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Market Mechanisms

To Support Reliable Operation

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OVERVIEW OF MARKETS

The ISO's Role in Electricity Markets

- The region has both wholesale and retail electricity markets
  - Wholesale costs are approximately 50-55% of total cost to consumers
- ISO's responsibility is to design and administer efficient wholesale markets
  - Design of wholesale markets is managed through a transparent stakeholder process
  - Stakeholder process includes discussions with market participants and states
  - Typical stakeholder process for a medium sized project is 6-9 months and for a large project is 12-18 months (prior to submission to FERC for approval)
- State Public Utilities Commissions design and administer the retail markets

Overview of Wholesale Markets

- New England launched wholesale markets in 1999
  - built upon historical “tight power pool” operating infrastructure
- 88% of New England’s generation is owned by merchant generating companies and not state-regulated utilities
- Wholesale market structure is complete
  - Energy, Ancillary Services and Capacity Markets
  - Demand resources can participate in markets (currently through specific programs, ultimately through full integration in 2017)
- Ongoing reports have shown markets are competitive
  - Annual Market Reports from Internal and External Market Monitors
- More than 400 wholesale market participants

Benefits Achieved

- Improved availability of generation
  - Increased from 81% in 1999 to 89% in 2006
- Cleaner plants have reduced emissions since 2000
  - 7.5% lower carbon dioxide emissions
  - 44% lower nitrogen oxide emissions
  - 65% reduction of sulfur dioxide emissions
- Fuel-adjusted wholesale prices decreased since 2000
- More than $8 billion in private investment in New England
  - Transparent prices help investors identify market opportunities
- More than $6 billion received from sale of power plants has reduced stranded cost throughout New England
- Generation investment risk shifted from consumers
  - Bankruptcies did not affect customers
- Forward Capacity Market attracting new resources

The Wholesale Markets

Energy imbalance managed in this market

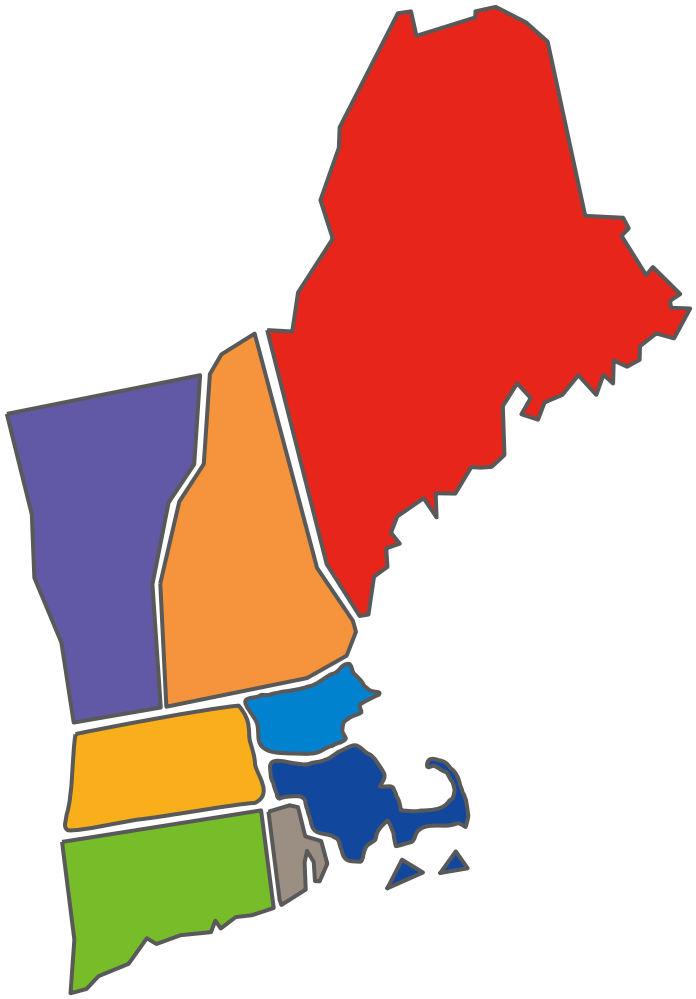
Market	Need Addressed by Market
Electric Energy Markets – Day-Ahead Energy Market & Real-Time Energy Market	Electricity – Day-to-day power
Ancillary Services Market − Forward Reserve Market (FRM) − Regulation − Real-Time reserve prices	Reliability − Reserve Power − Frequency
Forward Capacity Market	Assure long-term power
Financial Transmission Rights	Congestion Management

Energy Markets

- Day-Ahead Energy Market
  - Participants submit:
    - Offers to sell generator output or provide imports for a price
    - Bids to buy or export electricity for a price
  - Day-ahead clearing creates financially binding “schedules” at a clearing price
  - This creates price certainty and strong incentives for Real-Time performance
- Real-Time Energy Market
  - Offers and bids are submitted for actual generation and imports and exports
  - 5-minute pricing rolled up to hourly average
- Only real-time deviations from day-ahead schedules are exposed to/paid the real-time price

Locational Marginal Pricing

- Energy Markets use Locational Marginal Pricing (LMPs)
  - 900+ nodes or points on the system at which prices are calculated
  - Node prices are averaged into eight pricing zones generally corresponding to state boundaries, except Massachusetts, which has 3
- LMPs are made up of energy, congestion, and losses
  - Energy price is the same everywhere
  - Congestion and losses vary
- Market can readily discern congestion and losses, which influences investment decisions



Locations of LMPs

- **Node** – corresponds to a physical bus or collection of buses within the network.
- **Load zone** – aggregation of nodes. Zonal price is the load-weighted average of the prices of all nodes in the zone.
- **Hub** – representative selection of nodes to facilitate long-term commercial energy trading. The hub price is a simple average of LMPs at all hub locations.
- **External/proxy node** – location that serves as a proxy for trading between ISO-NE area and its neighbors.

Energy Component of LMPs

- ISO-NE commits and dispatches generators in economic-merit order
  - Generators with the lowest-price offers are committed and dispatched first; higher-priced generators are brought on-line as demand increases
- ISO's Energy Markets use Uniform Price Auction for price-setting
  - Market-clearing prices are based on the last generating unit needed to meet demand
  - All winners receive the highest price offer
  - Alternative is "Pay as Bid" Auction, in which each winner receives its own bid
  - In 'Pay as Bid', bidders increase bids to their estimate of highest clearing price and lowest cost resources may not be used
  - Uniform Price Auction generally is more efficient and helps ensure that the lowest-cost resources are dispatched

Net Commitment Period Compensation ("NCPC")

- NCPC is a "make-whole" payment to a resource whose hourly commitment and dispatch by ISO-NE resulted in a shortfall between the resource's offered value in the Energy and Regulation Markets and the revenue earned from output over the course of the day
- Typically, this is the result of some out-of-merit operation of resources occurring in order to protect the overall resource adequacy and transmission security of specific locations or of the entire control area
- Each generator is evaluated for NCPC on a daily basis
- The NCPC calculation is performed for the offer and value on the full 24 hour period
  - Costs of certain hours of out-of-merit operation may be recovered through net revenues in other hours during the day

Types of NCPC

Voltage NCPC Payments	Reliability costs paid to resources operated by ISO-NE to provide voltage control in specific locations
Distribution NCPC Payments	Reliability costs paid to units dispatched at the request of local transmission providers for the purpose of managing constraints on the low voltage (distribution) system (Real Time Market only)
2nd Contingency NCPC Payments	Reliability costs paid to resources providing adequate capacity in constrained areas to respond to a local second contingency
1st Contingency NCPC Payments	Reliability costs paid to eligible resources that are not providing 2nd Contingency, Voltage, or Distribution requirements

Reliable Operation Using These Markets

- Contingency analysis performed at regular intervals (every six minutes or on-demand) throughout the operating day.
- Congestion occurs when insufficient transmission capacity is available to implement all of the desired flows simultaneously and still meet reliability criteria.
- FTRs are available as a hedge against such transmission congestion.
- In case adequate resources do not clear the day-ahead energy market, ISO New England, as the Regional Balancing Authority and System Operator will commit out-of-economic-merit resources in order to satisfy load and operating reserve requirements and maintain transmission security of the entire balancing authority area.

Reliable Operation Using These Markets

- The ISO New England System Operator runs a security constrained economic dispatch at regular intervals (every 10 minutes or on-demand) based on actual system conditions
  - Re-dispatches resources based on their real-time energy market offers to ensure secure operation (i.e., path flows are not beyond limits for 1st and 2nd contingencies)
  - Uses the most optimal set of resources to solve the problem.
  - The security constrained economic dispatch signals are sent to resources in real-time resulting in transmission security.
- My opinion – not speaking for the ISO New England:
  - This construct provides a more effective and faster resolution of a real-time reliability problem than curtailing schedules or using remote resources that may be the only ones at the disposal of the responsible balancing authority.

Market Participation by “Demand Response”

- “Demand response” refers to market participants’ reduction of their electricity consumption in exchange for compensation based on wholesale market prices
- Benefits of Demand Response participation:
  - Creates the lowest average prices and total bills over time
  - Improves economic efficiency
  - Promotes customer choice
  - Stimulates investment in load shifting technologies (e.g., energy storage, plug-in electric vehicles)

Ancillary Services

- Ancillary Services are services that ensure the reliability of the transmission of electricity to serve load
- Ancillary Services Markets:
  - Reserve Markets
    - Markets for acquiring operating reserves
  - Regulation Market
    - Market for selecting and paying for generation needed to manage small changes very short term in system electrical load

Reserve Markets

- These markets (forward and real-time) acquire the generating resources that provide replacement electricity when there is a sudden loss of a large generator, or a major transmission line
  - Without resources to replace this sudden loss, load would have to be shed to prevent a blackout
  - The forward market buys reserves in advance
  - The real-time market compensates assets that provide reserves in amounts that vary from those acquired through the forward market
- Types of Reserves
  - 10-minute spinning reserves are provided by resources already synchronized to the grid and able to provide output within 10 minutes
  - 10-minute and 30-minute non-spinning reserves are provided by resources not currently synchronized to the grid but capable of starting and providing output within 10 and 30 minutes

Regulation Market

- Purpose
  - Regulation services, also known as automatic generation control (AGC), allow the system operator to physically balance supply and demand on a minute-to-minute basis
  - Approved generators submit offers to maintain system frequency
    - Area Control Error (ACE) measured every four (4) seconds
      - Determines generation levels and whether operators must increase or decrease output

Other Ancillary Services

- Other specialized ancillary services are bought and sold outside of these markets
  - Voltage support (formally called volt ampere reactive (VAR) support), which allows the New England control area to maintain transmission voltages within acceptable limits
  - Black-start capability, which compensates generators capable of restoring generation to restart the transmission system following a system-wide blackout
- Load is charged for these through the Regional Network Service Charge, which is the charge to transmission customers for use of the system

FORWARD CAPACITY MARKET

Forward Capacity Market (FCM)

- Objective is to procure capacity to meet forecasted requirements (known as the "Installed Capacity Requirement") 3 years in advance
- Auction is held annually to select a portfolio of supply and demand resources
- Resources eligible for Forward Capacity Auction (FCA):
  - Supply Resources
    - Traditional generation (e.g., oil, coal, natural gas)
    - Intermittent/renewable generation (e.g., hydro, wind)
  - Demand Resources
    - Include installed measures that result in verifiable reductions in demand
  - Imports
- Resources must be "qualified" by ISO-NE – meaning it is determined that they can reasonably be expected to be available during the relevant commitment period

Auction Structure

- FCA held 3 years in advance of the commitment year, which begins June 1st each year
  - Third commitment period began June 1, 2012; FCA #7 held Feb. 4-5, 2013
- Resources with capacity obligations obtained in the auctions are paid the auction clearing prices
- FCA includes a Descending Clock Auction
  - At high price there will be more than enough resources to meet capacity requirements of the system and local capacity zones
  - During the auction process, prices will drop
  - As prices drop, some resources will remove themselves from the auction
  - Prices will continue to drop until the point at which lowering the price would cause the supply to no longer meet capacity requirements

Forward Capacity Market Objectives

Sends appropriate price signals to attract new investment and maintain existing resources when and where they are needed – ensuring reliability

- Provide a long-term (up to 5 year) commitment to new supply and demand to encourage investment
- Attract new resources to constrained regions through an additional source of income
- Penalize non-performance when resources fail to provide capacity during a shortage event

Summary FCM Auction Results

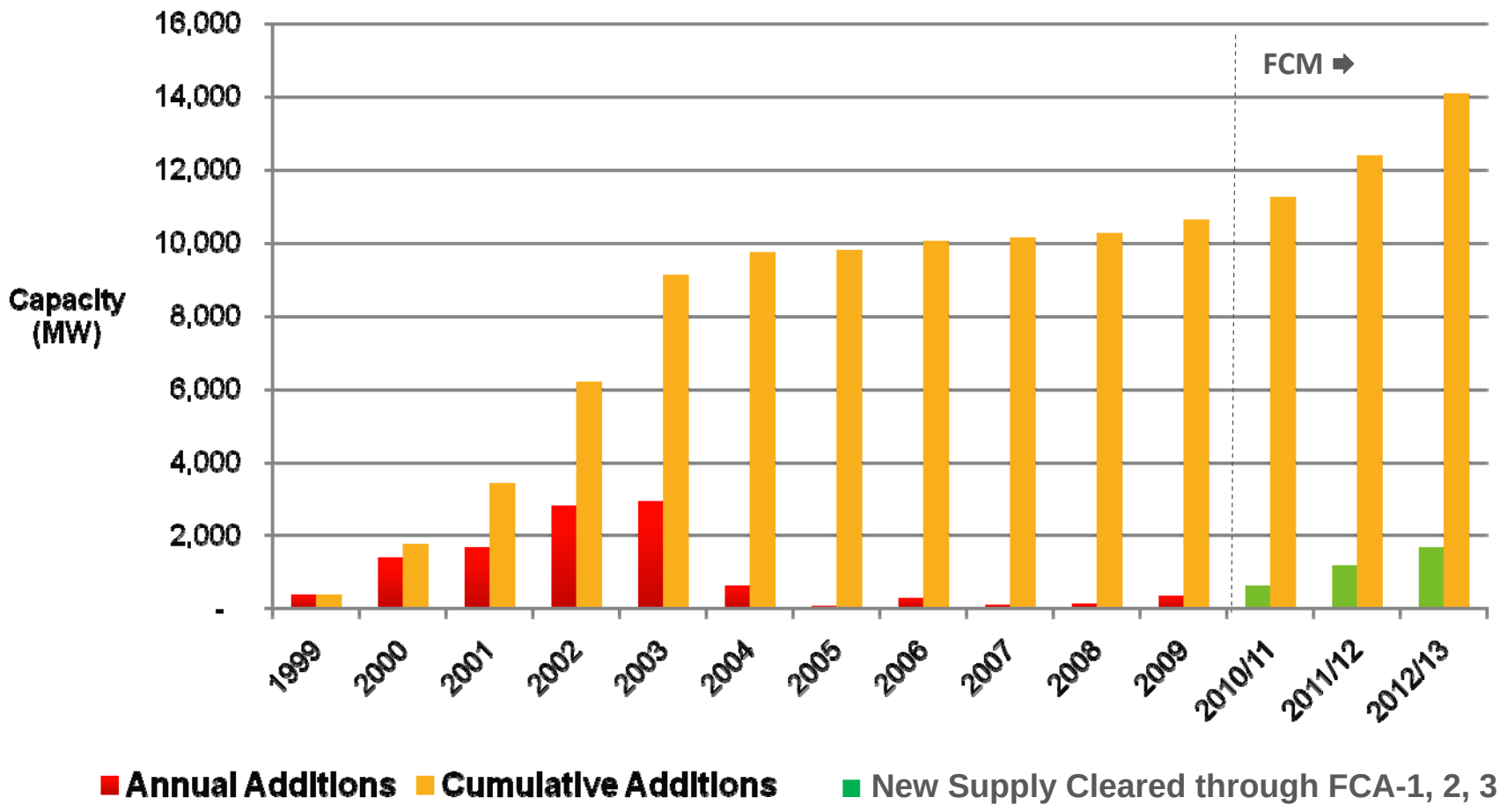
AUCTION	Total Qualified (MW)	Cleared Genrtn (MW)	Cleared DR (MW)	Cleared Imports (MW)	Total Capacity Acquired (MW)	Capacity Required (MW)	Floor Price	Excess Supply (MW)	Prorated Price
FCA-1 (2010/11)	39,165	30,865	2,279	933	34,077	32,305	$4.50	1,772	$4.25
FCA-2 (2011/12)	42,777	32,207	2,778	2,298	37,283	32,528	$3.60	4,755	$3.12
FCA-3 (2012/13)	42,745	32,228	2,867	1,901	36,996	31,965	$2.95	5,031	$2.54
FCA-4 (2013/14)	40,412	32,247	3,261	1,993	37,501	32,127	$2.95	5,374	$2.52
FCA-5 (Initial Results) (2014/15)	40,077	31,439	3,468	2,011	36,918	33,200	$3.21	3,718	$2.86

Notes:

- These are the initial results from each auction; amounts will change with monthly and annual reconfiguration auctions.
- Demand resource totals include a 600 MW cap on real-time emergency generation resources.
- Floor and prorated prices are per kilowatt-month.

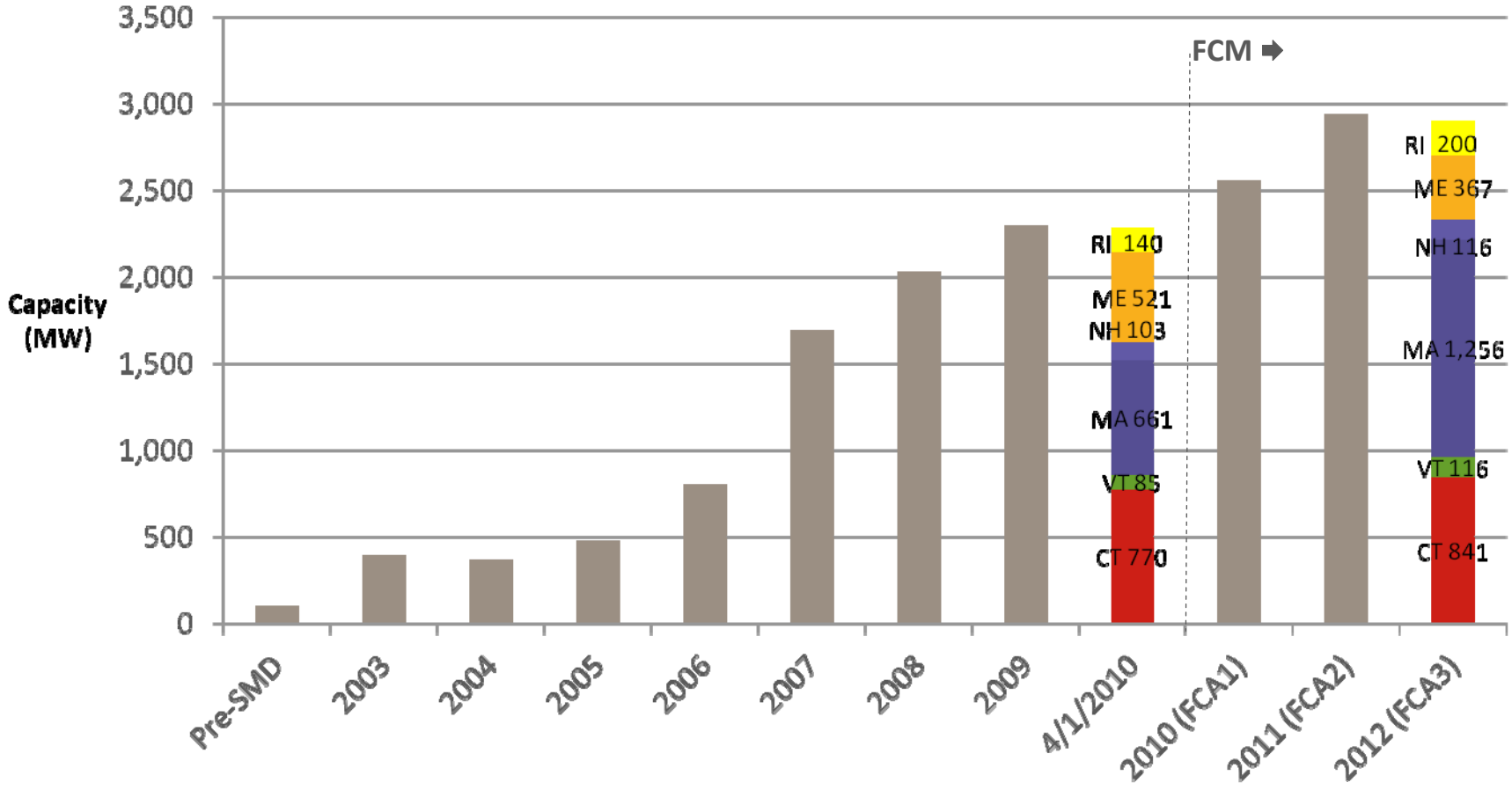
New Generation Additions in New England

10,500 MW Added Since 1999; 3,500 MW Committed for 2010-2012



Demand Resources in New England

Forward Capacity Market Promotes Growth

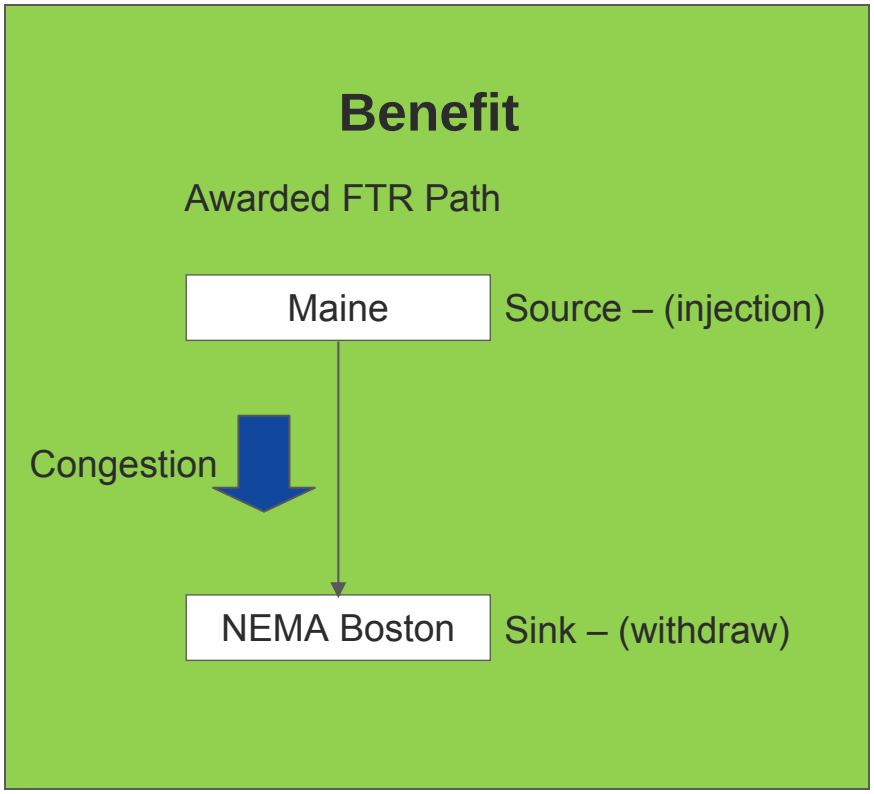
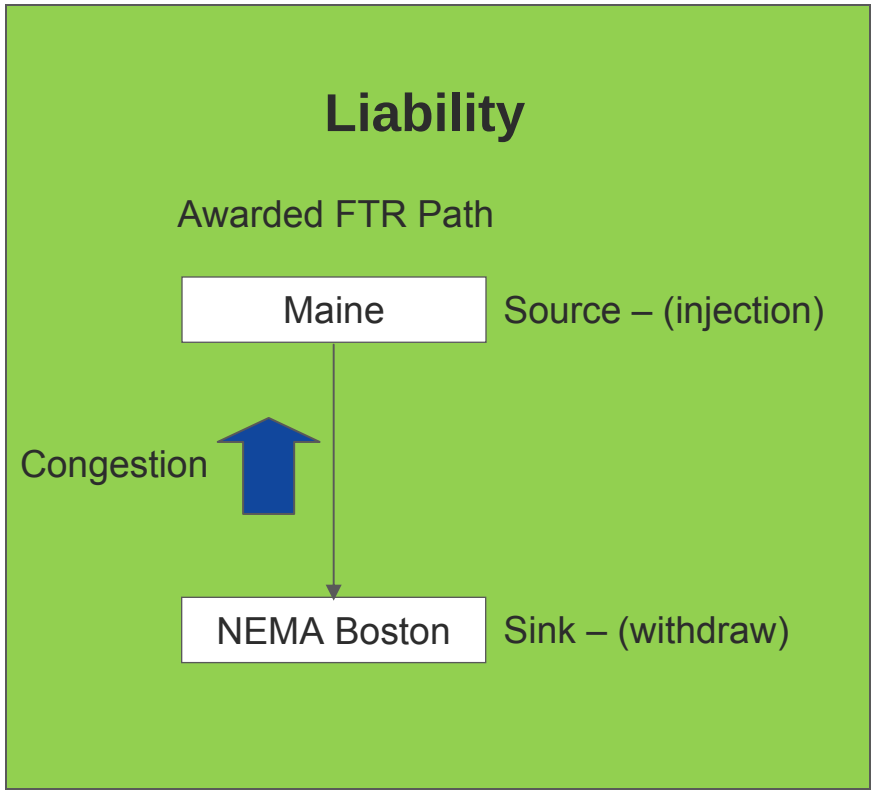


Through 2009: Total DR Enrollment in ISO Programs

2010-2012: Total DR Cleared in FCM (New and Existing)

FINANCIAL TRANSMISSION RIGHTS

Financial Transmission Rights (FTRs)

- FTRs are financial instruments bought at auction to hedge against the effects of day-ahead congestion
  - Congestion occurs when insufficient transmission capacity is available to implement all of the desired flows simultaneously
  - FTRs are “obligations”
- Owning an FTR entitles the holder to a credit or charge based on the locational difference between day-ahead congestion components

FTR Benefit or Liability