Constraint Specific Transmission Shortage Pricing

Study Review & Recommendation

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Agenda

- Overview
- Project Objective
- Scope of Study
- Study Review
- Recommendations
- Next Steps

Overview

- **The NYISO is considering ways to avoid potentially over and under valuing transmission constraints related to the current transmission constraint pricing logic.**
  - Currently, the NYISO uses a single graduated mechanism to value all transmission shortages for facilities/Interfaces with a non-zero value constraint reliability margin (CRM).
- **A key principle in enhancing the current transmission constraint pricing logic is the efficient pricing of constraints such that market prices support reliable operations and reflect actual system conditions.**
- **Transmission constraints can be valued according to principle characteristics such as:**

1. CRM value
   a) CRM values are assigned for each facility and interface with two designations: zero-value and non-zero value.
      - Non-zero values are currently equal to or greater than 20 MW
      - The NYISO recently filed a proposal with FERC for authorization to utilize non-zero values less than 20 MW where warranted
      - The current non-zero values utilized include 20 MW, 30 MW, 50 MW and 100 MW
2. Voltage level
   a) Facilities included in the dataset are representative of 230 kV and higher transmission facilities throughout the NYCA, 138 kV facilities in NYC and LI, and a single 115 kV facility in the North zone
      - The 115 kV facilities that began being secured in May 2018 are not included in the historic data analysis
3. Location
   a) Limiting facilities in the dataset were assigned to a location that aligns with one of the 11 NYISO Load Zones.

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Project Objective

- **This study seeks to identify under what circumstances/system conditions transmission constraints are potentially being under or over valued:**
  - Identify instances where a transmission constraint may be routinely "relaxed" because there are frequently insufficient resources to resolve the constraint.
  - Identify scenarios where a transmission constraint has a high Shadow Price which may be over valuing the constraint and/or scenarios where a transmission constraint has a low Shadow Price which may be under valuing the constraint.

Scope of Study

Initial Step: NYISO staff studied:

1. The impact of the NYISO's implementation of the revised transmission constraint pricing logic (implemented on June 20, 2017), which included:
   - The modification of the value for the second step of the graduated Transmission Shortage Cost mechanism from $2,350 to $1,175/MWh.
   - The application of the graduated Transmission Shortage Cost mechanism more broadly to include all facilities assigned non-zero CRM values.
2. How other ISOs/RTOs implement transmission shortage pricing.
3. How the NYISO implements transmission shortage pricing, including factors such as CRM values, Shadow Price capping mechanisms, and "relaxation" of transmission constraints.

Second Step: The NYISO proposed potential enhancements for improved transmission constraint pricing.

- An impact assessment to test concepts will be conducted in the next phase of the project.

Third Step: The NYISO will publish a report summarizing the results of both the proposed improvements and recommendations for market enhancements.

- Project Deliverable – Study report reviewed with stakeholders and published.

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Study Review

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Historical Transmission Constraint Analysis

- **The NYISO performed historic data analysis on actual Real-Time Dispatch (RTD) binding transmission constraints for the period from July 2017 through February 2018.**
  - The purpose of the analysis was to further evaluate the impact and operation of the current transmission constraint pricing logic.
  - The results of this analysis were previously discussed at the June 25, 2018 MIWG http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-06-25/Constraint%20Specific%20Transmission%20Shortage%20Pricing_MIWG_6-25-2018_Final_UPDATED.pdf.
- **The data was segmented by principle transmission constraint characteristics including CRM value, location, and voltage level to determine market outcome data trends.**
- **The pricing outcomes were analyzed to determine under what circumstances transmission shortages were potentially being over and undervalued based on the current logic.**

Analysis Definitions

- Shortage MW: the sum of any demand curve MW provided through the graduated Transmission Shortage Cost mechanism and any relaxation MW (i.e., constraint relaxation) that were relied upon to help resolve a transmission constraint.
- Type 1 – Resolved without Shortage MW: Represents RTD binding transmission constraints that are managed without the use of any Shortage MW. These constraints are resolved through the capability available from physical resources without reliance on any demand curve MW or relaxation MW.
- Type 2 – Resolved with Shortage MW: Represents the RTD binding transmission constraints that were resolved by use of some amount of Shortage MW. These constraints are resolved by some amount of demand curve MW and/or relaxation MW (or a combination thereof).
  - Sub – Definitions of Type 2 – Resolved with Shortage MW:
    - Type 2a – Resolved with Demand Curve MW Only: These constraints are resolved with some amount of MW available from the resource capability afforded by the 20 MW demand curve component of the graduated Transmission Shortage Cost mechanism, but no amount of relaxation MW. These constraints may also have been resolved in part by physical generation redispatch.
    - Type 2b – Resolved with Demand Curve MW and Relaxation MW: This category represents: (1) transmission constraints resolved in whole or in part with resource capability available through the 20 MW demand curve component of the graduated Transmission Shortage Cost mechanism and some amount of relaxation MW; and (2) transmission constraints resolved with relaxation MW without any use of the demand curve component of the graduated Transmission Shortage Cost mechanism (i.e., facilities/Interfaces assigned a zero-value CRM). These constraints may also have been resolved in part by physical generation redispatch.

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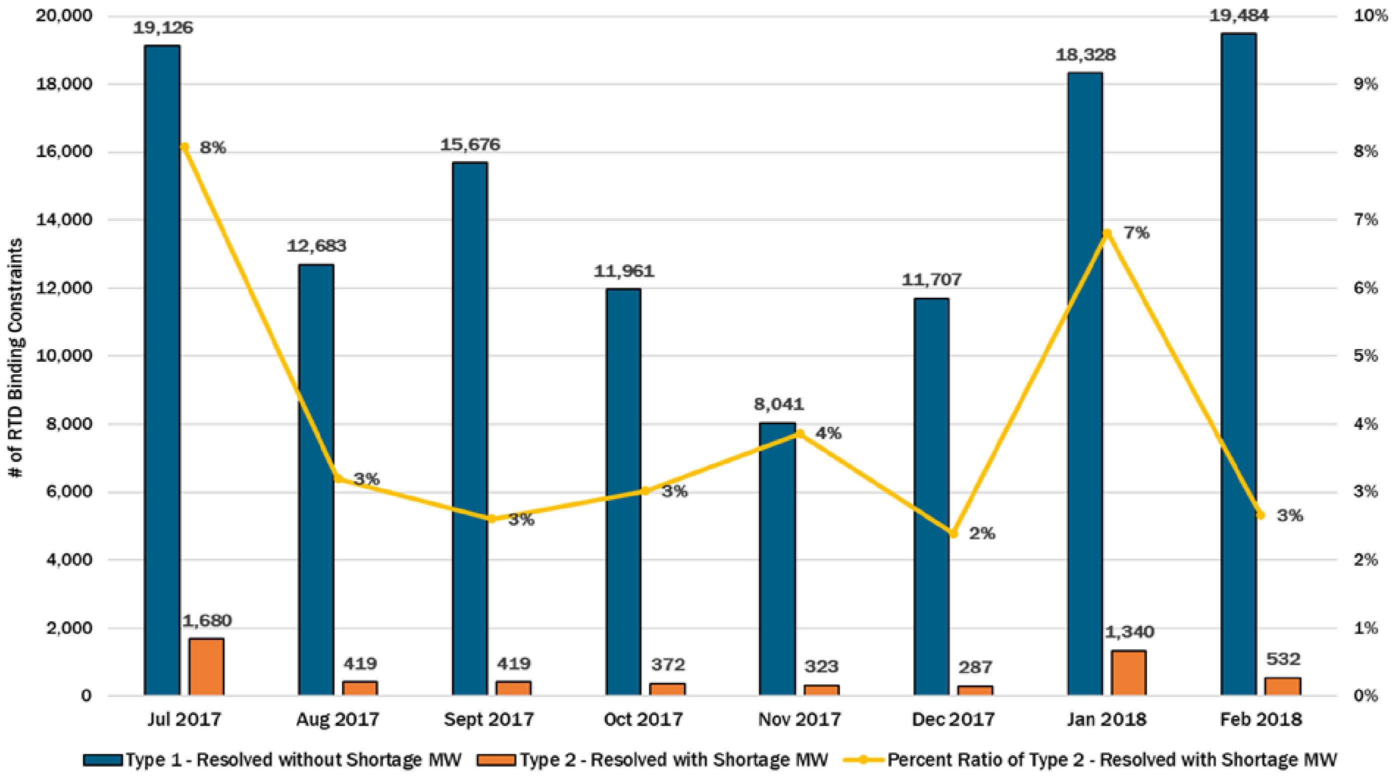
Historical Transmission Constraint Analysis – Broad View of Data



- Of the entire 122,378 RTD binding transmission constraints, approximately 4% of the constraints were categorized as Type 2 – Resolved with Shortage MW.
- The vast majority of constraints are resolved without the reliance on any demand curve MW or relaxation MW and are managed through the redispatch capability of available resources.

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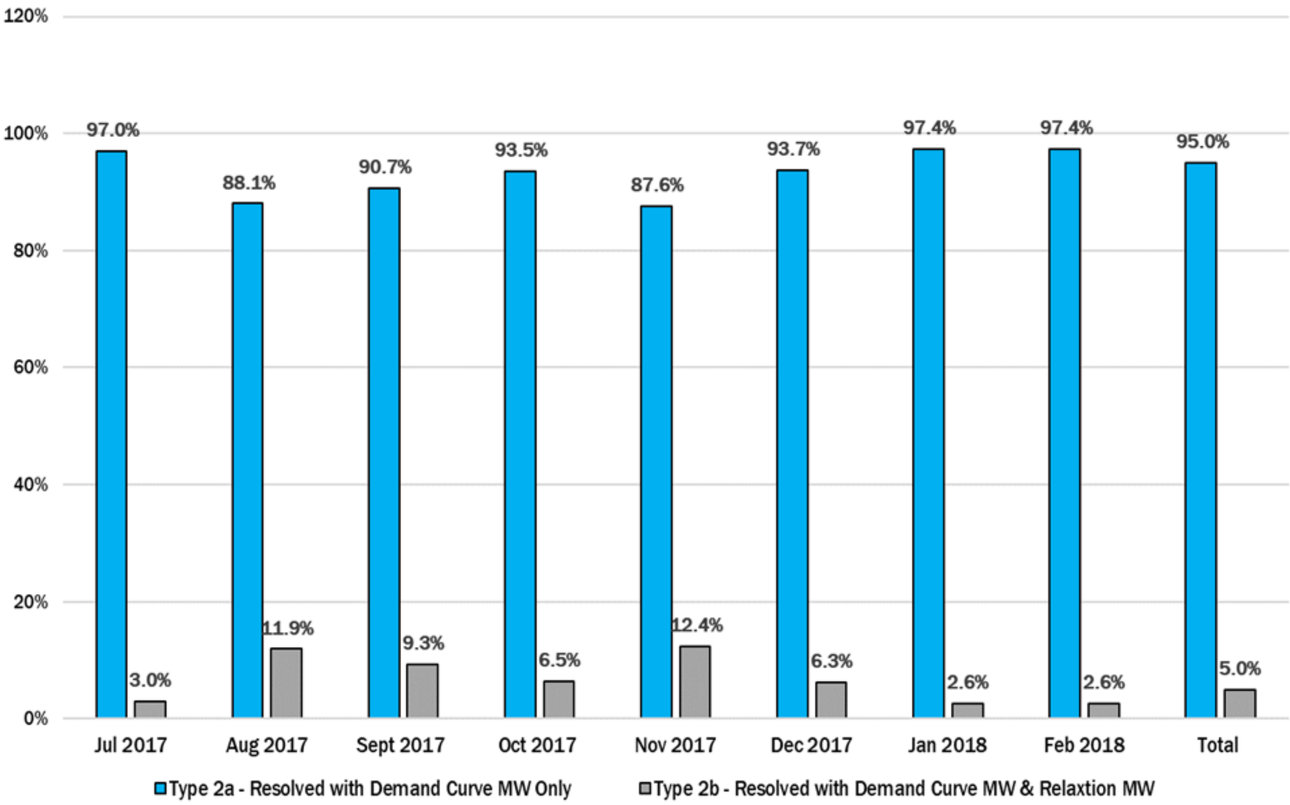
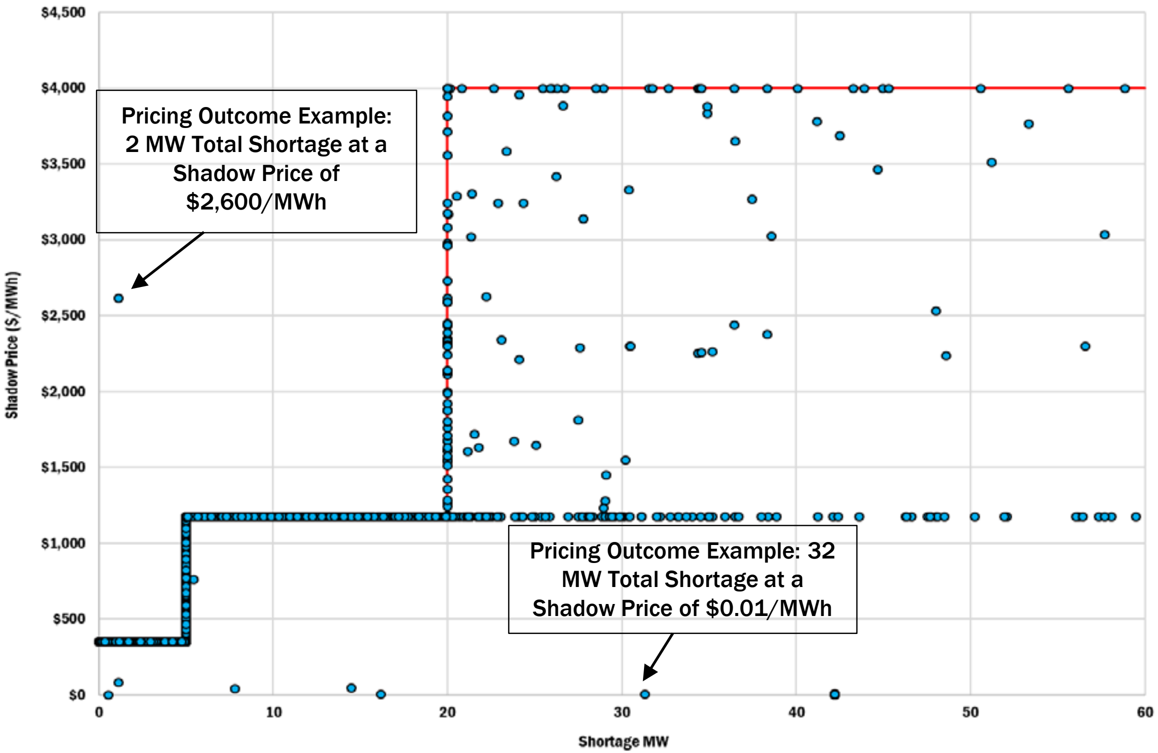
Summary of Type 2 – Resolved with Shortage MW Sub-Groups



- Overall, 95% of Type 2 – Resolved with Shortage MW are categorized as Type 2a – Resolved with Demand Curve MW Only
- 5% are characterized as Type 2b – Resolved with Demand Curve MW and Relaxation MW
- Of the entire dataset constraint relaxation is used to resolve RTD binding transmission constraints only 0.2% of the time

Investigating Pricing Outcomes

Scatter Plot of Constraints Categorized as Type 2 – Resolved with Shortage MW (July 2017 – February 2018)



- The pricing outcomes highlight instances where the utilization of the current transmission constraint pricing logic can result in less predictable and transparent Shadow Prices
- These situations are recognized as areas for potential enhancements to the current pricing logic.

* The pricing outcome examples are representative of zero value CRM facilities

Conclusions on Segmented Data Analysis

- **Location**
  - For certain locations in the NYCA, a high relative percentage of transmission constraint are resolved utilizing Shortage MW as there are typically insufficient dispatch capability in these locations.
    - For example, transmission constraints in the West zone were found to bind relatively infrequently during the study period, but when binding required utilization of shortage MW more than half of the time
      - The high frequency of Shortage MW usage may be attributed, in part, to the unique locational impacts of Lake Erie loop flows and imports from Ontario.
  - The West, Central, North, and Mohawk Valley zones present some of the highest percentages of transmission constraints that require utilization of some level of constraint relaxation for resolution.
    - For example, of the constraints resolved with demand curve MW and relaxation MW, 100% of the constraints in the Central zone are resolved through constraint relaxation as the RTD binding constraints in this location represent a zero-value CRM facility.
  - Additional data available within the "Location Figures" section of the appendix (see Slides 29-30)

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Conclusions on Segmented Data Analysis

Voltage Class

- Pricing outcomes were examined at varying voltage levels to assess whether the cost to solve constraints materially differs by voltage level or if any other trends were identifiable that should be considered in developing potential enhancements.
- Of constraints resolved with Shortage MW, on average, Shadow Prices and transmission constraint relaxation are greater and more frequent for limiting facilities at the 345 kV level.
- In general, a greater amount of constraint relaxation is used to resolve RTD binding transmission constraints as the voltage level increases.
- A pricing mechanism that accounts for varying voltage levels may help to provide pricing outcomes that are more representative of the severity of the constraint.
- Additional data available within the “Voltage Figures” section of the appendix (see Slides 32-33)

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Conclusions on Segmented Data Analysis

CRM Value

- Facilities assigned a 20 MW CRM value accounted for the vast majority of RTD binding constraints in the dataset that were resolved with Shortage MW, which is expected given the majority of the facilities in the NYCA are assigned this CRM value
- Facilities assigned a 50 CRM value accounted for the second highest percentage of RTD binding constraints that were resolved with Shortage MW.
- In general, for RTD binding constraint resolved with Shortage MW, facilities assigned a 50 MW CRM value exhibited the highest average Shadow Price and relaxation MW values among facilities and interfaces assigned a non-zero CRM value.

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Conclusions on Segmented Data Analysis

- **CRM Value**
  - Of the binding constraints resolved with Shortage MW associated with facilities assigned a zero-value CRM, 100% required utilization of some level of constraint relaxation to be resolved.
  - Among facilities and interfaces assigned non-zero CRM values, constraints for facilities with a 50 MW CRM value showed the highest percentage need for some level of constraint relaxation to be resolved.
  - Creating a pricing mechanism that considers differing CRM values assigned to facilities and interfaces could provide for more efficient pricing outcomes that are more consistent with the severity of the shortage at issue.
  - Additional data available within the "CRM Figures" section of the appendix (see Slides 35-36).

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Recommendations

Recommendation

- The NYISO recommends that enhancements to the current transmission constraint pricing logic be pursued to develop a more refined approach that considers voltage class, location and variations in the CRM values considering overall comprehensive shortage pricing logic.

Recommendation Framework

- **Key objectives for potential enhancements are:**
  1. Ensuring that transmission shortages are appropriately valued based on the severity of the constraint, considering tradeoff costs with meeting other market constraints such as Operating Reserves;
  2. improving transparency and predictability of the methodology used to develop transmission constraint prices; and
  3. developing a structure that is feasible, robust and reliable.

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NYISO's Principles and Factors for Effective Transmission Constraint Pricing

Principle for Effective Transmission Constraint Pricing:

- **Efficient Pricing of Constraints**
  - The transmission demand curve used within the graduated Transmission Shortage Cost mechanism is intended to establish an effective shadow price that ensures that security constrained economic dispatch develops resource schedules that are consistent with how the grid is operated.
  - Therefore, the shadow price of a given transmission constraint should account for characteristics, such as voltage class, CRM value, and/or location, and ultimately the availability of resources to secure the transmission constraint.

Factors for Effective Transmission Constraint Pricing:

- **Voltage class**
  - The options available to resolve transmission constraints, including the types and number of resources capable of providing relief can vary by voltage level.
- **Location**
  - The New York State electric grid presents varying locational challenges to maintain security. Shadow Prices of transmission constraints in certain locations are set by the graduated Transmission Shortage Cost mechanism in many cases due to the lack of flexible resources available to resolve such constraints cost-effectively.
- **CRM value**
  - The NYISO assigns varying CRM values to facilities to account for the expected level of un-modeled flows over the facility. The CRM is a critical component of the market software that allows the transmission system to be operated within limits. The most commonly utilized 20 MW CRM value serves as the basis for the current graduated Transmission Constraint Pricing mechanism.

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Recommended Design Elements to Consider

- **Developing appropriate enhancements cannot be done effectively by considering only one criteria in an isolated environment.**
  - Each criteria must be considered as interconnected variables to help manage transmission constraints.
  - Considering how the criteria interplays and impacts each other is imperative when designing enhancements to the current graduated Transmission Shortage Cost mechanism.

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Additional considerations

- **Provide for enhancements that make the graduated Transmission Shortage Cost mechanism available to set price in more instances**
  - Facilitating the reduction and/or discontinuation of constraint relaxation logic for internal facilities/interfaces
- **A graduated pricing mechanism should be developed for internal facilities currently assigned a zero-value CRM**
  - The intent is produce more transparent and predictable pricing outcomes that better align with the severity of transmission shortages related to such internal facilities.
- **Overall, the proposed recommendations improve market efficiency by producing price signals that reflect the systems conditions at the time of transmission shortages.**

Next Steps

Develop an MDCP

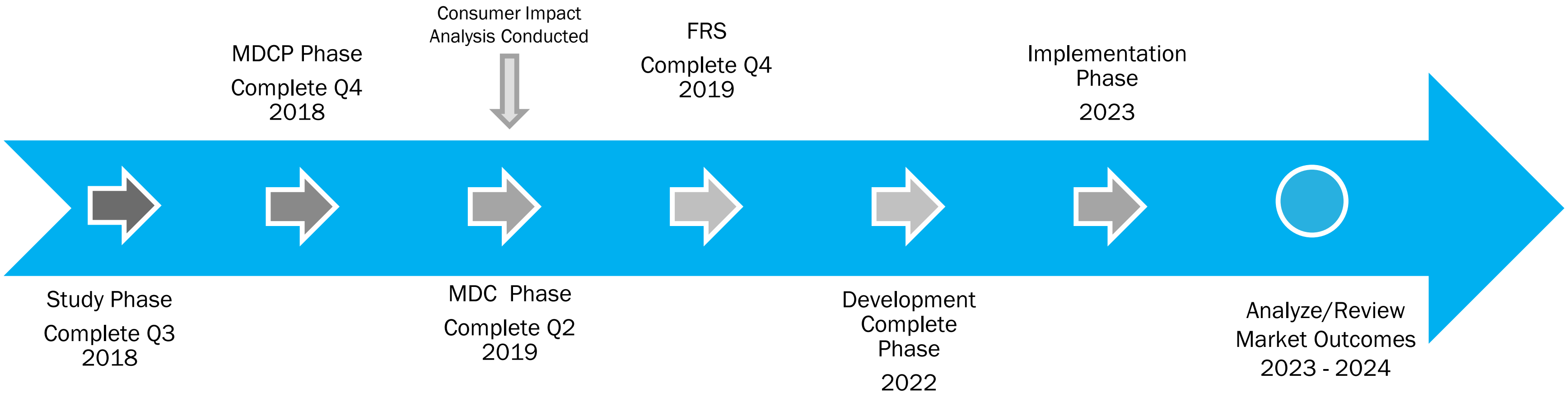
- **Conduct Analysis to determine shadow prices at various confidence levels.**
  - Analyze Shadow Prices of transmission constraints that were solved with physical resources, segmented by the principle transmission constraint pricing characteristics (i.e., CRM value, location, and voltage class).
  - Data provides visibility into the overall cost to solve transmission constraints with physical resources at various confidence levels (e.g., 99%, 95%).
  - Review tradeoffs with reserves and regulation to ensure maintenance of the relative priority for enforcing reliability requirements.
- **Analysis will help to set the framework for designing enhancements to the demand curve component of the transmission constraint pricing logic and establishing the Market Design Concept Proposal.**

Next Steps

- **Q4 2018 – Market Design Concept Proposal (MDCP) Phase**
- **October – November 2018**
    - Determine methodology to set price and MW values for enhanced transmission demand curves.
  - December 2018
    - Finalize MDCP and present to Market Participants
- **Q1 2019 - Market Design Complete Phase**
- February 2019
    - Conduct simulations to test and assess concepts
    - Complete Market Design proposal and propose specific enhancements to the current transmission constraint pricing logic to stakeholders.
  - March 2019
    - Conduct Consumer Impact Analysis and present results to Market Participants
- **Q2 2019 – Market Design Complete Phase (continued)**
  - April – May 2019
    - Finalize design proposal (including development/review of accompanying tariff revisions)
  - May 2019 – Present/review final design at MIWG
  - June 2019 – Seek stakeholder approval at BIC and MC

Projected Milestone Timeline

- Timeline reflects expected project milestones as they were published in the 2018 Master Plan.
- Once the final Market Design is approved, this timeline will be re-evaluated.



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Appendix

Location Figures

Percent of Constraints Categorized as Type 2 – Resolved with Shortage MW by Location (July 2017 – February 2018)

	Type 1 - Resolved without Shortage MW	Type 2 - Resolved with Shortage MW	
Location	Count of Constraints	Count of Constraints	Percent Resolved by Type 2
West	659	748	53.16%
Central	5,240	13	0.25%
North	2,206	191	7.97%
Mohawk Valley	292	63	17.75%
Capital	10,957	217	1.94%
Hudson Valley	984	44	4.28%
Dunnwoodie	432	7	1.59%
NYC	60,471	2,907	4.59%
LI	35,765	1,182	3.20%
Total	**117,006**	**5,372**	**4.39%**

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Percent of Constraints Categorized as Type 2b – Resolved with Demand Curve MW and Relaxation MW by Location (July 2017 - February 2018)

Type 2 - Resolved with Shortage MW (July 2017 - Feb. 2018)			
Location	Count of Type 2a - Resolved with Demand Curve MW Only	Count of Type 2b - Resolved with Demand Curve MW & Relaxation MW	Percent of Type 2b - Resolved with Demand Curve MW & Relaxation MW
West	686	62	8.3%
Central	-	13	100.0%
North	164	27	14.1%
Mohawk Valley	21	42	66.7%
Capital	217	-	0.0%
Hudson Valley	43	1	2.3%
Dunwoodie	6	1	14.3%
NYC	2,808	99	3.4%
LI	1,156	26	2.2%
Total	5,101	271	5.0%

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Voltage Figures

Statistics of Constraints Categorized as Type 2 – Resolved with Shortage MW by Voltage Level (July 2017 - February 2018)

Type 2 - Resolved with Shortage MW (July 2017 - Feb. 2018)								
Voltage Level	Average Shadow Price	Max Shadow Price	Min Shadow Price	Range of Shadow Price	Average of Relaxation MW	Max of Relaxation MW	Count of Constraints	Percent of Constraints
115 kV	$ 560.41	$1,175.00	$ 350.00	$ 825.00	1.26	59.10	127	2.36%
138 kV	$ 594.85	$4,000.00	$ 0.01	$3,999.99	0.63	89.83	3,856	71.78%
230 kV	$ 863.74	$4,000.00	$ 350.00	$3,650.00	0.72	43.25	855	15.92%
345 kV	$1,171.09	$4,000.00	$ 350.00	$3,650.00	15.38	439.26	385	7.17%
Interface	$ 615.54	$2,445.59	$ 350.00	$2,095.59	2.60	188.95	149	2.77%
Total							5,372	100.00%

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Percent of Constraints Categorized as Type 2b – Resolved with Demand Curve MW and Relaxation MW by Voltage Level (July 2017 - February 2018)

Type 2 - Resolved with Shortage MW (July 2017 - Feb. 2018)			
Voltage Level	Count of Type 2a - Resolved with Demand Curve MW Only	Count of Type 2b - Resolved with Demand Curve MW & Relaxation MW	Percent of Type 2b - Resolved with Demand Curve MW & Relaxation MW
115 kV	124	3	2.36%
138 kV	3,755	101	2.62%
230 kV	789	66	7.72%
345 kV	288	97	25.19%
Interface	145	4	2.68%
Total	5,101	271	5.04%

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CRM Figures

Statistics of Constraints Categorized as Type 2 - Resolved with Shortage MW by CRM Value (July 2017 – February 2018)

Type 2 - Resolved with Shortage MW (July 2017 - Feb. 2018)								
CRM Value (MW)	Average Shadow Price	Max Shadow Price	Min Shadow Price	Range of Shadow Price	Average of Relaxation MW	Max of Relaxation MW	Count of Constraints	Percent of Constraints
0	$ 985.20	$3,054.30	$ 0.01	$3,054.29	69.53	178.37	38	0.71%
20	$ 627.17	$4,000.00	$ 350.00	$3,650.00	0.72	439.26	3,800	70.74%
30	$ 588.91	$4,000.00	$ 350.00	$3,650.00	0.12	16.44	570	10.61%
50	$ 979.01	$4,000.00	$ 350.00	$3,650.00	4.47	214.30	815	15.17%
100	$ 615.54	$2,445.59	$ 350.00	$2,095.59	2.60	188.95	149	2.77%
Total							5,372	100.00%

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Percent of Constraints Categorized as Type 2b – Resolved with Demand Curve MW and Relaxation MW by CRM Value (July 2017 – February 2018)

Type 2 - Resolved with Shortage MW (July 2017 - Feb. 2018)			
CRM Value (MW)	Count of Type 2a - Resolved with Demand Curve MW Only	Count of Type 2b - Resolved with Demand Curve MW & Relaxation MW	Percent of Type 2b - Resolved with Demand Curve MW & Relaxation MW
0	-	38	100.00%
20	3,689	111	2.92%
30	562	8	1.40%
50	705	110	13.50%
100	145	4	2.68%
Total	5,101	271	5.04%

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

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- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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