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Congress of the United States
House of Representatives
COMMITTEE ON ENERGY AND COMMERCE
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MEMORANDUM

March 3, 2015

To: **Subcommittee on Energy and Power Democratic Members and Staff**

Fr: **Committee on Energy and Commerce Democratic Staff**

Re: **Hearing on "The 21st Century Electricity Challenge: Ensuring a Secure, Reliable and Modern Electricity"**

On Wednesday, March 4, 2015, at 10:15 a.m. in room 2123 of the Rayburn House Office Building, the Subcommittee on Energy and Power will hold a hearing on "The 21st Century Electricity Challenge: Ensuring a Secure, Reliable and Modern Electricity." The purpose of the hearing is to examine how new and advanced grid technologies, as well as energy analytics, can help build a more modern electric system that enhances the continued safe, reliable, and affordable delivery of electricity to consumers.

I. BACKGROUND

The National Academy of Sciences (NAS) has referred to the electricity grid of the United States as the greatest engineering achievement of the 20th century because it delivers critical energy services to consumers in an instantaneous, affordable, and ubiquitous fashion with good dependability.[1] New technology, particularly in information sciences and controls, has and will continue to spur improvements in the economics, environmental performance, reliability, and flexibility of a system that is being called on for ever-greater performance from aging infrastructure.

In its 2009 publication, "America's Energy Future: Technology and Transformation," the NAS expressed an urgent need for expansion and modernization of the power grid to enhance reliability and security, accommodate load growth and demand changes, and enable new energy efficiency and supply technologies. NAS cited a particular need to accommodate increases in

[1] National Research Council of the National Academy of Sciences, *America's Energy Future: Technology and Transformation* (Jul. 28, 2009).

intermittent solar and wind energy sources, and that overall "modernization of these systems would have a number of economic, national security, and social benefits."[2]

According to the Energy Information Administration (EIA), investment by U.S. investor-owned utilities in the electricity distribution system has increased over the past two decades, peaking at $20 billion in 2012.[3] Investment levels remain higher than in the early 2000s and the preceding decade. The electricity distribution system consists of lines, substations, and transformers that lowers voltage to levels required for customers such as homes and businesses. Transmission systems, which consist of the infrastructure necessary to deliver electricity from power plants to substations located near demand centers, have also experienced increased investment over the past two decades.

Much of the spending on distribution has dealt with "hardening" the system and making it more resilient to extreme weather events.[4] Between 2003 and 2012, it is estimated that weather-related outages cost the economy an average of $18 to $33 billion annually in the United States. In 2013, the President's council of Economic Advisors advocated for additional spending in this area because, "[g]rid resilience is increasingly important as climate change increases the frequency and intensity of severe weather."[5] Over the past decade, major spending areas included replacing vulnerable equipment with better designed, technologically advanced equipment and installing smart grid technologies like automated circuit breakers and feeder switches, as well as mapping systems that immediately stop problems from spreading and show utilities where problems are located.[6]

II. CHANGING FACE OF GENERATION AND RENEWABLE ENERGY INTEGRATION

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[2] National Research Council of the National Academy of Sciences, *America's Energy Future: Technology and Transformation*, at 60 (Jul. 28, 2009).

[3] U.S. Energy Information Administration, *Electricity distribution investments rose over the past two decades* (Oct. 24, 2014) (online at www.eia.gov/todayinenergy/detail.cfm?id=18531).

[4] Edison Electric Institute, *Before and After the Storm, Update* (Mar. 2014) (online at www.eei.org/issuesandpolicy/electricreliability/mutualassistance/Documents/Before%20and%20After%20the%20Storm.pdf).

[5] Council of Economic Advisors, *Economic Benefits of Increasing Electric Grid Resilience to Weather Outages* (Aug. 2013) (online at energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf).

[6] U.S. Energy Information Administration, *Electricity distribution investments rose over the past two decades* (Oct. 24, 2014) (online at www.eia.gov/todayinenergy/detail.cfm?id=18531).

According to the U.S. Energy Information Administration (EIA), there has been a shift in electricity generation away from coal-fired generation, which declined steadily since 2007, toward cleaner sources of electricity.[7] While natural gas electricity generation has increased to 27%, non-hydro renewable generation grew to approximately 7% of U.S. energy generation (and now surpasses hydroelectric output).[8] Of that non-hydro renewable category, wind generation (which grew by just over 9% in 2014) still dominated in terms of overall output.[9] This diversification of the U.S. power supply resulted in 38% of electric generation coming from coal, 27% from natural gas, 19% from nuclear, and 13% from renewable sources, including hydropower.[10]

Renewable energy capacity continues to develop in the U.S. The wind industry saw record growth in 2012 with about 13 gigawatts (GW) of added capacity, and is expected to see an additional 11 GW of capacity added in 2015.[11] Solar power saw an exponential increase in generation from 1.8 GW in 2011 to 17.4 GW by the end of 2014.[12] Much of that growth and the continued gains in solar deployment will be in the area of rooftop solar.

Wind and solar power are variable energy resources because they do not provide power 24 hours a day. However, there are a range of technologies and practices being developed and deployed to integrate these renewable energy resources into the grid to boost fuel diversity while maintaining reliability. For example, greater turbine aggregation, greater geographic dispersion of turbines, and improved wind forecasting are reducing overall wind generation variability.[13]

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[7] U.S. Energy Information Administration, *Short Term Energy Outlook February 2015* (Feb. 10, 2015) (www.eia.gov/forecasts/steo/data.cfm?type=figures).

[8] U.S. Energy Information Administration, *Short Term Energy Outlook February 2015-U.S. Electricity Generation by Fuel, All Sectors* (Feb. 10, 2015) (http://www.eia.gov/forecasts/steo/data.cfm?type=figures).

[9] U.S. Energy Information Administration, *Short Term Energy Outlook February 2015-U.S. Renewable Energy Supply* (Feb. 10, 2015) (http://www.eia.gov/forecasts/steo/data.cfm?type=figures).

[10] U.S. Energy Information Administration, *Short Term Energy Outlook February 2015-U.S. Electricity Generation by Fuel, All Sectors* (Feb. 10, 2015) (http://www.eia.gov/forecasts/steo/data.cfm?type=figures).

[11] U.S. Energy Information Administration, *Today in Energy: Wind power capacity additions expected to increase in last quarter of 2014* (Dec. 18, 2014) (online at http://www.eia.gov/todayinenergy/detail.cfm?id=19251).

[12] U.S. Energy Information Administration, *Electricity Data Browser – Net generation from solar*

[13] U.S. Department of Energy, *20% Wind Energy by 2030*, at 75-101 (Jul. 2008) (online at www.nrel.gov/docs/fy08osti/41869.pdf).

Similarly, innovative energy storage technologies, including thermochemical, electrochemical, and flywheel technologies for concentrated solar power installations, reduce the intermittency of solar generation.[14]

III. THE SMART GRID

Although there appears to be consensus that our electricity system is evolving toward a smart grid, and although much of the required technology is available already, there are significant implications for system investment, markets, regulation, and institutional roles of adapting smart grid technologies. A smart grid may mean different things in a traditional vertically-integrated monopoly utility environment, operating on a cost-of-service rate design, than in a competitive-retail market with unbundled generation and wires services. While there are many candidate technologies competing to play key roles in the smart grid, there is also a need for common communication protocols and assurance of interoperability. Smart meters and smart appliances can only be as intelligent as the time-sensitive and cost-sensitive designs for rates incorporated by regulators into utility tariffs.

Smart grid technologies take advantage of computerized communications and controls to send price signals through smart meters to consumers reflecting the real-time costs of the power they consume. Between 2009 and 2012, $7.9 billion in American Recovery and Reinvestment Act funds drove smart metering infrastructure deployments.[15] Since then, spending on deployments has decreased due to a variety of reasons, including the development of cheaper smart meter technologies.[16] To date, smart meters have already been deployed to 39% of electricity customers in the United States.[17] They will be able to control (or have their utilities control) their usage as voluntary demand response, responding to economic signals – and obtaining economic rewards. Distributed generation such as rooftop solar and combined heat and power projects will be more easily accommodated on the grid and potentially welcomed as resources offering ancillary services. Ultimately, a smart grid could further enable plug-in hybrid and pure electric vehicles to bring significant benefits not only to our transportation system, but also to our electricity system in the form of readily useable energy storage for demand response.

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[14] U.S. Department of Energy, *SunShot Initiative High Penetration Solar Portal: System Technologies* (online at solarhighpen.energy.gov/topics/system_technologies).

[15] U.S. Energy Information Administration, *Electricity distribution investments rose over the past two decades* (Oct. 24, 2014) (online at www.eia.gov/todayinenergy/detail.cfm?id=18531).

[16] Bloomberg New Energy Finance, *Sustainable Energy in America 2015 Factbook*, (Feb. 2015) (online at www.bcse.org/images/2015%20Sustainable%20Energy%20in%20America%20Factbook.pdf).

[17] Bloomberg New Energy Finance, *Sustainable Energy in America 2015 Factbook*, (Feb. 2015) (online at www.bcse.org/images/2015%20Sustainable%20Energy%20in%20America%20Factbook.pdf).

The timing and steps of the transition process from the system of today to a new and smarter system tomorrow will affect the need for investment in new generation, transmission, and distribution facilities, even as the demand for such investments is growing. As consumers become acclimated to new choices and autonomy in their electricity use and purchasing, utilities must have full confidence that they can accommodate such consumer freedoms without compromising system operations or reliability. And, some consumers may in fact prefer traditional flat rates and no-hassle service while others leap at the opportunity to custom-tailor their relationships with their utilities.

Such a transition process may be inevitable, but it will not be easy. It will inevitably involve significant governmental participation, if not direction. The transition could conceivably create negative effects on the system as well as benefits if it is not managed appropriately. This process must be managed with relative uniformity by an industry comprised of many utilities with private, public, and cooperative ownership, and which is subject to Federal, State, and local regulatory authorities.

IV. WITNESSES

The following witnesses have been invited to testify:

Tom Siebel
Chairman and Chief Executive Officer
C3 Energy

Dean Kamen
Founder and President
DEKA Research & Development Corporation

Michael Atkinson, P.E.
President
Alstom Grid North America,
On behalf of GridWise Alliance

Joel Ivy
General Manager
Lakeland Electric
On behalf of the American Public Power Association

Christopher Christiansen
Executive Vice President
Alevo, Inc.
On behalf of the Energy Storage Association

Naimish Patel
Chief Executive Officer

Gridco Systems

Paul Nahi
President and Chief Executive Officer
Enphase Energy