CTS with ISO-NE Answers to Questions

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CTS Workshop Follow up (MIWG)
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Agenda

- Quick overview on the benefits of CTS with ISO-NE
- Provide some answers to questions asked at the previous MIWG review of CTS with ISO-NE

Benefits of CTS with ISO-NE

- **Coordinated Transaction Scheduling (CTS)**

  The objective of CTS is to improve efficiency of energy scheduling with neighboring ISOs.

- **Efficiency Impact**

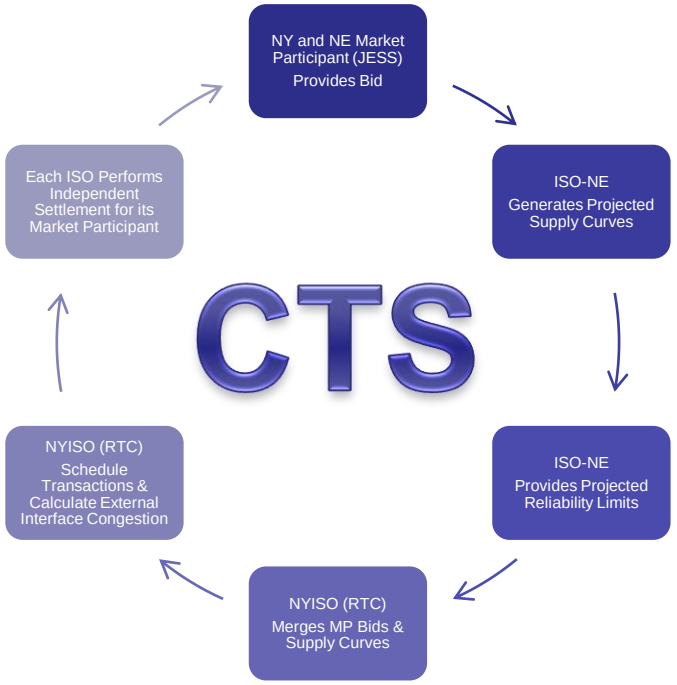
  CTS will allow market participants to schedule based on the price difference between the NYISO and the neighboring ISOs, thereby:

  - ***improving the arbitrage opportunities available;***
  - ***improving the convergence of energy prices throughout the regions resulting in more efficient utilization of existing transmission capability; and***
  - ***allowing more efficient access to lower cost resources throughout the regions.***

  In addition, the NYISO and ISO-NE will make quarter-hour scheduling available at the Sandy Pond Proxy Generator Bus when CTS is implemented.

Benefits of CTS with ISO-NE

- **Today**
  - ***RTC schedules interchange without any knowledge of ISO-NE reliability limits.***
  - ***Any reductions in the normal Reliability Limits after RTC has produced an interchange schedule can result in transaction cuts by operators during the checkout process, potentially resulting in a less economic interchange schedule.***



- **Tomorrow (post CTS w/ ISO-NE activation)**
  - ***RTC will be supplied with reliability limits as inputs, allowing RTC to schedule the most economic interchange possible within the range of the limits.***
  - ***Transaction cuts after RTC has scheduled interchange should be minimized.***

Savings Review

- **Impact of ISO-NE Reliability Limits on Production Cost and the Consumer**

The NYISO has reviewed the Production Cost Savings and Consumer Savings detailed in the January 21, 2011 "Benefits of Coordinating the Interchange Between New York and New England" presentation by Potomac Economics.

The assumptions and results were:

- ***The simulation assumption of imposing a 500MW limit on the size of the adjustment in the interchange in any interval***
- ***The simulation results required interchange adjustments of much less than 500MW for Ideal Interchange****
  - **Flow adjusted into NY 44%, average 264MW**
  - **Flow adjusted into NE 43%, average 228MW**

***2008-2010 average results**

ISO-NE changes to Limits

- In 2014 the NYISO implemented manual reductions of limits in real time on the NY-NE scheduling interface on 7 days based on restrictions communicated from ISO-NE
- In 2014 ISO-NE cut approximately 1700 MWh of interchange transactions to manage ramp over the course of 26 days

ATC/TTC & Supply Curve Postings

- Posting of ATC/TTC values will be for all 10 RTC intervals
- The final Supply Curve price used by RTC to develop the net interchange will be posted

ISO-NE Reliability Limits

- **ISO-NE has provided the following explanation of how they will determine Reliability Limits**
- **The NE 30 Min Limit**
  - ***Will be calculated by ISO-NE for each interval based on data from the same case that produced ISO-NE's CTS proxy bus prices for the net interchange***
    - **The calculation will incorporate RTC's advisory NY/NE net scheduled interchange for all NY/NE interfaces**
  - ***Represents the interface flow at which NE can no longer maintain 30 min (Total Operating) reserves***
  - ***Is calculated using the following equation:***
    - **Net Interchange + surplus of Total Operating reserves**
  - ***Is applicable only in the NE-to-NY direction***

ISO-NE Reliability Limits

- **The NE 10 Min Limit**
  - ***Will be calculated by ISO-NE for each interval based on data from the same case that produced ISO-NE's CTS proxy bus prices for the net interchange***
    - **The calculation will incorporate RTC's advisory NY/NE net scheduled interchange for all NY/NE interfaces**
  - ***Represents the interface flow at which NE can no longer maintain 10 min reserves***
  - ***Is calculated using the following equation:***
    - **Net Interchange + surplus 10 Min reserves + 30 Min reserve requirement**
    - **In this instance 30 Min reserve is not synonymous with Total Operating reserve**
    - **Based on this definition, NE 10 Min Limit will never be equal to or more restrictive than the NE 30 Min Limit**
  - ***Is applicable only in the NE-to-NY direction***

ISO-NE Reliability Limits

- **The NE Min Gen Limit**
  - ***Will be calculated by ISO-NE for each interval based on data from the same case that produced ISO-NE's CTS proxy bus prices for the net interchange***
    - **The calculation will incorporate RTC's advisory NY/NE net scheduled interchange for all NY/NE interfaces**
  - ***Represents the interface flow at which NE has dispatched all internal generation to EcoMin***
  - ***Is calculated using the following equation:***
    - **Net Interchange - Backdown room to EcoMin of internal NE Generation**
  - ***Is applicable only in the NY-to-NE direction***
  - ***Will not cross zero (will not require NYISO to import energy from NE)***
  - ***When a Min Gen limit is sent there must be no other limits sent or NYISO will discard the entire message***

ISO-NE Reliability Limits

- **MP Question:**
  - ***Q: NYISO has stated that ISO-NE may limit the potential transfers across the interface to prevent going short of a reserve product in the exporting area. Would NYISO please explain how this new part of the proposal is consistent with the CTS Tariff rules that have been approved by FERC? Please also explain how, assuming this treatment is allowed, it will be enforced in the market.***

ISO-NE Reliability Limits

- **NYISO Response:**
  - ***Like NYISO, ISO-NE is authorized by its Tariffs to take all actions it believes are necessary to secure the New England system and to ensure continuous, reliable delivery of electricity to loads. Implementing CTS will not remove ISO-NE's existing authority to reduce the ATC at Sandy Pond when ISO-NE determines it is necessary to do so to protect reliability in NE. When reliability requires, ISO-NE can change the ATC available on their side of the border, and can reject transactions at check-out and cut e-tags in order to effectuate the new limit. ISO-NE had authority to take actions to protect reliability before CTS was developed. The CTS with NE tariff revisions did not remove ISO-NE's existing authority to protect the reliability of the NECA.***

ISO-NE Reliability Limits

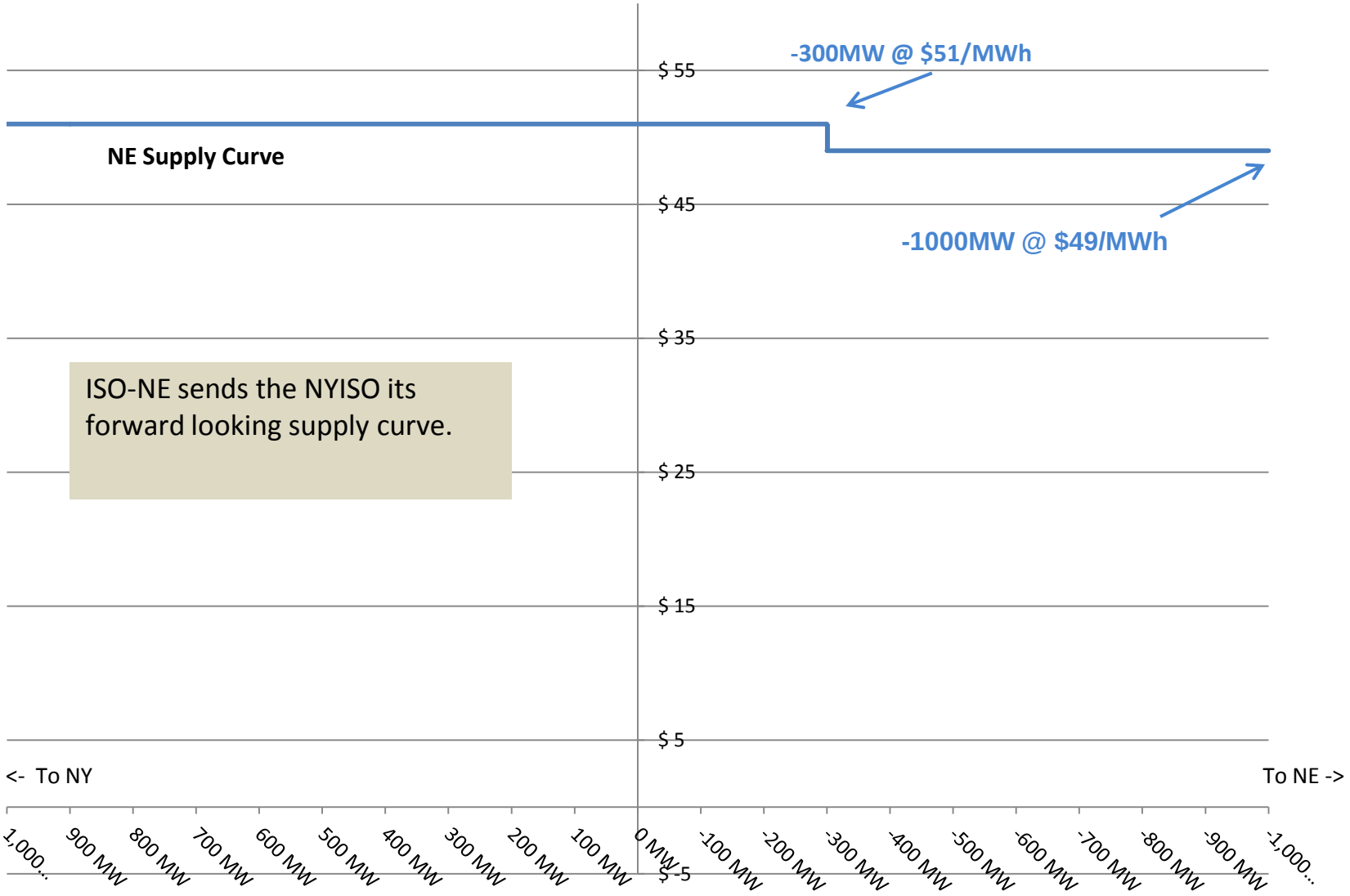
- **NYISO Response:(Continued)**
  - ***Even with the proposed reliability limits, the CTS with NE proposal will be a significant improvement on current practice. Today, ISO-NE can implement changed or new ATC limits after the NYISO has begun its economic evaluation of transactions for the upcoming hour. ISO-NE can enforce the new/changed limits by cutting transactions that were scheduled in NY. If NE sends NYISO its reliability limits (including projected future reliability limits covering an up to 2.5 hour forward-looking window), RTC will be able to take these limits into consideration when it optimizes interchange and establishes proxy bus prices.***
  - ***The proposed rules for implementing reliability limits will be included in the Tariff revisions NYISO presents to its stakeholders.***

Economic Evaluation Example 1

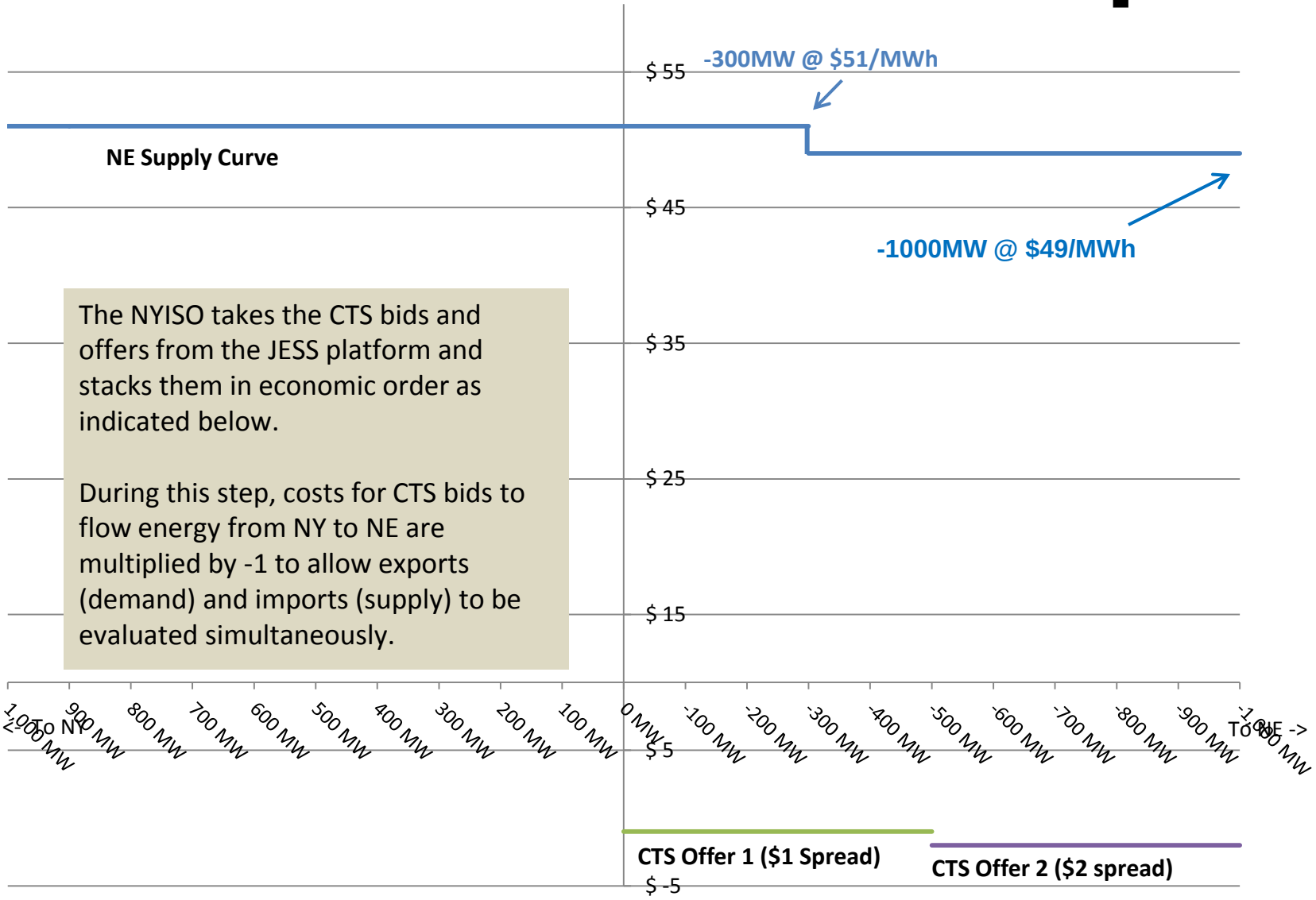
- **NYISO receives the following supply points from ISO-NE:**
  - ***Point 1: -1000MW @ $49/MWh***
    - NE forecasts its price is $49/MWh for 1000 MW of energy delivered from NY
  - ***Point 2: -300MW @ $51/MWh***
- **Separately, NYISO receives the following CTS offers from market participants:**
  - ***CTS Offer 1: 500MW (from NY to NE) @ $1/MWh***
    - The scheduling MP is willing to pay to schedule up to 500 MW of energy from NY to NE if the NY LBMP is expected to be at least $1/MWh lower than the NE price
  - ***CTS Offer 2: 500MW (from NY to NE) @ $2/MWh***
- **NYISO combines the NE supply points and CTS offers by stacking them economically, as illustrated in the following slides resulting in:**
  - ***Enriched CTS Offer 1 pt 1: 300MW (from NY to NE) @ $50/MWh***
    - The bid should be scheduled to the extent the price RTC expects NY to charge for the up to 300 MW that will be exported to NE is $50 or less; applies to the first 300 MWs potentially exported from NY
  - ***Enriched CTS Offer 1 pt 2: 200MW (from NY to NE) @ $48/MWh***
    - The bid should be scheduled to the extent the price RTC expects NY to charge for the up to 200 MW that will be exported to NE is $48 or less; applies to potentially exported MWs 301-500
  - ***Enriched CTS Offer 2: 500MW (from NY to NE) @ $47/MWh***
    - The bid should be scheduled to the extent the price RTC expects NY to charge for the up to 500 MW that will be exported to NE is $47 or less; applies to potentially exported MWs 501-1000

Sign convention: negative MWs = flow in the NY to NE direction, positive MWs = flow in the NE to NY direction
For simplicity, this example assumes no other external transactions at other interfaces.

Economic Evaluation Example 1



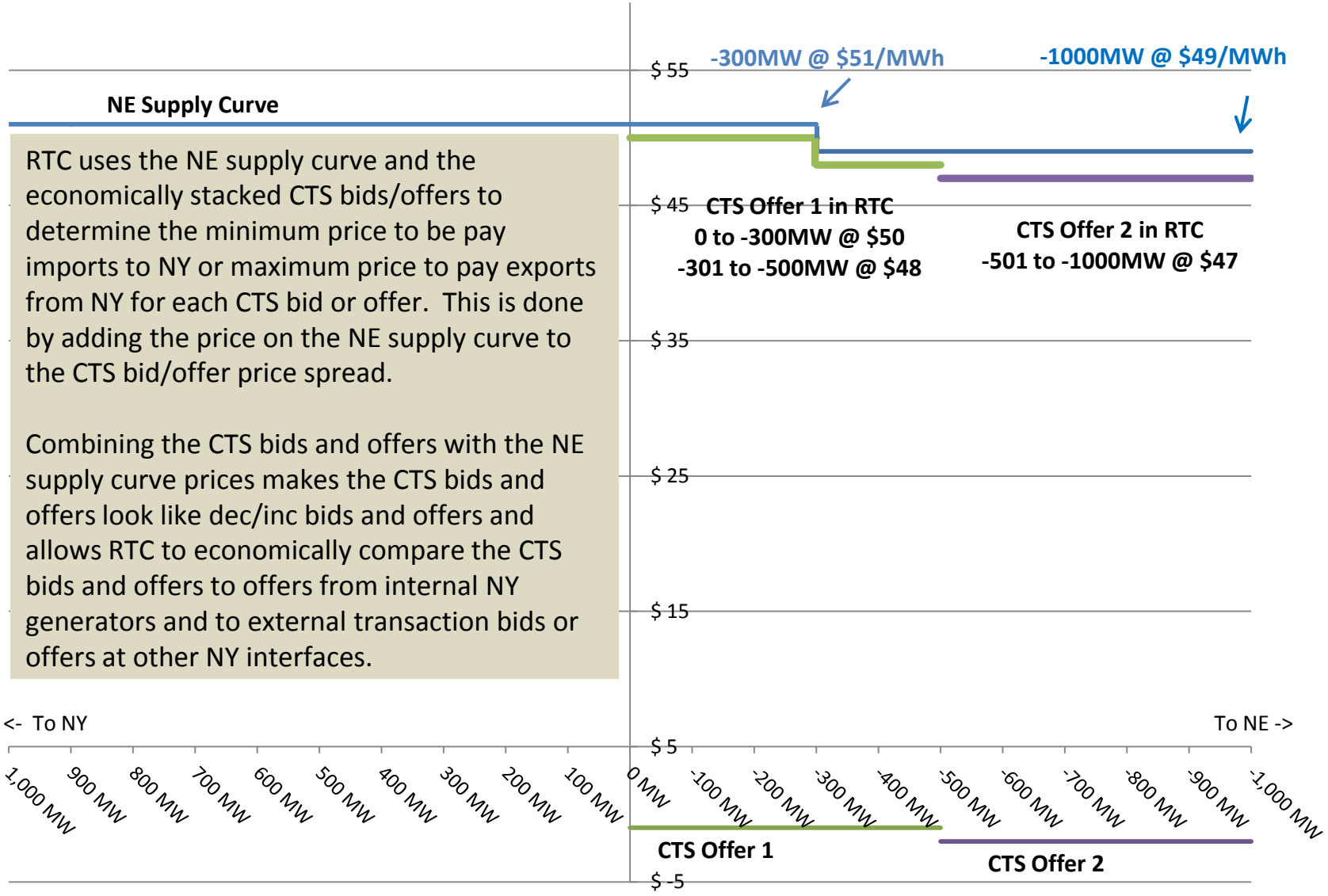
Economic Evaluation Example 1



The NYISO takes the CTS bids and offers from the JESS platform and stacks them in economic order as indicated below.

During this step, costs for CTS bids to flow energy from NY to NE are multiplied by -1 to allow exports (demand) and imports (supply) to be evaluated simultaneously.

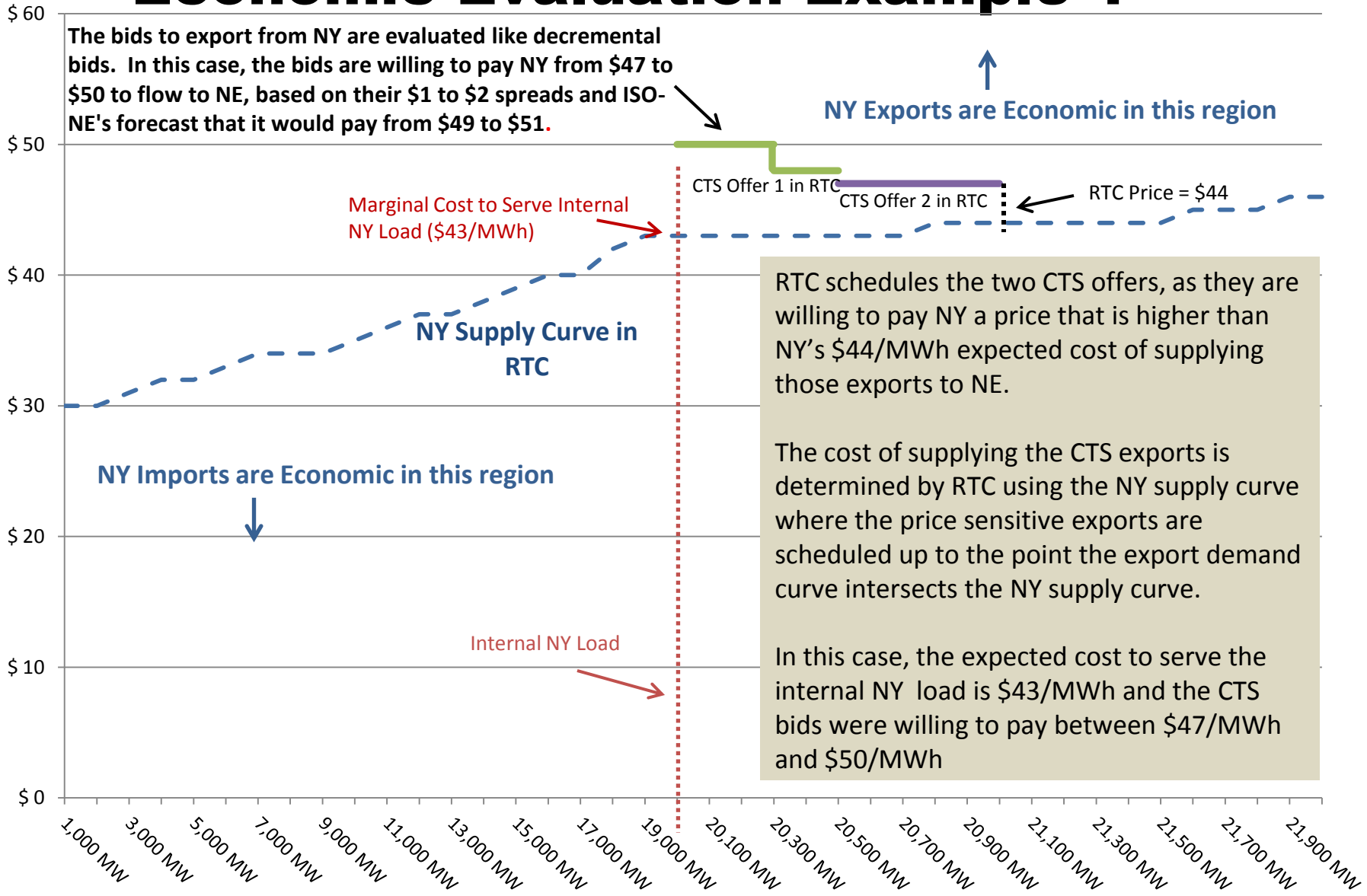
Economic Evaluation Example 1



RTC uses the NE supply curve and the economically stacked CTS bids/offers to determine the minimum price to be pay imports to NY or maximum price to pay exports from NY for each CTS bid or offer. This is done by adding the price on the NE supply curve to the CTS bid/offer price spread.

Combining the CTS bids and offers with the NE supply curve prices makes the CTS bids and offers look like dec/inc bids and offers and allows RTC to economically compare the CTS bids and offers to offers from internal NY generators and to external transaction bids or offers at other NY interfaces.

Economic Evaluation Example 1



RTC schedules the two CTS offers, as they are willing to pay NY a price that is higher than NY's $44/MWh expected cost of supplying those exports to NE.

The cost of supplying the CTS exports is determined by RTC using the NY supply curve where the price sensitive exports are scheduled up to the point the export demand curve intersects the NY supply curve.

In this case, the expected cost to serve the internal NY load is $43/MWh and the CTS bids were willing to pay between $47/MWh and $50/MWh

Economic Evaluation Example 1

- **RTC schedules both CTS offers fully because the RTC price ($44/MWh) with the additional 1000MWs of exports provided a larger than $2 spread from the ISO-NE supply curve price ($49/MWh)**
- **The 1000MWs of flow from NY to NE due to the CTS offers being scheduled results in ISO-NE having a $49/MWh settlement price**
  - ***The same 1000MWs of flow from NY to NE results in the NYISO having a $44/MWh RTD price, which equal the settlement price because there is no External Interface Congestion***
  - ***In this case, RTC perfectly predicted RTD conditions and the NYISO RTC price equals the NYISO RTD price***
- **CTS Offer 1 Settlement: 500MW (from NY to NE) @ $1/MWh**
  - ***Pays the NYISO (withdrawal) $22,000 = 500MW * $44/MWh***
  - ***Paid by ISO-NE (injection) $24,500 = 500MW * $49/MWh***
  - ***Net = ($49/MWh - $44/MWh)*500MW = $2,500***
- **CTS Offer 2: 500MW (from NY to NE) @ $2/MWh**
  - ***Pays the NYISO (withdrawal) $22,000 = 500MW * $44/MWh***
  - ***Paid by ISO-NE (injection) $24,500 = 500MW * $49/MWh***
  - ***Net = ($49/MWh - $44/MWh)*500MW = $2,500***

This example has no External Interface Congestion

Economic Evaluation Example 2

- **NYISO receives the following supply points from ISO-NE:**
  - ***Point 1: -1000MW @ $49/MWh***
    - NE forecasts its price is $49/MWh for 1000 MW of energy delivered from NY
  - ***Point 2: -300MW @ $51/MWh***
- **Separately, NYISO receives the following CTS offers from market participants:**
  - ***CTS Offer 1: 500MW (from NY to NE) @ $1/MWh***
    - The scheduling MP is willing to pay to schedule up to 500 MW of energy from NY to NE if the NY LBMP is expected to be at least $1/MWh lower than the NE price
  - ***CTS Offer 2: 500MW (from NY to NE) @ $2/MWh***
- **NYISO combines the NE supply points and CTS offers by stacking them economically, as illustrated in the following slides resulting in:**
  - ***Enriched CTS Offer 1 pt 1: 300MW (from NY to NE) @ $50/MWh***
    - The bid should be scheduled to the extent the price RTC expects NY to charge for the up to 300 MW that will be exported to NE is $50 or less; applies to the first 300 MWs potentially exported from NY
  - ***Enriched CTS Offer 1 pt 2: 200MW (from NY to NE) @ $48/MWh***
    - The bid should be scheduled to the extent the price RTC expects NY to charge for the up to 200 MW that will be exported to NE is $48 or less; applies to potentially exported MWs 301-500
  - ***Enriched CTS Offer 2: 500MW (from NY to NE) @ $47/MWh***
    - The bid should be scheduled to the extent the price RTC expects NY to charge for the up to 500 MW that will be exported to NE is $47 or less; applies to potentially exported MWs 501-1000

Sign convention: negative MWs = flow in the NY to NE direction, positive MWs = flow in the NE to NY direction
For simplicity, this example assumes no other external transactions at other interfaces.

Economic Evaluation Example 2

- **Additionally, a line that is part of the NY-NE AC Interface trips**
  - ***NY to NE Transfer Capability is reduced to 800MW***
    - Normal Transfer Capability is 1400MW from NY to NE
  - ***NE to NY Transfer Capability is reduced to 850MW***
    - Normal Transfer Capability is 1200MW from NE to NY
- **Assume RTC has the same load and NY supply curve as Example 1**
- **The reduced transfer capability results in CTS offer 2 only receiving a partial schedule of 300MW**
  - ***The 800MW NY to NE transfer limit is enforced by RTC which results in a TTC constraint***
  - ***The RTC price at Sandy Pond is set by CTS Offer 2 at $47/MWh***
  - ***The RTC price at Sandy Pond would have been $44/MWh without the 800MW limitation***

Economic Evaluation Example 2

- **The difference between the TTC constrained ($47/MWh) and the unconstrained ($44/MWh) LBMP at Sandy Pond is the External Interface Congestion ($3/MWh)**
- **This $3/MWh of External Interface Congestion (EIC) is split 50/50 between the NYISO and ISO-NE settlement prices**
  - ***The 800MW of flow from NY to NE results in ISO-NE having a $49/MWh real-time price***
    - **The $49/MWh real-time price is reduced by 50% of the $3/MWh EIC to a $47.50/MWh settlement price**
  - ***The same 800MWs of flow from NY to NE results in the NYISO having a $44/MWh RTD price***
    - **The $44/MWh RTD price is increased by 50% of the $3/MWh EIC to $45.50/MWh**
- **CTS Offer 1 Settlement: 500MW (from NY to NE) @ $1/MWh**
  - ***Pays the NYISO (withdrawal) $22,750 = 500MW * $45.50/MWh***
  - ***Paid by ISO-NE (injection) $23,750 = 500MW * $47.50/MWh***
    - **Net = ($47.50/MWh - $45.50/MWh)*500MW = $1,000**
- **CTS Offer 2: 500MW (from NY to NE) @ $2/MWh**
  - ***Pays the NYISO (withdrawal) $13,650 = 300MW * $45.50/MWh***
  - ***Paid by ISO-NE (injection) $14,250 = 300MW * $47.50/MWh***
    - **Net = ($47.50/MWh - $45.50/MWh)*300MW = $600**

Congestion Allocation Impacts

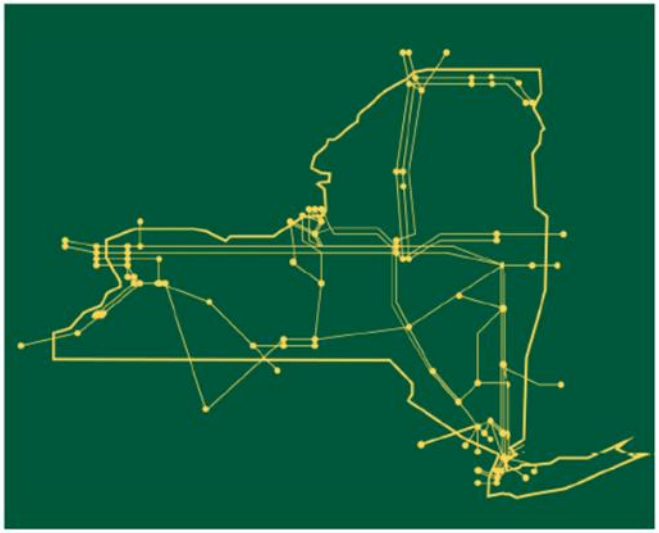
- **In example 2, the real-time External Interface Congestion was split 50/50**
- **If neither CTS offer had a DAM schedule, then the collection of $45.50/MWh would result in a Balancing Congestion Residual (Surplus) of $1.50/MWh * 800MWs = $1200 in NY**
  - ***This surplus is the result of paying the internal NYCA generation $44/MWh for the 800MW, but collecting $45.50/MWh for the 800MW***

- **If both CTS offers were fully scheduled in the DAM, then the collection of $45.50/MWh would result in a Balancing Congestion Residual (Shortfall) that is $300 less than it would have been without congestion sharing**
  - ***CTS Offer 1 has no real-time settlement since it perfectly balanced its DAM and RTM schedules***
  - ***CTS Offer 2 real-time schedule = 300MW***
    - **DAM schedule associated with CTS Offer 2 = 500MW**
  - ***With 50/50 congestion split, CTS Offer 2 paid the DAM price for its energy and is paid (since it is an export) $9,100 in RT = (500MW-300MW)*$45.50/MWh***
    - **Generators are also dispatched down 200MW from DAM schedules, which results in payments from Generators of $8,800 = 200MW*$44/MWh**
    - **Balancing Congestion Residual (Shortfall) = $300 = $9,100 - $8,800 = 200MW * $1.50/MWh**
  - ***Without 50/50 congestion split, the NYISO real-time settlement price would have been $47/MWh ($44/MWh + $3/MWh)***
    - **CTS Offer 2 would have been paid $9,400 in RT = (500MW-300MW)*$47/MWh**
    - **Generators are also dispatched down 200MW from DAM schedules, which results in payments from Generators of $8,800 = 200MW*$44/MWh**
    - **Balancing Congestion Residual (Shortfall) = $600 = $9,400 - $8,800 = 200MW * $3/MWh**

Next Steps

- **Coordination Agreement & Tariff**
  - *MIWG (March 2015)*
  - *MIWG (April 2015 - May 2015)*
  - *BIC (June 2015)*
  - *MC (July 2015)*
  - *BOD (August 2015)*
  - *Filing (August 2015)*
  - *FERC Approval (October 2015)*

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.



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