Overview of Distributed Energy Resource Integration in ISO New England

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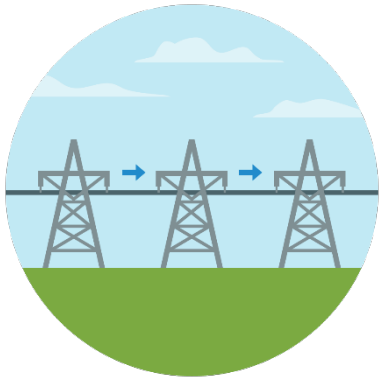
ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

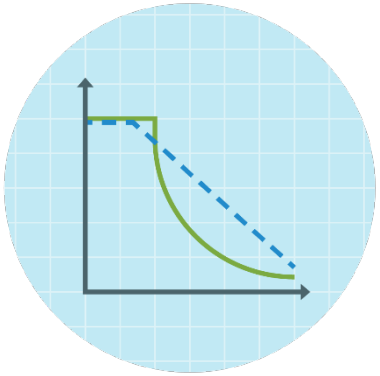
Grid Operation

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



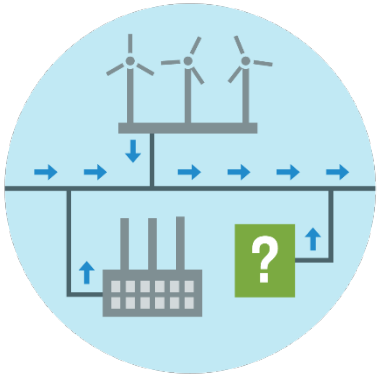
Market Administration

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

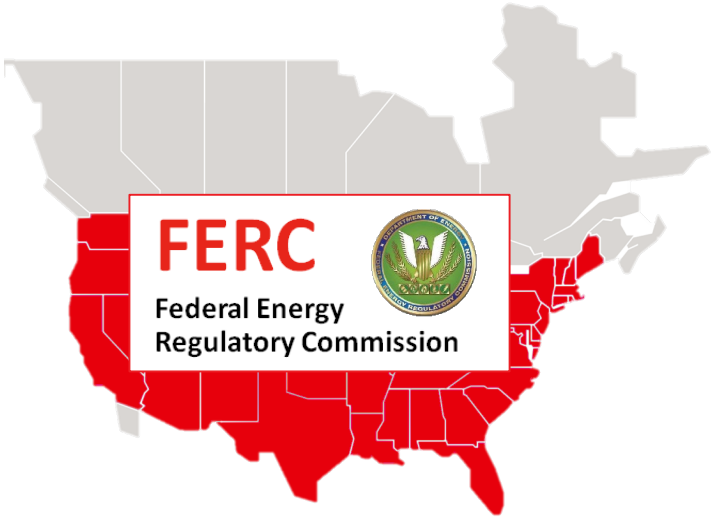


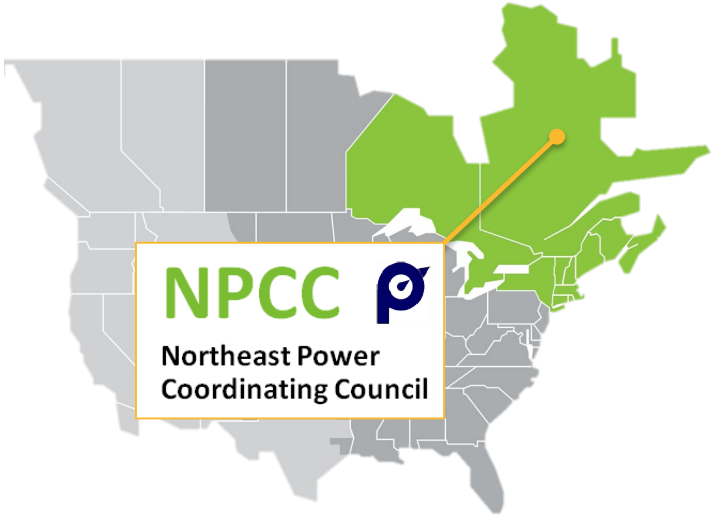
Power System Planning

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



Numerous Entities Provide Oversight of and Input on ISO's Responsibilities

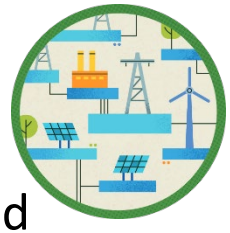




SETTING THE STAGE IN NEW ENGLAND

The Power Grid is Undergoing Radical Transformation

Renewable and Distributed Energy Is on the Rise

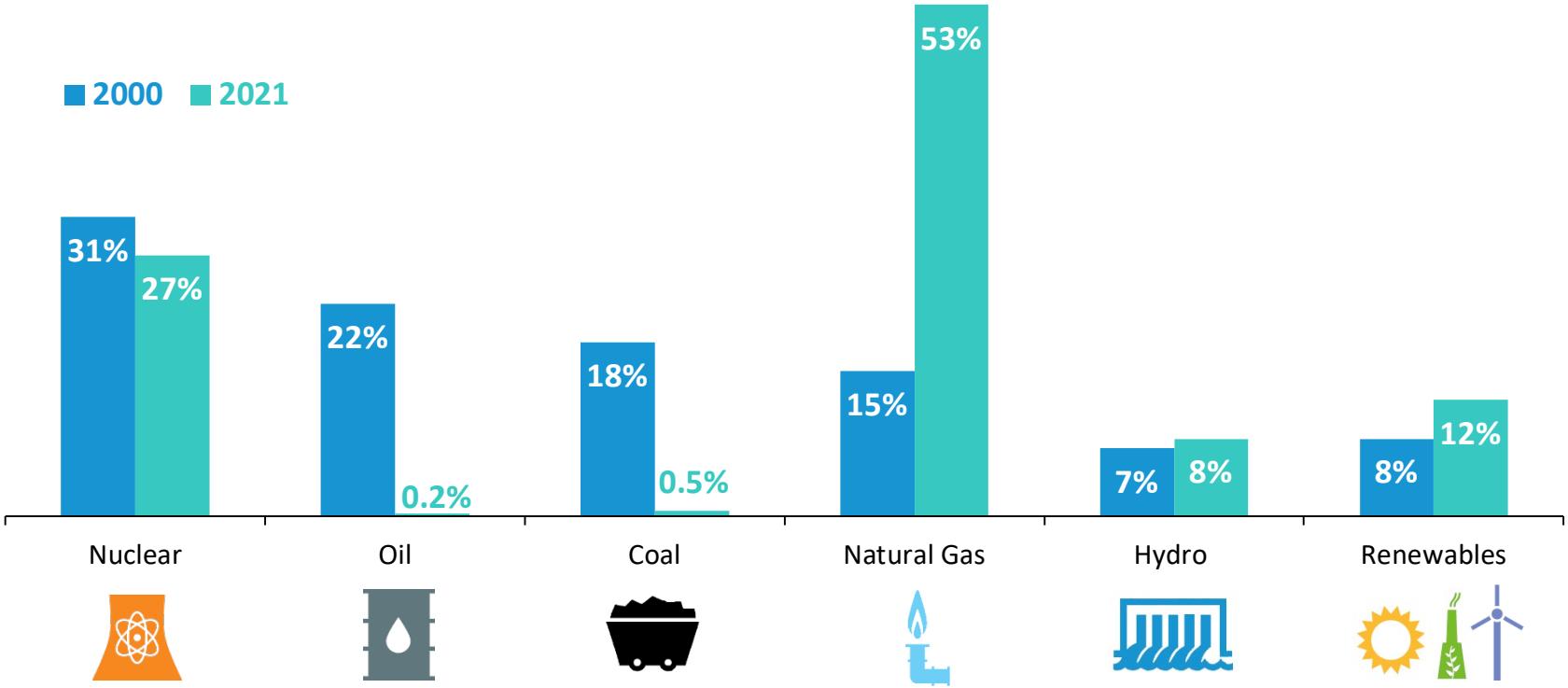


- State policies are driving rapid changes to the grid, and generation and pricing dynamics are expected to shift in the future
  - Forecasts show large growth in distributed energy resources and variable, renewable resources which will eventually become the new "baseload" resource and produce most of the electrical energy
    - But these distributed and renewable resources exhibit significantly different operational characteristics than traditional types of resources
  - Periods of over-generation with zero or negative prices, and under-generation with high prices are anticipated
  - Flexible, balancing resources will be necessary to:
    - Reduce production/increase load during periods of over generation
    - Increase production/decrease load during periods of under generation

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

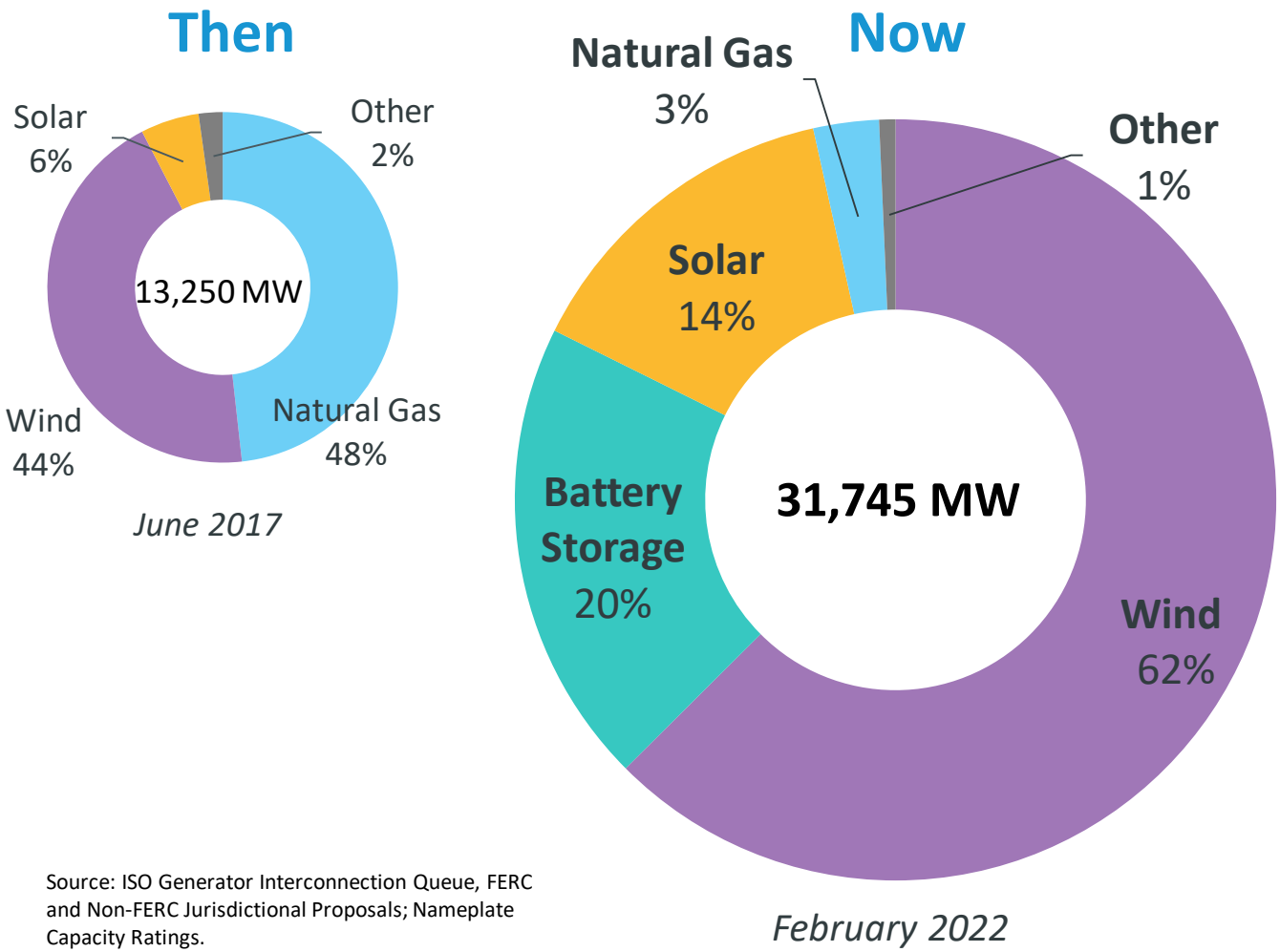
Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2021)



Source: ISO New England Net Energy and Peak Load by Source; data for 2021 is preliminary and subject to resettlement
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.

The ISO Generator Interconnection Queue Provides Snapshots of the Future Resource Mix

Dramatic shift in types of proposed resources from natural gas to wind



Source: ISO Generator Interconnection Queue, FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings.

Offshore Wind

CT	3,600 MW
MA	14,109 MW
ME	12 MW
RI	704 MW

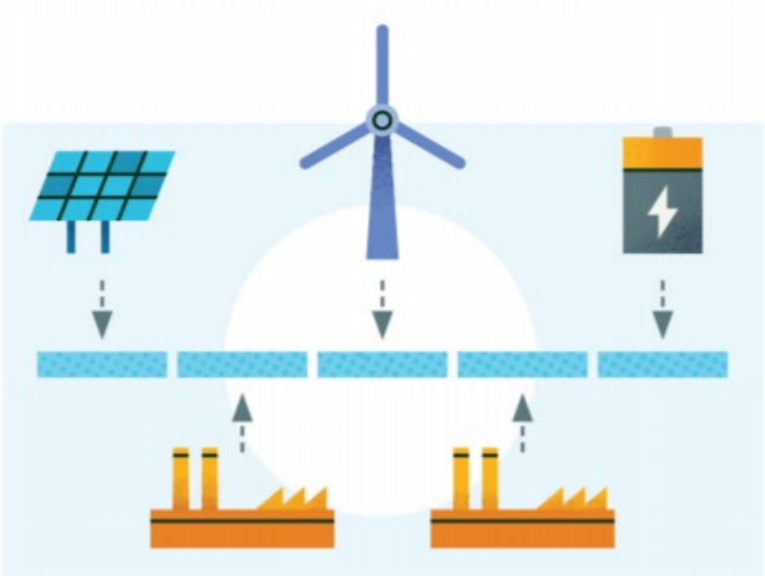
Onshore Wind

CT	4 MW
ME	1,425 MW

New England Will Need Flexible Resources to Balance the Variability of Renewables

ISO is working to adapt both its operations and markets so the grid stays reliable and prices competitive as our energy mix transitions

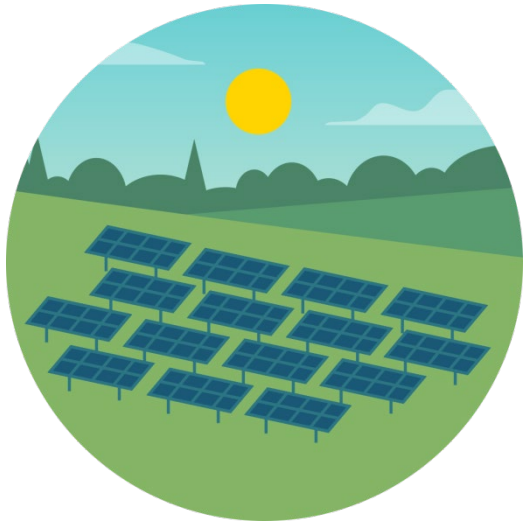
Due to state policies driving change, **variable, renewable resources** will eventually become the new "baseload" resource and produce most of the electrical energy



Balancing resources will be necessary to "fill in" the energy gaps, which may last from seconds to weeks, and occur when renewable resources are not available or are not producing at full capacity

ISO New England Forecasts Growth in Distributed Generation Resources

- Since 2013, the ISO has led a regional **Distributed Generation Forecast Working Group** (DGFWG) to collect data on distributed generation (DG) policies and implementation, and to forecast long-term incremental DG growth in New England
- The DGFWG focuses on the following types of DG resources:
  - Under 5 MW
  - Connected to the distribution system
  - Not visible to the ISO directly
  - Specifically solar photovoltaic (PV) resources, the largest DG component
- The ISO forecasts strong growth in solar PV over the next 10 years

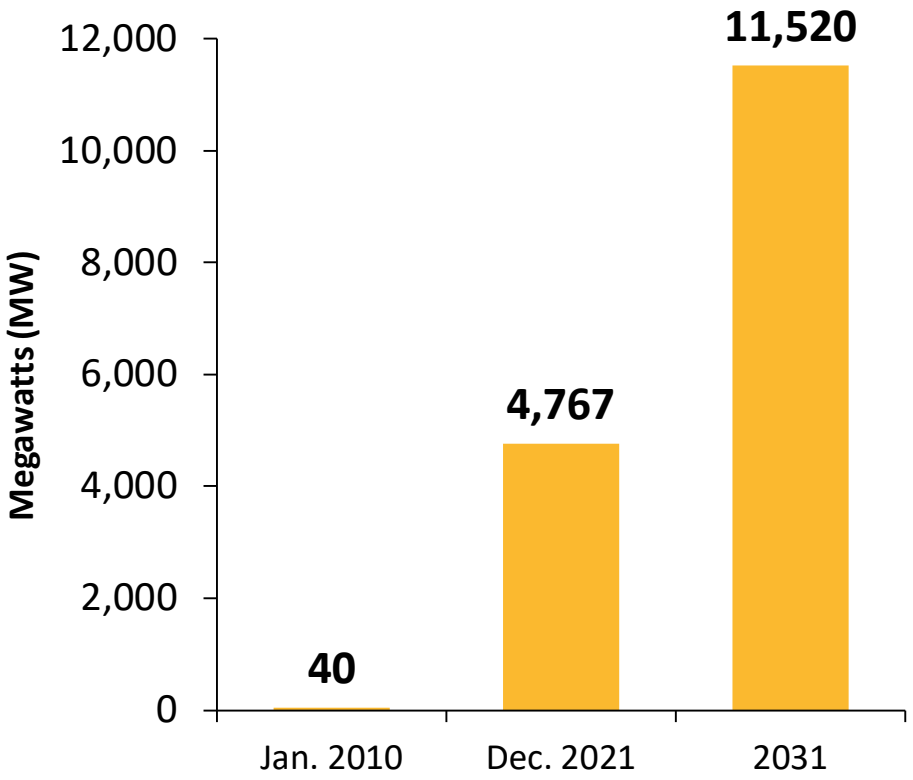


ISO New England Forecasts Strong Growth in Solar Photovoltaic (PV) Resources

December 2021 Solar PV Installed Capacity (MW_{ac})

State	Installed Capacity (MW_{ac})	No. of Installations
Connecticut	809	63,735
Massachusetts	2,953	130,040
Maine	125	7,403
New Hampshire	157	12,186
Rhode Island	288	12,641
Vermont	434	17,296
New England	**4,767**	**243,301**

Cumulative Growth in Solar PV through 2031 (MW_{ac})



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: ISO New England 2022-2031 Forecast Report of Capacity, Energy, Loads, and Transmission (2022 CELT Report) (May 2022), and December 2021 Distributed Generation Survey Results; MW values are AC nameplate.

FERC ORDER NO. 2222

Participation of Distributed Energy Resource Aggregations in Wholesale Markets

Integration of Distributed Energy Resources and Other New Technologies

- The ISO's Order No. 2222 proposal recognizes these dynamics and creates opportunities for Distributed Energy Resources (DERs), bundled together through DER Aggregation (DERA) to respond to market prices
  - The ISO's proposal allows DERA's to provide flexibility by reducing demand, injecting energy, withdrawing energy, and providing regulation in response to market prices
- To comply, ISO/RTOs either need to:
  - Revise their tariffs consistent with specific requirements from the Order, or
  - Demonstrate how current tariff provisions satisfy the intent and objectives of the Order

Key Compliance Directives of Order No. 2222

Order No. 2222 has eleven key compliance directives:

1. Allow DERAs to participate directly in RTO/ISO markets and establish DER aggregators as a type of market participant; DERAs may include more than one technology type, i.e. heterogeneous aggregations
2. Allow DER aggregators to register DERAs under one or more participation models that accommodate the physical and operational characteristics of the DERA
3. Address size requirements for DERAs and individual DERs
4. Address locational requirements for DERAs
5. Address distribution factors and bidding parameters for DERAs
6. Address information and data requirements for DERAs

Key Compliance Directives of Order No. (cont.)

7. Address metering and telemetry requirements for DERAs
8. Establish market rules on coordination between the RTO/ISO, DER aggregator, distribution utility, and Relevant Electric Retail Regulatory Authorities (RERRAs)
9. Address modifications to the list of DERs in a DERA
10. Address market participation agreements for DER aggregators
11. Implement opt-in provision for distribution companies with ≤ 4 million MWh of annual sales

The ISO's proposal

- The ISO's compliance proposal creates two new market participation models and amends several existing models in order to allow the participation of DERAs in the region's energy and ancillary services markets. Further, the proposal amends the tariff in order to allow DERAs to participate as capacity resources in the Forward Capacity Market (FCM).
- In addition, to comply with enumerated FERC directives, the proposal:
  - sets a minimum size of 100 kilowatts (kW) for DERAs;
  - includes an opt-in provision for small electric distribution companies;
  - creates a registration process to allow electric distribution companies to determine whether DERA participation in wholesale markets may pose risks to the safe and reliable operation of the distribution system;
  - and creates a framework to coordinate the real-time operation of DERAs and DERs with electric distribution companies and aggregators.

DERs would be able to participate under existing models or the proposed new models

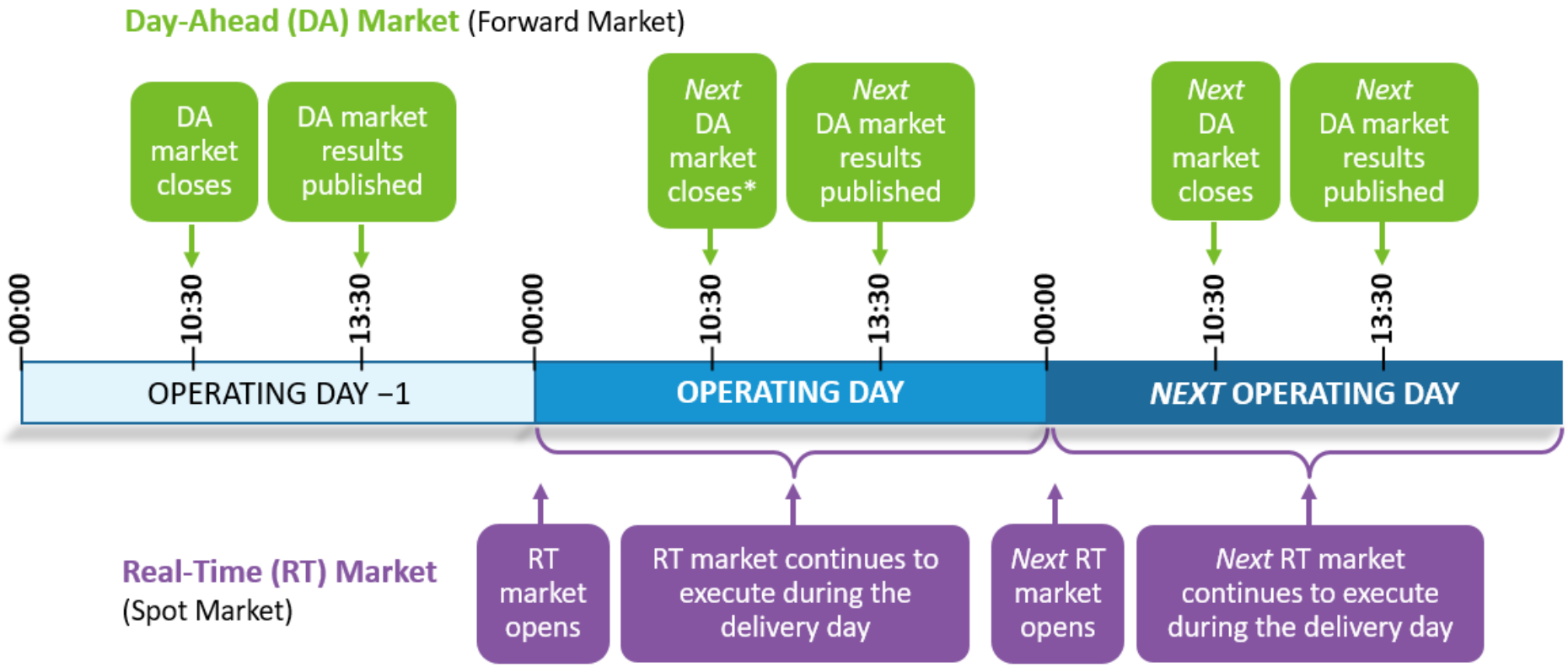
- DERs can currently participate in ISO markets using any of the ISO's existing participation models for which they qualify
- Five ISO-administered markets:
  - Forward Capacity Market
  - Forward Reserve Market
  - Day-Ahead Energy Market
  - Real-Time Energy Market
  - Regulation Market – Eleven ISO-administered market participation models including:
    - Desired Dispatch Point Dispatchable Generator
    - Do-Not-Exceed (DNE) Dispatchable Generator
    - Settlement Only Resource/Generator (SOG)
    - Continuous Storage Facility (CSF)
    - Dispatchable Asset Related Demand (DARD)
    - Demand Response Resource (DRR)
    - Several others
- ISO does not plan to change the existing participation market models with the Order No. 2222 compliance proposal – DERs that are currently participating under the existing models will be unaffected by the proposal
- ISO expects to propose two new models to facilitate heterogeneous aggregations to participate in the markets

General DERA characteristics under the ISO's initial proposal

- A DERA would:
  - Be an aggregation of one or more DERs, depending on the size and location of the DERs
  - Include one technology type or multiple technology types
  - Be generation only, or load only, or generation and load
  - Be settlement-only or dispatchable
  - Could simultaneously participate in wholesale markets and retail programs
- It is the DERA, not the constituent DERs, that would be offered into the markets, potentially dispatched, and settled by the ISO

FERC ORDER NO. 2222 - OPERATIONAL COORDINATION FRAMEWORK

Energy Market Timelines



Operational Coordination Among the ISO, DER Aggregator, and Distribution Utility

- Order 2222 requires establishment of market rules on coordination among the RTO/ISO, DER Aggregator, and Distribution Utilities (DUs)
- The proposed process of ongoing operational coordination mainly includes data flow and communications in
  - Day-Ahead
  - Real-Time
- For purposes of real-time operational coordination, ISO does not typically interact with DUs
  - ISO interactions are typically with Local Control Centers (LCCs)
- It is not anticipated that ISO will require interaction with DUs for the purposes of coordinating real-time DER dispatch
  - Verbal communications regarding DERA dispatch with ISO are anticipated to be via the DER Aggregator or the LCC, when necessary

Proposed Framework Operational Coordination - High Level Overview

- ISO has no visibility of the distribution system, so close coordination and effective communication is critical
- Overview of Coordination Activities
  - DER Aggregators submit aggregation level offers to the ISO
    - offers are inclusive of restrictions due to distribution constraints
  - ISO clears the market and provides aggregation level instructions to DER Aggregators
  - DER Aggregators determine an asset-level operation plan to meet the ISO's instructions
  - DU performs distribution reliability analysis, if necessary, and informs the DER Aggregator of any operating constraints impacting either the asset or the aggregation
  - DER Aggregators update offers in order to reflect any constraints identified by the DU

ISO New England's Order 2222 Compliance Proposal

- On February 2, 2022 the ISO filed its proposal to comply with FERC Order No. 2222 related to Distributed Energy Resource Aggregations (DERAs)
- The Proposal has proposed two effective dates:
  - FCM-related changes would go into effect in Q4 2022, in order to **allow DERAs to participate in Forward Capacity Auction #18 (FCA #18)**
  - Energy and Ancillary Service changes would be effective in Q4 2026, allowing DERAs to be commercial and integrate beginning on June 1, 2027 – the beginning of the FCA #18 Capacity Commitment Period

Newswire Article: ISO-NE files its Order No. 2222 compliance proposal with FERC

For more information: Order 2222 Key Project Page

Looking Ahead: Operating the Future Grid

- New England is moving beyond the goal of ensuring reliability at the lowest cost, state-level policies and legislation have driven the focus and growth in renewable resources
- During the past 10 years, the ISO's goal has been to reduce or eliminate barriers that inhibit participation on both the grid- and wholesale level
  - The ISO has adapted its markets, operations, and planning to prepare for the grid of the future
- In the coming decades, ISO will continue to work to ensure the power system can transform the resources it currently uses and also adapt the transmission system and wholesale markets as consumer demand grows from the decarbonization of other sectors

2021 Regional Electricity Outlook

Questions