

OPERATING RESERVE

Presentation to Technical Panel

November 22, 2017

Purpose and Context

To provide the Technical Panel background information on Operating Reserve (OR)

- There are four OR-related initiatives underway or starting in 2018
- These initiatives consider market improvements that can be implemented in the near-term and are compatible with the IESO's Market Renewal Program
- Various Market Rules and Market Manuals may be affected but it is too early to identify the specific impacts

Operating Reserve 101

What is Operating Reserve?

- Operating Reserve (OR) is stand-by power or demand reduction that the IESO can call on with short notice to manage an unexpected mismatch between generation and consumption
- 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 resulting in a more restrictive operating limit that reduces or completely removes access to available supply

Overview of the OR Markets

- The IESO administers three separate OR markets in addition to the energy market
- The three classes of OR are defined by the time required to bring the energy into use
 - 10-minute spinning reserve (10S)
 - 10-minute non-spinning reserve (10N)
 - 30-minute reserve (30R)
- Prices and schedules are determined every five minutes for each reserve class and they are co-optimized with energy
 - Anticipatory prices and schedules are determined in the day-ahead commitment and pre-dispatch processes

OR Requirements

- Regulatory standards set the amount of OR the IESO must schedule and the associated performance requirements
 - Northeast Power Coordinating Council (NPCC) Regional Reliability Reference Directory #5
 - North American Electric Reliability Corporation (NERC) Standard BAL-002
- Minimum OR requirements for Ontario are:
 - 10-minute reserve to cover the largest contingency
 - Typically 900 MW (at least 25% must be 10S)
 - 30-minute reserve to cover $\frac{1}{2}$ of 2nd largest contingency
 - Typically 450 MW

Offering into the OR Market

- Dispatchable loads and dispatchable generators are currently eligible to participate in the OR markets
 - Under certain circumstances, imports may provide non-synchronized reserve
- OR is offered as follows:
 - Price/quantity pair specifying the value and amount of reserve offered for a given hour
 - Ramp rate to specify how quickly the resource output can be moved up or down
- 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

Scheduling of Operating Reserve

- The IESO's dispatch algorithm builds a stack every 5 minutes from lowest to highest price based on the submitted offers/bids for OR markets and the energy market
- Energy bids and offers, and OR offers are simultaneously evaluated to meet electricity demand and OR requirements at lowest total cost (aka joint optimization or co-optimization of energy and OR)
- 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 and Performance Requirements

- When the IESO needs to activate OR, resources scheduled for OR are activated based on their energy bid/offer price from lowest to highest
- When scheduled OR from a resource is activated, it must provide the energy within the time period for the product activated
 - If activated for 10-minute reserve, the resource has 10 minutes to provide the energy
 - If activated for 30-minute reserve, the resource has 30 minutes to provide the energy
- The resource must be able to sustain the supply of operating reserve energy for at least one hour

Operating Reserve Initiatives

Operating Reserve Initiatives

The IESO has launched or will launch a number of engagements that aim to enhance the OR markets

Enabling System
Flexibility

Expanding
Participation in OR

- Address system flexibility needs
- Create opportunities for a wider range of resources

Control Action OR
Phase 1

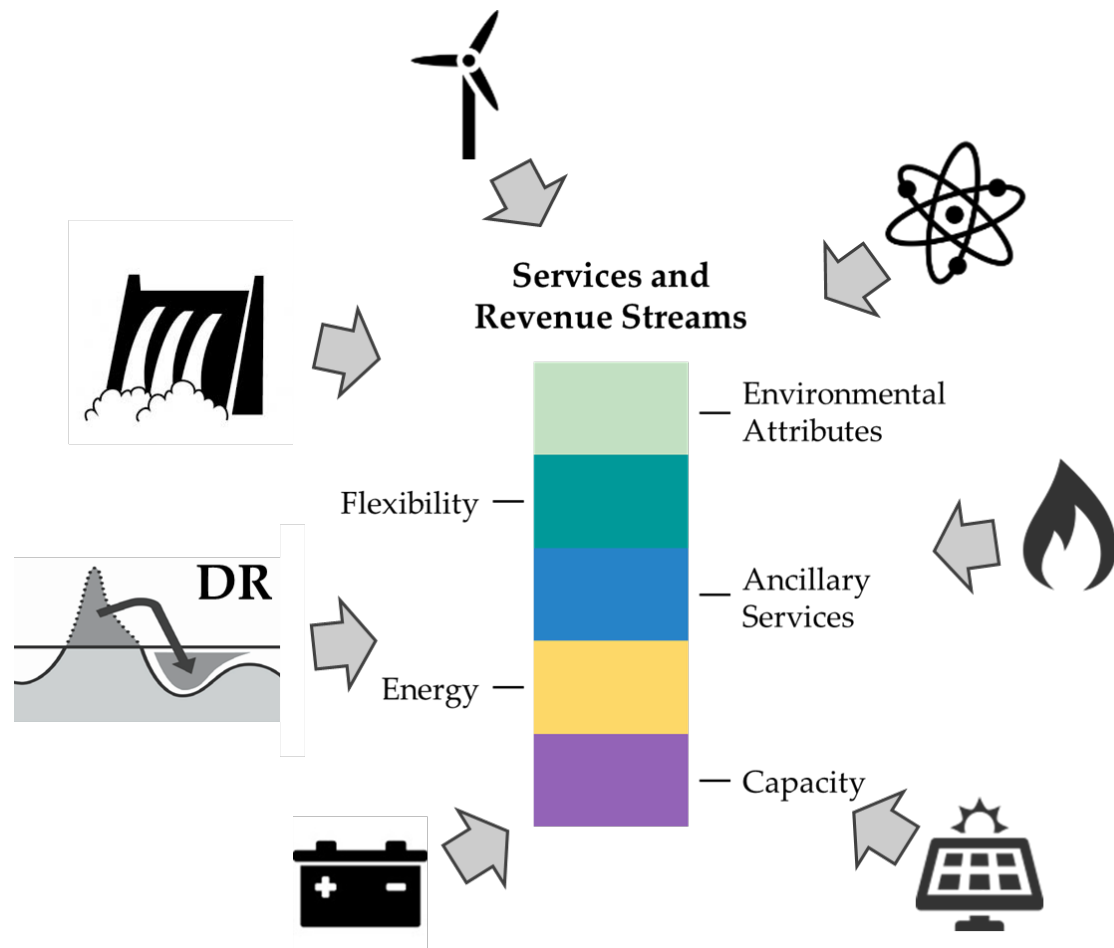
Control Action OR
Phase 2

- Improve operational and market efficiency

Aligned with Market Renewal Program

Alignment with Market Renewal Program

- Transition to a system with clearly defined products for needed services
- Expand opportunities for participation from a wider range of resource types
- Combination of clearly defined products with high participation will improve overall efficiency of the market



Enabling System Flexibility

Background	<ul style="list-style-type: none">• Ontario needs more flexible capability to match the needs of Ontario's evolving supply mix
Objective	<ul style="list-style-type: none">• Determine potential solutions that can enable and achieve flexibility to meet evolving system needs
Status	<ul style="list-style-type: none">• Launched in June 2016 with 5 meetings held to date• IESO initiated the engagement without a proposed solution in mind and sought suggestions from stakeholders• Timing of the need and stakeholder feedback led to proposing an interim solution to increase OR requirements for flexibility• Proposed interim solution enables existing resources to provide required flexibility• An enduring solution to be determined in Market Renewal• Proposed Market Rule and Market Manual changes to be presented at next meeting• Market Rule and Market Manual changes anticipated in Q1/Q2 2018

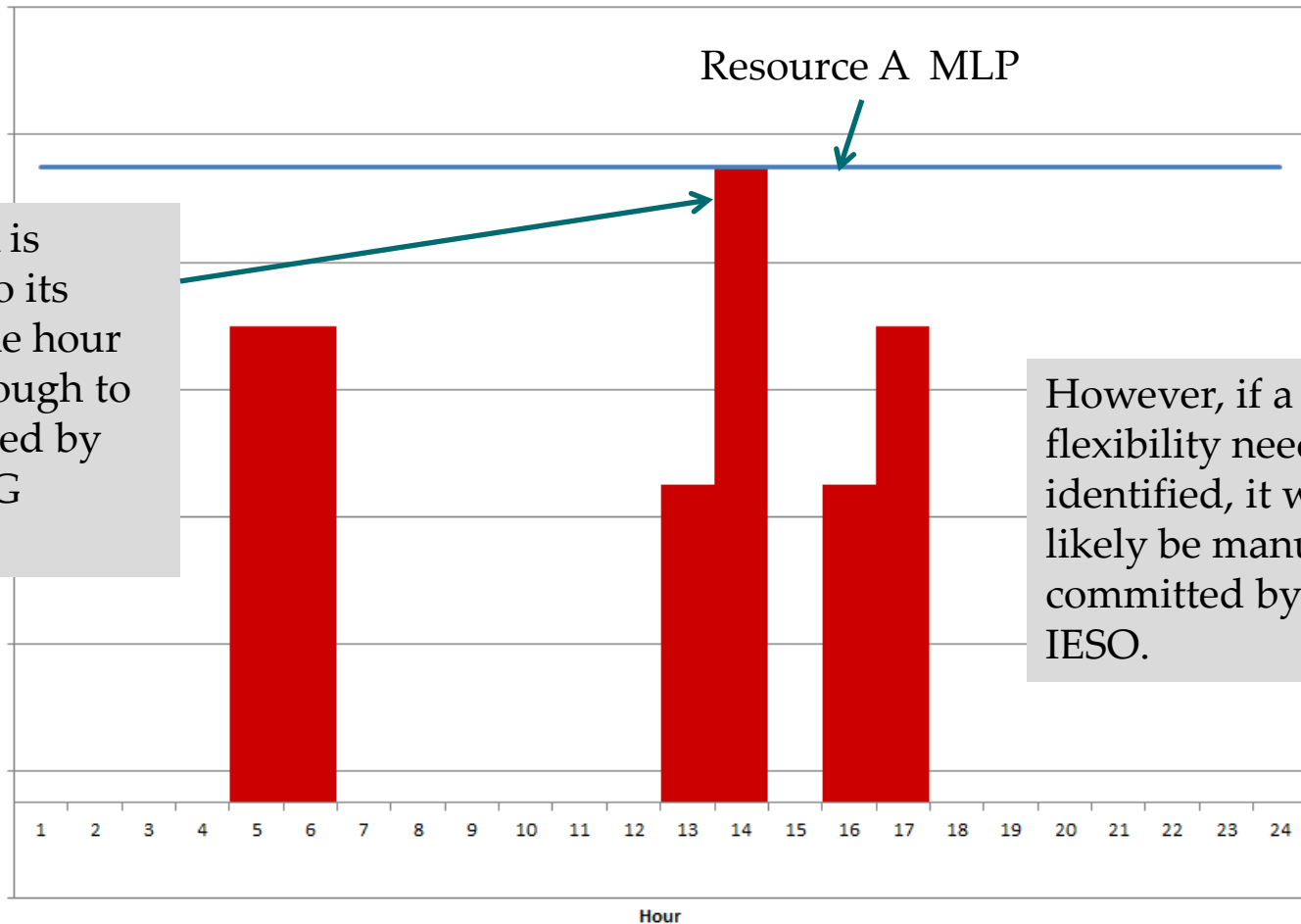
Nature of Flexibility Need

- Flexibility is the capability of the system to respond to intra-hour differences between expected supply/demand levels and actual production/consumption
- Flexibility need is influenced by forecast uncertainty of variable generation and demand
 - Large over-forecasts of variable generation and under-forecasts of demand within hour of dispatch are of concern
- Forecast improves significantly in the 30-minute timeframe
 - Resources already on-line or able to start up and synchronize within 30-minutes can provide flexibility
- Current measures to increase flexibility include:
 - Manually committing/constraining resources
 - Adjusting variable generation and demand forecasts
 - Curtailing exports

Proposed Interim Solution

- Flexibility need represented as additional 30-minute OR can be determined many hours ahead of real-time dispatch
 - Allows resources time to adjust offers to provide flexibility
 - Increases transparency of flexibility need
- Pre-dispatch/day-ahead commitment processes can be used to economically schedule resources to meet additional 30-minute OR requirement for flexibility
 - Leverages current market processes and existing resources for flexibility
- Resource commitments may result to provide flexibility and additional 30-minute OR scheduled can also be activated for flexibility if required

Example: Current Means to Increase Flexibility

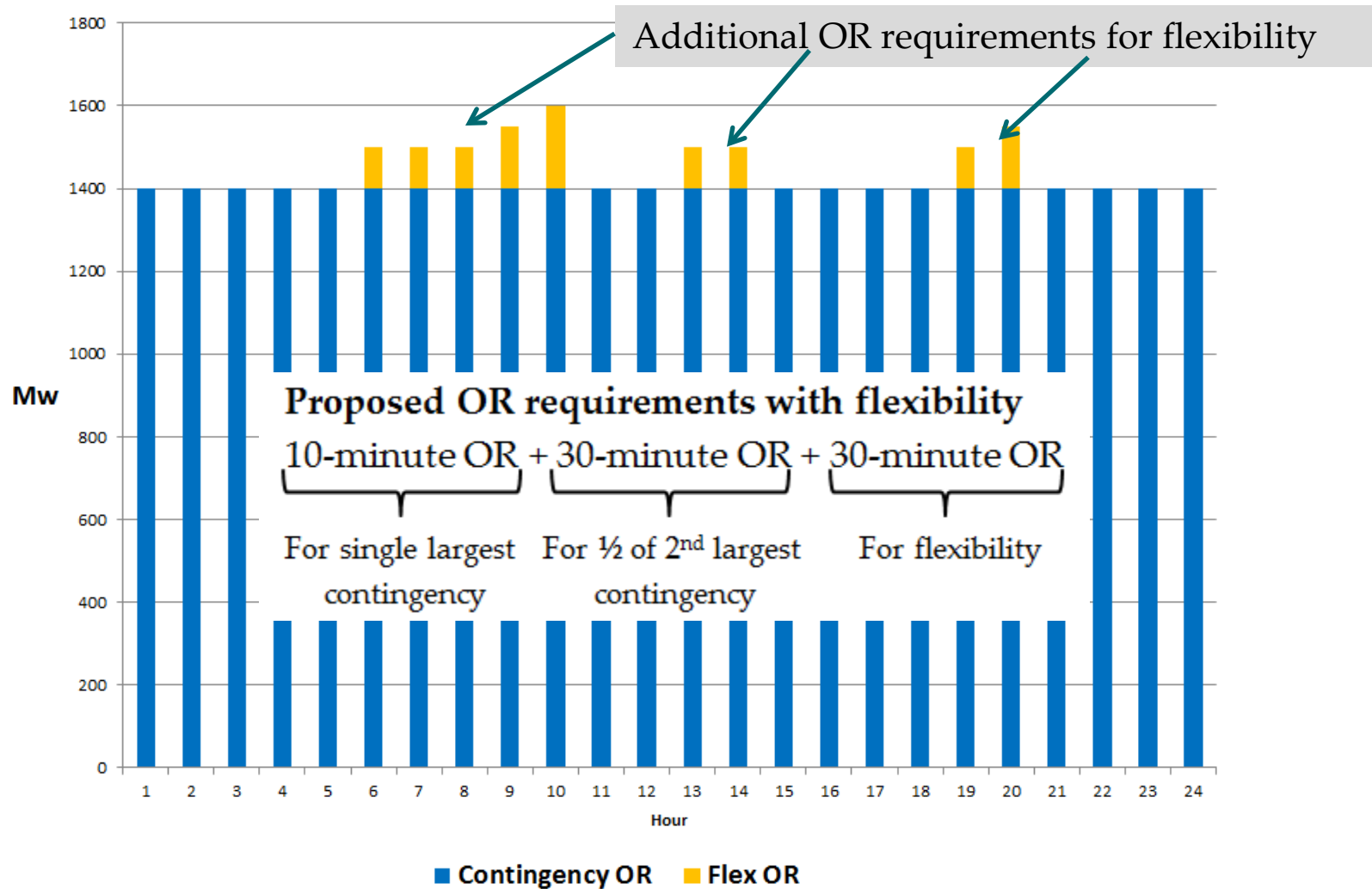


Resource A is economic to its MLP for one hour and not enough to be committed by the RT-GCG program.

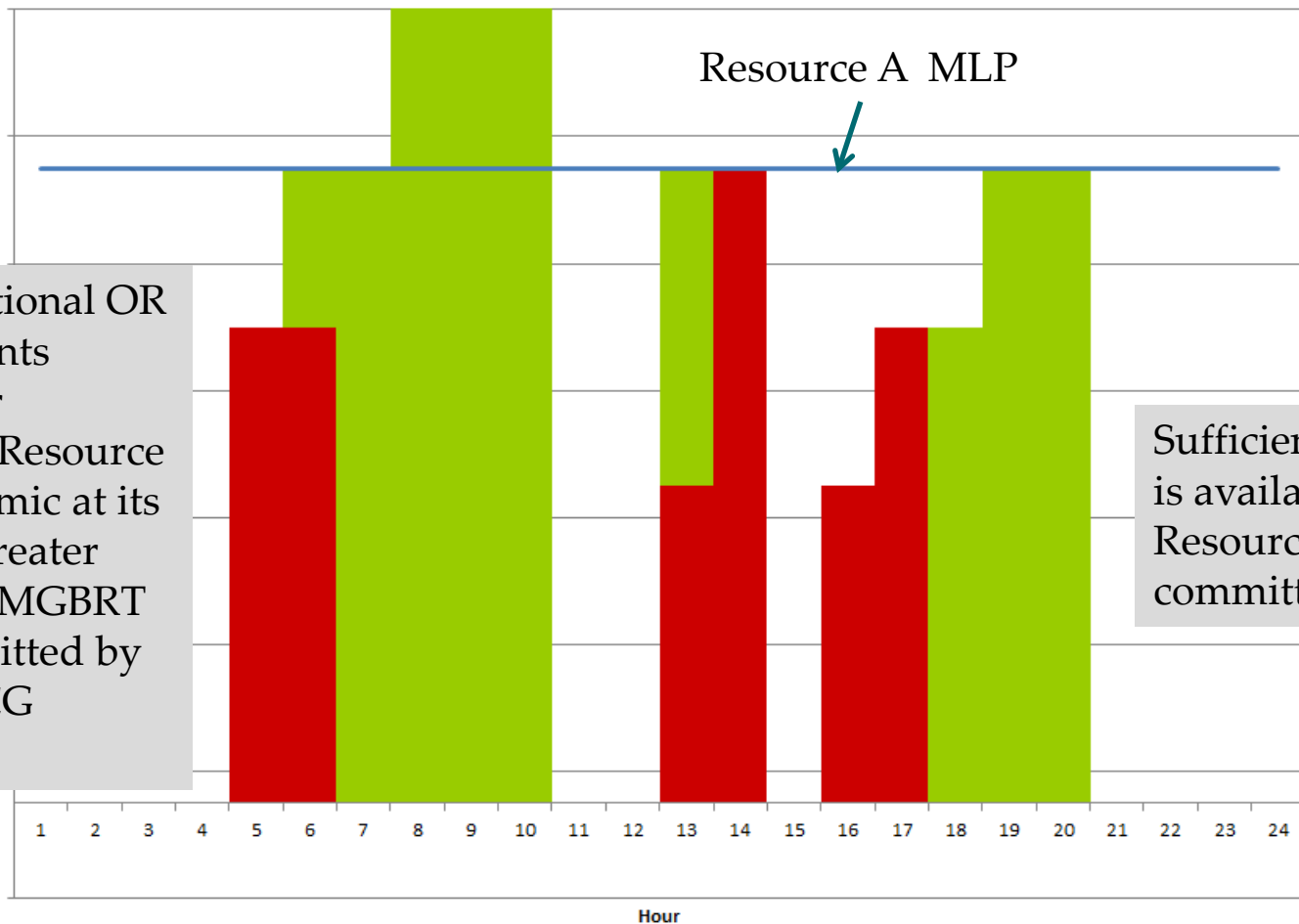
However, if a flexibility need is identified, it would likely be manually committed by the IESO.

■ PD Energy Schedules Status Quo — MLP

Example: Scheduling Extra OR for Flexibility



Example: Resource Commitment for Flexibility



With additional OR requirements needed for flexibility, Resource A is economic at its MLP for greater than ½ its MGBRT and committed by the RT-GCG program.

Sufficient flexibility is available with Resource A committed.

■ PD Energy Schedules with Flex OR ■ PD Energy Schedules Status Quo — MLP

Expanding Participation in OR

Background	<ul style="list-style-type: none">• Currently hydro, gas, dispatchable load, biofuel and imports actively participate in the OR market
Objective	<ul style="list-style-type: none">• The IESO is interested in hearing from stakeholders regarding interest and potential for expanding participation in the OR market from additional resource types
Status	<ul style="list-style-type: none">• First session on November 10th provided background on OR and requested feedback from stakeholders• Initial feedback and analysis to inform on subsequent engagement activities• No Market Rule changes anticipated in the near-term

Control Action Operating Reserve Phase 1

Background	<ul style="list-style-type: none">• Since 2003, the IESO has utilized standing offers in the OR markets to represent two control actions (voltage reduction and forgoing the 30-min OR requirement) that can be used to help meet system needs
Objective	<ul style="list-style-type: none">• Reallocation of CAOR offers quantities to better represent the capabilities of the two control actions in the respective 10 and 30 minute OR markets
Status	<ul style="list-style-type: none">• First session on October 13th discussed the issue and the IESOs recommended solution• Change to CAOR offer quantities to be presented at December 6th Board meeting for approval• No Market Rule changes anticipated

Control Action Operating Reserve Phase 2

Background	<ul style="list-style-type: none">• Subsequent to the changes in Phase 1, an overall review of the CAOR mechanism will be conducted
Objective	<ul style="list-style-type: none">• Review the effectiveness of the CAOR mechanism and identify any further improvements
Status	<ul style="list-style-type: none">• This initiative will launch in 2018

OR Initiatives at the IESO

