# Fast Start Pricing Compliance Filing Details (ER19-2722)

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Market Implementation Committee

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# FERC Compliance Directives

- PJM is required to submit a compliance filing addressing:
  - Additional clarity for Fast Start capable resources
  - Revised Offer Verification process for Composite Offers

- Additional compliance requirements:
  - Remove tariff language intended to provide additional uplift and lost opportunity cost payments
  - Remove tariff language indicating TPS **will not** be performed in the Pricing Run

*January 2021 MIC Presentation detailing FERC Order

# FERC Compliance Directives

- PJM required to include preferred date of implementation
- Compliance filing needs to be filed on or before Tuesday February 16, 2021 (Monday February 15, 2021 is a Federal Holiday)

# Eligible Fast-Start Resources

- Units must first be classified as Fast-Start capable in order to qualify for Fast-Start Pricing
- Generators based on technology type are pre-defined as Fast-Start Capable by default
- Resource not classified as Fast-Start capable may seek to be Fast-Start capable during the annual review period
  - Deadline to submit request: April 15
  - PJM review period (includes consultation with IMM): April 15 – May 31
  - Effective: June 1 and onwards
- Supporting data must be provided to prove unit can startup within one hour
- If unit cannot meet their bid in parameters, may lose Fast-Start capable designation
  - To be reconsidered, the unit may submit supporting data during the annual review period

# Eligible Fast-Start Resources

- Resources classified as FS capable by default:
  - Generation Type:
    - Fuel Cells
    - All CTs
    - Diesels
    - Hydro
    - Battery
    - Solar
    - Landfill
    - Wind
- All Economic Load Response

- Resource classified not FS capable by default*:
  - Combined Cycle
  - Steam
  - Nuclear

*Resources may request to be considered FS Capable

# Eligible Fast-Start Resources

- Once a unit is deemed Fast-Start capable, they must also meet the following requirements in order to qualify for Fast-Start Pricing:
  - Notification Time + Startup Time <= 1 hour
  - Minimum Run Time  <= 1 hour
  - Resources must be online and running for PJM

- Pumped Hydro resources using the PJM Hydro Optimizer, partially Pseudo-tied resources, and dynamically scheduled resources are not eligible for Fast-Start Pricing

# Fast-Start Impact on Offer Verification

- Order 831 requires validation of incremental energy offers above $1000 prior to using them to set LMP
- FERC is mandating that a Fast-Start resource's Composite Energy Offer over $1,000/MWh is validated prior to being eligible to set LMP
- For Fast-Start resources, Composite Energy Offer, is the incremental offer plus amortized commitment costs
- For offer verification validation purposes, the Composite Energy Offer includes the amortized Start Up and No Load cost at all times for generation resources
- For offer verification validation purposes, the Composite Energy Offer includes the amortized Shutdown cost at all times for Economic Load Response resources

# Offer Verification - Effective Offers over $1,000/MWh

**For Generation Resources:**

- If the Composite Energy Offer is calculated to be above $1,000/MWh at the resource's economic maximum
  - PJM will validate the startup cost and no load cost plus incremental offer
  - New display in Markets Gateway to provide validation results
  - No changes to existing logic for validating incremental energy offers above $1,000/MWh
  - Applies to both cost and price-based offers

- Composite Energy Offers cannot be above $2,000/MWh for the purpose of setting LMP

# Offer Verification - Effective Offers over $1,000/MWh

**For Economic Load Response (ELR):**

- If Composite Energy Offer is above $1,000/MWh:
  - Shutdown cost must be validated
  - The Market Seller is to provide PJM supporting documentation in advance that supports the end use customer's incremental and shutdown costs if they exceed $1,000/MWh
  - No changes to the existing logic for validating incremental energy offers

- Composite Energy Offers cannot be above $2,000/MWh for the purpose of setting LMP

# Offer Verification - Effective Offers over $1,000/MWh

- **Composite Energy Offer** = incremental offer + (no load ($) / EcoMax (MWh)) + (startup ($) / (EcoMax (MWh)*min run time))
- The following logic will be applied for the Composite Energy Offer above $1000/MWh and less than or equal to $2000/MWh

| Startup | No Load | Composite Offer | Adjustment (If needed) |
|---|---|---|---|
| Pass | Pass | INCR + ASU + ANL | None |
| Pass | Fail | INCR + ASU + adjustment | Take from No Load to get offer to $1000/MWh, up to submitted No Load value |
| Fail | Pass | INCR + ANL + adjustment | Take from Startup to get offer to $1000/MWh, up to amortized submitted Start Up value |
| Fail | Fail | INCR + adjustment | Take from No Load first, up to submitted No Load, then from Start Up, to get $1000/MWh |

**INCR** = Incremental Offer at Ecomax **ASU** = Amortized Start Up Cost **ANL** = Amortized No Load Cost

# Example 1

## Scenario: Startup Fails, No Load passes with uncapped composite offer above $1000 at Economic Maximum

| | Submitted Amortized Cost | Validation Test Result |
|---|---|---|
| Startup | 200 | Fail |
| No Load | 100 | Pass |

| Min Run Time | 1 Hour |
|---|---|
| Ecomax | 40 MW |

| Incr. Offer Curve | | Submitted ASU ($/MWh) | Submitted ANL ($/MWh) | Uncapped Offer ($/MWh) | Incr. Offer Curve ($/MWh) | Effective ASU (($/MWh) | Effective ANL ($/MWh) | Modified Composite ($/MWh) |
|---|---|---|---|---|---|---|---|---|
| MW | ($/MWh) | | | | | | | |
| 40 | 900 | 200 | 100 | 1 1,200 | 900 | 2 0 | 100 | 1,000 |

1. Original submitted composite offer is above $1000; therefore, offer verification is triggered
2. Since Startup failed, exclude Startup cost from verified composite offer

*After the minimum run time has been met, the modified composite offer at the bid in Economic Maximum will remain at $1000 as the updated verified composite offer is $1000.

# Example 2

## Scenario: Verified composite offer below $1000 and failed startup is needed to cap offer at $1000

| | Submitted Amortized Cost | Validation Test Result |
|---|---|---|
| Startup | 200 | Fail |
| No Load | 100 | Pass |

| Min Run Time | 1 Hour |
|---|---|
| Ecomax | 40 MW |

| Incr. Offer Curve | | Submitted ASU ($/MWh) | Submitted ANL ($/MWh) | Uncapped Offer ($/MWh) 1 | Incr. Offer Curve ($/MWh) | Effective ASU (($/MWh) 3 | Effective ANL ($/MWh) 2 | Modified Composite ( $/MWh) |
|---|---|---|---|---|---|---|---|---|
| MW | ($/MWh) ) | | | | | | | |
| 40 | 725 | 200 | 100 | 1,025 | 725 | 175 | 100 | 1,000 |

1. Original uncapped composite offer is above $1000; therefore, offer verification is triggered
2. Since No Load pass reasonability test, included it in the composite offer
3. Since verified offer is below $1000, additional startup cost is needed to get the composite offer to $1000
   A. $175 amortized Startup cost is needed [$1000 – (725+100)]

*After the minimum run time has been met, the verified composite offer is $825 ($725 incremental offer + $100 of amortized No Load).

# Example 3

## Scenario: Incremental offer is above $1000 with NL passed

| | Submitted Amortized Cost | Validation Test Result |
|---|---|---|
| Startup | 200 | Fail |
| No Load | 150 | Pass |

| | |
|---|---|
| Min Run Time | 1 Hour |
| Ecomax | 40 MW |

| Incr. Offer Curve | | Submitted ASU ($/MWh) | Submitted ANL ($/MWh) | Uncapped Offer ($/MWh) 1 | Incr. Offer Curve ($/MWh) | Effective ASU (($/MWh) | Effective ANL ($/MWh) 2 | Modified Composite ($/MWh) 3 |
|---|---|---|---|---|---|---|---|---|
| MW | ($/MWh) | | | | | | | |
| 40 | 1050 | 200 | 150 | 1,400 | 1050 | 0 | 150 | 1,200 |

1. Original uncapped composite offer is above $1000; therefore, offer verification is triggered
2. Since No Load pass reasonability test, included it in the composite offer
3. Capped composite offer during minimum run time is $1,200 (Exclude Startup)

*After the minimum run time has been met, the verified composite offer would *still* be $1,200 ($1,050 + $150 No Load).

# Offer Verification - Effective Offers over $1,000/MWh

- Validation Details (Status Quo)
  - Information submitted to COA and commodity cost from Platts/ICE will be used to perform validation
  - Composite Energy Offer will be calculated and validated at the resource's Economic Maximum MW or Shutdown Cost for ELRs
  - Fast-Start resources with Composite Energy Offer over $1,000/MWh, will be screened and validated each time a variable affecting the Enhanced Energy Offer calculation is changed

| | |
|---|---|
| • Incremental Offer | • Minimum Run Time |
| • Startup Cost | • Economic Maximum MW |
| • No Load Cost | *Shutdown Cost for ELRs Only |

# Market Settlement Changes

- Specific to Market Settlements, the Commission found that PJM had submitted Tariff language that complied with this directive.

- However, the Commission also found that PJM had submitted additional, unnecessary Tariff provisions that would provide additional uplift payments.

# Accepted Settlement Components

- Dispatch Differential Lost Opportunity Cost Credits
- Double Counting of Commitment Costs

# Rejected Settlement Components

- The following settlement components will be removed from the compliance filing:
  - Day-ahead Scheduling Reserve (DASR) Lost Opportunity Cost Credits
  - Day-ahead Transaction Make Whole Payments
  - Real-time Make Whole Credit

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**Please send feedback on compliance directive, if any, to the above contacts.**

# Appendix – Market Settlement Details

# Dispatch Differential Lost Opportunity Cost Credits

- The FERC order accepted PJM's proposal to use lost opportunity cost (LOC) credits to offset the incentive for over-generation or price chasing
  - Incentive can exist when a resource is dispatched down to maintain power balance due to the need to accommodate the inflexibility of Fast-Start resources as well as the inclusion of commitment costs into the LMP
  - Pool-scheduled and dispatchable self-scheduled resources are eligible to receive this LOC credit

# Dispatch Differential LOC

- Objective
  - Minimize incentive for a resource to deviate from dispatch instructions by chasing LMP
- Approach
  - Calculate a Dispatch Differential LOC (DD LOC) that is the difference between additional revenue above cost that a resource would have received if it operated at the Pricing Run MW and the actual revenue above cost the resource earned

# Dispatch Differential LOC

- Resources will continue to receive eligible LOC credits if scheduled for:
  - Regulation
  - Synchronized Reserve
  - Reactive Services
  - Reduced or suspended due to a transmission constraint or for other reliability reasons
- For these resources, existing LOC credits cover the differences between the pricing run and the dispatch run and as a result these resources will not be eligible for DD LOC
- Eliminates the potential for duplicate LOC credits for the same MWs

# Dispatch Differential LOC

- Dispatch Differential LOC will only be calculated for the Real-time Market
- Dispatch deviations can only occur in the Real-time Energy Market, so this LOC does not apply to the Day-ahead Market

# Dispatch Differential LOC

- Five-minute interval based calculation

- Dispatch Differential LOC will equal the positive difference between the revenue above cost that a resource would have received if it operated at the Pricing Run MW and the actual revenue above cost the resource earned

- Dispatch Differential LOC credits will be allocated to Real-time load plus exports on an hourly basis

# Dispatch Differential LOC Calculation

- Pricing Run Revenue Above Cost

  (Expected MW Output * $LMP_P$) – Incremental Energy Offer for Expected MW Output

  Expected MW Output is the MW value of the resource based on the Final Offer at the five minute Real-time LMP at the resource bus

- Dispatch Run Revenue Above Cost

  Greater of (Dispatch MW, Actual MW) * $LMP_P$ –

  Lesser of (Cost of Dispatch MW, Cost of Actual MW)

- Dispatch Differential LOC = Max(Pricing Run Revenue Above Cost – Dispatch Run Revenue Above Cost, 0)

# Dispatch Differential LOC Calculation

| Segment | MW | Price | Cost |
|---|---|---|---|
| 1 | 85 | $20 | $1700 |
| 2 | 95 | $27 | $235 |
| 3 | 100 | $30 | $142.50 |
| Total Cost | | | $2077.50 |

| | Dispatch Run | Pricing Run |
|---|---|---|
| Energy | 85 MW | 95 MW |
| Reserves | 0 MW | 5 MW |

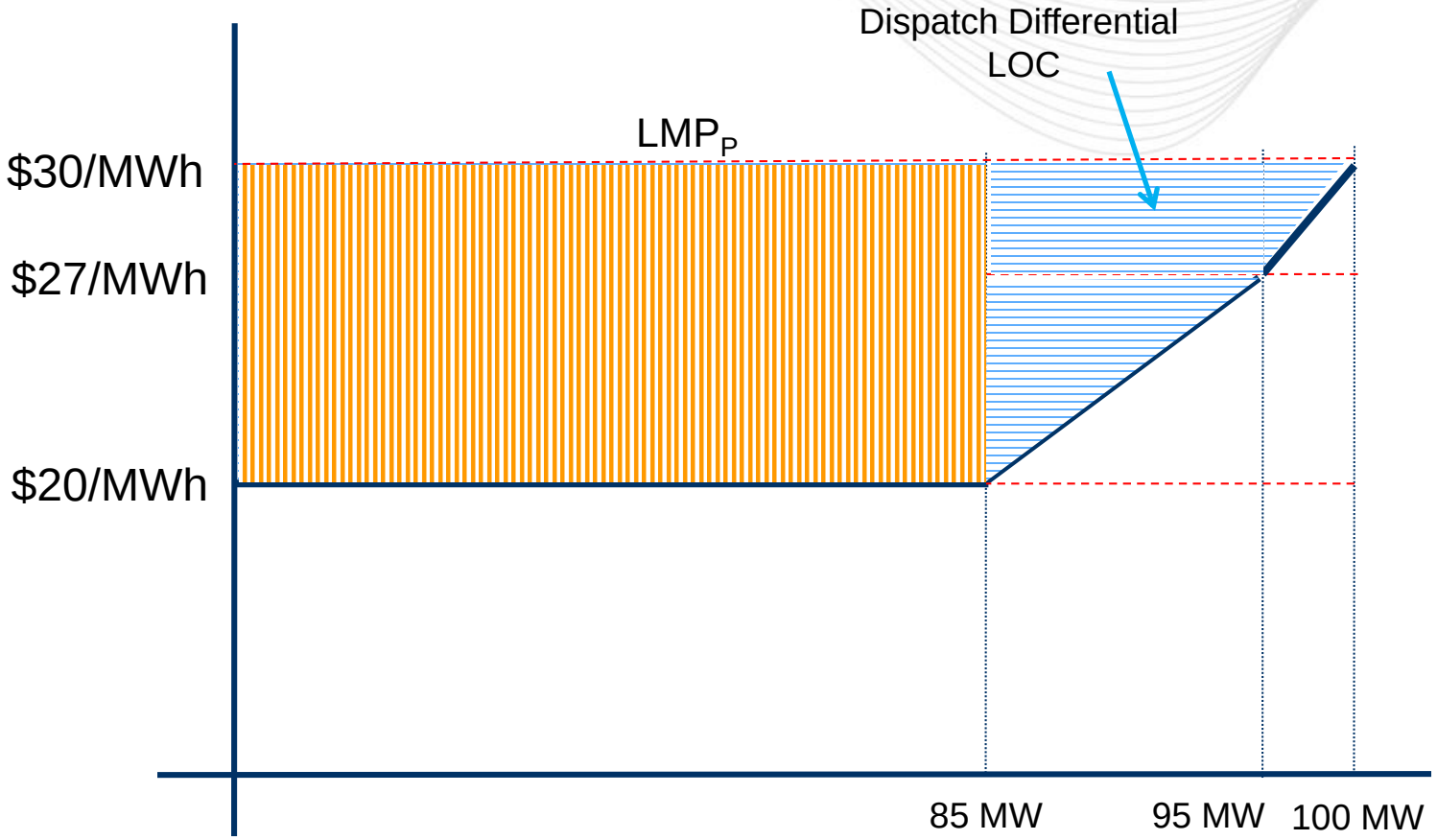
| | Value |
|---|---|
| Dispatch MW | 85 MW |
| Actual MW | 85 MW |

Pricing Run Revenue Above Cost = (Expected MW Output * $LMP_P$) – Incremental Energy Offer for Expected MW Output
= (100 MW * $30/MW) - $2077.50
= $3000 – $2077.50
= $922.50

Dispatch Run Revenue Above Cost = Max (Dispatch MW, Actual MW * $LMP_P$) – Min (Cost of Dispatch MW, Cost of Actual MW)
= (85 MW * $30/MW) – (85 MW * $20/MW)
= $2550 - $1700
= $850

Dispatch Differential LOC = Pricing Run Revenue Above Cost - Dispatch Run Revenue Above Cost
= $922.50 - $850
= $72.50

# Dispatch Differential LOC Calculation




Pricing Run Revenue Above Cost
$922.50

Dispatch Run Revenue Above Cost
$850

Dispatch Differential LOC
$72.50

# Double Counting of Commitment Costs

A resource is dispatched higher in Real-time than in Day-ahead

(positive balancing MW)

**AND**

The resource is made-whole for 100% of its startup and

no-load costs in Day-ahead.

*When these are true, the resource has an opportunity to collect revenues in Real-time to cover costs that have already been compensated via Day-ahead uplift.*

*This situation can occur today and  is not unique to Fast-Start Pricing.*

# Double Counting Solution

- Costs recovered via uplift in the Day-ahead Market that are subsequently recovered in Real-time Market revenues are subtracted from Day-ahead uplift
- Implemented by calculating Operating Reserve Targets:
  - Day-ahead Operating Reserve Target = Total DA Offer Cost* – DA Revenue
  - Balancing Operating Reserve Target = Total RT Offer Cost* – Total Revenue**

*Total Offer Cost includes Incremental Offer + Startup + No Load

**Total Revenue includes DA Credits + Balancing Credits + Ancillary Service Revenue + Real-time Make Whole Credits

# Double Counting Examples

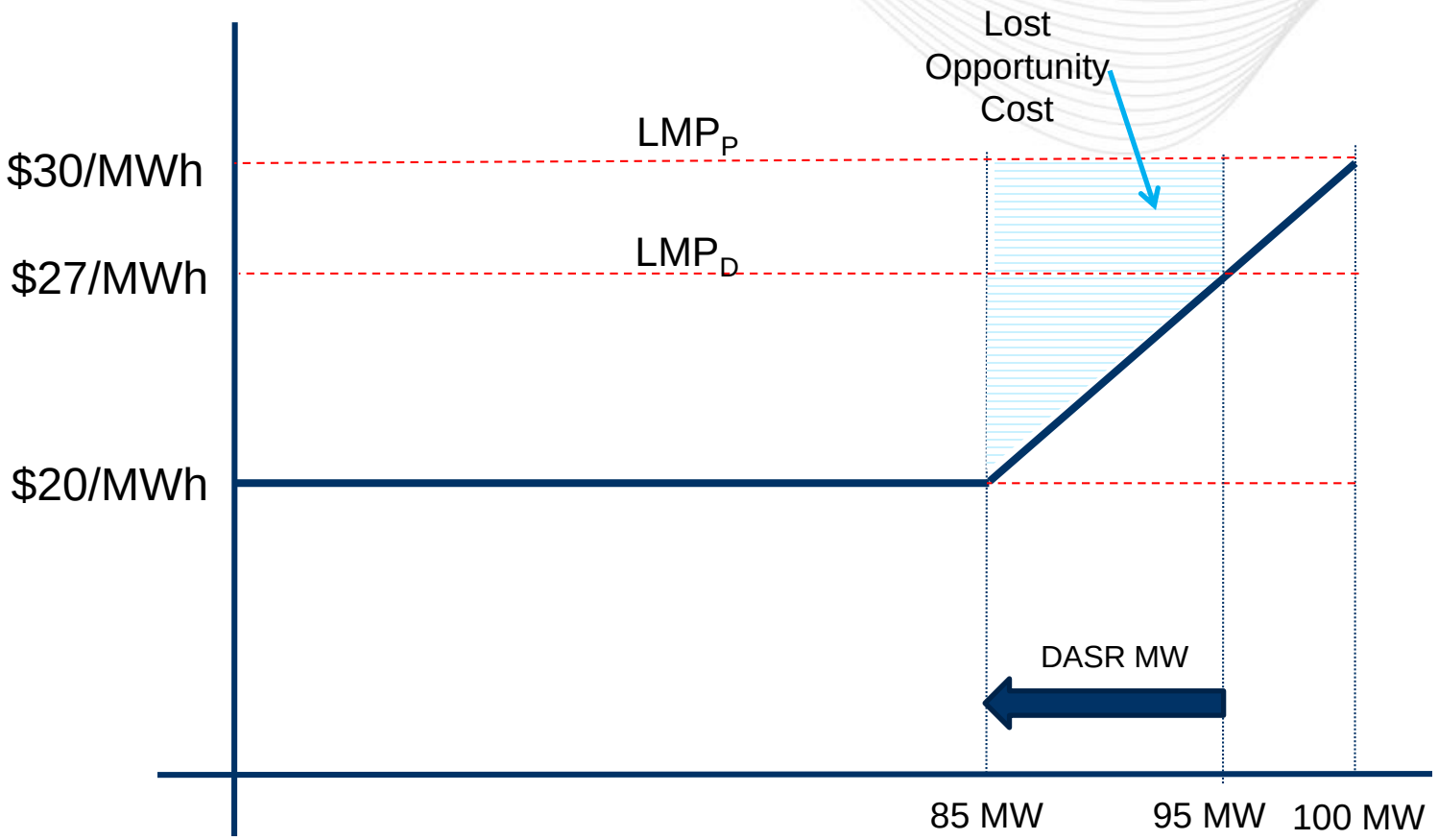
- The total Operating Reserve Credits are capped to ensure no over payment
  - DA OR Credit Offset = MAX(DA OR Target - Bal OR Target, 0)
  - Bal OR Credit = MAX(Bal OR Target – DA OR Credit, 0)
    - The balancing credit is equal to the portion of balancing uplift that wasn't recovered via Day-Ahead uplift (Status quo)
- This calculation will apply to all resources, not only Fast-Start

| DA OR Target | Bal OR Target | Day-ahead OR Credit Offset | Day-Ahead OR Credit | Bal OR Credit | |
|---|---|---|---|---|---|
| $90 | $100 | $0 | $90 | $10 | Status Quo |
| $100 | $100 | $0 | $100 | $0 | Status Quo |
| $110 | $100 | $10 | $100 | $0 | Over Payment Resolved |
| $50 | $0 | $50 | $0 | $0 | Over Payment Resolved |

# Day-ahead Scheduling Reserve (DASR) LOC

- With Fast-Start Pricing, LOC is calculated to ensure that the DASR MW the resource is backed down in the Day-ahead dispatch run receives the same revenue above cost the resource could have received if it had been assigned energy for that same quantity
  - Goal is to maintain indifference between providing energy and reserves
- If DASR Clearing Price Credits < (Offer + Lost Opportunity Cost), resource is eligible for DASR LOC credit
- Introduces new Billing Line Item for DASR LOC credit

# Day-ahead Scheduling Reserve (DASR) LOC




| Dispatch Run | |
|---|---|
| Energy MW | DASR MW |
| 85 MW | 15 MW assignment (backed down 10 MW) |

Lost Opportunity Cost = $65
This value is the foregone revenue, not the Lost Opportunity Cost Credit.

The LOC Credit is based on the difference between the DASR credits and (Offer + LOC)

LOC not paid for MW from 95 to 100 MW.
This is the equivalent of DD LOC, which is not being paid in the Day-ahead market.

# Day-ahead Transaction Make Whole Payments

- Day-ahead Transactions include:
  - Virtual Transactions
    - Increment Offers
    - Decrement Bids
    - Up-to Congestion Transactions
  - Price Responsive Demand
  - Dispatchable Exports

- Transactions that clear in the Day-ahead dispatch run but are not economic in the Day-ahead pricing run will be made whole to their offer

# Real-time Make Whole Credit

- These credits represent the cost of MWs that are provided in real-time in excess of the resource's day-ahead assignment that are not compensated by real-time LMP
- Credits only apply to pool-scheduled or dispatchable self-scheduled resources

# Real-time Make Whole Credit

- Eligibility rules:
  1. Real-time dispatch MW greater than Day-ahead assignment
  2. Real-time dispatch MW greater than the output level of the resource based on the intersection of RT LMP with the offer curve

# Real-time Make Whole Credit Calculation

A. Using Final Offer, calculate the cost of the MWs between the:

(1) Greater of DA Schedule MW and expected MW output at RT LMP

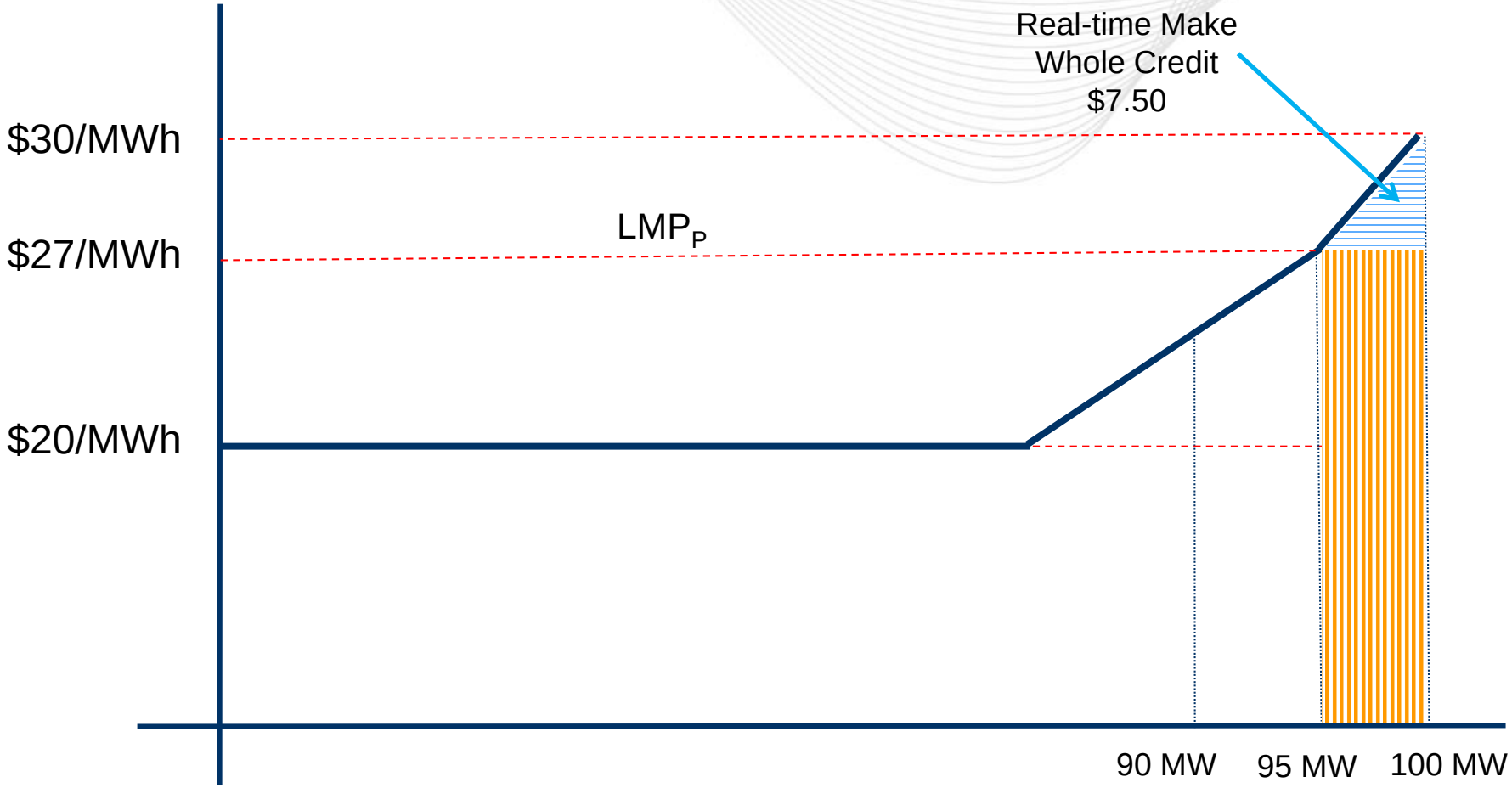
AND

(2) Lesser of RT Dispatch MW and actual MW output

B. Calculate the revenue for the MW difference between (1) and (2) at RT LMP

C. The Real-time Make Whole Credit is equal to the positive difference between the cost and revenue: A – B.

# Real-time Make Whole Credit Calculation




DA Schedule = 90 MW

Expected MW at RT LMP = 95 MW

RT Dispatch = 100 MW

Actual Output = 100 MW

Cost of MWs
$142.50

Revenue for
MW difference
$135

# Operating Reserve Credits

- Status Quo
  - Balancing Operating Reserve segments
- Changes
  - Real-time Make Whole Credit is an additional revenue component to offset Balancing Operating Reserve credits