Significant Energy Storage Capacity Additions Keep Costs Low and Power Reliable in Texas

The addition of 5 GW of energy storage in Texas over the last year helped the state avoid energy conservation appeals and contributed to $750 million in energy cost reductions.

A new analysis from the American Clean Power Association (ACP) highlights how the rapid addition of energy storage capacity in Texas, as well as renewable resources, has kept energy costs low for consumers, avoiding conservation appeals to the public during weather events and mitigating concerns over widespread power outages.

Rising energy demand and increasing adverse winter and summer weather events are resulting in consistently higher energy demand hours and additional stress placed on the Texas power grid.

Without signs of slowing, demand in the Texas market has grown year-over-year due to factors including rising population, industrial growth, as well as electrification.

Texas and its independent system operator, The Electric Reliability Council of Texas (ERCOT), have served as a prime example of how rapidly our energy systems must evolve in the United States to be able to consistently deliver reliable and affordable energy to consumers—especially when Texans need it most.

In the past year, ERCOT has deployed much needed energy capacity, with the help of low cost and ERCOT's open access policies, outpacing increasing demand and quickly providing the resources necessary to navigate prolonged moments of stress on the grid.

Energy storage and renewable resources have driven nearly all recent capacity growth in ERCOT. Energy storage, solar, and wind, represented almost 50% of ERCOT's power mix by the end of September 2024. More energy storage, wind, and solar online have limited the need for less efficient and more expensive resources, helping to streamline the grid and lower overall energy costs.

The following ACP analysis includes a comparison of operating conditions across the ERCOT grid in 2023 and 2024. The analysis reveals the impact that energy storage is having on improving grid reliability and reducing power prices.

Demand is growing quickly in ERCOT

Texas set records for electricity demand in both 2023 and 2024. In 2023, the state experienced its hottest year ever, with its second-hottest summer[1] driving unprecedented power usage. By comparison, summer 2024 was less extreme, but still ranked sixth hottest ever[2]. ERCOT's total electricity usage between January and September 2024 hit a new high of 354 TWh. This marked a 3% increase from 2023 and a 6% increase from 2022, driven by population growth, electrification, and new industrial energy users.

Figure 1: Hourly Load in ERCOT across 2023 and 2024 (2024 only goes through end of September)[3]

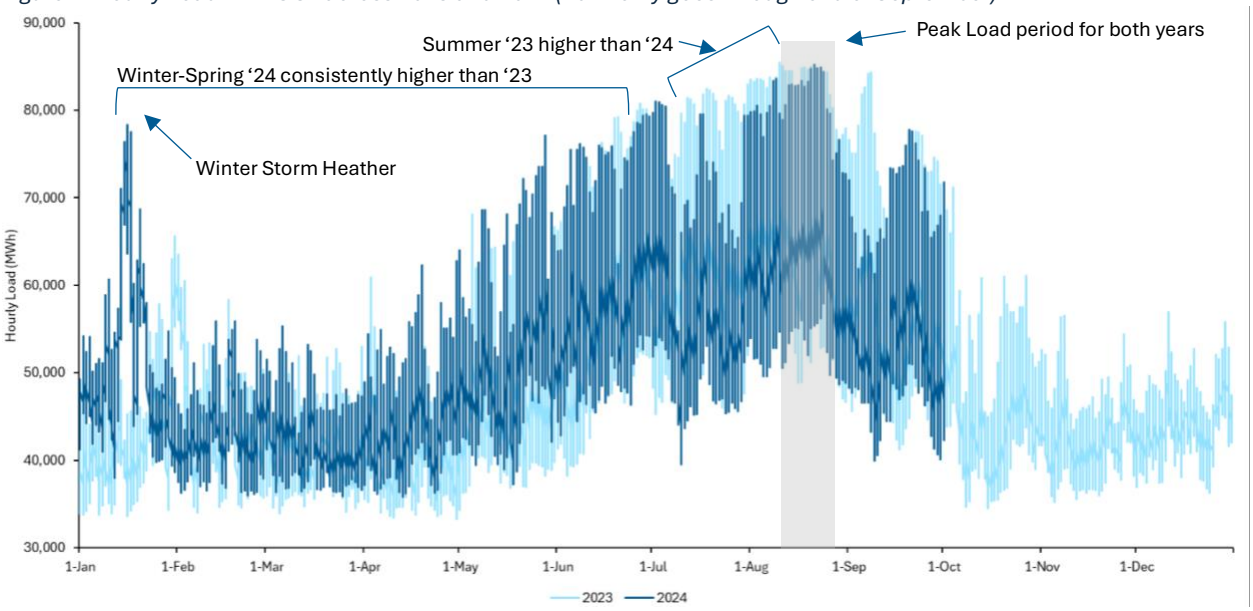
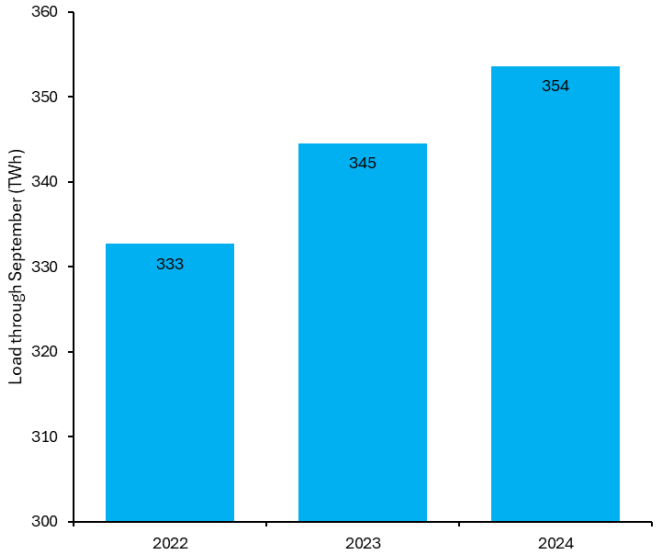


Figure 2: ERCOT Total Load (January through September)

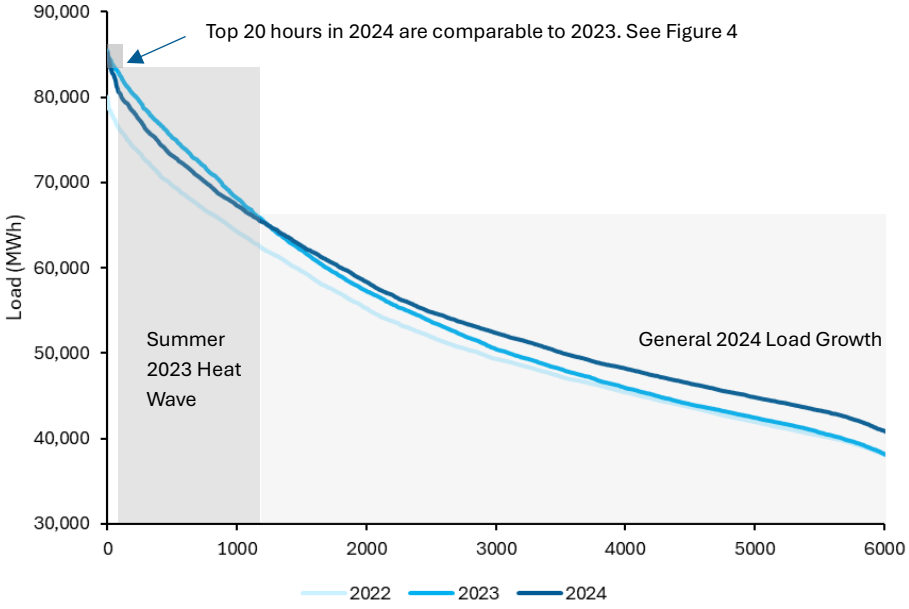


[1] **Source**: Erin Douglas & Yuriko Schumacher. "Texas just recorded its second hottest summer on record." *The Texas Tribune*. 9/7/23.
[2] **Source**: ERCOT. Item 6: 2024-25 Winter Weather Update. 12/3/24
[3] **Source**: ERCOT's Hourly Load Data Archives

The duration curve in

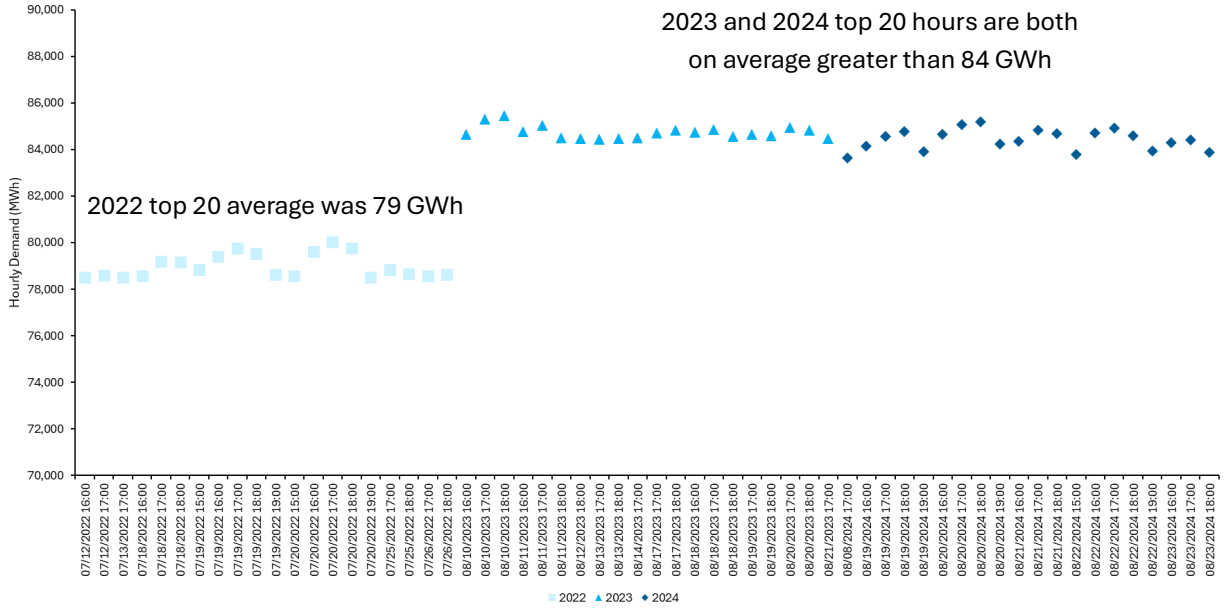
Figure 3 shows hourly load in ERCOT ranked over the last three years of the first 9 months. While 2023 saw roughly 1,000 hours of higher load than 2024 (summer heatwave pressure on electric cooling), 2024 has consistently seen higher loads during non-summer months (general load growth and Winter Storm Heather).

Figure 3: Duration Curve of ERCOT Annual Load (January through September)



Despite these surges, the summer peak load—the 20 hours of highest demand—remained nearly identical between 2023 and 2024. What changed, however, was the tools available for the grid to respond.

Figure 4: Top 20 Load Hours by Date



Energy storage in combination with wind and solar have created a more reliable and cost-efficient grid

Between the peak summer of 2023 and Winter Storm Heather in January 2024, ERCOT only added 1 GW of storage. In that time, ERCOT issued only two requests for conservation, on January 14 and 15 during Winter Storm Heather. In the six months that followed, the Texas grid added another 4 GW of battery storage, putting ERCOT in a much better position to handle summer heat. As a result, ERCOT did not issue any conservation calls in summer 2024. This is despite the fact ERCOT saw near equivalent top demand hours during the summer compared to 2023.

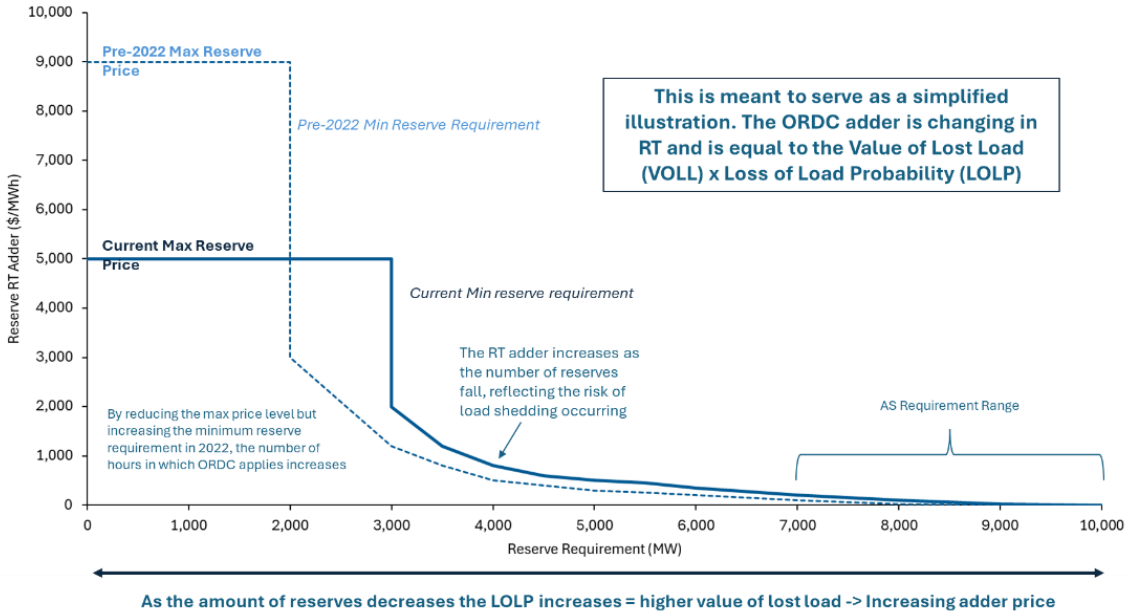
In contrast, ERCOT issued 11 conservation notices in 2023, including notices for 7 days in a row from August 24-30th. On September 6th, the situation became so dire that ERCOT initiated emergency alert levels. These are periods that align with times that Physical Responsive Capability (PRC) is low. PRC is the amount of frequency responsive resources that are available to respond quickly to system events. It is required to be a minimum of 2,300 MW. The closer the system gets to that limit, the higher the possibility of load shed[4].

More energy storage in ERCOT reduces the risk of PRC dropping. In 2023, there were 23 hours in which ERCOT's PRC was below 5,000 MW, four of which were below 4,000 MW. In contrast 2024 has only experienced 4 hours in which PRC was below 5,000 MW[5], all of which were above 4,700 MW. Moreover, ERCOT's PRC never got as low as it did in 2023[6].

Relatedly, with more available capacity, ERCOT's price adders contributed less to real-time (RT) prices. Within ERCOT, these price adders come via the form of the Operating Reserve Demand Curve or ORDC. The ORDC is a pricing mechanism that creates a RT adder to reflect the value of available reserves based on the value of lost load and loss of load probability for a certain level of resource reserves. It has a max price of $5,000/MWh and a minimum contingency level of 3,000 MW. Ultimately, the tighter supply is to demand, the greater the chance an ORDC price adder will be applied. Figure 5 gives a simplified version of how this works. The closer your reserves reach 3,000 MW, the greater the price adder could be.

[4] A measure of last resort by a system operator to keep supply and demand of electricity in balance, in which they direct transmission operators to temporarily disconnect some customers so that demand doesn't surpass available supply.
[5] As the end of September 2024
[6] It is important to note that large flexible loads increased in ERCOT in 2024 compared to 2023. However, these flexible loads reduced their demand during high price hours which helped balance the grid and free up resource availability.

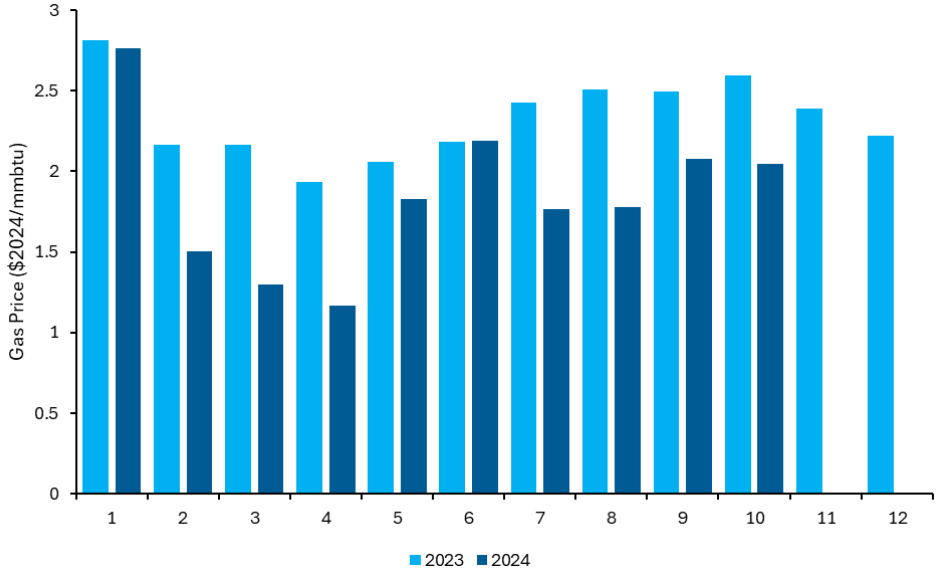
Figure 5: ERCOT ORDC Illustration



In 2022 the ORDC adder accounted for up to 15% on the average RT price, indicating the consistent tightness of the market. By 2024, the highest it ever reached was just 2%.[7]

The result is lower prices and a more durable grid. The price of energy in a wholesale market is largely dictated by the highest operating cost resource used. In ERCOT, that is typically a gas plant, meaning natural gas prices have an outsized impact on power prices. Gas prices were cheaper in 2024 than 2023 by about $0.5/MMBtu, roughly $4-6/MWh[8].

Figure 6: Natural Gas Price (Houston Shipping Channel) by Month[9]



[7] **Source**: ERCOT Item 7: Summer 2024 Operational and Market Review. 10/10/24
[8] Unless otherwise noted all $ are in real 2024 for appropriate comparison. Any 2023 prices are inflated at a rate of ~3%.
[9] **Source**: S&P Capital IQ. Historical Monthly Average Natural Gas price by hub

However, RT prices in 2024 were on average $31/MWh less than 2023 and thus not completely explained away by gas price. In the peak month of August 2024, power prices were, on average, $160/MWh less than same month in 2023. The cause for low prices in 2024 is more wind, solar, and storage. Renewables help limit the need for less efficient and more expensive resources while storage aids in reducing price adders in the real-time market via the ORDC.[10]

Figure 7: Monthly RT Price Comparison[11]

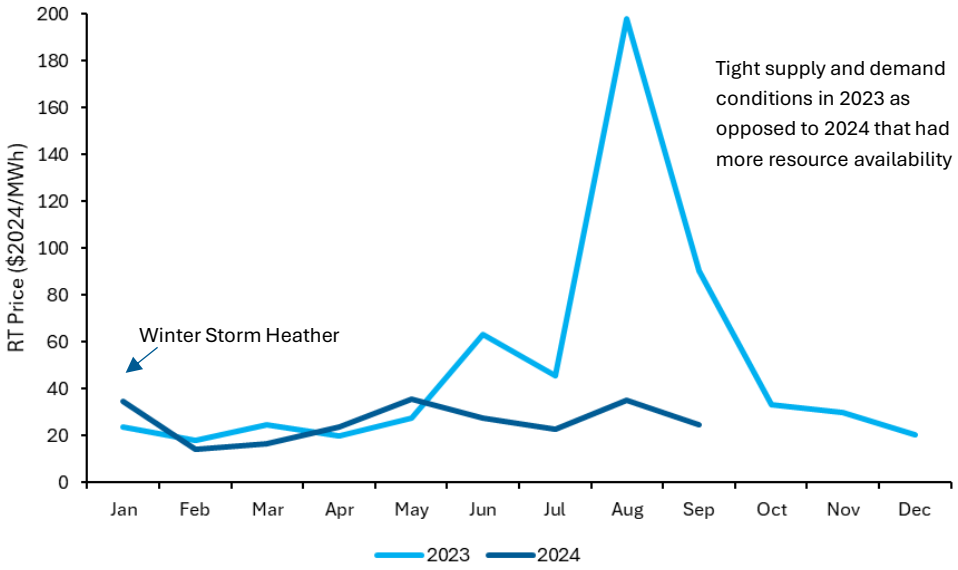
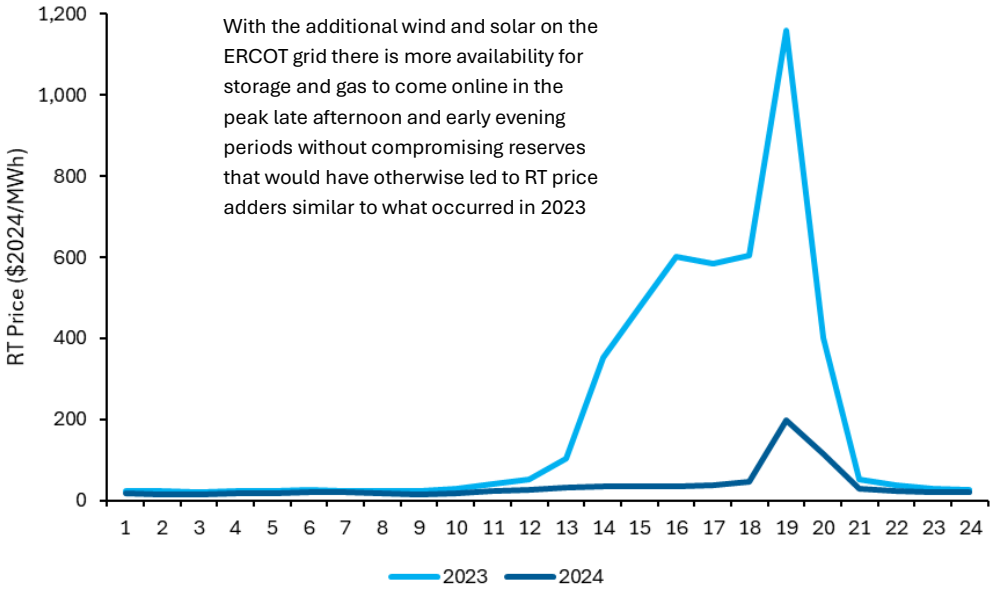


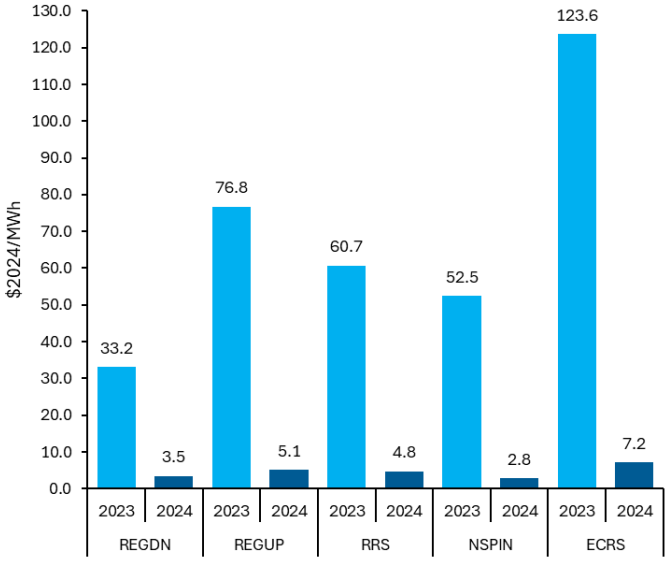
Figure 8: Avg Day in August RT Price Comparison[11]



[10] Congestion in ERCOT was also lower in 2024 than the previous two summers, lowering the impact of "congestion rent" on final LMPs.
[11] **Source**: ERCOT hourly data via GridStatus.io ERCOT Live

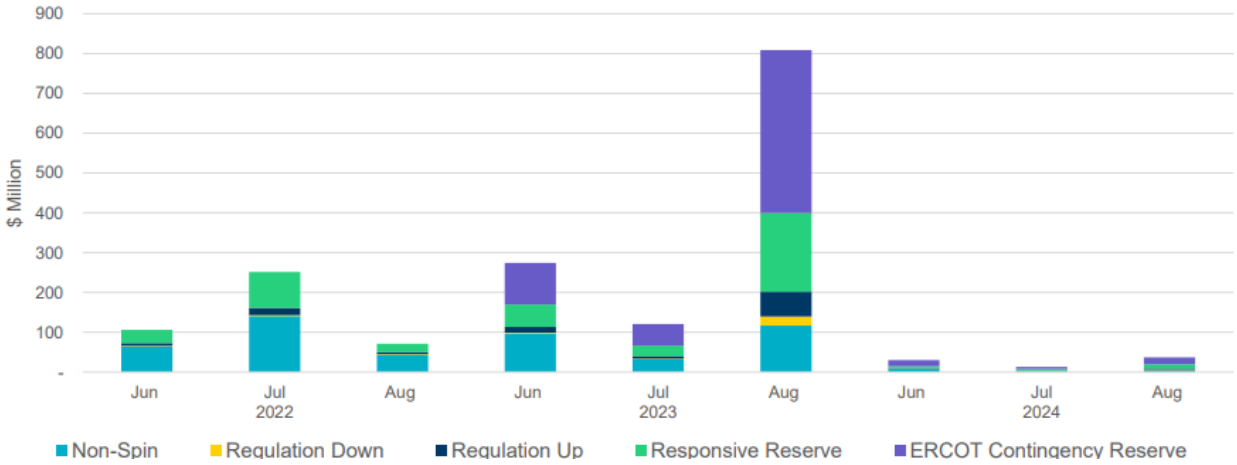
Similarly, with more storage on the grid, ancillary service (AS) prices were lower in 2024. Storage is significantly cheaper on an operational basis than alternative technologies in providing AS. Moreover, competition among storage plants drives AS prices lower. Average ancillary service prices in summer 2024 were below $5/MWh compared to average prices ranging from $30-125/MWh in 2023.

Figure 9: Average Summer Price of AS Products in 2023 and 2024[12]. Note June 2023 was the first month of ECRS



Lower prices mean a lower total AS cost for the ERCOT market. The nominal cost of AS, as calculated by ERCOT, reached a summer monthly high of $250M in 2022, $800M in 2023, but only $36M in 2024.

Figure 10: Nominal cost of AS in ERCOT over summer months. Graph via ERCOT's Summer 2024 Operational Review7



[12] **Source**: ERCOT. Historical DAM Clearing Prices for Capacity

The growth of storage, solar, and wind surpass that of demand

These cost savings and grid efficiencies in the face of high electricity demand, are driven by the slew of new clean energy capacity. By the end of September 2024, wind, solar, and storage accounted for 82 GW of ERCOT's capacity, representing almost 50% of ERCOT's power mix.

The addition of both storage and solar has been meteoric, with the Lone Star state adding over 30 GW in just the last two years. Meanwhile, ERCOT has only added 1.5 GW of net new gas capacity and lost 0.8 GW of coal capacity.

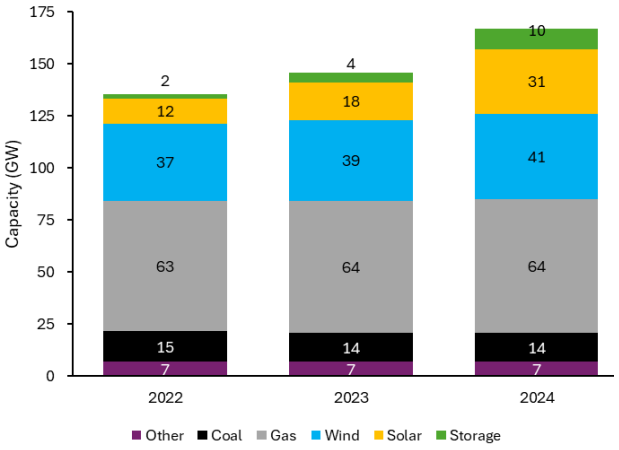
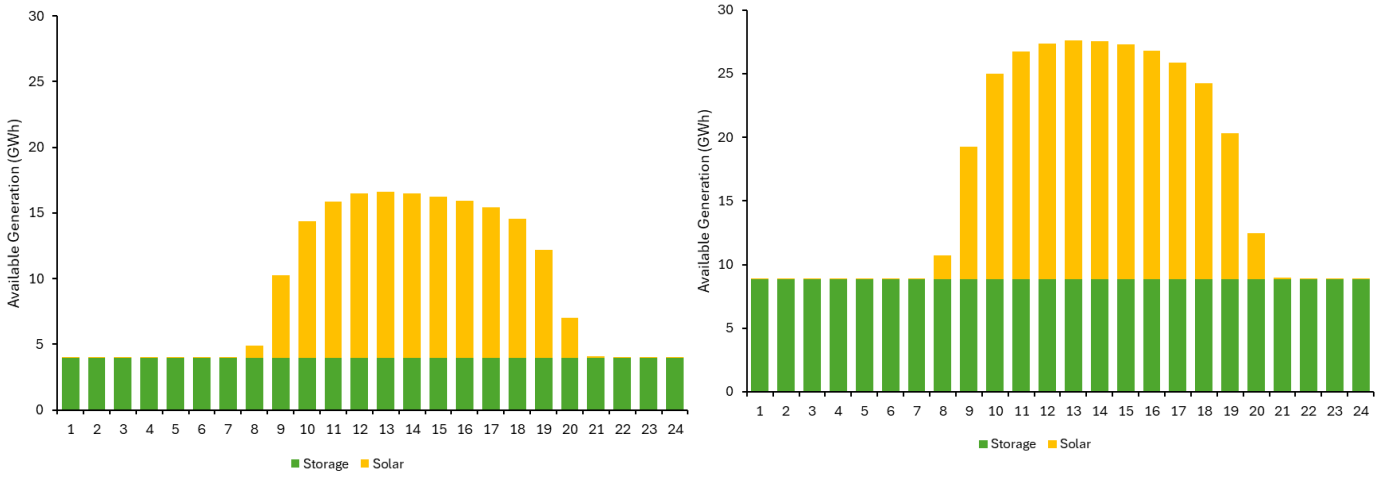


Figure 11: ERCOT Capacity by Fuel Type (2022-2024)[13]

In the last nine months solar has grown by 13 GW and battery storage by over 5 GW. The result is much more available capacity, especially during peak summer months. Figure 12 shows the average hourly available capacity of solar and storage in a typical day in August in ERCOT in (a) 2023 and (b) 2024[14].

Figure 12: Average Daily Storage[15] *and Solar*[11] *in August (a) 2023 and (b) 2024*

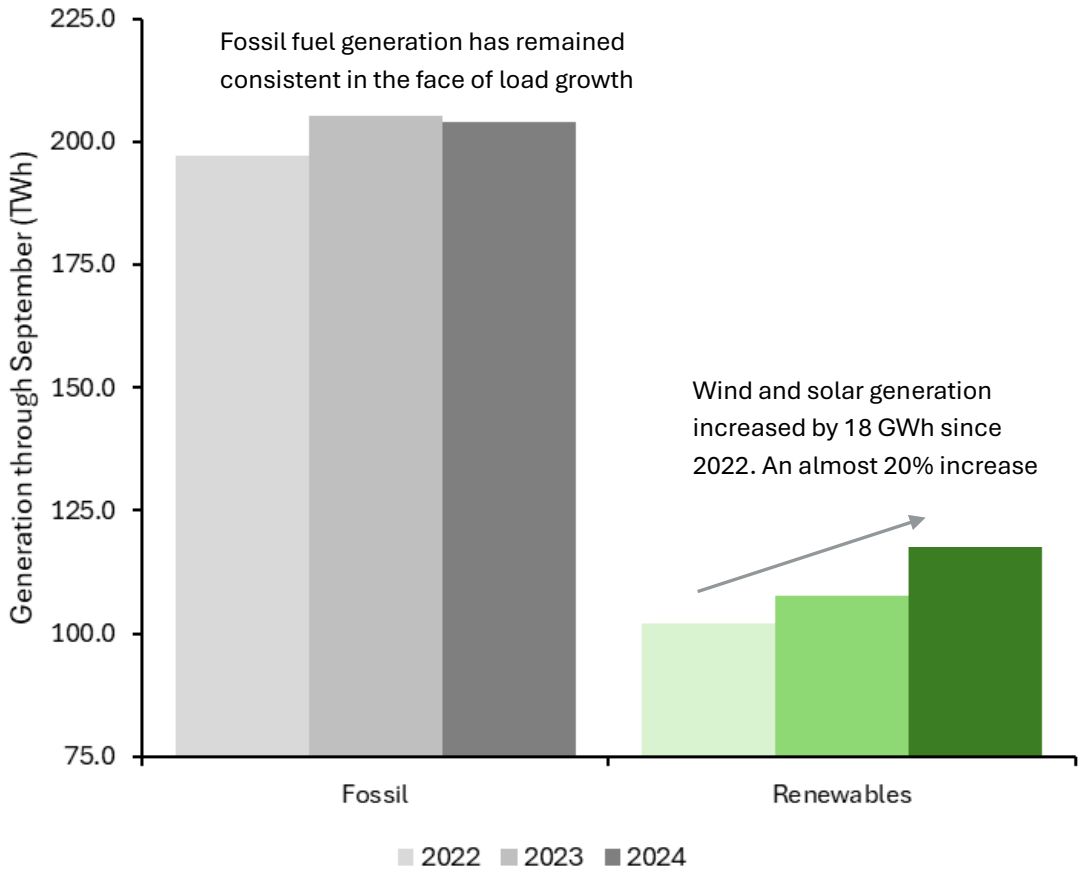


[13] **Source**: S&P Capital IQ: ERCOT Historical & Future Power Plant Capacity Data. As of end of Sep 2024
[14] Storage is total online capacity whereas solar is actual average generation.
[15] **Source**: ERCOT's Resource Capacity Trend Charts for August 2023 and 2024

Energy storage, wind, and solar have altered ERCOT's dispatch dynamics

The expansion of energy storage, wind, and solar has reshaped ERCOT's generation mix, adding resource diversity that complements thermal power generation. Renewable energy generation increased by over 10 TWh in 2024, a 23% year-over-year jump, raising its share of total generation from 31% to 34%.

Figure 13: Renewable vs Fossil Fuel Generation in ERCOT (January through September)[16]



Battery storage couples well with high solar deployment as it can charge during low priced solar producing hours of the day. It then dispatches in the late afternoon and early evening peak periods when solar generation is ramping down, and electricity demand is rising. These dynamics are highlighted in Figure 14 and Figure 15 which show hourly generation during the peak day of 2023 and 2024. Overall, in 2024 more solar and storage was utilized, and the hourly energy price was lower with more resources online despite near identical peak loads.

[16] **Source**: S&P Capital IQ - Monthly Generation Data

Figure 14: Hourly Dispatch on August 10th 2023, Peak Load of 85.2 GWh at 6pm (Hour 18)[11]

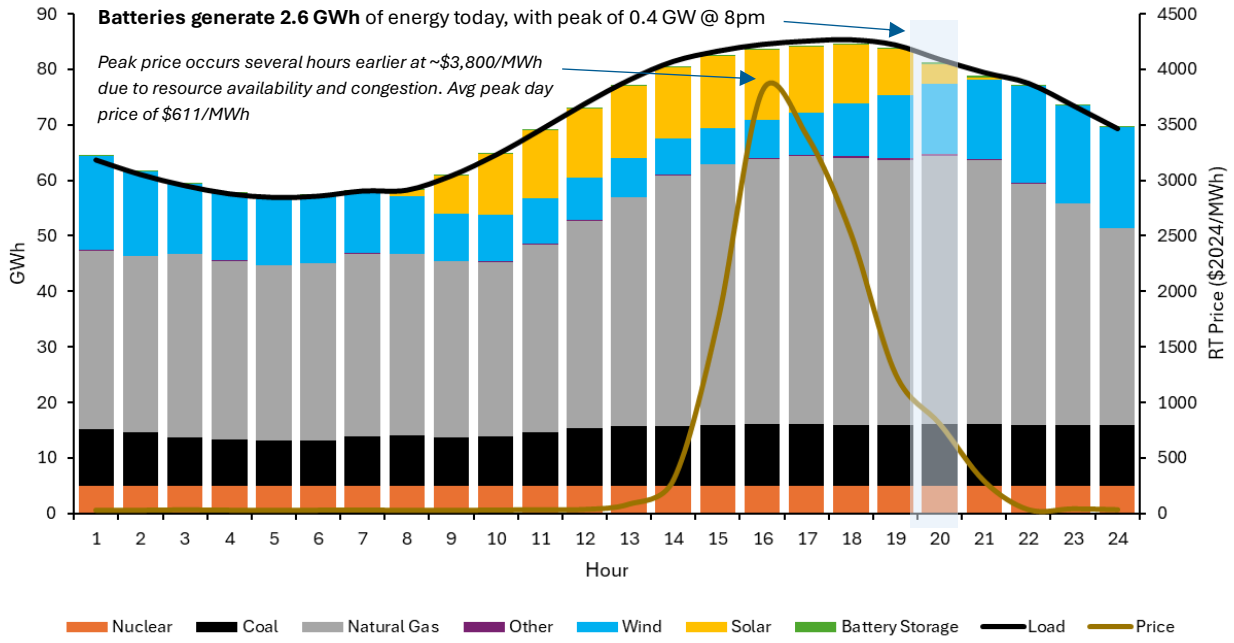
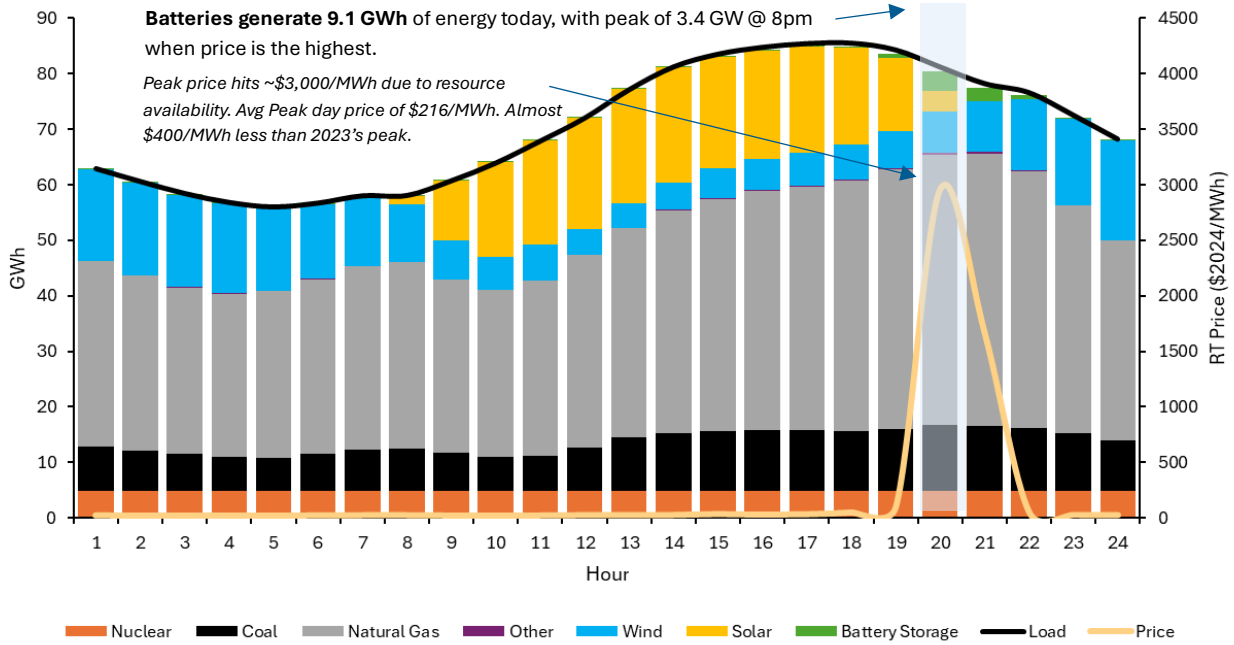


Figure 15: Hourly Dispatch on August 20th 2024, Peak Load of 85.2 GWh at 6pm (Hour 18)[11]



The charts above show that, on the peak load day of 2024 (August 20th), storage played a much larger role in meeting load. Unlike 2023, which saw consistent gas dispatch during the afternoon and early evening periods, solar dispatch was high enough in 2024 that gas and storage climbed only as solar generation was decreasing.

Focusing on energy storage dynamics during August 20, 2024, reveals that batteries are largely charging during the middle of the night and early morning when demand and electricity prices are low. Energy storage was discharging the most during solar ramp down when demand and prices were greatest.

Figure 16: 5 Minute Storage Dispatch on August 20th 2024

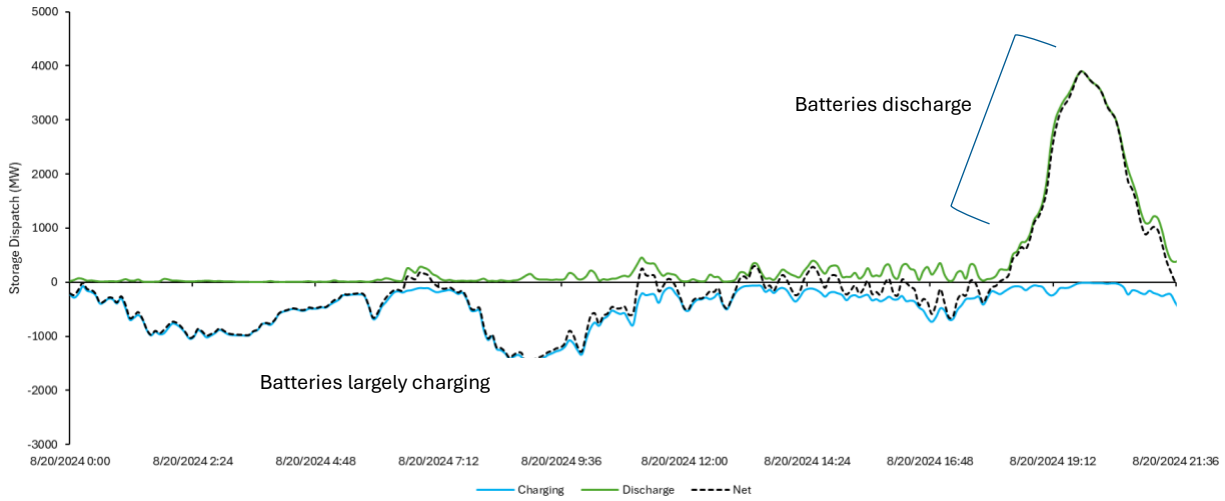


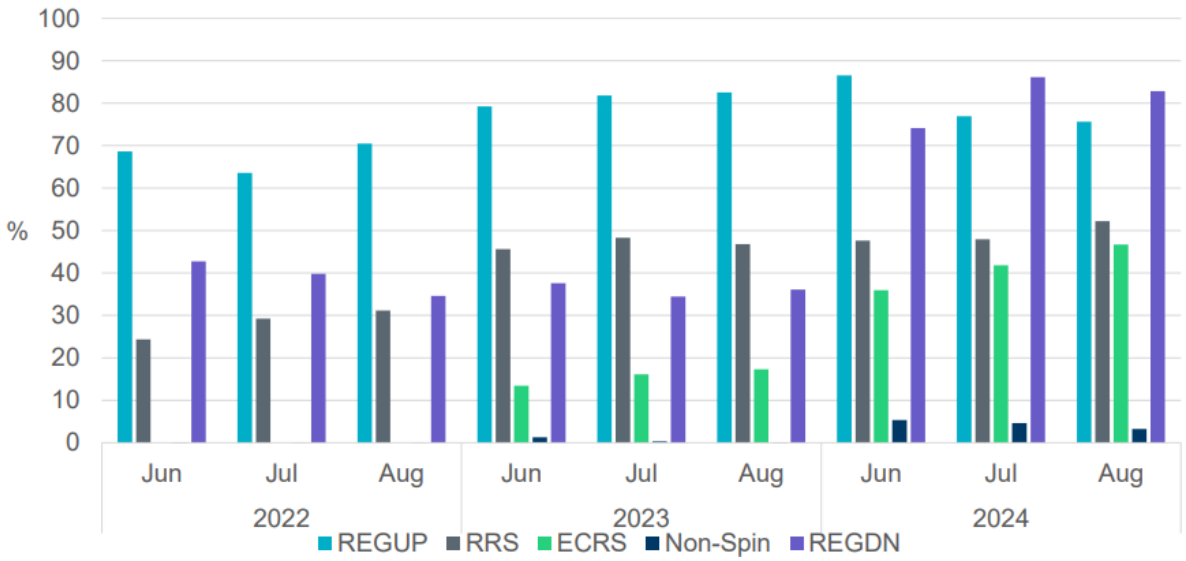
Photo Credit: Fluence

Energy Storage's role in ERCOT's Energy and Ancillary Services Market

Given ERCOT's market design, load profile, and resource mix, the majority of ERCOT's batteries are intentionally designed to be less than 2-hour duration. As such, value of the first GWs of storage that interconnected to the ERCOT market was in the AS market, bidding primarily into spinning reserves (RRS) and regulation ancillary service.

However, the flexibility of these resources, coupled with their increased capacity, has allowed increased competition for them across all AS products. The result is a greater share of AS procurement through batteries as seen in Figure 17. Like any market, when you allow for more competition, you put downward pressure on prices. Furthermore, battery storage on an operational basis is low cost. The outcome is batteries meeting more AS requirements, improving grid responsiveness and reliability, and lowering prices.

Figure 17: Storage as percentage of total ERCOT AS Procurement. Graph via ERCOT's Summer 2024 Operational Review[7]

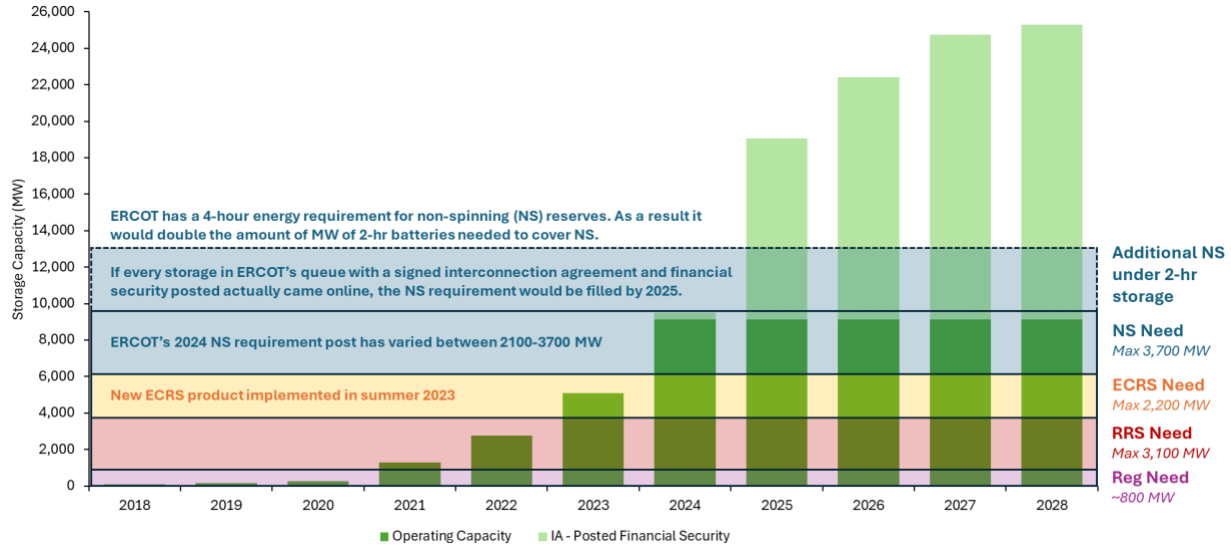


In summers 2022 and 2023, storage accounted for 30-40% of regulation down services. In 2024, after significantly more capacity was added, storage consistently provided 80% of the service. ECRS, a new AS product that came online in June 2023, saw storage account for only 20% of it last summer. By 2024 it climbed to a high of almost 50%[17].

This trend will only continue. Battery storage capacity in ERCOT is becoming a greater and greater share of the AS market as seen in Figure 18, with non-spin being the longer holdout given its duration requirements. The result is cheaper AS prices and total savings to the ERCOT system as previously explained.

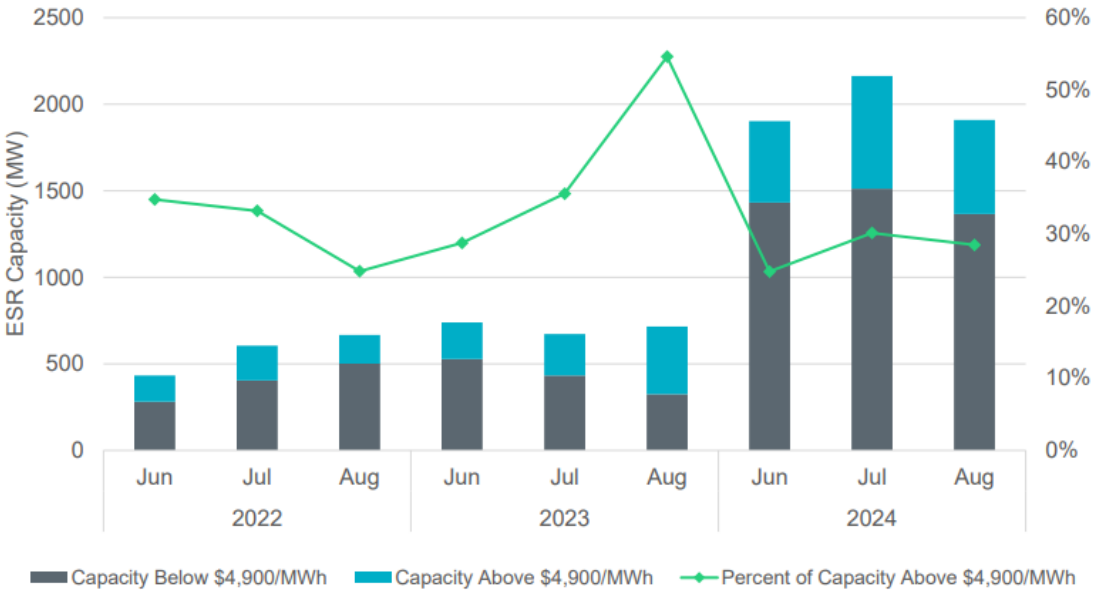
[17] Non-spinning reserves require 4-hr duration, so ERCOT is just now seeing more participation in that market from storage as those longer duration batteries interconnect

Figure 18: Storage Capacity in ERCOT as related to AS need[18]



While storage was selective in energy arbitrage before, the influx of operating capacity has allowed storage to bid more into the RT market. In addition, a lower proportion was offered at ERCOT's price cap of $5,000/MWh. Both of these dynamics are captured by ERCOT's own analysis (Figure 19). The system is no longer tight, and more storage exists to compete with one another for setting the market price. The outcome is an efficient market in which wholesale energy prices are lowered as highlighted at the top of this report.

Figure 19: Energy Storage offered in RT ERCOT Market. Graph via ERCOT's Summer 2024 Operational Review[7]



[18] What is noted as "max" is the highest average monthly AS need seen in 2024 as of the end of September

Conclusion

Texas is proving that a cleaner, more reliable, and more affordable grid is not just possible, it's already within reach. Texas' investment in energy storage and clean power has fundamentally transformed its energy grid. By 2024, storage and renewable capacity growth outpaced demand increases, providing the grid with greater resilience and lower costs. The results are undeniable: fewer emergency alerts, reduced reliance on fossil fuels, and significant savings for both the system and consumers.

Chrisholm Grid, Fort Worth, Texas

Photo Credit: Eolian Energy