TESTIMONY OF STEVEN G. HAUSER
CEO
GRIDWISE ALLIANCE
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"MODERNIZING ENERGY AND ELECTRICITY DELIVERY SYSTEMS: CHALLENGES AND OPPORTUNITIES TO PROMOTE INFRASTRUCTURE IMPROVEMENT AND EXPANSION"
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Introduction

Good morning Chairman Upton, Ranking Member Rush, full Committee Chairman Walden and Ranking Member Pallone, and distinguished Members of this Subcommittee. I am Steven Hauser, CEO of the GridWise Alliance (GWA). I appreciate the opportunity to testify at today's hearing on such an important topic and with such distinguished colleagues.

In 2001, the Senate Energy and Natural Resources Committee asked me to testify before them on the opportunity to use the emerging information and communications technologies to improve the efficiency and operation of the electricity grid. Two years later, during one of the most significant blackouts in U.S. history, I founded the GridWise Alliance to educate public policy makers and advance the modernization of the electricity sector. At the same time, the newly-formed Office of Electricity at the U.S. Department of Energy (DOE) launched a Research and Development (R&D) program to focus experts around the country on these same issues.

Gridwise Alliance members include investor-owned and municipal electric utilities, as well as rural electric cooperatives; information and communications equipment and service providers; Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs); national laboratories; academic institutions; and, more. From the very beginning, our goal was to represent the broad interests of all the stakeholders who have a role in building and operating the electricity grid. We have advocated for policies that are clearly in the Nation's interest rather than those of individual companies.

We applaud the leadership that this Subcommittee and the Full Committee have demonstrated over the past decade and more with the "Smart Grid" Title (i.e., "Title XIII") of the 2007 Energy Independence and Security Act (EISA) being a major policy change that has served to motivate

many significant changes throughout the industry in the years since. Today's hearing continues to demonstrate your desire to place a high priority on these issues and explore new policies that will continue to lead our Nation toward an effective, safe and reliable electricity grid for the next several decades.

The electric system *is* probably the most critical infrastructure and has been a major driver of our economic success for over a century. From the very beginning, Congress has recognized the need for effective national policies to drive the expansion and sophistication of the grid. While decades ago, electricity provided basic safety, security, and comfort to our citizens, today it is at the foundation of every aspect of our Nation's society. Our digital economy, our national security, and all aspects of this sector and all other critical infrastructure sectors, and our daily lives depend on a reliable, safe, affordable, resilient, and secure electric system.

For many decades, we promised our citizens access to electricity anywhere, anytime. We have realized the need to change this paradigm, being more efficient and smarter about the ways in we use electricity, resulting in a much more complex electric grid, actively managing loads, installing generation much closer to loads, and integrating new sources of power. Over the past several years, the electricity industry has experienced fundamental changes on a scale not witnessed since the creation of the electric system more than 100 years ago. Our Nation's grid must continue to be modernized and evolve to respond to these changes. The future grid needs, and will need, to manage not only for daily operations that our digital economy requires, but also for increasing security, resiliency, reliability, consumer choice, affordability, flexibility, and more. Fortunately, new technologies and capabilities have come along to help us address these changes. The *challenge* we face is that our infrastructure has not kept pace with these rapidly-changing needs and demands. In addition, the business models and policies also need to be revamped to ensure the grid and grid operators remain viable.

One key point I want to leave with you today is that, because the electric system is critical infrastructure, and because this infrastructure is in desperate need of being modernized, GridWise believes that any infrastructure package *must* include the electric system and, as part of this, **must address grid modernization or "smart grid."** The modernized grid or "smart grid" refers to the need for integrating a myriad of distributed resources requiring the two-way flow of

power, an increase in sensors, resulting in a significant increase in information, and communications to facilitate management and optimization of the grid.

Congress has an opportunity to demonstrate leadership in this regard. Grid modernization is an area that has garnered bipartisan support in the past and should continue to do so. Modernizing the grid will help create highly-skilled jobs and stimulate economic growth. It also will help reduce costs, and increase reliability, resilience, and security in the near and long term.

In fact, aging electric infrastructure is responsible for nearly 25 percent of the power outages in the U.S., according to one report.[1] The Electric Power Research Institute (EPRI) estimates that momentary power outages and "power quality events cost businesses as much as $15-$20 billion annually."[2] And, these are just a portion of the costs across our entire economy.

Grid Modernization Technologies and Capabilities Help Create Jobs, Enhance Economic Growth and Competitiveness, and are Cost Effective

The adoption of new technologies and further innovation in these fields also will lead to the creation of highly-skilled jobs and will enhance our Nation's economic growth and competitiveness. EPRI has estimated **the total benefit from the smart grid to be between $1.3-2 trillion from 2010-2030** and benefit-to-cost ratios are found to range from 2.8 to 6.0.[3]

Nearly every state and most utilities are now considering the best way to modernize their electricity infrastructure, with some states and utilities leading the way. We recognize that each has its own priorities and constraints that result in unique policy approaches that fit its specific situation. What works in California and New York does not necessarily work well in Oregon or Michigan. Regardless of the specifics, however, the technologies and capabilities apply almost universally.

- **Michigan:** In your state of Michigan, Mr. Chairman, DTE Energy has been working on a project called "Building a Predictive Grid for the Motor City," which is using sensors and

[1] Tollgrade Communications, Inc., "Predictive Grid Quarterly Report: Building a Predictive Grid for the Motor City," Volume 1, February 2015, p. 1. (Hereinafter referred to as "Predictive Grid Quarterly Report.")
[2] Predictive Grid Quarterly Report, p. 4.
[3] EPRI, *Estimating the Costs and Benefits of Smart Grid: A Preliminary Estimate of the Investment Requirements and the Resultant Benefits of a Fully Functioning Smart Grid, 2011 Technical Report*, Final Report, March 2011 (March 2011 Final Report), pp. 1-4, available at: http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001022519&Mode=download.

analytics software to help detect and prevent outages.[4] Thus, updating our infrastructure with these types of technologies and capabilities provides one way to address the problems at hand, and could help create jobs and help reduce the tremendous costs to businesses and society as a whole, which, in turn, will help boost our economy.

- **Illinois:** "Through October of 2014, ComEd [in Illinois] said grid modernization ha[d] helped avoid more than 1 million outages and reduced the frequency of outages by 19 percent."[5]
- **Oregon:** Portland General Electric has been a leader in implementing smart grid technologies, such as smart meters and advanced distributed peak management systems.
- **Texas:** Since 2011, CenterPoint Energy in Texas, through its intelligent grid, has avoided nearly 200 million customer outage minutes, by rerouting power around faults. A study by the Electric Power Research Institute (EPRI) has suggested that when deployed across Houston over the next several years, CenterPoint Energy's intelligent grid could ultimately save consumers $1.6 billion in prevented losses according to the DOE's Interruption Cost Estimate (ICE) calculator.[6]
- **California:** In 2013, PG&E invested in smart grid technologies that helped reduce the average duration of a service interruption for its customers to an all-time low, with a 40 percent improvement. Its customers also experienced the fewest service interruptions in company history.[7] That is, PG&E's advanced automation technology avoided more than 40 million customer outage minutes between 2012 and 2014 and saved over $40 million in one year alone.[8] From July 2013 to June 2014, it also experienced $21.2 million in direct customer savings and nearly $80 million in total cost savings; $11 million in avoided costs; and $4.5 million in customer energy usage savings, or benefits.[9]

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[4] Predictive Grid Quarterly Report, p. 2.
[5] Wernau, Julie, "ComEd's smart grid plan may get more time," Chicago Tribune, December 2, 2014, available at: http://www.chicagotribune.com/business/ct-smart-grid-extension-1203-biz-20141202-story.html.
[6] EPRI/CenterPoint Energy Houston Electric, *Cost/Benefit Analysis of CenterPoint Energy's Intelligent Grid Project*, October 2014, included in a 2015 Distribution Cost Recovery Factor (DCRF) Filing (Docket 44572) to the Public Utility Commission of Texas (PUCT).
[7] PG&E, *PG&E Smart Grid Annual Report – 2014*, October 1, 2014, p. 2.
[8] PG&E, *PG&E Smart Grid Annual Report – 2014*, October 1, 2014, p. 3, p. 8, respectively.
[9] PG&E, *PG&E Smart Grid Annual Report – 2014*, October 1, 2014, p. 8. Projects that contribute to PG&E's Smart Grid project benefits include: PG&E's SmartMeter™ project; PG&E's SmartMeter™ outage information improvement; PG&E's SmartRate™ program; PG&E's Home Energy Reports project Energy Alerts, and My Energy Site; PG&E's automated demand response program; PG&E's Fault Location and Service Restoration (FLISR) project; and, PG&E's Modular Protection and Automation Control (MPAC) project.

Some brief illustrations of the quantity and types of highly-skilled jobs produced by grid modernization are as follows:

- A Report by the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE) contains the following feedback from Snohomish PUD in Washington State: "We've more than doubled the number of engineers that are attached to the control room, but we're not a huge organization. We originally had three SCADA engineers in the entire department. Now we call it the OT department, and it includes code writers and engineers. We have a real-time engineer in the control room. The OT group reports to our engineering department. . . . And we've told the IBEW . . . that would be a job expectation. So what we see in the very long run is that we'll have field people who eventually become possibly engineers or operators in the future."[10]
- In the same DOE-OE Report, a Duke Energy Project Director states: "[o]ur Grid Management organization has nearly doubled since we started the project. We have added engineers, technicians, and a couple of schedulers to help keep track of it all. Two of the engineers have the title of DMS Optimization Engineer. Their job is to help us bring additional value to the system because they now have increased visibility of the grid. Their job is to learn new things about the system and figure out how to make it work better."[11] Duke Energy further stated that they "added folks with two-year degrees, four-year degrees, and a PhD.[(s)], . . . " so these truly are highly-skilled jobs.[12]

Grid Modernization Technologies and Capabilities Enhance System Resilience, Reliability, and Security

Let me now turn to the need to enhance the **resilience, reliability, and security** of the grid for a moment. Many "smart grid" technologies already exist and are making a difference in significantly enhancing electric system reliability and resilience. Grid modernization, or "smart grid" technologies help prevent outages and enable the grid to better withstand outages when they do occur, due to a human-caused or natural disaster, as elaborated on in a report entitled *Improving Electric Grid Reliability and Resilience: Lessons Learned from Superstorm Sandy*

[10] (U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE), *Insights into ADMS*, February 2015, p. 24, available at: https://www.smartgrid.gov/files/ADMS-Guide_2-11.2015.pdf. (Hereinafter referred to a: *Insights into ADMS*.)
[11] *Insights into ADMS*, p. 12.
[12] *Insights into ADMS*, p. 34.

and Other Extreme Events the GridWise Alliance published to help share lessons learned following such events.[13]

To elaborate, for instance, these types of technologies allow control room operators to gain better and faster visibility of faults on the grid, which can facilitate faster outage restorations. These dramatic technological developments also provide utility crews with greater situational awareness in often dangerous situations, which enables them to do their jobs more safely and efficiently. One utility executive, for example, stated that ". . . . [Advance Distribution Management System] (ADMS) is very, very key to . . . [providing] us optics and transparency in real-time information. We used to drive around with flashlights at 2:00 a.m. looking for a tree on the circuit, and now we go to our control center and find out exactly where the fault is and expedite deployment of a truck to fix the problem."[14,15]

In addition, homes and businesses can continue operating electricity and heat or air conditioning, depending on the locale, thus ensuring continued safety, health, and economic productivity. Consequently, investing in and deploying these technologies, and improving our grid infrastructure on the front end, will substantially reduce the economic impacts from outages and power quality disturbances down the road, thereby resulting in dramatic cost savings to society as a whole.

Cybersecurity threats, extreme weather events, and other hazards present challenges and strong incentives for prompt action to proactively facilitate the transition to our twenty-first century electric system. The above technologies and capabilities will improve daily operations as well as emergency situations. They also will help balance load and optimize the management and operation of the grid.

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[13] GridWise Alliance, *Improving Electric Grid Reliability and Resilience: Lessons Learned from Superstorm Sandy and Other Extreme Events, June 2013, available at: www.gridwise.org.*

[14] "An advanced distribution management system (ADMS) is the software platform that supports the full suite of distribution management and optimization. An ADMS includes functions that automate outage restoration and optimize the performance of the distribution grid. ADMS functions being developed for electric utilities include fault location, isolation and restoration; volt/voltampere reactive optimization; conservation through voltage reduction; peak demand management; and support for microgrids and electric vehicles." — Gartner IT Glossary. *Insights into ADMS,* p. 5.

[15] Statement by Tracy Bridge, Executive Vice President and President of the Electric Division, CenterPoint Energy, *Insights into ADMS,* p. 4.

Relatedly, during extreme events, "smart technologies" also enable the isolation and continued service to limited portions of the grid, as needed, to prevent larger outages or provide for localized grid recovery from such events. **Princeton University in New Jersey** serves as a prime example of a microgrid that helped maintain power during Superstorm Sandy. In addition, "[a]fter Sandy in 2012, state regulators approved Consolidated Edison Inc.'s request for $1 billion in grid upgrades to protect the New York City utility system against flooding and intense storms. The improvements have averted more than 65,000 customer blackouts since Sandy struck, Con Edison has said."[16]

Just Monday (February 13, 2017), there was a report of the Nation's tallest dam in California experiencing damage, resulting in nearly 200,000 residents being evacuated.[17] Some of the initial "cascading" effects were as follows: "[s]tores closed. Shelters opened. Local gas stations were swarmed with cars as residents tried to leave town. Evacuees waited in traffic trying to get out of low-lying areas" for hours.[18] The same type of situation can, and has, resulted from widespread power outages, whether from natural- or human-caused incidents, as I have noted herein. Some examples of the types of relief and solutions that "smart" technologies could facilitate in this and other events include: transportation management, knowledge of availability of fuel at gas stations, and information regarding the estimated duration of the evacuation, so emergency responders and residents alike could plan for food and shelter accommodations.

More technologies and capabilities, such as microgrids, as well as energy storage and minigrids, also are becoming increasingly available to ensure we not only maintain, but improve, resilience, reliability, and security. I am not suggesting that technology alone will solve all outage-related problems; they will not. Nor will we prevent ***all*** outages.

Hardening is needed, too. "About 1.2 million FP&L customers blacked out by [Hurricane] Matthew had power restored within two days after the storm, the company said. NextEra has

[16] Polson, Jim, "10 Days of Blackouts Cut to 2 After U.S. Utility Spends Billions," BloombergMarkets, October 17, 2016 (updated October 18, 2016).
[17] Madison Park and Eliott C. McLaughlin, "Evacuations ordered over concerns at California dam system," CNN.com, February 13, 2017, available at: http://www.cnn.com/2017/02/12/us/california-oroville-dam-failure/index.html.
[18] Madison Park and Eliott C. McLaughlin, "Evacuations ordered over concerns at California dam system," CNN.com, February 13, 2017, available at: http://www.cnn.com/2017/02/12/us/california-oroville-dam-failure/index.html.

spent more than $2 billion hardening Florida's power grid over the past decade."[19] "They invested their own $2 billion in everything from simple stuff like concrete poles rather than wooden poles to mak[e] the grid smarter and harder with information technology," according to U.S. Energy Secretary Ernest Moniz. "Hurricane Matthew could have left `a lot of' customers without power for 10 to 15 days."[20]

Solutions to Ensure and Accelerate the Transformation to the Twenty-First Century Electricity System

I offer the following initial recommendations whereby Congress can help achieve results to help catalyze grid modernization to meet the substantial infrastructure needs I have only touched on here in my testimony.

At a high level, the types of areas that infrastructure legislation could address in the grid modernization space include, but are not limited to: public-private partnerships to leverage scarce resources and help mitigate the risks of private sector investments; research, development, and deployment; workforce training; and, technical assistance to state and local governments, who need a range of help to "get up to speed" on the dramatic transformation facing this industry. These types of efforts could focus on the following areas (again, these are only examples and are not meant to be limiting in any way).

1) **Transmission:** Such as, promoting the deployment of advanced technologies for new and existing transmission, including transmission technologies that *use existing* transmission lines or rights-of-way, and thereby enhance system efficiency, eliminate the need to build new lines, and relieve congestion;
2) **Resilience:** Including a comprehensive approach to planning proactively as well as to rebuilding "smarter" after a natural disaster, not just with the "same old" technology and/or infrastructure, and "hardening" physical infrastructure; and,
3) **"Smart Cities" Initiatives:** That bolster the "smart" infrastructure of cities to improve reliability, resilience, security, and efficiency in the electric sector, as well as across critical infrastructure sectors, such as water, transportation, and telecommunications

[19] Polson, Jim, "10 Days of Blackouts Cut to 2 After U.S. Utility Spends Billions," BloombergMarkets, October 17, 2016 (updated October 18, 2016).
[20] Polson, Jim, "10 Days of Blackouts Cut to 2 After U.S. Utility Spends Billions," BloombergMarkets, October 17, 2016 (updated October 18, 2016).

through improved domestic and global coordination, better (and different) workforce training, sharing of best practices, and more.

To elaborate, we need to:

- Foster ongoing public-private collaboration, which is essential to facilitating this transformation; for example, utilities, technology companies, and other stakeholders already are partnering with DOE-OE and/or with National Laboratories to help determine and simulate potential threats to the electric system, and demonstrate technologies and capabilities that improve situational awareness, and reduce major outages;
- Relatedly, test, measure, and verify the benefits and costs of emerging technologies as well as the associated business models, regulatory models, rate design structures, and more through demonstrations and pilot programs;
- Maximize transparency and educate and empower consumers so they can better manage their electricity consumption, especially as they become both producers and consumers of electricity, or "prosumers";
- Establish a shared vision of where we want to go in terms of achieving a twenty-first century grid infrastructure and the steps we will take to achieve this vision (like "putting a man on the moon.");
- Facilitate work underway at DOE and the National Laboratories on a grid architecture, so we have a platform that enables all of the distributed resources and other changes to the grid, while maintaining system reliability and security;
- Conduct scenario modeling and analysis to test concepts and their validity before deploying projects at scale; and, create performance metrics to measure and evaluate whether various grid modernization goals actually are being achieved; and,
- Develop guidance for states and leverage best practices in a way that offers tools for states to undergo the transition to a twenty-first century electricity system.

During this transition, it will be important to take into consideration regional, state, and local geographic and other key differences.

Conclusion

I will conclude as I began by stating that: because the electric system is critical infrastructure, and because this infrastructure is in dire need of upgrade and modernization, any infrastructure package *must* include not only energy and the electric system, but also must address **grid modernization or "smart grid."** Virtually every day we learn of reports of failing infrastructure that is costing American taxpayers huge sums, as noted in the prior section. We are seeing the increasing need not just to repair, but to upgrade and harden, failing infrastructure, to withstand extreme weather events and ever-changing human-caused threats.

We have an historic opportunity to accelerate the modernization and transformation of our Nation's electric grid. Action is needed now because these issues are complex and the situation is pressing – becoming more dire by the day, as the aforementioned examples illustrate – and the technological and policy changes required will take years to implement. On the other hand, this transformation can help optimize the grid, spark economic growth and competitiveness, create jobs, and dramatically reduce the physical, economic, and human impacts of natural- and human-caused threats.

We need to look beyond smart meters and communications, and achieve the critical infrastructure needed to make the grid more efficient, reliable, secure, and resilient. We must create the policy and economic structures that leverage scarce resources and incentivize utilities to make smart grid investments.

There is a broad consensus that there is a national imperative to modernize our nation's electric system. Congress must play a leadership role in taking up and passing vital grid modernization infrastructure legislation. We stand ready as a resource to you and your colleagues as you proceed.

Mr. Chairman, thank you for this opportunity to testify today. I look forward to answering questions from you and your colleagues.