NYISO Hybrid Gas Turbine Pricing

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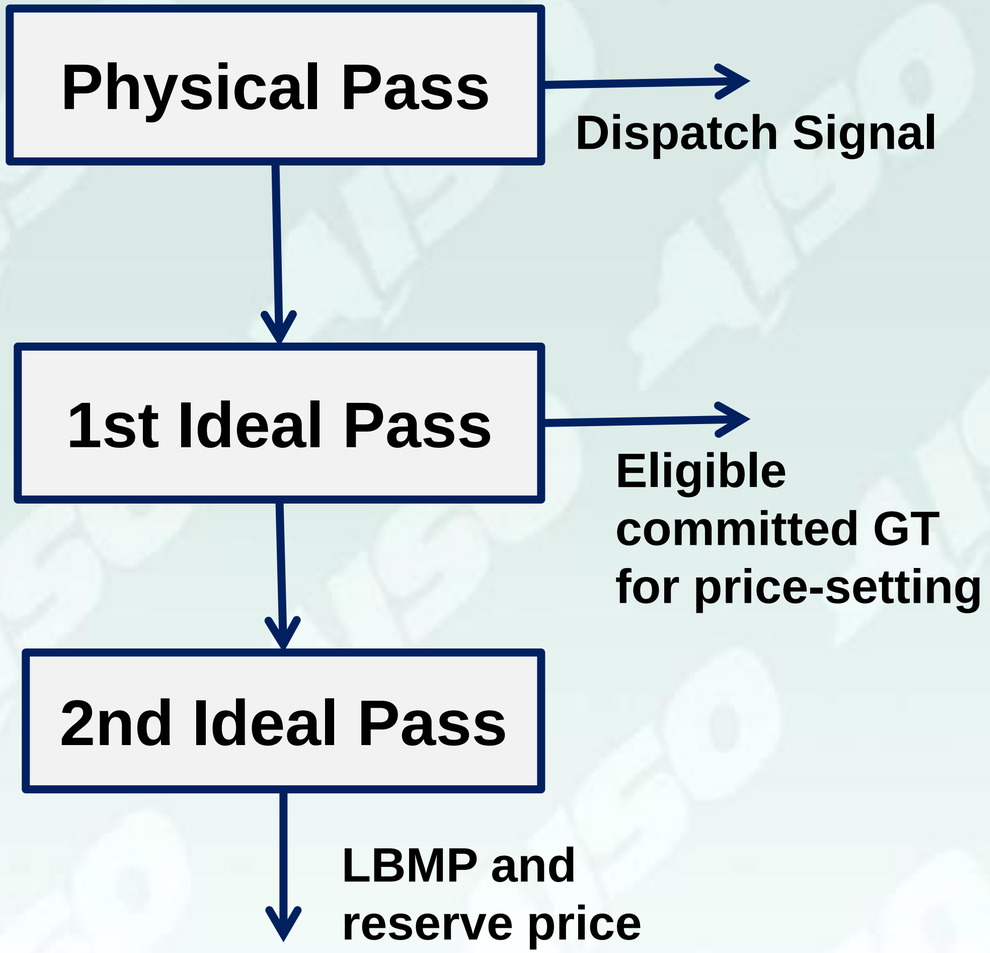
Overview

- Real-Time Market Overview
- Implementation of RTD Passes
- Illustration of Hybrid Gas Turbine (GT) Logic
- Examples
- Summary

NYISO Real-Time Market

- Real-Time Commitment (RTC) is a multi-period Security Constrained Unit Commitment and Economic Dispatch model that determines the commitment status of fast start resources
- Real Time Dispatch (RTD) is a multi-period Security Constrained dispatch model that determine the dispatch of units and Locational Based Marginal Price (LBMP)
- RTD is executed over multiple passes and the unit dispatch and LBMP are determined from different passes

Implementation Flow of RTD Passes



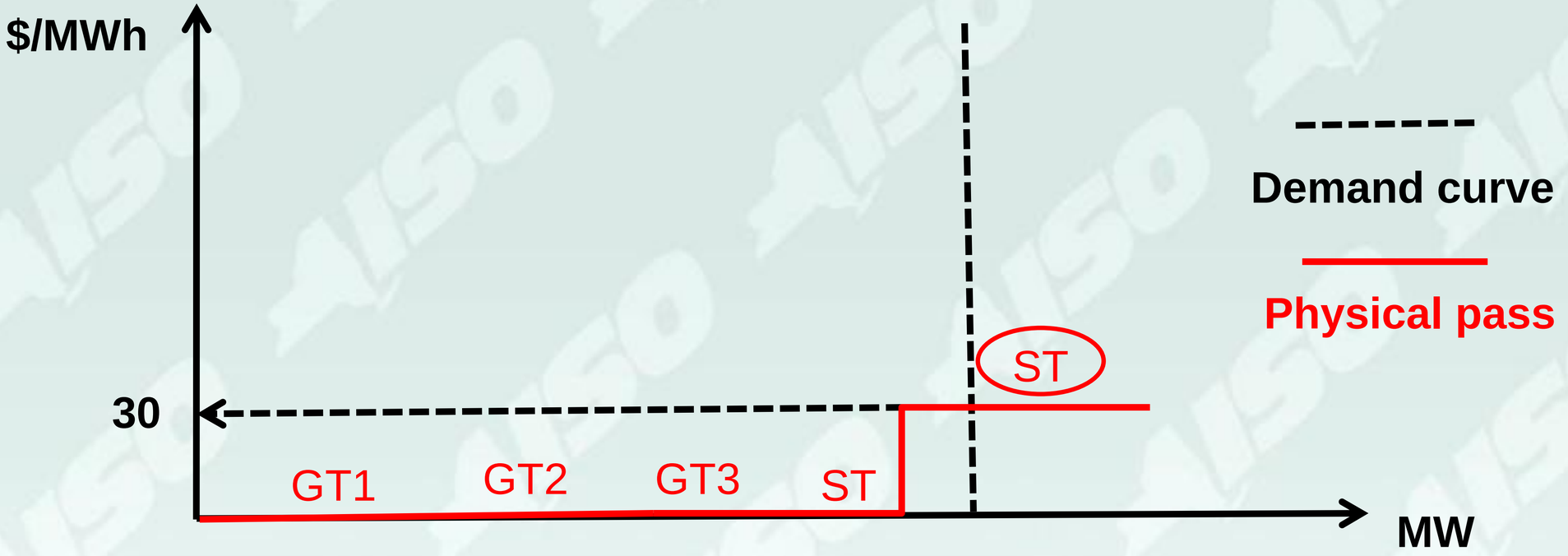
1. “Physical Pass” determines the physical dispatch that respects the unit physical characteristics and sends the dispatch signal to resources
2. “First Ideal Pass” evaluates the eligibility of committed block loaded GTs to set price in the second ideal pass
3. “Second Ideal Pass” relaxes the lower operating limit of eligible block loaded GTs, and determines the clearing price for energy and reserves

Hybrid GT Logic: Example

- **Assume the load is 420 MW**
- **Steam unit is dispatchable between 30 MW to 300 MW**
- **GT1-GT3 are all committed block GTs that are within Minimum Run time**

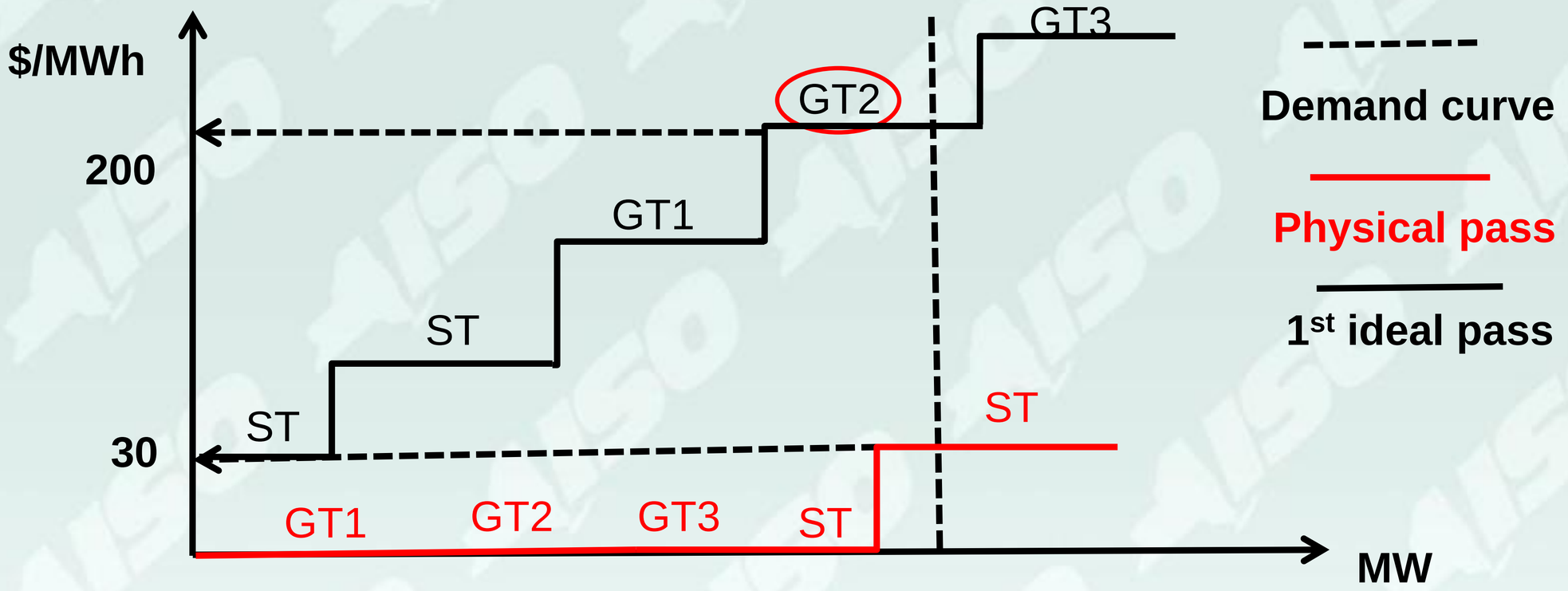
Unit	Offer Price ($/MWh)	Pmin (MW)	Pmax (MW)
Steam	30	30	300
GT1	150	100	
GT2	200	100	
GT3	250	50	

Hybrid GT Logic: Physical Pass



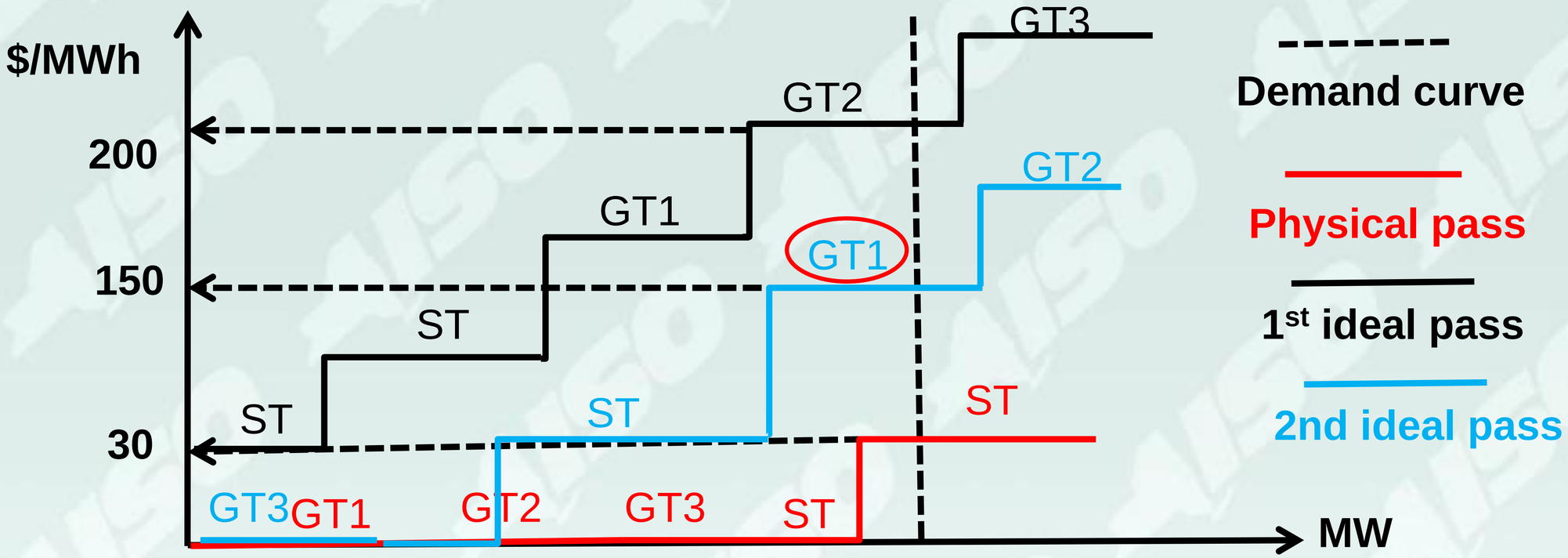
- In physical dispatch, GT1-GT3 are all fixed at their block capacity, steam unit makes up the remaining load
- If the LBMP is determined from physical pass, the ST sets the price at $30/MWh

Hybrid GT Logic: First Ideal Pass



- The GT3 is dispatched to 0 MW in the first ideal dispatch, which indicates it is uneconomic and not eligible to set price in the second ideal pass
- If the LBMP is determined from the first ideal pass, then GT2 sets price at $200/MWh

Hybrid GT Logic: Second Ideal Pass



- The "uneconomic" GT3 is fixed at its block capacity and not eligible to set price. The LBMP is set by GT1 at $150/MWh
- Economic unit GT2 is displaced as the price-setting resource by uneconomic unit GT3
- Hybrid GT logic is a compromise between treating all the block GTs as dispatchable (1st ideal pass) and treating all the block GTs as non-dispatchable (physical pass)

Impact on Supplemental Payments

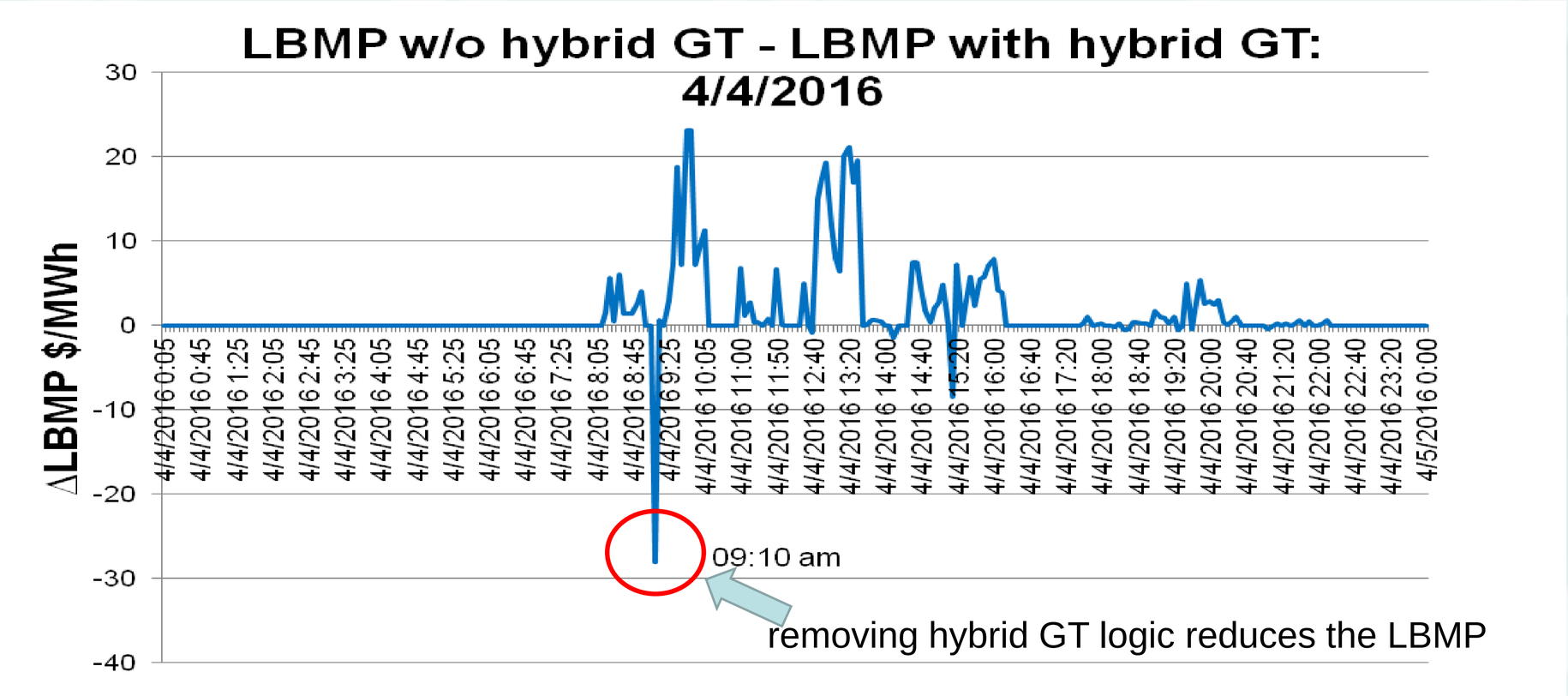
- **Hybrid GT logic may impact the uplift payments and Lost Opportunity Costs (LOC)**
  - ***LOC = maximum possible as-bid profit – actual cleared profit***
  - ***Uplift = max(0, total as-bid cost – total revenue)***
  - ***Uplift is a special type of LOC***

Unit	Offer Price ($/MWh)	Physical Dispatch (MW)	With hybrid GT logic (current implementation): LBMP=$150		Without hybrid GT logic: LBMP=$200	
			Uplift ($)	LOC ($)	Uplift ($)	LOC ($)
Steam	30	170	0	15,600	0	22,100
GT1	150	100	0	0	0	0
GT2	200	100	5,000	0	0	0
GT3	250	50	5,000	0	2,500	0

Impacts of Hybrid GT logic

- **In general, removing the hybrid GT logic results in an increase in LBMP**
  - ***This can result in lower uplift costs but can increase the Lost Opportunity Cost***
- **In some instances, removing hybrid GT logic results in a decrease in LBMP**
  - ***This can result in higher uplift costs but can decrease the Lost Opportunity Cost***

NYISO Production Case



- **In most off-peak hours, the fast start GT is not committed, removing hybrid GT logic has no price impact**
- **In most peak-hour instances, removing hybrid GT logic increases the LBMP**
- **In some instances, removing hybrid GT logic reduces the LBMP**

Hybrid GT Logic - Impacts on LBMP

- **The following example shows how the LBMP can decrease when the hybrid GT logic is removed**
  - ***To illustrate how Hybrid GT logic can result in a decrease in LBMP, a Sensitivity Analysis is used in the following example***
  - ***The Sensitivity Analysis is used to identify the marginal unit(s) that respond to a one MW increase in load***

Impact on LBMP With Hybrid GT Logic

	Interval 1 (binding interval)	Interval 2 (advisory interval)	Interval 3 (advisory interval)	Interval 4 (advisory interval)	Interval 5 (advisory interval)
Unit	Offline GT 1	Offline GT 1	Offline GT 1	Offline GT 1	Offline GT 1
Re-dispatch (MW)	1.00	1.00	1.00	1.00	1.00
Per Unit Cost ($/MWh)	68.97	68.97	68.97	68.97	69.29
Unit		Unit 1	Unit 2	Unit 3	Unit 4
Re-dispatch (MW)		-1.15	-1.00	-1.00	-1.05
Per Unit Cost ($/MWh)		23.89	28.55	28.55	29.10
LBMP ($/MWh)	230.04				

- RTD optimizes over five consecutive intervals including one binding interval and four advisory intervals. The redispatch cost in both binding and advisory intervals is reflected in the binding interval's LBMP
- GT1 is an eligible fast-start offline GT. It is considered dispatchable in the ideal pass and it is the marginal unit in the binding interval of this example
- An offline GT is assigned a zero ramp-down constraint in order to ensure its minimum run time constraint is respected. If the GT is dispatched up in binding interval it cannot be dispatched below that level in the advisory intervals
- To keep the power balance, the relatively cheap marginal units (unit 1-4) in advisory intervals need to be dispatched down by one MW
- The total redispatch cost is $230.04 which is also the LBMP in the binding interval

Impact on LBMP Without Hybrid GT Logic

	Interval 1 (binding interval)	Interval 2 (advisory interval)	Interval 3 (advisory interval)	Interval 4 (advisory interval)	Interval 5 (advisory interval)
Unit	Offline GT 1	Offline GT 1	Offline GT 1	Offline GT 1	Offline GT 1
Re-dispatch (MW)	1.00	1.00	1.00	1.00	1.00
Per Unit Cost ($/MWh)	68.97	68.97	68.97	68.97	69.29
Unit		Unit 5	Unit 6	Unit 7	Unit 8
Re-dispatch (MW)		-1.08	-1	-1	-0.99
Per Unit Cost ($/MWh)		46.43	29.52	29.52	36
LBMP ($/MWh)	200.61				

- If the hybrid GT logic is removed, the more expensive units (unit 5-8) become marginal units in the advisory intervals (interval 2-5)
- Backing down the more expensive marginal units (unit 5-8) cause the LBMP to drop from $230.04 to $200.61/MWh, which is lower than the LBMP determined using the hybrid GT logic
- When an offline GT (GT1 in this example) is the marginal unit in the binding interval, removing the hybrid GT logic may cause the LBMP to drop

Summary

- **Hybrid GT logic**
  - ***Provides a compromise between recognizing the physical characteristic of a block-loaded GT and allowing block-loaded GTs to be eligible to set price***
  - ***Impacts the LBMP and the supplemental payments***

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

- ***Maintaining and enhancing regional reliability***
- ***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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