

Energy Efficiency in PJM Capacity Market

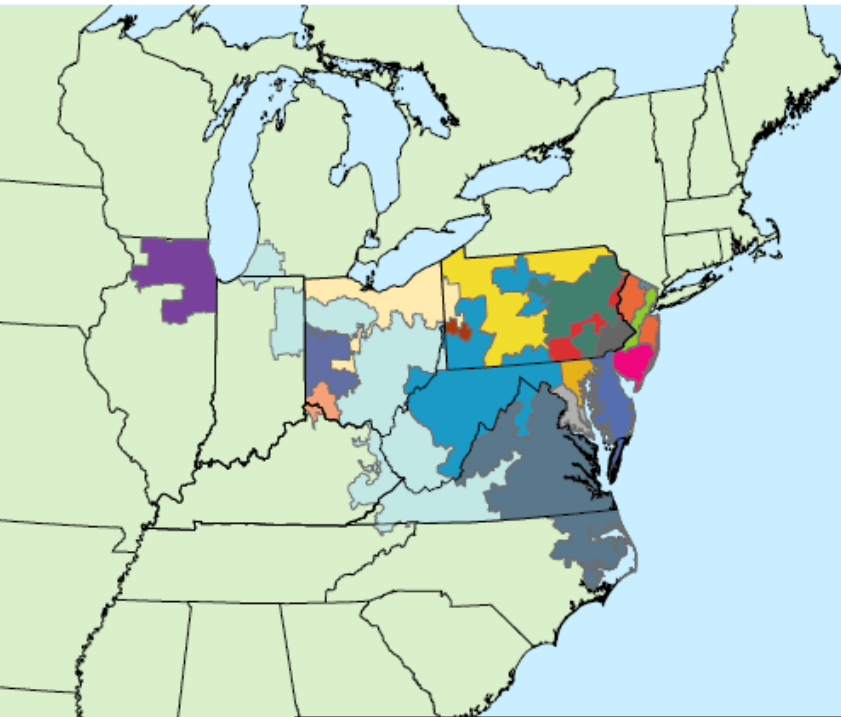
DOE Webinar




















November 15, 2012

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PJM Capacity Market Operations



Legend	
ZONE	
	Allegheny Power Systems
	American Electric Power Co., Inc.
	American Transmission Systems, Inc.
	Atlantic Electric Company
	Baltimore Gas and Electric Company
	ComEd
	Dayton Power and Light Co.
	Delmarva Power and Light Company
	Dominion
	Duke Energy Ohio and Kentucky
	Duquesne Light
	Jersey Central Power and Light Company
	Metropolitan Edison Company
	PPL Electric Utilities
	PECO Energy
	Pennsylvania Electric Company
	Potomac Electric Power Company
	Public Service Electric and Gas Company
	Rockland Electric Company

PJM coordinates the movement of wholesale electricity in all or part of 13 states and the District of Columbia.

As a Regional Transmission Organization (RTO), PJM:

- Coordinates and directs the operation of the region's transmission grid
- Administers a competitive wholesale electricity market
- Plans regional transmission expansion improvements to maintain grid reliability and relieve congestion.

Key statistics	PJM Today
Millions of people served	60.1
Miles of transmission lines	59,750
Generation capacity in MW	185,600
Square miles of territory	214,000
Area served	13 states + D.C.

- **Capacity** represents the commitment of generation and demand side resources to ensure that the demand for electricity can be met.
- A Load Serving Entity (LSE) (i.e., a utility or other electricity supplier) is required to have the resources to meet its' customers' demand plus a reserve amount.
- A LSE can meet that requirement with capacity resources that they own, with capacity purchased from others under contract, or with capacity obtained through PJM's capacity market auctions.

- PJM's capacity market, known as Reliability Pricing Model (RPM), procures capacity resources for future LSE requirements.
- Provides forward pricing signals to encourage retention of existing resources and development of new resources.
- RPM is a series of auctions for a Delivery Year in the future.
- Majority of capacity is procured in the first auction conducted for a Delivery Year, known as the Base Residual Auction.

3 Years

RPM Structure

20 months

10 months

3 months

May

May be scheduled at any time prior to DY

Sept

July

Feb.

June 1

May 31

Delivery Year

Base Residual Auction

Conditional Incremental Auction
(Effective 12/13 DY)

First Incremental Auction

Second Incremental Auction

Third Incremental Auction

Ongoing Bilateral Market

In RPM, **Resources** are =

**Generation
Resources**

**Demand
Resources
(DR)**

**Energy Efficiency
Resources
(EE)
(Effective with 11/12 DY)**

**Qualifying
Transmission
Upgrades
(QTU)**

- Installation of more efficient devices or equipment or implementation of more efficient processes/systems exceeding building codes, appliance standards, or other relevant standards at the time of installation as known at the time of the commitment to the capacity market.
- Designed to achieve a continuous reduction in electric demand at the End-Use Customer's retail site that is not reflected in the peak load forecast prepared for the Delivery Year.
 - Value of EE installation is measured during defined EE Performance Hours
- Fully implemented at all times during the Delivery Year, without any requirement of notice, dispatch, operator intervention.
 - If dispatchable, it would be considered a Demand Resource.

Meets definition if end-use customer installation exceeds standard

- Retrofitting devices:
 - Lighting
 - Refrigerators
 - Air Conditioners
 - Motors
- Building Weatherization
- Process Improvements

Does not meet definition

- Removing devices (e.g., de-lamping)
- Reducing load by a change of behavior (such as switching off devices)
- Adding generation (e.g., back-up generation, solar, wind, or co-gen)
- Switching an appliance or process from electric to gas
- Installing EE measures on transmission and distribution system as opposed to end-use customer's site

- ✓ Must meet PJM's definition of Energy Efficiency
- ✓ EE installation must be scheduled for completion prior to DY
- ✓ EE installation is not reflected in peak load forecast posted for the BRA for the DY initially offered
- ✓ EE installation exceeds relevant standards at time of installation as known at time of commitment
- ✓ EE installation achieves load reduction during defined EE Performance Hours
- ✓ EE installation is not dispatchable

- EE Resource is defined as EE project(s) or portion of EE project(s) in a zone that represents the installations of EE during a defined period of time from June 1 to May 31.
- EE Resource must have a minimum demand reduction value of 0.1 MW to participate in RPM Auction
- Only a PJM Member may offer an EE Resource into an RPM Auction



Installation Period & DY Eligibility

Installation Period	Fully Installed for Summer	Eligible DYs	Remaining Auction Opportunities
June 2009-May 2010	2010	2011/2012, 2012/2013, 2013/2014	2013/2014 3 rd IA
June 2010-May 2011	2011	2011/2012, 2012/2013, 2013/2014, 2014/2015	2013/2014 3 rd IA 2014/2015 2 nd & 3 rd IAs
June 2011-May 2012	2012	2012/2013, 2013/2014, 2014/2015, 2015/2016	2013/2014 3 rd IA 2014/2015 2 nd & 3 rd IAs 2015/2016 1 st , 2 nd , & 3 rd IAs
June 2012-May 2013	2013	2013/2014, 2014/2015, 2015/2016, 2016/2017	2013/2014 3 rd IA 2014/2015 2 nd & 3 rd IAs 2015/2016 1 st , 2 nd , & 3 rd IAs 2016/2017 BRA, 1 st , 2 nd , & 3 rd IAs
June 2013-May 2014	2014	2014/2015, 2015/2016, 2016/2017, 2017/2018	2014/2015 2 nd & 3 rd IAs 2015/2016 1 st , 2 nd , & 3 rd IAs 2016/2017 BRA, 1 st , 2 nd , & 3 rd IAs 2017/2018 BRA, 1 st , 2 nd , & 3 rd IAs
June 2014-May 2015	2015	2015/2016, 2016/2017, 2017/2018, 2018/2019	2015/2016 1 st , 2 nd , & 3 rd IAs 2016/2017 BRA, 1 st , 2 nd , & 3 rd IAs 2017/2018 BRA, 1 st , 2 nd , & 3 rd IAs 2018/2019 BRA, 1 st , 2 nd , & 3 rd IAs
June 2015-May 2016	2016	2016/2017, 2017/2018, 2018/2019, 2019/2020	2016/2017 BRA, 1 st , 2 nd , & 3 rd IAs 2017/2018 BRA, 1 st , 2 nd , & 3 rd IAs 2018/2019 BRA, 1 st , 2 nd , & 3 rd IAs 2019/2020 BRA, 1 st , 2 nd , & 3 rd IAs

EE Resource may be eligible to receive Capacity Market (RPM) revenue for up to four consecutive Delivery Years.

- ✓ Submit M&V Plan prior to RPM Auction
- ✓ Establish credit with PJM Credit Department prior to RPM Auction
- ✓ Submit Post-Installation M&V Report prior to Delivery Year committed
- ✓ Permit Post- Installation M&V Audit by PJM or Independent Third Party

- Measurement and Verification (M&V) Plans
 - Describes M&V methods and techniques that will be used to determine and verify the Nominated EE Value of the EE Resource
 - Initial M&V Plan must be submitted no later than 30 days prior to the RPM Auction in which the EE Resource is initially offered
 - Updated M&V Plan must be submitted no later than 30 days prior to the next RPM Auction in which the EE Resource is to be subsequently offered.
 - PJM will review and approve the Nominated EE Value that may be offered into the RPM Auction
- Post-Installation Measurement and Verification (PI M&V) Report
 - Includes the results of actual measurement and verification activities prior to each Delivery Year the EE Resource is committed.
 - PI M&V Report must be submitted no later than 15 business days prior to each Delivery Year the EE Resource is committed
 - PJM will review and approve the final Nominated EE Value for Delivery Year

- Nominated Energy Efficiency Value is the expected average demand reduction (MW) during the EE Performance Hours
- EE Performance Hours: between hour ending 15:00 EPT and the hour ending 18:00 EPT during all days from June 1 through August 31, inclusive, that is not a weekend or a recognized holiday.

Nominated EE Value is equivalent to the “ICAP” or Installed Capacity value of a generation resource.

Unforced Capacity (UCAP) value of an EE Resource is calculated as:

$$\text{Unforced Capacity Value Of EE Resource} = \text{Nominated EE Value} * \text{DR Factor} * \text{Forecast Pool Requirement (FPR)}$$

For Example:

$$\text{103.4 MW} = 100 * 0.957 * 1.0806$$

Unforced Capacity Value For EE Resource = 103.4 MW

- If Final UCAP value of the EE resource is less than the UCAP committed in RPM Auctions, a Daily Capacity Resource Deficiency Charge will be assessed for the shortfall, unless replacement capacity is specified.
- If an Audit conducted during the Delivery Year reveals a UCAP value of the EE resource that is less than the UCAP value supported by PI M&V Report, a Daily Capacity Resource Deficiency Charge will be assessed for any incremental shortfall *retroactively* from the start of the Delivery Year.
- Daily Charge = Shortfall (MW) * Daily Deficiency Rate (\$/MW-day)
- Daily Deficiency Rate (\$/MW-day) = Provider's Weighted Average RCP for the EE Resource + Higher of (20% * Provider's Weighted Average RCP OR \$20/MW-day)
- EE Resource Provider still receives Auction Credit

Energy Efficiency (EE) Cleared in RPM Auctions

Delivery Year	Auction	Total EE Resources Offered in PJM (UCAP MW)	Total EE Resources Cleared in PJM (UCAP MW)
2011/2012	3 rd IA	92	78
2012/2013	BRA	653	569
	2 nd IA	46	17
	3 rd IA	83	81
2013/2014	BRA	757	679
	1 st IA	72	69
	2 nd IA	144	122
2014/2015	BRA	832	822
	1 st IA	150	134
2015/2016	BRA	940	923

UCAP MW values are rounded.



Energy Efficiency (EE) Offered/Cleared in 2015/2016 RPM BRA

LDA	Zone	Offered EE*	Cleared EE*
EMAAC	AECO	1.6	1.2
EMAAC/DPL-S	DPL	16.2	15.5
EMAAC	JCPL	-	-
EMAAC	PECO	20.8	14.8
PSEG/PS-N	PSEG	11.9	10.7
EMAAC	RECO	-	-
EMAAC Sub Total		50.5	42.2
PEPCO	PEPCO	56.2	55.8
SWMAAC	BGE	103.6	103.6
MAAC	METED	4.1	3.4
MAAC	PENELEC	4.1	3.4
MAAC	PPL	18.7	14.2
MAAC** Sub Total		237.2	222.6
RTO	AEP	213.9	213.9
RTO	APS	0.8	0.8
ATSI	ATSI	48.1	44.9
RTO	COMED	422.4	422.4
RTO	DAY	2.0	2.0
RTO	DEOK	4.6	4.6
RTO	DOM	7.2	7.2
RTO	DUQ	4.1	4.1
Grand Total		940.3	922.5

*All MW values are expressed in UCAP

**MAAC sub-total includes all MAAC Zones

	LDA	RTO	MAAC	EMAAC	SWMAAC	PS	PS NORTH	DPL SOUTH	PEPCO	ATSI
DY 11/12	3IA	\$5.00	-	-	-	-	-	-	-	-
DY 12/13	BRA	\$16.46	-	\$139.73	\$133.37	-	\$185.00	\$222.30	-	-
	2IA	\$13.01	-	\$48.91	\$13.01	-	\$48.91	\$48.91	-	-
	3IA	\$2.51	-	\$2.51	\$2.51	-	\$2.51	\$2.51	-	-
DY 13/14	BRA	\$27.73	\$226.15	\$245.00	\$226.15	\$245.00	\$245.00	\$245.00	\$247.14	-
	1IA	\$20.00	\$20.00	\$178.85	\$54.82	\$178.85	\$178.85	\$178.85	\$54.82	-
	2IA	\$7.01	\$10.00	\$40.00	\$10.00	\$40.00	\$40.00	\$40.00	\$10.00	-
DY 14/15	BRA	\$125.99	\$136.50	\$136.50	\$136.50	\$136.50	\$225.00	\$136.50	\$136.50	-
	1IA	\$5.54	\$16.56	\$16.56	\$16.56	\$16.56	\$410.95	\$16.56	\$16.56	-
DY 15/16	BRA	\$136.00	\$167.46	\$167.46	\$167.46	\$167.46	\$167.46	\$167.46	\$167.46	\$357.00

Note: If no price is listed for an LDA, the LDA was not modeled in the RPM Auction.

Resource Clearing Prices for Annual product type.

- A cleared EE Resource in an RPM Auction would receive the Annual-product **Resource Clearing Price** for the location in which the resource resides.
- EE Provider that cleared an EE Resource is assessed daily Auction Credits (revenues) during the actual Delivery Year.
- Auction Credits are billed weekly throughout the Delivery Year.

Example:

An EE Provider that cleared 10 MW (UCAP) of an EE Resource located in PECO zone (part of the EMAAC LDA) in the 15/16 BRA would receive Annual-product RCP in EMAAC = \$167.46/MW-day.

*Daily Auction Credit = 10 MW * \$167.46/Mw-day = \$1674.60/day*

*Annual Auction Credits = \$1674.60/day * 366 days/year = \$612,903.60/yr*

- Infancy of EE Resources in PJM
- Costs of M&V activities
- Credit Requirements
- Audit Costs
- Exposure to Deficiency Charges
- Expense of Replacement Capacity
- Market Rule Changes



Synapse
Energy Economics, Inc.

Energy Efficiency in the Forward Capacity Market (FCM)

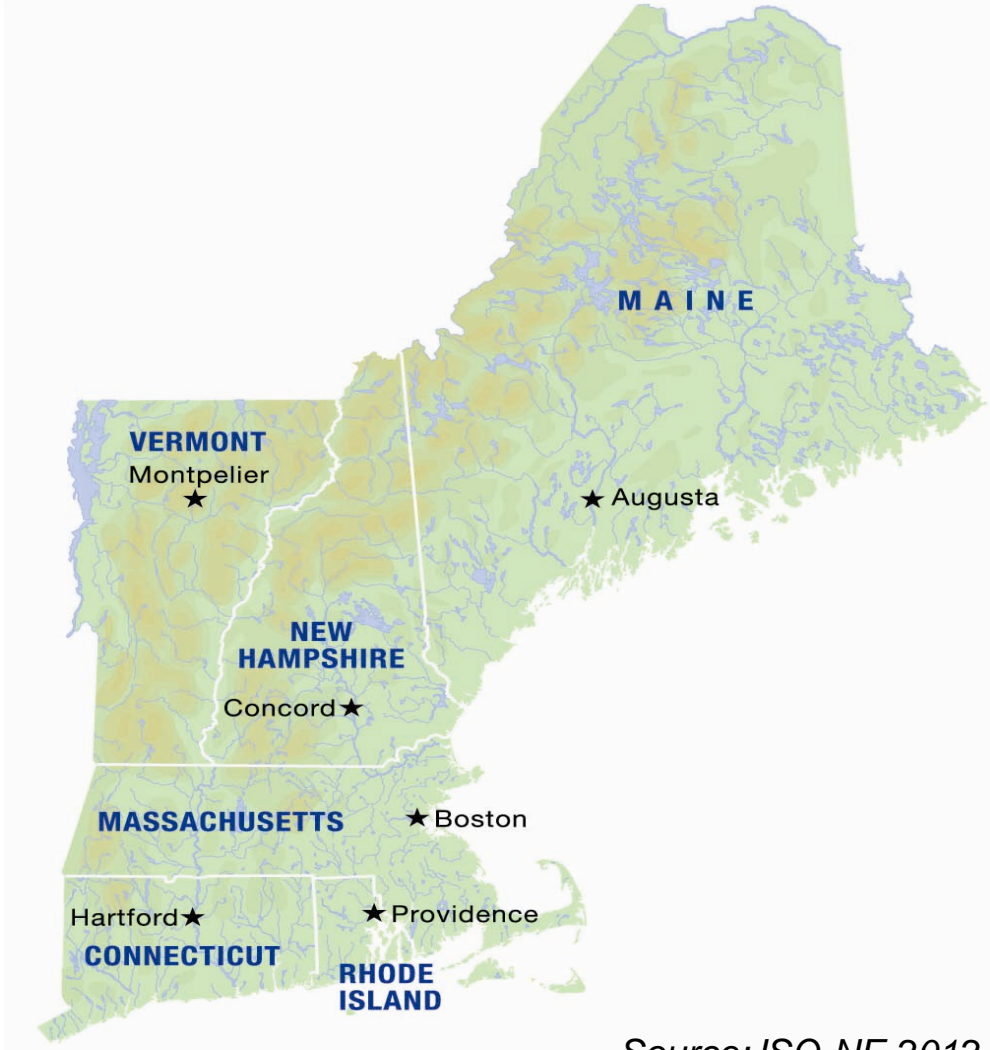
DOE Better Buildings Neighborhood Program Webinar
November 15, 2012

Doug Hurley

Energy System modeling, analysis, expert testimony, and stakeholder representation for...

- Consumer Advocates and Public Interest Groups in more than 25 states
 - More than 20 PUCs and Attorneys General
 - Over 40 Environmental Groups and Foundations
-
- NEPOOL Representation for Consumer Advocates, Energy Efficiency, Renewable Generation, and Environmental Advocates

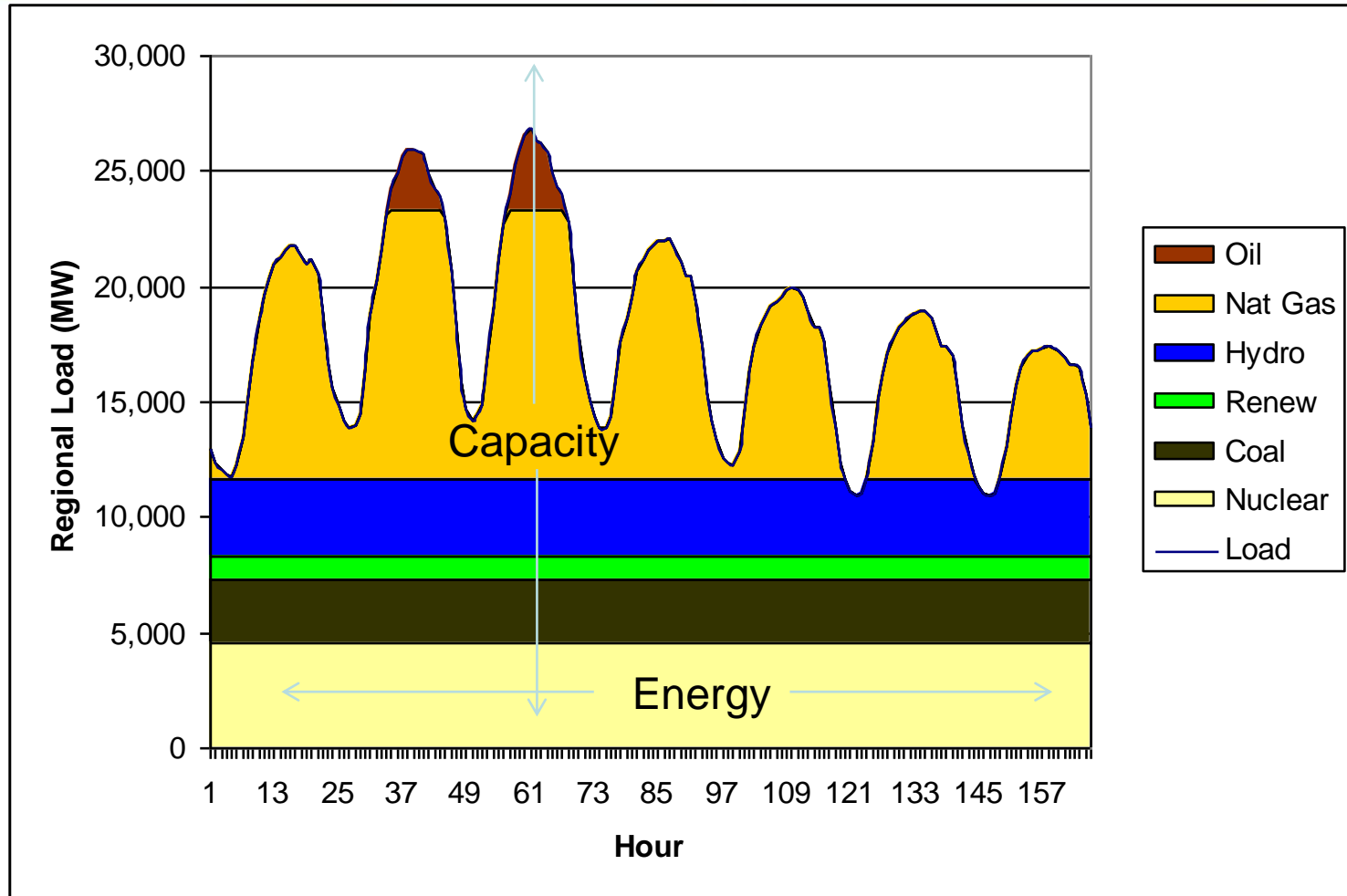
Independent System Operator of New England



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

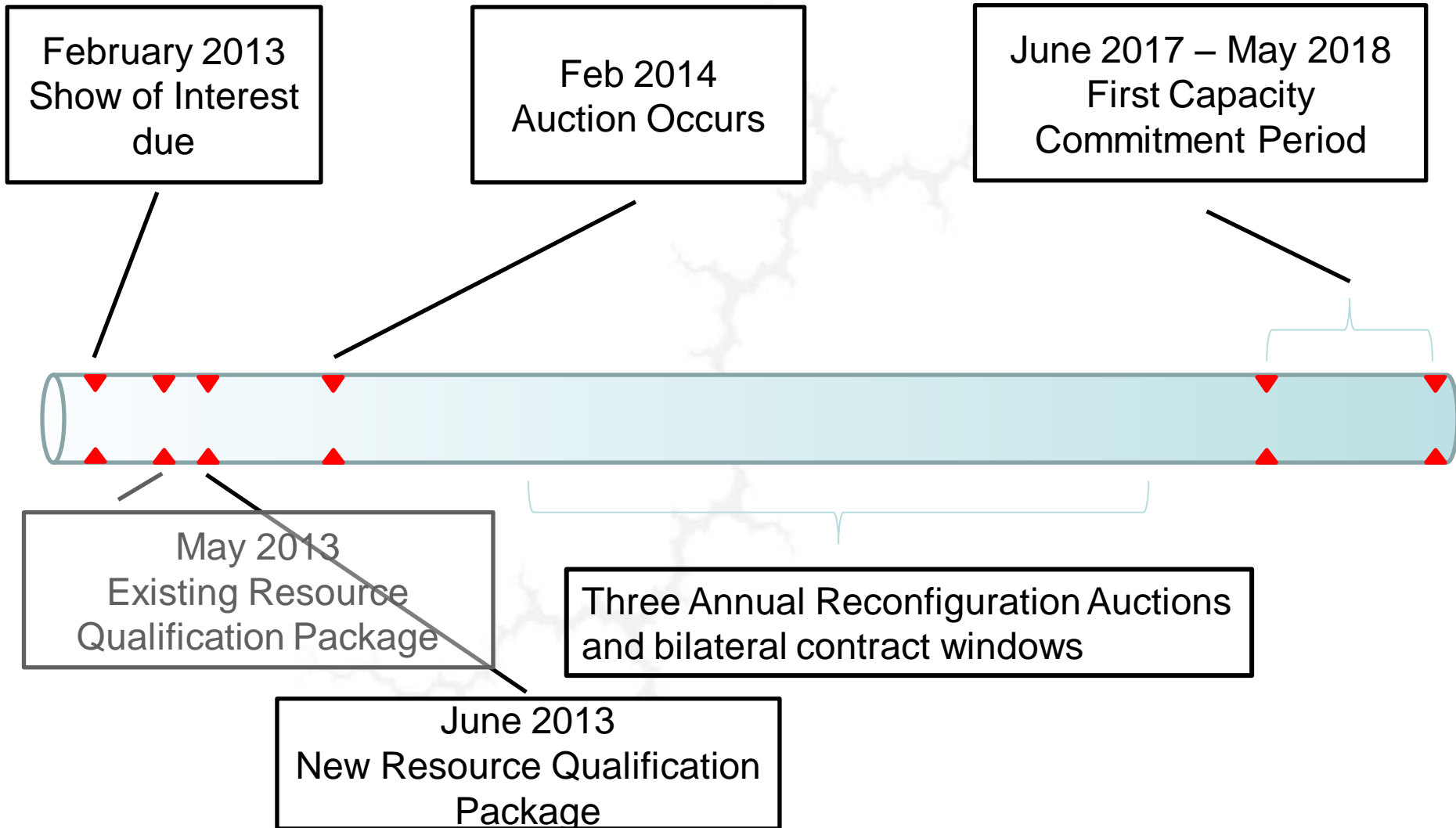
Source: ISO-NE 2012 Regional System Plan

What Is A Capacity Market?



Important: Capacity measures PEAK demand reduction, NOT energy savings.

Forward Capacity Auction-8 Timeline



Resources Eligible to be Capacity

- **Generation**
 - Traditional generation, a.k.a. central station power plants
 - Renewable generation
- **Demand Resources**
 - Demand Response
 - Reduction in end-use customer load in response to a dispatch signal from the system operator
 - Distributed Generation
 - On-site, behind-the-meter generation that runs on its own schedule. E.g., rooftop solar, CHP
 - Energy Efficiency, as rated during peak load hours

Projects cannot also be reported by another entity!

Demand Resource Performance Hours

- Active Demand Resources
 - Real Time Demand Response
 - Real Time Emergency Generation
 - Measured during hours when dispatched by the ISO-NE
- Passive Demand Resources (EE, DG)
 - On Peak Resources are measured:
 - Jun – Aug weekday non-holidays from 1-5pm
 - Dec – Jan weekday non-holidays from 5-7pm
 - Seasonal Peak Resources are measured:
 - During hours when real-time load is 90% or greater of forecasted seasonal peak load
 - These hours are NOT known in advance
 - Market Participant chooses On Peak or Seasonal Peak

- Project Name
- Commercial Operation Date
- Demand Resource type (RTDR, RTEG, On Peak, Seasonal Peak)
- Estimated Summer and Winter demand reduction value
 - Capacity value is 108% of demand reduction value
- Load Zone (must have at least 100kW per load zone)
- Project Description
 - Measure Type (EE/DG)
 - Customer Classes
 - Single Facility \geq 5 MW
- Project contact information
- Market Participant status

- \$1,000 Qualification Process Cost Reimbursement Deposit

New Capacity Qualification Package

- Elections
 - Multi-year price option (up to 5 years)
 - Rationing at clearing price
 - Offers below threshold price
 - Type of Critical Path Schedule
- Forms to submit
 - Project Description (info by facility class and measure type)
 - Source of Funding
 - Customer Acquisition Plan
 - Measurement & Verification (M&V) Plan
 - Supporting M&V Documents (i.e. studies to prove savings and impact factors)

- M&V Plan Form - Sections (Corresponding to M-MVDR Section(s))
- Section I (Section 2 &4): Equipment, Measure and Practice Detail
- Section II (Section 3): Project General Assumptions
- Section III (Section 5): Measurement and Verification Approach
- Section IV (Section 5 &6): Methodology for Establishing Baseline Conditions
- Section V (Section 7): Statistical Sampling Plan
- Section VI (Section 8): Demand Reduction Value Calculations

- Final action to accept capacity obligation at a price
- Descending clock auction
 - Price starts high, and drops
 - Resources exit the auction as the price drops, until we have the required amount.
 - New resources can exist during any round
 - Potential rationing of marginal unit
- Usually takes 2 days to run
- Clearing in the auction is a contract to provide capacity in a future year, at the clearing price

- Financial Assurance
 - \$2/kW qualified
 - ~\$3/kW cleared at auction
 - 2 x ~\$5/kW cleared, once per year thereafter
 - Returned when project is commercial
- Reconfiguration Auctions
 - To shed or gain an obligation. Price can be higher or lower than the FCA price
- Penalty for non-performance
- Manage resource in future years, then exit

- Quarterly or monthly milestone reporting until resource fully commercial
- Monthly performance reporting
- Annual M&V Certification from independent third-party auditor
- Ad-hoc audits from ISO-NE staff
- Annual Existing Capacity Qualification
 - Report on measures that have expired (end of measure life)
- Annual Minimum Eligibility Criteria as a market participant

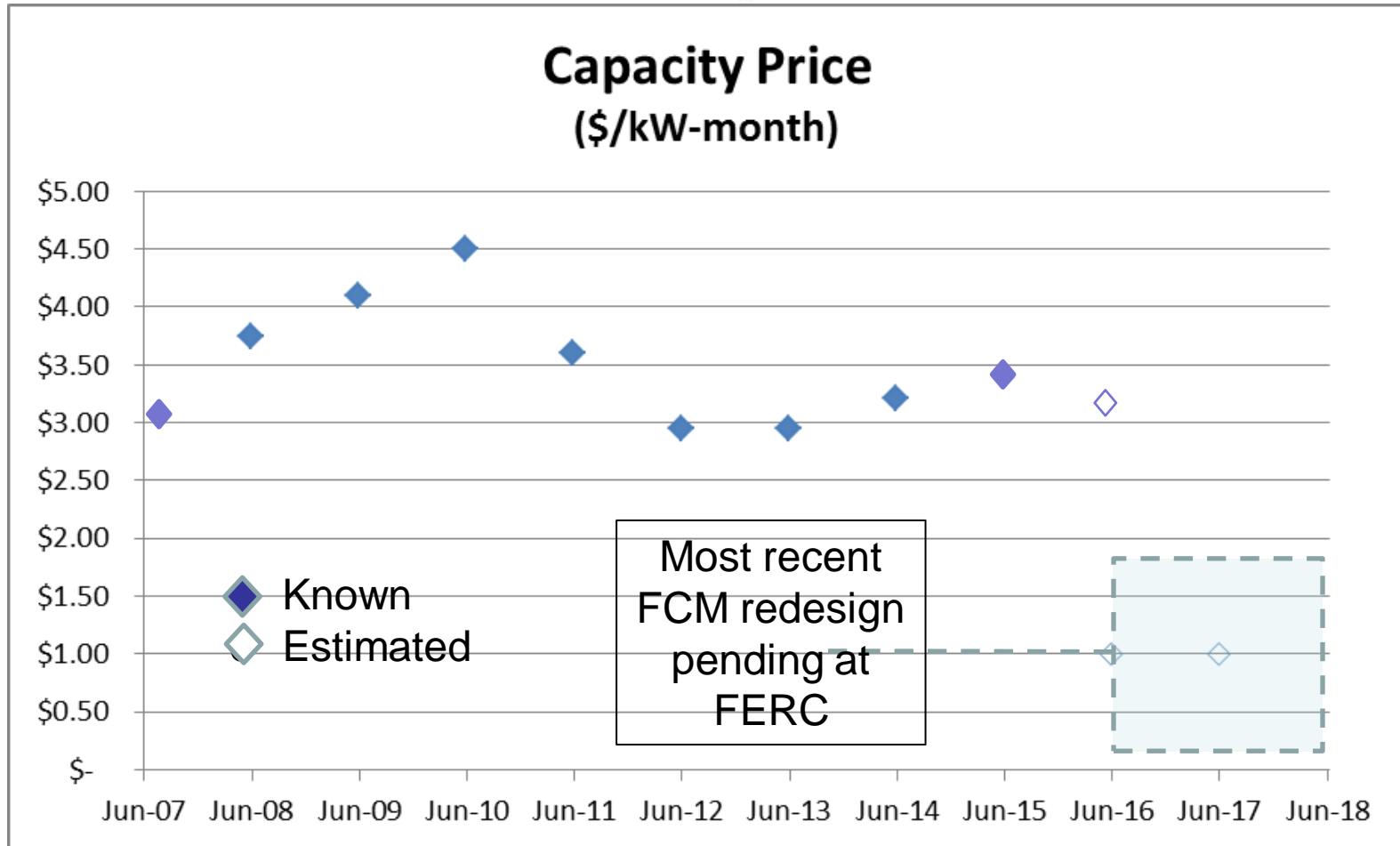
EE in FCM so far

Auction	Delivery Date	Amount of New EE Cleared
FCA-1	June 2010	660 MW
FCA-2	June 2011	226 MW
FCA-3	June 2012	211 MW
FCA-4	June 2013	258 MW
FCA-5	June 2014	221 MW
Average Annual	2011 - 2014	229 MW
Average Annual Forecasted Peak Load Growth		400 MW (~1.2%)

Notes:

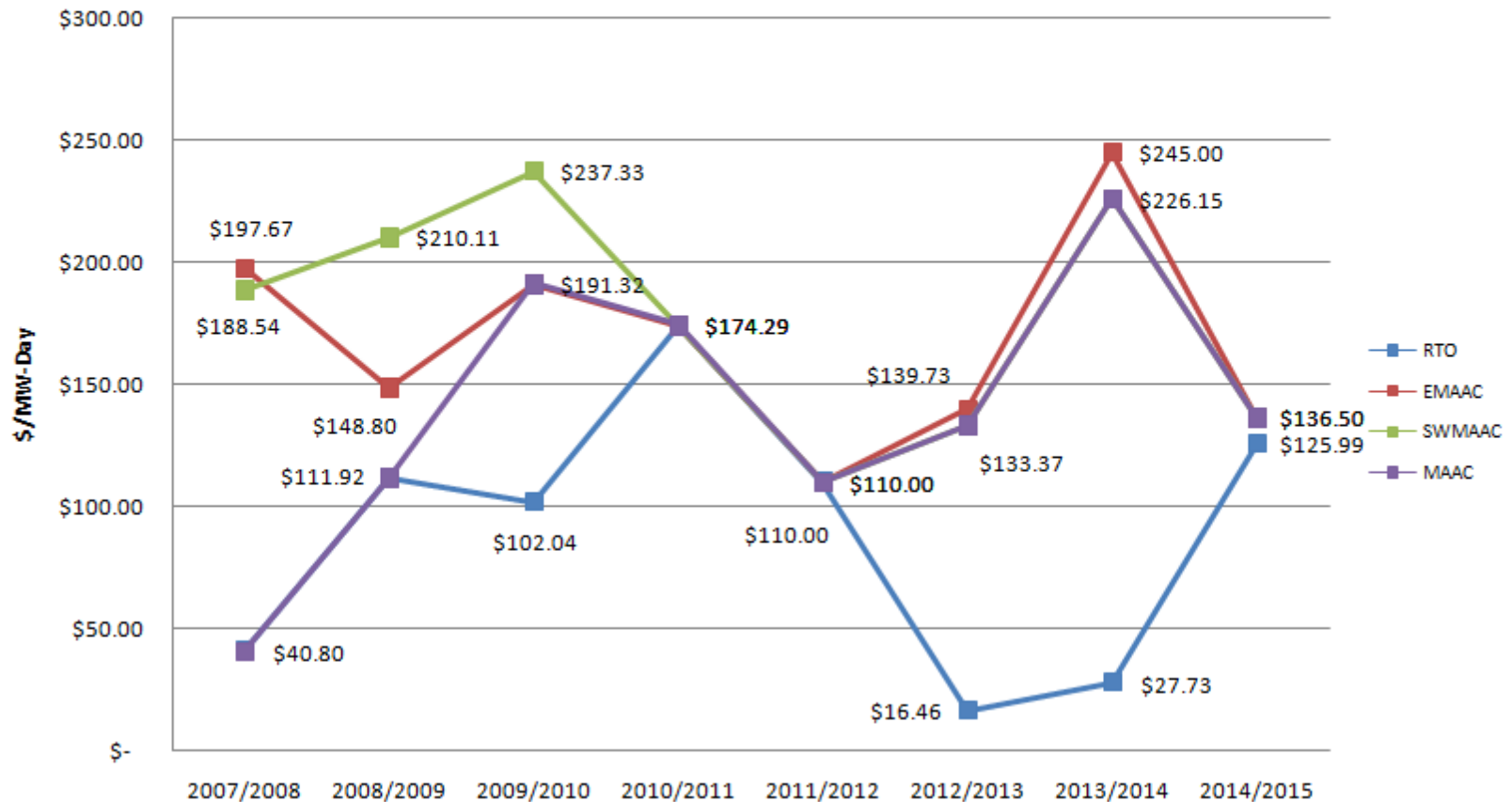
1. As measured on summer afternoons.
2. More EE is being installed than has been bid into the FCM ... for now.

New England FCM Prices



Caveat: FCM Market Rules changing every year since FCA-3.

RPM Base Residual Auction Resource Clearing Prices (RCP)



Source: PJM 2014-2015 RPM Base Residual Auction Results report

- Think like a Market Participant
 - Financial risk, potential rewards, ongoing process, price fluctuation
 - Must plan 4+ years in advance
 - Annual costs to report and manage resource
- More stringent and different M&V
 - Exact MW, not benefits of MWh
 - Statistical accuracy of sampling
 - Annual certification
- Changing market rules

www.synapse-energy.com

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