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Pathways to Decarbonization – Operability Assessment

Monique Chugh, Senior Advisor, Reliability Assurance

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Agenda

- The Fundamentals of Reliability
- Operability
- Focus Areas for Pathways Operability Assessment

Purpose of Engagement

- To inform stakeholders of the IESO's approach to its Operability Assessment as part of the Pathways to Decarbonization Study
- To discuss key areas of interest among stakeholders in how Operability and Reliability are essential to developing pathways to achieve decarbonization of Ontario's electricity system

Background

- The IESO periodically produces Operability Assessments to evaluate how real-time operations will be impacted by the changing technologies and resources within Ontario's power system - The resource mix is a fundamental component to assessing operability
- With the Pathways to Decarbonization study, the IESO will verify that pathways meet the capacity and energy needs of the system, while providing the characteristics necessary to reliably operate the electricity system
- Potential decarbonization pathways may mean that the operational characteristics of the new resource mix are quite different from today's portfolio of resources

The Fundamentals of Reliability

The Fundamentals of Reliability

Reliability is the ability to deliver the right amount of electricity when and where it is needed, while accounting for a number of risks

The IESO ensures reliability across multiple time frames:

- Long-term - 20 years out;
- Near-term - Weeks and days ahead; and
- Real-time - On a minute-to-minute basis each day

The Fundamentals of Reliability (2)

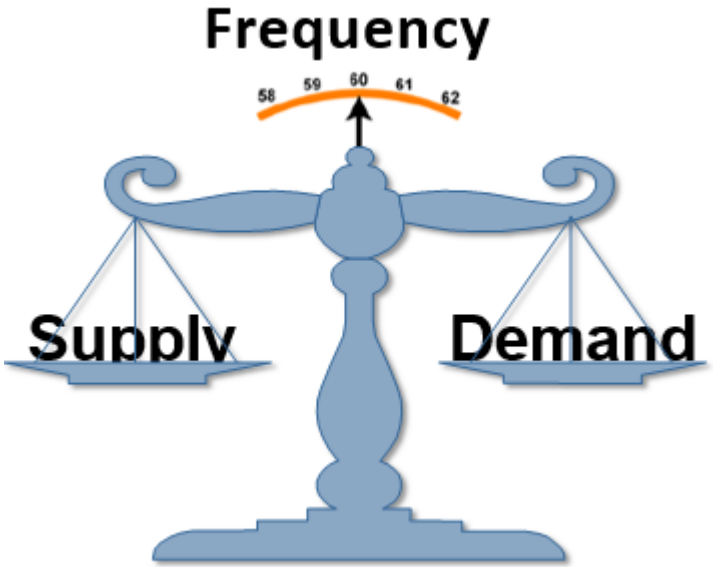
To ensure reliability, the IESO:

- Forecasts supply and demand, plans for future system needs, secures supply resources, procures various electricity services to support reliability, and recommends the development of transmission infrastructure
- Anticipates, prepares for, and responds to, unexpected events or emergencies on the system

- As more sectors electrify and reliance on the electricity system increases, ensuring reliability will become even more important

The Fundamentals of Reliability (3)

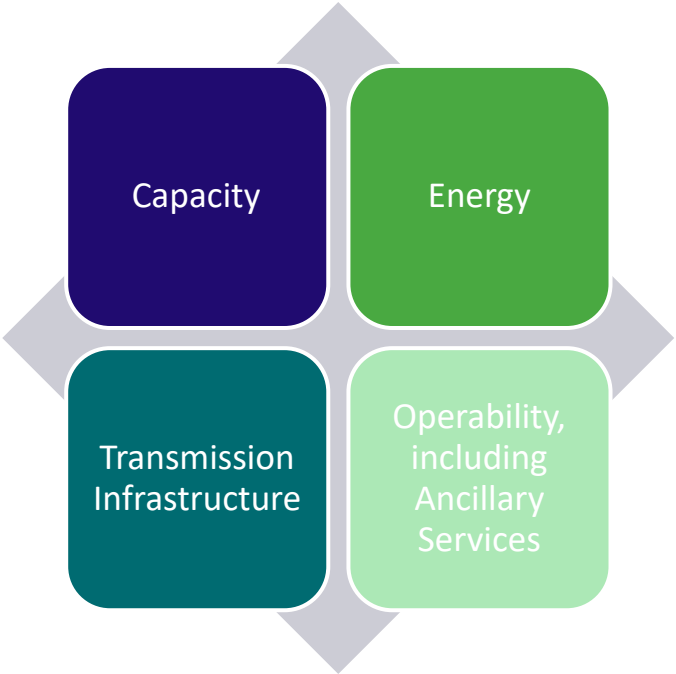
- Since electricity cannot easily be stored, the IESO must balance supply and demand every second of the day
- As Ontario's electricity system evolves and becomes more complex, the challenges of maintaining a reliable system increase



Elements of a Reliable Electricity System

A reliable system must possess adequate:

- **Capacity,** to meet peak electricity demand at any moment in time
- **Energy,** to supply electricity demand over a period of time
- **Transmission Infrastructure,** to deliver electricity from generators along high-voltage power lines to load centres
- **Operability,** to be able to manage a variety of real-time conditions
- **Ancillary Services,** critical to reliable grid operation, including frequency regulation and voltage control



Operability

What is Operability?

Operability refers to the IESO's ability to manage a variety of conditions on the power system that are anticipated, or as they occur in real-time

It is important that the IESO assesses operability in advance of real-time, to prepare our control room operators for the expected and unexpected, such as:

- Variability of supply
- Fluctuations in load
- Availability of transmission
- Changes in the amount of imports

The IESO continuously assesses and plans for different scenarios in order to have confidence that all conditions can be managed reliably

How Operability is Achieved

Operability is achieved by having a diverse resource mix with a range of operating characteristics, including the ability to:

- Respond to five-minute dispatch instructions
- Change power output to follow hour-to-hour changes in demand
- Address imbalances between supply and demand in real-time
- Help with system recovery following an event
- Deliver energy for a sustained period of time

Focus Areas for Pathways to Decarbonization Operability Assessment

Focus Areas for Pathways Operability Assessment

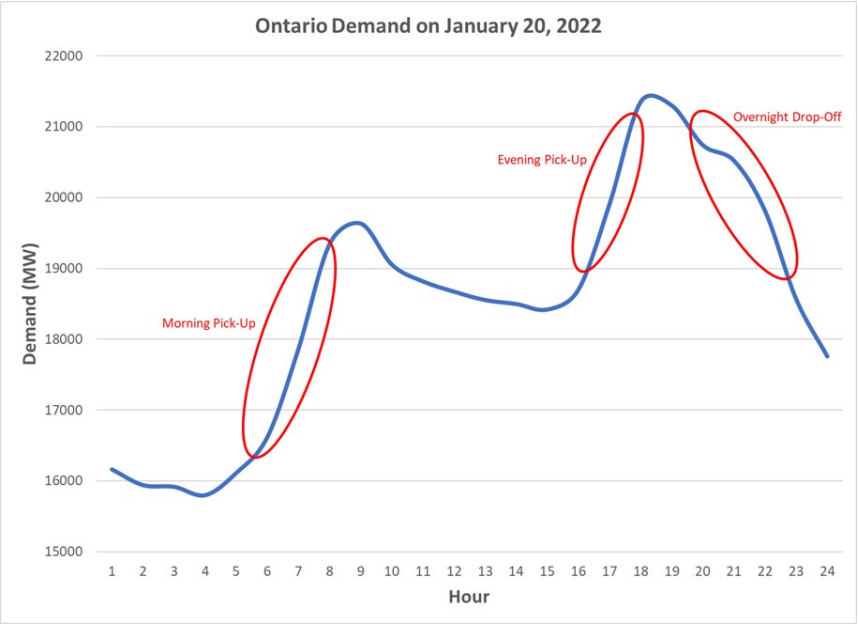
- The Pathways operability assessment will focus on the key areas of Ramping, Flexibility and Event Management
- Ancillary Services and Resilience, which are also important aspects of operability, are out-of-scope for this assessment, as they are detailed studies and are unlikely to change the high level outcomes of the study

Ramping

The ability of the system to follow changes in Ontario demand from hour to hour and during periods of large demand changes

Why does ramping matter and when do we need it?

- Having sufficient ramping capability ensures that supply is matched with demand
- The IESO will assess the ability of the future resource mix to follow these changes in demand, particularly during times of the day when demand is increasing, and with the impact of more variable generation



Flexibility

The ability of the system to respond to intra-hour variations in resource output or demand

When do we need flexibility?

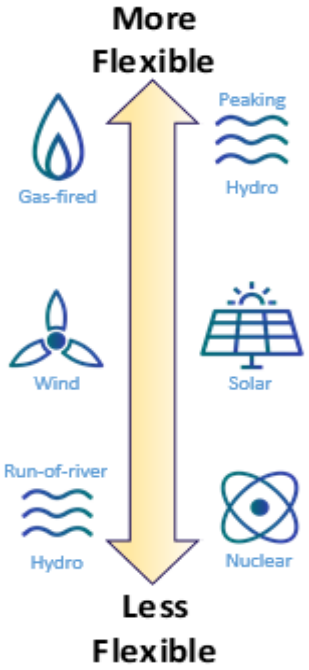
- To respond to normal variations in demand and supply (e.g. output from variable generation resources)
- To respond to abnormal variations due to unexpected changes or conditions that arise

Why does flexibility matter?

- Having sufficient flexibility ensures that supply is matched with demand
- As Ontario's electricity system moves towards a decarbonized resource mix, with an increased penetration of variable generation resources and emerging technologies, a diverse resource mix that is able to quickly respond to intra-hour changes will be necessary to ensuring reliability of the power system

Example

- **Flexible resources** are able to increase or decrease their output quickly in response to system needs
- Ontario's current resource mix consists of a diverse set of resources that can provide a reliable source of supply while also responding to changing system conditions
- A **diverse resource mix** means having resources that are located in different geographic areas of the province, with different fuel types and technologies and providing a range of services



Event Management

The ability of system to maintain operations during disruptive events and return to normal operations as quickly and efficiently as possible

What conditions do we plan for?

- Extreme temperatures over sustained periods
- Adverse weather, including storms, high winds, etc.
- Fuel supply issues
- Unusual conditions that may impact demand

Why does event management matter?

- Extreme weather events have occurred in recent years that have impacted the electricity system in Ontario and in other jurisdictions, and are likely to occur with increasing frequency
- The electricity system needs to be resilient through a variety of conditions, and the future resource mix in Ontario will need to provide characteristics required to withstand these conditions

Next Steps

Timing	Engagement Activity
March/April	IESO in process of producing its response to stakeholder feedback received on the study assumptions – aiming to post in April
Q2	Continued targeted discussions with stakeholders on assumptions
Q2/Q3	Share additional information around assumptions and/or final assumptions (if required)
Q4	Final report to Minister

Thank You

ieso.ca

1.888.448.7777

customer.relations@ieso.ca

engagement@ieso.ca

@IESO_Tweets

linkedin.com/company/IESO

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