

Education and Awareness

Energy Workstream High-Level Designs

Other Market Participants

December 11, 2018

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Purpose and Approach

- This exercise will provide education and practical understanding of the key aspects of the Energy High-Level Designs (HLDs)
- Focus of today will be on design decisions that are most impactful
- The presentation is split into three sections:
 - A. Summary of the relevant core design concepts
 - B. High-level walk through of operational activities to compare new design features to the current design
 - C. Settlement scenarios relevant to the resource group

SECTION A: DESIGN CONCEPTS

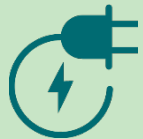
Introduction

- This section will begin with a recap of the rationale for Market Renewal, and summarize the key initiatives in the energy work stream
- The presentation will then outline the key design concepts most relevant for participants including:
 1. Locational Pricing
 2. Residuals
 3. Price Responsive Load
 4. Day-Ahead Market Participation
 5. Virtual Transactions
 6. Market Power Mitigation

Market Renewal Overview

- Ambitious set of initiatives that amounts to a fundamental redesign of Ontario's electricity markets and **prepares us for future change**
- Current design has served Ontario well but demands of a modern **grid evolving rapidly**
- **Reforms are required** to allow the IESO to continue to manage the grid reliably & cost effectively

Market Renewal Activities



ENERGY work stream

- Single Schedule Market (SSM)
- Day-Ahead Market (DAM)
- Real-Time Unit Commitment (ERUC)



CAPACITY work stream

- Incremental Capacity Auction (ICA)



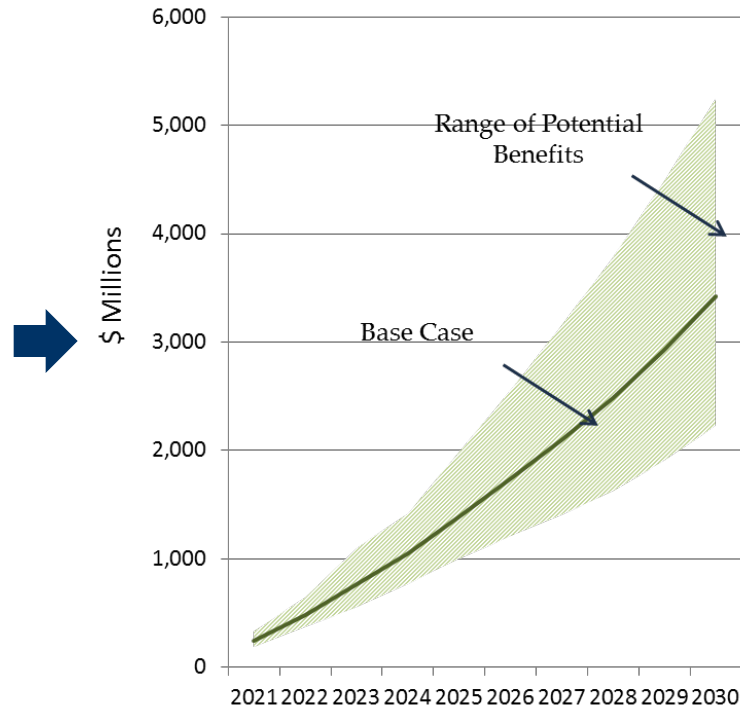
Near-term Projects

Market Renewal

Future Projects

Developing a Benefits Case

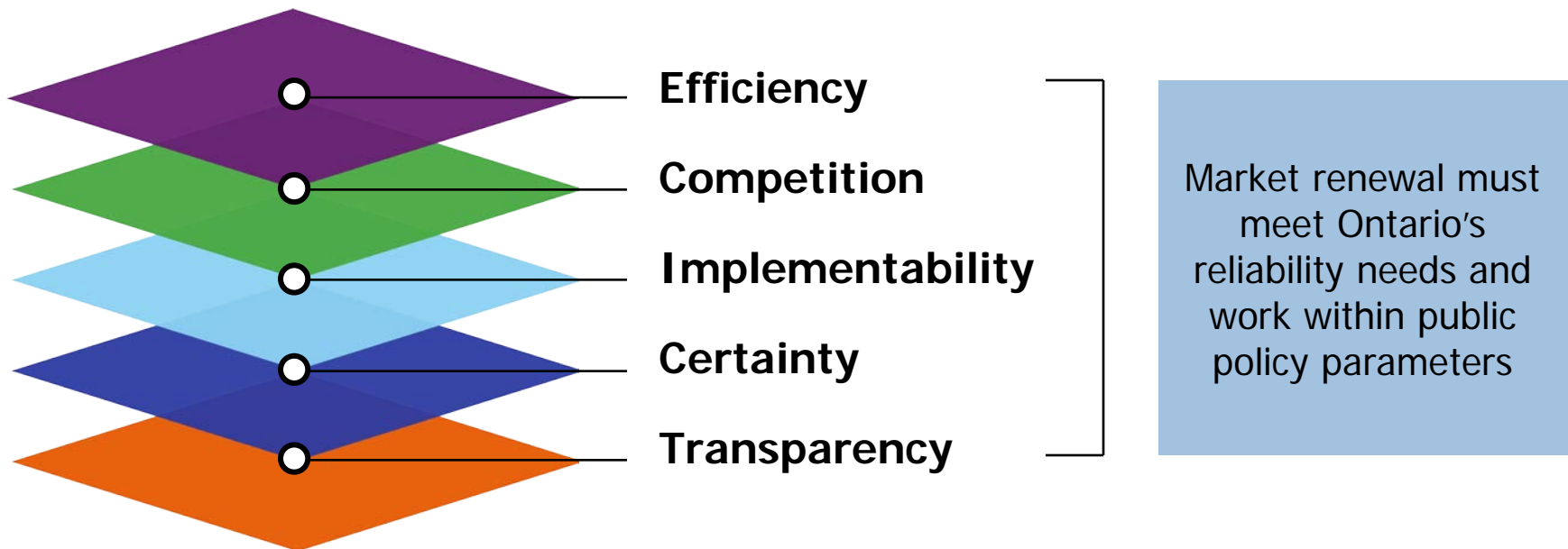
The IESO spent eight months analyzing the potential benefits of market renewal together with stakeholders under a range of future scenarios.



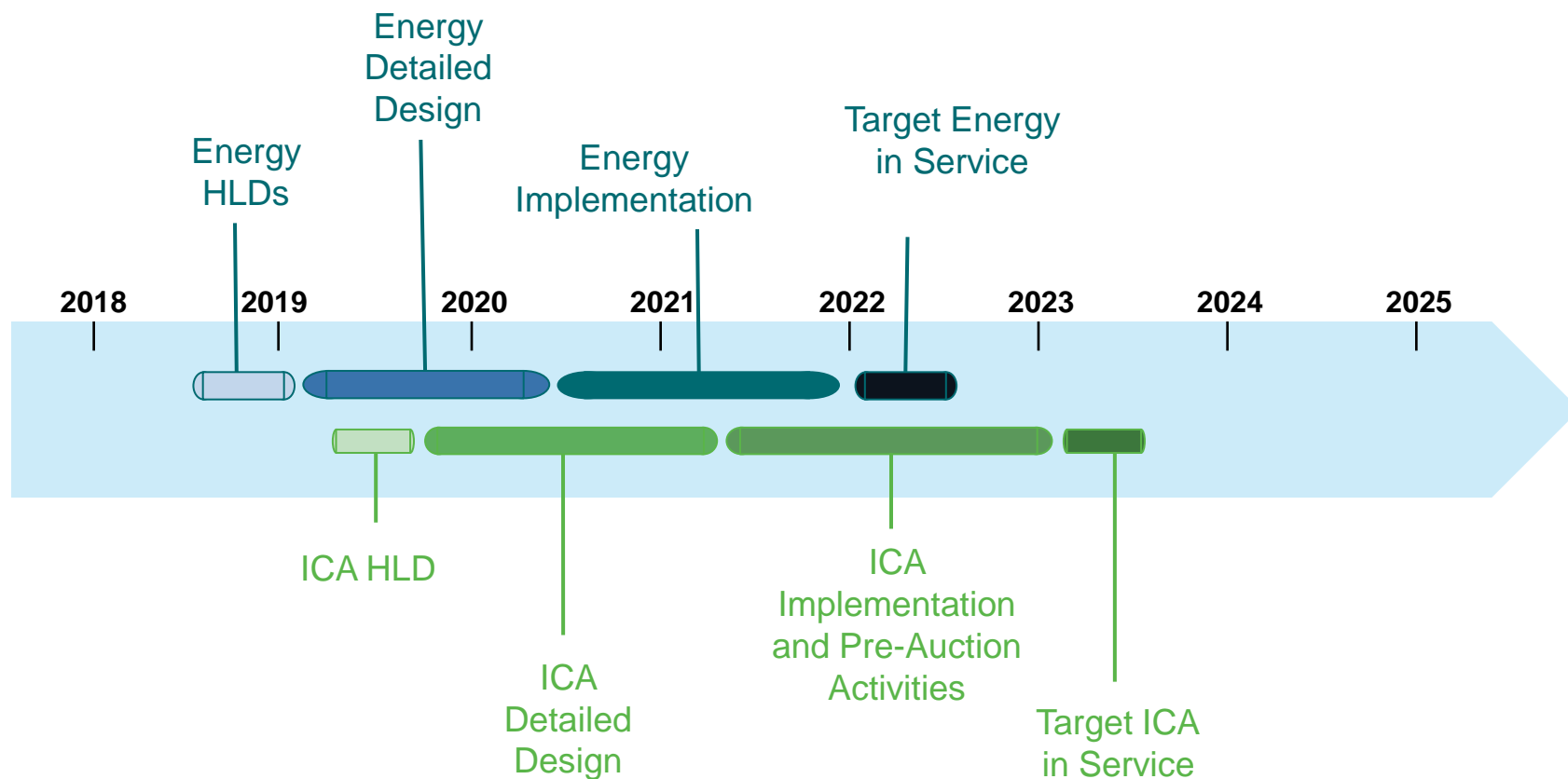
Market Renewal is expected to deliver an average of **\$3.4 billion in efficiency savings** (most of which will flow to Ontario's consumers) over a 10-year period with a potential to reach as high as **\$5.2 billion**.

Market Renewal Principles

A more efficient, stable marketplace with competitive and transparent mechanisms that meet system and participant needs at lowest cost.



Market Renewal Timeline



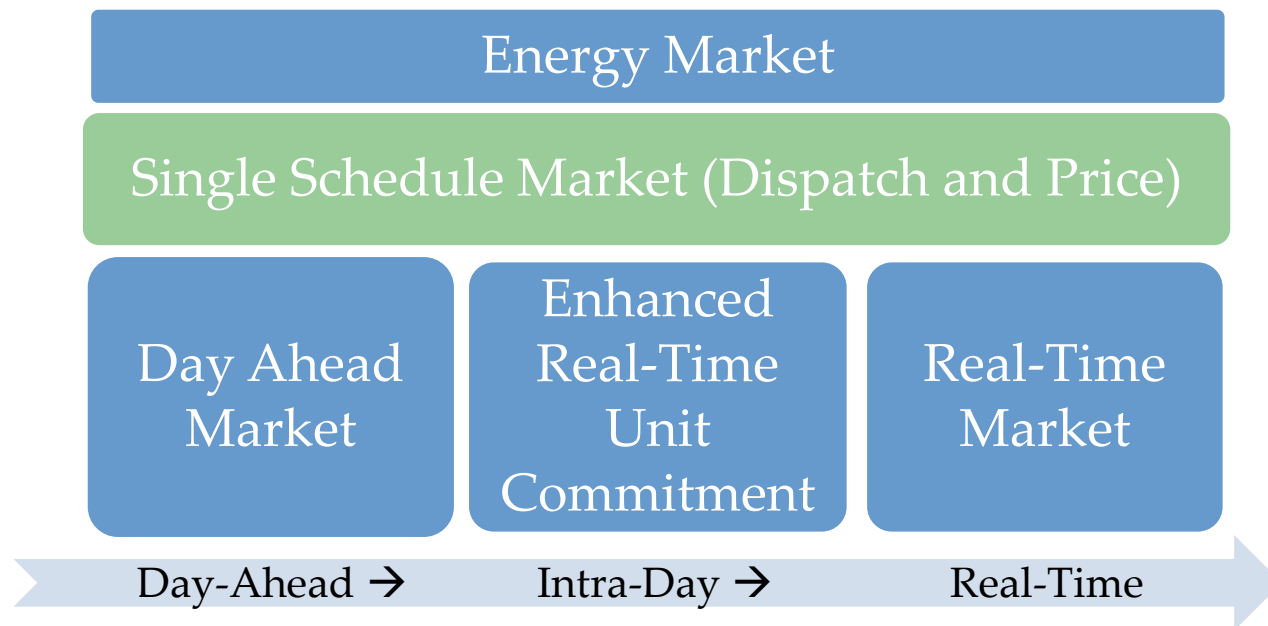
**This graphic is for illustrative purposes only and dates are subject to change*

Market Renewal and Contracts

- Market Renewal is focused on improving the efficiency of Ontario's electricity markets, consistent with contract provisions and fairness to all contract counterparties, the IESO is not targeting to extract value from contracts
- The IESO will continuously work with our contract counterparties to understand contract implications, and address these changes throughout the design of the MRP

Single Schedule Market - The Big Picture

- This initiative will replace Ontario's two schedule market with a single schedule market (SSM) that better aligns price with dispatch
- Improving the energy price signal in Ontario is a foundational change that is required to address existing challenges and prepare for the market of the future



Ontario's Current Market Design

Ontario's current market uses two different schedules (sets of calculations) to determine price and dispatch in Ontario

Schedule 1

- Determines a province-wide uniform price for energy (MCP)
- Ignores certain physical limitations of the system
- Used to settle the market financially

When there are differences between the two schedules, out-of-market CMSC* payments must be made to maintain reliability

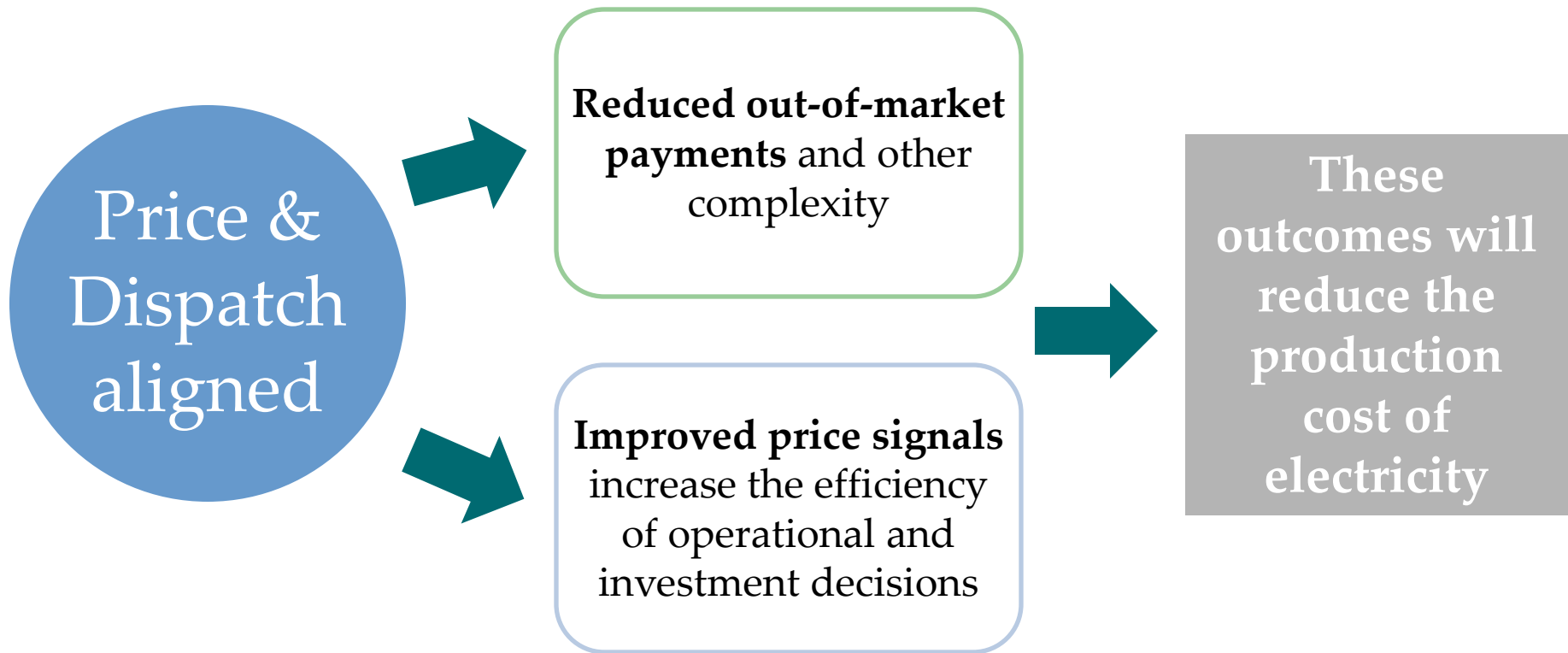
These payments have led to inefficient behaviour and costly outcomes for consumers

Schedule 2

- Calculates "shadow" prices at each node
- Considers all relevant physical limitations of the system
- Prices used to dispatch resources

CMSC = Congestion Management Settlement Credit

Single Schedule Market



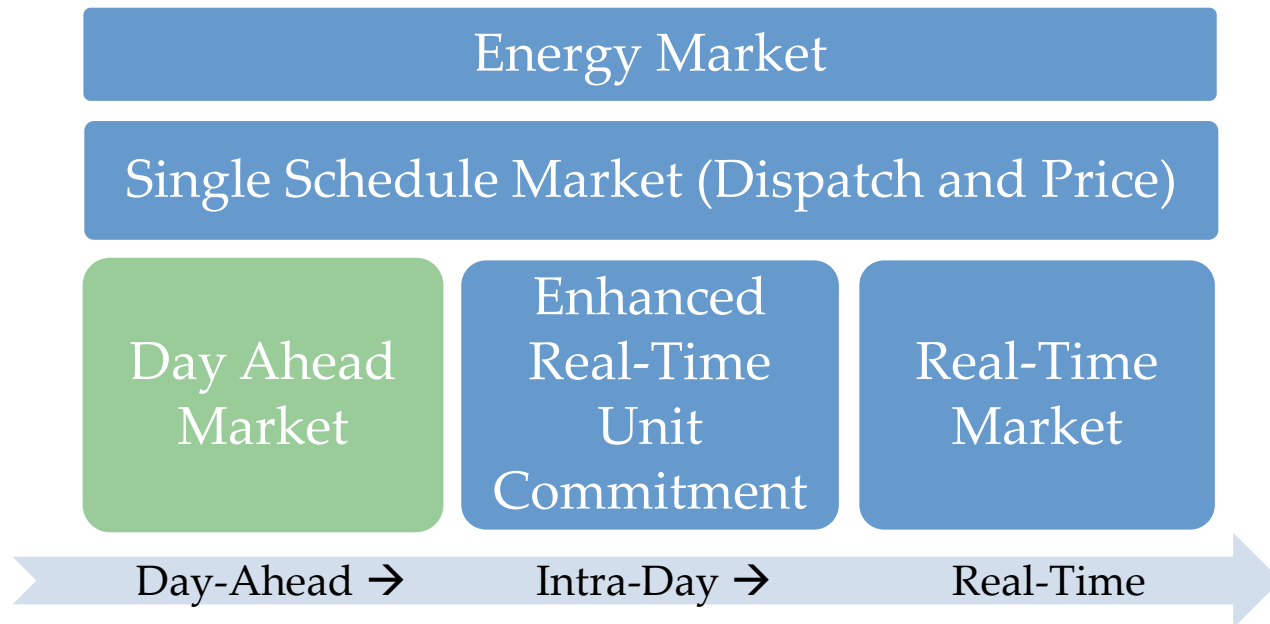
Enabled by Single Schedule Market

Single Schedule Market – Key Takeaways

- SSM will introduce locational prices for energy and operating reserve that will more accurately reflect the value of those services, enabling more efficient operational and investment decisions
- Unlocks other market changes including the day-ahead market
- Allows resources that can provide the most value to the system to benefit from accurate locational prices
- More efficient design will deliver a reliable supply of energy to Ontarian's at a lower cost

Day-Ahead Market: The Big Picture

- A day-ahead market will provide financially binding day-ahead schedules
- It is enabled by the single schedule market design and will operate prior to pre-dispatch and real-time



Why a Day Ahead Market?

Current Day-Ahead Commitment Process (DACP)	Day-Ahead Market (DAM)
<ul style="list-style-type: none">• Participants submit day-ahead bids and offers primarily to declare availability in real-time.	<ul style="list-style-type: none">• Participants submit day-ahead bids and offers to compete with other for a day-ahead price.
<ul style="list-style-type: none">• Day-ahead bids and offers may be less efficient because they are not competing for a price	<ul style="list-style-type: none">• Day-ahead bids and offers are more efficient because they are competitive
<ul style="list-style-type: none">• Exports can participate but are not incentivized to do so	<ul style="list-style-type: none">• Exports have incentive to participate in the DAM
<ul style="list-style-type: none">• Resources are scheduled to meet Ontario demand, providing a rough approximation of tomorrow's operation	<ul style="list-style-type: none">• Resources are scheduled to meet total Market demand, providing a better view of tomorrow's operation

A day-ahead price signal incentivizes more efficient participation from all resources

How it Works

- DAM produces hourly schedules and prices that are financially binding, introducing a 'two-settlement' system

Day Ahead Settlement

Scheduled Day-Ahead
Quantity

multiplied by

Locational Day-Ahead
Price



Real-Time Settlement

(Actual Real-Time
Quantity* *minus*
Scheduled Day-Ahead
Quantity)

multiplied by

Locational Real-Time
Price

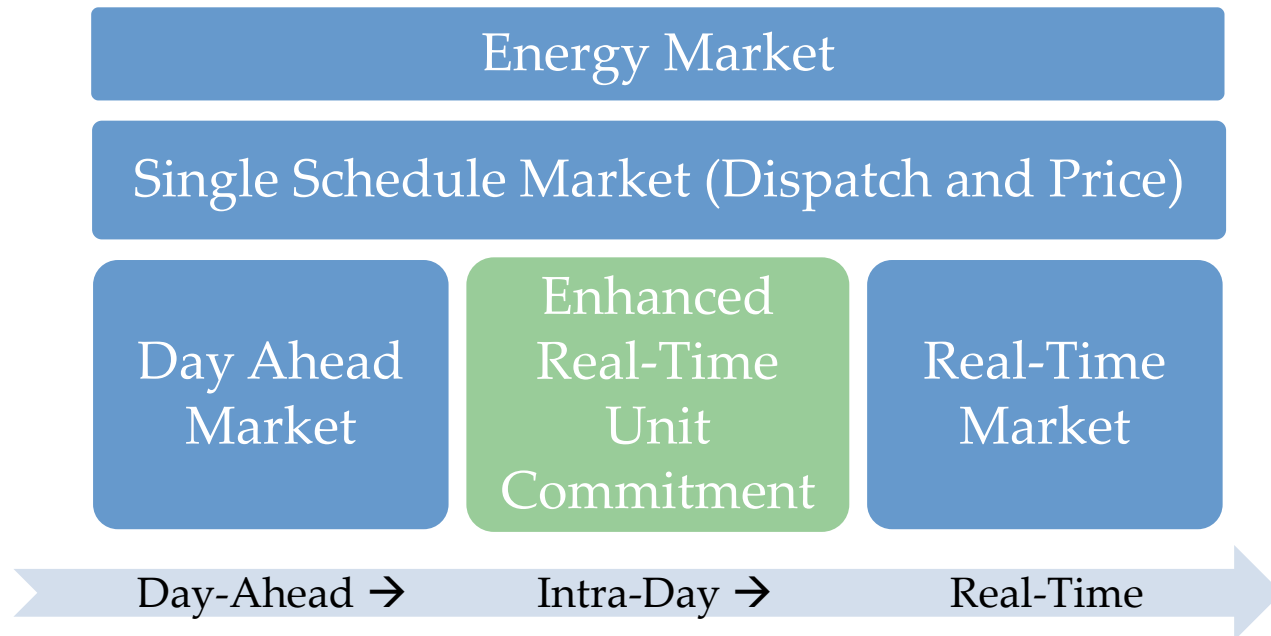
- Real-time settlement only used for balancing deviations from day-ahead schedules

Day-Ahead Market – Key Takeaways

- Financially binding DAM will improve participation in day-ahead scheduling, helping to ensure reliability while efficiently scheduling resources
- Provides an opportunity to lock in prices day-ahead
 - Allows consumers to reduce exposure to real-time price spikes
 - Provides increased financial certainty for all participants

ERUC: The Big Picture

- Enhanced real-time unit commitment will operate in the pre-dispatch timeframe, after day-ahead / before real-time



Summary of Issues with Current Real-time Unit Commitment Process

Incomplete Picture

Not all costs are considered in optimization process

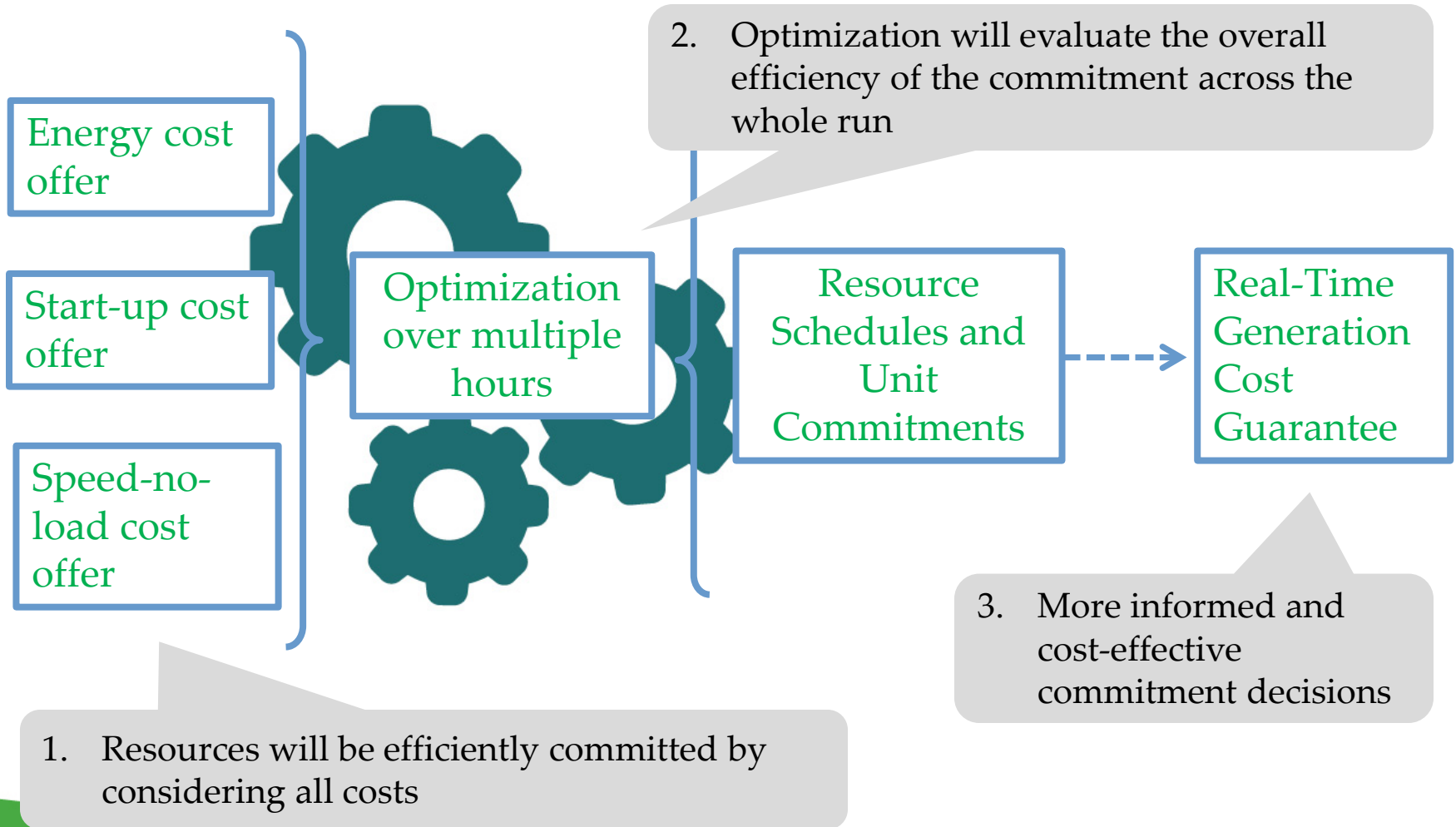
Lack of Competition

After-the-fact cost submission means no competition between generators on those costs

Limited look-ahead

Optimizes commitments based on a single hour

Enhanced Real-Time Unit Commitment Process



Enhanced Real-Time Commitment – Key Takeaways

- The ERUC project is replacing today's pre-dispatch process and the Real-Time Generator Cost Guarantee program
- Improved pre-dispatch process will help to ensure that resources are scheduled when they are among the lowest cost options
 - Improved optimization will avoid instances of higher cost resources being committed ahead of more competitive options

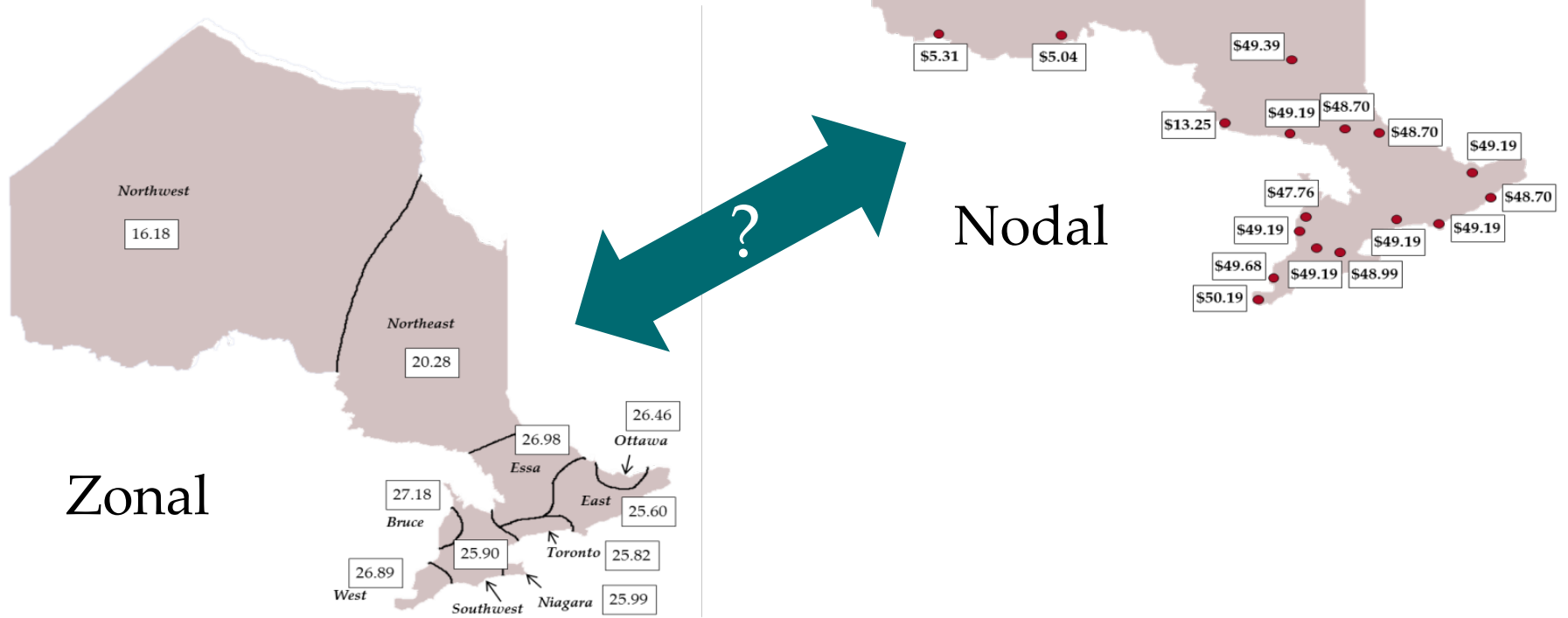
KEY DESIGN CONCEPTS

Design Concept 1 – Locational Pricing

Context

- Locational Marginal Pricing (LMP) is a foundational feature of Market Renewal
- Locational prices will:
 - ✓ Align price with dispatch
 - ✓ Significantly reduce out-of-market payments
 - ✓ Unlock broader market renewal benefits
 - ✓ Reduce the cost of energy for Ontario consumers

Design Concept 1 – Locational Pricing Options



Design Concept 1 – Locational Pricing

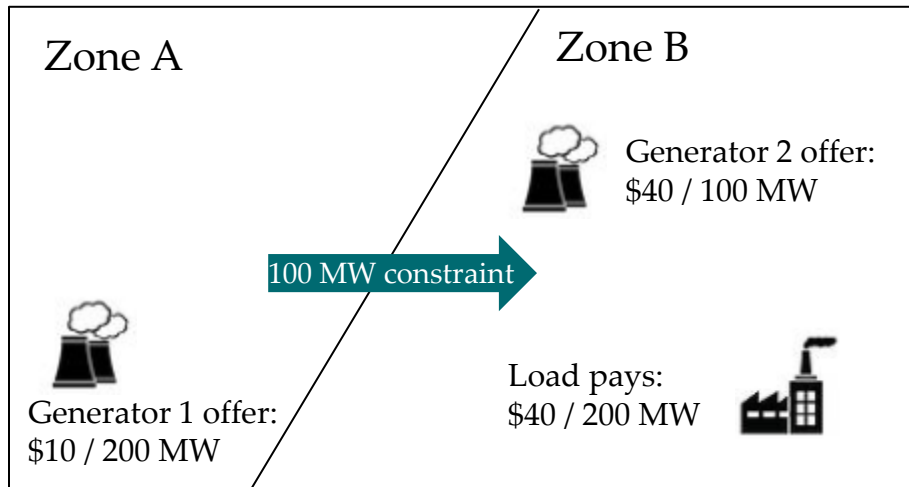
Pricing Summary

Participant	Customer Class	Current settlement price:	SSM settlement price:
IESO-Settled Loads	Dispatchable Loads	Uniform Market Clearing Price (MCP)	Nodal
	Non-dispatchable Loads (including LDCs)	HOEP	Zonal with Nodal option
LDC-Settled Loads	Large Customers (>250,000KWh)	HOEP	TBD by OEB
	Small Customers (<250,000 KWh)	RPP	
Suppliers	N/A	Uniform Market Clearing Price (MCP)	Nodal

Design Concept 2 - Residuals

Overview of Residuals

- Congestion and loss residuals (“Residuals”) are created in all electricity markets that have locational pricing for loads
- Suppliers and loads are exposed to different prices which result in more money collected from loads than is paid to suppliers



Simplified residual settlement example	
Load pays	$\$40 \times 200 = \$8,000$
Generator 1 receives	$\$10 \times 100 = \$1,000$
Generator 2 receives	$\$40 \times 100 = \$4,000$
Residual for load	\$3,000
Load net payment with residual rebate	$8,000 - 3,000 = \$5,000$

- Residuals will be returned to consumers on a quarterly basis

Impact of Residuals

- Residuals will be returned to consumers in zones with higher than average prices

- Helps to ensure all consumers share in the benefits of a single schedule market

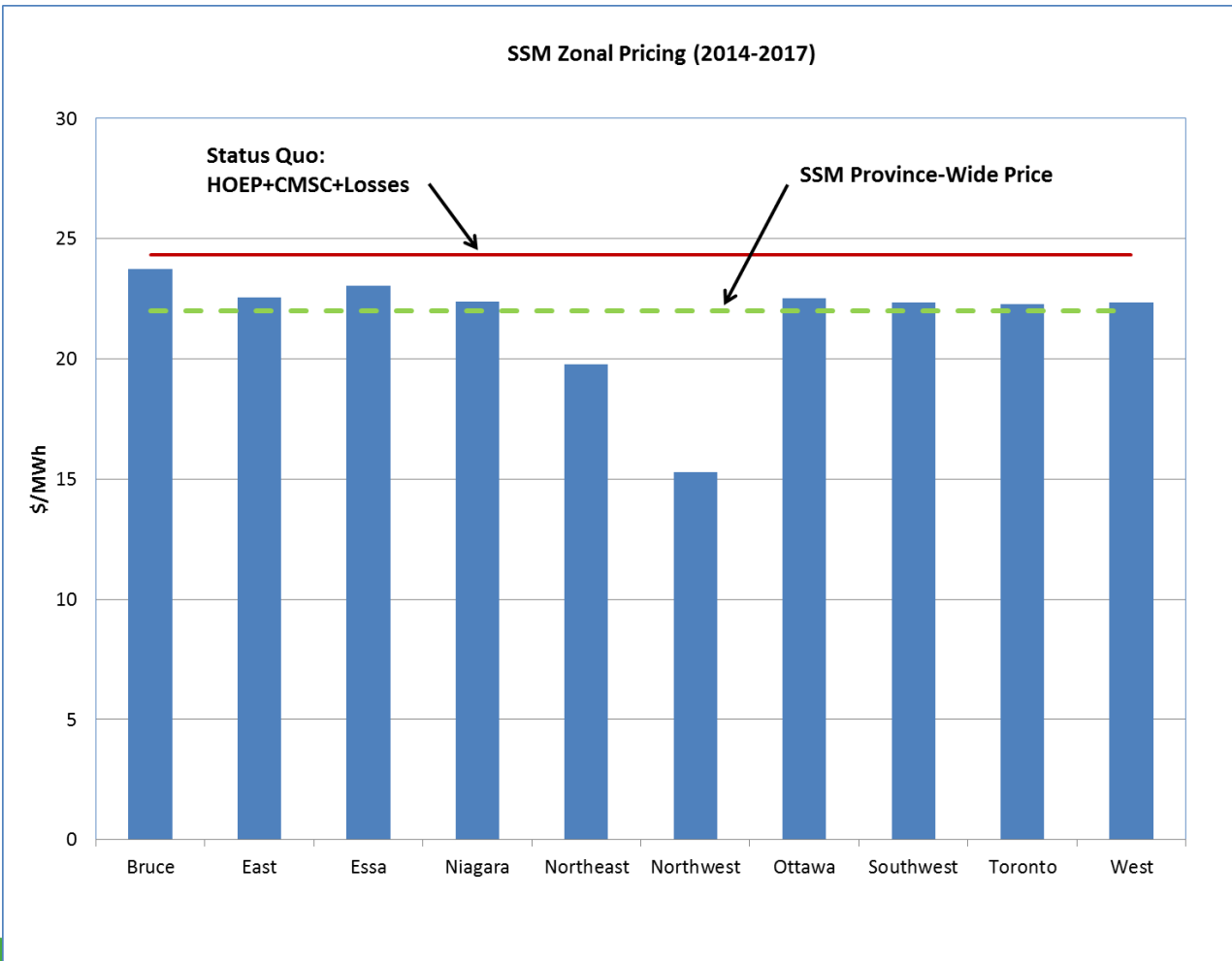
Residual disbursement mechanism

- Different zones likely to receive residuals at different times

- Residual disbursement would be performed quarterly

Design Concept 2 - Residuals

Zonal Energy Prices with SSM



- Historical analysis undertaken to further understand the impact of residuals
- All zones pay less than status quo
- Energy costs reduced by \$246M on average annually from 2014-2017
- Northern Ontario prices are less than those in Southern Ontario
- Southern Ontario prices are very close to the SSM average province-wide price
- Zonal pricing includes residuals returned to consumers

Design Concept 3 – Price Responsive Loads

A New Type of Market Participant

Key features of Price Responsive Loads (PRLs) include:

- 1 Provide own bids into the DAM
- 2 Receive financially binding DAM schedules
- 3 Continue to be non-dispatchable in real-time
- 4 Nodal pricing with one year election period

PRL status will be contingent on meeting certain criteria such as being a market participant and complying with metering and prudential requirements

Why PRLs?

- Introduction of Price Responsive Loads:
 - ✓ Increases consumer choice
 - ✓ Improves efficiency of scheduling and unit commitments
 - ✓ Open to expanded role for buy-side in the future

Participation

- Resources will be incentivized to participate in DAM through:
 - Financially binding schedules which will provide financial and operational certainty
 - Alignment of contracts and regulatory framework for the new market
 - Physical withholding obligations
- Participants should understand risks associated with limited DAM participation including:
 - Increased exposure to real-time price volatility;
 - Being partially or entirely prevented from being dispatched in real-time; and
 - Potential penalties for physically withholding from DAM

Context

- Virtual transactions are financial instruments used to buy and sell energy in the DAM just like physical energy bids and offers
- Virtual transactions are evaluated just like physical bids and offers and can receive a DAM schedule and are subject to two settlement
- Since they do not represent physical load or supply, real-time quantities are always zero and their balancing settlement is always for their full DAM schedule

Benefits

- The DAM design will include virtual transactions as they provide the following benefits:
 - ✓ Improving convergence between DA and RT prices and schedules, thus supporting an efficient and reliable unit commitment
 - ✓ Enabling participants to hedge their own risk against real-time price volatility
 - ✓ Increasing liquidity which reduces opportunities for price manipulation through physical withholding
- Market participants will be allowed to submit virtual transactions into the DAM as energy offers and load bids, but not operating reserve

Context

- Market power mitigation (MPM) is important where competition in the market is restricted
- Prices impacted by market power do not reflect marginal costs and result in inefficient outcomes that drive up costs to consumers
- Market power can be exercised through:

Economic Withholding

To offer a portion of or all available capacity at a higher than competitive price

Physical Withholding

To not offer a portion or all available capacity into the market

Design Concept 6 – Market Power Mitigation

Application

- MPM will be triggered where the IESO determines competition to be restricted
- MPM will apply to energy, operating reserve and certain operational parameters
- MPM will be applied through conduct and impact tests:
 - **Conduct test:** defines the boundaries within which participants will not be mitigated. The test will be based on reference levels which will provide proxies of competitive offers
 - **Impact test:** defines how much of an impact that offers in excess of the conduct threshold can have on market prices before mitigation is applied

Design Concept 6 – Market Power Mitigation

Summary for Suppliers*

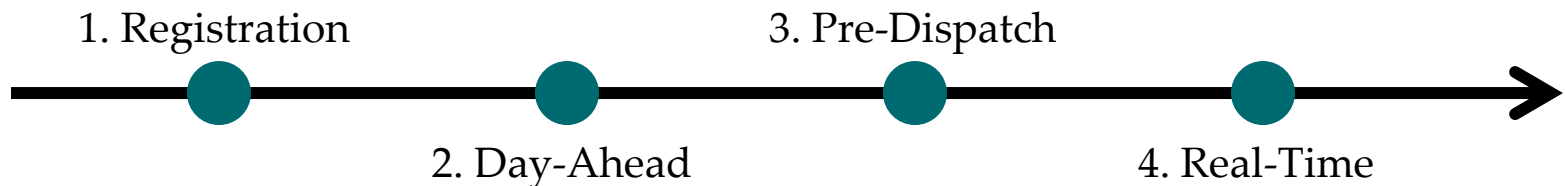
	Economic Withholding	Physical Withholding
Tests	<p><i>Conduct and impact tests</i></p> <p><i>Conduct test: Are offers/operational parameters beyond competitive thresholds?</i></p> <p><i>Impact test: Will settlement costs be beyond set threshold?</i></p>	<p><i>Conduct and impact tests</i></p> <p><i>Conduct test: Did resource not offer all available capacity?</i></p> <p><i>Impact test: Were settlement costs beyond set threshold?</i></p>
Timing	<i>Before DAM, PD and RT schedules are produced</i>	<i>After energy delivery</i>
Test standard	<i>Both conduct and impact tests failed</i>	
IESO Response to Failed Tests	<i>Offers adjusted to reference levels before scheduling</i>	<i>Settlement Adjustment</i>

*MPM considerations for consumers will be explored further in detailed design

SECTION B: OPERATIONAL WALK THROUGH

Introduction

- The section will compare the most relevant new design features to the current design for suppliers and consumers
- This will be illustrated chronologically through four stages:



- The section will start with a recap of the current design and then move on to describe the new design, first for suppliers and then for consumers

1. Registration – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
Register resource, including operational data			

2. Day-Ahead – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p>	<p>Submit energy and OR offers</p> <p>Receive DACP schedule</p>		

3. Pre-Dispatch – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p>	<p>Submit energy and OR offers</p> <p>Receive DACP schedule</p>	<p>Opportunity to update energy and OR offers</p> <p>Receive PD schedule</p>	

4. Real-Time – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p>	<p>Submit energy and OR offers</p> <p>Receive DACP schedule</p>	<p>Opportunity to update energy and OR offers</p> <p>Receive PD schedule</p>	<p>Generate as per dispatch instructions</p> <p><i>Settlement based on RT generation and uniform market clearing price (MCP)</i></p>

1. Registration – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p> <p>Operational data subject to additional validation for market power mitigation (MPM)</p>			

2. Day-Ahead – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p> <p>Operational data subject to additional validation for market power mitigation (MPM)</p>	<p>Submit offer price and quantity</p> <p>MPM checks</p> <p>Receive financially binding schedule</p> <p><i>DAM settlement based on financially binding schedule and nodal price</i></p>		

3. Pre-Dispatch – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p> <p>Operational data subject to additional validation for market power mitigation (MPM)</p>	<p>Submit offer price and quantity</p> <p>MPM checks</p> <p>Receive financially binding schedule</p> <p><i>DAM settlement based on financially binding schedule and nodal price</i></p>	<p>Submit or update energy and OR offers</p> <p>MPM checks</p> <p>Receive PD schedule</p>	

4. Real-Time – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Register resource, including operational data</p> <p>Operational data subject to additional validation for market power mitigation (MPM)</p>	<p>Submit offer price and quantity</p> <p>MPM checks</p> <p>Receive financially binding schedule</p> <p><i>DAM settlement based on financially binding schedule and nodal price</i></p>	<p>Submit or update energy and OR offers</p> <p>MPM checks</p> <p>Receive PD schedule</p>	<p>Generate as per dispatch instructions</p> <p><i>RT settlement based on real-time generation and nodal price</i></p>

1. Registration – Current Design

Load type	Registration (settlement price/status)	Day-Ahead Commitment Process	Pre-Dispatch	Real-Time
Non-Dispatchable Load	HOEP only			
Dispatchable Load	Uniform MCP only			

2. Day-Ahead – Current Design

Load type	Registration (settlement price/status)	Day-Ahead Commitment Process	Pre-Dispatch	Real-Time
Non-Dispatchable Load	HOEP only	IESO submit forecast for NDL		
Dispatchable Load	Uniform MCP only	Submit energy bids and OR offers		

3. Pre-Dispatch – Current Design

Load type	Registration (settlement price/status)	Day-Ahead Commitment Process	Pre-Dispatch	Real-Time
Non-Dispatchable Load	HOEP only	IESO submit forecast for NDL	IESO updates forecast for NDL	
Dispatchable Load	Uniform MCP only	Submit energy bids and OR offers	Opportunity to update energy bids and OR offers	

4. Real-Time – Current Design

Load type	Registration (settlement price/status)	Day-Ahead Commitment Process	Pre-Dispatch	Real-Time
Non-Dispatchable Load	HOEP only	IESO submit forecast for NDL	IESO updates forecast for NDL	Consume as needed and settlement based on HOEP
Dispatchable Load	Uniform MCP only	Submit energy bids and OR offers	Opportunity to update energy bids and OR offers	Consume as per dispatch schedule and settlement based on uniform MCP

1. Registration – Market Renewal Design

Load type	Registration (settlement price/status)	Day-Ahead Market	Pre-Dispatch	Real-Time
Non-Dispatchable Load	Zonal pricing with option for nodal pricing			
Price-Responsive Load	Nodal pricing option only			
Dispatchable Load	Nodal pricing option only			

Option to select PRL status*

*PRL status will be contingent on meeting certain criteria such as being a market participant and complying with metering and prudential requirements

2. Day-Ahead – Market Renewal Design

Load type	Registration (settlement price/status)	Day-Ahead Market	Pre-Dispatch	Real-Time
Non-Dispatchable Load	Zonal pricing with option for nodal pricing	IESO submits forecast for NDL		
Price-Responsive Load	Nodal pricing option only	Submit energy bids for DAM participation and settlement		
Dispatchable Load	Nodal pricing option only	Submit energy bids & OR offers for DAM participation and settlement		

Financially binding schedule

3. Pre-Dispatch – Market Renewal Design

Load type	Registration (settlement price/status)	Day-Ahead Market	Pre-Dispatch	Real-Time
Non-Dispatchable Load	Zonal pricing with option for nodal pricing	IESO submits forecast for NDL	IESO forecasts for NDL and PRL	
Price-Responsive Load	Nodal pricing option only	Submit energy bids for DAM participation and settlement	Financially binding schedule	
Dispatchable Load	Nodal pricing option only	Submit energy bids & OR offers for DAM participation and settlement		Opportunity to update energy bids and OR offers

4. Real-Time – Market Renewal Design

Load type	Registration (settlement price/status)	Day-Ahead Market	Pre-Dispatch	Real-Time
Non-Dispatchable Load	Zonal pricing with option for nodal pricing	IESO submits forecast for NDL	IESO forecasts for NDL and PRL	Consume as needed, settled on zonal/nodal price* via modified settlement
Price-Responsive Load	Nodal pricing option only	Submit energy bids for DAM participation and settlement		Consume as needed, settled on nodal price via two settlement
Dispatchable Load	Nodal pricing option only	Submit energy bids & OR offers for DAM participation and settlement	Opportunity to update energy bids and OR offers	Consume as per dispatch schedule, settled on nodal price via two settlement

Financially binding schedule

*Zonal or nodal as elected in registration

SECTION C: SETTLEMENT SCENARIOS

Introduction

- This section will provide a series of simplified examples to illustrate the high-level settlement process for consumers and dispatchable generators
- Three scenarios will be presented:
 1. Real-Time energy production **equal to** Day-Ahead schedule
 2. Real-Time energy production **greater than** Day-Ahead schedule
 3. Real-Time energy production **less than** Day-Ahead schedule

Settlement for Suppliers

Day-Ahead

Scheduled Day-Ahead Quantity
multiplied by
Locational Day-Ahead Price

Suppliers are **paid for DA**
scheduled injections

Real-Time (balancing)

(Actual Real-Time
Quantity* *minus*
Scheduled Day-Ahead
Quantity)
multiplied by
Locational Real-Time
Price

Suppliers are **paid for**
incremental RT injections
but **pay for undelivered DA**
scheduled injections



*Scheduled Real-Time Quantity for Operating Reserve

Suppliers Scenario 1:

**REAL-TIME PRODUCTION
AND DAY-AHEAD SCHEDULE
EQUAL**

Suppliers S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>		

The supplier makes two offers one offer to show that it is willing to inject 100 MW as long as the price is greater than or equal to \$20, and another to indicate it will inject an additional 150 MW if the price is greater than or equal to \$40

Suppliers S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$100</div> <div>Supplier scheduled at 250 MW</div>	
Energy settlement	250 MW x \$100 = \$25,000	

The locational day-ahead market clears at \$100 and the supplier receives a financially binding schedule for 250 MW...

Suppliers S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$100</div> <div>Supplier scheduled at 250 MW</div>	<div>Market clears at \$50</div> <div>Supplier injects 250 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$(250 \text{ MW} - 250 \text{ MW}) \times \$50 = \$0$

The supplier's real-time injection is the same as its day-ahead schedule so no balancing settlement applies...

Suppliers S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center;">100 MW at \$20</div> <div style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center;">150 MW at \$40</div>	<div style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center;">Market clears at \$100</div> <div style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center;">Supplier scheduled at 250 MW</div>	<div style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center;">Market clears at \$50</div> <div style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center;">Supplier injects 250 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$+(250 \text{ MW} - 250 \text{ MW}) \times \$50 = \$0$

The supplier is paid \$25,000 for injecting 250 MW

Locational day ahead settlement = (Day-Ahead Quantity x Day-Ahead Price), Locational Real-Time settlement = (Real-Time Quantity - Day-Ahead Quantity) x Real-Time Price

Suppliers S1: RT and DAM injection equal

– Summary

- In this scenario, the supplier placed two offers in the DAM which were both accepted at the locational market clearing price
- The participant's real-time injection matched its day-ahead schedule, and as a result, the supplier was not exposed to the fall in real-time prices
- Overall, this scenario demonstrates how participants can increase financial certainty when they offer into DAM their expected real-time capability

Suppliers Scenario 2:

REAL-TIME PRODUCTION GREATER THAN DAY-AHEAD SCHEDULE

Suppliers S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>		

The supplier makes two offers one offer to show that it is willing to inject 100 MW as long as the price is greater than or equal to \$20, and another to indicate it will inject an additional 150 MW if the price is greater than or equal to \$40

Suppliers S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<p>100 MW at \$20</p> <p>150 MW at \$40</p>	<p>Market clears at \$25</p> <p>Supplier scheduled at 100 MW</p>	
Energy settlement	$100 \text{ MW} \times \$25 = \$2,500$	

The locational day-ahead market clears at \$25 and the supplier receives a financially binding schedule for 100 MW...

Locational day ahead settlement = (Day-Ahead Quantity x Day-Ahead Price)

Suppliers S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$25</div> <div>Supplier scheduled at 100 MW</div>	<div>Market clears at \$100</div> <div>Supplier injects 250 MW</div>
Energy settlement	$100 \text{ MW} \times \$25 = \$2,500$	$(250 \text{ MW} - 100 \text{ MW}) \times \$100 = \$15,000$

The locational real-time market clears at a higher cost than the locational day-ahead market and the participant injects an additional 150 MW...

Suppliers S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$25</div> <div>Supplier scheduled at 100 MW</div>	<div>Market clears at \$100</div> <div>Supplier injects 250 MW</div>
Energy settlement	$100 \text{ MW} \times \$25 = \$2,500$	$+ (250 \text{ MW} - 100 \text{ MW}) \times \$100 = \$15,000$

The supplier is paid \$17,500 for injecting 250 MW

Locational day ahead settlement = (Day-Ahead Quantity x Day-Ahead Price), Locational Real-Time settlement = (Real-Time Quantity - Day-Ahead Quantity) x Real-Time Price

Suppliers S2: RT injection greater than DAM

– Summary

- In this scenario, the supplier placed two offers in the DAM, of which only one was accepted given the locational day-ahead market clearing price
- In real-time, the participant increased injection from the DAM schedule due to higher prices in real-time
- Overall, the scenario illustrates how the supplier had certainty day-ahead on the price of its first 100 MW of supply and had the flexibility to capture higher real-time prices for the remaining 150 MW

Suppliers Scenario 3:

REAL-TIME PRODUCTION LESS THAN DAY-AHEAD SCHEDULE

Suppliers S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>		

The supplier makes two offers one offer to show that it is willing to inject 100 MW as long as the price is greater than or equal to \$20, and another to indicate it will inject an additional 150 MW if the price is greater than or equal to \$40

Suppliers S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$100</div> <div>Supplier scheduled at 250 MW</div>	
Energy settlement	250 MW x \$100 = \$25,000	

The locational day-ahead market clears at \$100 and the supplier receives a financially binding schedule for 250 MW...

Suppliers S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$100</div> <div>Supplier scheduled at 250 MW</div>	<div>Market clears at \$25</div> <div>Supplier injects 100 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$(100 \text{ MW} - 250 \text{ MW}) \times \$25 = -\$3750$

The locational real-time market price clears lower than the locational day-ahead price and the supplier injects 150 MW less than its financially binding day-ahead schedule...

Suppliers S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div>100 MW at \$20</div> <div>150 MW at \$40</div>	<div>Market clears at \$100</div> <div>Supplier scheduled at 250 MW</div>	<div>Market clears at \$25</div> <div>Supplier injects 100 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$+ (100 \text{ MW} - 250 \text{ MW}) \times \$25 = -\$3750$

The supplier pays \$3750 to buy back 150 MW of its day-ahead schedule and gets a net payment \$21,250 for injecting 100 MW

Locational day ahead settlement = (Day-Ahead Quantity x Day-Ahead Price), Locational Real-Time settlement = (Real-Time Quantity - Day-Ahead Quantity) x Real-Time Price

Suppliers S3: RT injection less than DAM - Summary

- In this scenario, the supplier placed two offers, which were both accepted given the locational day-ahead market clearing price
- The locational clearing price then dropped in the real-time market and the market participant reduced their injection and bought back the difference
- This scenario illustrates how a participant gains financial certainty through the locational DAM by offering in their expected real-time capability. In this case, the supplier profited from offering into the locational DAM even though the locational real-time market required less supply

SETTLEMENT FOR CONSUMERS

Settlement for DLs and PRLs

Day-Ahead

Real-Time (balancing)

Scheduled Day-Ahead Quantity
multiplied by
Locational Day-Ahead Price



(Actual Real-Time Quantity* *minus* Scheduled Day-Ahead Quantity)
multiplied by
Locational Real-Time Price

Loads **pay for DA**
scheduled withdrawals

Loads **pay for incremental**
RT withdrawals but are
paid for unconsumed DA
scheduled withdrawals

*Scheduled Real-Time Quantity for Operating Reserve

Settlement for NDLs

- The majority of NDL consumption will be settled based on DAM prices:
 - The IESO will forecast NDL demand and submit DAM bids on behalf of NDLs
 - Deviations between the IESO forecast and actual consumption will be settled at the real-time price (based on the equation below)

Actual Real-Time
Quantity
multiplied by
Locational Day-
Ahead Price



Actual Real-Time
Quantity
multiplied by
Value of forecast
deviations

Consumers Scenario 1:

REAL-TIME AND DAY-AHEAD CONSUMPTION EQUAL

Consumers S1: RT and DAM consumption equal

Bids	Locational Day-Ahead	Locational Real-Time
<p>15 MW at \$300</p> <p>5 MW at \$1500</p>		

The consumer places two bids: one bid to show that it is willing to consume 5 MW as long as the price is less than or equal to \$1500 and another to indicate it will consume an additional 15 MW if the price is less than or equal to \$300

Consumers S1: RT and DAM consumption equal

Bids	Locational Day-Ahead	Locational Real-Time
<div style="border: 1px solid #0070C0; border-radius: 15px; padding: 10px; margin-bottom: 10px; background-color: #0070C0; color: white; text-align: center;">15 MW at \$300</div> <div style="border: 1px solid #0070C0; border-radius: 15px; padding: 10px; background-color: #0070C0; color: white; text-align: center;">5 MW at \$1500</div>	<div style="border: 1px solid #808080; border-radius: 15px; padding: 5px; text-align: center; margin-bottom: 10px;">Market clears at \$20</div> <div style="border: 1px solid #808080; border-radius: 15px; padding: 5px; text-align: center;">Load scheduled at 20 MW</div>	
Energy settlement	$-20 \text{ MW} \times \$20 =$ -\$400	

The locational day-ahead market clears at \$20 and the consumer receives a financially binding schedule to consume 20 MW...

Consumers S1: RT and DAM consumption equal

Bids	Locational Day-Ahead	Locational Real-Time
<div style="border: 1px solid #0056b3; border-radius: 15px; padding: 10px; margin-bottom: 10px; background-color: #0056b3; color: white; text-align: center;">15 MW at \$300</div> <div style="border: 1px solid #0056b3; border-radius: 15px; padding: 10px; background-color: #0056b3; color: white; text-align: center;">5 MW at \$1500</div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; margin-bottom: 5px;">Market clears at \$20</div> <div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px;">Load scheduled at 20 MW</div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; margin-bottom: 5px;">Market clears at \$250</div> <div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px;">Load consumes 20 MW</div>
Energy settlement	$-20 \text{ MW} \times \$20 =$ -\$400	$(-20 \text{ MW} - (-20 \text{ MW})) \times \$250 = \$0$

The consumer's real-time consumption is the same as its day-ahead schedule so no balancing settlement applies...

Consumers S1: RT and DAM consumption equal

Bids	Locational Day-Ahead	Locational Real-Time
<div style="border: 1px solid #0056b3; border-radius: 15px; padding: 10px; margin-bottom: 10px; background-color: #0056b3; color: white; text-align: center;">15 MW at \$300</div> <div style="border: 1px solid #0056b3; border-radius: 15px; padding: 10px; background-color: #0056b3; color: white; text-align: center;">5 MW at \$1500</div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; text-align: center; margin-bottom: 10px;">Market clears at \$20</div> <div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; text-align: center;">Load scheduled at 20 MW</div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; text-align: center; margin-bottom: 10px;">Market clears at \$250</div> <div style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; text-align: center;">Load consumes 20 MW</div>
Energy settlement	$-20 \text{ MW} \times \$20 =$ -\$400	+ $(-20 \text{ MW} - (-20 \text{ MW})) \times \$250 = \$0$

The consumer pays \$400 for consumption of 20 MW

Locational day ahead settlement = (Day-Ahead Quantity x Day-Ahead Price), Locational Real-Time settlement = (Real-Time Quantity - Day-Ahead Quantity) x Real-Time Price

Consumers S1: RT and DAM consumption equal – Summary

- In this scenario, the consumer placed two bids in the DAM which were both accepted at the locational market clearing price
- The participant's real-time consumption matched its day-ahead schedule, and as a result, the consumer was not exposed to the price spike in the real-time
- Overall, this scenario demonstrates how participants can avoid exposure to real-time price volatility if their real-time consumption matches their day-ahead schedule

WRAP-UP

Summary

- Market Renewal will help to more efficiently deliver a reliable supply of energy to Ontarians
- Existing contracts and regulation will need to evolve but will also ease the transition to a new market design for suppliers
- Best practice and stakeholder feedback are being leveraged to develop a practical market design that works for Ontario suppliers
- The single schedule market will provide a more accurate locational signal for the value of energy and OR in Ontario allowing the resources that are best able to meet system needs to benefit
- DAM and ERUC will help to ensure that resources will be scheduled when they are the lowest cost option to meet system needs

How To Get Involved

- Review and provide feedback on HLDs
 - SSM HLD is available at: <http://www.ieso.ca/Sector-Participants/Market-Renewal/Single-Schedule-Market-High-Level-Design>
 - ERUC and DAM HLDs will be published before year end
- Participate in detailed design engagement
 - See engagement plan for further details: <http://www.ieso.ca/-/media/Files/IESO/Document-Library/engage/mrp/mrp-energy-dd-engagement-plan.pdf?la=en>
- Engage with appropriate industry associations to follow MRP progress
- Subscribe to IESO Bulletin to receive periodic updates on MRP

Further Reading

- For further information on the design, stakeholders are invited to review materials online at:
 - Single Schedule Market: <http://www.ieso.ca/Sector-Participants/Market-Renewal/Market-Renewal-Single-Schedule-Market>
 - Day-Ahead Market: <http://www.ieso.ca/Sector-Participants/Market-Renewal/Market-Renewal-Day-Ahead-Market>
 - Enhanced Real-Time Commitment: <http://www.ieso.ca/Sector-Participants/Market-Renewal/Market-Renewal-Enhanced-Real-Time-Unit-Commitment>