

# Market Development Advisory Group (MDAG)

May 30, 2019

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# Agenda

- 9:00 am Welcome and Introduction
- 9:15 am Background on Operating Reserve
- 10:45 am Break**
- 11:00 am Overview of Market Surveillance Panel (MSP) recommendations
- 11:30 am Innovation Roadmap and how it interfaces with the MDAG Workplan
- 12:00 pm Adjourn**

# Welcome and Introduction

# Background on Operating Reserves

# What is Operating Reserve (OR)?

- Operating reserve is available capacity held in excess of what is required to serve actual load
- Can be called by the IESO with short notice to manage an unexpected mismatch between generation and consumption
- Three types of reserves
  - Regulating
  - Contingency
  - Flexibility

# Types of OR

Type of OR	Requirement and Usage
<b><u>Regulating</u></b> – for second to second balancing and frequency control within dispatch interval	<ul style="list-style-type: none"><li>• Must meet NERC Control Performance Standards (CPS)</li><li>• Automatically deployed within dispatch process</li><li>• Not co-optimized with energy</li><li>• +/- 100 MW minimum requirement</li></ul>
<b><u>Contingency</u></b> – for unexpected loss of system elements	<ul style="list-style-type: none"><li>• Must meet NERC &amp; NPCC reliability requirements</li><li>• 10-minute reserve to cover largest contingency (at least 25% must be synchronized)</li><li>• 30-minute reserve to cover 1/2 of 2<sup>nd</sup> contingency</li><li>• Scheduled through the IESO market</li></ul>
<b><u>Flexibility</u></b> – for variability and uncertainty in future dispatch intervals	<ul style="list-style-type: none"><li>• Additional 200MW of 30-minute reserve above contingency amounts</li><li>• Scheduled through the IESO market</li></ul>

# OR Markets

- The IESO administers three separate OR markets in addition to the energy market for contingencies and flexibility
  - 10-minute spinning reserve (10S)
  - 10-minute non-spinning reserve (10N)
  - 30-minute reserve (30R)

# Participating in the OR Market

- The current market allows dispatchable generators and loads, and some imports to participate offer OR
- The resource must have a bid or offer in the energy market equal or greater to the quantity of OR offered
  - E.g. a generator offering 10 MW of 30R must also offer at least 10 MW into the energy market
- Prices and schedules are determined every five minutes for each reserve class
- OR offered but not scheduled for one class may be scheduled for a lower class
  - E.g. offers for 10S could be scheduled to meet 10N or 30R requirements



# OR Activation

- Activation refers to using the resources scheduled for OR to produce energy
- OR may be activated by the IESO in response to
  - A sudden unexpected increase in demand
  - A generation loss or when several generators are unable to follow their dispatch instructions
  - The loss of transmission limiting or eliminating access to available supply
- A resource called for activation must provide energy to the OR amount scheduled for up to 1 hour
  - Within 10-minutes for 10S/10N, and 30-minutes for 30R

# Scheduling of Operating Reserve

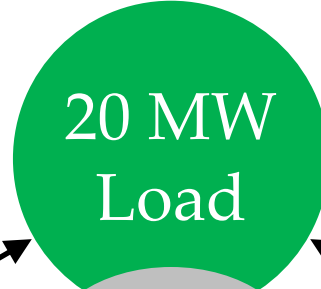
- The market dispatch algorithm ensures that the objectives of meeting energy and OR requirements are achieved at the lowest cost
- Joint optimization/co-optimization of energy and OR is utilized such that energy bids and offers, and OR offers are simultaneously evaluated

# Energy and OR Scheduling

How should the generators be scheduled to meet the 20 MW load and 10 MW of OR?

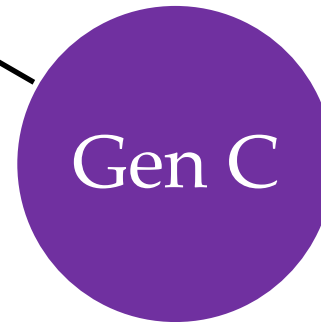
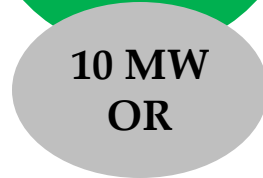
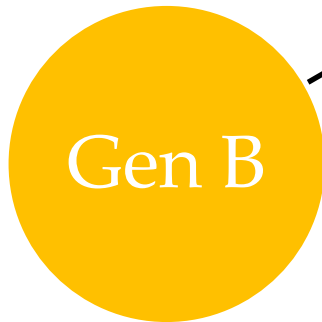


Gen A offers  
Energy: 10 MW @ \$23/MWh  
OR: 10 MW @ \$4/MW



Gen C offers  
Energy: 15 MW @ \$25/MWh  
OR: 15 MW @ \$4/MW

Gen B offers  
Energy: 10 MW @ \$24/MWh  
OR: 10 MW @ \$2/MW



# Scheduling for Cheapest Energy First

**Energy cost:**

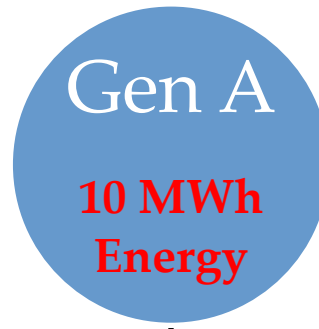
$$10 \times 23 + 10 \times 24 = \$470$$

**OR cost:**

$$10 \times 4 = \$40$$

**Total cost:**

$$\$470 + \$40 = \$510$$



Gen A offers

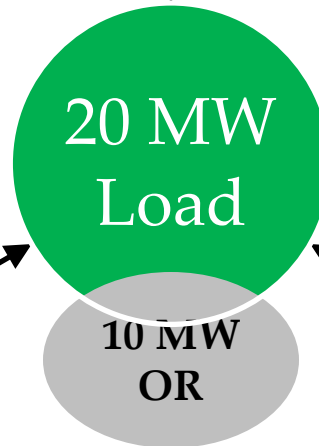
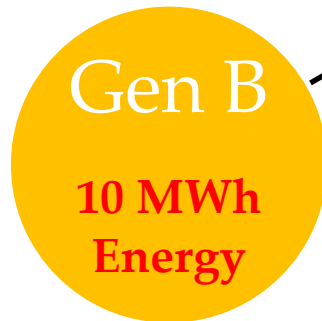
Energy: 10 MW @ \$23/MWh

OR: 10 MW @ \$4/MW

Gen B offers

Energy: 10 MW @ \$24/MWh

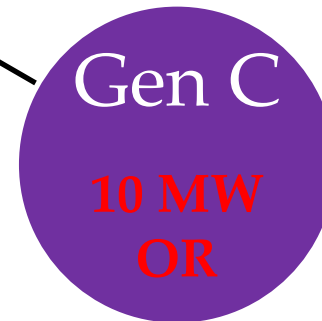
OR: 10 MW @ \$2/MW



Gen C offers

Energy: 15 MW @ \$25/MWh

OR: 15 MW @ \$4/MW



**But this is  
not the  
cheapest  
solution...**

# Co-optimization Math

$$\text{Minimize } \sum_{i \text{ Generator}} \left( \overbrace{\text{Energy } P_i \times \text{Energy } Q_i}^{\text{Energy Cost}} + \overbrace{\text{OR } P_i \times \text{OR } Q_i}^{\text{OR Cost}} \right)$$

subject to

$$\sum_{i \text{ Generator}} (\text{Energy } Q_i) = \text{Demand}$$

Supply to meet demand

$$\sum_{i \text{ Generator}} (\text{OR } Q_i) = \text{OR Requirement}$$

Supply to OR needs

$$\text{Energy } Q_i + \text{OR } Q_i \leq \text{Capacity}_i$$

Energy + OR cannot exceed generator capacity

# Co-optimization of Energy and OR

## Energy cost:

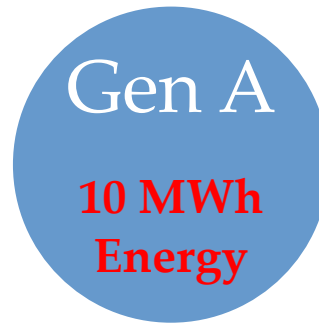
$$10 \times 23 + 10 \times 25 = \$480$$

## OR cost:

$$10 \times 2 = \$20$$

## Total cost:

$$\$470 + \$40 = \$500$$



Gen A offers

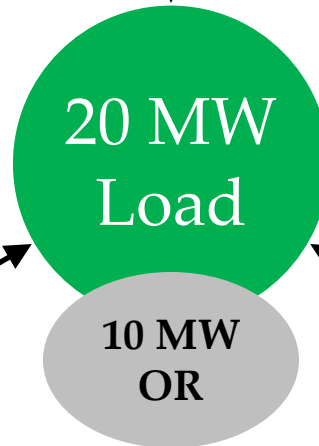
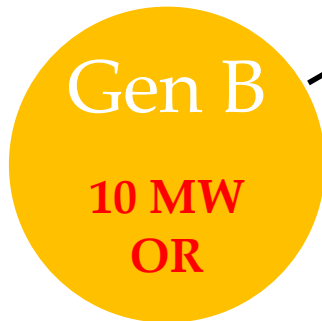
Energy: 10 MW @ \$23/MWh

OR: 10 MW @ \$4/MW

Gen B Offers

Energy: 10 MW @ \$24/MWh

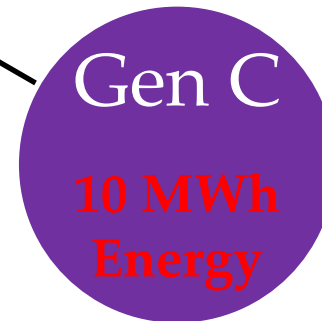
OR: 10 MW @ \$2/MW



Gen C Offers

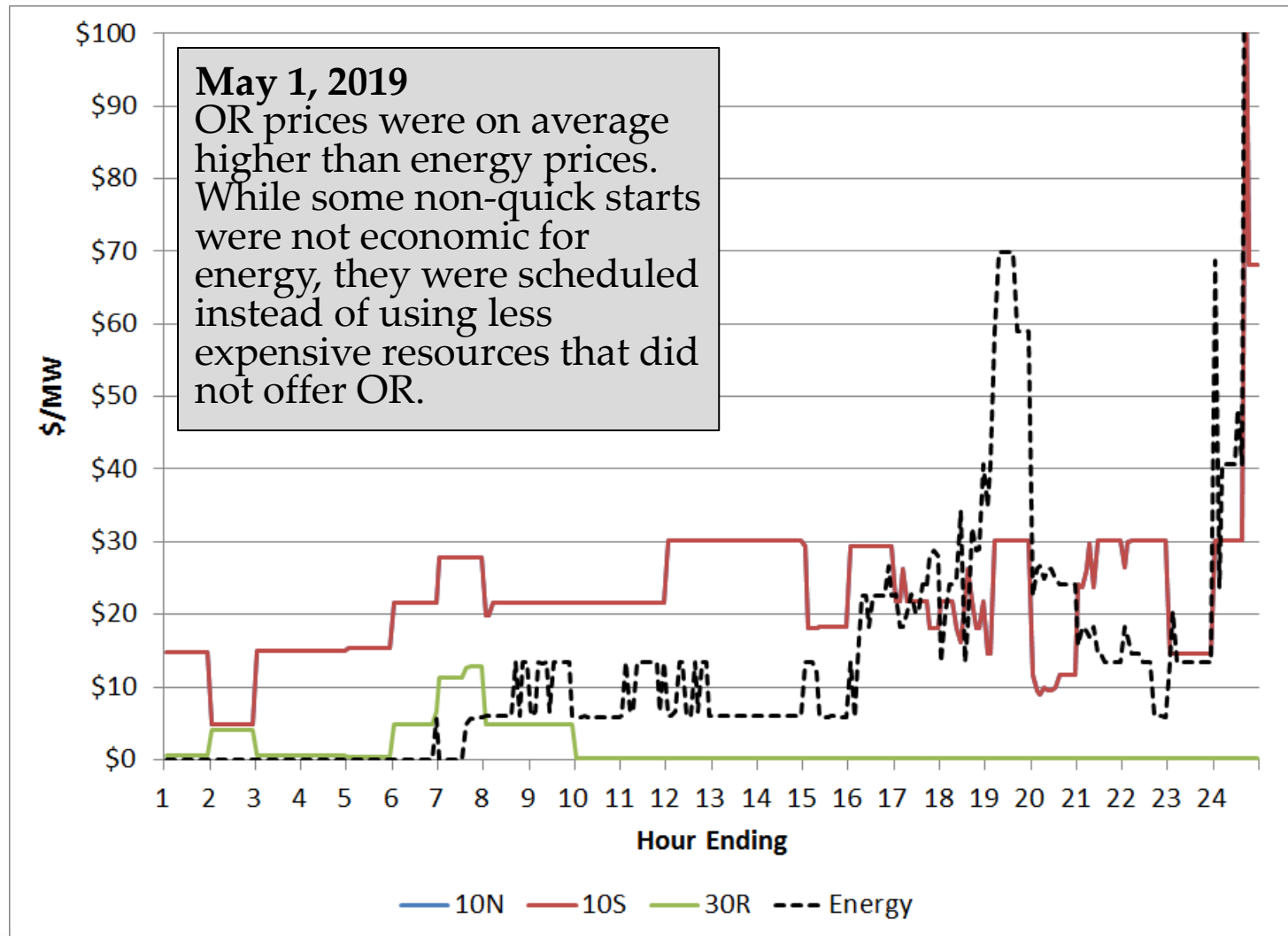
Energy: 15 MW @ \$25/MWh

OR: 15 MW @ \$4/MW



This is the  
cheapest  
solution

# Co-optimization Market Outcome



# OR Shortage

- During periods of high demand and/or tight supply the dispatch algorithm prioritizes to ensure that energy requirements are met first and remaining available capacity may be insufficient to meet OR requirements
- Penalty pricing is used to prioritize meeting energy requirements first



# Penalty Pricing

**+\$6,000 for Energy shortfall**  
**+\$4,000 for OR shortfall**

No Energy or OR shortfall  
No penalty prices apply.  
Total system cost is \$500.

Gen A  
10 MWh Energy

Gen A Offers  
Energy: 10 MW @ \$23/MWh  
OR: 10 MW @ \$4/MW

Gen B Offers  
Energy: 10 MW @ \$24/MWh  
OR: 10 MW @ \$2/MW

Gen B  
10 MW OR

20 MW Load  
10 MW OR

Gen C Offers  
Energy: 15 MW @ \$25/MWh  
OR: 15 MW @ \$4/MW

Gen C  
10 MWh Energy

What happens if the load increases to 30 MW?

# Evaluate Energy Shortfall

Energy shortfall: \$6,000 penalty applies. Total cost is  $\$625 + \$6,000 = \$6,625$ .

**+\$6,000 for Energy shortfall**  
**+\$4,000 for OR shortfall**

Gen A  
10 MWh Energy

Gen A Offers  
Energy: 10 MW @ \$23/MWh  
OR: 10 MW @ \$4/MW

Gen B Offers  
Energy: 10 MW @ \$24/MWh  
OR: 10 MW @ \$2/MW

Gen B  
10 MW OR

30 MW Load  
10 MW OR

Gen C Offers  
Energy: 15 MW @ \$25/MWh  
OR: 15 MW @ \$4/MW

Gen C  
15 MWh Energy

# Evaluate OR Shortfall

**+\$6,000 for Energy shortfall**  
**+\$4,000 for OR shortfall**

**OR shortfall: \$4,000 penalty applies. Total cost is \$735 + \$4,000 = \$4,735.**

**Gen A**  
**10 MWh Energy**

**Gen A Offers**  
Energy: 10 MW @ \$23/MWh  
OR: 10 MW @ \$4/MW

**Gen B Offers**  
Energy: 10 MW @ \$24/MWh  
OR: 10 MW @ \$2/MW

**Gen B**  
**5 MWh Energy**  
**5 MW OR**

**30 MW Load**

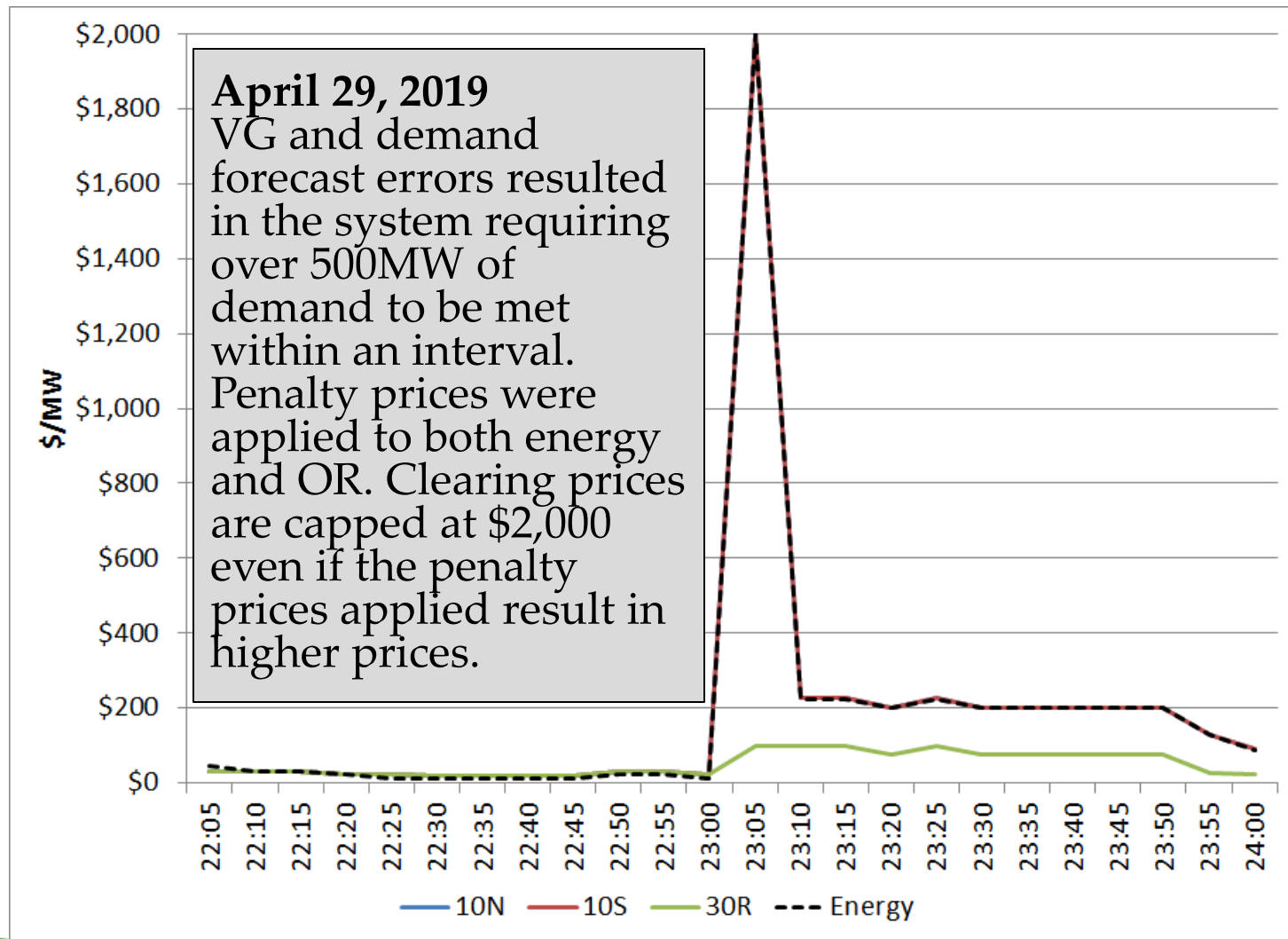
**Gen C Offers**  
Energy: 15 MW @ \$25/MWh  
OR: 15 MW @ \$4/MW

**Gen C**  
**15 MWh Energy**

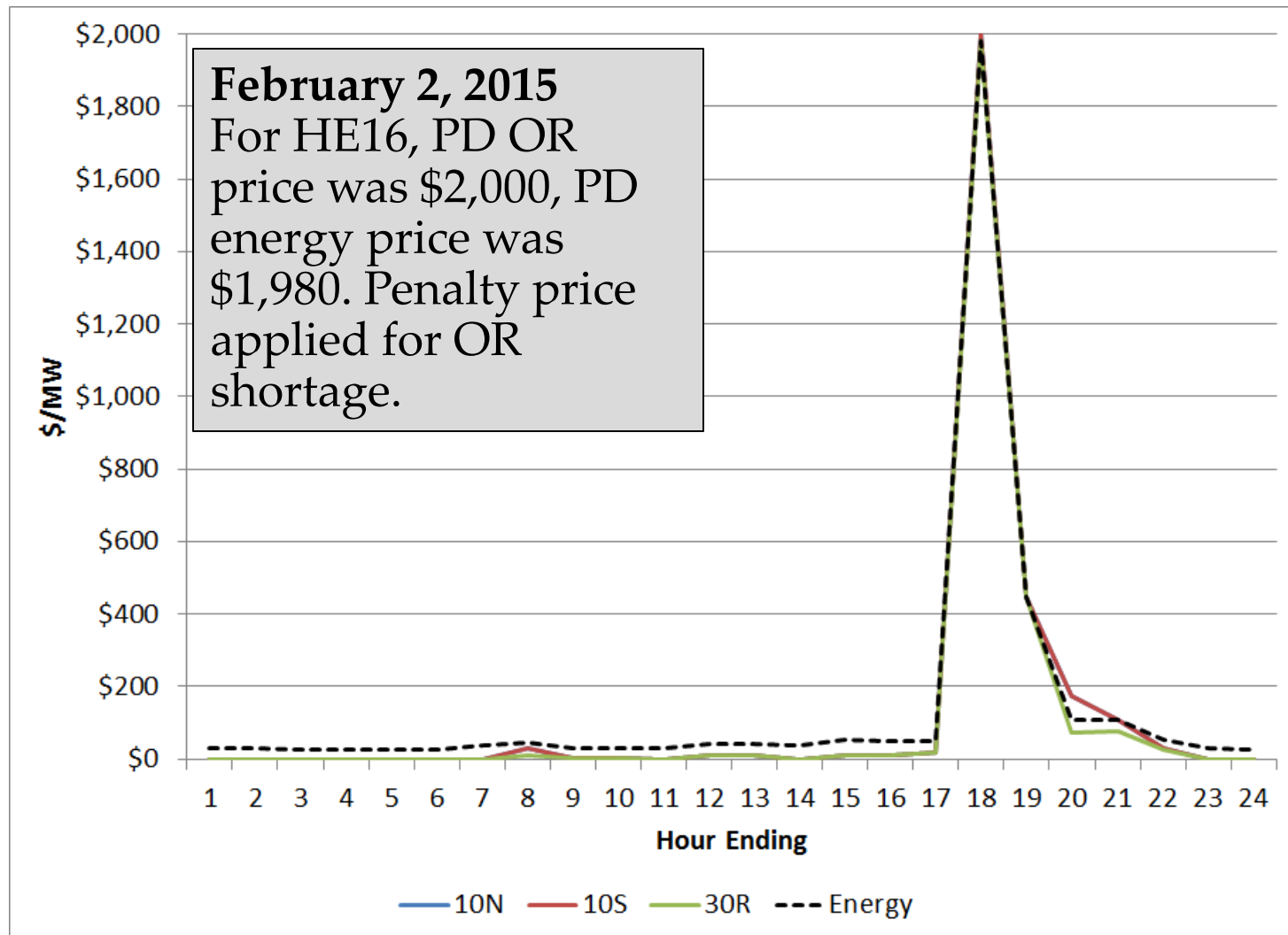
**10 MW OR**

**This is the cheapest solution and also meets demand**

# Shortage Condition in Real-Time



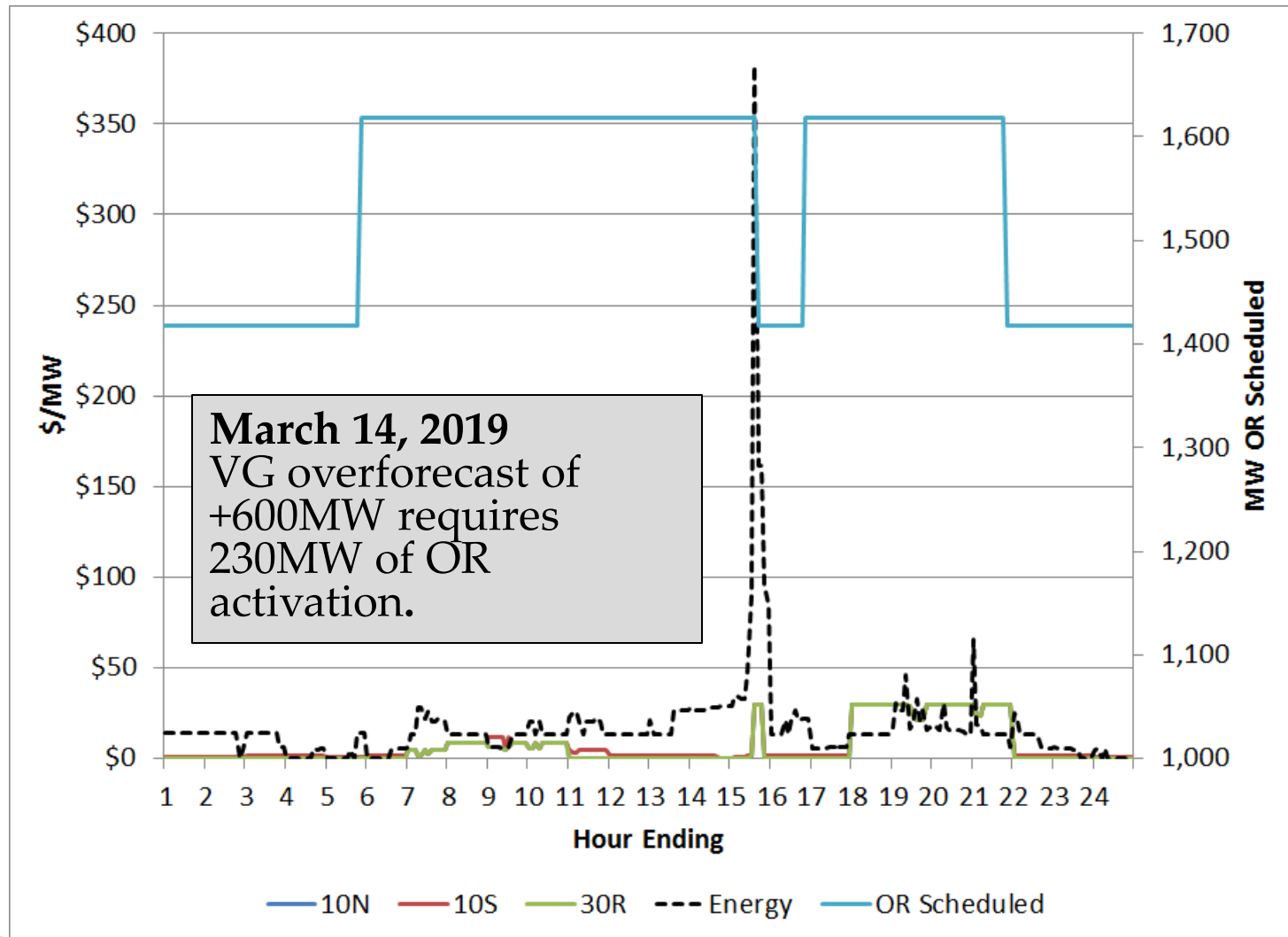
# OR Shortage Condition in Pre-Dispatch



# OR Activation

- When IESO activates OR, resources scheduled for OR are activated based economics and system conditions
- During OR activation, the OR requirement may be decreased by the amount activated
- The reduced OR requirement after activation must be recovered within the timeframes specified by the NPCC

# Activation Example



# MSP Recommendations



# Purpose

- To provide MDAG members with an overview of the Market Surveillance Panel and its role in initiating market development projects

# Who is the Market Surveillance Panel?

- The Market Surveillance Panel (MSP) is a Panel of the Ontario Energy Board (OEB)
- The MSP's mandate is set out in OEB By-law #3:
  - Monitoring activities and behaviour and recommending remedial action
  - Investigating market activities and the behaviour of market participants or the IESO and making recommendations related to the results of its investigations
  - Reporting on the results of its monitoring and investigations

## Panel Members

Glenn Leslie (*Chair*)

Donald Dewees\*

George Pessione

\*Member of MDAG

# How Does the MSP Report on their Findings?

## Monitoring Reports *(semi-annual)*

The MSP report has three sections:

1. A general assessment of the market
2. Specific market outcomes (such as pricing, demand, supply, etc.)
3. An analysis of anomalous market outcomes

## Other Reports *(as needed)*

- Investigation reports (eg possible gaming investigations)
- Reviews of market issues (eg CMSC, ICI program)

- MSP findings can lead to issuing **recommendations**, usually directed to the IESO
- Panel reports are published on the [OEB's website](#); IESO's responses are posted on the OEB site and an annual status update is published on the IESO's [website](#)

# Identifying Market Change Initiatives

- MSP recommendations are one source of market change initiatives
- The IESO must prioritize all possible market change initiatives
- The MDAG will play a key role in helping the IESO evaluate and prioritize potential market change initiatives



# What Does the IESO do with MSP Reports?

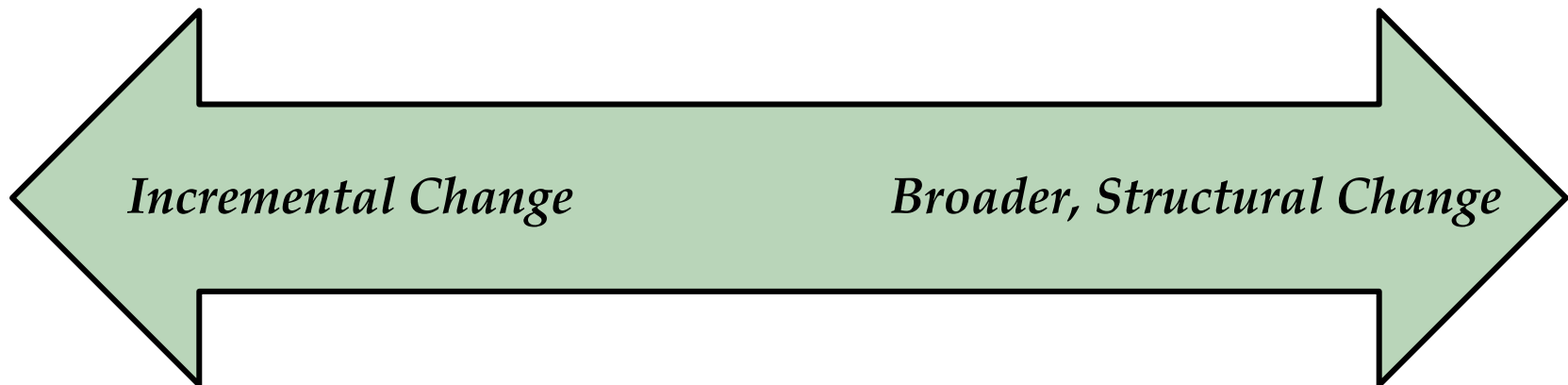
- On each report the IESO carefully reviews the Panel's analysis and recommendations
  - The results of the IESO's review may lead to further study, steps to implement a change, or an explanation why a change is not necessary
- The IESO responds to Panel recommendations and considers implementation based on materiality and other priorities
- In light of Market Renewal, the IESO's response to MSP recommendations considers whether Market Renewal addresses the issue or if any change is aligned with Market Renewal

# Scope of Recommendations

- MSP Recommendations can range from incremental improvements to broader market design reviews

e.g. Variable Gen. Forecast Tool  
or, Const-On Export Price Floor

e.g. GCG program  
or, TR Review



# Recommendation Complexities

- Sometimes a simple fix can be the solution but other times a deeper dive into the issue can reveal additional complexities and linkages
  - For example, setting the replacement bid price for constrained-on export transactions to \$0/MWh for CMSC calculation (*March 2018 report*)
- Factors IESO may take into consideration:
  - Impact on overall market efficiency in short and longer-term
  - Materiality
  - Reliability/Operability impacts
  - Linkages to other initiatives

# MDAG and MSP Recommendations

- The summary provided was intended to give MDAG members a better understanding of how the IESO approaches MSP recommendations
- Market Surveillance Panel recommendations will continue to be a valuable source of market initiatives to be considered by the IESO for future improvement and evolution
- The Market Development Advisory Group will have the opportunity to discuss, evaluate and prioritize future research initiatives and market enhancement projects including those that come from MSP recommendations



# Innovation Roadmap and how it Interfaces with the MDAG Workplan

# Purpose

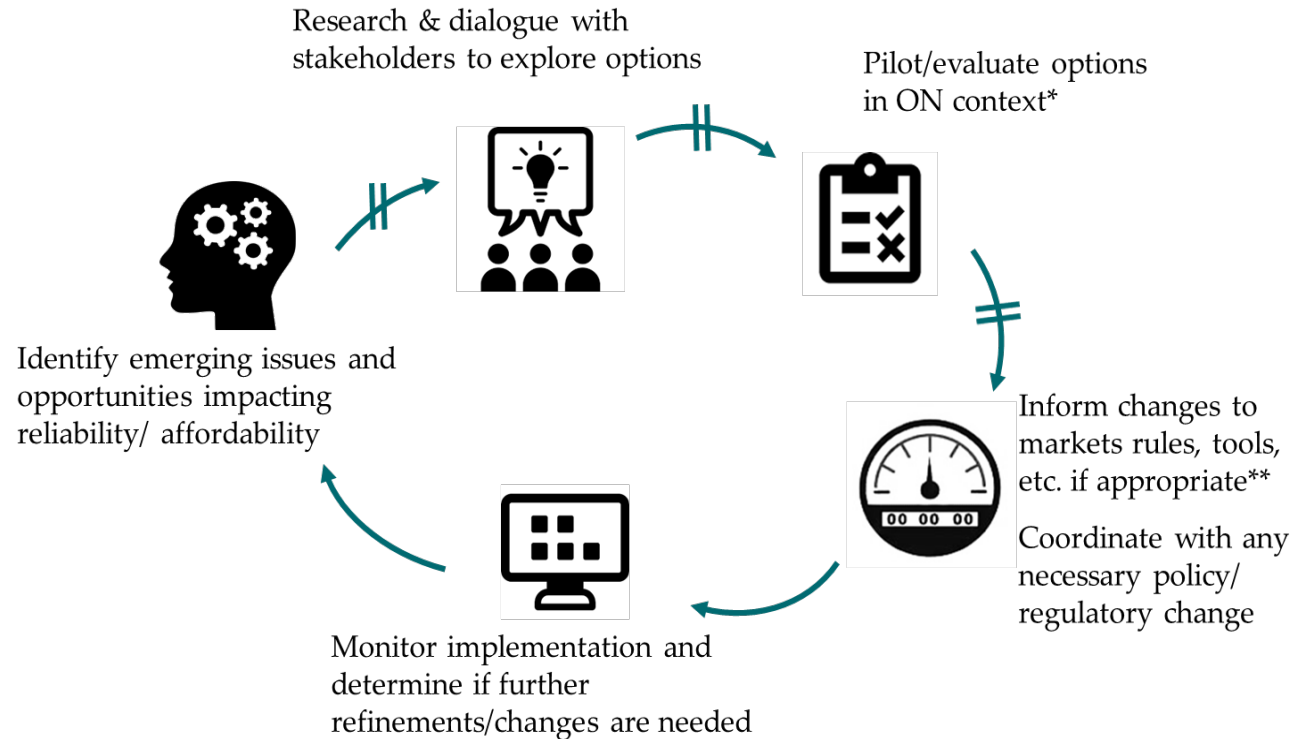
- To provide a brief overview of the Innovation Roadmap and Work Plan activities underway/planned for 2019
- Discuss how activities within the Innovation Roadmap Work Plan will inform the work of MDAG /market evolution and how MDAG members can inform the work set out in the Roadmap

# Background

- In 2018, IESO engaged with stakeholders to develop an Innovation Roadmap and associated Work Plan
- The Roadmap establishes priorities for understanding and preparing for the change, challenge and opportunities facing the IESO and Ontario's electricity sector through 2030 to support a cost-effective and reliable electricity system (see Appendix A for priorities)
- Stakeholders emphasized the need for objective research to better understand a range of challenges and opportunities
- IESO's Innovation Roadmap Work Plan sets out the specific initiatives that IESO will engage in or support
  - The Innovation Roadmap and Work Plan are available here <http://ieso.ca/en/Get-Involved/Innovation/Innovation-Roadmap>

# Overview of Decision Making Framework for Initiatives to Enable Innovation in Support of System Affordability and Reliability

- Decision gates (||): evaluate outcomes/determine whether and how to move forward
- \*Pilot in Ontario context where necessary (e.g. understand ON-specific market, regulatory, policy barriers and test possible solutions)
- \*\*Any proposals for IESO capital projects require a business case that includes a cost-benefit analysis and are weighed against other proposed projects to maximize impact of limited budget on ratepayer outcomes; *MDAG input will inform how priorities are set*



*Opportunities exist for MDAG involvement throughout this cycle*

# Innovation Roadmap and MDAG

- The IESO will bring Innovation Roadmap initiatives to the MDAG for discussion/input when:
  - Initiatives have the potential to materially impact the IESO Administered Markets in the future,
  - Initiatives would benefit from MDAG input, and/or
  - The IESO believes MDAG members would benefit from being informed about planned or ongoing initiatives
- Our objective is to enable MDAG members to inform and be informed by markets related discussions through a single IESO forum
- MDAG will be an important input to how IESO prioritizes implementation of innovative solutions that are found to improve affordability/reliability (e.g. enabling new resources in IESO markets)

# Research and White Papers

## In progress/2019 start



- Research and white papers will create a shared, fact-based understanding of emerging economic, technical, environmental, and social issues likely to impact the electricity sector
- They will provide transparent and objective information to inform policy, planning and investment decisions

	Project Title	Details
1	Evolving consumer preferences, choices and behaviours	<ul style="list-style-type: none"> <li>• Examination of customers attitudes/preferences for reliability, cost, supply mix to understand preferences with regards to future market participation/design and potential pace of consumer uptake of DERs/other technology</li> </ul>
2	Non-wires alternatives (NWA): markets and transmission-distribution interoperability	<ul style="list-style-type: none"> <li>• Explore design options for non-wires alternatives (NWAs) markets and requirements for the transmission-distribution interface to ensure reliable system and local market operations</li> </ul>
3	Distribution sector evolution: structural options [with ETNO]	<ul style="list-style-type: none"> <li>• Examine options for allocation of roles/responsibilities for DER ownership, operations, etc. in a high DER future</li> <li>• Final to be released prior to IESO Summit in June</li> </ul>
4	System cost allocation options: potential impacts on wholesale markets, system operations and innovation	<ul style="list-style-type: none"> <li>• Investigate options for allocating costs incurred through the renewed markets and explore the impact of options on market efficiency/reliability</li> </ul>
5	Conceptual framework for integration of distributed energy resources (DERs) in IESO-administered markets	<ul style="list-style-type: none"> <li>• Explore options for the expanded participation of DERs in the IESO administered markets</li> </ul>

# Demonstration/Evaluation Projects

In progress/2019 start



- Demonstration and evaluation projects will identify and evaluate the potential of new solutions to improve electricity system reliability and cost-effectiveness
- Projects will help develop understanding of market, system, policy, and regulatory barriers and potential solutions to enable new resources to compete in IESO markets

	Project Title	Details
1	Transactive Energy demonstration projects testing methods for generating distribution-level locational marginal price (DLMP) signals to enable economically efficient and reliable integration of DER	<ul style="list-style-type: none"> <li>• With Opus One Solutions, Toronto Hydro, Hydro Ottawa and Lakeland Power, test methods for generating distribution-level locational price signals to enable economically efficient and reliable integration of DERs on the grid</li> </ul>
2	Phase 1 Energy Storage Program: Inform IESO energy storage integration with real-world field research from Phase 1 facilitates	<ul style="list-style-type: none"> <li>• Gain early experience with the registration, commissioning and operation of energy storage facilities</li> </ul>
3	Alternative Technologies for Regulation (ATR) program	<ul style="list-style-type: none"> <li>• Explore the merits of two new wholesale market products that leverage the fast-ramping capabilities of energy storage: fast regulation service and synthetic inertia service</li> </ul>
4	Non-wires alternatives to traditional transmission and distribution assets (IESO York Region NWA Demonstration Project)	<ul style="list-style-type: none"> <li>• Demonstrate an NWA market for DERs, with a focus on the transmission-distribution interface, to provide both system-level and local electricity services in York Region</li> </ul>
5	Models for energy efficiency to compete in IESO-administered markets – targeted call through Grid Innovation Fund	<ul style="list-style-type: none"> <li>• Pilot a transitional auction-based mechanism for procuring EE to inform decisions enabling the resource to compete in the renewed IESO-administered markets</li> </ul>

Thank you for joining us!

Questions?

Next MDAG Meeting: June 27