September 23, 2017

TO: Members, Subcommittee on Energy

FROM: Committee Majority and Minority Staff

RE: Hearing entitled "Powering America: Technology's Role in Empowering Consumers"

I. INTRODUCTION

The Subcommittee on Energy will hold a hearing on Tuesday, September 26, 2017, at 10:00 a.m. in 2123 Rayburn House Office Building. The hearing is entitled "Powering America: Technology's Role in Empowering Consumers." The hearing will explore the role advanced energy technologies play in empowering the nation's electricity consumers.

II. WITNESSES

- **Arvin Ganesan**, Vice President, Federal Policy, Advanced Energy Economy;
- **Karen Butterfield**, Chief Commercial Officer, STEM;
- **Monica Lamb**, Director, Regulated Markets, LO3 Energy;
- **Bryan Hannegan**, Ph.D, President and CEO, Holy Cross Energy;
- **Val Jensen**, Senior Vice President, Customer Operations, ComEd; and,
- **Todd Sandford**, Senior Vice President, North America Distributed Energy and Power, Direct Energy

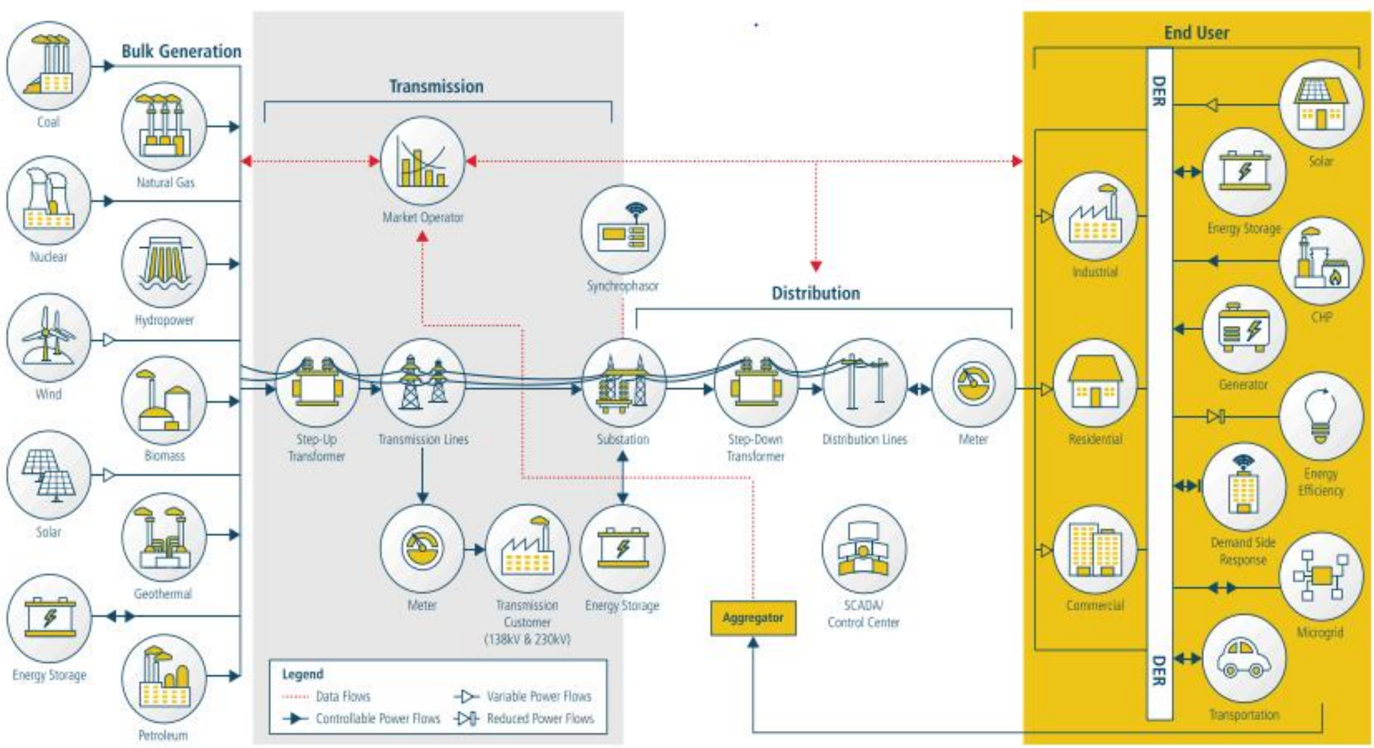
III. BACKGROUND

The electric power industry is encountering a significant transformation due in part to advances in technology and changing consumer preferences. New technologies have the potential to further optimize the electric grid by enabling greater balance of supply and demand. Consumers' expectations are changing as they utilize new technologies to gain greater control over their electricity consumption and generation. Until recently, consumers have had little choice in how they manage their electricity. Utilities, corporations, states, local entities, and other relevant industry participants are recognizing the need to address and integrate these new technologies to meet consumers' demand and preferences.

Wholesale v. Retail

Energy technologies affecting electricity generation, transmission, and distribution come in a variety of forms including, but not limited to, energy storage, microgrids, energy management systems, distributed generation, demand-side management, smart meters, smart appliances, and other intelligent grid technologies. Many of these technologies fall into the category of "distributed energy resources" (DER). These are typically small power sources that can be aggregated to provide power necessary to meet regular demand.[1] Most of these technologies are located on the distribution level of the U.S. electric power grid and are managed and integrated at the retail level by utilities. However, as use of these technologies continues to grow, they will likely have impacts at the wholesale level.

Figure A-1. Schematic Representation of the U.S. Electric Power System



The electric power system comprises the following broad sets of systems: bulk generation, transmission, distribution, and end use (including DERs).

QER 1.2 Appendix A: Electricity System Overview

Electricity markets have retail and wholesale components. Retail markets involve the sale of electricity to consumers; whereas, wholesale[2] markets involve the sale of electricity among electric utilities and electricity traders before it is eventually sold to consumers. Under the Federal Power Act (FPA), the Federal Energy Regulatory Commission (FERC) has jurisdiction

[1] Electric Power Research Institute's (EPRI) definition of distributed energy resources, *see* http://www2.epri.com/Our-Work/Pages/Distributed-Electricity-Resources.aspx
[2] A "wholesale sale" is a "sale for resale" – i.e., a sale of electricity from a generator to a local utility.

over the wholesale markets[3], but not retail markets.[4] Retail markets are regulated at the state level by state public utility commissions. These traditional jurisdictional lines are becoming blurred, in part, by the development and deployment of new technologies, state energy policies, and the expansion of wholesale markets into trade of new energy "products" such as demand response markets.[5]

Wholesale electricity markets differ from other competitive markets – demand is ultimately determined at the retail level. As a result of fixed prices, retail use is relatively insensitive to prices and changes in the short term. Most states have chosen to keep the retail rate for electricity stable, even though the wholesale rates vary considerably throughout the day and over the course of the year.[6] A stable retail rate means electricity consumers do not receive a price signal encouraging them to reduce their electricity consumption when costs are high.[7] Large industrial customers, on the other hand, may receive real-time price signals.[8] New software and hardware devices designed to provide consumers with the ability to manage their energy use may not have as great an impact under stable retail rates.

The increased use of distributed generation, energy storage, energy management technologies, and other distributed energy resources offer the potential for significant efficiency improvements, improved resiliency, and greater flexibility for the grid. These technologies facilitate the transition from a grid designed for one-way flow of energy from generators to consumers to a grid that supports energy flows along multiple paths. The transition is driving changes in both wholesale and retail markets as well as within different businesses that are part of the electricity sector.

Energy Storage

Energy storage systems can create a more resilient energy infrastructure and bring cost savings to utilities and consumers. There are diverse energy storage technologies that include – batteries,[9] flywheels,[10] compressed air energy storage,[11] thermal,[12] and pumped hydro-power.[13] While large-scale electricity storage is limited at this time, technologies such as batteries and

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[3] The Federal Power Act authorizes the Federal Energy Regulatory Commission (FERC) to regulate "the sale of electric energy at wholesale in interstate commerce," including both wholesale electricity rates and any rule or practice "affecting" such rates. *See* 16 U.S.C. §§824(b), 824d(a), 824e(a).
[4] Federal Energy Regulatory Commission v. Electric Power Association, 577 U.S. ____ (2016)
[5] Robert R. Nordhaus, *The Hazy "Bright Line": Defining Federal and State Regulation of Today's Electric Grid,* Energy Bar Association, (2015).
[6] *See* Fed. Energy Regulatory Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 768 (2016).
[7] Matthew R. Christiansen, *FERC v. EPSA: Functionalism and the Electricity Industry of the Future,* 68, Stanford L.R. 100, 103 (2016).
[8] *Id.*
[9] Solid state batteries – a range of electrochemical storage solutions, including advanced chemistry batteries and capacitors and Flow Batteries – batteries where the energy is stored directly in the electrolyte solution for longer cycle life, and quick response times. *See* Energy Storage Association's *Energy Storage Technologies,* http://energystorage.org/energy-storage/energy-storage-technologies
[10] *See* http://energystorage.org/energy-storage/storage-technology-comparisons/thermal
[11] *See* http://energystorage.org/energy-storage/storage-technology-comparisons/caes
[12] *See* http://energystorage.org/energy-storage/storage-technology-comparisons/thermal2
[13] *See* http://energystorage.org/energy-storage/energy-storage-technologies/pumped-hydro-power

flywheels are being developed for deployment on a larger scale. Hydro-electric pumped storage is being used in multiple locations across the U.S.[14] Currently, generating plants, transmission and distribution lines, substations and other equipment must be sized to meet the maximum amount needed by consumers at any time, in all locations.[15] If cost-competitive energy storage technologies are more widely used, other grid assets may no longer need to be sized to meet maximum power demands.

Storage provides an array of benefits to the electric grid and to electricity consumers. Electricity energy time-shift is the storage of electric energy when its value and/or price is low; and use of the stored energy when the value and/or price is high, which typically occurs during peak demand. Storage also provides key ancillary services including reserves or back up power, momentary and hourly reconciliation of electrical supply and demand to stabilize the alternating current frequency at which the grid operates (60 cycles per second), and voltage support that is required to maintain the voltage of the electric grid.[16]

Microgrids

Microgrids, also known as an electrical island, are localized groupings of electricity generation, energy storage, and electrical loads. Where microgrids exist, electric loads are typically still connected to a traditional centralized grid. When the microgrid senses an outage, it disconnects from the central grid and uses its own generation and storage capabilities to serve the local electrical load.[17]

Microgrid generation resources can include natural gas, wind, solar, diesel, or other energy sources. A microgrid's multiple generation sources and ability to isolate itself from the larger network during an outage on the central grid ensures highly reliable power. The effectiveness of microgrids is further enhanced through energy storage. Storage systems not only provide backup power while the microgrid's generation sources are coming online, they can also be used to regulate the quality of power and protect sensitive systems like hospital equipment that might be vulnerable to power surges during restoration efforts.[18]

Another function of microgrids is the ability to sell surplus power back to the central grid or storing for later use. In combination with energy storage and energy management systems, microgrids can also provide ancillary services to the broader electric grid such as voltage and frequency regulation. Microgrids also reduce dependence on long distance transmission lines, thereby reducing transmission energy losses.[19]

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[14] Pumped Hydro storage involves pumping water to high reservoirs during times of low electricity demand, then letting the water flow downhill through electricity-generating turbines when demand for power rises.
[15] *See* http://energystorage.org/energy-storage/energy-storage-technologies
[16] Federal Energy Regulatory Commission (FERC), *Energy Primer – A Handbook of Energy Market Basics,* (November 2015).
[17] National Electrical Manufactures Association (NEMA), *Storm Reconstruction: Rebuild Smart – Reduce Outages, Save Lives, Protect Property,* (2013).
[18] *Id.*
[19] National Electrical Manufactures Association (NEMA), *Storm Reconstruction: Rebuild Smart – Reduce Outages, Save Lives, Protect Property,* (2013).

Digitization and Energy Management Systems

The digitization of the electric power systems through the deployment of information and communications technologies is aiding in the decentralization of electricity resources.[20] This can result in improved efficiencies across a utility, allowing for optimized generation, improved workforce productivity, better understanding of consumer behavior, and faster diagnostics – all of which can improve reliability and reduce costs to the utility and consumer.[21] An increasingly digital electric grid is making it easier to compute and communicate the value of electricity in a more precise and granular manner. These technologies enable electricity demand to become increasingly responsive to changes in the price of electricity.[22]

Emerging software and technologies related to the internet of things also has the potential to enhance the nation's energy infrastructure. Installing smart meters and devices directly to individual infrastructure components can create a network of devices with the ability to make real time decisions in order to decrease costs, improve reliability, and provide improved customer services. In many instances, these energy networks depend upon block chain technology which utilizes a distributed electronic ledger to record and verify system data in a secure and verifiable way. Using block chain technology, consumers have the ability to participate in new types of energy management platforms, such as a peer-to-peer trading platform, which allows grid participants to generate and trade electricity amongst themselves.[23]

IV. ISSUES

The following issues may be examined at the hearing:

- What challenges and opportunities the electric power industry is encountering with advances in new energy technology and changing consumer preferences;

- How new energy technologies have the potential to further optimize the electric grid, but at the same time are blurring the traditional wholesale and retail jurisdictional lines; and

- How consumers' expectations are changing as they utilize more technologies to gain greater control over their electricity consumption and generation.

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[20] MIT Energy Initiative, *Utility of the Future*, (Dec. 2016) http://energy.mit.edu/wp-content/uploads/2016/12/Utility-of-the-Future-Full-Report.pdf
[21] U.S. Department of Energy, *Quadrennial Energy Review – Second Installment: Transforming the Nation's Electricity System* (Jan. 2017).
[22] MIT Energy Initiative, *Utility of the Future*, (Dec. 2016).
[23] Don and Alex Tapscott, *How Blockchain Technology Can Reinvent the Grid*, (May 2016) http://fortune.com/2016/05/15/blockchain-reinvents-power-grid/

V. STAFF CONTACTS

If you have any questions regarding this hearing, please contact Annelise Rickert, Jason Stanek or Wyatt Ellertson on the Majority Committee staff at (202) 225-2927, or Rick Kessler on the Minority Committee staff at (202) 225-3641.