50 States of GRID MODERNIZATION

Q4 2021 Quarterly Report & 2021 Annual Review

Executive Summary

NC CLEAN ENERGY TECHNOLOGY CENTER

February 2022

AUTHORS

Rebekah de la Mora
Brian Lips
Vincent Potter
Autumn Proudlove
David Sarkisian

The NC Clean Energy Technology Center is a UNC System-chartered Public Service Center administered by the College of Engineering at North Carolina State University. Its mission is to advance a sustainable energy economy by educating, demonstrating and providing support for clean energy technologies, practices, and policies. The Center provides service to the businesses and citizens of North Carolina and beyond relating to the development and adoption of clean energy technologies. Through its programs and activities, the Center envisions and seeks to promote the development and use of clean energy in ways that stimulate a sustainable economy while reducing dependence on foreign sources of energy and mitigating the environmental impacts of fossil fuel use.

CONTACT

Autumn Proudlove (afproudl@ncsu.edu)

PREFERRED CITATION

North Carolina Clean Energy Technology Center, *The 50 States of Grid Modernization: 2021 Review and Q4 2021 Quarterly Report,* February 2022.

COVER DESIGN CREDIT

Cover design is by Capital City Creative.

DISCLAIMER

PREVIOUS EDITIONS AND OTHER 50 STATES REPORTS

Previous executive summaries and older editions of *The 50 States of Grid Modernization* are available for download here.

In addition to *The 50 States of Grid Modernization*, the NC Clean Energy Technology Center publishes additional quarterly reports called *The 50 States of Solar* and *The 50 States of Electric Vehicles*. These reports may be purchased at here. Executive summaries and older editions of these reports are available for download here.

ABOUT THE REPORT

WHAT IS GRID MODERNIZATION?

Grid modernization is a broad term, lacking a universally accepted definition. In this report, the authors use the term grid modernization broadly to refer to actions making the electricity system more resilient, responsive, and interactive. Specifically, in this report grid modernization includes legislative and regulatory actions addressing: (1) smart grid and advanced metering infrastructure, (2) utility business model reform, (3) regulatory reform, (4) utility rate reform, (5) energy storage, (6) microgrids, and (7) demand response.

PURPOSE

The purpose of this report is to provide state lawmakers and regulators, electric utilities, the advanced energy industry, and other energy stakeholders with timely, accurate, and unbiased updates about how states are choosing to study, adopt, implement, amend, or discontinue policies associated with grid modernization. This report catalogues proposed and enacted legislative, regulatory, and rate design changes affecting grid modernization during the most recent quarter.

The 50 States of Grid Modernization report series provides regular quarterly updates and annual summaries of grid modernization policy developments, keeping stakeholders informed and up to date.

APPROACH

The authors identified relevant policy changes and deployment proposals through state utility commission docket searches, legislative bill searches, popular press, and direct communications with industry stakeholders and regulators.

Questions Addressed

This report addresses several questions about the changing U.S. electric grid:

- How are states adjusting traditional utility planning processes to better allow for consideration of advanced grid technologies?
- What changes are being made to state regulations and wholesale market rules to allow market access for distributed energy resources?
- How are states and utilities reforming the traditional utility business model and rate designs?

- What policy actions are states taking to grow markets for energy storage and other advanced grid technologies?
- Where and how are states and utilities proposing and deploying advanced grid technologies, energy storage, microgrids, and demand response programs?

Actions Included

This report focuses on cataloguing and describing important proposed and adopted policy changes related to grid modernization and distributed energy resources, *excluding policies specifically intended to support only solar technologies*. While some areas of overlap exist, actions related to distributed solar policy and rate design are tracked separately in the *50 States of Solar report series,* and are generally not included in this report.

In general, this report considers an "action" to be a relevant (1) legislative bill that has been introduced or (2) a regulatory docket, utility rate case, or rulemaking proceeding. Only statewide actions and those related to investor-owned utilities are included in this report. Specifically, actions tracked in this issue include:

Studies and Investigations

Legislative or regulatory-led efforts to study energy storage, grid modernization, utility business model reform, or alternative rate designs, e.g., through a regulatory docket or a cost-benefit analysis.

Planning and Market Access

Changes to utility planning processes, including integrated resource planning, distribution system planning, and evaluation of non-wires alternatives, as well as changes to state and wholesale market regulations enabling market access.

Utility Business Model and Rate Reform

Proposed or adopted changes to utility regulation and rate design, including performance-based ratemaking, decoupling, time-varying rates, and residential demand charges.

Grid Modernization Policies

New state policy proposals or changes to existing policies related to grid modernization, including energy storage targets, energy storage compensation rules, interconnection standards, and customer data access policies.

Financial Incentives for Energy Storage and Advanced Grid Technologies

New statewide incentives or changes to existing incentives for energy storage, microgrids, and other modern grid technologies.

Deployment of Advanced Grid Technologies

Utility-initiated requests, as well as proposed legislation, to implement demand response programs or to deploy advanced metering infrastructure, smart grid technologies, microgrids, or energy storage.

Actions Excluded

This report excludes utility proposals for grid investments that do not include any specific grid modernization component, as outlined above, as well as specific projects that have already received legislative or regulatory approval. Actions related exclusively to pumped hydroelectric storage or electric vehicles are not covered by this report (a separate report series available from the NC Clean Energy Technology Center covers electric vehicle actions). Time-varying and residential demand charge proposals are only documented if they are being implemented statewide, the default option for all residential customers of an investor-owned utility, or a notable pilot program. Actions related to inclining or declining block rates are not included in this report. While actions taken by municipal utilities and electric cooperatives are not comprehensively tracked in this report, particularly noteworthy or high-impact actions are included. The report also excludes changes to policies and rate design for distributed generation customers; these changes are covered in the 50 States of Solar quarterly report.

EXECUTIVE SUMMARY

2021 GRID MODERNIZATION ACTION

In 2021, 50 states plus DC took a total of 823 policy and deployment actions related to grid modernization, utility business model and rate reform, energy storage, microgrids, and demand response. Table 1 provides a summary of state and utility actions on these topics. Of the 823 actions identified, the most common were related to deployment (186), followed by policies (185), and financial incentives (129).

Table 1. 2021 Summary of Grid Modernization Actions

Type of Action	# of Actions	% by Type	# of States
Deployment	186	23%	46
Policies	185	23%	40 + DC
Financial Incentives	129	16%	39
Business Model and Rate Reform	120	15%	42 + DC
Planning and Market Access	109	13%	28 + DC
Studies and Investigations	94	11%	31 + DC
Total	**823**	**100%**	**50 States + DC**

Note: The "# of States/ Districts" total is not the sum of the rows because some states have multiple actions. Percentages are rounded and may not add up to 100%.

TOP TEN MOST ACTIVE STATES OF 2021

Ten states taking the greatest number of particularly impactful actions are noted below.

Connecticut

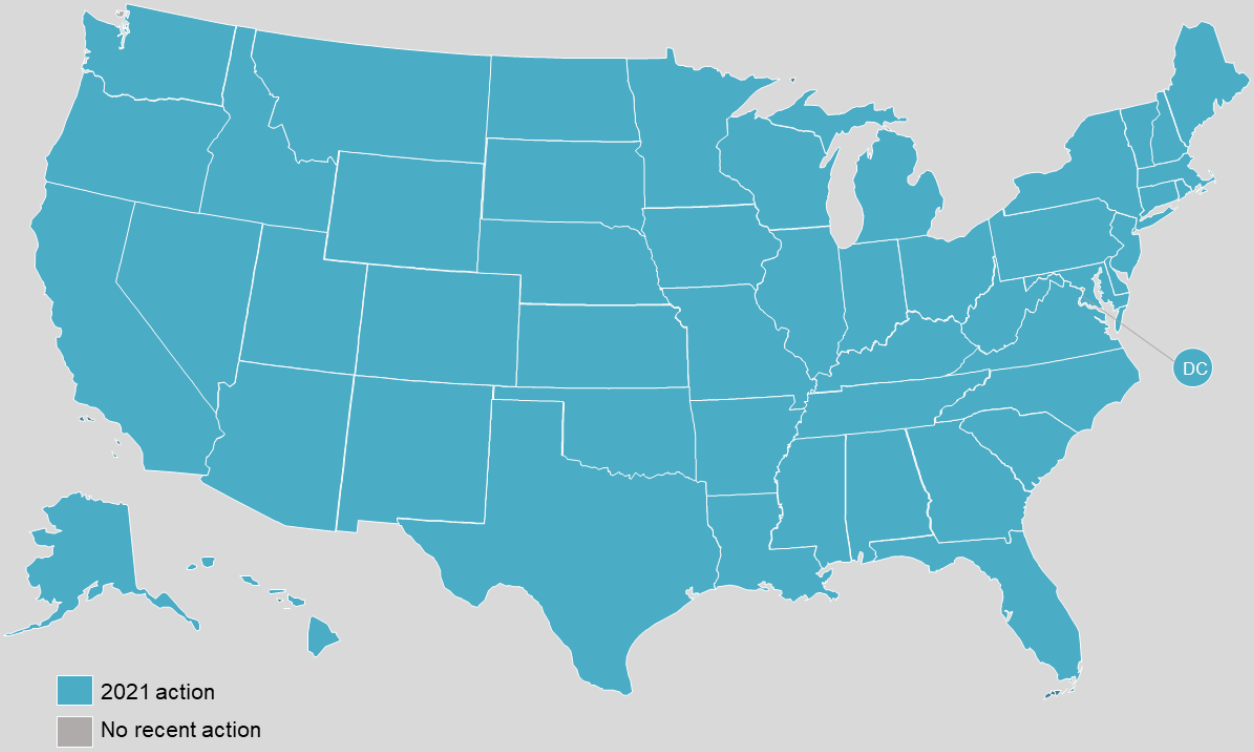
Connecticut lawmakers adopted an energy storage target in 2021, while regulators continued their grid modernization efforts through several targeted proceedings. The Public Utilities Regulatory Authority approved a new energy storage incentive program and opened a proceeding to adopt a performance-based regulation framework, while utilities filed revised advanced metering infrastructure plans.

California

The California Public Utilities Commission approved over $400 million in grid modernization investments proposed by Southern California Edison, while undertaking a number of efforts related to grid resilience and extreme weather events. San Diego Gas & Electric proposed a

real time pricing pilot, and the California Energy Commission approved new standards requiring solar and storage for certain buildings. The Commission also adopted rates, tariffs, and rules to facilitate the commercialization of microgrids earlier in the year.

Figure 1. 2021 Legislative and Regulatory Action on Grid Modernization



North Carolina

The North Carolina Utilities Commission approved many of Duke Energy's Grid Improvement Plan investments during 2021, while initiating working groups on rate design and climate resiliency. State legislators enacted a bill authorizing the use of performance-based regulation, and regulators approved new dynamic rate designs for Duke Energy. The Southeast Energy Exchange Market also took effect, of which Duke Energy is a participant.

Illinois

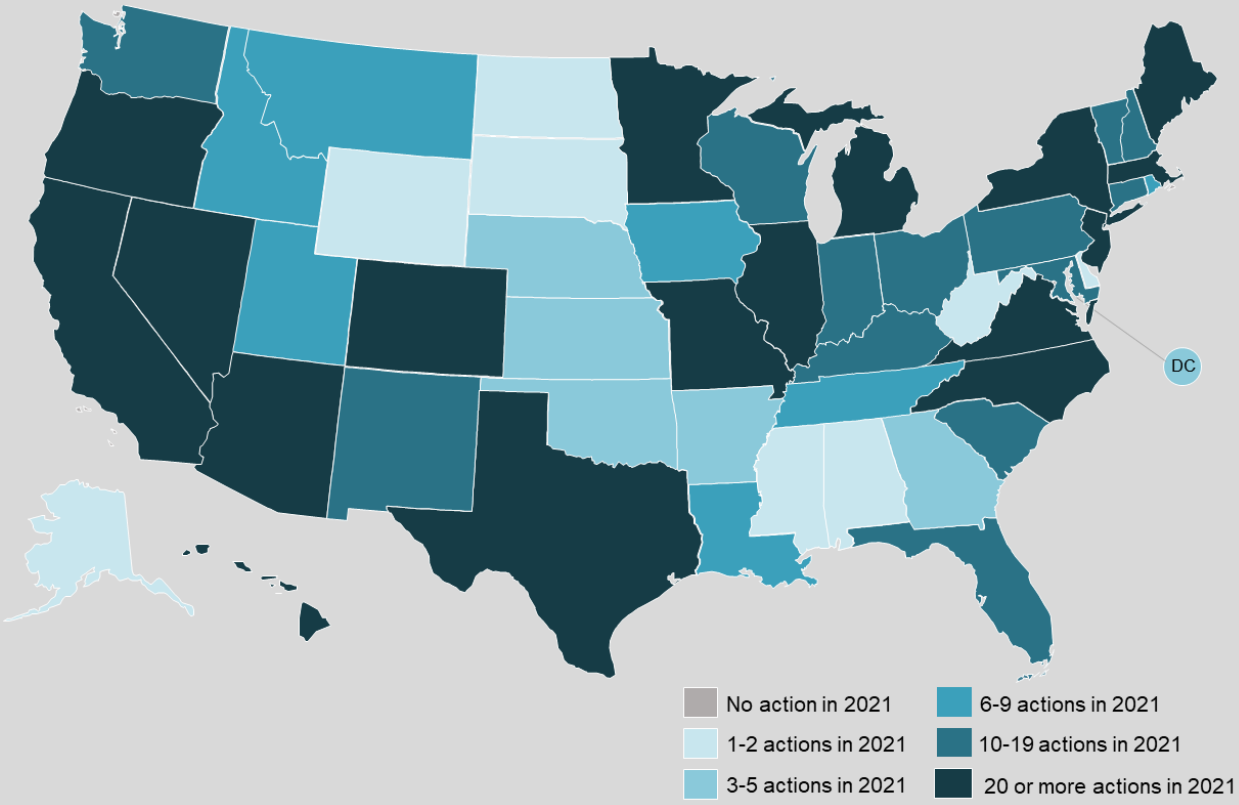
Illinois lawmakers passed a major piece of energy legislation during 2021, which requires the Illinois Commerce Commission to establish a comprehensive performance-based regulation framework and directs utilities to engage in multi-year integrated grid planning. The bill also calls for an energy storage study and establishes storage rebates, among other provisions.

The Commission also approved a variety of smart grid investments proposed by Ameren Illinois and Commonwealth Edison.

Maine

Maine legislators adopted an energy storage target in 2021, as well as bills requiring a stakeholder group to consider a holistic grid planning process and the Public Utilities Commission to study the feasibility of a statewide energy data platform. The Commission also opened a proceeding on rate design and continued its investigation of alternative regulatory mechanisms.

Figure 2. 2021 Grid Modernization Activity, by Number of Actions



Hawaii

Hawaii regulators approved a microgrid services tariff in May 2021, which will facilitate microgrid development in the state. Regulators also adopted three additional performance incentive mechanisms for the HECO utilities and approved a new emergency demand response program. The Commission also considered numerous solar-plus-storage power purchase agreements filed by the HECO utilities.

Michigan

The Michigan Public Service Commission led multiple working groups related to grid modernization during 2021, including groups addressing new technologies and business models, distributed energy resource (DER) rate design, and data access. Three Michigan investor-owned utilities filed their electric distribution infrastructure investment plans for 2021-2025, totaling over $700 million in grid modernization investments. State regulators also addressed market rules related to energy storage and DER aggregation.

Texas

Texas saw a flurry of legislative activity focused on grid resilience, following the major winter weather event hitting the state in February 2021. Regulators opened several dockets to consider grid resilience and wholesale market design, while utilities filed proposals to deploy advanced metering infrastructure. SWEPCO also filed a proposal to implement new time-of-use rates, and Xcel Energy requested approval for a resiliency service tariff.

Minnesota

Minnesota's investor-owned utilities filed their integrated distribution plans in 2021, including planned grid modernization investments. Utilities also filed proposals for new demand response agreements and advanced metering infrastructure deployment. Regulators considered time-of-use rate options and approved default residential time-of-use rates for Minnesota Power. The Commission is also addressing access to electric distribution grid data and customer energy usage data.

Massachusetts

Massachusetts' three investor-owned utilities filed their 2022-2025 grid modernization plans during 2021. Together, the plans include over $1.6 billion in grid modernization investments. The Department of Public Utilities also issued a decision on system planning and cost allocation for capital infrastructure projects to enable interconnection. State lawmakers introduced numerous bills related to energy storage and grid modernization, and extended property tax incentives to energy storage projects early in the year.

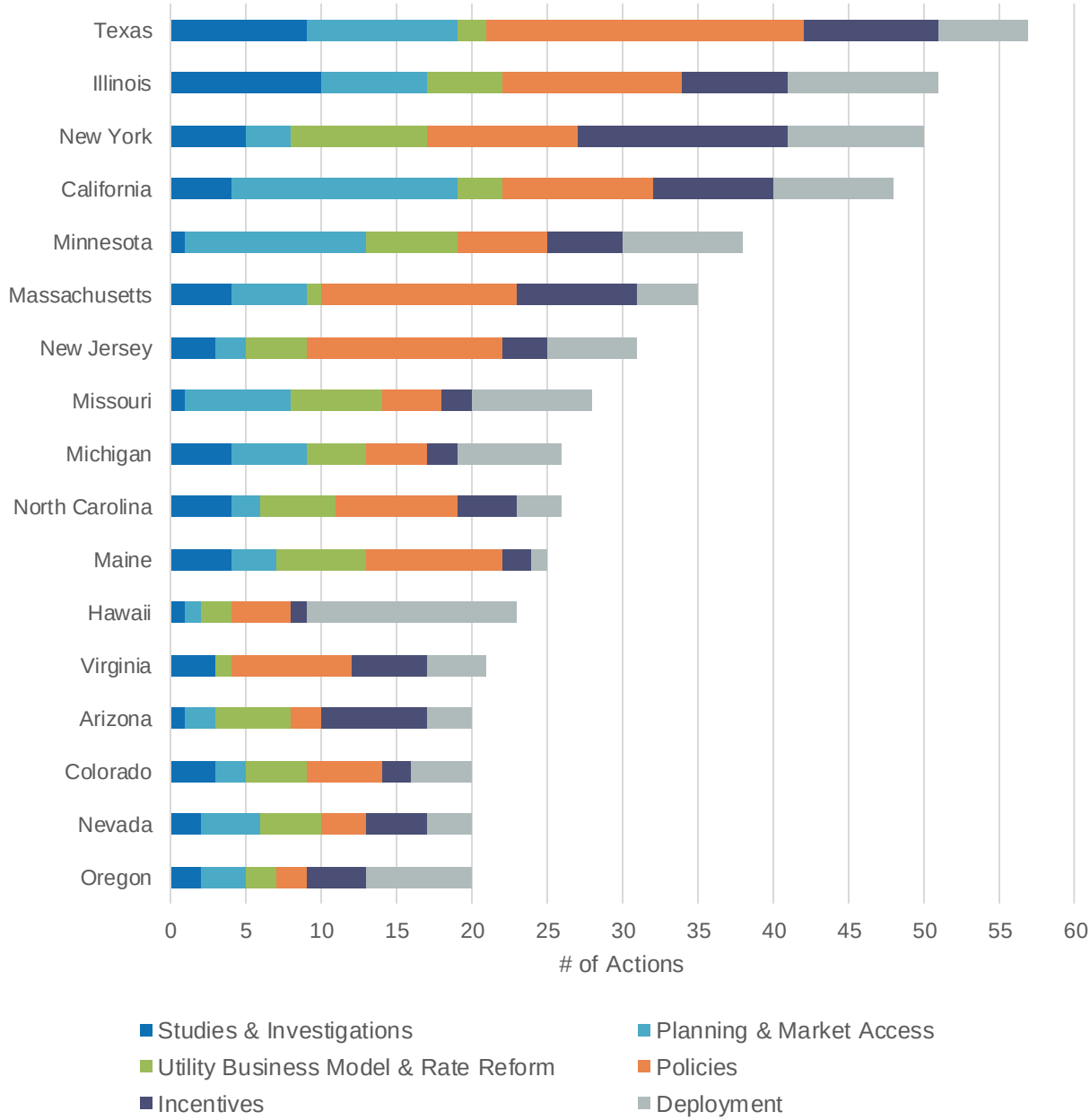
TOP GRID MODERNIZATION TRENDS OF 2021

Grid Modernization Technology Deployment on the Rise

Grid modernization technology deployment increased substantially in 2021, with energy storage deployment proposals leading the way and nearly every state considering deployment activities. Deployment actions increased by 35% over 2020, with utilities filing requests for pre-approval or cost recovery of grid modernization investments, RFPs to procure storage and

demand response, as well as integrated resource plans and distribution system plans including planned future investments.

Figure 3. Most Active States of 2021



States Examining Wholesale Market Reforms

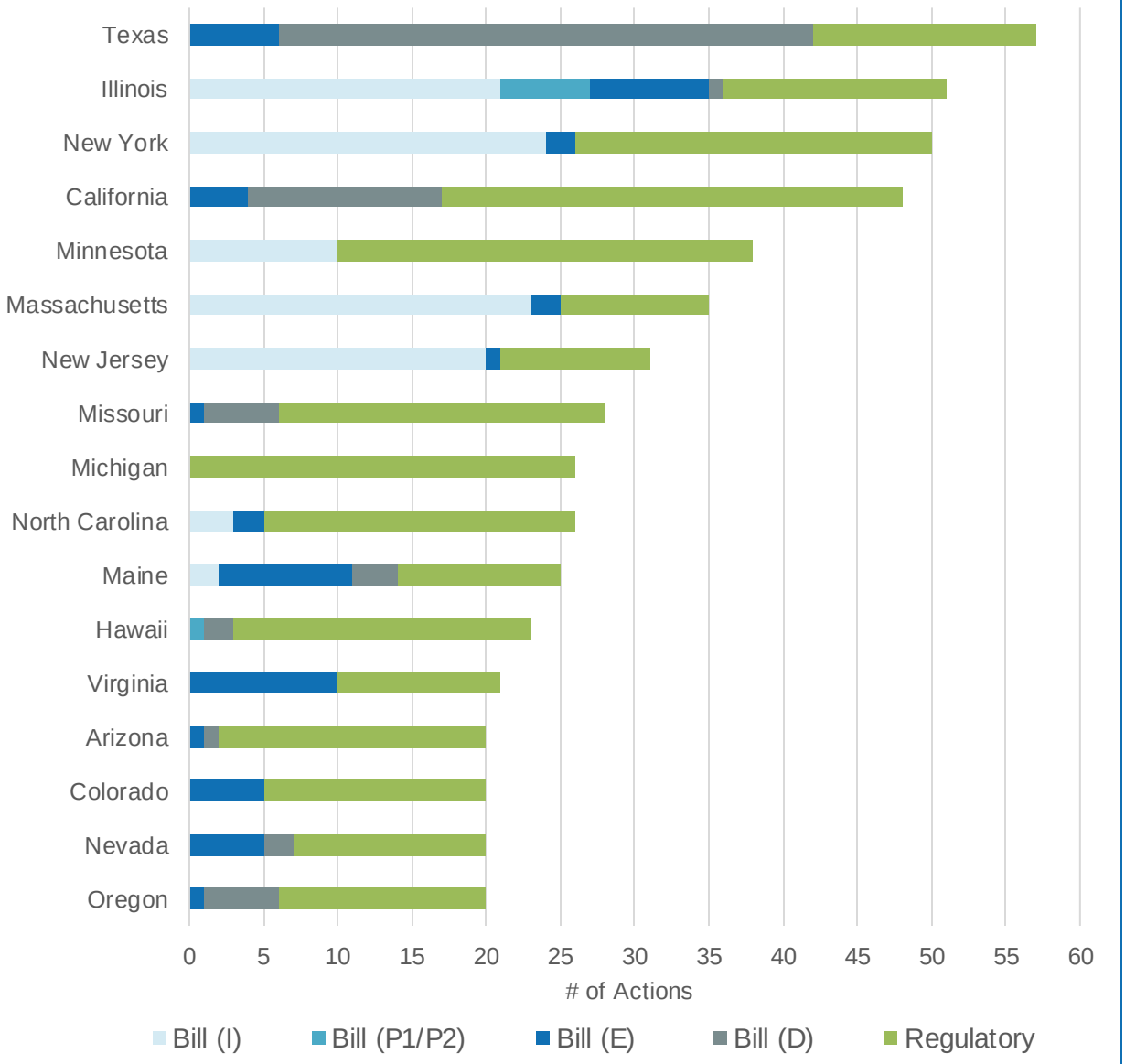
Wholesale market reform was a major topic of consideration during 2021, with a number of states, such as Colorado, Nevada, and Oregon, exploring the possibility of joining an existing regional transmission organization (RTO). Other states, including Mississippi and Missouri, examined the costs and benefits of current RTO membership, while several southeastern

states discussed the potential of a Southeast Energy Exchange Market, which was approved in October 2021.

A More Phased Approach to Grid Investments

An increasingly step-wise or phased approach to grid investment was seen in utility plans and regulator decisions during 2021. Dominion Energy filed Phase 2 of its Distribution Grid Transformation Plan in Virginia, while North Carolina regulators approved revised grid improvement plans put forward by Duke Energy covering three years rather than the original ten years. In other states, utilities are filing distribution system plans that include a long-term vision and a short-term investment plan.

Figure 4. Most Active States of 2021, by Action Status



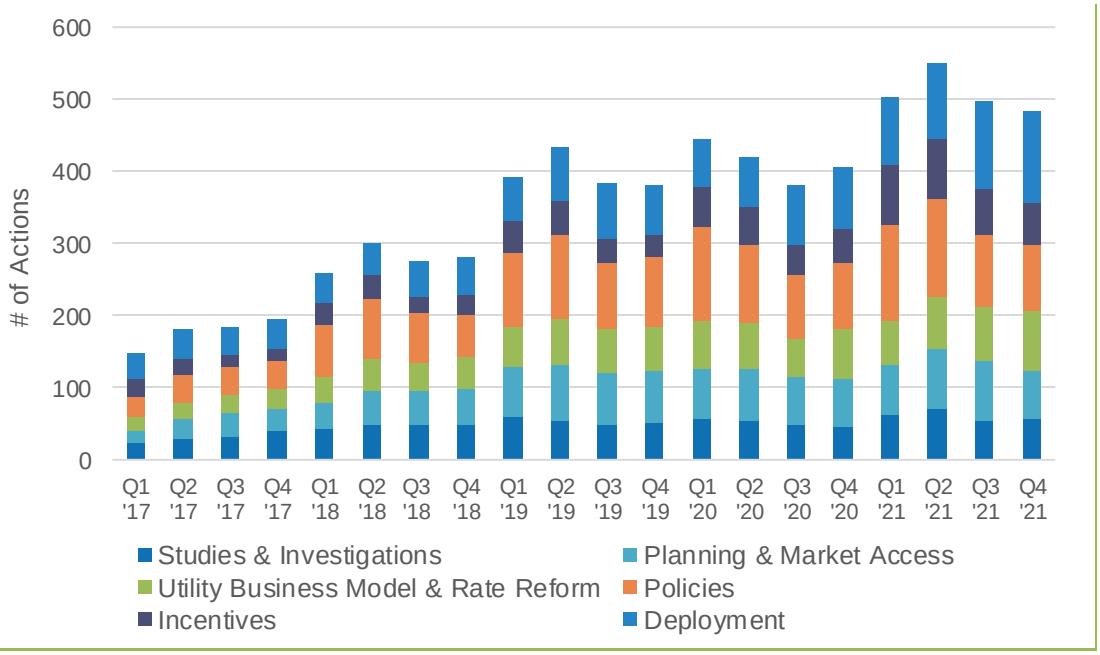
Exploring Ways to Improve Grid Resilience

Many states placed new focus on grid resilience following the February 2021 winter storm that resulted in extended power outages for many customers. Policymakers and regulators in Texas, a state hit particularly hard by the storm, considered a variety of policies and market reforms to improve resilience, while a number of states opened up investigatory proceedings to evaluate the impacts of the storm and how to enhance grid resilience.

States Enabling the Use of Performance-Based Regulation

Several states took steps to enable the use of performance-based regulation (PBR) during 2021. Illinois lawmakers passed legislation requiring the Illinois Commerce Commission to create a comprehensive PBR framework, while North Carolina legislators authorized the use of PBR. In Washington, the state legislature enacted a bill directing the Utilities and Transportation Commission to develop a policy statement addressing alternatives to cost-of-service regulation, including performance incentive mechanisms.

Figure 5. Total Number of Grid Modernization Actions by Quarter



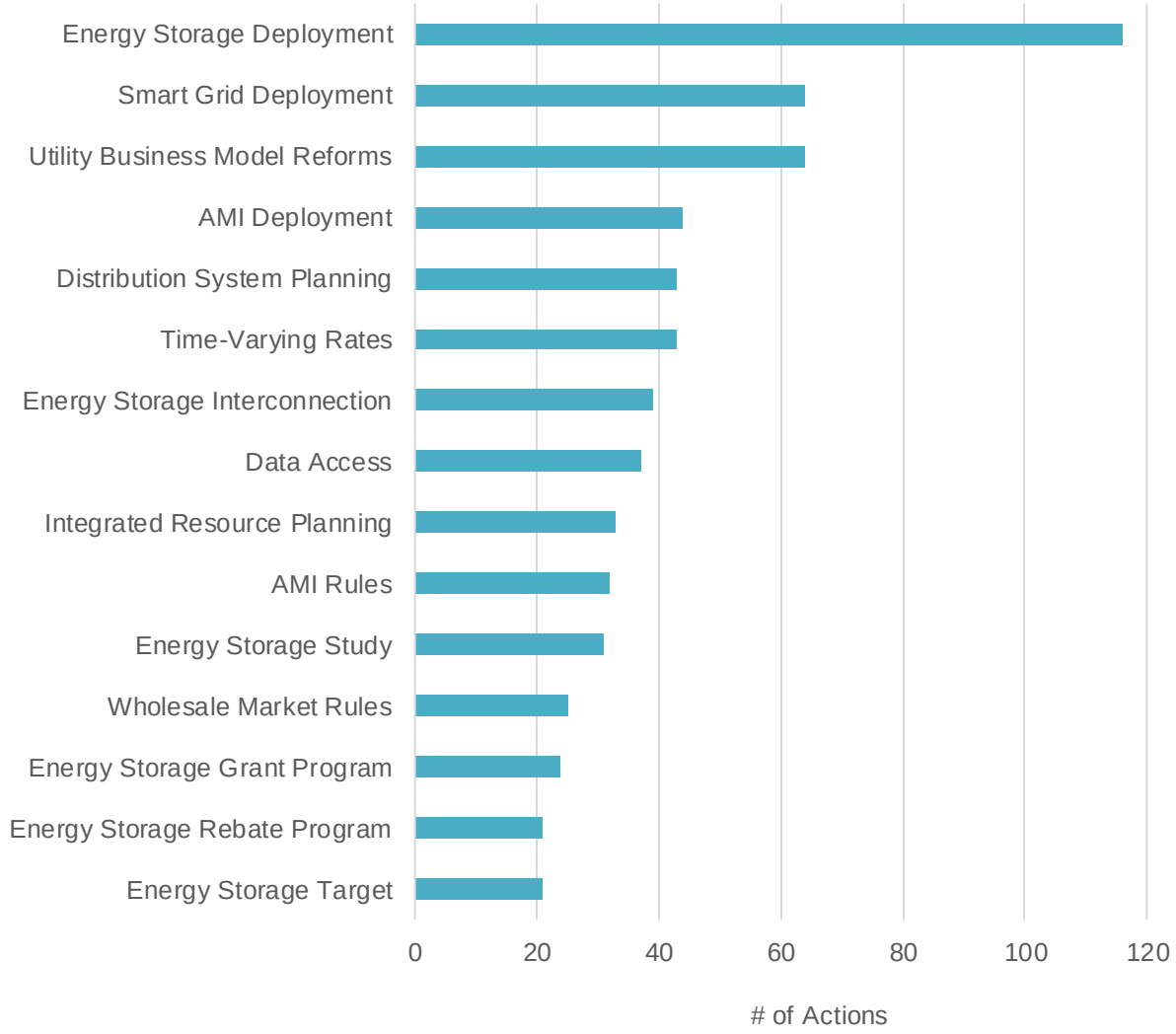
Utilities Proposing Increasingly Granular Rate Designs

Utilities across the country are proposing increasingly granular rate structures, including three-part time-of-use rates and designs incorporating critical peak pricing. In North Carolina, regulators approved new dynamic rates with critical peak pricing periods proposed by Duke Energy. The Minnesota Public Utilities Commission approved Minnesota Power's default residential time-of-use rate, while Maine regulators are exploring a variety of rate designs to promote state policies.

States Undertaking Coordinated, Multi-Part Investigations

A number of states are taking a coordinated, multi-part approach to their grid modernization investigations and rulemakings. Connecticut, for example, has several sub-dockets progressing simultaneously on topics including storage, advanced metering infrastructure, and non-wires alternatives. Maryland and Michigan also have multiple working groups and proceedings open, each focusing on specific elements of grid modernization.

Figure 6. Top Grid Modernization Actions of 2021



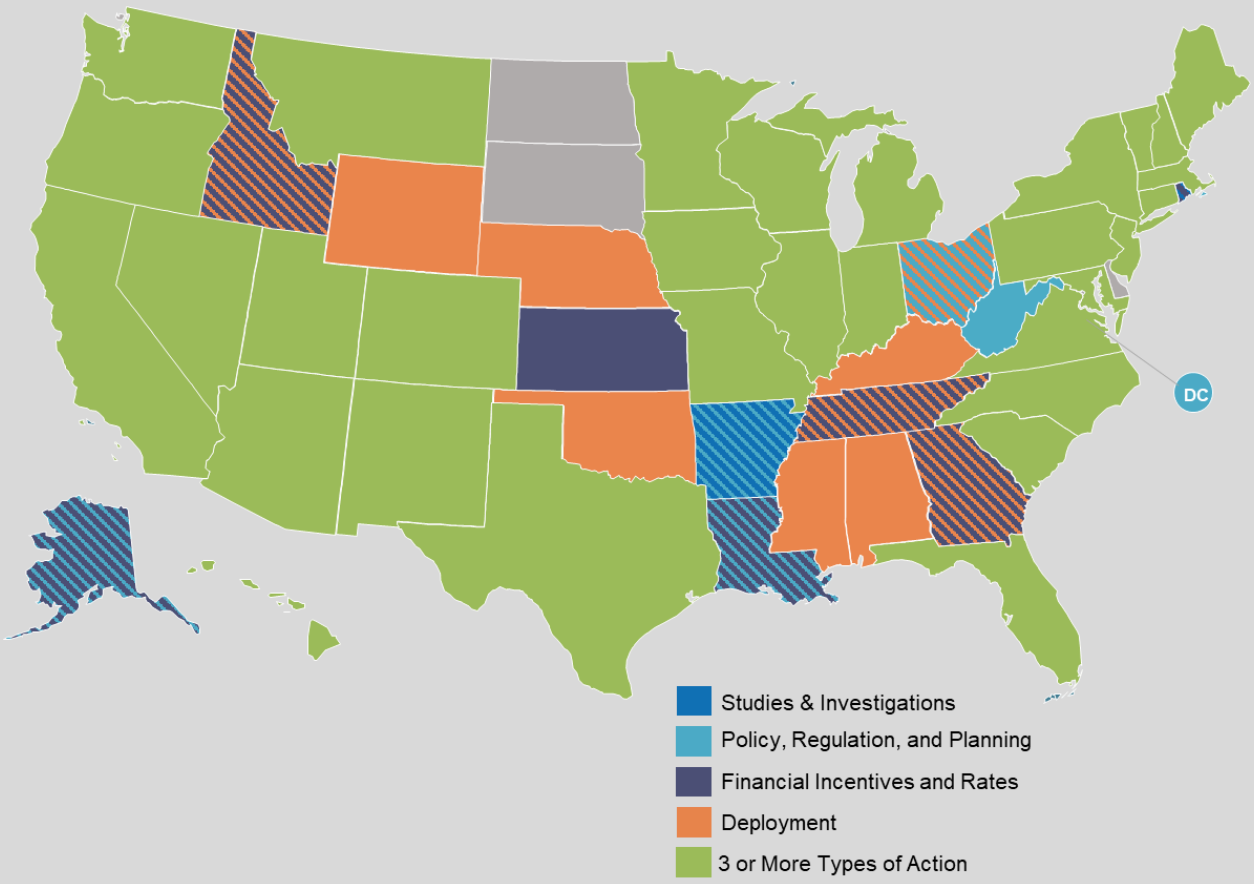
Establishing New Incentives for Energy Storage

Several states and utilities established new incentives for energy storage systems in 2021. Property tax incentives were one of the most common incentive types under consideration, with Colorado, Vermont, and other states approving special property tax treatment for storage systems. Arizona and Virginia are among the states extending sales tax exemptions to energy storage, while Arizona regulators approved new utility rebates for battery systems.

Dedicated Distribution System Planning Efforts Growing More Common

Following several states' efforts to develop distribution system planning guidelines, many utilities are now filing dedicated distribution system plans identifying grid needs and planned investments, while providing stakeholders with an opportunity to comment on the plans. Utilities in Michigan, Minnesota, and Oregon are among those filing distribution system plans in 2021. Regulators in Colorado approved distribution system planning rules in 2021, while a stakeholder group in Maine is exploring the implementation of a holistic grid planning process.

Figure 7. 2021 Energy Storage Action, by Type of Action



Integrated Resource Plans Incorporating Growing Amounts of Storage Capacity

Utility integrated resource plans (IRPs) are incorporating growing amounts of new energy storage capacity. Idaho Power's 2021 IRP includes 1,685 MW of battery storage to be added between 2021 and 2040, while the utility's 2019 IRP included only 80 MW of new battery storage. IRPs recently filed by utilities in Kentucky, New Mexico, Utah, among other states, include substantial amounts of new storage capacity.

LOOKING BACK: 2017 to 2021

Total grid modernization action increased by about 25% over the past year, with states and utilities taking approximately 822 actions in 2021, compared to 658 actions in 2020, 612 actions in 2019, 460 actions in 2018, and 288 actions in 2017. In 2021, activity increased in every category tracked by this report, with greatest increases in financial incentives (39%) and deployment (35%). The number of states taking actions also increased or held steady in every category from 2020 to 2021.

Figure 8. Number of Grid Modernization Actions 2017-2021

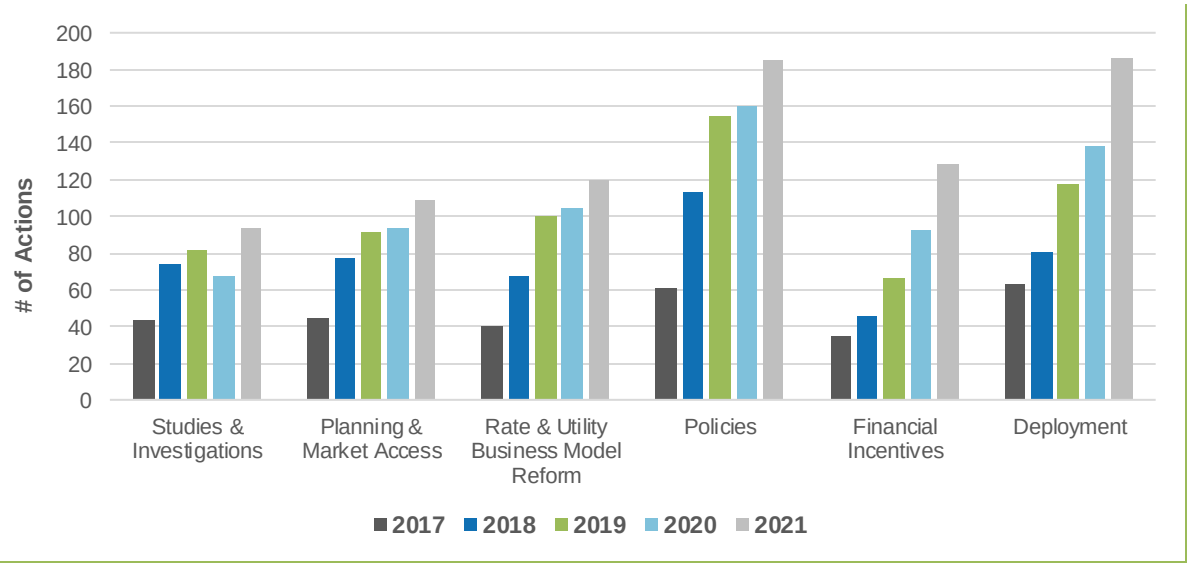
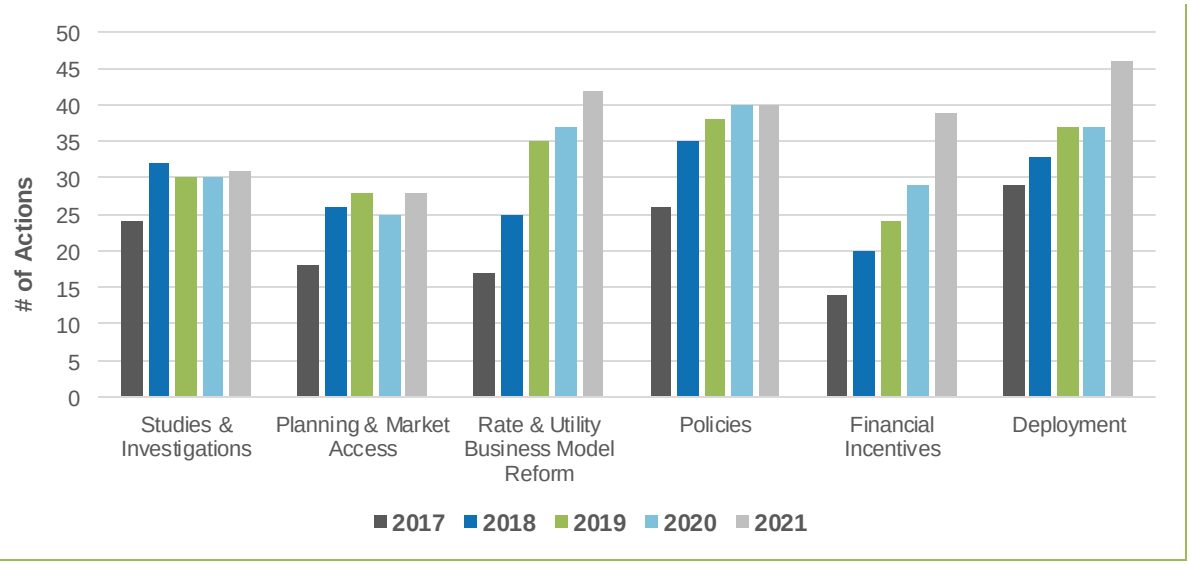


Figure 9. Number of States Taking Grid Modernization Actions 2017-2021



Q4 2021 GRID MODERNIZATION ACTION

In the fourth quarter of 2021, 48 states plus DC took a total of 484 policy and deployment actions related to grid modernization, utility business model and rate reform, energy storage, microgrids, and demand response. Table 2 provides a summary of state and utility actions on these topics. Of the 484 actions identified, the most common were related to deployment (128), followed by policies (92), and utility business model and rate reform (81).

Table 2. Q4 2021 Summary of Grid Modernization Actions

Type of Action	# of Actions	% by Type	# of States
Deployment	128	26%	41
Policies	92	19%	29 + DC
Business Model and Rate Reform	81	17%	34 + DC
Planning and Market Access	67	14%	23 + DC
Financial Incentives	59	12%	22
Studies and Investigations	57	12%	27 + DC
Total	**484**	**100%**	**48 States + DC**

Note: The "# of States/ Districts" total is not the sum of the rows because some states have multiple actions. Percentages are rounded and may not add up to 100%.

TOP 5 GRID MODERNIZATION DEVELOPMENTS OF Q4 2021

Five of the quarter's top policy developments are highlighted below.

Southeast Energy Exchange Market Becomes Effective

The Southeast Energy Exchange Market (SEEM) agreement took effect in October 2021, after the Federal Energy Regulatory Commission (FERC) remained divided on the proposal and failed to take action on it. FERC later denied a rehearing request on the basis of the request being filed late. The SEEM is an automated trading platform designed to enable sub-hourly, bilateral transactions between utilities in the southeast.

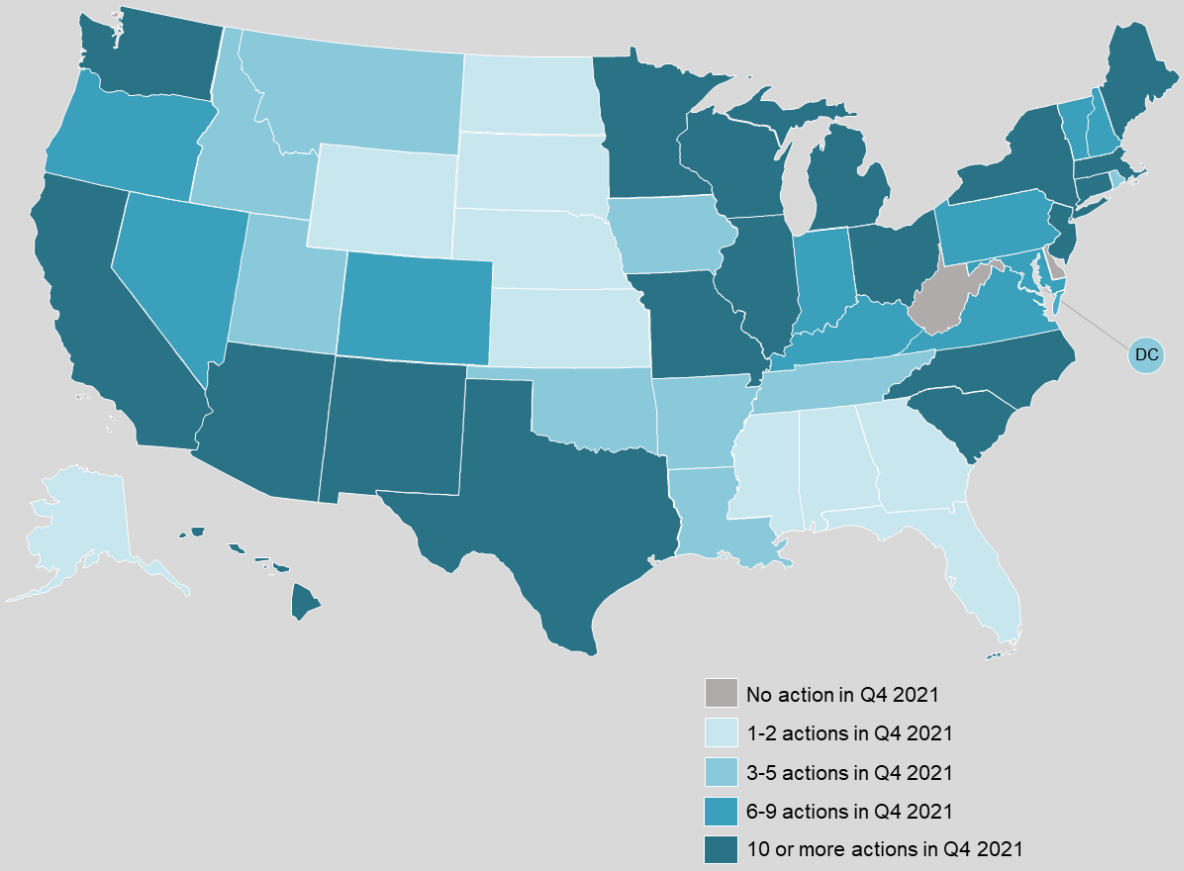
Ohio Regulators Approve Settlement on AEP Ohio's gridSMART Phase 3 Program

The Public Utilities Commission of Ohio approved a stipulation allowing for $223 million in capital spending as part of AEP Ohio's gridSMART Phase 3 program. AEP Ohio's original gridSMART Phase 3 plan included $700 million in capital investment over 15 years. The stipulation allows investments in AMI, volt/var optimization, among other categories, but rejects the distribution automation circuit reconfiguration, broadband fiber, and intelligent line sensor investments.

California Public Utilities Commission Approves Demand Response Measures

The California Public Utilities Commission issued a decision in December 2021, approving new demand response measures to prepare for potential extreme weather events. The decision adds an emergency load reduction program that allows residential customers to receive compensation for reduction in energy use during system emergencies, creates a new smart thermostat program, and allows utilities to procure incremental demand response resources from third-party providers through bilateral contracts.

Figure 10. Q4 2021 Legislative and Regulatory Action on Grid Modernization



RTO Studies Completed in Colorado and Oregon

Regulators in both Colorado and Oregon completed studies during Q4 2021 examining the potential benefits of joining a regional transmission organization (RTO). Colorado's study found that RTO participation could provide potential cost savings of 4 to 5 percent and benefits of helping the state achieve its clean energy goals. Oregon's study determined widespread (but

not universal) agreement that there is value in joining an RTO, but market design and governance issues are of key importance.

North Carolina Lawmakers Authorize Performance-Based Regulation

North Carolina legislators authorized performance-based regulation with the passage of H.B. 951 in October 2021. The bill specifies that if a utility files a performance-based regulation application, it must include a decoupling mechanism, one or more performance incentive mechanisms, and a multi-year rate plan. Shortly after the bill's enactment, the Utilities Commission opened a proceeding to develop performance-based regulation rules.

MOST ACTIVE STATES AND SUBTOPICS OF Q4 2021

The most common types of actions across the country related to energy storage deployment (78), followed by smart grid deployment (51), utility business model reforms (43), advanced metering infrastructure deployment (37), and time-varying rates (31). The states taking the greatest number of actions related to grid modernization in Q4 2021 can be seen in Figure 12. New York, Massachusetts, and Minnesota took the greatest number of actions during the quarter, followed by California, Michigan, Missouri, Illinois, and North Carolina.

Figure 11. Most Common Types of Actions Taken in Q4 2021

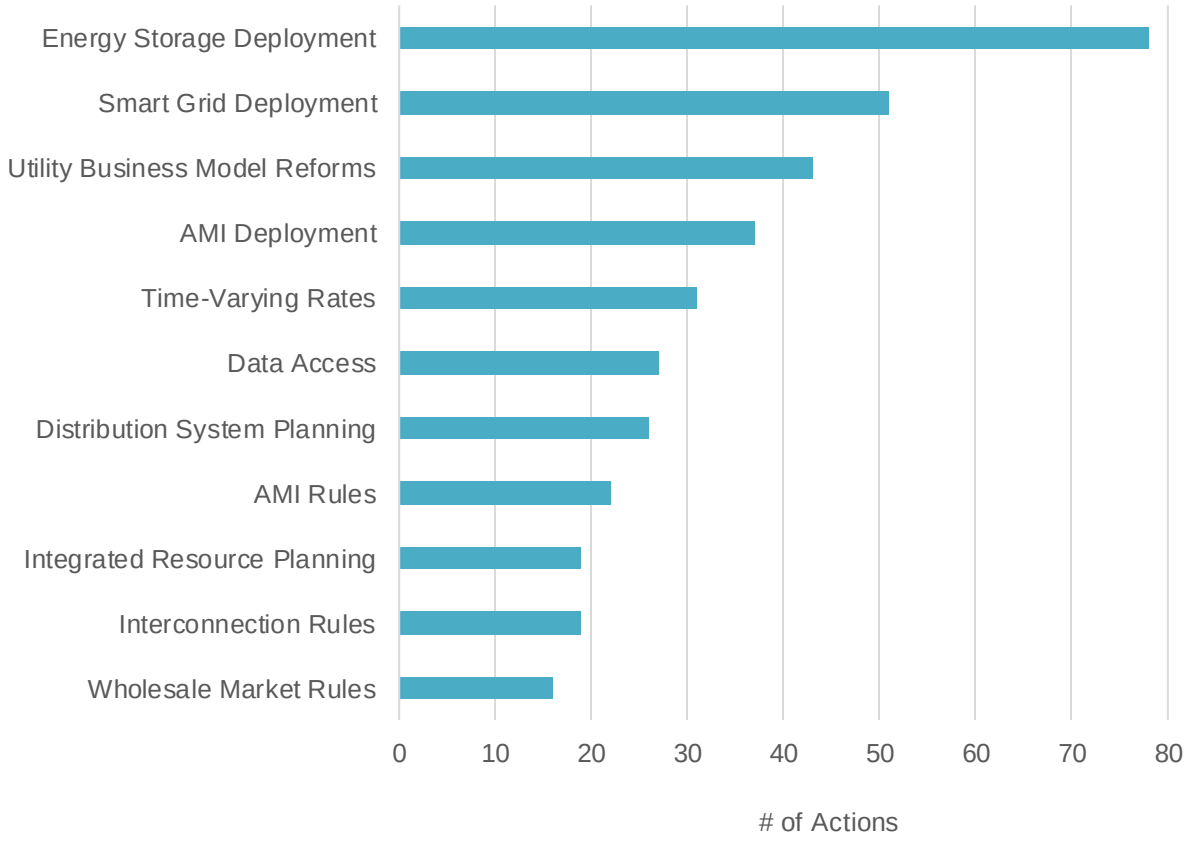
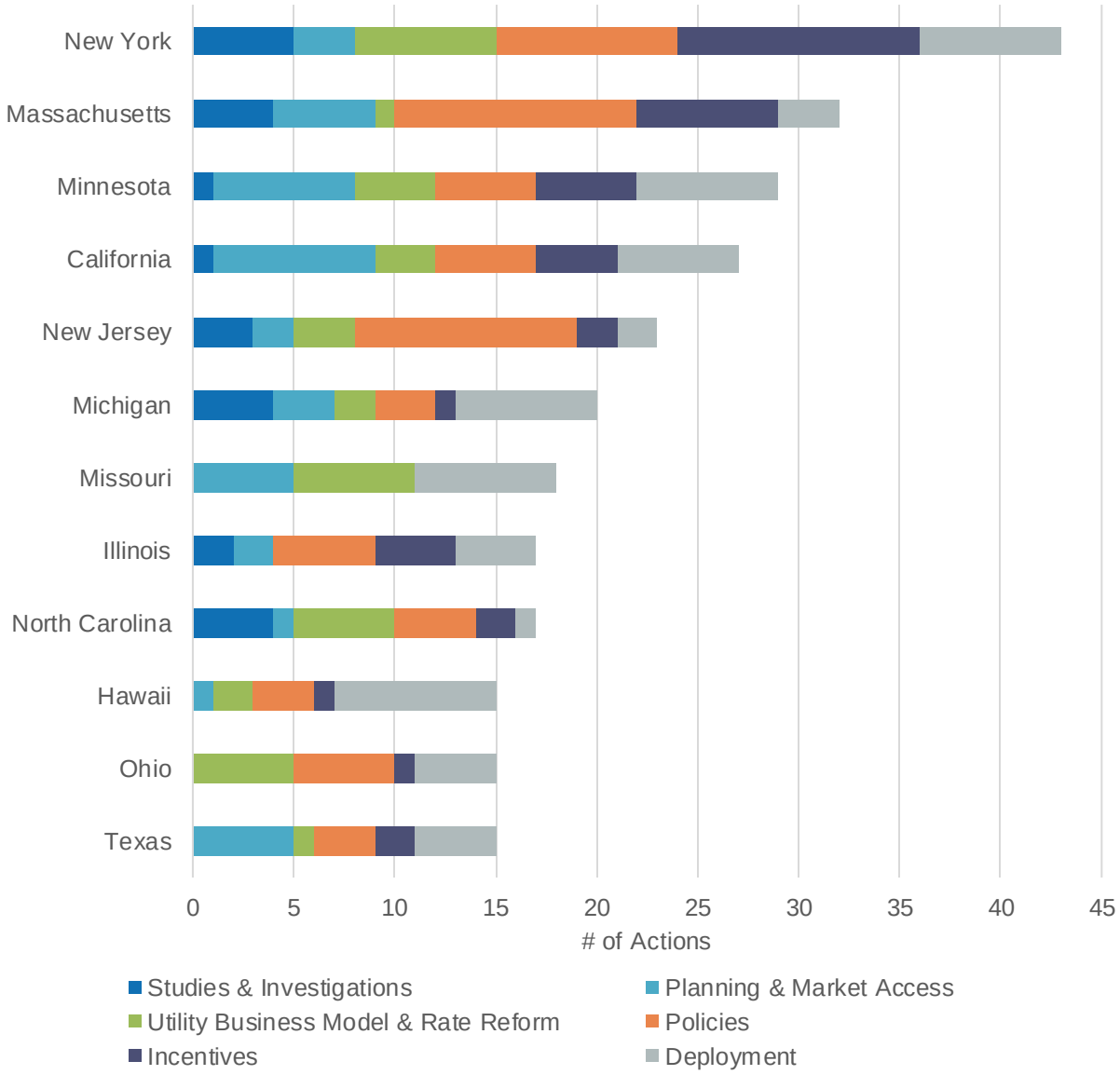


Figure 12. Most Active States of Q4 2021



FULL REPORT DETAILS & PRICING

FULL REPORT DETAILS

Content Included in the Full Quarterly Report:

- Detailed tables describing each pending and recently decided state and utility grid modernization action addressing: (1) smart grid and advanced metering infrastructure, (2) utility business model reform, (3) regulatory reform, (4) utility rate reform, (5) energy storage, (6) microgrids, and (7) demand response. Actions are broken out into the following categories:
    - Studies and Investigations
    - Planning and Market Access
    - Utility Business Model and Rate Reforms
    - Policies
    - Financial Incentives
    - State and Utility Deployment
- Links to original legislation, dockets, and commission orders for each legislative and regulatory action
- Excel spreadsheet file of all actions taken during the quarter and separate Powerpoint file of all summary maps available upon request
- Qualitative analysis and descriptive summaries of grid modernization policy action and trends
- Outlook of action for the next quarter

WHO SHOULD PURCHASE THIS REPORT

The 50 States of Grid Modernization allows those involved in the electric industry to easily stay on top of legislative and regulatory changes. The report provides a comprehensive quarterly review of actions. At a cost of $500 per issue (or $1,500 annually), the 50 States of Grid Modernization offers a significant time and financial savings. With direct links to original sources for all actions, customers may stay on top of policy developments between quarterly reports.

Advanced Energy Technology Businesses

- Identify new market opportunities, as well as changing and risky markets
- Stay on top of state policy developments relevant to your business
- Give your own team a head start in tracking legislative and regulatory proceedings

Investor-Owned and Public Power Utilities

- Learn about the approaches being taken by other utilities facing similar opportunities and challenges

- Stay on top of relevant state policy developments
- Utilize an objective source of information in legislative and regulatory proceedings

Investors and Financial Analysts

- Identify new investment opportunities and emerging areas of growth, as well as risky investments
- Identify active utility investment proceedings

Advocacy Organizations

- Learn about the diverse grid modernization actions occurring across the country
- Learn about the outcomes of other states' policy decisions
- Utilize an objective source of information in legislative and regulatory proceedings

Researchers and Consultants

- Access valuable data requiring a vast amount of time to collect first-hand
- Identify research needs to inform grid modernization proceedings
- Cite an objective source in your own research and analysis

PRICING

Visit https://www.dsireinsight.com/subscriptions/ to purchase the full 50 States of Grid Modernization 2021 Annual Review and Q4 Quarterly Report or learn more about our additional subscription offerings.

Subscription Type	Annual Subscription	Single Report
50 States of Grid Modernization Report	$1,500	$500
Single-Tech Subscription (Grid Modernization & Energy Storage) *(Includes 50 States of Grid Modernization report, plus biweekly legislative & regulatory grid modernization/energy storage tracking, policy data sheets, & quarterly webinars)*	$4,500	N/A
All-Tech Subscription *(Includes 50 States of Grid Modernization report, 50 States of Solar report, & 50 States of Electric Vehicles report; plus biweekly legislative & regulatory tracking; policy data sheets, & quarterly webinars for solar, grid modernization/energy storage, & electric vehicles)*	$10,500	N/A

Customers purchasing an annual subscription receive complimentary access to all past editions of the report. Previous editions of the 50 States of Grid Modernization are offered at a discounted rate upon request.

COMPLIMENTARY COPIES FOR POLICYMAKERS

We offer complimentary copies of the 50 States of Grid Modernization, 50 States of Solar, and 50 States of Electric Vehicles to **policymakers and regulators only** (limited to federal and state legislators and staffers, utility commissioners, utility commission staff, state consumer advocate office staff, and state energy office staff). Contact us to receive a complimentary copy of the most recent report.

CUSTOMIZED SOLUTIONS

The NC Clean Energy Technology Center also offers customized policy research and analysis services. Visit http://www.dsireusa.org/services/ to learn more.