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Forecasting and Operation of DERs under Different T-D Coordination Models

ESIG Meteorology and Market Design for Grid Services Workshop
Denver, CO

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Who We Are and What We Do



Reliably operate Ontario's province-wide system 24/7



Support innovation



Create electricity market efficiencies



Work closely with communities to explore sustainable options



Plan for Ontario's future energy needs



Enable province-wide Conservation

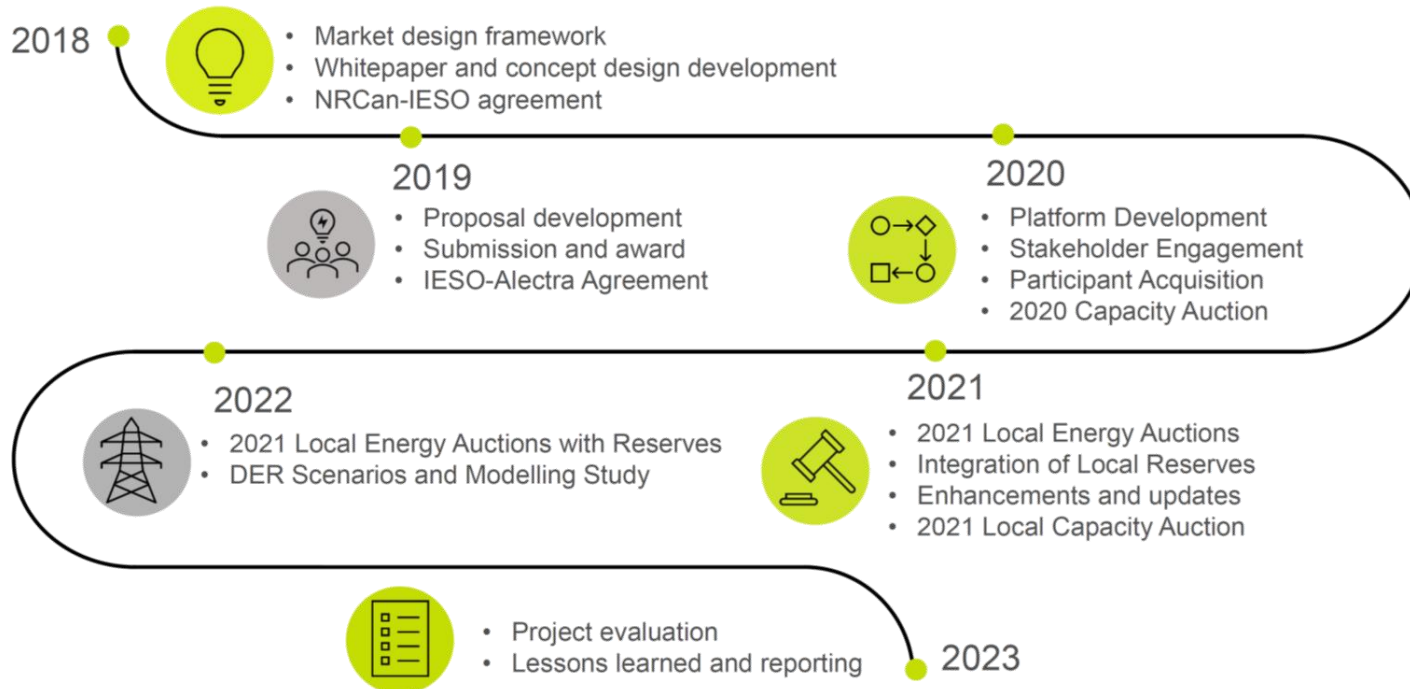
Ontario's System at a Glance

Installed Capacity	38,944 MW
Record Summer Peak (August 1, 2006)	27,007 MW
Record Winter Peak (December 20, 2004)	24,979 MW
Annual Energy Consumed (2020)	132.2 TWh
Retail Customers (2019)	~ 5.2 million
Transmission Lines	30,000 km
Planning Regions	21
Interconnections	New York, Quebec, Manitoba, Michigan, Minnesota

Demonstration Goal and Structure

- Funded by NRCan* and IESO with Alectra Utilities as delivery partner
- Contributes to distribution market and transmission-distribution (T-D) coordination
- Capacity, energy, and reserves services were secured using auctions
- Distribution system operator (DSO), Alectra Utilities, uses local services to manage distributed energy resources (DER) as non-wires alternatives (NWA)
- Envisions a “Total DSO” model, where the DSO manages local services and acts as a “super aggregator” in the wholesale market
- Reliability needs were simulated; the services, auctions and DER operations were real
- Demonstration focused on dispatchable DER, e.g., demand response, batteries, etc.

Demonstration Activities Timelines



Local Energy Service Process

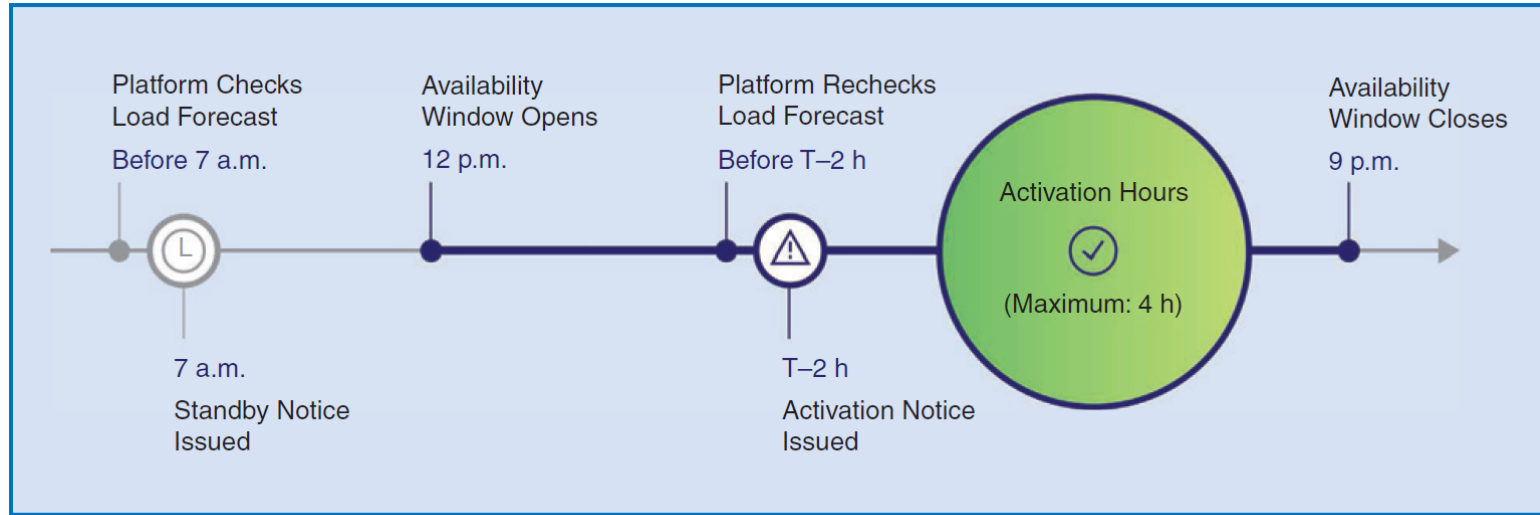


figure 5. A process for local energy service in the demonstration.

Local Loading Forecast and Threshold

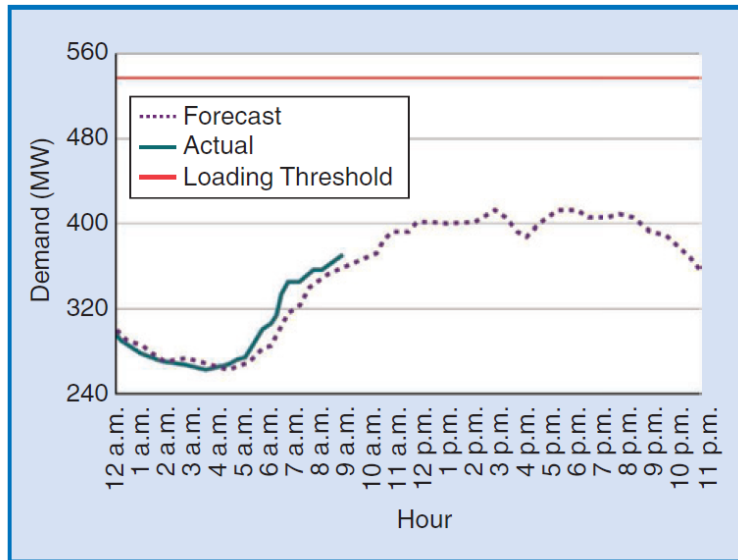


figure 3. The demand forecast for part of the demonstration area on 6 October 2021.

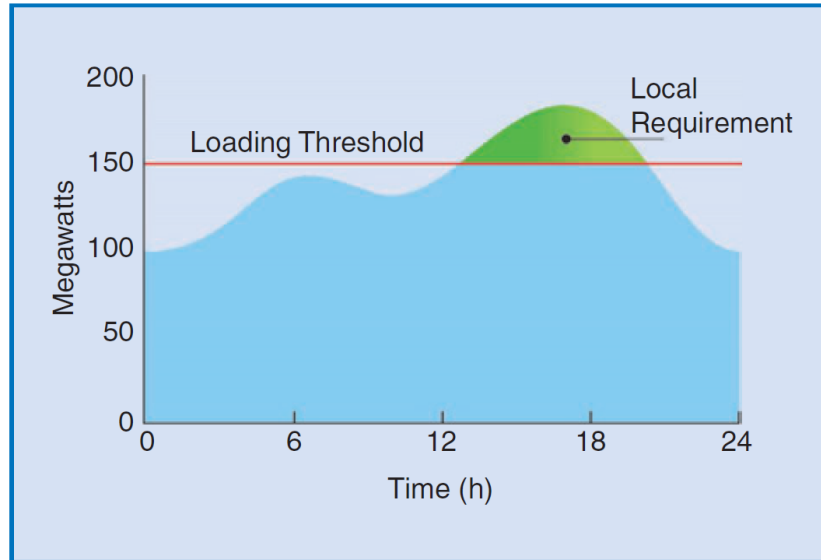
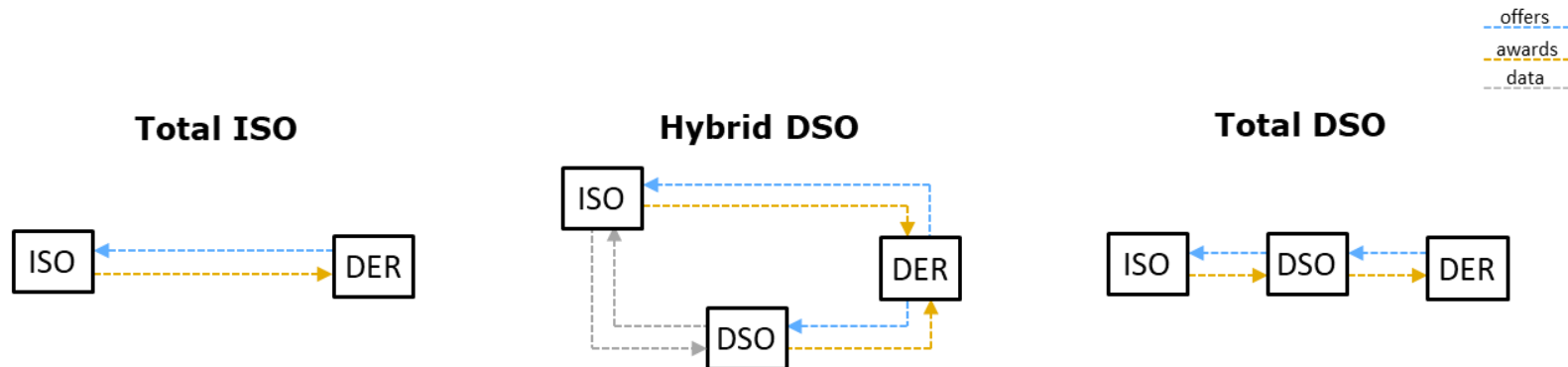


figure 4. The loading threshold and local requirement for energy.

T-D Coordination Frameworks



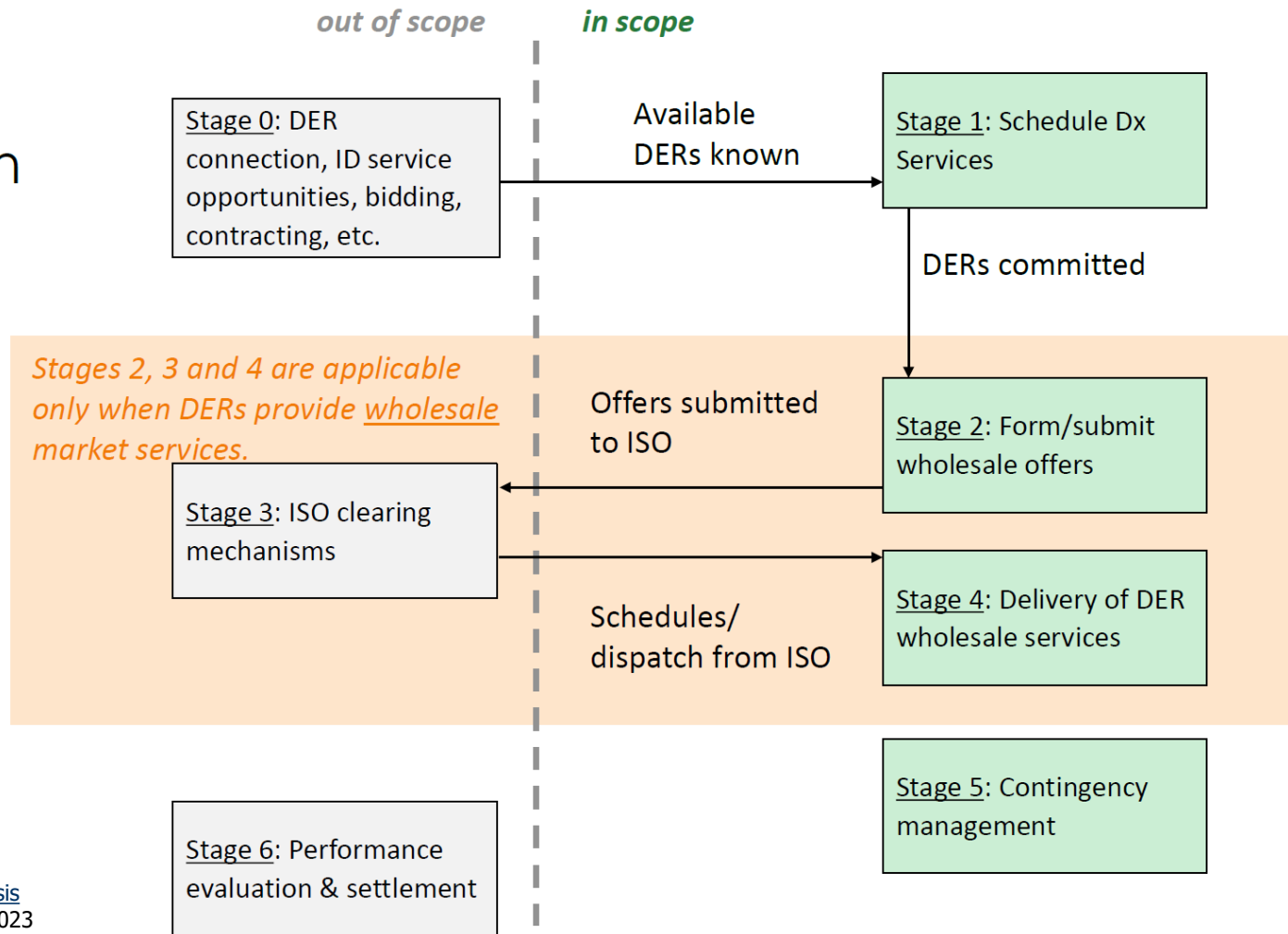
Framework adapted from: De Martini., Kristov, & Taft, Transmission-Distribution-Customer Operational Coordination. U.S. DOE, 2018

Observability into Dispatchable DER at T-D Interface

- As part of demonstration, EPRI developing a study, "Procuring Grid Services from Distributed Energy Resources (DER) - A Scenario-Based Exploratory Analysis"
- Coordination protocols provide the ISO and distributors with advance "visibility" into each other's respective use of DER(A) for services and the expected conditions on the system
- Protocols include distributors' ability to "override" ISO schedules and dispatch of DERs to ensure safety and reliability of the distributions system
- Distribution services "stackable" with wholesale services if distribution services are planned ahead of ISO day-ahead and real-time market processes
- Scheduled distribution services are reflected (e.g., as "price taker") in wholesale market bids/offers by 3rd-party aggregator or DSO, depending on DSO model

Coordination Stages

(Apply to Each Scenario)



IESO's Forecasted and Observable T-D Variables

Observable variables:

- IESO has observability on power at T-D interface and DER participating in the wholesale market
- IESO does not have observability on DER participating in distribution services only and non-dispatchable loads
- IESO requires distributors to notify about material deviations from load forecasts at T-D interface, e.g., due to unplanned contingencies.

Forecasted variables:

- IESO forecasts power demand for non-dispatchable loads at each T-D node using load distribution factors.
- DERs connected downstream of T-D interface that participate in the wholesale market are excluded from the load forecast.
- DERs connected downstream of T-D interface that participate in distribution services only are included in the load forecast.

Impact of Dispatchable DERs on IESO Forecasts

- Material deviations from IESO's load forecasts at T-D interface can impact reliability
- Conclusions from case-based analysis conducted by EPRI for IESO/Alectra:
 1. DERs participating in wholesale market: Bidding mechanisms provide sufficient visibility on load demand at T-D interface
 2. DERs participating in distribution services only:
 - a) Distribution service for normal conditions: IESO's nodal forecast provides sufficient observability
 - b) Distribution service for abnormal conditions: Unexpected deviations at T-D interface may occur, requiring DSO notifications if material, which existing coordination processes capture

Developing Forecasting for the T-D Interface

The forecasting approach at the T-D interface depends on the DSO model and needs to consider a number of cases

- DSO model: Hybrid DSO (various), Total DSO, Load Serving Entity (LSE)
- Dispatchability: dispatchable DER, non-dispatchable DER, non-dispatchable load
- Forecast type: day-ahead forecasts and real-time forecasts
- Service provision: distribution service, wholesale service, distribution and wholesale service, none
- Congestion: binding distribution constraints or free-flow distribution power flow
- Condition: normal distribution conditions or abnormal conditions (planned or unplanned)

Thank You

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