Innovation Roadmap:
IESO York Region Non-Wires Alternative Demonstration

Public Webinar

December 12, 2019

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Purpose

- Present the concept design for the IESO York Region Non-Wires Alternative (NWA) Demonstration project (the "Demonstration")
- Share findings from the two white papers that informed the concept design
- Ensure that stakeholders understand this initiative and seek feedback on aspects of the Demonstration project
  - How to maximize participation and ensure success
  - Timelines and proposed eligibility requirements
  - Additional white paper concepts worth exploring

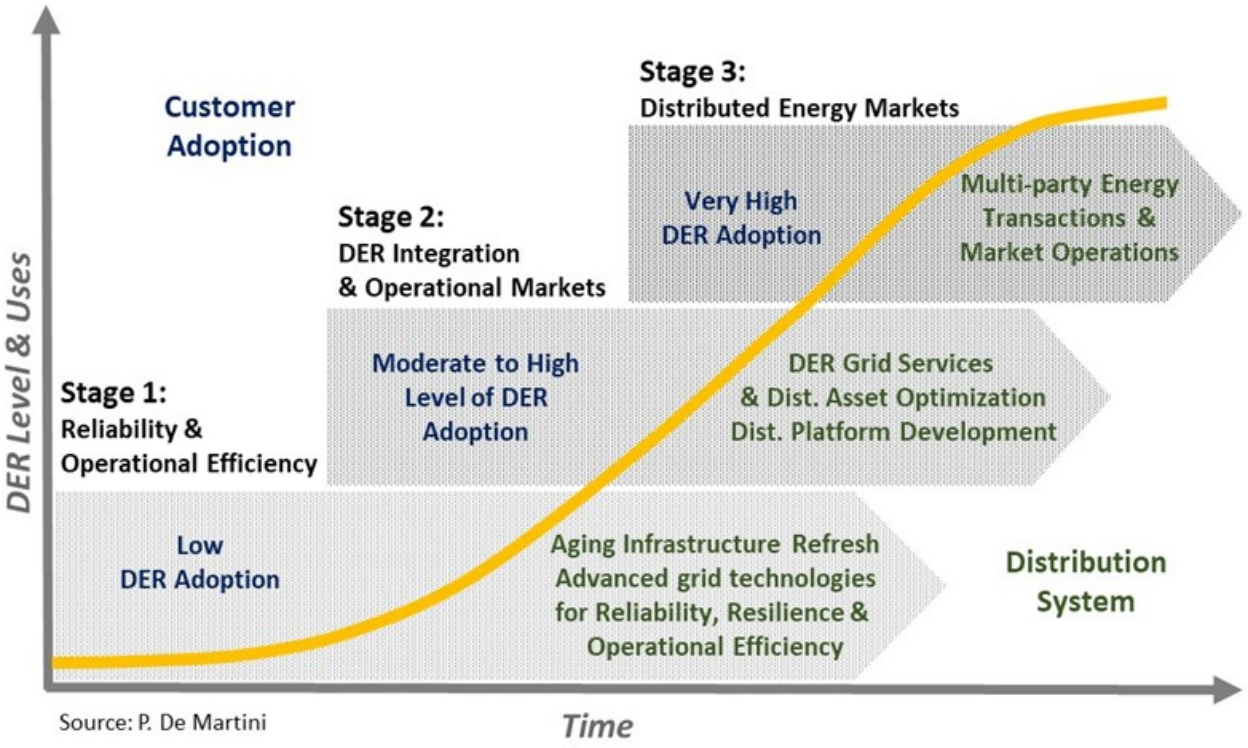
Overview

- The IESO is initiating a demonstration in York Region to explore market-based approaches to secure services from distributed energy resources (DERs) for local needs, while coordinating across the electricity system
- Demonstration concept design is supported by two white papers
  - Now posted on Innovation and Sector Evolution White Paper Series webpage
- Development of a Transmission-Distribution Interoperability Framework
  - Explores models for coordination between Distribution System Operators (DSOs) and a transmission system operator (TSO) in a high-DER future
- Non-Wires Alternatives Using Energy and Capacity Markets
  - Explores market-based approaches to acquiring DERs used as NWAs in the context of DSO-TSO coordination models
- Demonstration and white papers are not intended to advocate for specific solutions, instead to explore options and considerations

Highlights from

Development of a Transmission-Distribution Interoperability Framework

Distribution-Level Evolution



Reference: U.S. Department of Energy, Modern Distribution Grid: Decision Guide, Volume III, Office of Electricity Delivery & Energy Reliability, June 28, 2017

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Key Grid Architecture Principles

- Used to analyze potential alternative system structures and identifying coordination required for reliability

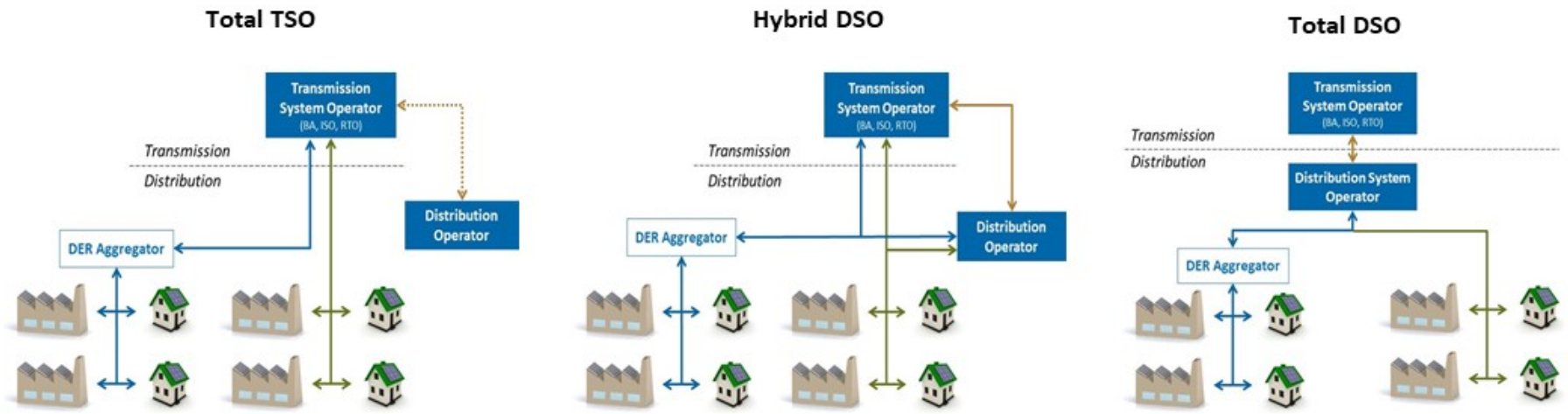
Observability	Operational visibility of the distribution network and integrated DER
Scalability	Ability of the system to work well for very large quantities of DERs
Layered decomposition	Solving large-scale optimization problems by breaking them down into sub-problems
Tier bypassing	Data-flow paths that skip over a tier of the physical power system
Hidden coupling	Two or more controls operating separately, with a partial view of the state of the grid
Latency cascading	Latency in data flow due to data going through a series of systems and organizations
Cybersecurity	Exposure to vulnerability depending on data flow

Reference: J Taft, Grid Architecture 2, Pacific Northwest National Laboratory, 2016

Distribution System Operators

- The DSO is the entity responsible for planning and operational functions associated with a high-DER distribution system
  - Incorporates enhanced functional capabilities needed
- Provides some analogous functions for the distribution system that an ISO (or TSO) provides for the bulk power system
- Allows coordination of high volumes of DER across the system with a transition to a more decentralized architecture
  - In a layered structure, operational control is performed within concentric layers and at the interfaces between layers
  - Examples of interfaces: transmission to distribution, distribution to microgrid, microgrid to individual building
- A range of models exist for TSO-DSO coordination at the T-D interface

Conceptual T-D Model Framework



Reference: De Martini, P., Kristov, L., & Taft, J., Transmission - Distribution - Customer Operational Coordination. U.S. Department of Energy Final Draft, 2018

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Independent DSO

- Independent DSO (IDSO) would be established in order to:
  1) Create a competitive arena for third-party DERs, such that DERs owned by the distributor or affiliates are not advantaged
  2) Separate distribution infrastructure planning from distributors, which have incentives to build and rate-base network assets
- Creating a new separate IDSO entity may require complex coordination arrangements between the IDSO and LDC
- Addressing (1) requires an open-access framework, similar to the transmission level in restructured jurisdictions
- Addressing (2) requires structuring financial incentives based on performance metrics rather than on return on assets

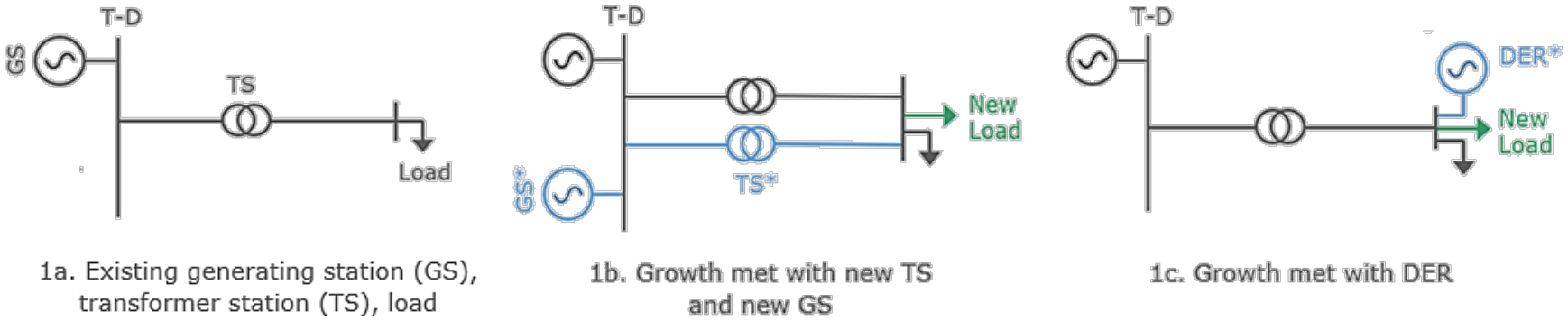
Highlights from

Non-Wires Alternatives Using Energy and Capacity Markets

Non-Wires Alternatives

- NWAs are resources that provide electricity service as alternatives to T&D solutions, such as a new stations or lines
  - E.g. generation, storage, demand response, and energy efficiency
- T&D costs can be avoided, reducing system costs, if the DERs are the more cost-effective solution
- Industry interest in NWAs is driven by the significant current and future expected deployment of DERs in many jurisdictions
- NWAs can be used instead of transmission- or distribution-level network infrastructure
  - At the distribution level, only DERs appropriately sited can meet need
  - At transmission level, DERs and transmission-connected resources can meet need
- DERs used as NWAs may additionally be capable of providing service as an alternative to transmission-connected resources

Illustrative Cost Reduction



1a. Existing generating station (GS), transformer station (TS), load

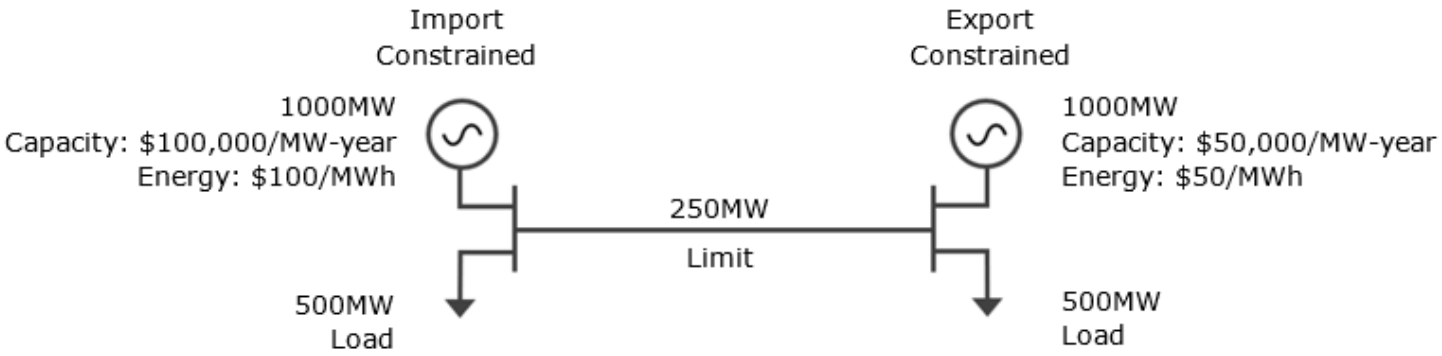
1b. Growth met with new TS and new GS

1c. Growth met with DER

- If DER can meet the need as alternative to network infrastructure plus centralized generation, then DER could "stack" the two value components
- DERs used as NWAs need to operate when local demand is high and limits of the upstream network infrastructure is expected to be exceeded
  - Output of passive/non-dispatchable DERs used as NWAs must align with need
  - Active management of active/dispatchable DERs used as NWAs is needed

NWAs using Capacity Markets

- Capacity market sets locational capacity requirements in defined capacity zones to ensure resource adequacy needs are met
  - If zone is import-constrained, a minimum amount of capacity secured
  - If zone is export-constrained, a maximum amount of capacity secured

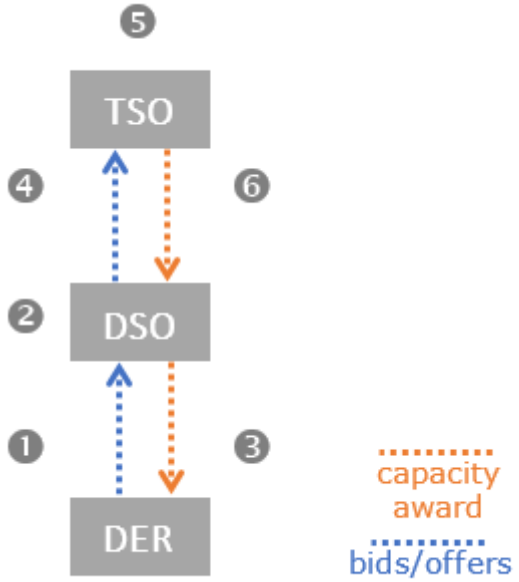


- Zonal capacity price signals are generated, providing an incentive for market participants to focus their efforts in high-priced, high value zones
- Concepts of capacity zones and zonal prices can be applied to NWAs to distribution system infrastructure

Capacity Market with Total DSO

- White paper lays out illustrative TSO-DSO capacity market coordination processes and considerations for three models (Total TSO, Total DSO, and Explored Hybrid DSO)

- E.g. illustrative coordination process steps for Total DSO model:



Coordination process steps:

1. DERs submits capacity market bids to DSO
2. DSO clear auction for all distribution-level capacity zones
3. DERs subject to distribution capacity market rules
4. DSO submit capacity market bids to TSO
5. TSO clears auction for all transmission-level capacity zones
6. DSO subject to transmission capacity market rules

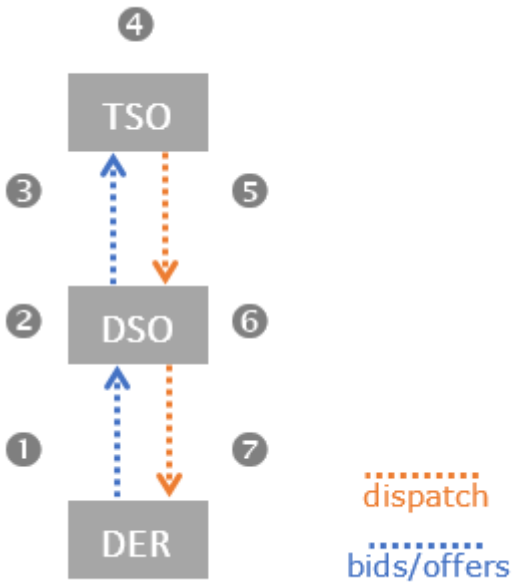
NWAs Using Energy Markets

- Locational Marginal Pricing (LMP) reflects the variation in energy price by location due to energy losses and network constraints
- In "fit-and-forget" approach, sufficient distribution network capacity is installed to ensure that network constraints are not exceeded
- Using dispatchable DERs as NWAs to distribution network involves purposeful management of binding constraints
  - DERs used as NWAs need to be sited and operated where and when the local gross peak load is expected to exceed the limits of the up-stream T&D network
  - The constraint would bind in hours when the loading on the distribution network is expected to exceed limits, if not for DERs dispatched
- Distribution LMP (DLMP) can extend LMP and reflect the impact of distribution network constraints and losses

Energy Market with Total DSO

- White paper lays out illustrative TSO-DSO energy market coordination processes and considerations for three models (Total TSO, Total DSO, and Explored Hybrid DSO)

- E.g. illustrative coordination process steps for Total DSO model:



Coordination process steps:

1. DERs submit energy market bids to DSO
2. DSO aggregates market bids and identifies DER dispatch needed as NWAs
3. DSO submits aggregated energy market bids to TSO
4. TSO clears transmission-level market
5. TSO dispatches DSO
6. DSO disaggregates TSO dispatch of DERs
7. DSO dispatches DERs, including DERs needed as NWAs

Concept Design for

IESO York Region NWA Demonstration

Demonstration Objectives

- Demonstrate concepts from white papers in a real-world application
- The objectives of the Demonstration Project are to explore:
  - Use of distributed energy resources as non-wires alternatives
  - Use of market constructs to secure and operate DERs for local needs
  - How a distribution-level and transmission-level market could be interoperable
  - Process changes needed to enable an IDSO model, if pursued in the future
- Learnings will inform other IESO initiatives including addressing barriers to implementing NWAs in regional planning as well as the Grid-LDC Interoperability Standing Committee
- Learnings can also inform other policy and regulatory initiatives currently underway in Ontario

Project Funding and Structure

- Project has $5M of funding from Natural Resources Canada, matched with $5M million from the IESO's Grid Innovation Fund
- Project is a proof-of-concept, demonstrating how market constructs could be employed to use DERs as NWAs, while addressing T-D interoperability
  - a local capacity auction consistent with IESO's capacity auction
  - the use of distribution locational marginal price (DLMP)
  - transmission-distribution system and market coordination by establishing an Independent Total DSO
- Demonstration market will operate in a simulated, test environment to be used that is isolated from the real IESO market and system operations
- The IESO has executed an agreement with Alectra Utilities to deliver the project based on IESO's Demonstration concept design

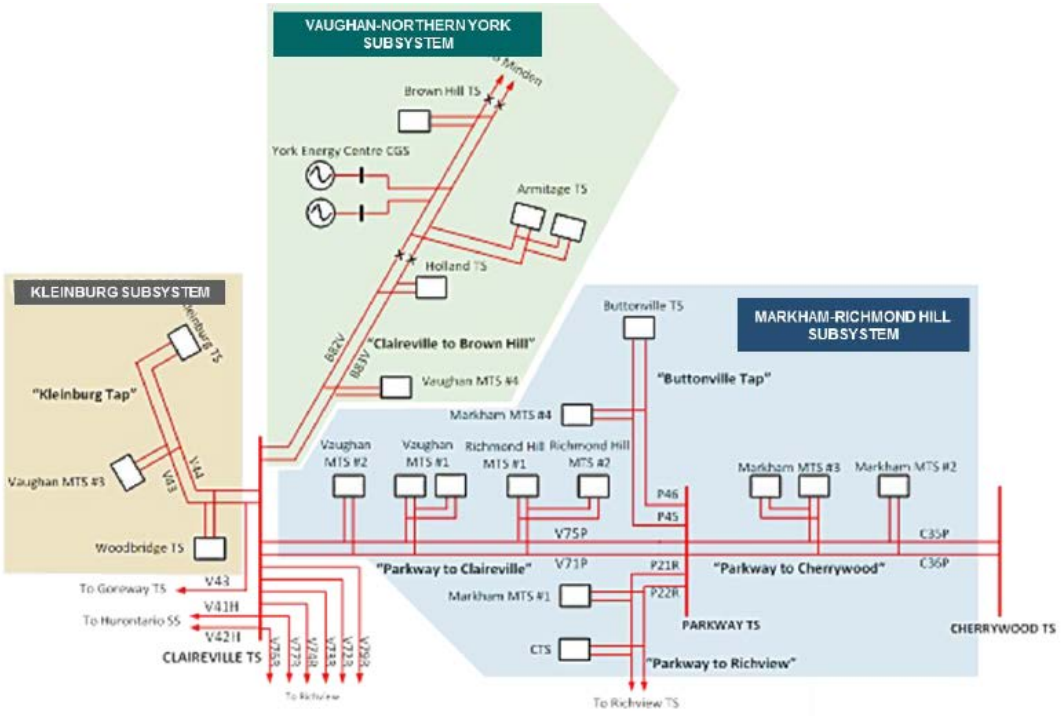
Total Independent DSO Model

- The demonstration adopts an Independent DSO (IDSO) model
  - Participating DERs cannot be owned by the LDC or affiliates
  - IDSO model is intended to enable non-discriminatory competition among 3rd party DERs for the provision of electricity services
    - Demonstration will be transparent re: eligibility, dispatch, settlement, etc.
- Adopting Total IDSO model in the demonstration
  - Hybrid DSO model could help in near term (e.g. < next 5 years) with lower levels of DER penetration as transition made in longer term (e.g. > next 5 years) to Total DSO to accommodate greater penetration
  - Total DSO model simpler to implement in demonstration, given fewer interfaces
- With Total IDSO model, IDSO compensates participating DERs for (a) local energy/capacity and (b) wholesale energy/capacity value
  - IDSO will in turn participate in a simulated IESO market effectively as an aggregator, notionally being compensated for wholesale value

York Region IRRP

- Integrated Regional Resource Plan (IRRP) study began in Q3 2018; completion expected mid-Q1 2020
- Includes a 20-year forecast of peak electricity demand based on:
  - Electricity demand forecast information from distributors
  - Energy efficiency targets
  - Contribution of contracted distributed generation
  - Impact of extreme weather conditions
- York Region is one of the fastest-growing regions in Ontario
  - Extensive urbanization over the past decade is expected to continue
  - Peak demand of over 2000 MW
- Demonstration is specifically focused on southern York Region
  - Specifically, Markham, Richmond Hill, and Vaughan
  - Existing station infrastructure expected to reach limit in mid- to late-2020s

Demonstration Area



- Southern York Region peak demand is about 1350 MW
- Demonstration will include area serviced by: Markham #1 - #4 MTS, Buttonville TS, Richmond Hill #1-#2 MTS, Vaughan #1 - #4 MTS

Simulated Need, Actual Dispatch

- Demonstration market will operate in a simulated, test environment that is isolated from the IESO market and system operations
  - Need will be simulated by modeling transformer capabilities as being exceeded during peak hours
    - i.e. not addressing a real local reliability need
  - Demonstration will also simulate wholesale market participation
    - Participants won't have typical obligations of Market Participants
    - Approach minimizes impact on IESO's market and operational systems
    - Potential to pursue actual participation in the later stage of the project
- Actual energy and capacity services will be secured from DERs, which will be required to physically operate
  - Focused on services that are expected to have the most local value (i.e. energy and capacity)

Local Capacity Auction

- Local capacity auctions will be used to coordinate new incremental DER capacity to assure that adequate resources are secured for simulated need
- Based on initial forecasts, peak demand in the Demonstration area is expected in the summer season; two auctions proposed:
  - First local capacity auction in Q4 2020 for the 2021 summer commitment period (May 1 to October 31)
  - Second local capacity auction in Q4 2021 for the 2022 summer commitment period (May 1 to October 31)
- Capacity target proposed to be 10 MW in the first auction and 20 MW in the second auction, subject to revisit after first auction
- DERs that clear in the Demonstration's capacity auction will be required to be available for dispatch by maintaining energy bids in the Demonstration's energy market

Proposed DER Eligibility

- Eligible DERs must make incremental contribution to meeting local need
- Resources eligible to participate include:
  - Dispatchable DERs, including demand response, storage, gas engines, combined heat and power
  - Non-dispatchable DERs that are not currently constructed and driven by the Demonstration, including solar PV
  - DERs with capacity ≥100 kW are eligible on a stand-alone basis; DERs <100 kW are eligible on an aggregated basis, including residential DR
  - DERs directly connected to the distribution system
  - Behind-the-meter (BTM) DERs eligible as DR
  - DERs participating in the Industrial Conservation Initiative (ICI) are eligible

Proposed DER Eligibility (Continued)

- DERs not eligible to participate include:
  - DERs owned/operated by LDCs or affiliates
  - DER facilities that make use of diesel as fuel
  - Energy Efficiency will be ineligible, given separate IESO pilot
- DERs participating in the demonstration are not eligible to participate in IESO administered markets
- Eligibility of IESO-contracted dispatchable DERs reviewed case-by-case

Local Energy Market

- During the commitment period, participating DERs will be required to be available during business days from 12:00 to 21:00 EST
- Proposed to adopt process used for Hourly Demand Response
  - DERs receive a "standby report" in advance of a potential activation between 15:00 EST day ahead until 07:00 EST on the dispatch day
  - DERs receive an activation notice approximately 2.5 hours prior to dispatch
  - DERs may be activated once per day for up to four consecutive hours
  - Criteria for standby report and for activation notice will be transparent
- Proposed that DERs will be dispatched up to 20 times in commitment period
- Baselining methodology similar to that used for Hourly Demand Response in IESO's energy market will be adopted for DR
- A basic DLMP algorithm developed by the IESO will be used for the demonstration

Anticipated Demonstration Timelines

Major Milestones	Timing
Demonstration Concept Design	December 2019
Stakeholder Engagement (ongoing)	Q4 2019 – Q4 2020
Service Agreement & Capacity Auction Process documents	Q3 2020
Local Capacity Auction	Q4 2020
Summer Commitment Period	May 1, 2021 – October 31, 2021
Mid-point review & potential refinements	Q3 – Q4 2021
Local Capacity Auction	Q4 2021
Summer Commitment Period	May 1, 2022 – October 31, 2022
Final Review and Lessons Learned	Q4 2022

Stakeholder Feedback Requested

- The IESO is requesting feedback on:
  - Concept design for Demonstration project, as outlined in this deck
  - NWA using Energy and Capacity Markets white paper
  - Development of a T-D Interoperability Framework white paper
- Feedback on the following questions would be particularly helpful:
  - How can participation in the demonstration auction be maximized?
  - What are challenges/opportunities to the adopted T-D model?
  - Are the proposed eligibility requirements reasonable?
  - Are demonstration timelines reasonable?
  - Are there other concepts worthwhile to explore in the demonstration?
  - Are there other issues that are important to the success of the demonstration?
- Send feedback to engagement@ieso.ca by January 10, 2020
  - Please use the feedback form that can be found under the December 12, 2019 entry on the Innovation and Sector Evolution White Paper Series webpage

Stakeholder Engagement Schedule

Timing	Engagement Activity
December 5, 2019	Draft white papers and concept design posted
December 12, 2019	Public webinar to seek feedback on concept design and white paper findings
December 12 - January 10, 2020	Window for written feedback submission on concept design and white paper findings
February 2020	IESO response to stakeholder feedback posted
Q1 2020	Public webinar to seek feedback on demonstration design price formation
Q3 2020	Public webinar to seek feedback on draft capacity auction process and service agreement materials
Q4 2020	Design of IESO York Region NWA Demonstration auction finalized

QUESTIONS & COMMENTS