Praveen Kathpal
Vice President
Global Market Development
AES Energy Storage

October 3, 2017

Testimony of Praveen Kathpal, Vice President of Global Market Development of AES Energy Storage Before the U.S. Senate, Committee on Energy and Natural Resources – Full Committee Hearing to Examine Energy Storage Technologies

Thank you, Chairwoman Murkowski, Ranking Member Cantwell and Distinguished Members of the Committee. My name is Praveen Kathpal and I am Vice President of Global Market Development at AES Energy Storage and serve as Chair of the Board of Directors for the Energy Storage Association, the leading national voice of the United States energy storage industry. I am honored to testify in front of you today on the topic of energy storage and its role in the electric power sector.

Background on AES Energy Storage

The AES Corporation is a Fortune 200 company headquartered in Arlington, Virginia that provides affordable, sustainable energy to U.S. states including Ohio, West Virginia and California, territories like Puerto Rico and the Virgin Islands, as well as in 16 other countries including the Dominican Republic, Chile, Brazil, the Netherlands and Northern Ireland. AES was founded more than 35 years ago with a focus on how to think differently about technology, business models and market structures to deliver innovative solutions to customers. There is no better example of our approach to innovation than in our energy storage business.

In 2007, AES Energy Storage was founded as a subsidiary of AES to commercialize applying battery technology to the electric grid. Ten years ago, battery-based energy storage on the grid was viewed as experimental, and did not exist as a business opportunity. We knew the technology and the solution would be viable, economic and profitable on its own. We designed and built the first megawatt-scale lithium-ion battery energy storage project in Indianapolis, integrating two large containers of batteries to prove that large-scale battery-based energy storage could connect to an electric grid,

operate as a complete system, and respond to a remote signal to charge or discharge the battery.

Since then, AES has been recognized as the world leader in utility-scale battery energy storage systems, and we have found a business case for storage in every market we have entered.

Today, energy storage is a proven solution and is operating successfully across the country and in many overseas markets. AES continues to be a market leader and pioneer new uses of grid-scale battery energy storage. To fuel future growth, earlier this year Siemens and AES announced we will partner to create Fluence, a new, U.S.-headquartered global energy storage technology and services company that unites the scale, experience, and reach of its two parent companies to lead the next growth phase for storage – taking this vital technology to more customers in over 160 countries around the world.

Industry Context

Energy storage sits at the center of global trends shaping the electricity industry, in particular the acceleration electrification of our society and adoption of renewable and distributed energy sources.

Electricity is fundamental to everything we do, representing nearly 40 percent of U.S. end-user energy use, with transportation and industrial fuel use representing an additional 51 percent, two sectors expected to increasingly electrify in the coming years. According to the International Energy Agency, 2015 saw the number of electric vehicles on the road surpass 1 million, a major milestone, a number projected to jump to 530 million globally by 2040. As we continue to pursue the electrification of transportation and other industries, our need for clean, reliable, and affordable electricity will continue to increase.

Energy storage is also the key enabler of the integration of greater amounts of renewables into the electric power system, answering consumers' and businesses' growing demand for clean energy. Wind and solar will account for 64% of new power generating capacity added globally over the next 25 years. AES' view is that increasing

access to low-cost, reliable electricity drives economic growth and furthers our mission of improving lives.

Today, our electric power system is lagging behind every other vital societal network in terms of efficiency, reliability and flexibility. IHS Markit studied four critical networks - data, travel, perishable goods and natural gas - and found that each had storage amounting to at least four days' worth of demand, and even years' worth in the case of data networks. The electric network has only 20 minutes. In the key networks IHS studied, incorporating storage across the network ensured availability, enabled greater network responsiveness, improved resiliency, and increased utilization of existing assets.

Energy storage is vital for transforming our electric grid so it can meet the needs of a rapidly changing energy landscape, as we electrify industries and increase our adoption of renewables and distributed generation. Adding storage unlocks the full potential of the electric power system, increasing access to abundant clean energy.

It also enables us to address today's power system challenges such as the United States' aging electricity infrastructure. The United States' electric power generation fleet is aging with a growing segment in need of replacement. The average generation asset has been in service 28.7 years, and 20% of capacity have been in service for 45 years or longer. In addition, the U.S. transmission and distribution grids are also aging and utilities are ramping up investments to modernize them, with spending having ballooned from $10.2 billion in 2010 to $20.1 billion five years later. Unexpected retirements of nuclear generating stations and other conventional energy infrastructure facilities have put pressure on utilities and policymakers to find other resources – in cases within months – to maintain reliability. The threat of extreme weather events only exacerbates these needs.

AES believes that battery technology, lithium-ion in particular, is uniquely suited to address these issues. Lithium-ion technology is mature with a 25-year history operating in consumer electronics and more robust industrial applications including transportation. The electric power sector is now benefiting from safety advances from electric vehicle applications, lithium-ion technology's robust global supply chain and the collective research and development investment of a global network of leading companies, many of whom have been our technology partners over the past 10 years. Rapid lithium-ion adoption has driven down costs for lithium-ion batteries dramatically, with prices

having dropped 73% over the last 7 years and are projected to decline another 72% by 2030.

Business Opportunity for Battery-Based Energy Storage

Battery-based energy storage is a unique tool for the electric power sector because it manages to solve three problems at once – the need to lower costs, to lower emissions, and to improve reliability and resilience.

Energy storage lowers costs to utilities and their customers by avoiding the need to build new gas-fired peaking power plants, and by avoiding or deferring transmission and distribution infrastructure needs. It can be built in right-sized increments rather than the typical lumpy investment profile where large generation or grid assets are built in anticipation of future demand growth, the occurrence of which is increasingly uncertain. Energy storage also enables utilities and power generators to operate existing generating assets and transmission and distribution lines more efficiently. Lastly, storage is fuel-agnostic, meaning utilities can charge their facilities with the lowest-cost energy sources.

Those lowest-cost energy sources are increasingly the cleanest as well – solar and wind installations represented more than 60% of new U.S. electric generating capacity installed in 2016 and 55% of new capacity installed globally in the same year. Energy storage is increasingly seen as an enabling technology to accelerate the adoption of renewable energy.

Having enough power generation capacity to meet demand during peak time periods is a growing need for the industry, with 41 GW of peaking capacity needed nationwide by 2030, representing $45 billion in generation infrastructure investment. That total includes regions with more concentrated needs such as 5 GW in the Southwest, 4 GW in the Midwest and 10 GW in the Southeast. Investor-owned electric companies are also planning to invest approximately $56 billion on modernizing transmission and distribution infrastructure in 2017. In both cases, energy storage offers a cost-competitive, flexible resource utilities are already finding can help them meet these needs.

Commercial Cases for Utility-Scale Battery Energy Storage

Two utilities in the western U.S. are leading the way on harnessing energy storage for these key grid needs. In 2014, Southern California Edison, the largest utility in our most populous state, was facing the retirement of older natural gas-fired power plants and the unexpected retirement of a large nuclear power plant. They needed to select new sources of capacity to meet their customer's needs. SCE ran a procurement solicitation in which energy storage was compared against gas-fired generation, demand response and other resources. They awarded AES the world's first long-term contract to provide peaking capacity from a battery-based energy storage facility in Long Beach, California. This plant will be able to provide 100 MW of power for four continuous hours, directly substituting for the need to build a new gas-fired peaking plant. It was selected by SCE on an economic basis, meaning that it will provide the capacity at a lower net cost to SCE's customers than obtaining the same amount capacity from a traditional gas-fired peaking plant. SCE's decision in this case was a watershed proof point for the economics, scale, and technology maturity of battery-based energy storage to meet electric system needs.

Arizona Public Service recently partnered with AES to become one of the first electric utilities in the country to choose energy storage to avoid the need to rebuild transmission and distribution poles and wires serving a small town 90 miles outside of Phoenix where peak electricity demand is increasing. By placing a relatively modest sized battery array at the end of the last 20-mile segment of power line, APS will save its customers the cost of rebuilding those lines, which cross over difficult terrain. When not being used to serve customer demand, the battery system will provide additional benefits like voltage regulation and delivery of excess solar power, as well as the capability to add additional storage as needed, all at a similar cost. In a number of cases, energy storage enables utilities to defer or avoid entirely investments in a variety of fundamental, single-function grid assets like wires, poles, transformers and substations, and in the process, get the most value from the transmission and distribution lines they already own and use. As communities across the U.S. and elsewhere around the globe work to modernize their electric grids, utilities are beginning to recognize that energy storage enables them to think more broadly about their investment options and strategy.

Deploying battery energy storage also provides significant value on small, isolated grid systems like those in Northern Chile, where AES has deployed three arrays. They

work in concert with conventional generation sources to provide grid stability, and an instant response to disturbances in the grid, such as when a large power plant or transmission line suddenly stops working. These applications are similar to how energy storage would be used in island or microgrid applications, where many energy resources need to work in concert with each other, and energy storage fills the gaps between supply and demand to ensure the reliable and efficient delivery of electricity, often avoiding the need to burn diesel fuel in generators, the predominant source of fuel in remote areas.

Battery energy storage can also be deployed in mere months to answer unexpected capacity needs. In 2016, when a critical natural gas storage facility providing peak reserve capacity near Los Angeles had to be taken out of service, the California Public Utility Commission (CPUC) directed Southern California investor-owned electric utilities to fast-track additional energy storage options to enhance regional energy reliability. In response, SDG&E expedited ongoing negotiations and contracted with AES Energy Storage to build two projects for a total of 37.5 MW of 4-hour duration lithium-ion battery energy storage. The larger project, a 30 MW facility built in Escondido, Calif., is currently the world's largest li-ion battery installation, and both the Escondido project and a smaller 7.5 MW installation was built in El Cajon were completed and online in eight months. Battery-based energy storage can to be deployed in months compared to the years required for traditional assets, which enabled southern California's utilities unparalleled flexibility to meet their local capacity needs.

In addition, energy storage adds resilience and can protect electric grids during extreme weather events. In the last month, Hurricanes Irma and Maria – Category 4 and 3 hurricanes on the Saffir-Simpson scale, respectively – impacted the Dominican Republic on September 7th and 21st, 2017 and stressed the local grid. AES had just deployed two 10-megawatt energy storage arrays on the Dominican grid, and as each hurricane approached the island, the grid operator requested that both systems be kept online and operational during the storm to help maintain grid stability. Conditions on the Dominican electric grid were volatile during both hurricanes as generation, transmission, and distribution networks were damaged or shut down. Both of the energy storage arrays responded as intended and helped keep the grid operating throughout the storm, even with nearly 40 and 55 percent of the Dominican Republic's generation assets forced to shut down during Hurricane Irma and Hurricane Maria, respectively.

Policy Drivers to Accelerate Energy Storage Adoption

We are seeing important state and federal policy developments that will accelerate the adoption of energy storage by lowering barriers to entry, and fostering competition between energy storage and conventional solutions to meet electricity system needs. At the federal level, we are pleased to see the proposed rulemaking from the Federal Energy Regulatory Commission that would provide fair and equal access for storage resources to wholesale power market products and services. We are also pleased to see FERC provide the direction that storage resources providing a transmission function can seek cost recovery through cost-based and market-based rate structures. We believe these are important policy initiatives at FERC that can create lasting wholesale market changes that fully value the unique capabilities that storage brings and to encourage consideration of storage use for infrastructure needs.

We also see a lot of recent momentum in state policy. States like California, Oregon and Massachusetts have instituted storage targets to accelerate adoption and realization of benefits to rate payers. Many other states including Nevada, New York, Maryland, Colorado, and Minnesota are actively pursuing storage studies of their own and considering further policy guidance for grid planners. In New Mexico, the state's Public Regulation Commission introduced a rule to include energy storage in utility integrated resource planning studies. Similarly, in Washington state, the Utilities and Transportation Commission is working on a policy statement that would encourage utilities to evaluate storage as an alternative when procuring new power capacity or upgrading their infrastructure. At AES, we believe that these types of state policies can be widely replicated to accelerate energy storage adoption across the country.

The Department of Energy has a few limited programs currently which provide technical, economic, and grid integration analysis and technical support related to energy storage. We believe that directing those analyses at real generation, transmission, or distribution problems will accelerate the adoption of storage as a cost-effective alternative to conventional electricity system investments. Expanding these programs or providing support directly to utilities, state public utility commissions, independent system operators and regional transmission organizations, reliability entities, state energy offices, and consumer advocates to analyze storage in state and regional context for generation, transmission, and distribution planning, will accelerate a

more efficient level of storage investment. Areas where we currently see good analyses or programs looking at the right programs are:

- National Renewable Energy Laboratory work on the capacity value of energy storage and production cost modeling of energy storage benefits;
- Pacific Northwest National Laboratory work on energy storage in integrated resource planning; and
- Office of Energy Efficiency and Renewable Energy Analytical Support Program for State Public Utility Commissions work on the consideration of energy storage in integrated resource planning and transmission and distribution planning.

Chairwoman Murkowski, thank you again for the opportunity to testify today – I would like to invite you and the other Members of the Committee to visit any of our storage facilities in the United States. I am happy to take any questions.

Thank you.

The AES Corporation
4300 Wilson Boulevard
Arlington, VA 22203
aes.com