2020 Regional Electricity Outlook

ISO new england

New England can achieve its clean-energy goals at the least cost, while keeping the power system reliable, by harnessing competitive market forces.

Our Mission

Through innovation and collaboration, ISO New England ensures that New England has reliable, competitively priced wholesale electricity today and into the future.

The company's engineers, economists, computer scientists, and other professionals fulfill this mission through three interconnected responsibilities:

- Managing 24/7 operation of the region's high-voltage power grid
- Administering the region's billion-dollar competitive markets for buying and selling wholesale electricity
- Planning for the future power needs of 15 million New Englanders

The ISO is an independent not-for-profit—none of its board members, officers, or employees has any financial interest in any company doing business in the region's wholesale electricity marketplace. The Federal Energy Regulatory Commission (FERC) regulates the ISO.

About This Report

ISO New England's unique role gives it an objective, bird's-eye view of trends that could affect the region's power system. The *Regional Electricity Outlook* is one of the many ways the ISO keeps stakeholders informed about the current state of the grid, issues affecting its future, and ISO initiatives to ensure a modern, reliable power system for New England. Please also see our Annual Work Plan at www.iso-ne.com/work-plan for information on the ISO's major projects for the year to improve our services and performance. Contact ISO New England's Corporate Communications and External Affairs teams at (413) 535-4309 for copies of this report.

Visit www.iso-ne.com/reo.

ISO new england

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From the Board Chair and CEO:

The Clean-Energy Transition: How to Get There from Here

Kathleen Abernathy
Board Chair

Gordon van Welie
President and Chief Executive Officer

New England is unquestionably on a path to a clean-energy future. From large-scale offshore wind procurements to the smallest rooftop solar arrays, the New England states are turning to a wide range of renewable resources to fulfill their clean-energy goals. And now, as the states ramp up their goals to achieve up to 100% renewable resources in the electricity sector and move to decarbonize the entire economy in the coming decades, the question for us here at ISO New England has become: how do we get there from here?

For more than a decade, ISO New England has been preparing for this transition. Through the creation of vibrant, competitive electricity markets, the ISO and New England stakeholders have brought about one of the cleanest, most efficient fleets of power generating resources in the country, achieved very low wholesale energy prices that reflect the efficiency of the market design, and facilitated a dramatic reduction in emissions—all while successfully maintaining reliable 24/7 bulk power system operations.

While the path to decarbonizing the electricity industry is well underway, the journey to decarbonize the other sectors has really only just begun. As the transportation sector and the heating and cooling industry turn to carbon-free electricity, the ISO firmly believes that the region can achieve its clean-energy goals at the least cost, while keeping the power system reliable, by harnessing competitive market forces.

In 2019, coal and oil-fired resources produced less than half a percent of New England's electricity—only 0.1% of New England's electricity came from oil-fired power plants and 0.4% from coal plants. And New England had the second lowest annual average wholesale energy price on record.

The region currently does this using a suite of competitive markets—the energy, ancillary, and capacity markets—that attract and sustain the resources needed to operate the grid reliably and deliver economic and environmental benefits to the region. But, as the number of renewable resources increase, the market architecture will need to be updated so wholesale prices remain competitive and all resources get paid a fair price for providing their products and services. We see the introduction of two sets of market innovations, the CASPR (Competitive Auctions for Sponsored Policy Resources) auction platform and the Energy-Security Improvements, as the next steps toward achieving the region's long-term, carbon-free goals.

Where We Are Today: CASPR and ESI Market Mechanisms

CASPR was designed as a solution that should, over time, enable a reliable and efficient turnover in New England's power fleet—moving the power system away from fossil fuel resources to serving the region's electricity needs using

renewables—all done by achieving a fair, market-based price. In the coming years, we anticipate that, as they become more cost-competitive, renewable resources will enter the wholesale market directly and the need for CASPR will diminish.

Carbon pricing would work to more quickly change the overall economics of all resources in the market, making renewable and low-carbon resources more cost-competitive than high-carbon-emitting resources. The ISO is ready to introduce such a mechanism on the wholesale level; however, this will require support of the New England states or federal legislation.

In addition to CASPR, the ISO and New England stakeholders are working on market enhancements called the Energy-Security Improvements (ESI) initiative. ESI is a critical market enhancement designed to keep the system reliable during energy-limited conditions, such as extreme cold weather. Furthermore, ESI will also provide the market structure needed as the New England system makes the change from fossil fuel to renewable resources that are inherently intermittent and may be energy-limited during extended periods of inclement weather. ESI will introduce stronger, market-based compensation for electric energy and reserve services and will select the least-cost resources to provide electrical energy when called on by the ISO. ESI is expected to be in place by mid-2024.

For ISO New England, a broadened scope for the region's power grid is expected to increase both the power system planning and operational complexity—and this will drive a need for more investment in staff skills, training, and software development.

Today, Tomorrow, and Beyond: Our Work Together Continues

As we move forward in the coming years, New England's wholesale markets must continue to adapt to the region's changing resource mix and the changing needs of its power system. This adaptation will be necessary because of the anticipated impact to the power system should the states fully decarbonize other carbon-based sectors. As the states' plans become more formalized and the transportation and heating sectors decarbonize, they will turn to the region's power grid for electricity: to keep our plug-in electric vehicles moving and to keep

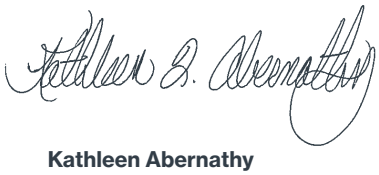
the temperature in our houses and businesses comfortable. As a result, the demand for carbon-free electricity will likely increase over the coming decades and the power grid will become even more important than it is today because every sector of the economy will be dependent on it.

The states, stakeholders, and the ISO will need to continue to collaborate to understand what the period beyond 2030 may look like, including the forecasted demand for clean electricity from other sectors, and the likely market-based pathways to supplying this demand. Analyzing future pathways for decarbonization will also allow the region to have an informed discussion about whether, and where, additional transmission investments will be required to enable the vast quantities of grid-scale renewable energy.

ISO New England respects the environmental policy objectives of the New England states and believes that a strong, competitive wholesale market provides the best structure for achieving these objectives in a cost-effective and reliable way. By working with the states and other industry stakeholders, we together will determine if there are better market design solutions or needed adjustments to the markets. ISO New England is dedicating market-development and planning resources in 2020, and beyond, to discuss potential future market frameworks that are consistent with state decarbonization goals, as outlined in the summary of our strategic plan presented later in this report.

ISO New England has worked tirelessly for the past two decades to ensure the region's power system is there to serve New England and its consumers every day—today, tomorrow, and for decades to come. We are proud of our accomplishments to date in ensuring the region's power system reliability through competitive wholesale markets, and we pledge to continue this dedication as the region transitions to a clean-energy future. We also know that, based on our history, collaboration with all industry and government stakeholders will be paramount to achieve this successful transition. The next phase of our region's energy journey has begun—and we are excited by the prospects.

Sincerely,



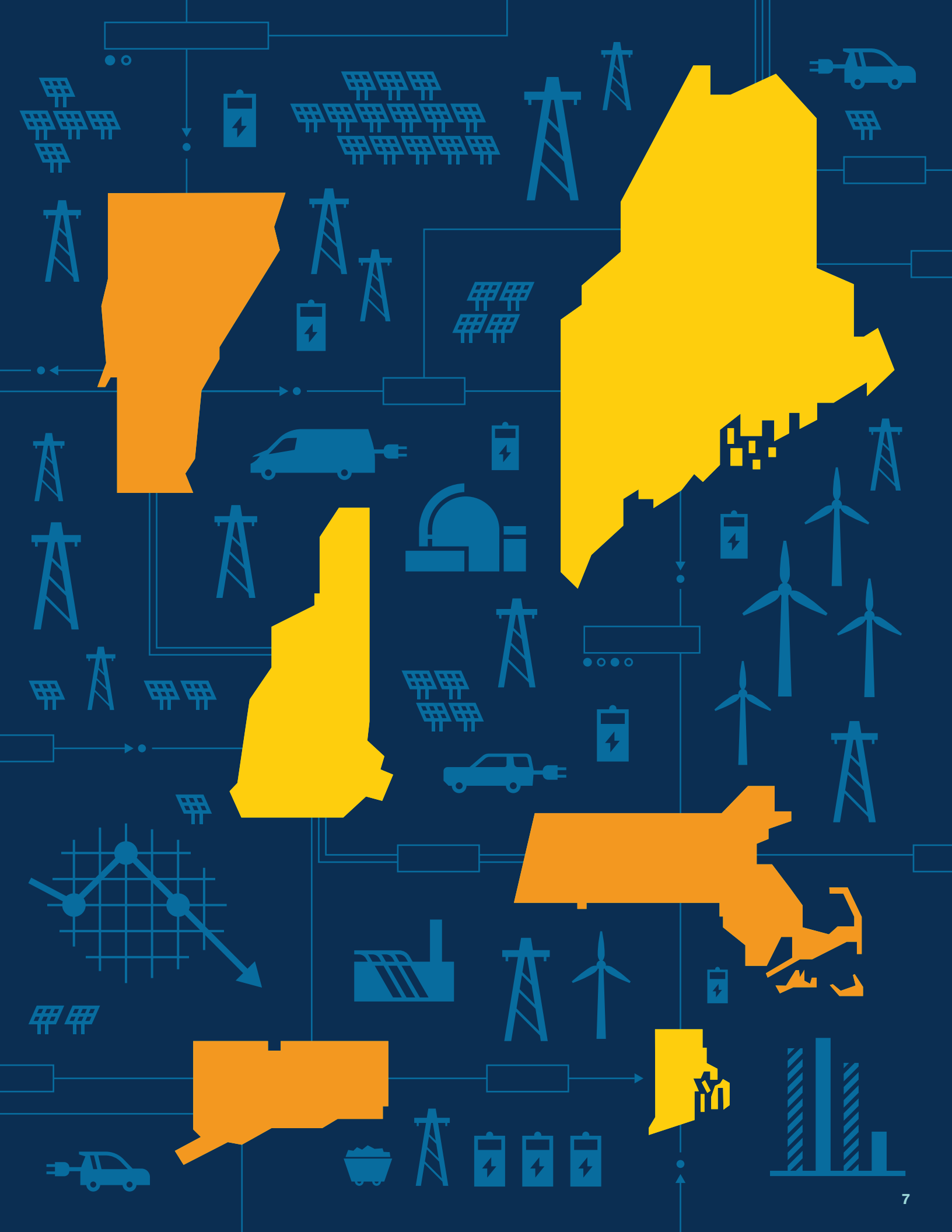
Kathleen Abernathy
Board Chair

Gordon van Welie
President and Chief Executive Officer

Focusing on State Goals:

Achieving Cleaner, Lower-Cost Power

New England restructured its electricity industry more than 20 years ago, driven by state and federal initiatives that were guided by the principle that a reliable supply of competitively priced electricity is fundamental to a thriving society and economy. Specifically, the overarching goals of introducing wholesale competitive markets were to lower costs, encourage innovation, and shield consumers from unwise investments.



For decades before restructuring, the region's utilities operated as vertically integrated, rate-payer-funded, regulated monopolies that generated, transmitted, and distributed electricity. Dissatisfied with investments that increased consumer rates while limiting funds for needed infrastructure, the federal government, with support from the New England states, introduced wholesale markets where privately developed resources would compete with each other to provide the *least-cost, reliable* wholesale electricity supply, regardless of the fuel or technology used to generate the electricity.

Through a cooperative effort, federal, state, and industry officials agreed to create ISO New England in 1997 as the independent administrator of the region's wholesale electricity markets and operator of the regional power grid. In this role, the ISO is bound by its regulator, the Federal Energy Regulatory Commission, to allow participation in the highly competitive markets by all resources. The FERC and the ISO carry out laws created by Congress, which set US federal policy related to power. The ISO does not set policy and does not select the mix of resources being developed in the region. Congress has reserved the right to site generation to the states.

While the states were focused on markets driving efficiency and innovation, they also began introducing clean-energy incentives and emission-reduction goals, focusing first on reducing greenhouse gas (GHG) emissions from the electric power industry. Emissions regulations work well with the wholesale markets by making higher-polluting power plants more expensive to operate and providing a reliable means for cleaner resources to come on line in their place.

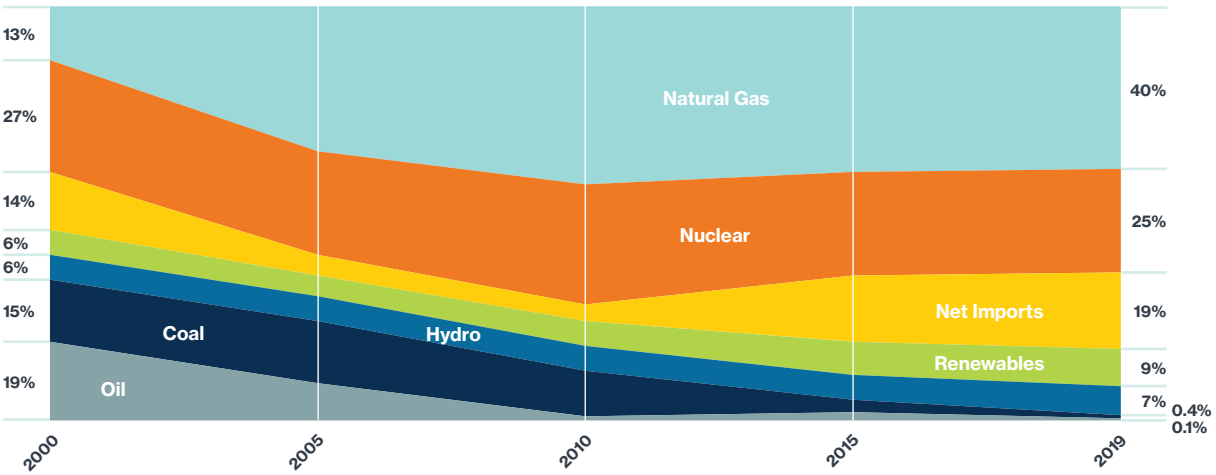
Over two decades, the market and policy approach has driven change in the direction the states have been seeking: around $16 billion in private investment in some of the most efficient, lowest-emitting power resources in the country, shifting investment costs and risks away from consumers, lowering wholesale prices, reducing carbon emissions, and enabling the transition to an even lower-carbon system. This is evidenced by the following:

Lower-Emitting Sources of Energy Supply Almost All of New England's Electricity

Sources of Grid Electricity in New England (Annual Net Energy for Load)

In 2019, efficient natural-gas-fired generation, nuclear, other low- or no-emission sources, and imported electricity (mostly hydropower) provided roughly 99.5% of the region's electricity.

Source: ISO New England, generation data, and *Net Energy and Peak Load by Source Report*



The Rapid Development of a Cleaner, Cheaper, More Efficient Power Fleet in New England

When the wholesale markets opened to competition, private investors pursued the development of natural-gas-fired power plants because they used advanced technology that made them run efficiently; were relatively inexpensive to build, site, and interconnect; and their lower carbon emissions compared to coal and oil helped the region meet state environmental policies. As nearby shale gas emerged as an inexpensive and plentiful fuel resource in the 2008 timeframe, natural gas generators became the go-to resource for New England, clearing as the largest resource type in the market year after year.

In contrast, aging coal-fired, oil-fired, and nuclear power plants have been closing largely because their operating, fuel, and environmental-compliance costs make them too expensive to compete against lower-cost resources. Consumers have benefited from this least-cost resource mix created through competitive markets. Since 2013, roughly 7,000 megawatts (MW) of mostly coal, oil, and nuclear generation have retired or have announced plans for retirement in the coming years. Another 5,000 MW of oil and coal, which now run only during peak demand or periods of gas pipeline constraints, are likely to retire soon. (The region's remaining two zero-carbon-emitting nuclear facilities, Millstone and Seabrook, supply a quarter of the electricity New England consumes in a year). Competition in the markets brought about this change at a faster pace than under the traditional industry model. Under wholesale markets, private companies have carried the risks of uneconomic investments, not utilities and their customers.

A Major Reduction in Emissions from the Power System

The shift to cleaner, more efficient generation and strong regional investment in transmission improvements to move this power to consumers that demand it has resulted in a striking decrease in annual generator air emissions, compared here between 2001 and 2018. Emissions rose slightly between 2017 and 2018 because oil- and coal-fired plants, which typically don't run often, became critical during a winter cold spell when fuel for natural-gas-fired generators was limited and expensive.

Regional Power Plant Emissions Have Plummeted with Changes in Resource Fleet

New England Generator
Air Emissions, 2001 vs. 2018

The **80 million short tons of carbon dioxide emissions** avoided regionally between 2001 and 2018 is like taking more than **17 million passenger vehicles off the road** for a year. For comparison, in 2016, roughly 5.1 million vehicles were registered in New England.

Carbon Dioxide (CO_2) ↓ **36%**
major driver of climate change

Nitrogen Oxide (NO_x) ↓ **74%**
adds to smog

Sulfur Dioxide (SO_2) ↓ **98%**
with NO_x, leads to acid rain

Source: ISO New England and the US Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator

Remarkably Low Wholesale Electricity Prices

Markets reveal a resource's operating cost, and a primary driver of operating costs is fuel. As lower-cost, highly efficient natural gas plants displaced older oil and coal plants, wholesale electricity prices declined. After plummeting almost 50% a decade ago, average wholesale energy prices have remained consistently low since then. The average annual price was $42.02 in 2009 and $30.67 in 2019.

Lower wholesale prices translate into lower power-supply charges for consumers. These charges are just one part of an electric customer's bill: retail electricity prices also reflect a state's longer-term, fixed-price contracts for energy; the recovery of the costs to pay for the transmission and distribution systems; stranded costs from legacy, vertically integrated utility investments; and various policy-driven adders, such as funding energy efficiency (EE) and solar photovoltaic (PV) incentive programs. So while wholesale market costs have been consistent over time and across the New England states in recent years (ranging from 7.48 cents/kilowatt-hour (kWh) to 7.81 cents/kWh in 2018), retail power supply rates vary significantly across the New England states (ranging from 8.92 cents/kWh to 13.51 cents/kWh in effect on January 1, 2019), due in large part to the different laws and power procurement practices of each state and the utilities within each state.

In 2019, New England experienced a mild winter that moderated natural gas prices, a cool summer that tempered air conditioning use, and surging amounts of solar power and energy efficiency that lessened electricity demand from the grid. The markets responded in-kind, and New England had the second lowest

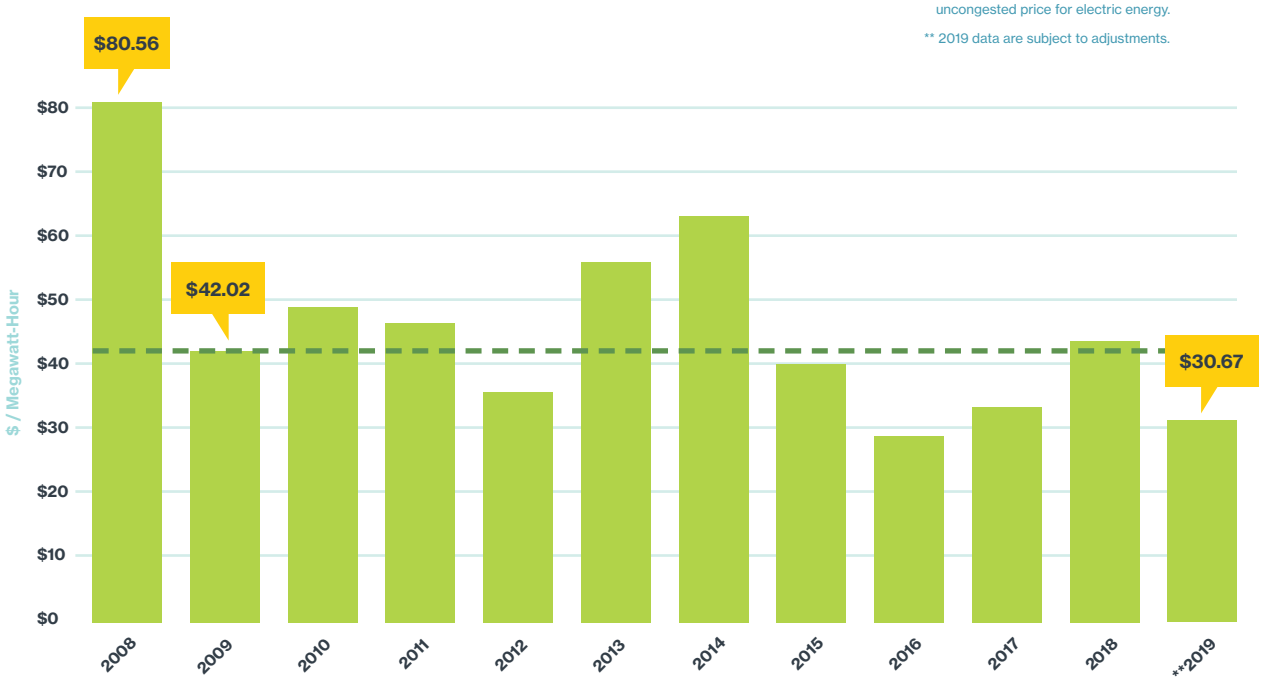
The Average Annual Wholesale Energy Price Has Remained Consistently Low Over the Past Decade

Average Real-Time Hourly Energy Market Price at the Hub*

Note: Higher prices in 2013 and 2014 were largely due to spikes in natural gas prices during wintertime fuel-delivery constraints.

* The Hub is a collection of 32 locations in New England used to represent an uncongested price for electric energy.

** 2019 data are subject to adjustments.



annual average price since the introduction of the current market structure in 2003. Higher real-time power prices in 2013 and 2014 were largely due to spikes in natural gas prices during wintertime natural gas delivery constraints.

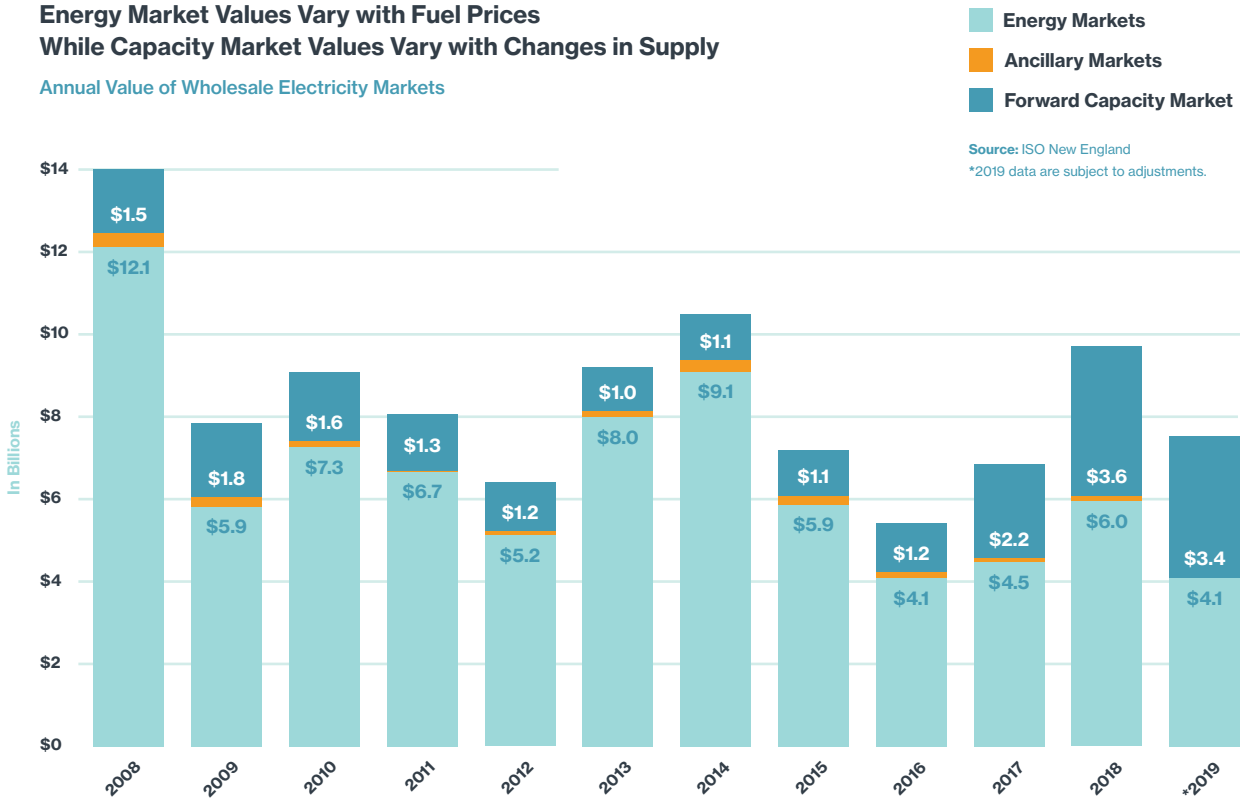
Whereas the energy market value varies with fuel prices, the capacity market value varies with changes in amounts of electricity-producing resources. Strong competition has generally kept capacity market auction prices low for most years, but when generation started to retire, the capacity market value over the past few years has increased. The capacity market works in tandem with the energy and ancillary service markets to provide revenue that attracts and sustains power resources needed today and into the future.

Robust transmission system enables region to move low-cost, clean power

Before industry restructuring, New England saw little investment in transmission infrastructure. Over the past 20 years, the ISO's continuous study of the transmission system has helped guide cooperative regional investment that not only improves reliability but enables the competitive markets to work as designed. Transmission system upgrades allow the ISO to dispatch the most economic resources throughout the region, allow less-efficient resources to retire, and enable the interconnection of power plants with lower emissions. Upgrades have nearly eliminated congestion costs in the New England energy market and, with the aid of low natural gas prices and other factors, have helped drive down and mitigate "uplift" payments to run specific generators to meet local reliability needs.

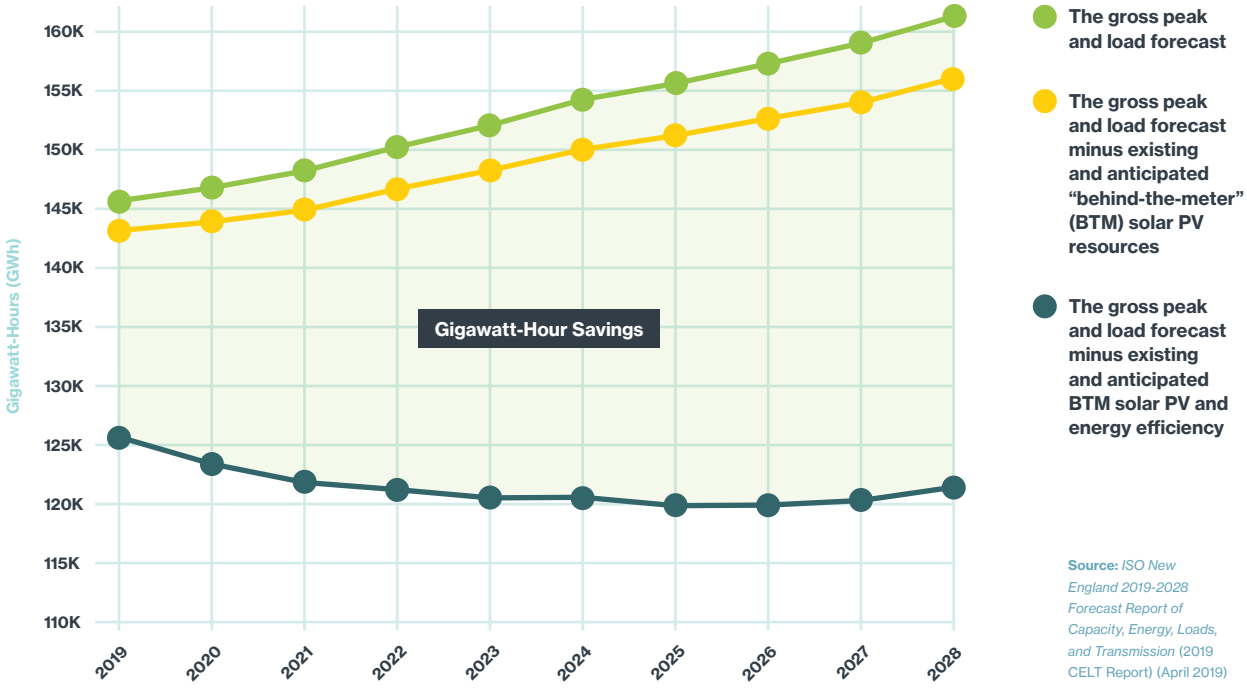
Energy Market Values Vary with Fuel Prices While Capacity Market Values Vary with Changes in Supply

Annual Value of Wholesale Electricity Markets



Energy Efficiency and Behind-the-Meter Solar Are Forecasted to Significantly Reduce Grid Electricity Use Over the Next 10 Years

Projected Annual Energy Use (GWh) With and Without EE and PV Savings



Source: *ISO New England 2019-2028 Forecast Report of Capacity, Energy, Loads, and Transmission* (2019 CELT Report) (April 2019)

In a system that traditionally saw load grow every year, EE and BTM solar are reducing peak demand growth and overall grid electricity use over the next 10 years.

The Steep Growth of Energy Efficiency and Solar Power that Are Driving Down Annual Grid Use

New England's 7.2 million retail electricity customers used over 119,000 gigawatt-hours (GWh) of electricity from the grid in 2019, down from the record 136,355 GWh consumed in 2005. Today, 20% of total system capacity is provided by distributed energy resources that reduce demand from the grid and the need to turn on or build expensive power plants.

State policies and wholesale market revenues are stimulating the rapid growth of energy efficiency and demand response. New England states invest billions of dollars on EE programs that promote the use of energy-efficient appliances and lighting and advanced cooling and heating technologies (nearly $5.4 billion on EE programs from 2013–2018 and another $10.7 billion between 2021 and 2029). Nearly 3,000 MW of EE

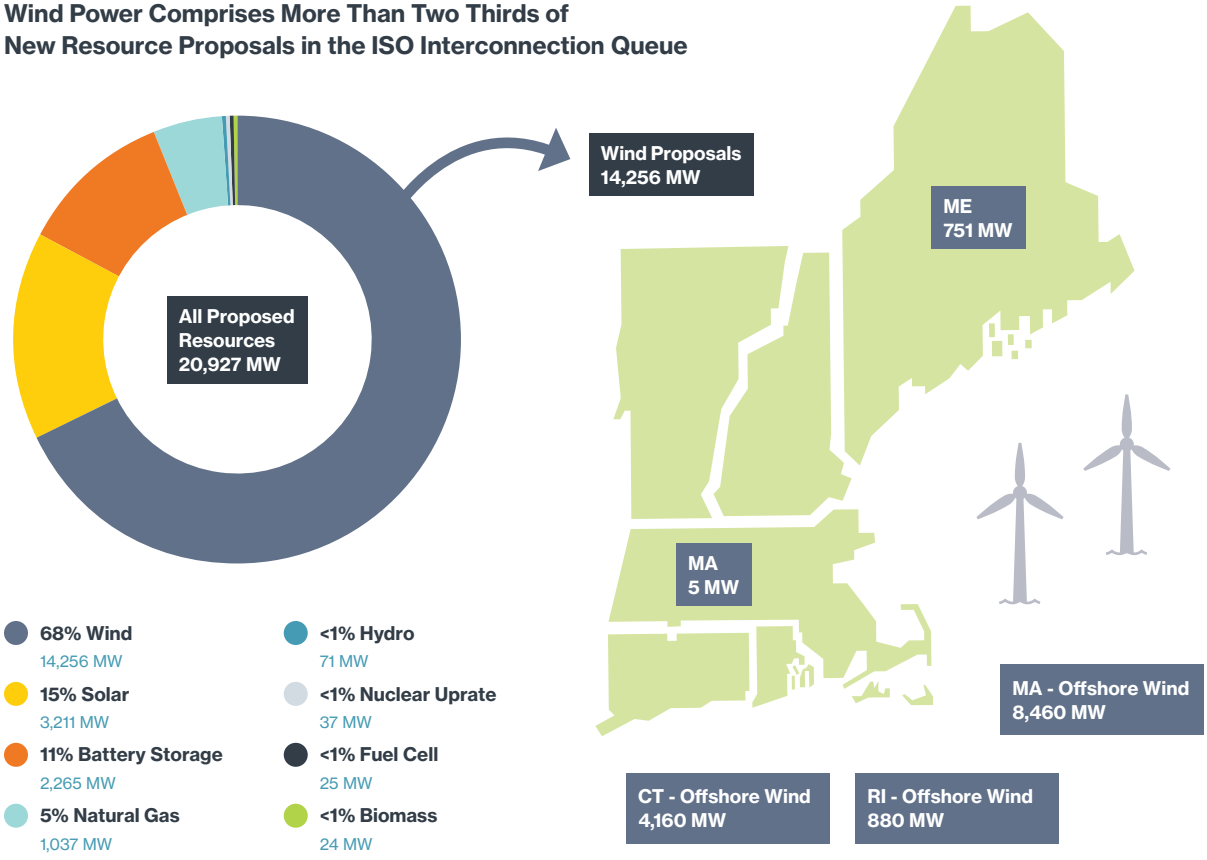
measures and 500 MW of demand response can reduce electricity demand from New England's power grid—that's 10% of system capacity acquired in the Forward Capacity Auction. And New England is first in the nation to innovate and enable demand resources to fully participate in the energy and reserve markets.

Incentivizing local/residential solar power is also a top priority for New England policymakers, with the states spending billions of dollars on making solar energy affordable for consumers. New England started the decade with 40 MW of behind-the-meter (BTM) solar photovoltaic resources. Today, more than 183,000 installations span the six states, with a combined nameplate generating capability of more than 3,400 MW. The region is on track to reach nearly 8,000 MW over the next decade. Though these resources don't participate in the markets, the markets are flexible to changes in grid demand, so grid electricity is not over produced—or over purchased.

Wind, Grid Solar, and Battery Projects Dominate New Resource Proposals

Developers of clean-energy resources are taking advantage of state incentives, declining technology costs, and revenues from the wholesale markets. About 95% of resources currently proposed for the region are grid-scale wind, solar, and battery projects.

Wind Power Comprises More Than Two Thirds of New Resource Proposals in the ISO Interconnection Queue



Note: Some natural gas proposals include dual-fuel units (with oil backup). Some natural gas, wind and solar proposals include battery storage.

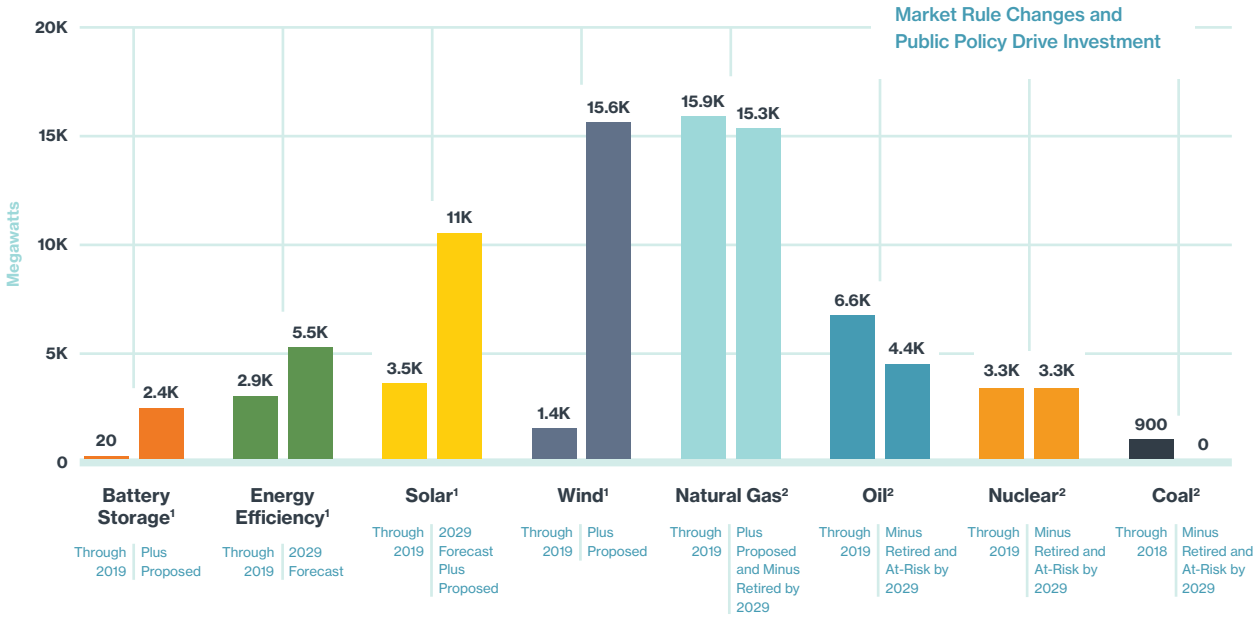
Source: ISO Interconnection Request Queue (January 2020) FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings

ISO New England has more than 14,000 MW of wind interconnections under study, which is by far the largest group of resources seeking to connect to the region's electricity grid (as of January 2020). The New England coast offers prime conditions for offshore wind, and about 13,500 MW of proposed wind is located offshore of Massachusetts, Rhode Island, and Connecticut, with most of the remaining located onshore in Maine. In 2016, the wind turbines at the Block Island Wind Farm began putting power onto the electricity grid, making the 30 MW project the first offshore wind farm in the United States.

Solar and battery storage now rank second and third in the ISO Interconnection Request Queue, both surpassing natural gas. New storage technologies are emerging, driven by technological advances, falling costs, support from the states, and changes to the markets that enable storage participation. About 20 MW of grid-scale battery-storage projects have come on line since 2015; nearly 2,300 MW of grid-scale stand-alone energy-storage projects are requesting interconnection. Grid-scale and behind-the-meter energy storage can contribute a number of benefits: provide grid operators with short-term reliability services, maximize the output from wind and solar resources by storing their excess energy, defer transmission and distribution system upgrades when strategically placed, shave the peak during times of high system demand, provide backup power during localized power outages, and enable the development of microgrids.

Battery Storage, Energy Efficiency, and Renewables Are Trending Up in New England

Projected Changes in Key New England Power Resources and EE

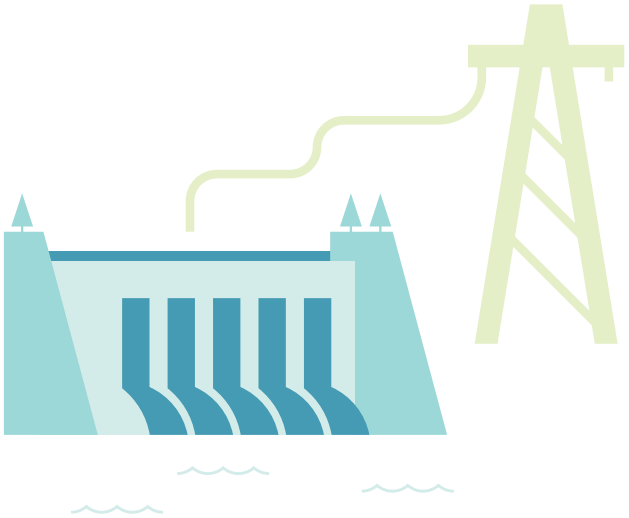


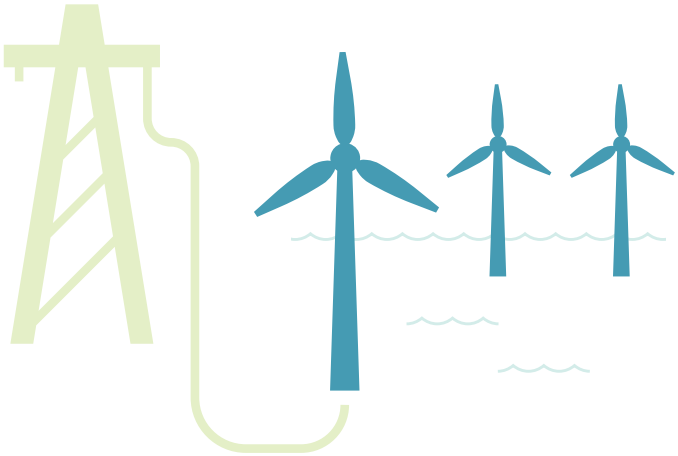
Notes: Numbers are rounded. Not all proposed new projects are built; historically, almost 70% of proposed new megawatts in the ISO Interconnection Request Queue have ultimately withdrawn.

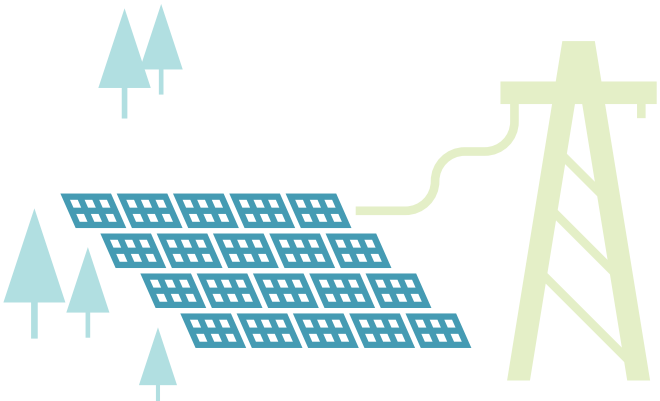
1. Nameplate capacity. Battery storage includes existing and proposed grid-connected resources; some wind and solar projects also include batteries. Solar includes existing and proposed grid-connected resources, as well as existing and forecasted BTM resources. EE includes resources in the capacity market, as well as forecasted future capacity.

2. Nameplate capacity for proposed projects; summer seasonal claimed capability for existing units based on primary fuel type. Some oil units can also burn natural gas and vice versa. The 2029 at-risk values are hypothetical, reflecting retirement delist bids, plus the possible loss of nearly 2,100 MW of generation.

Source: ISO New England, *ISO Interconnection Request Queue* (January 2020), *2019 CELT Report, Draft 2020 Solar PV Forecast* (February 2020), *2020 Draft Energy-Efficiency Forecast* (February 2020), *Seasonal Claimed Capability Monthly Report* (January 2020), *Status of Nonprice Retirement Requests and Retirement Delist Bids* (August 2019), and *2016 Economic Studies Phase I Assumptions* (2016)







Region will need investment in the superhighway for moving clean-energy

Even with substantial investment made to modernize the transmission system and enable the free flow of low-cost power, additional transmission (and distribution) system upgrades will be needed to accommodate large amounts of diverse clean-energy sources—from large-scale offshore wind, remote Canadian hydropower, and hundreds of thousands of distributed solar and storage sources. Think of the grid as the superhighway for moving the clean-energy that ultimately will be fundamental to reliably converting millions of vehicles and heating systems in buildings to electricity.

ISO New England has no authority over siting processes or permits, and because of local opposition and other factors, transmission investments can take a long time to come to fruition in New England. To achieve decarbonization goals, the region must be proactive in developing infrastructure that aligns with supply growth and is available when needed. Regional coordination may not alleviate local opposition but may help make the siting process more successful.

Focusing on Our Role:

Planning, Innovating, and Enabling a Reliable, Clean-Energy Grid

ISO New England is a leader in operational and market innovation to get the grid ready for the future—one that will primarily use clean-energy resources to meet consumer demand. The ISO team of highly skilled technical staff have the unique responsibility, independent of any technological, financial, or other interests, to minimize risk to the reliable operation of the power system and ensure that the competitive markets can continuously provide sufficient revenues for all resources needed for grid reliability.

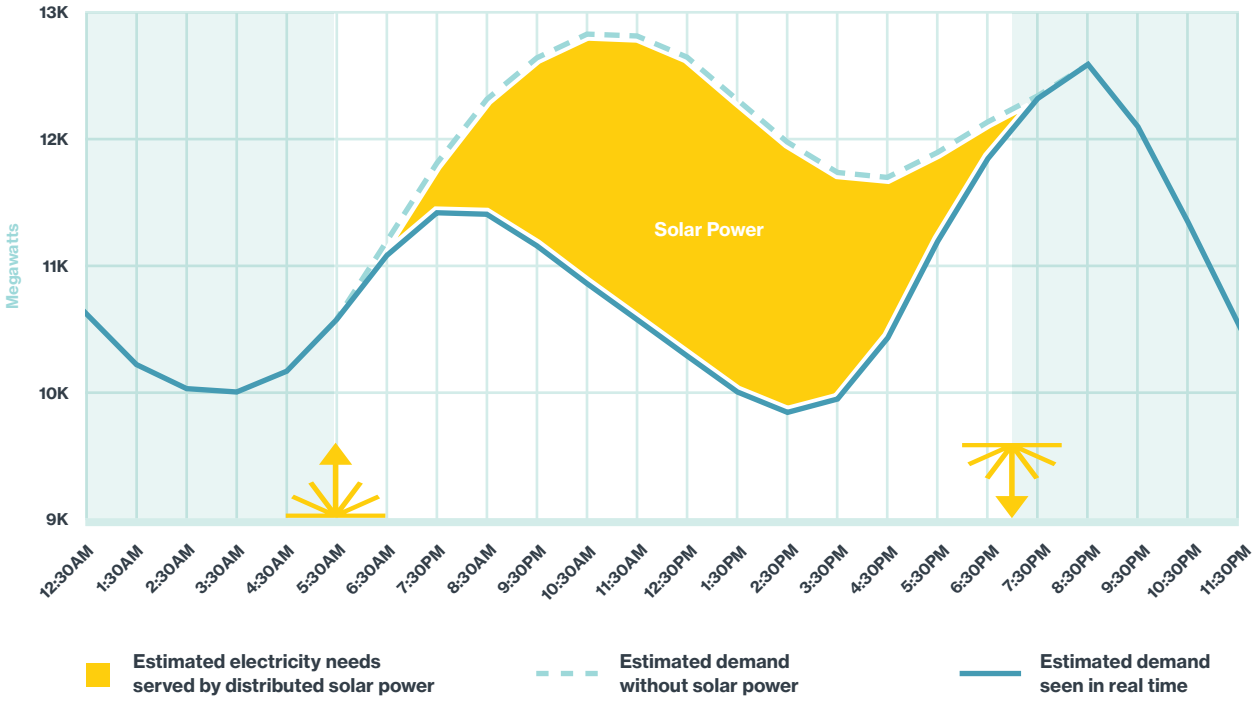
Year after year, the ISO's experts have been working steadily and intensively to integrate high levels of renewable and distributed resources—**energy efficiency, demand-response resources, energy storage, wind,** and **solar**—into system operations, wholesale electricity market design, and power system planning. This includes innovating ways to help the states achieve their climate and energy goals while maintaining the integrity of the region's grid and competitive markets. These efforts have been developed through countless hours of stakeholder discussion, with their differing interests, leveraging the region's strong history of collaboration.

Innovations in Forecasting Enable Grid Operators to Continuously Balance Supply and Demand

Although not connected to the bulk power grid, hundreds of thousands of behind-the-meter solar installations are in operation across the six states, which the ISO must plan for in terms of the extreme changes in electricity demand they create on the grid. When the sun is shining and conditions are optimal, the ISO sees a significant reduction in regional electricity demand from the grid due to BTM solar. These resources are reducing thousands of megawatts of grid demand during heatwaves in the summer, and on cool sunny spring days, the region sometimes uses less grid electricity in the middle of the day than in the middle of the night—something that never happened before. In 2018, grid electricity demand on Thanksgiving Day did not peak as usual in the morning as New Englanders turned on their ovens; the use of BTM solar pushed the peak to after sunset.

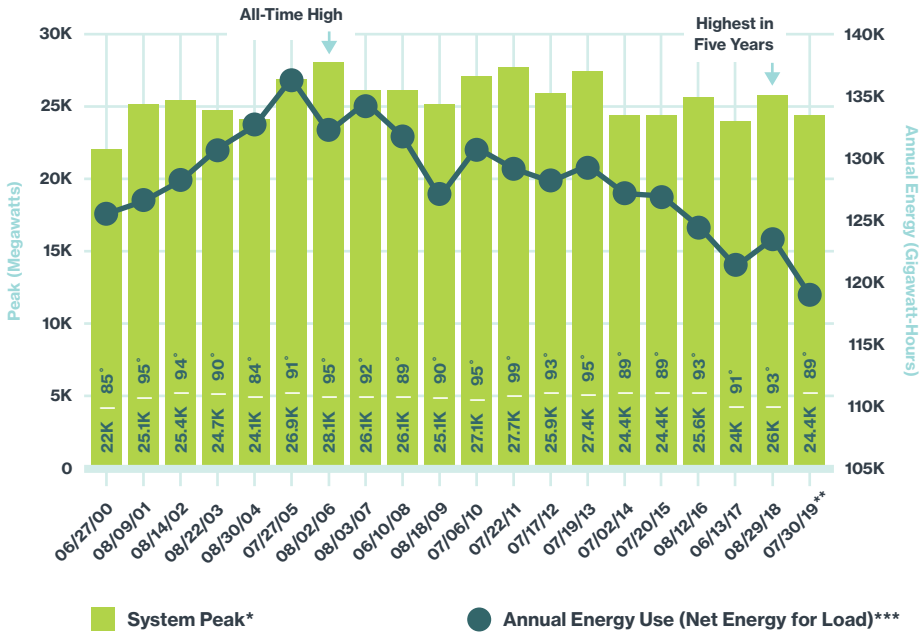
For the First Time, in 2018, New England Used Less Grid Electricity During the Day than in the Middle of the Night

On April 28, 2018, at 1:30 p.m., Behind-the-Meter Solar Reduced Grid Demand by More than 2,300 MW



New England's Power System Must Be Prepared to Meet Peak Demand Even If Peaks Aren't Historically High

Peak Demand vs. Annual Energy Use on New England Power System as of January 24, 2020



* The sum of metered generation and metered net interchange, less demand from pumped storage units. Starting with full market integration of demand response on June 1, 2018, this total also includes the grossed-up demand-response value.

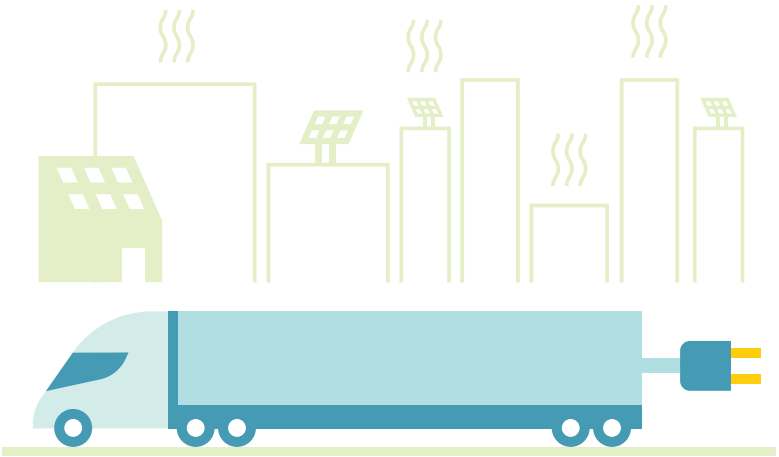
**Annual peak, as of January 24, 2020. Values are preliminary and subject to adjustment.

***Net energy for load (NEL) is the total amount of grid electricity produced by generators in New England and imported from other regions during the year to satisfy all residential, commercial, and industrial customer demand.

Source: ISO New England, *Seasonal Peaks since 1980 Report*, *Net Energy and Peak Load Report* and *Annual Generation and Load Data for ISO NE and the Six New England States Report*.

Despite significant declines in annual electricity use from the grid, weather can still drive spikes in demand, for which the grid must be prepared. For example, when the dew point is above 70° Fahrenheit, every one-degree increase can cause demand to rise by about 500 MW—the amount produced by a medium-sized power plant. Summer 2018 was marked by spells of hot and humid weather that drove electricity demand on the power grid to peaks not seen in five years, and New England reached its highest Labor Day peak ever recorded. Conversely in 2019, other than one hot weekend in July when both days reached all-time, top-10 peak weekend demand days, New England experienced relatively cool average temperatures, leading to the lowest summer-season grid demand and the second-lowest wholesale pricing since 2003.

Now, to fully meet climate goals, the states are looking to convert the transportation and heating sectors to run on cleaner electricity. Electrification initiatives will ramp up aggressively over the next few decades, and by midcentury, these efforts likely will introduce considerable new demand for electricity across the region.



Predicting the unpredictable

The ISO's grid operators can no longer rely on historical patterns of electricity use or traditional weather forecasts to accurately predict how much electricity must be generated to meet second-to-second demand. The proliferation of distributed resources that drastically reduce (or someday increase) electricity demand from the grid make long-term planning challenging. The ISO is continuously innovating both long-term and daily forecasting processes to accurately predict grid demand levels.

2012: Developed the first multistate, long-term **energy-efficiency** forecast in the nation.

2013: Developed a highly accurate **hourly wind** forecast for the region and each individual wind farm to help manage the fluctuating output of **wind resources**; these forecasts integrated into control room operations in 2014.

2013: Launched the regional Distributed Generation Forecast Working Group to collect data on **solar** and **storage** policies and implementation and to forecast long-term incremental growth in distributed generation (≤ 5 MW, connected to the distribution system, and not directly visible to the ISO).

2014: Developed the first multistate, long-term forecast for BTM **solar** installations.

2015: Prototyped a short-term **solar** power forecast based on the sun's strength (irradiance) to help estimate how much electricity demand will be reduced by BTM solar resources.

2017: Hired a full-time meteorologist on staff to help with more precise weather forecasting. Cloud cover, haze, humidity, rain, and snow conditions can vary widely across the six New England states—leading to a range of outputs from the region's **solar** installations. New England has erratic weather conditions, and every New Englander knows how hit or miss weather forecasts can be—even from town to town.

2018: Improved its innovative **energy-efficiency** forecast methodology to more accurately forecast the amount of EE installed on the distribution systems operated by local utilities across the region.

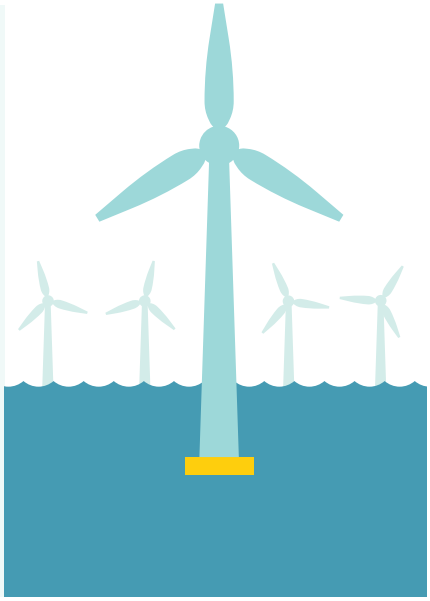
2019: Launched a new method of predicting **solar** PV output regionally that is integrated into the existing day-ahead and seven-day operational load forecasts. Given that the ISO cannot feasibly collect performance data directly from all 183,000 individual PV systems, these efforts will enhance visibility and help the ISO grid operators forecast variations in system demand with the higher degree of accuracy needed to operate the grid reliably and efficiently.

2019: Incorporated improved modeling of BTM **solar** in the calculations that help determine the amount of capacity to procure through the Forward Capacity Market. A more accurate forecast of future loads helps avoid excessive costs to load for capacity that isn't needed.

2020: Expanding 10-year planning forecast to quantify the impact that the increases in **electric vehicles** and **electric heat pumps** will have on long-term grid electricity demand.

Expediting the reliable interconnection of distributed resources

A number of BTM solar resources are being proposed for areas without corresponding consumer demand or infrastructure to support it. Although these systems are interconnected to the distribution system, in large numbers, they can affect the bulk power system. The ISO is required to conduct reliability analyses, and in some cases, may identify upgrades needed for integrating these systems reliably. Delaying projects can be frustrating for developers, policymakers, and consumers. The ISO is serving as an informational resource on distributed-generation interconnection for state officials, developers, and other stakeholders as they consider changes to their state interconnection processes.



Wholesale Markets Enable the Proliferation of Renewable and Distributed Energy Resources

Renewable resources like wind are variable, inverter-based generators that operate differently from conventional power resources. For a decade, the ISO has been developing the ability of renewable and distributed energy resources to participate and earn revenue in the wholesale markets and implementing operational tools to efficiently manage the grid with increasing amounts of these resources.

2010: Studied the potential impacts of integrating large amounts of **wind** resources into the New England system.

2013: Integrated into our operations, power system data from phasor measurement units (PMUs) and associated computer systems installed across the region to increase the observability of system conditions, enable new applications, and improve oscillation detection, which help manage the variability of demand from **BTM solar** and the variability of supply from **wind** resources. The ISO has also worked with leading universities to demonstrate how cloud computing can be used to create a reliable, secure, resilient, and affordable platform for managing PMU data and sharing it with neighboring grid operators.

2014: Introduced the ability to offer negative prices (i.e., pay to operate) in the energy market, enabling primarily **wind** but also **solar** power to continue operating during low-load conditions when they otherwise could be curtailed.

2014: With scientists from the Lawrence Livermore National Laboratory, studied how high-performance computing can be used to model and simulate a new robust unit-commitment solution for dispatching variable **wind**.

2015: Introduced an "energy-neutral" dispatch signal to integrate new **energy-storage** technologies, such as batteries and flywheels, into the regulation market to provide real-time frequency-regulation services.

2015: Improved the interconnection study process for elective transmission upgrades (ETUs) and introduced new rules that ensure that renewable resources can deliver capacity and energy into the wholesale electricity markets. Today, private developers are competing in state procurements to build transmission projects that would enable the delivery of thousands of megawatts from mostly **wind** resources in northern Maine and hydro resources in Canada.

2016: Included **wind and intermittent hydro** resources into real-time dispatch, enabling them to set real-time prices for the first time.

2017: Improved real-time fast-start pricing to help incentivize power resources that can quickly ramp up their output to bridge the steep increase in grid demand that occurs when **solar** PV shuts off quickly as the sun sets or clouds roll in.

2017: To accommodate high interest from new **wind** projects in Maine, implemented a new methodology that enables the ISO to study multiple interconnection requests from the same area together in a "cluster." This helps more quickly advance projects seeking to interconnect to the regional grid and participate in the markets and allows resources to share interconnection costs.

2018: Fully integrated **demand-response resources** into the energy and reserve markets, rounding out their participation in the capacity market.

2018–2020: Ahead of federal requirements mandated by FERC Order 841, implemented and planned for a number of market enhancements for **storage**, which have the physical capability to act as generators, demand, or both, providing a means for simultaneous participation in the energy, reserves, and regulation markets.

2019: Enable **wind** resources with capacity supply obligations to begin participating in the Day-Ahead Energy Market.

Lead the smart grid application of high-voltage direct-current (HVDC) facilities and flexible alternating-current transmission systems (FACTS), which improve the controllability and transfer capability of transmission infrastructure—key factors in the connection of more **renewable energy resources**.

ISO-NE trail blazes demand resources in markets

Unlike EE and behind-the-meter PV, demand-response resources can be dispatched by the ISO. They reduce their electricity consumption from the regional grid by shifting the time of their demand (such as changing the operating times of machines, adjusting times of water use, or modifying temperatures), by switching to an on-site generator (distributed generation), or by switching to a storage device such as a battery. This has paved the way for the full integration of storage, microgrids, and other small-scale distributed energy resources, which will also rely on aggregators to integrate them into the market like demand-response resources do. The region has received national and international recognition for the extent to which demand resources have been fully integrated into the wholesale markets.

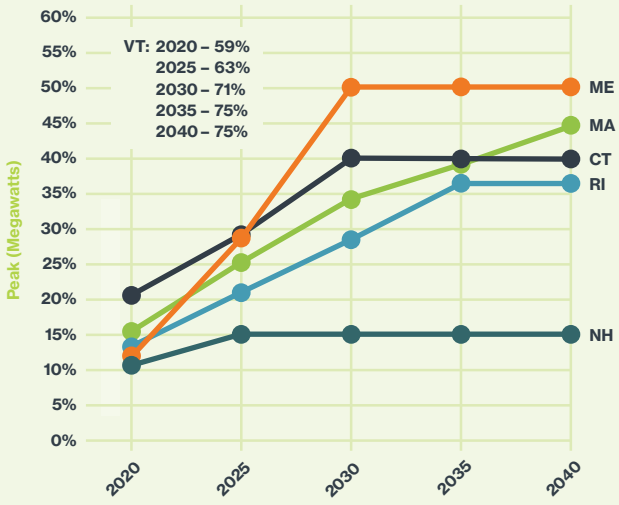
Helping the states accelerate the clean-energy transition to fulfill their GHG goals

Despite significantly reduced emissions from the power system, action toward meeting economywide GHG goals set by the states is just getting underway. There is a growing desire to accelerate actions needed to meet the climate goals. With deadlines looming, the states are eager for the quicker transformation of the power grid to renewables and for electrification of the broader economy.

Because large-scale renewable resources typically have higher up-front capital costs and different financing opportunities than more conventional resources, they have had

State Renewable Portfolio Standards Are Rising

Class I or New Renewable Energy Resource (%)



All six New England states have renewable energy standards

Electricity suppliers are required to provide customers with increasing percentages of renewable energy to meet state requirements

- Vermont's standard recognizes new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.

To Meet Their Public Policy Goals, the States Are Seeking to Develop (or Retain) Clean-Energy Resources Through Large-Scale Procurement Efforts

States Accelerate Clean-Energy Procurements

Note: Nameplate MW may be higher than qualified FCM capacity MW.

State(s)	State Procurement Initiatives for Large-Scale Clean-Energy Resources	Resources Eligible/Procured	Target MW (nameplate)
CT	**2019:** Offshore Wind RFP	Offshore Wind	400–2,000 MW
MA	**2019:** Section 83C II Offshore Wind RFP	Offshore Wind	800 MW
RI	**2018:** Renewable Energy RFP	Solar, Wind, Biomass, Small Hydro, Fuel Cells and Other Eligible Resources	400 MW
CT	**2018:** Zero-Carbon Resources RFP	Nuclear, Hydro, Class I Renewables, Energy Storage	Approx. 1,400 MW (11,658,080 MWh)
CT	**2018:** Clean-Energy RFP	Offshore Wind, Fuel Cells, Anaerobic Digestion	252 MW
MA, RI	**2017:** Section 83C I Offshore Wind RFP	Offshore Wind	800 MW (MA) 400 MW (RI)
MA	**2017:** Section 83D Clean-Energy RFP	Hydro Import	Approx. 1,200 MW (9,554,000 MWh)
MA, CT, RI	**2015:** Multi-State Clean-Energy RFP	Solar, Wind	390 MW

difficulty competing in the wholesale markets. Therefore, the New England states are promoting, at varying levels and speed, the development of specific clean-energy resources to meet their public policy goals.

Several states have established public policies that direct electric power companies to enter into rate-payer-funded, long-term contracts for large-scale carbon-free energy that would cover most, if not all, of the resource's costs. Long-term contracts carry risk given the rapid development and falling costs of new technologies—and this risk of stranded costs is placed back on consumers. As policymakers seek to convert the transportation and heating sectors to carbon-free electricity to fully meet climate goals, this public policy trend is expected to continue.

Pricing carbon within the competitive market structure is the simplest, easiest, and most efficient way to rapidly reduce GHG emissions in the electricity sector. Moreover, placing a realistic price on carbon would enable consumers to pay accurate, competitive prices without the risk of paying for stranded costs. However, New England state policymakers and other stakeholders responsible for putting this approach into motion have not pursued a carbon-pricing option that effectively reflects decarbonization goals, neither economywide nor in the electricity sector.

In the absence of a regional strategy for realistic carbon pricing, ISO New England designed and implemented Competitive Auctions for Sponsored Policy Resources (CASPR) to enable the resource transition to take place in a manner that does not compromise reliability. CASPR is a state-of-the-art solution that allows state-sponsored clean-energy resources (such as state-contracted offshore wind) into the capacity market without artificially depressing prices for all other resources. Unrestricted entry of state-sponsored resources into the capacity market could lead to economic distortions, undermine the competitiveness of the market, and cause retirements to happen too quickly. Or, it could deter new investment in other resources that don't have a contract but are needed to operate the grid reliably (such as merchant investment in grid-scale storage technologies).

Pricing carbon within the competitive market structure is the simplest, easiest, and most efficient way to rapidly reduce GHG emissions in the electricity sector.

It is important to note that CASPR does not prevent potential capacity resources from clearing in the primary auction if they are economic. Rather, it provides an opportunity for state-sponsored resources unable to clear in the primary auction to trade with a capacity resource seeking to retire, thereby avoiding the expensive and inefficient acquisition of more resources than required for reliability.

The ISO conducted the first substitution auction in conjunction with Forward Capacity Auction #13 in 2019. CASPR will work over time, depending on the timing and buildup of the economic incentives for buyers and sellers. While CASPR is a second-best solution for reducing (or eliminating) carbon from the power sector, the market design demonstrates ISO New England's consideration of the region's climate goals and adherence to our mission to ensure reliability through a competitive wholesale market structure.

Regional cap-and-trade GHG reduction initiatives work well with markets

In addition to their individual state goals and laws, all six New England states have been members of the Regional Greenhouse Gas Initiative (RGGI) since 2007. The first mandatory cap-and-trade program in the United States to limit carbon dioxide (CO_2) in the power sector, RGGI is a tool for some of the states to invest in efforts, such as energy efficiency and renewable energy, via the revenue-generating auction mechanism of CO_2 allowances. However, the caps on allowances to date have not been restrictive enough to raise prices to a level that spurs development of renewable resources without other incentives or power purchase agreements. The New England states have also participated in discussions with the Transportation and Climate Initiative, a regional collaboration of Northeast and Mid-Atlantic states and the District of Columbia that seeks to improve transportation, develop the clean-energy economy, and reduce carbon emissions from the transportation sector. The goal of the initiative is the design of a proposal for a regional low-carbon transportation policy using a cap-and-invest program or other pricing mechanism to reduce carbon emissions from transportation fuels.

What is the capacity market?

Power resources compete in the Forward Capacity Market to take on a commitment to be available to meet projected demand for electricity three years out. The FCM works in tandem with the energy and ancillary services markets to provide revenue that attracts and sustains power resources needed today and into the future. Over the years, the FCM has enabled the entry of nearly 12,000 MW from energy efficiency, demand response, renewable resources and natural gas plants. And it has provided an orderly process for the retirement of almost 7,000 MW from older fossil units and nuclear plants.

Focusing on Energy Security:

Reliably Operating a Future Power Grid with a High Penetration of Renewable and Energy-Limited Resources

The New England power grid is no longer comprised mostly of conventional, thermal generation that stores fuel on site. Instead, the system is increasingly made up of generating facilities that run on *just-in-time* energy sources: natural gas (from pipelines and LNG deliveries), wind, and solar energy.

Natural Gas, Wind, and Solar Are Especially Variable in Winter

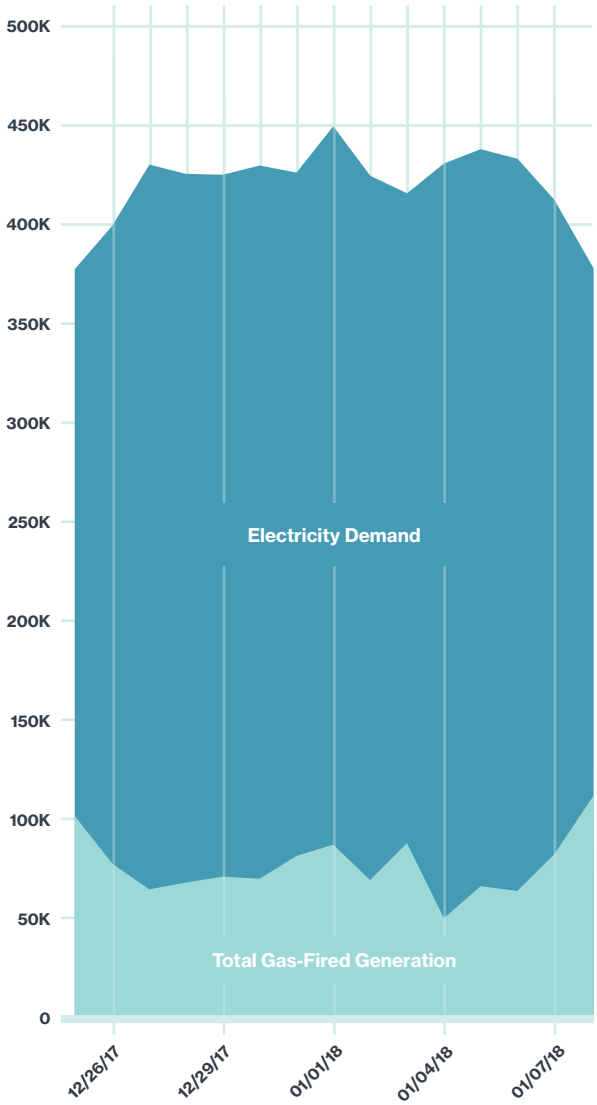
With limited options for storing natural gas, most natural-gas-fired plants rely on just-in-time fuel delivered to New England through interstate pipelines. However, interstate pipeline infrastructure has only expanded incrementally over the last several decades, even as reliance on natural gas for home heating and for power generation has grown significantly.

During cold weather, most natural gas is committed to local utilities for residential, commercial, and industrial heating. As a result, we are finding that during severe winter weather, many power plants in New England cannot obtain fuel to generate electricity. Liquefied natural gas (LNG), brought to New England by ship from overseas, can help fill the gap—but regional LNG storage and sendout capability is limited, and its timely arrival depends on long-term weather forecasts, global market prices, and other logistical challenges.

Winter also imposes the most challenges for solar output in New England due to snow, clouds, and shortened daylight hours. In addition, shortened winter days means consumers use the most electricity after sunset, and therefore solar doesn't reduce winter peak demand. While offshore wind experiences its highest production during winter, winter storms that limit solar power can also significantly limit the output of wind generation. This type of variability is an understandable challenge in meeting the states' decarbonization goals through greater renewable, weather-dependent technologies, and it poses new technical challenges to the grid's reliability.

During Cold Weather, Natural-Gas-Fired Generation Supplies a Small Fraction of the Region's Electricity

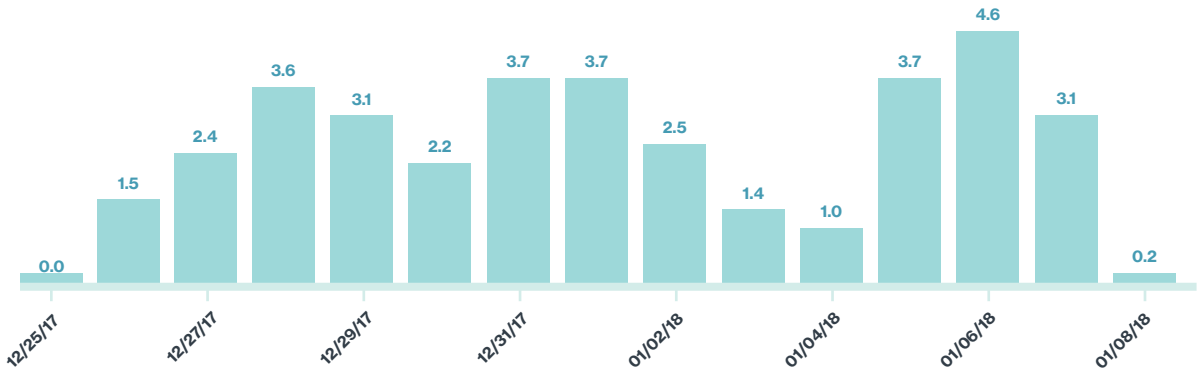
Electricity Demand and Total Gas-Fired Generation
December 26, 2017–January 9, 2018



Gas-fired generation plummets during extended cold weather. Remaining oil-fired and coal units presently cover that 'energy supply gap.' But these resources are likely to retire in the coming years.

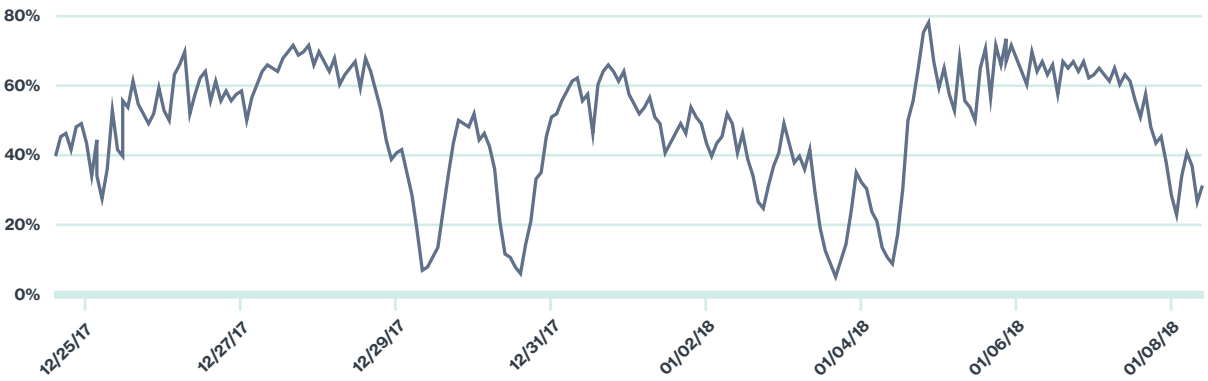
Cold Weather Exposes New Reliability Risks

Estimated Unavailable Natural Gas Generation Capacity (GW) | December 25, 2017–January 8, 2018



Natural gas generation is severely limited due to infrastructure constraints. During extended cold weather, renewable energy output can be highly variable. Both technologies rely on just-in-time delivery of their energy sources.

Output from Wind Fleet Generation | December 25, 2017–January 8, 2018 *(Share of Nameplate)*



Sources: *ISO New England Cold Weather Operations* (2/2018, p.50); *ISO-NE Seven Day Capacity Forecast, Anticipated Cold Weather Outages* (12/25/2017–1/8/2018)

From storing fossil fuel to storing clean energy: flexible resources will be required

Although New England currently enjoys the benefit of almost 2,000 MW of large-scale hydroelectric energy-storage facilities (that can pump water uphill at night to generate power the next day), future storage technologies that can offer longer-term and even seasonal electricity-storage capability are becoming important to balancing electricity supply and demand. The region is in the nascent stages of developing new grid-scale lithium-ion batteries, and much more grid-scale, clean-energy storage capability may ultimately be needed, including clean fuels.

The synergies between renewable energy sources and flexible energy storage is already evident in the grid's operation. Consumers' demand for power can be low on many days when the sun is shining and the wind is blowing steadily. Yet, without greater capabilities to convert and store that zero-carbon electricity, much of that power may simply go unused. And conversely, if the region experiences high electricity demand on days when the output from renewable resources falters (due to adverse weather), the grid requires a considerable amount of flexible-resource capacity that can promptly respond—and sustain output for as long as needed—to fill the gap.

Until storage technologies can supply much more energy for extended periods, the system's existing fleet of modern, flexible natural gas resources will remain essential for meeting energy demand and, critically, filling the "energy gap" when the weather is uncooperative for wind and solar and the system's existing grid-scale storage facilities run low.

Storage also consumes energy and may not provide assistance once depleted

Energy-storage resources draw electricity from the power system or directly from a generating resource (such as a colocated solar or wind facility) as they "stockpile" energy, and then send electricity to the grid at a later time. Overall, they consume more energy than they supply, as operations and losses during energy conversion consume some of their "inventory" of stored energy. If these resources are already depleted during a system emergency, they would not be able to provide help but would instead sit idle, making their "inventory management" and optimization a key technical challenge for the grid's reliability.

Managing Energy Security to Date

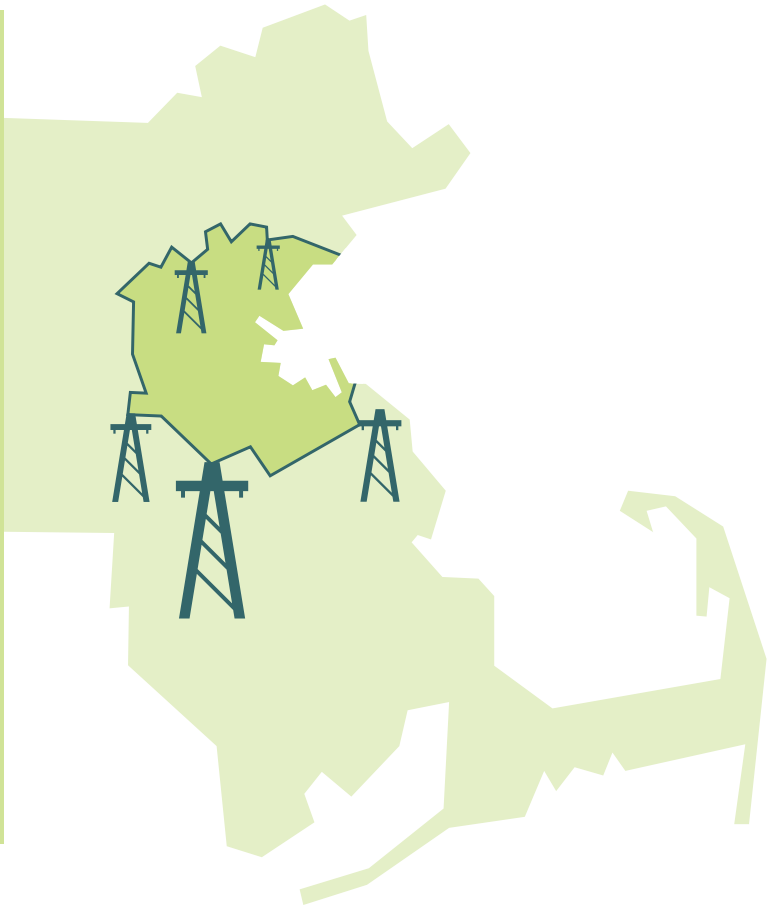
In New England, interstate natural gas pipeline constraints, combined with the retirement of many older (oil and coal-fired) power plants, have heightened the region's energy-security concerns. The ISO doesn't have authority over pipelines or other fuel infrastructure that supply New England's power plants. Instead, the ISO has the ability to develop market rules that result in accurate pricing signals that incentivize power suppliers to make investments in their generation facilities and fuel-supply arrangements to operate reliably and profitably.

Over nearly two decades, the ISO has made many successful market and operational enhancements to improve gas system and electric power system coordination; boost power plants' performance; and lead generation owners to make more resilient fuel-supply arrangements across all system conditions (and, at times, working to delay the retirement of key facilities still needed for reliability). The most recent changes, since the publication of the 2019 REO, include:

- Temporarily retaining the Mystic Generation Station in Everett, MA from retiring, using a special cost-of-service contract. ISO New England was given federal approval to retain resources from retiring for a limited period based on the region's fuel-security reliability challenges in winter.
- Developing a temporary Inventoried Energy Program, a short-term, stop-gap program to be in effect for the winters of 2023/2024 and 2024/2025. This mechanism provides revenues to resources with inventoried energy that contribute to reliable operations during cold winter conditions and reduce the potential for these resources to retire prematurely for uneconomic reasons.

Competitive solution for the Boston area's anticipated transmission needs

In late 2019, the ISO issued its first request for proposals (RFP) to address transmission system upgrades needed in the Boston area with the coming retirement of the Mystic Generating Station—one of the largest power plants in New England and located in the region's largest city. The issuance of the RFP marks a milestone as ISO New England's first competitive transmission solicitation under FERC Order 1000, which created a competitive selection process for transmission upgrades and enables the potential for more creative transmission engineering and technology solutions. Prospective developers have until March 4, 2020, to submit their initial applications; the ISO expects to make a final selection in the summer of 2021.



The Next Step Forward: Ensuring Enough Flexible Supply Each Day to Manage the Uncertainties in an Increasingly Energy-Limited Power System

The design of the wholesale energy markets is based on the physics of the power system. Generators with stored fuel provide enough flexibility for the daily energy market to balance electricity supply and demand over the course of the day, reliably and at least cost. However, a system predominantly comprised of generating facilities with just-in-time fuel supplies—wind, solar, or natural gas—loses flexibility.

In the coming years, the ISO must ensure that the grid has sufficient energy "on demand" to power New England if these just-in-time gas-fired and renewable technologies are unavailable simultaneously. Grid electricity will need to balance supply and demand over time spans from *fractions of a second to several weeks*—to operate through both instantaneous disturbance and throughout sustained variation in demand, availability of resources, and weather conditions.

To solve this challenge, ISO New England and regional stakeholders are proactively developing long-term market enhancements known as **Energy-Security Improvements (ESI)**, to be put in place in 2024. ESI introduces strong market-based compensation for new energy and reserve services that will reward the lowest-cost resources that can firm-up their energy sources and deliver electricity reliably when unforeseen grid operating challenges arise. These new competitive market mechanisms create powerful incentives that will help ensure that enough flexible resources are on line or available in the region during energy-limited conditions.

New England is the first in the nation to bring forward a market design that will directly recognize and compensate resources for the reliable, flexible, and responsive attributes they provide and will thereby help accelerate the transition to reliable zero-carbon, renewable resources and storage technologies.

For example, a solar facility with battery storage has the same opportunity to provide these reliability services as a natural gas plant with a contract for liquefied natural gas or an offshore wind farm that operates at a high capacity factor during winter. All may be rewarded under the ESI design.

ESI does not favor fossil fuels—rather, it focuses on promoting reliable energy output instead of compensating for specific production inputs such as fossil fuel. By contrast, direct subsidies to selected generators to procure additional fuel would benefit only those selected resource owners, providing no incentive for the systems' other resources—or for potential new technologies, such as current and future storage technologies—that may ultimately comprise the most cost-effective long-term solutions.

The design maintains New England's transparent, technology-neutral principles of competition and a familiar framework for resources:

1. **Reliability.** Minimize the heightened risk of unserved electricity demand
2. **Cost Effectiveness.** Leverage established markets and efficiently use the region's infrastructure
3. **Sustainability.** Facilitate innovation that can reduce energy-security risk as technology continues to evolve

ESI is comprised of two conceptual components:

1. *File with FERC: April 15, 2020; Take Effect: June 1, 2024:* Create new option-based services in the day-ahead markets that compensate for the flexibility of energy "on demand" to manage uncertainties each operating day. The ESI design will firm up and formalize the option to call on 3,500 to 5,000 MW of potential energy "in reserve" each day, as follows, with a range of specific delivery-response times, to help ensure reliable operations—capabilities previously relied on but not properly compensated:

   - **Generation Contingency Reserves (GCR):** Three new day-ahead ancillary services that ensure operating reserve energy (GCR 10-minute spinning reserve, GCR 10-minute nonspinning reserve, and GCR 30-minute reserve)
   - **Replacement Energy Reserves (RER):** Two new day-ahead ancillary services that ensure energy through the balance of the day to cover any "supply gap" that may arise if scheduled energy suppliers' falter (RER 90-minute and RER 4-hour reserve)
   - **Energy Imbalance Reserves (EIR):** A day-ahead means to ensure energy to cover any "gap" between forecast consumer demand the next day and the supplies scheduled from both fossil and forecasted renewable resources

2 *In development 2020–2021:* Develop a **new, seasonal forward market auction** that awards competitive, resource-neutral forward contracts to reduce both investors' and consumers' risks of achieving any combination of more reliable energy supplies or longer-term (multimonth) energy-storage arrangements.

Designing and implementing long-term winter energy-security improvements is a large, complex, multiyear project to develop the rules, complete quantitative and qualitative analyses on the design, and review the details with stakeholders. After filing a proposal with FERC in April 2020 and awaiting its response, implementing market administration processes and developing new software and IT systems is expected to take another three to four years.

Focusing on the Future:

Sustaining a Power Grid that Can Reliably Support a Carbon-Free Economy and Society

Future Market Analyses: Thinking Even Longer Term

In 2019, the ISO received requests from the New England States Committee on Electricity, New England Power Generators Association, and other participants, that we dedicate time and staffing in 2020 and beyond to discuss potential future market frameworks that will help them achieve their state decarbonization goals.

According to Energy Information Administration data, almost 75% of New England's GHG emissions come from the transportation sector and residential, commercial, and industrial buildings, with the remaining 25% from the electricity sector. Regional policymakers are considering which policy instruments will best incentivize New Englanders to adopt electric vehicles and convert their homes and businesses to electric heat.

As the region moves toward these goals, we must ensure that the wholesale markets and regional planning process can bring to fruition a power system that continuously and reliably supports the electrification of millions of vehicles, homes, and buildings with low-to-no-carbon energy.

The New England power system will look very different in that future world, and the "electrification of everything" raises important questions about where the region is heading in the coming decades in terms of the overall architecture of the regional power system and wholesale market structure. We are committed to working with the states and industry stakeholders to evaluate how wholesale markets can sustain a power grid that can reliably support decarbonization across New England's economy and society.

ISO-NE Strategic Planning

ISO New England is guided by a purposeful and integrated business planning approach to assist the organization in thinking strategically about the future and drive focus toward a common target for years to come. Our strategic planning framework aligns the organization's purpose with measurable goals and objectives that are a direct reflection of ongoing input from states and stakeholders. The framework provides the foundation for the development of our annual work plans and associated budgets.

The strategic plan provides clarity and focus for the company during this time of change. As the region moves along its decarbonization journey, ISO New England's goal is to collaborate with the New England states and industry stakeholders to ensure that competitive markets and reliability stay aligned and keep pace with environmental policies and rapid technological changes.

Discussions with the states on the future of New England's market framework are included as part of our 2020 Annual Work Plan (www.iso-ne.com/work-plan).

STRATEGIC PLAN SUMMARY

Objective:
Provide Reliable Operations and Robust Planning

Strategy:
Meet regional and national reliability standards

INITIATIVES

Participate in and influence national reliability and cybersecurity standards

Maintain and invest in robust operator training and compliance monitoring program

Implement state-of-the-art cyberdefense posture through cybersecurity investments

Provide improved situational awareness of fuel constraints to marketplace

Strategy:
Manage robust planning process to identify needed infrastructure investments

INITIATIVES

Study and publish 10-year power system needs with emphasis on role/impact of emerging technologies and evolving grid

First Order 1000 RFP to address retirement of Mystic Power Station

Study on- and offshore wind interconnections on timely basis using cluster study process

Strategy:
Develop innovative approaches for reliable transition to hybrid grid

INITIATIVES

Work with stakeholders to integrate regional policy actions into operations and planning

Improve long- and short-term forecasting of EE/PV/wind profiles

Implement state-of-the-art energy-storage models

Objective:
Ensure Open, Competitive Wholesale Markets

Strategy: Achieve resource adequacy

INITIATIVES

Maintain effective Forward Capacity Market and support stakeholder discussion on the future of the wholesale market structure

Continue to evaluate the efficacy of the Forward Capacity Market, including CASPR

Implement improved incentives for new commercial resources to be operational on time

Objective:
Run Efficient, Cost Effective, High Quality Business

Strategy: Create transparent, accountable budgets

INITIATIVES

Require robust internal and external review of annual budget requirements

Deliver capital portfolio, on budget and schedule, with high quality

Employ active risk management of operating and capital budgets

Strategy: Prepare workforce for evolving industry

INITIATIVES

Recruit high-quality candidates for organization's current and future needs; ensure ongoing training and development

Maintain competitive compensation and benefits

Ensure up-to-date leadership succession plans and development for internal leadership candidates

Maintain a positive work environment, enabling employees to deliver their best results

Strategy: Be trusted, independent source of information

INITIATIVES

Make accurate information accessible and transparent to marketplace via easy-to-use tools

Foster open communication and support robust stakeholder process

Publish ongoing studies to inform region of economic outcomes of different resource portfolios

Strategy: Ensure proper design and price formation

INITIATIVES

Design and implement new ancillary products to address energy security (ESI)

Co-optimize energy and ancillary products in Real-Time and Day-Ahead Energy Markets to improve price formation (ESI)

Strategy: Ensure markets enable and accommodate hybrid grid

INITIATIVES

Support regional discussions on valuing environmental attributes in wholesale markets

Evaluate new ancillary products to operate system reliably with increasing intermittent resources (ESI and other)

ISO Metrics:

Measuring ISO New England's Performance, Accountability, and Transparency

Accountability and Transparency

$1.01 per Month

The services and benefits the ISO provides to keep competitively priced power flowing will cost the average New England residential electricity consumer $1.01 per month in 2020, based on 750 kilowatt-hours per month usage. The ISO's 2020 operating budget is $201.7 million, which is $3.7 million more than 2019, or a 1.9% increase. This includes $1.3 million of special purpose funds for work related to FERC Order 1000, which, if underutilized, will be returned in a following year. Other increases are for funding (other than to maintain current operations): **cybersecurity, NERC Critical Infrastructure Protection (CIP) compliance, and energy security market improvements**. The FERC-approved budget is the result of a robust stakeholder discussion to set priorities. Full financial statements are available at www.iso-ne.com/about.

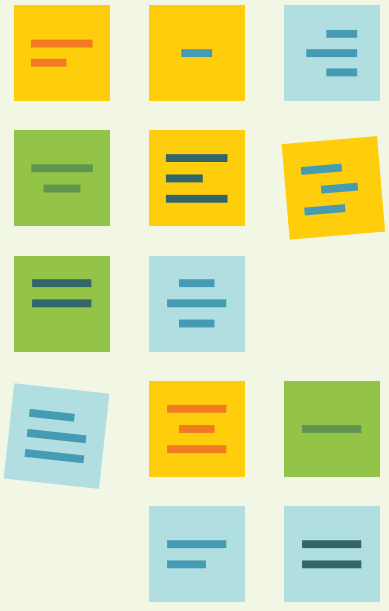
97% Satisfaction

The latest survey of market participants (2019) revealed high overall satisfaction levels with the information and services the ISO provides. Positive satisfaction among respondents with an opinion was 97%. Responses help the ISO identify and prioritize improvements in system operations, market administration, the website, and other information products.

9,600 Issues Resolved

The ISO has a strong culture of responsiveness and outreach to keep market participants and other stakeholders well informed. In 2019:

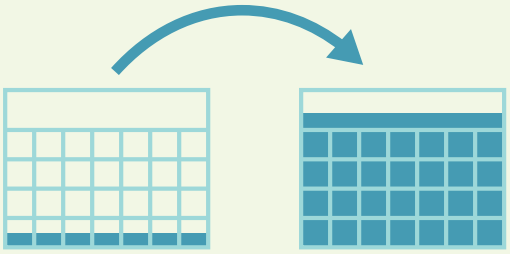
- ISO Customer Support resolved over 9,600 issues submitted via phone call, email, and Ask ISO self-service.
- We held classroom or web-conference trainings for over 800 stakeholders and made over 79 e-learning modules and 163 presentations available on the ISO website for stakeholders.
- Our extensive website was accessed over 1.1 million times by more than 350,000 unique visitors.
- ISO senior management, subject matter experts, and other staff met well over 500 requests from stakeholders and the media for presentations, panel discussions, technical answers, and interviews.



70+ Stakeholder Meetings

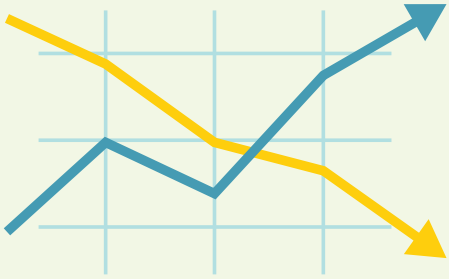
The ISO's stakeholders are a wide-ranging group, from **market participants** to **regulators** to **policymakers** to **environmental advocates** and **retail consumers**. Their diverse perspectives help inform discussions and generate solutions to regional challenges and ensure a collaborative process in the administration of New England's wholesale electricity markets and power system. Changes to the *ISO New England Inc. Transmission, Markets, and Services Tariff* and associated procedures, which govern the administration of the region's wholesale electricity markets and the operation of the bulk power system, are all vetted through the New England Power Pool (NEPOOL) stakeholder process. Stakeholders also interact regularly with ISO staff and participate in committees and working groups. In 2019, the ISO coordinated or participated in 73 meetings of the Markets, Reliability, Transmission, and Participants Committees and the Planning Advisory Committee (PAC). The Consumer Liaison Group (CLG) also met quarterly to share information about the power system and wholesale electricity markets' impacts on consumers. The PAC and CLG are open to the public, while the rules governing NEPOOL, the association of regional market participants, determines attendance for the other committees.

2019 Improvements for a Better Stakeholder Experience



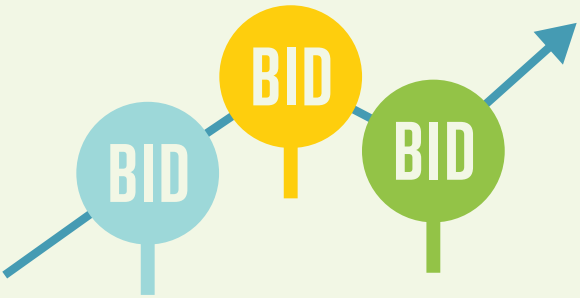
Forward Capacity Market Delayed Commercial Resource Treatment

This new monthly "failure-to-cover" charge incentivizes market participants unable to fulfill their capacity supply obligation to take action to cover their obligation or assume a charge.



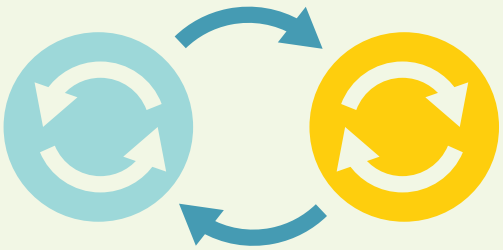
Annual Reconfiguration Transactions (ARTs)

ARTs were introduced to provide the equivalent of a bilateral transfer of a capacity supply obligation at a fixed price. By entering into an ART and participating in an annual reconfiguration auction, a capacity supplier can achieve price-quantity assurance (to the extent the capacity is substitutable) when either acquiring or shedding an obligation.



Financial Transmission Rights—Balance of Planning Period

The FTR BoPP augments the FTR bidding process by implementing multiple on-peak and off-peak auctions for the months remaining in the annual period. This provides market participants with more opportunities to configure their FTR portfolio.



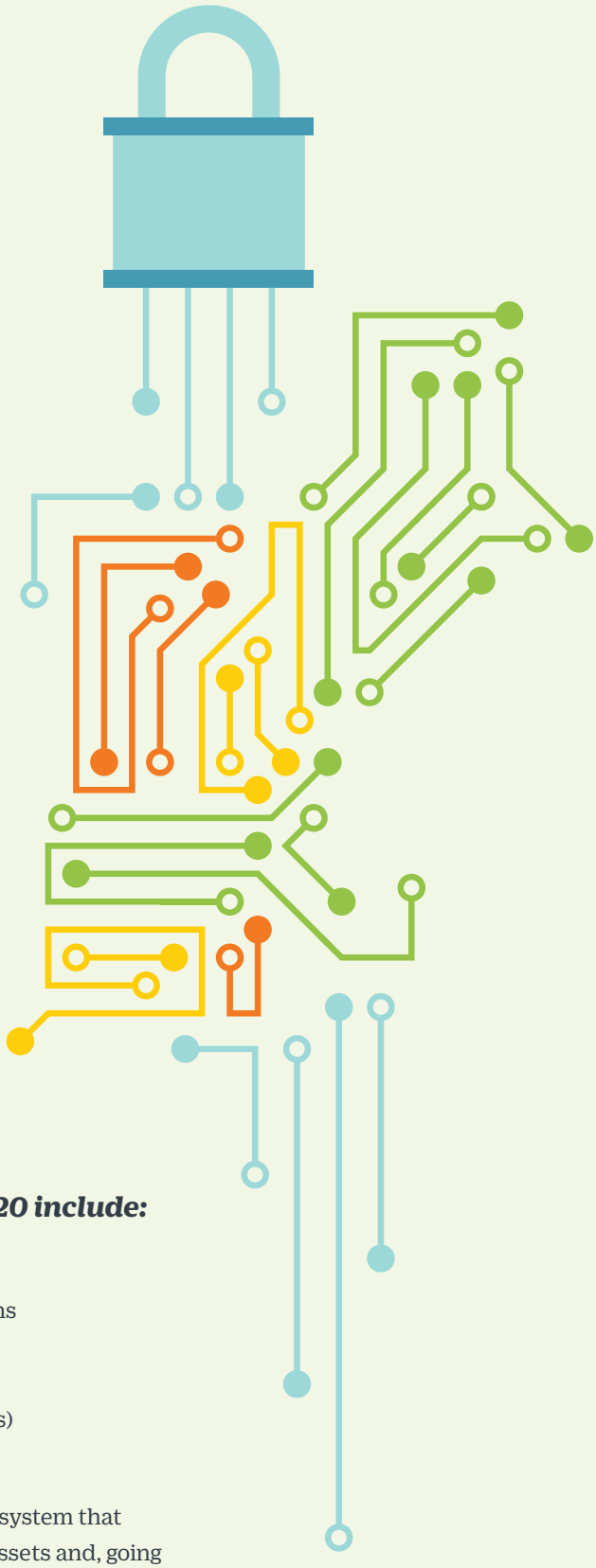
New Software for Scheduling External Transactions

The 16-year-old Enhanced Energy Scheduling software was replaced by the New England External Transaction Tool (NEXTT), a new software application for market participants to submit external transactions in the Day-Ahead and Real-Time Energy Markets. Numerous improvements allow customers to better manage their external transactions, with the tool being an important part of the day-to-day operation of the electricity grid.

Cybersecurity to Protect the Grid and Marketplace

A successful cyberattack on ISO New England would result in loss of control over critical IT systems, jeopardizing the reliable operation of the power system. The energy sector faces significant risk of attempted cyberintrusion, and the bulk power system is the only industry subject to mandatory and enforceable cybersecurity standards. Violation of the North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection standards can result in fines of up to $1 million per violation per day.

The ISO continuously works internally and with stakeholders and regulators to meet evolving threats and build on our already extensive 24/7 systems of process controls, advanced detection and response, redundancy in systems and control centers, and intensive employee training. These help us detect, respond to, and recover from any cyberattacks, as well as to comply with mandatory standards. And more than 100 employees participated in GridEx V, hosted by NERC and designed to exercise coordinated responses to cyber and physical attacks.



The ISO's cybersecurity initiatives for 2020 include:

- Enhancing network security and building a new network to safeguard control center communications
- Complying with all NERC standards, including:
  - CIP-012 (communications between control centers)
  - CIP-013 (supply chain risk management)
- Implementing an Identity and Access Management system that automates and secures access to CIP and non-CIP assets and, going forward, will serve as a foundation for the ISO's cybersecurity program

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ISO new england

ABOUT ISO NEW ENGLAND

The ISO was established to ensure that a not-for-profit, independent organization with no financial stake in the energy industry would design and administer New England's competitive wholesale electricity markets and guide the development of a reliable and efficient power grid.

The ISO is the regional energy expert in power system operations, wholesale electricity market design and development, and power system planning.

ISO New England delivers value to the region by being a stable presence in a changing and challenging industry.

For more than 20 years, ISO New England has been an effective manager, with proven experience and expertise to handle evolving industry challenges.

The ISO recognizes the environmental policy imperative within the region and is working hard to facilitate the integration of renewable energy while continuously ensuring that electric power reliability is delivered through competitive wholesale markets.

ISO New England is synonymous with innovation. The ISO will continue to innovate advances in markets, operations, and planning as the region transitions to a low-to-no carbon power grid that will be used to electrify millions of vehicles and building heating systems across the region.

The ISO successfully collaborates with market participants and regulatory commissions and is committed to working with the states to ensure that wholesale markets can bring to fruition a power grid that reliably supports decarbonization across New England's economy and society.


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