Stakeholder Engagement Reading Material
Session: Market Power Mitigation – September 27, 2019

The engagement session to review select design topics within the Market Power Mitigation section will be held on September 27, 2019. The session will cover the following two design topics:

- Conduct and impact test thresholds; and
- Reference levels.

The purpose of this document is to provide stakeholders with information on the detailed design and set expectations for the session. These materials are required reading for the session.

Contents

1. Session Objective

The detailed design engagement meetings are to be considered technical working sessions. The sessions will focus on specific topics that external stakeholders either expressed an interest in during the high-level design phase or where the IESO has identified the need for further stakeholder input to inform the draft detailed design. Each session will concentrate on the proposed design for one specific aspect of the energy market detailed design.

The IESO is publishing materials for each engagement session no later than two weeks in advance of the session. This information is being shared in advance to provide stakeholders the opportunity to review and consider the potential impacts on their organization. The material should also help stakeholders identify who from their respective organizations may be most appropriate to attend the session and provide feedback. Stakeholders are encouraged to submit questions in advance of the sessions that will be addressed either at or before the session.

Stakeholder feedback, questions or concerns can be sent directly to engagement@ieso.ca.

These sessions will allow for interactive discussions with stakeholders regarding the reading material which will be focused on the questions identified below.

Stakeholders may also submit written feedback after the session if they choose to do so. However, these engagement sessions are designed to collect stakeholder feedback in-person and to facilitate a discussion with other stakeholders on that feedback. The IESO will use the input from these sessions to inform the detailed design decisions. Following each engagement session, the IESO will publish a brief summary of the discussion and allow for a short window for feedback for those not able to participate.

In the pre-engagement session, the IESO will be asking the following questions:
- Do stakeholders understand the proposed design?
- Do stakeholders understand the rationale for the proposed design?
- Do stakeholders agree that the proposed design is consistent with the Market Renewal principles? If not, what changes would be required to better align with the principles?

Figure 1 - Principles of Market Renewal

PRINCIPLES				
Efficiency	**Competition**	**Implementability**	**Certainty**	**Transparency**
Lower out-of-market payments and focus on delivering efficient outcomes to reduce system costs	Provide open, fair, non-discriminatory competitive opportunities for participants to help meet evolving system needs	Work together with our stakeholders to evolve the market in a feasible and practical manner	Establish stable, enduring market-based mechanisms that send clear, efficient price signals	Accurate, timely and relevant information is available and accessible to market participants to enable their effective participation in the market

2. Background

Competition is a key principle of the Market Renewal Program and the most effective way to encourage efficient outcomes. In electricity markets, competition drives market participants towards submitting offers at marginal cost, resulting in efficient dispatch and prices.

In situations where competition is restricted, one or more market participants may hold market power as a result. Market power enables a participant to profitably alter their offers significantly from their marginal costs. A market participant can also exercise market power by withholding some supply from the market in order to increase the price at which the remaining supply is sold. This withholding may be done through economic or physical means. A market participant can exercise economic withholding by offering a portion or all of their available capacity at an artificially high price so that it is not scheduled. A market participant can exercise physical withholding by not offering a portion or all of their available capacity into the market. The exercise of market power drives up costs to consumers because market prices would not reflect the actual marginal costs of supply, which leads to inefficient outcomes in the short- and long-run.

System operators use market power mitigation (MPM) to prevent market participants from using market power to increase prices or make-whole payments to their own advantage. Market power mitigation therefore prevents undue wealth transfers between market participants and helps to maintain the efficiency of the market.

MPM is intended to prevent the material exercise of market power but avoid unnecessary intervention in market outcomes. The MPM guidelines (listed in Section 3.2) outline the priorities which underpin the design. The MPM framework supports the market as the primary instrument to provide reliability and efficient dispatch and prices; it does not supplant it.

3. Conduct and Impact Test Thresholds

In high-level design the IESO determined that a conduct and impact test was the most appropriate approach for market power mitigation and that it would be run ex-ante with respect to the setting of schedules, dispatch instructions and prices.[1] The following sections provide a brief overview of conduct and impact tests, the scope of the decisions to be made in detailed design, and proposed decisions with supporting rationale[2].

3.1. Overview

A conduct and impact test is a method for identifying exercises of market power. It determines whether offers made by market participants (e.g. for energy, operating reserve, start-up) were higher than what would be expected under competitive pressures, and if those higher offers raised prices or make-whole payments as a result. Under this test, market power is only considered to be exercised if prices or make-whole payments are affected. When market power has been exercised, and price or uplift payments have been affected, offers from a market participant that are above its 'reference level' by a defined

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[1] See Section 3.2 of the Single Schedule Market High Level Design.

[2] Note: This document only discusses how the conduct and impact test will apply to offers for energy. Operating reserve offers will also be subject to conduct and impact testing. The design for operating reserve offers will be included in the Market Power Mitigation section of the detailed design document.

amount are mitigated down to the corresponding reference levels. Reference levels represent an estimate of what would be offered by a market participant had they been subject to unrestricted competition.

3.1.1. Triggers

The conduct and impact test is only triggered for market participant offers that are subject to restricted competition. For the purposes of the conduct and impact test, the IESO is defining restricted competition as when one or more of the following conditions are met:

- The offer is within a constrained area;
- A resource is selected out-of-market for reliability purposes; or,
- Global market power mitigation has been triggered.

Constrained Areas

One way in which competition can be restricted is when a transmission constraint binds, leaving a reduced set of supply resources that can meet demand (load) behind the constraint. The resulting "load pocket" typically has prices that are higher than in areas without binding constraints. In some situations, a load pocket can be created when a single constraint binds, and in others multiple transmission constraints must all bind before a load pocket is formed.

Areas of the transmission system that are regularly impacted by binding transmission constraints and load pockets are known as constrained areas. Constrained areas are classified based on how frequently the transmission constraints are expected to bind. The three types of constrained areas are defined below:

- **Broad Constrained Area (BCA)**: Transmission constraints that bind infrequently. Resources that are inside a BCA can prevent the violation of a transmission constraint.
- **Narrowly Constrained Area (NCA)**: areas of the transmission grid that are expected to be frequently constrained. All transmission constraints that define the NCA must bind to create a load pocket. The IESO will designate these areas based on the number of hours annually that these areas of the grid are constrained.
- **Dynamic Constrained Area (DCA)**: areas of the transmission grid that are expected to be congested on a persistent basis for shorter periods of time (i.e. less than a year). All transmission constraints that define the NCA must bind to create a load pocket. These areas can be created by outages or de-ratings of grid components that may alter congestion patterns on the grid.

Reliability Constraints

There are specific situations where the system operator needs to manually set the schedule for, commit, or dispatch a resource. These out-of-market actions are occasionally required in order to ensure the reliability of the IESO-controlled grid. In these cases, the selection of the resource is based on the system operator's best judgment instead of a competitive process.

Global Market Power

The global market power design examines the different ways in which competition may be restricted due to constraints that affect the entire system. Global market power triggers are intended to assess whether competition is restricted due to reasons other than local transmission constraints and if the preconditions for the exercise of global market power exist. These triggers are based on global constraints that might potentially restrict competition across the market as a whole.

The IESO has identified two conditions that together will trigger the test for global market power mitigation:

- The IESO is not able to schedule incremental imports on its interties with New York and Michigan; and
- The price at the reference location (Richview) and the prices at the New York and Michigan interties are all greater than a defined threshold value (excluding intertie congestion).
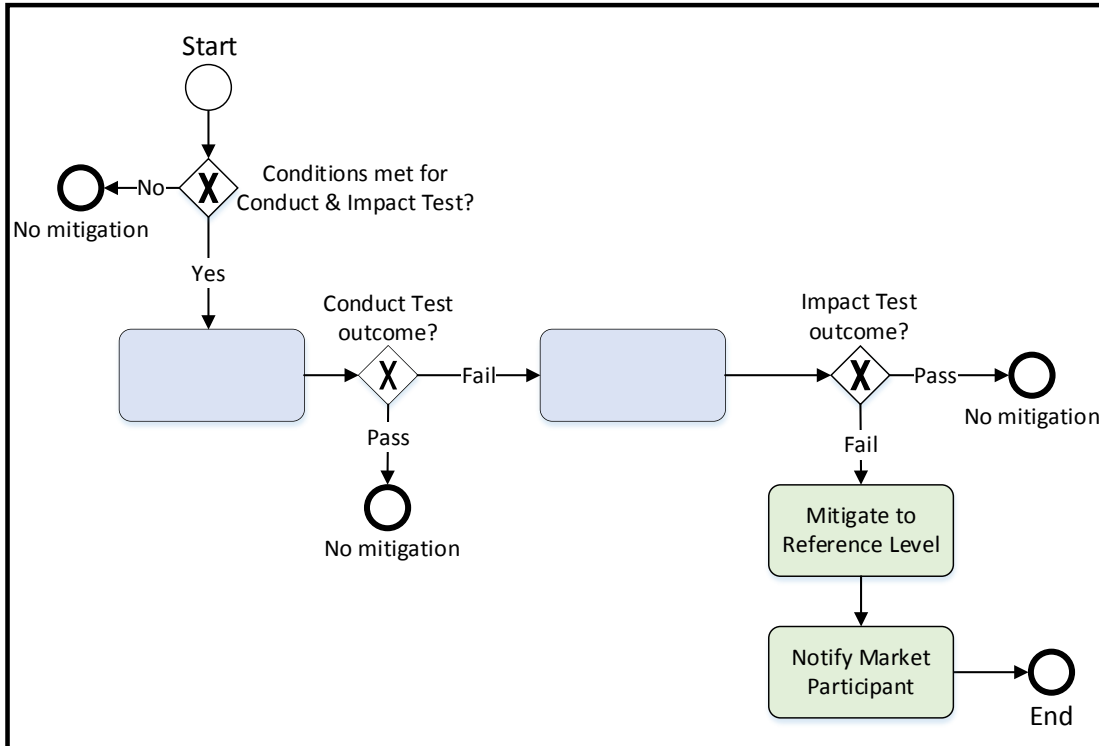
3.1.2. Conduct and Impact Test Process

As illustrated in **Figure 2** and described above, the conduct and impact test is only carried out under specific system conditions, corresponding to when and where competition is restricted. The test will be run ex-ante during the day-ahead, pre-dispatch, and real-time timeframes.

Once triggered, the conduct test runs to determine if any market participants offered above their reference level by more than the applicable conduct threshold. If all market participant offers pass the conduct test, the test ends. If one or more market participant offers fail the conduct test, the impact test is run.

The impact test determines if prices or make-whole payments were increased by more than the applicable impact threshold. If the impact test fails, all market participant offer parameters that failed the conduct test are mitigated down to the applicable reference level values.

Figure 2 - Conduct and Impact Test Process Overview

The IESO will notify market participants if their offer was mitigated and to which reference level. There may be extenuating circumstances where the market participant believes that the financial reference level was inappropriate. Such circumstances may include, but are not limited to, cases where:

- the market participant offering the resource requested a change to its reference level within a pre-defined period prior to market scheduling, but the IESO was unable to update the reference level in time; or

- the market participant offering the resource did not request a change to its reference level within a pre-defined period prior to market scheduling, but believes an incorrect reference level was used.

To address such circumstances, the IESO intends to implement an ex-post cost recovery process to reconcile the reference level used for mitigation and the fuel and opportunity costs that the market participant considers, and the IESO agrees are, more appropriate. Only fuel and opportunity costs up to the originally submitted hourly offer price will be eligible for recovery. These costs must be consistent with those defined in the reference level methodology (See Section 4.3).

This ex-post cost recovery process will be implemented as a part of the IESO's existing Notice of Disagreement[3] (NOD) process.

3.1.3. Offer Parameters

The offer parameters that will be subject to the conduct and impact test, and will have defined reference levels, are[4]:
- Financial Offer Parameters:
  - **Energy Offer**: the offered price to sell energy and comprises up to 20 price ($)-quantity (MW) pairs representing 19 energy offer laminations. Energy offers are denominated in dollar per MWh units ($/MWh).
  - **Start-Up**: the cost, in dollars per start, to bring an off-line generation unit through start-up procedures, including synchronization and ramp, up to its minimum loading point.
  - **Speed No-Load**: the cost, in dollars per hour, to maintain a generation unit synchronized to the IESO-controlled grid with zero net energy injected into the system for one hour.
- Non-Financial Offer Parameters:
  - **Energy Ramp Rate:** the rate, in MWs/min, at which a dispatchable resource associated with a generation or load facility can increase or decrease its energy output or consumption.
  - **Minimum Loading Point (MLP):** the minimum output, in MW, that a resource associated with a generation facility must maintain to remain stable without the support of ignition.

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[3] Section 1.3.5 of Market Manual 5.5 - Physical Markets Settlement Statements; Section 1.3.4 of Market Manual 5.7 - Financial Market Settlement Statements.
[4] Additional parameters may be added as the design for other topics continues to develop, including those for operating reserve offers and new data inputs for hydroelectric resources.

- **Lead Time:** the amount of time, in hours, needed for a resource associated with a non-quick start generation or pseudo-unit facility to start-up and reach its MLP from an offline state.
- **Minimum Generation Block Run Time (MGBRT):** the minimum number of consecutive hours a resource associated with a generation facility must be scheduled to its MLP.
- **Minimum Generation Block Down Time (MGBDT):** the minimum number of hours between when a resource associated with a generation facility can be scheduled back to its MLP after re-synchronizing.
- **Maximum Number of Starts Per Day:** the maximum number of times a resource associated with a generation facility is physically able to be started within a dispatch day.

3.2. Detailed Design Decision

In detailed design the IESO needs to establish the acceptable range of offer values and price impacts that determine the pass/fail outcome of the conduct and impact tests. These ranges are represented by thresholds. In general, the conduct and impact test thresholds should be higher in areas with significant competition and lower in areas and circumstances where competition is restricted.

The IESO used the guidelines that were established in the Single Schedule Market high-level design[5] to guide development of the conduct and impact test thresholds. The guidelines state that the conduct and impact thresholds will:

1. Promote market outcomes that are consistent with those that would result under competitive participation;
2. Consider and account for relevant Ontario-specific issues that could otherwise significantly impact the efficiency of the mitigation regime;
3. Result in intervention in the market that is not greater than needed to constrain the material exercise of market power;
4. Not unnecessarily distort efficient incentives for market participation;
5. Balance the administrative burden of maintaining the mitigation regime against the effectiveness of that regime; and
6. Become less permissive as competition is more restricted.

3.3. Conduct Test Thresholds

The conduct test will evaluate the financial and non-financial parameters of market participant offers against the resource's reference levels. The test will determine if the market participant's offer is within the threshold for each measure, relative to the corresponding reference level. The threshold that applies will be determined by the condition that triggered the test (e.g. type of constrained area). The conduct test thresholds are listed in **Table 1** and **Table 2** below. The rationale for the thresholds are included below the tables.

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[5] See Section 3.2.3 of the Single Schedule Market High Level Design.

Table 1 - Conduct Test Thresholds (Financial)

Trigger Condition	Energy[6]	Start-Up and Speed No-Load
Broad Constrained Area	200% or $100/MWh increase	100% increase
Global Market Power		
Narrowly Constrained Area	50% or $25/MWh increase	25% increase
Dynamic Constrained Area	50% or $25/MWh increase	25% increase
Reliability Constraint	10% or $25/MWh increase	10% increase

Energy

The thresholds for energy offers are consistent with the MPM guidelines, are informed by the practices of other jurisdictions, and are consistent with those in the current ex-post local market power framework. The thresholds become less permissive as competition is more restricted. Including a 10% threshold for reliability constraints reduces the chance that mitigation is inappropriately applied to resources that are needed to support reliability.

Start-Up and Speed No-Load

The thresholds for start-up costs and speed no-load costs are consistent with the principles of MPM and informed by the practice of other jurisdictions. The thresholds become less permissive as competition is more restricted. A threshold of 100% above the reference value would limit intervention in BCAs where competition is not systemically restricted. Including a 10% threshold for reliability constraints and manual dispatches reduces the chance that mitigation is inappropriately applied to resources that are needed to support reliability.

Table 2 - Conduct Test Thresholds (Non-Financial)

Trigger Condition	Energy Ramp Rate	Minimum Loading Point	Max. # of Starts Per Day	Lead Time, MGBRT, MGBDT
Broad Constrained Area	50% decrease	100% increase	50% decrease, or value less than 1/day	Increase of more than 3 hours for any one parameter, or a total increase of more than 6 hours across all parameters
Global Market Power				
Narrowly Constrained Area	25% decrease	100% increase	50% decrease, or value less than 1/day	
Dynamic Constrained Area				
Reliability Constraint	25% decrease	10% increase	Decrease by 1, or value less than 1/day	

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[6] Energy offers below $25/MWh are excluded from conduct and impact testing.

Energy Ramp Rate

The ramp rate threshold value for BCAs comes from best practices in other jurisdiction. The jurisdictions that use conduct and impact test methodology all use this same value for their threshold for ramp rates. Using this value has a proven track record and there is no specific reason to vary the approach. Reducing the threshold where competition is more restricted (NCA, DCA, Reliability and Manual Dispatch) is consistent with the MPM guidelines.

Minimum Loading Point

The minimum loading point thresholds are consistent with the MPM guidelines and also with industry best practices as seen in other jurisdictions.

Lead Time

Due to implementation challenges, any parameters that can impact the length of a commitment will be mitigated relying only on a conduct test rather than a full conduct and impact test. Offer submissions will be tested to determine if the submitted value of the relevant parameter is greater than the reference level plus the conduct threshold. Any submissions of these parameters above the allowable values will be prevented by data validation.

Minimum Generation Block Run Time

Due to implementation challenges, any parameters that can impact the length of a commitment will be mitigated relying only on a conduct test rather than a full conduct and impact test. Offer submissions will be tested to determine if the submitted value of the relevant parameter is greater than the reference level plus the conduct threshold. Any submissions of these parameters above the allowable values will be prevented by data validation.

Minimum Generation Block Down Time

Due to implementation challenges, any parameters that can impact the length of a commitment will be mitigated relying only on a conduct test rather than a full conduct and impact test. Offer submissions will be tested to determine if the submitted value of the relevant parameter is greater than the reference level plus the conduct threshold. Any submissions of these parameters above the allowable values will be prevented by data validation.

Maximum Number of Starts per Day

Due to implementation challenges, any parameters that can impact the length of a commitment will be mitigated relying only on a conduct test rather than a full conduct and impact test. Offer submissions will be tested to determine if the submitted value of the relevant parameter is greater than the reference level plus the conduct threshold. Any submissions of these parameters above the allowable values will be prevented by data validation.

The maximum number of starts thresholds are consistent with best practices in other jurisdictions. Many of the jurisdictions that use conduct and impact test methodology use similar thresholds. Using these thresholds has a proven track record and there is no specific reason to vary the approach.

3.4. Impact Test Thresholds

If one or more market participant offers fail the conduct test, the impact test will run. The impact test has two components: a price impact test and a make-whole payment impact test.

The ex-ante price impact test will compare the prices that would have occurred if all parameters offered by market participants were used (the 'as-offered' results) against prices that would have occurred if the offer parameters that failed the conduct test were replaced with their reference levels (the 'price impact test' results). If the as-offered results are greater than the price impact test results by more than the relevant impact threshold, then the price impact test is failed.

The ex-post make-whole payment impact test will compare the make-whole payments for a resource that would have occurred if all parameters offered by a market participant were used (the 'as-offered' results) against the make-whole payments for a resource that would have occurred if the offer parameters that failed the conduct test were replaced with their reference levels (the 'make-whole impact test' results). If the as-offered results are greater than the make-whole payment impact test results by more than the relevant impact threshold, then the make-whole payment impact test is failed.

The impact test thresholds are listed in **Table 3** below. The rationale for the thresholds are included below the table.

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Table 3 - Impact Test Thresholds

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Trigger Condition		
Broad Constrained Areas	Lesser of: 100% or $50/MWh increase	10% increase
Global Market Power		
Narrowly Constrained Areas	Lesser of: 50% or $25/MWh increase	10% increase
Dynamic Constrained Areas		
Reliability Constraint	N/A[7]	Any increase

Energy Price
The energy price thresholds are consistent with the MPM guidelines. The thresholds become less permissive as competition is more restricted and are consistent with best practices from other jurisdictions. The current local market power framework does not provide corollaries to measuring price impact due to the fact that the current market is based on a uniform price.

Make-Whole Payments
The make-whole payment thresholds are consistent with the MPM guidelines as discussed. They become less permissive as competition is more restricted.

4. Reference Levels
When one or more parameters of a market participant's offer fails the conduct and impact test, that offer parameter is mitigated to the appropriate reference level. The following sections provide a brief overview of reference levels, the scope of the decisions to be made in detailed design, and decisions with supporting rationale.

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[7] Reliability constraints will result in incremental injections of energy provided to the market. Thus reliability constraints will potentially impact make-whole payments, but are not expected to materially impact prices.

4.1. Overview

Reference levels represent an estimate of what would be offered by a market participant had they been subject to unrestricted competition. Reference levels will be established for both financial and non-financial parameters of a market participant's offer. The parameters are listed in Section 3.1.3.

4.2. Detailed Design Decision

There are a number of methodologies that could be potentially be used to establish reference levels. Each methodology uses a slightly different approach and dataset for determining the reference levels. The IESO presented examples of different methodologies with external stakeholders during Single Schedule Market high-level design engagements. In detailed design the IESO will decide which methodology will be used to determine each of the financial and non-financial reference levels.

As decided in high-level design, the following principles will guide the approach to reference level methodology[8]:

1. Reference levels are informed by short-run marginal costs.
2. Short-run marginal costs are generally determined on the basis of:
    a. Fuel costs
    b. Variable operating and maintenance costs
    c. Opportunity costs
    d. Any other appropriate costs.

4.3. Financial Reference Levels

In high-level design, the IESO decided that financial reference levels would be determined using as many as three different methodologies: 1. recent offers (offer-based methodology), 2. recent locational marginal prices (LMPs) at the resource (LMP-based methodology), and 3. a resource's short-run marginal cost (cost-based methodology). Stakeholder feedback on this topic suggested that stakeholders felt strongly that reference levels should be cost-based and should not be determined on the basis of recent offers or LMPs. Given this feedback as well as further research and analysis, the IESO has decided to only establish reference levels for financial offer parameters using a cost-based methodology.

A cost-based methodology uses market participant and IESO-gathered data to establish an approximation of each resource's short-run marginal costs. Short-run marginal costs are expenses that are incurred if the resource operates and not incurred if the resource does not operate. There are three categories of relevant costs: energy, start-up, and speed no-load. Long-term costs necessary to keep the resource in service and available are not included in energy market reference levels.

Separate sets of reference levels will be established for the day-ahead and real-time timeframes, as well as on-peak and off-peak hours, where applicable. For energy offers, the IESO will determine an energy offer reference level curve for on-peak and off-peak hours for each offer block. This will involve up to 20 non-decreasing values of the reference level to form a monotonically increasing cost curve. The reference level curve will be used for mitigation of the price-quantity pairs submitted by the market participant. For speed no-load offers and start-up offers, the IESO will determine single on-peak and off-peak reference levels.

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[8] See Section 3.3 of the Single Schedule Market High Level Design.

4.3.1. Establishing and Updating Reference Levels

Consultation

The IESO will establish financial reference levels for each resource[9] through a consultation process. Market participants will submit documentation to the IESO outlining their costs and other supporting information. To aid this submission process the IESO will provide participants with a detailed outline of costs that may be included in each category of financial reference levels. The IESO will assess all submitted information for cost eligibility and reasonableness, review any other information it acquires and deems relevant, and determine the reference levels in consultation with the market participant.

Once established, the IESO will make the financial reference levels available to each market participant. The reference levels will remain in effect until:

- The IESO makes changes to the reference level methodology that warrants revision of the original reference levels
- The IESO identifies a need for a cost data audit or a review for completeness and accuracy; or
- The market participant notifies the IESO of a decrease in its initially submitted costs or requests a consultation with the IESO to revise their reference levels values.

The IESO will review the reference level methodology at least once every three years. For clarity, this review will only be performed to ensure that the initially established methodology for setting reference levels, including all eligible cost categories, remains accurate and complete.

Market participants must inform the IESO if their initially submitted short-run marginal costs have decreased within two business days following such a change coming into effect.

Market Participant Access to Reference Levels

The IESO will make available to each market participant the cost-based reference levels applicable to that market participant's financial offers.

In addition, in case of a market power mitigation event, the market participant will be notified and informed of the hour in which their resource was mitigated and the reference level that was applied.

Ongoing Updates

Certain components of the reference levels that are initially determined by the IESO in consultation with market participants will be updated as frequently as is necessary and reasonable. These components include: fuel costs that are relevant to natural gas, oil, diesel and other fossil fuel resources, and opportunity costs that are relevant to hydro and storage resources.

Fuel costs for gas-fired resources will be based on a universal pre-approved index price. Therefore, the fuel costs for gas-fired resources under this approach will have been updated on a daily basis (excluding weekends).

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[9] The IESO does not intend to set energy reference levels for dispatchable loads (including storage facilities when charging), demand response, exports, imports and virtual demand and supply. Those resources are not subject to the conduct and impact test. The IESO will establish the start-up and speed no-load reference levels only for generation facilities for which market participants are eligible to submit start-up offers and speed no-load offers, in particular, dispatchable non-quick start generation facilities.

To determine the fuel costs for oil-fired and biomass-fired steam turbines and other resource types and, if applicable, the opportunity costs, the IESO will aim to establish an automated process for updating those costs in collaboration with each market participant. This process will enable the IESO to perform such ongoing updates and avoid the necessity of the market participant submitting new data every day.

Intra-day Revisions

Market participants may request a temporary revision to the fuel or opportunity cost components of a resource's reference levels if they believe that the existing reference levels will not reflect short-run marginal costs for one or more hours of a specific trading day. The discrepancy between anticipated costs and reference level costs must be caused by an unforeseen event that occurs up to 24 hours prior to the trading day. Market participants have the option to request a revision if the fuel or opportunity costs for a resource are higher, and are obligated to notify the IESO if the costs are lower.

Market participants must submit requests for such intra-day reference level revisions during specific timeframes. The window for request submissions will be set to at least 30 minutes before the close of the offer window for the DAM and the mandatory[10] window in the real-time market. Standard rules for submitting offers and offer revisions will apply. The request must also be accompanied by supporting documentation at the time of submission.

If the IESO finds the request verifiable and substantiated, it will revise the applicable cost component for one or more hours of that trading day. If the IESO is not able to verify and substantiate the change request in time or does not approve the change request, it will use the original reference level and notify the market participant.

4.3.2. Calculation of Cost-Based Reference Levels

The IESO will design the reference levels to include all short-run marginal[11] costs. Costs that are incurred in the production of energy are included in the reference levels. Table 4 provides more specific guiding principles related to each component of the reference levels.

Table 4 - Guiding Principles for Financial Reference Levels

Reference Level	Guiding Principle
Energy cost	Marginal costs incurred in the production of energy, after a resource is started and synchronized are relevant to the energy component of the reference levels
Speed no-load cost	Marginal costs associated with operating a generation unit in a synchronized status while injecting no energy to the IESO-controlled grid are relevant to the speed no-load component of the reference levels
Start-up cost	Marginal costs attributed to the production of energy and incurred in starting the resource can be included in the start-up component of the

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[10] If a market participant wishes to revise their submitted DAM dispatch data for the real-time market, then the market participant must submit the data no later than 2 hours prior to the dispatch hour, which is the mandatory window.

[11] Also referred to as "short-run avoidable costs".

Reference Level	Guiding Principle
	reference level

The following formulas will be used to calculate reference levels for the financial parameters of market participant offers. Each formula contains a number of cost components, which are further described in Section 4.3.3.

$$\textbf{\textit{Energy Cost}}^{12} = [\textit{Incremental Heat Rate} \times (\textit{Fuel Costs} + \textit{Service Price Adder}) \times \textit{Performance Factor}] + \textit{Emission Costs} + \textit{Operation and Maintenance} + \textit{Opportunity Costs} + \textit{Other Incremental Costs}$$

$$\textbf{\textit{Speed No-Load Cost}} = [\textit{No Load Heat Consumption} \times (\textit{Fuel Costs} + \textit{Service Price Adder}) \times \textit{Performance Factor}] + \textit{Emission Costs} + \textit{Operation and Maintenance}$$

$$\textbf{\textit{Start-up Cost}} = [(\textit{Fuel Costs} + \textit{Service Price Adder}) \times (\textit{Start-up Fuel Volume} + (\textit{Start-up Fuel Volume} \times \textit{Compressor Fuel Volume Adder}) \times \textit{Performance Factor}] + (\textit{Start-up Carbon Price Adder} \times \textit{Start-up Fuel Volume}) + (\textit{Electricity Consumption Quantity} \times \textit{Electricity Consumption Price}) + \textit{Operation and Maintenance}$$

4.3.3. Cost Components

The definition for each cost component used in the above formulas is provided below. The IESO will develop further details and methodology for each of the cost component in these formulas. The following list provides a high-level description for each cost component included in the formulas:

- **Incremental Heat Rate**: This component represents the fuel needed by the resource to produce an additional MWh of energy. The IESO will use the incremental heat rate rather than the average heat rate to determine the incremental energy cost.
- **Performance Factor**: The performance factor is a means to account for uncertainties across resources and changes to resource efficiency without having to adjust the heat rate for the resource. Resource efficiency is measured by the fuel consumption per MWh of production or per start. The asset-specific performance factor can be estimated as the ratio of actual fuel consumed over a historical period of time to the theoretical fuel consumed based on the uniform heat rate for that resource type and MWh of production during the time period.
- **Emissions Costs for Energy and Speed No-Load**: Fossil fuel resources will be allowed to include the costs associated with emissions based on the relevant emissions policy, such as the Federal Carbon Backstop, and the emission rate. This rate indicates the quantity of emissions by the resource for each MWh of power produced in their energy cost and speed no-load costs. A generic resource-specific rate for each resource type will be used as a default. The IESO will

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[12] The Other Incremental Costs category will, for example, include water usage fees such as hydro rental charges in lieu of fuel costs that hydro resources may incur.

work with market participants to calculate the emissions costs to include in the reference levels for energy and speed no-load offers.

- **Start-Up Carbon Price Adder:** This component will be defined in alignment to the IESO's existing RT-GCG[13] program for Non-Large Final Emitter (non-LFE) Generators[14] and for Large Final Emitter Generators (LFE) Generators.[15]

- **Operation and Maintenance (O&M)**: Only O&M costs incurred as the result of energy production are relevant to the reference levels. Incremental O&M costs can be incurred on a $/start, $/hour, or $/MWh basis. The basis on which variable O&M costs are incurred indicates where it is best to include the costs in the financial offer parameters. O&M incurred on a $/MWh basis qualifies to be included in the energy costs, while O&M costs incurred on a $/start and $/hour basis qualify to be included in the start-up costs and speed no-load costs. The IESO will work with market participants to identify and group certain costs into each of the three parts of the short-run marginal costs.

- **Other Incremental Costs:** These costs will include additional elements for different resource types. For example, for hydro resources it will include water rental charges.

- **No Load Heat Consumption**: This component is the minimum fuel burn that would be hypothetically consumed if the resource were to back down to a zero power output while staying synchronized.

- **Fuel Costs:** This component will be defined in alignment to the IESO's current RT-GCG framework. Specifically, the fuel costs for energy, speed no-load and start-up costs will be based on a universal pre-approved index for gas-fired resources and the resource-specific pre-approved value for oil-fired and biomass-fired generation facilities. The IESO will develop the approach to be used to determine fuel costs for all other resource types in Ontario in collaboration with market participants. Consistent with the current RT-GCG program, the IESO will continue to include the following fuel cost adders:
  - Compressor Fuel Volume Adder: A universal pre-approved value consistent with the current RT-GCG framework will be added to the fuel volume in reference levels for energy, speed no-load, and start-up offers for the incremental percentage of fuel consumed by the compressor associated with each start, including volumes for injecting or removing gas from storage.
  - Service Price Adder: A universal pre-approved value consistent with the current RT-GCG framework will be added to the fuel cost in reference levels for energy, speed no-load, and start-up offers for the additional services related to the marketer risk premium, commodity charge for transportation, balancing and storage

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[13] Carbon Price Adder may be updated in case of any changes to the regulation.

[14] Non-Large Final Emitter Generators are defined as: i) facilities emitting less than 10ktCO2e (kilotonne CO2 equivalent) per year; and ii) facilities emitting between 10ktCO2e to 50ktCO2e, that do not opt-into the Output Based Pricing System (OBPS).

[15] Large Final Emitter Generators are defined as: i) facilities emitting more than 50ktCO2e per year; and ii) facilities emitting between 10ktCO2e to 50ktCO2e, that voluntarily opt-in to OBPS.

- o For the energy offer and speed no-load offer reference levels, the IESO may include an appropriate adder that may vary by location to account for fuel delivery charges but will exclude any charges that are applied on a monthly or an annual basis.
- **Start-Up Fuel Volume**: The amount of fuel needed to start a thermal resource. This value varies depending on how long the resource has been offline. Thermal resources may be allowed to submit different start-up fuel levels for starting up from a cold, warm and hot state. Therefore, reference levels will also likely be set differently depending on the state.
- **Electricity Consumption Quantity:** Consistent with the IESO's existing RT-GCG program, this component is the pre-approved value specific to a resource in a generation facility for the incremental quantity of electricity consumed during start up, when starting from a cold state.
- **Electricity Consumption Price:** Consistent with the IESO's existing RT-GCG program, this component is the universal pre-approved value ($/MWh) for the cost of electricity represented by Average Supply Cost for Regulated Price Plan + Wholesale Market Services Rate + regulatory charges (Rural and Remote Rate Protection, Ontario Electricity Support Program, Debt Retirement Charge). The universal pre-approved value will be updated on the date that changes to any of the individual components of the value become effective. These consist of:
    1. Average Supply Cost for Regulated Price Plan that is available on the Ontario Energy Board website in the "Regulated Price Plan: Price Report", which is published every six months.
    2. Wholesale Market Services rate that is available on the Ontario Energy Board website in the "Decision on Regulatory Charges", which is published annually.
    3. Rural and Remote Electricity Rate Protection rate that is also available in the "Decision on Regulatory Charges".
    4. Ontario Electricity Support Program rate that is also available in the "Decision on Regulatory Charges".
    5. Debt Retirement Charge that is available in O. Reg. 493/01: DEBT RETIREMENT CHARGE - RATES AND EXEMPTIONS.
- **Opportunity Costs**: All resources with intertemporal production limitations, such as hydro and storage, incur an opportunity cost when they produce power. These resources may sacrifice the opportunity to produce power in a future interval by producing it in the current interval. Intertemporal production limitations vary depending on the resource type. All of these intertemporal opportunity costs can be included in the reference levels. Reservoir hydro resources and all resources that have constrained production can shift their production across time. Opportunity costs for such resources represent the expected future profits that the market participants give up when these resources produce an additional MWh in the current time period. Therefore, the objective is to estimate the price at which the resource is indifferent between using its water to produce power and storing the water for future use in a particular interval. The IESO will develop a methodology for determining opportunity costs in collaboration with stakeholders.

Certain cost components of the formulas may not apply for all resource types. **Table 5** indicates what cost components are relevant for different resource types.

Table 5 - Relevant Cost Components by Resource Type

Cost Component	Applicable Resource Types	Non-applicable Resource Types
Incremental Heat Rate	• Resources that consume fuel to produce energy. This includes natural gas, diesel, oil, biomass/waste and nuclear resources.	• Resources that do not consume fuel to produce energy. This includes hydro, wind, solar and storage.
Fuel Costs	• Resources that consume fuel to produce energy. This includes natural gas, diesel, oil, biomass/waste and nuclear.	• Resources that do not consume fuel to produce energy. This includes wind, solar and storage.
Performance Factors	• Thermal resources that may experience some decline in performance during certain seasons or weather conditions, or due to age or declining efficiency.	• Resources that do not consume fuel. If these resources experience a decline in efficiency as they age, it will be captured in higher O&M costs or other cost components.
Emissions Costs	• Fossil fuel resources including natural gas, diesel and oil.	• All non-fossil fuel resources such as hydro, wind, solar, and storage.
Start-Up Carbon Price Adder	• Fossil fuel resources including natural gas, diesel and oil.	• All non-fossil fuel resources such as hydro, wind, solar and storage.
Operation and Maintenance (O&M costs)	• All resources incur O&M costs. The allocation of O&M costs between incremental, no load, and start-up will vary by resource type.	
Other Incremental Costs	• Hydro resources may incur water usage fees (i.e. "hydro rental charges") in lieu of fuel costs.	
No Load Heat Consumption	• Resources that consume fuel to stay synchronized with the system. These include natural gas, diesel, oil, biomass/waste, and nuclear. • Hydro resources may incur water usage fees in lieu of fuel costs.	• Resources that do not consume fuel to produce energy. These include wind, solar and storage.
Opportunity Costs	• Resources that are constrained in the total amount of energy that they can produce and have the ability to shift production across time periods. These include reservoir hydro, pumped hydro and storage.	• Thermal resources and variable generation resources generally do not forego any opportunities to sell energy. Therefore, they do not incur opportunity costs.
Start-Up Fuel Volume	• Resources that consume fuel to start such as natural gas, diesel, oil, biomass/waste and nuclear.	• Resources that do not consume fuel to produce energy. This includes wind, solar and storage.
Electricity Consumption Quantity	• Resources that consume power during start-up such as natural gas, diesel, oil, biomass/waste and nuclear.	• Resources that do not consume fuel to produce energy. This includes hydro, wind, solar and storage.

Cost Component	Applicable Resource Types	Non-applicable Resource Types
Labour	• Resources that need to have additional staff on site during operation. However, these labour costs can be avoided by maintaining an offline but ready status.	

Table 6 provides a list of example costs that are relevant to the reference levels, mapped to the applicable resource types[16].

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Table 6 - Examples of Costs Relevant to Reference Levels

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Cost Category	Examples	Applicable Resource Type
Energy Costs	• Fuel cost based on current fuel prices and variable delivery charges	• Thermal resources
	• Emissions	• Fossil resources
	• Water rental charges	• Hydro resources
	• Pumping power	• Pumped storage hydro resources
	• Incremental labour needed after resource is synchronized	• All resources
No-Load Costs	• Fuel costs	• Thermal resources
	• Emissions costs	• Fossil resources
	• Fuel procurement risk	• Natural gas resources
Start-up Costs	• Start-up fuel	• Thermal resources • Different for Hot, Intermediate, Cold
	• Start-up power	• Thermal resources
	• Risk of start failure	• Thermal resources
Operation and Maintenance (If incurred in the production of power)	• Repairs	• All resources
	• Boiler Operation and Maintenance	• Steam turbine resources
	• Turbine overhauls	• All resources
	• Replacement parts	• All resources
	• Pollution control service	• Fossil resources
	• Inspections	• All resources
	• Refurbishments	• All resources
	• Cleaning/Servicing	• All resources
	• Labour	• All resources

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[16] Note: not intended to be an exhaustive list of relevant costs.

Cost Category	Examples	Applicable Resource Type
Opportunity Costs	• Potential net revenues lost if outputting power in future intervals rather than this interval (based on expected future power prices)	• Hydro and storage resources • Resources with limited emissions allowances, constrained fuel storage/delivery, operating restrictions, or physical limitations

4.4. Non-Financial Reference Levels

The IESO will establish reference levels for non-financial offer parameters using a registration-based methodology.

During facility registration market participants will submit data and supporting documentation to the IESO to establish both registered values and reference levels. A resource's registered values reflect its operational capabilities. Market participants must register values for the resource that are consistent with the IESO's Market Information Management (MIM) validation procedures.

A resource's non-financial reference levels represent an assessment of how the resource is reasonably capable of operating in a competitive environment, as opposed to an operational limit used for the purpose of the MIM process. While data for non-financial offer parameters used in the MIM process is reflective of technical limitations of the resource, it is not necessarily reflective of the resource's operation during competitive conditions. The IESO will determine non-financial reference levels based on the criteria of competitive performance across a resource's range of production. The IESO will develop these criteria and detailed guidelines for market participants to submit reference level data for non-financial offer parameters, including what supporting documentation will be required to support the verification process.

The reference levels for non-financial offer parameters will be determined:

- by season (summer and winter); and
- for on-peak and off-peak hours.

The IESO will provide the ability for market participants to register different values for a given non-financial parameter (i.e., for different seasons, on-peak and off-peak hours) for the purpose of setting the non-financial reference levels. However, values for non-financial parameters that do not vary across these dimensions should be identical.

Each time a market participant submits dispatch data for non-financial offer parameters in the day-ahead, pre-dispatch, and real-time timeframes, the IESO will continue to verify those inputs against the resource's registered values.

Due to implementation challenges, the set of non-financial parameters that can impact the length of a commitment (identified above) will be mitigated relying only on a conduct test rather than a full conduct and impact test. Offer submissions for that set of parameters will be tested to determine if the submitted value of the relevant parameter is greater than the reference level plus the conduct threshold. Any submissions of these parameters above the allowable values will be prevented by data validation.

Testing of the set of non-financial parameters that do not impact the length of a commitment will be incorporated into the normal conduct and impact methodology.

4.4.1. Market Participant Access to Non-Financial Offer Reference Levels

The IESO will make available to each market participant the reference levels for non-financial offer parameters applicable to that market participant's financial offers.

In the event that a resource is mitigated, the market participant will be notified in which hour its resource was mitigated and to what reference level.

Market participants might make physical or operational changes to a resource which impact the operational characteristics described by a non-financial reference level. In these cases, the market participant shall update the registered value of the relevant non-financial reference level no later than 2 business days following such a change.

4.4.2. Rationale

The IESO identified two options for non-financial reference level methodologies: registration-based and offer-based. A registration-based methodology uses data submitted during facility registration to calculate a resource's reference levels. Under this methodology, different sets of reference levels can be established for scenarios where non-financial offer parameters may vary, such as summer/winter and off-peak/on-peak hours. An offer-based methodology uses historical offer data to establish reference levels for each resource. Under this methodology, reference levels are calculated based on past offers from the resource when it was economically scheduled.

Consistent with the feedback received from stakeholders regarding a preference for cost-based vs. offer-based reference levels for financial parameters, the IESO will establish non-financial reference levels using a registration-based approach. This will allow participants and the IESO to establish a set of non-financial reference levels without relying on historical data; such data may not accurately reflect a resource's capabilities on a given day.

5. Conclusion

In preparation for the engagement session on September 27, stakeholders are encouraged to submit any questions or requests for clarification that would benefit the interactive session.

For questions or feedback, please email engagement@ieso.ca.