Grid-LDC Coordination and Interoperability Initiatives

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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 the things we are doing to address some of these challenges and understand the opportunities DERs present

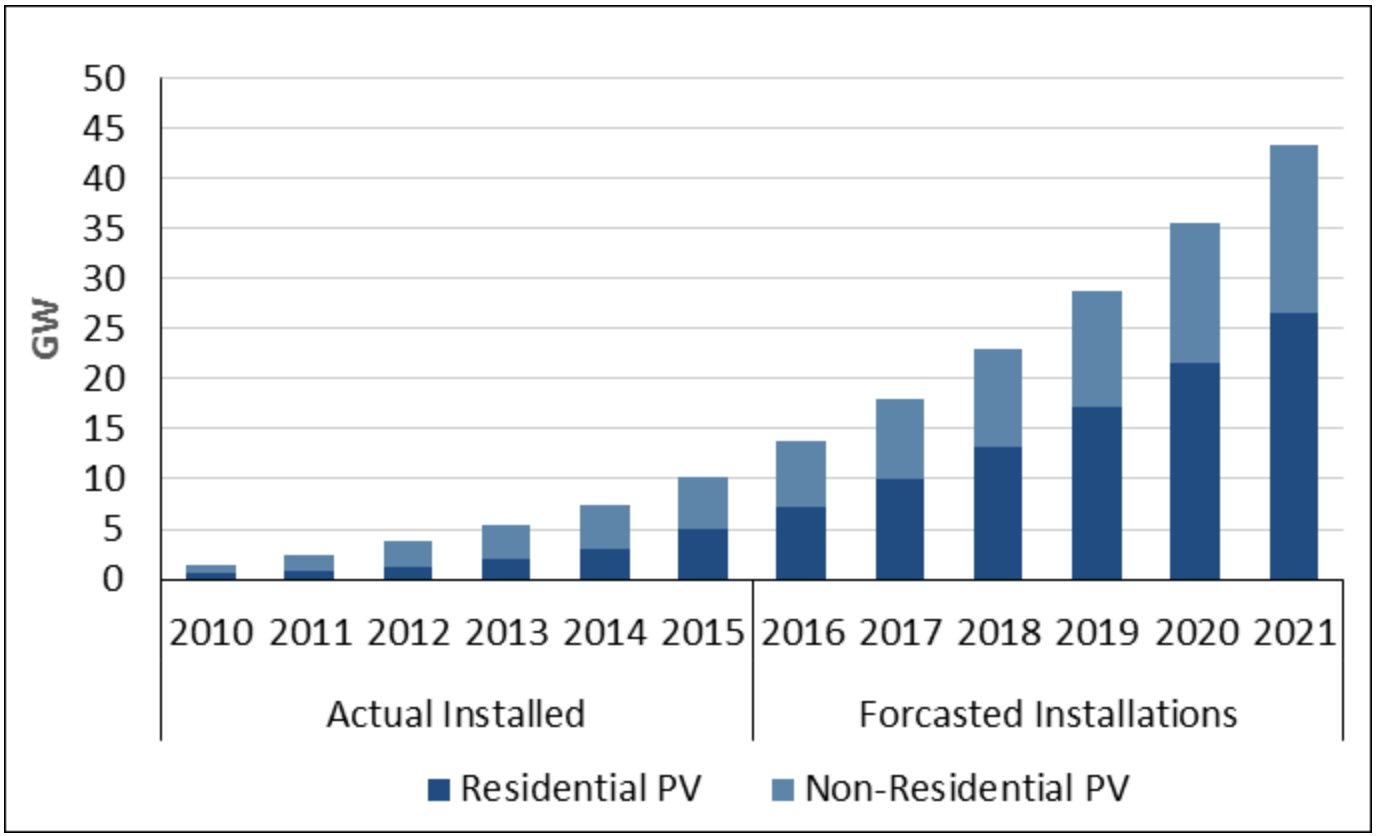
What are Distributed Energy Resources?

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 exclude 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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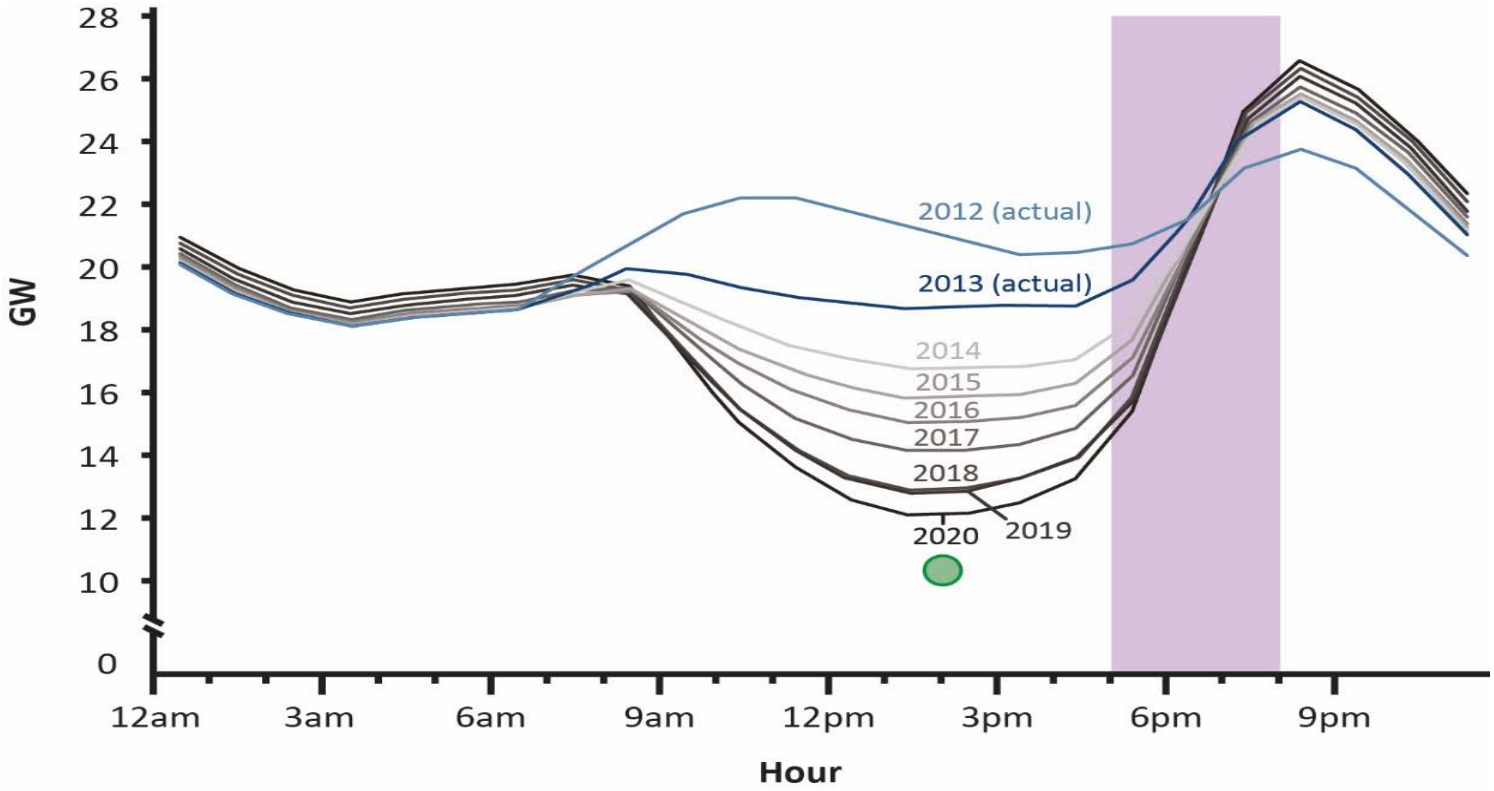
California Demand Impacts



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 planning, forecasting, and modeling
  - Both transmission and distribution entities should develop a common framework to facilitate data exchange
  - Observability and controllability of the power system will require access to data concerning existing and planned DERs
  - Transmission and distribution planners should be assessing impact of DERs on forecasting, dispatch, and control of the power system

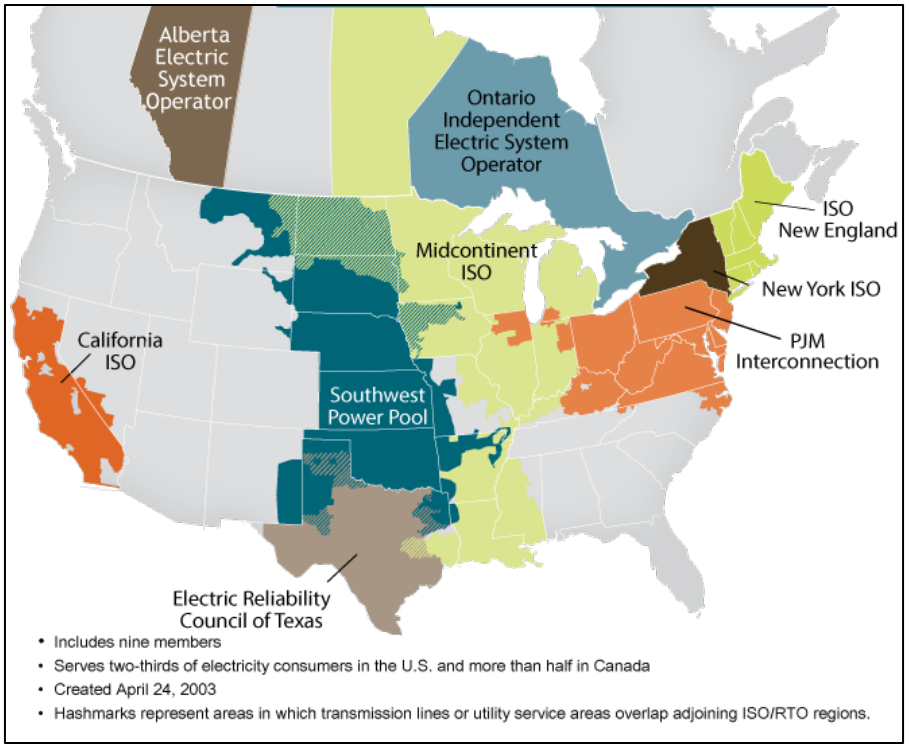
NERC's Distributed Energy Resources Task Force

- 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

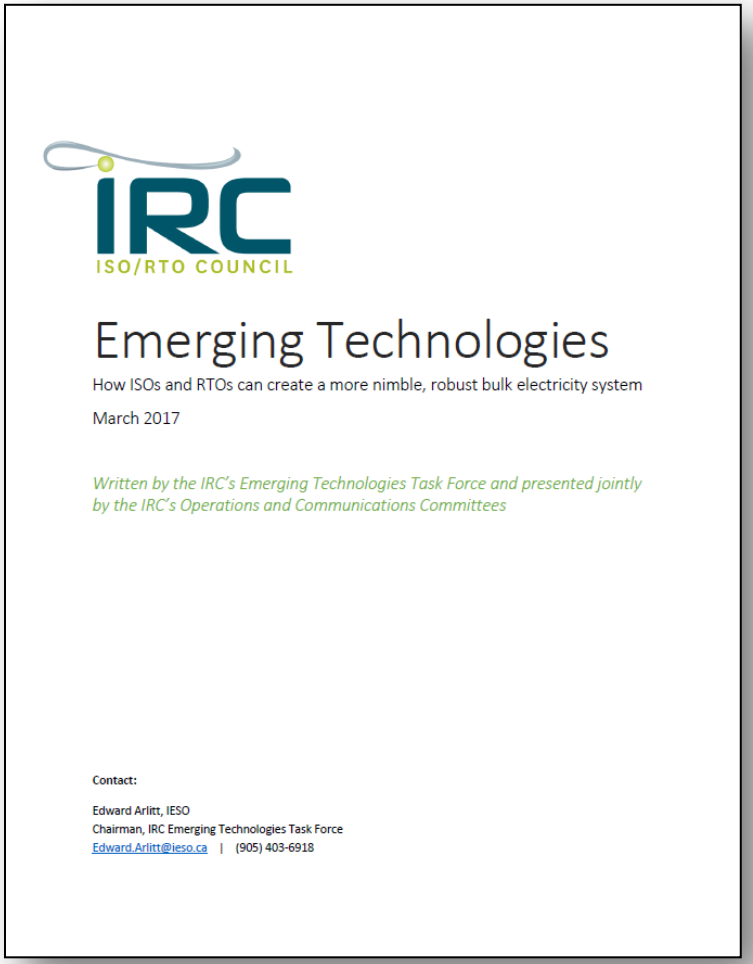
Distributed Energy Resources Task Force - Recommendations

- Develop a set of guidelines to assist in modeling and assessments of DERs to account for their impact on power system operations
- Evaluate data sharing requirements across the transmission-distribution interface to allow for assessments of future DERs
- 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
- Collaborative research, knowledge exchange and learning will be required in system planning studies and operations with greater penetration of DERs

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

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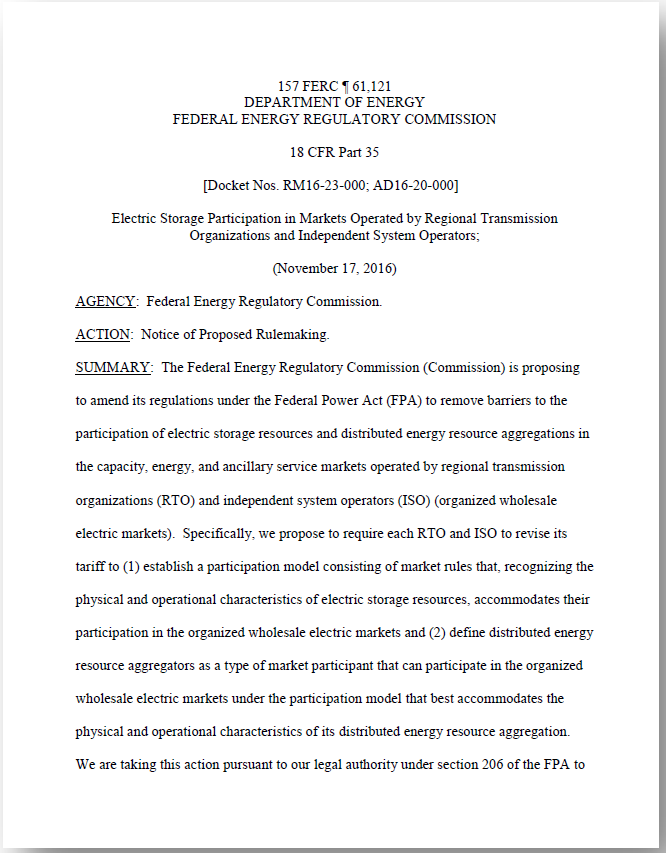
IRC Positions: A Distributed Electricity System

The IRC:

- Recognizes that there must be some form of **coordinating influence** in a high-DER future to help ensure reliability.
- Will facilitate a continent-wide dialogue whereby increased DER penetration will benefit bulk electricity system. 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

DERs in Ontario

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

More DER on the horizon

- More than 2,000 MW of solar generation added to the distribution system over a 6 year period
- 600 MW of wind is connected to the distribution system
- 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 5 MW
- 34 MW of storage expected to connect and provide regulation service and/or reactive support and voltage control

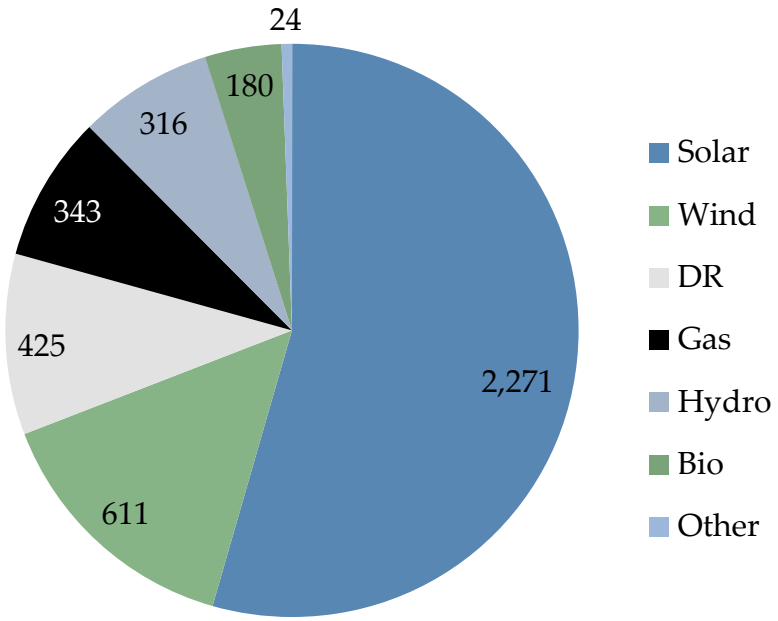
Some experiences with other forms of DER

- Batteries and Flywheel Resources currently 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

- 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 scaled up using the ratio of contracted to telemetered capacity in order to reflect the total capacity
- 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 data sharing framework between the IESO and LDCs
  - Explore the feasibility for increased adoption of residential solar storage type technologies within the LDC sector by using PowerStream's POWER.HOUSE initiative
  - 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

- Grid-LDC Interoperability and Data Sharing Framework issued January 25, 2017
- Grid-LDC Interoperability Standing Committee established in January 2017
- POWER.HOUSE Feasibility Study issued April 18, 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 are:
  - 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