Joint Stakeholder Meeting

ISO-NE and NYISO Inter-Regional Interchange Scheduling (IRIS)

January 21, 2011 / Albany, NY

Agenda

Today:

- Joint Stakeholder Meetings and Presentation Plan
- RT Interface Scheduling: Inefficiencies and Causes
- Benefit Analysis (*Potomac Economics*)
- Real-Time Scheduling System Details

Joint Stakeholder Meetings

Purpose:

- **Discuss** white paper's options, pros/cons, how they work, rationale, & likely impact on the markets
- **Gather stakeholder input** on merits, concerns, questions
- **Forge consensus** on a design option the ISOs can implement

Joint ISO white paper:

- **Presents** in-depth analysis of problems, solution options, rationales, and joint ISO recommendations for reforms.

Presentation Plan for Element Details

Day 1 (1/21, AM): Current system, benefit analysis

(1/21, PM): RT scheduling system (Tie Opt&CTS)

Day 2 (2/14): DA & RT market linkages; DA external transactions; interface settlements in detail

Day 3 (3/7): FTRs, NCPC & fee recommendations, conforming capacity rule changes

Day 4 (3/28): Q&A, follow-up's on additional detail as requested, discussion of draft DBD structure

Real-Time Interface Scheduling: Inefficiencies and Causes

ISOs' Primary Concerns at NY/NE Interface

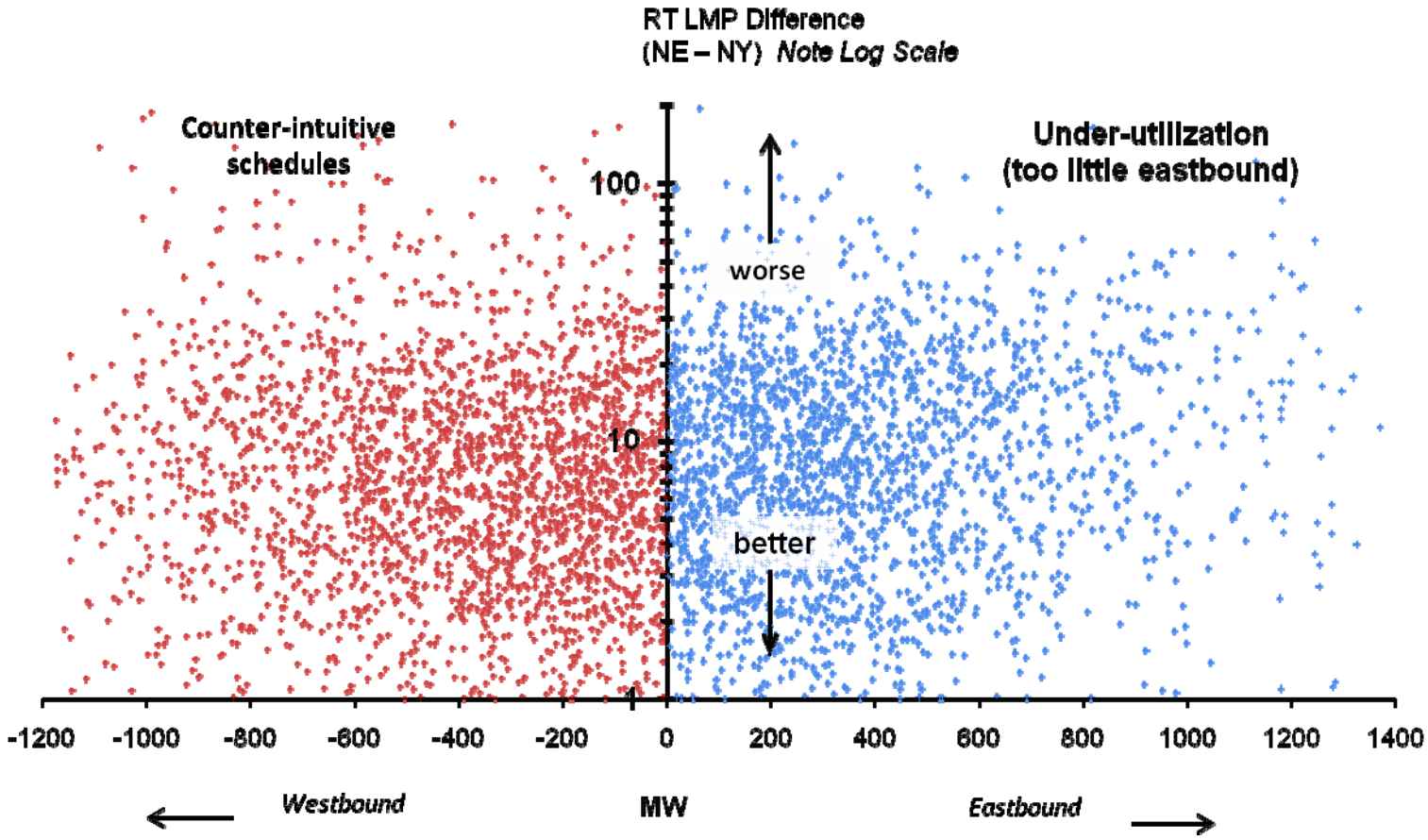
Two Practical Concerns:

- **"Wrong-way" real-time net schedules** (high → low-cost direction) over 4000+ hours / yr
- **Substantial under-scheduling** the other 4000+ hrs

Consequence: Production costs higher than necessary

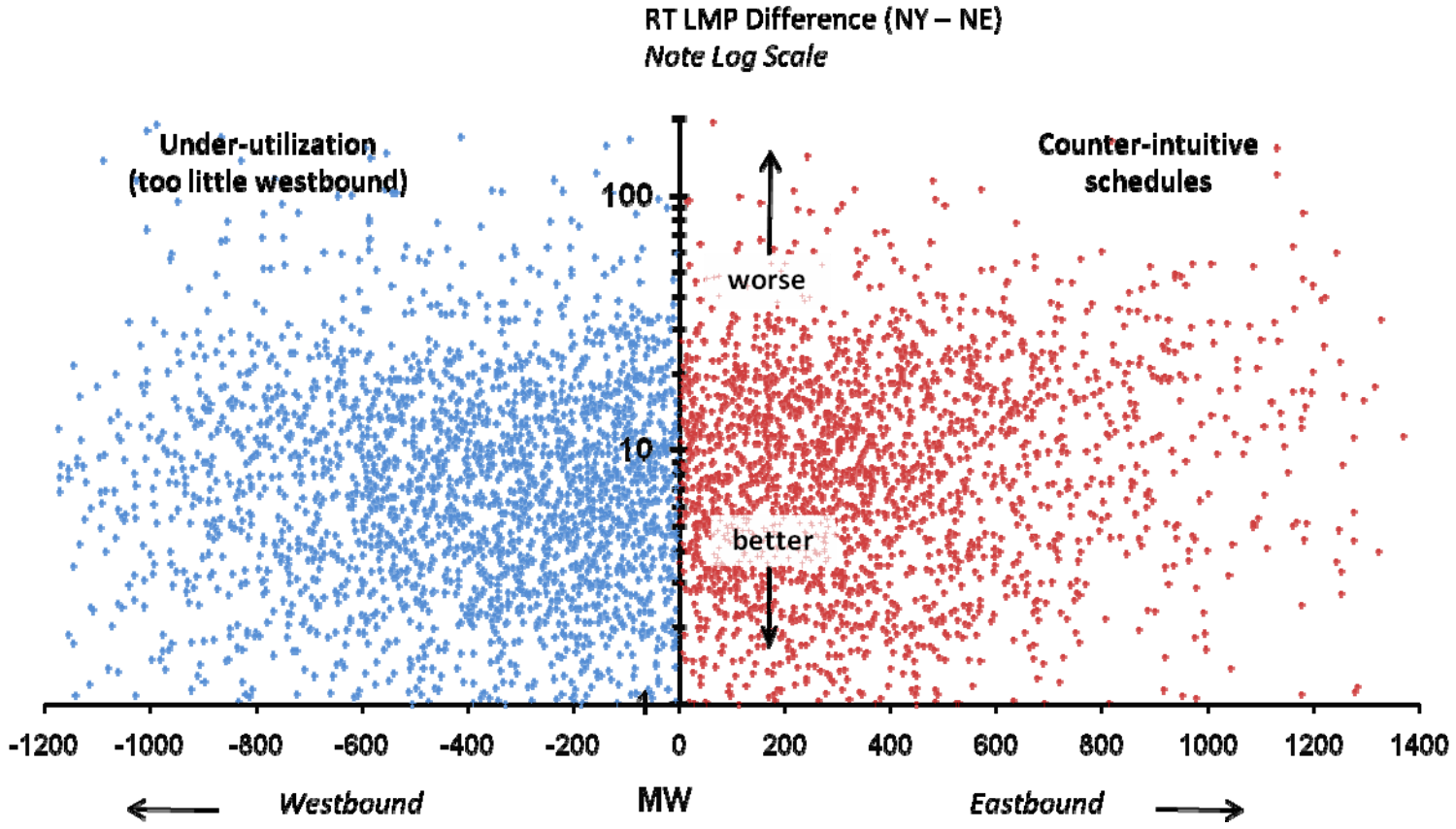
Evidence: Next slides show key data from white paper

(A) RT Schedule and Interface LMP Difference: Hours when LMP **NE > NY** LMP



Source: *ISO White Paper,* Figure II-2(a)

(B) RT Schedule and Interface LMP Difference: **Reverse Case**: LMP **NY > NE** LMP



Source: *ISO White Paper,* Figure II-2(b)

Why does this occur?

Reason 1 (of several):

- System conditions, and LMPs at interface, can **change quickly**
  - *RT price spread at border is volatile (next slide).*
- Current external scheduling system does not react rapidly

Reason 2:

- **Fees and uplift allocation** to RT external transactions deter:
  - 'Unwinding' wrong-way flow positions in real-time;
  - Arbitrage when the tie is under-scheduled approaching real-time

RT LMP spread at NY/NE interface is volatile

Index of (e.g.) 7 means: The *median* hourly change in the LMP spread (either direction) is $7 /MWh **or more**

Source: *ISO White Paper,* Figure II-7

On average in 2009 – a low volatility year – the region with the lower LMP switched **three times a day.**

Q: Are the inefficiencies all due to changing conditions *after* the RT schedule is set?

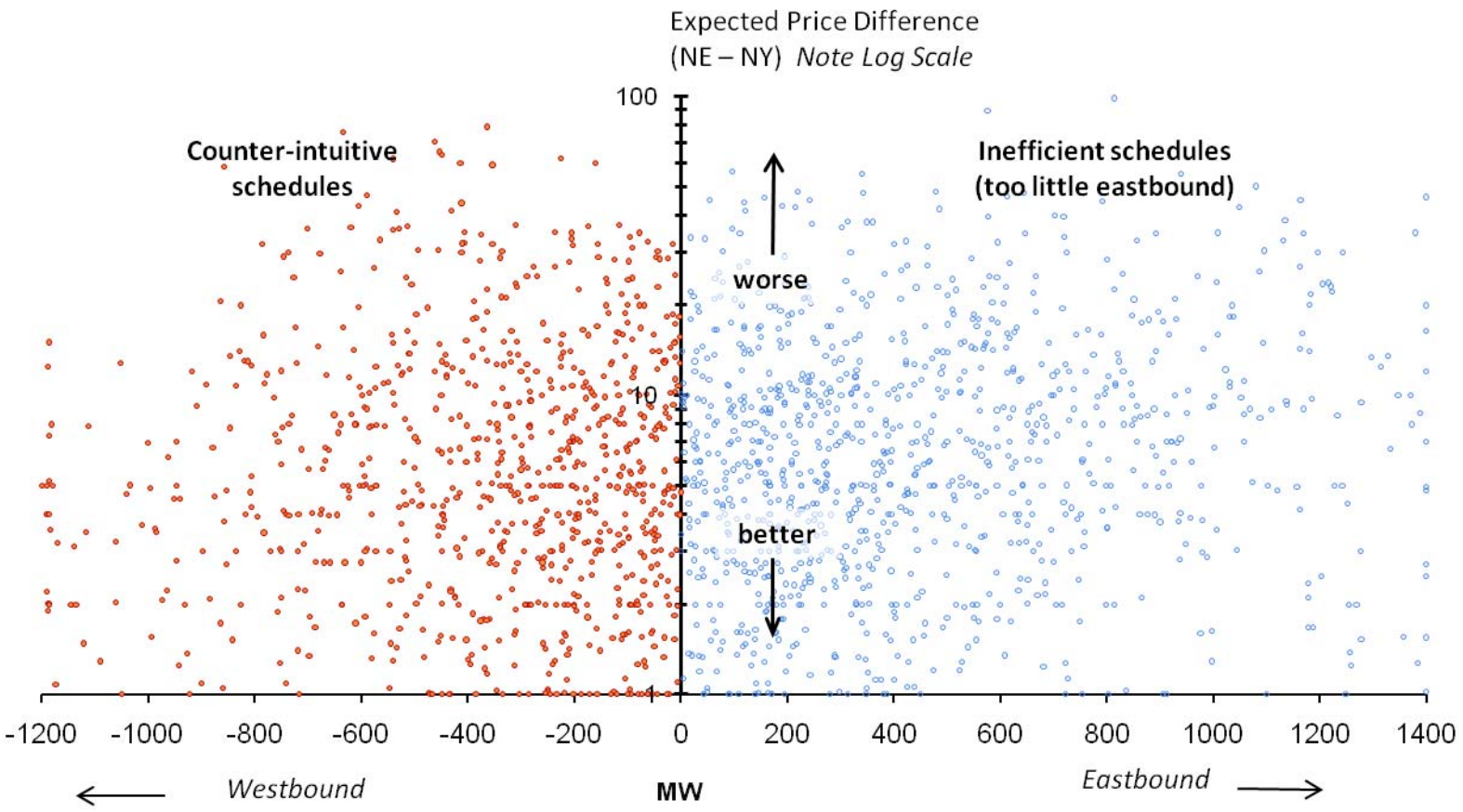
A: **No.** At 'check-out' (45 min prior to hour) we see:

- Under-utilization of the interface
- Frequent, large price spreads
- Counter-intuitive net scheduled flows

Evidence: *Next slides →*

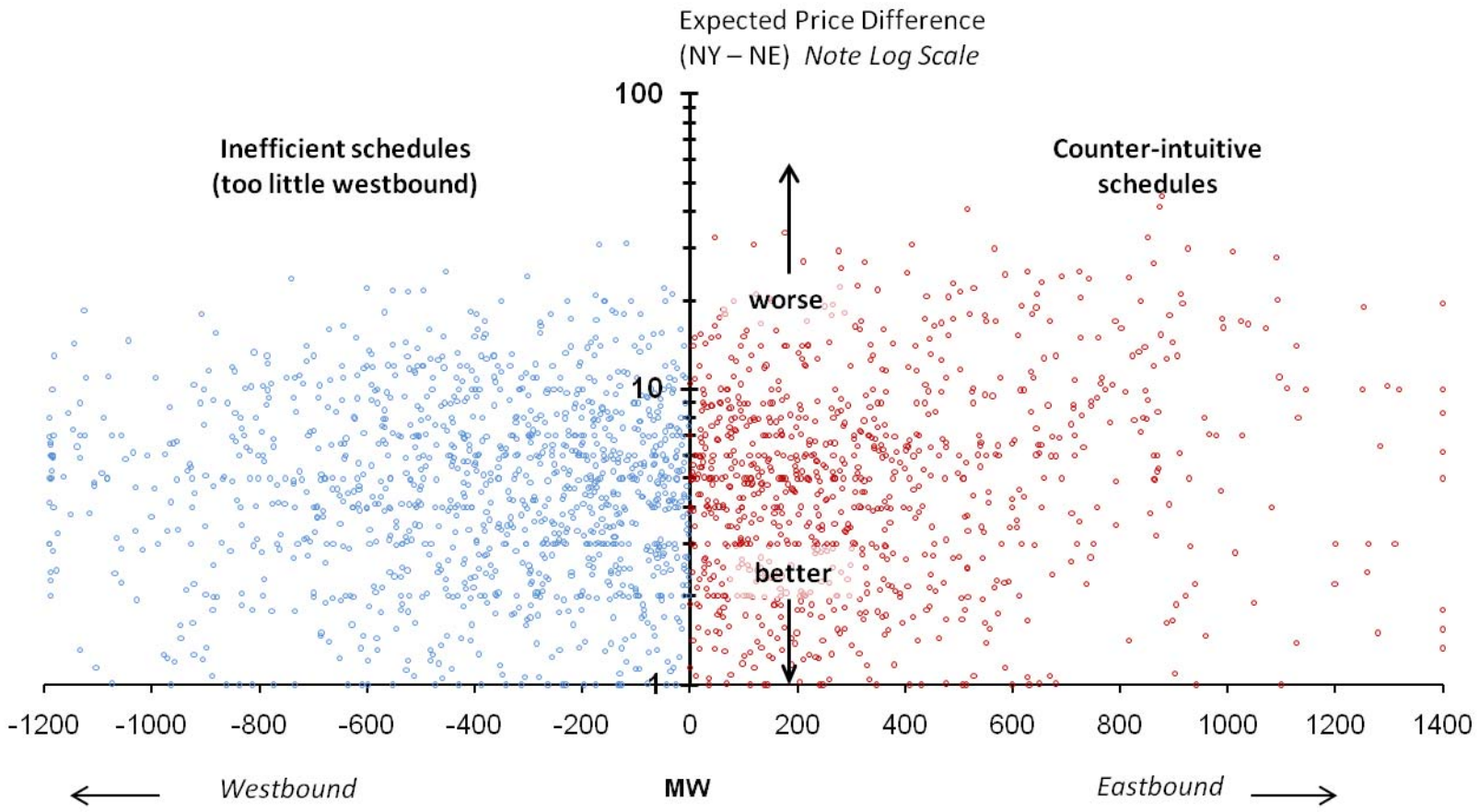
Bottom line: Today's scheduling process produces inefficient RT interface results.

(C) Price Difference At Time Interface Scheduled: Hours when Expected LMP **NE > NY** LMP



Source: *ISO White Paper,* Figure II-8(a)

(D) Price Difference At Time Interface Scheduled: **Reverse Case:** Hours when Expected LMP **NY > NE**



Source: *ISO White Paper,* Figure II-8(b)

Fixing the Problems: Two Central Objectives

What should an efficient scheduling system do?

1. **Equalize LMPs** at interface at time schedule is set;
2. **Update** real-time schedule as fast as conditions change.

- **These two objectives** guided the ISOs' joint analysis of design options for RT interface scheduling
  - Can solutions achieve Objective 1? **Yes.**
  - Can solutions achieve Objective 2? **Better, not perfect** (*and tech. improves*)

Solution Options:

Benefit Analysis

(*See* Potomac Economics Materials)

Solution Options: Main Elements

Solution Options: Six Key Elements

1. **New RT Inter-Regional Interchange System** (IRIS)
   - *Two IRIS options for stakeholder consideration (next).*
2. **Higher-frequency** schedule changes (15 min)
3. **Eliminate NCPC** credits/debits & fees on ext. txns
4. **DA market:** External txn remain similar to today, *plus:*
5. **Congestion pricing** (DA & RT) at external nodes
6. **FTRs** at external interfaces (NY/NE)

Solution Options:
RT Scheduling System Details

Real-Time Interface Scheduling (IRIS)

- **Design Objectives:**
  1. **Equalize LMPs** at interface at time schedule is set;
  2. **Update** real-time schedule as frequently as feasible.
- **Two design options** for real-time interface scheduling with greatest potential for efficiency improvement:
  - **Tie Optimization** (TO)
  - **Coordinated Transaction Scheduling** (CTS)
- **Both are market-based solutions, but differ** in the market information they require of market participants.

Tie Optimization Solution Option:

Concept and RT Scheduling System

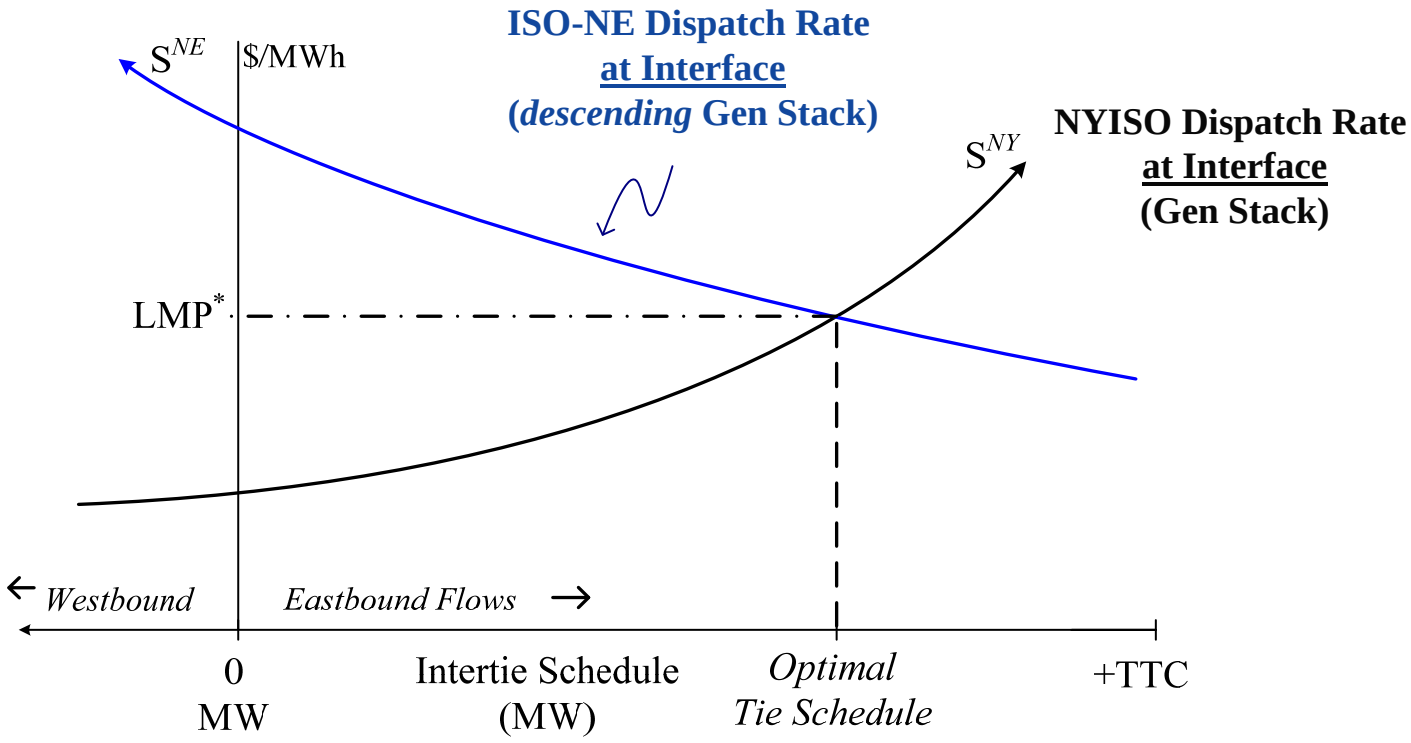
Solution Option A: Tie Optimization

Core concept: ISOs manage transmission ties between regions in same way ISOs manage transmission internally.

- Effectively, a coordinated dispatch using bid-based supply offers from all dispatchable resources sets real-time tie schedule every 15 min.

- **ISOs would use the same market-based, economic dispatch** logic that underlies competitive energy market design in each ISO.
  - Each ISO currently optimizes all *internal* transmission flows to minimize total bid-based production costs
  - Tie Optimization simply extends process by adding the (7) external ties *between* ISO-NE & NYISO.

Economic Logic



- Tie Optimization minimizes total production costs for *both* regions.
- It equalizes LMP at border when schedule set (Objective 1)

Key Points

- **Tie Optimization uses the bid-based supply offers** in each region (the dispatch stacks) to determine:
  - The RT interface schedule (every 15 min);
  - The RT LMP (proxy bus LMP) at the interface.
- **There are no** RT external offers (export/import) per se.
- **So:** How do the two ISOs coordinate their economic dispatch and "cross the stacks" to set the schedule?

Time for some details…

How Does It Work?

Higher-Frequency Scheduling (HFS):

Tie Optimization Option

Scheduling Objective

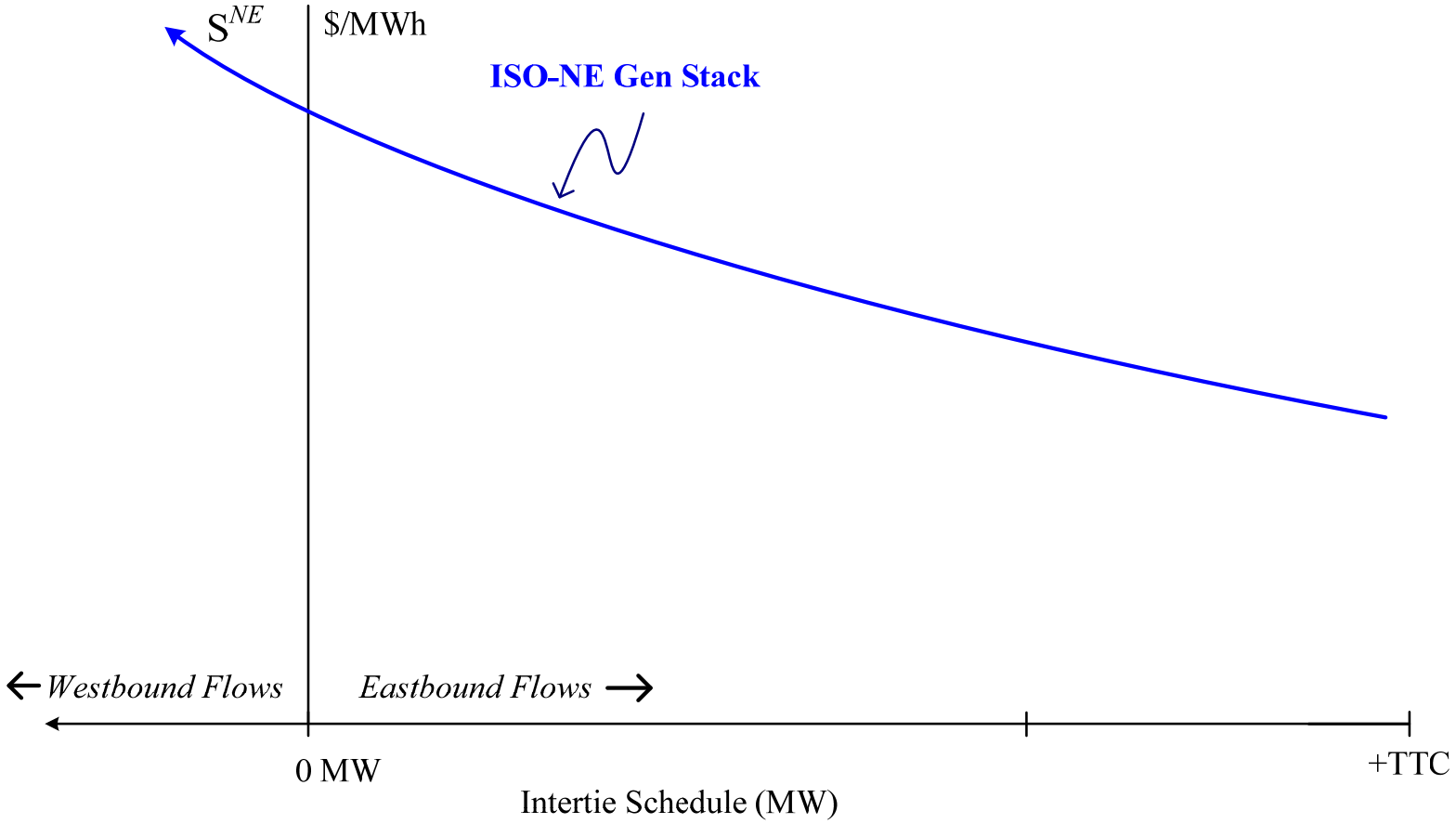
The scheduling process is designed to achieve the following objectives:

1. Account for increase/decrease in each region's (bid-based) marginal cost at the interface at varying levels of interchange
2. Optimize the real-time interface schedule to minimize production cost of both regions
3. Minimize latency delay (the time delay between when the interface is scheduled and when power flows)

How is objective achieved?

1. Account for increase/decrease in each region's (bid-based) marginal cost at the interface at varying levels of interchange.

   - Build ISO-NE resource supply stack for delivery/receipt at the NY/NE border for a range of interchange
     - ISO-NE performs a set of "pre-scheduling" unit-dispatch system evaluations to determine the (bid-based) cost of incremental and decremental energy at the interface (proxy bus).
     - This evaluation determines the complete proxy-bus supply stack over the range of available transmission capacity of the interface.
     - ISO-NE operational constraints on tie flows may limit the available dispatch range.

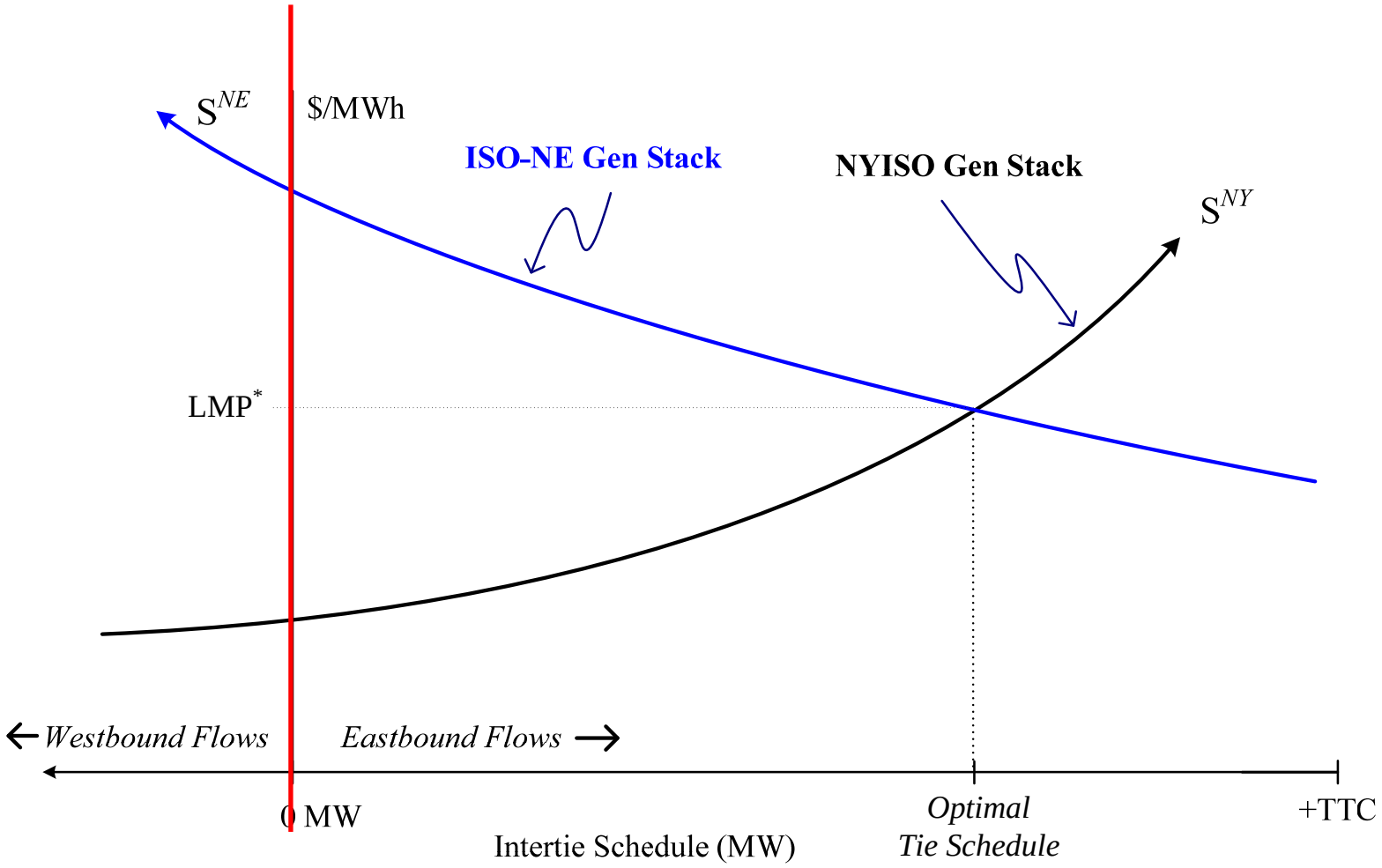


How is objective achieved?

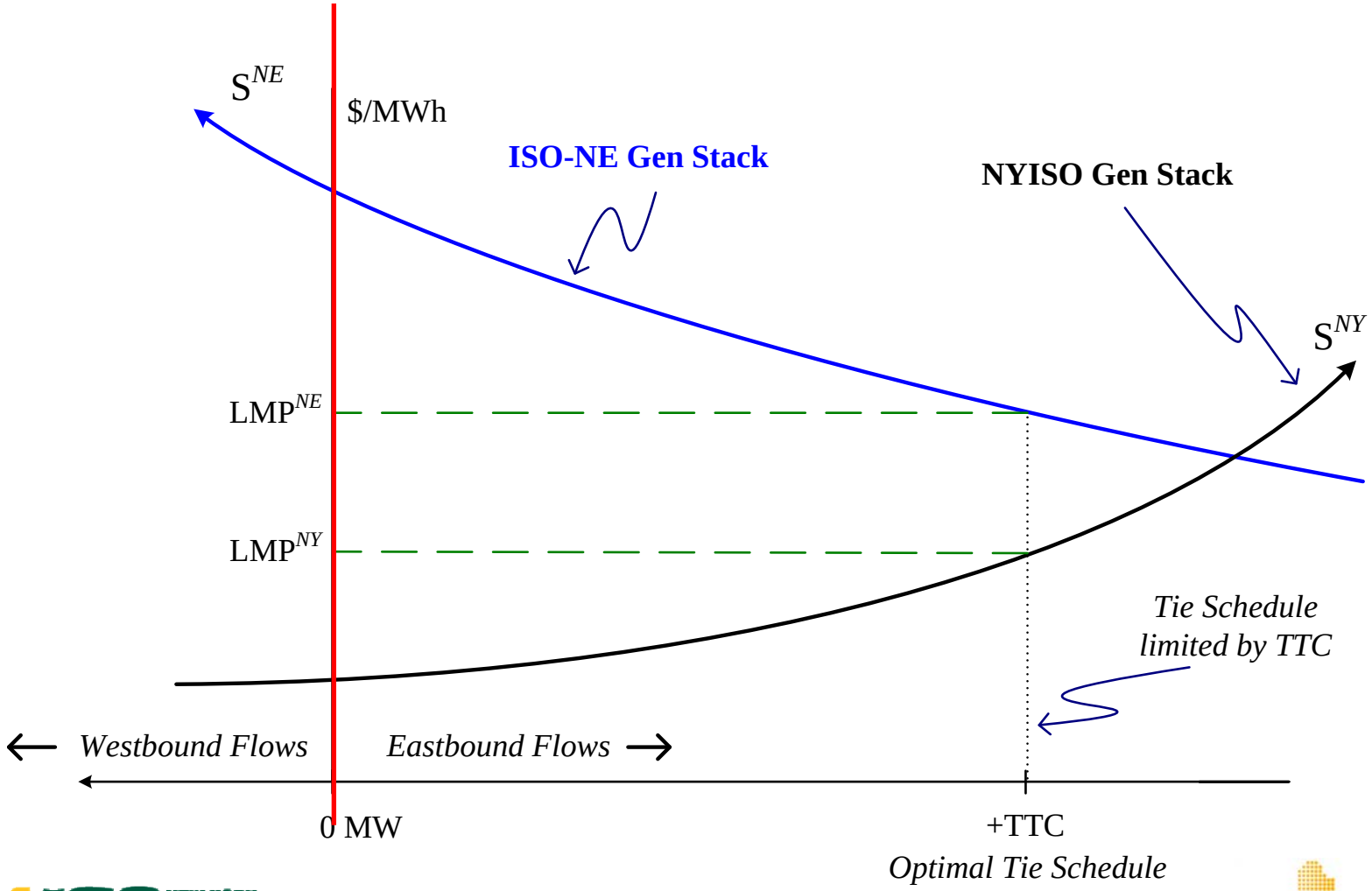
2. Optimize the real-time interface schedule to minimize production cost of both regions

   - Compare ISO-NE resource supply stack at the border with NYISO resource offers using production cost minimization algorithms to identify lowest costs resources in the combined region
     - ISO-NE passes the completed resource supply stack (proxy bus supply stack) to NYISO. Includes any constraints indicated by ISO-NE governing interface flows over the upcoming schedule intervals.
     - NYISO integrates the ISO-NE resource supply stack into its Real-Time dispatch (RTD) optimization as an incremental cost incurred (by ISO-NE) to provide additional power across the interface into NYISO, and a decremental cost avoided (by ISO-NE) with additional flow into ISO-NE.
     - The optimization determines scheduled interface flow target.
     - Incorporated into the optimized interface schedules are any NYISO constraints expected over the upcoming schedule intervals, restrictions at the border, and all constraints from ISO-NE.

Optimal Schedule w/o TTC Limits



Optimal Schedule w/ TTC Limits



How is objective achieved?

3. Minimize latency delay (the time delay between when the interface is scheduled and when power flows)

   - Continuously re-evaluate interchange scheduling decision
   - Rebalance with changing system conditions using as short a lead time as possible.

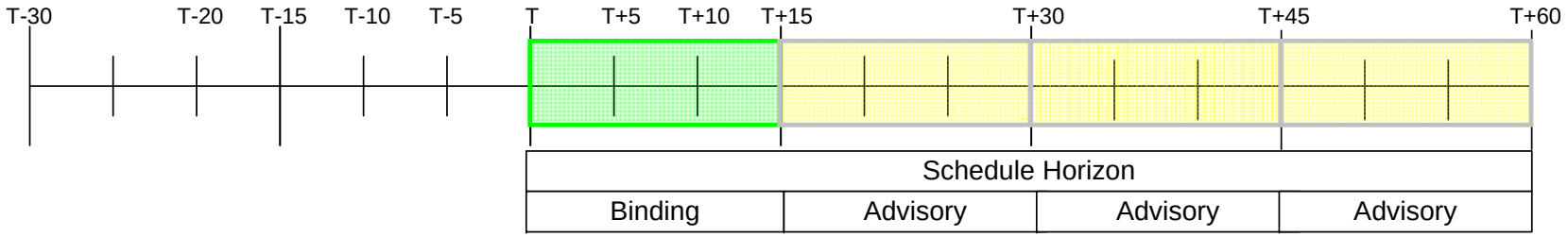
Scheduling Timeline

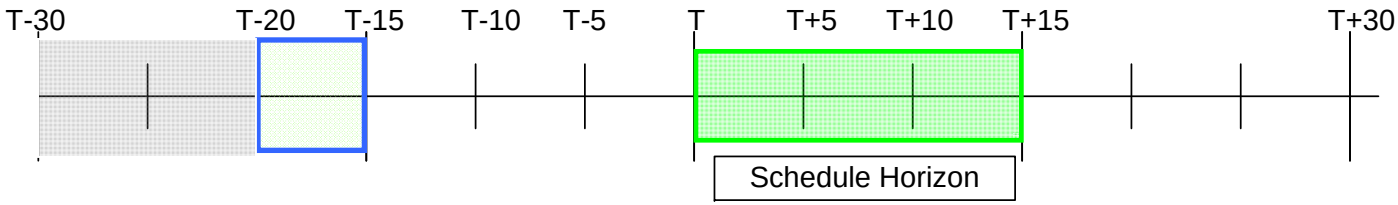
What happens when, exactly?

- The following slides walk through a potential time sequence of steps and times necessary to develop and implement an interface schedule.

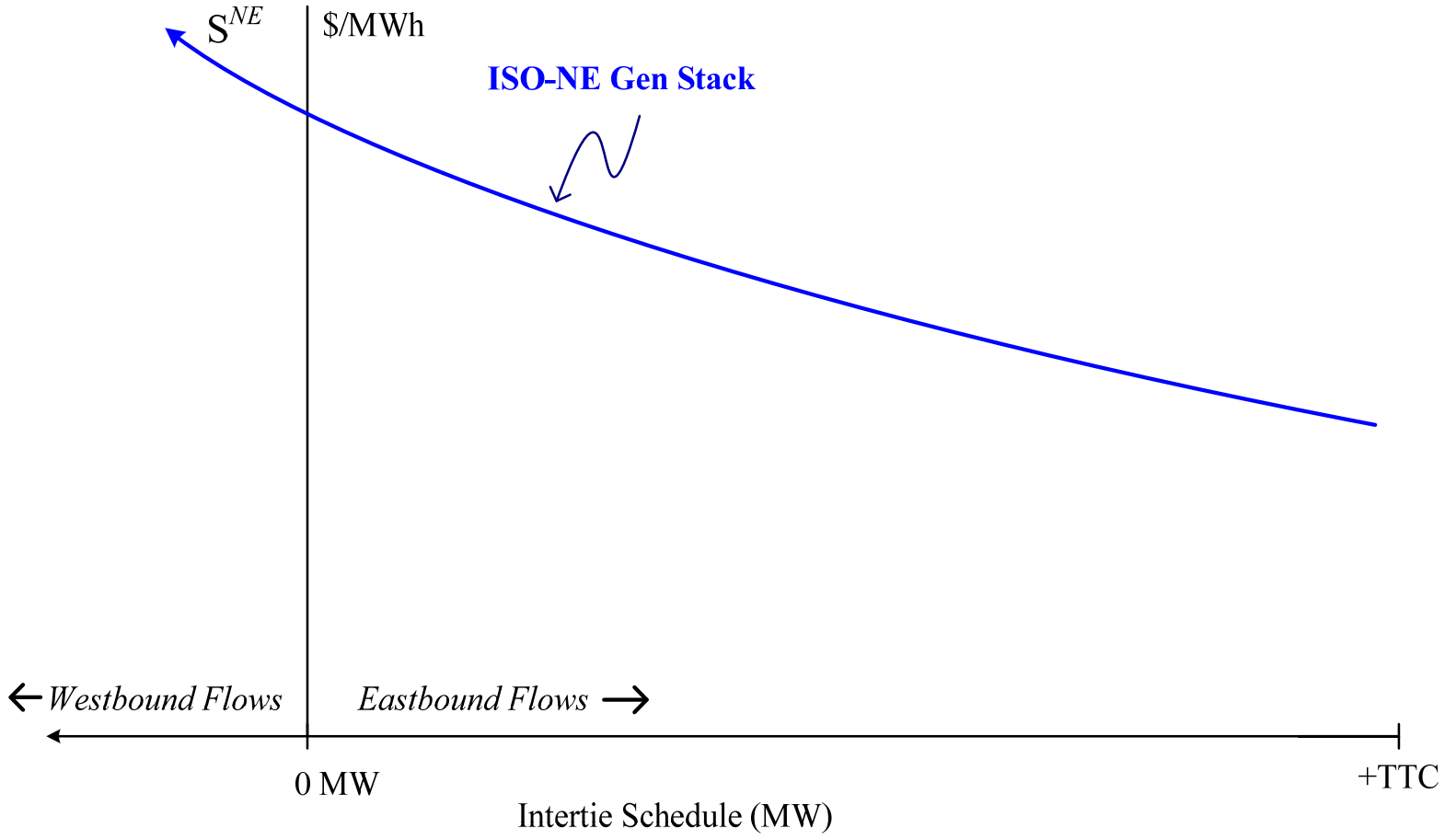
Scheduling Horizon

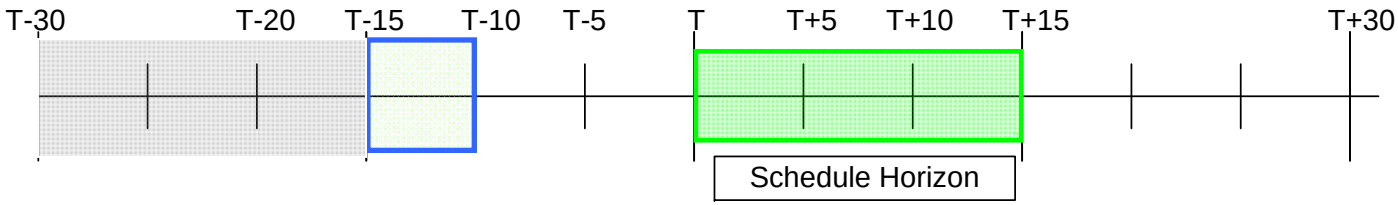
- The process of determining the net interface schedule for the upcoming scheduling horizon utilizes a look-ahead system projecting system conditions for the upcoming hour.
- The scheduling horizon is made up of one binding 15-minute interval and three advisory 15-minute intervals for the upcoming tie schedule intervals.
- The look-ahead advisory net interface schedules provides the system operators with information (expected net interface flows) that can be important for evaluating the near-term system trajectory (up to 60 minutes out).





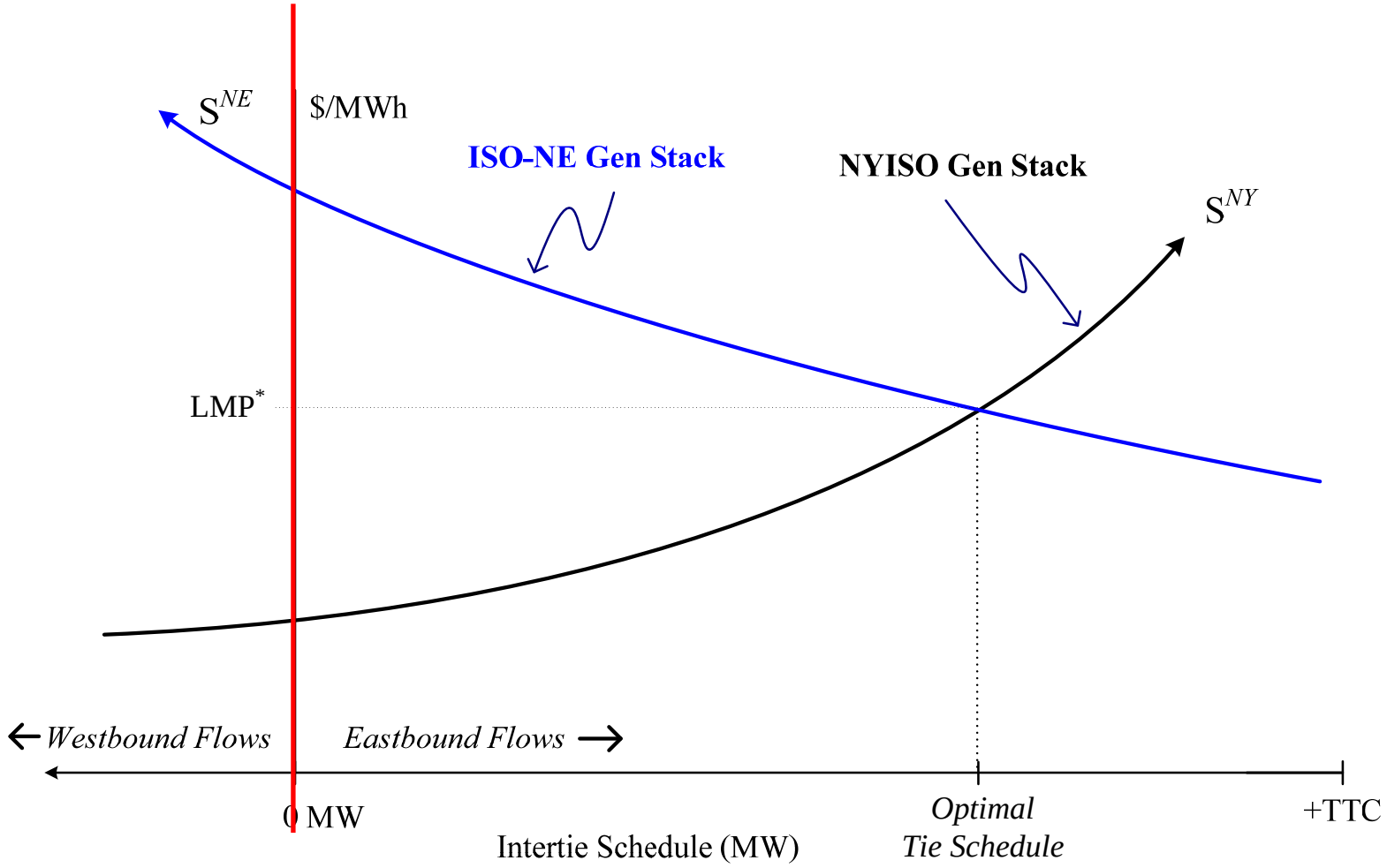
- @T-20 : Step Pre-Schedule
  - *ISO-NE performs a set of "pre-scheduling" unit-dispatch system evaluations to determine the (bid-based) cost of incremental and decremental energy at the interface proxy bus at time T.*
  - *This evaluation determines the complete resource supply stack (proxy-bus supply stack) over the range of available transmission capacity of the interface.*
  - *ISO-NE operational constraints on interface flows during these scheduling intervals may limit this range, and would be incorporated into the evaluation.*
  - *ISO-NE passes the completed resource supply stack (proxy bus supply stack) to NYISO. Accompanying this information are any constraints indicated by ISO-NE operators governing interface flows over the upcoming schedule intervals.*



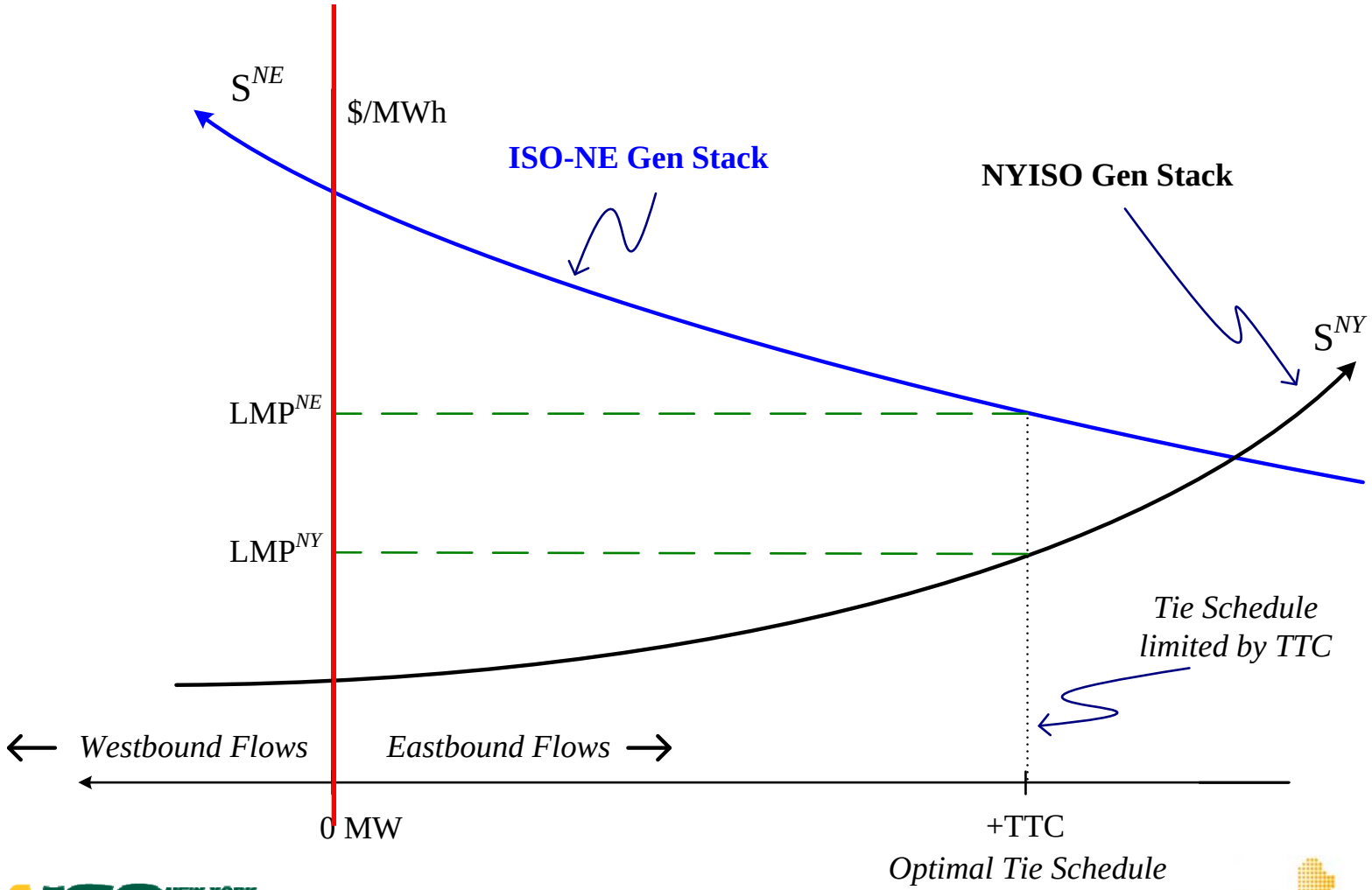


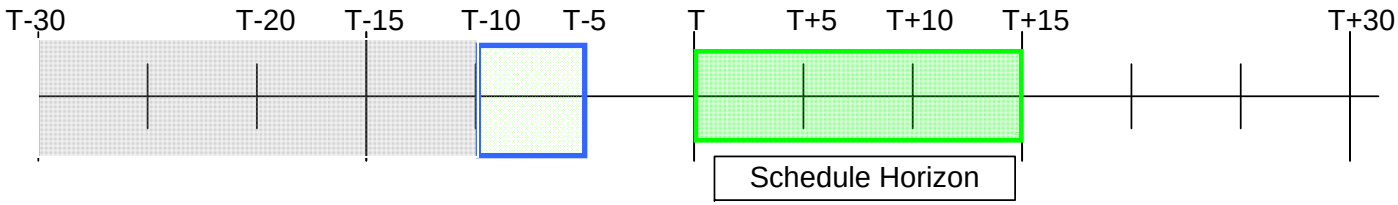
- @T-15 : Step TieOpt
  - *NYISO integrates the ISO-NE resource supply stack into its Real-Time dispatch (RTD) optimization as an incremental cost incurred (by ISO-NE) to provide additional power across the interface into NYISO, and a decremental cost avoided (by ISO-NE) by additional power flows across the interface into ISO-NE.*
  - *The RTD optimization determines desired interface flow for the 15 minute period starting at time T.*
  - *If there are no binding constraints on the interface, each target equates NYISO's expected RT LMP at the border with ISO-NE's expected LMP at the border.*
  - *After NYISO completes the RTD optimization it passes the optimized interface schedule MW to ISO-NE. Incorporated into the optimized tie schedules are any constraints indicated by NYISO governing interface flows expected over the upcoming schedule intervals, as well as all constraints received from ISO-NE.*

Optimal Schedule without TTC Limits

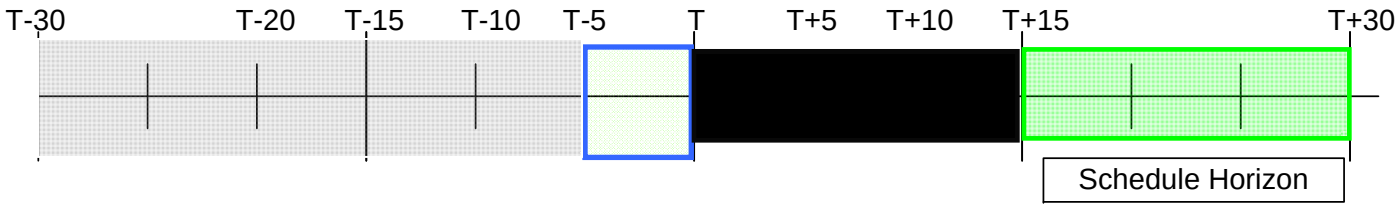


Optimal Schedule with TTC Limits





- @T-10 : Step RTD
  - *Each ISO performs its internal (real-time) dispatch, taking the optimized interface schedule MW for T as an input. The ramp profile is executed from T-5 to T+5.*



- @T-5 : Step RTD
  - *Each ISO performs its internal (real-time) dispatch, taking the optimized interface schedule MW for T as an input. The ramp profile is executed from T-5 to T+5.*
- @T-5 : Step Pre-Schedule
  - *Process initiates for next schedule horizon*

Big Picture: What Problems Are Solved?

- **Wrong-way flows:** Tie Optimization automatically sets flow schedule in economically-correct direction at the time the schedules are set (every 15 min)
- **Inflexibility of current system** to respond to changes in system conditions and source of lowest cost power.
- **Inefficient under-utilization of transmission** due to too little power being scheduled in correct direction in RT.
- **Non-transparency** of interface congestion costs.

CTS Solution Option:

Concept and RT Scheduling System

Solution Option B: Coord. Trans. Scheduling

Core concept: ISOs set interface schedule using offers to buy and sell across the interface in real-time energy market

Two major innovations:

1. A new RT bid format, called an **interface bid**
2. **Coordinated clearing** (scheduling) of RT interface bids

- **Total cleared interface bids** determine the RT interface schedule
- **Both CTS and Tie Opt'n** update the schedule every 15 min.

Interface Bids

An interface bid (IB): An offer to simultaneously buy and sell at each side of the interface.

- A price, quantity (MW), and a direction (where to import/export)
- **Ex:** An interface bid of $3/MWh for 20MW eastbound is:
  - an offer to **buy** at NY-side and **sell** at NE-side of interface
  - if the expected interface LMP difference (always sink – source) is $3/MWh or greater when the offer is cleared.
- Bidders receive RT LMP difference at NY/NE interface.

IB Submission & Features

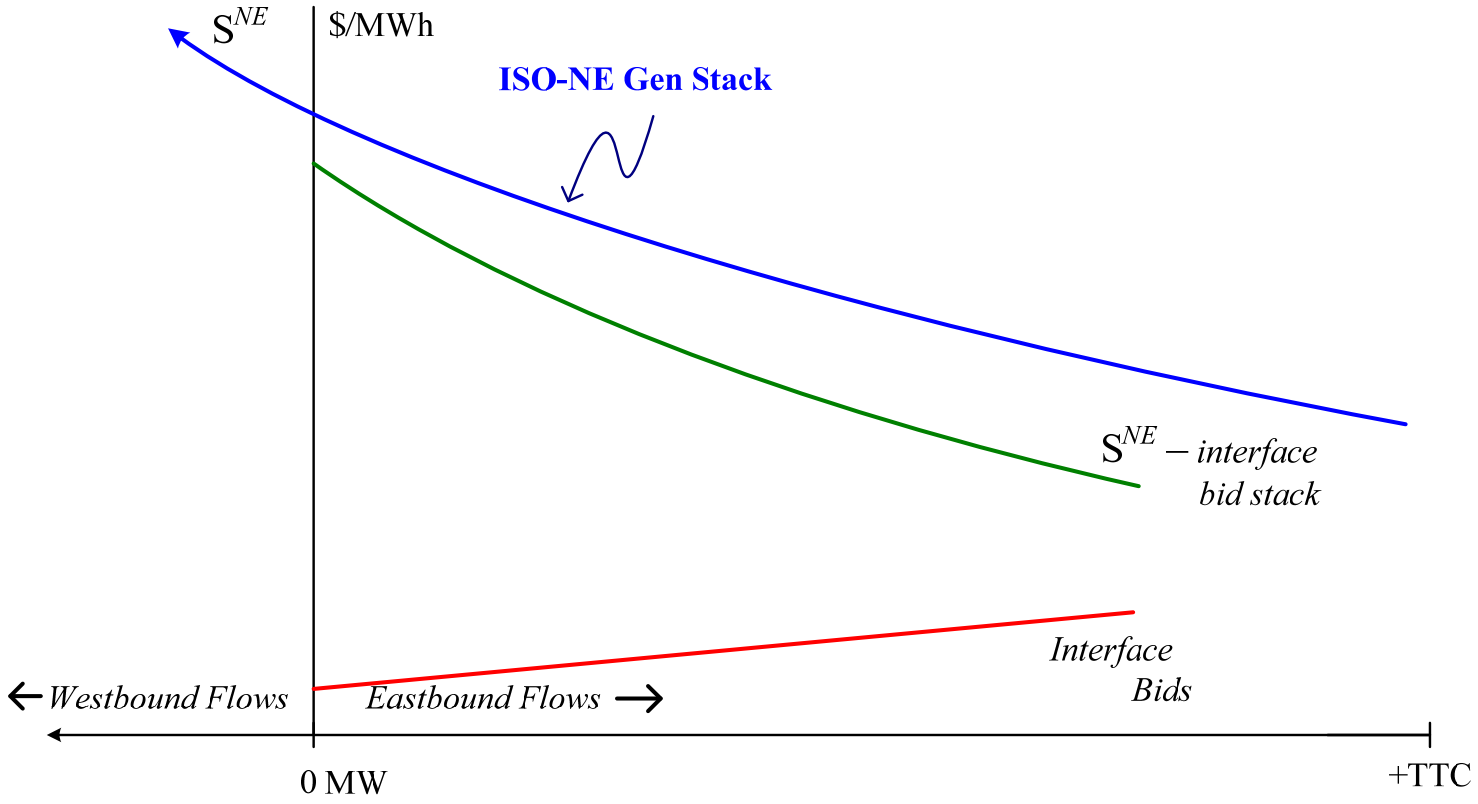
- **Submission to common portal** for both NYISO & ISO-NE
  - *Eliminates today's 'check-out' failures with RT ext. transactions.*
- Can submit **multiple bids** (price-quantity-direction triples)
- Can submit for any **'strip' of 15-minute** intervals
  - *Bids clear every 15 min against expected RT LMP difference at interface for the upcoming 15-min interval*
- Can submit new IBs **up to 75 min before an interval** starts

CTS Design Option

Interface Bid Clearing with Higher-Frequency Scheduling (HFS)

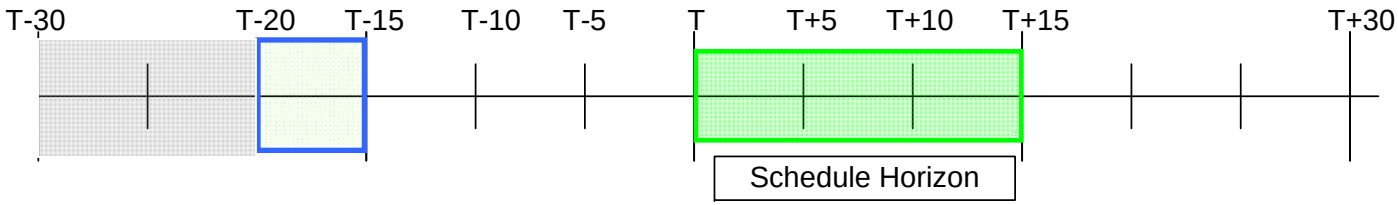
Distinctions between CTS & Tie Opt.

- The only functional difference in the implementation of HFS for CTS is the additional step to incorporate the interface bids
- After development of the ISO-NE resource supply stack in Step Pre-Schedule:
    - Order interface bids in the NY to NE direction by lowest to highest bid.
    - Subtract the interface bids (red curve) from the ISO-NE supply curve (blue curve) for the corresponding direction and magnitude to produce an interface bid stack (green curve).
    - The resulting curve reflects both the marginal cost of resources as well as the requested interface bid.
    - Similar modifications are made for the NE to NY direction, to add the desired interface bids to the ISO-NE resource supply stack.
    - The resulting supply curve dispatch range may be reduced if an insufficient range of interface bids are available.

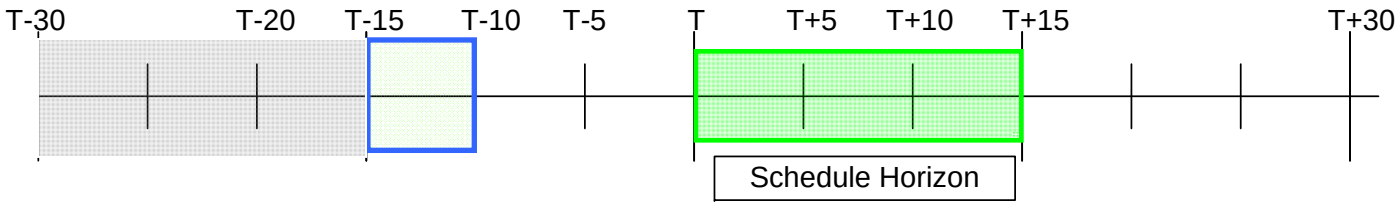

S^{NE}
$/MWh
ISO-NE Gen Stack
S^{NE} – interface bid stack
Interface Bids
← Westbound Flows
Eastbound Flows →
0 MW
+TTC

Distinctions between CTS & TO

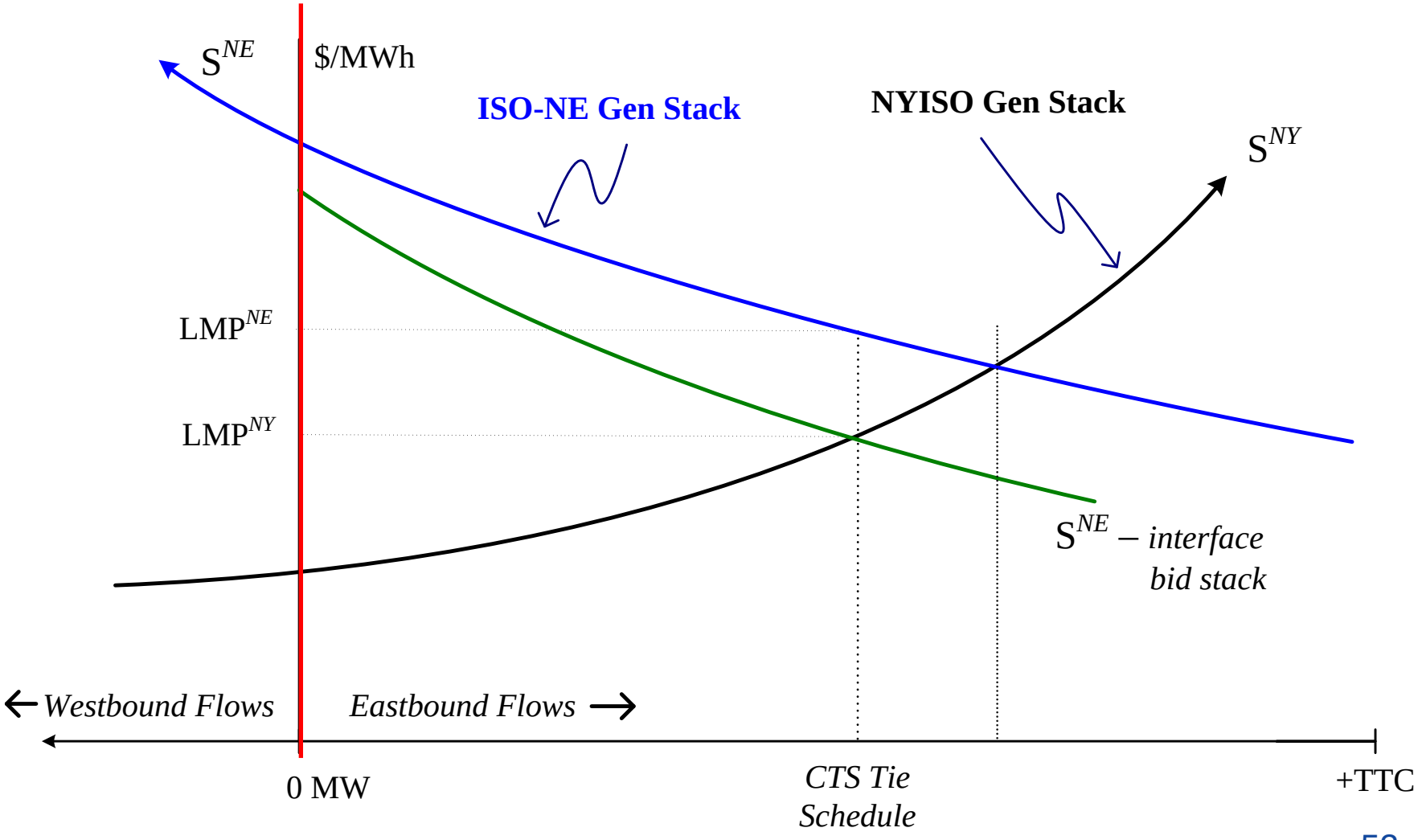
- The optimization **steps** to determine the desired interchange schedule are **functionally identical** between CTS and TO.
- The resulting interchange schedule will be different under CTS than under TO **if** the interface is not limited by TTC constraints.



- @T-20 : Step Pre-Schedule
  - *ISO-NE determines resource supply stack and incorporates available interface bids.*
  - *This evaluation determines the complete resource supply stack and range given available transmission capacity of the interface and any bids and offers. ISO-NE operational constraints on interface flows and availability of bids/offers may limit the available scheduling range.*
  - *ISO-NE passes the completed interface bid stack to NYISO. Accompanying this information are any constraints indicated by ISO-NE governing interface flows over the upcoming schedule intervals.*



- @T-15 : Step TieOpt
  - *NYISO integrates the resulting interface bid stack into its Real-Time dispatch (RTD) optimization as an incremental and decremental cost.*
  - *The RTD optimization determines desired interface flow for the 15 minute period starting at time T.*
  - *After NYISO completes the RTD optimization it passes the interface schedule MW to ISO-NE. Incorporated into the schedules are any constraints indicated by NYISO operators governing interface flows expected over the upcoming schedule intervals, as well as all constraints received from ISO-NE.*



Big Picture: What Problems Does CTS Fix?

- **Wrong-way flows:** CTS automatically sets flow schedule in economically-correct direction at the time HFS updates the schedule (every 15 min)
- **Inflexibility of current system** to respond to changes in system conditions and source of lowest cost power.
- **Less under-utilization of transmission,** due to too little power being scheduled in correct direction in RT.
- **Non-transparency** of interface congestion costs.

Final Points:

Upcoming Joint Schedule and Logistics

Stakeholder Review & Discussion

Next joint stakeholder meetings:

- Understand options in detail, gather feedback, refine into preferred design basis document (DBD) by April-May.
- ISOs need *common DBD* on IRIS due to coordination issue
- **Next Meeting Schedule:**
  - Feb 14 (ISO-NE hosting)
  - March 7 (ISO-NE hosting)
  - March 28 (NYISO hosting)
  - April 28 (NYISO hosting)

Presentation Plan for Element Details

Feb 14: DA & RT market linkages; DA external transactions; interface settlements in detail

March 7: FTRs, NCPC & fee recommendations, conforming capacity rule changes

March 28: Q&A, follow-up's on additional detail as requested, discussion of draft DBD structure

Next Steps: 2011+ Schedule

- **Jan-Apr:** Joint stakeholder meetings
- **Apr-May:** Advisory votes on design options (DBD) *from both NEPOOL and NYISO stakeholders*
- **June-Oct:** Stakeholder tariff & market rule processes (separate but parallel timing)
- **Dec 2011:** Target FERC filings (ISO-NE & NYISO)
- **Spring 2013 (est):** Implementation complete

Questions?

Contact:

Robert Pike

Director, Market Design, NYISO

rpike@nyiso.com

(518) 356-6156

Contact:

Matthew White

Senior Economist, ISO-NE

mwhite@iso-ne.com

(413) 535-4072