

Getting Ready for the Hybrid Grid



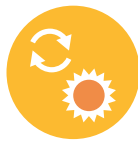
ISO New England's cutting-edge efforts are facilitating New England's transition to a smarter, greener grid — while advancing power system security, reliability, and efficiency.

Leveraging State-of-the-Art Resources and Operations

New England's traditional power system is steadily shifting toward a more complex, less predictable hybrid grid. As more renewable resources, such as wind power, supply the regional power system, solar power, energy storage, energy efficiency, electric vehicles, and smart meters are also changing not only how much electricity people draw from the grid, but when they draw it. This transformation in the way the region generates, delivers, and consumes electricity is also changing how ISO New England runs the power system today and how we will run the hybrid grid in the future.

Renewables and distributed resources:

Weather-dependent power resources, such as wind turbines, and distribution-level resources, such as solar photovoltaic (PV) systems, are changing historical patterns of electricity supply and demand and driving the need for unprecedented agility in grid operations and sophisticated forecasting tools.



Energy storage: Wholesale markets are providing new opportunities for advanced energy-storage technologies. Once it is grid-scale and cost-effective, this energy storage should help balance wind and solar resources' intermittent output. To keep the lights on, efficient, fast-start natural gas power plants will continue to be required, and solutions to the region's natural gas constraints will be needed.



Smart grid: New technologies allow grid conditions to be monitored in real time, enabling greater operational control and flexibility. But this new "digital grid" — with its two-way communication flow — produces large volumes of data, requiring investment in both high-speed computing capability and protection against cyber threats.



Resources with low to no emissions dominate proposed new power resources in New England.

Source: ISO Generator Interconnection Queue (August 2016)



57%
Natural Gas



35%
Wind



5%
Solar



1%
Battery Storage



2%
All Other

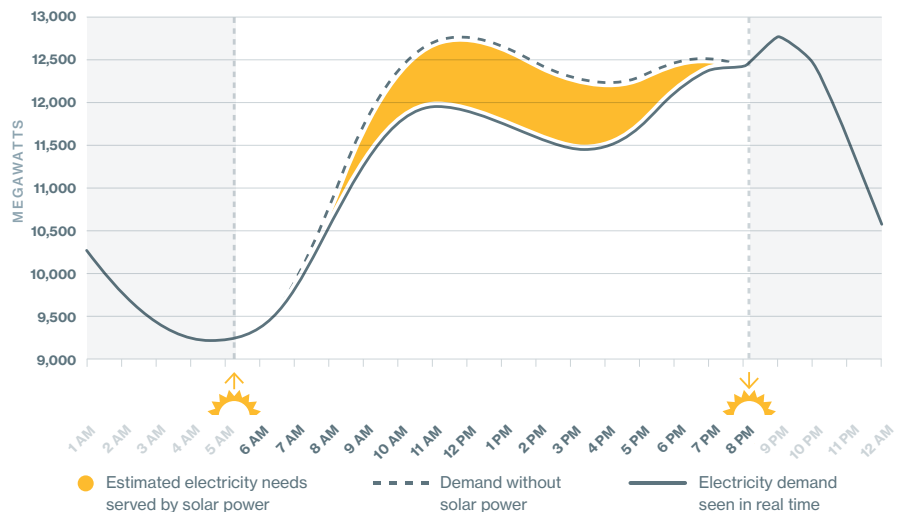
Predicting the Unpredictable

Grid operators rely on accurate forecasts to precisely dispatch power resources to meet demand. The ISO is breaking new ground with tools to anticipate the output and effects of renewable energy, energy efficiency, and distributed generation. We have:

- Boosted our system operators' real-time awareness of wind generation with enhanced software and displays, and established a seven-day hourly forecast of regional wind power that's exceeded all accuracy expectations
- Introduced first-of-a-kind, multistate forecasts of energy-efficiency measures and PV capacity to more accurately predict how much generating capacity New England will need up to 10 years down the road
- Prototyped a day-ahead forecast of regional behind-the-meter PV output based on forecasts of irradiance (the sun's strength), which helps estimate how much electricity demand will be reduced by PV
- Participated in IBM's Watt-Sun project, which applied machine learning to solar forecasting technologies

Solar Power's Effect on Regional Electricity Demand

May 23, 2015



In New England, most distributed generation comes from PV systems, which reduce the electricity drawn from the grid, with weather determining the size and timing of these reductions.

Revolutionizing Resource Dispatch

As new technologies emerge and the resource mix changes, the ISO refines how system operators calculate and schedule power resources to meet electricity demand and reliability requirements in the least-cost way. We have:

- Engineered a revolutionary method of accounting for the variable “fuels” powering low-priced wind resources and certain hydro resources, which can now be dispatched more efficiently and set the real-time price for wholesale electricity
- Opened the door for new energy-storage technologies, such as batteries and flywheels, to compete in the Regulation Market by introducing an “energy-neutral” dispatch signal to integrate these resources into grid operations
- Invented a tool that estimates the amount of natural gas available to regional generators
- Been working to harness cognitive computing technology for even greater efficiencies in coordinating outages for generators and transmission equipment, saving millions of dollars for the region

Driving “Cloud Coverage”

The region’s new phasor measurement units (PMUs) measure key elements of grid dynamics at 30 times per second, allowing operators to more quickly spot and fix problems that could cascade into a blackout. But data this big requires powerful and expensive computer systems. We’re working with leading universities to pioneer the use of cloud computing for a reliable, secure, and affordable platform for managing PMU data and sharing it with neighboring grid operators.

We’re also leading the industry’s use of high-speed cloud computing to more quickly and cost effectively run vast, complex studies that would be impossible on traditional local IT infrastructure. So far, we’ve cut one type of transmission planning study for the region from eight hours to 30 minutes.

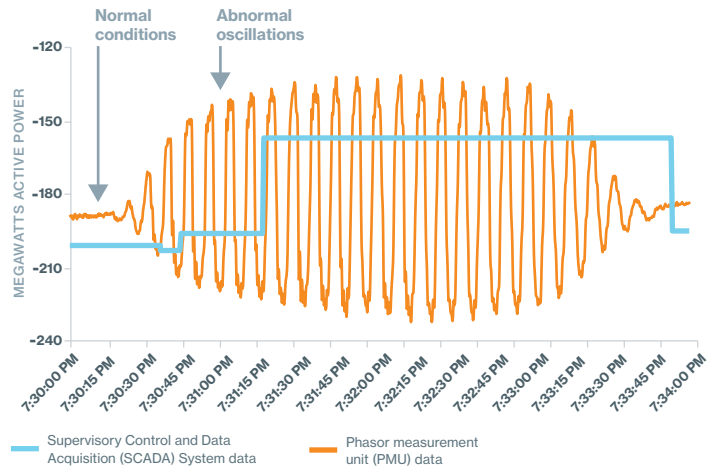
Strengthening Cyber Security

To be able to detect, withstand, and recover from cyber threats inherent to highly interconnected networks, the ISO has put in place comprehensive, round-the-clock protections, including an extensive system of process controls, advanced detection and response systems, and redundancy in systems and control centers.

A Competitive Marketplace Is Key

New England’s open, fair, and transparent wholesale electricity marketplace creates strong competition among resources, which has propelled the progression to a cleaner, greener grid. As the industry evolves and public environmental policies have a broader impact, the ISO pursues innovative market designs to ensure the markets continue to attract new technologies, sustain necessary power resources, and yield competitive prices for New England.

New PMU data reveals much more detail on grid conditions than was possible with traditional SCADA data.



The ISO’s “Think Tank” Environment

ISO New England’s highly-skilled engineers, economists, and IT professionals actively pursue innovations on behalf of the region. Through in-house research and collaborations with leading academic institutions and tech developers, the ISO finds groundbreaking solutions to New England’s current and coming grid challenges and explores how new technology can bolster reliability and save costs. The ISO shares its findings worldwide through published papers and pilot software.

Learn more at
www.iso-ne.com/smart-grid.



About ISO New England

Created in 1997, ISO New England is the independent, not-for-profit corporation responsible for the reliable operation of New England’s electric power generation and transmission system, overseeing and ensuring the fair administration of the region’s wholesale electricity markets, and managing comprehensive regional electric power planning.