

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.

Project EDGE

Final Knowledge Sharing Report - Public Webinar | 18th October 2023

Nick Regan Project EDGE Lead, AEMO
Anoop Nambiar EDGE Program Lead, AusNet & Mondo

ARENA ACKNOWLEDGEMENT AND DISCLAIMER

This Project received funding from ARENA as part of ARENA's Advancing Renewables Program. The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.



Recording in progress

- This webinar will be recorded for the benefit of those who are unable to attend
- The recording and presentation will be available on the AEMO website

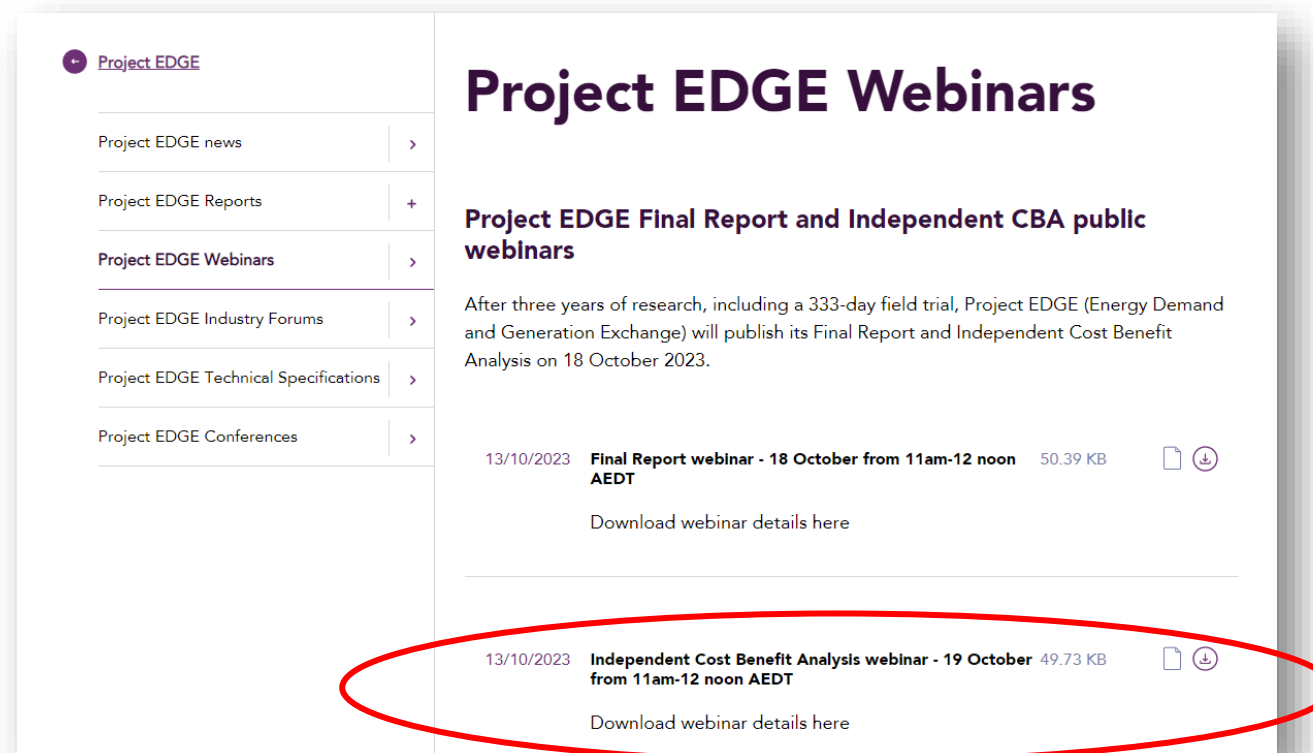
Questions and answers

- Submit questions for the end at **slido.com** with **#4197226**
- Any question we don't get to, the team will answer after the webinar

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Independent CBA webinar

- Thursday 19 October, 11am-12 noon AEDT
- Dial in details on **Project EDGE website** (Webinars)

A screenshot of the Project EDGE website's 'Webinars' page. The page has a left-hand navigation menu with links for 'Project EDGE news', 'Project EDGE Reports', 'Project EDGE Webinars', 'Project EDGE Industry Forums', 'Project EDGE Technical Specifications', and 'Project EDGE Conferences'. The main content area is titled 'Project EDGE Webinars' and features a sub-heading 'Project EDGE Final Report and Independent CBA public webinars'. Below this, there is a paragraph of text: 'After three years of research, including a 333-day field trial, Project EDGE (Energy Demand and Generation Exchange) will publish its Final Report and Independent Cost Benefit Analysis on 18 October 2023.' There are two webinar entries listed. The first entry is dated '13/10/2023' and titled 'Final Report webinar - 18 October from 11am-12 noon AEDT' with a file size of '50.39 KB' and a download icon. Below it is a link 'Download webinar details here'. The second entry is dated '13/10/2023' and titled 'Independent Cost Benefit Analysis webinar - 19 October from 11am-12 noon AEDT' with a file size of '49.73 KB' and a download icon. This second entry and its associated link are circled in red.

Today's agenda

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Opening remarks: Ian Kay – CFO, ARENA

The Australian CER/DER context & challenges

Project EDGE overview

Key Technical findings

CBA findings

Sharing benefits with customers

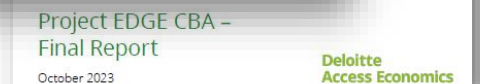
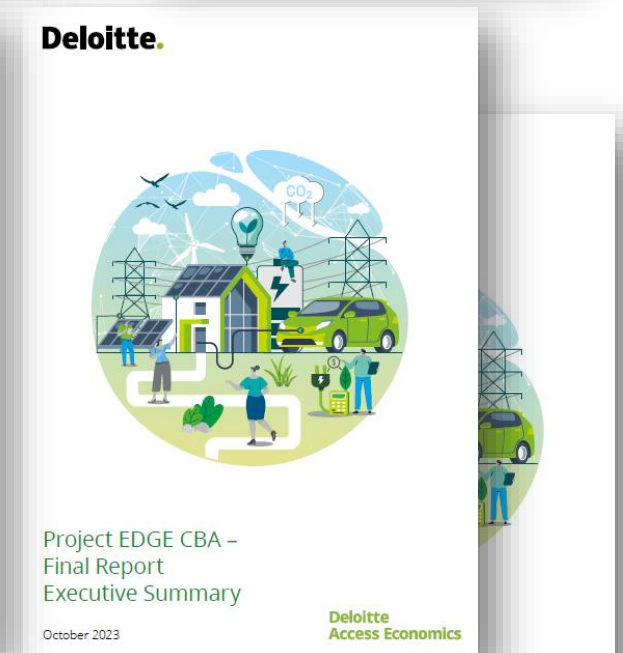
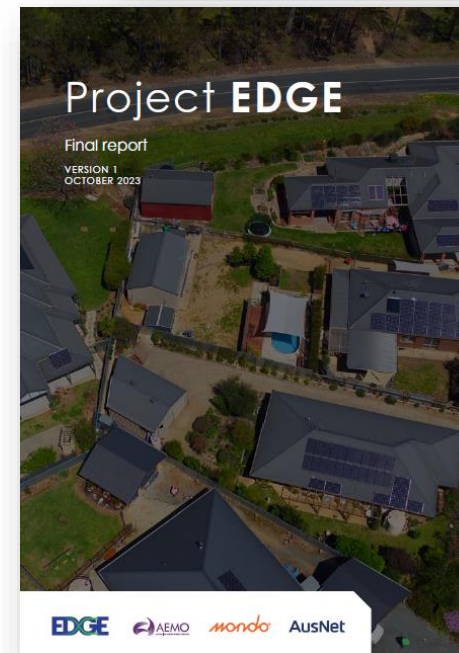
Conclusion & next steps

Q&A

Speakers:

Nick Regan – AEMO

Anoop Nambiar – AusNet and Mondo



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The Australian CER/DER context

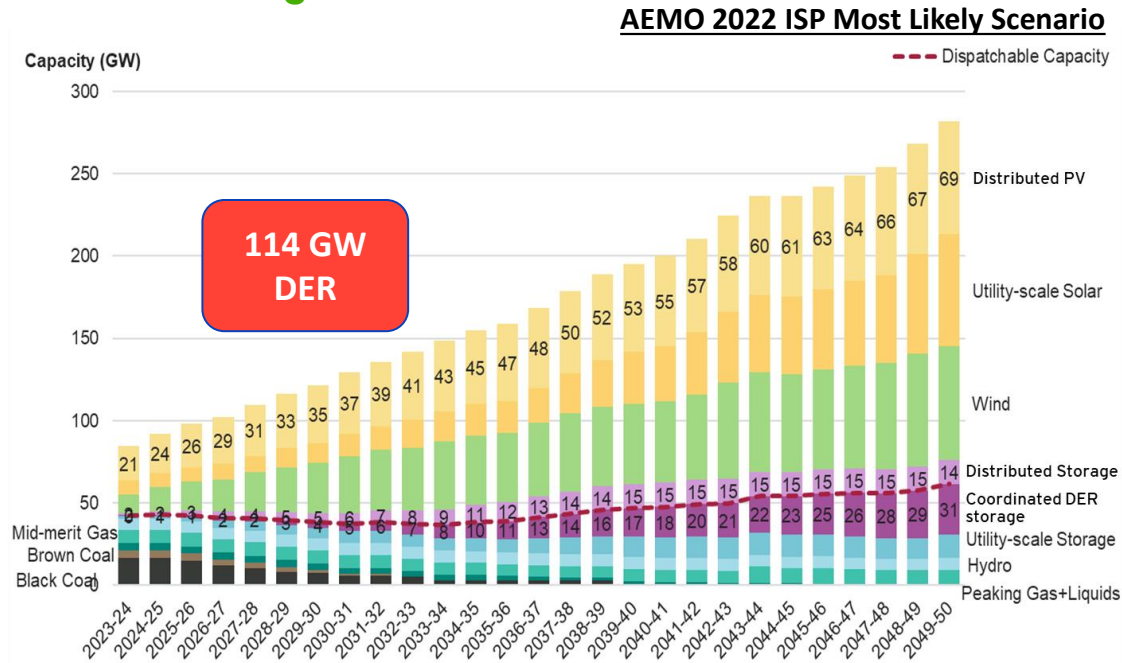
The National Electricity Market is experiencing its largest transformation ever with fossil fuel exits, rapid uptake of renewables and DER

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The rapid uptake and anticipated scale of DER in the NEM represents both challenges and opportunities for the power system and electricity consumers

The scale of change



- In 2050, **40% of total NEM installed capacity** may be distribution connected
- Electricity usage from the grid **to nearly double**
- Rooftop solar PV to **increase 5-fold**

Challenges and opportunities

Uncoordinated DER at this scale will impact power system security.

We are already experiencing challenges with NEM dynamics and power system security today.

Current forecasts show gaps in electricity reliability

AEMO's 2023 Electricity Statement of Opportunities (ESOO) forecasts numerous reliability gaps (the ability of the system to meet energy demand levels)

But Coordinated DER can improve NEM reliability

Sensitivity modelling found:

- **Reliability risk**
The reliability forecast improves considerably with coordinated DER
- **Cost impacts**
Integrating DER could avoid costs along the electricity supply chain
- **Influencing factors**
Consumer trends could influence the degree of DER uptake and coordination
- **Support**
Policy and consumer support for coordinated DER is key

Project EDGE can inform this transformation to be one where voluntarily coordinated DER supports more affordable, reliable and cleaner electricity for all consumers

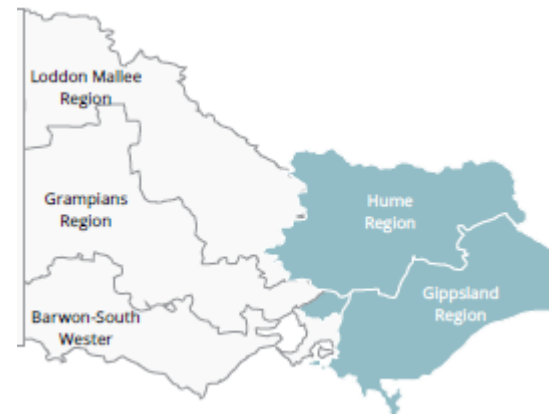
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Project EDGE overview

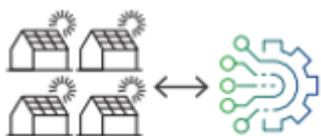
Project EDGE demonstrated a proof-of-concept two-sided arrangement that enables efficient & secure coordination of aggregated DER, and facilitates the delivery of both wholesale and local network services at the grid edge in the NEM

Target outcome: provide a practical evidence base to inform Australia's National Electricity Market (NEM) reforms regarding an efficient DER integration pathway that benefits of all consumers



Explainer – Project EDGE key concepts

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Aggregator / Virtual Power Plant (VPP)

- Synonymous terms, these actors represent many customers' DER, collectively managing devices to provide electricity services, sharing benefits with customers
- Customers grant Aggregators permission to use their DER and data within their preferences
- Aggregators may also be electricity retailers



Dynamic Operating Envelope (DOE)

- A dynamic operating envelope provides upper and lower bounds on the import or export power, in a given time interval, for either individual DER assets or a connection point
- An export-only version ('Flexible Export Limit' or FEL) is currently being offered in South Australia



Bi-directional Offer (BOffer)

- Bi-directional Offer means a market offer that includes both generation & load across the aggregator's registered portfolio of customer sites or, NMs
- This is consistent with current NEM configurations (IESS rule change)



Wholesale Dispatch Instruction

- Dispatch Instructions are issued in the NEM by AEMO to Aggregators for the purpose of meeting the supply and demand balance in EDGE by either generating / exporting to grid or by consuming / importing from grid as a single DER portfolio



DER Data Exchange Hub

- Refers to digital infrastructure allowing data exchange between multiple industry actors such as Aggregators, Networks and AEMO
- In EDGE the DER Data Exchange hub facilitated operational coordination between all parties but did not coordinate customer DER directly

Project EDGE : 3-year cross-industry collaboration, part funded by ARENA delivered in partnership between AEMO, AusNet Services and Mondo

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Tech. vendors

opusone
solutions
DSO capability
Develop DERMS Platform

energy web

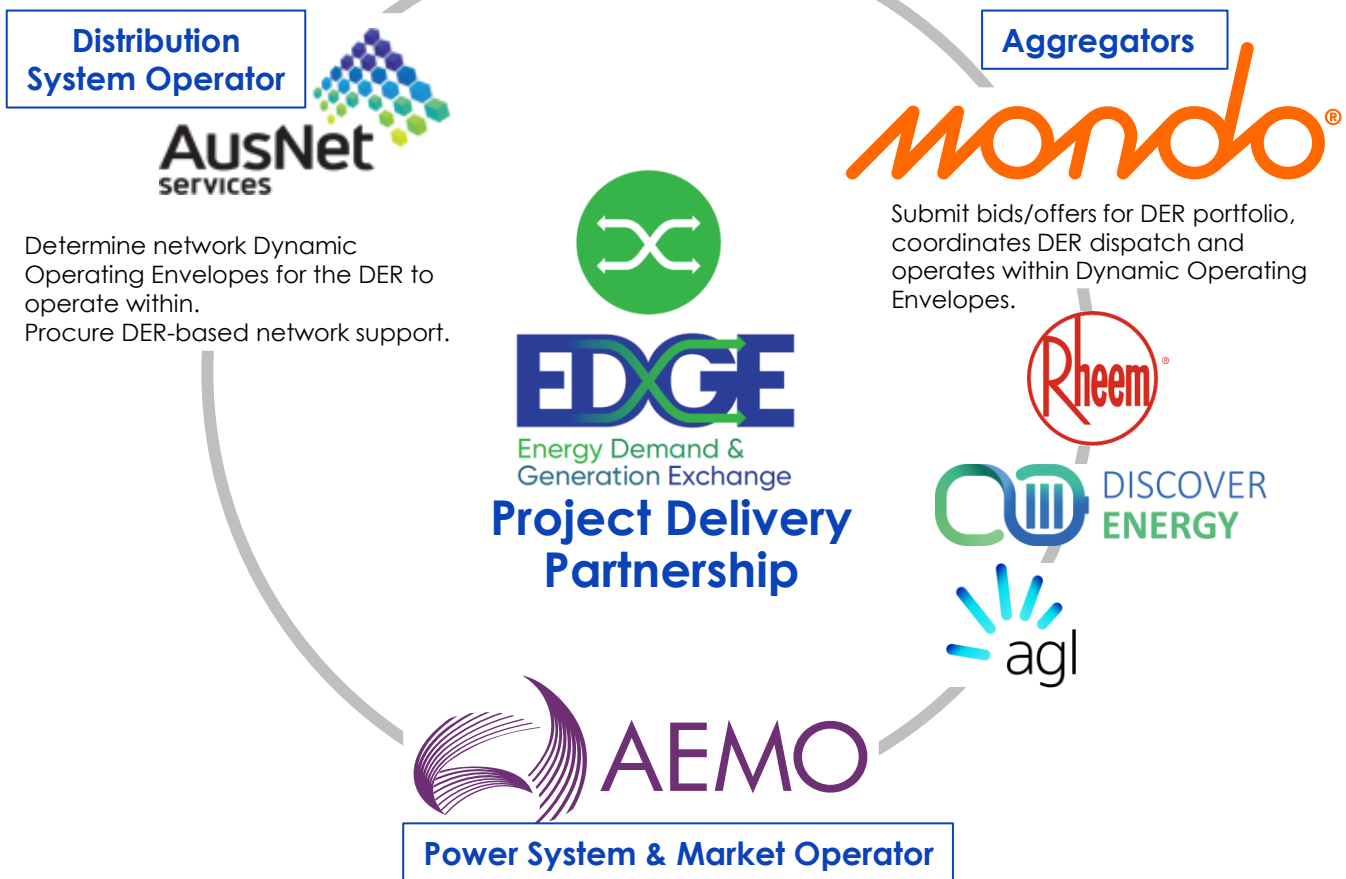
Digital identity & data exchange
Develop EDGE trial data exchange technology solution

PXiSE
Energy Solutions, LLC
Market logic/intelligence
Develop EDGE trial dispatch operating logic



ARENA
Funding Partner

Project sponsorship and funding



Supporting vendors



Networks and Research

Develop Research Plan and Develop OE algorithms



Customer Insights

Advance customer insights research

Deloitte.

Independent Cost Benefit Analysis

Determine if EDGE concepts are economically in the long-term interests of consumers and under which conditions



Independent Project Manager

Coordinate and manage the Project



Knowledge Sharing

Facilitate development of Knowledge Sharing Deliverables

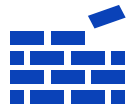
Project EDGE trialled an evolution of the NEM where price-responsive DER can be efficiently integrated into market arrangements

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Project EDGE is complete, supplying a practical evidence base to inform Australia's DER integration reforms to benefit all consumers

ROBUST FIELD TRIAL



54

Platform Functionality releases occurred:
 • 8 major
 • 46 minor



INNOVATIVE CONCEPTS

Project EDGE tested innovative concepts:

Aggregator participation in multiple markets

Value stacking of multiple services

A scalable DER data exchange approach

RICH SAMPLE

320+

Residential and Commercial & Industrial Customers



22



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

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

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.

University designed Research Plan



150+

Over formal Stakeholder Engagements

INFORMING REFORM

Past, Current, Future:

- Scheduled Life
- Integrating Energy Storage Systems
- DEIP DOE WG
- AER Flexible Export Limits (DOE)
- Flexible Trading Arrangements
- DER Data Exchange
- DER Network Services

A COMPREHENSIVE EVIDENCE BASE

Customer insights study



Independent Cost Benefit Analysis



Independent technology & cyber security assessment



Specialist techno-economic analysis



Robust end-to-end field trial with real customers



25+

Released Knowledge Sharing Reports and Presentations

STAKEHOLDER ENGAGEMENT

Key Findings

All consumers stand to benefit from the accelerated, optimised integration of DER via Virtual Power Plants (VPPs) in the NEM

1. DER coordination via VPPs is **technically feasible** today
2. And **economically feasible**, benefitting all consumers
3. It requires **clearly define industry roles**
4. And **sharing benefits with customers**

Project EDGE identified a practical framework of roles and capabilities to scale DER integration today, with the flexibility to facilitate new innovations as industry needs evolve

Project EDGE demonstrated end-to-end roles and technical feasibility of capabilities to integrate DER while maintaining system and network security and reliability for consumers

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Project EDGE successfully coordinated DER operations between all 5 participants using extended roles and demonstrated that coordinated DER at scale can accelerate the secure and reliably transition to net zero

Wholesale market services

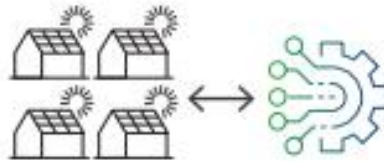
- Aggregators provide scheduled wholesale electricity services within DOEs
- Value driven by aggregators optimising DER on behalf of customers
- Central dispatch coordinated by AEMO

Efficient data exchange

- Secure, efficient and scalable
- Facilitate DER service delivery & secure grid operation between organisations
- Ecosystem enabled in EDGE by DER data exchange hub (new capability)

Aggregators

Customer Resource Optimisation

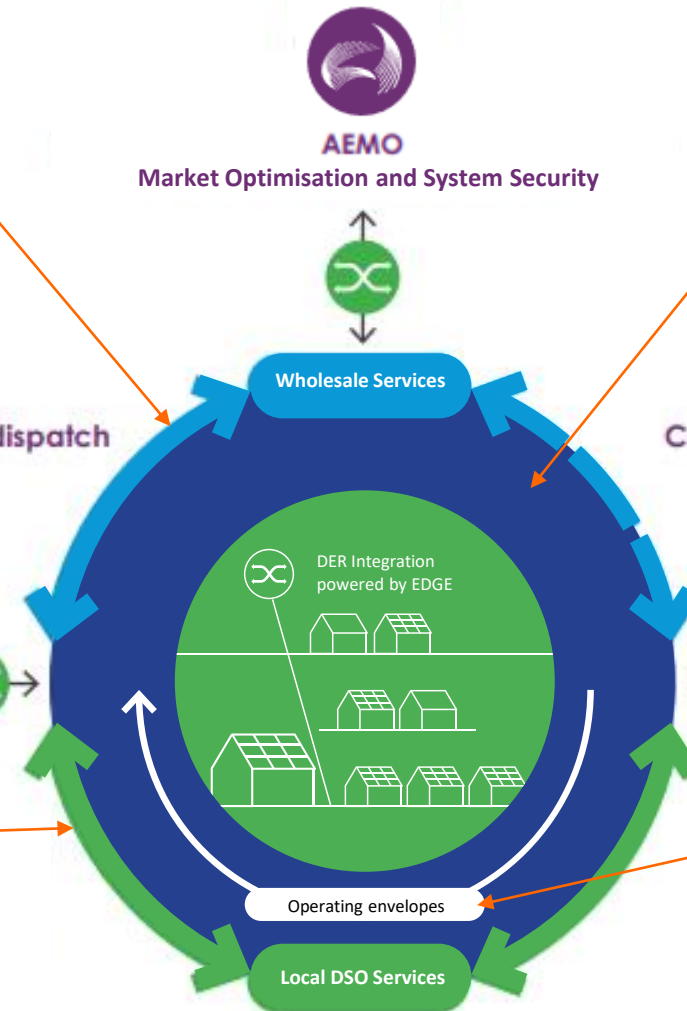


Network support services (NSS)

- DER provide services accounted for in their bi-directional offers
- DNSP triggers the service
- AEMO does not dispatch NSS

Bids and dispatch

Collaboration



Distribution System Operator (Evolved DNSPs)

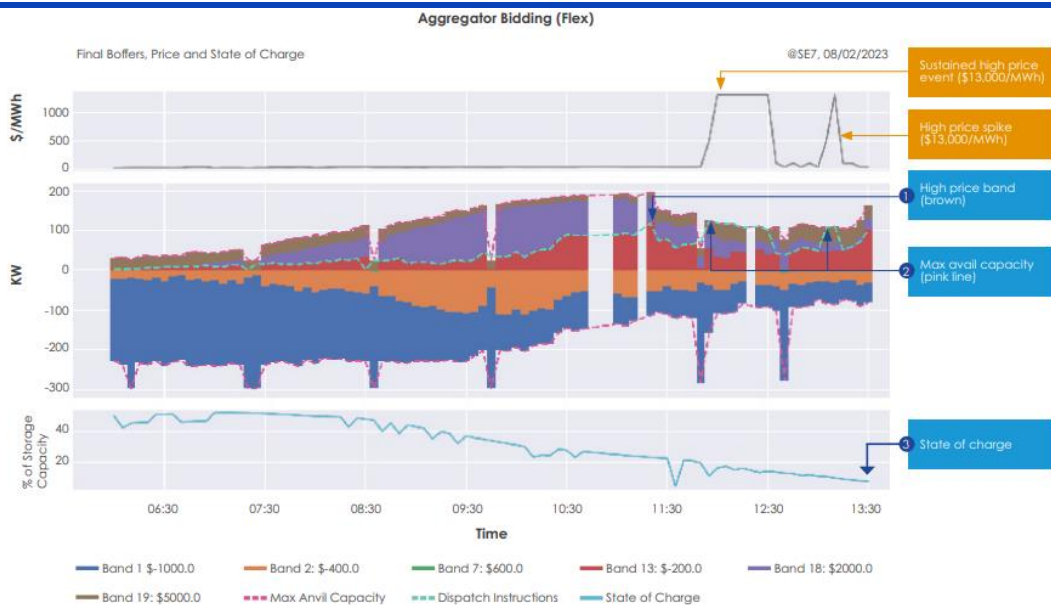
Network Optimisation

Local constraints

- DNSP communities dynamic operating envelopes (DOEs)
- Optimise their network utilisation to maximise available DER capacity

VPPs can operate in normal and emergency conditions to varying degrees and EDGE identified the capabilities needed

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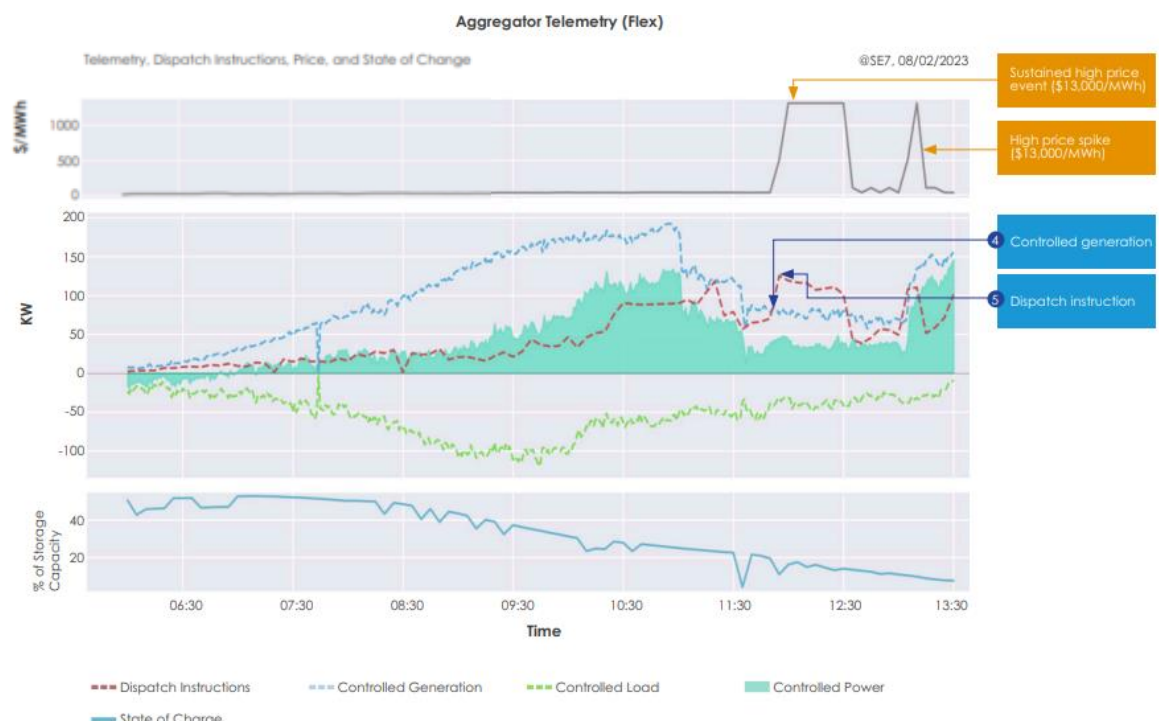


The main capabilities aggregators need to develop are:

- Reliable forecasting capabilities
- Bidding and re-bidding behaviour
- Provision of operational data
- Coordinating DER as a portfolio to meet dispatch target conformance (including linear ramping)

The main capabilities aggregators need to develop are:

- DOE conformance
- Communications and compensatory controls
- Understanding market requirements for scheduled resources
- Service co-optimisation and value stacking

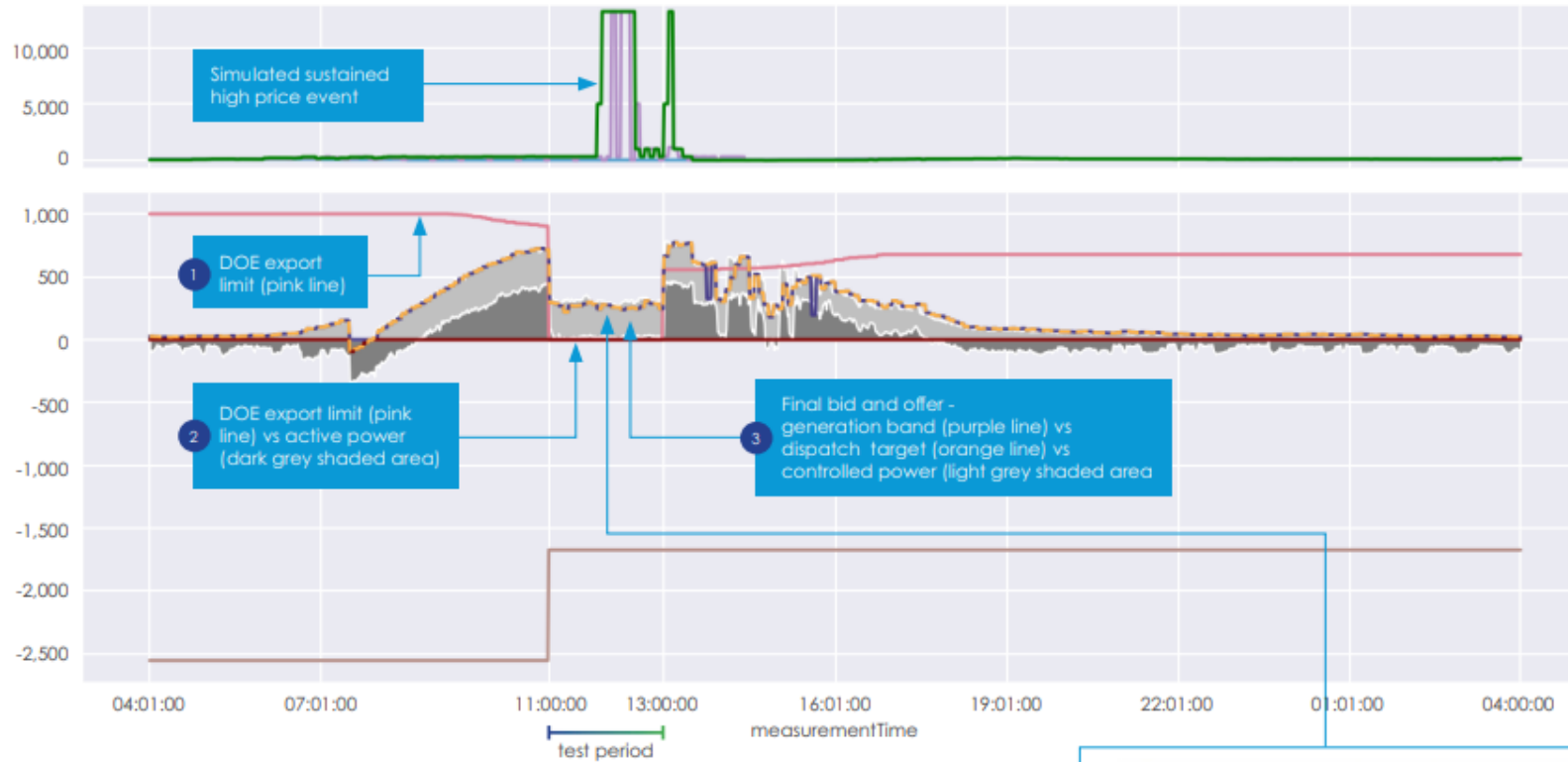


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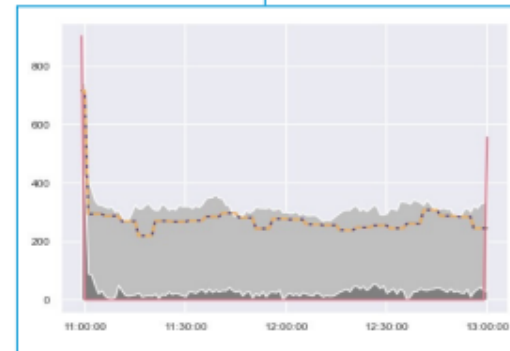
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Real World Scenario: Constrain System Output - DOE Limit DUID Net Flow to Zero (Aggregator B) — 2023-02-08 (Flex)



- 1 hour ahead price forecast
- 4 hours ahead price forecast
- rrp
- active power
- controlled power
- DOE export limit
- DOE import limit
- final Flex boffer (generation band)
- final Flex boffer (load band)
- dispatch target



Field tests also demonstrated aggregators could respond and conform during emergency and extreme price events in real time

This includes operating DER that limits export into the network, while providing customers with additional services (self-consumption)

Overall, the results from real world events show aggregators have the potential to coordinate their DER portfolios in challenging scenarios

VPP capability is best matured via a service-based stepping-stone approach

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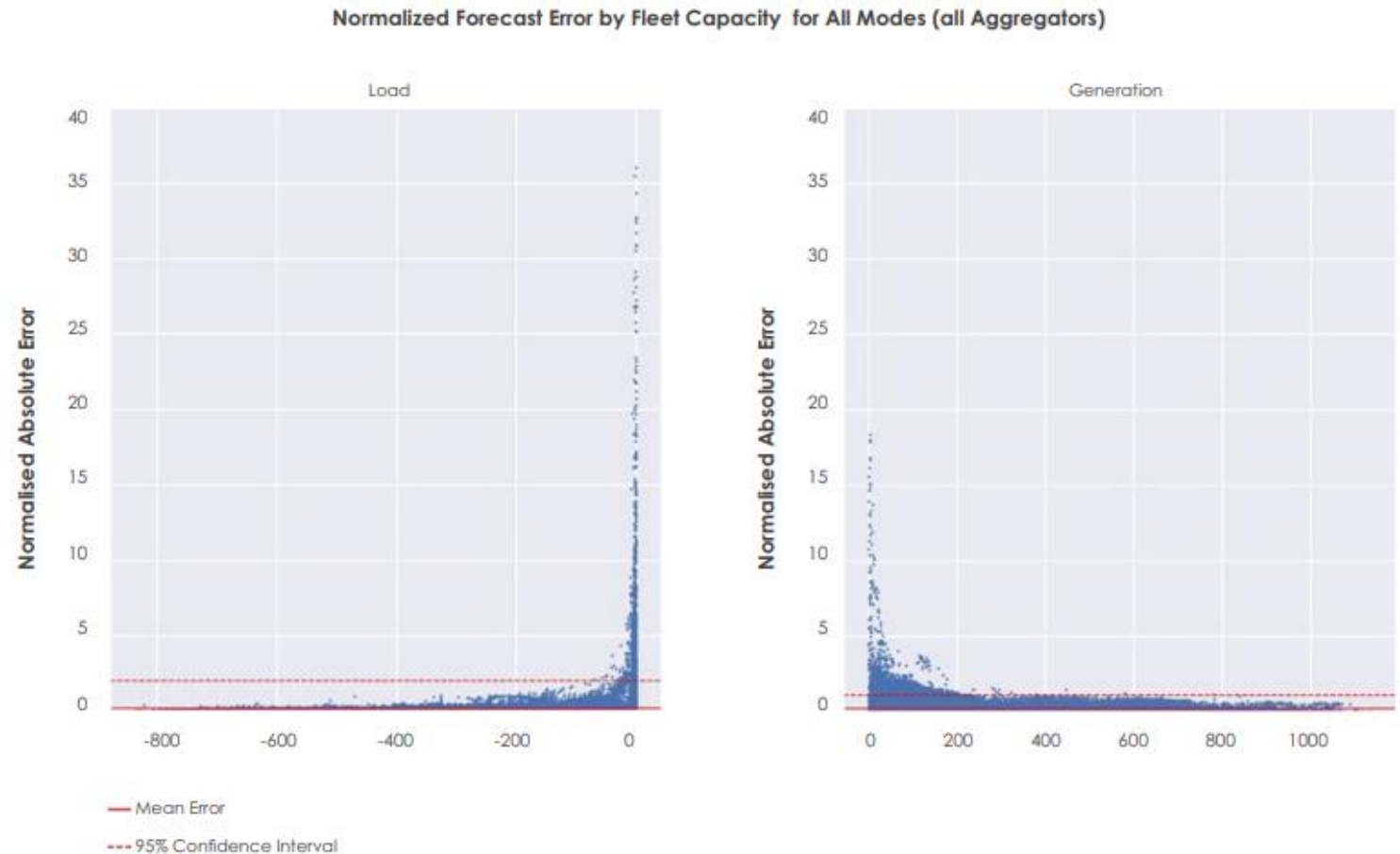


Stepping-stone participation enables revenue access aligned to capabilities

- Integration into dispatch will require enhanced capabilities
- But it also enables access to current and emerging markets and services
- Stepping-stone strikes a balance between costs and benefits
- Enables aggregators to develop sufficient scale to absorb costs of graduating to the next step

The EDGE field trial showed ability of aggregators to deliver wholesale services

To mature required capability for full participation at scale, a service-based stepping-stone approach aligning revenue opportunities with VPP system development is recommended



Aggregators, not AEMO or DNSPs, are best placed to value stack and optimise DER for customers

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Aggregator roles and responsibilities

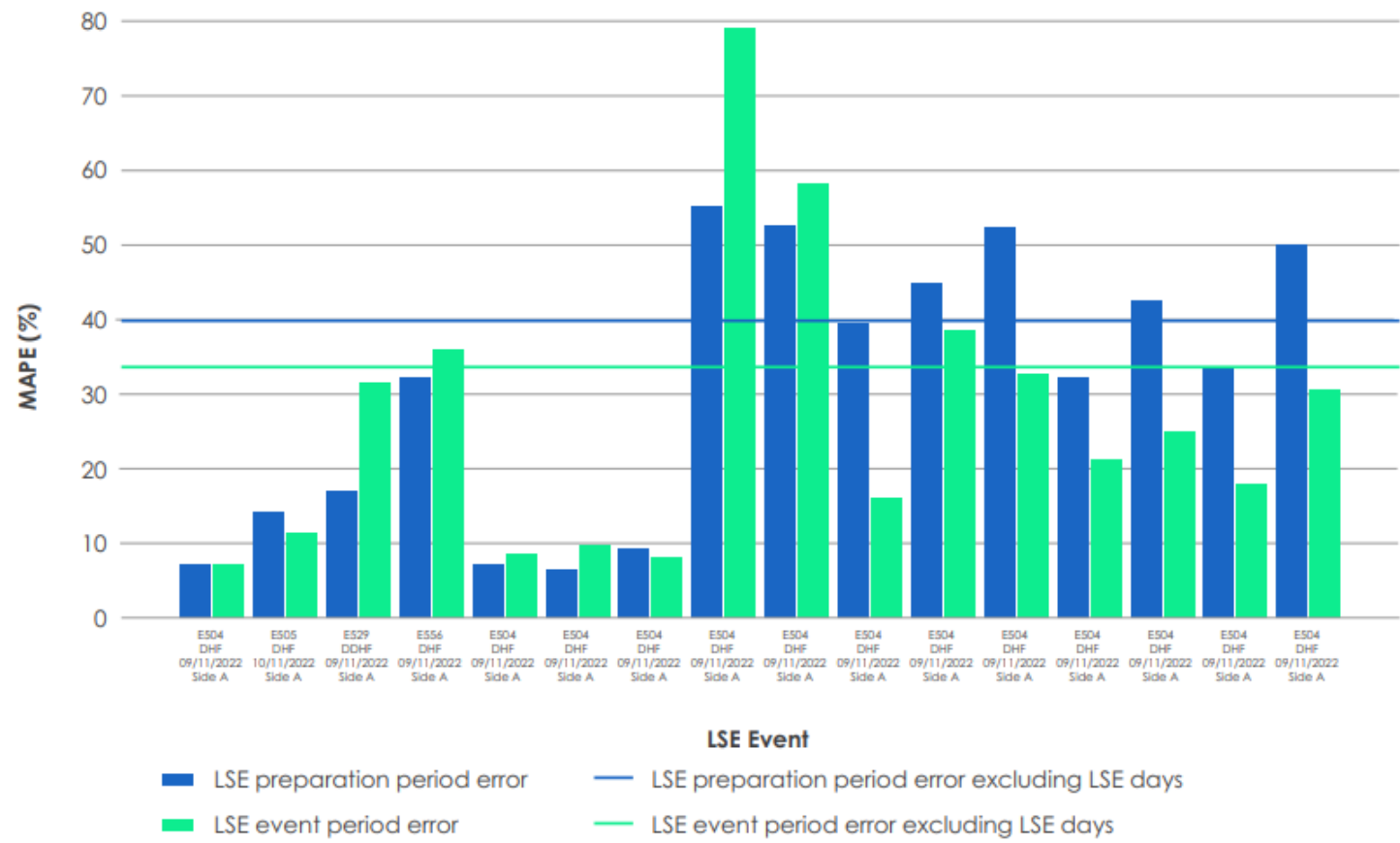
- Aggregators responsible for:
 - Coordination of DER
 - Delivery of services and/or respond to market signals
 - DOE compliance

- Aggregators are the actor best able to economically optimise DER

- Best placed to manage risks and incentives

- Potential for value stacking

The EDGE field trial showed aggregators can simultaneously deliver multiple services

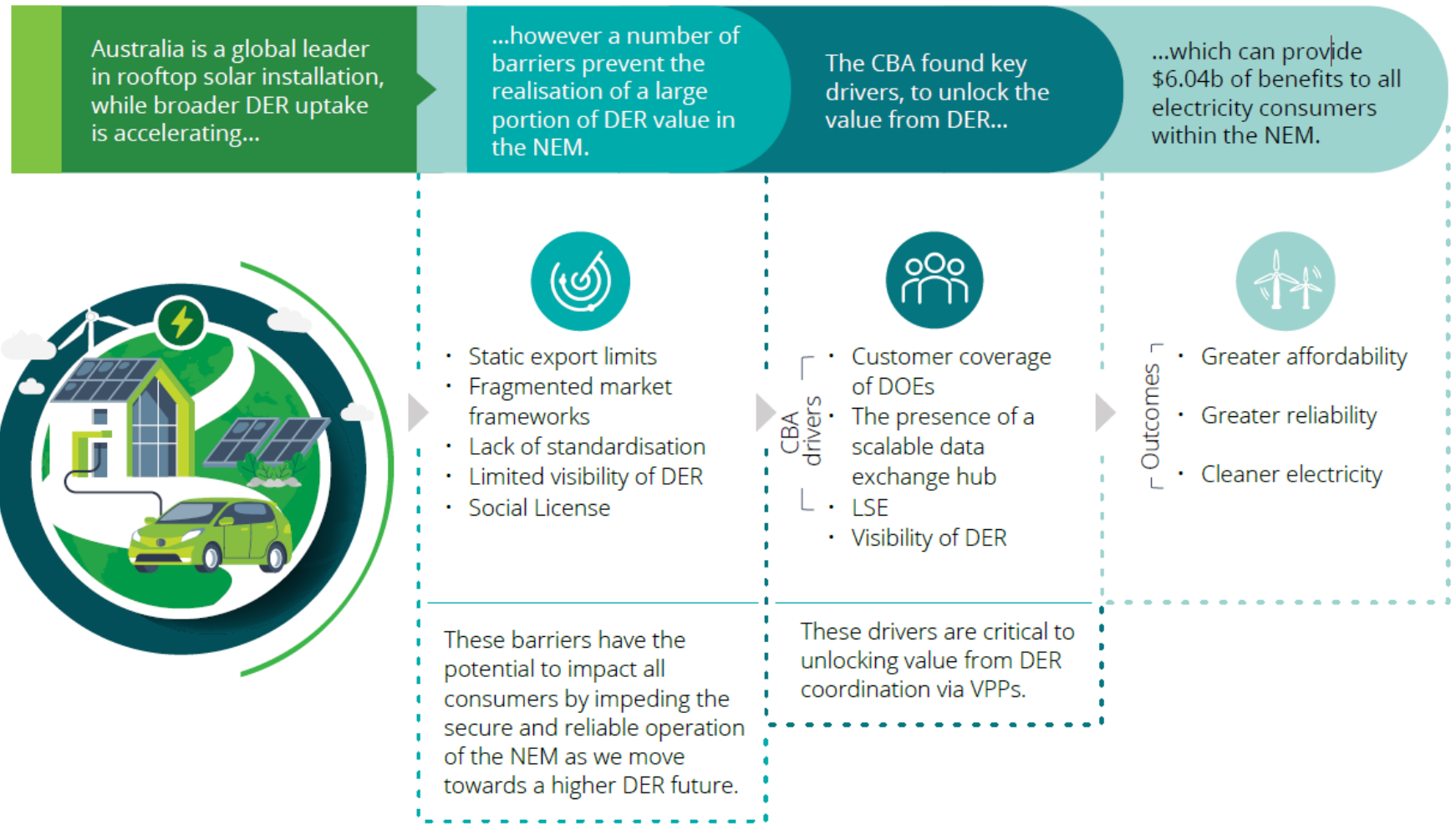


Integrating DER into the NEM – Benefits and Challenges

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Project EDGE demonstrates that market integration of DER creates value by reducing energy costs for all consumers. The Project EDGE arrangement of roles and responsibilities underpins the realisation of benefits identified in the CBA.



Independent CBA Findings (Deloitte AE)

\$6 billion in value from reduced cost for electricity consumers

\$3 billion additional societal benefits through emissions reductions from Electricity Market

Additional benefits identified but not quantified:

- Value addition from introduction of V2G services at scale.
- Positive feedback loop that delivers value from DER earlier for consumers.
- Further innovation in energy services enabled through a common DER information exchange and services model

Customers are central to the transition

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DER customers are generally optimistic, but unclear, about the benefit of their DER joining a VPP. They need certainty that their energy service provider will ensure the customer is better off overall

Investment drivers

Investment in DER currently driven by self-consumption

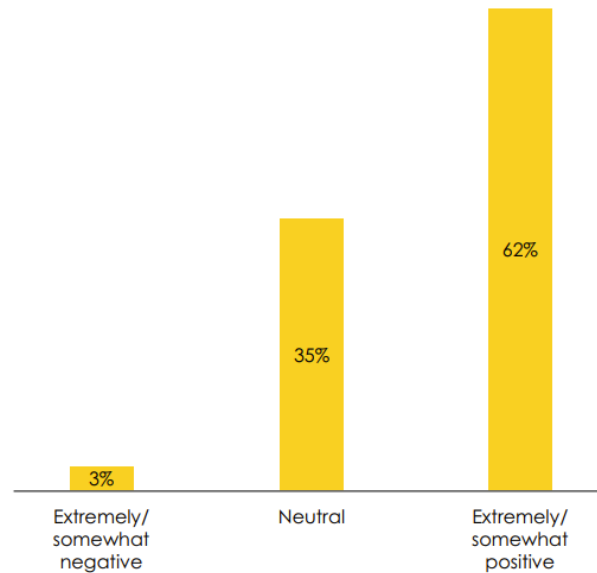
- Not for participation in markets
- But market participation can provide customers with additional value

Barriers

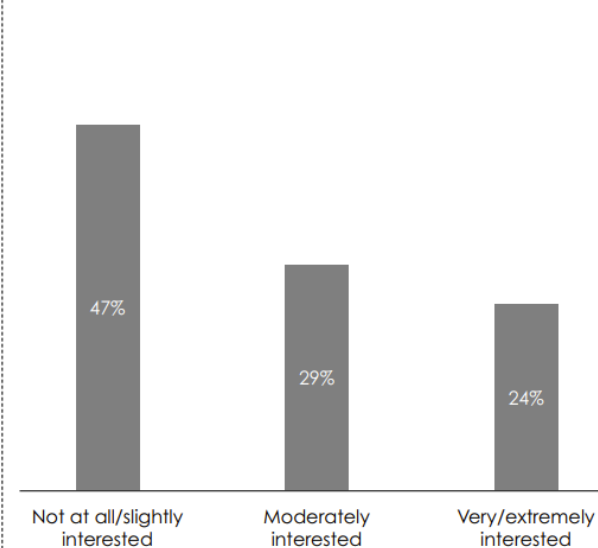
Barriers to scale are customer value and trust. These can be addressed by:

- Reducing costs and unlocking revenue opportunities for VPP aggregators
- Clearly demonstrating the value provided to VPP customers

Positive opinion about VPPs



Interest in joining a VPP



Social License and Trust is required to promote large scale participation of DER customers

Cost of DER and uncertainty around real benefits currently limit DER customer interest in joining VPPs

VPPs exist now in the NEM. To reach a critical mass and scale their size and benefit to all consumers, Regulatory and Funding support will be initially required to implement the enabling EDGE arrangement

A data hub enables scaled DER market-enablement

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Project EDGE has proven, at small-scale, that a DER data hub works in practice in almost 1 year of field trials

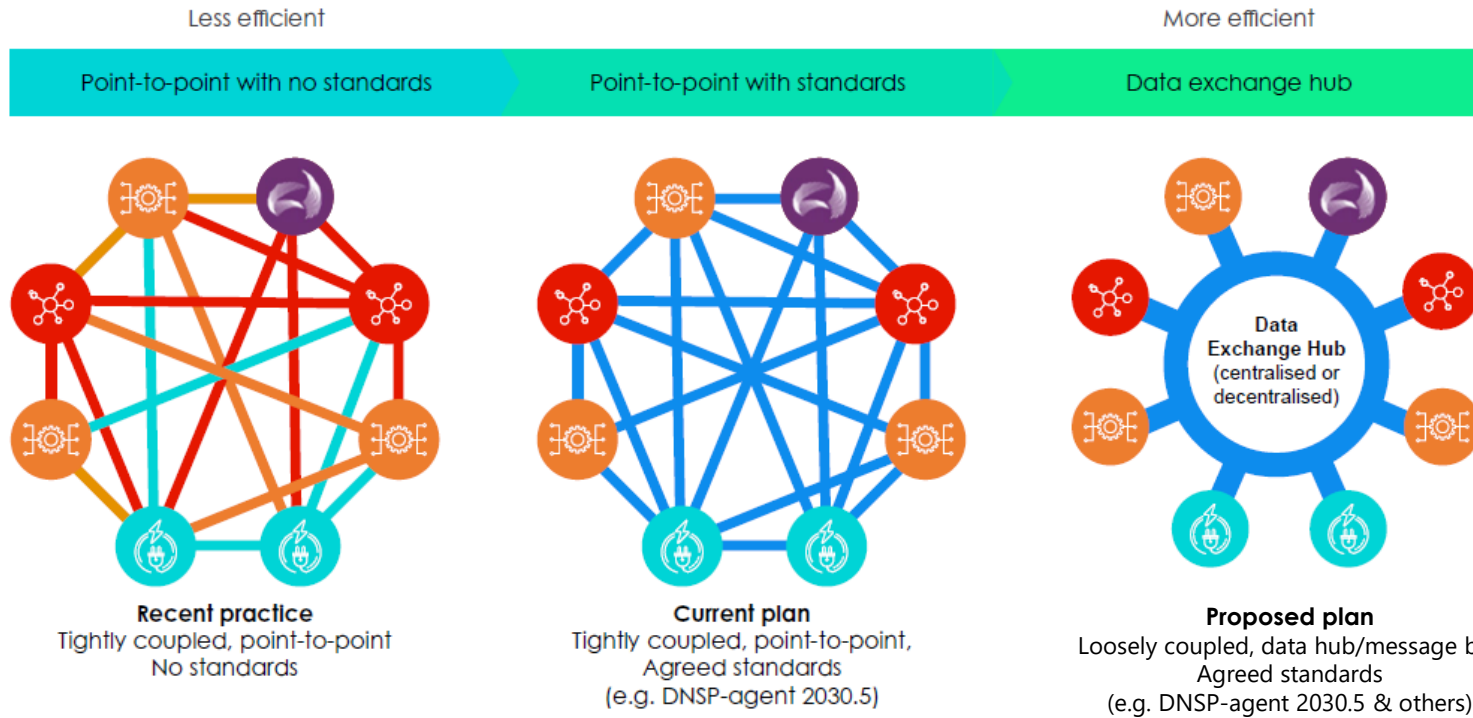
Data hub approach unlocks value for consumers by reducing industry costs and enabling access to a greater scope of service opportunities for DER Aggregators serving customers

Current data exchange challenges

- Data inconsistencies
- High data exchange costs
- Limited visibility

Data Exchange research activities

- Field Trial Operations
- Independent desktop assessment
- Independent Cost benefit analysis
- Stakeholder engagement
- International case studies



\$0.5bn cost reduction, plus upside (DER aggregator revenue opportunities)



- EDGE found a DER data hub approach is more efficient and scalable
- Aligns to the long-term interests of consumers
- One of the key enablers of economic benefits identified by the CBA
- The UK 'digital spine' represents a post card from the future

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Conclusion & Next Steps

Coordinated action is required to deliver value for consumers



There is an immediate opportunity to unlock the benefits of DER

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Timely action in implementing the capabilities identified in Project EDGE will help realise considerable consumer value, drive emissions reduction and help secure, reliable operation of the NEM as we move towards a higher DER future.

Foundational priorities identified

Removing customer constraints



- **Social licence** needs to be built across industry to **foster customer trust**
- Reduce constraints on solar exports for as many customers as possible
- Achieved through broad customer coverage of **DOEs, starting simple**
- All consumers can benefit from VPPs coordinating their DER

Setting the rules



- Clear set of roles and responsibilities for market participants
- Aggregators optimise DER for customers and **value stack**
- DSO capabilities confirmed and identified a path to implementation
- The EDGE hybrid model roles drive the net benefit identified by the CBA

Laying the foundations



- A **DER data exchange hub architecture** lays the foundations for DER market enablement, DOE coverage and visibility
- Is flexible to evolve and scale with industry needs over time

AEMO, AusNet and Mondo are committed to taking coordinated action on DER integration with policy makers and industry leaders using the practical evidence base delivered by Project EDGE

Thank you for being on the Project EDGE journey!

Questions & contact

EDGE@aemo.com.au

For further information for Project EDGE, please visit:

<https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/project-edge>



Links to EDGE publications and other webinars are available

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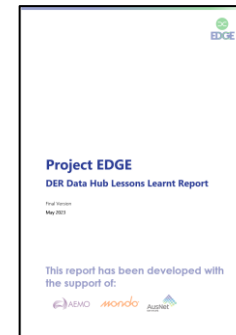
For any questions, comments or feedback please contact: EDGE@aemo.com.au



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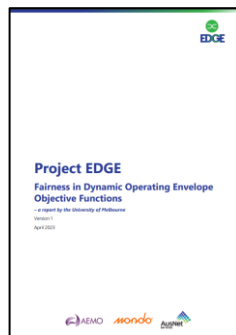
[Customer insights](#)



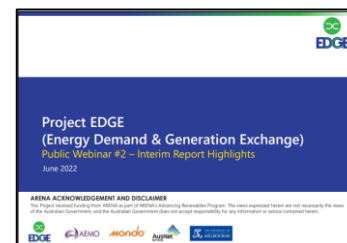
[DER data exchange](#)



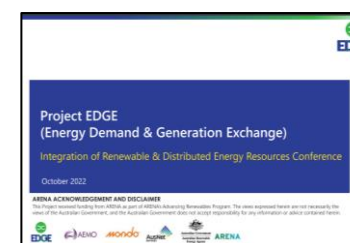
[Cost Benefit Analysis](#)



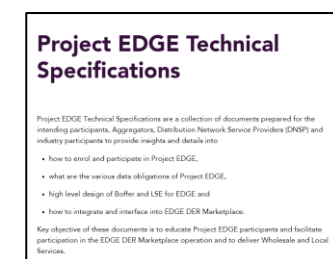
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