Comparison of Distribution System Operator (DSO) Models

Best Practices for North American Utilities

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Managing demand is more important than ever

Ontario will experience

60%

growth in electricity demand by 2050.

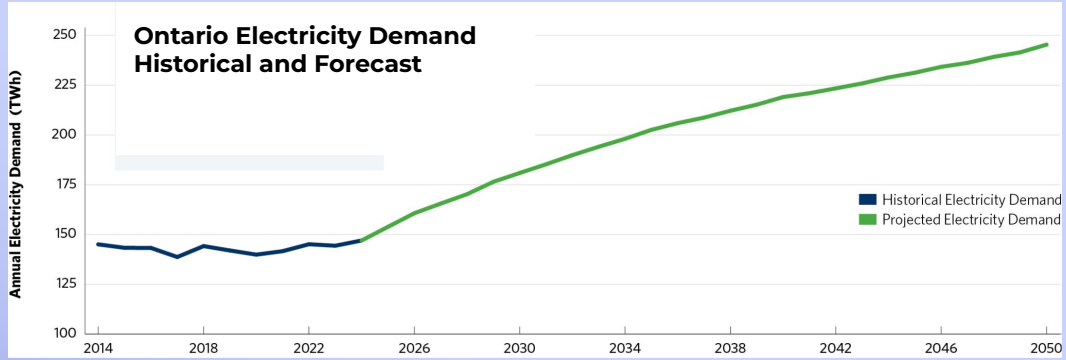
We can't build capacity fast enough

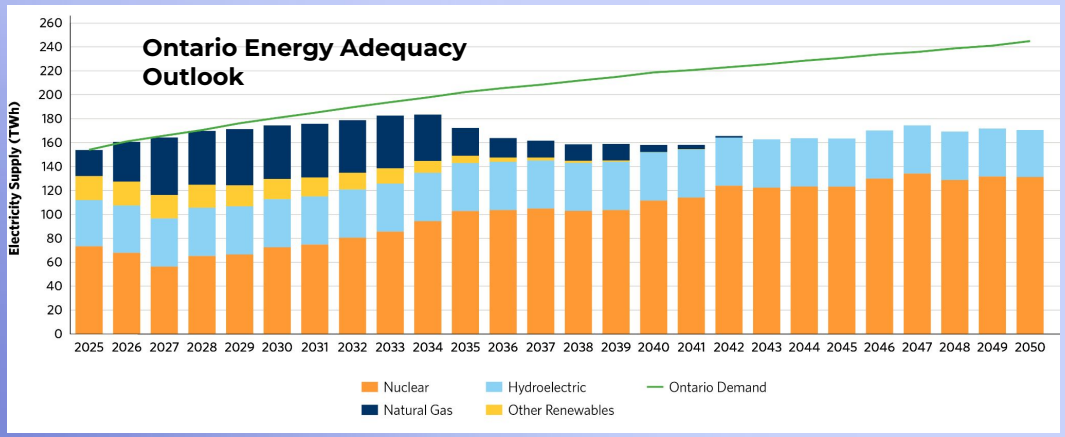
Deploying

80-160 GW

of *flexible load* through virtual power plants (VPPs)

Could Save **US $10 Billion in Annual Grid Costs**





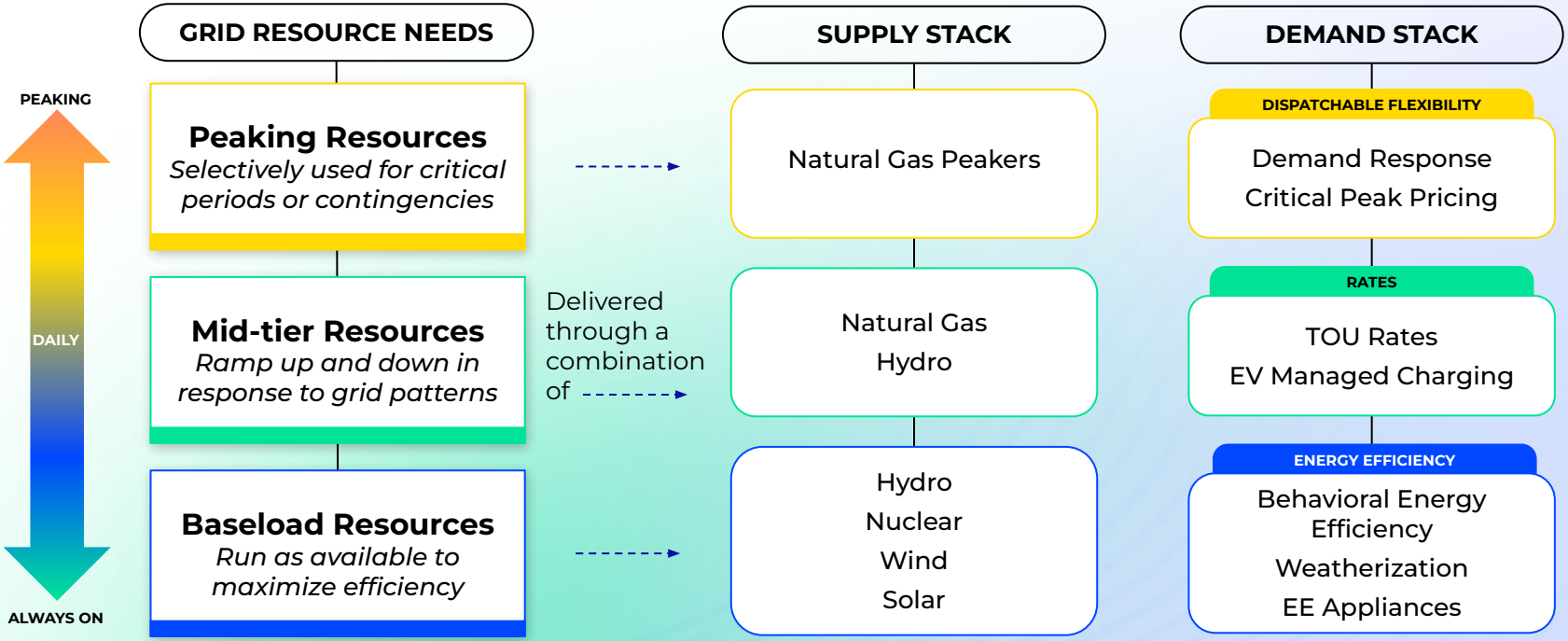
MARKET CHALLENGE:

DSM isn’t reaching its full potential

75-80% of customers are willing to take action to manage their energy, yet the majority of EE, time varying rates (TVR), and DR programs only achieve single-digit enrollment rates

Existing DSM Trend	Implication
Programs designed individually	Contradictory rules and eligibility criteria exclude potential participants
Independent funding and procurement	Little or no ability to pivot and reallocate budget based on program performance
Separate implementation timelines and pathways	Fragmented customer experiences limit participation & impact
Isolated program evaluation	“Cannibalization” hinders deemed savings and cost-effectiveness

Demand Stack: A coordinated strategy that serves both customer needs and grid requirements



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DSOs can enable utilities to

Connect the Control Room to the Customer

ADMS Partner
Grid Optimization

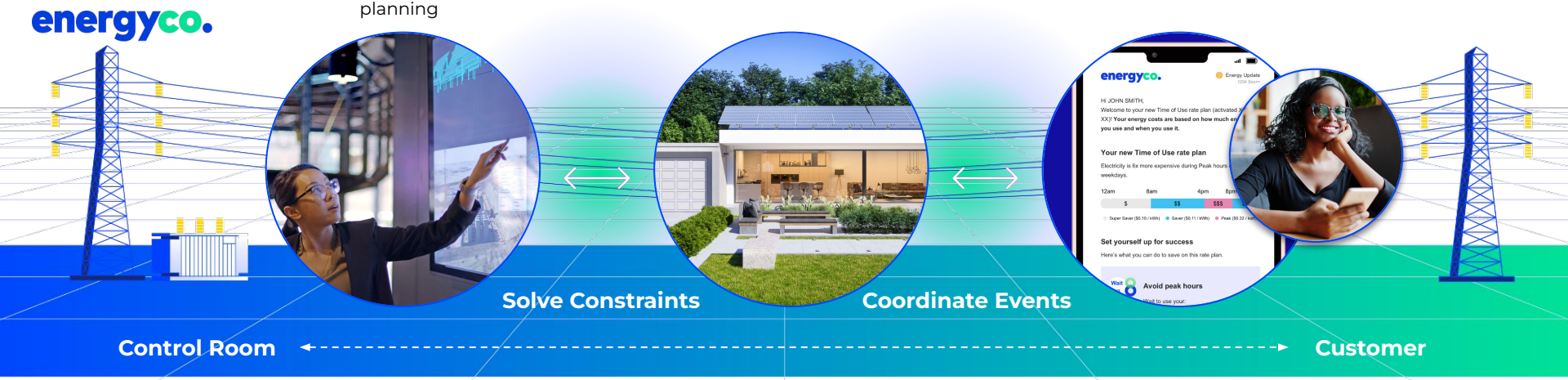
BENEFIT
Utility maximizes the value of their investments in ADMS and DERMS; both for day-to-day operations and long-term planning

DERMS
Flexibility Services

BENEFIT
DERs truly become resources ones that can be monitored and managed in a predictable and reliable way

Uplight Platform
Customer Engagement

BENEFIT
Customers are educated and engaged about how their participation benefits them, their community, and the system



Through Uplight, demand response is simple for customers and powerful for utilities

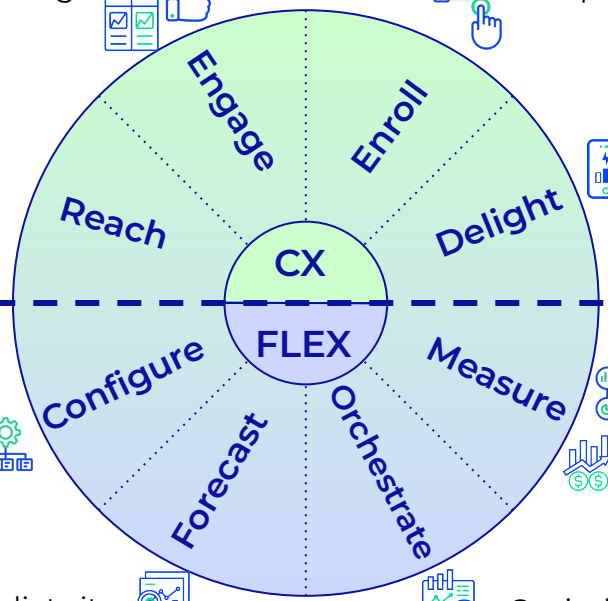
Customer Experiences

Build trust through tailored messaging & offerings

Convert recruits through simple digital experiences

Raise interest & verify eligibility across channels

Personalized feedback to inform and retain



Utility Capabilities

Customize program & data model

Analyze M&V, reports, & BI dashboards

Monitor & predict site & portfolio availability

Optimize grouping & sequencing to maximize performance

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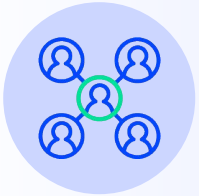
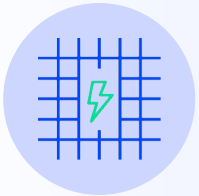
Utility Goals for DSO and Load Flexibility

Utilities are increasingly focused on becoming **distribution system operators (DSO)**, managing two-way flow of power on the distribution grid. To become a DSO, utilities must orchestrate DERs to optimize across the following goals:

Cost-effective aggregation of DER assets: procure, aggregate, and manage lowest-cost capacity from DER aggregators to address key use cases on the distribution grid.



Simplicity of vendor management: reduce complexity associated with procuring and managing multiple DER aggregators.



Visibility of DER assets on distribution network: increase visibility of the types, location, and operational characteristics of DER assets on the distribution grid to inform planning and operation of distribution system.

Control of DER assets on distribution network: provide direct control over DER assets to enable reliable operation and address grid needs in real time.

High quality customer engagement: provide customers with reliable information and create a frictionless experience.

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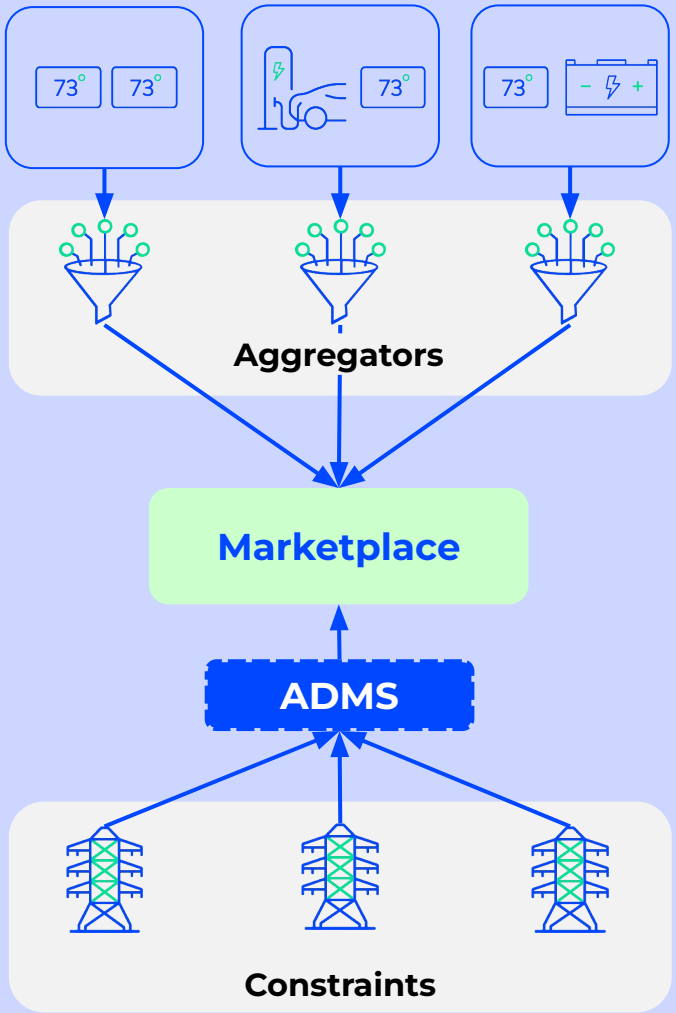
The Distribution Marketplace (DM) Model

Initially launched in the UK, the DM Model has the following features:

- Seeks to create a competitive and fungible marketplace for load flexibility.
- DM vendor serves as intermediary between system operators and DER aggregators.
- DM vendor exposes location, time, volume and costs of distribution constraints.
- DM vendor invites bids from 3rd party DER aggregators to address distribution constraints.
- Utility enters into contracts with multiple 3rd party aggregators.
- Operational control of DERs stays with third-party aggregators; utility has no direct control of DER assets.



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Vendor and Aggregator Participation in Distribution Marketplace

DM vendors facilitate 3rd party aggregator participation via three steps:

Market Set Up
Open flexibility market

- ***Membership***: registration of aggregator on distribution marketplace.
- ***Market set-up***: definition of market rules and platform configuration.
- ***Flex need***: publication of constraint areas and signal of a flexibility need.
- ***Qualification***: aggregator supplier review process facilitated by the DM vendor, which may include signing of T&C's or agreements for services.

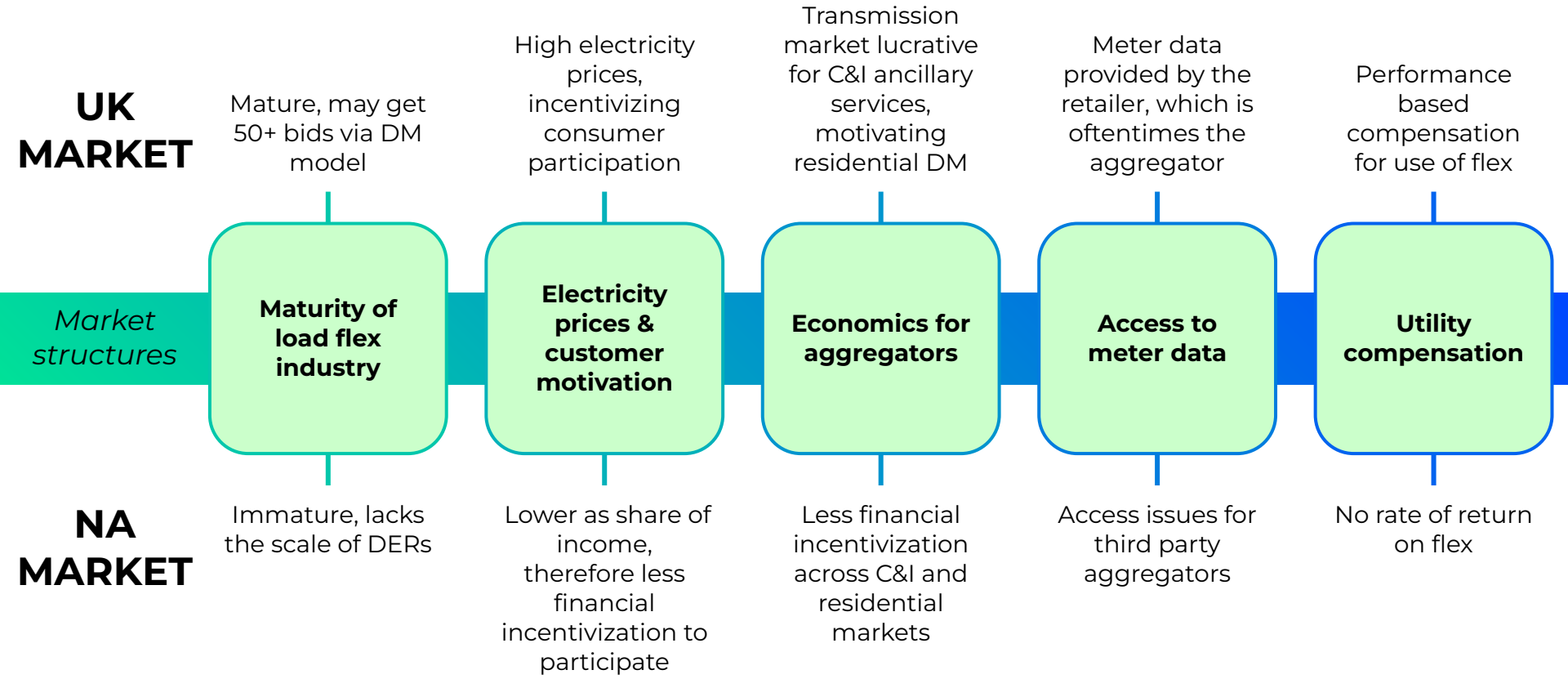
Trading
Price discoverability & transaction

- ***Reservation***: reservation of flexibility ahead of time.
- ***Activation***: activation of flexibility closer to delivery time.
- ***Dispatch notifications***: notifications for flexibility service providers and dispatch.

Post Trading
Validation & invoicing

- ***Validation***: verification that flexibility has been delivered.
- ***Financial settlement***: invoicing and payments.

North American (NA) DM Model Challenges due to Nascent Market Structure



Utility Load Flexibility Goals with the DM Model

 **Cost-effective aggregation of DER assets**	**Med**: Market structure can allow for most cost-effective aggregators to participate based on bids; however, less mature market will lead to fewer bids, reducing price competition.
 **Visibility of DERs on distribution network**	**Low**: Utility has limited visibility into DER location. The aggregator is the party with direct visibility and may not bid all DERs.
 **Control of DERs on distribution network**	**Low**: Utility has limited control over all DERs in service territory. The aggregator has control and is the party bidding specific DERs.
 **High quality customer engagement**	**Low**: Utility does not engage with end customer. The aggregator is the party that manages the customer relationship.
 **Simplicity of vendor management**	**Med**: Utility contracts with DM vendor **and** must manage contracts with individual aggregators.

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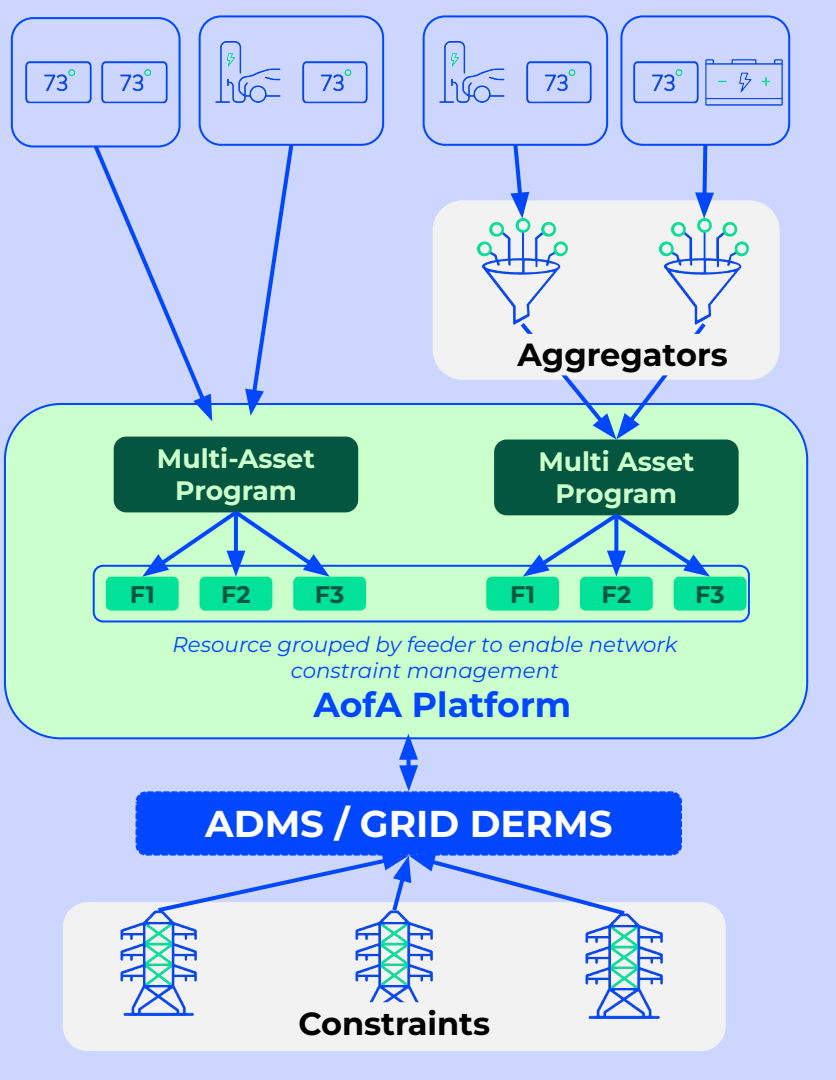
The Aggregator of Aggregators (AofA) Model

Provides a single pane of glass to enable aggregator participation and manage various utility flexibility programs at the technology and/or feeder level.

The AofA Model has the following features:

- **Aggregation of Flexibility:** Consolidates flexibility data from various aggregators and provides a comprehensive overview of available resources.
- **Customer Engagement:** Option for utility-led customer engagement reduces customer confusion and the potential for false or misleading advertising.
- **Dispatch Coordination:** Coordinates dispatch signals via any Open Protocol between the utility and aggregators.
- **Data Management:** Manages program and performance data used to evaluate effectiveness.
- **Market Interaction:** May interact with energy markets on behalf of aggregators, participating in bidding and settlement processes.
- **Integration with ADMS / GRID DERMS:** Responsible for integrating with GRID DERMS to support situational awareness and advanced use cases such as targeted dispatch.



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CASE STUDY

$40M Savings over 3 Years with 240 MW of Flexibility Management

Profile:

Largest municipally-owned energy utility in the US with 840,000 electric customers in the San Antonio area

Challenge:

Operating multiple DR programs with point solutions; Lack of consolidated view for capacity analysis and dispatch

Solution:

Flex manages 10 residential and C&I flexibility programs; Next-day M&V analysis for increased customer engagement

- **C&I-1:** 8 MW
- **C&I-2**: 2 MW
- **C&I-3:** 92 MW
- **C&I-4:** 6 MW
- **C&I-5:** 25 MW
- **Nest:** 41 MW
- **Resideo:** 22 MW
- **EnergyHub:** 20 MW
- **WhiskerLabs:** 4 MW
- **Other T-stats:** 20 MW

Total: 240 MW

133 MW of C&I Demand Response
1,000 C&I Customers
DLC & Notifications-Based Dispatch

Multiple Value Streams

T&D Savings	Wholesale Price Hedging	Emergency DR

$12M Savings in 2021 DR Season

10 Weeks Deployment

"240 MW is equivalent to a natural gas-powered peaking plant in our generation portfolio"

John Bonnin
Vice President, Energy Supply (Retired)

Benefits of the Aggregator of Aggregators Model

Specialized Focus

Aggregators can concentrate on specific customer segments and/or DER types, tailoring their outreach and engagement strategies for optimal results. This leads to enhanced customer satisfaction and program effectiveness.

Streamlined Integration

Utilities need to integrate with only one DERMS platform, reducing operational costs and simplifying data management.

Efficient Coordination

The centralized DERMS platform streamlines communication and coordination between the utility and aggregators, facilitating efficient program operation and data exchange.

Standard Flexibility, Forecasting, & M&V

The centralized DERMS platform enables consistent forecasting and measurement & verification (M&V) processes across aggregators. This standardization enhances data quality and facilitates immediate and accurate program evaluation.

Seamless Grid Integration

The presence of a centralized DERMS platform enables integration with ADMS / GRID DERMS platform, enabling real-time situational awareness and efficient dispatch of resources at the network level, even with multiple aggregators.

Utility Load Flexibility Goals with the Aggregator of Aggregators Model

Cost-effective aggregation of DER assets	**Med**: Utility competitively procures a AofA vendor to recruit and orchestrate DER assets and manage dispatch of other aggregators.
Visibility of DERs on distribution network	**High**: Utility can view all DER types, across locations, technologies, and customer classes, via a “single pane of glass” afforded by AofA.
Control of DERs on distribution network	**High**: Utility can control and dispatch all DER types, across locations, technologies, and customer classes, via a “single pane of glass” afforded by AofA.
High quality customer engagement	**High**: Customer communications may be managed by utility through single vendor, which acts as an extension of the utility, rather than on an aggregator-by-aggregator basis.
Simplicity of vendor management	**High**: Consolidation to one AofA vendor which manages aggregator dispatch on behalf of the utility.

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Defining Opportunities and Objectives

- **What are your views on the opportunity and policy objectives for DSO capabilities?**
  Uplight agrees with OEB's views on opportunity and policy objectives for DSO capabilities. As OEB notes, investments in DSO capabilities and associated grid modernization will help enhance system reliability and optimize local electricity networks, especially in light of increasing load growth and affordability pressures on ratepayers. Introducing DSO capabilities aligns with Ontario's policy objectives, including supporting electrification and ensuring cost-effective system planning. By enabling more dynamic and efficient grid operations, these investments help the province adapt to evolving energy needs while maintaining affordability and reliability for consumers.

- **What are your views on the use cases and value of DSO capabilities for Ontario, including the importance of DSO capabilities in capturing more of the benefits DERs can provide?**
  As noted previously in this presentation, and in alignment with OEB's Discussion Paper, we believe DSOs can unlock a variety of use cases and value for DERs, customers, and the grid. Chief among these is that DSOs can enable cost-effective aggregation of DER assets, simplify DER/A vendor management for utilities and customers, increase visibility and control of DER assets on a utility's distribution network, and foster high quality customer engagement.

- **How should the OEB's objectives (as set out in section 1 of the OEB Act) be balanced and reflected in the development of a DSO policy framework for Ontario?**
  We defer to OEB's expertise on this matter.

Evaluating Proposals and Approaches

- **Is an evolutionary approach to developing DSO capabilities appropriate for Ontario to pursue in order to achieve the policy objectives set out in the Staff Discussion Paper?**
  Uplight is broadly supportive of an evolutionary approach to developing DSO capabilities. We note that the success of DSO models are highly dependent on local electricity policies, regulations, and market features, including for example: maturity of the local demand flexibility industry, local electricity market prices, economics for aggregators, access to meter data, and utility compensation (e.g., earnings opportunities).

  We note that in Ontario there are widely varying perspectives on how the DSO market should be designed, who should administer it, the role that aggregators should play, and the means to ensure cost-effectiveness.

  Given the relative immaturity of the DER market in Ontario, and the wide-ranging perspective on DSO market development, we believe it is critical for OEB to enable flexibility in DSO structure across LDCS in order to develop firsthand experience and knowledge of what works and does not work.

  Thus, as noted by OEB, we believe it is sensible to adopt *an evolutionary, evidence-based approach to develop DSO capabilities in a manner that considers Ontario-specific circumstances and minimizes the risk of stranded investment*.

Evaluating Proposals and Approaches (cont)

- **What are your views on each of the three proposals presented in the Staff Discussion Paper?**
  Proposal 1 would require distributors to assess the need for DSO capabilities to address system needs. Uplight is supportive of assessments to determine the highest value use cases for DSO by utilities. We agree with OEB's assertion that such an assessment will help ensure that grid modernization investments are made where and when appropriate.

  Proposal 2 would develop a simplified DSO model structured around the "Regulated DSO model." In the Regulated DSO model, the DSO would procure a DER/A for the distribution system via a program-based mechanism. At the same time, the IESO would procure a DER/A for the wholesale electricity market. While we believe this approach could work, it does not appear to enable DER/As to stack value across the distribution system and wholesale market, which would reduce the cost-effectiveness of the DSO.

  Thus, we would encourage a program-based approach (like the Regulated DSO model) wherein the DSO also facilitates offers of DER/A into the wholesale market. We note that this approach has been undertaken by several utilities in the U.S. (e.g., PSEG, PG&E, etc.)

  Proposal 3 would afford regulatory flexibility to address the diversity of needs that necessitate the development of capabilities, which could outstrip those contemplated for the Simplified DSO. This prompts the opportunity to define an advanced model that best suits Ontario's conditions given the roles of distributors, other incumbents, the design of current markets and other factors canvassed earlier in this paper. This stream of work would also examine requirements and supports that are necessary for delivery of DSO capabilities on a shared basis, including assessments of the benefits of a common platform.

  Uplight is generally supportive of options to increase flexibility of DSO design, including the DSO-as-a-Service model that would facilitate participation from smaller LDCs.

Balancing Standardization and Flexibility

- **How should the OEB best balance the benefits of a standard approach relative to the innovation and insights that could be gleaned from enabling greater flexibility and diversity through experimentation?**
  Experience shows that the most successful programs take a design-test-learn-refine approach, enabling LDCs or other stakeholders to experiment with approaches and scale those that are most successful in their unique market context.

  Thus, we propose that OEB encourage LDCs to develop 3-5 year pilot programs that enable them to test and measure key features of interest in the DSO. While we agree with the DNV analysis that the Regulated DSO approach (i.e., a LDC-led, program-based approach) is the most efficient means of deploying DSOs in Ontario, it is entirely possible that various distribution-level, market based models could best address the needs for certain use cases or market segments (e.g., for C&I facilities).

  We also believe running a series of test and learn pilot programs would provide valuable data and experience to inform creation of an actionable roadmap for DSO implementation. Thus, we also agree with the Ontario Energy Association's recommendation to develop a sector-led working group—comprising LDCs, aggregators, software developers, and the OEB—to co-develop the DSO model(s) and a scalable implementation roadmap.

  To summarize, we believe a design-test-learn-refine approach, combined wiht a comprehensive roadmapping process, would provide the LDCs a valuable opportunity to experiment with various DSO approaches, identify the approach(es) that best suit their needs, and devleop a roadmap and implementation plan to scale the most successful approaches over time.

Summary Slide

- Load growth from electrification and new industrial load (e.g., data centers) requires investment in DSO capabilities and associated grid modernization solutions to enhance system reliability, optimize local electricity networks, and keep the grid affordable.
- Multiple models exist for DSO deploying, each of which have pros and cons for Ontario's unique market context
- There are significant structural differences between North American and European/UK electricity markets, which LDCs, regulators and industry leaders should be mindful of when designing a new DSO in Ontario.
- Ontario would benefit by piloting different DSO models in order to determine what works or does not work. Based on results of 3-5 year pilot programs, LDCs will be well positioned to scale up investment in the "right" DSO model in Ontario.

Questions?

Neil Veilleux, Vice President of Market Development
Uplight
neil.veilleux@uplight.com

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Appendix: Reference Slides

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DNV

Table 1-3. DSO models overview

	Regulated DSO Model	Dual Participation DSO (DP-DSO) Model	Market Facilitator (MF-DSO) Model	Total DSO (TDSO) Model
Synopsis	This model is a continuation of the current status quo and can serve as a baseline model. This model supports the augmentation of DSO functions by applying rule-based mechanisms that may better fit the horizontal integration of DNO-DSO functions and in the absence of mature and reliable flexibility markets.	This model separates the DNO and DSO functions within the same organisation, allowing a market-based approach to DER integration yet limiting the DSO's network planning responsibilities.	This model separates the DNO and DSO functions within the same organisation, but without limiting the DSO's responsibilities in relation to network planning and with the DSO acting as a facilitator of flexibility at both Dx and Tx levels.	This model separates the DNO and DSO functions and businesses, allowing a market-based approach for DER integration, widening the DSO responsibilities compared to DP-DSO towards a total-DSO model.
Brief Overview of Roles	The DSO directly procures congestion management services through mandatory bilateral contracts, managing distribution network congestion, while the IESO handles transmission network congestion.	The DSO and IESO share responsibility for market administration. The DSO manages services to the distribution system and the IESO manages wholesale market services. DERs participate in wholesale markets directly or via aggregators.	The DSO acts as a non-commercial aggregator, optimises the distribution network, and coordinates with the IESO for wholesale market services.	The DSO operates distribution-level markets with DERs directly participating. For wholesale market services, the DSO acts as an aggregator, and DERs participate through the DSO.

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