Intraday Offers Education

August 7, 2017

PJM©2017

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 or any pending FERC Filings or Orders.

http://www.pjm.com/documents/agreements/pjmagreements.aspx

PJM©2017

Agenda

Introduction	**9:30 a.m. – 9:40 a.m.**
Day-Ahead Market / Rebid / Intraday Period	9:40 a.m. – 10:15 a.m.
Break	10:15 a.m. – 10:30 a.m.
DR/Ancillary Services/Switch to Cost/TPS/Opt-Out / Dual Fuel Availability	11:00 a.m. – 12:00 a.m.
Lunch	12:00 p.m. – 12:45 p.m.
Settlements	12:45 p.m. – 1:55 p.m.
Break	1:55 p.m. – 2:05 p.m.
Offer Validation	2:05 p.m. – 3:55 p.m.
Close	**3:55 p.m. – 4:00 p.m.**

PJM©2017

Introduction

PJM©2017

Intraday Offer Overview

- Introduction of Intraday Offers (IDO) will enable hourly differentiation and modifications for certain parameters of supply offers for
  - Generation Resources
  - Demand Resources
- Benefits:
  - Allows Energy Market offers to be more flexible
  - Allows participants to more accurately reflect costs throughout the operating day
  - Improved coordination with the gas market timing

PJM©2017

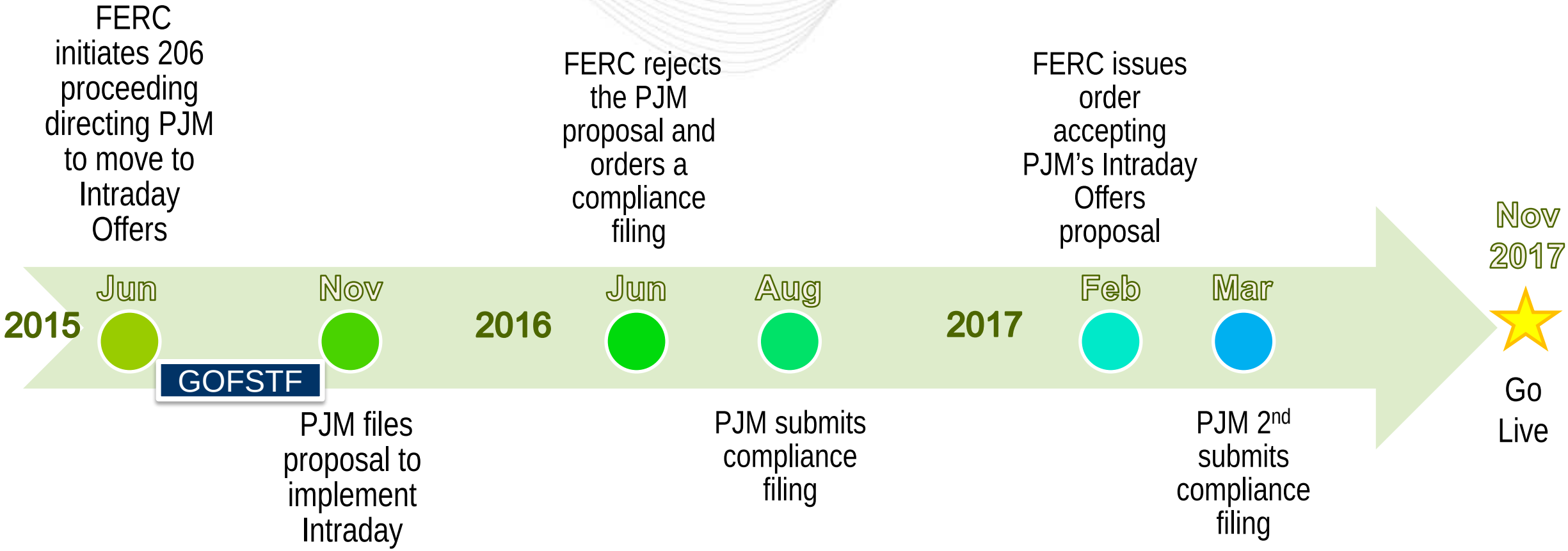
Key Features of Intraday Offers

	Today	IDO
Offer Curve Granularity	Daily Curve	Hourly Differentiated Curves
Update Timeline	No updates after Rebid Period	Updates permitted 65 minutes prior to operating hour*
Regulation and Sync Reserve Offer Flexibility	Daily Offer	Hourly Offer
Dual Fuel Flexibility	Election made day before; updates made 3 hours in advance of operating hour	65 minutes in advance of operating hour
Market Mitigation	Offline units evaluated	Online and Offline units evaluated, Self-Scheduled units included

*Subject to business rules specified in later slides

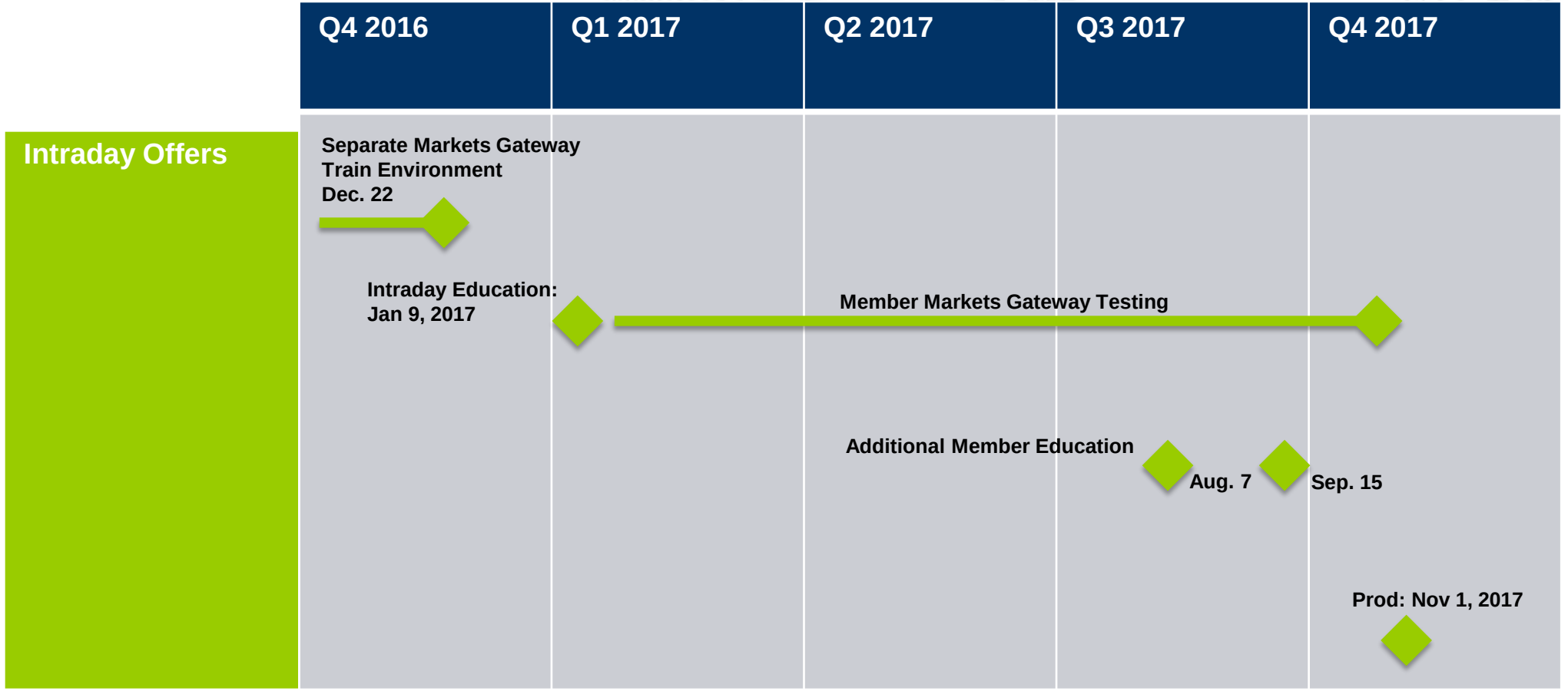
PJM©2017

Intraday Offers (Hourly Offers) Filing History



PJM©2017

Intraday Offers Roadmap



Market trials scheduled for September 19 & 20, and October 4 & 5

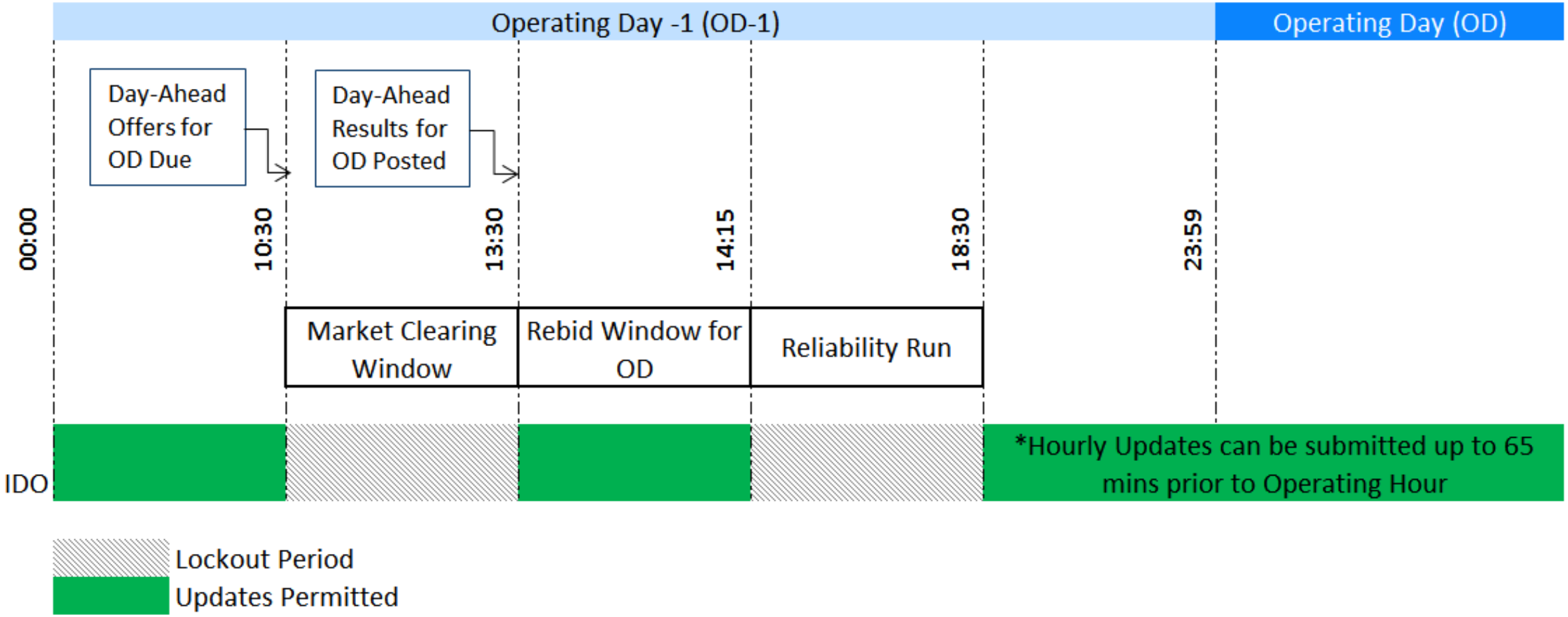
PJM©2017

Market Trials

- Market trial days will be available on Sep. 19 & 20, as well as on Oct. 4 & 5. Markets personnel will be dedicated to answering questions and helping to resolve any issues
- Users will have the ability:
  - To enter DA daily and differentiated offer information
  - See DA results daily on the Markets Results screen
  - Exercise price updates for committed/uncommitted schedules
  - Enter hourly updates while observing lock-out periods
- Notes:
  - All of the above are available on a daily basis, everyday
  - Intraday Offers Train environment does not have RT engines, or RT dispatching
  - Although there are no RT commitments, DA commitments can be used to experience price updates for committed/uncommitted schedules and lockout periods
  - There is no Settlements capability

PJM©2017

Submitting and Updating Offer Timelines



PJM©2017

General Impacts

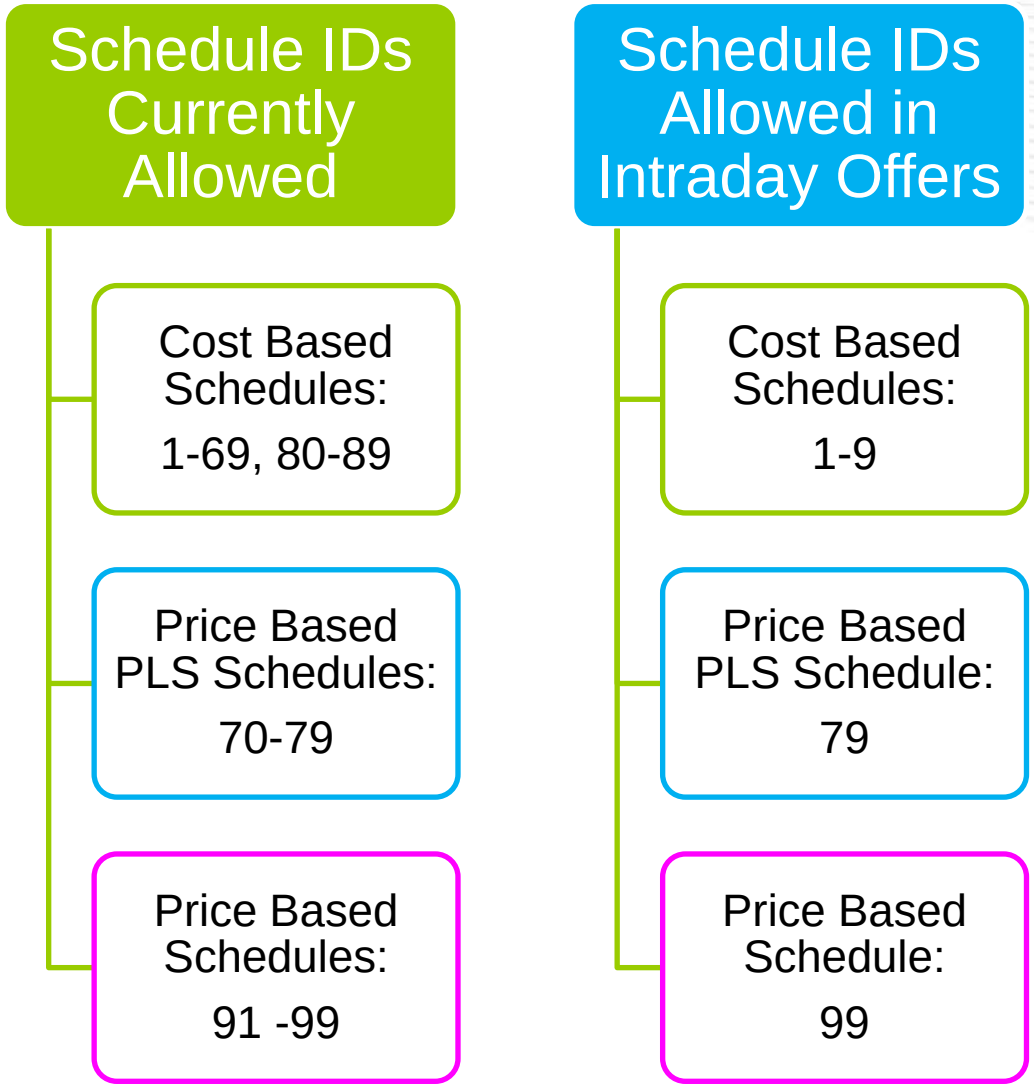
PJM©2017

Change to Allowable Schedule IDs

- The implementation of Intraday Offers will limit the schedule IDs that can be created and offered
  - This impacts **all** Generation resources, not just those that plan to update schedules hourly
- Schedules using IDs not in the new list cannot be made available in Markets Gateway starting on the November 1 market day
- Members should begin using the reduced number of Intraday Offers schedule IDs at their earliest convenience to minimize the implementation impact

PJM©2017

Converting Schedule IDs



- PJM posted a step by step guide with instructions to:
  - Create new schedules with the accepted IDs
  - Download existing schedule details to copy to the new accepted IDs
  - Guide to Convert Schedule IDs in Markets Gateway has been added to the Markets Gateway Tools page, under Intraday Offers
- Will require Market Seller action by October 31 in order to offer into the Day-Ahead Market on November 1

PJM©2017

Schedule Market Type

- Today Generation schedules can be assigned a Market Type
  - Day-Ahead
  - Balancing
  - Both
- With the Intraday Offers Implementation, this Market Type field will be removed from the Schedule Detail and Schedule Selection screens
- Non-Capacity Resources wishing to offer only in Real Time may change the unit's Commit Status from Unavailable prior to DA to Available after the DA Market

PJM©2017

Schedule Market Type

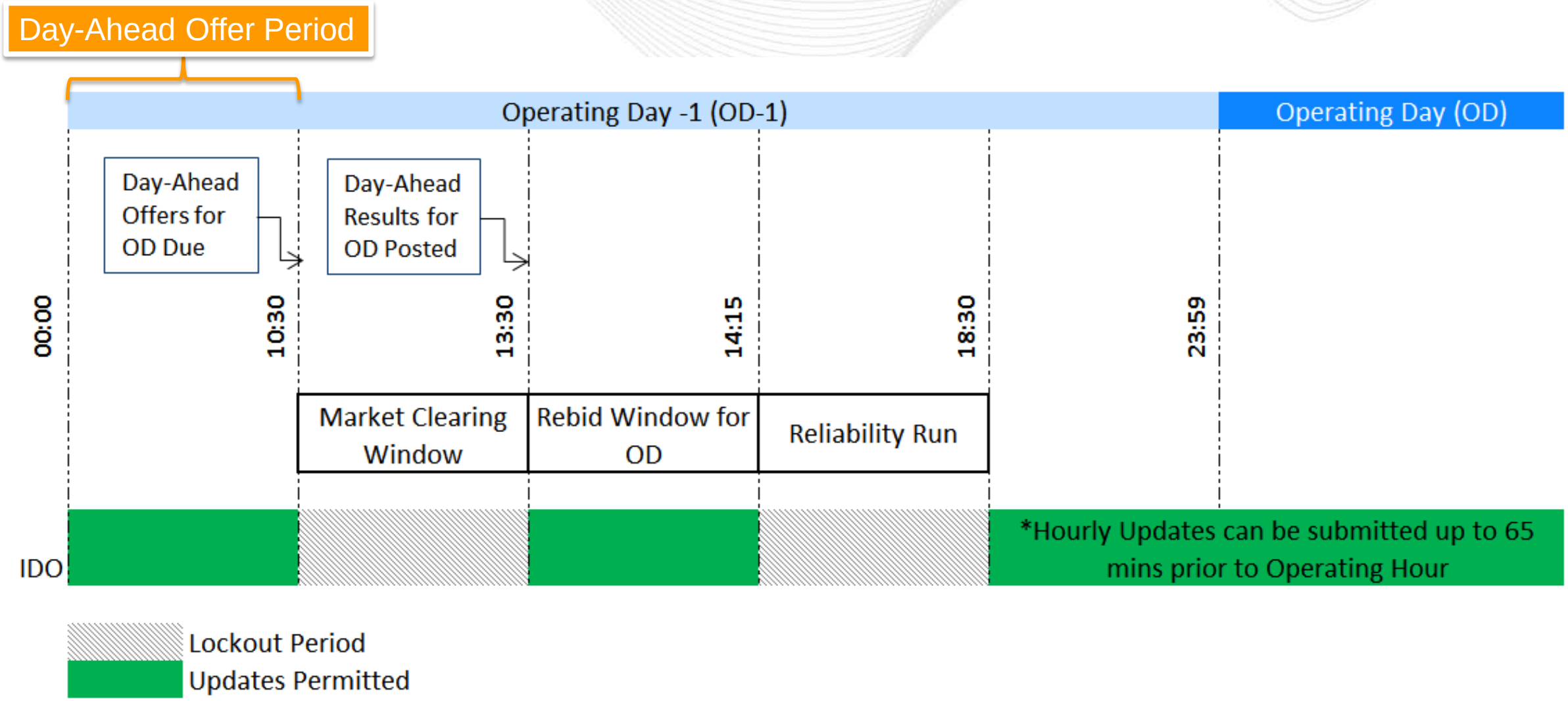
- Units wishing to offer differently between DA and RT can update schedule availability during the Rebid Period
  - Exceptions exist for Dual Fuel units
- May update the offer intraday

PJM©2017

Impacts to Day-Ahead Market Offers

PJM©2017

Impacts to Day-Ahead Offers



PJM©2017

Impacts to Day-Ahead Offers

- Segmented Ramp Rate will be considered in Day-Ahead Market Clearing starting November 1
- Schedule availability will continue to be designated on a daily basis, however will be able to change offer curves and certain parameters that differ on an hourly basis.
- Parameters include:
  - No Load Cost
  - Startup Cost (Cold, Intermediate, Hot)
- New screens will be added to Markets Gateway to support the hourly differentiated values
  - Offer Updates
  - Detail Updates

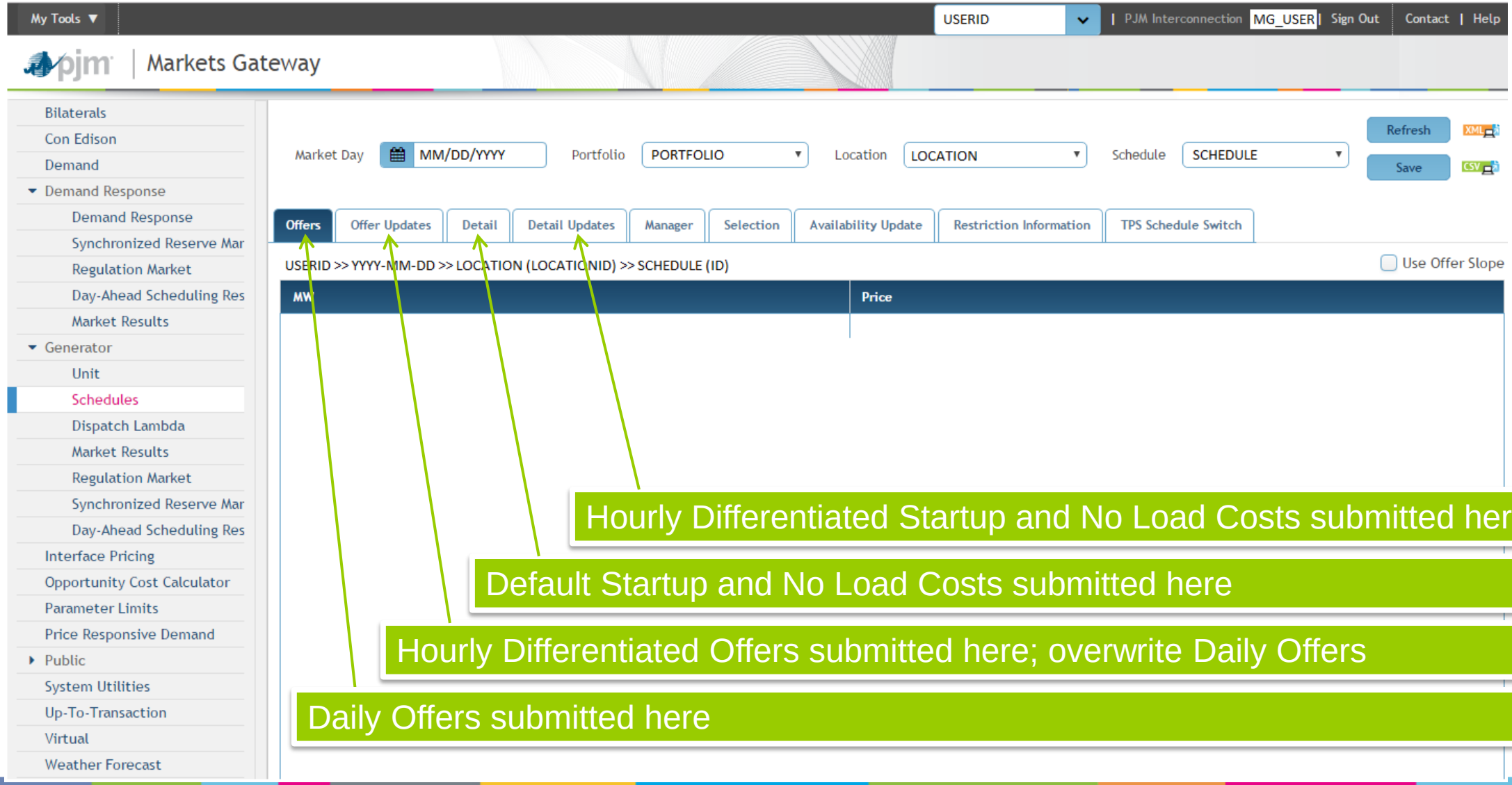
PJM©2017

Impacts to Day-Ahead Offers

- Daily offers and parameters must continue to be submitted
- Hourly differentiated values supersede the daily values on the Offer and/or Detail pages
  - Hourly differentiations are made via the Offer Updates or Detail Updates pages of Markets Gateway
- Hourly differentiated values made on the Offer Updates or Detail Updates pages are not carried over into the next operating day

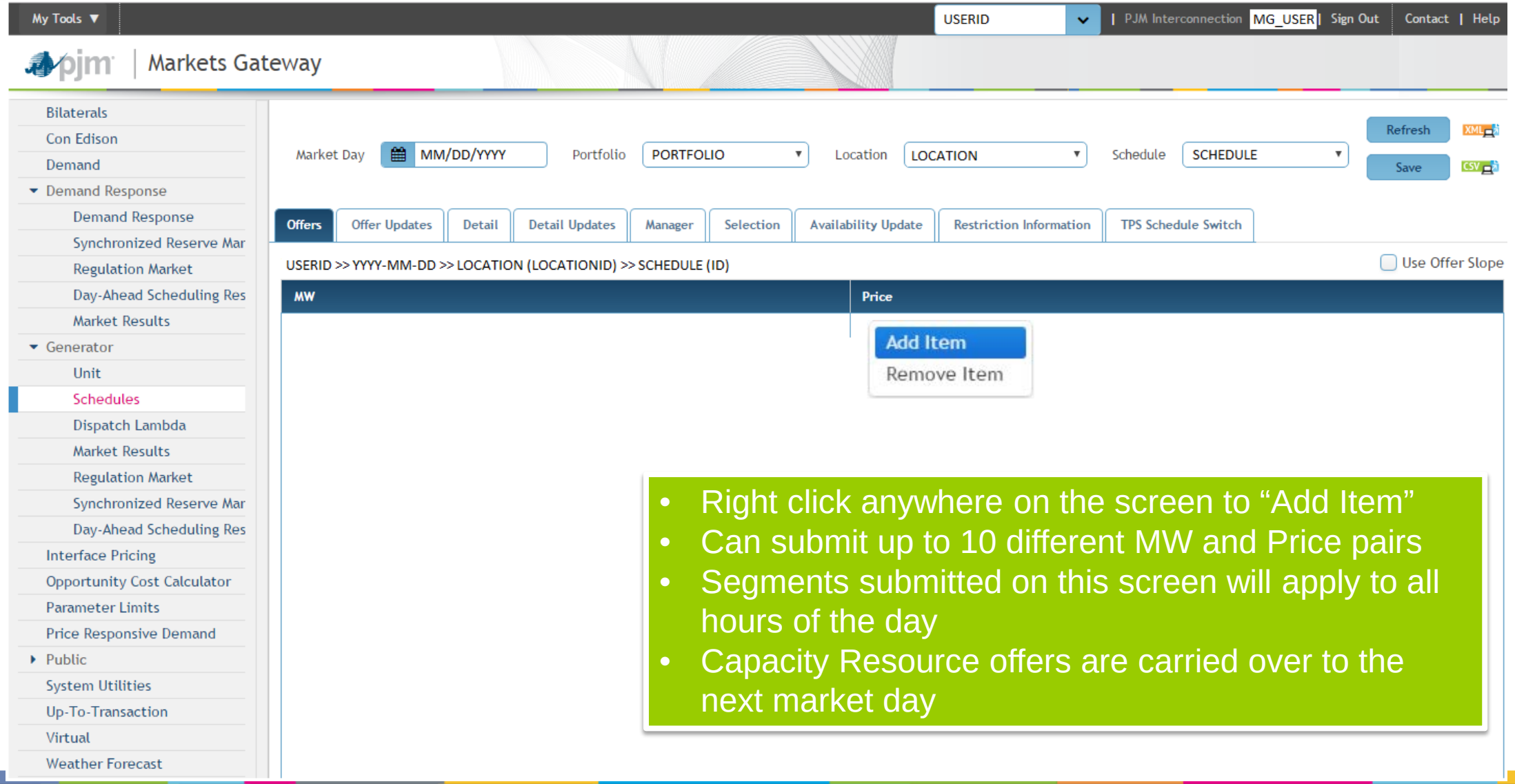
PJM©2017

Markets Gateway Screens



PJM©2017

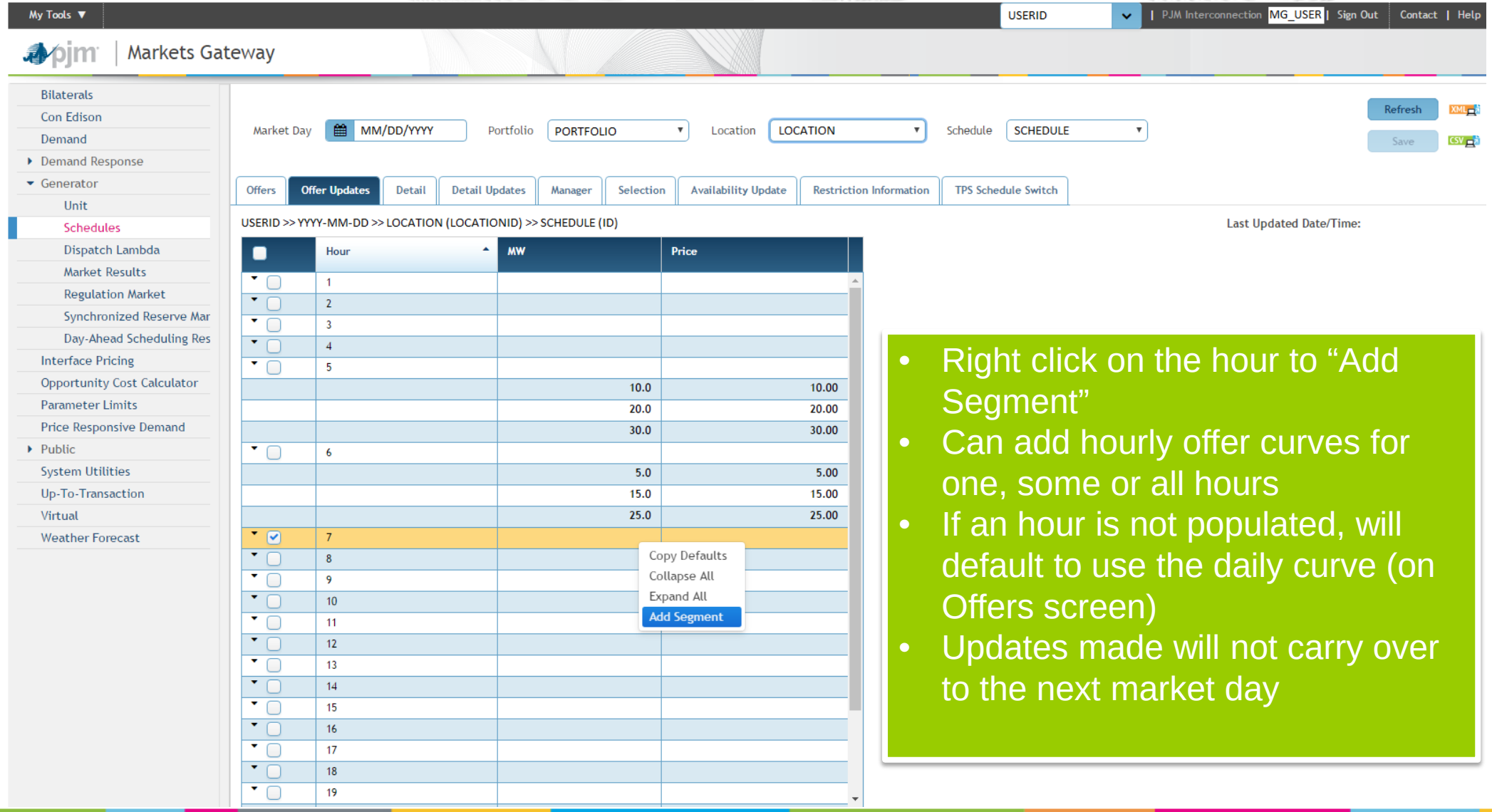
Offers Screen in Markets Gateway



- Right click anywhere on the screen to “Add Item”
- Can submit up to 10 different MW and Price pairs
- Segments submitted on this screen will apply to all hours of the day
- Capacity Resource offers are carried over to the next market day

PJM©2017

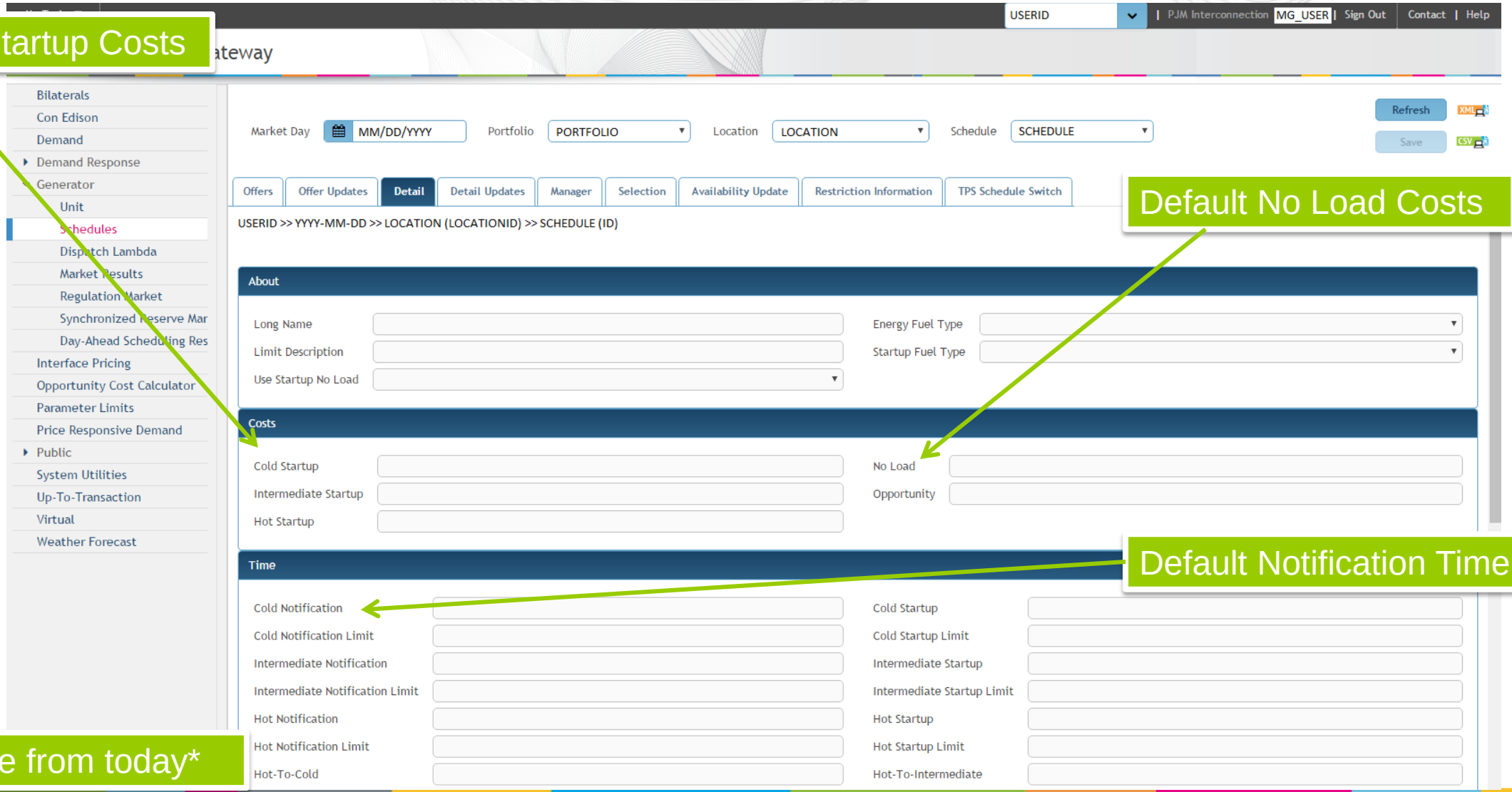
Offer Updates Screen in Markets Gateway



- Right click on the hour to “Add Segment”
- Can add hourly offer curves for one, some or all hours
- If an hour is not populated, will default to use the daily curve (on Offers screen)
- Updates made will not carry over to the next market day

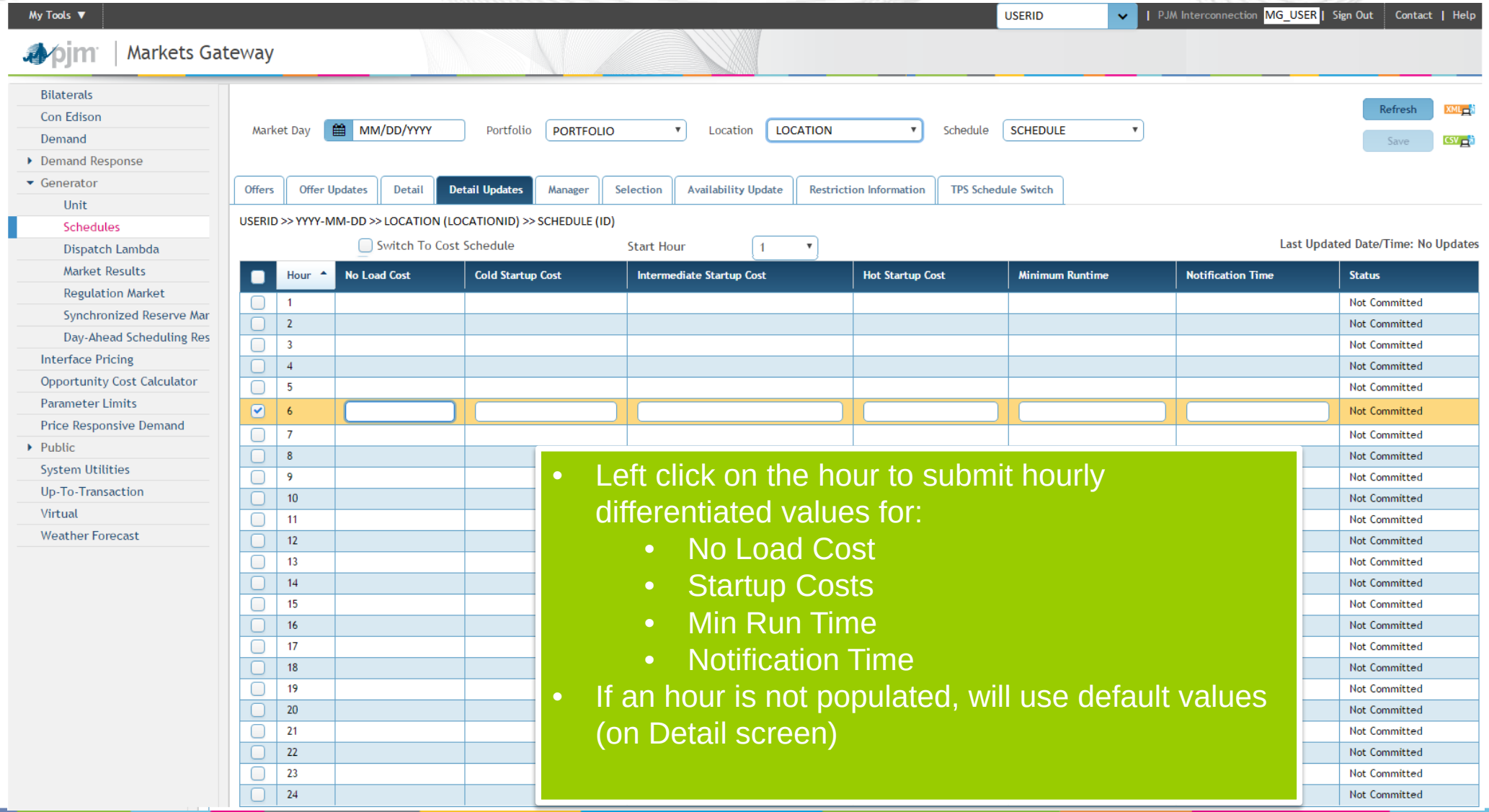
PJM©2017

Detail Screen in Markets Gateway



PJM©2017

Detail Updates Screen in Markets Gateway



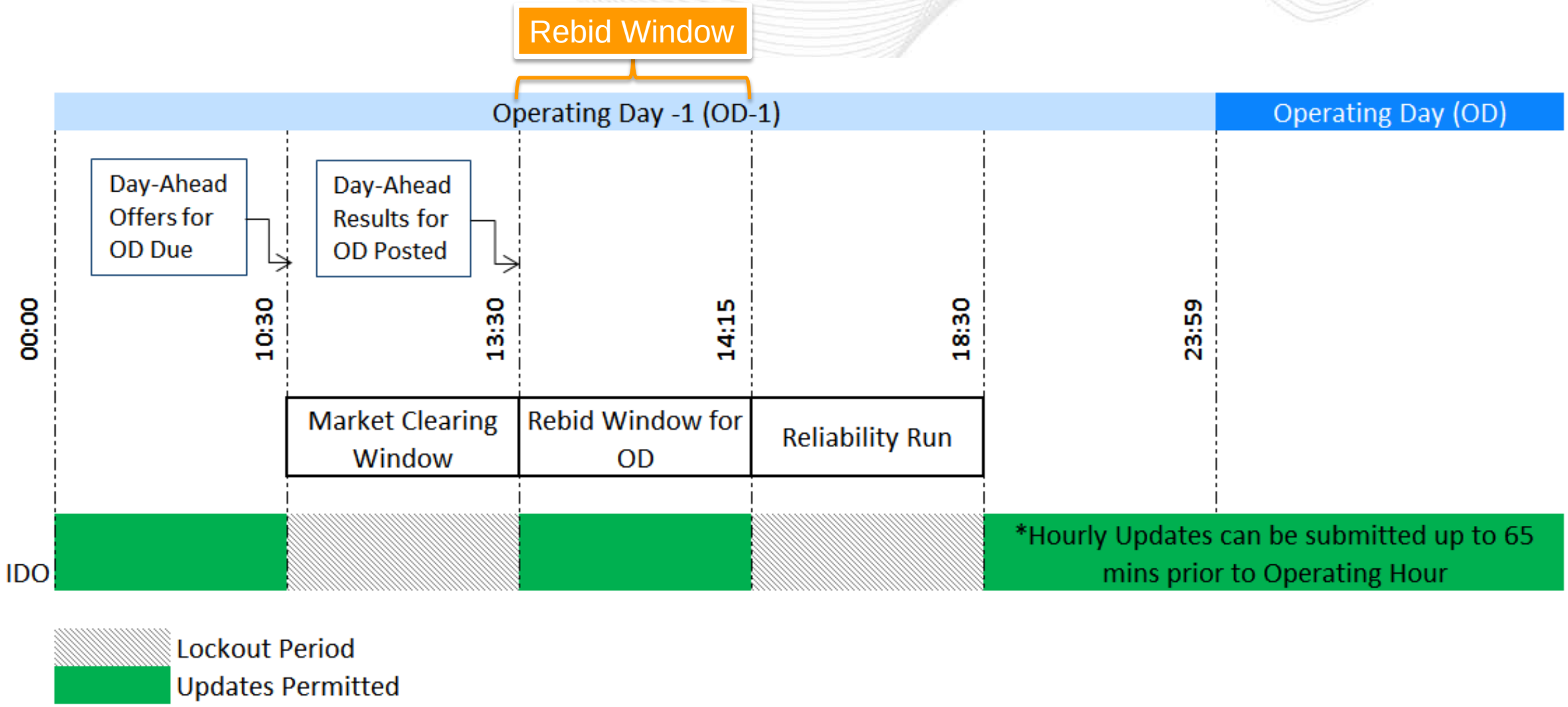
- Left click on the hour to submit hourly differentiated values for:
  - No Load Cost
  - Startup Costs
  - Min Run Time
  - Notification Time
- If an hour is not populated, will use default values (on Detail screen)

PJM©2017

Updates to Offers during Rebid Period

PJM©2017

Impacts to Rebid Period



PJM©2017

Updating Offers During Rebid Period

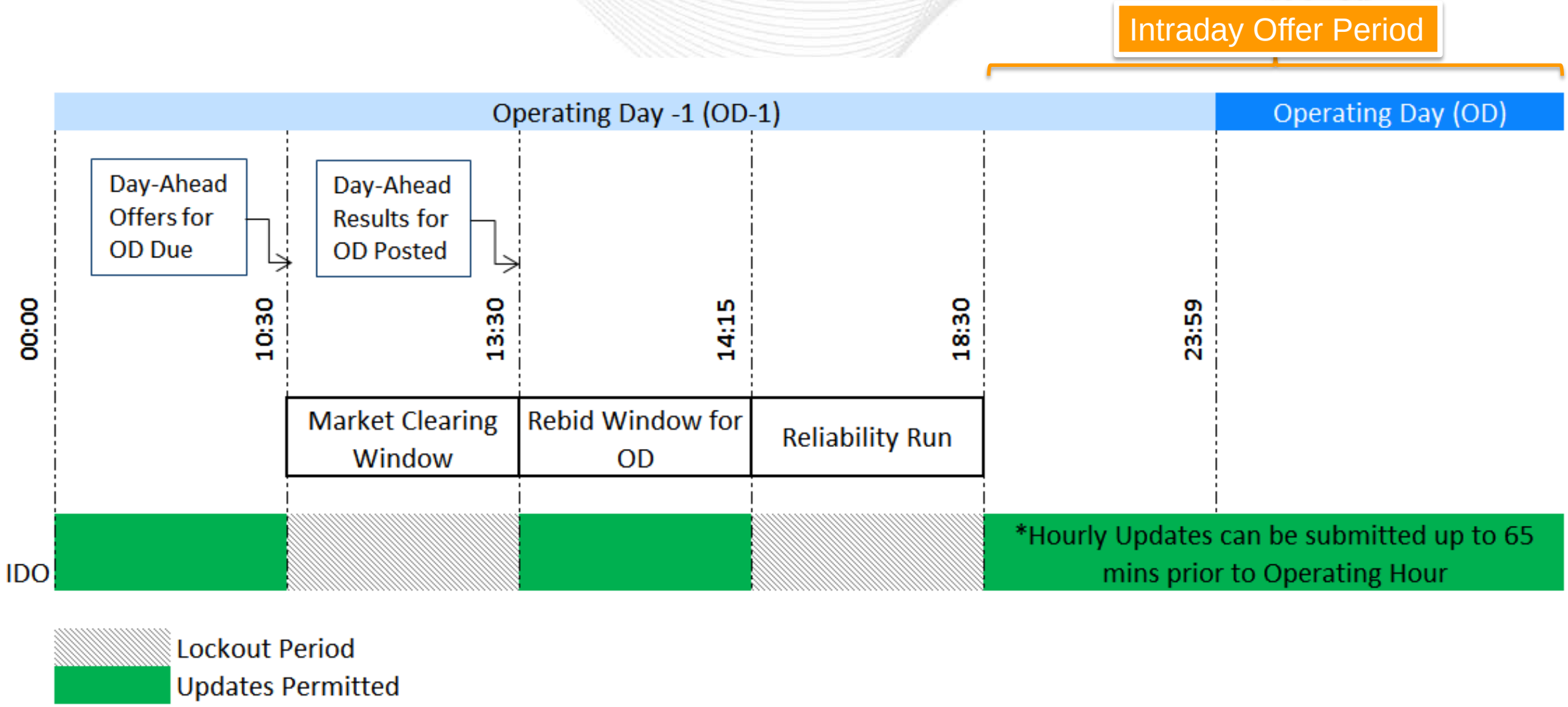
		Today	IDO
Committed Day-Ahead	Offer MW	No updates permitted for entire day	No updates permitted for committed hours
	Offer Price	No updates permitted for entire day	Updates permitted to offer price for all hours (price schedule offer price cannot be increased for an hour that is committed)
Not Committed Day-Ahead	Offer MW	Updates may be submitted prior 1415	Updates may be submitted prior 1415
	Offer Price	Updates may be submitted prior 1415	Updates may be submitted prior 1415, and again after 1830

PJM©2017

Intraday Updates to Offers

PJM©2017

Impacts to Real Time Offers



PJM©2017

Intraday Updates to Energy Offers

- Generation offers can be updated after the Reliability Run is complete, starting at 18:30 up to 65 minutes prior to operating hour
- Potential Updates to Offers include:
  - Price component of the Offer Segment
  - No load and Startup Costs
  - Notification Time
  - Min Run Time
  - Switch to Cost Schedule

PJM©2017

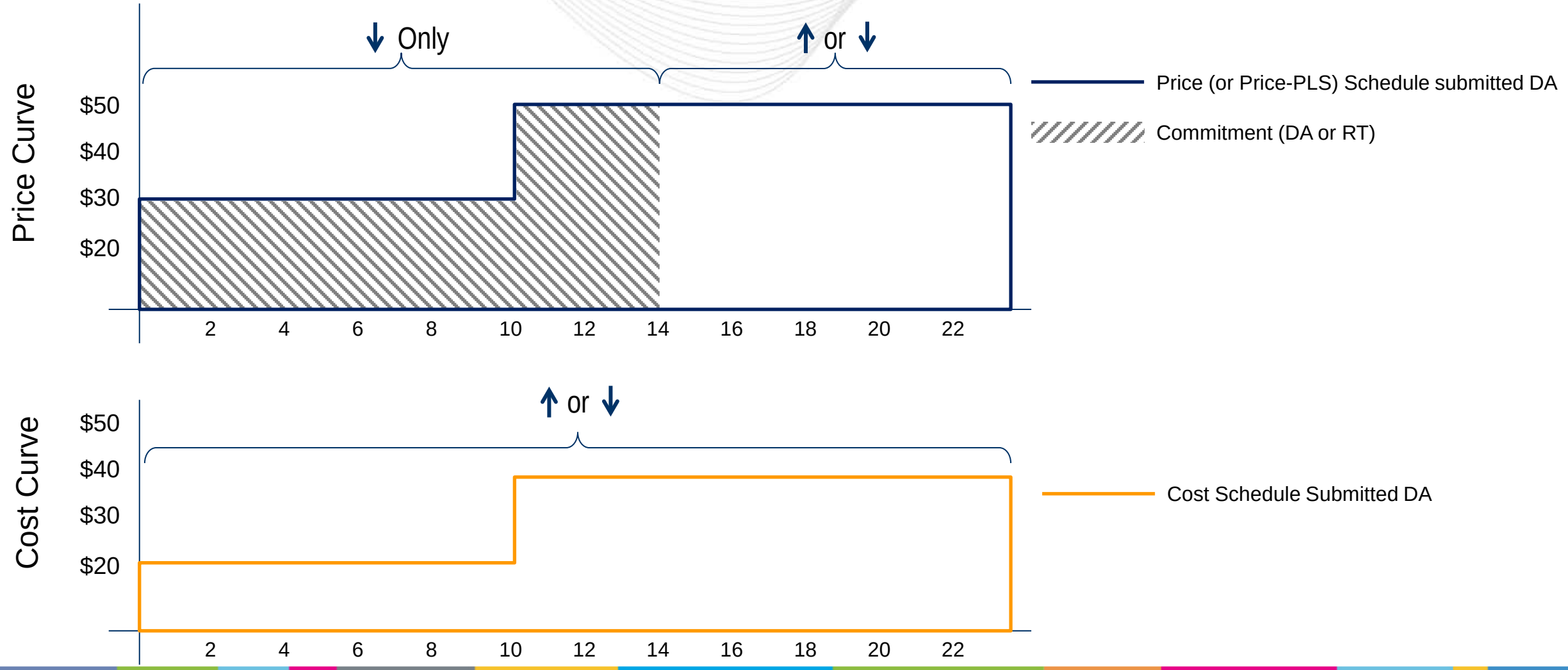
Incremental Energy Offer Price Updates

Type of Unit	Type of Schedule	Committed Hours	Uncommitted Hours
Cost-Based*	Cost	Increase/Decrease	Increase/Decrease
Price-Based	Price	Decrease	Increase/Decrease
	Cost	Increase/Decrease	Increase/Decrease

*Cost-Based units cannot have a Price-Based schedule

PJM©2017

Allowable **Real Time** Schedule Updates – Price-Based Unit



PJM©2017

What Determines a Price Increase?

Price Schedule at Commitment

Segment	MW	Price
1	10	$5
2	15	$7
3	20	$10
4	25	$15

Update to Price Schedule

Segment	MW	Price
1	10	$5
2	15	**$8**
3	20	$10
4	25	$14

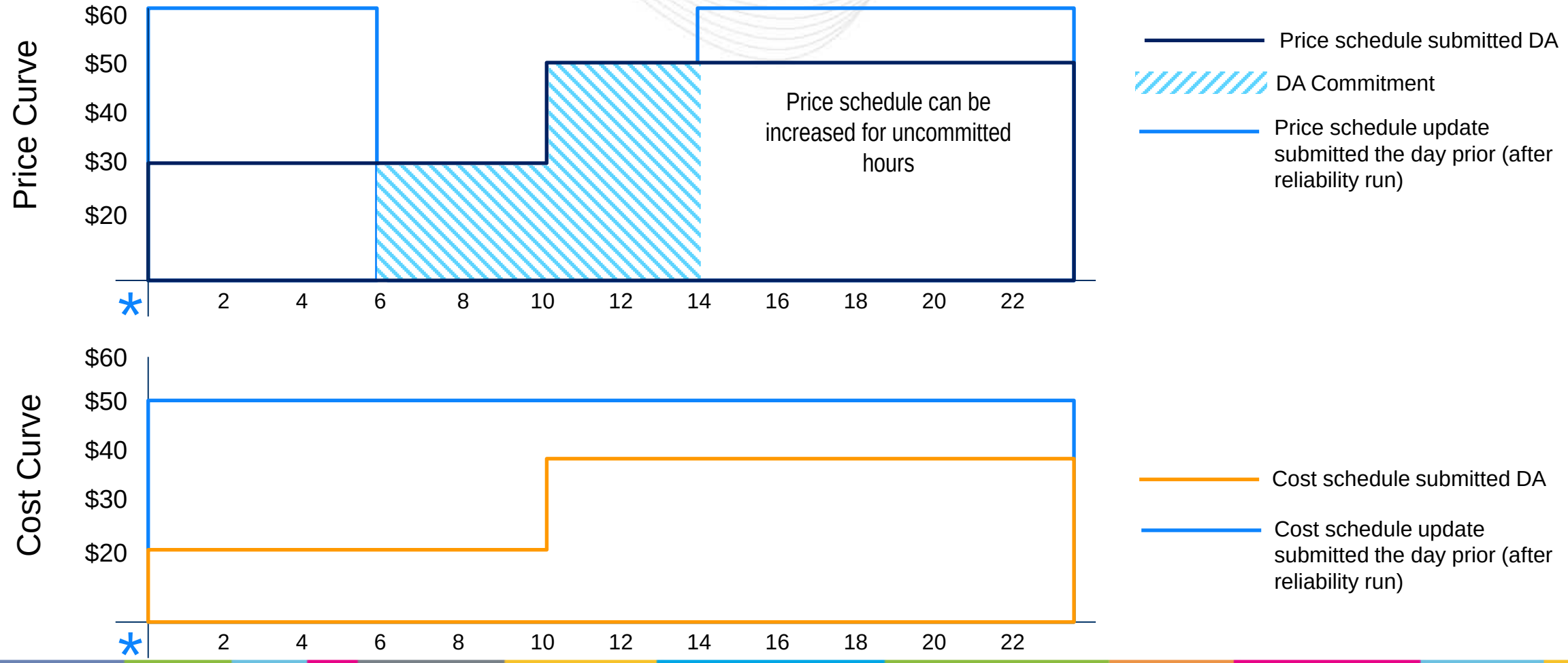
Price increases are determined at the segment level

A decrease in price for one segment does not off-set an increase in another segment

PJM©2017

Example 1: Committed on Price – Increase to Offer in RT

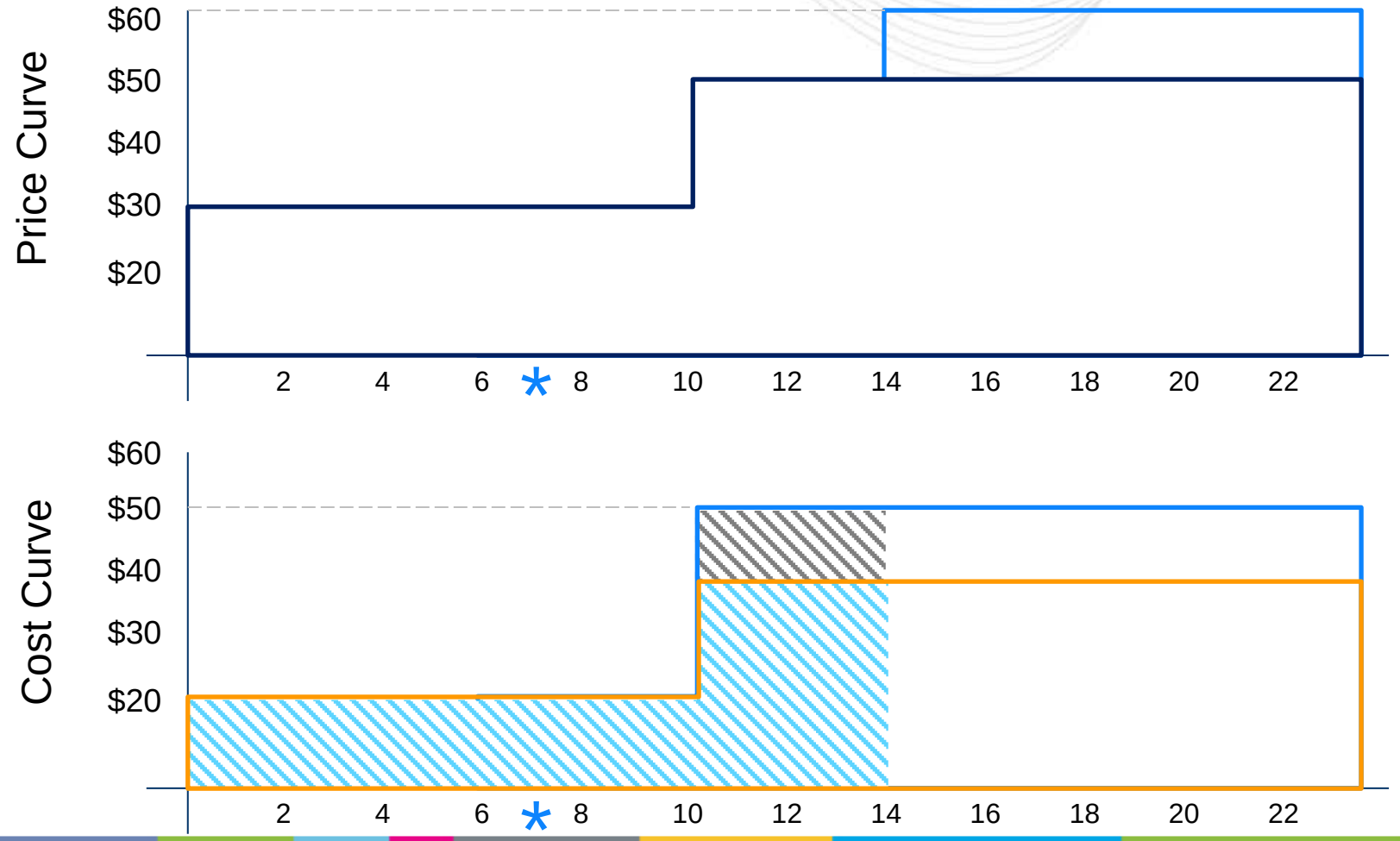
Assume cost increases for the entire day after DA market clears



PJM©2017

Example 2: Committed on Cost – Increase to Offer in RT

Assume cost increases for hour 10 and beyond



PJM©2017

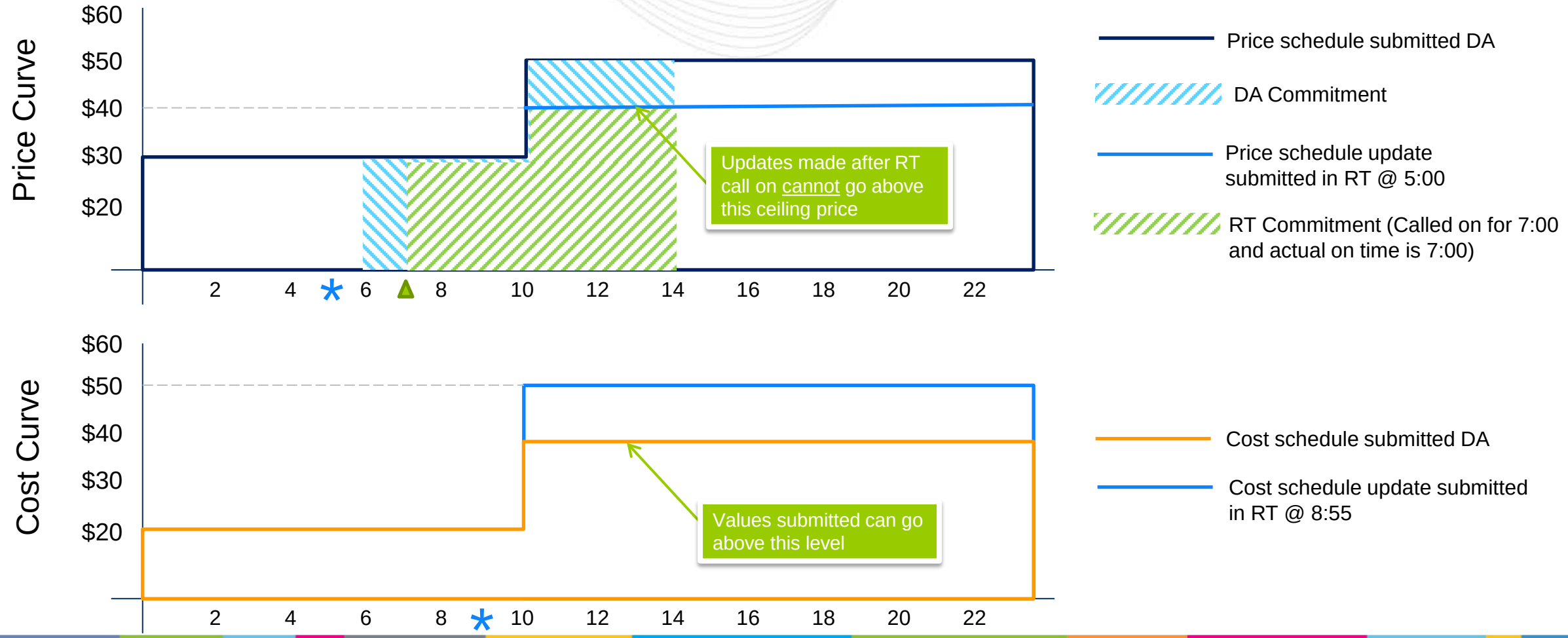
Updates to Price for Flexible Units

Example: A flexible unit is committed in DA and called on to run in RT

- It updates its price before being called in RT
- The most recent update prior to the commitment becomes the ceiling price
- If for DA the price is $50, but at RT the price is updated to $40, then the unit is subsequently committed, $40 will be the ceiling price

PJM©2017

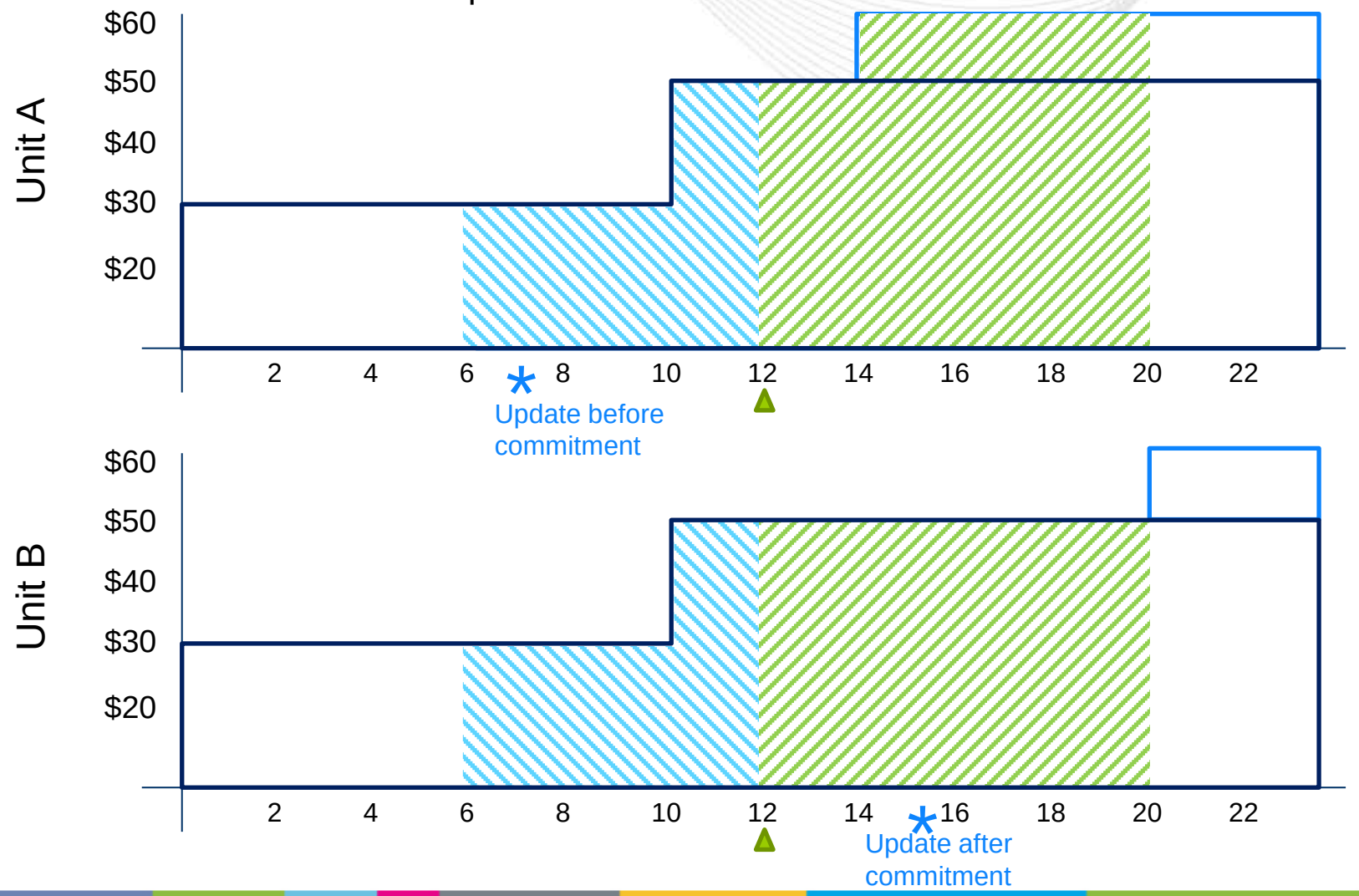
Example 3: Flexible Unit Decreases Offer before RT Call On



PJM©2017

Example 4: Price Increase Before vs. After RT Call On

Both units are price-based with min run time = 8 hours



Price schedule submitted DA

DA Commitment 6:00 – 14:00

Price schedule update submitted in RT @ 7:00

RT Commitment (Called on for 12:00 and actual on time is 12:00)

HB 14-20: Commitment uses latest schedule update

Price schedule submitted DA

DA Commitment 6:00 – 14:00

RT Commitment (Called on for 12:00 and actual on time is 12:00)

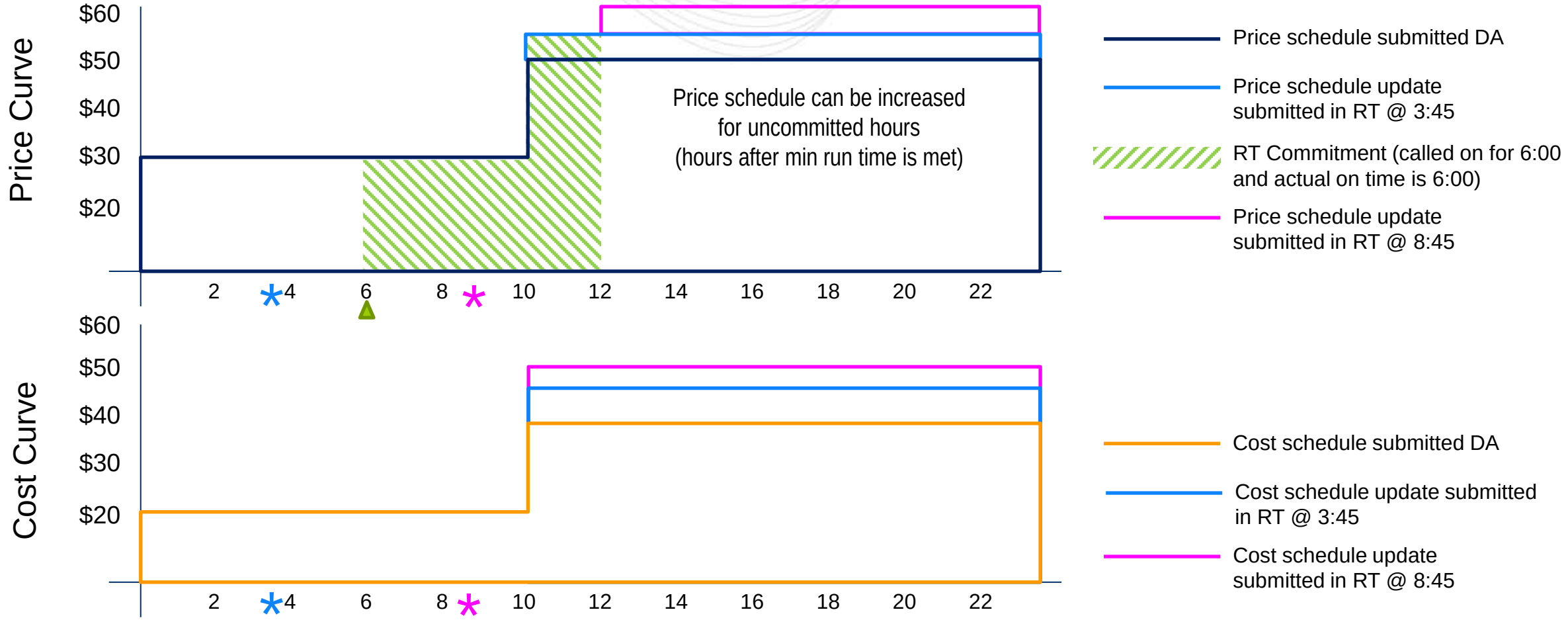
Price schedule update submitted in RT @ 15:55

HB 14-20: Commitment uses latest schedule update (schedule submitted DA)

PJM©2017

Example 5: Committed on Price in RT (No DA Commitment)

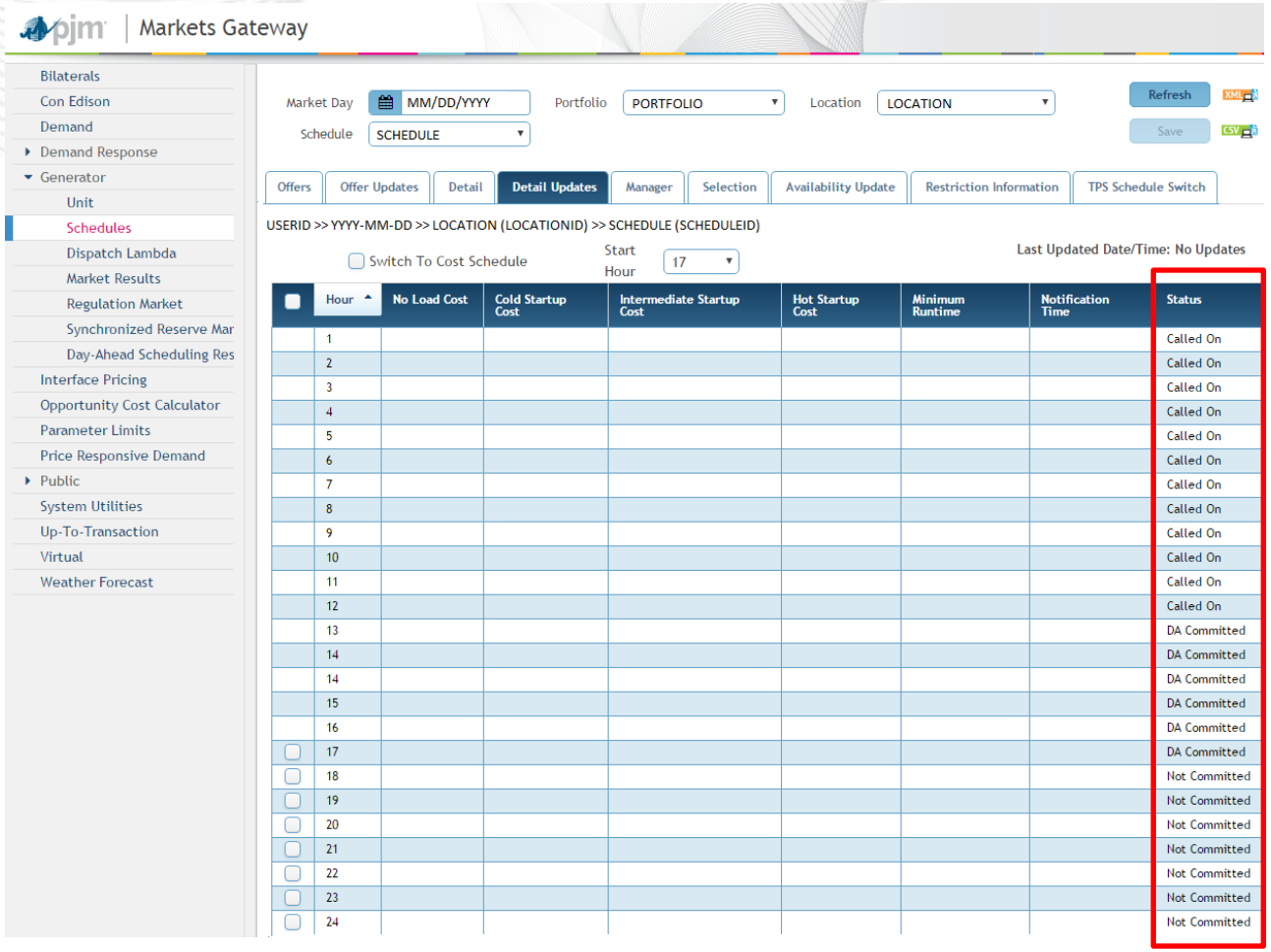
Unit has a min run time of 6 hours. Assume cost increases for hours 10 and beyond subsequent to DA offer submission. Offer is updated in RT prior to RT commitment. Offer is then updated again in RT after commitment decision is made.



PJM©2017

Price Increase Lockout Periods

- Units are locked out of increasing Price schedules in Markets Gateway for the duration of their DA commitment
- If commitment is extended in RT, the lockout period will also be extended
- More specific rules for lockout periods exist for flexible units – this will be communicated in a supplemental FAQ document



PJM©2017

Real Time Updates to No Load and Startup Costs

- No load cost and startup costs (cold, intermediate, hot) can be updated hourly via the Detail Updates Screen based on the following rules:

Type of Schedule	Startup/No load Election	Current Updates Permitted	Future Updates Permitted
Cost	Cost	Updated Daily on Schedule Detail Screen	Increase/Decrease hourly except for lockout period
Price	Cost	Updated Daily on Schedule Detail Screen	Increase/Decrease hourly except for lockout period
	Price	Specified biannually on Unit Detail screen	No change to current functionality

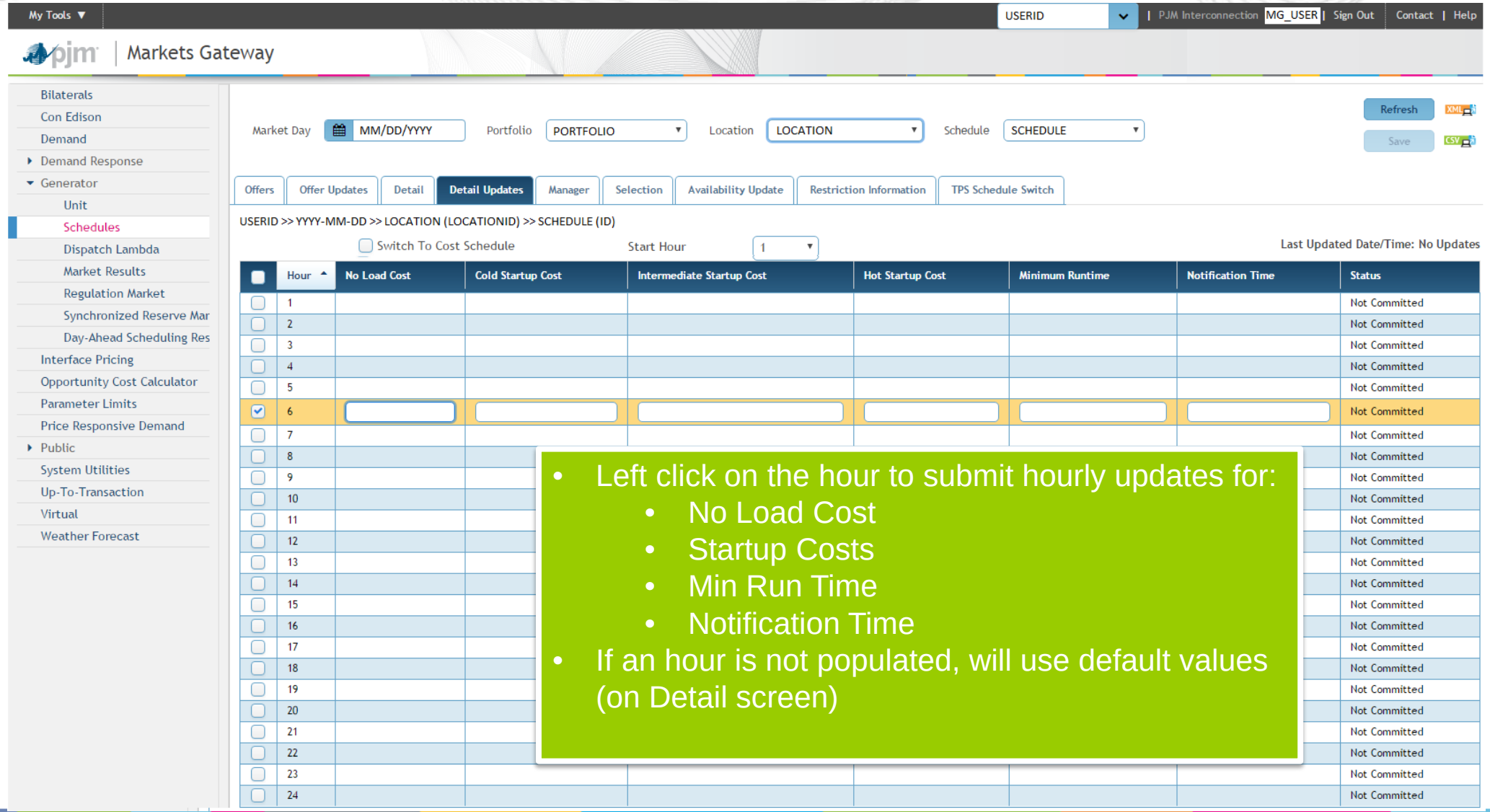
PJM©2017

Real Time updates to Notification Time and Min Run Time

- Notification Time and Min Run Time:
  - May be updated hourly starting 7 days in advance, up to 65 minutes before the start of the target hour (excluding lockout periods)
  - Updates are used in Reliability Run and Real Time only
  - Min Run Time cannot be updated for committed hours
  - Updates made via the Detail Updates Screen

PJM©2017

Detail Updates Screen in Markets Gateway



- Left click on the hour to submit hourly updates for:
  - No Load Cost
  - Startup Costs
  - Min Run Time
  - Notification Time
- If an hour is not populated, will use default values (on Detail screen)

PJM©2017

BREAK

PJM©2017

Impacts to Demand Response Resources

PJM©2017

DSR Offer Price and Shut Down Cost

- Incremental energy offer price and the shut down cost of a DSR can be updated up to 65 minutes prior to the start of the target hour under the following conditions:

Committed Hours	Uncommitted Hours
Decrease	Increase/Decrease

- Price will be added to the Demand Response > Hourly Updates screen
- Shut Down Cost will be added to new Demand Response > Parameter Updates screen

PJM©2017

DSR Notification Time and Min Down Time

- Hourly Notification Time and Min Down Time Values:
  - Can be submitted up to 65 minutes before the start of the target hour (excluding lockout periods)
  - Updates only used in Reliability Run and Real Time
  - Updated via Load Response > Hourly Updates screen
  - Min Down Time cannot be updated for committed hours

PJM©2017

Impacts to Ancillary Service Offers

PJM©2017

Impact to Generation Regulation Offers

	Today	IDO Implementation	Opt Out of IDO
Offer Price Granularity	Daily	Hourly	Hourly
Offer Price Update Deadline	1415 Day Before	65 minutes prior to Operating Hour	1415 Day Before
Offer MW/Status Granularity	Hourly	Hourly	Hourly
Offer MW/Status Update Deadline	60 minutes prior to Operating Hour	65 minutes prior to Operating Hour	65 minutes prior to Operating Hour

PJM©2017

Impact to Demand Response Regulation Offers

	Today	IDO Implementation
Offer Price Granularity	Daily	Hourly
Offer Price Update Deadline	1415 Day Before	65 minutes prior to Operating Hour
Offer MW/Status Granularity	Hourly	Hourly
Offer MW/Status Update Deadline	60 minutes prior to Operating Hour	65 minutes prior to Operating Hour

PJM©2017

Impact to Generation Synchronized Reserve Offers

	Today	IDO Implementation	Opt Out of IDO
Offer Price Granularity	Daily	Hourly	Hourly
Offer Price Update Deadline	1415 Day Before	65 minutes prior to Operating Hour	1415 Day Before
Offer MW Granularity	Hourly	Hourly	Hourly
Offer MW Update Deadline	2 hours prior to Operating Hour	65 minutes prior to Operating Hour	65 minutes prior to Operating Hour
Hourly Availability Update Deadline	60 minutes prior to Operating Hour	65 minutes prior to Operating Hour	65 minutes prior to Operating Hour

PJM©2017

Impact to Demand Response Synchronized Reserve Offers

	Today	IDO Implementation
Offer Price Granularity	Daily	Hourly
Offer Price Update Deadline	1415 Day Before	65 minutes prior to Operating Hour
Offer MW Granularity	Hourly	No Change
Offer MW Update Deadline	60 minutes hours prior to Operating Hour	65 minutes prior to Operating Hour
Hourly Availability Update Deadline	60 minutes prior to Operating Hour	65 minutes prior to Operating Hour

PJM©2017

Switch to Cost Schedule

- If a unit is committed on a price schedule and its cost schedule incremental energy offer subsequently exceeds its price schedule value, it may elect to be switched to its cost schedule
  - Unit will be switched to use the cheapest available cost schedule
  - The unit must then stay on its cost schedule for the rest of the Operating Day
  - The price schedule will become unavailable and will not be permitted to made available again for the rest of the Operating Day

PJM©2017

Switch to Cost Schedule

Today (GUCC)

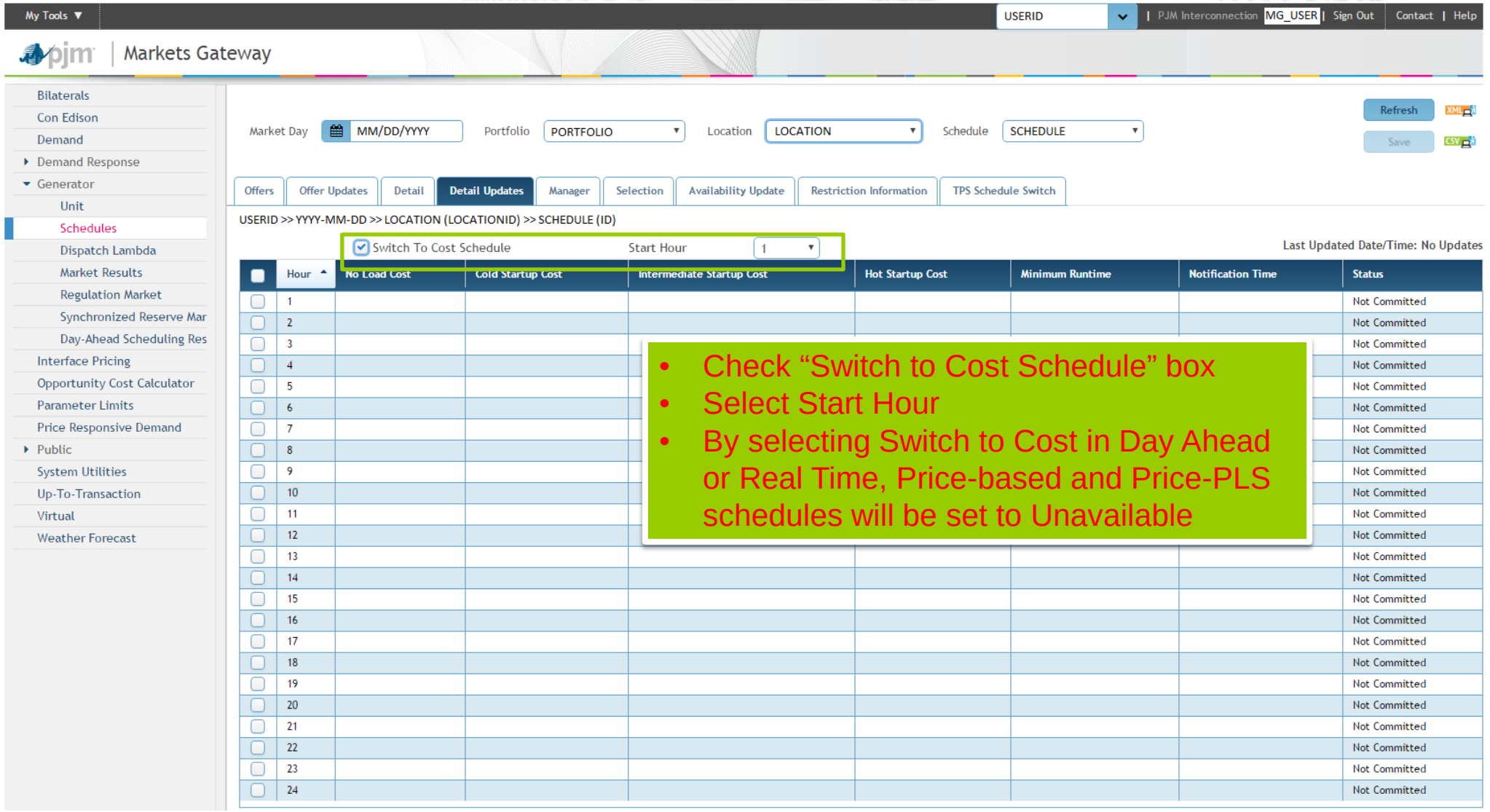
- Elected on “Availability Update” screen
- Elect between 1830 and 2100 the day before
- Election does not propagate to subsequent market days

Intraday Offer Implementation

- Elected on “Detail Updates” Screen
- Elect prior to DA, or 1830 the day before and 65 minutes prior to operating hour
- Election does not propagate to subsequent market days

PJM©2017

Switch to Cost in Markets Gateway



PJM©2017

Three Pivotal Supplier (TPS) Test

- The TPS test is a test for structural market power. The test examines the concentration of ownership of the supply compared to the level of demand

- PJM utilizes the Three Pivotal Supplier (TPS) Test to mitigate market power for:
  - Transmission Constraints
  - Regulation Market
  - RPM

PJM©2017

Three Pivotal Supplier Test

- A test failure means that the ownership of the required supply is concentrated among few suppliers:
  - Those suppliers have the potential to exercise market power (structural market power)
  - It does not mean those suppliers are attempting to exercise market power
  - A test failure triggers mitigation as a preventative step in the event of a concentration of ownership
- Resources that fail TPS are placed on the cost or price schedule that results in the lowest overall system production cost (DA Market) or the lowest dispatch cost (RT Market). This is referred to as offer capping.

PJM©2017

Three Pivotal Supplier Test (DA)

- DA TPS will be updated to consider hourly differentiated offers in the TPS test evaluation
- “Must run” resources will be included in the evaluation and subjected to mitigation
- TPS testing performed for binding transmission constraints

PJM©2017

Three Pivotal Supplier Test (RT)

- Real-time energy TPS testing is performed in the ITSCED application for binding transmission constraints
- Currently, TPS testing is performed for offline units only, as part of the RT unit commitment process
- Under Intraday Offers
  - there will be no change to the TPS process for offline resources.
  - there will be an online unit TPS test performed following the completion of either the DA commitment period, or the min run time if the unit was committed in real-time
- For the online resources that have met their commitment period, TPS testing will occur every hour until they are released
- For self-scheduled units committed in the Real-time Market (and not in the Day-Ahead Market), the TPS test will be performed at end of the first hour of their commitment and occur every hour until the resource comes offline

PJM©2017

Online Unit TPS Test and Offer Capping

- Units running in real-time beyond completion of either the DA commitment period, or the min run time if the unit was committed in real-time will be subject to evaluation for market power on an hourly basis and will be offer capped as follows:
  - Units operating on a price-based schedule whose owner passes the TPS test will not be offer capped and will remain on the price-based offer.
  - Units operating on a price-based schedule whose owner fails the TPS test will be offer capped.
  - Units operating on a cost-based schedule will remain on that schedule regardless of the results of the TPS test.

PJM©2017

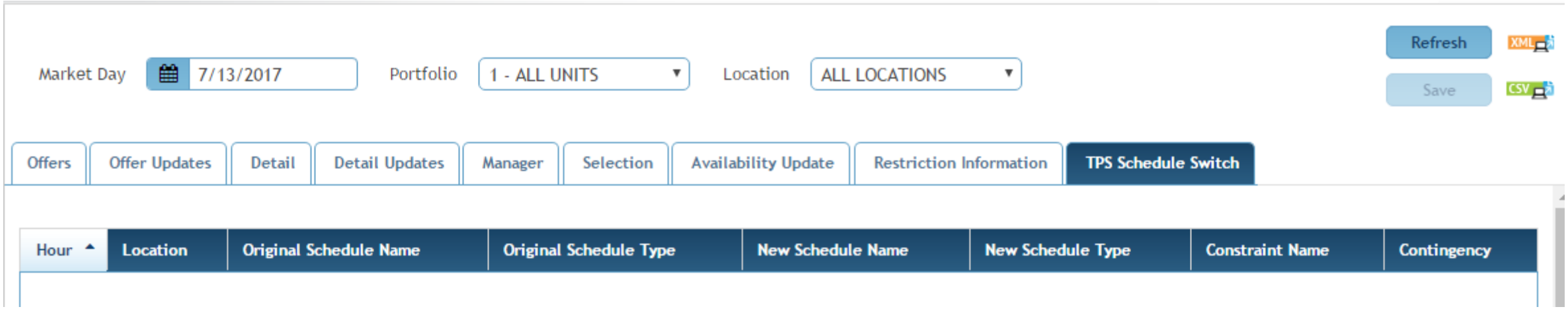
Offer Capping Duration

- Offer capped resources will remain offer capped until the earlier of:
  - End of the day
  - Unit is released
  - Start of its next pre-existing commitment
    - Applies to units cycled in the day-ahead commitment or brought online in real-time prior to day-ahead commitment

PJM©2017

Visibility into Online TPS Offer Capping

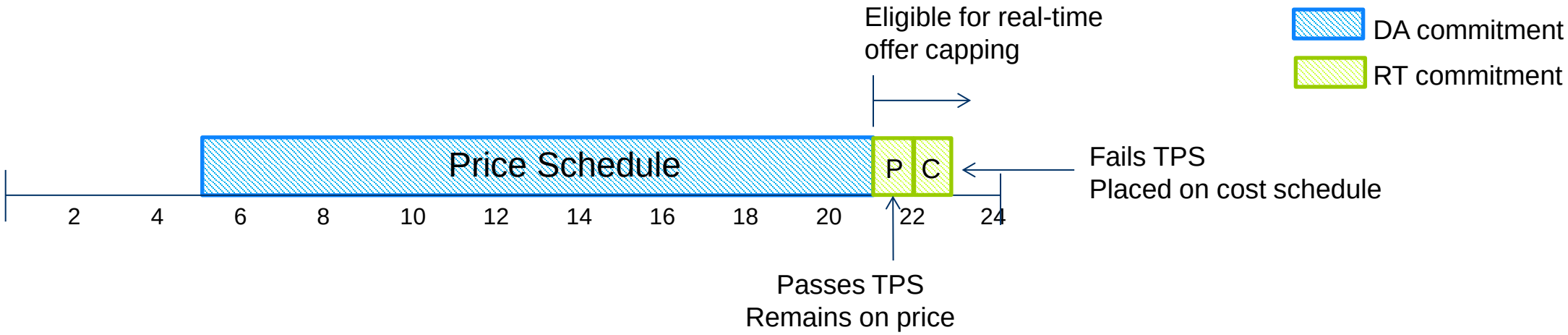
- Participants will be notified of offer capped units via a new screen in Markets Gateway (Generator>Schedule>TPS Schedule Switch)
- Will display units offer capped as a result of the Real Time Online TPS test
- Information will be updated starting 20 minutes prior to the upcoming operating hour.



PJM©2017

TPS Example 1

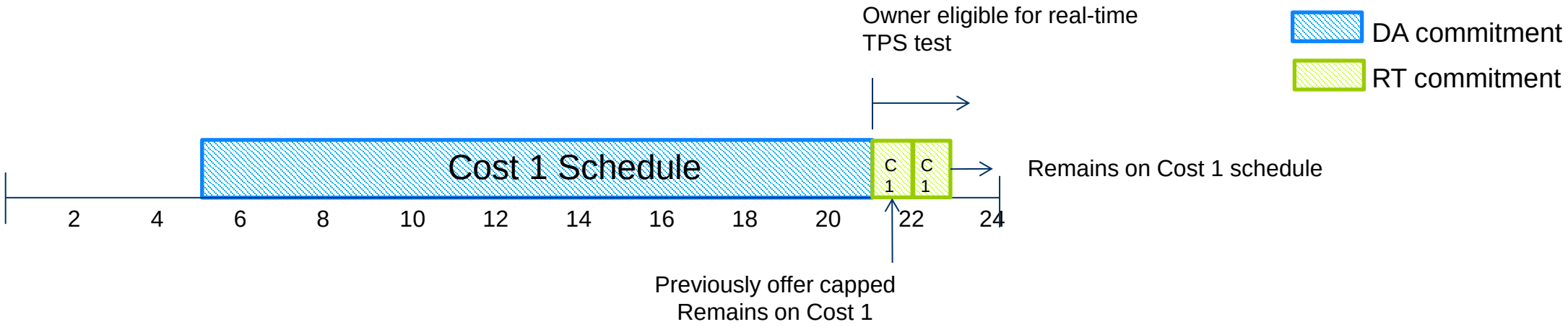
- Resource has 2 available schedules: Price and Cost
  - Price Schedule dispatch cost = $50
  - Cost Schedule dispatch cost = $40
- Resource committed in DA Market, resource owner passes the DA TPS test. Not offer capped.
- Resource will remain on the cost schedule until the earlier of the end of the day or when it is released



PJM©2017

TPS Example 2

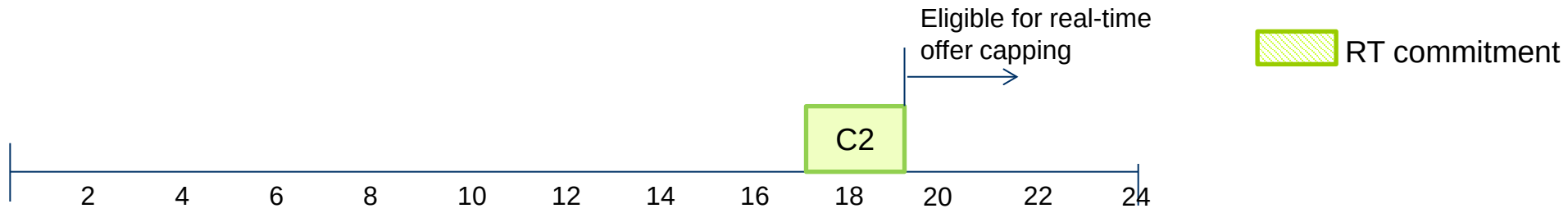
- Resource has 3 available schedules: Price, Cost 1 and Cost 2
  - Price Schedule dispatch cost = $50
  - Cost 1 Schedule dispatch cost = $40 **$55**
  - Cost 2 Schedule dispatch cost = $45
- Resource committed in DA Market, resource owner failed the DA TPS test. Resource offer capped on the Cost 1 schedule.



PJM©2017

TPS Example 3

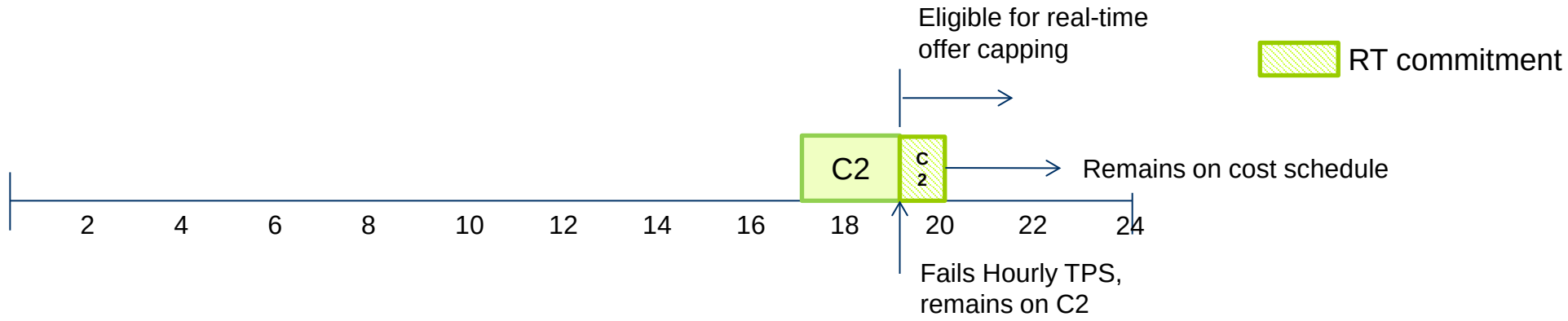
- Resource committed in Real Time
- Resource has a 2 hour min run time
- Resource has 3 available schedules: Price, Cost 1 and Cost 2
  - Price Schedule dispatch cost = $50
  - Cost 1 Schedule dispatch cost = $45
  - Cost 2 Schedule dispatch cost = $40
- Resource committed in real-time starting in HE17 on Cost Schedule 2 since owner fails TPS test at the time of commitment decision



PJM©2017

TPS Example 3

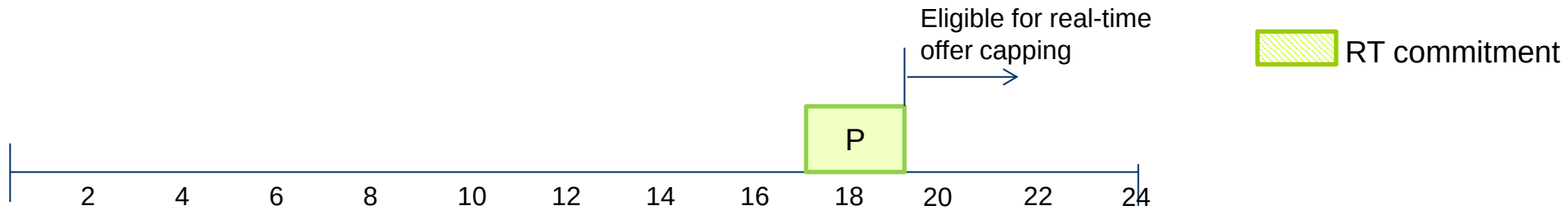
- Participant makes updates to the Cost 2 schedule in real time after being committed
  - Price Schedule dispatch cost = $50
  - Cost 1 Schedule dispatch cost = $45
  - Cost 2 Schedule dispatch cost = ~~$40~~ $50



PJM©2017

TPS Example 4

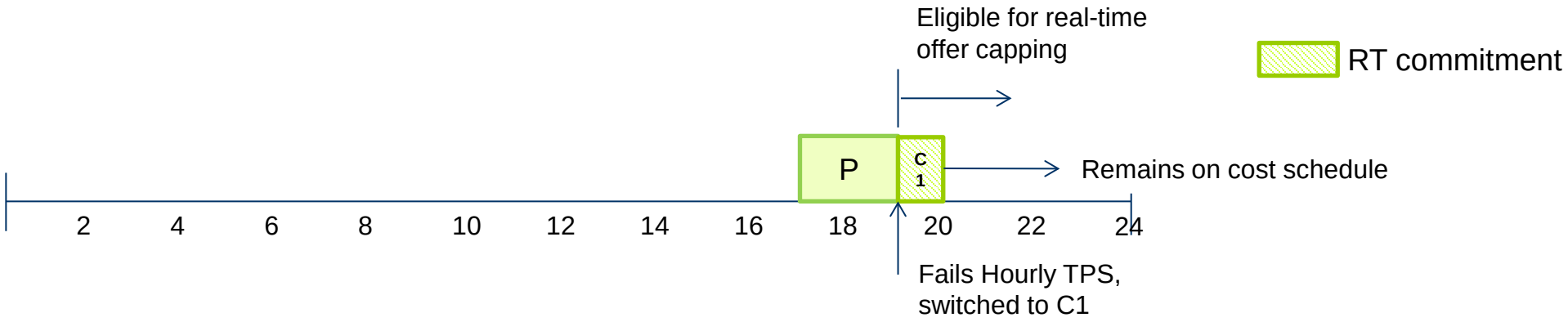
- Resource committed in Real Time
- Resource has a 2 hour min run time
- Resource has 3 available schedules at the time of commitment: Price, Cost 1 and Cost 2
  - Price Schedule dispatch cost = $35
  - Cost 1 Schedule dispatch cost = $45
  - Cost 2 Schedule dispatch cost = $40
- Resource committed in real-time HE17 on the Price schedule since the owner fails the TPS test at the time of commitment and Price is the cheapest available schedule.



PJM©2017

TPS Example 4

- Participant makes updates to the Cost 1 schedule in real-time after being committed
  - Price Schedule dispatch cost = $35
  - Cost 1 Schedule dispatch cost = ~~$45~~ $30
  - Cost 2 Schedule dispatch cost = $40



PJM©2017

Opt-in/Opt-out

- Original design had a default of all resources opted-in, but allowed users to opt-out of Intraday updates, as long as supported by their Fuel Cost Policy (FCP)
- PJM and MA have now agreed to make opt-out the default at go-live, and for any new units added at a later date
- If a resource's approved FCP dictates that fuel costs will be updated in real-time, then the resource must opt-in
- If the FCP requires updates in real-time and the resource does not formally opt-in, its cost offers may be found non-compliant with its FCP and be subject to penalties
- If a resource's FCP changes and updates are no longer required, the resource may opt-out

PJM©2017

Opting In/Out in Markets Gateway

- Users must communicate their desire to opt in or opt out in the month prior to the month they want to begin opting in/out
- The option may only be selected/deselected prior to midnight of the 15th day of the month prior to the month the election will begin
  - Process for opting-in prior to November 1 will be communicated at a later date
- Opt in/out is generator specific, and continues until the user cancels, by unchecking the box
- There is no XML capability for opt out
- There is no opt-out option for Demand Response

PJM©2017

Opt Out

- If a Generator has chosen to opt out of Hourly updates on a monthly basis in accordance to their Fuel Cost Policy, certain capability is still available:

If a Generator opts out, they may:

- Provide hourly differentiation for their DA offer
- Update the incremental energy offer, min run time, and no load and startup costs during the Rebid period for hours where the unit does not have a Day-Ahead commitment.
- Update schedule based notification time (except during lockout periods)
- Utilize “Switch to Cost” functionality
- Update Regulation and Spin MW values 65 minutes prior to the operating hour

If a Generator opts out, they may NOT:

- Update incremental energy offer, min run time, no load and start-up costs after the Rebid period
- Update Regulation and Spin cost and price after the rebid period or throughout the operating day

PJM©2017

Managing Dual-Fuel Units Intraday

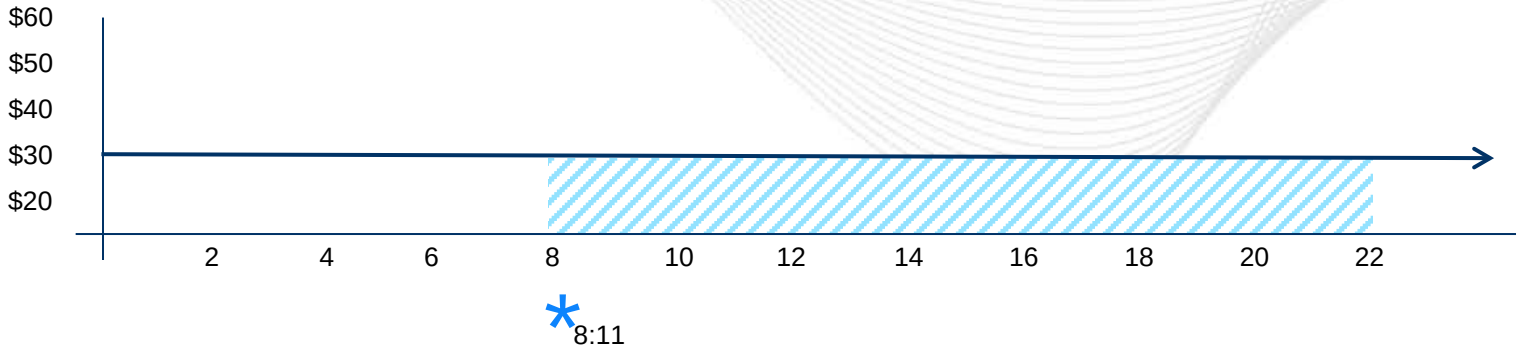
PJM©2017

Schedule Availability Update for Combined Cycle

- Situations may arise for Dual Fuel units when a fuel switch is required
- If a unit is designated as Dual Fuel on the Generator>Unit>Detail tab in Markets Gateway, schedule availability may be changed hourly throughout the operating day
  - May be changed in Real Time only, after the Reliability Run and 65 minutes before the operating hour
  - For cost schedules only
  - Price schedule remains Available (note: changing Availability does not imply switch to cost)
  - Schedule may be changed from Available to Unavailable, and vice versa, as needed
  - One cost schedule per fuel type may be Available at any one time
  - Can be changed for hours in which a schedule is not committed

PJM©2017

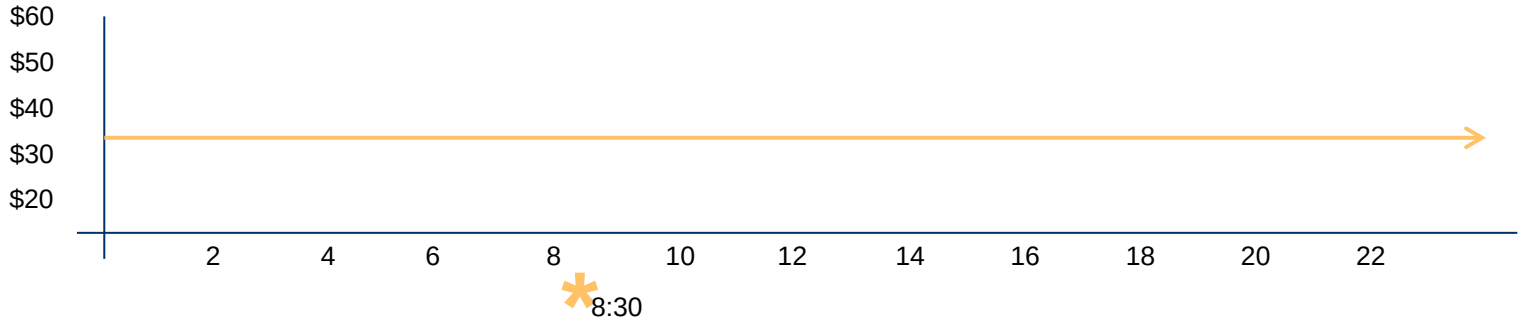
Dual Fuel Example #1



Price schedule (gas) submitted DA ($30)

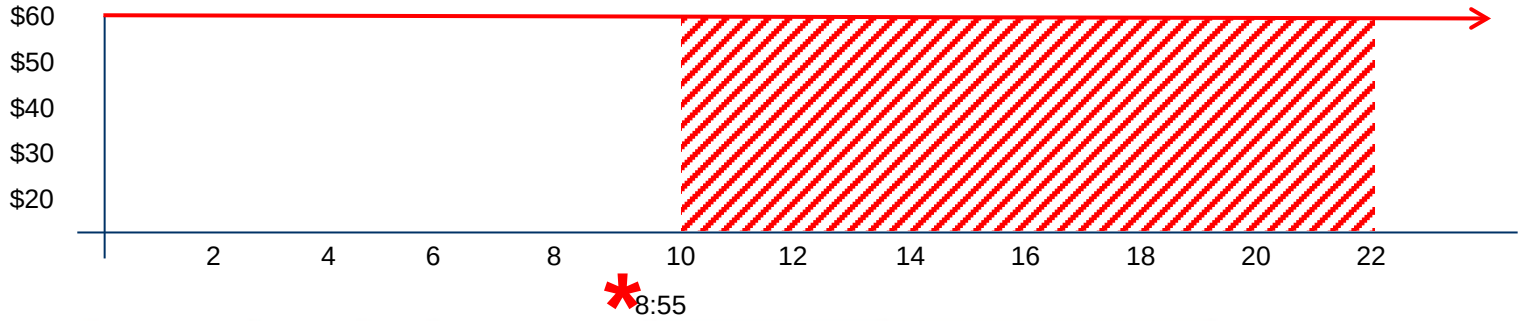
DA Commitment

8:11 - 2 hrs. of gas remain



Cost schedule (gas) ($35)

8:30 - Gas cost schedule made Unavailable starting at 10:00



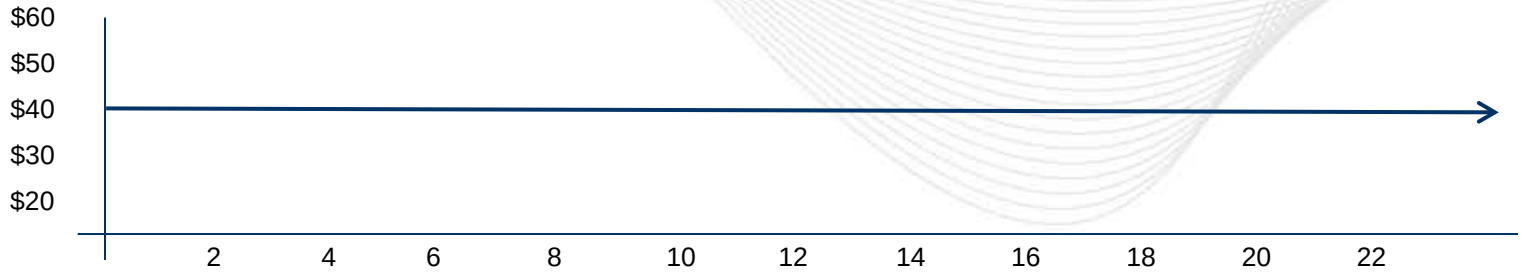
Cost schedule (oil) ($60)

8:55 – minimum of T-65 min. switch to cost for 10:00

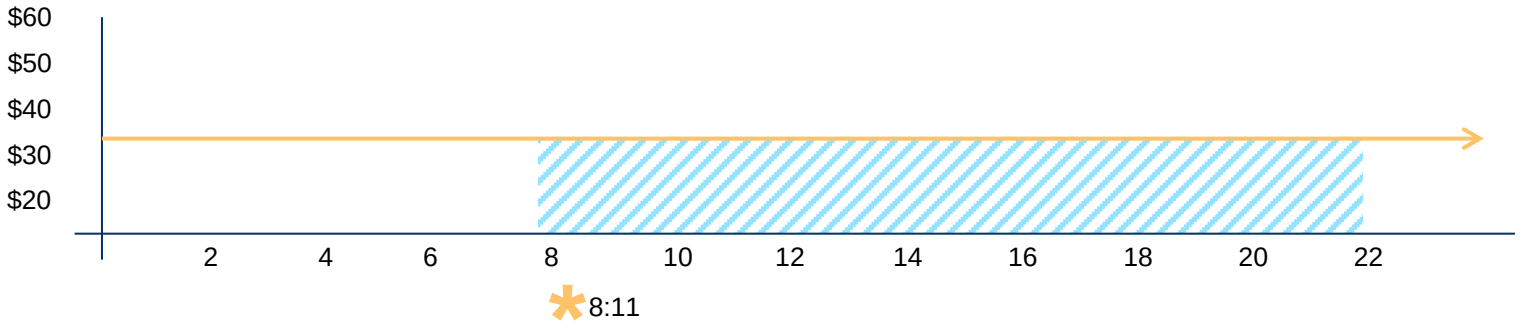
Balance of Commitment

PJM©2017

Dual Fuel Example #2



Price schedule (gas) submitted DA ($40)

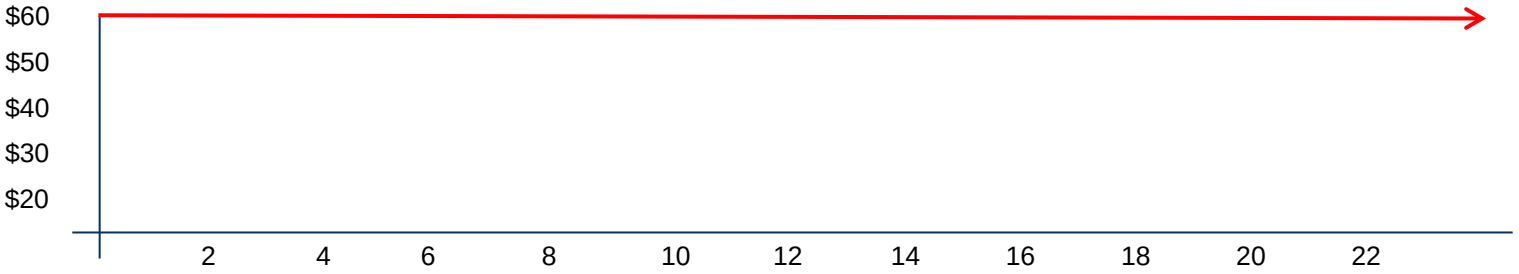


DA Commitment

Cost schedule (gas) ($35)

8:11 – Determine 2 hrs. of gas remains

Gas cost schedule availability cannot be updated for committed hours. Call to Dispatch required



Cost schedule (oil) ($60)

PJM©2017

Impacts to Market Settlements

PJM©2017

Impacts to Market Settlements

- Intraday Offers has impacts on the following Market Settlement areas:
  - Operating Reserve Credits
    - Day-Ahead Operating Reserve Credits will use hourly differentiated offer
    - Balancing Operating Reserve Credits have changes to the version of schedule to which a resource will be made whole and changes in the balancing value portion of the calculation
  - Lost Opportunity Cost Credits
    - Changes to the version of the schedule on which a resource will be compensated

PJM©2017

Terminology

- Committed Offer
  - The offer on which a resource was scheduled for a particular clock hour
- Real Time Offer
  - Any update to an existing offer made after the close of the Day-Ahead offer period
- Final Offer
  - The offer on which a resource was dispatched by the Office of the Interconnection for a particular clock hour for the Operating Day

PJM©2017

Review of Balancing Operating Reserves

- Purpose is to cover costs represented in Resource offers
  - Results in prices and compensation that preserves the incentive for generation and Demand Resources to follow real-time dispatch signals/instructions
- The total resource offer amount for generation, including startup and no-load costs as applicable, is compared to its total energy market value for specified operating period segments during the day
  - If the total value is less than the offer amount, the difference is credited to the PJM Member.

PJM©2017

Balancing Operating Reserve Credit Calculation

- Balancing Operating Reserve Credit =

  Real Time Offer[1] – Balancing Value[2] – DA Value – DA Operating Reserve Credit – Any Sync/Non Sync/Reactive/DASR revenue

[1]Real Time Offer = Energy Offer + including startup and no-load costs as applicable

[2]Balancing Value = (RT MW[3] – DA MW) * RT LMP

[3]Greater of:

- RT MW
- Lesser of: Desired MW and DA MW

PJM©2017

Adjustment to Balancing Value

- The Balancing Value accounts for the difference in Real Time output compared to the Day-Ahead commitment valued at the RT LMP
- Increases to offer prices after commitment would result in units being dispatched down
  - As a result the unit has to buy back energy in Real Time
  - Absent a change, this behavior could result in a BOR Credit due to the balancing value going negative

PJM©2017

Existing Balancing Value Illustration

	Day-Ahead		Final RT Offer	
Segment	MW	Price	MW	Price
1	50	5	50	10
2	100	10	100	15
	DA LMP = $10, DA Scheduled MWh = 100 MW		RT LMP = $10, RT Dispatch Desired MWh = 50 MW	

RT Generation MW = Greater Of:

RT Generation MWh

=50 MW

Lesser of:

RT Dispatch Desired MWh = 50 MW

DA Scheduled MWh = 100 MW

=50 MWh

= 50 MWh

Balancing Value =

(RT Generation MW – DA Scheduled MW) * RT LMP

(50 MW - 100 MW) * $10

= -$500

A negative balancing value results in an increased Balancing Operating Reserve Credit

PJM©2017

Adjusted Balancing Value Illustration

	Day-Ahead		Final RT Offer	
Segment	MW	Price	MW	Price
1	50	5	50	10
2	100	10	100	15
	DA LMP = $10, DA Scheduled MWh = 100 MW		RT LMP = $10, RT Dispatch Desired MWh = 50 MW	

Balancing Value =

(RT Generation MW – DA Scheduled MW)

* RT LMP

(100 MW - 100 MW) * $10

= $0

RT Generation MW = Greater Of:

RT Generation MWh

=50 MW

Lesser of:

Greater Of:

RT Dispatch Desired MWh = 50 MW

Committed Offer Desired MWh = 100 MW

=100 MW

DA Scheduled MWh = 100 MW

=100 MWh

= 100 MWh

PJM©2017

Segmented Make-Whole Payments

- Balancing Operating Reserve credits are calculated by operating segment within an Operating Day.
- A resource will be made whole for two periods for each synchronized start
  - The two periods are as follows:
    1. greater of the DA Commitment and Min Run time **at the time of commitment**
    2. hours in excess of #1 (above)
- Segment does not “carry over” to the next day
- Start-up costs (and applicable no-load costs) will be in the segment “greater of the DA Schedule or Min Run Time”

PJM©2017

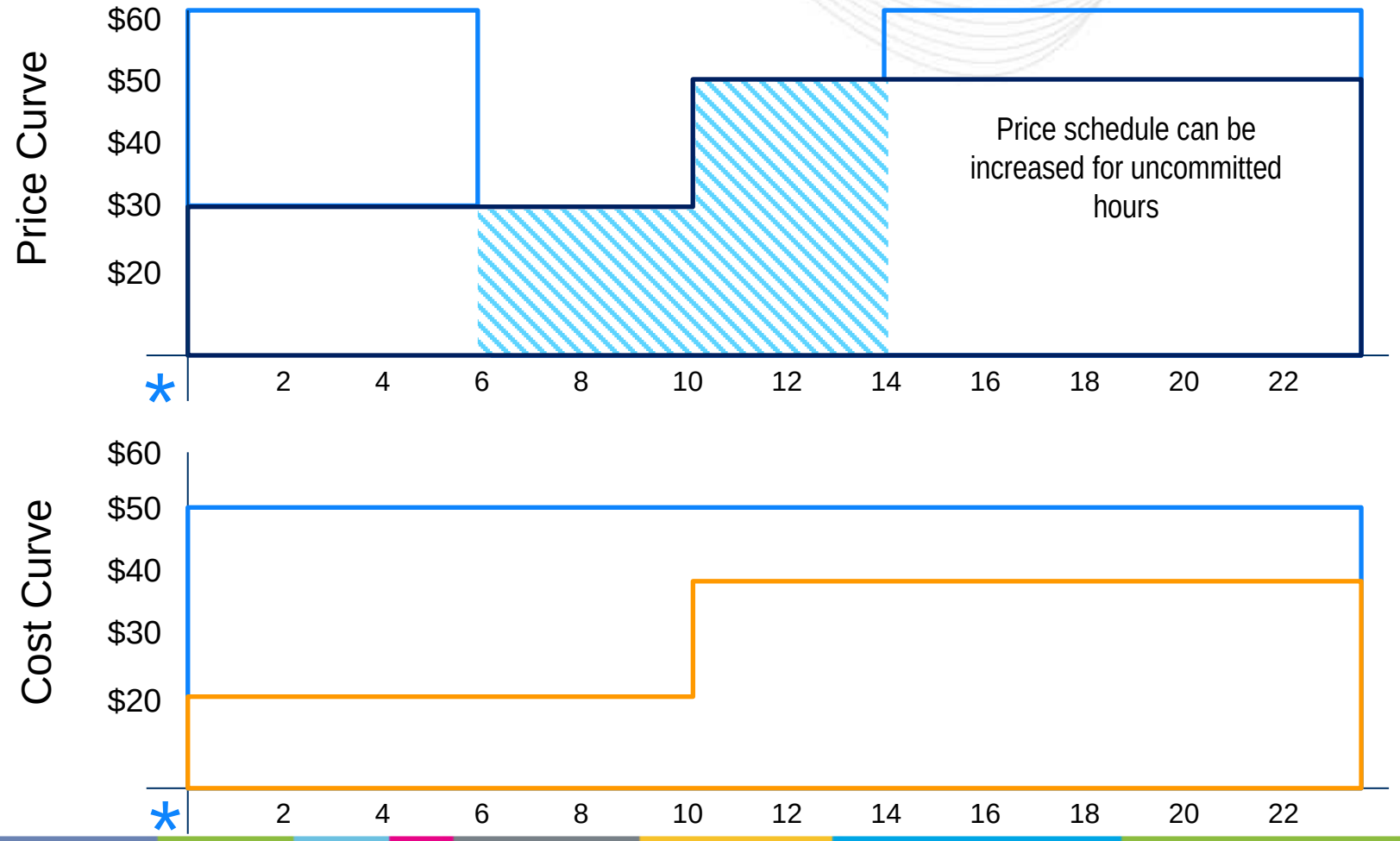
Impacts to Balancing Operating Reserve Credits

- The offer used in the Balancing Operating Reserve make-whole can vary hourly
- Pool-Scheduled Resources will be made whole in Real Time to the lesser of:
  - Committed Offer
  - Final Offer

PJM©2017

Example 1: Committed on Price – Increase to Offer in RT

Assume cost increases for the entire day after DA market clears



DA Commitment

Committed Offer: Price schedule submitted DA

Final Offer: Price schedule update submitted at 22:55

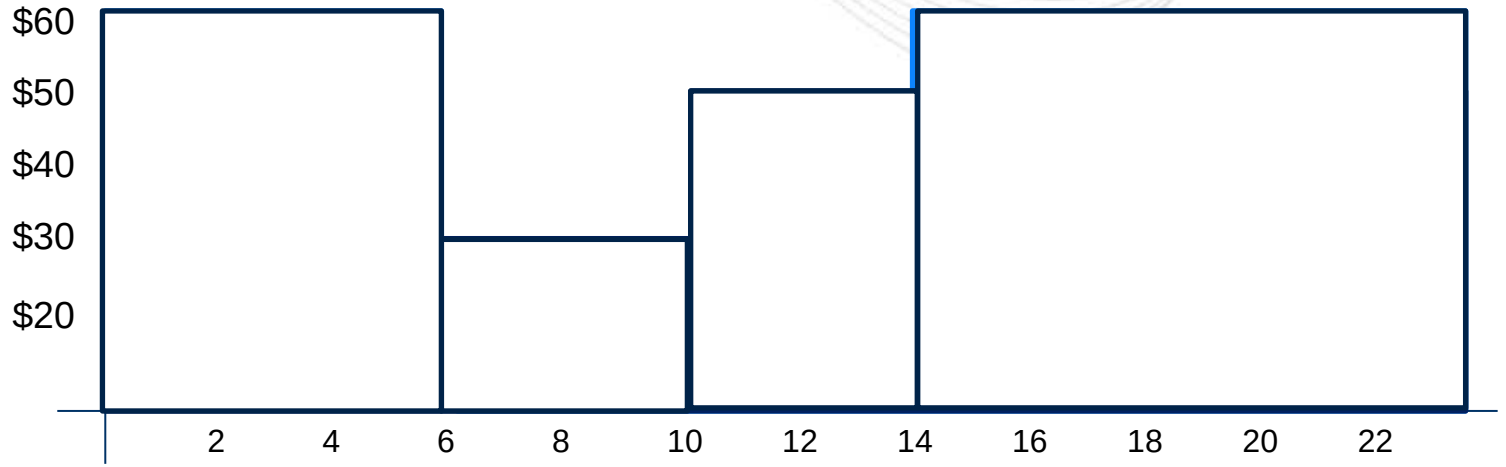
Cost schedule submitted DA

Cost schedule update submitted in RT the day prior (after the DA market clears)

PJM©2017

Example 1: Committed on Price – Increase to Offer in RT

Assume cost increases for the entire day after DA market clears



The offer used for the Operating Reserves Credit calculations:

Offer Used for Day-Ahead:

- For HB 6 – 10 the offer used is $30
- For HB 10 – 14 the offer used is $50

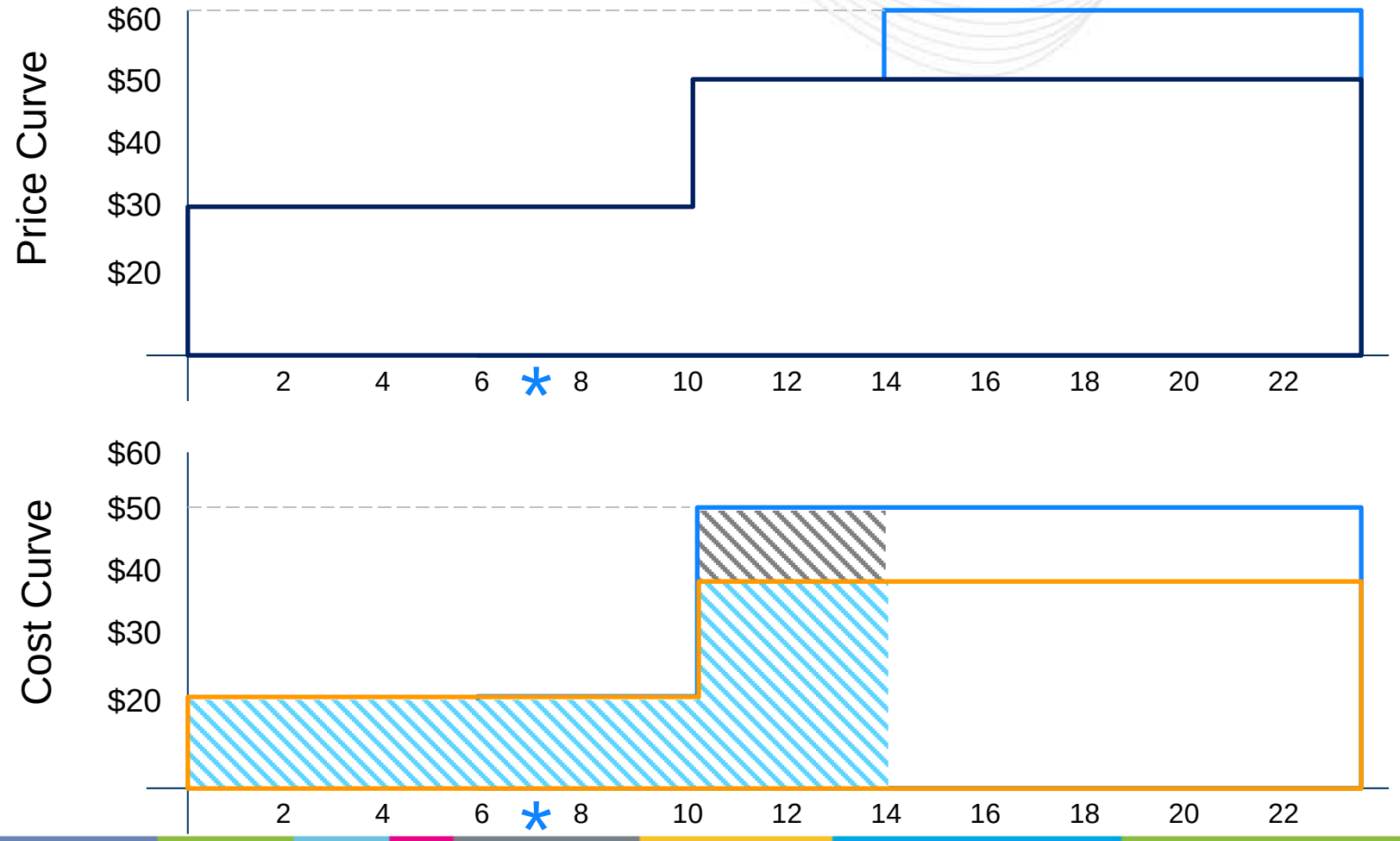
Offer Used for Balancing (If the unit is called online):

- For HB 6 - 10 the offer used is $30 (segment 1)
- For HB 10 – 14 the offer used is $50 (segment 1)
- If the resource was extended before HB 6 or past HB 14, then the offer used is $60 (segment 2 excluding ramp)

PJM©2017

Example 2: Committed on Cost – Increase to Offer in RT

Assume cost increases for hour 10 and beyond



DA Commitment

DA Offer: Price schedule submitted DA

Intraday Offer: Price schedule update submitted in RT @ 7:00

Committed Offer: Cost schedule submitted DA

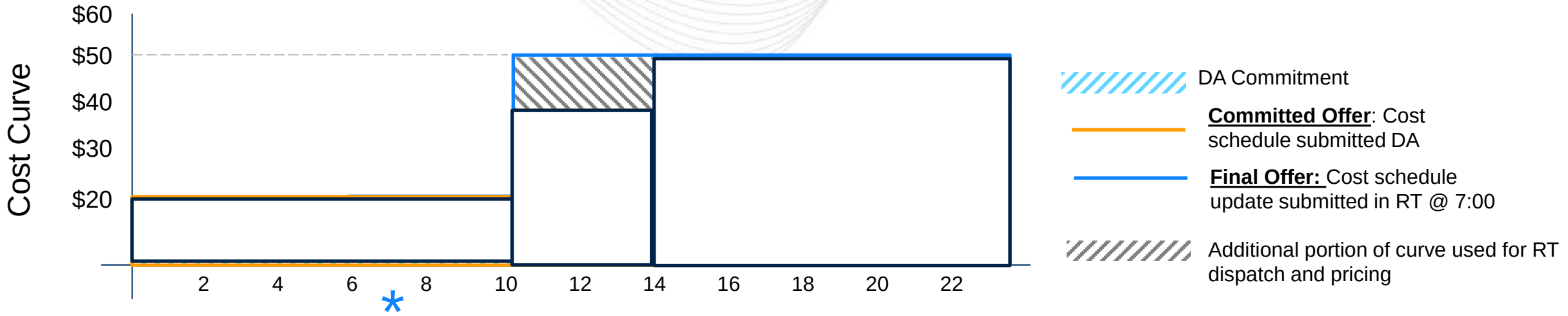
Final Offer: Cost schedule update submitted in RT @ 7:00

Additional portion of curve used for RT dispatch and pricing

PJM©2017

Example 2: Committed on Cost – Increase to Offer in RT

Assume cost increases for hour 10 and beyond



The offer used for the Operating Reserves Credit calculations:

Offer Used for Day-Ahead:

- For HB 0 – 10 the offer used is $20
- For HB 10 – 14 the offer used is $40

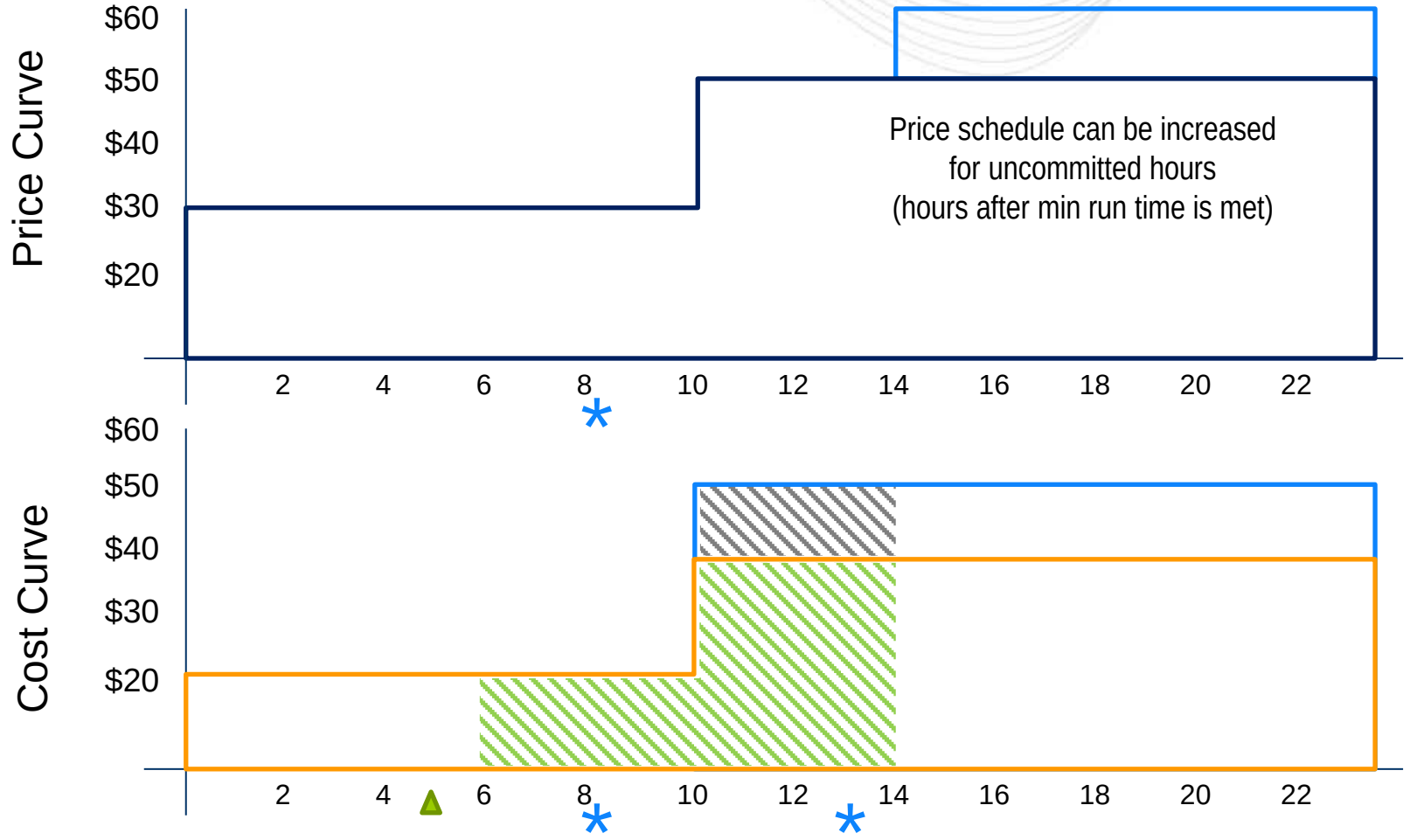
Offer Used for Balancing:

- For HB 0 – 10 the offer used is $20 (segment 1)
- For HB 10 – 14 the offer used is $40 (segment 1)
- If the resource was extended past HB 14, then the offer used is $50 (segment 2)

PJM©2017

Example 3: Committed on Cost in RT (for min run) – Increase to offer during committed and uncommitted hours

Unit has a min run time of 8 hours. Assume cost increases for hours 10 and beyond subsequent to DA offer submission and offer was not updated prior to RT commitment.



Price schedule submitted DA

Price schedule update submitted in RT @ 8:11

Committed Offer: Cost schedule at time of RT Commitment

RT Commitment (commitment decision made @ 5:00) – used for make whole

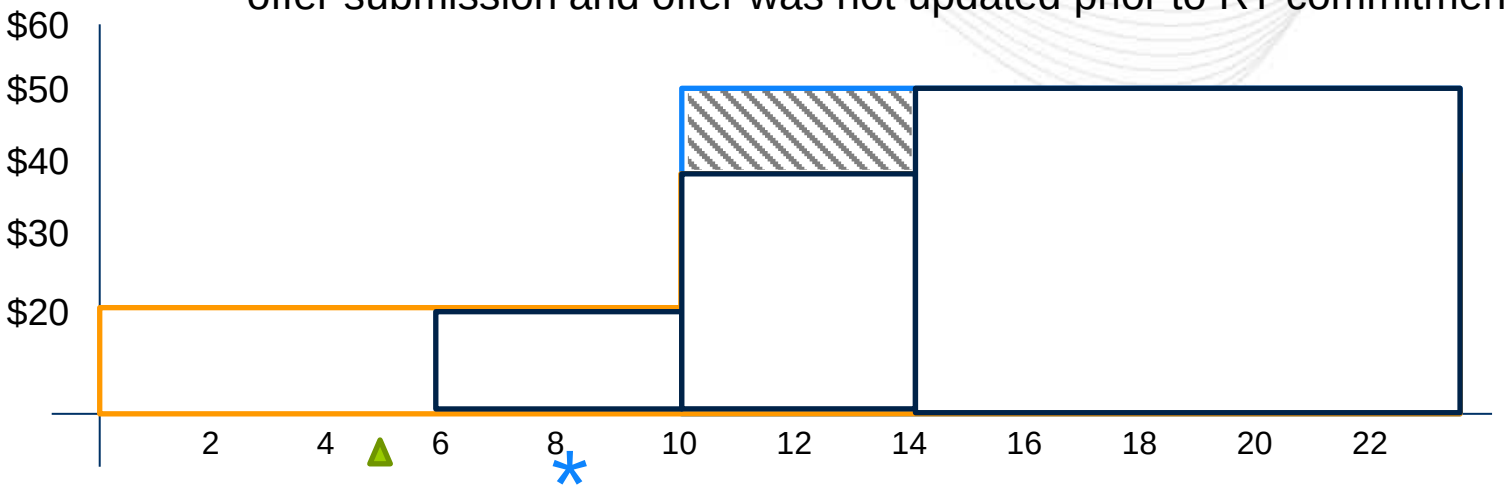
Final Offer: Cost schedule update submitted in RT @ 8:11

Additional portion of curve used for RT dispatch and pricing (not included in make whole)

PJM©2017

Example 3: Committed on Cost in RT (for min run) – Increase to offer during committed and uncommitted hours

Unit has a min run time of 8 hours. Assume cost increases for hours 10 and beyond subsequent to DA offer submission and offer was not updated prior to RT commitment.



Committed Offer: Cost schedule at time of RT Commitment

RT Commitment (commitment decision made @ 5:00) – used for make whole

Final Offer: Cost schedule update submitted in RT @ 8:11

Additional portion of curve used for RT dispatch and pricing (not included in make whole)

The offer used for the Operating Reserves Credit calculations:

Offer Used for Day-Ahead:

- Not Committed

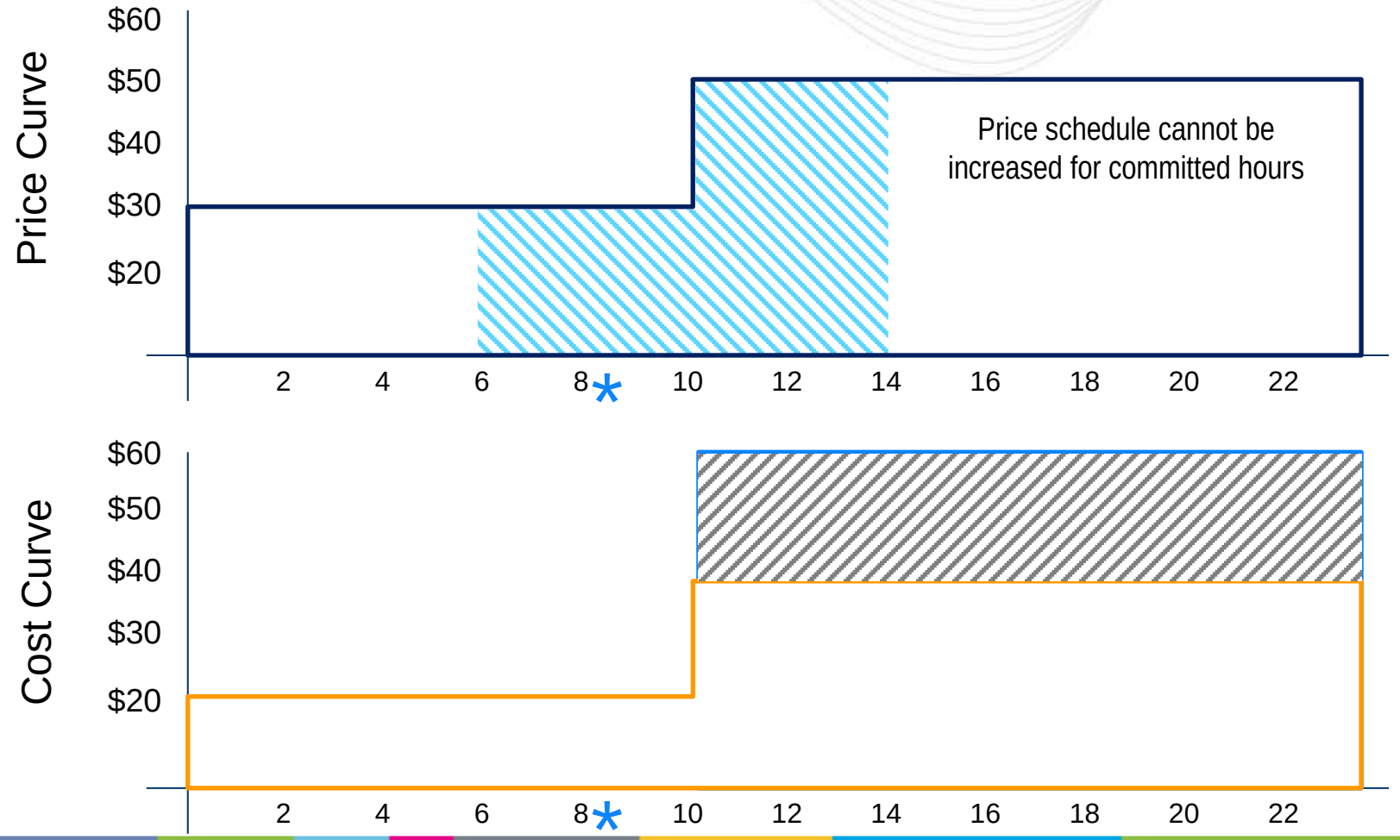
Offer Used for Balancing:

- For HB 6 - 10 the offer used is $20 (segment 1)
- For HB 10 – 14 the offer used is $40 (segment 1)
- If the resource was extended past HB 14, then the offer used is $50 (segment 2)
  - In this case the Committed Offer would be the $50 offer

PJM©2017

Example 4: Committed on Price – Increase to Offer in RT and Elect Switch to Cost

Assume cost increases starting HE 11, elect Switch to Cost at 8:30 a.m. to be effective HE 11



DA Commitment

Committed Offer: Price schedule submitted DA

* Increase Cost Offer and elect Switch to Cost effective 10:00

Cost schedule submitted DA

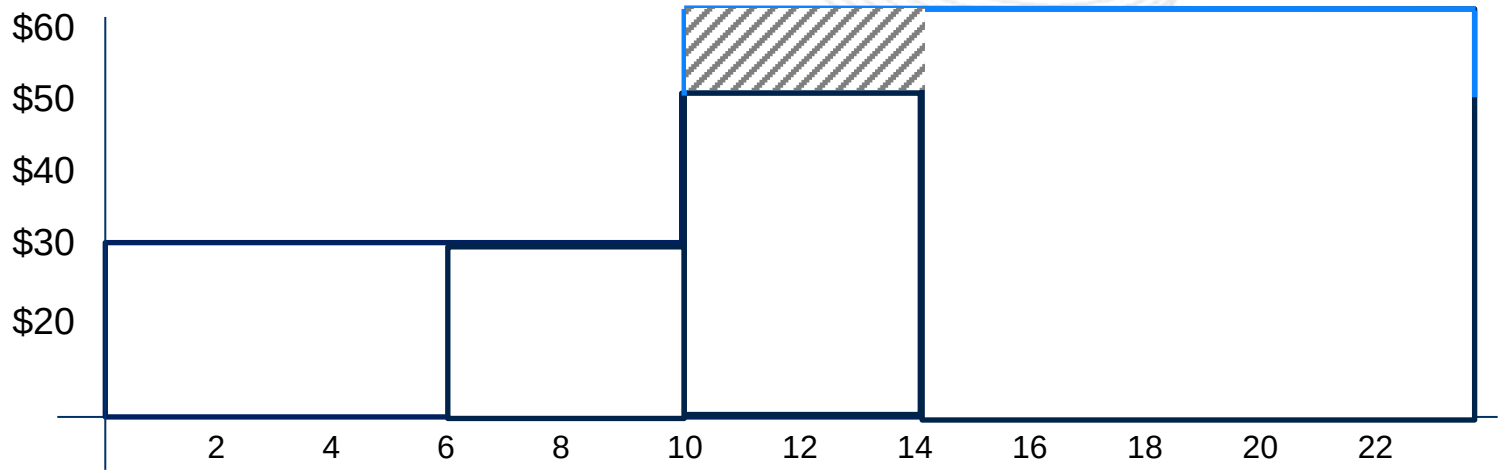
Final Offer starting 10:00: Cost schedule update submitted in RT @ 8:30

Additional portion of curve used for RT dispatch and pricing (not included in make whole)

PJM©2017

Example 4: Committed on Price – Increase to Offer in RT and Elect Switch to Cost

Assume cost increases for the entire day after DA market clears, elect Switch to Cost at 8:30 a.m. to be effective 10:00



DA Commitment

Committed Offer: Price schedule submitted DA

Final Offer for 10-23: Switch to Cost uses Final Cost schedule submitted in RT @ 8:30

Additional portion of curve used for RT dispatch and pricing

The offer used for the Operating Reserves Credit calculations:

Offer Used for Day-Ahead:

- For HB 6 – 10 the offer used is $30
- For HB 10 – 14 the offer used is $50

Offer Used for Balancing:

- For HB 6 - 10 the offer used is $30 (segment 1)
- For HB 10 – 14 the offer used is $50 (segment 1)
- If the resource was extended past HB 14, then the offer used is $60 (segment 2 excluding ramp)

PJM©2017

Lost Opportunity Cost Credits

- Generators whose output is reduced or suspended for reliability may be eligible for Lost Opportunity Credits
- Pool scheduled resources will be compensated using the *higher* of:
    - the Committed offer
    - the Final offer
- Self Scheduled resource compensation rules will be detailed on further slides

PJM©2017

LOC for Pool Scheduled Units

- Lost Opportunity Cost Credit
  = (LOC Deviation * RT LMP) – Total Lost Opportunity Cost Offer
  Where LOC Deviation =
  LMP Desired Output using schedule being dispatched on
  Minus
  Actual Output
- Total Lost Opportunity Cost Offer =
  Hourly Integrated value under the greater of Committed or Final Offer Curve

PJM©2017

Lost Opportunity Cost for Self-Scheduled Resources

- Self-scheduled resources committed on a:
  - Cost Schedule will be compensated using greater of Committed or Final Offer
  - Price Schedule will be compensated using greater of Committed or Final Offer unless there is an available Cost Offer that is greater than the Price Schedule

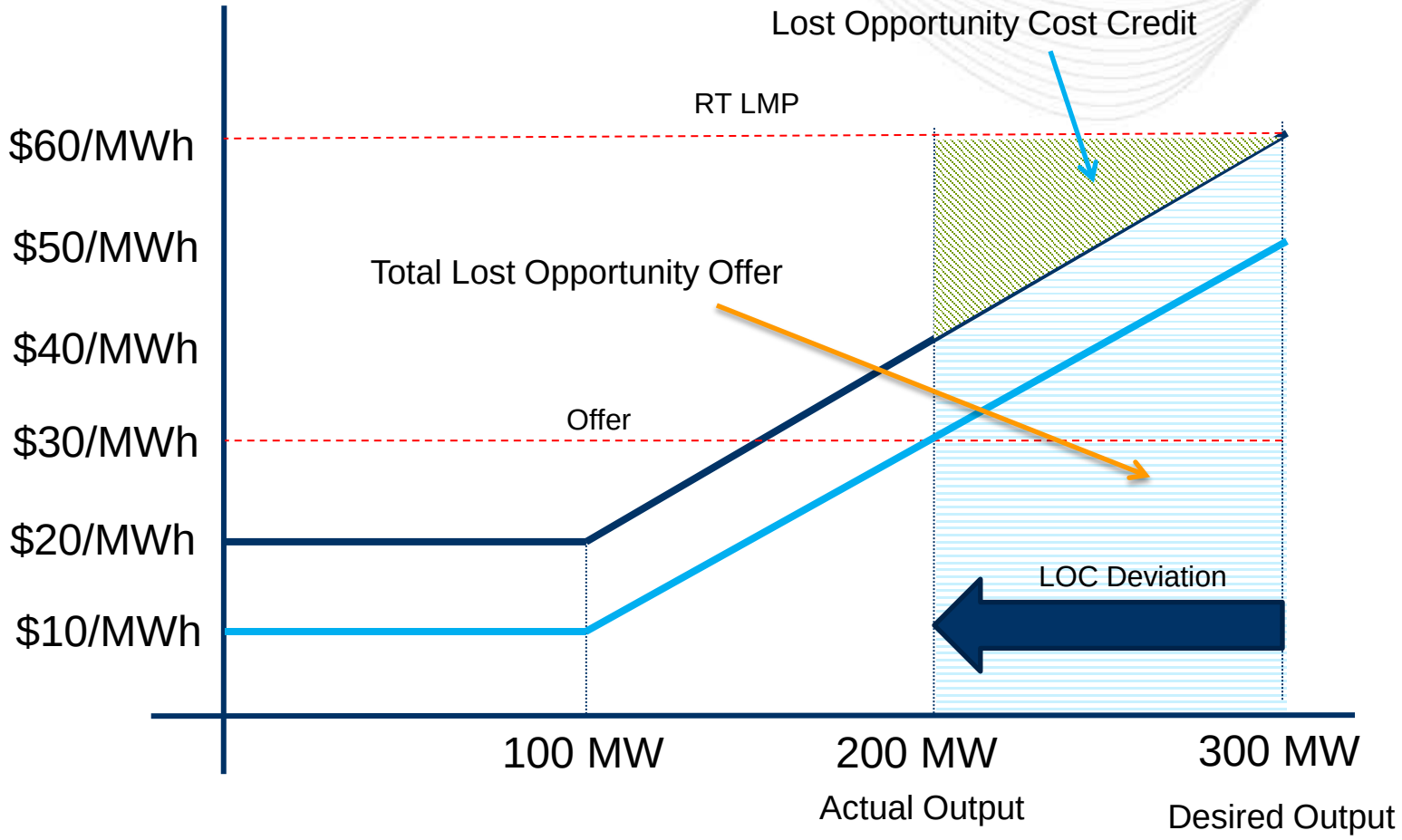
PJM©2017

Lost Opportunity Cost for Flexible Resources

- Flexible Resources are defined as having:
  - Combined startup and notification time less than or equal to 2 hours
  - Min Run time less than or equal to 2 hours
- Flexible Resources are not eligible for LOC if the Real Time Offer is greater than the DA Committed Offer
- LOC for Resources committed DA but not operated in Real Time will be calculated using the higher of:
  - the Committed Offer
  - the last Real Time Offer submitted for the Committed Offer

PJM©2017

Example 1: Pool Scheduled Generating Unit with Updated Offer



Committed Offer: Price schedule submitted DA

Final Offer: Price schedule update submitted in RT @ 7:00

EcoMax = 300 MW

EcoMin = 100 MW

RT LMP = $60

Offer at Actual Output = $30

Unit is mitigated in RT and backed down to 200 MW.

Applicable offer is the greater of Committed or Final Offer which in this case is the Committed Offer.

Lost Opportunity Cost Credit

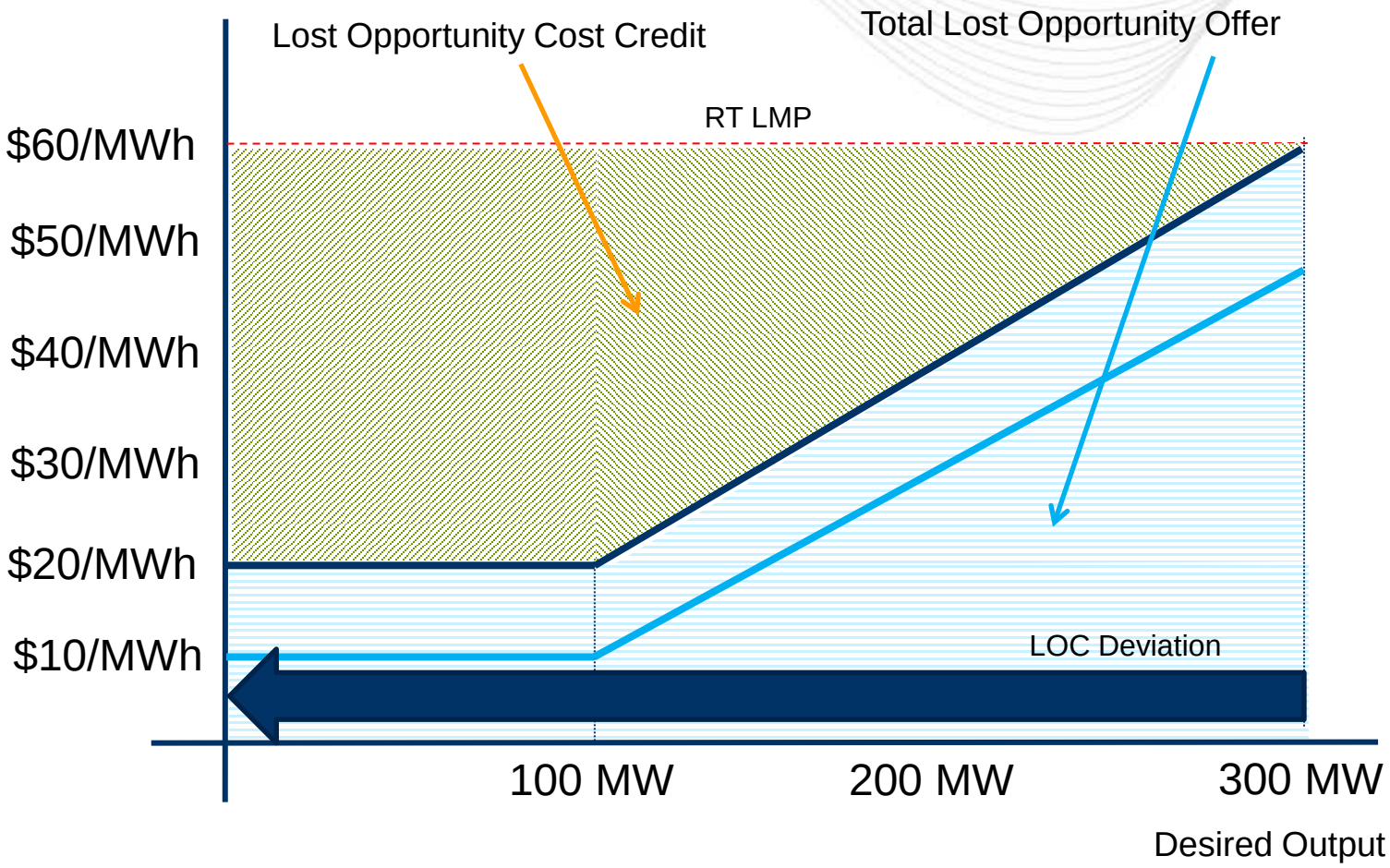
= (LOC Deviation * RT LMP) – Total Lost Opportunity Offer

= (100 MW *$60) - $5000

= $1000

PJM©2017

Example 2: Pool Scheduled in DA Not Called in RT



Committed Offer: Price schedule submitted DA

Final Offer: Price schedule update submitted in RT @ 7:00

EcoMax = 300 MW

EcoMin = 100 MW

RT LMP = $60

No-load cost = $100

Start-up cost = $500

Unit is committed Day-ahead for 5 hours, but does not operate in Real Time.

Applicable offer is the greater of Committed or last Real Time Offer which in this case is the Committed Offer.

Lost Opportunity Cost Credit

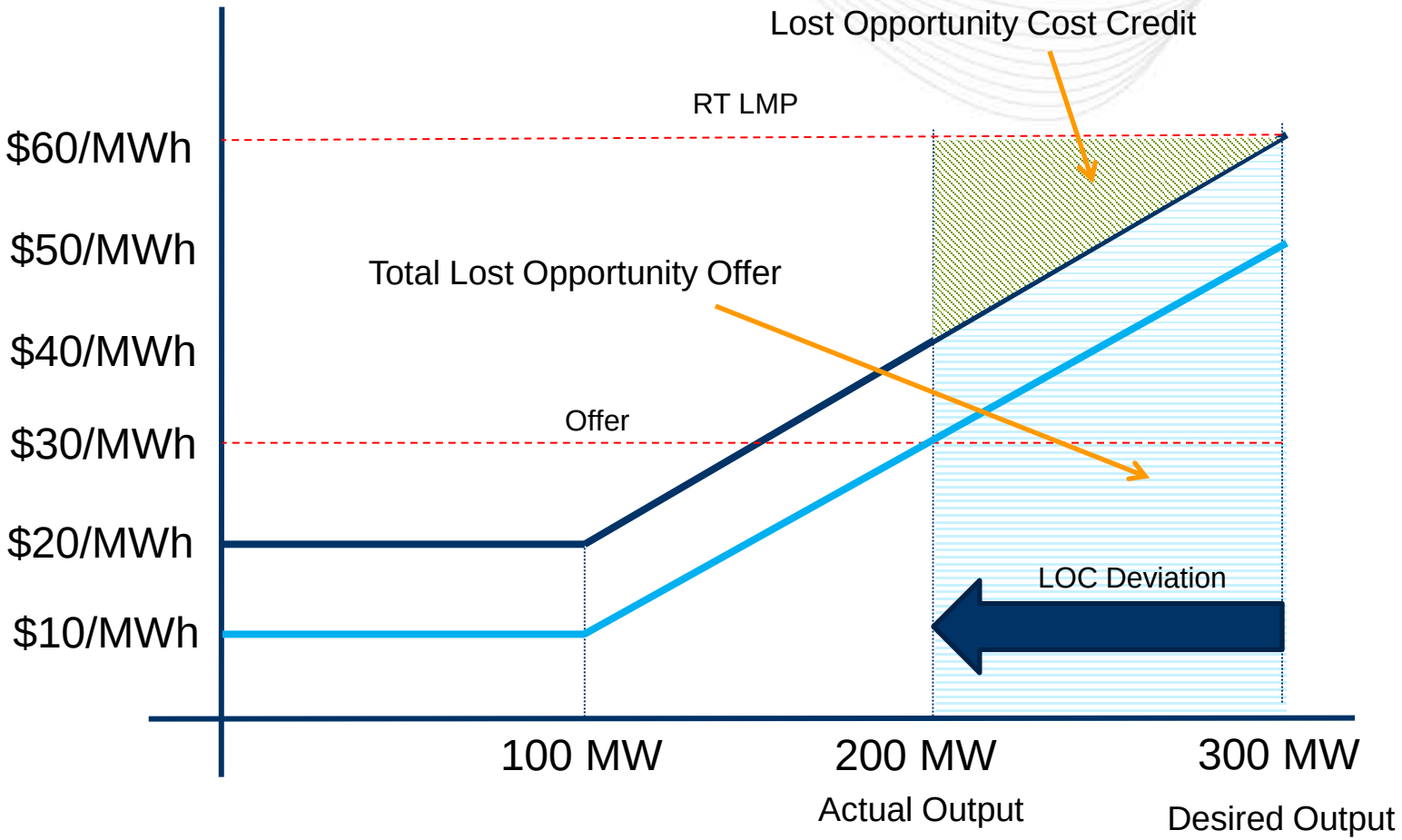
= (Day-ahead MW * RT LMP) – (Total Lost Opportunity Offer + no-load + start-up/5)

= (300 MW * $60) – ($10000 + $100 + $100)

= $7800

PJM©2017

Example 3: Self-Scheduled Generating Unit



Day-Ahead Offer: Price schedule submitted DA

Real Time Offer: Price schedule update submitted in RT @ 7:00

EcoMax = 300 MW

EcoMin = 100 MW

RT LMP = $60

Offer at Actual Output = $30

Unit is mitigated in RT and backed down to 200 MW.

Applicable offer is the greater of Day-Ahead or Real Time which in this case is the Day-Ahead Offer.

Lost Opportunity Cost Credit

= (LOC Deviation * RT LMP) – Total Lost Opportunity Offer

= (100 MW *$60) - $5000

= $1000

PJM©2017

Conclusion

PJM©2017

Ongoing Communication Plan

- Any updates to the functionality discussed in this session will be communicated at the Tech Change Forum
- Following the completion of today's session, and the one planned for Sep. 15, the team will evaluate if additional education would be beneficial. Communication regarding anything additional will be via:
  - MIC
  - Markets Gateway User Distribution List
  - Technotify
  - Demand Response Subcommittee

PJM©2017

Supporting Materials

- Additional Materials are available under the “Intraday Offers” section of the Markets Gateway Tools Page
  - Markets Gateway Impacts Education Slides and January 9th Recording
  - Updated External Specification Guide
  - XML Schema, including XSD information
  - Markets Gateway User Guide (intraday offer-related updates available in July)
  - Guide to Convert Schedule IDs in Markets Gateway
  - Intraday Offers Frequently Asked Questions Document
    - Accessing the Intraday Offers Markets Gateway Training Environment
    - Market Rule Changes
    - XML/Browserless Information & Examples

PJM©2017