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Australian Renewable Energy Agency

ARENA

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Energy Security Board

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ARENA response to the consumer energy resources reforms package

This submission provides information and insights relevant to the following consumer energy resources (CER) reform papers:

- AEMC Review into Consumer Energy Resources Technical Standards Consultation Paper[1]
- ESB Interoperability Policy Directions Paper[2]
- AER Flexible Export Limits Issues Paper[3]

ARENA acknowledges the important role of interoperability, technical standards and flexible exports in supporting the efficient integration of DER and ensuring the future energy system is safe, reliable and delivers increased value to all consumers.

ARENA has funded more than 50 projects and studies across demand flexibility, electric vehicles (EVs) and DER that continue to contribute valuable knowledge and insights relevant to these papers. Appendix A provides a list of recent projects, studies and activities that may be of interest to the market bodies in relation to developing a nationally consistent approach to interoperability policy.

In summary:

- ARENA acknowledges that consumers have much to gain in ensuring that choices and investments made today about DER devices and software will not materially limit future choices.
- ARENA continues to support innovation of advanced device management across a range of DER and demand flexibility use-cases, including VPP market integration,

[1] https://www.aemc.gov.au/sites/default/files/2022-09/220928_emo0045_consultation_paper_-_public_version.pdf
[2] https://www.datocms-assets.com/32572/1665556228-interoperability-policy-directions-paper-final.pdf
[3] https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/review-of-regulatory-framework-for-flexible-export-limit-implementation/initiation#step-84921

HEMS, EV managed charging and V2G, and DOEs, all of which are underpinned by developments in interoperability capability.

1. AEMC Review into Consumer Energy Resources Technical Standards Consultation Paper

Non-compliance with CER technical standards

Project MATCH (Monitoring and Analysis Toolbox for Compliance in a High DER future)[4] is an ARENA-supported desktop study led by the University of NSW (UNSW), in partnership with the Australian Energy Market Operator (AEMO) and Solar Analytics. The project aims to develop an improved understanding of DER fleet behaviour during disturbance events, including DER compliance with AS4777.2.

The preliminary findings on standards compliance from Project MATCH's latest Lessons Learnt Report[5] include:

- Following the introduction of AS/NZS4777.2:2020, only 37% of inverters installed in the NEM during Q1 2022 was configured with the correct 2020 grid code at the time of installation.
- Following activities to address compliance through remote capabilities, it was estimated that approximately 45% of the Q1 2022 fleet in the NEM are configured with the correct grid code. The low improvement rate was attributed to limited inverter internet connectivity and data entry errors associated serial numbers.
- Based on the reporting above, and further manufacturer advice on the behaviour of their inverters, it is estimated that ~70% of the Q1 2022 fleet would ride-through a disturbance, even where the correct 2020 Standard grid code was not applied.
- States with remote curtailment capability (SA and WA) have somewhat higher rates of compliance to the new standard.
- Most manufacturers have retained the old standards in their menu options, and installers are preferencing selection of these older standards during the installation process, leading to poor compliance to the 2020 Standard grid code.

Additional analysis was undertaken to consider compliance to AS/NZS4777.2:2020 by assessing the behaviour in the field of inverters in performing Volt-VAr behaviours as mandated by the Standard. It was identified that 72% of sites did not exhibit a significant Volt-VAr response based on the local voltage conditions experienced.

Note that Project MATCH will continue to monitor compliance to AS/NZS4777.2:2020.

The latest report from the SA Power Networks (SAPN) ARENA-supported Flexible Exports Trial highlights[6] the importance of the recent introduction of AS4777.2:2020 in relation to system security and notes the compliance observed for flexible exports connections where a

[4] https://arena.gov.au/projects/project-match/
[5] https://arena.gov.au/knowledge-bank/project-match-knowledge-sharing-report-2021-2022/
[6] https://arena.gov.au/projects/sa-power-networks-flexible-exports-for-solar-pv-trial/

proportion of sites have outstanding issues[7]. SAPN is working closely with the solar industry through their Solar Industry Reference Group (SIRG) to ensure systems and processes are accessible and that industry has the right skills and processes to support flexible exports beyond the trial. SAPN has identified installers as a key group that needs to be engaged and upskilled to support the transition from passive to smart connected DER[8].

The Distributed Energy Integration Program (*DEIP) DER Market Integration Trials Summary Report*[9] provides an overview of the various approaches to DER market integration being trialled by ARENA-supported Project EDGE (AEMO), Project Symphony (Western Power) and Project Converge (Evoenergy), and Ausgrid's Project Edith. The report notes that the increasing uptake of DER across the NEM and Wholesale Electricity Markets (WEM) is changing usage patterns on the local distribution network, which can be highly variable across the network and will continue to change over time as more DER is installed. Networks and AEMO are currently implementing a range of measures to manage changing system dynamics. The report highlights that mandating standards such as AS4777 Volt-VAr and Volt-Watt settings are one of several options available to incentivise the use of DER to defer or avoid network augmentation. Other options being trialled by the four DER market integration trials include directly procuring network services from DER (sometimes called 'non-network solutions') and using price signals such as critical peak pricing or dynamic network tariffs.

2. ESB Interoperability Policy Directions Paper

Importance and value of interoperability

ARENA recognises interoperability as a critical enabling capability necessary to unlocking the potential value afforded by demand flexibility for both customers and the broader energy system. Modelling from the *Valuing Load Flexibility in the NEM*[10] study indicates that optimising flexible demand in a high DER scenario (State of the World 4) can produce savings between $8-18 billion. The study found that behind-the-meter (BTM) storage and EVs constituted the highest single contribution to flexible capacity, highlighting the importance of maturing interoperability between devices to support flexibility.

The *Smarter Homes for Distributed Energy*[11] study assessed how customers can coordinate their DER through a HEMS and considered the readiness of available HEMS products and services to respond to DOEs. DER-owners can directly benefit from HEMS products and services, including via energy bill savings and access to additional revenues streams through market participation. The study found that many existing HEMS service providers stack as many value streams as possible to manage financial risk and maximise value, including energy bill optimisation (e.g. via cost-reflective tariffs), energy market participation, and the provision of network services such as peak shaving and voltage management.

[7] https://arena.gov.au/knowledge-bank/flexible-exports-lessons-learnt-report-4/
[8] Ibid.
[9] https://arena.gov.au/knowledge-bank/deip-der-market-integration-trials-summary-report/
[10] https://arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem/
[11] https://arena.gov.au/knowledge-bank/smarter-homes-for-distributed-energy/

However, as the DEIP DOEs Workstream *Outcomes Report*[12] notes, poor BTM interoperability presents a potential barrier to consumers recognising the full potential benefit of DOEs and other potential value streams. The *State of DER Technology Integration Report*[13] considers interoperability between devices, and between devices and systems, as being at the trial stage and that without agreement on communications systems, standards and protocols, DER device capabilities will be underutilised, and customers will not be able to fully participate in markets.

Reflections on the five interoperability domains and the use-cases

Domain 1. DER – market interoperability

AEMO's Project EDGE is testing wholesale bidding models aligned with the Trader role considered under AEMO's Flexible Trading Arrangements and Schedule Lite reforms, and a bidding format aligned to a scheduled bidirectional unit under the Integrating Energy Storage (IESS) rule change[14]. Similarly, Western Power's Project Symphony is testing DER participating in three system-level market services – Energy Services, Constrain to Zero, and Essential System Services[15]. Project partner Mondo found that "*without agreed standards for DER information exchange, the cost of aggregating a diversity of solar and battery installations will severely impact the overall value of a DER market.*"[16]

Domain 2. BTM (CER – CER) interoperability

HEMS providers interviewed as part of the *Smarter Homes for Distributed Energy*[17] study identified the lack of interoperability standards at the customer asset level as a significant challenge. The lack of open device standards or requirements for customer assets has resulted in multiple closed on-site ecosystems operating through proprietary protocols. This has resulted in HEMS providers being unable to gain an optimal level of local, on-site control in situations where proprietary protocols are used or where access permissions are denied. This has resulted in HEMS either unable to control devices at all, or only able to achieve limited control, even when the device is technically capable of more sophisticated control. Consequently, the potential value to be unlocked from the device is reduced.

HEMS providers noted that even where multiple device integration is possible, the lack of standardisation has made the integration process costly and time consuming. Standardised communication protocols used for on-site communication links can be open to a high level of interpretation and different implementations by OEMs, and these variations can limit how effective the standard is at supporting interoperability.

The *Smarter Homes for Distributed Energy*[18] study suggests investigating the costs and benefits of BTM open device standards (whether mandatory or voluntary), including leveraging international standards addressing DER interface interconnection requirements

[12] https://arena.gov.au/knowledge-bank/deip-dynamic-operating-envelopes-workstream-outcomes-report/
[13] https://arena.gov.au/knowledge-bank/state-of-der-technology-integration-report/
[14] https://arena.gov.au/knowledge-bank/deip-der-market-integration-trials-summary-report/
[15] Ibid.
[16] https://arena.gov.au/knowledge-bank/project-edge-interim-public-project-report/
[17] https://arena.gov.au/knowledge-bank/smarter-homes-for-distributed-energy/
[18] Ibid.

such as IEEE 1547-2018. The study also highlights the importance of considering relevant regulatory perspectives to support competition and customers protections.

Project Symphony's *Latest Lessons Report*[19] identified the poor uptake of standards such as AS4755 by manufacturers and technology providers as a barrier to the pilot trial, resulting in limited compatibility and interoperability between DER devices and the technology platforms. Project Symphony found a "significant proportion" of existing DER devices were unable to be integrated into the technology platforms without offering additional product enhancements such as compatible appliance replacement, which limited the pool of eligible customers. The report recommends that "*future or scaled VPP rollouts will need to be supported by a common adoption of standards and protocols including consideration for mandatory application*".

The DEIP Interoperability Steering Committee (ISC)[20] supports the development and implementation of industry technical standards with a focus on interoperability capabilities to better enable the integration of DER into the Australian energy system. The DEIP ISC is led by the Australian National University (ANU) and comprises representatives from Energy Security Board (ESB), market bodies and peak industry bodies, and aims to ensure all DER devices can communicate effectively and provide communication-enabled grid support functions as required. The DEIP ISC is exploring the co-existence of multiple standards and protocols required to enable interoperability, including the potential for different communications protocols that are applicable to different devices (e.g. electric vehicles, inverters, load).

The DEIP ISC continues to engage with Standards Australia and the IEEE on the development of DER communication protocol CSIP-AUS[21], and is expected to provide guidance in early 2023 on how security protocols can be best employed to secure the CSIP-AUS interoperability standard. The ISC's current work package is expected to finalise in mid-2023.

Domain 3. CER – DNSP interoperability

The *Smarter Homes for Distributed Energy*[22] study identified the need to progress DNSP to customer connection point interoperability. Preliminary findings from Project EDGE *Interim Report*[23] suggest that a common communication protocol (i.e. common data model with common commands) may facilitate the scalability of DOE data exchange between Distribution System Operators (DSO), aggregators and DER devices.

Prioritisation of interoperability domains and policies

Based on project insights, a logical approach to future priorities for interoperability policy (post-implementation of CSIP-AUS) could be:

[19] https://arena.gov.au/knowledge-bank/project-symphony-lessons-learnt-2/
[20] https://arena.gov.au/knowledge-innovation/distributed-energy-integration-program/interoperability-steering-committee/
[21] https://arena.gov.au/knowledge-bank/common-smart-inverter-profile-australia/
[22] https://arena.gov.au/knowledge-bank/smarter-homes-for-distributed-energy/
[23] https://arena.gov.au/knowledge-bank/project-edge-interim-public-project-report/

1. Concurrent progression of domain 2 (BTM interoperability) and domain 3 (CER – DNSP), as the products and services are more advanced in these domains than the others (e.g. HEMS, traditional demand response, DOEs) (noting that DER-owners will be the primary beneficiaries).
2. Later priorities could consider domain 1 (CER – market), domain 4 (DNSP – X) and domain 5 (DNSP – AEMO) concurrently, as the products and services in these domains are still emerging (e.g. shaped operating envelopes, procurement of local network services) and the domains are interdependent (noting that all consumers will benefit from the progression of these domains).

Interoperability and data access/sharing

It is important to ensure that agreed standards are applied consistently to avoid small differences in application (e.g. software and hardware architectures, and integration methods) to prevent additional complexity for third-parties operating across multiple DNSP regions, thus negating efficiency gains[24].

DNSPs currently send network constraint and DOEs aggregators and third parties via point-to-point data exchange. Irrespective of whether point-to-point data exchange or a centralised data hub is used, data exchange without industry standards creates barriers to participation. It is more efficient for each DNSP to develop its own server that aligns with CSIP-AUS and require third parties to register with the server, than allowing OEMs and aggregators operating in global markets to not set up with the required protocols in the Australian market[25].

Internet reliability and poor network service

DER devices that are remotely orchestrated using customers' home Wi-Fi and data would reduce installation barriers and Project Symphony *Aggregator Report*[26] estimates that data usage would be 500MB to 1GB per month.

Early customer insights findings from the SAPN Flexible Exports Trial show that while many customers understand there is a requirement for internet connection on their systems (to support flexible exports), there was a limited understanding of the need to maintain that internet connection and ensure it is live for the system to operate most effectively[27]. Research on customer sentiment undertaken by Project Symphony revealed that 44% of residential customers and 39% of business customers prefer device orchestration enablement via gateway devices rather a 4G connection or using the customer's existing home Wi-Fi and data (roughly one-third of respondents indicated no preference)[28]. Previous ARENA-funded projects have also experienced interoperability and device communication challenges due to unreliable internet services in regional areas, such as anecdotal stories of customers taking their home Wi-Fi modems when leaving for holidays. This suggests further engagement is needed with customers on the role internet connectivity has in the emerging DER ecosystem.

[24] https://arena.gov.au/knowledge-bank/project-edge-interim-public-project-report/
[25] Ibid.
[26] https://arena.gov.au/knowledge-bank/project-symphony-aggregator-report/
[27] https://arena.gov.au/knowledge-bank/flexible-exports-lessons-learnt-report-4/
[28] https://arena.gov.au/knowledge-bank/project-symphony-aggregator-report/

Cyber security and interoperability

Cybersecurity continues to be an area to prioritise, particularly considering recent cyber-attacks in the telecommunications and health sectors. Cybersecurity in the Australian energy system continues to be significantly underdeveloped despite the developments in DER technology, and consequently, cyber threats pose a potential risk to consumers. The *State of DER Technology Integration Report*[29] highlighted that AEMO, DNSPs, third-party providers and customers could be vulnerable to cyber-attacks if cybersecurity doesn't develop in line with advances in technology. The report notes that "the consequences of those attacks could not only impact energy consumers and energy organisations, but also have serious broader impacts on society, public health, safety and the economy."

The *Smarter Homes for Distributed Energy*[30] study identified limited regulatory requirements for cyber security as being a challenge for HEMS providers. The study recognised that HEMS providers are "currently managing cyber security" but that national regulatory requirements for cyber security in HEMS/DOE interactions were raised by stakeholders as a potential gap that needed to be addressed.

Proposed approach to standardising CSIP-AUS for DOE implementation

The *DEIP DOEs Workstream Outcomes Report*[31] outlines the Working Group's insights on how a national design and implementation framework for DOEs can be progressed and focuses on the immediate-term opportunities available to increase DOE implementation. Considerable stakeholder consultation over 18 months found that CSIP-AUS/ IEEE2030.5 provides a suitable framework for network-client communication, and it is currently being adopted by various DOE trials underway.

The *DEIP DOEs Workstream Outcomes Report*[32] recognised the world-leading position Australia holds in regard to the development and implementation of DOEs, and therefore greater Australian representation on international standards committees is needed to influence standards development.

3. AER Flexible Exports Limits Issues Paper

Capacity allocation and methodology

ARENA supports the principles-based approach to capacity allocation outlined in the AER's Issues Paper to support near-term innovation whilst recognising the need for an appropriate level of guidance to protect customers and deliver the most beneficial outcomes for all customers as DOEs mature.

The *DEIP DER Market Integration Trials Summary Report*[33] provides a useful overview of the different allocation methods being trialled between Project EDGE, Project Symphony,

[29] https://arena.gov.au/knowledge-bank/state-of-der-technology-integration-report/
[30] https://arena.gov.au/knowledge-bank/smarter-homes-for-distributed-energy/
[31] https://arena.gov.au/knowledge-bank/deip-dynamic-operating-envelopes-workstream-outcomes-report/
[32] Ibid.
[33] https://arena.gov.au/knowledge-bank/deip-der-market-integration-trials-summary-report/

Project Converge and Project Edith. The report highlights the (perceived) trades-off in fairness and efficiency between simple, uniform DOEs applied to all consumers and more complex DOEs based on inverter size or forecasted exports.

Project EDGE[34] initially assumed that DOEs could be calculated to economically optimise capacity allocation among NMIs by comparing aggregators' bids but found during the design process that bids supplied by aggregators at a whole-of-fleet level were unable to provide the level of detail necessary for NMI-level DOE calculations[35]. Alternative models where aggregators supplied NMI-level bids were considered too costly for aggregators and were not pursued[36]. Project EDGE completed a desktop study based on field trial data to explore what the maximum theoretical value of economically optimising DOEs is, and whether DNSP DOE calculations or independent market mechanisms are better[37].

As part of Project EDGE, the University of Melbourne provided a high-level assessment of how different objective functions would affect the fairness and efficiency of capacity allocation. The study highlights that fairness and equity are obvious important considerations and how capacity is allocated amongst multiple active customers can have a significant impact on the financial benefits each customer (and subsequently aggregator) is able to receive when participating in market services. The findings suggest that improving fairness among multiple customers (i.e. equal allocation) reduces the overall efficiency, and the use of weighting factors (depending on stakeholder priorities) can significantly influence the allocation of operating envelopes[38]. Note that this assessment does not seek to determine the most appropriate objective function, only the potential impacts of various principles behind the objective functions.

The *Distribution Constraints Optimisation Algorithm Report*[39] is a comprehensive report produced by Project Symphony that compares and assesses the various DER control methods, network capacity forecasting and allocation methods, and the benefits and costs of five past and active trials exploring flexible exports (i.e. Dynamic Limits DER Feasibility Study, SAPN Advanced VPP Grid Integration Trial, Zepben Project Evolve, SAPN Flexible Exports Trial, and AEMO Project EDGE).

Consumer understanding and interest, and consumer participation

One of the primary objectives of the SAPN Flexible Exports Trial is to explore the customer experiences of flexible exports, focusing on developing social licence for export management. Below is a high-level summary of the customer experience and system performance learnings detailed in the latest report[40]:

[34] https://arena.gov.au/projects/project-edge-energy-demand-and-generation-exchange/
[35] https://arena.gov.au/knowledge-bank/project-edge-interim-public-project-report/
[36] Ibid.
[37] Ibid.
[38] https://www.researchgate.net/publication/348404040_Deliverable_12_High-level_Assessment_of_Objective_Functions
[39] https://arena.gov.au/knowledge-bank/project-symphony-distribution-constraints-optimisation-algorithm-report/
[40] https://arena.gov.au/knowledge-bank/flexible-exports-lessons-learnt-report-4/

- The main information sources that customer cited were direct outreach from AusNet[41], word of mouth and the trial website. Very few customers were referred from their installer.
- Some customers stated that their reason for joining the trial as “they were unable to export anything otherwise”; most customers were motivated to “increase green energy for everyone”, to “support the community” and to “stop exports going to waste”.
- Most customers found their solar installation (including the flexible exports offer) went smoothly
- Majority of customers were satisfied with the export levels they are receiving on the flexible exports connection.
- All customers demonstrated at least a basic understanding of the reasons for flexible exports being trialled and what the equipment does (a mix of basic and good understanding).
- All customers were comfortable with the DNSP having visibility of their exports and managing the export limits.

In order to mirror business-as-usual conditions, SAPN have enabled all installers to sell and install flexible exports systems in the trial, rather than contract installations from a specific sub-set of specially trained installers. Anecdotal findings from discussions with these installers indicate that:

- accessible quick reference guides and materials were of value
- the inclusion of “native” inverter options that don’t require additional hardware, like the SwitchDin Droplet, would make installations more straight forward
- timely support to help troubleshoot issues onsite is critical
- some solar installers don’t have experience with communications wiring which can make troubleshooting a challenge[42].

Integration with export pricing

The *DEIP DER Market Integration Trials Summary Report*[43] recognised that how local network capacity is allocated, and the pricing models applied to access greater capacity, impacts the level of market services offered from DER.

The ARENA-supported SAPN and Tesla Advanced VPP Grid Integration [44] demonstrated how a VPP can operate in energy markets while adhering to local dynamic export limits. The trial used a ‘simple’ model where SAPN sent site-level export limits to Tesla via an application programming interface (API) and Tesla ensured all bids into the market (made by Energy Locals as the registered market participant) adhered to these limits.

As summarised in the *DEIP DER Market Integration Trials Summary Report*[45], Ausgrid’s Project Edith is trialling a form of DOE allocation with the Trader selecting a ‘subscription level’ for the minimum capacity a consumer needs, whereas Project Converge is at the other

[41] AusNet Services is a partner in the Flexible Exports Trial
[42] https://arena.gov.au/knowledge-bank/flexible-exports-lessons-learnt-report-4/
[43] https://arena.gov.au/knowledge-bank/deip-der-market-integration-trials-summary-report/
[44] https://arena.gov.au/projects/advanced-vpp-grid-integration/
[45] https://arena.gov.au/knowledge-bank/deip-der-market-integration-trials-summary-report/

end of the spectrum using shaped operating envelopes (SOEs). SOEs are DOEs with an allocation methodology similar to how capacity is allocated on the transmission network[46]. Project EDGE and Project Symphony are researching a range of sophisticated allocation methodologies. Project [47] uses shaped operating envelopes (SOEs), which are DOEs with an allocation methodology similar to how capacity is allocated on the transmission network. An assessment completed by the University of Western Australia for Project Symphony found that SOEs perform moderately well in scenarios where there is surplus hosting capacity but as hosting capacity reduces with increasing rooftop PV penetration, SOEs may result in an over allocation of capacity or [48]. The assessment suggests that DOEs have an advantage over SOEs through publishing[49].

Efficient communication of flexible export limits at scale

Findings from a theoretical evaluation of three data exchange models (point-to-point integration, a centralised data hub and a decentralised data hub) completed by Project EDGE indicate that a data hub approach (either centralised or decentralised) may represent the most secure and low-cost option for consumers and industry[50]. Project EDGE also conducted testing during the declared market suspension in the NEM earlier this year to better understand what factors need to be considered when directing the market in a high DER future. Below are the key insights from the tests as provided in the latest report[51]:

- Visibility for AEMO of the DOEs was provided by the data exchange hub being trialled in Project EDGE. This scalable data exchange approach allows multiple subscribers to receive certain data, including AEMO and aggregators.
- The importance of AEMO receiving DOEs via a data exchange hub rather than direct point to point integration between each DNSP would be more pronounced for a future where many VPPs need to be directed across many DNSP boundaries.

It is important to note that these findings are from an ongoing trial and that more research may be required to determine the most appropriate approach to communication DOEs at scale.

About ARENA

The Australian Renewable Energy Agency (ARENA) was established in 2012 by the Australian Government. ARENA's function and objectives are set out in the *Australian Renewable Energy Agency Act 2011.*

ARENA provides financial assistance to support innovation and the commercialisation of renewable energy and enabling technologies by helping to overcome technical and commercial barriers. A key part of ARENA's role is to collect, store and disseminate

[46] https://arena.gov.au/knowledge-bank/deip-der-market-integration-trials-summary-report/
[47] https://arena.gov.au/projects/project-converge-act-distributed-energy-resources-demonstration-pilot/
[48] https://arena.gov.au/knowledge-bank/project-symphony-distribution-constraints-optimisation-algorithm-report/
[49] Ibid.
[50] https://arena.gov.au/assets/2022/07/project-edge-interim-public-project-report.pdf
[51] https://arena.gov.au/knowledge-bank/project-edge-lessons-learnt-2/

knowledge gained from the projects and activities it supports for use by the wider industry and Australia's energy market institutions.

Please contact Caitlin Sears, Knowledge Sharing Manager via caitlin.sears@arena.gov.au if you would like to discuss any aspect of ARENA's response.

Sincerely,

Rachele Williams

Rachele Williams

General Manager - Project Delivery, ARENA

Appendix A. Relevant ARENA activities

Project	Funding	Information
Projects		
AEMO Project EDGE (2020)	$12.92M	Project EDGE is demonstrating a proof-of-concept DER Marketplace that enables efficient and secure coordination of aggregated DER to provide wholesale and local network services within the constraints of the distribution network.
Western Power Project Symphony (2021)	$8.55M	Pilot project orchestrating DER as a VPP to participate in a future energy market and unlock greater economic and environmental benefits for customers and the wider community.
Evoenergy Project Converge (2021)	$2.85M	Pilot demonstrating new DER orchestration capabilities known as 'Shaped Operating Envelopes' which will allow DNSPs to improve network congestion management, minimise network expenditure and improve DER market bidding into energy and ancillary service markets.
SAPN Flexible Exports (2020)	$2.08M	Project aims to produce a flexible connection option for solar PV systems to remove the potential need for permanent zero-export settings, increasing value to the customer and increasing low-cost renewable energy available to the market.
Zepben Project Evolve (2019)	$4.29M	Project developed DOEs to increase the network hosting capacity of DER by maximising their participation in energy, ancillary and network service markets, while ensuring the secure technical limits of the electricity networks are not breached.
Rheem SA Smart Network Project (2021)	$1.98M	The project is exploring alternative approaches for demonstrating active control of hot water systems within South Australia. The project involves collaboration with Combined Energy Technologies (CET), a leading provider of home energy management systems (HEMS) in

		providing active control over the hot water systems.
SA Power Networks Advanced VPP Grid Integration (2019)	$1.03M	Project demonstrated the use of DOEs to deliver higher levels of energy exports to the grid from DER and tested the value this can create for customers and VPP operators.
AEMO VPP Demonstrations (2019)	$3.46M	The project was designed to provide early insights on how to integrate VPPs into market frameworks at scale, and observed VPPs delivering FCAS, responding to energy price signals, and delivering local network services, at times simultaneously.
EV Smart Charging		
Jemena Smart Charging (2020)	$1.55M	This project explores the role of DNSPs in co-ordinating EV charging by using technology to manage charging with real-time information of network capacity.
Origin Smart Charging (2020)	$0.84M	This project is trialling smart charging programs for residential and commercial fleets.
AGL EV Orchestration Trial (2020)	$2.89M	This project is a large-scale EV charging orchestration trial comprising 300 EVs across Queensland, New South Wales, Victoria and South Australia. It also contains an aspect of V2G.
Realising Electric V2G Services Project (2020)	$2.73M	This project seeks to unlock economic and grid benefits of V2G services by installing V2G chargers at various fleet depots in ACT government
Studies		
DEIP DER Market Integration Trials Summary Report (2022)		This report presents a summary of the approaches to DER market integration being tested by AEMO's Project EDGE, Western Power's Project Symphony, Ausgrid's Project Edith and Evoenergy's Project Converge.
Smarter Homes for Distributed Energy (2021)		This study assessed how residential energy customers can coordinate their DER through a HEMS. The study considers the readiness of

		available HEMS products and services to respond to DOEs.
Energy-as-a-Service (EaaS) Study (in progress)		This study seeks to understand what challenges might exist to EaaS business models and how industry and/or governments might unlock the potential of EaaS and accelerate its uptake as a beneficial infant industry.
State of DER Technology Integration Report (2021)		This report identifies and categorises the technologies and data required to efficiently integrate DER into Australian electricity markets.
Valuing Load Flexibility in the NEM (2021)		This study provides important information about how increased demand-side participation across major sectors of the Australian economy can contribute to the energy transition.
Other		
DEIP Dynamic Operating Envelopes Workstream (2021)		This workstream explored the value that DOEs offer to the energy transition. The workstream aimed to build a shared understanding of the opportunities and challenges, share insights on approaches currently under investigation, and identify reforms that could be implemented to establish DOEs.
DEIP Interoperability Steering Committee (2022)		This workstream supports the development and implementation of industry technical standards with a focus on interoperability capabilities to better enable the integration of DER into the Australian energy system.