ATTACHMENT D: PROCUREMENT POLICY CASE STUDIES[1]

California has the largest and most diversified energy storage fleet in the nation, and the fleet is growing rapidly. Customer installations grew from 61 MW at the start of 2017 to at least 582 MW by the end of 2021, largely driven by 468 MW of Self Generation Incentive Program (SGIP)-funded installations. Grid-scale installations grew from 130 MW/510 MWh or 10% of all installations in the country in 2017 to 2,300 MW/8,800 MWh or 44% of all installed capacity in the country by the end of 2021.

Energy storage is a key ingredient to the state's rapid transition to clean energy and deep decarbonization. The CPUC has continuously evolved its policies and explored innovative solutions to support this transition. However, California regulators still share many of the same policy and market adaptation challenges as we see in other states—increased shares of variable generation from renewables, an acceleration of weather and environmental stressors, and rapid development of distributed energy resources on homes and business *clash* with deep institutional practices that are particularly difficult to adapt. Policymakers, utilities, and other stakeholders in other states have brought forward a variety of innovative solutions to dissolve silos in planning and markets and to open the door to the wide range of benefits energy storage has to offer. In order for California policy to continue to innovate the CPUC will need to continue to explore and learn from a variety of policy and market approaches.

The goal of this attachment is to highlight effective energy storage procurement policies and programs in other states that might be helpful to the CPUC as it seeks to break down barriers to cost-effective and high-value energy storage investments in the state.

This attachment is based on a review of U.S. policies and programs for energy storage development, and of relevant industry publications and data. We focus on case studies in 5 states where we observe major steps towards overcoming institutional, market, or policy hurdles that limit the ability of energy storage to contribute to grid optimization, renewables integration, or GHG emissions reductions.

We start with a jurisdictional screening process to identify states that face renewables integration challenges and that have actual energy storage deployment and operational experience. Out of the screening results we select examples of energy storage-related policies and programs from 5 states that appear to be successfully improving the ability of energy storage to contribute to grid optimization, renewables integration, or GHG emissions reductions. We conclude with a summary of key observations.

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New York

New York accounts for about 6% of existing and planned energy storage capacity in the U.S. as of July 2022 (EIA 2022a). The state has relatively little capacity operational, but with most of the planned MW procured before 2021 the state is expected to soon see a wave of installations.

New York has one of the most aggressive energy storage procurement targets in the country. The state's June 2018 Energy Storage Roadmap outlines a multi-pronged policy approach for accelerated energy storage deployment (NY Agencies Staff 2018).

In December of 2018, the New York Public Service Commission (PSC) issued an Energy Storage Order establishing a statewide energy storage goal of 3,000 MW by 2030, with an interim target of 1,500 MW by 2025 (NY PSC 2018). The progress in state's energy storage procurement is facilitated by several state policies and programs, and by end of 2021 New York procured 1,230 MW of energy storage towards meeting that statewide goal (NY DPS 2022). In early 2022 state Governor Hochul announced plans to increase the energy storage goal to at least 6,000 by 2030 (NY State 2022).

Most of New York's energy storage procurement so far has been driven by the "Bridge Incentive" program for market acceleration, administered by New York State Energy Research and Development Authority (NYSERDA). The Bridge Incentive program provides partial funding for energy storage projects. It is similar to the Self-Generation Incentive Program in California, but in addition to customer-sited projects, the Bridge Incentive program supports bulk grid storage projects providing wholesale energy, ancillary services, and/or capacity. The Bridge Incentive program's "first-come, first-served" approach is not necessarily tied to value provided to grid.

Pairing with Renewables

New York's 2018 Energy Storage Order directed the IOUs to hold competitive solicitations to procure dispatch rights of at least 350 MW of bulk-level energy storage in New York by the end of 2022 (NY PSC 2018). The initial round of solicitations in 2019-2020 failed to meet these targets and resulted in procurement of only 130 MW of energy storage. Based on developer feedback and IOU petitions, in-service date deadline for storage resources is extended from 2022 to 2025 and the maximum contract term is increased from 7 years to 10 years.

Another 101.2 MW of energy storage is procured under NYSERDA's Renewable Energy Standard (RES) solicitations, which provide large-scale renewable projects the option to augment their development with energy storage. While under RES contracts, NYSERDA pays only for RECs generated by renewables, and projects paired with energy storage get additional points during bid evaluation. Proposers considering energy storage must submit two bids, one with and one without storage, needed to evaluate costs and benefits of the addition of energy storage facilities. Energy storage can be co-located with renewables or in a separate location in New York, but projects already under utility contract or receiving storage incentives from NYSERDA are not eligible.

Value of DER/Value Stack

Retail rate reforms are a crucial component of New York's integration of distributed energy resources. In 2017, New York started to transition from net metering to a new approach called the Value of Distributed Energy Resources (VDER) or Value Stack. Under the VDER approach, distributed energy resources (DERs) are compensated for up to 5 MW, depending on when and where they provide electricity to the grid. The VDER Value Stack compensates DER projects in the form of bill credits including their estimated energy value, capacity value, environmental value, demand reduction value, locational system relief value, and community credits. Co-located energy storage projects are eligible for environmental value and community credit only if they are charged exclusively from solar PV or wind.

VDER is the most common compensation mechanism chosen by the developers in New York to monetize the value of energy storage, the value of pairing with renewables, and value under a variety of use cases (NY DPS 2022). VDER so far has been successful to help projects monetize value, but actual performance of the energy storage resources is not yet evaluated.

Soft Cost Reduction

While battery energy storage hardware-related costs are mainly driven by national and global market conditions, "soft costs" such as permitting, interconnection, customer or site acquisition costs vary greatly by location. New York's 2018 Energy Storage Order identified high soft costs as a major barrier for energy storage deployment in New York and approved several initiatives to achieve soft cost reductions in the state. The initiatives include:

- Technical assistance for permitting agencies in New York to facilitate informed decision-making when they consider energy storage installations;
- Development of data platform with granular system and load data needed to reduce energy storage site identification and customer acquisition costs;
- Education of developers on storage solutions, economics, and market rules;
- Improved interconnection rules;
- DER portal to collect and provide access to non-propriety performance and financial information to build confidence in deployed systems and project economics; and
- Development of appropriate decommissioning and end-of-life actions and processes based on input from utilities, market participants, local communities, and state agencies.

The New York Public Service Commission also directed Department of Public Service Staff to prepare an annual report to keep track of installed cost of energy storage systems and document progress towards reducing soft costs in that year. To accomplish that, there has been increased emphasis in collecting detailed cost data from storage projects supported by various state initiatives in New York. For example, NYSERDA requires all applicants to submit data on total installed costs and a breakdown of cost components for hardware, engineering & construction, permitting & siting, and interconnection before they can receive any payments under the Bridge Incentive program.

Hawaiʻi

Hawaiʻi accounts for almost 2% of existing and planned energy storage capacity in the U.S. as of July 2022 (EIA 2022a). The state's existing and planned energy storage fleet reflects a high share of installations co-located with solar and wind farms. Hawaiian Electric Companies includes the state's three investor-owned utilities—Hawaii Electric Light Co Inc, Maui Electric Co Ltd, and Hawaiian Electric Co Inc—and serves five islands and 95% of the state's electricity demand (EIA 2022b).

Over the past decade Hawaiʻi has been a national leader in innovative clean energy deployments and policies. The state's innovations are, in part, motivated by a historical dependence on expensive oil for electricity generation and a variety of operational and infrastructure development challenges inherent to island and archipelago systems. In 2015 Hawaiʻi passed legislation to establish a 100% renewables target by 2045—3 years before any other U.S. state implemented 100% clean energy target. In the absence of a storage mandate, Hawaiʻi's grid-scale energy storage is procured largely through utilities' renewable solicitations to meet increasing RPS goals. Through multiple solicitations, the Hawaiian Electric Companies procured over 700 MW of storage capacity expected to be online in 2022–2023. Of that amount, 530 MW is co-located with solar generation, increasing RPS-eligible generation by about 16 percentage points. In 2020 Kauaʻi Island Utility Cooperative procured a unique hybrid hydroelectric + pumped storage hydroelectric + solar PV + DC-coupled battery energy storage project which will cover 25% of island's load. That project is discussed further in **Attachment E (End Uses and Multiple Applications)**.

Hawaiʻi's major changes to the industry's traditional electricity policy and planning paradigm, in support of a clean energy transformation, include:

- In 2015, the nation's first state target for 100% clean energy (100% renewables by 2045);
- At the end of 2015, an end to the net energy metering (NEM) tariff, followed by refinements to time-of-use rates, which is credited for significantly accelerating customer-sited energy storage attachment rates (Barbose et al. 2021);
- After 2017, development of a cross-grid domain integrated grid planning process that includes planning across all grid domains and a customer-focused survey and knowledge-sharing campaign, as part of Hawaiian Electric Companies' Grid Modernization Plan;
- At the end of 2021, a decision for Hawaiian Electric to transition away from cost of service regulation to performance-based rates, as part of developing a sustainable business model for the utility.

We focus on NEM and associated retail rate reform for our Hawaiʻi case study, due to its relevance to California's urgent need to develop significantly stronger grid signals to customers to enable energy storage use cases and operations that are beneficial to both customers and to the grid.

NEM and Retail Rate Reform

Hawaiʻi's NEM and retail rate reforms are crucial components of the Hawaiian Public Utilities Commission's efforts to align customer behavior with grid needs.

Under NEM Hawaiʻi saw a rapid increase in distributed energy resource adoption for many years. About 21% of single-family homes in the Hawaiian Electric Companies' service territories had rooftop solar in 2016 (Hawaiian Electric Companies 2017). In early 2014, when California's Duck Curve was only conceptual and not yet observed, the Hawaiian Electric Companies made industry headlines when it reported actual solar overgeneration and associated energy backfeed problems on neighborhood circuits with high solar PV penetration (Wesoff 2014; St. John 2014). Along with a success story of high customer solar PV adoption, the Hawaiian Electric Companies' challenges with energy backfeed provided the industry with an example of the dangers and costs of unhindered solar resource expansion without parallel advancements in the grid's ability to absorb solar generation when produced.

In October 2015 the Hawaiian Public Utilities Commission (HI PUC) made the decision to end the Hawaiian Electric Companies' net energy metering program to new participants (HI PUC 2015). Even with existing NEM customers protected from the change, this decision came with great controversy. Legal battles ensued, stakeholders argued over equity issues, and the customer-sited solar industry loudly contracted.

The HI PUC's October 2015 decision discusses how combination of NEM with "extraordinarily high" retail rates and "dramatic" cost reductions in renewables and storage was driving high DER adoption and a backlog of thousands of customers waiting to interconnect DERs (HI PUC 2015). The HI PUC also found that the NEM program was not designed for the high degree of DER adoption observed. Although it was clear NEM was not sustainable going forward, a permanent successor was not immediately identified. As an interim measure, customers with new DER interconnections were subject to a minimum bill and had an option to export to the grid in exchange for energy credits.

In September 2019 the Hawaiian Public Utilities Commission opened a proceeding to explore options for DER programs and rate designs more sustainable over the long-term (HI PUC 2019). Stakeholders submitted their advanced rate design proposals in March 2021 with a focus on design and implementation of default time-of-use (TOU) rates for residential and commercial customers. The Hawaiian Electric Companies proposed a 3-part TOU rate that would be mandatory for customers with DERs, and that would include evening on-peak, overnight, and mid-day periods (Hawaiian Electric Companies 2021). The Division of Consumer Advocacy (Consumer Advocate) proposed either a 3-part TOU rate with similar period definitions or a 4-part TOU including a morning peak period. Consumer Advocate emphasized long-run marginal cost as an efficient price signal, using CPUC as an example to follow, and recommended consideration of TOU combined with critical peak pricing (CPP) to signal for the more extreme grid-constrained times (Consumer Advocate 2021). Representatives of DER suppliers (DER Parties) proposed a 3-part customer bill, including a customer charge, a grid access charge, and TOU rates (DER Parties 2021). The DER Parties' proposed TOU rates include 3 periods with relative rate levels at a specific 3:2:1 ratio, for on-peak, off-peak, and mid-day periods, to optimize customer response (DER Parties 2021).

As of the time of this study the Hawaiian Public Utilities Commission has not yet made a decision on the advanced rate design track of its DER policies proceeding. The context of this proceeding has obvious parallels to issues faced by the CPUC and will be an important proceeding to watch for opportunities to learn from both commonalities and differences.

TOU rates in California, for example, are not sufficient to align the operations of customer-sited energy storage with grid needs. Compared to the California IOUs' 2-part TOU rates, more granular 3-part and 4-part TOU rates would better incentivize general charge and discharge patterns with the grid (e.g., charging during the day rather than overnight). However, TOU rates as the only dynamic pricing mechanism cannot capture the significant value energy storage can provide by fine-tuning charging and discharging at the specific times when the grid is constrained. For example, if time of use peak pricing is 4–9 p.m. a customer with 2-hour storage may automatically discharge from 4–6 p.m. even if the grid has the greatest need after 6 p.m. This is a reality we saw in 2020 and 2022, when CAISO had a Stage 3 Emergency on August 14, 2020 from 6–9 p.m., a Stage 3 Emergency on August 15, 2020 from 6–7 p.m., and an Energy Emergency Alert 3 on September 6, 2022 from 5–8 p.m.

Although painful for the customer-sited solar industry, the end of NEM appears to have facilitated growth in customer-sited energy storage use cases over the past 5 years. Overall, Hawaiʻi's transition away from NEM better incentivized self-consumption of solar PV by limiting or reducing compensation for grid exports. Also, despite a slowdown, the share of single-family homes in the Hawaiian Electric Companies' service territories with rooftop solar continued to grow to 32% in 2022 (Hawaiian Electric Companies 2022). According to a 2021 LBNL report, Hawaiʻi had the nation's highest storage attachment rate in 2020, with 80% of residential customers and 40% of non-residential customers who had solar PV also had a storage system installed. California, in contrast, is a distant second in the list, with a storage attachment rate to solar of 8% for residential and 2% for non-residential customers.

Arizona

Arizona accounts for about 5% of existing and planned energy storage capacity in the U.S. as of July 2022 (EIA 2022a). The existing fleet includes several large projects like the hybrid 280 MW concentrating solar power plus 6 hours of storage at the Solana Generating Station.

Storage investments are mostly driven by the utilities' corporate strategy. In early 2022 Arizona regulators voted to maintain RPS at 15% and rejected a proposed 100% clean energy rule that would include a 5% energy storage target (ACC, 2022a). The vote was in response to public opposition to the ratepayer cost of a renewables buildout in comparison to a future with mostly natural gas-fired generation.

Instead, utility initiatives such as Arizona Public Service Company's (APS) pledge to 100% carbon-free electricity by 2050 motivate clean energy and energy storage builds (ACC, 2022b). APS is the state's largest investor-owned utility, serving about a third of Arizona's electricity demand (EIA 2022b). The company's clean energy goals include significant investment in energy storage.

In 2019 APS announced an initiative to add **850 MW of battery storage by 2025**. The utility's plans stalled for two years after a catastrophic safety failure at the 2 MW/2MWh McMicken Battery Energy Storage System in April 2019. In 2021 APS resumed its energy storage development plans with enhanced safety protocols (see **Attachment F (Safety Best Practices)** for more discussion).

APS Residential Battery Pilot

APS developed and administers several demand-side management programs, including a residential battery incentive pilot for **customer-sited energy storage**. The pilot was originally developed as the Residential Energy Storage Pilot and was approved by the ACC in 2020 (ACC 2021). The original pilot was designed to offer customers up to $2,500 if they install a new battery system, enroll in a time-of-use rate plan, and commit to discharging during peak hours.

APS subsequently renamed the pilot the **Residential Battery Pilot** and refined its structure to offer customers two options:

aps
APS RESIDENTIAL BATTERY PILOT

https://www.chargingrewards.com/apsbattery/

(1) A data only option in which customers agree to connect to the utility's resource operating platform and share battery performance data, or

(2) A data plus dispatch option in which customers agree to sharing data and 80% of the battery's capacity with the grid during capacity-constrained periods (APS 2021).

    Under this second option, customers receive an additional $1,250 up-front payment, and capacity sharing is limited to 100 events per year over 3 years. ACC approved $1.8 million for this revamped pilot in 2021 to run for 3 years.

APS' stated objectives of this pilot are to encourage customers to (a) charge during off-peak hours, (b) discharge during peak hours, and (c) share battery performance data. The utility stated intentions to use the collected battery performance data to "inform future efforts to scale distributed energy storage capacity on the grid" (APS 2021).

With relevance to California, this pilot is particularly innovative in its approach to collect and learn from data on customer-sited battery performance and operating patterns (regardless of capacity-sharing with the grid). Furthermore, the pilot's mechanism to call on a firm commitment from customers to share capacity under option #2 is a step closer to unlocking RA capacity value compared to voluntary response programs like California's ELRP and California's plea-based emergency alerts.

Nevada

Nevada has relatively little operational storage (25 MW in 2021) but installed capacity is expected to grow to over 1,500 MW by the 2023–2024 timeframe. Total existing and planned energy storage capacity as of July 2022 is about 8% of the U.S. (EIA 2022a). Sierra Pacific Power Company and Nevada Power Company, both of which conduct business as NV Energy, are the state's investor-owned utilities.

State RPS and utility IRPs are the primary drivers of storage procurements in Nevada. In 2020 the state set a 1,000 MW by 2030 storage mandate for NV Energy, but the utility already met most of the requirement by that time. The state's ambitious clean energy goals of 50% renewables and energy efficiency by 2030 and 100% goal by 2050 are expected to be met largely by solar. This would create challenges similar to those experience in California that can be addressed by energy time shift services provided by energy storage.

Solar plus storage projects rank high economically in renewable solicitations due to cost synergies, ITC applicability to storage, and improved RA capacity value. Most storage capacity procured in the state (95%) is co-located with utility-scale solar projects that are needed to meet future RPS. More recently, NV Energy's 2021 integrated resource plan identified two solar + storage projects to replace a retiring 522 MW coal plant.

Utility Contracts with Corporate Entities

In 2019 NV Energy signed a landmark deal with Google for 350 MW solar plus 250–280 MW co-located battery storage to serve the electricity needs of a large data center in Nevada. At the time, Google was reportedly the largest corporate purchaser of renewable energy in the world and had amassed over 5.5 GW in renewable energy contracts internationally—enough to match its total annual global energy consumption (NV Energy 2019a). The NV Energy deal supports Google's strategy to de-carbonize even further through renewable energy matched to consumption on an <u>hourly</u> basis, in recognition that *when* renewable energy is produced matters for electric sector GHG emissions reductions. The deal also serves NV Energy's needs for clean energy and capacity during summer evening peaks when the grid is most constrained. In 2020 the Public Utilities Commission of Nevada approved procurement of the Dry Lake Solar Project and the Chuckwalla Solar Project, each with co-located 4-hour battery systems, earmarked to serve the NV Energy/Google deal (PUCN 2020).

The parties structured their long-term energy supply agreement to serve both Google and other customers on NV Energy's grid. NV Energy procured the solar plus storage facilities on behalf of Google and in tandem with the utility's various resource planning processes. Once the solar plus storage projects are in operation (expected by January 1, 2024), Google is charged a fixed rate for all attributes of the project (energy, capacity, renewable credits) to serve its data center with a minimum of 70% renewable energy on average hourly (NV Energy 2019b). Some hours may be served at less than 70%, and some at more than 70%, but not over 100%. In other words, excess solar generation output that is not stored but injected to the grid is not counted towards meeting the contract's minimum renewable energy requirement. Over an entire year, the hourly renewable energy shares (capped at 100%) must average to at least 70%. In addition, Google receives a credit for residual capacity provided to the grid during grid-strained summer evenings (NV Energy 2019a).

In 2019 NV Energy estimated the deal would provide \$3–11 million in customer benefits annually, and \$19–165 million in total, depending on actual data center load and on a contract extension option (NV Energy 2019a).

Texas

Texas' independent system operator, ERCOT, had 833 MW of operational grid-connected battery capacity on its system by the end of 2021; 70% of that capacity was installed in 2021 (ERCOT 2022b). Installed capacity is expected to reach about 7,800 MW by 2024 (ERCOT 2022b). As of 2022 the state is second to California in quantity of total operational and planned energy storage capacity in the nation.

We include Texas as a case study due to its recent high volume of energy storage development and as a pronounced market and policy contrast to California. Without a state-level storage mandate or utility contracts, most energy storage in Texas is developed by independent power producers (IPP) as merchant projects. Texas demonstrates what types of energy storage use cases and services emerge as part of a viable private business proposition without policy intervention.

Energy Market-Driven Storage Duration

In contrast to the CAISO marketplace, ERCOT's marketplace is characterized by an "energy-only" approach to fixed investment cost recovery, associated scarcity pricing and more volatile energy prices, and energy prices that are highest during traditional peak periods during the day. As such, energy storage developers are highly incentivized to invest in instantaneous (MW) capacity—rather than energy capacity (MWh)—to capture market revenues during ERCOT's highest-priced hours and/or to provide ancillary services.

ERCOT's statistics on the distribution of durations in its energy storage fleet as of the end of 2021 demonstrate developers' focus on instantaneous capacity investments (ERCOT 2022a). Most operational batteries (97%) are designed with durations of two hours or less (Figure 1, top). One operational project has a duration of about four hours. Projects not yet commercially online but in an advanced stage of the interconnection process reflect similar duration trends. All batteries in advanced development are designed with durations of 2.5 hours or less (Figure 1, bottom).

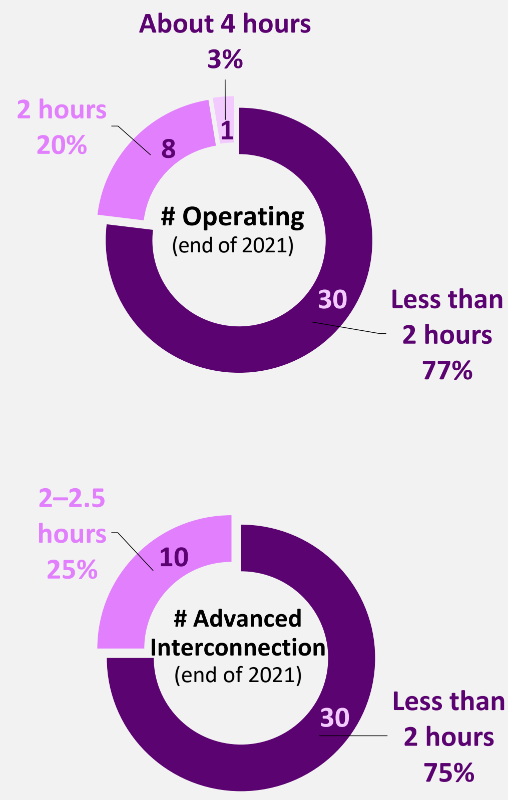

Figure 1: ERCOT's trends in battery energy storage duration.

Developers' focus on standalone storage reflects how operational constraints needed to capture co-location benefits (from tax credits and shared costs) can significantly reduce the market value of storage in Texas. Unlike in California, the highest-priced hours in ERCOT's energy market still occur during the day. Not being able to discharge at that time due to a solar charging requirement or a joint point of interconnection limit is detrimental to the economics of hybrid projects in ERCOT (for more discussion *see* Gorman et al. 2021). Around 70–80% of operational and planned energy storage MW is from standalone batteries. Solar plus storage accounts for most of the remaining, with some capacity co-located with wind farms and some co-located with thermal generation (ERCOT 2022a).

A February 2021 winter storm in Texas tragically resulting in hundreds of deaths exposed grid vulnerabilities to extreme weather (Svitek 2022; Cai et al. 2022). Absent policy intervention, in ERCOT's reactive investment market it is unlikely that developers will build energy storage with sufficient duration to support bulk grid reliability and resilience under new and changing environmental stressors.

Key Observations

NYSERDA's RES solicitations create an avenue for maximizing joint renewables plus storage value by requiring two bids from developers: one with and one without storage.

With the aim for better integration of distributed energy resources, **New York** transitioned from net metering to Value of Distributed Energy Resources (VDER) compensation in the form of bill credits for estimated energy value, capacity value, environmental value, demand reduction value, locational system relief value, and community credits.

New York's soft cost reduction efforts are centered around several data-driven initiatives to streamline permitting, siting, and customer acquisition, and to keep track of actual progress over time.

In the context of high distributed solar PV penetration, elimination of net energy metering along with retail rate reforms are crucial components of the **Hawaiian Public Utilities Commission's** efforts to align customer behavior with grid needs.

Arizona Public Service Company's Residential Battery Pilot demonstrates an innovative approach to (a) collect and learn from data on customer-sited battery performance and operating patterns and (b) establish a firm commitment from customers to share capacity with the grid during grid-constrained periods.

NV Energy's contract with Google for 350 MW solar plus 250–280 MW co-located battery storage demonstrates an innovative procurement approach to stacking customer-specific benefits with broader grid benefits.

Energy storage investments in **ERCOT** highlights the strong incentives for merchant developers to configure systems for very short durations to capture energy and ancillary services market revenues.

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