Energy Efficiency in PJM Capacity Market

DOE Webinar
November 15, 2012
Terri Esterly
Sr. Lead Engineer
PJM Capacity Market Operations
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**

<table>
<thead>
<tr>
<th>Metric</th>
<th>PJM Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millions of people served</td>
<td>60.1</td>
</tr>
<tr>
<td>Miles of transmission lines</td>
<td>59,750</td>
</tr>
<tr>
<td>Generation capacity in MW</td>
<td>185,600</td>
</tr>
<tr>
<td>Square miles of territory</td>
<td>214,000</td>
</tr>
<tr>
<td>Area served</td>
<td>13 states + D.C.</td>
</tr>
</tbody>
</table>
What does Capacity mean?

• **Capacity** represents the commitment of generation and demand side resources to ensure that the demand for electricity can be meet.

• 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.
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RPM Structure

Base Residual Auction

Residual Auction

Second Incremental Auction

Third Incremental Auction

Conditional Incremental Auction (Effective 12/13 DY)

First Incremental Auction

3 Years

20 months

10 months

3 months

May

Sept

July

Feb.

Ongoing Bilateral Market

Delivery Year

May 31

June 1
What is a Capacity Resource in RPM?

In RPM, **Resources** are =

- **Generation Resources**
- **Demand Resources** (DR)
- **Energy Efficiency Resources** (EE) (Effective with 11/12 DY)
- **Qualifying Transmission Upgrades** (QTU)
PJM Energy Efficiency (EE) Definition

• 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.
Does EE installation meet PJM’s definition of EE?

<table>
<thead>
<tr>
<th>Meets definition if end-use customer installation exceeds standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Retrofitting devices:</td>
</tr>
<tr>
<td>– Lighting</td>
</tr>
<tr>
<td>– Refrigerators</td>
</tr>
<tr>
<td>– Air Conditioners</td>
</tr>
<tr>
<td>– Motors</td>
</tr>
<tr>
<td>• Building Weatherization</td>
</tr>
<tr>
<td>• Process Improvements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does not meet definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Removing devices (e.g., de-lamping)</td>
</tr>
<tr>
<td>• Reducing load by a change of behavior (such as switching off devices)</td>
</tr>
<tr>
<td>• Adding generation (e.g., back-up generation, solar, wind, or co-gen)</td>
</tr>
<tr>
<td>• Switching an appliance or process from electric to gas</td>
</tr>
<tr>
<td>• Installing EE measures on transmission and distribution system as opposed to end-use customer’s site</td>
</tr>
</tbody>
</table>
Eligibility Criteria for EE Installation

- 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.
<table>
<thead>
<tr>
<th>Installation Period</th>
<th>Fully Installed for Summer</th>
<th>Eligible DYs</th>
<th>Remaining Auction Opportunities</th>
</tr>
</thead>
</table>

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

- 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:

\[
\text{Unforced Capacity Value of EE Resource} = \text{Nominated EE Value} \times \text{DR Factor} \times \text{Forecast Pool Requirement (FPR)}
\]

For Example:

\[
103.4 \text{ MW} = 100 \times 0.957 \times 1.0806
\]

Unforced Capacity Value For EE Resource = 103.4 MW
Compliance during Delivery Year

• 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

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

*UCAP MW values are rounded.*
<table>
<thead>
<tr>
<th>LDA</th>
<th>Zone</th>
<th>Offered EE*</th>
<th>Cleared EE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAAC</td>
<td>AECO</td>
<td>1.6</td>
<td>1.2</td>
</tr>
<tr>
<td>EMAAC/DPL-S</td>
<td>DPL</td>
<td>16.2</td>
<td>15.5</td>
</tr>
<tr>
<td>EMAAC</td>
<td>JCPL</td>
<td>-</td>
<td>-</td>
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<tr>
<td>EMAAC</td>
<td>PECO</td>
<td>20.8</td>
<td>14.8</td>
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<td>PSEG/PS-N</td>
<td>PSEG</td>
<td>11.9</td>
<td>10.7</td>
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<tr>
<td>EMAAC</td>
<td>RECO</td>
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<td>-</td>
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<tr>
<td><strong>EMAAC Sub Total</strong></td>
<td></td>
<td><strong>50.5</strong></td>
<td><strong>42.2</strong></td>
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<tr>
<td>PEPCO</td>
<td>PEPCO</td>
<td>56.2</td>
<td>55.8</td>
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<tr>
<td>SWMAAC</td>
<td>BGE</td>
<td>103.6</td>
<td>103.6</td>
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<tr>
<td>MAAC</td>
<td>METED</td>
<td>4.1</td>
<td>3.4</td>
</tr>
<tr>
<td>MAAC</td>
<td>PENELEC</td>
<td>4.1</td>
<td>3.4</td>
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<td>MAAC</td>
<td>PPL</td>
<td>18.7</td>
<td>14.2</td>
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<tr>
<td><strong>MAAC</strong> Sub Total</td>
<td></td>
<td><strong>237.2</strong></td>
<td><strong>222.6</strong></td>
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<tr>
<td>RTO</td>
<td>AEP</td>
<td>213.9</td>
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<tr>
<td>RTO</td>
<td>APS</td>
<td>0.8</td>
<td>0.8</td>
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<tr>
<td>ATSI</td>
<td>ATSI</td>
<td>48.1</td>
<td>44.9</td>
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<tr>
<td>RTO</td>
<td>COMED</td>
<td>422.4</td>
<td>422.4</td>
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<tr>
<td>RTO</td>
<td>DAY</td>
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<td>2.0</td>
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<tr>
<td>RTO</td>
<td>DEOK</td>
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<tr>
<td>RTO</td>
<td>DOM</td>
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</tr>
<tr>
<td>RTO</td>
<td>DUQ</td>
<td>4.1</td>
<td>4.1</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>940.3</strong></td>
<td><strong>922.5</strong></td>
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</table>

*All MW values are expressed in UCAP

**MAAC sub-total includes all MAAC Zones
<table>
<thead>
<tr>
<th>LDA</th>
<th>RTO</th>
<th>MAAC</th>
<th>EMAAC</th>
<th>SWMAAC</th>
<th>PS</th>
<th>PS NORTH</th>
<th>DPL SOUTH</th>
<th>PEPCO</th>
<th>ATSI</th>
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<tbody>
<tr>
<td>DY 11/12</td>
<td>3IA</td>
<td>$5.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>DY 12/13</td>
<td>BRA</td>
<td>$16.46</td>
<td>-</td>
<td>$139.73</td>
<td>$133.37</td>
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<td>$185.00</td>
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<td></td>
<td>2IA</td>
<td>$13.01</td>
<td>-</td>
<td>$48.91</td>
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<td>$48.91</td>
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<tr>
<td></td>
<td>3IA</td>
<td>$2.51</td>
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<td>$2.51</td>
<td>$2.51</td>
<td>-</td>
<td>$2.51</td>
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<tr>
<td>DY 13/14</td>
<td>BRA</td>
<td>$27.73</td>
<td>$226.15</td>
<td>$245.00</td>
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<td>2IA</td>
<td>$7.01</td>
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<td>$40.00</td>
<td>$40.00</td>
<td>$40.00</td>
<td>$10.00</td>
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<tr>
<td>DY 14/15</td>
<td>BRA</td>
<td>$125.99</td>
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<td>$136.50</td>
<td>$225.00</td>
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<td>$410.95</td>
<td>$16.56</td>
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<tr>
<td>DY 15/16</td>
<td>BRA</td>
<td>$136.00</td>
<td>$167.46</td>
<td>$167.46</td>
<td>$167.46</td>
<td>$167.46</td>
<td>$167.46</td>
<td>$167.46</td>
<td>$167.46</td>
</tr>
</tbody>
</table>

Note: If no price is listed for an LDA, the LDA was not modeled in the RPM Auction.
What is a cleared EE Resource paid?

• 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
Challenges & Risks

- 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
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

February 2013
Show of Interest due

Feb 2014
Auction Occurs

June 2017 – May 2018
First Capacity Commitment Period

May 2013
Existing Resource Qualification Package

June 2013
New Resource Qualification Package

Three Annual Reconfiguration Auctions and bilateral contract windows
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
Show of Interest

- 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 100 kW per load zone)
- Project Description
  - Measure Type (EE/DG)
  - Customer Classes
  - Single Facility >= 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)
ISO-NE M&V Plan

- 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
Auction

• 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
Other Considerations

• 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
Ongoing Reporting

• 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

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

### 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

Capacity Price
($/kW-month)


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

Doug Hurley