



Review of Dynamic Operating Envelope Adoption by DNSPs

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This report was commissioned by the Australian Renewable Energy Agency (ARENA). The report presents the findings of the CutlerMerz review, which was prepared to provide an overall evaluation of ARENA's demand response portfolio in terms of the value provided to ARENA's stakeholders and the energy industry more generally and to identify lessons learned which may be applied to future programs.

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Acronyms and Abbreviations

Term	Definition
ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AMI	Advanced Metering Infrastructure
ARENA	Australian Renewable Energy Agency
CP	CitiPower
CSIP	Common Smart Inverter Profile
DAPR	Distribution Annual Planning Report
DEIP	Distributed Energy Integration Program
DER	Distributed Energy Resources
DERMS	Distributed Energy Resources Management System
DMIA	Demand Management Innovation Allowance
DNSP	Distribution Network Service Provider
DOE	Dynamic Operating Envelope
DSO	Distribution System Operator
ESB	Energy Security Board
HEMS	Home Energy Management System
ICT	Information Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
LV	Low Voltage
MSO	Model Standing Offer
NEM	National Electricity Market
NSW	New South Wales
NT	Northern Territory
PC	Powercor
PQ	Power Quality
RCP	Regulatory Control Period
SA	South Australia
SAPN	SA Power Networks
STPIS	Service Target Performance Incentive Scheme
UE	United Energy
VPP	Virtual Power Plant

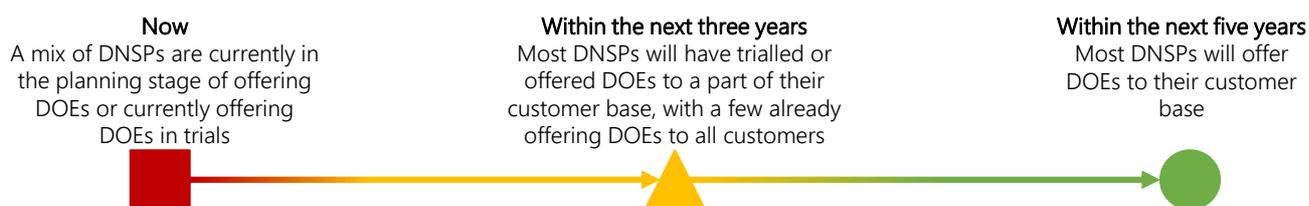
Executive Summary

The Distributed Energy Integration Program (DEIP) Dynamic Operating Envelopes (DOE) Working Group has engaged CutlerMerz to review the current state of DOE implementation across Australian Distribution Network Service Providers (DNSPs) and the approaches taken. The review is a key input to the DEIP DOE Working Group's DOE White Paper and provide insights that can inform the development of a national model for the rollout of DOEs across Australia.

To undertake the review, CutlerMerz engaged with each of the Australian DNSPs by way of a targeted survey questionnaire, which contained a range of specific questions grouped into three focus areas: service offering, technical characteristics of the DOE offer and reporting and compliance.

From our analysis of the DNSP responses, it is clear that DOEs are very much an emerging feature of the electricity system. Eight out of the 16 DNSPs are currently offering DOE services in a trial capacity to their customers, with other DNSPs currently in the planning stage to consider implementing DOEs as shown in Figure 1. CutlerMerz' review shows that most DNSPs have a timeframe to incorporate DOEs in their connection agreements to their wider customer base within the next five years. For example, the government in an Australian jurisdiction has mandated that all new small-scale generators must have the capability to support DOEs in the export direction from July 2022.

Figure 1 – Summary of the timeline to offer small-scale DOEs



With regards to the three focus areas described above, the key findings of our review are summarised below and further detailed in Section 2.

Service Offerings

In general, the key features of DOE implementation have yet to be determined by DNSPs. The key themes were:

- **Tiered offering¹** – Currently not offered in networks that offer DOE services, with the DNSPs providing various responses as to whether these will be offered in the future.
- **Grandfathering of existing arrangements²** – In the future, most DNSPs plan to introduce grandfathering, or the phasing out of existing arrangements for exports as offerings for DOEs become increasingly available to customers.
- **Tariff arrangements** – Currently no changes to tariff arrangements for customers with DOEs, with various responses on whether networks will change tariff arrangements in the future.
- **DOE customer obligations in the Model Standing Offer (MSO)³** – The majority of DNSPs are either in the process of updating or considering updating their MSO setting with respect to the terms and conditions for connecting small-scale distributed energy resources (DER) systems such as household solar.
- **Performance guarantees⁴** – DNSPs have largely chosen not to provide performance guarantees or service standards for DOEs to their customers to date.

Technical Characteristics

¹ Refers to an offering that enables customers to pay for greater access and lower curtailments

² Refers to the phasing out of existing arrangements

³ A document approved by the AER detailing the basic or standard connection service offered by a distribution system and a retail customer as defined in the National Electricity Rules (Chapter 5A)

⁴ Refers to a minimum standard of export available

There was a much greater level of consistency between DNSPs regarding the technical characteristics of DOEs. The key themes were:

- **Communications protocols** – DNSPs were almost unanimous in having adopted, or proposing to adopt, the IEEE 2030.5 CSIP-AUS standards.
- **Forecasting period** – Most DNSPs calculate, or propose to calculate, their DOEs on a 24 hour forecast at the 5 minute interval level.
- **DOE characteristics** – Applied to real power (i.e. on a kW basis) for exports where this will be expanded to both export and imports for some networks, with lower and upper limits.
- **Spatial characteristics** – Most DNSPs agree DOEs should be calculated based on the locational characteristics of the network or the constraint (e.g. hosting capacity available or the level of DER penetration within a region or on a given asset).
- **Approach to capacity allocation** – Currently and in the future, there is no consistent approach to applying and allocating hosting capacity to customers.
- **Contingency procedure** – DNSPs will apply a fall-back procedure to revert limits to a safe level or a default setting if the DOE cannot be communicated. The Australian version of the Institute of Electrical and Electronics Engineers (IEEE) 2030.5 Common Smart Inverter Profile (CSIP) seeks to standardise the required fallback behaviour when communication is lost.

Reporting and Compliance

DNSP responses were quite variable on how DOE outcomes should be reported and how compliance should be verified and enforced. The key themes were:

- **Approach to reporting DOE outcomes** – Could include kW/kWh outside of DOE limits, dynamic capacity/potential, curtailment, extent of DOE breaches occurring over time, compliance against technical requirements. If available, agents or aggregators may also be responsible for reporting on compliance. DNSPs may present results in their Distribution Annual Planning Reports (DAPRs).
- **Party responsible for compliance** – Customers accountable, with the potential for customers to engage aggregators or others to take on primary responsibility for managing their systems, acting as the customer's agent.
- **Approach to verifying compliance** – Through customer metering, Power Quality (PQ) data, connected Home Energy Management System (HEMS) or inverters and/or data from aggregator systems, audited regularly.
- **Approach to enforcing compliance** – Corrections similar to dealing with non-compliances with AS4777 as well as penalties. Enforced through contractual arrangements or technical requirements for DER connections.

Based on the information provided by DNSPs, there are a variety of approaches to offering DOEs. In particular, there was a high degree of variability on the service offering of the DOEs themselves and the approach to reporting and compliance. By contrast, DNSP responses on the technical characteristics of DOEs were mostly aligned.

In areas where there are diverging views between DNSPs, CutlerMerz considers there is a need to further explore options to assist in identifying whether national standardisation would be beneficial for DNSPs and their customers. CutlerMerz recognises that each DNSP has differing conditions on their network and that a more flexible approach may provide better outcomes for consumers and network operations than adopting a standard approach in many circumstances. At the same time, providing consistency in the technical standards, and the approaches to reporting and compliance may streamline approaches for technology and service providers.

Ongoing consultation between DNSPs, market bodies, key industry bodies and customers will be necessary to optimise DOE implementation across the network.

1 Introduction

1.1 Background

At the time of writing, the Distributed Energy Integration Program (DEIP) Dynamic Operating Envelopes (DOE) Working Group is preparing a White Paper on DOEs intended for public release in February 2022. The White Paper is intended to serve as a summary of the work that the DEIP and industry has achieved to date in terms of DOEs, and to explore what next steps are needed to ensure that DOEs are delivered in a way that is most beneficial to consumers.

The White Paper will bring together the perspectives of all the DEIP DOE Working Group members representing customers, networks, market bodies, Energy Security Board (ESB), and research institutions.

1.2 Objectives and Scope

CutlerMerz has been engaged to review the current state of DOE implementation and approaches among Australian DNSPs, in order to inform the development of a national model for the rollout of DOEs across the National Electricity Market (NEM). The review is intended to be a key input to the White Paper.

1.3 Definitions

We have adopted the definition of DOEs established by the DEIP DOE Working Group⁵:

“Operating envelopes represent the technical limits within which customers can import and export electricity. Dynamic operating envelopes vary import and export limits over time and location based on the available capacity of the local network or power system as a whole.”

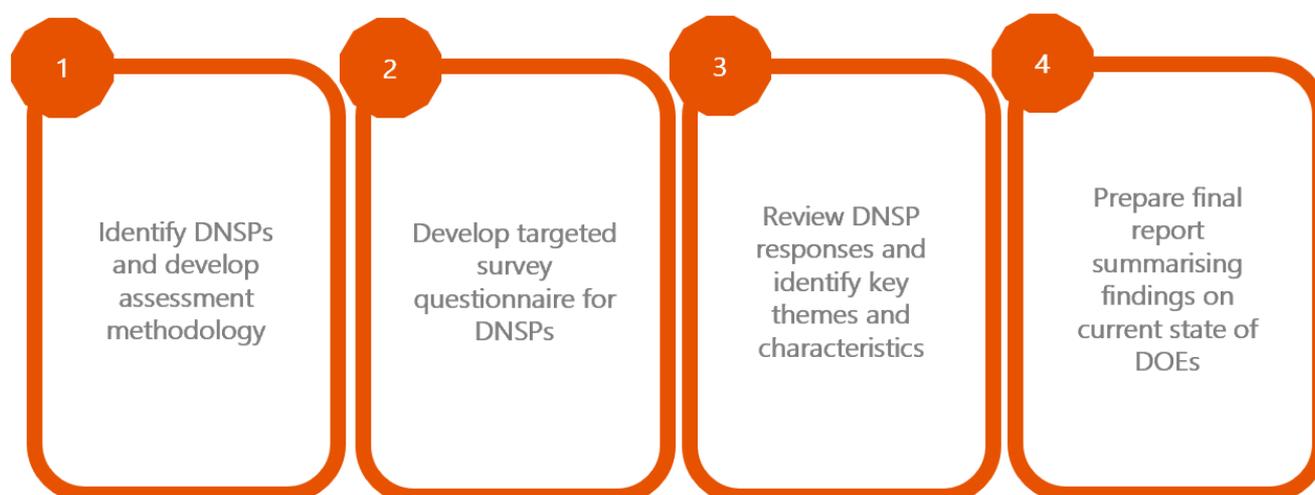
CutlerMerz has noted that the terms “flexible” and “dynamic” appear to be used interchangeably and has thus treated them the same for the purposes of this review. We also observe that the DOEs being considered to date are all export based. DOEs for flexible loads are not being considered at this time.

For the purposes of this review, CutlerMerz have applied the term DOEs to small-scale DER systems connected to the low voltage network only.

1.4 Approach

CutlerMerz undertook the review using a four-step approach, presented in Figure 2 below.

Figure 2 – CutlerMerz review approach



⁵ As outlined in the DEIP DOE Working Group’s Allocation Principle’s Workshop Summary: <https://arena.gov.au/assets/2021/09/doe-workshop-summary.pdf>

This high-level approach was underpinned by a review framework to facilitate concise and meaningful reporting on the current state of DOEs. CutlerMerz developed this framework based on a list of indicative topics and questions to Distribution Network Service Providers (DNSPs) assembled by the DEIP DOE Working Group. We built on this list and refocused the questions into the following three categories⁶:

- **Service Offering** – The nature and type of DOE services that DNSPs offer to their customers, both now and in the future. Questions include whether or not the DNSP has existing DOE offers and the proportion of customers eligible for these offers, details of the service offering such as performance guarantees, pricing, and contracting, as well as the DNSPs intended timeframe for rolling out DOEs across their customer base.
- **Technical Characteristics of the DOE Offer** – The power system attributes associated with delivering the service offerings identified above. Questions include export/import limits, DOE forecasting periods, communication systems and protocols, how curtailment is allocated, and the contingency procedures in the event of communication systems failure.
- **Reporting and Compliance** – The responsible parties for ongoing reporting and compliance of DOE performance, and the regulatory framework to prescribe and delineate roles and responsibilities. Questions include the physical attributes to report on, verification and enforcement options in the event of non-compliance.

The list of categorised questions were incorporated into a targeted survey questionnaire sent to all Australian DNSPs on 22 October 2021⁷. Additional correspondence with the DNSPs occurred in the following weeks on the level of consultation undertaken and to further clarify specific responses.

Responses to the survey questionnaire from DNSPs along with further information provided to specific follow-up questions provided the primary data and information on which the review was based. This information was supplemented by additional information obtained from desktop research.

⁶ Additional questions were also compiled in relation to the level of expenditure by DNSPs on projects directly or indirectly supporting DOEs, both currently and in future regulatory periods. This can include projects such as community batteries that support DOE capability in the local network or any DER related projects that include a DOE component. The summary of these can be found in Appendix A.

⁷ Refer to Appendix B for the full list of questions asked in the questionnaire.

2 Results and Observations

This section details the results stemming from the DNSP's survey responses and CutlerMerz' desktop research across current offerings, consultation facilitated, the service offering, technical characteristics of the DOE offer, and reporting and compliance. DNSPs also provided information on their current and future expenditure on DOE enablement which is detailed in Appendix A. We have anonymised our analysis of the responses of these DNSPs in the sections below for confidentiality purposes.

2.1 Overview of current offerings

Due to the innovative nature of the technologies, most DNSPs are in the early stages of considering DOEs. Of the 16 DNSPs, eight have progressed to field trials⁸:

- One DNSP is conducting a pilot of DOEs in areas with high solar constraints through the ARENA-funded project. All new solar customers in the trial are offered either a 1.5 kW static limit or a 1.5 kW – 10 kW flexible limit with a DOE. This DNSP has previously trialled and demonstrated DOEs between July 2019 and March 2021 in other projects and trials.
- Another DNSP is conducting a pilot of DOEs for customers who are constrained in their ability to export
- A DNSP is participating in Project EDGE⁹ focused on developing and testing DOEs within a pilot of the Hybrid model proposed by the Open Energy Networks initiative, with operational trials expected to commence in Q2 of 2022.
- One DNSP offers DOEs to customers through a pilot predominantly focused on a single feeder supplying mainly residential customers.
- Another DNSP is currently trialling DOEs with a small group of residential customers on three feeders.
- A few other DNSPs are trialling LV DOEs with 44 pole-top batteries utilising an IEEE2030.5 server to community with the batteries, as well as in a neighbourhood battery trial where DOEs will be communicated to the battery to increase solar hosting capacity. They are also network partners in an EV trial which involves issuing an export DOE to smart chargers.

Our review found that most DNSPs have a timeframe to incorporate DOEs in their connection agreements to their wider customer base within five years, including the following:

- A number of DNSPs are part of Project Evolve¹⁰ which focuses on developing operational systems for distribution networks and aggregators to enable DOE. However, these technologies have yet to be trialled with customers under demonstrations and trials.
- One DNSP will start trialling dynamic network pricing and DOEs under a trial within the next few years.

Other networks are also looking to trial DOEs, establish a plan to further consider implementing DOEs in their network, or are moving straight into offering DOEs to their customers.

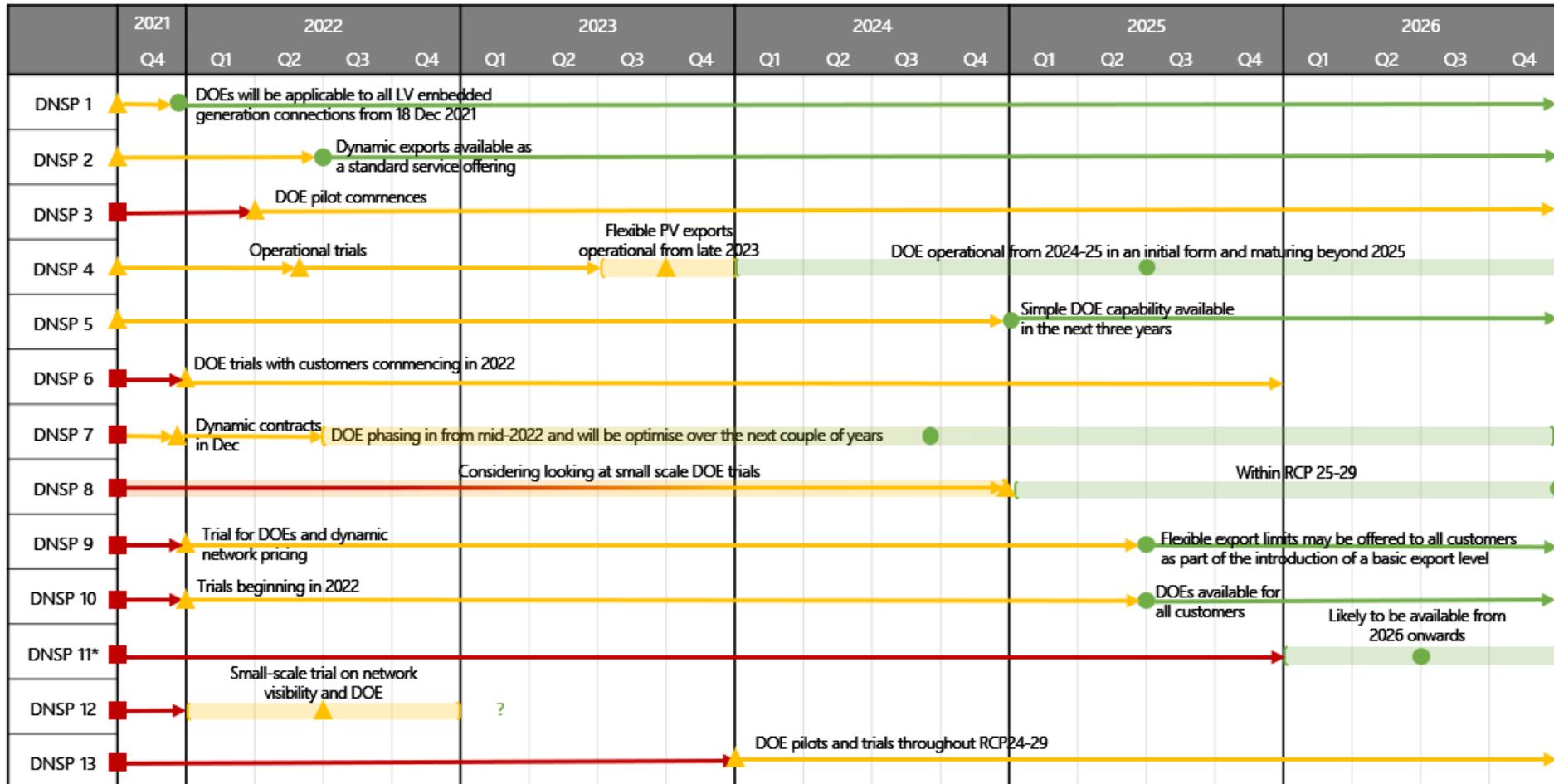
A full overview of the DOE implementation timeframes across all DNSPs is shown in Figure 3.

⁸ Note that one DNSP curtails solar PV exports through applying dynamically-changing setpoints which raises or lowers the real power output of the PV system. However, in some instances where a VPP service is used, the DNSP will provide set points to the solar PV system but describe the operational envelope to the VPP service provider. As such, we have noted that this DNSO is currently in the partial-offering stage and inferred their responses to relate to the allocation of setpoints which does not reflect DOEs.

⁹ More information available here: <https://aemo.com.au/-/media/files/initiatives/der/2021/edge-factsheet.pdf?la=en>

¹⁰ More information available here: <https://arena.gov.au/projects/evolve-der-project/>

Figure 3 – Timeline of planned small-scale DOE offerings



Note: DNSPs are shown in no particular order. DNSPs that exist in a conglomerate or as part of a broader entity have been treated as a single DNSP.
 *The timing and level of this DNSP's DOE roll-out will depend on market designs, their role within that market design and technology maturity.



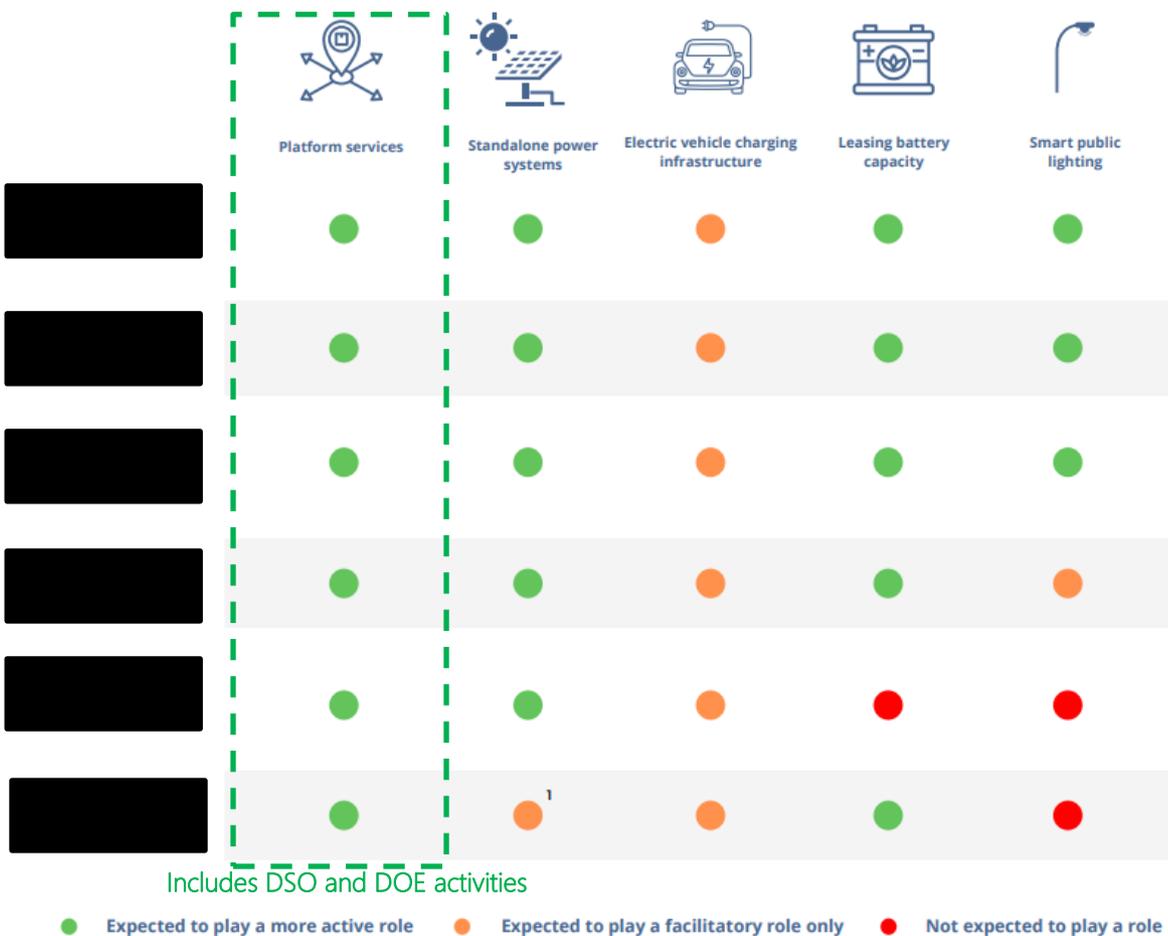
2.2 Consultation

CutlerMerz separately asked DNSPs about the nature of their consultation on matters related to DOEs. We have additionally conducted desktop research to identify how DNSPs have consulted and what the consultation involved.

As part of their upcoming 2024-29 regulatory proposals, the DNSPs of four jurisdictions are jointly consulting with stakeholders on the role DNSPs should play in providing emerging energy services, including DOEs. Figure 4 shows the role these DNSPs expect to play across several emerging services in their next regulatory period. The category ‘Platform services’ includes consideration of DOEs, with the consultation seeking feedback on whether they should be expressly recognised as a distribution service.

Additional consultation has also been conducted by these DNSPs individually. A DNSP have discussed DOEs with their customer panels in preparation of their Regulatory Proposal for 2024-29, as well as their external working groups for their trials. The other DNSPs have engaged directly with customers to better understand how and when customers use energy storage and generation technology.

Figure 4 – Expected role in providing emerging services in 2024-29 period¹¹ (DNSPs anonymised)



Another DNSP consulted with industry stakeholders between December 2020 and February 2021 and from November 2021 on enabling dynamic customer connections for DER. Among other things, the consultation looked to facilitate industry input to shape the overall solution for dynamic connections. This DNSP also consulted on DOEs in a range of forums, with presentations to governments, industry representative groups, working groups, project teams, peer

¹¹ More information available here: <https://talkwith.tasnetworks.com.au/70268/widgets/343267/documents/214081>

DNSPs, DER management systems and utility server providers, original equipment manufacturers, customer groups, standards organisations and electrical contractors.

In another jurisdiction, the State government sought submissions in 2020 on proposed export limit requirements for distributed solar generating systems. Stakeholders were invited to provide feedback on whether dynamic export limits for distributed generation technology, including battery storage, would be of value. The State government has subsequently moved to mandate this capability in all new systems installed after July 2022. The state's DNSP also consulted extensively with customers and industry stakeholders on the introduction and implementation of DOEs during 2018 to 2019, as part of the development of their 2020-25 regulatory proposal and are also surveying customers on their experience with DOEs as part of their trial.

In another jurisdiction, consultation on DOEs was covered as part of an issues paper. Feedback was sought to identify the measures that could be put in place to ensure that DOEs do not unnecessarily limit DER output in preference of other alternatives such as load management or other generation sources. In addition, one DNSP is engaging and consulting customers through a trial through the aggregator whilst another DNSP has conducted customer and installer surveys and facilitated information sessions to gauge the need for DER control.

2.2.1 Information for customers on DOEs

As part of the survey questionnaire, we asked DNSPs whether they provide informative material and offer engagement processes to customers wanting to connect their systems using DOEs. Several DNSPs responded that they are considering offering customers information and engagement opportunities relating to DOEs but that these are in their initial stages or will be introduced in line with DOE implementation. Other networks have tailored information available on offerings on export limits and DOEs, however these are still limited to information on trials.

In some cases, information to customers are available through aggregators. However, in these instances information is mostly limited to information introducing the trial, the offering for customers themselves, or general information on virtual power plants rather than on DOEs.

2.3 Service Offering

Across the networks, key features of the DOE service offering currently in place and planned for the future varied between the DNSPs in some areas:

- **Tiered offering** – Currently not offered in networks that offer DOE services, with the DNSPs providing various responses in whether these will be offered in the future.
- **Grandfathering of existing arrangements** – In the future, most DNSPs planning to introduce grandfathering, or the phasing out of existing arrangements for exports as offerings for DOEs become increasingly available.
- **Tariff arrangements** – Currently no changes to tariff arrangements for customers with DOEs, with various responses in whether networks will change tariff arrangements in the future.
- **DOE customer obligations in the Model Standing Offer (MSO)¹²** – Currently only one DNSP has updated their MSO to include DOEs (for flexible export limits only), where other networks are either in the process of updating or will consider updating their MSO in the future.
- **Performance guarantees** – DNSPs have chosen not to provide performance guarantees or service standards for DOEs to their customers to date.

The current status and future plans for DER service offerings are summarised in Table 1 and Table 2 respectively and discussed further in the sections below. Where no responses were received from DNSPs they have been omitted.

¹² A document approved by the AER detailing the basic or standard connection service offered by a distribution system and a retail customer as defined in the National Electricity Rules (Chapter 5A)

Table 1 – Summary of the current features of DOE service offerings

	Tiered offering	Grandfathering of existing arrangements	Changes to tariff arrangements	DOE customer obligations in the MSO	Performance guarantees
DNSP 2	Not offered	Yes	No changes to tariffs	Yes	None
DNSP 3	Not offered	Not considered	No changes to tariffs, but trial has incentives	No. Connection arrangements for active control approved by DNSP. Contractual and commercial arrangements to be considered.	Aggregator expected to provide assurance of a financially "no worse off" guarantee for pilot program
DNSP 4	Not offered	Not considered	No changes to tariffs*	No. Contractual and commercial arrangements to be considered.	None
DNSP 5	Not offered	Not considered	No changes to tariffs*	No. Contractual and commercial arrangements to be considered.	None
DNSP 6	Not offered	Not considered	-	No	-

*These DNSPs are assumed to have no changes to tariffs as they are currently in a trial process and further considerations for tariffs for introduction of flexible connection agreements are yet to take place

Table 2 – Summary of the future features of DOE service offerings

	Tiered offering	Grandfathering of existing arrangements	Changes to tariff arrangements	DOE customer obligations in the MSO	Performance guarantees
DNSP 1	-	-	No changes to tariffs	Technical connection requirements to be updated	-
DNSP 2	To be explored and expected to be offered in the next few years	Already offered	Tariffs may offer various choices of service levels for exporting customers	Already updated	Available post-2025 as part of the changes to the DER Access, Pricing and Incentive Arrangement
DNSP 3	-	-	Expected there will be a need to introduce	-	-
DNSP 4	-	-	-	Will be developed	-
DNSP 5	-	-	-	-	-
DNSP 6	-	-	-	To be updated to include capability for dynamic management of exports	-
DNSP 7	Likely to be offered	Existing systems, particularly those that do not comply with current standards, are expected to be set to the minimum fixed limit	No changes to tariffs	Initially through negotiation only. MSOs will be enabled for systems <30 kVA at least but require systems to be developed /redesigned to scale	-
DNSP 8	-	Expected there will be a need to introduce	-	Will develop new and/or updated offers	-
DNSP 9	-	Likely to be introduced	Dynamic network pricing	-	A paper trial of a DOE STPIS will be conducted to inform this
DNSP 10	Not envisioned	Likely to be introduced	No changes to tariffs as its likely not to be linked to DOEs	-	-
DNSP 11	Potentially offered if there is a network constraint	-	-	To be updated	Available post-2025 as part of the changes to the DER Access, Pricing and Incentive Arrangement
DNSP 12	-	-	Considering financial incentives to DOEs	-	-
DNSP 13	-	-	-	-	-

2.3.1 Tiered offering

Tiered offerings refer to an offering that enable customers to pay for greater access and lower curtailments. Amongst the DNSPs that currently offer DOEs for small-scale customers, tiered offerings were not offered. There were mixed responses on the plans to include tiered offerings, where:

- One DNSP does not currently envision the need for tiered options
- Another DNSP noted that they will work towards developing a tiered offering through their customer consultation process for their upcoming regulatory reset, with an expectation that it will be offered after 2025
- Other networks currently do not have a clear direction and will investigate or consider the option.

Further investigations detailing potential structures for tiered offerings and their advantages or disadvantages may support the design and offering of DOEs in networks where DOEs have yet to be offered.

2.3.2 Grandfathering existing arrangements

From the DNSPs that currently offer DOEs to their customers, only one DNSP incorporates a form of grandfathering of the connection agreements of existing customers. Existing customers that upgrade their systems will need to enter into a new connection arrangement based on their location on the network. Options include fixed or flexible (DOE) arrangements. As such, only those that choose to change their system will be moved to current arrangements and those that do not will remain on their existing arrangement.

Amongst the networks that provided a response in this area, DNSPs are mostly in alignment that grandfathering of existing connection agreements will need to be introduced, or at least will be considered and investigated. However, one DNSP noted that they are investigating whether DOEs can be offered to older sites that are not compliant with AS/NZS 4777.2:2020. In this instance, further consideration of approaches to grandfathering may support and potentially fasten the provision of DOE services.

2.3.3 Tariff arrangements

Currently, there are no changes to the existing set of tariffs that are offered for customers with DOEs. DOEs are currently considered as an additional function that are separate to tariffs.

In the future, there is a mix of responses from DNSPs where:

- One DNSP expects to be able to offer choices of service levels for exporting customers with different tariffs from 2025 onwards (where changes to the current rules allow networks to include “feed-in” components in their network tariffs)
- Another DNSP will provide dynamic network pricing where the price of the tariff components will reflect the level of available capacity in the network
- Another DNSP will consider incorporating financial incentives in the tariffs
- Other networks envision that there will not be changes to their tariffs to allow for DOE specific arrangements.

Further assessment of various approaches can outline the need for changes in tariff arrangements with DOEs (if any) and support the implementation of DOEs across networks.

2.3.4 DOE customer obligations in the Model Standing Offer

Between the DNSPs that currently offer DOEs, only one DNSP has updated their MSO to include new rules around embedded generator connections, particularly in congested areas of the network. Other DNSPs noted that they have not updated their MSO, where contractual and commercial arrangements are to be considered.

In the future, most DNSPs are planning to move from offering (or planning to offer) DOEs to develop or update their MSOs to include capability for DOEs. The remaining DNSPs either did not comment or are looking to further investigate and consider DOE obligations in the MSO.

Despite the future plans for DNSPs to potentially develop or update their MSOs, changes may not be needed as the recent amendment to the Deemed Standard Connection Contracts allows distributors to temporarily interrupt or curtail services in accordance with the conditions of the tariff arrangements or contract with retailers, or at the direction of a relevant authority¹³

2.3.5 Performance guarantees

Currently, none of the DNSPs provide performance guarantees to their customers with respect to DOEs. A current trial anticipates that the aggregator assures customers are not financially “worse off”. Most networks also did not comment on any future plans for guaranteeing performances. A DNSP noted that they will look to conduct a paper trial of a DOE Service Target Performance Incentive Scheme (STPIS) which will help to inform the AER in developing a DOE STPIS as noted in the latest rule changes to the DER Access, Pricing and Incentive Arrangement¹⁴. Other networks, such noted that these will be more defined post 2026 as outlined in the AEMC’s recent rule change.

2.4 Technical Characteristics of the DOE Offer

DNSPs were mostly aligned with the technical characteristics of DOEs, with a few inconsistencies in some areas:

- **Communications protocols** – DNSPs were almost unanimous in having adopted, or proposing to adopt, the IEEE 2030.5 CSIP-AUS standards¹⁵ or have noted that they will align to industry best practice.
- **Forecasting period** – Currently most DNSPs calculate their DOEs 24 hours ahead at the 5 minute interval level, with some networks looking to further refine and shorten the forecasting window in the future.
- **DOE characteristics** – Currently, DOEs are applied to real power (i.e. on a kW basis) for exports where this will be expanded to both export and imports for some networks, with lower and upper limits.
- **Spatial characteristics** – Networks are mostly in alignment where DOEs should be calculated based on the locational characteristics of the network or the constraint (e.g. hosting capacity available or the level of DER penetration within a region or on a given asset).
- **Approach to capacity allocation** – Currently and in the future, there is no consistent approach to allocating hosting capacity to customers.
- **Contingency procedure** – Networks currently and in the future will mostly apply a fall-back procedure to revert the limits to a safe level or a default setting.

The current snapshot and future plans for the DOE technical characteristics is summarised in Table 3 and Table 4, and discussed further in the sections below.

¹³ Clause 10.5 in the NERR Schedule 2 - Model terms and conditions for deemed standard connection contracts, as recently amended in the AEMC’s Access, pricing and incentive arrangements for distributed energy resources, available here: <https://www.aemc.gov.au/sites/default/files/2021-08/Final%20determination%20-%20Access%2C%20pricing%20and%20incentive%20arrangements%20for%20DER.pdf>

¹⁴ The AEMC notes that the current STPIS arrangements do not include performance measures for export services which may incentivise networks to offer limited expert services that are not in the long-term interest of consumers. As such, the AER will conduct a review of current arrangements to consider arrangements that incentivise efficient delivery of export services rather than solely focusing on maintaining and improve services. This is set to be published by the end of 2022. More information available here: <https://www.aemc.gov.au/sites/default/files/2021-08/Final%20determination%20-%20Access%2C%20pricing%20and%20incentive%20arrangements%20for%20DER.pdf>

¹⁵ More information available here: <https://www.arena.gov.au/assets/2021/09/common-smart-inverter-profile-australia.pdf>

Table 3 – Summary of the current features of the technical characteristics of the DOE offer

	Communications protocols	Forecasting period	DOE characteristics	Spatial characteristics	Approach to capacity allocation	Contingency procedure
DNSP 2	IEEE 2030.5 CSIP-AUS	24 hrs ahead at 5-min intervals. 15 min window for solar-only customers	Export limits using real power between 1.5-10 kW	Based on local network capacity	Equal allocation for customers downstream of constraint	Fall back behaviour to a known safe export level (as defined in IEEE 2030.5 CSIP-AUS)
DNSP 3	IEEE 2030.5 for the DSO platform, but DSO to Aggregator protocols is yet to be confirmed	Indicative DOEs on 3 days ahead. Finalise DOEs on a 24 hrs ahead	Export limits using real power on a kW-basis	Currently applied to one feeder	Various approaches tested, including equal allocation for customers downstream of a constraint, equal allocation across all participants	Revert to default settings or the approved connection requirements as per the agreement
DNSP 4	IEEE 2030.5	24 hrs ahead at 5-min intervals.	Upper P limit on the inverter*	Based on the level of DER penetration and available hosting capacity	-	Revert to a default setting that is a "fail safe"
DNSP 5	IEEE 2030.5	5-min intervals	Applied on a kW-basis	Currently only applied to one feeder	-	-
DNSP 6	IEEE 2030.5	-	-	-	-	-

* DOEs are applied at the connection points; customers can choose to have their inverter respond

Table 4 – Summary of the future features of the technical characteristics of the DOE offer

	Communications protocols	Forecasting period	DOE characteristics	Spatial characteristics	Approach to capacity allocation	Contingency procedure
DNBP 1	IEEE 2030.5	24 hrs ahead for generation. 25 hrs ahead for network load and weather	Applied on a kW-basis	Varies between microgrids and the level of solar PV penetration	Applied on a percentage of generation between all customers	Ramp down to safe levels
DNBP 2	IEEE 2030.5 CSIP-AUS	24 hrs ahead at 5-min intervals. 15 min window for solar-only customers	Export limits using real power between 1.5-10 kW, and import limits	Based on local network capacity	Equal allocation for customers downstream of constraint	Fall back behaviour to a known safe export level (as defined in IEEE 2030.5 CSIP-AUS)
DNBP 3	IEEE 2030.5 for the DSO platform, but DSO to Aggregator protocols is yet to be confirmed	Potential testing on a 30-min ahead for finalised DOEs	Export limits using real power on a kW-basis	Based on network location and non-participant behaviour	Various approaches tested, including equal allocation for customers downstream of a constraint, equal allocation across all participants	Revert to default settings or the approved connection requirements as per the agreement
DNBP 4	IEEE 2030.5 where feasible (some features required for the EDGE project are not yet included in the standard)	24 hrs ahead at 5-min intervals. Also testing intra-day and hourly.	Both export and import limits on a kW-basis, also considers reactive power in the calculation	Based on the level of DER penetration and available hosting capacity	Various approaches are being tested within Project EDGE, including equal allocation, maximised service, and weighted allocation etc.	Revert to a default setting that is a "fail safe"
DNBP 5	IEEE 2030.5	5-min intervals	Applied on a kW-basis	Varies between local network characteristics (i.e. strong urban grids vs weak fringe of grid locations)	-	-
DNBP 6	IEEE 2030.5 but will depend on the use case	Depends on the constraint to be managed and the best investment of resources	DOE characteristics will be independently load and export tested. 2-sided active power DOEs as market matures.	-	Determined through engagement with Customer Advisory Panel over time	Initially fail safe to zero export. Will work with AEMO to ensure a fall back position that supports a 100% RE system
DNBP 7	IEEE 2030.5 CSIP and IEEE 2030.5 CSIP-AUS when available	24 hrs ahead	Both export and import limits. Lower limits of 1.5 kW. Upper limit will vary based on phases and physical network capability	Depends on the level of information available. Starts with higher level network data, optimising further to apply DOEs to areas or asset levels	-	Revert to reduced fixed limits. Might be able to use stored forecasts until communications resume.
DNBP 8	IEEE 2030.5, as per industry consensus	-	Applied on a minimum and maximum kW-basis	Based on localised constraints	Equal allocation for customers downstream of constraint	Smart meter based emergency control

DNBP 9	IEEE 2030.5	As per Evolve project	As per Evolve project	As per Evolve project	As per Evolve project	-
DNBP 10	Likely to be CSIP-AUS, will be sure to be aligned to other DNSPs	-	Likely to be on a kVA-basis but introduced on a kW-basis first	Based on (near) real-time localised constraints	-	Revert to default set points based on inherent hosting capacity of the network
DNBP 11	Depends on technical standards as agreed from various industry working groups	-	-	-	Depends on the type of system limitation (e.g. localised vs system-wide constraints)	Depends on technical standards as agreed from various industry working groups
DNBP 12	Trials will have a direct API integration, but are watching the development and implementations of IEEE 2030.5	5-min intervals	Upper limit on exports on a kW-basis	Varies between connections (where they will be individually assessed based on constraints analysis capabilities)	-	Fall back measures to safe levels (set to 2 kW in the trial)
DNBP 13	IEEE 2030.5	-	-	-	-	-

2.4.1 Communications protocols

There is broad alignment across DNSPs in applying or planning to apply the Australian IEEE 2030.5 Common Smart Inverter Profile (CSIP) standard¹⁶, which is currently the agreed industry practice for communications. However, the existing standard does not include features that are being used in a current trial, which suggests additional updates to the communications protocol will need to be included as required to align to the improvements or additional functionality.

2.4.2 Forecasting period

There is a degree of consistency in the forecasting period from DNSPs that are currently offering DOEs to their customers. The standard forecasting period looks to use forecasts for the next 24 hrs at 5-min intervals. These approaches are mainly consistent in the networks' aspirational approach.

The key differences in approaches between networks in their current and future plans include the following:

- A DNSP looks to provide shorter forecasting period of 15-mins ahead to customers with only a solar PV system installed as the system can't be responsive to a forecast with no ability to time shift
- Another DNSP is testing intra-day forecasting which is typically linked to updating hourly AMI power quality data and transformer voltage data
- One DNSP's forecasting period will mature over time moving from seasonal to 5 minute market as trials confirm. This will occur over coming regulatory periods
- Another DNSP provides additional information to aggregators, where an indicative DOE is published 3 days in advance before being finalised 24 hrs ahead. This DNSP is potentially looking to further refine its forecasting period down to 30-mins ahead for finalising DOEs
- Another DNSP base their DOEs on generation and solar PV generation forecasts over a 24-hr period, and network load and weather forecasts over a 25 hr period.

2.4.3 DOE Characteristics

There is broad alignment on the DOE characteristics among DNSPs which currently offer DOE services. Among these DNSPs, DOEs are offered on a kW-basis, typically without a lower export limit guarantee. One DNSP notes that their export limits currently ranges between 1.5 – 10 kW. However, limits may go to zero if required in the event of a major network fault or a system emergency.

The other networks who are not currently offering DOEs have proposed to apply similar characteristics. However, some networks have expressed some differences to the current approach.

- Several DNSPs are intending to provide both an export and an import limit
- One DNSP noted that the DOEs are likely to be applied on a kVA-basis but will initially be introduced on a kW-basis.

2.4.4 Spatial characteristics

Currently, most DOE offerings are being provided through trials and pilots which are usually limited to one spatial region or network asset. However, two DNSP's approach to calculating and issuing DOEs is based on the characteristics of the network at a localised level. Factors include the local network capacity or hosting capacity available and the level of DER penetration.

This is mostly the approach that other networks are planning to implement, noting that the level of spatial variation will depend on the information available.

¹⁶ Note that networks did not suggest any variations to the standard were or are going to be adopted

2.4.5 Approach to capacity allocation

For those networks who are currently offering DOEs and provided a response, a consistent approach is yet to be developed. This is further highlighted in the future approaches outlined by the networks. Approaches include the following:

- Equal allocation for customers downstream of a constraint and therefore share the network constraint
- Equal allocation across all participants or all customers in the network
- Weighting the allocation based on a weighting factor (which has yet to be determined)
- Allocating based on the percentage of generation between all customers (i.e. based on the size of their system).

Networks that did not provide an identified approach noted that the method will need to consider the type of system limitations that the DOE will help to alleviate and should be designed based on industry learnings and engagement. Accordingly, further investigation and customer consultation on the approaches for allocating capacity which considers network conditions which may vary across DNSPs may be of value to networks in rolling out DOEs.

2.4.6 Contingency procedures

From those that have contingency procedures, networks mostly apply a fall-back procedure which reverts the DOE to level deemed safe, or a pre-determined default setting. One DNSP notes that this is the process that is outlined in the CSIP-AUS standard.

Most other networks are planning to use the same contingency procedure, with the exception of one DNSP who have identified using smart meter based emergency controls. For those that do not currently have a view or are looking to identify an approach through industry working groups, a framework may help to identify a suitable approach for networks.

2.5 Reporting and Compliance

Responses varied on how DOE outcomes should be reported and how compliance should be verified and enforced. For the most part, customers were deemed to have to monitor DOE information, although the information should be presented in a clear and transparent way so that performance levels are easily understood.

The main themes from DNSP responses for reporting DOE outcomes, responsibility for compliance, verifying and enforcing compliance are summarised in Table 5 and discussed in the sections below.

Table 5 – Summary of the perceived features of reporting and compliance obligations

DNBP	Approach to reporting DOE outcomes	Party responsible for compliance	Approach to verifying compliance	Approach to enforcing compliance
DNBP 1	-	Customers	Through audits where customer systems are reviewed for compliance	In accordance with technical requirements for connecting DER
DNBP 2	Being considered as part of DER access and pricing arrangement. Customers need good resources that give them transparency of the performance level they are receiving, and the AER needs to be satisfied that DNSPs are providing the level of service they should be.	Customer (outsourced to agent)	Customers' interval metering data	A standards-compliant inverter that meets the CSIP-AUS IEEE 2030.5 standard should be compliant by design
DNBP 3	DSO will have network monitoring comprising traditional SCADA, distribution transformer monitors and AMI meters	Aggregator	Through AMI (at NMI) and on-site devices (via Aggregator)	In accordance with technical requirements
DNBP 4	Likely that useful information would be the extent to which dynamic network capacity has been made accessible to customer DER participation, the extent of potential curtailment that is occurring as a result of the implementation of the DOEs, and the extent of DOE breaches that occur over time	Customer / aggregator	AMI PQ measurement data	No view yet.
DNBP 5	As part of IPART licence conditions that are being taken forward in response to the DEIP rule change	Customer (outsourced to an agent)	Simple reporting and follow up arrangement to promote compliance	Pragmatic approach where networks are constrained, for example using real-time control
DNBP 6	-	Customer	Use of the smart meter data	Utilise AMI data to verify compliance
DNBP 7	In a way where customers can monitor and networks to monitor constraints with a view to targeted upgrades	Customer (backed by adequate consumer protections)	Measurement data with an appropriate accuracy, resolution and monitoring timeframe	Penalties, however, need to be balanced with socioeconomic impacts
DNBP 8	No strong view at this stage - could be total MW/MWh outside of compliance to DOE limits	Aggregator or VPP operator	Through DER measurement / smart meter data compared to DOE limits	No strong view except approach should not heavily rely on physically attending site

DNSP 9	Self-reporting by agent complying with DOEs and periodic checking of this against connection level data	Customer (outsourced to an agent)	Aggregators complying with DOEs	Corrections or penalties
DNSP 10	Different parties will report outcomes based on the nature of the outcome in different forms, for example customer compliance, network congestion management outcomes, network utilisation, market outcomes, customer/retailer/VPP financial outcomes.	Customer	Through metering and comms of the device administering the DOEs (e.g. HEMS or inverter)	-
DNSP 11	-	Needs to be driven by market model design as part of the rule change consideration	Needs to be driven by market model design as part of the rule change consideration	Needs to be driven by market model design as part of the rule change consideration
DNSP 12	How much curtailment occurred, how much additional export was allowed (relative to static limits), and how hosting capacity for further DER has improved as a result of the DOE.	Customer (outsourced to an agent)	-	Systems should revert to safe fallback position in the first instance until compliance is restored. In successive instances systems could be switched off
DNSP 13	Through the DAPR	Aggregator	Contractual arrangement through a settlement and verification processes which needs work to be done to clearly define obligations	Contractual arrangement through a settlement and verification processes which needs work to be done to clearly define obligations

2.5.1 Approach to reporting DOE outcomes

From the survey responses, DNSPs, aggregators and agents may have a role in reporting on compliance. The following aspects could be reported on:

- Total kW/kWh outside of DOE limits
- Dynamic capacity/potential curtailment available for DER participation
- Extent of DOE breaches occurring over time
- Compliance against technical requirements or agreements.

Considering the level of variance between the responses of DNSPs, further investigation into the approaches to reporting DOE outcomes may be useful for DNSPs.

2.5.2 Party responsible for compliance

Overall, DNSPs agreed that customers should be held accountable for compliance with DOEs, with aggregators or agents (if available) potentially taking on responsibility for managing the systems on the customers' behalf in some cases, or retailers/installers ensuring systems are compliant. In the NEM, customers hold the connection contract with their network and so are most suited to be held accountable for compliance with DOEs. However, it was noted that customers can potentially tamper with their systems, reinforcing the idea that it is the customer that should be made to account for compliance. Most DNSPs indicated that customers should be able to delegate responsibility to an agent, be it an aggregator, retailer or VPP operator, as they would be better prepared to manage the systems on their behalf or ensure the system is compliant.

2.5.3 Approach to verifying compliance

DNSPs agreed that in order to verify compliance, data should be measured with an appropriate accuracy, resolution and monitoring timeframe, either through customer metering, PQ data, connected HEMS devices or inverters. Where appropriate, the data would be checked with aggregators (if available) as well as against contractual arrangements through settlement and verification processes that will be determined based on industry thinking around regulatory obligations of all participants. Separate, audit functions and programs should be set up to audit a sample of systems.

However, it is noted that the primary means to ensure compliance for simple systems may involve certification against the relevant standards such as CSIP-AUS. For more complex arrangements where the customer's equipment is controlled by a third party, additional compliance measures may be required.

2.5.4 Approach to enforcing compliance

In terms of enforcing compliance, approaches similar to dealing with non-compliances with AS4777 were suggested as well as penalties. The actual metering of, and communication with the device administering the DOEs, such as HEMS or inverters, were suggested as a means of enforcement, as were contractual arrangements or technical requirements for connecting DER. DNSPs overwhelmingly pointed out that verifying and enforcing compliance should not be reliant on physically attending the site. This was mostly due to costs, effort and risks of doing so.

3 Conclusions

The review has been designed to provide a snapshot of the current state of DOE implementation across Australian DNSPs, drawing out key themes and highlighting areas of alignment and divergence. By benchmarking DNSPs across a range of clear, objective measures, we have obtained meaningful insights into the considerations for a nationally consistent framework for DOEs.

DOEs are a relatively nascent feature of the Australian electricity system, and as such, the level of understanding of DOEs varies substantially between DNSPs. The responses received from DNSPs accordingly reflect a range of different conceptions and practical approaches to implementing DOEs. Currently, eight out of the 16 DNSPs offer DOE services to their customers in a trial capacity to a small subset of their customer base whilst the other DNSPs are in the process of considering or actively moving towards deploying DOEs to their customer base with most DNSPs looking to incorporate DOEs within five years.

Implementation approaches vary widely between DNSPs. A summary of the findings in relation to the key focus areas of service offerings, technical characteristics and approaches to reporting and compliance is provided below.

Service Offerings

In general, there was a high degree of variance among DNSPs regarding the details of the DOE services to be provided, both in terms of the few existing service offerings and those in the pipeline. The key themes were:

- **Tiered offering** – Currently not offered in networks that offer DOE services, with the DNSPs providing various responses as to whether these will be offered in the future.
- **Grandfathering of existing arrangements** – In the future, most DNSPs plan to introduce grandfathering, or the phasing out of existing arrangements for exports as offerings for DOEs become increasingly available to customers.
- **Tariff arrangements** – Currently no changes to tariff arrangements for customers with DOEs, with various responses in whether networks will change tariff arrangements in the future.
- **DOE customer obligations in the MSO** – The majority of DNSPs are either in the process of updating or considering updating their MSO setting with respect to the terms and conditions for connecting small-scale DER systems such as household solar.
- **Performance guarantees** – DNSPs have largely chosen not to provide performance guarantees or service standards for DOEs to their customers to date.

Technical Characteristics of the DOE Offer

There was a much greater level of consistency between DNSPs regarding the technical characteristics of DOEs. The key themes were:

- **Communications protocols** – DNSPs were almost unanimous in having adopted or proposing to adopt the IEEE 2030.5 CSIP-AUS standards.
- **Forecasting period** – Most DNSPs calculate or propose to calculate their DOEs on a 24 hr forecast at the 5 min interval level.
- **DOE characteristics** – Applied to real power (i.e. on a kW basis) for exports where this will be expanded to both export and imports for some networks, with lower and upper limits.
- **Spatial characteristics** – Most DNSPs agree DOEs should be calculated based on the locational characteristics of the network or the constraint (e.g. hosting capacity available or the level of DER penetration within a region or on a given asset).
- **Approach to capacity allocation** – Currently and in the future, there is no consistent approach to applying and allocating curtailments to customers.

- **Contingency procedure** – DNSPs will apply a fall-back procedure to revert limits to a safe level or a default setting if the DOE cannot be communicated. The Australian version of the IEEE 2030.5 CSIP seeks to standardise the required fallback behaviour when communication is lost.

Reporting and Compliance

DNSP responses were quite variable on how DOE outcomes should be reported and how compliance should be verified and enforced. The key themes were:

- **Reporting DOE outcomes** – Could include kW/kWh outside of DOE limits, dynamic capacity/potential, curtailment, extent of DOE breaches occurring over time, or compliance against technical requirements. If available, agents would be responsible for reporting on compliance with the approach to reporting aligning to IPART's licence conditions. DNSPs may present findings in their DAPRs.
- **Responsibility for compliance** – Customers accountable, with the potential for customers to engage aggregators or others to take on primary responsibility for managing their systems, acting as the customer's agent.
- **Verifying compliance** – Through customer metering, PQ data, connected HEMS devices or inverters, checked with aggregators and audited regularly
- **Enforcing compliance** – Corrections similar to dealing with non-compliances with AS4777 as well as penalties. Enforced through contractual arrangements or technical requirements

Based on the information provided by DNSPs, there are a variety of approaches to implementing DOEs. In particular, there was a high degree of variability on the service offering of the DOEs themselves and the approach to reporting and compliance. By contrast, DNSP responses on the technical characteristics of DOEs were mostly aligned.

In areas where there are diverging views between DNSPs, CutlerMerz considers there is a need to further explore options to assist in identifying whether national standardisation would be beneficial for DNSPs and their customers. CutlerMerz recognises that each DNSP has differing conditions on their network and that a more flexible approach may provide better outcomes for consumers and network operations than adopting a standard approach in many circumstances. At the same time, providing consistency in the technical standards, and the approaches to reporting and compliance may streamline approaches for technology and service providers.

Ongoing consultation between DNSPs, market bodies, key industry bodies and customers will be necessary to optimise DOE implementation across the network.

Appendix A – DOE-related expenditure by DNSPs

This appendix describes the projects and programs that DNSPs are undertaking in the current regulatory period, or planning to undertake in future regulatory periods, which support DOE capability.

Table 6 – DOE expenditure

	Investments in the current and next regulatory periods	Future investments to increase DOE service offerings
DNBP 1	Utility server to support limited DOE devices (based on projected requirements) and early work on Distributed Energy Resources Management System (DERMS) which will be captured in the next regulatory period. Other expenditure includes development of standards, processes and systems amendments. These costs are supported under normal operating budgets and are expected to support the delivery of long-term savings.	Community batteries
DNBP 2	Currently developing a DER Integration Strategy as part of the regulatory proposal for the next reset. This may include some funding to enable DOEs, but how much has not yet been determined.	Considering the costs and benefits of expanding their existing capability.
DNBP 3	Will require over \$50m investment in low voltage data, modelling and analytics and communication and control to enable DER integration on the network.	Tariff reform to incentivise utilisation of DER capacity. Also trialling network batteries as part of a capability uplift program over the next three years.
DNBP 4	In the current regulatory period, investing in delayed and real time smart meter data visibility. Also ramping up data access progressively and building capability for Low Voltage (LV) analytics, including LV state estimation trials. This is largely opex data costs and some capex in terms of analytics systems and a DERMS trial. In 2025-29, expect to make a case to materially ramp up data access as well as invest in DERMS and other supporting systems to enable flexible connections / DOEs to be provided to customers.	Implementing a dynamic voltage management system to improve hosting capacity as well as new technology solutions like LV STATCOMs and LV community batteries deployed to constrained LV networks where unlocking constraints are economically positive.
DNBP 5	In the current regulatory period, investing approximately \$6m in capex for better LV visibility although not all is targeted at DOE enablement. Other projects and trials are funded through ARENA and the Demand Management Innovation Allowance (DMIA). Investments for the next regulatory period are yet to be determined.	Yet to be determined.
DNBP 6	The current projects in progress relating to DER integration that include the building of DOE capability represent an investment that is aligned with current regulatory funding.	Following the current trials, it is anticipated that investment will be aimed at progressively operationalising the DOE capability and offerings to customers. These investments have not yet been fully costed.

DNBP 7	Currently being determined as part of the DER access and pricing arrangement to be applied from 2026 onwards.	Currently being determined as part of the DER access and pricing arrangement to be applied from 2026 onwards.
DNBP 8	Procured IEEE2030.5 that is being used for network owned batteries and established a 3rd party API for the retailer to utilise the battery in market.	Integrated system planning tools to identify constraints under different DER penetration scenarios. DER management solutions for a range of use cases. Platform for the calculation of DOEs that can evolve overtime.
DNBP 9	\$32 million in capex in the 2020-2025 period to develop the required capabilities and roll out dynamic export limits across the network region.	Considering a mix of network investments like substation upgrades and non-network solutions. No specific plans in relation to network-connected batteries. Will consider all potential solutions to upstream constraints on their merits to prepare investment plans for 2025-2030, noting that DNSPs have no mandate under the rules to invest in export capacity until the Access and Pricing rule change comes into effect in 2025.
DNBP 10	Under a program of work in the next regulatory period, will invest in LV modelling data uplift, LV sensors to monitor power flow, and foundations to detect network constraints in real time.	Maintaining export limits up to 10 kW per phase for Basic Micro Embedded Generation, the equal highest for such connections in Australia. Commenced LV DER hosting capacity analysis that will inform on the sustainability of current export limits, and potential options to consider.
DNBP 11	Approximately \$2m in DMIA funding for network visibility and DOE calculation and another \$2m in in-kind support which will put in place infrastructure, systems and participants to test and develop DOE capabilities.	Community batteries are currently being investigated. Too early to determine investments into increasing DOE service offerings but intending to follow the industry.
DNBP 12	Expenditure covers current pilots on DOEs and on engaging commercial and industrial customers only under bi-lateral contracts. Further investments looking at LV visibility and management requirements. Metering fleet to be 100% Advanced Metering Infrastructure (AMI) within the next 6 years, i.e. by the end of next regulatory period.	Investments planned to increase Distribution System Operator (DSO) capability, including aspects such as network assets (e.g. energy storage and visibility) and Information Communications Technology (ICT).
DNBP 13	Investments for more than \$10m on DOE enablement.	Deploying a suite of tools to manage a high penetration DER business future. These include hosting capacity (network) batteries, community batteries, DERMS across most microgrids, and a range of complementary customer facing products.

Appendix B – Survey Questionnaire

Service offering

Questions in this category are targeted at understanding the nature and type of DOE services offered to customers, including availability across DNSP customer base, details of DOE offerings and key features of DOE contracts.

1. Do all customers with embedded generation receive an offer for DOEs? What is the basis for providing a DOE?
2. Do load customers receive an offer for DOEs? What is the basis for providing a DOE?
3. Is there a tiered-service offering where customers can pay for greater access and lower curtailment? Is this consistent between single and three phase offers?
4. Is there grandfathering of existing import/export limits in connection agreements following introduction of DOE offers?
5. What are the tariff arrangements for customers with a DOE?
6. Are DOE customer obligations listed in the DNSP's Model Standing Offer? If not, how is the DOE contract established?
7. What performance guarantees are provided to customers?
8. What information material and engagement processes are available for customers who want to connect using a DOE?
9. When are DOEs expected to become available to all customers?

Technical characteristics of the DOE offer

Questions in this category are targeted at establishing the physical characteristics and systems underpinning the DOE products offered to customers.

1. What is the standard DOE forecasting period?
2. What are the characteristics of the DOE offers (e.g. upper and lower bounds of export/import, kW, KVA, etc)?
3. How are DOEs proposed to change between different areas or zones?
4. How will curtailment be applied (e.g. proportional, equal volume)?
5. What communications protocol are proposed to be / have been adopted? (e.g. IEEE 2030.5 plus any relevant variation)
6. What contingency procedures are proposed to be in place for communicating with customers if API systems fail?

Reporting and compliance

Questions in this category are targeted at establishing the regulatory requirements associated with ongoing reporting and compliance obligations.

1. How should DOE outcomes be reported?
2. Who should be responsible for compliance with DOEs (e.g. customer / retailer / aggregator / VPP)?
3. How should compliance be verified and enforced?

DOE expenditure

Questions in this category are targeted at establishing the types of projects and expenditure on systems and infrastructure to accommodate DOEs.

1. What investments are being undertaken during the current regulatory period, and forecast for the next regulatory period, and what is their associated cost? (e.g. LV visibility)? Please provide in terms of capex or opex, where possible.
2. What investments are being considered to increase the DOE service offerings in the future (e.g. community batteries)?