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USAID/NARUC East Africa Regional Regulatory Partnership Exchange:

Regional Power Trade in New England

Andrew Greene
Massachusetts Dept. of Public Utilities
Energy Facilities Siting Board

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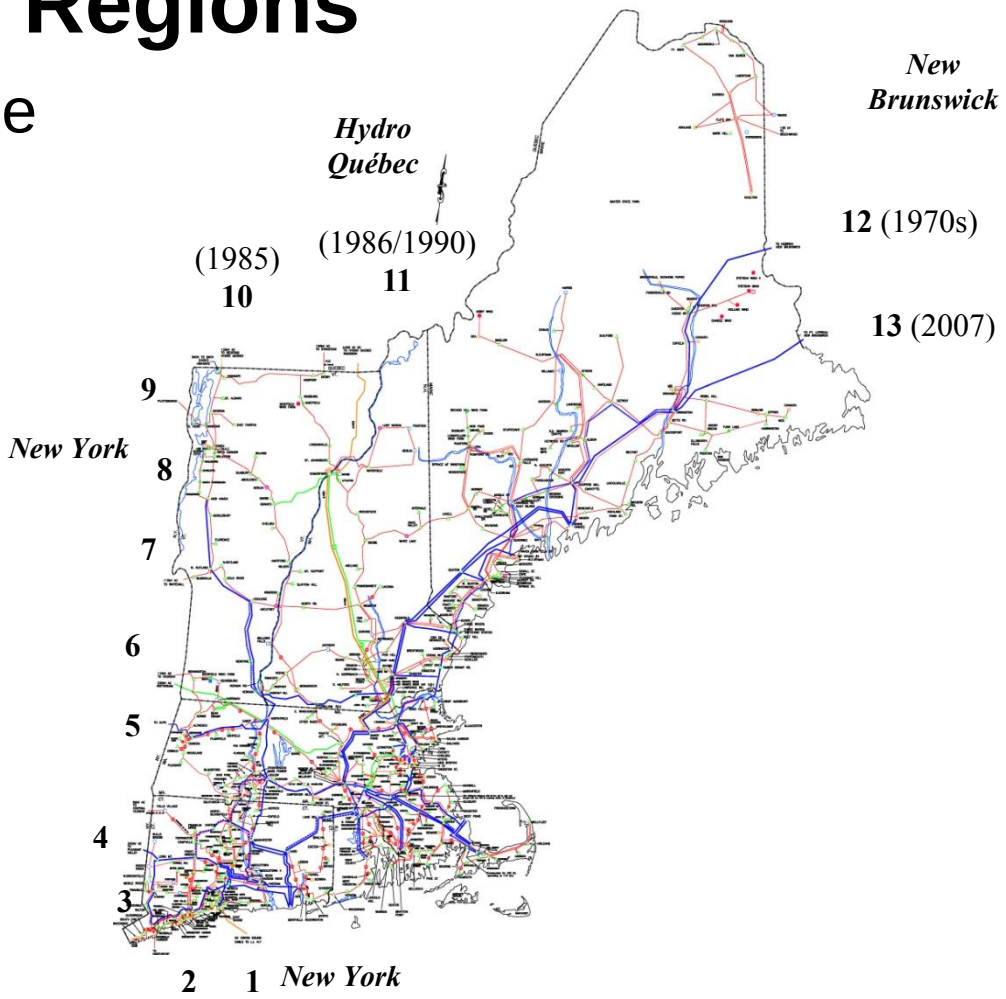
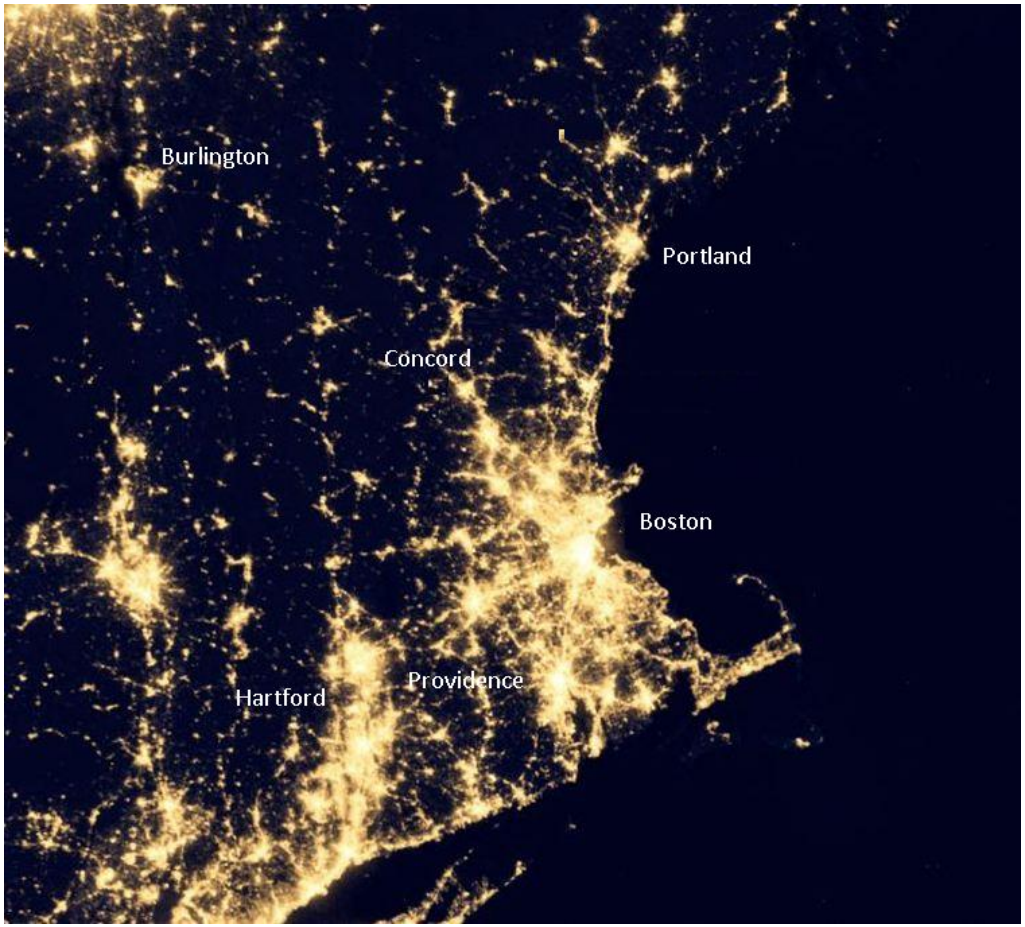
Ties to Neighboring Regions

- Interconnections with three neighboring regions
  - New York
  - Quebec
  - New Brunswick
- 13 interconnections
  - 9 New York Ties (1-9)
  - 2 Quebec Ties (10-11)
  - 2 New Brunswick Ties (12-13)
- Last 5 years region has been a net importer
  - 14% of region's energy met by imports in 2013; primarily from Eastern Canada
  - 2013 net imports: ~19,000 GWh





Source: www.nasa.gov/sites/default/files/images/712129main_8247975848_88635d38a1_o.jpg

- Majority of electricity demand is in southern New England and on the coast
- In order to satisfy demand, region utilizes:
  - Generation
  - Transmission
  - Interconnections with neighbors
  - Energy Efficiency and Demand Response

The Great Northeast Blackout of 1965

- On Nov. 9, 1965, a blackout occurred as several Northeastern states and parts of Canada were hit by a series of power failures lasting as long as 13 hours.
- The blackout covered 80,000 miles and affected more than 30 million people.
- The blackout was caused by a faulty relay at a station in Ontario, Canada.

Response to the Northeast Blackout of 1965

- Concern about the system's reliability at the national and local levels.
- At the national/international level, the industry responded by creating a voluntary, utility-managed reliability organization, the North American Electric Reliability Council in 1968.
- At the regional and local level, the Northeast's power companies formed three "power pools" to ensure a dependable supply of electricity, including the New England Power Pool.

New England Power Pool ("NEPOOL")

- Formed in 1971 by the region's private and municipal utilities.
- Intended to foster cooperation and coordination among utilities in the six-state region.
- Now, it has expanded to be a group of generators, transmission owners, marketers, public power companies and end users.

Prior to the 1970s

- Utilities handled every aspect of providing electricity:
  - Generation
  - Transmission
  - Distribution to homes and businesses
- Utilities were regulated local monopolies that operated independently of each other.

1970s

- New England has limited fossil fuel resources, so the traditional fuels used in power generators (natural gas, oil and coal) all were imported into New England.
- The early 1970s' oil embargo resulted in rapid increases in the cost of fuel to operate power plants translated into equally large jumps in retail power prices.

1970s

- Continued increases in oil prices and unstable fuel supplies led electric utilities to construct new power plants that relied on domestic coal and nuclear power. These plants cost much more to build than simple oil or natural gas-fired generators.
- Consequently, the fixed costs of utility operations increased further increasing retail electricity prices.
- In 1979, the worst accident in the US commercial nuclear power plant history occurred at the Three Mile Island plant in Pennsylvania. While the accident was not in New England, it did have an impact on the completion of nuclear reactors in New England.

1990s

- By the 1990s, New England's electricity rates were among the nation's highest. The natural consequence was consumer complaints and increased regulatory oversight.
- Academics, companies and others began to talk to legislatures about the benefits of competition. With competition there would be incentive to improve service, minimize prices or invest in new facilities and technologies.

Restructuring of Wholesale Electric Power

- As early as the 1970s, the United States Congress and the Federal Energy Regulatory Commission ("FERC")—which oversees the electricity industry nationally—began enabling the restructuring of wholesale electric power.
- By the mid-1990s some of the New England states began to open proceedings to examine restructuring how their utilities operated.

Independent System Operator of New England (ISO-NE)

- Created by FERC in 1997
- In 2005, FERC designated it the regional transmission organization for the area, which gives it broader authority over the day-to-day operation of the transmission system and greater independence to manage the power grid and wholesale markets.
- Three main responsibilities
  - Reliable operation of the electric grid.
  - Administration of the wholesale electricity markets.
  - Plan for future system needs.

Creation of the Markets

- ISO-NE, NEPOOL and the states worked together to implement the wholesale markets in 1999.
  - Between 1999 and 2003, New England experienced a 34%, or about a 10,000 MW, increase in new plants, significantly improving reliability and making genuine competition possible.
- In 2003, the region adopted the Standard Market Design ("SMD").
  - SMD added features such as a Day-Ahead Market to protect against price volatility.
- In 2008, ISO-NE held its first Forward Capacity Auction and the Forward Capacity Market was implemented in 2010.

Reliability Core of ISO New England's Mission

Fulfilled by three interconnected and interdependent responsibilities

Managing comprehensive regional power system planning

Overseeing the day-to-day operation of New England's electric power generation and transmission system

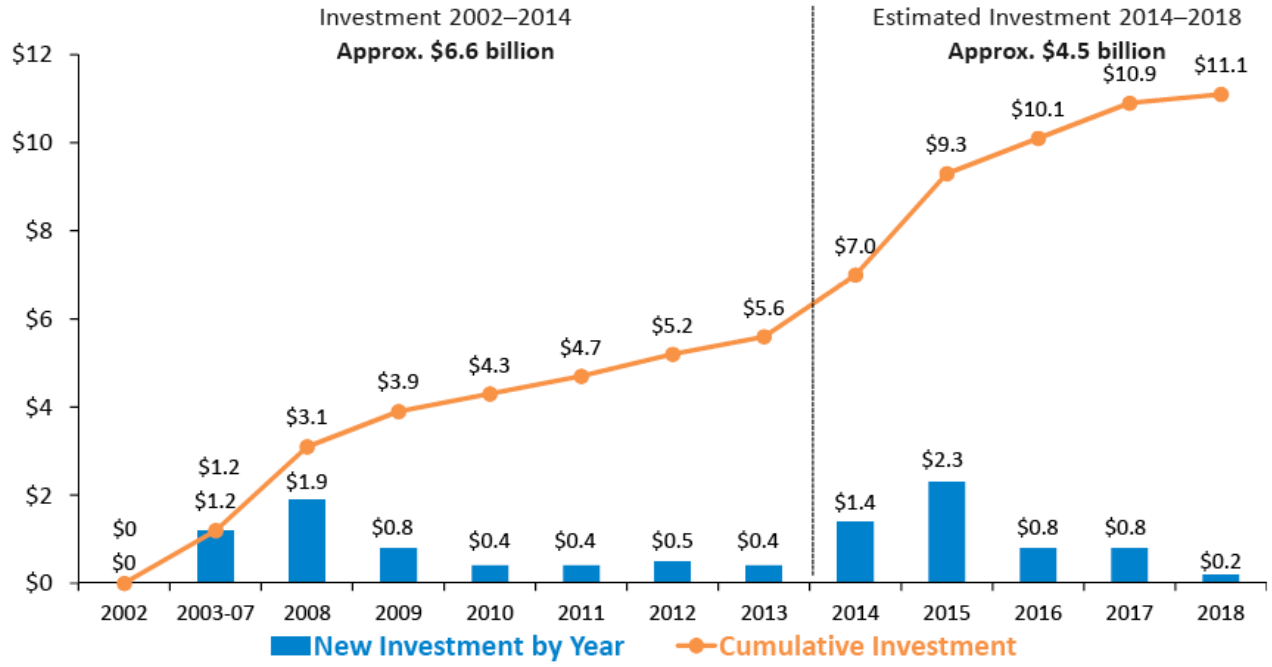
Developing and administering the region's competitive wholesale electricity markets

Operate the Regional Power System

- Balance supply and demand
- Maintain minute-to-minute reliable operation of region's power grid
- Coordinate and schedule maintenance outages
- Coordinate operations with neighboring power systems

- Perform centralized dispatch of the lowest-priced resources
- Least-cost resources dispatched first
  - ISO moves up supply curve (often referred to as the bid-stack) to satisfy regional energy demand
  - Results in the displacement of more expensive units and lower prices

Transmission Investment in New England



Source: ISO New England RSP Transmission Project Listing, June 2014
Estimated future investment includes projects under construction, planned and proposed

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Energy is Primary Driver of Wholesale Costs

Energy Market

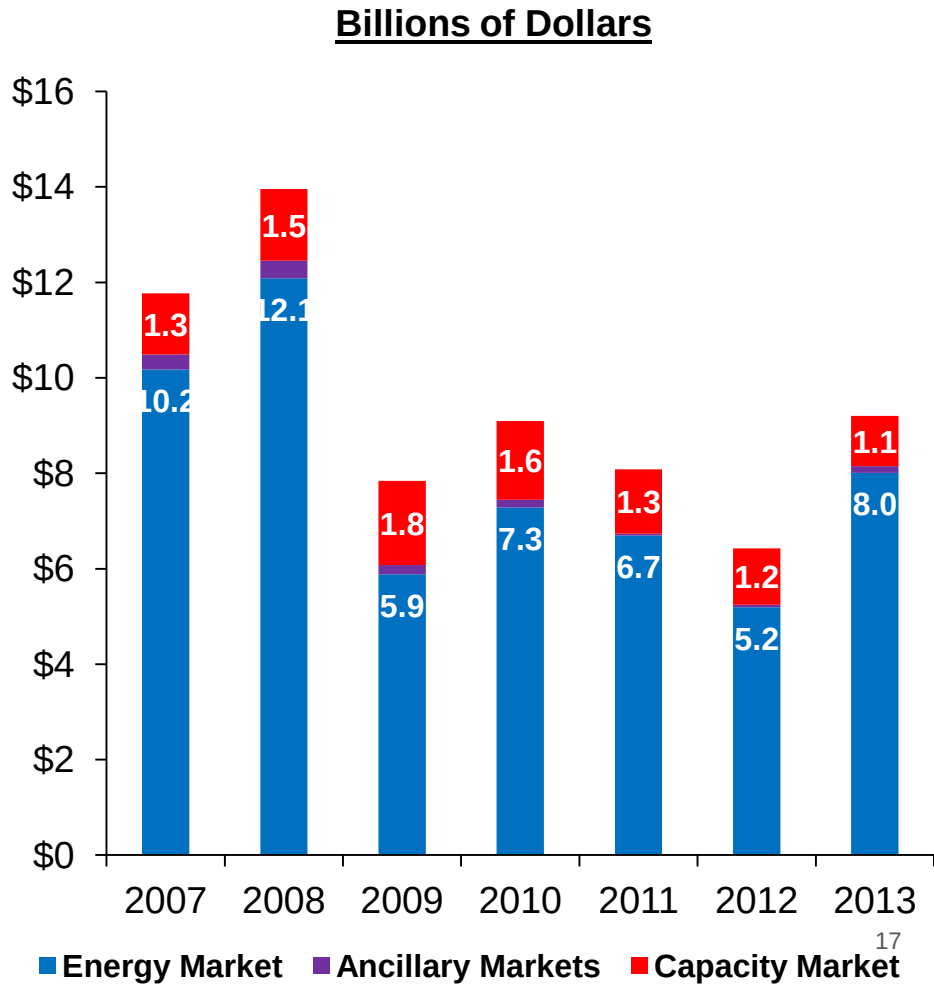
Wholesale price for electric energy is determined by supply and demand in daily energy markets – about $6-$12 billion annually

Capacity Market

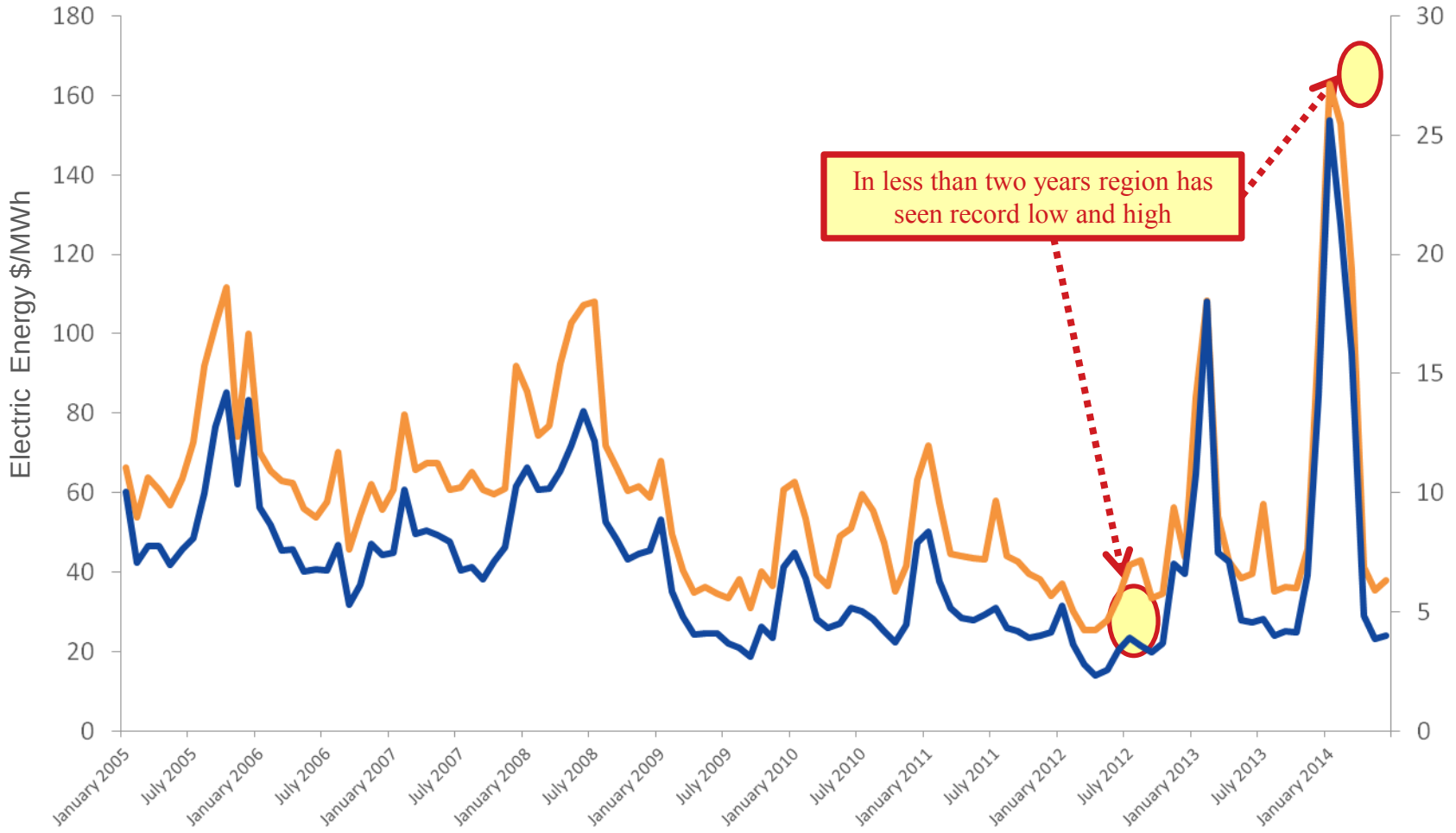
ISO determines capacity needs three years into the future and resources compete to sell capacity to system through annual auctions – about $1-$2 billion annually

Ancillary Services

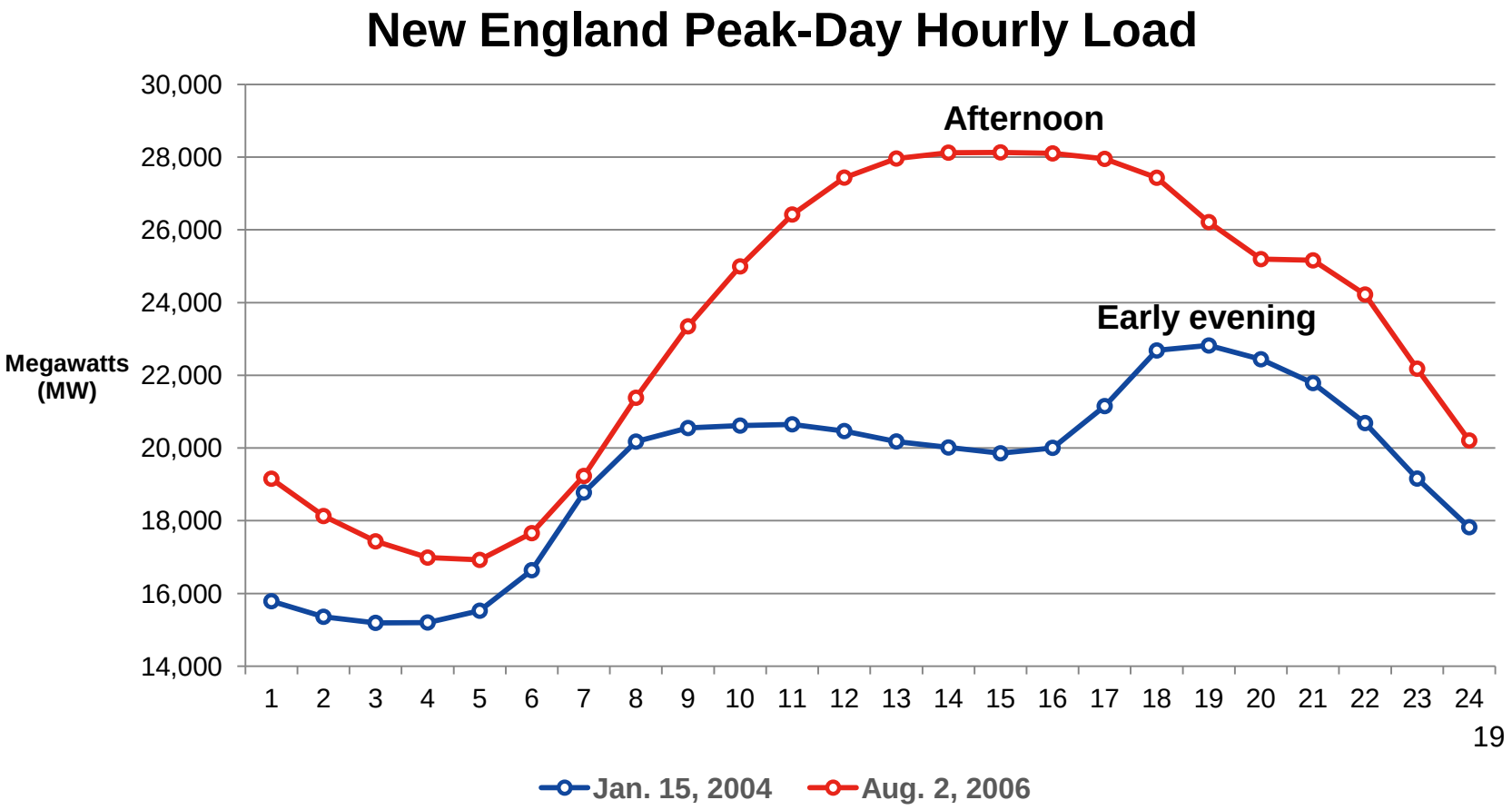
Resources are compensated for providing regulation services and reserves to ensure the reliability of the transmission system in real time – about $40-370 million annually



Wholesale Electricity Prices Track Natural Gas



Region's Electricity Use Varies by Season



Elements of Regional Wholesale Markets

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

System for purchasing and selling electricity using supply and demand to set the price

Market where resources receive compensation for having invested in capacity and delivers in the capacity commitment period(s)

Services that ensure the reliability of production and transmission of electricity

New England's Wholesale Electricity Markets

Energy Markets

Day-Ahead Energy Market

Produces financially binding schedules for the production and consumption of electricity the day before the operating day

Real-Time Energy Market

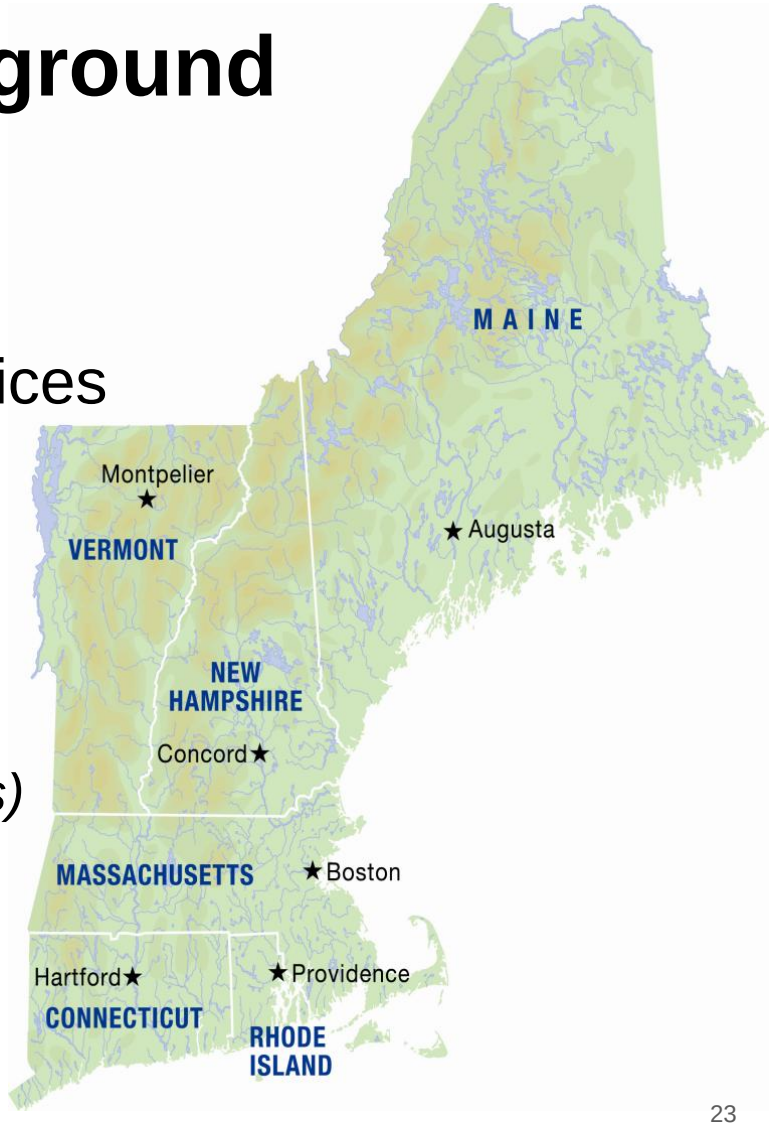
Balances differences between the Day-Ahead scheduled amounts of electricity and the actual real-time requirements

Locational Marginal Pricing

- The auctions (both forward and spot) determine prices that can vary by location.
  - Losses occur when you move power and vary based on how much transmission power must go over the lines.
  - There can be “congestion” (transmission limits) on the power grid that may limit the usage of the cheapest power sources at times.
- There are hundreds of distinct locations and distinct prices in our system.
  - Prices can change
    - Every few minutes during the spot market
    - Every hour in the Day-Ahead Market

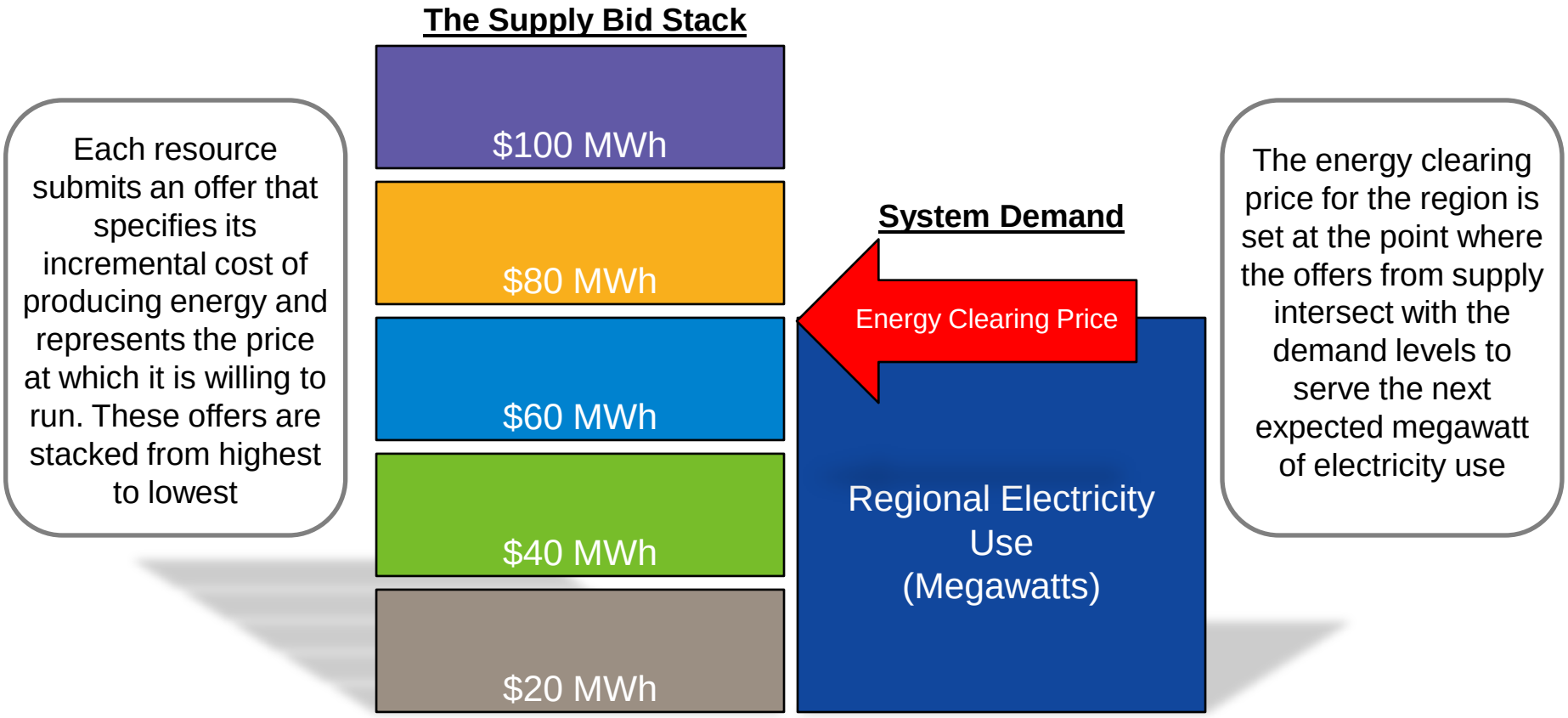
Electricity Auctions: Background

- Daily auctions for electric power
- Determine wholesale electricity prices
- Buyers and sellers are:
  - Large energy users *(buyers)*
  - Distribution utilities/retailers *(buyers, serving homes & businesses)*
  - Power plant owners *(sellers)*
  - Financial traders *(buy and sell)*



Uniform Clearing Price Auction

"Bid Stack" allows ISO to compare resource offers and establish a single price for resources dispatched and used to meet demand on the system



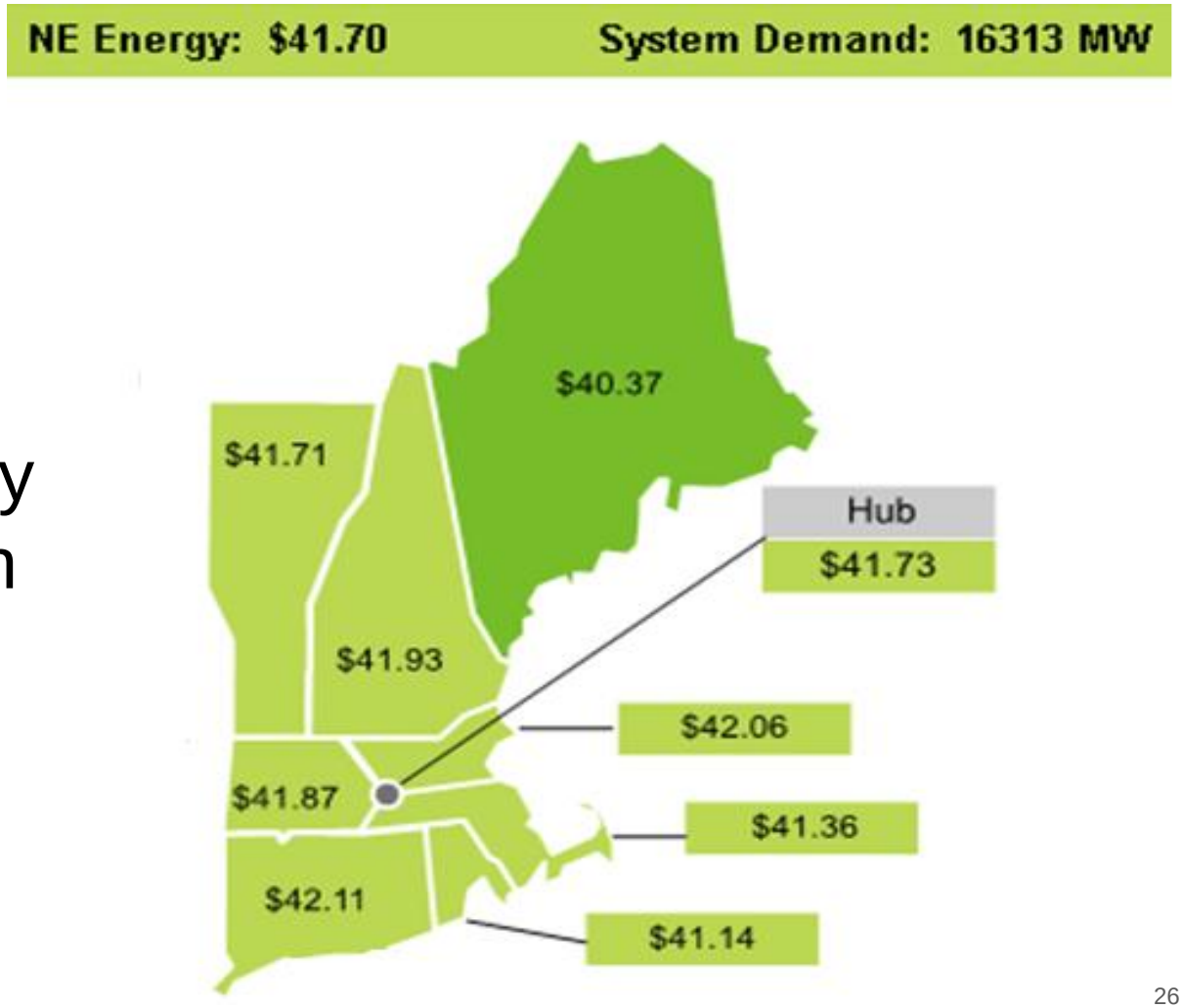
The benefits of uniform clearing price auctions are discussed in a brief paper on ISO New England's Web site: http://www.iso-ne.com/pubs/whtpprs/uniform_clearing_price_auctions.pdf

The Grid: Prices Vary by Location!

- How does this work across a power grid that stretches from northern Maine to southern Connecticut and everywhere in between?
  - Forward and spot auctions
  - Prices that vary by location
    - Losses occur when you move power and vary based on how much transmission power must go over
    - There is ‘congestion’ (transmission limits) on the power grid that may limit the usage of the cheapest power sources at times
  - Hundred of distinct locations with distinct prices that change every few minutes in spot market, every hour day-ahead

Location Marginal Prices

New England has eight energy zones each with a unique price



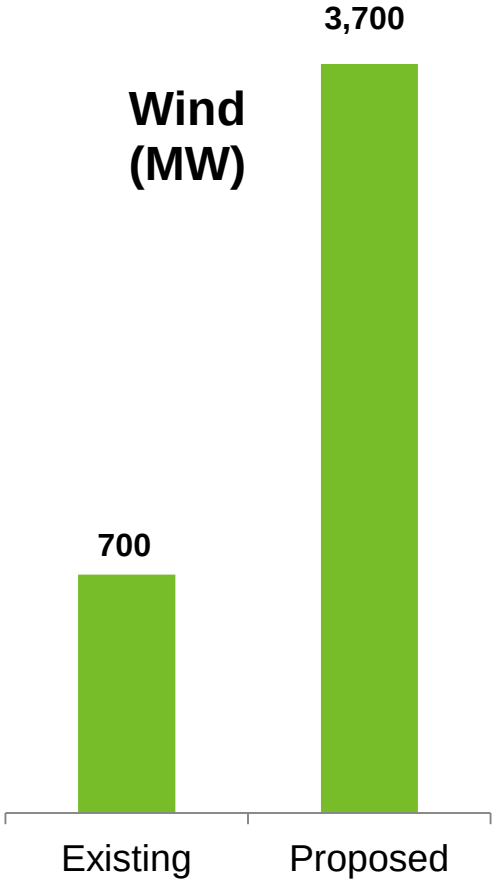
“At-Risk” Generator Retirements Have Begun

About 8,300 MW of generation identified as at-risk of retiring in coming years
3,000 MW of generation has announced retirement in the coming years

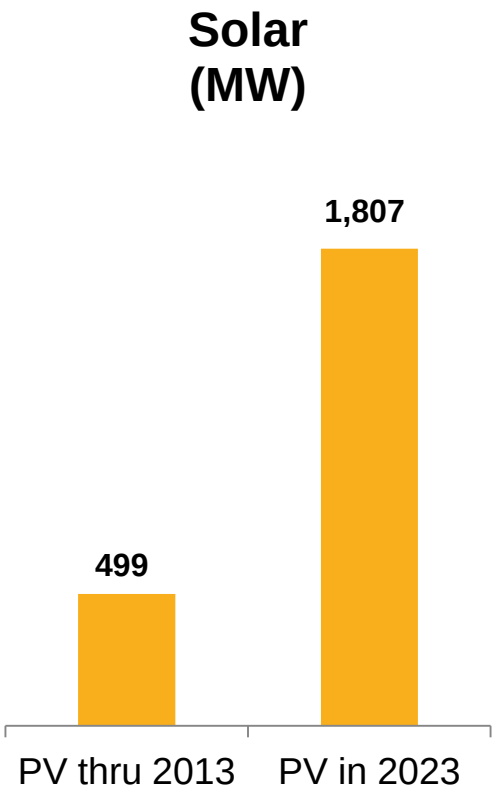
Major Retirement Requests:

- **Salem Harbor Station (749 MW)**
  - 4 units (coal & oil)
- **Vermont Yankee Station (604 MW)**
  - 1 unit (nuclear)
- **Norwalk Harbor Station (342 MW)**
  - 3 units (oil)
- **Brayton Point Station (1,535 MW)**
  - 4 units (coal & oil)
- *Additional retirements are looming*

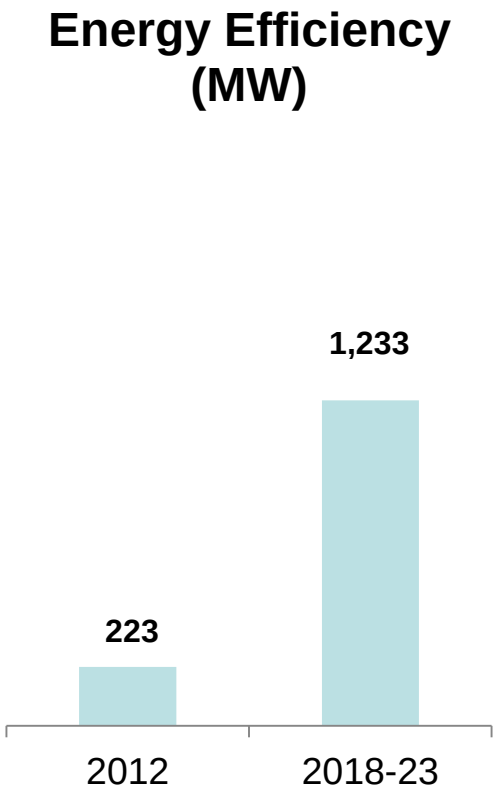
Renewable and EE Resources Trending Up



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



2014 Final Interim ISO-NE Solar PV Forecast, nameplate capacity, based on state policies.



Final ISO-NE Energy-Efficiency Forecast for 2018-23, peak MW savings based on state-sponsored EE program budgets: $5.7 billion.

Forward Capacity Market: Overview

- Procure enough capacity to meet New England's forecasted Installed Capacity Requirement (ICR) three years in the future
- Allow new and existing capacity projects to compete in market
- Select a portfolio of supply and demand resources through a competitive Forward Capacity Auction (FCA) process
  - Proposed resources must be pre-qualified to participate in the auction
  - Proposed resources must participate and clear in the auction to be paid for capacity
- Provides a long-term commitment to new supply and demand resources to encourage investment

Monitoring the Markets

ISO New England's market monitoring structure relies on:

- FERC's Office of Energy Market Regulation (OEMR)
- ISO's Internal Market Monitor
- The External Market Monitor (Potomac Economics)

The IMM ensures that prices properly reflect competitive supply and demand conditions and assists FERC in enhancing the competitiveness of wholesale electricity markets for the benefit of consumers.

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Lessons Learned

- A market can have a combination of vertically integrated resources and non-vertically integrated resources.
- The introduction of competition is generally regarded as a positive development, although there are some new concerns about generation fuel supply.
- Key features are open access and non-discriminatory pricing.
- Market development can be done in stages.

Questions?