



A GTM Squared Insight

Emerging U.S. Energy Storage Markets

**Arizona, Colorado, Florida,
Massachusetts, Nevada, New Jersey,
New York, Texas, and Virginia**

From Julian Spector

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StoragePlus

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StoragePlus is a weekly column from Julian Spector.

The column is part of GTM Squared, a premium service delivering insights on the most important trends in power and renewables.

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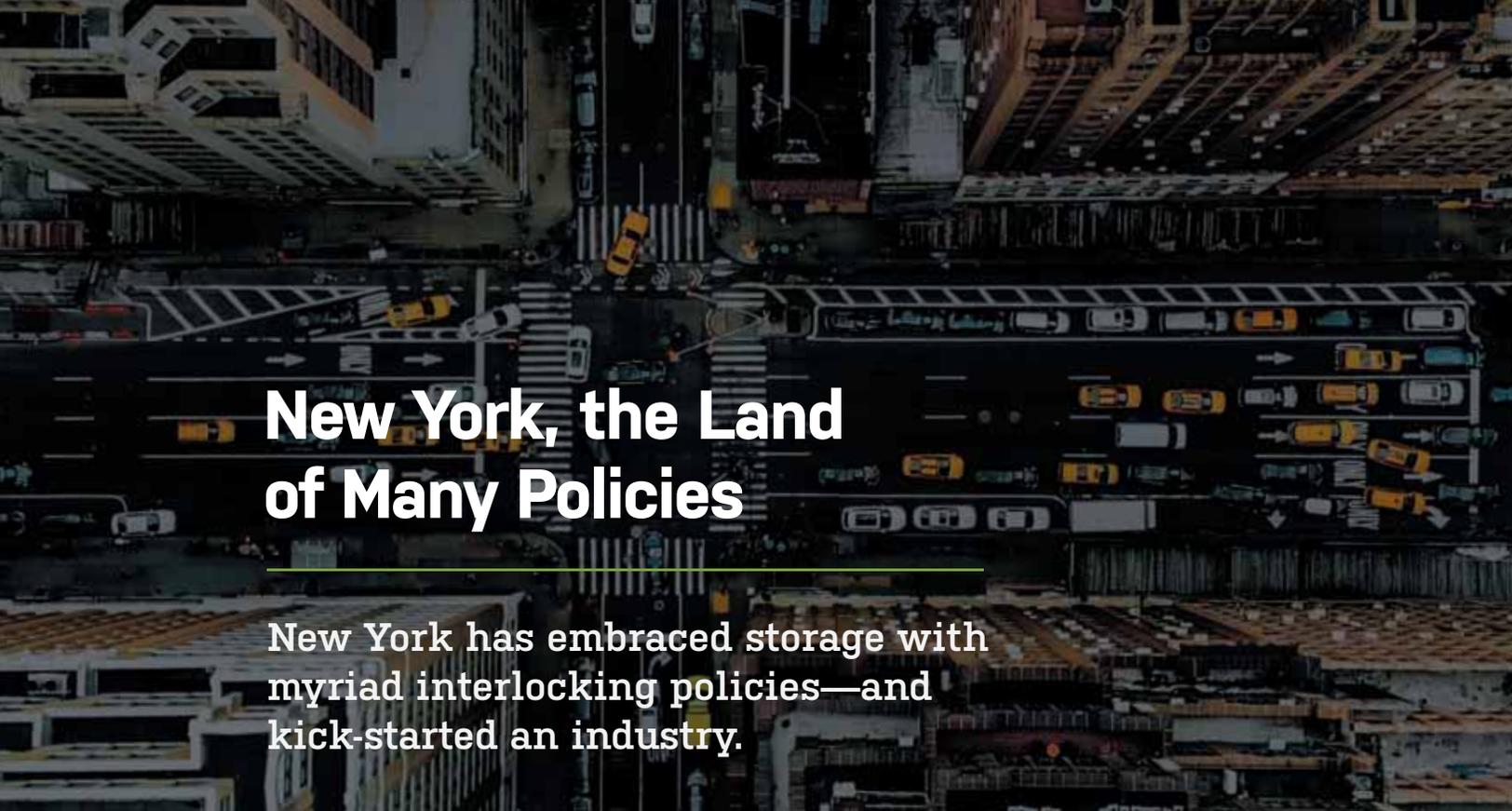
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New York, the Land of Many Policies

New York has embraced storage with myriad interlocking policies—and kick-started an industry.

We're embarking on a multipart series to explore the emerging state markets for energy storage. The goal is to expose readers to the new market opportunities popping up around the country, along with the local challenges and the cast of characters you should be familiar with in each location.

The "emerging" label deserves some explanation, as energy storage remains fairly novel everywhere. The key here is to investigate places where the industry is in flux. Maybe a new law breaks open deployment opportunities where none existed or new rate designs create a price signal that's spurring investment. Or broader market dynamics organically made storage a cost-effective tool for customers.

If you follow Storage Plus, you've absorbed plenty of news about California's bustling storage market and all the many policies it passed to support that. PJM is old news — who even develops there any more? And Hawaii is pretty well established; it kicked off the 100 percent renewable commitment trend way back in 2015 and has several rounds of large-scale storage procurement under its belt already. We'll set those three aside for now.

To kick things off, we turn to New York, which has emerged as a vital hub of storage activity on the East Coast.

It turns out, policy works

New York state proved how quickly an all-hands-on-deck policy charge can create market activity.

It wasn't always like that. As recently as 2017, state leaders had little action to show for their stated interest in energy storage as a tool for the state's decarbonization strategy. The state was mandating 50 percent renewables, but leadership hesitated when it came to applying a "centrally planned" approach to storage. The legislature unanimously passed a bill to create a storage target, only to watch Gov. Andrew Cuomo sit on it for months.

That policy inaction shifted rapidly by the dawn of 2018. Cuomo finally signed the storage law, then upped the ante by proposing his own (non-binding) storage deployment target of 1,500 megawatts by 2025.

Since then, storage policies have come fast and furious, including:

- A \$280 million "bridge incentive," launched in the spring of 2019, that covers some of the calculated gap between what storage can earn given current market rules and what value it provides to the system. Wood Mackenzie analyst Brett Simon estimates this would incentivize at least 1.8 gigawatt-hours of additional storage by 2025.
- \$55 million for a similar program in Long Island, which grapples with geographical constraints on power supply exacerbated by summer peaks from seasonal tourist influx. The local distribution grid operator will also pay homeowners for using their own batteries to reduce usage during crucial peak hours. That "bring-your-own-device" program gives homeowners an additional reason to combine batteries with home solar.
- A nitrogen oxide emissions rule that tightens enforcement on the worst-polluting peaker plants. Operators can comply by shutting down old plants and replacing them with storage, or by adding storage to hybridize plants so the thermal generators run less often.

- The non-wires alternative doctrine, which gives utilities a share of profit for money they save by avoiding capital-intensive grid upgrades. This hasn't proven itself a huge source of business for storage, but it has supported a few installations, and storage is a natural tool for non-wires alternatives to use if they proliferate.
- Aggressive offshore wind development. The state targeted 9 gigawatts of offshore wind by 2035, compared to zero offshore capacity currently installed. Dealing with the influx of this generation to the transmission-constrained New York City region will almost certainly require grid storage, and quite possibly long-duration storage.

The full range of impacts from these policies is still being determined. The peaker emission rule, for instance, has taken effect but does not kick in the enhanced pollution restrictions until May 2023, so it hasn't changed things on the ground yet. But the block grant program is clearly achieving its intended purpose of getting installations going; the stream of press releases about battery plants being built or developed with grant funds attest to that.

The retail storage grants have stimulated "substantial numbers of projects," especially solar-plus-storage systems in the 1- to 5-megawatt range, said Bill Acker, executive director of the New York Battery and Energy Storage Technology Consortium, a local industry group more commonly known as NY-BEST. Numerous larger bulk storage systems have entered the queue to serve the NYISO wholesale markets, although they take longer to develop. And several utility procurements are wrapping up that could lead to more large-scale battery capacity.

As of Q4 2019, New York had built 57 megawatts of front-of-the-meter storage, placing it in fourth place among single-state markets, according to data from Wood Mackenzie.

Regulatory challenges from near and afar

That's the good news for storage developers. But two regionally specific challenges could stymie development: an arcane matter of federal energy regulation and the risk-averse fire-permitting process for batteries in New York City.

The partially populated Federal Energy Regulatory Commission decided in February that energy storage plants should be subject to a rule that will likely make them less competitive in the NYISO capacity markets.

Power plants in an area spanning the lower Hudson Valley, Westchester and New York City must undergo a "buyer-side mitigation" test before they can compete in the capacity markets. This test was designed to ensure that utilities that own generation don't use out-of-market revenue streams to undercut the market and suppress prices.

"Clearly, no one in the storage industry has the intent to do that," Acker said.

Not only does a fledgling storage industry lack the market power to game the system, but price suppression would directly undercut the business case of a battery, which would be to earn as much money as possible for the delivery of capacity. The state, the ISO, NY-BEST and others petitioned FERC to make an exception.

But in a 2-1 ruling, the Republican majority applied the buyer-side mitigation test to storage and renewables in that mitigation zone.

"It's certainly a bit of a barrier; there's no doubt about that," Acker said.

The test only applies to that delineated region, so upstate batteries can bid their capacity unencumbered. Some facilities could pass the test and avoid the administrative price hike, Acker noted. But the state is exploring other options via proceedings to revamp resource adequacy procurement and to reform the buyer-side mitigation rule itself.

File this under the broader theme of state clean energy policy clashing with the market rules adjudicated by FERC. In practical terms, though, it could deny storage developers valuable capacity revenue that they need to make projects worthwhile, unless the state figures out a workaround.

"The key thing for us in 2020 is sorting through the ability to participate in the ISO markets and/or the state resource adequacy parallel path," Acker said.

If federal oversight can slow storage deployment, so can local permitting decisions. In particular, New York City's Fire Department has taken a cautious approach to allowing lithium-ion batteries into densely packed city buildings. Last April's explosion at a grid battery in Arizona corroborated the need to ensure safe installations.

The fire department has issued guidance for outdoor battery projects, which will speed things up compared to the early days when the standards were still being figured out. But it remains very challenging to do indoor projects in occupied buildings, like the basement of a high rise, Acker said. That so far has kept things pretty quiet in the state's largest load pocket, where local capacity has unusually high value.

Notable projects

To close, we're going to examine a few early projects that exemplify New York's specific style of storage market development.

Revamping commercial storage

The commercial storage business model that developed in California — subsidized batteries helping businesses reduce demand charges — has largely failed to spread elsewhere. Now even the pioneers of that model are pursuing alternatives, including selling software or supplying solar-plus-storage developments.

New York City has developed an alternative model: batteries that rent space from commercial landlords in order to serve specific grid needs. This drastically simplifies the relationship with

the host company: It merely needs to have space and a desire to cash a regular lease check; no complicated demand analytics required.

GI Energy, a Shell company, tested this out in a four-battery demonstration with utility Con Edison in 2019. Enel X later put it to work at a big-box store mall in Brooklyn's East New York neighborhood, building the city's biggest battery.

These systems hold promise for future development. They give Con Ed access to local capacity in dense urban areas, where gas plant development would be impractical. Recall that these are the same areas that have the old, dirty peakers targeted by the new nitrous oxide regulation. And since these are larger outdoor systems, they don't need to worry about the higher scrutiny applied to indoor batteries.

Putting the bridge grant to work

Key Capture Energy used the bridge grant to build a 20-megawatt battery near Albany, claiming the title of largest battery in the state when it reached completion last fall. It will face competition from a 20-megawatt system GlidePath Power Solutions is developing in Ulster, replacing a previously planned gas plant, but that won't be online until 2021.

Key Capture approaches storage much like developing a merchant thermal plant. The team runs quantitative analyses on transmission flows and congestion to pinpoint promising nodes for siting, then assesses a range of wholesale market activities and contracted activities to maximize revenue.

As the first bulk storage project to make use of the incentive, this one serves as a proof of concept that the policy can spur development. Now we need to see how it performs. But the folks at Key Capture don't seem interested in money-losing projects that claim market share; they have to answer to private equity firm Vision Ridge Partners, which means they need to justify projects based on private equity-grade returns.

Clean peaker for real

Ravenswood Generating Station sits on the banks of the East River, pumping out 2.2 gigawatts of power for New York City. But it soon could transform into a vision of the future grid.

Owner LS Power got regulatory approval in 2019 to add 316 megawatts of batteries to the site, replacing 16 old peaking units that have retired already or rarely run. It could be the first major use of batteries on the East Coast to deliver power comparable to a conventional peaker plant.

The deal is not yet done, however. Projects this size don't just happen without some revenue locked in; watch for the results of Con Ed's capacity solicitation from last fall for clues as to how the developer might secure that. The dynamics around FERC's capacity market ruling also need to be sorted out.

But this project rides a few trends that aren't going away: New York City needs peak capacity; the state wants more capacity from batteries rather than fossil fuels; land is scarce, giving LS Power an advantage since it has the land and interconnection already. If LS can turn those structural needs into a business case, others will surely follow.



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Massachusetts Pinpointed the Value of Storage. Now It's Trying to Deliver It.

New policies have spurred development, but the industry's still waiting for faster interconnection and clarity on revenue opportunities.

Massachusetts has spent the last four years bringing an energy storage market to life, and its efforts are starting to produce results.

The state government produced a landmark study on the value of energy storage back in 2016. The State of Charge report clarified the value that storage technology could provide for the grid and pointed out the ways market rules would not allow it to earn compensation for its full range of values. Its comparison to the storage baked into other critical supply chains, like food or water, made for a great conversational pitch on the importance of grid batteries.

That report set the template for the subsequent states that began their journey of storage actualization with a systemwide study. In New York, such efforts justified the Bridge Incentive program. In Massachusetts, it led to an initial round of grant-funded projects, then a storage adder on the new solar incentive and a prompt from the legislature to encourage storage to mobilize clean energy for peak power.

Those policies build toward a 2025 target of 1,000 megawatt-hours. The state counts 108 megawatt-hours installed as of February 15, with 10 times that amount in the pipeline.

That sequence, from study to declining subsidies that taper into market-based storage competition, is exactly what the industry needed from Massachusetts, said Dan Berwick, general manager of development at Borrego Solar.

"They did an amazing job of policymaking on this," said Berwick, who develops solar and storage in Massachusetts. "It's a model you should follow if you're a policymaker."

On the other hand, Gov. Charlie Baker's administration formulated these policies ahead of an overarching strategy for long-term decarbonization. Baker just proposed a net-zero emissions target for 2050 in his January State of the Commonwealth address, after several years of hashing out specific clean energy programs with extensive stakeholder input.

"These timelines are taking so long because the administration has been unsure of their process for planning," said Michael Green, executive director at Climate-XChange, a Boston-based nonprofit that advocates for carbon pricing. "There seems to be an interest in saying the right thing, but the process often struggles with intention and lucidity."

Storage projects are in motion, but the market is still young, and several key dynamics are still being worked out. Interconnection studies weigh down project timelines. Wholesale market revenues remain elusive, except for a few early adopters. The first-of-its-kind Clean Peak policy has yet to take effect.

Still, the storage industry enjoys explicit support from the legislative and executive branches, and Massachusetts has strong cohesion around a vision of a clean energy future. Storage has been tapped for a crucial role in that. It's in training now, but with a clear pathway to step up for more serious duties.

Massachusetts' key storage policies (in roughly chronological order)

Advancing Commonwealth Energy Storage grants

Not a policy so much as a one-off disbursement, the ACES grants paid out \$20 million to put batteries in the field. The roster of winners, announced in December 2017, reads as a guide to the companies with the most interest in the state's nascent market.

SMART with storage adder

This is the center of gravity for storage in Massachusetts today. The state's Department of Energy Resources crafted a storage adder for the Solar Massachusetts Renewable Target, which pays extra for every kilowatt-hour of solar generation when a system is tied to energy storage. That's not a nuanced price signal — it has little to say about what the storage actually does — but it offers a way to kick-start activity as the business models for storage come into view. It's supporting business cases like storing power for solar plants that face interconnection constraints or the program cap of 5 megawatts (AC) of capacity; batteries can shift generation for export later, enlarging revenue compared to a standalone solar design.

New energy efficiency includes storage

Massachusetts prides itself on national leadership in energy efficiency. Historically, that focused on old-school, passive reduction efforts like swapping out lightbulbs. But the \$3 billion Mass Save program allotted for 2019 through 2021 puts batteries to work for peak-demand reduction.

Enrolled home batteries will receive commands from utilities National Grid or Eversource, dispatching them for up to three hours at a time. The battery owner gets paid based on participation; a 5-kilowatt battery could earn \$1,125 per year, according to information published by the program. Combined with an investment tax credit, that goes a long way toward paying down the cost of the battery. It also gives the aggregator companies a path to market.



Clean peak

Peak hours are expensive and tend to be dirty; clean energy generation doesn't always line up with those hours, especially when the energy is solar and the peak comes in the evening. A "clean peak" rule requires utilities to buy a certain amount of their power for peak hours from clean sources. Several states have talked about this, but Massachusetts signed it into law first; the actual rule, though, is still moving through its procedural steps and has not been officially put into force. After a legislative review period, it could take effect in June. That needs to happen to give companies firm guidance on how to move forward.

A recent journal article questioned the emissions benefits of this policy, based on modeling of the Massachusetts grid during 2018 and 2019.

Offshore wind bonanza

Like much of the upper Atlantic Seaboard, Massachusetts wants big growth for its currently nonexistent offshore wind sector. This will work alongside distributed solar and imported Canadian hydropower to supply a highly renewable grid. The general thinking is that, when several gigawatts of intermittent power start washing ashore, they will create economic opportunities for storage to time-shift that power to more valuable hours, dodge transmission congestion or maintain power quality amid the fluctuations.

"Offshore wind is going to be a massive source of clean energy across the Eastern Seaboard, and to me, it's a no-brainer to pair energy storage with it," said Daniel Finn-Foley, energy storage director at research firm Wood Mackenzie.

For context on the stakes here, the state has awarded 800-megawatt projects to Vineyard Wind and Mayflower Wind. Together, they will produce the equivalent of 12 percent of the state's annual electricity consumption. Another 1,600 megawatts of offshore wind could be on the way. The wind farms have to get built first, though, so the ensuing storage opportunity remains a few years away at least.

Key challenges

Slow interconnection

It is a truth universally acknowledged: A storage developer active in Massachusetts must be in want of speedier interconnection.

As new batteries attempt to hit the grid, the study process whereby utilities and the independent system operator calculate a project's grid impacts frequently results in additional requests, costly requirements and delays. This can set back timelines by a year or more.

The interconnection obstacle materialized most dramatically in May when National Grid froze 1 gigawatt of solar deployments to perform a months-long "cluster study" on transmission system impacts arising from SMART-funded projects. The utility opted to wait until after the incentive went into effect to study whether the entirely predictable flood of developments would have some cumulative effect on the grid.

The first phase wrapped up last fall, releasing 300 megawatts of projects with no additional transmission-upgrade costs. The next phase of the study should wrap up this March. The incident also triggered an investigation into National Grid by the state's Department of Public Utilities.

These and other interconnection delays create real business impacts. Larger regional or national players can generally absorb the cash flow requirements of a longer-than-expected development cycle. But smaller shops that heeded the governor's call and geared up for the state's storage push have had a harder time grappling with this barrier.

Revamping the way the grid works brings some inherent complexity. But the state has identified interconnection as an area in need of improvement, and the key stakeholders are working on it, said Engie Storage CEO Chris Tilley.

"It's been slower than we'd hoped, but we have good parties that are earnestly trying to make the market work," he said.

Unclear wholesale market opportunities

The consensus view is that the New England ISO offers clearer pathways for batteries to participate compared to much of the country. It wasn't an accident that rooftop solar installer Sunrun won its first wholesale capacity contract for residential storage in New England, not its home state of California.

But with so few batteries actually providing bulk storage or aggregated storage to the wholesale markets, the industry still has a lot to learn about how to make money there.

"We haven't seen many of the [large-scale] projects fully developed up to this point, given the timelines with development," said Will Lauwers, emerging technology division director at DOER.

After completion, battery plants must contend with the volatility of prices. The most recent Forward Capacity Market auction, for instance, cleared at \$2 per kilowatt-month in February, declining by nearly half from the previous year's clearing price.

"That's definitely a difficult signal for new resources to project revenue against," Lauwers noted.

A possible upside of that meager price is that it could dissuade new gas-plant investment, squeezing supply until demand pulls up prices. By that time, battery costs will have fallen and developers will have more time to build up their operational capabilities.

Borrego Solar has some assets participating in the wholesale market, said Berwick. But whereas the solar-plus-storage business case is clearly paying off today, wholesale operations for storage are still developing into a workable business proposition.

Engie Storage has a battery in the wholesale market as well. Tilley described it as a "for-profit project" that nonetheless is helping the company learn more about how to operate within market constraints and maximize revenue.

One of the challenges for storage operation is to perform multiple roles while fulfilling the requirements of each program or market, said

Jonathan Poor, Engie Storage director of business development. The federal Investment Tax Credit requires a certain level of solar charging, which has to be factored in when discharging for demand response or a capacity obligation, for instance.

The shadow of FERC

Massachusetts participates in ISO New England, which is subject to regulation by the Federal Energy Regulatory Commission. That body recently pushed back on state-level clean energy policies in PJM and New York. Both decisions work to raise the bid price of clean energy assets in the market, on account of support they receive from state policies.

"FERC has shown a new, or at least renewed, appetite to intervene in markets where states are trying to incentivize renewables and storage," WoodMac's Finn-Foley said. "If FERC considers subsidized resources a threat to competition in PJM, I don't see any reason why they wouldn't [come to] the same conclusion in New England."

This hasn't happened yet, but it's a relatively new cloud hanging over the horizon for states including Massachusetts.

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Nevada's Storage Market: From Desert to Land of Wild Opportunity

The state's rapid turn to massive storage-plant construction mirrors the maximalism of Las Vegas itself.

Nevada soon could become the sleeper hit of the energy storage industry.

There's nothing much to see if you look at installed capacity right now — it's literally zero. But a handful of major projects have already been approved that will change that situation rapidly.

Major utility NV Energy has three battery plants totaling 100 megawatts slated to come online in 2021. Another 590 megawatts are approved and on their way for 2023, which would shoot Nevada to the top three state markets for front-of-the-meter storage that year.

Whether or not this is evidence of a healthy market springing up is a matter of debate. The major projects all flow through regulated utility NV Energy, the Berkshire Hathaway-owned company that serves four-fifths of the state. The utility sees the value of cheap desert solar power and recognizes a need to store it for more valuable dispatch in summer peak hours, when Las Vegas air conditioning hits maximum velocity.

So far, storage development happens when NV Energy asks for it. Commercial installations have yet to materialize, while residential battery installers have found some traction but not much. Sunrun, the largest home solar installer, does not even offer its Brightbox solar-plus-storage product in the state, despite a lively standalone solar market.

But in January, Google unveiled a proposed solar-plus-storage project to power a new data center with round-the-clock clean energy, a first of its kind for corporate procurement. NV Energy is the one delivering it, but Google proved that corporate demand can make things happen in Nevada.

If not so bustling as neighboring states California or Arizona, Nevada nonetheless stands out in the nation for its rapid acceptance of a highly renewable future and its willingness to invest in big batteries to make it happen.

The case for massive storage in Nevada

Unlike the other states we've examined, where storage comes to market serving a variety of policy and market needs, Nevada storage is all about one thing: time-shifting solar power plants for lucrative peak-hour delivery.

NV Energy first delved into this format in 2018 and doubled down with three projects proposed and approved last year. They are:

- Quinbrook Infrastructure Partners' Gemini project, 690 megawatts solar with 380 megawatts/1.5 gigawatt-hour storage
- 8Minute Solar Energy's Southern Bighorn, 300 megawatts solar with 135 megawatt/540 megawatt-hour storage
- EDF's Arrow Canyon, 200 megawatts solar with a 75 megawatt/375 megawatt-hour battery

Nevada enjoys exceptional conditions for solar generation in the desert, which make it a highly attractive low-priced power option, said Robert Johnston, who tracks energy policy in the state as a senior staff attorney at Western Resource Advocates, which promotes a transition to clean energy in the Interior West.

"However, peak demand is not aligned with the sun and continues on into the late afternoon and evening hours as solar generation declines and disappears, but the heat of the day lingers and air conditioning load remains high," he noted.

So the system either uses cheap solar by day and fires up more expensive gas peaker plants by night, or finds a way to use that cheap solar for the late afternoon and evening peaks.

The battery plants attached to solar plants make that possible. The contract structure makes it profitable: The utility agreed to pay 6.5 times more for power delivered during the hours of 4 to 9 p.m. in June, July and August than it pays for the plant production the rest of the time.

Blending the on- and off-peak production yields an expected levelized cost of energy of \$33.17 to \$38.44 per megawatt-hour, which compares to an expected new combined-cycle gas plant LCOE of \$58 per megawatt-hour.

All three of those recently approved batteries outsize anything built today in terms of megawatt-hour storage capacity. Unlike perhaps any other utility, NV Energy signed off on truly massive battery plants without spending years piloting tiny batteries first.

"Although from a scale perspective, these were relatively large solar and battery projects, the underlying technology was well proven," said NV Energy spokesperson Kristen Saibini.

Keep that in mind the next time some other utility says it needs to study small batteries for years before it feels confident in the technology.

The other factor that distinguishes Nevada is how the adoption of massive energy storage advanced on its own merits, rather than following a prescriptive policy.

Here's Saibini explaining the utility's thought process: "In early 2018, NV Energy ran a competitive solicitation for renewable energy and storage projects which resulted in pricing that, for the first time, compared well to the company's forecasted energy and capacity costs. This allowed the company to make significant investments in both solar energy and battery capacity that would not require an increase in customer power bills."

Or, in the words of Sean Kiernan, head of development at 8Minute Solar: "It's largely market-driven."

Policy battles set the stage

In 2019, Nevada adopted a 50 percent renewable electricity target that comes due in 2030. But NV Energy had already embarked on a solar-storage building spree in 2018, and the three biggest projects were in the works by the time the legislature passed that goal.

This timeline differentiates the state from New York or Massachusetts, where a concerted storage policy strategy preceded and made possible the growth in installations. But it would be wrong to say policy had no role to play; it served as the backdrop against which NV Energy made its decisions.

Nevada gained notoriety in the energy policy arena thanks to the 2015 solar wars. Many utilities at the time were pushing to roll back the net metering payments that rooftop solar customers received. Nevada's regulators heard NV Energy's plea and went further than regulators anywhere else: They slashed solar customer compensation and applied the new rules to existing customers who had signed up based on the old set of rules.

Flying in the face of basic notions of fairness and business environment continuity, this decision prompted a massive public backlash. The legislature responded by passing a law in 2017 increasing compensation for solar customers, establishing a right to self-generate electricity, speeding up interconnection and banning solar-specific fees. In the meantime, voters approved a retail-choice ballot initiative in 2016, which would have eliminated NV Energy's monopoly status — one of the least desirable outcomes any monopoly can imagine.

Under Nevada rules, the measure needed to win again in 2018. With that threat looming, NV Energy unveiled an ambitious ramp-up of clean energy, including its first grid-scale battery projects.

"This 'high renewables' vision was part of an aggressive and successful campaign by the utility to defeat the Energy Choice Initiative,

which was overwhelmingly rejected by Nevadans on the required second vote in the 2018 election," Johnston said.

Clean energy worked on its own terms as a cost-effective source of peak power. But it also served as a messaging tool, demonstrating goodwill and defending the utility from policies it hoped to avoid.

What the future holds

The already-approved projects will take NV Energy from around 14 percent renewable power in 2017 to 40 percent in 2024. That leaves six years to close the gap to 50 percent.

The three latest projects stand out globally in their scale and ambition. Whether future projects can match or exceed their grandeur is an open question.

8minute Solar Energy foresees more opportunities to develop similar projects in Nevada, Kiernan said. And that type of solar-storage project pioneered in Nevada is drawing interest from utilities elsewhere.

"In a state like Nevada that's got a tremendous amount of solar resource, having the dispatchable capabilities of plants like this will continue to be a central component of their resource planning efforts," Kiernan said. "It is very uncommon for us at 8minute to be advancing projects and have the buyer be interested just in solar. Everybody wants solar-plus-storage."

Fans of the format include not just desert utilities but also tech giant Google, which made headlines earlier this year for creating the first corporate offtake deal for solar-paired storage with NV Energy.

The innovative project, still awaiting regulatory approval, extends the corporate renewable procurement trend into round-the-clock clean energy. Google will buy clean power from an NV Energy project combining 350 megawatts of solar with a battery of at least 250 megawatts (megawatt-hour capacity undisclosed).

When Google doesn't need the plant's output, NV Energy can tap it for grid stability, most notably for clean capacity during those pesky summer peak hours. The structure sets up a win-win between Google's corporate interests and NV Energy's ratepayers. If regulators sign off, this model could serve any other tech giant looking to build a data center in Nevada.

On one hand, Nevada's new storage market remains out of reach to all but the best large-scale developers, capable of mustering cheap capital and putting together some of the biggest solar-storage deals in the world. The introduction of corporate storage procurement could open up more opportunities for smaller-scale commercial and industrial development.

But Nevada's impact may be felt in other states. It's hard to find a better baseline of how quickly storage adoption can accelerate when a utility grasps the potential. It's an inspiring model for sunny states grappling with tricky peak power demands. And as more states commit to 50 percent carbon-free goals of their own, Nevada's solar-plus-storage adoption may well prove that goal to be not just achievable but actually easy.

For residents of places where the utility chooses not to proactively invest in such things, Nevada teaches a different lesson: When a populace pushes clean-energy policy through concerted legislative and political action, utilities must eventually take notice.

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BATTERY BATTERY BATTERY

The advertisement features a dark blue background with white text. At the bottom, there are three glowing battery icons, each with the word 'BATTERY' written below it. The overall design is clean and professional, emphasizing the company's expertise in energy storage.



Virginia Just Created an Energy Storage Market Out of Thin Air

A new energy bill makes Virginia a market to watch. "Last year, we were talking about pilots; this year, we're talking about 2.7 gigawatts."

Virginia, as it stands today, can hardly be called an energy storage market. But its governor just signed a clean-energy omnibus bill so comprehensive and thorough that, almost overnight, it converted the state into a storage market to watch.

Richmond's entry sets a new standard for ambitious clean energy policy. Not only does it call for closing fossil-fueled plants by midcentury, but it also introduces energy-efficiency savings targets for the first time in the state's history, ramps onshore renewables by 16 gigawatts, targets 5.2 gigawatts of offshore wind by 2034, lifts caps on distributed generation, and commits the state to joining the Regional Greenhouse Gas Initiative.

"The Commonwealth is open for business," said clean energy policy expert Katherine Hamilton, chair of 38 North Solutions and a lifelong Virginian. "There are a lot of companies that have been wanting to do business in the Commonwealth, and now they're going to be able to."

But it's the energy storage-specific points that we'll focus on because they make Virginia the next emerging East Coast market to watch. The specifics still have to be worked out, but one thing is clear: The state will have to buy massive amounts of batteries as well as long-duration storage in the next 15 years to obey the law and balance the influx of renewables.

The bill sets a storage procurement mandate of 2.7 gigawatts by 2035 for Dominion Energy, the state's largest investor-owned utility. Appalachian Power Co. must obtain 400 megawatts. And regulators will pick interim targets to ensure that the long-term target has real teeth and gets things moving right away.

Virginia's leaders grappled with how to push the clean energy agenda forward without subjecting ratepayers to undue costs. One method for maintaining that balance was requiring at least 35 percent of storage capacity to be third-party-owned, ensuring market-based competition to keep prices reasonable.

Also notable: The bill directs State Corporation Commission regulators to include the social cost of carbon in their weighing of options. This adjustment could become especially impactful when larger battery plants start to compete with gas plants for the crucial peak capacity role. Storage plants will still have to make sense on their own terms, but this language could give some storage plants an edge in otherwise close calls.

"This is a huge step forward for how we as a state evaluate and approve the addition of new power plants," said Rachel Smucker, Virginia policy and development manager for solar industry group MDV-SEIA.

Radical acceptance in just a year

If this all seems a bit dizzying, that's because it is.

A year ago, Virginia was nowhere near the top of the list for promising energy storage markets. Dominion Energy, to be sure, operated the truly massive Bath County pumped hydro storage facility. But that 3,003-megawatt system opened for business in 1985.

As for new and exciting developments, Dominion proposed a four-battery pilot project in 2019, with the goal of studying the basic functions of modern battery technology over the next five

years. That proposal just won official approval in February, so the four systems aren't expected in service until early 2021.

"Last year, we were talking about pilots; this year, we're talking about 2.7 gigawatts of storage," said Dominion energy storage specialist Ricky Elder III, who manages business development in the Regulated Power Generation team.

Storage isn't the only area where Dominion's outlook has evolved.

In December 2018, the regulators at the State Corporation Commission took the unprecedented step of rejecting Dominion's integrated resource plan. The plan's projected demand levels outpaced those of the PJM Interconnect, the grid operator for much of Virginia, and called for several gigawatts of new gas combustion turbines to meet the peaks. Fast-forward a year, and Dominion pledged net-zero emissions by 2050 across its 18-state operations.

That declaration came as the Clean Economy Act was working its way to a final vote. Sweeping energy system overhauls become increasingly achievable when a state's premier utility enthusiastically commits to the vision.

"We look at it as a giant leap forward for Virginia," Elder said of the legislation. "With the passing of the Virginia Clean Economy Act, we are now going to be a leader in the energy future of the country."

Projects still need to pass muster with the SCC as good deals for ratepayers. But, instead of politically fraught gas expansion, the utilities can build out a massive amount of renewables and earn their regulated rate of return, with clear political and regulatory cover.

Achieving the onshore and offshore renewables targets in the law will make storage essential, Elder noted.

Since the law requires phasing out gas plants in the next three decades, Virginia could start swapping its gas peaker pipeline for lithium-ion peaker plants, of the sort under development in New York and the Western U.S.

"We firmly believe that storage solutions can do the same job [as gas peakers] with [lower] emissions and now for lower cost," said Ray Hohenstein, market applications director at Virginia-based storage supplier Fluence. "Now we have a chance to really make that happen in Virginia."

Dominion is taking a broad view of storage technologies (the legislation kept things technology-agnostic).

Besides the lithium-ion batteries underway in the pilots, the company is developing a pumped hydro storage facility in southwestern Tazewell County. That one is geared for 800 megawatts of capacity, with 10 hours of storage duration. But it will take a decade to develop, which is why you don't see many new pumped hydro units coming online.

Until recently, Virginia wasn't on the radar for startups developing long-duration alternatives to lithium-ion, such as flow batteries. But Elder is digging into those, too, because his grid system will need some in the next 15 years.

"We are actively reviewing and pinging the market on technologies that are not necessarily just lithium-ion-based technologies," Elder said.

Next up: Working through the details

The next milestone in the law's implementation will be Dominion's integrated resource plan filing in May. The utility will take an initial stab at thinking through how the law's requirements translate into resource procurement for the coming years.

Then the action moves to the State Corporation Commission, which has until New Year's Day 2021 to incorporate the energy storage components of the new law into the state's regulatory code.

That means deciding interim targets and weaving storage into existing utility planning and procurement protocols.

The law also stipulates: "The regulations shall include programs and mechanisms to deploy energy storage, including competitive solicitations, behind-the-meter incentives, non-wires alternatives programs, and peak demand reduction programs."

If that doesn't get your storage policy salivary glands a-pumping, then go get your taste buds checked out. This provision means that, in less than a year, Virginia must lay out a veritable feast of cutting-edge storage policies, the sort of things other states took much longer to deliberate about and eventually enact.

This includes the promise of behind-the-meter incentives, which could borrow the "bring your own device" framework that has gained momentum in New England, paying homeowners for letting a utility tap their battery to reduce demand during peak times. Then again, Dominion may be a better fit for the utility-driven virtual power plant that Vermont's Green Mountain Power set up: The utility owns and controls batteries in rural homes that suffer from blackouts; the batteries keep the homes online in an outage but also help the utility reduce peak demand.

New York famously developed the non-wires alternative framework, which lets utilities earn money for offsetting a more expensive grid upgrade with a series of distributed energy assets on customer sites in the affected area. Con Ed did that with the Brooklyn Queens Demand Management program, although it's harder to find evidence of this approach proliferating organically across the state. Even if it hasn't become a bustling market yet, New York's work on the concept has already inspired similar approaches elsewhere in the country.

Additional regulatory work needs to happen outside of Virginia's borders, Hohenstein added.

"PJM is the wholesale market that operates the bulk of Virginia, and it is not currently well suited to recognize the capacity value of energy storage," he said. "We're hopeful that within the next year or so the rules will be updated."

"Elections matter"

Most states have yet to adopt ambitious clean energy overhauls, so advocates elsewhere could learn from Virginia's example.

"To me, it says elections matter," said Hamilton. "We elected people who really care about the future of Virginia and the climate. If you had not had the General Assembly change parties, this would not have happened."

Beyond the changing political tides in Richmond, where Democrats took control of the legislature last November, the bill's passage attests to what happens when clean energy trade groups and environmental advocates team up.

"This shows the power of a new coalition to advance really interesting energy and climate legislation in the Commonwealth," said Harry Godfrey, executive director of the Virginia chapter of the Advanced Energy Economy industry group.

By uniting those two contingents, the bill didn't just say no to something (fossil-fueled power); rather, it suggested a desirable alternative. It's not unlike what happened in Oxnard, California when local activists fighting a new gas plant received a boost from the maturing storage industry and its ability to deliver real capacity alternatives to gas-fired plants.

Virginia has other, regionally specific reasons to care about the grid overhaul, Godfrey noted. Fossil-fueled climate change threatens the state's ample shorelines, naval bases and maritime industry. And its national defense corridor and dense concentrations of internet facilities also ascribe a concrete value to electrical resilience.

A new template for energy storage policy formation

Finally, for all those states that have yet to embark on their journey of energy storage discovery, Virginia proffers a new template for policy formation.

New York and Massachusetts chose the studious route of calculating the value of storage and using executive leadership to craft several interlocking energy and environmental policies to bring storage to life. Nevada, and arguably Arizona, became notable storage markets without completing any arduous policy crafting; their geographical and market dynamics made the technology inherently valuable enough that the utilities wanted it on their own terms.

Virginia's policy establishment had yet to sink its teeth into storage, and the utilities hadn't pushed massive adoption previously. Instead, stakeholders used legislation to break the inertia and set a clear agenda for storage market development.



The advertisement features the GTM3 logo in the top left corner. The main text reads: "Access More Insights from Our Experts on the Global Energy Transformation, visit www.gtmsquared.com". Below this text, there are two overlapping images: a smartphone displaying a GTM3 article titled "The Best Utility Storage Energy Storage in 2016" and a document titled "Comparing the IPCC's Renewable Energy Scenarios With Current Growth Rates". To the right of the document is a yellow banner with the word "The Lead" in large red letters and a portrait of a woman.



Arizona's Storage Market, Absent Policy Drivers, Is 'Totally Driven by Economics'

The desert state shows what can happen when the value of storage is easily quantifiable.

Arizona proved that, when the circumstances are right, a vibrant energy storage market can spring up despite the absence of supporting policies.

The state has drifted toward purple in national elections, but its state-level politics retain a decidedly Republican bent. That means no climate-change-related policy directives to speak of and no sweeping clean-energy legislation to dictate renewables or energy storage procurement, as seen in several neighboring states.

Even so, the regulators at the Arizona Corporation Commission deserve credit as a laboratory of ideas for clean-grid planning. They came up with the moratorium on new gas-plant construction, back in 2018, justified as a fiscally conservative tool to prevent ratepayer dollars going to large and risky capital investments at a time of rapid technological change. And several commissioners have proposed clean energy overhauls; they just haven't actually adopted one yet.

Instead, the state's regulated utilities have gotten there on their own.

Arizona Public Service accelerated from 2-megawatt battery pilots to an unprecedented commitment to pair every major solar plant with a battery to deliver "solar after sunset." Tucson Electric Power set an early solar-plus-storage price record with NextEra in 2017, pushing that asset class forward at a time when few were thinking ambitiously about it. Salt River Project has announced the state's largest battery so far: 1,000 megawatt-hours slated for the Sonoran Energy Center by June 2023.

In installed front-of-the-meter storage capacity, Arizona trails only California, Texas, Hawaii and New York, according to Wood Mackenzie's latest Energy Storage Monitor. It also registers on the residential storage leaderboard: In 2019, Arizona delivered the third-most home battery storage capacity, 11.2 megawatt-hours, trailing only California and Hawaii.

The physical characteristics of Arizona lend themselves exceptionally well to cheap solar — so well that it made sense to pay a little extra for batteries to move that generation into more valuable times. But, crucially, the state's regulated utilities have the ability to calculate the usefulness of storage through the grid value chain. They can put it to work as capacity, or renewables integration, or a distribution power quality asset, or a transmission deferral project, or anything else they can think of.

That differentiates Arizona from states where these duties are balkanized by law among different types of companies, where no single owner can actualize all the values storage provides. New York and Massachusetts needed extensive policymaking to get storage off the ground because they had to cover the gaps in the existing patchwork of policies governing storage deployment.

In that sense, Arizona offers other states a glimpse of the future, when storage technology becomes more cost-competitive and customers gain a clearer pathway for monetizing its benefits.

Making the most of the desert sun

Arizona stands out for the clarity of its storage use case, which derives from the regional desert geography. Here's the basic paradigm, as described by Ken Wilson, a technologist who works on Arizona grid modernization issues for Western Resource Advocates.

"It's one of the best markets for battery storage in the country," he told me recently. "They have such a good solar resource, but also a big load from air conditioning in the summer, so they have a need to shift energy into the evening hours after the solar is no longer producing."

The regional sunshine blesses Arizona with cheap solar power, but that asset can offer only limited help with the chief grid operations problem: late afternoon and evening air-conditioning use in the summer, when temperatures around Phoenix shoot well past 100 degrees.

The conventional approach would be to meet that evening ramp with gas-fired peaker plants. But building out a fleet of new plants to keep pace with creeping peak load forecasts makes for a very expensive proposition.

These structural elements gave storage its first chance to shine in the capacity role, absent a helping hand from policymakers. Tucson Electric Power put its deal together in 2017. Then Arizona Public Service, the largest investor-owned utility in the state, put out a request for proposals for any resource that could deliver a guaranteed five hours of capacity during those summer peaks. The gas peakers showed up, ready for another routine win.

Instead, in February 2018, APS awarded the contract to First Solar for a solar-plus-battery peaker plant. A year later, the company rolled out a plan to install 850 megawatts of storage to super-size this model across its whole solar portfolio.

"It's totally driven by economics," said Wilson. "The solar resource is so good that the big utility-scale solar is very cheap. Even when you combine that cheap energy with battery storage, it's still a very attractive price."

Another, longer-term geographic push factor for storage: next-door California has its own problem with surplus solar generation. Especially in the shoulder months when AC use is lower, California routinely generates more solar power than it can find a use for, pushing spot prices very low or even into negative territory.

"They'd love to be able to store that for a while and use it on their systems," Wilson said of the Arizona utilities.

The problem is those utilities have their own solar arrays cranking at the same time; large, cost-effective storage would be necessary to arbitrage the great deal on California electrons and shift them to a time when Arizona could make the most use of them.

Policy backdrop

It would be wrong to say Arizona's utilities came around to storage in a vacuum. The state has hosted lively debates on cutting-edge clean energy policy; it just hasn't adopted it yet.

Since ACC regulators are elected statewide and often emerge from the domain of Arizona politics, this commission's deliberations are livelier than most. Hence the moratorium on new gas plants, which even California regulators have yet to match.

Prior to the moratorium, former Commissioner Andy Tobin proposed a full-blown clean energy overhaul. It would have required 80 percent clean electricity by 2050, a storage deployment target of 3 gigawatts by 2030 and a clean peak standard to deploy market forces toward shifting cheap renewables to higher-value evening hours. After two years of debate, the commissioners have yet to adopt this or any other clean energy reform. In that time, Massachusetts took the clean peak standard concept, passed it into law and honed a rule in the executive branch, which should take effect in a couple of months.

Arizona's clean-energy debate lives on. Comments at a March workshop suggest that a majority of commissioners support a 100 percent clean energy by 2050 goal.

Commissioner Lea Márquez Peterson, who took over Tobin's seat in March that, suggested they vote on a simple policy statement affirming that goal. Coronavirus response has rightfully taken center stage, she told Greentech Media, and hashing out a finely tuned long-term clean energy regulatory regime in the midst of this crisis will take additional time. Passing the policy stance would set a long-term vision for the state that can be fleshed out later with the ACC's ongoing energy rulemaking.

"I think we need to put a line in the sand and say, absolutely, Arizona is committed to a 100 percent clean energy by 2050," she said.

Details to be figured out later include how to change utility resource planning, interim targets for renewables and energy storage, what to do with old coal plants, and more.

This vision has become decidedly less controversial since APS voluntarily adopted it earlier this year. The other major utilities agree that goal is doable, Márquez Peterson added.

"It's to the credit of utilities that things are moving ahead at a very nice pace even without some bigger statewide goals," Wilson said.

With the utilities on board and appropriate ratepayer protection language included, it's hard to see why such a commitment would not pass. Then the question would be determining what changes if the state belatedly adopts the same clean energy goal as its largest utility.

Neighboring New Mexico offers one answer. Various factions got together and passed a clean-energy transition law that balanced 100 percent carbon-free goals with financing tools and funding to ease the economic blow of coal plant retirements. That's the sort of thing that utilities on their own probably won't be able to pull off — L.A.'s municipal utility has been importing power from a remote Utah coal plant, and rather than let it retire and crater the local economy, it signed up for a new gas plant of disputed usefulness.

Arizona has a few more coal plants chugging along; with clarity on transitional funding for their communities, retirement dates may be able to move up.



The one big problem

All of this storage acceleration froze last year, however, when one of APS' early battery facilities caught fire and exploded, injuring several first responders.

The company immediately halted operations at its other battery facilities and paused development of new ones, pending the outcome of an investigation. That process has not wrapped up nearly a year later, leaving the state's energy storage industry in limbo.

This marked the first U.S. grid battery fire of the industry's modern era; that it happened at a site supplied by a top-tier integrator, Fluence, and owned by an experienced utility, deepened the impact. It showed that batteries can be dangerous even when handled by experts.

But nobody seems to think this will hold back energy storage development in the long run. In the immediate aftermath of the explosion, APS President Jeff Guldner told regulators that the incident "hasn't changed our determination to move forward" with the battery plans.

Commissioner Márquez Peterson acknowledged that the battery failure was "horrible," but said APS has committed to improving safety standards and communications protocols as a result.

"We've learned from that situation," she said. "I think the battery is the future. [...] I believe Arizona is still very committed."

Assuming that is true, and battery deployments resume in the coming months — COVID-19 construction delays are another matter entirely — here are the projects that exemplify Arizona's approach to storage, hinting at the roles that future projects could play:

- McMicken/Festival Ranch: Before it caught fire, McMicken and its twin performed power quality roles on distribution feeders with a high penetration of rooftop solar. This early utility-owned project, supplied by Fluence, gave APS confidence in further battery development.
- Punkin Center: This battery, also from Fluence, installed capacity in the remote desert town of Punkin Center. The growing population was maxing out bandwidth on the wires during peak times. APS found it could tap the battery for less than half the cost of a conventional wires upgrade, marking an early instance of the non-wires alternative doctrine popping up outside of New York.
- Tucson Electric Power's solar-storage trendsetter: In the spring of 2017, utility TEP shocked the world by signing a solar-plus-storage PPA with NextEra for a blended price of less than \$45 per megawatt-hour over 20 years. This set a precedent that solar paired with storage, at scale, was not just doable but was actually attractive in certain locales. Subsequent Arizona utility-scale development followed a similar model on an even larger scale.



Best of the Rest: 4 Emerging State Energy Storage Markets to Watch

These states hold big potential for grid-scale batteries, but they're still building toward sustainable investment opportunities.

Let's catch up with the next tier of markets, ones where developers are gaining interest, or maybe a landmark project is moving forward, or political forces are mobilizing to give storage a boost, but where the pathway is not so clear as in the Arizonas and Massachusettses of the world.

The preceding entries showed that the emergence of a thriving storage market requires strong policy engagement from the executive and legislative branches of state government or clear leadership from utilities that see the value in storage.

We'll examine states that are pulling those elements together. New Jersey has strong executive branch commitments to storage, but they aren't backed up by serious policymaking and the utilities haven't seen enough value to lead the way on their own. Colorado has strong executive commitments and utility leadership, but those promising factors have yet to generate actual construction on the ground. Similarly, Florida Power & Light put its state on the storage map with a single announced project, but that alone is not sufficient to make Florida a stop on the storage industry's itinerary.

Then there's Texas, which has a policy regime that tends to block storage more than encourage it, and where utilities can't lead the way because storage must be developed by independent power producers in a rough-and-tumble marketplace. Texas holds great potential if anyone can figure out how to make money there.

Colorado

Right now, Colorado doesn't look like much of a storage market. It has just 5 megawatts of utility-scale batteries in operation and nothing much under construction. And yet, this state has had an outsize impact in kick-starting a grid modernization trend that's launching storage into the field around the country.

It started with Xcel Energy surprising itself and the world with just how cheap solar-plus-batteries had gotten for the arid Plains region. The utility's solicitation results in early 2018 showed that this type of resource could compete effectively against all other types of power plants — if you baked in five years of estimated cost declines and industry learnings.

Then things really heated up. That November, Jared Polis won the governorship on a platform of 100 percent renewable energy. Within days of that election, Xcel, the largest utility in the state, got out in front of the popular mandate. The company voluntarily committed to a zero-carbon power mix by 2045, kicking off a trend that by now has become near-compulsory among major utilities.

At Greentech Media's Energy Storage Summit in Denver last December, Gov. Polis affirmed that he feels "pretty bullish on storage" as a vehicle for delivering his ambitious clean energy agenda. The question now is, how does this stuff actually get built?

Xcel holds the keys to the biggest projects. It won regulatory approval in August 2018 for a plan to close 660 megawatts of coal capacity early and replace it with cleaner things. That package includes 275 megawatts of energy storage, with two major solar-plus-storage projects in the Pueblo area. But those are due in 2022.

Otherwise, some of the state's small utilities and electric cooperatives are procuring their own storage. The Platte River Power Authority, for instance, was on track to finish a 1-megawatt/2-megawatt-hour battery at the Rawhide Prairie Solar plant in Q1 (prior to the coronavirus pandemic).

Such projects show that diversity of customers is possible, but the strength of the Colorado storage economy ultimately depends on how regularly Xcel summons the 100 Megawatt Club.

Florida

The Sunshine State has 24 megawatts of storage operating in front of the meter, with nothing under construction.

But it soon will be home to the largest grid battery known to humankind, assuming that utility Florida Power & Light follows through on its stated intentions of building a 409-megawatt/900-megawatt-hour behemoth in southwestern Manatee County.

The use case is indicative of where future storage development will go here. The famously sunny state is finally starting to generate a decent amount of solar power as FPL gets on board with building, owning and rate-basing renewable power (its unregulated sister company, NextEra Energy Resources, is one of the largest renewables developers in the world). At the same time, a generation of decades-old thermal plants is heading for retirement. FPL decided it makes more sense to replace a couple of 1970s-era gas plants with this enormous battery and local solar generation rather than new-build gas plants.

If that pioneering project works out in late 2021, it's easy to envision the utility opting to rinse and repeat across its territory.

It's also worth noting that FPL has demonstrated an enviable ability to get what it wants from the state's regulatory and political institutions. What it wants now could be to build lots of large and ambitious batteries, solving grid challenges and banking returns on investment for its shareholders.

Florida won't be an open marketplace any time soon. But a regulated environment where the lead utilities enthusiastically procure storage still means business for storage manufacturers and integrators. For the industry, the best case here is that Florida

goes the way of Arizona or Nevada, where the regulated system generates lots of mega-projects, even if it all flows through a handful of monopolies.

That monopoly has recently crumbled in the arena of home solar, though, and that opens up the possibility of a home storage market. So far, the appeal is almost entirely linked to the promise of clean backup power in the face of extreme weather.

"There's no significant time-of-use rates, no grid services opportunities, etc.," said Brett Simon, a Wood Mackenzie analyst tracking behind-the-meter storage. "Backup is the only thing pushing people to buy. Hurricane concerns are real."

New Jersey

In storage matters, as in so many other things, New Jersey pales in comparison to its neighbor across the Hudson River.

New Jersey hosts a respectable 43 megawatts of utility-scale storage, but New York has more. And New Jersey adopted an ambitious storage deployment target — 600 megawatts by 2021 and 2,000 megawatts by 2030 — only to have New York come along with a bigger one.

If anything, New Jersey has become a symbol of the limits of targets as a storage market-creation tool. Though the governor picked a number, that state has yet to develop the supporting policies that would give developers enduring reason to build there.

In New York, projects aren't getting built because the governor picked a number out of the air; they're getting built because the executive branch disbursed a block grant to seed the market, regulators adopted a tariff that pays distributed assets like storage for their unique capabilities, and several other regulatory and policy advances occurred.

The corresponding developments in New Jersey simply haven't happened.

That leaves the development to entrepreneurial folks such as Viridity, which decided to challenge the notion that new projects can't make money in PJM's fast frequency market after the cataclysmic rule changes

there. Viridity recently built two 20-megawatt projects, packed with slightly longer durations than was typical in PJM. Those projects alone account for nearly all the state's substantial projects.

Otherwise, big news for the New Jersey storage scene comes along when utility PSE&G installs 2 megawatt-hours of Tesla batteries at a former municipal landfill, as it did in February. "PSE&G also installed a decorative iron fence for security and planted 91 new trees and a mix of perennial plants and shrubs to improve the curb appeal of the project and the neighborhood," the company explained in its announcement.

The utility has also asked regulators to spend \$109 million on 35 megawatts of storage, which it says would "jump-start" the state's attempt to meet its goal. Some jump-starting is in order for the state to get anywhere close to 600 megawatts by the end of next year.



Texas

Nobody seems totally sure how to make money with storage in Texas. Given that situation, a surprisingly large amount of storage activity has already happened there.

The state clocks 129 megawatts of front-of-the-meter batteries in operation, more than any other single state besides California. And the interconnection queue counts some 4 gigawatts of storage projects requesting to come online next year.

What exactly they do is another matter. Some have tried batteries as an experimental add-on to wind plants. Others used them to monetize solar production that was getting clipped. A newer crop of developers has strategies for how to tap profits in the wholesale market when peak hours send prices through the roof.

There's no model for Texas storage, only some forbidden fruits. There's no capacity market to pay batteries as in other states. And batteries count as generation in Texas, which means wires utilities cannot own them. That pretty much leaves the market to anyone willing to gamble on merchant risk, which is not a lot of storage developers or financiers.

Macro trends point in an alluring direction, though. Wind and solar are pushing down average energy prices, which squeezes the economics for new gas plant investment. At the same time, the peaks are getting peakier. In theory, that creates an opportunity for battery plants that cost less to build than a gas plant, perhaps load up on cheap renewable power when possible, and lap up the money from peak minutes faster than other plants can react.

Once one company shows it's possible, others will follow.



A GTM Squared Insight

Emerging U.S. Energy Storage Markets

Arizona, Colorado, Florida,
Massachusetts, Nevada, New Jersey,
New York, Texas, and Virginia

From Julian Spector



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