ISO New England Identifies Growing Fuel-Security Risk as the Power System Undergoes Rapid Transformation

The New England Council's
New England Regional Energy Forum

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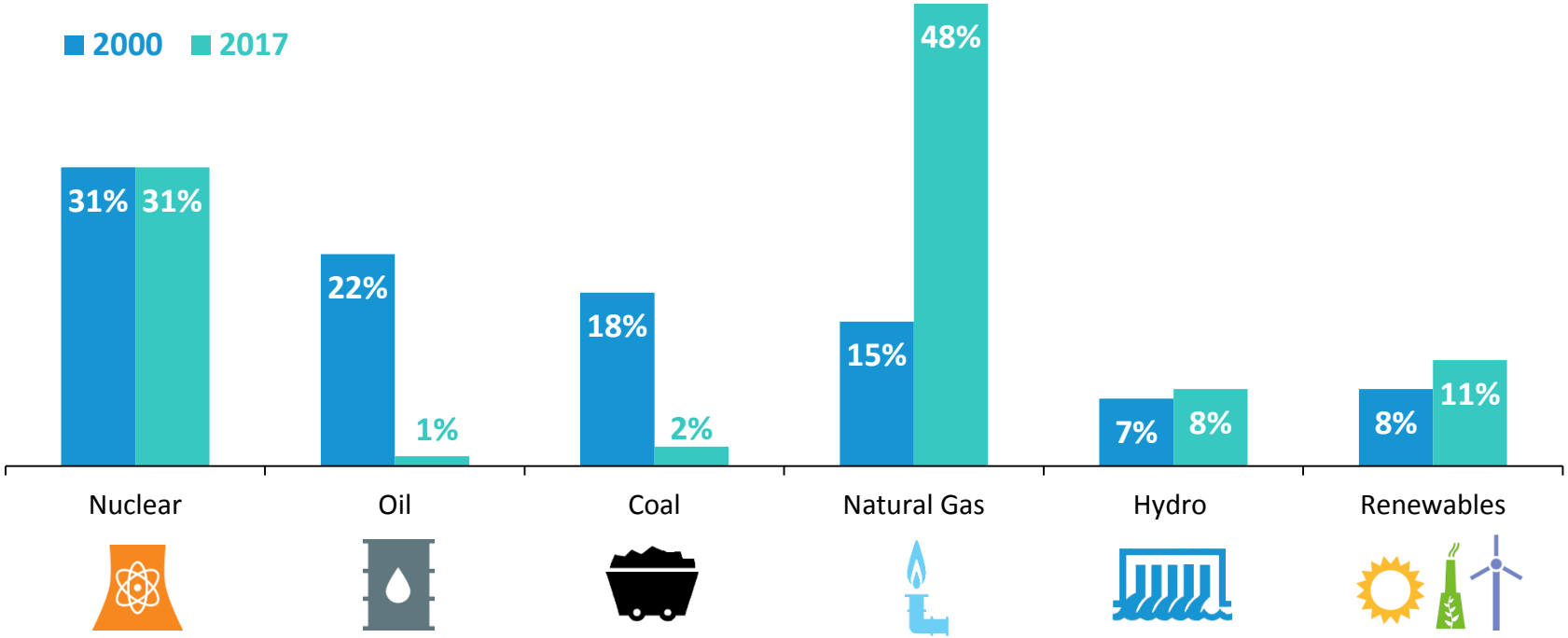
PRESIDENT & CEO

KEY MESSAGES

- The New England power system is changing rapidly
  - New England is shifting away from resources with stored fuels (coal, oil, nuclear) toward resources with just-in-time fuel (natural gas) and resources that are weather dependent (wind and solar)
- ISO's *Operational Fuel-Security Analysis* shows the region trending in a negative direction with regard to fuel-security risk
- ISO's operating experience during recent cold weather period reinforces fuel-security analysis

New England Has Seen Dramatic Changes in the Energy Mix: *From Coal and Oil to Natural Gas*

Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2017)



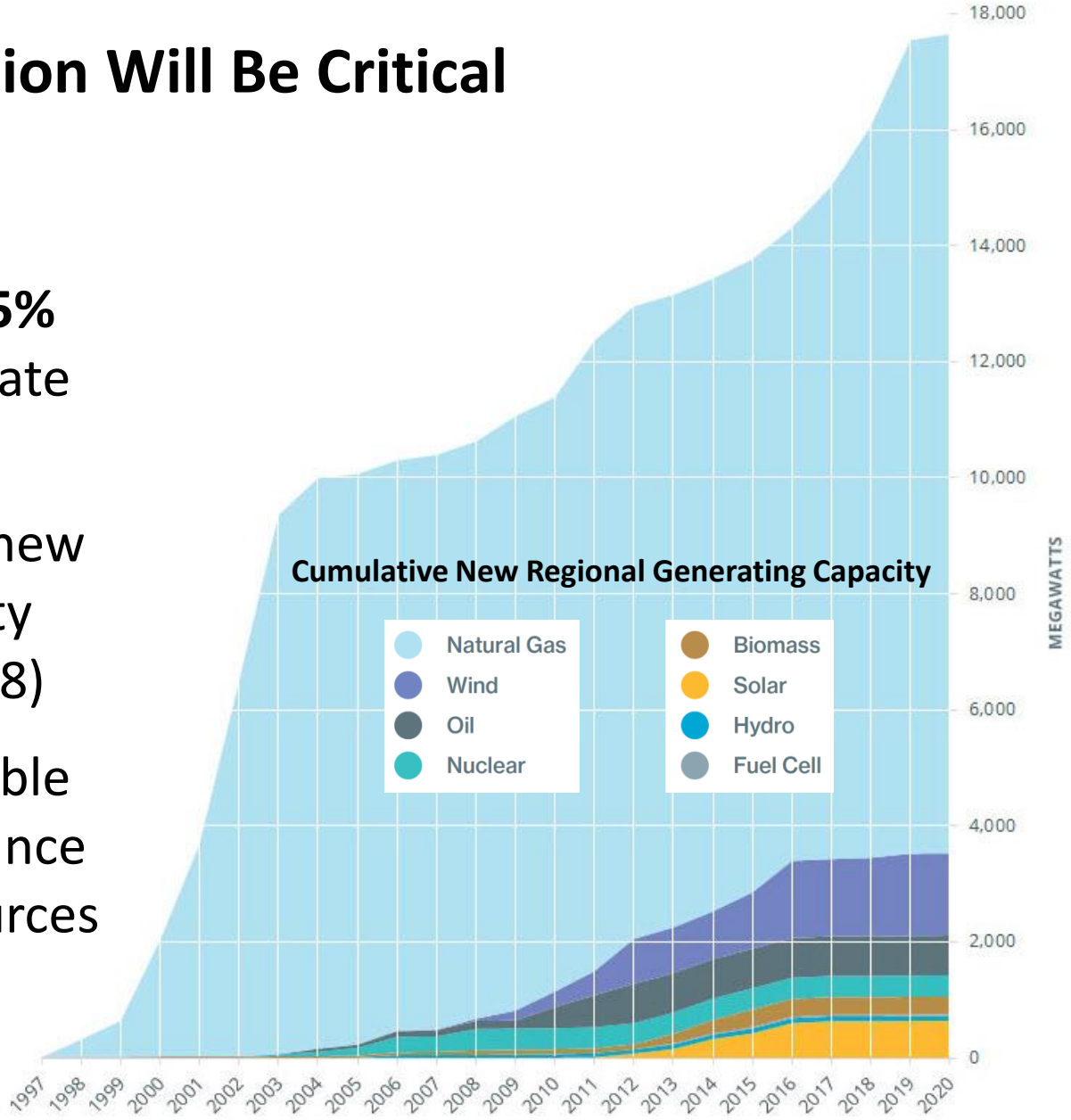
Source: ISO New England Net Energy and Peak Load by Source
Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, municipal solid waste, and miscellaneous fuels.
This data represents electric generation within New England; it does not include imports or behind-the-meter (BTM) resources, such as BTM solar.

Since 2013, More Than 4,600 MW of Generation Have Retired or Announced Plans for Retirement in the Coming Years

- More than **5,000 MW** of remaining coal and oil are at risk of retirement
- These resources have played a **critical** role in recent winters when natural gas supply is constrained in New England

Gas-Fired Generation Will Be Critical for Years to Come

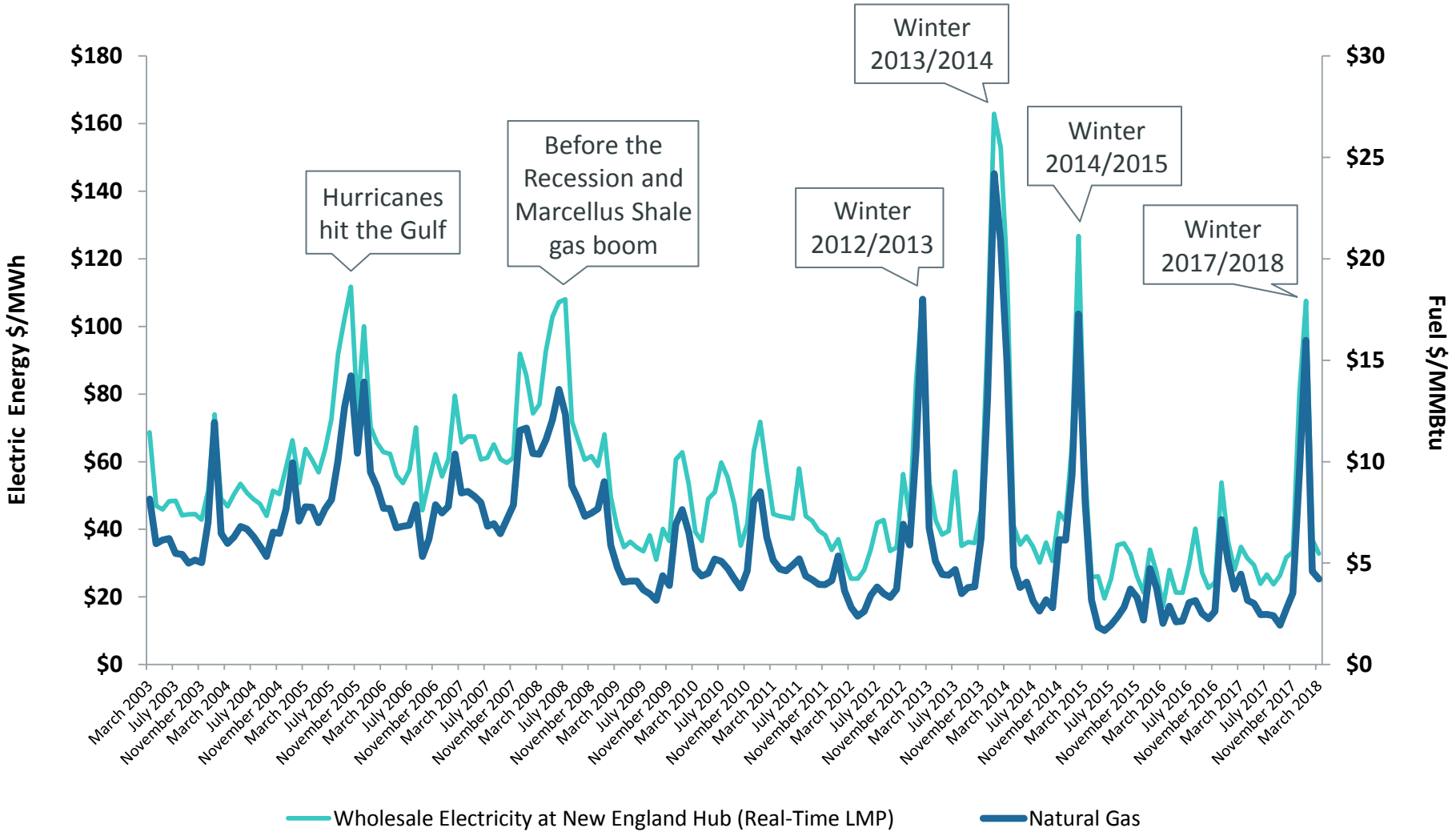
- Primary fuel for **45%** of capacity; alternate fuel for **11%** more
- **31%** of proposed new generating capacity (as of January 2018)
- Provides fast, flexible generation to balance intermittent resources



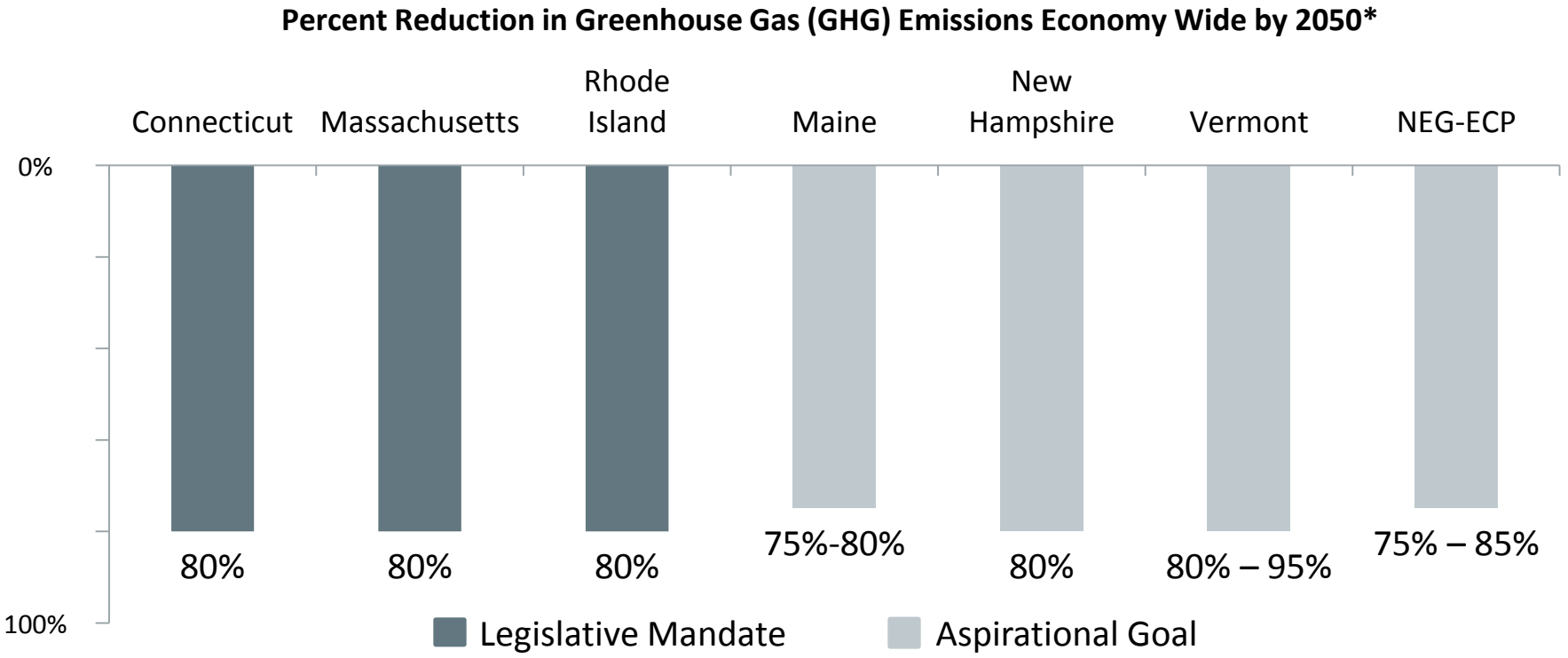
Note: New generating capacity for years 2016–2020 includes resources clearing in recent Forward Capacity Auctions.

Natural Gas and Wholesale Electricity Prices Are Linked

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



States Have Set Goals for Reductions in Greenhouse Gas Emissions: *Some Mandated, Some Aspirational*

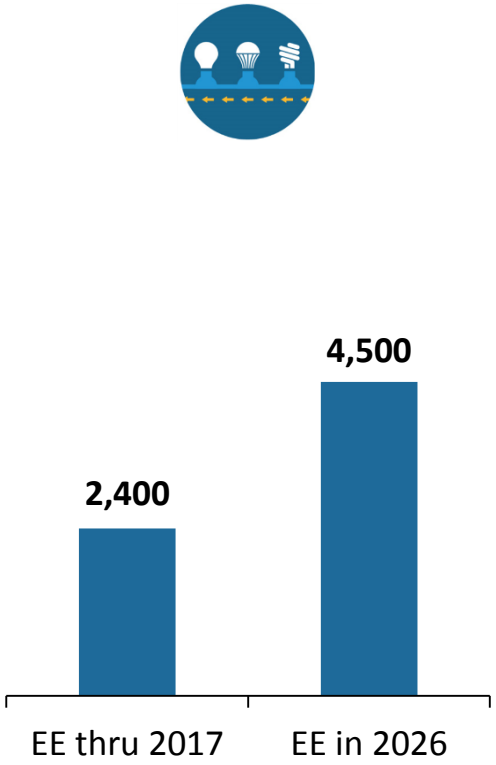


The New England states are promoting GHG reductions on a state-by-state basis, and at the regional level, through a combination of legislative mandates (e.g., CT, MA, RI) and aspirational, non-binding goals (e.g., ME, NH, VT and the New England Governors and Eastern Canadian Premiers).

* MA, RI, NH, and VT use a 1990 baseline year for emissions reductions. CT and the NEG-ECP use a 2001 baseline. ME specifies reductions below 2003 levels that *may* be required "in the long term." For more information, see the following ISO Newswire article: http://isonewswire.com/updates/2017/3/1/the-new-england-states-have-an-ongoing-framework-for-reducin.html.

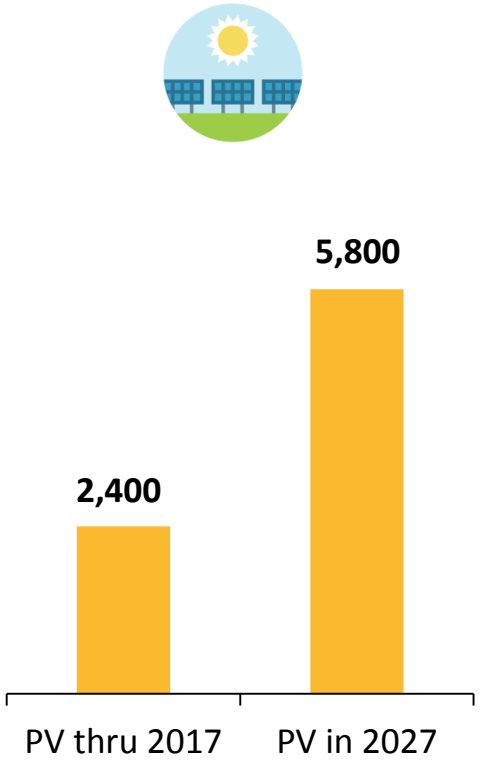
Energy-Efficiency and Renewable Resources Are Trending Up in New England

Energy Efficiency
(MW)



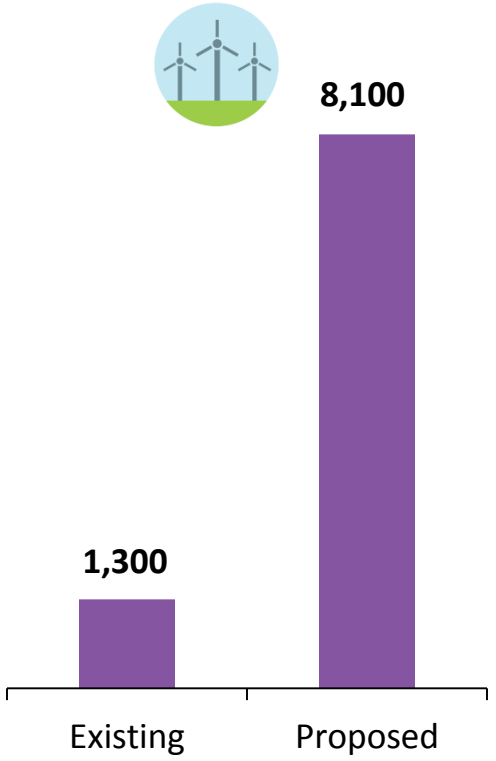
Final 2017 CELT Report, EE through 2017 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2026 includes an ISO-NE forecast of incremental EE beyond the FCM.

Solar
(MW)



Final 2018 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."

Wind
(MW)



Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; some wind proposals include battery storage.

New Energy Storage Technologies Are Coming On Line

- **20 MW** of grid-scale battery storage projects have come on line since late 2015
  - Can only provide energy for relatively brief periods of time
- More than **400 MW** of grid-scale energy storage are requesting interconnection
- New England has a successful history of operating the region's two large pumped-storage facilities, which can supply **1,800 MW** of power within 10 minutes for up to 7 hours

Economy-Wide Decarbonization Could Increase Grid Demand

- Increased adoption of electric vehicles (EVs) and greater use of electric heating could drive more demand for electricity
- The ISO plans to work with regional stakeholders this year to quantify the impact of the states' decarbonization policies on long-term demand for power

A “Hybrid Grid” Is Emerging

The region is changing how it generates, delivers, and uses electricity

- Large grid-connected power resources + thousands of small “behind-the-meter” resources
- Changes in how much grid energy people use and when they use it
- Significant amounts of variable generation and some battery storage
- Two-way grid communications

FUEL SECURITY

- Ensuring adequate fuel for generators is the most **pressing** challenge to future grid reliability
- Launched in the fall of 2016, ISO New England's *Operational Fuel Security Analysis* shows the region is **trending** in a negative direction with regard to fuel-security risk

Study Seeks to Understand the Future Effects of Trends Already Affecting Power System Operations

- The analysis examines **23** possible fuel-mix combinations during the 2024-2025 winter, and quantifies each case's **fuel-security risk**
  - *i.e.,* the number and duration of energy shortfalls that would require implementation of emergency procedures to maintain reliability

- The study assumed **no** additional natural gas pipeline capacity to serve generators would be added during the study timeframe
- The study seeks to illustrate the **range of potential risks** that could confront the power system if fuel and energy were constrained during the winter
  - The scenarios, in aggregate, show the region trending in a **negative direction** with regard to fuel-security risk

Study Modeled Wide Range of Resource Combinations Considering Five Key Fuel Variables

1. 

Retirements of coal- and oil-fired generators
(the study assumes that New England will have no coal-fired power plants in winter 2024/2025)

2. 
Imports of electricity over transmission lines from New York and Canada

3. 
Oil tank inventories (i.e., how often on-site oil tanks at dual-fuel power plants are filled throughout the winter)

4. 

Level of liquefied natural gas (LNG) injections into the region's gas delivery and storage infrastructure

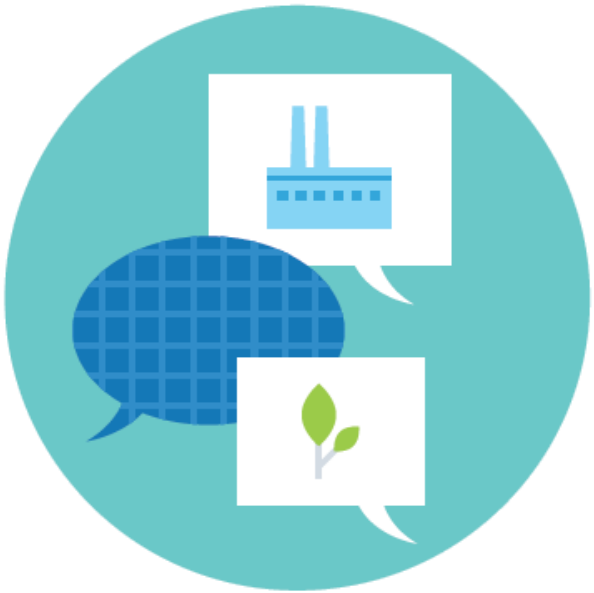
5. 
Level of renewable resources on the system

Study Suggests Six Major Conclusions

1. **Outages**: The region is vulnerable to the season-long outage of any of several major energy facilities.
2. **Key Dependencies**: As we retire more resources, reliability becomes heavily dependent on LNG and electricity imports; more dual-fuel capability is also a key reliability factor.
3. **Logistics**: Timely availability of fuel is critical, highlighting the importance of fuel-delivery logistics.
4. **Risk**: All but four of 23 scenarios result in load shedding, indicating a trend towards increased fuel-security risk.
5. **Renewables**: More renewables can help lessen fuel-security risk but are likely to drive oil-and coal-fired generator retirements, requiring high LNG imports to counteract the loss of stored fuels.
6. **Positive Outcomes**: Higher levels of LNG, imports, and renewables can minimize system stress and maintain reliability; delivery assurances for LNG and imports, as well as transmission expansion, will be needed.

ISO New England Will Continue to Discuss the Results of the Study with Stakeholders

- As the region's grid operator responsible for **reliability**, the ISO must independently assess the level of risk to reliable power system operations
- A **key question** to be addressed will be the level of fuel-security risk that the ISO, the region, policymakers, and regulators are willing to tolerate
- Discussions with **stakeholders** on potential solutions to address the region's fuel-security risks are targeted to begin later in 2018

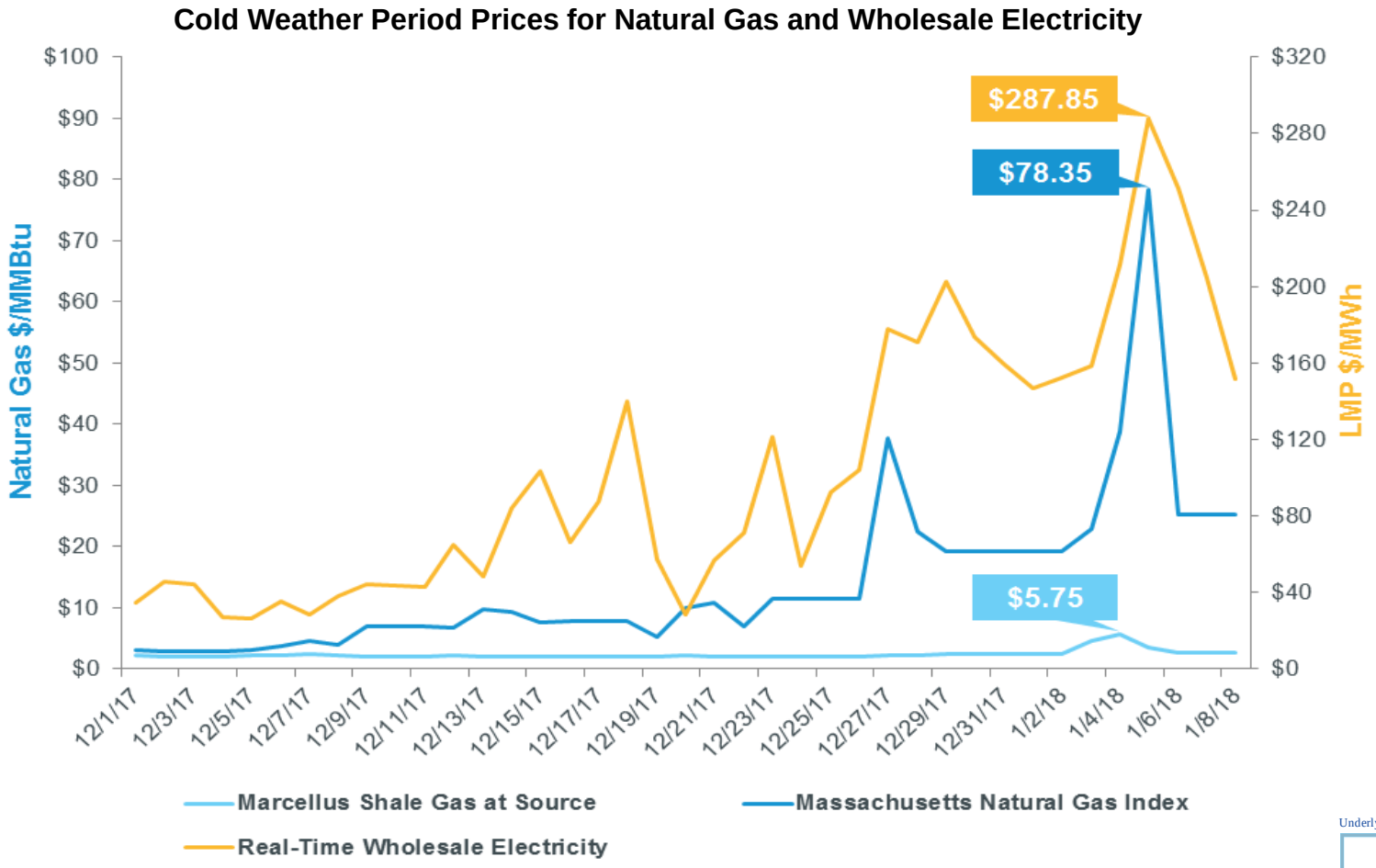


Recent Cold Weather Period Reinforces Findings in *Operational Fuel-Security Analysis*

- During the recent cold weather period (from December 26 to January 8), gas and oil **fuel price inversion** led to oil being in economic merit and base loaded, leading to rapid depletion of the region's oil supply
- Fuel delivery **logistics** became a concern
  - Heating customers get priority for oil and gas
  - Storms can delay trucked oil and LNG tankers
  - Truck drivers face restrictions on driving time
- With oil being base loaded, **emissions** limitations became a concern for several oil-fired generators

Frigid Cold Drove Up Regional Demand for Natural Gas

This led to spikes in natural gas prices, which then led to spikes in wholesale electricity prices; with natural gas at a premium, oil generation became economic

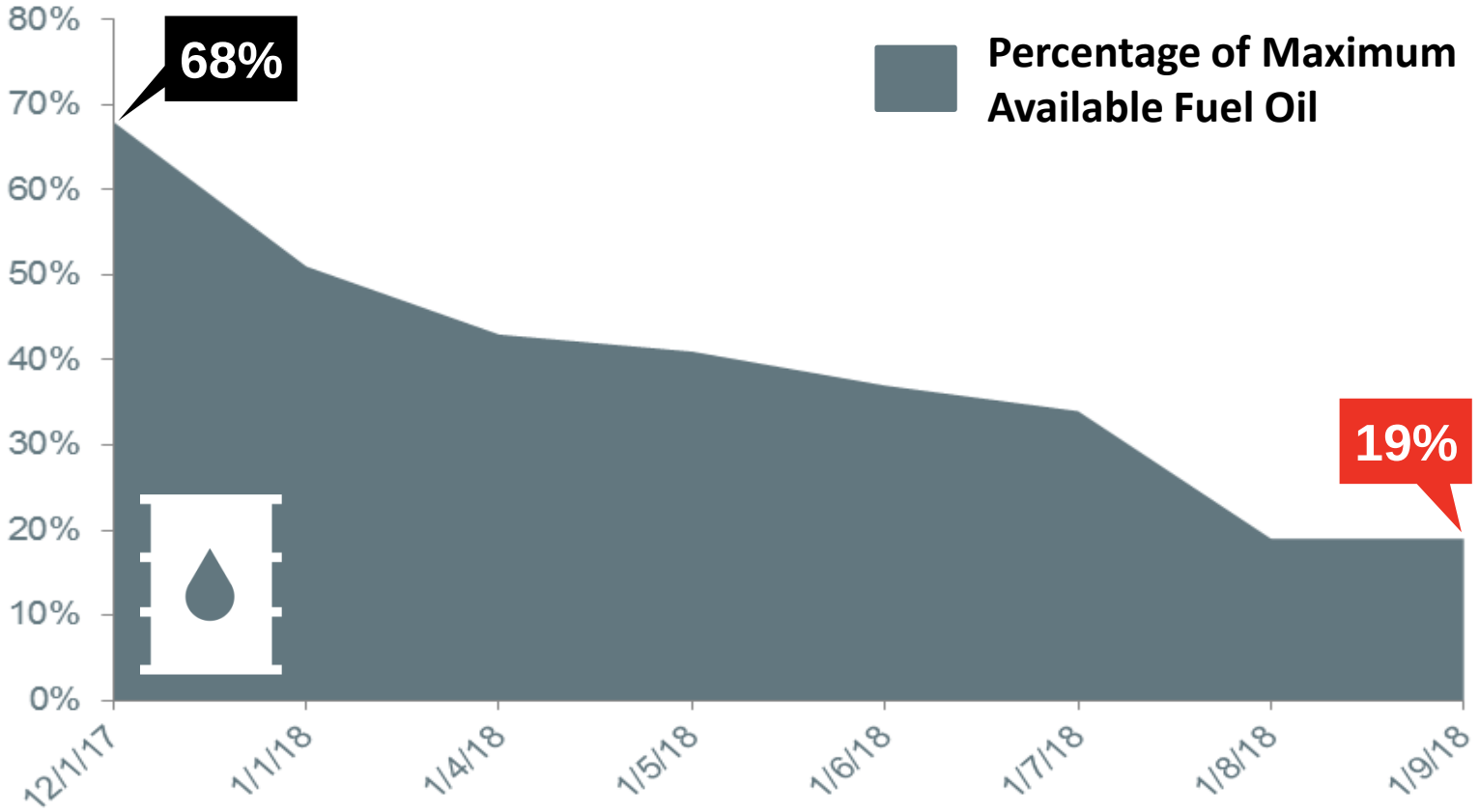


Underlying natural gas data furnished by:

ICE Global markets in clear view

Generators' Oil Inventories Declined Rapidly

Several large oil units were left with only enough fuel for a few more days, forcing the ISO to posture (hold back) units to conserve this fuel

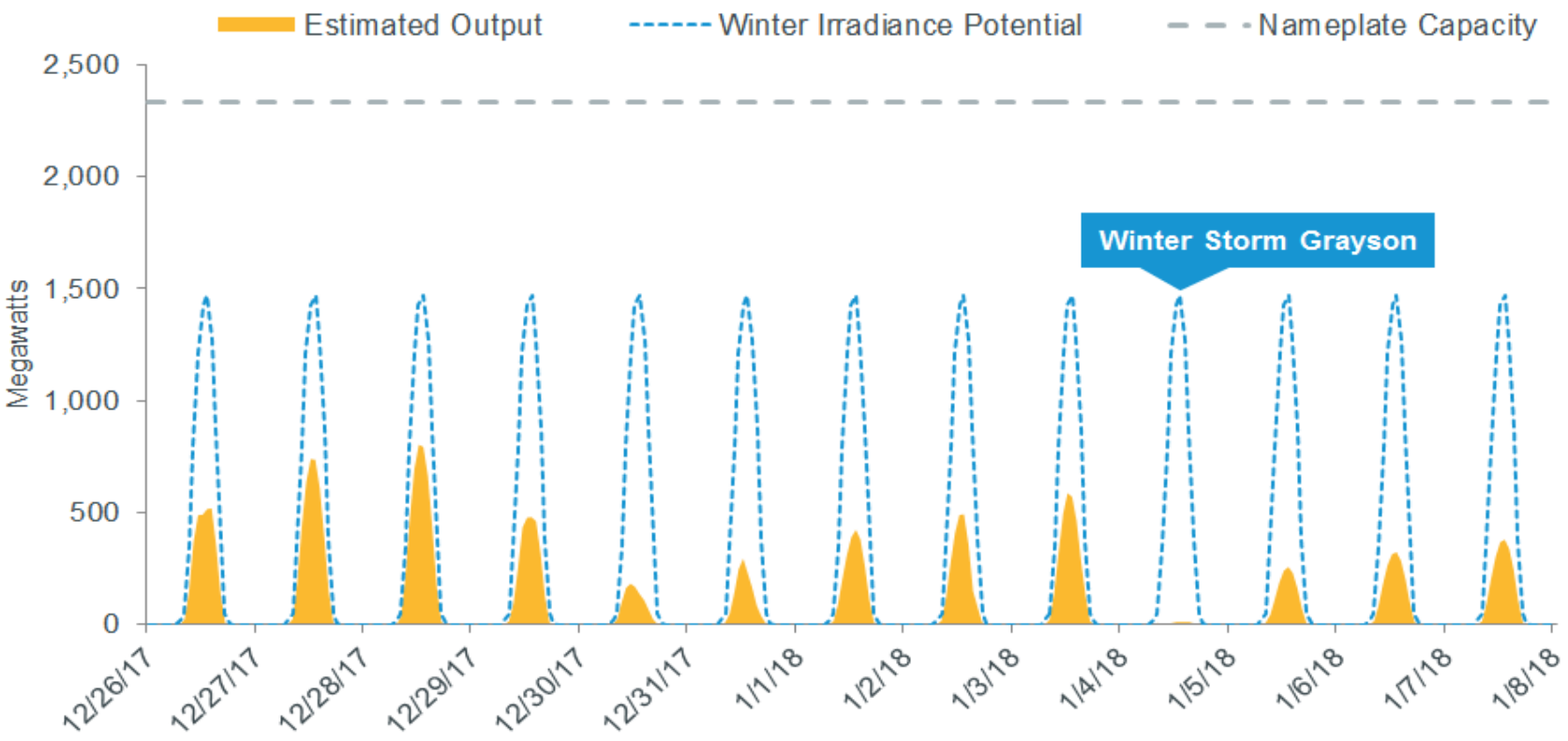


Note: This chart is the ISO's best approximation of usable oil, discounting unit outages, reductions, or emissions.

The Variability of Solar PV Was Also On Display

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

Potential vs. Actual Estimated Output from Behind-the-Meter Solar Power



Note: Output derived from statistical sampling of actual meter readings.
Winter irradiance potential reflects the energy that PV capacity could produce at this time of year with clear skies and no snow cover.

Fuel Security: Structural, Regulatory, and Market Design Challenges

- We assumed fuel-security challenges could be addressed by **improving performance incentives for generators** and that additional fuel infrastructure would be built (e.g. dual fueling); however, investment in adequate fuel infrastructure has stalled
- A number of the states are creating **additional emission restrictions**, further limiting the use of fossil-fired resources
- Fuel infrastructure is shared between heating and electric industries and **reaches capacity during cold weather**
  - Logistics of fuel deliveries becomes very complex and prone to congestion and delays, significantly increasing operational risk
  - Forward contracting is needed to ensure availability of infrastructure and timely provision of the commodity
- Fuel suppliers have **insufficient incentives to meet demand from *spot* customers** (generators) during cold weather conditions
- The **ISO has *no jurisdiction* over fuel infrastructure** and has to seek fuel adequacy through appropriate incentives/obligations for generators, who generally do not have a long-term view on fuel supply
- Non-gas generation (and fuel infrastructure) is retiring in the **absence of sufficient incentives** to provide the reliability services needed during cold weather periods

Recent Retirement Bids Trigger Action on Fuel Security

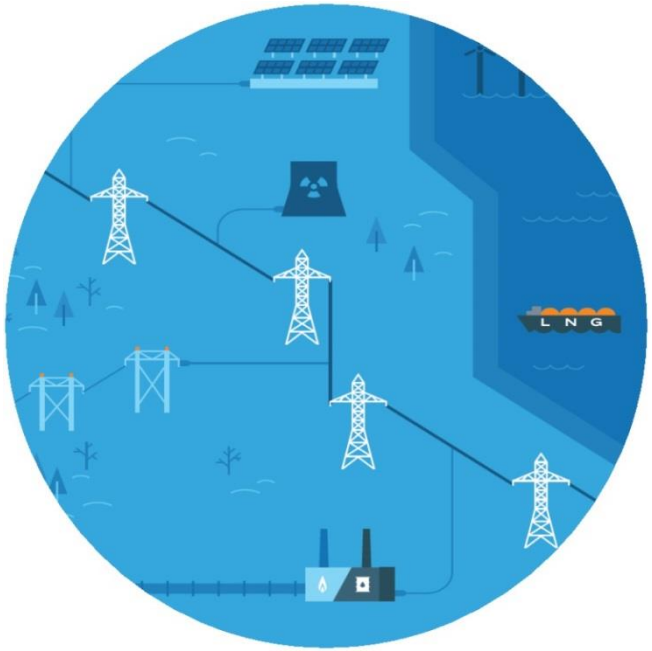
- Retirement bids have been submitted for Units 7, 8, & 9 and the jet at the Mystic Generating Station (Boston) for the upcoming Forward Capacity Auction
  - Units 8 & 9 are the primary customer for the Distrigas LNG terminal that supplies both the Mystic station and the New England pipeline system
    - Exelon is in the process of acquiring the Distrigas facility to ensure fuel supply for these units
- An updated fuel-security analysis shows that the loss of Units 8 & 9 and/or Distrigas presents an ***unacceptable risk to reliability***
- Exelon has stated that Units 8 & 9 will be retired unless it can recover its costs

ISO-NE Working on Three Tracks to Address Fuel-Security Challenge

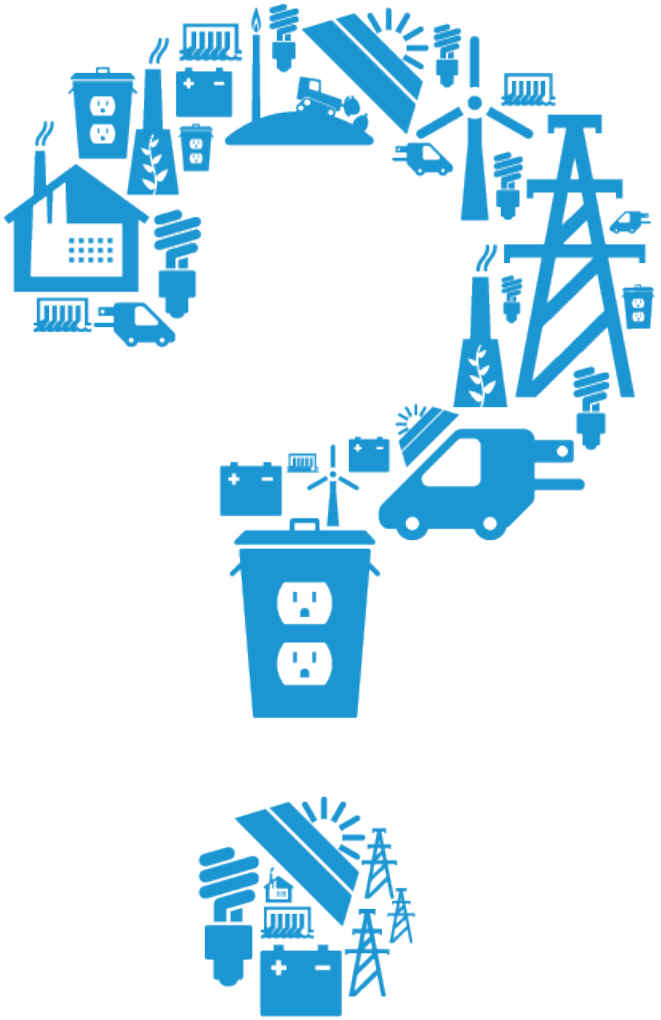
- Immediate: Ask FERC for a ***tariff waiver to ensure fuel security*** by retaining Mystic 8 & 9; Exelon will ask FERC for cost-of-service compensation
- Short-term: Working with stakeholders, develop ***changes to the tariff*** to make fuel security a reason resources can be retained for reliability
  - File changes by end of 2018 so they are in place before the March 2019 retirement bid deadline for FCA #14
- Long-term: Working with stakeholders, develop a ***market-based solution*** that will ensure there is sufficient firm energy to maintain reliability in winter
  - Needed resources and infrastructure will be ***compensated through the market***, rather than reliability contracts

Closing Thoughts…

- We see significant challenges ahead for **fuel security**
- There will be a **cost** associated with alleviating fuel constraints and a **cost** associated with inaction
  - The ISO can take action through its market design and tariff to procure ‘insurance’ to alleviate, but not eliminate, fuel-security risk
  - The states can weigh the costs and environmental trade-offs and take action to shape infrastructure solutions that significantly mitigate fuel-security risk



Questions



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