

# The Expanding Role of Distributed Energy Resources and Storage in the Regional Power System

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# Advanced Energy Storage Is Emerging in the Region – Building on Existing, Large-Scale Storage Capability

- Battery storage projects totaling roughly 100 MW of capacity have requested interconnection to the regional power system
- Over the past year, 17 MW of storage have interconnected to the system
- New England has benefited from grid-scale electrical energy storage capabilities for more than 40 years



# New England Has A Comprehensive Suite of Wholesale Electricity Markets

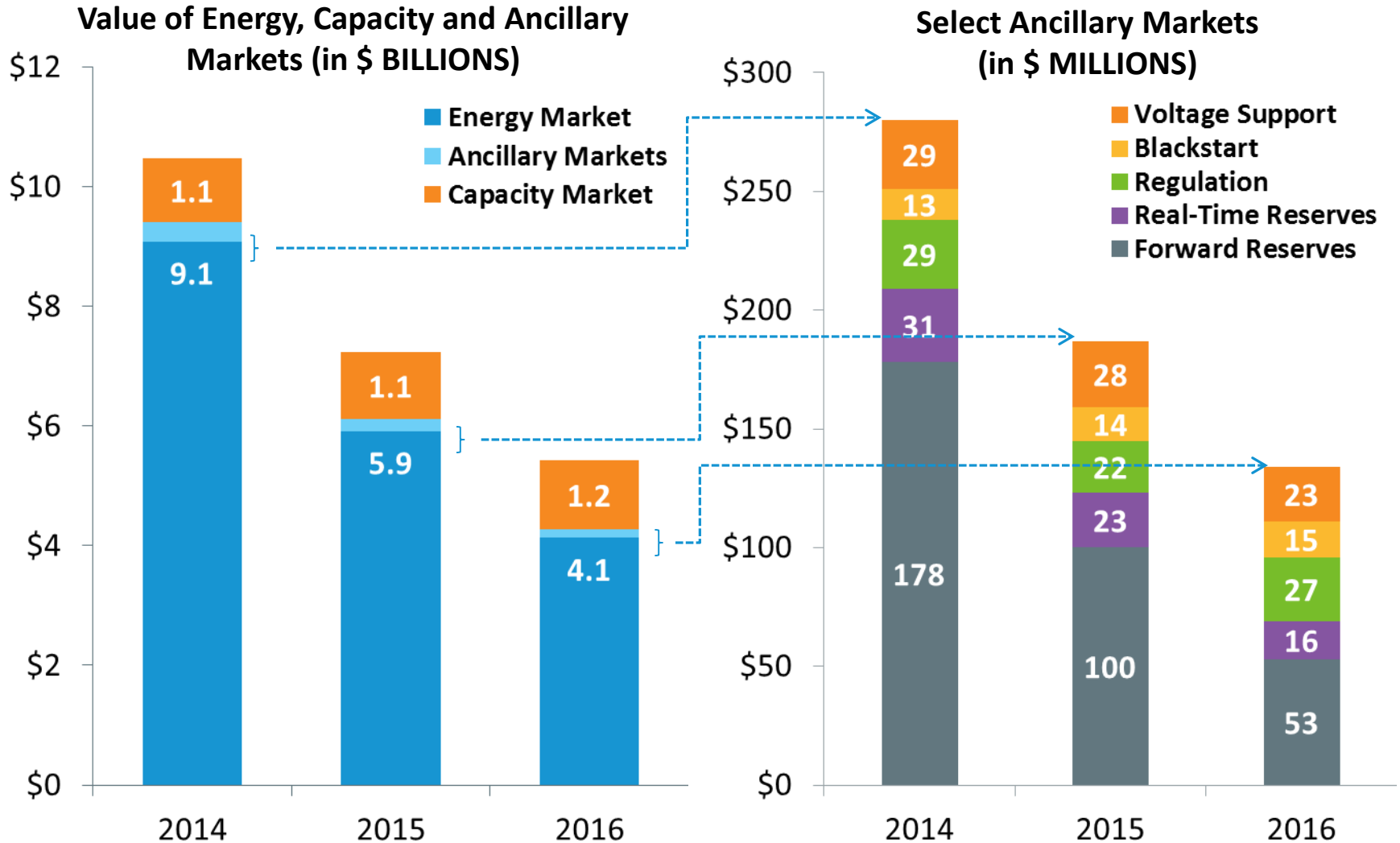


- Wholesale markets are designed to meet the region's reliability needs and do not target specific technologies
- Each market has product-specific requirements
- There are no rules specific to energy storage
- Storage can participate under a variety of configurations

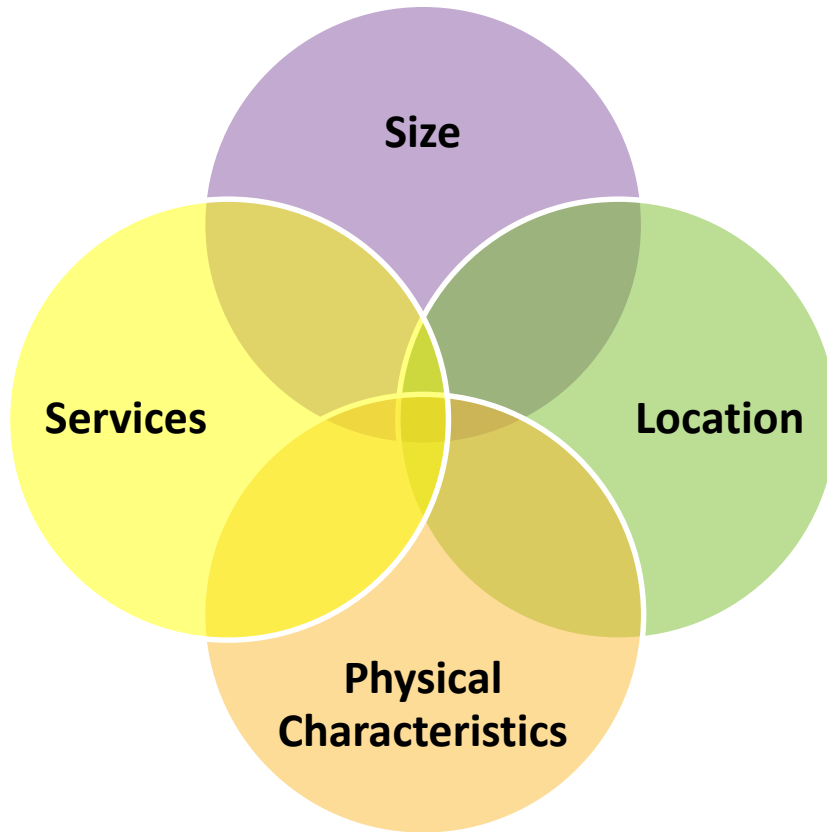


# Annual Value of Wholesale Electricity Markets

*Resources That Can Provide Reserves, Regulation, Voltage Support and Blackstart Capability Have Opportunities in New England's Ancillary Services Markets*



# Participation of Storage Is a Function of Many Factors Including the Size and Location of the Resource



- Larger (> 5 MW) storage generally participate directly in the wholesale markets and provide most of the services
- Smaller storage can participate in many different ways including aggregating with other resources or not directly participating in all markets

# Storage Can Participate Indirectly in the Markets

- Consumers can use energy storage to reduce capacity, energy and ancillary service costs (this is a form of demand-side activity that does not require direct participation in the wholesale markets)





## Storage Can Also Participate Directly in the Wholesale Markets on Both the Demand- and Supply-Sides

- On the demand-side, a storage resource can reduce a customer's capacity costs by responding to real-time changes in wholesale energy prices (at the nodal level), and potentially provide reserves and regulation services
- On the supply-side, a storage resource can respond to real-time changes in wholesale energy prices, and potentially provide capacity, reserves and regulation services



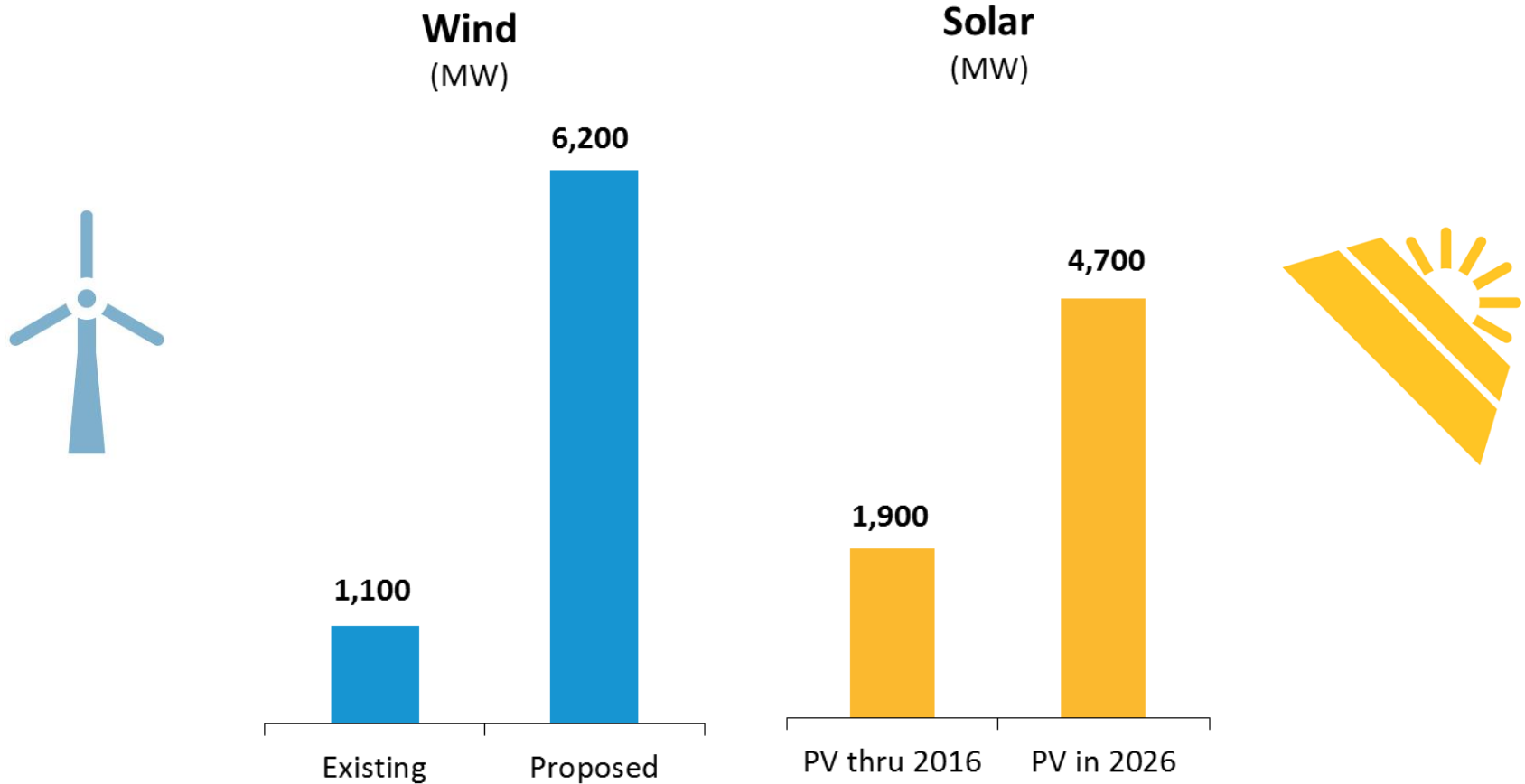
# Storage Can Aggregate to Provide Regulation Service as an Alternative Technology Regulation Resource

- Individual small controllable loads or small storage devices (<1 MW) may be aggregated into a single regulation resource across the system by managing consumption in response to 4-second dispatch instructions
  - The ISO dispatches the aggregated Alternative Technology Regulation Resource (ATRR)
  - The aggregator then dispatches the individual loads or storage devices to produce the required aggregate response (reducing consumption or increasing supply)
- Participants can modify their regulation capacity, performance characteristics, and offer prices of regulation resources hourly to reflect changes in the availability of their underlying facilities throughout the day





# Flexible Resources Will be Needed to Balance Increasing Levels of Variable Generation



Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; megawatts (MW).

*Final 2017 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."*

# Recent Rule Changes Will Enhance Participation of Different Technologies and the Value of Flexible and Fast-Responding Resources



## **Do-Not-Exceed Dispatch**

*(Effective March 2016)*

Rule change enables wind and other intermittent resources to be dispatched in the real-time energy market

# Recent Rule Changes Will Enhance Participation of Different Technologies and the Value of Flexible and Fast-Responding Resources *(continued)*



## **Pumped Storage Modeling**

*(Effective March 2017)*

Rule change allows pumped storage to better reflect their operating characteristics into their offers and will improve economic dispatch

## **Fast-Start Pricing**

*(Effective March 2017)*

Rule changes enables an ISO-committed fast-start resource to set the real-time locational marginal price

## **5-Minute Settlements**

*(Effective March 2017)*

Sub-hourly settlements improves a resource's incentives to follow dispatch instructions, and aligns real-time energy and reserves compensation with performance

# Recent Rule Changes Will Enhance the Value of Flexible and Fast-Responding Resources and Enable Storage's Participation in the Markets (*continued*)



## Price-Responsive Demand

*(Effective June 2018)*

Rule changes enable demand response to participate in the energy market as a dispatchable resource and be capable of providing reserves

## Pay-for-Performance

*(Effective June 2018)*

Capacity market reforms provide capacity resources with market-based incentives to perform at times of need

## Dispatchable Storage

*(Effective December 2018)*

Allow storage resources to participate in the regulation market following the energy neutral signal while being dispatchable in the energy market and capable of providing reserves

# While Implementing Market Rule Changes ISO New England Is Exploring Other Enhancements

The ISO is evaluating options to value a resource's ramping capability in real-time and integrate reserves into the day-ahead market

2016

- Do-Not-Exceed Dispatch

2017

- Fast-Start Pricing
- 5-Minute Settlements
- Pumped Storage Modeling

2018

- Price-Responsive Demand
- Pay-for-Performance
- Dispatchable Storage



## The ISO Continually Evaluates Opportunities to Enhance the Market Design to Enable New Technologies

- Storage can participate in the markets today
- ISO has recently made rule changes to better integrate storage and other technologies into the markets
- The ISO is looking at further enhancements to better incorporate technologies into the markets and value reliability services
- The region will need flexible resources to help balance the quantities of wind and solar being added to the system

