision to the AS Product Set: NPRR 863 approved

Current target for FFR implementation is March 1, 2020

ECRS will be implemented no earlier than January 2022

Current Framework

Regulation

*157 to 687 MW**

Responsive Reserve Service

1. PFR
2. Load Resources on Under Frequency Relay (UFR)
3. 10 minute ramp

*2,300 to 3,200 MW**

Non-Spin

*967 to 2,361 MW**

Overall A/S: 3,807 to 5,958 MW*

NPRR 863

Regulation

*157 to 687 MW**

→ **No Change**

Responsive Reserve Service (RRS)

- Fast Frequency Response (FFR)
- Load Resources on UFR
- Primary Frequency Response (PFR)

*2,300 to 3,200 MW**

→

FFR
- Triggered at 59.85 Hz and full response in 15 cycles
- Once deployed, sustain for up to 15 mins. Once recalled, restore within 15 mins

PFR
- PFR capable capacity reserved on generators or Controllable Load Resources (CLR)
- Minimum 1,150 MW must be provided by resources capable of PFR

Load Resources on UFR
- Triggered at 59.70 Hz and full response in 30 cycles
- Sustain until recalled. Once recalled, restore within 3 hours
- Beyond the minimum PFR, up to 60% of total RRS can come from Load Resources on UFR or FFR.

ERCOT Contingency Reserve Service (ECRS)

- 10 minute ramp
- Load Resources may or may not be on UFR

*508 to 1,644 MW***

→

Generation
- Online or offline capacity that can be converted to energy within 10 minutes
- Dispatched by SCED

Load Resources (UFR not required)
- Up to 50% of ECRS capacity can come from Load Resources with or without UFR
- Once deployed, must respond within 10 minutes. Restoration within 3 hours

Non-Spin

*0 to 1,180 MW****

→

No protocol changes.
- Proposed methodology for Non-Spin Reserve Service quantities in this framework - quantities computed using 2018 A/S Methodology are reduced by ECRS quantities.

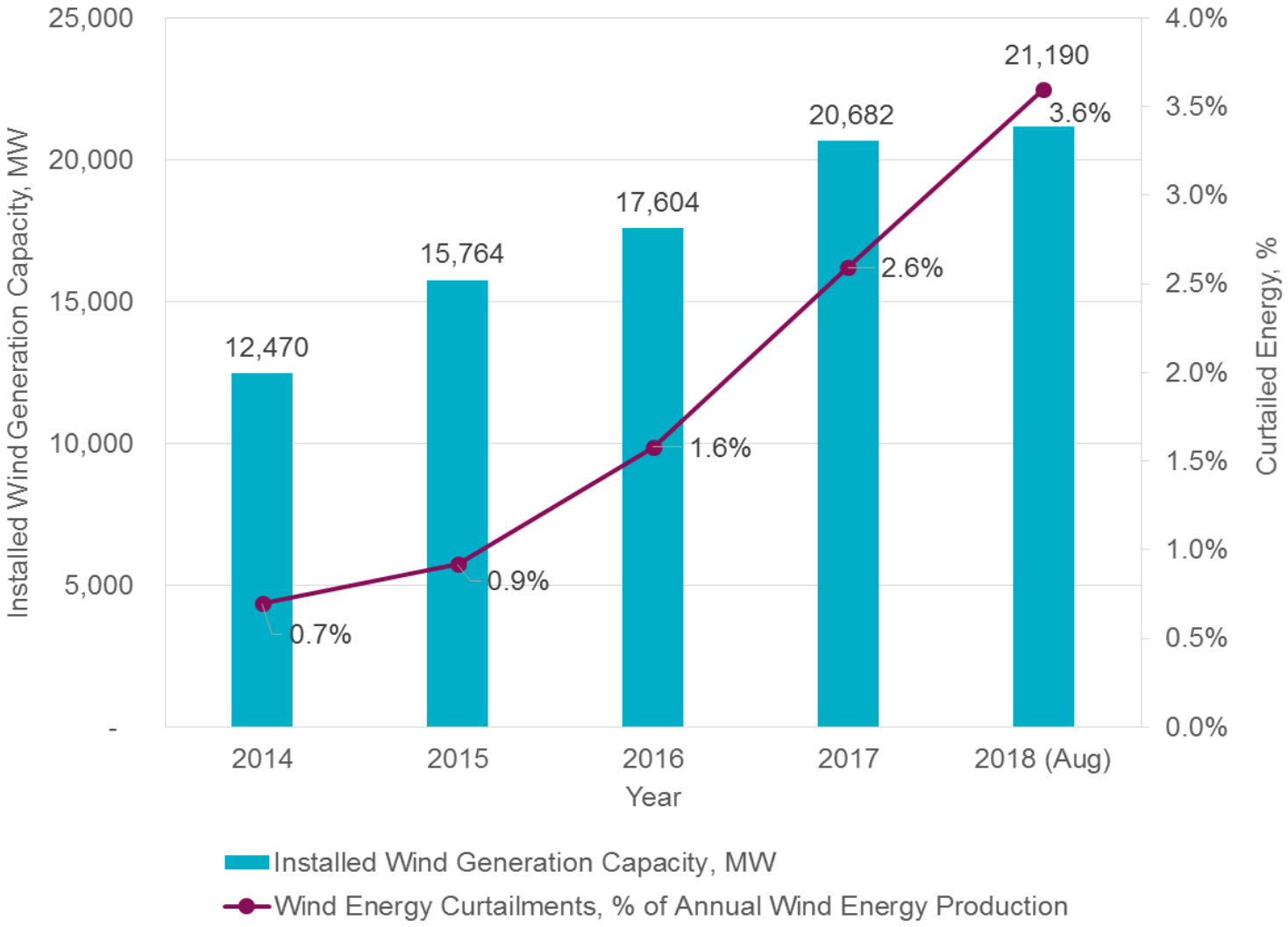
Overall A/S: 3,807 to 5,958 MW*

*Quantities computed/estimated using 2018 Ancillary Service Methodology. **Quantities estimated using this reference. ***Quantities estimated using this reference and method in box on far left.
For Discussion Purposes Only. The intent of this slide is to represent NPRR 863 (with STEC comments from 10/1/2018). Protocol language prevails to the extent of any inconsistency with this one page summary.

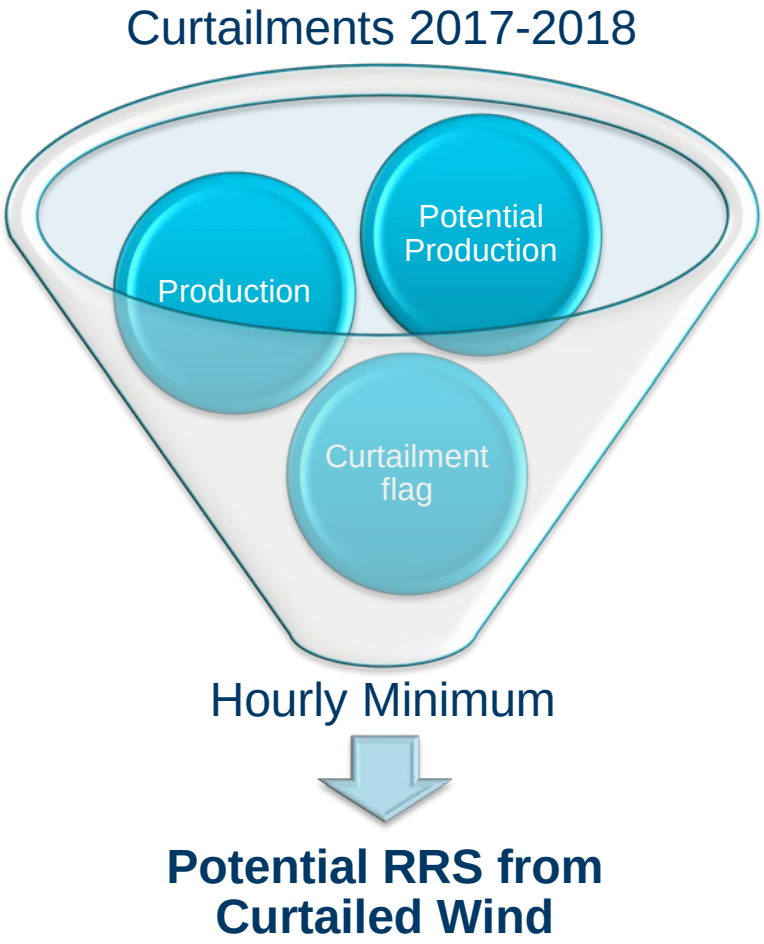
Provision of RRS from Curtailed Wind Generation

- No barriers for wind and solar resources to qualify and provide any of the aforementioned AS
- However, currently these resources are incentivized to produce as much energy as is available and not keep “headroom” for reserve provision;
- Provision of AS from curtailed capacity may be of interest;
- Wind and solar resources are already providing PFR from curtailed capacity with great performance;
- There seems to be no issues with short term exceedance of transmission limits during such events ;
- With 10-min energy component ramp component no longer being a part of RRS there is less potential for long RRS deployment.

Wind Energy Curtailments 2014 – 2018 (through Aug.)



Historic Curtailment Analysis

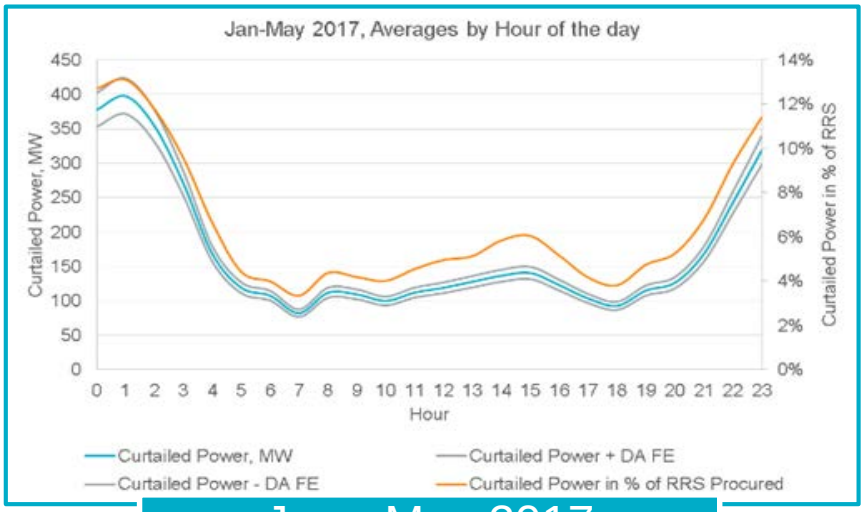


- 4-second historic system-wide curtailment data are available;
- Minimum curtailment in an hour is used to determine potential RRS amount;

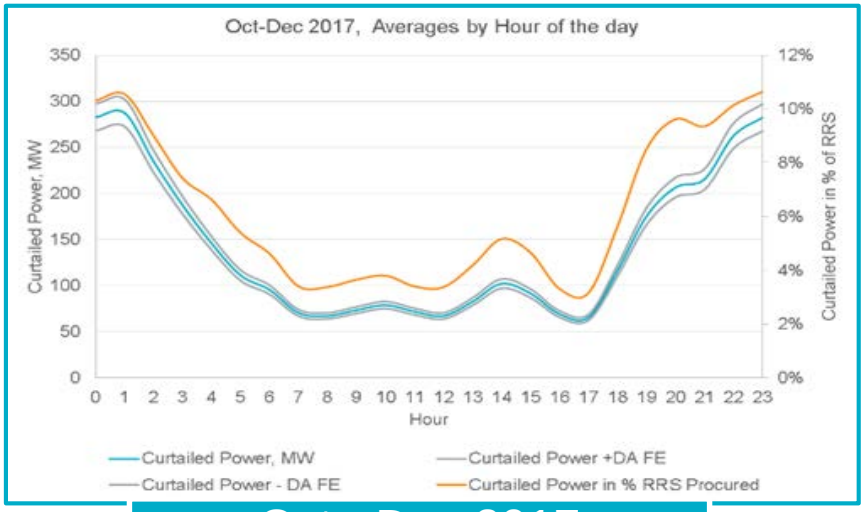
Based on this analysis there are:

- 40 hours in 2017 and
- 107 hours in 2018 when **entire** RRS requirement could have been provided from curtailed wind generation

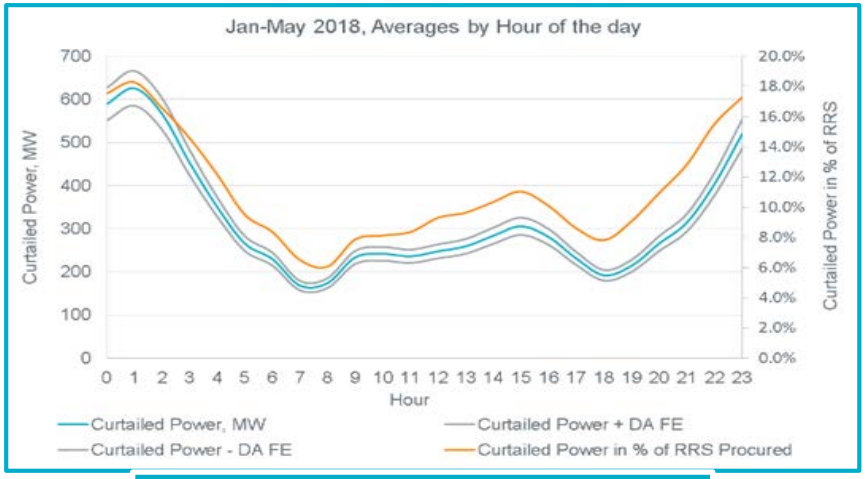
Average Wind Power Curtailments in 2017-2018



Jan - May 2017



Oct - Dec 2017



Jan - May 2018

Can WGRs Fulfill RRS Qualification Requirements?

- Online and capable of ramping to their responsibility within 10 minutes.
- Communications equipment to receive deployment signals for RRS.
- Governors in service with ±17 mHz deadband and 5% droop.
- The test lasts 8 hours; the generator is requested to provide an amount of RRS that qualification is being requested for.
- After each large event the primary frequency response performance of all generators is evaluated.
- The full amount of RRS provided from a generator must be ≤ 20% of unit's high sustainable limit.

Conclusions

- All generators in ERCOT including wind, solar and storage are required to have PFR in service. This provides an important “safety net” during frequency events.
- ERCOT introduced two new AS products: FFR and ECRS to serve its needs for faster response and flexibility;
- No barriers in ERCOT for wind and solar resources to provide any AS;
- Provision of RRS from curtailed generation capacity may be of interest;
- Historic data analysis indicates good potential for provision of RRS from curtailed wind, especially, during night hours in shoulder seasons.
- 100% of total RRS requirement could be provided from curtailed wind during some hours in a year.

Thank you! Questions?

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