



# Reliability Pricing Model Training

February 2012

# Welcome

# Disclaimer:

PJM has made all efforts possible to accurately document all information in this presentation. The information seen here does not supersede the PJM Operating Agreement or the PJM Tariff both of which can be found by accessing:

<http://www.pjm.com/documents/agreements/pjm-agreements.aspx>

For additional detailed information on any of the topics discussed, please refer to the appropriate PJM manual which can be found by accessing:

<http://www.pjm.com/documents/manuals.aspx>

- Explain the demand component of the RPM
- Learn about available supply resources in RPM
- Explain how RPM Auctions are conducted
- Explain how to participate in RPM Auctions
- Explain delivery year resource performance assessments
- Understand how settlements occur
- Provide high-level overview of Fixed Resource Requirement (FRR) Alternative

# Reliability Pricing Model Introduction

RPM Training – Section A  
February 2012

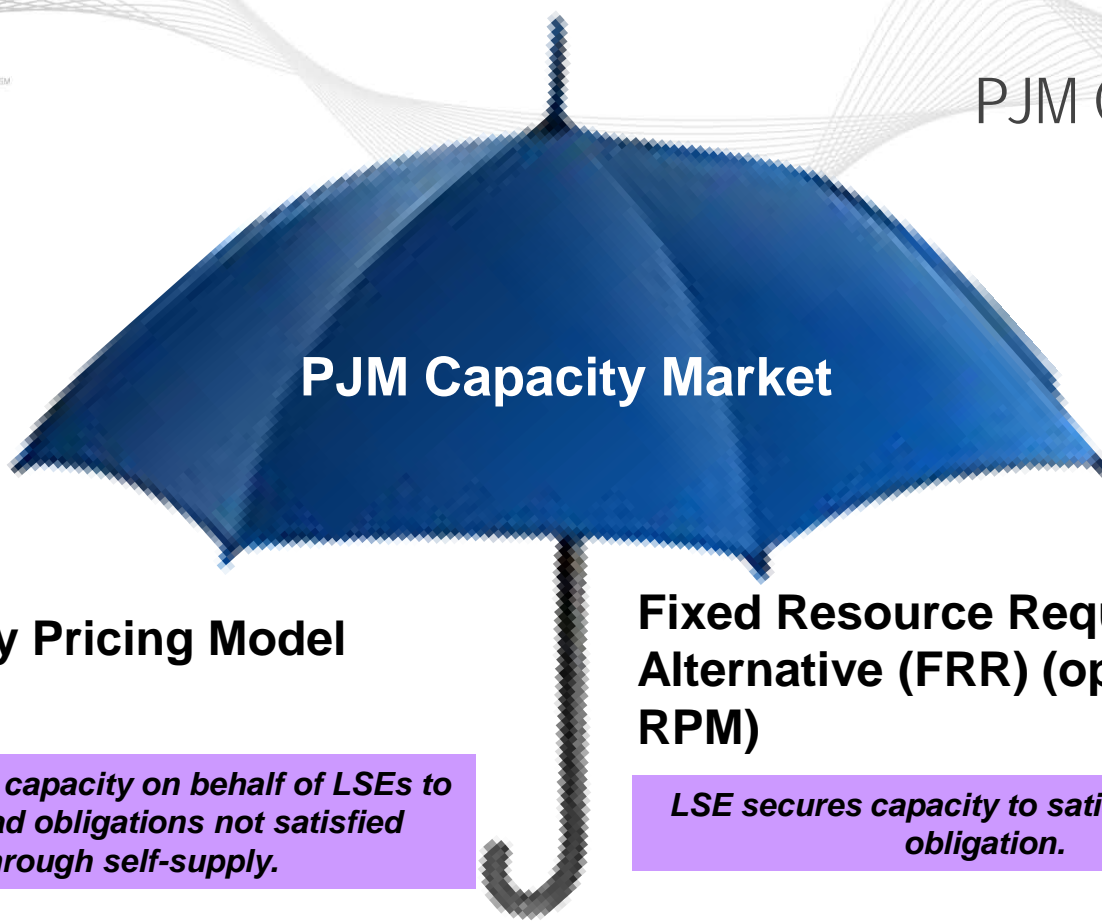
## Capacity

- A commitment of a resource to provide energy during PJM emergency under the capped energy price.
- Capacity revenues paid to committed resource whether or not energy is produced by resource.
- Daily product

## Energy

- Generation of electrical power over a period of time
- Energy revenues paid to resource based on participation in PJM's Day-Ahead & Real-Time Energy Markets
- Hourly product

Capacity, energy & ancillary services revenues are expected, in the long term, to meet the fixed and variable costs of generation resources to ensure that adequate generation is maintained for reliability of the electric grid.



## PJM Capacity Market

### Reliability Pricing Model (RPM)

*PJM secures capacity on behalf of LSEs to satisfy load obligations not satisfied through self-supply.*

### Fixed Resource Requirement Alternative (FRR) (opt-out of RPM)

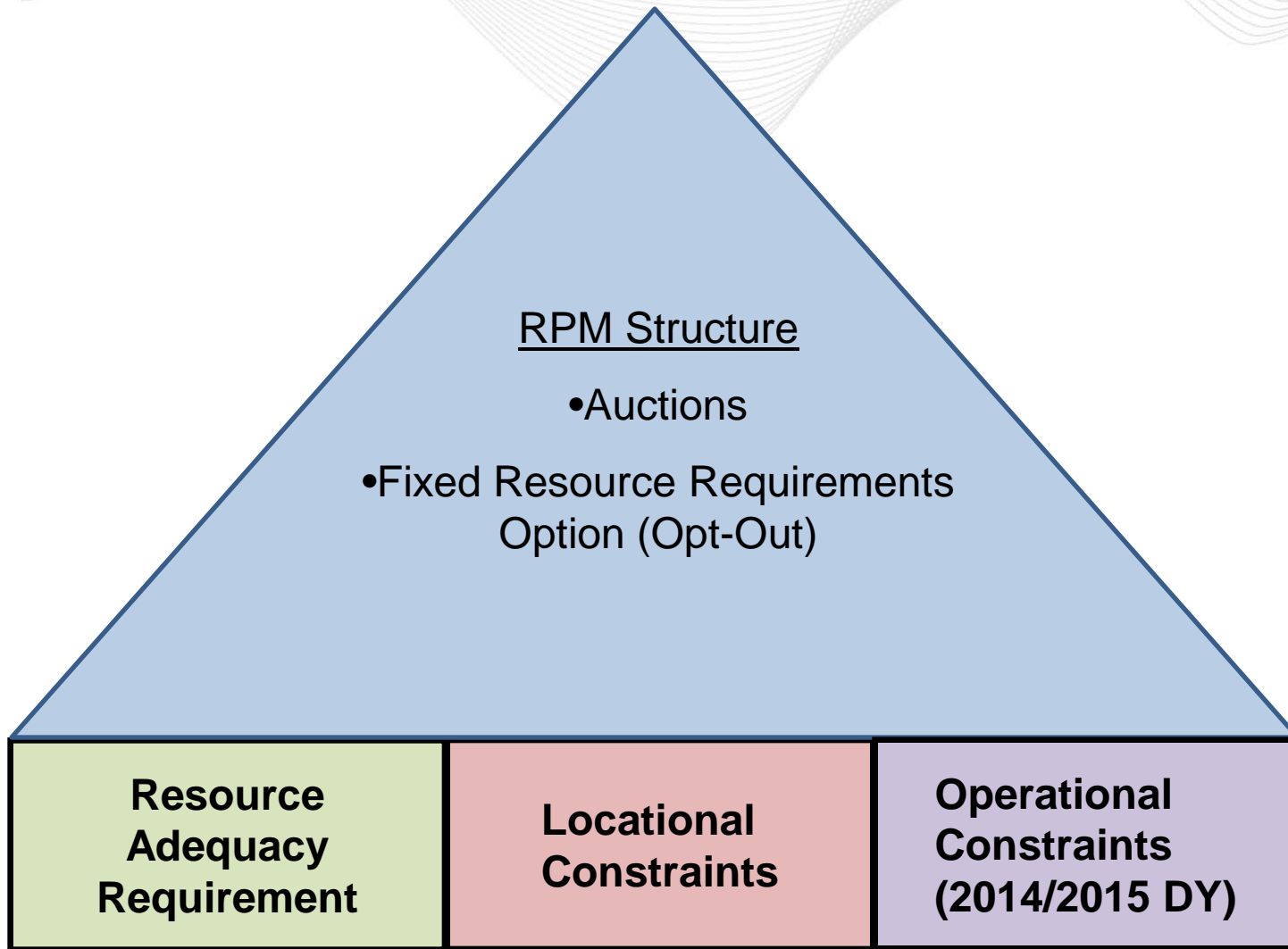
*LSE secures capacity to satisfy their load obligation.*

PJM Capacity Market is designed to ensure adequate availability of resources that can be called upon to ensure the reliability of the electric grid.

- Reliability Pricing Model (RPM) is PJM's resource adequacy construct
- RPM is part of an integrated approach to ensuring long-term resource adequacy and competitively priced delivered energy
- RPM aligns the price paid for capacity with overall system reliability requirements
- RPM includes pricing to recognize and quantify the locational value of capacity (effective 2007/2008 Delivery Year) and the operational value of capacity (effective 2014/15 Delivery Year)
- RPM provides forward investment signals

- Resource commitments to meet system peak loads three years in the future
- Three year forward pricing which is aligned with reliability requirements and which adequately values all capacity resources
- Provide transparent information to all participants far enough in advance for actionable response

Purpose of RPM is to enable PJM to obtain sufficient resources to reliably meet the needs of electric consumers within PJM.



- Determines the amount of capacity resources required to serve the forecast peak load and satisfy the reliability criterion.
- The reliability criterion is based on Loss of Load Expectation (LOLE) not exceeding one event in ten years.

An Installed Reserve Margin (IRM) = 15.4% satisfies the reliability criterion for the 2015/16 Delivery Year Base Residual Auction.

Resource Adequacy ICAP Requirement = Forecast Peak Load \* (1+ IRM)

- **Installed Capacity (ICAP)** value of a unit is based on the summer net dependable rating of a unit as determined in accordance with PJM's Rules and Procedures.
- **Unforced Capacity (UCAP)** value of a unit is the installed capacity rated at summer conditions that is not on average experiencing a forced outage or forced derating.

$$\text{UCAP} = \text{ICAP} \times (1 - \text{EFORd})$$

- **Equivalent Demand Forced Outage Rate (EFORd)** is a measure of the probability of a generating unit will not be available due to forced outages or forced deratings when there is demand on the unit to operate.

UCAP Concept is extended to value load management resources (DR & ILR resources), energy efficiency resources, qualifying transmission upgrades in RPM.

## Installed Reserve Margin (IRM)

- Used to establish level of **installed** capacity resources that will provide acceptable level of reliability

## Forecast Pool Requirement (FPR)

- Used to establish level of **unforced** capacity resources that will provide acceptable level of reliability
- $FPR = (1 + IRM) * (1 - \text{pool-wide avg. EFORd})$

Example: 2015/2016 DY Base Residual Auction

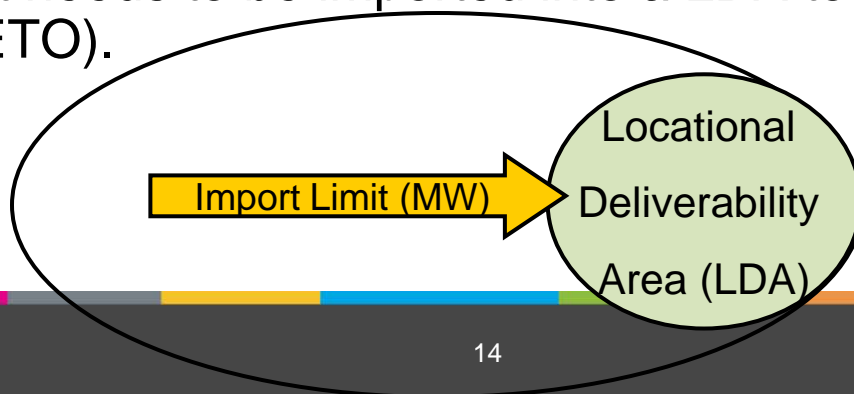
IRM = 15.4%, Forecast Peak Load = 163,168 MW, Pool-wide avg. EFORd = 0.0590

ICAP Requirement = Forecast Peak Load \* (1+ IRM) = 188,295.9 MW

FPR = (1+0.154)\*(1- 0.0590) = 1.0859

UCAP Requirement = Forecast Peak Load \* FPR = 177,184.1 MW

- Locational Constraints are capacity **import capability limitations** that are caused by
  - transmission facility limitations, or
  - voltage limitations.
- PJM determines constrained sub-regions (i.e., locational deliverability areas (LDAs)) and respective LDA Reliability Requirements to be included in RPM Auctions to recognize and quantify the locational value of capacity.
- Constrained Locational Deliverability Areas (LDAs) are determined by comparing the import limit of a LDA (CETL) to the amount of capacity that needs to be imported into a LDA to meet the reliability criterion (CETO).



CETL = Capacity Emergency Transfer Limit

CETO = Capacity Emergency Transfer Objective

RTEPP has currently identified 25 sub-regions as Locational Deliverability Areas (LDAs) for evaluating the locational constraints.

- Regions
  - Western PJM (ComEd, AEP, Dayton, APS, Duquesne, ATSI, Duke)
  - Mid-Atlantic Area Council (MAAC) Region
    - Eastern MAAC (PSE&G, JCP&L, PECO, AE, DPL & RECO)
    - Southwestern MAAC (PEPCO & BG&E)
    - Western MAAC (Penelec, MetEd, PPL)
- Zones
  - AE, AEP, APS, ATSI, BGE, Comed, Dayton, DUQ, Dominion, DPL, Duke, JCPL, MetEd, PECO, Penelec, PEPCO, PPL, PSEG
- Sub-Zones
  - PSEG Northern Region (north of Linden substation)
  - DPL Southern Region (south of Chesapeake and Delaware Channel)

*PJM required to make a filing with FERC before adding a new LDA.*

- An LDA is modeled if:
  - LDA has  $CETL < 1.15 \text{ CETO}$
  - LDA had locational price adder in any of three immediately preceding BRAs
  - LDA is likely to have a locational price adder based on a PJM analysis using historic offer price levels
  - LDA is EMAAC, SWMAAC, and MAAC

An LDA that does not meet the criteria above may be modeled if PJM identifies reliability concerns with LDA.

*LDAs modeled in a Base Residual Auction are modeled in the Incremental Auctions for the Delivery Year.*

CETL = Capacity Emergency Transfer Limit  
CETO = Capacity Emergency Transfer Objective

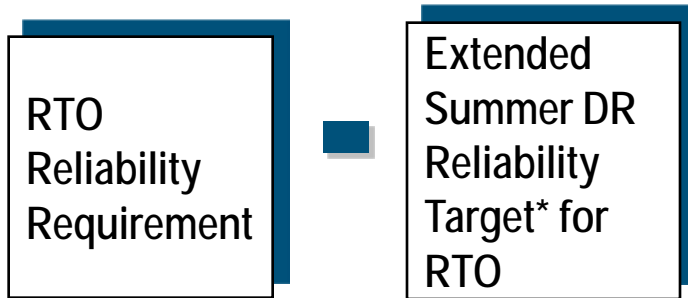
# Criteria to Include Backbone Transmission Upgrades in CETL Study for RPM Auctions

- To be included in BRA, a corporate officer must submit at least 60 days prior to posting BRA planning parameters:
  - Critical path project development schedule
  - Certify that schedule is reasonably achievable
  - Certificates of public convenience and necessity (or equivalent regulatory approval) must have been filed in all jurisdictions that require such certificates
- To be included in IA, project sponsor must provide 60 days before each auction:
  - Updated development schedule certified by corporate officer showing that project remains on schedule
  - Show Right-of-Way (ROW) secured before IA: 50% ROW by linear distance by 1<sup>st</sup> IA, 75% of ROW by 2<sup>nd</sup> IA, 100% of ROW by 3<sup>rd</sup> IA
  - All certificates been issued by responsible regulatory bodies by 2<sup>nd</sup> IA
- PJM or independent third party to audit project development schedule 30 days before each auction to confirm project remains on progress for completion prior to DY

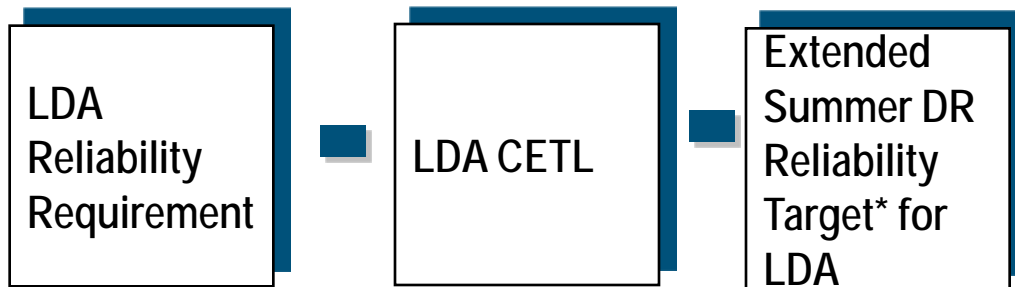
- Limitations of Demand Resources with regards to availability and duration of interruptions are potential Operational Constraints
  - *As the commitment of Limited DR (with 10 interruptions/6 hours per interruption limitations) increases, the commitment of “unlimited resources” decreases, and the need to interrupt Limited DR would increase beyond the tariff limit, and system reliability problems could result.*
- PJM determines Minimum Annual Resource Requirement and Minimum Extended Summer Resource Requirement for RTO and modeled LDAs and includes such requirements in RPM Auctions to recognize and quantify the operational value of capacity resources
- RPM Auction clearing process will select Annual Resources or Extended Summer DR in out-of-merit order if needed to satisfy the minimum requirements

**Minimum Annual Resource Requirement** = Minimum amount of capacity PJM seeks to procure from Annual resources (generation, Annual DR, and energy efficiency resources) located in RTO/LDA

**RTO Minimum Annual Resource Requirement =**



**LDA Minimum Annual Resource Requirement =**



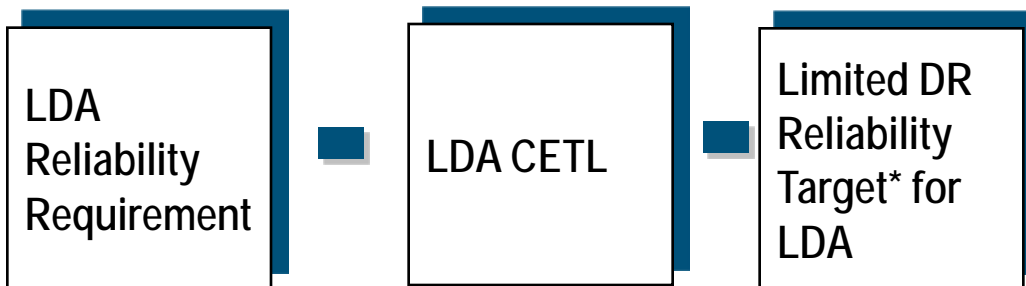
*\*Extended Summer DR Reliability Target = maximum amount of the combination of Extended Summer DR and Limited DR (in UCAP) determined by PJM in accordance with DR Reliability Target Analysis Procedures.*

**Minimum Extended Summer Resource Requirement** = Minimum amount of capacity PJM seeks to procure from Annual resources (generation, Annual DR, and energy efficiency resources) and Extended Summer DR located in RTO/LDA

**RTO Minimum Extended Summer Resource Requirement =**



**LDA Minimum Extended Summer Resource Requirement =**



*\*Limited DR Reliability Target = maximum amount of Limited DR (in UCAP) determined by PJM in accordance with DR Reliability Analysis Procedures.*

- Higher auction clearing prices in the constrained areas provide incentive to:
  - Build new resources (generation, DR, or EE resources) in the constrained region
  - Provide incentive to either not retire a unit, or to re-activate an existing unit that had been mothballed
  - Build new transmission from the unconstrained to the constrained region (increasing the import limit)
- Higher auction clearing prices to Annual Resources or Extended Summer DR (if operational constraint(s) is binding) provide incentive to:
  - Develop and maintain less limited resources (Annual Resources or Extended Summer DR)

3 Years

20 months

10 months

3 months

May

May be scheduled at any time prior to DY

Sept

July

Feb.

June 1

May 31

EFORd Fixed

Delivery Year

Base Residual Auction

Conditional Incremental Auction  
(Effective 12/13 DY)

First Incremental Auction

Second Incremental Auction

Third Incremental Auction

Ongoing Bilateral Market

Activity	Purpose	Cost of Procurement
Base Residual Auction	Procurement of RTO Obligation less an amount reserved for short lead time resources, less FRR Obligation	Allocated to LSEs through Locational Reliability Charge
1 <sup>st</sup> Incremental Auction	Allows for: <ol style="list-style-type: none"> <li>(1) replacement resource procurement</li> <li>(2) increases and decreases in resource commitments due to reliability requirement adjustments; and</li> <li>(3) deferred short-term resource procurement</li> </ol>	Allocated to resource providers that purchased replacement resources and LSEs through Locational Reliability Charge
2 <sup>nd</sup> Incremental Auction		
3 <sup>rd</sup> Incremental Auction		
Conditional Incremental Auction	Procurement of additional capacity in a LDA to address reliability problem that is caused by a significant transmission line delay	Allocated to LSEs through Locational Reliability Charge
Interruptible Load for Reliability (ILR)	ILR Option eliminated starting with 12/13 DY	

- Participation by LSEs for load served in PJM region is mandatory, except for those LSEs that have elected Fixed Resource Requirement (FRR) Alternative
  - PJM procures capacity on behalf of LSEs through RPM Auction
  - LSE is responsible for paying a Locational Reliability Charge
  - May choose to hedge Locational Reliability Charges
- Participants with Non-Zone Load will be included in RPM if the load that is located outside the PJM region is to be served by qualified PJM capacity resources. Such load will be included in the PJM load forecasts.
  - Prior to a BRA for a future Delivery Year, PJM will confirm with existing LSEs that are serving non-zone load that they intend to serve such load in the future Delivery Year.

- An LSE may participate in FRR Alternative and avoid participation in RPM, only if the LSE meets the eligibility requirements of the FRR Alternative as defined in Schedule 8.1 of the Reliability Assurance Agreement
- Written notification of LSE's election of the FRR Alternative is required
- Submittal of an FRR Capacity Plan through eRPM system is required
- Election of FRR Alternative for an FRR Service Area is for a minimum term of five consecutive Delivery Years.

- Participation is mandatory for resource providers with:

- available unforced capacity from **existing generation** located within the PJM market footprint; or
- bilateral contracts for available unit-specific capacity resources that are **existing generation** located within the PJM market footprint.

*Exceptions for resource providers that are FRR Entities.*

*Generation is treated as existing when the generation is (a) in service at commencement of RPM Auction or (b) not yet in service but has cleared an RPM Auction for any prior Delivery Year.*

All participation by resource providers is subject to the market power mitigation rules described in Attachment DD, Section 6 of PJM Open Access Transmission Tariff.

- Participation is voluntary for resource providers with:
  - External generation;
  - Planned generation (includes new units and upgrades to existing unit not yet in service that have not cleared at an unmitigated price in a prior Delivery Year);
  - Existing demand resources;
  - Planned demand resources;
  - Energy Efficiency resources;
  - Qualifying Transmission Upgrades.

Home > Markets & Operations > Reliability Pricing Model > RPM Auction User Information

## RPM Auction User Information

The Reliability Pricing Model (RPM) is comprised of one base residual auction and up to three incremental auctions per delivery year (June 1 - May 31). The information on this page presents general information as it pertains to each delivery year, including modeling information, planning parameters, and summary auction results.

Participant-level information may be accessed via the eRPM system.

[Login](#)

eRPM application information is available on the [eRPM eTools Web page](#).

	Posting Date
<a href="#">Implementation of Peak Hour Period Availability (PHPA) Enhancement</a> (PDF)	08.23.2010
<a href="#">06.01.2010 Transition from Non-Unit Specific Transactions</a> (PDF)	05.20.2010
<a href="#">RPM Offers and Commitments by Fuel Type</a> (XLS)	04.16.2010
<a href="#">DPL and PSEG Subzonal LDAs by ZIP Code</a> (XLS)	
<a href="#">Planned Demand Resource RPM Auction Participation Information</a>	
<a href="#">Peak Hour Period Availability Charge and Credit FAQ</a> (PDF)	
<a href="#">RPM Base Residual Auction FAQs</a> (PDF)	
<a href="#">RPM Incremental Auction FAQs</a> (PDF)	
<a href="#">RPM Pricing Point Definitions</a> (PDF)	
<a href="#">RPM Brattle Report</a> (PDF)	
<a href="#">RPM Schedule</a> (XLS)	07.27.2010
<a href="#">Key Expected Transmission Upgrades</a> (XLS)	02.15.2007

**RELATED INFORMATION**

- [Reliability Pricing Model FAQs](#)
- [Manuals](#)
- [Industry Resources](#)
- [eTools](#)

**RECENT DOCUMENTS**

- AUG 12** [eRPM User Guide](#) 2010 Posted 74 days ago [PDF](#)

**CONTACT INFORMATION**

For additional information, please contact the RPM Team at 1-800-440-6666.

RPM Schedule of Activities is posted on the RPM Auction User Information Web Page.

# Questions?

# Reliability Pricing Model Demand in RPM

RPM Training – Section B  
February 2012

- Variable Resource Requirement Curve
  - What is VRR Curve?
  - Use of VRR Curve
  - Posting of VRR Curve

The Variable Resource Requirement (VRR) Curve is a downward sloping demand curve that relates the maximum price for a given level of capacity resource commitment relative to reliability requirements.

- The price is higher when the resources are less than the reliability requirement and lower when the resources are in excess.
- VRR Curves are defined for the PJM RTO and for each constrained Locational Deliverability Area (LDA) modeled within the PJM region.

- VRR Curve is an input into the clearing of the Base Residual Auction only.
- A PJM Buy Bid based on an Updated VRR Curve Increment may be incorporated into the Demand Curve for an Incremental Auction.
- A PJM Sell Offer based on an Updated VRR Curve Decrement may be incorporated into the Supply Curve for an Incremental Auction.

- VRR Curve is determined prior to the Base Residual Auction
- Curve parameters are posted by February 1<sup>st</sup> prior to the Base Residual Auction
- Posted curve parameters may be adjusted prior to the BRA to account for entities that have elected the FRR Alternative
- Updated VRR Curve is determined and posted one month prior to an Incremental Auction

- Updated load forecast, IRM/FPR, and DR Factor.
- Updated RTO Reliability Requirement due to load forecast and FPR changes.
- Updated LDA Reliability Requirements due to changes in CETO values.
- Updated LDA CETL values considering changes in Backbone Transmission Upgrades included (see the criteria specified for each auction - Attachment DD – Sec. 5-11A).
- Updated RTO/LDA Minimum Annual Resource Requirements and Minimum Extended Summer Resource Requirements (starting 2014/2015 DY)
- RTO and LDA Short-Term Resource Procurement Target Applicable Share to be procured in the Incremental Auction.
- Updated VRR Curves
- For RTO and LDA, total amounts to be purchased/sold using PJM Buy Bids/Sell Offers. The (MW, Price) points for the PJM Buy Bids/Sell Offers.

Planning Parameters will be posted no later than one month prior to each Incremental Auction.

Delivery Year

- 2007/2008
- 2008/2009
- 2009/2010
- 2010/2011
- 2011/2012
- 2012/2013

	Posting Date
<a href="#">2012/2013 First Incremental Auction Report (PDF)</a>	09.24.2010
<a href="#">2012/2013 First Incremental Auction Results (XLS)</a>	09.24.2010
<a href="#">2012/2013 1st Incremental Auction Planning Parameters (XLS)</a>	10.18.2010
<a href="#">2012/2013 RPM Pricing Points (XLS)</a>	05.14.2010
<a href="#">ATSI FRR Integration Auctions Results (PDF)</a>	03.26.2010
<a href="#">ATSI Zone FRR Preliminary UCAP Obligations for 11/12 &amp; 12/13 DYs (XLS)</a>	12.31.2009
<a href="#">2012/2013 BRA Mitigated Supply Breakdown (PDF)</a>	05.29.2009
<a href="#">2012/2013 BRA Clearing Price Map (PDF)</a>	05.27.2009
<a href="#">2012/2013 Base Residual Auction Report Document (PDF)</a>	05.15.2009
<a href="#">2012/2013 Base Residual Auction Results Document (XLS)</a>	05.15.2009
<a href="#">Key Expected Transmission Upgrades (XLS)</a>	02.20.2009
<a href="#">Planned Demand Resource RPM Auction Participation Information (PDF)</a>	02.13.2009
<a href="#">Net E&amp;AS Offset for 2012/2013 Net CONE Calculations (PDF)</a>	02.13.2009
<a href="#">2012/2013 Net CONE Calculation (XLS)</a>	04.09.2009
<a href="#">Communication to Members RPM BRA Deadlines (PDF)</a>	01.30.2009
<a href="#">RPM Planning Parameters (XLS)</a>	05.22.2009
<a href="#">RPM Resource Model (XLS)</a>	02.13.2009
<a href="#">Preliminary Market Structure Screen Results - 2012/2013 Auction (XLS)</a>	02.03.2009

2013/2014

Market Trials and Simulations

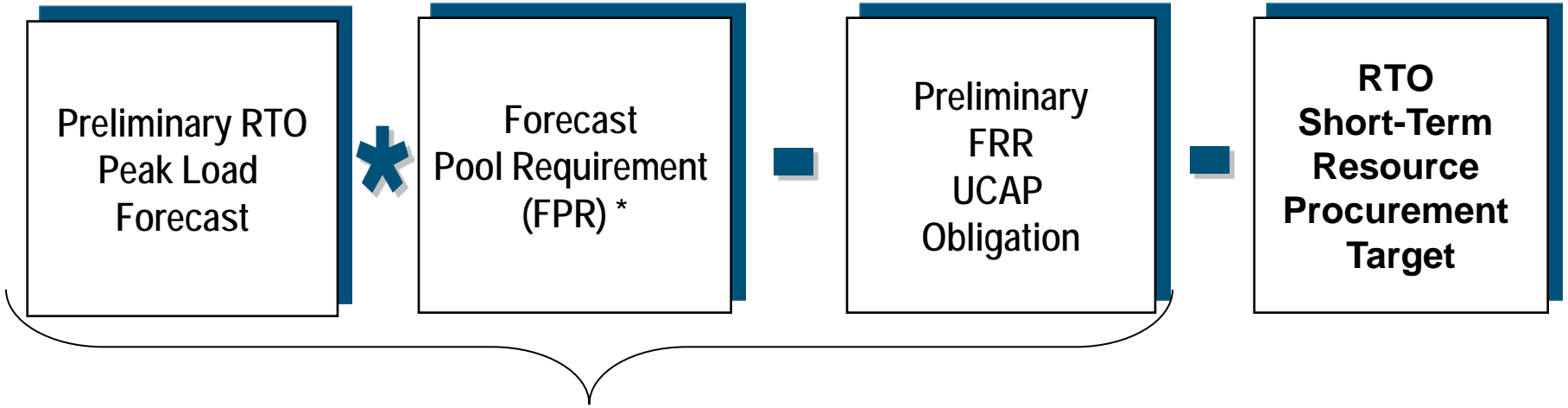
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Effective 12/13 DY,  
Planning Parameters  
posted by Delivery Year  
and Auction on RPM  
Auction User Information  
web page.

The VRR Curve is based on:

- Target level of capacity
- Cost of New Entry
- Net Energy and Ancillary Services (E&AS) Offset

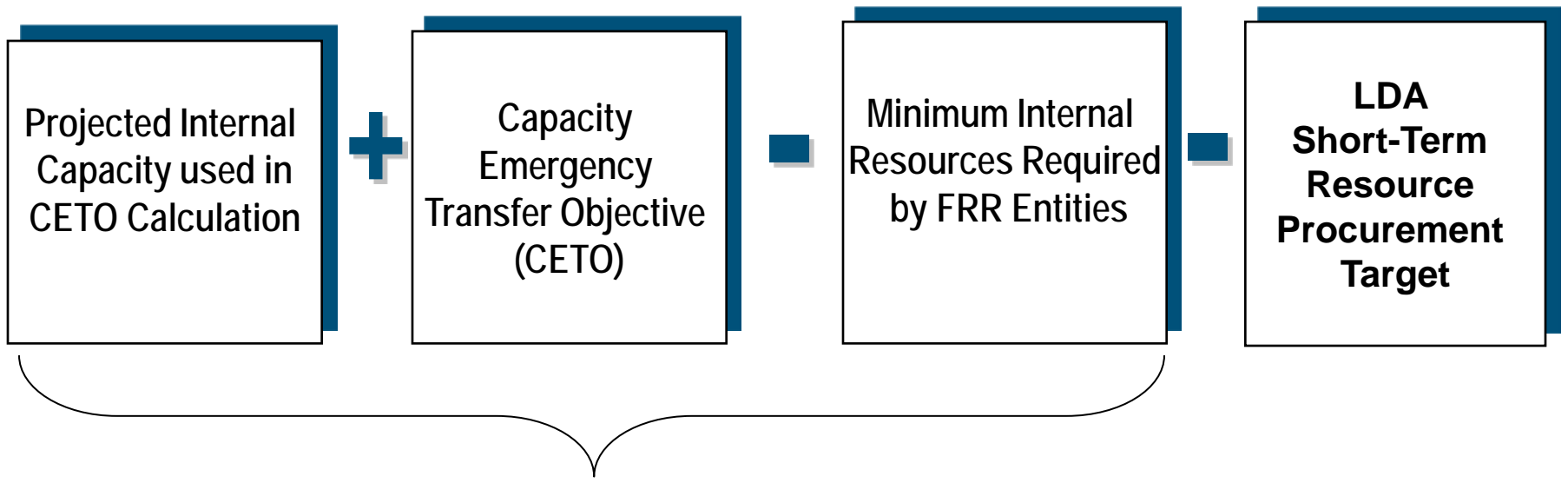
- The **PJM RTO Target Level** is determined as PJM Region Reliability Requirement less RTO Short-Term Resource Procurement Target



***PJM Region Reliability Requirement***

\*  $FPR = (1 + IRM) * (1 - \text{Pool-wide Avg. EFORD})$

- Individual **LDA Target Level** is determined as LDA Reliability Requirement less LDA Short-Term Resource Procurement Target



***LDA Reliability Requirement***

- Short Term Resource Procurement Target (STRPT) for an RPM Auction represents the amount of resources to be reserved for procurement in a future Incremental Auction.

RPM Auction	RTO Short Term Resource Procurement Target
Base Residual Auction	2.5% of RTO BRA Reliability Requirement
1 <sup>st</sup> Incremental Auction	2% of RTO BRA Reliability Requirement
2 <sup>nd</sup> Incremental Auction	1.5% of RTO BRA Reliability Requirement
3 <sup>rd</sup> Incremental Auction or Conditional Incremental Auction	Not Applicable

- The RTO quantities in all auctions are allocated to zones pro rata based on Preliminary Zonal Peak Load Forecasts (reduced by load served under FRR Alternative).
- LDA Short Term Resource Procurement Target is the sum of zonal allocations of all zones in the LDA.

## Short Term Resource Procurement Target Applicable Share

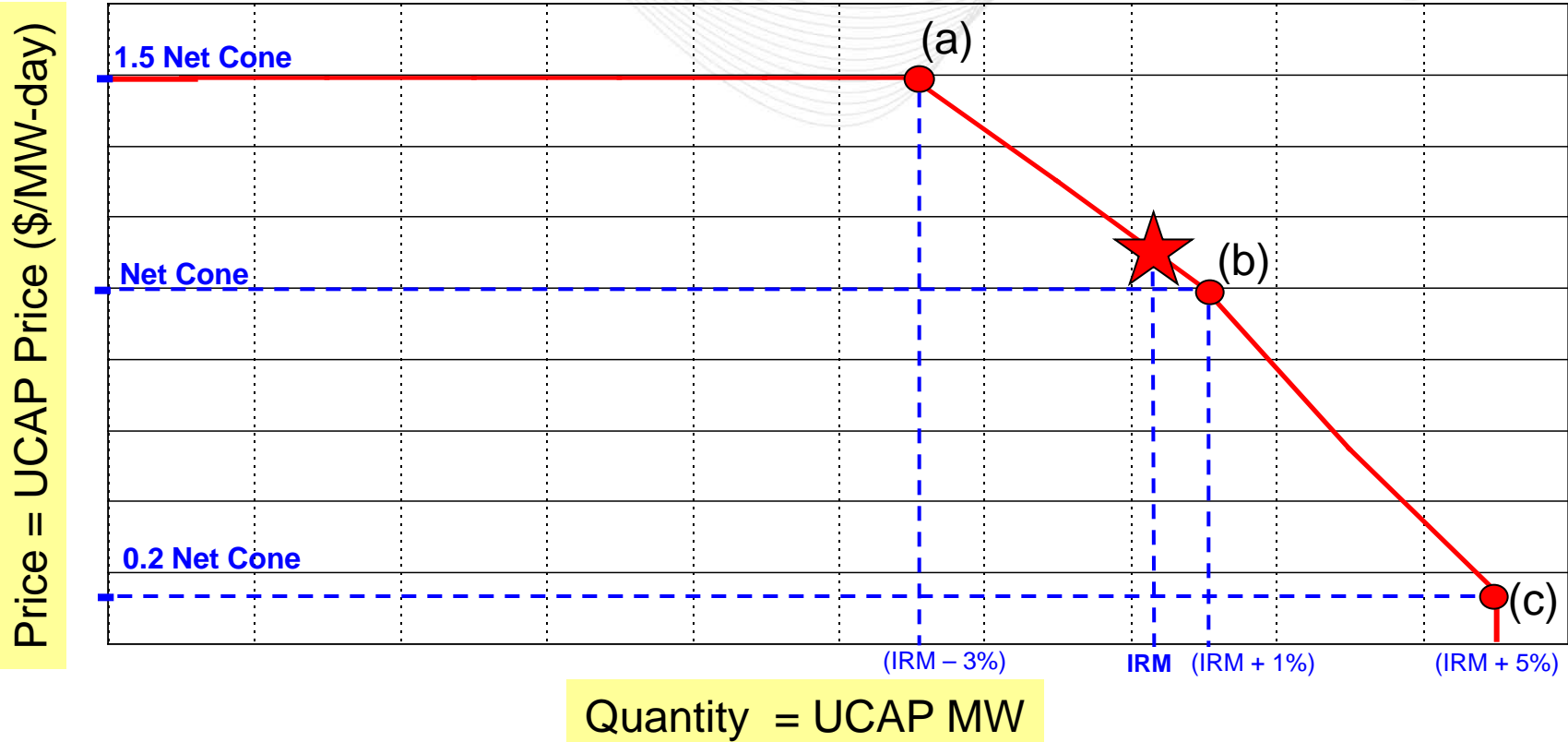
- Short Term Resource Procurement Target Applicable Share for an Incremental Auction represents the targeted amount of short term resources to be procured by PJM in an Incremental Auction.

Incremental Auction	RTO STRPT Applicable Share	LDA STRPT Applicable Share
1 <sup>st</sup> Incremental Auction	0.2 * RTO BRA STRPT	0.2* LDA BRA STRPT
2 <sup>nd</sup> Incremental Auction	0.2 * RTO BRA STRPT	0.2 * LDA BRA STRPT
3 <sup>rd</sup> Incremental Auction	0.6 * RTO BRA STRPT	0.6 * LDA BRA STRPT
Conditional Incremental Auction	Not Applicable	Not Applicable

# 2015/2016 Short Term Resource Procurement Target & Applicable Share

	<b>BRA</b>	<b>First Incremental Auction</b>	<b>Second Incremental Auction</b>	<b>Third Incremental Auction</b>
Target Percent	2.5%	2.0%	1.5%	0
Target, MW	4,405.1	3,524.1	2,643.1	0
Applicable Share, Percent of BRA Target	0	0.2	0.2	0.6
Applicable Share, MW	0	881.0	881.0	2,643.1

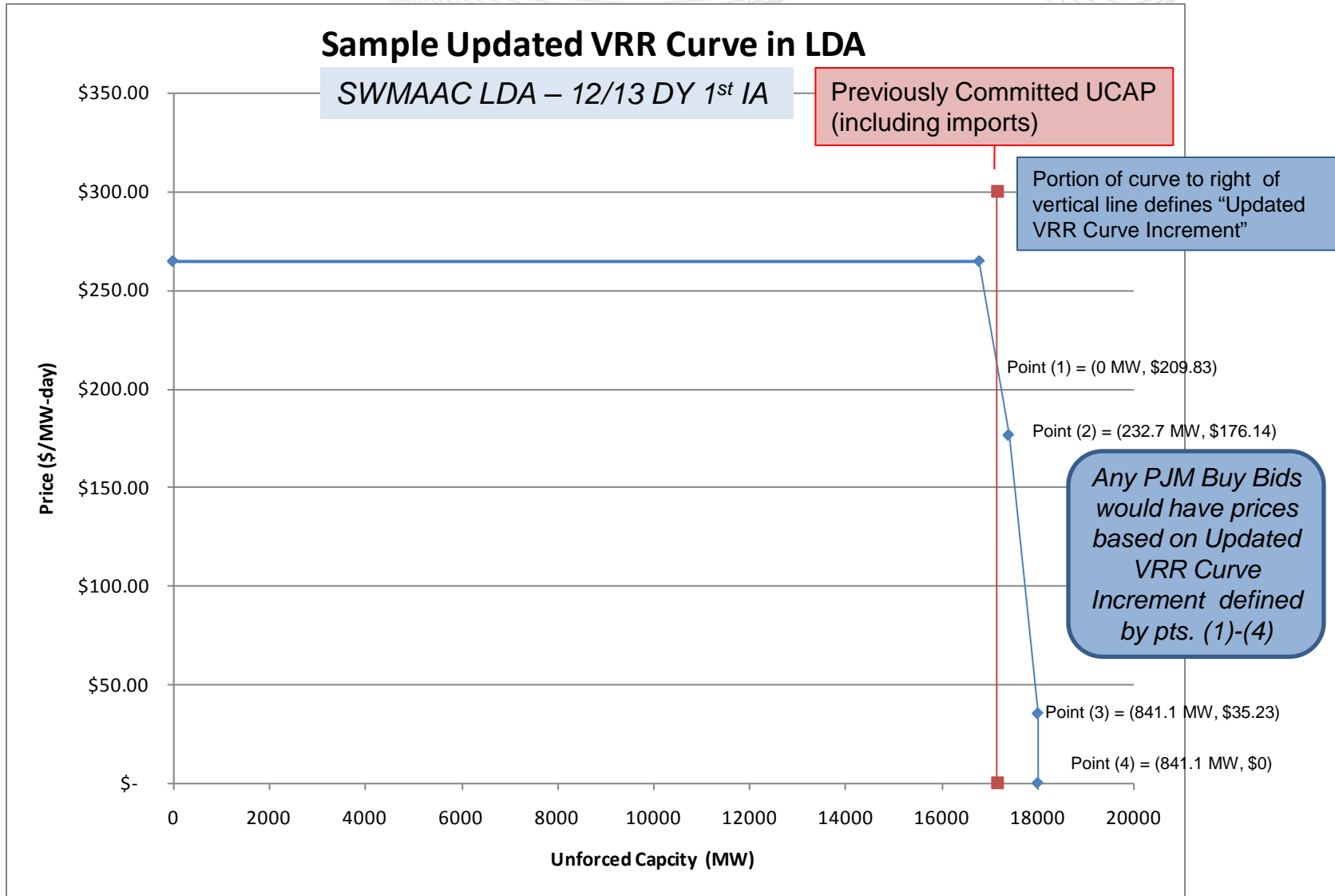
Target % is the percentage of BRA Reliability Requirement of 176,204.2 MW.  
Applicable Share is the fraction of BRA Target of 4,405.1 MW.



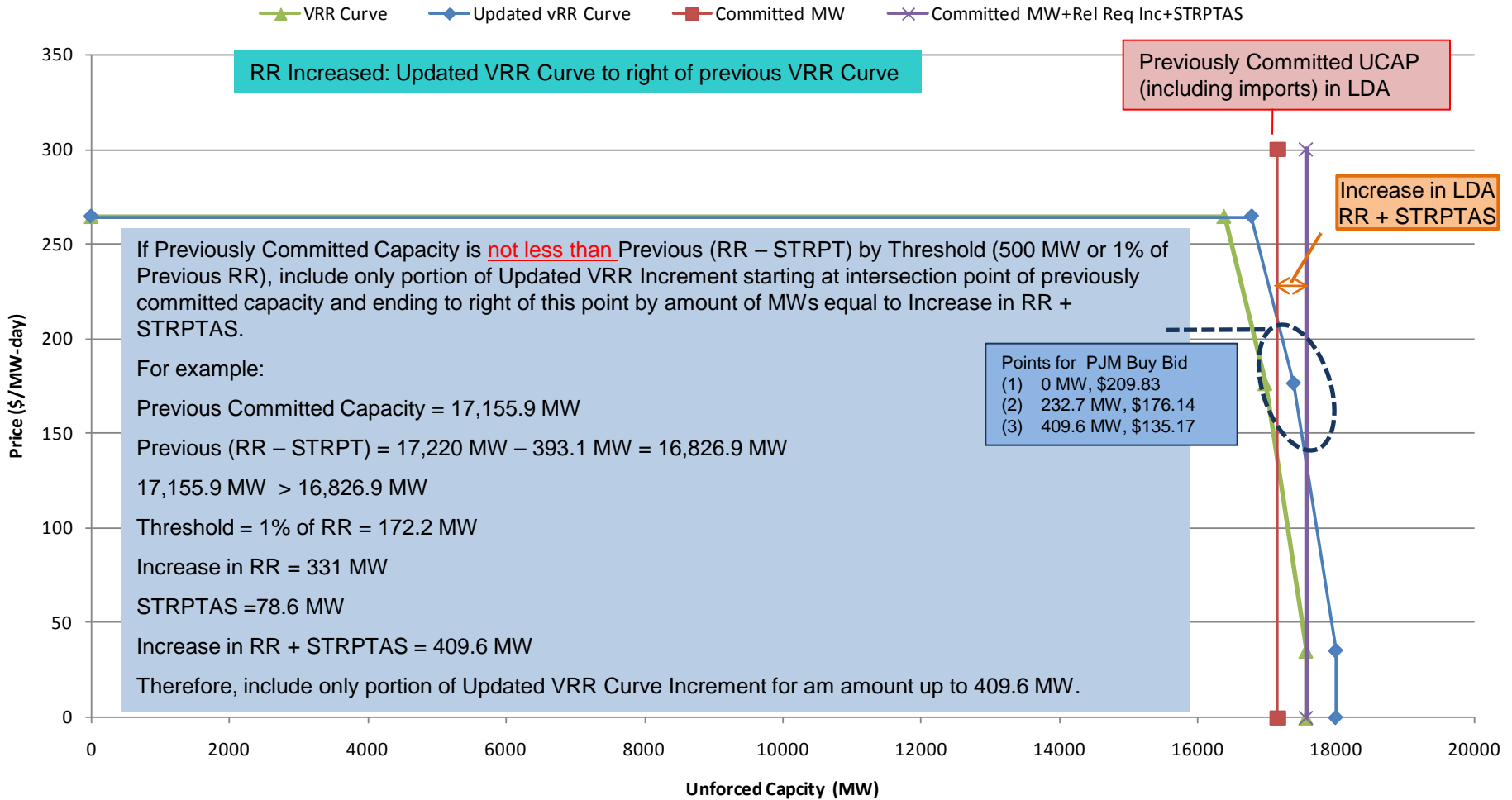
A VRR Curve is defined for the PJM Region.  
 Individual VRR Curves are defined for each Constrained LDA.

- Demand curve(s) are defined in advance of a Base Residual Auction based on Variable Resource Requirement curve concept.
- Demand curve(s) for 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> Incremental Auctions are built based on locational buy bids that are submitted by participants and any buy bids that are submitted by PJM.
- Demand curve(s) for Conditional Incremental Auction are built based on buy bid that is submitted by PJM.
- PJM Buy Bids are defined in advance of a Scheduled or Conditional Incremental Auction.

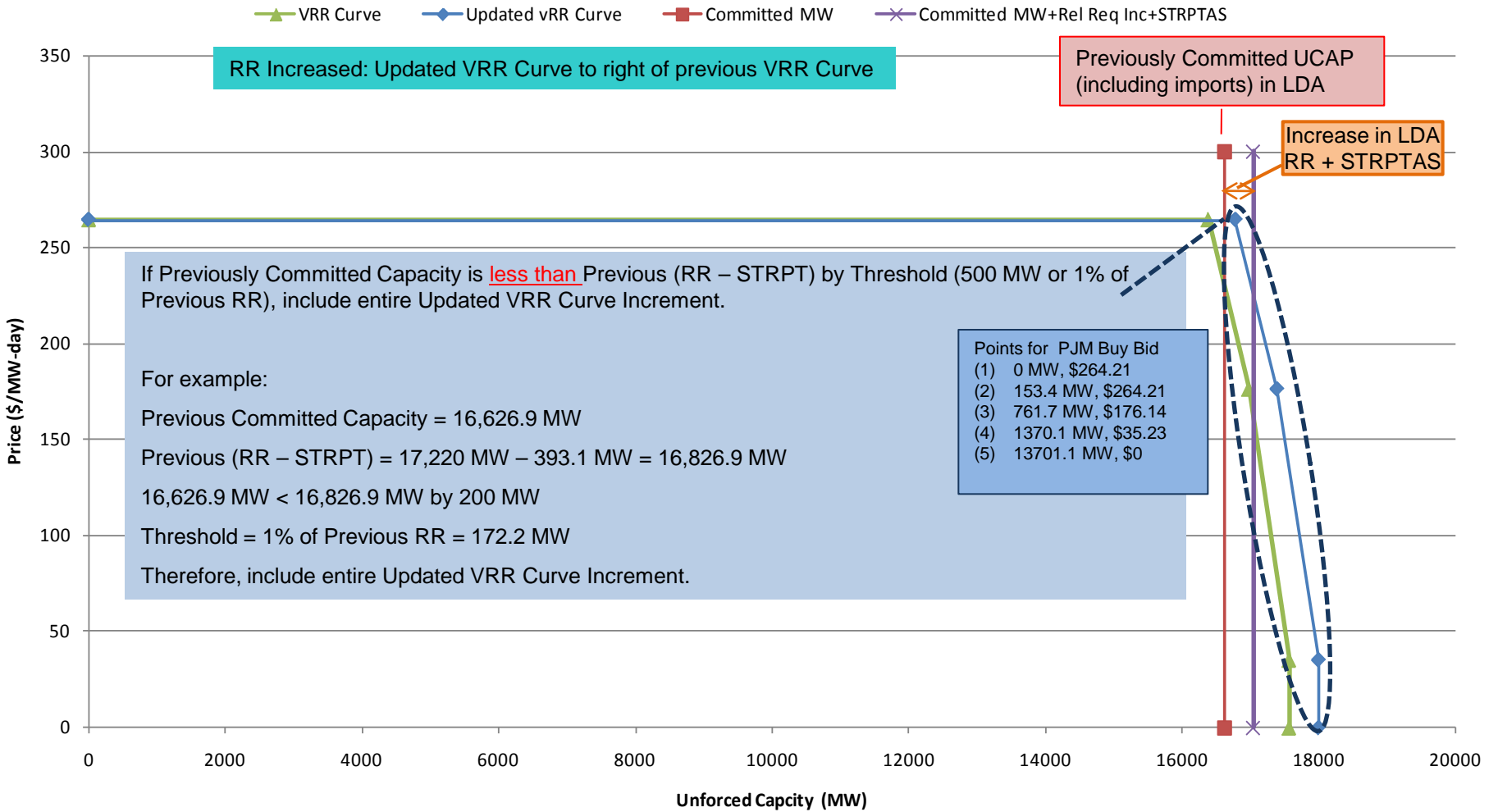
- PJM Buy Bids in an Incremental Auction may be due to:
  - Increase in RTO/LDA Reliability Requirement (RR) beyond a threshold (500 MW or 1% of prior RR). Threshold does not apply for 3<sup>rd</sup> IA.
    - If parent LDA meets threshold, an increase in the child LDA RR will be reflected even if the child LDA does not meet the threshold.
  - Short-Term Resource Procurement Target (STRPT) Applicable Share (i.e., deferred short-term resource procurement)
  - Inclusion of entire uncleared portion of the updated VRR Curve (i.e., entire Updated VRR Curve Increment) if prior auction's (RTO/LDA RR – STRPT) exceeds total capacity committed in all prior auction's by the threshold
- The determination of the PJM Buy Bid quantity in scheduled IA also considers the uncleared PJM Buy Bids/Sell Offers from prior IA
- PJM Buy Bid prices based on Updated VRR Curve Increment
- PJM Buy Bids are defined in advance of the Incremental Auction



## VRR Curve and Updated VRR Curve in LDA

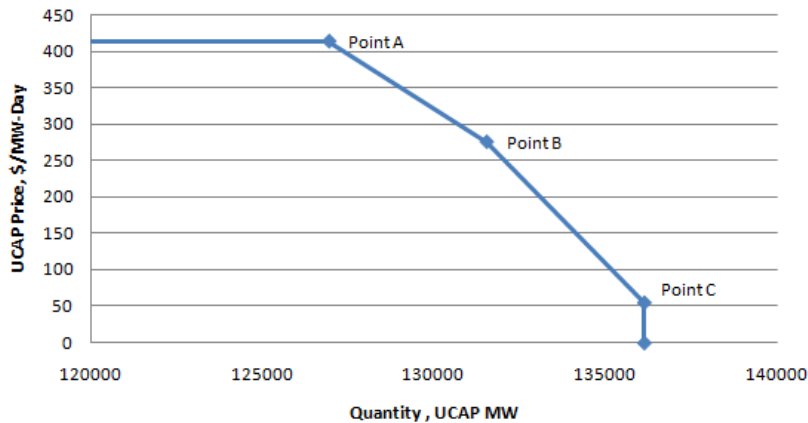


## VRR Curve and Updated VRR Curve in LDA

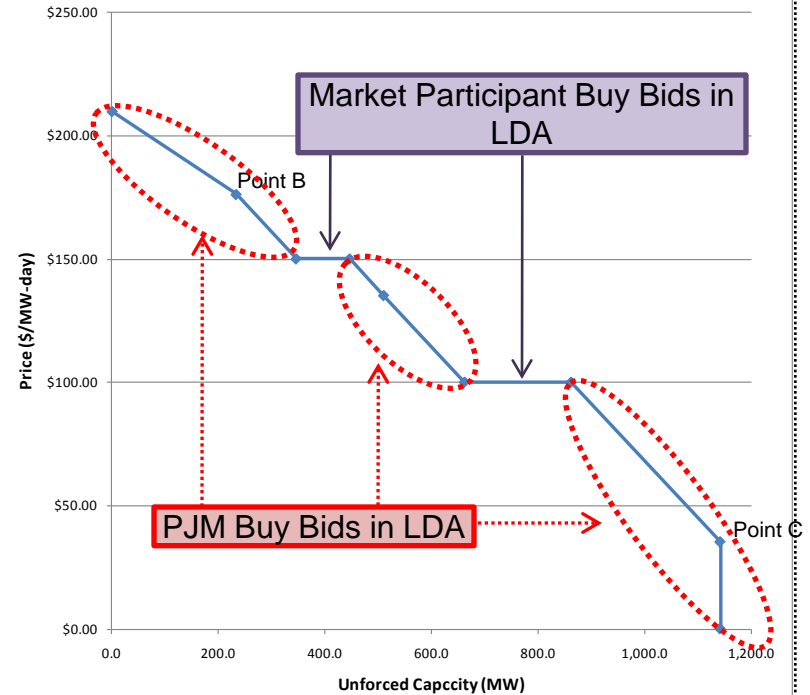


## Demand Curve in BRA

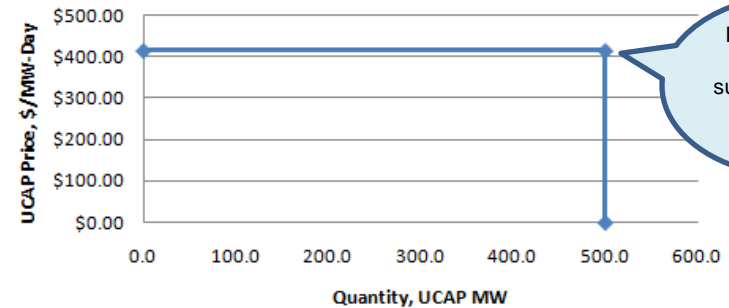
**PJM Variable Resource Requirement Curve with FRR Adjustment 2012/2013**



**Sample Incremental Auction Demand Curve**



**Sample Conditional Auction Demand Curve**



PJM Buy Bid in Conditional IA submitted at price equal to 1.5 NCONE

- Conditional Incremental Auctions may be held if the in service date of a backbone transmission upgrade that was modeled in the Base Residual Auction is announced as delayed by Office of the Interconnection beyond July 1 of the Delivery Year for which it was modeled and the delay causes reliability criteria violation.
- If conducted, the demand curve will be a single buy bid entered by PJM for the required MWs at 1.5 times the Net CONE in the LDA with the reliability criteria violation.
- PJM will seek to procure any remaining capacity amount not procured in Conditional Incremental Auction in the next scheduled Incremental Auction.

- ✓ BRA VRR Curve(s) posted by Feb. 1 prior to BRA
- ✓ VRR Curve(s) used in BRA
- ✓ VRR Curve(s) may be reposted prior to BRA due to LSEs electing FRR Alternative
- ✓ Updated VRR Curve(s) posted one month prior to IA
- ✓ Updated VRR Curve Increment used to develop PJM Buy Bids for Incremental Auctions
- ✓ Demand Curve(s) in 1<sup>st</sup>, 2<sup>nd</sup>, & 3<sup>rd</sup> IAs are developed based on locational buy bids submitted by participants and PJM
- ✓ Demand Curve in Conditional Incremental Auction based on locational buy bid submitted by PJM

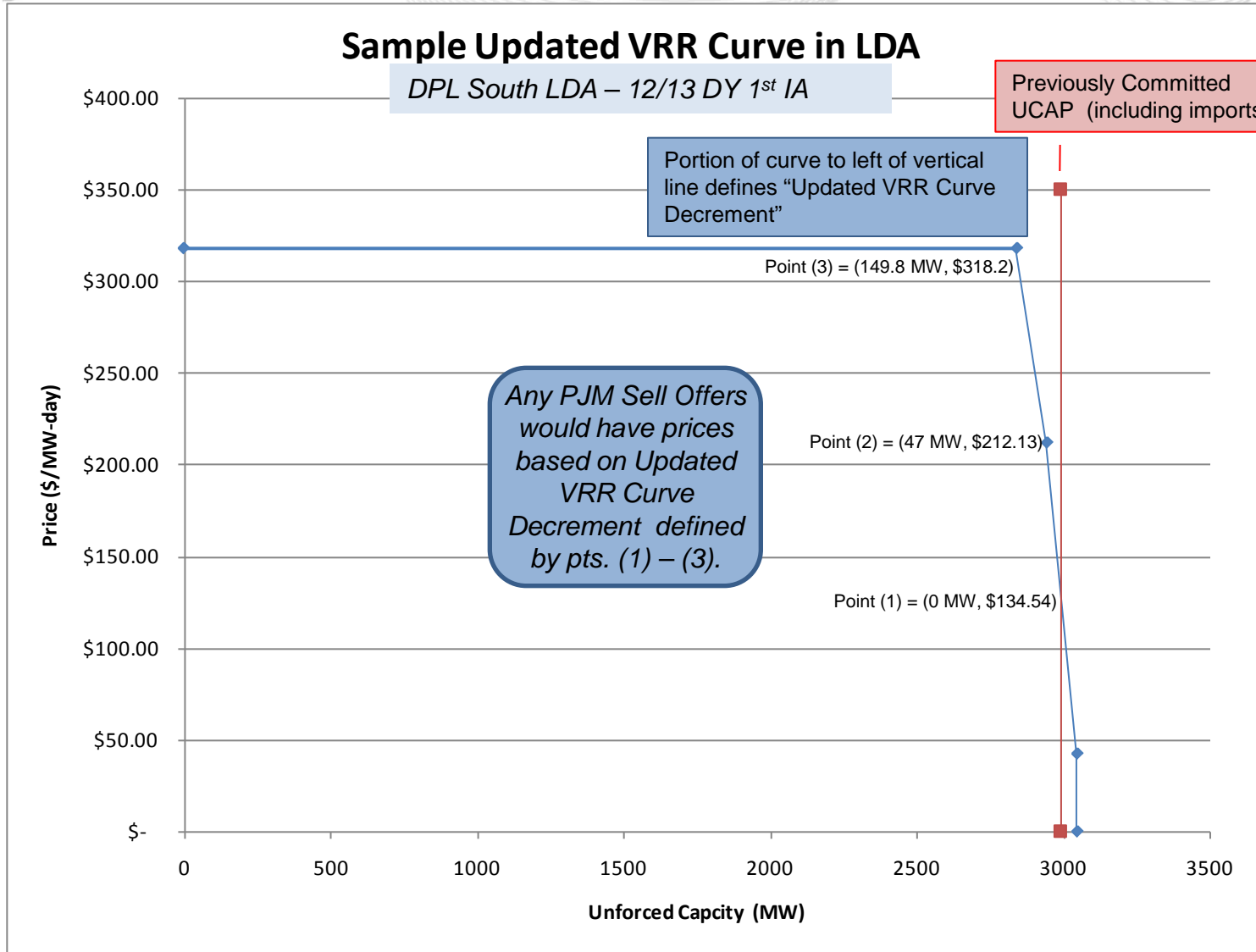
# Questions?

# Reliability Pricing Model Supply in RPM

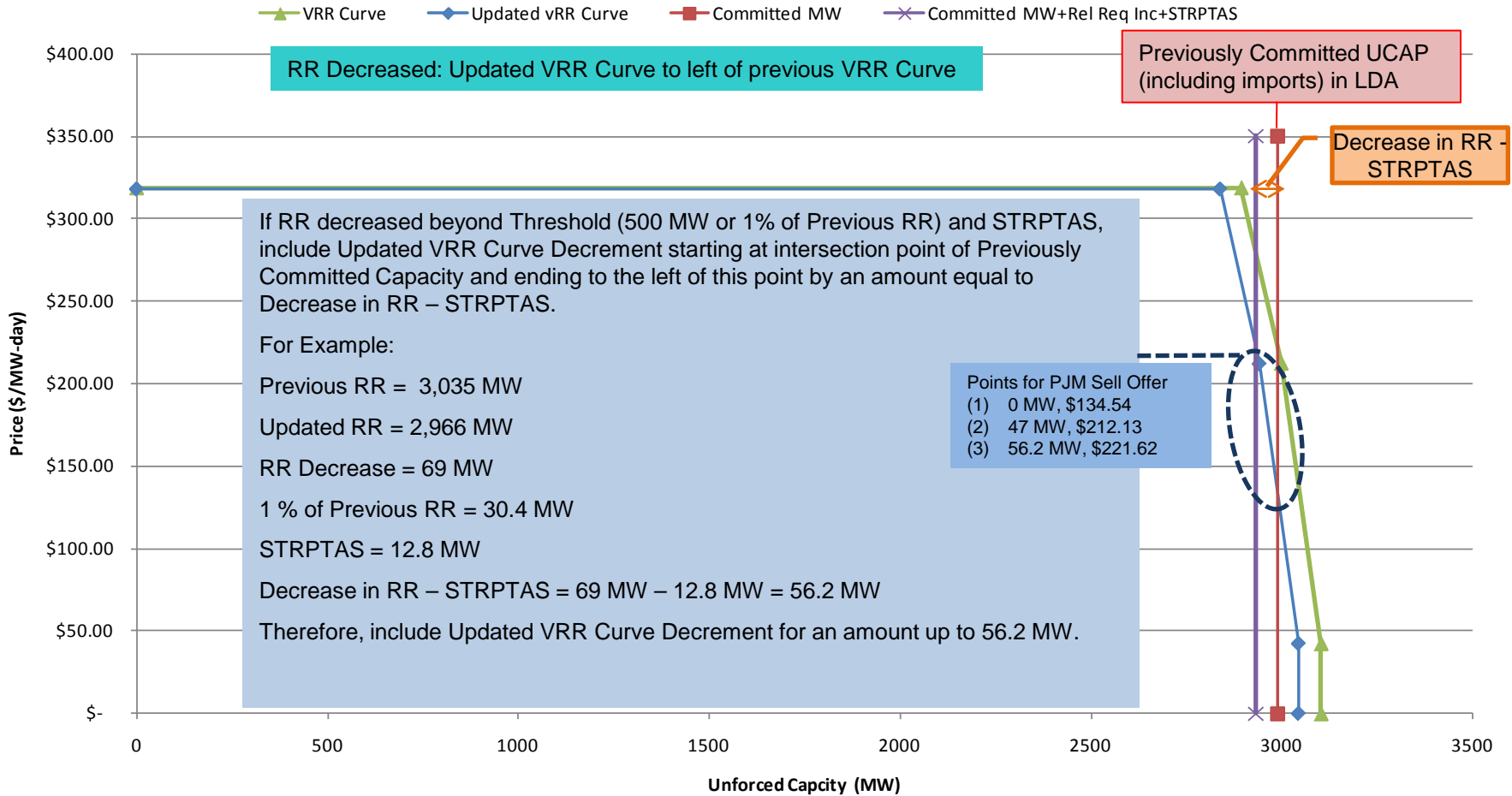
RPM Training – Section C  
February 2012

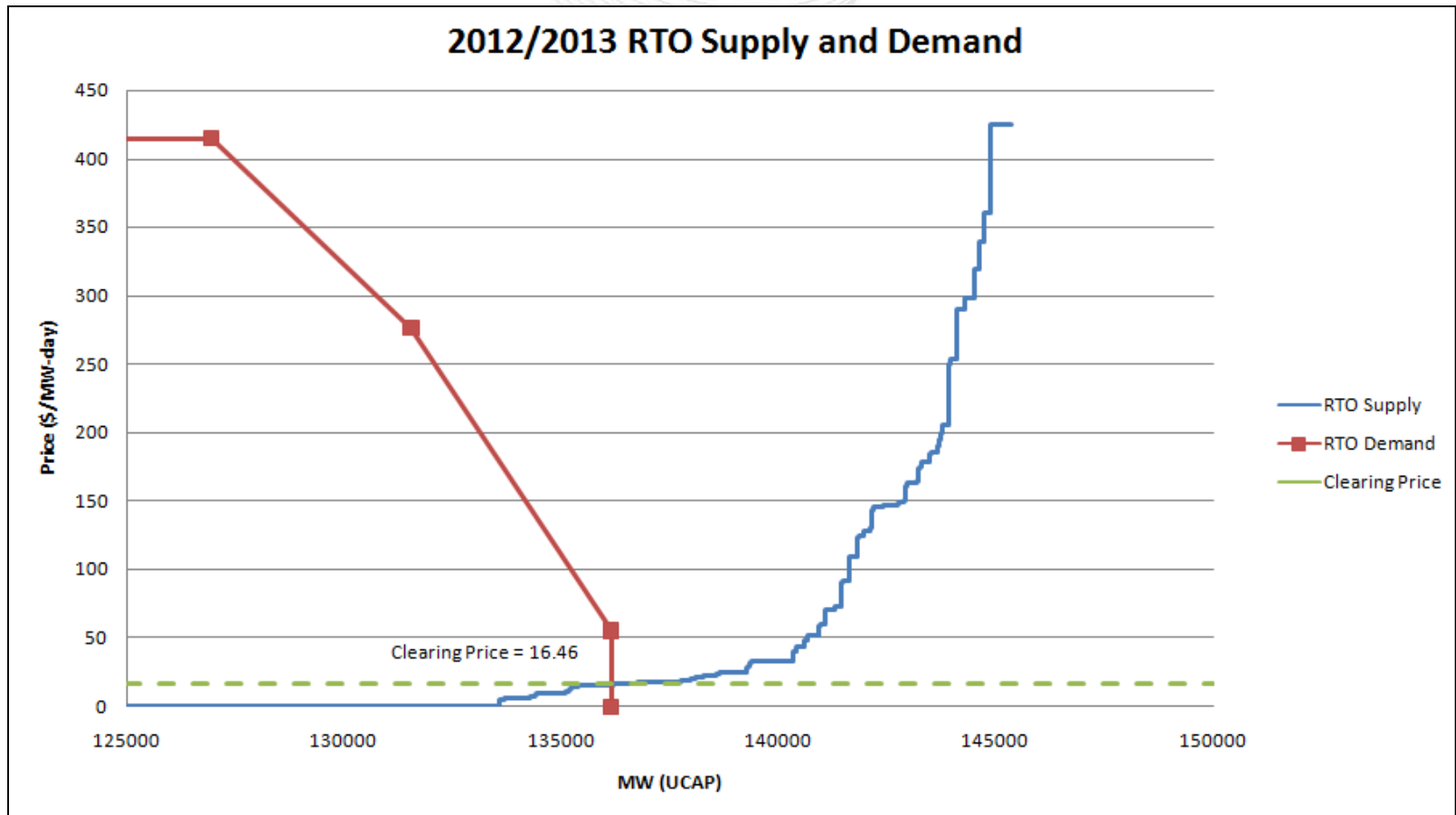
- Supply of unforced capacity is procured to meet the demand as a function of the clearing of RPM Auctions.
- Supply curve is defined based on the resource-specific offers submitted by providers
  - Supply curve for Incremental Auctions may include locational non-unit specific sell offers submitted by PJM to release commitments
- Supply that is procured in the RPM multi-auction clearing ensures that sufficient resources are committed to meet the reliability requirements.

- PJM Sell Offers in an Incremental Auction to release commitments may be due to:
  - Decrease in RTO/LDA Reliability Requirement(s) beyond the threshold and RTO/LDA Short Term Resource Procurement Applicable Share
  - Need to release commitments in the parent LDA of an LDA with a reliability violation in the Scheduled IA that occurs after a Conditional IA.
- The determination of the PJM Sell Offer quantity in scheduled IA also considers uncleared PJM Buy Bid/Sell Offer from prior IA
- PJM Sell Offer prices based on Updated VRR Curve Decrement
- PJM Sell Offers are defined in advance of Incremental Auction



## VRR Curve and Updated VRR Curve in LDA





In RPM, **Resources** are =

Generation  
Resources

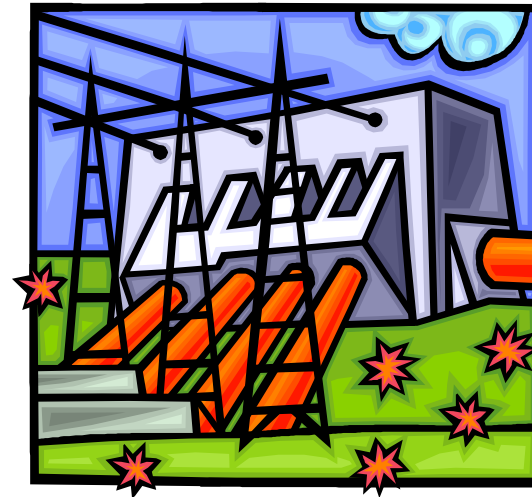
Demand  
Resources  
(DR)

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

Qualifying  
Transmission  
Upgrades  
(QTU)

In RPM, **Generation Resources** can be:

- ✓ Internal or External
- ✓ Existing or Planned





# Qualifications for Offering Generation Resources

Qualification	Existing Internal	Existing External	Planned Internal (includes upgrades to existing units)	Planned External (includes upgrades to existing units)
<p>Deliverability</p>	<p>Pre-certified by PJM as meeting generation deliverability test.</p>	<p>Indication of intended ATC path to deliver external capacity is provided at time of offer.</p> <p>Firm transmission service from unit to border of PJM needs to be obtained by start of DY.</p> <p>Deliverability demonstrated prior to start of DY by either (1) obtaining firm PTP transmission service on PJM OASIS from border into PJM; or (2) obtaining "Network External Designated" transmission. Either option (1) or (2) may require transmission upgrades to be completed prior to June 1<sup>st</sup> of DY.</p>	<p>Unit is participating in RTEPP.</p> <p>Start date of Interconnection Service is on or before start of DY.</p> <p>Impact Study Agreement has been executed for unit to participate in BRA.</p> <p>Interconnection Service Agreement (ISA) executed for unit to participate in IA.</p>	<p>Same deliverability requirements as "Existing External" generation.</p> <p>Start date of Interconnection Service is on or before start of DY.</p> <p>Functionally equivalent System Impact Study Agreement has been executed with applicable TO/TP for unit to participate in BRA.</p> <p>Functionally equivalent Interconnection Service Agreement (ISA) executed for unit to participate in IA.</p>



# Qualifications for Offering Generation Resources (Cont'd)

Qualification	Existing Internal	Existing External	Planned Internal (includes upgrades to existing units)	Planned External (includes upgrades to existing units)
Letter of Non-recallability	NA	X	NA	X
Unit resides in eRPM resource portfolio of a signatory of PJM Operating Agreement	Accomplished through a "Approved" CAP MOD or unit-specific bilateral transaction.	Accomplished through a "Provisionally Approved" unit-specific transaction with "External Party" as Seller. ("Approved" status granted when all generation deliverability requirements satisfied.)	Accomplished through a "Provisionally Approved" CAP MOD. ("Approved" status granted once unit or upgrade is commercial.)	Same requirements as "Existing External" generation.
Relevant portion of unit not specified in FRR Capacity Plan for DY.	X	X	X	X
Historical NERC/GADS unit performance data is provided in PJM format	PJM already has data in eGADs to establish EFORD & EFORD-5 yr.	5 years of historical data is requested.	Class average data or 5 yrs of historical data (if upgrade) will be used to establish EFORD & EFORD-5 yr.	Class average data or 5 yrs of historical data (if upgrade) will be used to establish EFORD & EFORD-5 yr.
Applicable Credit has been posted with PJM.	NA	Only required if deliverability requirements have not been met yet.	X	X

# Qualifications for Offering Generation Resources (Cont'd)

Qualification	Existing Internal	Existing External	Planned Internal (includes upgrades to existing units)	Planned External (includes upgrades to existing units)
Operating and maintenance information submitted in eDART and eGADs.	X	X	X (once operational)	X (once operational)
Owner/operator performs summer and winter net capability tests.	X	X	X (once operational)	X (once operational)
Communication path is established between PJM dispatchers and unit operator.	X	X	X (once operational)	X (once operational)

# Questions?

Delivery Year	Resource Type Options	Product Type Options	Program Type Options
2012/2013 DY – 2013/2014 DY	<input type="checkbox"/> Demand Resources <ul style="list-style-type: none"> <li>• <i>Existing or Planned</i></li> </ul>	<input type="checkbox"/> Limited DR	<input type="checkbox"/> Direct Load Control (DLC) <input type="checkbox"/> Firm Service Level (FSL) <input type="checkbox"/> Guaranteed Load Drop (GLD)
Effective 2014/2015 DY	<input type="checkbox"/> Demand Resources <ul style="list-style-type: none"> <li>• <i>Existing or Planned</i></li> </ul>	<input type="checkbox"/> Limited DR <input type="checkbox"/> Extended Summer DR <input type="checkbox"/> Annual DR	<input type="checkbox"/> Direct Load Control (DLC) <input type="checkbox"/> Firm Service Level (FSL) <input type="checkbox"/> Guaranteed Load Drop (GLD)

Requirement	Limited DR	Extended Summer DR	Annual DR
Availability	Any weekday, other than NERC holidays, during June – Sept. period of DY	Any day during June-October period and following May of DY	Any day during DY (unless on an approved maintenance outage during Oct. - April)
Maximum Number of Interruptions	10 interruptions	Unlimited	Unlimited
Hours of Day Required to Respond <i>(Hours in EPT)</i>	12:00 PM – 8:00 PM	10:00 AM – 10:00 PM	Jun – Oct. and following May: 10 AM – 10 PM Nov. – April: 6 AM- 9 PM
Maximum Duration of Interruption	6 Hours	10 Hours	10 Hours
Notification	Must be able to reduce load when requested by PJM All Call system within 2 hours of notification, without additional approvals required		
Registration in eLRS	Must register sites in Emergency Load Response Program in Load Response System (eLRS)		
Compliance	Must provide customer-specific compliance and verification information with 45 days after the end of month in which PJM-initiated LM event occurred.		

## **PJM recognizes three types of LM Programs:**

- Direct Load Control (DLC) – Load management which is initiated directly by the LSE's market operations center, employing a communication signal to cycle equipment
- Firm Service Level (FSL) – Load management achieved by a customer reducing its load **to** a pre-determined level (the Firm Service Level), upon notification from the LSE's market operations center
- Guaranteed Load Drop (GLD) - Load management achieved by a customer reducing its load **by** a pre-determined amount (the guaranteed load drop), upon notification from the LSE's market operations center

- Behind the Meter Generation may offer into the Base Residual Auction or Incremental Auctions as a Demand Resource.
- If the DR offer clears in any of the auctions, the Behind the Meter Generation **cannot** be netted from load for the purposes of calculating Peak Load Contributions for the Delivery Year.

See PJM Manual  
14D, Appendix A  
for BTMG  
Business Rules.

# Questions?



- 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.

- ✓ 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 shall be 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 Resources are eligible to be offered into RPM Auctions
- EE Resource may be eligible to receive Capacity Market (RPM) revenue for up to four consecutive Delivery Years.

Installation Period	Fully Installed for Summer	Eligible DYs
June 2008-May 2009	2009	2011/2012, 2012/2013
June 2009-May 2010	2010	2011/2012, 2012/2013, 2013/2014
June 2010-May 2011	2011	2011/2012, 2012/2013, 2013/2014, 2014/2015
June 2011-May 2012	2012	2012/2013, 2013/2014, 2014/2015, 2015/2016
June prior to DY – May prior to DY	DY	DY, DY+1, DY+2, DY+3

Nominated EE Value represents the ICAP Value of an EE Resource.

- **Nominated EE Value is expected average demand reduction (MW) during the defined EE Performance Hours in the Delivery Year.**
  - EE Performance Hours are between hour ending 15:00 EPT and hour ending 18:00 EPT during all days from June 1 through August 31, inclusive, of such Delivery year, that is not a weekend or federal holiday.
- Measurement & Verification (M&V) Plan describes the method and procedures for determining the Nominated EE Value of an EE Resource and confirming the Nominated EE Value is achieved.
- The minimum Nominated EE Value accepted is 0.1 MW.

- ✓ Submit M&V Plan prior to RPM Auction
  - Single M&V Plan may be submitted to cover multiple EE Resources
  - Single M&V Plan must clearly document the Nominated EE Value of each EE Resource covered in the Plan
- ✓ Establish credit with PJM Credit Department prior to RPM Auction
- ✓ Submit Post-Installation M&V Reports
- ✓ Permit Post- Installation M&V Audit by PJM or Independent Third Party

# Questions?

- A Qualifying Transmission Upgrade may be offered into BRA to increase import capability into a constrained LDA (Sink LDA) from a Source LDA.
- Such upgrades must:
  - have a Facilities Study Agreement executed
  - conform to all applicable standards of the PJM Regional Transmission Expansion Planning Process
  - have an in-service date on or before the start of the Delivery Year.
  - have been approved and an incremental import capability value must have been assigned by the PJM Planning Dept at least 45 days prior to the Base Residual Auction.

## **What if there is a delay?**

- If the upgrade cleared in the BRA and is not completed by the start of the Delivery Year, the party should provide a replacement in the form of an equivalent amount of capacity resource within the Sink LDA.
- If replacement capacity is not provided, a Transmission Upgrade Delay Penalty will be applied.

Resource Type	Capacity Value
<p><b>Generation Resource</b></p>	<p>Summer Net Dependable Rating, converted to <u>Unforced Capacity (UCAP)</u></p>
<p><b>DR, ILR, &amp; EE Resources</b></p>	<p>UCAP Equivalent is calculated (based on load reduction amount, Forecast Pool Requirement (FPR), DR Factor)</p>
<p><b>Transmission Upgrade</b></p>	<p>Valued in terms of an increase in import capability into a constrained LDA.</p>

## Calculated based on Unforced Capacity (UCAP)

Unforced Capacity (UCAP) value of a generating unit is calculated as:

$$\begin{array}{l} \text{Unforced} \\ \text{Capacity} \\ \text{Value} \\ \text{of Unit X} \end{array} = \begin{array}{c} \text{SUMMER} \\ \text{Installed Capacity} \\ \text{(ICAP)} \\ \text{Rating} \end{array} * (1 - \text{EFORd}^*)$$

*For Example:*

$$\begin{array}{l} \text{96 MW} \end{array} = \begin{array}{c} \text{100 MW} \end{array} * (1 - .04)$$

Unforced Capacity Value For Unit X = 96 MW

*\*EFORd = Equivalent Forced Outage Rate*

- The nominated value is the maximum load reduction of an end-use customer site.
- The process to determine this value is consistent with the process for the determination of the capacity obligation for the customer.

Load Management Product Type	Nominated Value
Direct Load Control	# Customers * Per Participant Impact * Loss Factor
Firm Service Level	Peak Load Contribution – (Firm Load Level * Loss Factor)
Guaranteed Load Drop	Min (Peak Load Contribution, Customer Load Reduction Value * Loss Factor)

The maximum load reduction for each resource is adjusted to include system losses.

# UCAP Value of Load Management Products

Unforced Capacity (UCAP) value of a Load Management Products is calculated as:

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

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

*For Example:*

$$\underline{10.3} \text{ MW} = 10 * 0.957 * 1.0806$$

Unforced Capacity Value For DR or ILR Resource = 10.3 MW

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:*

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

**Unforced Capacity Value For EE Resource = 103.4 MW**

# Questions?

- The purpose of a bilateral, unit-specific transaction is to transfer the ownership of a specified amount of installed capacity from one party to another.
- **Bilateral**: Both parties of a unit-specific transaction must confirm the transfer of installed capacity from the seller to the buyer via the eRPM system prior to the start date of the transaction.
- **Unit-specific**: Transactions are from a specific unit, not “slice of system” or “generic” MWs

All transactions will be validated to ensure the seller has capacity to sell for the term of the transaction.

- US Transactions will be **“Provisionally Approved”** if Seller is “External Party”, transaction passes all validation checks, and the external unit has not met the transmission and generation deliverability requirements yet.
- US Transactions will be **“Approved”** if the transaction is confirmed by Buyer and Seller, passes all validation checks, and has met the transmission service and generation deliverability requirements (if an external unit).

- Available ICAP purchased through a bilateral unit-specific transaction may be:
  - Directly offered into RPM Auctions
  - Used as Replacement Capacity
  - Used to Import Capacity into PJM
  - Used to Export Capacity out of PJM

Unit-specific bilateral transactions that cover the Delivery Year must be in “**Provisionally Approved**” or “**Approved**” status in the eRPM system prior to the opening of the Base Residual Auction or an Incremental Auction’s bidding window in order to be offered into an RPM Auction.

- **Exporting** a generation resource is accomplished by entering into a bilateral transaction with “External Party (EXT)” listed as the “Buyer” in the unit-specific transaction.
  - Capacity Type = Available or Unoffered
- Exports that will result in a Commitment Compliance Deficiency are not permitted.
- The party that submitted the Cap Mod for a unit is the only party that can export a generation resource.
- Appropriate documentation must be submitted to PJM to demonstrate that the party exporting the resource has a financially and physically firm commitment to an external sale of its capacity and therefore, is exempt from the offer requirement for capacity resources in Attachment DD, Section 6.6 of PJM Open Access Tariff.

- **Importing** a generation resource is accomplished by entering into a bilateral transaction with “External Party (EXT)” listed as the “Seller” in the unit-specific transaction.
  - Capacity Type = Available
- US transaction that represents a capacity import will not be granted a “**Provisionally Approved**” status unless:
  - A letter of non-recallability is submitted to PJM
  - Intended Available Transfer Capability (ATC) path to deliver the external capacity is provided,
  - RPM Credit Requirements have been satisfied

An “**Approved**” status will not be granted until firm transmission service from the unit to the border of PJM has been obtained and generation deliverability has been demonstrated (includes obtaining firm ATC reservation into PJM).

- Unoffered ICAP purchased through a bilateral unit-specific transaction may be:
  - Used to Export Capacity out of PJM
  - Sold to an FRR Entity
  
- Unoffered ICAP purchased through a bilateral unit-specific transaction may *not* be:
  - Offered into an RPM Auction
  - Used as Replacement Capacity

- Cleared UCAP purchased through a bilateral unit-specific transaction:
  - Will result in a transfer of the Auction Credit from the Seller to the Buyer.
  - Will result in a transfer of RPM Resource Commitment from the Seller to the Buyer.
- Cleared UCAP already has an RPM Commitment, and may not be:
  - Offered into an RPM auction
  - Used as Replacement Capacity

- Unit-specific transactions **cannot** be submitted by participants from the time an RPM Auction bidding window is open through the time the RPM Auction results are posted.

RPM Auction Schedule is posted on the RPM Auction User Information page of the PJM website.

- ✓ Capacity Modification, DR Modification, EE Modification, or Bilateral Unit-Specific (for available capacity) Transactions need to be in a “Provisionally Approved” or “Approved” status before the opening of the RPM Auction bidding window in order to offer the associated capacity into the RPM Auction.
- ✓ For planned resources and external capacity without firm transmission service, establish credit in advance of the RPM Auction.
- ✓ Unoffered or Cleared capacity purchased through a unit-specific bilateral transaction may not be offered into an RPM Auction or used in a replacement capacity transaction.

# Questions?