# TDWG Working Group Meeting #17

## Sub-group B Deliverables Overview

**Tuesday May 27th, 2025**

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# Agenda

1. TDWG Deliverables Overview – Hani Taki (5 Mins)
2. B1 Sub-group Deliverables Overview – Hisham Omara (5 Mins)
3. Sub-group Work Package Discussion (25 Mins)
    1. Work Package 1 – Vivek Somasundaram (5 Mins)
    2. Work Package 2 – Ken Chadha (5 Mins)
    3. Work Package 3 – Sunny Patel (5 Mins)
    4. Work Package 4 & 5 – Hisham Omara (10 Mins)
4. Next Steps & Feedback Questions – Rei Marzoughi (5 Mins)
5. Q&A (20 Mins)
6. Appendices

# 01

## B1 TDWG Deliverables Overview

# Context

The **Transmission-Distribution Coordination Working Group** (TDWG) was **initiated in 2022** with the **IESO working closely with LDCs** and other stakeholders to inform the **DER Market Vision and Design Project**.[1,2]

The goal was to develop coordination protocols enabling the effective participation of Distributed Energy Resources either individually or in aggregation—in the IESO-administered wholesale markets. Ultimately, the work was meant to support evolving system needs related to the integration of a broader range of DERs while maintaining both transmission and distribution-level reliability.[3]

This was a collaborative engagement between:

- The IESO;
- Ontario Distribution and Transmission Companies;
- DER Aggregators; and
- other stakeholders with knowledge of grid operations, planning and/or DER integration.

The primary objective was to establish T-D coordination protocols that:

I. Enable timely, transparent communication between IESO, LDCs, and DER participants
II. Avoid conflicts, double counting, and unintended consequences
III. Support reliable coordination across both market and operational levels

Deliverables were developed for three different coordination models:

1. Dual Participation DSO (DP-DSO)
2. Total DSO (T-DSO)
3. Market Facilitator DSO (MF-DSO)

[1]The Project is a key focus area of IESO's DER integration activities and is what much of the near-term DER Roadmap efforts build towards.
[2]The DER Market Vision and Design Project will continue to be advanced through the Enabling Resources Program.
[3]Transmission-Distribution Coordination Working Group (TDWG) Terms of Reference – https://www.ieso.ca/-/media/Files/IESO/Document-Library/engage/tdwg/tdwg-20220516-terms-of-reference.pdf

# TDWG Deliverables Overview

| Deliverable | Coordination Protocols<br>A | Functional Assessment<br>B1 | Communication Assessment<br>B2 | Shared Platform<br>B3 |
|---|---|---|---|---|
| Strategic question | How will IESO, utilities and DERs coordinate amongst each other? | What **functions and capabilities** do utilities need to coordinate DERs? | What mediums will information be communicated through between system actors? | What are the requirements of a data sharing platform for coordination? |
| Lead(s) | IESO | Alectra, Toronto Hydro | Hydro One | Alectra |
| Key highlights | Coordination protocols on how IESO, LDCs and DERs will communicate during day ahead and real time (every 5 min) timeframes | User journeys of the **critical systems needed** during the planning and operational (real-time) timeframes for LDCs to coordinate DER facilitation. Includes requirements for both **LDCs and future role as DSO.** | Highlighted current communication pathways that exist, and future communication overview from EPRI for a global perspective. | Highlighted similar solutions across European markets, conducted requirement gathering workshops and drafting initial requirements documentation to support data exchange. |
| Sub-group team | Hydro One, Essex, Alectra | Essex, IESO, Elexicon, Power Advisory, Rodan Energy, PowerConsumers | Essex, Alectra, IESO, PowerAdvisory | Hydro One, IESO, PowerConsumers, Rodan Energy |

*Q4 2024 - Removed from Project

# 02

## B1 Sub-group Deliverables Overview

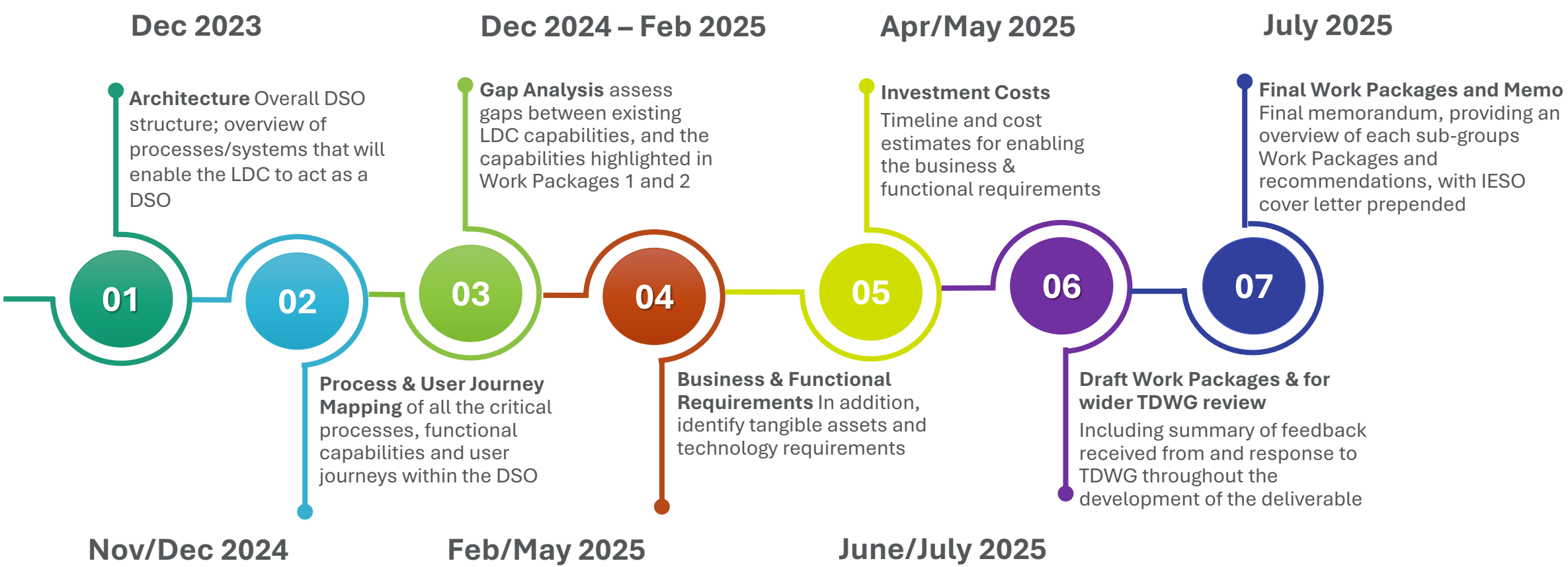
# Sub-group B1 Functional Assessment – DSO Models

**Distribution System Operator Definition (TDWG):** The entity responsible for operation of the electric distribution system and operational coordination with IESO at the transmission-distribution (T-D) interfaces. The DSO's capabilities may include advanced operational functions, such as operational planning, active management of DER/A to ensure distribution system reliability, and procurement and activation of DER/As for provision of distribution services.

The three types of DSOs models under consideration are Dual Participation DSO, Total DSO, and Market Facilitator DSO.

| Dual Participation DSO Model (DP-DS0) | Total DSO Model (T-DSO) | Market Facilitator Model (MF-DS0) |
|---|---|---|
| Under this model, DER/As participate directly in the wholesale market and are dispatched and optimized by the TSO to meet bulk system needs.<br><br>1. The DSO dispatches DER/A to meet local system needs.<br><br>2. DER/A are responsible for communication requirements associated with DER/A dispatching, curtailment, bids and offers between all parties | Under this model, the DSO is the sole counterparty for both the TSO and DER/A for wholesale and distribution-level services<br><br>1. DER/A participate directly with the T-DSO and the T-DSO submits a single set of wholesale market bids/offers that reflects the bids and offers of all participating DER/A within the service area.<br><br>2. The T-DSO would be subject to the same market rules, obligations, and penalties that apply to all wholesale market participants. | This model shifts away from T-DSO model, with two key differences.<br><br>1. The DSO would not be acting as an aggregator or market participant; it would only facilitate the participation of DERs within the service area.<br><br>2. The DER/A would maintain the commercial relationship with each market operator. The DSO would be responsible for relaying dispatch orders to DER/A based on local and bulk needs, communicating all information to the TSO, as well as providing measurement, verification, and settlement. The DSO will be responsible for optimizing distribution grid operations to support DER participation and limit curtailment. |

# Sub-group B1 Functional Assessment – Work Packages



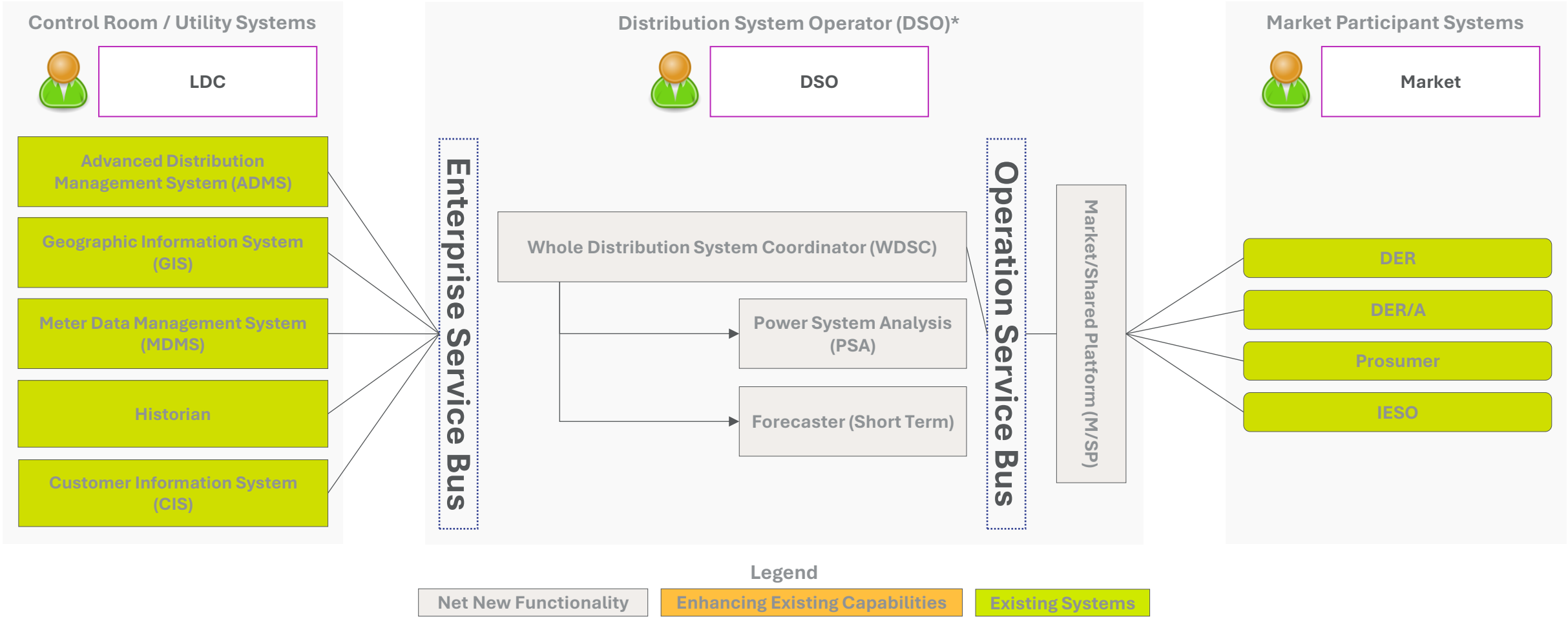
# 03.1

## Work Package #1

## DSO Architecture

# Proposed DSO Architecture – Operational Elements

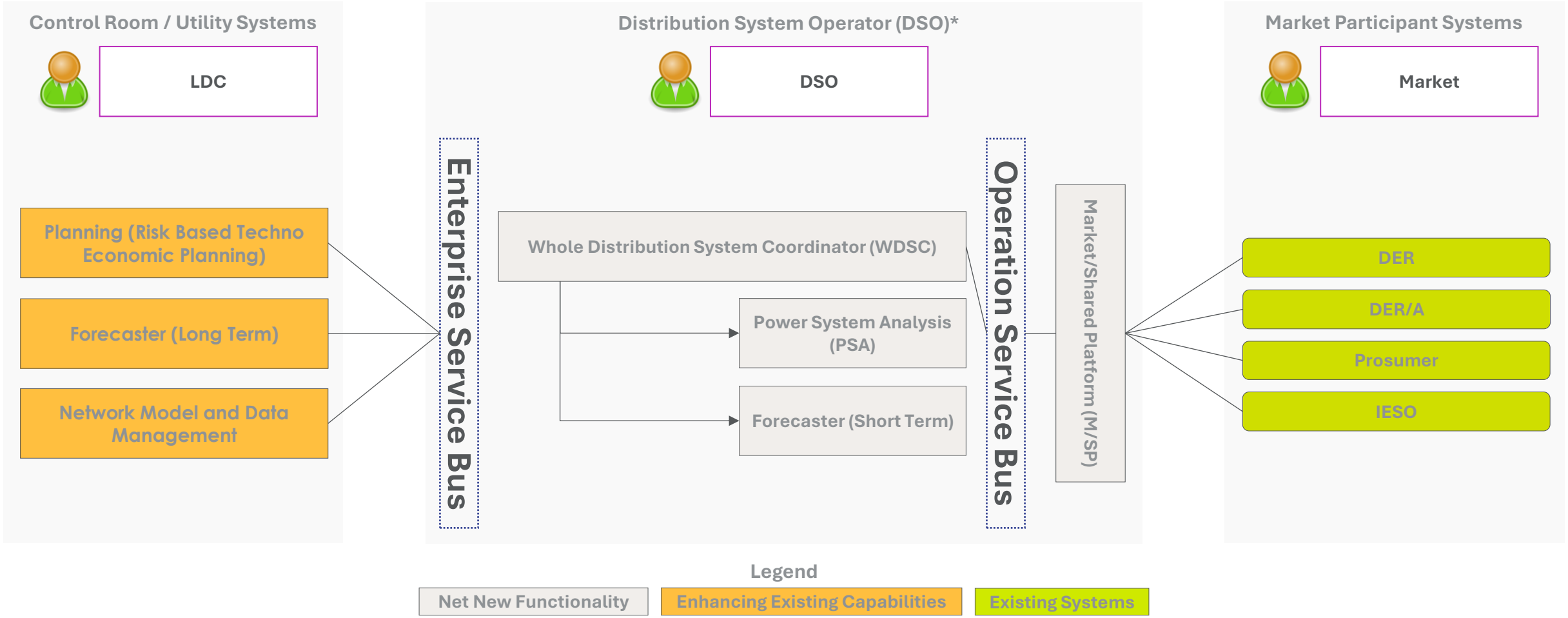
*Elements required for day-to-day DSO operation*




*DSO functionalities are LDC functionalities, and this Architecture does not provide commentary on ownership

# Proposed DSO Architecture – Planning Elements

*Elements required for longer-term decision making and coordination*




*DSO functionalities are LDC functionalities, and this Architecture does not provide commentary on ownership

# 03.2

## Work Package #2

## Process & User Journey Mapping

# Work Package #2 Fast Facts

**3**

## DSO Models

The 3 models considered include the Dual Participation DSO, Total DSO, and Market Facilitator DSO

**4**

## User Journeys

4 total User Journeys were developed, which were centered around the “LDC & IESO Journey” and “Host LDC, Embedded LDC, and IESO Journey”, with and without a Shared Platform

**12**

## DSO Model Permutations

Incorporating the 10 DSO process along with the 3 different DSO models to create B1 Work Package #1

**10**

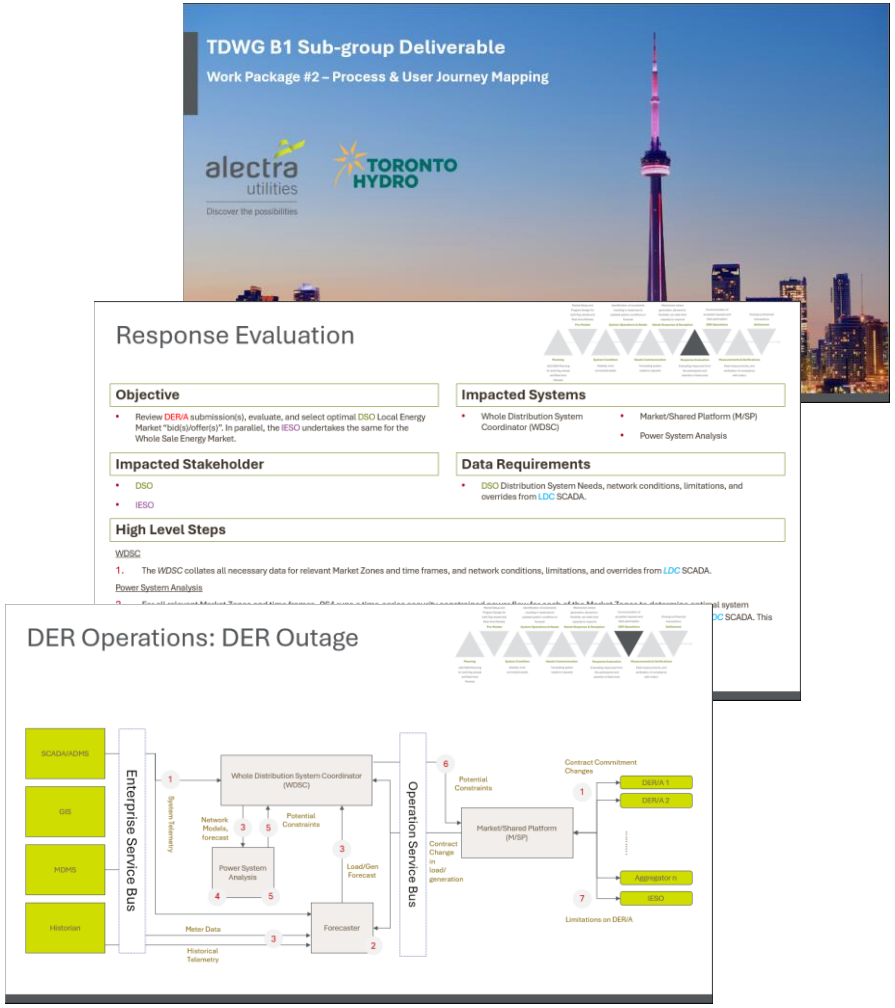
## DSO Processes

Identified 10 DSO process, consistent across the 3 different models for all 4 User Journeys, covering the end-to-end operations of a DSO

**400+**

## Baseline Operating Guide for DSO Models

400+ slide PowerPoint guide that outlines the overall objectives, stakeholders, systems, data requirements and steps for the 10 DSO Process across the 3 different models for all 4 User Journeys emphasizing end-to-end co-ordination



# Overview of DSO Models, User Journeys, and Processes

## Dual DSO (DP-DSO)

- DER/As directly participate in wholesale market; individually scheduled by IESO.
- DSO assesses IESO dispatch impacts, applies distribution-based limits as needed.
- Independently manages DER/As to meet local distribution system requirements.

## Total DSO (T-DSO)

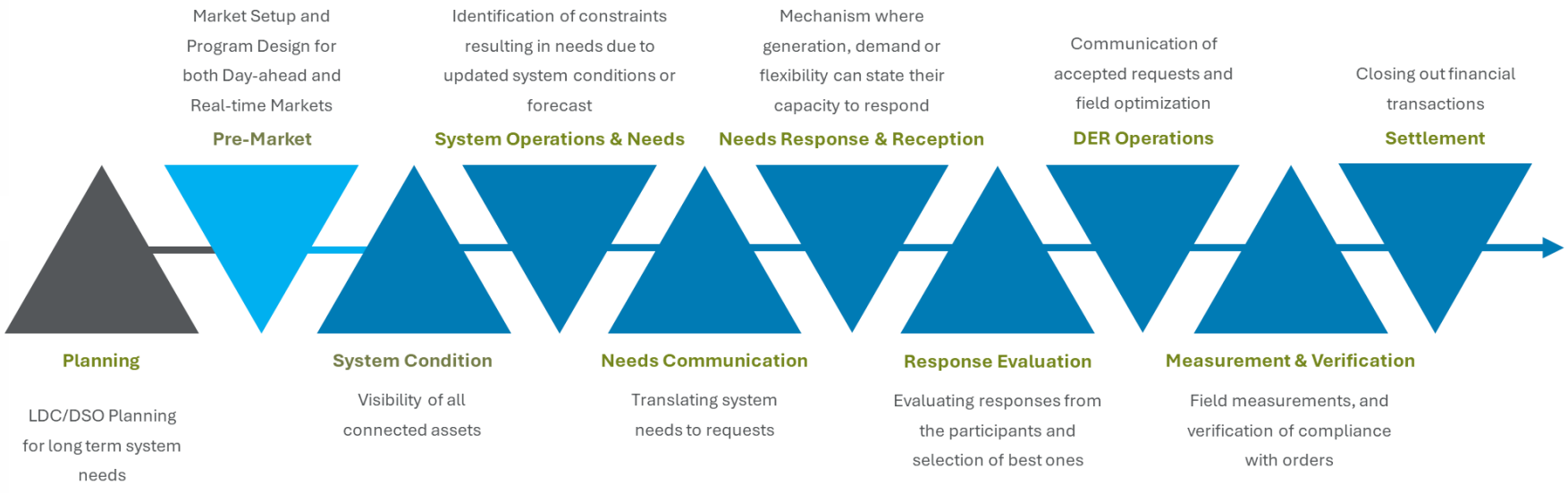
- Single point of interaction with IESO; DER/As don't directly participate in wholesale market.
- Aggregates DER/A bids, submits combined offers to IESO, and administers dispatch instructions.
- Optimizes DER/As to balance wholesale market commitments with distribution reliability needs.

## Market Facilitator (MF-DSO)

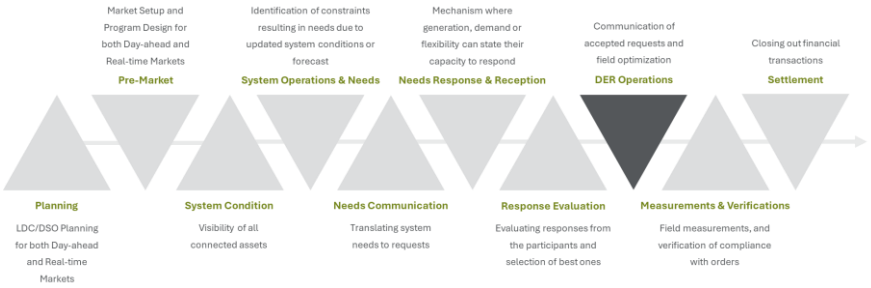
- Acts as intermediary: passes DER/A bids to IESO and relays schedules without modifications.
- Applies reliability-based operational limits but does not alter wholesale bids or dispatches.
- Optimizes distribution system to minimize DER/A curtailment, enhancing wholesale participation and local reliability.

| With the Shared Platform | | Without the Shared Platform | |
|---|---|---|---|
| LDC & IESO Journey | Host LDC, Embedded LDC, and IESO Journey | LDC & IESO Journey | Host LDC, Embedded LDC, and IESO Journey |
| Standard User Journey covering each DSO model with a Shared Platform | Embedded and Host LDS User Journey covering each DSO model with a Shared Platform | Standard User Journey covering each DSO model without a Shared Platform | Embedded and Host LDS User Journey covering each DSO model without a Shared Platform |

## User Journeys



# DER Operations: Dispatch




## Objective

- DSO dispatching DER/A

## Impacted Systems

- Market/Shared Platform (M/SP)

## Impacted Stakeholder

- IESO
- DSO
- DER/A

## Data Requirements

- Selected "Bid"

## High Level Steps

M/SP

1. *IESO* runs market optimizations and provides information on all the selected bids (asset owner, dispatch schedule, etc....)
2. *M/SP* sends the dispatch schedules to *WDSC*

WDSC

3. *WDSC* collates all necessary data (Contracts, load & generation forecast, network models, system telemetry)

Power System Analysis

4. *PSA* runs a time-series (for the appropriate market time frames) security constraint power flow for each of the zones to determine the impact of contracted committed contracts on the system (network conditions continuously change)
5. *PSA* runs a time-series (for the appropriate market time frames) security constraint power flow for each of the zones to determine optimal network operations to accommodate maximum *DER/A* participation, if step 4 identifies system constraints

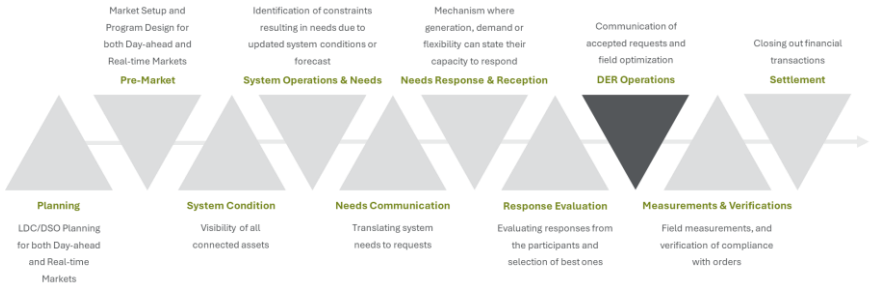
WDSC

6. *WDSC sends the dispatch signal to DER/As*

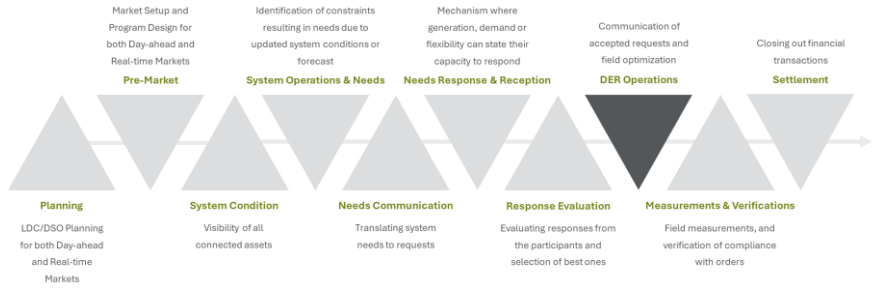
M/SP

7. *M/SP informs DER/A and IESO of any limitations placed on DER/A with support information*
8. *M/SP facilitates the dispatch signal*
9. *DER/A* acknowledges receipt and commitment

# DER Operations: Dispatch



# T–D Protocols Alignment



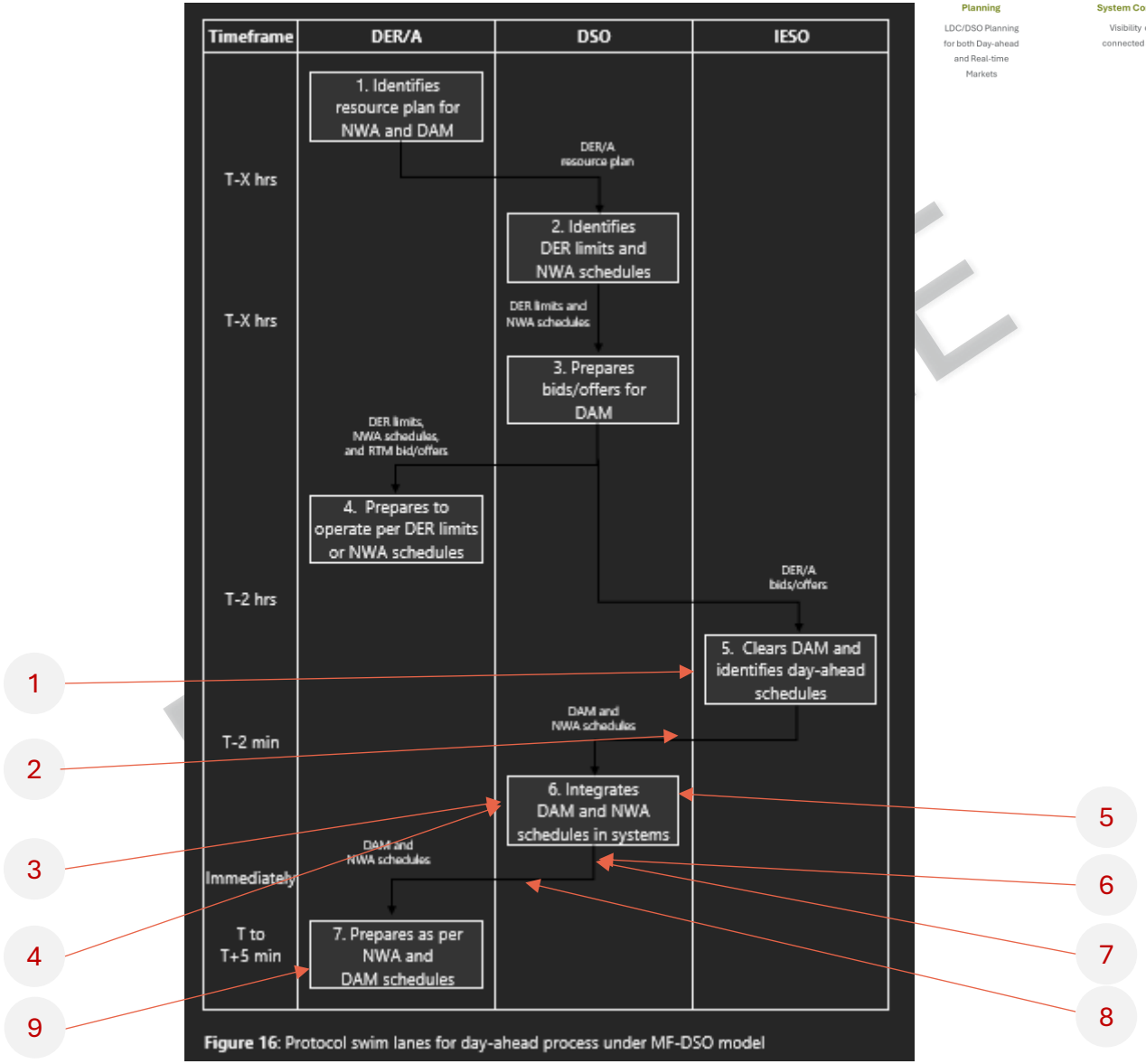




**Figure 16**: Protocol swim lanes for day-ahead process under MF-DSO model

# Summary of Major Model Process Differences

| Process | Dual DSO (DP-DSO) | Total DSO (T-DSO) | Market Facilitator (MF-DSO) |
|---|---|---|---|
| Planning | ▶ | ▶ | ▶ |
| Pre-Market | ▶ | ▶ | ▶ |
| System Condition | ● | ● | ● |
| System Operation and Needs | ■ | ■ | ■ |
| Needs Communication | ▶ | ■ | ▶ |
| Needs Response & Reception | ▶ | ■ | ▶ |
| Response Evaluation | ▶ | ■ | ▶ |
| DER Operations – Selection | ● | ● | ● |
| DER Operations – DER Outage | ■ | ■ | ■ |
| DER Operations – Distribution Constraints | ■ | ■ | ■ |
| DER Operations – Dispatch | ■ | ■ | ■ |
| Measurement & Verifications | ▶ | ■ | ▶ |
| Settlement | ▶ | ▶ | ▶ |

● **Minor Difference** ▶ **No Difference** ■ **Major Difference**

1. Generally, the differences between models are related to the exchange and coordination of information between different actors/systems
2. For User Journeys without the Shared Platform, the main difference is that communication between the IESO, LDC, DSO and DER/A would be managed through point-to-point integration between the parties
3. In the case of an Embedded and Host LDC, the major additional difference is an extra communication/co-ordination step that includes the Host LDC

# 03.3

## Work Package #3

## Gap Analysis

# Work Package #3 Fast Facts

## 74%

### Response Rate

35/47 EDA member LDC responded, with 4 non-members also providing responses. Highest response rate for a survey from EDA.

## 5.2MM

### Customers

Responses received from LDC cover ~5.2MM customers or 96% of all EDA member LDC customers.

## 11

### Sections

Questions were divvied into 11 sections that covered the DSO Processes.

## 82

### Questions

Structured questions to understand the general readiness for DSO operations across the province.

- To identify the existing gaps in transitioning to a DSO, the sub-group developed an survey and worked alongside the EDA to collect feedback from LDC members.
- The goal was to achieve a clear insight into the preparedness of LDCs across Ontario for the potential implementation of DSO capabilities.
- The survey inquired about the current state of operations directly related to the DSO Process specified in Work Package #2, irrespective of the DSO model used.

# Gap Analysis – Selected Observations

1. Strong Operational Foundations
   I. 70% operate centralized control rooms.
   II. 69% provide 24/7 customer or operational support.
2. Technology & System Adoption
   I. 97% utilize GIS tools extensively for planning.
   II. 89% rely on SCADA for real-time monitoring of systems.
3. Active DER Integration
   I. 54% manage over 100 DER connections; 23% have more than 500 DERs connected, demonstrating tangible DER integration progress.
4. Reliable & Accurate Processes
   I. 66% report highly accurate and reliable settlement processes.
   II. 74% effectively identify operational needs using combined manual and automated systems.
5. Proactive Steps Toward DSO Readiness
   I. 71% prioritize expanding SCADA coverage, enhancing real-time visibility crucial for DSO operations.
   II. 69% plan significant workforce upskilling to manage DER integration and advanced grid functionalities (will be critical for transitioning into effective DSOs).

1. Visibility & Automation Challenges
   I. 34% report <25% SCADA asset visibility; 50% have real-time telemetry capabilities >75% visibility
   II. Just 1 utility reports full DER observability; majority (84%) have partial visibility.
2. Preparedness & Capability Gaps
   I. 69% moderately prepared for increased DER integration.
   II. 91% require upskilling and training to effectively manage DERs and optimize DSO operations.
3. DER Management & Control Gaps
   I. 51% unable to control DERs via current systems.
   II. 89% do not actively engage DERs for operational needs.
4. Resource Constraints
   I. 57% face budget limitations impacting planning and technology upgrades.
   II. 69% identify high costs as barriers for upgrading monitoring systems.
5. Standardization Needs
   I. 69% lack standardized communication tools.
   II. 71% desire standardized criteria for evaluating DER responses.

# 03.4

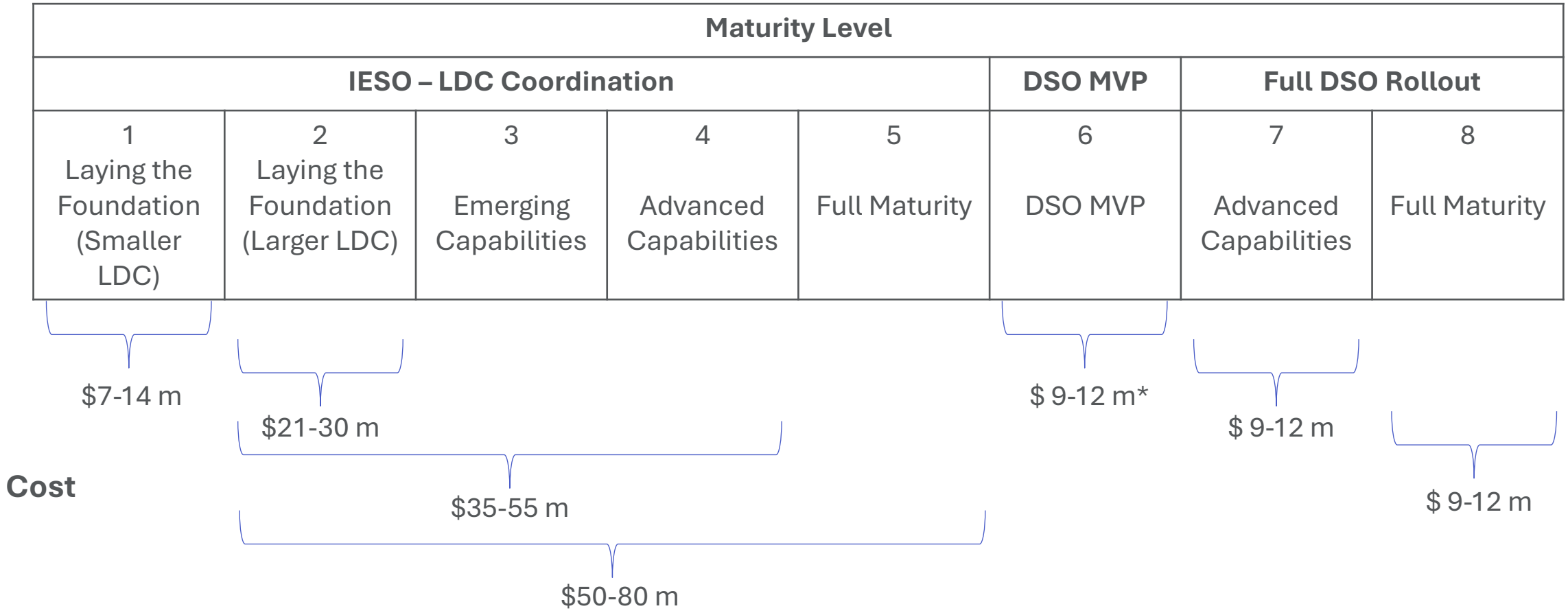
## Work Package #4 & 5

## Business & Functional Requirements
## &
## Investment Costs

# Business & Functional Requirements

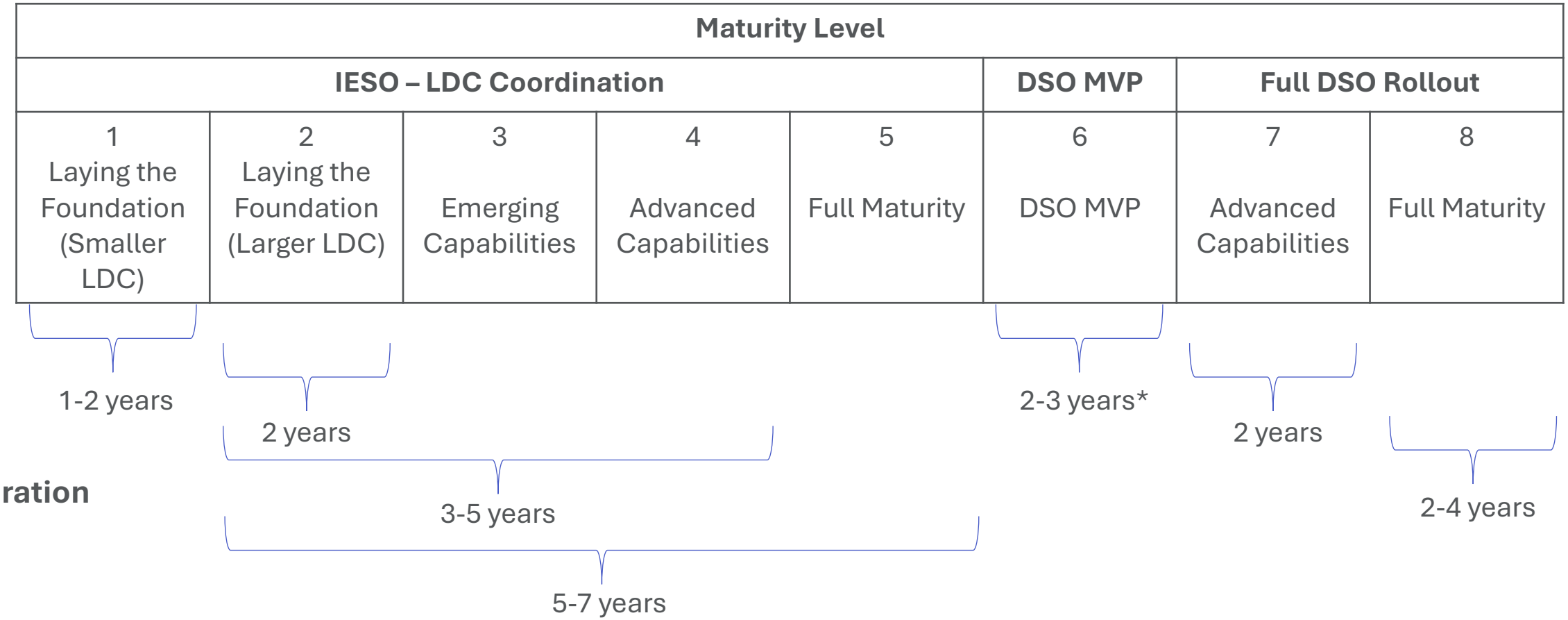
| | Maturity Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | IESO - LDC Coordination | | | | | DSO MVP | Full DSO Rollout | |
| | 1<br>Laying the Foundation (Smaller LDC) | 2<br>Laying the foundation (Larger LDC) | 3<br>Emerging Capabilities | 4<br>Advanced Capabilities | 5<br>Full Maturity | 6<br>DSO MVP | 7<br>Advanced Capabilities | 8<br>Full Maturity |
| Forecast | Forecasting - Weather Forecast, External | Forecasting - DER Assets | Forecasting - Weather Forecast | | | Forecasting - Market Commitments | | Forecasting - Weather Forecast, Internal |
| | Forecasting - Load | Forecasting - LDC TD Coordination Support (Limited and Manual) | | Forecasting - LDC TD Coordination Support (semi-automated) | Forecasting - LDC TD Coordination Support (Mature and Automated) | | | |
| | Forecasting Engine (Limited and Manual) | Forecasting Engine (Semi-Automatic) | Forecasting Engine (Mature and Automated) | | | | | |
| | | | | Forecasting Engine - Short Term (Limited and Manual) | Forecasting Engine - Short Term (Mature and Automated) | | Forecasting Engine - Long Term | |
| | | | | Forecasting Engine - Generation Forecast (Limited and Manual) | Forecasting Engine - Generation Forecast (Mature and Automated) | | | |
| | | | | Forecasting Engine - Load Forecast (Limited and Manual) | Forecasting Engine - Load Forecast (Mature and Automated) | | | Network Model Update - Operations |
| | | Network Model Update - Asset Nameplate | Network Model Update (Limited and Manual) | Network Model Update (Semi-automatic) | Network Model Update (Mature and Automated) | | | Network Model Update - Emergency |
| Powerflow/System Analysis | Power System Analysis | Optimal Power Flow (LDC TD Coordination Support) - Analysis (Limited) | Optimal Power Flow (LDC TD Coordination Support) - Analysis (Maure) | | | Optimal Power Flow - Analysis (Limited) | Optimal Power Flow - Analysis (Mature) | |
| | | | | | | Optimal Power Flow - DSO Request Creation | | |
| | | | | | | Optimal Power Flow - Reporting | | |
| | | | | | | Optimal Power Flow (Limited and Manual) | Optimal Power Flow (Mature and Automated) | |
| Communication | Communication Platform | Communication Platform - Request | | | Communication Platform - DSO Request | | Communication Platform - DSO Offer Revocation | Communication Platform - Emergency |
| | | Communication Platform - Service Offer | Communication Platform - Service Order | | Communication Platform - DSO Offer | Communication Platform - DSO Order | Communication Platform - DSO Offer Rejection | |
| | | | | Communication Platform - Settlement Report | | Communication Platform - Settlement Report (DSO services) | Communication Platform - DSO Order Revocation | |
| | | Communication Platform (Limited and Manual) | Communication Platform (Mature and Automated) | | | | | |
| Measurement and Verification | Measuring & Validating - LDC | Measuring & Validating | | | Settlement - Report | | Settlement - Penalty | Settlement - Emergency |
| | Measuring & Validating - Market Participant | | | | | Settlement - Payment | Settlement - Dispute | Settlement - BAU Integration |
| Valuation | | | | | | Valuation - Long Term Contracts | Valuation - Voltage Reduction | |
| | | | | | | Valuation - Outage Management | Valuation - Switching | Valuation - Asset Management and Maintenance |
| | | | | | | Valuation - Locational Price (NWS/DSO) | | |
| | | | | | | Valuation - Comparison | | |

# Investment Costs




Notes and Assumptions
1. Pricing is based on similar implementations, referencing SSEN Transition Project, SPEN FUSION Project and AustNet DER Marketplace
2. Costs reflective of effective deployment in Ontario (economies of scale)
* Assuming minimum of level 4 maturity level exists

# Timeline




Notes and Assumptions
* Assuming minimum of level 4 maturity level exists

# 04

## Next Steps

# Next Steps

1. Members of TDWG are requested to review Work Packages #1 through #5, and provide insights, inquiries, and feedback.
2. Work in collaboration with the Leads for Deliverables 2 and 3 to implement necessary changes, such as standardizing terminology and incorporating additional process steps.
3. Evaluate the feedback, comments, and inquiries collected from the wider TDWG, and incorporate them into the pertinent Work Packages.
4. Submit Work Packages #1 through #5 for final distribution.

# Feedback Questions

1. In terms of the proposed architecture (Work Package #1), are there any existing or net new systems that should also be included?
2. What is the primary concern, as it relates to co-ordination, with each of the three coordination models discussed (i.e., DP-DSO, T-DSO, and MF-DSO)?
3. From a market participant perspective and regardless of the coordination model, what integration approach would lead to lower barrier of entry for participation:
    1. A “single pane of glass” (i.e., access to all available markets in one interface); or
    2. Individual integration(s) with multiple separate markets

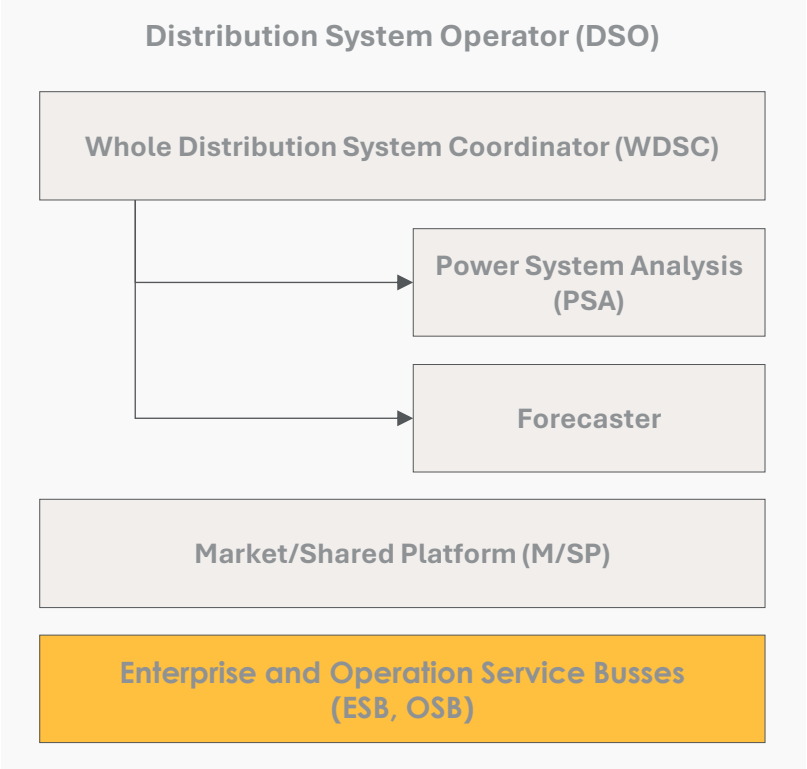
# 00

# Appendices

# Subgroup B1 Functional Assessment – Work Packages

| Work Package # | Name | Description | Output |
|---|---|---|---|
| 1 | DSO Architecture | Define the overall DSO structure and an overview of the processes/systems that will enable the LDC to act as a DSO | A deck outlining overarching DSO structure (flowchart/map) and required systems for each model (high-level) |
| 2 | Process & User Journey Mapping | Mapping of all the critical processes, functional roles and user journeys within the DSO | A deck outlining the critical processes and user journeys for each model |
| 3 | Gap Analysis | Gap analysis that will assess the gap between the existing LDC capabilities and the capabilities highlighted in Work Packages 1 and 2 | A document outlining the gap analysis for each model |
| 4 | Business & Functional Requirements | Defining the business and functional requirements. In addition, identify tangible assets and technology requirements | A spreadsheet outlining the key business and functional requirements for each model |
| 5 | Investment Costs | Timeline and cost estimates for enabling the business and functional requirements | A spreadsheet with a costing breakdown for each model |

# Architecture Definitions (DSO)




**Whole Distribution System Coordinator (WDSC)** is the "brain" of the DSO's Operations[1]

- Responsible for conducting continuous power flow analyses of the network's ever-changing state
- Determines grid needs in terms of physics and electromagnetics, and computes the DER/A quantities that could address them (e.g., DER/A-supplied energy additions or reductions, or in future use cases, ancillary services such as reactive power)

**Power System Analysis (PSA)** is the DSO's Analytical Engine

- Determines system conditions/needs and evaluates responses based on the ability to, at minimum, run a 3-phase unbalanced security constrained power flow or optimal power flow (snapshot and time series) with the inputs being a network model, load and generation forecasts, and asset demographics that include, but are not limited to, ampacity ratings, operating limits, de-rating factors, asset condition, short circuit, and reverse power flow.
    - Discrete asset demographics would be visible to the DSO, but aggregated (where possible), at the Point of Interconnection (POI) for the IESO.
- The objective function would be based on technical outcomes that would benefit relevant Market/Market Zone (e.g., voltage conservation, loss minimization, constrain minimization etc.).
- The PSA must conduct this analysis for relevant Market/Market Zone (for all voltage levels of all LDC feeders in that zone) within a 5–10-minute window.

**Forecaster** is an engine that can generate a System-wide/Market/Market Zone level load and generation forecast at different time granularity levels as needed.

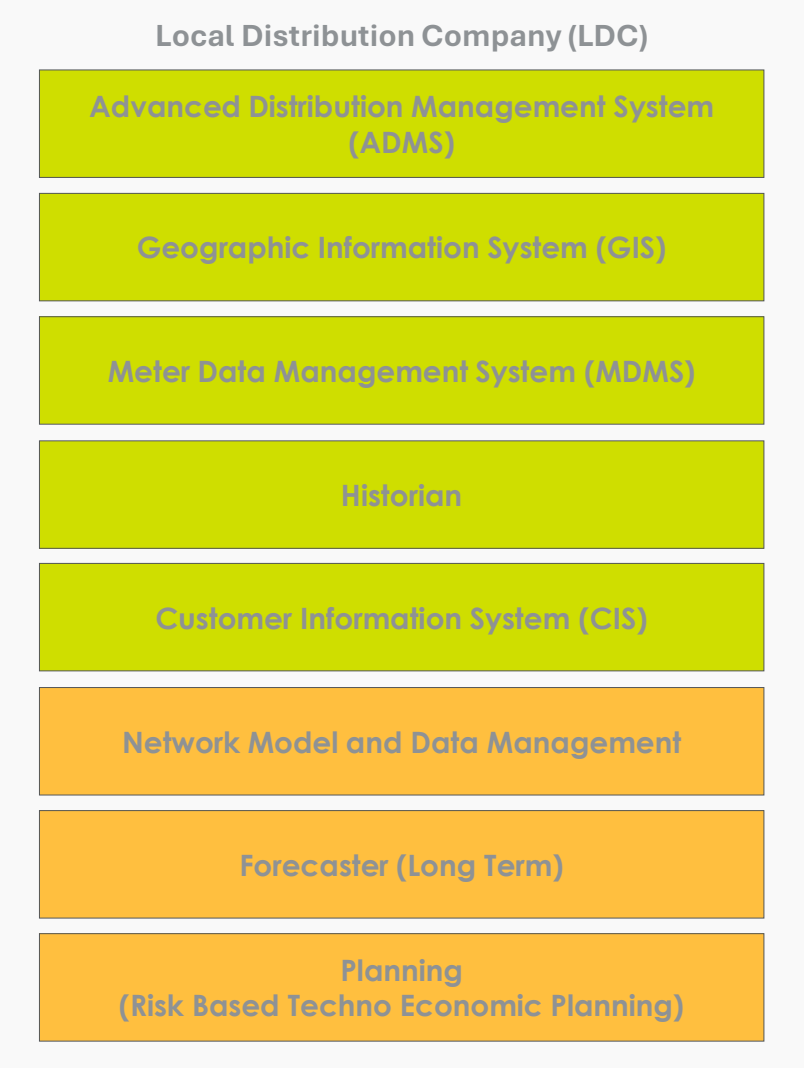
**Market/Shared Platform (M/SP)** is an exchange platform that helps facilitates transactions, enables information sharing, and supports an ecosystem of market services. It is external to utility's control room infrastructure.[2]

- Communicates distribution grid and potential wholesale market needs to the market where DER/As can make offers
- Enables market-clearing functions (DSO level only), and information sharing among market participants including, but not limited to, registering participating DER/As in various markets/programs, tracking contractual obligations, bids/offers at both wholesale and DSO levels,
- Shares system and dispatch information/instructions with market participants and the IESO , enabling each party to make informed decisions

**Enterprise and Operation Service Busses (ESB, OSB)** – An Enterprise Service Bus is an integrated solution that provides fundamental interaction and communication services for complex software applications via an event-driven and standards-based messaging engine, or bus, built with middleware infrastructure product technologies. This is the ideal integration approach, however, LDCs could undertake other approaches that provide system separation and integration.

[1] Whole Distribution System Coordinator – UK, Scottish and Southern Energy Network's TRANSITION Project
[2] Shared Platform – TDWG B3 Deliverable

# Architecture Definitions (LDC)




**Advanced Distribution Management System (ADMS)**

- Combines a distribution management system (DMS) analysis to optimize network operations, a field-proven SCADA system to address modern cybersecurity requirements, and an embedded outage management system (OMS) for improved resilience and reliability.

**Geographic Information System (GIS)**

- Provides a map-centric, intuitive way to model, design, maintain, and manage facility and land-based information. This enables collaboration, network management and analytics to improve performance for utilities.

**Meter Data Management System (MDMS)**

- Responsible for cleansing, calculating, providing data persistency, and disseminating consumption and event data obtained from meters installed on delivery points.
- The key data being tracked is metered commodity consumption and meter-related events, regardless of the type of commodity metered, type of meter, communication technology or collection device.

**Historian**

- is an integrated portfolio of software to collect, store, view, analyze, and share operational data with users within and beyond the enterprise.

**Customer Information System (CIS)**

- A CIS application serves as the backbone for the LDC's customer data management with a focus on handling customer data, billing, and consumption information

**Planning (Risk Based Techno Economic Planning)[3]**

- Planning toolset(s) will allow planners to pivot away from worst case scenario assessments to an approach that captures the economic and technical details of operational realities within planning, quantify and evaluate potential investment scenarios (network reconfiguration, flexibility procurement, expansion strategies, and non-wires alternatives) based on asset benefits by type, capacity, location, and time and determine the different cost components of each potential solution, assess their technical viability at addressing system needs, and compare the solutions to reveal the lowest cost and/or highest customer value options.
- The outputs would be shared with the DSO for operationalization.

**Forecaster (Long Term)**

- Forecaster is an engine that can generate a nodal and system wide load and generation forecast at different time granularity levels (time series planning granularity)

**Network Model and Data Management**

- Network model and data management capability focused on continuously maintaining the accuracy and integrity of network models and all associated data that will support the function of all system

[3] Planning (Risk Based Techno Economic Planning: UK, Scottish and Southern Energy Network's MERLIN project

# Overview of DSO Models

| DSO Model | Description* |
|---|---|
| Dual Participation DSO (DP-DSO) | A DSO that facilitates direct participation by DER/As in the wholesale market as well as DER/A provision of distribution services. DER/As participate directly in the wholesale markets and the IESO schedules and dispatches DER/As to meet bulk system needs. The IESO models each DER/A that participates in the wholesale market as though it were connected at the appropriate T-D interface. The DP-DSO assesses the impacts of IESO dispatches of DER/As and applies operational limits on the DER/As if needed for distribution system reliability. The DP-DSO communicates such limits to the DER/As, and the DER/A is responsible for notifying the IESO of its reduced capability or unavailability. Simultaneously, the DSO can schedule and activate DER/As to meet distribution system needs based on their locations on the distribution system. |
| Total DSO (T-DSO) | A DSO that coordinates all wholesale market and distribution system services provided by DER/As, eliminating their direct participation in the wholesale market. The T-DSO serves as the sole wholesale market participant for its distribution system, and the IESO only needs to interact with a single entity for wholesale services provided by DER/As. The T-DSO submits bids/offers that represent the combined bids/offers of the participating DER/As under each T-D interface node (or multiple nodes, if permitted). The T-DSO receives wholesale market schedules and dispatches from the IESO and then administers its own instructions to DER/As, making any adjustments that may be appropriate based on changing distribution system conditions. Adjustments may include re-optimization of DER/As to prevent a shortfall in meeting the wholesale market dispatch. The T-DSO would be subject to the same market rules that apply to all wholesale market participants. DER/As also provide distribution services to the T-DSO, which schedules and activates DER/As to meet distribution system needs. |
| Market Facilitator (MF-DSO) | A DSO that facilitates the direct participation of DER/As in the wholesale market through two distinct features. First, the MF-DSO acts as an intermediary between the DER/As and IESO by gathering DER/A bids and offers and providing these to the IESO, and by relaying IESO schedules and dispatches to DER/As. In executing these actions, the MF-DSO assesses the reliability impacts of the bids and IESO dispatches on the distribution system and applies operational limits on the DER/A if needed. The MF-DSO does not otherwise adjust the DER/As' wholesale market bids/offers or schedules/dispatches. Second, the MF-DSO optimizes the distribution system to minimize the curtailment of the DER/As, with the aim of improving the DER/As' ability to participate in the wholesale market (in the context of the MF-DSO, the objective of the DSO's optimization activity is to minimize DER/A curtailment while maintaining distribution system reliability and security of supply). DER/As also provide distribution services to the MF-DSO, which schedules and activates DER/As to meet distribution system needs via a local market. |

*From B4 Sub-group "Glossary of Working Terms and Definitions" - TDWG Meeting #14 (May 31st, 2024)

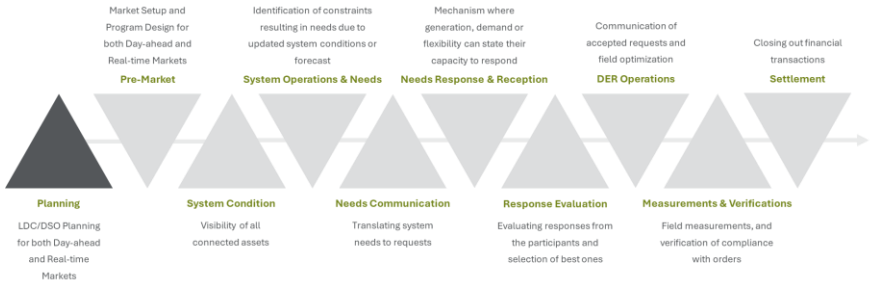
# Description of DSO Processes

| Process | Description |
|---|---|
| Planning | This is a pre-operational stage. LDC planning determines long term system needs and defines the types of services for procurement. |
| Pre-Market | This is a pre-operational stage. System operators upload network models and define boundaries. Market Participants create an account, receive login details, setup their profile, and register their DER asset(s) to participate in an applicable market(s). |
| System Condition | This is the first operational stage in the process. This stage requires that the LDC SCADA platform receives information about the current and future state of the system. This could include but isn't limited to, electrical measurements on lines and at substations (real power, reactive power, apparent power, current, etc..), existing generation forecasts and commitment from assets, forecasted load, state of charge of large scale batteries, an asset reliability metric, planned work (capital and maintenance) resulting in abnormal circuit configurations etc.. |
| System Operation and Needs | The Whole Distribution System Coordinator (WDSC) ingests the system condition data and identify future system issues that need to be resolved (i.e. supply, demand imbalance, a thermal constraint of a line/cable, a risk of voltage deviating outside of the operational limits). |
| Needs Communication | These needs are translated into programs or services that are required. The DSO then posts the needs on the Shared Platform or directly to market participants (depending on the user journey) to procure. |
| Needs Response & Reception | Participants publish their ‘responses’, directly on the Shared Platform or directly to the relevant Market Operator (depending on the user journey), which includes how much power and for what duration participants can increase/decrease generation or load and for what price they are willing to do this for. |
| Response Evaluation | The WDSC calculates a techno-economic optimal dispatch schedule (utilizing PF and/or OPF) for the system to solve the System Need(s), while risks with non-delivery for System-wide/Market(s)/Market Zone levels and time frames. |
| DER Operations | The optimal dispatch is communicated with market participants through the DSO via direct connections or APIs for relevant Market(s)/Market Zone(s). |
| Measurement & Verifications | Post-dispatch metered data is collected to verify actual generation and consumption. The output is posted to the Shared Platform (depending on the user journey). |
| Settlement | Metered data is compared to contracted volumes and prices to calculate payments and penalties for each participant. The output is posted to the Shared Platform (depending on the user journey). |

# Overview of DSO User Journeys

| User Journey | Description | DSO Model Covered |
|---|---|---|
| LDC and IESO Journey (with Shared Platform) | Standard User Journey covering each DSO model with a Shared Platform | Dual Participation DSO (DP-DSO) |
| | | Total DSO (T-DSO) |
| | | Market Facilitator DSO (MF-DSO) |
| LDC and IESO Journey (without Shared Platform) | Standard User Journey covering each DSO model without a Shared Platform | Dual Participation DSO (DP-DSO) |
| | | Total DSO (T-DSO) |
| | | Market Facilitator DSO (MF-DSO) |
| Host LDC, Embedded LDC, and IESO Journey (with Shared Platform) | Embedded and Host LDS User Journey covering each DSO model with a Shared Platform | Dual Participation DSO (DP-DSO) |
| | | Total DSO (T-DSO) |
| | | Market Facilitator DSO (MF-DSO) |
| Host LDC, Embedded LDC, and IESO Journey (without Shared Platform) | Embedded and Host LDS User Journey covering each DSO model without a Shared Platform | Dual Participation DSO (DP-DSO) |
| | | Total DSO (T-DSO) |
| | | Market Facilitator DSO (MF-DSO) |

# User Journey Description Overview




**Current Process discussed on the slide**

## Objective

**Identifying the objective of the Process**

- x

## Impacted Systems

**Systems utilized in the Process**

- x
- x
- x

## Impacted Stakeholder

**Stakeholders engaged during the step**

- x
- x
- x

## Data Requirements

**Key data requirement to enable the operations of the Process**

- x

## High Level Steps

**Chronological list of the steps in the Process**

XXX

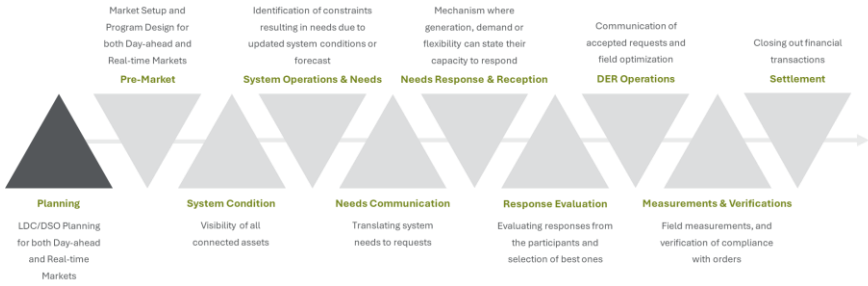
1. x
2. x
3. x

XXX

1. x

**The system(s) associated with the step**

# User Journey Description Overview




**Current Process discussed on the slide**

Planning (Risk Based Techno Economic Planning)

2

1

Enterprise Service Bus

Service Procurement Requirements

**High level data and/or instruction exchanged between systems or stakeholders**

3

Whole Distribution System Coordinator (WDSC)

Forecaster (Long Term)

1

Network Model and Data Management

1

Forecast, Network Model

**The step number. This number maps back to the previous slide that details the Process**

# Differences Between User Journeys

| Journey | Steps | Description |
|---|---|---|
| Dual Participation DSO | System Conditions and System Needs | The DSO informs the DER/A of the limits, and the DER/A is responsible for communicating any limits to the IESO |
| | Field Operation – DER Outage | The DSO does NOT run a time-series (for the appropriate market time frames) security constraint power flow for each of the zones to determine optimal network operations to accommodate maximum DER participation, if step 4 identifies system constraints. If a constraint is identified, the limits are communicated to the DER/A and the DER/A is responsible for communicating any limits to the IESO |
| | Field Operation – Distribution Constraints | The DSO does NOT run a time-series (for the appropriate market time frames) security constraint power flow for each of the zones to determine optimal network operations to accommodate maximum DER participation if step 4 identifies system constraints. If a constraint is identified, the limits are communicated to the DER/A and the DER/A is responsible for communicating any limits to the IESO |
| | Field Operation - Dispatch | The DSO would not dispatch the DER/A for wholesale services, the IESO would inform the DSO. The DSO does NOT run a time-series (for the appropriate market time frames) security constraint power flow for each of the zones to determine optimal network operations to accommodate maximum DER participation if step 4 identifies system constraints. If a constraint is identified, the limits are communicated to the DER/A and the DER/A is responsible for communicating any limits to the IESO |

# Differences Between User Journeys

| Journey | Steps | Description |
|---|---|---|
| Total DSO | System Conditions and System Needs | The process starts with the DSO determining distribution system needs and potential system limits on any DERs. |
| | Needs Communications and Response Reception | The DSO would communicate LDC and wholesale needs through MSP to DER/As. The DER/As submit their bids for both |
| | Response Evaluation | The DSO would evaluate the bids for BOTH LDC and wholesale market and select the bid, and aggregate the response back to the IESO |
| | Field Operation - Selection | The DSO would select the bid for BOTH LDC and wholesale market |
| | Field Operation – DER Outage | The DSO would be required to reoptimize the system and go back to the market to address the shortfall in its IESO aggregated bid. If they are unable, would communicate to the IESO |
| | Field Operation – Distribution Constraints | The DSO would be required to reoptimize the system and go back to the market to address the shortfall in its IESO aggregated bid. If they are unable, would communicate to the IESO |
| | Field Operation - Dispatch | The DSO disaggregates the IESO signal and send it to the respective DER/As |
| | Measurement and Verification | The DSO would be the party for submitting the measurements to IESO and would be handling disputes with both the DER/A and IESO |

# Differences Between User Journeys

| Journey | Steps | Description |
|---|---|---|
| Host LDC and Embedded LDC | System Conditions and System Needs | The DSO would collect relevant telemetry and account for limits set by the Host LDC. All communication would require the inclusion of the Host LDC |
| | Needs Communications and Response Reception | All communication would require the inclusion of the Host LDC |
| | Field Operation - Selection | All communication would require the inclusion of the Host LDC |
| | Field Operation – DER Outage | The DSO would collect relevant telemetry and account for limits set by the Host LDC. All communication would require the inclusion of the Host LDC |
| | Field Operation – Distribution Constraints | The DSO would collect relevant telemetry and account for limits set by the Host LDC. All communication would require the inclusion of the Host LDC |
| | Field Operation - Dispatch | All communication would require the inclusion of the Host LDC |
| | Measurement and Verification | The DSO would collect relevant telemetry from the Host LDC and make available to the DER/A. All communication would require the inclusion of the Host LDC |
| All Journeys without the shared platform | All steps | All communication between the IESO, DSO and DER/A would be managed through point-to-point integration between the parties |