ERCOT Contingency Reserve Service (ECRS)

Pengwei Du, Fellow of IET
Supervisor – Resource Forecasting and Analysis

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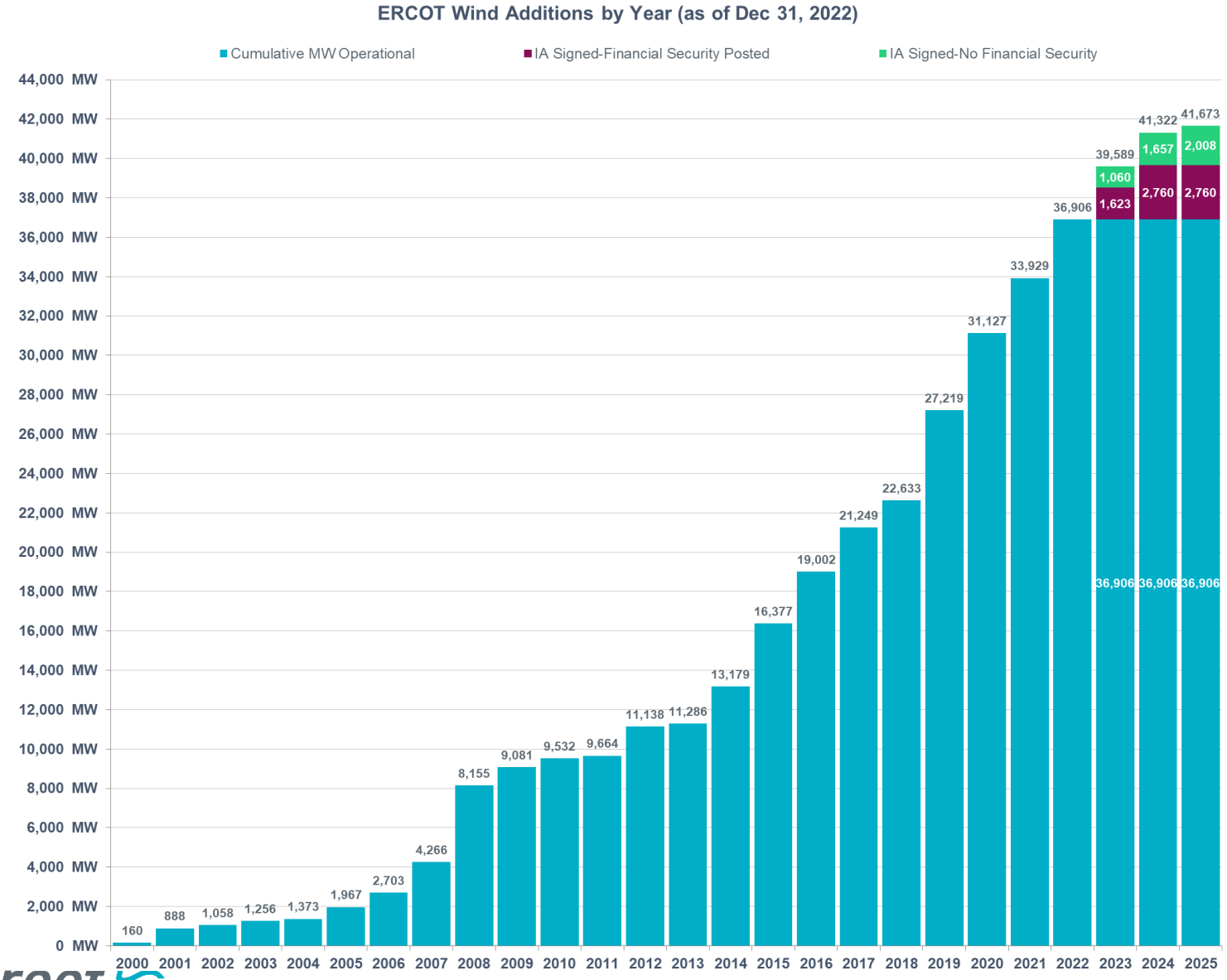
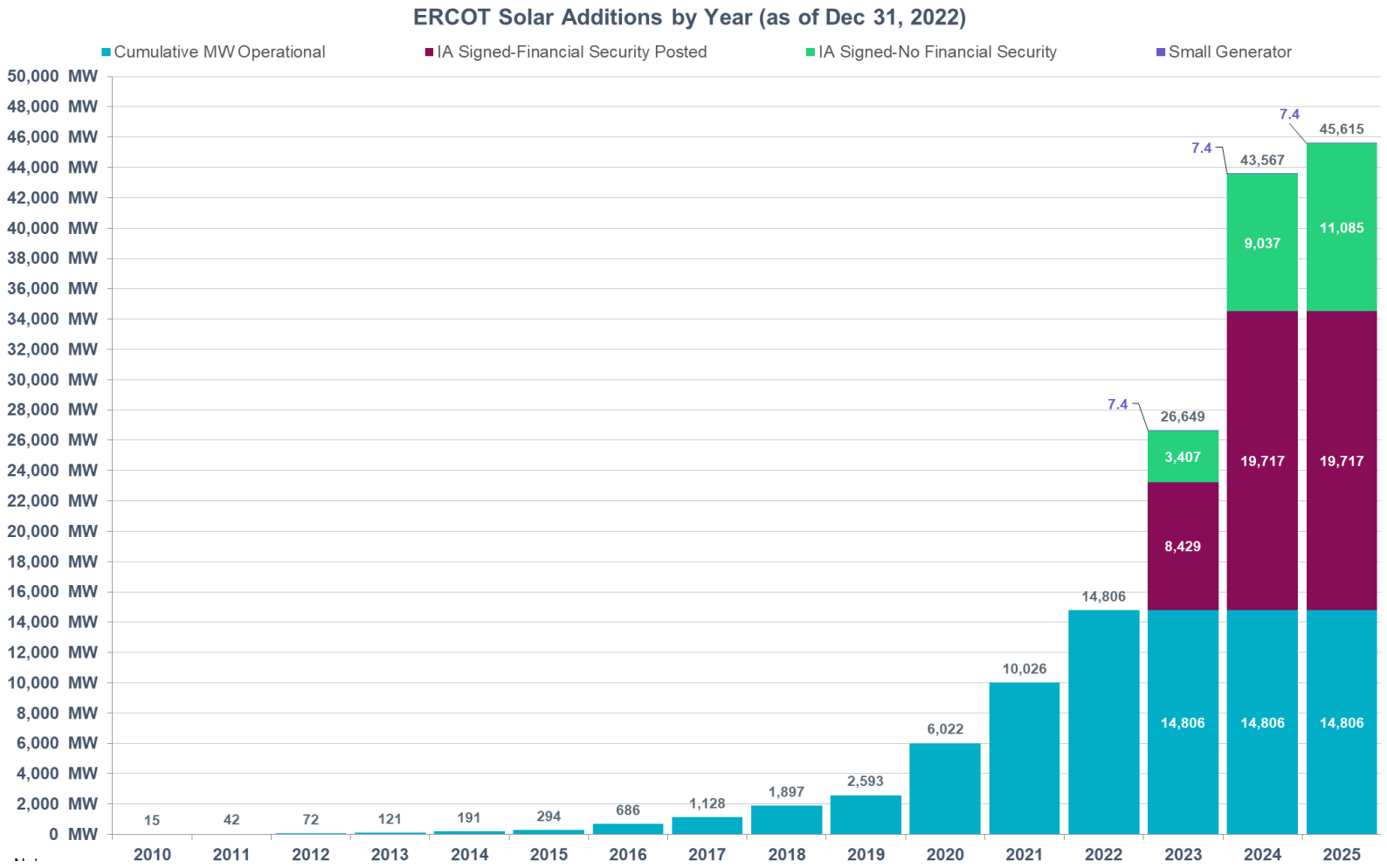
Overview

- Operational challenges associated with increasing amount of wind/solar generation resources at ERCOT
- Methodology to determine ECRS requirements
- ECRS deployment mechanism

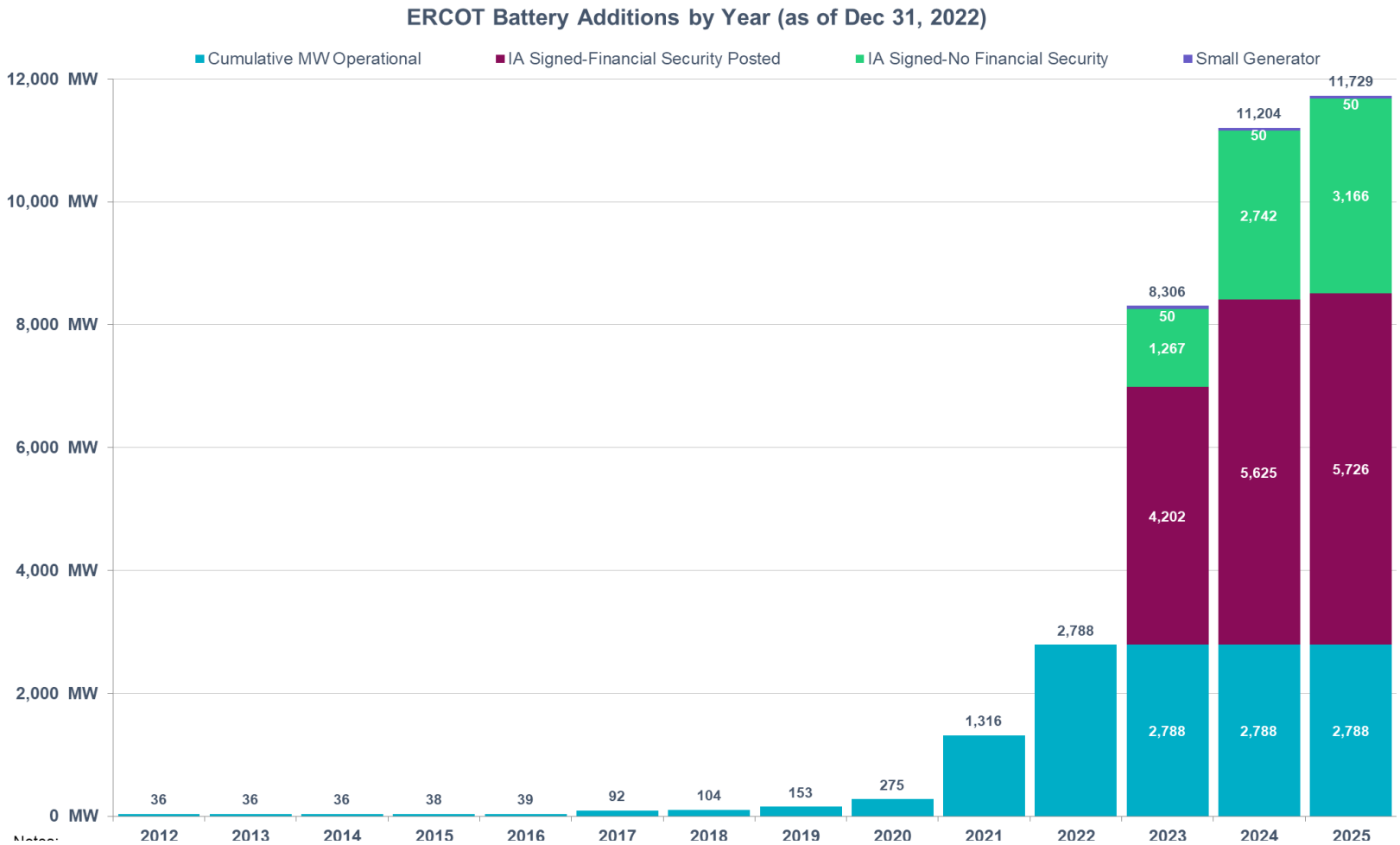
Growth in Wind Installed Capacity



Growth in Solar Installed Capacity



Growth in Battery Installed Capacity



Background on ECRS

- ERCOT Contingency Reserve Service (ECRS) is a service that is provided using capacity that can be sustained at a specified level for ***two*** consecutive hours and is used to restore or maintain the frequency of the ERCOT System:

  a) In response to significant depletion of Responsive Reserve (RRS);
  b) As backup Regulation Service;
  c) By providing energy to avoid getting into or during an Energy Emergency Alert (EEA); and
  d) Upon detection of insufficient capacity for net load ramps during periodic checking of available capacity.

- ECRS can be deployed within 10-min upon the receipt of the deployment instructions.

Ancillary Service Framework at ERCOT

CURRENT FRAMEWORK

REGULATION

*67 to 921 MW**

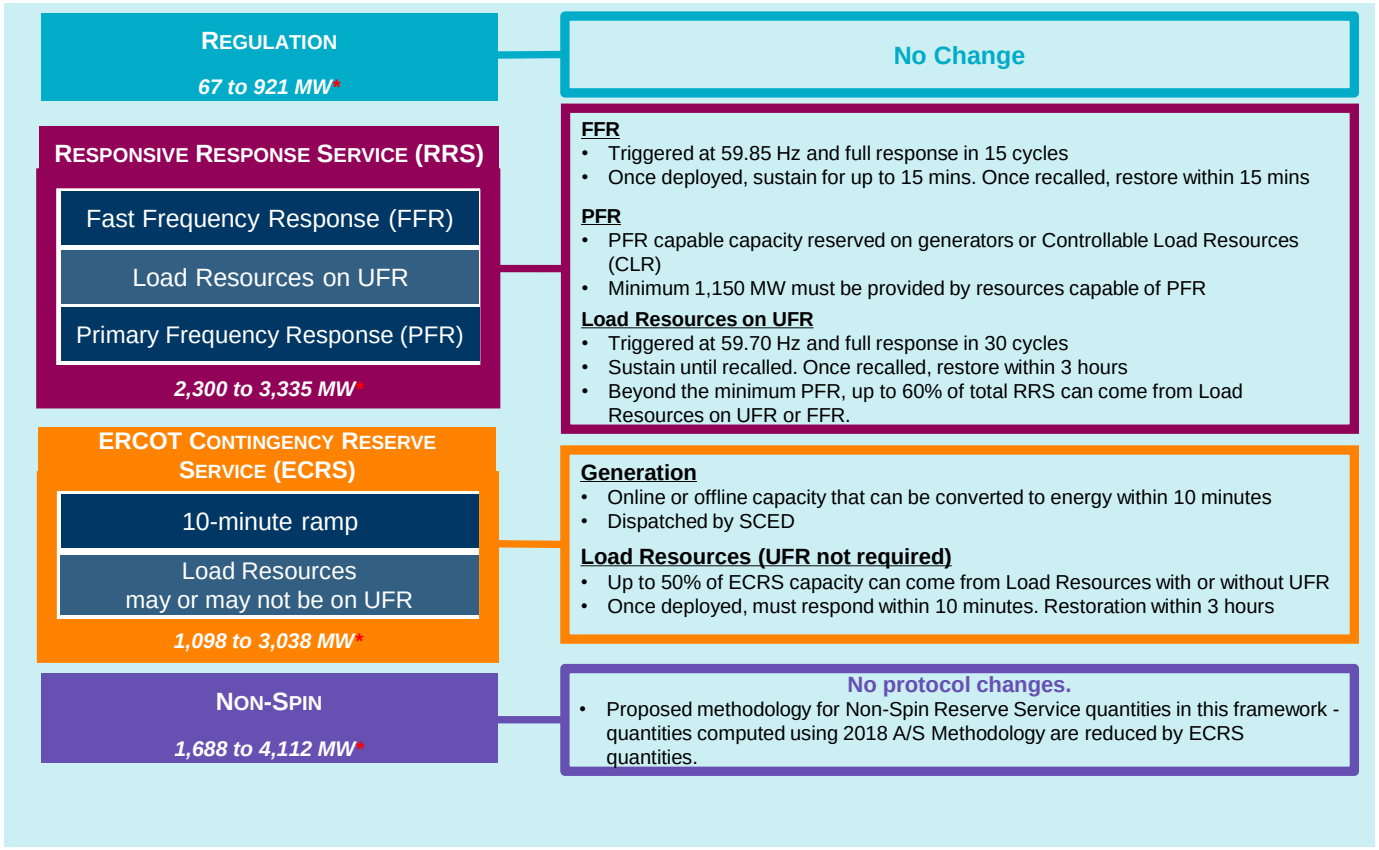
RESPONSIVE RESERVE SERVICE

1. Primary Frequency Response
2. Load Resources on Under Frequency Relay (UFR)

*2,300 to 3,335 MW**

NON-SPIN

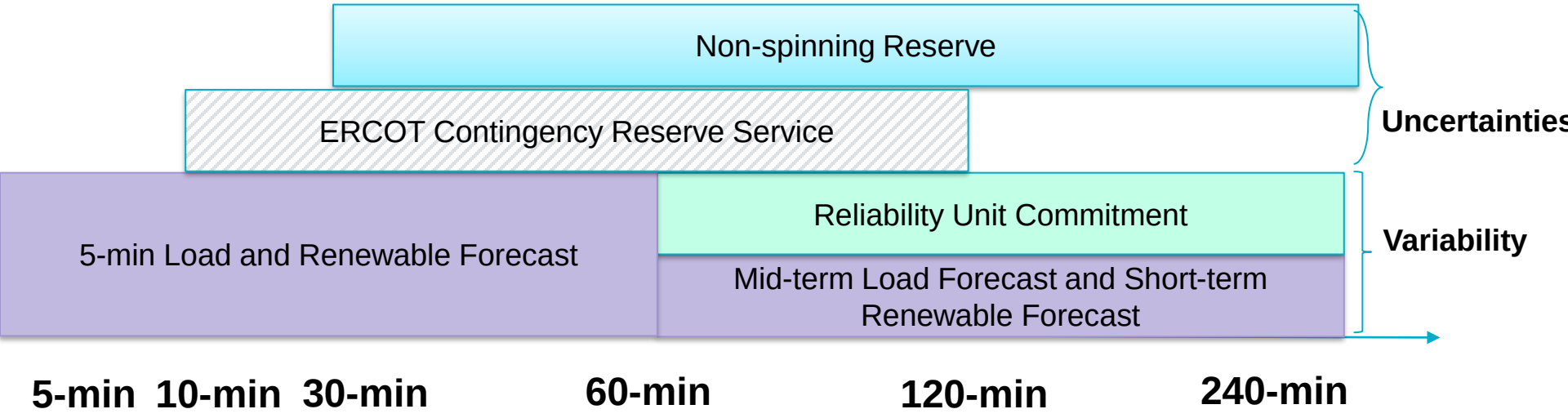
*2,226 to 5,633 MW**



*Quantities computed/estimated using 2023 Ancillary Service Methodology.

Market and Operations

- ERCOT ensures that there are enough resources and resource flexibility available on the system to meet net load, net load changes, and uncertainties by using Ancillary Services and Reliability Unit Commitment.



Comparison between ECRS and Non-Spin

	ECRS	Non-Spin
Reliability Objective	ECRS may be deployed to a) Help restore the frequency to 60 Hz within ten minutes of a significant frequency deviation b) Provide energy upon detection of insufficient capacity for net load ramps c) Provide energy to avoid or during the implementation of an EEA d) Provide backup to Reg-Up	Non-Spin may be deployed to provide additional capacity a) During situations when there isn't sufficient capacity for energy dispatch b) For intra-day forced outage of units and during sustained frequency decay or sustained low frequency operations. c) When SCED(*) does not have enough energy available to execute successfully
Primary Forecast Risk	Errors in 5-minute load/wind/solar forecast that is used in SCED dispatch (via GTBD)	Errors in hourly load/wind/solar forecast that is used in RUC(*)
Qualification Criteria	Provided using capacity that can be sustained at a specified level for ***two*** consecutive hours	Provided using capacity that can be sustained at a specified level for ***four*** consecutive hours
Response	Deployed within ***10*** minutes upon the receipt of deployment instruction	Deployed within ***30*** minutes upon the receipt of deployment instruction

* SCED: Security Constrained Economic Dispatch (SCED)
RUC: Reliability Unit Commitment

Understand Impact of Solar Generation

- Solar installed capacity in ERCOT is expected to increase significantly. This growth in solar installed capacity may,
  - **exacerbate the magnitude of the net load ramps that the grid may experience**,
  - **introduce more uncertainties in intra-hour and hourly net load forecasts**, and
  - increase the potential for lower inertia during lighter load periods (typically in shoulder months).
- To assess the impact of growth in wind and solar on net load, a study was performed in 2021
  - Interpolated the 2020 wind and solar profiles to build expected net load profiles under the following 3 scenarios (10 GW solar, 20 GW solar and 30 GW solar).
  - Analyzed upward net load changes in **5-min**, **10-min**, **30-min**, **60-min** and **180-min**.

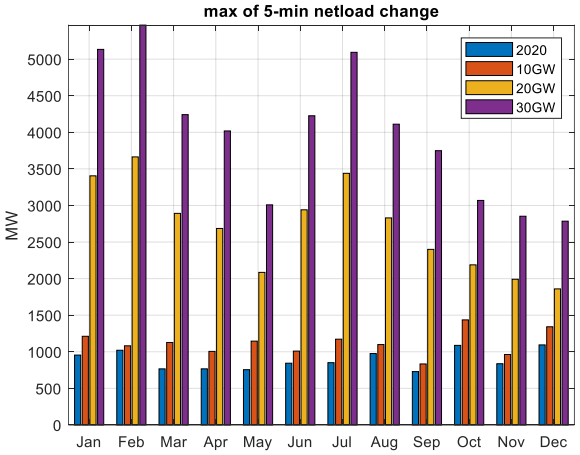
Scenario	Load	Wind Installed Capacity	Solar Installed Capacity
2020 (BASE)	2020 ERCOT Load	27 - 30 GW	2.5 - 5 GW
10 GW Solar	2020 ERCOT Load	35 GW	10 GW
20 GW Solar	2020 ERCOT Load	35 GW	20 GW
30 GW Solar	2020 ERCOT Load	35 GW	30 GW

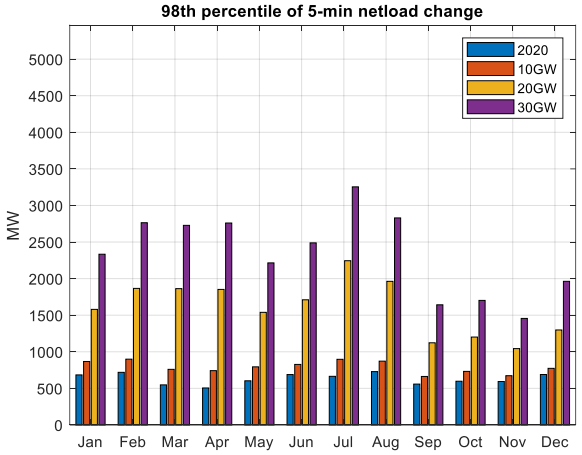
- More details can be found in **Impact of Growth in Wind and Solar on Net Load**

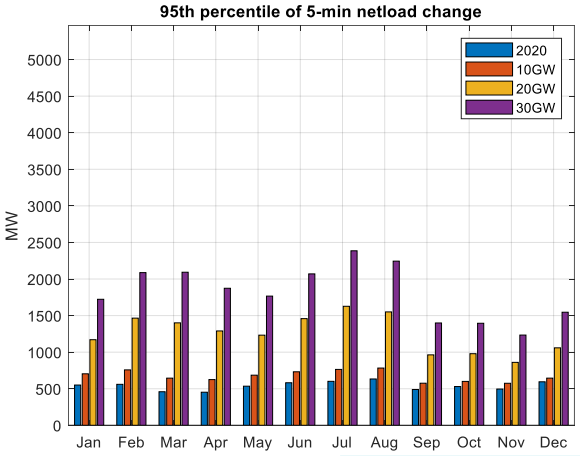
5-min Net Load Change

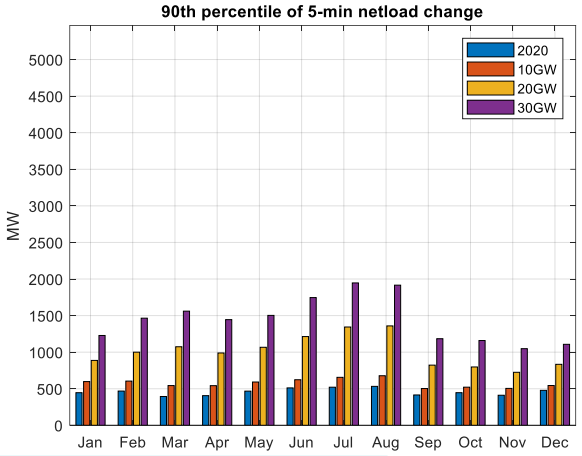
- In comparison to 2020, on an average
  - there is a marginal increase in the 5-min net load ramps in the 10 GW scenario.
  - the 5-min net load ramps increase by ***~150%*** in the 20 GW scenario.
  - the 5-min net load ramps increase by ***~300%*** in the 30 GW scenario
  - **Winter**, **Spring** and **Summer** months have the most prominent changes in extreme 5-min net load ramp magnitudes.

- There is a vast difference between the maximum value and the 98th percentile. This signifies that the most extreme 5-min net load ramps occur very few times.







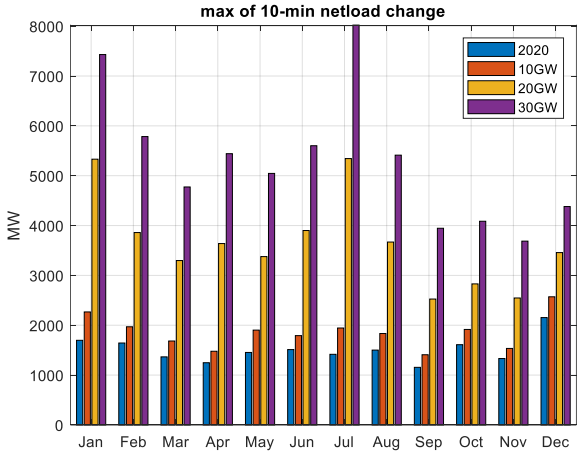


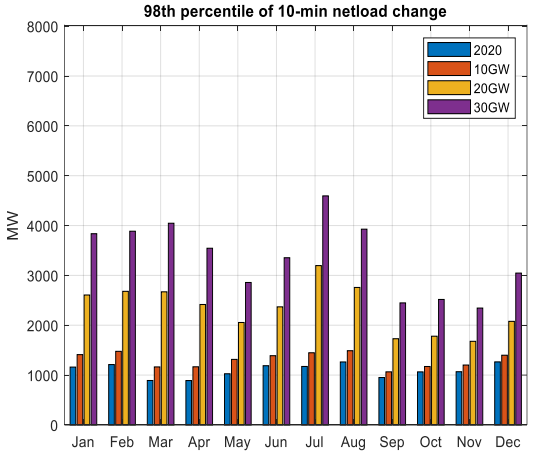
	5-min Net Load Up Change			
Scenario	Max	98th	95th	90th
2020	1,094	729	634	533
10 GW	1,436	899	783	678
20 GW	3,664	2,245	1,627	1,359
30 GW	5,466	3,254	2,386	1,946

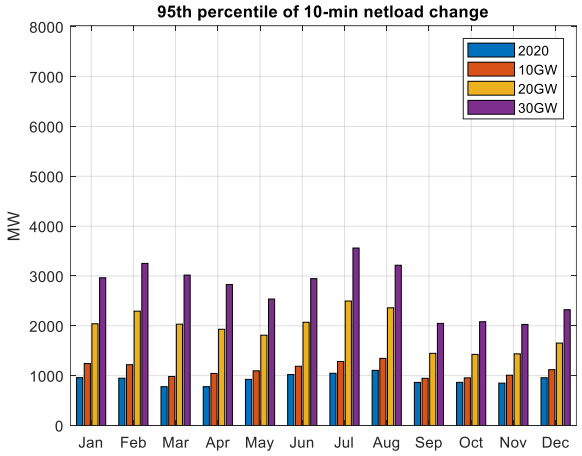
10-min Net Load Change

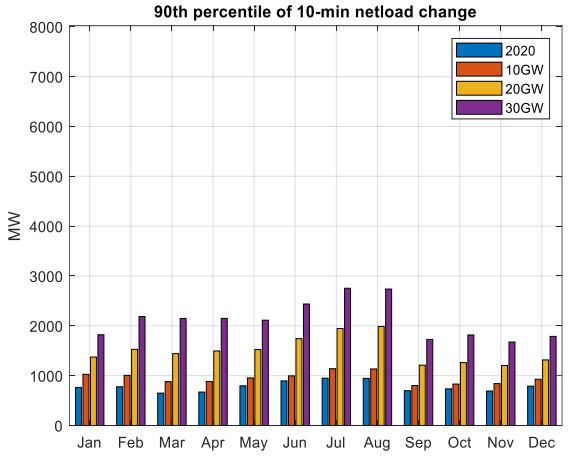
- In comparison to 2020, on an average
  - there is a marginal increase in the 10-min net load ramps in the 10 GW scenario.
  - the 10-min net load ramps increase by ***~150%*** in the 20 GW scenario.
  - the 10-min net load ramps increase by ***~250%*** in the 30 GW scenario
  - **Winter**, **Spring** and **Summer** months have the most prominent changes in extreme 10-min net load ramp magnitudes.

- There is a vast difference between the maximum value and the 98th percentile. This signifies that the most extreme 10-min net load ramps occur very few times.







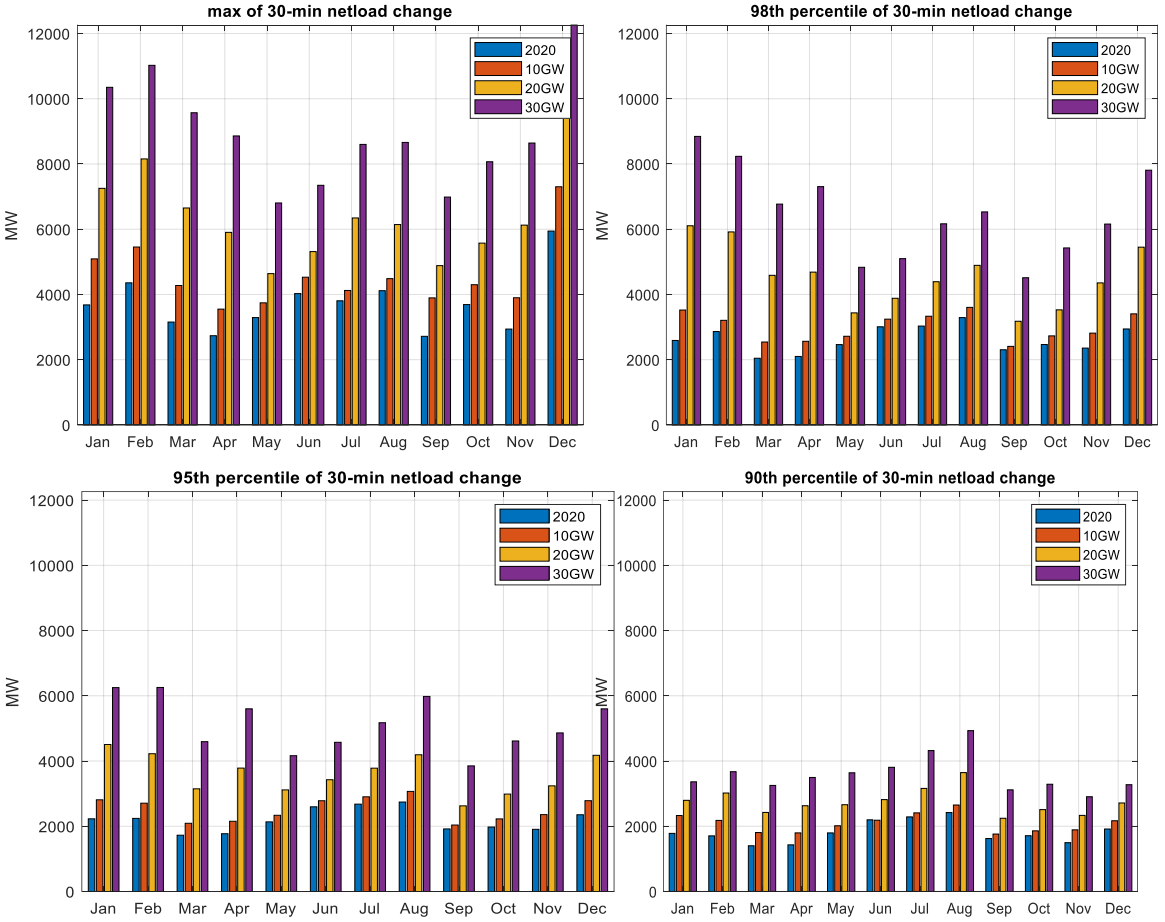


	10-min Net Load Up Change (MW)			
Scenario	Max	98th	95th	90th
2020	2,154	1,265	1,107	949
10 GW	2,571	1,489	1,347	1,139
20 GW	5,343	3,197	2,497	1,987
30 GW	8,022	4,595	3,560	2,753

30-min Net Load Change

- In comparison to 2020, on an average
  - there is a marginal increase in the 30-min net load ramps in the 10 GW scenario.
  - the 30-min net load ramps increase by ***~75%*** in the 20 GW scenario.
  - the 30-min net load ramps increase by ***~150%*** in the 30 GW scenario.
  - **Winter**, **Spring** and **late Summer** months have the most prominent changes in extreme 30-min net load ramp magnitudes.

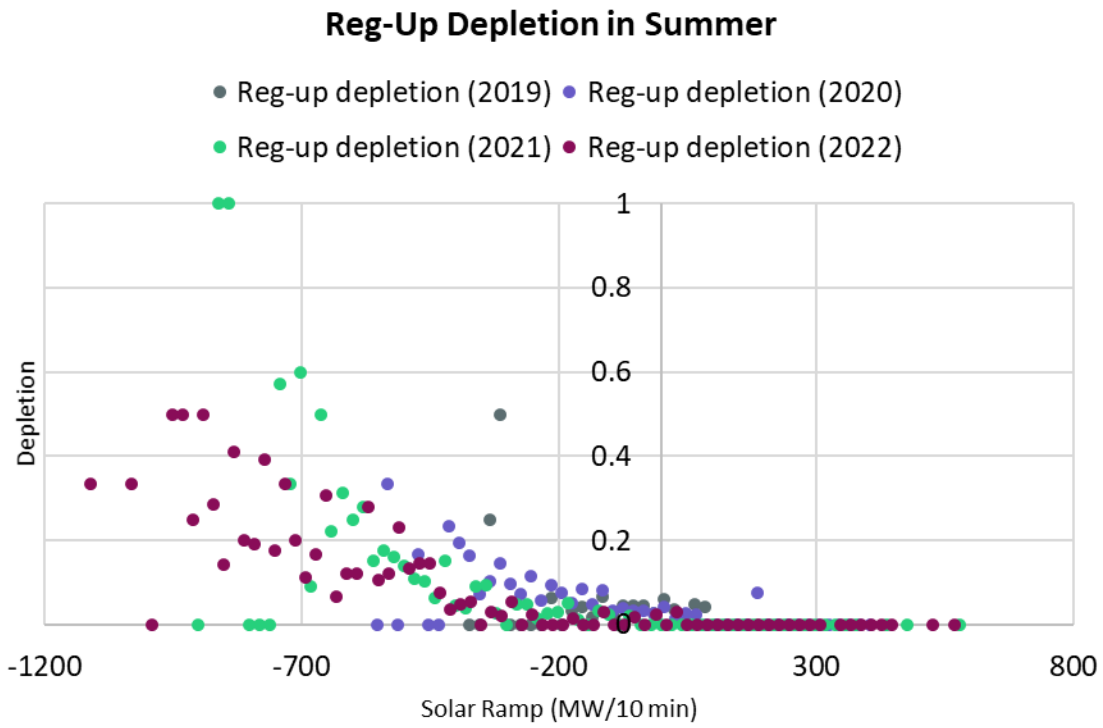
- There is a vast difference between the maximum value and the 98th percentile. This signifies that the most extreme 30-min net load ramps occur very few times.

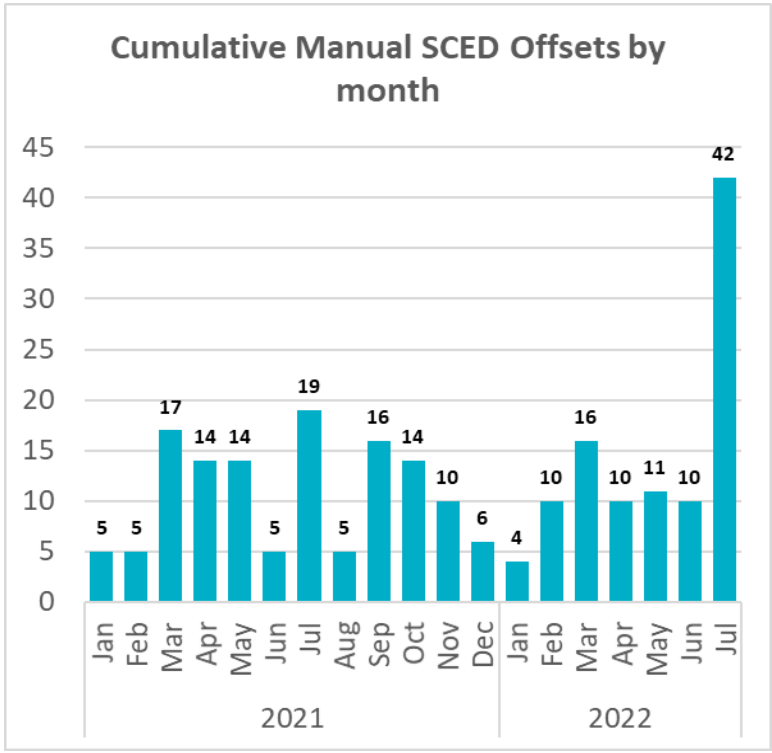


Scenario	30-min Net Load Up Change (MW)			
	Max	98th	95th	90th
2020	5,944	3,290	2,743	2,419
10 GW	7,302	3,604	3,069	2,651
20 GW	9,672	6,106	4,507	3,645
30 GW	12,259	8,846	6,256	4,931

Regulation usage and SCED offset Trends

- As the solar installed capacity has increased, during the evening hours, the magnitude of 10-min solar ramps have increased and there has been more reliance on regulation up deployments and SCED offsets.





Overview

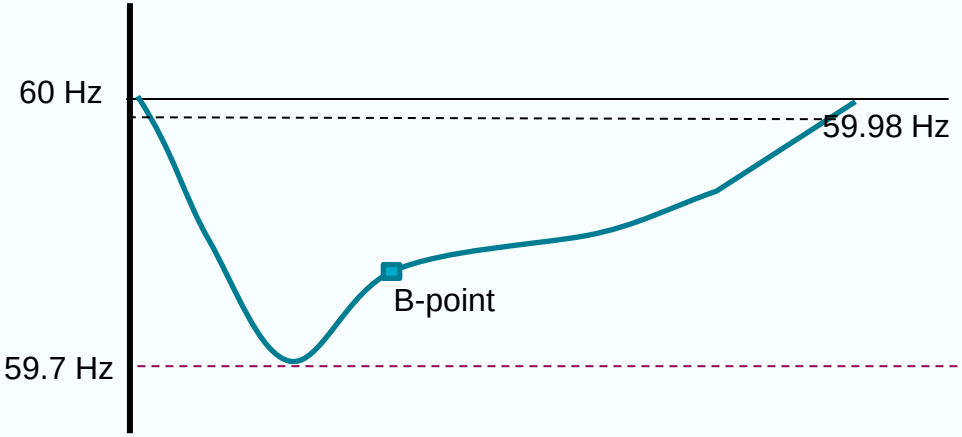
- Operational challenges associated with increasing amount of wind/solar generation resources at ERCOT
- Methodology to determine ECRS requirements
- ECRS deployment mechanism

ECRS Requirements Methodology

- ERCOT is proposing to compute ECRS requirements as the sum of,
  1. capacity needed to recover frequency following a large unit trip and
  2. capacity needed to support sustained net load ramps.

Method for Determining MWs needed for Frequency Recovery

- To meet BAL-003 requirement, capacity needed to recover frequency from B-point (i.e., settling frequency) to 59.98 Hz is determined by using dynamic simulations/studies that are run at varying inertia levels.
- In every simulation, a single medium-size unit is tripped offline such that the C-point (frequency nadir) is stays just above 59.7 Hz*.
- Capacity needed to recover frequency using this approach is determined for each hour of each month using two years historical data.



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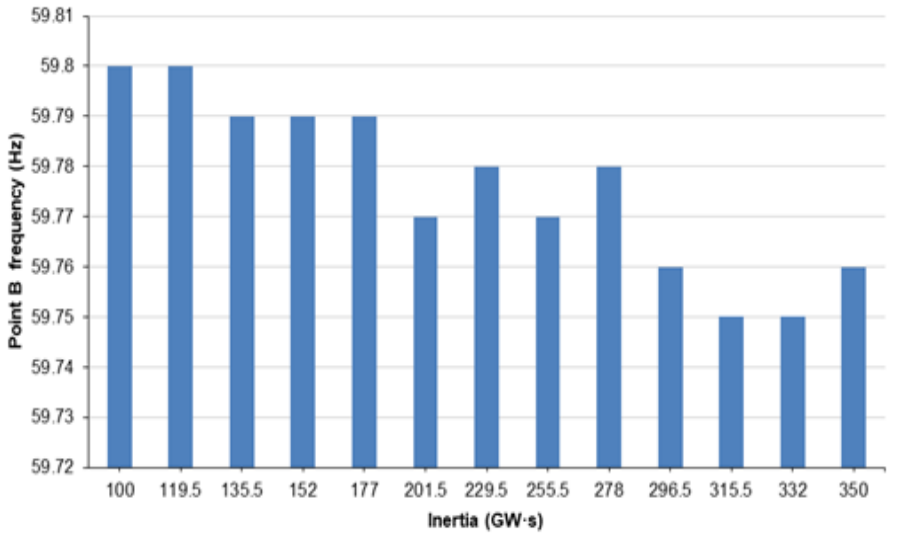
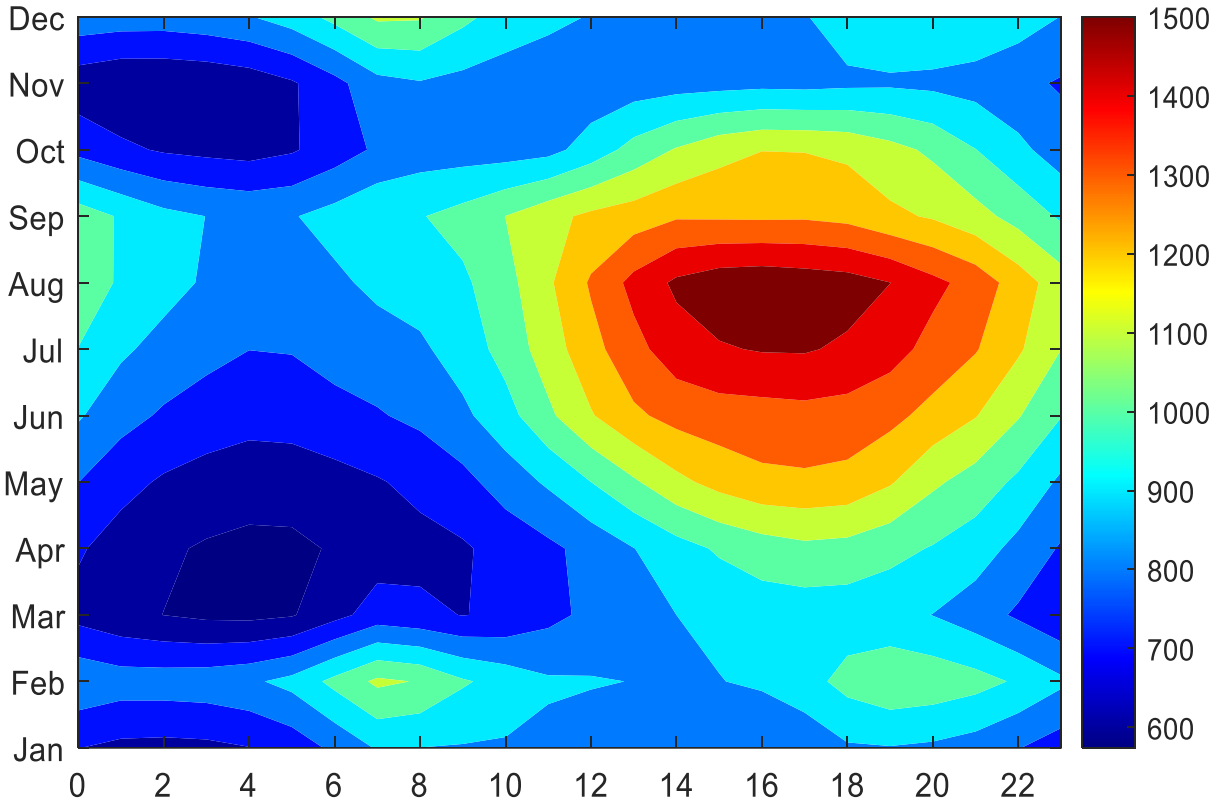


$MW_{need} = (59.98\ Hz - Freq_{B\text{-}point}) * (1\%\ load\ in\ MW/0.1\ Hz)$

*59.7Hz is the trigger frequency for Load Resources that are providing RRS using an under-frequency relay.

MWs needed for Frequency Recovery

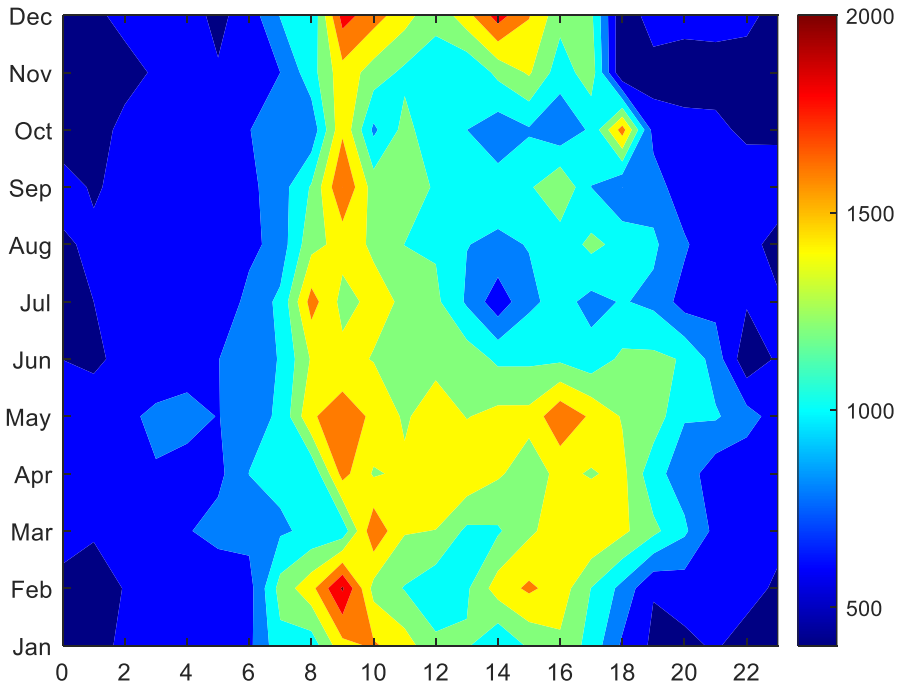


	Min	Mean	Max
MW_{need}	574 MW	951 MW	1,572 MW

Method for Determining Additional MWs needed for sustained Net Load Ramps

- Capacity needed to support sustained net load ramps will be computed using
  - 85th to 95th percentile of 30-minute ahead intra-hour net load forecast errors for same hours of same month of previous two years
    - The percentile associated with every hour will be determined based on the risk of net load up ramp. Periods where the risk of net load ramp is highest will use 95th percentile and 85th percentile for periods with lowest risks.
  - An additional adjustment will be included to account for the impact of increase in over-forecast error from expected growth in solar generation installed capacity.

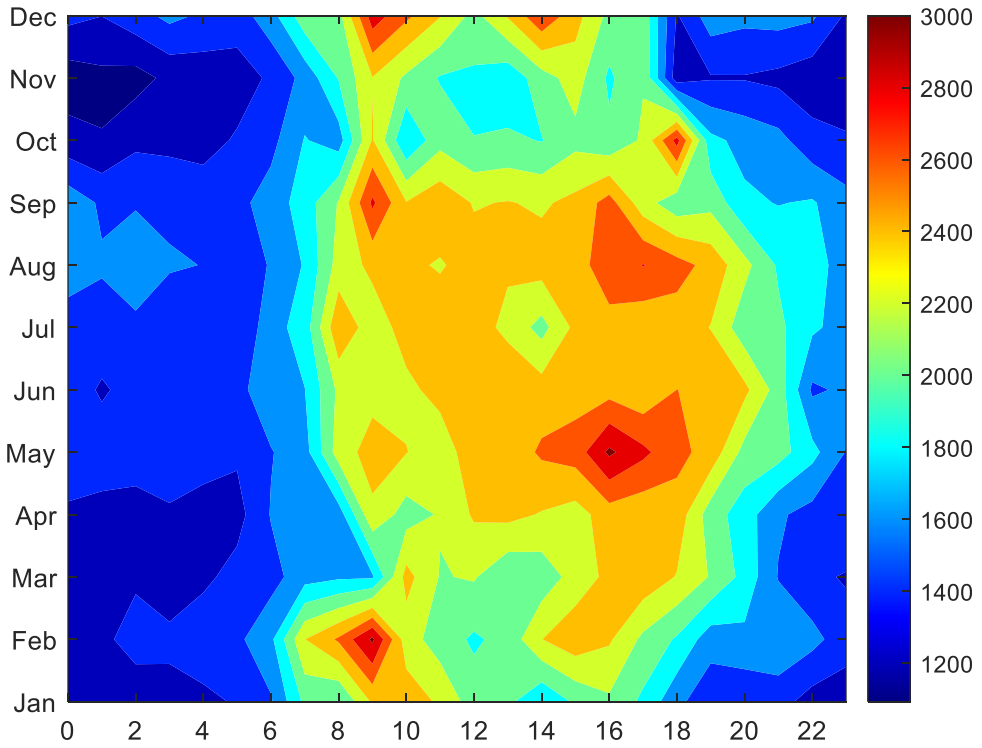
MWs needed for Intra-hour Net Load Forecast Errors (With Solar Adjustment)



	Min	Mean	Max
MW_{need}	403 MW	981 MW	2,027 MW

ECRS Requirement for 2023

- Total ECRS requirement for every hour is computed as the sum of
  1. capacity needed to recover frequency following a large unit trip and
  2. capacity needed to support sustained net load ramps (with solar adjustment)



	Min	Mean	Max
ECRS	1,093 MW	1,933 MW	3,039 MW

Overview

- Operational challenges associated with increasing amount of wind/solar generation resources at ERCOT
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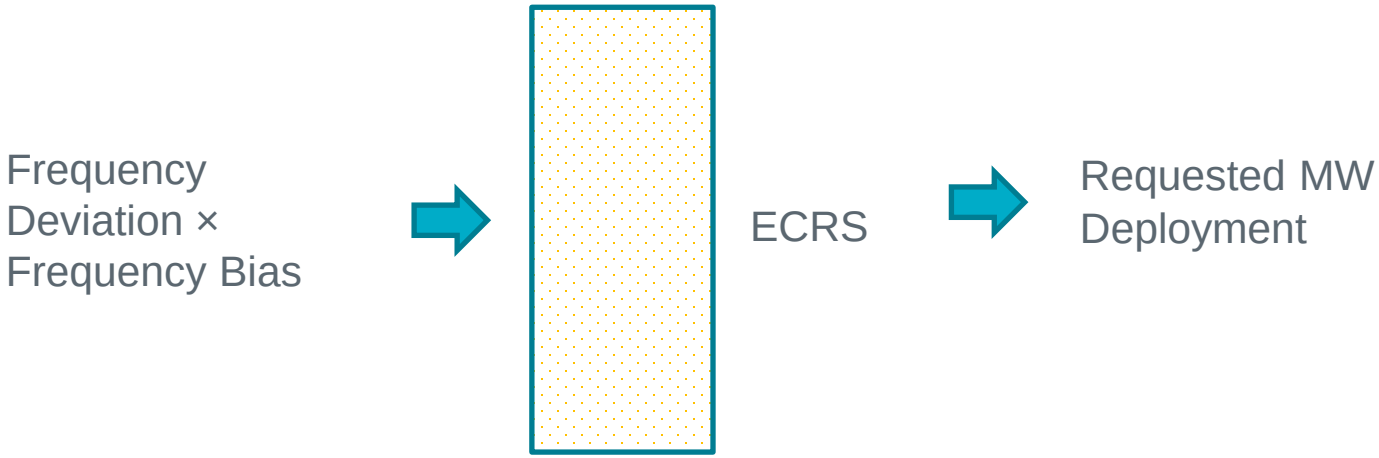
ECRS Deployment based on Frequency Deviation

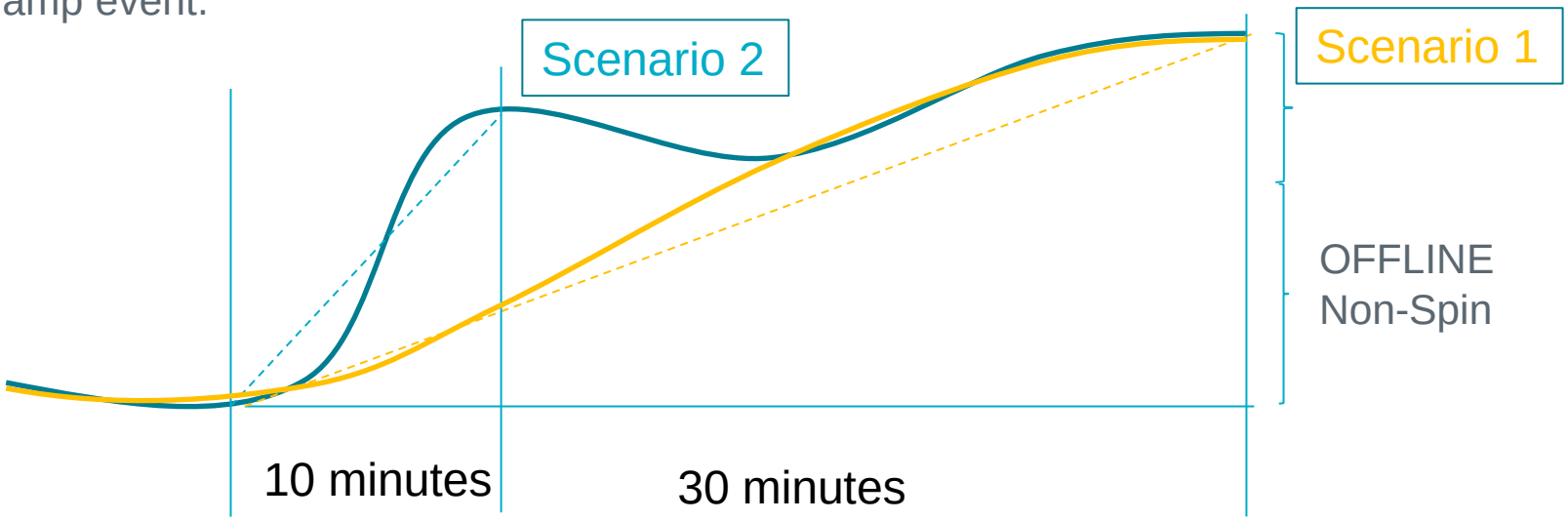
- Following large unit trips or other large frequency deviation, ECRS-Gen will be deployed to replenish the deployed Responsive Reserves (RRS) or Regulation Up (Reg-Up). Specifically, EMS's Load Frequency Control (LFC) will,
  - Release all or partial capacity of ECRS-Gen to respond to a frequency deviation when the power requirement to restore frequency to normal exceeds available Reg-Up.



  - Recall the deployed ECRS-Gen when the frequency is restored above 59.98 Hz

ECRS Deployment based on Net Load Ramps

- ECRS may also be deployed to respond to a large, sustained, rapidly increasing net-load up ramp event.



- Scenario 1: Reg-Up is exhausted and Net Load continues to grow. There is shortage in the available capacity to SCED within 30 minutes, i.e., OFFLINE Non-Spin Deploy Trigger < 0 MW, Offline Non-Spin may be deployed partially or entirely.
  - If the magnitude of Net Load increase exceeds the amount of available OFFLINE Non-Spin, deployment of ECRS-Gen will provide more capacity to SCED.

- Scenario 2: If the grid experiences a ramp issue for the incoming large 10-min Net Load change, deployment of ECRS-Gen will avoid exhausting Reg-Up.

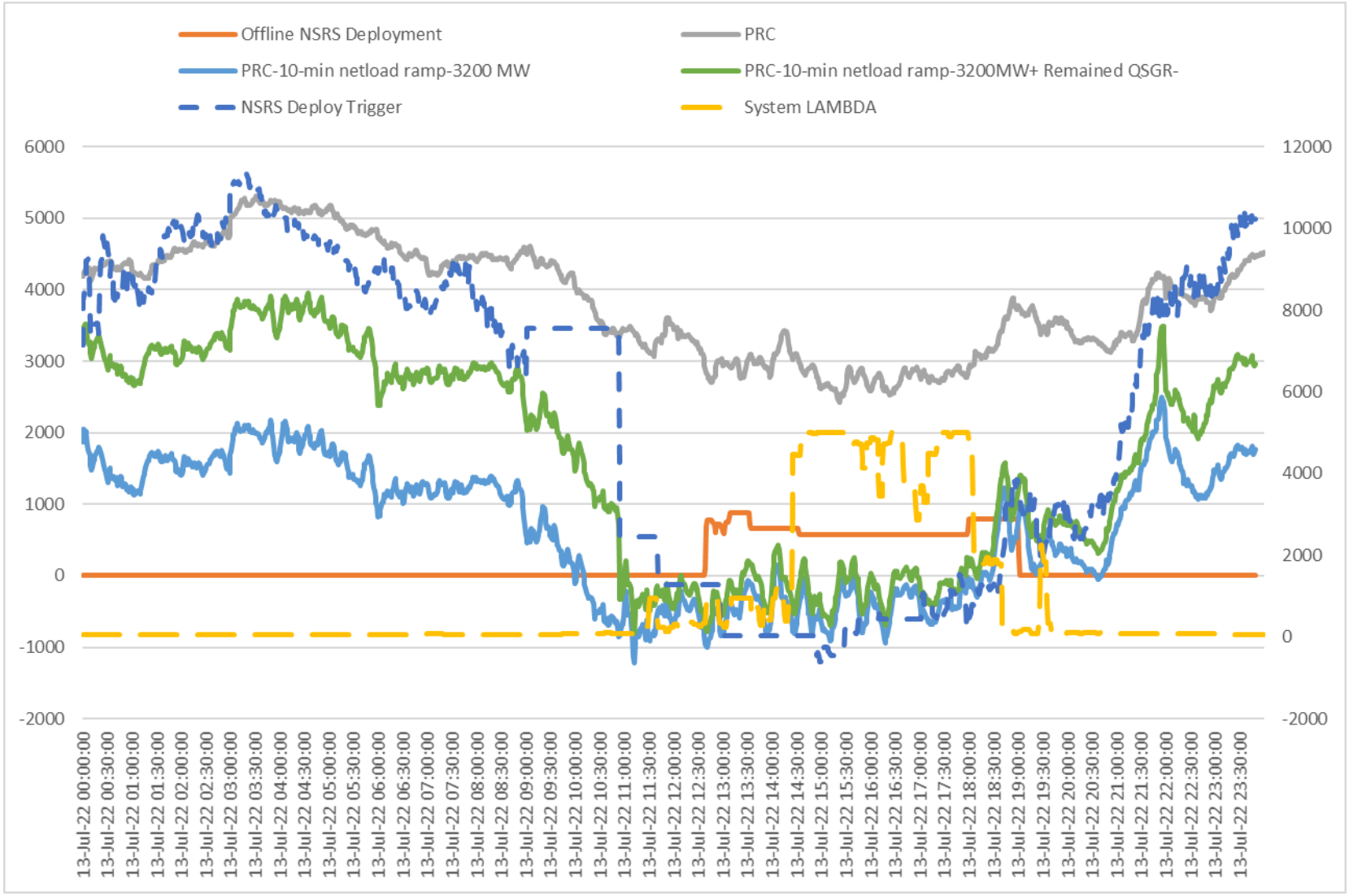
ECRS Deployment based on Net Load Ramps

- To respond to issues related to net load ramps, ERCOT developed the following two triggers to decide when ECRS-gen deployment may be needed

1. Trigger 1 : (Physical Responsive Capability (PRC) – 3200 MW) – (projected 10min Net Load ramp) + Remaining Quick Start Generation Resource (QSGR) capacity < 0 MW
   - Through this approach, deployment of ECRS can 1) provide OFFLINE Non-Spin more time to be fully deployed or 2) prevent the grid from entering Advisory if ECRS amount if sufficient.

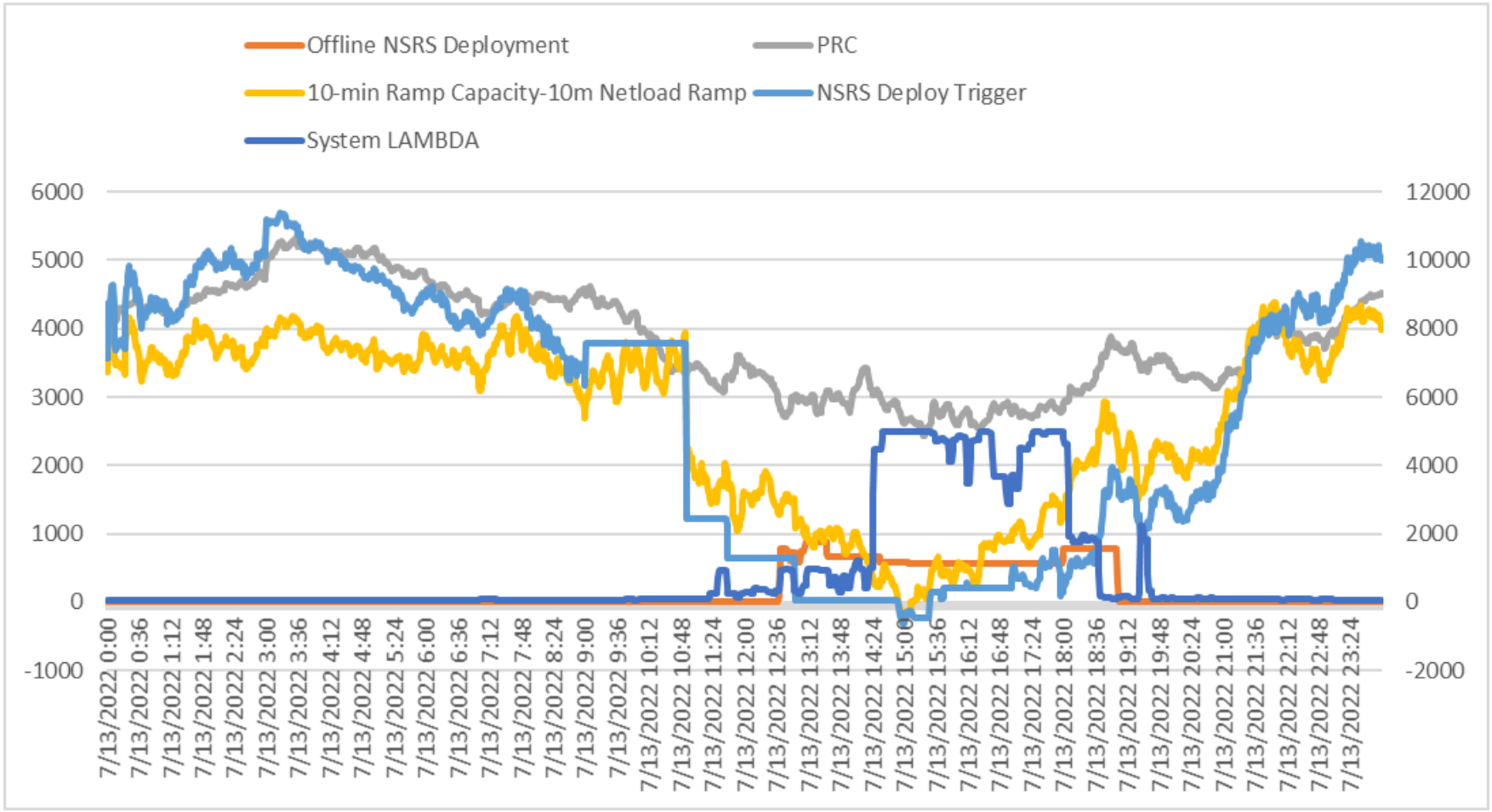
2. Trigger 2: (10min ramp capacity) – (projected 10min Net Load ramp) < 0 MW
   - ECRS may be deployed when there is lack of 10min ramping capacity.

Trigger 1: July 13, 2022



*Triggers for OFFLINE Non-Spin Deployment: (1) (High Ancillary Service Limit (HASL) – Gen – Intermittent Renewable Resource (IRR) Curtailment) – (30-minute net load ramp) < 0 MW (2) Physical Responsive Capability (PRC) < 3200 MW and not expected to recover within 30 minutes without deploying reserves

Trigger 2: July 13, 2022



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Summary

- With increase in installed solar capacities, ERCOT expects to experience the large net load ramps during 5-min, 10-min, 30-min.

- ERCOT Contingency Reserve Service (ECRS) is a service that is provided using capacity that can be sustained at a specified level for two consecutive hours and can be deployed within 10-min upon the receipt of instructions.
  - Specially designed to help ERCOT to improve reliability 1) to recover frequency following a large unit trip and 2) to provide capacity to support sustained net load ramps.

- Two triggers for manual deployment of ECRS-Gen have been designed to identify times when there is a potential for reliability issues due to sustained net load up ramps.

Question?