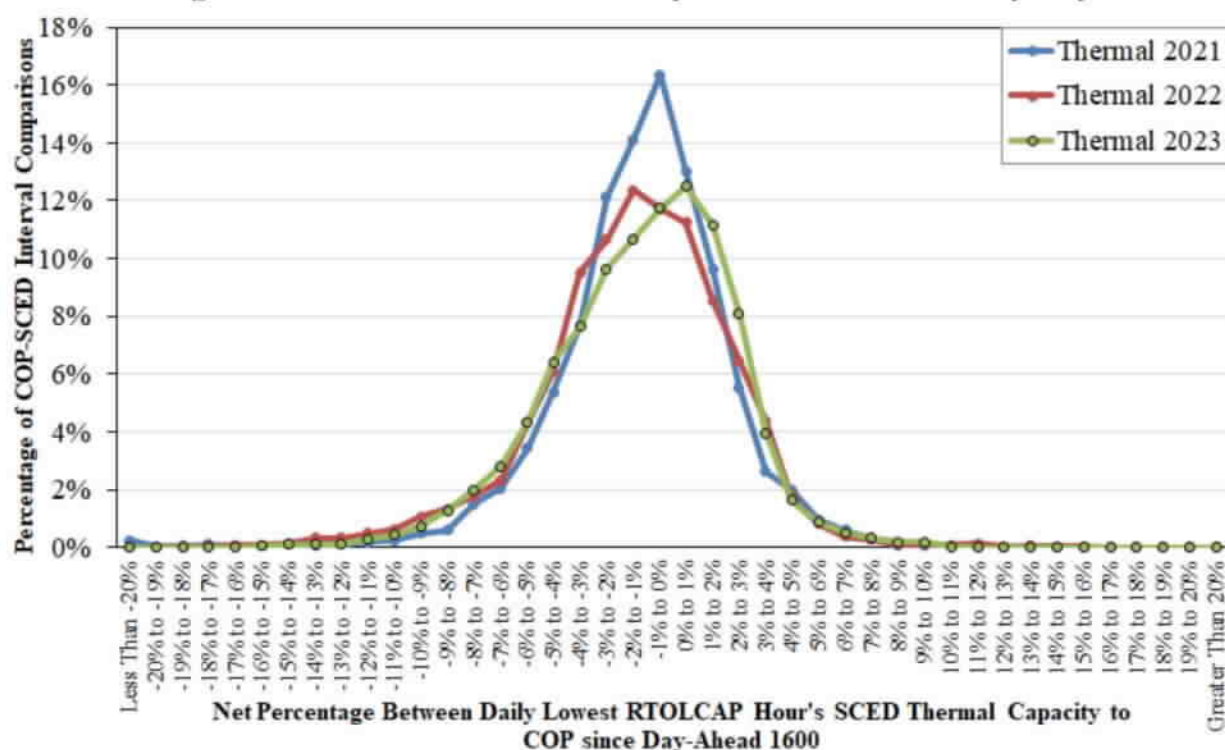


which are discussed in Section III: Appendix: Demand and Supply in ERCOT, the differences will not be highlighted here.

Figure A39 shows the frequency of percentage error between SCED thermal capacity and its respective COP for the daily operating hour experiencing the lowest RTOLCAP for the full year. The comparisons include applicable COP comparisons 24 hours up to the operating hour starting with the day-ahead COP snapshot at 1600. The analysis focuses on the net difference as a percentage of the SCED thermal capacity to control for load fluctuations between years. The last three years have shown a trend towards an error greater than 1%. The bucket granularity is very small as to be able to capture the minutiae differences in the curve between 2022 and 2023.

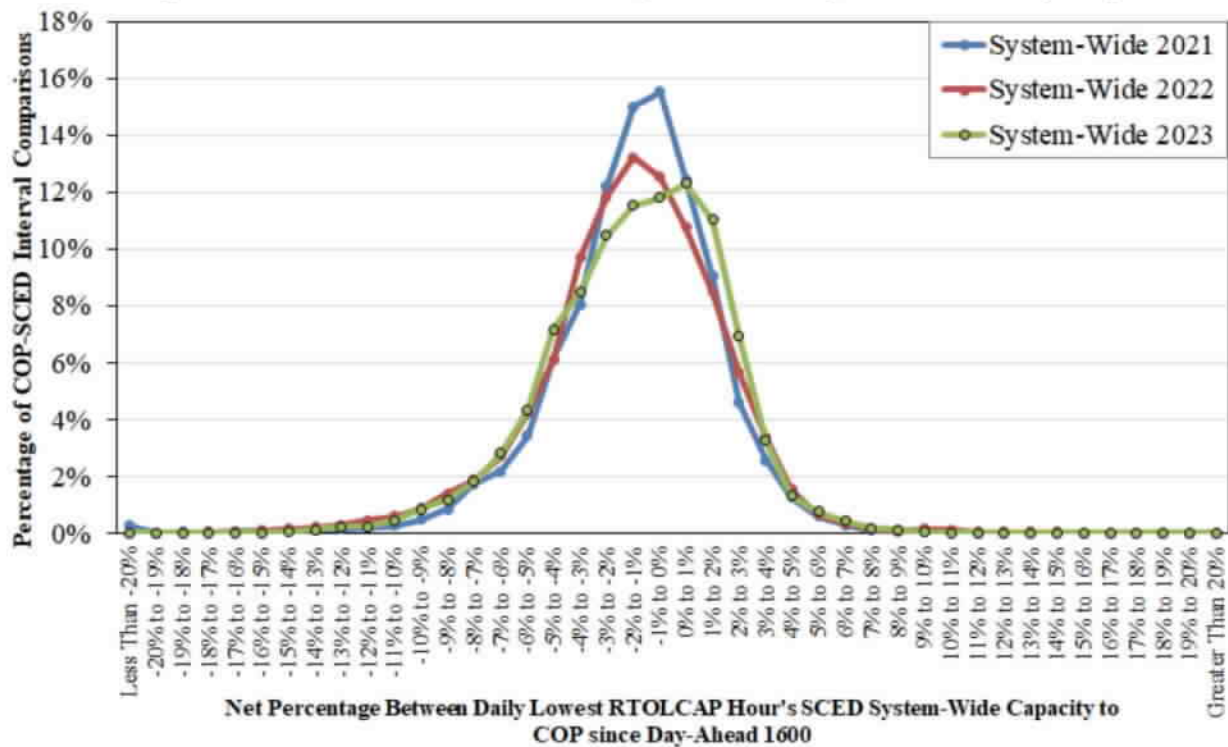
Figure A39: Real-Time to COP Comparisons for Thermal Capacity



When analyzing the average net between SCED thermal capacity and the respective COP reported from 24 hours to the last valid COP, there appears to be a tendency to under-report COP capacity 24 hours ahead, commit some capacity, and then decommit at the end of the adjustment period a small percentage of the time. The curve from 2021 is generally similar to the curves from the previous two years, but 2022 and 2023 are notably more depressed, exhibiting a much smaller contrast. This is because there were more instances of COP errors than in previous years for the low RTOLCAP hours. The curve in 2023 shows an increased bias towards under-representing the amount of thermal real-time capacity for the low RTOLCAP hour as compared to 2022. Figure A40

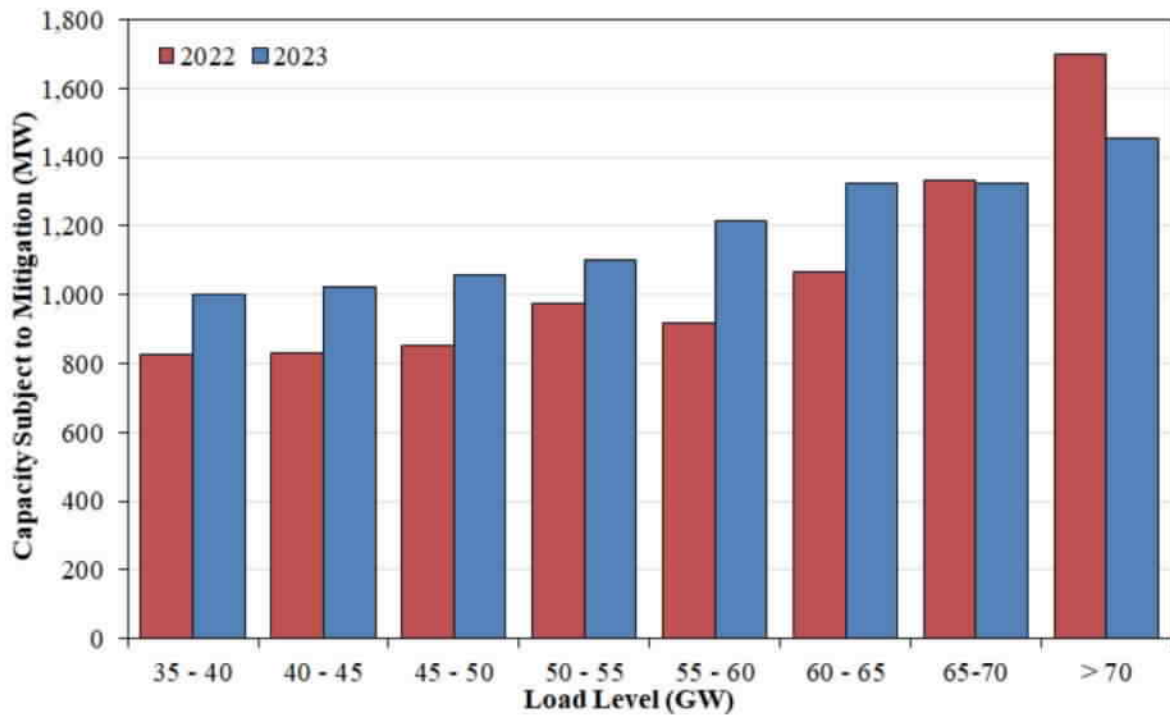
Figure A40 summarizes the same analysis as above, but for system-wide capacity for the daily lowest RTOLCAP operating hour of each year. The curves in 2022 and 2023 are similar to those viewed in Figure A39, whereas there is a clearer depression in the peak for the 2021 COP when viewing the low RTOLCAP hours and their respective COP snapshots. Solar and wind forecasts indicate less hours for the low RTOLCAP hours 24 hours prior to the operating hour.

Figure A40: Real-Time to COP Comparisons for System-Wide Capacity



F. Mitigation

The next analysis computes the total capacity of RUC and self-committed resources subject to mitigation by comparing a generator's mitigated and unmitigated (as submitted) offer curves and determining the point at which they diverge. The difference between the total unit capacity and the capacity at the point the curves diverge is calculated for all units and aggregated by load level. The results are shown in Figure A41.

Figure A41: Average Capacity Subject to Mitigation

The average amount of capacity subject to mitigation in 2023 was higher than in 2022 at all load levels except for the highest two load levels (65-70 and >70). It is important to note that this measure includes all capacity above the point at which a unit's offers become mitigated, without regard for whether that capacity was actually required to serve load.

VII. APPENDIX: RESOURCE ADEQUACY

In this section, we provide a supplemental analysis of the economic signals present in 2023 that will facilitate the investment needed to maintain a set of resources that are adequate to satisfy the system's needs. We provide the estimate of the level of "net revenue" that resources received from ERCOT real-time and ancillary services markets.

A. Locational Variations in Net Revenues in the West Zone

Fuel prices are a substantial determinant of net revenues because they are the primary offset from market revenues when calculating net revenues. In 2020, we noted the growing separation in natural gas prices between the Waha location in the west and Katy locations in the east. Drilling activity in the Permian Basin of Far West Texas has produced a surplus of natural gas, and consequently, much lower prices at the Waha location. As seen in Figure A42 below, prices were down overall in 2023. Waha prices in 2023 dipped below \$0 multiple times and were once again more volatile than Katy.

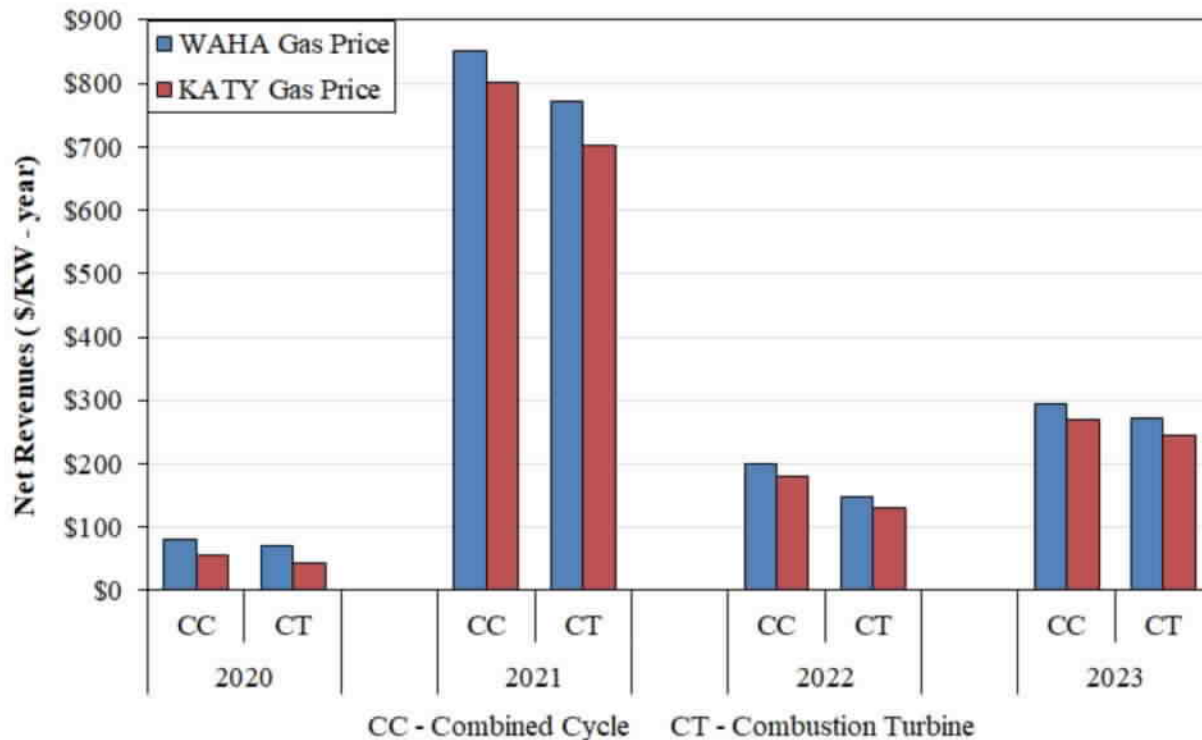
Figure A42: Gas Price and Volume by Index



Historically, resources in the West Zone have had lower net revenues than resources in the other zones, but that was not the case in 2021 through 2023. The divergence between Waha and Katy gas prices contributed to greater net revenues for West Texas gas-fired generators. Figure A43 provides a comparison of net revenue for both types of natural gas units, assuming Katy and

Waha gas prices. Net revenues based on Waha gas prices contributed to higher West Zone revenues.

Figure A43: West Zone Net Revenues



B. Reliability Must Run and Must Run Alternative

Reliability-Must-Run procedures are essential for determining and addressing the need for generation units to support grid reliability. Although no new Reliability Must-Run (RMR) contracts were awarded in 2023, a number of NSOs were submitted, as detailed below. ERCOT determined that none of the resources listed below were necessary to support ERCOT transmission system reliability.

Five resources suspended operations (i.e., mothballed) in 2023: one combined cycle, two gas turbines, one wind, and a portion of a combined cycle.¹⁷⁶ One ESR with an HSL of 101.7 MW submitted an NSO to temporarily suspend operation for a designated timeframe due to some reason other than a forced outage.¹⁷⁷ Two resources experienced forced outages resulting in

¹⁷⁶ https://www.ercot.com/services/comm/mkt_notices/M-E050523-01;
https://www.ercot.com/services/comm/mkt_notices/M-B072723-01;
https://www.ercot.com/services/comm/mkt_notices/M-A061423-01.

¹⁷⁷ https://www.ercot.com/services/comm/mkt_notices/M-C102023-01;
https://www.ercot.com/services/comm/mkt_notices/M-C102023-02.

submission of NSOs, totaling 72 MW. One Private-Use Network of 61 MW was permanently decommissioned and retired.¹⁷⁸

Two NSOs submitted in 2023 had different outcomes. Deer Park Refining Limited Partnership converted four Private-Use Network resources into Settlement Only Transmission Self-Generators, totaling 120 MW.¹⁷⁹ Barney Davis G1, a resource with an HSL of 292 MW, submitted an NSO on July 23, 2023, to become effective on November 24, 2023; however, the NSO was withdrawn on October 27th, 2023.¹⁸⁰

¹⁷⁸ https://www.ercot.com/services/comm/mkt_notices/M-B020323-01.

¹⁷⁹ https://www.ercot.com/services/comm/mkt_notices/M-E052623-01.

¹⁸⁰ https://www.ercot.com/services/comm/mkt_notices/M-B062723-04.

VIII. APPENDIX: ANALYSIS OF COMPETITIVE PERFORMANCE

In this section, we provide supplemental analyses to evaluate market power from two perspectives: structural (does market power exist) and behavioral (have attempts been made to exercise it). Market structure is examined by using a pivotal supplier analysis that indicates the frequency with which a supplier was pivotal at higher load levels. Market participant conduct is evaluated by reviewing measures of physical and economic withholding. These withholding patterns are examined relative to the level of demand and the size of each supplier's portfolio.

A. Structural Market Power Indicators

When the Residual Demand Index (RDI) is greater than zero, the largest supplier is pivotal (i.e., its resources are needed to satisfy the market demand). When the RDI is less than zero, no single supplier's resources are needed to serve the load if the resources of its competitors are available.

1. Voluntary Mitigation Plans

In 2023, three market participants had active VMPs. Each of these VMPs went through significant modifications regarding non-spinning reserves in March of 2023. Pursuant to those modifications, NRG's ancillary services offers are no longer covered by their VMP; Luminant has a \$20 per MWh non-spinning reserve offer cap; and Calpine has a dynamic formula based on its offers for other ancillary services.

i. Calpine VMP

Calpine's VMP was initially approved in March of 2013.¹⁸¹ Because its generation fleet consists entirely of natural gas fueled combined cycle units, the details of the Calpine plan are somewhat different than the others. Calpine may offer up to 10% of the dispatchable capacity of its portfolio at prices up to \$500 per MWh. Additionally, Calpine may offer up to 5% of the dispatchable capacity of its portfolio at prices no higher than the system-wide offer cap. When approved, the amount of capacity covered by these provisions was approximately 500 MW.

In March of 2023, Calpine's VMP was amended to eliminate the provision allowing non-spinning reserve offers in the day-ahead market to be made up to and including the high system-wide offer cap.¹⁸² A dynamic formula for non-spinning reserve offers was substituted for the

¹⁸¹ *Petition of Calpine Corporation for Approval of Voluntary Mitigation Plan*, Docket No. 40545, Order (Mar. 28, 2013).

¹⁸² *Request for Approval of an Amended Voluntary Mitigation Plan for Calpine Corporation Pursuant to PURA § 15.023(f) and 16 TAC § 25.504(e)*, Docket 54741, Order (Mar. 23, 2023).

Appendix: Analysis of Competitive Performance

eliminated provision.¹⁸³ The new formula is based on Calpine's offers for other ancillary services, recognizing that non-spinning reserves are of lower value to the ERCOT system than responsive reserve service, regulation up, or ECRS. Calpine's VMP remains in effect from the date it was approved by the PUCT until terminated by the Executive Director of the PUCT or Calpine.¹⁸⁴

ii. NRG VMP

NRG's plan, initially approved in June 2012 and modified in May 2014,¹⁸⁵ allows the company to offer some of its capacity at prices up to the system-wide offer cap. Specifically, up to 12% of the difference between the high sustained limit and the LSL – the dispatchable capacity – each natural gas unit (5% for each coal or lignite unit) may be offered no higher than the greater of \$500 per MWh or 50 times the natural gas price. Additionally, up to 3% of the dispatchable capacity for each natural gas unit may be offered no higher than the system-wide offer cap. The amount of capacity covered by these provisions is approximately 500 MW.

Before March of 2023, NRG's VMP provided that offers or bids for energy and ancillary services in the day-ahead market could be submitted at prices up to and including the high system-wide offer cap.¹⁸⁶ In March of 2023, the PUCT terminated, in part, NRG's VMP, ensuring that the VMP no longer provided NRG with an absolute defense for offer or bids made in the day-ahead ancillary services market at prices up to and including the HCAP.¹⁸⁷ In February of 2024, NRG filed a letter with the PUCT expressing NRG's intent to exercise its right to terminate its VMP, effective March 1, 2024.¹⁸⁸

¹⁸³ *Id.*

¹⁸⁴ *Id.*

¹⁸⁵ *Request for Approval of a Voluntary Mitigation Plan for NRG Companies Pursuant to PURA § 15.023(f) and P.U.C. Subst. R. 25.504(e)*, Docket No. 40488, Order (Jul. 13, 2012); *Request for Approval of an Amended Voluntary Mitigation Plan for NRG Companies*, Docket No. 42611, Order (Jul. 11, 2014).

¹⁸⁶ *Request for Approval of an Amended Voluntary Mitigation Plan for NRG Companies*, Docket No. 42611, Order (Jul. 11, 2014).

¹⁸⁷ *Request for Ratification of PUCT Staff's Termination in Part of the Amended Voluntary Mitigation Plan for NRG Companies*, Docket 54740, Order (Mar. 23, 2023).

¹⁸⁸ *Request for Ratification of PUCT Staff's Termination in Part of the Amended Voluntary Mitigation Plan for NRG Companies*, Docket No. 54740, NRG Notice Regarding Voluntary Mitigation Plan (Feb. 23, 2024).

iii. Luminant VMP

Luminant received approval from the PUCT for a new VMP in December 2019.¹⁸⁹ The PUCT terminated Luminant's previous VMP on April 9, 2018, as a result of its merger with Dynegy, Inc.¹⁹⁰ The new VMP provides for small amounts of capacity from non-quick start, non-combined cycle natural gas-fired units to be offered up to 12% of the dispatchable capacity for each unit at prices up to \$500 per MWh, and up to 3% of the dispatchable capacity may be offered at prices up to and including the HCAP. When approved in late 2019, the amount of capacity covered by these provisions was less than 900 MW. In addition, the plan defines allowable limits for energy offers from Luminant's quick start combustion turbines.

Before March of 2023, Luminant's VMP provided that offers in the day-ahead market for ancillary services could be made up to and including the high system-wide offer cap. In March of 2023, Luminant's VMP was amended to place a cap on offers in the day-ahead market for non-spinning reserve service of \$20 per MWh for all resources.¹⁹¹

B. Evaluation of Supplier Conduct

Figure A44 below shows the relationship of short-term outages and derates to load levels during the winter, spring, and fall quarters of 2023.

¹⁸⁹ *PUCT Staff Request for Approval of a Voluntary Mitigation Plan for Luminant Energy Company, LLC under PURA §15.023(f) and 16 TAC §25.504(e)*, Docket No. 49858, (Dec. 13, 2019).

¹⁹⁰ *See Application of Luminant Power Generation LLC, Big Brown Power Company LLC, Comanche Peak Power Company LLC, La Frontera Holdings LLC, Oak Grove Management Company LLC, and Sandow Power Company Under Section § 39.158 of the Public Utility Regulatory Act*, Docket No. 47801 (Nov. 22, 2017); on April 9, 2018, Luminant filed a letter with the PUCT terminating its VMP upon closing of the proposed transaction approved by the PUCT in Finding of Fact No. 36 of the Order in Docket No. 47801, see also *Request for Approval of a Voluntary Mitigation Plan for Luminant Companies Pursuant to PURA § 15.023(f) and P.U.C. Subst. R. 25.504(e)*, Docket No. 44635, Order Approving VMP Settlement (May 22, 2015).

¹⁹¹ *Request for Approval of an Amended Voluntary Mitigation Plan for Luminant Energy Company LLC Pursuant to PURA § 15.023(f) and 16 TAC § 25.504(e)*, Docket No. 54739 (Mar. 23, 2023).

Figure A44: Outages and Deratings by Load Level and Participant Size

