



**Synapse**  
Energy Economics, Inc.

# Wholesale Electric Market Economics

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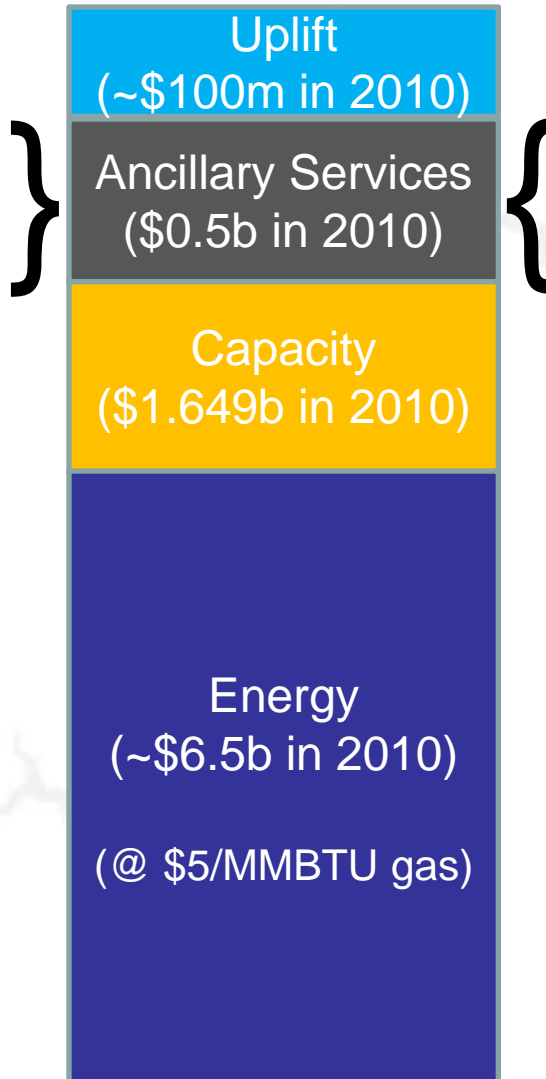
15 June 2011

Presented by Doug Hurley and Paul Peterson

# New England Markets and Relative Size

All other ancillary services far less costly to load overall.

But Revenue can be significant for any one unit. (reserves for peakers in CT were selling at \$14/kW-mo)



Forward Reserves

30-min

10-min non-spin

10 min spin (free!)

Real-Time Reserves

Regulation

Black Start

VAR

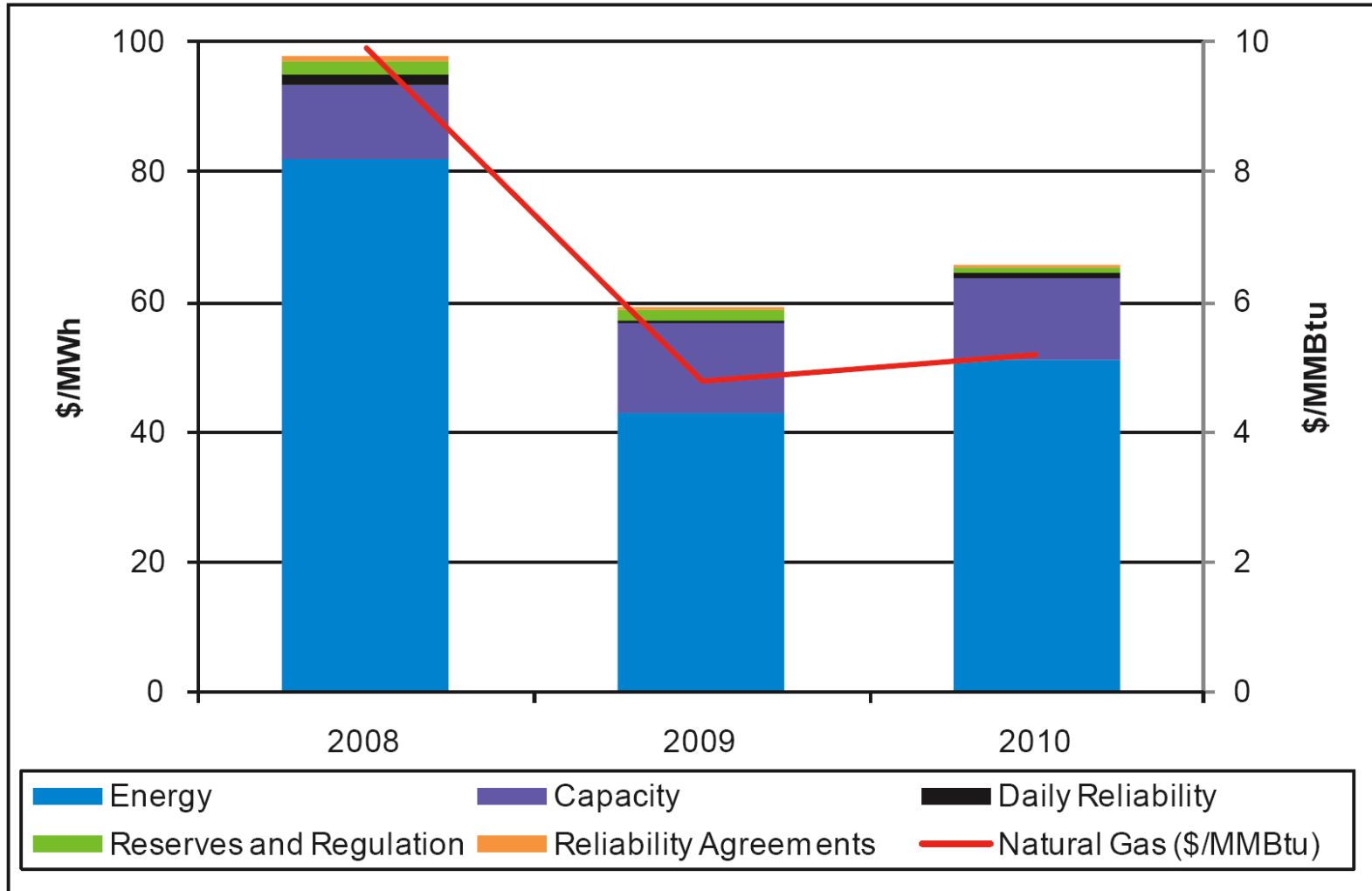
VAR Capacity

Financial Transmission

Rights (FTRs and LTTRs)

Others?

# Marginal Fuel Drives Costs



**Figure 1-3: All-in cost for electricity.**

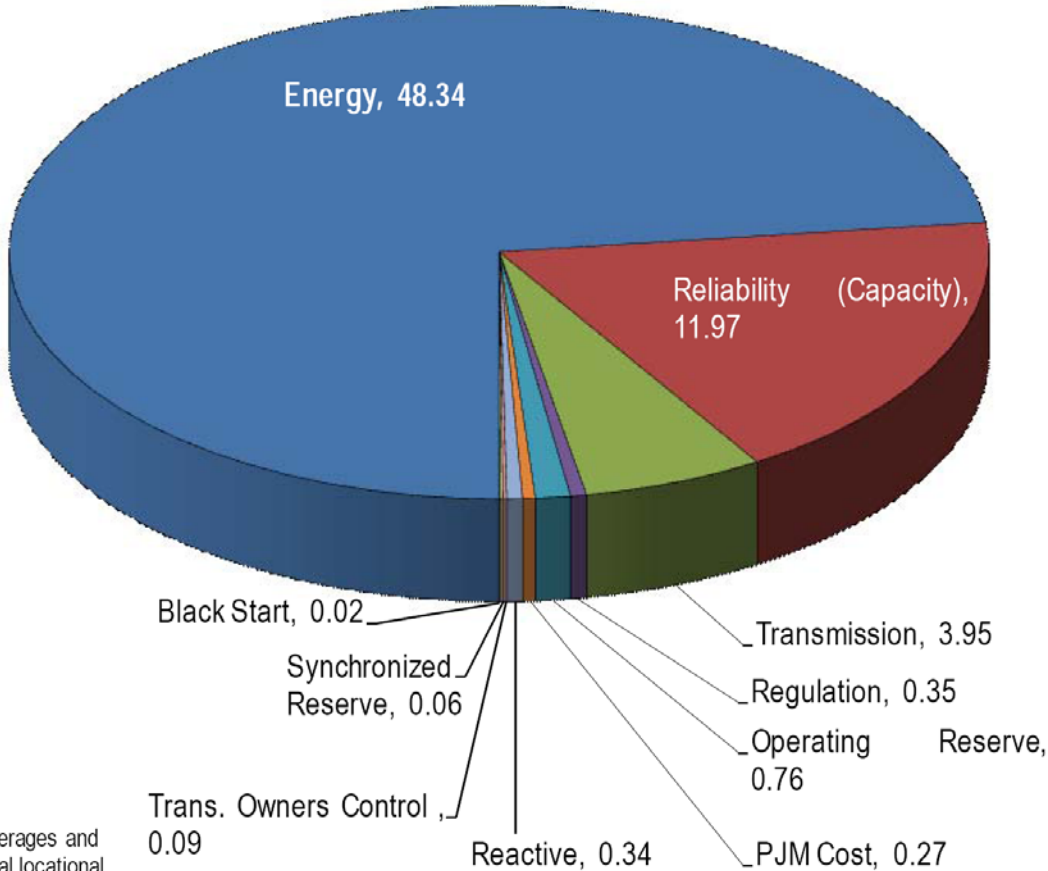
*Source: 2010 Annual Markets Report, Figure 1-3*

# PJM Wholesale Market Costs

Figure 1: Components of PJM Total Wholesale Power Cost in 2010

Full-Year 2010  
(\$/MWh)

TOTAL: \$66.15/MWh



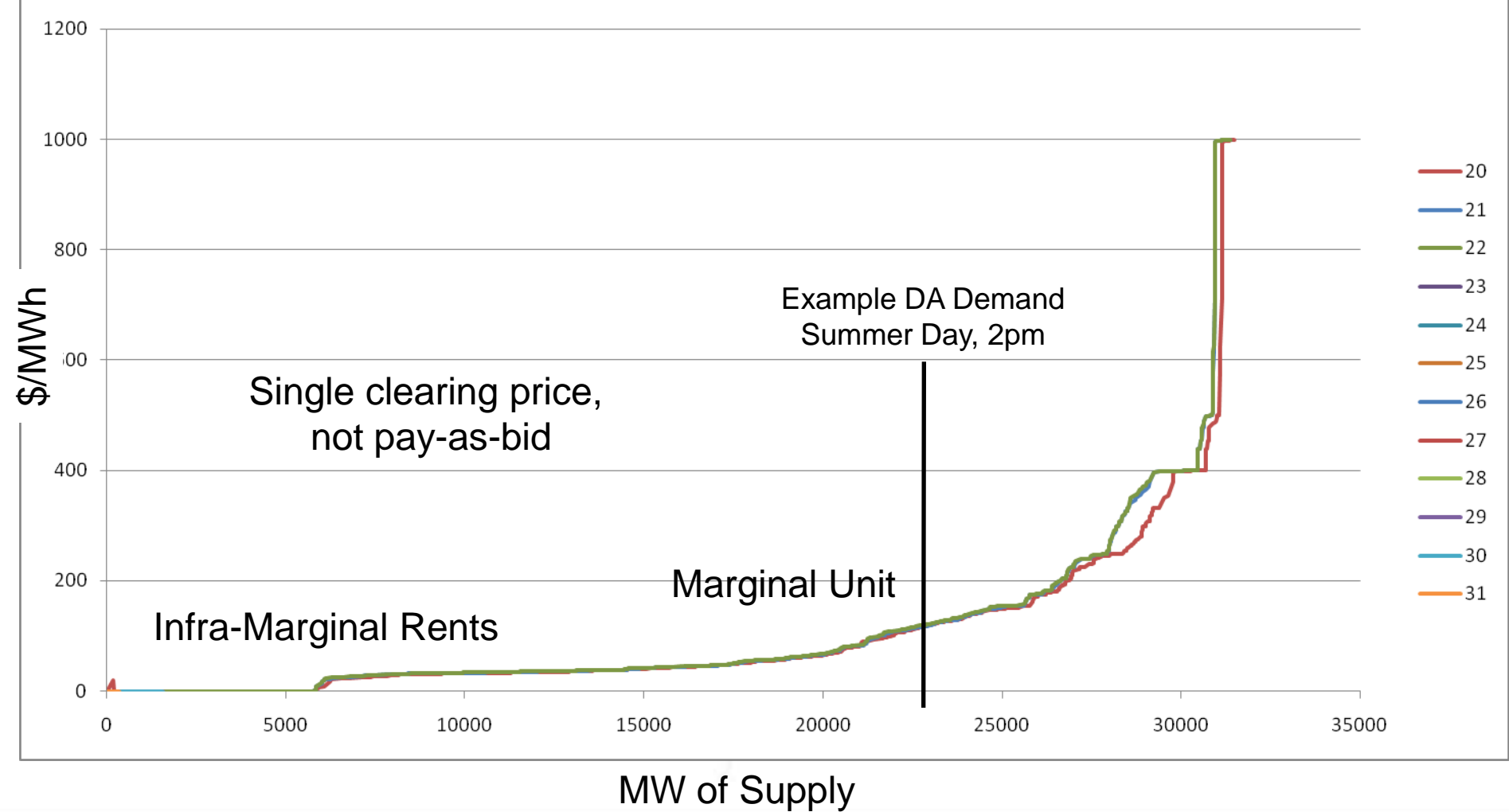
\* Values are PJM averages and do not reflect potential locational cost differences.

- Day Ahead
  - Financial transactions one day ahead of the operating day
  - Involves a guess about how much load in RT
  - Can be changed before Real Time
  - ~90% of the market
  - Avg \$48.89/MWh in 2010
- Real Time
  - “Balancing” market
  - Only ~10% of market
  - Much more susceptible to price spikes and drops
  - Weather, generation or transmission outages
  - Fuel supply disruptions
  - Avg \$49.56/MWh in 2010

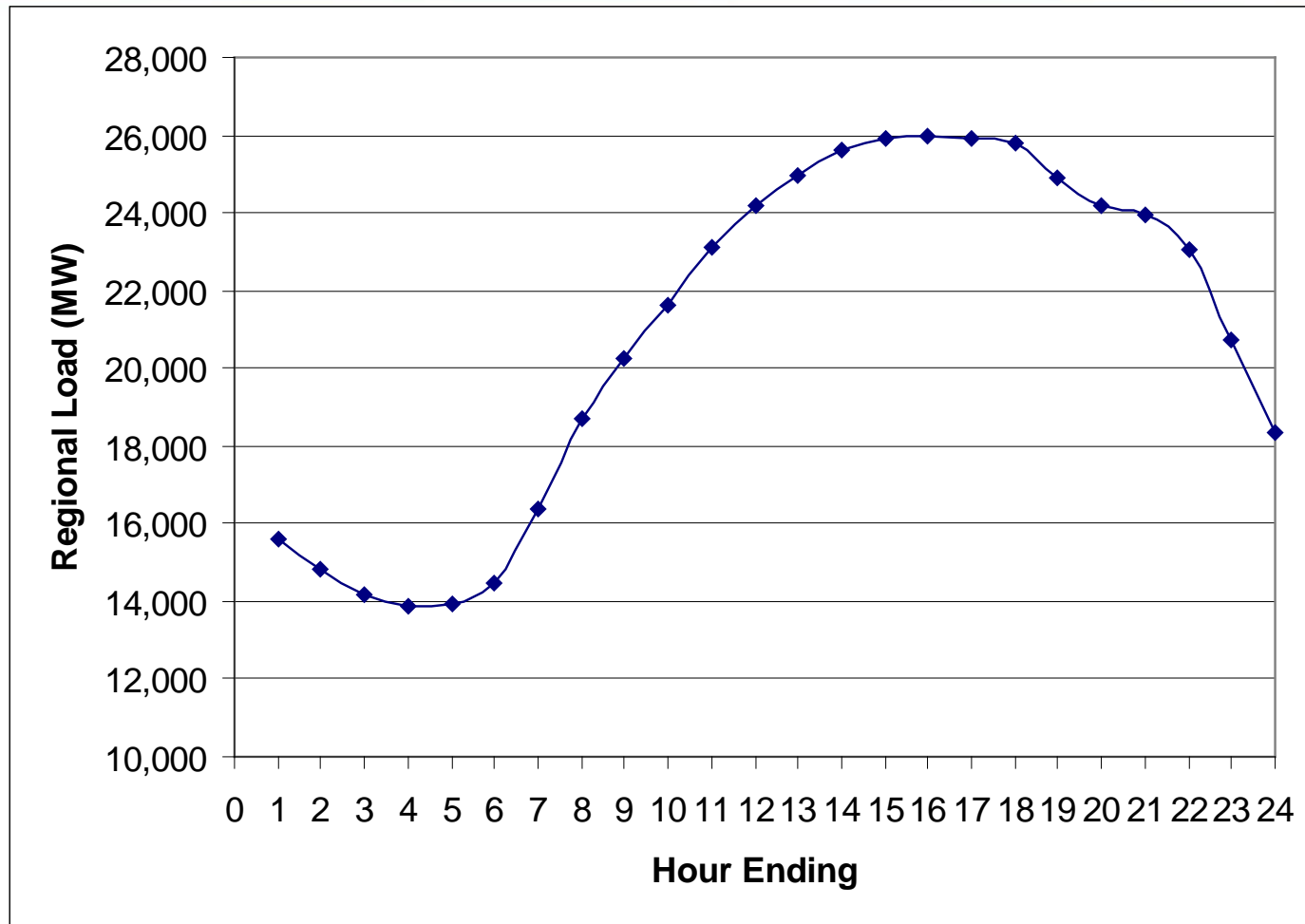
NYISO also has an Hour-Ahead Market (HAM)

# Day-Ahead Energy Market Supply Curve

## DA Supply Stack for July 20-31, 2010

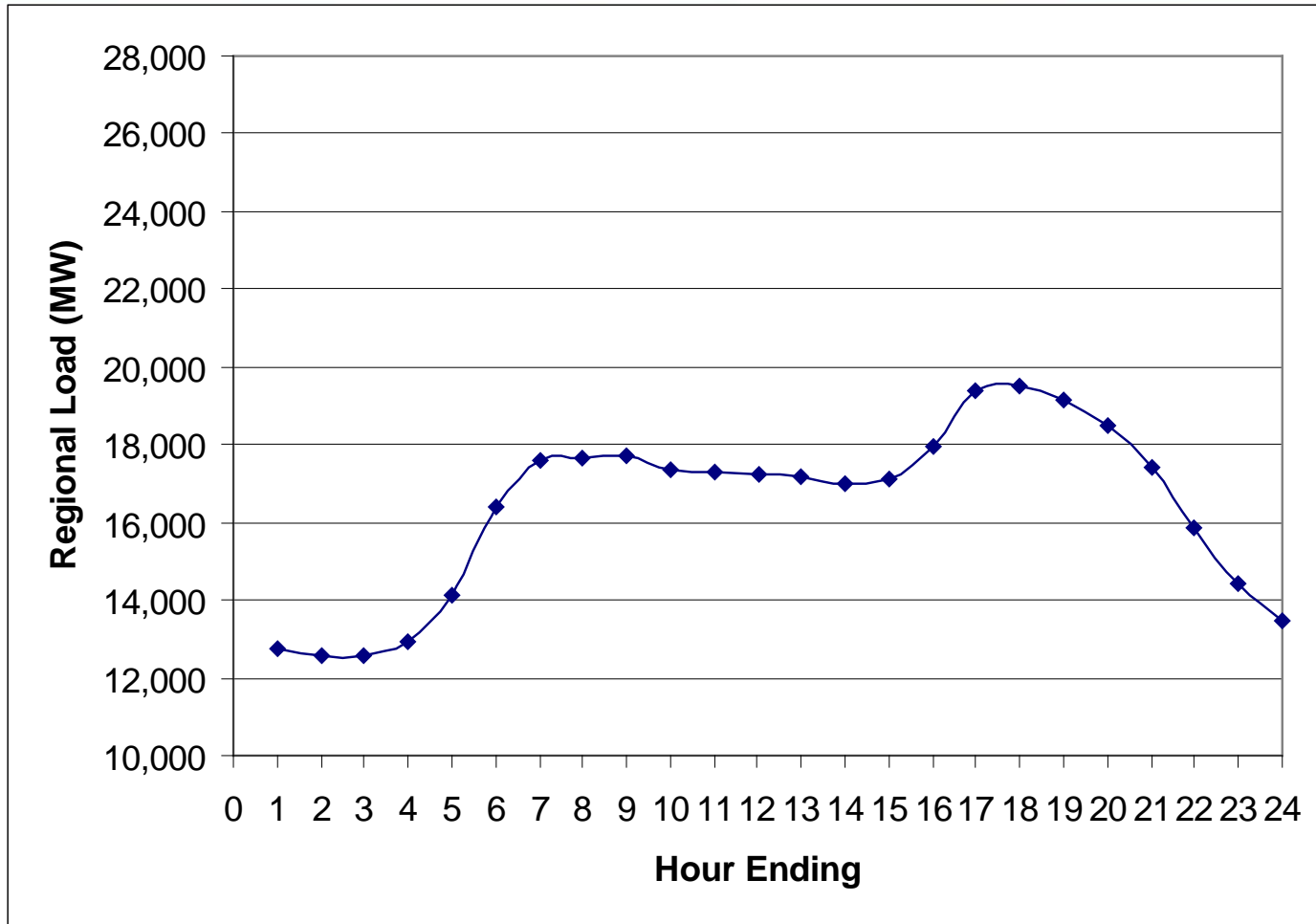


# Summer Day Load Shape



New England load on a typical summer day (9 June 2008)

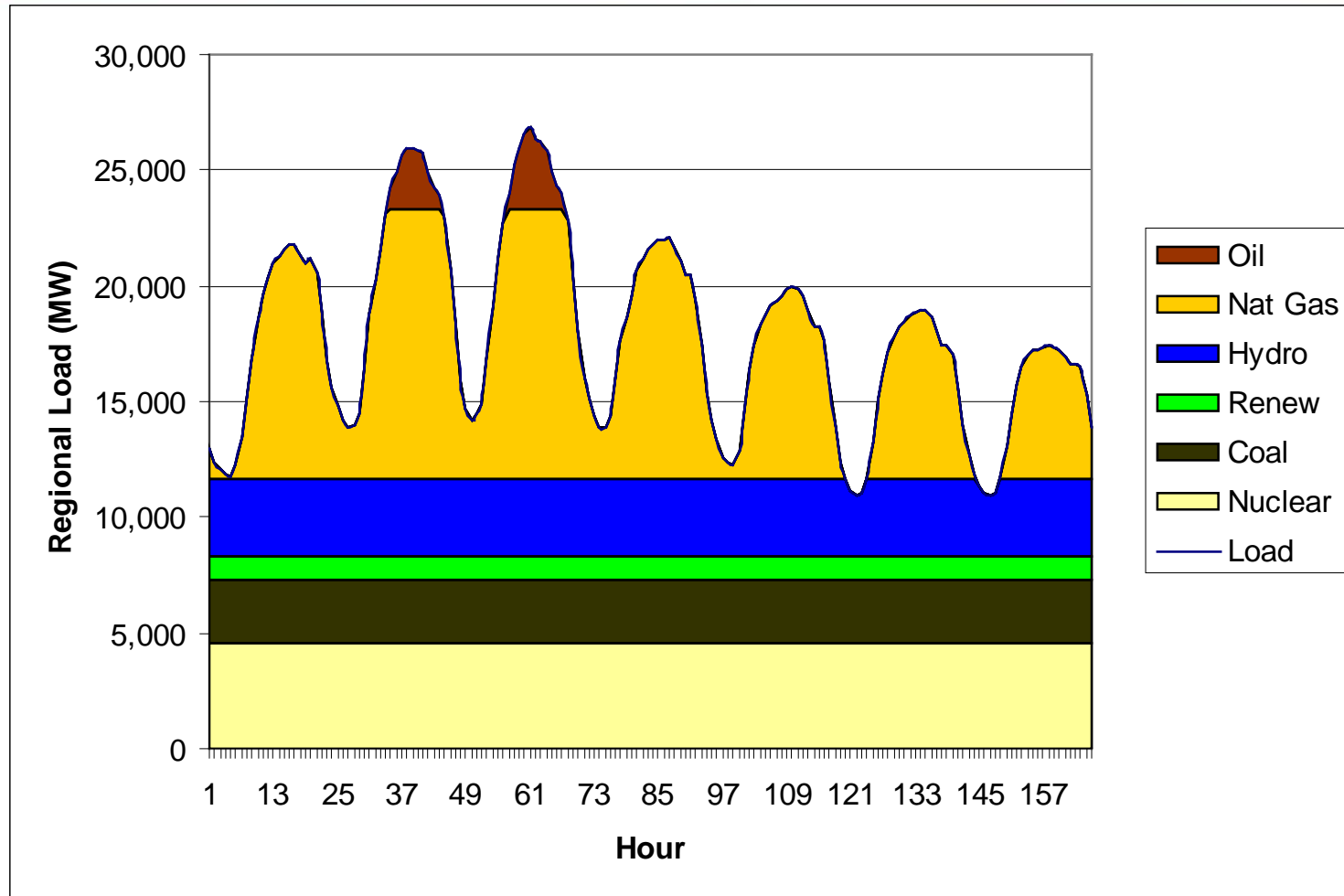
# Winter Day Load Shape



New England load on a typical winter day (23 Jan 2008)

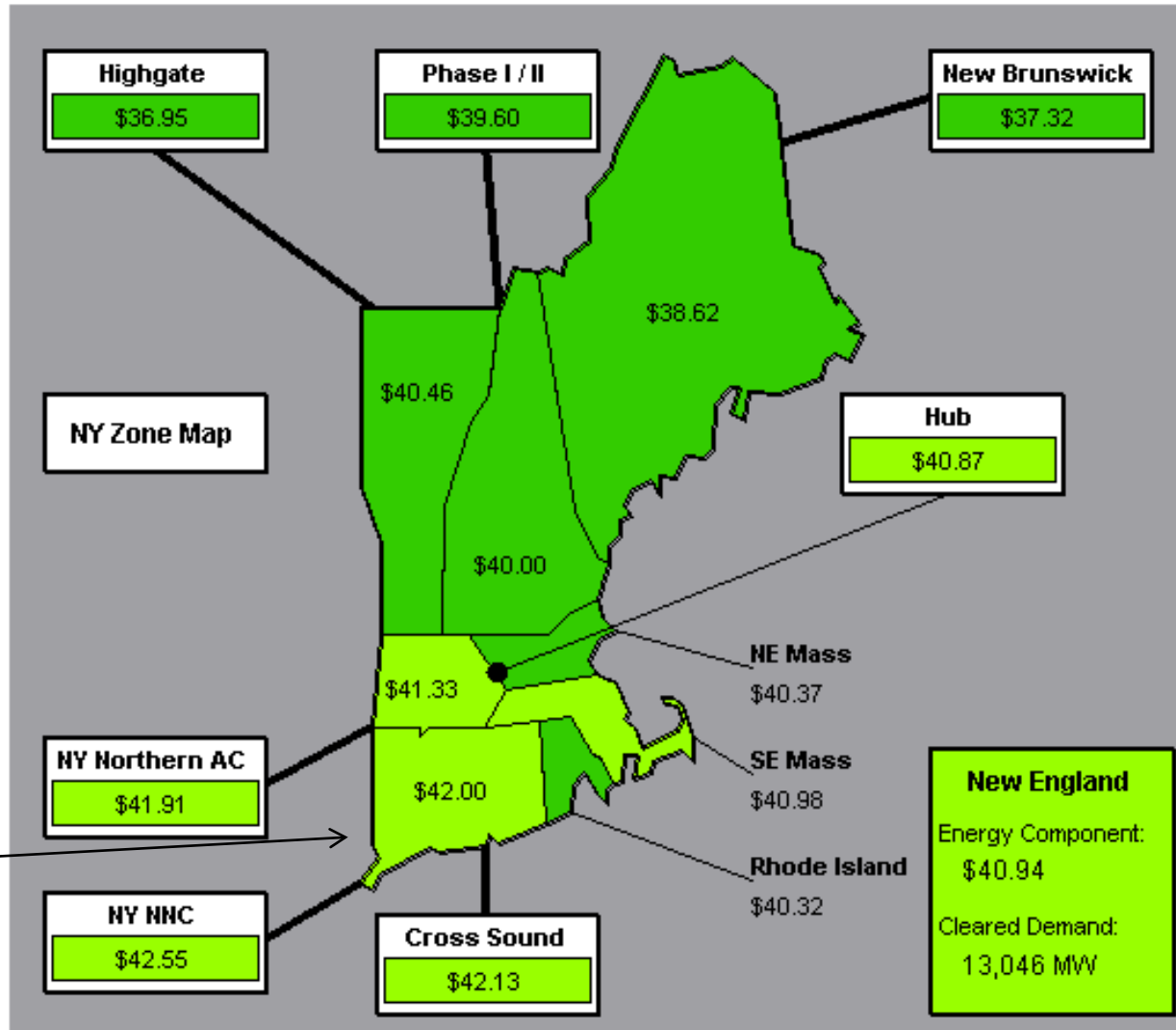


# Typical Summer Week



New England load and resources on a typical summer week (8-14 June 2008).  
Supply must equal demand, so SCED determines dispatch order.

# Locational Marginal Price (LMP)

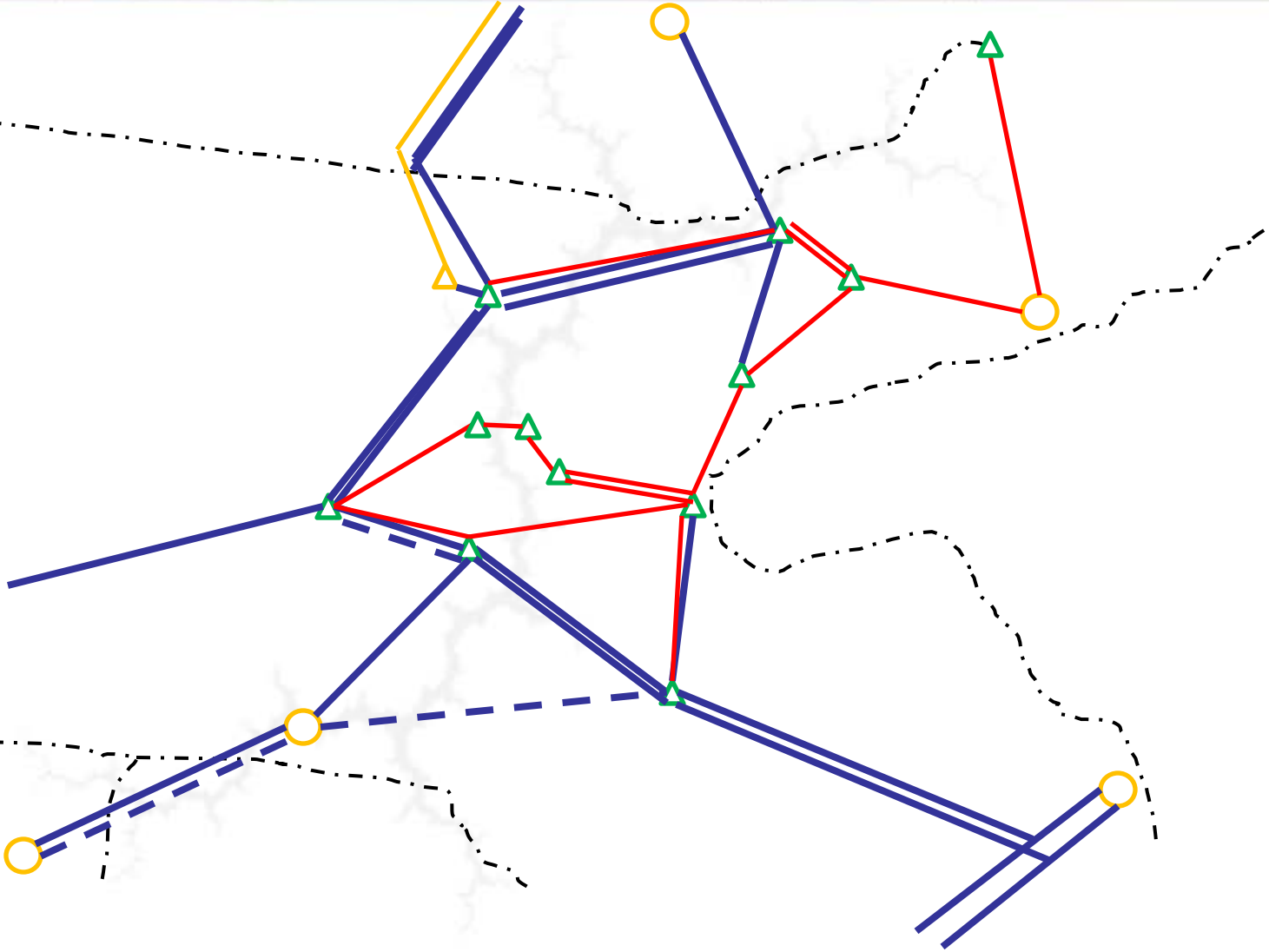


Sunday  
55 degrees  
raining

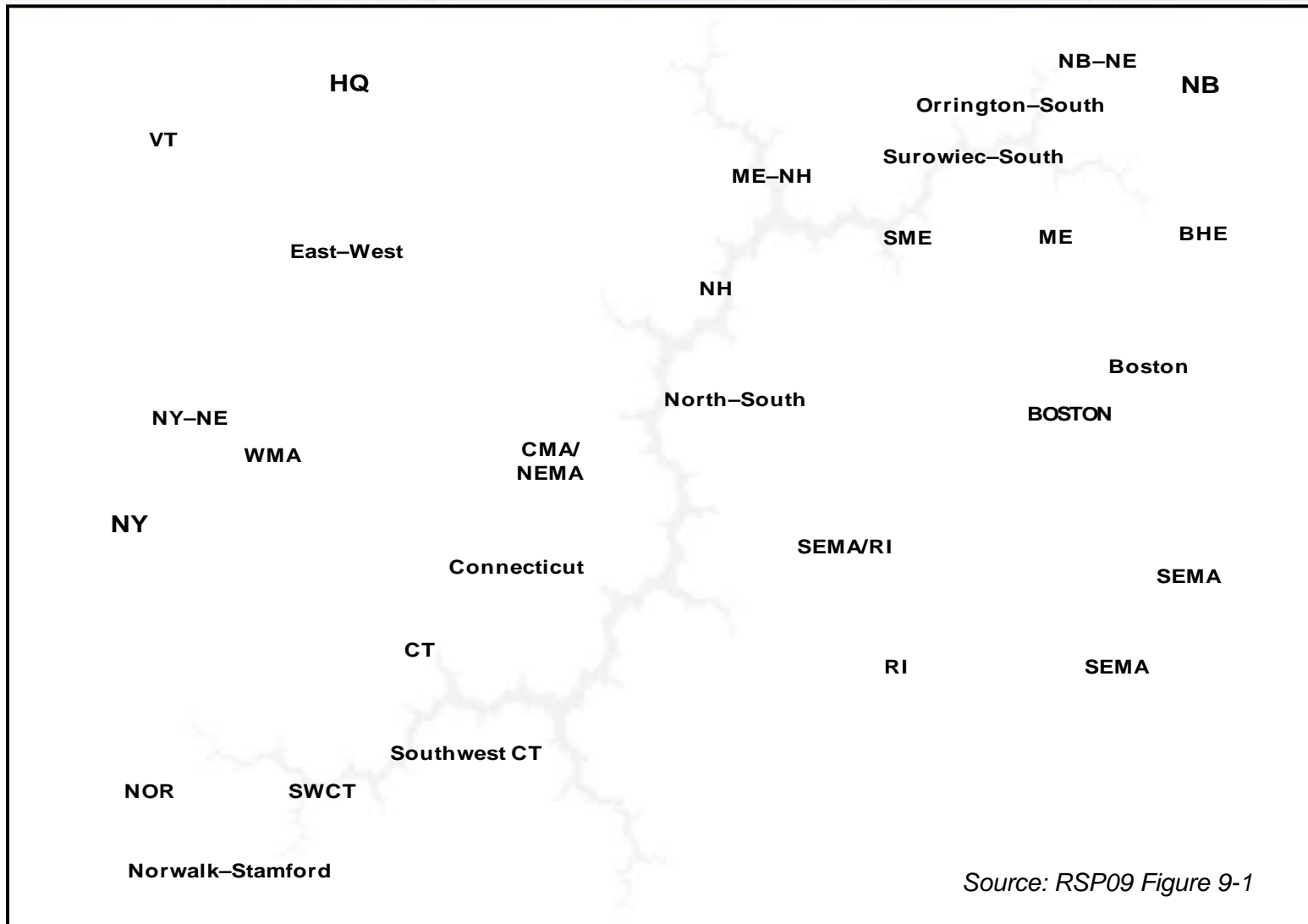
June 9,  
CT was at  
\$200+/MWh

# Very Simple Sample Transmission Map

- Plant
- △ Substation
- 345 kV
- 115 kV
- HVDC



# Transmission Engineering View



Source: RSP09 Figure 9-1

# Load Duration Curve

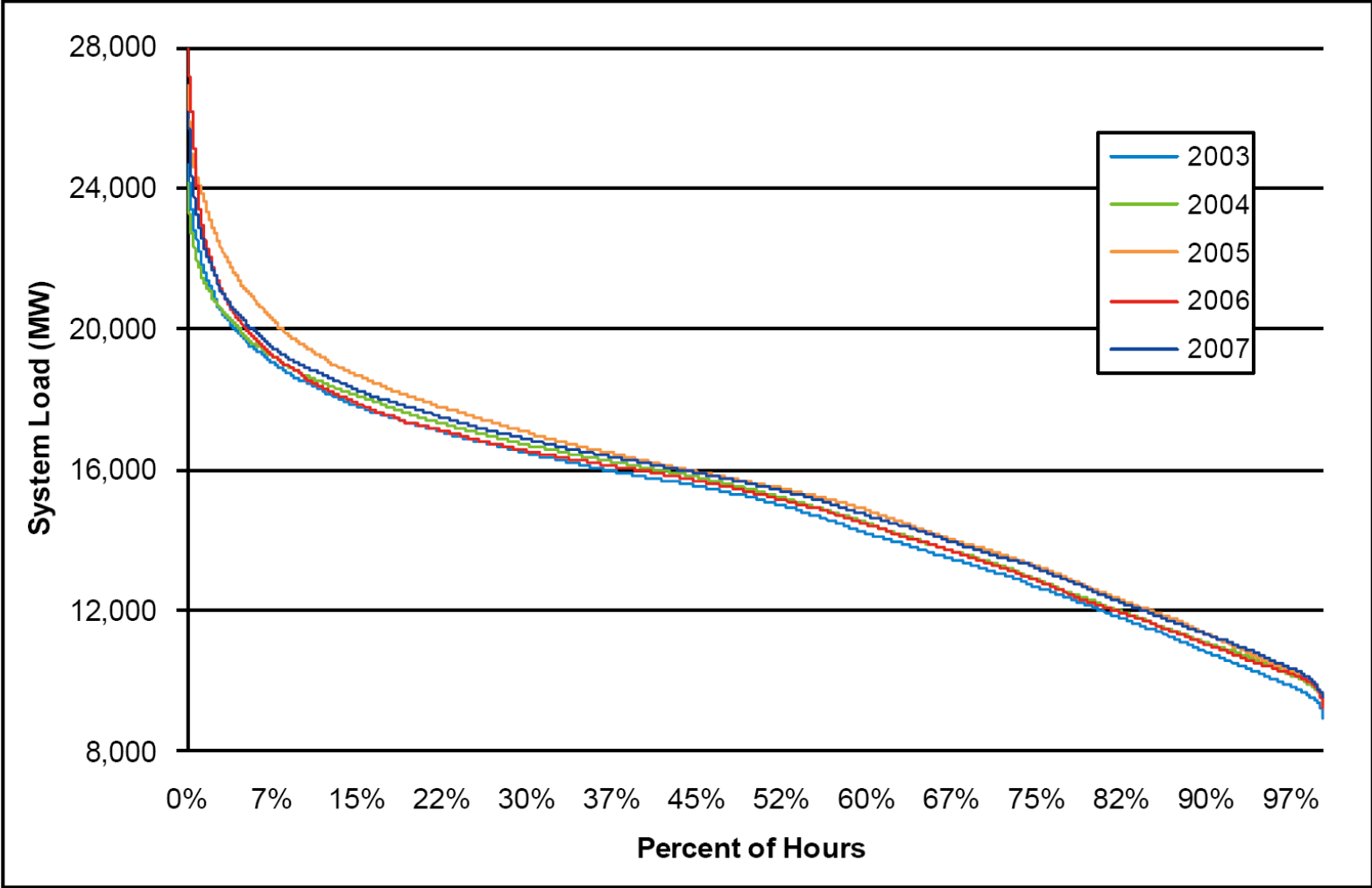


Figure 2-3: New England hourly load-duration curves, 2003 to 2007.

Source: 2007 ISO-NE Annual Markets Report

# Fuel Mix – 2008 Capacity and Generation

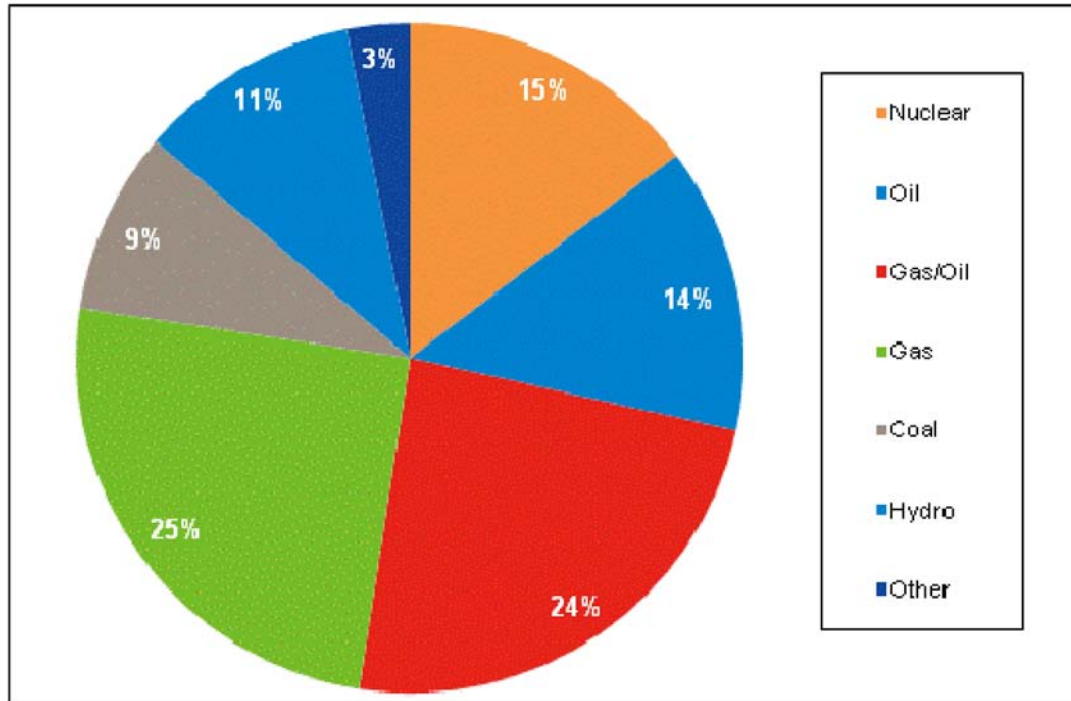


Figure 3-14: System summer capacity by fuel type, 2008.

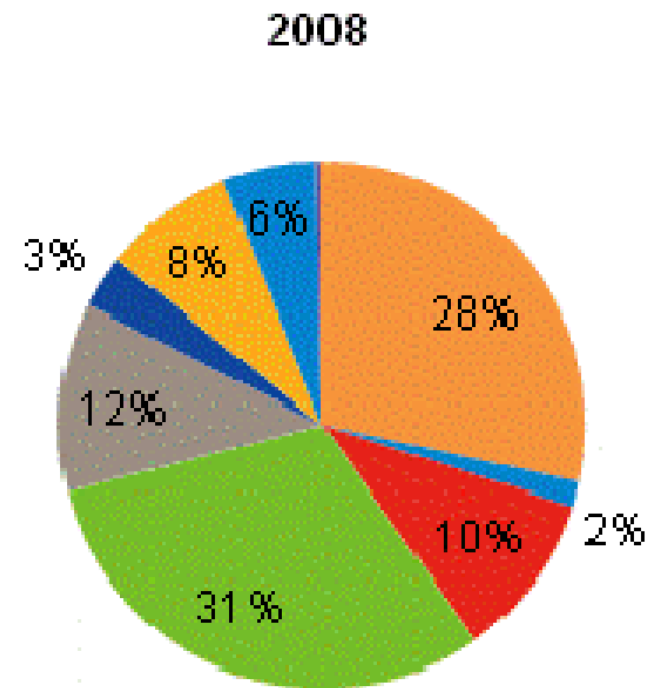
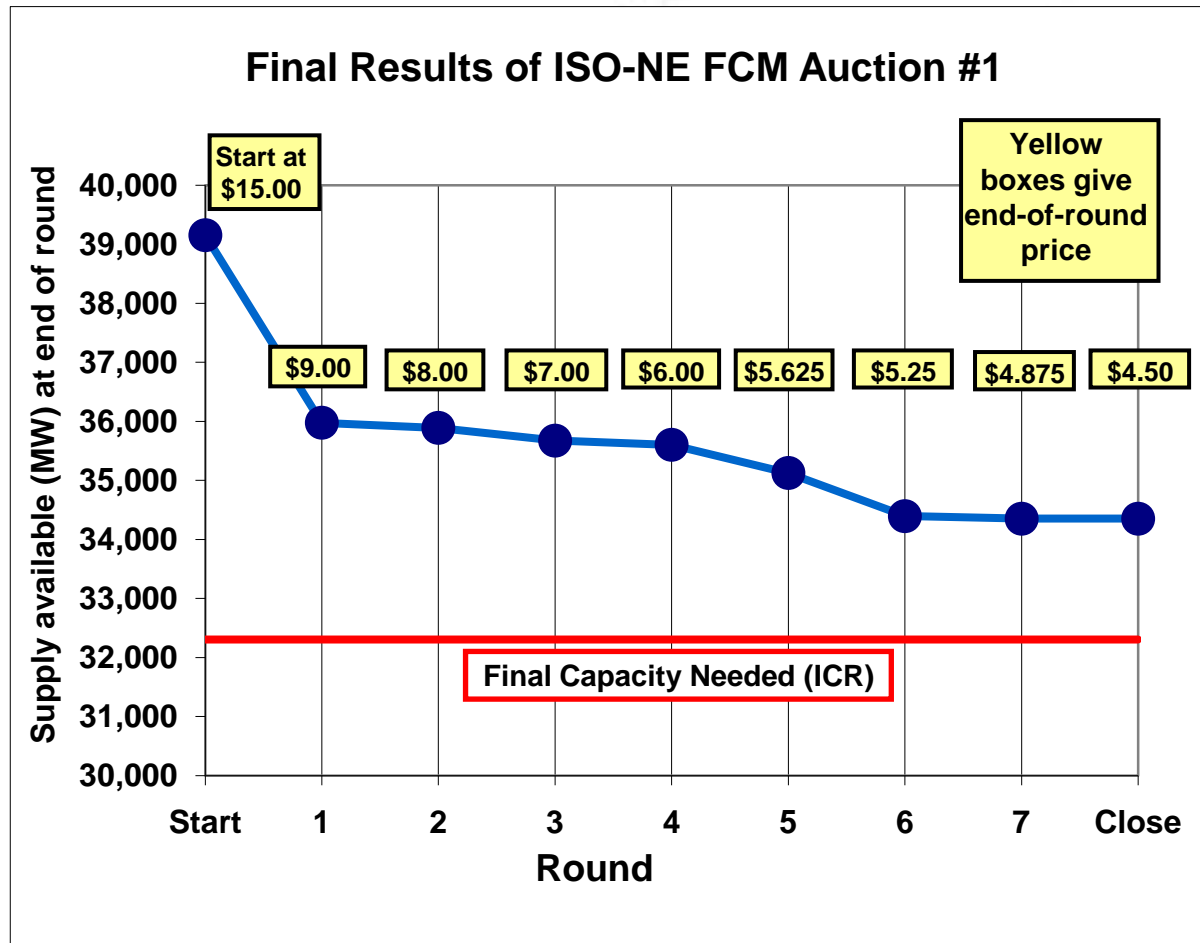


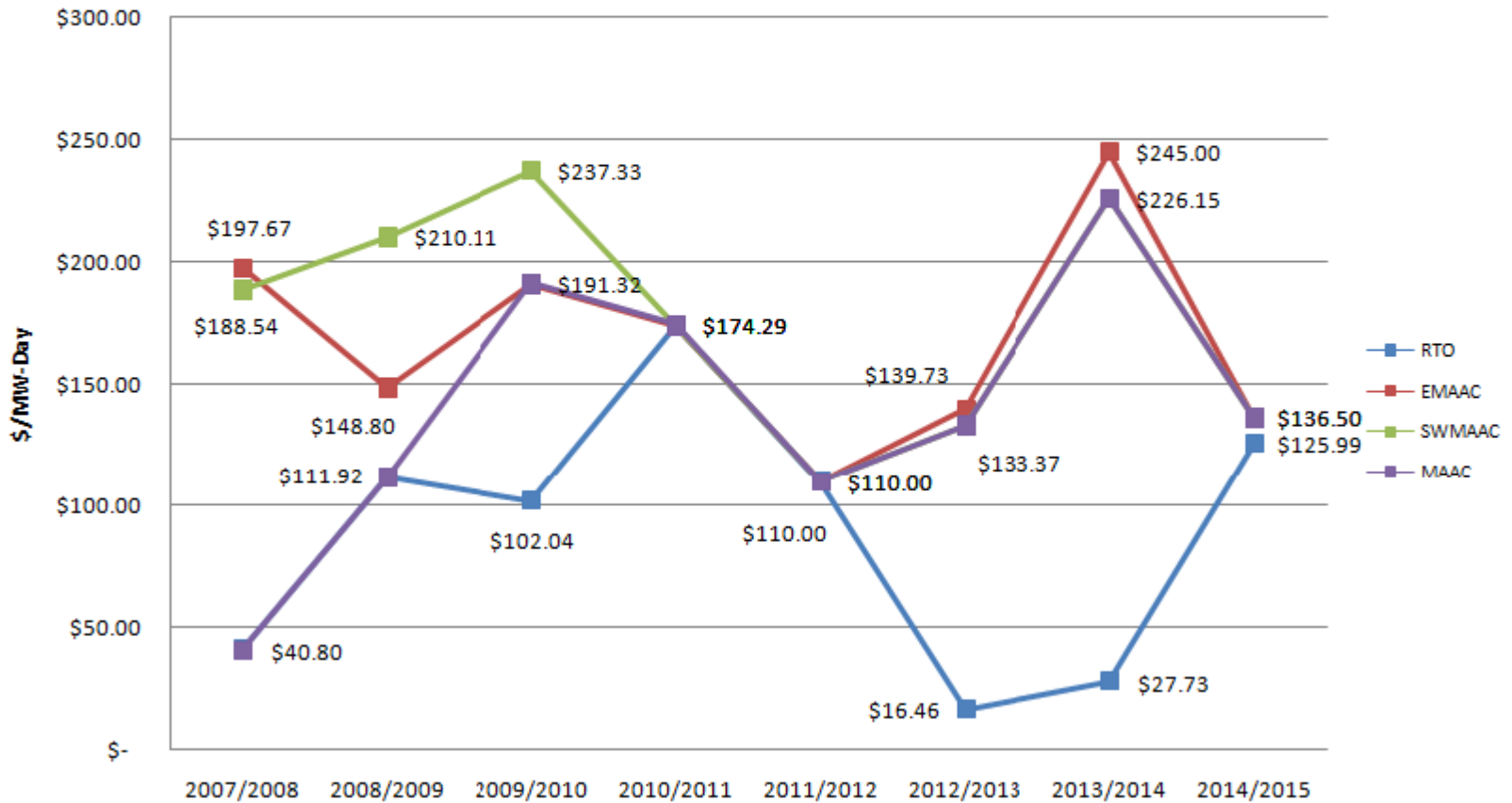
Figure 3-15: New England Generation by Fuel Type

# Descending Clock Auction



# PJM Capacity Auctions

## RPM Base Residual Auction Resource Clearing Prices (RCP)





# ISO-NE Capacity Auctions

Auction	Delivery	Price (\$/kW-mo)*	Pro-rated Price
Pre-FCM	Until June 2006	\$0.50 - \$1.00	n/a
Transition Period	June 2007	\$3.05	n/a
Transition Period	June 2008	\$3.75	n/a
Transition Period	June 2009	\$4.05	n/a
FCA-1	June 2010	\$4.50	\$4.25
FCA-2	June 2011	\$3.60	\$3.13
FCA-3	June 2012	\$2.95	\$2.57
FCA-4	June 2013	\$2.95	\$2.52
FCA-5	June 2014	\$3.21	~\$2.90

*\* Price in Maine slightly lower in FCAs 3-5 due to export constraint*

# Locational Forward Reserve Market Price

Period	Zone	10-min Price	30-min Price
Summer 2009	ROS	\$6,297/MW-month	\$0
	SWCT	\$14,000	\$14,000
	CT	\$14,000	\$14,000
	Boston	\$6,297	\$0
Winter 2009/10	ROS	\$6,080	\$0
	SWCT	\$13,900	\$13,900
	CT	\$13,900	\$13,900
	Boston	\$6,080	\$0
Summer 2010	ROS	\$5,950	\$5,950
	SWCT	\$13,900	\$13,900
	CT	\$13,900	\$13,900
	Boston	\$0	\$0
Winter 2010/11	ROS	\$5,500	\$5,500
	SWCT	\$6,023	\$6,023
	CT	\$6,023	\$6,023
	Boston	\$0	\$0

# Real Time Reserve Price

**Table 1-4**  
**Average TMSR Price for Intervals with Nonzero Prices by Quarter, 2009 to 2010**

	Q1	Q2	Q3	Q4
<b>2009 average TMSR price for intervals with nonzero prices<sup>(a)</sup></b>	\$23.74	\$15.65	\$21.11	\$42.76
<b>2010 average TMSR price for intervals with nonzero prices<sup>(a)</sup></b>	\$57.06	\$38.08	\$47.57	\$14.89

*Units: \$/MWh*

(a) Ten-minute spinning reserve (TMSR), also called 10-minute nonsynchronized reserve, is reserve capability offered by on-line generating units able to increase output within 10 minutes in response to a contingency.

*Source: 2010 Annual Markets Report, Table 1-4*

# Fuel Price & Transmission Effects

- Lower SEMA Transmission
  - Prices of oil and natural gas flipped
  - Canal Units out-of-merit, and now committed for contingency protection
  - Committed, paid, but not setting price
  - New transmission solutions alleviate the need
- Generation owners generally like congestion

# The New England Electric Grid



- 6.5 million households and businesses; population 14 million
- Over 8,000 miles of high-voltage transmission lines
- 13 interconnections to electricity systems in New York and Canada
- More than 32,000 MW of total supply (includes 1,693 MW of demand-resource capacity)
- All-time peak demand of 28,130 MW, set on August 2, 2006
- More than 300 participants in the marketplace (those who generate, buy, sell, transport, and use wholesale electricity)
- \$10 billion annual total energy market value (2007)
- More than \$1.0 billion in transmission investment made for reliability since 2002; another \$4.0 to \$7.0 billion planned over the next 10 years
- Approximately \$1.0 to \$2.0 billion of economic transmission investment under study for development of renewable resources
- Two major 345-kilovolt projects in various stages of construction

- 14 million people in 6.5 million homes and businesses
- 350+ generating stations
- 8,000+ miles of high voltage transmission lines

Figure 2-1: Key facts about New England's bulk electric power system and wholesale electricity market.

From ISO New England 2008 Regional System Plan



# PJM Local Deliverability Areas

Figure A-3 PJM locational deliverability areas

