Day-Ahead Market High-Level Design

Independent Electricity System Operator

DECEMBER 2018

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LIST OF ABBREVIATIONS

Abbreviation	Description
ADE	Availability Declaration Envelope
BCA	Broad Constrained Area
CMSC	Congestion Management Settlement Credits
DACP	Day-Ahead Commitment Process
DAM	Day-Ahead Market
DL	Dispatchable Load
EPT	Eastern Prevailing Time
ERUC	Enhanced Real-Time Unit Commitment
EST	Eastern Standard Time
FTR	Financial Transmission Rights
HDR	Hourly Demand Response
HOEP	Hourly Ontario Energy Price
ICP	Intertie Congestion Price
IESO	Independent Electricity System Operator
IOG	Import Offer Guarantee
ISO	Independent System Operator
ISP	Intertie Settlement Price
LMP	Locational Marginal Price
LSE	Load Serving Entity

Abbreviation	Description
MCP	Market Clearing Price
MGBRT	Minimum Generation Block Run-Time
MIO	Multi-Interval Optimization
MLP	Minimum Loading Point
MRP	Market Renewal Program
MW	Megawatt
NCA	Narrowly Constrained Areas
NDL	Non-Dispatchable Load
NERC	North American Electric Reliability Corporation
NISL	Net Intertie Scheduling Limit
NQS	Non-Quick Start
OR	Operating Reserve
PD	Pre-Dispatch
PRL	Price Responsive Loads
RT	Real-Time
RTM	Real-Time Market
SSM	Single Schedule Market
TR	Transmission Rights
TS	Transformer Station
VG	Variable Generation

Description of Core Concepts

Short-Run Marginal Cost

The additional cost that is incurred if a supply resource produces one more unit of electricity.

Binding Constraint

To ensure safe, reliable operation of the grid, transmission lines have constraints on the amount of electricity they can carry. A binding constraint occurs when the flow of electricity on a transmission line is equal to a constraint.

Two-Settlement System

In a day-ahead market, energy is bought and sold one day before it is consumed or generated. The real-time market, or balancing market, is used to schedule and price the actual amount of energy physically consumed and supplied in real-time. These two markets create a two-settlement system in which participants receive:

- A day-ahead settlement for their day-ahead scheduled quantities at day-ahead prices, and
- A real-time balancing settlement if their actual real-time quantities differ from their day-ahead scheduled quantities, at real-time prices.

Pre-Dispatch

The timeframe between clearing of the day-ahead market until real-time operations, during which optimization of bids and offers is performed to address changes in system conditions.

Price-Setting Eligibility

The determination made by the market on which scheduling characteristics and which cost components are allowed to set locational marginal prices.

Price Convergence

Price convergence happens when day-ahead market prices and real-time market prices are, on average, the same over a reasonable period of time. While the actual real-time price may differ substantially on a given day due to less certain real-time outcomes, longer time price convergence reflects accurate price formation.

1. Executive Summary

Designing the Electricity Market of the Future

Every minute of every day, the Independent Electricity System Operator (IESO) is responsible for ensuring the reliability of the province's electricity grid, administering Ontario's electricity markets, and providing businesses, communities and consumers with the power they count on to meet their needs. Achieving these objectives is complicated by the fact that our existing electricity markets have not kept pace with the dramatic sector-wide developments – technological advances, an evolving operating and regulatory environment and a more diverse supply mix – that are continuing to transform the energy landscape.

Market Renewal: The Rationale for Change

In May 2002, the opening of transparent, wholesale competitive electricity markets in Ontario marked a shift from large, centralized and publicly owned bodies providing services to passive customers to one where buyers and sellers connect to cost effectively supply more engaged consumers with the electricity they need.

While the IESO has made incremental changes to market design to ensure system reliability, the consensus has been clear for some time: the markets require foundational and wide-reaching reforms. That is where the IESO's Market Renewal Program (MRP) comes into play.

Part of our broader efforts to continually rethink the way we do business, this redesign will address persistent, costly design flaws in the current system, and prepare us to more effectively manage future change. In the end, the IESO will deliver more efficient markets, ensuring that all Ontarians have a stable and reliable supply of electricity at the lowest cost.

To lay the groundwork for market renewal, in 2016 the IESO committed to a made-in-Ontario approach by establishing an internal market renewal team supported by an external Market Renewal Working Group, a representative stakeholder forum to advise and inform the IESO on important strategic, policy and design issues affecting the program's success.

In the two years since, this collaborative effort has delivered a compelling benefits case study, a comprehensive market renewal engagement framework founded on agreed-upon principles, and general consensus on important high-level design decisions that will shape Ontario's new marketplace.

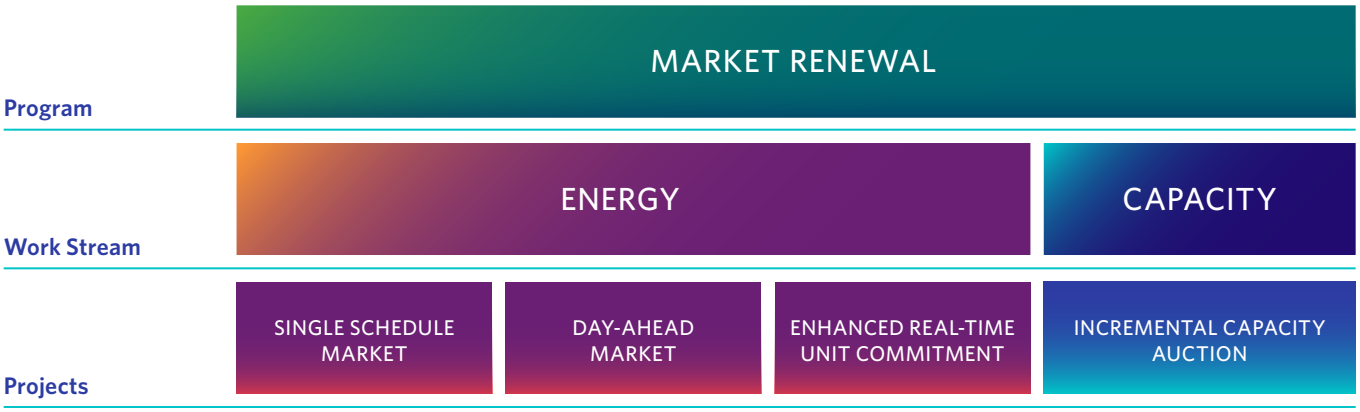
Market Renewal Initiatives

To deliver on its mission to enhance the efficiency of Ontario's wholesale electricity markets, the MRP will:

- Replace the two-schedule market with a **single schedule market** (SSM) that will address current misalignments between price and dispatch, eliminating the need for unnecessary out-of-market payments
- Introduce **a day-ahead market** (DAM) that will provide greater operational certainty to the IESO and greater financial certainty to market participants, which lowers the cost of producing electricity and ensures we commit only the resources required to meet system needs
- Reduce the cost of scheduling and dispatching resources to meet demand as it changes from the day-ahead to real-time through the **enhanced real-time unit commitment** (ERUC) project
- Improve the way Ontario acquires the resources to meet longer-term supply needs by implementing an **incremental capacity auction** (ICA) that will drive down costs by encouraging greater competition in acquiring the resources to meet system needs

Together, these projects are expected to deliver an average of $3.4 billion in savings over a 10-year period.

FIGURE 1: MARKET RENEWAL PROGRAM WORK STREAMS



Developing a Balanced Market Design: Incorporating Stakeholder Input

At the outset, we recognized that our success in creating a market that better meets the needs of suppliers and consumers would depend, in part, on the broad support of stakeholders who were prepared to invest time and effort in developing solutions that will work for the sector and the IESO.

With this in mind, the IESO committed to designing the new energy markets collaboratively and established a comprehensive consultation framework. Built on agreed-upon principles – efficiency, competition, implementability, certainty and transparency – this framework reinforces the importance of giving interested parties an opportunity to provide feedback.

While each of the four MRP initiatives addresses specific needs, they all follow the same design process shown in Figure 2.

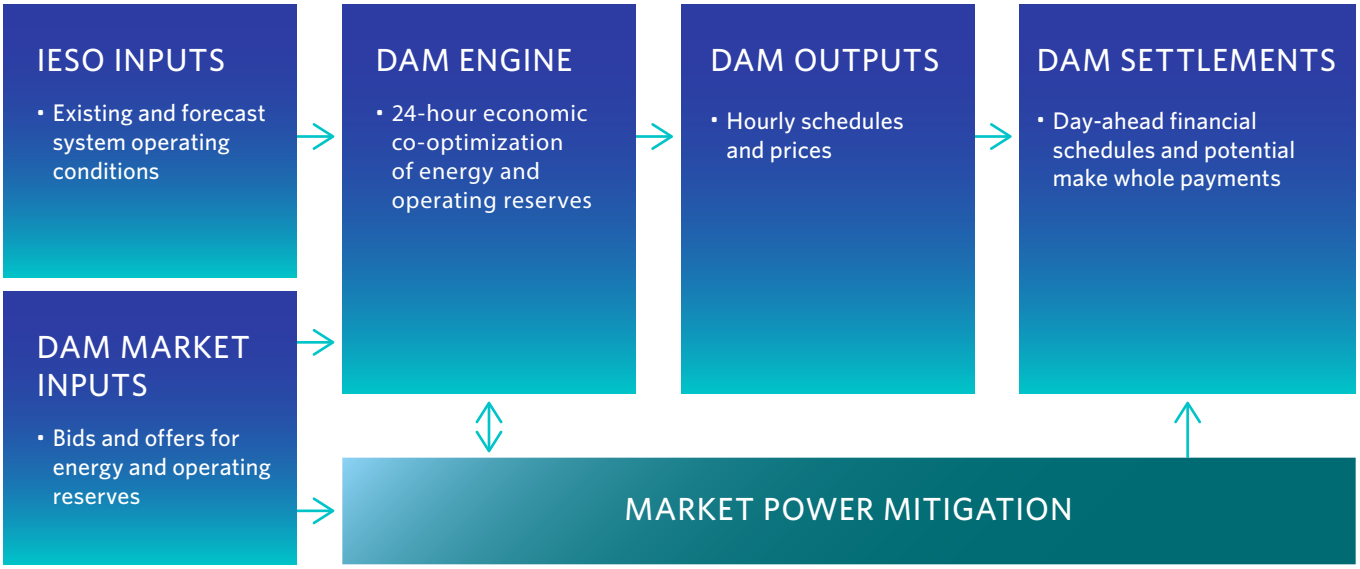
FIGURE 2: PROJECT DESIGN PROCESS

Day-Ahead Market

Increasing Financial and Operational Certainty

The day-ahead market is a standard component of electricity market design in North America and around the world. In fact, all other North American electricity markets include DAMs within their design. DAMs provide financially binding schedules for participating resources a day in advance of operation. Typically, most of the supply is scheduled in the DAM and the real-time market (RTM) is used to balance any deviations that occur between day-ahead and real-time. Financially binding DAMs provide a high-level of financial and operational certainty to market participants and to the system operator. This certainty enables resources to manage their risks and system operators to schedule a cost-effective and reliable supply of electricity.

FIGURE 3: DAY-AHEAD MARKET PROCESS



In the late 1990s when Ontario's electricity markets were being designed, electricity markets were relatively new and DAMs were not yet the common feature they are today. Although the potential for a DAM was considered prior to market opening, Ontario's electricity markets were launched in 2002 without a day-ahead scheduling process. The need to effectively schedule resources in advance of real-time soon emerged and the IESO began exploring the potential for a DAM in 2003. However, Ontario's unique two-schedule system proved to be a major barrier to implementing a DAM. As a result, the IESO opted for an alternative solution and introduced the day-ahead commitment process (DACP) in 2006.

While introducing important improvements over Ontario's original market design, the DACP has a number of shortcomings. Specifically, not all resources participate fully or efficiently in the DACP. For example, due to an inability to lock-in prices for the next day, exports lack the incentive to participate in the DACP, focusing instead on participating in the RTM where settlement prices[1] are determined. Other resources may participate in the DACP but with less accurate offers than in the RTM where they are competing for a settlement price.

While most resources do not receive any form of financial certainty from the DACP, the process does provide cost guarantees for imports and non-quick start (NQS) resources[2] when they are among the lowest-cost options for meeting expected demand. Cost guarantees incent these resources to participate by eliminating the risk that they might not recover the costs they have incurred in advance of real-time and before settlement prices are determined.[3] Failure of resources to participate fully or efficiently in the DACP results in an incomplete view of the next day's demand and supply, diminishing the IESO's ability to schedule and commit the lowest-cost set of resources to meet the next day's demand.

With the introduction of an SSM in Ontario, the IESO is now in a position to implement a DAM, encouraging all resources to participate more fully and efficiently in the day-ahead timeframe by providing financially binding day-ahead prices and schedules. Improved day-ahead participation will provide the IESO with more operational certainty and market participants with more financial certainty as real-time approaches, enabling improved planning and risk management. For example, suppliers will be better able to manage arrangements for real-time fuel supply and consumers will be able to consume at planned levels confident that they will not be exposed to unexpectedly high real-time costs. Financially binding prices and schedules will also encourage greater participation from imports and exports, providing a much more accurate picture of expected real-time conditions.

In addition to improving on the IESO's current DACP, the DAM will also effectively work alongside the other market renewal initiatives within the energy work stream: the SSM and enhanced real-time unit commitment (ERUC). Locational pricing, introduced through the SSM, will be used across all timeframes (day-ahead, pre-dispatch and real-time) in order to deliver more efficient scheduling and dispatch outcomes. ERUC will use the outputs of the DAM as inputs in its commitment process to ensure that day-ahead schedules are accounted for in the pre-dispatch timeframe. Three-part offers consisting of energy, start-up and speed-no-load costs will be used in the DAM and ERUC to make scheduling decisions for NQS resources. Having a cohesive design across all timeframes for the energy markets will help maximize both market efficiency and benefits for Ontario consumers.

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[1] Settlement prices are the price a supplier is paid for production and a consumer pays for consumption.

[2] Non-quick start resources have start-up times greater than an hour and must remain online for a minimum period of time at a minimum level of generation prior to shutting down to avoid damaging their equipment.

[3] Day-ahead guarantees are based on day-ahead schedules and are distinct from the real-time generator cost guarantee program that applies to the pre-dispatch timeframe.

Since October 2017, when the IESO hosted the first DAM stakeholder meeting, consultation has taken place on all aspects of DAM design, including in-depth discussions of the applicability for Ontario of different options for each of the proposed design elements. Throughout the process, we have taken into account how the choices we considered would affect stakeholders, doing our best to ensure decisions reflect their collective feedback, adhere to our guiding principles and anticipate unintended outcomes.

While collaboration does not necessarily signal agreement on every detail, the design decisions have been extensively discussed, and provide a strong foundation for the detailed work required to implement the DAM.

To manage the scope and complexity of the DAM, the IESO focused the design work and engagement with stakeholders, separating the project into 18 design elements. These elements were grouped into three categories: Participation and Input Data; Execution, Timing, Real-Time Integration and Price Formation and Settlement Topics. The following sections focus on the most material design elements in each category.

Participation and Input Data at a Glance

Broad participation in the IESO's electricity markets drives competitive behaviour, which typically results in efficient market outcomes. The participation and input data design elements are focused on creating opportunities and setting out the conditions for participating in the DAM.

As is the case in other jurisdictions, resources that receive capacity obligations from the incremental capacity auction (ICA) will be required to participate in Ontario's DAM. To increase liquidity and enhance competition, which leads to greater discipline and improved day-ahead participation, virtual transactions[4] will also be allowed. The IESO expects that the opportunity to gain more certainty ahead of real-time operations will encourage robust participation in the DAM. Resources without a capacity obligation will not be required to participate in DAM; however, in the event that contracted or rate-regulated resources do not have the right incentives to participate in the DAM prior to the implementation of the renewed market, existing offer obligations will be maintained as a transitionary measure.

Under the DACP, the IESO submits offer quantities on behalf of variable generation (VG) resources while the resources submit their own prices. This arrangement works because the day-ahead offers do not impact VG settlement. With DAM schedules impacting their settlement, VG resources may continue to use the IESO forecast if they wish, but they will be responsible for their offered quantities under the DAM.

To further expand the benefits of the DAM and widen participation, non-dispatchable loads will be given the option to become price responsive loads (PRLs) – a new category of market participant that will be created as part of the DAM. PRLs will be able to participate directly in the DAM by submitting energy bids, but will continue to be non-dispatchable in real-time. The IESO will continue to forecast demand and bid on behalf of non-dispatchable loads that do not choose to become PRLs.

[4] Virtual transactions are supply offers and load bids that participate in the DAM, but will not deliver or consume physical power in the real-time market.

Execution, Timing, Real-Time Integration and Price Formation at a Glance

These design elements deal with a disparate set of decisions that are required to deliver an effective DAM design. Key decisions within this category relate to market power mitigation, price-setting eligibility, treatment of hydroelectric resources, and DAM timing.

Market power mitigation is an important element of deregulated wholesale electricity markets. A market thrives when there is effective competition among many resources. When competition is restricted, market participants can exercise their "market power" by either economically or physically withholding energy from the market to increase the price.

The IESO has always had a framework to address the potential exercise of market power. Under the current system, however, market power mitigation is carried out after it occurs, and so is based on actual values rather than estimates.

With the implementation of a DAM, market power mitigation will be applied in all operational timeframes – day-ahead, pre-dispatch and real-time. The IESO will apply conduct and impact tests to determine whether economic or physical withholding is occurring and to what extent it might impact the market. Market participant behaviour will be measured against reference levels and thresholds known to market participants to assess whether mitigation is required.

To reduce market power mitigation impacts on settlements, before-the-fact conduct and impact tests will be carried out to detect economic withholding. Before-the-fact mitigation will ensure that settlements do not have to be revised. If the tests fail, offer prices will be adjusted to reference values, which will then be used to produce schedules.

Before-the-fact tests are not feasible for physical withholding, so tests for physical withholding will be carried out after-the-fact. Where physical withholding is found to have occurred, the market will not be resettled. Instead, adjustments to the settlement of the responsible market participant will be made.

Ensuring that the widest range of resources possible is eligible to set prices will enhance competition and support efficient price signals in Ontario. Certain resources that are unable to set prices in real-time, such as imports and exports (because they are not dispatchable on a five-minute basis) will be eligible to set prices through the DAM (which schedules on an hourly basis). The introduction of virtual transactions and PRLs in Ontario will expand the resources able to set prices in the day-ahead timeframe, and help enhance the day-ahead price signal.

Currently, hydroelectric resources that have interdependencies with other resources on the same river system are allowed to revise their offers after initial DACP results are released. This opportunity is offered to ensure that hydroelectric resources can deliver on the schedules they receive. However, under a DAM and a two-settlement system this approach will no longer be feasible. To enable fair competition and to increase the likelihood that hydroelectric resources receive feasible day-ahead schedules, the IESO intends to model additional hydroelectric operating characteristics in the day-ahead scheduling process. By better modelling hydroelectric resources' physical constraints, the IESO and market participants will benefit from a more accurate view of the next day's operations.

The DAM needs to be aligned with the year-round gas nomination deadline of 14:00 EPT so that natural gas resources can base fuel supply decisions on already determined day-ahead schedules. To help achieve this alignment, the DAM will use Eastern Prevailing Time (EPT) rather than Eastern Standard Time (EST) which is used by DACP. The DAM will run between 10:00 and 13:30 EPT after the 06:00 to 10:00 EPT submission window for bids and offers closes.

Some aspects of the DACP will be maintained in the DAM. For example, combined-cycle facilities that produce power using both gas and steam currently have an opportunity to reflect the physical characteristics of their resources through a "pseudo-unit" model. This model will continue to be used in the DAM and will also be incorporated into the pre-dispatch timeframe through the ERUC initiative.

As is the case with the DACP, the DAM engine will also include three passes in order to produce final prices and schedules. While the inputs for each pass of the DAM engine will differ in some ways from the DACP (as explained in detail later in this document) the general approach remains, with each pass playing an important role in ensuring the IESO schedules the lowest-cost available resources to meet demand on the following day.

Settlement Topics at a Glance

A key concept within the DAM is the two-settlement process. Resources that participate within the DAM will receive a financially binding schedule that will see them pay (in the case of consumers) or be paid (in the case of suppliers) for their day-ahead schedule based on their day-ahead locational price. When the quantity resources produce or consume in real-time differs from their day-ahead schedule, these deviations will be settled (balanced) based on real-time locational prices.

DAM Participants will be Settled Based on the Following Two-Settlement Equation:

Day-Ahead Settlement		Real-Time Balancing Settlement
Day-ahead market scheduled quantity (Q_{DAM}) multiplied by the day-ahead market locational price ($\$_{DAM}$)	+	Real-time market actual quantity (Q_{RTM}) less the day-ahead market scheduled quantity (Q_{DAM})multiplied by the real-time market locational price ($\$_{RTM}$)
$Q_{DAM} \times \$_{DAM}$		$(Q_{RTM} - Q_{DAM}) \times \$_{RTM}$

Non-dispatchable loads (NDLs) that continue to be represented in the day-ahead timeframe by the IESO's load forecast will be settled such that their balancing settlements[5] will be allocated proportionately among all NDLs based on their real-time consumption. This is because NDLs do not submit their own bids into the market.

[5] Settlement for non-dispatchable loads is described in detail in the body of this document.

Conclusion

The DAM high-level design is an important step toward the implementation of a more robust day-ahead scheduling process in Ontario. The DAM will help drive broad and efficient day-ahead participation leading to improved scheduling decisions. Increased financial and operational certainty will help existing and future market participants manage risk, reducing exposure to real-time price volatility and enabling suppliers to better manage their operations and fuel costs. The introduction of virtual transactions and PRLs will help to foster greater competition and thereby increase market efficiency. Together these features will improve the efficiency of day-ahead scheduling in Ontario, making better use of existing assets and helping to reduce costs for consumers.

The culmination of months of extensive consultation with stakeholders, this document is both a comprehensive summary of the decisions that will enable the introduction of a day-ahead market and a stepping-off point for engagement on the detailed decisions that will need to be addressed before implementation.

This high-level design is part of a series of reforms that will fundamentally transform the province's electricity markets, and which, taken together, will enable us to deliver electricity to consumers at lowest cost and better prepare the IESO and market participants for whatever the future may hold.

2. Participation and Input Data

A day-ahead market (DAM) is expected to drive broader and more efficient participation from supply and load resources relative to the current day-ahead commitment process (DACP) because financially binding DAM schedules increase financial and operational certainty for all resources ahead of real-time. Greater certainty is realized because market participants will know what their revenues or costs will be if their DAM schedules materialize in the real-time market (RTM). While the DAM encourages resources to participate, the efficiency of the DAM is directly tied to the level and accuracy of that participation:

- The level of participation depends on the number of resources participating in the DAM as a greater number of resources participating will increase DAM liquidity and help drive a more stable DAM price signal.
- The accuracy of participation depends on how reflective DAM offers and bids are of a resource's expected energy delivery or consumption in the RTM. For Ontario, the accuracy of IESO's forecast for NDL will be equally important.

Accurate representation of RTM outcomes in the DAM supports price convergence. Greater price convergence coupled with greater price stability can therefore increase DAM efficiency.

The Participation and Input Data design elements outline features for new and existing resources that will drive greater and more accurate participation in the DAM. There are existing resources that are not expected to require new features to participate in the DAM. This is because the DACP has already laid the foundation for these resources to participate in the DAM. An example is the "pseudo-unit" model the IESO uses to schedule non-quick start (NQS) resources based on their combined-cycle characteristics. The design elements in this section specifically address the rationale behind:

- Implementing a DAM without an explicit obligation for resources to participate;
- Providing opportunities for variable generation (VG) resources and non-dispatchable loads (NDL) to participate by themselves in the DAM;
- Allowing virtual supply and load resources (virtual transactions) to compete with physical transactions in the DAM; and
- Using existing input parameters in the DAM engine.

2.1 Offer Obligations

2.1.1 Design Element Description

Offer obligations in the market ensure that resources submit supply offers or load bids for energy and operating reserve (OR).

Current Market

The IESO currently uses both the DACP and RTM to schedule supply and load resources to ensure energy and OR requirements can be satisfied in real-time. Resource offers and bids must be present for the IESO to do this and resources are encouraged to participate in both timeframes. Resources are driven to submit offers and bids into the RTM because their settlements are based on real-time results.

Since the DACP does not impact the settlement of most resources, resources have less incentive to submit offers and bids in the day-ahead timeframe. However, the IESO still needs to produce a dependable view of the next day to ensure reliable operations. Without a financial incentive for all resources in DACP, the IESO requires resources to submit offers and bids into the DACP if they wish to be eligible for dispatch in the RTM. This obligation is referred to as the availability declaration envelope (ADE). For most resources, the ADE is established such that real-time schedules will not exceed the quantity offered in the day-ahead timeframe. For VG resources, the ADE is established based on available capacity and not by the quantity offered through the IESO's centralized forecast for VG resources.[6]

The ADE encourages resources to participate in the DACP because it makes them eligible for dispatch in the RTM. Resources will therefore submit bids and offers into the DACP because failing to do so would make them unavailable to participate in real-time. As a result, the ADE obligation provides the IESO with assurance that sufficient offers will be available for the DACP to produce a reliable resource commitment for the next day.

Future Market

Under a DAM, the IESO must consider whether an obligation within the IESO-administered market for resources to submit day-ahead offers and bids is still required to ensure sufficient participation in the day-ahead timeframe.

The DAM will be financially binding and the two-settlement system provides an incentive for resources to participate in the day-ahead timeframe. Resources that participate in the DAM can lock in a DAM price for their DAM schedules, and use the RTM to balance the difference. Resources benefit from greater financial and operational certainty with DAM schedules and prices rather than waiting for less predictable dispatches and prices in real-time. Financial certainty is created because resources know what their costs and revenues will be if their DAM schedules materialize in real-time. Operational certainty is created because a resource can better plan for real-time operations by securing fuel and staff in advance. As a result, resources should have a natural incentive to participate in the DAM even without an offer obligation.

[6] The use of available capacity instead of submitted offer quantity for VG is due to the inherently uncertain nature of wind and solar conditions.

In other jurisdictions, these financial market incentives are coupled with must-offer obligations for resources that have a capacity obligation and are required to satisfy resource adequacy.[7] These performance obligations complement the natural financial incentive to ensure participation into the DAM. Capacity-based performance obligations provide assurance to system operators that capacity resources will offer the availability that they have been paid for into the DAM.

Ontario is different from other jurisdictions because adequacy is currently ensured via long-term contracts and rate-regulation. These constructs are tied to RTM participation, which is appropriate given that Ontario does not have a financially binding DAM. As the market evolves, it will be important for incentive structures to also evolve so that they are aligned with the new market, to drive efficient DAM participation. The goal will be that any contract amendments or changes to the regulatory framework should ensure that DAM participation is not inhibited or otherwise distorted.

2.1.2 Decisions

The IESO has determined that an explicit obligation for resources to participate in the DAM is not required as long as all resources have proper incentives to do so.

It is anticipated that resources that clear in the incremental capacity auction will have obligations that require participation in the wholesale energy market. In addition, contracted and regulated resources should have the right incentives for participating in the DAM. In the event that the right incentives are not in place before the renewed market goes live, the IESO proposes that the ADE offer obligation would be retained as a transitionary measure. Methodologies used to establish the ADE would be identical to those existing under the current market.

Because maintaining the ADE would be sub-optimal, compared to the desired steady state in which contracted and rate regulated resources have the right incentives and are aligned with the new market, best efforts will be made to obviate the need for this requirement prior to the launch of the renewed market.

2.1.3 Detailed Design Considerations

The IESO will facilitate discussions and monitor progress of contracted and rate-regulated resources having incentives to participate in the DAM.

2.1.4 Linkages

The Offer Obligation design element is linked to DAM design elements 4 (Virtual Transactions) and 6 (Market Power Mitigation) as follows:

- *Virtual Transactions:* improve DAM efficiency by providing non-physical resources (virtual transactions) with an opportunity to compete with physical resources in a DAM; and
- *Market Power Mitigation*: will include an after-the-fact mitigation mechanism to adjust settlement outcomes where resources have exercised market power by physically withholding from the DAM.

[7] The term capacity market is used generically, including other mechanisms to satisfy resource adequacy.

2.2 Supply Participation: Variable Generation

2.2.1 Design Element Description

This design element considers the potential for VG resources (solar and wind resources) to assume responsibility for submitting their own offer quantities into the DAM.

Current Market

Under the DACP, day-ahead offers are jointly submitted by the IESO and VG resources. The IESO submits the hourly offer quantities based on a centralized forecast and the VG resources specify the hourly offer prices for those quantities. This method is also used to schedule and dispatch VG resources in the pre-dispatch and RTM.

Other jurisdictions use a similar arrangement for their intra-day and RTM processes, but not for the DAM. VG resources that participate in DAMs are responsible for choosing their own offer prices and quantities because the DAM is a financial market that participants use to gain financial certainty.

Future Market

Under a DAM, VG resources have an opportunity to take a more active role in the energy market by choosing how they participate in DAM. This means that VG resources participating in the DAM should have more autonomy and be responsible for choosing to submit their own offer prices and quantities, providing them with financial certainty available to other supply resources. VG resources are encouraged to participate in DAM when they can lock in a DAM price on a DAM schedule they have reasonable assurance of delivering in the RTM. This encourages active and more efficient participation between VG resources and other supply resources competing in a DAM.

VG resources are in the best position to manage their participation in a financially binding DAM, like all other supply resources, if they are driven to compete in the energy market. It would be inappropriate for the IESO to continue to manage VG participation in the DAM, given the financial binding two-settlement. If VG output was over-forecasted in the DAM relative to their actual delivery in the RTM, there would be a balancing amount for the undelivered energy. This cost would otherwise then be recovered through out-of-market uplift charges that would be passed on to consumers and exports.

While it would be more appropriate for VG resources to manage both offer prices and quantities in a financially binding DAM, this is not the case for pre-dispatch and the RTM where physical participation is required. To ensure these commitment and scheduling decisions support reliable system operation in the physical RTM, VG forecast uncertainty is managed by the IESO. Therefore, using the IESO's centralized VG forecast to predict VG resource schedules in the pre-dispatch timeframe would support reliability. The same logic holds true for the RTM, where VG output can vary within the dispatch hour based on prevailing wind and solar conditions. VG resources would still need to provide a price for those quantities so that the IESO can continue to dispatch VG resources based on their marginal costs.

2.2.2 Decisions

The IESO has determined that VG resources participating in the DAM will assume responsibility for submitting both offer quantities and prices into the DAM. Providing these choices to VG participants gives them the same financial opportunities and risks as other supply resources in the DAM. Greater efficiencies can be achieved when resources compete to provide energy market services.

The IESO recognizes that shifting this responsibility to VG resources may create an additional administrative burden on VG resources as they prepare for DAM participation. To facilitate a smoother transition, the IESO will provide VG resources with an option to elect the IESO's centralized forecast quantity as their own offer quantity on an hourly basis.

2.2.3 Detailed Design Considerations

The IESO will need to consider the software changes required to support the mechanics of how VG dispatch data will be submitted and integrated into the DAM, pre-dispatch and real-time. The mechanics include providing VG resources the option to elect the IESO's centralized forecast quantity.

2.2.4 Linkages

There are no identified linkages for this design element.

2.3 Load Participation

2.3.1 Design Element Description

For DAMs to work effectively, demand (load) quantities should be scheduled in the DAM close to the amounts that are actually consumed in the RTM. If only a portion of the actual RTM load was represented in the DAM, less supply would be scheduled in the DAM relative to the RTM. Scheduling less supply in the DAM to meet lower-than-expected load would result in lower DAM prices relative to RTM prices. Conversely, scheduling more supply in the DAM to meet greater-than-expected load relative to the RTM would result in higher DAM prices relative to RTM prices. Price differences between the DAM and the RTM that are driven by a less accurate representation of actual load in the RTM can distort efficient participation from suppliers in the DAM. While virtual transactions[8] will help prices converge and minimize inaccurate bidding strategies, they can only do so to the extent that bidding and pricing gaps between the DAM and RTM are predictable. Physical load participants should submit bids that are as reflective of real-time expectations as possible. This would allow them to increase financial certainty on a larger portion of their expected real-time consumption. Therefore, accurate load participation is critical to providing load participants with greater financial and operational certainty, and increasing the effectiveness of the DAM. This design element establishes opportunities for physical load to be represented as accurately as possible in the DAM.

Current Market

In Ontario, only a relatively small portion of load market participants currently submit their own bids into the DACP or the RTM. These load market participants include dispatchable loads (DLs) and hourly demand response (HDR) resources. There is a third class of load market participants called non-dispatchable loads (NDLs) that do not submit their own bids into the DACP or the RTM. The IESO currently represents all NDLs in the DACP and the RTM using a centralized load forecast because it is responsible for ensuring there is enough supply to meet forecasted NDL consumption. This approach also removes much of the administrative burden from having NDLs forecast their own load.

The IESO currently produces a day-ahead NDL forecast using a less granular, province-wide approach. The province-wide forecast is generated using historical load consumption and expectations of future load consumption based on a number of factors, including weather forecasts. Forecast consumption at a specific NDL location is determined by allocating a portion of the province-wide forecast to each NDL location using load distribution factors that account for historical load patterns. The NDL forecast is typically more accurate at the province-wide level and less accurate at the NDL's location because factors such as local weather conditions and actual consumption plans are too difficult for the IESO to account for so many NDL participants.

A less granular, province wide NDL forecast is sufficiently accurate for the IESO to schedule resources in the DACP. While a more granular forecast would produce a more efficient DACP schedule, it is less relevant because DACP is not a market and not used to settle resources. Forecast NDL consumption is more accurate in the RTM because load patterns are more predictable as real-time conditions become more certain.

[8] The mechanics and benefits of virtual transactions are described in DAM design element 4 (Virtual Transactions).

Future Market

In the Ontario DAM, the accuracy of the NDL forecast becomes more important because the accuracy of the forecast will impact the overall settlement of all resources. The importance of NDL forecast accuracy is even greater in a DAM with locational pricing. It would be less efficient for IESO to continue to forecast NDL consumption in the DAM using the less granular approach currently used in DACP. This is less efficient because supply resources could be over- or under-scheduled in the DAM where there is price separation due to transmission limitations. For instance, higher load in a congested area could schedule more resources in that area than required. A more granular load forecasting approach would support more efficient outcomes and encourage efficient participation because DAM results would better reflect RTM expectations.

Another way to achieve more accurate load representation is for loads to represent their own consumption in the DAM. Loads are in a much better position than the IESO to forecast their expected consumption at their own location. This is an advantage for loads because it allows them to take a more active role in managing their energy costs through the DAM. Giving NDLs the ability to manage their own costs through the DAM is more efficient because they know their load expectations in real-time better than the IESO.

The DAM would be most efficient if all NDLs could participate for themselves because NDLs would be encouraged to bid in their expected load. This is the participation model used in other jurisdictions with a DAM. In other jurisdictions, load serving entities (LSEs) and load retailers are responsible for bidding on behalf of their NDL customers. LSEs and load retailers take on this responsibility because they are the entities responsible for securing supply for their load customers. Ontario is not in a position to achieve such active load participation due to regulatory barriers for local distribution companies (LDCs) to take on financial positions for their load customers. LDCs make up the majority of NDLs and are currently limited to the business of electricity distribution. Examples of NDLs that would be eligible to participate in the DAM include transmission-connected industrial loads.

A more granular NDL forecast combined with some loads participating for themselves can produce DAM schedules and prices that are more reflective of expected conditions in real-time. More accurate DAM price signals will encourage the most efficient behaviour because resources would have of greater financial certainty in the DAM.

2.3.2 Decisions

The IESO has determined that it will continue to represent the majority of NDLs since few NDLs are expected to be eligible for DAM participation. Having the IESO continue to represent NDLs is the only way to ensure effective DAM participation until a greater level of load participation can be realized, perhaps through the establishment of LSEs.

The IESO will increase the accuracy of the NDL forecast by moving from a less granular global NDL forecast to a more granular zonal forecast. A zonal forecast will be used in the DAM, pre-dispatch and RTM to support scheduling consistency and efficiency across all timeframes. A more accurate load distribution across all timeframes can improve DAM to real-time price convergence and encourage efficient DAM participation.

A more accurate load forecast will also improve the efficiency of unit commitment decisions in both DAM and pre-dispatch scheduling. A day-ahead and intra-day load distribution that is more reflective of real-time load conditions means the lowest-cost resources that would have been scheduled to meet that load in real-time are committed in advance.

The IESO will provide eligible NDLs with the option of becoming a price responsive load (PRL). PRLs will have the ability to submit their own bids into the DAM and be eligible to receive DAM schedules, but would continue to be non-dispatchable in real-time. Providing loads the option to become price responsive in the DAM can increase day-ahead scheduling efficiency because they would be encouraged to bid in a level of load that is consistent with their intentions in real-time.

In the short term, the IESO expects the initial uptake of PRL status will come from industrial transmission-connected or embedded loads that satisfy IESO registration requirements. Over the longer term, as the market and sector continues to evolve, the PRL design is expected to be able to accommodate future regulatory, metering and modelling changes that would be required to facilitate expanded load participation from LDCs and load aggregators in the future.

2.3.3 Detailed Design Considerations

The IESO will consider the appropriate electrical zones to forecast NDLs based on the forecast accuracy that can be achieved. Ontario is currently dividing into 10 electrical zones. It may be more practical to amalgamate one or more of the existing zones. This could mean, for example, including the Bruce zone that has low load relative to supply within the Southwest zone. Factors to consider include magnitude of load and the quality and quantity of input data for historical demand, weather and embedded generation.

The means by which load market participants can opt-in or opt-out of PRL status, including how the IESO's zonal demand forecast takes this into account, will also be determined.

2.3.4 Linkages

The Load Participation design element is linked to DAM design element 13 (Two-Settlement for Supply and Load) because NDLs represented by the IESO load forecast will be settled differently from loads participating for themselves in the DAM.[9]

[9] This is discussed in detail under DAM's, "Two-Settlement for Supply and Load" design element under section 4.1.

2.4 Virtual Transactions

2.4.1 Design Element Description

Virtual transactions are a best practice feature in all other jurisdictions with a DAM. Virtual transactions are supply offers and load bids that can be submitted into the DAM that do not represent physical supply or demand. A DAM can include virtual transactions because unlike the RTM, it does not require the physical delivery or consumption of energy. DAM schedules are purely financial obligations that market participants compete for in order to increase financial certainty ahead of the RTM. While a resource should be driven to participate to maximize their financial certainty, some market participants may be more unwilling than others from offering as much of their expected real-time capability into the DAM as possible. Market participants that offer less than their expected real-time capability could produce less efficient DAM schedules because DAM prices would tend to persistently diverge from real-time prices. Virtual transactions help to address inefficient scheduling outcomes by providing non-physical resources with an opportunity to compete with physical resources in the DAM. Increased liquidity from virtual transactions also helps to reduce opportunities for market participants to manipulate DAM prices by physically withholding energy from the DAM.

Virtual transactions help align schedules and prices between the DAM and RTMs by arbitraging predictable price differences between the two markets. Price differences between the DAM and RTM can occur when physical suppliers and loads strategically offer more or less in the DAM than their expected real-time availability or consumption. Physical supply and load resources may do this to increase profits or reduce costs. For instance, a physical supplier can achieve greater profits by withholding energy from the DAM and raising DAM prices. Similarly a physical load may bid less into the DAM to avoid the risk of overpaying for energy if their actual consumption in the RTM turns out to be less than their DAM schedule. To the extent these behaviours are predictable, virtual transactions can increase market efficiency by improving DAM to RTM price convergence.

Virtual transactions are encouraged to drive price convergence because of their ability to arbitrage price differences between the DAM and RTM. The profit potential for virtual transactions arises when the DAM and RTM prices do not fully converge. A virtual supply offer will occur when the virtual supplier expects the DAM price at a location to be greater than the RTM price. Submission of the virtual supply offer corrects this imbalance by increasing DAM supply. Increasing supply offers into the DAM will drive the DAM price down toward the RTM price until the price differential prompting the virtual supply offer is reduced. Conversely, a bid from virtual demand will increase the price in the DAM toward the RTM price.

Other jurisdictions with DAMs have reported that virtual transactions have helped to converge DAM and RTM prices. The virtual transactions can serve as a proxy for physical supply or load that have been underbid into the DAM and have caused DAM and RTM prices to not fully converge. Price convergence enables more efficient DAM resource scheduling because DAM schedules will more accurately reflect expected supply and demand conditions in real-time.

It is important to note that virtual transactions are only evaluated in the DAM. They are unable to impact intra-day scheduling decisions and RTM dispatches because they have no physical ability to deliver energy. With an understanding that virtual transactions can be scheduled in the DAM but have no physical presence in real-time, one could assume that system operators might face reliability issues in real-time without sufficient certainty about physical conditions day-ahead. System operators manage this risk by including a reliability scheduling pass[10] either within or after the DAM. This pass ignores the presence of virtual transactions in its evaluation to ensure that sufficient NQS resources are operationally committed by the DAM and available to meet forecast load in the RTM.

Virtual transactions are modelled in the DAM much like physical resources, allowing DAM to evaluate and schedule virtual transactions against each other and against other physical transactions. Virtual resources can be modelled at a nodal or aggregate location. In a nodal implementation, virtual supply and load resources are modelled just like physical resources and can co-exist at any physical supply or load location in the DAM. In an aggregate implementation, virtual supply and load resources are modelled to represent a collection of individual supply or load locations. This is achieved by apportioning virtual offer and bid quantities across the individual physical locations within the aggregated area using pre-determined distribution factors or ratios. Distribution factors are inputs into the DAM set by the system operator and are typically reflective of historical load flow distributions observed on the transmission system. Aggregate implementations mean fewer virtual transactions need to be evaluated in the DAM, reducing overall DAM engine complexity and run-time.

Virtual transactions can lengthen the time required to execute the DAM or, in some cases, may prevent the DAM model from solving. A second risk is that participants can engage in inefficient virtual transactions because of their ability to profit from price differences between the DAM and RTM. Inefficient virtual transactions can occur where predictable locational price differences are triggered by persistent modelling discrepancies between the DAM and RTM. A predictable price difference between two locations could result from a binding transmission constraint between these locations being persistently more restrictive in the RTM than the DAM. A virtual transaction can profit from these modelling differences by submitting a virtual supply offer at one location and a virtual supply bid of the same value at another location (offsetting transactions). If both transactions clear the DAM, the participant would realize a net profit between the two virtual supply and load transactions because of the price difference in the RTM. This can unnecessarily increase congestion shortfall payments that are recovered through uplift.

[10] The reliability scheduling pass will be executed within the DAM engine. The features of this pass are described in the Functional Passes design element.

Other jurisdictions have implemented a variety of measures to address these issues, including the aggregate level implementation approach described earlier. An aggregate implementation also reduces a market participant's ability to profit from persistent modelling discrepancies because a participant would have difficulty in predicting how the submission of offsetting virtual transactions at aggregate locations would be apportioned to specific physical supply and load locations within the aggregated area. Reducing the volume of virtual transactions can also be achieved in a nodal implementation by limiting the locations at which virtual transactions may be bid or offered and limiting the numbers of bids or offers per market participant. Additional measures commonly used to manage virtual transaction volumes in other jurisdictions include:

- Not permitting virtual transactions to participate at intertie locations considering intertie transactions already provide non-physical market participants the ability to produce or consume energy in the DAM;
- Applying administrative fees and minimum bid and offer quantities to discourage market participants from submitting many transactions to earn profits on as many DAM to RTM price differences as possible (fishing activities); and
- Imposing a limit on the amount of net energy that can be injected or withdrawn at biddable locations to prevent the DAM engine from failing. The DAM engine could fail, for example, if an excessive amount of virtual supply cleared at a particular location such that acceptable voltages cannot be calculated by the DAM engine.

These measures have been successful in ensuring that virtual transactions provide an overall benefit to market efficiency.

2.4.2 Decisions

The IESO has determined that market participants will be allowed to submit virtual transactions into the DAM as energy offers and load bids. Virtual transactions will not be available for operating reserve. Virtual transactions are expected to provide the efficiency benefits observed in other jurisdictions. The following measures will be put in place in to maximize DAM efficiency while minimizing any adverse impacts on DAM engine performance.

Virtual Transaction Modelling

Virtual transactions will be enabled at aggregated locations rather than actual physical supply and load locations. As mentioned, arbitraging price differences created by modelling discrepancies between the DAM and RTMs can increase uplift costs without actually helping DAM and real-time prices converge. Aggregated locations can also mitigate virtual transactions from generating infeasible DAM results and causing DAM delays or failures.

Virtual transactions will not be allowed at intertie nodes since intertie transactions already enable non-physical market participants the ability to produce or consume energy in the DAM. A separate category of virtual transactions to support intertie trading would therefore be redundant.

Administration Fee

An administrative fee will be applied to each virtual transaction on a per MWh basis to discourage market participants from fishing activities intended to earn profits on as many DAM to RTM price differences as possible. The fee would discourage traders from inundating the DAM engine since they could only profit off DAM to RTM price differences that are large enough for the virtual transaction to at least recover the administration fee.

Minimum Offer or Bid Amount

A minimum offer or bid amount will be imposed for virtual transactions. Similar to the administration fee, the minimum offer or bid amount will also discourage fishing activities that provide little market value or adversely impact DAM engine performance.

Maximum Energy Injections or Withdrawals at Biddable Nodes

There will be a limit on the amount of net energy that can be injected or withdrawn at biddable locations. This will prevent an excessive amount of virtual transactions from being evaluated at a particular location to prevent the DAM engine from failing.

2.4.3 Detailed Design Considerations

The measures noted in section in 2.4.2 will need to be further defined during detailed design as follows:

Virtual Transaction Modelling

The IESO will need to define a set of aggregated locations that virtual transactions can be offered or bid.

Administration Fee

The IESO will need to determine the administration fee and whether it will only be applied to all submitted virtual transactions, cleared virtual transactions, or both. Methods by which the administration fee is allocated, collected and disbursed will also need to be determined.

Minimum Offer or Bid Amount

A threshold for the minimum offer or bid amount will need to be determined.

Maximum Energy Injections or Withdrawals at Biddable Nodes

The IESO will need to determine how the DAM engine will impose this limit. Limits could either be manually populated as inputs to the DAM engine or performed automatically by the DAM engine when the engine is at risk of not being able to resolve the DAM.

Other detailed design considerations not related to the measures listed above include:

Market Participant Volume Limits

An additional measure that may be explored is whether the DAM engine is capable of limiting the number of virtual transactions an individual market participant could submit for a given trading day. This control could be added to minimize adverse impacts on DAM engine performance if the other measures noted in section 2.4.2 prove to be insufficient.

Floor Prices and Ceiling Prices

Some physical resources are currently not allowed to offer within the full range of the Minimum MCP to the Maximum MCP. The IESO will need to determine whether similar restrictions are required for virtual transactions.

2.4.4 Linkages

The Virtual Transactions design element is linked to the DAM design element 6 (Market Power Mitigation) design element because the IESO will need to determine how to mitigate physical resources from using virtual transactions to exercise market power.

2.5 Reliability Input Parameters

2.5.1 Design Element Description

Reliability input parameters (input parameters) are reliability requirements and physical transmission constraints that the DAM engine must either satisfy or respect when determining DAM schedules for physical and virtual resources. Reliability requirements represent projected ancillary services such as operating reserve, while physical transmission constraints represent maximum transfer capabilities of the power system. For clarity, input parameters do not include market participant dispatch data. This design element establishes the input parameters that will be used in the DAM considering all of the input parameters currently used in the DACP.

The DACP currently uses the following input parameters, which are also common to all other jurisdictions with a DAM:

- ***Ancillary Service Requirements:*** local and global operating reserve requirements, regulation procurement schedules, and voltage support or reliability must-run contracts;
- ***Power System Network Model:*** representation of the topology of the power system, including injection locations for supply and withdrawal locations for demand;
- ***Contingency Set:*** "what if" scenarios that model the potential for power system equipment to experience a failure. Scenarios that are required to meet reliability criteria are modelled to ensure resources are scheduled to levels that will not place remaining power system equipment at risk; and
- ***Internal transmission and intertie limits:*** maximum transfer capabilities of the power system.

2.5.2 Decisions

The IESO has determined that existing input parameters will ensure resources can continue to be reliably scheduled to meet system needs under a DAM. A review of DAM input parameters used in other jurisdictions confirms no additional input parameters are needed for the Ontario DAM.

2.5.3 Detailed Design Considerations

Input parameters associated with the power system model and the contingency set described in section 2.5.1 will be reviewed once the virtual transaction design is finalized. Virtual transactions will need to be included in the power system model and the contingency set so the DAM can continue to satisfy reliability criteria when evaluating virtual resources against physical resources.

2.5.4 Linkages

There are no identified linkages for this design element.

3. Execution, Timing, Real-Time Integration and Price Formation

The main objective of the DAM design is to encourage greater and more efficient participation of resources. The DAM drives broader participation because it provides resources with an ability to lock in a DAM price for their DAM schedules. Even greater and more efficient resource participation can be realized by introducing features that allow the DAM to better reflect resource operating characteristics, allow market participants to make more-informed offers and bids, and improve price signals. These features include:

- Applying market power mitigation within the DAM engine to prevent resources from exercising market power through economic withholding;
- Maximizing the amount of resources eligible to set DAM prices to maximize the efficiency of DAM price signals;
- Aligning the timing of the DAM with that of the gas-market to ensure NQS resources have an opportunity to secure gas transport in a timely manner and at lowest cost;
- Executing the DAM engine in Eastern Prevailing Time (EPT) so that market participants can better inform their offers year-round;
- Increasing DAM to RTM scheduling certainty by improving the optimization of hydroelectric resources and maintaining the optimization of NQS resources through the existing "pseudo-unit" model for combined-cycle facilities; and
- Minimizing the likelihood of over-committing NQS resources by reducing the minimum number of hours an NQS resource is eligible for an operational commitment in the DAM.

3.1 Market Power Mitigation

3.1.1 Design Element Description

Market power mitigation refers to the actions necessary to prevent market participants from taking advantage of market power. This can occur when a lack of competition creates incentives for participants to raise their offer prices above their short-run marginal costs and inappropriately profit as a result.[11]

A market participant can exercise market power by either economically or physically withholding supply from the market. Economic withholding occurs when a portion or all of a resource's available supply is offered at prices that are too high. Physical withholding occurs when some or all available capacity is not offered into the market, increasing the prices at which the remaining supply is sold.

The exercise of market power reduces economic efficiency because resulting prices do not reflect short-run marginal costs. Higher consumer costs from the exercise of market power are inconsistent with the premise of a competitive electricity market. This design element establishes the controls that will be put in place to address the potential for market participants to exercise market power in the DAM.

Current Market

The IESO currently applies market power mitigation in the RTM on an ex-post or "after the fact" basis for both economic and physical withholding. With a uniform price, exercises of market power primarily impact out-of-market payments, not prices. As a result, exercises of market power tend not to impact other market participants and can be addressed using ex-post processes. The IESO does not currently apply any mitigation in the day-ahead timeframe, since the DACP does not directly set prices paid by consumers.

Future Market

As discussed in the SSM high-level design document,[12] ex-post mitigation for economic withholding under the DAM or an RTM with locational prices is not effective. Ex-post mitigation would likely require resettlement of the entire market when a resource was found to have exercised market power. This endeavour would be too burdensome, costly and disruptive to be a viable option.

Other jurisdictions mitigate economic withholding on an ex-ante or "before-the-fact" basis by replacing excessively high offers with estimates of competitive reference levels. This can help drive dispatch and prices that are not significantly inconsistent with competitive outcomes.

It is not possible for other jurisdictions to respond to physical withholding on an ex-ante basis. Doing so would require offer quantities to be replaced with higher values. This could result in schedules that resources are physically unable to deliver. Instead, many jurisdictions mitigate for physical withholding by issuing settlement adjustments after the fact. Settlements adjustments are intended to discourage resources from physically withholding their supply in both the DAM and RTM.

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[11] Market power can also be exercised by reducing prices to depress the energy price as discussed under the heading "Uneconomic Production" in subsection 3.1.2.

[12] This is discussed in detail under section 3.1 (Timing of Application) of the SSM High Level Design.

A methodology commonly adopted by other jurisdictions for mitigation of market power is known as the conduct and impact test. The conduct and impact test helps to determine whether market participants offered above competitive levels[13] and whether prices or uplift were above competitive outcomes. This process includes an implicit structural test: if market participant behaviour was not accompanied by significantly higher prices, then market power was not determined to be exercised.

The conduct and impact test can be effectively used to address the potential exercise of market power for both economic and physical withholding in the DAM. As discussed earlier, the key difference is that market power mitigation tests are applied ex-ante for economic withholding and ex-post for physical withholding.

3.1.2 Decisions

The decisions presented in this section build on the market power mitigation decisions outlined in the SSM High-Level Design. Decisions directly related to the DAM are presented below. For additional decisions related to market power mitigation, refer to the SSM High-Level Design.

Mitigation Process

A conduct and impact test will be used to address the potential exercise of market power for both economic and physical withholding in the DAM. Mitigation under a conduct and impact test will be directly tied to actual exercises of market power rather than the potential for the exercise of market power.

Conduct and impact tests will require several parameters to evaluate whether market power has been exercised. These include reference levels, conduct thresholds and impact thresholds. Conduct and impact thresholds will establish the offer prices and price impacts that trigger mitigation. In general, the conduct and impact thresholds will be lower and less permissive when and where competition is restricted. These thresholds will be added to the reference levels. Reference levels are set based on the short-run marginal cost of a resource and are therefore proxies for the competitive offer for that resource.

Economic Withholding

Conduct and impact tests for economic withholding in the DAM will be applied using the ex-ante approach in the DAM engine. Offer prices and non-price parameters that fail the conduct and impact test will be mitigated prior to the determination of DAM schedules and prices. Mitigation is achieved by replacing resource offer prices and non-price parameters with the reference levels, or competitive proxies, established for that resource. This will help drive DAM schedules and prices are not significantly inconsistent with competitive outcomes.

As stated in the SSM high-level design, under the ex-ante mitigation regime,[14] a binding transmission constraint can potentially restrict competition and will therefore be one precondition to mitigating market participants for economic withholding.

[13] The competitive level that will prevent mitigation is offering at a price that does not fail the conduct test. The competitive level will reflect the reference level plus some allowed margin (the conduct threshold).

[14] SSM High Level Design page 39

Physical Withholding

Conduct and impact tests for physical withholding in the DAM will be conducted ex-post since it is not possible for the IESO to accurately assess each facility's production and capability ex-ante. The IESO will assess the energy capability of a resource that was withheld, as well as the energy capability of a participant's resource portfolio that was potentially withheld. Reference levels will be determined ex-post based on a resource's energy capability at the time of DAM engine execution.

Formula-based, ex-post settlement adjustments will be made if a market participant is found to have exercised market power through physical withholding. Similar approaches are taken by the Midcontinent Independent System Operator (MISO) and the New York Independent System Operator (NYISO). In order to discourage repeat occurrences of physical withholding, the IESO will increase settlement adjustments with each instance of physical withholding within a certain period. These settlement adjustments will be confidential to the market participant except where a market participant is repeatedly found to have physically withheld. This means the IESO will publish information identifying the market participant and the settlement adjustment where a market participant is found to have repeatedly exercised market power through physically withholding. These controls scale the responses to physical withholding with the frequency of the behaviour.

If the mitigation regime for physical withholding fails to contemplate other ways in which competition could be restricted, market participants could avoid mitigation if there is no binding transmission constraint. Consistent with the approach adopted for economic withholding, the IESO will consider other potential restrictions to competition in determining when to test for physical withholding.

Uneconomic Production

Exercises of market power in the DAM are typically mitigated to prevent market participants from raising DAM prices to increase DAM profits. However, under certain situations, there is a potential for market participants to increase their two-settlement profits by lowering RTM prices through the exercise of market power. This situation arises when a supply resource receives a DAM schedule that it is no longer able to fully deliver in the RTM because of a binding constraint in the RTM.

When a binding constraint occurs in the RTM that did not originally occur in the DAM, real-time prices may be lower than DAM prices because less supply will be available for dispatch in the RTM. For a supplier with a DAM schedule, this situation can result in a favourable two-settlement outcome because the supplier would buy back any undelivered portions of its DAM schedule at a lower RTM price. Suppliers with market power behind the binding transmission constraint can further reduce their RTM balancing costs by lowering their offer prices to push the RTM price as low as possible. In fact, they could generate an RTM balancing payment by offering at negative prices.

The conduct and impact thresholds described earlier are not intended to address this type of exercise of market power, as it does not increase prices and involve offers significantly below reference levels. It is not practical to add a low-priced conduct threshold to avoid this behaviour. Doing so would unnecessarily limit the ability of participants to conduct their business. It is only when the conditions discussed above align when low-priced offers necessitate intervention.

The approach commonly taken in other markets to mitigate this type of behaviour is to identify when these conditions occur and then to modify real-time settlement prices. This mitigation reduces the ability of participants to take advantage of these circumstances. In the presence of these controls, attempting to do so would not successfully lower real-time settlement prices and would not significantly increase settlement from undelivered energy.

3.1.3 Detailed Design Considerations

The IESO will need to need to determine the conduct and impact thresholds and reference levels used to test for economic and physical withholding. Determining the set of conduct and impact thresholds will be done on a market-wide basis. While there will be different conduct and impact thresholds depending on the degree to which competition is restricted, the same set of conduct and impact thresholds will be common to all participants.

Reference levels should, however, reflect the characteristics of each individual resource. The IESO will need to determine the appropriate reference levels for each resource in the market.

The IESO will also need to determine the settlement adjustment that will be applied on a first-time finding of physical withholding, as well as the criteria that will be applied to increase the settlement adjustment for repeat findings and whether to make those findings public.

The IESO will also determine the criteria that will be applied to detect uneconomic production and the pricing rules that will be applied when those criteria are met.

The IESO will determine potential restrictions to competition, similar to those considered for economic withholding, that will result in testing for physical withholding.

3.1.4 Linkages

There are no identified linkages for this design element.

3.2 Price-Setting Eligibility

3.2.1 Design Element Description

Only certain resources are eligible to set prices. The SSM Price-Setting Eligibility design element established that a resource will be eligible to set prices if it is both economically marginal and capable of producing an incremental unit of energy or operating reserve. That design element also established that operating range restrictions of a resource, such as MLP output, will not be eligible to set prices.

Price settling eligibility will need to be consistent between the DAM and RTM. Price setting consistency helps to support price convergence under similar conditions in the two market timeframes. However, there are situations where a resource will be eligible to set prices in the DAM but not in the RTM. This is because some resources are capable of producing an incremental unit of energy or operating reserve in the DAM but not in the RTM. The DAM price setting eligibility design element addresses whether similar resources should be capability of setting prices in DAM but not in real-time.

In other jurisdictions several types of resources are allowed to set DAM prices even though they are unable to set real-time prices because it provides market participants with the most efficient price signal for the set of resources scheduled in the DAM. Having more resources available to set DAM prices will better reflect the value of producing or consuming the next unit of energy or operating reserve. The following resources are typically eligible in other jurisdictions to set DAM prices even though they are unable to set real-time prices:

- Import offers and export bids (intertie transactions);
- Virtual supply offers and load bids (virtual transactions);
- Demand response bids; and
- Price responsive load (load serving entity or load retailer) bids.

Intertie transactions and HDR resources are also currently eligible to set informational (shadow) prices in the DACP even though they do not set prices in real-time. Virtual transactions and price responsive load bids do not exist in the DACP.

3.2.2 Decisions

The IESO has determined that resources that can be scheduled to produce an incremental unit of energy or operating reserve on an hourly basis in the DAM will be eligible to set DAM prices, even if they are unable to set prices in real-time. As described in section 3.2.1, this will provide market participants with a more efficient price signal in the DAM. MLP output (or other operating range restrictions) of a resource will not be permitted to set prices in either the DAM or the RTM because these restrictions are unable to be marginally varied in either market.

3.2.3 Detailed Design Considerations

At this time, the IESO has not identified any further considerations for detailed design.

3.2.4 Linkages

The Price-Setting Eligibility design element is linked to the DAM design element 14 (Make-Whole Payments) design element because DAM prices may be less than the offer price of a resource where only a portion of the resource's operating restriction was required to meet demand.

3.3 Functional Passes

3.3.1 Design Element Description

The Functional Passes design element describes how the DAM engine will determine resource schedules for energy and operating reserve (OR), make NQS resource[15] unit commitments, and set DAM locational prices for energy and OR settlement.

Current Market

The DACP engine currently determines resource schedules for energy and OR and NQS resource operational commitments using a multi-pass structure. The DACP does not produce locational prices used for settlement.

Pass 1 determines hourly resource schedules and NQS resource operational commitments to meet hourly Ontario-wide average demand for the next day at the lowest possible cost based on submitted bids and offers.[16] Hourly Ontario-wide average demand, rather than peak demand, is used in this pass so that resources are not over-committed. Using a peak demand forecast may over-commit NQS resources since the peak demand only occurs over a short period in each hour. Pass 1 hourly inputs include:

- Dispatchable supply offers and dispatchable load bids;
- Self-scheduler forecasts;
- Import offers and export bids;
- IESO forecasts for VG; and
- IESO Ontario-wide average demand forecast for NDL.

Pass 2 is known as a reliability pass. This pass tests whether to operationally commit additional NQS resources (above those selected in Pass 1), in order to meet hourly Ontario-wide peak demand. Since peak demand only occurs over a short period in each hour, Pass 2 prioritizes the use of spare energy on resources that were already committed in Pass 1 if this would be more economic than committing a new NQS resource. Pass 2 hourly inputs include:

- Supply and load resource schedules and NQS resource commitments from Pass 1;
- IESO forecast for VG; and
- IESO Ontario-wide peak demand forecast for NDL.

Pass 3 has the same objective as Pass 1, but uses the commitments determined in Passes 1 and 2 to meet hourly Ontario-wide average demand. This ensures resources are not over-scheduled in the final results that are used to determine NQS resource cost guarantee commitments. Pass 3 hourly inputs include:

- Any modified supply and load resource schedules and new NQS resource commitments from Pass 2;
- IESO forecasts for VG; and
- IESO Ontario-wide average demand forecast for NDL.

The NQS resource commitments resulting from those three passes are passed to the pre-dispatch engine as operational commitments for all hours an NQS resource is scheduled above its MLP in the DACP.

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[15] An NQS resource is a generator that takes longer to start-up and come online than a quick-start resource, with a minimum lead time of at least one hour, and that must remain operating at its MLP for its MGBRT.

[16] Bids and offers include both price and quantity information (e.g., 50 MWh at $30/MWh) and non-price/quantity parameters (e.g., daily energy limits, minimum loading points and run-times)

Treatment in Other Jurisdictions

In other jurisdictions with a DAM, a similar approach to Ontario's DACP is used in determining DAM hourly schedules and prices for energy and OR however, the following are three key differences:

Pass 1 – In other jurisdictions a market commitment pass uses market participant bids and offers to determine a unit commitment schedule for bid load. It also includes the ability to perform ex-ante market power mitigation.[17] Market power mitigation is not performed by the DACP engine because the DACP does not produce prices that are used for settlement.

Pass 2 – Similar to the IESO DACP, this pass is also known as the reliability pass that tests whether additional NQS resources need to be committed to meet the next day's forecasted conditions. This pass is managed differently in different jurisdictions. Some perform their reliability pass within the DAM while others perform it after the DAM. Performing this pass within the DAM supports DAM to RTM price convergences and increases operational certainty for the IESO by ensuring NQS resources can procure gas supply and transport to support their DAM schedules in a timely manner. Executing this pass within the DAM supports price convergence because final DAM schedules and prices will take into account the impact of an additional NQS resource commitment. Gas generation resources are provided with a timelier fuel procurement because they receive their DAM schedules before the gas market's timely nomination window of 14:00 EPT. Jurisdictions that carry out their reliability pass after DAM have experienced issues with gas generation resources having to procure fuel and fuel transportation later in the day.

Pass 3 – Is known as the final scheduling and pricing pass and includes the production of DAM schedules and prices that are used for settlement. This differs from the IESO's DACP in that the DACP only produces informational locational prices that are not used for settlement.

3.3.2 Decisions

The IESO has determined that the DAM engine will comprise three passes.

Pass 1 will serve as the DAM's market commitment pass. The purpose of this pass is to determine the commitment of resources to satisfy bid load. It will include the application of ex-ante market power mitigation on incremental energy, OR and resource non-price parameters. This pass will consider offers and bids from market participants themselves rather than IESO forecasts on their behalf. These include offers from VG resources, bids from PRLs, and virtual offers and bids (virtual transactions). These inputs are consistent with other jurisdictions, where this initial pass in the DAM engine is solved exclusively with offers and bids from market participants. The major exception for Ontario is NDLs. As discussed in the Load Participation design element, the IESO will continue to forecast NDL consumption to serve as an input to this pass until a sufficient level of NDLs take on PRL status. Pass 1 hourly inputs include:

- Dispatchable supply offers, including offers from VG resources;
- Dispatchable load bids, HDR bids, and PRL bids;
- Self-scheduler forecasts;
- Import offers and export bids;
- IESO's hourly zonal average demand forecasts representing NDLs that are not registered as PRLs; and
- Virtual bids and offers.

[17] This is discussed in detail under DAM design element 6 (Market Power Mitigation).

Pass 2 will be maintained as a reliability pass within the DAM, assessing whether additional resources are required to meet hourly zonal peak demand. Pass 2 ignores virtual transactions since these offers and bids have no intent of delivering or consuming physical energy in the RTM. VG resource offers and PRL bids are also replaced with IESO hourly forecast quantities. This allows the IESO to perform an assessment of whether sufficient physical energy will be online to meet forecast conditions in real-time, and make additional NQS resource commitments if required.

Performing Pass 2 within the DAM also allows additional NQS resource commitments to be reflected in DAM schedules and prices ultimately produced by Pass 3. This increases operational certainty by providing gas resources with timelier fuel procurement. Capturing resource commitments in DAM prices also supports day-ahead to real-time price convergence. Pass 2 hourly inputs include:

- Physical supply and load resource schedules and NQS unit commitments from Pass 1;
- IESO forecasts for VG; and
- IESO hourly zonal peak load forecast for NDL and PRL rather than the Ontario-wide forecast used in DACP.

Pass 3 will perform final scheduling and calculate zonal prices and locational prices that include loss and congestion components. Settlement ready prices need to be determined in order to provide participants with accurate DAM settlements. NQS unit commitments will be passed to the pre-dispatch engine as operational commitments for the hours of an NQS resource's minimum generation block run-time (MGBRT).[18] Pass 3 will produce final schedules and prices based on market participant offers and bids, largely the same inputs as used in Pass 1. Pass 3 inputs include:

- NQS unit commitments from Passes 1 and 2;
- PRL bids;
- VG resource offers;
- Virtual offers and bids;
- IESO's hourly zonal average load forecast representing NDLs that are not registered as PRLs;
- Any modified supply and load resource schedules from Pass 2.[19]

The DAM engine will also be capable of evaluating an NQS resource's ramping energy on an hourly basis. Including NQS ramping energy supports greater price convergence between DAM and real-time by aligning DAM scheduling outcomes with real-time expectations. It also reduces the potential for increased uplift due to over-commitment of additional NQS resources in the DAM. Evaluating NQS ramp-up schedules means that hourly ramp-up schedules will be produced by the DAM and form part of an NQS resource's financially binding schedule. If NQS resources did not receive a financially binding DAM schedule for their ramp, other resources would be scheduled in lieu of the NQS ramp energy in order to balance load in the DAM.

[18] The decision to commit an NQS resource only for its MGBRT hours is described in DAM design element 11 Initiation of Operational Commitments.

[19] See the detailed design considerations section.

3.3.3 Detailed Design Considerations

The IESO will further consider the decision for the DAM engine to include ramp hours as part of an NQS resource's financially binding schedule. The IESO will proceed with implementation if evaluating additional ramp profile parameters does not add a significant amount of processing time to the DAM engine such that it would prevent the DAM from executing with the determined execution time of 3.5 hours. The additional complexities associated with NQS ramp parameters should also not come at a significant implementation cost such that other higher priority software improvements could be placed at risk.

The IESO will determine if it is necessary to implement market power mitigation in Pass 2 or Pass 3 of the DAM engine. This is because a resource not scheduled in Pass 1 but economic for scheduling in Pass 2 or 3 could exert market power that did not previously trigger market power mitigation in Pass 1.

The IESO will also need to determine how Pass 3 (final scheduling and pricing pass) will handle modified supply and load resources schedules from Pass 2 (reliability pass) once the IESO knows how the additional operating characteristics for hydroelectric resources will be modelled in the DAM engine.

3.3.4 Linkages

The Functional Passes design element is linked to DAM design element 10 (Submission and Posting Timelines) design element since the solution time for functional passes must occur within the allowable time period. It is also linked to the DAM design element 14 (Make Whole Payments) design element since financially binding ramp schedules for NQS resource will result in additional DAM revenues that will impact the DAM make-whole payment calculation for NQS resources.

3.4 Optimization of Hydroelectric Resources

3.4.1 Design Element Description

Hydroelectric resources have many unique operating characteristics that impact the amount of energy and operating reserve they are able to produce. Some relate to physical equipment limitations, while others are determined by regulatory and environmental requirements related to public safety and fish spawning. Operating characteristics common to most hydroelectric resources include minimum output requirements, limited start-up cycles, daily energy limits and scheduling dependencies with adjacent upstream or downstream resources on the same river system. Hydroelectric resources can be infeasibly and inefficiently scheduled in an energy market if these operating characteristics are not respected by energy market software. The risk of receiving an infeasible schedule would reduce a hydroelectric resource's willingness to participate in a financially binding DAM. This is because an infeasible DAM schedule would not accurately reflect what the resource is actually capable of delivering in the RTM. A financially binding DAM schedule that is incapable of being delivered in the RTM places the market participant at an increased risk of having to buy out of its DAM schedule at a loss. Infeasible DAM schedules would therefore decrease the efficiency of the DAM because hydroelectric resources would be less encouraged to participate in the DAM. This presents a significant risk to the efficiency of the Ontario DAM considering hydroelectric resources represent nearly one-quarter of Ontario's available capacity.

The same conclusion holds true for NQS resources (combined-cycle facilities) that have scheduling dependencies between generating units with primary fuel (fossil fuel) and secondary fuel (steam) sources. As a result, the "pseudo-unit" model currently used to optimize NQS resources in the DACP will be retained under the DAM.

Current Market

The scheduling efficiency of the DACP is important because DACP is used to commit NQS resources. In order to make efficient DACP commitment decisions, resource operating characteristics are respected in the DACP for a number of resource types. Operating characteristics of hydroelectric resources include daily energy limits to ensure a hydroelectric resource will not be scheduled beyond its maximum energy capability. A key operating characteristic that is not considered by the DACP but is common to most hydroelectric resources are scheduling dependencies with adjacent upstream or downstream resources on the same river, operated by the same market participant. These operating characteristics apply to cascade hydroelectric resources which have time-lag dependencies between resources on the same river system and are difficult to manage through the independent resource offer curves used today. A downstream resource may need to generate in one hour in order to pass the water being received from an upstream resource generating in the hour prior. The DACP process recognizes this challenge by enabling cascade hydroelectric resources to revise their offers prior to the final run of DACP to correct for any infeasible schedules produced by the initial run of DACP.[20] This resubmission window helps produce feasible cascade hydroelectric resource schedules, resulting in a more dependable view of the next day.

[20] The DACP process consists of an initial scheduling run, a resubmission window for cascade hydroelectric resources, and a final scheduling run.

Future Market

The importance of hydroelectric resources receiving feasible day-ahead schedules increases under a DAM because DAM schedules have a clear financial impact. An infeasible DAM schedule could expose hydroelectric resources to costly real-time balancing settlements if they cannot physically deliver their DAM schedule. This would mean that hydroelectric resources would have to buy out of an infeasible DAM schedule. Unless addressed, hydroelectric resources would be forced to mitigate this risk by offering less energy in the DAM. This behaviour could produce less efficient DAM outcomes by scheduling higher priced resources to meet demand.

Retaining the resubmission window for cascade hydroelectric resources could be seen as a way for these resources to continue mitigating the risk of receiving an infeasible schedule. This could however introduce potential market power issues because it would enable hydroelectric resources with an ability to improve their DAM settlements, while potentially harming the settlement of other resources types.

3.4.2 Decisions

The IESO has determined that the DAM will not include a resubmission window for cascade hydroelectric resources and that additional operating characteristics should be modelled in the DAM for all hydroelectric resources. A resubmission window would provide hydroelectric resources with an unfair advantage over other resources. Modelling additional operating characteristics for all hydroelectric resources in the DAM will increase the likelihood of hydroelectric resources receiving a feasible DAM schedule. Feasible schedules will provide the IESO and market participants with greater operational and financial certainty. Hydroelectric operating characteristics will also be modelled in the new pre-dispatch engine being introduced by the ERUC initiative to maintain scheduling certainty and efficiency as real-time approaches.

Improved hydroelectric resource optimization is important to the efficiency of the wholesale market since hydro units are frequently dispatched as the marginal resource. Because other jurisdictions have less hydroelectric as part of their supply mix, security constrained economic dispatch software has not yet developed features to model these complex relationships.

In the absence of any existing functionality, the IESO recognizes that incorporating hydroelectric modelling within its optimization may present implementation challenges. Nevertheless the IESO is committed to improving the optimization of hydroelectric resources to the extent that is feasible. The IESO will examine ways to implement the following hydroelectric operating characteristics within the DAM and pre-dispatch engines.

Must-Run Requirements

Must-run requirements define the minimum amount of energy a resource must produce over a period of time in order to satisfy regulatory, environmental, safety or equipment constraints. Must-run conditions can be represented as minimum hourly energy quantities or a minimum amount of energy that must be produced by the end of the day. Without an explicit mechanism for hydroelectric resources to identify must-run energy, they risk being scheduled to levels below their minimum must-run requirement. To mitigate this risk, hydroelectric resources currently submit low offers to increase the likelihood of scheduling their must-run conditions.

Limited Number of Resource Starts Per Day

Hydroelectric resources are capable of quickly responding to dispatches but are at risk of becoming unavailable when the number of up and down dispatches from an energy quantity of zero exceeds pre-defined thresholds that are imposed to prevent equipment failure. The number of up and down dispatches can be minimized by controlling the number of times a resource is started. Not respecting these constraints in the DAM and pre-dispatch engines places a hydroelectric resource at risk of not being able to meet schedules generated once the pre-defined thresholds are exceeded.

Intertemporal Dependencies Between Two or More Resources Operated by the Same Market Participant on a Cascade River System

Hydroelectric resources have time-lag dependencies between resources on the same river system that can be difficult to manage only through their offer curves. Market participants should have the option of establishing scheduling dependencies between two or more resources such that all, some, or none of the resources could be economically scheduled. This capability presents two scheduling challenges. One is that the software must optimize around multiple resource dependencies and the second is that some resources have the ability to connect at different points of the transmission system. Market participants should also have the option of adding or removing scheduling dependencies after the DAM and throughout the pre-dispatch timeframe to reflect changes in water management conditions.

Multiple Daily Energy Limits that Represent Quantities of Energy with Different Opportunity Costs

Environmental and regulatory conditions can limit the amount of water a hydroelectric resource can use to produce energy over the course of a day. The value of this limited hydroelectric energy is based on the principle of opportunity cost, the value of using limited water to produce energy at a particular time at a given price or saving it for future use at higher prices. Often, a hydro resource's daily energy limit can consist of multiple quantities of water with different opportunity costs. Quantities of water that must be used in the short term (e.g., run-of-river water) will have a relatively lower opportunity cost compared to water that can be stored in a forebay for future use at times of potentially higher prices.

Currently, hydroelectric resources are able to submit a single daily energy limit (DEL) value for use in the DACP and pre-dispatch processes. This single DEL ensures that these resources are not over-scheduled throughout the course of the day. However, the single DEL does not adequately represent that within a resource's DEL there could be multiple quantities of water with different opportunity costs. As a result, the scheduling of hydroelectric resources can be less efficient because the DACP and pre-dispatch algorithms do not recognize the different opportunity costs of limited water.

Enabling multiple DELs to represent quantities of energy with different opportunity costs should result in a more accurate representation of costs and improved resource optimization within the DAM and pre-dispatch engines. Even greater efficiencies could be realized if multiple DELs could be specified for a set of resources that are separately offered into the market even though they belong to the same generation facility and share the same forebay.

Forbidden Regions

Forbidden regions are predefined operating ranges where a hydroelectric facility cannot maintain steady operation without causing equipment damage. Respecting forbidden regions in the DAM and pre-dispatch engines will ensure these resources are not scheduled to levels at which they are physically unable to operate.

3.4.3 Detailed Design Considerations

The hydroelectric operating characteristics described in this design element will only be modelled within the DAM and pre-dispatch engines. Whether and how these characteristics are transferred to the RTM for dispatch will need to be addressed in detailed design.

The IESO will also need to integrate the modeling of these hydroelectric operating characteristics in the DAM and pre-dispatch with existing offer structures and scheduling capabilities. Maintaining that will preserve the following existing operational flexibility of hydroelectric resources:

- Ability to use monotonically increasing hourly offers (i.e., price-quantity pairs). Price-quantity pairs are already a proven mechanism to facilitate the co-optimization of energy and OR, allowing resources to be evaluated under one offer structure in the DAM, pre-dispatch and real-time; and
- Ability to schedule hydroelectric resources for energy and OR above any minimum or below any maximum operating restrictions imposed by the new software requirements.

3.4.4 Linkages

There are no identified linkages for this design element.

3.5 Submission and Posting Deadlines

3.5.1 Design Element Description

The Submission and Posting Deadlines design element defines the time when all supply offers and load bids must be submitted by market participants and when results from the DAM will be published.

In other jurisdictions, DAM results are typically posted at least a half hour prior to the gas market's timely nomination deadline of 14:00 EPT. Meeting the 14:00 EPT deadline ensures gas resources can secure pipeline capacity to meet their DAM schedules for the next day. The deadline for market participants to submit their offers and bids into the DAM can be determined by working backwards from a posting deadline based on the DAM engine's expected execution time. Execution times are typically between 2.5 and 3.5 hours.

Some jurisdictions have considered executing their DAM process in prevailing time[21] rather than standard time, to achieve greater alignment with the gas market's timely nomination window. The gas market is also executed in prevailing time, enabling gas resources the ability to secure pipeline capacity by the timely nomination deadline of 14:00 EPT to meet their DAM schedules for the next day.

In some cases, jurisdictions time the start of their DAMs following the closing of DAMs in adjacent jurisdictions. This provides intertie traders with the ability to know their import or export schedules in one market before finalizing their submissions in the adjacent market. This alignment can increase the likelihood of intertie transactions clearing in both DAMs and improve import and export certainty as real-time approaches. An example of this is NYISO's DAM results typically being posted before MISO's DAM begins.[22]

The IESO's DACP is currently executed in EST with a submission window that opens at 06:00 EST and closes at 10:00 EST. The DACP is executed within a five-hour window, with results posted no later than 15:00 EST. The DACP takes longer than a typical DAM because it features two runs with an offer resubmission window, for cascade hydroelectric resources to use, in between the two runs. The DACP was also primarily designed for execution in EST to maintain consistency with the hourly EST schedules it produces, as well as EST operation in the RTM. A 15:00 EST DACP execution deadline prevents a gas resource from seeing its DACP schedule and securing pipeline capacity before the timely nomination deadline of 14:00 EPT. This can result in less efficient market results and less operational certainty, particularly in tight pipeline conditions.

[21] Prevailing time changes with daylight savings time, and is the time that would normally be seen on a clock. Standard time does not change year around, and accordingly is one hour behind prevailing time from March to November in locations that use daylight savings time.

[22] While the NYISO typically posts by 09:30 EPT, their market rules specify a posting deadline of no later than 11:00 EPT.

3.5.2 Decisions

The IESO has determined that the DAM will be executed in EPT with results posted by 13:30 EPT to provide greater alignment with the gas market and normal business hours all year long. Posting DAM results by 13:30 EPT helps gas resources to secure pipeline capacity by the timely nomination deadline of 14:00 EPT to meet their DAM schedules for the next day. EPT execution will also eliminate the need for market participants to adjust day-ahead processes to account for differences between prevailing time and standard time during daylight savings time. While the DAM will be executed in EPT, hourly DAM schedules will continue to be published in EST and consistent with EST scheduling and dispatch in both pre-dispatch and the RTM.

The IESO expects the DAM engine to take approximately 3.5 hours to produce results based on software capabilities observed in other jurisdictions. Working backwards from a posting deadline of 13:30 EPT, translates into the DAM submission window closing at 10:00 EPT. This timing will also benefit import offers and export bids between Ontario and the NYISO considering the NYISO typically posts its results before 10:00 EPT. The IESO will maintain a four hour submission window for the DAM, resulting in the submission window opening at 06:00 EPT.

For reference, the EPT submission and posting timelines and corresponding EST timelines are illustrated as follows:

FIGURE 4: DAM SUBMISSION WINDOW AND EXECUTION TIMING DURING DAYLIGHT SAVINGS (MARCH THROUGH NOVEMBER)

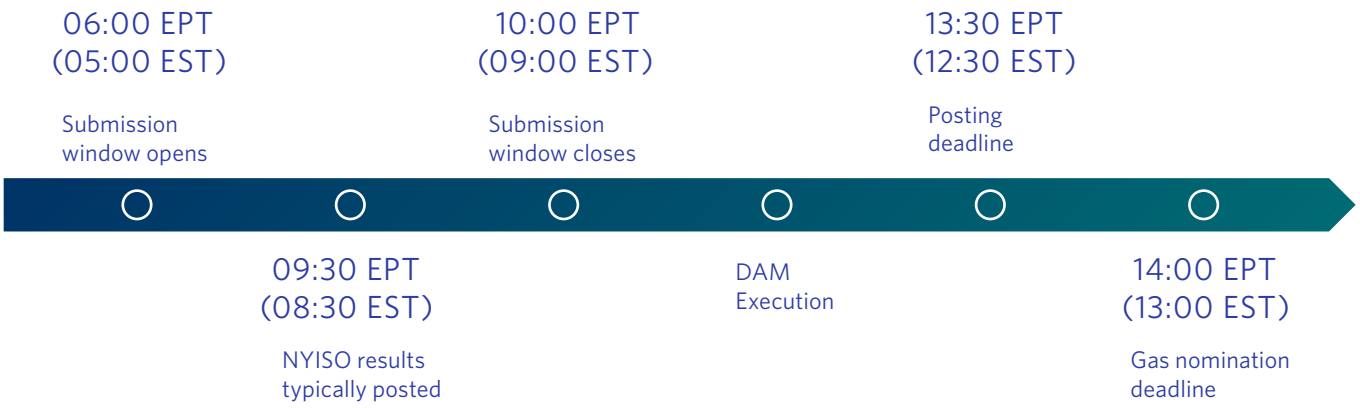
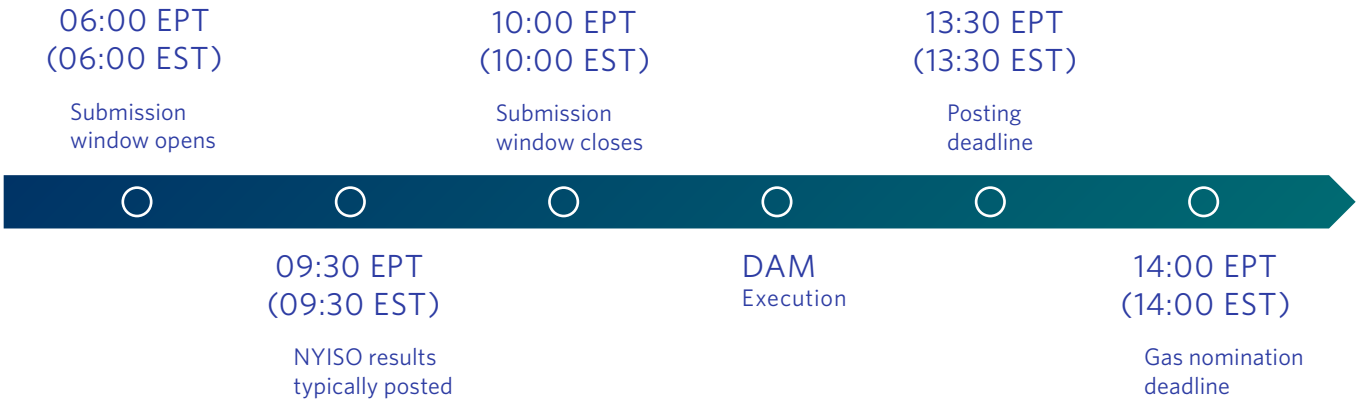


FIGURE 5: DAM SUBMISSION WINDOW AND EXECUTION TIMING DURING NON-DAYLIGHT SAVINGS (NOVEMBER THROUGH MARCH)



3.5.3 Detailed Design Considerations

The IESO will need to determine the potential for the DAM submission deadline to be adjusted depending on the impact that improved hydroelectric modelling will have on software execution times. This decision will also inform whether the start of the submission window should be adjusted accordingly.

3.5.4 Linkages

The Submission and Posting Timelines design element is linked to the DAM design element 12 (Reporting Obligations) design element because the timing of DAM-related reports will need to align with DAM timelines.

3.6 Initiation of Operational Commitments

3.6.1 Design Element Description

An operational commitment is a guarantee to an eligible NQS resource that it will not be required to operate below its MLP or be dispatched offline before its MGBRT has been completed. An operational commitment provides a higher degree of certainty for the IESO to know further in advance when NQS resources will be online in the RTM. The IESO can be better prepared to manage unforeseen reliability issues with the advanced knowledge of when NQS resources will be online. This design element will establish the length of time an NQS resource will be guaranteed a dispatch to its MLP in real-time starting with the first hour of its DAM schedule. The length of the operational commitment must at a minimum cover the NQS resource's MGBRT because the MGBRT is a physical equipment limitation.

Current Market

The DACP currently issues operational commitments to NQS resources for all hours of their day-ahead schedule, including all hours scheduled beyond their MGBRT. Commitment of a resource beyond its MGBRT is required because the current pre-dispatch is not capable of evaluating an NQS resource's minimum operating restrictions over a multi-hour period. Operational commitments from DACP are passed to pre-dispatch to maintain scheduling efficiency and operational certainty. Without an operational commitment beyond its MGBRT passed from DACP, pre-dispatch could prematurely dispatch an NQS resource offline.

Future Market

The need for an operational commitment beyond an NQS resource's MGBRT will be diminished once the new pre-dispatch model is in place. The ERUC initiative will replace the current pre-dispatch with a more efficient means of evaluating when NQS resources are needed.

3.6.2 Decisions

The IESO has determined that the length of an NQS resource's operational commitment only be for the duration of its MGBRT. This strikes a balance between providing market participants and the IESO with sufficient operational certainty and minimizing the risk of additional uplift for potential day-ahead over-commitments. This also contributes to overall market efficiency because the pre-dispatch engine will be able to make more efficient scheduling decisions as real-time approaches.

While the focus of this design element is the length of the operational commitment, it is important to clarify that an NQS resource can still receive a financially binding DAM schedule for hours beyond its MGBRT. Any scheduled hours beyond MGRBT will also respect the resource's MLP.

3.6.3 Detailed Design Considerations

The IESO will need to determine how and when market participants will be notified of their DAM operational commitments so that market participants are prepared to come online. To complete the communication loop, IESO will need to receive a confirmation from market participants that they are coming online. The timing and medium for communication need to be determined.

3.6.4 Linkages

There are no identified linkages for this design element.

3.7 Reporting Obligations

3.7.1 Design Element Description

Reporting obligations determine how public and private information currently reported by the IESO as part of the IESO's DACP needs to change under a DAM. Public information is generally referred to as a publication while private information is generally referred to as a notification. Modified publishing and notification of information will be required to ensure market participants can effectively participate in a financially binding DAM.

Market participants mainly use information currently provided by the IESO before and after the DACP to form their bids and offers and make operational plans for real-time (e.g., gas procurement). Information currently published before DACP includes forecast supply and demand conditions, and transmission outages. Information currently published after DACP includes scheduling limits and binding constraints, and informational LMPs (i.e., shadow prices[23]). Private notifications made to market participants include their energy and operating reserve schedules after the DACP has completed.

Other jurisdictions have public and private reporting obligations very similar to the DACP reporting obligations listed above. Other jurisdictions also report additional information that is fundamental to DAMs. This information provides transparency and assists market participants with informing their offers into the DAM. Reporting requirements typically found in jurisdictions with DAMs, but not in DACP, include:

- Publication of LMPs used for market participant resource settlement;
- Notification of reference levels used to facilitate ex-ante market power mitigation on market participant resources; and
- Publication of virtual transactions submitted into and scheduled by the DAM.

These additional reporting requirements are not needed for the DACP because the DACP does not produce prices used for settlement.

3.7.2 Decisions

The IESO has determined that the following reporting changes are required under a DAM:

Public Information

LMPs will be published for energy and all classes of OR at all settlement locations, and will include congestion and loss components. These are the prices used to settle all resources in the DAM and can also assist market participants with informing their offer and bid submissions into the RTM or future DAMs. DAM LMPs will be published by the DAM posting deadline of 13:30 EPT.

Binding constraints will continue to be published and include marginal values that represent the cost savings of relaxing a transmission constraint by 1 MW. Marginal values for binding constraints provides information on what parts of the system are congested. This information can encourage market participants to offer greater dispatch capability and earn greater revenues with an ability to alleviate constraints. Binding constraints will also be published by the DAM posting deadline of 13:30 EPT.

[23] Shadow prices are the cost of energy at each injection and withdrawal point in Ontario.

Reports on virtual transactions will be published to show hourly offered and cleared transactions in aggregate form. These reports will be published at the DAM posting deadline to maintain transparency and reporting consistency currently provided for other resource types.

Forecast supply and demand conditions, resource schedules and transmission outages will continue to be published under the DAM with the expectation that the timing and frequency of reporting will not change significantly. However, information associated with the resubmission window for cascade hydroelectric resources and ADE obligation will cease to be published as these features will not exist in the DAM.

Private Information

Market participants will be notified of the reference levels used to facilitate ex-ante market power mitigation for their resources. Reference level notifications will be sent out before the DAM submission window closes. Market participants will also receive a private report to notify what revisions were made to dispatch data if their resources were mitigated. This will provide market participants with greater transparency to DAM results, including their prices and resource schedules. Market participants will be notified of any mitigated results with or shortly after DAM scheduling and pricing results. This timing should provide market participants with sufficient time to revise their offers prior to the first run of pre-dispatch at 20:00, as required.

3.7.3 Detailed Design Considerations

The IESO will perform a comprehensive review of information publishing and notification across all energy market timeframes to determine the complete details of required reporting content and the timing of report publishing and notification.

3.7.4 Linkages

The Reporting Obligations design element is linked to DAM design element 10 (Submission and Posting Deadlines) design element because the timing of submission and posting deadlines will need to align with the timing of information reporting.

4. Settlement Topics

4.1 Two-Settlement for Supply and Load[24]

4.1.1 Design Element Description

A DAM introduces a two-settlement system that will encourage greater and more efficient participation. The two-settlement system includes a DAM settlement and an RTM balancing settlement. In the first DAM settlement, supply is paid and loads are charged their DAM scheduled quantities for energy and operating reserve (OR) at the applicable DAM price. It is the DAM settlement that encourages DAM participation because resources can lock in a DAM price for their DAM schedules. The RTM balancing settlement only occurs if actual energy production or consumption differs from a resource's DAM schedule. Real-time quantity differences from a resource's DAM schedule are settled at RTM prices. The RTM balancing settlement also encourages resources to deviate from their DAM schedules when system conditions and prices change in real-time. For example, suppliers may be dispatched to lower quantities in response to real-time conditions if it is economic for them do to so.

The two-settlement system applies for both energy and OR, however there is a difference in the type of quantity used for each product in the RTM balancing settlement. While DAM settlements are based on hourly scheduled quantities for energy and OR, the RTM settlement is based on actual metered quantities for energy and scheduled quantities for OR. Scheduled quantities are used for OR because it is standby energy, not actual energy. It can only be measured as energy once activated.

Current Market

The IESO currently administers a single settlement via the RTM. The DACP is not directly used to settle resources since it is a reliability process used only to commit sufficient resources a day in advance. A day-ahead price and the complexity of a two-settlement system are not required to meet IESO reliability needs in the DACP. Instead, a simpler cost guarantee is provided to committed resources if real-time revenues do not cover their day-ahead costs.

[24] This is a resultant of merging DAM design elements, "Two-Settlement for Supply" and "Two-Settlement for Load".

Future Market

The DAM provides a day-ahead price signal and includes a two-settlement system to encourage all resources to participate as fully and efficiently possible. The two-settlement system is used to settle all resources that offer or bid for themselves into the DAM because resources are in the best position to manage their financial opportunities and risks. An opportunity for a supply resource would be to lock in a DAM price for greater financial certainty whereas a risk would be to buy out of its DAM schedule due to a forced outage in real-time at a loss.

The two-settlement system is appropriate for resources that participate for themselves because it settles resources at their location, and resources are responsible for managing offers and bids at their location. Participating resources can adjust their bids and offers into the DAM to manage their exposure to real-time balancing settlements.

A modified settlement should however be considered for non-dispatchable load (NDL) because the IESO will forecast demand quantities into the DAM on their behalf. Since an individual NDL has no control over how much of the IESO's centralized DAM forecast will be distributed to their location, they have limited ability to manage their exposure to real-time balancing settlements. It would therefore be more appropriate to distribute the sum of all real-time balancing settlements for NDL in a proportionate manner rather than allocate each NDL the balancing settlement at their location.

4.1.2 Decisions

The IESO has determined that all resources that offer and bid into the DAM for themselves be settled using the standard two-settlement system. This is based on the sum of equations 1 and 2 below:

Equation 1 – DAM Settlement for Resources that Submit Their Own Bids/Offers

$$\text{DAM Settlement} = Q^{m}_{DA} \times p^{m}_{DA}$$

Equation 2 – RT Balancing Settlement for Resources that Submit Their Own Bids/Offers

$$\text{RT Balancing Settlement} = (Q^{m}_{RT} - Q^{m}_{DA}) \times p^{m}_{RT}$$

Where:

Q^{m}_{DA} is the day-ahead quantity of energy or operating reserve scheduled at *wholesale meter or intertie metering point* 'm' for a given settlement hour.

p^{m}_{DA} is the day-ahead LMP of energy or operating reserve at *wholesale meter or intertie metering point* 'm' for a given settlement hour.

Q^{m}_{RT} is the real-time quantity of energy generated or consumed, or operating reserve scheduled at *wholesale meter or intertie metering point* 'm' for a given settlement hour.

p^{m}_{RT} is the real-time LMP of energy or operating reserve at *wholesale meter or intertie metering point* 'm' for a given settlement hour.

NDLs will have a modified settlement equation. As described in section 4.1.1, a modified settlement is required since the NDL has no control over the DAM schedule it receives and the IESO is limited in its ability to predict how much energy NDL participants will consume at their location. The IESO has determined that the sum of equations 3 and 4 will be used for NDLs:

Equation 3 – Modified DAM Settlement for NDLs

$$\text{Modified DAM Settlement for NDL} = (Q_{RT}^{m} \times p_{DA}^{m})$$

Equation 4 – Modified Balancing Settlement for NDLs

$$\text{Modified Balancing Settlement for NDL} = (Q_{RT}^{m} \times FD_{x})$$

Where:

Q_{RT}^{m} is the real-time quantity of energy generated or consumed, or operating reserve scheduled at *wholesale meter or intertie metering point* 'm' for a given settlement hour,

p_{DA}^{m} is the day-ahead LMP of energy or operating reserve at *wholesale meter or intertie metering point* 'm' for a given settlement hour, and

FD_{x} is the total value of the IESO's forecast deviation for all NDLs in dollars per MWh for a given settlement hour. It is a function of the total sum of forecast deviations at every NDL location and the sum of DAM to RTM price differences at each NDL location.

The modified DAM settlement defined in equation 3 ensures NDLs will only be exposed to settlement when they actually consume energy in real-time. Similar to today's market, NDLs that do not consume energy in real-time will not incur any costs, regardless of whether the IESO had forecasted them to use energy.

The modified balancing settlement defined in equation 4 ensures that NDLs that consume in real-time will have the total balancing amount of the IESO forecast deviations proportionately allocated to them based on their actual real-time consumption. Proportionately allocating the value of the IESO's forecast deviation allows it to be more evenly spread in a fair and non-discriminatory manner among all NDLs that have consumed power.

4.1.3 Detailed Design Considerations

The IESO will need to determine who should bear the financial responsibilities of HDR bids that clear the DAM. HDR resources can currently represent embedded loads that are neither settled nor metered with the IESO. These loads' lack of metering with the IESO presents a settlement challenge because net settlement between the DAM and real-time balancing market cannot be accurately determined without actual metered quantities. Coordination with the DR Working Group and the Incremental Capacity Auction (ICA) initiative is required to determine whether changes to DR participation rules must be in place for the opening of the DAM or if this can wait until DR is integrated into the ICA.

Another consideration is whether the value of IESO forecast deviations will be distributed to NDLs on a global or zonal level. The IESO will need to assess how the locational prices and behaviour of NDLs in one zone may impact the value of IESO forecast deviations distributed to another zone to determine whether a zonal level of distribution should be used.

4.1.4 Linkages

There are no identified linkages for this design element.

4.2 Make-Whole Payments

4.2.1 Design Element Description

Make-whole payments apply to circumstances in a DAM where a resource is either "scheduled-up" to produce more energy than is economic at the LMP (incurring an operating cost loss), or is "scheduled down" to produce less energy than is economic at the LMP (incurring an opportunity cost). The need for make-whole payments in a DAM is expected to be infrequent and immaterial. That's because DAM prices will generally be greater than or equal to the offer price of scheduled supply resources and less than or equal to the bid price of scheduled load resources.

There may be a limited set of conditions where DAM prices or revenues do not sufficiently cover a resource's as-offered or as-bid costs. Resources may need to be scheduled out-of-merit in the DAM in order to maintain system reliability. Conditions that could trigger out-of-merit scheduling in the DAM include constraint violations, co-optimization of energy with operating reserve or the commitment of an NQS resource in the reliability pass of the DAM engine.

Current Market

Only NQS resources and imports are currently eligible for a make-whole payment in the DACP. NQS resources are provided this assurance because they are operationally committed in the DACP. This means they are expected to come online in real-time for their DACP-scheduled hours above MLP. This make whole payment provides the IESO assurance that NQS resources are encouraged to deliver on their DACP commitments. In order for NQS resources to deliver on their DACP commitments, they need to incur costs in the day-ahead timeframe. These costs are reflected in the NQS resource's three-part offers which represent their start-up, speed no load, and incremental energy costs. Since real-time conditions can change from DACP assumptions, the revenues that NQS resources earn in the RTM may not sufficiently cover the day-ahead costs they incurred.

The make whole payment for NQS resources also depends on whether the resource actually came online in the RTM and incurred those costs. The make whole payment accounts for the resource coming online in a timely manner by reducing the make whole payment eligibility on a pro-rated basis for every 5 minutes the resource is late to reach its MLP after 30 minutes has passed in the first hour of its DACP schedule above MLP. This provides the IESO added assurance that the resource is available for RTM dispatch above its MLP in a timely manner.

Imports are provided a make whole payment for every hour they are scheduled in the DACP if the day-ahead costs they incurred to schedule the transaction as an export in the neighbouring jurisdiction are not covered by RTM revenues.

Future Market

Under a DAM, it will be important for all dispatchable resources, not just NQS resources and import transactions, to be eligible for a make whole payment if their DAM revenues do not cover their as-bid or as-offered costs in the DAM. This is because the DAM will impact the settlement of all resources that receive a DAM schedule. Without a make whole payment, dispatchable resources would be encouraged to offer or bid into the DAM less efficiently by raising their offer prices to ensure DAM prices cover their actual costs. Alternatively, resources may reduce the amount of energy they are willing to offer or bid in the DAM.

DAM make-whole payment eligibility is typically different for resources that only have incremental energy costs compared to other resources with additional costs, namely start-up and speed-no-load costs. Resources that submit incremental energy costs, through single-part offers, are typically eligible for a make-whole payment in any hour that their hourly energy and operating reserve revenues do not cover their as-offered costs. Resources that submit three-part offers are typically eligible for a make-whole payment if the sum of their energy and operating reserve revenues from their entire DAM schedule do not cover their cumulative as-offered costs. The treatment is different because start-up and speed-no-load costs can be distributed across multiple hours whereas incremental energy costs are not.

NQS resources, or any resource permitted to submit three-part offers into the DAM, should also continue to be subject to the additional make-whole payment eligibility rules that depend on whether the resources actually delivered energy in the RTM and incurred their start-up and speed no load costs. A resource should not qualify to recover costs that were not actually incurred in the RTM to avoid unnecessary uplift costs to consumers.

While the DAM provides make whole payments to ensure dispatchable resources participate efficiently in the DAM, consideration must also be given to how these DAM make whole payments interact with RTM make-whole payments to ensure efficient outcomes in both markets.

4.2.2 Decisions

The IESO has determined that all dispatchable supply and load resources, including imports and exports, will be eligible for a DAM make-whole payment when energy and OR revenues do not sufficiently cover their as-offered or as-bid costs. This implies that non-dispatchable resources will not be eligible. Non-dispatchable resources include self-scheduling resources, NDLs and virtual transactions. Self-scheduling resources and NDLs are price takers, and therefore are not scheduled to operate at a loss, while virtual transactions do not have production costs like physical resources.

While DAM make-whole payments are expected to be infrequent and immaterial, they are a necessary design feature that encourages resources to maintain efficient offers and bids into the DAM. Without a DAM make-whole payment for dispatchable resources, market participants would be encouraged to raise their offer prices or withhold energy from the DAM. This less efficient DAM participation can raise DAM prices and send price DAM price signals that are inconsistent with expected real-time outcomes.

DAM make-whole payment eligibility will be different for resources with additional costs that are captured as three-part offers relative to other resources that submit single-part offers.

Make-Whole Payment Eligibility for Resources that Submit Three-Part Offers

Resources that are permitted to submit three-part offers will be eligible for a DAM make-whole payment if its energy costs, operating reserve costs, and commitment costs are not covered by the energy and operating reserve revenues earned over its entire DAM schedule.[25] A resource must actually generate in real-time in order to qualify for start-up and speed-no-load costs, since a resource should not qualify to recover costs it did not actually incur.

[25] Ramp energy and the revenue earned during their ramp period will be offset in the DAM make-whole payment. Accounting for NQS resource ramp energy in the DAM will reduce the likelihood of over-committing additional NQS resources in the DAM to clear bid load. It also helps support greater price convergence between a DAM and RT by aligning DAM scheduling with RT outcomes.

Start-Up Cost Eligibility for Resources that Submit Three-Part Offers

A resource's start-up cost will only be eligible for a make whole payment if the resource actually reaches its MLP in the first hour of its DAM schedule at or above MLP. This should encourage the resource to come online in a timely manner if it intends to meet its DAM schedule. The proportion of start-up costs that a resource will be eligible to recover will be dependent on when the resource actually reaches its MLP:

- A resource will be eligible to fully recover its start-up cost if the resource reaches its MLP within the first 30 minutes after the start of the first hour of its DAM schedule where it is scheduled to be at or above its MLP;
- A resource will be eligible to partially recover its start-up cost if the resource reaches its MLP between 30 and 90 minutes after the start of the first hour of its DAM schedule where it is scheduled to be at or above its MLP; however, start-up costs will be reduced by $1/12$th for every five-minute interval the resource is delayed in reaching its MLP; and
- A resource will not be eligible to recover any start-up costs if the resource fails to reach its MLP by more than 90 minutes after the start of the first hour of its DAM schedule where it is scheduled to be at or above its MLP.

Speed-No-Load Cost Eligibility that Submit Three-Part Offers

A resource will be eligible to fully recover its speed-no-load cost for each hour of its DAM schedule if it actually produces energy for the entire hour. However, speed-no-load costs will be reduced by 1/12th for every five-minute interval the resource is not generating in an hour. Again, this is to ensure a resource is only eligible to recover these costs if they actually occur.

Make-Whole Payment Eligibility for Resources that Submit Single-Part Offers

All other dispatchable suppliers and loads, including imports and exports, will be eligible for DAM make-whole payments in every hour that their as-offered or as-bid costs are not covered by the hourly energy and operating reserve revenues earned.

4.2.3 Detailed Design Considerations

It is difficult to uncover all potential issues with respect to make-whole payments in high-level design due to the complexity of the settlement. As such, the IESO has determined that the following set of make-whole payment guidelines will inform decision making for all make-whole payment calculations during detailed design. The guidelines will ensure make-whole payments are designed to avoid overpayment while continuing to provide resources with an incentive follow their dispatches.

Dam and Real-Time Make-Whole Payment Guidelines

- When a resource is not scheduled in the DAM, the real-time make-whole payments should either bring the resource back to its operating profit for dispatched-down events; or bring the resource back to its operating cost for dispatched-up events.
- When a resource is scheduled in the DAM, the real-time make-whole payments should take into account any DAM make-whole payments to avoid over compensation and unnecessary uplift costs.
- The real-time make-whole payment should not cover costs that arise from a resource deviating from dispatch instructions due to faults within its own control (e.g., derates, testing equipment).
- The real-time make-whole payment should consider any real-time balancing revenues and costs incurred for OR to avoid under-compensation.

4.2.4 Linkages

The Make-Whole Payments design element is linked to DAM design element 15 (Uplift Recovery) design element because DAM make-whole payments are recovered through uplift costs that are allocated to certain market participants.

4.3 Uplift Recovery

4.3.1 Design Element Description

Uplift recovery is a mechanism used to recover the cost of make-whole payments and other electricity market services not otherwise recovered through revenues in the energy and OR markets. As discussed in the Make-Whole Payments design element, make-whole payments are required to ensure resources participate efficiently in the DAM. This design element establishes which market participants will be allocated the cost of DAM make-whole payments and other DAM services such as OR.

The IESO currently allocates the cost of make-whole payments and OR schedules to all load and export market participants because loads and exports ultimately benefit from the energy produced and OR provided. These costs are proportionately allocated to loads and exports based on how much energy they consume in the RTM.

Other jurisdictions also proportionately allocate the cost of DAM make-whole payments and OR schedules to real-time loads and exports based on their real-time consumption. Jurisdictions have not contemplated allocating these costs to DAM loads and exports over concerns that these resources would not participate in the DAM to avoid uplift allocation.

Some jurisdictions allocate the cost of make-whole payments to market participants that were specifically responsible for causing resources that are eligible for a make-whole payment, to be scheduled. This is typically very difficult to determine because many factors can contribute to the scheduling of a resource. However, there are situations where market participant behaviours can be easily traced back to the scheduling of a resource, and therefore, any make-whole payments that may be required. A common example is the commitment of resources in the reliability pass of the DAM engine. As discussed in the Functional Passes design element, system operators use a reliability pass to ensure sufficient physical resources are committed in the DAM to meet forecast conditions in real-time. This is achieved by ignoring virtual transactions and replacing physical load bids with forecasted quantities from the system operator. With virtual transactions and physical load bids excluded from this pass, the impact these resources have on the commitment of other resources can be determined.

Eligible make-whole payments for resources committed in the reliability pass are typically allocated to virtual supply transactions and physical loads because these resources may offer or bid less efficiently into the DAM to increase profits or reduce costs. Virtual supply transactions can increase their profit potential by offering excess energy into the DAM such that the reliability pass over-commits[26] a physical resource. Virtual supply transactions can profit from this outcome because resource over-commitments in the DAM can suppress real-time prices relative to DAM prices. Similarly, physical load resources may bid less into the DAM to mitigate the risk of overpaying for energy in the DAM if their actual consumption in the RTM turns out to be less than their DAM schedule. This could cause a physical supply resource to be committed uneconomically in the reliability pass of DAM if the system operator's load forecast is significantly higher than what the physical loads bid.

[26] The reliability pass could over-commit a resource because this pass ignores virtual supply transactions. The more virtual supply transactions are ignored, the more likely a physical supply resource will be committed.

4.3.2 Decisions

The IESO has determined that the cost of DAM make-whole payments and DAM OR costs will be proportionately allocated to loads and exports based on their real-time consumption. As described in 4.3.1 above, this approach will retain incentives for loads and exports to participate in DAM.

The IESO has also determined that the cost of DAM make-whole payments, if required for a resource committed in the reliability pass of DAM, be allocated to PRLs when they are scheduled to consume less in the DAM relative to their real-time consumption. Allocation will be based on the amount of real-time energy a PRL consumed above its DAM schedule. This allocation encourages more efficient participation from PRLs that could otherwise strategically underbid in the DAM and increase costs for other PRLs that have not strategically underbid.

Virtual supply transactions will also be allocated the cost of DAM make-whole payments that may be generated in the reliability pass for every MWh cleared in the DAM. As described in 4.3.1 above, this allocation should discourage virtual suppliers from potentially over-committing resources to increase their profit potential.

Any residual make-whole payment costs not allocated to PRLs and virtual supply transactions would be the result of the IESO over-forecasting load in the reliability pass of DAM. These residual costs will be recovered proportionately from real-time loads and exports based on their real-time consumption.

4.3.3 Detailed Design Considerations

Publishing the allocation of uplift costs will be reviewed during detailed design considering best practices in other jurisdictions. Providing market participants information about uplift cost allocation can help them better understand the factors driving uplift and improve investment decisions to meet system needs.

4.3.4 Linkages

The Uplift Recovery design element is linked to DAM design element 14 (Make-Whole Payments) design element because DAM make-whole payments impact the amount of uplift that needs to be recovered.

4.4 Financial Transmission Rights

4.4.1 Design Element Description

Financial transmission rights (FTRs) provide a mechanism for market participants to hedge price uncertainty that may arise from congestion. Currently, FTRs provide a mechanism to hedge congestion on an intertie path between Ontario and a neighbouring jurisdiction.

Congestion creates price differences on an intertie when the quantity of net economic import offers or export bids exceeds the intertie's physical transfer capability. The holder of an FTR is hedged against congestion for their energy transaction, if the energy transaction is scheduled on the same path/direction and for the same quantity as the FTR. For example, a 100 MW import transaction will be hedged against import intertie congestion if the importer holds a 100 MW of FTRs in the import direction on the same path. In this example, the import would have been settled at a lower price (relative to prices within Ontario) due to import congestion. In combination with an FTR hedge, the import would have received the equivalent of the price paid by the consuming loads located within Ontario.

FTRs in Ontario are currently settled at real-time prices because interties transactions are settled at real-time prices. However, in jurisdictions with a DAM, FTRs are settled at DAM prices to provide a hedge for congestion on DAM schedules because the DAM is the opportunity for participants to hedge against RTM price volatility. FTRs are not offered to hedge real-time congestion because intertie traders have the ability to hedge real-time congestion with a DAM schedule.

For example, a 100 MW import scheduled at an intertie that is import congested in the DAM, will be hedged against import intertie congestion if the importer holds a 100 MW of FTRs. Just like in the previous example, this import would be settled at a lower DAM price (relative to prices within Ontario) due to import congestion. However, when combined with an FTR this import would receive the DAM price paid by the consuming loads located within Ontario. No additional settlement would apply provided that 100 MW DAM schedule is actually delivered in RTM.

Internal Financial Transmission Rights

Unlike other jurisdictions, FTRs that provide a hedge against internal congestion currently do not exist and are not being contemplated in the Market Renewal Program.

Internal FTRs in others markets were created specifically to provide a hedge against congestion costs for forward power contracts when implementing a SSM. This hedge enables commercial relationships between Load Serving Entities (who are required to procure capacity for their own adequacy) with energy suppliers who might be located at different locations relative to the load. Without an internal FTR, energy deliveries between the suppliers and the LSE would be subject to congestion risk which if left unmitigated would place uncertainty premiums on the value of the contract. Ontario does not have LSEs, and does not have a need to implement internal FTRs.

Through the SSM initiative, the IESO has determined that internal congestion rents and loss residuals (the residuals) will be returned to Ontario consumers according to the degree to which they are impacted by congestion and losses on the IESO-controlled grid. This methodology is simpler than an internal FTR approach and provides reasonably efficient incentives for consumers to respond to a nodal/zonal price signals.

4.4.2 Decisions

The IESO has determined that intertie FTRs will be settled at DAM prices to provide market participants with the ability to hedge DAM congestion. Settling FTRs at DAM prices will also drive greater import and export participation in the DAM since it is a market participant's only opportunity to hedge congestion.

4.4.3 Detailed Design Considerations

The decision to settle external FTRs at DAM prices will inform the Transmission Rights Market Review. The Transmission Rights Market Review is an upcoming stakeholder engagement under the Market Renewal Program that will consider potential improvements to the FTR market and ensure compatibility with the Market Renewal Program.

4.4.4 Linkages

There are no identified linkages for this design element.

4.5 Market System Failures

4.5.1 Design Element Description

A market system failure (failure) typically occurs when either the DAM or RTM experiences a software interruption or is deemed to generate invalid results. Failures require the use of administrative pricing to support timely and reasonably accurate resource settlement. Administrative pricing is a necessary after-the-fact price correction process used to ensure prices still appropriately reflect the incremental cost of energy or operating reserve at a specific at location and time, to the best extent practical. Market suspension is considered another type of failure that requires administrative pricing, however, suspensions are a very rare occurrence when compared to software interruptions or invalid results. The introduction of a DAM provides the administrative pricing process with another source for prices and schedules that can, under certain conditions, be utilized for RTM price administration.

Current Market

Current administrative pricing principles are derived from the current market rules and provide a foundation for price correction under specific market conditions. They ensure that price corrections are fair and transparent to all impacted parties. The IESO adheres to two sets of administrative pricing principles. One set is for market system failures when the market is not suspended and a different set when the market is suspended. The distinction is necessary due to the fact that under market suspension the grid may be operated without using market based signals.

When the market is not suspended, administrative prices should reflect what would have otherwise been produced by the market absent the failure. These principles assume that valid and up-to-date bids and offers are available and IESO resources are being dispatched on the basis of market system outcomes (economically). Failures that result in a non-suspension condition occur much more frequently than failures that result in market suspension.

The duration of a non-suspension failure determines the administrative pricing mechanism used. A short-term failure is considered to be less than or equal to four hours. For short-term failures, schedules and prices calculated before or after the market failure are copied into the affected intervals to administer the price.

A long-term failure is deemed anything greater than four hours. For long-term failures, hourly prices are derived using an average of the hourly Ontario energy prices (HOEP) corresponding to the affected hours over the previous four business or non-business days, as applicable.

When the market has been suspended real-time operational decisions may not reflect market-based information. In this rare instance, the administered pricing should be fair and reasonable to suppliers and loads. The administered pricing should also be understandable, transparent and administratively simple. Lastly, the corrected prices should only try to reflect a current market price if grid operations are based, to some extent, on market-based information signals.

Administrative prices are currently used for the RTM. The DACP does not require administrative pricing because the DACP does not produce settlement prices.

Treatment of Market Failures in Other Jurisdictions

DAM Failures

When DAM failures occur, they are typically addressed by implementing one of the following actions to correct prices for settlement:

- Utilizing previous days DAM schedules and prices;
- Disregarding the DAM results or lack thereof and settling with real-time prices only;
- Recalculating incorrect pricing using the best available data.

Real-Time Market Failures

When RTM failures occur, implementation of one, or a combination of the following actions may be used to correct prices for settlement:

- Recalculation of the affected prices using best available data where practical;
- Using the last valid or most recent valid dispatch to copy forward or backward;
- Using prices calculated for an electrically similar node;
- Applying the DAM prices for the affected hours.

Using a combination of methods is applied when the failure extends beyond a specified number of intervals. Copying the last good interval forward may only be a reasonable representation for a finite period of time, after which another method may reflect a more accurate price.

4.5.2 Decisions

The IESO has made the following determinations with respect to DAM market failures:

Day-Ahead Market Failures

As described in the figure 6 below, the expected DAM posting deadline is 13:30 EPT. In the event that there are issues with the DAM execution, the IESO has determined that DAM results be delayed, re-evaluated and published up until 15:30 EPT. This will ensure the IESO can continue to confirm day-ahead intertie schedules with neighbouring jurisdictions no later than 16:00 EPT.

Beyond the 15:30 EPT deadline, DAM results could provide less financial and operational certainty due to stale data. If DAM results cannot be posted by 15:30 EPT, the DAM will be declared a failure. Once DAM is declared a failure day-ahead prices and schedules will not be created or published. As a result, administered pricing will not be used to settle the DAM as there will be no data to administer. Rather, the RTM will be used to schedule and dispatch resources for the next day and there will only be an RTM settlement.

Following a DAM failure, the IESO will conduct a reliability assessment for the next day and make any required NQS reliability commitments. NQS reliability commitments made as a result of the reliability assessment following a DAM failure would be communicated to participants before 18:30 EPT to provide sufficient time for gas-fired resources to secure fuel ahead of the evening gas nomination deadline of 19:00 EPT. This timing also ensures that NQS reliability commitments are reflected in the first run of pre-dispatch at 20:00 EST.

FIGURE 6: DELAYED DAY-AHEAD MARKET TIMELINES

Real-time Market Failures

Market Non-Suspension

In the future DAM will be providing day ahead market data in the form of prices and schedules. Due to the availability of this market data, new options for real-time price correction have become available.

When the RTM is not suspended, it is determined that one or a combination of the following options be utilized to administer the prices:

- Use the most recent price that was successfully generated before or after the failure.
- Apply the DAM price calculated for the corresponding hour of the market failure.
- Recalculate market prices and schedules using offline simulations.

These methods can be used in isolation from, or in conjunction with one another. Allowing any option or any combination of options to be utilized will result in the best representation of what the market tools could have created, absent the failure, given the available data.

Market Suspension

When the RTM is suspended the administered prices will be determined using an average from RTM prices of the corresponding hour or hours from the four most recent business or non-business days, as applicable. This recommendation maintains the existing administrative pricing guidelines.

4.5.3 Detailed Design Considerations

The IESO will need to determine the following under detailed design:

- Appropriate methods of price correction and compensation for electrical islands, if required;
- The possibility of identifying incorrect, published DAM prices after-the-fact and applying administered pricing to DAM;
- Determine conditions under which each methodology of price administration is appropriate. Using one method may only be appropriate for a finite number of intervals. Another method may reflect a more valid price for future intervals;
- Determine appropriate compensation following administrative pricing to ensure participants are not financially harmed and kept whole;
- Define appropriate timing for price correction methodologies; and
- Identify what communications are required externally during failures, and specify timelines.

4.5.4 Linkages

There are no identified linkages for this design element.

Appendix 1 – Day-Ahead Market Design Elements

Participation and Input Data

1 Offer Obligations

2 Supply Participation: Variable Generation

3 Load Participation

4 Virtual Transactions

5 Reliability Input Parameters

Execution, Timing, Real-Time Integration and Price Formation

6 Market Power Mitigation

7 Price-Setting Eligibility

8 Functional Passes

9 Optimization of Hydroelectric Resources

10 Submission and Posting Deadlines

11 Initiation of Operational Commitments

12 Reporting Obligations

Settlement Topics

13 Two-Settlement for Supply and Load

14 Make-Whole Payments

15 Uplift Recovery

16 Financial Transmission Rights

17 Market System Failures

Appendix 2 – Interim Engagement Summary Report

Engagement: Day-Ahead Market – Market Renewal Project
Engagement Initiation: September 2017
Interim Summary Report Issue Date: December 2018

Interim summaries are provided for extensive engagements to support stakeholders' understanding of the work already completed and to outline the next steps or phases. This interim engagement summary provides an overview of the Day-Ahead Market (DAM) stakeholder engagement activities and outlines how stakeholder feedback has helped shape the high-level design (HLD).

Engagement Description/Background

Since the engagement was launched in September 2017, the IESO has been working with stakeholders to design and develop a Day-Ahead Market. A DAM will provide market participants with price certainty ahead of real-time, increase operational certainty for both market participants and the IESO, and reduce out of market payments. The implementation of a DAM is a key element under the Energy work stream of the IESO's Market Renewal Program (MRP).

Stakeholder involvement has been essential in this process to ensure that the DAM HLD reflects the unique characteristics of the Ontario marketplace and considers the practical implications of design decisions on impacted stakeholders.

The engagement activities listed in this summary have enabled stakeholder views and preferences to be considered in the DAM design elements. Input from stakeholders has informed the decisions reflected in the DAM HLD and has helped lay the foundation for the upcoming detailed design phase.

Engagement Objective

The primary objective of this engagement was to provide a forum for stakeholders to contribute to the development of the overall DAM design. Active engagement from interested stakeholders throughout this engagement and in future related engagements is critical to ensure that a wide variety of perspectives are considered, resulting in a robust market design that can meet system and participant needs at lowest cost.

A secondary objective was to provide information and education to assist stakeholders in understanding the purpose and scope of the DAM initiative and to facilitate their contributions to the engagement discussions.

Stakeholders have helped to shape the HLD through their participation in engagement sessions and through written feedback to the IESO.

Engagement Approach

The overall stakeholder engagement framework for the MRP, of which the DAM HLD engagement was a component, is designed to facilitate dialogue with market participants and stakeholders to inform decisions that will significantly reshape Ontario's electricity marketplace. The framework is based on the IESO's engagement principles and enables participation from all levels of stakeholders through:

- Engagement forums tailored to each initiative to provide opportunities for in-depth and focused discussions on specific design elements
- Education sessions to support stakeholder' participation in engagement forums
- The work of the Market Renewal Working Group (MRWG), which guides, advises and informs the IESO on strategic, policy and design issues that affect the program's success
- Technical subcommittees that provide a forum for focused discussion on MRP issues identified by the MRWG
- One-on-one meetings as part of ongoing relationship building

Stakeholder Participation

In 2018, the IESO hosted eight engagement meetings on the DAM design with an average of 55 stakeholders in attendance per session.

Throughout 2017 and 2018, stakeholders took part in a series of meetings led by the IESO and its external consultant (FTI). At the introduction of the DAM engagement, stakeholders participated in three education sessions designed to facilitate their participation in engagements across the MRP. Following this, stakeholders were involved in discussions concerning the design options and then the preliminary decisions. Throughout these engagement activities, stakeholders provided valuable and constructive feedback that helped to inform the design decisions recorded in this document.

The HLD reflects the contributions of a diverse set of stakeholders, including:

- Generators representing a broad range of technologies and fuel types
- Consumers (e.g., large industrial and commercial enterprises, low-volume consumers)
- Demand response aggregators
- Emerging technologies/developers
- Intertie traders
- Local distribution companies
- Market Surveillance Panel
- Industry associations
- Consultants
- Gas utilities
- Government, specifically the Ministry of Energy, Northern Development and Mines (formerly the Ministry of Energy)
- Energy Regulator (Ontario Energy Board)

How Stakeholder Input Was Used

The IESO received stakeholder feedback during and after each engagement meeting. All feedback and responses were publicly posted on the DAM engagement page.

The following IESO response documents include a summary of the feedback submissions by stakeholders from the first engagement until the release of the HLD:

- Response to Feedback from the September 20, 2018 Meeting
- Response to Feedback from the July 18/19, 2018 Meeting
- Response to Feedback from the May 23/24, 2018 Meeting
- Response to Feedback from the March 27, 2018 Meeting (Market Power Mitigation)
- Response to Feedback from the March 27, 2018 Meeting
- Response to Feedback from the January 31, 2018 Meeting
- Response to Feedback from the October 30, 2017 Meeting

The following is a summary of some of the key areas of focus for which stakeholders submitted feedback and directly helped inform the design decisions of the DAM. This is not an exhaustive list, as other design elements also benefited from the input of active stakeholders. The responses to feedback above should be consulted for a detailed record of discussions. The DAM design tracker also provides a history of how design decisions were discussed and developed.

Design Element	Discussion Points
Offer Obligations	Feedback from stakeholders prompted the IESO to propose changes from its preliminary decision to impose an offer obligation in DAM to prevent physical withholding. This feedback included three themes. The first is that a must-offer requirement could be punitive to resources by conflicting with existing contractual obligations. The second is that there are existing financial incentives in certain contracts to address the risk of physical withholding. The third is that defining a must-offer quantity to address physical withholding could be challenging considering a resource's expected availability can vary on an hourly basis. The IESO took this feedback into consideration and determined that the complexity of quantifying the expected availability for different resources would be impractical. As a result, the IESO revised the preliminary decision by removing the obligation to offer into the DAM and instead mitigate for physical withholding after the fact.
Submission and Posting Deadlines	The IESO received feedback indicating that DAM submission and posting deadlines should be implemented in EPT to improve alignment with the gas market all year long. Using EPT year-round would also provide participants with more time to submit day-ahead offers and make post-DAM scheduling decisions during normal business hours. The IESO acknowledged this feedback and revised the preliminary decision on DAM execution from 9:00-12:30 to 10:00-13:30 EPT.
Optimization of Hydroelectric Resources	The IESO identified the need to remove the current DACP resubmission window which hydroelectric resources use to increase the likelihood of receiving a feasible day-ahead schedule. While the resubmission window works well under the DACP, it could give hydroelectric resources an unfair advantage over other resources under a DAM. In lieu of a resubmission window in DAM, the IESO began discussing potential software requirements in the optimization engine to model hydroelectric resources. Stakeholders showed particular interest in how the IESO would determine the needed requirements and asked to be included in this development. Stakeholders also asserted that the IESO develop these requirements during the HLD rather than the detailed design phase. Stakeholder feedback received from this meeting was used by the IESO to develop software requirements that will be included in the vendor RFP.
Virtual Transactions	Stakeholders supported the IESO's preliminary decision to implement virtual transactions on opening of the DAM. As design decisions on virtual transactions progressed, stakeholders suggested that virtual transactions be implemented at intertie zones to provide greater visibility of expected flows across the interties. The IESO clarified that virtual transactions would not be allowed at intertie zones as existing intertie transactions are already in effect virtual transactions since intertie transactions are also not required to demonstrate physical ability to produce or consume energy. A separate category of virtual transactions at interties would therefore be redundant in the DAM.
Design Tracker/ Issues Log	In addition to stakeholder feedback and the IESO response documents, stakeholders proposed the IESO adopt a design tracker and issues log to provide more clarity and progress updates on ongoing issues or design issues. The IESO agreed with the suggestion and has maintained both an Issues and Actions Log and a DAM Design Tracker.

Engagement Outcome and Next Steps

The culmination of these engagement activities is the completion of the draft HLD document, which is reflective of the decisions discussed with stakeholders at the engagement meetings.

Engagement activities will continue on the HLD until all three energy work stream HLDs are finalized in early 2019. The engagement plan for the detailed design phase includes a new engagement approach.

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