

# Opportunities for Ontario's distributors in a renewed electricity market



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# Overview

- Substantial reforms to Ontario's wholesale electricity market through the Independent Electricity System Operator's (IESO's) Market Renewal Program (MRP) are being implemented
  - Changes to the IESO-Administered Markets (IAMs) with the objective of creating a more reliable and cost-effective electricity system, and addressing known inefficiencies of the IAMs
  - MRP will be the foundation for future changes to Ontario's electricity system, particularly as it relates to changes resulting from increases in uptake of renewable generation and Distributed Energy Resources (DERs)
- IESO's MRP does not explicitly consider distribution system impacts and the evolving role that Local Distribution Companies (LDCs)
- With MRP as the foundation, this presentation explores potential next steps for LDCs to explore in terms of new roles, functions and opportunities

Ivey Electricity Workshop

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# Background on MRP

- IESO is implementing a **Single Schedule Market (SSM)** to replace the existing two-schedule system of constrained and unconstrained schedules used for price and dispatch formation across Ontario
  - This is being accomplished by the introduction of **Locational Marginal Pricing (LMP)** to better reflect the true cost of supplying a particular geographic location and improve alignment between scheduling and dispatch
  - Changes to load pricing are also part of the package to improve price signals for market participants and increase market efficiency
- In addition the MRP introduces a **Day-Ahead Market (DAM)** to replace the Day-Ahead Commitment Process currently used by the IESO
  - The DAM is financially-binding and thus provides financial certainty to market participants and thus reduces price volatility in the real time spot markets
  - One significant feature of the DAM, is that enables **non-dispatchable loads (NDLs)** the option to elect to become **Price Responsive Loads (PRLs)**, which allows them to submit their own schedules

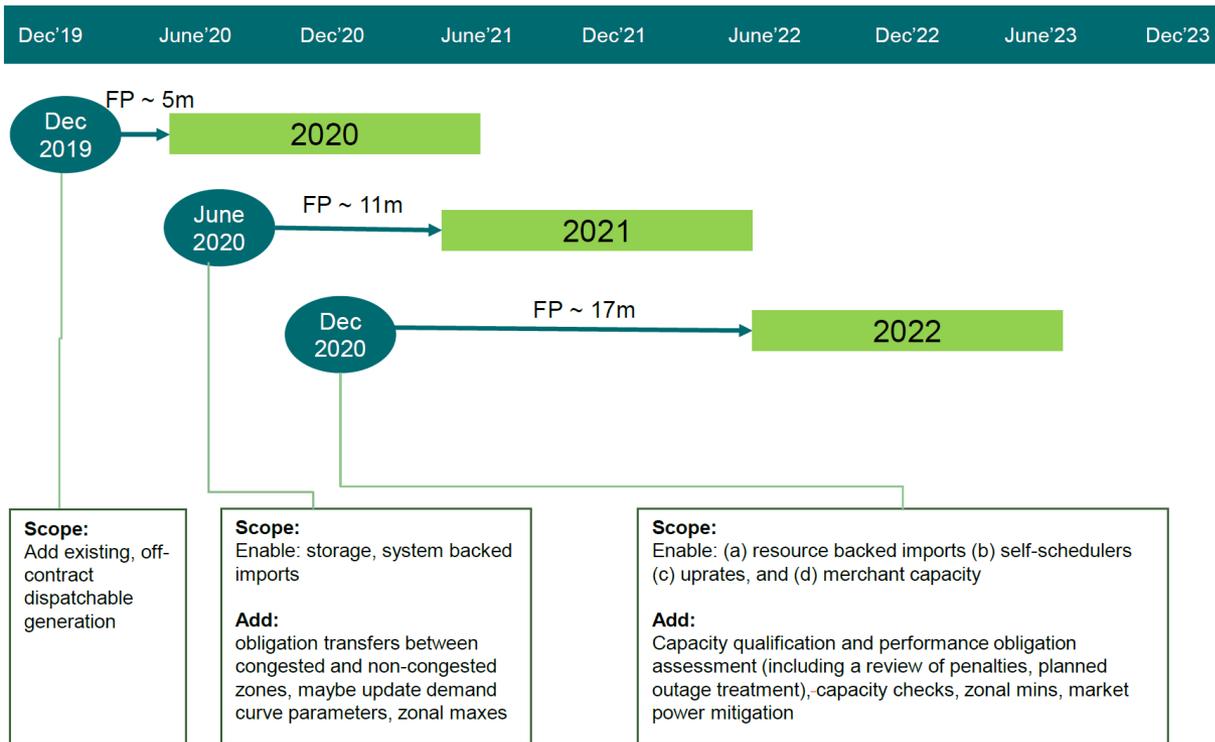
*Note: MRP also includes Enhanced Real-time Unit Commitment which is not discussed in this presentation*

# Overview of load pricing under MRP

	Dispatchable Load	PRLs	NDLs *LDCs are NDLs*	Non-IESO Market Participants
<b>Today:</b>	5-min Market Clearing Prices (MCP) + Congestion Management Settlement Credits (CMSC) (i.e., MCP + CMSC)	Does not exist in today's market	Hourly Ontario Energy Price (HOEP)	HOEP
<b>SSM:</b>	LMPs (aka "nodal" prices)	LMPs	"Ontario zonal price" (i.e., single province-wide price or uniform price), with option to elect to become PRL	Assumed to be "Ontario zonal price"
<b>DAM:</b>	Eligible to participate	Required to submit bids in DAM, but continue to be non-dispatchable in real time	No participation requirements, IESO forecasts for NDLs, modified settlement	Assumed not to participate in DAM

**Note: OEB has not outlined potential changes to non-IESO market participant consumers resulting from MRP implementation**

# Capacity Auctions

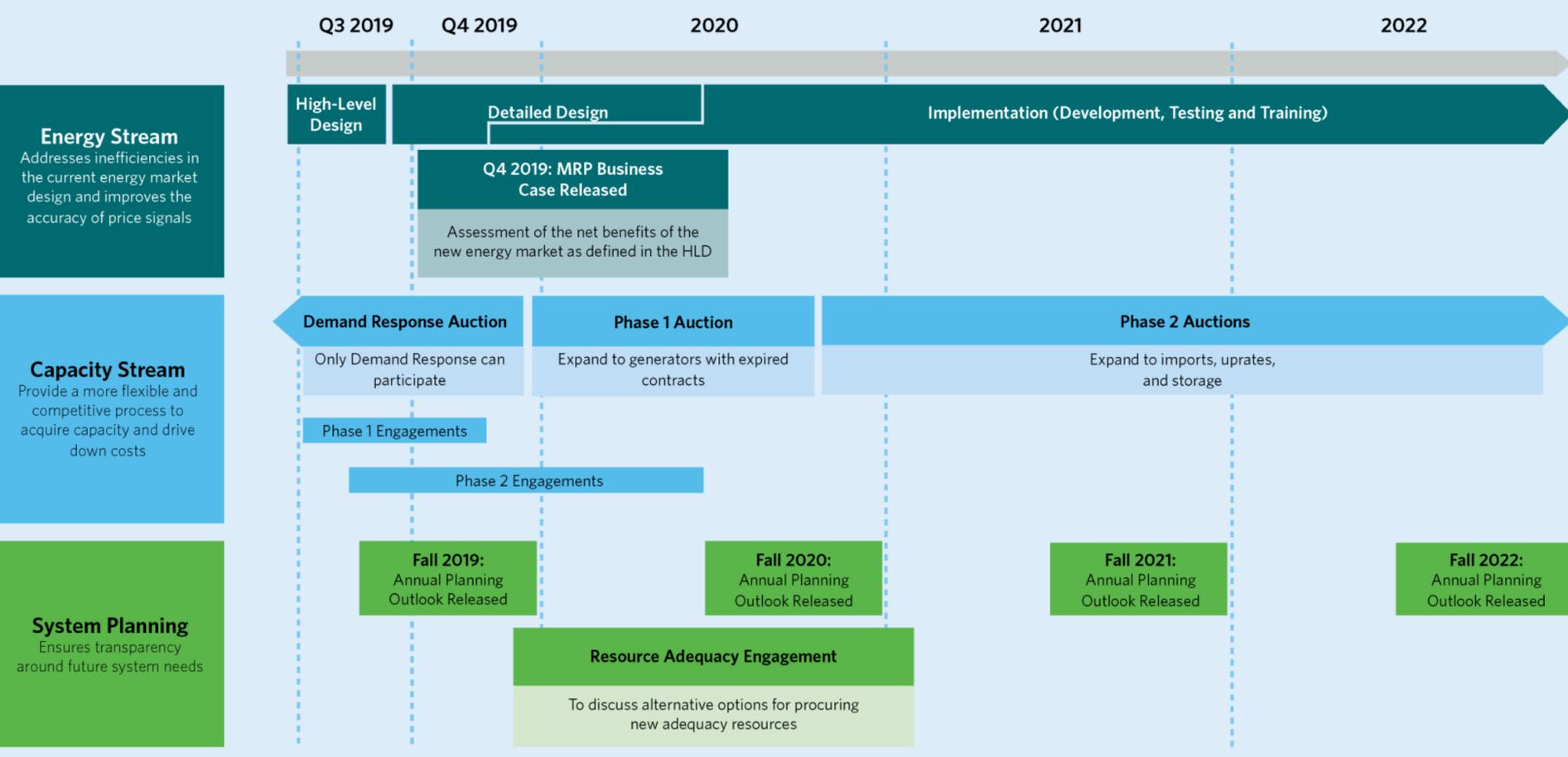


**Source: IESO**

- IESO's Capacity Auctions are competitive procurement mechanisms that enable eligible resources to offer a capacity product for a short, 1-year commitment period
- Currently, behind-the-meter energy storage is eligible to participate as a DR resource

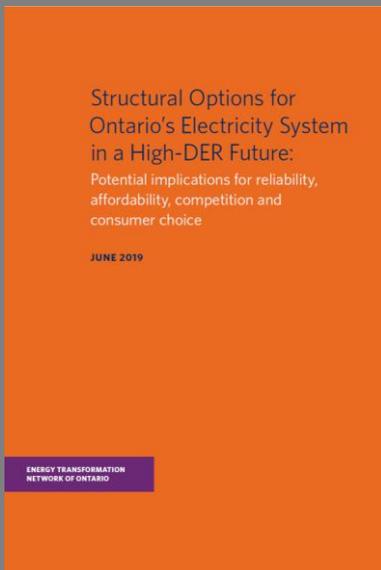
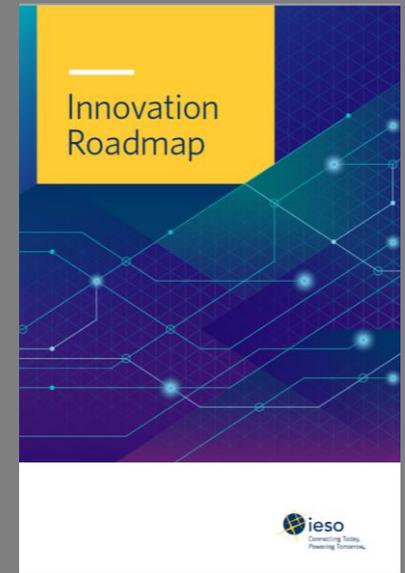
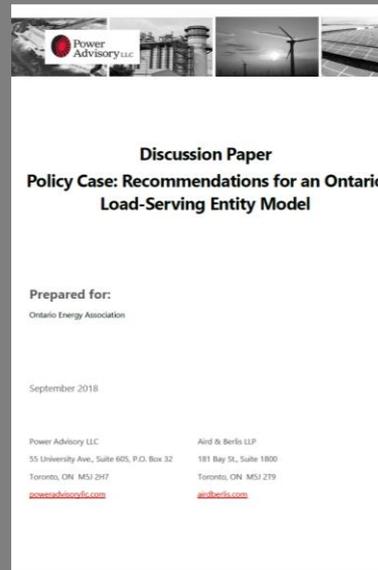
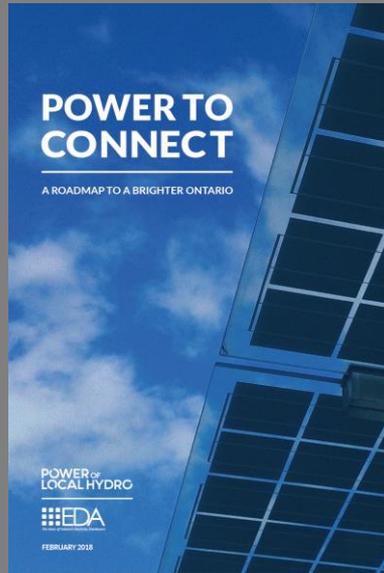
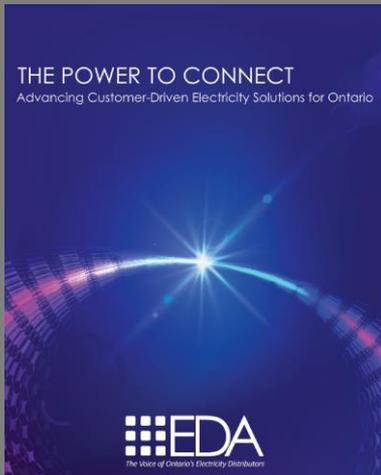
- Despite cancelling the incremental capacity auction (ICA), IESO is proceeding with Capacity Auctions by adapting the pre-existing Demand Response (DR) Auction
- In addition to DR, other resources, including off-contract generation and energy storage, will be incorporated
- Future Capacity Auctions will be scheduled based on the outcomes of the IESO's upcoming consultation on meeting Resource Adequacy

# MRP Summary



Source: IESO



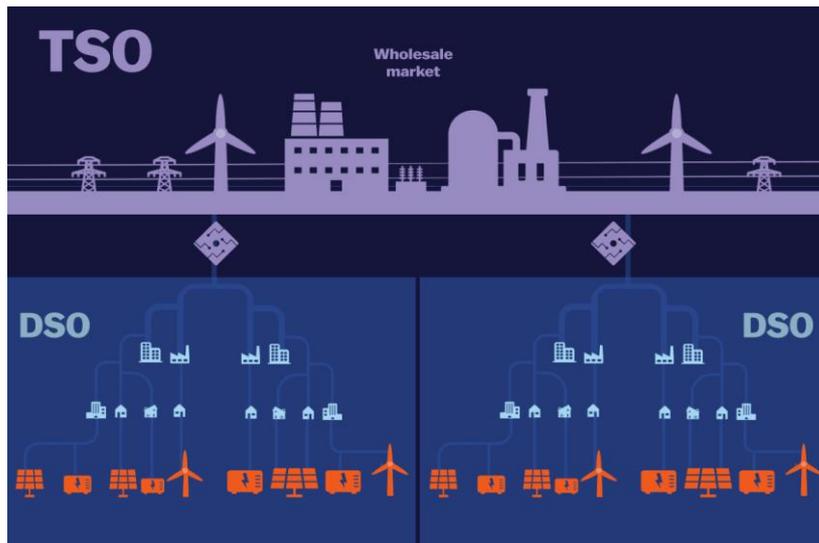


## Evolution of Ontario's distributors

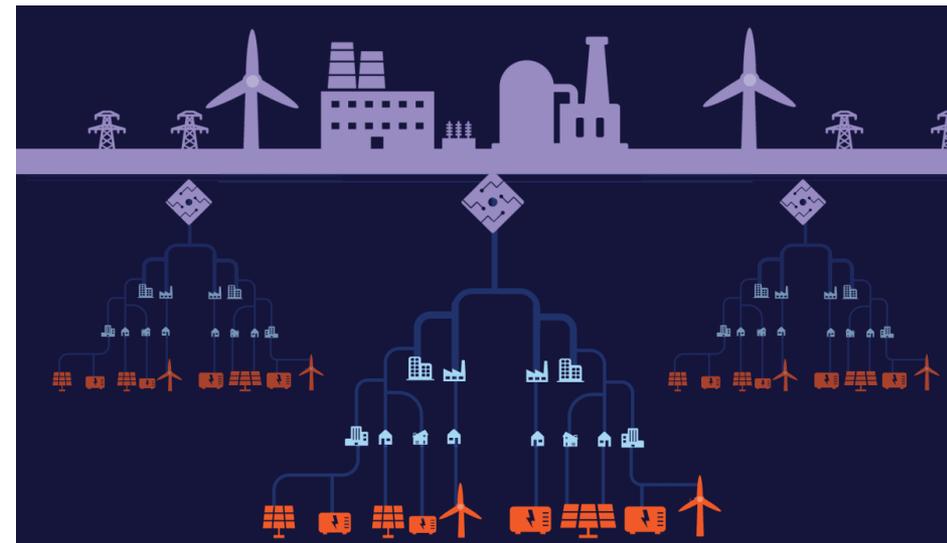
- Significant discussion with respect to new roles and functions that Ontario's LDCs may perform in future
- While the eventual "end state" may not be certain, what first steps can LDCs start to explore today?

# Future Grid Architecture Models: GCO vs. LDA

## Grand Central Optimization



## Layered Decentralized Optimization



*Images from VOX*

Kristov, L., De Martini, P., & Taft, J. D. (2016). A tale of two visions: Designing a decentralized transactive electric system. *IEEE Power and Energy Magazine*, 14(3), 63-69.

# Future Grid Architecture Models: GCO vs. LDA

## Grand Central Optimization

- Distribution System Operator (DSO) provides coordination services and utilizes DERs to support distribution system operations, defer investments, etc.
- Minimal DSO – Transmission System Operator (TSO) would see DERs in optimization as if located at T-D station
- Total TSO – full view of the distribution network
- DSO new functions to coordinate activities of DERs, and however limited to maintain system reliability as DERs respond to TSO dispatch

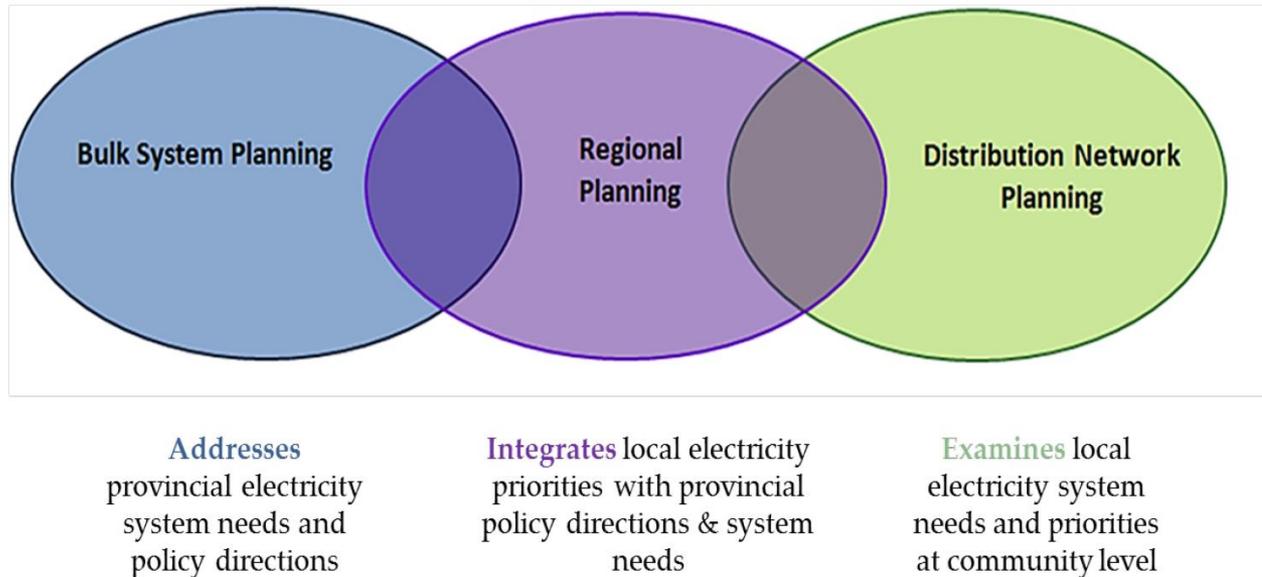
## Layered Decentralized Optimization

- DSO aggregate all DERs within local distribution area (LDA), e.g., node, including from third-party aggregators
- DSO submits a single bid to the wholesale market at the node reflecting net aggregated needs
- TSO optimizes bids and does not require visibility into the distribution system; DSO decides how best to utilize DERs within LDA in response to TSO dispatch
- DSO also obtains services from DERs to support distribution operations
- Requires sufficient liquidity and DER diversity

# What first steps may LDCs consider in the transition towards new grid architecture?

- With the onset of MRP implementation, we have identified four areas where increased distribution sector involvement should be further explored in the near term
- Rationale for considering:
  - Existing roles within the Ontario and statutory framework
  - Driving savings for customers
  - Increasing efficiencies at the wholesale level
  - Capacity building towards longer-term vision



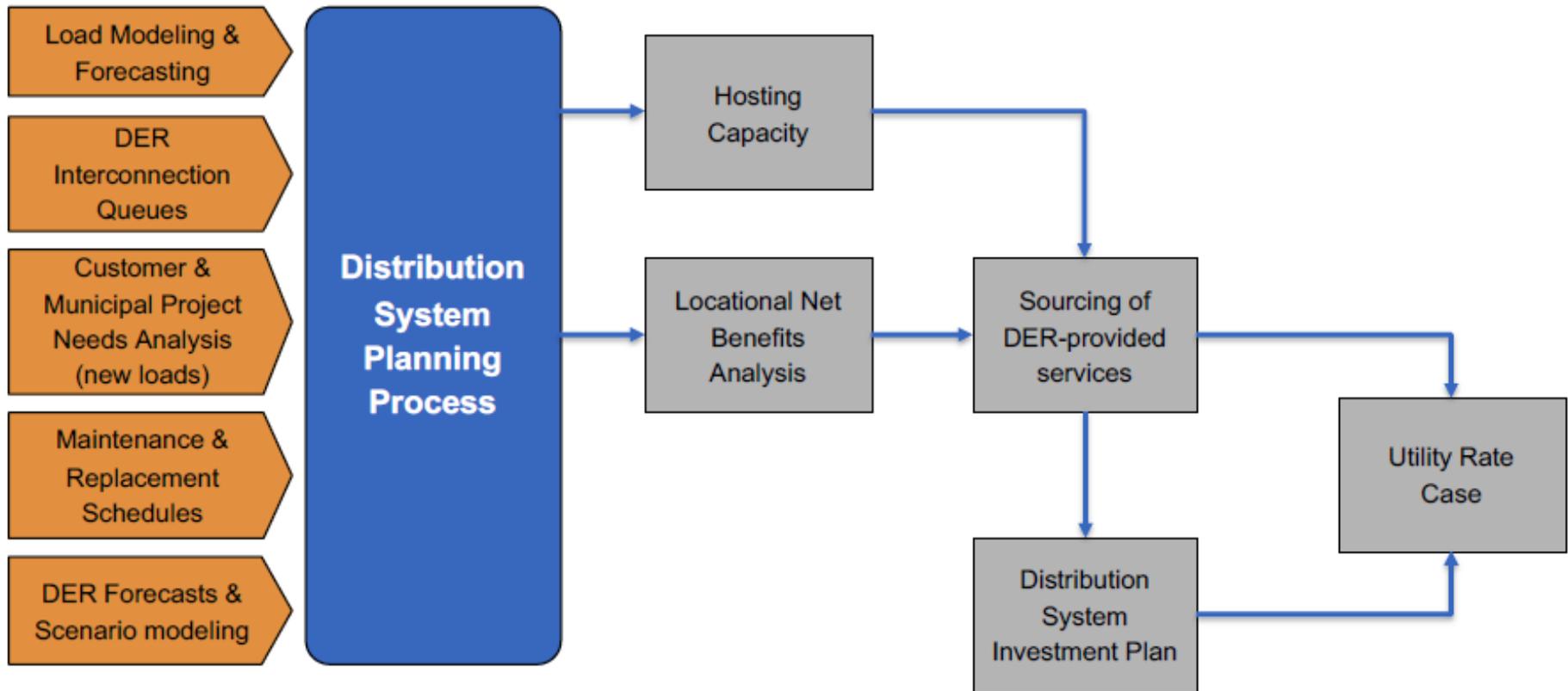


- Regional planning is conducted by IESO with input from transmitter and distributors (and others)
- IESO is currently engaging in consultation to review the Integrated Resource Planning (IRRP) process, and is considering options to remove barriers for Non-Wires Alternatives (NWA's)

**Source: IESO**

- Both EDA's Power To Connect and the OEA's Load Serving Entity (LSE) discussion paper emphasized the need to augment the role of LDCs with respect to planning for resource requirements
  - Wide range of inputs, local factors effecting resource and system needs
  - Customer driven uptake of DERs impacting load forecast

# A renewed approach for distribution system planning



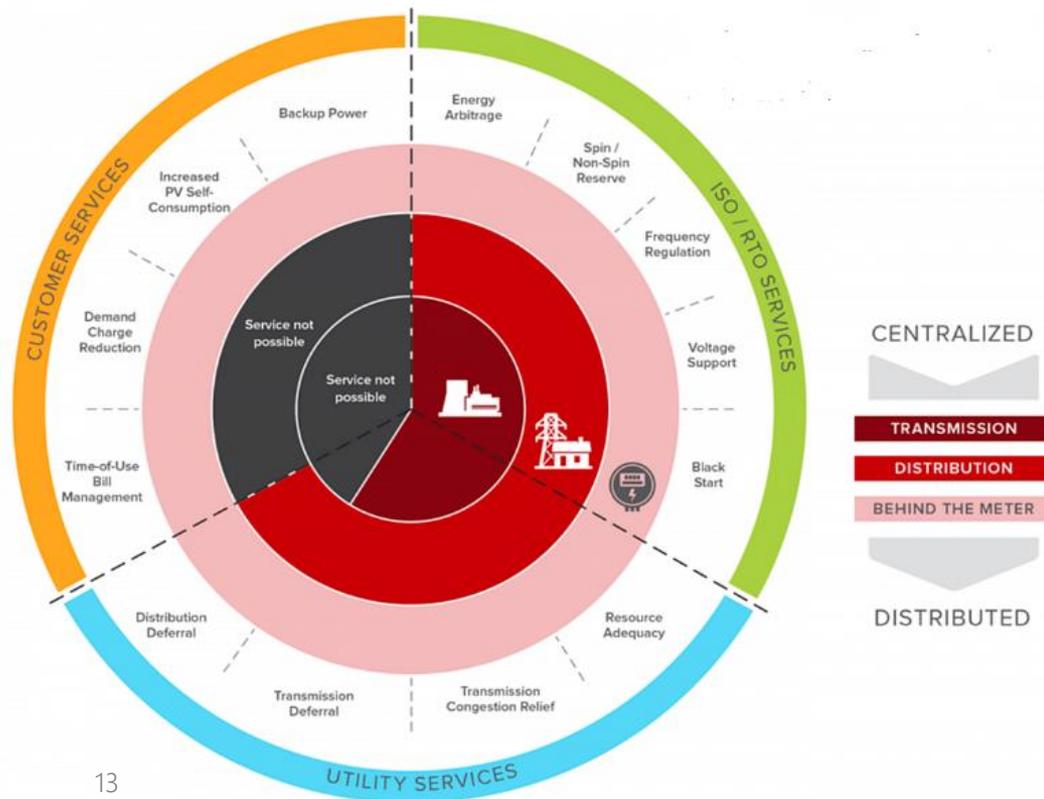
Advanced Energy Economy. (2018, June 29). Distribution System Planning: Proactively Planning for More Distributed Assets at the Grid Edge.



- Building on improved planning for system needs, NWA's consisting of a DERs and other solutions will be identified through DSPs
- Cost of NWA's to the LDC's customers should be offset by the local capacity value, energy value, and other value streams (e.g., ancillary services, environmental attributes, etc.)
- For example, one potential value stream could be the IESO's Capacity Auctions (Note: IESO's Grid Innovation Fund is conducting a pilot auction for energy efficiency in 2020)

**Two potential paths:**

- **Local need put to competitive bid** – supplier bids project to distributor, with assumption of revenues obtained from IAM
- **LDC-owned asset** – as contemplated by EDA, revenues earned in IAM would be considered "revenue offsets" in rate-filings



Fitzgerald, G., Mandel, J., Morris, J., & Touati, H. (2015). The economics of battery energy storage: How multi-use, customer-sited batteries deliver the most services and value to customers and the grid. Rocky Mountain Institute

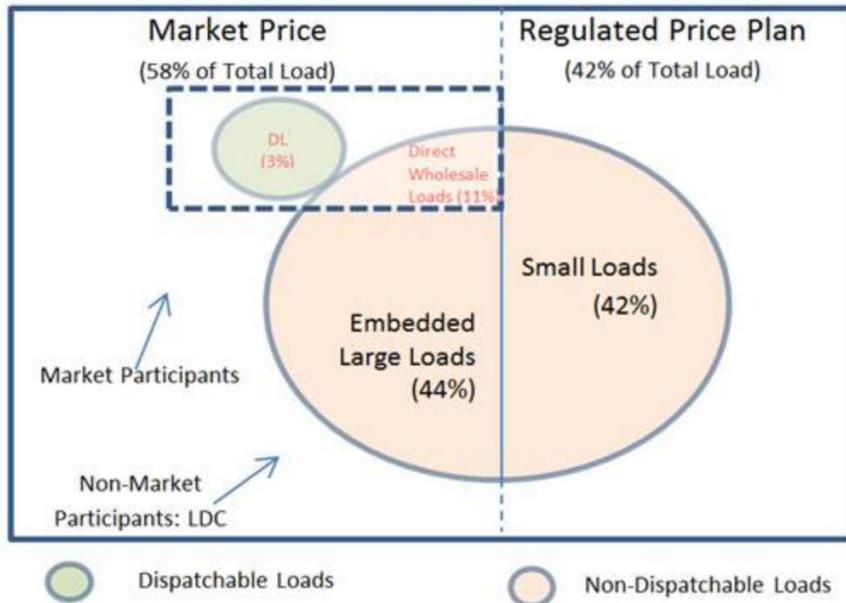
# Example of simplified NWA consisting of energy efficiency

- A DSP identifies a system need due to local area load growth in a pocket its distribution system
- The LDC solicits bids through a competitive and technology-agnostic procurement process to meet the localized need
- A targeted energy efficiency program is determined to be the most cost-effective and viable solution to defer grid expansion by stacking the following revenue streams
  - Savings resulting from differed distribution system capital investment
  - Shared savings with electricity customers resulting in reduced consumption and lower bills
  - Capacity value recognized through capacity auction
- Overall benefit to be shared with the LDC's customers
  - Reduced grid expansion costs due to selection of most cost-effective solution
  - Reduced costs associated with resource adequacy due to increased competition in capacity auction
- Approach needs to be coordinated with OEB (e.g., remuneration framework) as well as the IESO (e.g., inter-operability)



- IESO forecasts demand for all NDLS
  - NDLS are IESO Market Participant consumers, consisting of primarily of large industrial consumers and LDCs who flow through energy costs to their customers
  - LDCs are the largest group of NDLS in Ontario
- As DERs increase it has become increasingly challenging to accurately forecast load, resulting in the potential to over- or under-commit resources in the day-ahead process
- One of the IESO's rationale for introducing the DAM includes increasing participation from loads, including the introduction of PRLs
  - PRL customers would become DAM participants and would be motivated to accurately forecast their own consumption to maximize benefit of day-ahead pricing
  - PRLs may also respond to low real-time prices and increase consumption (e.g., potential storage arbitrage)
- IESO's DAM proposal does not preclude LDC participation, but IESO indicates that there are regulatory or legislative barriers preventing for LDCs to become PRLs (i.e., they are not LSEs)

# Consideration for PRLs



Source: IESO

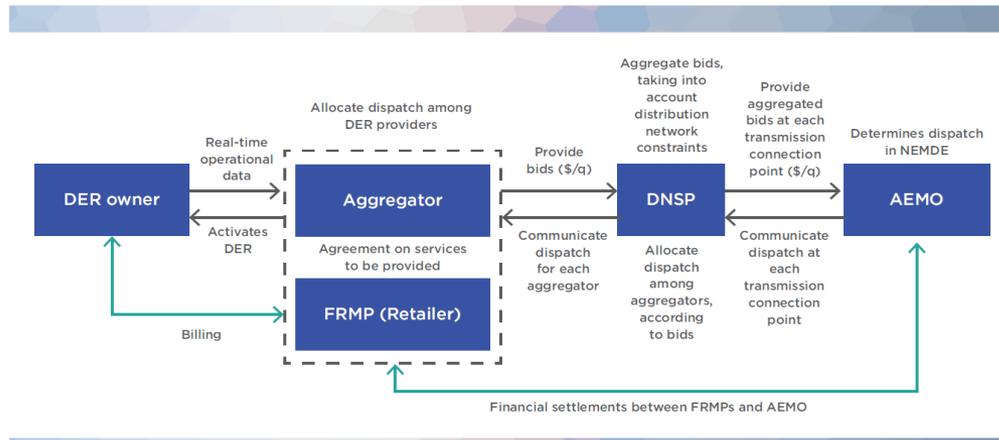
- The PRL option provides consumers with an opportunity to actively participate in the IAM without being subject to IESO dispatch, which may be desirable depending on location within the province (e.g., Northern Ontario expected to have lower LMPs relative to Ontario Zonal Price)
- However, IESO market participation remains impractical for smaller consumers
- LDCs could enter into agreements with customers (e.g., local DR programs) or leverage energy storage assets, and share energy savings with customers
- With improved planning and grid visibility LDCs would be well positioned to predict day-ahead demand (e.g., knowledge of passive DERs, outage information, etc.)



- As part of their Innovation and Sector Evolution White Paper Series, the IESO is developing a white paper on Transmission Distribution Interoperability
- The purpose of the white paper is to:
  - provide a practical understanding within Ontario's electricity sector of how roles and technical requirements could evolve in the future and to provide considerations for comparing and evaluating potential evolutionary paths
  - IESO may use findings to further policy and regulatory efforts related to the evolution of the distribution sector in Ontario
- The scope includes providing:
  - a detailed definition of the functions that will need to be fulfilled in a high-DER future in order to provide a reliable and cost-effective supply of electricity;
  - clarity on the interfaces between entities, data exchange requirements, and IT and communication technologies needed to coordinate actions of various entities in a high-DER future; and
  - initial considerations on the merits and drawbacks of potential models for allocating functions to various entities (e.g. IESO, distributors, aggregators, etc.) in a high-DER future

# Model for consideration

Figure 15: Two Step Tiered Platform; DNSPs optimising distribution level dispatch



Consultation on how best to transition to a two-way grid that allows better integration of Distributed Energy Resources for the benefit of all consumers



Ex. Two aggregators of DERs offer 1 MW each behind a 1.5 MW network constraint (\$5/MWh, and \$6/MWh)

The aggregated bid to the ISO would show availability of 1 MW at \$5/MWh, and 0.5MW at \$6/MWh

- Distribution Network Service Provider (DNSP, which is equivalent to an LDC) takes responsibility for optimisation of DER dispatch within their own networks
- DNSP aggregates bids, taking into account distribution network constraints that may prevent DER operation
- DNSP pass aggregated bids to AEMO (ISO) associated with each transmission connection point
- The aggregated distributed resources would appear to ISO's dispatch engine as a single virtual generator or scheduled load located at the transmission connection point

# Model for consideration, continued

- With all bids received, the AEMO (ISO) calculates dispatch targets at each transmission connection point, and communicate these to the DNSP
- DNSP disaggregate dispatch targets to each aggregator, based upon their respective bids (with the lowest priced offers having the most access to network capacity) and the aggregators would then activate their customer's DER to meet the required dispatch targets
- The advantages of this model are:
  - DNSPs takes responsibility for management of DERs in their own networks (e.g., quantify and manage the limits of the network) and limits duplication of resources at other organisations
  - Facilitates a more decentralised operation of distribution networks (e.g., manage "fringe of grid" operations without constant centralised control) and helps manage degrees of complexity
- The disadvantages are:
  - Experience with real-time dispatch processes need to invest in new capabilities
  - Interface between DNSPs and ISO around the communication of aggregated bids in real-time will need be carefully designed to minimise complexity

# Conclusion

- Many opportunities to consider roles, new functions and evolution of LDC business model, for example,
  - IESO's Innovation and Sector Evolution Whitepaper Series
  - IESO's Market Development Advisory Group
  - IESO's review of the IRRP process
  - IESO's upcoming Resource Adequacy engagement
  - OEB's Utility Remuneration and Responding to DERs policy initiatives
- MRP sets a new baseline for these discussions
  - Locational value of resources – including DERs and energy efficiency
  - New modes of IAM participation – including PRLs
  - New revenue streams - including capacity auctions



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