New York ISO
Independent System Operator

Consumer Impact Analysis :
Constraint Specific Transmission Shortage Pricing
Reposted in Response to Stakeholder Feedback*

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*See Slides 23-30 for additional data in response to stakeholder feedback

Background

- **Transmission facility ratings limit the amount of energy that can flow from one location to the next on the bulk electric system.**
- **The NYISO assigns a non-zero constraint reliability margin (CRM) to most facilities and interfaces to help manage transmission modeling uncertainty.**
  - The CRM value represents a reduction to the otherwise applicable transmission facility rating or interface limit that is used to set the effective limit in the market software
  - A zero value CRM is applied to facilities that accommodate flows out of generation pockets, as well as external interfaces
- **The existing transmission constraint pricing (TCP) logic applies a single graduated pricing mechanism to all facilities assigned a non-zero CRM value.**

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Background (Contd.)

- The NYISO is proposing to utilize a revised and more graduated transmission shortage pricing mechanism that better accounts for the various non-zero CRM values assigned to facilities.
- The NYISO's proposal is intended to better align the transmission shortage pricing mechanism with the severity of transmission constraints.
- As part of the revised transmission shortage pricing mechanism, the NYISO is also proposing to eliminate most occurrences of constraint relaxation by including pricing values for shortages that exceed the applicable CRM value and assigning a non-zero CRM value to internal facilities currently assigned a zero value CRM

Current Transmission Shortage Pricing Mechanism

- The following limits on Shadow Prices are applied in instances of transmission shortages (implemented on June 20, 2017)

Facility Type	Shortage (MW)	Shortage Price ($/MWh)	Shadow Price Cap
Non-Zero CRM Value	Up to 5	$350	$4000
	>5 to 20	$1175	
Zero Value CRM	N/A	N/A	$4000

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Summary of NYISO's Proposal

- **The NYISO is proposing to implement a revised approach to the current TCP logic consisting of the following components:***
  1. Establish a revised six-step transmission shortage pricing mechanism for facilities currently assigned a non-zero CRM value (see the following slide for additional details)
     - Each step corresponds to a specified percentage of the applicable CRM value. The final step will price all shortages in excess of the applicable CRM value
  2. Apply a non-zero CRM value (e.g., 5 MW) to internal facilities currently assigned a zero value CRM, with a separate two-step transmission demand curve mechanism for such facilities
     - First step is valued at $100/MWh. This step would price transmission shortages up to the proposed CRM value.
     - Second step is valued at $250/MWh. This step would price all shortages in excess of the proposed CRM value.
  3. Maintain the current single value $4,000/MWh shadow price capping method for external interface facilities (zero value CRM) permitting the continued use of constraint relaxation for external interfaces

**Refer to the presentation at the June 17, 2021 ICAPWG/MIWG meeting for additional details regarding the NYISO's proposal*

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NYISO'S Proposal for Non-Zero CRM Value Facilities

- The proposed 6-step transmission demand curve structure for various non-zero CRM values is represented in the table below:

	Proposed Transmission Shortage Pricing Curve steps											
CRM Value (MW)	Step 1 (MW)	Step 1 ($/MWh)	Step 2 (MW)	Step 2 ($/MWh)	Step 3 (MW)	Step 3 ($/MWh)	Step 4 (MW)	Step 4 ($/MWh)	Step 5 (MW)	Step 5 ($/MWh)	Step 6 (MW)	Step 6 ($/MWh)
10	<=2	$200	>2-4	$350	>4-6	$600	>6-8	$1,500	>8-10	$2,500	>10	$4,000
20	<=4	$200	>4-8	$350	>8-12	$600	>12-16	$1,500	>16-20	$2,500	>20	$4,000
30	<=6	$200	>6-12	$350	>12-18	$600	>18-24	$1,500	>24-30	$2,500	>30	$4,000
50	<=10	$200	>10-20	$350	>20-30	$600	>30-40	$1,500	>40-50	$2,500	>50	$4,000
60	<=12	$200	>12-24	$350	>24-36	$600	>36-48	$1,500	>48-60	$2,500	>60	$4,000
65	<=13	$200	>13-26	$350	>26-39	$600	>39-52	$1,500	>52-65	$2,500	>65	$4,000
100	<=20	$200	>20-40	$350	>40-60	$600	>60-80	$1,500	>80-100	$2,500	>100	$4,000

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Consumer Impact Analysis (IA) Evaluation Areas

- Developed the potential impact on all four evaluation areas

RELIABILITY The proposed enhancements are intended to facilitate efficient re-dispatch by the NYISO's market software to alleviate transmission constraints The proposal is intended to facilitate appropriate trade-offs between transmission constraints and reserve products	COST IMPACT/ MARKET EFFICIENCIES A short run annual energy cost impact ranging from a potential savings (reduction) of approximately \$1.6 million statewide to a to an increase of approximately \$5.8 million No expected material capacity market impact in the short run.
ENVIRONMENT/ NEW TECHNOLOGY No direct short-term benefit is expected to result from the proposed enhancements	TRANSPARENCY The proposed enhancements should improve the predictability/understandability of market outcomes

Cost Impact Analysis

Summary of Potential Cost Impact

- **The NYISO estimates the potential for a short run annual energy cost impact for the proposal that ranges from a savings (reduction) of approximately $1.6 million statewide (represents ~0.03% of ~$4.7 billion total energy market transactions in 2019[1]) to an increase of approximately $5.8 million (represents ~0.12 % of ~$4.7 billion total energy market transactions in 2019[1]).**
  - This estimate does not include impacts due to changes in reserves and regulation prices.
  - The range of the potential impact is derived from two different approaches to estimating the potential impact of the proposal on energy costs
    - One approach is based solely on impacts to Day-Ahead prices (see Slides 10-16)
    - An alternative approach seeks to account for the impacts from potential changes to real-time prices on Day-Ahead prices (see Slides 23-30)
- **The NYISO does not expect the proposal to have a material capacity market impact in the short run.**
  - The studied energy market impacts are relatively small compared to the market size and therefore not expected to result in material changes to the net EAS offset values and resulting reference point prices for the ICAP Demand Curves.

1. The total quantity of energy transactions is derived from the 2019 average monthly LBMP and load data

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Cost Impact Methodology – Day-Ahead Pricing Impact

- **Using the NYISO's market software, re-ran select Day-Ahead Market (DAM) days. The following revisions were included in the market software re-runs:**
  1. Incorporated the proposed six-step transmission demand curve mechanism for facilities currently assigned a non-zero CRM value
     - See Slide 6 for additional details
  2. Assigned a 5 MW CRM value to internal facilities currently assigned a zero value CRM, and incorporated the proposed two-step transmission demand curve mechanism for such facilities
     - See Slide 5 for additional details

  Note: Consistent with the NYISO's proposal, the re-runs maintained the current single value $4,000/MWh shadow price capping method for external interface facilities

Cost Impact Methodology – Day-Ahead Pricing Impact (cont'd)

- **Approach used to select days for re-runs:**
  - Selected multiple days based on actual historical DAM transmission constraint costs during recent months (June through mid-July 2021) to ensure the simulations are based on updated software and market rules. The proposed shortage pricing values for the revised six-step transmission demand curve mechanism were used as the basis for selecting the appropriate days
    - The actual historical binding transmission constraints for each hour were segmented into pricing ranges ("categories") as further described on next slide (Slide 12) to determine the total number of binding transmission constraints for each category for each hour. The segmented counts were summed for all hours of each day to determine the total count of binding transmission constraints occurring within each category for each day
    - For any given hour, it is possible for binding transmission constraints to occur in more than one category
    - The days selected for use in conducting the re-runs represented the day with the highest number of transmission constraint pricing values identified for each category; provided that separate days were utilized for each category

Cost Impact Methodology – Day-Ahead Pricing Impact (cont'd)

- **Categories and selected days are identified below:**
  - Category 1: Constraint cost <=$200 /MW for two or more hours in the day
    - Day selected for re-run: 7/8/2021
  - Category 2: $200/MW < Constraint cost <= $350/MW for two or more hours in the day
    - Day selected for re-run: 6/28/2021
  - Category 3: $350/MW < Constraint cost <= $600/MW for two or more hours in the day
    - Day selected for re-run: 7/7/2021
  - Category 4: $600/MW < Constraint cost <= $1,500/MW for two or more hours in the day
    - Day selected for re-run: 6/29/2021
  - Category 5: $1,500/MW < Constraint cost <= $2,500/MW for two or more hours in the day
    - No day was found to represent this category
  - Category 6: $2,500/MW < Constraint cost <=$4,000/MW for two or more hours in the day
    - No day was found to represent this category

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Cost Impact Methodology – Day-Ahead Pricing Impact (cont'd)

- **The price delta values calculated using re-run prices and original prices were applied to days in a one-year period to estimate the potential annual consumer impact**
  - The NYISO used DAM prices and load values from 2019 for the purpose of this analysis
  - 2019 DAM days were reorganized into different categories based on similar logic as adopted for selecting days for re-runs (see Slide 11) and as further described below and on the next slide (Slide 14)
  - Days were categorized as follows:
    - "Category 6" day: two or more transmission constraint costs of $2,500/MWh - $4,000/MWh
      - No 2019 DAM days were identified as falling within this category
    - "Category 5" day: two or more transmission constraint costs of $1,500/MWh - $2,500/MWh
      - No 2019 DAM days were identified as falling within this category
    - "Category 4" day: two or more transmission constraint costs of $600/MWh - $1,500/MWh
    - "Category 3" day: two or more transmission constraint costs of $350/MWh - $600/MWh
    - "Category 2" day: two or more transmission constraint costs of $200/MWh - $350/MWh
    - "Category 1" day: two or more transmission constraint costs of less than $200/MWh

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Cost Impact Methodology – Day-Ahead Pricing Impact (cont'd)

- **Additional details regarding categorization methodology for 2019 DAM days:**
  - It is possible for a day to have sufficient variation in binding transmission constraint costs to qualify for more than one category. In such instances, the day was generally assigned to the category that had the highest constraint count
    - For example, if a day had four "Category 2" constraints and two "Category 3" constraints, the day was deemed a "Category 2" day
    - Since most days during the historical period had the highest number of "Category 1" constraints, this category was applied only if the day did not qualify for any other category
      - For example, if a day had forty "Category 1" constraints and three "Category 4" constraints, the day was deemed a "Category 4" day.
    - If a day had an equal number of constraints in two categories, it was assigned the highest value category applicable for such day
      - For example, if a day had four "Category 2" constraints and four "Category 3" constrains, the day was deemed a "Category 3" day
  - Price delta values calculated from re-runs in each category were applied to the days in the respective category
    - For example, the applicable price delta values corresponding to the re-run for Category 1 was applied to all days in 2019 that fell into that category.

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Cost Impact Methodology – Day-Ahead Pricing Impact (cont'd)

- **The NYISO compared LBMPs from re-run cases to the original LBMPs to determine percent delta in zonal LBMPs.**
  - Percent delta values were determined for each hour of the day for each Load Zone.
- **The percent delta values were used to estimate the consumer impact due to potential changes in DAM energy prices.**
  - The price deltas corresponding to the different categories were applied to days in the historical one-year period that fell in those categories.
  - The LBMP delta ($/MW) for the different categories were multiplied by the corresponding hourly actual real-time load during the historical one-year period to determine the impact due to the change in Energy prices
- **The NYISO also compared reserve and regulation prices from re-run cases to the original prices to determine a delta in Ancillary Services prices.**

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Potential Energy Cost Impact – Day-Ahead Pricing Impact

- **The estimated short run annual energy market impact from the NYISO's proposal is a reduction in energy cost of $1.6 million statewide.**
  - This estimate was derived by applying the hourly zonal price deltas from four re-run days to one year of historical data
    - The actual results may vary from the potential impact estimated by this methodology.
  - The NYISO recognizes that there may be additional impacts on energy prices due to changes in real-time prices. Factors like possible changes in bidding behaviors due to changes in real-time prices have not been considered when calculating the estimated potential impact determined by this analysis.
    - In response to stakeholder feedback, the NYISO did conduct re-runs for a limited number of real-time (RTD) intervals to provide information regarding potential impacts of the proposal on real-time transmission constraint costs and zonal LBMPs.
      - Results from this analysis are further described in later slides (see Slides 18-22)
    - In response to stakeholder feedback at the September 14, 2021 ICAPWG/MIWG, the NYISO conducted an additional analysis that seeks to assess the potential impacts to energy costs resulting from changes in real-time prices being reflected in DAM price
      - Results from this analysis are further described in later slides (see Slides 23-30)

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Potential Impacts on Ancillary Services Prices

- **The NYISO observed a small impact on DAM reserve and regulation prices for the re-runs conducted as part of this analysis**
  - The observed delta (re-run–original) in reserve and regulation prices ranged from -$1.6/MWh to $1.4/MWh and was generally limited to only a few hours across the days that were re-run.
    - Additional information is provided in the Appendix.
  - The observed price deltas were developed for informational purposes but were not used to calculate a potential estimate of the impact on annual reserve and regulation costs.
    - Price differences are a result of the redispatch and are highly dependent upon the specific units scheduled for these services during a given day. Therefore, using re-runs from 4 days to calculate an impact for an entire year would not provide an accurate representation.

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Informational Real-Time Analysis

- **The NYISO re-ran select RTD intervals to provide information regarding the potential impacts of its proposal on real-time transmission constraint costs and zonal LBMPs.**
  - Two RTD intervals were selected for the re-runs. The selection of these intervals was based on the transmission constraint costs observed in the actual historical data.
    - 6/29/2021 15:40
      - Contains multiple transmission constraints with higher constraint costs (> $1,175/MWh)
    - 6/29/2021 15:55
      - Contains multiple transmission constraints with lower constraint costs (between $200/MWh and $350/MWh)
  - Transmission Constraint costs and zonal LBMPs were compared across the original and re-run cases.
    - Only those transmission constraints that were common across both cases were used for comparison.

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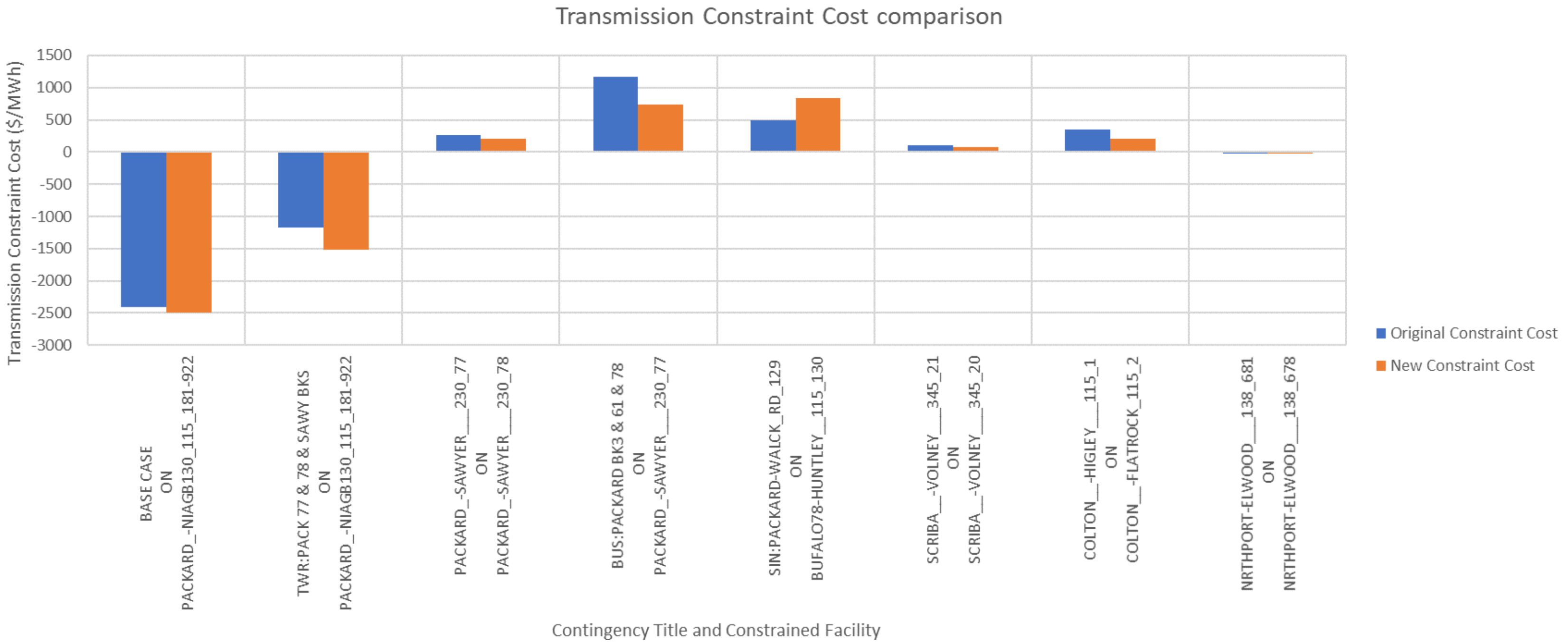
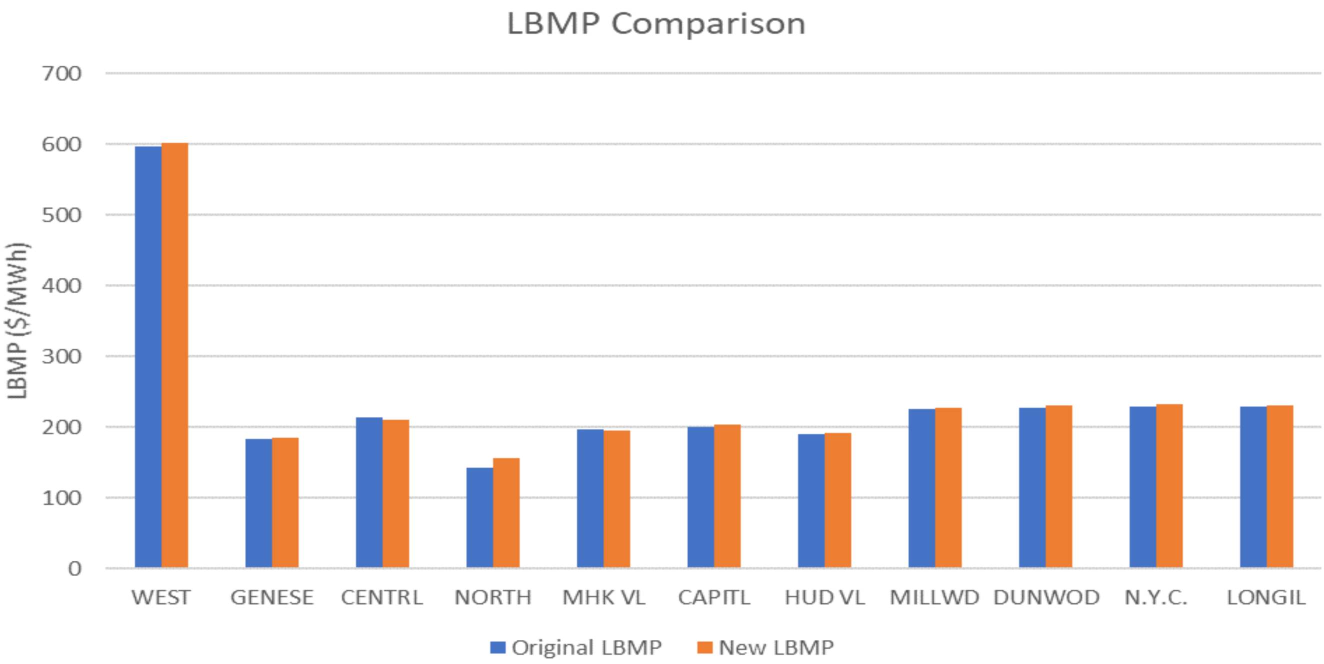
Informational Real-Time Analysis

- **RTD re-run: 6/29/2021 15:40**
  - The proposed enhancements resulted in the transmission constraint costs increasing on some facilities while decreasing on others



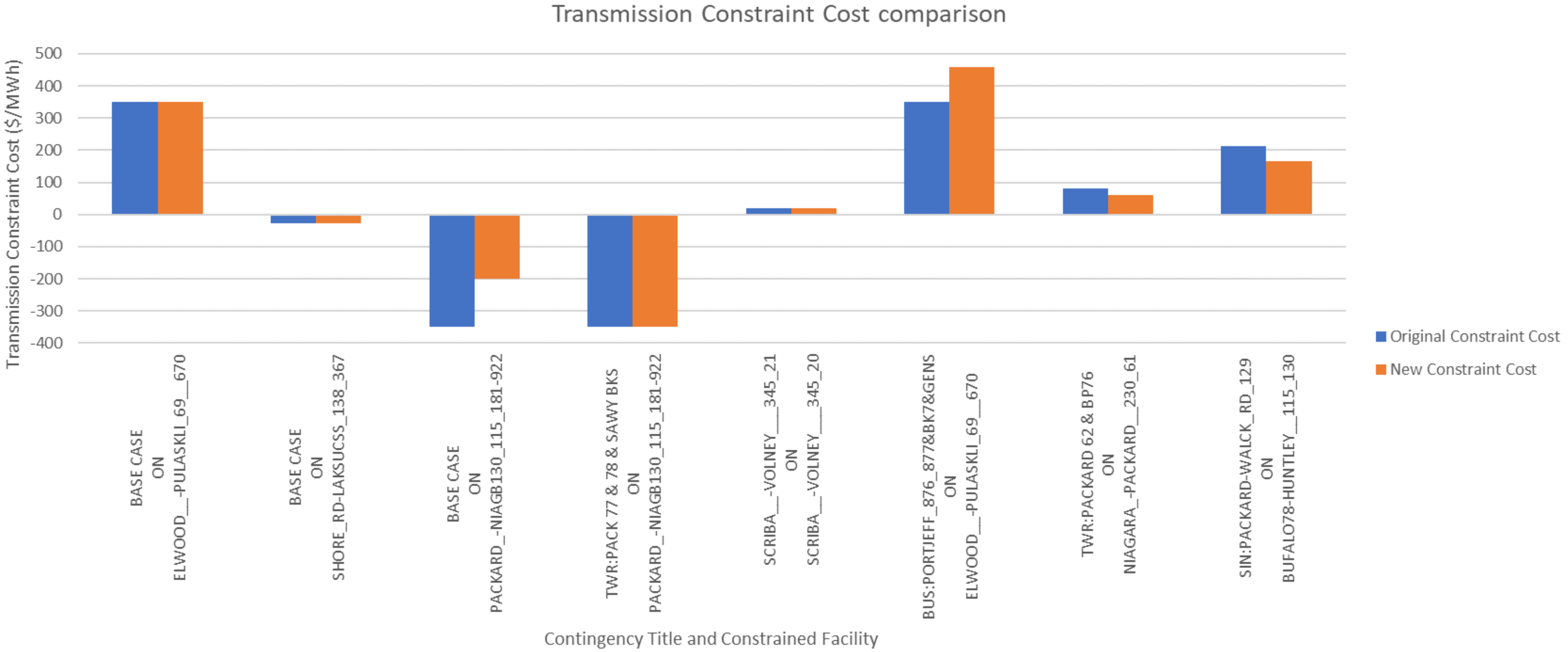
Informational Real-Time Analysis

- **RTD re-run: 6/29/2021 15:40**
  - The proposed enhancements resulted in limited changes to zonal LBMPs
    - The range of impact for this interval across all Load Zones was -1.9% to 9.5%



Informational Real-Time Analysis

- **RTD re-run: 6/29/2021 15:55**
  - Consistent with the results for the other RTD re-run, the proposed enhancements resulted in the transmission constraint costs increasing on some facilities while decreasing on others



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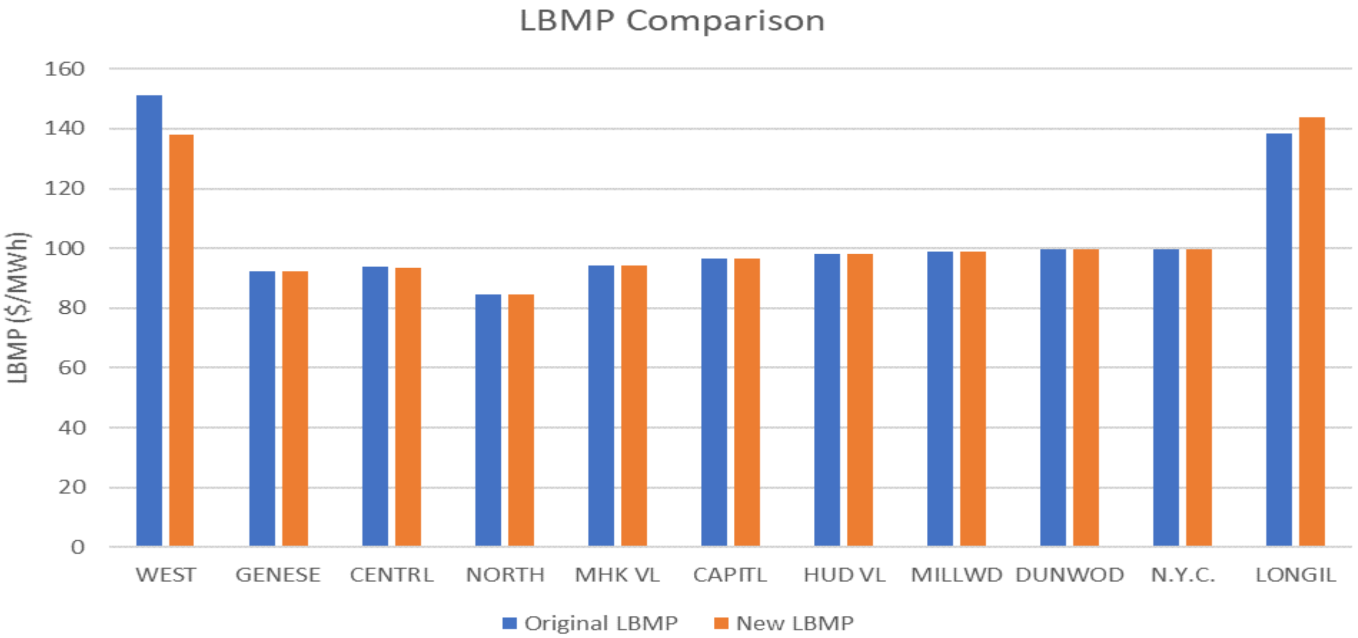
Informational Real-Time Analysis

- **RTD re-run: 6/29/2021 15:55**
  - The impact of the proposed enhancements on zonal LBMPs was limited to only two zones (Load Zone A [West] and Load Zone K [LI]); zonal LBMPs in other Load Zones were unchanged
    - Change in the zonal LBMP for West was -9% and 4% for LI



Additional Energy Market Cost Impact Analysis

Summary of Additional Cost Impact Analysis

- The energy market impact analysis presented at the September 14, 2021 ICAPWG/MIWG meeting was based on changes in Day-Ahead Market (DAM) prices
- In response to stakeholder feedback, the NYISO performed this additional analysis presented over the next few slides (Slides 24 to 30) to estimate the potential energy cost impact of the NYISO's proposal due to changes in real-time prices.
  - This analysis was requested by certain stakeholders at the September 14, 2021 ICAPWG/MIWG meeting
  - In this analysis, the potential for changes to DAM energy prices due to changes in real-time prices are estimated and used to calculate a potential short run annual cost impact
- Based on the assumption that real-time market impacts translate directly to the DAM market impacts, the NYISO estimates the potential for a short run annual energy cost increase of approximately $5.8 million (represents ~0.12 % of ~$4.7 billion total energy market transactions in 2019[1]) based on its estimate of potential impacts to real-time prices.
  - This estimate assumes perfect foresight in terms of how potential changes in real-time prices would impact DAM prices. The NYISO recognizes that, in actuality, foresight may not be perfect and therefore expects the actual impact to be lower than estimated by this alternative assessment methodology.
  - This estimate is derived by applying the zonal LBMP deltas from 7 re-run RTD intervals to an entire year of DAM energy prices and load data. The actual results may vary from the potential impact estimated by this alternative methodology.

1. The total quantity of energy transactions is derived from the 2019 average monthly LBMP and load data.

Cost Impact Methodology – Real-Time Pricing Impact

- **Using the NYISO's market software, a few Real Time Dispatch (RTD) intervals were re-run. The following revisions were included in the market software re-runs (these are the same revisions made for purposes of the initial impact analysis based solely on potential changes in DAM prices):**
  1. Incorporated the proposed six-step transmission demand curve mechanism for facilities currently assigned a non-zero CRM value
     - See Slide 6 for additional details
  2. Assigned a 5 MW CRM value to internal facilities currently assigned a zero value CRM, and incorporated the proposed two-step transmission demand curve mechanism for such facilities
     - See Slide 5 for additional details

  Note: Consistent with the NYISO's proposal, the re-runs maintained the current single value $4,000/MWh shadow price capping method for external interface facilities

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Cost Impact Methodology – Real-Time Pricing Impact (cont'd)

- **Approach used to select RTD intervals for re-runs:**
  - Selected multiple intervals based on actual historical real-time transmission constraint costs during recent months (June through mid-July 2021) to ensure the simulations are based on updated software and market rules.
    - Selecting multiple RTD interval ensures that intervals with high as well as low transmission constraint costs were captured
    - The actual historical binding transmission constraints for each RTD interval were segmented into pricing ranges ("categories") as further described on next slide (Slide 27) to determine the total number of binding transmission constraints for each category for each RTD interval.
    - For a given interval, it is possible for binding transmission constraints to occur in more than one category
    - The interval selected for use in conducting the re-runs represents the interval with the highest number of transmission constraint pricing values identified for each category; provided that separate RTD intervals were utilized for each category
  - Approach used is substantially similar to the approach used to select DAM days to re-run for the initial impact analysis based solely on potential changes in DAM prices

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Cost Impact Methodology – Real-Time Pricing Impact (cont'd)

- **An RTD interval was selected to represent each category as identified below:**
  - Category 1: Interval with two or more transmission constraint costs<= $50/MW
    - RTD interval selected to re-run: 7/9/2021 17:35
  - Category 2: Interval with two or more transmission constraint costs between $50/MW and $100/MW
    - RTD interval selected to re-run: 7/15/2021 17:15
  - Category 3: Interval with two or more transmission constraint costs between $100/MW and $200/MW
    - RTD interval selected to re-run: 6/27/2021 14:35
  - Category 4: Interval with two or more transmission constraint costs between $200/MW and $350/MW
    - RTD interval selected to re-run: 6/27/2021 16:10
  - Category 5: Interval with two or more transmission constraint costs between $350/MW and $600/MW
    - RTD interval selected to re-run: 6/30/2021 17:15
  - Category 6: Interval with two or more transmission constraint costs between $600/MW and $1,500/MW
    - RTD interval selected to re-run: 7/7/2021 17:50
  - Category 7: Interval with two or more transmission constraint costs > $1,500/MW
    - RTD interval selected to re-run: 7/7/2021 18:00

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Cost Impact Methodology – Real-Time Pricing Impact (cont'd)

- **The price delta values calculated for different "Categories" using re-run prices and original prices were applied to all RTD intervals in a one-year period.**
  - The steps involved in the calculation are discussed below and on next slide (Slide 28)
- **All binding transmission constraints in 2019 RTD intervals were categorized using a similar methodology as adopted for the selection of intervals to re-run. Transmission constraints were categorized as follows:**
  - "Category 1" constraint: A transmission constraint with cost less than $50/MW
  - "Category 2" constraint: A transmission constraint with cost between $50/MW and $100/MW
  - "Category 3" constraint: A transmission constraint with cost between $100/MW and $200/MW
  - "Category 4" constraint: A transmission constraint with cost between $200/MW and $350/MW
  - "Category 5" constraint: A transmission constraint with cost between $350/MW and $600/MW
  - "Category 6" constraint: A transmission constraint with cost between $600/MW and $1,500/MW
  - "Category 7" constraint: A transmission constraint with a cost greater than $1,500/MW

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Cost Impact Methodology – Real-Time Pricing Impact (cont'd)

- **A percent price delta for each RTD interval was calculated using a weighted average approach**
  - The calculation was based on the count of different constraints in each category for that interval and the applicable price delta for those categories
  - For example, suppose an RTD interval had two "Category 4" constraints and one "Category 5" constraint, and the percentage price delta for a particular Load Zone is -0.02% for "Category 4" constraints and 0.1% for "Category 5" constraints
    - $Weighted\ average\ price\ delta\ for\ the\ Load\ Zone\ for\ the\ RTD\ interval$

$$= \frac{2*(-0.02\%)+1*(0.1\%)}{2+1} = 0.02\%$$

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Cost Impact Methodology – Real-Time Pricing Impact (cont'd)

- Percent price delta values for all hours in 2019 were calculated from the percent price delta values for each RTD interval
- Hourly percent price delta values were applied to 2019 DAM energy prices to estimate the annual consumer impact.
  - The hourly percent LBMP delta for each Load Zone was applied to corresponding DAM zonal LBMPs to calculate a change in the hourly zonal DAM prices for 2019. This hourly delta in DAM prices was multiplied by corresponding real-time load during the historical one-year period to estimate a potential impact due to the change in Energy prices.

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Additional Impacts

Reliability Impacts

- The proposed enhancements are intended to facilitate efficient re-dispatch by the NYISO's market software to alleviate transmission constraints.
- The proposal is intended to facilitate appropriate trade-offs between transmission constraints and reserve products.

Environmental Impacts

- No direct short-term benefit is expected to result from the proposed enhancements.

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Impact on Transparency

- The proposed enhancements contemplate: (1) eliminating the use of constraint relaxation for all internal transmission facilities, and (2) better aligning transmission constraint costs with the severity of the constraint.
- These objectives should improve the predictability/understandability of market outcomes.

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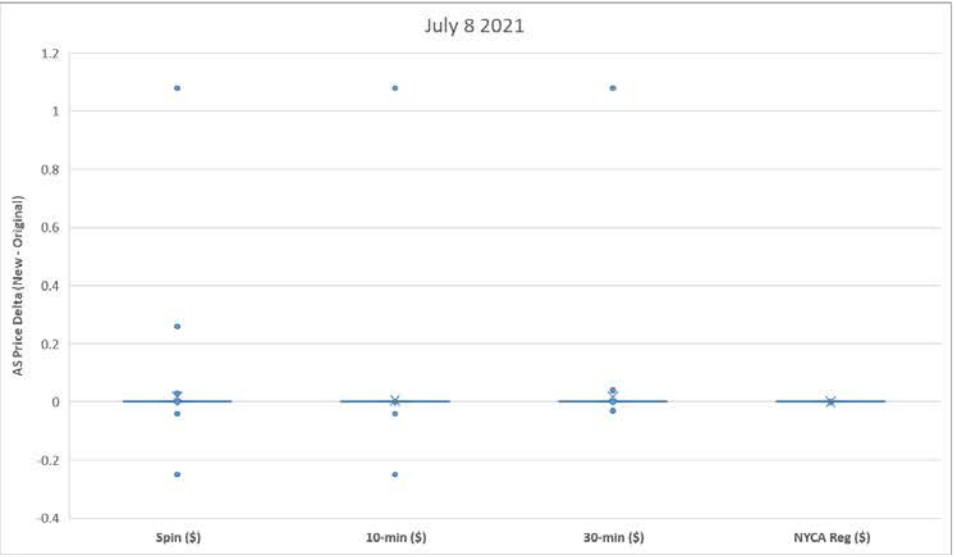
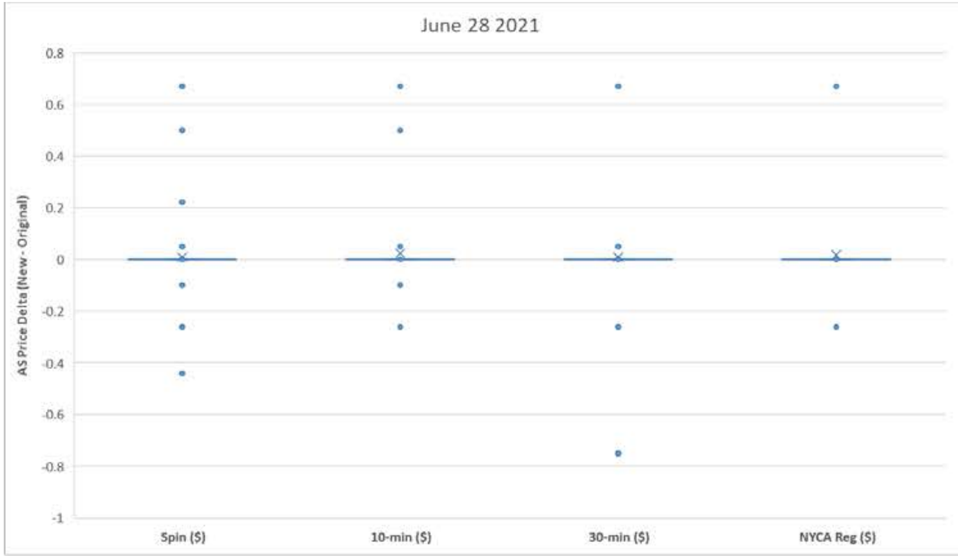
Appendix

Delta in Ancillary Service Prices

- The box and whisker plots below show the reserve and regulation price deltas observed for two of the re-runs (6/28/2021 and 7/8/2021)





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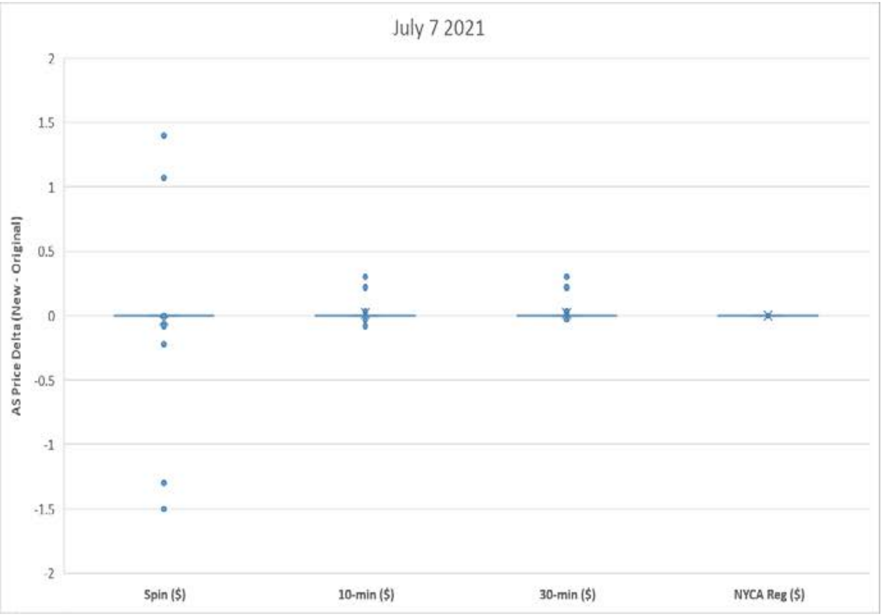
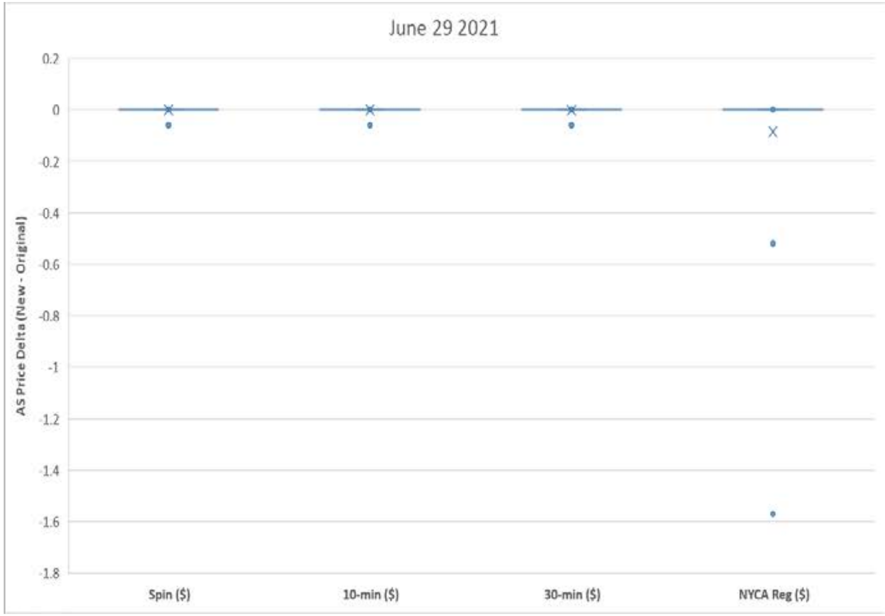
Delta in Ancillary Service Prices

- The box and whisker plots below show the reserve and regulation price deltas observed for the other two days that were re-run (6/29/2021 and 7/7/2021)





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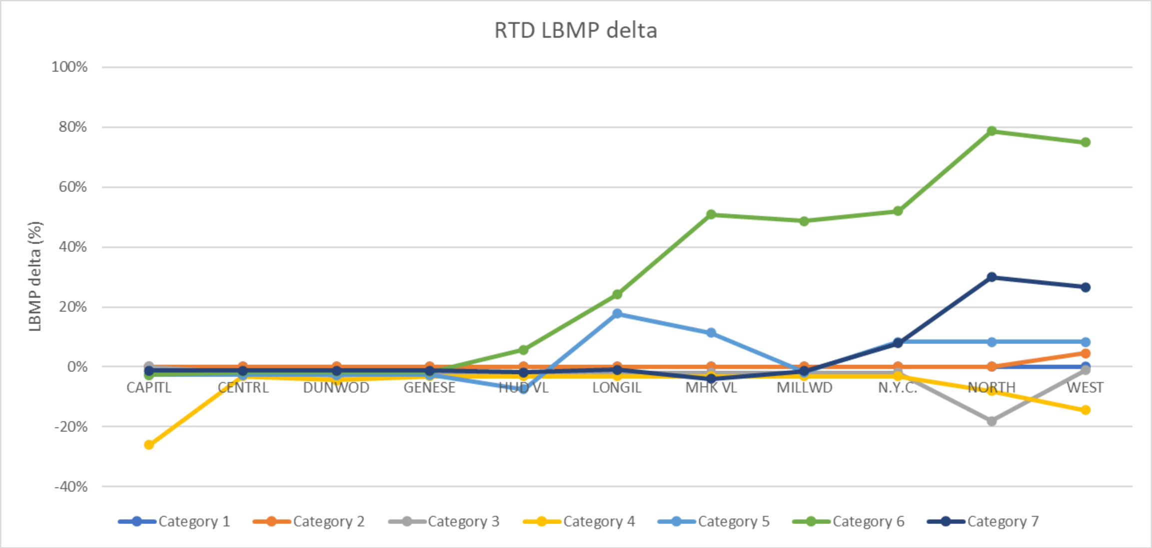
RT Pricing Impact Analysis

- The RTD re-runs show higher impact on Zonal LBMPs for inter



costs.

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