ERCOT Summer 2019 Update

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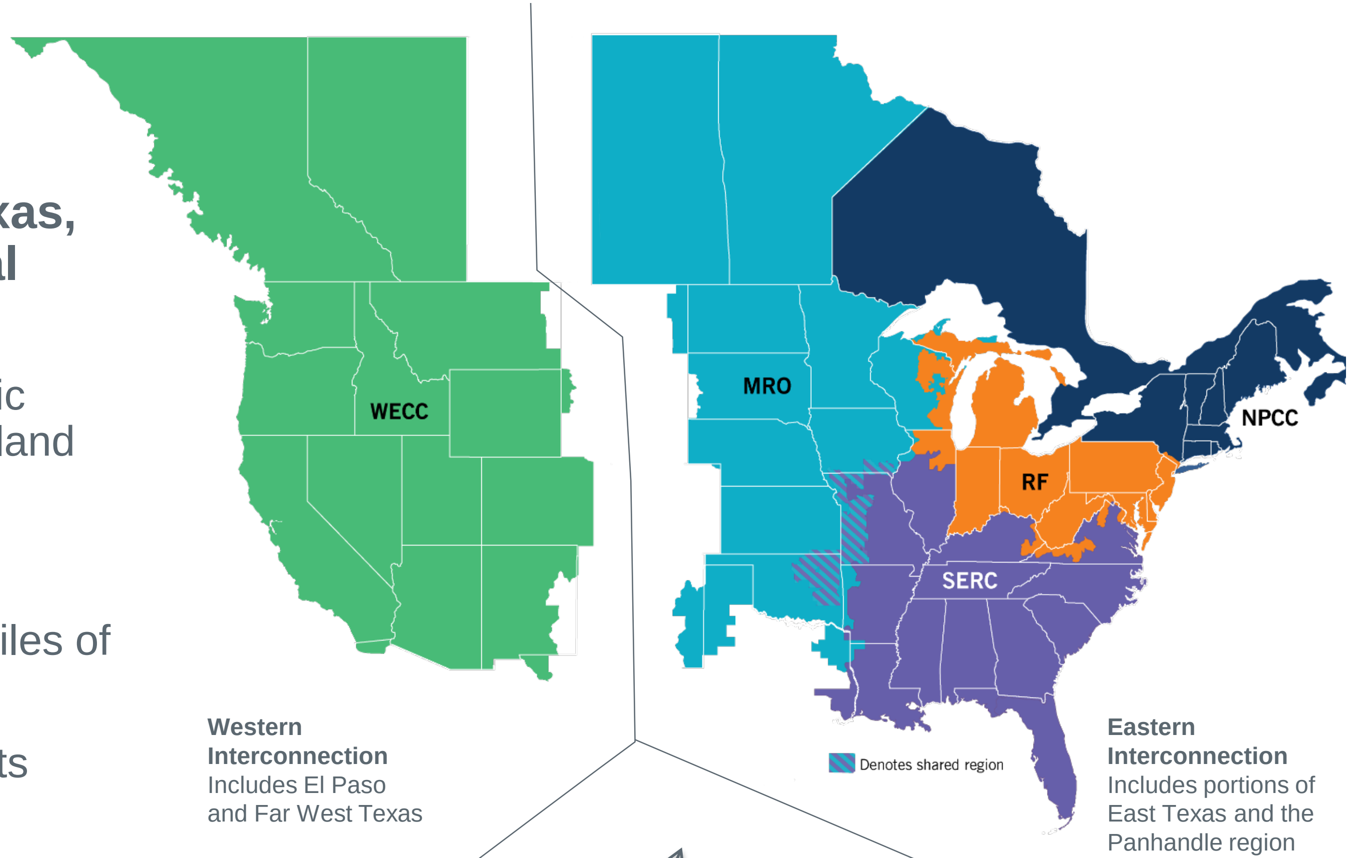
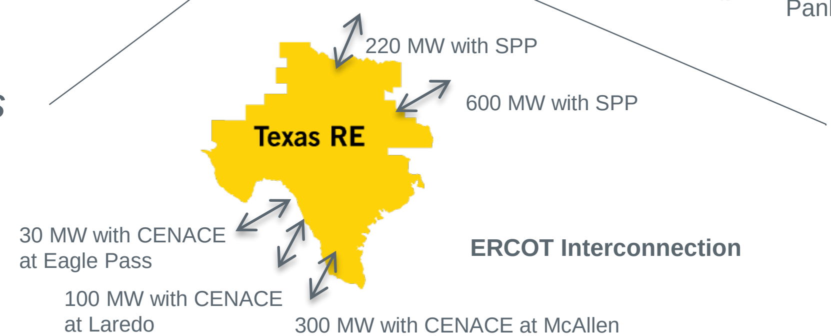
The ERCOT Interconnection

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

- 90% of Texas electric load; 75% of Texas land
- 74,666 MW peak, August 12, 2019
- More than 46,500 miles of transmission lines
- 650+ generation units (excluding PUNs)



ERCOT connections to other grids are limited to ~1,250 MW of direct current (DC) ties, which allow control over flow of electricity



Unique Aspects of the ERCOT Interconnection

- ERCOT is a fully intrastate system and market subject to federal policy for reliability (through NERC) and state policy for market design and resource adequacy.

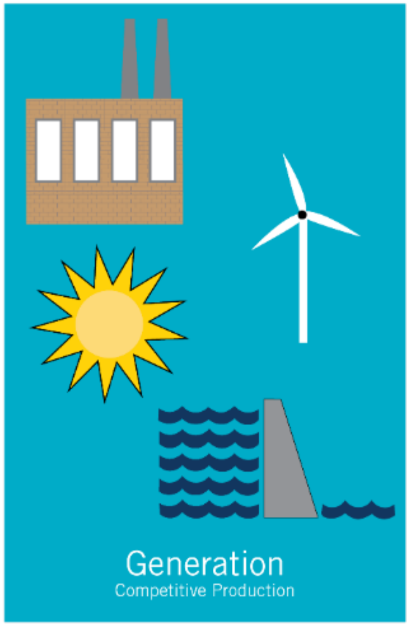
- Unlike other interconnections and ISO/RTOs: a single regulator, with policy set by the Texas Legislature; implemented and enforced by the Public Utility Commission of Texas (PUCT).

- In addition to ERCOT in the Texas RE region, the PUCT has state jurisdiction over utilities in the MRO, SERC, and WECC NERC regions and assessment areas. The PUCT works with REs and ISO-RTOs to coordinate issues of common interest among the regions in Texas.

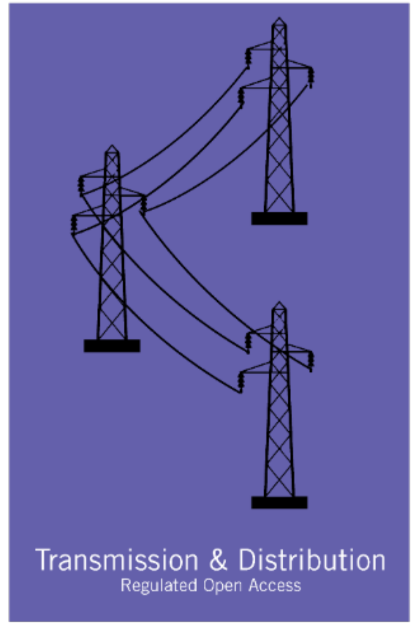
- Jurisdictional issues have been heavily litigated and are now subject to a set of settled rules. For a colorful history, see: Richard D. Cudahy, "The Second Battle of the Alamo: The Midnight Connection," *Natural Resources & Environment (American Bar Association)* (Summer 1995).

Market Structure in ERCOT

The ERCOT market operates based on a structure established by 1999 Texas legislation:



- Generating units are owned by merchant competitors companies (except for municipal and cooperative units
- Compete in ERCOT market to serve load
  - o An open market overseen by PUCT.



- Transmission and distribution lines and related facilities are owned and operated by regulated utilities.
  - o Utilities are full regulated by PUCT.
- Transmission costs recovered on “postage stamp” basis

- Retailers compete to serve consumers’ electric load in ~75% of state (except 25% in municipal and cooperative utility areas)
- Active retail competition
  - 92% have switched
  - ~15% switches in a year
- Nearly 100% smart meters

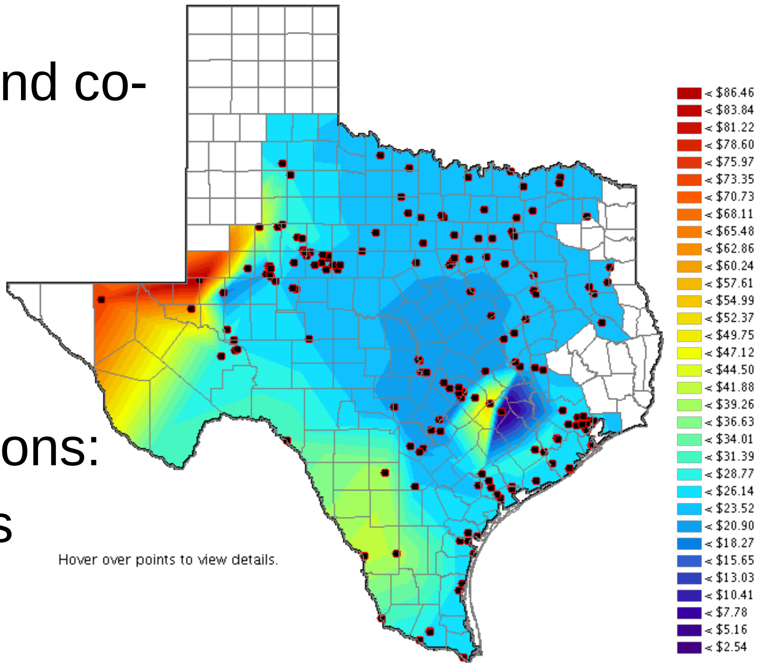
Resource Adequacy in the ERCOT Market

- There is no mandatory reserve margin that must be maintained.
  - Reserve margins may fluctuate significantly based on market entry and exit
  - PUCT and ERCOT are studying methods of measuring reserve margins that take into account market dynamics

- Economic price signals are essential to maintaining reliability.
  - ERCOT's energy-only market includes a $9,000 MWh offer cap, along with an Operating Reserve Demand Curve (ORDC) triggered by scarcity conditions
  - The economic consequences of scarcity pricing provide extremely strong incentives for generator performance
  - Price-responsive demand is key to the optimal functioning of the market

Market Design: Energy-Only Nodal Market

- All generators submit offers for generation output. ERCOT commits generation units only if necessary for reliability
- Voluntary Day-Ahead Market (DAM); Ancillary Services procured in DAM and co-optimized with energy
- Real-Time Market clears every five minutes, using generation with the lowest offers to serve the load
- Reliability tools for emergency conditions:
  - Supply and demand-side reserves
  - Reliability-Must-Run contracts for retirements that threaten system reliability



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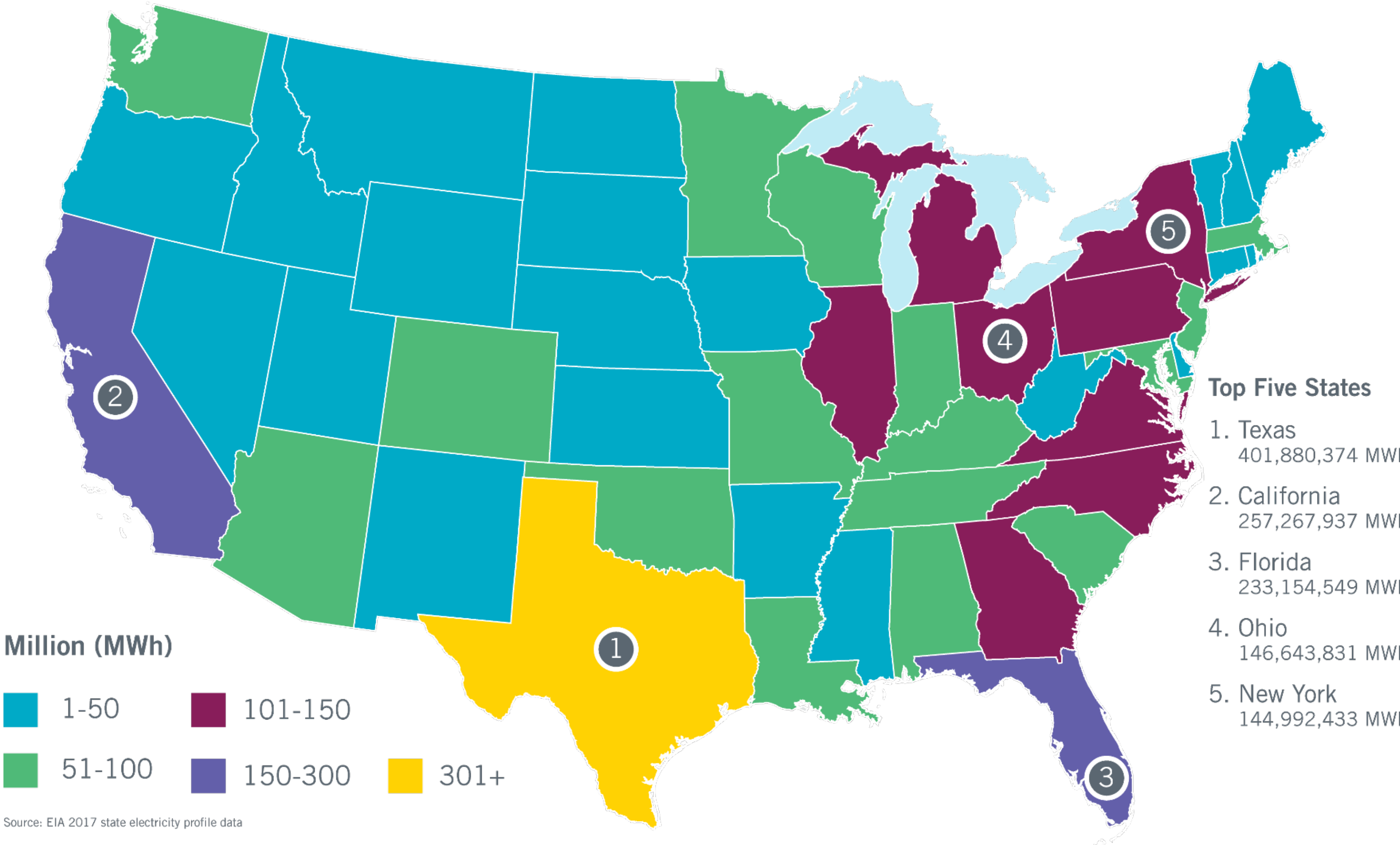
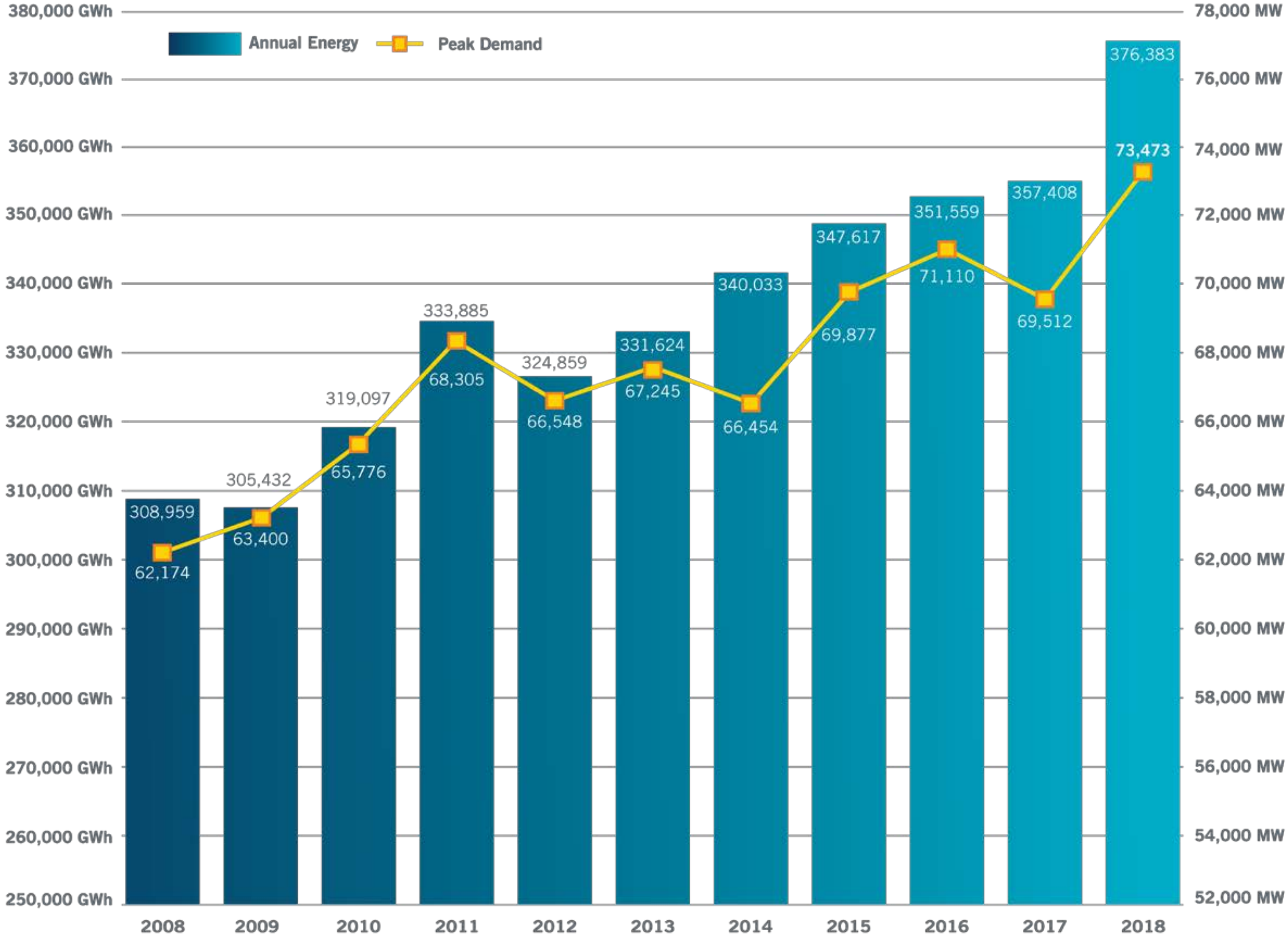
Texas Consumes More Electricity Than Any State



Source: EIA 2017 state electricity profile data

Consistent Load Growth in ERCOT (2008-2018)



Current Demand Records

Peak Demand Record: 74,666 megawatts (MW)*

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

Weekend Peak Demand Record: 71,915 MW*

- Sunday, August 11, 2019, 5-6 p.m.

Winter Peak Demand Record: 65,915 MW

- Wednesday, Jan. 17, 2018, 7-8 a.m.

**New records are preliminary, subject to change in final settlement*

Monthly Peak Demand Records

January: 65,915 MW (Jan. 17, 2018)

February: 57,265 MW (Feb. 10, 2011)

March: 60,756 MW (March 5, 2019)

April: 53,486 MW (April 28,2017)

May: 67,265 MW (May 29, 2018)

June: 69,123 MW (June 27, 2018)

July: 73,473 MW (July 19, 2018)

August: 74,666 MW (Aug. 12, 2019)*

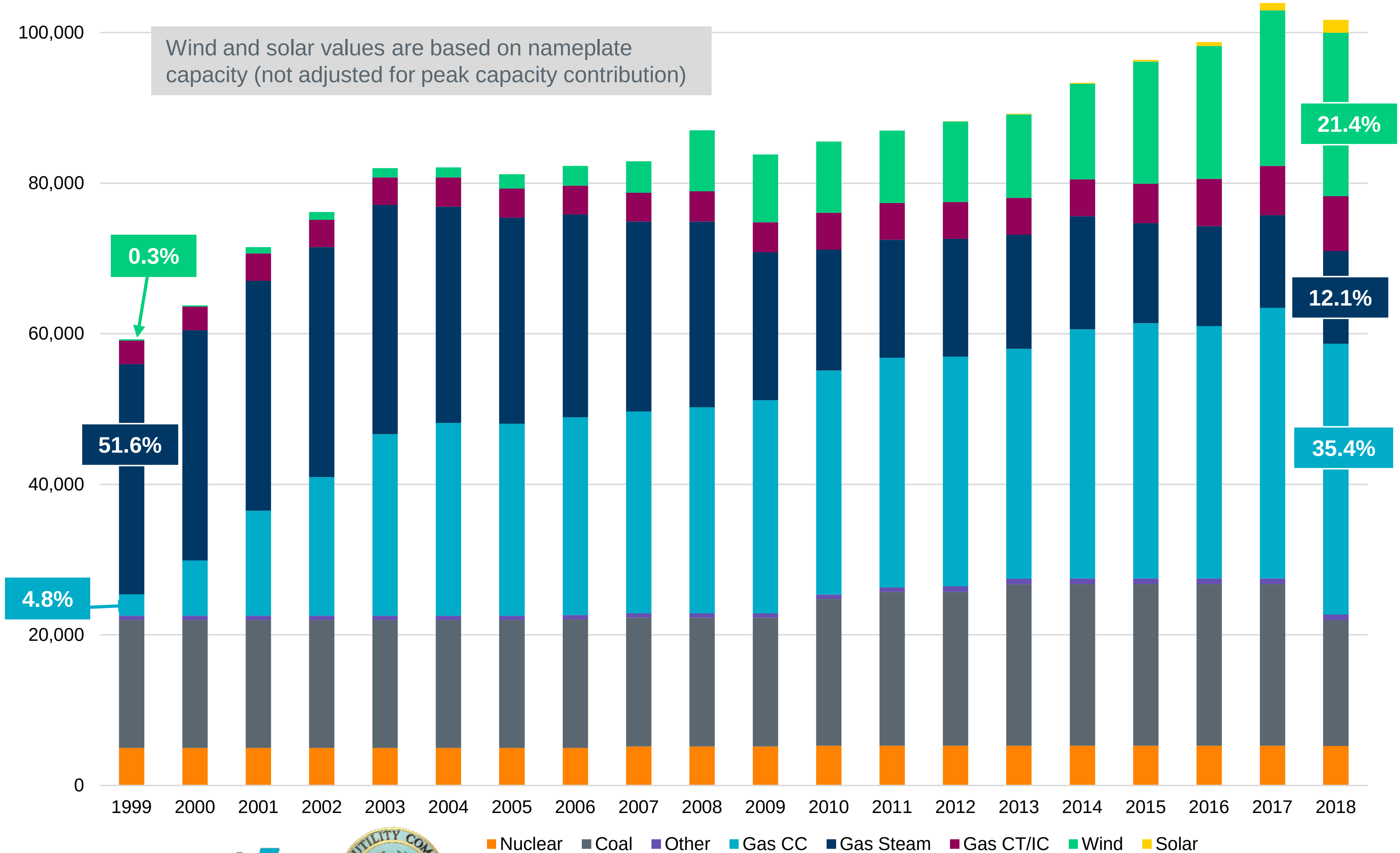
September: 68,817 MW (Sept. 6, 2019)*

October: 65,066 MW (Oct. 2, 2019)

November: 56,317 MW (Nov. 14, 2018)

December: 57,932 MW (Dec. 19, 2016)

ERCOT Installed Capacity (1999-2018)



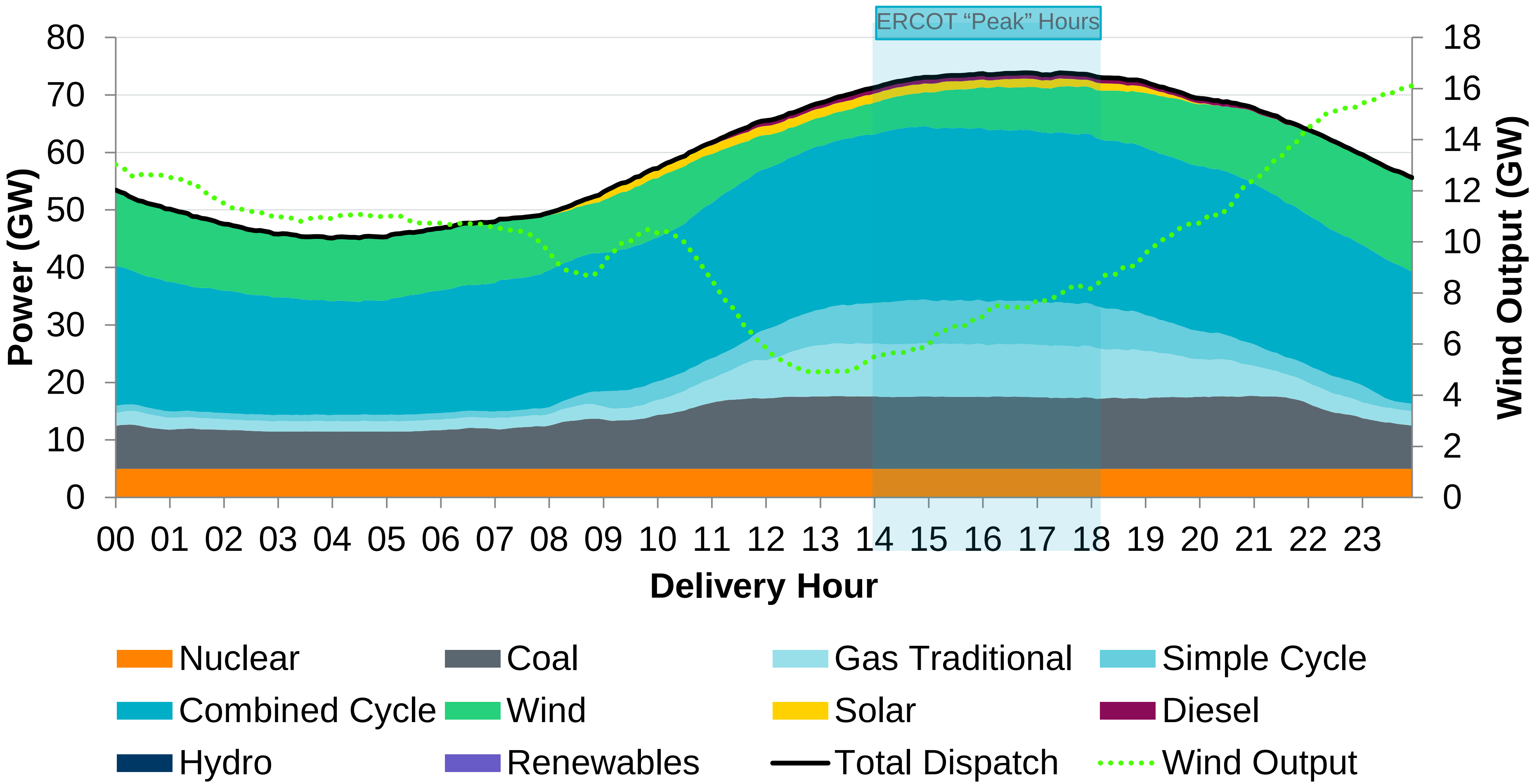
The Summer 2019 Seasonal Assessment of Resource Adequacy (SARA) Values vs. Actuals at Peak Demand

	2019 Actual Peak Demand (8/12/19)	Final 2019 Summer SARA*	Difference
Total Resources, MW	80,098	78,930	1,168
Thermal and Hydro	64,401	65,526	(1,125)
Private Use Networks, Net to Grid	3,203	3,437	(234)
Switchable Generation Resources	2,837	2,726	111
Wind Capacity Contribution	7,447	4,898	2,549
Solar Capacity Contribution	1,394	1,405	(11)
Non-Synchronous Ties	816	938	(122)
Peak Demand, MW	74,666	74,853	(187)
Reserve Capacity, MW	5,432	4,077	1,355
Total Outages, MW	3,972 **	4,226	(254)
Capacity Available for Operating Reserves, MW	1,460	(149)	1,609

Largest absolute difference

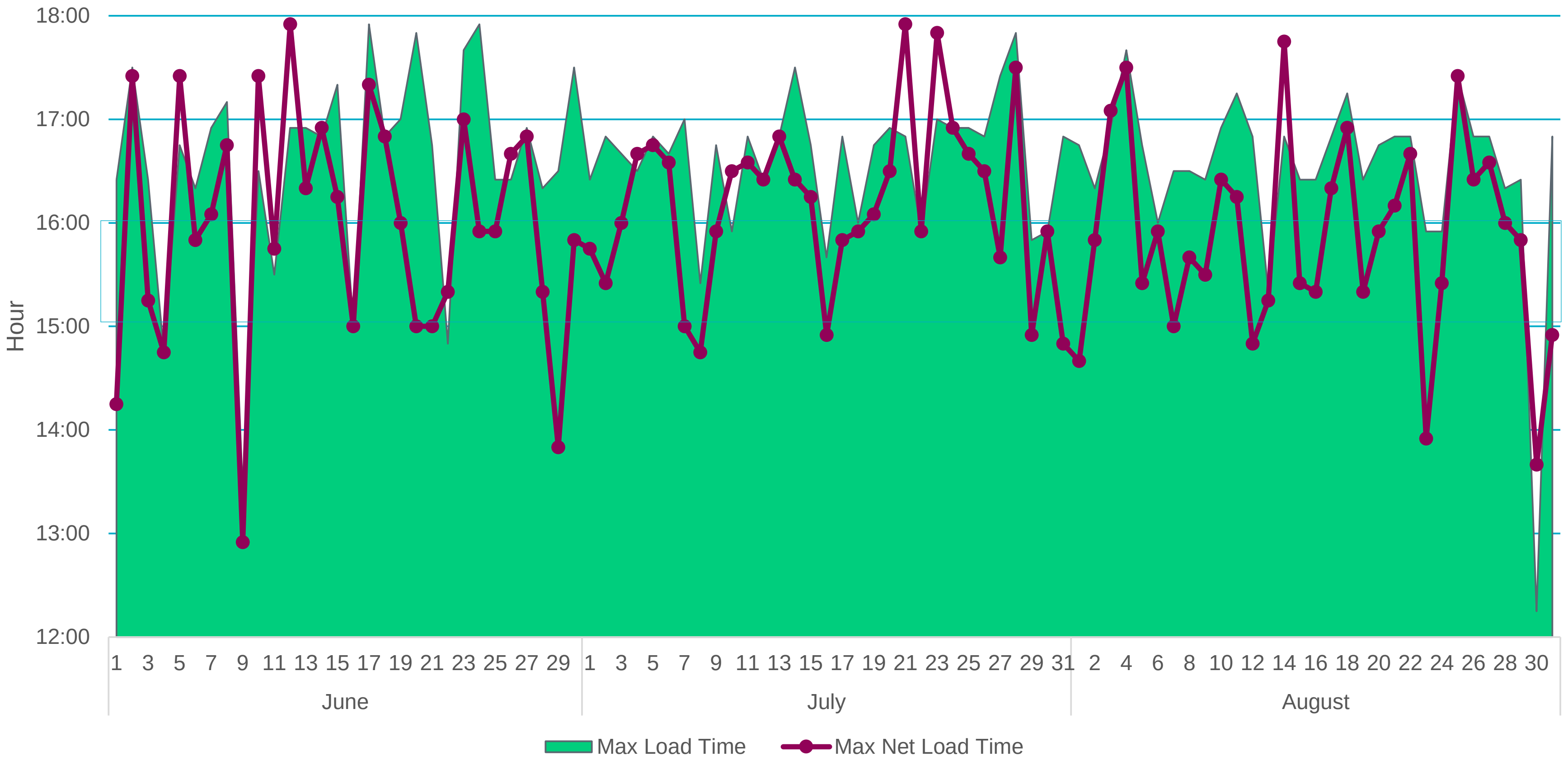
Source: Final 2019 Summer SARA
*The totals for the Final 2019 Summer SARA column combine multiple rows into a single row in some cases. (E.g., already in-service Thermal and Hydro Resources with planned Thermal and Hydro Resources).
**The outage information in this table was extracted on Sept. 16, 2019.

Closer Look at Peak Demand Day of Aug. 12



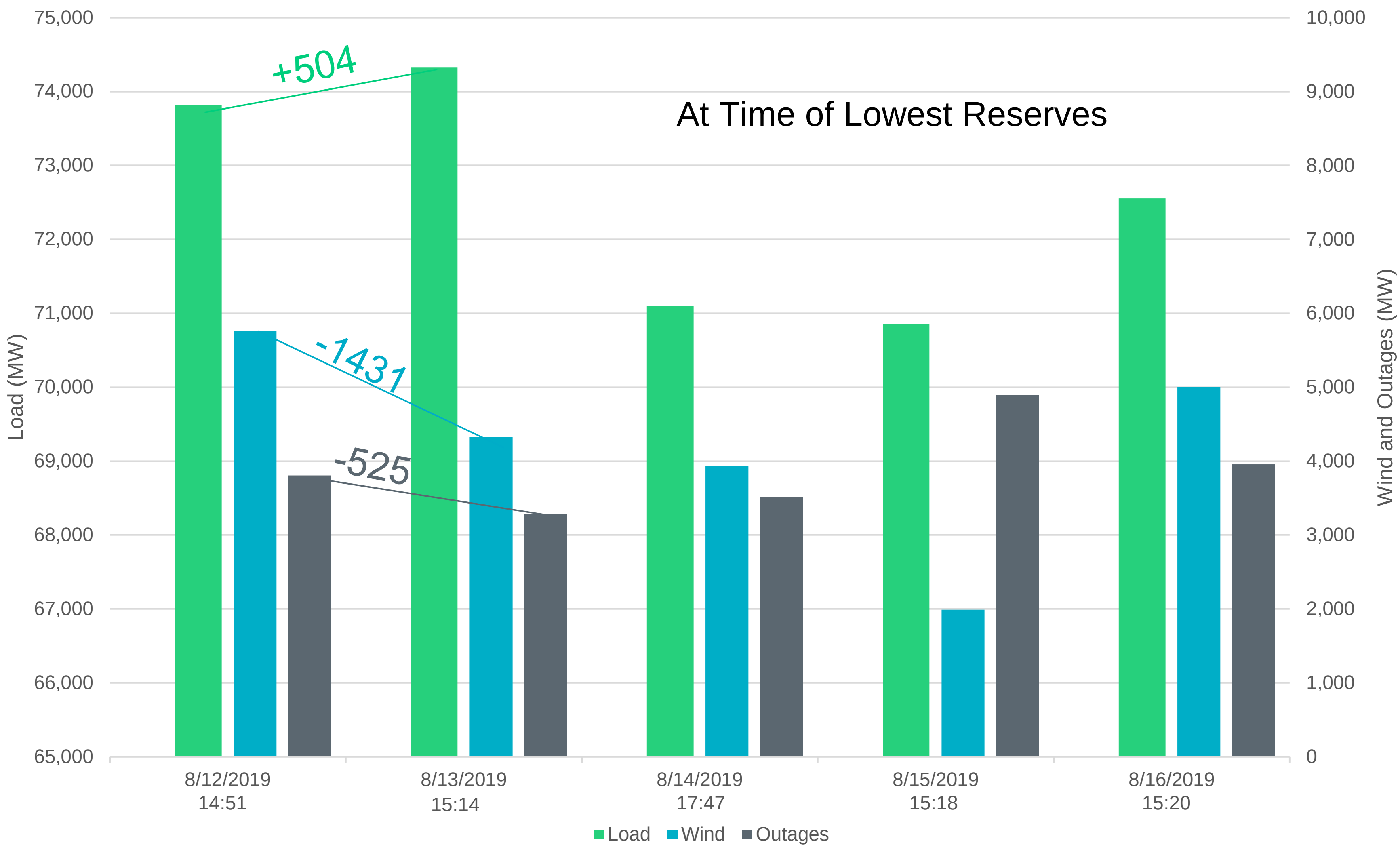
Timing of Peak Load and Peak Net Load (Load - IRR)

- During summer 2019, the peak net load frequently occurred prior to peak load.
- Net peak load occurred prior to 4 p.m. nearly 2/3 of the days in August.



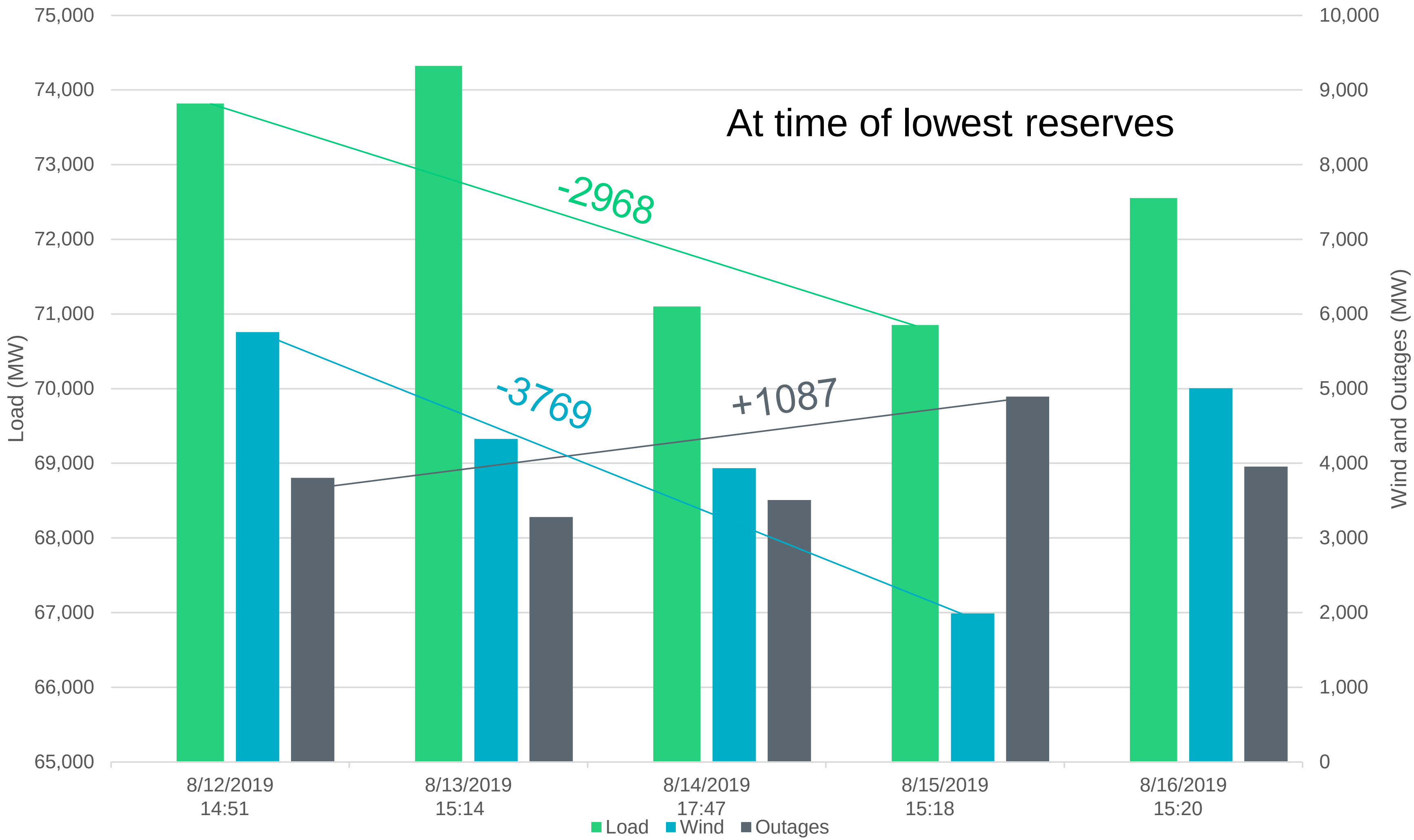
Time is rounded to nearest 5-minute interval

Load, Wind, and Outage Differences – 8/12-8/13



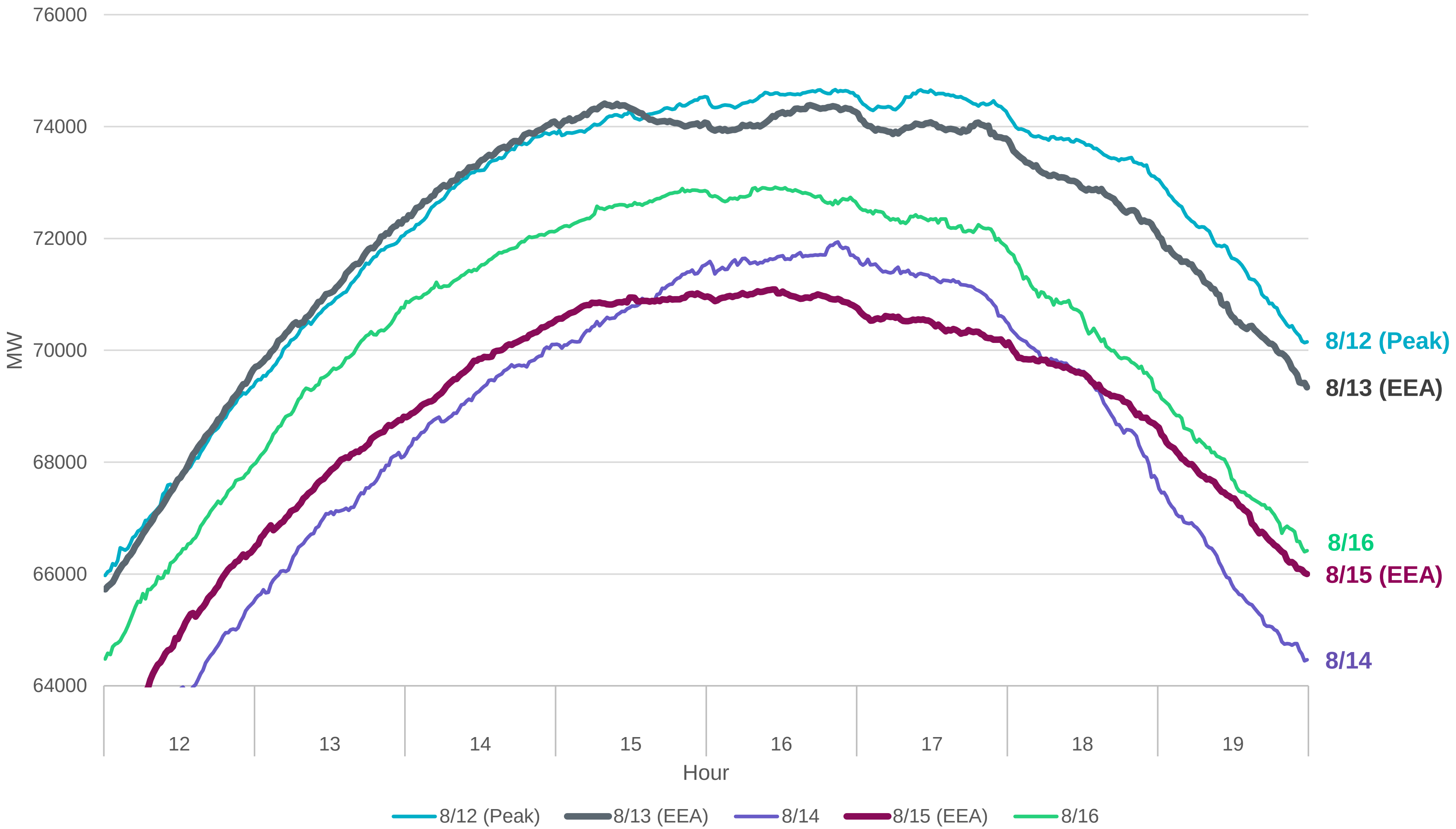
Outages Shown are non-IRR Outages

Load, Wind, and Outage Differences – 8/12-8/15



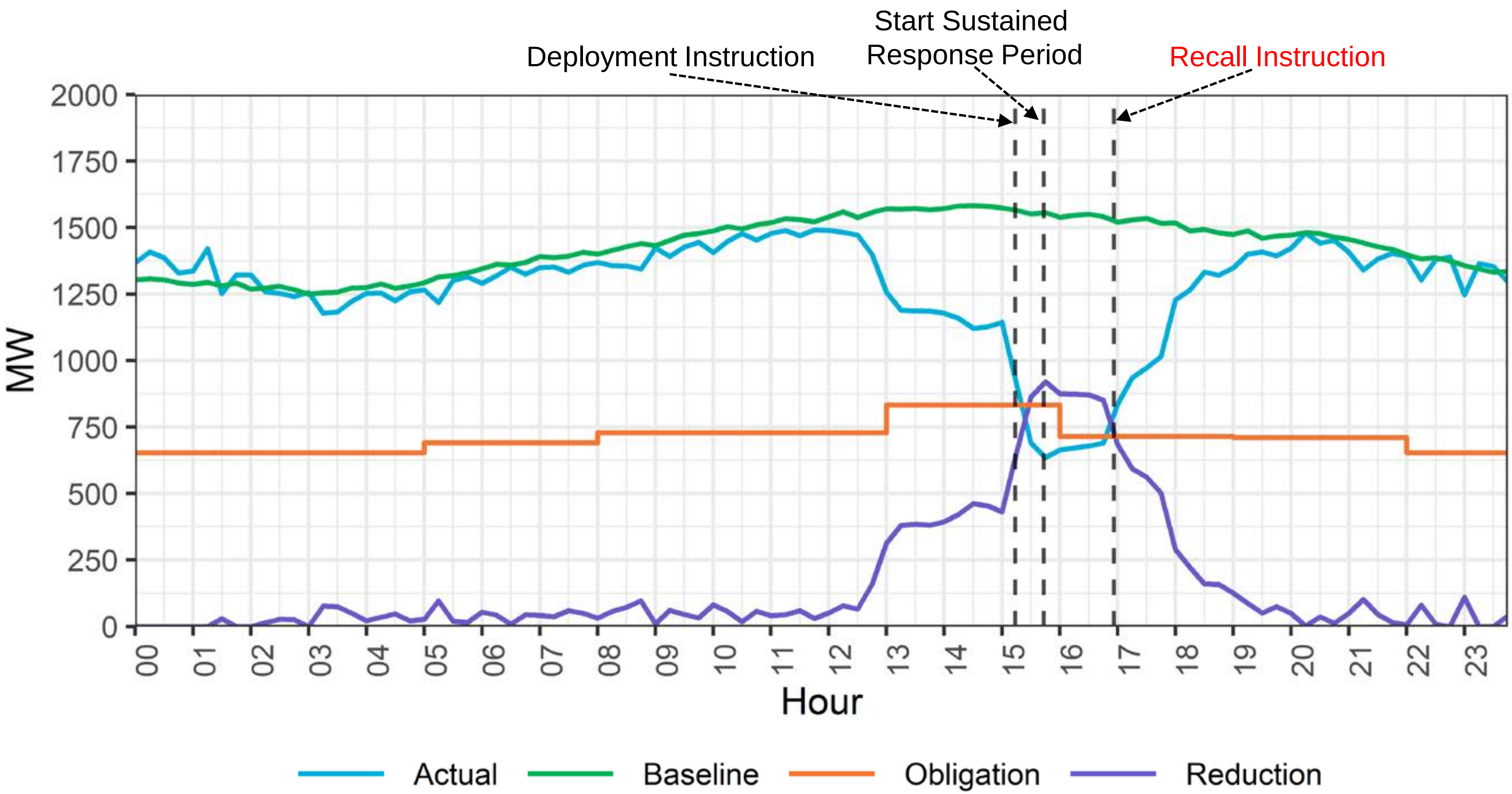
Outages shown are non-IRR outages

Load Patterns – 13:00-20:00 on 8/12-8/16

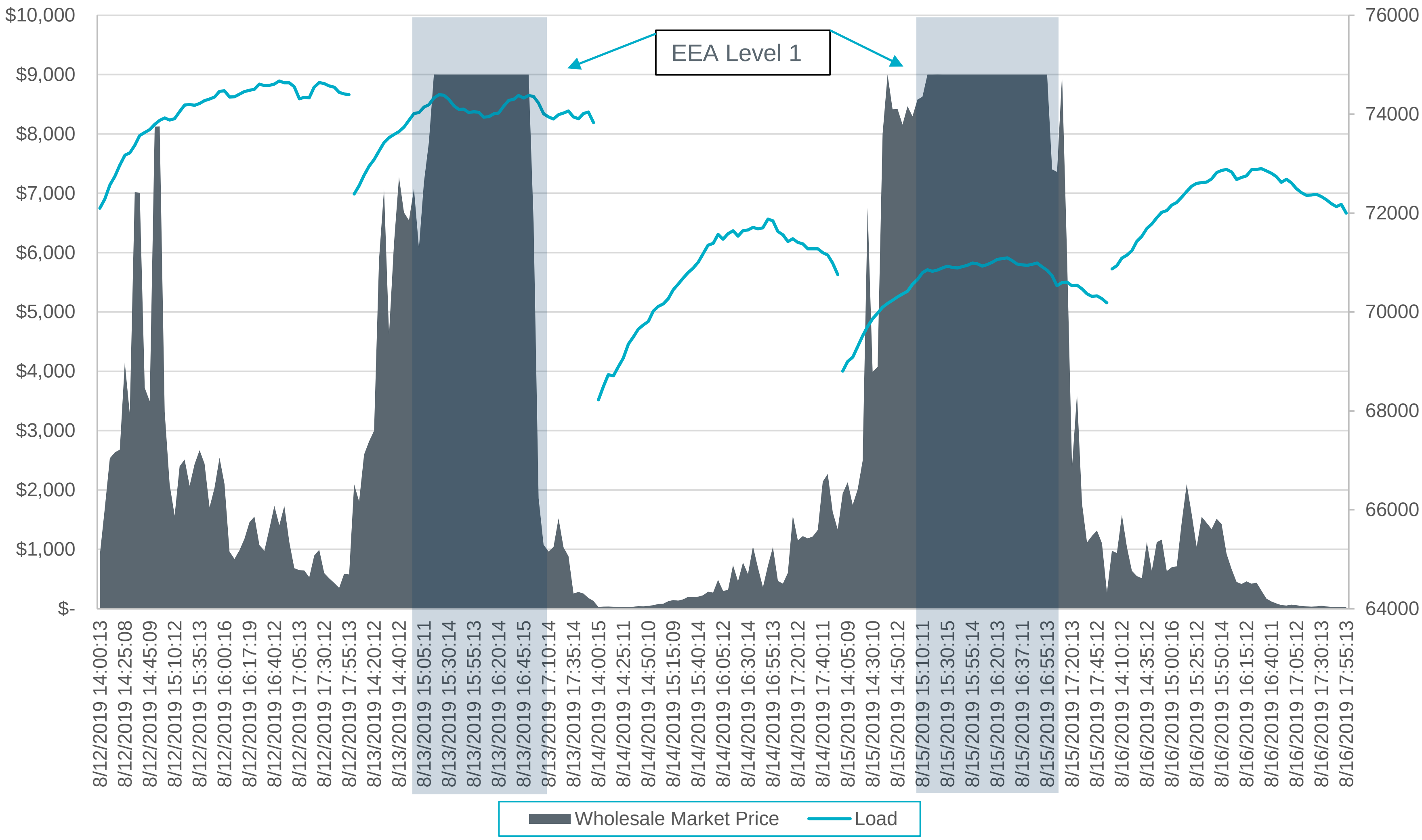


Aug. 15 Emergency Response Service (ERS) Deployment

- Fleet-wide, ERS deployment exceeded the obligation.

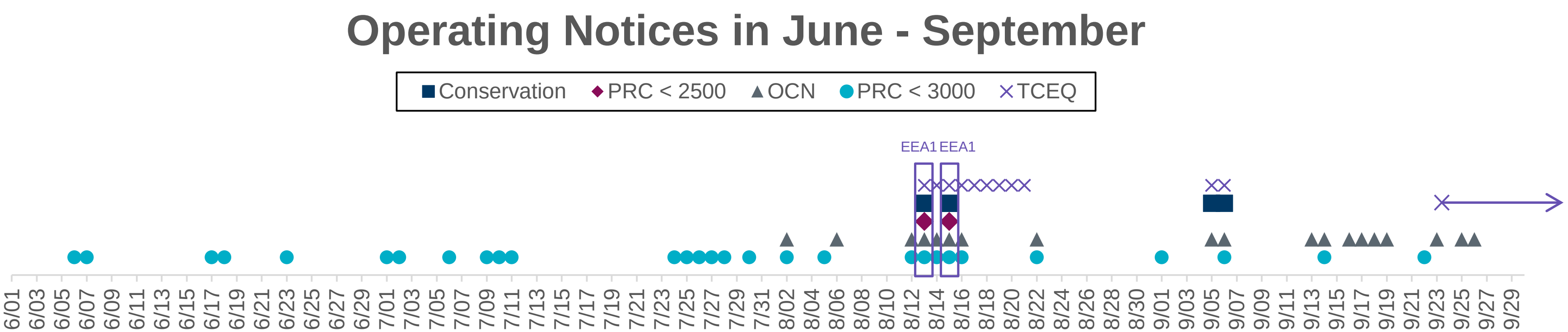


Peak Week: Wholesale Prices and Load (2 to 6 p.m.)



Operating Notices Issued in June – September 2019

- 19 Operating Condition Notices (OCNs) for reserve capacity shortage
- 29 Advisories due to Physical Responsive Capability (PRC) less than 3,000 MW
- 2 Watches due to PRC less than 2,500 MW
- 2 EEA Level 1 events
- 3 conservation requests
  - 2 request during August EEAs and 1 for Operating Days 9/5 and 9/6
- 3 TCEQ Notice of Enforcement Discretion
  - 2 system-wide notices, for Operating Days 8/13-8/21 and Operating Days for 9/5-9/6
  - 1 notice for Permian Basin units for Operating Days beginning 9/25



Key Observations for Summer 2019

- Early summer was mild, but August was very hot and September was well above normal. Based on mean temperature, June – September 2019 ranks as the 4th hottest summer on record in Texas.
- Tightest conditions frequently occurred earlier than time of peak demand (the peak net load).
- Resource performance continues to outpace historical patterns.
- Overall, the market outcomes supported reliability needs.