UNECE Digitalisation in Energy Task Force

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Case Study: Grid Edge Management Reference Architecture & Policy Recommendations for Interoperability and Resiliency

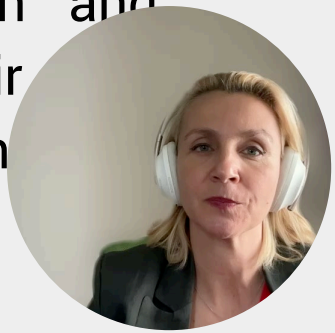
Study Objectives & Motivation

- addresses the challenge of distributed energy resources (DERs) integration to support grid resilience
- identifies key infrastructure requirements
- assesses policy developments and derives recommendations

Whilst the energy sector is making advances towards decarbonisation, decentralisation and digitalisation, the increasing share of DERs in the energy mix is still not being sufficiently harnessed for their potential in the energy transition, yet continue to create chal grid management

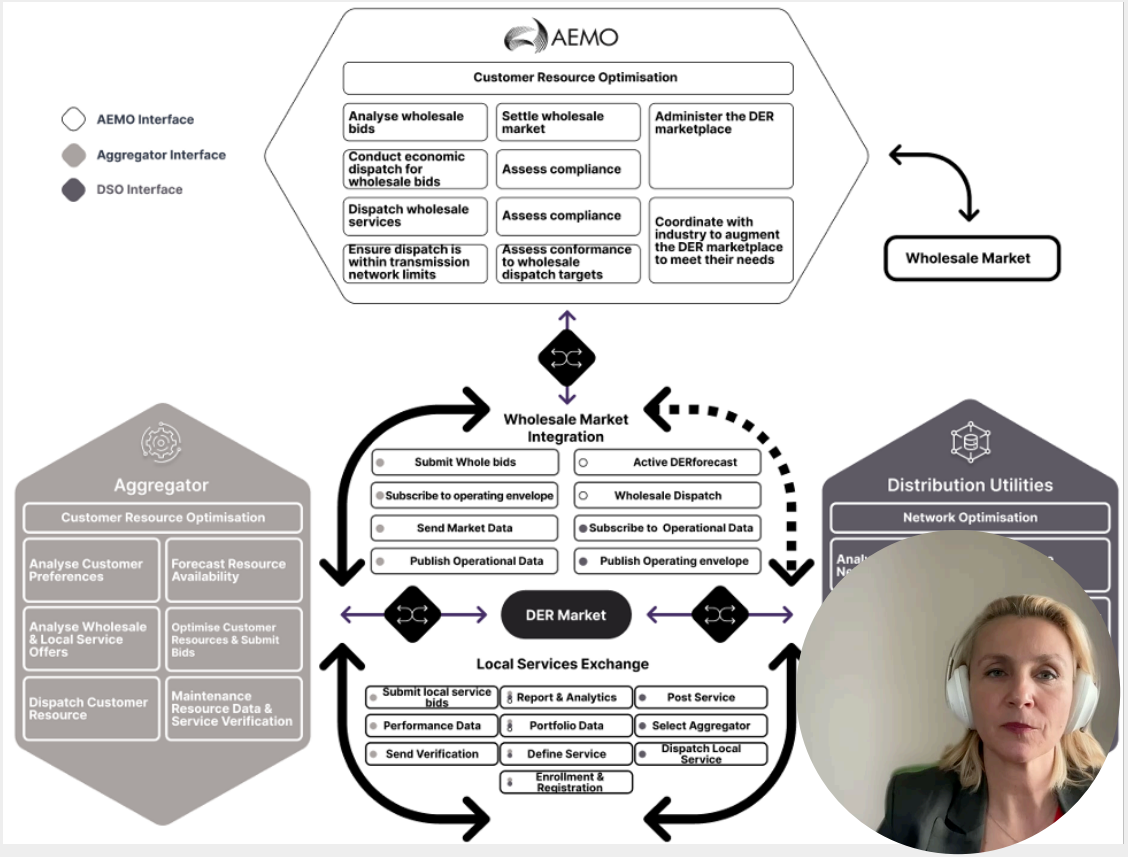
Reference infrastructure requirements for DER integration

1. **Ease of DER Installation**: standardised, transparent and simplified process for DER acquisition and installation to ensure consumer protection and encourage increased DER investment
2. **Submetering Capacity**: making available asset-level generation and consumption data to drive interoperability for diverse energy services, and
3. **Flexibility Registry**: providing DERs with identification and standardised interconnection functionality to ensure fair access and interoperability of different services includin integration, while maintaining privacy and security.



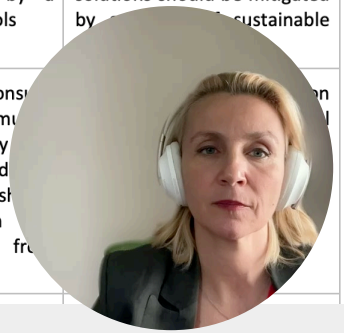
Rising Action I: Decentralised Data Exchange Platform for Energy Assets: EDGE Project in Australia (implemented in collaboration with the Energy Web Foundation)

- **Scalable Data Exchange:** DER data comes in large volumes and in a variety of types and formats. A single integration Data Hub (as opposed to bespoke IT integrations) for market actors enables scalable multiparty data exchange.
- **DER Registry:** Authentication and authorisation frameworks are needed to establish trusted relationships between systems, assets, and organisations. EDGE showcases a digital “passport” and “visa” solution for DER to be fully engaged in market transactions and services.
- **Data Processing for Wholesale and Local services:** Data from market actors (e.g., distribution utilities, FSPs, or market operators) is ingested and processed to deliver several use cases at the wholesale level (e.g., dispatch DER fleets as a forecasted resource) and local level (e.g., enrol DER in demand and response schemes).
- **Governance and system integrity:** Organisations can encode business logic and enforce rules based on requirements and responsibilities needed for specific use cases. By having a decentral logic execution predefined and embedded into the solution verifiability is ensured without relying on a single broker



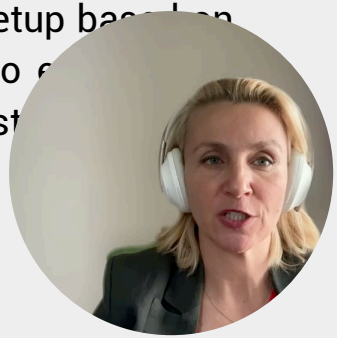
Local Energy Trading:
Peer-to-Peer vs. Peer-to-Market (Community Trading) vs. Self-Consumption Schemes

	Peer-to-Peer (P2P) / Transactive Energy (TE)	Peer-to-Market (Community Trading)/ Limited Transactive Energy (TE)	Community Self-Consumption (CSC)
Short Description	Decentralised or centralised exchange operating a peer-to-peer marketplace where prosumers/producers/consumers trade energy directly	Decentralised or centralised exchange operating a peer-to-market marketplace where prosumers/producers/consumers trade energy with the community at a single community price (usually set by regulator)	Community generates and consumes energy together, typically from shared DER such as a community PV or battery but other than sharing common resources there is no trading
Ownership	Individual and possibly also community-owned DER; marketplace operated by software in line with local regulation and community usually registered as a legal entity	Individual and possibly also community-owned DER; marketplace operated by software in line with local regulation and community usually registered as a legal entity	Community-owned DER
Benefits	Most efficient energy distribution / DER use, cost reduction, especially if trading between communities is also enabled (bottom-up energy market design)	More efficient energy distribution / DER use, cost reduction, energy conservation incentives, such as demand response or other flexibility services	Use of renewable energy, cost reduction, community building
Challenges for Greater Adoption / Scale	Requires digital infrastructure (submetering) and sophisticated marketplace operation technology, investment in DER; limited user-friendly applications available	Requires digital infrastructure (submetering) and simple marketplace operation technology, investment in DER; limited user-friendly applications available	Investment in DER required; administrative hurdles for shared resources and governance of these resources
Policy and regulation considerations	Needs a regulatory framework that supports P2P trading based on market conditions, ideally using DLT for marketplace operation and support for community management and uptake of digital solutions with higher user interaction and more user choices	Needs a regulatory framework that supports community (peer-to-market) trading, support to community registration and uptake of digital solutions	Policies that support renewable energy and community energy initiatives are beneficial. Regulatory barriers might include zoning restrictions and utility regulations. Other barriers include permitting related to DER acquisition and knowledge gap.
Environmental Impact	Positive impact as it encourages the use of renewable energy and conservation, while any carbon footprint of digital solutions should be mitigated by a choice of sustainable tools	Positive impact as it encourages the use of renewable energy and conservation, while any carbon footprint of digital solutions should be mitigated by a choice of sustainable tools	Positive impact as it encourages the use of renewable energy and conservation, while any carbon footprint of digital solutions should be mitigated by [illegible] sustainable
Social impact	Prosumers/producers/consumers empowerment but may also increase the digital divide, although studies have shown that households with less resources also benefit from reduced prices	Prosumers/producers/cons[illegible]ers and commu[illegible] empowerment but may increase the digital d[illegible] although studies have sh[illegible] that households with resources also benefit fr[illegible] reduced prices	[illegible]n



Global Policy Recommendations -
to ease DER installation and enhance submetering capacity

- DER acquisition and installation, including submetering, and necessary retrofit installations to be provided as turnkey or packages, with permitting simplified.
- Legal and standardisation frameworks to ensure clear discernment among different submetering options for customers and options to apply different forms of submetering, be they actual smart metres or home management system with the relevant functionality (one such example is the Australian DER monitoring guide).
- Standards for submetering systems should be consistent in their requirements for areas such as location of commodity (i.e., electricity, water and gas) entry into the building (or unit - be it interior or exterior), property size, building structure, system lifespan, ease of maintenance, and how the sub-meter will be read. Billing systems are an understandably bespoke setup based on the needs of the premise owner and yet consumer help and call centres need to e… homeowner questions or complaints can be addressed in a timely and consist… Allowing customers self-help options should be part of the standard offering.



Global Policy Recommendations -
to advance DER flexibility management with increased interoperability, privacy and security

- Smart grid operators and service providers should ensure that they are compliant with relevant privacy and data protection regulations, e.g. GDPR, CCPA. This involves conducting regular privacy impact assessments, maintaining records of data processing activities, and appointing a data protection officer to oversee privacy compliance and ensure that consumer privacy rights are respected and protected. Anonymising data and using decentralised databases additionally improve data security. Techniques like differential privacy and federated learning can also be applied to ensure secure and private analytics.
- Implementing a data exchange hub/flexibility registry, should be a priority across jurisdictions. Such action can simplify, reduce cost and increase the security of data exchange between industry participants
- A data exchange hub should be based upon well-designed interconnection standar
  regulations, outlining procedural and technical requirements for connecting DERs
  otherwise accessing DER data to provide a range of energy services;
- A decentralised data exchange can potentially offer greater scalability, resilience, and s
  than centralised systems

Global Policy Recommendations -
to enable peer-to-peer energy trading for a more optimal DER use and grid resilience

- Findings from regulatory testbeds and pilot projects should be reviewed and objectives set for any further testing, supporting development and accelerating application of emerging technologies to enable local energy trading methods that bring most benefits to individuals while supporting grid resilience, especially peer-to-peer trading, and encompassing also trading between communities.
- Review for applicability national policy from other countries that are specifically made to remove barriers for DERs to compete fair[l] regional organised capacity, energy and ancillary services market[s]
- Explore dynamic tariff model research and implementation to be[nefit] local flexibility.