Day-Ahead Market High-Level Design

Executive Summary

Independent Electricity System Operator

DECEMBER 2018

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Powering Tomorrow.

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.

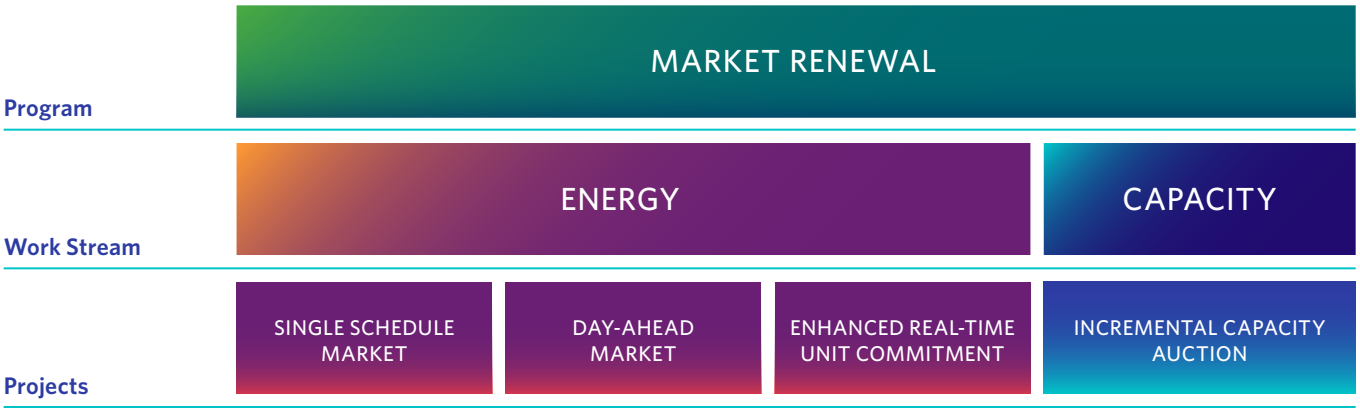
Market Renewal Initiatives

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.

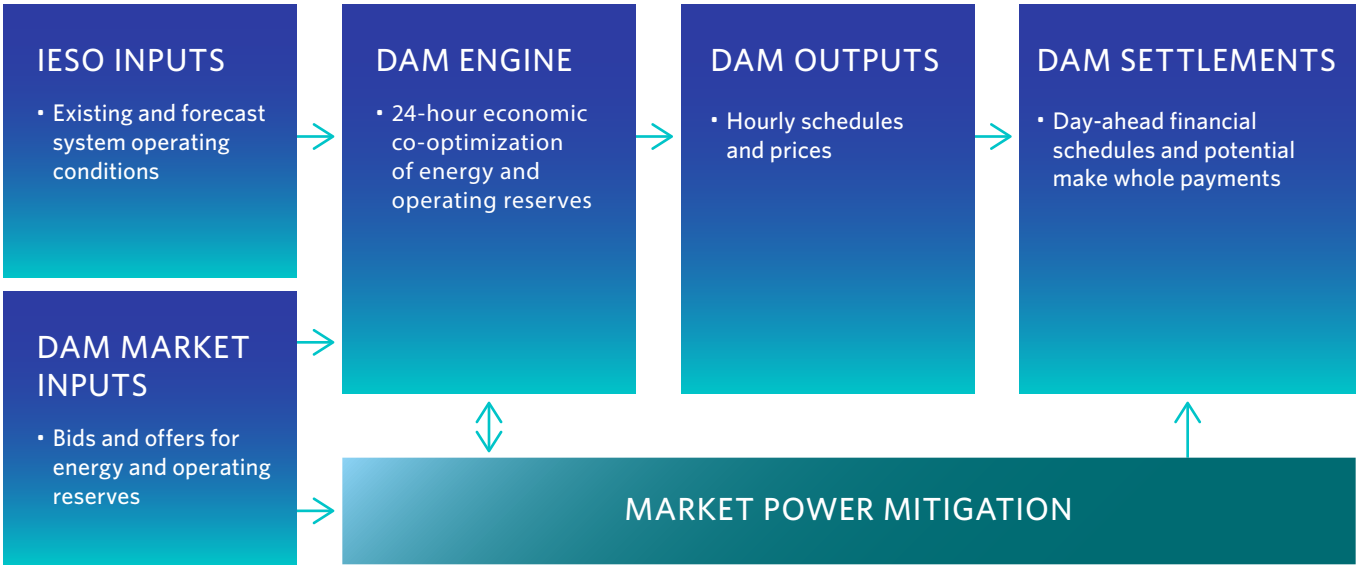
FIGURE 2: PROJECT DESIGN PROCESS

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.

Independent Electricity System Operator
1600–120 Adelaide Street West
Toronto, ON M5H 1T1

Phone: 905.403.6900
Toll-free: 1.888.448.7777
Email: customer.relations@ieso.ca

@IESO_Tweets
OntarioIESO
linkedin.com/company/ieso

ieso.ca

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