Single Schedule Market Pricing Issues

Presented by
Scott Harvey and Susan Pope

Phase 1 - Session 3
Module G: Market Power Mitigation

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TOPICS

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G. Market Power Mitigation

Market Power Mitigation

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1. What is Local Market Power and Market Power Mitigation?

Local Market Power Mitigation — Overview

The exercise of local market power typically entails economically or physically withholding some supply from the market in order in raise the price at which the remaining supply is sold.

- **Economic withholding**: to offer a portion of or all available capacity at a high price so that it is not scheduled;
- **Physical withholding**: to not offer a portion of or all available capacity into the market.

In single schedule electricity markets with uplift payments and multi-settlement systems, there is also the potential for the exercise of market power to depress the prices at which deviations from day-ahead market schedules are settled or to inflate uplift payments.

Local Market Power Mitigation — Overview

Avoiding the exercise of significant market power is an important goal both from the standpoint of maintaining efficient electricity markets and from the standpoint of avoiding undue wealth transfers.

- The exercise of significant market power reduces economic efficiency because prices impacted by market power do not reflect marginal costs, resulting in inefficient outcomes in both the short and long-run.
- Undue wealth transfers from the exercise of market power would be inconsistent with the premise for introducing competition into electricity markets.

Local Market Power Mitigation — Overview

Market power mitigation is intended to ensure that electricity markets are not impacted by the exercise of significant market power by addressing the potential for the exercise of local market power through:

- Submission of high offer prices and/or restrictive operating parameters intended to raise the price of energy or reserves;
- Submission of low offer prices and/or operating parameters intended to depress the price of energy;
- Submission of high start-up or minimum load costs and/or restrictive operating parameters intended to inflate uplift payments.

Physical withholding is generally addressed through after the fact penalties for physical withholding.

Local Market Power Mitigation — Overview

Market power mitigation in the context of electricity markets, refers to a process that attempts to approximate competitive market outcomes when some market participants possess local market power.

- Market power mitigation is typically applied by replacing market participant offers that are identified as materially departing from estimated short-run marginal costs (including opportunity costs) with an estimate of a cost based offer (referred to as a reference price).
- Market power mitigation designs can differ in implementation complexity, effectiveness, market impact, and transparency.

Local Market Power Mitigation — Overview

All North American ISOs (other than Alberta) apply some form of local market power mitigation in which offer prices, and sometimes non-price bid parameters, can be replaced with estimated competitive values.

- Offer price floors and ceiling are also sometimes used to limit the exercise of local market power.

2. Review of Current IESO Mitigation Design

IESO Market Power Mitigation — Current

The exercise of local market power is currently addressed in the IESO energy markets through various controls:

- The clawback of CMSC payments through an after-the-fact review under the IESO's local market power mitigation provisions;
- Eligibility requirements that limit CMSC payments;
- Limits on constrained-off CMSC payments for intertie transactions;
- Replacement offer price floors used to calculate CMSC payments for suppliers, constrained on dispatchable loads, and constrained on exports.
- Offer cap of $2,000.

IESO Market Power Mitigation — Current

A core design feature of the current IESO market power mitigation design is that it uses what is called a “pivotal supplier test” to identify resource owners potentially able to exercise local market power.

- Suppliers identified by the pivotal supplier test as possessing local market power are subject to having their offer prices replaced with estimated cost based offers and having their CMSC payments recalculated using these estimated cost based offers.

IESO Market Power Mitigation — Current

In the current Ontario market the exercise of local market power has a very limited impact on the uniform price used to settle the energy market because the uniform price is not very strongly related to the cost of meeting load.

- Most transmission and resource constraints are not taken into account in calculating prices
- Actual generation ramp capability is not used in calculating prices;
- Minimum load blocks are treated as dispatchable.

IESO Market Power Mitigation — Current

An important characteristic of the current local market power mitigation process is that because it only impacts CMSC payments for the resource concerned, and does not affect settlement prices for the market as a whole, it can be applied after-the-fact.

- This is not the case in single schedule markets in which the exercise of local market power can materially impact clearing prices for all buyers and sellers within a constrained region.
- After-the-fact mitigation of offer prices in single schedule markets would entail resettling the entire market, which would be costly and disruptive.

3. Impact of SSM Designs on Mitigation

SSM Market Power Mitigation — Timing

In light of the unworkability of after-the-fact mitigation of local market power in single schedule markets, ISOs coordinating markets based on single schedule pricing generally apply local market power mitigation on an ex-ante (before the event) basis.

- Offers are tested for market power and mitigation applied before day-ahead or real-time nodal prices are calculated.
- The main exception is mitigation applied to the calculation of uplift payments which can be applied after the fact because it does not impact clearing prices.

SSM Market Power Mitigation Design

There are two core approaches for applying ex ante mitigation in single schedule markets:

- **Pivotal supplier** tests evaluate the potential for the exercise of local market power based on whether particular firms or groups of firms are pivotal in the sense that at least some of their output is needed to manage transmission congestion, i.e. avoid overloads, on a particular transmission constraint;
- **Conduct and impact** tests evaluate whether offer prices likely reflect the exercise of local market power based on whether the offer price level of particular resources would materially impact either energy or reserve clearing prices or uplift payments.

SSM Market Power Mitigation Design

Ontario currently utilizes a single pivotal supplier test to apply market power mitigation to some CMSC payments. Among other North American ISOs:

- ERCOT uses a **single pivotal supplier test** as one element of a multi-step process in which the application of local market power mitigation is evaluated;
- The California ISO and PJM use a **three pivotal supplier test** to apply local market power mitigation;
- The New York ISO, MISO, ISO New England and SPP use a **conduct and impact test** to apply local market power mitigation.

The application of the conduct and impact test by ISO New England and SPP has steps that involve the application of a pivotal supplier test.

SSM Market Power Mitigation Design

In addition, all North American ISOs coordinating single schedule markets (except Alberta) designate some locations or types of dispatch instructions as inherently non-competitive and automatically subject to mitigation.

- Resources dispatched or committed outside the normal market process to maintain system or local reliability;
- Non-competitive proxy buses (New York ISO).

Mitigation is generally applied after the fact in the ISO settlement system in these situations because the out-of-merit dispatch does not impact the market clearing prices.

SSM Market Power Mitigation Design

The IESO currently utilizes a single pivotal supplier test to evaluate the potential for the exercise of local market power and to trigger mitigation.

- The IESO could continue to base local market power mitigation on a single pivotal supplier test under a single schedule market design.
- The IESO would, however, need to make some fundamental changes in the process used to apply the single pivotal supplier test in order to apply mitigation before the dispatch and before prices are calculated.
- The IESO could choose to make other changes in the local market power mitigation design to account for potential changes in market participant incentives under a single schedule pricing system.

4. Overview of Alternative Mitigation Designs

SSM Market Power Mitigation Design

Market power mitigation designs based on either a pivotal supplier test or a conduct and impact test involve several processes:

- A process for determining whether mitigation will be applied;
- A process for determining the cost based offer prices (reference prices) and/or operating parameters that will be used in applying mitigation;
- A process for applying mitigation through the substitution of offer prices and/or operating parameters and the calculation of market clearing schedules and settlement prices.

SSM Market Power Mitigation — Design

We described above at a very high level how a pivotal supplier test and a conduct and impact test determine whether mitigation will be applied.

- In this section we describe in more detail how the two approaches test for the application of market power mitigation.
- The sections that follow discuss the timeframe and software for applying the tests, then discuss the determination of reference prices.

Pivotal Supplier Test — The Concept

The core concept in using a pivotal supplier test to trigger market power mitigation:

- **Single pivotal supplier test**: Can load in the constrained region be met without violating the transmission constraint being tested and without dispatching up any of the resources controlled by the supplier being tested?
- **Multiple pivotal supplier test**: Can load in the constrained region be met without violating the transmission constraint being tested and without dispatching up any of the resources controlled by the suppliers being tested?

Pivotal Supplier Test — The Concept

Two key features of the pivotal supplier test as it is applied by ISOs within the current software designs are:

- It is applied separately to each transmission constraint;
- It is applied separately to each supplier or combination of suppliers.

These features can require carrying out the pivotal supplier calculation many times for a single dispatch interval to cover all binding transmission constraints and to identify all potentially pivotal suppliers.

Pivotal Supplier Test — The Concept

It is important to understand that the conceptual description of what a pivotal supplier test is intended to test does not describe the actual calculations used to carry out the test.

- In particular, pivotal supplier tests are not applied by actually dispatching the available resources of suppliers other than those being tested for pivotality.
- This would require a dispatch solution for each tested supplier, for each binding constraint, which would require far too much solution time to be actually carried out.
- The California ISO, PJM and ERCOT all use simplified approximations to carry out the pivotal supplier test in an ex ante time frame.

Pivotal Supplier Test — The Concept

If a supplier or group of suppliers fails the pivotal supplier test, the offer prices of the failing resources are subject to replacement with a reference offer price that would be used in the unit commitment and dispatch and for calculating prices. ISOs use a variety of rules for replacing offer prices of resources that fail a pivotal supplier test:

- One approach is to cap resource offer prices at the estimated reference price or at a specified margin over the estimated reference price;
- Another approach is to cap resource offer prices at the higher of the estimated reference price or the clearing price at the resource's location if the constraint being tested did not bind, i.e. at a hypothetical unconstrained price at that location.

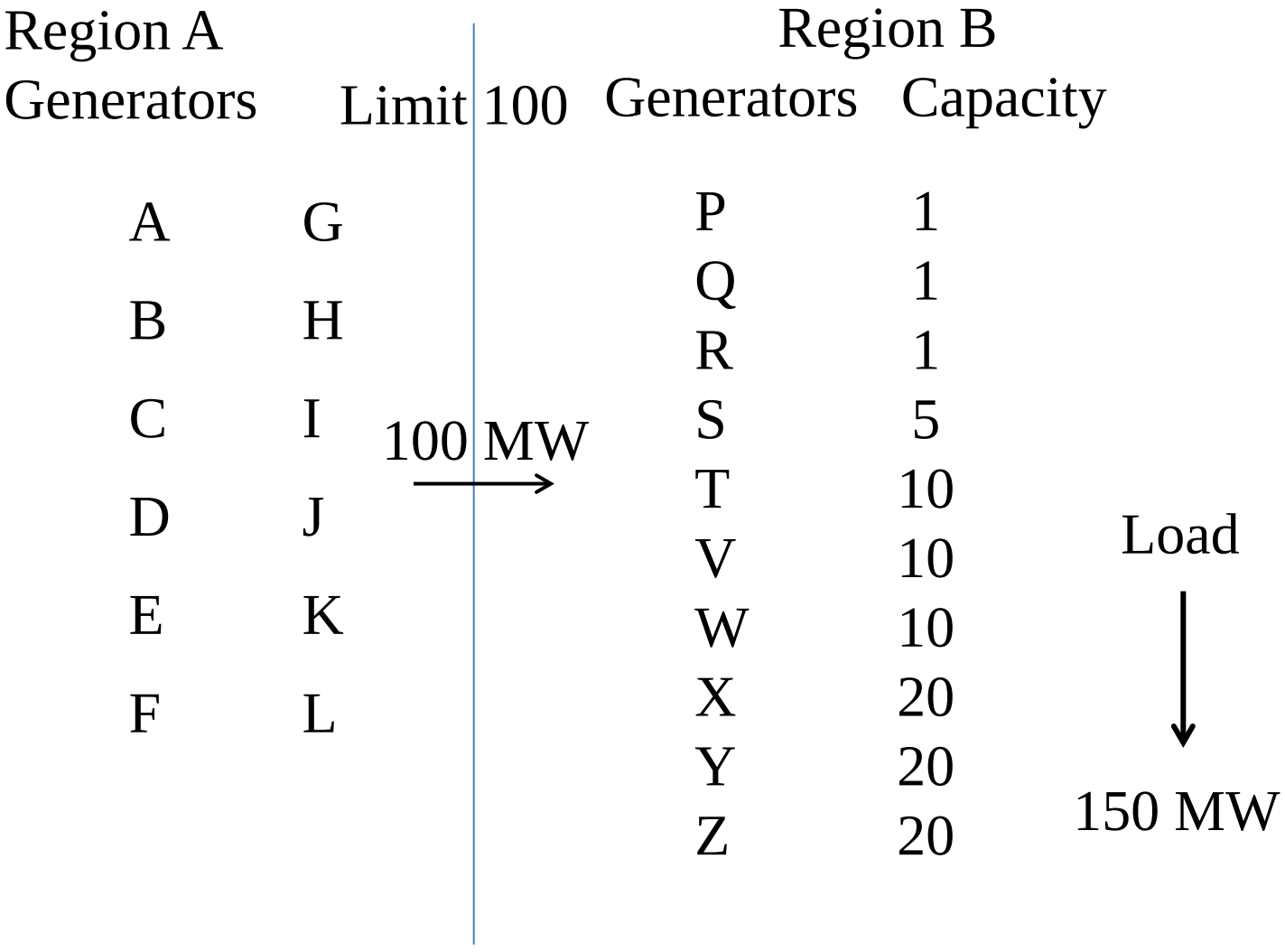
Pivotal Supplier Test — The Concept

The final step in applying a market power mitigation process based on a pivotal supplier test is to dispatch the market and calculate LMP prices for settlements using the capped/replacement offer prices.

Pivotal Supplier Test — Example

We will use a simple example to illustrate how a pivotal supplier test works in a little more detail than described above.

- In the next section we will use the same example to illustrate the operation of a conduct and impact test.



For the purposes of this example, it is assumed that each generator is separately owned and operated.

Pivotal Supplier Test — Example

Generators T, V, W, X, Y and Z located in the transmission constrained region B in the example above would all fail a three pivotal supplier test.

- The combined capacity of any two of X, Y and Z and the capacity of any one of T, V or W would be at least 50 MW, leaving only 48 MW of fringe capacity to meet 50 MW of net load.
- All of the generators would pass a one or two pivotal supplier test as withholding the output of even the two largest suppliers would leave at least 58 MW of capacity to meet 50 MW of load.

Pivotal Supplier Tests — Example

A core feature of pivotal supplier tests is that the test is intrinsically linked to competitive structure and to an assessment of whether a supplier possesses local market power.

- The submission of offer prices that exceed reference prices will not by itself trigger offer price mitigation under a pivotal supplier test based market power design.
- Suppliers T, V, W, X, Y and Z could all submit offers in excess of their reference prices without triggering mitigation based on the pivotal supplier test if the transmission constraint did not bind because suppliers in region A also submitted high offer prices.

Pivotal Supplier Test — Complications

In order to allow the test to be applied in both day-ahead and real-time energy markets there need to be a number of simplifications in how the test is actually applied by each ISO with respect to:

- Identification of binding transmission constraints for future intervals;
- Accounting for the cost effectiveness of the supply provided by fringe suppliers;
- Taking account of the impact of other transmission constraints that may limit the output of fringe suppliers;
- Identifying the set of resources potentially possessing market power when a particular transmission constraint is binding;

Pivotal Supplier Test — Complications

- Taking account of supply that is offered at low prices, or even as price taking supply, by a potentially pivotal supplier;
- Applying the pivotal supplier test to commitment costs;
- Accounting for limited ramp capability of fringe suppliers;
- Applying the pivotal supplier test to non-price bid parameters.

The application of the pivotal supplier test on an ex ante basis will likely require the IESO to introduce some simplifications that are not necessary in the current after-the-fact application of the test.

Pivotal Supplier Test — Choices

In addition to choices as to how the application of the conceptual test will be simplified so it can be applied in real- time, there are a number of design choices:

- If some suppliers are pivotal, will only those identified as pivotal be subjected to mitigation or will the offers of all suppliers, no matter how small their capacity, be subjected to mitigation?
- Will the test take account of whether the output has been sold and its price fixed in a forward contract, i.e. will it take into account whether the potentially pivotal supplier would be a net buyer if it withheld some or all of its supply from the market?

Conduct and Impact Tests — Concept

The principal alternative to pivotal supplier tests for applying market power mitigation in single schedule electricity markets is the Conduct and Impact Test design. The Conduct and Impact design has three components:

- **Scope**: What is the region within which the test is applied?
- **Conduct**: Do the offer prices or other bid components of any resource exceed the estimated competitive offer price level by the amount of the conduct threshold?
- **Impact**: Does using the offers and other bid components that violate the conduct threshold to clear the market collectively raise the projected market price at any location by more than the impact threshold?

Each component is discussed below.

Conduct and Impact Tests — Scope

Test Scope: Conduct and impact tests are not necessarily applied specifically to the resources able to relieve a specific transmission constraint but can be applied to all resources in the market, or to all the resources in a market sub-region.

- The ex ante application of the conduct and impact test in the New York ISO is limited to Zone J (New York City) and load pockets within Zone J.
- The MISO applies the conduct and impact test to resources located within “broad competitive areas” defined by whether resources in the region have shift factors above a predefined threshold on a binding transmission constraint, and to a handful of predefined narrow competitive areas.

Conduct and Impact Tests — Scope

- ISO New England applies the conduct and impact test to resources that are: a) pivotal in the overall New England market, or b) located within "constrained areas."
- SPP applies the conduct and impact test to resources that: a) have shift factors above a predefined threshold on a binding transmission constraint, or b) are located within predefined "frequently constrained areas." There are currently two frequently constrained areas.

Conduct and Impact Tests — Conduct

The conduct test is triggered when submitted offers/bids or parameters exceed a reference baseline by the amount of the "conduct threshold."

- Conduct thresholds for energy and reserve market bids can be specified either in percentage or $/MW terms.
- Conduct thresholds for start-up costs and non-price bid parameters are typically specified in percentage terms.
- Conduct thresholds for time based parameters are often specified in hours.

The details of the conduct and impact test thresholds used by the New York ISO, MISO, ISO New England and SPP are reviewed in the appendix accompanying this presentation.

Conduct and Impact Tests — Conduct

The New York ISO and MISO also have conduct thresholds for uneconomic production. These thresholds are reviewed in the appendix to this presentation.

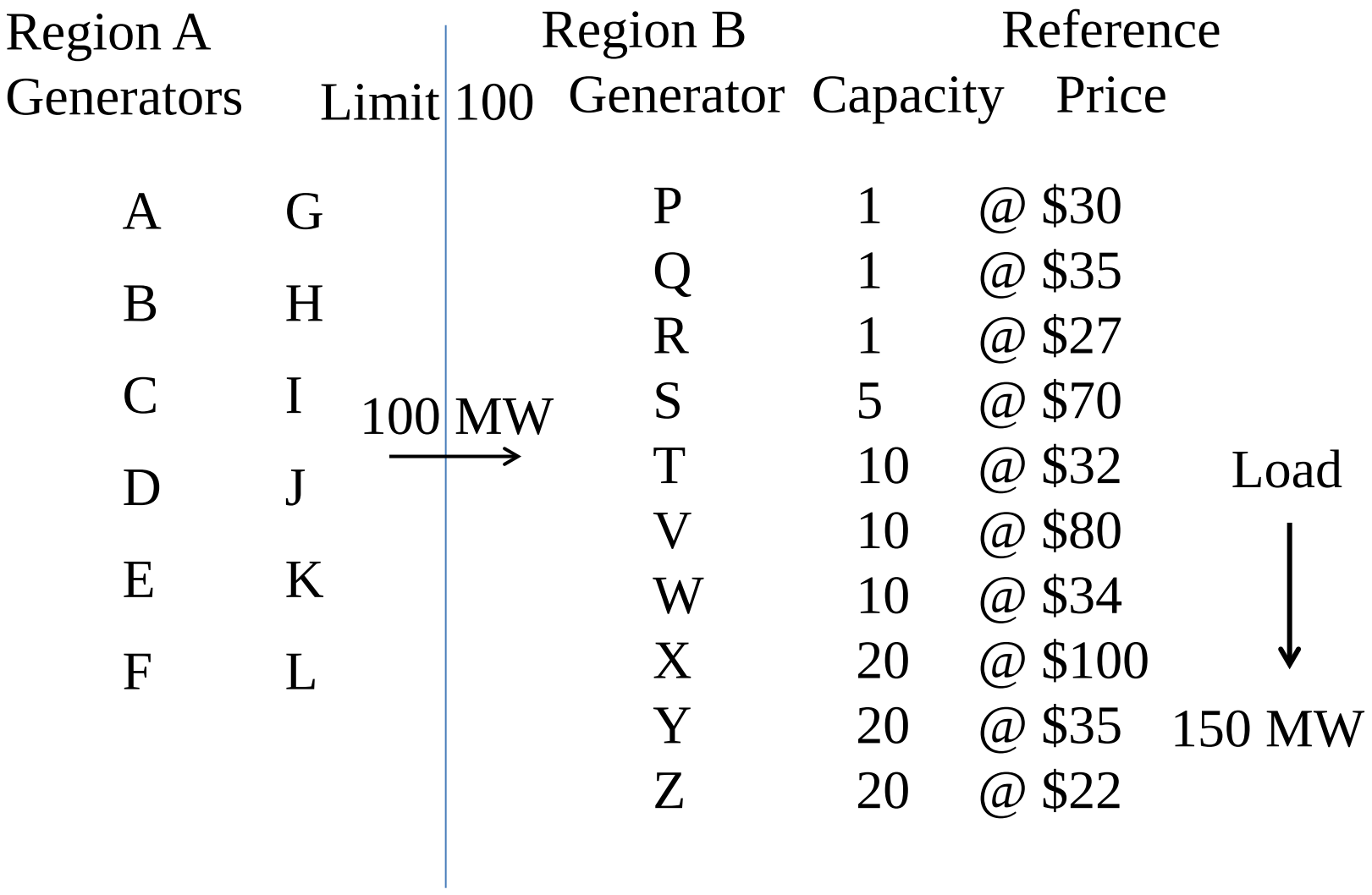
ISO New England and SPP do not have mitigation policies applying to uneconomic production.

Conduct and Impact Tests — Impact

The impact test is applied by comparing the LMPs and uplift payments between two scenarios:

- Scenario #1: Dispatch and pricing is solved based on submitted offers/bids and non-price parameters.
- Scenario #2: Dispatch and pricing is solved substituting reference level offers and non-price parameters for the offers and parameter values that exceed the conduct threshold.

If the LMPs and/or uplift payments calculated in scenario #2 exceed those calculated for scenario #1 by the amount of the "impact threshold," the offers or non-price parameters exceeding the "conduct threshold" are replaced with the reference values in the actual dispatch.



Each generator is assumed to be an independent supplier.

Conduct and Impact Test — Example

The example above is the same example used to illustrate the pivotal supplier test, but with reference prices added. We noted that Generator Z would pass a one pivotal supplier test because even without its output there would be 78 MW of capacity to meet 50 MW of load.

- An impact test would calculate a clearing price for region B of $34 based on the reference prices~~;~~.
- If Generator Z offered its supply at $100 and all other suppliers offered their supply at their reference price, the clearing price in the impact test would be $100 and the price impact would be $66.
- If $66 exceeded the impact threshold, mitigation would be applied to the offer of Generator Z.

Conduct and Impact Test — Example

If Generator A offered its supply at $200 in the example above and all other suppliers offered their supply at the reference price, the clearing price in the impact test would be $34, so the conduct of Generator A would have no price impact and mitigation would not be applied.

If Generator A offered its supply at $200, Generator Z offered its supply at $100 and all other suppliers offered their supply at the reference price, the clearing price in the impact test would be $100, the price impact would be $66 and mitigation would be applied to both Generators A and Z if the impact threshold were $66 or less.

Conduct and Impact tests — Complications

A fundamental characteristic of conduct and impact tests is that they are workable from an implementation standpoint only if the impact test is applied collectively to all bids and offers that violate the conduct threshold.

- A high offer price by a resource owned by a fringe competitor could be subjected to mitigation if high offer prices by a completely different supplier caused the impact test to be violated.
- It should generally be feasible to apply the impact test independently to multiple regions, rather than across all targeted regions in one model pass.
- This would require an additional pass to calculate the dispatch and prices for regions failing the impact test.

Conduct and Impact Test Complications

Conduct and impact tests differ from pivotal supplier tests in the simplifications that are required to apply the test in the day-ahead market and, particularly, in real-time.

- Like the pivotal supplier test, the application of the conduct and impact test depends on projections of future conditions which may identify too few or too many binding transmission constraints and may not be triggered by a binding constraint if a resource is committed to manage a local constraint that does not bind once the resource is committed.

Conduct and Impact Test Complications

Unlike the pivotal supplier test, the conduct and impact test does not have to rely on approximations in accounting for:

- The cost effectiveness of the supply provided by fringe generation,
- The impact of transmission constraints that may limit the output of the competitive fringe,
- Supply that is offered at low prices or as price taking supply by a supplier potentially able to exercise market power,
- The impact of commitment costs or ramp rate limits of fringe suppliers, or
- The-impact of non-price bid parameters on prices.

Conduct and Impact tests — Summary

The core limitations of the conduct and impact test are:

- Unless it is coupled with the identification of a constrained region, the outcome of the test is not tied to any structural analysis of competition, so the test could trigger mitigation even if there is no constraint binding and no firms possess local market power;
- When the impact threshold is exceeded, mitigation is applied to all resources within the region whose offers exceeded the conduct threshold without regard to the impact of the individual resource offer;
- The conduct and impact test requires two or possibly three full executions of the unit commitment and dispatch software.

5. Timing of Mitigation Test

Timing

The application of market power mitigation on an ex ante basis involves a number of tradeoffs.

- The further in advance of real-time that market power mitigation is applied, the greater the potential for real-time conditions to differ from those assumed in the mitigation process.
- On the other hand, the further in advance market power mitigation is applied, the more time there is to carry out the analysis of market power.

The application of market power mitigation on an ex ante basis will also require that the IESO be able to estimate competitive costs (reference prices) on an ex ante basis.

Timing

Most ISOs operating single schedule markets currently apply market power mitigation in the real-time dispatch using a look ahead program that executes prior to the real-time dispatch.

- If application of mitigation is triggered in the look-ahead program, mitigated offer prices are-used in the real-time dispatch.
- This timing can result in inconsistencies between the conditions used to test for mitigation and actual conditions in the real-time dispatch.
- Transmission constraints may bind in the look ahead program used to evaluate market power but not in real-time.
- Transmission constraints may bind in real-time but not bind in the forward evaluation of market power.

Timing

Applying mitigation prior to the real-time dispatch is also necessary to allow commitment and interchange scheduling decisions to be made based on mitigated offer prices.

- The application of market power mitigation to commitment costs complicates the application of pivotal supplier tests because a transmission constraint that causes a resource to be committed may not bind in the energy dispatch after the resource is committed.
- If mitigation were applied only when transmission constraints bound in the energy dispatch, committable resources possessing locational market power could exert it by submitting high commitment cost offers, low incremental energy offers, and receiving inflated cost guarantee payments.

Timing

PJM and the California ISO have historically avoided the potential for the exercise of market power through excessive commitment cost offers by requiring commitment cost offers to be based on estimated costs without regard to whether a resource possesses market power.

- This approach can lead to inefficient commitment decisions when estimated costs (reference prices) are materially lower than actual costs.
- The potential for reference prices to be out of line with actual costs is greatest when the gas transportation system is constrained and gas prices are volatile.

Timing

It should in principle be possible to trigger the application of the pivotal supplier test for a particular transmission constraint if the constraint binds in one of the commitment iterations and hence the constraint is kept in the constraint set, even if not binding.

- However, no ISO has implemented such a design.
- There would also be complications in calculating the amount of congestion relief needed in carrying out the pivotal supplier calculations for constraints that were not binding in the dispatch solution.

If constraints do not bind in the dispatch, the impact from the potential exercise of market power would reflected in uplift costs which can be reviewed and mitigated after the fact.

Timing

The MISO, NYISO, ISO-NE and SPP avoid these timing issues related to the mitigation of commitment costs because they utilize the conduct and impact approach to market power mitigation.

- The application of the conduct and impact test does not necessarily depend on whether a particular constraint binds in the dispatch, particularly in the case of resources committed for local reliability.
- The impact test is applied to bid cost guarantees (uplift payments) as well as to energy and reserve prices and can be applied after the fact.

Timing

The trend in SSM markets is to allow resources to adjust their offer prices over the operating day, which requires that offer prices be subject to mitigation on a continuing basis in some circumstances.

- Most ISOs that allow changes in offer prices have some kind of limit on offer price changes during the minimum run time of the resource.
- When mitigation is triggered in forward looking commitment programs, mitigation is typically applied in all RTD intervals of the forward period in which mitigation was triggered.

6. Reference Prices

Reference Prices

Most market power mitigation designs include “reference prices” which are used to approximate the competitive cost level.

- The current IESO after-the-fact review and recovery of CMSC is also based on reference prices.
  - Hydro – MCP, or 30 day average MCP weighted by market schedules, or agreed costs or opportunity costs;
  - Fossil and Intertie – MCP or 90 day average offer/bid prices during intervals that the resource was economic; and
  - Uncontested Intertie – Energy Market Price.

Because mitigation is applied after the fact, these reference prices can also be determined after the fact based on actual fuel cost- or opportunity cost.

Reference Prices

The ability of the IESO to calculate reference prices after the fact under the current design is particularly important during periods of fuel price volatility as it allows actual transaction cost data to be taken into account in determining reference prices for after the fact mitigation.

- This will not be feasible if local market power mitigation is applied ex ante.
- It will be necessary to determine reference prices for use in the ex ante mitigation.

Reference Prices

ISOs coordinating single schedule markets with ex ante market power mitigation use a variety of methods to determine reference prices:

- Gas price indexes;
- Prior offer prices, (sometimes adjusted for changes in fuel prices);
- Prior market clearing prices (sometimes adjusted for changes in fuel prices);
- Agreed upon reference prices reflecting opportunity costs;
- ISO formulas/models used to estimate commitment costs and opportunity costs;
- ISO review of market participant models used to estimate opportunity costs (such as for complex hydro system opportunity cost models).

Reference Prices

Increasing reliance on gas fired generation during winter conditions has lead some ISOs to shift to designs in which the market participant can submit offers reflecting current spot fuel prices subject to after the fact mitigation.

- The NYISO implemented this kind of design in mid-2014.[1]
- ISO New England implemented this kind of design in December 2014.[2]
- The California ISO is discussing such a design in its stakeholder process.[3]

1.See Docket ER14-1735

2.See Docket ER13-1877

3.See http://www.caiso.com/informed/Pages/StakeholderProcesses/CommitmentCosts_DefaultEnergyBidEnhancements.aspx

7. Other Design Elements

Other Design Elements

The core features of market power mitigation designs in single schedule markets have been outlined above. Other features are:

- Some ISOs have rules that allow resources to be made whole through uplift payments for revenues forgone due to inappropriate offer price mitigation;
- Some ISOs have rules that allow resources to be compensated for costs in excess of the offer cap if they submit offers at the cap;
- Some ISOs have rules that allow the after the fact application of mitigation to a resource in a location not subject to ex ante mitigation, with the mitigation applied only to the prices used to settle that resource.