NESEA™
NORTHEAST SUSTAINABLE ENERGY ASSOCIATION

Understanding Our
Energy Distribution Systems:

# Gas Infrastructure and Deliverability in New England

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March 5, 2014

LEVITAN & ASSOCIATES, INC.
MARKET DESIGN, ECONOMICS AND POWER SYSTEMS

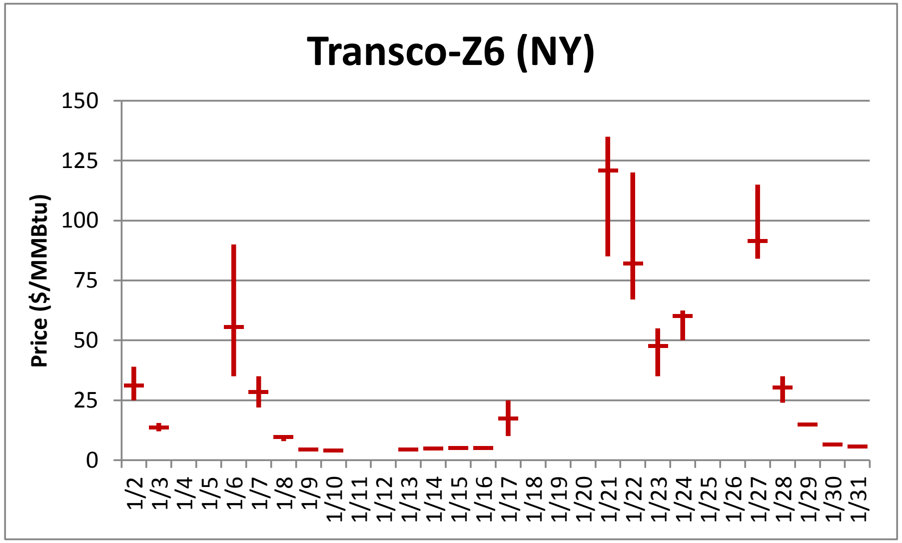
# Agenda



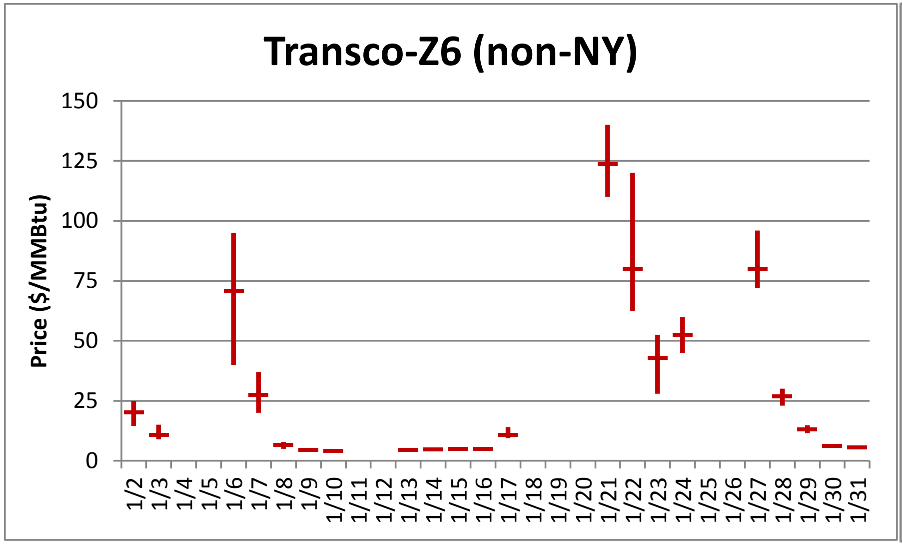
- Price Discovery During the Polar Vortex
- New England's P/L Infrastructure
  - Marcellus shale E&P impact on supply / deliverability
  - Decline in gas portfolio diversity -- pipeline economic obsolescence
  - Reduced LNG Imports
  - Potential infrastructure expansion efforts

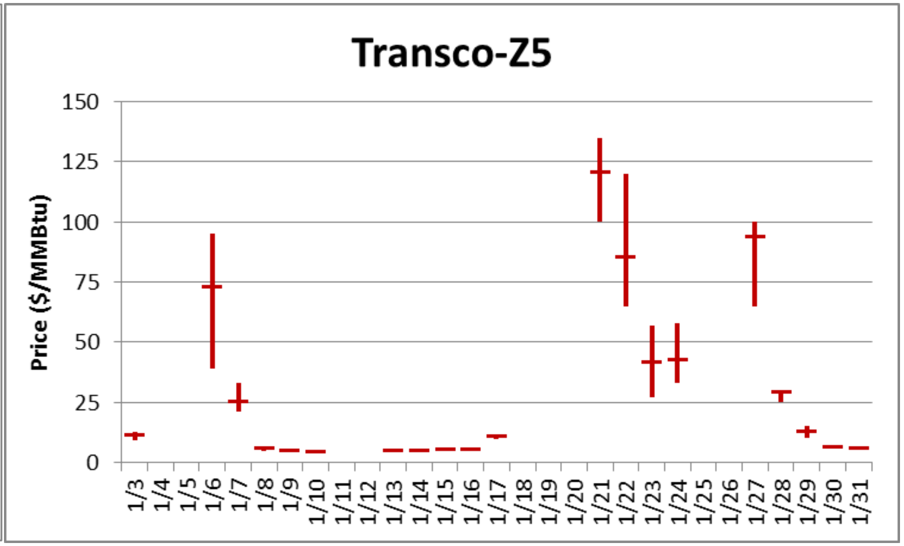
# Next Day Strip Prices, January 2014

(High, Low, Weighted Average)




TZ6 (non-NY) is VA/MB border to Linden, NJ
TZ5 is GA/SC to VA/MD border

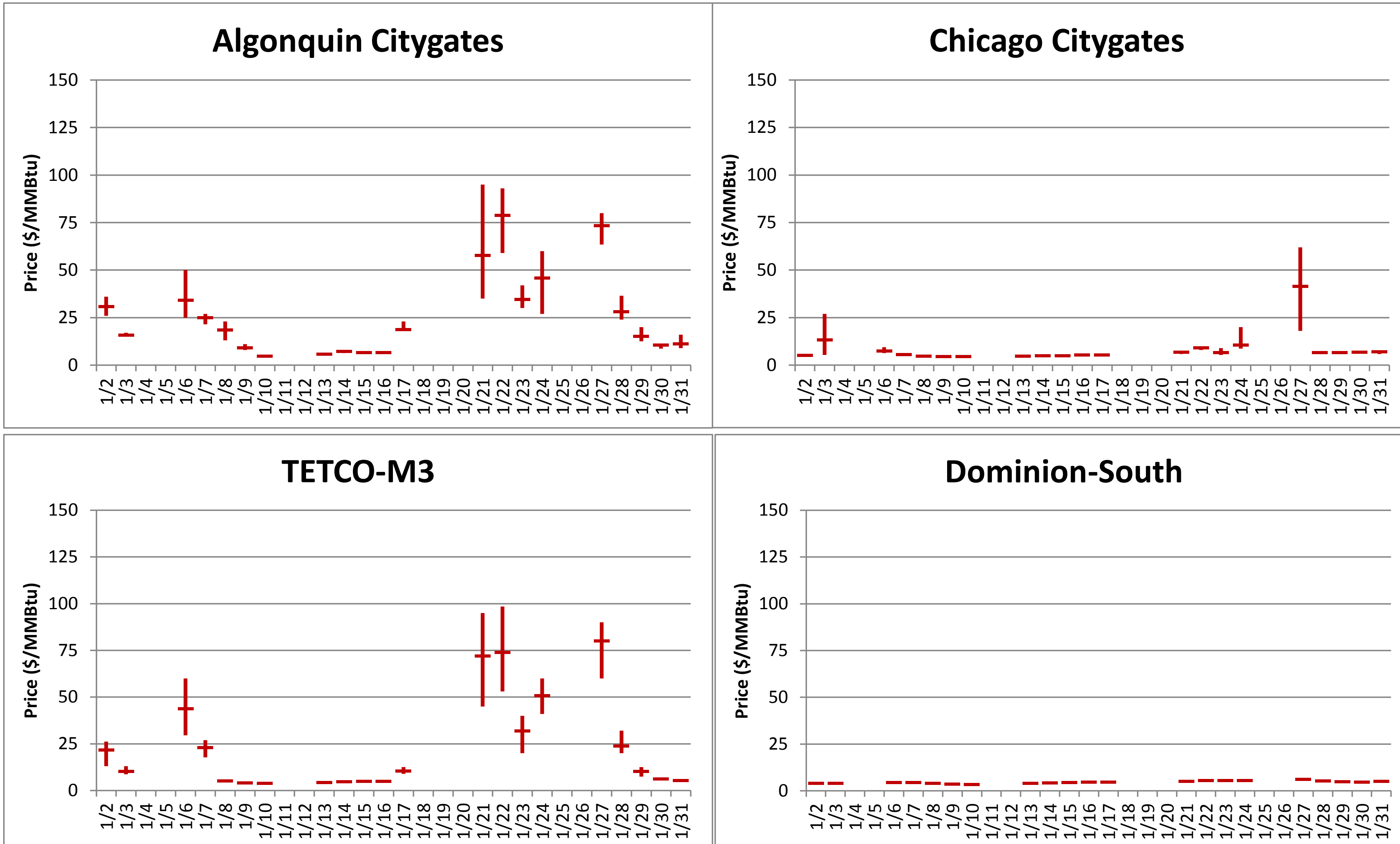



Source: ICE

# Next Day Strip Prices, January 2014

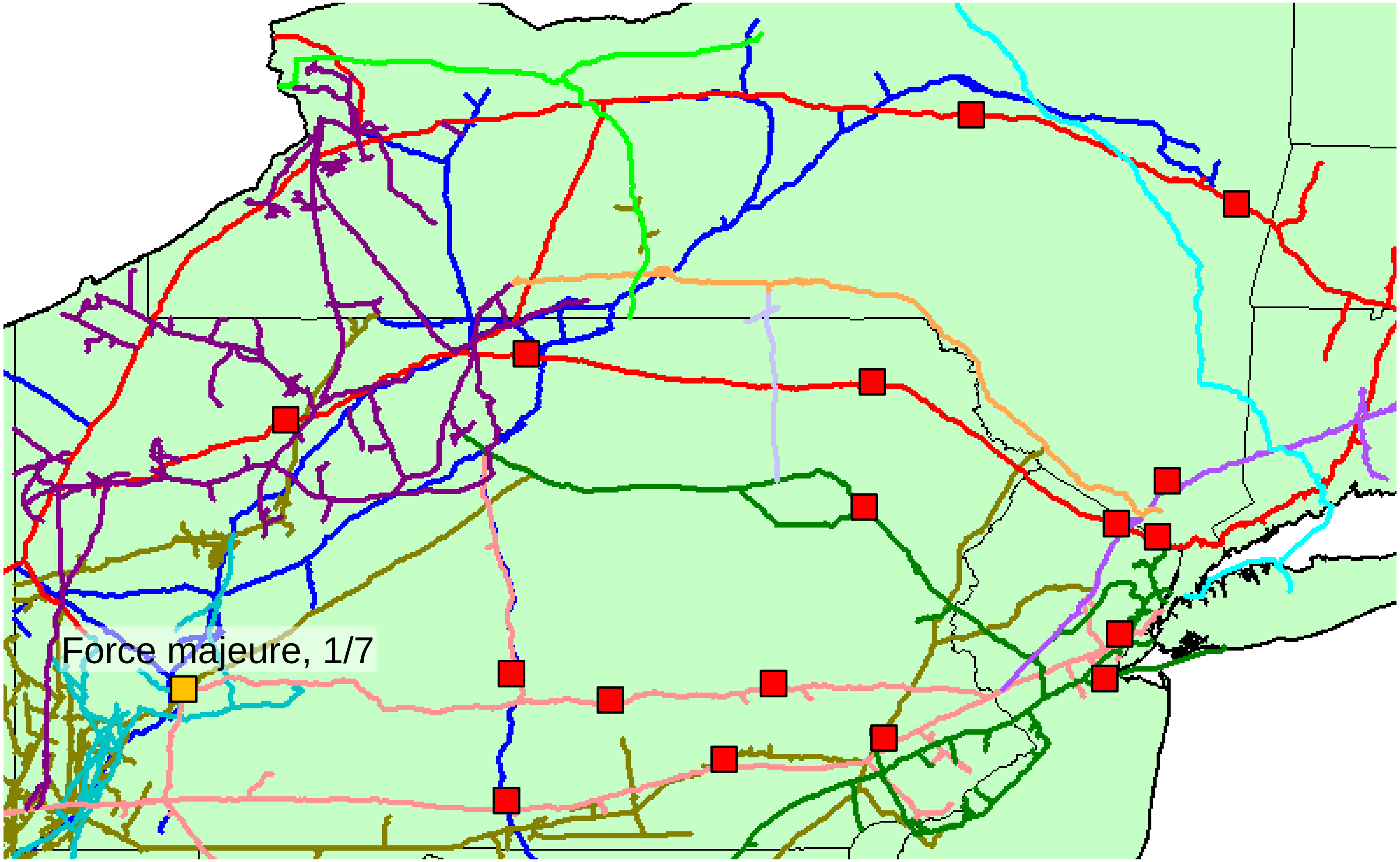
(High, Low, Weighted Average)




Source: ICE

# Chokepoints Across the Supply Chain into the NYFS

January 6-7, January 21-23, 2014

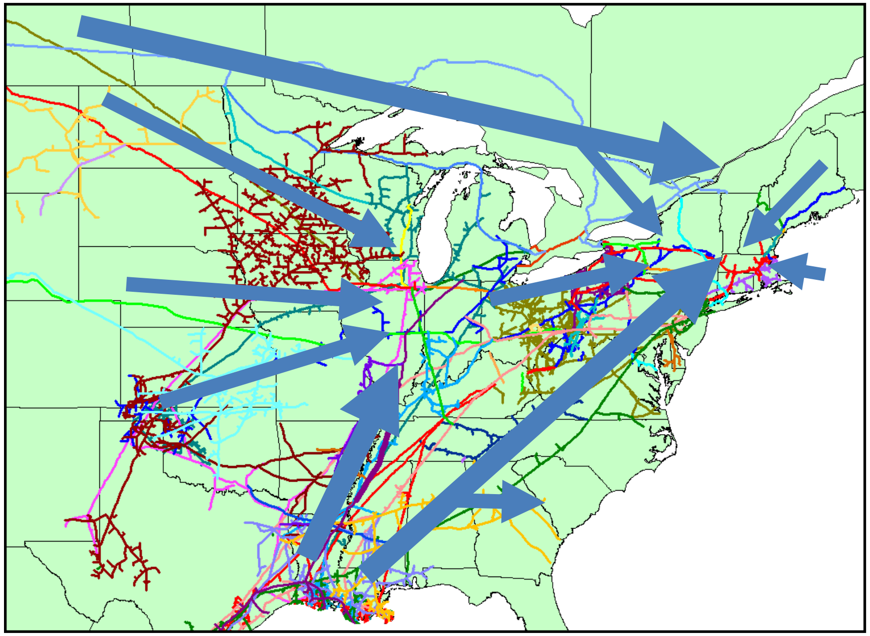



Source: Pipeline EBB Critical Notice postings

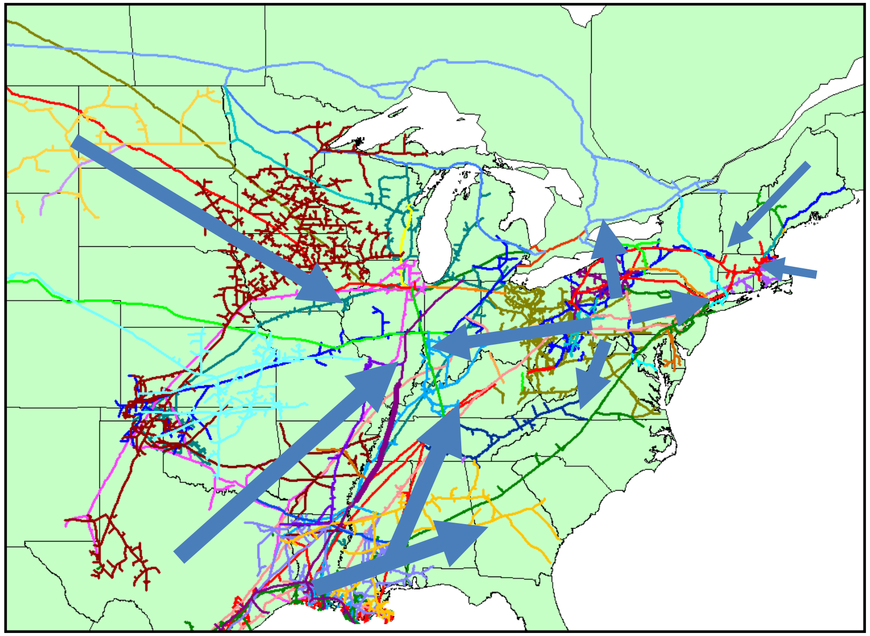
# Pre-Shale and Post-Shale Gas Flow Patterns



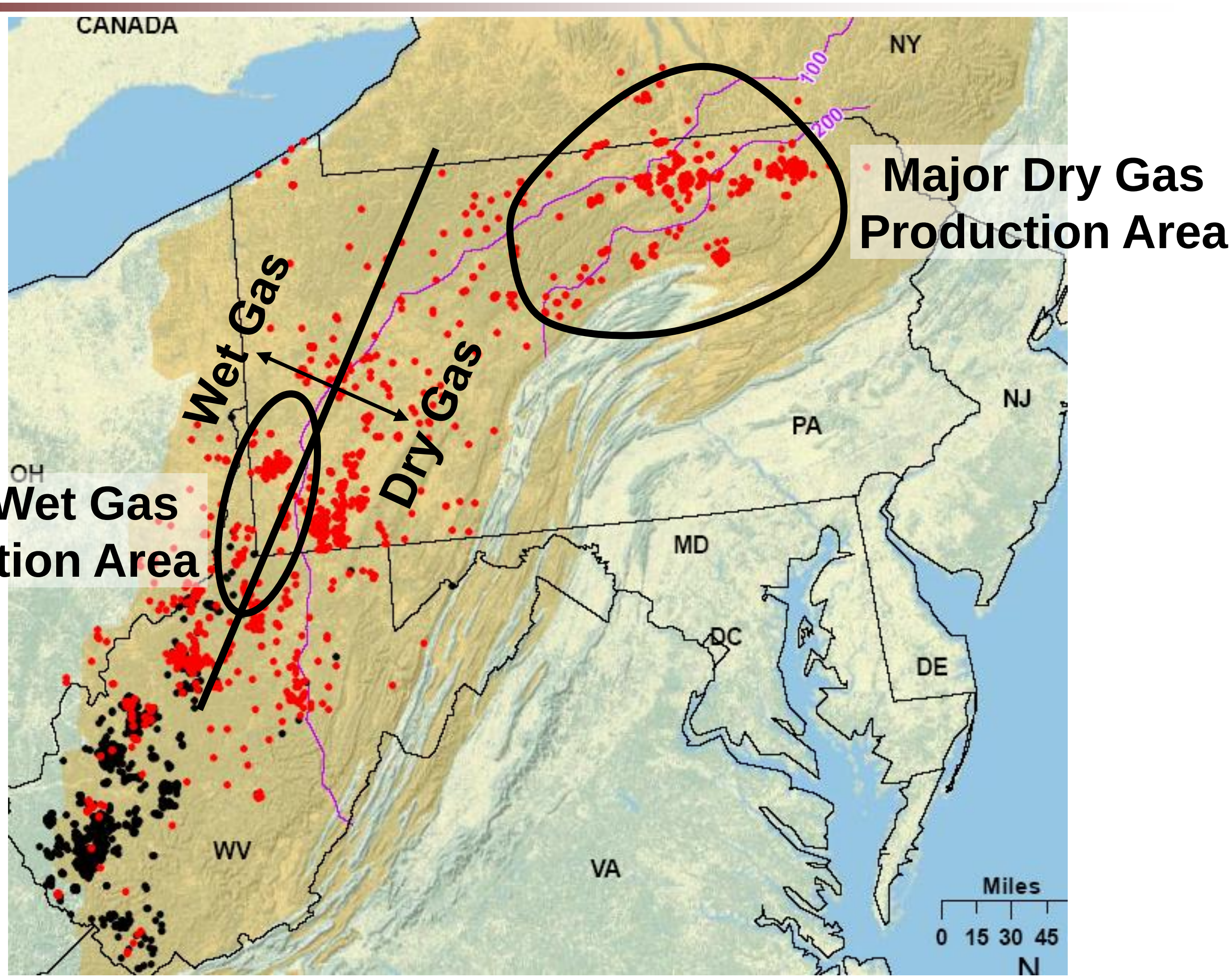
Pre-Shale Flow Patterns



Post-Shale Flow Patterns



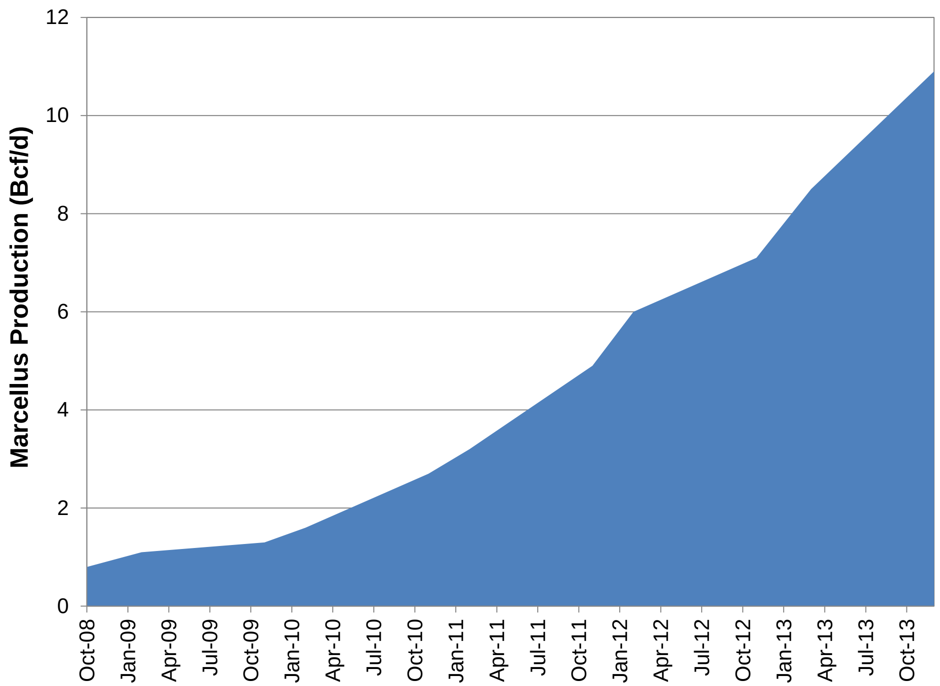
# Wet and dry shale gas production




*Sources: EIA, Pennsylvania State University Marcellus Center, Dominion Resources, Pennsylvania Department of Conservation and Natural Resources*

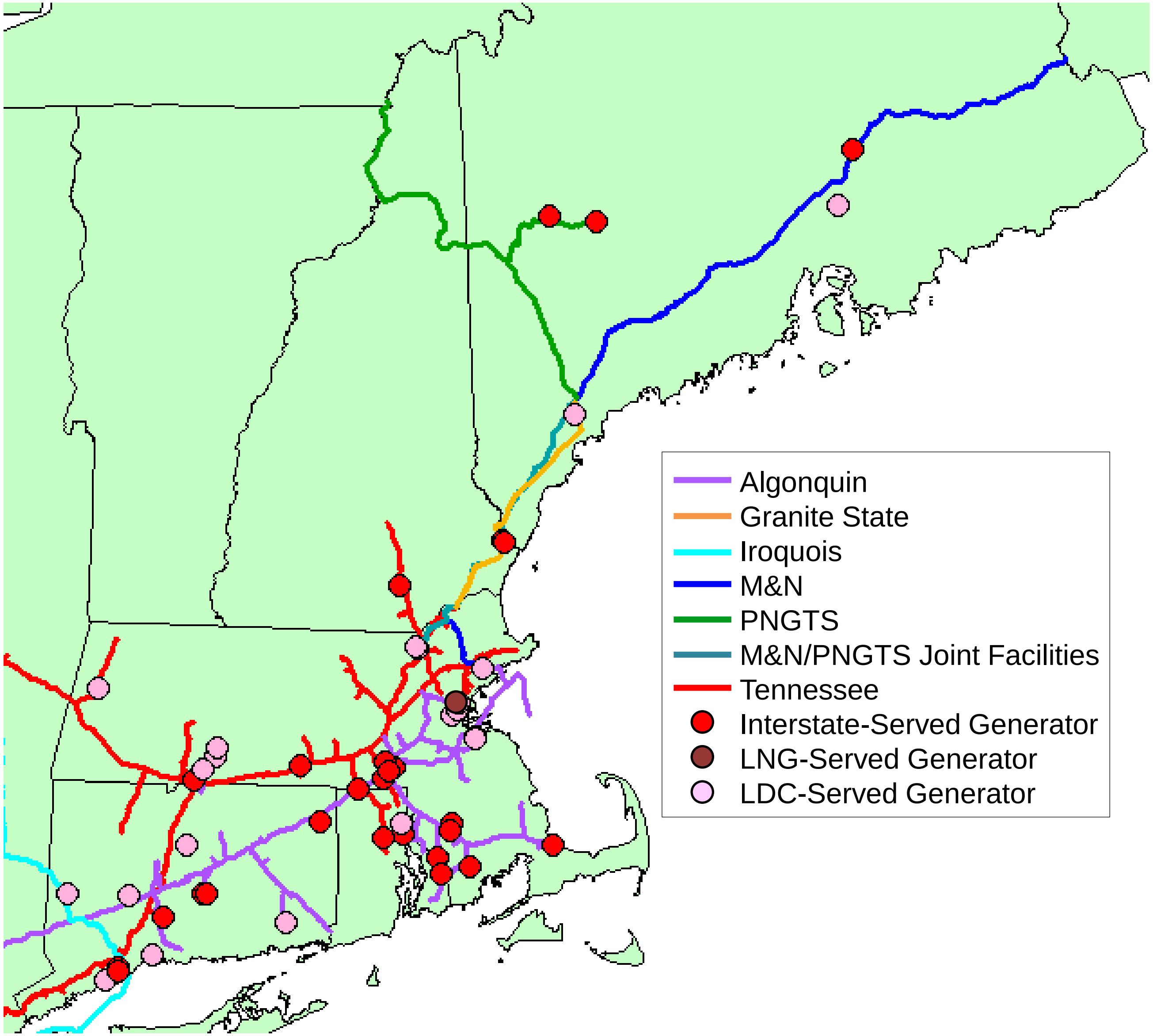
# Radical Change in Traditional Flows

- Shale gas fundamentally altering traditional flows
  - Long haul transportation from WCSB obsolete
  - Marcellus gas supplanting gas from GoM and Canada
  - Declining Sable Island production, uncertainty around Deep Panuke
  - Reversal of flow through New York / Ontario
  - LNG imports limited to contract quantities, periodic arbitrage
    - Flexible cargoes to EU or Asia

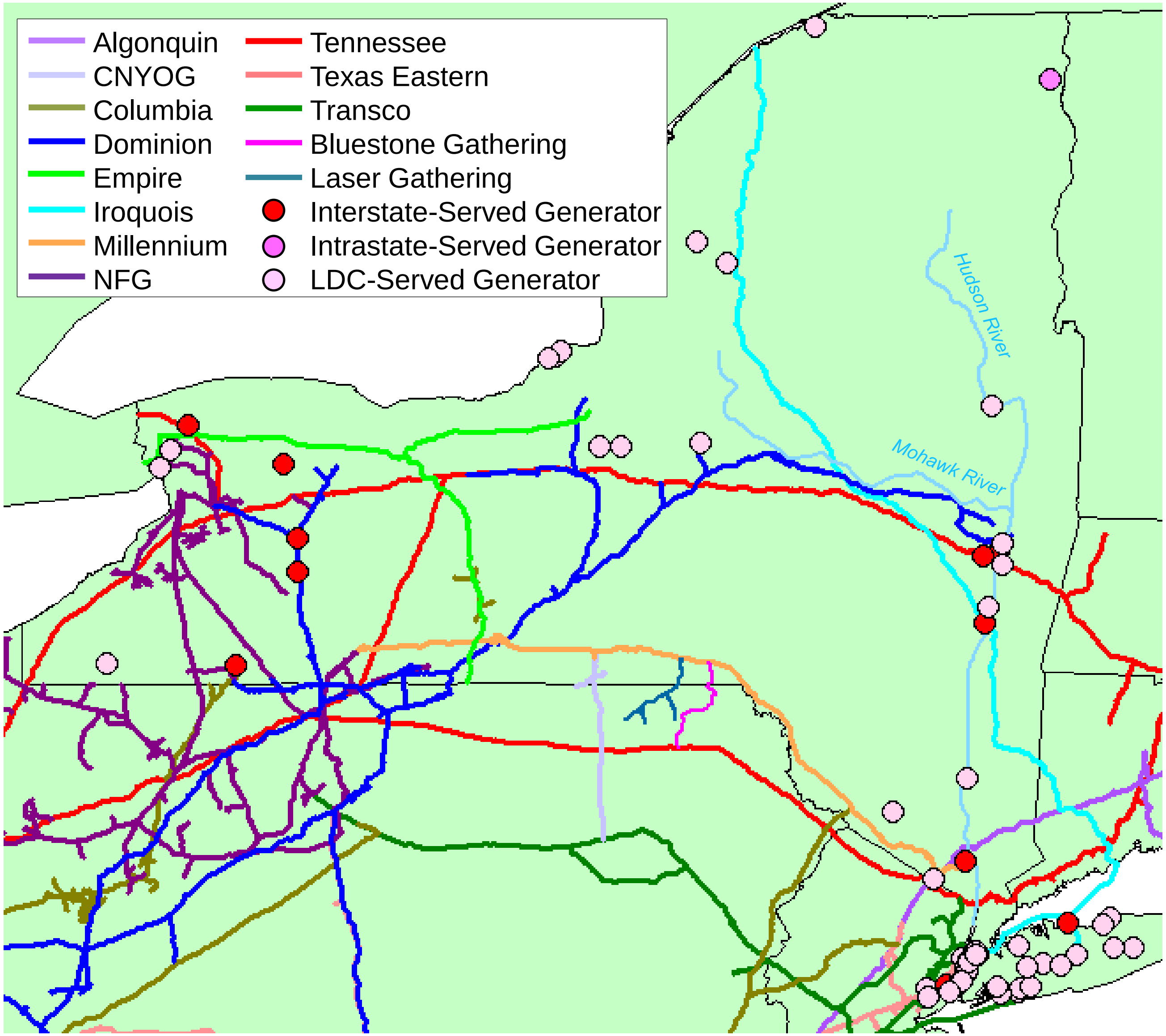



*Source: Bentek Energy*

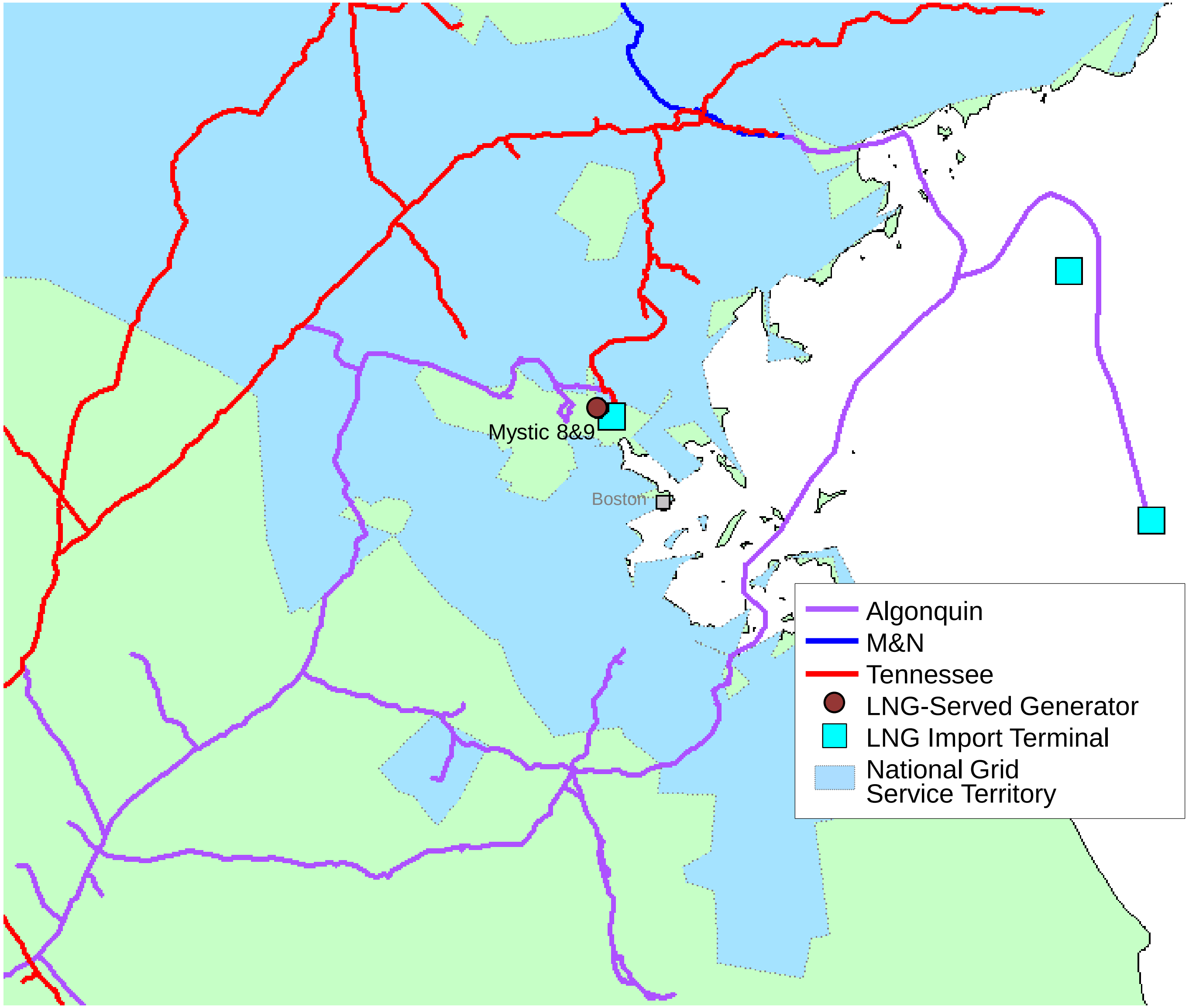
# Interstate Pipelines Operating in New England



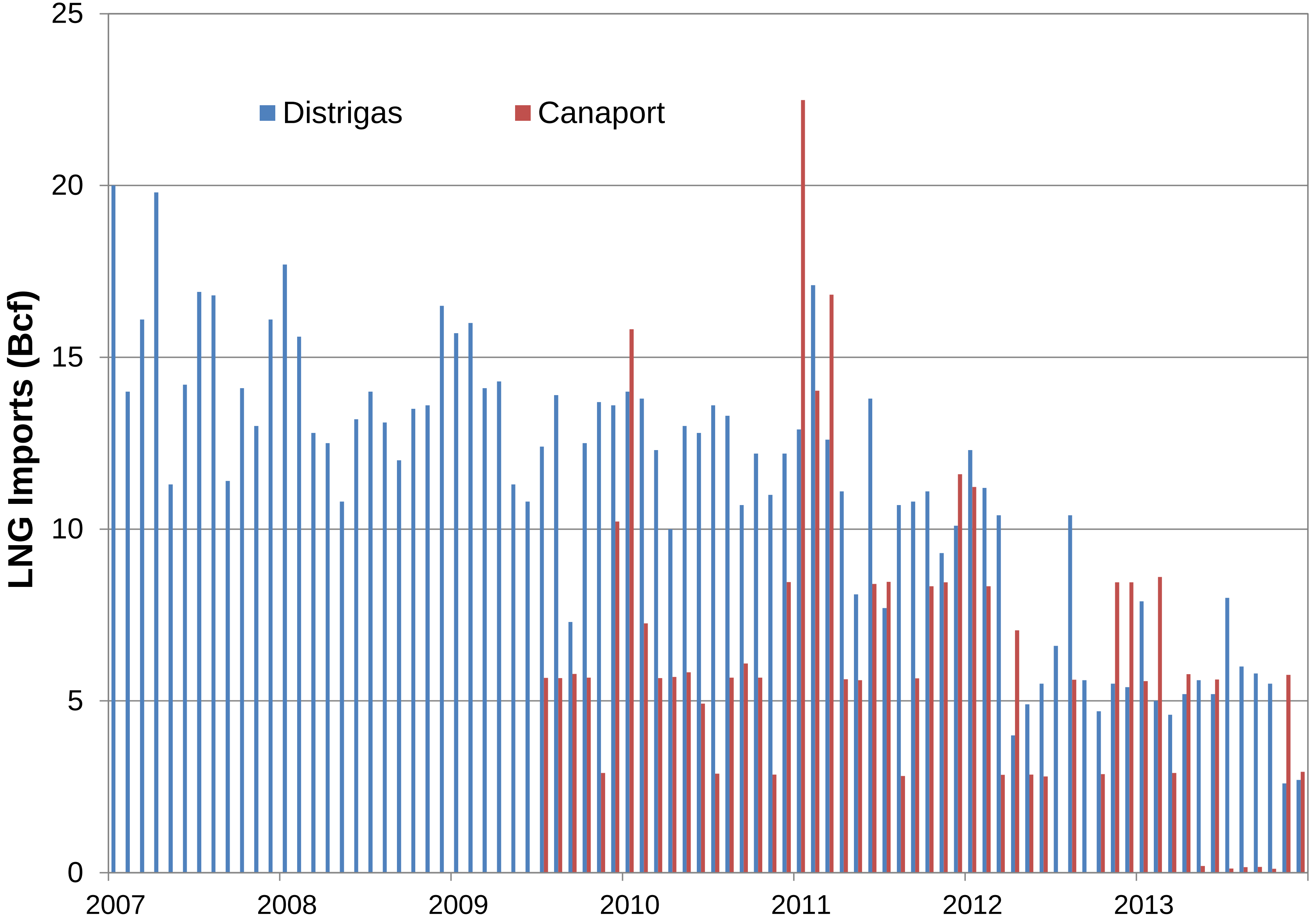
# Interstate Pipelines Operating in New York



# LNG Import Terminals in New England

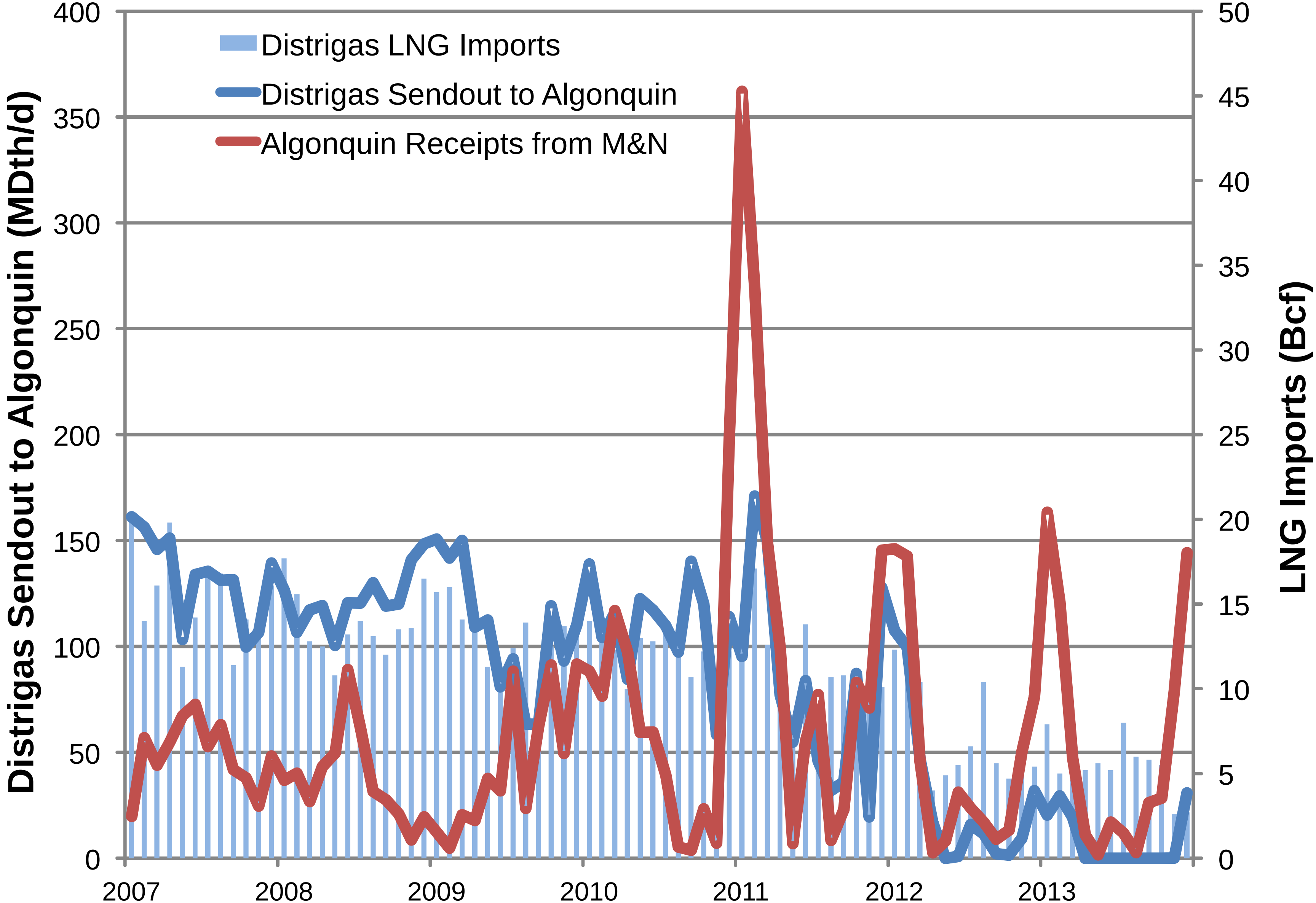


# Northeast LNG Imports




Source: DOE Office of Fossil Energy, NEB

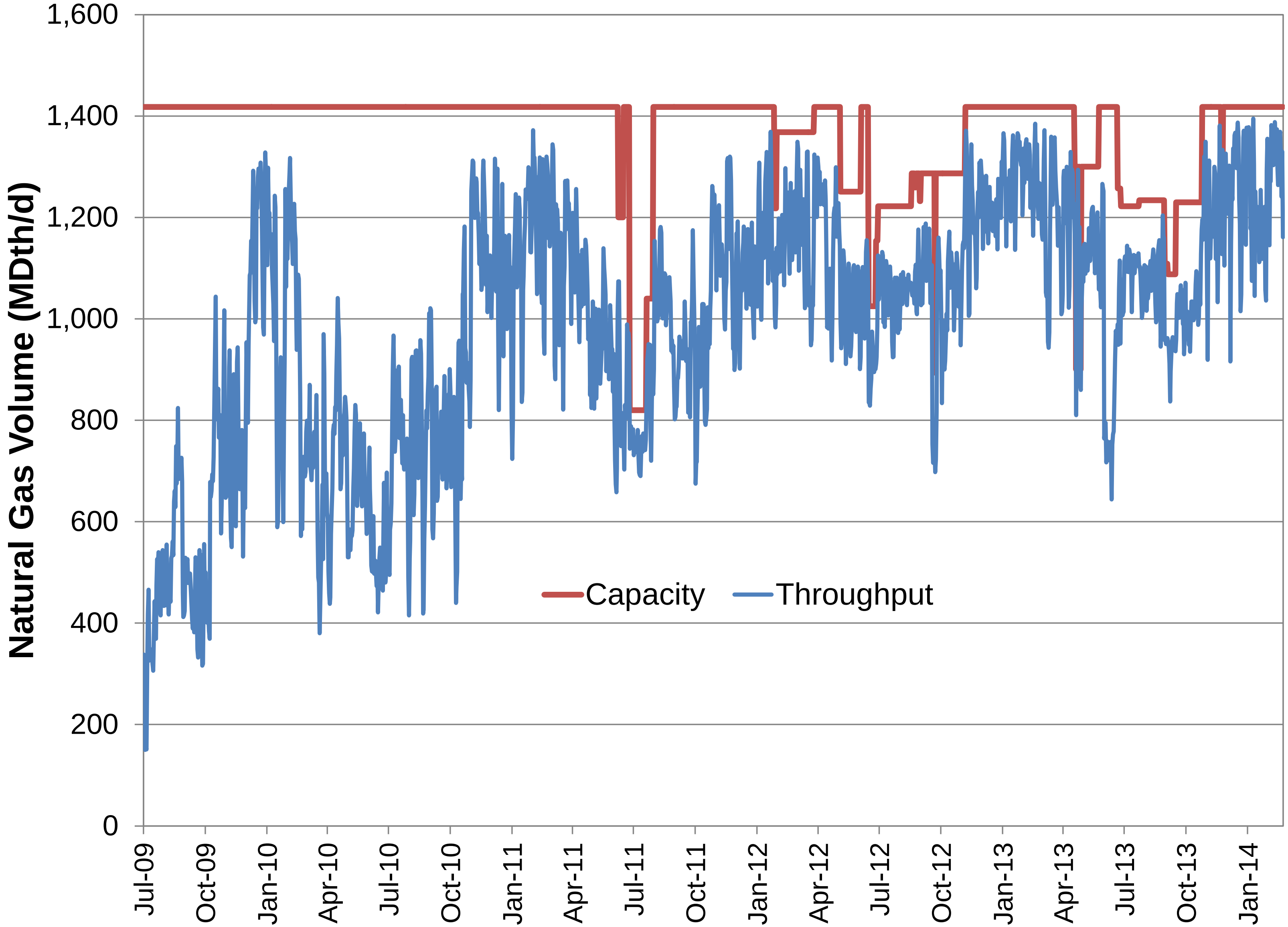
# Decline in East-End Supplies




Source: DOE Office of Fossil Energy, Spectra Energy

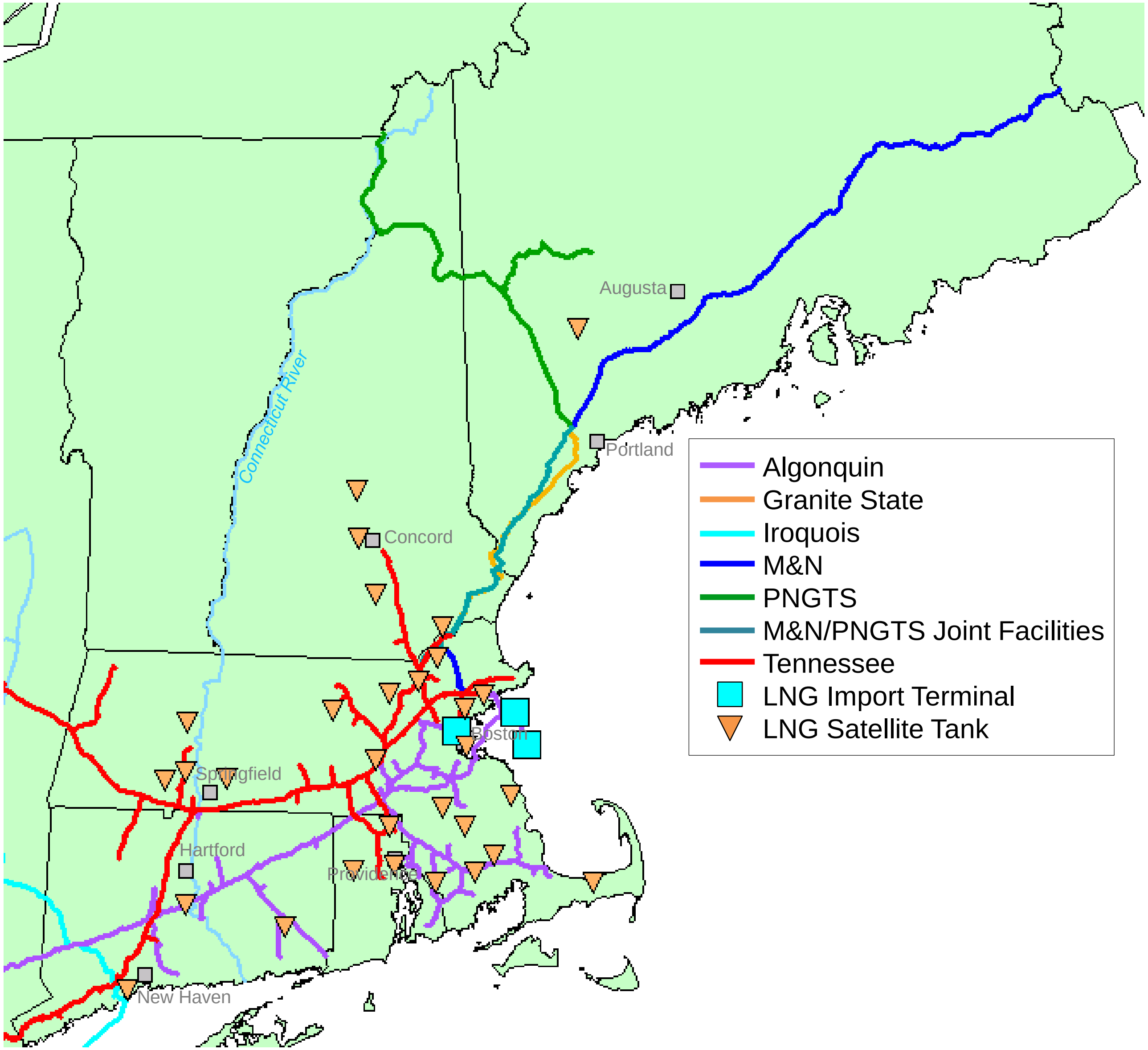
# Constraints on West-End Supplies

*Algonquin Southeast Compressor Station (NY/CT Border)*

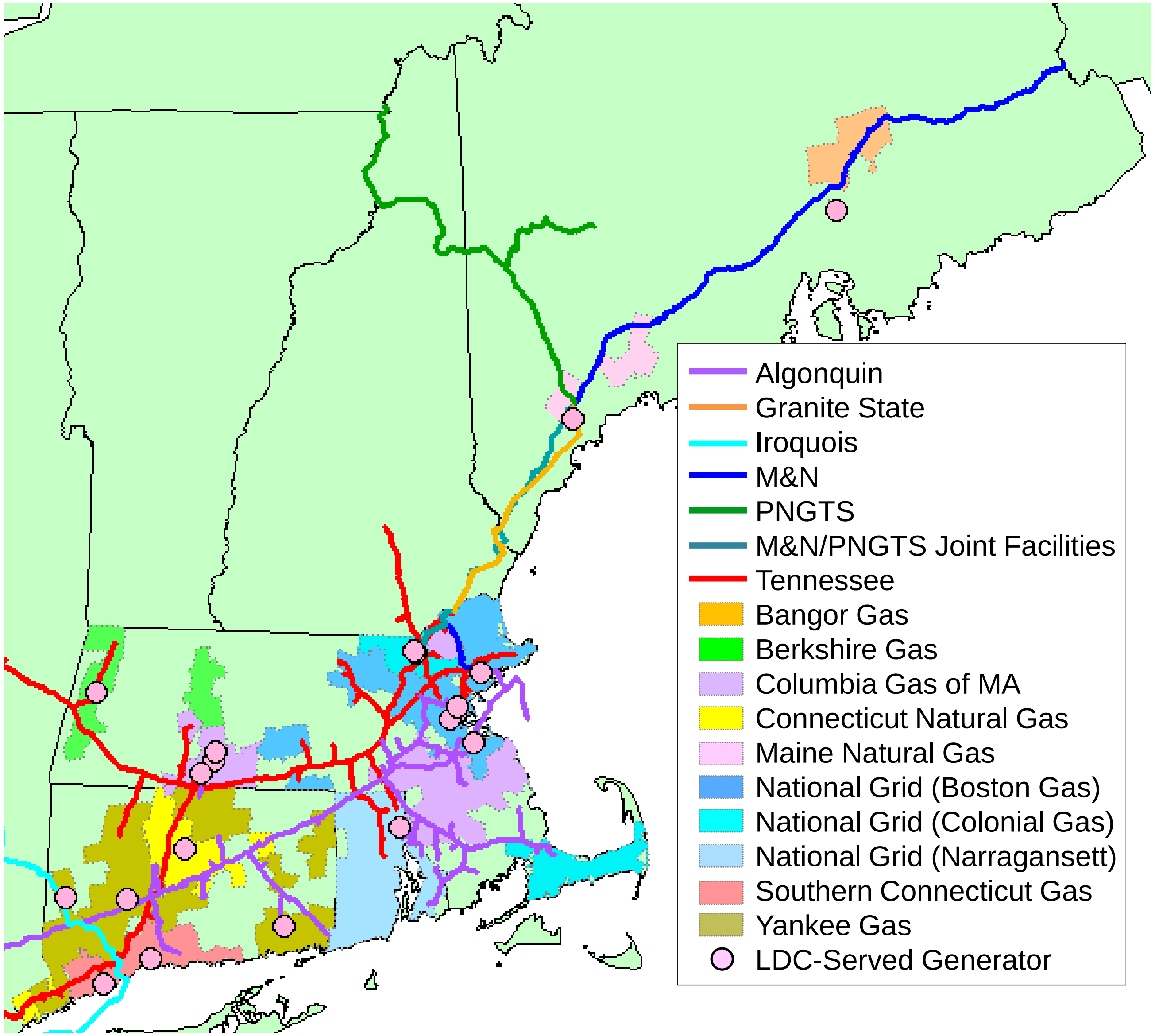



Source: Spectra Energy

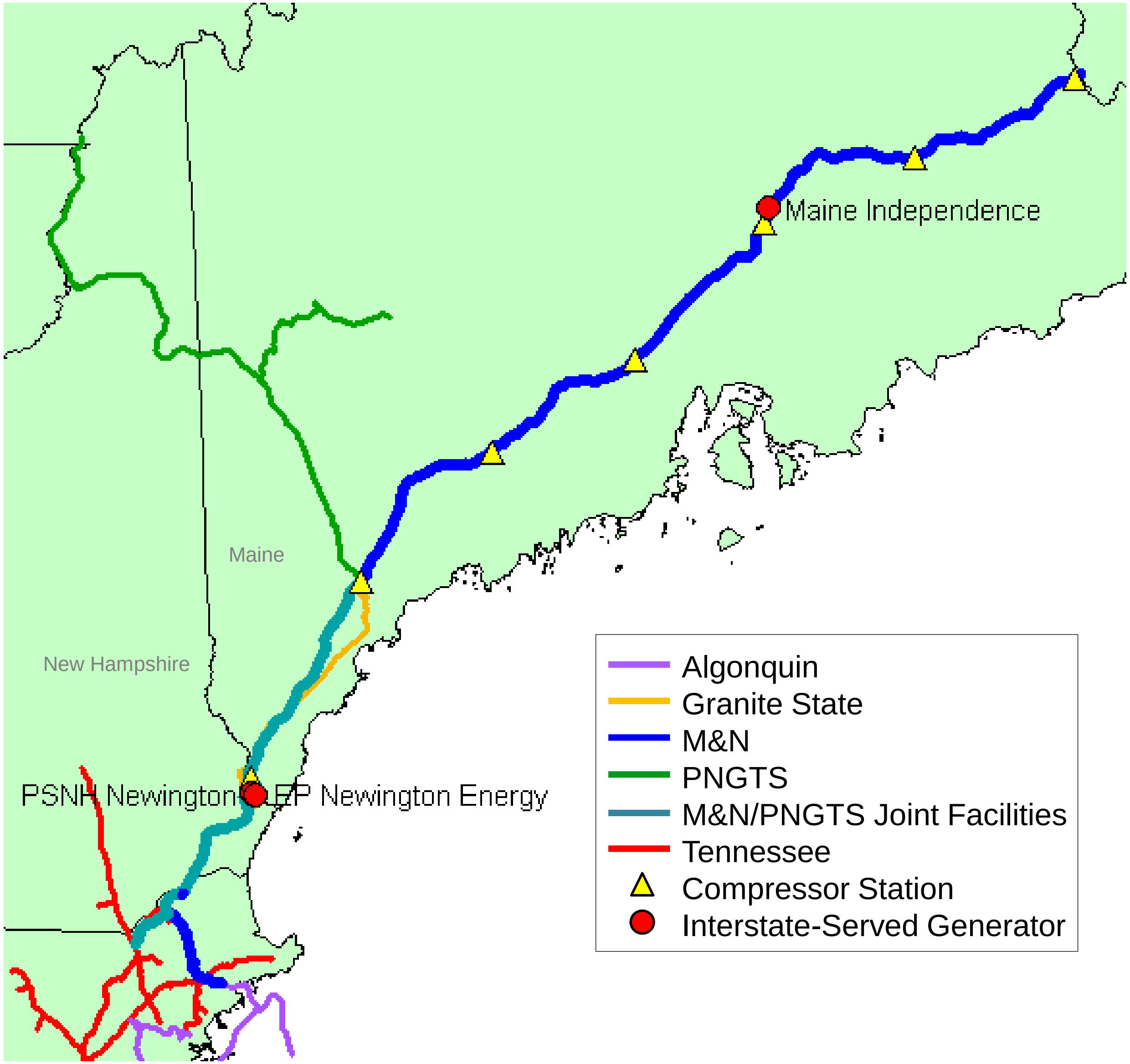
# LNG Facilities in New England



# LDCs Serving New England Generators



# M&N Pipeline Facilities





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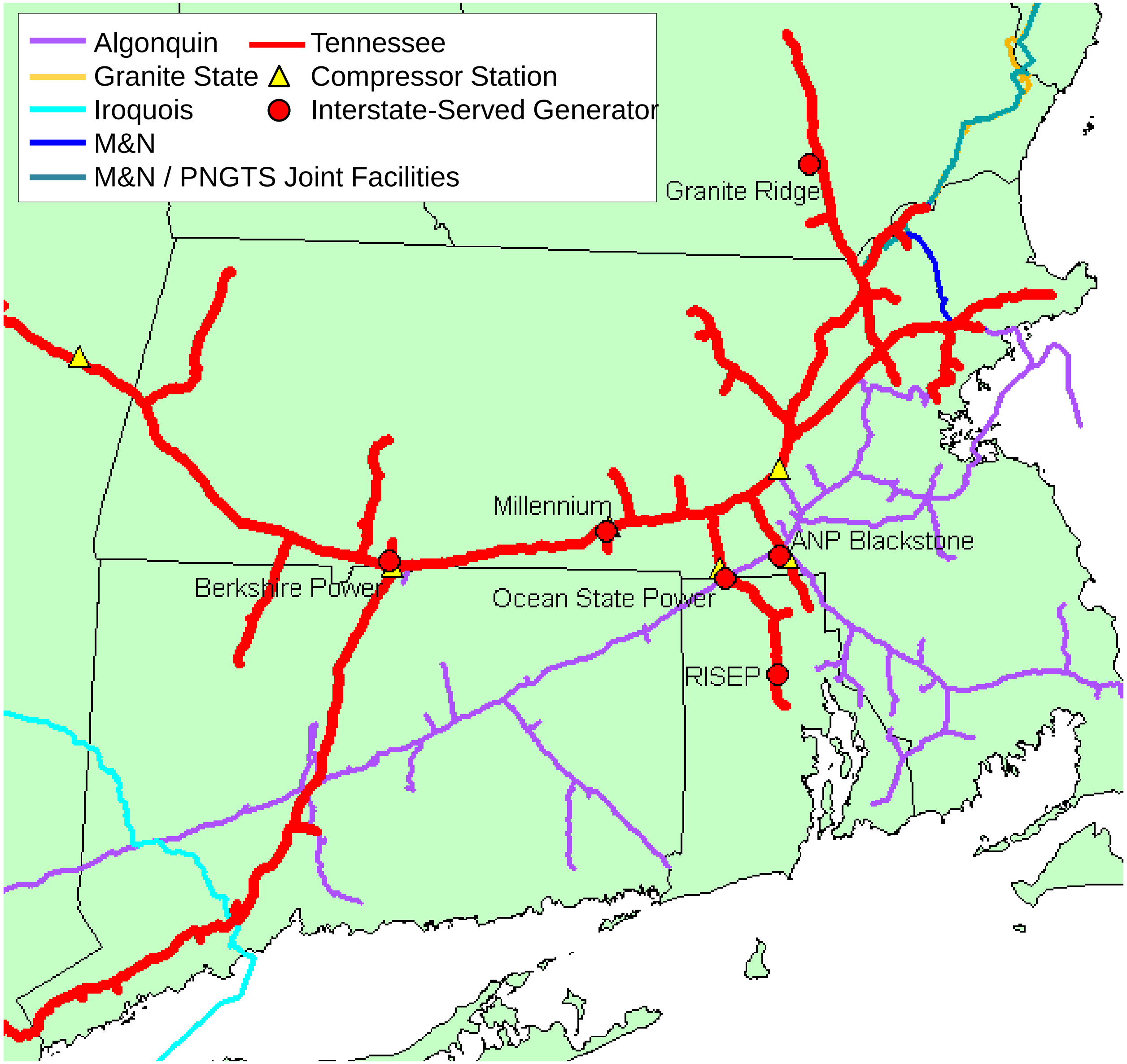
# Tennessee Pipeline Facilities in New England





# Concluding Thoughts

- Loss of New England's P/L portfolio diversity heightens economic and operational risks
- High basis and volatile gas prices likely here to stay until pipeline enhancements alleviate congestion along traditional pathways into the region
- Existing ISO wholesale market design does not induce genco commitments for firm transportation
- Bulk power security during the winter is derived largely from oil
  - Many oil generation plants at the local level are at-risk for retirement
  - Combined cycle, gas turbine, and steam turbine generators on oil cannot sustain the provision of ancillary services

# Electric Grid Structures

**NESEA BuildingEnergy 14**

***Understanding Our Energy Distribution Systems***

March 5, 2014

Paul Peterson

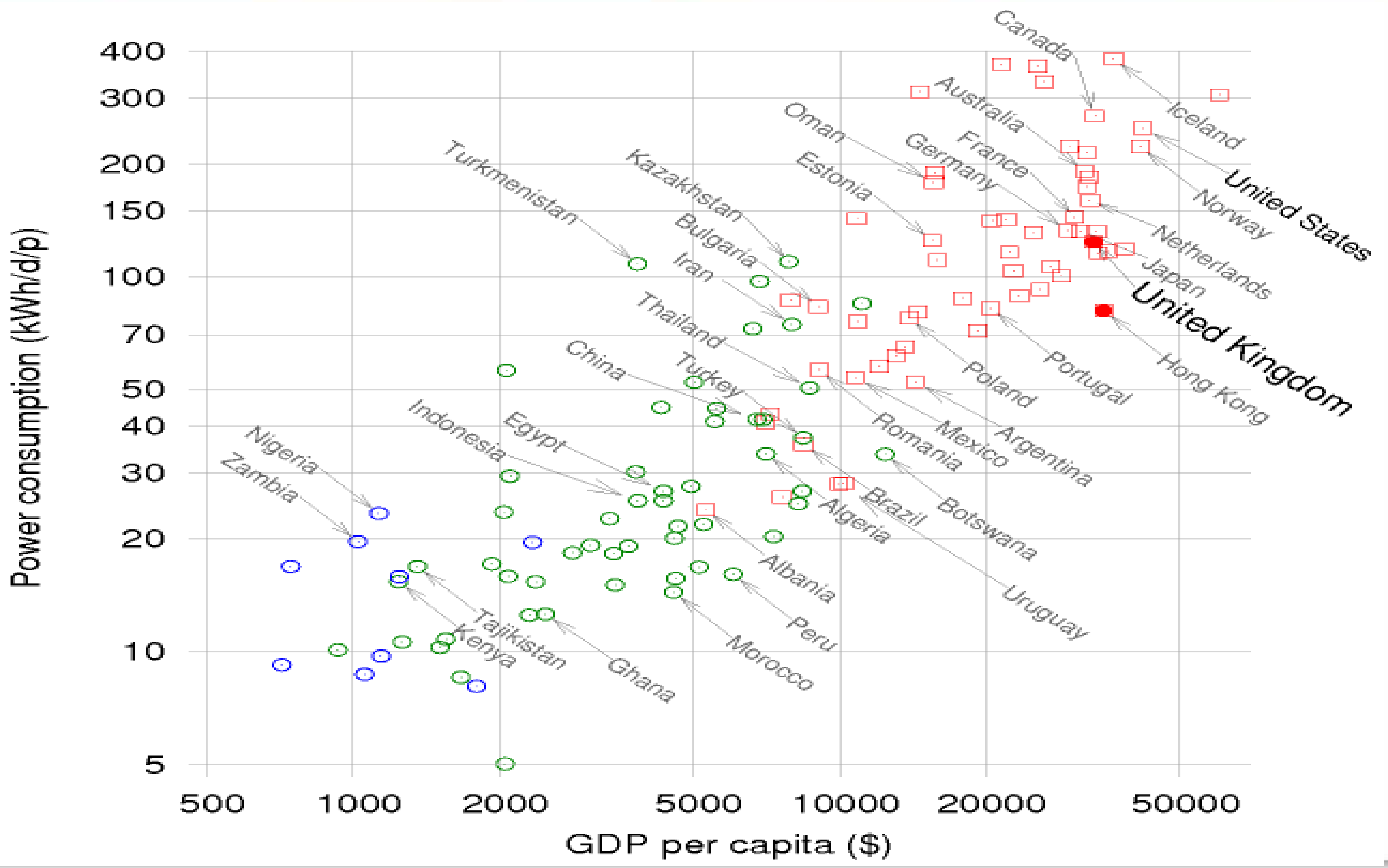
 | 

## Synapse Energy Economics

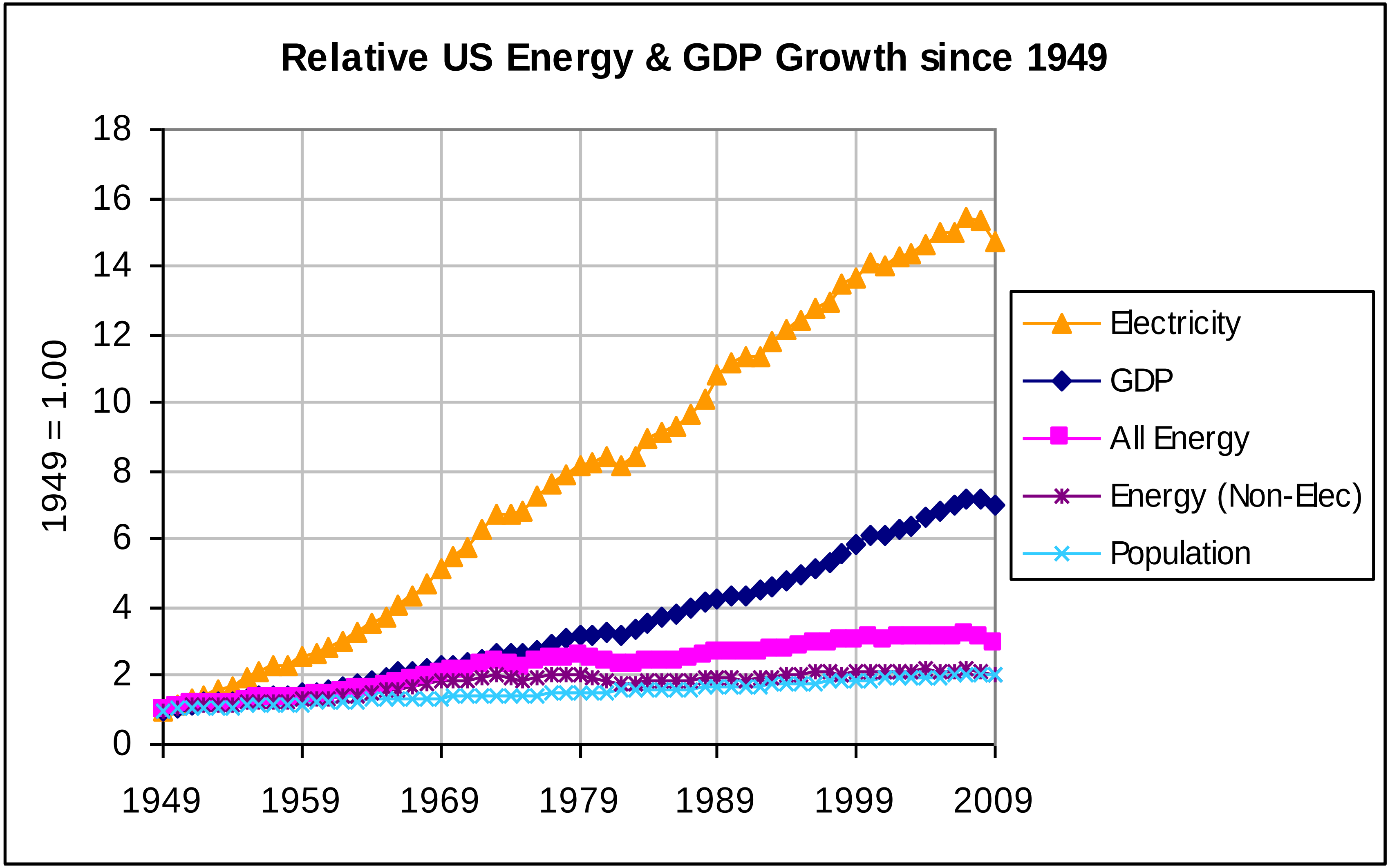
- Consulting firm in Cambridge Massachusetts with a staff of 30 people
- Issues
  - Electric industry restructuring & utility rate cases
  - Wholesale markets, ISOs, and RTOs
  - System Planning and resource development
  - Environmental impacts of power industry
- Clients
  - State Consumer Advocates and Utility Commissions
  - Public Interest and Environmental groups
  - EPA and DOE
  - RTO stakeholders

 |  

# Energy Intensity

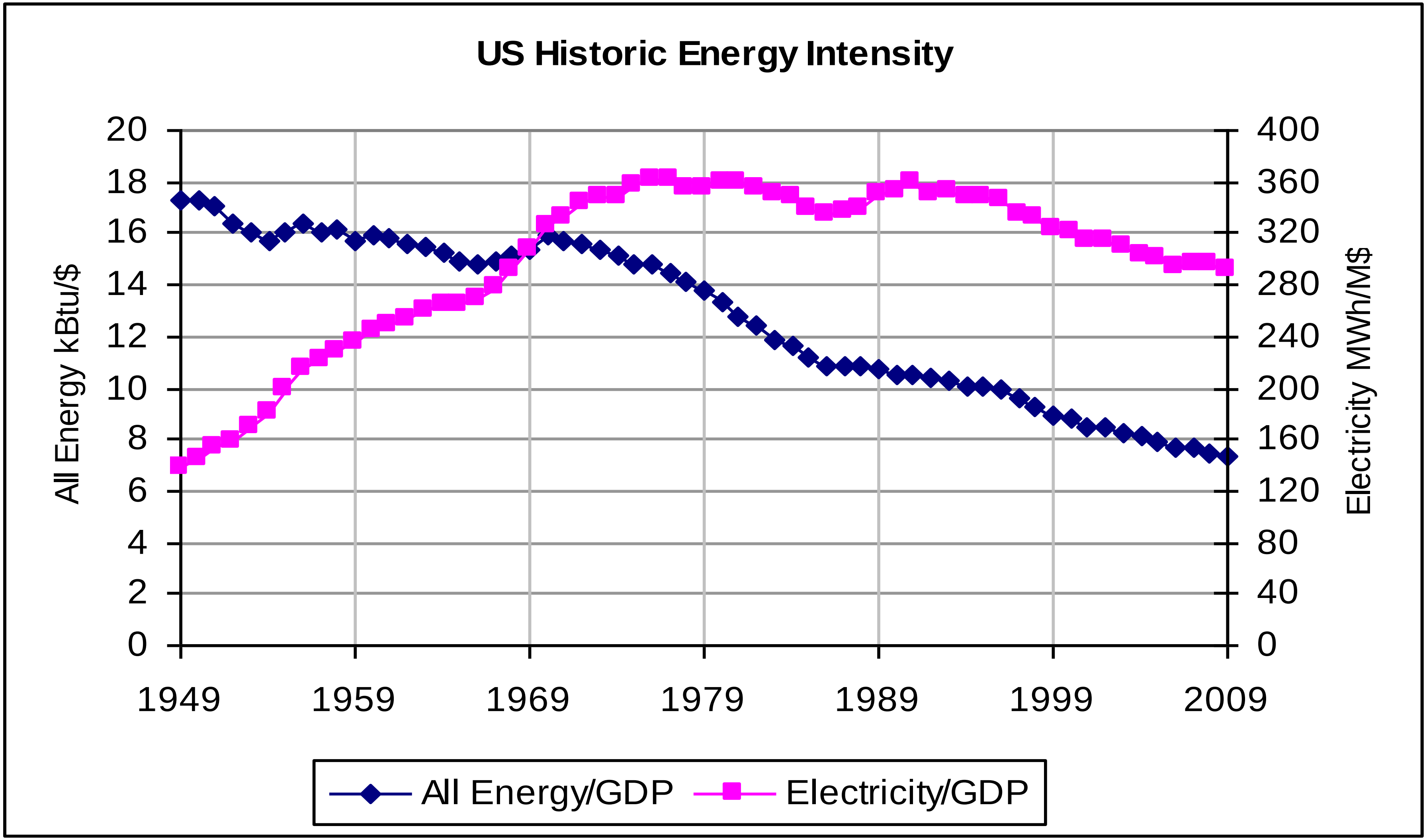


# Trends



Relative US Energy & GDP Growth since 1949
1949 = 1.00
0
2
4
6
8
10
12
14
16
18
1949
1959
1969
1979
1989
1999
2009
Electricity
GDP
All Energy
Energy (Non-Elec)
Population

# Declining energy intensity



Three elements to power system

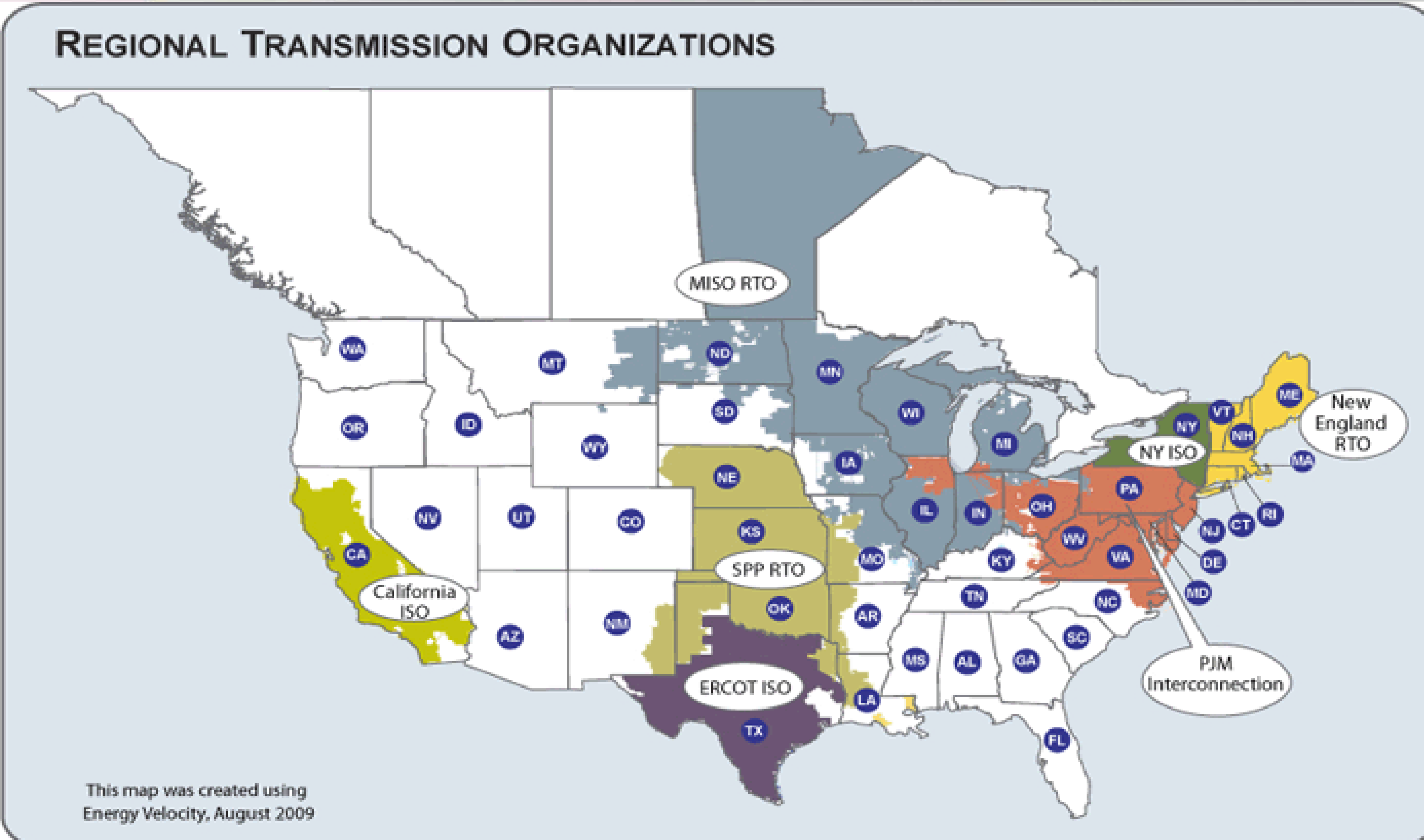
- Supply (resources)
- Demand (loads)
- Wires (T&D systems)

Inter-connected electric systems are the largest machines ever engineered

- 24/7 balancing of supply and demand
- Cascading effect of disruptions
- Controls for local systems

 |  

# North American electric machines



# New England's Electric Power Grid at a Glance


- 6-state region: 14 million residents and 6.5 million meters
- 37,000 MW of capacity resources
  - Includes generation, demand resources and imports
- 8,400 miles of high-voltage transmission
  - $5 billion in investment since 2002
  - $6 billion planned over next 5 years
- 28,130 MW all-time peak demand
- $5 billion total energy market (2012)

# Planning issues

## Peak Load

- Summer: MW needed for summer peak day
- Winter: MW needed for winter peak day
- Daily: MW needed for each daily peak

## Energy

- MWH needed to meet total annual demand

## Reliability Needs

- Resource adequacy (thermal loads on wires)
- Security dispatch (voltage, stability and daily operation)

# System operations

- Energy to meet forecast load in each hour
  - Day Ahead, adjusted by a reliability review
  - Real Time
- Reserves to be available for contingencies
  - 10 minute
  - 30 minute
- Dispatch instructions to fine tune/balance
  - Voltage
  - Regulation to fine tune the balance
- Capacity to meet annual peak load

## Traditional operation of power grids

- Day-ahead forecast of hourly loads (weather)
- Day-ahead commitment of generation
- Real-time management of generation by operators

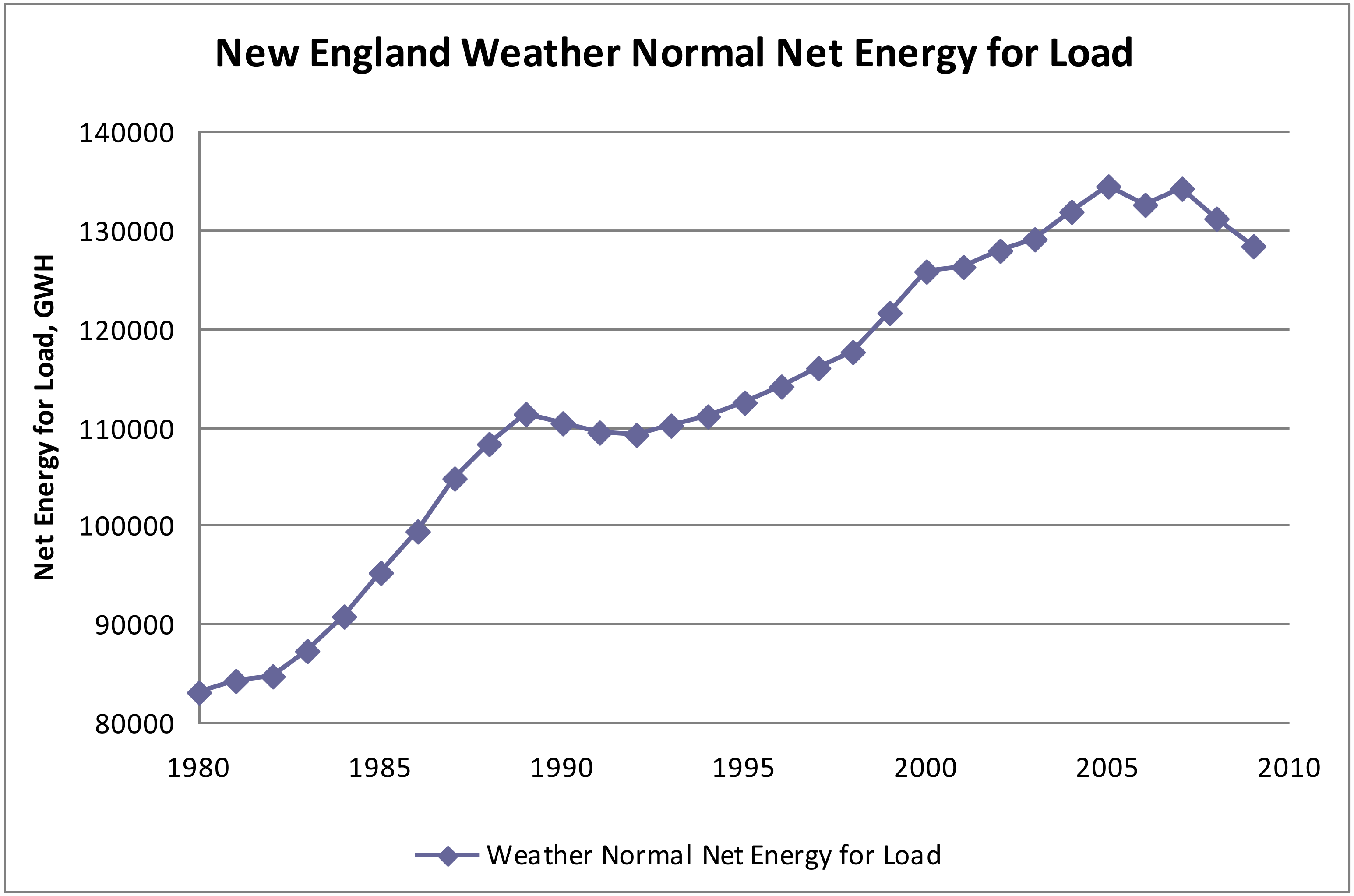
## Evolving operation of power grids

- Day-ahead offers by Supply and Load
- Day-ahead dispatch schedule includes instructions to both Supply and Load
- Real-time balancing based on offers

## Supply and load are variable/manageable

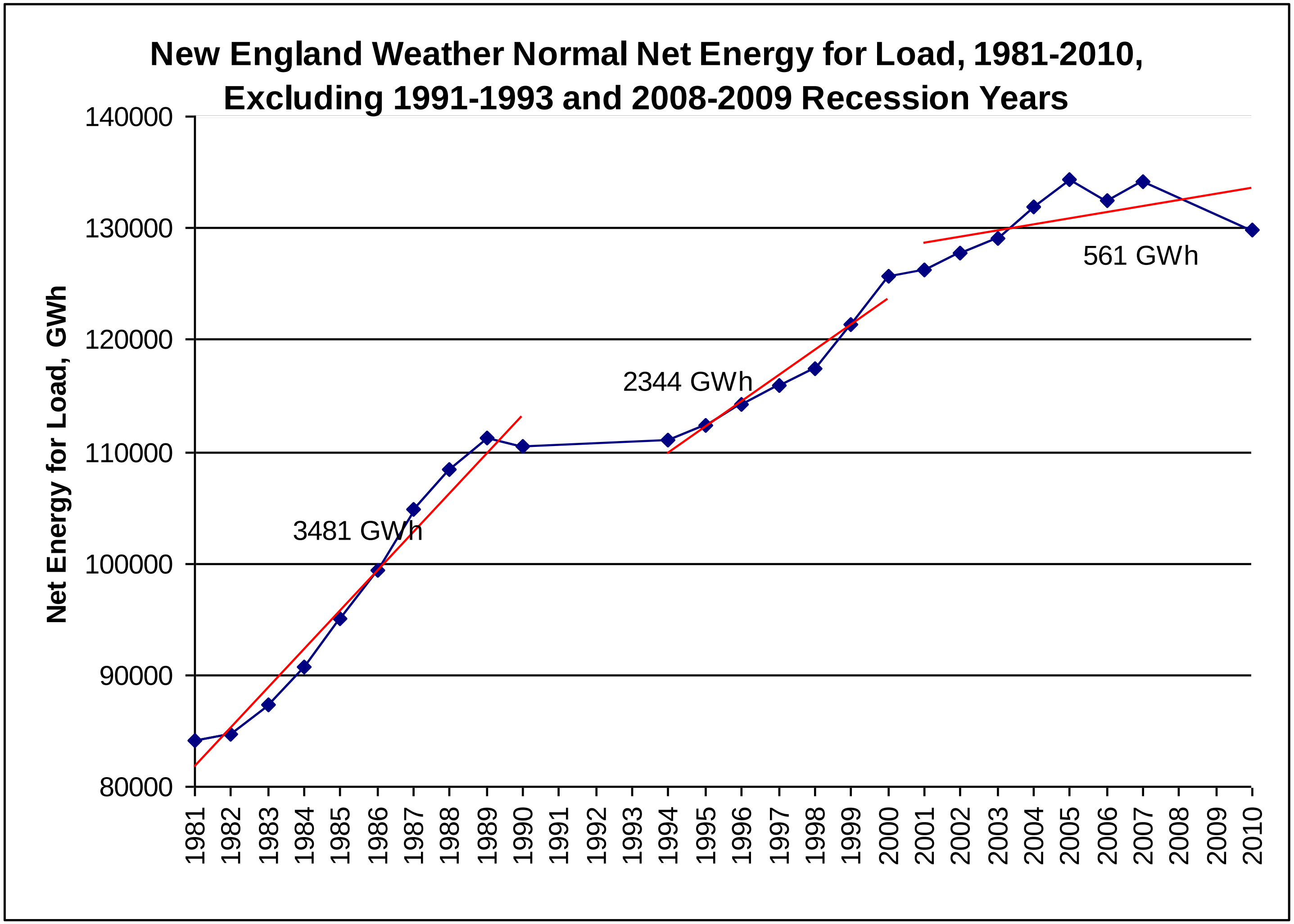
# Energy load

(1980-2009)



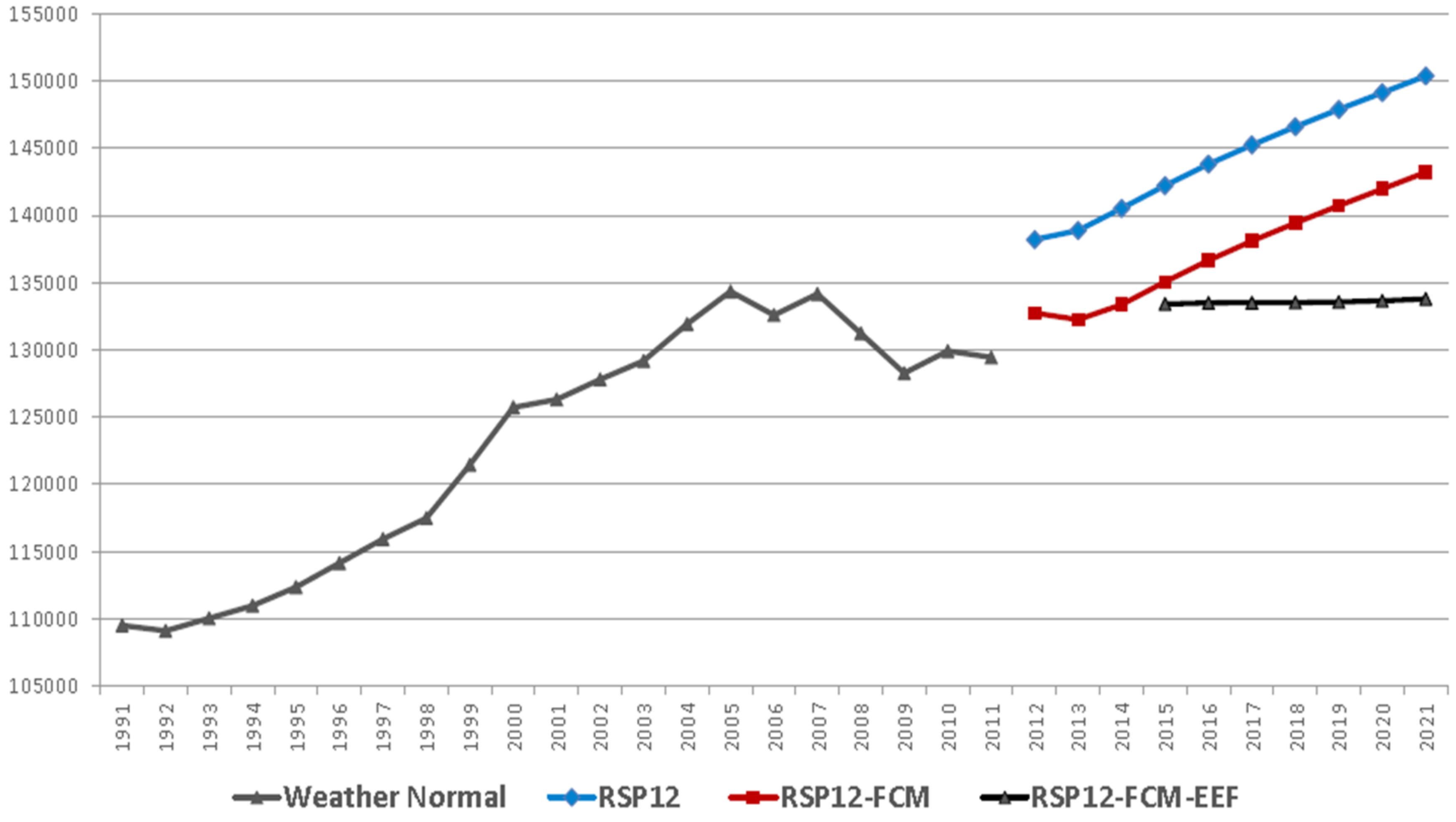

 

# Declining slope to flat



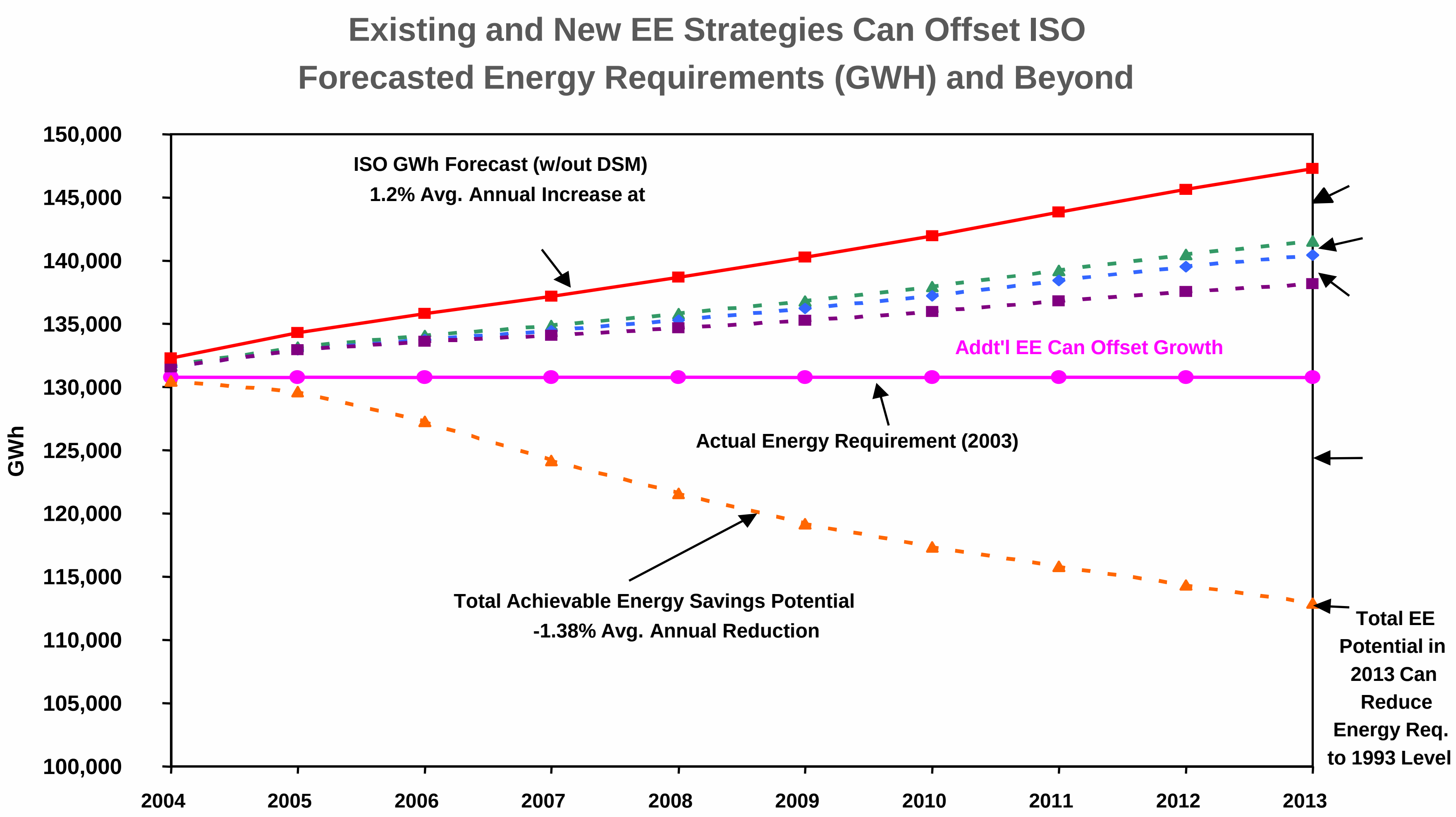
# ISO-NE RSP12 annual energy (GWh)

## Weather Normal History 1991-2011 and Forecast 2012-2021

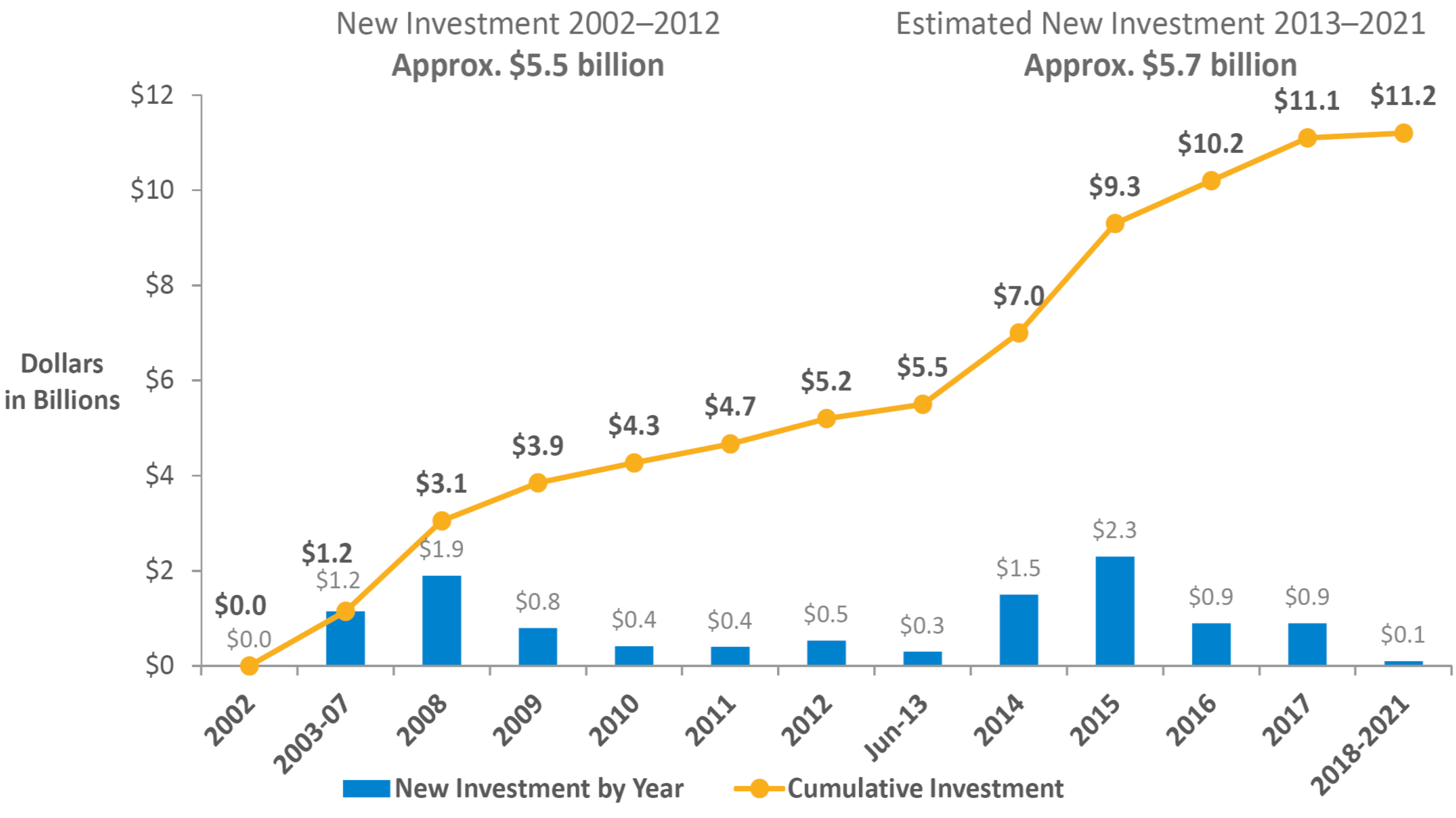


# Northeast Energy Efficiency Partnerships 2005 estimate of EE potential

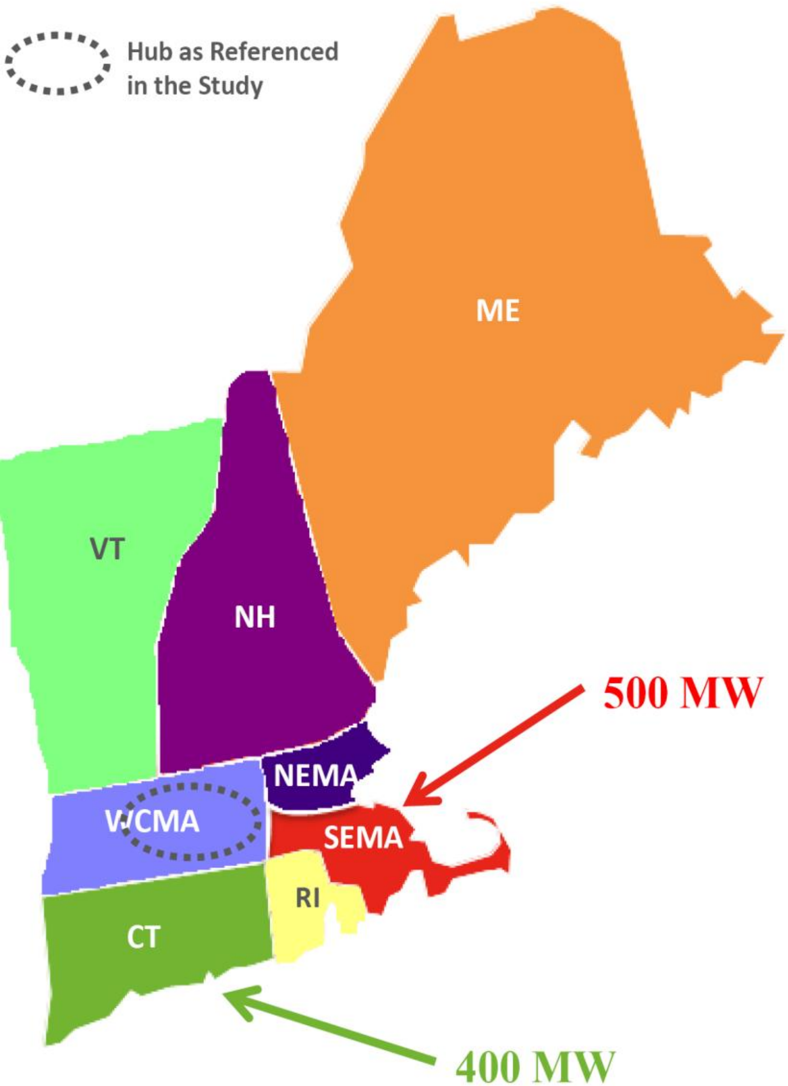


# Transmission Investment in New England




Source: ISO New England Transmission Project List, through June 2013 Update.

# Retirement Study Observations

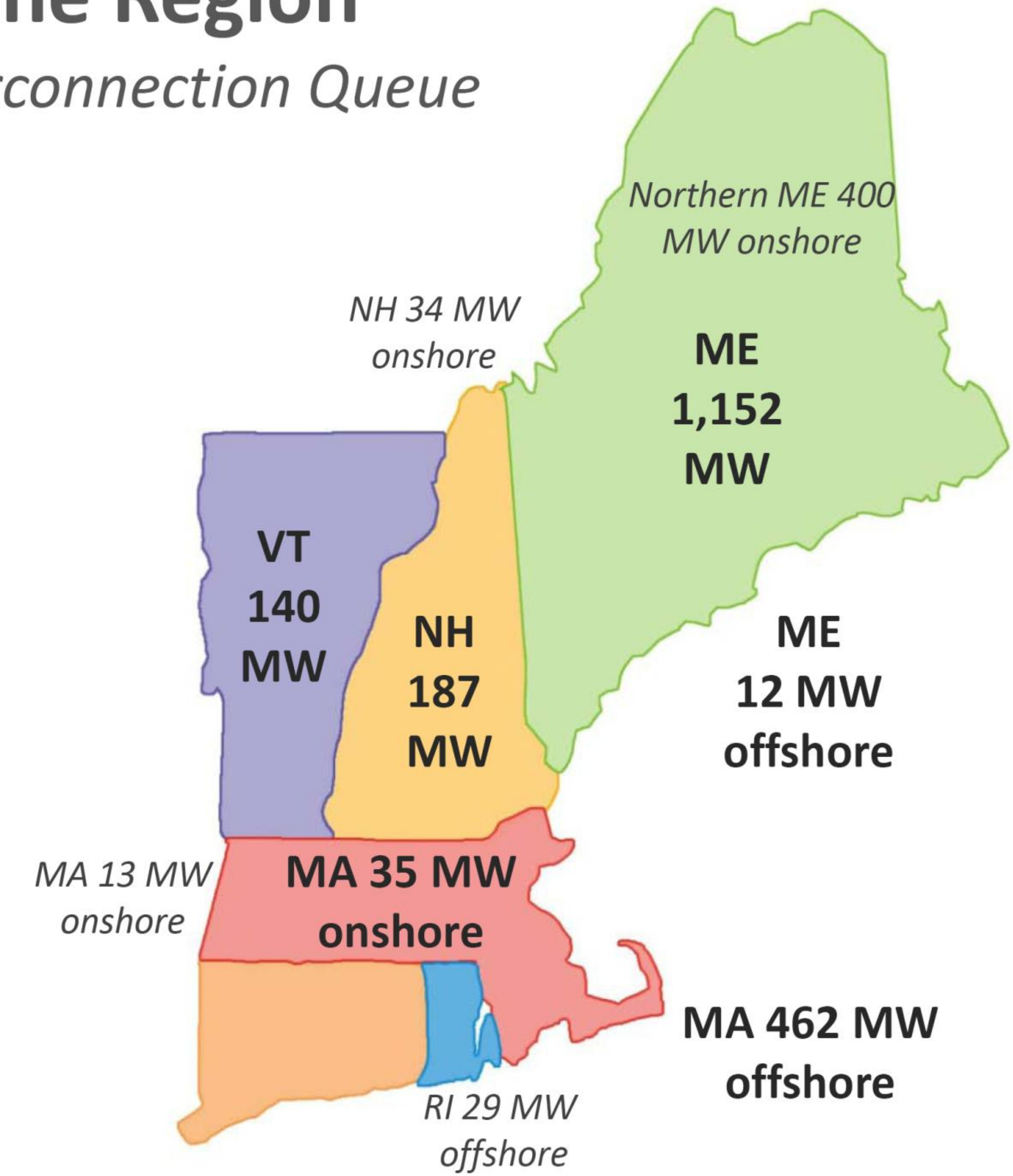



- If 8,300 MW retire by 2020, resource adequacy needs dictate replacement capacity of approximately 6,000 MW plus new energy-efficiency resources
- With currently planned system configuration, at least 900 MW of the 6,000 MW replacement capacity must be in specific locations due to transmission constraints
  - 500 MW must be in Southeastern Massachusetts
  - 400 MW must be in Connecticut
- Approximately 5,100 MW may need to be integrated into Hub
  - Transmission may be needed to make resources deliverable to the Hub
  - From the Hub, power can be delivered to much of the load

# Wind Proposed for the Region

*Based on April 1, 2013 Interconnection Queue*

- 2,453 MW proposed (*includes non-FERC jurisdictional*)
- Majority of wind development proposals in Maine and northern New England
- Offshore projects proposed in Massachusetts, Maine, and Rhode Island




Note: FERC-jurisdictional wind project totals are bold-faced; non-FERC-jurisdictional totals are non-boldfaced; numbers may not add to 2,453 MW total due to rounding.

# ISO New England DG forecast

- Interim forecast for 2014 System Plan
  - DG forecast working group (DGFWG)
  - Focus on solar PV
  - Developing state inventories
- Complete forecast for 2015 System Plan
  - Other DG, including CHP
  - Refinement to solar PV
- Operational issues are a concern

# Interim PV Forecast

## *January 27, 2014 Draft*

| States | Annual Total MW (MW, AC nameplate rating) | | | | | | | | | | | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thru 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | |
| CT | 77.1 | 50.6 | 45.6 | 65.6 | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 | 557.9 |
| MA | 352.7 | 188.6 | 139.4 | 139.4 | 139.4 | 132.8 | 132.8 | 132.8 | 132.8 | 132.8 | 132.8 | 1,756.4 |
| ME | 5.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 20.0 |
| NH | 9.9 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 35.1 |
| RI | 10.1 | 8.4 | 6.6 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 64.7 |
| VT | 54.0 | 20.3 | 13.5 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 141.8 |
| Annual Policy-Based MWs | 508.7 | 271.8 | 209.1 | 220.7 | 195.8 | 189.2 | 146.6 | 146.6 | 13.8 | 11.3 | 1.5 | 1,915.1 |
| Annual Post-Policy MWs | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 47.5 | 47.5 | 180.3 | 182.9 | 192.7 | 660.8 |
| Annual Nondiscounted Total (MW) | 508.7 | 271.8 | 209.1 | 220.7 | 200.7 | 194.1 | 194.1 | 194.1 | 194.1 | 194.1 | 194.2 | 2,575.9 |
| Cumulative Nondiscounted Total (MW) | 508.7 | 780.5 | 989.7 | 1,210.4 | 1,411.2 | 1,605.3 | 1,799.4 | 1,993.5 | 2,187.6 | 2,381.7 | 2,575.9 | 2,575.9 |

Discounted MWs

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Discounted Annual | 508.7 | 244.7 | 177.8 | 176.6 | 148.1 | 143.1 | 121.8 | 121.8 | 55.4 | 54.2 | 49.3 | 1,801.4 |
| Total Discounted Cumulative | 508.7 | 753.4 | 931.1 | 1,107.7 | 1,255.8 | 1,398.9 | 1,520.7 | 1,642.6 | 1,698.0 | 1,752.1 | 1,801.4 | 1,801.4 |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual: Total Discounted SSCC (MW) | 178.0 | 85.6 | 62.2 | 61.8 | 51.8 | 50.1 | 42.6 | 42.6 | 19.4 | 19.0 | 17.3 | 630.5 |
| Cumulative: Total Discounted SSCC (MW) | 178.0 | 263.7 | 325.9 | 387.7 | 439.5 | 489.6 | 532.3 | 574.9 | 594.3 | 613.2 | 630.5 | 630.5 |

Notes:

(1) Yellow highlighted cells indicate that values contain post-policy MWs

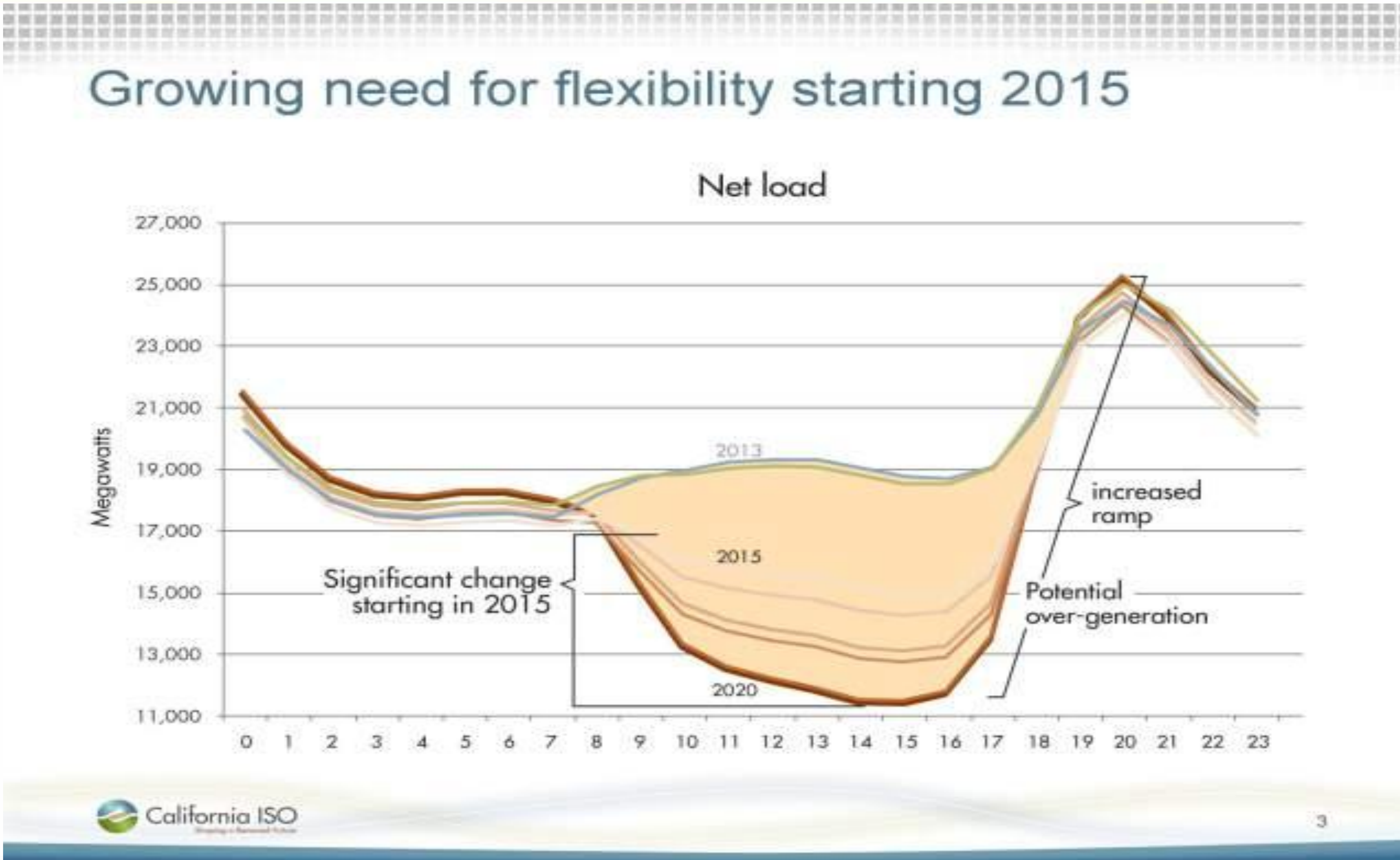
(2) Some “Thru 2013” values must be reconciled with distribution queue data

(3) All values are not final and are subject to change based on updated data and stakeholder input

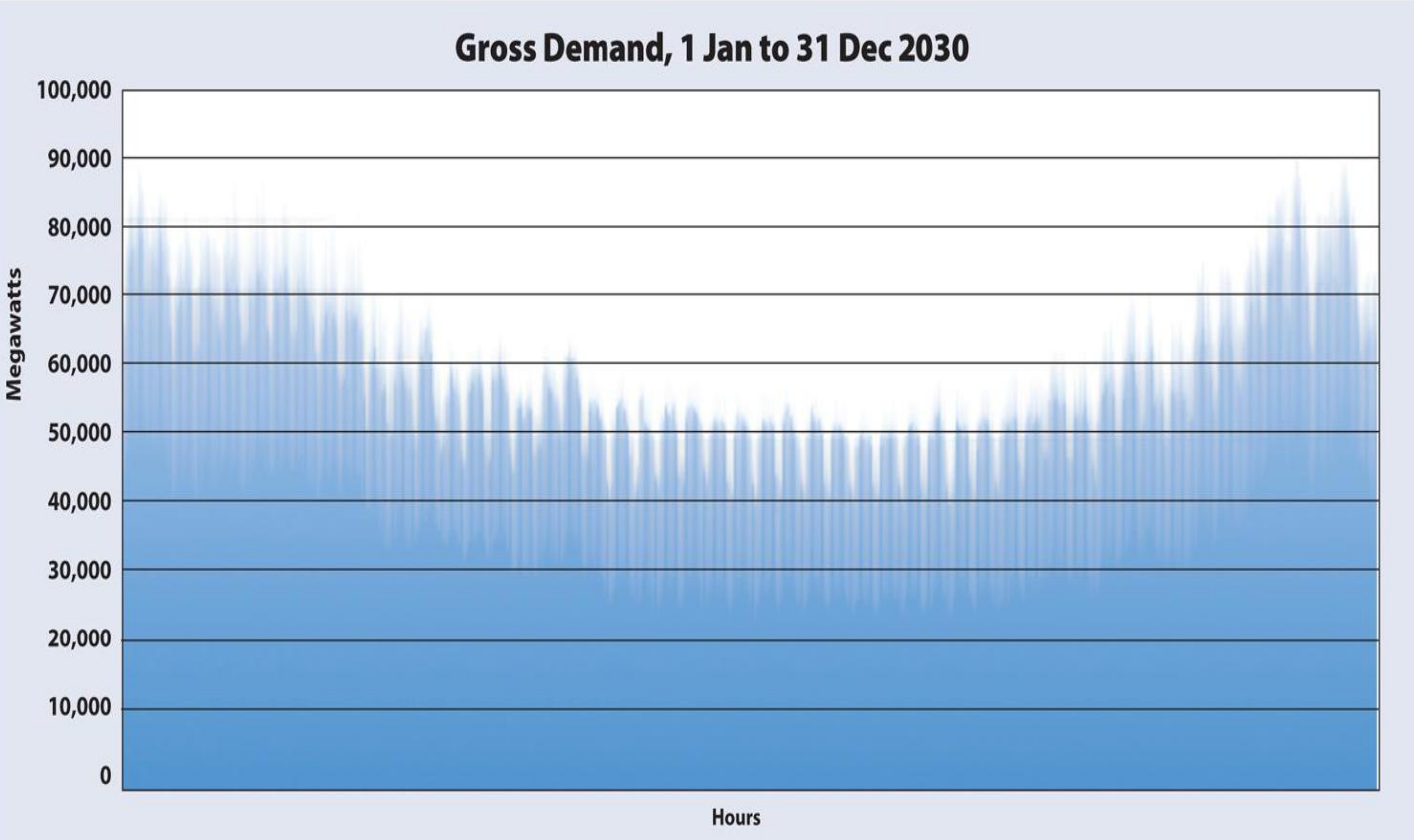
# 2013 New England market changes

- Change timing of Day Ahead Market (gas)
- Expand use of daily reoffer period
- Winter 2013-2014 fuel purchases (gas)
- Increase quantity of operating reserves
- Increase frequency of higher reserve prices
- Update shortage event trigger (30 min)
- Refer non-performing generators to FERC
- FCA-8 retirements and scarcity
- FCA-9 design changes (proposed)

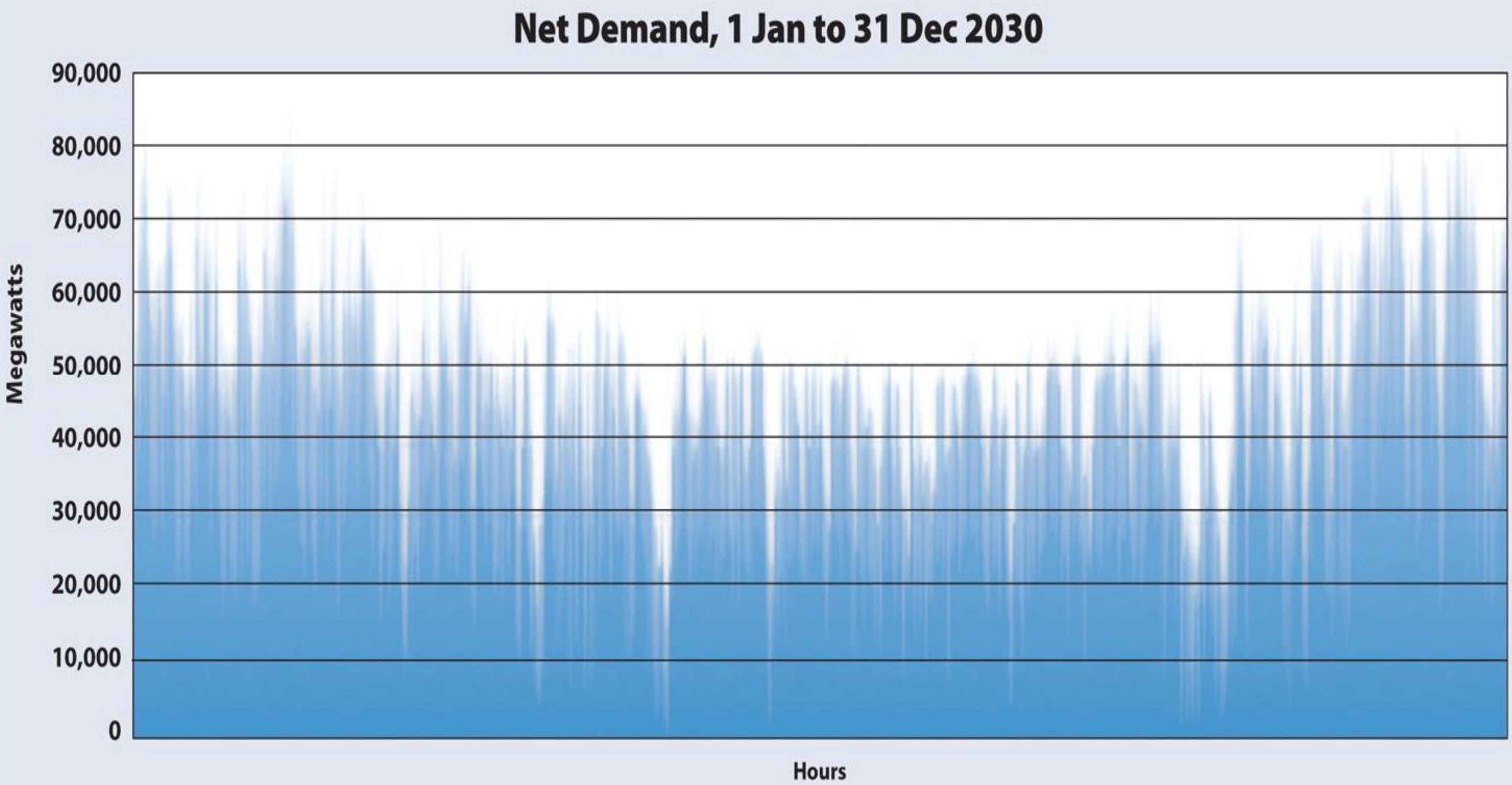
# CAISO Duck Curve



# Traditional representation of loads



# Loads with more Variable Energy Resources



# Future structure

Interconnected Grid with more DG

- Enhanced reliability
- Greater efficiency
- Lower cost

Completely distributed grid?

Role of storage?

Net-zero energy buildings?

Carbon policy?

EPRI, *The Integrated Grid,* February 2014, for background

# Elements of persuasion

- Reliability
  - the grid will be unstable if . . .
- Economics
  - unnecessary costs will be imposed if . . .
- Fairness
  - these resources/customers will be harmed if . . .
- Policy
  - the public interest will be ignored if . . .

All four = success

# Questions?

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