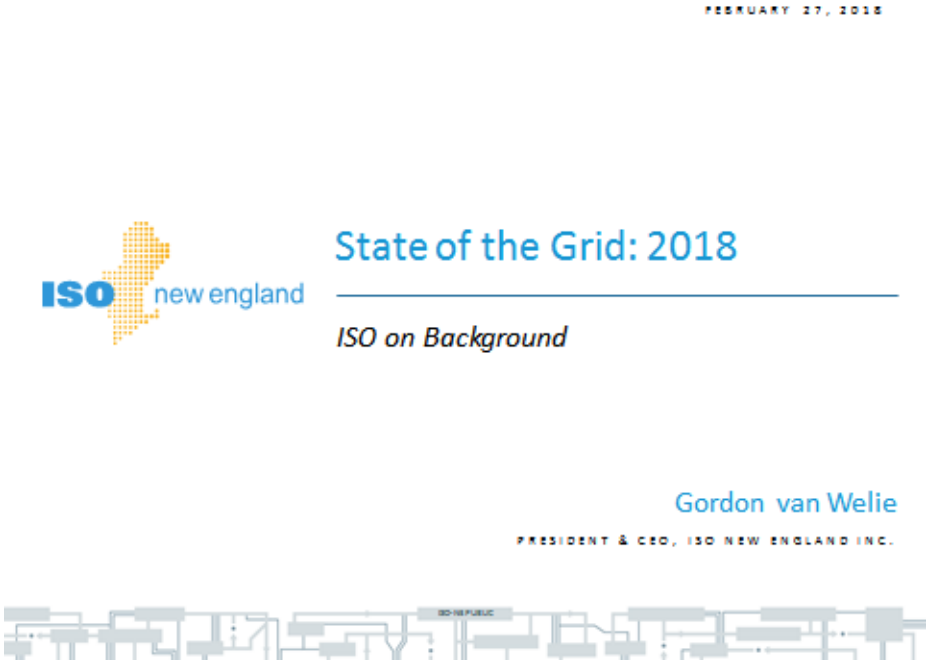
ISO New England State of the Grid: 2018
Remarks and slides
February 27, 2018



Slide 2—About the *ISO on Background* Series

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 11th "ISO on Background" session.

ISO New England offers these media briefings periodically to provide an in-depth look at the trends affecting New England's electricity industry. We call these sessions *ISO on Background,* but the content is **on the record**, and may be quoted and attributed to the speaker.

After the briefing concludes, the presentation and remarks will be posted in the press release section on the ISO New England website.

Slide 3—Agenda

Agenda

- 10:30 to 10:35 a.m. **Welcome**
  Ellen Foley, director, Corporate, Media, and Web Communications
- 10:35 to 11:05 a.m. **State of the Grid: 2018**
  Gordon van Welie, president and CEO
- 11:05 to 11:30 a.m. **Question-and-Answer Session**

Today's briefing will last about 40 minutes, with time at the end for questions from the media.

Slide 4—Overview of Presentation

Overview of State of the Grid: 2018

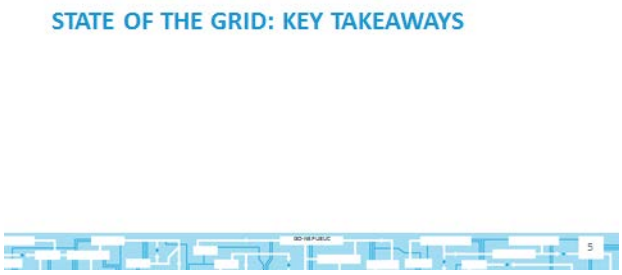
- New England's Power System Today
- The Changing Grid
- Fuel Security
  - 2017/2018 Arctic Cold Spell
  - *Operational Fuel-Security Analysis*
- Setting the Stage for the Future
- Conclusions
- Q & A
- Appendix: Additional Data

During today's briefing, Gordon van Welie will update you on the state of the grid today and look ahead to New England's future power system. He'll outline the challenges the ISO's system operators faced during the cold spell earlier this year. These challenges underscored the concerns examined in the *Operational Fuel-Security Analysis* released last month. The presentation will also touch on some of the ISO's work to prepare for the future grid.

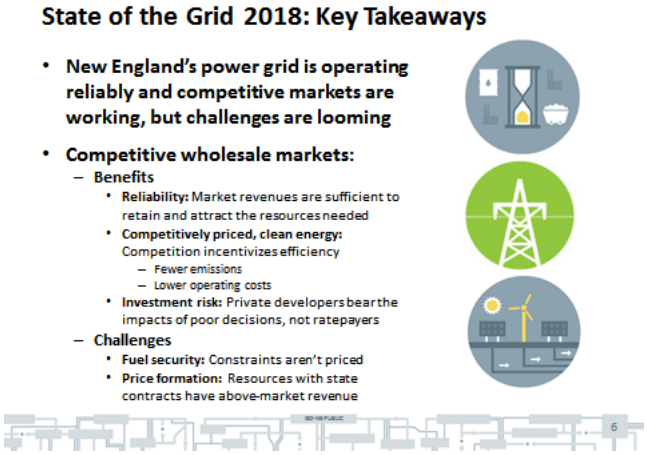
Finally, the posted presentation will include an appendix with more data on New England's power system landscape in 2018.

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

Slide 5—Title Slide—Key Takeaways



Slide 6—Key Takeaways



Thank you, Ellen, and thanks to all of you for calling in today. A lot has happened since our last briefing, and 2018 looks to be another busy year.

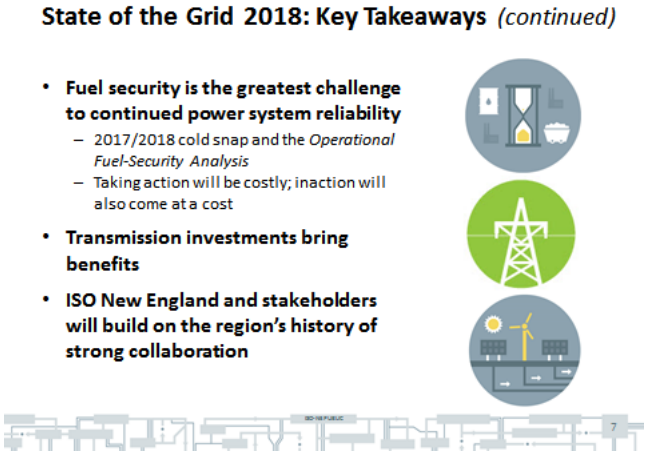
The state of New England's power grid is this: The power system continues to operate reliably and competitive markets are working, but significant challenges are on the horizon.

First, the power system infrastructure is solid. There are enough power plants and demand-side resources on the system to meet peak consumer demand, and extensive transmission system upgrades are bolstering reliability. However, there are challenges to the timely delivery of the fuels needed to produce electricity. This growing fuel security risk is making reliable operations more

tenuous.

The wholesale electricity markets are providing competitive prices, spurring investment in new resources, and facilitating the shift to cleaner energy and lower emissions. At the same time, initiatives by the New England states to develop more renewables and clean-energy resources are posing challenges to competitive pricing in the markets, which could ultimately weaken resource adequacy—that is, the assurance that the region has enough resources to meet demand. Further, the markets don't always show the true costs of inadequate fuel security.

Slide 7—Key Takeaways, continued

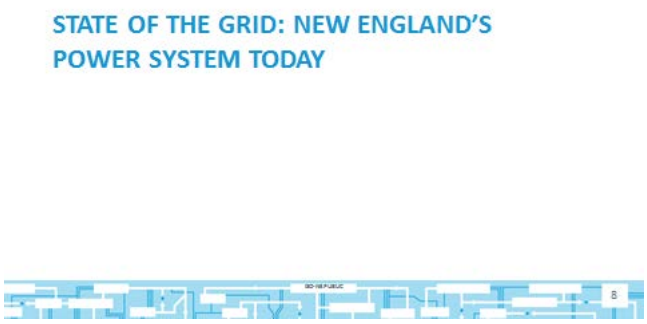


Because the region's fuel-security risks pose a challenge to continued power system reliability, we'll take a closer look at the ISO's year-long study on fuel security as well as the extended period of cold weather at the end of December and beginning of January. That cold spell underscored some of the very real challenges to reliability posed by fuel-security risks.

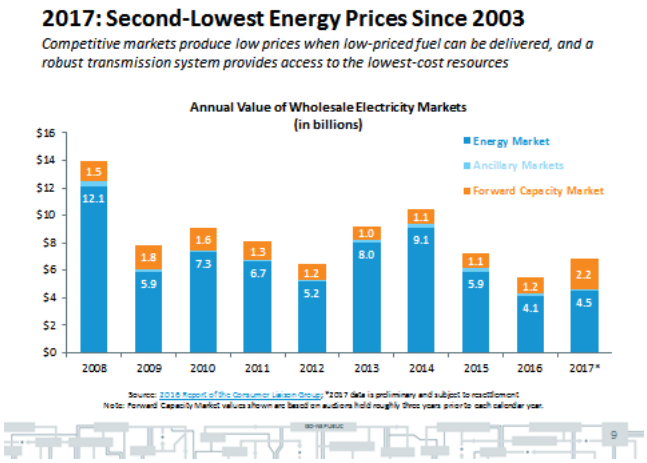
I'll also note the benefits of the ISO's collaborative transmission planning process, including a robust transmission system that has improved reliability, lowered congestion costs, and set the stage for new resources to compete.

Along the way, I'll point out some of the work the ISO has accomplished with industry stakeholders and the states to address challenges and to keep improving on the critical services we provide to New England's 14 million residents.

Slide 8—Title Slide—State of the Grid: New England's Power System Today

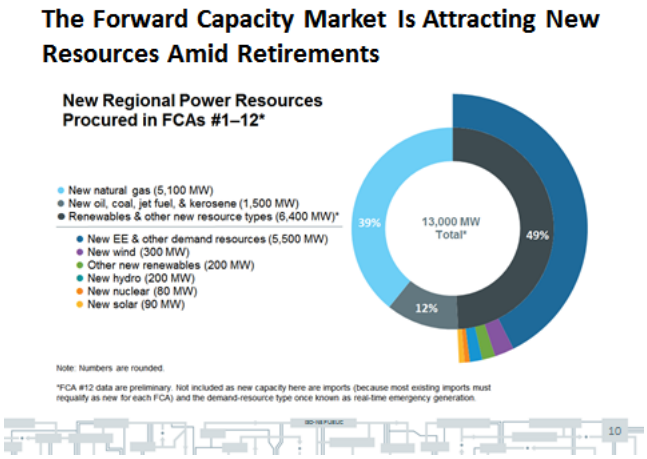


Slide 9—2017: Second-Lowest Wholesale Prices Since 2003



In an efficient wholesale market, low fuel prices will translate into low wholesale power prices. Natural gas is the main fuel used to generate electricity in New England and in 2017, the price of natural gas was very low. And when the natural gas delivery system is not constrained, New England's fleet of newer, highly efficient natural gas generators can produce electricity at lower prices. As a result, at $4.5 billion, the preliminary value of New England's daily electricity markets in 2017 was the second-lowest since the current markets were launched in 2003. The lowest energy market value was recorded the year before, in 2016. Low natural gas prices were possible due to mild weather for most of the year, which dampened overall demand for both natural gas and electricity. When natural gas demand is low, there's room in the region's natural gas pipelines for low-cost shale gas to flow into New England.

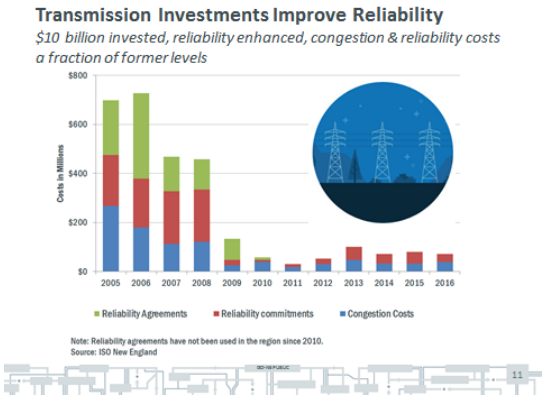
Slide 10—The Forward Capacity Market Is Attracting New Resources Amid Retirements



In addition to the daily market where electricity is bought and sold, the ISO operates the Forward Capacity Market where resources compete to provide the capacity to produce electricity three years in the future. The most recent capacity auction, held earlier this month, concluded at the lowest price in five years. Capacity prices in previous auctions were higher after a wave of retirements ended in a slight capacity shortfall in 2014. But those higher prices attracted new resource investments to New England. The robust competition among existing and new resources in recent auctions is bringing prices back down, as you can see on Slide 45 in the Appendix. Over time, capacity prices can be expected to rise as renewable resources lower energy market revenues.

The mix of new resources that will receive capacity revenues includes natural gas, wind, and solar generators, and energy-efficiency measures. Natural gas and energy efficiency make up the biggest portion of new resources.

Slide 11—Transmission Investments Improve Reliability



Since 2001, the ISO has led a collaborative, regional transmission planning process that identifies

weaknesses and bottlenecks on the high-voltage transmission grid, and then develops the most cost-effective solutions.

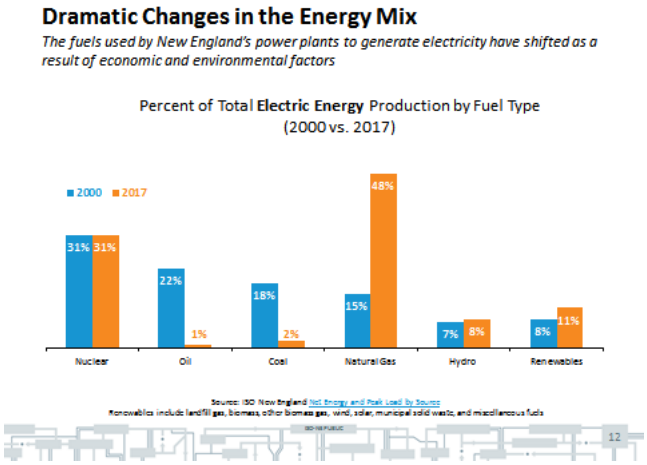
As a result, New England has invested $10 billion to complete about 750 transmission projects in all six states. These upgrades were necessary to shore up the system's reliability, but they have benefits beyond reliability. They also enable electricity to flow freely around the region so the lowest-cost resources can be used to meet demand, no matter where they're located.

These transmission investments enabled congestion and other reliability costs to shrink from nearly $700 million in 2005 to about $57 million last year.

Generally, the lowest-cost resources are more efficient and cleaner than some of the older, less-efficient generators that have retired in this more competitive landscape. As a result, emissions have dropped significantly, as you can see on slide 47 in the appendix.

New England's transmission investments bring less risk of blackouts, lower wholesale energy costs, and less air pollution. They also provide the foundation for a greener and more flexible power system.

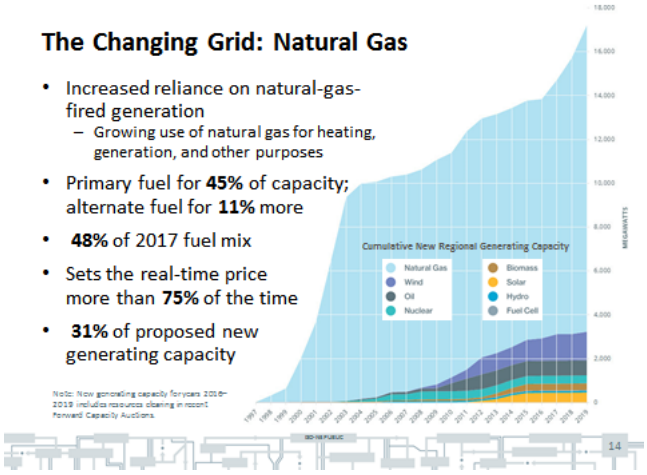
Slide 12—Dramatic Changes in the Energy Mix



With the competitive markets, the ISO dispatches the lowest-cost resources first to meet demand. Because natural gas is typically less expensive than coal or oil, natural-gas power plants are used most often to generate electricity. Last year, 48% of the electricity generated by New England power plants came from natural gas. If imported electricity is added to the mix, natural gas generated 41% of the energy used here last year.

Slide 13—Title Slide—State of the Grid: The Changing Grid

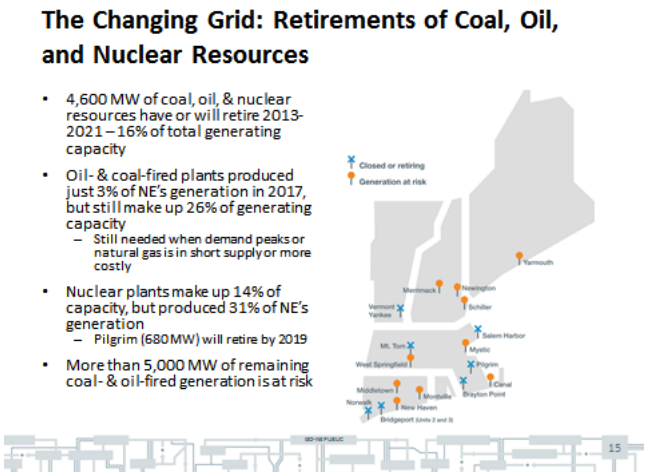
Slide 14—The Changing Grid: Natural Gas



Immense growth in new natural-gas power plants has been the biggest factor in the evolution of New England's power grid to date. Natural gas is the primary or secondary fuel for more than half of the existing power plant fleet, and almost a third of the proposed new capacity would use natural gas.

Natural gas demand continues to grow, for both heating and power generation, but the infrastructure that delivers natural gas to New England has only expanded incrementally. Recent pipeline expansion projects were built specifically for natural gas utilities to serve their heating customers.

Slide 15—The Changing Grid: Retirements of Coal, Oil, and Nuclear Resources

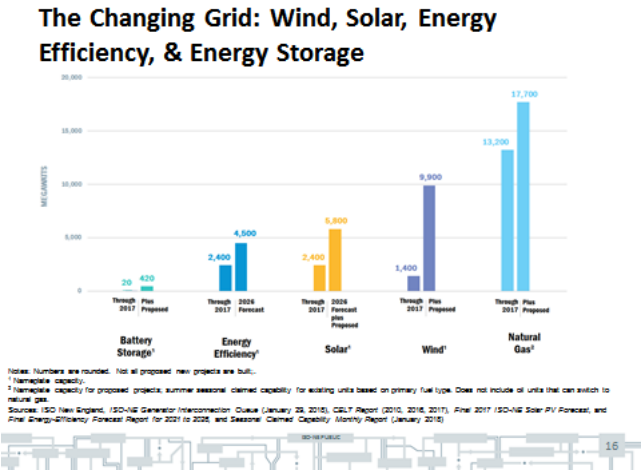


Power plants fueled by coal and oil, as well as some nuclear stations, are being edged out by low-priced natural gas. Between 2013 and 2021, a full 16% of New England's non-gas generating capacity has retired or will retire. The retiring resources include two of the region's four nuclear stations, as well as coal and oil generators.

More than 5,000 megawatts of the remaining coal- and oil-fired generators are at risk of retirement because of low revenues in the energy markets as well as environmental restrictions. But these are the resources we rely on in winter.

As more oil, coal and nuclear plants seek to retire in the coming years, keeping the lights on could become even more tenuous. To avoid greater reliability risks, we soon may need to make sure replacement energy from new resources will be online before non-gas resources can be allowed to retire.

Slide 16—The Changing Grid: Wind, Solar, Energy Efficiency, & Energy Storage

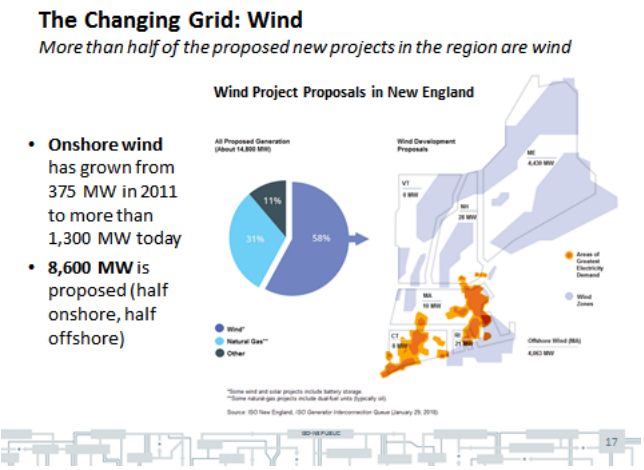


Wind, sun, energy efficiency, and energy storage are rapidly expanding on the New England grid. Their growth is driven by federal and state incentives, as well as advances in technology resulting in falling development costs. The opportunity to compete and earn money in ISO New England's wholesale power markets is also a factor.

This chart shows where we stand today with each of those resource types, and illustrates their potential growth. Because the attrition rate of new projects in the ISO interconnection queue is nearly 70% of all the megawatts proposed, many of these projects may not get built. For some perspective, the chart also shows the region's natural-gas capacity and projected growth.

All these renewable and clean-energy resources are growing rapidly, but it will be many years before New England can rely on these sources for all its power needs.

Slide 17—The Changing Grid: Wind

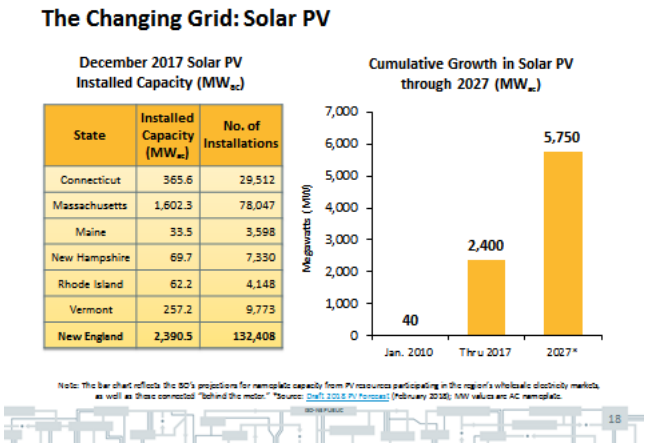


Wind energy resources have grown significantly, from 375 megawatts in 2011 to more than 1,300 megawatts today. That's due in large part to state and federal incentives. About 8,600 megawatts of new wind is proposed for New England, which for the first time is more than the proposed natural gas generation. However, half of the wind projects would be sited in remote areas of northern New England. Tapping into this onshore wind would require a sizeable investment in transmission lines to carry their energy to load centers in southern New England.

The ISO recently developed new rules to allow clusters of these onshore wind proposals to be studied together to potentially share in the transmission costs. Offshore wind projects would be located closer to population centers and need less transmission, but are more costly to build.

To aid wind's integration into markets and operations, the ISO also developed a regional wind forecast and has changed market rules.

Slide 18—The Changing Grid: Solar PV

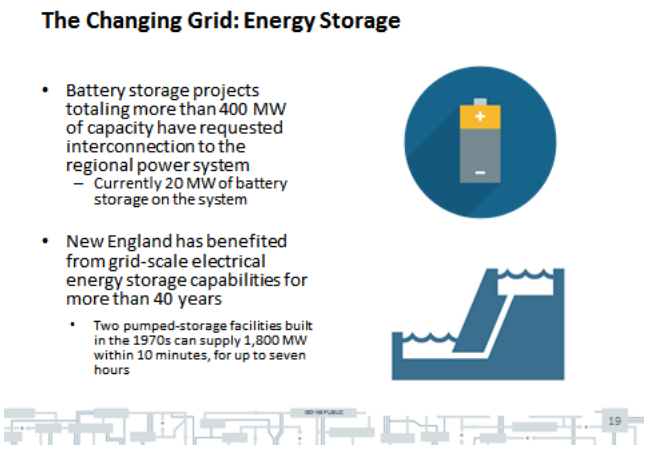


Solar PV has exploded in New England, largely because of state incentives. Solar has grown from just 250 megawatts to 2,400 megawatts in just five years. Almost all of that comes from more than 130,000 small installations on homes or businesses. They're on the low-voltage distribution system, which the ISO does not operate, and this can create challenges in operating the high-voltage transmission system. In the aggregate, all of these tiny facilities can cause deep dips in consumer demand on sunny days, with steep increases in demand as the sun goes down. Slide 49 in the appendix illustrates that effect.

To address PV's growing impacts on demand, the ISO has participated in national and regional studies to enhance daily and hourly forecasting of wind and solar output. The ISO has also developed a long-term forecast of PV growth. This year's preliminary forecast projects New England

will have more than 5,700 megawatts of behind-the-meter solar by 2027.

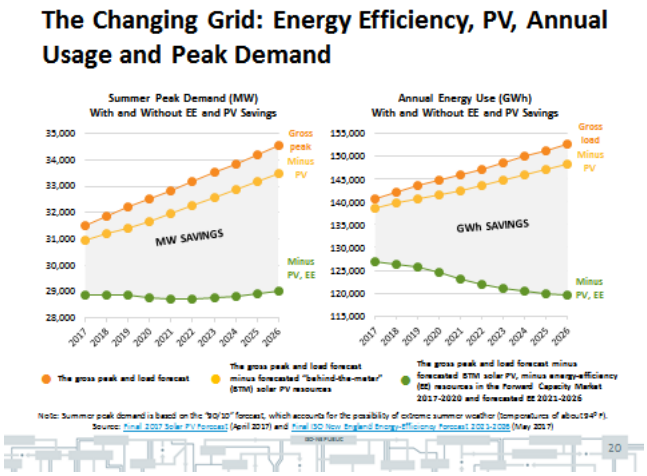
Slide 19—The Changing Grid: Energy Storage



Expanding **energy storage** on the grid is a priority for several states. Currently, the New England power system has about 20 megawatts of battery storage, with another 400 megawatts proposed. Advanced energy storage will be a key to balancing the variable output of renewable resources. Current battery technology can provide a few hours of electricity before recharging is required. However, New England also needs more large-scale storage that can help the system ride through longer periods, such as an entire winter when natural gas or oil is in short supply, or after more non-gas power plants have retired. Today's advanced storage technologies can't provide the scale or duration of energy needed to cover long-term energy shortfalls. The region's pumped hydroelectric storage facilities are capable of large energy injections for up to seven hours. The ISO has worked for years to integrate advanced storage technologies, with their unique characteristics, into operations and markets. Batteries and other advanced storage resources have been able to participate in the ISO's regulation market for several years. By the end of this year, they will also be able to compete in the daily energy markets as dispatchable resources, just like conventional generators.

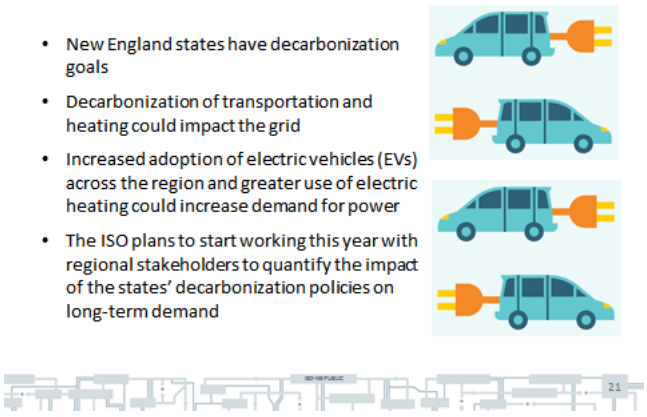
Still, for the foreseeable future, New England will be dependent on stored and imported fossil fuels and imported electrical energy, which includes energy from hydro generators in Canada, to ensure system reliability when gas pipelines are constrained.

Slide 20—The Changing Grid: Energy Efficiency, PV, Annual Usage and Peak Demand



The New England states are national leaders in **energy efficiency, or EE**. Four are ranked in the top 10, including Massachusetts at number one. The states have invested nearly a billion dollars a year in EE, and the ISO's EE forecast estimates they'll spend another $7.2 billion by 2026. The ISO's 2017 PV and EE forecasts show that, because of these resources, peak demand is growing, but slightly, and total annual electricity consumption is projected to drop.

Slide 21—The Changing Grid: Decarbonization



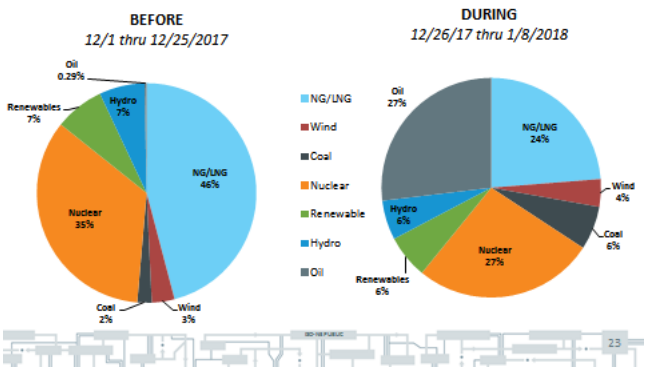
Some New England states are pursuing policies to reduce carbon emissions from other sectors, which has the potential to reverse declining demand for electricity. As the use of fossil fuels for transportation and heating declines, more electricity will be needed to keep all those electric vehicles charged and heat pumps going. The ISO plans to begin discussions with its stakeholders this year about the potential future impacts of economy-wide decarbonization in New England.

Slide 22—Title Slide—State of the Grid: Fuel Security—2017/2018 Arctic Cold Spell

STATE OF THE GRID: FUEL SECURITY – 2017/2018 ARCTIC COLD SPELL

Slide 23—Shifting Generation Mix Before and During the Two-Week Outbreak of Arctic Cold

Shifting Fuel Mix Before and During the Two-Week Outbreak of Arctic Cold



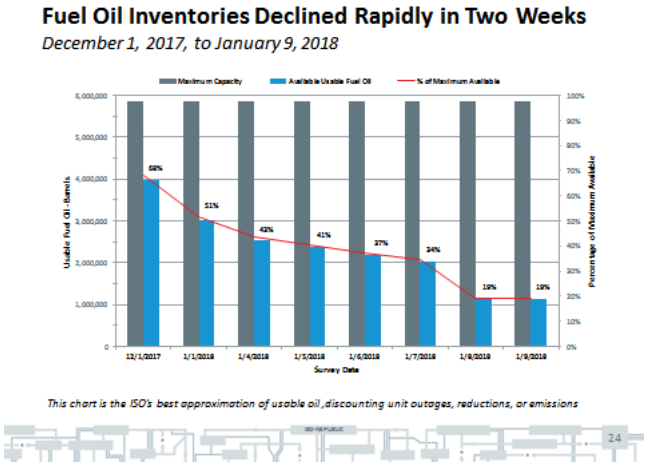
The last week of December and the first week of January were among the coldest stretches of extreme winter weather in New England in decades. The extended cold spell caused demand for natural gas to spike, raising prices so dramatically that natural-gas generators were more expensive to run than the older coal and oil plants. The region's wholesale markets, which select the lowest-cost resources, turned to these aging generators to meet the demand for power. From December 1 until the cold spell began, oil and coal plants contributed just 2% of the energy generated by New England power plants. During the cold spell, from December 26 through January 8, they contributed a full third of the energy. Natural gas dropped from generating almost half the energy to just 24% during the cold stretch.

This illustrates something I said earlier—that coal and oil power plants rarely run most of the year, but they are still needed during extreme weather events. Nuclear power is also a key contributor.

The ISO's system operators did a superb job of operating the power system through the cold spell.

As a result, some observers have suggested that the absence of emergencies shows that the power system is fine, it can handle extreme cold weather, and new energy infrastructure is not needed. This view misses several significant factors. First, generators that use coal and oil are retiring in greater numbers. In the future, many of the resources we relied on this winter may not be around when extreme weather limits natural gas availability. Liquefied natural gas, or LNG, was a key component of the fuel used by natural gas plants this time, but LNG is a global commodity and may only be available at very high prices. As it happens, LNG cargoes were drawn to New England during the cold spell because the prices in New England were the highest in the world.

Slide 24—Fuel Oil Inventories Declined Rapidly in Two Weeks

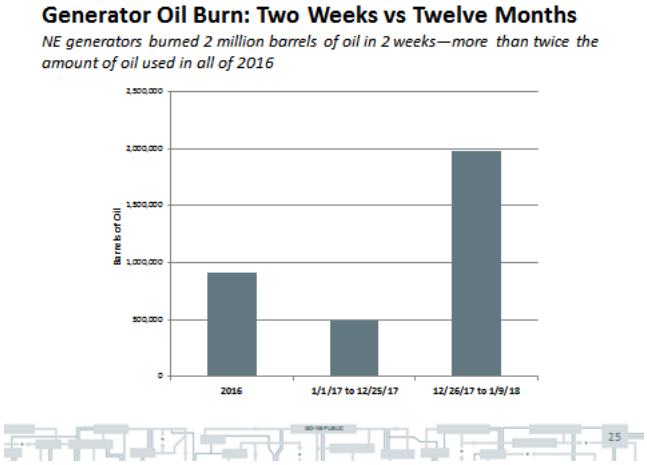


Because oil plants were used heavily throughout the cold spell, their oil inventories declined rapidly, as you can see from the red line in this chart. Toward the end, several large oil-fired generators had just enough fuel for a few more days of operation, and deliveries of more oil were several days away. Fortunately, the cold weather broke before they ran out of fuel.

This highlights the logistics of replenishing oil inventories in winter. New England imports almost all its fuel, so delivery logistics are a fundamental factor in reliable operations during winter.

Winter storms can delay deliveries of oil by road, and LNG by sea; tanker truck drivers can run up against restrictions on driving time; heating oil customers get priority for deliveries; and oil deliveries can be delayed when rivers ice up or there aren't enough oil barges when the entire East Coast is seeking oil deliveries.

Slide 25—Generator Oil Burn: Two Weeks vs Twelve Months

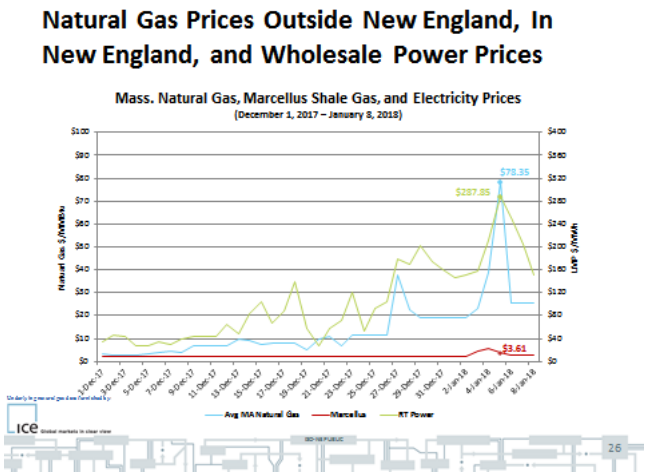


During the two weeks of Arctic cold, New England generators burned through about 2 million barrels of oil. That's about 84 million gallons. That's more than twice as much as all the oil used by New England power plants during the entire year of 2016.

The contribution of other types of generators was crucial. For instance, electricity produced by the Millstone nuclear station during the cold spell is equivalent to what could be produced by about 880,000 barrels of oil, and the power from the Mystic 8 and 9 units in Boston, which are fueled by LNG from the nearby Distrigas import facility, was the equivalent of more than 360,000 barrels of oil.

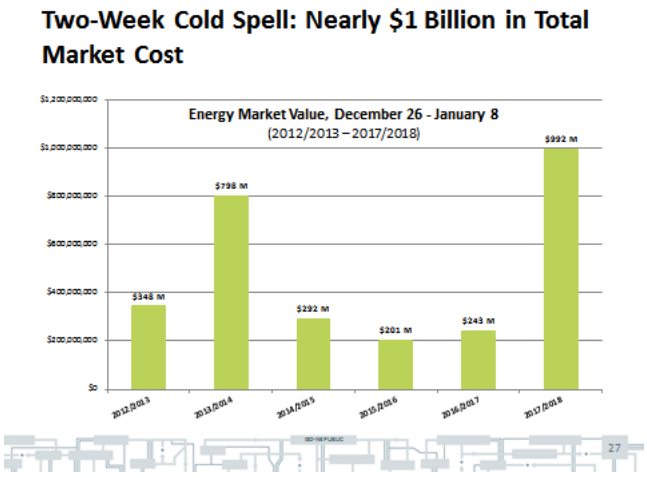
While oil plants help keep the lights on, they also contribute to higher emissions. Just one week into 2018, several oil-fired generators were already nearing their annual emissions limits. Although we hope that state regulators would approve requests to waive those limits to maintain power system reliability during a cold spell, the region could find itself in a similar situation during the summer when demand is peaking, but some generators have already hit their limits earlier in the year.

Slide 26—Natural Gas Prices Outside New England, In New England, and Wholesale Power Prices



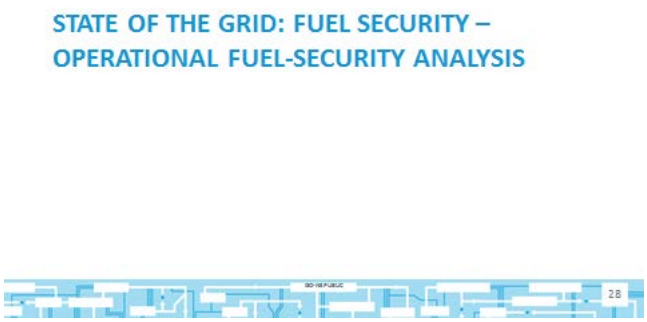
The premium paid in New England for natural gas pipeline constraints is significant. The red line at the bottom of this chart shows the prices of Marcellus shale gas at the source, in Pennsylvania. Marcellus gas was $3.61 per million Btus on January 5th. The blue line shows that the natural gas price in Massachusetts rose to $78 that day. The green line shows real-time, wholesale power prices in New England, which tracked the Massachusetts gas price.

Slide 27—Two-Week Cold Spell: Nearly $1 Billion in Total Market Cost

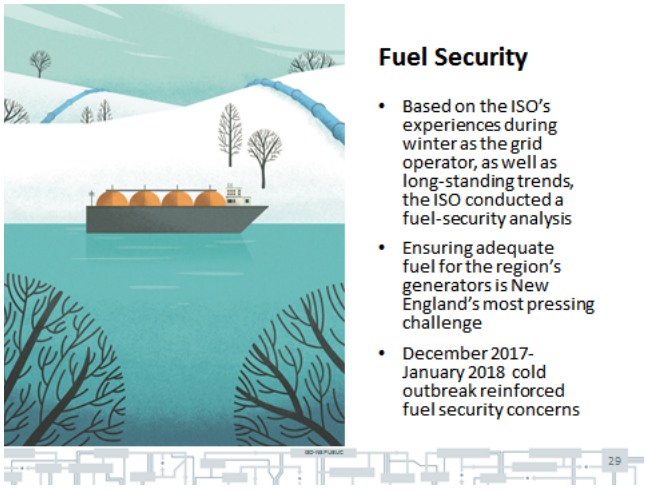


Wholesale electricity costs for that two-week cold spell total about $990 million, or about four times more than the $243 million incurred during the same two-week period last year.

Slide 28—Title Slide—State of the grid: Fuel Security–Operational Fuel-Security Analysis



Slide 29—Fuel Security



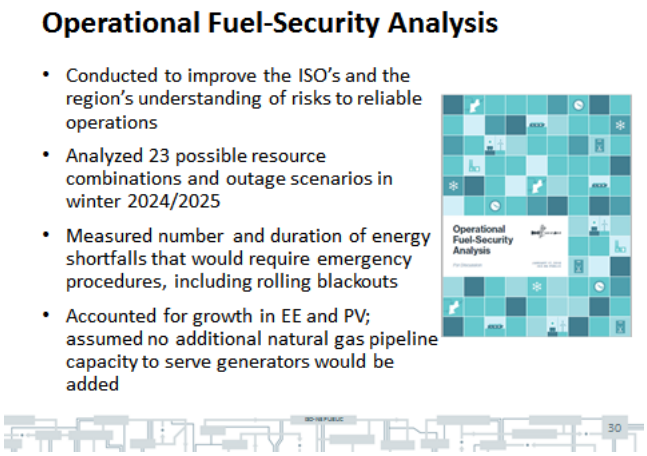
The ISO's concerns about fuel security are well-established. This has been a focus since January 2004 when another brutal cold spell, with natural gas pipeline constraints, challenged the reliable operation of the grid.

The three major trends affecting the power system are likely to make operating conditions more tenuous unless they are addressed. Briefly, these trends are: first, the increasing reliance on natural gas for heating and power generation; second, the limited expansion of natural gas delivery capacity; and third, the retirements of power plants that use fuels other than natural gas. Additional renewable resources can help meet demand and maintain reliability when they are running, but because their output is dependent on the weather, they may not be available when needed.

Fuel security is the ability of power plants to have or get fuel when needed. Based on the ISO's

experiences operating the grid through challenging winter conditions over the last two decades, fuel security is the greatest challenge to continuing power system reliability. What we saw during this winter's cold spell reinforced those concerns.

Slide 30—Operational Fuel-Security Analysis



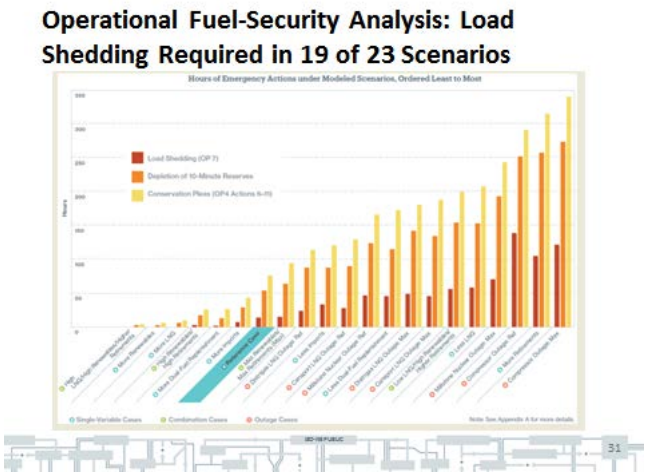
The ISO has conducted multiple studies of the region's natural gas capacity and all have concluded the capacity will not be sufficient to meet future peak demand. However, expansion of the region's natural gas pipeline capacity is unlikely anytime soon, so the ISO decided to study how the system could be operated with the fuel available under a wide range of resource scenarios. The study focused on an entire cold winter in 2024/2025.

The study examined 23 possible resource combinations with five key variables. They are LNG, oil, imports, renewable resources, and retirements of non-gas generators. The study also looked at the impact of outages at four major energy facilities. The study assumed that no additional pipeline capacity would be built in New England, and accounted for growth in energy-efficiency measures and behind-the-meter solar. There were several scenarios that met or exceeded state procurement goals for renewable resources.

Examining fuel availability over an entire winter enabled us to quantify several crucial reliability factors. These include the operational impact of dwindling oil supplies, the region's dependency on LNG and electricity imports as winter progresses and, in particular, the sensitivity of reliable system operations to these factors as non-gas generators retire and renewable generation grows.

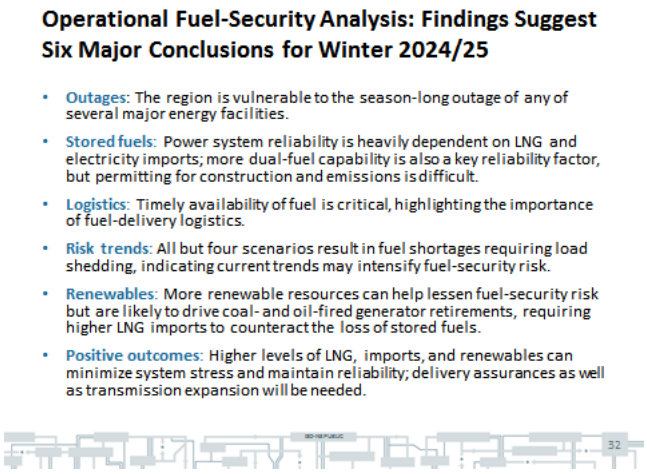
The study measured how often there would be energy shortfalls requiring emergency actions, including rolling blackouts, to ensure reliability and preserve the integrity of the system.

Slide 31—Operational Fuel-Security Analysis: Load Shedding Required in 19 of 23 Scenarios



The study found that rolling blackouts would be needed in 19 out of the 23 scenarios. The reference case is a reasonable approximation of how the system could look in seven years, given current trends, and 14 hours of load shedding were required in that scenario.

Slide 32—Operational Fuel-Security Analysis: Findings Suggest Six Major Conclusions for Winter 2024/25



The results show that the trends affecting the regional power system, particularly the retirements of oil generators, could worsen fuel-security risk unless they are addressed. Extended outages, or retirements, of the remaining nuclear plants would have significant detrimental effects.

The study showed that having stored fuels like LNG and oil at dual-fuel units, combined with imports from Canadian hydro facilities, could be one key to maintaining reliability. However, building new energy infrastructure in New England is difficult, and emissions restrictions are tightening dual-fuel

generators' ability to use oil.

Non-gas generator retirements can be countered with more renewable energy, but the region will become more reliant on LNG imports as a result. High levels of LNG, renewables, and imports could minimize system stress. But as with all fuels, firm delivery assurances would be required.

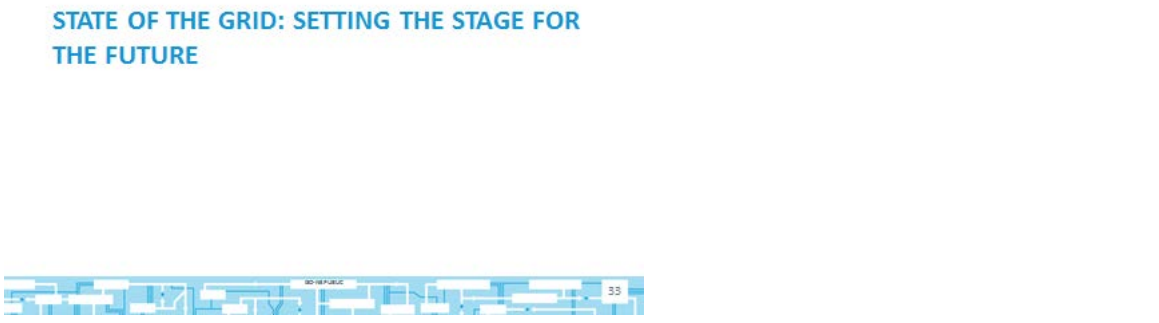
The study also outlines the uncertainties around fuel delivery logistics, which I mentioned earlier.

The study does not propose solutions or address costs, but it's clear that solving these fuel-security challenges will be costly. All options are costly, whether the region chooses to invest in renewable energy with the related transmission, or in fuel infrastructure with long-term contracts, or in further measures to reduce demand for wholesale electricity and natural gas.

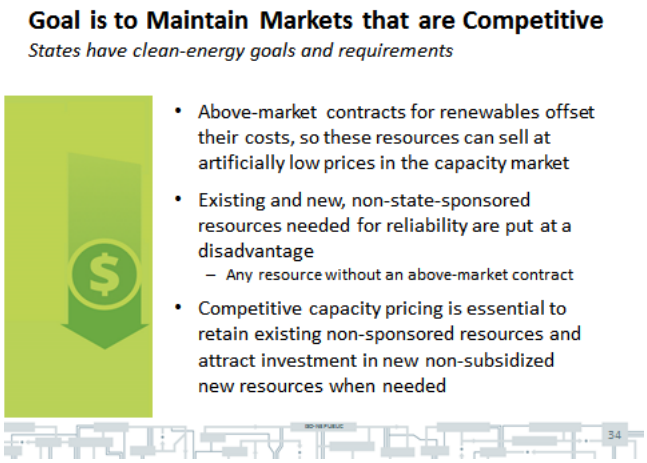
However, inaction also comes at a cost, including greater risks to reliability and higher emissions when it's more economical to burn oil than natural gas. The financial cost could include chronic price spikes during cold weather. And if reliability risks are imminent, the ISO will take steps to avoid them. That could include paying non-gas resources not to retire. However, the ISO does not have the authority to seek to delay resource retirements when fuel security is jeopardized; currently, that authority extends only to resources whose retirements would jeopardize transmission security.

In other words, the region can pay the bill for its fuel-security risks periodically, in spiking wintertime prices and potential energy shortages, or the region can pay the costs proactively and avoid reliability risks by investing in infrastructure, firm fuel contracts, and other incentives. In this regard, infrastructure could include further efficiency measures, electric transmission and new renewable energy resources, storage facilities for liquid fossil fuels, and gas pipeline infrastructure.

Slide 33—Title slide—State of the Grid: Setting the Stage for the Future



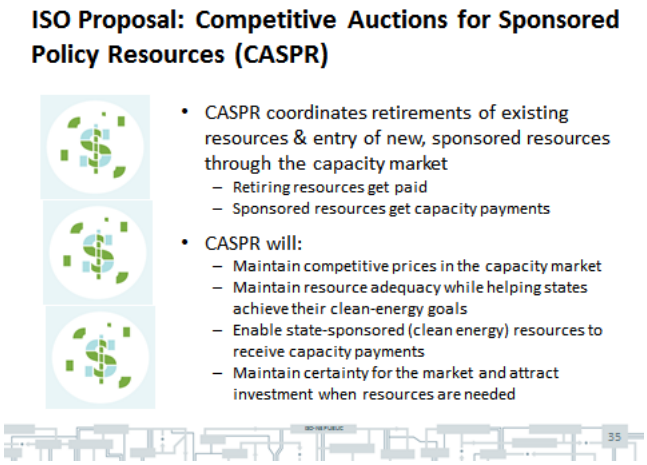
Slide 34—Goal is to Maintain Markets that are Competitive



The New England states, particularly Massachusetts, Connecticut and Rhode Island, are focused on getting more renewable and clean energy. They're requiring their regulated utilities to enter into long-term contracts for clean energy.

New resources with above-market, state-sponsored contracts can participate in the markets at artificially low prices. That would reduce the revenues of other resources that are needed to keep the lights on. It wouldn't only affect the finances of existing fossil-fuel generators. That price suppression would also affect other new resources that don't qualify for the states' initiatives or don't win the state contracts.

Slide 35—ISO Proposal: Competitive Auctions for Sponsored Policy Resources (CASPR)



As the ISO considers the future of the wholesale energy and capacity markets, it's taking the states' ambitious clean-energy goals and requirements into account.

The ISO has proposed a major market innovation to enable state-sponsored resources to get into the capacity market and earn revenues without affecting other resources. It will also boost the incentive for struggling resources to retire. This proposal is currently under review by our regulator, the Federal Energy Regulatory Commission.

Slide 36—Other Major Market Initiatives in 2018

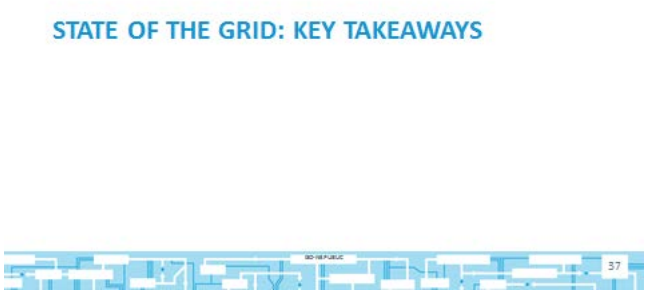
Two major projects that have been years in the making are scheduled for implementation on June 1 this year.

The first, "pay-for-performance," will provide incentives for power producers to deliver on their promises to produce electricity during times of system stress. If they underperform, they'll pay the resources that over-performed to make up for their failure.

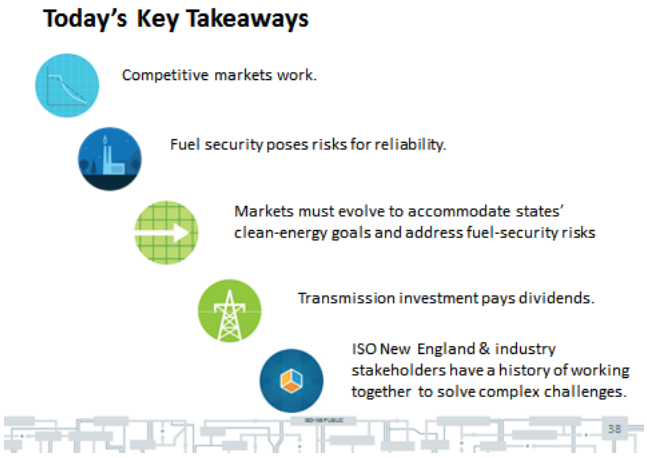
The second initiative will fully integrate demand-response resources, or DR, into the competitive energy and reserves markets, where they can compete with conventional generators. ISO New England will be the first in the country to fully integrate DR into energy dispatch, building on its longstanding commitment to DR. The ISO has had DR programs for almost twenty years, and DR has been able to compete and earn revenues in the capacity market since its inception.

The ISO continually reviews and enhances its rules for operations and the markets to enable new types of resources, with new operating characteristics, to participate in the markets on a comparable basis as conventional generators. The project to further integrate advanced storage into the energy market by the end of this year is an example of that.

Slide 37—Title slide—Key Takeaways



Slide 38—Today's Key Takeaways



The ISO's daily, reliable operation of the grid is possible because the region's competitive markets are working today to ensure both resource adequacy and resource performance.

But the continued reliability of the power system is challenged by fuel security risks, and competitive markets are challenged by above-market contracts for state-sponsored resources. These challenges could impact both resource adequacy and resource performance.

Fuel security is the greatest risk to continued power system reliability. Taking action to address that risk will be costly, but inaction also has costs—and reliability would be at risk.

Long-term reliability depends on the region's well-established, collaborative planning process. The result has been a robust transmission system that enables more resources to connect and compete. Long-term reliability also depends on a properly functioning capacity market that ensures we have

adequate resources to produce electricity when we need it.

Maintaining competitive pricing in the markets and addressing fuel security risks are the ISO's highest priorities.

The ISO will continue working to improve competitive pricing in the wholesale markets. The goal is to ensure fuel-security risks are appropriately valued, while also accommodating state goals for more renewables and clean energy resources. The ISO's focus in the coming years is to develop market and operational solutions to the region's fuel-security challenges, but the ISO cannot direct construction of new natural gas infrastructure.

We look forward to discussing these important issues with the states, market participants, consumer advocates, and all regional stakeholders. New England has a long history of working together to solve challenges on the power system. We also stand ready to support regional policymakers as they consider difficult investment decisions or regulatory changes that can help New England meet its need for competitively priced, clean, and reliable power.

Thanks again for calling in today. I'll be happy to take questions now. Ellen will explain how you can submit questions.

SLIDE 39—For More Information

See posted State of the Grid: 2018 presentation for *Appendix: Additional Data*.