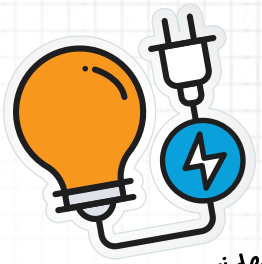
PJM's Advanced Technology Initiative



Watch a video

The initiative:

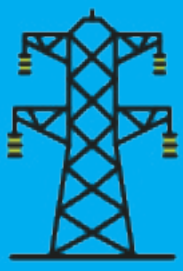
Provides opportunities for innovators – including PJM staff, member organizations, research and academic institutions, and industry experts – to advance power grid operations and wholesale electricity markets.

Builds on PJM's history of innovation and reflects its commitment to community collaboration and enhancing the reliability and cost-effectiveness of the bulk power system.

Supports innovation in-house, in partnerships and through its Advanced Technology Pilot Program.

Select a topic to explore

DIMA



Dynamic Line Rating

Synchrophasors

Virtual Power Plants

Energy Storage

PJM Pilot Program

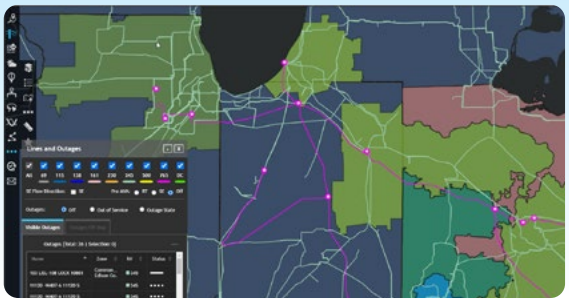
Dispatch Interactive Map Application

PJM continues to enhance its Dispatch Interactive Map Application (DIMA). DIMA is a powerful tool that was developed to enhance dispatchers' situational awareness. It simplifies and consolidates important data from multiple sources into a single geospatial display, enabling operators to more quickly and easily identify problems and coordinate the operation of the region's transmission system. DIMA also is available to PJM Transmission Owners.

DIMA provides multiple layers of real-time information on several critical elements, including:

Electrical equipment

DIMA displays real-time information from the PJM energy management system about electrical equipment, such as transmission lines, substations, generators and a host of other subsystems – all quickly configurable to suit the operator's needs.

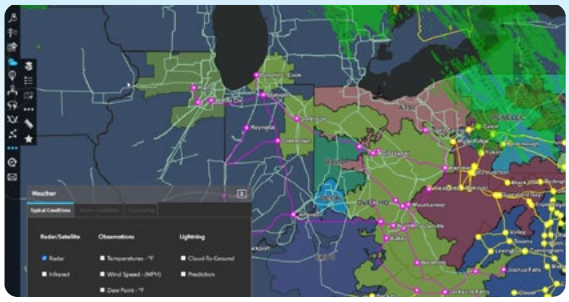


Gas infrastructure

Being able to quickly understand how potential disruptions of this fuel supply to generator and compressor stations could impact the operation of the power system is a critical skill for grid operators, as an increasing amount of generation comes from natural gas.

Weather

PJM operators can view historic and future radar, detailed temperature, wind and solar conditions, cloud coverage, severe weather such as lightning, floods and storms, and National Weather Service bulletins.



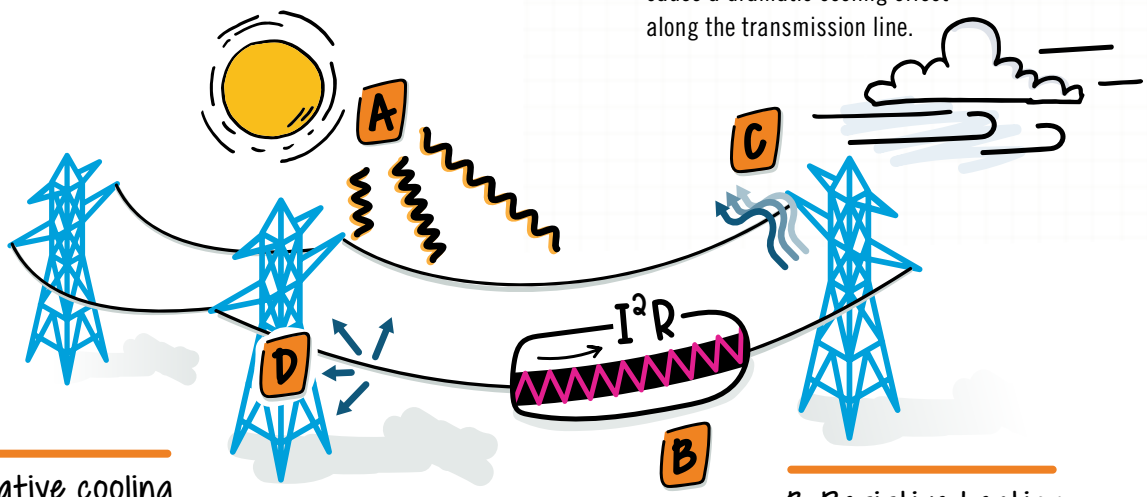
Load management

With the ability to provide reliability services alongside traditional generation resources, demand-side resources, such as loads, behind-the-meter generation and energy storage, are increasingly useful tools for operators to manage the grid.

Dynamic Line Rating

A. Solar heating
Just as the sun warms the air and the Earth's surface, heat from the sun's rays will raise the temperature at the conductor's surface.

C. Convective cooling
Nearby wind carries away warm air surrounding the conductor and can cause a dramatic cooling effect along the transmission line.



D. Radiative cooling
Even with no wind, transmission lines lose a portion of their heat to cooler ambient air.

B. Resistive heating
As current passes through the conductor, heat is generated inside the conductor by electrical losses.

Dynamic Line Rating (DLR) technology uses advanced sensors and software to monitor real-time conductor temperature along a transmission line.

It then uses this data to calculate an actual rating for the line based on environmental conditions as opposed to modeled scenarios.

In this way, DLR technology can accurately measure the real-time capacity on transmission lines, which could potentially help relieve congestion, create economic efficiencies and contribute to system resilience.

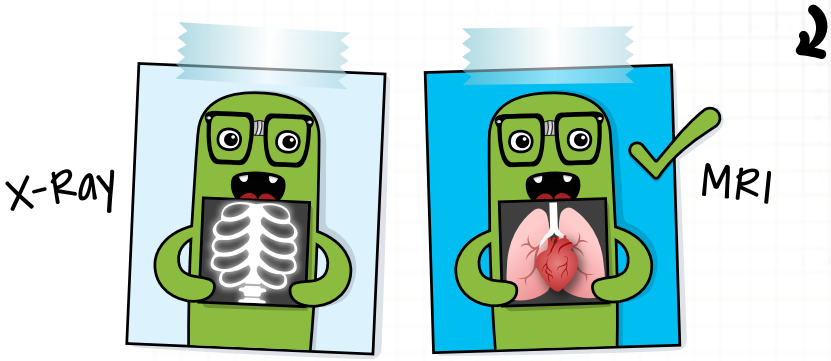
In 2016, PJM partnered with American Electric Power and DLR technology companies LineVision and Lindsey to demonstrate the use of this technology and its potential benefits more widely. PJM and its partners undertook a one-year study of a hypothetical installation on one of its most congested lines. The analysis found that use of the technology could reduce annual system congestion payments by more than $4 million – providing a rapid two-month payback of the estimated $500,000 installation cost.

In October 2022,
DLR data began streaming to PJM operators as part of a PPL Electric Utilities project for three transmission projects in northeastern Pennsylvania. PPL Electric Utilities estimates that this project can save customers $23 million annually in congestion costs.

Synchrophasors

Like an MRI shows a clearer picture than an X-ray, PMU devices provide a detailed view of the broader system.

With the aid of a $14 million U.S. Department of Energy stimulus grant, PJM and its member transmission owners have installed more than 750 phasor measurement units (PMUs) to collect synchrophasor data from more than 245 substations.

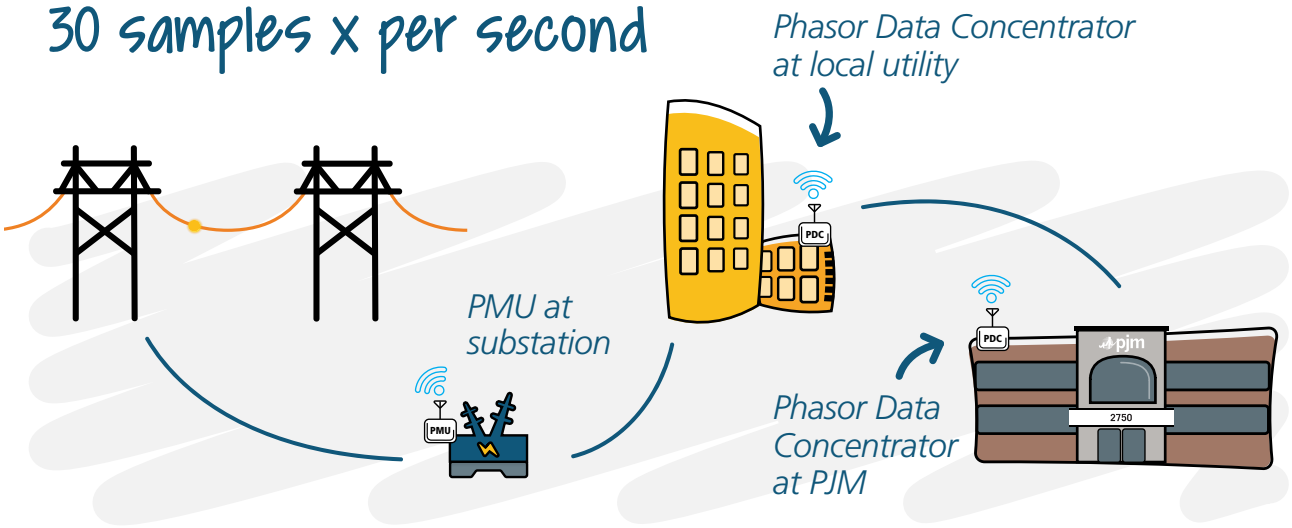


PMUs are monitoring devices that collect synchrophasor data and can reveal subtle differences in changes in various characteristics of electricity, including voltage and current, frequency and other important features of the underlying electrical waves.

Synchrophasor technology compiles data much faster and at a higher resolution (30 samples per second) than SCADA (supervisory control and data acquisition) technology, painting a clearer picture of the grid at any given moment – and over time. PJM is developing advanced applications of this technology to improve the efficiency, reliability and resilience of the power system.

For example, the high-resolution data from PMUs can help capture certain generator dynamics. Therefore, PJM is now doing automated generator model validation using synchrophasor data. Previously, in order to validate generator dynamic models, planning engineers needed to manually run simulations over a process that could take several days. Now, the whole process is automated, only takes several minutes and requires minimum supervision.

PJM is researching other applications, including geomagnetic disturbance monitoring and wide-area controls.



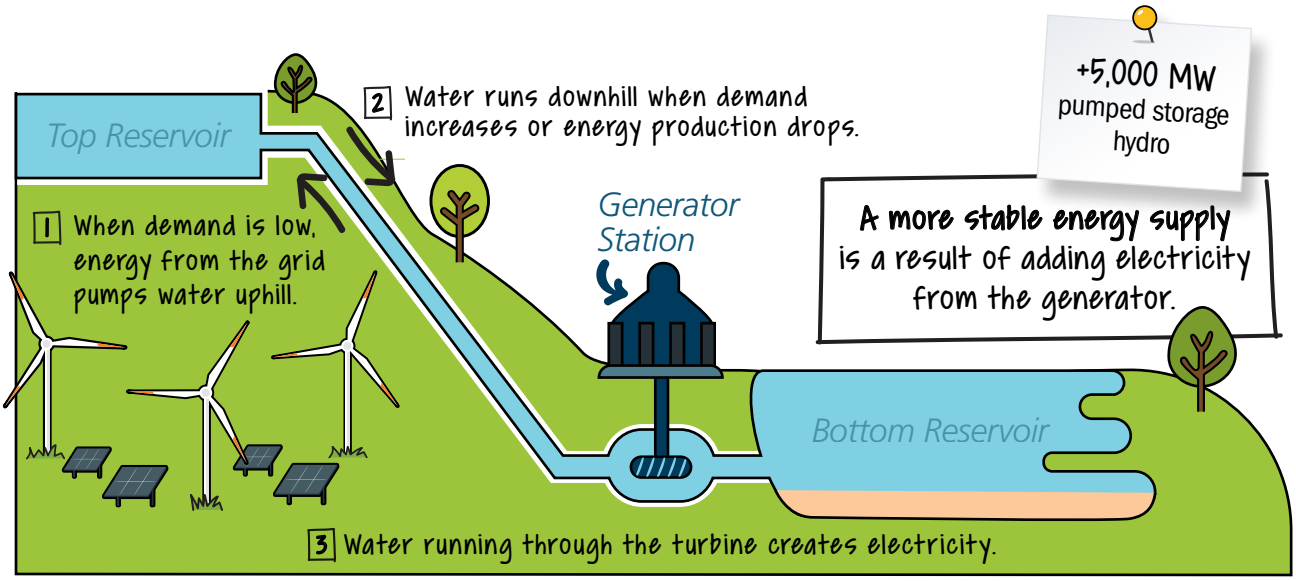
Energy Storage

Operating an efficient and reliable grid that is increasingly dependent on renewable resources will require greater system flexibility and essential reliability services being provided by new resource types. PJM's interest in energy storage reflects this trend.

Energy storage can help grid operators keep the power supply stable when wind, solar or other variable resources are changing their output due to weather conditions or more traditional resources are unavailable. It also can improve the efficiency of the transmission system by increasing the utilization factor of existing transmission and distribution networks as well as existing generation sources.

In the past, PJM has worked with various companies and national laboratories to advance the use and application of energy storage and ensure that the PJM wholesale market is capable of allowing all forms of energy storage to participate, be properly valued and compete in the market.

Today, approximately 5,000 MW of pumped storage hydro and 320 MW of battery, flywheel, and thermal energy storage are qualified to participate in the PJM market. This includes everything from large central station generation plants connected at transmission to small kilowatt-level behind-the-meter applications. Energy storage is expected to grow in the region significantly, with more than 55,000 MW of stand-alone storage and 28,000 MW of hybrid resources (i.e., solar and storage) awaiting study in the interconnection queue as of 2023.

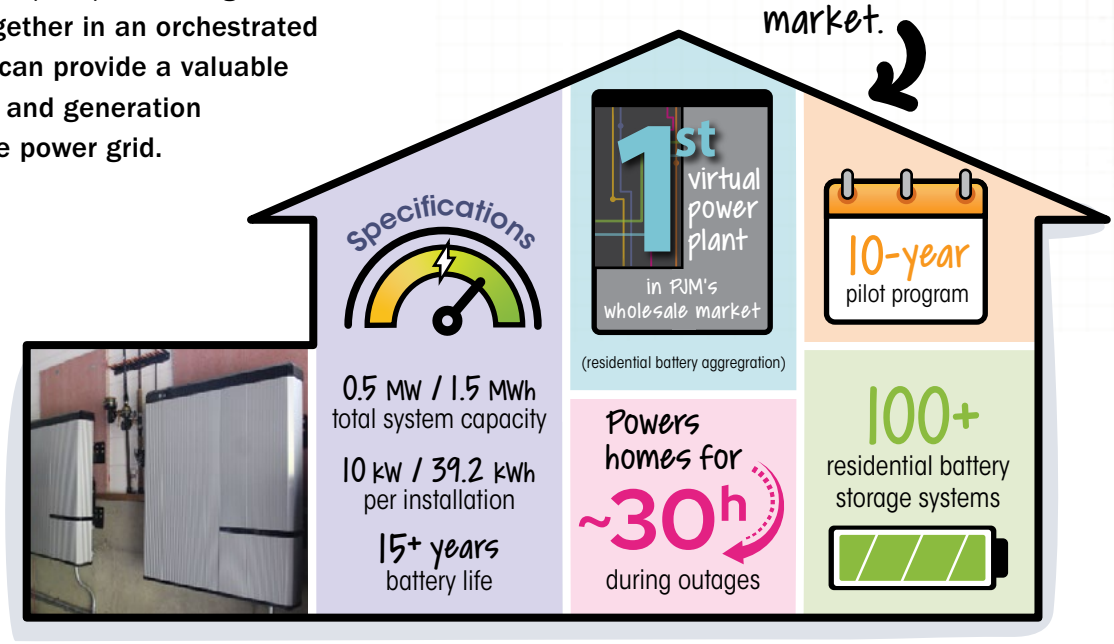


In March 2018, the Federal Energy Regulatory Commission (FERC) issued a new regulation, Order 841, mandating that all ISOs and RTOs create a market participation model in which energy storage resources can provide all of the market services that they are technically capable of offering. As a result of this order, and coinciding with other changes to PJM's capacity market, PJM made market rule changes to the capacity resource accreditation process that more accurately reflect the value that energy storage resources provide in meeting the region's resource adequacy needs.

Virtual Power Plants

Virtual power plants (VPPs) are generally considered to be a connected aggregation of distributed energy resource (DER) technologies. When responding together in an orchestrated fashion, VPPs can provide a valuable source of load and generation flexibility in the power grid.

First residential battery aggregated virtual power plant in PJM's wholesale market.



In March 2021, FERC issued a comprehensive rulemaking on DER aggregation, called Order 2222, which required that wholesale market operators develop a market participation model for DER aggregation – or VPPs. PJM is working with stakeholders, states and FERC to design and implement this new market participation model for VPPs that increases market access, enhances market competition and promotes reliability.

To demonstrate the value of VPPs at both the retail and wholesale level, PJM and Delmarva Power partnered to explore how the new Elk Neck Battery Storage VPP will participate in the region's wholesale market for ancillary services.

The project involves a residential community located on the Elk Neck Peninsula in Cecil County, Maryland. Each of the 110 homes involved is equipped with battery storage that can serve the energy needs of the individual homeowners or, aggregated and controlled together, provide reliability services to the local distribution system – as well as the RTO – by both charging and discharging from the grid.

Sunverge, a San Francisco-based provider of DER control, orchestration and aggregation platforms, is collaborating with Delmarva on the project.

The project was approved by the Maryland Public Service Commission under the Maryland Energy Storage Pilot Program and was subsequently introduced to PJM stakeholders through the Emerging Technologies Forum, a stakeholder group established to support PJM's Advanced Technology Pilot Program.

PJM Advanced Technology Pilot Program

Visit PJM's website to learn more

Since PJM is an independent and profit-neutral company, it does not directly fund pilot projects. Rather, it is an active participant in the project, providing human resources, analysis and other expertise. In certain cases, PJM offers its corporate campus or other physical resources as a test site for new technology.

PJM's pilot program provides a transparent testing ground to study the viability of integrating emerging technologies that enhance system reliability, operational and market efficiency, and resilience.

PJM is involved in a number of proposed or active advanced technology pilot projects across its footprint. These projects cover a broad spectrum of technologies and concepts, including energy storage, dynamic flexible load response, transmission operations, distributed energy resources and microgrids.

These projects vary by topic, scope, funding source and duration, but they have a common theme of contributing to the reliable and cost-efficient operation of the electric grid of the future. Information and lessons learned from these pilot projects are shared with PJM stakeholders via the Emerging Technologies Forum.

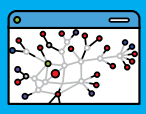
Continue learning about PJM's Advanced Technology Pilot Program.

2014

PJM implements new tool to enhance dispatch's situational awareness

Learn more

2018



Cascading trees assess the probability and consequences of large cascading outages

Learn more

2021

FERC's Order 2222 sets requirements for DER aggregation

Learn more

2022

DLR data begins streaming to PJM operators

Learn more

2023

Installed PMUs count reaches 750 in the PJM footprint

Learn more

2023

~83,000 MW of stand-alone storage and hybrid resources awaiting study in the interconnection queue

Learn more