

Education and Awareness

Energy Workstream High-Level Designs

Intertie Traders

December 10, 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 to intertie traders
- 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

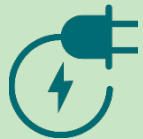
Introduction

- 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 intertie traders including:
 1. Locational Pricing
 2. Real-Time Intertie Pricing
 3. Virtual Transactions
 4. Financial Transmission Rights
 5. Pre-Dispatch Participation
 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)



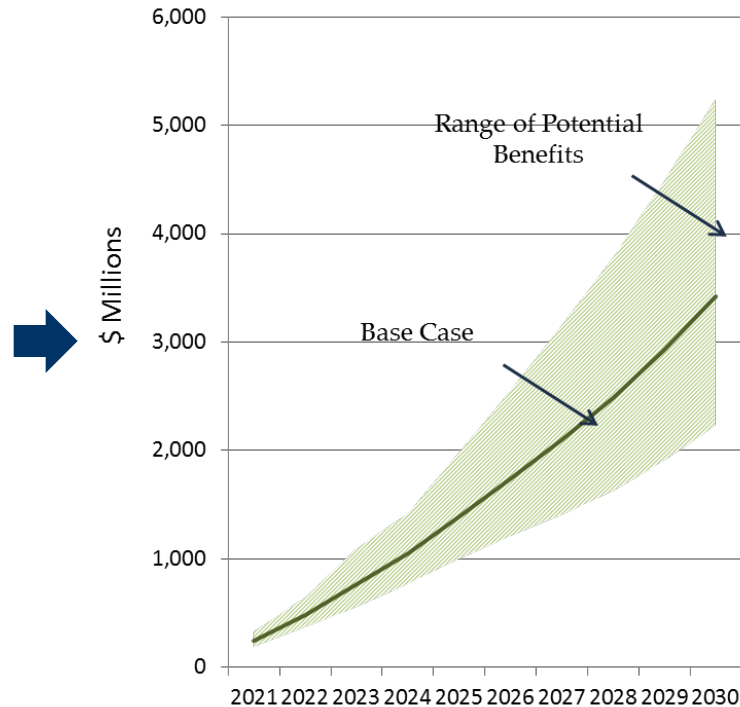
Near-term Projects

Market Renewal

Future Projects

Developing a Benefits Case

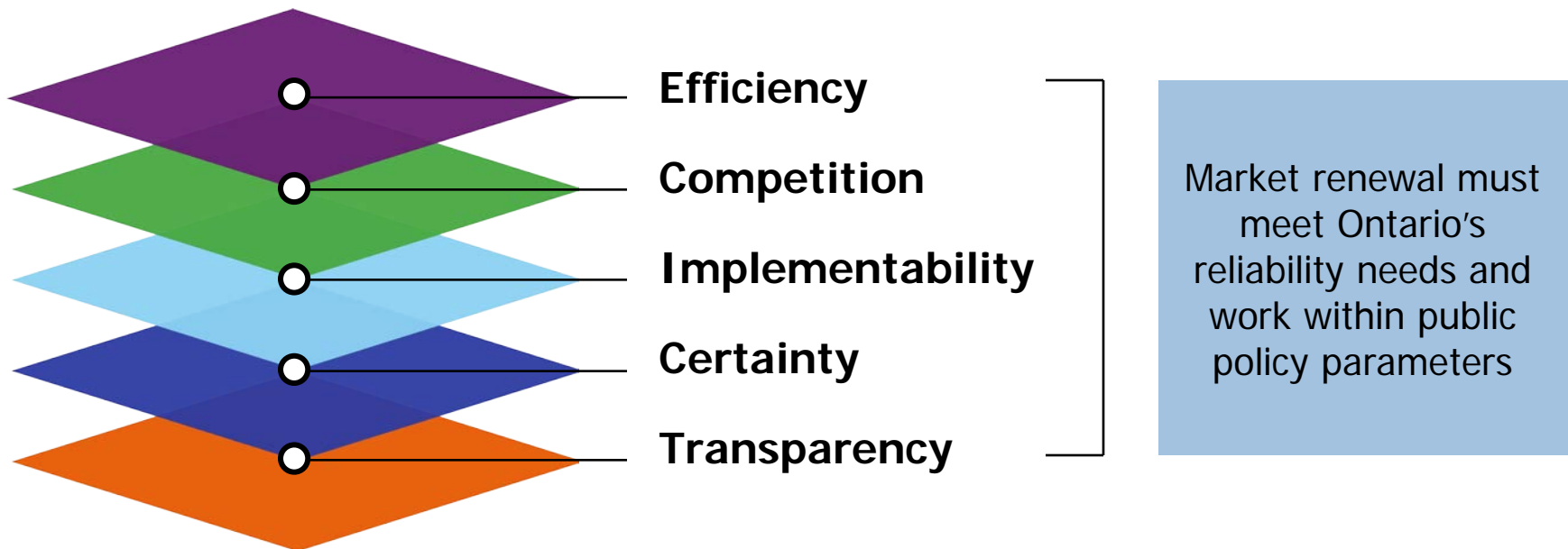
The IESO spent eight months analyzing the potential benefits of market renewal together with stakeholders under a range of future scenarios.



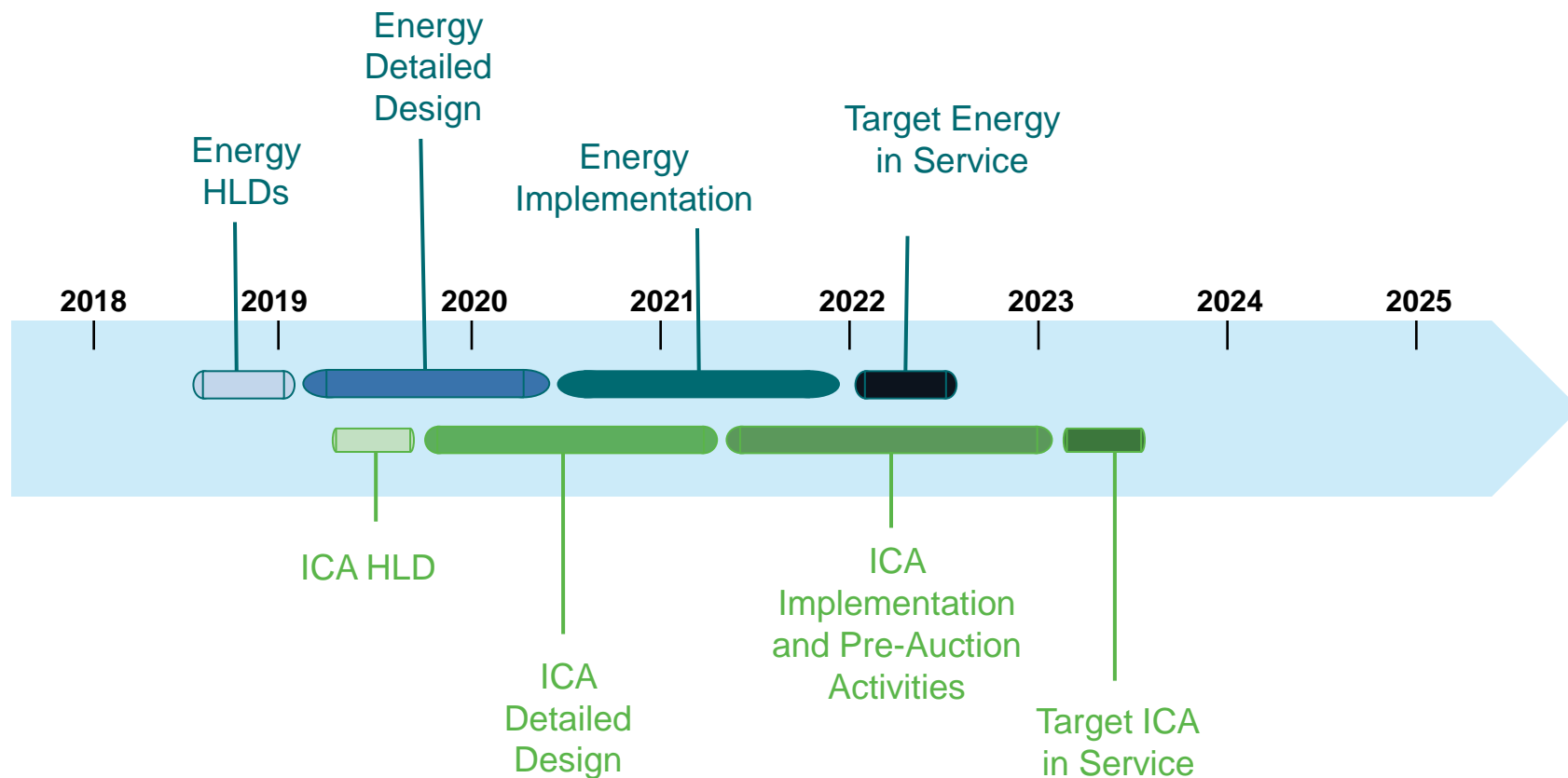
Market Renewal is expected to deliver an average of **\$3.4 billion in efficiency savings** (most of which will flow to Ontario's consumers) over a 10-year period with a potential to reach as high as **\$5.2 billion**.

Market Renewal Principles

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



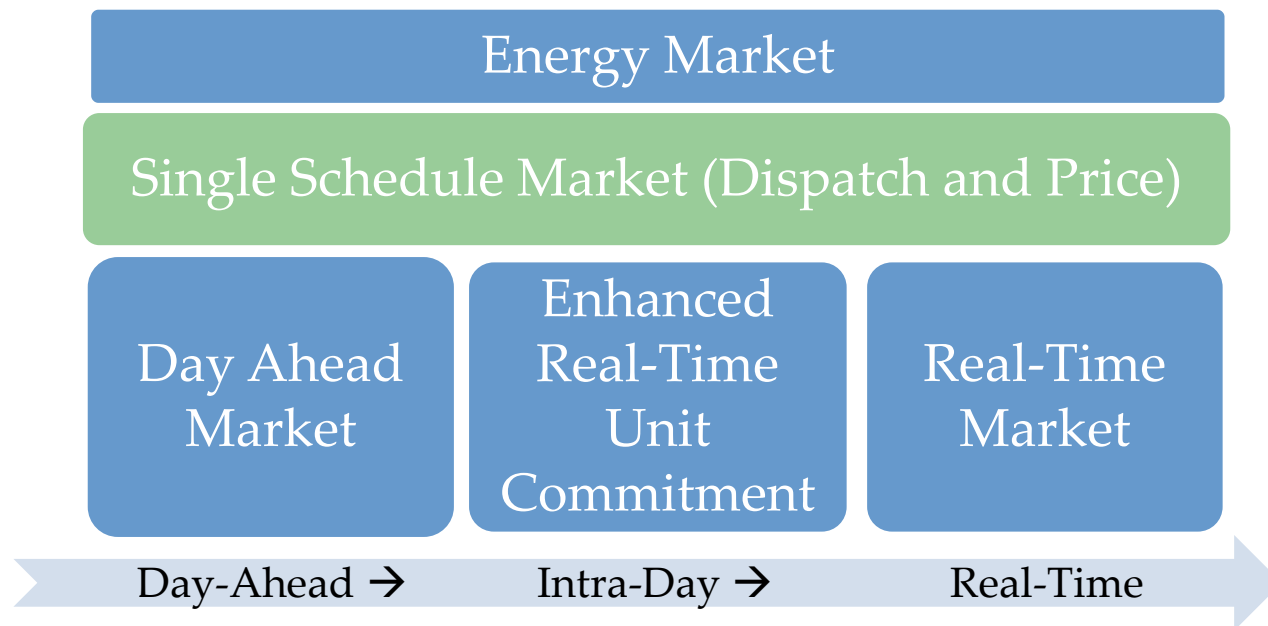
Market Renewal Timeline



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

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

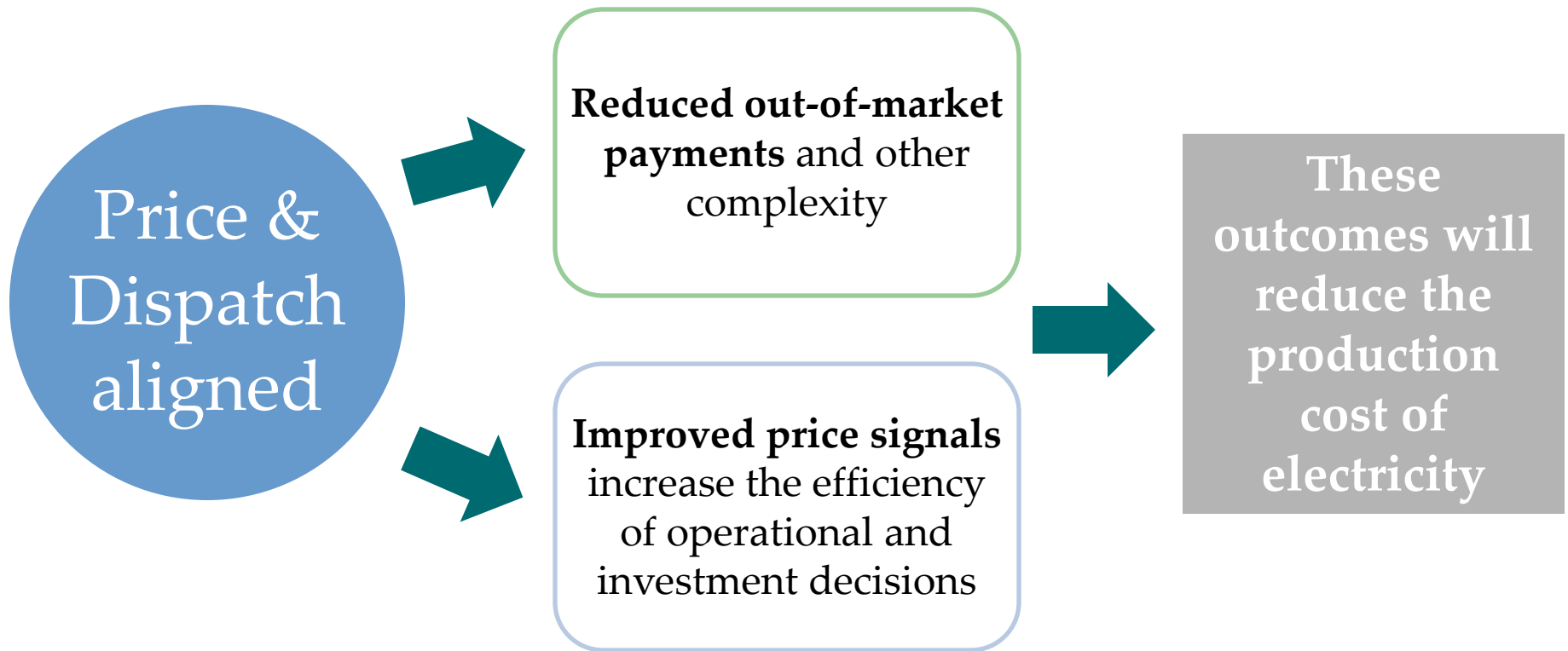
These payments have led to inefficient behaviour and costly outcomes for consumers

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



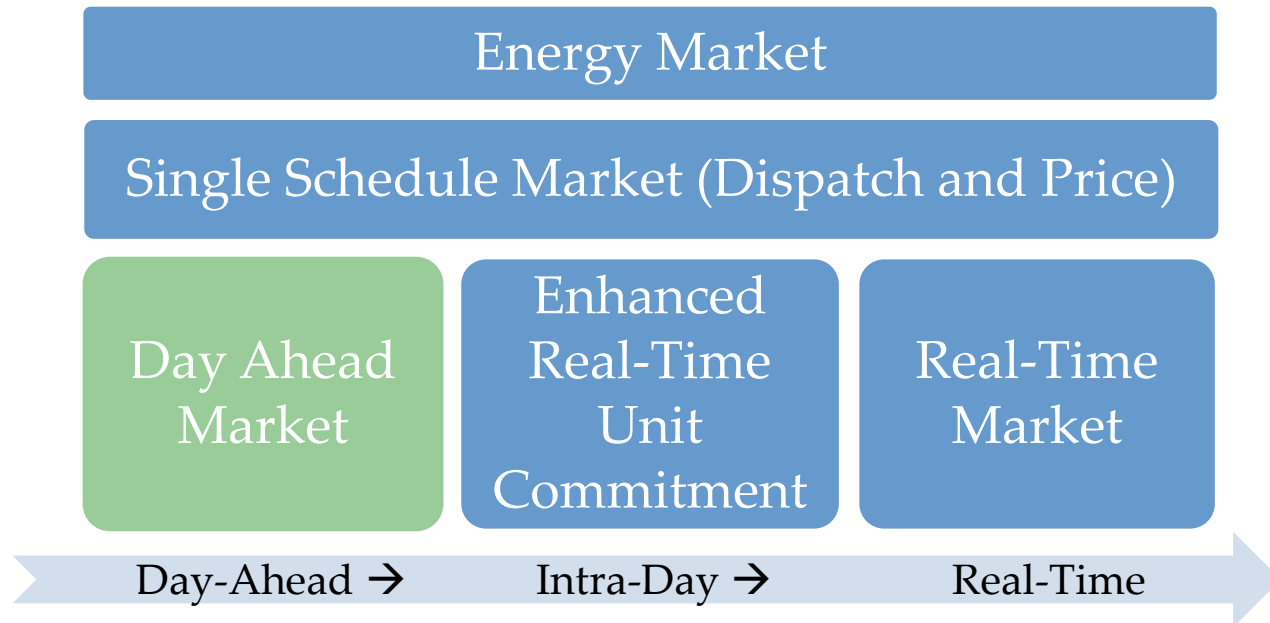
Enabled by Single Schedule Market

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

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

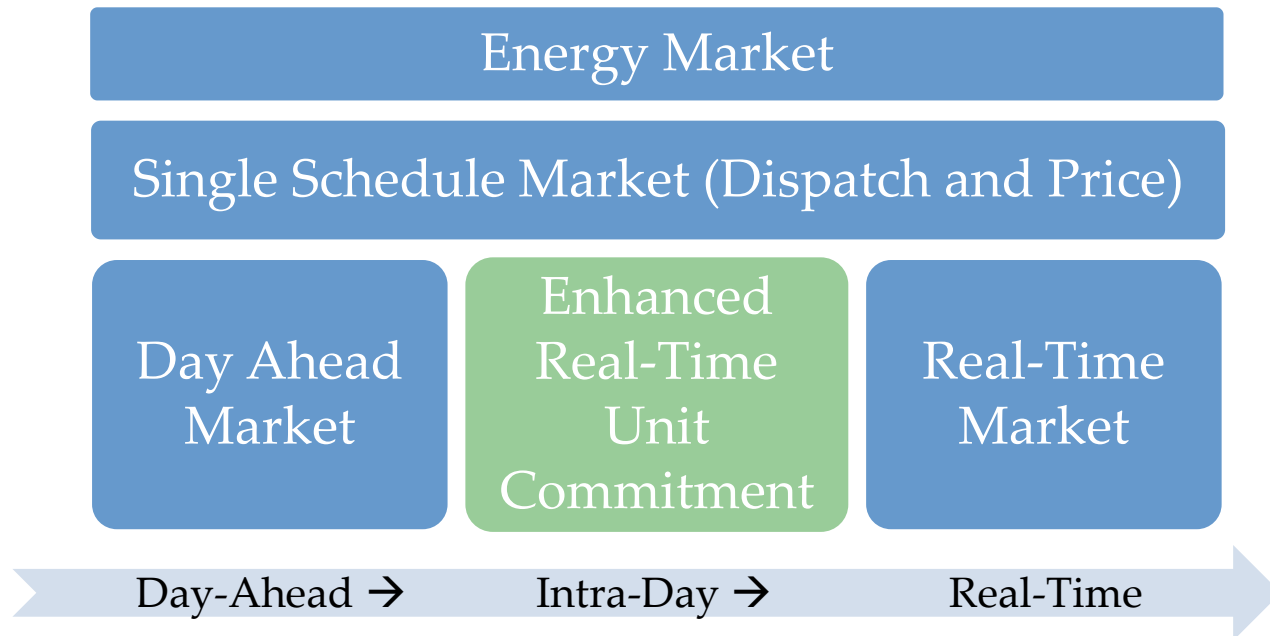
- Real-time settlement only used for balancing deviations from day-ahead schedules

Day-Ahead Market – Key Takeaways

- Financially binding DAM will improve participation in day-ahead scheduling, helping to ensure reliability while efficiently scheduling resources
- Participation in the DAM can help to reduce exposure to real-time price volatility

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

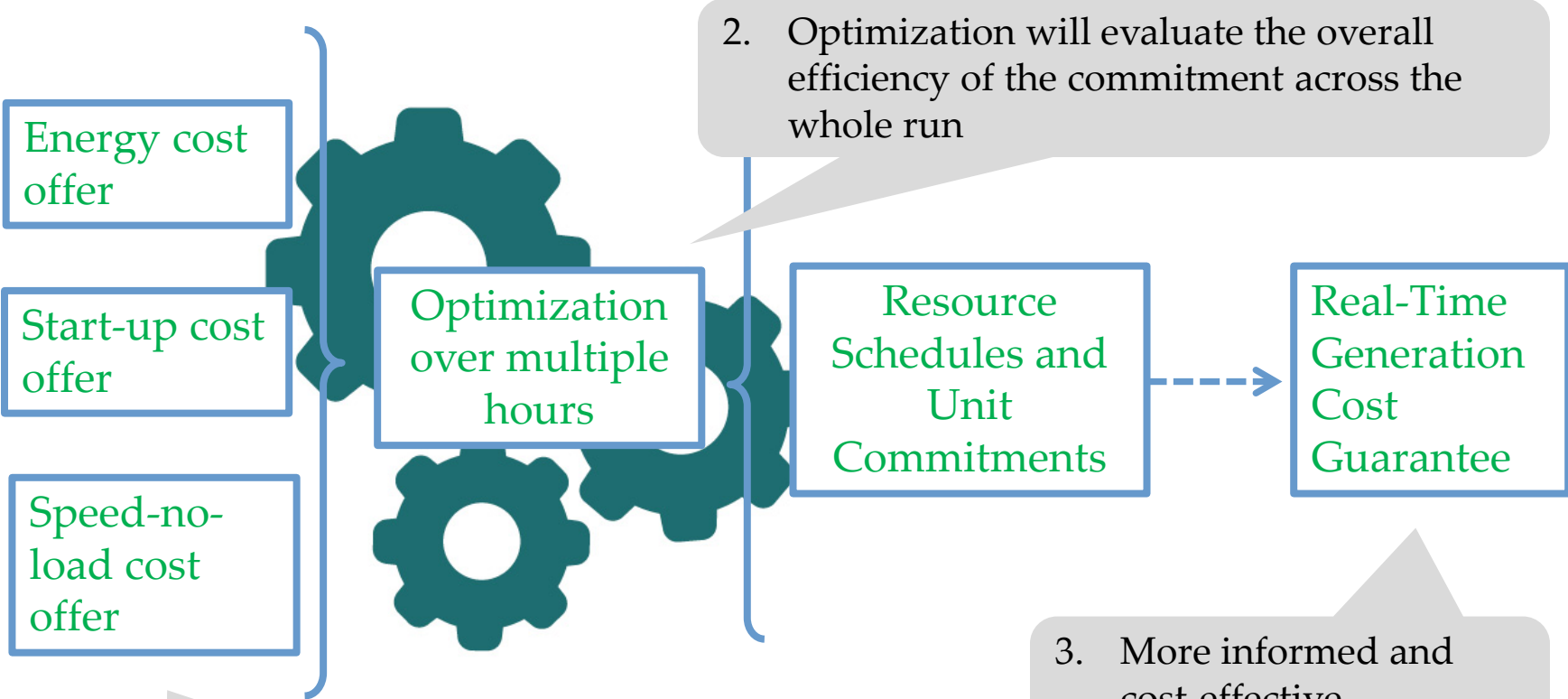
Lack of Competition

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



1. Resources will be efficiently committed by considering all costs

2. Optimization will evaluate the overall efficiency of the commitment across the whole run

3. More informed and cost-effective commitment decisions

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 to reliably meet demand

KEY DESIGN CONCEPTS

Design Concept 1 – Locational Pricing for Generators and Loads

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 for Generators and Loads

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 changes to the intertie settlement price will be covered in the next section

Real-Time Pricing Today

- Intertie congestion pricing (ICP) represents price differences between locations in Ontario and interties with other jurisdictions
- Under the current market design, ICP representing the cost of congestion at the interties is calculated in the hour-ahead pre-dispatch (PD) timeframe

$$PD\ ICP = PD\ Intertie\ Price - PD\ Ontario\ MCP$$

- The ICP is then added to the real-time (RT) uniform price to determine the intertie settlement price (ISP)

$$RT\ ISP = RT\ Ontario\ MCP + PD\ ICP$$

- Whilst this design is reasonable, it can result in inefficiencies which will be addressed in the new market design by introducing a new pricing methodology

SSM - Import Congestion

- RT intertie settlement in import congested hours will equal the lesser of the final PD intertie LMP and the RT internal node LMP:
 - **RT ISP = Min {RT Internal Node LMP, Final PD Intertie LMP}**
- ✓ Encourages importers to offer in line with expected marginal value
- ✓ More efficient scheduling of internal resources
- ✓ Importers will still be eligible for the real-time import offer guarantee (IOG) to promote reliability

Design Concept 2 – Real-Time Intertie Pricing

SSM - Export Congestion

- RT intertie settlement will be equal to RT internal node LMP plus PD ICP for export congested hours (*i.e., consistent with the current ICP methodology*)
 - **PD ICP = PD Intertie LMP – PD Internal Node LMP**
 - **RT ISP = RT Internal Node LMP + PD ICP**
- ✓ Reflects divergence between PD and RT prices
- ✓ Helps to ensure exports that are efficient in RT are scheduled

SSM - No Congestion

- When there is no congestion, the intertie congestion price is zero and settlement prices will be equal to the RT LMP at the internal node near the intertie
 - ✓ Encourages efficient bids and offers from market participants to minimize the long-term cost of operating the system

Virtual Transactions

- Virtual transactions are purely financial instruments used to buy and sell energy in the DAM
- 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 for energy as they provide the following benefits:
 - ✓ Improving convergence between DA and RT prices and schedules, thus supporting 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
- Virtual transactions will be implemented in the new design on an aggregated node basis

Financial Transmission Rights (FTRs)

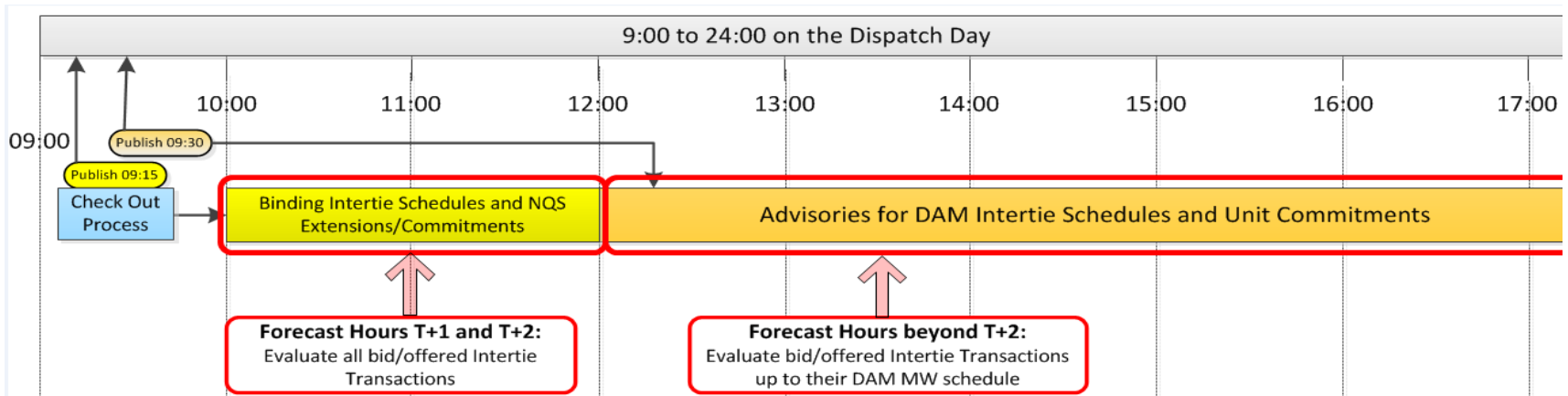
- In the new design, FTRs will be settled at DAM prices to provide market participants with the ability to hedge DAM congestion at interties
 - The DAM and FTRs settled at DA prices provides an opportunity for participants to hedge against real-time market price volatility
- This design feature will inform the upcoming Transmission Rights Market Review which will consider potential improvements to the FTR market and ensure compatibility with the Market Renewal Program

Design Concept 5 – Pre-Dispatch Participation

Intertie Transactions in Pre-Dispatch

For reliability purposes, intertie bids/offers will be considered differently in pre-dispatch based on whether they have DAM schedules:

- All intertie bids/offers, including non-DAM scheduled, will be economically assessed for pre-dispatch in both T+1 and T+2
- Only DAM-scheduled intertie bids/offers will be economically assessed for pre-dispatch in T+3 and beyond



- Approach helps to ensure schedules reflect intertie transactions that have the highest certainty of flowing in real-time

Uncompetitive Interties

- In general, market power mitigation is not required on interties because they have high levels of competition
- Market power mitigation will be applied on interties when an intertie is deemed and designated to be uncompetitive
- Interties will be designated as uncompetitive when it is determined that:
 - The majority of the trade on the intertie comes from one market participant, or
 - There are reasonable grounds to believe that a market participant controls the level of transactions on the intertie

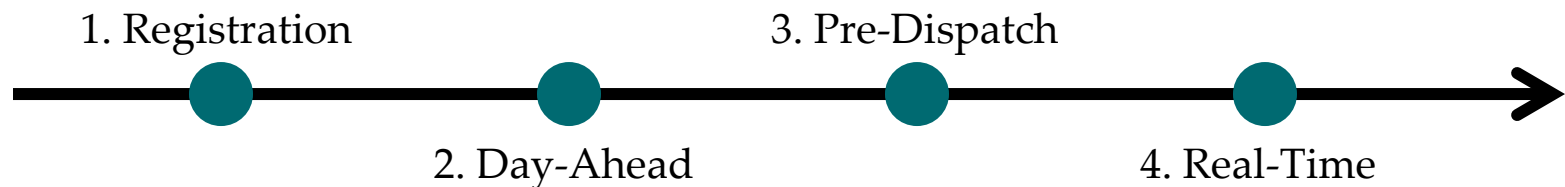
Uncompetitive Interties

- The designation of an uncompetitive intertie will:
 1. Require that the IESO has a reasonable expectation that significant restrictions to competition exist
 2. Apply across all timeframes (i.e., day-ahead, pre-dispatch and real-time)
 3. Require public notification before coming into force
- After an intertie is designated as uncompetitive, mitigation will be applied through pricing rules to modify pricing on the intertie
- Pricing rules for designated uncompetitive interties will be developed in detailed design

SECTION B: OPERATIONAL WALK THROUGH

Introduction

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



- The section will start with a recap of the current design before then moving on to describe the new design

1. Registration – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
Obtain NEB license and complete market registration			

2. Day-Ahead – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Obtain NEB license and complete market registration</p>	<p>To participate in DACP: submit energy bids/offers, and OR offers</p> <p>Receive advisory schedule</p>		

3. Pre-Dispatch – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Obtain NEB license and complete market registration</p>	<p>To participate in DACP: submit energy bids/offers, and OR offers</p> <p>Receive advisory schedule</p>	<p>Submit or update energy bids/ offers, and OR offers</p> <p>Receive final PD schedule</p>	

4. Real-Time – Current Design

Registration	Day-Ahead Commitment Process (DACP)	Pre-Dispatch (PD)	Real-Time (RT)
<p>Obtain NEB license and complete market registration</p>	<p>To participate in DACP: submit energy bids/offers, and OR offers</p> <p>Receive advisory schedule</p>	<p>Submit or update energy bids/ offers, and OR offers</p> <p>Receive final PD schedule</p>	<p>Deliver as per scheduling protocol with other jurisdictions</p> <p><i>Settlement based on RT schedule and inertia settlement price</i></p>

1. Registration – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p data-bbox="123 386 502 539">Obtain NEB license and complete market registration</p> <p data-bbox="123 572 502 725">Monitor list of un-competitive interties for MPM</p>			

2. Day-Ahead – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p data-bbox="117 379 504 544">Obtain NEB license and complete market registration</p> <p data-bbox="117 565 504 715">Monitor list of un-competitive interties for MPM</p>	<p data-bbox="548 379 935 544">Submit energy bids/offers, and OR offers</p> <p data-bbox="548 565 935 672">Receive financially binding schedule</p> <p data-bbox="548 694 935 915"><i>Settlement based on DAM schedule and intertie settlement price</i></p>		

3. Pre-Dispatch – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p data-bbox="117 379 504 544">Obtain NEB license and complete market registration</p> <p data-bbox="117 565 504 715">Monitor list of un-competitive interties for MPM</p>	<p data-bbox="548 379 935 544">Submit energy bids/offers, and OR offers</p> <p data-bbox="548 565 935 672">Receive financially binding schedule</p> <p data-bbox="548 694 935 915"><i>Settlement based on DAM schedule and intertie settlement price</i></p>	<p data-bbox="979 379 1365 544">Submit or update energy offers/ bids and OR offers</p> <p data-bbox="979 565 1365 1115"><i>All intertie bids/offers will be economically assessed for hours T+1 and T+2. T+3 and beyond only for DAM scheduled intertie bids/offers, or emergency and capacity backed transactions</i></p> <p data-bbox="979 1136 1365 1229">Receive final PD schedule</p>	

4. Real-Time – Market Renewal Design

Registration	Day-Ahead Market (DAM)	Pre-Dispatch (PD)	Real-Time (RT)
<p data-bbox="117 379 504 544">Obtain NEB license and complete market registration</p> <p data-bbox="117 565 504 715">Monitor list of uncompetitive interties for MPM</p>	<p data-bbox="542 379 929 544">Submit energy bids/offers, and OR offers</p> <p data-bbox="542 565 929 672">Receive financially binding schedule</p> <p data-bbox="542 694 929 915"><i>Settlement based on DAM schedule and intertie settlement price</i></p>	<p data-bbox="973 379 1360 544">Submit or update energy offers/ bids and OR offers</p> <p data-bbox="973 565 1360 1115"><i>All intertie bids/offers will be economically assessed for hours T+1 and T+2. T+3 and beyond only for DAM scheduled intertie bids/offers, or emergency and capacity backed transactions</i></p> <p data-bbox="973 1136 1360 1229">Receive final PD schedule</p>	<p data-bbox="1404 379 1810 601">Deliver as per scheduling protocol with other jurisdictions</p> <p data-bbox="1404 622 1810 843"><i>Settlement based on RT schedule and intertie settlement price</i></p> <p data-bbox="1404 865 1810 1086"><i>MPM pricing rules applied to real-time settlement if intertie uncompetitive</i></p>

SECTION C: SETTLEMENT SCENARIOS

Introduction

- This section will provide a series of simplified examples to illustrate on a high-level the mechanics of the day-ahead and real-time settlement process
 - *Note that the settlement scenarios illustrated here do not cover the ISP*
- Four scenarios will be presented:
 1. Real-Time energy import **equal to** Day-Ahead schedule
 2. Real-Time energy import **greater than** Day-Ahead schedule
 3. Real-Time energy import **less than** Day-Ahead schedule
 4. Real-Time energy export **equal to** Day-Ahead schedule

Day-Ahead and Real-Time Settlement

Day-Ahead

Real-Time (balancing)

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

Suppliers are **paid for DA**
scheduled injections



(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

Importers Scenario 1:

REAL-TIME INJECTION AND DAY-AHEAD SCHEDULE EQUAL

S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644">100 MW at \$20</div> <div data-bbox="175 665 610 855">150 MW at \$40</div>		

The importer 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

S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644">100 MW at \$20</div> <div data-bbox="175 662 610 852">150 MW at \$40</div>	<div data-bbox="707 454 1141 629">Market clears at \$100</div> <div data-bbox="707 648 1141 852">Importer scheduled at 250 MW</div>	
Energy settlement	250 MW x \$100 = \$25,000	

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

S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644">100 MW at \$20</div> <div data-bbox="175 662 610 852">150 MW at \$40</div>	<div data-bbox="701 454 1141 629">Market clears at \$100</div> <div data-bbox="701 648 1141 852">Importer scheduled at 250 MW</div>	<div data-bbox="1257 454 1698 629">Market clears at \$50</div> <div data-bbox="1257 648 1698 852">Importer injects 250 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$(250 \text{ MW} - 250 \text{ MW}) \times \$50 = \$0$

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

S1: RT and DAM injection equal

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644" style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center;">100 MW at \$20</div> <div data-bbox="175 662 610 852" style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center;">150 MW at \$40</div>	<div data-bbox="701 454 1141 629" style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center;">Market clears at \$100</div> <div data-bbox="701 648 1141 852" style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center;">Importer scheduled at 250 MW</div>	<div data-bbox="1257 454 1698 629" style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center;">Market clears at \$50</div> <div data-bbox="1257 648 1698 852" style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center;">Importer injects 250 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$+(250 \text{ MW} - 250 \text{ MW}) \times \$50 = \$0$

The importer 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

S1: RT and DAM injection equal – Summary

- In this scenario, the importer 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 importer 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

Importers Scenario 2:

REAL-TIME INJECTION GREATER THAN DAY-AHEAD SCHEDULE

S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="177 439 612 644">100 MW at \$20</div> <div data-bbox="177 662 612 856">150 MW at \$40</div>		

The importer 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

S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 439 610 644">100 MW at \$20</div> <div data-bbox="175 662 610 858">150 MW at \$40</div>	<div data-bbox="703 508 1141 651">Market clears at \$25</div> <div data-bbox="703 662 1141 851">Importer scheduled at 100 MW</div>	
Energy settlement	$100 \text{ MW} \times \$25 = \$2,500$	

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

S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 439 614 644">100 MW at \$20</div> <div data-bbox="175 662 614 858">150 MW at \$40</div>	<div data-bbox="701 508 1141 654">Market clears at \$25</div> <div data-bbox="701 662 1141 853">Importer scheduled at 100 MW</div>	<div data-bbox="1251 454 1688 644">Market clears at \$100</div> <div data-bbox="1251 662 1688 853">Importer 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...

S2: RT injection greater than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 439 610 644">100 MW at \$20</div> <div data-bbox="175 662 610 858">150 MW at \$40</div>	<div data-bbox="701 508 1141 651">Market clears at \$25</div> <div data-bbox="701 662 1141 851">Importer scheduled at 100 MW</div>	<div data-bbox="1248 454 1688 644">Market clears at \$100</div> <div data-bbox="1248 662 1688 851">Importer injects 250 MW</div>
Energy settlement	$100 \text{ MW} \times \$25 = \$2,500$	$+ (250 \text{ MW} - 100 \text{ MW}) \times \$100 = \$15,000$

The importer 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

S2: RT injection greater than DAM – Summary

- In this scenario, the importer 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 importer 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

Importers Scenario 3:

REAL-TIME INJECTION LESS THAN DAY-AHEAD SCHEDULE

S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 439 612 644">100 MW at \$20</div> <div data-bbox="175 662 612 853">150 MW at \$40</div>		

The importer 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

S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<p data-bbox="175 454 610 644">100 MW at \$20</p> <p data-bbox="175 662 610 852">150 MW at \$40</p>	<p data-bbox="722 454 1139 629">Market clears at \$100</p> <p data-bbox="722 662 1139 852">Importer scheduled at 250 MW</p>	
<p data-bbox="175 931 610 1025">Energy settlement</p>	<p data-bbox="722 931 1139 1053">250 MW x \$100 = \$25,000</p>	

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

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

S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644">100 MW at \$20</div> <div data-bbox="175 662 610 852">150 MW at \$40</div>	<div data-bbox="710 454 1145 644">Market clears at \$100</div> <div data-bbox="710 662 1145 852">Importer scheduled at 250 MW</div>	<div data-bbox="1248 525 1682 672">Market clears at \$25</div> <div data-bbox="1248 682 1682 852">Importer 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 importer injects 150 MW less than its financially binding day-ahead schedule...

S3: RT injection less than DAM

Offers	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644">100 MW at \$20</div> <div data-bbox="175 662 610 852">150 MW at \$40</div>	<div data-bbox="710 454 1145 629">Market clears at \$100</div> <div data-bbox="710 662 1145 852">Importer scheduled at 250 MW</div>	<div data-bbox="1248 525 1682 672">Market clears at \$25</div> <div data-bbox="1248 682 1682 852">Importer injects 100 MW</div>
Energy settlement	$250 \text{ MW} \times \$100 = \$25,000$	$+ (100 \text{ MW} - 250 \text{ MW}) \times \$25 = -\$3,750$

The importer pays \$3,750 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

S3: RT injection less than DAM – Summary

- In this scenario, the importer 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

Exporters Scenario 4:

REAL-TIME AND DAY-AHEAD WITHDRAWAL EQUAL

S4: RT and DAM withdrawal equal

Bids	Locational Day-Ahead	Locational Real-Time
<div data-bbox="175 454 610 644">150 MW at \$30</div> <div data-bbox="175 665 610 855">50 MW at \$40</div>		

The exporter places two bids: one bid to show that it is willing to export 50 MW as long as the price is less than or equal to \$40 and another to indicate it will export an additional 150 MW if the price is less than or equal to \$30

S4: RT and DAM withdrawal equal

Bids	Locational Day-Ahead	Locational Real-Time
<p>150 MW at \$30</p> <p>50 MW at \$40</p>	<p>Market clears at \$5</p> <p>Exporter scheduled at 200 MW</p>	
Energy settlement	$-200 \text{ MW} \times \$5 =$ -\$1000	

The locational day-ahead market clears at \$5 and the exporter receives a financially binding schedule to export 200 MW...

S4: RT and DAM withdrawal equal

Bids	Locational Day-Ahead	Locational Real-Time
<div style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center; margin-bottom: 10px;">150 MW at \$30</div> <div style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center;">50 MW at \$40</div>	<div style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center; margin-bottom: 10px;">Market clears at \$5</div> <div style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center;">Exporter scheduled at 200 MW</div>	<div style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center; margin-bottom: 10px;">Market clears at \$25</div> <div style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center;">Exporter withdraws 200 MW</div>
Energy settlement	$-200 \text{ MW} \times \$5 =$ -\$1000	$(-200 \text{ MW} - (-200 \text{ MW})) \times \$25 = \$0$

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

S4: RT and DAM withdrawal equal

Bids	Locational Day-Ahead	Locational Real-Time
<div style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center; margin-bottom: 10px;">150 MW at \$30</div> <div style="background-color: #4a86e8; color: white; border-radius: 15px; padding: 10px; text-align: center;">50 MW at \$40</div>	<div style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center; margin-bottom: 10px;">Market clears at \$5</div> <div style="border: 2px solid #808080; border-radius: 15px; padding: 10px; text-align: center;">Exporter scheduled at 200 MW</div>	<div style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center; margin-bottom: 10px;">Market clears at \$25</div> <div style="border: 2px solid #76c73a; border-radius: 15px; padding: 10px; text-align: center;">Exporter withdraws 200 MW</div>
Energy settlement	$-200 \text{ MW} \times \$5 =$ -\$1000	$(-200 \text{ MW} - (-200 \text{ MW})) \times \$25 = \$0$

The exporter pays \$1,000 for consumption of 200 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

S4: RT and DAM withdrawal equal – Summary

- In this scenario, the exporter 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 exporter 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
- 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 reliably 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>