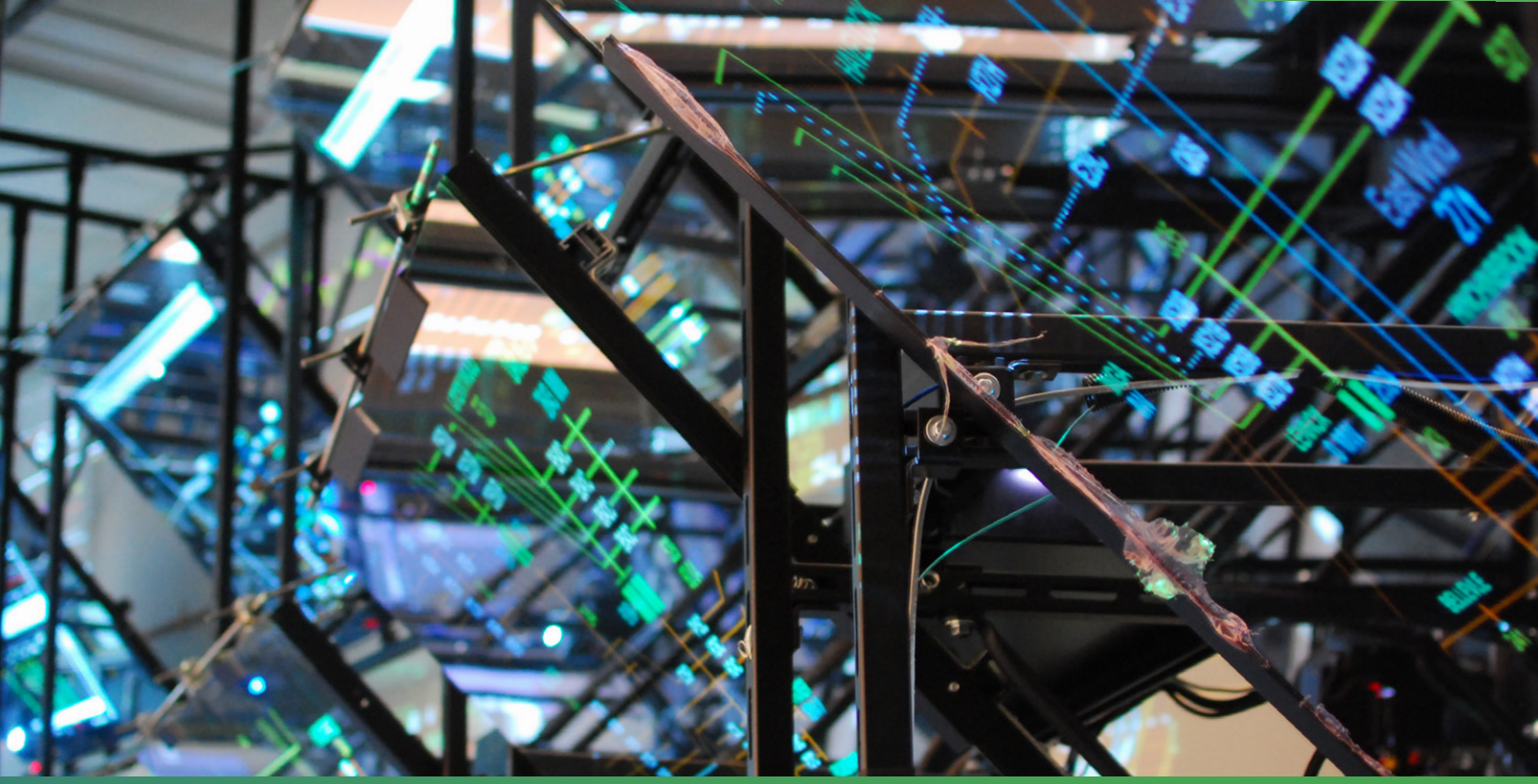


Single Schedule Market High-Level Design

Executive Summary

Independent Electricity System Operator

SEPTEMBER 2018

ieso
Connecting Today.
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.

Marginal incentives for loads

The incentive for price sensitive loads, if they are able, to reduce consumption in response to relatively high locational prices.

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.

Intertie congestion constraints

The transmission lines that connect Ontario to other jurisdictions (i.e., interties) have constraints on the amount of electricity they can carry. "Intertie congestion" results when demand to flow electricity to or from Ontario is greater than can be accommodated.

Out-of-merit

At times, to maintain safe, reliable and efficient operations, the IESO directs a supply resource to produce more or less electricity. When a resource may not appear to be the most economic unit, based on the bids and offers submitted, it is said to be dispatched "out-of-merit." Such results are the lowest-cost way to satisfy reliability or to achieve the most efficient dispatch.

Design Elements

Price Formation

1 Energy Price - Congestion Component

2 Energy Reference Price

3 Energy Price - Loss Component

4 Pre- or Post-Interval Pricing

5 Intertie Congestion Pricing

6 Supplier Pricing

7 Operating Reserve Reference Price

8 Operating Reserve Price - Congestion Component

9 Constraint Violations

10 Out-of-Market Operator Actions

11 Multi-Interval Optimization

12 Price-Setting Eligibility/Operating Restrictions

Market Power Mitigation

13 Mitigation Process

14 Timing of Application

15 Reference Levels

Load Pricing

16 Pricing for Loads

17 Congestion Rents and Loss Residuals

Settlement Topics

18 Make-Whole Payments

19 Uplift Recovery

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.

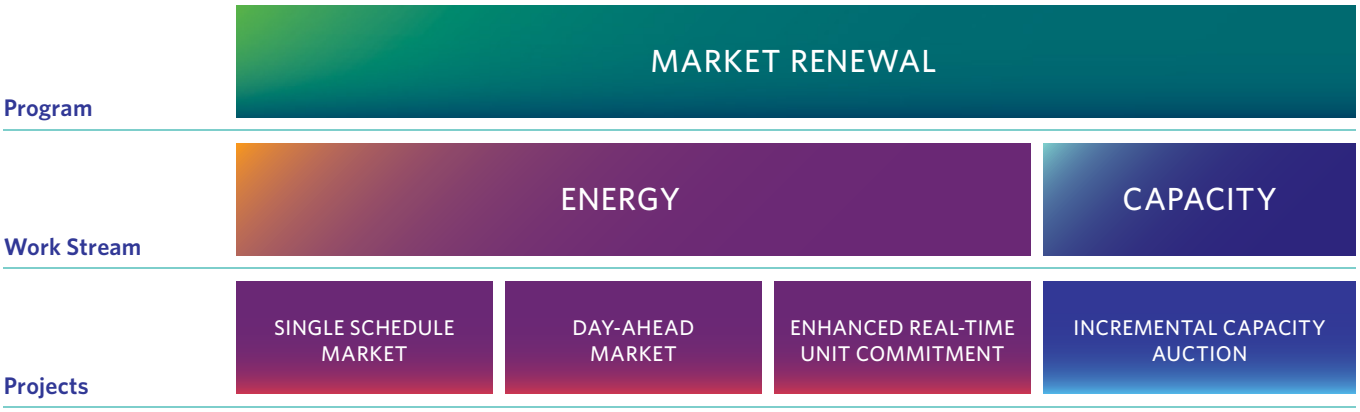
Market renewal initiatives

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 $3.4 billion in savings over a 10-year period, with the potential to reach as high as $5.2 billion.

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

The single-schedule market
Laying the foundation

When the province's wholesale electricity markets were introduced in 2002, the Market Design Committee at the time recommended a two-schedule market as a way to simplify the transition from a regulated system to fully-fledged markets. This decision has endured and Ontario is now the only jurisdiction in North America with a two-schedule market for energy.

Currently, the pricing schedule ("unconstrained schedule") is used to set a single price across the province every five minutes. This uniform market clearing price (MCP) is then used to establish the province-wide hourly Ontario energy price (HOEP) for electricity. Because this price doesn't take into account actual system conditions or operational constraints, it doesn't reflect the real cost of generating or consuming electricity at different locations.

However, in order to maintain reliability, the dispatch schedule ("constrained schedule"), which determines the physical dispatch instructions, has to take all system and operational limitations into account.

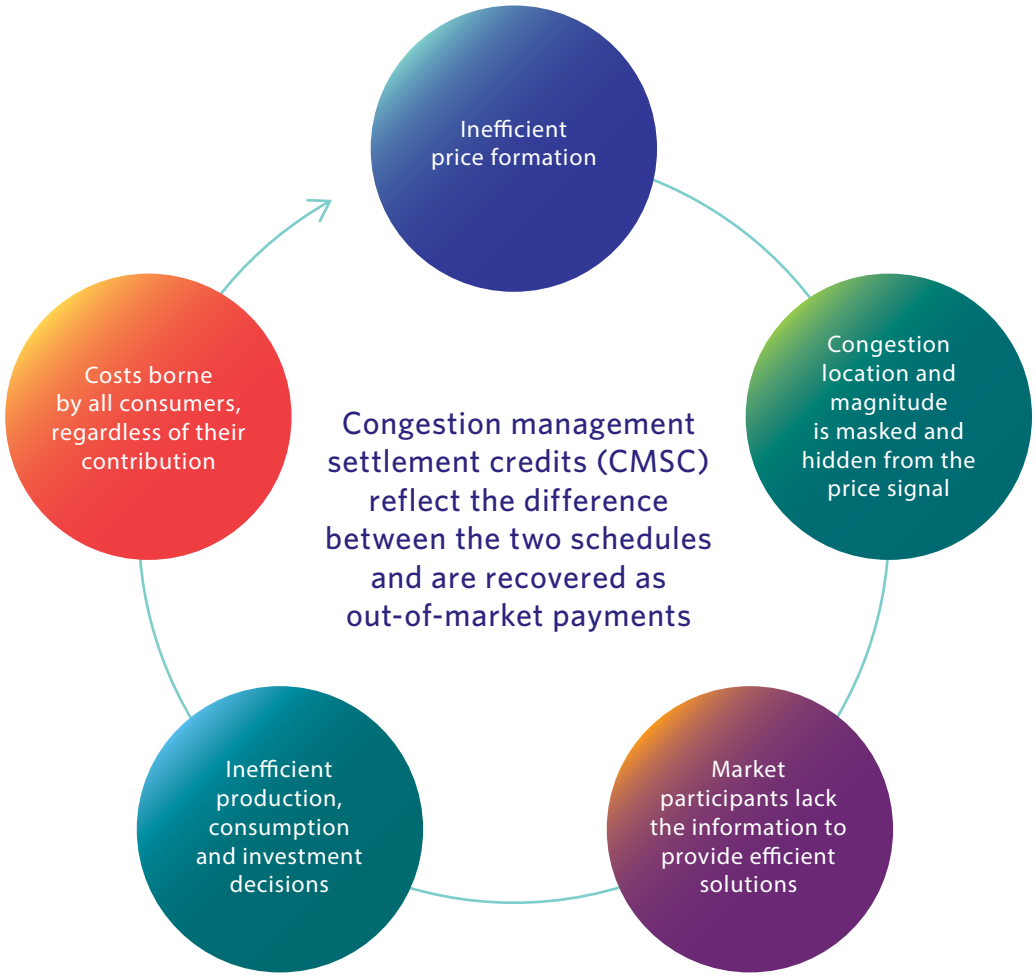
This system results in two key challenges for Ontario. First, when price and dispatch are not aligned, decisions that make financial sense to market participants may not be efficient or reliable for the markets as a whole. Second, the differences between price and dispatch require a complex series of out-of-market payments – or congestion management settlement credits (CMSC) – to ensure all market participants follow dispatch instructions to maintain reliability.

The larger the divergences between those two schedules, the more out-of-market payments in the form of CMSC are required to reconcile the difference. Greater divergences also increase the probability of inefficient outcomes, such as higher costs, complex settlements and opportunities for market participants to game the system (see Figure 3). CMSC payments are not transparent and as such not subject to the scrutiny of transparent markets or the pressures of open competition.

With the proposed SSM design, market prices will reflect the true costs of producing or consuming electricity at a given place and time. Transparent price signals will support more open competition between market participants and lead to more efficient outcomes without the need for the CMSC payments that are a necessary feature of the current design. In addition, the introduction of a single market schedule will allow the IESO to implement important changes to the energy markets, such as the establishment of a day-ahead market and enhanced real-time unit commitment.

Finally, as technology changes empower a larger range of consumers, more granular pricing will help consumers connect their actions to needs on the system, and maximize the economic benefit for both.

FIGURE 3: EFFECTS OF CMSC PAYMENTS



Since May 2017, when we hosted the first SSM stakeholder meeting, consultation has taken place on all aspects of the SSM design, including in-depth discussions of the applicability for Ontario of different options for each of the proposed design elements. Throughout this 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 address 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 new single-schedule model.

To manage the scope and complexity of the SSM, the IESO focused the design work and engagement with stakeholders, separating the project into 19 design elements. These elements were then grouped into one of four categories: Price Formation, Market Power Mitigation, Load Pricing and Settlement Topics. The following sections focus on the most material design elements in each category.

Price formation at a glance

Improving the way electricity is priced – and ensuring as many of the underlying costs as possible are reflected transparently in the energy price – is one of the goals of market renewal. With more granular prices, resources will be better able to make decisions that will improve efficiencies and reduce total system costs. For this reason, locational marginal prices – commonly referred to as LMPs – are a key element of single schedule markets.

In an SSM, locational prices will align with dispatch by accounting for congestion and losses – power loss from "distance travelled" from the supply resource – on the system.

Paying supply resources a locational energy price that reflects system conditions where they are connected to the grid will help ensure they present offers that accurately reflect their short-run marginal costs. This, in turn, will result in efficient dispatch, reducing the long-run cost of operating the system.

Under the new structure, operating reserves or standby capacity that allows the IESO to respond to short-term unexpected changes, such as downed transmission lines or generators, will also vary by region to reflect locational constraints.

The move will minimize the need for out-of-market or make-whole payments, which compensate generators when they face a shortfall between their offer price and the revenue earned through market clearing prices. While the cost of make-whole payments will drop dramatically with an SSM in place, these payments will still be required occasionally to ensure market participants will not lose money as a result of following IESO instructions to maintain system reliability.

Market power mitigation at a glance

A market thrives when there is open and fair competition among many resources. Competition becomes unfair when market participants 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 prevent participants from exercising market power and protect consumers from higher costs. 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 alignment of price and dispatch under the SSM, after-the-fact mitigation will no longer be viable.

Instead, the IESO will move to an approach that mitigates "before-the-fact" for economic withholding – a shift that prevents offers that are too high from affecting dispatch schedules and market prices. This approach is in keeping with the one used by other North American system operators.

This means that, where possible, the IESO will adjust offer prices for market participants that fail the tests for market power to their respective, pre-determined reference levels ahead of dispatch. In general, the test thresholds that determine what offer level and price impact trigger mitigation will be higher in areas with significant competition and lower in areas where competition is restricted.

As part of its market power mitigation strategy, the IESO will also address a number of scenarios that may create opportunities for the exercise of market power. These include situations where suppliers could set the LMP at their location or lower their office price to profit from the congestion caused by a transmission constraint, when interties are deemed to be uncompetitive – for example, because the majority of the trade comes from a single market participant – and when import congestion could drive price increases in Ontario.

Load pricing at a glance

While an SSM introduces locational pricing for those that supply electricity directly to the wholesale market, the prices sent to different classes of consumers merit a separate group of design elements. The high-level design deals with the pricing for loads (also known as electricity consumers) that are market participants[1] and typically directly connected to the IESO-controlled grid. This group represents about 14 per cent of total load in Ontario and includes the largest industrial and commercial facilities in the province.

Locational pricing is not just a cornerstone of a more dynamic and active marketplace; it also help ensure that consumers' energy consumption decisions are linked to actual system needs, leading to greater operational and economic efficiencies. For example, accurate price signals can encourage price-sensitive loads to reduce consumption when local prices are high, reducing demand and putting downward pressure on prices in a relatively high-priced region and, ultimately, enabling cost reductions for the responding loads and other loads in the region.

The IESO has examined best practices from other jurisdictions and has decided on a zonal pricing design – a weighted average of nodal prices within the zone[2] – as the right choice for Ontario. Loads will also have the option to move to nodal pricing depending on their preference. By moving to zonal prices, loads that are connected to the IESO-controlled grid or are market participants with limited or no ability to respond to price signals will still see benefits in the form of overall price reductions.

As a consequence of transitioning some loads from a uniform price to a locational one, congestion rents and loss residuals will be collected as part of the energy settlement. Congestion rents are the difference in the price paid by consumers and the price paid to suppliers when there is congestion on the system. Similarly, loss residuals result from the difference between the amount paid for losses by loads and the amount paid for losses to generators.

Money collected as a result of congestion rents and losses will be returned to Ontario consumers according to the degree to which they are impacted by congestion on the system. In practical terms, this means consumers who are exposed to higher LMPs in zones where there is congestion will see their prices reduced toward the provincial average.

The high-level design decisions on load pricing primarily apply to larger consumers who are market participants. While this is not within our jurisdiction, the IESO is not aware of any plans to move residential and low-volume consumers from the province-wide uniform commodity cost set through the Ontario Energy Board's Regulated Price Plan (RPP). However, these consumers will still benefit from the move to LMP, as the actions of suppliers and larger loads will result in more efficient operational outcomes for the system and, ultimately, help lower costs for all consumers in Ontario.

Settlement topics at a glance

These design elements deal with situations when offer prices do not align with dispatch – for example during unexpected events, which can lead to reliability concerns for the IESO.

In instances where a resource is dispatched to produce more or less energy than that implied by the LMP, the resulting "operating cost loss" or "opportunity cost" is addressed through make-whole

[1] As market participants, local distribution companies (LDCs) will be charged zonal prices. However, Ontario's current regulated price plan (RPP) is legislatively mandated and requires LDCs to charge uniform RPP prices to their RPP customers (low-volume consumers).

[2] Pricing zones, which correspond to Ontario's existing 10 electricity zones, usefully segment the Ontario grid according to congestion and expected price separation.

payments and uplift recovery payments. In both cases, these payments incent market participants to adhere to dispatch instructions, providing the IESO with greater operational certainty.

Under the SSM, the IESO will continue to assign make-whole uplift charges on an hourly basis to all loads and exports to recuperate the cost of services that are not otherwise recovered through other charges.

Conclusion

Our goal, at the IESO, has always been to operate markets that provide clear signals for the value of needed services, and ensure prices accurately reflect system conditions, permitting both suppliers and consumers to make more informed decisions. In providing a blueprint to achieve this goal, the single schedule market high-level design addresses longstanding concerns with the current two-schedule market structure.

Collectively, the decisions included in the document – starting with the replacement of uniform pricing across the province with pricing that reflects the true costs of producing and consuming electricity – resolve the costly misalignment between price and dispatch. Once implemented, the high-level design will also dramatically reduce existing complexities, paying the way for other cost-saving initiatives, including the day-ahead market.

The culmination of 18 months of extensive consultation with stakeholders, this document is both a comprehensive summary of the decisions that will enable us to move to an SSM, and a stepping-off point for engagement on the detailed decisions that will need to be addressed before implementation.

As the initial high-level design, it also represents the first in 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.

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