JANUARY 21, 2020

Market Development Advisory Group Expanding Participation in Operating Reserve and Energy (EPOR-E)

ieso
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Meeting Participation

- Webcast participation (including audio):
  - Meetview link
  - Use the chat function to ask a question
- Teleconference participation (audio only):
  - Local (+1) 416 764 8640; Toll Free (+1) 888 239 2037
  - Press *1 to alert the operator that you have a question;
  - Press *0 for any other operator assistance
- There will be pauses throughout to ask questions; when asking a question, state your name and who you represent
- The activities of the MDAG are guided by the IESO Engagement Principles

Purpose

- Discuss scope of work for EPOR-E
- Discuss markets requirements and discuss gaps and considerations in meeting requirements for certain technologies
- Outline next steps

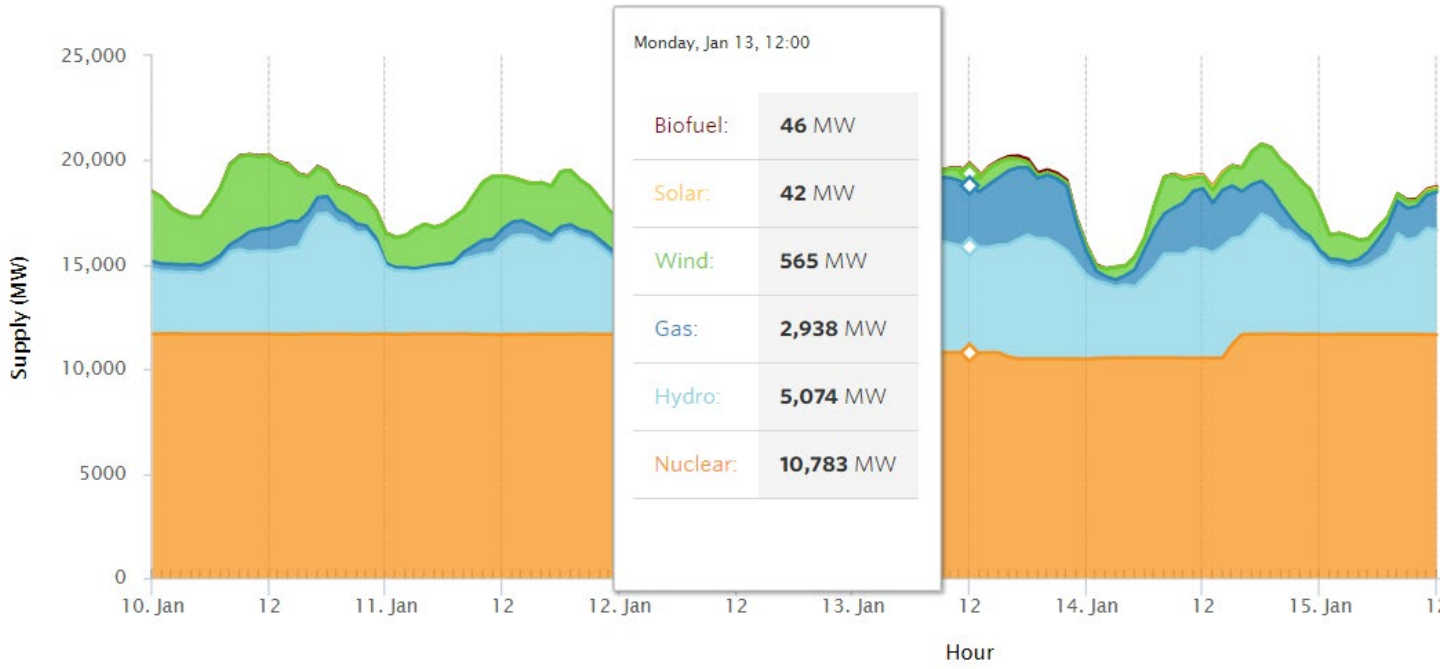
Context: Energy and Operating Reserve Market Overview

Energy Market Overview

- The IESO is constantly matching supply with demand
- There is a large amount of supply required to meet demand over the course of the day, which can and must be met by a large pool of resources types
- Due to the large amount of supply needed, the use of fairly certain forecasts in the IESO's scheduling process allows the IESO to optimize resources over the course of a day, finding opportunities to where they best fit and have the greatest efficiency in the market. This allows the variety of resources to participate, which include dispatchable, self-scheduling, and intermittent

Energy Market Overview (cont'd)

- OR being a short-term reliability product requires that only dispatchable facilities participate



OR Market

- IESO is required to carry OR to manage contingencies and ensure reliability of the interconnected system
  - OR is a reliability product that gets activated for unexpected contingencies
- There are three classes of OR, each defined by the time required to deliver energy when activated:
  - 10 minute spinning reserve (10S)
  - 10 minute non-spinning reserve (10N)
  - 30 minute reserve (30R)
- IESO is leveraging its 30R to manage uncertainty from variable generators by acquiring a higher than required reserve level

OR Requirements

- North American reliability standards determine the minimum amount of operating reserve capacity that Ontario is required to schedule, as well as minimum performance requirements
  - Northeast Power Coordinating Council (NPCC) Regional Reliability Reference Directory #5
  - North American Reliability Corporation (NERC) Standard BAL-002
- Minimum OR requirements for Ontario are:
  - **10 minute reserve** to cover **largest contingency**
    - Typically 900 MW
    - At least 25% of this must be synchronized to the grid (10S)
  - **30 minute reserve** to cover **½ of second largest contingency loss**
    - Typically 450 MW

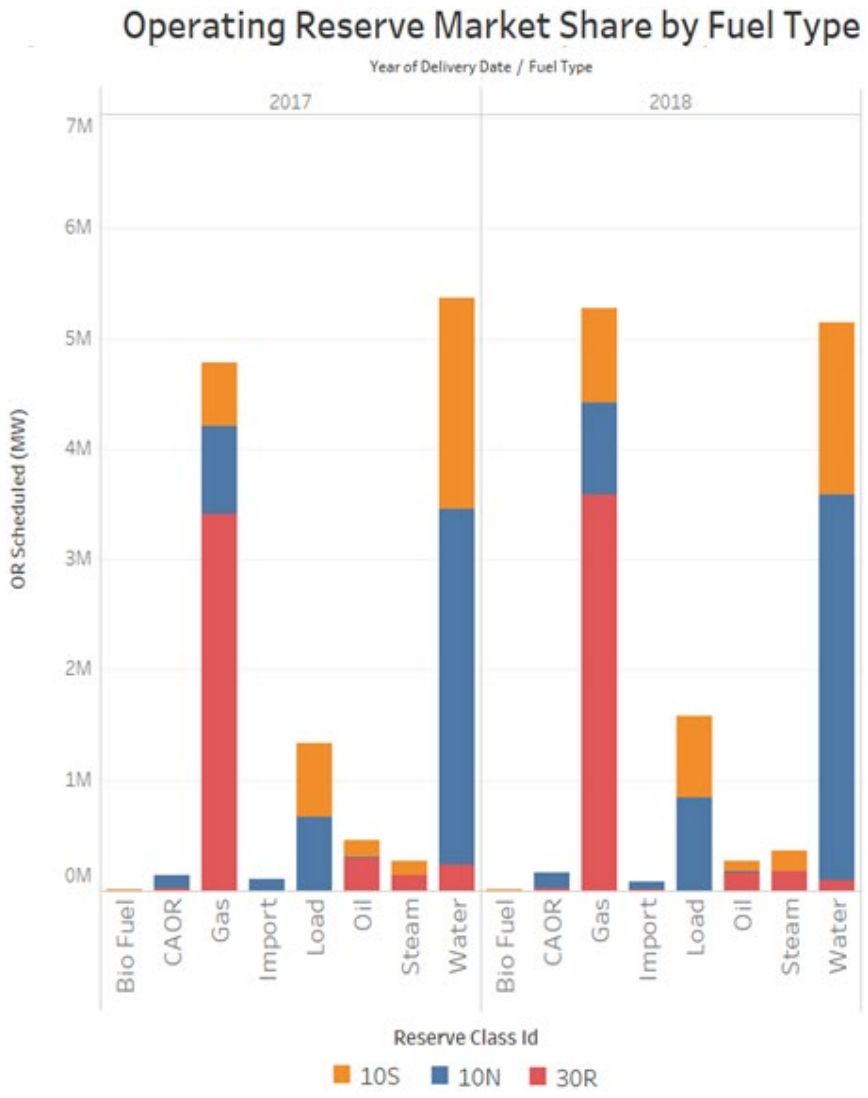
Overview of the OR Market

- Doe to the important nature of this product, OR resources have to be dispatchable and provide the IESO with certainty that Due to the important nature of this the product can be delivered
  - Operational Certainty – the IESO can depend on the resource to be able to provide the activated OR when and as long as required
  - Delivery certainty – the IESO has to have visibility and clarity on where the electricity will be delivered to ensure it is useful to assist with the contingency
- As technologies evolve, it is important the IESO considers its requirements and examines if other technologies can also provide OR

Note: CAOR – Control Action Operating Reserve

Overview of the OR Market (cont'd)

- Since OR resources may have to deliver energy at specific levels, the resources have to be primarily dispatchable and have to submit energy offers/bids
  - This allows the IESO to co-optimize the three OR products and energy to ensure it can meet reliability as cost-effectively as possible



Requirements to Participate in Energy

Requirements:

- Submit energy bids or offers into the DACP (Day-Ahead Commitment Process)
  - DACP submissions are required to meet the resource Availability Declaration Envelope requirements
  - DACP submissions can only be made between 6:00 a.m. to 10:00 a.m. day-ahead
  - Bids and offers must include – Day, Hour, Price-quantity pairs, ramp rates, resource ID
- Follow dispatch instructions
  - Dispatch compliance – meet energy schedules from the IESO

Non-compliance with requirements:

- The IESO enforces compliance with market rules by applying sanctions if and when appropriate
- These sanctions include and are not limited to suspension and financial penalties

Requirements to Participate in OR

Requirements:

- Submit OR offers in the DACP
  - OR offers must be for an amount equal to or less than a resource's energy bid/offer
- Resources have to:
  - Be dispatchable or a boundary entity
  - Be able to provide the energy within the time frame specified by the class of operating reserve involved (either 10 minutes or 30 minutes), as per the NPCC (Northeast Power Coordinating Council) requirements
  - Be able to sustain injection or withdrawal of energy for up to one hour, as per the NPCC requirements
- Depending on resource type, more specific requirements may apply
  - For example, dispatchable load participants must have a predictable consumption cycle and must meet additional eligibility criteria

Requirements to Participate in OR (cont'd)

Non-compliance with requirements:

- The IESO has the ability to enforce compliance actions if a resource does not meet its dispatch target when activated for OR
  - The enforcement actions include directing a resource to remove its reserve offers from the market for a period of two days to indefinitely (depending on the frequency of the failures) and re-testing the resource

EPOR-E Scope of Work

Recap

- As part of the 2020 Work Plan, the MDAG is undertaking a scoping and assessment exercise to identify potential market development projects that expand participation in Operating Reserve and Energy (EPOR-E)
- The focus of this work is on existing market participants and identifying high-value market enhancements that can be made in the short term
  - EPOR-E is leveraging the information coming from the storage project and the DER Whitepapers to also examine the potential of emerging resources (storage, hybrids, DERs) to provide OR

Recap (cont'd)

- Market change projects identified through EPOR-E will be prioritized together with the MDAG and then included on the 2021 Work Plan
  - These market change projects will thereafter be submitted into the IESO's wider project assessment process to ensure project is appropriately resourced and prioritized with other corporate initiatives
- Member input was received into the EPOR-E scope of work (SoW) in Q4, 2019 and the final SoW will be published in February

Process

- EPOR-E will be developed in collaboration with MDAG members and other interested stakeholders to complete the research required
  - Internally, a cross-functional project team is being assembled to leverage expertise from other business units that will also ensure alignment with other work
  - Externally, we will work in close collaboration and seek regular touch-points with stakeholders throughout the development of the project
- We are looking for stakeholders to participate, provide feedback on materials and also proactively provide input on:
  - Technical capabilities
  - Commercial considerations
  - Experience from other jurisdictions

Process (cont'd)

- The IESO is open to supplementing public stakeholder meetings with individual meetings with interested parties
- MDAG's role will be to ensure market principles are adhered to and that the projects are aligned with the future markets vision

Resource Types to be Explored in EPOR-E

- Based on feedback from stakeholders, EPOR-E will look at opportunities to expand participation across the following technologies:

Resource Type	Description
Variable Generators	Solar and Wind
Demand response (DR)	Physical and Virtual loads
"Not-so-quick-starts" (NSQS)	Units that have shared characteristics with a quick start and a non-quick start unit, but have no defined resources model with the IESO market
Distributed Energy Resources (DER)	Items to be considered are aggregated generators and virtual DR –Taking IESO's DER whitepapers into consideration, EPOR-E will explore potential DER market participants
Storage	EPOR-E will liaise with the IESO's Storage Design Project (SDP) and ensure alignment of SDP and EPOR-E
Hybrids	These may include a current generator or a load that wants to utilize behind-the-meter storage in energy or OR

Project Phases

- The IESO expects to leverage information assembled in other initiatives for this project and assess the relevance for this initiative
- EPOR-E will be conducted in three distinct phases:

Phase	Description
Requirements and participation	Identify requirements, provide detailed information (i.e. market rules, tools, and manuals and processes) and assess barriers
Development of options	Development of options for addressing the barriers and thereby expanding the participation of resources in OR and Energy
Assessment of options	Options will be assessed for viability and then prioritized together with the MDAG members.

Timeline

- The expected timeline for the different phases is as follows:

	Q4, 2019	Q1, 2020	Q2	Q3	Q4
Phase 1	**Requirements and Participation**				
Phase 2		**Development of options (potential projects)**			
Phase 3				**Assessment of options**	
MDAG meetings		IESO to present overview of requirements and potential barriers & seek member feedback	Discuss potential options to addressing key barriers	Finalize options and receive further member feedback	IESO and MDAG members to prioritize projects for 2021 Work Plan

Requirements and Barriers Framing

Requirements and Barriers

- EPOR-E will examine the current requirements and assess if any of these are barriers to participation, where IESO will leverage work from other forums and initiatives on barriers to participation
  - It is important to come to a common understanding on how resource types participate in the energy and OR markets, and understanding the opportunities for both the IESO and participants

Participants	EPOR-E	Market Development Projects
The IESO will do a deeper dive on the participant barriers to ensure solutions can be assessed in sufficient detail. Participants include NERSC, ESAG, DRWG and DER Whitepaper.	The IESO will look at the requirements , working with MDAG stakeholders to ensure that barriers are correctly identified and solutions are reflective of the technical and commercial considerations while ensuring market efficiency	EPOR-E will identify actual market development projects. The IESO will work with MDAG to transparently assess the priority of the projects for implementation starting in 2021

Requirements

- Due to the importance of OR to ensure reliability for the interconnected system, stringent requirements are fundamental and require the oversight of NERC and NPCC
- Under EPOR-E, the IESO will assess these requirements, as well as the energy requirements, and how they flow through the market rules, manuals, tools and processes
  - IESO will focus on the requirements that it has control over but does not preclude a discussion on requirements that are set by third parties
- These requirements will then be examined to see whether they can be met in a different way that would increase market competition and liquidity
- Potential changes need to still need reliability requirements that the IESO has and also deliver enhanced market efficiency

NPCC - Northeast Power Coordinating Council
NERC - North American Reliability Corporation

Requirements and Barriers to Participation Categorization

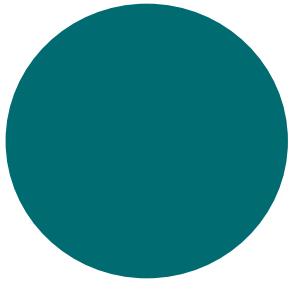
- The IESO will examine requirements and barriers under various categories

Category	Requirements
Technical Capability	What are the technical capabilities of the various resources
Regulatory	Linkages to the regulatory standards imposed by external parties (i.e. Ontario Energy Board)
Market Entry	Market participation requirements
Contacts	Linkages with IESO contracts
Operations	Operational requirements
Settlements	Settlement requirements

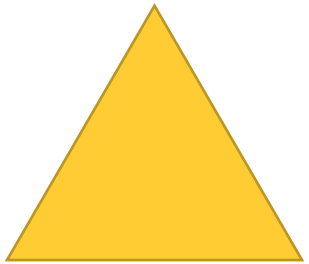
Considerations and Participation

Participation in Energy and Operating Reserve

Each shape will represent a specific resource type.



The teal circle represents the specific resource type is able to participate and additional opportunities may exist



The yellow triangle represents the specific resource type can participate with some limitations

The purple square specific resource type cannot participate

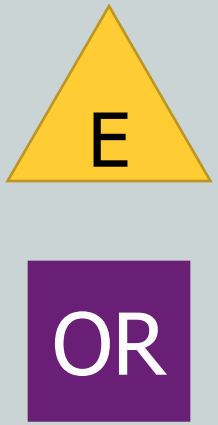
Technology Considerations – Current Participants (Solar and Wind)

The table below and the following 4 slides provide a high level overview of considerations that need to be addressed as part of this review.

Technology Type	Considerations
Solar and Wind 	Variable Generators (VG) are currently able to participate in the energy market as a dispatchable resources, but are not able to participate in OR. Some of the considerations the IESO will need to explore to see if they are able to provide OR include: • Without significant changes to improve operational certainty, the intermittent nature of facilities means that they are unlikely to be able to sustain output or meet timing requirements of OR (10 or 30 minutes) • Dispatchability of VG resources provides a potential opportunity to examine whether curtailed wind could provide OR Other considerations: Lack of financial incentive – PPAs

Technology Considerations – Current Participants (HDR)

Technology Type	Considerations

Hourly Demand Response (HDR)
 
	• They participate in the energy market for dispatch but are not settled in the energy market. Receiving only the capacity auction payments as revenue. These resources are typically activated in 4 hour blocks, where the IESO gives them a standby, and activation notice before dispatching.
	• HDR resources have limited certainty in operation and delivery limiting their ability to provide energy and meeting OR requirements. The considerations that will need to be explored include:
	  • The IESO does not have telemetry on HDR, limiting the IESO's ability to see if they are available and if they are providing their service
	  • Aggregated resources are modeled at a zonal level node, actual contributors might be at a different location than required
	  • HDR resources are currently activated 2.5 hours in advance, and we require OR within a 10 or 30 minute timeframe

Technology Considerations – Current Participants (NSQs)

Technology Type	Considerations
"Not-so-quick-start" (NSQS) E OR	NSQS resources are technically capable to provide energy and OR as a dispatchable resource. The IESO will explore ways to further leverage these resources for the provision of the three operating reserve products.

Technology Considerations – Emerging Technologies

Technology Type	Considerations
Storage 	Storage resources are currently able to participate in the energy market, with limitations, but cannot currently provide OR. The IESO is exploring these considerations and limitations for participation in IESO markets through the Energy Storage Advisory Group (ESAG). EPOR-E will monitor progress on ESAG and identify if additional opportunities should be pursued.
Distributed Energy Resources (DER) 	Certain DERs types are able to participate in IESO markets. The IESO is exploring DER issues in a series of whitepapers. EPOR-E will monitor progress with the DER whitepapers and identify if additional opportunities should be pursued.

Technology Considerations –Non-market Participants

Technology Type	Energy and Operating Reserves
Hybrid 	Currently, Hybrids do not participate in the market. The IESO will be exploring this resource through EPOR-E to properly define, verify the considerations and if the IESO should enable their participation in the market.

Next Steps

- The IESO will post the Scope of Work (SOW) in February
- At the March MDAG meeting (date to be confirmed) the IESO will discuss updates on requirements and barrier identification and assessment
- With EPOR-E being a collaborative project the IESO will be accepting stakeholder feedback throughout the course of the initiative
- Please reach out engagement@ieso.ca if you would like to set up a 1-on-1 meeting to discuss considerations

Appendix – Additional Resources

- Operating Reserve:
  - *Background on Operating Reserve, MDAG presentation from May 30th, 2019 slides 4 - 22*
  - *The market manuals*