EBC New Hampshire Program

New Hampshire’s Evolving Energy Future
Welcome

Robert Varney

Chair, EBC New Hampshire Chapter

President, Normandeau Associates
Program Introduction and Purpose: What You Will Learn

Barry Needleman

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Environmental Business Council of New England
Energy Environment Economy
ISO New England Overview and Regional Update

Kate Epsen

External Affairs Representative

ISO-NE
Overview of Presentation

• About ISO New England
• Electric Grid at a Glance
• Resource Developments
• Grid Transformation
• Transmission Updates
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
ISO New England Keeps Power Flowing Across the Region Every Minute of Every Day
Numerous Entities Including an Independent Board Provide Oversight of and Input on ISO’s Responsibilities

New England’s Industry Structure

*NESCOE: New England States Committee on Electricity
**NECPUC: New England Conference of Public Utilities Commissioners
• **7.2 million** retail electricity customers drive the demand for electricity in New England (14.8 million population)
  - Region’s all-time summer peak demand: **28,130 MW** on August 2, 2006
  - Region’s all-time winter peak demand: **22,818 MW** on January 15, 2004

• Energy efficiency (EE) and behind-the-meter (BTM) solar are reducing peak demand growth and overall electricity use over the next ten years
  - -0.4% annual growth rate for summer peak demand (with EE and BTM solar)
  - -0.4% annual growth rate for overall electricity use (with EE and BTM solar)

• BTM solar is shifting peak demand later in the day in the summertime

Note: Without energy efficiency and solar, the region’s peak demand is forecasted to grow 0.7% annually and the region’s overall electricity demand is forecasted to grow 1.1% annually. Summer peak demand is based on the “50/50” forecast for typical summer weather conditions.
Markets Select the Most Cost-Efficient Resources to Meet Current and Future Electricity Needs

**Electric Energy**: The Day-Ahead and Real-Time Energy Markets are forward and spot markets for trading electric energy. Energy prices fluctuate throughout the day and at different locations in New England, reflecting the amount of consumer demand, constraints on the system, and the price of fuel that resources use to generate electricity.

**Short-Term Reliability Services**: Resources compete in the ancillary markets to provide backup electricity as well as services needed to support the physical operation of the system, such as frequency regulation and voltage support. These services are critical during periods of heavy demand or system emergencies.

**Long-Term Reliability Services**: Resources compete to sell capacity to the system in three years’ time through annual Forward Capacity Auctions. The Forward Capacity Market works in tandem with the Energy Markets to attract and sustain needed power resources today and into the future.
Energy Market Values Vary with Fuel Prices While Capacity Market Values Vary with Changes in Supply

Annual Value of Wholesale Electricity Markets
(in billions)

- **Energy Market**
- **Ancillary Markets**
- **Forward Capacity Market**

Source: [2018 Report of the Consumer Liaison Group](#); *2018 data are subject to adjustment

Note: Forward Capacity Market values shown are based on auctions held roughly three years prior to each calendar year.
Generation and Demand Resources Are Used to Meet New England’s Energy Needs

- 350 dispatchable generators in the region
- 31,200 MW of generating capacity
- 20,300 MW of proposed generation in the ISO Queue  
  - Mostly wind and solar proposals
- Roughly 7,000 MW of generation have retired or will retire in the next few years
- 500 MW of active demand response and 2,600 MW of energy efficiency with obligations in the Forward Capacity Market*
  - Effective June 1, 2018, demand resources have further opportunities in the wholesale markets

* In the Forward Capacity Market, demand-reduction resources are treated as capacity resources.
Dramatic Changes in Power System Resources

The resources making up the region’s installed generating capacity have shifted from nuclear, oil, and coal to natural gas.

Percent of Total System **Capacity** by Fuel Type
(2000 vs. 2018)

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>2000</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>18%</td>
<td>13%</td>
</tr>
<tr>
<td>Oil</td>
<td>34%</td>
<td>22%</td>
</tr>
<tr>
<td>Coal</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>18%</td>
<td>47%</td>
</tr>
<tr>
<td>Hydro</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>Renewables</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: [2018 CELT Report](https://www.iso-ne.com), Summer Seasonal Claimed Capability (SCC) Capacity

Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, municipal solid waste, and miscellaneous fuels.
Dramatic Changes in the Energy Mix

The fuels used to produce the region’s electric energy have shifted as a result of economic and environmental factors.

Percent of Total **Electric Energy** Production by Fuel Type (2000 vs. 2018)

- **Nuclear**: 31% (2000) vs. 30% (2018)
- **Oil**: 22% (2000) vs. 1% (2018)
- **Coal**: 18% (2000) vs. 1% (2018)
- **Natural Gas**: 49% (2018)
- **Hydro**: 7% (2000) vs. 8% (2018)
- **Renewables**: 8% (2000) vs. 10% (2018)

Source: ISO New England *Net Energy and Peak Load by Source*

Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, municipal solid waste, and miscellaneous fuels.

This data represents electric generation within New England; it does not include imports or behind-the-meter (BTM) resources, such as BTM solar.
Lower-Emitting Sources of Energy Supply Most of New England’s Electricity

• In 2018, most of the region’s energy needs were met by natural gas, nuclear, imported electricity (mostly hydropower from Eastern Canada), renewables, and other low- or non-carbon-emitting resources

• Region is transitioning away from older coal and oil resources

*Data is subject to adjustment
Natural Gas Has Been the Dominant Fuel Source for New Generating Capacity in New England

Cumulative New Generating Capacity in New England (MW)

- Natural Gas
- Nuclear (uprate)
- Wind
- Solar
- Biomass
- Hydro
- Fuel Cell
- Oil

Note: New generating capacity for years 2019 – 2022 includes resources clearing in recent Forward Capacity Auctions.
Natural Gas and Wholesale Electricity Prices Are Linked

Monthly average natural gas and wholesale electricity prices at the New England hub

Wholesale Electricity at New England Hub (Real-Time LMP)  Natural Gas

Underlying natural gas data furnished by:
Since 2013, Roughly 7,000 MW of Generation Have Retired or Announced Plans for Retirement in the Coming Years

- Include predominantly coal, oil, and nuclear resources
- Another **5,000 MW** of remaining coal and oil are at risk of retirement
- These resources have played an **important** role in recent winters when natural gas supplies are constrained in New England

Source: [ISO New England Status of Non-Price Retirement Requests and Retirement De-list Bids](March 14, 2019)
Power Plant Emissions Have Declined with Changes in the Fuel Mix

New England Generator Air Emissions 2000 vs. 2017

- The **70 million short tons** of carbon dioxide emissions avoided regionally between 2001 and 2017 is like taking more than **13.5 million passenger vehicles** off of the road for a year.

- For comparison, in 2016, roughly **5.1 million vehicles** were registered in New England.

Forward Capacity Market Overview

• Procures resources to meet New England’s forecasted capacity needs three years in the future

• Selects a portfolio of **supply** and **demand** resources through a competitive Forward Capacity Auction (FCA) process
  – Resources must be pre-qualified to participate in the auction
  – Resources must participate and clear in the auction to be paid for capacity during the capacity commitment period

• Allows **new capacity projects** to compete in the market and set the price for capacity in the region

• Provides a long-term commitment to new supply and demand resources to encourage **investment**
FCA #13 Attracted and Retained a Variety of Resources to Ensure Resource Adequacy in 2022-2023

• The auction concluded with commitments from 34,839 MW of capacity to be available in 2022-2023
  – 29,611 MW of generation, including 783 MW of new generation in the primary auction and 54 MW of new generation in the substitution auction
  – 4,040 MW of energy-efficiency and demand-reduction measures, including 654 MW of new resources
  – 1,188 MW of total imports from New York, Québec and New Brunswick

• Roughly 2,009 MW of resources submitted retirement de-list bids, while an additional 40 MW of resources submitted permanent de-list bids
  – ISO New England retained two units, Mystic 8 and 9, for 2022-2023 for fuel security reasons
Capacity Market Costs Reflect Changing Supply Outlook

As a “forward” market, consumers can anticipate future changes in capacity costs

Total Capacity Market Costs

Capacity prices peaked when significant generator retirements signaled a need for investment in new resources

Capacity prices for the current commitment period (June 1, 2019 – May 31, 2020) were set three years ago (in the 2016 auction)

Capacity prices reach their lowest level in six years as new resources enter the market and fill retirement gaps

Capacity prices in the most recent auction will show up three years into the future in the commitment period for June 1, 2022 – May 31, 2023

Range: ~$1.1B to $1.8B

Billions of Dollars (rounded)

<table>
<thead>
<tr>
<th>Commitment periods</th>
<th>Auction years</th>
<th>Est. dollars per kilowatt-month</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCA 1–7</td>
<td>2010–2017</td>
<td>$2.95 – $4.50 per kW-mo.</td>
</tr>
<tr>
<td>FCA 8</td>
<td>2017–2018</td>
<td>$7.03*</td>
</tr>
<tr>
<td>FCA 9</td>
<td>2018–2019</td>
<td>$9.55*</td>
</tr>
<tr>
<td>FCA 10</td>
<td>2019–2020</td>
<td>$7.03</td>
</tr>
<tr>
<td>FCA 11</td>
<td>2020–2021</td>
<td>$5.30</td>
</tr>
<tr>
<td>FCA 12</td>
<td>2021–2022</td>
<td>$4.63</td>
</tr>
<tr>
<td>FCA 13</td>
<td>2022–2023</td>
<td>$3.80</td>
</tr>
</tbody>
</table>

* Prices may be higher for some capacity zones.
FCA #13 Featured the First Substitution Auction for Sponsored Policy Resources

• The first *Competitive Auctions with Sponsored Policy Resources* (CASPR) **substitution auction** was held in conjunction with FCA #13 for state-sponsored resources seeking commitments in the 2022-2023 timeframe

• The CASPR design is intended to:
  – **Accommodate** sponsored policy resources into the Forward Capacity Market over time, and
  – **Preserve** competitively based capacity pricing for other resources

• The substitution auction closed with **Vineyard Wind**, an offshore wind project in development off the coast of Massachusetts, assuming an obligation of **54 MW** from an existing resource that will retire in 2022-2023
What Is a Hybrid Grid?

There are two dimensions to the 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 greater resources that face constraints on energy production.
States Have Set Goals for Reductions in Greenhouse Gas Emissions: *Some Mandated, Some Aspirational*

The New England states are promoting GHG reductions on a state-by-state basis, and at the regional level, through a combination of legislative mandates (e.g., CT, MA, RI, and ME) and aspirational, non-binding goals (e.g., NH, VT and the New England Governors and Eastern Canadian Premiers).

MA, RI, NH, ME, and VT use a 1990 baseline year for emissions reductions. CT and the NEG-ECP use a 2001 baseline.
Renewable Energy Is on the Rise

State policy requirements are a major driver

State Renewable Portfolio Standard (RPS)*
for Class I or New Renewable Energy

Notes: State RPS requirements promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Connecticut’s Class I RPS requirement plateaus at 40% in 2030. Maine’s Class I/IA RPS requirement increases to 50% in 2030 and remains at that level each year thereafter. Massachusetts’ Class I RPS requirement increases by 2% each year between 2020 and 2030, reverting back to 1% each year thereafter, with no stated expiration date. New Hampshire’s percentages include the requirements for both Class I and Class II resources (Class II resources are new solar technologies beginning operation after January 1, 2006). New Hampshire’s Class I and Class II RPS requirements plateau at 15.7% in 2025. Rhode Island’s requirement for ‘new’ renewable energy plateaus at 36.5% in 2035. Vermont’s ‘total renewable energy’ requirement plateaus at 75% in 2032; it recognizes all forms of new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.
Wind Power Comprises More Than Half of New Resource Proposals in the ISO Interconnection Queue

**All Proposed Resources**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Megawatts</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>14,073</td>
<td>65%</td>
</tr>
<tr>
<td>Solar</td>
<td>2,975</td>
<td>14%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>2,047</td>
<td>10%</td>
</tr>
<tr>
<td>Battery Storage</td>
<td>2,265</td>
<td>1%</td>
</tr>
<tr>
<td>Hydro</td>
<td>71</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Biomass</td>
<td>37</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Fuel Cell</td>
<td>5</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>21,492</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Source: ISO Generator Interconnection Queue (September 2019) FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings Note: Some natural gas proposals include dual-fuel units (with oil backup). Some natural gas, wind, and solar proposals include battery storage.*

**Proposals by State**

<table>
<thead>
<tr>
<th>State</th>
<th>Megawatts (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>10,091</td>
</tr>
<tr>
<td>Connecticut</td>
<td>5,555</td>
</tr>
<tr>
<td>Maine</td>
<td>2,519</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>2,833</td>
</tr>
<tr>
<td>Vermont</td>
<td>145</td>
</tr>
<tr>
<td><strong>New Hampshire</strong></td>
<td><strong>348</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21,492</strong></td>
</tr>
</tbody>
</table>

*Source: ISO Generator Interconnection Queue (September 2019) FERC and Non-FERC Jurisdictional Proposals*
Energy-Efficiency and Renewable Resources Are Trending Up in New England

<table>
<thead>
<tr>
<th></th>
<th>Energy Efficiency (MW)</th>
<th>Solar (MW)</th>
<th>Wind (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EE thru 2018</strong></td>
<td>2,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EE in 2028</strong></td>
<td>5,200</td>
<td></td>
<td>14,000</td>
</tr>
<tr>
<td><strong>PV thru 2018</strong></td>
<td></td>
<td>2,900</td>
<td></td>
</tr>
<tr>
<td><strong>PV in 2028</strong></td>
<td></td>
<td>6,700</td>
<td></td>
</tr>
<tr>
<td><strong>Existing</strong></td>
<td></td>
<td>1,300</td>
<td></td>
</tr>
<tr>
<td><strong>Proposed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Final 2019 CELT Report*, EE through 2018 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2028 includes an ISO-NE forecast of incremental EE beyond the FCM.

*Final 2019 ISO-NE PV Forecast*, AC nameplate capacity from PV resources participating in the region’s wholesale electricity markets, as well as those connected “behind the meter.”

Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; some wind proposals include battery storage.
Energy Efficiency Is a Priority for State Policymakers

2018 State Energy-Efficiency Scorecard

Ranking of state EE efforts by the American Council for an Energy-Efficient Economy:

- Massachusetts 1
- Rhode Island 3
- Vermont 4
- Connecticut 5
- Maine 14
- New Hampshire 21

- Billions spent over the past few years and more on the horizon
  - Nearly $5.3 billion invested from 2012 to 2017
  - ISO estimates $10.6 billion to be invested in EE from 2020 to 2028

Source: American Council for an Energy-Efficient Economy

Energy Efficiency and Behind-the-Meter Solar Are Reducing Peak Demand and Annual Energy Use

The gross peak and load forecast
The gross peak and load forecast minus existing and anticipated “behind-the-meter” (BTM) solar PV resources
The gross peak and load forecast minus existing and anticipated BTM solar PV and energy efficiency

Note: Summer peak demand is based on the “90/10” forecast, which accounts for the possibility of extreme summer weather (temperatures of about 94°F).
ISO New England Forecasts Strong Growth in Solar Photovoltaic (PV) Resources

December 2018 Solar PV Installed Capacity (MW\textsubscript{ac})

<table>
<thead>
<tr>
<th>State</th>
<th>Installed Capacity (MW\textsubscript{ac})</th>
<th>No. of Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>464.3</td>
<td>35,889</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1,871.3</td>
<td>90,720</td>
</tr>
<tr>
<td>Maine</td>
<td>41.4</td>
<td>4,309</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>83.8</td>
<td>8,231</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>116.7</td>
<td>5,993</td>
</tr>
<tr>
<td>Vermont</td>
<td>306.3</td>
<td>11,864</td>
</tr>
<tr>
<td>New England</td>
<td>2,883.8</td>
<td>157,006</td>
</tr>
</tbody>
</table>

Cumulative Growth in Solar PV through 2028 (MW\textsubscript{ac})

- Jan. 2010: 40 MW
- Thru 2018: 2,900 MW
- 2028: 6,700 MW

Note: The bar chart reflects the ISO’s projections for nameplate capacity from PV resources participating in the region’s wholesale electricity markets, as well as those connected “behind the meter.” The forecast does not include forward-looking PV projects > 5 MW in nameplate capacity. Source: Final 2019 PV Forecast (March 2019); MW values are AC nameplate.
State Installed Solar PV “Heat Maps”

• Understanding the spatial distribution of existing solar PV resources will be critical to the ISO’s ongoing integration activities within both System Planning and System Operations.

• Based on the data provided by distribution owners, the ISO has aggregated the installed nameplate capacity by town within each state, and generated heat maps showing the results.

Note: Heat map reflects MW of solar PV installed through December 2018.
New Hampshire Installed Solar PV “Heat Map”

Note: Heat map reflects solar PV installed through December 2018. Legend shows color scale of nameplate megawatts per town.
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
The ISO Is Leading Efforts to Account for Solar Resources Connected to the Distribution System

• **Forecasting Long-Term Solar Growth**
  – The ISO tracks historical growth and predicts levels of solar development 10 years into the future
  – The solar forecast is used in transmission planning and market needs assessments

• **Forecasting Short-Term Solar Performance**
  – The ISO creates daily forecasts of solar generation production to improve daily load forecasts and situational awareness for grid operators

• **Improving Interconnection Rules**
  – The ISO is engaged with industry stakeholders to strengthen interconnection standards and reduce reliability concerns
Energy Security Improvements (“ESI”): The ISO’s Long-Term Proposed Solution For Energy Security Challenges

**Solution Takes Three Parts**

*Stakeholder Process and Implementation is Multi-Year Effort*

<table>
<thead>
<tr>
<th>Market Change</th>
<th>What it Does</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Reserve Services</td>
<td><em>Brings into the day-ahead markets reliability services not presently being valued or compensated in markets</em></td>
<td>File with FERC: <strong>April 15, 2020</strong>&lt;br&gt;Take Effect: <strong>June 1, 2024</strong></td>
</tr>
<tr>
<td>Replace Single Day-Ahead Market with a Multi-Day-Ahead Market</td>
<td><em>Procure resources over a rolling, multi-day-ahead horizon</em></td>
<td><strong>TBD</strong></td>
</tr>
<tr>
<td>New Forward Market Ahead of the Winter Period</td>
<td><em>Seeks to facilitate investments in costly supplemental energy supply arrangements well in advance of winter</em></td>
<td><strong>TBD</strong></td>
</tr>
</tbody>
</table>
TRANSMISSION UPDATES
Regional Transmission Planning

• As the Regional Transmission Organization, the ISO is required to identify transmission infrastructure solutions that are essential for maintaining power system reliability

• Through an open stakeholder process, the ISO is responsible for the development of long-range plans to address future system needs over the ten-year planning horizon
  – Summarized in a biennial Regional System Plan (RSP)

2019 RSP Update: ISO Plans to Release Final RSP19 in early November

• Also responsible for studying all requests to interconnect to the bulk transmission system
New Hampshire Needs Assessment

• The ISO completed the most recent Needs Assessment (NA) for NH in November 2018 for the 2027 timeframe
  – Concluded that there are reliability needs that must be addressed in the near term, but did not complete the Solutions Study

• Changes to the FCM and load forecasts required a new NA for NH in 2019
  – Final Study Scope and assumptions discussed at the September PAC
  – New NA will be for 2019-2029
The announced retirement of Mystic Station in Boston prompted the initiation of a transmission reliability assessment.

The initial Needs Assessment for Boston has been completed:
- While some time-sensitive needs have been identified, solutions are expected to be able to be identified quickly.
- Non-time-sensitive needs (driven by the retirement of Mystic 8 and 9) are expected to remain when the Needs Assessment is updated in the fall.

To develop solutions to the non-time-sensitive needs, the ISO plans to issue its first RFP for competitively developed regulated transmission by the end of the year.

Once the updated Needs Assessment is complete, the RFP can be issued in December.
Economic Studies: Offshore Wind & Transmission Upgrades

- Three requests for studies submitted to ISO in 2019 (details here)

<table>
<thead>
<tr>
<th>Requester</th>
<th>Purpose of request</th>
</tr>
</thead>
<tbody>
<tr>
<td>NESCOE</td>
<td>Impacts on transmission system and wholesale market of increasing penetration of off-shore wind resources</td>
</tr>
<tr>
<td>Anbaric</td>
<td>Impacts on energy market prices, air emissions and regional fuel security of large penetration of off-shore wind resources</td>
</tr>
<tr>
<td>Renew</td>
<td>Economic impact of conceptual increases in hourly operating limits on the Orrington-South interface from conceptual transmission upgrades</td>
</tr>
</tbody>
</table>

- Next steps:
  - Obtain preliminary results by Q4 2019, additional results and sensitivity analyses by Q2 2020
Transmission Planning for Public Policy

• Initiated by FERC Order 1000 (Initial notice in 2009)
  – In addition to introducing competition in transmission; FERC gave ISO a role planning transmission for public policy (state, federal and local)

• Mapped out in ISO-NE Transmission Planning Process Guide
  – Process required every 3 years: No needs identified the first time (2017)

• ISO-Led Process (through the Planning Advisory Committee (PAC)
  – ISO plans to issue notice Jan. 15, 2020 to restart process
  – NESCOE & stakeholder comments due May 1
  – PAC to discuss process milestones
ISO New England Releases Several New Publications

**2019 Regional Electricity Outlook**
Provides an in-depth look at New England’s biggest challenges to power system reliability, the solutions the region is pursuing, and other ISO New England efforts to improve services and performance.

**New England Power Grid Profile**
Provides key grid and market stats on how New England’s wholesale electricity markets are securing reliable electricity at competitive prices and helping usher in a cleaner, greener grid.

**New England State Profiles**
Provides state-specific facts and figures relating to supply and demand resources tied into the New England electric grid and state policies transforming the resource mix in the region.
Questions
New England’s Power System: A Collective State Update

Environmental Business Council NH: NH’s Evolving Energy Future
October 2, 2019

Ben D’Antonio, Counsel & Analyst
New England States Committee on Electricity
NESCOE is New England’s Regional State Committee, governed by a Board of Managers appointed by each of the New England Governors to represent the collective views of the six New England states on regional electricity matters.

**Focus:** Resource Adequacy, System Planning & Expansion

**Resources:** 5 full-time staff with diverse disciplines & experience. Consultants on markets, transmission & for independent studies.

**More information:** including filings & comments at
- [www.nescoe.com](http://www.nescoe.com)
- Twitter: @NESCOEStates
Overview

• State Laws and Mechanisms

• Analysis of Renewable and Clean Energy

• Resource Adequacy and State Laws
Regional Focus on Energy Security

Winter Program I-III
- Purpose was to aid ISO-NE in maintaining reliability while region addressed long-term risks associated with (1) increased dependence on natural gas and (2) resource performance during periods of stressed system conditions.
- Forward Capacity Market (FCM) 
  - Process sufficient capacity to meet the reliability requirements.
  - Attract new resources.
  - Retain existing resources without contracts.
  - Prices reflect market fundamentals.

Operational Fuel Security Analysis (OFSA)
- Purpose was to stimulate discussion with regional stakeholders and policymakers as to how an increase in gas cost would impact the region's ability to address electricity risk, the degree of operational risk the region is willing to accept, and whether additional changes to the market design may be necessary to address system reliability and export risks.

ISO-NE Energy Security Solutions (Chapters 1, 2, & 3)
- In response to certain market announcements, and to address unacceptable fuel supply risks to the region during the winter months, ISO-NE requested FERC to consider adopting certain provisions.

Pay-for-Performance (PFP)
- Purpose was to improve financial consequences for retirement and to provide incentives for operators to ensure that resources can reliably provide energy and reserves when supply is scarce.

ISO-NE Energy Security Solutions (Chapters 1, 2, & 3)
- Mystic Everett Contract
- The energy contract between ISO-NE and Eversource Energy provides a long-term solution to regional energy security risks.

ISO-NE Energy Security Solutions (Chapters 1, 2, & 3)
- Interim Solution
- Tariff Authority Order
- ISO-NE requests FERC to amend the proposed tariff to reflect the long-term solution.

Chapter 2a: Mystic Everett Contract
- Mystic Everett Contract provides a long-term solution to regional energy security risks.

Chapter 3: Long-Term Solution
- FERC directed ISO-NE to develop a market-based solution to improve energy security in New England. ISO-NE's current proposal includes:
  - A new market-based solution.
  - A new, long-term solution.
  - A new, long-term solution.

ISO-NE Energy Security Solutions (Chapters 1, 2, & 3)
- ISO-NE requests FERC to amend the proposed tariff to reflect the long-term solution.

Chapter 2b: Interim Solution
- Interim Solution
- Tariff Authority Order
- ISO-NE requests FERC to amend the proposed tariff to reflect the long-term solution.

ISO-NE Energy Security Solutions (Chapters 1, 2, & 3)
- Interim Solution
- Tariff Authority Order
- ISO-NE requests FERC to amend the proposed tariff to reflect the long-term solution.

(Extended to April 2020)
State Law Basics

• Each New England State adopts laws and regulations reflective of the policies each state identifies as appropriate for consumers in that state as well as the mechanisms through which to implement those policies

• New England States with policies that prioritize clean energy resources have committed to explore a mechanism to value the attributes of those resources, while ensuring consumers in any one state do not fund the public policy requirements mandated by another state’s law
State Laws and Mechanisms

- State Laws
  - Energy Efficiency
  - Renewable Resources
  - Carbon Dioxide Emissions Reduction

- Programs and Mechanisms to Support State Laws
  - System Benefits Charge and Other Electric Bill Surcharges
  - Renewable Portfolio Standard
  - Net Metering
  - Long-Term Contracting
  - Regional Greenhouse Gas Initiative (RGGI)
  - Other Initiatives
Energy Efficiency – the “first” fuel

Installed measures (e.g., products, equipment, systems, services, practices and/or strategies) on end-use customer facilities that **reduce the total amount of electrical energy needed, while delivering a comparable or improved level of end-use service.** Such measures include, but are not limited to, the installation of more energy efficient lighting, motors, refrigeration, HVAC equipment and control systems, envelope measures, operations and maintenance procedures, and industrial process equipment. – **ISO-NE Tariff §I.2.2.**
## Renewable Resources

<table>
<thead>
<tr>
<th>Common Technologies</th>
<th>State</th>
<th>State-Specific Additional Technologies</th>
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<tbody>
<tr>
<td>• Wind</td>
<td>Maine</td>
<td>Municipal Solid Waste (“MSW”) with recycling, combined heat and power (“CHP”), Thermal</td>
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<tr>
<td>• Solar Photovoltaic (PV)</td>
<td></td>
<td></td>
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<tr>
<td>• Small Hydro</td>
<td>Massachusetts</td>
<td>Sustainable biomass, certain new or incremental hydroelectric, MSW with recycling</td>
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<tr>
<td>• Landfill Gas</td>
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<td></td>
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<tr>
<td>• Biomass (subject to eligibility requirements)</td>
<td></td>
<td></td>
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<tr>
<td>• Anaerobic Digestion</td>
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<tr>
<td>• Geothermal</td>
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<td>• Solar Thermal</td>
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<td>• Ocean Thermal</td>
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<tr>
<td>• Wave</td>
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<tr>
<td>• Tidal</td>
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<tr>
<td>• Fuel Cells using Renewable Fuels</td>
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</tr>
<tr>
<td>• Sustainable biomass</td>
<td>Connecticut</td>
<td>Sustainable biomass, MSW, fuel cells using non-renewable energy, CHP, new hydro, large-scale hydro</td>
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<tr>
<td>• New Hampshire</td>
<td></td>
<td>(only if shortfall in Class I resources, capped at 5% in 2020), low-emission advanced renewable energy</td>
</tr>
<tr>
<td>• Useful thermal energy</td>
<td></td>
<td>conversion technologies</td>
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<tr>
<td>• “Useful thermal energy”</td>
<td>Vermont</td>
<td>Large Hydro, small distributed generation</td>
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<tr>
<td>• CHP, new or co-fired biomass</td>
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<tr>
<td>• Biodiesel</td>
<td>New Hampshire</td>
<td></td>
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<tr>
<td>• Renewable Fuels</td>
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</tr>
</tbody>
</table>
Carbon Dioxide Emissions Sources

Energy Related Carbon Dioxide Emissions, by Sector 2016

- 44% Percentage for Massachusetts
- 24% Percentage for all states
- 11% Percentage for Maine
- 10% Percentage for New Hampshire
- 7% Percentage for Rhode Island
- 4% Percentage for Vermont

Sources: U.S. Energy Information Administration, U.S. Department of Transportation, ISO New England

Note: EIA's electric power emissions represent generation that is geographically located within the state. Not all states measure emissions in this manner.
# Carbon Dioxide Emissions Reduction Targets

<table>
<thead>
<tr>
<th></th>
<th><strong>Power Sector</strong></th>
<th><strong>Economy-Wide</strong></th>
<th><strong>Legal Authorities</strong></th>
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<tr>
<td><strong>Connecticut</strong></td>
<td></td>
<td>10% below 1990 levels by 2020</td>
<td>Conn. Gen. Stat. §§ 22a-200a and 22a-200c</td>
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<tr>
<td></td>
<td></td>
<td>45% below 2001 levels by 2030</td>
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<td>80% below 2001 levels by 2050</td>
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<tr>
<td><strong>Maine</strong></td>
<td>Regional Greenhouse Gas Initiative (RGGI): 2.5% per year reduction until 2020;</td>
<td>10% below 1990 levels by 2020</td>
<td>38 Me. Rev. Stat. ch. 3-A and 3-B</td>
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<td></td>
<td>Approximately 750 thousand tons per year until from 2021-2030</td>
<td>80% below 1990 levels by 2050</td>
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<td><strong>Massachusetts</strong></td>
<td></td>
<td>25% below 1990 levels by 2020</td>
<td>Mass. Gen. Laws ch. 21A § 22 and ch. 21N § 3</td>
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<td></td>
<td>80% below 1990 levels by 2050</td>
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<tr>
<td><strong>Rhode Island</strong></td>
<td></td>
<td>10% below 1990 levels by 2020</td>
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<td>80% below 1990 levels by 2050</td>
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<tr>
<td><strong>Vermont</strong></td>
<td></td>
<td>40% below 1990 levels by 2030</td>
<td>30 V.S.A. § 255 2016 Comprehensive Energy Plan</td>
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<td></td>
<td></td>
<td>80-95% below 1990 levels by 2050</td>
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</table>
The following section provides information on a range of programs and mechanisms used by New England states to support certain types of electric generation resources that are able to satisfy public policies reflected in statutes and regulations.
System Benefit Charge (SBC) and Other Electric Bill Surcharges

Average Annual Energy Efficiency Budgets, by Funding Source 2019-2024 ~ $1.1 Billion per Year

Forecasted Annual Energy Demand, After Impact of Solar PV and Energy Efficiency
New England Region Wide

Source: ISO-NE Energy Efficiency Forecast

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<th>2020</th>
<th>2021</th>
<th>2022</th>
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<td><strong>Rhode Island</strong></td>
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Renewable Portfolio Standard

Total projected RPS targets (all classes) for New England, 2019 to 2030, in GWh

- Total New RPS Resources
- Total Existing RPS Resources

### Total RPS Targets

<table>
<thead>
<tr>
<th>Year</th>
<th>Total New RPS</th>
<th>Total Existing RPS</th>
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<tr>
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<tr>
<td>2030</td>
<td>140,000</td>
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</table>
Total projected policy resource targets (all classes) and goals for New England, 2019 to 2030, in GWh
Behind-the-Meter Solar

Forecasted Energy from Behind-the-Meter Solar PV Resources, GWh

*Note: Behind-the-Meter resources may qualify for net metering and/or other programs, including RPS

Source: ISO New England Solar PV Forecast
Long-Term Contracts

- Clean Energy Request for Proposals (RFP)
  - Entities from three of the New England States - Connecticut, Massachusetts, and Rhode Island - jointly issued an RFP from private developers of clean energy and transmission. The three states selected projects that were, collectively, about 460 MW. None of the projects included transmission.

- Massachusetts Long-Term Contracts for Clean Energy
  - Massachusetts Electric Distribution Companies (EDCs) entered into long-term contracts with H.Q. Energy Services Inc. and related transmission agreements with Central Maine Power Company (CMP) in connection with the New England Clean Energy Connect 100% Hydro project. The Massachusetts Department of Public Utilities (DPU) approved the long-term contracts with Hydro Quebec Energy Services, Inc. FERC approved the related transmission agreements with CMP. The project is subject to further federal review and approval.

- Connecticut, Massachusetts, and Rhode Island Long-Term Contracts for Off-shore Wind
  - Massachusetts EDCs entered into long-term contracts with Vineyard Wind LLC for an 800 megawatt offshore wind generation project. In 2019, the DPU approved the Vineyard Wind contracts and subsequently approved a request by the EDCs to issue an RFP soliciting additional offshore wind generation.
  - The Rhode Island Public Utilities Commission has approved a long-term contract for the Revolution Wind 400 megawatt offshore wind generation project.
  - In 2018, the CT Public Utilities Regulatory Authority approved long-term contracts for the 200 megawatt Revolution Wind project.

- Connecticut Zero Carbon Solicitation and Procurement
  - Connecticut selected two nuclear power bids from Millstone Power Station and Seabrook Nuclear Power Plant, along with nine solar project bids totaling 165 MW – two of which are paired with energy storage – and one 104 MW offshore wind project in a solicitation for zero-carbon electricity-generating resources.

**Note: Several states have already procured clean energy resources via long term contract under these and other existing state energy procurement authorities**
Regional Greenhouse Gas Initiative (RGGI)

RGGI CO2 Emissions – 2017 Model Rule Review, Draft Model Rule Policy Scenario Results

Source: www.RGGI.org
Other Initiatives

- **Green Banks**
  - Connecticut Green Bank
  - Rhode Island Infrastructure Bank
  - Vermont Economic Development Authority

- **Grid Modernization**
  - Distribution System Planning

- **Storage**
  - Massachusetts Energy Storage Initiative

- **Electric Vehicles**
  - New England Governors – Eastern Canadian Premiers’ 2014 Resolution: five percent (5%) fleet market share penetration of alternative fuel vehicles by 2020
  - Four New England States joined the 2013 State Zero-Emissions Vehicle Program Memorandum of Understanding:
    - Connecticut: 175,000 (est.) by 2025
    - Massachusetts: 300,000 by 2025
    - Rhode Island: 43,000 by 2025
    - Vermont: 18,000 by 2025
This analysis is to inform consideration of options; it is not a recommendation or an expression of preferences.

For more information, please visit the Resource Center at NESCOE’s Website nescoe.com.
Resource Adequacy and State Policies

- States’ long-term contracts with resources capable of supporting state policies may not be counted toward ISO-NE’s FCM procurement target

- Renewable Technology Resource (RTR) Exemption Phasing-out

- ISO-NE’s “CASPR” reforms allow new resources supported by long-term contracts to buy-out retiring resources’ capacity supply obligations
WHAT IS NESCOE?

NESCOE is a not-for-profit entity that represents the collective perspective of the six New England Governors in regional electricity matters and advances the New England states' common interest in the provision of electricity to consumers at the lowest possible prices over the long-term, consistent with maintaining reliable service and environmental quality.

WHO WE ARE  OUR WORK

Our resources

Communications and Filings provides access to documents submitted by NESCOE to the Federal Energy Regulatory Commission (FERC), ISO New England (ISO-NE) and other entities, as well as presentations to various audiences.

VISIT RESOURCE CENTER
Regional Clean Energy Transformation

Steven Casey
Manager, Strategic Planning
Eversource Energy
Eversource Battery Storage Update

October 2, 2019
Big Picture Context

We are evolving to a distributed, decarbonized power system that has two parts:

**Part 1**

Large renewable resources

Strategy and tactics to integrate large renewable resources are mature.

**Part 2**

Flexible resources
(storage, EV chargers, smart thermostats)

Strategy and tactics to integrate flexible resources still in early stages.
Energy Storage Opportunity

Many Use Cases Allowing Value Stacking

- Reduce energy supply costs through reduced capacity market procurement
- Reduce transmission costs through reduced share of Regional Network Service
- Enhanced reliability/resiliency
- Renewables integration
- Retirement of peaking resources
- Deferral of infrastructure in hard to build spots

**Prices Expected to Continue Decline**

Lithium-ion battery price outlook

Lithium-ion battery pack price (real 2018 $/kWh)

Source: BloombergNEF
Our Storage Projects

**Westmoreland, NH**
*1.7 MW / 7.1 MWH Project*
Pair EE, DR, and battery storage to:
- Improve resiliency by more than 80%
- Reduce energy peaks
- Defer construction of distribution line

**Connecticut**
*Three Projects - 8.5 MW Total*
- Two projects will enable islanding of critical facilities in rural areas, while deferring upgrades
- One project will help integrate renewables
All three projects will reduce energy peaks

**MA Solar & Storage**
*Approx. 30 MW*
- Add batteries to 8-9 ES-owned solar sites
- Satisfy MA Clean Peak Standard
- Reduce peaks and increase reliability

**Outer Cape MA**
*25 MW / 38 MWh*
- Reliability and resiliency improvements
- Defer construction of distribution line in environmentally sensitive area

**Martha’s Vineyard MA**
*4.9 MW / 20 MWh*
- Reduce reliance on diesel generators
- DER Integration & peak shaving
BAE Systems
In the hands of NH – energy market impacts
A manufacturing perspective

Environmental Business Council of New England
Mark Bailey
Director of Electronic Systems Facilities

October 2, 2019
BAE Systems
A commanding breadth of capabilities

At BAE Systems, we provide some of the world’s most advanced, technology-led defense, aerospace and security solutions.
Electronic Systems footprint

15,500 Employees
$5B Revenue

* ~500 people work at other sites with less than 50 employees
Electronic Systems utility rates at a glance

Summary of Utility Cost

Square Footage: 7.2 million

Electrical Use / Spend:
165 million kWh / $18.8 million

Natural Gas Usage / Spend:
215,000 Dth / $1.7 million
New Hampshire **efficiency and conservation** results

Key points:

- Compared to a 2015 Baseline:
  - **$940k or 9%** of YOY utility costs have been offset
  - **9.6 million kWh or 12%** of YOY usage has been offset

- This is equivalent to offsetting the carbon emissions of:
  - **764,000 Gallons** of Gasoline
  - **800 Homes** of Energy Usage
Where we’ve been and where we are

- Closely manage our supply via third party procurement service
- Employ energy engineers focused on energy efficiency and life cycle cost
- Employ building automation specialists for efficient operation
- Mature utility cost takeout program
- Mature incentive/rebate capture program
- Reinvest funds in other efficiency and sustainability projects

Cost increase of 1 cent negates ~$800,000 of efficiency efforts
Watch list

- Complex legislation impacting the market and investment
- Siting difficulties impacting investment in fuel and generation (NIMBY, other acronyms?)
- Cost shifting
- Legislation passed ahead of cost considerations, viable technology, and market structure
- ISO New England: Operational Fuel-Security Analysis. Rolling blackouts...

Regarding energy – we are in the hands of New Hampshire
Desired future state for energy

- Low cost
- Reliable grid
- Robust supply
- Diverse fuels
- Stable system
- Minimal carbon footprint
- Predictable energy market

Create a competitive market place for business and a growing economy.
How do we get there...

- Educated stakeholders
- Have a balanced discussion
- Legislation that enables investment
- Develop innovative solutions
- Manage the introduction of solutions
- Balance passion with patience

Our expertise is manufacturing. We rely on energy experts to provide a robust energy future.
Thank you
We look forward to a **bright future**

Mark Bailey
Director of Electronic Systems Facilities
October 2, 2019
Moderated Discussion

Moderator: Barry Needleman, McLane Middleton

Panelists:

• Mark Bailey, BAE Systems
• Senator Jeb Bradley, State of New Hampshire
• Steven Casey, Eversource
• Ben D’Antonio, NESCOE
• Kate Epsen, ISO-NE
• Senator Dan Feltes, State of New Hampshire

Environmental Business Council of New England
Energy Environment Economy