DER Integration

Innovations in Managing Increasing DER Penetrations

EPRI View from the TOP Webinar Series 2026

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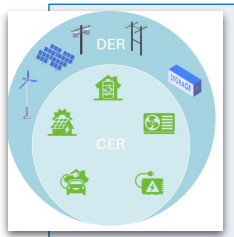
Welcome and Agenda

EPRI are recording this webcast and will post the recording, transcription and materials (where possible) for those that could not make it.

Introduction to the EPRI View from the TOP - 2026 Webinar Series
(Aidan Tuohy EPRI)

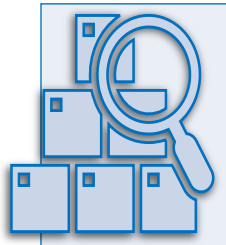
Introduction to ISON
(Luke Robinson AEMO)



Summary of the Report Key Findings
(Adrian Kelly, Mario Couto - EPRI)

System Operator Perspectives

- Bob Kott - CAISO
- Prashant Kansal, Thinesh Devadhas Mohanadhas



Actions for Research and Wider Community Based on Report Findings
(Adrian Kelly, Luke Robinson and All)

Questions and Open Discussion
(10-15 Mins All Moderated by EPRI)

Transmission Operations and Planning

Innovating Grid Operations, Shaping Strategic Planning

View from The TOP

Transmission Operations & Planning R&D Public Webinar Series

New for 2026: A public webinar series

- R&D highlights from EPRI and our global collaborators
- 8-12 webinars delivered throughout 2026
- Topics spanning operations, planning and markets issues
- Coordinated with existing EPRI forums
- Open to all participants

Not a Member? Sign up Here!

Save the Date

March 4 11am ET

AI in Operations and Planning

Recordings & materials posted at: top.epri.com

EPRI/ISON DER Integration Webinar

Luke Robinson

GM System Modelling & ISON – Operations - AEMO

5 February 2026


ercot
Your Power. Our Promise.


ENERGINET


EirGrid


California ISO


NESO
National Energy
System Operator


AEMO

What is ISON?

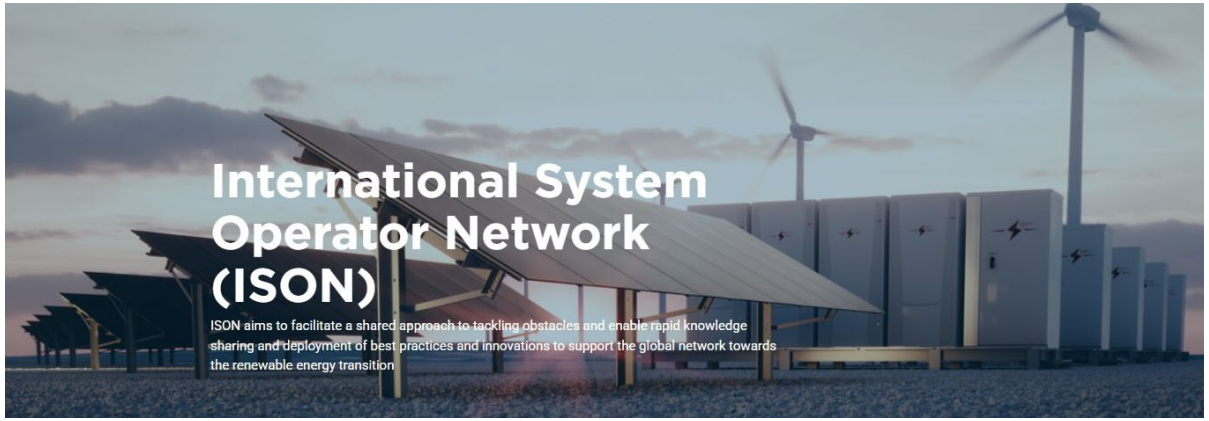
- The International System Operator Network (ISON) brings together a network of system operators from Australia, the US and Europe.
- ISON goal is to focus on real-world, practical solutions to enable the operation of reliable, secure, high-renewable power systems.
- ISON also aims to disseminate information and cooperate with others for shared benefit.

ISON Website & Resources

- ISON website:

  https://www.isonetwork.org/

- Publicly available information includes:
  - Overview of ISON and member organisations
  - Priority topics and activities
  - Selected publications and updates



ISON Priority Topics

- ISON provides a forum to align on system operator priorities and support secure and reliable system operation.
- For 2026, ISON has identified priority focus areas relating to:
  - Large loads
  - Oscillation detection
  - Control room of the future
  - AI foundations and use-cases
- There is also ongoing collaboration continuing across planning, system restoration, system services and other topics.

How ISON Collaborates

- Technical working groups
- Regular technical sessions and workshops
- Sharing of operational experience and lessons learned
- Peer-to-peer discussions between system operators and others engaged in the energy transition globally
- Cross-organisation collaboration on emerging issues
- Visits / secondments between ISON member organisations


ISON

Summary of the DER Integration Report

DER Integration Report

Objective

To provide a global perspective to navigate the transition from centralized to decentralized resources by identifying systemic risks, closing technical capability gaps, highlighting innovations and developing vision architectures.

Mitigating Systemic Risks

Addressing seven critical vulnerabilities—ranging from common mode failures and resource uncertainty to dynamic stability and extreme weather resilience—to ensure grid reliability in a high-DER penetration environment.

Bridging Institutional and Technical Gaps

Closing the seven identified capability gaps (such as data exchange, visibility, and market participation) through cross-industry collaboration (TSO-DSO-Regulator) and the adoption of innovative boundary digital systems.

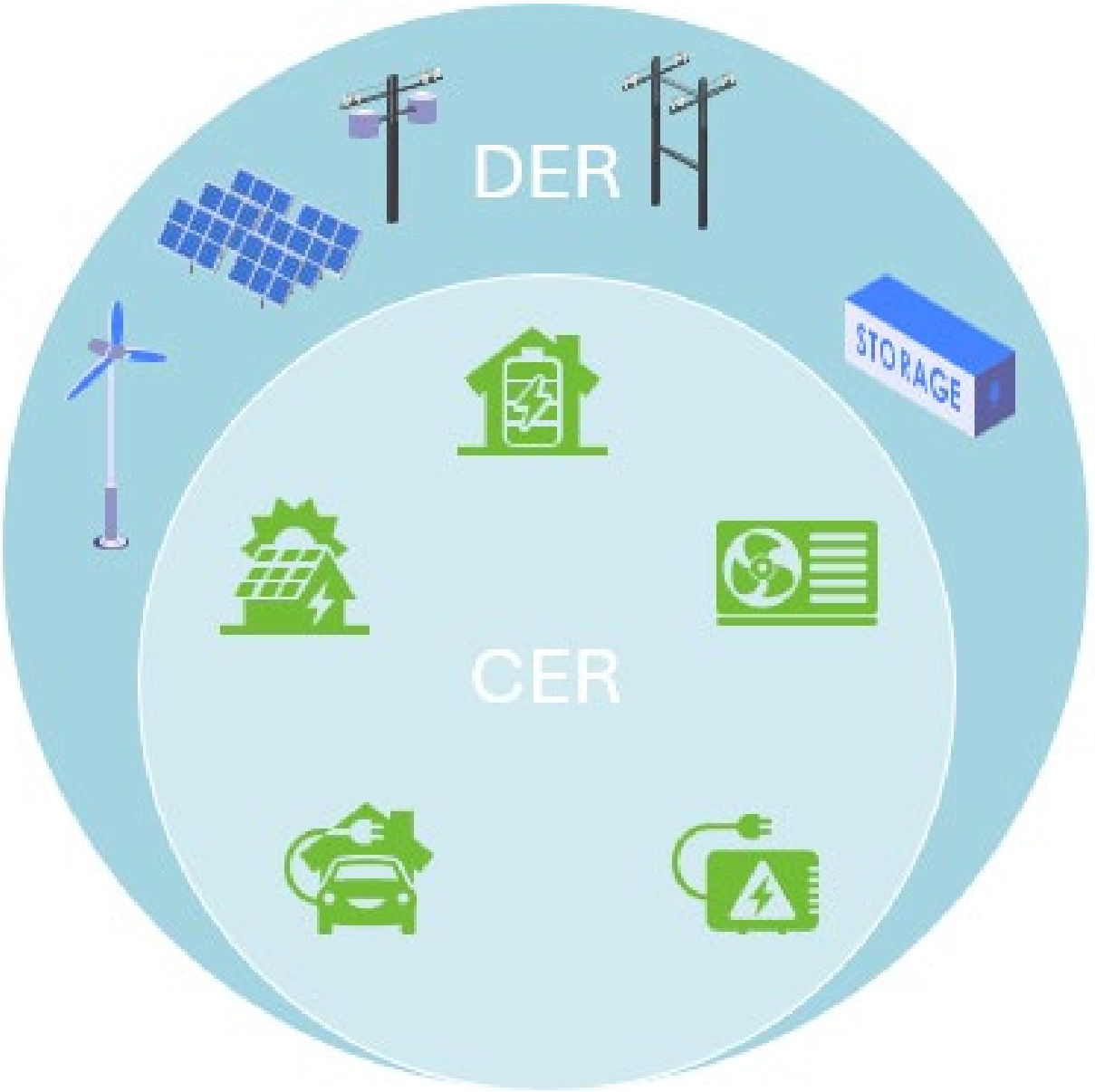
Note: This is focused primarily on challenges for transmission network operators

Link to the Report

First - A Note on Terminology for this Presentation

Distributed Energy Resources

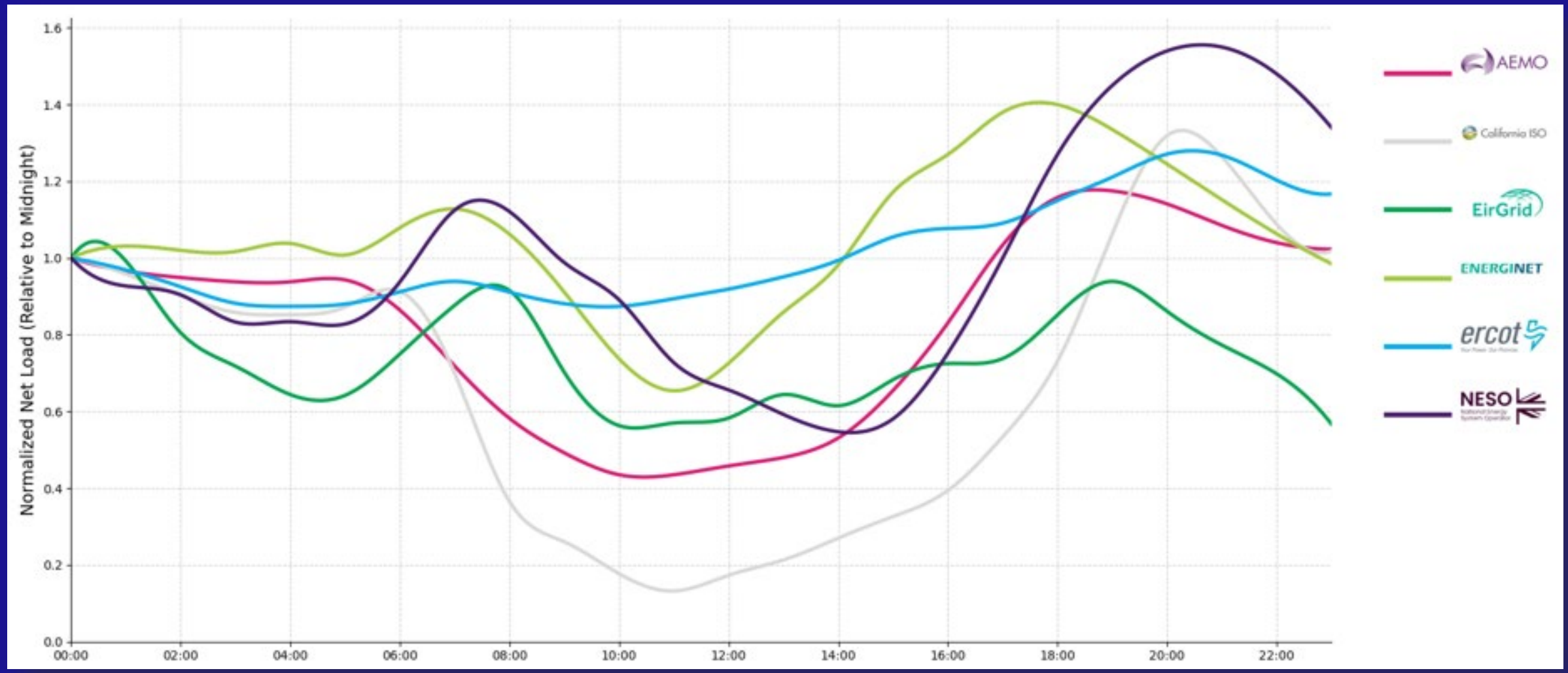
All resources not connected to the bulk electricity (transmission) system. Can be directly participating in the market or aggregated.



Consumer Energy Resources

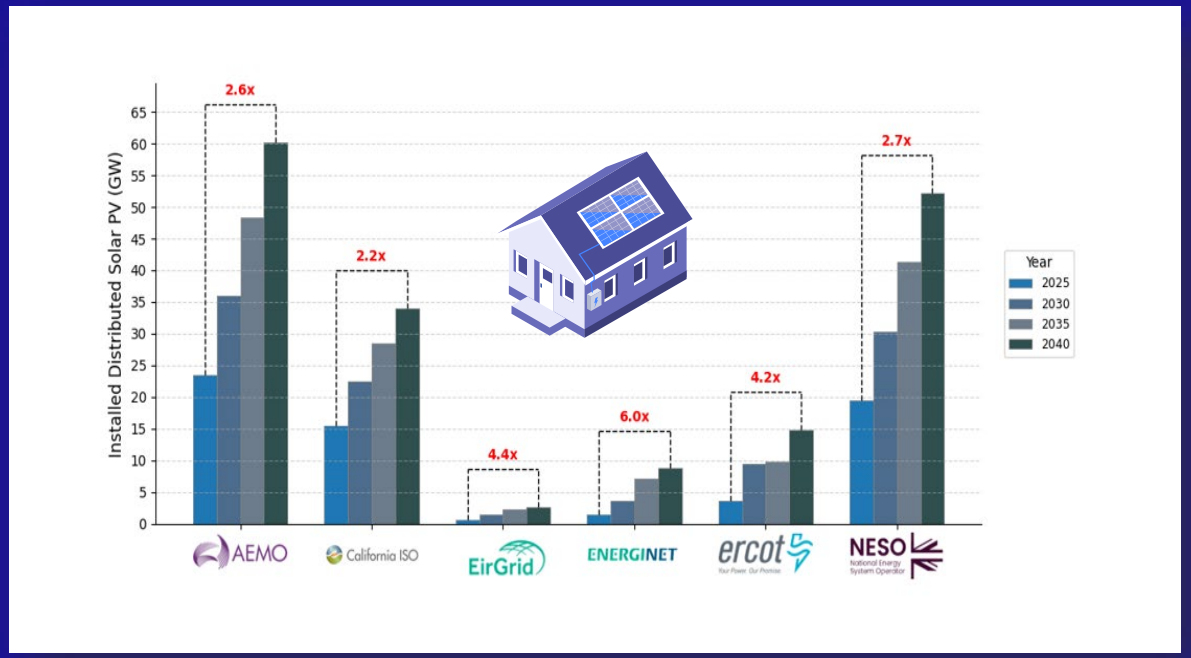
DER that is connected behind-the-meter, or at LV. CER can be aggregated to participate in markets

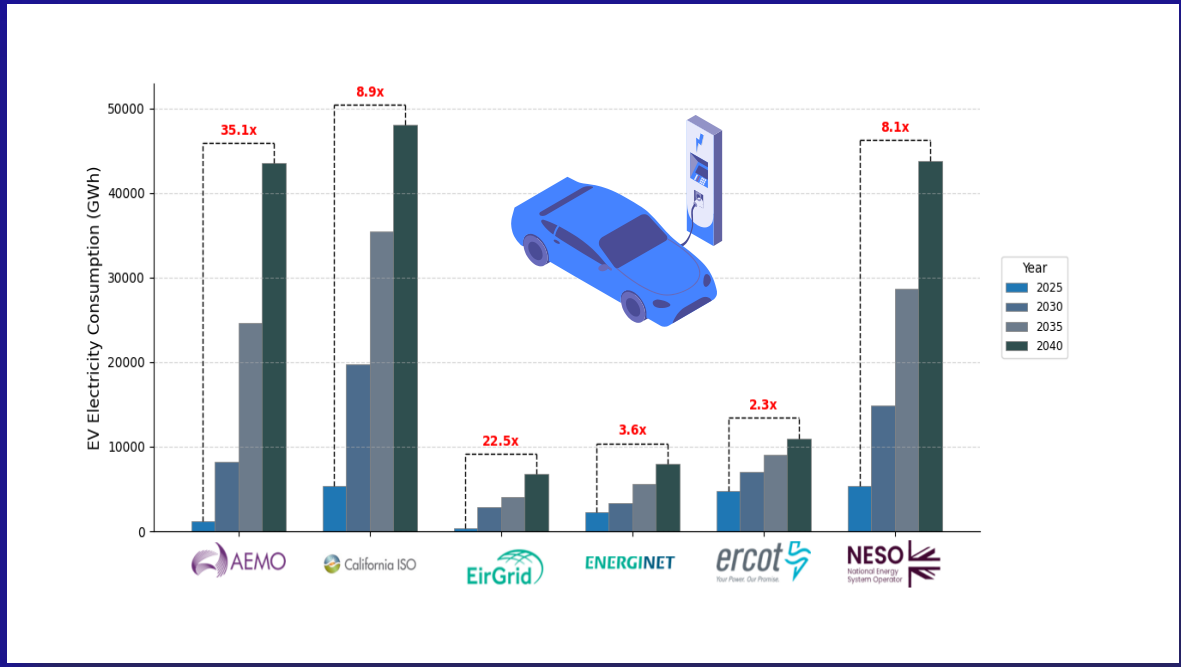
A Flock of Ducks - Normalised Load Shape for Summer Days – ISON Members



Installed DPV Growth Rates to 2040

Growth in DPV and EV are a proxy for growth in CER and DER





This growth in CER/DER will change transmission system operational modes.

Shifting operational modes will introduce or increase operational risks, without mitigations

Emerging Risks with Increasing DER/CER

Rises in DER/CER Shift Operational Modes and Increase Risks.
7 Common Risks Across ISON Members Identified

High Level Risk Assessment per ISON - SO

Risks	AEMO	CAISO	EirGrid	Energinet	ERCOT	NESO
Resource adequacy and load variability	High	Medium	Medium	Low	High	Medium
Resource uncertainty	High	High	High	Medium	High	Medium
Extreme weather vulnerability	Medium	High	Low	Low	Medium	Low
Transmission and distribution congestion	High	Low	High	High	Low	Medium
Dynamic stability and fault ride-through	High	Medium	High	Low	Low	Medium
Common mode failure and resource performance	Medium	Medium	Medium	Medium	Low	Medium
Performance during emergency operation	High	Low	High	Low	Low	Low

Assessment for Today → These Risks Will Increase with Increased DER/CER Without Mitigations

How to Address the Risks? → The 7 Capability Gaps

Gap name	Gap description
1. Standardisation of taxonomy and best practice sharing	The need to agree on a standard definition and taxonomy and architecture for DER and CER.
2. Data management and exchange	The need for robust data management procedures, protocols and infrastructure for secure data exchange between electricity industry entities with ownership or operational responsibilities for DER so that the characteristics of the network DER can be modelled and studied at all levels.
3. Modelling and simulation	The need to develop accurate models of IBR when modelling the dynamic behaviour of DER and to evolve the modelling of IBR to encompass massive quantities of IBR-based CER for dynamic voltage and frequency simulations and fault ride-through in a range of simulation tools.
4. Operational forecasting	The need to enhance the forecasting capability of system operators and enabling enhanced commercial forecasting through enhanced data exchange mechanisms will be key enablers of facilitating more renewable based DER and in optimising the full system resource portfolio, including demand.
5. Visibility and controllability	The need for real-time data visibility of the output of DER and aggregated CER is essential for TSO awareness, short-term forecasting, and planning and as an input to operational technology applications. The ability to directly control DER and CER is subject to regulatory approval, but an ability to indirectly control (through DSOs) may be required in future.
6. Market mechanisms and participation	The need to develop robust pathways for DER and CER participation in all available energy markets to maximize DER utilisation and flexible networks. Given the emerging nature of DER and in particular CER participation, shared experiences and practices will be a key enabler of innovation.
7. Leveraging DER during emergencies	The need to ensure UFLS schemes are coordinated for DER and to leverage DER for black start. Reducing the risk of restoring with DER requires new control strategies, communication protocols, and updates to grid codes as well as visualisation and control technology.

The Capability Gaps are Generalisable Across Jurisdictions

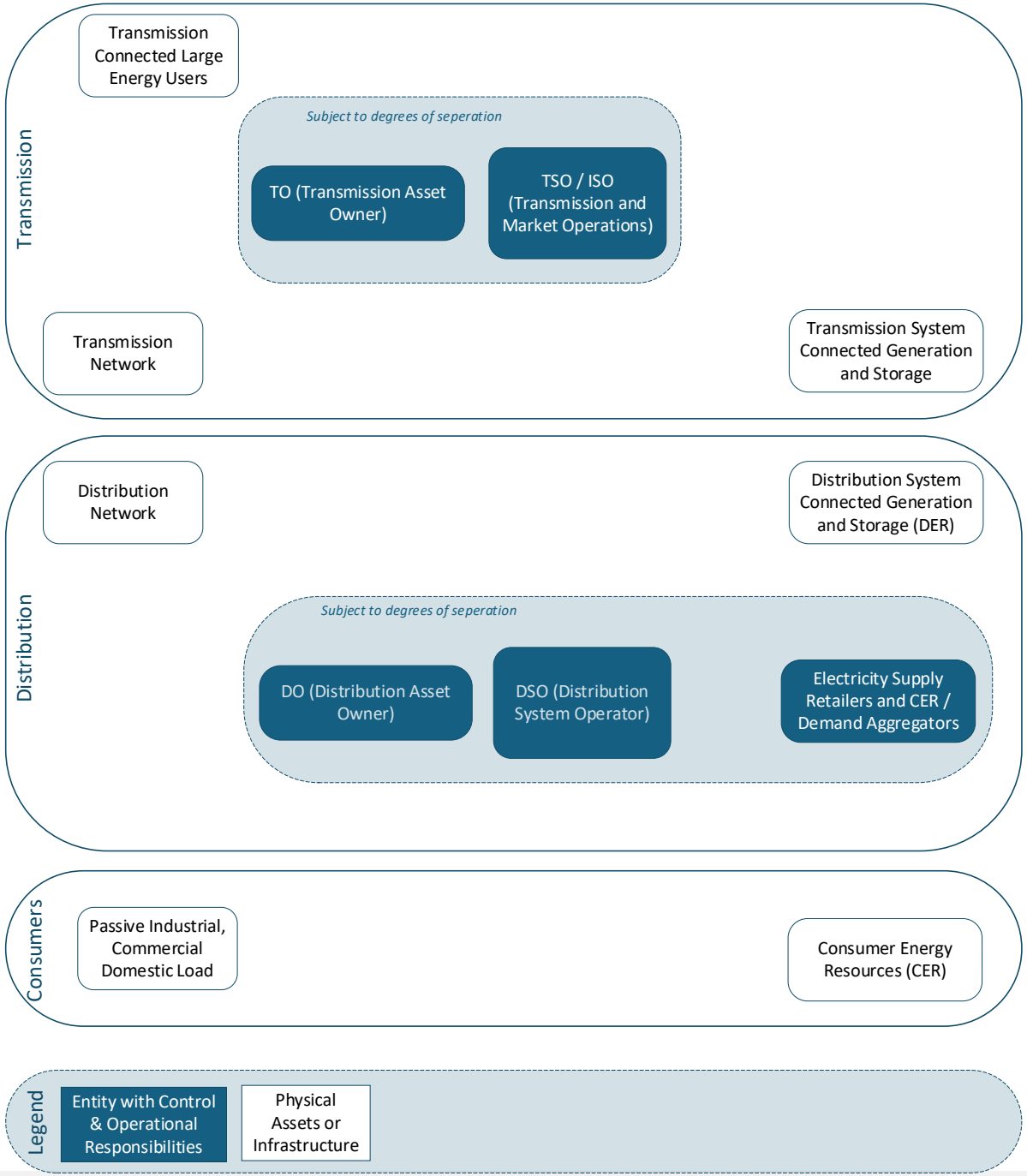
Capability Maturity Model for the SOs

EPRI assessed the capability gaps for the system operators, relative to each other according to defined criteria.
SOs validated the assessment with reference to existing initiaves, and technologydescribed in the report.

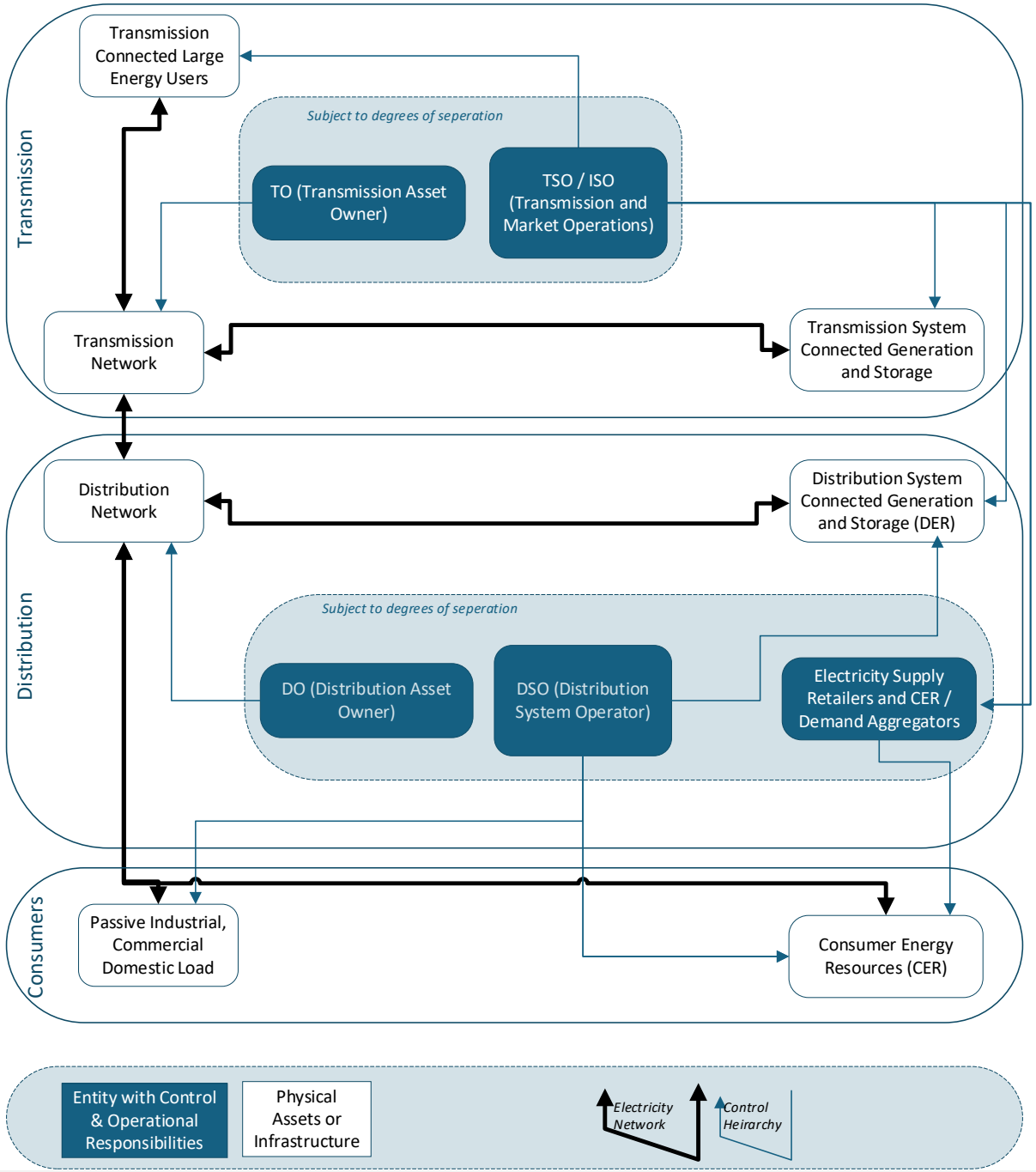
Maturity Descriptions	**Developing** maturity means very limited capability or early-stage development	**Established** maturity means basic technology exists to address the gap but further enhancement is required	**Enhanced** maturity means the technology is innovative and pioneering to global operators

Gaps	AEMO	CAISO	EirGrid	Energinet	ERCOT	NESO
1. **Standardisation of taxonomy and best practice sharing**	Established	Developing	Developing	Developing	Developing	Developing
2. Data management and exchange	Developing	Developing	Established	Enhanced	Enhanced	Developing
3. Modelling and simulation	Enhanced	Established	Enhanced	Enhanced	Developing	Developing
4. Operational forecasting	Enhanced	Enhanced	Established	Established	Established	Established
5. Visibility and controllability	Developing	Developing	Enhanced	Developing	Established	Developing
6. Market mechanisms and participation	Developing	Developing	Established	Established	Established	Established
7. Black start and restoration	Established	Developing	Developing	Developing	Developing	Established

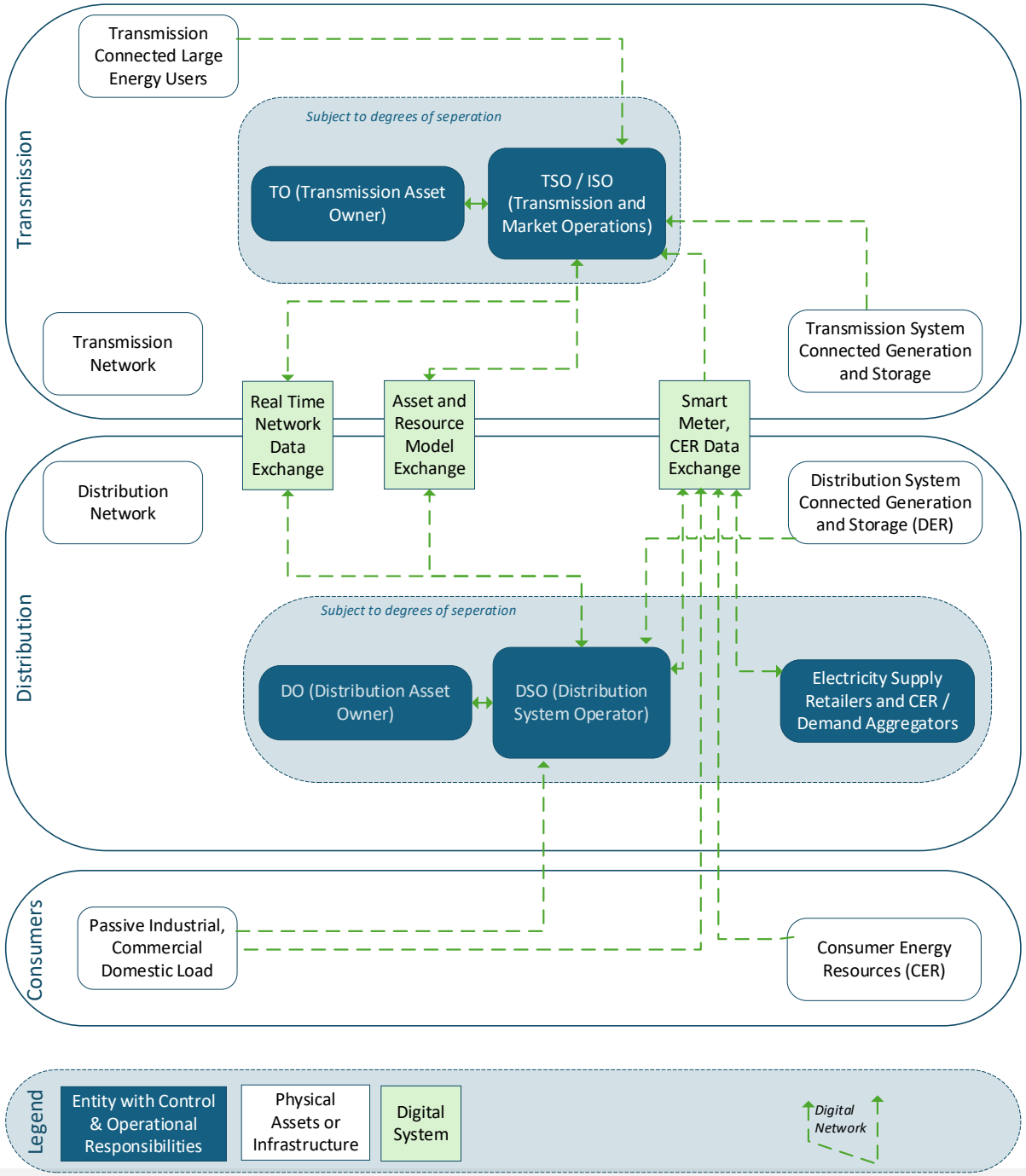
DER Vision Architecture - Functional Entities and Physical Assets



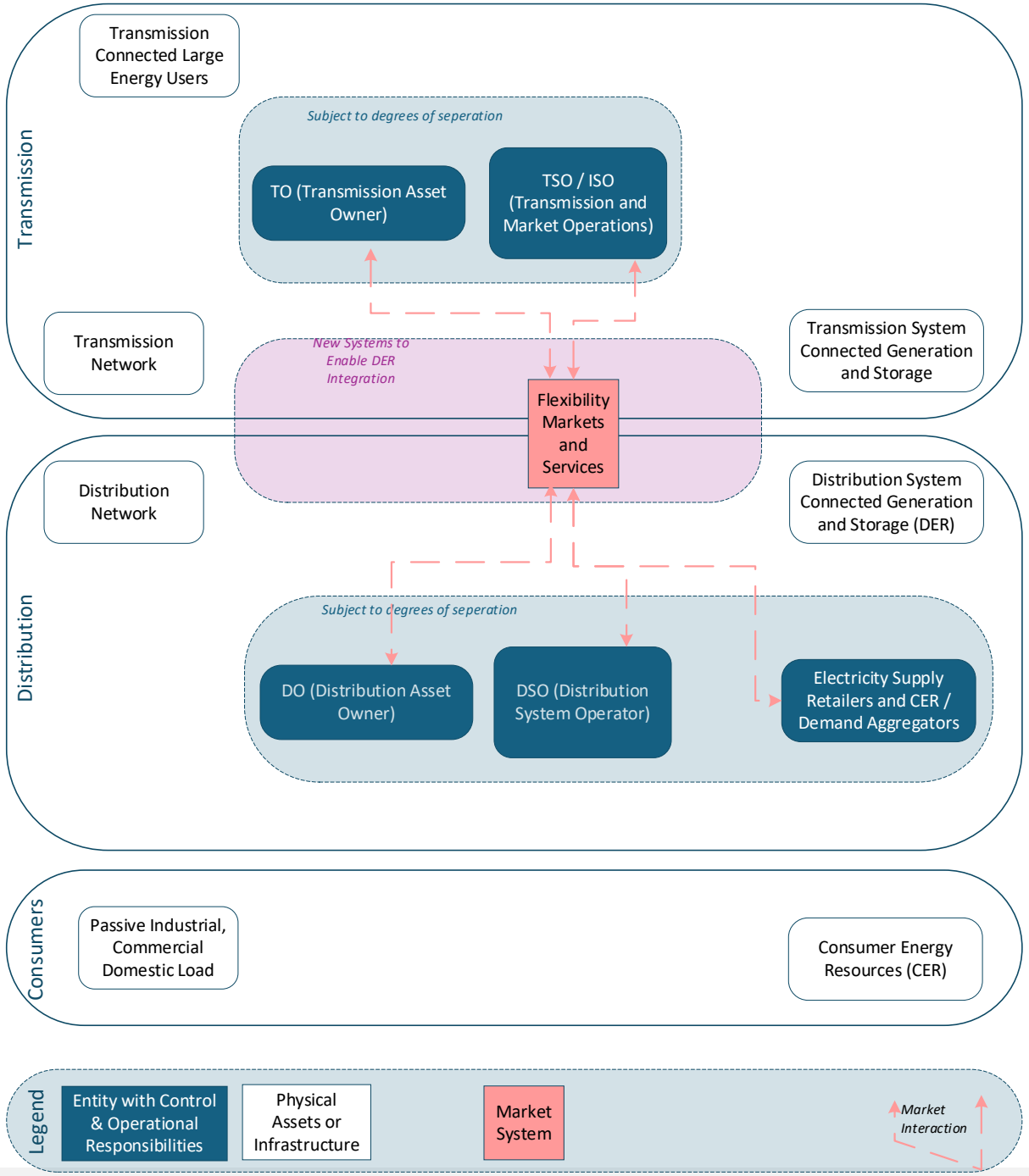
DER Vision Architecture - Electrical Networks and Control



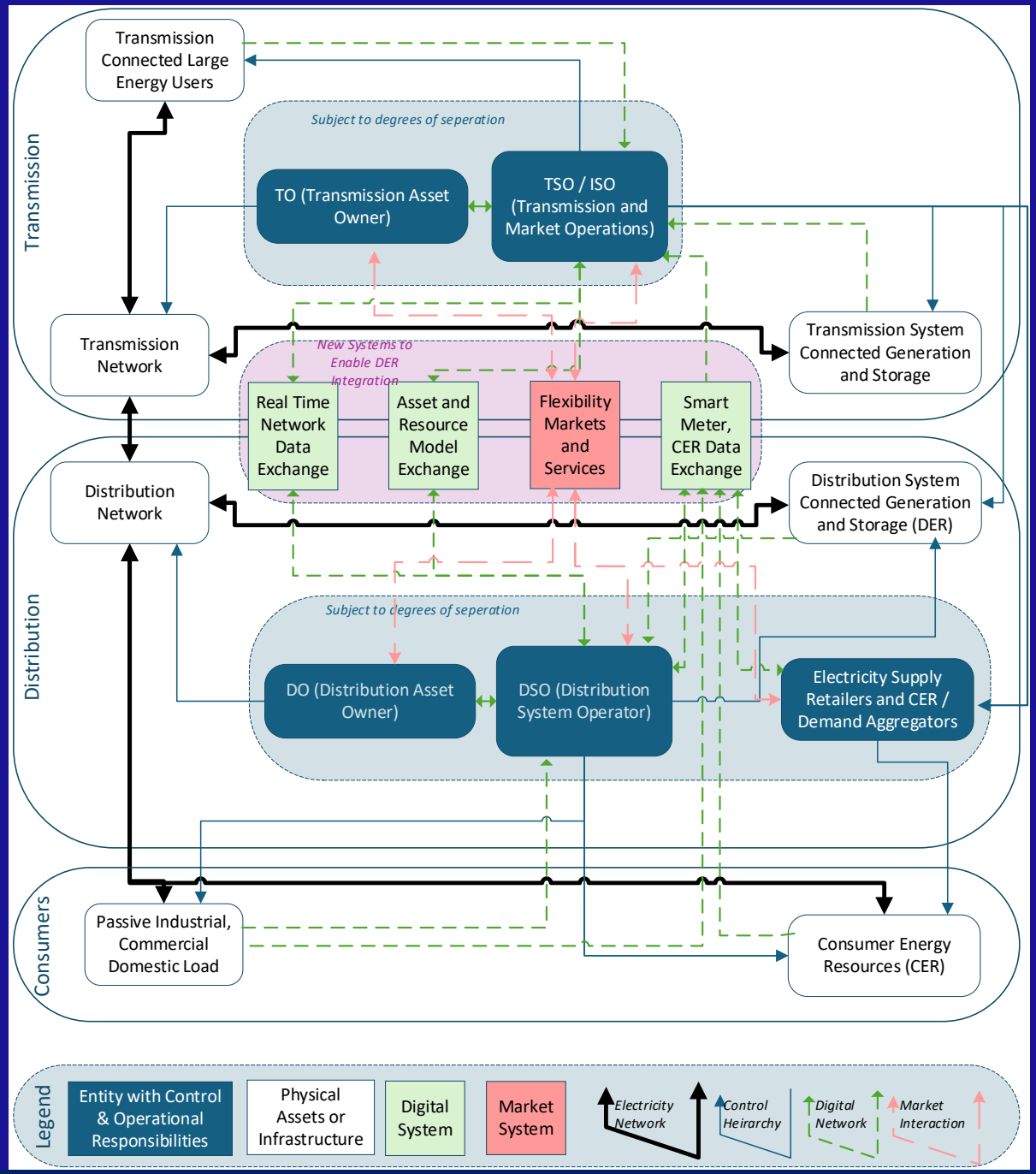
DER Vision Architecture - Digital Networks and Data Exchange



DER Vision Architecture - Market Systems and Transaction Flows



DER Vision Architecture - Complete



Discussion from ISON Members – CAISO, ERCOT

California ISO

DER Innovations

EPRI Transmission Operations and Planning Webinar Series – International System Operator Network (ISON) Perspectives on DER

February 4, 2026

CAISO DER Innovations

DERs and DER Aggregations modeled in CIM15	Modelled at the delivery point to the Bulk Electric System Resource SC reflect any distribution system limitations in OMS
Load Forecasting processes incorporate impacts of behind the meter DER	BTM Solar ~20k MW and BTM batteries ~ nearing 3k MW
2010 changes for broader A/S wholesale participation and PDR model	
2012 introduced the non-generator resource (NGR) model	accommodates storage, DR, DER, DERA, and microgrids
2015-2020 Energy Storage and distributed energy resources, phase 1-4	
2025 Demand and Distributed Energy Market Integration Working Group	

Global DER/CER Efforts and Innovations

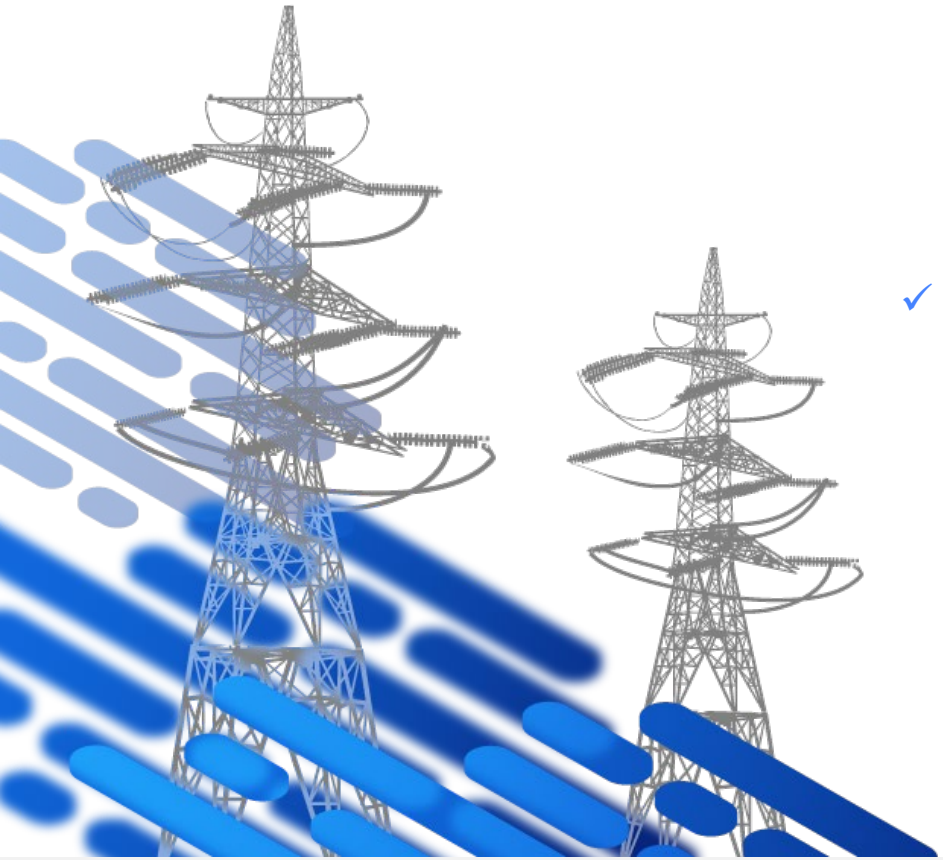
- IEEE Code Standardisation
- CIM / CGMES in Europe
- Smart Meter Rollout & Data Warehousing
- TSO-DSO Data Exchange Mechanisms
- DER_Aggregated Models
- Look Ahead Security Assessment Tools
- Fault Ride Through Assessments
- Continually Improving Operational Forecasting
- Crowd Sourced Forecasting
- Introduction of DERMS
- Wide Area Visibility with PMUs
- Deep Controllability by Regulation and Design
- New Flexibility Market Mechanisms
- Data Exchange Platforms
- DER For Blackstart and Restoration
- UFLS Modernization
- Automated Control Switching

Recommendations and Actions, Next Steps

Recommendations for Stakeholders - *Regulators and policy-makers*

- ✓ Mandate clear functional roles and develop legally binding primacy rules to govern DER/CER control in real-time operations.
- ✓ Establish frameworks for joint TSO–DSO procurement and activation of flexibility provided by DER/CER.
- ✓ Support regulatory sandboxes and innovation zones to trial coordination mechanisms without penalty risk.

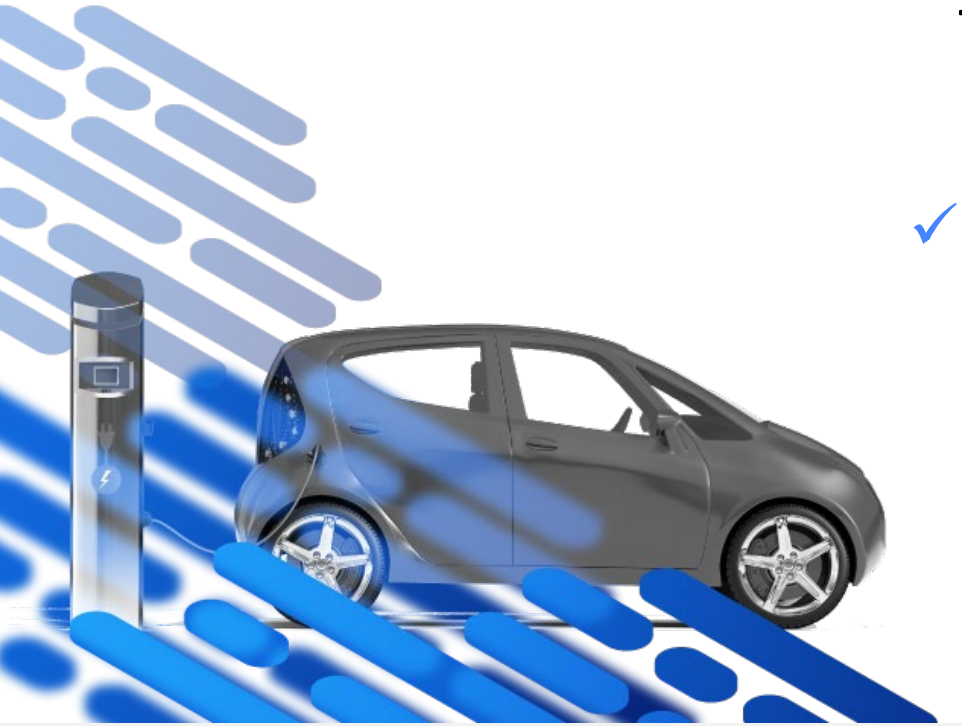
Recommendations for Stakeholders - *DSOs and TSOs*



- ✓ Jointly define interface protocols, fallback procedures, and real-time coordination responsibilities
- ✓ Co-invest in interoperability platforms and shared data models.
- ✓ Embed DER coordination into operational planning and outage/restoration procedures.
- ✓ Enable value stacking – allowing DER to access multiple revenue streams by participating in both wholesale and distribution-level markets.
  - ✓ While it improves returns, clear frameworks are needed to ensure service performance is upheld and system operation remains reliable and coordinated.
- ✓ Need to establish primacy rules – which define clearly understood hierarchies among network services and flexibility options to prevent conflicts when multiple system operators (e.g., TSO and DSOs) request services simultaneously.
  - ✓ For service providers contracted with multiple parties – such as a DSO and TSO – primacy rules clarify which party's service request takes precedence, avoiding contradictory commands (e.g., increasing generation for one operator while decreasing for another) and promoting coordinated, responsible asset use.

Recommendations for Stakeholders - *Aggregator/CER flexibility service providers*

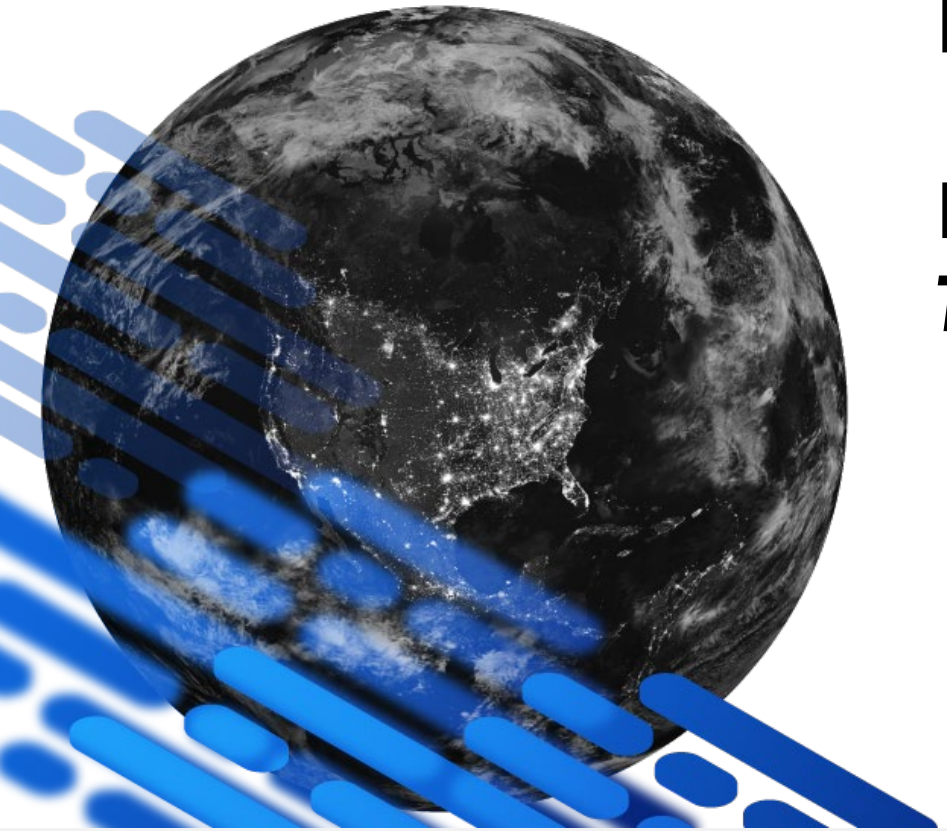
- ✓Engage with both TSO and DSO coordination frameworks.
- ✓Provide real-time flexibility availability and forecasting data in standardised formats.
- ✓Participate in pilot projects to co-design market and operational systems and interfaces.



Recommendations for Stakeholders - *Technology providers*

- ✓ Prioritise development of open, modular architectures that allow integration across DERMS, ADMS, and TSO EMS.
- ✓ Offer location-specific DER models that can be embedded into control and planning tools.
- ✓ Ensure cybersecurity and digital identity mechanisms that work in multi-party environments.

Questions and Comments?



Thank You for Your Participation and Engagement

Look out for the *Next Views from the TOP invite March 4th 2024*

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