Reserve Market Settlements

Suzanne Coyne
Principal Consultant, Market Settlements
RCSTF
April 13, 2026

PJM Proposed Reserve Market Settlements

Reserve Products	DA or RT	DA Clearing Price Credits	Balancing Clearing Price Credits	Availability Penalty Rate	Performance Penalty Rate	Reserve Uplift Credit
Synchronized Reserve	Both	☑	☑	1.25 * RT SR MCP	Greater of Avg cost of SR procurement OR Highest RTO RT Energy Price in the 6 intervals following the SR event	☑
10-Min Ramp/ Uncertainty Reserve	Both	☑	☑	1.25 * RT 10-Min RUR MCP	☒	
30-Min Ramp/ Uncertainty Reserve	Both	☑	☑	1.25 * RT 30-Min RUR MCP	☒	
30-Min Secondary Reserves	Both	☑	☑	☒	1.5 * RT 30-Min Reserve MCP	
Day-ahead Scheduling Reserves (60-min NonSpin Reserves)	DA Only	☑	☒	Greater of 1.25 * DA DASR MCP OR RT 30-Min Reserves MCP	Greater of 1.5 * DA DASR MCP OR 1.5 * RT 30-Min Reserve MCP	☒
Energy Gap Reserves (60-min Spin Reserves)	DA Only	☑	☒	Greater of 1.25 * DA EG MCP OR RT 30-Min RUR MCP	☒	☒

Day-Ahead and Balancing Settlement

- Like the existing reserve market products, PJM proposes a Day-Ahead and Balancing settlement construct for the newly proposed reserve market products
- In general, for any reserve market, this means:
  - DA Reserve Market Clearing Price Credit =
    DA Cleared MW * DA Reserve Market Clearing Price
  - Balancing Reserve Market Clearing Price Credit =
    (RT Cleared MW – DA Cleared MW) * RT Reserve Market Clearing Price

Reserve Market Cost Allocation

- DA and Balancing Reserve Market Clearing Price Credits (for all reserve markets) will be allocated as charges to market participants based on their ratio share of real-time load plus exports
  - Currently these charges are allocated to real-time load, where load is offset by reserve market bilateral transactions
  - As part of this proposal, PJM recommends removing the option to enter reserve market bilateral transactions due to inactivity (no reserve market bilaterals have been submitted since 2014).

Availability Penalty Settlements

- Availability penalties are assessed to resources that don't move down far enough to provide the assigned "up" reserve product, or up far enough to provide the assigned "down" reserve product in RT.
  - This applies to the following products: 30-Min RUR (up and down), 10-Min RUR (up and down) and Synchronized Reserve
- These Availability Penalty Charges replace the existing practice of capping the reserve assignments in the reserve credit calculations under the current rules.
  - The existing capping rules remove any credit the resource receives for MW not provided in RT.
- Availability penalties are also assessed to the DA DASR (60-Min Spin) and Energy Gap Reserve (60-Min Non-Spin) products that do not meet the availability obligations.

Availability Penalty Settlements

- For each market that has availability penalties:

  Availability Penalty Charge =

  Availability Shortfall MW * Availability Penalty Rate

- Revenues from Availability Penalties will be allocated on a RT load plus exports ratio share basis to participants that paid clearing price charges, and which did not incur a performance penalty, for the respective reserve market.

Performance Penalty Settlements

- Performance penalties are assessed to resources that are deployed during an event or asked to convert offline reserves to energy, and which do not provide the full amount of reserves in response to PJM's instructions
  - This applies to the following products: Day-Ahead Scheduling Reserves (60-min Non-Spin Reserves), 30-Min Secondary Reserves and Synchronized Reserves
- Performance penalties already apply to Offline 30-minute Reserves (i.e. secondary reserves) and Synchronized Reserves under the current rules

Performance Penalty Settlements

- For each market that has performance penalties:

  Performance Penalty Charge =

  Performance Shortfall MW * Performance Penalty Rate

- Revenues from Performance Penalties will be allocated on a RT load plus exports ratio share basis to participants that paid clearing price charges, and which did not incur a performance penalty, for the respective reserve market.

Reserve Market Uplift Settlements

- PJM also proposes reforms to the calculation of reserve market uplift credits.
  - These are currently referred to as reserve market Lost Opportunity Cost Credits and will be renamed Reserve Market Uplift Credits going forward.
- Uplift credits are paid to ensure reserve market revenues cover the costs of maintaining the reserve assignment.
  - These payments are designed to ensure resources are indifferent to being assigned energy or reserves.

Reserve Market Lost Opportunity Cost Credit Settlements – **Status Quo**

Reserve Market Lost Opportunity Cost Credits

- are paid separately by Reserve Market (SR, SecR, NSR)
- A single LOC credit for each reserve market accounts for both DA and RT market costs and revenues.

LOC credit is paid when revenues do not exceed the following costs:

- DA and Balancing Reserve Market offers
- DA and Balancing opportunity costs (forgone energy profit due to backing down to make room for the reserve assignment)

Resources are also made whole for any Reserve Market buy-back, unless the resource's own actions cause the decrease in assignment.

Opportunity Cost complexities and interactions – **Status Quo**

The forgone profit (i.e. opportunity cost) is calculated for:

- The DA reserve assignment
- Any *additional* reserves assigned in the RT market (RT MW – DA MW)
- Only MW where the resource is backed down in order to provide the assignment

The forgone profit calculation occurs ***separately*** for the Synchronized Reserve and Secondary Reserve products

This introduces some complexities in settlements as illustrated in examples covered in the appendix and presented at the February 11, 2026 RCSTF meeting, link.

Proposed Reserve Market Uplift Settlement Reforms

1. Create a unified reserve uplift credit across all reserve markets, rather than calculating uplift credits for each individual reserve market

2. Simplify the settlements opportunity cost calculation

- Shift from covering day-ahead and balancing opportunity costs to covering RT opportunity costs
  - The calculation will now recognize the binding nature of the DA reserve commitments thru the addition of profits or losses stemming from differences in the DA and RT reserve market clearing prices
- Use Tracking Ramp Limited Desired as the economic desired metric consistent with other uplift calculations

3. Ensure only actions resulting from following PJM's directives are compensated for reserve market buy-backs.

Proposed Reserve Market Uplift Credit Settlements

Unified Reserve Market Uplift Credit

Reserve Market uplift credit is paid when revenues do not exceed the following costs:

- RT Reserve Market offers
- RT Reserve Market opportunity costs
  - forgone energy profit due to backing down to make room for the full RT reserve assignment(s) OR
  - losses due to moving up to make room for the full RUR down reserve assignment
  - less any profits or losses stemming from differences in the DA and RT reserve market clearing prices (in recognition of having to buy out of a DA reserve commitment if assigned for energy rather than reserves in RT)

Resources will also be made whole for any Reserve Market buy-back, unless the resource's own actions cause the decrease in assignment.

Proposed Reserve Market Uplift Credit

Reserve Market Uplift Credit =

All Reserve Market Costs

- RT Reserve Market Offer Amounts
- \+ Real-time Opportunity Cost
- − Additional DA Buy Out Cost

−

All Reserve Market Revenues

- DA Reserve Market CP Credits
- \+ Balancing Reserve Market CP Credits
- \+ Opportunity Cost Credit Owed
- \+ Market Revenue Neutrality Offset

Orange highlighting indicates new or changed elements of the calculation

- The combination of Balancing Reserve Market CP Credits, Opportunity Cost Credit Owed by Reserve Market, and Market Revenue Neutrality Offset for increases in energy will continue to be used to account for any Reserve Market buy-back and any costs that are the responsibility of the resource (i.e. Opportunity Cost Credit Owed) or already made-whole via increases in energy market revenues (i.e. Market Revenue Neutrality Offset).
- Any actual Performance Penalties or Availability Penalties paid are the responsibility of the Market Participant and will not offset Reserve Market Revenues.

Rationale for Inclusion of Full RT Opportunity Cost in Reserve Market Uplift Calculation

The shift from balancing opportunity cost to real-time opportunity cost ensures resources are compensated for the opportunity cost for the full range of MW that were backed down to provide reserves in real-time.

- Addresses cases under the current calculation where a resource is not fully compensated for RT opportunity cost, including when the resource was not backed down to provide the assigned DA reserve MW.
- Better adheres to the principle of making a resource indifferent to being assigned for energy or reserves in real-time.
  - The calculation ensures the resource will earn at least what it would have earned had it been assigned for energy rather than reserves in RT.

Rationale for Removal of DA Opportunity Costs in Reserve Market Uplift Calculation

- The proposed Reserve Market Uplift calculation no longer considers DA Opportunity Costs.
- It still recognizes the financially binding nature of the DA commitment by recognizing the additional cost the resource would incur to buy out of the DA market (in excess of the DA revenues) if the resource was assigned energy instead of the assigned RT reserve MW.
- Additional Buy Out Cost = $\text{Min}\left(\text{DA Reserve Assignment, RT Reserve Assignment}\right) \text{ X}$

$$\left(\text{RT Reserve Clearing Price} - \text{DA Reserve Market Clearing Price}\right)$$

The Additional Buy Out Cost could be positive or negative, either adding to the costs to be made whole or reducing them.

RT Opportunity Cost minus Additional Buy Out Cost represents the net revenues the resource would have received if assigned for energy rather than reserves in RT.

Proposed RT Opportunity Cost Examples

Reserve Market Uplift Credit =

All Reserve Market Costs

- RT Reserve Market Offer Amounts
- \+ **Real-time Opportunity Cost**
- − **Additional DA Buy Out Cost**

−

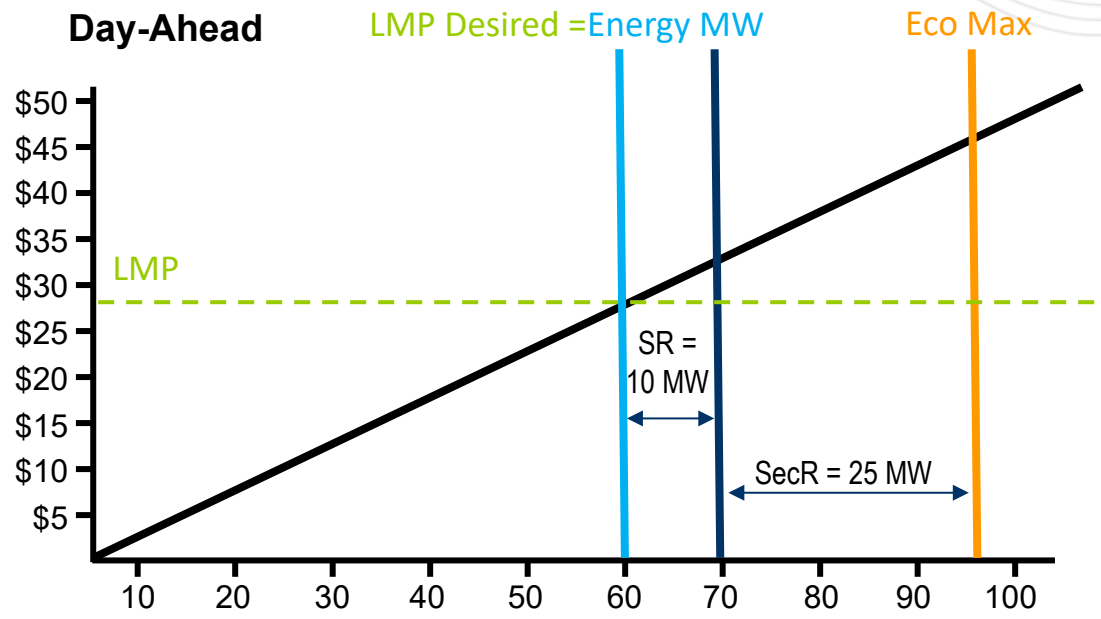
All Reserve Market Revenues

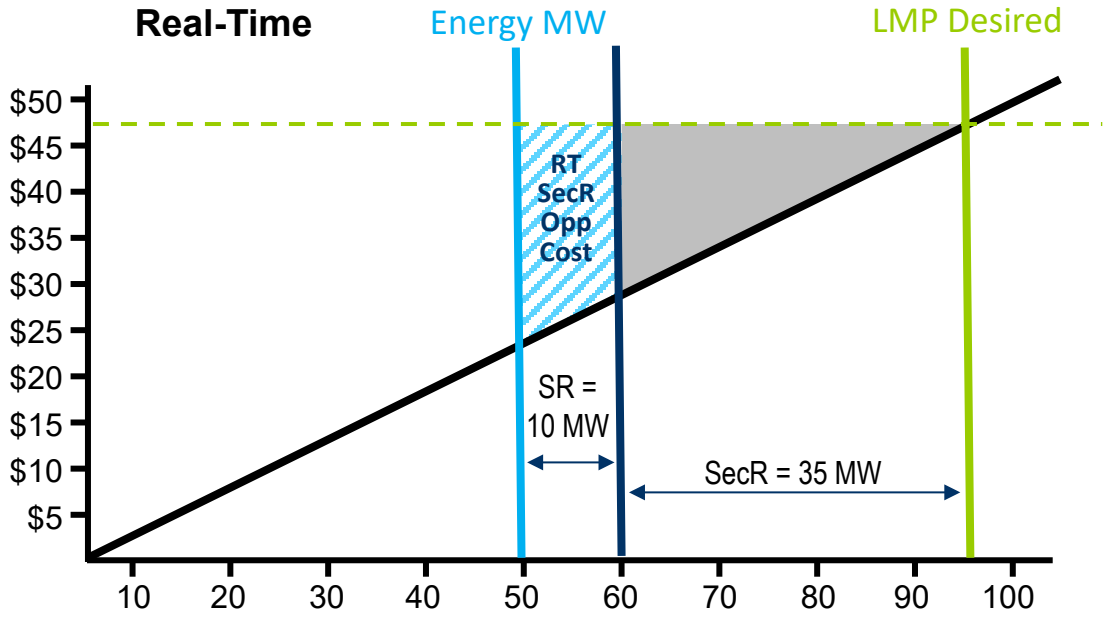
- DA Reserve Market CP Credits
- \+ Balancing Reserve Market CP Credits
- \+ Opportunity Cost Credit Owed
- \+ Market Revenue Neutrality Offset

- The following examples illustrate the proposed changes to the RT Opportunity Cost and the Additional DA Buy out cost components of the reserve market costs.
- Additional reserve market uplift credit spreadsheet examples will be provided for a future meeting.

Example 1: DA and Balancing Opportunity Costs – Status Quo

Scenario	In the **DA Market**, resource has headroom to provide a **25 MW SecR** assignment and **10 MW SR** assignment and is not required to reduce from its economically desired output to provide reserves.	In the **RT Market**, resource was reduced from its economically desired output of 95 MW to provide a **35 MW SecR** assignment and **10 MW SR** assignment.

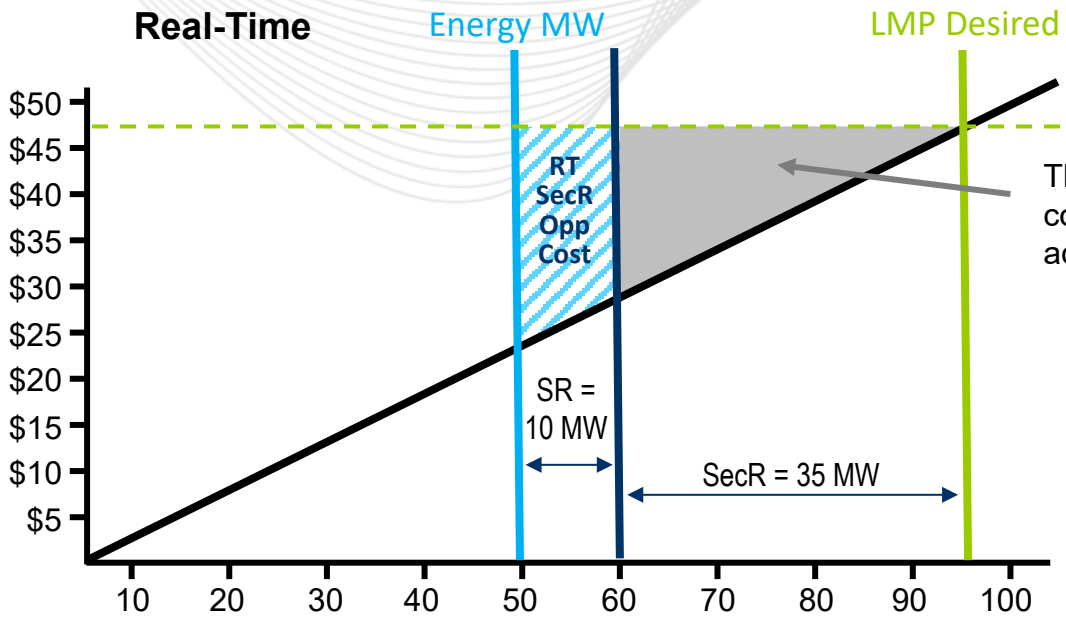




Key Takeaways – DA Reserve Market

- Resource did not forgo energy revenues to provide reserves (LMP Desired = Energy MW)
- DA SR Opp Cost = $0
- DA SecR Opp Cost = $0

Example 1 continued: Balancing Opportunity Costs – Status Quo



These MW were captured by DA opportunity cost (which was $0 and not reflective of the actual opportunity cost in RT)

Key Takeaways – RT Reserve Market

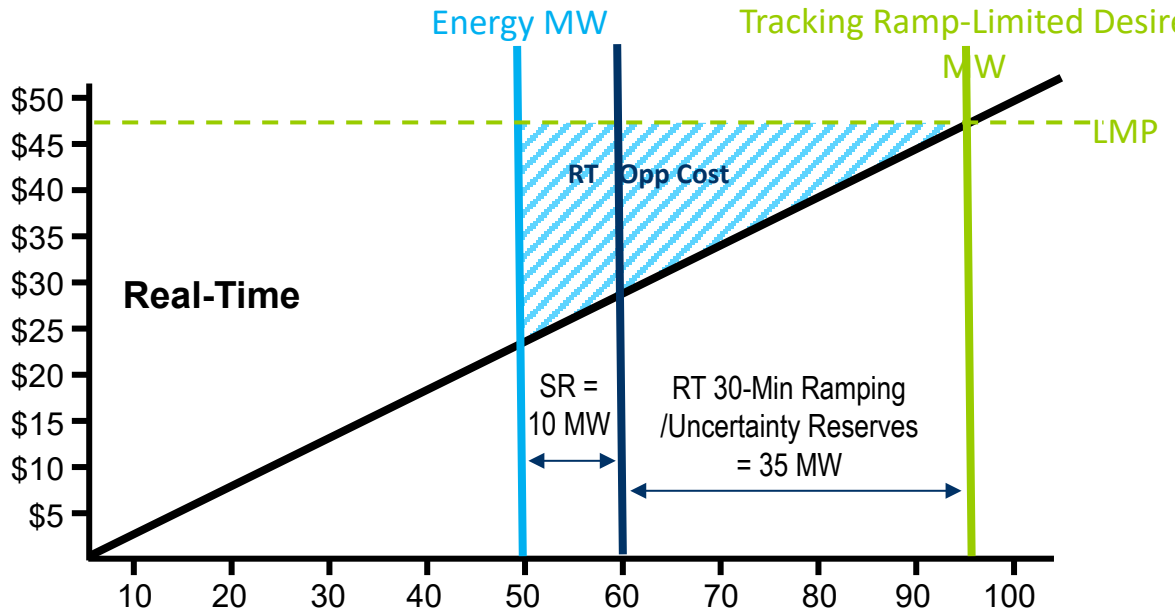
- Backed down to provide both SR and SecR Assignments in RT

- RT SR Assignment = 10 MW (same as DA)
- RT SecR Assignment = 35 MW (10 more MW than DA)
- Bal SR Opp Cost = $0 (there were no balancing MW for SR)
- Bal SecR Opp Cost evaluated from 50 MW to 60 MW (the additional 10 MW not covered by DA opp cost)
- Although all of the resource's RT reserve MWs came from MW that were backed down to provide reserves instead of energy, Bal Opp cost is only calculated for the additional 10 MW deviation from its DA output of 60 MW

Example 1: RT Reserve Market Opp Cost – Proposed Rules

Scenario:	In the **DA Market**, resource has headroom to provide a **25 MW 30-Min RUR** assignment and **10 MW SR** assignment and is not required to reduce from its economically desired output to provide reserves.	In the **RT Market**, resource was reduced from its economically desired output of 95 MW to provide a **35 MW 30-Min RUR** assignment and **10 MW SR** assignment.

*Same scenario as previous example except replaced SecR assignments with 30-Min RUR assignments



Key Takeaways – Proposed RT Reserve Market Opportunity Cost

- Backed down to provide both the RT SR Assignment and the RT 30-Min RUR Assignment
- RT Opp Cost evaluated for the amount the resource was backed down to provide all RT Reserve assignments.
- Preserves the incentive to provide reserves if the economic desired energy value increases in RT and increases the opportunity cost. Resource is indifferent to providing reserves or energy.

Example 1: Additional Buy Out Cost – Proposed Rules

Scenario:	In the **DA Market**, resource has the following assignments: **25 MW 30-Min RUR** assignment @ $2 MCP **10 MW SR** assignment @ $5 MCP	In the **RT Market**, resource has the following assignments: **35 MW 30-Min RUR** assignment @ $5 MCP **10 MW SR** assignment @ $10 MCP

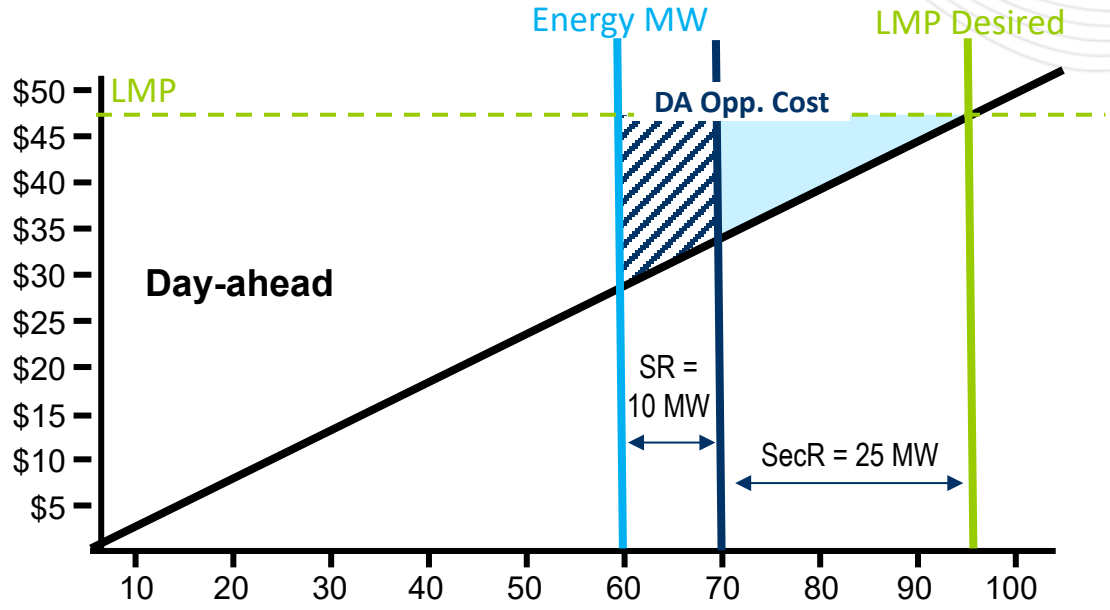
$$\text{Additional Buy Out Cost} = \text{Min}\left[\text{DA Reserve Assignment, RT Reserve Assignment}\right] \text{ X } \left[\text{RT Reserve Clearing Price} - \text{DA Reserve Market Clearing Price}\right]$$

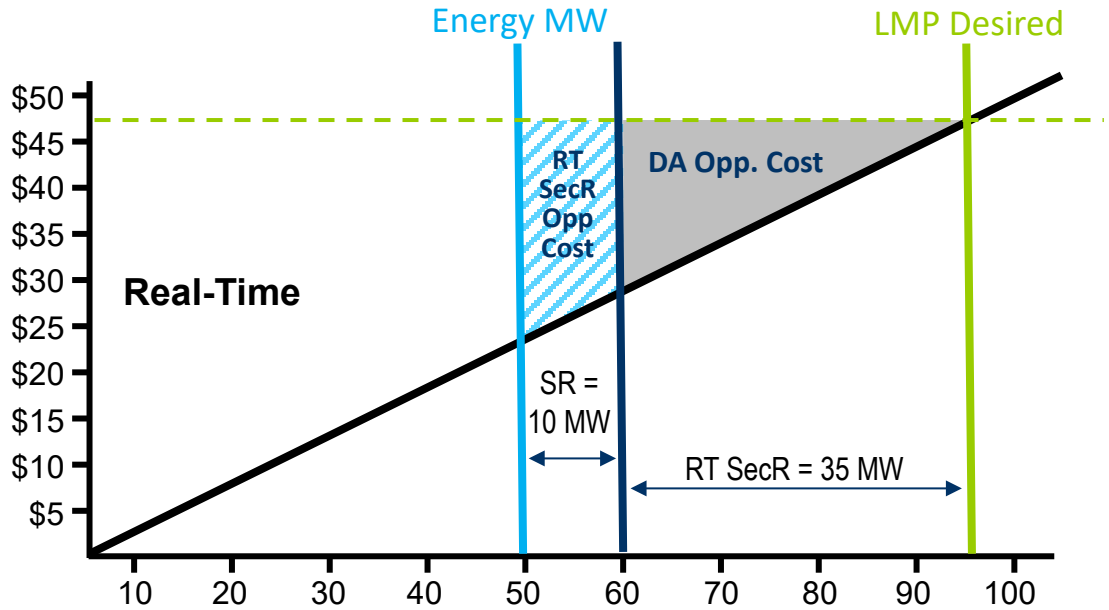
Key Takeaways – Proposed Additional Reserve Market Buy Out Cost

- 30-Minute RUR Buy Out Cost = Min (25 MW, 35 MW) * ($5 - $2) = $75
- SR Buy Out Cost = Min (10 MW, 10 MW) * ($10 - $5) = $50
- The additional buy out cost of $125 is subtracted from the cost side of the uplift equation.
- The buy out cost represents the additional cost (in excess of its DA revenues) the resource would have incurred if assigned for additional energy instead of the RT reserve MW.

Example 2: DA and RT Opportunity Costs – Status Quo Rules

Scenario	In the **DA Market,** resource was reduced from its economically desired output of 95 MW to provide a **25 MW SecR** assignment and **10 MW SR** Assignment.	In the **RT Market,** the resource was reduced from its economically desired output of 95 MW to provide a **35 MW SecR** assignment and **10 MW SR** assignment.





Key Takeaways – DA Reserve Market

- Backed down to provide reserves
- DA SR Assignment = 10 MW
- DA SecR Assignment = 25 MW
- DA SR Opp Cost evaluated from 60 to 70 MW
- DA SecR Opp Cost evaluated from 70 to 95 MW

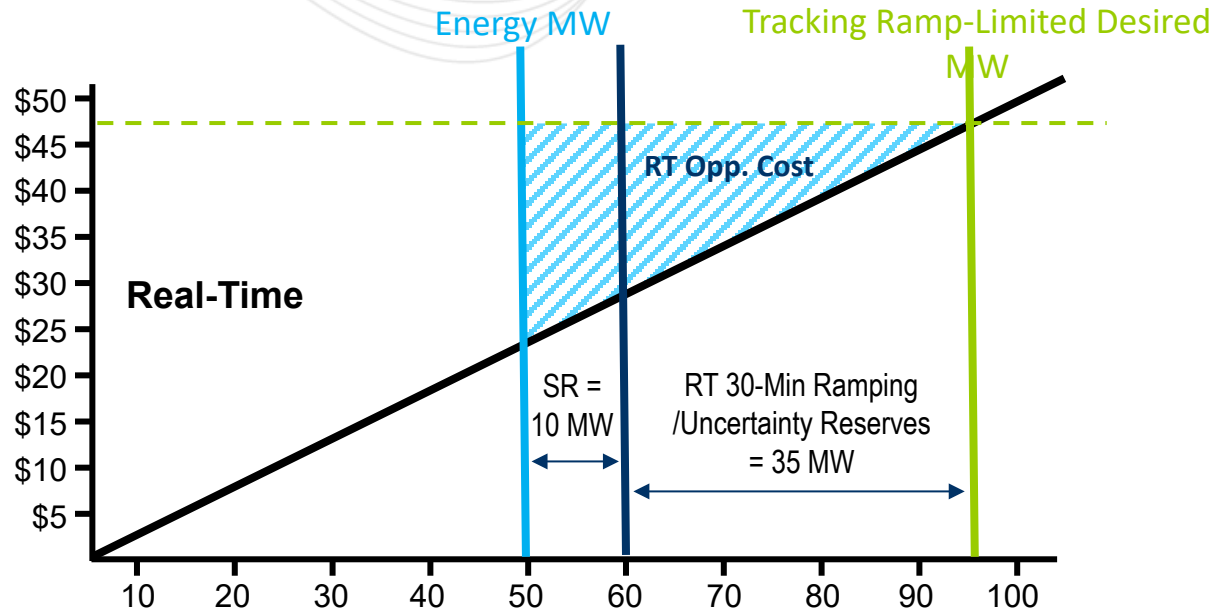
Key Takeaways – RT Reserve Market

- Backed down to provide reserves
- RT SR Assignment = 10 MW (same as DA)
- RT SR opp cost = $0
- RT SecR Assignment = 35 MW
- RT SecR Opp Cost evaluated for **additional** deviation in MW to provide RT SecR assignment, from 50 to 60 MW

Example 2: RT Reserve Market Opportunity Cost – Proposed Rules

Scenario	In the **DA Market,** resource was reduced from its economically desired output of 95 MW to provide a **25 MW 30-Min RUR** assignment and **10 MW SR** Assignment.	In the **RT Market,** the resource was reduced from its economically desired output of 95 MW to provide a **35 MW 30-Min RUR** assignment and **10 MW SR** assignment.

*Same scenario as previous example except replaced SecR assignments with 30-Min RUR assignments



Key Takeaways – Proposed RT Reserve Market Opportunity Cost

- Backed down to provide both the RT SR Assignment and the RT 30 RUR Assignment
- Unified RT Opp Cost evaluated for amount the resource was backed down to provide all RT Reserve assignments.
- Since reserve product assignments can shift between the DA and RT Markets, the proposed rules remove the complexity required to associate costs to a specific reserve market.

Example 2: Additional Buy Out Cost – Proposed Rules

Scenario:	In the **DA Market**, resource has the following assignments: **25 MW 30-Min RUR** assignment @ $2 MCP **10 MW SR** assignment @ $5 MCP	In the **RT Market**, resource has the following assignments: **35 MW 30-Min RUR** assignment @ $5 MCP **10 MW SR** assignment @ $10 MCP

$$\text{Additional Buy Out Cost} = \text{Min}\left[\text{DA Reserve Assignment, RT Reserve Assignment}\right] \text{ X } \left[\text{RT Reserve Clearing Price} - \text{DA Reserve Market Clearing Price}\right]$$

Key Takeaways – Proposed Additional Reserve Market Buy Out Cost

- 30-Minute RUR Buy Out Cost = Min (25 MW, 35 MW) * ($5 - $2) = $75
- SR Buy Out Cost = Min (10 MW, 10 MW) * ($10 - $5) = $50
- The additional buy out cost of $125 is subtracted from the cost side of the uplift equation.
- The buy out cost represents the additional cost (in excess of its DA revenues) the resource would have incurred if assigned for additional energy instead of the RT reserve MW

MRNO / Opp Cost Owed Changes

- Under both the current and proposed rules, a resource is not made whole for negative revenues stemming from buying out of the DA reserve market if the resource's own actions caused the reserve assignment to decrease in real-time.
- Eligibility rules define the scenarios that disqualify a resource for being made whole for these costs.
- With the introduction of new reserve markets, the list of actions should be reviewed and updated, accordingly.

- **Example: Status Quo Synchronized Reserve eligibility rules from OATT Attachment K Appendix Section 3.2.3A (f)(iii)**

A resource is not eligible for Market Revenue Neutrality Offset for Synchronized Reserve in a Real-time Settlement Interval for any of the following conditions:

(A) A resource's real-time Synchronized Reserve assignment decreases due to the resource being self-scheduled to provide energy or Regulation;

(B) A resource reduces its flexibility in real-time such that the resource no longer qualifies to provide Synchronized Reserve in real-time;

(C) A resource's Final Offer is less than its Committed Offer;

(D) A resource trips offline or otherwise becomes unavailable in real-time;

(E) A resource does not follow dispatch as described in section 3.2.3(o) above and section 3.2.3(o-1) above; or

(F) A resource increases its Synchronized Reserve offer price in the Real-time Synchronized Reserve Market from its offer price in the Day-ahead Synchronized Reserve Market.

Reserve Market Uplift Cost Allocation

- Reserve Market Uplift charges will be allocated as charges to net purchases across all reserve markets based on net purchase ratio share
  - Net Purchases will be defined as real-time load plus exports, offset by any self-scheduled MW
    - This is the same as status quo, except exports will be included in this cost allocation moving forward.

Contact

Facilitator:
Lisa Morelli, Lisa.Morelli@pjm.com

Secretary:
Amanda Egan, Amanda.Egan@pjm.com

SME/Presenter:
Suzanne Coyne,
Suzanne.Coyne@pjm.com

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

Reserve Market Settlements

Acronyms

Acronym	Term & Definition
LMP	**Locational Marginal Price** is defined as the marginal price for energy at the location where the energy is delivered or received. For accounting purposes, LMP is expressed in dollars per megawatt-hour ($/MWh). LMP is a pricing approach that addresses Transmission System congestion and loss costs, as well as energy costs.
SR	**Synchronized Reserves** are reserves provided by resources that are synchronized to the grid and can response within 10 minutes.
RUR	**Ramping/Uncertainty Reserves** are reserves that would be procured to manage forecasted ramp and uncertainty operational flexibility needs.

PJM Glossary

Appendix

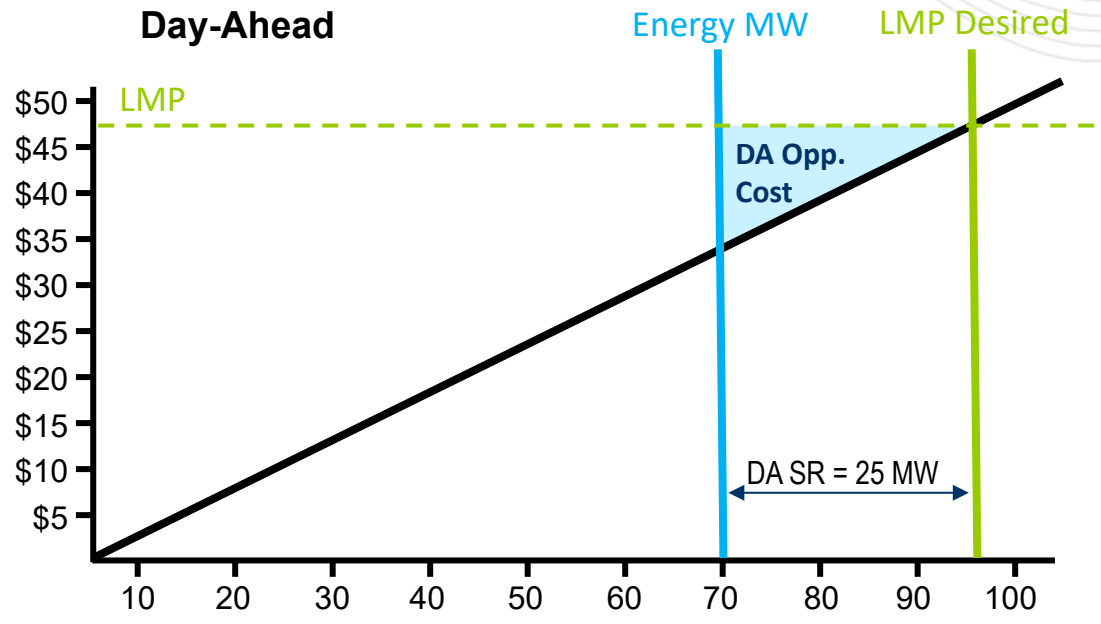
The slides in this appendix describe the STATUS QUO reserve market settlement rules. They are included to provide additional context around the need for reform as presented in the preceding slides.

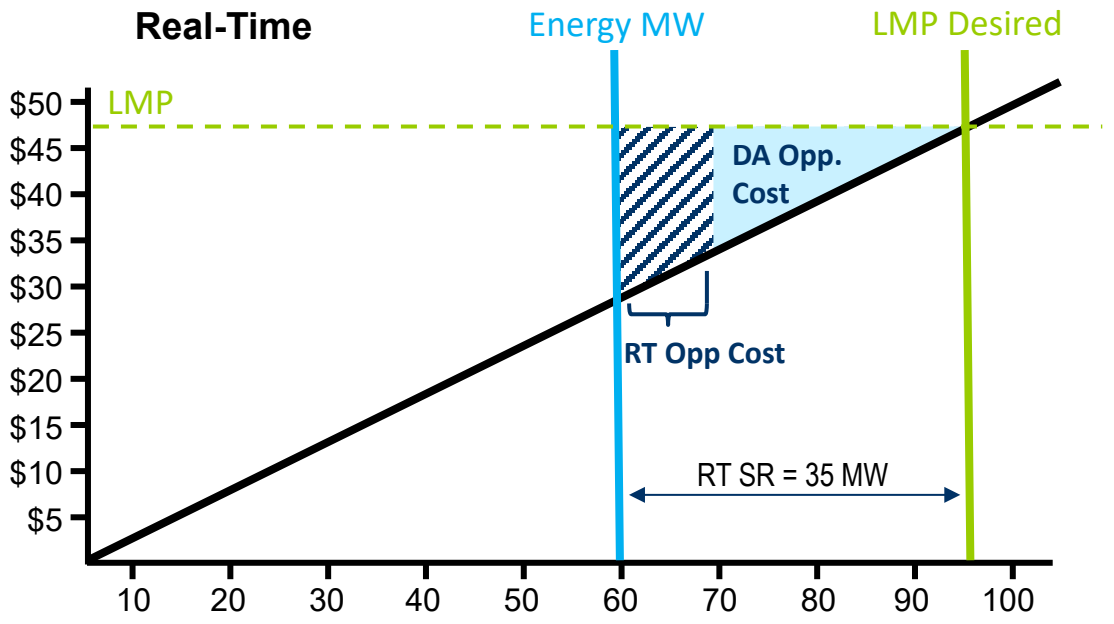
DA and RT Interactions – Status Quo

Scenario

In the **DA Market**, resource was reduced from its economically desired output of 95 MW to provide a **25 MW SR** assignment.

In the **RT Market**, resource was reduced from its economically desired output of 95 MW to provide a **35 MW SR** assignment.





Key Takeaways – DA Reserve Market

- Backed down to provide reserves
- DA SR Assignment = 25 MW
- DA Opp Cost evaluated from 70 MW to 95 MW

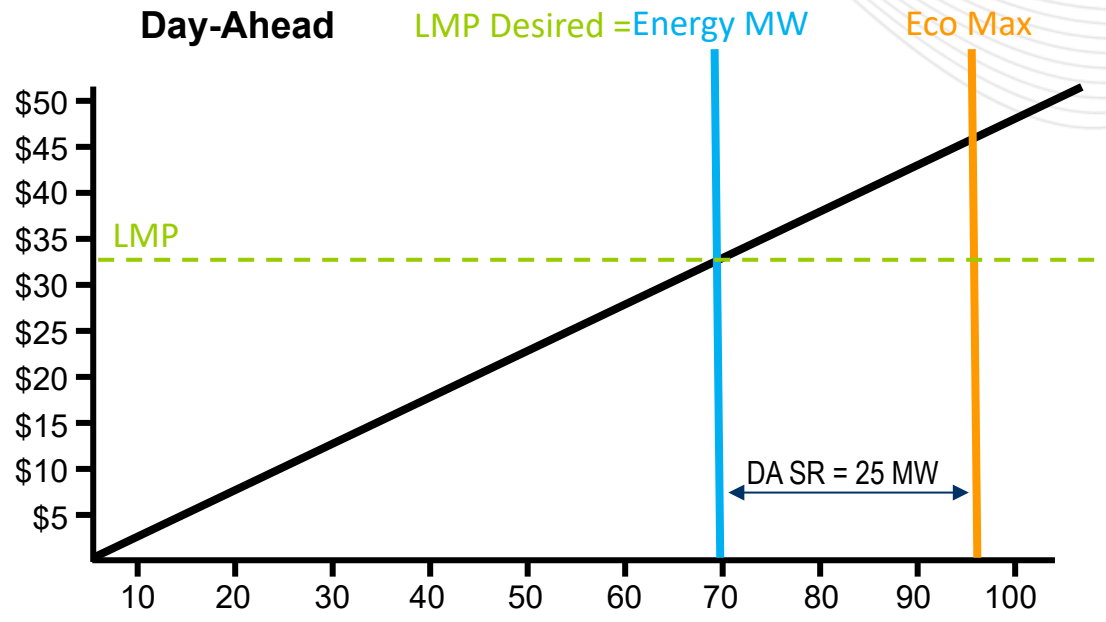
Key Takeaways – RT Reserve Market

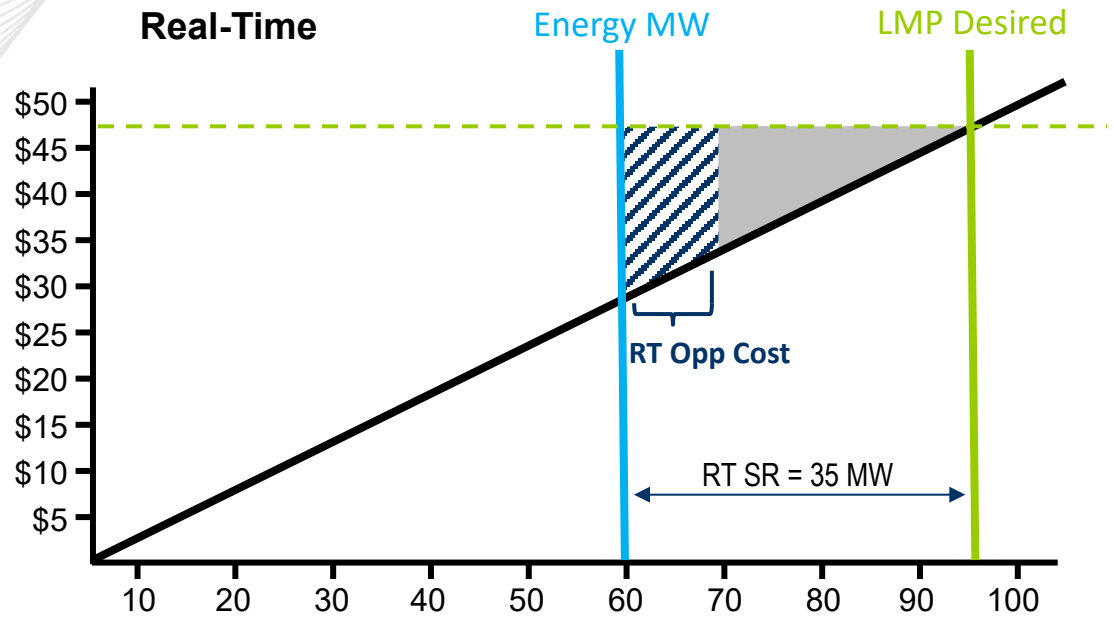
- Backed down to provide additional reserves
- RT SR Assignment = 35 MW
- RT Opp Cost evaluated for additional MW to provide reserves from 60 MW to 70 MW

Scenario

In the **DA Market**, resource has headroom to provide a **25 MW SR** assignment and is not required to reduce from its economically desired output to provide the reserves.

In the **RT Market**, resource was reduced from its economically desired output of 95 MW to provide a **35 MW SR** assignment.





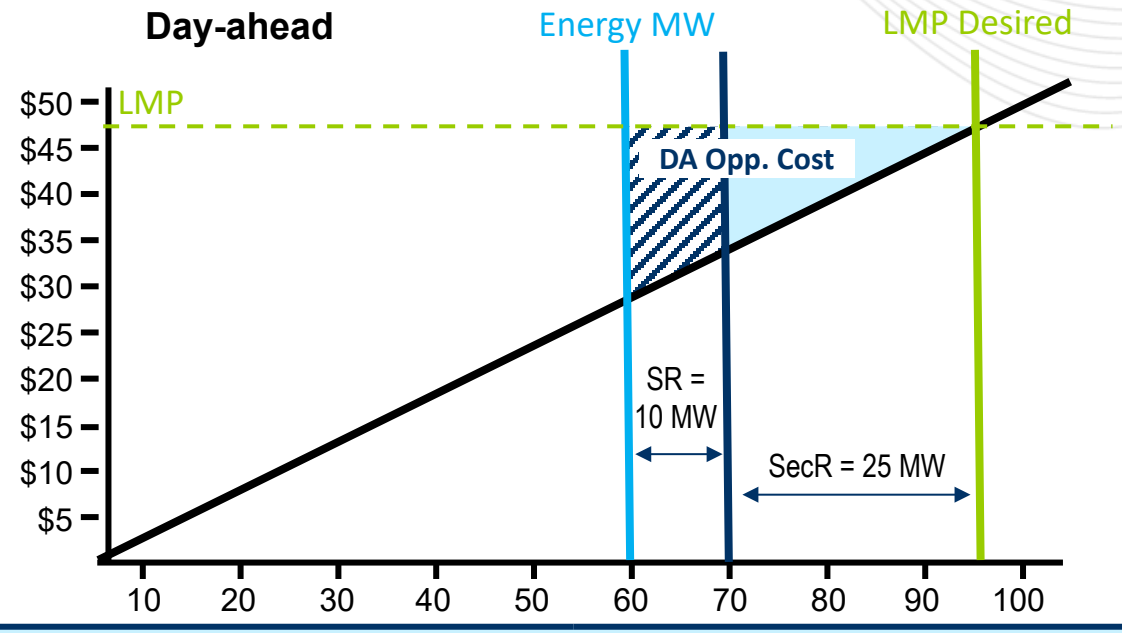
Key Takeaways – DA Reserve Market

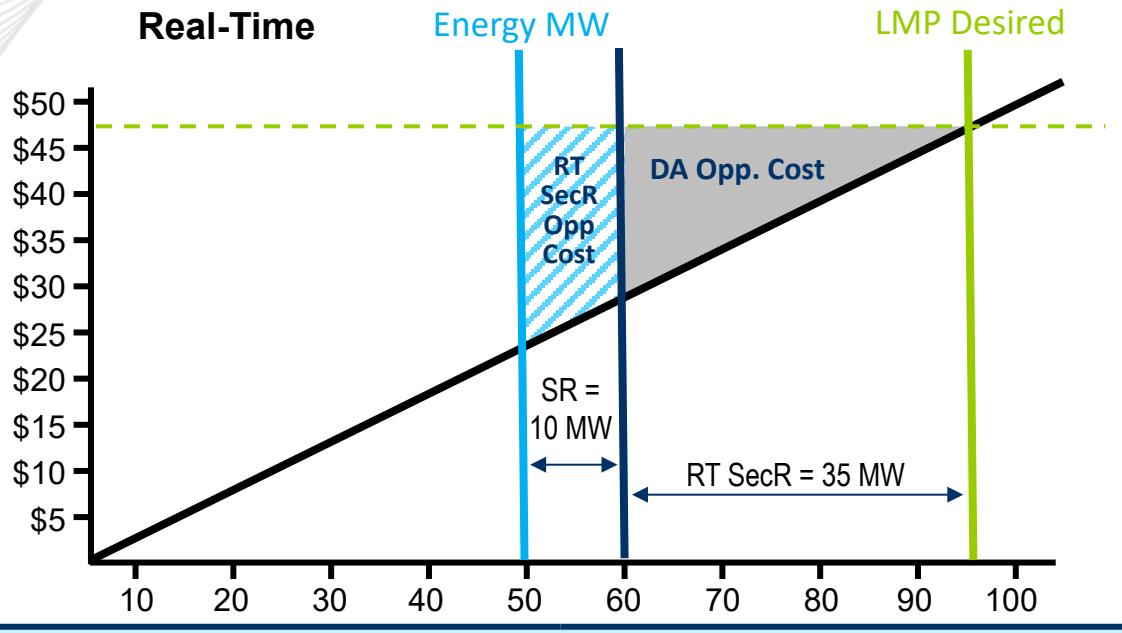
- DA SR Assignment = 25 MW
- Resource did not forgo energy revenues to provide reserves (LMP Desired = Energy MW)
- DA Opp Cost = $0

Key Takeaways – RT Reserve Market

- RT SR Assignment = 35 MW
- Resource backed down from LMP desired of 95 MW to provide reserves
- RT Opp cost is calculated for the additional 10 MW deviation from its DA output of 70 MW to provide the reserve assignment
- RT Opp Cost evaluated from 60 MW to 70 MW

Scenario	In the **DA Market,** resource was reduced from its economically desired output of 95 MW to provide a **25 MW SecR** assignment and **10 MW SR** Assignment.	In the **RT Market,** the resource was reduced from its economically desired output of 95 MW to provide a **35 MW SecR** assignment and **10 MW SR** assignment.





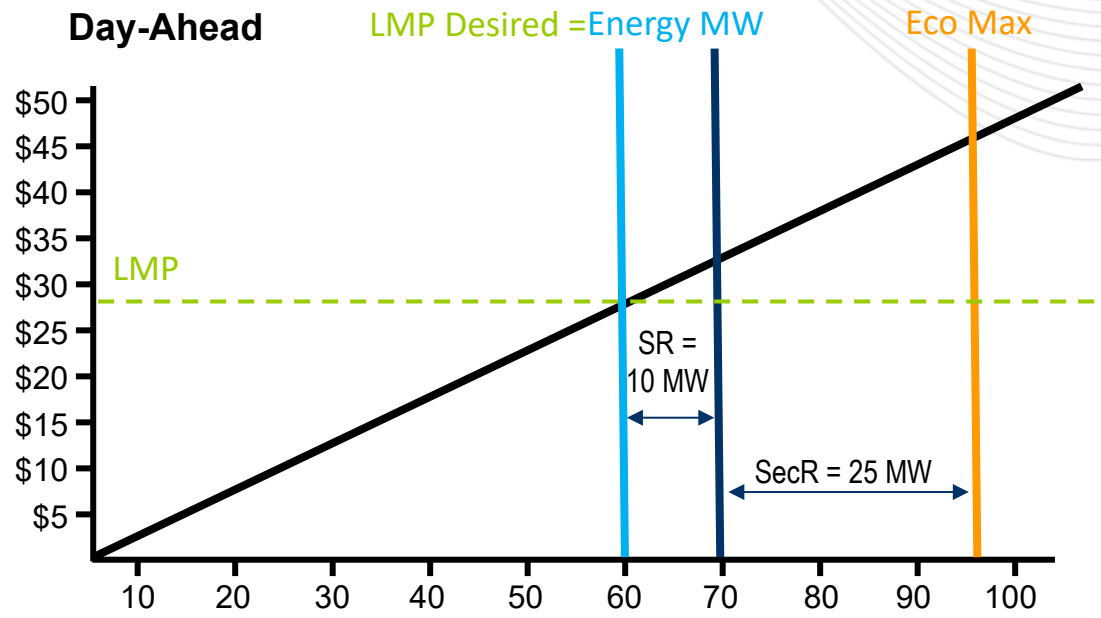
Key Takeaways – DA Reserve Market

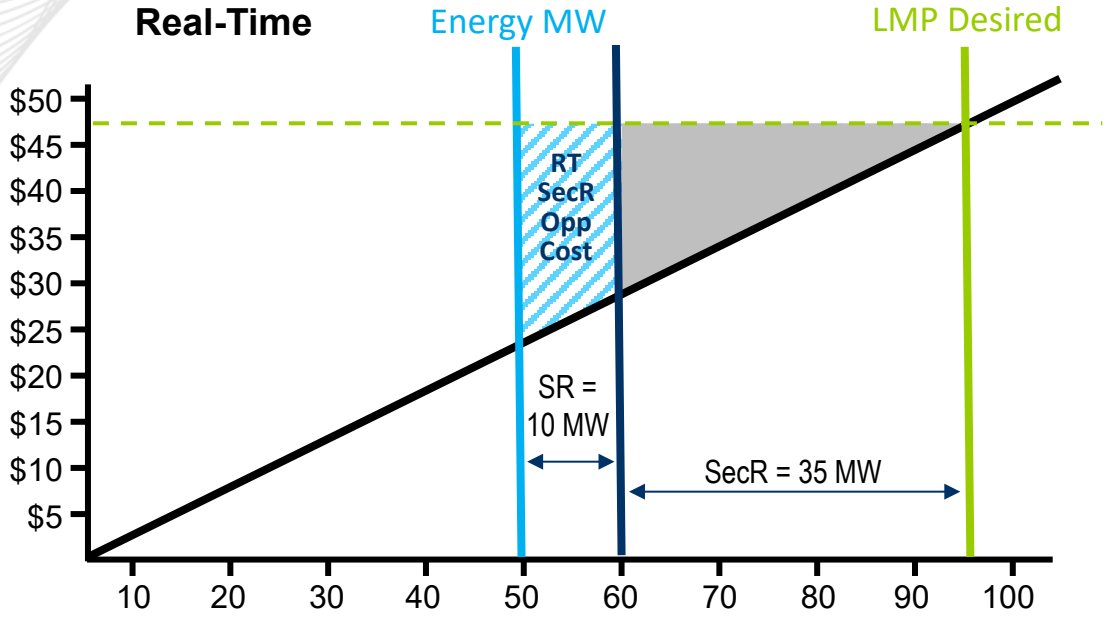
- Backed down to provide reserves
- DA SR Assignment = 10 MW
- DA SecR Assignment = 25 MW
- DA SR Opp Cost evaluated from 60 to 70 MW
- DA SecR Opp Cost evaluated from 70 to 95 MW

Key Takeaways – RT Reserve Market

- Backed down to provide reserves
- RT SR Assignment = DA SR Assignment = 10 MW
- RT SR opp cost = $0
- RT SecR Assignment = 35 MW
- RT SecR Opp Cost evaluated for **additional** deviation in MW to provide RT SecR assignment, from 50 to 60 MW

Scenario	In the **DA Market**, resource has headroom to provide a **25 MW SecR** assignment and **10 MW SR** assignment and is not required to reduce from its economically desired output to provide reserves.	In the **RT Market**, resource was reduced from its economically desired output of 95 MW to provide a **35 MW SecR** assignment and **10 MW SR** assignment.





Key Takeaways – DA Reserve Market

- DA SR Assignment = 10 MW
- DA SecR Assignment = 25 MW
- Resource did not forgo energy revenues to provide reserves (LMP Desired = Energy MW)
- DA SR Opp Cost = $0
- DA SecR Opp Cost = $0

Key Takeaways – RT Reserve Market

- Backed down to provide reserves
- RT SR Assignment = DA SR Assignment = 10 MW
- RT SecR Assignment = 35 MW
- RT SR Opp Cost = $0
- RT SecR Opp Cost evaluated from 50 MW to 60 MW
- RT Opp cost is calculated for the additional 10 MW deviation from its DA output of 60 MW to provide the reserve assignment

Key Observations from the Prior Status Quo Examples

- Resources can be simultaneously assigned for more than one reserve product.
- Reserve product assignments can shift between the DA market and RT markets resulting in a shift in RT opportunity cost settlements between products.
- Settlements for RT Opportunity costs is a balancing methodology
  - If a resource is not backed down in the DA market to provide reserves and is backed down in the RT market to provide reserves, this can result in $0 opportunity costs.

Market Revenue Neutrality Offset – Status Quo

- The Market Revenue Neutrality Offset is the calculation we use to ensure a resource isn't made whole for costs recovered via another market.

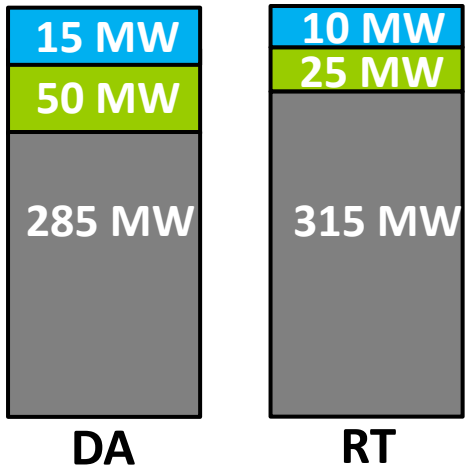
- The Market Revenue Neutrality Offset calculation recognizes any additional profit (revenue above cost) earned in the market(s) with the increased real-time assignment(s) to offset any cost incurred from buying back its day-ahead reserve assignments in the markets where the assignment was decreased in real-time.

- The Market Revenue Neutrality Offset is added to the revenue side of the Lost Opportunity Cost Credit calculation (which shrinks the amount of the buy back they are owed)

Market Revenue Neutrality Offset Example – Status Quo

- Resources are made whole for buying out of their day-ahead reserve positions when that buy out occurred because of PJM's instructions
- The SR and SecR LOC credits for the buy backs are reduced by any profit they earned from the increase in their energy MW so there is no double counting.

Balancing Settlement = (RT MW – DA MW) * RT Price



Synch Reserve = -25 MW * $25 = ($625)

Sec Reserve = -5 MW * $9 = ($45)

Energy = 30 MW * $50 = $1,500

Use profit (any of this revenue above cost) to offset these losses.

Opportunity Cost Credit Owed

- If a resource's own action causes the RT assignment to be less than the DA assignment, the cost of the buy back from the day-ahead reserve assignment becomes the Market Seller's responsibility.
- The Opportunity Cost Credit Owed value captures this cost responsibility and ensures the resource is not made whole for that cost.
- Opportunity Cost Credit Owed is added on the revenue side of the LOC Credit calculation to reduce the amount of LOC Credit the resource will receive.
- Resources will either have a Market Revenue Neutrality Offset value (if eligible) or an Opportunity Cost Credit Owed value (if ineligible). They will not have both offsets in the LOC credit calculation.
- Pool-scheduled resources may also be eligible for energy make whole payments (Balancing Operating Reserves). Any Market Revenue Neutrality Offset profit transferred to reserves is also accounted for in the energy make whole calculations.

PROTECT THE POWER GRID

THINK BEFORE YOU CLICK!

pjm

BE ALERT TO MALICIOUS PHISHING EMAILS

Report suspicious email activity to PJM.

Call (610) 666-2244 or email it_ops_ctr_shift@pjm.com