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COMMENTS

PROJECT NO. 52373

REVIEW OF WHOLESALE ELECTRIC	**§**	**PUBLIC UTILITY COMMISSION**
	§	
MARKET DESIGN	**§**	**OF TEXAS**

RECURRENT ENERGY COMMENTS

Recurrent Energy ("Recurrent") appreciates the opportunity to provide feedback and propose potential solutions related to the Electric Reliability Council of Texas ("ERCOT") market design in response to Project 52373: *Review of Wholesale Market Design* issued by the Public Utility Commission of Texas (the "Commission").

Recurrent is a leading wholesale solar and energy storage project developer. Most recently, Recurrent developed one of the largest solar plus storage projects (Slate, a 300 MWac solar and 140.25 MWac / 561 MWh storage facility) and the second largest battery energy storage project in the world (Crimson, a 350 MWac / 1,400 MWh facility), both of which are being constructed. These projects and the more than 11 GWh of energy storage projects Recurrent has under development across the United States are designed in part to help provide grid reliability and resiliency services. As a major provider of market-based infrastructural projects for grid reliability, Recurrent appreciates the Commission's consideration of the comments herein.

I. Executive Summary

In response to the catastrophic impacts of Winter Storm Uri as directed by the Legislature of Texas in Senate Bill 3,[1] ERCOT must enhance its existing competitive market construct to ensure reliability for Texas consumers over the long term. These enhancements should include a procurement mechanism for energy storage to provide additional resilience when factors like extreme weather diminish the reliability of other energy sources and the State's natural gas pipeline infrastructure. Given the capital-intensive nature and long investment horizons inherent in constructing new energy projects, ERCOT's market prices must provide a sustainable forward revenue opportunity that is sufficient to attract such investment well in advance of potential

[1] S.B. No 3 requires the PUC to implement measures to prepare to operate during a weather emergency including mandated weatherization, establish an emergency pricing program, and exploring energy market design changes. Available at: https://capitol.texas.gov.tlodocs/87R/billtext/pdf/SB00003I.pdf

disruptions to the power grid. To date, the short-term price signals provided by ERCOT's scarcity pricing framework have failed to accomplish this core resiliency objective.

ERCOT's existing energy-only market design uses administratively determined scarcity pricing to incentivize investment in new generation supply to meet energy demand during rare scarcity conditions. This "crisis-based" market design has produced modest success in keeping costs to consumers relatively low during periods of stable weather and load conditions. However, it also produced catastrophic system failures and cascading bankruptcies during periods of volatile weather and load conditions, as demonstrated by Winter Storm Uri. As shown in the depiction below, analysis performed by the North American Reliability Corporation ("NERC") found that ERCOT is particularly susceptible to reliability risk during extreme weather scenarios.[2]

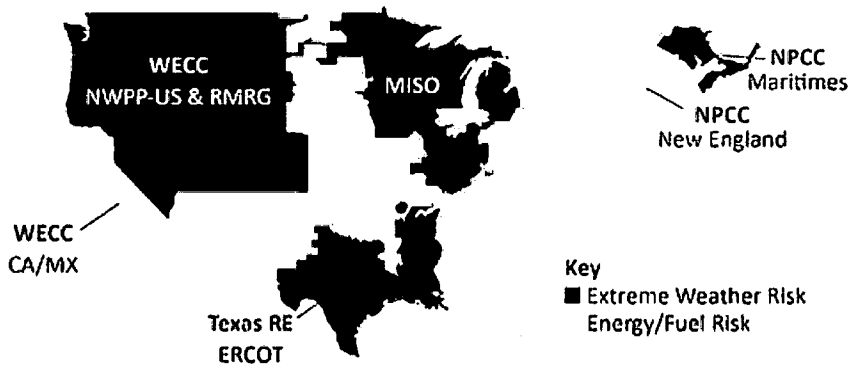

Figure 1: Areas with Reliability Risks During Extreme Weather Events and/or Fuel Supply Disruptions

While NERC previously categorized the risk to reliability from extreme weather as high impact, low frequency events, recent extremes "demonstrated that these events could no longer be treated as rare."[3] Experts anticipate that the frequency and intensity of extreme weather events, and the consequent load volatility, will increase over time. Therefore, it is imperative that ERCOT establish a new market paradigm to mitigate power system disruptions by incentivizing the deployment of additional energy storage resources – ensuring that the power grid will have sufficient capacity available during periods in which generation supply is scarce.

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[2] NERC 2020-2021 Winter Reliability Assessment at page 6. Available at: https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_WRA_2020_2021.pdf

[3] Testimony of James B. Robb Before the Committee on Energy and Natural Resources United States Senate (March 11, 2021). Available at: https://www.nerc.com/news/Headlines%20DL/NERC%20Reliability%20Hearing%20Testimony%203-11-21%20-%20Final.pdf

ERCOT's diverse generation mix continues to increase penetrations of low-cost wind and solar. Despite the benefits of these resources, the variable nature of their generation profile introduces new grid dynamics that must be accounted for in ERCOTs management of the grid to ensure system resilience. Battery storage is uniquely suited to complement intermittent generation through the ability to store low-cost off-peak supply, contributing to controllable load-shifting activities and providing fast-responding Ancillary Services. Battery storage, both standalone and co-located with other generation sources, should be prioritized as part of the reliability solution in ERCOT to provide greater system resilience and manage extreme weather conditions without relying on secondary fuel sources.

Even with recent and planned expansions of Ancillary Services available to Battery Storage, Ancillary Service market expectations represent a relatively small and finite demand that likely does not build the investment case required to incentivize the amounts of new battery storage that could provide significant reserve capacity under ERCOT's most stressed conditions. As Ancillary Service prices typically mirror Real-Time energy prices, in the absence of extreme shortage events, prices will not reach levels that are either high enough or sustained over long periods sufficient to incent new investment. This can be seen in the comparison of Ancillary Service prices during the period of 2019 to 2020, in which prices fell by approximately 50%, with total costs of Ancillary Services per MWh falling from $2.33 per MWh in 2019 to $1.00 per MWh in 2020[4]. A new reliability-based product with a forward procurement would serve to bridge the gap between modest scarcity outcomes and Ancillary Services product saturation and the investments needed to prevent loss of load from the system's largest contingencies.

ERCOT should supplement existing Ancillary Service products with a forward procurement to provide a reliability backstop to ERCOT's existing market design. This procurement can be designed by ERCOT to provide resilience against the drivers of crisis conditions and the deployment of last resort reserves. As discussed in detail below, such a model can achieve this result as a standalone construct or as a complement to other market changes, such as the development of new or improved Ancillary Services that incentivize suppliers to provide additional reliability services over longer procurement horizons.

II. Energy Storage as a Reliability Product

A key feature of this energy storage proposal is defining the product in terms of ERCOT's resilience needs during extreme weather events and the capability of the resources seeking to participate in the program. Recurrent proposes that ERCOT procure enough energy storage resources to manage the swings in generation and load that can occur during extreme weather scenarios.

Recurrent proposes that the Commission direct ERCOT to develop a forward procurement for an ancillary reliability product that would act as an insurance policy to ensure that ERCOT is able to

[4] 2020 State of the Market Report. Available at: https://www.potomaceconomics.com/wp-content/uploads/2021/06/2020-ERCOT-State-of-the-Market-Report.pdf

maintain the flow of electricity during periods of expected outages, swings in intermittent output, and other contingencies.

ERCOT would determine the amount of product required on an annual basis and procure resources through a competitive mechanism. Contracted resources would maintain a performance obligation, with a penalty for non-performance.

Managing Volatility During Extreme System Events

One of the primary challenges that ERCOT faced during Winter Storm Uri was the extreme volatility in generator outages. As shown in the table below, the amount of available generation fluctuated by over 6,000 MW on February 15, 2021, alone.[5] Procuring sufficient energy storage capacity to both supply energy during these outages, as well as consume surplus supply when other resources return to service provides a unique opportunity to bolster system resilience and keep costs low.

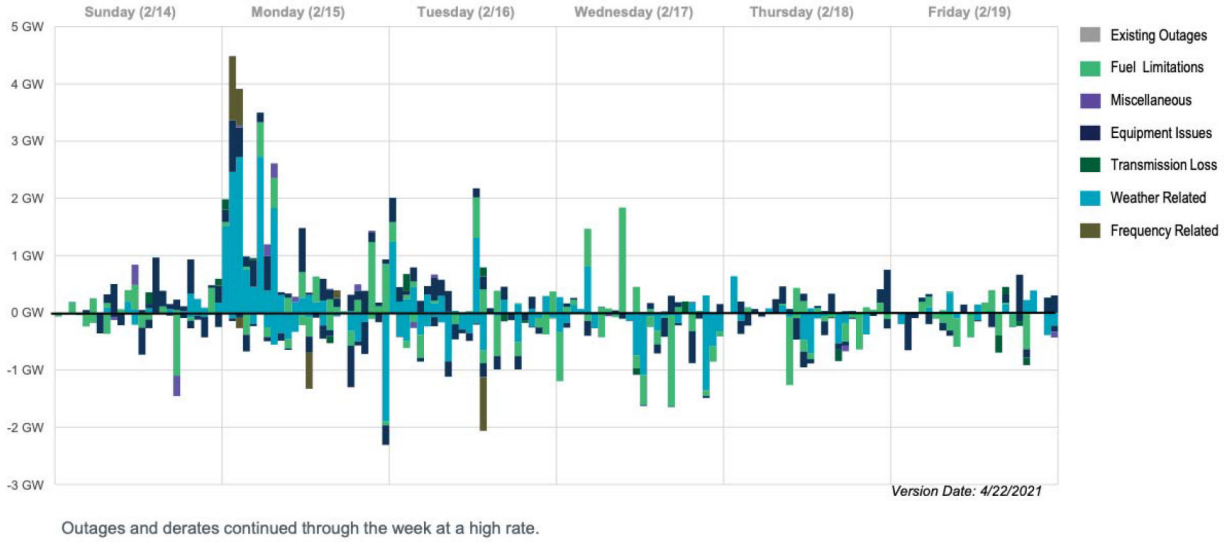

Figure 2: Incremental Generator Outages & Derates by Hour

While outages occurred across all resource types, the sharpest drop-offs were seen in coal and natural gas resources. The figure below compares the average generation by fuel type available during Winter Storm Uri versus scenarios contemplated by ERCOT's Seasonal Assessment of Resource Adequacy ("SARA") report.[6] These outage statistics further illustrate the value proposition of procuring additional supply from resources that are not operationally linked to other potential causes of failure, such as natural gas and coal delivery infrastructure. As with the generation failures of February 15, over 6,100 MW of generation was similarly unavailable on

[5] ERCOT Report on Winter Storm Generator Outages by Cause. Available at: http://www.ercot.com/content/wcm/lists/226521/ERCOT_Winter_Storm_Generator_Outages_By_Cause_Updated_Report_4.27.21.pdf

[6] Available at: http://www.ercot.com/content/wcm/lists/197378/SARA-FinalWinter2020-2021.pdf

February 16, 2021, due to fuel limitations. An incremental storage procurement mechanism could have mitigated these outages.

Fuel Source	Expected capacity (GW)	Extreme Scenario Capacity (GW)	Actual Average Generation (GW)	Deficit (GW)	% Deficit [From Expected Capacity]	Deficit Extreme Scenario (GW)	% Deficit [From Extreme Scenario Capacity]
Gas	48.4	38.4	30.3	−18.1	−37%	8.1	−21%
Coal	13.6	10.8	7.8	−5.8	−43%	3	−28%
Wind	7.1	1.8	3.8	−3.3	−46%	−2	111%
Nuclear	5.2	4.1	4.1	−1.1	−21%	0	0%
Solar	0.3	0.3	0.77	0.47	157%	−0.47	157%

Figure 3: Comparison of Actual vs. Expected Generation during Winter Storm Uri

To maintain the integrity of the system, demand must be tightly matched to supply. The rapid decrease in generation caused a frequency drop below the required 59.4 Hz for four minutes and 23 seconds. Had ERCOT remained under 59.4 Hz for nine minutes, the ERCOT grid could have collapsed, resulting in a system-wide blackout event. Texas is particularly vulnerable to unplanned generation outages, as it endures freezes, extreme heat, droughts, hurricanes, and windstorms.

During these events, ERCOT could deploy procured energy storage as a reliability product to balance unplanned swings in generation and load, maintaining system balance and slowing the deployment of emergency reserves. Energy storage can also be utilized to provide improved frequency regulation and voltage support due to its comparative advantage in fast-ramping and reactive power characteristics. To further align incentives between ERCOT, project developers, and equipment manufacturers, the energy storage procurement product definition could be tailored to select the resources that provide ERCOT with the fastest and most flexible ramping capability.

Manage Net Peak Load Variability

During the past few years, scarcity events in ERCOT have most often occurred in conjunction with the peak net load as opposed to peak demand. Peak net-load, load net of wind and solar generation, often occurs about two hours earlier than peak demand. In recent years, the net peak has been the more important determinant of supply shortages.

This difference is due to varying output patterns in intermittent generation in various locations. While ERCOT has enhanced their net load forecasting, unanticipated net load shapes create challenges in managing the proportion of rotating mass-based inertia on ERCOT's grid. While energy storage can help manage net peak variations, the proportional amount of storage needed

lags far behind the growth rate of intermittent generation, with utility-scale solar expected to grow to 28,000 MW by 2024.[7]

Despite the need for the reliability benefits of energy storage, forward incentives to support the financing needs of widespread investment in storage in ERCOT has not yet materialized. To date, investment in storage lags other markets with high rates of renewables penetration. Existing energy arbitrage and Ancillary Service opportunities in ERCOT's Day-Ahead and Real-Time markets alone do not provide adequate and reliable compensation to support ERCOT's growing need for energy storage.

ERCOT to Define Product to Support Longer-Duration Storage Resources to Better Align with System Needs

ERCOT should define a sustained time that can cover a contingency and prevent near blackout conditions. Short-duration batteries can currently participate in Fast Frequency Response and may be able to participate in ERCOT Contingency Response Service, with required sustain times of 15 minutes and one hour, respectively. Longer-duration batteries, such as those with a minimum duration of about four hours, would provide sufficient resilience against longer periods of system instability and domino outage effects, such as those that occurred in Winter Storm Uri.

Five-Year Contract Terms Meet Investor Needs for Revenue Certainty While Avoiding Risk to Customers from Longer-Term Contracts

As seen in other markets, merchant investment has proven difficult to secure financing for storage projects without long-term contracts. Recurrent proposes a fixed-price contract for five years as multi-year price certainty is necessary for project financing. Five years would provide the revenue certainty needed to unlock project financing at a lower cost-of-capital necessary to develop more projects and longer-duration storage projects that can provide operating capacity during contingency events. This meets the needs of investors to finance larger capital-intensive projects while avoiding the costs to consumers of longer-term contracts.

Contracted entities should also be able to transfer obligations to a qualified replacement resource. Permitting contracted entities to transfer obligations to a qualified replacement resource would allow new technology to replace existing procurements and continue to encourage technological innovation.

Performance Obligations Incentivize Best Performance During Emergencies and Signal Market Exit for Least Reliable Resource

This resource adequacy paradigm is closely patterned on conventional options contract frameworks. It is predicated on the principle that suppliers are paid under the five-year option

[7] ERCOT Report Capacity Changes by Fuel Type Charts, August 2021. Available at: http://www.ercot.com/content/wcm/lists/219848/Capacity_Changes_by_Fuel_Type_Charts_July_2021.xlsx

contract to assume the risk of failing to perform when necessary. Recurrent proposes that contracted resources be subject to a reasonable and clearly defined performance penalty that is a multiple of the revenues that suppliers would earn from selling the reliability option. For example, a total penalty of 1.5x the contract rate could provide sufficient incentive for market participants to ensure their resource performs appropriately when called upon by ERCOT or the interconnected transmission utility to do so. The Commission should direct ERCOT to work with stakeholders to "right-size" the performance obligation and penalty risk.

Use of a Forward Auction RFP Procurement Builds on ERCOT's Competitive-Market Principles

To procure the product, ERCOT should evaluate competitive mechanisms, including a competitive auction, RFP solicitation, or a mechanism that imposes procurement obligations on load-serving entities. Of available options, Recurrent highlights the descending clock-style auction, which can be designed as a sealed bid auction with rounds that would promote competition while addressing market power concerns.

A two-stage, sealed-bid descending clock auction would provide the benefits of both pure descending-clock and sealed bid auction formats. Before each auction, bids and offers would be qualified by ERCOT and subject to review. The auction is then conducted in discrete rounds by an auctioneer, with each round stating the starting price, end of round price, and excess supply at the end of the preceding round.

The initial round would collect bids, with suppliers stating the quantity they are willing to supply at the auction starting price. During each round, participants would indicate their willingness to proceed with MW quantities within the range of the start and end of round prices. Suppliers wishing to exit would submit a sealed withdrawal price. By not revealing withdrawal prices, the auction process would help to limit potential seller-side market power.

The auction would close when enough bids/offers have withdrawn to clear the auction, such that supply is short at the end-of-round price. At the close, the remaining resources would enter the second pricing stage of the auction. The second phase would run an optimization algorithm that considers price and quantity pairs along with input parameters to determine a market-clearing price and final resource commitment. This phase would ensure that awards are consistent with protocol rules to be developed by ERCOT.

Battery Storage Products Can be Expanded to Consider Other Flexible Solutions

The unique ability of Battery Storage to act as both generation and load allows for innovative and strategic methods of managing grid flexibility.

One such innovation would be for ERCOT to incentivize Battery Storage resources to store curtailed renewable energy. The most advantageous locations, in terms of maximum generating capability for wind and solar, are located far away from urban load centers, which has caused stability constraints on the ability to transfer the power generated.

Typically, energy storage is charged during low energy prices and dispatched to meet system demand. Alternatively, storage can also provide time-shift services, storing excess energy production that would otherwise be curtailed. ERCOT could allow storage resources that are not subject to the constraint to charge at a discount from the surplus generation that is otherwise unable to serve load, therefore contributing both to system reliability and efficiency. Conversely, ERCOT might also explore the use of storage as a load management tool. For example, if another critical grid-service generator remaining online during extreme events is subject to local load flows, storage could act as a balancing resource during an extreme event. As ERCOT continues to work on holistic solutions to address transmission constraints, improving deliverability in constrained areas would help optimize renewable output in the most resource-rich regions.

III. Conclusion

Battery storage as a reliability product should be part of the solution for a more reliable grid in ERCOT, alongside weatherization and other improvements to ERCOT's energy market design. ERCOT should procure energy storage resources as a reliability product to manage supply loss due to unplanned generation outages during extreme weather events. Recurrent suggests the use of a five-year, fixed-price contract, procured through a competitive auction, to secure investment in longer-duration batteries that provide the required reliability services. The procurement should be specifically tailored, in size and eligibility requirements, to provide necessary system resilience, without imposing the costs of over-procurement on consumers.

Recurrent appreciates the opportunity to offer these comments on ERCOT market design and looks forward to working with the Commission and ERCOT stakeholders to develop innovative solutions for a more reliable and resilient grid.

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Executive Summary of Proposal:

- Longer-Duration Battery Storage is uniquely able to provide reliability solutions to swings in generation experienced due to extreme weather events and net-load uncertainties.

- Current market signals and opportunities for Battery Storage do not provide the required investment incentives for Battery Storage to be able to fill this reliability need.

- A five-year, fixed price contract would provide sufficient revenue certainty for financing, while not passing the costs of long-term contracts onto consumers.

- A seal-bid, descending-clock auction could be tailored to commit resources according to ERCOT's defined need.

- This solution is intended to work in tandem with proposed improvements to ERCOT's energy market, including changes to the ORDC and new Ancillary Service products.

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