First Year Evaluation of CTS between New England and New York

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Introduction and Summary

- Potomac Economics has performed a study assessing:
  - ✓ CTS, which currently makes interchange adjustments based on: (i) forecasted price differences and (ii) participant offers; and
  - ✓ Tie Optimization ("TO"), which would make interchange adjustments based only on forecasted price differences.
- After Year 1 of CTS, this study has evaluated the tariff-defined trigger that could lead the RTOs to move to TO after Year 2.
- In Year 1, we estimate that TO would have increased production costs by $0.3 million because of forecast errors.
  - ✓ The trigger for moving to TO would not have been satisfied.
  - ✓ We discuss the forecast errors and potential improvements the RTOs could explore to reduce them.

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Overview of Presentation

- Background
- Description of Model
- Summary of Results
- Discussion of Forecasting Issues
- Conclusions
- Appendix

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Background

Background

- In 2011, Stakeholders in the ISO-NE and NYISO markets considered options for improving interchange between markets
- Two options emerged:
  - ✓ Tie Optimization
  - ✓ Coordinated Transaction Scheduling
- Simulations performed at the time found that TO would perform better than CTS.
  - ✓ TO simulations resulted in $3.4 million/year (35 percent) of additional production cost savings
  - ✓ However, it is difficult to simulate trading behavior under CTS
- Ultimately, stakeholders adopted CTS, but the filing included a process for switching to TO, if warranted

Background

- CTS implemented on December 15, 2015
- NYISO tariff requires:
  - ✓ MMU perform evaluation after first year & after second year
  - ✓ MMU shall estimate:
    - 31.2(i) - *actual bid production cost savings…that would have occurred had the ISOs had an infinite number of zero bids in the CTS process… (“**Tie Optimization Interchange**”);* and
    - 31.2(ii) - *actual bid production cost savings…that would have occurred had the ISOs had an infinite number of zero bids in the CTS process, but utilizing actual real-time prices from each market rather than the forecasted prices that were used in the CTS process (“**Optimal Interchange**”).*
  - ✓ Second year evaluation triggers potential market design change

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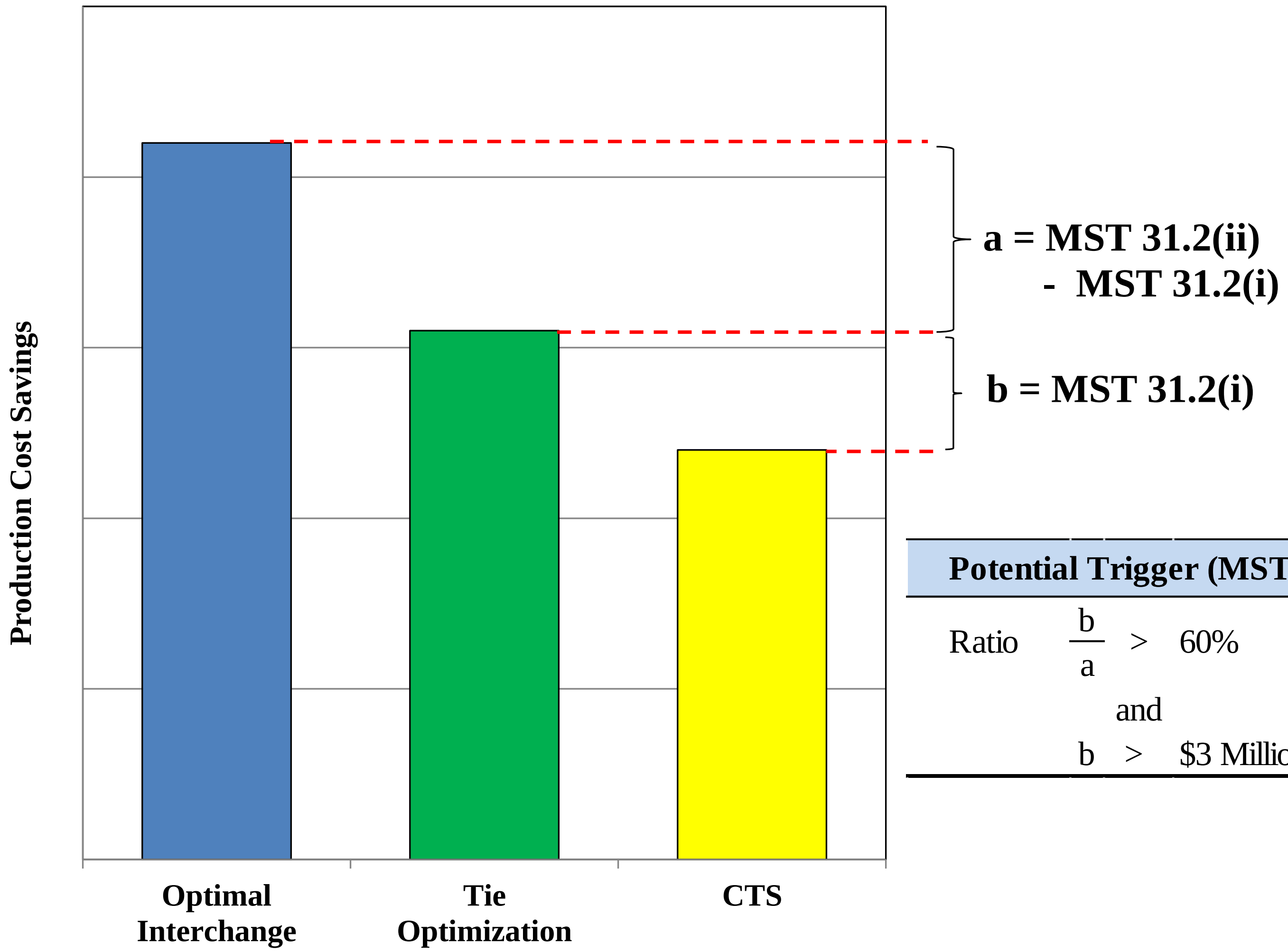
Background
Illustration of Potential Triggers



Potential Trigger (MST 31.2.1)			
Ratio	$\frac{b}{a}$	>	60%
		and	
	b	>	$3 Million/Year

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Description of Simulation Model

Description of the Simulation Model

- Adjusts interchange toward higher-priced market until:
  - ✓ Interface is fully loaded;
  - ✓ Internal constraints prevent additional re-dispatch;
  - ✓ Adjustment reaches 200 MW; or
  - ✓ Prices at the border equalize.
- Supply curves constructed for each market:
  - ✓ Based on IE offers from online and offline 10-minute resources;
  - ✓ Respects active transmission constraints:
    - – Units with low congestion component eligible to go down only,
    - – Units with high congestion component eligible to go up only
  - ✓ Ignores ancillary services requirements and ramp limits.

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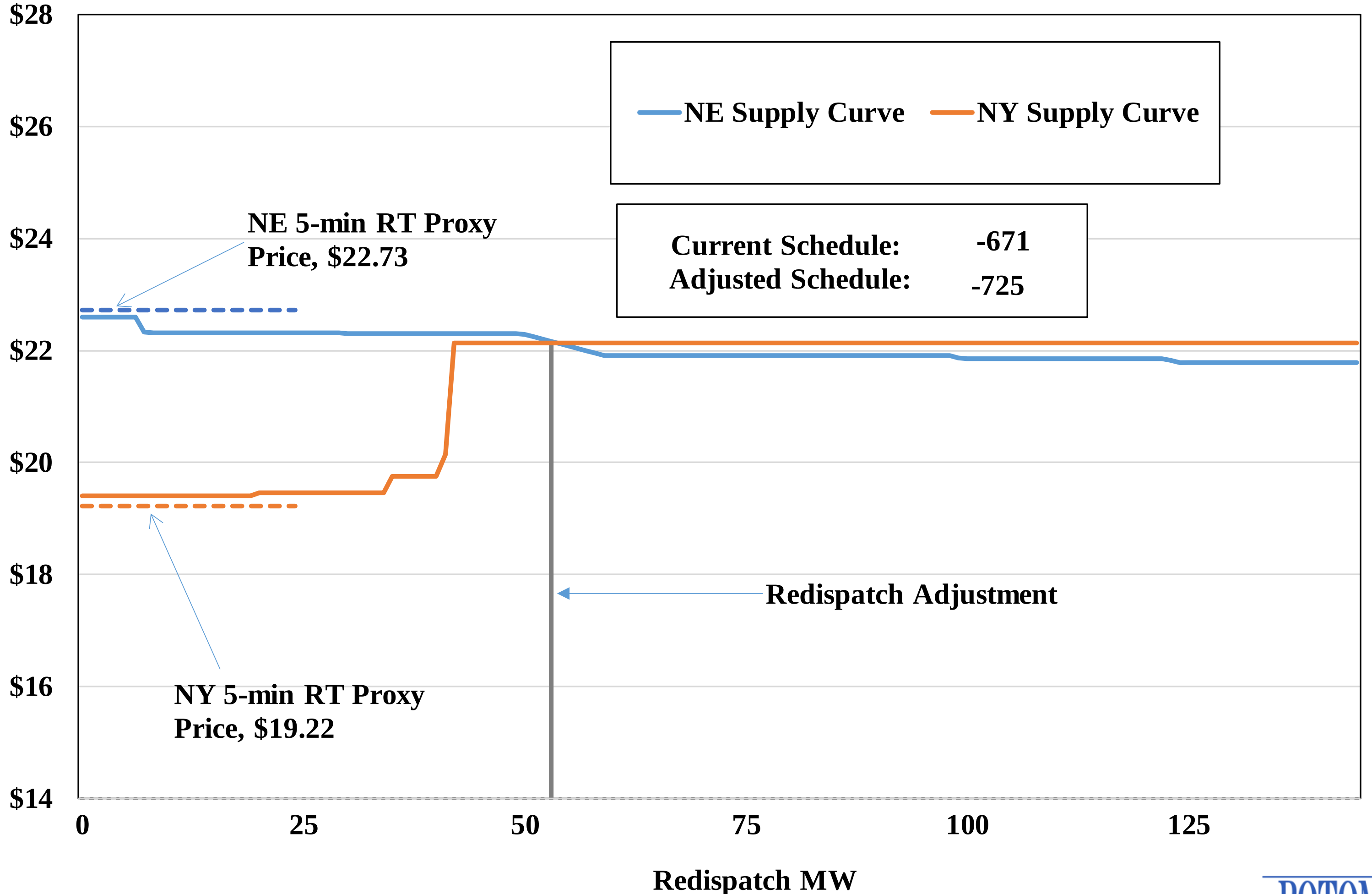
Description of the Simulation Model
Optimal Interchange Case

- Interchange adjustments every 5 minutes toward the optimal level
- Up/down supply curves constructed from eligible resources based on NYISO RTD and ISO-NE LMPc results
- Bid production cost savings are always non-negative
- The following figure illustrates this for a particular interval (August 1 at 9:05)

Description of the Simulation Model
Illustration of Optimal Interchange Case



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Description of the Simulation Model
Tie Optimization Case

- Step 1: Sets interchange every 15 minutes to forecast optimum.
  - ✓ NYISO supply curves based on RTC “binding” intervals
  - ✓ ISO-NE supply curves based on step-function evaluated by RTC:
    - – ISO-NE creates a 7-point piecewise linear supply curve; and
    - – NYISO converts this to a 7-step function for the RTC evaluation.
- Step 2: Calculates bid production cost savings resulting from interchange that is set in Step 1.
  - ✓ Reflects interchange ramp profile (e.g., if Step 1 is +200 MW at :30, Step 2 assumes +100 MW at :30 and +200 MW at :35/:40)
  - ✓ NYISO and ISO-NE supply curves based on 5-minute results
  - ✓ Production cost savings are not necessarily positive
- This is illustrated in the following two slides.

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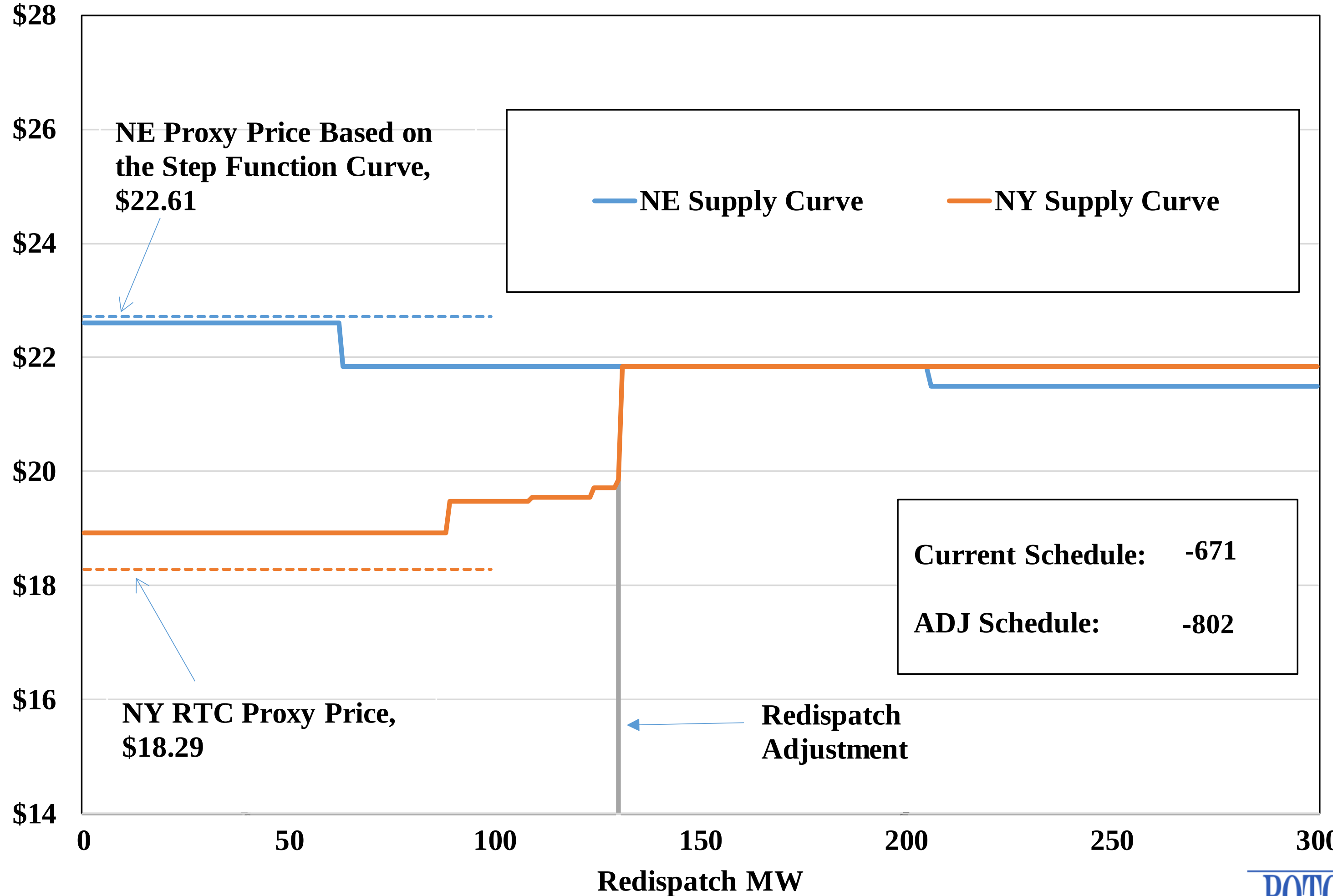
Description of Simulation Model
Illustration of Tie Optimization Step 1



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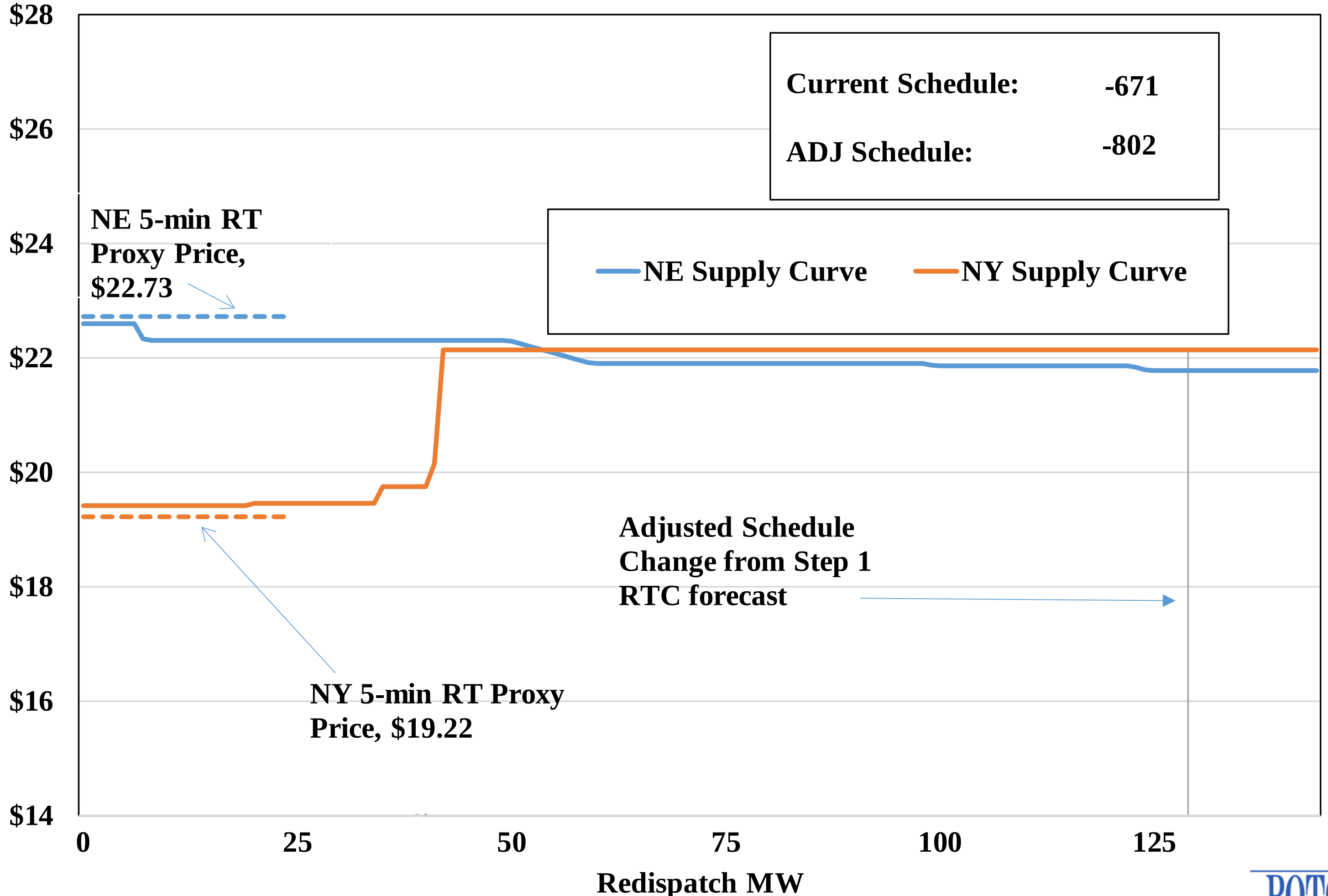
Description of Simulation Model
Illustration of Tie Optimization Step 2



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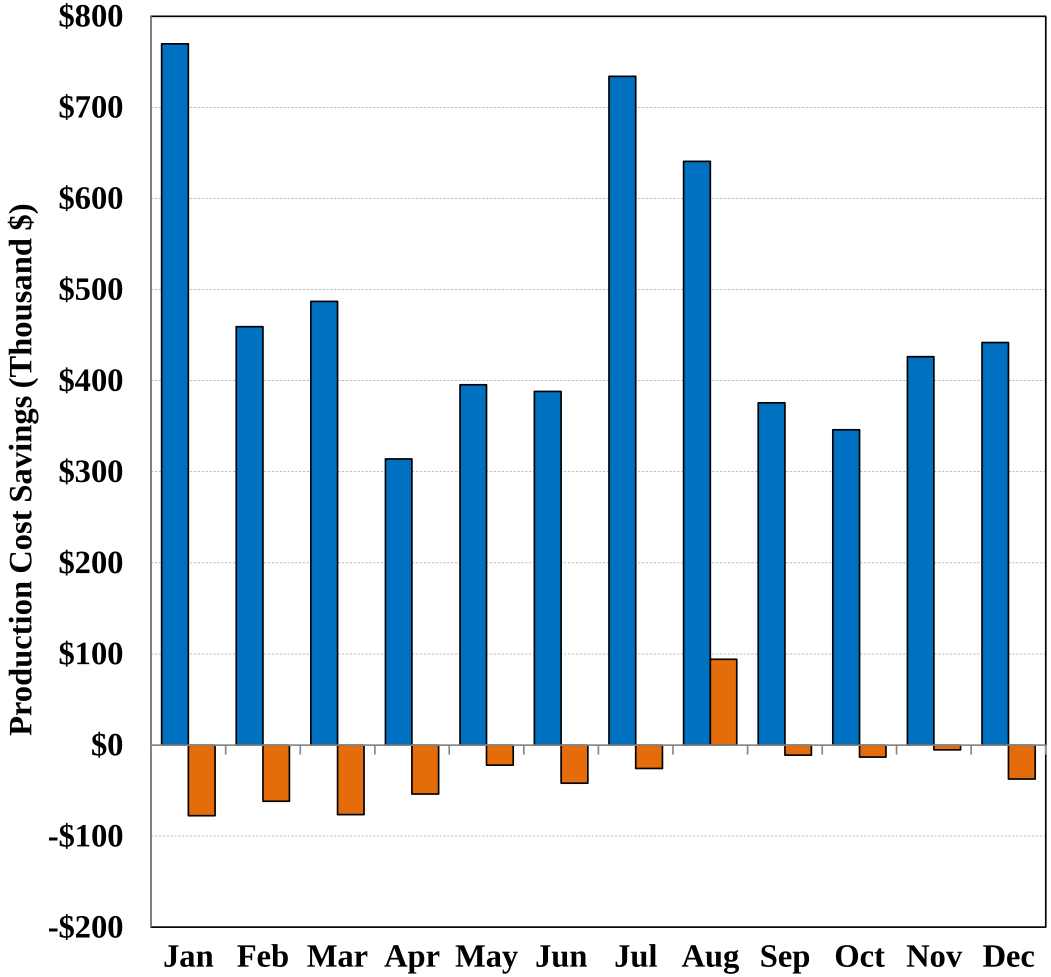
Summary of Results

Summary of Simulation Results for 2016

- The figure shows monthly production cost savings for Optimal Interchange (“OI”) and Tie Optimization (“TO”) cases.
  - ✓ We estimate OI would reduce regional bid production costs by $5.8 million, while TO would *increase* them by $0.3 million.
- The table summarizes the results comparing the interchange adjustments in the two cases:
  - ✓ No Adjustment: No interchange adjustments for both TO and OI.
  - ✓ Same Adjustment: Same interchange adjustments for TO and OI.
  - ✓ Over-Adjustment: (a) TO over-adjusts the interchange in the same direction as OI, or (b) TO adjusts but OI does not.
  - ✓ Under-Adjustment: TO under-adjusts the interchange in the same direction as OI.
  - ✓ Adjustment in Wrong Direction: TO adjusts in the opposite direction as OI.

Estimated Production Cost Savings

By Month, 2016



Production Cost Savings ($M)	
Optimal Interchange	$5.8
Tie Optimization	-$0.3

Trigger Value for 2016	
b =	-$0.3M
a =	$6.1M
b / a =	-5%

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Estimated Production Cost Savings
By Category of Adjustment, 2016

Category of Adjustment		Production Cost Savings ($M): Tie Optimization (TO)	Production Cost Savings ($M): Optimal Interchange (OI)	% of 5-Minute Intervals
No Adjustment				20%
Same Adjustment		$0.7	$0.7	6%
Over Adjustment	Same Direction as OI	-$0.1	$0.1	10%
	No OI Adjustment	-$0.5		9%
Under Adjustment	Same Direction as OI	$0.8	$1.7	18%
	NO TO Adjustment		$2.3	24%
Adjustment in Wrong Direction		-$1.3	$1.0	13%
Total		**-$0.3**	**$5.8**	**100%**

Discussion of Forecasting Issues

Discussion of Forecasting Issues

- The next figure summarizes the distribution of forecast errors.
  - ✓ Green: Distribution of NE-side forecast error

    = (a) Forecast using 7-step supply curve – (b) LMPc price
  - ✓ Blue: Distribution of NY-side forecast error

    = (c) RTC price – (d) RTD price
  - ✓ Red: Distribution of forecast error differential

    = [(c) – (a)] – [(d) – (b)]. When this is positive, the values is shown with the "Over-Forecast Amount" group. When this is negative, the values are shown with the "Under-Forecast Amount" group.
  - ✓ The bars show the average production cost savings in our TO simulations for each category.

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Discussion of Forecasting Issues

- ISO-NE forecast of the border price was $0.81/MWh *higher* on average than the actual price in 2016,
  - ✓ NYISO forecast was $1.33/MWh *lower* than the actual price.
  - ✓ The forecasts would have led TO to systematically over-schedule toward ISO-NE.
- Forecast errors by each ISO were widely distributed, exceeding $10/MWh in 13 to 21 percent of intervals.
- The forecast error of the border price differential (the red line) exceeded $10/MWh in nearly 30 percent of intervals, leading to larger inefficiency of interchange scheduling.
  - ✓ The production cost savings from TO were generally negative when forecast errors were greater than $6/MWh.

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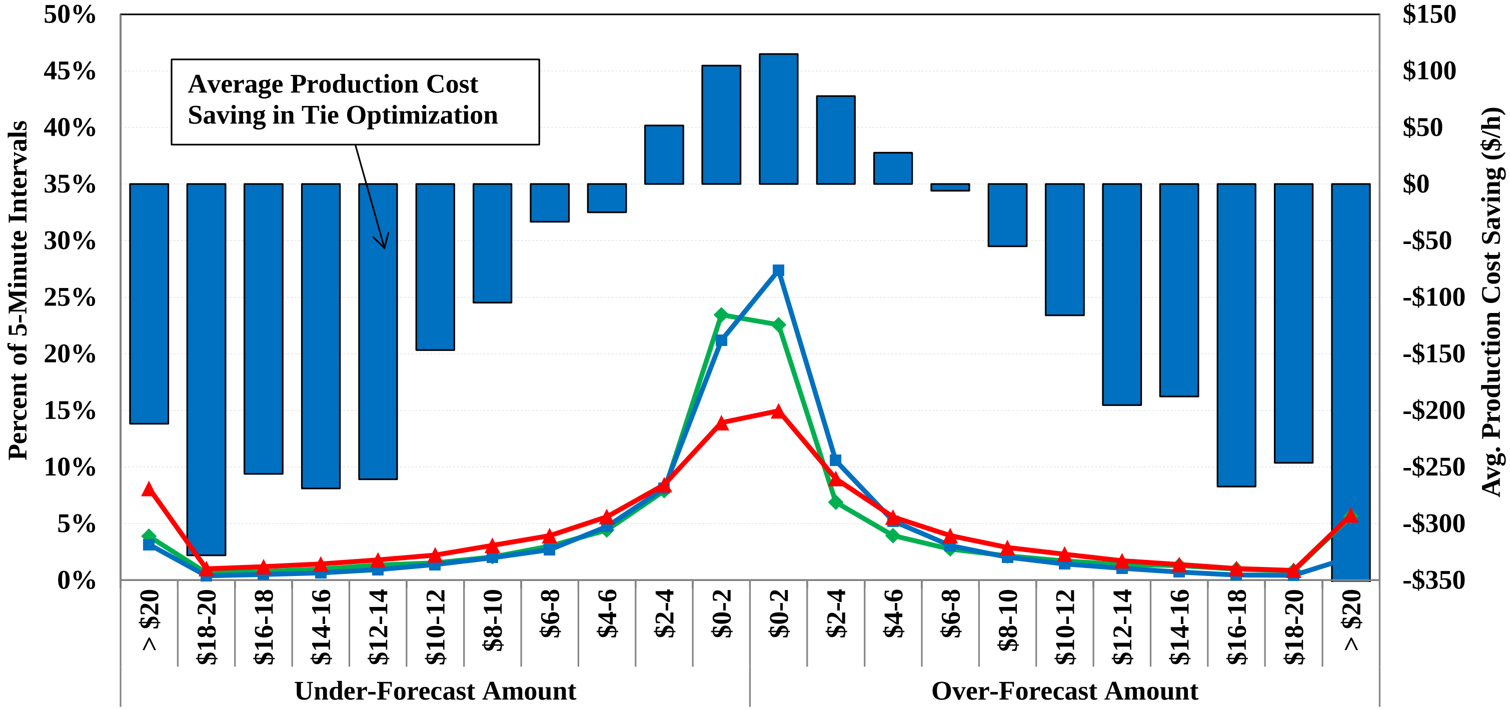
Forecast Errors and Production Cost Savings Shortfalls



	Forecast Error ($/MWh)				% of Intervals When Forecast Errors	
	MEAN	MIN	MAX	STD	Within $10/MWh	Beyond $20/MWh
NE Forecast	$0.81	-$1,629	$1,150	$33	79%	9%
NY Forecast	-$1.33	-$2,344	$2,125	$33	87%	5%
Border Differential	-$2.14	-$2,401	$3,660	$47	71%	14%

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Conclusions

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Conclusions

- Based on our simulations for Year 1:
  - ✓ Optimal Interchange would have resulted in a $5.8 million decrease in regional production costs
  - ✓ Tie Optimization would have yielded a $0.3 million *increase*.
- Although the study of Year 1 is for advisory purposes, the results are well below the tariff thresholds that would trigger an assessment by the ISOs.
- Forecast errors would likely have led Tie Optimization to adjust the interchange to a suboptimal level or even in the wrong direction relatively frequently.
  - ✓ Regardless of whether the ISOs use Tie Optimization or CTS, these results highlight the need to enhance forecasting tools.
  - ✓ Accurate forecasting is also important for efficient commitment of fast start units and external transactions at other interfaces.

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Conclusions

- We have previously identified factors that contribute to poor forecasting in the ISO-NE and NYISO markets, including:
  - ✓ Inconsistency between the scheduling models and dispatch models related to the timing of external interchange ramp
  - ✓ NYISO uses a 7-step approximation of ISO-NE’s supply function
  - ✓ Load forecast and wind forecast errors in both markets
  - ✓ Other factors that lead to transient real-time price volatility in the NYISO market (e.g., loop flows)
- See 2015 NYISO SOM Report at pages 54-59, 94-97 and 2015 ISO-NE Annual Report at pages 75-85.

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Simulation Examples

- This appendix provides two additional illustrative examples from our simulations:
  - ✓ Example 1: Both TO and OI adjust the interchange in the same direction, but TO under-adjusts (below the optimal level in OI).
    - Production cost savings are positive for TO but lower than for OI.
  - ✓ Example 2: TO and OI adjust the interchange in the opposite direction because of TO forecast in the opposite direction.
    - Production cost savings are negative for TO.

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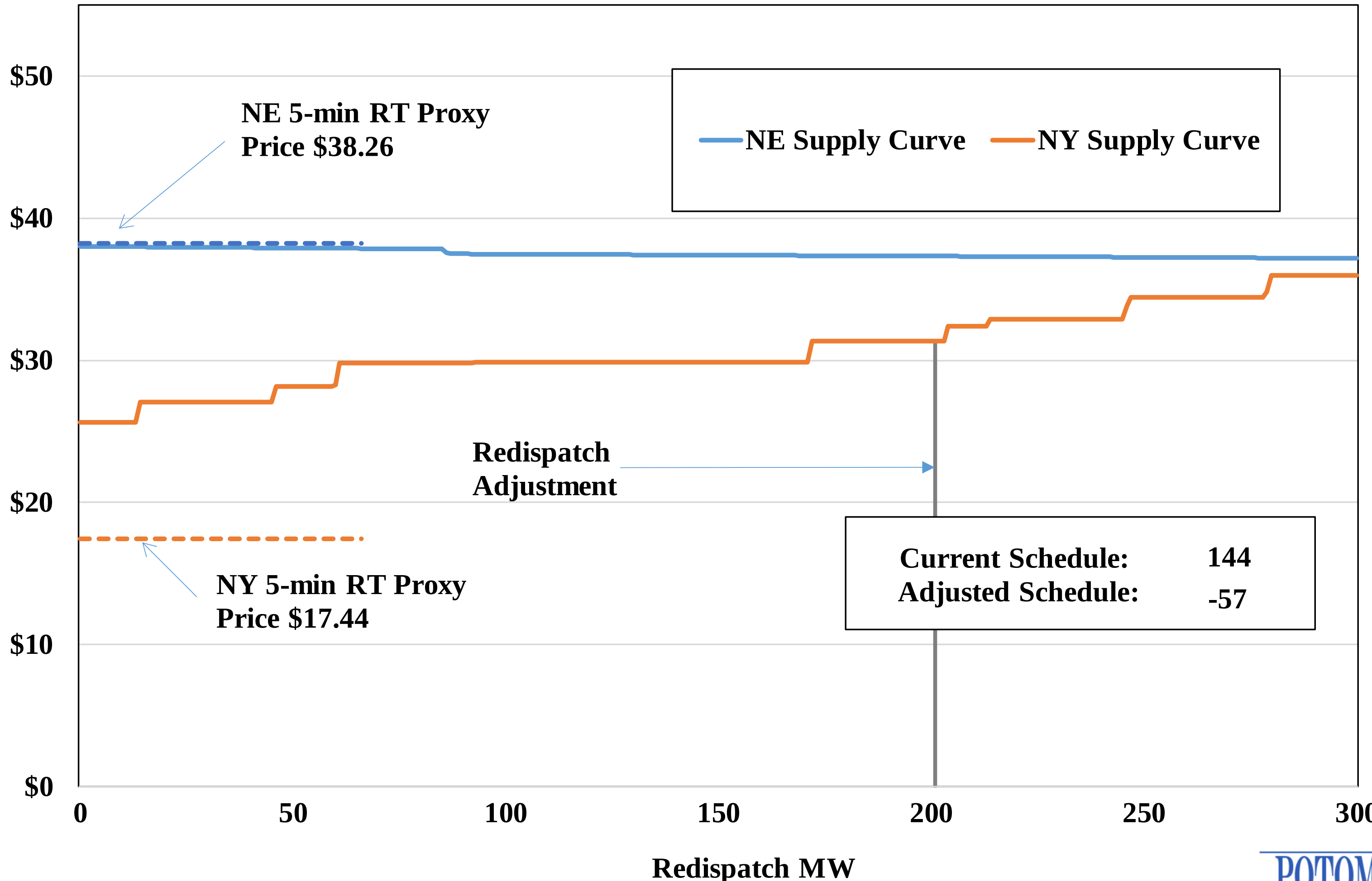
Example 1: Optimal Interchange Case June 1 at 15:20



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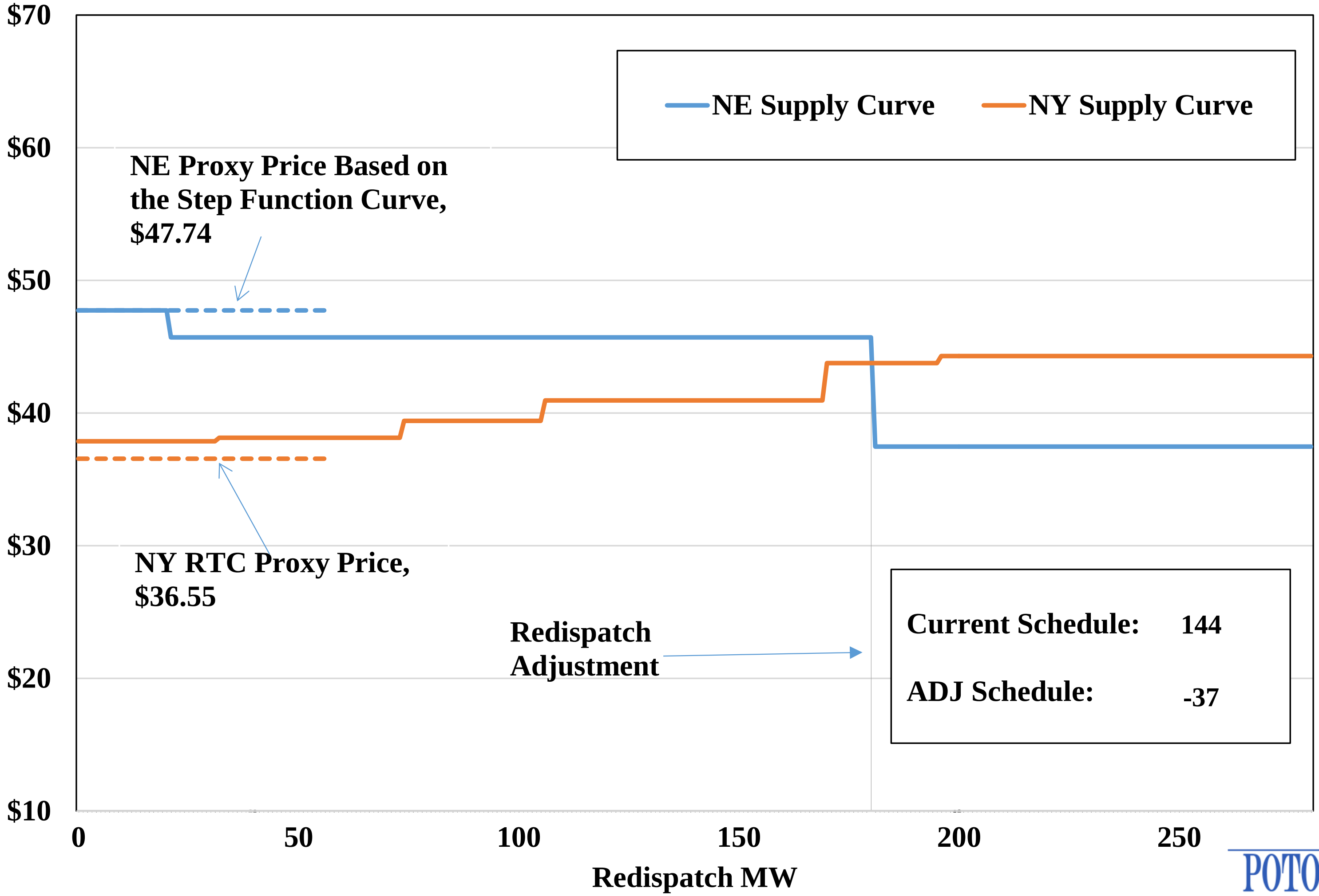
Example 1: Tie Optimization Step 1
June 1 at 15:20



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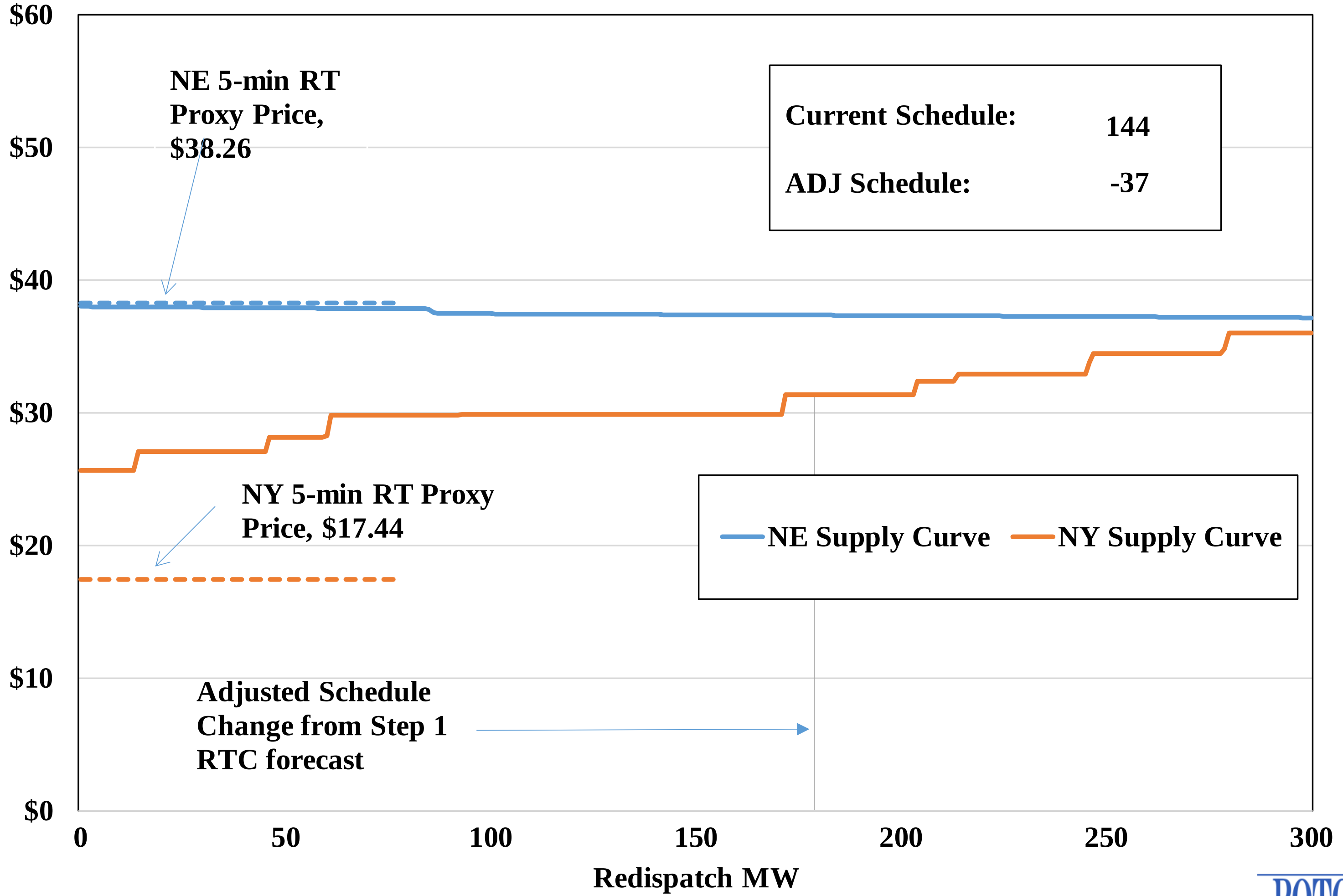
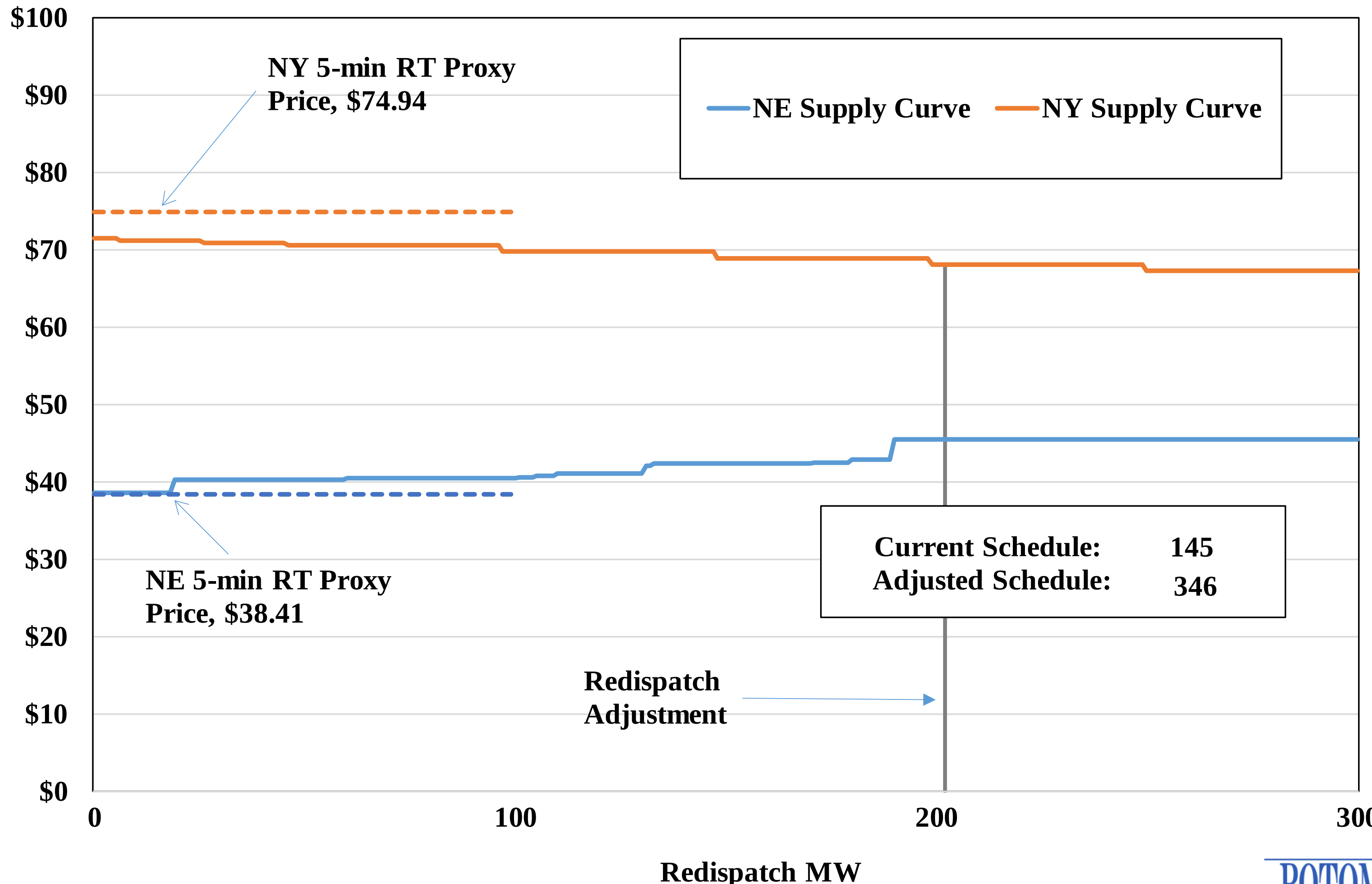
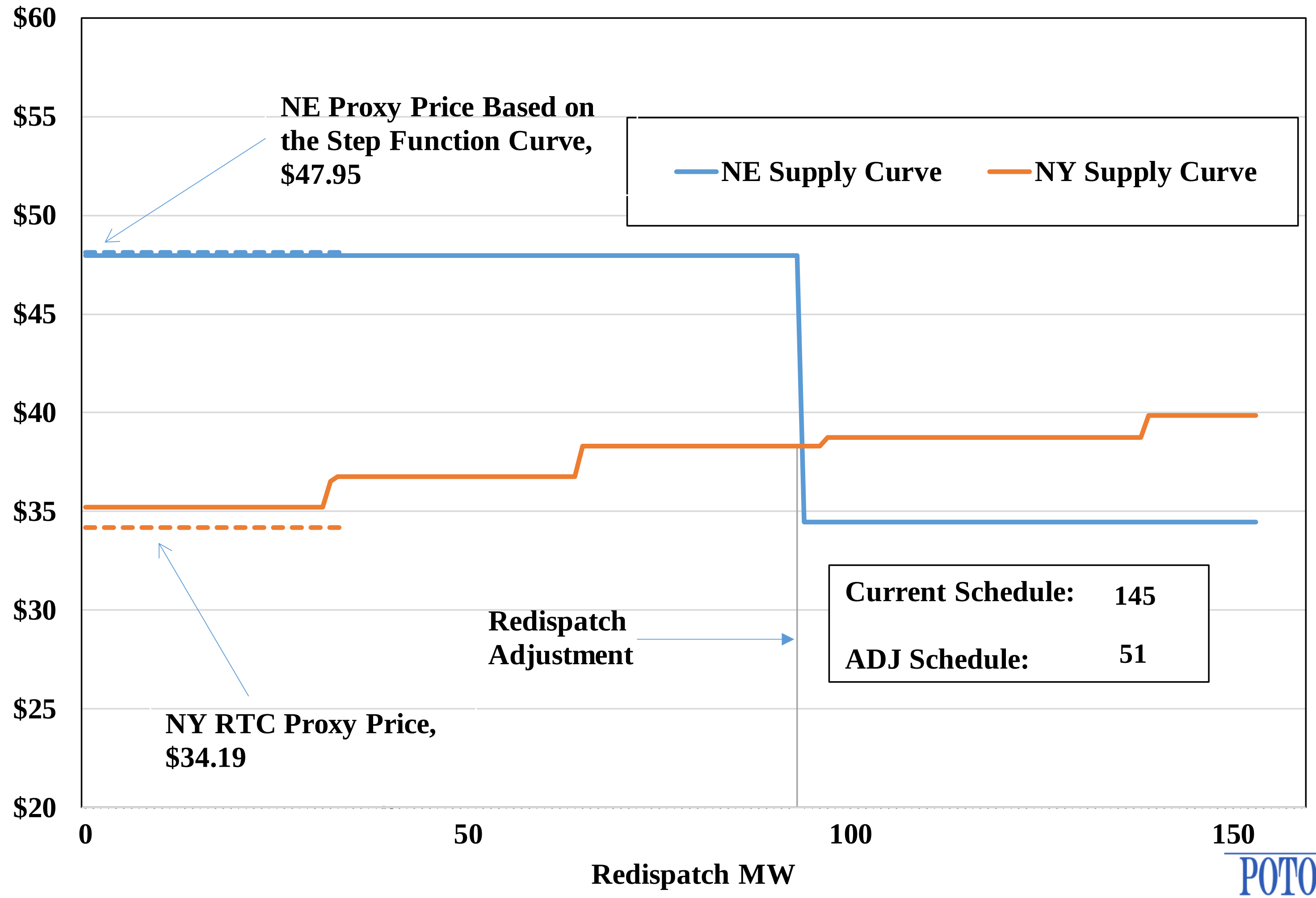
Example 1: Tie Optimization Step 2
June 1 at 15:20



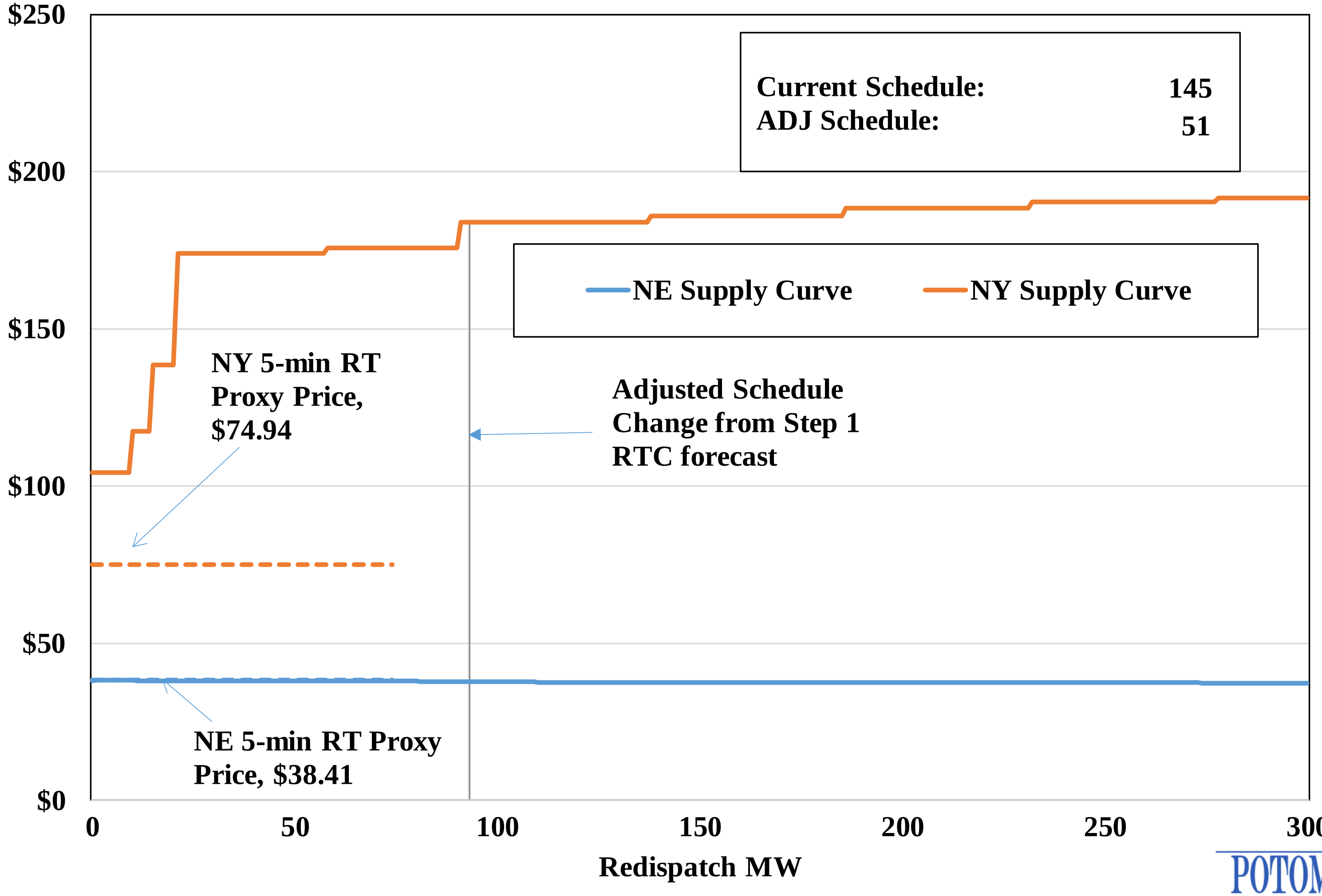
Example 2: Optimal Interchange Case June 1 at 16:10



Example 2: Tie Optimization Step 1
June 1 at 16:10



Example 2: Tie Optimization Step 2
June 1 at 16:10



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