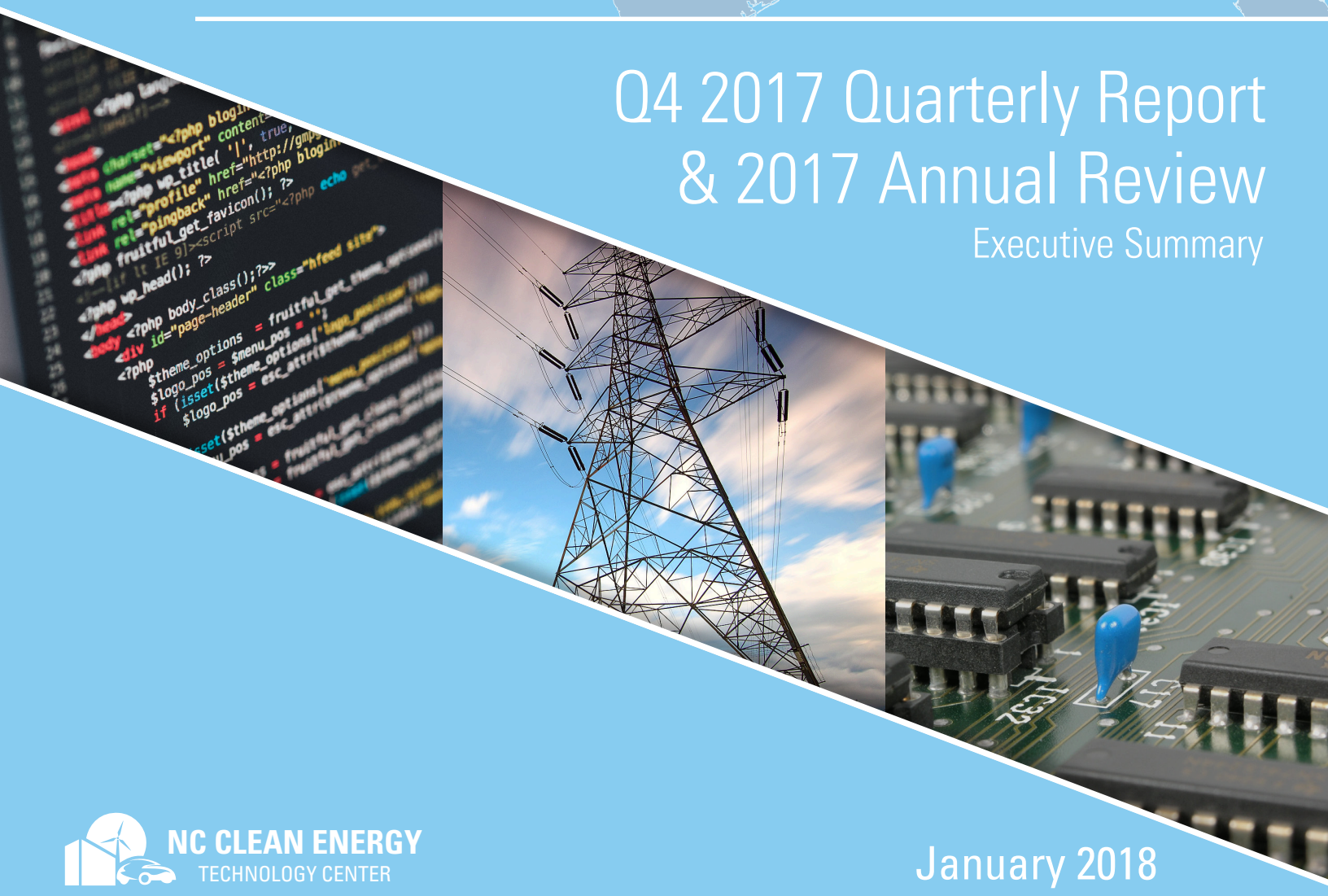
50 States of GRID MODERNIZATION

Q4 2017 Quarterly Report & 2017 Annual Review

Executive Summary



NC CLEAN ENERGY TECHNOLOGY CENTER

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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.

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PREFERRED CITATION

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Previous editions of *The 50 States of Grid Modernization* are available for download at www.nccleantech.ncsu.edu/the-50-states-reports/ or by clicking here:

- Q3 2017: Full Report | Executive Summary
- Q2 2017: Full Report | Executive Summary
- Q1 2017: Full Report | Executive Summary

In addition to *The 50 States of Grid Modernization*, the NC Clean Energy Technology Center publishes a quarterly report called *The 50 States of Solar*. Previous editions of *The 50 States of Solar* are available for download at www.nccleantech.ncsu.edu/the-50-states-reports/ or by clicking below. Full versions may be purchased at https://commerce.cashnet.com/NCSU-NCCETC.

- Q4 2017 and 2017 Policy Review – Executive Summary
- Q3 2017 Executive Summary
- Q2 2017 Executive Summary
- Q1 2017 Executive Summary
- Q4 2016 and 2016 Policy Review – Executive Summary
- Q3 2016 Executive Summary
- Q2 2016
- Q1 2016
- Q4 2015 and 2015 Policy Review
- Q3 2015
- Q2 2015
- Q1 2015
- Q4 2014

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 deployment of 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.

Time-varying rate 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.

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 advanced 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 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. While actions taken by municipal utilities and electric cooperatives are not comprehensively tracked in this report, particularly noteworthy or high-impact actions will be covered. The report also excludes changes to policies and rate design for distributed generation customers and changes related to electric vehicles; these changes are covered in the 50 States of Solar and 50 States of Electric Vehicles quarterly reports, respectively.

EXECUTIVE SUMMARY

2017 GRID MODERNIZATION ACTION

In 2017, 39 states plus DC took a total of 288 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 288 actions catalogued, the most common were related to deployment (63), followed by policies (61), and planning and market access (45).

Table 1. 2017 Summary of Grid Modernization Actions

Type of Action	# of Actions	% by Type	# of States
Deployment	63	22%	29
Policies	61	21%	26 + DC
Planning and Market Access	45	15%	18 (+ 5 RTOs)
Studies and Investigations	44	15%	24 + DC
Business Model and Rate Reform	40	14%	17 + DC
Financial Incentives	35	13%	14
Total	**288**	**100%**	**39 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 2017

Ten states taking the greatest number of actions related to grid modernization, or some of the most impactful actions, are noted below.

New York

New York's Reforming the Energy Vision proceeding, which continued throughout 2017, addresses many different aspects of grid modernization, including distribution system planning, non-wires alternatives, and storage compensation rules. The Governor signed into law a bill creating an energy storage target, as well as a property tax exemption for electric energy storage.

California

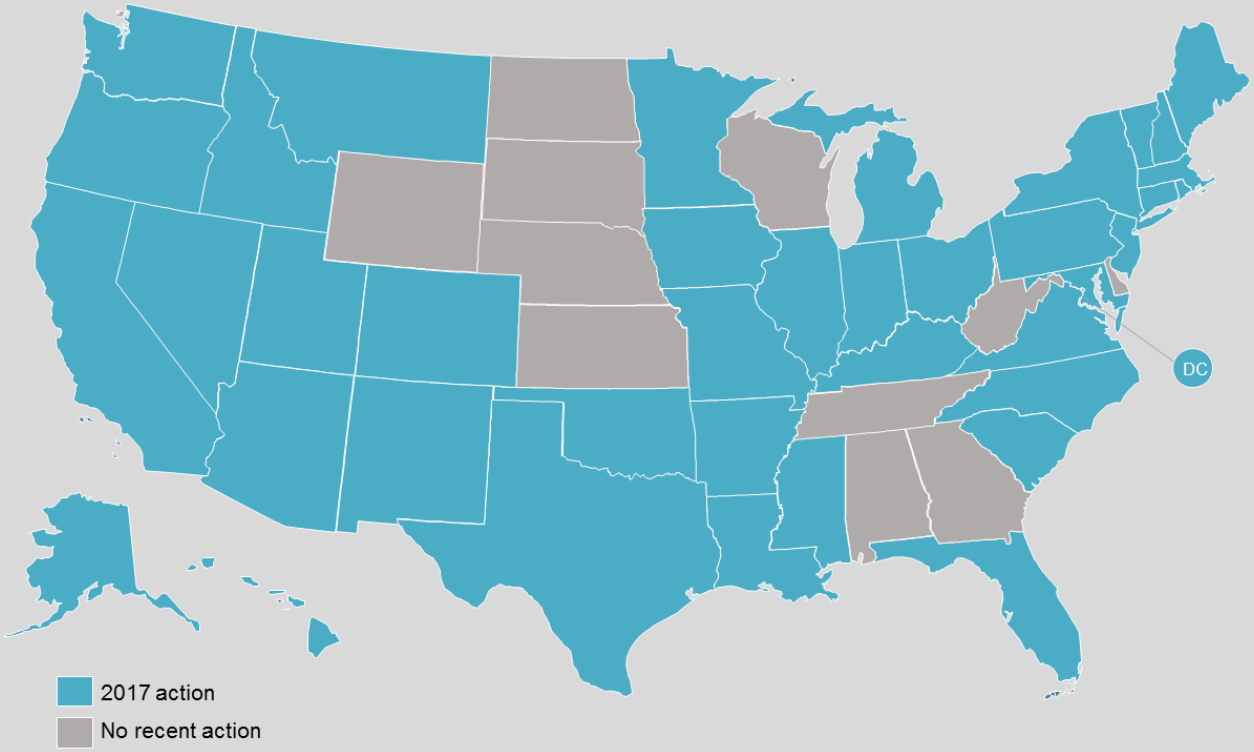
California regulators addressed distribution system planning, the state's energy storage target, a grid modernization investment proposal from Southern California Edison, and several other

topics during 2017. Modifications were made to the state's Self-Generation Incentive Program, and stakeholders worked with the California Independent System Operator to address rules for demand response and storage participation in the wholesale market.

Rhode Island

The state of Rhode Island initiated its Power Sector Transformation Initiative in 2017, an expansive grid modernization proceeding addressing several topics, including data access, distribution system planning, utility business models, and transportation electrification. National Grid filed its Power Sector Transformation investment plan later in 2017. The state also addressed evaluation of non-wires alternatives and solar-plus-storage compensation.

Figure 1. 2017 Legislative and Regulatory Action on Grid Modernization



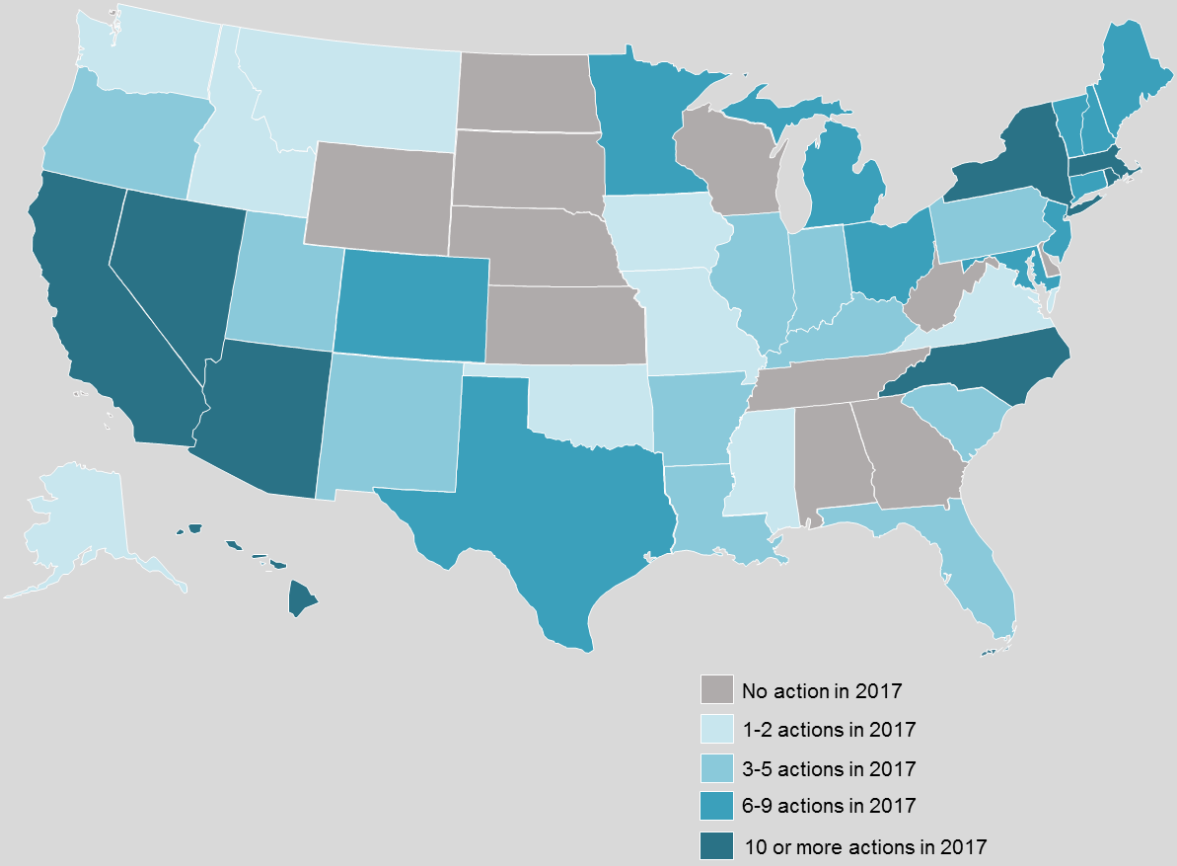
Hawaii

Regulators considered a grid modernization proposal from Hawaii's three investor-owned utilities in 2017, as demand response and energy storage proposals. The Public Utilities Commission also addressed compensation for solar-plus-storage systems, and a study of alternative utility regulatory models is underway. Several bills were under consideration during the year, including legislation to create an energy storage tax credit and facilitate microgrid development.

Maryland

The Maryland Public Service Commission continued with its broad grid modernization proceeding in 2017, addressing several topics, including data access, electric vehicles, energy storage, interconnection, and rate design. The state legislature also initiated an energy storage study and adopted the nation's first state tax credit for energy storage systems.

Figure 2. 2017 Grid Modernization Activity, by Number of Actions



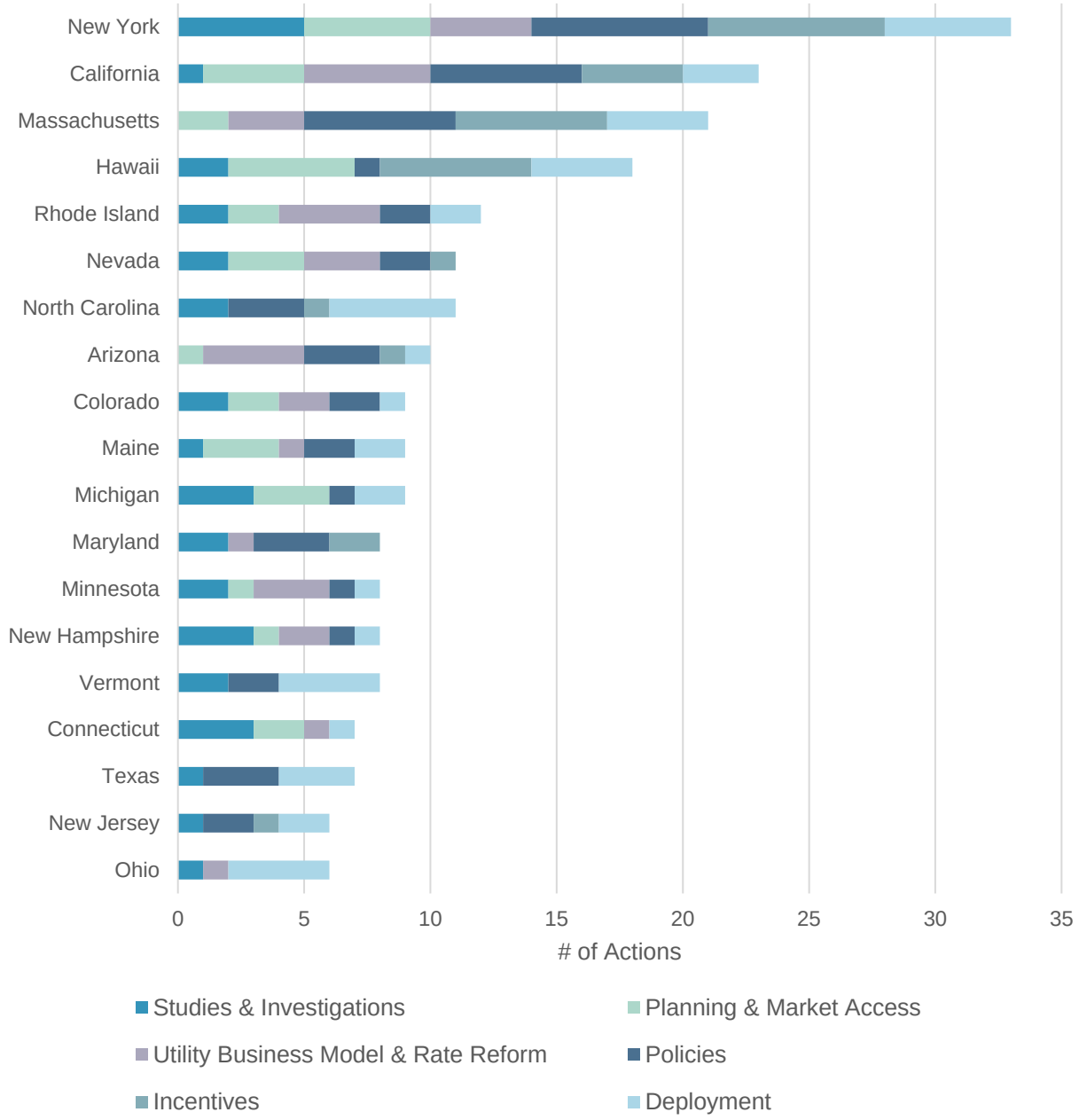
Massachusetts

Massachusetts regulators established an energy storage target, addressed compensation rules for solar-plus-storage, and considered grid modernization investment proposals from all three investor-owned utilities in 2017. Several bills were introduced during the year that would create new incentives for energy storage, grid modernization planning processes, and rate design guidelines.

Michigan

Pursuant to legislation enacted in late 2016, the Michigan Public Service Commission undertook a number of grid modernization activities in 2017, including studies addressing demand response, alternative utility business models, and solar-plus-storage compensation. The Commission also addressed integrated resource planning rules, and two utilities – Consumers Energy and DTE Electric – filed draft grid modernization investment proposals.

Figure 3. Most Active States of 2017



Nevada

In 2017, the Nevada state legislature enacted legislation creating an energy storage incentive program and initiating an energy storage study to consider whether or not the state should adopt an energy storage procurement target. Voters and regulators are considering restructuring of the state's electric industry in advance of a second ballot vote, and integrated resource planning and time-varying electricity rates were also addressed during the year.

Vermont

The Vermont Public Utility Commission opened a broad investigatory proceeding in 2017, addressing grid modernization and utility business models. The state's Department of Public Service also published an energy storage study and policy recommendations, as directed by Act 53. Green Mountain Power filed applications for approval of three energy storage projects during the year and announced a new program to deploy battery storage systems at customer homes.

Arizona

Arizona regulators issued a decision requiring Arizona Public Service to consider energy storage options in integrated resource planning and as alternatives to transmission and distribution investments. Regulators also considered special rate tariffs for energy storage owners, residential time-varying electricity rates, interconnection rules for energy storage systems, and adoption of a clean peak standard.

Honorable Mention: North Carolina

The North Carolina state legislature initiated an energy storage study in 2017, while the Utilities Commission considered interconnection rules for emerging technologies and data access rules. Duke Energy announced plans for a $13 billion grid investment package, which includes AMI and self-optimization investments, and received approval to develop a microgrid in western North Carolina.

TOP GRID MODERNIZATION TRENDS OF 2017

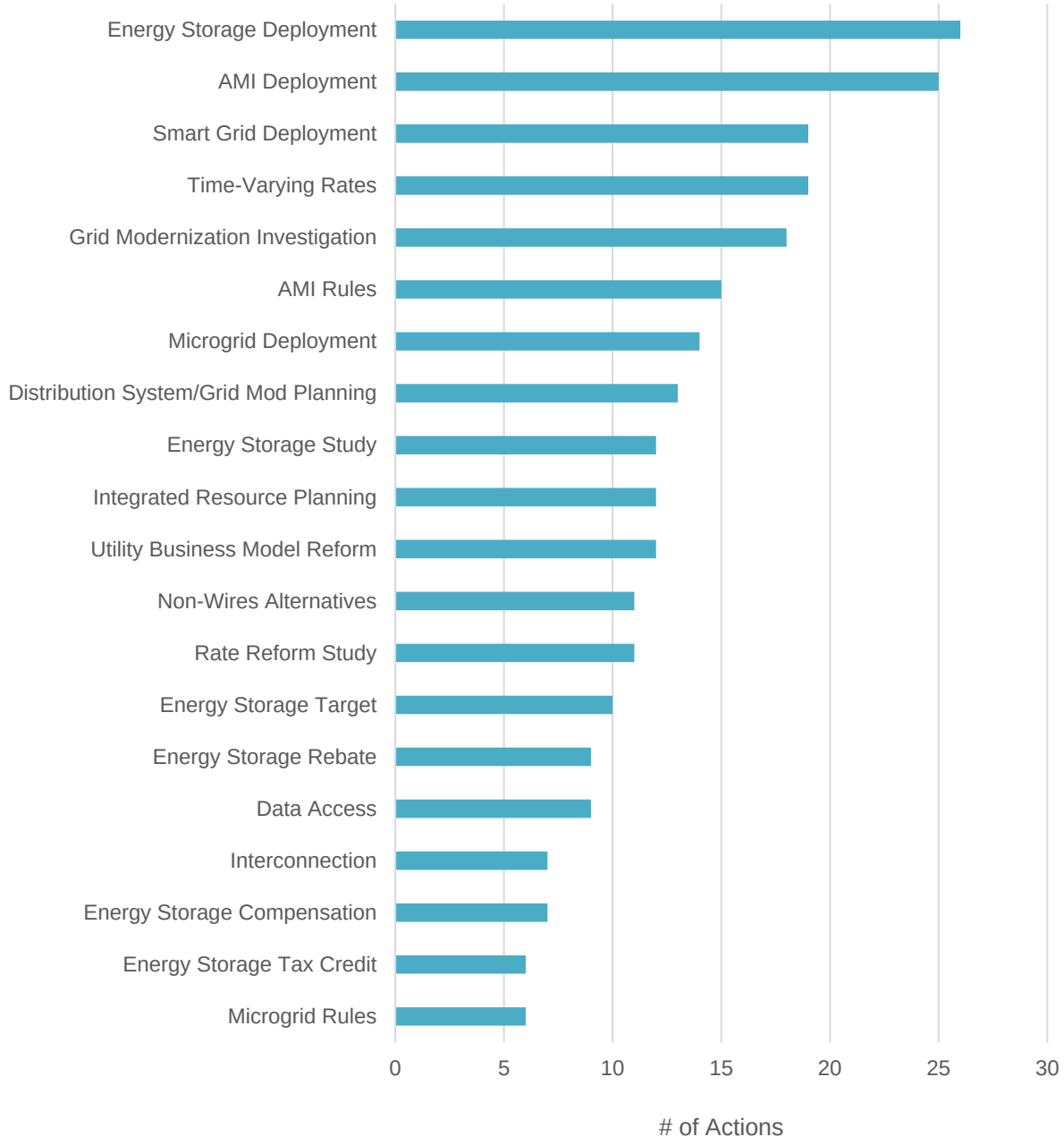
States Taking Diverse Approaches to Grid Modernization

Throughout 2017, states took a wide variety of approaches to grid modernization. Some states focused heavily on studies, while others took greater action on deployment and pilot projects, took several different types of action. Furthermore, some states placed a greater emphasis on technology, while others keyed in on policy or rate design. In line with a trend toward comprehensive approaches, many states considered technology, policy, rate design and utility business model reforms simultaneously.

Gathering Information through Studies and Pilots

A major trend present throughout 2017 was that of states and utilities working to gather information on various aspects of grid modernization through studies, investigations, and pilot projects. Studies and investigations were undertaken on both broad and narrow topics during the year, while most pilot projects related to time-varying rates or deployment of energy storage and microgrids.

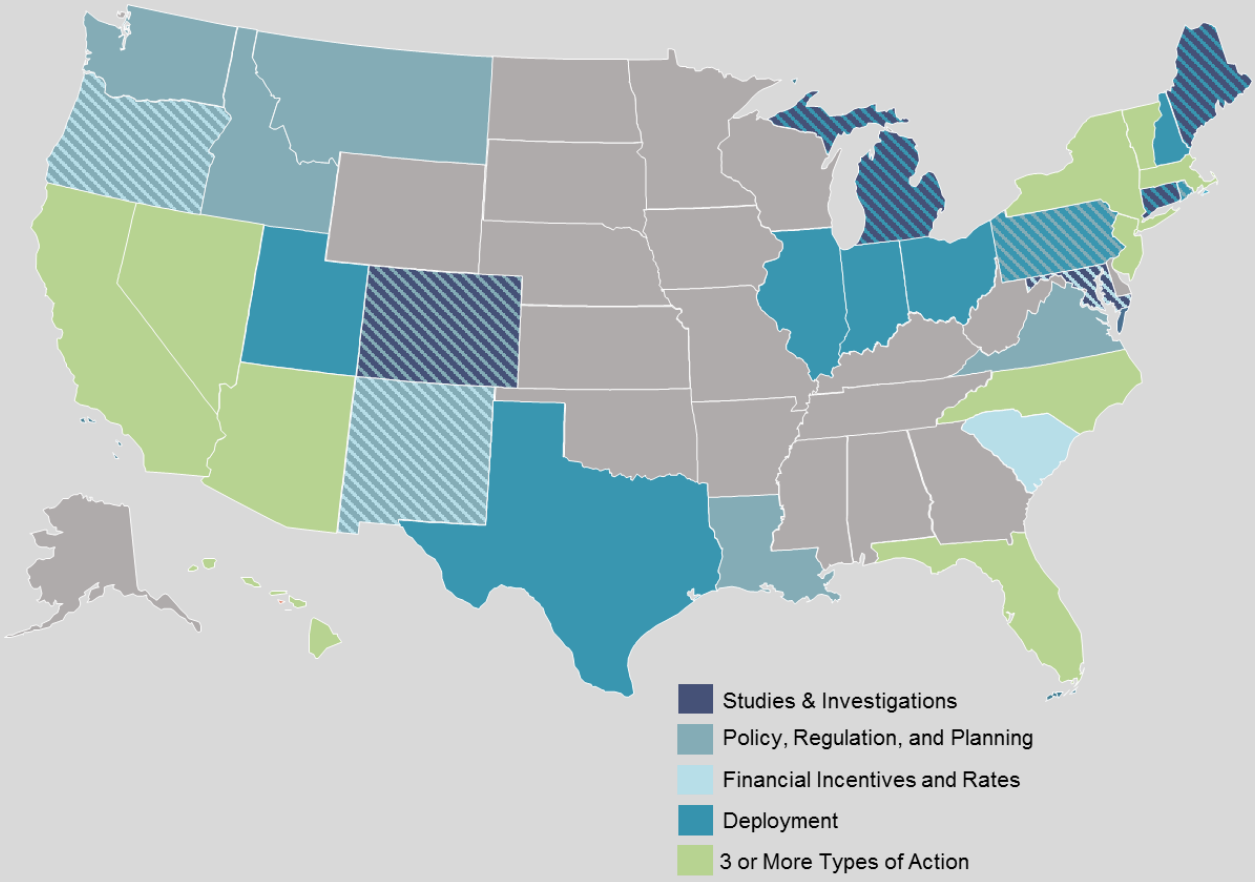
Figure 4. Top Grid Modernization Actions of 2017



Energy Storage Taking Focus

As 2017 progressed, state and utility action related to energy storage climbed. At least 31 states took actions related to energy storage during the year. A wide variety of actions were taken, including conducting studies, amending resource planning and interconnection rules, considering incentives for storage systems, adopting procurement targets, and deploying storage facilities.

Figure 5. 2017 Energy Storage Action, by Type of Action



Comprehensive and Coordinated Approaches to Grid Modernization

Several states – including Illinois, Ohio, Rhode Island, and Vermont – initiated broad proceedings in 2017, addressing many different elements of grid modernization in a coordinated fashion. Similar proceedings also continued in Maryland, New Hampshire, and New York. A common element of these comprehensive approaches is stakeholder engagement, with working groups and workshops frequently utilized.

Evaluating Storage as Part of Integrated Resource Planning

A growing trend among states is consideration of the way in which energy storage is evaluated within the integrated resource planning process. Regulators in New Mexico and Washington amended statewide integrated resource planning rules to require the evaluation of storage alternatives, while regulators adopted similar rules for individual utilities in Arizona and Louisiana.

Rate Reforms Center on Time-Varying Rates

In 2017, time-varying electricity rates was by far the most frequently considered type of utility rate reform. Policymakers and regulators in 11 states took statewide action related to time-varying rates, or considered utility proposals related to default or mandatory time-varying rates. Time-varying rates were also considered as part of tariffs designed specifically for battery storage owners.

Questions Emerge Over Utility and Third-Party Technology Ownership

In several states, questions related to technology ownership were considered. In Maine and Texas, utility requests to own microgrid (including a solar PV array and battery storage system) and battery storage assets, respectively, came into focus as regulators considered whether the utilities (both in restructured states) are permitted to own these assets. In Arkansas, the Public Service Commission is considering utility ownership versus third-party ownership of DERs as part of a generic proceeding on DERs and data access.

Grid Modernization Investment Costs Often a Point of Contention

In several proceedings considering utility grid modernization investment proposals, the issue of cost became a major point of contention among parties during 2017. In Hawaii, regulators directed the utilities to revise their original plan because of its high cost, while plans in California and North Carolina have also received criticism over cost and which specific investments should be prioritized.

Q4 2017 GRID MODERNIZATION ACTION

In the fourth quarter of 2017, 35 states plus DC took a total of 196 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 196 actions catalogued, the most common were related to deployment (41) and policies (41), followed by studies and investigations (39).

Table 2. Q4 2017 Summary of Grid Modernization Actions

Type of Action	# of Actions	% by Type	# of States
Deployment	41	21%	25
Policies	41	21%	23 + DC
Studies and Investigations	39	19%	23 + DC
Planning and Market Access	31	15%	14 (+ 5 RTOs)
Business Model and Rate Reform	27	15%	12
Financial Incentives	17	9%	7
Total	**196**	**100%**	**35 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 2017

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

New York Enacts Legislation Creating an Energy Storage Target

New York became the fourth state, following California, Oregon, and Massachusetts, to adopt an energy storage procurement target with the signing of A.B. 6571 in November 2017. The bill directs the Public Service Commission to establish a specific target that is to be achieved by 2030. In early January 2018, the Governor also announced $260 million in funding to reach 1,500 MW of storage deployment.

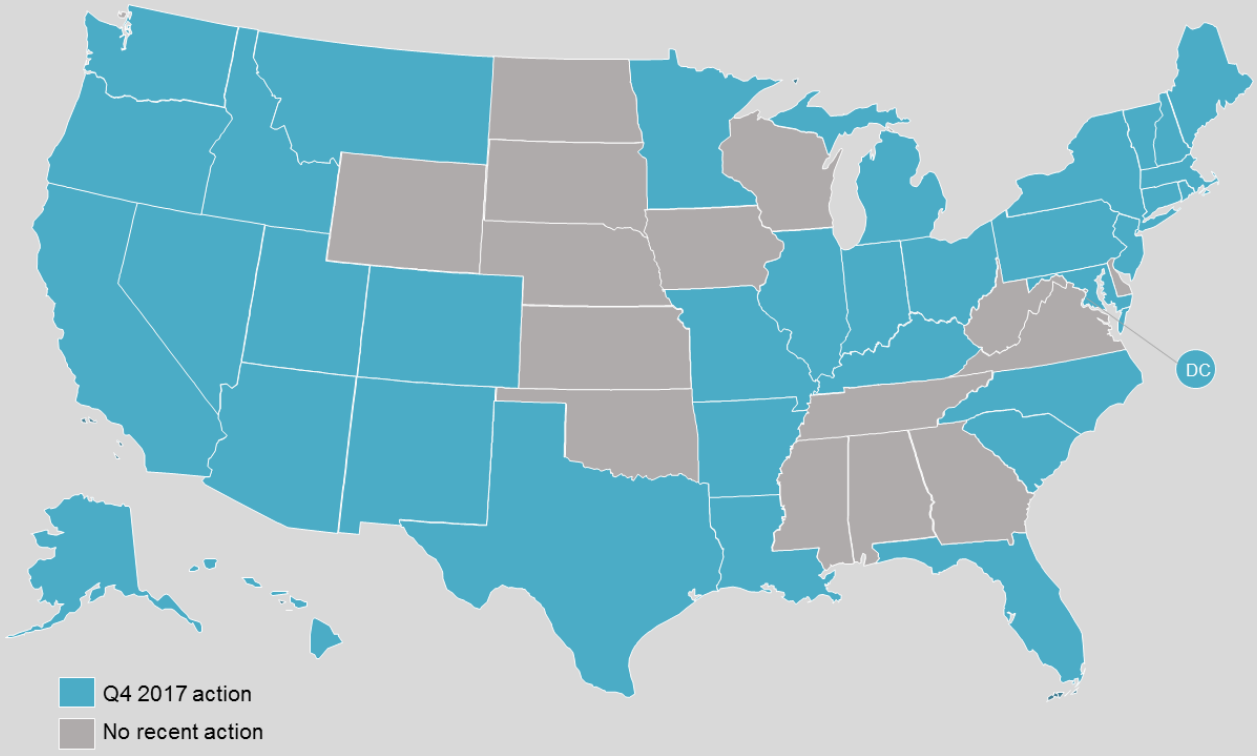
Rhode Island Power Sector Transformation Initiative Phase One Report Published, and National Grid Investment Plan Filed

Rhode Island's Power Sector Transformation Initiative Phase One Report was published in November 2017, outlining goals and recommendations for the future of the state's electricity system. The report address four major topics: utility business model reform, grid connectivity and advanced metering, distribution system planning, and beneficial electrification. Later in November, National Grid filed for approval of its Power Sector Transformation investment plan, which is intended to implement certain goals of the Initiative.

Vermont Department of Public Service Publishes Energy Storage Study

The Vermont Department of Public Service published its final energy storage study in November 2017, as directed by legislation enacted earlier in the year. The study included many policy recommendations, including analyzing storage options within integrated resource planning and developing cost-benefit methodologies. Notably, the study recommended against adoption of an energy storage procurement target at this time.

Figure 6. Q4 2017 Legislative and Regulatory Action on Grid Modernization



Colorado and Connecticut Regulators Open Distribution System Planning Investigations

The Colorado Public Utilities Commission opened a proceeding in October 2017 to examine several different topics and serve as a pre-rulemaking on distribution resource planning, where stakeholders may submit proposed rules. In Connecticut, regulators opened an investigatory proceeding in November 2017 to examine distribution system planning and rate design issues.

Arkansas Public Service Commission Begins Examining Data Access Issues

In November 2017, the Arkansas Public Service Commission expanded a generic proceeding addressing renewable distributed generation to evaluate all distributed energy resources, as

well as several specific questions related to data access. This action comes on the heels of the Commission's approval of Entergy Arkansas' request to deploy advanced metering infrastructure throughout its service territory.

MOST ACTIVE STATES AND SUBTOPICS OF Q4 2017

The most common types of actions across the country related to energy storage deployment (19), followed by grid modernization investigations (16), smart grid deployment (16), and advanced metering infrastructure deployment (15). Notably, energy storage deployment has displaced advanced metering infrastructure deployment as the most common type of action taken for the first time this year.

The states taking the greatest number of actions related to grid modernization in Q4 2017 can be seen in Figure 8. New York, Massachusetts, and California continued to see the most action during the quarter, followed by Rhode Island, Michigan, and Nevada. New York and California were the only states to take action in all six categories during Q4 2017.

Figure 7. Most Common Types of Actions Taken in Q4 2017

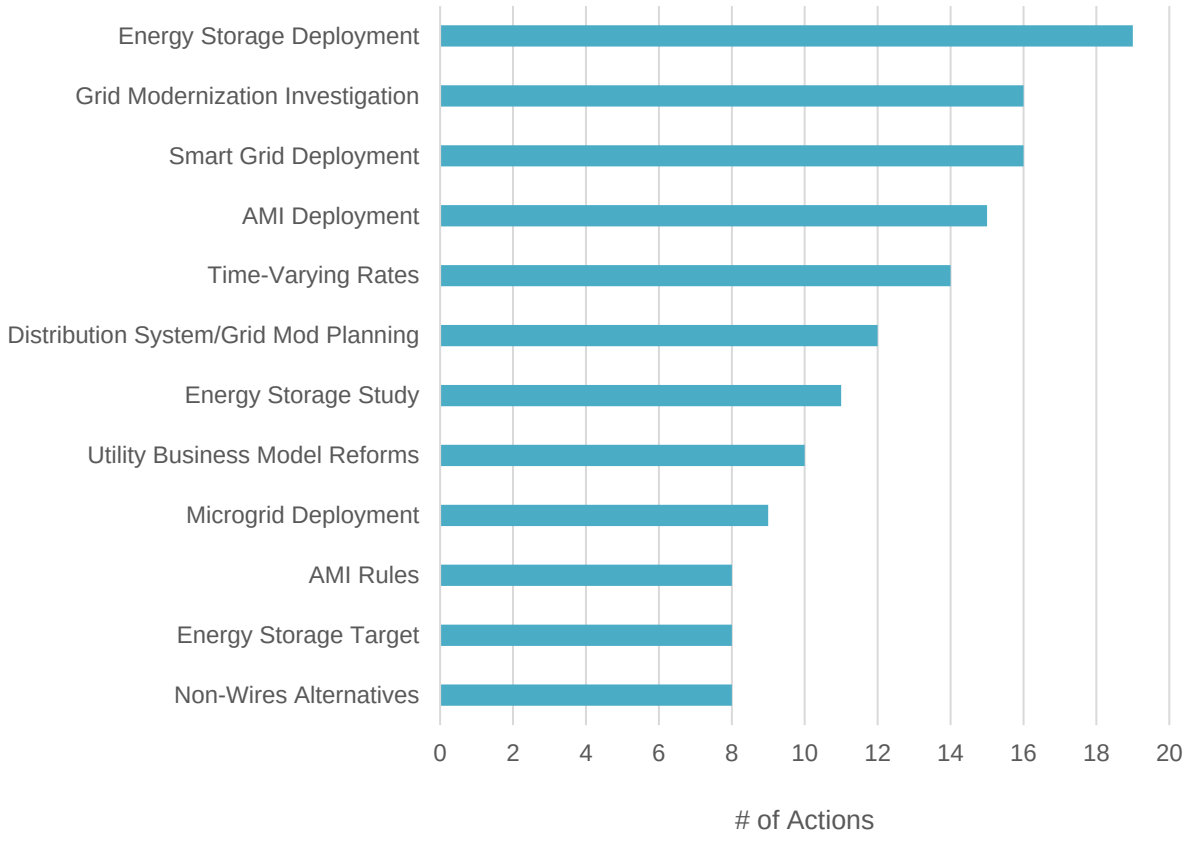
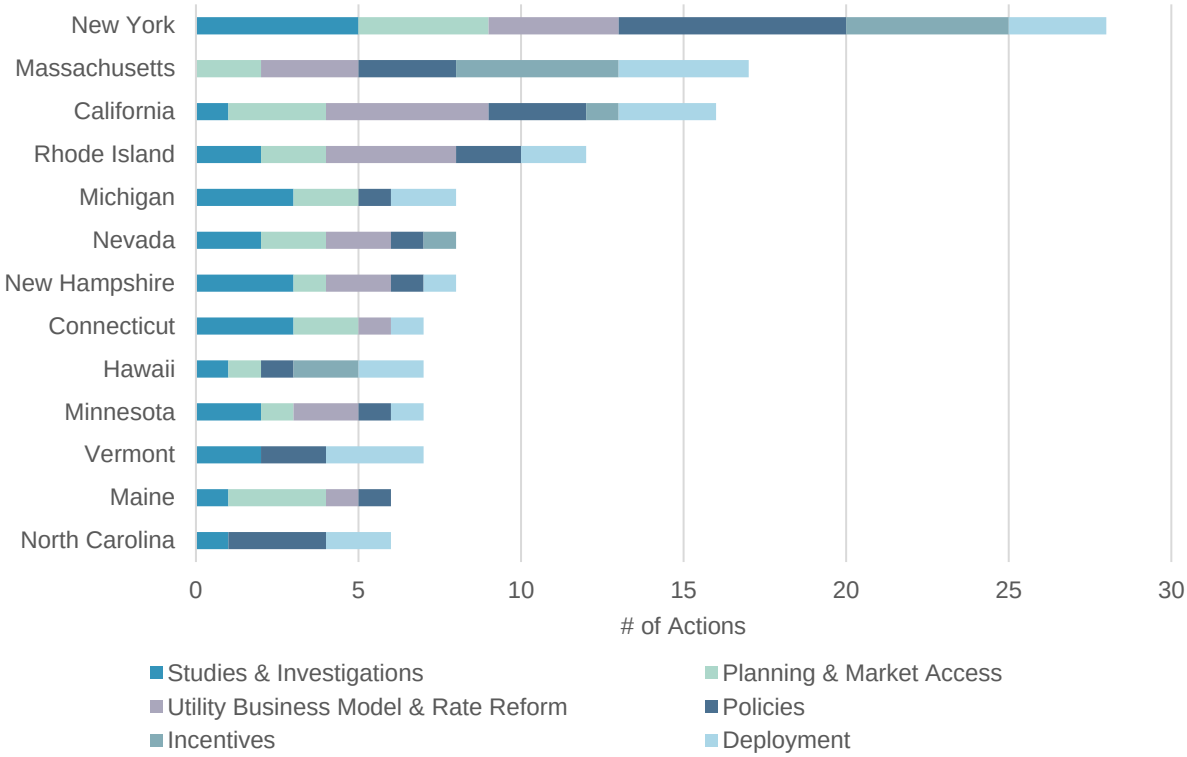


Figure 8. Most Active States of Q4 2017



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
- Summary maps of action for each policy category above, including a separate Powerpoint file of all summary maps
- 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, saving weeks and thousands of dollars in staff time. At a cost of $500 per issue (or $1,600 annually), the 50 States of Grid Modernization offers an significant time and financial savings. With direct links to original sources for all actions, customers may stay on top of legislative and regulatory developments between quarterly reports.

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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

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