



PJM Markets and Resource Overview

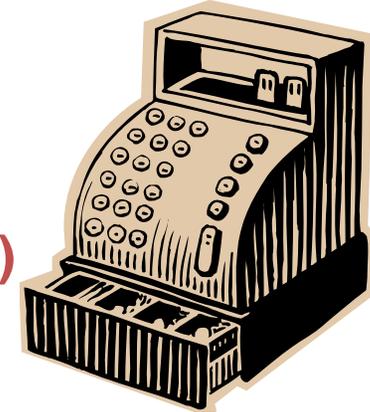
Combined Heat and Power Forum
Columbus OH
March 9, 2012



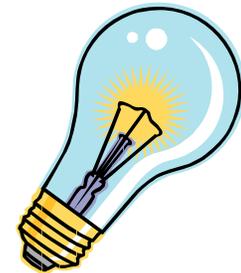
Markets

Market Evolution

- **Real-Time Energy Market** (April 1, 1997)
- **Financial Transmission Rights** (June 1, 1999)
- **Capacity** (January, 1999) **RPM** (June 2007)
- **Day-Ahead Energy Market** (June 1, 2000)



- **Ancillary Services Markets**
 - **Regulation** (June 1, 2000)
 - **Synchronized Reserves** (December 1, 2002)
 - **Day-ahead Scheduling Reserves** (June 2008)
 - **Black Start Services** (December 1, 2002)
 - **Reactive Services**



Cost Based
Services



Regional Planning Process

Regional Planning Objectives

- 15 year outlook to identify reliability standards violations
- Test the transmission system against mandatory national standards and PJM regional standards
- Reliability and economic efficiency drivers



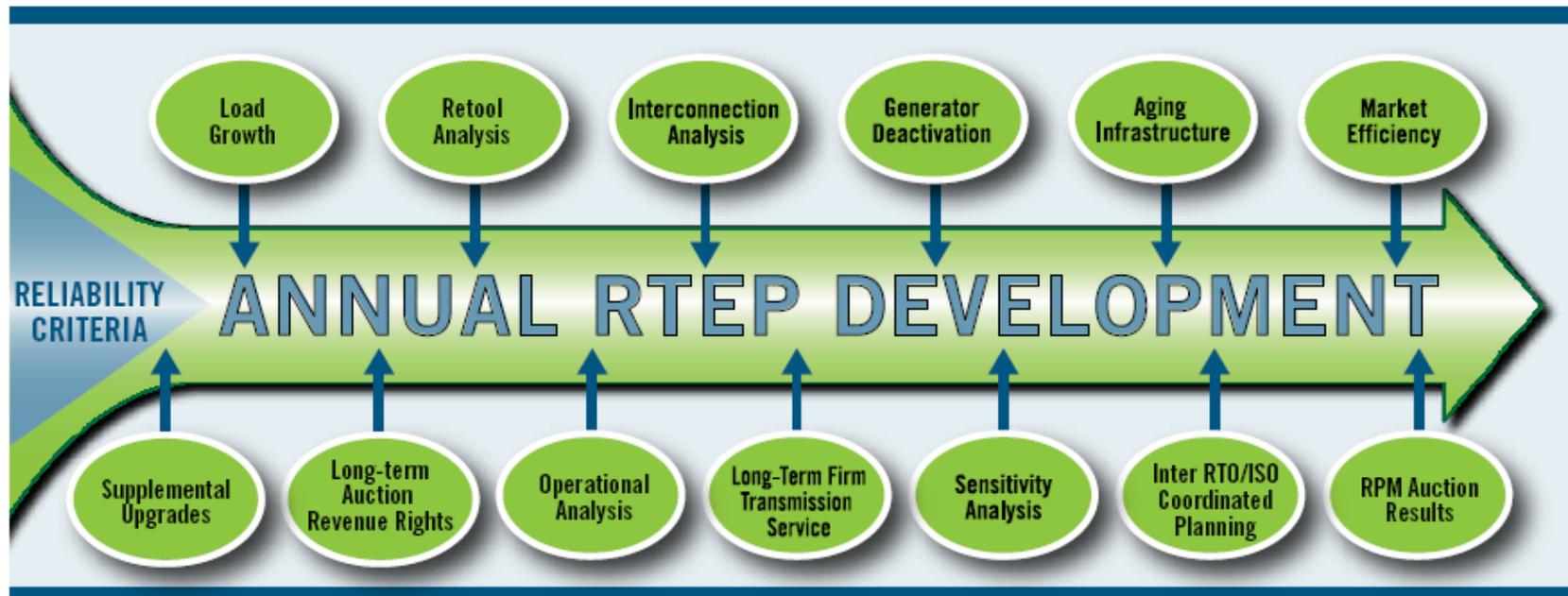
Regional Planning Objectives

- Develop transmission reinforcements in collaboration with Transmission Owners
- Develop a unified Strategy for the entire PJM footprint – the RTEP
- Submit Plan to PJM's independent governing Board for consideration and approval

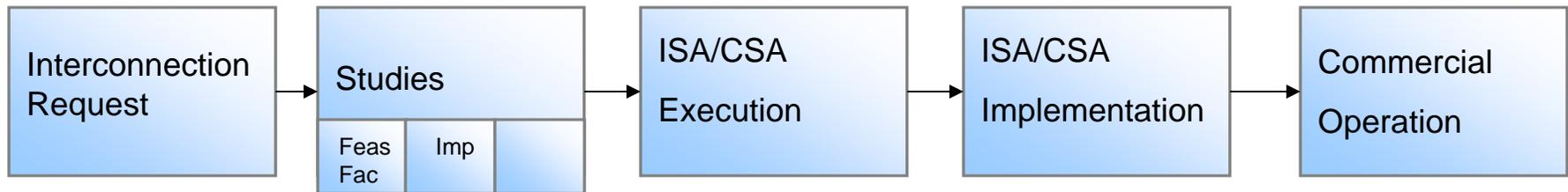


RTEP Process Definition

PJM's RTEP process identifies transmission enhancements to preserve regional transmission system reliability, taking into consideration numerous driving factors.

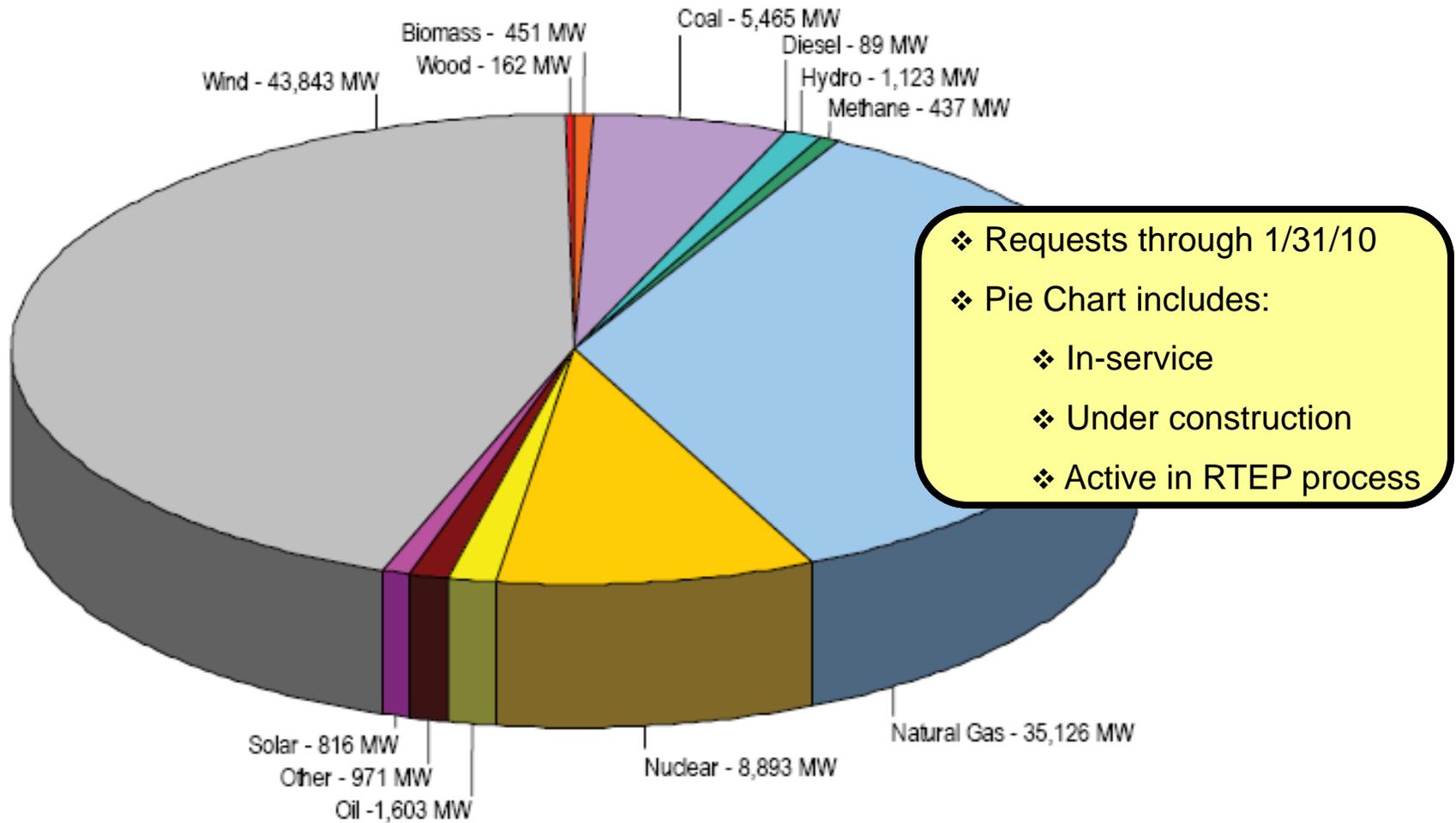


Interconnection Request Process



Note: Projects May Drop Out of the Queue at any Time

Fuel Mix of Queued Generation Interconnection Requests



Approved Upgrades (through 12/31/10)

\$ 19.02 Billion → Transmission additions & upgrades approved by the PJM Board since 1997

\$ 15.6 Billion → Baseline transmission upgrades fundamentally to ensure reliability.

\$ 3.4 Billion → Transmission upgrades to accommodate more than 50,000 MW of new generation and new merchant transmission facility capability



Energy Market LMP Basics

➔ Pricing method PJM uses to:

- ⇒ price energy purchases and sales in PJM Market
- ⇒ price transmission congestion costs to move energy within PJM RTO
- ⇒ price losses on the bulk power system

➔ Physical, flow-based pricing system:

- ⇒ how energy actually flows, NOT contract paths

PJM Settles the market:

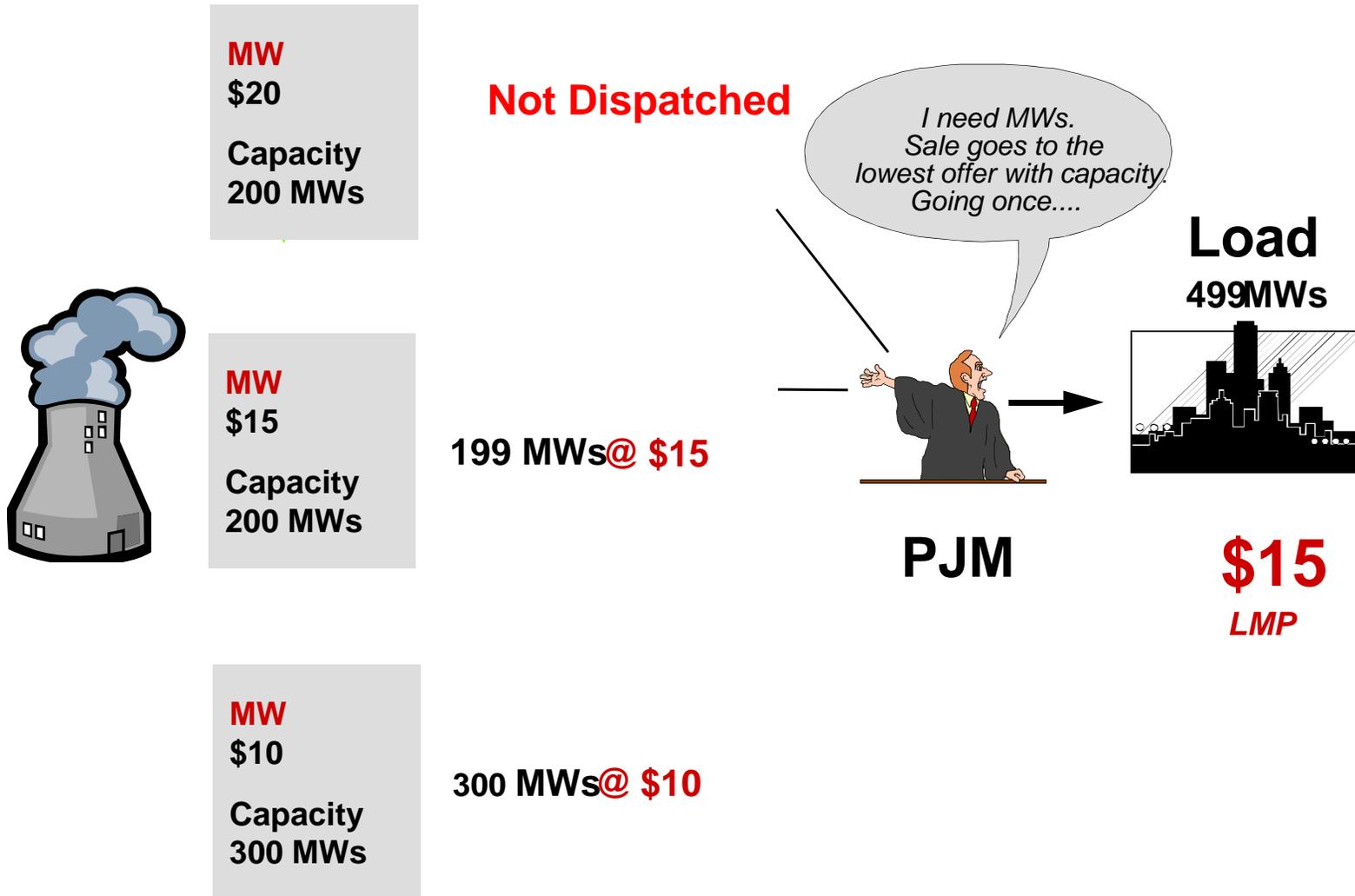


Electric Generators (Sellers) get paid the clearing price at their interconnection point (node)



Loads (Buyers) pay at their zonal LMP

Economic Dispatch Exercise





Locational Marginal Price the Energy Market Clearing Mechanism

$$\text{LMP} = \text{System Energy Price} + \text{Transmission Congestion Cost} + \text{Cost of Marginal Losses}$$

LMP is made up of 3 independent components

LMP Components Marginal Losses

Cap = 2,000 Mw

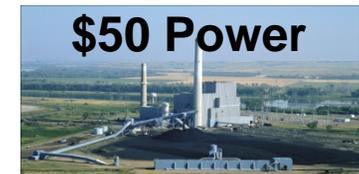
Dispatch 1000 MW



System Energy Price =	\$20
Congestion =	\$30
Losses =	\$ 2
LMP=	<u>\$52</u>

System Energy Price =	\$20
Congestion =	\$ 0
Losses =	(\$ 1)
LMP =	<u>\$19</u>

Dispatch 500 MW



Cap = 1,500 Mw

Capacity Reliability Pricing Model

Capacity vs. Energy

Capacity

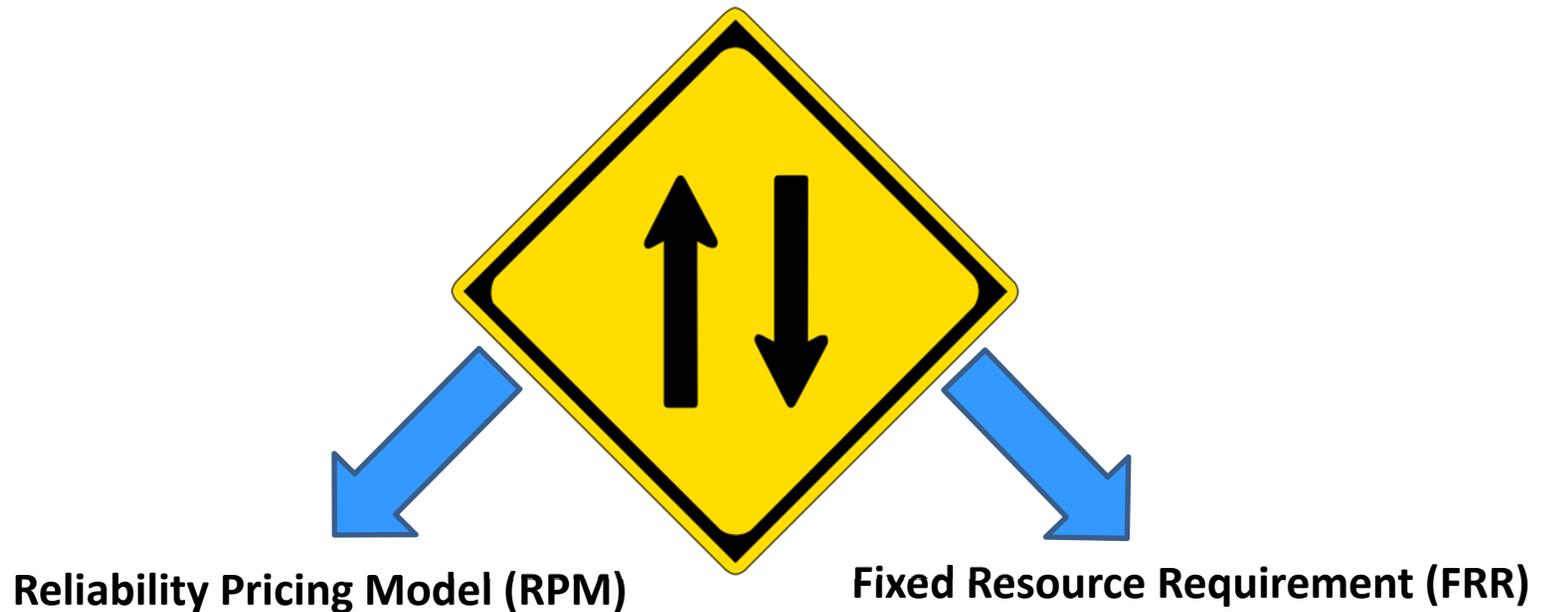
- A commitment of a resource to provide energy during PJM emergency under the capped energy price.
- Capacity revenues paid to committed resource whether or not energy is produced by resource.
- Daily product

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



PJM secures capacity on behalf of LSEs to satisfy load obligations.

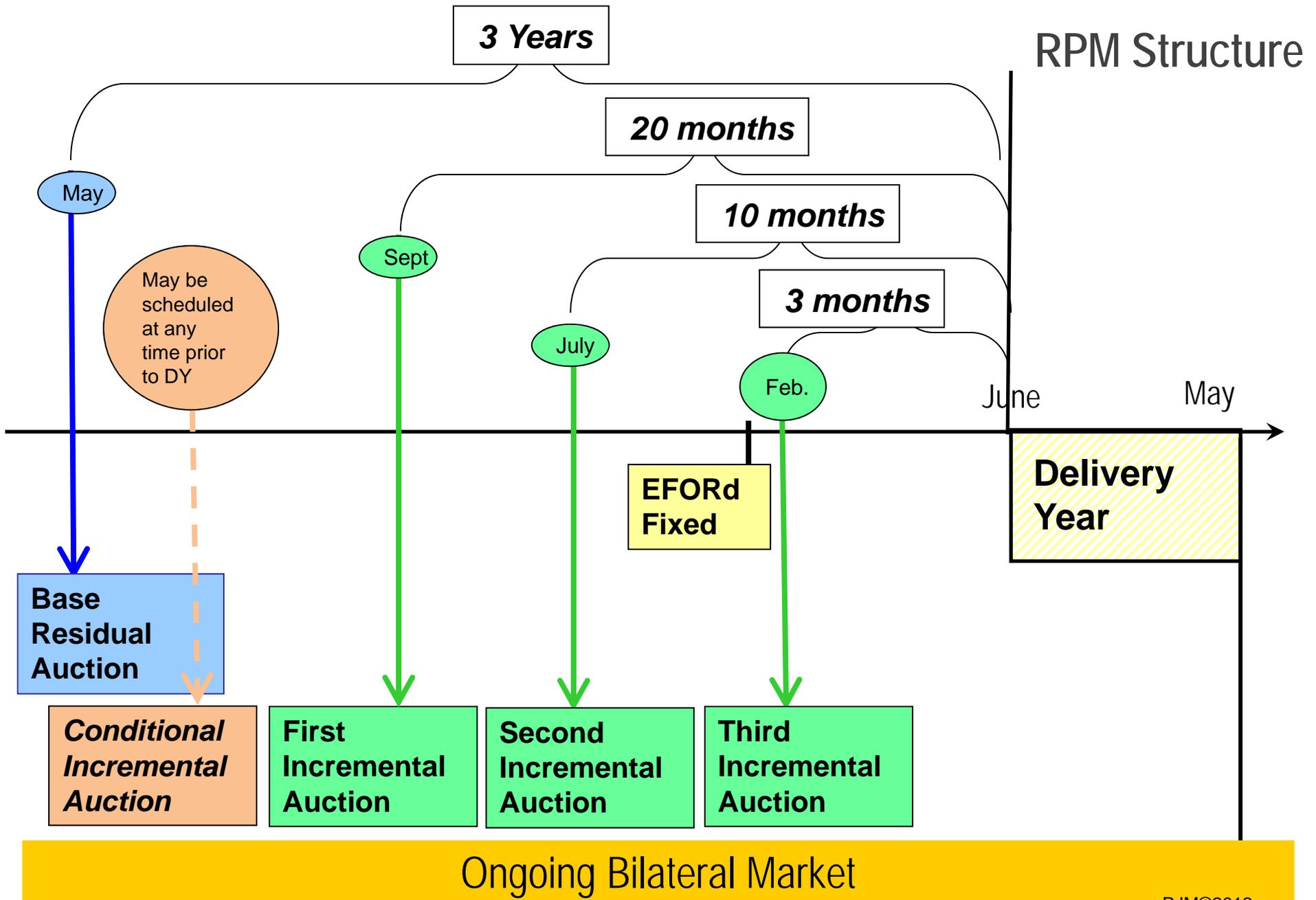
LSE secures capacity to satisfy their load obligation.

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

Objectives of RPM

- Resource commitments to meet system peak load three years in the future
- Three year forward pricing aligned with reliability requirements to adequately value capacity resources
- Provide transparent information to 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.



Participation by Resource Providers in RPM

- Participation is mandatory for resource providers with:
 - available unforced capacity from **Existing Internal PJM Generation**; or
 - bilateral contracts for available **Existing Internal PJM Generation**; or
 - **Planned Resources** which **cleared in a prior auction** at an unmitigated price



Participation by Resource Providers

- Participation is voluntary for resource providers with:
 - External generation;
 - Planned generation;
 - Existing demand resources;
 - Planned demand resources;
 - Energy Efficiency resources;
 - Qualifying Transmission Upgrades.



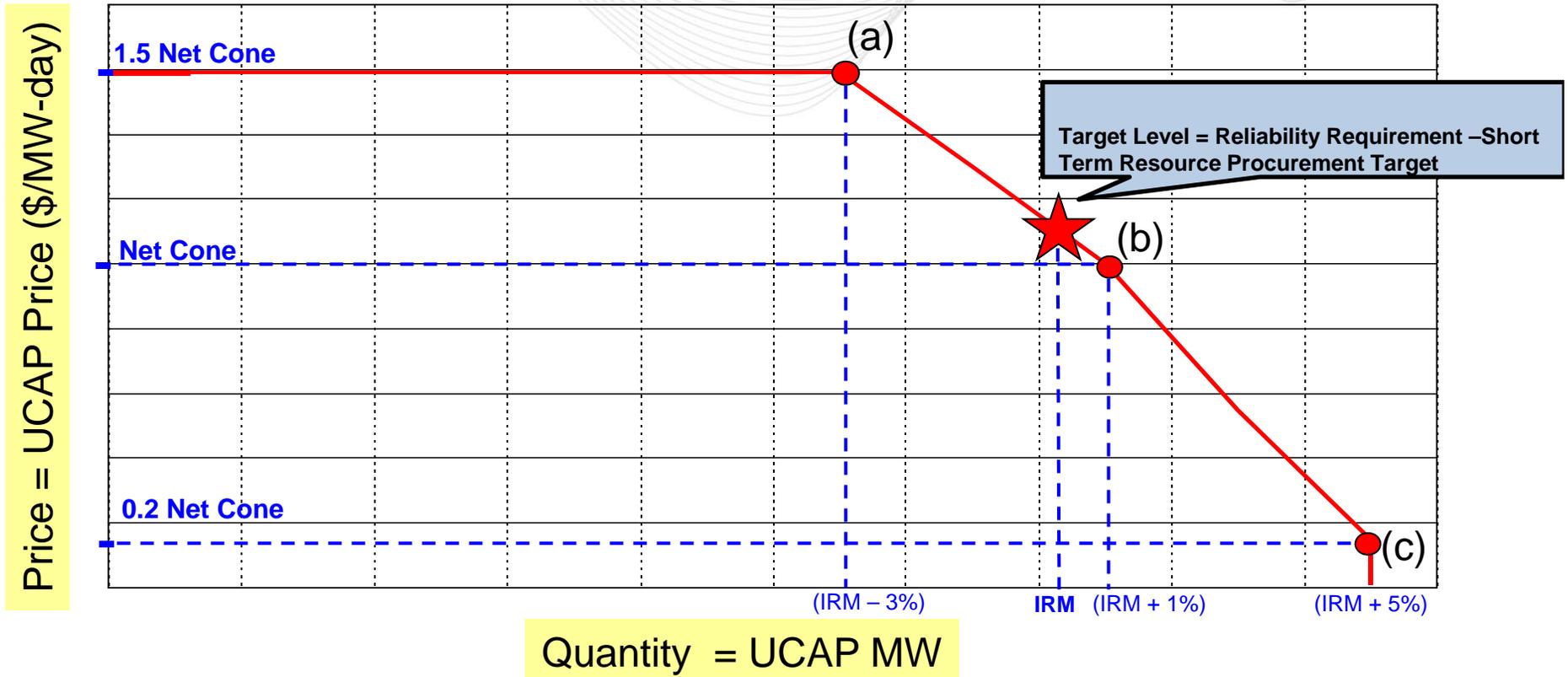
Generation Resources

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

- Internal or External
- Existing or Planned

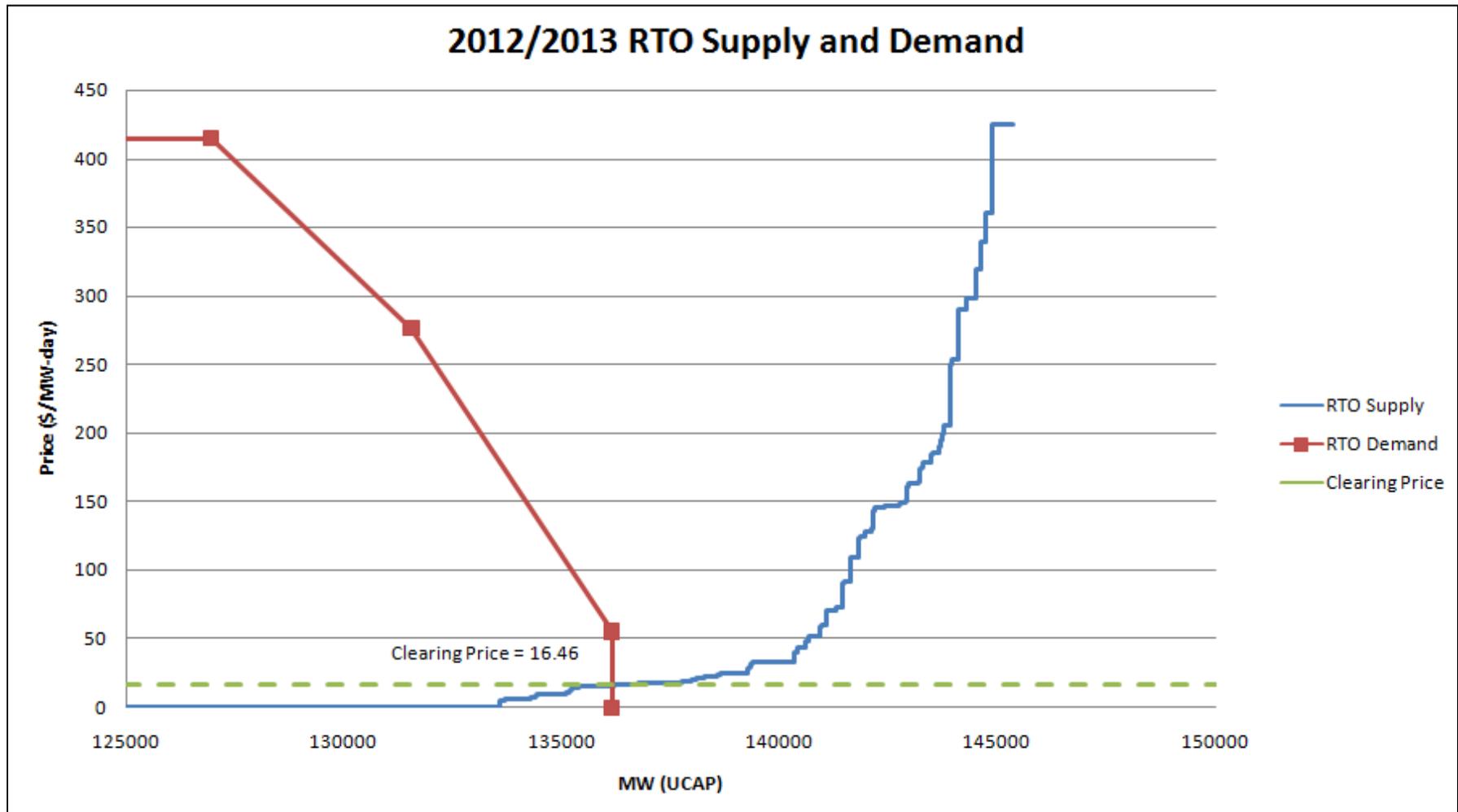


Illustrative Example of a VRR Curve



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

Example of Supply Curve 2012/2013 BRA



Purpose of Resource Performance Assessments

- Provide the means to assess whether or not a resource honored their commitments and provided the expected reliability services during the Delivery Year.
- Incent resource providers to perform through exposure to deficiency or penalty charges
- Deficiency or penalty charges are distributed to LSEs or over-performing resource providers.



Performance Assessment Types

Assessment	Purpose
RPM Commitment Compliance	Determines if sufficient unforced capacity on resource during DY to meet its RPM commitments
Peak-Hour Period Availability	Measures if generation resource was available during critical peak-hour periods during DY
Summer/Winter Capability Testing	Determines if generation resource demonstrated its ICAP commitment amount through summer and winter testing
PSM Compliance	Determines if generation resource took an unapproved planned or maintenance outage during peak season period
Load Management Event Compliance	Determines if committed demand resource or certified ILR resource reduced load during a PJM initiated LM event
Load Management Test Compliance	In the absence of a PJM-initiated LM event, this assessment determines if committed demand resource or certified ILR resource reduced load during a CSP-initiated test

- Regulation Market
- Synchronized Reserve Market
- Reactive Services

Purpose: To provide for the continuous balancing of generation and load

- Generation and Demand Response resources
- Transmission customer must provide or purchase
- RMCP = Regulation Market Clearing Price
- Regulation Price = Higher of RMCP or offer price plus opportunity cost

Synchronized Reserves Market

Purpose: To bring generation and load back in balance after the loss of generation

- LSE's have obligation to purchase based on Load Ratio Share
 - Bilateral
 - Scheduling owned resources
 - Purchase from Synchronized Reserve Market
- Co-optimized with Regulation Market
- Allows for participation by Demand Side Response resources

Reactive Supply & Voltage Control

Purpose: To maintain transmission voltages within acceptable limits.

- FERC approves reactive revenue requirements
- PJM calculates zonal rate
- Paid by transmission customers
- Credits go to generation resources and transmission owners

Settlements

Current Month

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16 Weekly Bills issued	17	18	19 Payments due to PJM	20	21
22 Payments made to participants	23	24	25	26	27	28
29	30	31				

Billing Cycle

Weekly Billing Cycle:

- Runs Thursday – Wednesday
- Weekly bills sent the following Tuesday
- Payments due PJM on the following Friday via Automated Clearing House (ACH) or Wire Transfer
- Disbursements made to participants the following Monday

Following Month

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	2	3	4	5	6	7
8	9	10	11	12 Payments due to PJM (EOM and 1 st week)	13	14
15 Payments to participants (EOM and 1 st week)	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				PJM©2012

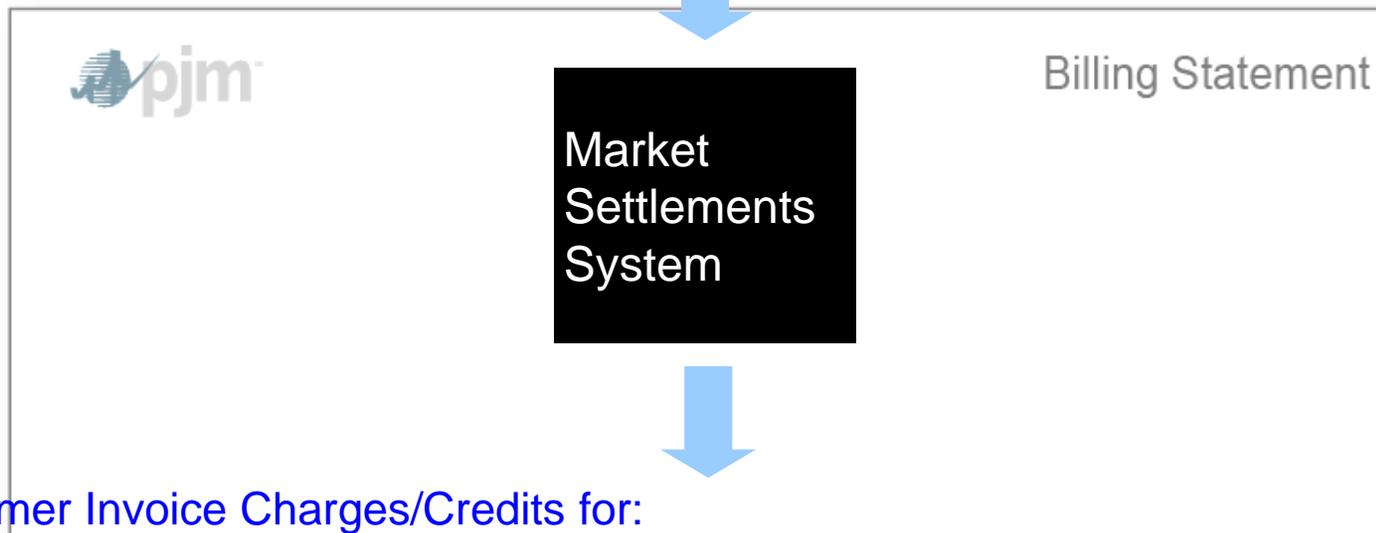
Monthly Billing Statement:

- Issued on the 5th business day of the following month
- Financially settled together with the following month's first weekly billing statement's financial statement

Market Settlements Process

Inputs to Settlements

Day-ahead schedules, real-time metering, interchange schedules, internal eSchedules, Ancillary Service obligations, transmission reservations, LMPs, FTR positions, capacity positions, other miscellaneous data



Customer Invoice Charges/Credits for:

Energy Markets

Transmission Service

Ancillary

Reliability Pricing Model

Miscellaneous categories

Charges and Credits

CHARGES

Spot Market Energy
Transmission Congestion
Network Transmission
Firm and Non-Firm Point to Point
Transmission Losses (P to P)
Regulation
Spinning Reserve
Black Start Service
Operating Reserves
PJM Schedule 9 & MAAC
Transitional Market Expansion
Reactive Supply
Capacity Credit Market & Capacity Deficiency
FTR Auction
Meter Correction
Ramapo PAR
Reconciliation
Distribution Facilities

CREDITS

Spot Market Energy
Transmission Congestion
Network Transmission
Firm Point to Point
Non-Firm Point to Point
Transmission Losses
Regulation
Spinning Reserve
Black Start Service
Operating Reserves
Reactive Supply
Capacity Credit Market
Capacity Deficiency
FTR Auction
FTR Auction Revenues
Reconciliation
Distribution Facilities

PJM Bill

	<u>Day Ahead</u>	<u>Balancing</u>	<u>Total</u>
Spot Market Energy	(200)	(200)	(400)
Transmission Congestion	100	100	200
Network Transmission	-----	-----	---
Firm Point to Point	-----	200	-----
Non-Firm Point to Point	-----	-----	200
Transmission Losses	10	20	30
Spinning Reserve	-----	-----	---
Black Start	-----	-----	---
Regulation	-----	-----	20
Operating Reserves	20	20	40
PJM Schedule 9	-----	-----	10
Reactive Supply	-----	-----	10
MAAC	-----	-----	5
Capacity Credit Markets	-----	-----	---
Capacity Deficiency	-----	-----	---
Meter Correction	-----	-----	5
Ramapo PAR	-----	-----	5
Reconciliation	-----	-----	5

Charges and credits can be positive or negative

Settlement Information

- Detailed Settlement Reports (both Monthly and Weekly) are provided electronically via the PJM MSRS System (Market Settlement Reporting System)
- Overdue balances are subject to interest charges
- Weekly settlements (as opposed to monthly settlements) will reduce the default exposure for all PJM members
- PJM Credit Policy: Attachment Q, PJM Tariff
- Invoices paid to PJM Settlements Inc.

Accessing the PJM Guide to Billing



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committees & groups

planning

markets & operations

documents

Home > Markets & Operations > Market Settlements > Guides & Forms

Guides & Forms

Additional links to settlement-related guides and forms.

- Guide to Billing (PDF) ← **Guide to PJM Billing**
- Billing Change Form
- Billing Statement Notification Form
- 2009 Business Calendar (PDF)
- 2009 Holiday Deadline Extensions (PDF)
- June 2009 - May 2010 Weekly Billing Calendar (PDF)
- 2008 Business Calendar (PDF)
- Agency Principles (PDF)
- Nodal Settlement Rules (PDF)
- Network Service Peak Loads 2009 (PDF)
- ACH Draft Authorization Form (PDF)

RELATED INFORMATION

- Operational Data
- Operating Agreement
- Reliability Assurance Agreement
- Agency Principles
- Nodal Settlement Rules
- Network Service Peak Loads 2009

RECENT DOCUMENTS

- Reactive Supply and Voltage
- MAY 7 Control Revenue Requirements - March 2009 (PDF) 2009 Posted 11 days ago
- MAY 4 June 2009 - May 2010 Weekly Billing Calendar (PDF) 2009 Posted 14 days ago
- MAY 4 ACH Draft Authorization Form (PDF) 2009 Posted 14 days ago
- APR 23 April 2009 (PDF) 2009 Posted 25 days ago

Operational Data

- eTools
- Energy Market
- Reliability Pricing Model
- Financial Transmission Rights
- Ancillary Services
- Demand Response
- Market Settlements**
- Guides & Forms
- Billing Contact Change Form
- Billing Statement Notification Form
- MSRS Reports
- Preliminary Billing Reports - Ancillary Services Market Data



Net Energy Metering (NEM) Senior Task Force Overview

Net Energy Metering (NEM) - Background

- Since ~2009, various “Net Energy Metering” laws and regulations have been adopted in many, if not all, states within the PJM service region
- Pursuit of renewable generation and renewable portfolio standards influenced regional NEM laws and regulations
- Net Energy Metering, with certain requirements and restrictions, permits customers to self-generate electrical energy and connect to the local distribution/transmission system
- The traditional electrical provider, if asked, must permit the customer to ‘attach’ to the electric network
- In the event of a net positive electrical injection, the electrical provider is to compensate the customer via defined timelines and rates described in the regional regulation or law



PJM Efforts Regarding Net Energy Metering

- PJM Net Energy Metering problem statement & charge identified and approved in December
- PJM NEM Senior Task Force (NEMSTF) kicked off in January
- This NEMSTF is an open forum and welcomes any interested party
- The NEMSTF is to complete their findings and recommendations by June 1, 2012
- The NEMSTF materials may be found:
 - www.pjm.com
 - Under Committees & Groups, Task Forces, Net Energy Metering Senior Task Force



PJM Consensus-Based Issue Resolution Process Phases

- Problem Statement & Charter Adoption
- Education, Multilateral Learning & Discovery
- *Interest Identification/Discussion (Current Phase)*
- Solution Development
 - Matrix and decision support tools
 - Establish design components
 - Develop potential solution options
- Decision-Making

Terminology – NEMSTF Interests/Concerns

Illustrative Examples

- Interconnection requirements for NEM Projects
- Accurate locational modeling of NEM resources, regarding where energy revenues are actually generated
- Circumstances whereby NEM projects may be considered capacity resources
- Desire to ensure NEM injections are understood and incorporated into real-time dispatch
- Accurate NEM real-time metering and revenue quality data
- Understanding likely regulatory interpretations (e.g., When will NEM injections into the grid be considered wholesale sales for resale, if ever?)
- Accuracy of NEM calculations and PJM settlements (e.g., LMP point utilized as generation bus or load bus)
- Represent how NEM units might obtain revenue from PJM administered markets

Questions?