Project EDGE

Demonstrations Insights Forum | 18 April 2023

Acknowledgment of Country

We acknowledge the Traditional Owners of country throughout Australia and recognise their continuing connection to land, waters and culture.

We pay our respects to their Elders past, present and emerging.

Purpose and Agenda

Purpose

- Update stakeholders on recent project developments and share select Data Exchange findings to date

Time	Description
1.05-1.35	EDGE Preliminary Results: Data Exchange (Nick Regan - AEMO)
1.35-2.20	Technology and Cyber Security Assessment Report (Rick Ross, Bijoy Lobo & Tim White - EY)
2.20-2.30	Q & A & Meeting Close

Project EDGE

Field Trial Conclusion and Project Update

Nick Regan (AEMO)

Field Trial has ended, what did we achieve?

The Project EDGE Field Trial Ran 24/7 for 333 days from 2nd May 2022 to 1st April 2023 4 AM (not an April Fool's Joke!)

54 Platform Functionality releases occurred:
- 8 major
- 46 minor

Project EDGE tested innovative concepts:
- Aggregator participation in a DER marketplace
- Value stacking of multiple value streams
- A decentralised data exchange approach

320+ **Residential** and **Commercial** & **Industrial** Customers

22

12 Enrolment cycles including:
- AusNet & AEMO validations
- Enrolment in Marketplace

400+ **DER assets** including Rooftop Solar, Batteries, controlled Hot Water systems and other loads

Project EDGE brings together:
- Diverse mix of customers
- DER equipment,
- Manufacturers
- DER device control systems

Field Tests conducted, including:
- Decentralised data exchange
- Participant and communication failures
- Market interventions, contrasting networks and AEMO
- Extreme wholesale prices

333 Days in Operational Trial
- 10 Organisations working across 6 time zones
- Operated 24/7 to data collection to support research outcomes
- Provided LSE & Wholesale services using single platform

3.5MW+ Flexible capacity available

EDGE includes Retailer and Non-Retailer Aggregator business models.

PROJECT ACTIVITIES

Nov '21 – MVP Marketplace delivered

Mar '22 – Detailed Project Research Plan published

Mar '22 – Full DER Marketplace developed.

May '22 – Field Trial Starts

Phase 4 Commences

June '22 – Public Interim & Customer Insights Reports published

Sep '22 – Additional aggregators onboarded.

Phase 5 Commences

Dec '22 – Lessons Learnt Report #2 delivered

Dec '22 – CBA methodology delivered

Mar '23 – Field Trials Ends

Jun '23 – Final Report Delivered

STAKEHOLDER MANAGEMENT

150+ Over formal Stakeholder Engagements

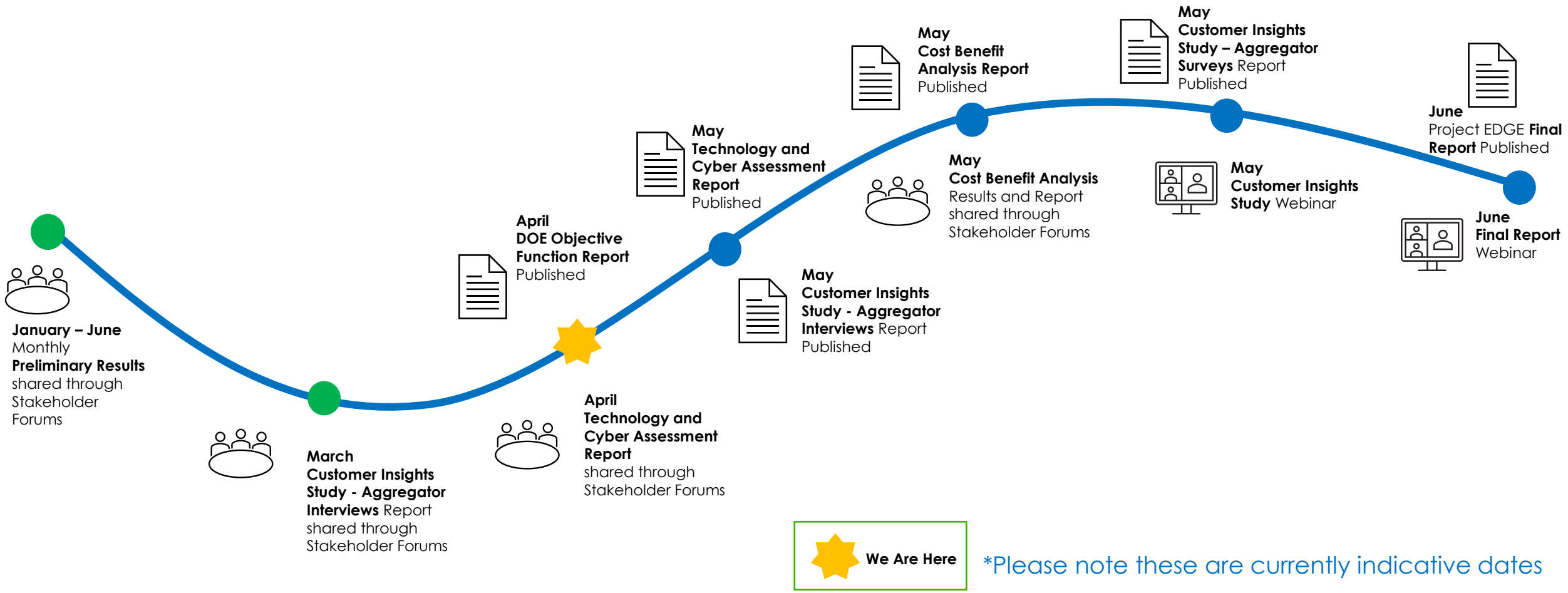
20+ Released Knowledge Sharing Reports and Presentations

INFORMING REFORM

Current and past:
- Scheduled Lite
- Integrating Energy Storage Systems
- DEIP DOE WG
- AER Flexible Export Limits (DOE)
- Flexible Trading Arrangements
- DER Data Exchange
- DER Network Services

Project EDGE - 2023 Knowledge Sharing Roadmap

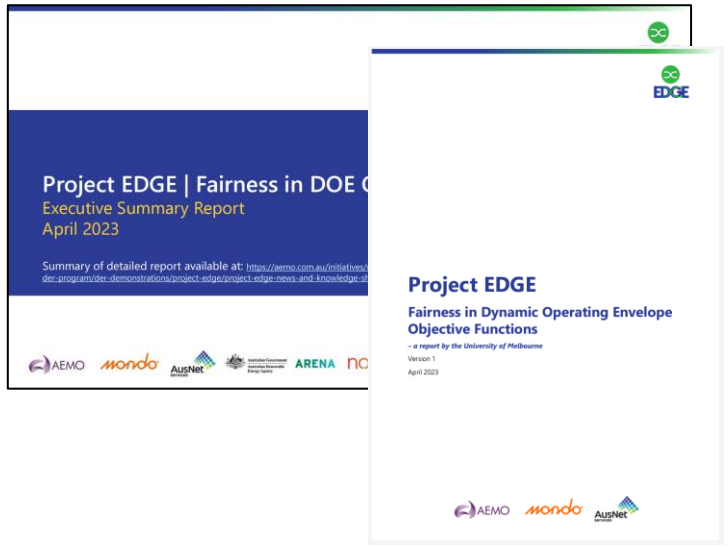
PROJECT EDGE Knowledge Sharing Calendar



*Please note these are currently indicative dates

Fairness in DOE Objective Function Study now available

- **The Fairness in DOE Objective Function Study completed by the University of Melbourne looks at the network allocation capacity that is applied across a spectrum DOE Objective Function options. The study shows there will only be a difference in results between the DOE objective functions if a constraint in the network is encountered when allocating capacity.**
- In these infrequent circumstances, DER customers will still be able to self-consume their solar as only exports are being managed in times of constraints.
- This work examines the technical, economic, and fairness impacts of a DNSP utilising different DOE objective functions to allocate network capacity among customers.



Key Study Discussion Points

1. **Fairness** has different meanings to different people & with different financial outcomes for DER and Non-DER consumers. Should this be measured by:
   - Fairness only for customers with DER receiving a DOE

   OR

   - Fairness for all customers existing in the network including those who own DER
2. Increasing system **efficiency** will also likely lead to better outcomes/be fairer for all customers in general

- An Executive Summary Report is provided to convey the study results in a way that is accessible to a wide audience of management, policy and non-technical stakeholders. It can be read stand-alone without diminishing understanding of the key results.
- This summary and the accompanying detailed report are available on AEMO's Project EDGE webpage*

*Available at: https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/project-edge/project-edge-news-and-knowledge-sharing

Project EDGE

Preliminary Results – Operational Data Exchange

Nick Regan (AEMO)

Preliminary results – data exchange (field trials)

Focus of this analysis

Qualitative Aggregator interviews and quantitative analysis from field trials of:

- The data communications capabilities required by participants to maintain secure operation of the power system and distribution network
- Resilience, latency and accuracy of operational data exchange systems

Research question 6

What is the most efficient and scalable way to exchange data between industry actors, considering privacy and cyber security, to benefit all customers?

Hypothesis C

AEMO and DNSPs need to develop capabilities that maintain the secure operation of power system and distribution network that is resilient to data outages associated with public internet failure in a high DER future.

Key preliminary insights & Implications

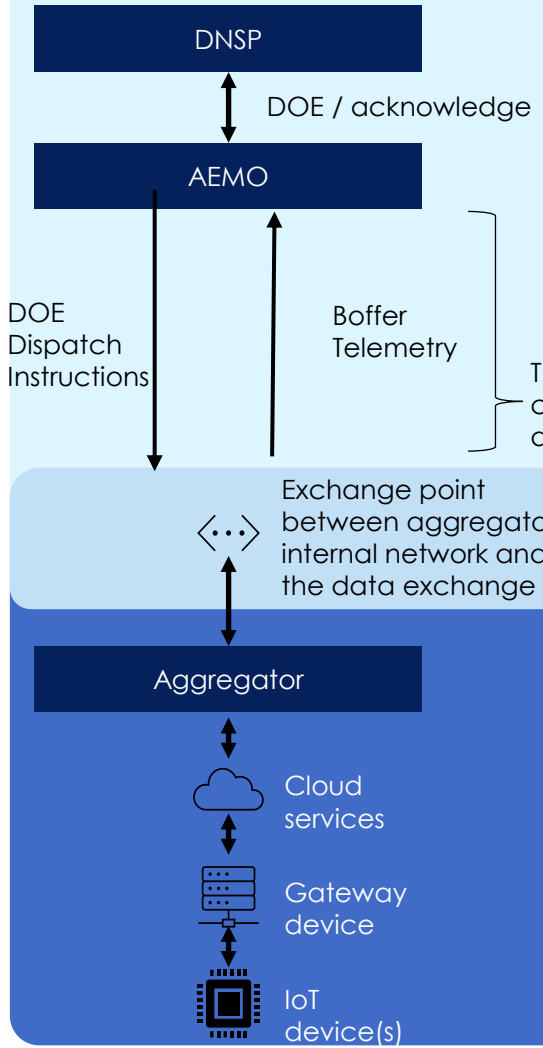
- Strong data comms & analysis is a foundation for VPPs to monetise electricity services, but VPPs need to be commercially viable to invest in these capabilities
- Standardisation to minimise the costs of coordinating DER can improve the commercial viability of VPPs
- As DUID level telemetry is more frequently transmitted, fleet coverage reduces due to latency between IoT devices and aggregator cloud
- DER resources may not be able to meet the same data communications standards as scheduled resources today, may require capability to manage a different risk profile by AEMO / DNSPs
- Future data comms standards relating to fleets of DER need to be **cognisant of both the power system risks to be managed and the commercial feasibility for Aggregators implementing solutions** that comply with these standards

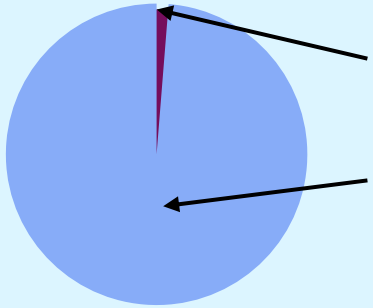
Other Data Exchange Findings

- Adequate industry cyber security requirements are needed to ensure system security. Aggregators (and other participants) have some 'Protect' measures but need to develop capabilities that assume compromise (Detect, Isolate, Defend, Recover)
- Includes reliable fail safes and fall-back default operations including alternative mechanisms of DER fleet monitoring and control that do not share a common mode of failure.
- A nationally aligned DER data exchange approach with appropriate data governance will be required to support efficient and reliable data exchange at scale. This could be achieved through a data hub rather than point-to-point approaches.
- In trial rural areas, WIFI was not reliable and accounts for several communications dropouts, devices could capture data to transmit when services are brought back online.

Operational Data Exchange Performance Insights: Aggregator DUID (whole of fleet) Telemetry

Current State – Data Exchange Hub





1%: the total quantity of traffic for dispatch instructions, DOE messages, and telemetry traffic

99%: the **quantity of traffic for boffers**

This aligns with the approach adopted by the Integrating Energy Storage Systems (IESS) rule change. It will enable storage units to submit a single bid that comprise 20 energy bids bands, and to receive a single dispatch instruction.[1]

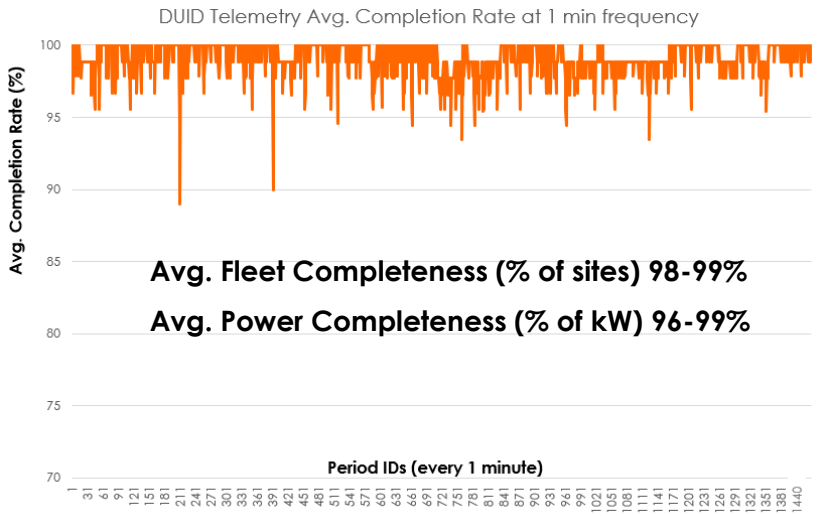
90-95 %: aggregator informed fleet coverage (sites) at any given time in 1 minute frequency of aggregated DUID telemetry submission

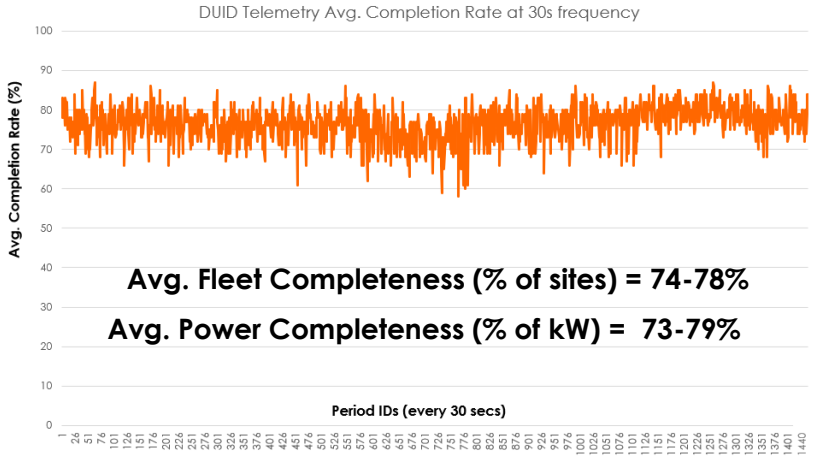
1.01 minutes latency: between aggregator informed of IoT measurement time to placement on the data exchange hub

** The associated latency was set by some aggregators to ensure 90 – 95% fleet coverage. As latency is decreased then fleet coverage would also decrease

Some trial customers are also located in a rural area – results are likely to be different in urban areas due to internet coverage and reliability

As DUID level telemetry is more frequently transmitted, fleet coverage reduces due to latency between IoT devices and aggregator cloud





Focus of this analysis

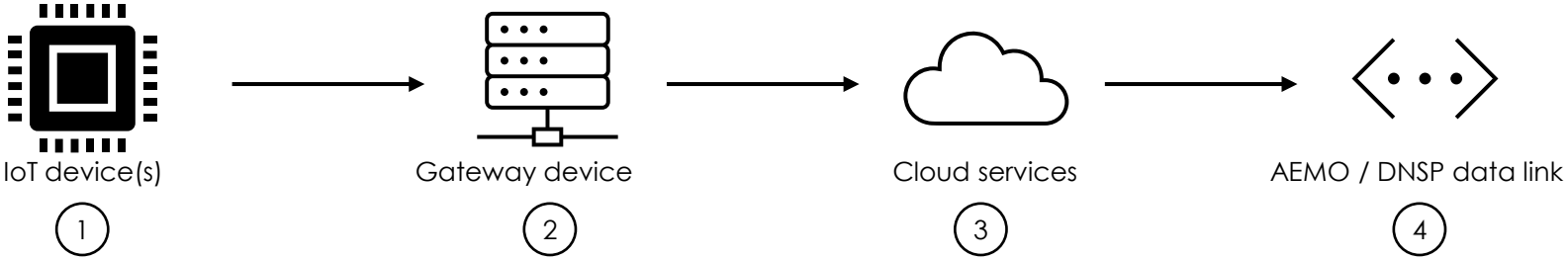
- **Why**: Current Data Comms Standards and SCADA require very frequent telemetry transmission (20s or less). It is hypothesised that this requirement delivered by fleets of consumer-owned DER will yield poor quality data in terms of completeness compared with current transmission-scale assets. This would represent additional operational risk for AEMO that would need to be managed.
- **What**: Analysis based on timestamps received from IoT to Aggregator cloud, before being packaged into DUID telemetry and sent to the DER Data Hub.
- To determine the relationship between DUID telemetry data 'completeness' and frequency of transmission from Aggregator to AEMO in terms of how much of their portfolio's capacity is reflected in the DUID telemetry.

Results

- Preliminary results shown for one aggregator, data for remaining two aggregators is currently being analysed.
- Fleet completeness (% of sites) and Power completeness (% of kW) profiled across days noting peak internet usage times (see results on figures opposite).
- No meaningful variation on the day or time of day during the sample week from this aggregator.
- Overall, all aggregators noted that power completeness is almost 1:1 with fleet completeness.
- This trend may differ in a portfolio where a few large sites provide a significant portion of aggregator capacity in which case additional comms sophistication may warrant investment.

Aggregators' identified challenges to scaled DER communications with a higher data sampling rate leading to increased costs to serve their customers

A series of workshops provided insights to the aggregators' internal communications network.



5 s - 30 s:
Current IoT sampling rate capability

Devices have differing localised storage capabilities

2 / 3 Aggregators:
Request data from their fleet at 1 minute intervals enabling 90 - 95 % fleet coverage

3 / 3 Aggregators:
Ingest data into cloud based solution

5-minute data captured and stored

10 – 15 s:
Latency time between the gateway device and the transport link to AEMO / DNSP

Challenges Identified

Increased sample rate (i.e. from 1 min to 30 seconds) leads to**:**

- **increased IoT storage cost** to account for internal comms outages (replacement of IoT devices to meet specification)
- **Software upgrades:** IoT vendor driven updates will have a large impact to fleet (5-10min outages observed in EDGE).
- **energy management systems cost** to upgrade legacy architecture
- **increased cloud storage cost** (doubling the data)
- **increased telecommunications cost** (doubling the data)
- **Synchronisation of time stamps** to a 'source of truth' clock
- **Parallel processing** will likely be required, at a cost

Overall, doubling sample rate equates to much more than doubling costs.

Implications

It is expected that larger fleet sizes will have a lower proportion of coverage outages due to diversity.

Whilst it has been observed that transmission of DUID telemetry at high frequency is **technically possible (<1 min), future data comms standards relating to fleets of DER need to be cognisant of both the power system risks to be managed and the commercial feasibility for Aggregators implementing solutions that comply with these standards**

This may require capability to manage residual risks to be developed by AEMO and DNSPS in addition to Aggregators

Turning insights into action: Industry Discussion

How should industry progress this discussion?

Who should determine data comms standards for DER Fleets?

What considerations do you have for this process?

Housekeeping

Recording in progress

- This forum will be recorded for the benefit of those who are unable to attend
- The recording will be available on the AEMO's Project EDGE website

Questions and answers

- There will be an opportunity for questions at the end of the presentation

AEMO EDGE Technology and Cybersecurity Assessment Presentation

22 March 2023

Building a better working world

Table of contents

Intro, Scope of the Assessment

EY has been engaged to conduct a theoretical assessment of different approaches to DER data exchange. An overarching evaluation framework was developed that considers the National Electricity Objective, the Project EDGE data exchange principles, and use assessment criteria that focus on the four categories of data exchange characteristics

EY conducted this assessment in the context of a high DER future (>100 GW by 2050) anticipated in the Integrated System Plan.

Assessment Framework: Data Exchange Options

Success Criteria: Industry Alignment

National Electricity Objective (NEO)

To promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

- Price, quality, safety and reliability and security of supply of electricity
- The reliability, safety and security of the national electricity system.

Project EDGE: Data Exchange Principles

- Reduce cost, and complexity of data exchange
- Agree and implement standards
- Decouple actors and avoid hidden coupling
- Reduce barriers to entry
- Consistent user experience across regions
- Ensure data privacy, security and quality

Project EDGE: Research Plan

- Wholesale market participation enabled at scale
- Distribution network limits in wholesale dispatch considered
- Efficient and scalable trade of local network services enabled
- Efficient, scalable and secure data exchange enabled
- Integrated technology

Assessment Criteria

1 Scalable, Stable & Resilient

Ability for the integration approach to handle ad-hoc load (peaks and troughs incl. instability) without impacting the performance, stability and reliability of the national energy system

2 Interoperable, Modular & Flexible

Ability for the integration approach to support connection and communication across a diverse heterogeneous energy network (devices, systems and networks) in a coordinated and structured manner.

3 Secure, Trustworthy & Auditable

Ability for the integration approach to enable privacy-preserving energy scheduling that can be trusted to ensure the integrity of the national energy system in a transparent, integral and where required, confidential way. This includes mitigations against and considerations for cyber attacks across the future distributed national energy system

4 Standardised, Accessible & Fair

Ability for the integration approach to enforce standardised communication protocols across the network while supporting the long term interests of consumers through ensuring market accessibility (low barrier to entry) and equitable governance and operations

Assessment Rating

Each data exchange option will be assessed against the each of the four assessment criteria.

The assessment rating will be measured utilising Likert scale response anchors of:

Unlikely, Neutral, Likely

in respect to the likelihood of the approach being suitable in achieving the purpose of the assessment criteria and the intentions of the success criteria.

- Point to Point Data Exchange
- Centralised Data Exchange
- Decentralised Data Exchange

The Project EDGE hypothesis is that an **industry data hub** is:

- **An alternative, more efficient solution than a point-to-point exchange approach.**

Project EDGE is testing two versions of an industry data hub, centralised and decentralised.

EY has also has also conducted assessments relating to:

- Cyber security
- Resilience
- Compensatory controls
- Feasibility of establishing decentralised data exchange infrastructure

Theoretical evaluation of data exchange options: PtP, Centralised & Decentralised

The overarching evaluation scored each data exchange approach against the criteria in the assessment framework, and also provided qualitative commentary from the perspective of different industry participants.

Integration Hub Average

POINT-TO-POINT
1
Unlikely

CENTRALISED	DECENTRALISED
2	**2.75**
Neutral	**Likely**

A decentralised approach can theoretically deliver greater benefits than centralised across the assessed criteria.

- Point-to-point data exchange solutions scored lowest in each category, indicating they are not suitable at scale.
- Point-to-point integrations manageable at small scale, but point-to-point approaches could lead to inefficient outcomes for consumers in the long term

- No single source of failure, highly resilient and enable easy restoration
- Enables high interoperability, is modular and flexible. Can support any chosen data model or communication protocol.
- No single entity has complete control to view, write, or modify protocol. On a permissioned platform any change can be seen, verified and is immutable, increasing trust and auditability.
- Infrastructure and associated costs decentralised to participants. Infrastructure hosting costs may be allocated more directly to DER customers if desired.

IMPORTANT TO NOTE:

- This is a theoretical assessment - 'enterprise -grade' decentralised energy technologies not yet widely available.
- While DER data exchange is small, less distinction between centralised and decentralised.
- As DER penetration scales the advantages of decentralised approach should hit a tipping point where they outweigh costs and complexities of making the transition.
- Key question relates to timing of net benefits and whether strength of benefits warrants a decentralisation pathway **before** tipping point to reduce costs and complexities of transition.
- Also needs to be considered in context of broader developments in electricity industry system architecture.
- Further analysis required to assess costs and benefits of such a transition in more detail.

Cyber Assessment

The evaluation conducted a separate cyber security threat assessment on the data exchange approaches. This assessment reviewed a number of potential cyber security risks associated with DER data exchange and outlined a number of mitigating controls that could result in a lower residual risk level.

Cyber Security Risks	Mitigating Controls
Unauthorised access and Disclosure of sensitive information • Through leveraging the multiple software ecosystems leveraged in the DER ecosystem	**Implement Secure by Design principles across software development processes.** • Through leveraging the multiple software ecosystems leveraged in the DER ecosystem.
Data Disclosure or Unavailability of Key DER Resources • Via lack of appropriately managed Supply chain risk	**Cyber security requirements should be established and information sources monitored.** • Based on best industry practices to identify and address supply chain threats and risks.
Increased impact of a potential cyber-attack • Absence of asset and entity classifications processes could lead to inappropriate security control application	**DER Marketplace entities should perform a Business Impact Analysis (BIA).** • Understand the criticality of their assets and implement appropriate controls to ensure the right level of protection against Cyber-attacks.

Resilience & Compensatory Controls Assessment

Each of the three data exchange approaches has been assessed for their resilience, and their ability to monitor triggers for compensatory control as well as enact compensatory control. The pre-conditions and post-condition considerations for the enactment of compensatory control have also been defined.

- **The Project EDGE Design Principles seek to ensure:**
  - **Safe, reliable** and **secure** supply of electricity
  - A low barrier to entry, cost effective and consistent user experience is provided
- **The future DER approach:**
  - Must be scalable, resilient and not overly complex
  - Simultaneously enables compensatory control of DER when communication loss occurs

Point-to-point

- **Low fit for safe, reliable and secure DER data exchange at scale**
  - Tight coupling of market participants
  - Limited resilience
  - Inability to monitor triggers for compensatory control

Centralised Hub (CH)

- **The best fit to the intended resilience goals**
  - Best enabled trusted participation and distributed identity management
  - Based on ensuring loose coupling, and decentralised worker approach for use cases such as Dynamic Operating Envelope (DOE) partitioning
  - Enables the scalability of data exchange for a future full NEM wide DER roll-out and market participation

Decentralised Data Hub (DDH)

- **Found to have a medium fit for scalability without the decentralised worker approach to use cases**
  - Key advantage is reduction of human involvement required
  - Lowers transaction cost while raising assurance of execution and enforcement processes
  - Further work required to understand threshold/scale at which a decentralised approach becomes more efficient than centralised

It is recommended that AEMO work with DNSPs so that:

- A consistent approach to DER compensatory controls is adopted across DNSPs.

- An operational procedure between DNSPs and AEMO control rooms is developed to share visibility of default DER control settings.

- To agree different DefaultDERControl settings to apply under different seasons or operating conditions.

Feasibility of a Decentralised Approach

If a DER data hub approach is recognised as a more efficient and scalable way to facilitate data exchange across numerous use cases than a point-to-point approach, then the following realistic options may be considered:

Centralised

- Adding DER data exchange use cases (such as the Dynamic Operating Envelopes) to the existing eHub and Shared Market Protocol
- Consideration of how that should evolve towards a target state following in the NEM 2025 Program – Industry Data Exchange and DER Data Hub projects

Decentralised

- Establishing an alternative decentralised data hub for DER use cases that can operate in parallel, and separately, to the eHub
- Prioritise consistent approaches for elements such as Identity and Access Management
- Consider how these two approaches could converge over time in the NEM 2025 Program – Industry Data Exchange and DER Data Hub projects

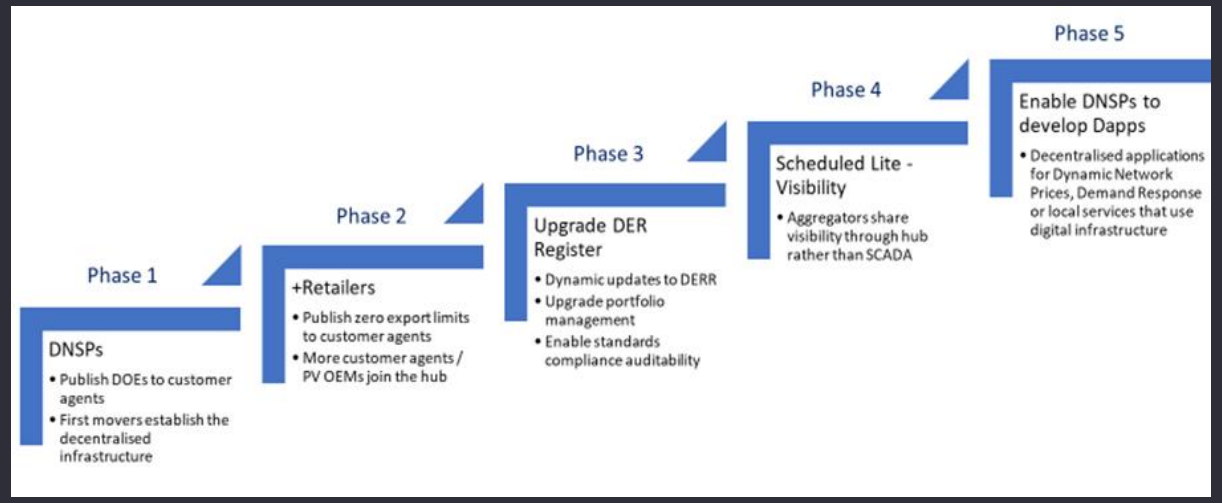
A decentralised model for a shared DER Data Hub is considered theoretically feasible, and it warrants time, effort and resources to explore an implementation in more detail given the potential consumer benefits identified.

It is important to also consider:

- The scale of effort required to develop a detailed design and business case for implementation.
  - This could be addressed in the NEM 2025 Program, Industry Data Exchange and DER Data Hub projects
- How a phased implementation may be more appropriate than a single ‘big bang’ approach.
  - A successful small-scale implementation for an initial use case may pave way to add further use cases.
  - Economies of scale may not be achieved until later phases.

Feasibility of a Decentralised Approach

In evaluating the case for the first small-scale implementations, it is important to consider the potential long-term benefits of decentralisation, taking all stakeholder impacts into account together. The Project EDGE cost benefit analysis is considering a multi-stakeholder perspective.



A phased implementation roadmap should also consider use cases in adjacent sectors that may deliver greater efficiency gains for consumers. For example:

- Sharing of standing and operational data from electric vehicle charge points
- Particularly since charge points would need to receive DOEs from DNSPs in future.

Australia is not alone in exploring these concepts, for example in the UK:

- Catapult Energy Systems: Delivering a Digitalised Energy System report recommended the UK Government to "create a radically different energy system, driven by open-source software and open standards," facilitated through the deployment of a "Digital Spine" to create a network of connected nodes to efficiently share data.
- Department of Transport aims to establish an EV Chargepoint Datahub, so that standing and operational charge point data is made available so that consumers can easily locate available and working charge points.
- Ofgem is proposing a a common digital energy infrastructure to facilitate distribution flexibility market liquidity

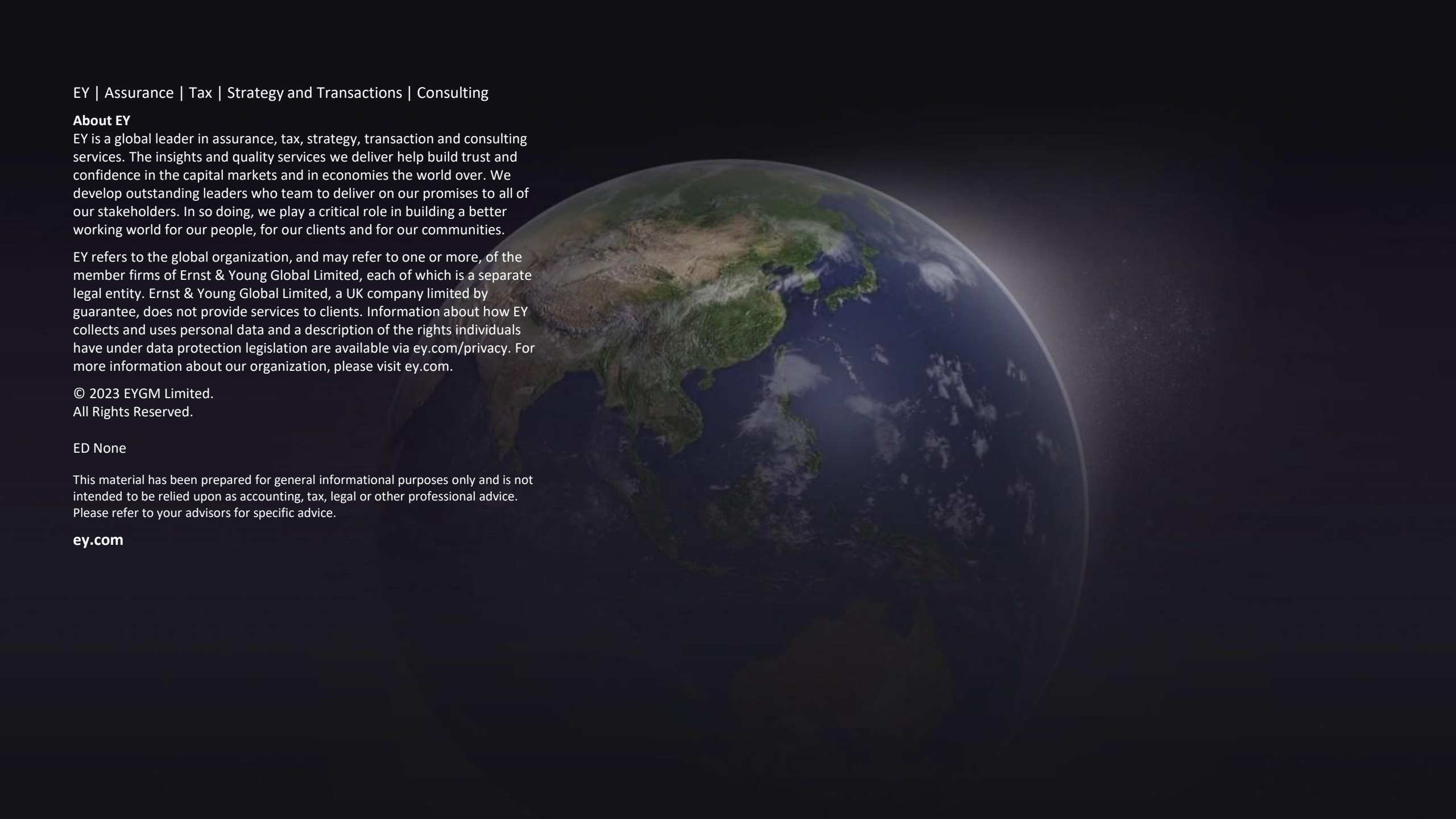
These are very similar concepts to data exchange hub that Project EDGE is examining.

Suggested Next Steps

If utilising an industry data hub is considered in the long-term interest of consumers for DER related data exchange, and that the benefits of decentralised technology solutions/components are worthy of further exploration, some next steps may include the following:

- Identify appropriate use cases and voluntary participants for a phase 1 implementation.
- Design a minimum viable product (for phase 1 implementation) and aspirational Enterprise and Solution Architecture (conceptual and logical)
- Evaluate potential implementation models, including Governance, cost recovery and operational models.

These activities could all be progressed within the broader context of the NEM 2025 Program, specifically the Industry Data Exchange and DER Data Hub projects, and through broad engagement with industry stakeholders.



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ED None

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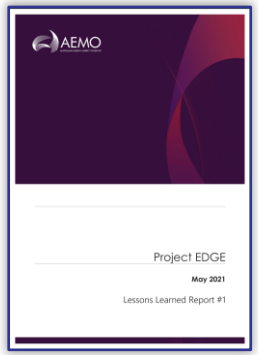
Project EDGE Publications

Knowledge Sharing Reports

Fact Sheet

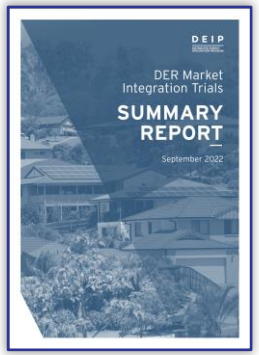


Lessons Learned # 1

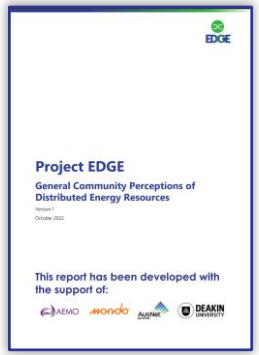
Public Interim Report

Customer Insights Study

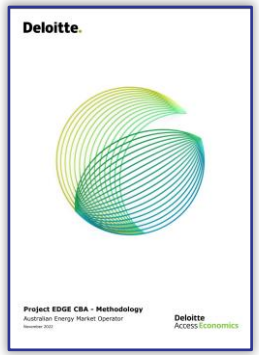
Customer Insights Literature Review



DEIP DER Market Integration Report



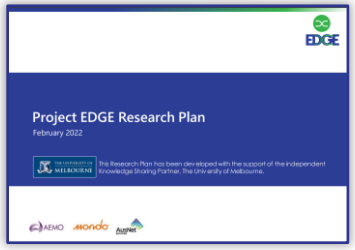
Community Perceptions of DER



Cost Benefit Analysis

Lesson Learnt #2

Presentations & Webinars



Research Plan

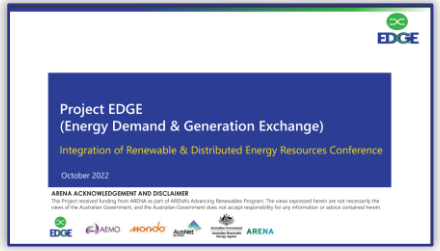
Webinar #1

Public Interim Report Webinar

Conferences

Energy Systems Integration Conference

DEIP Dive DER Market Integration Conference



Renewable and Distributed Resources International Conference

For further news and knowledge sharing publications, please visit the Project EDGE website

For any questions, comments or feedback please contact: EDGE@aemo.com.au

Close and next steps