Grid-LDC Coordination and Interoperability Initiatives

Nicholas Ingman, Director, Market Operations

Stakeholder Advisory Committee Meeting

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Presentation Outline

The presentation provides:

- A North American view of Distributed Energy Resources (DERs) from both a reliability and market perspective
- An overview of some of the operability issues we are facing in Ontario as a result of increased penetrations of DER
- Insight into some of the things we are doing to address some of these challenges and understand the opportunities DERs present

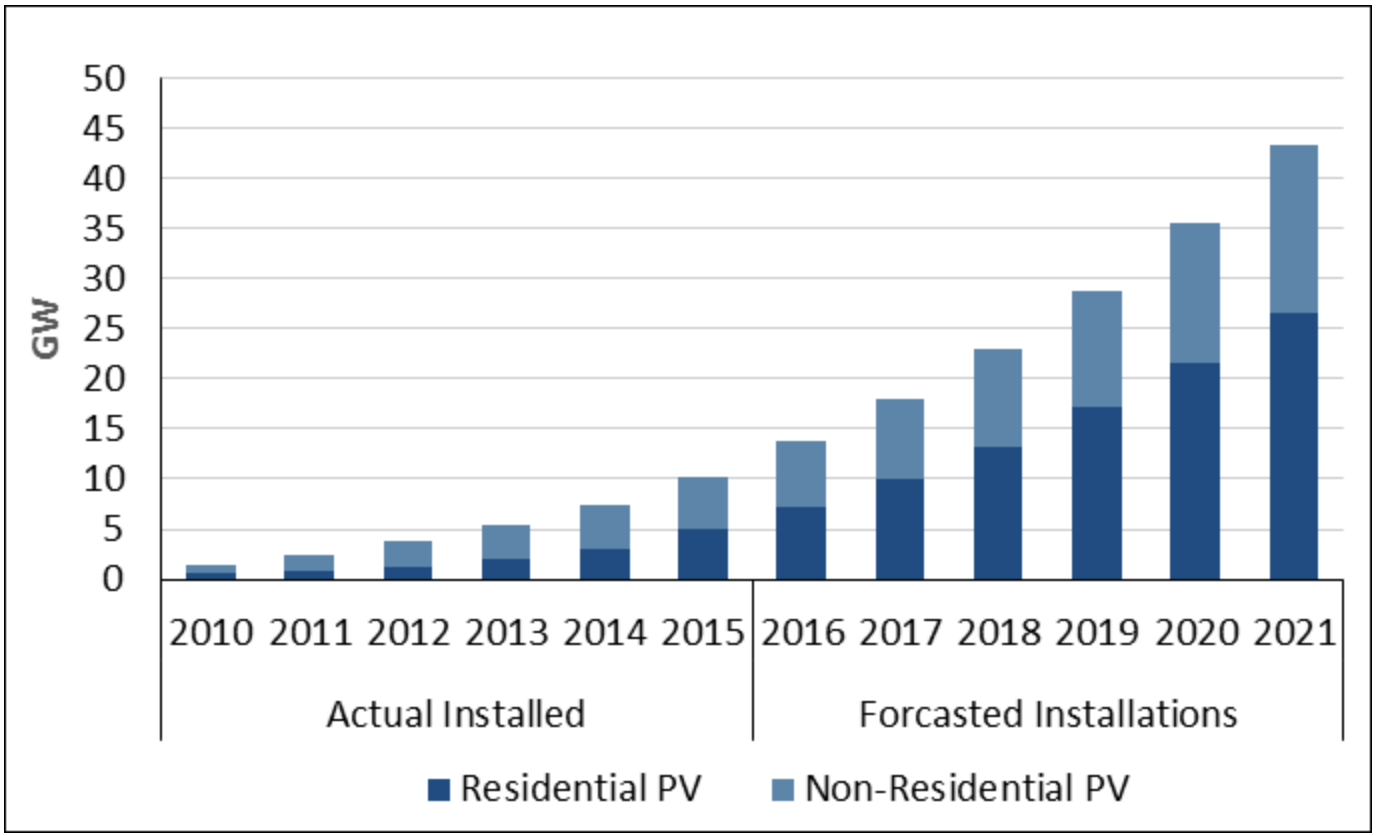
What are Distributed Energy Resources?

Distributed Energy Resources (DERs) are any electricity producing resources or controllable (dispatchable) loads connected to a distribution system that are capable of serving electricity demand.

- DERs include, but are not limited to, generation, storage, and controllable load resources, but excludes persistent load reduction
- DERs may operate individually or be aggregated into virtual units
- DERs may connect directly to the distribution system or be integrated into a load

A NORTH AMERICAN PERSPECTIVE

North American DER Penetration Levels



Source: NERC's 2016 Long-Term Reliability Assessment – December 2016

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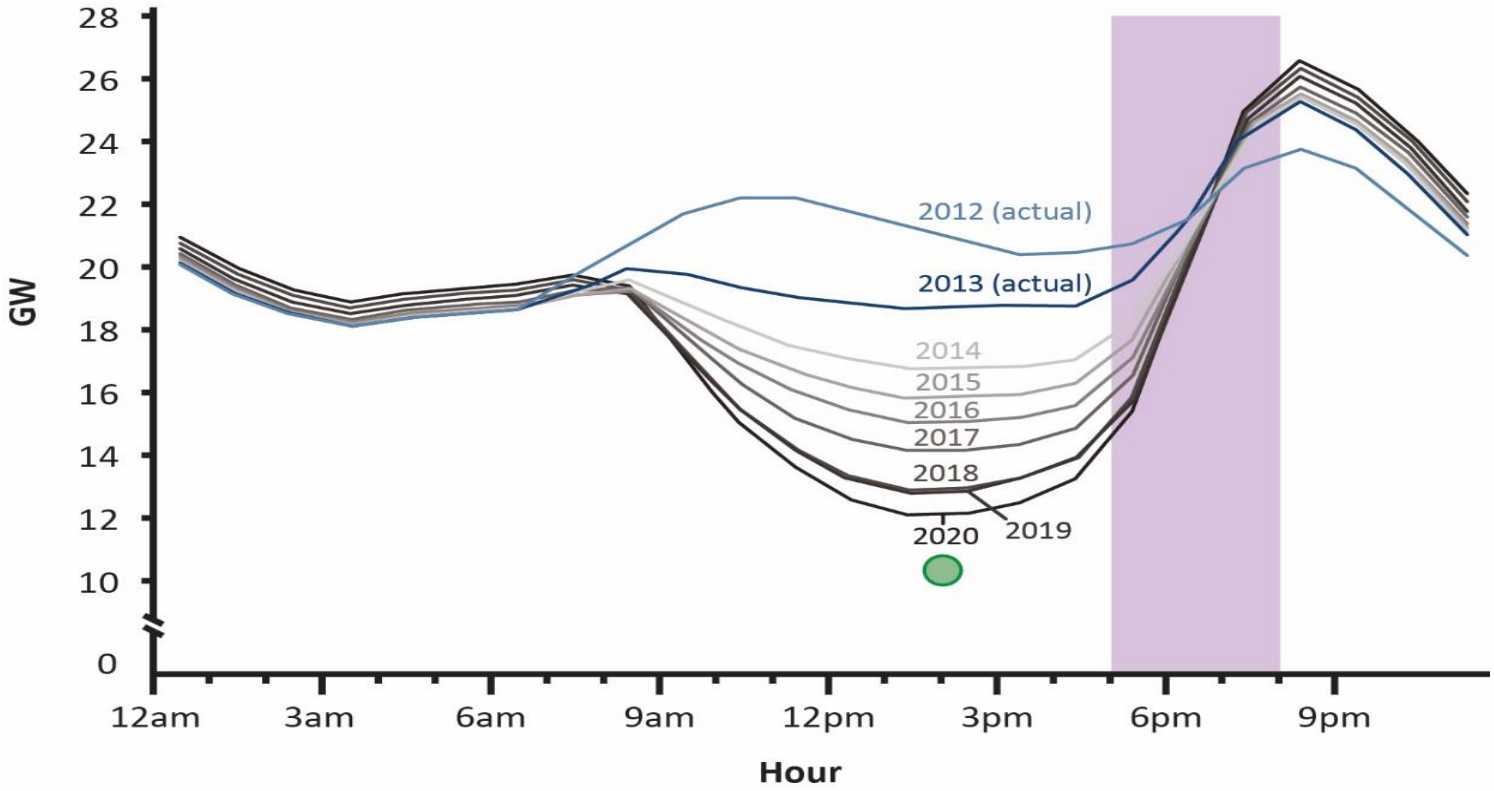
California Demand Impacts



Source: NERC's DER Task Force Report – February 2017

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NERC's 2016 Long Term Reliability Assessment (LTRA)

- NERC's latest LTRA identified:
  - Data and information exchange across the transmission and distribution interface is a crucial aspect of power system planning, forecasting, and modeling
  - Both transmission and distribution entities should develop a common framework where this type of data exchange can be facilitated to ensure the reliability of the bulk system
  - Adequate operator observability and controllability of the bulk system will require access to information and data concerning existing and planned DERs
  - System planners, both transmission and distribution, should be assessing the penetration of large amounts of DERs that may require changes to forecasting, dispatch, and control of the bulk power system

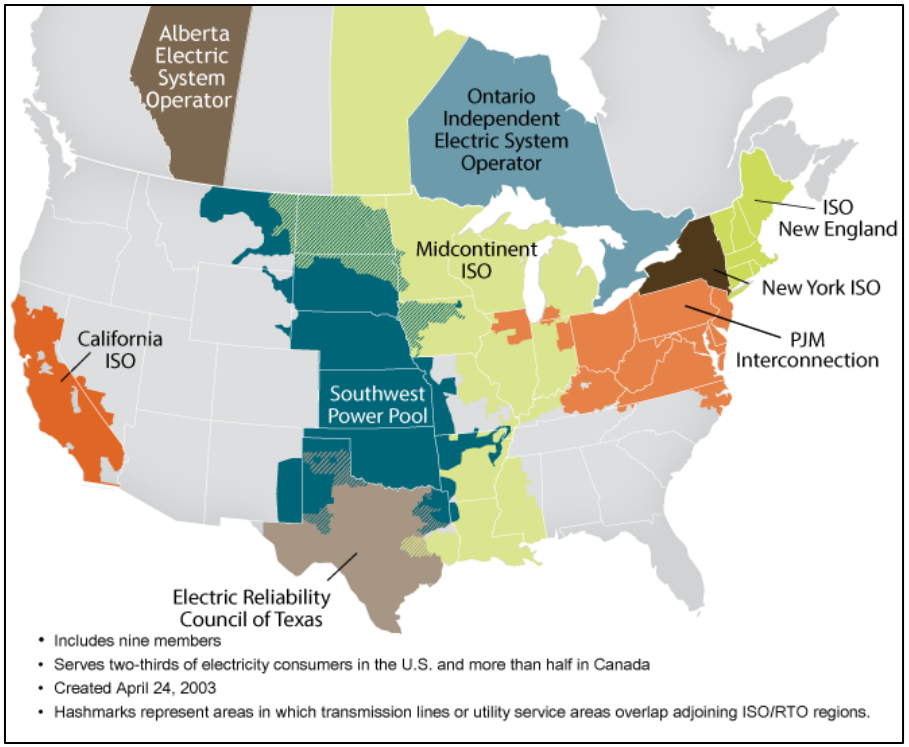
NERC's Distributed Energy Resources Task Force

- Established by NERC in response to a recommendation of the *Essential Reliability Services Task Force* (ERSTF)
- The task force:
  - examined existing practices for incorporating DERs into planning models and studies
  - identified operational impacts to the Bulk Power System
  - reviewed existing NERC standards
  - explored existing policies oriented to support the reliable integration of DERs

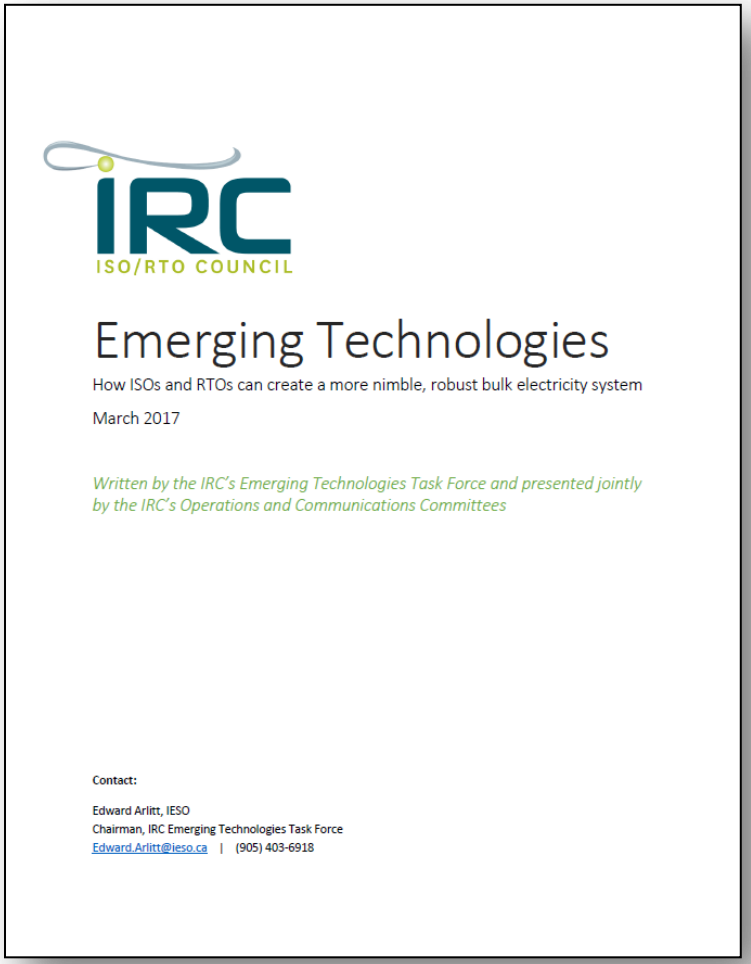
Distributed Energy Resources Task Force - Recommendations

- Develop a set of guidelines to assist in modeling and assessments, such that owners/operators of the bulk power system can account for the impact of DER
- Further evaluate data requirements and sharing of information across the transmission-distribution (T-D) interface to allow for adequate assessment of future DER deployments
- Improve the modeling of DERs for power system studies
- Improve coordination efforts between distribution and transmission entities to determine appropriate use of future DER capabilities
- The limited existing knowledge and experience of modeling DER in system planning studies and operating with higher levels of DER will require future collaborative research, knowledge exchange, and learning.

ISO/RTO Council Emerging Technologies Task Force Report



- Includes nine members
- Serves two-thirds of electricity consumers in the U.S. and more than half in Canada
- Created April 24, 2003
- Hashmarks represent areas in which transmission lines or utility service areas overlap adjoining ISO/RTO regions.



IRC
ISO/RTO COUNCIL

Emerging Technologies

How ISOs and RTOs can create a more nimble, robust bulk electricity system

March 2017

Written by the IRC's Emerging Technologies Task Force and presented jointly by the IRC's Operations and Communications Committees

Contact:

Edward Arlitt, IESO
Chairman, IRC Emerging Technologies Task Force
Edward.Arlitt@ieso.ca | (905) 403-6918

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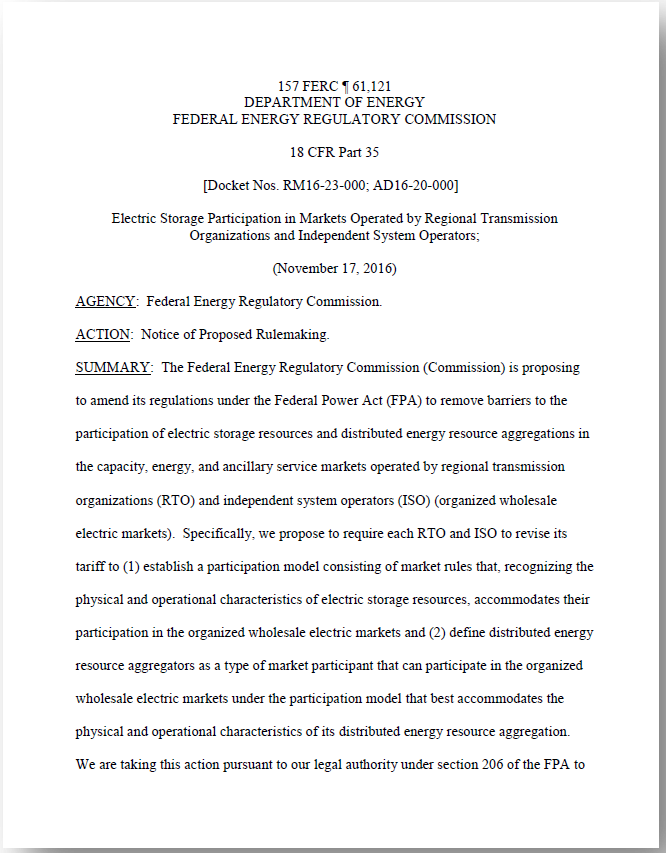
IRC Positions: A Distributed Electricity System

The IRC:

- Recognizes that there must be some form of **coordinating influence** in a high-DER future to help ensure reliability.
- Will continue to facilitate a continent-wide dialogue on the appropriate means by which mass DERs and the bulk electricity system can mutually benefit each other. This **dialogue should focus on effective transfer of data across the transmission/distribution system interface** while allowing maximum flexibility for suitable local policies and market mechanisms to develop.
- In jurisdictions where Distribution System Operators (DSOs) exist, these entities should conform to a sufficiently rigorous set of standards that allows for the safe interaction between DSOs, non-utility actors and the bulk electricity system.
- Supports policies to ensure that if variability at the distribution level results in a risk to system reliability **ISO/RTOs have appropriate authority over DERs** — or otherwise isolate their impact from the bulk electricity system.

US Markets - FERC Notice of Proposed Rulemaking (NOPR)



157 FERC ¶ 61,121
DEPARTMENT OF ENERGY
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 35

[Docket Nos. RM16-23-000; AD16-20-000]

Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators;

(November 17, 2016)

AGENCY: Federal Energy Regulatory Commission.

ACTION: Notice of Proposed Rulemaking.

SUMMARY: The Federal Energy Regulatory Commission (Commission) is proposing to amend its regulations under the Federal Power Act (FPA) to remove barriers to the participation of electric storage resources and distributed energy resource aggregations in the capacity, energy, and ancillary service markets operated by regional transmission organizations (RTO) and independent system operators (ISO) (organized wholesale electric markets). Specifically, we propose to require each RTO and ISO to revise its tariff to (1) establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, accommodates their participation in the organized wholesale electric markets and (2) define distributed energy resource aggregators as a type of market participant that can participate in the organized wholesale electric markets under the participation model that best accommodates the physical and operational characteristics of its distributed energy resource aggregation. We are taking this action pursuant to our legal authority under section 206 of the FPA to

- Issued November 17, 2016
- A potentially significant development for U.S. electricity markets
- Raises the possibility of a formalized, mandatory framework for integrating storage and DERs into wholesale electricity markets

AN ONTARIO PERSPECTIVE

DER in Ontario

- DERs have existed in Ontario since the beginning of the electricity system
- Recent growth of DERs has been driven by government policy
- Realizing the potential value of DERs requires greater integration into system planning and operations
- Realizing the potential and managing challenges presented by DER requires enhanced coordination between the IESO and LDCs

More DER on the horizon

- There has been more than 2,000 MW of solar generation added to the distribution system over a 6 year period
- We expect to see over 3,000 MW of embedded wind and solar generation by the early 2020's
  - more than 1,000 MW of this capacity are solar installations less than 5MW

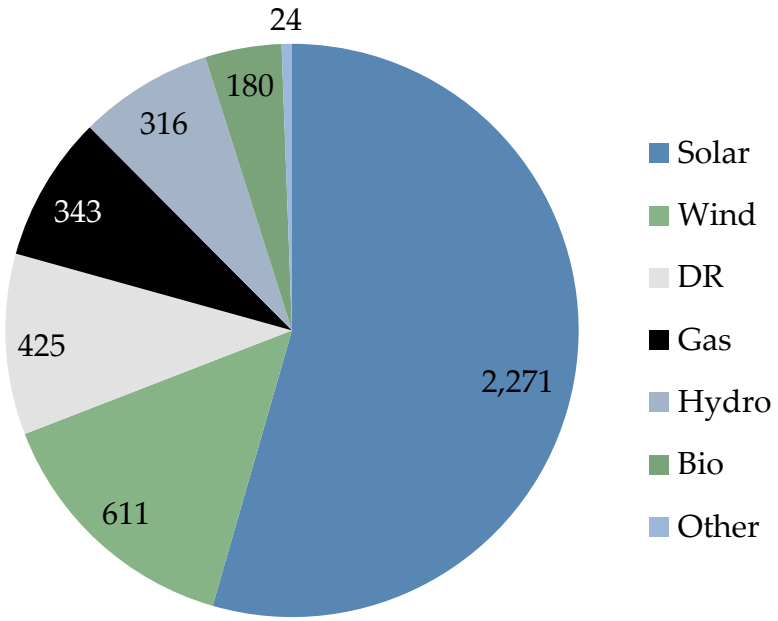
Some experiences with other forms of DER to date

- Batteries and Flywheel Resources being used to provide Regulation Service – a grid reliability service
- Aggregated Residential Load participating in the Demand Response Auction
- The emergence of Solar/Storage technology and virtual power plants within a number of service territories

Significant DER Within Ontario's Footprint and limited Visibility

Contracted and Installed DER by Resource Type (As of February 2017)

(4,169 MW)



- Current IESO visibility of embedded generation:
  - 867 MW of solar
  - 340 MW of wind

Forecasting Challenges

- Output from embedded generators directly offsets the need for the same quantity of grid supplied electricity
- IESO has limited visibility of renewable resources connected to the distribution system
  - Only variable generation facilities greater than 5 MW and traditional resources (gas, hydro, etc.) greater than 10 MW are required to register with the IESO and send operational and meteorological telemetry
- Embedded generation forecasts are therefore scaled up using the ratio of contracted to telemetered capacity in order to reflect the total capacity across the province (i.e. an approximation)
- Longer term demand forecasting will become more challenging as FIT programs end and we move to more net-metering

INITIATIVES UNDERWAY IN ONTARIO

Grid/LDC Coordination Initiative

- A partnership between Alectra (then PowerStream) and the IESO Initiated in June 2016 to:
  - Explore ways to enhance reliability and efficiency through coordination of IESO and LDC-controlled resources
  - Establish a framework for data sharing between the IESO and all LDCs
  - Explore the feasibility for increased adoption of residential solar storage type technologies within the LDC sector by using PowerStream's POWER.HOUSE initiative, as a test case
  - Understand the grid integration and operability impacts of increased adoption of POWER.HOUSE, and similar solutions, deployed within the distribution sector at large.
  - Inform the discussion and development of community-based energy options for the York Region Integrated Regional Resource Plan (IRRP).

Deliverables to date

- POWER.HOUSE Feasibility Study issued April 18, 2017
- Grid/LDC Interoperability and Data Sharing Framework issued January 25, 2017
- Grid-LDC Interoperability Standing Committee established in January 2017
- Data sharing protocols established for real-time and forecast data between Alectra and the IESO, including the ability to:
  - Receive real-time aggregated embedded generation data by delivery point
  - Produce variable generation forecasts by delivery point
  - Receive Geo-magnetically Induced Current (GIC) values from distributor (or LDC) owned Transformer Stations that have this capability

Grid-LDC Interoperability Standing Committee

- Representatives from LDC operations staff and sector partners
- Objectives:
  - Establish a partnership to discuss issues and opportunities for a more coordinated operation of Ontario's electricity system
  - Increase awareness of upcoming changes at both the grid and distribution levels to understand the impact on system operations and identify practical ways to leverage these opportunities
  - Identify existing capabilities that can be better leveraged to support efficient and reliable operation of Ontario's electricity system

What's Next

- Grid-LDC Interoperability Standing Committee meeting on June 8
  - Discuss feedback received at March Committee meeting
  - Continue to share operations perspectives – i.e. Hydro One Distribution Management System (DMS)
  - Discuss opportunities for future collaboration within the Interoperability Framework