



# ISO New England Overview

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*NESCAUM*

**Eric Wilkinson**

SENIOR EXTERNAL AFFAIRS REPRESENTATIVE



# Logistics



- Restroom location
- Emergency exits
- Designated smoking areas
- Security
  - Sign in and out; return visitor badges at reception area
  - Do not wander halls unescorted
- Recycling
  - Paper recycling bins are located in the conference room; glass, plastic, and metal recycling bins are located throughout the buildings

# Agenda

- 9:30 a.m.      **Arrival and Badging**
- 9:15 a.m.      **ISO Overview Presentation**  
*Eric Wilkinson, Representative, External Affairs*
- 10:30 a.m.     **Control Room Tour**  
*John Norden, Director, System Operations*
- 11:30 a.m.     **Adjourn**



# About ISO New England

- **Not-for-profit corporation created in 1997 to oversee New England's restructured electric power system**
  - Regulated by the Federal Energy Regulatory Commission (FERC)
- **Regional Transmission Organization**
  - Independent of companies doing business in the market
  - No financial interest in companies participating in the market
  - Neutral as to resource fuel type
- **Major Responsibilities**
  - Operating the Regional Power System
  - Administering Wholesale Electricity Markets
  - Regional Power System Planning

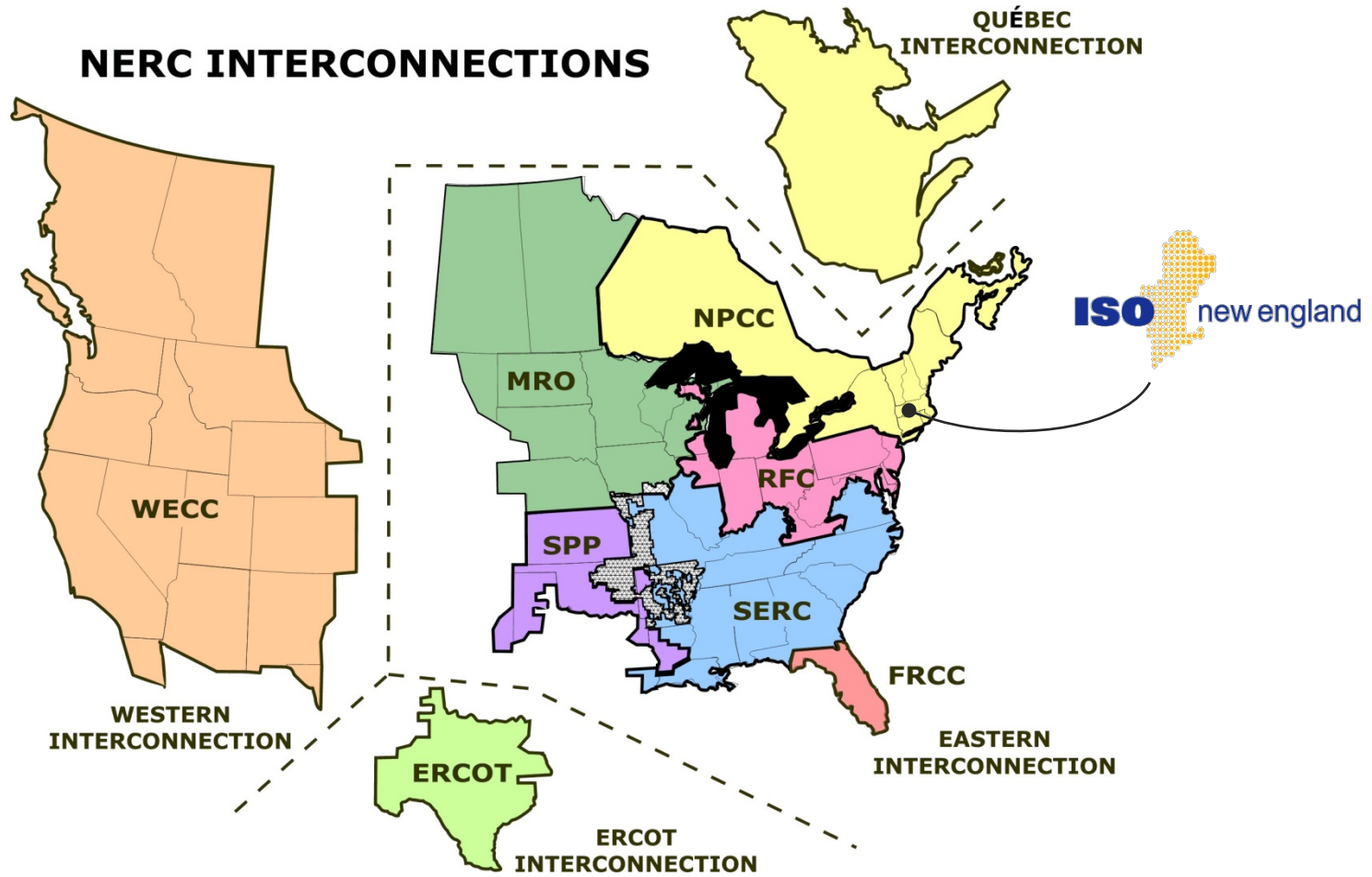


# New England's Electric Power Grid at a Glance

- 6.5 million households and businesses; population 14 million
- 350+ generators
- 8,000+ miles of high-voltage transmission lines (115 kV and above)
- 13 interconnections to electricity systems in New York and Canada
- 31,750+ megawatts (MW) of generating capacity and approximately 1,850 MW of demand resources
- 28,130 MW all-time peak demand, set on August 2, 2006
- 500+ buyers and sellers in the region's wholesale electricity markets
- \$5 billion in transmission investment since 2002; approximately \$6 billion planned over next 5 years
- \$8 billion total energy market value in 2013



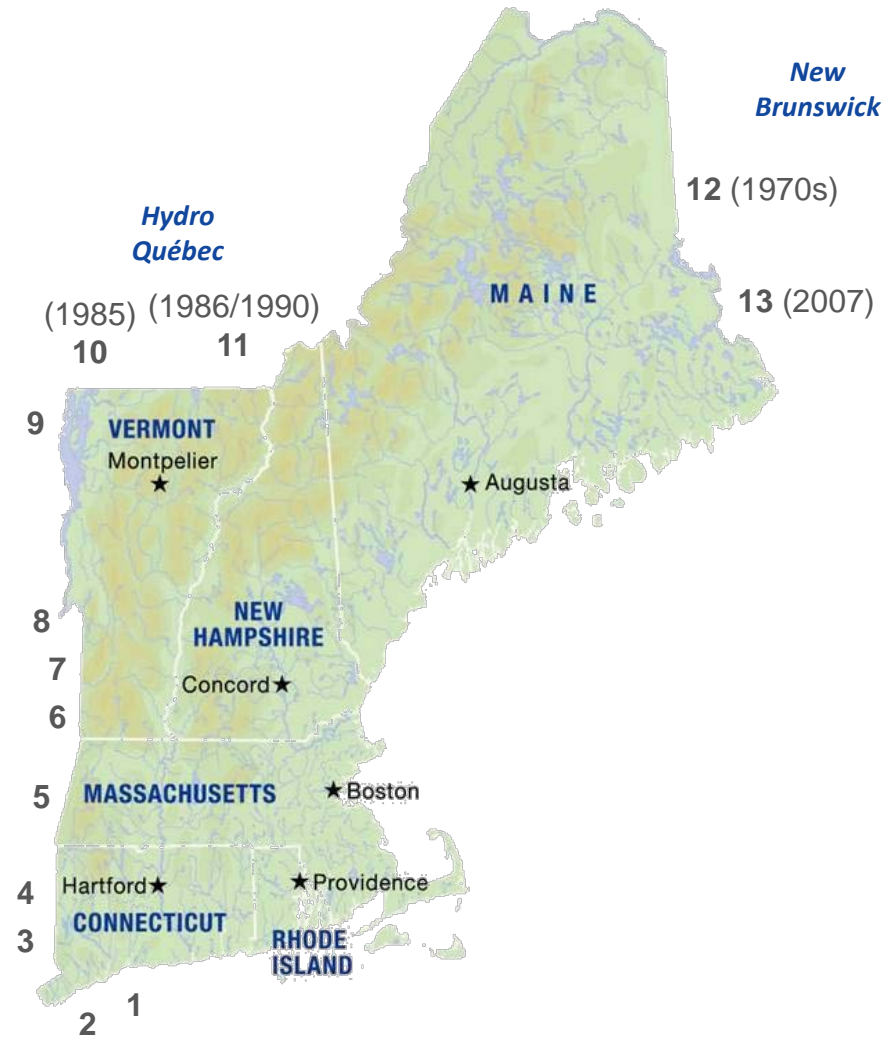
# We are Part of the Eastern Interconnection



# Ties to Neighboring Regions

*New England is not an energy island*

- Transmission system is tied to neighboring power systems in the U.S. and Eastern Canada:
  - New York (9 ties)
  - Hydro Québec (2 ties)
  - New Brunswick (2 ties)



# ISO New England's Responsibilities

## Operating the Regional Power System

- Balance electricity supply and demand every minute of the day by centrally dispatching the generation and flow of electricity across the region's transmission lines.

## Administering Wholesale Electricity Markets

- Develop and administer the region's marketplace through which wholesale electricity is bought and sold.

## Regional Power System Planning

- Ensure the development of a reliable and efficient power system to meet current and future electricity needs.



# Operate the Regional Power System

- Maintain minute-to-minute reliable operation of region's power grid
- Perform centralized dispatch of the lowest-priced resources
- Coordinate and schedule maintenance outages
- Coordinate operations with neighboring power systems



# Administer Wholesale Electricity Markets

## New England's Wholesale Electricity Markets

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graph TD; A[New England's Wholesale Electricity Markets] --- B((Energy Market)); A --- C((Forward Capacity Market)); A --- D((Ancillary Services));
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### Energy Market

Daily market for wholesale customers to buy and sell electric “energy”

### Forward Capacity Market

Three-year forward market that commits “capacity” resources to meet system resource-adequacy needs

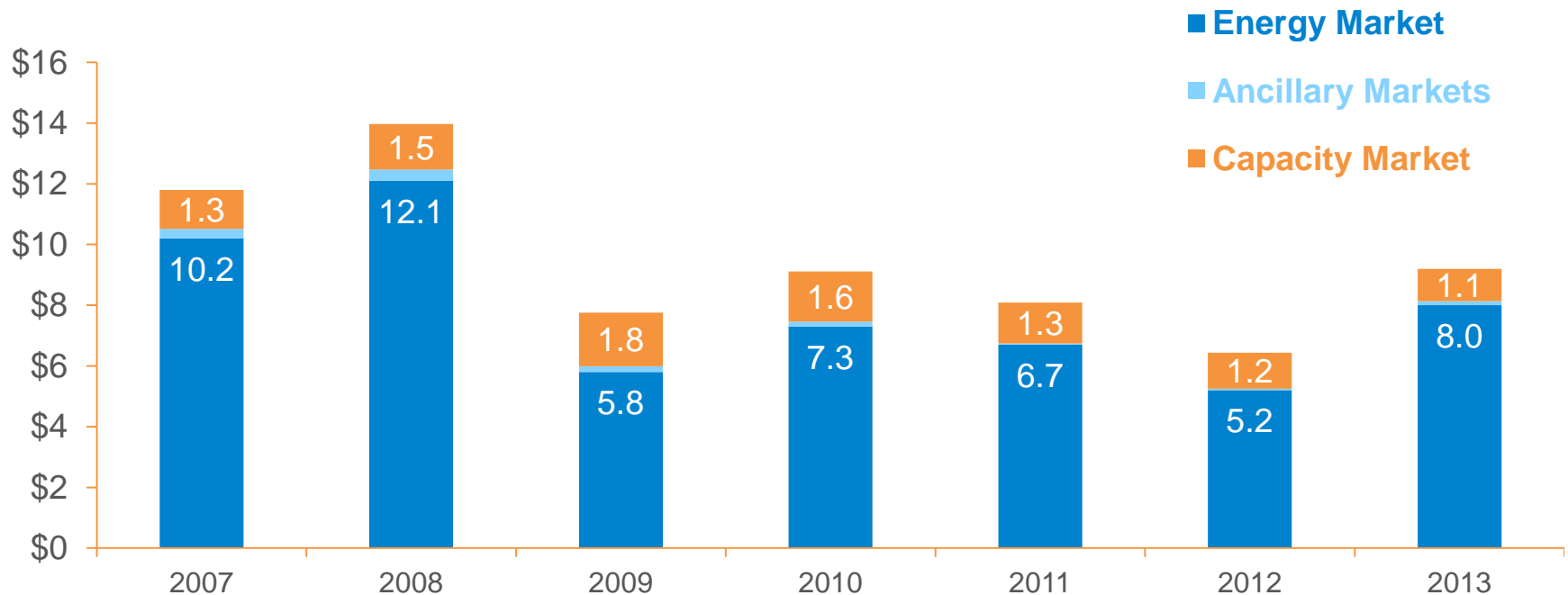
### Ancillary Services

Reserves and regulation provide support for system operations

# New England's Wholesale Electricity Markets

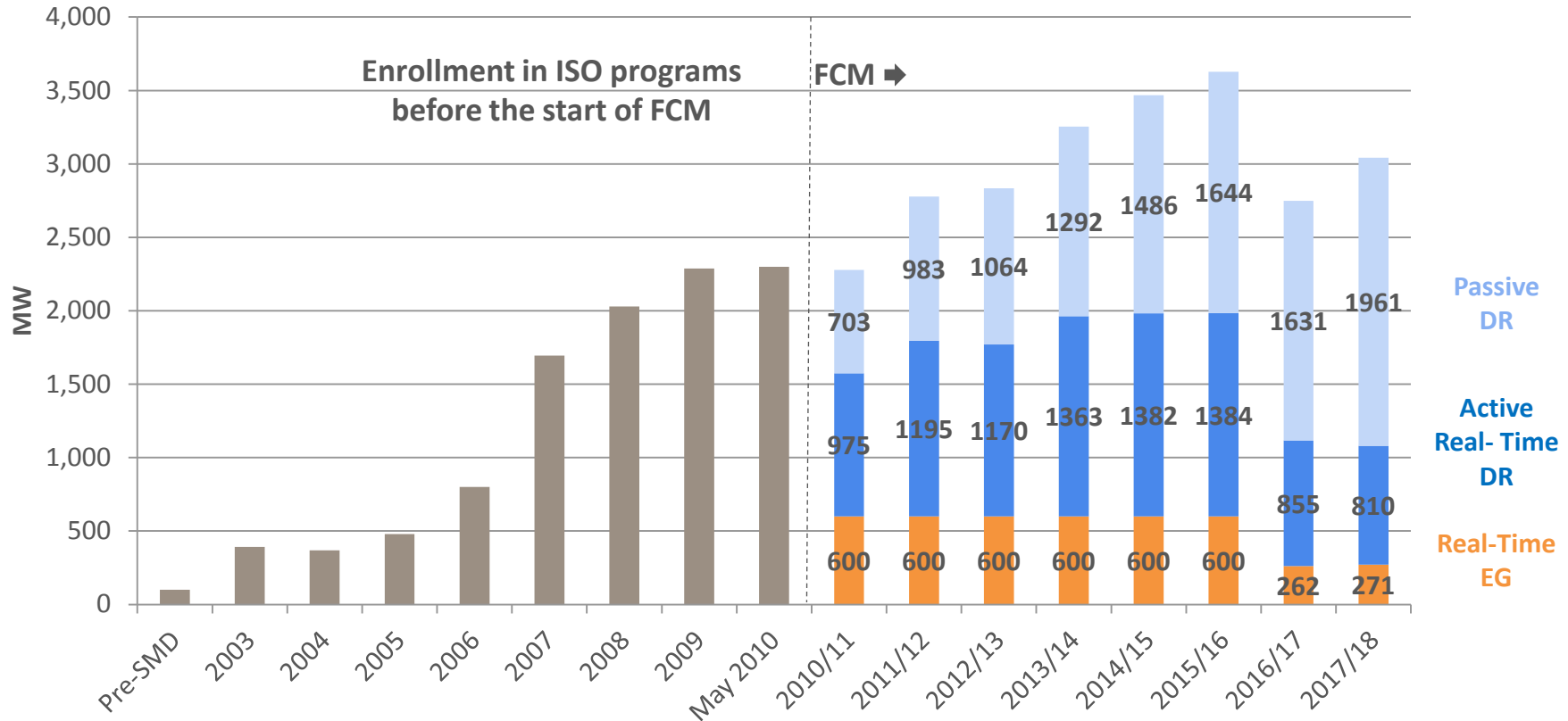
Wholesale market costs have ranged from \$6 billion to \$14 billion over last five years

Annual Value of Wholesale Electricity Markets  
(in billions)



# Demand Resources in New England Capacity Market

## Demand Resource Participation in Region



Note : Total real-time emergency generation (EG) capped at 600 MW:  
 Cap reached for FCAs #1 – #6 (2010/11–2014/16); RTEG cleared below cap over last two auctions

Source data: ISO-NE FCA Auction Results filings

# FCA Cleared Demand Resources by Measure Type in MW\*

Commitment Period	Distributed Generation Fossil	Distributed Generation Renewable	Energy Efficiency	RTDR & Load Management	Emergency Generation	Grand Total
2010-11	46.309	0.168	654.543	977.718	874.824	2553.562
2011-12	92.681	0.171	890.378	1194.779	758.603	2936.612
2012-13	86.236	0.682	974.635	1205.788	630.297	2897.638
2013-14	126.921	1.188	1166.503	1366.621	688.209	3349.442
2014-15	130.675	1.188	1350.556	1385.628	721.807	3589.854
2015-16	255.378	1.188	1513.619	1257.925	616.734	3644.844
2016-17	212.757	1.229	1537.611	734.223	262.213	2748.033
2017-18	214.030	1.188	1844.227	710.627	270.524	3040.596

\*This information represents ISO New England's estimate of measure types of Demand Resource projects that cleared in prior FCAs based on project descriptions, asset registration, and CPS monitoring, all values in MW and include the applicable gross-up factor. Source data: ISO-NE FCA Auction Results filings

# Regional Power System Planning

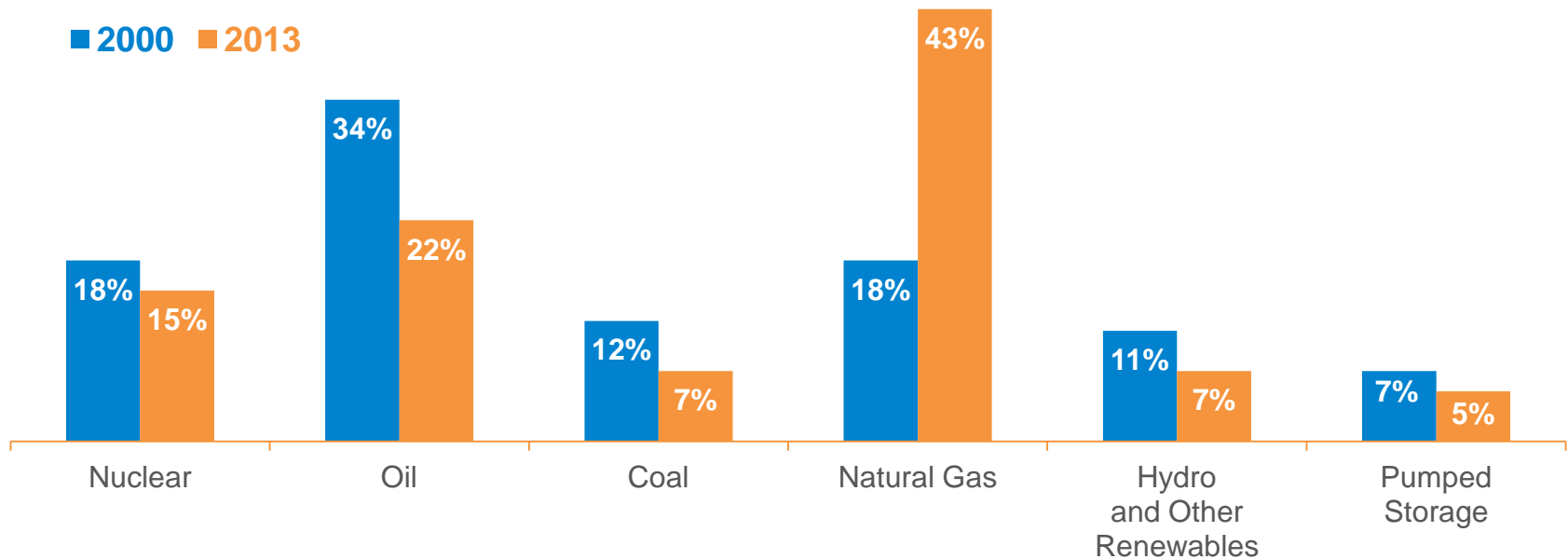
- Administer requests for interconnection of generation, and regional transmission system access
- Conduct transmission system needs assessments
- Plan regional transmission system to provide regional network service
- Develop annual Regional System Plan (RSP)
  - RSP13 looks at system needs 10 years ahead (2013-2022)



# Dramatic Changes in Power System Resources

The resources making up the region's installed capacity have shifted as a result of economic and environmental factors

Percent of Total System **Capacity** by Fuel Type  
(2000 vs. 2013)

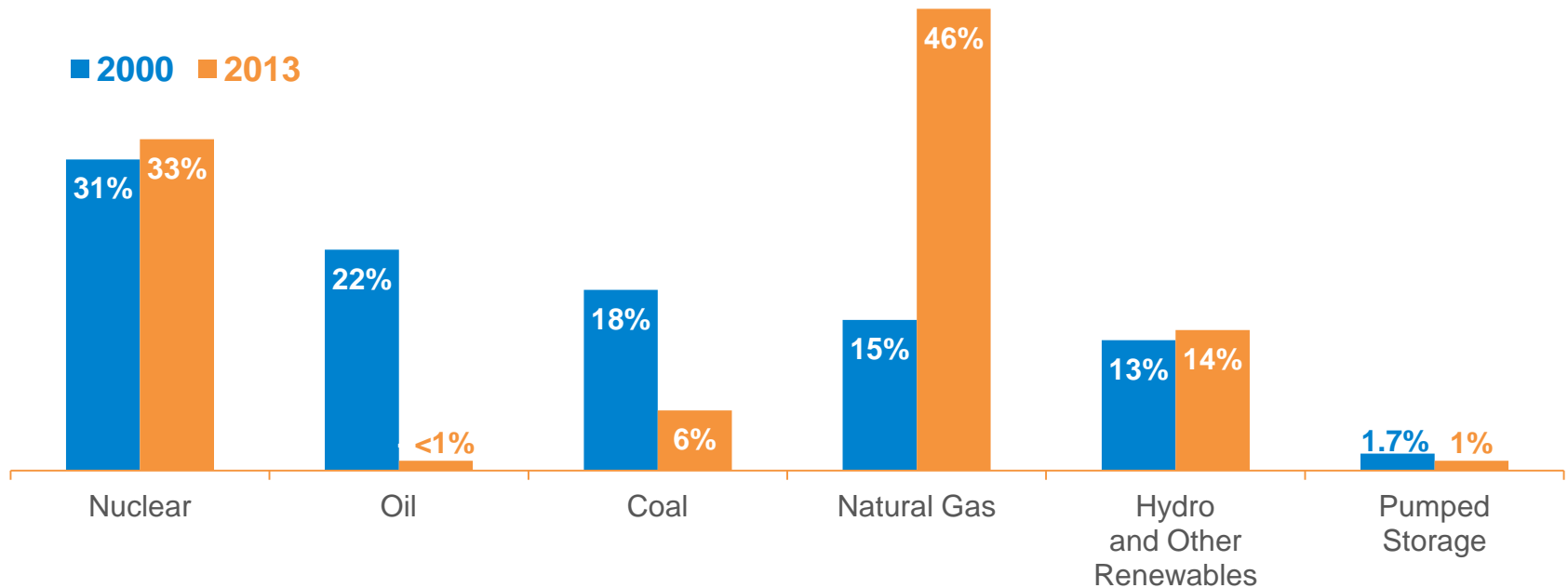


Source: ISO New England 2014 Regional Electricity Outlook

# Dramatic Changes in the Energy Mix

The fuels used to produce New England's electric energy have shifted as a result of economic and environmental factors

Percent of Total **Electric Energy** Production by Fuel Type  
(2000 vs. 2013)

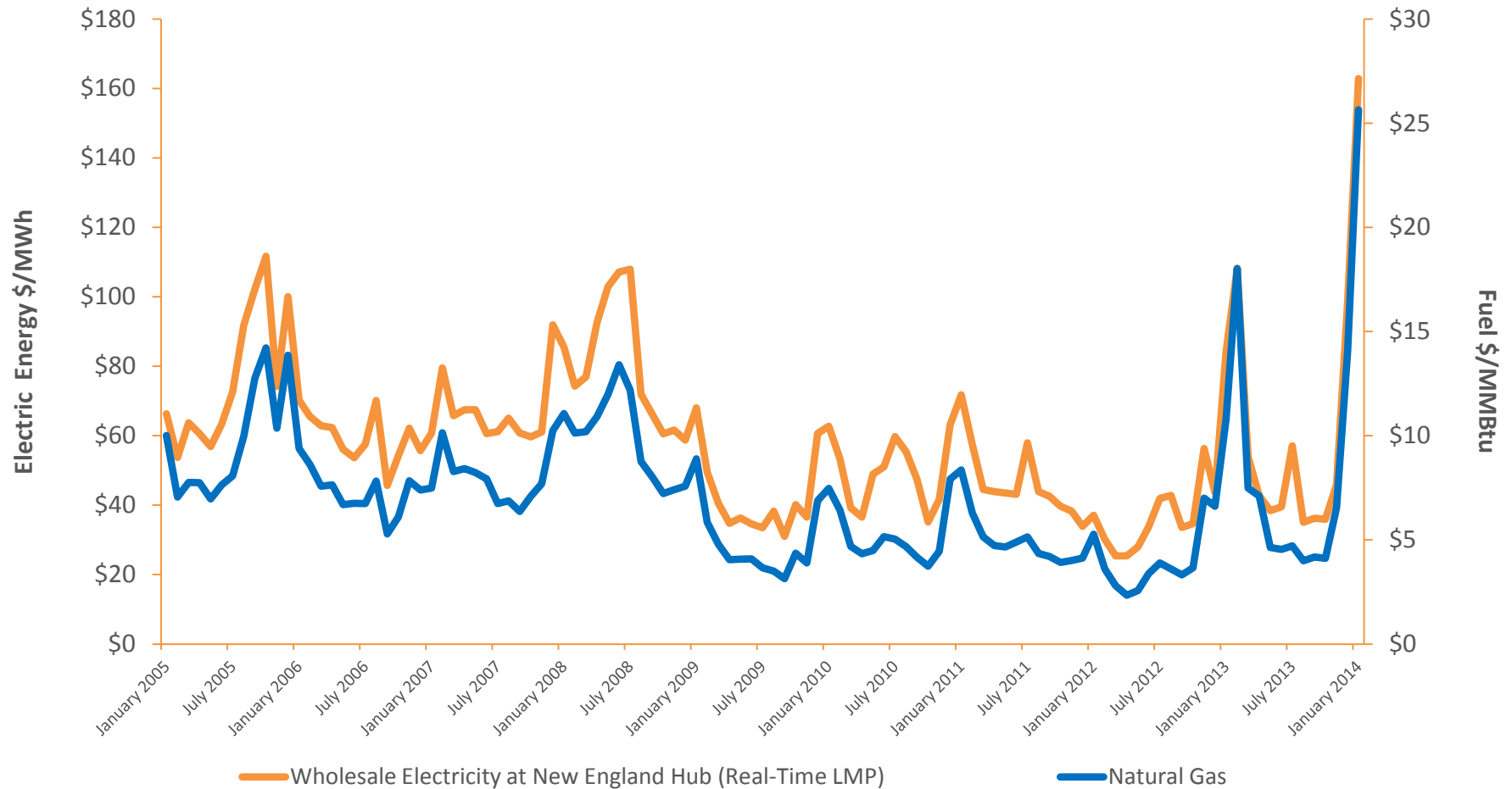


Source: ISO New England 2014 Regional Electricity Outlook



# Natural Gas and Wholesale Electricity Prices Linked

Because of New England's heavy reliance on natural gas as a fuel source, natural gas typically sets the price for wholesale electricity



# Power Plant Emissions have Declined with Changes in the Fuel Mix

*Reduction in Aggregate Emissions (ktons/yr)*

Year	NO <sub>x</sub>	SO <sub>2</sub>	CO <sub>2</sub>
2001	59.73	200.01	52,991
2012	20.32	16.61	41,975
<b>% Reduction, 2001–2012</b>	<b>↓ 66%</b>	<b>↓ 92%</b>	<b>↓ 21%</b>

*Reduction in Average Emission Rates (lb/MWh)*

Year	NO <sub>x</sub>	SO <sub>2</sub>	CO <sub>2</sub>
1999	1.36	4.52	1,009
2012	0.35	0.28	719
<b>% Reduction, 1999–2012</b>	<b>↓74%</b>	<b>↓ 94%</b>	<b>↓ 29%</b>

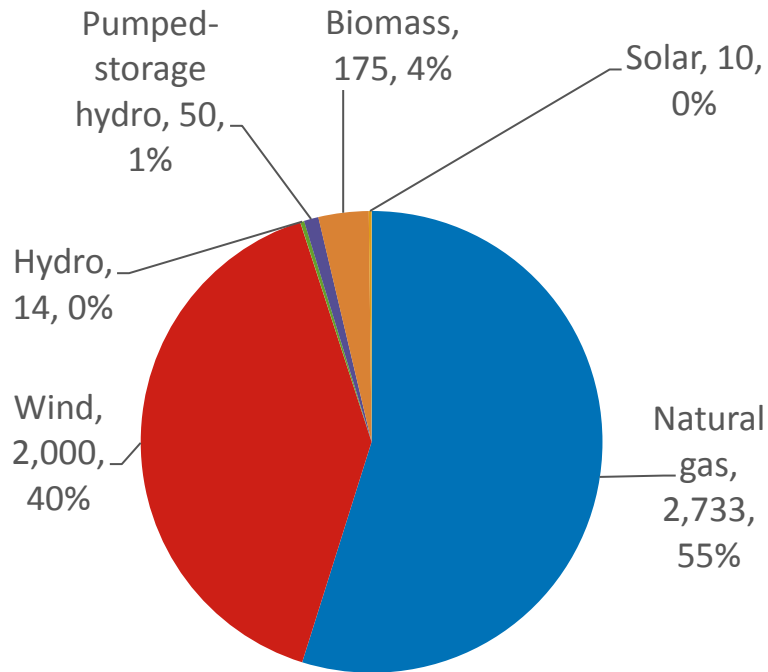
Source: [2012 ISO New England Electric Generator Air Emissions Report](#), January 2014

[http://www.iso-ne.com/committees/comm\\_wkgrps/prtcpts\\_comm/eag/mtrls/2014/mar52014/2012\\_emissions\\_report.pdf](http://www.iso-ne.com/committees/comm_wkgrps/prtcpts_comm/eag/mtrls/2014/mar52014/2012_emissions_report.pdf)

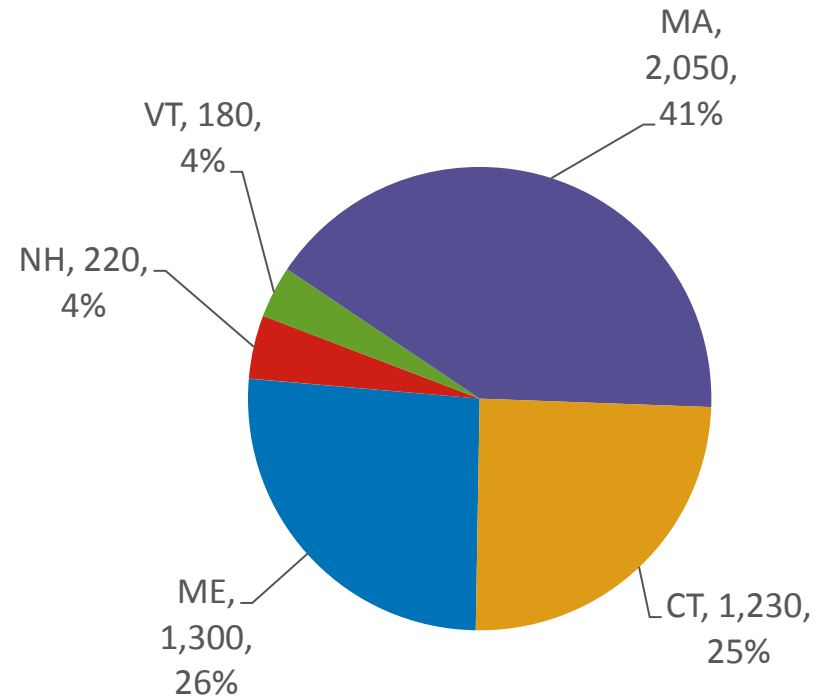
# Generator Proposals in the ISO Queue

*Approximately 5,000 MW*

## By Type



## By State



Note: Natural gas and biomass include dual fuel units (oil)

Source: ISO Generator Interconnection Queue (January 2014)

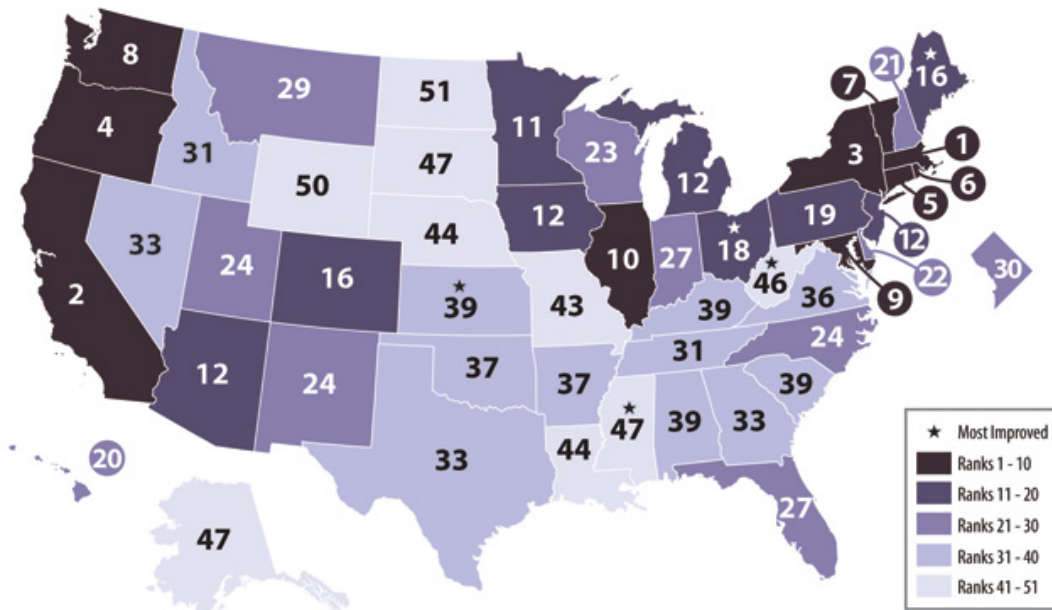
# ENERGY EFFICIENCY

## WIND

## SOLAR

# Energy-Efficiency is a Priority for New England

2013 State Energy-Efficiency Scorecard



Source: American Council for an Energy-Efficient Economy

Ranking of state EE efforts by the *American Council for an Energy-Efficient Economy*:

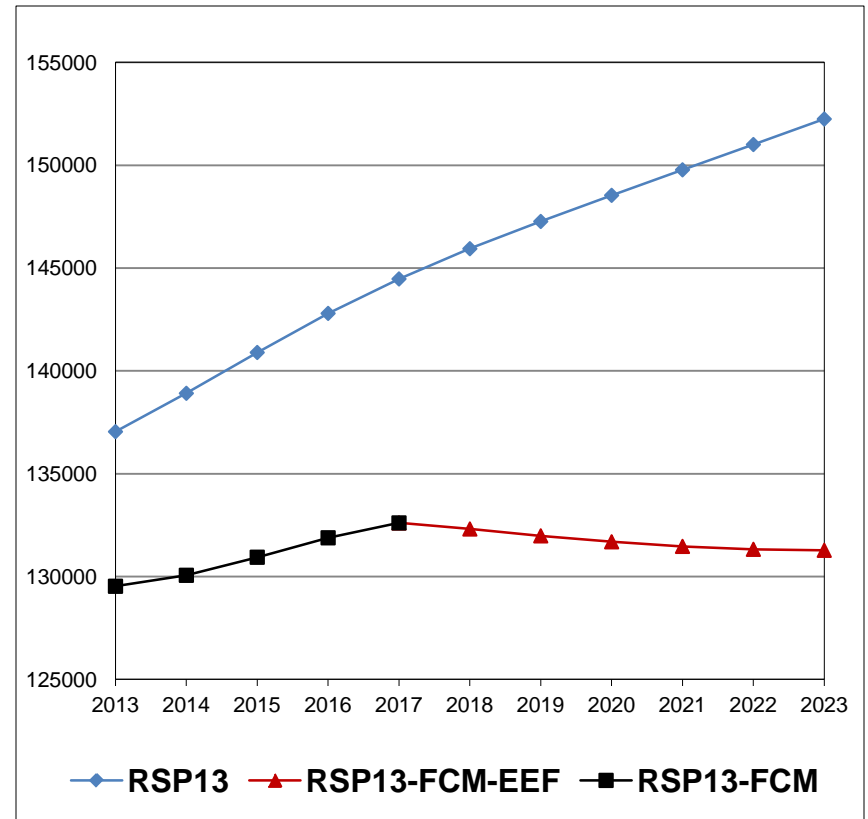
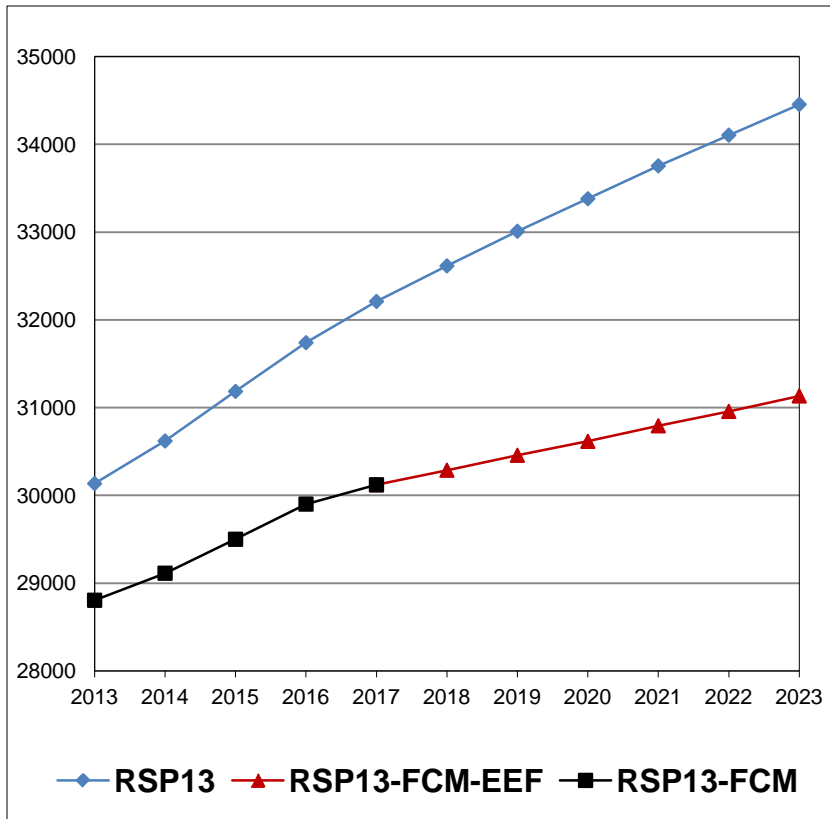
- Massachusetts 1
- Connecticut 5
- Rhode Island 6
- Vermont 7
- Maine 16
- New Hampshire 21

- Billions spent over the past few years and more on the horizon
  - Approximately \$2.3 billion invested from 2009 to 2012
  - ISO estimates \$6.3 billion to be invested in EE from 2017 to 2023

# Energy-Efficiency Forecast

## New England: Summer 90/10 Peak (MW)

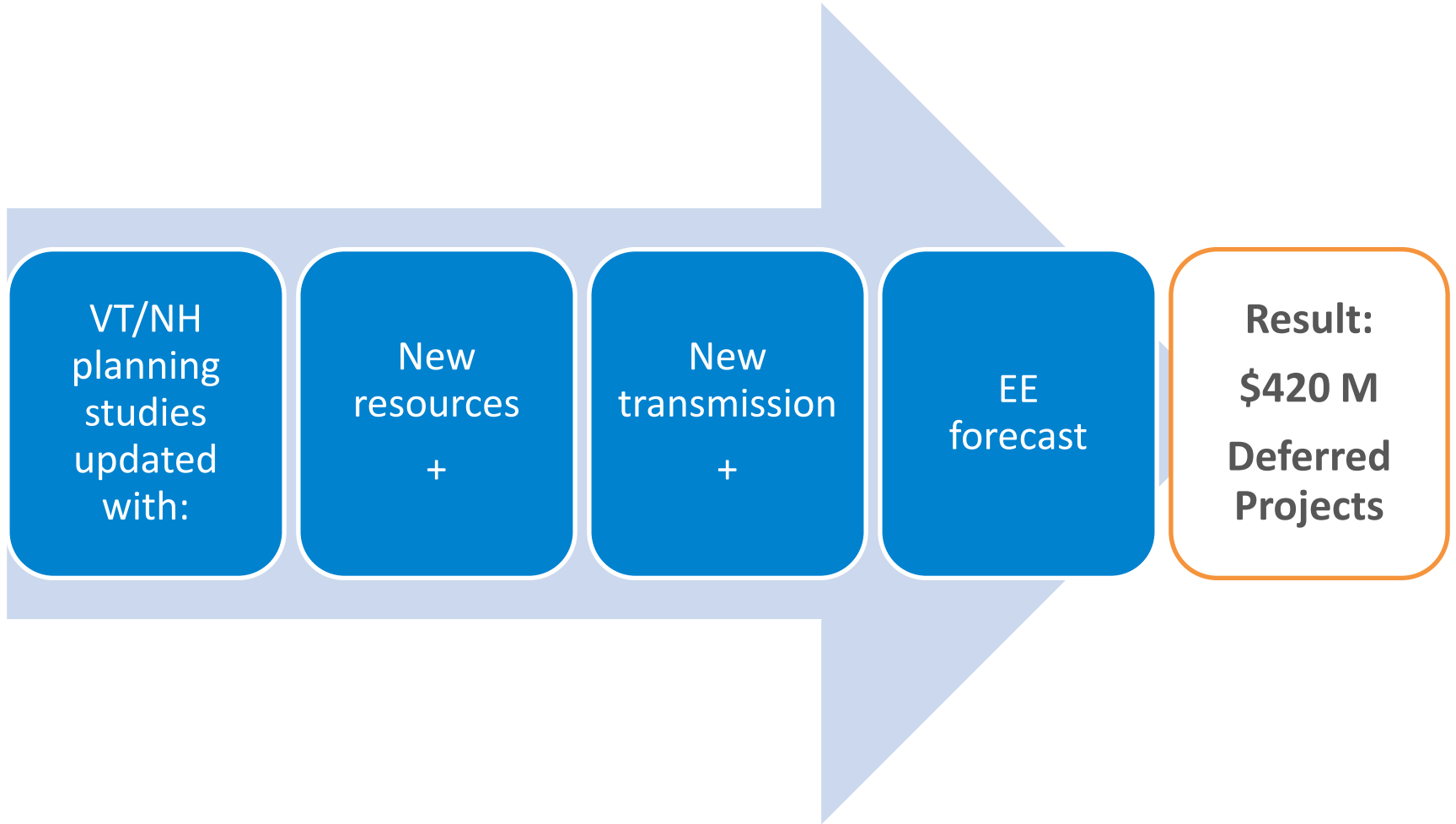
## New England: Annual Energy Use (GWh)



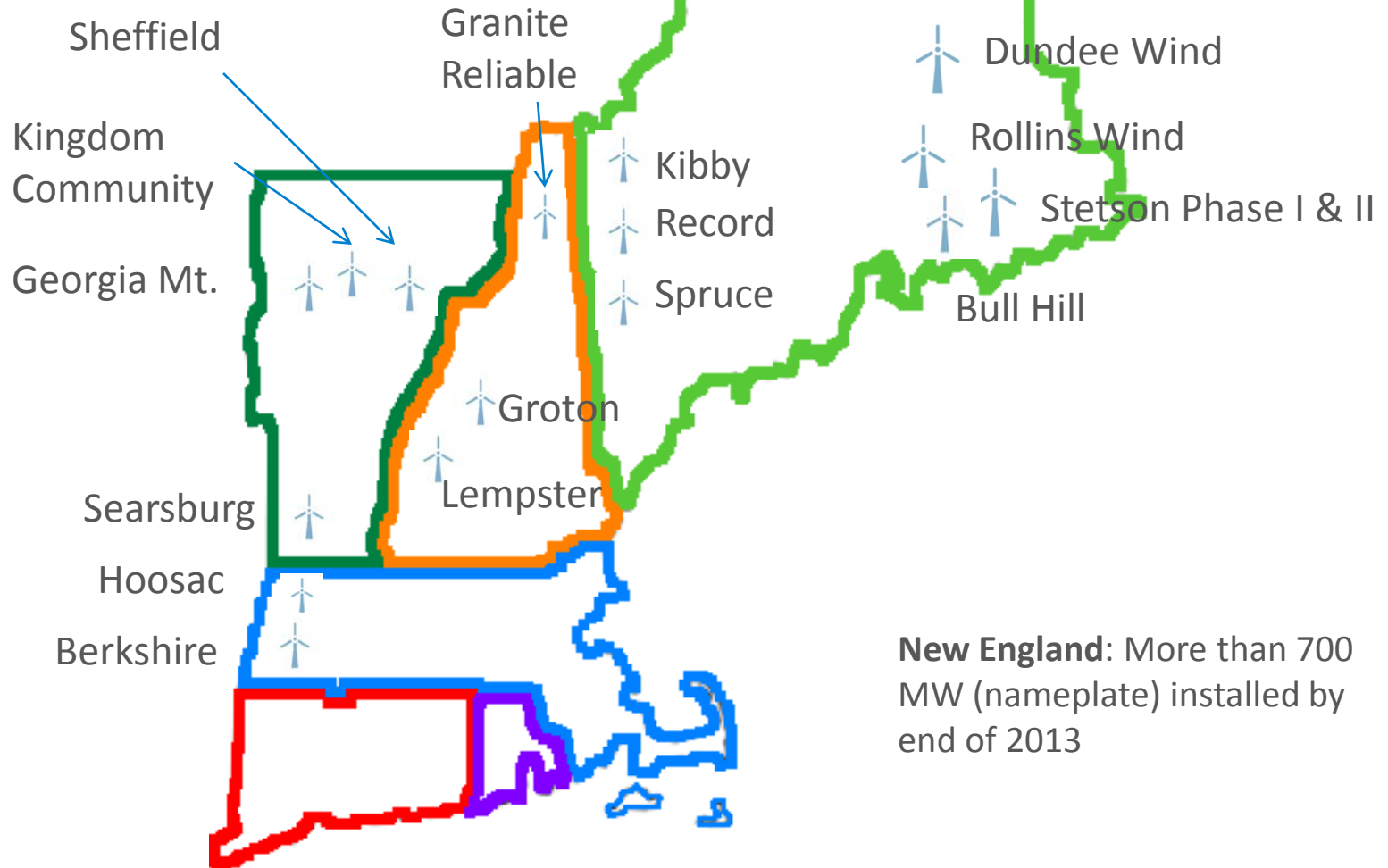
Source: ISO-NE EE Forecast for 2018-2023, March 2014

# EE Forecast Is Affecting Grid Planning

*Previously Identified Transmission in Vermont & New Hampshire Deferred*



# Wind Resources in New England Markets



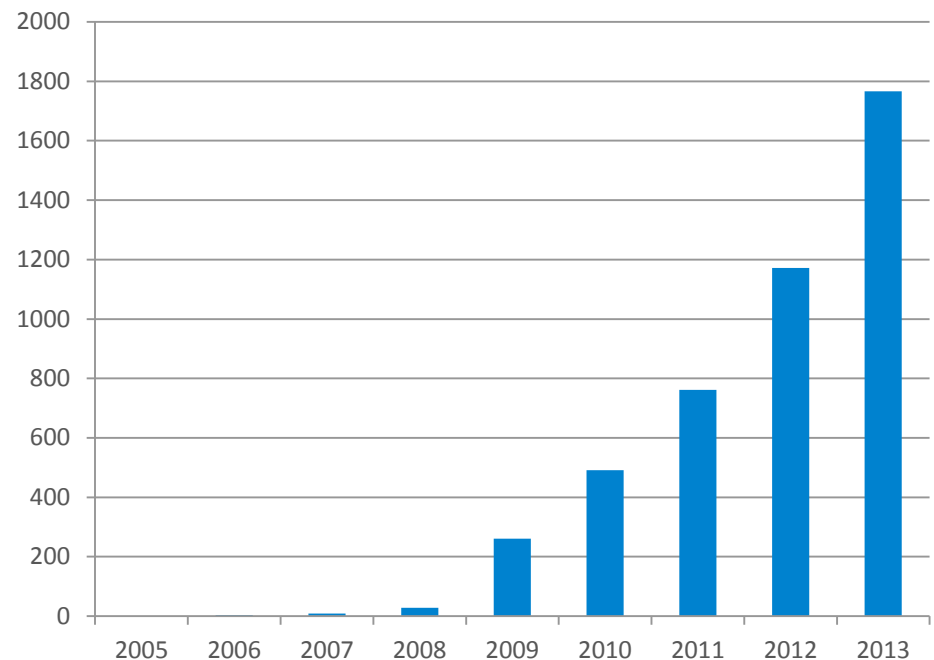


# Annual Electricity Produced by Wind Resources

- In 2013, wind resources generated 1,766 GWh within ISO-NE service territory
- Total New England generation in 2013 was 112,040 GWh

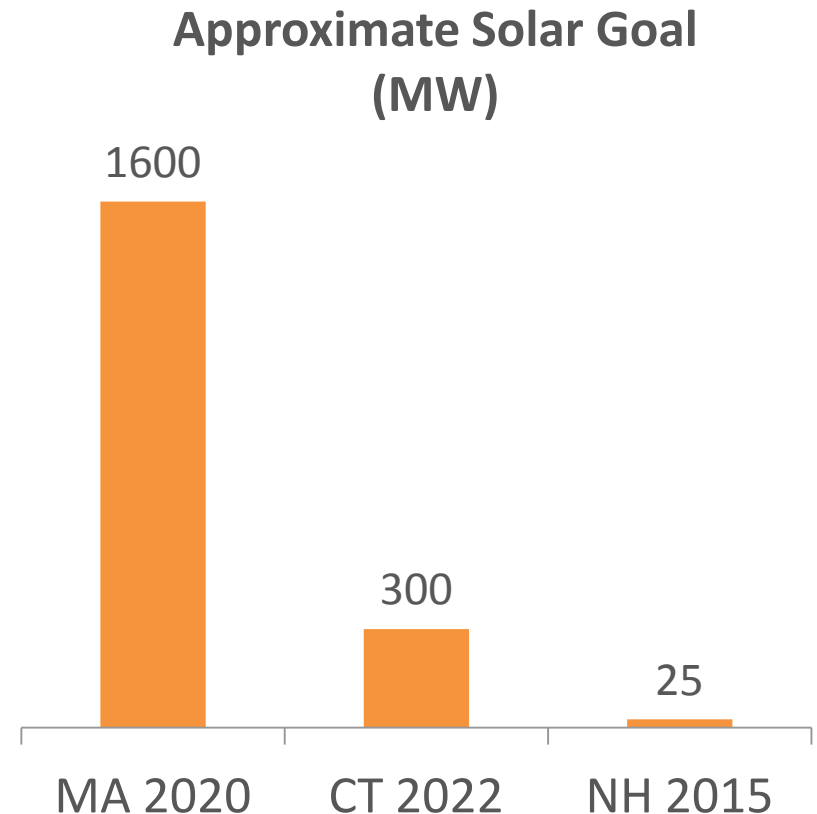
– Gas	41,542
– Nuclear	37,183
– All renewables	8,751

New England Wind Energy Production (GWh)



# Region Experiencing Growth of Solar and Other Distributed Generation (DG)

- Solar (PV) growing via state policies
- PV will likely be the dominant DG technology
- VT, RI, ME have DG programs without specific solar goals



# Distributed Generation Forecast Working Group

- The ISO began an initiative in September 2013, working with the states and regional utilities, to forecast long-term incremental DG growth
- In support of this effort, the ISO created a regional Distributed Generation Forecast Working Group (DGFWG) as a vehicle to collect data on DG policies and implementation from states and utilities
- The ISO released the final interim PV forecast April 2, 2014
  - Based on state policy goals for DG
  - See [http://www.iso-ne.com/committees/comm\\_wkgrps/othr/distributed\\_generation\\_frct/index.html](http://www.iso-ne.com/committees/comm_wkgrps/othr/distributed_generation_frct/index.html)

# Final Interim PV Forecast

States	Annual Total MW (MW, AC nameplate rating)											Totals
	Thru 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
CT	73.1	51.4	46.4	66.4	46.4	46.4	46.4	46.4	46.4	46.4	46.4	561.8
MA	361.6	187.2	138.1	138.1	138.1	131.6	131.6	131.6	131.6	131.6	131.6	1,752.8
ME	8.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	30.0
NH	8.2	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	35.4
RI	10.9	8.1	6.3	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	62.8
VT	31.7	22.8	16.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	6.8	141.8
<b>Annual Policy-Based MWs</b>	<b>493.6</b>	<b>274.5</b>	<b>211.9</b>	<b>223.3</b>	<b>198.6</b>	<b>192.1</b>	<b>148.7</b>	<b>148.7</b>	<b>17.1</b>	<b>14.4</b>	<b>2.2</b>	<b>1,925.0</b>
<b>Annual Post-Policy MWs</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>4.7</b>	<b>4.7</b>	<b>48.0</b>	<b>48.0</b>	<b>179.7</b>	<b>182.4</b>	<b>192.2</b>	<b>659.7</b>
<b>Annual Nondiscounted Total (MW)</b>	<b>493.6</b>	<b>274.5</b>	<b>211.9</b>	<b>223.3</b>	<b>203.3</b>	<b>196.7</b>	<b>196.7</b>	<b>196.7</b>	<b>196.7</b>	<b>196.7</b>	<b>194.4</b>	<b>2,584.7</b>
<b>Cumulative Nondiscounted Total (MW)</b>	<b>493.6</b>	<b>768.1</b>	<b>980.1</b>	<b>1,203.3</b>	<b>1,406.6</b>	<b>1,603.3</b>	<b>1,800.1</b>	<b>1,996.8</b>	<b>2,193.6</b>	<b>2,390.3</b>	<b>2,584.7</b>	<b>2,584.7</b>

## Discounted MWs

<b>Total Discounted Annual</b>	493.6	247.1	180.1	178.6	150.1	145.2	123.5	123.5	57.7	56.4	49.7	1,805.6
<b>Total Discounted Cumulative</b>	493.6	740.7	920.8	1,099.4	1,249.5	1,394.7	1,518.3	1,641.8	1,699.5	1,755.9	1,805.6	1,805.6

## Final Summer SCC (MW) Based on 35% [Assume Winter SCC equal to zero]

<b>Annual: Total Discounted SSCC (MW)</b>	172.8	86.5	63.0	62.5	52.5	50.8	43.2	43.2	20.2	19.7	17.4	632.0
<b>Cumulative: Total Discounted SSCC (MW)</b>	172.8	259.2	322.3	384.8	437.3	488.2	531.4	574.6	594.8	614.6	632.0	632.0

# Resource Shift Creates Reliability Challenges

- **ISO New England** is increasingly reliant on resources with uncertain performance and availability
  - **Intermittent resource growth** with inherently uncertain output
  - **Natural gas resources** lack fuel storage and rely on “just-in-time” fuel
  - **Coal, oil-steam fleet** is being displaced by more efficient resources
- ISO estimates **up to 8,300 MW of non-gas-fired generation is “at risk” for retirement by 2020** (28 older oil and coal units)
  - If all retire, ISO estimates 6,300 MW of new or repowered capacity will be needed in the region
- Almost **3,400 MW of generation plan to retire within the next five years**
  - Source: Status of Non-Price Retirement Requests; October 23, 2013

# Major Non-Gas-Fired Generators Retiring

## Vermont Yankee Nuclear Station

Unit 1: 604 MW  
Total: 604 MW

## Salem Harbor Station

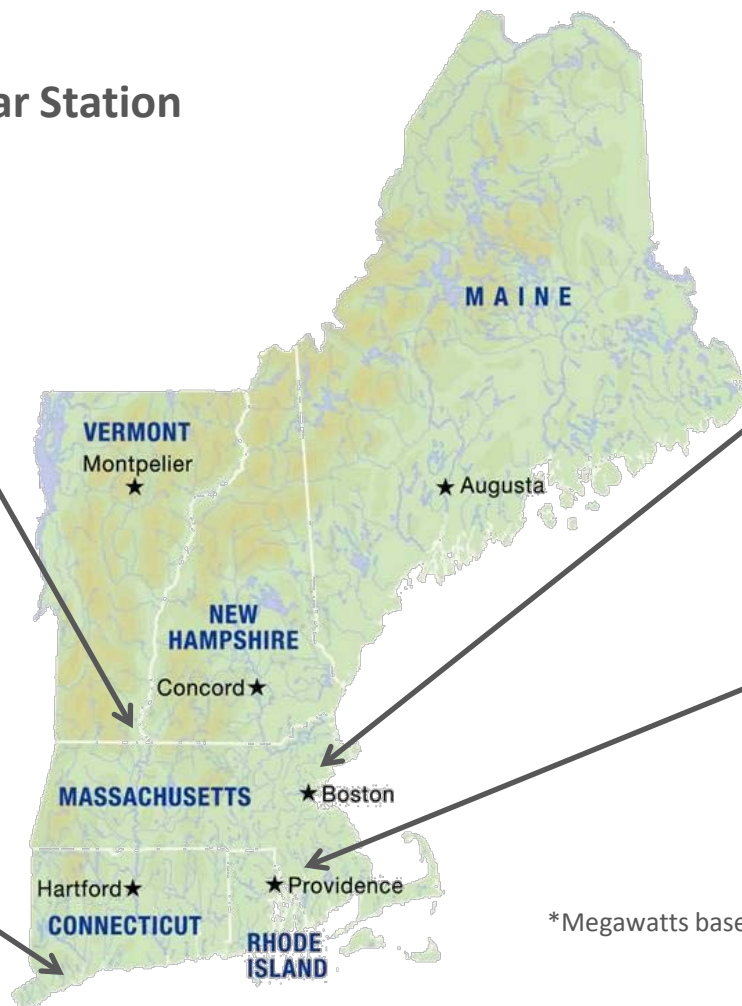
Unit 1: 82 MW (coal)  
Unit 2: 80 MW (coal)  
Unit 3: 150 MW (coal)  
Unit 4: 437 MW (oil)  
Total: 749 MW

## Norwalk Harbor Station

Unit 1: 162 MW (oil)  
Unit 2: 168 MW (oil)  
Unit 10: 12 MW (oil)  
Total: 342 MW

## Brayton Point Station

Unit 1: 239 MW (coal)  
Unit 2: 239 MW (coal)  
Unit 3: 612 MW (coal)  
Unit 4: 435 MW (oil)  
Brayton Diesels 1-4: 10 MW  
Total: 1535 MW



\*Megawatts based on relevant FCA summer qualified capacity

Source: Status of Non-Price Retirement Requests; December 20, 2013

# New England Governors Commit to Regional Cooperation on Energy Infrastructure Issues

- Dec. 2013: Region's governors announced the need for strategic investments in energy resources and infrastructure:
  - Energy efficiency
  - Renewable generation
  - Natural gas pipelines
  - Electric transmission
- Ensure a reliable, affordable and diverse energy system
- Enable states to meet clean energy and greenhouse gas reduction goals and improve economic competitiveness



# New England Governors Request ISO's Support to Develop Electric and Natural Gas Infrastructure

- January 2014: Governors, through NESCOE, request ISO technical support and tariff filings at FERC to support their objectives to expand energy infrastructure
- **New Electric Transmission Infrastructure**
  - Enable delivery of 1,200 MW to 3,600 MW of clean energy into New England from no and/or low carbon emissions resources
- **Increased Natural Gas Capacity**
  - Increase firm pipeline capacity into New England by 1000 mmcf/day above 2013 levels, or 600 mmcf/day beyond announced projects
  - Targeted to be in-service by winter 2017/18
- **Cost recovery through ISO tariff**
  - States to decide on cost allocation





# Conclusion

- Energy landscape is changing rapidly
- Region is seeing growth in renewable energy, energy efficiency and distributed generation
- Region is also seeing the retirement of older fossil-fueled generators
- ISO New England is planning for this changing energy landscape to ensure reliable system operations



# Questions

