# GRID MODERNIZATION INDEX4

November 2017

GRIDWISE ALLIANCE

in partnership with CLEAN EDGE NAVIGANT

## About GridWise Alliance

The GridWise Alliance represents the broad and diverse stakeholders that design, build, and operate the electric grid. Since 2003, the Alliance has been at the forefront of educating legislators and regulators about the critical need to modernize our nation's electricity system. For more information about the GridWise Alliance, please visit: http://www.gridwise.org.

## Acknowledgments

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GridWise would like to thank the Project Team and Advisory Committee members for their efforts. See Appendix B for the complete list of Team and Committee members.

**DISCLAIMER:** The state rankings included in the GridWise Alliance's Grid Modernization Index 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.

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# FOREWORD: POWERING OUR FUTURE

**STEVE HAUSER**
CEO
*The Gridwise Alliance*
*November 2017*

On behalf of the members and staff of the GridWise Alliance, we are pleased to publish the 4th Grid Modernization Index (GMI-4). It has been nearly two years since the last GMI and the results demonstrate a much broader participation in grid modernization across the United States.

A decade ago, the U.S. Congress passed ***The Energy Independence and Security Act of 2007***. GridWise was very involved in the creation of Title XIII-Smart Grid of that act. The opening text of Title XIII (Section 1301) states:

*It is the policy of the United States to support the modernization of the nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet the future demand growth and to achieve each of the following, which together characterize a Smart Grid:*

- *Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid.*
- *Dynamic optimization of grid operations and resources, with full cyber-security.*
- *Deployment and integration of distributed resources and generation, including renewable resources.*
- *Development and incorporation of demand response, demand-side resources, and energy-efficiency resources.*
- *Deployment of "smart" technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications, concerning grid operations and status, and distribution automation.*
- *Integration of "smart" appliances and devices.*
- *Deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal storage air conditioning.*
- *Provision of timely information and control options to consumers.*
- *Development of standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid.*
- *Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices and services.*

Just over one year later, ***The American Recovery and Reinvestment Act of 2009*** also became law. The combination of the two acts resulted in a combined taxpayer and ratepayer investment of more than $10 billion towards the goals listed above. While that initial funding is long past, investments in these initiatives are accelerating and becoming more widespread throughout the industry.

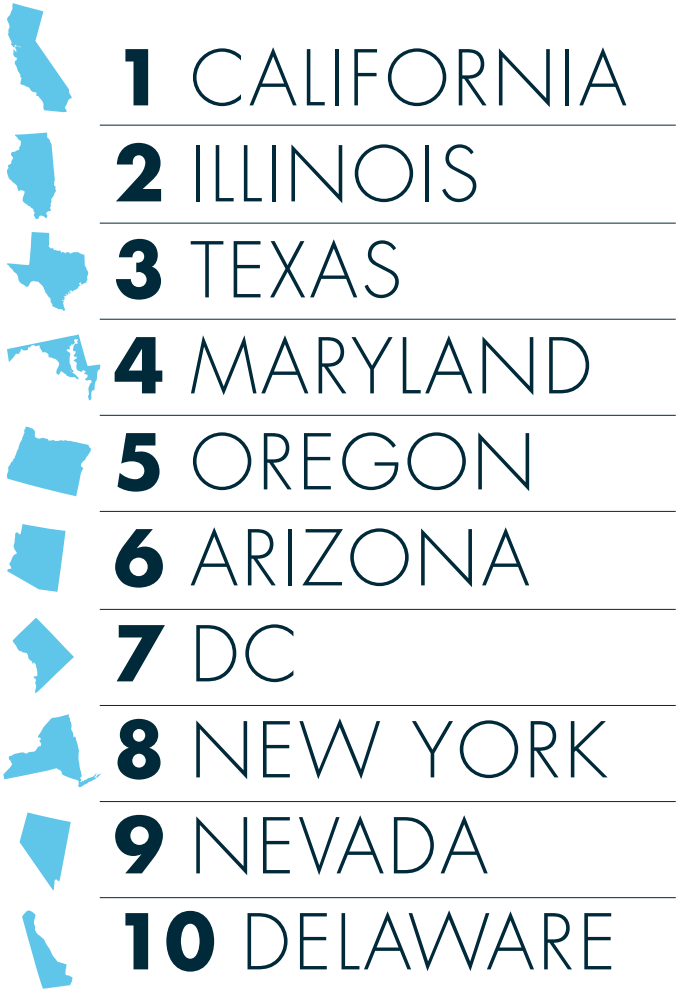
Even prior to 2007, GridWise recognized the need to involve a broad stakeholder community in achieving these goals, including policy makers at all levels of government, consumers of all sizes and types, public and private utilities, and technology providers. Involving such a diverse group of stakeholders across 50 states and the District of Columbia has been difficult and time consuming. However, our investments in this process (in partnership with many others) are clearly paying off.

Recent weather events further validate the growing urgency to act thoughtfully and comprehensively to modernize the electric grid and critical infrastructure. While damage to the grid in Houston and surrounding areas during Hurricane Harvey was substantial, recovery times were much less than in previous storms because of the major improvements made to the grid by the local utilities. Similarly, recovery times in Florida have also been greatly improved in recent years due to the new technologies that have been deployed. Storms, fires, and other natural events are not going away and may be intensifying. It is critical to place more emphasis on preparing for these and other external factors that may disrupt electrical service to customers and the economy.

GridWise launched its Grid Modernization Index more than five years ago to measure how well the industry was progressing in meeting these national goals. During that time, we have taken feedback from many stakeholders and gradually improved the quality and consistency of the data collected and the scores given. In GMI-4, we have instituted a process that will be easier to replicate and will allow us to analyze trends more easily. We will also continue to coordinate closely with the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability to ensure that our efforts align with evolving national priorities.

Finally, we want to emphasize that this is not a contest between states. We understand that unique state and local considerations result in different approaches, investment strategies, and rates of adoption. Markets transcend boundaries, and drive technology improvements and cost reductions. Technologies that enable grid modernization are less expensive and more capable now than they were just a decade ago. Policies, however, particularly at the state and local levels, do drive the speed and scale of grid modernization. We hope that our Grid Modernization Index has been and will continue to be useful across the industry, reflecting both the opportunities and barriers for creating a truly modern grid.

STEVE



# KEY TAKEAWAYS

The Grid Modernization Index (GMI-4) ranks and analyzes all 50 U.S. states and the District of Columbia, based upon the degree to which they are moving toward a modernized electric grid. The grid is changing to accommodate new cost-effective technologies and evolving consumer expectations. Federal, state, and local policymakers and elected officials are also striving for a cleaner and more reliable grid while ensuring affordable access for all consumers.

Cost declines are one key driver of grid modernization. The cost of wind and solar energy (and increasingly energy storage, electric vehicles, and other emerging technologies) have decreased to where they are often the least-cost option for both utilities and consumers. Environmental impacts, and related concerns, are also driving consumers and policymakers to seek out these emerging options. At the same time, utilities continue to prioritize reliability and cost-effectiveness while finding effective ways to integrate these new technologies.

Similarly, the declining costs of new sensors, communication technologies, and IT systems are enabling smarter, more efficient grid operations by leveraging customer usage data, smart devices, and other highly automated systems. These systems are increasingly being deployed where and when it makes sense, resulting in higher utilization of existing assets, greater system efficiency, lower environmental impact, and improved reliability.

The next two decades promise even greater innovation through smart cities programs, electrification of transportation systems, more sophisticated ways of managing customer loads, and integration of distributed energy resources (DERs).

The GridWise Alliance's primary goal is to involve and represent the entire spectrum of viewpoints on these issues (spanning regulators, regional transmission operators/independent system operators, utilities, vendors, IT system providers, and other stakeholders), understand the changes taking place, and find reasonable, effective solutions for modernizing the grid. Indeed, grid modernization will require not only continued technology innovation, but innovative policies and business models to address the speed and scale of change.

In this context, we offer GMI-4 with methodological improvements and updated data reflecting changes that have taken place across the country over the past two years.

Key takeaways based on our analysis of the GMI-4 results, are shown on the following page.

**1** **The pace of grid modernization efforts has accelerated, particularly on the policy front.** Many states are undertaking grid modernization initiatives or proceedings, including facilitating the adoption of advanced metering infrastructure (AMI), DERs, implementing pricing schemes and demand response (DR) mechanisms, and enacting other related policies. These actions are aimed at expanding the use of renewable energy resources, storage, and electric vehicles; increasing operational efficiency; and improving resilience.

**2** **Recent hurricanes and other extreme weather events, as well as human-caused cybersecurity and physical security threats, are focusing attention on grid resilience.** While some states are leading the way, GMI-4 shows that several states are actively planning for and incentivizing resiliency and security. These efforts will begin to expand to other states, ensuring that customers are less vulnerable to natural and man-made disasters.

**3** **Leading states continue to make progress toward comprehensive grid modernization.** Each state follows its own approach to policy, business and regulatory models. Unique local and regional circumstances compel each state to develop its own approach to grid modernization. However, it is critical that states pioneering new ideas effectively communicate lessons learned to states that can build on their experience.

**4** **Many states are just beginning their own grid modernization efforts.** As innovative new technologies become more cost-effective, additional states are joining the leaders in actively pursuing grid modernization agendas. As more and more initiatives and programs show clear benefits, additional states are actively engaging in the discussion and implementation of grid modernization efforts.

**5** **Some of the early movers may be seeing their momentum slow, particularly in the Grid Operations category.** Some states that received an influx of American Recovery and Reinvestment Act (ARRA) funding to modernize their grid are being surpassed by states with ongoing, locally-funded efforts.

**6** **Utilities are prioritizing efforts to address customer demands for greater choice and the capability to manage their own energy usage.** The trend is towards greater utility engagement and communications with customers. Investments in a range of technologies enable these efforts, providing greater visibility to customers and enhancing situational awareness for grid operators. Innovative utilities are creating better methods for communicating critical information to customers.

**7** **Clean energy targets by states, cities, and corporations are driving utility efforts to accommodate rapid growth in DERs.** With some states, cities, and corporations now targeting up to 100% renewables, efforts by a growing number of utilities to meet these goals are impacting their long-range planning, product and service offerings, and grid operations.

# OVERVIEW

As with each of the previous GMIs, we group the data into three general categories:

- **STATE SUPPORT**, which includes plans and policies that support grid modernization;
- **CUSTOMER ENGAGEMENT**, which ranks states on their rate structures, customer outreach, and data collection practices;
- **GRID OPERATIONS**, which benchmarks the deployment of grid modernization technologies such as smart meters, sensors, controls and analytics.

## Data Collection Process Improvements

Data collection for GMI-4 took place from late 2016 through August 2017. For the first time, the GridWise Alliance utilized an online data collection portal as the primary means of data collection (see Appendix A for the full list of indicators). State regulators, utility representatives, and other industry stakeholders accessed the portal to answer questions and remit data. After they submitted their answers, GridWise project team members followed up with respondents by phone and/or e-mail to clarify details, fill in gaps, and supplement data as needed.

Based on feedback provided by GridWise members and industry stakeholders, and to streamline the data collection process, GridWise began this fourth edition of the GMI by evaluating each GMI-3 question for efficacy, deleting those that were less essential and combining questions where appropriate. The final set of questions was available to all state representatives and other stakeholders through the online data collection portal. This portal allowed respondents to answer questions on their own schedule, reducing the time and effort needed for follow-up and manual data gathering. The portal allowed respondents to exit and return to where they left off.

Questions in the data collection portal were divided into five sections:

- State Support
- Customer Engagement and Pricing
- Advanced Metering Infrastructure
- Distribution
- Transmission

The data collection portal was designed so that states could designate multiple subject matter expert respondents to answer the questions that were relevant to them. Respondents were asked to select the portions of the GMI they wanted to address, and saw only those questions. This was particularly useful for the AMI, distribution and transmission questions, enabling, for example, contacts in different utility departments to address questions simultaneously.

While the AMI, distribution, and transmission questions were asked separately in the portal, the AMI and distribution questions were scored together as the Grid Operations category. As a result of feedback provided during the data collection process, GridWise team members determined that the questions focused on transmission operations would yield inconsistent results and were therefore removed from GMI-4 scoring. The transmission questions will be reevaluated prior to initiating data collection for GMI-5.

Numerous attempts were made to obtain a complete data set for each state. Some data points were not easily or consistently available for all states. In instances where

states did not submit responses for particular sections and there was no new publicly available information, GridWise leveraged data from GMI-3 to calculate scores. In these cases, GridWise mapped the data obtained for GMI-3 to the questions asked in GMI-4 in order to assign credit.

## Simplification of Scoring Methodology

The scoring system in GMI-4 has been changed as part of the improved data collection process. For previous GMIs, most questions were scored on a 1 to 5 scale, with GridWise team member knowledge of state activities often determining final question scores. For GMI-4, states are scored on an objective set of criteria for each question. Some questions were scored on simple yes/no responses, while others were scored on a multi-point scale, based on the range of deployment/coverage. We found that with all other things being equal, these changes resulted in a general decrease in scoring for all states of about 10%.

A majority of questions in the Customer Engagement and Grid Operations categories asked respondents to indicate the extent of customer or system coverage by smart grid functionality. Answer choices were 1-9%, 10-49%, 50-89%, and 90-100%. However, feedback prior to and during the data collection process allowed GridWise to adjust the scoring rubric to reflect successful implementation of customer engagement initiatives. For instance, 9% of customers opting into a specific customer pricing program could be considered highly successful for customer engagement functions. In those cases, that response should receive full credit. Therefore, for Customer Engagement questions 1, 8, and 9, partial credit was awarded for 1-9% and 10-49%, while full credit was awarded to more than 50% customer coverage. For Customer Engagement questions 2, 4-7, and 10-13, full credit was awarded to responses with any amount of customer coverage.

Similarly, for 22 of the 24 questions in the Grid Operations category, states were awarded partial credit based on the percentages of system coverage stated above. Partial credit was awarded to responses that indicated coverage of 1-9% and 10-49%, while full credit was awarded when responses noted more than 50% system coverage. An emerging trend for state grid modernization plans is to focus grid operation improvements on the highest-value parts of their system. With this scoring method, GMI-4 is able to more accurately award points to states that are actively implementing system improvements at any scale.

To develop final scores, GMI-4 questions were given point values ranging from 1 to 5 based on their market impact and importance. Points earned were added together to calculate category scores. The categories are not weighted equally; State Support has 32 total points, Customer Engagement has a top score of 31 points, and Grid Operations is worth a maximum of 37 points. Category scores were added together to obtain overall scores, with a total maximum possible score of 100 points.

**STATE SUPPORT 32PTS**

- Grid Modernization Policy/Plan
- Data Access RPS/EERS
- Security Plans
- Education/Outreach/Measurement/Reporting Requirements
- DER Incentives/Mandates
- Workforce/Economic Development

**CUSTOMER ENGAGEMENT 31PTS**

- Dynamic Tariffs/Rate Structures
- Communication with Customers
- DER Tariffs
- Data Access/Sharing
- Customer Segmentation/Analytics

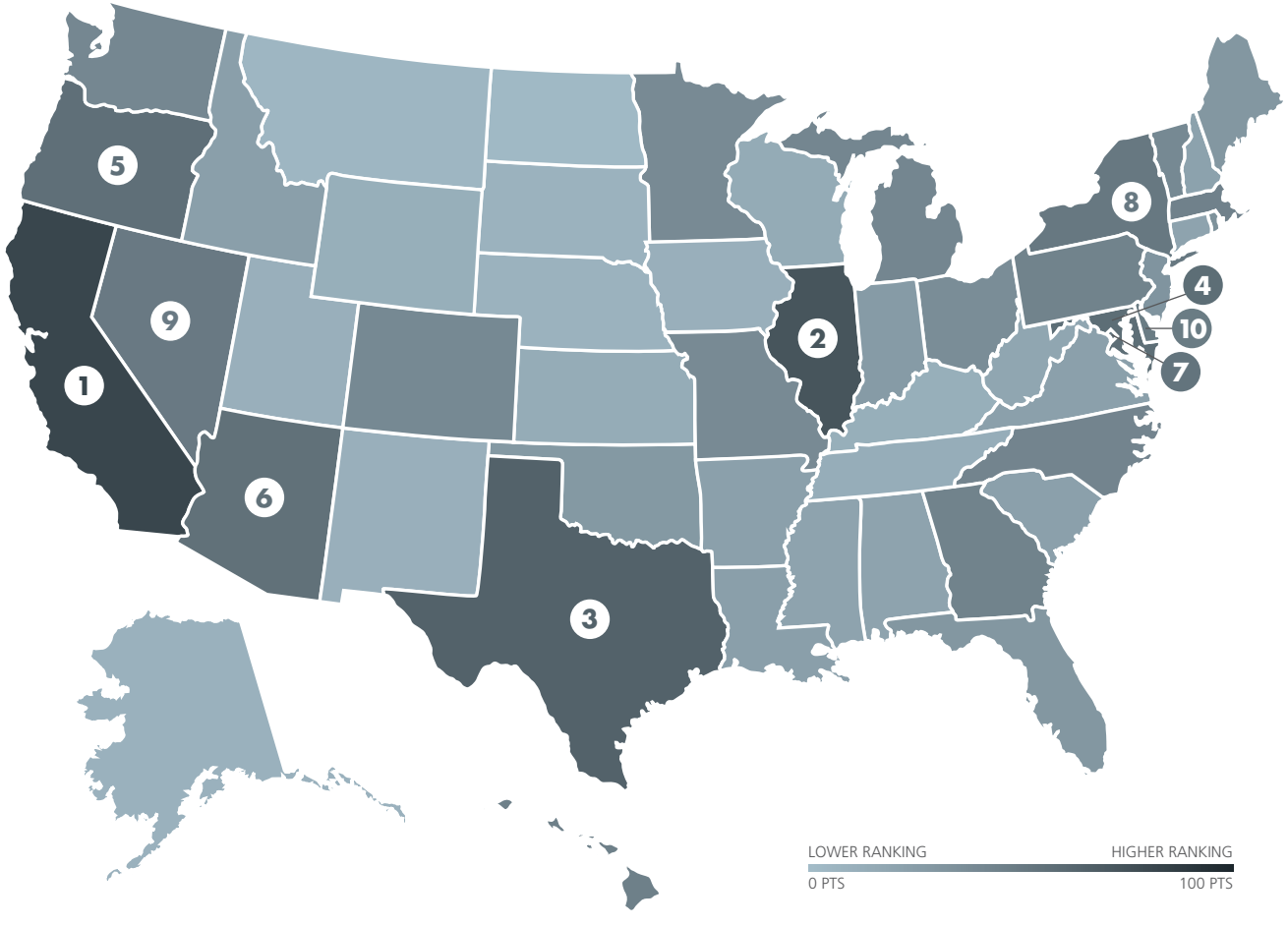
**GRID OPERATIONS 37PTS**

- AMI Penetration/Integration
- Advanced Sensors for Transmission & Distribution
- Energy Storage & Microgrids
- Integration of Distribution Management Systems
- Probabilistic Planning
- Advanced GIS & Visualization

**100 TOTAL POINTS**

The GMI-4 report is organized to show overall results and trends from this year's index, including a deeper discussion of the states with the top overall GMI scores and ones with significant increases in rankings. The report then provides an in-depth look at each of the three GMI categories.

# OVERALL RESULTS




| RANK | +/- | STATE | LEADERSHIP SCORE |
|---|---|---|---|
| 1 | 0 | California | 81.5 |
| 2 | 0 | Illinois | 73.0 |
| 3 | 0 | Texas | 64.6 |
| 4 | 0 | Maryland | 57.5 |
| 5 | 2 | Oregon | 56.8 |
| 6 | 3 | Arizona | 55.5 |
| 7 | -2 | District of Columbia | 53.5 |
| 8 | 8 | New York | 51.0 |
| 9 | 5 | Nevada | 50.1 |
| 10 | -4 | Delaware | 48.5 |
| 11 | 1 | Hawaii | 46.0 |
| 12 | 8 | Massachusetts | 44.8 |
| 13 | -5 | Pennsylvania | 44.0 |
| 14 | -4 | Georgia | 43.5 |
| 15 | -4 | North Carolina | 43.3 |
| 16 | -1 | Michigan | 41.7 |
| 17 | 12 | Washington | 40.5 |
| 18 | 17 | Colorado | 40.0 |
| 19 | -6 | Vermont | 39.6 |
| 20 | 2 | Missouri | 39.0 |
| 21 | -2 | Minnesota | 38.8 |
| 22 | 3 | Ohio | 36.8 |
| 23 | 25 | Rhode Island | 34.0 |
| 24 | 2 | New Jersey | 32.3 |
| 25 | -8 | Florida | 30.1 |
| 26 | -5 | Maine | 29.5 |
| 27 | -9 | Oklahoma | 29.0 |
| 28 | -4 | Indiana | 27.0 |
| 29 | 4 | Louisiana | 24.4 |
| 30 | 2 | Idaho | 23.9 |
| 31 | -8 | Virginia | 23.4 |
| 32 | -2 | Arkansas | 23.2 |
| 33 | 1 | South Carolina | 23.1 |
| 34 | -6 | New Hampshire | 21.6 |
| 35 | -4 | Connecticut | 21.4 |
| 36 | 7 | Mississippi | 21.3 |
| 37 | -10 | Alabama | 21.0 |
| 38 | -1 | West Virginia | 19.0 |
| 39 | 1 | Wisconsin | 15.1 |
| 40 | -4 | Kansas | 14.4 |
| 41 | 3 | Tennessee | 13.2 |
| 42 | -3 | Wyoming | 11.9 |
| 43 | 2 | Kentucky | 11.6 |
| 44 | -3 | New Mexico | 11.0 |
| 45 | 1 | Iowa | 10.7 |
| 46 | -8 | Utah | 10.5 |
| 47 | 0 | Alaska | 10.3 |
| 48 | -6 | South Dakota | 9.0 |
| 49 | 1 | Nebraska | 8.5 |
| 50 | -1 | Montana | 6.3 |
| 51 | 0 | North Dakota | 3.3 |

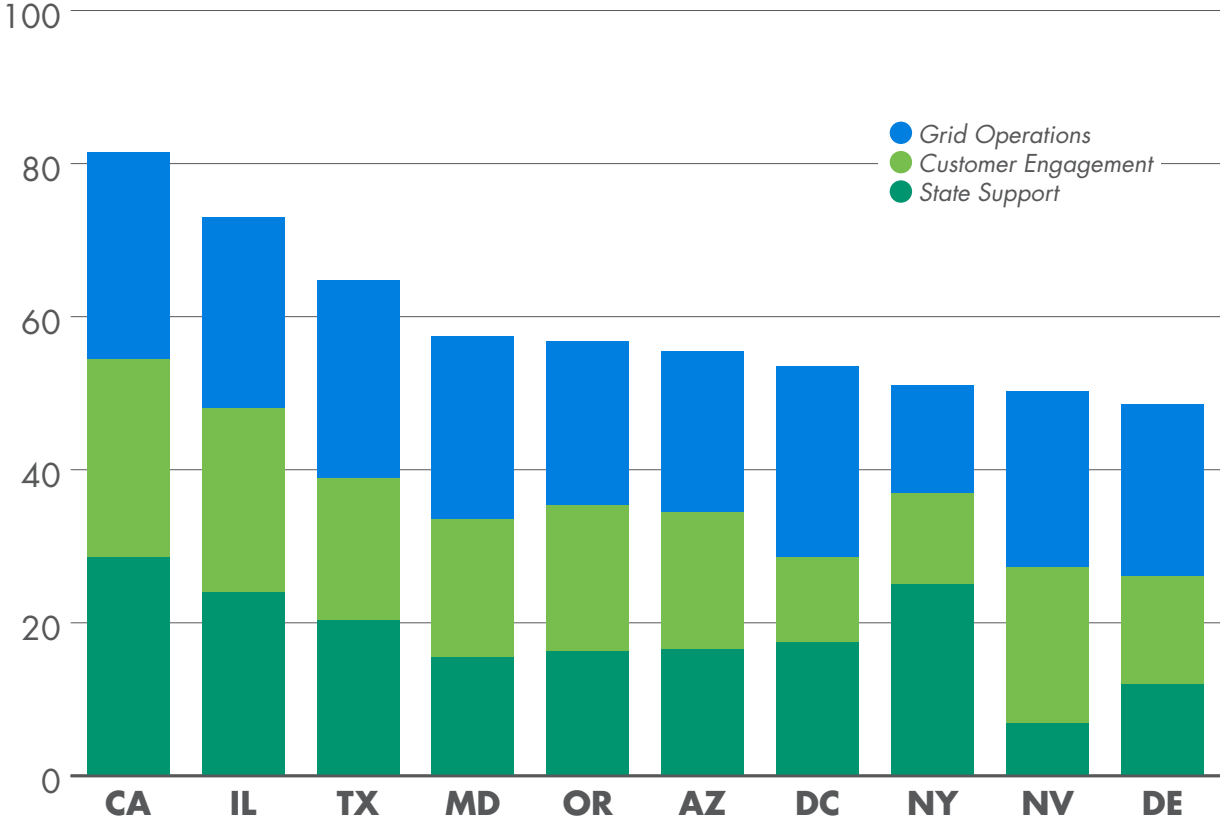
# OVERALL RESULTS

For the second consecutive edition of the GMI, California ranks highest in the nation overall with a score of 82, and also has the top score in each of the three GMI categories. California's lead over #2 Illinois has increased to nine points, although both states saw an overall decline in their scores as a result of changes to the scoring methodology.

The three states ranked behind California remain unchanged from GMI-3. Illinois comes in second, repeating its best-ever performance from the previous GMI. Texas remains #3, nine points behind Illinois, and there is then a seven-point drop to #4 Maryland.

Whereas 24 points separate California from Maryland, only nine points separate Maryland from #10 Delaware. Oregon moves up two places to the fifth spot, while Arizona climbs three spots to #6 and the District of Columbia drops two places to seventh. New York climbs eight spots to #8, while Nevada moves up five places to #9 and Delaware is ranked 10th. The two states previously ranked in the top 10, Pennsylvania (previously #8) and Georgia (previously #10), now rank 13th and 14th, respectively.

## FIGURE 1: 4TH GRID MODERNIZATION INDEX: TOP 10 STATES




*Source: Grid Modernization Index, GridWise Alliance and Clean Edge, Inc.*

# STATES WITH GAINS OF AT LEAST FIVE POINTS OR FIVE RANKING SPOTS

### RHODE ISLAND

↑25

↑24.0

Governor support with strategic energy goals and adoption of clean energy measures.

### WASHINGTON

↑17

↑21.0

An aggressive Clean Energy Fund is supporting improvements to the grid.

### COLORADO

↑12

↑16.8

Improved customer experience through upgraded forecasting techniques, clean energy analytics, and new offerings to customers.

### NEW YORK

↑8

↑9.8

Improved customer experience through upgraded forecasting techniques, clean energy analytics, and new offerings to customers.

### MASSACHUSETTS

↑8

↑10.3

State Support leadership leading to improvements in other categories. Increased smart grid planning.

### MISSISSIPPI

↑7

↑7.5

TVA has incentivized commercial and residential consumers to be more price aware about energy.

### NEVADA

↑5

↑8.4

Increased policy activity, improvements in AMI programs and Advanced Distribution Management Systems.

### OHIO

↑3

↑10.3

Improved State Support, including reinstating renewable portfolio standard.

### MISSOURI

↑2

↑8.0

Improvements in Customer Engagement and Grid Operations.

### NEW JERSEY

↑2

↑6.0

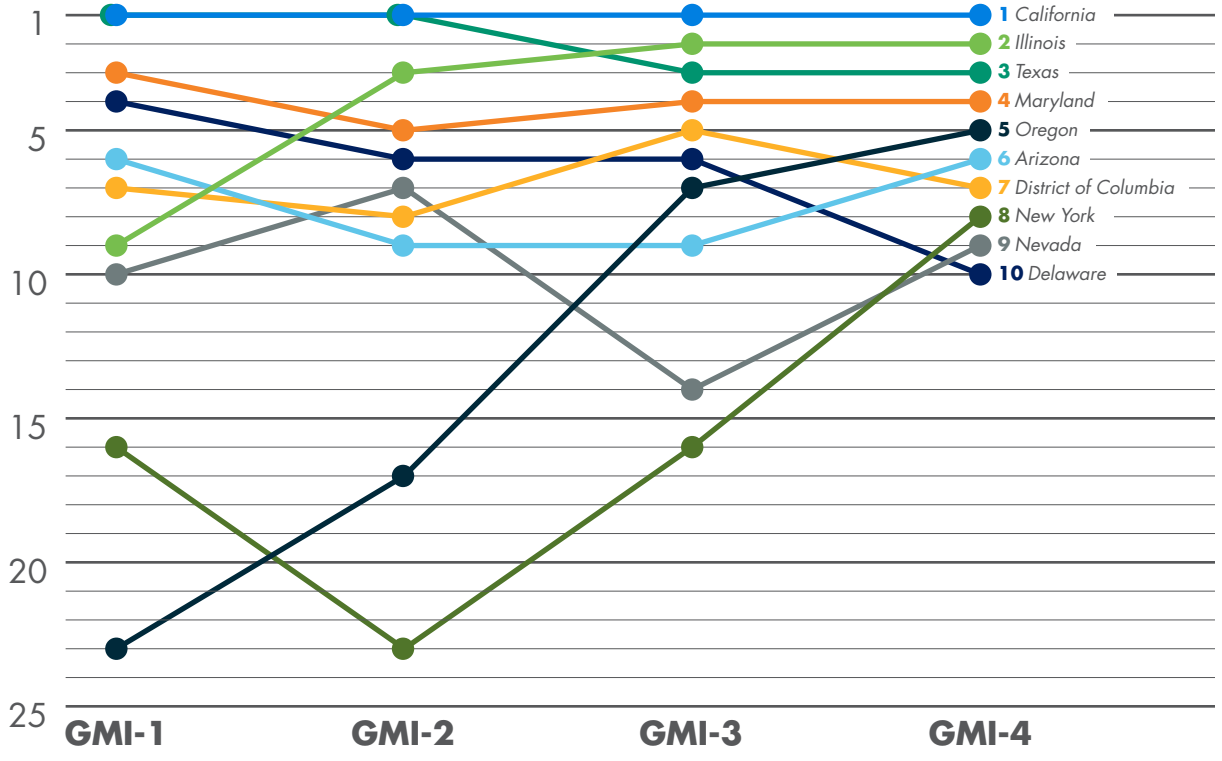
Strong improvement in State Support, including incentives for storage. Improvement in Customer Engagement as well.

Several states in GMI-4 have seen dramatic changes in their results. Rhode Island adds 24 points to its overall score, and jumps 25 spots in the rankings as a result to #23. Colorado, Massachusetts, Mississippi, Nevada, New York, and Washington also rise at least five ranking places and each add five or more points to their scores. On the other hand, 10 states – most dramatically Alabama (#37, down 10 spots) – see their rankings drop by at least five positions.

Except for Illinois and Texas, the 13 highest-ranked states are all located on the West Coast, in the mid-Atlantic or in the desert Southwest. These regions stand out as grid modernization leaders. New England and the Great Lakes states also tend to score well. Except for Georgia (#14) and North Carolina (#15), states in the South tend to fall in the bottom half of the rankings. Many states from the northern Great Plains and the interior West also place near the bottom of the rankings.

One notable theme in GMI-4 is the progress made by the middle states in the rankings: those in the top half of the overall rankings, but outside of the top 10. The point differential between #11 Hawaii and #25 Florida is about 16 points, similar to the 17 points that separate #1 California and #3 Texas. This middle group includes seven states that have added at least six points to their overall score. Additionally, the median overall score

## FIGURE 2: GMI-4 TOP 10 OVERALL STATES (INCLUDING HISTORICAL RANKINGS)




*Source: Grid Modernization Index, GridWise Alliance and Clean Edge, Inc.*

in GMI-4 jumped 3 points from the previous edition, which could be reflective of the increased efforts that states are putting into their grid modernization efforts.

As we highlight throughout GMI-4, each state goes about modernizing its grid differently, and the three highest-ranked states reflect this point. California's aggressive move to enact strong policies – including those that advance grid modernization, renewable energy, electric vehicles, energy efficiency, and energy storage – have resulted in consistently high rankings in each of the three categories. California's renewable portfolio standard (RPS), carbon reduction goals, and strong DERs market have forced it to move forward quickly on all fronts. Its utilities are required to submit plans to integrate DERs and other demand management resources. California also is preparing to move to default time-of-use (TOU) rates in 2019.

Second-ranked Illinois has always performed well in State Support, but over the years, its Customer Engagement and Grid Operations rankings have increased steadily. The state's major investor-owned utilities (IOUs) began making grid upgrades in 2012, including installing millions of smart meters. This has unlocked time-varying rates (TVRs) and helped electricity service providers (ESPs) streamline their outage management procedures. More recently, in December 2016, the state legislature and Gov. Bruce Rauner enacted bipartisan legislation to firm up the state's RPS by providing more funding for renewables. This is expected to result in increased wind and solar (particularly rooftop solar) energy development. Finally, in March 2017, Illinois joined the growing list of states with a "utility of the future" proceeding by launching its NextGrid study, which is being conducted by the Illinois Commerce Commission and expected to last about 18 months.

Overall #3 Texas' performance in State Support and Customer Engagement has always been strong, and its leadership remains solid in Grid Operations. As the only state that operates its own electric grid fully within its borders, Texas has addressed grid modernization with a key focus on enhancing resilience. The fully deregulated electricity market in Texas encourages innovation by both the "wires" companies, like CenterPoint Energy and Oncor, as well as by the various retail energy providers that engage customers directly. The city of Austin, for instance, has become a hotbed of projects, including Austin SHINES, which strives to integrate solar, storage, advanced inverters, and communication devices. (The city's municipal utility, Austin Energy, has a goal of 65% renewable energy by 2027.) Many rural electric cooperatives in the state are taking very innovative approaches to better serve their customers, including AMI and various DERs.

Plenty of changes are also underway outside of the top three states. A growing number of states have begun looking at making transformational changes that will affect how the electric utilities within them operate, and modifying the regulations that govern them. New York's Reforming the Energy Vision (REV) proceeding gets much of the attention, but other states have instituted similar proceedings, including Maryland, Massachusetts, Minnesota, Ohio, and Rhode Island; more states, such as Oregon, could join that list soon.

More broadly, 36 states are taking some form of action on the grid modernization front, according to second quarter 2017 data from the North Carolina Clean Energy Technology Center. Some states' plans are more ambitious than others, but all are planning for the future as the grid evolves. Many of these efforts are taking place outside of the GMI top 10 states. Notable examples include:

- **HAWAII** (#11) has a three-pronged strategy for creating a modernized grid: adopting new Reliability Standards Working Group rules; developing storage and advanced grid infrastructure; and connecting the islands via undersea transmission lines. Hawaii's primary utility, Hawaiian Electric Companies, filed its most recent grid modernization plan at the end of August 2017, following a stakeholder comment

period. This plan applies lessons learned from the U.S. Department of Energy's Next-Generation Distribution System Platform (DSPx) Initiative.

- **MASSACHUSETTS** (#12) requires its utilities to submit grid modernization plans, which include TVRs and advanced metering functionality. It is also moving forward on energy efficiency, data access, and a 200 MW-by-2020 energy storage mandate.

- **VERMONT** (#19) has made incremental investments in grid modernization following the 2009 receipt of a Smart Grid Investment Grant from the U.S. Department of Energy (DOE). Numerous utilities in the state, including Burlington Electric Cooperative, Green Mountain Power, and Vermont Electric Cooperative, have deployed new technologies as part of eEnergy Vermont. In addition, in the summer of 2017, Vermont's Public Service Board initiated a proceeding to review the state's grid modernization strategy.

- In **MISSOURI** (#20), the Public Service Commission in September 2017 began a grid modernization proceeding pertaining to regulation of and planning for DERs. The proceeding could serve as a precursor to grid modernization-related activities in the coming years.

- **OHIO** (#22) has a grid modernization proceeding it calls PowerForward. The Public Utility Commission (PUC) is seeking to address the "technological and regulatory innovation" that could "enhance the consumer electricity experience." This proceeding aims to chart a path forward for improved grid modernization policies and future grid upgrades. The state capital, Columbus, recently won the U.S. Department of Transportation's Smart City Challenge, resulting in significant grid infrastructure investments in partnership with utility American Electric Power.

- In **RHODE ISLAND** (#23), Gov. Gina Raimondo has been pushing the state to adopt more renewable energy, particularly through an increased RPS (38.5% by 2035), and the "1,000 by 2020" initiative that will boost clean energy deployment in the state to 1,000 MW by 2020. On the regulatory side, the PUC in early 2017 began a Power Sector Transformation Initiative, which is re-thinking grid modernization along four tracks, including analysis of utility business models, distribution system planning, grid connectivity functionality, and strategic electrification of transportation and heating.

- The Grid Modernization Working Group in **NEW HAMPSHIRE** (#34) submitted its final grid modernization report to the PUC in early 2017 after nearly two years of work. The report addresses everything from planning to AMI deployment to data issues. It recommends further proceedings to address the issues lacking consensus that were revealed as part of the stakeholder engagement process.

States are getting help as they proceed with their grid modernization efforts. The DOE and its partners have coordinated two efforts to educate stakeholders. The National Governors Association (NGA) is working with four states – Kentucky, Oregon, Rhode Island, and Washington – to help them better align grid modernization policy goals and market incentives. In addition, the National Association of Regulatory Utility Commissioners (NARUC) has worked with DOE – along with the Public Service Commissions in California, the District of Columbia, Hawaii, Minnesota, and New York – to develop a decision-making framework for a new distribution grid planning through its DSPx initiative.

Grid modernization is clearly advancing across the U.S., with more states taking action than ever before. The following sections will examine some of these trends in greater detail and offer insights into states' current status and future trends.

# THE TOP 10 STATES

**1 CALIFORNIA** ranks #1 overall for the second time in a row, and does so by a comfortable margin, having the highest score in each of the three GMI categories. The state has had the highest Customer Engagement score in all four editions of the GMI. California has procurement targets for electric vehicles (EVs), energy storage, renewable energy, and energy efficiency. It also requires its three IOUs to submit detailed plans for siting, valuing, integrating, and managing demand-side resources. California's total point score of 82 is nine points higher than #2 Illinois, and 17 points higher than #3 Texas.

**2 ILLINOIS**, with a score of 73, is ranked second overall. The state ranks second in State Support and third in Customer Engagement and Grid Operations, with its best ranking ever in the latter category. Illinois began aggressively planning in early 2017 for the utility of the future by initiating the NextGrid initiative, which aims to examine the use of new technologies to improve the state's electric grid while minimizing energy costs to consumers.

**3 TEXAS** remains ranked #3, with a score of 65. It ranks second in Grid Operations, sixth in State Support, and seventh in Customer Engagement. Distribution utilities in Texas – such as CenterPoint Energy, Oncor, and Bandera Electric – have developed innovative customer engagement strategies that leverage investments in AMI. These AMI investments have served as a basis for new advancements in the optimization of grid operations and storm restoration efforts through new analytical tools that mine meter information. In addition, Austin Energy is currently working on integrating solar and storage with advanced inverters and communication tools through its Austin SHINES project.

**4 MARYLAND**, with a score of 58, repeats its fourth-place performance from GMI-3. Like its neighbors and fellow top 10 finishers Delaware and the District of Columbia, Maryland ranks highest in Grid Operations, placing fifth in the category. Customer Engagement is also a strong suit, where the state comes in eighth. Maryland's lowest-ranking performance is in State Support (13th), though some initiatives recently underway could start to reverse that trend. The Maryland Public Service Commission launched a "targeted review" of the state's electric distribution system in 2016, and in March 2017 lawmakers enacted a tax credit for energy storage systems.

**5 OREGON** moves up two spots to #5, having made impressive gains in the past few years. It ranked #17 overall in GMI-2. For the first time, Oregon now ranks in the top 10 in both Customer Engagement and Grid Operations. In recent years, the state's legislature has taken on an active role with respect to grid modernization, having instituted an energy storage mandate, increased the state's RPS to 50% by 2040, and directed the PUC to examine how utilities operate and are regulated.

**6 ARIZONA** has risen three spots to #6, with a score of 56. Arizona notably experienced a rise in its State Support ranking, from #19 in GMI-3 to #10. It has begun to focus on integrating DERs, in particular solar and battery storage, resources which the major IOUs are beginning to consider more aggressively. The state's Residential Utility Consumer Office in 2016 proposed a Clean Peak Standard, which would mandate that a percentage of peak demand energy be supplied by renewable and/or distributed resources.

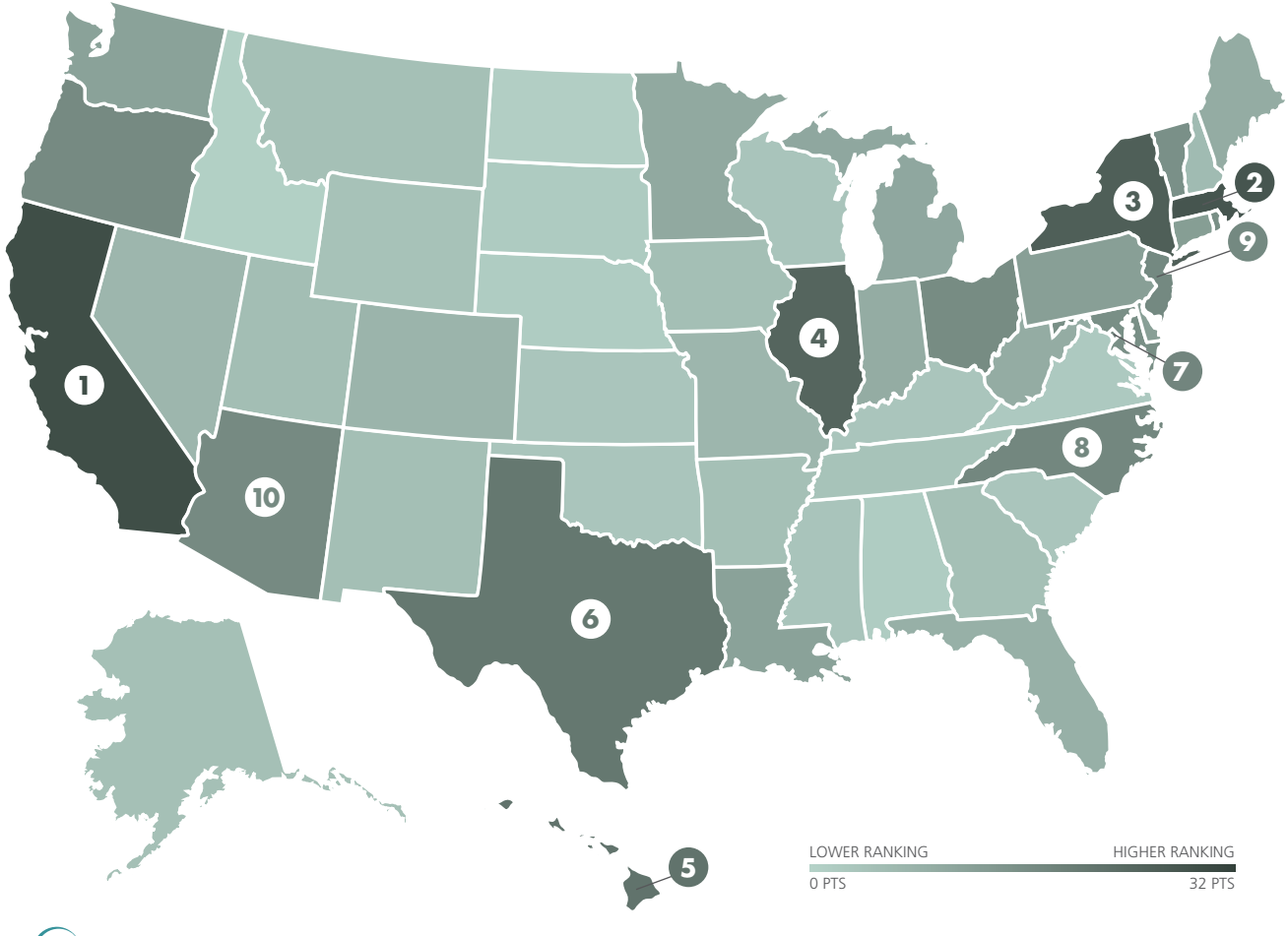
**7 THE DISTRICT OF COLUMBIA** ranks #7, with a score of 54. The District of Columbia rose to #7 in State Support and #3 in Grid Operations, both all-time highs. The District's Modernizing the Electric Delivery System for Increased Sustainability initiative continues to make progress: in January 2017, DC Public Service Commission staff proposed definitions for various generation sources, and parameters and timelines for pilot projects. This proceeding continues to evolve based on feedback provided by industry stakeholders.

**8 NEW YORK** now ranks #8 with a score of 51, rising eight spots while adding nearly 10 points to its score. This is largely due to a shift from planning to implementation of its REV initiative, which was initiated in 2014. GMI-4 represents New York's best performance in each category, as well as its best overall ranking. It rose four spots in State Support to #3, and its funding for energy storage and advanced demand response helped it rise 11 spots in Grid Operations to #16. The Brooklyn/ Queens Demand Management efforts by ConEd are a good example of an innovative approach to grid modernization, as is the New York Power Authority's initiative to become the country's first "digital" utility.

**9 NEVADA** ranks #9 overall with 50 points, a five-point increase from GMI-3. Customer Engagement has always been Nevada's strong point, where it has finished fourth in all four editions of the GMI. Nevada may be poised to improve on its #29 ranking in State Support. Gov. Brian Sandoval in 2017 signed bills reinstating net metering, incentivizing storage and EVs, creating a green bank, and studying a possible energy storage mandate. Gov. Sandoval currently chairs the National Governors Association, and has recently launched a new initiative entitled Ahead of the Curve, which focuses on the impact of technology innovation on the energy sector.

**10 DELAWARE** ranks #10, with a score of 49. Delaware posts another strong showing in Grid Operations (#8) and a solid performance in State Support (#17). Transportation electrification is a strong suit for Delaware, where the state incentivizes homeowners and businesses to install EV charging stations, and the University of Delaware continues to develop and deploy vehicle-to-grid technology designed to leverage these installations.

# STATE SUPPORT



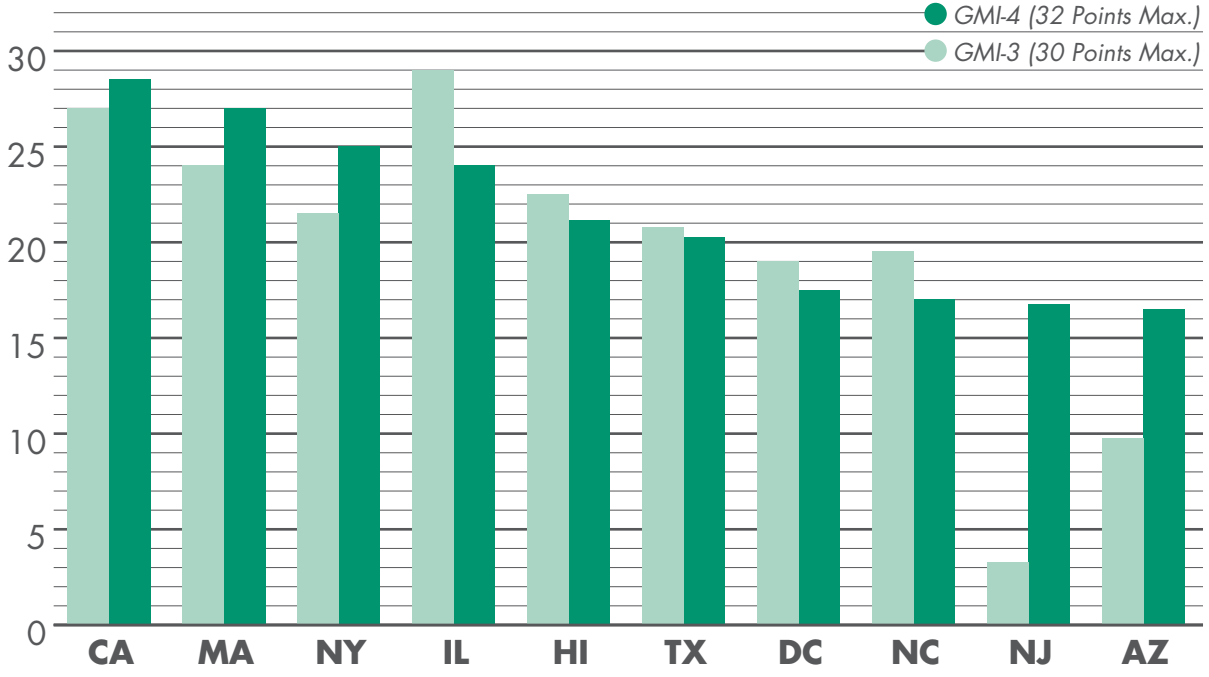

| RANK | +/- | STATE | LEADERSHIP SCORE |
|---|---|---|---|
| 1 | 1 | California | 28.5 |
| 2 | 1 | Massachusetts | 27.0 |
| 3 | 4 | New York | 25.0 |
| 4 | -3 | Illinois | 24.0 |
| 5 | 1 | Hawaii | 21.1 |
| 6 | 2 | Texas | 20.3 |
| 7 | 3 | District of Columbia | 17.5 |
| 8 | 1 | North Carolina | 17.0 |
| 9 | 31 | New Jersey | 16.8 |
| 10 | 9 | Arizona | 16.5 |
| 11 | -7 | Oregon | 16.3 |
| 12 | 8 | Ohio | 16.0 |
| 13 | -2 | Maryland | 15.5 |
| 13 | 19 | Rhode Island | 15.5 |
| 15 | -2 | Vermont | 15.3 |
| 16 | 2 | Connecticut | 12.5 |
| 17 | -3 | Delaware | 12.0 |
| 17 | -12 | Pennsylvania | 12.0 |
| 19 | 2 | Louisiana | 11.5 |
| 19 | 23 | Washington | 11.5 |
| 21 | -4 | Michigan | 10.3 |
| 22 | -7 | Minnesota | 10.0 |
| 23 | -11 | Indiana | 9.0 |
| 23 | 2 | Maine | 9.0 |
| 23 | 6 | West Virginia | 9.0 |
| 26 | 8 | Florida | 8.5 |
| 27 | -4 | Colorado | 7.5 |
| 28 | -12 | Missouri | 7.0 |
| 29 | -3 | Nevada | 6.8 |
| 30 | -8 | New Hampshire | 6.0 |
| 31 | -7 | Utah | 5.3 |
| 32 | -2 | Iowa | 5.0 |
| 32 | -4 | New Mexico | 5.0 |
| 34 | 1 | Arkansas | 4.8 |
| 34 | 4 | Montana | 4.8 |
| 36 | -3 | Alaska | 4.5 |
| 36 | 0 | Georgia | 4.5 |
| 38 | -11 | Wyoming | 4.3 |
| 39 | 9 | Tennessee | 4.0 |
| 40 | 7 | Mississippi | 3.8 |
| 40 | -3 | Wisconsin | 3.8 |
| 42 | -3 | Oklahoma | 3.5 |
| 43 | 3 | Kentucky | 3.4 |
| 44 | -13 | Kansas | 3.3 |
| 44 | -3 | South Carolina | 3.3 |
| 46 | -2 | Virginia | 2.5 |
| 47 | -2 | South Dakota | 2.3 |
| 48 | 3 | Alabama | 2.0 |
| 48 | -5 | Nebraska | 2.0 |
| 50 | 0 | North Dakota | 1.3 |
| 51 | -2 | Idaho | 0.9 |

# STATE SUPPORT OVERVIEW

The State Support category ranks states on their implementation of policies to advance and encourage grid modernization. Criteria in the category include specific plans, such as those that advance grid modernization, resiliency, and security; broad energy policies, such as RPS, energy efficiency resource standards, and carbon dioxide emissions goals; incentives and mandates for EVs, energy storage, and other technologies; and measures to ensure customer data privacy.

California, the overall Index leader, moves up one spot to first in this category in GMI-4. It supplants the previous State Support leader, Illinois, which drops to fourth after having taken the top spot in each of the first three versions of the GMI. Between them sit Massachusetts (#2) and New York (#3). Each of those states rises to its highest ranking ever in the category, as does #5 Hawaii. Rounding out the top 10 are Texas, the District of Columbia, North Carolina, New Jersey, and Arizona.

## FIGURE 3: GMI-4 STATE SUPPORT TOP 10 STATES (WITH GMI-3 AND GMI-4 SCORE COMPARISON)




*Source: Grid Modernization Index, GridWise Alliance and Clean Edge, Inc. NOTE: Compares State Support category scores for the top 10 State Support states in GMI-4. In GMI-3, released in January 2016, State Support was worth a maximum of 30 points. In GMI-4, it is worth 32 points.*

## STATE SUPPORT MAJOR THEMES AND TRENDS

- The highest-ranked states in this category are taking a more comprehensive approach to policies and regulatory proceedings that encourage grid modernization. Areas of primary focus include EVs, integration of DERs, energy storage, resiliency and reliability, cyber and physical security, and changes in regulatory models, including rate design structures.

- Incentives and mandates to encourage the deployment of energy storage technologies are becoming a popular policy option for supporting utility operations.

- Utilities are tailoring their modeling and planning efforts to meet increasingly aggressive EV infrastructure and RPS goals (50-100% renewables for some states).

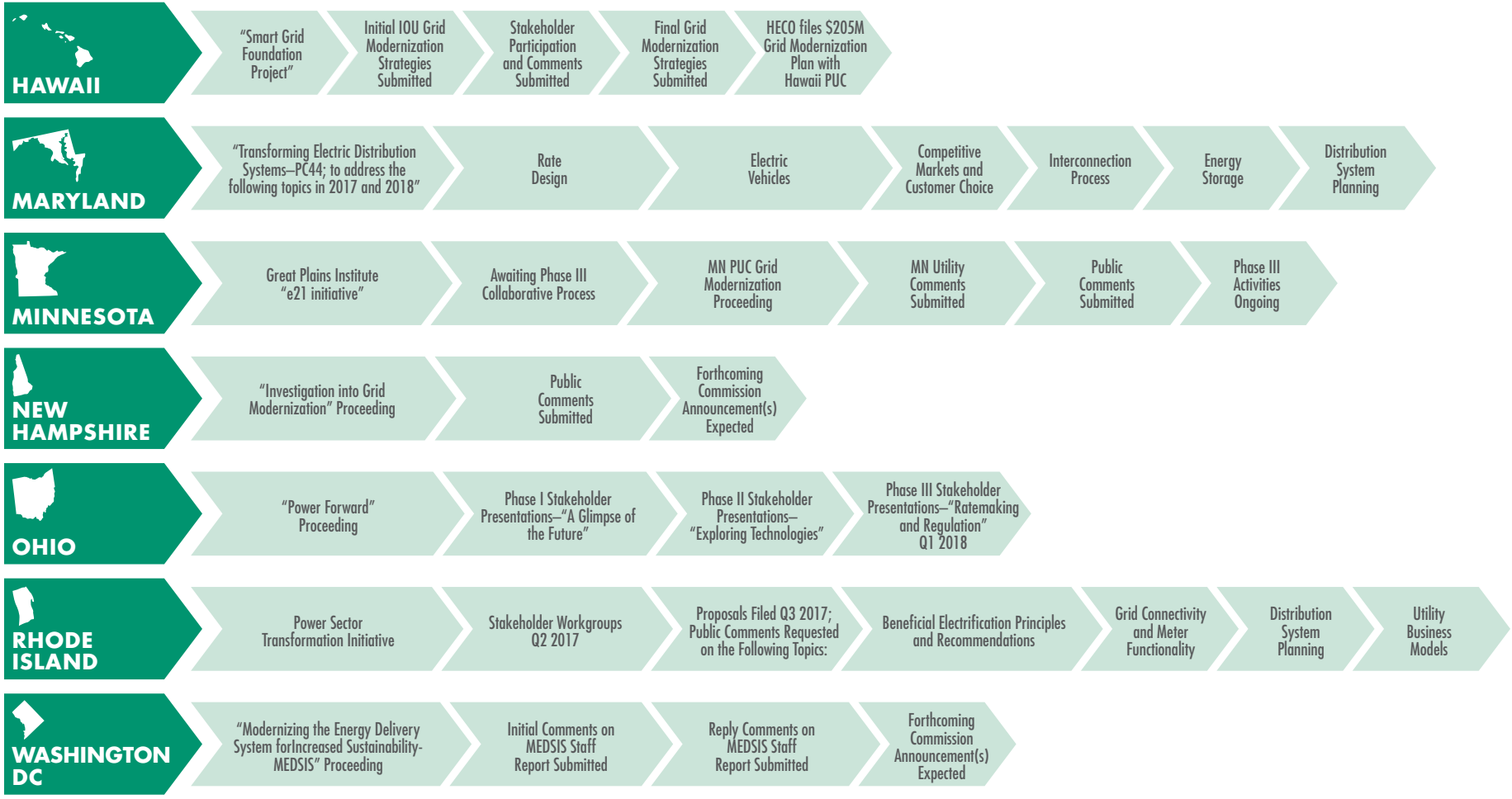
- Regulatory approval is a long process, requiring utilities to engage early and often with regulators and other stakeholders, and to articulate clear business cases for reform. However, general awareness of the need for grid modernization has increased among state energy offices, legislators, and commissions, resulting in an acceleration of activities.

- Significant education, outreach and technical assistance regarding these complex issues must continue for legislators, regulators, and staff.

Since 2013, the DOE has released three Voices of Experience documents, which offer grid modernization advice from utilities and regulators. One key point repeatedly emphasized is the need for states to have a grid modernization plan. GMI-4 shows that 17 states have both policies and strategies for grid modernization, while six states have either a strategy or a policy. In addition, 11 states require ESPs to submit grid modernization plans and report on the plans' progress; three additional states require ESPs to submit plans but not report on their progress. Finally, eight states have plans for the electrification of light duty vehicles, transit and municipal vehicles, and ports.

The ways in which states and utilities are preparing for the future is a key part of this category's scoring. GMI-4 asks whether states are planning for specific distributed technologies, providing credit for those taking proactive steps. Questions include whether states are examining how to leverage distributed generation (DG) and energy storage; whether states require ESPs to incorporate the impacts of DG, storage, or EVs into their resource planning; and whether they have policies allowing DR, DG, or storage to provide grid support.

# FIGURE 4: ACTIVE GRID MODERNIZATION PROCEEDINGS (SELECT STATE HIGHLIGHTS, AS OF OCTOBER 2017)




*Source: Compiled with information from E9 Insights*

Another important way that states can support grid modernization is to incentivize DERs, including renewable energy, energy storage, DR, energy efficiency, and EVs. California is the only state that incentivizes all of these sources. Massachusetts incentivizes all but DR. However, more than half of the states (28) receive at least half credit for this indicator, showing that incentives for distributed energy sources are becoming more widespread.

Energy storage incentives and mandates have received particular attention of late. A number of states have either instituted or examined a mandate for energy storage. California is a pioneer in this area: in 2013, its PUC approved a 1.3 GW-by-2020 storage mandate (more than 5 times the 231 MW of energy storage installed nationwide last year). Other states have followed, including Oregon and, more recently, Massachusetts and New York. Nevada is another state that could join this group, after Gov. Brian Sandoval signed a bill earlier in 2017 requiring regulators to consider a storage mandate. Plenty of other states that have not mandated energy storage have incentivized it in other ways, such as Maryland's new energy storage tax credit.

Other vital aspects of grid modernization are security and resilience. Cyber intrusions at more than one utility in recent years have exposed vulnerabilities in the nation's electric grid. Moreover, major hurricanes hit the U.S. in August and September 2017, resulting in widespread power outages in Texas, Florida, Puerto Rico, the U.S. Virgin Islands, and other areas. These events highlight the need for greater resilience from natural and human-caused events, which are expected to increase going forward.

Fifteen states have an energy resiliency plan, or are in the process of developing one. Nine states have mechanisms to incentivize increasing resiliency and reliability. Nine states have both a physical security plan as well as a cyber security plan, while four additional states have plans for one of the two. These results show that, while some states are actively preparing for threats, protection is by no means consistent, with more work needing to be done on these fronts.

The DOE's Voices of Experience research supports many of the findings in GMI-4, especially as it relates to how utilities and regulators interact. Among the key findings are that customers' expectations and desires to manage their energy usage are changing, grid modernization is not a one-size-fits-all process, and transparency and flexibility are important. The research also suggests actions to smooth the approval

## SPOTLIGHT: RHODE ISLAND

Rhode Island has taken an increasingly aggressive and comprehensive approach from both a policy and regulatory perspective to devise a new energy strategy for the state. Central to this approach was the adoption of Rhode Island's State Energy Plan. This plan, which was adopted in 2015, engages a broad group of stakeholders to build consensus around long-term planning in the state's energy strategy. This plan outlines decision making through 2035.

The thorough nature of Rhode Island's efforts to modernize its approach to energy planning is a key component of this effort. Although the objectives remain the same – retaining secure, low-cost, and sustainable energy for the state's citizens – this holistic approach to energy system planning, procurement, delivery, and regulation has unlocked new efficiencies and value streams that will continue to benefit both the state and the region.

In practice, this approach is being applied in the Rhode Island PUC's Power Sector Transformation Initiative. The initiative, which was begun at the direction of Gov. Gina Raimondo, is tasked with creating a new regulatory framework for Rhode Island's electric system. To that end, the PUC is engaging stakeholders to develop outcome-based solutions that address utility business models, distribution system planning, grid connectivity functionality, and strategic electrification of transportation and heating. This approach, and the emerging lessons from Rhode Island, will be important for other states interested in developing their own long-term planning strategies.

process for grid modernization plans, such as developing a well-researched, defensible budget, and making sure the business case being made to regulators is a clear, strong one.

## Rank Change Analysis

Nine states climbed at least five spots in this category since GMI-3, led by New Jersey's 31-place leap. At the other end of the spectrum are 10 states that dropped at least five spots from their previous ranking. (See map with rank changes on page 18.)

Of the three categories, the State Support rankings diverge the most from the overall Index results. Just six of this category's top 10 states appear in the top 10 overall rankings, whereas seven and eight states in Customer Engagement and Grid Operations, respectively, place in the top 10 overall. This could be the result of a time lag between states' implementation of grid modernization policies and their utilities' investments and activities resulting from them.

The Pacific Coast states perform well, with California and Hawaii both in the top 10, Oregon ranked #11, and Washington ranked #19. As a region, the East Coast rises to the top in this category, as well: nearly every state from North Carolina through New England ranks in the top 20, except for Maine (#23) and New Hampshire (#30). Meanwhile, the Southern states and the Great Plains tend to perform poorly, while many Great Lakes and interior West states rank in the middle.

On the whole, State Support scores are on the rise, particularly for states in the middle and lower tiers of the category. In GMI-3, the average state score was 33% of the total available points in the category. While that number declined to 31% in GMI-4, what is more illustrative is the increase in median category scores. The median state in GMI-3 received 25% of all possible points, while in GMI-4, the median rose to 27%.

Each state is acting in its own way and at its own pace. New York and other states have undertaken substantial grid modernization proceedings and comprehensive changes, while others are moving in a more piecemeal fashion, looking only at certain aspects of the grid. This diversity emphasizes the fact that there is no one-size-fits-all approach to grid modernization.

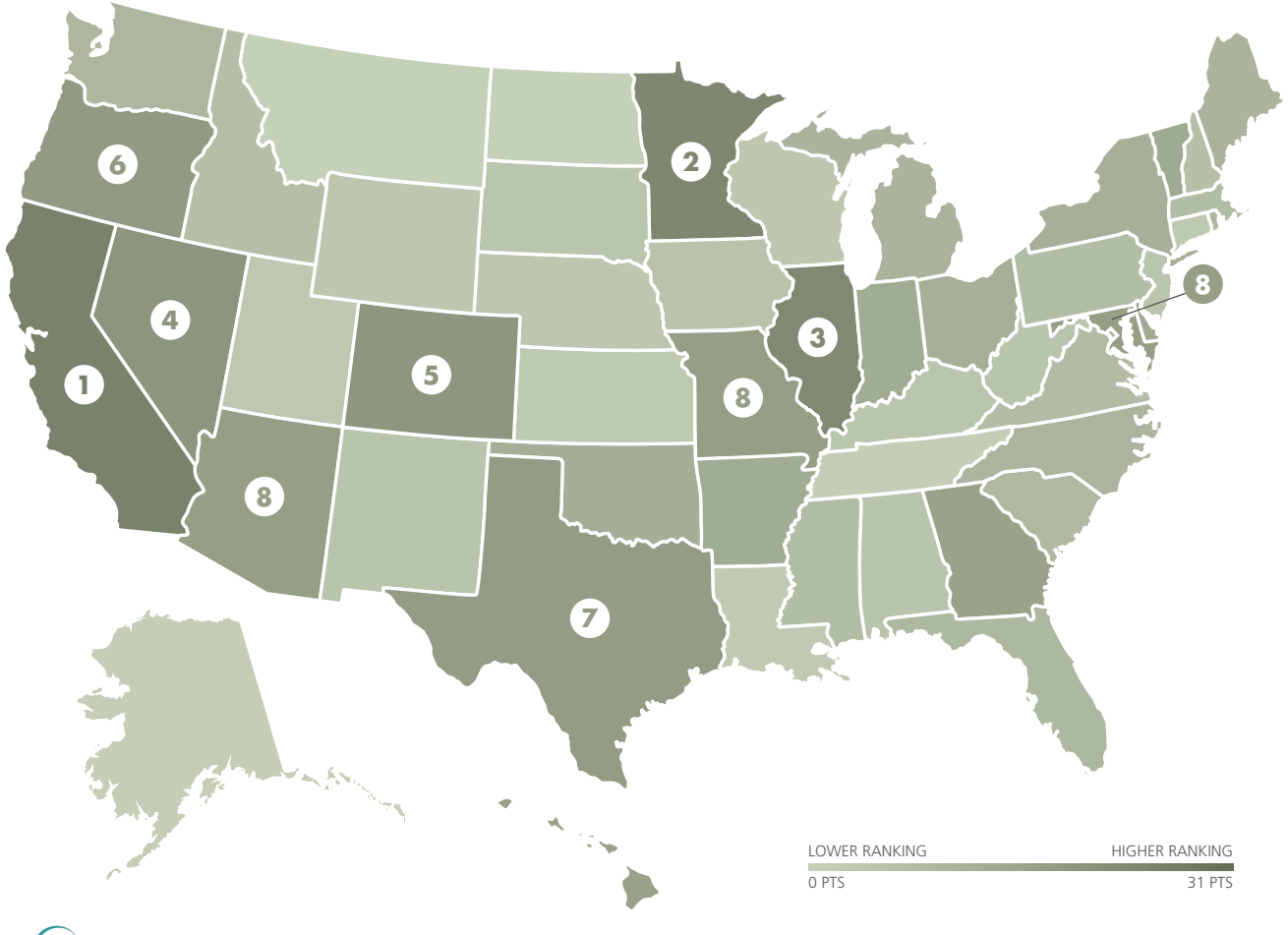
### SPOTLIGHT: MASSACHUSETTS

In June 2014, the Massachusetts Department of Public Utilities (DPU) was one of the first state commissions to require each of the state's electric distribution companies to develop and implement 10-year grid modernization plans. In requiring these plans, the DPU sought the following benefits: empowering customers to better manage and reduce electricity costs; enhancing the reliability and resiliency of electricity service in the face of increasingly extreme weather; encouraging innovation and investment in new technology and infrastructure; and addressing climate change with clean energy requirements.

In June 2017 with House Bill 1725, the Massachusetts legislature looked to accelerate these activities and require utilities to consider non-wires alternatives as part of their investment plans. This approach would encourage the deployment of more DERs. An additional proposal asked that utilities be required to file their modernization plans every five years rather than 10.

In addition, the Massachusetts Department of Energy Resources (DOER) recently established an energy storage procurement target of 200 MW by 2020. The announcement of the DOER target followed a lengthy stakeholder process that engaged numerous industry participants.

# CUSTOMER ENGAGEMENT



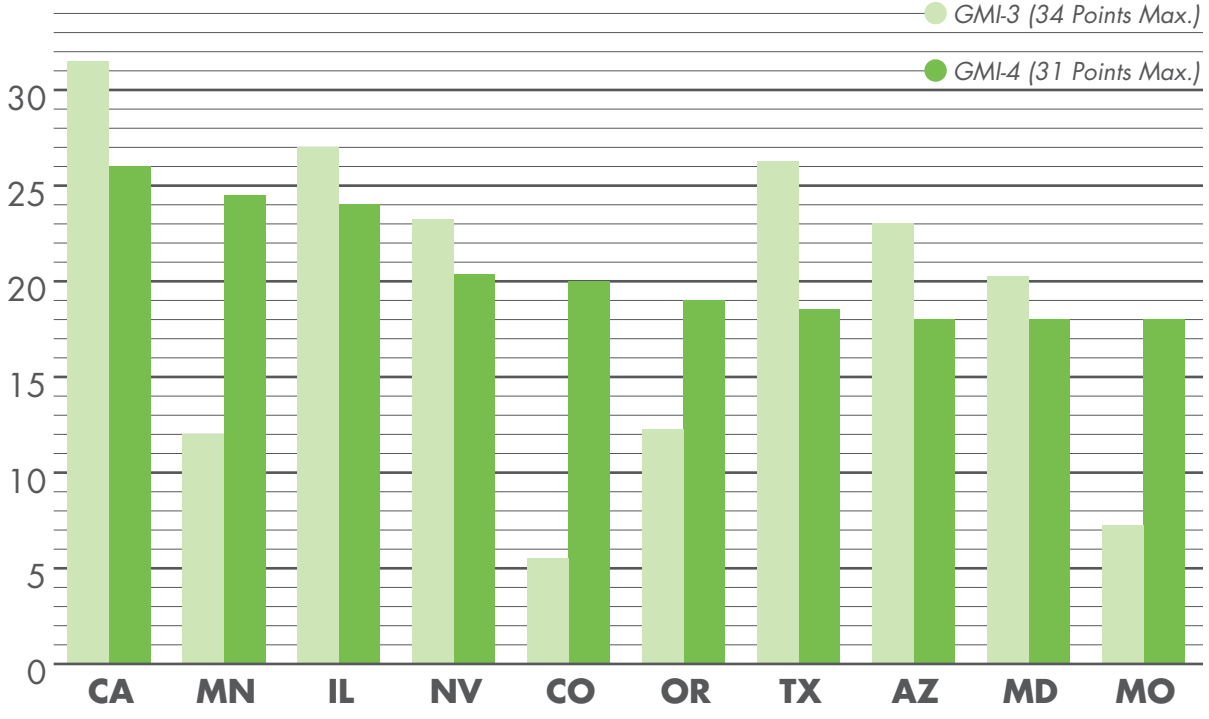

| RANK | +/- | STATE | LEADERSHIP SCORE |
|---|---|---|---|
| 1 | 0 | California | 26.0 |
| 2 | 15 | Minnesota | 24.5 |
| 3 | -1 | Illinois | 24.0 |
| 4 | 0 | Nevada | 20.4 |
| 5 | 28 | Colorado | 20.0 |
| 6 | 9 | Oregon | 19.0 |
| 7 | -4 | Texas | 18.6 |
| 8 | -3 | Arizona | 18.0 |
| 8 | -1 | Maryland | 18.0 |
| 8 | 19 | Missouri | 18.0 |
| 11 | -1 | Hawaii | 17.1 |
| 12 | -3 | Georgia | 16.5 |
| 13 | -1 | Vermont | 14.3 |
| 14 | -8 | Delaware | 14.0 |
| 15 | 14 | Indiana | 13.7 |
| 15 | 2 | Arkansas | 13.7 |
| 17 | -9 | Oklahoma | 12.6 |
| 18 | 2 | New York | 12.0 |
| 18 | 5 | Ohio | 12.0 |
| 20 | -9 | District of Columbia | 11.0 |
| 20 | -2 | Michigan | 11.0 |
| 20 | -9 | Maine | 11.0 |
| 23 | -1 | North Carolina | 10.7 |
| 24 | 2 | Washington | 10.0 |
| 25 | -4 | Florida | 9.7 |
| 26 | 19 | Rhode Island | 9.5 |
| 27 | -2 | South Carolina | 9.2 |
| 28 | -14 | Virginia | 8.4 |
| 29 | 12 | Massachusetts | 8.0 |
| 29 | 21 | Mississippi | 8.0 |
| 29 | -13 | Pennsylvania | 8.0 |
| 32 | -9 | Idaho | 7.0 |
| 33 | -5 | New Hampshire | 6.7 |
| 34 | 10 | New Jersey | 6.0 |
| 35 | -3 | Iowa | 5.7 |
| 36 | -6 | New Mexico | 5.5 |
| 36 | 0 | West Virginia | 5.5 |
| 38 | -7 | Alabama | 5.3 |
| 39 | -4 | Kentucky | 5.0 |
| 39 | -6 | South Dakota | 5.0 |
| 41 | 2 | Wisconsin | 4.2 |
| 42 | 4 | Nebraska | 4.0 |
| 42 | -3 | Wyoming | 4.0 |
| 44 | -6 | Utah | 3.7 |
| 45 | -8 | Kansas | 3.5 |
| 45 | -7 | Connecticut | 3.5 |
| 47 | -5 | Louisiana | 3.0 |
| 48 | -1 | Alaska | 1.5 |
| 48 | 1 | Tennessee | 1.5 |
| 50 | 1 | North Dakota | 1.0 |
| 51 | -3 | Montana | 0.8 |

# CUSTOMER ENGAGEMENT OVERVIEW

The Customer Engagement category ranks each state according to how well its utilities involve their customers in smart grid programs. This category encompasses a range of topics including the availability of different electricity pricing schemes; pricing for DER adoption; methods utilities use to communicate with their customers; and how customer data is used, both by customers and utilities.

Among the category's top 10 states, Customer Engagement efforts have vaulted several states to dramatic gains in the rankings from GMI-3. Although California repeats as the four-time category leader by earning 26 of a possible 31 points, four other leading states climbed at least nine places in the rankings. Minnesota comes in second, having jumped 15 spots since GMI-3. The other three are Colorado (up 28 places to #5), Oregon (#6, a nine-spot leap), and Missouri (up 19 spots to tie for eighth). The remainder of the top 10 is composed of Illinois (#3), Nevada (#4), Texas (#7), and Arizona and Maryland (both tied with Missouri at #8).

## FIGURE 5: GMI-4 CUSTOMER ENGAGEMENT TOP 10 STATES (WITH GMI-3 AND GMI-4 SCORE COMPARISON)




*Source: Grid Modernization Index, GridWise Alliance and Clean Edge, Inc. NOTE: Compares Customer Engagement category scores for the top 10 Customer Engagement states in GMI-4. In GMI-3, released in January 2016, Customer Engagement was worth a maximum of 34 points. In GMI-4, it is worth 31 points.*

## CUSTOMER ENGAGEMENT MAJOR THEMES AND TRENDS

- Leading utilities are offering customized energy programs and enhanced service levels that leverage foundational investments in AMI and apply data analytic frameworks to deliver new value streams to customers. Examples of such benefits include automatic system connection and disconnection, new approaches to outage status updates, and fault detection.

- Utilities are tailoring innovative communication strategies and programs to meet the requirements of increasingly diverse, engaged, and informed customer classes. At the same time, all customers are expecting faster recovery and new communications strategies from utilities to address wide-scale outages.

- Extreme weather events are causing many customers, including hospitals and military facilities, to demand greater reliability and resilience (such as backup generators and microgrids) to protect critical infrastructure.

- Successful programs are increasingly based on broader community input and outreach, leveraging external stakeholder groups and focusing on customers' needs.

One of the key aspects of any customer engagement program is communication. Participants in the DOE's Voices of Experience series emphasized communicating with your customers, particularly in the design and rollout of smart grid programs. As some respondents pointed out, grid modernization is a cultural change, both for customers and for utilities, whose workforces likely need to go through their own changes to adjust to a modernized grid. They also emphasize carefully crafting a utility's message, and then using multiple channels to roll it out. Glendale Water and Power in California, for example, created communication materials in multiple languages, then used multiple avenues (such as websites, newsletters, videos, and in-person events) to spread its customer engagement messaging.

The GMI asks whether utilities have conducted customer outreach campaigns to educate consumers on new capabilities and programs associated with grid modernization investments. Fifteen states receive full credit on this question, meaning utilities not only conduct, but also measure and track the success of such programs in order to continually improve them. Seven more receive at least partial credit. The indicator tracks well with the category results: of the 22 states receiving at least half credit, all but three (Florida, Idaho, and Virginia) rank within the top 22 states in the category.

Meanwhile, the states with less utility outreach generally place in the lower half of the category rankings. Customer outreach and education is a clear hallmark of utilities that engage well with their customers.

One lesson that comes out of the Voices of Experience process speaks to how utilities should conduct their outreach. The move to a smarter, modernized grid marks a significant change from how people are used to producing and consuming energy, Because of this, stakeholders stressed the importance of using community groups and other "ambassadors" to conduct education and outreach regarding new grid modernization programs and their consumer benefits. Examples range from community-based non-profits, to clean technology business groups, to a utility's own employees. Entergy New Orleans, for instance, partnered with seven local non-profit organizations to conduct outreach for its SmartView pilot project, which helps low-income customers use AMI to reduce their energy usage.

Leading utilities are also getting more information from their customers, and then using it to help craft outreach regarding new pricing programs. Fifteen states use their customer segmentation abilities to offer customized rate/pricing programs to their customers. Seven additional states use segmentation to better communicate with and understand their various customer classes. Data access runs two ways: nine states allow their residents to access their own usage data on at least a daily basis, as well as allowing third parties to access the same data. An additional 15 states allow either customers or third parties to access data, but not both.

This data is being used to offer a wide variety of rates and pricing programs, and not just to one class of customers. GMI-4 questions include asking utilities whether they offer dynamic pricing to their customers. These rate structures could include TOU/time-of-day rates, critical peak pricing, and real-time pricing schemes. Such rates encourage ratepayers to curtail usage during high-price periods, either by conservation or load shifting. Utilities in only four states offer such rates to residential customers and some commercial customers. These include the category's three highest-ranked states in California (which will mandate default TOU rates in 2019), Minnesota, and Illinois, along with #7 Texas. Dynamic pricing programs are more prevalent on the commercial side, as utilities in 25 states offer them to non-residential ratepayers.

## SPOTLIGHT: **NEVADA**

In February 2016, Nevada Gov. Brian Sandoval reconvened the state's New Energy Industry Task Force (NEITF), a group of diverse stakeholders from across Nevada's energy ecosystem. The Task Force's primary purpose is to advise Nevada's Office of Energy on approaches to promote renewable energy development and the deployment of DERs.

This policy-focused approach will frame Nevada's decision-making strategies and specifically address the following outcomes: encourage development of clean energy sources and integrate renewable energy technologies into Nevada's energy sector; help create a modern, resilient, and cost-effective energy grid; and support distributed generation and storage, with a specific focus on rooftop solar and net metering.

In September 2016, after numerous stakeholder meetings on a variety of topics, the NEITF provided a list of final recommendations to Sandoval for consideration. Some of these recommendations included requiring utilities to offer net metering to customer generators; modifications to the state's Integrated Resource Planning requirements to ensure greater diversity; promoting energy efficiency policies; consideration of new financing programs to encourage clean energy development; establishing limits on energy generated by fossil fuel sources; adopting new energy codes; and providing funding for demonstration projects that integrate DERs. A number of these recommendations were crafted into legislation and signed into law by Sandoval in early 2017.

DR programs, on the other hand, are much more popular. Utilities in 37 states offer DR programs to at least some of their customers. Utilities in 21 states have DR programs for three of the four major customer classes: large, medium, and small commercial and industrial (C&I), and residential. An additional 16 states have DR offerings for one or two of these customer classes.

Grid modernization technologies and capabilities available to utilities (like AMI and data analytics) also enable them to incentivize customer-owned DERs. These resources include EVs, storage, rooftop solar, small-scale wind, and fuel cells. GMI-4 shows that only nine states (including eight of the category's 15 highest-ranked states) are directly encouraging DER adoption through pricing programs among large C&I customers.

## Rank Change Analysis

Of the three GMI categories, Customer Engagement has experienced the largest improvement over the previous GMI. In GMI-3, the average state score was only 29% of the maximum, and the median score just 22%. Both of those figures were the lowest among the three categories in GMI-3. In GMI-4, however, the average state score was 33% of the maximum points, and the median score jumped more than seven percentage points to 31%. These results clearly show that states and ESPs have put a premium on engaging their customers in new and better ways as part of their grid modernization efforts.

In all, seven states show score increases of at least five points along with rankings jumps of five spots or greater, the most of the three categories. Along with Minnesota, Colorado, Oregon, and Missouri, the others are Indiana (#15), Rhode Island (#26), and Mississippi (#29). Conversely, Delaware, Oklahoma, and the District of Columbia all drop at least five ranking spots in the category.

The West generally has performed best in Customer Engagement, with five states (California, Nevada, Colorado, Oregon, and Arizona) placing in the top 10 spots, as well as #11 Hawaii. The Great Lakes region stands out as well (among those states, only Pennsylvania and Wisconsin are not ranked in the top 25 in this category). States in the Great Plains, interior West, and South populate the bottom 10 states in the category.

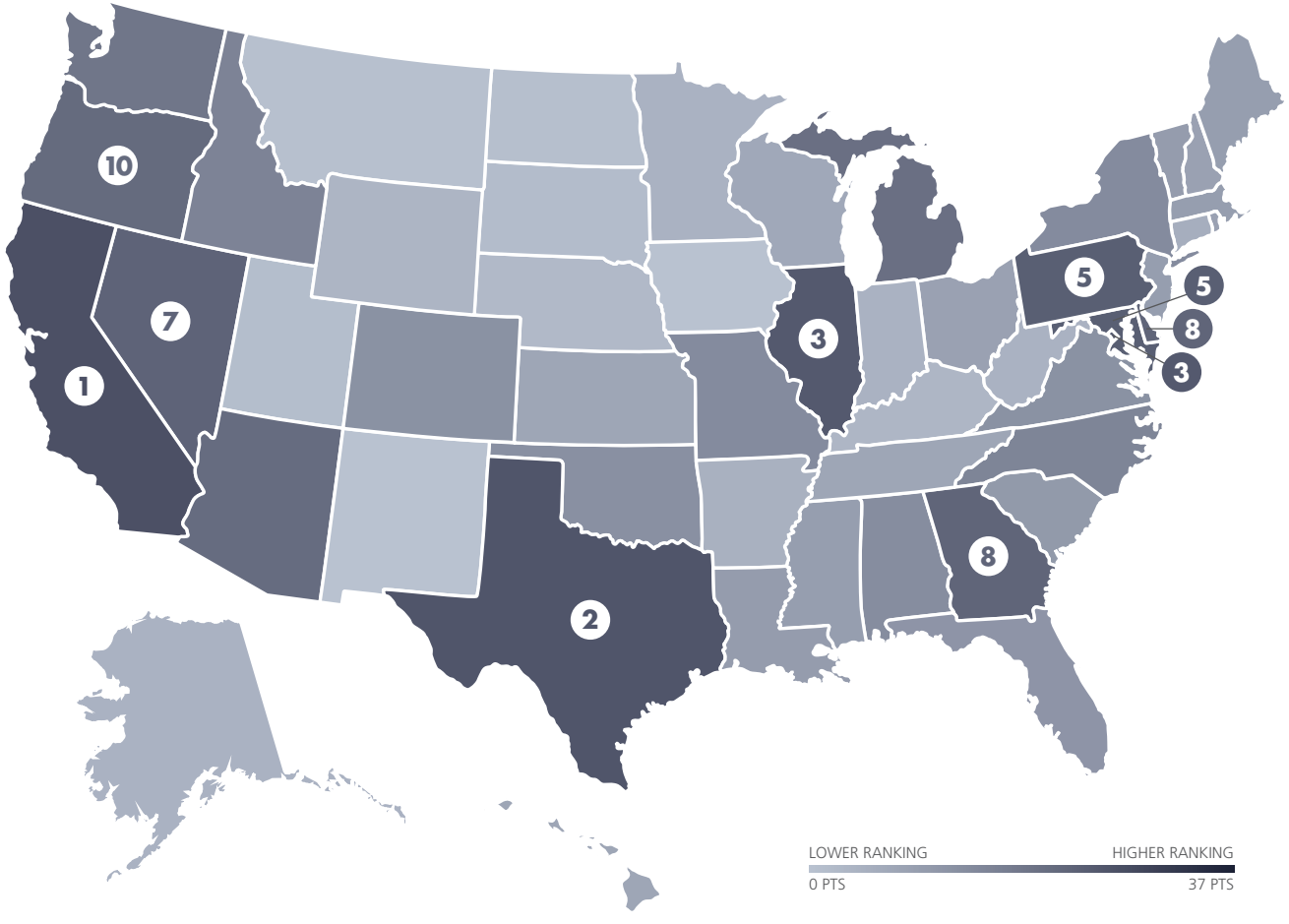
## SPOTLIGHT: **OREGON**

Oregon's efforts to encourage the modernization of its electric grid are advancing in parallel at both the legislative and regulatory level. In the summer of 2017, Oregon's House and Senate passed SB 978, which directs state regulators to review the impact of grid modernization through the deployment of new technologies, policies, and incentive structures. The legislation signed into law by Gov. Kate Brown requires Oregon's PUC to analyze potential changes to the state's regulatory model, as well as planning requirements for the state's electric utility companies.

A more nuanced change to Oregon's approach to grid modernization occurred with the PUC's amendment of Order No. 12-158 in late July. Prior to the Commission's amendment, Order No. 12-158 directed the state's three largest electric utility companies – Portland General Electric (PGE), Pacific Power, and Idaho Power – to file yearly smart grid reports. These reports will now be submitted biennially. PGE in recent Commission filings notes that the utility has completed or is in late-stage planning to support more than 50 grid-related modernization initiatives across its operating footprint. The Commission envisions that this reporting change will allow more time to execute long-term examination of initiatives like these and of potential investments and their impacts on consumers.

Oregon's Department of Energy has also worked collaboratively with the NGA's Center for Best Practices as one of four states participating in a 16-month long, energy-focused policy academy. The academy's goal is to provide deep technical assistance for states considering grid modernization, with an eye toward increased system resilience and increased penetration of renewables.

# GRID OPERATIONS




| RANK | +/- | STATE | LEADERSHIP SCORE |
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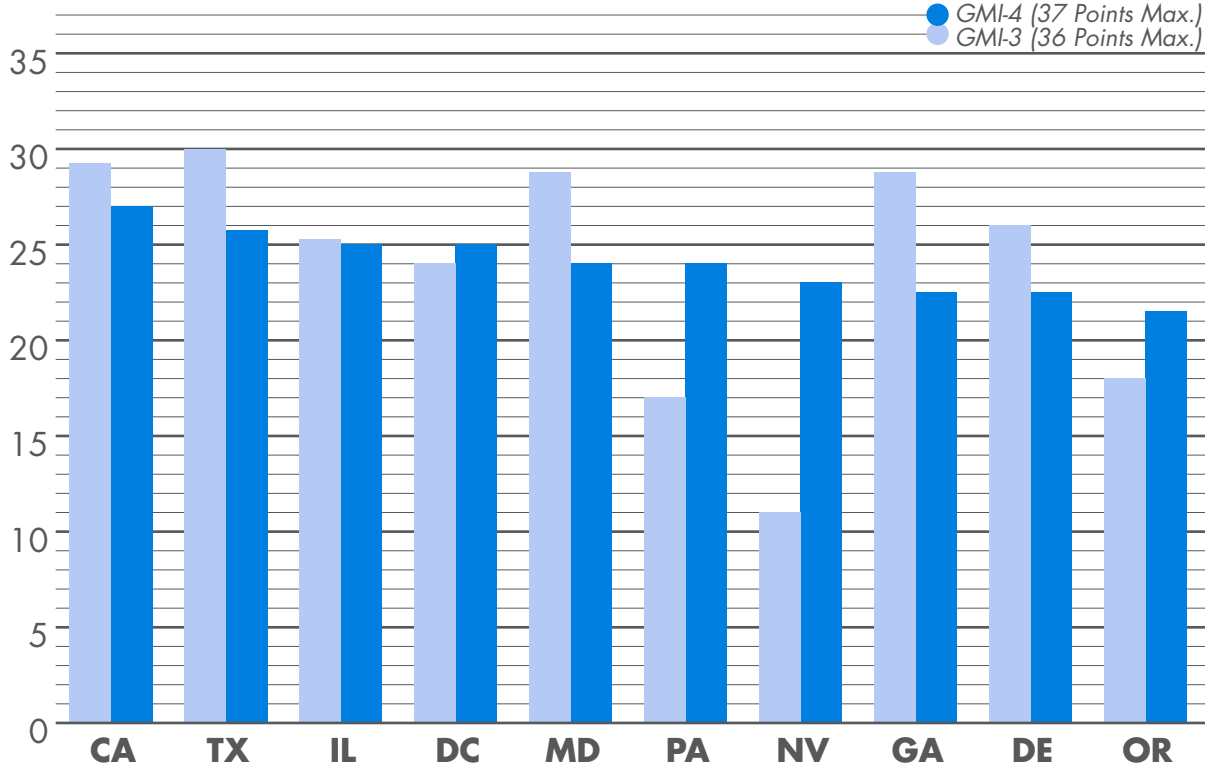
| 3 | 3 | Illinois | 25.0 |
| 5 | -2 | Maryland | 24.0 |
| 5 | 10 | Pennsylvania | 24.0 |
| 7 | 16 | Nevada | 23.0 |
| 8 | -3 | Delaware | 22.5 |
| 8 | -4 | Georgia | 22.5 |
| 10 | 4 | Oregon | 21.5 |
| 11 | 0 | Arizona | 21.0 |
| 12 | 0 | Michigan | 20.5 |
| 13 | 6 | Washington | 19.0 |
| 14 | 6 | Idaho | 16.0 |
| 15 | -2 | North Carolina | 15.6 |
| 16 | 5 | Missouri | 14.0 |
| 16 | 11 | New York | 14.0 |
| 18 | -8 | Alabama | 13.8 |
| 19 | -1 | Oklahoma | 12.9 |
| 20 | 23 | Colorado | 12.5 |
| 20 | -3 | Virginia | 12.5 |
| 22 | -14 | Florida | 11.8 |
| 23 | 2 | South Carolina | 10.7 |
| 24 | -8 | Vermont | 10.1 |
| 25 | 9 | Louisiana | 9.9 |
| 26 | 12 | Massachusetts | 9.8 |
| 27 | 3 | Maine | 9.5 |
| 27 | -5 | Mississippi | 9.5 |
| 27 | -18 | New Jersey | 9.5 |
| 30 | 19 | Rhode Island | 9.0 |
| 31 | -2 | New Hampshire | 8.9 |
| 32 | -4 | Ohio | 8.8 |
| 33 | 0 | Hawaii | 7.8 |
| 34 | -3 | Kansas | 7.7 |
| 34 | -8 | Tennessee | 7.7 |
| 36 | -1 | Wisconsin | 7.1 |
| 37 | -5 | Connecticut | 5.4 |
| 38 | -1 | Arkansas | 4.7 |
| 39 | -3 | West Virginia | 4.5 |
| 40 | 2 | Alaska | 4.3 |
| 40 | 0 | Indiana | 4.3 |
| 40 | -16 | Minnesota | 4.3 |
| 43 | 1 | Wyoming | 3.6 |
| 44 | -3 | Kentucky | 3.2 |
| 45 | 2 | Nebraska | 2.5 |
| 46 | -7 | South Dakota | 1.8 |
| 47 | -2 | Utah | 1.5 |
| 48 | 2 | North Dakota | 1.0 |
| 49 | -3 | Montana | 0.8 |
| 50 | -2 | New Mexico | 0.5 |
| 51 | 0 | Iowa | 0.0 |

# GRID OPERATIONS OVERVIEW

The Grid Operations category measures utilities on their deployment of grid modernization technologies and capabilities. This includes AMI, which is a foundational technology that enables grid modernization, as well as automated system management platforms and other communications, visibility, and control equipment. Grid Operations was split into three sections in the data collection portal: AMI, transmission, and distribution. As previously noted, as a result of feedback provided during the data collection process, GridWise team members determined that the questions focused on transmission operations would yield inconsistent results and were therefore removed from GMI-4 scoring. The transmission questions will be re-evaluated prior to initiating data collection for GMI-5.

California is the top Grid Operations state for the first time in GMI history, with a category score of 27. Texas led the category in GMI-3, but drops to second in this edition, returning to the same spot where it finished in the first two editions of the GMI. Illinois

## FIGURE 6: GMI-4 GRID OPERATIONS TOP 10 STATES (WITH GMI-3 AND GMI-4 SCORE COMPARISON)




*Source: Grid Modernization Index, GridWise Alliance and Clean Edge, Inc. NOTE: Compares Grid Operations category scores for the top 10 Grid Operations states in GMI-4. In GMI-3, released in January 2016, Grid Operations was worth a maximum of 36 points. In GMI-4, it is worth 37 points.*

## GRID OPERATIONS MAJOR THEMES AND TRENDS

- AMI remains a critical, foundational component of a modernized grid, with leading utilities implementing AMI programs that support diverse operational improvements and capture a wide range of customer benefits.
- More data from AMI, sensors, and new IT systems provide rich data streams for advanced analytical tools that enable enhanced decision-making capabilities. Visibility from these technologies enables utilities to improve performance across various utility functions, including customer service, metering, distribution, outage management, asset management, and market operations.
- New technologies and systems are being deployed incrementally, with utilities waiting until they can demonstrate the value of such technologies and systems, and proficiency using them, before adopting them on a more widespread basis.
- The increased penetration of DERs has made grid operations more complex. New software platforms and control systems are being deployed by a diverse group of utilities to automate grid operations and increase system efficiency and situational awareness.

and the District of Columbia tie for the third spot, and are followed by another tie between Maryland and Pennsylvania for fifth. Nevada finishes seventh, followed by Delaware and Georgia in a tie for eighth, with Oregon rounding out the top 10.

Although many ranking changes have occurred in GMI-4, the top 10 states in Grid Operations have remained relatively consistent over time. Of the top 10 Grid Operations states in GMI-4, only two – #7 Nevada and #10 Oregon – have ever finished worse than 15th in the category. The average state score in this category was just 31% of total category points, while the median state receives 26% of points.

One lesson that emerges from the Grid Operations results is the critical role of AMI, which remains an important component of a modernized electric system. Utilities in the highest-ranked states do a better job leveraging AMI for additional functionality and services. Specifically, in addition to asking what percentage of customers have advanced meters, the GMI queries utilities on their overall utilization of smart meters. Uses can include remote connect/disconnect and meter reading, enhancing the connection process, and integrating these technologies with other utility operating systems.

The eight states with the highest combined scores on these six AMI questions happen to be eight of the nine highest-scoring states in the category. More importantly, seven of those eight are in the top 10 overall GMI-4 rankings (and the eighth, Pennsylvania, is #13 overall). Delaware, the District of Columbia, Illinois, and Maryland receive the highest possible scores on the AMI questions. These states are using AMI to unlock customer data and to explore the capabilities it enables, like dynamic pricing.

Another key lesson involves the importance of visibility as a way to predict and control what is happening on utilities' distribution systems (particularly as DER penetrations rise). This also includes communications among distribution technologies. The GMI poses seven questions asking how states and their ESPs utilize geographic information system (GIS), analytics, and communications architecture to maintain the "health" of their distribution system.

In all, 17 states earn half or more of the available points on these questions, and all rank in the top 27 in the Grid Operations category. Seven of the nine top-performing states on this set of questions also rank in the top 10 in the category (the exceptions being #12 Michigan and #13 Washington). These results show that forward-thinking states are leveraging such technology to increase visibility into the grid, remove self-made reporting silos, and enable cross-system communications.

Another focus of states that perform well in this category has been the use of broadband networks. Leading utilities are installing broadband networks with increased security and monitoring to prepare for more robust operationalization of cloud-based services. The GMI asks five questions that get to the heart of this issue, such as whether states are using advanced visualization, asset optimization and utilization analytics, and whether interoperability standards are in place. Eleven states get at least half of the available points for this set of questions, and once again the category leaders rise to the top: all 11 of these states rank among the top 14 in the category.

GMI-4 also reports on specific issues surrounding DER integration, such as whether utilities have deployed EVs and EV charging infrastructure and behind-the-meter energy storage. None of these practices are ubiquitous at the utility level. Texas is the only state to get full credit for smart integration of EV charging. Six other states – California, the District of Columbia, Maryland, Missouri, Oregon, and Washington – get

## SPOTLIGHT: **COLORADO**

In June 2017, the Colorado PUC endorsed a pilot revenue decoupling program and large grid modernization investment proposal from Xcel Energy, the state's largest IOU. Under the terms of the program, which is targeted at residential customers, the PUC will establish annual revenue targets for Xcel. Any revenue that exceeds the established target will be applied to reducing rates the following year, while surcharges to customers will be added if the target is not achieved. The Commission asserted that this approach would encourage the expansion of energy efficiency programs and the deployment of DERs.

The grid modernization investments approved as part of Xcel's proposal include $193.7 million for integrated volt/VAR optimization and $418.7 million for the deployment of AMI. In addition to the AMI investment, the Commission also approved a TOU rate pilot. These investments are expected to be made between 2019 and 2024.

These efforts align with similar programs being executed by the state's public power authorities, electric cooperatives, and local utilities, most notably the Platte River Power Authority. Platte River operates utilities that serve the cities of Estes Park, Fort Collins, Longmont, and Loveland. Under Platte River's current 10-year strategic resource plan, the utility will expand energy efficiency programs, deploy additional renewable and distributed resources, and institute new pilot programs for DR.

half credit on the question. No state gets full credit for smart integration of DG and storage. Seven states get half credit; five of them are also among those receiving half credit for EV smart charging integration.

Finally, GMI-4 ranks states on whether their utilities are using single- or multi-party microgrids, and for what purpose the microgrids are being used. At present only eight states get credit for utilizing single-party microgrids, and just four get credit for multi-party microgrids. New York is the only state that receives full credit for both. This should not be too surprising; an important part of the state's post-Superstorm Sandy resiliency strategy and implementation of its REV initiative has been supporting and funding microgrid projects across the state. With the recent hurricanes and other extreme weather events, efforts to expand the use of microgrids are expected to increase nationwide.

## Rank Change Analysis

A handful of states that had previously ranked highly in Grid Operations have slid over time. Virginia was #1 in the category in the first two GMIs, but fell to #17 in GMI-3, and now to #20 in GMI-4. Florida, New Jersey, Ohio, and South Carolina show similar patterns. Southern states in particular were big recipients of federal ARRA grid modernization funds. This raises the question of what can be done to support states after federal funding cycles, which enable the deployment of pilots and demonstration projects, have been completed.

Seven Southern states – Georgia, North Carolina, Alabama, Virginia, Florida, South Carolina, and Louisiana – rank in the top 25. Mid-Atlantic states, including the District of Columbia, Maryland, Pennsylvania, and Delaware, also stand out as leaders.

# APPENDIX A

## GMI-4 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)
- Energy Resiliency Plan (1)
- Workforce Development (1)
- Energy in Economic Development Plan (1)

### CUSTOMER ENGAGEMENT

- 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)

### 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)

# APPENDIX B

## GMI-4 Project Team Members

GridWise could not have developed this GMI without the active participation of its members, who comprise the GMI Project Team. Without their diligence and hard work, the GMI would not be possible.

**John Alford** Accenture
**Donna Attanasio** George Washington University Law School
**Mina Badtke-Berkow** Environmental Defense Fund (EDF)
**Tom Bonner** Exelon – PECO
**Eileen Brannon** Oncor
**Cameron Brooks** E9 Insights
**Christopher Budzynski** Exelon
**Ward Camp** East Fork Group
**Mike Cochran** PacifiCorp
**Katie Conway** Alaska Energy Authority
**John Crawford** Rappahannock Electric Cooperative
**Charles DeBerry** Accenture
**Anita Decker** Northwest Public Power Association
**Keith Dodril** National Energy Technology Laboratory
**Stacey Donohue** Idaho Public Utility Commission
**Dan Francis** American Electric Power
**Bryan Garcia** Connecticut Green Bank
**Rick Geiger** ICF Consulting
**John Gibson** Avista
**Erik Gilbert** Navigant Consulting
**Heather Hall** Exelon – Pepco
**Wayne Harbaugh** Exelon – Baltimore Gas and Electric (BGE)
**Bob Jenks** Oregon Citizens' Utility Board
**Josh Keeling** Portland General Electric
**Joe Lenge** ConEdison
**Anne-Laure Leroyer** Aclara
**Jeff Malmen** Idaho Power
**Jillian Marwell** Exelon – Pepco
**Jesse Medlock** Oncor
**Alessandro Meynardi** Verizon
**Jessica Miley** Exelon
**Susan Mora** Exelon
**Diane Munns** EDF
**Quentin Nesbitt** Idaho Power
**Randy Nicholson** San Diego Gas & Electric Company
**Terry Oliver** Bonneville Power Authority (retired)
**Sean Peterson** Pacific Gas and Electric Company (PG&E)
**Mike Pezone** PG&E
**Carolyn Pharr** CenterPoint Energy
**Jennifer Pope** Idaho Office of Energy and Mineral Resources
**Bear Prairie** Idaho Falls Power
**Phil Precht** Exelon – BGE
**Will Price** Eugene Water & Electric Board
**Scott Pugrud** Idaho Office of Energy and Mineral Resources
**Gary Rackliffe** ABB
**Bilhuda Rasheed** Navigant Consulting
**Cheryl Roberto** TFC Utilities
**Heather Rosentrater** Avista
**Todd Ryan** Smart Wires
**Ronny Sandoval** EDF
**John Savage** Oregon Public Utility Commission
**Adam Schultz** Oregon Department of Energy
**Evan Shearer** Duke Energy
**Ed Sitar** Exelon – ComEd
**Tim Stanton** Navigant Consulting
**Chris Taylor** Exelon – Pepco
**Mary Vincent** Exelon – ComEd
**Warren Wang** Navigant Consulting

## GMI-4 Advisory Committee

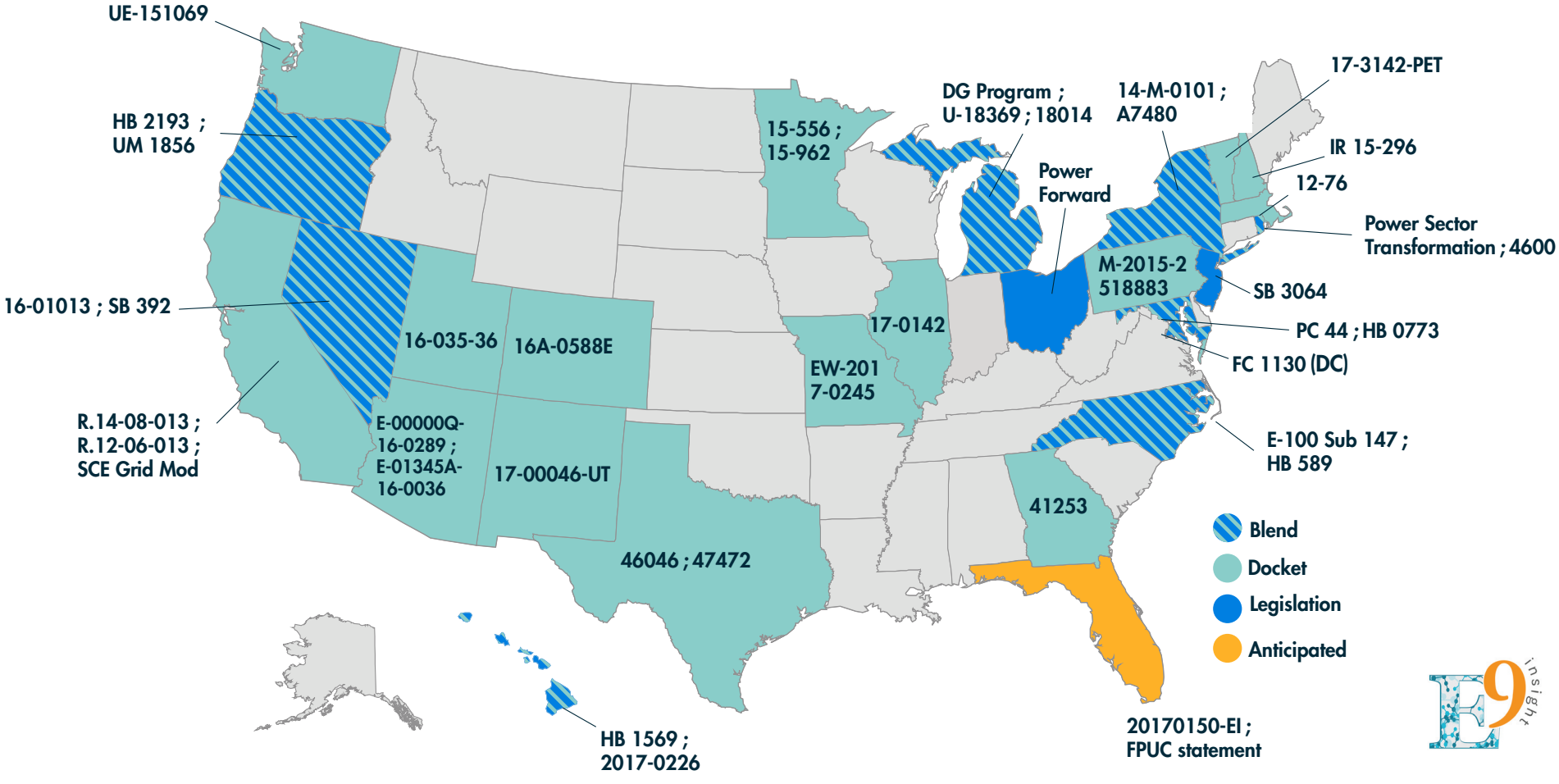
We also express our sincere appreciation to the GMI-4 Advisory Committee:

**Glen Anderson** National Conference of State Legislatures
**John Caldwell** Edison Electric Institute
**Sue Gander** NGA
**Stephen Goss** National Association of State Energy Officials (NASEO)
**Fred Hoover** NASEO
**Stephen Kalland** Database of State Incentives for Renewables & Efficiency (DSIRE), North Carolina State University
**Barry Lawson** National Rural Electric Cooperative Association (NRECA)
**Mary Ann Ralls** NRECA
**David Terry** NASEO
**Kiera Zitelman** NARUC

# APPENDIX C

## FIGURE 7: GRID MODERNIZATION PROCEEDINGS BY TYPE (AS OF OCTOBER, 2017)

*Source: E9 Insights*



# APPENDIX D

## FIGURE 8: OVERALL SCORES (GMI-3 VS GMI-4)

*Source: Grid Modernization Index, GridWise Alliance, and Clean Edge, Inc.*