

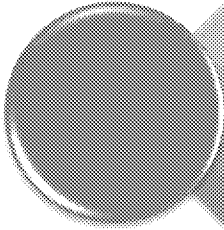
A MARKET DEVELOPMENT RETROSPECTIVE

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Markets, IESO

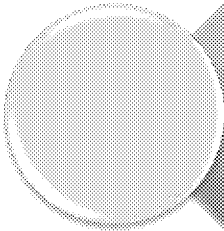
April 19, 2016

Purpose

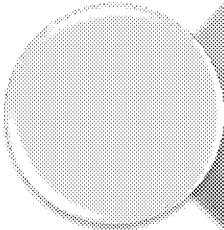
- Review our experience with key design features of the IESO-administered markets to outline:
 - the **complexity** of the current design and how it impacts both the IESO and market participants
 - the significant effort to identify, assess and address issues stemming from **inefficiencies** in the current design
 - why the current design is a **barrier** to achieving significant efficiency improvements and prepare the market for the future



Two Schedule Energy Market



Day-Ahead Scheduling



Real-Time Unit
Commitment

Ontario's Unique Two Schedule System

- The market uses two different schedules
 - The **constrained schedule** determines dispatch
 - The **unconstrained schedule** sets prices

Unconstrained Sequence	Constrained Sequence
• Determines a uniform, system wide market clearing price • Recognizes transmission limitations at the interties • Ignores internal transmission limitations • Establishes the market participants' schedules based on bids and offers • Uniform price is determined after-the-fact	• Determines market participant dispatch instructions based on: • Bids, offers • System conditions • Forecasted conditions • Produces locational "shadow prices" for information purposes • Recognizes all transmission limitations • Determined in advance

History of the Two Schedule System

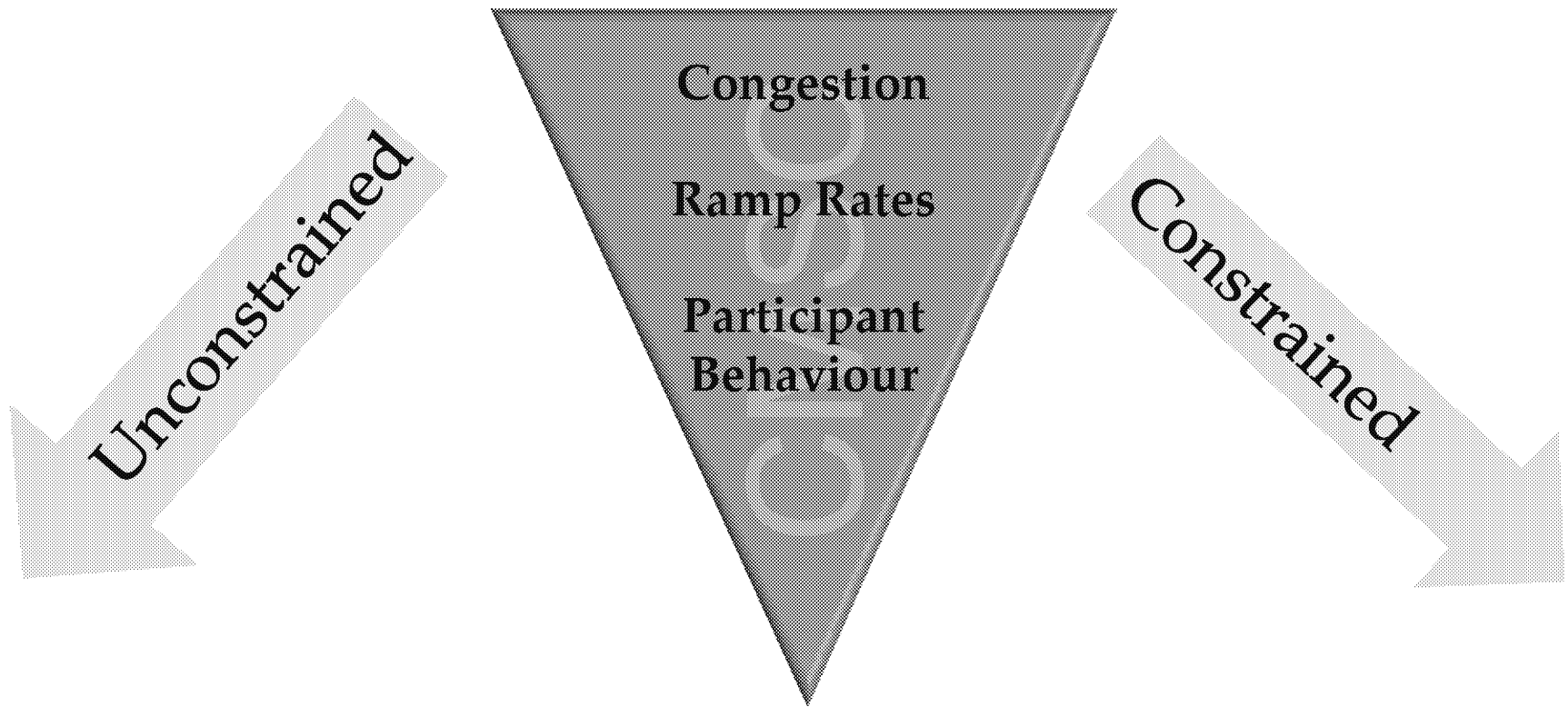
- Ontario's continued use of the two schedule system is unique in North American energy markets
- Adopting the two schedule system at market opening was a deliberate decision to ease the transition from the pricing structure that was in place prior to market opening
- The Market Design Committee recognized the limitations of this approach and suggested it be phased out after 18 months and replaced with congestion pricing

Need for Change Identified from the Start

“One of our key recommendations regarding the wholesale market is that there should be a locationally-uniform price for electricity for the first 18 months of the market, but that, thereafter, congestion pricing should be introduced...”

Market Design Committee, Final Report
January 1999

Limitations of the Two Schedule System



The larger the divergence between the two schedules, the more out-of-market payments, in the form of CMSC, are required to reconcile that difference.

Out of Market Payments

Inefficient Price
Formation

*Congestion
Management
Settlement Credits
(CMSC) reflect the
difference between the
two schedules and are
recovered as out-of-
market payments*

Congestion location
and magnitude is
masked and hidden
from the price signal

Market participants
lack the information to
provide efficient
solutions

Inefficient production,
consumption and
investment decisions

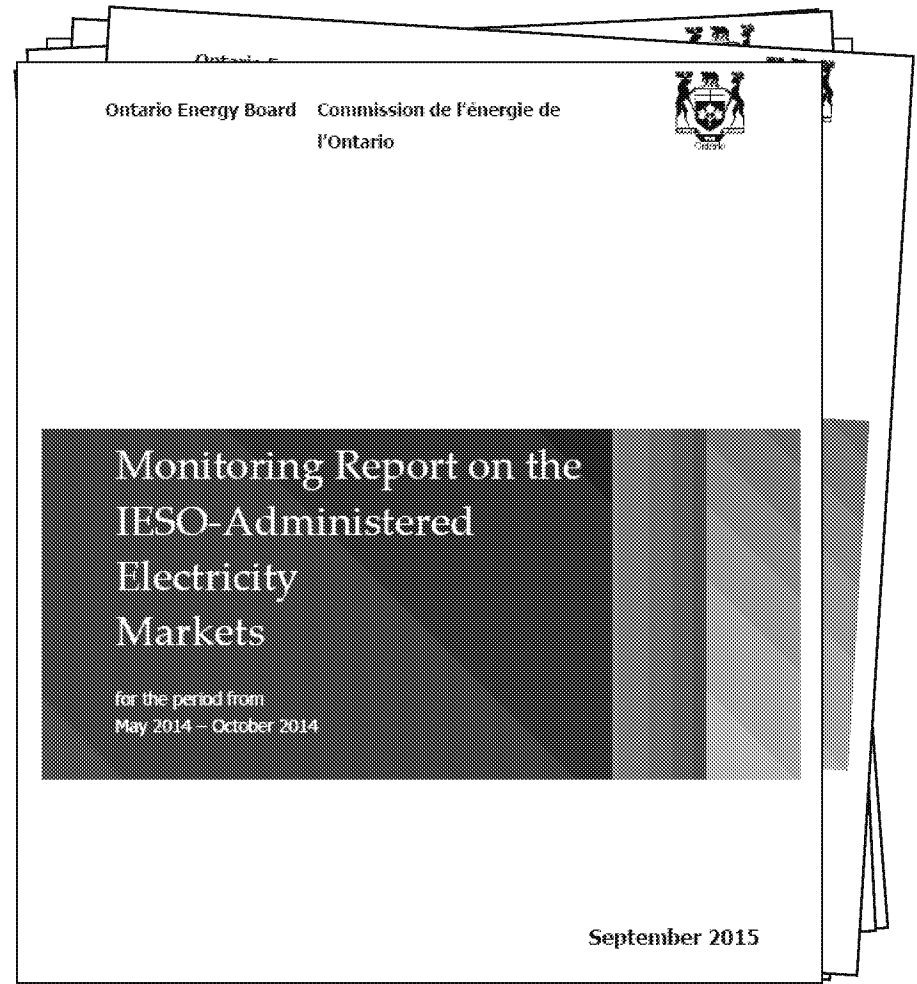
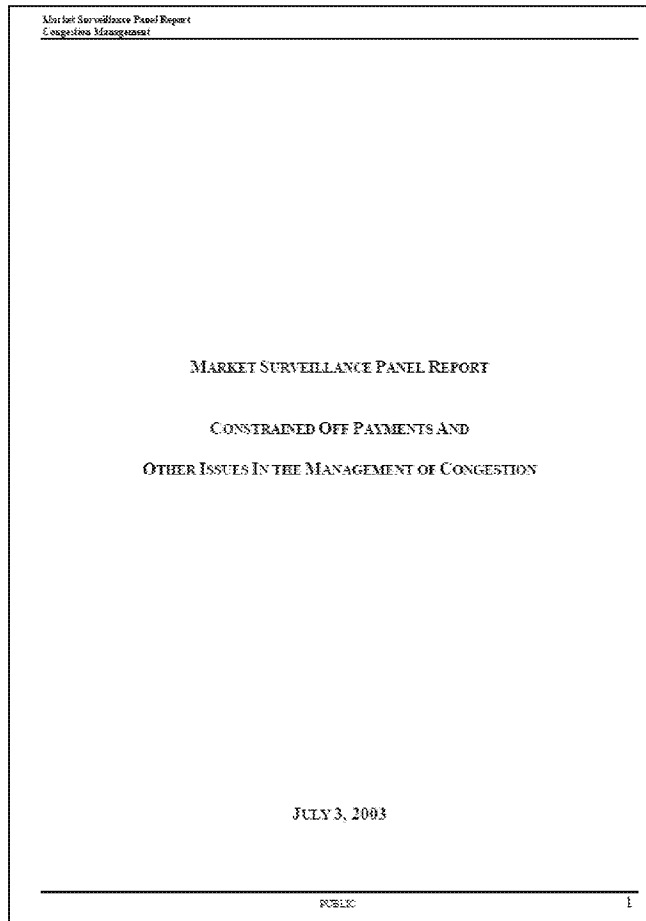
Costs borne by all
consumers,
regardless of their
contribution

Foreshadowing of Issues

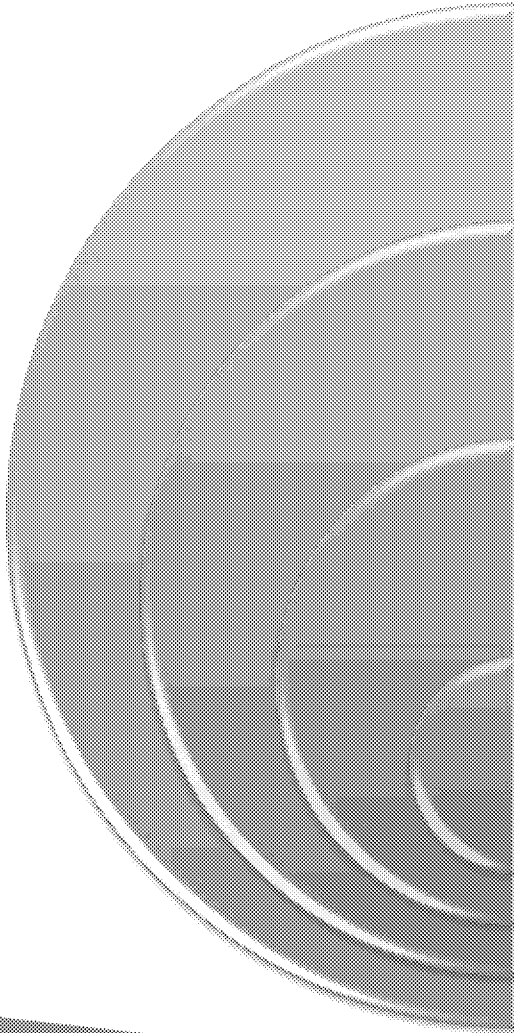
“During the first eighteen months of operations, we recommend that the IMO use a province-wide uniform price for settlements in the IMO’s spot market. Before it is implemented, however, we strongly urge that rules be developed to discourage gaming of side payments and to limit unfair arbitrage of the differences between uniform prices and underlying marginal costs.”

Market Design Committee, Second Interim Report
June 1998

Market Surveillance Panel



Pay As Bid Incentives



Participants can offer or bid just below or above the relevant shadow price to target constrained-on or constrained-off payments

Participants can seek to maximize out-of-market payments without changing their physical operation

Vastly different payment streams can result from the same dispatched quantity

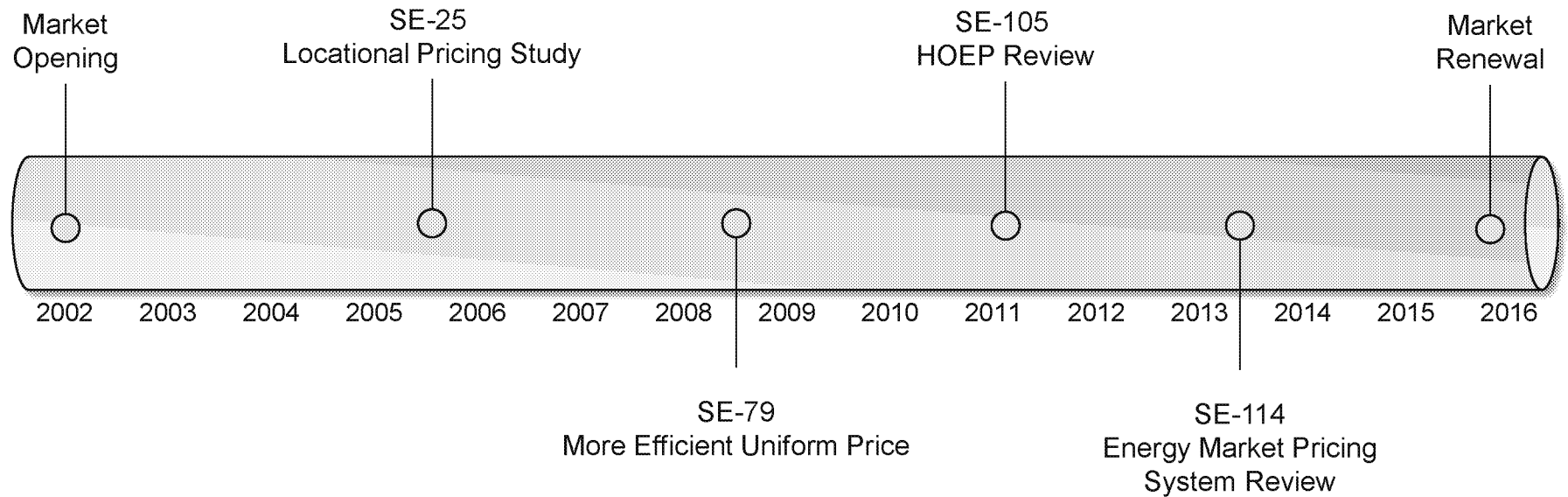
Gaming behaviour can be difficult and time-consuming to identify and rectify

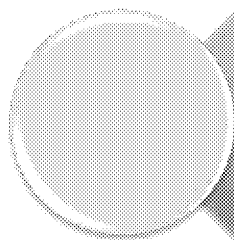
Market Rule Amendments

- The IESO has undertaken many market rule amendments to address either explicit gaming opportunities or unintentional outcomes related to CMSC

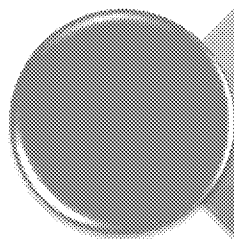


Stakeholder Consultations

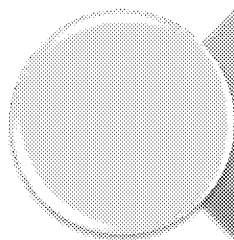




Two Schedule Energy
Market



Day-Ahead Scheduling



Real-Time Unit
Commitment

Unit Commitment Issues

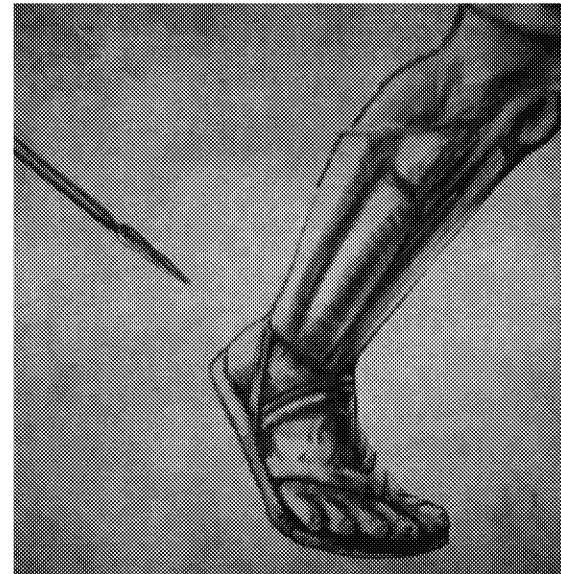
"We also recommended that the IMO should administer a voluntary, day-ahead forward market for purely financial contracts, in addition to the real-time (pre-dispatch) market.

... We cite the recommendation here as another example of our intent to design a market that gives significant commercial flexibility to market participants."

Market Design Committee, Final Report
January 1999

Day-Ahead Markets

- Most markets did not include day-ahead design features at their inception
 - They were adopted in most markets in the early 2000s to improve both efficiency and reliability
- The IMO launched a Day-Ahead Market (DAM) Working Group in 2003
 - Produced comprehensive high-level design
 - Very complex settlement due to two schedule system



Day Ahead Commitment Process (DACP)

- Reliability challenges in the summer of 2005 arose from high demand and limited supply
 - Ontario was highly dependent upon import transactions to maintain adequacy
 - Exacerbated by uncertainty due to import failures and time to bring generators online
- IESO introduced Day Ahead Commitment Process for summer of 2006
 - Reliability mechanism which commits imports and certain types of generation day ahead and provides financial guarantees to committed resources

DACP: Necessary but not Sufficient

DACP proved effective in maintaining reliability and ensuring necessary resources were available to meet demand

However, efficiency concerns remained:

- Resources were optimized for one hour based on incremental energy costs
- True commitment costs were only known after-the-fact

A better solution was necessary but the two schedule system continued to be a barrier

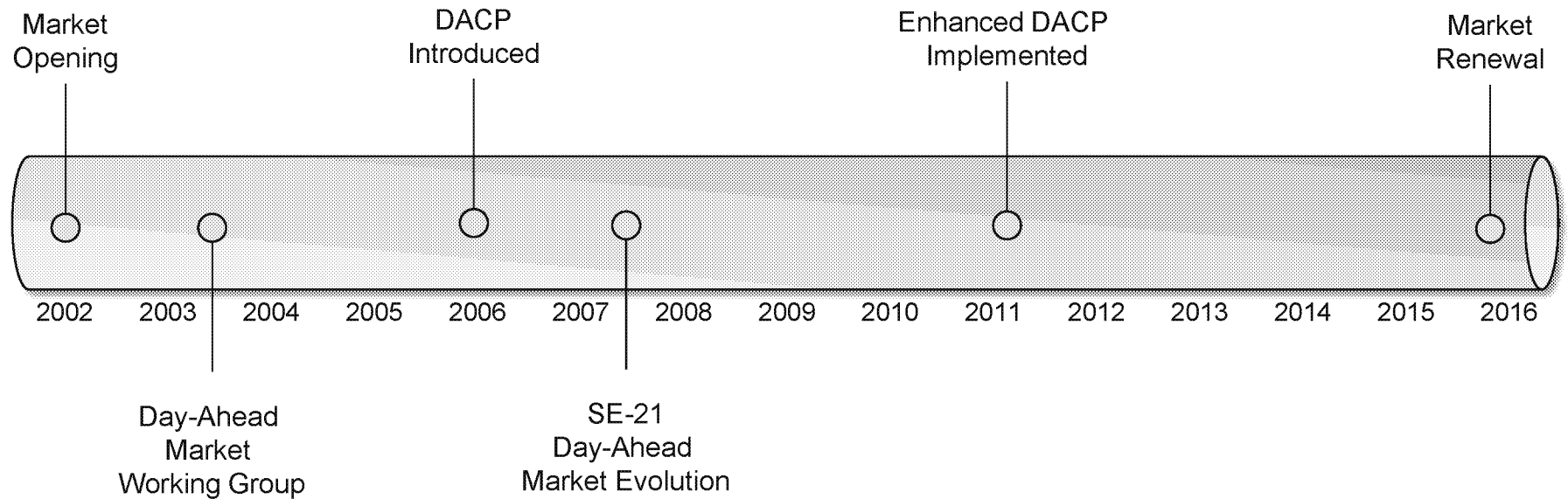
Enhanced DACP (EDAC)

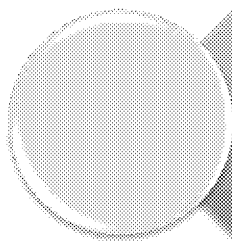
- In 2011, the IESO implemented an enhanced DACP
 - Optimized over 24 hours
 - Makes use of three part offers which include: incremental energy, start up, and speed-no-load costs
 - Pseudo-units allow for more effective scheduling of certain combined cycle natural gas facilities
 - Provides day-ahead cost guarantees for committed resources and imports

Inefficiencies Remain

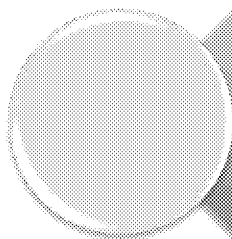
- DACP has reached the limits of its ability to drive greater efficiencies for commitments and participation
- The underlying challenges are:
 - Financial uncertainty due to lack of two-settlement
 - Incomplete information day-ahead, due to lack of participation of some resources (e.g. exports), and
 - Barriers to non-dispatchable resources who lack accurate price signals to plan their operation
- Incentives to participate day-ahead are undermined by real-time incentives

Stakeholder Consultations

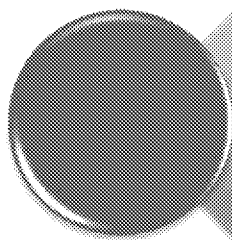




Two Schedule Energy
Market



Day-Ahead Scheduling



Real-Time Unit
Commitment

Spare Generation Online Program

- The Spare Generation Online (SGOL) program was launched in 2003 as a reliability mechanism
 - Incentivize non-quick start generators to come to market with guaranteed cost recovery for their minimum run time
 - Costs submitted after-the-fact
 - Minimal eligibility requirements
- To increase the efficiency of real-time unit commitment, eligibility requirements were improved
- Must be scheduled for minimum loading point (MLP) for at least half of the minimum run-time (MRT)

Real-Time GCG – Market Inefficiencies

The unit commitment process does not properly capture all costs and results in incomplete price signals

- True costs of a unit commitment start (start-up, speed-no load) are not known until much later, and hence not reflected in commitment decisions or price signals
- Costs beyond minimum loading point and minimum run time are not captured
- Optimization proceeds one hour at a time, independent of future hours
- Competing incentives between day-ahead and real-time unit commitment may drive participants to prefer one timeframe over another

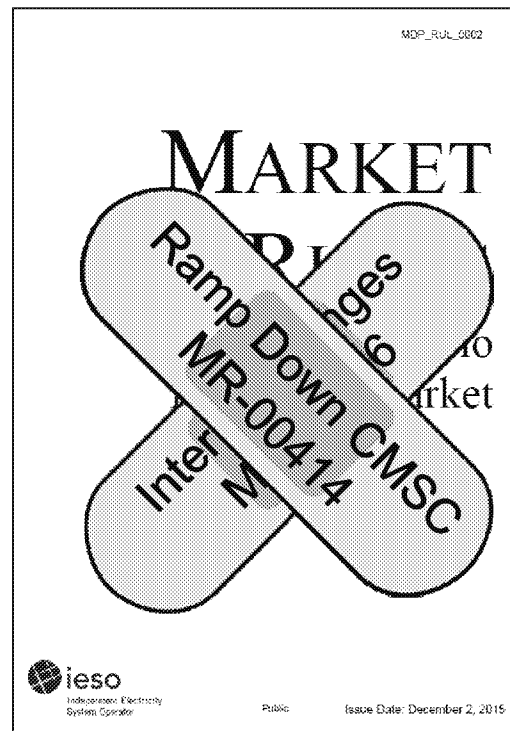
Real-Time GCG – Process Burden

The use of after-the-fact cost submissions burdens both IESO and market participants

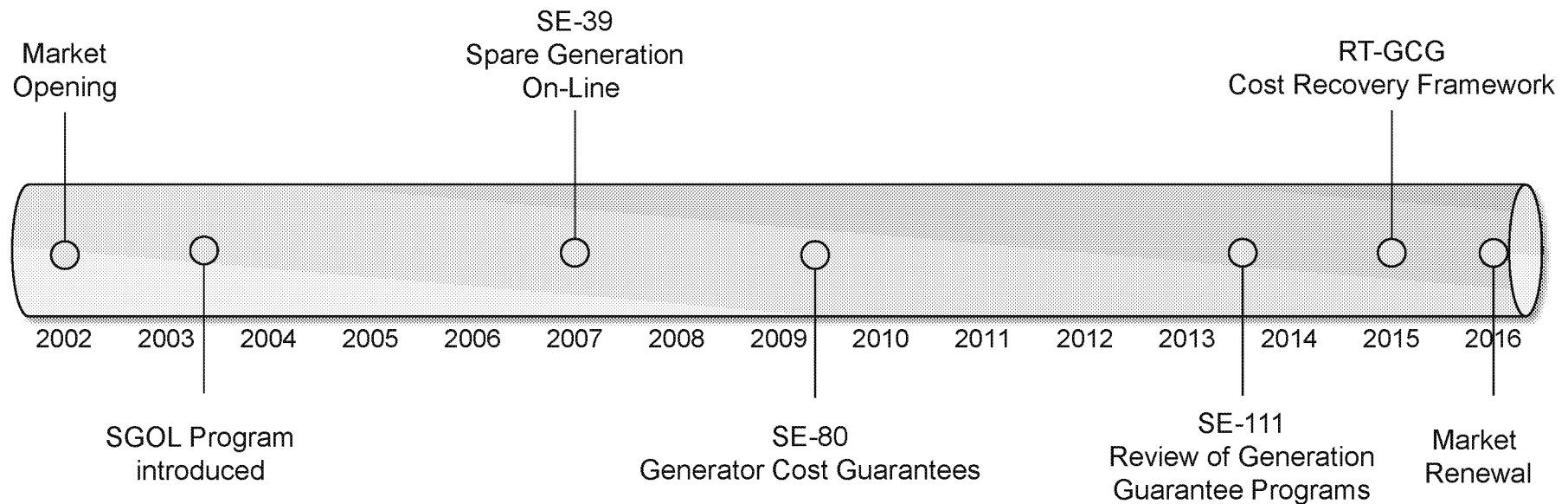
- The process of submitting and settling these costs requires significant effort
- IESO increasingly relies on audit provisions, rather than competitive market forces, to determine the appropriateness of these after-the-fact costs
- IESO is currently working with stakeholders on an interim framework for improved cost recovery

Market Rule Amendments

- The IESO has undertaken a number of market rule amendments to address shortcomings and unintended consequences of real-time unit commitment



Stakeholder Consultations



Final Summary

Two Schedule Energy Pricing

- Introduced as a temporary approach
- Reduces transparency and leads to gaming opportunities
- Requires on-going market rule amendments
- Complexity is a barrier to achieving efficiencies

Day-Ahead Scheduling

- DACP introduced to ensure reliability
- Has evolved but still has structural design issues
- Financially binding day-ahead markets (DAM) are proven features of other markets
- Too complex to introduce DAM with the two schedule system

Real-Time Unit Commitment

- After-the-fact cost submissions are burdensome and lack transparency
- Benefits realized already in day-ahead can be applied to real-time commitment
- An enduring solution is necessary

Setting the Stage for Change:

The Electricity Market Forum

Electricity Market Forum

- In 2011, the IESO convened a stakeholder consultation to identify issues and opportunities for the IESO-administered markets
- The Electricity Market Forum was established to:
 - identify the principal issues being encountered or anticipated in the operation of and participation in the IESO-Administered Markets, and
 - to make recommendations that address those issues
- The focus was on the challenges and issues arising from the design of the market, rather than broader policy decisions

Broad Stakeholder Participation

- The Electricity Market Forum called upon the expertise of both the Stakeholder Advisory Committee and the broader stakeholder community
- From March until September 2011, members of the Forum met regularly to discuss and consider issues, options and priorities
- A final report and road map for market evolution was issued and reflects broad consensus on the opportunities for changes in the market design

Final Report

Reconnecting Supply and Demand:

How Improving Electricity Pricing Can Help Integrate
A Changing Supply Mix, Increase Efficiency
and Empower Customers

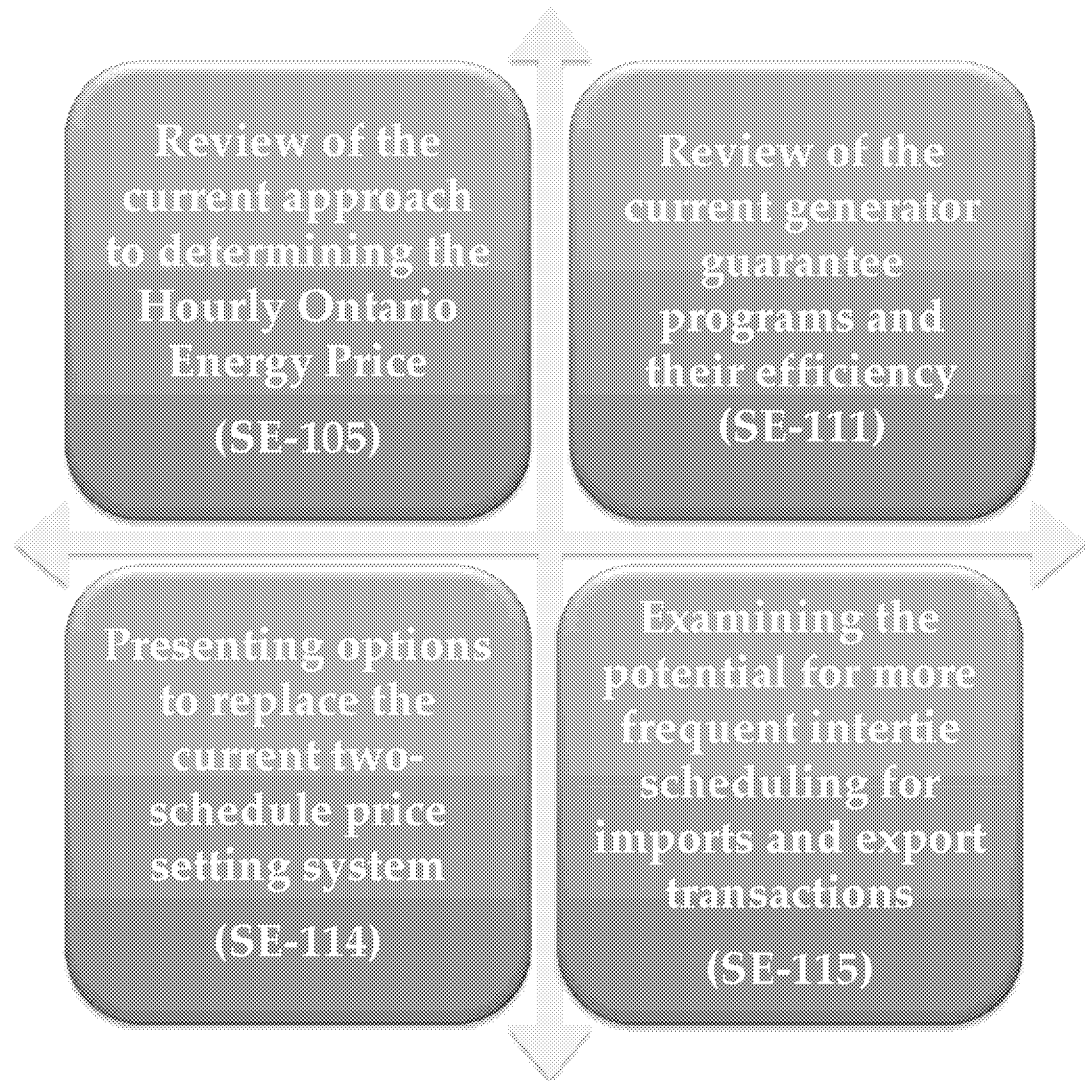
Report of the Chair of
the Electricity Market Forum
George Vegh
December 2011

Key recommendations:

- Review market programs to identify efficiency improvements
- Seek greater transparency of out-of-market costs
- Consider replacing two-schedule price setting system
- Facilitate easier trade with neighbouring jurisdictions

Market Studies

- In response to Forum, the IESO undertook a number of studies and engagements
- Analyses largely supported Forum conclusions



Moving Forward with Market Renewal

- The findings of these studies form a strong case for moving forward with market development
- A coordinated, holistic approach to renewing the foundations of Ontario's electricity market will help to realize the benefits identified through these studies
- We are now in a position to look forward, build upon our past efforts and implement changes