

# Improving the PJM Grid while Lowering Costs

PJM customers saved over \$20 million in 2013 with AES Energy Storage

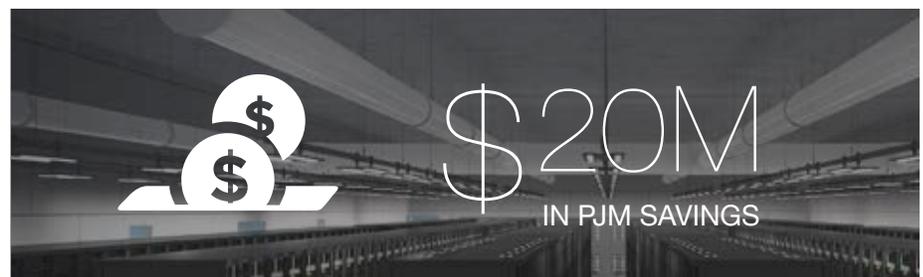
“Resilience is the ability to reduce the magnitude and/or duration of disruptive events.”

—Terry Boston, PJM President and CEO

## Executive Summary

In 2008, AES partnered with PJM to install the first advanced energy storage system for grid service. Since then, AES has added 128 MW of storage resources within the PJM footprint. These storage resources have been deployed at an installed cost lower than gas peakers

and show a real time response at least 100 times faster than conventional generators. In 2013 alone, AES’ energy storage assets yielded more than \$20 million in savings to PJM and its customers, proving that energy storage resources are both cost-effective and reliable. PJM now relies on dispatch of this flexible solution for frequency regulation across its system.





## PJM grid strengthened with nearly 130 MW of energy storage resources

As the nation's largest Regional Transmission Operator (RTO), PJM manages the flow of wholesale electricity for over 61 million customers.

### About PJM

As the nation's largest Regional Transmission Operator (RTO), PJM manages the flow of wholesale electricity for over 61 million customers in 13 states and the District of Columbia. One of PJM's critical functions is to maintain the second by second balance of supply and demand for electricity. It does that by forecasting customer load, scheduling sufficient energy to be generated, and then monitoring in real time to ensure that a perfect balance between load and demand is kept at all times. As load varies and unexpected events (such as generation and transmission outages) occur, PJM systems make split-second decisions to keep supply and demand precisely balanced in order to maintain a reliable power grid. To do this, PJM competitively procures operating reserves, called Ancillary Services, from qualified power

generators. These services provide the critical, fast-acting capacity needed to manage the momentary mismatches between electricity production and consumption.

### The Case for Storage in PJM

PJM works to provide cost-efficient, reliable energy to meet the needs of its 61 million consumers. It continuously looks for innovative ways to serve its customers. In 2008, PJM was looking ahead to the potential of integrating electric vehicles to the grid for Ancillary Services. At the same time in Indiana, AES had already completed certification of the first grid-scale lithium-ion battery system to supply Ancillary Services. When these paths crossed, what resulted was an opportunity to develop advanced grid reliability solutions to cost-effectively serve the world's largest power market.

Following a jointly developed plan, in late 2008 AES moved one containerized lithium-ion battery system to PJM headquarters and "Project Barbados" was born. This unit was able to both supply and withdraw up to 1 MW of power (i.e. from -1 MW to +1 MW), enabling it to participate in the PJM market for regulation

services. Working closely with PJM, AES registered the Barbados unit as a market participant and completed the market qualification tests to supply Ancillary Services, specifically frequency regulation. This was the first time a battery system qualified for power market services in PJM, and the first time a storage system generated revenue in any competitive market.

*"When AES came, they were thinking much bigger than anyone else that I'd seen in the battery industry."*

*—Terry Boston, PJM President and CEO*

### Solution Development

Project Barbados was just the beginning. PJM and AES continued their collaboration analyzing the performance of the storage system and reviewing the market regulation signals to evaluate ways of improving the performance of regulating reserves for the market.

This resulted in PJM reintroducing a more robust, dynamic regulation signal to take advantage of the



## AES storage arrays provide an efficient way to manage frequency regulation

benefits of fast responding units, such as the AES storage facility. According to Terry Boston, President and CEO of PJM, "From an operator's perspective, this is one of the fastest resources we have to respond automatically to any frequency deviation caused by renewables or even steel mills."

Consistent with its mission of improving lives by delivering reliable and sustainable energy solutions, AES has a strategic focus on growing its platform in PJM. AES has worked with PJM through regulatory impediments for storage in the form of interconnection technicalities, market registrations, SCADA signaling, net-metering, and FERC filing.

Following the initial Barbados project with AES' 64 MW Laurel Mountain storage resource in 2011, the 40 MW Tait resource in 2013, and the 20 MW Warrior Run resource in 2015, AES now has 128 MW of resources within PJM. These resources were developed with a speed that cannot be matched by conventional generating resources. The interconnection, market registration, engineering, procurement, construction and commissioning of the Tait storage array were completed in < 6 months, on-time and on-budget.



### Twice the Resource

While most grid resources, such as conventional generators and load elements, can only either supply or absorb power, energy storage can do both. The arrays can be discharged to supply energy like a power plant AND they can be charged to absorb energy like an industrial customer.

In the PJM Interconnection, AES' energy storage arrays have the capability to fully discharge, fully charge, and do anything in-between in response to the PJM regulation signal. As an example, the Laurel Mountain array can vary from -32 MW to +32 MW, which PJM views as a 64 MW resource with a 32 MW grid interconnection—twice the resource of a traditional power plant for the same installed capacity.

### Powerful Results

**COST EFFECTIVE:** By the end of 2013, AES' storage fleet had already saved PJM and its customers over \$20 million by lowering the cost of critical grid reliability services. These benefits accrued largely because fast resources like batteries provide regulation more efficiently (using less MW while having faster response and greater reliability) than traditional power plant resources.

Compared to the previous approach with traditional generation, the existing AES storage fleet in PJM has the potential to deliver more than \$300 million of savings to the region in the next 15 years—this from a resource with lower lifecycle cost, lower environmental impact, higher utilization rate and better availability than a traditional gas turbine peaking plant.

**SUSTAINABILITY:** By displacing regulation services provided by traditional power plants, AES' energy storage systems in PJM are estimated to reduce air emissions by 62,000 tons of CO<sub>2</sub> annually—the equivalent of removing around 11,000 cars from our highways. Further, with expected power plant retirements, advanced

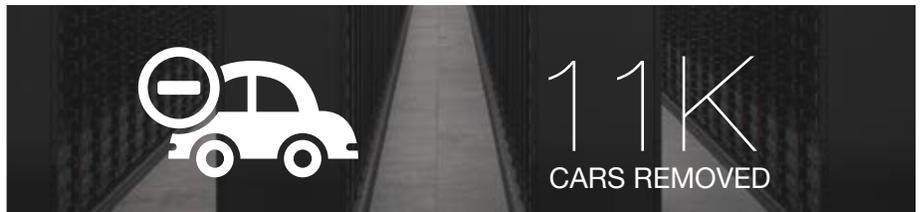


## AES storage fleet in PJM has the potential to save more than \$300 million

energy storage has offered PJM a sustainable way to integrate more renewables using a resource that has no direct emissions or water usage.

**RESILIENCY:** Severe weather events and other threats are driving a focus on smarter approaches to grid resiliency—beyond fortifying the security of existing assets. Storage facilities can be located within congested load zones making the delivery of energy less dependent on the availability of transmission lines.

**FLEXIBILITY:** Through AES’ energy storage fleet, PJM is able to provide nearly 130 MW of variation in less than one second, a response rate at least 100 times faster than traditional generation. Advanced battery solutions are also modular and scalable, so additional capacity can be added within the same footprint as it is needed.



### Looking Ahead

Having achieved over \$20 million in savings for PJM and its customers in just one year, AES’ has made significant progress in improving the resiliency of the grid while producing significant consumer savings. Looking ahead, AES continues its partnership with PJM while also developing proposals for 1000+ MW storage arrays in other markets, including California, Texas, Northern Ireland and the Philippines. Meanwhile, AES continues its work with leading regulators, utilities, and system operators across the globe to catalyze broad industry change as we work to build a clean, unbreakable grid.

“Energy storage has the ability to change everything as we know it today. For example, PJM has successfully linked AES’s lithium ion batteries to the grid to provide regulation service. These types of units provide grid operators with an efficient and accurate tool to deliver grid stability by balancing the varying load.”

—Chantal Hendrzak, PJM’s General Manager of Applied Solutions

### Quote Sources:

PJM 2013 Annual Report: <http://pjm.com/~media/about-pjm/newsroom/annual-reports/2013-annual-report.ashx>  
AES EEI video