Grid Modernization Index 2018

Key Indicators for a Changing Electric Grid

GRIDWISE ALLIANCE

E9 insight

About Gridwise Alliance

The GridWise Alliance (GridWise) and our members believe that the electric grid and its supporting infrastructure is the foundational component of an advanced digital economy. Our goal is to champion the principal concepts, policies, and investments needed to transform the electricity grid and accelerate the prudent changes required to maintain the grid's essential role in a robust economy.

GridWise uniquely serves the electricity industry by leveraging diverse stakeholder perspectives to articulate the numerous benefits of grid modernization. GridWise helps create a common understanding of the numerous and transformational operations-focused and policy-related changes taking place across the electricity industry. Our work ensures that emerging policy is aligned with industry best practices to facilitate effective and widespread change.

For more information, please visit www.gridwise.org.

About E9 Insight

E9 Insight brings visibility and insight to regulatory activities that most professionals find opaque and complicated. E9 Insight offers timely and comprehensive research into new and ongoing activities at regulatory commissions and other policy initiatives across the 50 states. Using a custom database, E9 Insight provides companies, investors, philanthropies, and government agencies with curated information allowing more informed business and advocacy strategies.

For more information, please visit www.e9insight.com .

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DISCLAIMER:

The state rankings included in the GridWise Alliance's Grid Modernization Index (GMI) were developed based on publicly available information regarding state energy policies, utility programs and technology deployments, and electric grid operations. In addition to stakeholder responses, interviews with regulators, policy makers, and utility operations personnel were also used in the process of finalizing state rankings. The final state rankings reflect a summary of the inputs collected and are not intended to prescribe specific policy initiatives or grid modernization investment strategies.

At a Glance

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Foreword

Rate of Change Continues to Increase

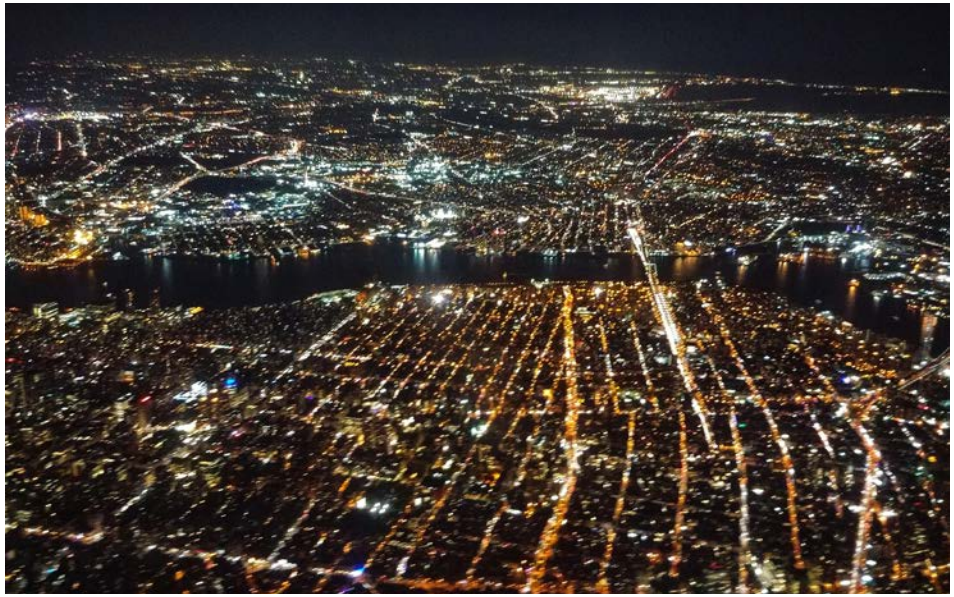
On behalf of the members and staff of the GridWise Alliance, I am pleased to provide the **Grid Modernization Index 2018** for the electricity industry and its many stakeholders. This is the 5th update of the GMI that we've published, and we plan to publish a similar update annually going forward. I've spoken to dozens of stakeholders from many states this past year and appreciate the overwhelmingly positive feedback and support that we've received.

As the GridWise Alliance celebrates its 15-year anniversary, I am truly amazed at the changes taking place across the industry. Concepts that we discussed back in 2003 as long-term goals are now a reality in many parts of the country. Customers have access to data and tools that allow them to manage their energy use and cost while supporting more effective grid operations. Power is typically restored to customers much more quickly after an outage occurs thanks to faster and more accurate data, along with equipment that automatically responds to these interruptions. Customers are increasingly choosing to install their own energy systems and connect them to the grid and grid operators are modifying their own systems to accommodate these distributed resources, creating a more flexible and resilient grid.

Today, most states and most utilities are actively exploring options for modernizing their electric grid. Even states that score low in our index are beginning to explore how to modernize their grids. It's no longer an option, but a necessity. However, we also appreciate, more and more, the difficulty of changes taking place, as well as the unique opportunities and challenges being faced by each state.

GMI-2018 provides an overview of the changes taking place across the country by evaluating progress in each state. I trust that you as a stakeholder will use this information as intended to stimulate our collective thinking and encourage further prudent and positive change.

Steve Hauser, CEO, The GridWise Alliance.

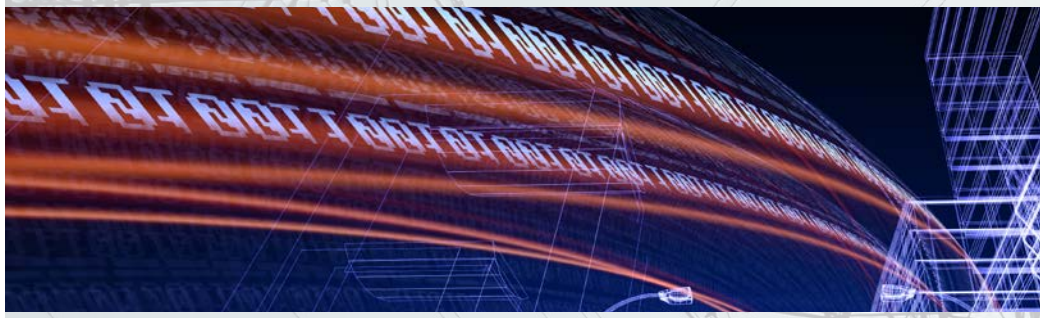


About GMI-2018

The GridWise Alliance's Grid Modernization Index (GMI) assesses and evaluates all 50 states and the District of Columbia (DC) based upon their progress in modernizing their state's electric grid. Using data inputs from key industry stakeholders and publicly available information, the GMI benchmarks each state on a wide range of factors that influence grid modernization policies, investments, and accomplishments.

The first GMI Report was released in 2013, with updated editions appearing in 2014, 2016, and 2017. Now in its fifth iteration, GMI-2018, following the structure of the previous versions, assesses the states on factors in three broad categories:

1. **STATE SUPPORT**, which is based on plans and policies that support grid modernization;
2. **CUSTOMER ENGAGEMENT**, which evaluates states on their rate structures, customer outreach, and data collection practices;
3. **GRID OPERATIONS**, which benchmarks the deployment of grid modernization technologies such as sensors and smart meters.



More than 75 metrics are examined across these three categories. Scores are assigned to each metric and totaled to create a score for each state in each of the three categories. The possible point totals are 32 for State Support, 31 for Customer Engagement and 37 for Grid Operations.

Diverse Approaches Strive For Common Outcomes

While grid modernization commonly strives to incorporate innovative new technologies into the electric system, how these efforts manifest from state to state varies widely. And that's appropriate, because each state is unique in its policies, demographics, regulatory structure, and market design. Because each state is unique, how grid modernization manifests will necessarily vary from state to state. Certainly, there are easy to identify parameters such as overall size and whether the state has restructured its wholesale or retail markets to support increased competition. But there are also subtle factors such as the dynamic between the legislature and the regulatory commission. Therefore, to the extent possible, GMI looks at each state in the context of the particular constraints and opportunities as they exist in each market.

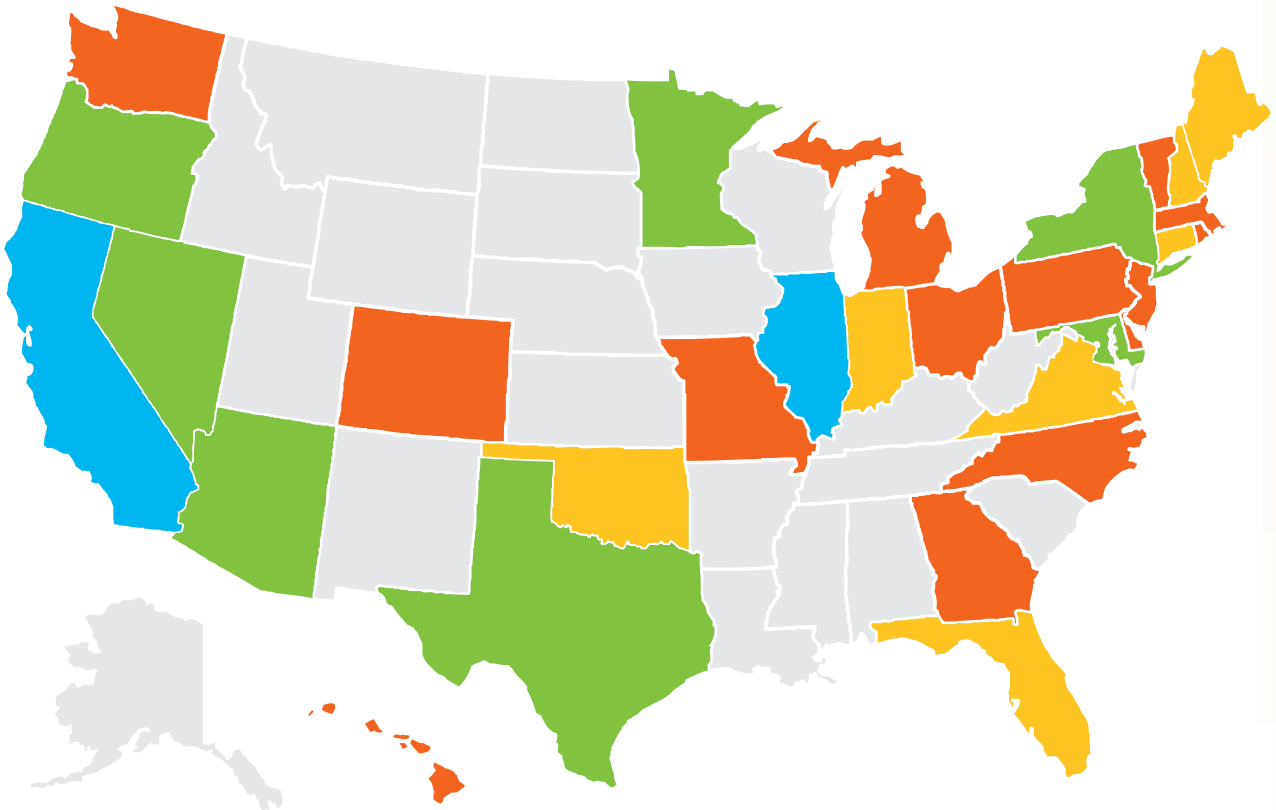
To be sure, modernizing the grid includes making core improvements to the physical infrastructure, such as more efficient equipment and systems that enable multi-directional flows of energy and voltage management to support increasing distributed energy resources. But modernizing the grid includes the policy landscape as much as the physical systems, which are inextricably linked to efforts coming from state legislatures, public utility commissions regulating investor-owned utilities, and independent governing boards overseeing public and cooperative utilities. Not surprisingly, there is near unanimity about what consumers want – affordable, reliable, and clean power. The challenge lies in how those terms are defined and how the benefits of the desired changes are measured.

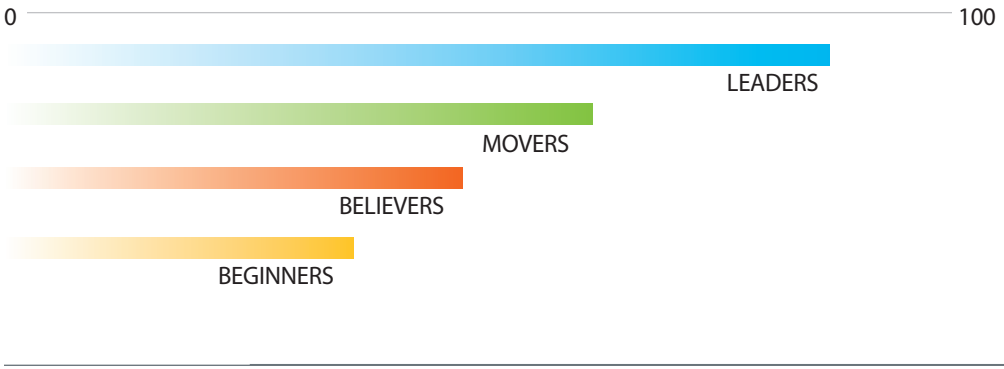
What then become the drivers and key objectives for "grid modernization?" In this regard, "success" in grid modernization may be as much a measure of how new business models are enabled as a measure of how the traditional business models are improved. Lower operating costs and higher asset utilization will drive energy affordability, but other benefits such as enabling customer choice, new technology adoption, and new service offerings are also key benefits of grid modernization.

Improved reliability drives increased automation and more real-time communication, not only with field crews, but also directly with customers. However, the path to reach higher reliability is different in Texas or Florida than in New Mexico or Iowa. Data centers, for example, require a much different solution to reliability than restaurants and retails stores. Hence, this diversity in grid modernization is not only expected but, in fact, necessary.

A modern grid will also strive to reduce impacts the electricity system has on the environment. It will provide innovative new approaches to increase the overall efficiency of the grid, actively identifying opportunities for customers to reduce their energy consumption as well as increase the efficiency of transmission and distribution equipment. A modern grid will also accommodate rapidly increasing clean technologies including solar, wind, and electrified transportation. The later adding significant new load to the system over the next decade and beyond.

The GridWise Alliance challenges state and local governments, public and private utilities, and other key stakeholders to take a holistic view of the need for modernizing the grid and continue to implement changes that create a grid that meets our future needs.





RANK	STATE		
1	California	82	LEADERS
2	Illinois	77	
3	Maryland	62	MOVERS
4	Arizona	60	
5	Oregon	58	
6	Texas	57	
7	New York	54	
8	Nevada	51	
8	District of Columbia	51	
10	Minnesota	50	
11	Michigan	48	BELIEVERS
11	Massachusetts	48	
11	Georgia	48	
11	Colorado	48	
15	Hawaii	47	
16	Delaware	46	
17	Pennsylvania	45	
18	Ohio	44	
19	Rhode Island	43	
20	Vermont	42	
20	Missouri	42	
22	Washington	41	
23	North Carolina	40	
24	New Jersey	37	
25	Virginia	32	BEGINNERS
26	Maine	29	
26	Oklahoma	29	
26	Connecticut	29	
29	Florida	27	
29	Indiana	27	
29	New Hampshire	27	
32	Louisiana	24	
32	Idaho	24	
34	Arkansas	23	
34	South Carolina	23	
36	Mississippi	21	
36	Alabama	21	
38	West Virginia	19	
39	Wisconsin	15	
40	Kansas	14	
41	Tennessee	13	
42	Wyoming	12	
42	Kentucky	12	
44	New Mexico	11	
45	Iowa	11	
46	Utah	10	
47	Alaska	10	
48	South Dakota	9	
49	Nebraska	8	
50	Montana	6	
51	North Dakota	3	

States Are Making Substantial Progress

We are pleased that GMI-2018 indicates that most states across the country are increasing their efforts to modernize their grids. Thirty states provided data this year with almost all of them showing an increase in their scores from last year.

Given the multiple criteria that can be applied, GMI focuses the analysis on developing an "index," rather than a "ranking." That is, it is less focused on comparing one state against another, but rather on comparing each state to what its fullest potential might be – expressed in coordinated activities that span across legislation, state policy, customer engagement, and technology deployment. Increasingly, grid modernization is less about specific devices or equipment and more about how the pieces fit together to create a system capable of transforming the traditional grid and the way that customers interact with it.

Our evaluation relies on certain guiding questions: What requirements has the state established regarding grid planning? Are there policies that encourage distributed energy? What data are available to consumers about their energy use? What data are available to other service providers about how the distribution system operates? Are utility investments being planned with an eye toward enabling new services? Or, are those investments merely using new tools to deliver the same service?

Rarely do these questions, and others being used, have straightforward answers. However, overall progress toward a more modern grid is most easily understood when described in clusters of states with similar scores reflective of both the specific actions in each state and also the degree to which those actions are aligned with the desired outcomes. These clusters are shown in the map on page 7, color coded and matched to the overall scores.

TWO STATES CONTINUE TO BE OUT FRONT (THE LEADERS)

Two states stand out for their coordination of policy, consumer and utility action: California and Illinois. Both have established legislative mandates and incentives that are driving utility action and have established technology platforms – such as advanced metering infrastructure – that provide direct consumer benefits. But beyond that, both states have proactively sought to establish policy frameworks that address the access, usage, and protection of customer data. In Illinois, the Future Energy Jobs Act established numerous requirements and incentives for renewable energy, storage, long-term planning, and energy efficiency, including peak demand reduction. Earlier this year, the Illinois Commerce Commission (ICC) issued a ground-breaking order to establish regulatory accounting treatment for cloud-based computing solutions, seen by many observers as a key pathway to move toward a service orientation (versus the traditional infrastructure focus core to most regulatory regimes). California, through its legislative public utility commission and other state agencies, has been a grid modernization pioneer. The utilities in the state have responded in kind, implementing distribution system planning processes, competitive solicitations for distributed energy, non-wires alternatives and new rate designs. Together, these "leaders" represent a bit more than 15 percent of the total U.S. electricity revenue.

California

California continues to be the grid modernization trailblazer recently, instituting distribution system planning requirements and many other leading grid modernization efforts. Most recently, California's SB 100 accelerated its Renewable Portfolio Standard to achieve a 60 percent target by 2030 and a 100 percent renewable and zero-carbon resource target by 2045. Senate Bill 350 codified California's goal of doubling energy efficiency across the state, with rolling demand-side management portfolios and demand response auction mechanisms. California uses a multi-pronged approach to support distributed energy

resources (DER), including competitive solicitations, multiple DER demo projects, a self-generation incentive program, a net metering tariff, and an energy storage target and default TOU rates. California has also reformed some aspects of utility business models, prioritizing third-party engagement, and customer choice.

Illinois

Illinois continues to implement instruments of a modernized grid. The ICC hosted NextGrid working groups—releasing preliminary drafts and reports in 2018, offering guidance on regulatory and business model reform, technology deployment and metering, and communication and customer data. Policies from the state's Future Energy Jobs Bill were also rolled out in 2018, including the Illinois Power Agency's Final Long-Term Renewable Procurement Plan, utility energy efficiency and peak demand reduction plans, and additional instruments of customer control – including smart inverter rebates for distributed generation customers. In May 2018, the ICC issued an order establishing regulatory accounting treatment for cloud-based computing solutions to integrate DER, while the commission continues to examine the topics of electric vehicles, smart utility apps, and energy storage.

EIGHT STATES SHOW SERIOUS PROGRESS (THE MOVERS)

Eight states – representing over 20 percent of U.S. electricity revenue – are clustered together representing states that have significant activity but may not reflect comprehensive or coordinated grid modernization or they may be in the early stages of implementing regulatory and policy changes. Many of these states have been active for many years emphasizing specific policies and programs. Arizona, for example, has been reviewing resource planning rule changes and has a strong foundation of advanced metering infrastructure. However, high-profile political battles at the Commission and across the state have limited a coordinated approach. Similarly, Maryland has launched an ongoing investigation focused on transforming the distribution system, including rate design, electric vehicles, competitive markets, interconnection, storage, and distribution system planning. All of these activities complement a strong foundation of advanced meters. New York, often heralded for the ambitious nature of their "Reforming the Energy Vision" initiative, has led efforts to move toward new rate structures and performance-based incentives for utilities, but progress has slowed primarily due to from leadership changes at the Commission. At the same time, utilities in the state have led innovative procurements of non-wires alternatives, such as the Brooklyn/Queens Demand Management (BQDM) program. Other states in this group – Oregon, Texas, Nevada, Minnesota, and the District of Columbia – have similar combinations of promising activities that we look forward to seeing develop more fully in the years ahead.

Arizona

As Arizona progresses a wholesale review of resource planning rules, the state moves into fourth place overall. Strong commission support for grid modernization activity is rooted in customer engagement opportunities as the state is served by 77 percent advanced meter deployment, including dynamic rate schedule options. The Commission is actively considering a proposed Clean Energy Standard Rule that would include a clean peak standard to quantify existing levels of clean energy resources deployed during peak periods; incrementally increasing that baseline annually through 2030. Part of the investigation will consider the potential role of blockchain technology to facilitate transactive energy markets, tracking of renewable energy credits, and applications for distributed ledger technologies on the grid.

Maryland

Maryland has several well-established efforts pushing the state toward a modern electric grid and the state is continuing to explore further. Maryland requires distribution system planning and has deployed advanced metering infrastructure (AMI) on 72 percent of its meters and VVO on a quarter of its circuits. The Commission's ongoing process to address reliability and service quality approved riders to accelerate upgrades to the distribution system for increased grid resilience. Maryland has a well-established EE program (EmPOWER Maryland) with a robust demand response component. The Commission's ongoing investigation, Transforming Maryland's Electric Grid, addresses rate design, electric vehicles, competitive markets, interconnection, storage, and distribution system planning.

FOURTEEN STATES ARE MAKING GOOD PROGRESS (THE BELIEVERS)

Fourteen states – representing nearly one third of all retail electric revenues – have notable programs, initiatives, or regulatory action focused on grid modernization. But often these represent isolated or early efforts to move toward grid modernization. Colorado, for example, is implementing advanced metering and has proposed a compelling plan for clean energy, but is still developing a coordinated strategy. Rhode Island has engaged in a far-reaching examination of opportunities to modify business models, but is only beginning to see utility proposals that align with the new opportunities. All of the states in this group have notable initiatives or legislation, but are either in the early stages of implementation or have not yet harmonized these efforts with other policies and utility action in the state.

Colorado

Colorado has been steadily implementing grid modernization best practices. Governor Hickenlooper established a GHG goal through executive order, which in part motivated Xcel's stakeholder developed Clean Energy Portfolio (CEP) in their ERP. The CEP led to the closing of two coal units early, adding 1,100 MW of wind, 700 MW of solar, and 275 MW of storage. The commission adopted Xcel's Advanced Grid Intelligence and Security initiative, which set Xcel approved AMI, integrated volt-var optimization, and an advanced communications network. Colorado has done most of its work incrementally but has opened a stakeholder investigation into revamping ERPs and Net-metering and Distribution Resource Planning.

Rhode Island

Rhode Island has significant commitments to grid modernization through policy, which has led to efficient investments in grid modernization in the future. In 2017, Governor Raimondo initiated the Power Sector Transformation Initiative, which laid the foundation for National Grid's Power Sector Transformation (PST) Plan which was approved in August 2018. National Grid's PST includes cybersecurity, a system data portal, distribution-feeder monitoring, data system control enhancements, GIS enhancements to integrate and utilize DERs, AMI deployment beginning in 2020, and storage incentives. The commission also completed an Investigation into the Changing Distribution System that set goals, rate design principles, and a Benefit-Cost Framework for all future decisions.

SEVEN STATES ARE GETTING SERIOUS (THE BEGINNERS)

Finally, seven states – representing 15 percent of all retail electric revenues – have exhibited promising new efforts or early-stage actions to support grid modernization, but do not yet have comprehensive roadmaps or coordinated activity around grid modernization. We will continue to monitor and support these state efforts and will especially welcome their efforts to build connections between the various activities underway.

Connecticut

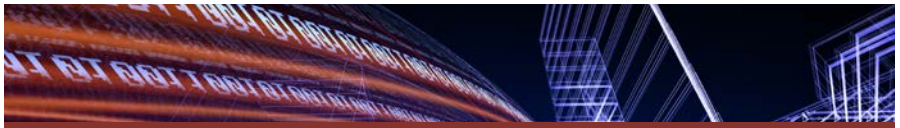
Connecticut is actively investigating the best practices of a modernized grid. With cross functional levels of legislative and regulatory support, the state is examining how to best integrate and optimize planning objectives, metrics, solutions, performance incentives, oversight, and procurement mechanisms. In 2018, Connecticut Governor Malloy signed SB-9, expanding the state RPS and launching a statewide shared clean energy program, moving the state closer to the goals established in CEEP's Comprehensive Energy Strategy (CES). In December 2017, the Public Utilities Regulatory Authority launched an investigation into distribution system planning and has since approved pilot demonstration projects for hosting capacity and analysis mapping, distributed energy load forecasting, and localized targeting of DER proposals. In 2018, Connecticut is trending up.

Virginia

In 2018, Virginia made a step towards grid modernization with the Grid Transformation Act, signed into law in March. The bill requires grid modernization plans, storage pilots, and requirements for three GW of solar and wind. In June, Dominion Energy filed its first phase of the Grid Transformation Plan to enhance the reliability, resiliency, and security of the electric distribution grid; improve service for customers; and provide them with more options for communications and control, as well as tools for managing their energy use. The plan will also facilitate the integration of distributed energy resources into the system, including full AMI deployment.

"The Rhode Island Department of Public Utilities and Carriers (DPUC) views the Grid Modernization Index as a valuable resource for collaborative learning across regulatory boundaries. This helps us solve a significant structural challenge built into the state by state regulatory infrastructure."

Macky McCleary, Administrator
Rhode Island DPUC



"The PUCO's PowerForward Roadmap is an important piece of Ohio's electricity policy, and resources like the Grid Modernization Index help us keep up to date on the latest advancements in grid mod policy."

Commissioner M. Beth Trombold, Ohio

Trends In State Policies

The State Support (SS) category ranks states on their implementation of policies and plans to advance and encourage grid modernization.

State	SS Rank	Score
California	1	29
Illinois	2	28
Ohio	3	24
New York	4	23
Hawaii	5	22
New Jersey	6	21
Arizona	6	21
Maryland	8	20
Rhode Island	8	20
Massachusetts	8	20
Minnesota	8	20

State Support Scoring Overview

California remains first in this category in GMI-2018 and Illinois returns to the top 3 after being fourth in GMI-4. Minnesota (T-8) and Ohio (3) experienced the largest point gain in State Support scoring, increasing their scores by 10 and 8 points respectively. Both of those states enter the top 10 in State Support rankings for the first time. New Jersey (T-6), Arizona (T-6), Maryland (T-8), and Rhode Island (T-8), each scored more than 4 points better in GMI-2018 than in GMI-4 showing their continuous improvement in this category.

Interesting Observations:

- In GMI-2018, the top 11 states in State Support averaged a total of 22.5 out of a possible 32 points. This is an increase of 3 points from GMI-4 (19.5-point average); and increase of 6 points from GMI-3 (16.5-point average)

No matter which of the top states are leading, the collective leading states are continuing to implement policies and push the limits of grid modernization planning.

- Eight of the top 11 states have formal plans or requirements for ESPs to provide consumer education and outreach on grid modernization benefits, yet this question had the lowest overall average score

While the top states are implementing formal plans, too many states aren't, which is leading to low scores. Thirty-eight states scored zero on this question.

- Overall, states are scoring best on their development of Energy Efficiency or Renewable Portfolio Standards

We are seeing a cascade effect, in which the leadings states are showing benefits from setting standards, and other states are starting to, and have already, followed suit. We can infer that the next cascade could, and very well should, be the development of specific plans and requirements to reach these goals.

The conversation among many state policy makers is moving into a phase that is colored more by consideration of the electric distribution system as a whole. This shift presents new challenges and opportunities. The traditional approach of cost-benefit analysis has served well for discrete technologies, but when there are now so many intertwined impacts and interactions, the evaluation tools and techniques need to adjust as well.

Responses obtained this year highlight signs of shifts toward more systems-based, as opposed to technology-specific approaches. This appears to be a trend that we expect to continue, however, each state is unique in its regulatory structure, demographics, and customer priorities. This means that there is no simple "domino theory" for how policy advances in the electric sector. Each jurisdiction of the regulated industry and each segment of the public power sector adapt policies and tools according to their particular needs. In addition, the data is more anecdotal in character than it is measurable by objective criteria.

As we look closely at what policy changes are taking place that will continue to drive grid modernization forward, there are a several notable themes that highlight a growing urgency and extensiveness in legislative and regulatory deliberations:

Storage is transforming the nature of the 'peak'

Technological changes in the past 2 decades have been truly staggering. It's sometime hard to remember a world before the iPhone. For the electric grid, the steady march of cost declines and performance improvements, first for solar, followed by storage, mean that the operating profile of the grid is changing. In the era of the "duck curve", it's become increasingly more complex to identify what "peak demand" means for grid operators – the concept around which markets have been built over the last century. Because storage can play so many roles for the grid, the challenge lies in properly valuing and incentivizing the effective deployment and use of storage. Some states are laying the foundation by developing pilot programs, like New Hampshire[1] and Oregon[2]. Many states have begun incorporating storage into the resource planning or renewable procurement processes in states like New Jersey[3], Connecticut[4], Colorado[5], and Michigan[6]. Other states such as Hawaii, California, and New York have developed tariffs aimed at valuing distributed storage.

Moving toward holistic evaluation

Regulators are trying to understand and frame how to assess the cost-benefit of grid modernization. Some regulators have chosen to invest time in creating cost benefit tools, which have aided in the evaluation of proposals. In Hawaii, regulators required HECO to scrap a Smart Grid Foundation[7] proposal because they wanted to first establish a commission driven Grid Modernization Strategy[8] cost-benefit analysis requirement. In Massachusetts' long-awaited grid modernization plans[9], the regulators decided that the utilities should move forward with many aspects of their plans, but did not pre-authorize any spending on AMI because "the anticipated benefits...do not justify the costs," although the order reiterates the goal of full deployment of AMI if and when it can be deployed cost effectively. In Rhode Island, the Governor-initiated stakeholder Power Sector Transformation Initiative and the multi-year Investigation into the Changing Electric Distribution System[10] resulted in grid modernization goals, which then led to a Cost-Benefit Framework and National Grid's Power Sector Transformation Plan[11].

Platforms may be the next focus area

While only a handful of states have adopted and incorporated the idea of distribution system operators as a platform for third-party and customer applications and innovations, the concept is taking root. One of the four objectives of Ohio's PowerForward initiative was "The Grid as a Platform" which "allows for varied and constantly evolving applications to seamlessly interface with the platform." New York baked platform thinking into the design of its Distribution Systems Implementation Plans[12] – imagining distribution utilities' role as continually enhancing their abilities to integrate distributed resources. Hawaii has also been actively designing utility markets with the idea of utilities as the platform for innovation and distributed resources – including incorporating this as a guiding principle for the Grid Modernization Strategy and in its development of its distribution energy policies[13].

Who's driving changes?

In some states, the legislature has taken the steering wheel on grid modernization, such as Virginia's Grid Transformation and Security Act of 2018[14]. In some states, the utilities are leading the charge and in others the regulators are laying the foundation. In each case, the outcomes can be fairly different, with benefits and downsides to each approach. In Hawaii, HECO attempted to get a Smart Grid Foundation initiative approved, but the commission required HECO to start from a stakeholder-led grid modernization strategy. In Colorado, Xcel proposed an Advanced Grid Intelligence and Security initiative without legislative or regulatory direction, which was approved with some modifications. Stakeholders in Colorado helped ensure customer benefits like increased data access. In North Carolina, Duke proposed a Power/Forward grid modernization proposal without regulatory directives, which drew high praise and criticism alike. In New York, REV (Reforming the Energy Vision) is an experiment in determining whether the right rules and market-based incentives can shift outcomes. Although REV has resulted in many promising high-profile pilots and distribution systems planning, there has been much stakeholder consternation about the speed of change and complexity of regulations.

Legislation is typically used as more of a blunt tool, producing swift results or mandates, which are typically less market based and more driven by a desired outcome. Where legislation typically cannot include the same level of nuance, regulatory action runs the gamut from being mired down in unnecessary levels of complexity to clear requirements moving towards desired outcomes. Utility-driven grid modernization has gotten some pushback by regulators, due to the lack of customer-facing improvements and cost-benefit analysis, but has produced real change in some states. It's worth noting that governors and stakeholders have also played major roles in each of these avenues for change.

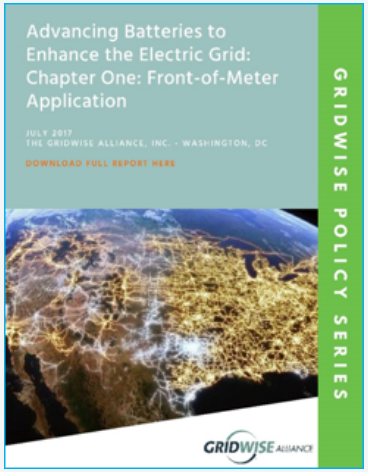
Public utilities are becoming leaders of change

While not all public municipal utilities are making big moves on the grid modernization front, there are several forward-looking public utilities worth highlighting. Despite the fact that many public utilities do not have the same regulatory or legislative requirements, some public utilities are acting fast due to pressure from constituents or changes in the fundamental economics of clean energy. Kit Carson Electric Cooperative in New Mexico and Delta Montrose Electric Association and Holy Cross Electric Association in Colorado have both now made moves to leave their transmission contract with their transmission provider, Tri-State Transmission, in order to deploy more low-cost, local renewables. Beyond their investments into the distribution system, Fort Collins' City Council voted to establish a 100 percent renewable energy goal following Platte River Power Authority's investigation into the economic plausibility of Zero Net Carbon. Austin Energy has been continuing its investment in their distribution system through its implementation of the Austin Energy Strategic Plan.

New York

New York legislators and regulators are undertaking significant efforts to modernize the state's electrical grid. The leading project, "Reforming the Energy Vision," initiated by Governor Cuomo, tasked the commission to align state energy markets and regulatory landscapes with overarching state policy objectives. As a part of REV, the utilities are required to file Distribution System Implementation Plans, a slew of progressive demonstration projects, and a Value of DER tariff. REV has promoted many non-wires alternatives, the most notable being the Brooklyn/Queens Demand Management (BQDM) plan, employs 52 MW of non-traditional customer-sited and utility-sited solutions that will allow it to avoid upgrades to two substations.

The Conversation Continues in the GridWise Policy Series



The GridWise Alliance published a Policy Series white paper in July 2017 entitled ***Advancing Batteries to Enhance the Electric Grid: Chapter One: Front-of-Meter Applications*** to discuss the wide-ranging potential benefits of front-of-meter battery installations and the most significant barriers to their broad deployment. To overcome these barriers to batteries' widespread implementation, the GridWise Alliance recommends policy makers consider the following steps:

1. Batteries with a primary purpose of supporting the transmission or distribution system should be allowed to be classified as transmission or distributions assets, respectively.
2. Subject to a streamlined project review process, electric distribution companies (EDCs) should be allowed to own and apply rate-based treatment as grid assets to batteries and their associated control systems.
3. To maximize the benefits of batteries connected to the distribution system, EDCs should have visibility and some level of input into and control of, such projects.
4. To help ensure a level playing field for third-party competitive providers, policy makers should encourage that EDC-owned and rate-based battery projects pass a reasonable economic benefit-to-cost screen before implementation.
5. Policy makers should encourage EDCs to proactively evaluate batteries side-by-side with conventional resources.
6. Policy makers should allow EDC-owned and rate-based battery projects to participate in the energy, capacity, and ancillary services markets.
7. Policy makers must ensure that batteries can offer all of the services they are technically capable of offering and be compensated fairly for those multiple services.
8. To effectively assess batteries' optimal applications, societal benefits, and system impacts, state policy makers should establish well-designed demonstration projects and pilot programs with clear objectives and transparent evaluation processes.
9. The Department of Energy (DOE) should continue to fund demonstration projects and pilots that promote sharing lessons learned and leveraging best practices among grid operators.
10. The DOE also should continue to fund robust research and development efforts to further expand battery capabilities and lower costs.

To download the full report, please visit https://gridwise.org/advancing-batteries-to-enhance-the-electric-grid-chapter-one-front-of-meter-applications/.

Ohio

The Ohio Public Utility Commission's (PUCO) yearlong review to enhance the consumer electricity experience, PowerForward, concluded this year, culminating in a roadmap report for the state's electricity future. PowerForward advanced a regulatory paradigm to support innovation while envisioning the distribution grid as an open access platform enabling various levels of customer engagement. As recommended, PUCO launched a series of workshops in October 2018 including; a Distribution System Planning Workgroup to identify issues in integrated distribution system planning; a Data and Modern Grid Workgroup to develop standardized access to customer energy data for third parties; and the PowerForward Collaborative. These groups were tasked with implementing the principles and objectives identified in the PowerForward roadmap, including monitoring the electric vehicle marketplace and streamlining a process to submit non-wires alternative projects. By April 2019, each distribution utility must file status reports and assessments of future grid functionality and associated grid modernization investment.

[1]Docket No. DE 17-189

[2]Docket No. UM 1856

[3]Assembly, No. 3723

[4]Docket No. 17-07-32

[5]Dockets No. 16A-0396E and 17M-0694E

[6]Docket No. U-20165

[7]Docket No. 2016-0087

[8]Docket No. 2017-0226

[9]Dockets No. 15-120, 15-121 and 15-122

[10]Docket No. 4600

[11]Docket No. 4780

[12]Docket No. 16-M-0411

[13]Docket No. 2014-0192

[14]Senate Bill 966

Trends In Customer Engagement

The Customer Engagement and Pricing category ranks states on their rate structures, customer outreach, and data collection practices.

As we noted earlier, many important and positive trends are increasing the ability of consumers to truly benefit from grid modernization activities. In particular, as the range of products, devices, and services available on the market continues to expand, it is creating new pathways for customers to be truly interactive with the grid and provide services that can be harvested every day and not only during critical moments.

Industry stakeholders generally agree that customer choice is a main driver for the changes taking place. They are often cited as the reason for either supporting or rejecting particular initiatives. The challenge is to understand and predict both current and future customer requirements. In the past, as an industry, we tended to group all consumers together (e.g. residential, commercial, industrial) and create generic views of their expectations. As the grid modernizes, our data and insight into consumers becomes much more granular, allowing us to develop greater refined "segments" of customers' expectations. Our goal is to turn this new information into a richer and more detailed understanding of how to design, build, and operate the electricity grid in the future.

Data services expanding in scope

Data is a lifeblood of customer engagement. For many years, utilities have been providing customers with more detailed assessment of their energy use and opportunities to save energy. Over the past decade, this type of feedback has opened a new category of energy efficiency based on spurring behavioral changes in how customers use energy and providing simple, clear opportunities for individuals and businesses to take action. Building from this foundation, there are now increasingly robust ways in which this customer data is being integrated into the standard practices for utilities.

Customer Engagement and Pricing Scoring Overview

California and Illinois come in at first and second, respectively, scoring 26 and 22 points out of a possible 31. Nevada, while not improving their score, moves into the top three after being fourth in GMI-4 due to Minnesota dropping 5 points and into fourth. There is not a lot of change within the rest of the top 10 and ties except for Michigan (T-6), which increased its score by 7 points, and makes its first appearance in the top states. Arizona, Maryland, Missouri and Michigan each scored 18 points, while Hawaii, Texas, and Georgia round out the top states with 17 points.

Interesting Observations:

- 43 of 51 states and DC have energy service providers (ESP) that have implemented some type demand response programs within their territories (This is up from 41 of 51 in GMI-4.).

ESPs are increasingly finding that demand response programs are valuable to their customers and are using them in greater numbers as regulatory markets allow.

- In GMI-4, ESPs in zero states and DC responded to having Distributed Systems Platforms for managing and aggregating demand response (DR), distributed generation, and storage for their customers. In GMI-2018, ESPs in four states (New York, Colorado, Michigan, and Minnesota) responded as having implemented this at some level of their customer base.

ESPs are beginning to utilize dynamic rate structures to the benefit of their customer base. While these opportunities remain scarce within ESPs throughout the country, this may be a telling sign of things to come for improved customer energy management.

- The score with the most positive change from GMI-4 to GMI-2018 was ESPs responding yes to providing Dynamic Mass Market pricing opportunities.

There may be a correlation as states change their market constructs. ESPs can capitalize on modernized rate structures to the benefit of their customers, especially at the C&I and large residential levels.

State	CEP Rank	Score
California	1	26
Illinois	2	22
Nevada	3	20
Minnesota	4	19
Oregon	4	19
Arizona	6	18
Maryland	6	18
Missouri	6	18
Michigan	6	18
Hawaii	10	17
Texas	10	17
Georgia	10	17

Customer devices are expanding their role

Some of the earliest demand response efforts involved utilities providing their customers with controllable thermostats that could be used to address peak loads. But as the range of devices available to consumers continued to increase, the utility-led approach left many customers without an easy way to enroll in programs and provide grid benefits. In recent years, that began to change with the advent of the so-called "bring-your-own-thermostat" program model, in which customer-purchased devices could be made available in the same way. Now, as the range of distributed

energy resources and other smart, grid-interactive technologies continues to expand, there is an emerging trend toward broad-based "bring-your-own-device" programs, including technologies such as storage. This allows the benefits coming from increased customer engagement to expand beyond only demand responses to other load-shifting applications, even during non-peak moments.

Marketplaces are increasing the range of products and services

Many utilities are building online marketplaces and thereby facilitating customer access to energy-saving and grid-interactive products. These utility-enabled services are capitalizing on the trends of increasing customer awareness generated through data and customer interest in taking a more active role in their own energy destiny.

Stakeholder engagement requirements continue to grow

Many states are embedding into their utility requirements' specific provisions for stakeholder engagement. Ohio, for example, is establishing new stakeholder groups to build from the PowerForward initiative. While these kinds of requirements are not entirely new, it seems that the idea that stakeholder engagement must be part of long-term planning or distribution system planning process, just to use one example, is a necessary component of ensuring that it will be accepted as it moves toward implementation.

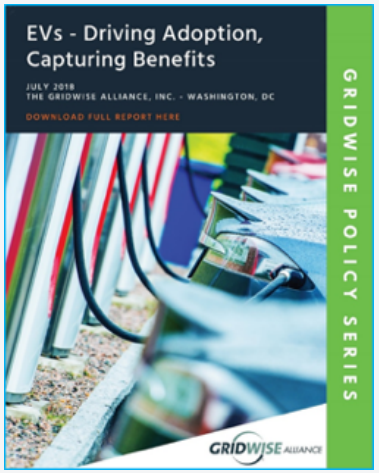
Nevada

Drawing support from the state legislature, the Nevada Public Utilities Commission (PUCN) has accelerated its effort to establish a framework for a modernized grid. Governor Sandoval's AB 405 (2017) re-established net metering in the state and directed NV Energy to file updated dynamic customer rate schedules that were not discriminatory or separate for distributed generation. In accordance with Section 27 of AB 405, NV Energy revised tariffs for optional TOU rates for residential and small commercial customers. More recently, the commission ordered Distributed Resource Planning, requiring the utilities to file a DRP to advance needs-based hosting capacity information for distributed resource developers and a cost-benefit analysis to compare DRP to conventional resources.

Oregon

Oregon has centered customers and DER integration in many of their grid modernization conversations. Oregon customers can participate in a myriad of programs including Dispatchable Standby Generation; Commercial and Industrial Time-of-Day Pricing; Residential and Small Commercial Time-of-Use Pricing; Flex Price/Critical Peak Pricing; a Flex Pricing Research Pilot; a Smart Thermostat Demand Response Pilot; and Energy Partner automated demand response programs. Oregon customers also have access to net energy metering credited at full retail rates. Although not fully implemented, Oregon is on the cusp of implementing their Community Solar Program.

Alliance Drives EV Recommendations through GridWise Policy Series



The GridWise Alliance published a Policy Series white paper in July 2018 entitled ***EVs – Driving Adoption, Capturing Benefits*** to advance the understanding of transportation electrification given the interdependent relationship between consumers, these vehicles, the grid, and electric charging infrastructure. The white paper presents trends, articulates the range of benefits EVs offer consumers and society, describes challenges to the rapid adoption of EVs, and proposes possible approaches to overcoming these challenges, including the following:

1. Craft policies and regulations to allow a wide variety of participants to deploy, own, and operate charging infrastructure and develop strategies for the management of charging to maximize its benefits.
2. Accelerate transportation electrification in a manner that provides customer value and efficient integration into the energy grid.
3. Encourage coordination between utilities, their large customers, OEMs, and third-party charging providers.
4. Support the rapid advancement of investment in all levels of EV charging.
5. Ensure that changes to the electric system are supported by business model, rate structure, and regulatory reforms that enable utilities and third-party providers to own assets and provide services.
6. Incorporate EVs and EV infrastructure in state and community planning for transportation, grid modernization, environmental compliance, and the integration of DERs.
7. Facilitate coordination among all stakeholders to leverage the best practices of integrating and optimizing EV loads into the grid.
8. Support a positive and consistent experience for drivers, charging station owners, and network operators.

To download the full report, please visit https://gridwise.org/evs-driving-adoption-capturing-benefits/.

Trends In Grid Operations

Grid Operations Scoring Overview:

The Grid Operations category benchmarks the deployment of grid modernization technologies such as sensors and smart meters.

State	CEP Rank	Score
California	1	27
Illinois	1	27
Texas	3	26
District of Columbia	4	25
Maryland	5	24
Pennsylvania	5	24
Nevada	7	23
Georgia	7	23
Delaware	7	23
Oregon	10	22

Grid Operations Scoring Overview

Following the trend, California and Illinois tied for best score, respectively, scoring 27 points each out of a possible 37. Illinois and Texas swapped positions while the remaining top 10 states all scored the same in GMI-2018 as they did in GMI-4 and saw no change in ranking.

Interesting Observations:

- Minimal change in data responses across the board on Grid Operations, with most responses received coming in for updates to improved feeder breakers and switches.

Improvements to the grid may be happening at a slower pace than improvements to policies and customer engagement programs.

- More than two-thirds of states reported AMI deployments at some level, as AMI continues to lead Grid Operation scoring with top 10 states receiving more than 95 percent of possible total points

It is no surprise that states that are leading in Grid Operations scoring are leading in AMI deployment and data utilization. States receiving zero points in AMI deployment also make up 5 of the lowest 7 overall scores.

Perhaps the most notable trend related to how grid operations are being affected by grid modernization is visible in how utilities are planning for and incorporating distributed energy into their grid operations. As the performance capabilities of customer-owned devices (whether solar photovoltaics, energy management systems, or storage) continues to accelerate, they are reaching scales that are becoming palpable and no longer only marginal use cases. This seems to be causing utilities and their regulators to take fresh approaches to how they plan for and operate grid resources.

Distribution planning complementing traditional system-wide planning

Distribution planning signals a move from devices towards more holistic planning. Regulators are now rethinking how and what they are planning due to the increased granularity of information we can now access about the distribution system and the vast potential for distributed resources on the customer side. Many states are considering requirements for distribution planning – such as Connecticut, Colorado, Maryland, Ohio and Missouri. A handful of states are implementing some form of distribution planning like Michigan[15], California[16], Indiana[17] and Hawaii[18]. In every state, top priorities of distribution planning are increased DER deployment, efficient investment, and increased resiliency. Key components of distribution planning are hosting capacity analysis, non-wires alternatives, and opportunities for customer control, all of which signal the need for planning operations to incorporate new, distributed resources in new ways.

Cybersecurity is emerging as a priority

The role of state regulators in addressing cybersecurity and developing standards is evolving as grid communication networks become more advanced and distributed. The fact that cybersecurity is an issue is indicative of the success in deployment of digital technology. While some state regulators are considering cybersecurity in the broader context of grid modernization, others are taking a more targeted approach. A few states with commission investigations include the District of Columbia, Texas[19], Illinois[20], Louisiana[21], Ohio, Vermont[22], Washington[23] and Oregon[24].

Texas

Texas first adopted advanced metering in 2007 and now has AMI installed across 75 percent of its distribution system. Interval metering data is delivered to customers via the Smart Meter Texas (SMT) portal and made available via Green Button Connect. The Commission updated these rules in 2018, making metering data more easily available to customers and third parties. The Commission is currently reviewing the regulatory history and framework for the use of Non-Traditional Technologies in electric delivery, accepting comment into November 2018. Topics include utility-owned assets, new technology options (beyond storage), and the overall effect on ERCOT wholesale prices.

District of Columbia

The District of Columbia has been keeping its physical infrastructure ahead of the curve. DC has full AMI penetration and has been utilizing AMI for outage management, customer analytics, automated outage communication, and workforce management. DC also utilizes distribution supervisory control and data acquisition (DSCADA), advanced GIS, and Fault Location Isolation & Supply Restoration (FLISR). DC also manages its feeder peak load, employs advanced transformer monitoring, and has a limited deployment of volt/var optimization. Through the Modernizing the Energy Delivery System for Increased Sustainability (MEDSIS) investigation, DC is exploring further improvements in the distribution system.

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[15]Docket No. U-20147

[16]Docket No. 14-08-013

[17]Docket No 44720 TDSIC-4 and 44910-NONE

[18]Docket No. 2017-0226

[19]Docket No. 46773

[20]Dockets No. 17-0855 and 17-1023

[21]Docket No. R-32702 and R-34172

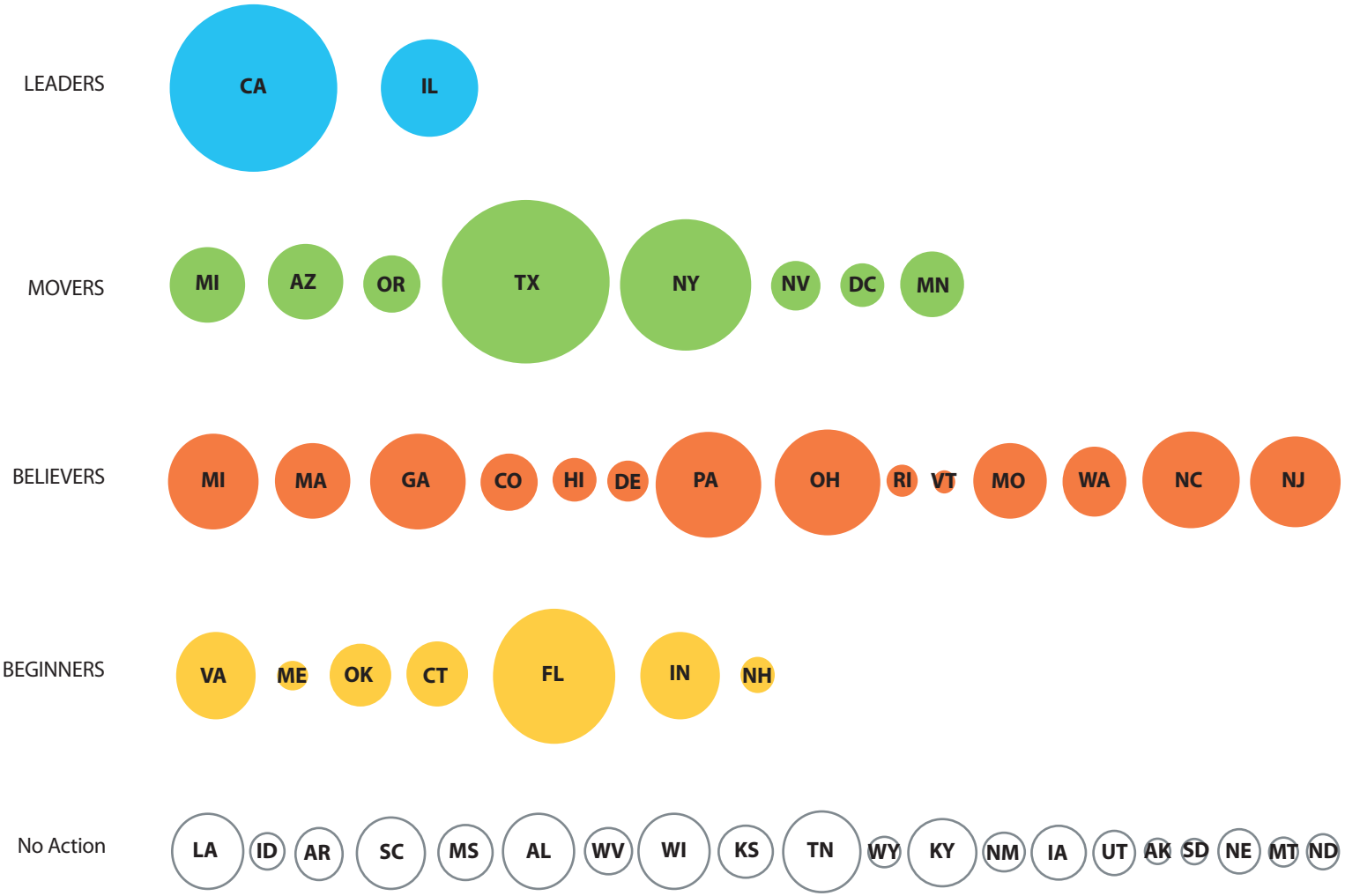
[22]Docket No. 7307

[23]Docket No. U-131799

[24]Dockets No. UM1657 and UM 1667

States of all sizes are engaged

Grid modernization activity is happening in states of all sizes and market structures. As shown in the following graphics, the size of the bubble is proportional to the state's annual electric sales. This seems to emphasize that these activities are not limited to only large states or small, or states where significant market restructuring has taken place. Similarly, there do not seem to be identifiable correlations with energy price or distributed energy penetration. This all suggests that the benefits of grid modernization are widely recognized across the industry.



Overall State Support Scores

California	29
Illinois	28
Ohio	24
New York	23
Hawaii	22
New Jersey	21
Arizona	21
Maryland	20
Rhode Island	20
Minnesota	20
Massachusetts	20
Vermont	18
Colorado	18
Oregon	17
Michigan	17
District of Columbia	15
Connecticut	15
Texas	14
North Carolina	14
Pennsylvania	13
Washington	12
Louisiana	12
Virginia	11
Missouri	10
New Hampshire	10
Georgia	9
Indiana	9
West Virginia	9
Delaware	9
Maine	9
Nevada	8
Florida	6
Utah	5
Iowa	5
New Mexico	5
Arkansas	5
Montana	5
Alaska	5
Wyoming	4
Mississippi	4
Wisconsin	4
Oklahoma	4
Kentucky	3
South Carolina	3
Kansas	3
South Dakota	2
Alabama	2
Nebraska	2
North Dakota	1
Idaho	1
Tennessee	0

Overall Customer Engagement and Pricing

California	26
Illinois	22
Nevada	20
Oregon	19
Minnesota	19
Maryland	18
Arizona	18
Missouri	18
Michigan	18
Hawaii	17
Texas	17
Georgia	17
Massachusetts	16
Delaware	15
Vermont	14
New York	14
Colorado	14
Indiana	14
Arkansas	14
Oklahoma	13
Ohio	12
District of Columbia	11
Maine	11
North Carolina	11
Washington	10

Florida	10
South Carolina	9
Rhode Island	9
Connecticut	9
Virginia	8
New Hampshire	8
Pennsylvania	8
Mississippi	8
Idaho	7
New Jersey	6
Iowa	6
West Virginia	5
New Mexico	5
Alabama	5
Kentucky	5
South Dakota	5
Wisconsin	4
Nebraska	4
Wyoming	4
Utah	4
Kansas	3
Louisiana	3
Alaska	2
North Dakota	1
Montana	1
Tennessee	0

Overall Grid Operations Scores

California	27
Illinois	27
Texas	26
District of Columbia	25
Maryland	24
Pennsylvania	24
Nevada	23
Delaware	23
Georgia	23
Oregon	22
Arizona	21
Washington	19
New York	17
Colorado	16
Idaho	16
North Carolina	16
Michigan	14
Missouri	14
Rhode Island	14
Alabama	14
Oklahoma	13
Massachusetts	13
Virginia	13
Florida	12
Minnesota	11

South Carolina	11
Vermont	10
Louisiana	10
New Jersey	10
Maine	10
Mississippi	10
New Hampshire	9
Ohio	9
Hawaii	8
Kansas	8
Wisconsin	7
Connecticut	5
Arkansas	5
West Virginia	5
Indiana	4
Alaska	4
Wyoming	4
Kentucky	3
Nebraska	3
South Dakota	2
Utah	2
North Dakota	1
Montana	1
New Mexico	1
Tennessee	0
Iowa	0

GMI 2018 Indicators

Below is the list of questions used to develop this GMI. The numbers in parentheses reflect the maximum number of points available for each question.

STATE SUPPORT

Customer Education/Outreach Plans (2)

Data Privacy Policies (1)

Customer Access to Data Usage (1)

3rd Party Access to Data Usage (1)

Leveraging DG/Storage (3)

DER Impacts Incorporated in Planning (1)

DER Retail Grid Support (1)

Incentives/Mandates for DERs/Storage/EVs/Efficiency (3)

CO2 Reduction Goals (1)

RPS/EERS (2)

Transportation Electrification Plans (2)

State Grid Modernization Policy/Strategy (2)

ESP Grid Modernization Plan (2)

Grid Modernization Cost Recovery (2)

Reporting of Grid Modernization Benefits (2)

Reliability/Resiliency Incentives (1)

Cyber/Physical Security Plans (2)

CUSTOMER ENGAGEMENT AND PRICING

Pricing Event Communication (2)

Standard Methodology for Data Access (2)

Customer Education/Outreach (2)

Segmentation Capabilities (5)

Dynamic Pricing (4)

CPP/RTP Rebates (2)

Net Metering (1)

Peak Renewable Generation Rates (1)

Distributed Systems Platform (1)

DR Programs (2)

Reactive Power (1)

Pricing for C&I DER Adoption (3)

DER Tariffs (3)

ESP-Owned DG/Storage Programs (1)

BTM Programs (1)

Energy Resiliency Plan (1)

Workforce Development (1)

Energy in Economic Development Plan (1)

GRID OPERATIONS

AMI Penetration (3)

Remote Meter Reading (1)

Remote Connect/Disconnect (1)

AMI Integration (5)

AMI for New Connections (1)

Real Time Smart Meter Data (1)

Volt/VAR Optimization (1)

FDIR/FLISR (2)

Distribution Feeders (1)

Real Time Load Flow (1)

Remote Operation of Feeders (1)

Remote Operation of Line Reclosers (1)

EV Charging Smart Integration (1)

DG/Storage Smart Integration (1)

Advanced Visualization (1)

Asset Optimization/Utilization Analytics (1)

Condition-Based Maintenance (1)

Forensic/Diagnostic Analysis (1)

Probabilistic Risk Assessment (1)

New Distribution Planning (1)

Enhanced Outage Management (1)

Fiber for Backbone/Backhaul (1)

Communication with Field Devices (1)

Data Integration Across Systems (1)

Advanced GIS (1)

Enhanced System Integration: GIS & Asset Management (1)

Enhanced System Integration: Grid Performance Analytics (1)

Microgrids: Single Party (1)

Microgrids: Multi Party (1)

Interoperability Standards (1)