



FEBRUARY 20, 2018



## State of the Grid: 2019

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*ISO in Depth*

Gordon van Welie

PRESIDENT & CEO, ISO NEW ENGLAND INC.



## About the *ISO in Depth* Series

- Opportunities for reporters to learn more about trends affecting New England's electricity industry
- Hosted by ISO New England senior management
- **Content is on the record**
- Please hold questions until the Q&A session at the end of the presentation
- Presentation and remarks will be posted at [www.iso-ne.com](http://www.iso-ne.com)>About Us>News and Media>Press Releases



Good morning, everyone. My name is Ellen Foley and I am the Director of Corporate, Media & Web Communications at ISO New England. I'm joined today by Gordon van Welie, president and CEO of ISO New England. Welcome to our annual State of the Grid media briefing.

ISO New England offers these *In Depth* media briefings to provide a closer look at the trends affecting New England's electricity industry. The content is **on the record**, and may be quoted and attributed to the speaker.

After the briefing concludes, the presentation and prepared remarks will be posted in the press release section on the ISO New England website. We will post a recording of the complete session later this afternoon or tomorrow morning.

## Agenda

- 10 to 10:05 a.m. **Welcome**  
Ellen Foley, director, Corporate,  
Media, and Web Communications
- 10:05 to 10:30 a.m. **State of the Grid: 2019**  
Gordon van Welie, president  
and CEO
- 10:30 to 11:00 a.m. **Question-and-Answer Session**



**Today's briefing** will last about 30 minutes, with time at the end for questions from the media.

## Overview of State of the Grid: 2019

- About ISO New England
- Key Takeaways
- 2018 Highlights
- Evolving Resource Mix
- Energy Security Risk
- Challenges to Competitive Markets
- Solutions
- Conclusions
- Appendix: 2018 Data Recap



During today's briefing, Gordon van Welie will update you on the state of New England's power grid

and the evolving resource mix that is leading the region to a hybrid power system. He'll discuss the risks to reliability posed by the region's energy security challenges, and the vulnerability of the competitive markets. The presentation will also touch on some of the ISO's work to manage these risks and prepare for the future.

An appendix with 2018 facts and figures and more data on New England's power system will be posted with the presentation shortly after this briefing ends.

## ABOUT ISO NEW ENGLAND



## ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

### Grid Operation

Coordinate and direct the flow of electricity over the region's high-voltage transmission system



### Market Administration

Design, run, and oversee the markets where wholesale electricity is bought and sold



### Power System Planning

Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years



Before we get started, a brief introduction to ISO New England may help provide some context.

The ISO was created in 1997 to operate the region's high-voltage power system, to design and administer competitive wholesale electricity markets, and to conduct long-term planning to ensure New England's power system can continue to meet the region's needs into the future. The ISO's three responsibilities are all geared toward ensuring power system reliability.

In its role as the independent grid operator, grid planner, and market administrator, ISO New England serves as an objective source for data and information that identifies the trends affecting the regional power system.

## ISO New England (ISO) Has Two Decades of Experience Overseeing the Region's Restructured Electric Power System

- **Regulated** by the Federal Energy Regulatory Commission
- **Reliability Coordinator** for New England under the North American Electric Reliability Corporation
- **Independent** of companies in the marketplace and **neutral on technology and fuel**



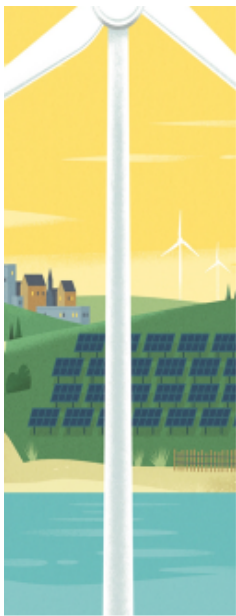
While the ISO is at the center of New England's electricity industry, there are some misconceptions about our role. The ISO is regulated by the Federal Energy Regulatory Commission and must abide by the commission's rulings, which are based on federal law.

That's why the competitive wholesale electricity markets must be neutral on both technology and fuel types. These markets provide a level playing field where the most efficient, cost-effective resources are chosen to serve consumer demand. The ISO doesn't buy or sell electricity or make a profit in the markets; we operate the markets where wholesale transactions occur.

The ISO doesn't make policy on any issues, such as carbon pricing or clean energy goals—policy matters are properly left to people who were elected or appointed to make those decisions. The ISO has no role in deciding issues involving retail electricity or distribution system matters, such as time-of-use rates or behind-the-meter resources – those are overseen by state policymakers and regulators.

Now I'll turn the briefing over to Gordon van Welie to update you on the state of New England's power grid in 2019.

## KEY TAKEAWAYS



### State of the Grid 2019: Key Takeaways

- **Grid is holding steady on a strong foundation, but the power system is changing and vulnerabilities are growing**
- **Strong foundation:** Operations, transmission, resources, & collaborative, long-term planning
- **Evolving resource mix:** Fleet is shifting from resources with on-site fuel (coal, oil, nuclear) toward:
  - Resources with “just-in-time” fuel delivery (natural gas)
  - Weather-dependent resources (wind, sun)
  - Distributed resources at homes and businesses (solar photovoltaic arrays)



Thanks, Ellen, and thanks to everyone for calling in today. I appreciate the opportunity to provide more information on how New England’s power system is doing, what we see on the horizon, and how the ISO is preparing for the future grid.

New England's power system is operating from a strong foundation, but the vulnerabilities we've discussed in previous briefings are still here, and still growing. The ISO is facing increasing complexities in operating the grid with a shifting resource mix, and in maintaining markets that are truly competitive while accommodating public policy goals.

Before I detail the vulnerabilities, let me first outline the four elements that make the power system's foundation strong. These are key ingredients for reliability.

The cornerstone is reliable operations. Our system operators have operated the grid reliably through the challenges posed by periods of record cold and record heat, high demand, and major equipment outages.

Second is a robust transmission system. Significant investment in badly needed upgrades have removed most bottlenecks and weak spots, and enhanced competition.

Third is resource adequacy. That means we have enough resources, whether they're power plants or resources that reduce demand for power. The Forward Capacity Market continues to attract and retain the capacity needed to meet demand.

Fourth, New England has a well-established, collaborative decision-making process engaging the ISO, market participants, state officials, and consumer advocates. That collaboration has worked very well over the last 20 years and will continue to be the place where we find the solutions to the region's challenges.

But industry trends and state policies are driving changes in the system. Nuclear, oil, and coal-fired power plants that operate with fuel stored onsite are retiring in greater numbers and they are being replaced by more natural-gas-fired power plants and renewable resources. The new resource mix is cleaner but it is also dependent on the weather or timely natural gas deliveries.

The states' clean energy initiatives are supporting more renewable resource development as well as a rapid expansion of distributed resources such as solar PV systems on rooftops, energy storage devices, and energy efficiency measures. This evolving resource mix is making power system operations more complex.





## State of the Grid 2019: Key Takeaways

- **Vulnerabilities:**
  - **Energy security risk:** With an evolving resource mix and inadequate fuel delivery infrastructure, there may not be enough energy to satisfy electricity demand during extended cold weather and, increasingly, year-round
  - **Competitive markets** are under stress: Public policy initiatives provide financial support to renewables & distributed resources, artificially suppressing prices for all resources
- **Adapting markets & operations:** ISO-NE continues to adapt market rules and planning and operational procedures to ensure continued reliability and fair competition for all resource types



The region's vulnerabilities are significant and the ISO has identified two areas of concern. They are energy security risk and shifting policy priorities that are challenging competition in the markets. While it will bring benefits, the evolving resource mix could also intensify the risk that there may not be enough energy to meet demand on the coldest days in winter. As the fleet shifts away from power plants with stored fuels to resources that depend on weather or just-in-time fuel deliveries, the risk of insufficient energy is likely to expand to other times of the year as well.

The region's fuel infrastructure remains limited, whether it's limited pipeline capacity or limited storage for oil or liquefied natural gas. While ISO New England can't address fuel infrastructure limitations directly, the competitive markets can be adapted to reflect the true cost of limited fuel availability and to compensate resources that provide energy security.

Competition in the markets is vulnerable even though, to date, competition has delivered on the original state and federal goals that created the markets 20 years ago. The markets have sparked competition that has lowered wholesale prices and spurred investments of more than \$16 billion in new, more efficient, cleaner power plants and resources that reduce demand. Competition shifted the burden of paying for unwise investment decisions from ratepayers and onto investors. However, state initiatives to achieve their clean energy goals and mandates have created a need for the markets to be adapted to sustain the benefits of competition.

## 2018 HIGHLIGHTS



### 2018: Major Milestones

- **Operational Fuel Security Analysis:** Defined the growing energy security risk the region faces, particularly during extended cold periods
- **Pay-for-Performance incentives:** Addresses an array of resource performance issues, not just fuel security. PFP's scarcity pricing provides strong signal to perform when system is already "at risk", but does not provide an advance signal of impending energy security risk
- **CASPR:** FERC approved the ISO's Competitive Auctions for Sponsored Policy Resources initiative, the first in the nation to provide a path into the capacity market for resources with state-sponsored contracts



Last year was a busy one for the ISO, with fuel security issues taking center stage right from the start. At the beginning of January, system operators were concerned that the region's oil-fired power plants might run out of fuel during a two-week cold spell. Fortunately, the extreme cold ended just in time, followed by milder weather that enabled oil plants to refill their storage tanks. Also in January, the ISO issued the [Operational Fuel Security Analysis](#), a study that concluded that energy security risk is the top challenge to power system reliability in New England. Energy security risk means resources may not have or may not be able to get fuel when needed.

A couple of months later, Mystic station, one of the largest power plants in New England, announced [plans to retire in 2022](#). Our studies determined that the retirement of the Mystic 8 and 9 units would pose an unacceptable risk to regional fuel security.

However, the tariff rules by which we operate didn't allow the ISO to retain resources needed for fuel security. The ISO and stakeholders developed [interim tariff language](#) that would allow the ISO to delay retirements that would increase the region's fuel security risk. The interim rules will apply for the next two years, while we continue working with stakeholders to develop an innovative, market-based mechanism that will place a value on energy security.

Developing the mechanism and then implementing the required software and operational changes will be a large project, so energy security will continue to be a major area of focus for the ISO this year and for years to come.

In 2018 the ISO also completed several major initiatives that had been in the works for some time:

- First, we implemented [Pay-for-Performance incentives](#). These incentives were developed to address an array of resource performance issues, not just fuel security. They may not address all aspects of the region's winter energy security challenges that have continued to intensify since the incentives were developed. Pay-for-Performance scarcity pricing provides a strong signal for resources to perform when the system is already at risk, but does not signal impending fuel supply shortages days or weeks ahead. Advance notice would give power plants time to obtain more fuel.
- Second, [FERC approved](#) the ISO's effort to protect competitive pricing in the capacity market while accommodating the states' clean-energy goals. Competitive Auctions for Sponsored Policy Resources, or CASPR, provides a path to capacity market revenues for new clean-energy resources with state-sponsored contracts. It also maintains competitive pricing for all resources, including those that don't have guaranteed contracts but are still needed to ensure reliability. During the capacity auction earlier this month, the ISO became the first grid operator to implement a market-based mechanism to accommodate sponsored resources.

## 2018: Major Milestones

*continued*



- **Price-responsive demand:** First grid operator to dispatch and price active demand response resources in the energy market, alongside conventional power plants
- **Advanced energy storage:** ISO-NE developed market rules that recognize the unique characteristics of advanced energy storage technologies, such as batteries. Rules go into effect this spring



- The ISO has long been a leader in development of demand-side resources that reduce demand from the grid, and took another step forward in 2018. Since the beginning of capacity market payments in 2006, energy efficiency measures and demand-response resources have been able to receive monthly capacity payments. In June, New England became the [first region to price active demand-response resources](#) in the daily energy market alongside generators.
- And since 2015, the ISO has worked with stakeholders on [new market rules that will go into effect this spring for advanced storage technologies](#). Batteries and other emerging storage technologies will be dispatched and priced in the real-time energy market in a manner that more fully recognizes their ability to transition rapidly between charging and discharging.

## EVOLVING RESOURCE MIX

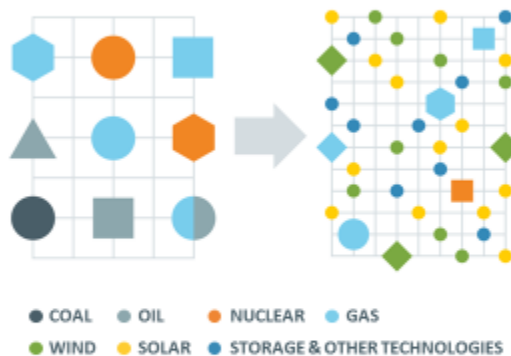


### A Hybrid Grid Is Emerging in New England

*There are two dimensions to this transition, happening simultaneously...*

1 A shift from conventional generation to renewable energy

2 A shift from centrally dispatched generation to distributed energy resources



*Maintaining reliable power system operations becomes **more complex** with the shift to more resources that face constraints on energy production*



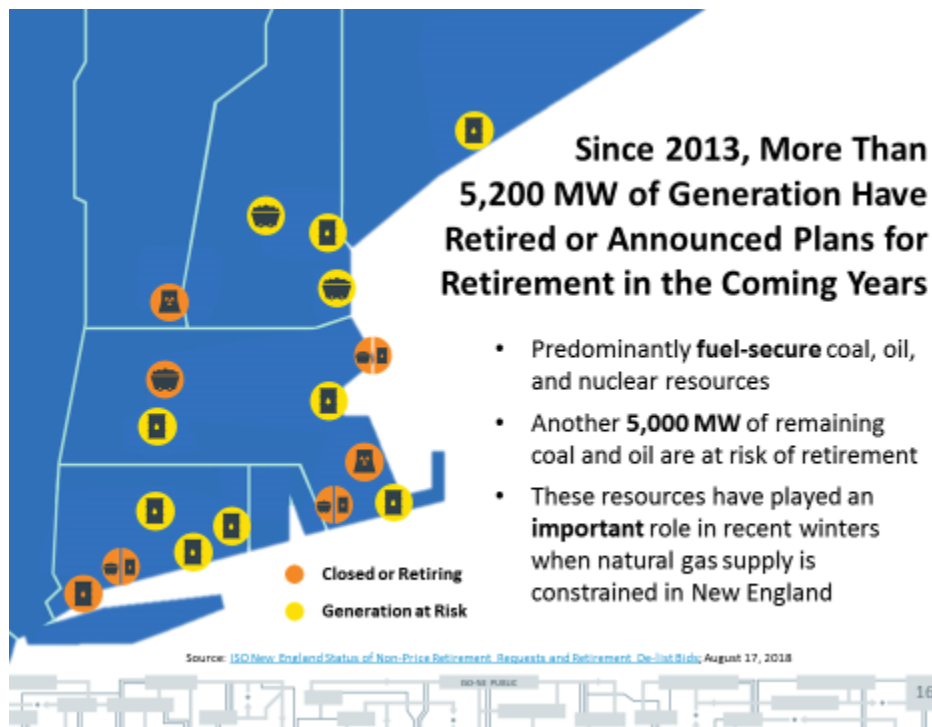
In this next section, I'll outline how the regional power system is evolving.

New England's grid is undergoing rapid change. The *traditional* power system is becoming a *hybrid* system where electricity needs will be met with conventional resources and large amounts of large-scale renewable resources connected to the regional transmission system. The conventional resources will largely be natural-gas-fired generators dependent on just-in-time deliveries of fuel,

while the wind and solar resources will be weather-dependent.

This hybrid system will also include thousands of small resources connected directly to retail customers or local distribution utilities. These rooftop systems aren't connected to the regional grid, but they are having a real impact on demand for power from the grid.

The rate of policy and technological change has a profound and complex impact on how grid resources operate and participate in the markets, how the ISO plans and runs the grid, and how consumers use grid services.

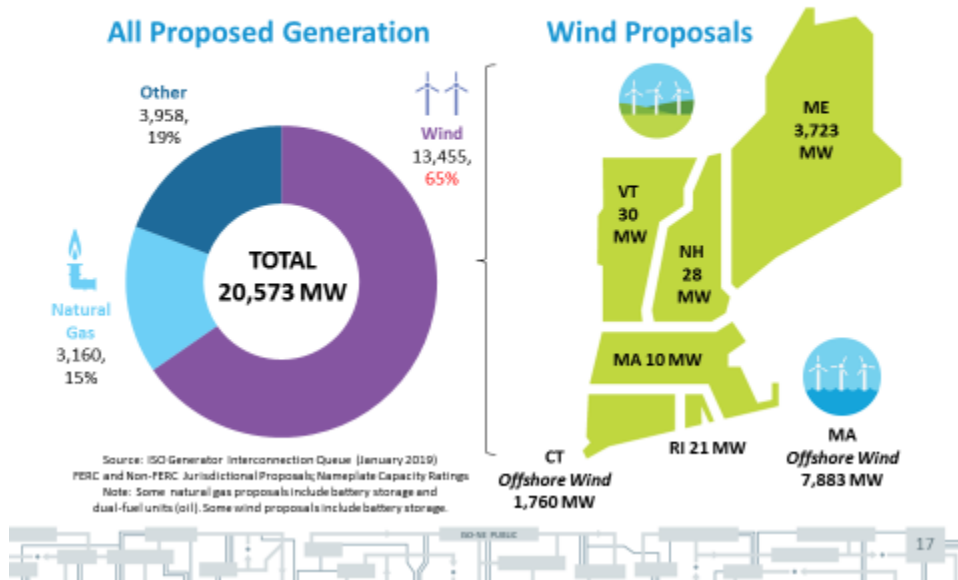


Between 2013 and 2022, more than 5,200 megawatts of oil, coal, and nuclear power plants will have retired. Further, the region's remaining two nuclear stations and another 5,000 megawatts of coal- and oil-fired generation are at risk of retirement in the coming years. That's a significant concern, because the region depends on these resources with onsite fuel supplies during cold weather. That's when natural gas may be in short supply or more expensive. After Pilgrim retires at the end of May, Millstone and Seabrook will be the region's two remaining nuclear facilities. They are critical components of a reliable hybrid grid because they are carbon-free and have a dependable, on-site fuel supply, but they are also at risk.

These retirements are driven largely by falling energy prices stemming from the low price of natural gas and the addition of large quantities of renewable energy. Environmental requirements are also a

factor.

## Wind Power Now Comprises Two-Thirds of New Resource Proposals in the ISO Interconnection Queue

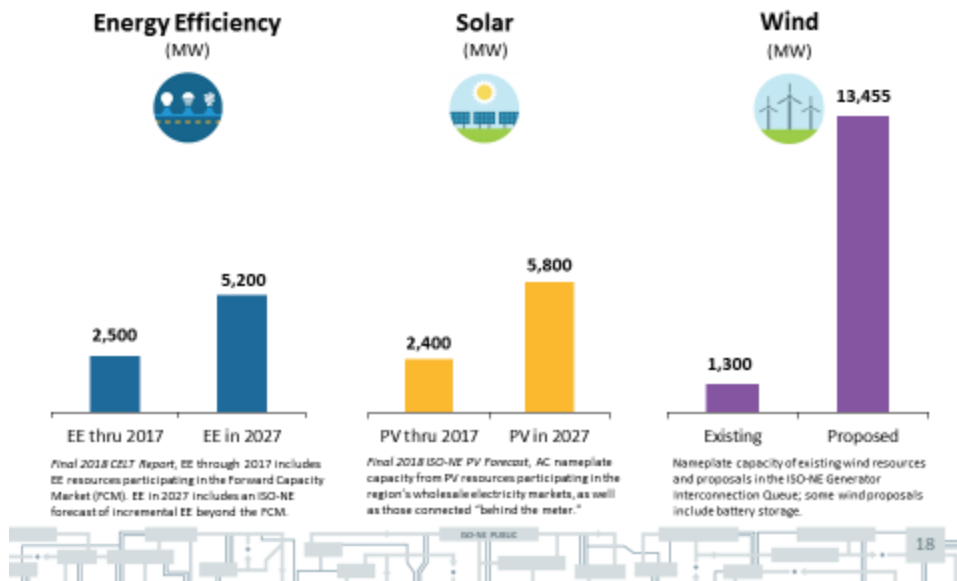


The region has been losing oil, coal, and nuclear plants, but proposals to build new generators are booming. The ISO's interconnection queue is at a high we've rarely seen—more than 150 projects totaling more than 20,000 megawatts are seeking to build in New England. Wind farms make up more than 60% of the new proposed megawatts. More than half of the megawatts from new wind farms would be offshore.

The ISO has made extensive operational and market changes to prepare for the growing levels of wind, solar, and battery storage, and several New England states are offering significant incentives for these clean-energy resources. The result is sizeable growth in proposals to connect these projects to the high-voltage power grid. The utility-scale solar projects counted here are in addition to the vast majority of New England's solar installations, which are connected at the distribution level at homes and businesses.

This is a robust portfolio of project proposals, but many of these projects will not get built. Historically, we've seen a 70% attrition rate for the megawatts proposed in the queue.

## Energy-Efficiency and Renewable Resources Are Trending Up in New England



The ISO operates the regional high-voltage power system, but these energy-efficiency and PV resources on local distribution systems are already changing the shape of demand for power from the regional grid. In order to understand their long-term impacts, the ISO developed innovative 10-year forecasts of the growth of behind-the-meter energy-efficiency measures and solar arrays. Energy efficiency in particular is dampening demand growth in New England, so much so that we're projecting a slight decline in both energy usage and peak demand over the next 10 years. While we expect demand to continue declining over the next 10 years, the ISO is monitoring the states' efforts to decarbonize the transportation and heating sectors. Eventually economy-wide decarbonization will increase demand for electricity but we don't expect electric vehicles or heat pumps to have a substantial effect on regional demand in the near future.



## New Energy Storage Technologies Are Coming On Line

- **20 MW** of grid-scale battery storage projects have come on line since late 2015
- Proposals for **more than 1,300 MW** of grid-scale, stand-alone energy storage projects by 2022
- A first: **20 MW** home solar and battery storage cleared FCA #13 for 2022-2023
- Meanwhile, New England has operated two large pumped-storage facilities for 40 years
  - They can supply **1,800 MW** of power in 10 minutes, for up to 7 hours

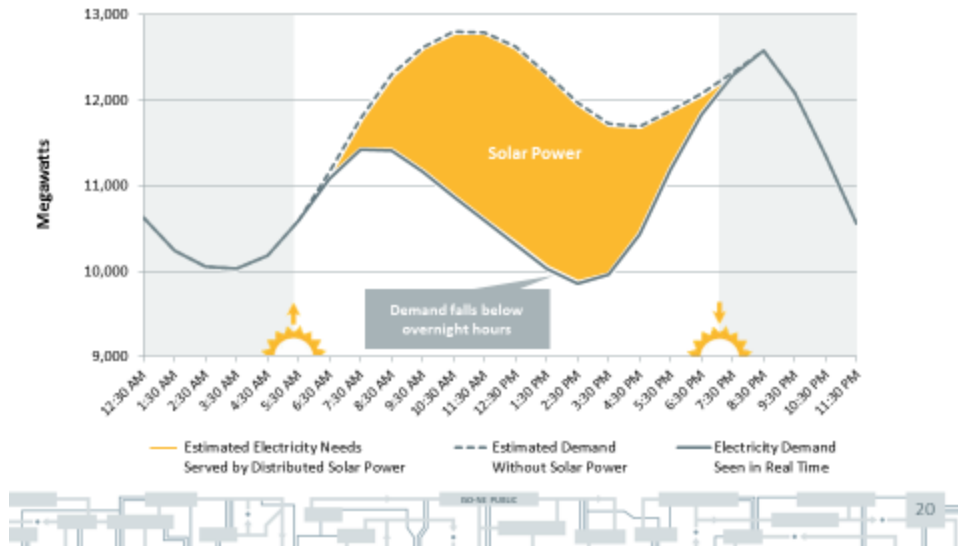


Currently, the region has about 20 megawatts of grid-scale battery storage capacity but by 2022, proposed new projects could add more than 1,300 megawatts.

To a degree, energy storage technologies will help address some of the region's energy supply constraints. They can provide fast energy and shave peak demand. However, their current technology is useful for emergencies that last for several hours, but can't help with fuel supply shortfalls that last for days or weeks. Natural gas pipeline constraints and the variability of renewable resources create a need for "seasonal" energy storage that can provide energy security for extended periods. For the foreseeable future, seasonal storage will be provided by oil and LNG in storage tanks, as well as imports from resources with onsite energy, such as hydro.

## Historic Dip in Midday Demand with Record-High Solar Power Output on April 21, 2018

*At 1:30 p.m., behind-the-meter solar reduced grid demand by more than 2,300 MW*

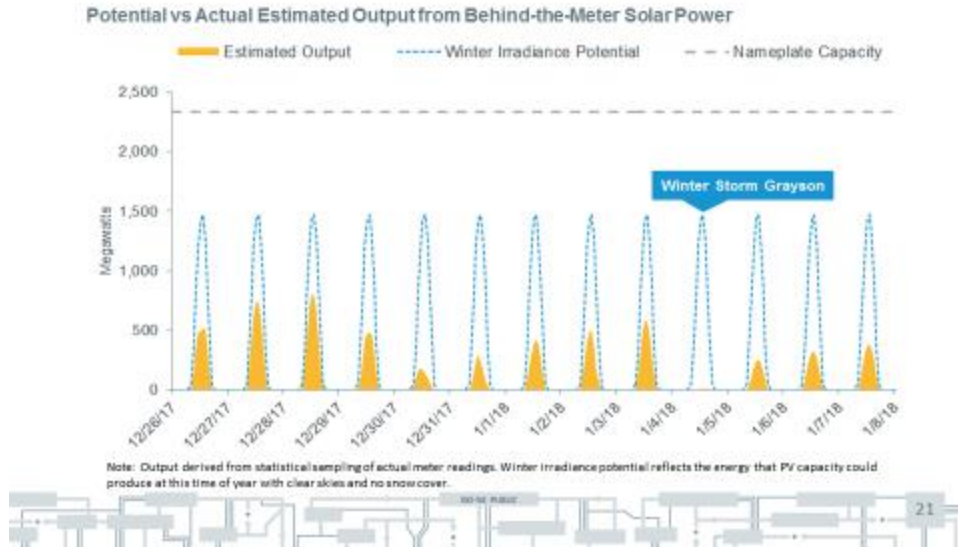


Almost 160,000 small solar arrays are providing power directly to homes and businesses around New England. Accurately forecasting solar output requires accurate weather forecasts for the entire six-state region. The forecasts must account for many factors that affect solar output, including variations in local humidity and temperature. That has become an increasingly complex part of our load forecasters' job.

[Saturday, April 21](#) last year is a good example of how the growth of solar will make system operations more complex. For the first time ever, New England residents used more electricity from the regional power grid while they were sleeping than they drew from the grid in the middle of the afternoon. Of course, they were still using electricity—but they were getting it from the solar panels on their roofs on a sunny day.

## The Variability of Solar PV Was On Display Last Winter

*During the cold spell, clouds and snow cover reduced output from regional solar power, adding to grid demand*

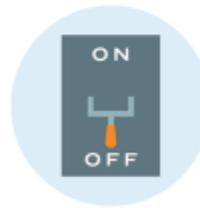


On the other hand, clouds and snow cover prevented solar panels from reaching their seasonal potential during last year's historic 16-day cold spell, particularly during Winter Storm Grayson. In time, energy storage systems will be able to help manage through day-to-day variations but may not be able to charge up again to help when bad weather lasts for multiple days.

## FCA #13 Attracted & Retained Resources Needed to Ensure Resource Adequacy in 2022-2023

*Featured first substitution auction for sponsored policy resources*

- Auction concluded with sufficient capacity to meet demand in 2022-2023 & lowest clearing price in 6 years due to surplus capacity. Other highlights:
  - 783 MW of **new generation** in the primary auction
  - 4,040 MW of **energy-efficiency and demand-reduction measures**, including 654 MW of new EE & DR resources
  - 20 MW from **home solar & battery storage**, a first in the US
- First substitution auction for state-sponsored resources
  - **Vineyard Wind**, a new offshore project, will assume a **54 MW obligation** from an existing resource that will retire in 2022-2023



New England's Forward Capacity Market has provided an essential revenue stream to attract and retain all types of resources. Capacity revenues will become increasingly essential to maintaining an adequate resource base as low-cost renewables and low-cost natural gas bring energy market revenues down.

The 13<sup>th</sup> capacity auction was conducted earlier this month. It featured the first substitution auction developed to accommodate state-sponsored resources while preserving competitive prices for all other resources.

The auction concluded at the lowest price in six years, with surplus capacity to be available in 2022-2023. It drew high levels of new resources, including power plants, wind, and solar. The auction procured more than 4,000 megawatts of energy efficiency and demand-response resources, representing more than 10 percent of the total capacity that cleared.

The auction also cleared SunRun's home solar and battery aggregation project, the first in the nation to receive a capacity market commitment from a grid operator. And Vineyard Wind, an offshore wind project with a state-sponsored contract, participated in FCA 13 and was able to acquire a 54-megawatt capacity obligation from a retiring resource in the substitution auction.

## ENERGY SECURITY RISK



## Several Industry Trends Make Energy Security a Growing Concern in New England



Significant retirements of large, non-gas-fired generation (coal, oil, nuclear)



Increase in natural-gas-fired generation relying on "just-in-time" fuel delivery



The shift to more resources susceptible to constraints on energy production (emerging hybrid grid)



Challenges with fuel-delivery logistics during cold weather conditions



Limited dual-fuel storage and tightening emission limits on (most) oil-fired generation



Last year we told you that winter energy security is the number-one risk to power system reliability, and that hasn't changed.

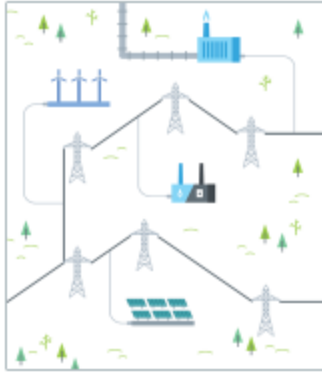
We've already discussed some of the factors that are making energy security such a concern—most prominently, retirements of resources with stored fuels and the shift to resources that are dependent on wind and sun, or generators that depend on just-in-time fuel deliveries.

Fuel delivery logistics are always a concern in winter, particularly when natural gas pipelines are running full to meet heating needs. We've seen deliveries of other fuels, particularly oil and LNG, hampered by winter conditions.

Some natural-gas-fired generators can burn oil stored onsite when they can't get natural gas or it's too expensive. However, their oil tanks only have a few days' worth of fuel, and replenishing their supply is subject to the same logistical challenges. Further, emissions regulations are growing stricter, which could limit how often generators can run on oil.

Fuel constraints could be addressed by more energy infrastructure in New England, but natural gas pipeline capacity is not the only solution, as we've pointed out before. Solutions could include investment in renewable resources and the related transmission infrastructure, increased imports and the related transmission, more oil and LNG storage, and generator contracts for adequate fuel.

## Winter Energy Security Is an *Energy Supply* Problem, Not a *Capacity* Shortfall Problem



- New England has sufficient *capacity* to meet highest peak demand
- Risk is insufficient fuel--natural gas, oil, wind, water, sun--for that *capacity* to generate all the *energy* needed, esp. in winter
- As hybrid grid develops, the risk could occur year-round with more just-in-time fuel and weather-dependent resources
- New market design will compensate resources that maintain energy inventory to protect the system against:
  - **Extended cold** weather conditions
  - Loss of **large energy production facilities**
  - Unexpected **re-supply challenges**



As the latest capacity auction results show, New England has enough capacity. The concern is whether there will be enough fuel for all those power plants to generate electricity, whether their fuel is natural gas, oil, wind, or sun.

As the transition to a hybrid grid continues, eventually nearly all resources in the fleet will have some energy limitations. Some generators will have limited inventories of oil or LNG, some will depend on “just-in time” natural gas delivered by pipeline, and wind and solar will not have control of their “fuel”. As this contingent of energy-limited resources grows, the region’s energy-security risks could become a year-round concern.

The ISO can’t address energy infrastructure constraints directly, so we will use the tools available to us to ensure continued reliability. We will adapt the way we operate the power grid and develop market rules to put a price on energy constraints. The ISO is developing an innovative multi-day-ahead energy market that will incentivize resources to have fuel when needed, whether it’s tomorrow or next week. Demand reductions will also be compensated.

## Nuclear Power Plants in New England

- In 1990, NE had 8 nuclear power stations
- They made up 25% of capacity
- Today 3 stations make up 13% of capacity...
- ...but generate 30% of the electricity
- Reliable, no emissions, low-cost energy
- But they are at risk

Plant Name	Location	Capacity (MW)	Shut down
Yankee Rowe	MA	185	1991
Millstone 1	CT	652	1995
CT Yankee	CT	619	1996
Maine Yankee	ME	870	1996
Vermont Yankee	VT	604	2014
Pilgrim	MA	677	May 31 2019
Millstone 2 & 3	CT	2,102	3,347 MW
Seabrook	NH	1,245	
<b>Total</b>	<b>New England</b>	<b>6,954</b>	



Nuclear power plants provide reliable, low-cost, carbon-free electricity. But they are financially challenged across the US, not just in New England, by low wholesale energy market prices. The loss of these resources, which provide a third of New England's power, will set the states' clean-energy goals back, put upward pressure on prices, and worsen the region's energy-security risks. Energy market enhancements and performance incentives in the capacity market will likely improve revenues for the nuclear units. However, they have other attributes, such as carbon-free energy, that are not valued in the wholesale market. The states could place a significant price on carbon that would flow through the wholesale markets, but to date they have not done so.

## CHALLENGES TO COMPETITIVE MARKETS



### Why Competitive Markets?

*New England restructured its power industry and launched competitive wholesale electricity markets in the late 1990s based on several key principles*



**Competition** among wholesale electricity buyers and sellers yield prices that accurately reflect a resource's true operating costs



**Efficiency and transparency** spur innovation and investment in new technologies and power resources to ensure power system reliability



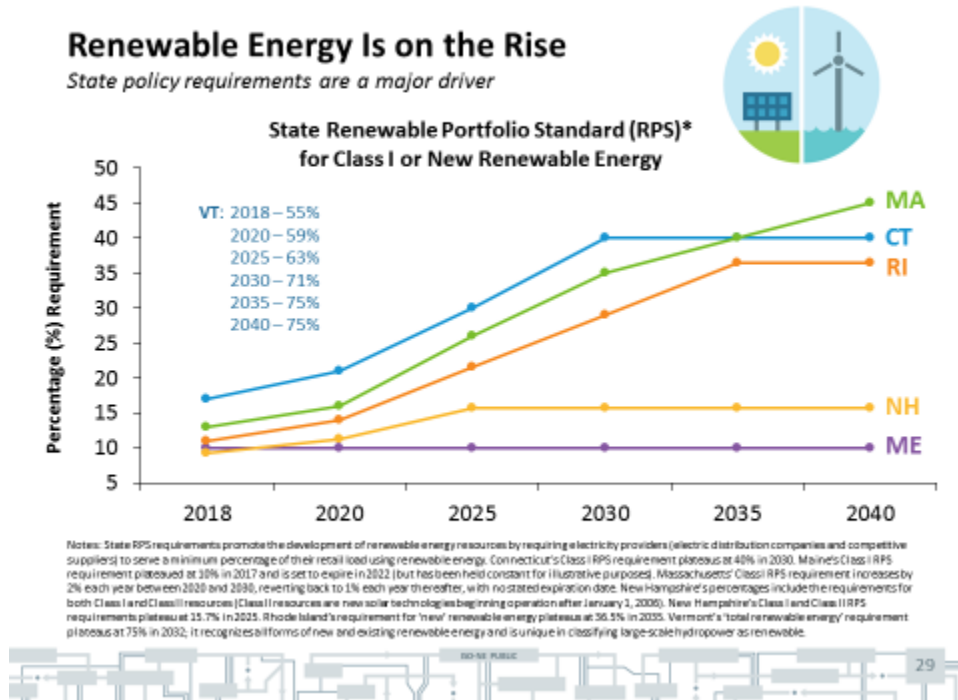
**Investment risk** associated with developing new power resources shifts from consumers to private investors



Competition, cost-effective prices, resource adequacy, innovation, and removing ratepayer risks were the original goals driving the creation of the competitive markets in the 1990s. Twenty years on, the markets have demonstrated that competition to provide electricity is the most efficient way to ensure that there are enough resources to meet demand at cost-effective prices. Competition also delivers incentives for efficiency and innovation, while insulating ratepayers from poor



investment decisions.



However, the original goals—and therefore the market design—did not include favoring one resource type over another. But now that is the prime objective for many policymakers.

Massachusetts, Rhode Island, and Connecticut have legislative mandates to achieve ambitious greenhouse gas reductions and are seeking long-term contracts for more than 5,600 megawatts of hydro imports, wind, and battery storage.

These state-sponsored contracts provide a guaranteed source of revenue to these renewable resources, which is often the boost they need to reach financial viability. However, resources with guaranteed revenues can distort competition and artificially suppress prices in the wholesale markets. That would put resources without sponsored contracts at a financial disadvantage. Establishing a realistic price on carbon would be an elegant and simpler way to achieve clean-energy goals through the markets without distorting competition.

## SOLUTIONS



### ISO New England Is Focused on Developing Solutions to Today's Grid Challenges

#### Addressing Energy Security

Innovating to incentivize the region's generators to have enough fuel to produce electricity when needed most, particularly in winter



#### Preparing for the Hybrid Grid

Accommodating the states' clean energy goals, planning for more renewables, and maintaining competitively based capacity pricing for all resources



ISO New England has the unique responsibility to identify and address the risks to the reliable operation of the power system and to ensure that the markets can provide cost-effective outcomes for the region. From its inception in 1997 to today, the ISO's approach has always been the same: To solve the challenges that emerge as the industry evolves.

Market rules are being developed that will help ensure energy security. These changes will reward the energy-secure attributes we need to maintain a reliable power system as the industry transitions

away from resources with onsite fuel and becomes more dependent on variable renewable energy, electric storage, and natural gas.

Generators will be compensated for helping to protect against the challenges of extended cold weather, when fuel deliveries could be delayed, or at other times when energy is limited. If it's clear we have more than enough fuel for tomorrow but will run short before the end of the week, resources that can save energy for the end of the week will be properly compensated. New England is the first grid operator in the nation to bring forward a market design that will directly compensate energy security attributes through competitive markets.

Importantly, this market design would be fuel neutral and technology neutral, allowing both conventional generators and advanced technologies like batteries to provide these services.

The ISO has adapted market rules and how we operate the power system to level the playing field for wind and solar resources and advanced storage devices. We've developed innovative wind and solar forecasts that not only help us operate the grid more reliably, but also help those resources operate up to their potential each day. We'll continue to innovate to integrate high levels of renewable and distributed resources, while upholding the markets' ability to attract investment in existing and new resources needed to run the grid reliably.

## CONCLUSIONS





- New England's power system: Strong, but changing rapidly to a hybrid grid with conventional, renewable, and distributed resources
- System is vulnerable to:
  - Growing energy security risk: The hybrid grid will have less stored fuel and depend more on just-in-time fuel deliveries, and weather. Loss of nuclear plants will intensify the risk to reliability, and put upward pressure on emissions and prices
  - Changing goals for competitive markets: Adapting markets to maintain a reliable resource base and cost-effective pricing while realizing state clean energy goals will be complex



The energy industry is experiencing change at a breathtaking pace in technology, economics, and policies. Fortunately, New England's power system is positioned to benefit from these changes. We have a strong transmission system, enough resources to meet peak demand, competitive wholesale markets, a talented crew and supporting staff operating the power grid around-the-clock, and a collaborative decision-making process.

The foundation is strong, but the region's resource mix is shifting toward a fleet with less onsite fuel and more resources subject to natural gas availability or changes in wind and sun. Nuclear power plant retirements will worsen the region's energy security risks and its emissions profile.

The ISO recognizes the states' policy imperative to move the region to a low-carbon future, but the policy choices are leading to complexities in market design as well as grid operations, thereby requiring adjustments to both.



- ISO New England employs the tools available to it to address the risks posed by a grid dominated by limited energy resources:
  - Competitive market design (e.g., CASPR and multi-day-ahead market)
  - Operational adjustments (e.g., coordination with natural gas industry)
- The ISO is actively taking renewable and distributed resources into account in planning, operations, and markets
- There are still challenges to be addressed
- The region's capacity for innovation and collaboration will be essential during the rapid transformation of the power system



The ISO sees trends on the horizon and prepares for them, whether it's growing levels of renewable and distributed resources, growing energy security risks, or growing challenges to accurate pricing in the capacity market.

The strong foundation we are standing on as we address these challenges is the long history of regional collaboration in New England. Market participants, consumer advocates, state regulators and policymakers, and the ISO have worked together continuously since the region started this industry restructuring journey 22 years ago. The history of New England's power system for the last two decades is a history of working together to adapt and evolve as the industry has changed.

This collaboration will be the key to successfully addressing the next phase of risks and challenges and maintaining a power system that continues to deliver reliable, clean, and cost-effective electricity to the region's residents and businesses.

Thanks again for dialing in, and I look forward to your questions.

# Questions



## APPENDIX: 2018 DATA RECAP



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