



March 5, 2019
Cold Weather Event

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Outline

- Review information that was anticipated/forecasted ahead of the March cold spell
 - Resource Outage Capacity
 - Load Forecast
 - Wind Forecast
- Review ERCOT's assessment on ability to meet demand and reserves during peak on March 5
- Discuss actions, outcomes and lessons learned
- Discuss outage practices, communication processes and potential cost recovery issues

In the News

Arctic front to bring widespread freeze to Central Texas

(KEYE-TV Austin, March 1, 2019)

Cold front to bring March freeze to Austin area early next week

(Austin American-Statesman, March 1, 2019)

Powerful cold front to bring winter back to Texas

(KZTV Corpus Christi, Feb. 28, 2019)

Strongest cold front of the winter

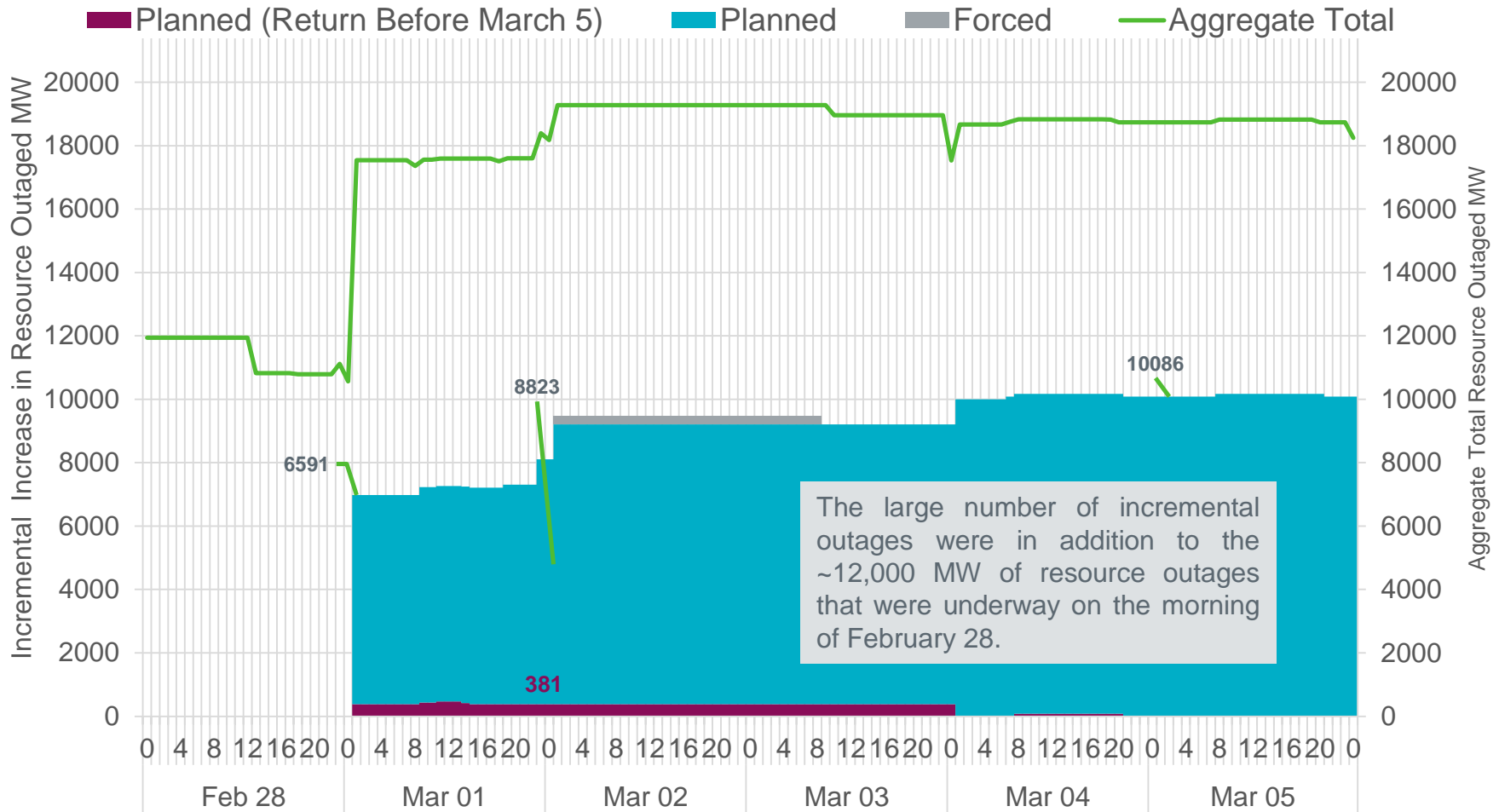
(KXAS-TV Dallas, March 1, 2019)

Arctic cold front to blow through South Texas this weekend, freeze likely

(WOAI-TV San Antonio, March 1, 2019)

Outage Capacity (non-IRR) for March 1 to March 5

- Five days in advance of the cold spell, more than 6591 MW of generation capacity was planned to be on outage on March 5 starting March 1 and an additional 2232 MW on March 2.

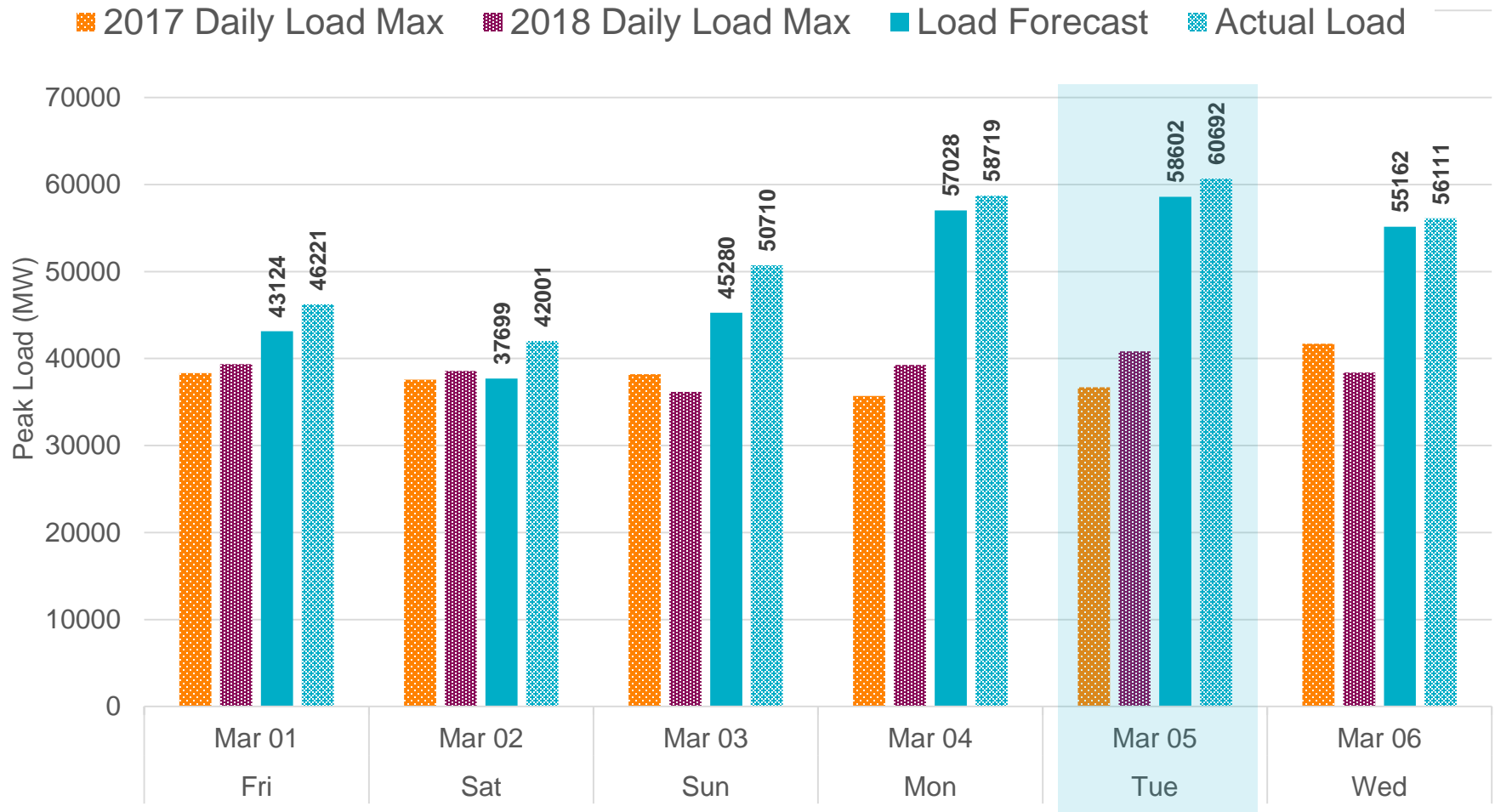


Operating Condition Notice (OCN)

- Issued OCN on February 27.
- Qualified Scheduling Entities (QSEs) instructed via hotline call to:
 - review fuel supplies,
 - review planned outages and consider delaying maintenance or returning from outage early, and
 - review winterization preparations.
- Only one unit delayed planned outage by afternoon of February 28.

Peak Load Forecast from Feb. 28 for March 1-5

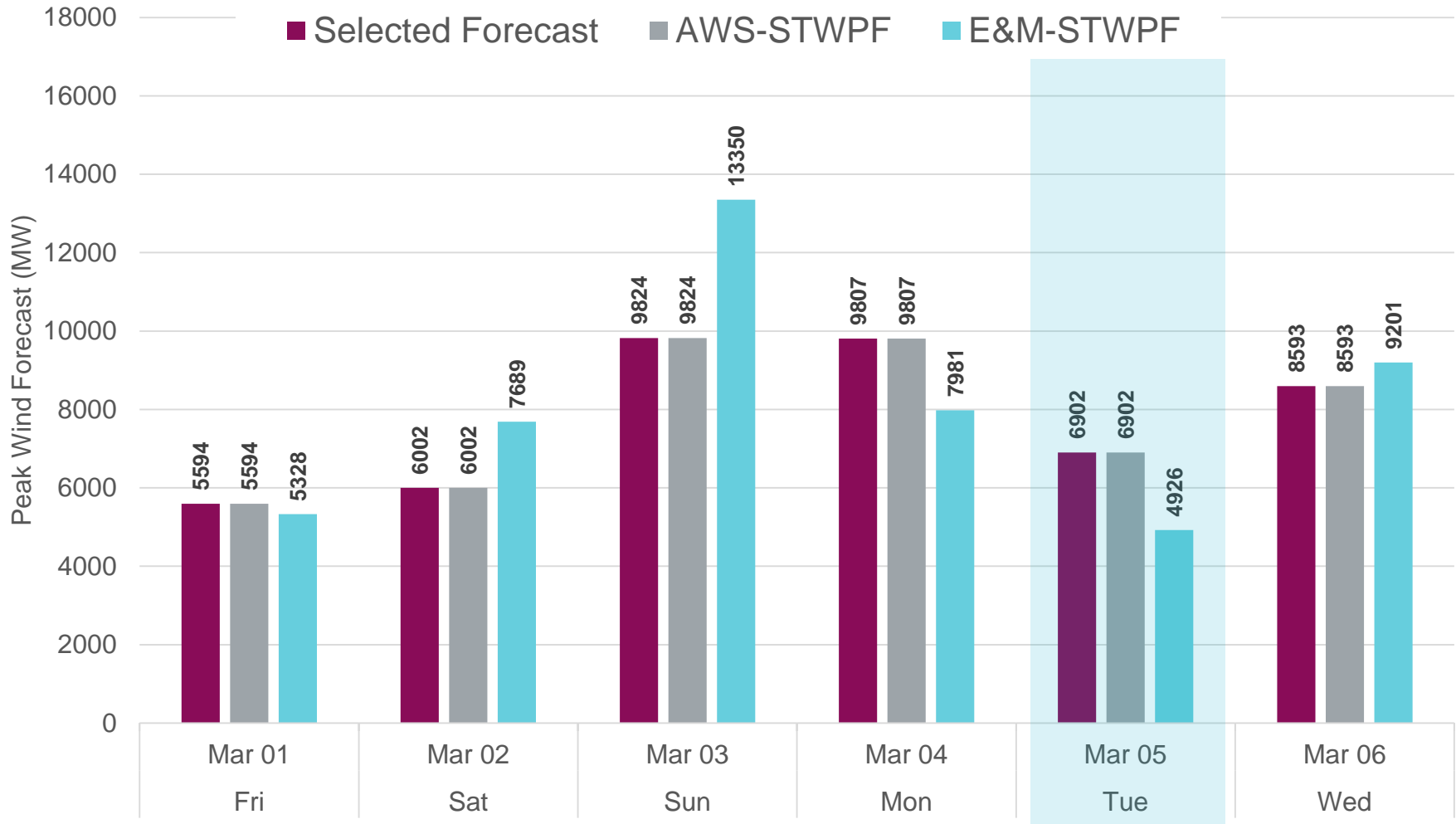
- Five days in advance of the cold spell, load forecast for the coldest days was over 58 GW, substantially higher than what is typical for this time of year.



- Peak load forecast for the days in 2019 are from 8 a.m. on Feb. 28.
- Peak load for the days in 2017 and 2018 did not necessarily occur at hour ending 8.

Wind Forecast at Peak from Feb. 28 for March 1-5

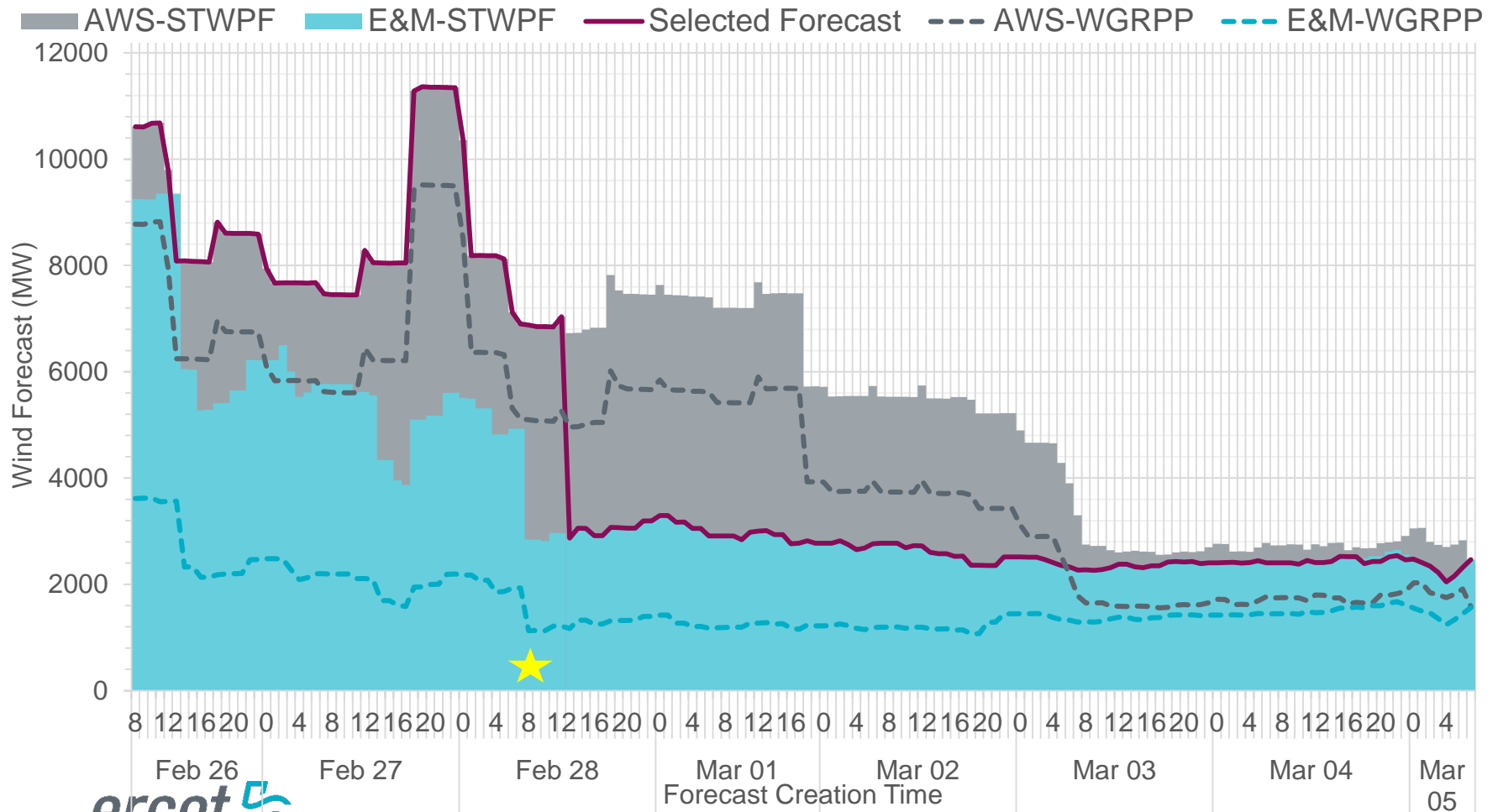
- Five days in advance of the cold spell, wind forecasts from both vendors (AWS and E&M) were indicating a decreasing trend in the amount of wind available at peak through March 5.



- Wind forecast is from 8 a.m. on Feb. 28.

Wind Forecast for Peak Hour on March 5

- Five days in advance of the cold spell, forecasts for hour ending 8 on March 5 from the two wind vendors showed large variations. On Feb. 28 after 1 p.m., the forecast selected to be used in all look-ahead studies (e.g., Outage Scheduling, RUC, DAM) was changed to the E&M forecast to better reflect expected conditions.



Uncertainties

- There are inherent uncertainties in predicting operating conditions 5-6 days in advance.
- The potential variance around the operating conditions is more significant during changing cold weather conditions due to timing and extent of cold fronts.
- Specific uncertainties that have to be accounted for during cold weather include:
 - Magnitude of demand forecast variation
 - Amount of wind generation at time of high demand
 - Potential gas restrictions
 - Forced outages of generation due to cold weather and other issues
 - Potential icing of wind turbines, etc.
- These uncertainties during these cold weather events typically tend to make operating conditions tighter.

Operational Planning

- ERCOT plans to serve load plus operating reserves in the operations planning horizon.
- To account for the significant uncertainties around the projected peak conditions for March 5, and the significant amount of planned outages scheduled for March 1, a range of scenarios were assessed on February 28.
 - This range of scenarios, based on experience, covered a reasonable range of potential outcomes.
- More extreme outcomes were possible.
 - Only assumed there would be an additional 2 GW of forced outages and that the load forecast would only go up 1,500 MW; each of these factors could be higher.
 - The actual outcomes for these factors were more extreme than what were considered in these reasonable scenarios.
- ERCOT did not specifically plan on the use of ERS, voltage reduction, etc. but assumed that those emergency resources could be used to cover the more extreme outcomes.

ERCOT Assessment on Feb. 28 for March 5 Peak

- Of the range of reasonable scenarios evaluated five days in advance of the cold spell, the scenario shown below was critical to plan for, although more extreme outcomes were possible:

	MW
	ERCOT ASSESSMENT 2/28 8:00
LOAD FORECAST	60000
REGULATION UP + RRS	3500
NON-SPIN	0
TOTAL NEEDS	63500
CONVENTIONAL GENERATION AVAILABLE	59000
WIND FORECAST	1000
LOAD RESOURCES	1000
DC TIE IMPORTS	0
GAS CURTAILMENTS	-1000
OTHER FORCED OUTAGES	-2000
TOTAL AVAILABLE	58000
SURPLUS/SHORTAGE	-5500

ERCOT Assessments on Feb. 28 for March 5 Peak

- The posted forecasts as of 08:00 on February 28 were more optimistic, because they did not take into account the risks that were considered in ERCOT's assessment, particularly for wind; ERCOT switched to using wind forecast from E&M at 13:00.

	MW	
	POSTED AT 2/28 08:00	ERCOT ASSESSMENT 2/28 8:00
LOAD FORECAST	58600	60000
REGULATION UP + RRS	3190	3500
NON-SPIN	1831	0
TOTAL NEEDS	63621	63500
CONVENTIONAL GENERATION AVAILABLE	59000	59000
WIND FORECAST	7000	1000
LOAD RESOURCES	1000	1000
DC TIE IMPORTS	0	0
GAS CURTAILMENTS		-1000
OTHER FORCED OUTAGES		-2000
TOTAL AVAILABLE	67000	58000
SURPLUS/SHORTAGE	3379	-5500

Rationale for Outage Start Delay

- The more reasonable scenarios from our assessments showed an up to 5,500 MW shortage with potential for more extreme conditions.
- As a result, some of the resources that were planning to start outage on March 1 were requested to delay their start times (~6,000 MW).
 - ERCOT anticipated that some of the units would be forced out rather than delay their outages.
 - If this occurred, or updated forecasts showed tighter conditions, ERCOT could ask the outages starting on March 2 to be delayed (~2,200 MW).
 - Due to response from March 1 outages, the additional planned outages were not needed.
- Overall, 6,500 MW of generation that was originally going to be on planned outage was available through the cold spell.

History of Protocol Section 3.1.6.9

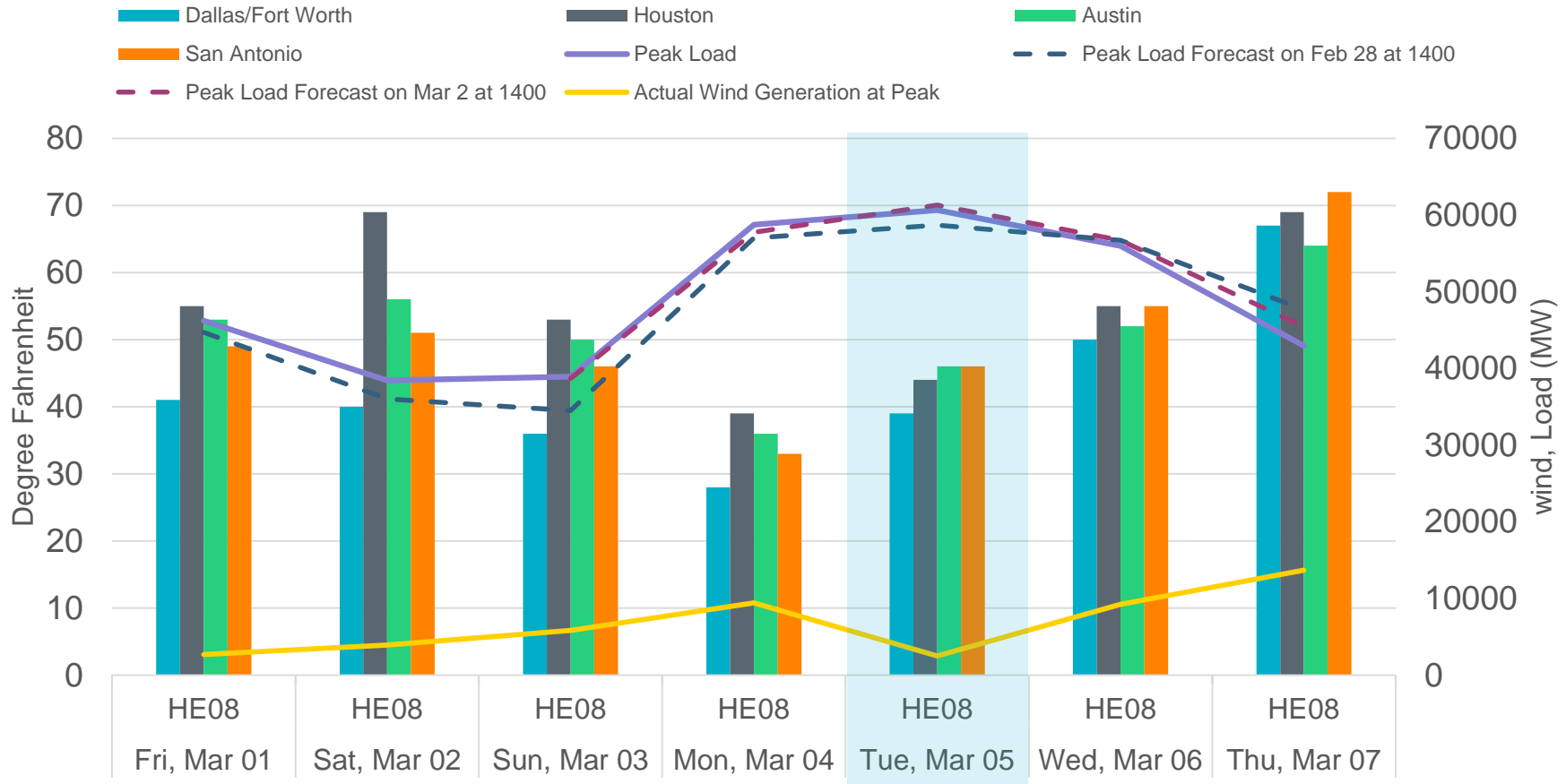
3.1.6.9 Withdrawal of Approval or Acceptance and Rescheduling of Approved or Accepted Planned Outages of Resource Facilities

(1) If ERCOT believes it cannot meet the applicable reliability standards and has exercised reasonable options, ERCOT may contact the QSE for more information prior to its withdrawal of the approval or acceptance of a Planned Outage schedule. ERCOT will only withdraw approval or acceptance of a Planned Outage to maintain reliability standards. ERCOT shall inform the affected QSE both orally and in written or electronic form as soon as ERCOT identifies a situation that may lead to the withdrawal of ERCOT's approval or acceptance. If ERCOT withdraws its approval or acceptance, the QSE may submit a new request for approval of the Planned Outage schedule provided the new request meets the submittal requirements for Outage Scheduling.

- While ERCOT did not actually withdraw resource outage approvals, Protocol Section 3.1.6.9 grants ERCOT the permission to do so.
- This section in the Protocols was added by NPRR 365 specifically to address a Recommendation from FERC/NERC report following the February 2011 Cold Weather Event.
- FERC/NERC expect that ERCOT would have the authority to recall outages if necessary for this type of event.

Cold Spell March 1-6

- Temperatures on March 4 and 5 were among the lowest experienced.* While March 4 was colder than March 5, peak load was higher on March 5. This was due to the extremely low temperatures and cloudy conditions in the prior 24 hours.



*In comparison with temperatures in spring months from 1950 through 2018.
Peak load for these days did not necessarily occur at hour ending 8.

Actual Conditions on March 5

	MW	
	ERCOT ASSESSMENT	ACTUAL
LOAD FORECAST	60000	61564
REGULATION UP + RRS	3500	-
NON-SPIN	0	-
TOTAL NEEDS	63500	61564
CONVENTIONAL GENERATION AVAILABLE	59000	61645
WIND	1000	2288
LOAD RESOURCES	1000	1405
DC TIE IMPORTS	0	1203
GAS CURTAILMENTS	-1000	-
OTHER FORCED OUTAGES	-2000	-
TOTAL AVAILABLE	58000	66541
SURPLUS/SHORTAGE	-5500	4977

Note that incremental forced outages on non-wind resources after Feb. 28 were ~4,050 MW

What Actual Conditions Would Have Been Without Outage Delays

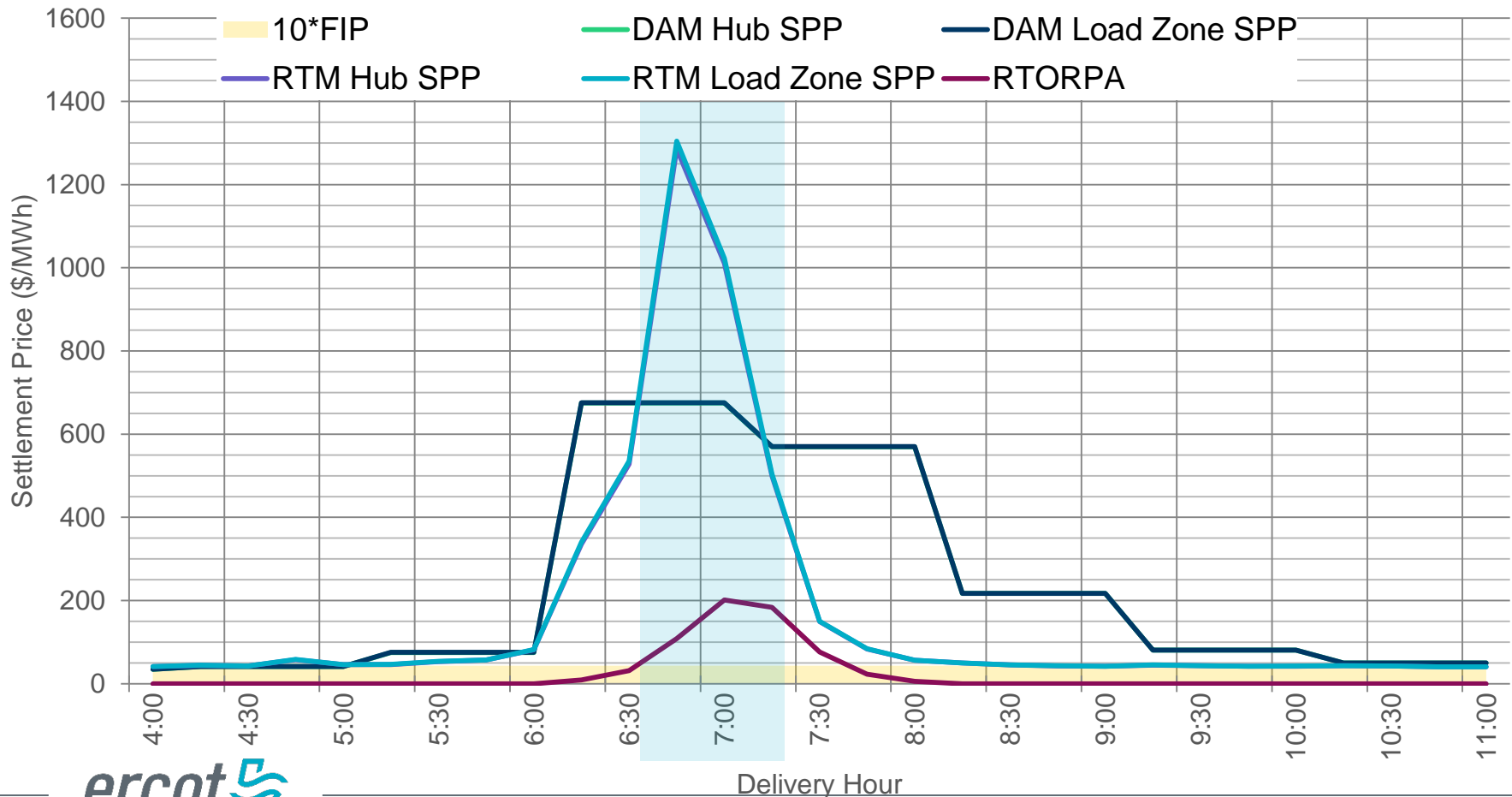
	MW		
	ERCOT ASSESSMENT	ACTUAL	ACTUAL W/O OUTAGE DELAY
LOAD FORECAST	60000	61564	61564
REGULATION UP + RRS	3500	-	-
NON-SPIN	0	-	-
TOTAL NEEDS	63500	61564	61564
CONVENTIONAL GENERATION AVAILABLE	59000	61645	55145
WIND	1000	2288	2288
LOAD RESOURCES	1000	1405	1405
DC TIE IMPORTS	0	1203	1203
GAS CURTAILMENTS	-1000	-	-
OTHER FORCED OUTAGES	-2000	-	-
TOTAL AVAILABLE	58000	66541	60041
SURPLUS/SHORTAGE	-5500	4977	-1523

Other Considerations

- This evaluation looks at the instantaneous peak on the morning of March 5.
- The integrated hourly peak was 60,692 MW
- Emergency Response Service would be used in EEA: ~935 MW (procured)
- ERCOT is required to shed firm load to restore 1000MW of reserves (as measured by Physical Responsive Capability) within 30 minutes

Pricing Outcomes for March 5

- Higher system-wide Settlement Point Prices (SPPs) were seen for the morning hours on March 5 in both the Day-Ahead Market (DAM) and Real-Time Market (RTM). There were periods of lower ORDC reserves and higher ORDC Price Adders (RTORPA) during the same period.



Potential Improvement Ideas

- Review resource outage practices, including:
 - Max starts any given day
 - Coordinated review
 - Process to withdraw or delay planned start dates
- Communication processes:
 - New type of OCN for situations like this
 - Phone communication standards
 - More complete communication of situation to all - ERCOT view vs. market view
- Cost recovery and/or price signals for outages withdrawn for system-wide capacity shortage
- Other?

APPENDIX

BAL-002 Disturbance Control Standard

R2. Each Responsible Entity shall develop, review and maintain annually, and implement an Operating Process as part of its Operating Plan to determine its Most Severe Single Contingency and make preparations to have Contingency Reserve equal to, or greater than the Responsible Entity's Most Severe Single Contingency available for maintaining system reliability.

EOP-011-1 Emergency Operations

R1. Each Transmission Operator shall develop, maintain, and implement one or more Reliability Coordinator-reviewed Operating Plan(s) to mitigate operating Emergencies in its Transmission Operator Area. The Operating Plan(s) shall include the following, as applicable:

- 1.1. Roles and responsibilities for activating the Operating Plan(s);
- 1.2. Processes to prepare for and mitigate Emergencies including:
 - 1.2.1. Notification to its Reliability Coordinator, to include current and projected conditions, when experiencing an operating Emergency;
 - 1.2.2. Cancellation or recall of Transmission and generation outages;
 - 1.2.3. Transmission system reconfiguration;
 - 1.2.4. Redispatch of generation request;
 - 1.2.5. Provisions for operator-controlled manual Load shedding that minimizes the overlap with automatic Load shedding and are capable of being implemented in a timeframe adequate for mitigating the Emergency; and
 - 1.2.6. Reliability impacts of extreme weather conditions.

EOP-011-1 Emergency Operations

R2. Each Balancing Authority shall develop, maintain, and implement one or more Reliability Coordinator-reviewed Operating Plan(s) to mitigate Capacity Emergencies and Energy Emergencies within its Balancing Authority Area. The Operating Plan(s) shall include the following, as applicable:

- 2.1. Roles and responsibilities for activating the Operating Plan(s);
- 2.2. Processes to prepare for and mitigate Emergencies including:
 - 2.2.1. Notification to its Reliability Coordinator, to include current and projected conditions when experiencing a Capacity Emergency or Energy Emergency;
 - 2.2.2. Requesting an Energy Emergency Alert, per Attachment 1;
 - 2.2.3. Managing generating resources in its Balancing Authority Area to address:
 - 2.2.3.1. capability and availability;
 - 2.2.3.2. fuel supply and inventory concerns;
 - 2.2.3.3. fuel switching capabilities; and
 - 2.2.3.4. environmental constraints.
 - 2.2.4. Public appeals for voluntary Load reductions;
 - 2.2.5. Requests to government agencies to implement their programs to achieve necessary energy reductions;
 - 2.2.6. Reduction of internal utility energy use;
 - 2.2.7. Use of Interruptible Load, curtailable Load and demand response;
 - 2.2.8. Provisions for operator-controlled manual Load shedding that minimizes the overlap with automatic Load shedding and are capable of being implemented in a timeframe adequate for mitigating the Emergency; and
 - 2.2.9. Reliability impacts of extreme weather conditions.