ADVANCED ENERGY ECONOMY
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Written Testimony of Arvin Ganesan, Vice President of Federal Affairs at Advanced Energy Economy, Before the U.S. House of Representatives, Energy Sub-Committee of the Energy and Commerce Committee

Thank you, Chairman Upton, Ranking Member Rush, Vice Chairman Olson, and Distinguished Members of the Committee. I am honored to testify today on the evolving role of consumers in the electricity system, and how technological innovation is transforming our electric grid for the better.

My name is Arvin Ganesan, and I am Vice President of Federal Affairs at Advanced Energy Economy (AEE). AEE is a national business association representing over 120 advanced energy businesses across the United States.

As an energy business association, we are unique. Our businesses currently produce, deploy, or use over 50 different energy technologies including battery storage, advanced natural gas generation, small modular nuclear reactors, solar, wind, demand response, energy efficiency, combined heat and power, electric vehicles, and smart grid technologies, among many others. In addition, many businesses that want to source their energy needs from advanced energy are joining AEE to reduce policy hurdles preventing them from doing so.

Today, I want to talk about the benefits of technological innovation for the grid and for consumers. Within that theme, I will discuss three points:

1) Falling costs, technological innovation, and consumer preferences are driving a transition to a more diverse resource mix in which advanced energy plays an increasingly dominant role.
2) Advanced energy brings numerous benefits such as increased reliability and resilience. At the same time, these technologies give consumers more control over their own energy use.
3) Technological innovation ultimately benefits consumers by increasing competition in the marketplace among energy technologies, driving down the cost of electricity, and increasing opportunities for customers to exercise choice in their power sources and save money by controlling their utility bills.

Declining costs and consumer preferences – including those of Fortune 100 and Fortune 500 corporations – will continue to drive market growth and innovation in the advanced energy industry

The advanced energy industry is a major economic engine in the United States. The U.S. industry generates $200 billion in revenue, equal to pharmaceutical manufacturing and approaching wholesale consumer electronics. In the six years that AEE has been tracking, advanced energy in the United States has grown by an average of 5% annually for a total of 28% compared to 2011. And it supports jobs across the country, as well, with more than 3 million jobs supported by the advanced energy sector. This includes nearly 2.2 million workers in energy efficiency, more than 650,000 workers

in advanced electric power generation, 100,000 workers in advanced grid technologies, and 250,000 jobs in advanced transportation. With the growth of the industry, technological advancement and deployment of advanced energy has accelerated as well.

Renewable energy has increasingly become a significant provider of energy, and will continue to grow in the United States based on economic competitiveness. The most basic indicator of power technology competitiveness is the levelized cost of energy (LCOE), which measures the average cost of electricity over the life of a project, including the costs of upfront capital, operations and maintenance, fuel, and financing. Since 2007, Lazard, a financial advisory and asset management firm, has tracked the LCOE of power technologies using a consistent methodology. Lazard's annual analyses show that from 2009 to 2016, the LCOE for utility-scale wind and solar power has declined by 66% and 85%, respectively. In their most recent analysis, Lazard finds that "wind and solar PV have become increasingly cost-competitive with conventional generation technologies, on an unsubsidized basis, in light of material declines in the pricing of system components…and dramatic improvements in efficiency, among other factors."

Additionally, while the addition of large scale storage is not required to add more solar or wind to the system, utility-scale solar photovoltaic and utility-scale technology combined with storage are poised to become the next cost-effective, fully dispatchable resources. New solar-plus-storage and wind-plus-storage systems are currently cost-competitive with new conventional resources and provide operational flexibility and enhancements to support grid reliability.

Because of this rapid decline in costs, large-scale renewable energy purchases that were once driven primarily by state policies (e.g., renewable portfolio standards) are now increasingly made based on economics and consumer preference. Large energy customers – most notably Fortune 100 and Fortune 500 companies – are the most significant drivers of this demand. AEE has been actively engaged with a number of these companies in numerous states pursuing policy opportunities to help meet this demand for renewable energy from corporate buyers.

Policies supporting corporate procurement of renewable energy can be a strong economic development tool at the state and local level. The ability to control energy costs and sources is a key priority for many companies, and – as mentioned a growing number of corporations are specifically seeking opportunities to purchase advanced energy – a choice often backed by an internal sustainability or renewable energy target. As of last year, AEE found that 71 of the Fortune 100 companies and 43% of Fortune 500 companies had set a renewable energy or energy-related sustainability target. This trend currently spans all industry sectors, with businesses in healthcare, chemical, apparel, financial services, and technology committing to purchasing more renewable energy.[1]

Many states – including those represented on the Committee – are leading the way in creating a market that meets the needs of these customers. As of this month, according to data compiled by the Business Renewable Center of Rocky Mountain Institute, Texas had the largest market for renewable energy contracted by corporates from offsite facilities, with 2,965 MW of deals signed. Other leading states include Oklahoma with 1,279 MW, North Carolina with 407 MW, Ohio with 390 MW, and Illinois with

[1] https://info.aee.net/growth-in-corporate-advanced-energy-demand-market-benefits-report

373 MW.[2] These states show that customers working proactively with utilities and developers are driving a massive expansion of the renewable energy market across the country.

Examples across the country demonstrate the extent to which U.S. corporations have succeeded in pursuing renewable energy within a competitive environment. For example, General Motors has committed to power 100% of its energy usage by renewable energy. While it has operations all around the country, the auto giant has signed the majority of its renewable contracts in Texas. This is both due to the favorable economics of wind energy and there the competitive market structure in the Lone Star State, which readily accommodates corporate procurement. GM has also recently announced additional purchases of renewable energy, from wind farms in Ohio and Illinois.

Many other companies have put in significant effort to develop creative solutions, such as Amazon Web Services, which has collaborated with Dominion Energy in Virginia to develop a new market-based rate to bring over 250 MW of new solar energy onto the grid in Virginia.[3] Through an entirely different mechanism, Microsoft recently contracted with its local utility provider in Wyoming to power its facilities from renewable energy and onsite backup natural gas generators, which the utility can call upon in times of need to provide additional reliability to the grid.[4] Walmart, headquartered in Bentonville, Arkansas, and with stores in all 50 states, has also pursued a number of different strategies to work toward its 100% renewable energy goal. As of May 2017, the company had installed 364 onsite solar facilities across the United States, with a goal to grow that number to 480 by 2020. The company has also pursued offsite purchases, including a recent transaction through its local utility in Alabama, Alabama Power, to purchase energy from a 72 MW solar facility.[5]

Declining costs and increased adoption of advanced energy also have a significant impact on the everyday consumer. More consumers are increasingly exercising choice and control over their energy needs, whether that means purchasing solar panels for their rooftop, charging electric vehicles in their garages at night, or managing their household energy consumption from their phone that is connected to a smart thermostat. Customers are now active participants in the grid, making it much more dynamic. Consumers are driving this change, and federal policy must recognize the increasing role of the consumer in the grid.

States are also recognizing the consumer value of advanced energy. Brooklyn, New York, is a notable example of how new regulatory policies can benefit consumers. As a population and economic boom takes place in Brooklyn, energy demand has spiked. The city estimated that a $1 billion investment in new equipment was needed to meet this demand. In response, the New York Public Service Commission (PSC) determined that the energy demand could be managed more cheaply through the use of other technologies, such as demand-side management and energy storage, and reduce the projected cost to $200 million. By making use of distributed energy resources (DERs), Brooklyn

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[2] http://businessrenewables.org/downloads/brc_nov_2016/State-of-the-market.pdf
[3] https://www.greentechmedia.com/articles/read/amazon-and-dominion-power-forge-a-new-renewable-energy-path-in-virginia and https://www.amazon.com/p/feature/gkkwdp34z5ou7ug
[4] http://www.utilitydive.com/news/how-microsoft-and-a-wyoming-utility-designed-a-data-center-tariff-that-work/430807/
[5] Walmart, "Scaling clean, affordable, renewable energy," 2017 Global Responsibility Report, http://corporate.walmart.com/2017grr/opportunity

consumers will receive a $800 million savings.[6]

Advanced energy enhances the reliability and resilience of the grid by increasing fuel diversity, promoting a more flexible energy system, and responding to extreme weather events.

We are currently undergoing a transition to a more diverse energy resource mix. Ten years ago, nearly half of U.S. power generation was supplied by a single resource: coal. Today, coal and natural gas each supply about one third of our electric power, nuclear one fifth, and hydro and non-hydro renewables another one fifth. This greater fuel diversity gives us more options for meeting electric power needs, increases competition, and drives down prices.

This transition has been primarily driven by consistently low natural gas prices, followed by flat electricity demand and competition from renewable energy, which has sharply fallen in cost. With grid management and operational techniques becoming more sophisticated, grid operators are now routinely managing high levels of wind and solar generation, sometimes exceeding 50% of load, without compromising reliability, levels that would have been viewed as impossible just a few years ago. These changes in resource mix are improving – not reducing – the reliability and resilience of the electric power system, as demonstrated by extreme weather events.

During the 2014 Polar Vortex, the extreme cold caused a winter-record demand for electricity and also contributed to the failure of 22% of the generation in PJM Interconnection territory. NERC conducted an assessment of the Polar Vortex event and found that, of unplanned power plant outages, coal plants accounted for 26% of the total and natural gas 55%. Outages due to extreme cold were caused by the freezing of onsite fuel supplies like coal piles, frozen control and sensor equipment, and the inability to receive fuel from outside providers due to natural gas pipelines constraints.[7,8] Facing this situation, grid operators were able to turn to demand response and wind energy, along with nuclear power, to meet electric power needs and keep the lights on even when other resources failed.

Utilities are implementing more advanced energy solutions to prepare for extreme weather events, as well. Austin Energy – one of country's largest community owned utilities serving more than a million people – contracted with Schneider Electric to implement an advanced distribution management system (ADMS). ADMS integrates the millions of data points from the grid into one easily accessible system. This allows grid operators to have access to fast and highly reliable information to understand and communicate the status of outages when responding to weather events, like the summer storm season in Austin. ADMS helps to fully integrate demand response and other distribution system services that creates a more resilient grid.

Other advancements in technology help maintain grid reliability. The New York Power Authority currently benefits from greater digitalization in the energy grid. NYPA is the state's largest public power

[6] http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=45800
[7] NERC. "Polar Vortex Review." (Sept. 2014) available online at http://www.nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final.pdf.
[8] PJM Interconnection. "Response to Consumer Reports on 2014 Winter Pricing." (19 Sept. 2014) available online at http://www.pjm.com/~/media/documents/reports/20140919-pjm-response-to-consumer-reports-on-2014-winter-pricing.ashx.

organizations with more than 1,400 circuit miles of transmission lines and has transmission cables that connect Westchester County to Long Island underneath Long Island Sound. Over the last five years, ship anchors have hit some of the transmission lines causing electrical problems for the area. The digital system can now let ships know when they are too close to wires, and to avoid dropping anchor there. A more cloud-based energy system also helps to anticipate problems and find outages quickly instead of having trucks driving around residential areas.[9]

Advanced energy companies are also empowering customers to take control of their own energy use, which has positive impacts for the grid. By providing personalized and actionable energy insights, Oracle has helped more than 15 million households save energy. These families have saved more than $1 billion on their energy bills by reducing their usage by more than 15 terawatt-hours. These savings are concentrated during peak hours, helping utilities manage the grid more efficiently.

Modernizing the aging energy infrastructure that has supported American prosperity for decades and moving toward a more diverse and dynamic energy system are the keys to maintaining a reliable grid in the future. Competition and innovation will drive down costs while meeting our energy needs as they evolve. And as mentioned earlier, this process has not only improved the overall functioning of the grid but acted as an economic engine as well. Giving these resources the chance to contribute to and compete in the U.S. energy system has resulted in growth and prosperity, and will continue to do so going forward.

Federal policy should pursue technology-neutral competition in wholesale markets to maximize benefits to consumers and enhance the reliability and resilience of the grid

Technological innovation benefits consumers by increasing competition in the marketplace between energy technologies, increasing customer choice, and driving down the cost of electricity. Organized competitive wholesale power markets are driving development of a 21st century electric system that adopts innovative technologies, drives down costs, and improves reliability and resilience through greater use of advanced energy technologies and services.

A 2016 paper by the conservative think-tank R Street Institute, *Wholesale Electricity Markets in the Technological Age*, emphasizes that well-functioning markets incentivize technological innovation while producing a reliable and affordable grid.

“RTO/ISOs have exhibited strong reliability performance and provide incentives for market participants to engage in reliable behavior. The open-access organized market model is better positioned to reduce barriers to entry, lower transactions costs, provide clear investment signals to investors that spur innovation and compensate resources fairly and efficiently in a manner consistent with market fundamentals.”[10]

Real life examples show these principles to be true. For example, the Midwestern and Mid-Atlantic states in the PJM territory have seen $11.8 billion in savings in just one year from demand response and energy efficiency, enabled by rules that allowed these resources to compete against additional

[9] https://dailyenergyinsider.com/featured/5244-digitizing-electric-sector-well-way-power-execs-say/
[10] https://www.rstreet.org/wp-content/uploads/2016/08/67.pdf

power generation.[11] As mentioned above, PJM also credited these resources with helping to keep the lights on during periods of system stress, such as the Polar Vortex.

Competitive wholesale power markets have opened important new opportunities for advanced energy technologies to provide reliability, resilience, and cost savings to consumers, but continue to suffer from technology-specific barriers that prevent advanced energy from providing a full suite of benefits. While some markets overseen by the Federal Energy Regulatory Commission (FERC) and managed by Regional Transmission Operators (RTO) and Independent System Operators (ISO) have opened opportunities for advanced energy technologies to compete on a level playing field with traditional generators and transmission operators, others have maintained legacy established rules (or even sought to enact new ones) that prevent advanced energy technologies from competing on price and performance; none has provided a completely level competitive playing field.

In fact, some market rules prevent new and emerging technologies from selling their services on the open market, stifling innovation and keeping our electricity system from being modernized for higher performance. Market rules vary by RTO/ISO but there are generally three common barriers to fair, open, technology-neutral competition:

1) Requirements that all energy resources have characteristics (such as size or operating time) that match the characteristics of traditional generating units;
2) Categorizing resources based on what they are (such as a power plant) rather than what they can do (such as produce, store, or save electricity); and
3) Prioritizing supply-side resources (such as power plants) over demand-side resources (such as efficiency).

In July 2017 testimony to the House Science, Space, and Technology Committee, AEE member AES Energy Storage highlighted a notable example of current market rules impeding innovative technologies from getting full compensation for its services in the market.[12] Indianapolis Power and Light (IPL) had difficulty integrating a new 20 megawatt battery storage system (developed by AES Storage for IPL) onto the grid, and getting fully paid for the reliability benefits that system provides. IPL faced difficulties interconnecting to the grid because Midcontinent Independent System Operator's (MISO) definition of a "storage" product was designed for older versions of storage, specifically "flywheel." MISO's rules had not been amended to allow for newer, advanced energy technologies to participate and be fully compensated, such as lithium ion batteries.

Similarly, compensation for grid services has not caught up with the capabilities of advanced energy technologies, such as solar and storage, as a fast-responding, reliable resource. The current framework incentivizes generators to run at full capacity, rather than configuring their inverters to leave the appropriate headroom required to offer these services, because there is no compensation for doing so. For example, First Solar recently completed a demonstration project with the California Independent System Operator (CAISO) and the National Renewable Energy Laboratory (NREL) to measure the

[11] Monitoring Analytics, the Internal Market Monitor for PJM. "Analysis of the 2013/2014 PJM Base Residual Auction Revised and Updated, September 20, 2010. Page 52.
[12] https://science.house.gov/sites/republicans.science.house.gov/files/documents/HHRG-115-SY-WState-KKumaraswamy-20170719.pdf

capability of utility-scale solar to provide flexibility to the grid.[13] The test data shows that utility-scale solar plants can provide services that range from spinning reserves, voltage support, ramping, frequency response, variability smoothing and frequency regulation, and offer them faster and with more accurate results than conventional generation.

FERC is aware of these issues, and is beginning to address them. The Commission currently has a Notice of Proposed Rulemaking (NOPR) related to removing barriers for storage and aggregated distributed energy resources (DER) – such as electric storage resources, electric vehicles, and distributed generation – participation in wholesale power markets. AEE fully supports, and is engaged with, this effort. The Commission also has a NOPR related to primary frequency response. This is an excellent start to address issues of compensation and the possible solutions that advanced energy can offer, but does not do enough, as it is limited to this one grid service and does not address larger utility-scale issues and capabilities for providing reliability to the grid. We look forward to working with FERC and Congress to ensure that federal rules and regulations do not impede innovative advanced energy technologies from fully participating in markets and receiving full compensation for the grid services they provide.

AEE appreciates the opportunity to testify before the Committee today, and looks forward to working with each of you to ensure that technological innovation continues to thrive in the United States to preserve a reliable, resilient, and affordable energy system.

Thank you,

Arvin Ganesan

[13] NREL, CAISO and First Solar, *Using Renewables to Operate a Low-Carbon Grid* (January 2017), available at http://www.caiso.com/Documents/UsingRenewablesToOperateLow-CarbonGrid.pdf