

# Overview of New England's Wholesale Electricity Markets

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ISO New England Inc.

# Disclaimer

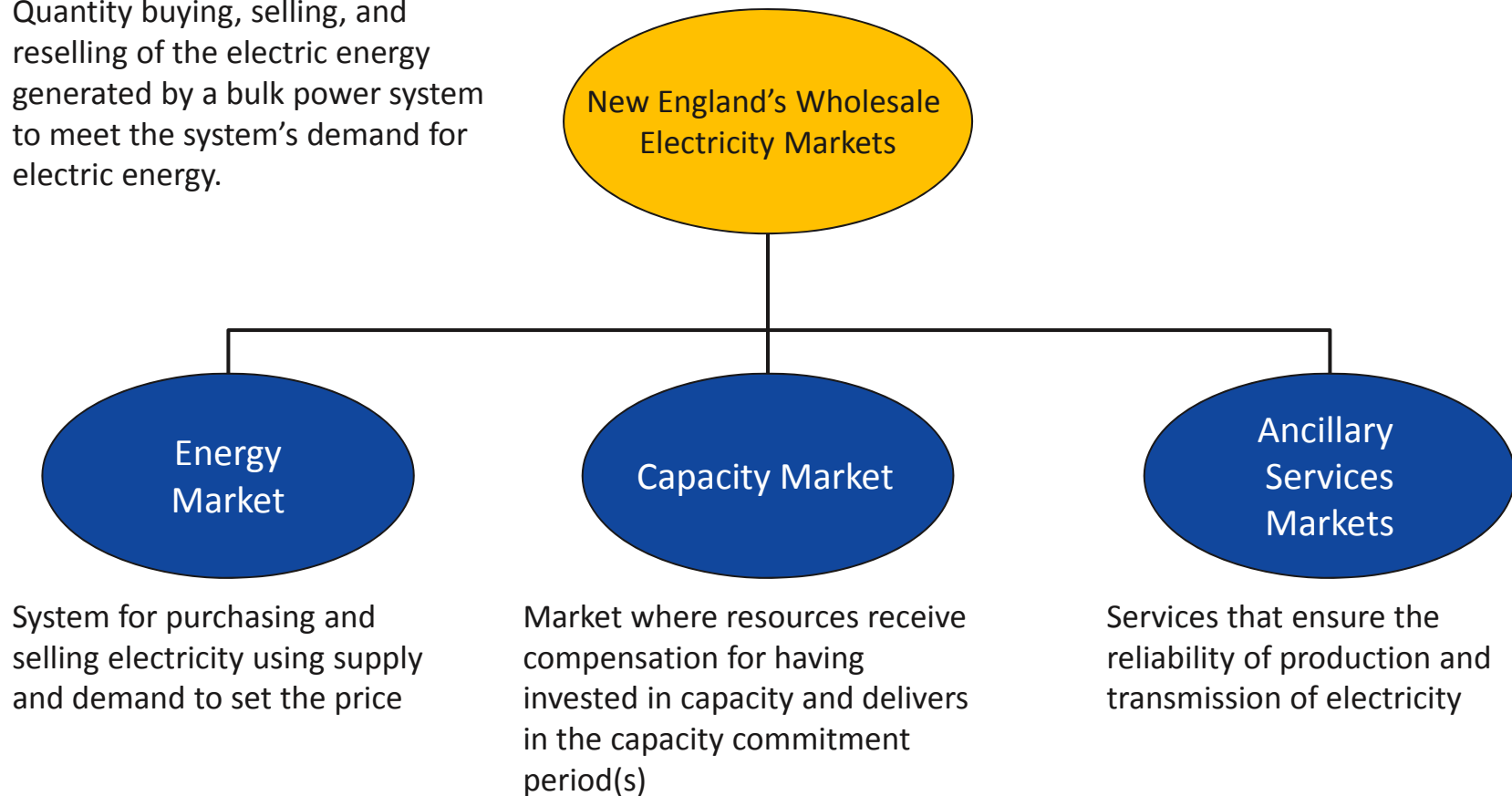
The materials presented are intended as an overview and does not address all the issues and requirements of the Wholesale Electricity Markets operated by ISO New England Inc.

You should not rely solely on this presentation for information, but should consult the effective Markets, Services and Transmission Tariff (“Tariff”) and the relevant Market Manuals, Operating Procedures and Planning Procedures (“Procedures”).

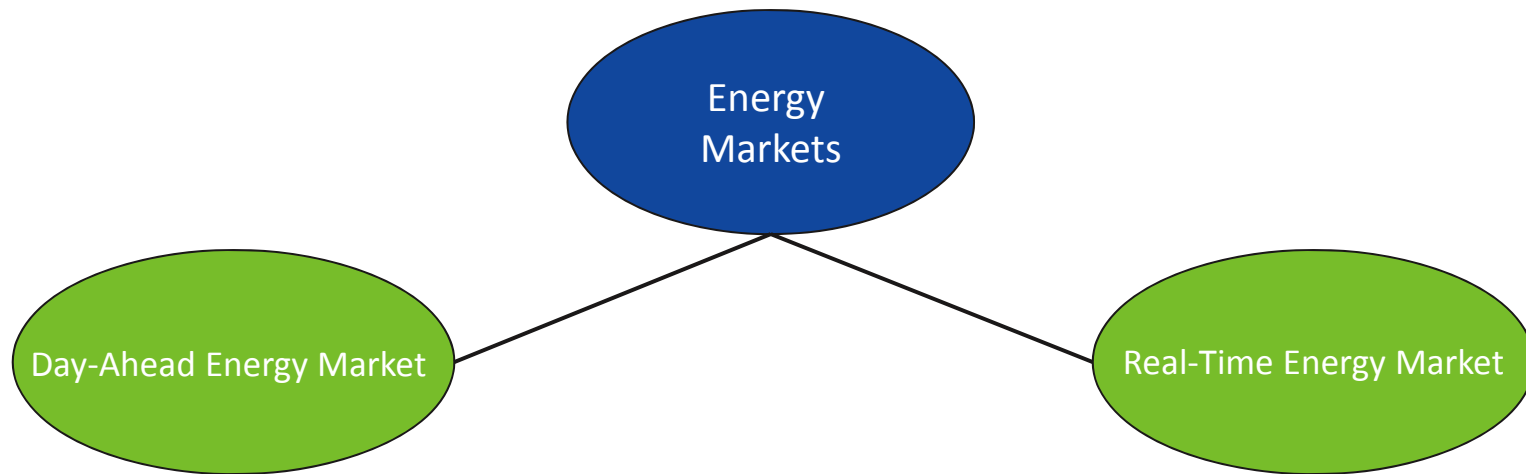
In case of a discrepancy between this presentation and the Tariff or Procedures, the Tariff and Procedures shall govern.

# New England's Wholesale Electricity Markets

Quantity buying, selling, and reselling of the electric energy generated by a bulk power system to meet the system's demand for electric energy.



# Electric Energy Markets



The Day-Ahead Energy Market produces financially binding schedules for the production and consumption of electricity the day before the operating day.

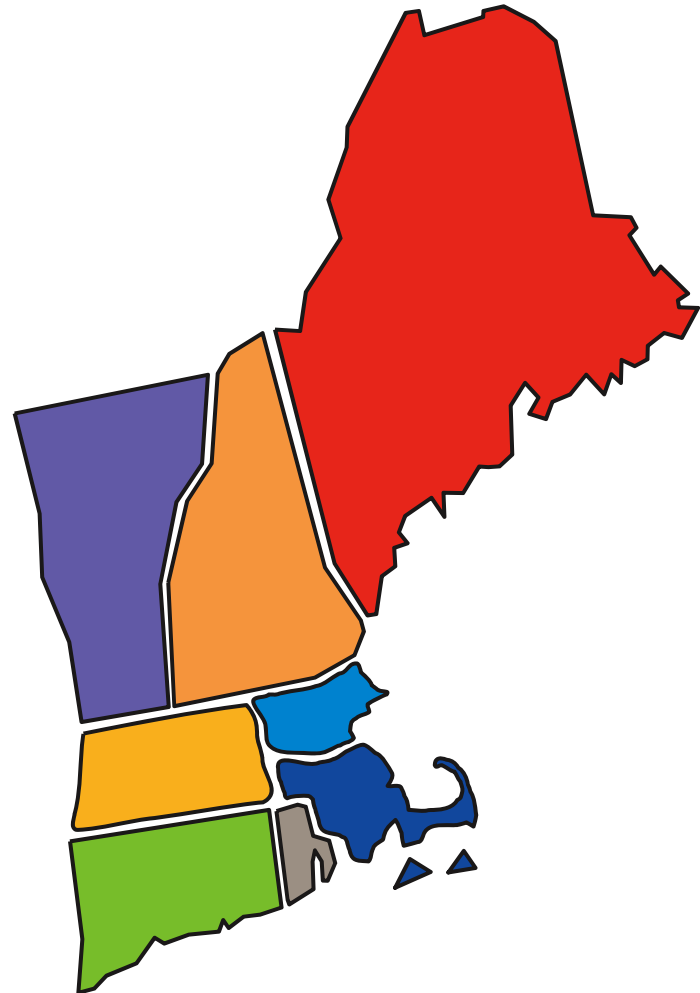
The Real-Time Energy Market balances differences between the day-ahead scheduled amounts of electricity and the actual real-time requirements.

# Economic Dispatch during Day-Ahead or Real-Time Committed Resources

- Objective is to minimize the total cost of producing electricity while keeping the system in balance
- Economic dispatch uses the least-cost resources in a single period (hourly in the Day-Ahead Energy Market, 10-minutes in the Real-Time Energy Market) to meet the demand
- New England assesses hourly resource costs and establishes the wholesale cost of energy based on a **uniform clearing price** auction

# Locational Marginal Pricing

- Hundreds of regional price points help establish wholesale prices
- Since 2003, the Energy Market features locational marginal pricing (LMP)
- Prices are made up of energy, congestion, and losses

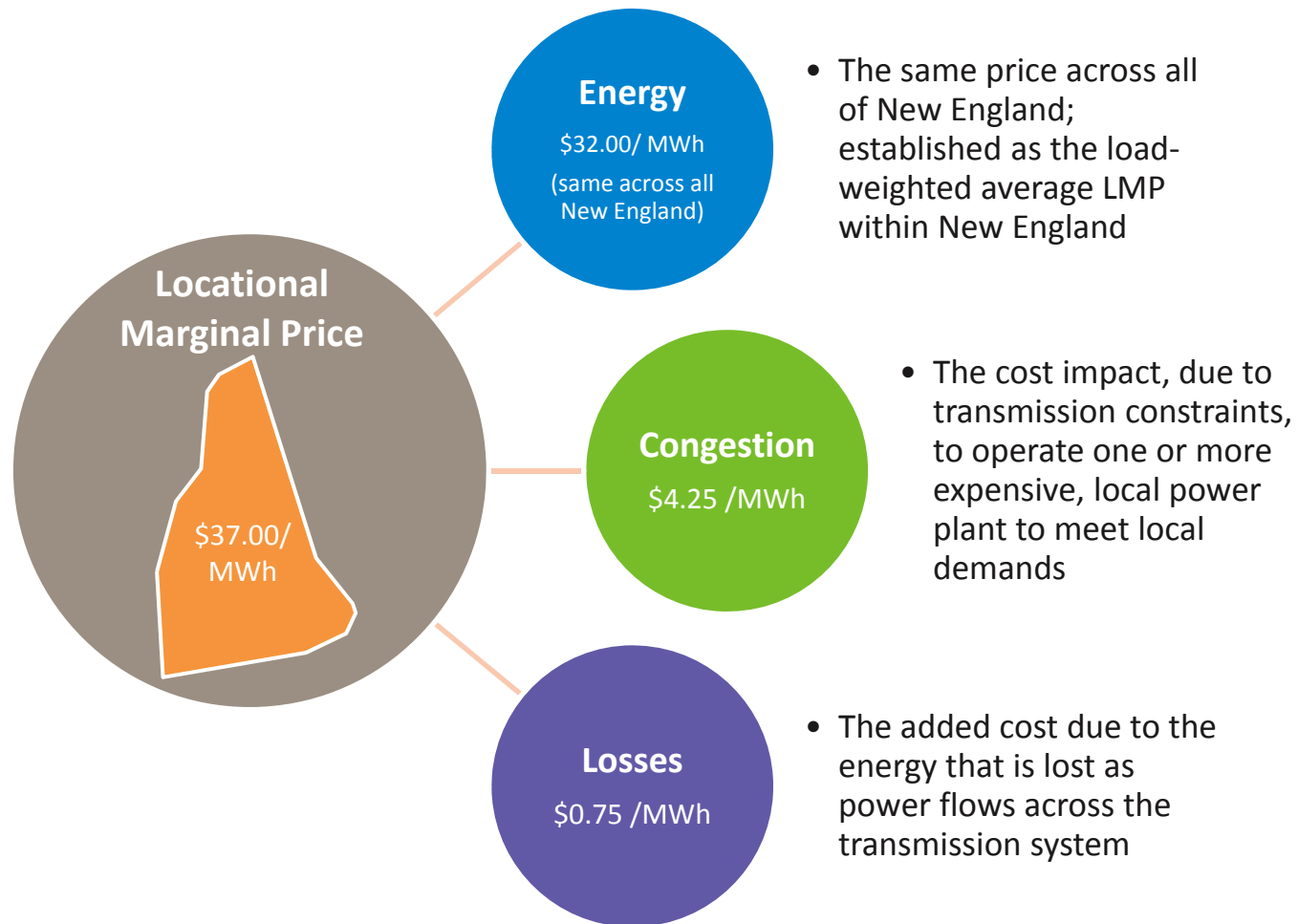


# Essential Features of the Energy Markets

- Nodes
  - 900+ specific pricing locations across New England
  - Generators are paid at their individual nodal price, which is unique for each modeled generator
- Zones
  - Eight load zones
  - Vast majority of load settles at zonal price
  - Zonal price is load-weighted average of nodal prices within a zone
  - 19 Dispatch zones for dispatching active Demand Resources
- Hub
  - Predefined node; straight average of 32 nodal prices
  - Hub was created to support bilateral trading

# The Elements of LMP

*Energy, Congestion, and Losses Reflect Local System Conditions*



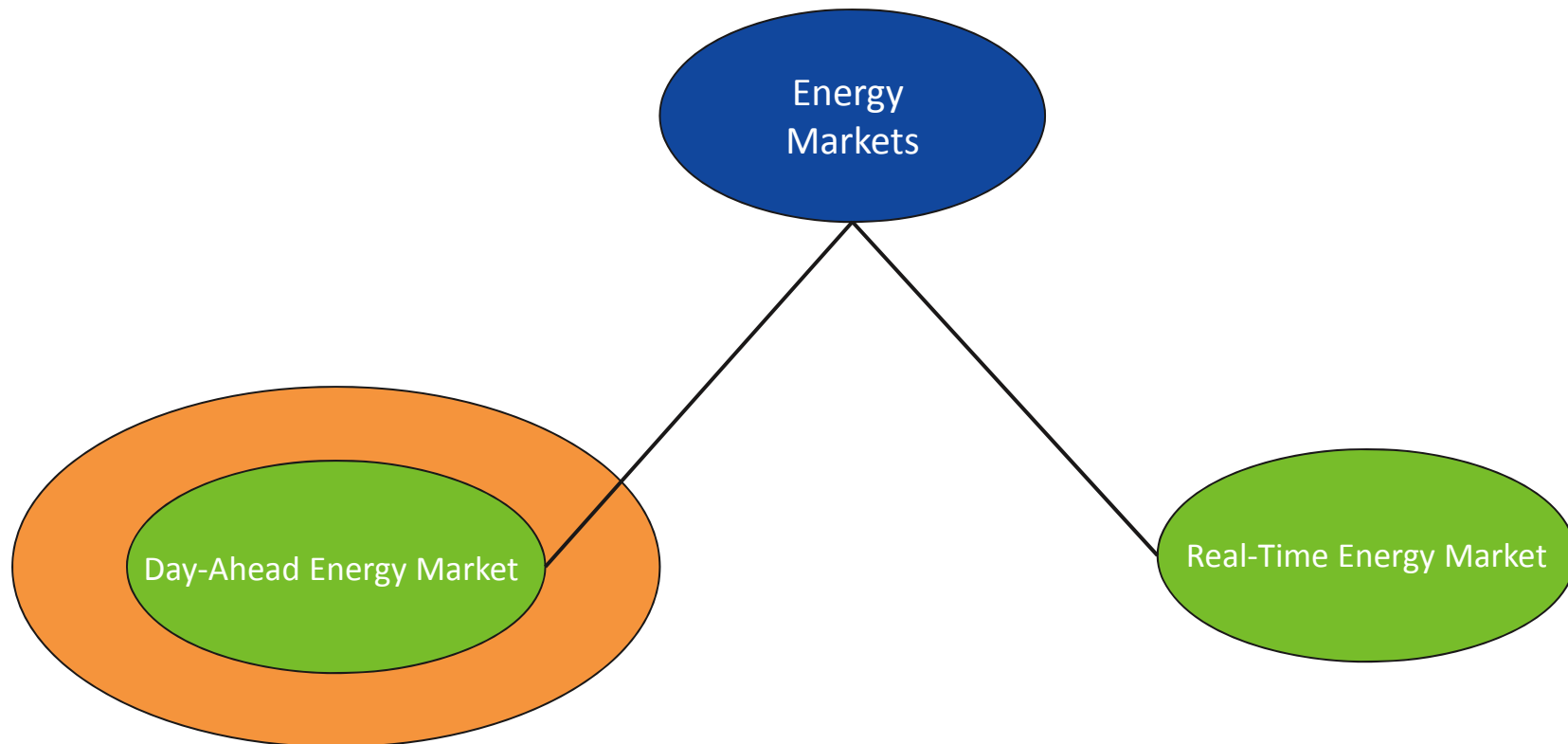


# Day-Ahead Market (DAM)

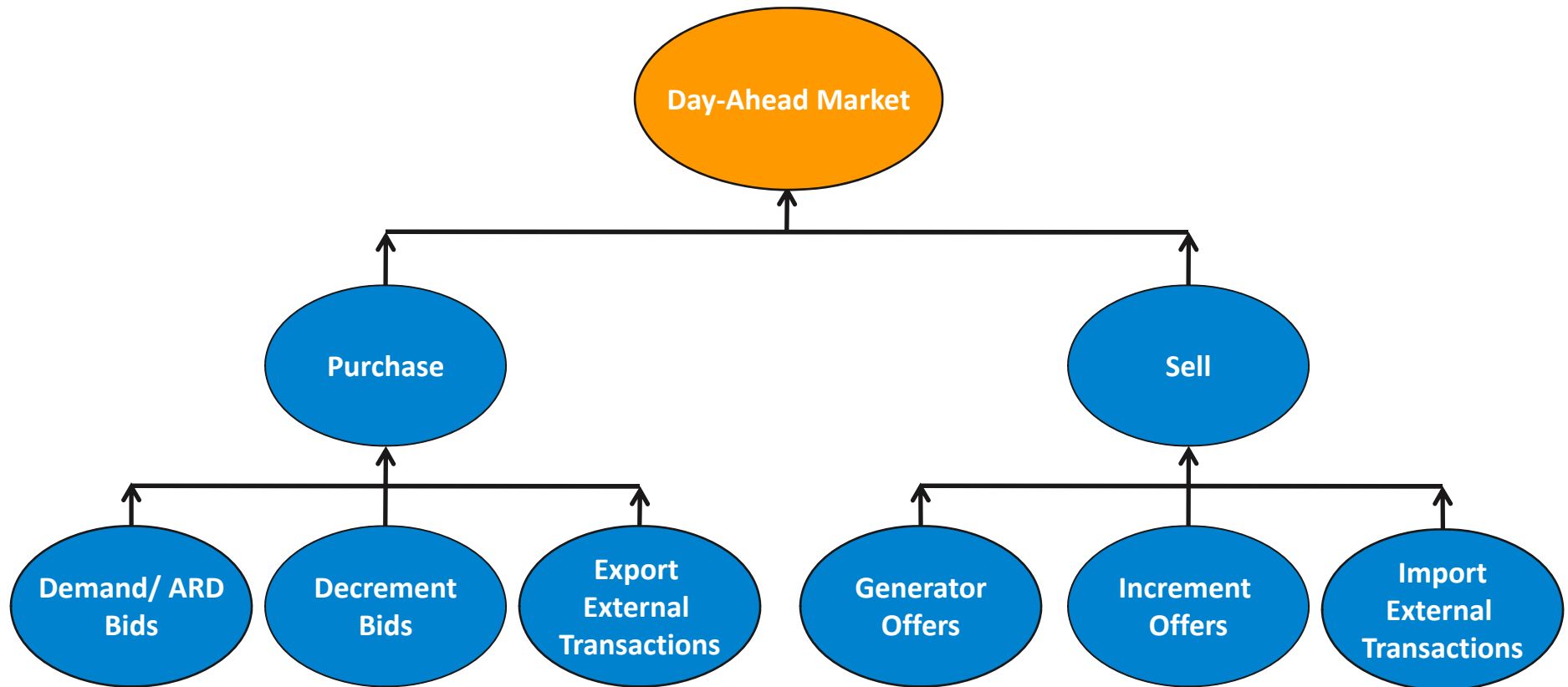
- A forward market to hedge against Real-Time (RT) price volatility
  - Allows Generation and Load Participants to secure Day-Ahead (DA) prices and reduce vulnerability to RT price fluctuations
  - Allows wholesale demand to participate in price determination
  - Provides a starting point for the initial unit commitment for the next operating day

# New England's Electric Energy Markets

## *Day-Ahead Energy Market*

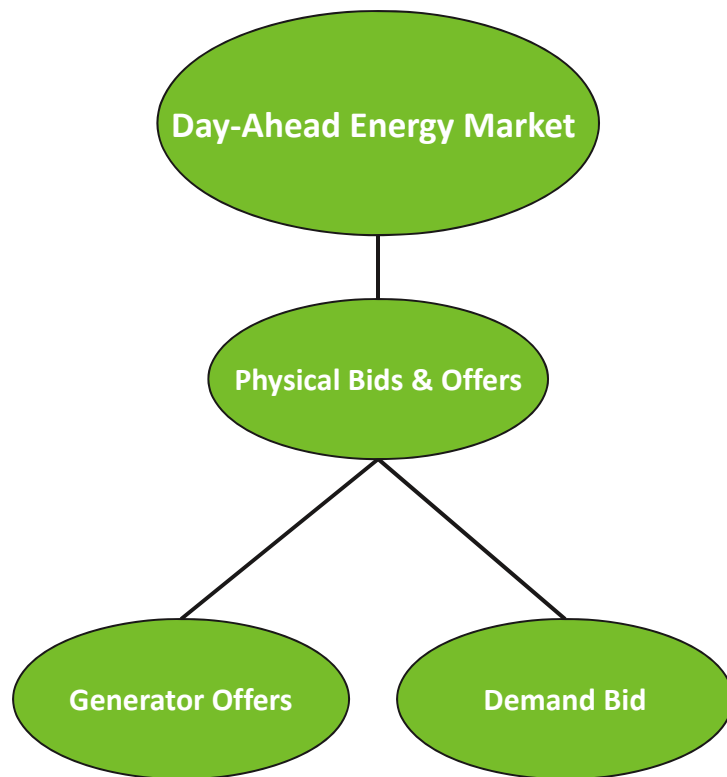


# DAM Participant Inputs



# Inputs to Day-Ahead Energy Market

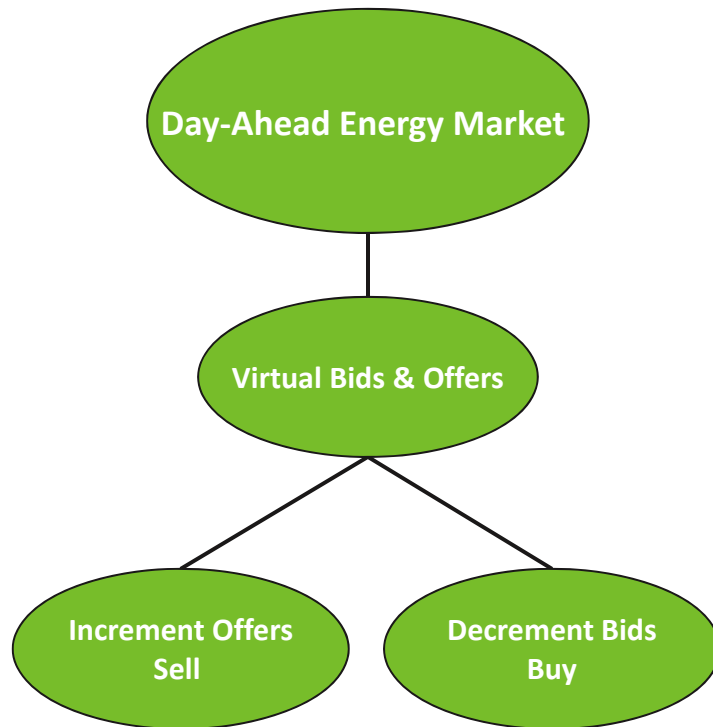
## *"Physical" Transactions*



- Tied to actual physical injections or withdrawals expected in the Real-Time Energy Market
- Allows participants an opportunity to establish a position in the financial market
- Generator offers - submitted information contains incremental energy offers in \$/MWh, also may contain fixed costs and parameters which contain attributes about the generator (minimum run time, maximum output, etc.)
- Demand bid - a bid to procure electricity at a specified load zone in the Day-Ahead Energy Market; demand bids must be associated with expected consumption in real-time

# Inputs to Day-Ahead Energy Market

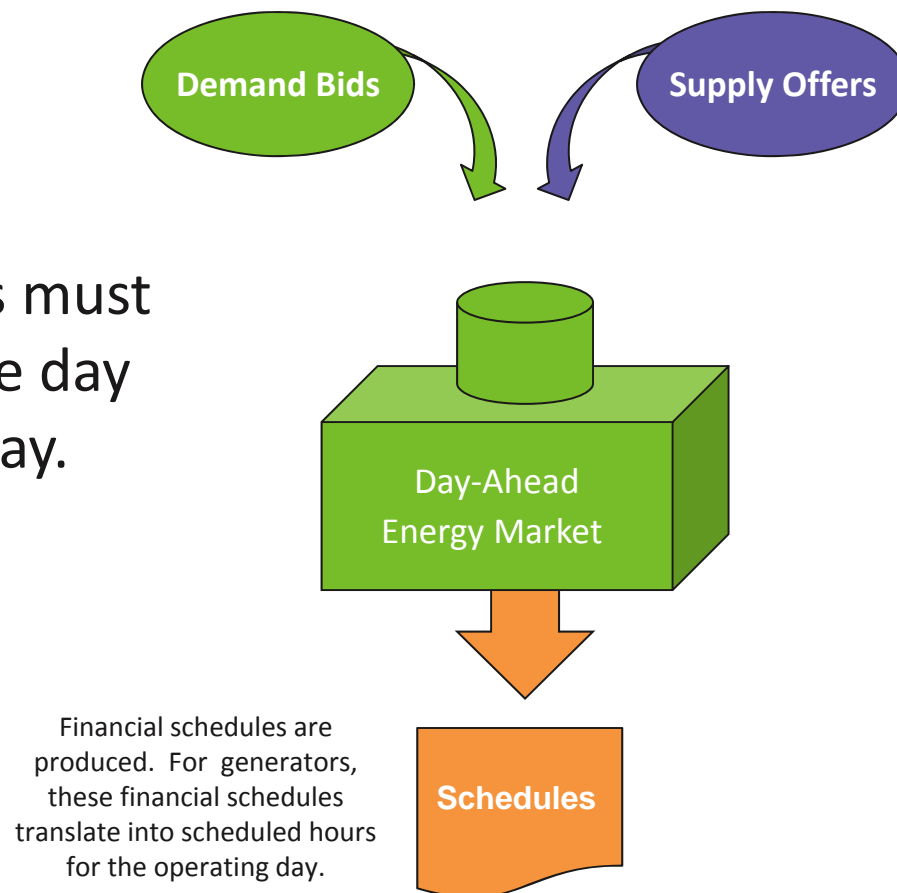
## *Virtual Transactions*



- Virtual transactions are not tied to physical delivery of electricity
- Allows participants an opportunity to establish a position in the electricity market
- Increment offer (INC) - a financial offer to sell electric energy at a specified location in the Day-Ahead Energy Market; virtual supply
- Decrement bid (DEC) - a financial bid to buy electricity at a specified location in the Day-Ahead Energy Market; virtual demand not associated with a physical load

# Inputs to Day-Ahead Energy Market

Day-ahead bids and offers must be submitted by noon the day before the operating day.

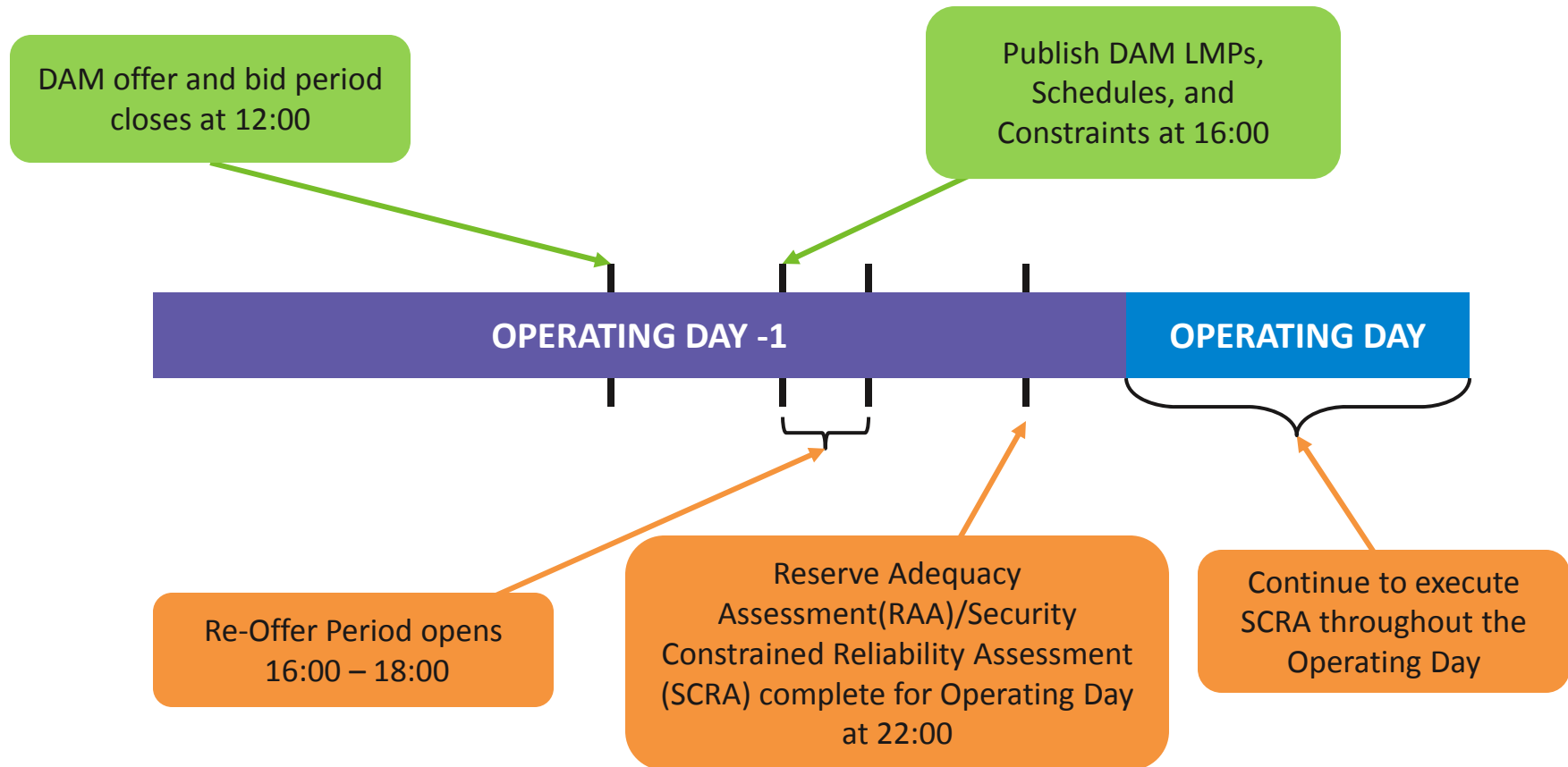


# Outputs of Day-Ahead Energy Market

- Schedule of commitments for next operating day (generation and external transactions)
- Day-ahead hourly LMPs
- Day-ahead settlement is based on the day-ahead prices and quantity that cleared
- Outputs occur by 4:00 p.m. (before operating day)

# Market Timelines

## Day-Ahead Market (DAM)

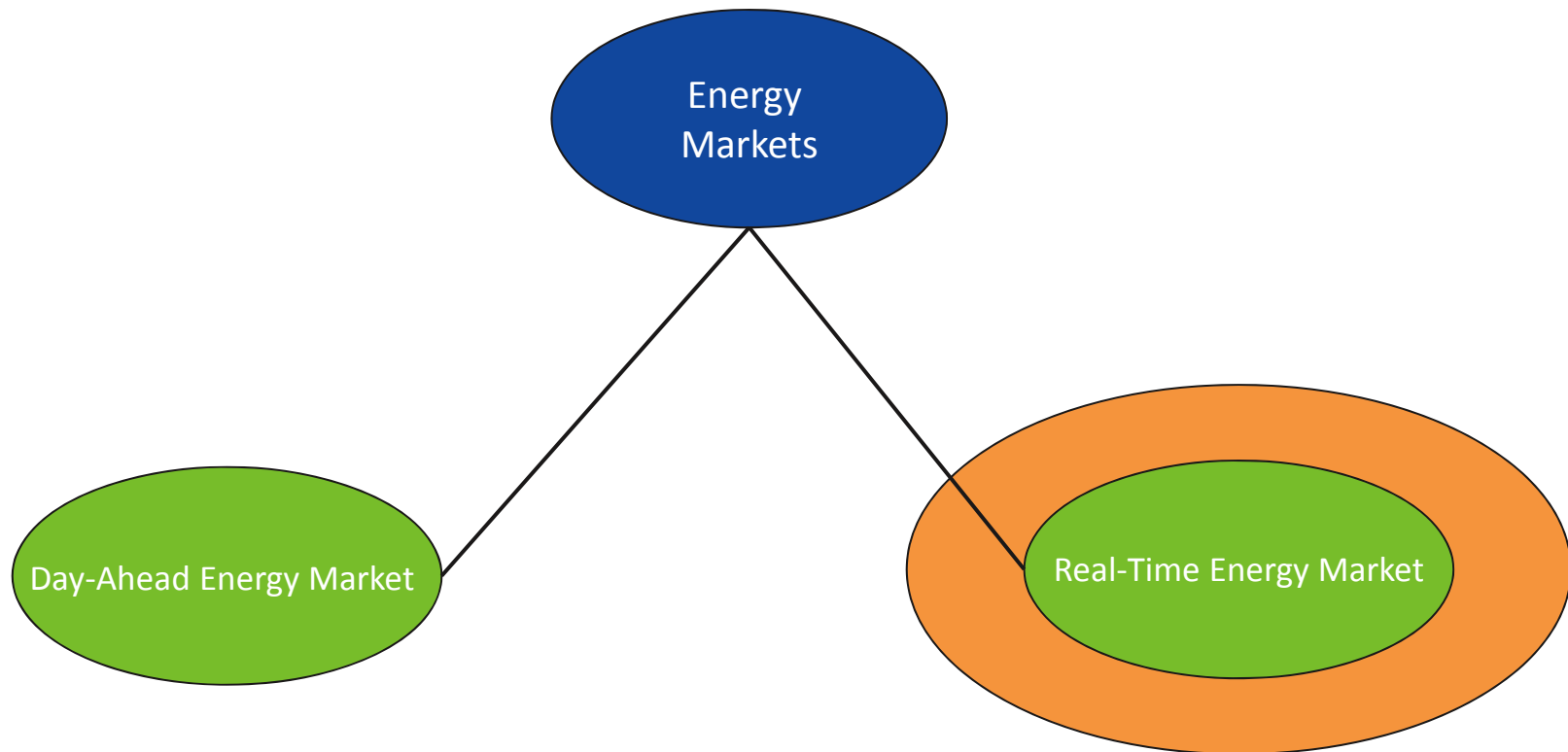


## Real-Time Market (RTM)



# New England's Electric Energy Markets

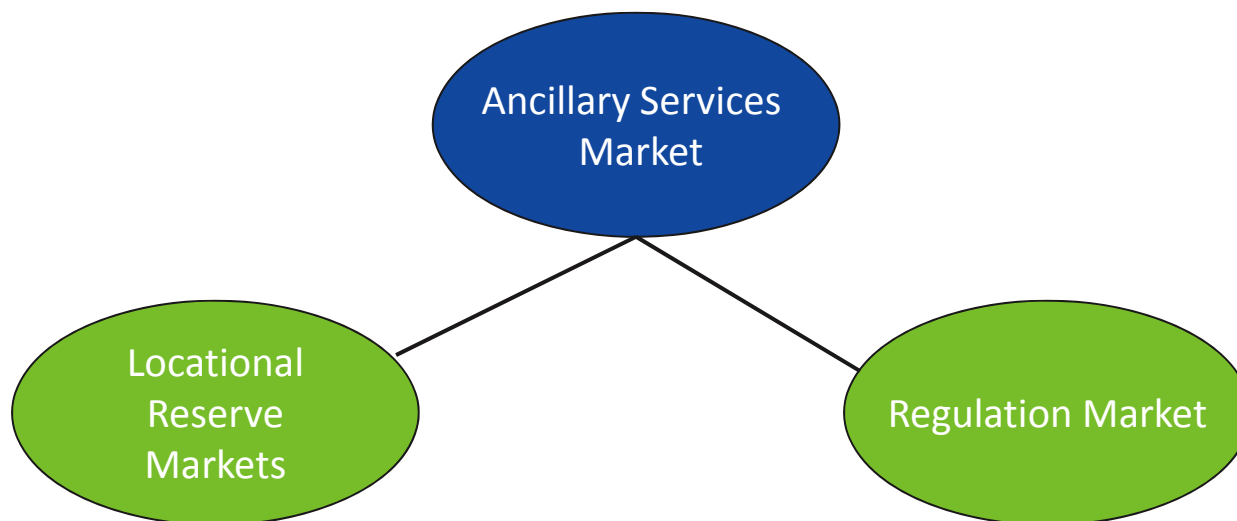
## *Real-Time Energy Market*



# Real-Time Energy Market

- Inputs – Reoffer Period between 4:00 - 6:00 p.m. (day before)
  - Actual system operating conditions
    - Metered load, generation, tie-line flows, etc.
    - Actual External Transactions
- Outputs
  - RT Hourly Commitment Schedules are produced after 6:00 p.m. (day before)
  - RT Dispatch signals are sent to generators (and dispatchable load) throughout the day (as often as five-minute updates)
  - RT hourly LMPs based on actual operating conditions
  - RT Settlement
    - Based on deviations between DA schedule and actual operations

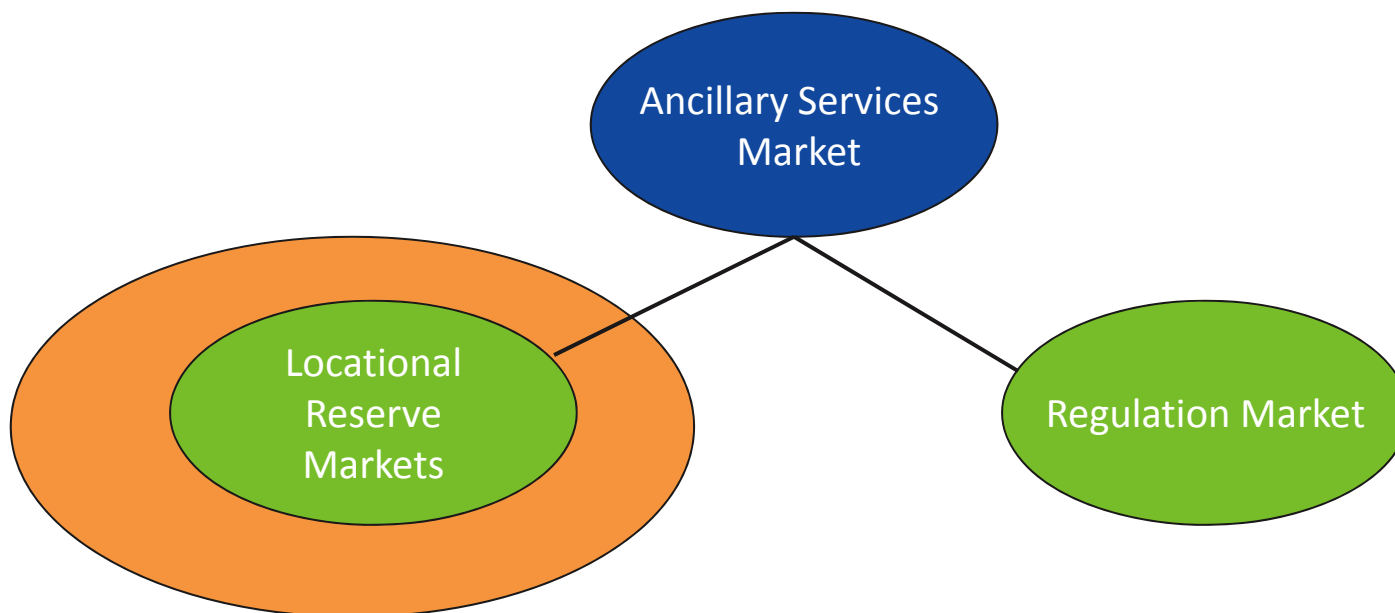
# Ancillary Services Markets



# Ancillary Services Markets

- Services that ensure the reliability and support of the transmission of electricity to serve load, including:
  - Locational Forward Reserve Market
    - Market for acquiring off-line operating reserves
  - Real-Time Reserves Market
    - Market for compensating operating reserves during real-time when supplies are limited
  - Regulation Market
    - Market for selecting and paying for generation needed to manage small changes in system electrical load

# Ancillary Services Markets



# Ancillary Services Markets

## *Forward Reserve Market*

- Compensates resources that will be used as operating reserves
  - Operating reserves are needed when there is a sudden loss of a large generator or a major transmission line during on-peak periods, both system-wide and in smaller load centered areas
- Without resources to replace this sudden loss, load would have to be shed to prevent a blackout

# Ancillary Services Markets

## *Forward Reserve Market (cont.)*

- Services procured
  - 10-minute non-spinning reserves (TMNSR) generally provided by resources not currently synchronized to the grid but capable of starting and providing output within 10 minutes
  - 30-minute reserves (TMOR) generally provided by resources not currently synchronized to the grid but capable of starting and providing output within 30 minutes

# Ancillary Services Markets

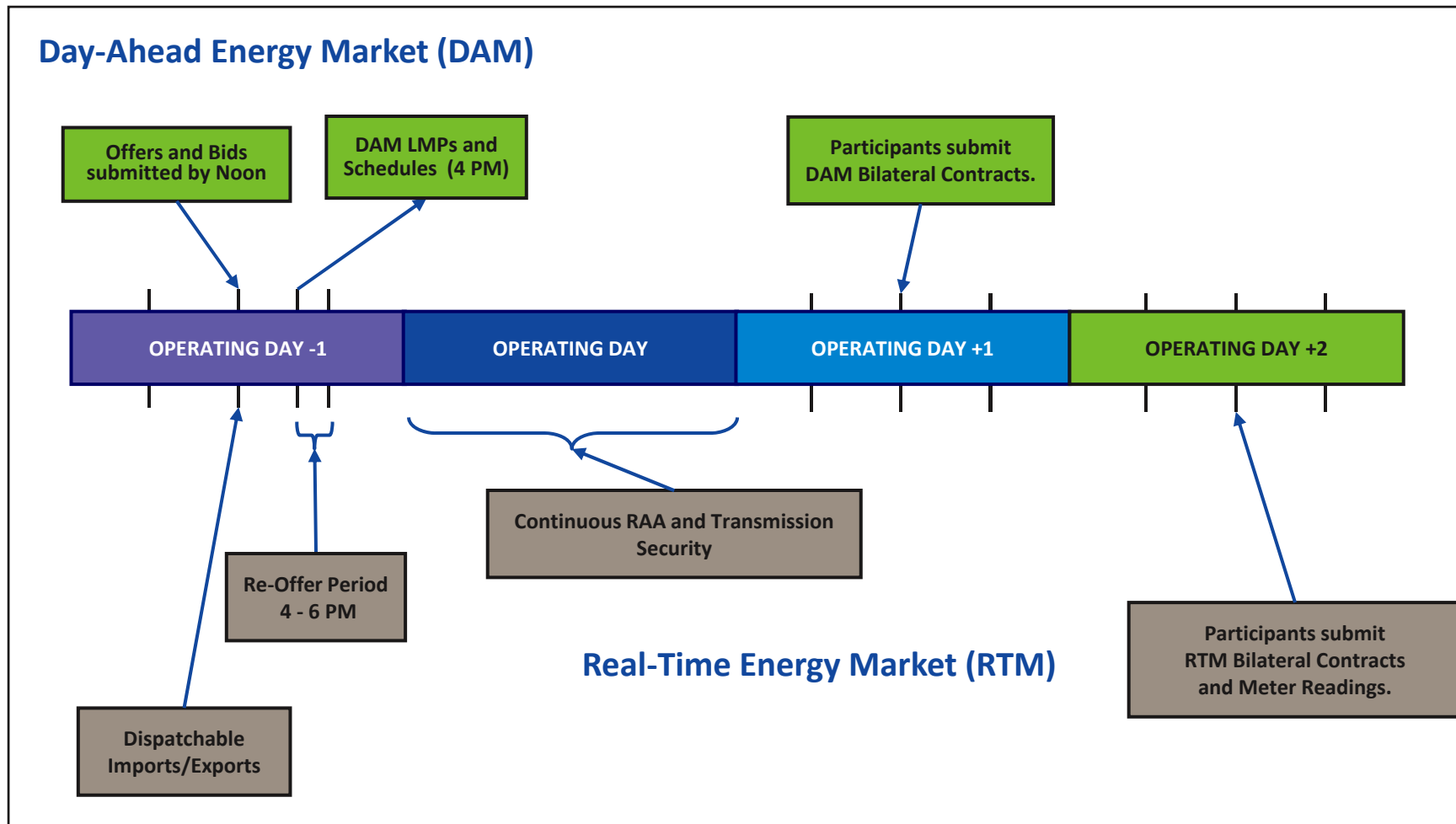
## *Real-Time Reserve Market*

- A market used to compensate resources that were used as operating reserves
  - Operating reserves are needed when there is a sudden loss of a large generator or a major transmission line during all periods
- Without resources to replace this sudden loss, load would have to be shed to prevent a blackout
- This market has no bids/offers and uses lost opportunity costs of reserve resources or penalty pricing to set the uniform clearing prices

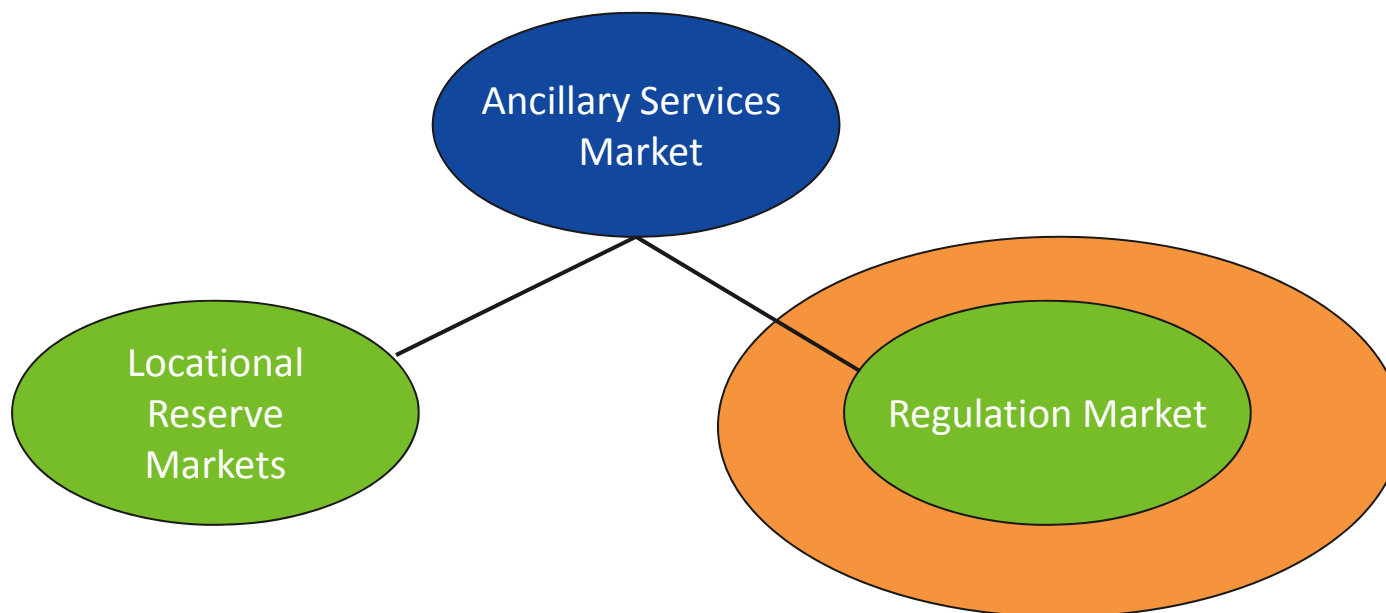


# Day-Ahead and Real-Time Energy Market

## Timelines



# Ancillary Services Markets



# Ancillary Services Markets

## *Regulation Market*

- Regulation service, also known as automatic generation control (AGC), allows the system operator to physically balance supply and demand and maintain frequency as close to 60 Hz as possible
- Approved generators submit offers
- Area Control Error (ACE)
  - Measured every four seconds
  - Determines generation levels (increase or decrease output)

# Comparison of Physical and Reliability Needs to New England Market Tools

Physical & Reliability	Market Tools
Electricity <ul style="list-style-type: none"><li>• Day-to-day power</li></ul>	Electric Energy Market <ul style="list-style-type: none"><li>• Day-Ahead Energy Market &amp; Real-Time Energy Market</li></ul>
Reliability <ul style="list-style-type: none"><li>• Reserve power</li><li>• Frequency</li><li>• Voltage support</li><li>• Black start capability</li></ul>	Ancillary Services Market <ul style="list-style-type: none"><li>• Forward Reserve Market (FRM)</li><li>• Regulation</li></ul>
Congestion Management	Financial Transmission Rights
Assure long-term power	Capacity Market <ul style="list-style-type: none"><li>• Forward Capacity Market</li></ul>

# Wholesale Electricity Markets

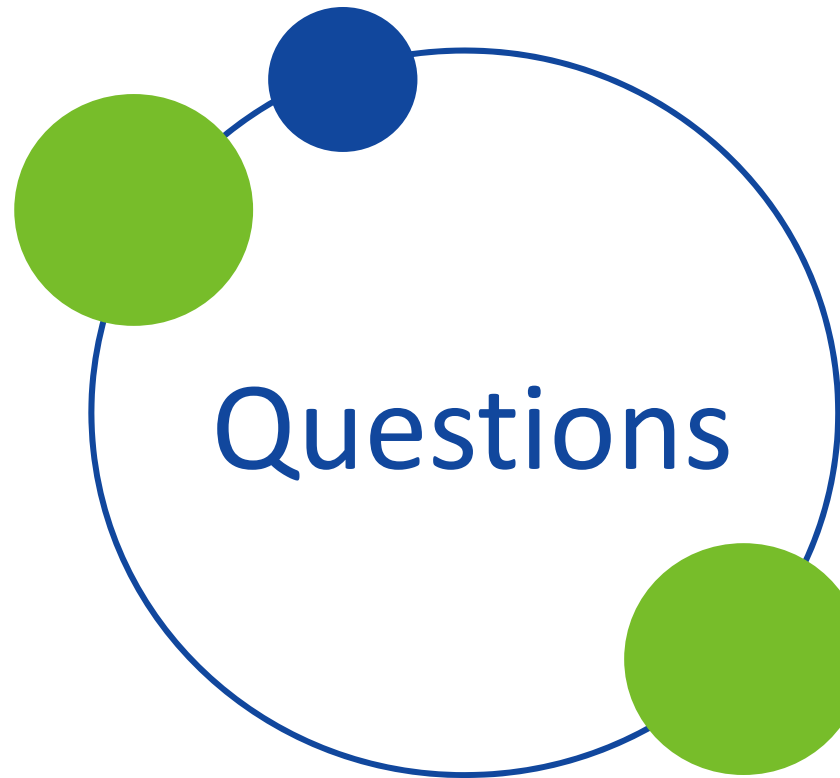
## Wholesale Electricity Markets

The purchase and sale of electricity from generators to resellers (marketers and retailers), along with the ancillary services needed to maintain reliability and power quality at the transmission level.

- FERC assures “just and reasonable” prices at the wholesale (production and transmission) level.

## Wholesale Competition

A system whereby a marketer or distributor of power would have the option to buy its power from a variety of power producers, and the power producers would be able to compete to sell their power to a variety of marketers and distribution companies.



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Find other information on our site: [www.iso-ne.com/Support/Training/TrainingMaterials](http://www.iso-ne.com/Support/Training/TrainingMaterials)  
Coming soon (anticipated by mid-June, 2011), web-based modules for Supply Resource and Demand Resource Operator Training courses recently held.