Energy Storage Policy:
State & Federal Considerations

Prepared for the

Vermont Public Utilities Commission (PUC)

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What I will be covering today.

1. General discussion of state-level U.S. energy storage policy—current status.

2. ISO-NE implementation of FERC Orders 841 and 2222 and their implications for distribution utilities and state regulators.

3. Setting the stage for the discussion on 12/7, which will be a deeper dive into New England policy issues:

   - ✓ What other NE states are doing with respect to developing regulations for the siting, interconnection, operation, and aggregation of storage facilities
   - ✓ State policies enabling participation in wholesale markets and/or state retail incentive programs.
   - ✓ Coordination between state rulemaking and changes within the ISO-NE.

Sandia's Policy & Outreach includes six core focus areas:

1. Educational outreach services to state regulatory utility commissions
2. Policy analysis and thought leadership via industry publishing
3. Support of state-level decarbonization modeling
4. Representation and engagement with federal policy groups
5. Collaboration with other federal labs
6. Support of the Energy Storage Grand Challenge and DOE—OE as needed

All of this work is funded by the US DOE Energy Storage Program managed by Dr. Imre Gyuk, DOE—Office of Electricity.

The U.S. market is not homogenous.

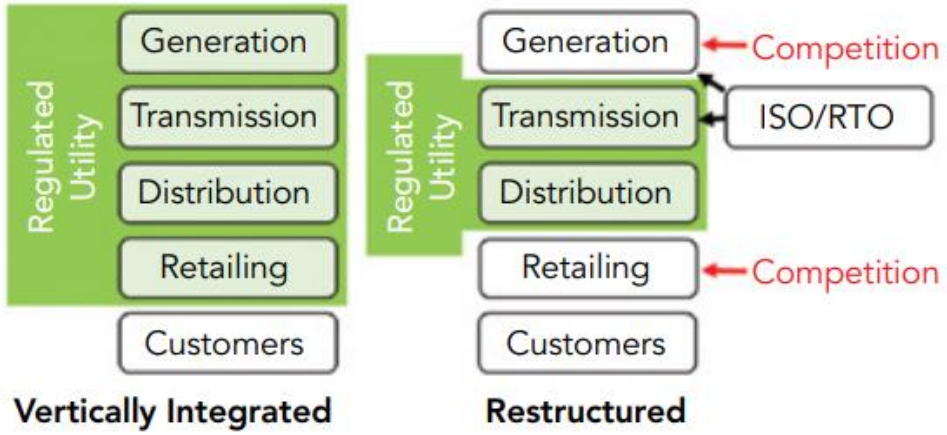
Regulated Markets

"Vertically integrated" utility **owns or controls** generation, transmission, and distribution

Regulated by states (public utility commissions) Cost recovery via rates charged to customers

PUC can direct utility action & investments

Status of Electric Restructuring by State



Restructured Markets

Market is **competitive**

Utilities usually prohibited from owning G&T assets.

RTOS/ISOs responsible for inter-/intra-state T, D and O&M with oversight from FERC

Role of PUC varies state to state

Energy storage policy development pathways vary across states.

Regulated states may instinctively emphasize distribution system applications:

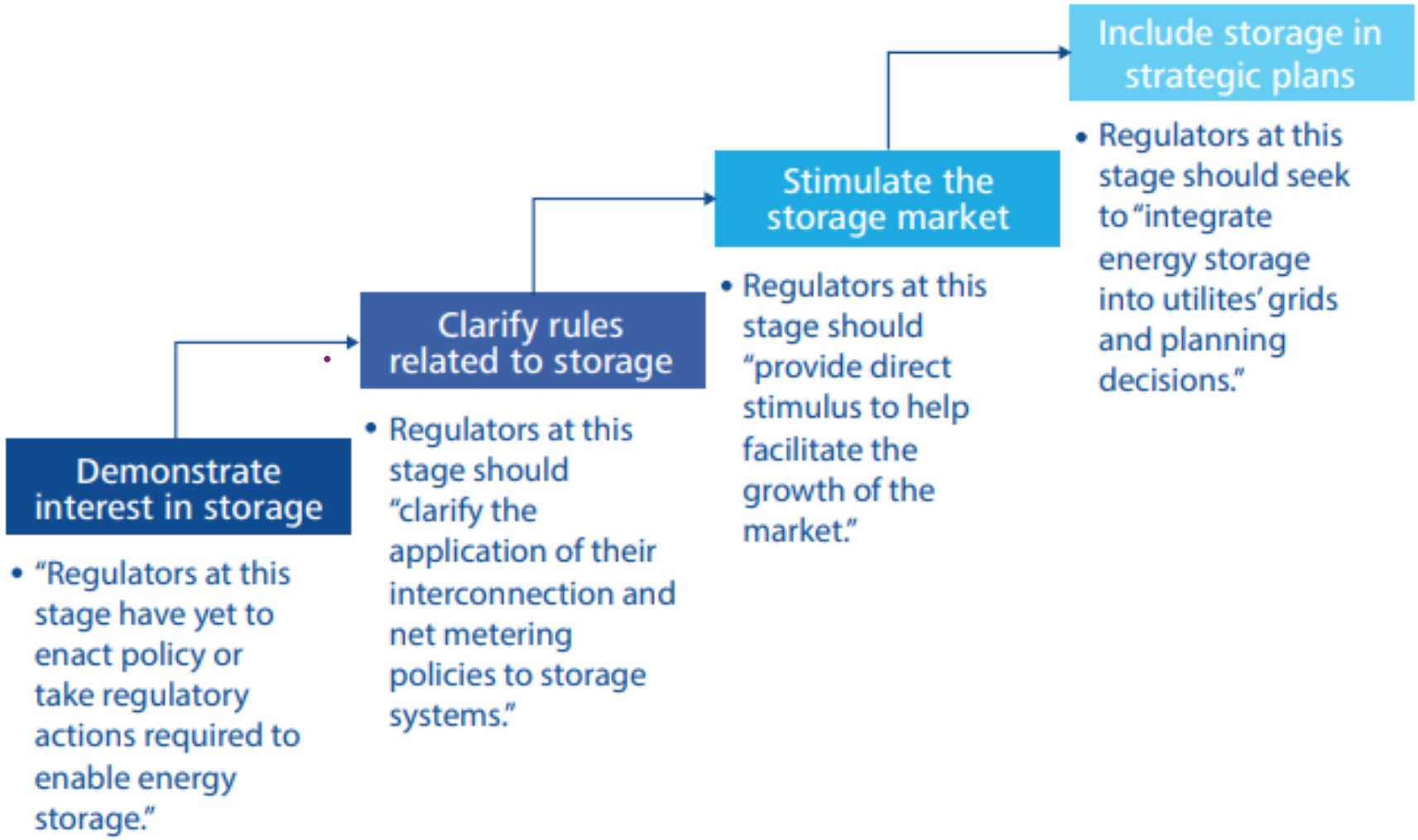
"ES needs to solve a problem."

Restructured states may place greater emphasis on developing a market:

"ES needs to make money."

States with Vertically Integrated IOUs	States with Restructured IOUs
• Consider expanding policies that encourage value stacking of BTM services (third-party asset ownership of BES assets is particularly effective) • Consider developing policies that encourage a wider range of BES services at the grid scale • Evaluate integrated resource planning (IRP) requirements for opportunities to encourage BES consideration • Consider adopting BES targets or mandates, and/or expanding renewable energy targets	• Consider developing policies that encourage value stacking of BES services at the grid scale • Consider adopting BES targets or mandates • Work with wholesale market organization to enable competition for grid services that BES can qualify to provide

State-level policymaking specific to ES is still quite nascent.



Source: Interstate Renewable Energy Council

- The majority of U.S. states are still at the far left of this trajectory, and may not have even taken the first step yet.
- This becomes even more the case when LDES/SES policymaking is in question.
- Arguably less than a handful of states have reached the top level (CA, NY, HI)

Energy Storage Policy—Current Status

- 19 states (plus the District of Columbia) have adopted decarbonization goals, however, not all have set policy for energy storage deployment.
- About 15 states have adopted some form of energy storage policy, which in all cases exists along with a renewables policy.
- Energy storage activity still driven mostly in states that have the following policies:
  - Utility **procurement mandates, targets or goals** (10 states);
  - Financial **incentives / subsidies** (CA, MD, NJ, NY);
  - State-funded **demonstration projects** (MA, MD, NY, UT, WA)
- Requiring storage in **utility IRPs** is also becoming more common. (NV, NM)

Deployment:

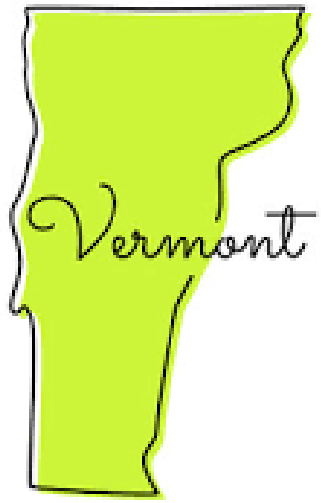
- Installation has been mostly concentrated in CA-ISO and PJM regions, and in states that have developed enabling policy frameworks. Texas is an exception, where business incentives & wholesale opportunities have driven ES development.
- 8 GW of utility-scale battery storage as of 2022 expected to increase by a further 20.8 GW by 2025 (ERCOT, NYISO, and ISO-NE)

The following states have adopted decarbonization / clean energy / renewable goals.

	STATE	DEADLINE	GOAL	CLEAR ROLE FOR ES/LDES
1	AZ	2070	100% carbon-free electricity	NO
2	CA	2045	100% carbon-free electricity	YES
3	CO	2050	100% carbon free electricity	Somewhat
4	CT	2040	100% carbon-free electricity	Somewhat
5	HI	2045	100% renewable energy	Somewhat
6	IL	2050	100% carbon-free electricity	Emerging
7	LA	2050	Net zero greenhouse gas emissions	NO
8	ME	2050	100% clean energy	NO
9	MA	2050	Net-zero greenhouse gas emissions	Somewhat
10	MI	2050	Economy-wide carbon neutrality	NO
11	NJ	2050	100% carbon-free electricity	Somewhat
12	NM	2045	100% carbon-free electricity	NO
13	NV	2050	100% carbon-free electricity	Somewhat
14	NY	2040	100% carbon-free electricity	Somewhat
15	OR	2040	Greenhouse gas emissions reduced 100 percent below baseline emissions	Somewhat
16	RI	2030	100% renewable energy	NO
17	VA	2045	100% carbon-free electricity	NO
18	WA	2045	100% zero-emissions electricity	Somewhat
19	WI	2050	100% carbon-free electricity	NO

Vermont is also quite unique.

1. Vermont is the only state in New England that has chosen not to restructure its electric industry by adopting retail competition.
2. Because Vermont utilities own few of their own generation resources and participate in the New England electric wholesale market, they share many characteristics with distribution companies in other New England states that have restructured.
3. Vermont is served by over 20 utilities. Green Mountain Power is the largest, serving about three quarters of the population, and the only IOU.
4. Vermont gets nearly all its electricity from renewable energy, with three quarters of it from firm renewables. More than half of Vermont`s electricity is imported, with most of that coming from Canadian hydroelectric power facilities.



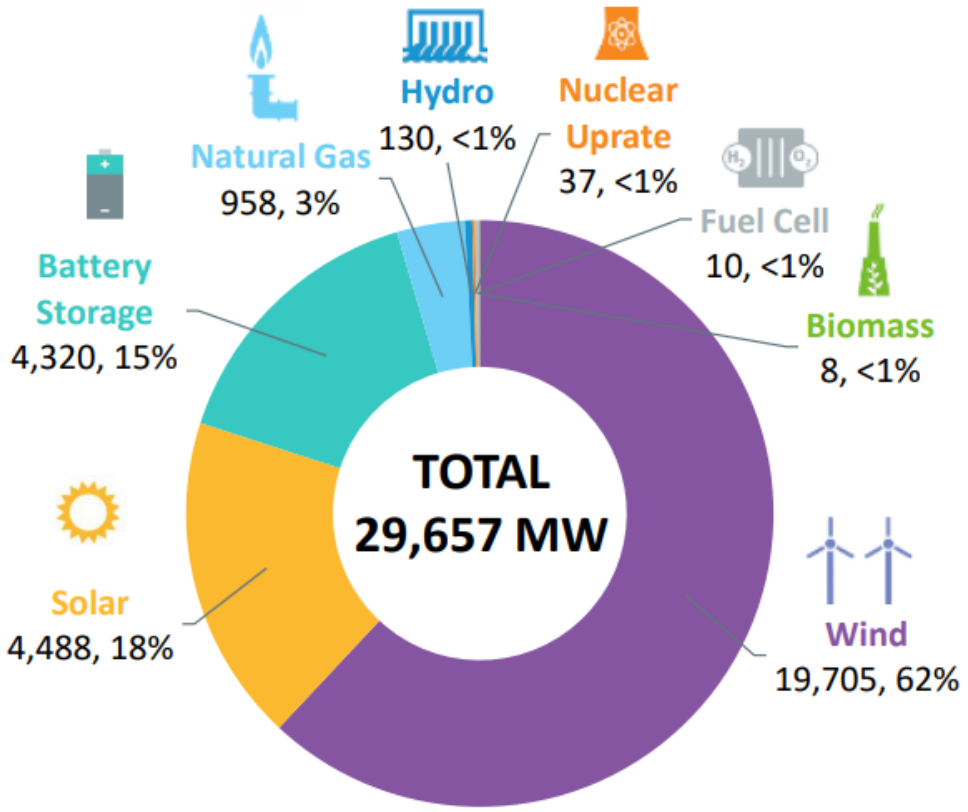
Passed in 2020, the legislation requires Vermont reduce emissions to:

- **26% below 2005 levels by 2025**
- **40% below 1990 levels by 2030**
- **80% below 1990 levels by 2050**

The need for energy storage in New England.

Flexible Resources (Such as Storage) Will Be Needed to Balance Increasing Levels of Variable Generation

All Proposed Resources



Source: ISO Generator Interconnection Queue (May 2021)
FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings
Note: Some natural gas proposals include dual-fuel units (with oil backup).
Some natural gas, wind, and solar proposals include battery storage.

Proposals by State

(all proposed resources)

State	Megawatts (MW)
Massachusetts	17,305
Connecticut	7,608
Maine	2,621
Rhode Island	1,542
New Hampshire	456
Vermont	125
Total	**29,657**

Source: ISO Generator Interconnection Queue (May 2021)
FERC and Non-FERC Jurisdictional Proposals

ES policy opportunities, gaps & barriers.

- The momentum has begun and is continuing, as state legislatures and governors have shown an increased interest in pursuing legislation designed to bolster the role of ES in achieving clean energy goals.
- High level goals are frequently handed down to regulatory commissions to implement.
- While FERC is driving federal policy at the RTO level (e.g., Orders 841 and 2222) putting "steel in the ground" is often more directly impacted by what is happening at the state level.
- Disconnects between state and federal policy create confusion and perpetuate barriers.
- Lack of uniformity across states can create a "patchwork" marketplace for storage and prevent market developments (thus, importance of inter-state coordination).

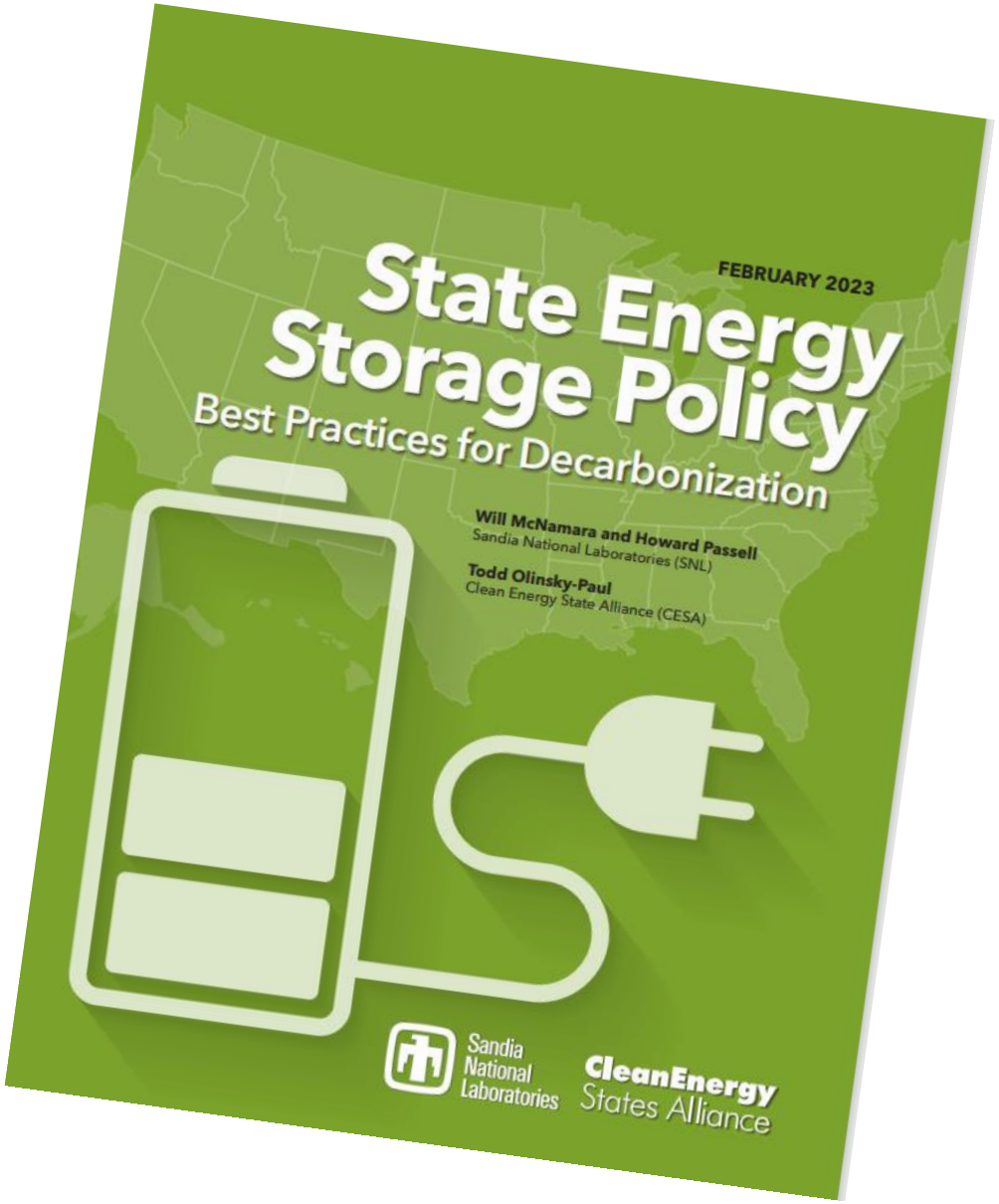
Nationally, policy levers for energy storage are emerging.

1. Procurement mandates, targets, or goals
2. Ownership models for ES assets
3. Inclusion of ES in utility IRPs
4. Incentives, tax credits, or other subsidies
5. Prioritization of specific use applications for ES technologies
6. State-sanctioned benefit-cost analysis
7. Distribution system modeling for location-specific siting of ES technologies
8. Changes to existing net metering programs to accommodate BTM energy storage
9. Changes to legacy interconnection standards to enable deployment of BTM ES
10. Changes to existing RPS programs to include or specifically carve out ES requirements
11. Use of time-variant electric rates to spur the development of BTM storage technologies
12. Retail rate re-design
13. Equity policies specific to ES technologies

Sandia's analysis seeks to continually assess:

- *The extent to which these policy issues are being prioritized in the leading decarbonization states;*
- *How they are being applied to help advance decarbonization efforts, and*
- *The extent to which key, preliminary outcomes from state activities can be measured.*

Sandia/CESA Survey of Decarbonizing States.



- The 2023 state survey provides insights into key state energy storage policy priorities and the challenges being encountered by some of the leading decarbonization states.
- Our intent was to: 1) highlight best practices; 2) explain barriers; and 3) underscore the urgent need to expand state energy storage policymaking to support decarbonization in the US.
- Respondents came from state utility commissions, state energy offices, and governors' offices.

The State Survey

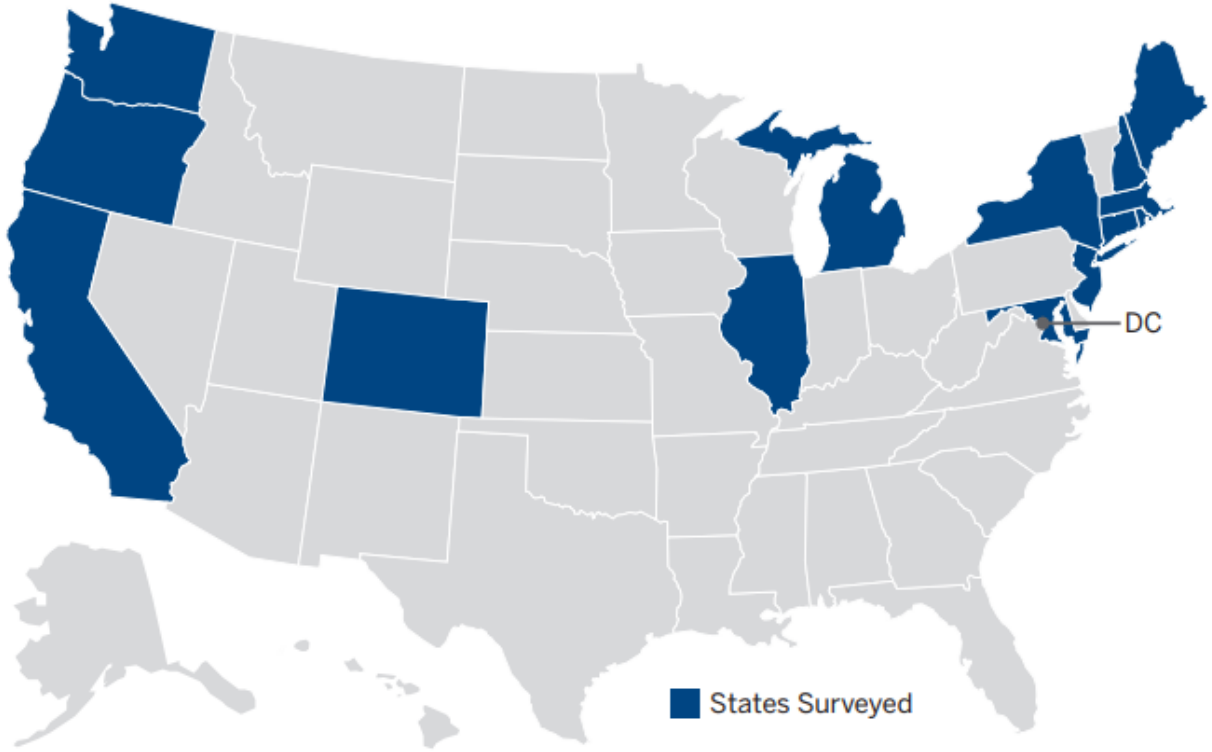
The state survey distribution resulted in 22 responses from 14 states plus the District of Columbia. The following states were represented in the survey responses:

California	Maine	New Hampshire
Colorado	Massachusetts	New York
Connecticut	Maryland	Oregon
District of Columbia	Michigan	Rhode Island
Illinois	New Jersey	Washington

Survey responses reflected a wide range of policymaking: from states that have no substantive ES policy development to states that have numerous and sophisticated polices, some of which have been in place for nearly a decade.

Survey results show a wide variety in state energy storage objectives, scopes, applications, and overall maturity of policies and programs.

Both FTM and BTM storage were considered in the survey questions.



Some policy levers seem to be prioritized.

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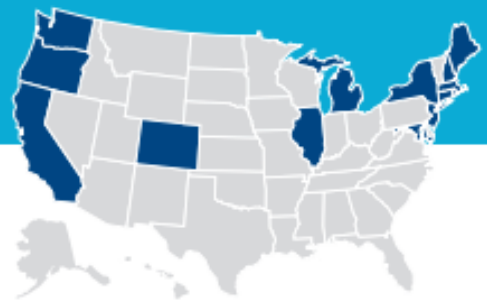


1. Procurement mandates, targets, or goals for energy storage procurement by regulated utilities
2. Utility ownership of energy storage assets
3. Incentives, tax credits, or other subsidies for energy storage
4. State-sanctioned benefit-cost analysis (BCAs) of energy storage
5. Distribution system modeling for location-specific siting of energy storage technologies

The survey sought to ascertain the extent to which these policy issues are being prioritized in the leading decarbonization states, how they are being applied to help advance decarbonization efforts, and the extent to which key, preliminary outcomes from state activities can be measured.

State Survey Results: High Level Observations

1. There is general acceptance of the principle that energy storage, particularly of long-duration capabilities, is a necessary tool to achieve decarbonization.
2. However, even the most advanced states face significant challenges in bringing energy storage to scale within their decarbonization timeframes.
3. Most states, even those that have adopted aggressive decarbonization goals, are still grappling with how to deploy sufficient amounts of energy storage, both FTM and BTM, to achieve these goals.
4. States cited diverse reasons for not moving more aggressively to develop energy storage policy and programs, including:
    a. Lack of clarity on which use cases (i.e., applications) of storage are best suited to serve in decarbonization efforts.
    b. The (perceived) high cost of energy storage.
    c. ES is "for the future, not now."
    d. Ongoing assessments of best practices for energy storage policy development.

Industry Survey Results and Takeaways

- Industry respondents *unanimously agreed* that state energy storage policies, programs, and regulations are essential to their business.
- They affirmed that their companies invest most of their efforts toward building market share in those states that adopt the most favorable energy storage policies.
  - **Supportive state policy is essential to build markets!**
- Industry respondents were *nearly unanimous* (6 out of 7) in viewing states with decarbonization goals or policies as generally more welcoming than states without.
  - **Related policies and targets, such as decarbonization, are also very important!**
- Industry respondents *unanimously cited* incentives/tax credits as being the single *most* helpful type of state energy storage policy
  - **While markets remain immature, direct incentives are most effective to bridge the energy storage economics gap.**

Industry Survey Results and Takeaways

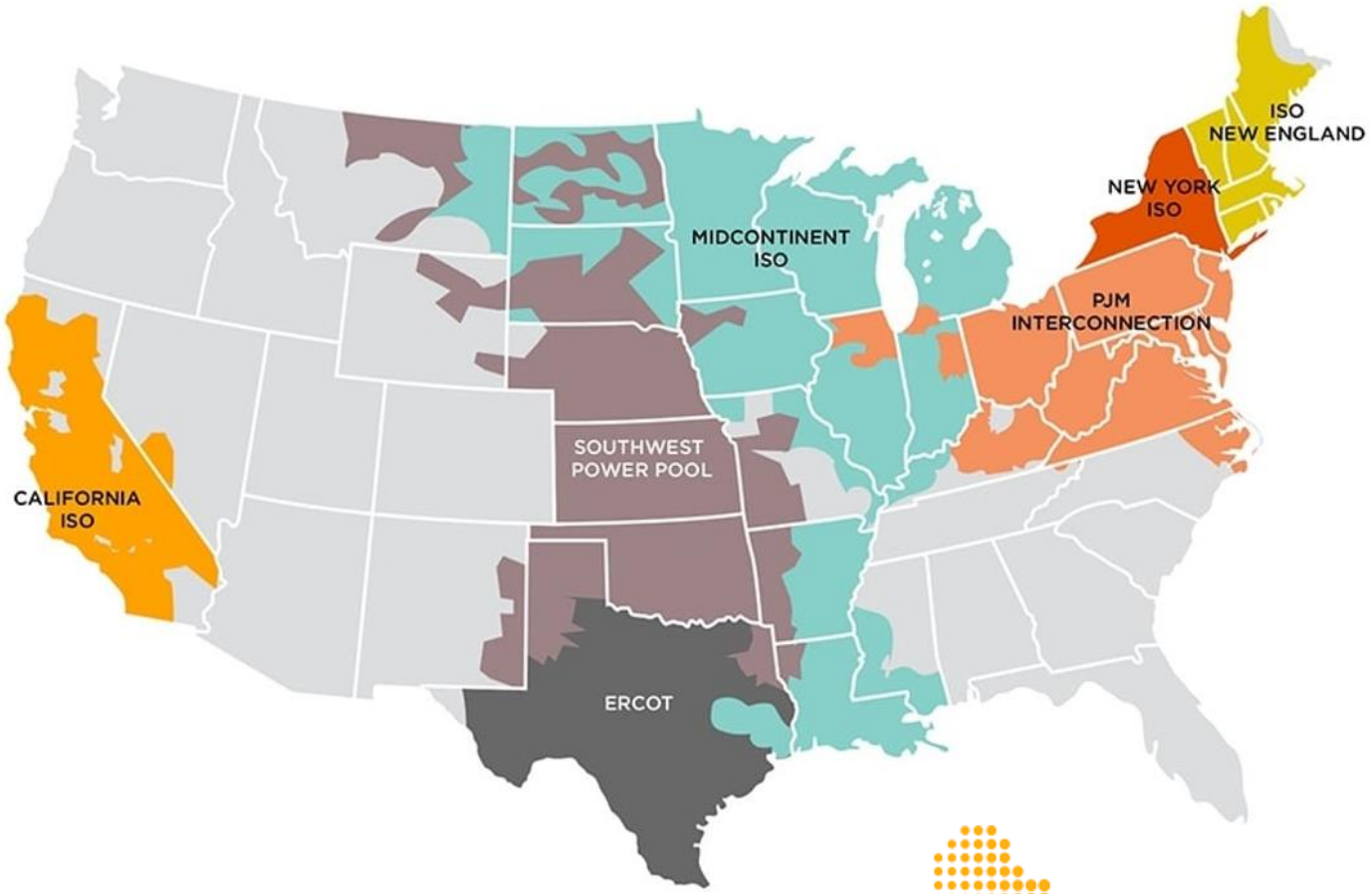
- Industry respondents were *nearly unanimous* (6 out of 7) in citing utility ownership of energy storage as the *least* helpful policy .
  - ✓ **Storage developers may view storage-owning utilities as unfair competition**
- Distribution system modeling and changes to solar net metering regulations were also cited by several respondents as being among the *least* helpful state policies
- Asked which energy storage policy types they *most* want to see states adopt, industry respondents gave a range of answers. Most popular:
  - ✓ **Incentives/tax credits**
  - ✓ **Procurement/RPS requirements**
  - ✓ **Changes to interconnection standards**
- Wholesale market policies are also very important, citing Texas as an example of a state that lacks storage policies but is attractive due to wholesale energy market opportunities.

State-level Regulatory Roadmaps

- ***Considerations:***
  - ✓ How can energy storage support broader clean energy goals adopted by the state?
  - ✓ Do the current regulatory structures allow energy storage to compete on a level playing field?
  - ✓ Are the right state agencies and stakeholders working together to address existing barriers for energy storage?

- ***Actions:***
  - ✓ Develop an ES Roadmap that identifies policy, technology and process changes to address challenges faced by the storage sector.
  - ✓ Determine what specific policies make the most sense in a specific state.
  - ✓ Ensure collaboration with all stakeholders.

Vermont is also impacted by FERC Orders and policies set by the New England ISO (NE-ISO).



ISO new england

- ✓ ISO-NE is an independent nonprofit regional transmission organization that serves the six New England states: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.
- ✓ ISO-NE handles wholesale electricity, while retail activities fall under the Vermont PUC's jurisdiction.
- ✓ ISO-NE does not own or operate energy infrastructure, nor does it decide which projects are developed or where they are sited.
- ✓ Rather, ISO-NE transmission engineers study the system to make sure power can move reliably across the region as new projects come online and consumer demand patterns change.

2 Major FERC Orders Impacting Energy Storage

FERC Order 841 (2018)

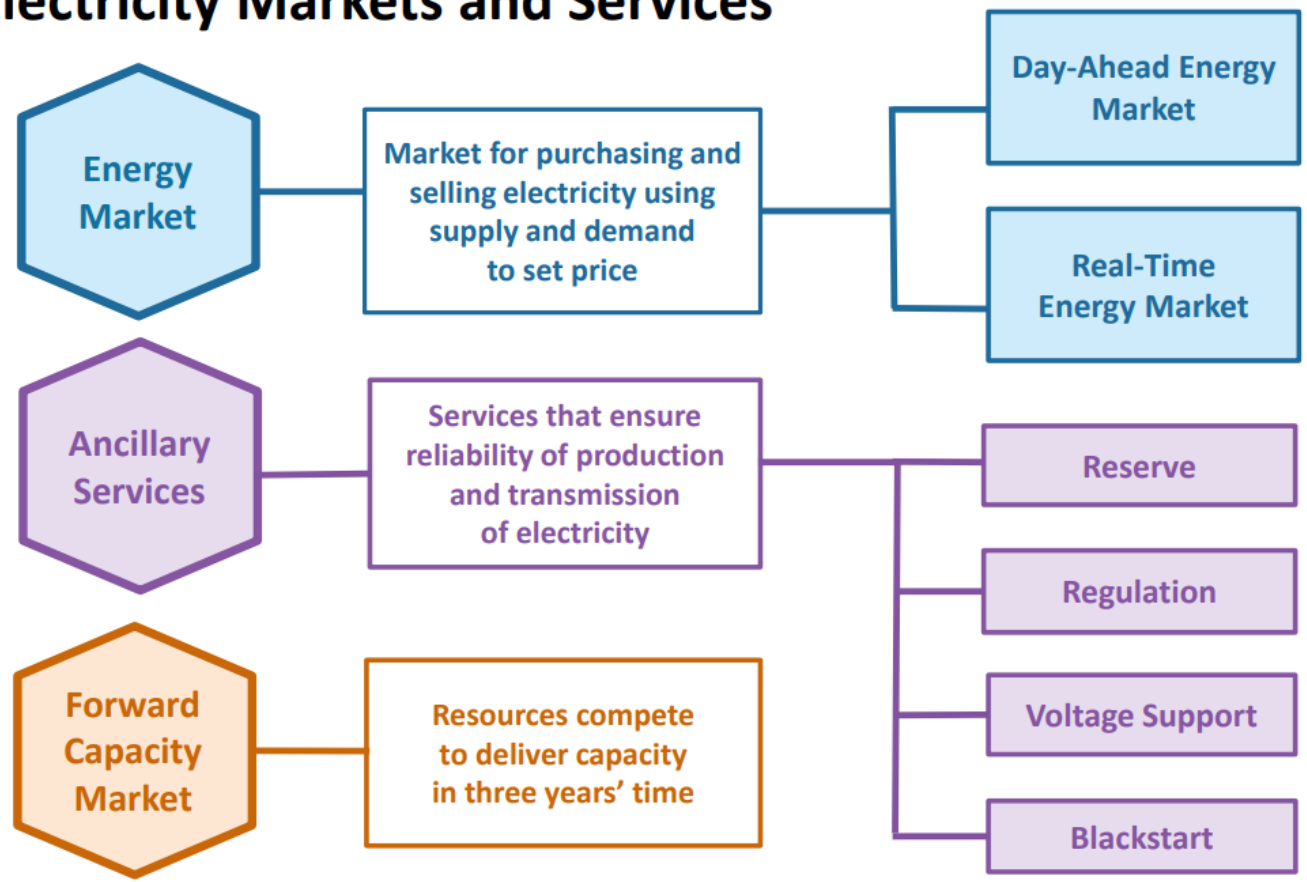
- Directed RTOs to remove barriers to the participation of electric storage in wholesale markets.
- RTOs must establish rules that open capacity, energy, and ancillary services markets to energy storage.
- Does not apply to vertically integrated, non-RTO markets (e.g., Texas)

FERC Order 2222 (2020)

- Focused on aggregated DERs (typically 1 kW to 10,000 kW).
- Intended to create a pathway for the energy generated by multiple, smaller DERs to be aggregated into a single market resource (a DERs aggregate).
- The DERs aggregate can then offer a portion of that output into the wholesale market.
- When combined into an aggregation, the output and activity of several or many DERs can satisfy minimum size and performance requirements for participation established by the RTO.

FERC's Orders are intended to create a "level playing field" for ES assets to participate in wholesale markets.

Storage Can Participate in All of the Region's Wholesale Electricity Markets and Services



ISO-NE administers several kinds of wholesale electricity markets, including:

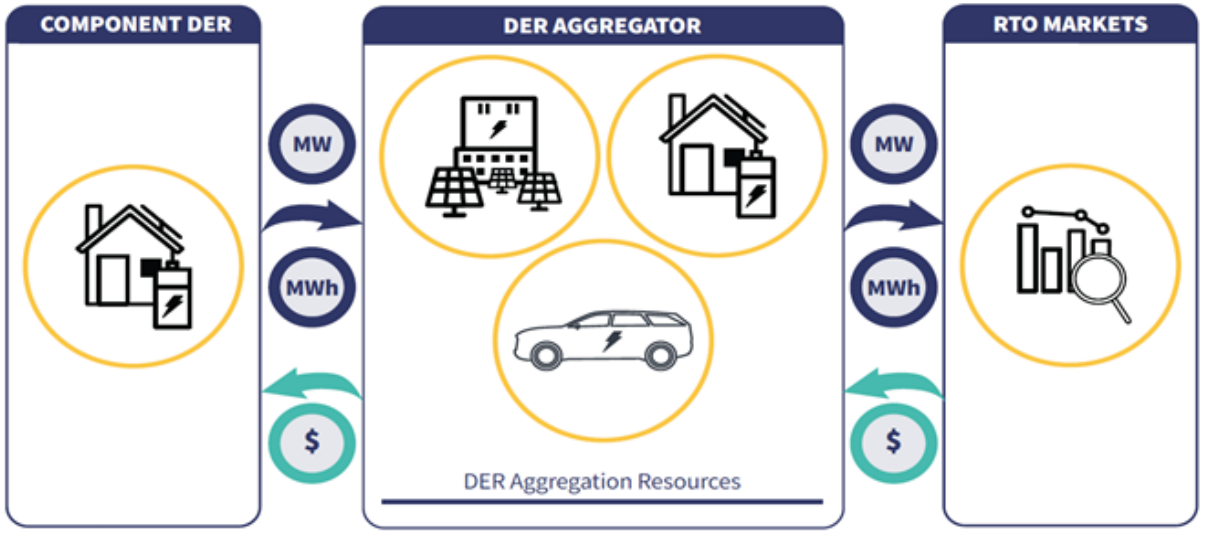
- Energy markets (standard electric energy products;
- Ancillary services (target products to maintain system functionality; and
- Capacity markets (capability or availability to produce power at a specific point in time).

Status of ISO-NE Compliance: Order 841

- On 11/22/2019, FERC accepted ISO-NE's Compliance Filing, to become effective **1/1/2024**, with some minor revisions, including:
  1. Lower the minimum size requirement for the participation model
  2. Make the participation model available to all storage technologies
- Storage assets are eligible to participate using one of 2 primary models:
  1. the **Binary Storage Facility** (BSF) model, for technologies that cannot operate continuously across their charge/discharge range, and are typically comprised of both a generator asset and a dispatchable-asset-related demand (DARD) (e.g., a pumped storage hydroelectric facility); or
  2. the **Continuous Storage Facility** (CSF) model, for technologies capable of charging or discharging at any MW level within its specified range and operating continuously across that range (e.g., lithium ion battery storage).
- Available reports indicate that no entities have registered to participated in BSF DARD Regulation , and 31 new entrants have registered to participate as CSFs.
- ISO-NE has submitted a Storage as Transmission only Asset (SATOA) filing allowing for batteries and pumped hydro), but these assets would only be allowed to serve a transmission reliability purpose and would not participate in wholesale transactions.

Of the two, Order 2222 arguably has the greater impact on state regulations.

- Market rules and metering/telemetry infrastructure must be developed to accommodate all potential forms of aggregated DERs.



FERC definition of DERs:

"Any resource located on the distribution system, or any subsystem thereof, or behind a customer meter."

ISO-NE DERs are largely split between energy efficiency and solar generation, with efficiency being the slightly larger resource.

Of the two, Order 2222 arguably has the greater impact on state regulations.

DERs have struggled to find a place in wholesale markets.

- "Distributed energy resources (DERs)" is a broad term that covers small, flexible resources, often sited at end-user locations, including batteries, electric vehicles, rooftop solar, and smart thermostats.
- DERs have proliferated across the U.S. in the last decade—primarily driven by customer demand, technology improvements, and falling prices.
- DERs have been associated with Demand Response resources (i.e., dispatched infrequently in times of severe grid stress).
- However, certain DERs have characteristics that enable them to be used more strategically (e.g., immediate dispatch).
- Microgrids are considered one form of DERs.

What are Distributed Energy Resources?

- Small-scale energy resources that can be aggregated to provide power
  - Connected to the distribution grid or behind customer meter
  - Generally <20 MWs
- Technologies include, but are not limited to:
  - Photovoltaics
  - Energy Storage
  - EVs & Charging Equipment
  - Fossil Fuel Generators
  - Energy Efficiency
  - Auxiliary Load Control

TECHNOLOGIES	ENERGY
DISTRIBUTED SOLAR	Energy Generator
DISTRIBUTED SOLAR ADVANCED INVERTER FUNCTIONALITY	Energy Generator
BATTERY STORAGE	Energy Storage
INTERRUPTIBLE LOAD	Load Shaping
DIRECT LOAD CONTROL	Load Shaping
BEHAVIORAL LOAD SHAPING	Load Shaping
ENERGY EFFICIENCY	Reduce Load

Existing Market Barriers to DERs

- High minimum size to participate
- Existing participation models (e.g. DR) not sufficient – limits operations and services
- Lack of visibility of DERs by ISO / lack of coordination between DSO and ISO
- Lack of clarity and specificity in rules
- Onerous technical requirements
- Some rules say, "you can't do this." e.g. can't net inject from behind the meter
- Inability to aggregate FOM resources
- No or limited rules for hybrid / heterogeneous resources

Creative solutions to full(er) participation in multiple value streams have been achieved, demonstrating the indomitable spirit of innovators

Other Interesting Things the Order Says

Other items of note:

- FERC has the jurisdiction to do this
  - DC Circuit Court of Appeals recently upheld FERC jurisdiction on distributed storage per Order 841
- No state "opt-out"
- "Opt-in" for small (under 4 million MWh per year) utilities
- A demand response (DR) resource can be a DER
- Does not affect existing DR rules
- An aggregation can contain a single resource
- Allow heterogeneous aggregations

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Order 2222 raises jurisdictional issues between federal and state regulators.

Federal (FERC / RTOs)

RTOs/ISO will propose—and FERC will either accept or reject:

- ✓ Which aggregated DERs within their regions should be eligible to participate in wholesale transactions (consistent with FERC definitions).
- ✓ Rates for wholesale sales from aggregated DERs and any other conditions of wholesale services provided by DERs.
- ✓ Metering and telemetry plans proposed by RTOs.

State PUCs

States will retain significant authority to address:

- ✓ Reliability and safety of DERs.
- ✓ Cost impacts on distribution systems.
- ✓ DERs aggregations are subject to state interconnection rules.
- ✓ Rates and conditions of retail DERs programs.
- ✓ States cannot regulate which DERs can participate in wholesale markets (or how).

A number of parameters and requirements still need to be addressed.

Parameters	Key Requirements
Eligibility of DER aggregators/DER types	DER aggregators must be an eligible market participant licensed to practice by the ISO according to its published rules. ISOs must allow all technology types and multitechnology combinations. ISO rules must prevent double-counting in retail and wholesale markets. Other than for small utilities, no broad opt-out provisions by states are allowed.
Geographical scope of aggregation	Encourages broad geographic scope of aggregation, but allows ISOs to propose to limit aggregations to a single pricing node.
Distribution factors and bidding parameters	Must account for physical and operational characteristics of DER aggregations and ensure they can fully offer their aggregations into ISO markets.
Information and data requirements	ISOs are required to transparently state the information and data that DER aggregators must provide them about the performance, physical parameters, and components of their aggregations.
Metering and telemetry requirements	ISOs have the flexibility to set these requirements, including whether to require metering and telemetry of individual DERs. ISOs must justify why they are necessary and explain why they do not result in undue barriers to participation.
Coordination	Requires ISOs to establish procedures for coordination between ISOs, DER aggregators, distribution utilities, and state and local regulators.

Status of ISO-NE Compliance: Order 2222

- Final / full approval of ISO-NE's compliance with Order 2222 **is still pending**.
- Rules must be developed to address minimum size requirements (i.e., aggregations can be as small at 100 kW), locational requirements (i.e., areas within which DERs can be aggregated), and metering and telemetry requirements.
- FERC's gave preliminary approval to ISO-NE's original filing (which was submitted 2/2/2022) but also required modifications based on a conclusion that ISO-NE could not sufficiently accommodate BTM DERs due to **a lack of viable metering and telemetry options** for these resources.
- ISO-NE continues to take the necessary steps to make these changes in anticipation of its proposed implementation timeline is 2026:
  - ✓ Accommodations specific to capacity markets already underway;
  - ✓ Need to develop requirements for energy and ancillary services markets;
  - ✓ Minimum size requirements for aggregations that cannot exceed 100 kW;
  - ✓ Utility opt-in requirements and information and data requirements; and
  - ✓ Safeguards to prevent "double counting" without blocking DERs' ability to participate through submetering requirements.

Status of ISO-NE Compliance: Remaining Issues

- **Submetering** – FERC has established that BTM DERs are DERs with a Point Of Interconnection (POI) located behind the Retail Delivery Point (i.e., a submeter).
  - ✓ Protestors were concerned that for BTM DERs, submetering was not a viable option because DERs are dependent on the host utility.
  - ✓ ISO-NE acknowledged that submetering cannot be accommodated until utility software systems (i.e., readers) are upgraded to handle both wholesale and retail settlements, and the timeline to implement those software systems is uncertain.
  - ✓ Metering at the Retail Delivery Point is outside FERC's jurisdiction
  - ✓ Message to ISO-NE: Go look at what PJM, NYISO and CA-ISO have done (e.g., third party metering option?)

- **Double Counting** – ISO-NE argued that submetering provides opportunities for double counting because "BTM DERs should not be permitted to sell energy into wholesale markets and at the same time consume that energy and avoid being charged for it."

Impacts & Implications on Utilities & State PUCs (1):

DERs have the potential to increase to hundreds of gigawatts of scale over the coming decade (i.e., the potential addition of thousands of small resources) that must be monitored and controlled.

- **Utility impacts:**
  - ✓ Utility planning must change: centralized, top-down resource planning and dispatch is no longer adequate to grapple with the complexity of DERs, nor is it appropriate to capture their full grid benefits.
  - ✓ Specifically, utilities need to know where DERs are located on the grid, their size and how they're being operated, preferably on a real-time basis.
  - ✓ Need for clear visibility into both grid hosting capacity, customer demand, as well as the end-use energy behind it.
  - ✓ Step one for any utility is to establish a baseline understanding of its grid by collecting data via nodal modeling and existing smart meters.
  - ✓ Utilities need to capture each resource, register them internally in their portfolio, and register their mapping to the distributed energy resource aggregates for pairing with the wholesale market.
  - ✓ ***Other, unforeseen implications!***

Impacts & Implications on Utilities & State PUCs (2):

DERs have the potential to increase to hundreds of gigawatts of scale over the coming decade (i.e., the potential addition of thousands of small resources) that must be monitored and controlled.

- **State PUC impacts:**
  - ✓ Increased need to work with ISO/RTO to develop compatible requirements.
  - ✓ Develop new policies for DERs as necessary (data access, aggregator registration processes, interconnection rules).
  - ✓ Increased utility funding requests for programs needed to meet new requirements (e.g., full AMI deployment, MDMS, GIS, etc.)
  - ✓ Heightened need to ensure consistency across the state; standardization will be vital: same data, same processes required across the board.
  - ✓ Increased need for distribution system analysis—e.g., hosting capacity studies, defining priority zones).
  - ✓ ***Other, unforeseen implications!***

Many other state-level policy questions result from Order 2222.

- How much control should utilities have over how DERs serving wholesale market needs are allowed to connect to the grid in the first place?
- How much control should utilities have over how often and at what scale DERs are dispatched to serve the bulk power grid, particularly when those actions could disrupt the lower-voltage grids utilities are responsible for?
- What hard boundaries should be established between payments for wholesale energy market activities and payments for retail-level (i.e., state-regulated and utility-administered) programs?
- When these jurisdictional or economic boundaries are in question, who gets to decide how to resolve them?
- Moreover, questions persist whether Order 2222 is an overreach of FERC's authority into a part of the grid that's traditionally been under state, not federal, jurisdiction: distribution lines.
- Tensions may intensify between DERs developers who will resist limits placed on how DERs can participate in wholesale energy markets, and utilities + state regulators who are concerned with how allowing DERs participate in wholesale markets may wreak havoc on distribution grids and state-level policy.

The energy storage policy landscape continues to evolve.

Sandia National Labs monitors and analyzes activity at the federal and state levels and publishes information in the Global Energy Storage Database, available at this link:

https://www.sandia.gov/ess-ssl/global-energy-storage-database/

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