Energy Transformation Taskforce

Issues Paper - DER Roadmap: Distributed Energy Resources Orchestration Roles and Responsibilities

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Disclaimer

The information, representations and statements contained in this issues paper have been prepared by the Energy Transformation Implementation Unit.

It is provided to assist in understanding the approach being taken to implement greater orchestration of distributed energy resources on the South West Interconnected System (SWIS).

Any views expressed in this consultation paper are not necessarily the views of the State of Western Australia, the Western Australian Government (including the Minister for Energy), or the Energy Transformation Taskforce, nor do they reflect any interim, firm or final position adopted by the Government in connection with the orchestration of distributed energy resources.

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1. Introduction

1.1 Electricity Transformation Strategy

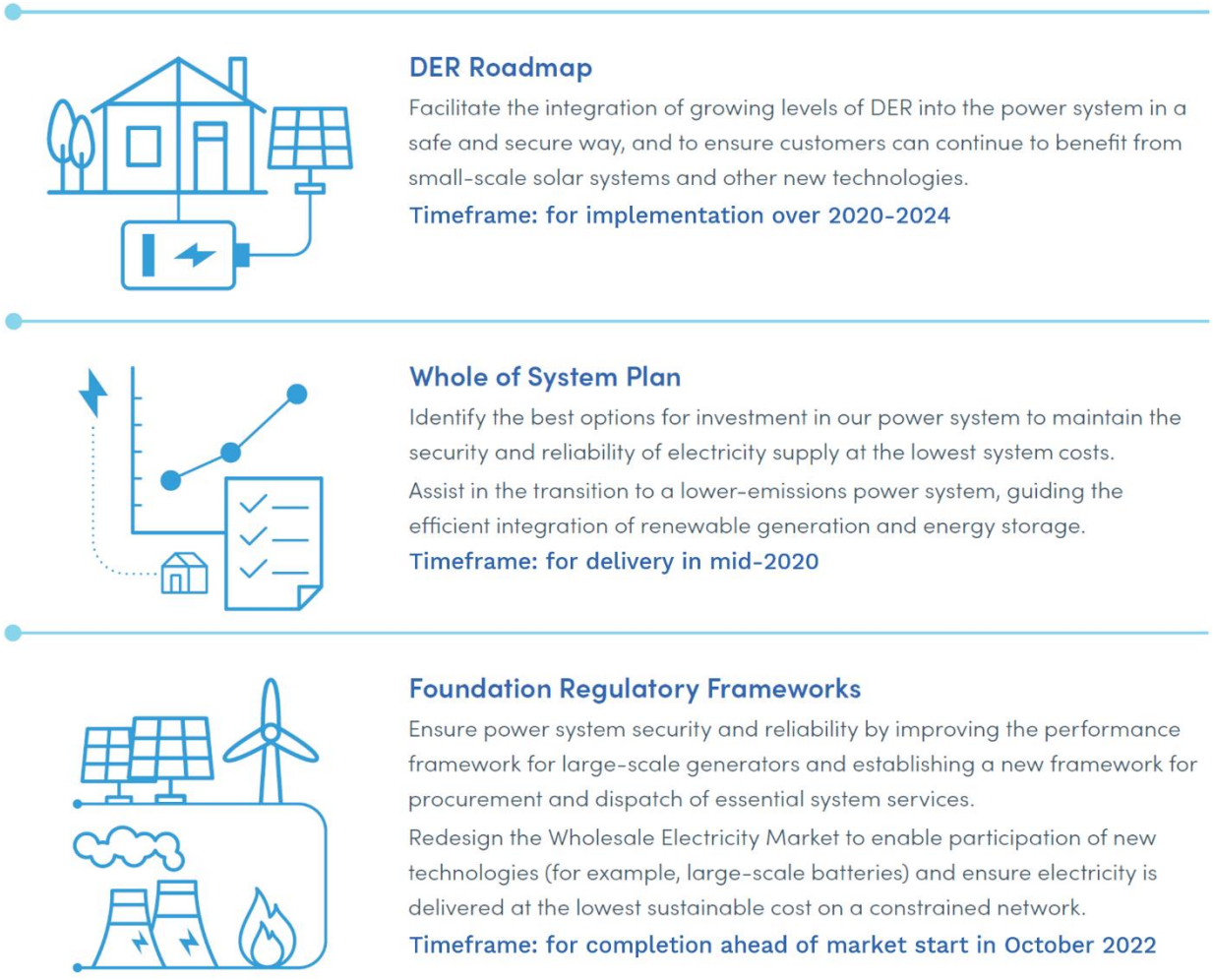
This paper forms part of the work to implement the actions outlined within the Distributed Energy Resources (DER) Roadmap, delivered as part of the Energy Transformation Strategy. The Strategy is the Western Australian Government's response to the energy transformation that is underway and the need for a plan for the future of our power system in the SWIS.

The delivery of the DER Roadmap, which was released on 4 April 2020, is being overseen by the Energy Transformation Taskforce (Taskforce). The Taskforce is being supported by the Energy Transformation Implementation Unit (ETIU), a dedicated unit within Energy Policy WA, a sub-department of the Department of Mines, Industry Regulation and Safety.

More information on the DER Roadmap, the Energy Transformation Strategy, the Taskforce, and ETIU can be found on the Energy Transformation website.[1]

This paper is prepared as part of the Distributed Energy Resources work stream of the Energy Transformation Strategy, as shown in Figure1, below.

Figure 1: Energy Transformation Strategy Workstreams



[1] https://www.wa.gov.au/organisation/energy-policy-wa/energy-transformation-strategy

The DER Roadmap outlines a vision for a future where DER is integral to a safe, reliable and efficient electricity system, and where the full capabilities of DER can provide benefits across the power system and value to all customers.

There are three parts to this vision:

- A safe and reliable electricity system where customers can continue to connect DER and where DER supports the system in an efficient way.
- DER capability offers value throughout the electricity supply chain.
- DER benefits flow to all customers, both with and without DER.

The DER Roadmap vision includes far greater DER participation in Western Australia's Wholesale Electricity Market (WEM) than exists today. To achieve this level of participation and enable greater orchestration of DER, change will need to be made to the roles and responsibilities of the Network Operator, the Market and System Operator, and Retailers or other entities who coordinate individual DER components.

1.2 Guiding principles

This issues paper follows the same guiding principles outlined in the DER Roadmap.[2] It also takes into consideration the WEM objectives.[3]

WEM objectives

Pursuant to the WEM Rules the objectives of the WEM are to:

- Promote the economically efficient, safe and reliable production and supply of electricity and electricity-related services in the South West Interconnected System (SWIS).
- Encourage competition among generators and retailers in the SWIS, including by facilitating efficient entry of new competitors.
- Avoid discrimination in that market against particular energy options and technologies, including sustainable energy options and technologies such as those that make use of renewable resources or that reduce overall greenhouse gas emissions.
- Minimise the long-term cost of electricity supplied to customers from the SWIS.
- Encourage the taking of measures to manage the amount of electricity used and when it is used.

2 *DER Roadmap*, p.37, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap

3 Wholesale Electricity Market Rule 1.2 - Objectives, available at https://www.erawa.com.au/rule-change-panel/wholesale-electricity-market-rules

1.3 Purpose of this paper

This paper is the first step in addressing DER Roadmap Action 24: DSO/DMO Plan – Roles and Responsibilities.

The capability of customers to interact with the power system will be increased by actions implemented as part of the DER Roadmap.

This paper seeks to define issues for discussion on changes that will enable customer DER to provide services to the network and participate in the Wholesale Electricity Market.

This paper discusses issues related to:

- A Distribution System Operator (DSO).
- A Market Operator that includes participation from DER, the DMO.
- Aggregators of DER.
- Customer protections and considerations.
- Supplementary issues.

The paper requests responses to 22 consultation questions, but stakeholder feedback should not be limited by these.

1.4 Background

The DER Roadmap set out the high-level requirements and outlines many actions required to integrate DER into the electricity system and market. In a future with high DER penetration, it is expected that DER will eventually provide services that support the power system and are rewarded for doing so. For the SWIS, this will require an evolution of the roles of Western Power and the Australian Energy Market Operator (AEMO), and the entry of 'DER aggregators' to the market.

The coordination of many individual customer DER by aggregators will allow small, distribution-connected electricity consumers to participate in the provision of services that benefit the power system. The development of mechanisms that allow DER to provide, and be compensated for, these services will open new value streams for customers and lower system costs.

This issues paper provides further detail on how a DSO and a DMO model may look like in the WEM, as well as how these new functions will be established and their interaction with traditional roles in the system (such as retailers).

Public comment is sought on these proposed roles to help in the development of policy and regulatory changes as there will be significant energy sector impacts associated with the transition.

This paper does not address detailed issues of a technical, contractual or regulatory nature, but identifies these issues for future resolution and propose high-level positions that will allow further detailed design work.

To deliver on the vision of enabling DER participation, the Roadmap outlines a series of Actions to conduct a DER Orchestration Pilot (Actions 22 & 23), and to define the DSO and DMO function set (Actions 24 to 32). These are listed in Table 1.

Table 1: DER Roadmap actions to facilitate DER participation.[4]

Roadmap Action	Roadmap Element	Description
24	DSO/DMO	By Dec 2020, develop a plan for the establishment of a DSO and DMO in the SWIS, including the identification of roles, functions, costs and practical operations. This plan should include an assessment of the costs and benefits to the system for the establishment of these functions.
25	DSO/DMO	By December 2020, identify legislation and regulatory framework requirements including timeframes for development and implementation to establish DSO and DMO functions.
26	DSO/DMO	By September 2021, finalise communications protocols, data and technology requirements to accurately predict and publish operating constraints on the distribution network under a DSO, and requirements for coordination with the system operator.
27	DSO/DMO	By December 2021, introduce changes to wholesale market arrangements necessary to enable the participation of DER in the wholesale market via a DER aggregator.
28	DSO/DMO	By June 2022, introduce adapted network connection agreements that enable the DSO, once established, to interact with devices on the distribution network.
29	DSO/DMO	By December 2022, deliver a DSO/DMO legislative and regulatory framework, for transition to commencement by 1 July 2023.
30	DSO/DMO	At 1 July 2023, DSO and DMO goes live in the SWIS, with active DER able to respond to meet network needs as well as be dispatched into the WEM and be compensated appropriately.
31	DSO/DMO	By July 2023, develop the initial design of the framework for a distribution services market[5] with fit for purpose arrangements for dispatch and settlement. Include an assessment of the cost and benefits of market creation.
32	DSO/DMO	By July 2024, commence the development of trials for a distribution services market for network support.

These Roadmap actions align with other work under the Energy Transformation Strategy through the Foundation Regulatory Frameworks workstream, in particular developing a new wholesale market design, including a framework for the provision of Essential (Power) System Services (ESS).[6]

This paper makes the following assumptions:

- Policy regarding the retail contestability threshold for small-use customers remains unchanged.
- The uptake and cost of DER will continue in line with recent trends.
- Associated DER Roadmap actions, such as work on inverter standards, communication requirements and the DER Orchestration trial progress in line with identified timeframes.

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4 *DER Roadmap,* p. 68, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap. Note that some dates have been amended to reflect updates following the publication of the DER Roadmap.

5 A distribution services market is one for the provision of network support services to the DSO. This market is not envisaged to be needed in the short to medium term in the SWIS but may emerge in the future as DER capabilities evolve and saturation increases.

6 Essential System Services were previously referred to as Ancillary Services.

- The Western Power Advanced Meter Infrastructure (AMI) deployment schedule is achieved.

This issues paper builds on information provided in the following publications:

- *DER Roadmap and supplements (Regulatory Settings Summary and DER Project Stocktake).*
- *Energy Transformation Taskforce Information Paper – Market Settlement: Implementation of five-minute settlement, uplift payments and Essential System Services Settlement.*
- *Energy Transformation Taskforce Information Paper - Registration and Participation Framework in the Wholesale Electricity Market.*
- *Energy Transformation Taskforce Information Paper - Essential System Services – Scheduling and Dispatch.*
- *Energy Policy WA – Directions Report, Creating a dynamic customer protections framework for behind-the-meter electricity services.*

This paper does not seek to resolve or set out a final position on many of the practical implementation issues that need to be addressed before the targeted 'Go Live' of a DSO and DMO on 1 July 2023[7], such as consumer protections or the regulatory framework pertaining to new aggregation related business models.[8] While many of these are discussed or mentioned in the paper, the primary focus is on defining functions, roles and responsibilities and where the boundaries of these lie. A series of issues associated with these definitions are identified for industry consultation.

In assessing the options and pathway for implementation of DER orchestration in the SWIS the Energy Transformation Taskforce will take into consideration the range of costs and benefits.

This paper will act as direct input for work on DER Roadmap Action 25: DMO/DSO Legislation and Regulation Requirements and Action 27: DER Wholesale Market Arrangements.

Feedback provided to this issues paper will be taken into consideration in the development of a final position paper which the Taskforce expects to release by the end of 2020.

1.5 Making a submission

The Taskforce invites feedback on the proposed roles and responsibilities outlined in this paper. Comment can be submitted in any of the following ways:

1. Email your written submission to energytransformation@energy.wa.gov.au
2. Contact energytransformation@energy.wa.gov.au to arrange a one-on-one discussion.
3. Post your written submission to Energy Policy WA at Locked Bag 11, Cloisters Square, WA 6850.

Consultation on the issues paper closes at **5.00pm (AWST), 25 September 2020**. Late submissions may not be considered.

In the interests of transparency and to promote informed discussion, submissions will be made publicly available on www.energy.wa.gov.au unless requested otherwise. Accordingly, stakeholders should clearly specify if the information they provide is confidential and, where possible, should separate confidential information from non-confidential information.

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7 *DER Roadmap*, p. 68, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap

8 Many of these issues are captured under the Electricity Retail Licencing and Exemption Review being undertaken by Energy Policy WA, more information is available https://www.wa.gov.au/organisation/energy-policy-wa/review-of-licensing-and-exemption-regulatory-framework

Persons making any claim for confidentiality should familiarise themselves with the provisions of the *Freedom of Information Act 1992* (Western Australia), which imposes obligations on Energy Policy WA in respect to the release of documents.

2. The Electricity System Today

2.1 The clear and present challenge

The challenges facing the current electricity system are well documented in the DER Roadmap.

The SWIS was designed for one-way flows of energy from large generators, though transmission networks down into distribution networks and finally to customers.

The rapid growth of rooftop solar photovoltaic (PV) has presented a new generation source that is displacing large volumes of energy from utility-scale generation (including wind and solar farms) at certain times. Energy from DER (self-consumed and exported) is currently largely not controllable and has impacts on power system operations, energy markets and network investment. It is only visible in the impact that it has on other elements of the power system and managing it relies on forecasts and estimates of its output and behaviour.

Rooftop solar PV is particularly vulnerable to significant seasonal and daily variability and, if unmanaged, will seriously threaten the security of the power system. The DER Roadmap concluded that to avoid this risk and harness the benefits of rooftop solar and other forms of DER, these resources need to be fully integrated into the operation of the power system. The aggregation of DER through development of a two-way market in the SWIS, with enhanced roles for a Distribution System Operator and a Distribution Market Operator, will be key to achieving this integration and accommodation of emergent retailer business models.

2.2 Existing roles

The following roles are important in the managing the power system on a day-to-day basis: Generators, the Network Operator, the System Operator, the Market Operator and Retailers.

The legislative frameworks that give power to these roles are listed in Appendix D: Legislative framework in the SWIS.

Generators

Large generators respond to contractual arrangements with customers and dispatch signals from AEMO. With few exceptions, large generators are connected to the transmission network and are generally located some distance from the Perth metropolitan area.

More recently, the number of intermittent large generators, such as wind and solar farms, has grown as a proportion of total generation capacity and this has implications for network, system and market operations.

However, the profound dynamic is that customer premises, located deep within the distribution network, have become generators as well as loads. The volume of electricity generated by distributed solar PV has grown rapidly over the last 5 years and now represents a significant proportion of total day time generation.

Currently energy exported from rooftop solar PV is not explicitly included in existing dispatch processes, and its effects are only visible through reductions in the overall demand. Other generators are effectively required to change their behaviour in response to the output from DER.

Network Operator

Western Power, as network operator, operates the transmission and distribution network within defined technical limits, and is responsible for managing new and existing network connections. Constraints have traditionally been managed through the augmentation of network with new investment in poles and wires. There are increasing opportunities to enable deferment of network augmentation through deployment of efficient non-network alternatives for network support, including battery storage.[9]

The recent rapid growth in rooftop solar PV has led to increasing two-way power flows and other challenges for the network operator. Unlike the transmission network, visibility of power flows is limited on the distribution network, although the deployment of AMI is improving capability.

System Operator

AEMO, as system operator, has responsibility under the WEM Rules to maintain system security and reliability. This includes dispatching generation and demand management facilities, assessing generation and network outages and determining ESS requirements.[10] In this context, 'secure' means that the power system operates within defined technical limits, and 'reliable' means that the supply of electricity is adequate to meet demand.

Market Operator

AEMO, as market operator, is responsible for operating the WEM in accordance with the WEM Rules and the related WEM Market Procedures. The current WEM design does not adequately contemplate energy or services sourced from DER. For example, the energy purchased from rooftop PVs and sold to customers on the distribution network is not captured in the same way as the energy sold under contracts between large generators and retailers. Instead, it is largely presented as a reduction to the notional wholesale meter.

The Energy Transformation Strategy is implementing market reforms that will help facilitate greater participation for aggregated DER from large numbers of very small customers.

Retailers

Retailers buy energy and sell to end use customers, primarily via the Western Power network.

State Government policy limits retail contestability in the SWIS to customers who consume more than 50MWh of electricity per year.[11] Below this level customers can only purchase energy from Synergy on regulated tariffs.[12] Regulated tariffs are determined by the State Government as part of the annual State Budget process.

Under various feed in-tariff and energy buyback schemes, Synergy has been required to offer payment for the energy exported from eligible small-use customer rooftop solar PV systems.

Customers above 50MWh consumption per year have choice of retailer and there are several operating in the SWIS. Retailers may enter into a power purchase agreement or other financial

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9 See the trial of PowerBank community batteries, Western Power's Perenjori battery, and Energy Policy WA's proposed changes to the *Electricity Networks Access Code 2004,* available at https://www.wa.gov.au/government/announcements/request-public-submissions-proposed-access-code-amendments

10 More information is available at: https://aemo.com.au/energy-systems/electricity/wholesale-electricity-market-wem/system-operations

11 More information is available at: https://www.erawa.com.au/gas/switched-on-energy-consumers-guide/can-i-choose-my-retailer

12 This does not include customers within embedded networks such as caravan parks, apartments or shopping centres which are usually billed by the embedded network operator or owner, which may in turn be a contestable customer.

arrangement with customers related to energy supplied from rooftop solar PV systems, but there is no regulated requirement to do so. As a result, energy from these systems ‘spills’ into the grid when it is excess to customer needs. This can have settlement implications for Synergy’s net energy position in the market even where it has no direct relationship with the customer.

The increasing ability of many small-use customers to self-supply a large proportion of their energy needs is challenging the traditional retail models.

3. The Future

3.1 The need for change

The AEMO's *2020 Wholesale Energy Market Electricity Statement of Opportunities* included, for the first time, forecasts of minimum demand, noting that:

> 'Strong uptake of behind-the-meter PV has continuously reduced the daytime minimum demand in the SWIS over the last three years. As early as 2023-24, minimum demand is forecast to fall below the 700 MW security threshold under the expected demand growth scenario.'[13]

and

> 'In all scenarios, decreasing demand minimums are primarily driven by projected growth in behind-the-meter PV installations. In the expected growth scenario, installed behind-the-meter PV capacity is forecast to increase from 1,372 MW to 2,051 MW between 2020-21 and 2024-25.'[14]

The DER Roadmap identifies that:

> 'Increasing DER penetration, in combination with the anticipated increases in large-scale renewable generation, will displace the dispatchable synchronous generators that provide ESS such as inertia, frequency control, system strength and voltage control. At times of low load, such generators will bid into the energy market at low prices to ensure they get dispatched (in order to avoid high costs of shutting down and re-starting). Increasingly, the wholesale market is experiencing negative prices during some trade intervals – generators are now paying to stay on. Over time, it will no longer be economic for these generators to remain online, decreasing the availability of ESS.'[15]

As an alternative to costly interventions by AEMO, the DER Roadmap sees aggregation and management of DER as a way of providing many of the services in the WEM as well as managing day-to-day issues faced in the managing the Western Power network.

The potential for DER to provide these types of services has been recognised widely, and many trials are underway locally, nationally and internationally that look at various aspects of DER integration. These include:

- Western Power and Synergy PowerBank trials.
- Western Power Mandurah Demand Management Services.
- Western Power on-load tap changer functionality in distribution transformers.
- Horizon Power Onslow Power Project.[16]
- South Australia Virtual Power Plant (VPP) for distributed battery storage.[17]

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13 AEMO *2020 Wholesale Energy Market Electricity Statement of Opportunities*, p. 8, available at https://aemo.com.au/energy-systems/electricity/wholesale-electricity-market-wem/wem-forecasting-and-planning/wem-electricity-statement-of-opportunities-wem-esoo

14 Ibid, p. 62

15 *DER Roadmap*, p. 30, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap

16 *DER Project Stocktake*, p. 43, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap

17 More information available at: https://virtualpowerplant.sa.gov.au/

- AEMO VPP Demonstrations enabling DER to provide contingency frequency services in the NEM.[18]
- ARENA/ANU Realising Electric Vehicle-to-Grid services trial.[19]
- Octopus (UK) for household load demand response at times of low system load.[20]
- OVO (UK) for EV fleet battery demand response for load/supply.[21]
- OFGEM (UK) work on the role of a DSO.[22]

Despite these trials, end-to-end integration of aggregated DER into the network, system management and energy markets is a new and evolving process and there is limited precedent, nationally or internationally, to follow.

The SWIS has different characteristics to most other large networks. The SWIS is an isolated power system not interconnected with other grids and has a single integrated network operator that looks after both transmission and distribution.[23] Many of the models and solutions proposed in other jurisdictions may not be directly applicable to the SWIS.

Western Australia does not have the luxury of waiting for the outcomes of national and international trials or to follow the lead of approaches in other markets. The speed at which rooftop solar has been installed in Western Australia, in part a result of the extremely favourable climate and solar resource, and the increasing effects that it has on the power system, means that rooftop solar can no longer continue to operate outside of the energy market, acting as an external distortion. It must be integrated into power system operation and valued alongside other energy types to address the risks outlined in the DER Roadmap.

3.2 DER Orchestration Pilot and development of the DSO, DMO and aggregator roles

The DER Roadmap outlines an ambitious program of work to address the risks to system security and stability. The relevant timeframes mean that it is necessary to undertake the DER Orchestration Pilot (now known as Project Symphony) outlined in the DER Roadmap concurrently with the design and implementation of the new roles outlined in this paper. There are substantial interactions and dependencies between the work being undertaken as part of Project Symphony, and the establishment of the DSO, DMO and aggregator roles.

It is critical to develop technical, customer and market requirements that ensure DER can support, and not challenge, the efficiency, reliability and security of the SWIS into the future. Project Symphony will consider the technologies, services, standards and processes, supporting regulatory

[18] More information available at:https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/pilots-and-trials/virtual-power-plant-vpp-demonstrations

[19] More information available at: https://arena.gov.au/projects/realising-electric-vehicle-to-grid-services/

[20] More information available at: https://octopus.energy/introducing-big-switch/

[21] More information available at: https://www.ovoenergy.com/electric-cars/vehicle-to-grid-charger

[22] More information available at: https://www.ofgem.gov.uk/publications-and-updates/ofgem-position-paper-distribution-system-operation-our-approach-and-regulatory-priorities

[23] The ERA has granted other distribution licences, but these have usually been in relation to mining activity. More recently, in March 2020, the ERA granted Enwave WA electricity distribution and electricity retail licences related to the operation of a microgrid attached to the Western Power network. It is conceivable that in the future there may be multiple microgrids or embedded networks with their own network operators. http://www.erawa.com.au/cproot/21089/2/Decision---Grant-of-EDL007-and-ERL028-and-approval-of-standard-form-contract---Enwave-WA-Pty-Ltd.pdf

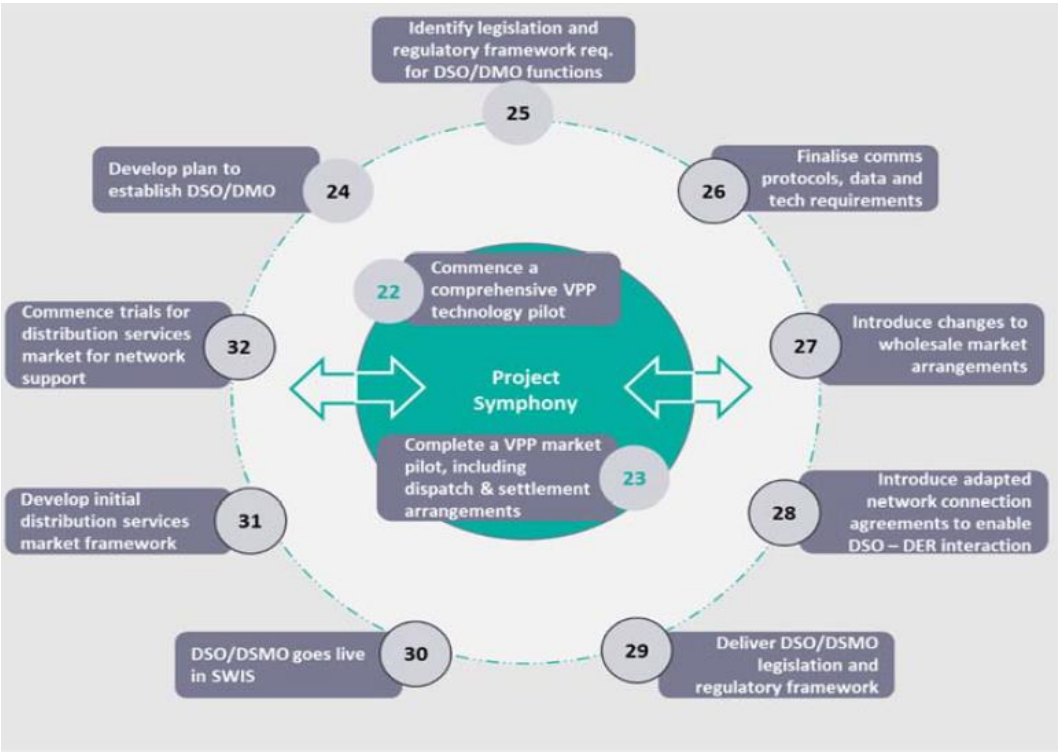
frameworks, market rules and proactive customer engagement to support successful and efficient integration of DER.

The pilot will help to identify gaps in policy, processes and technology that are specific to the SWIS through practical testing. Ideally, the orchestration pilot would be undertaken in advance of implementation work. However, the pressing need to commence design work, and implement changes in time to address the risks that have been identified mean an alternative approach is required.

The Taskforce recognises that there are potential risks in conducting the pilot in parallel with implementing regulatory and other changes. For example, the pilot may identify improvements or practical difficulties after important design decisions have already been made. However, these risks can be mitigated by proactive sequencing of policy determinations with outcomes from the orchestration pilot. Learnings from the pilot will also provide an important evidentiary base to inform the solutions put in place for the long term.

Project Symphony is currently being designed by Western Power, Synergy, AEMO and Energy Policy WA. Over the next two and a half years the project will seek to resolve the practical challenges of integrating DER as an active participant[24]in the market, and provide input to refine the functions of relevant parties to enable DER to be orchestrated and managed in a coordinated manner as an essential pre-requisite for the operation of a DSO and DMO.

Figure 2: Interaction between Project Symphony and the DER Roadmap



Note: Numbers refer to actions within the DER Roadmap.[25]

[24] Active DER can respond to external instructions to that modify its behaviour, for example to charge or discharge a battery. When 'aggregated' in large volumes this can allow DER to replicate some services normally provided by large generators. Passive DER acts independently of any instruction. This is distinct from autonomous capabilities of DER that automatically respond to environmental changes, for example the use of volt-var settings in inverters to automatically lower output in response voltage rise. Autonomous functions may exist in active or passive DER.

[25] *DER Roadmap,* pp. 65-68, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap

Project Symphony will also build industry capability by progressively developing and testing the core elements needed to optimally integrate DER for the benefit of all customers.

Specifically, the objectives of Project Symphony are to:

- Identify and test DER use cases.
    - *Network use cases* - The ability of aggregated DER to deliver a range of network services (as an alternative to transmission and/or distribution network upgrades) and the methodology for valuing these services. Example network use cases include:
        - voltage support; and
        - network capacity support.
    - *Market use cases* - The ability of aggregated DER to deliver WEM services, including specific Essential System Services (such as frequency regulation). Example market use cases include:
        - frequency regulation;
        - rate of change of frequency (RoCoF) control;
        - contingency reserve;
        - reserve capacity; and
        - managing system low - any future service to maintain system strength.
    - *Retailer/Aggregator use cases* - The ability of aggregated DER to navigate the multiple market, network, retailer and customer specific value propositions that can be presented to customers in a simple and understandable way. These may include:
        - wholesale energy costs reduction (price arbitrage);
        - Essential System Services payments;
        - Reserve Capacity Payments (e.g. Capacity Credits);
        - reserve capacity costs reduction (i.e. reduced Individual Reserve Capacity Requirements);
        - network costs reduction (e.g. reducing costs with respect to distribution tariffs);
        - customer bill reduction; and
        - customer specific value.
- Develop pilot prototypes of the platforms (such as Distributed Energy Resource Management Systems (DERMS))[26] and systems needed to operationalise DER integration and deliver on DER orchestration elements of WA's DER Roadmap.

[26] DERMS can have varying interpretations may perform different functions for different entities. For clarity, this document will instead refer to a DMO platform, DSO platform and aggregator platform as appropriate.

- Prepare a cost benefit analysis, supported by learnings from the project, which articulates the overall costs and benefits of various options to integrate DER into the wholesale market.
- Prepare a social science / behavioural analysis, supported by learnings from the project, to identify customer and stakeholder preferences regarding DER integration.
- Enable the customer journey of DER participation with exposure of a significant number of Synergy customers directly and with third-party aggregators via a parent aggregator platform.
- Inform the development of policy, market design and regulatory reform required to integrate DER in a fully functioning way in the market.

Practical elements of DER orchestration explored by Project Symphony will include:

- a map of responsibilities;
- control and communications protocols / processes between various parties, including the development and testing of Application Programming Interfaces (APIs)[27] for issuing deployment instructions to individual DER;
- capability of distributed consumer-grade hardware to meet performance standards necessary for real-time system security services;
- contractual relationships between customer and aggregator as well as between aggregator and market and between child to parent aggregators;
- identifying commercial and regulatory requirements;
- template contractual arrangements; and
- understanding financial and data flows.

Further information on Project Symphony will be announced as the project progresses, and comment on the project is not sought as part of this consultation.

3.3 New roles in the high-DER future

The DER Roadmap builds on work by the Open Energy Networks project (OpEN) exploring how DER can be integrated into energy markets, and the entities and relationships that are needed to achieve this.

OpEN modelled four different market frameworks for the integration of high levels of DER, and the OpEN Hybrid Model[28] has been used as the basis for developing a framework for the WEM.

[27] A set of functions and procedures allowing the creation of applications that access he features for data of an operating system, application, or other service.

[28] More information available at: https://www.energynetworks.com.au/assets/uploads/open_energy_networks_-required_capabilities_and_recommended_actions_report_22_july_2019.pdf

This position was taken based on analysis undertaken by OpEN on the costs of implementing the various models proposed, and on the characteristics of the power system and market in Western Australia:

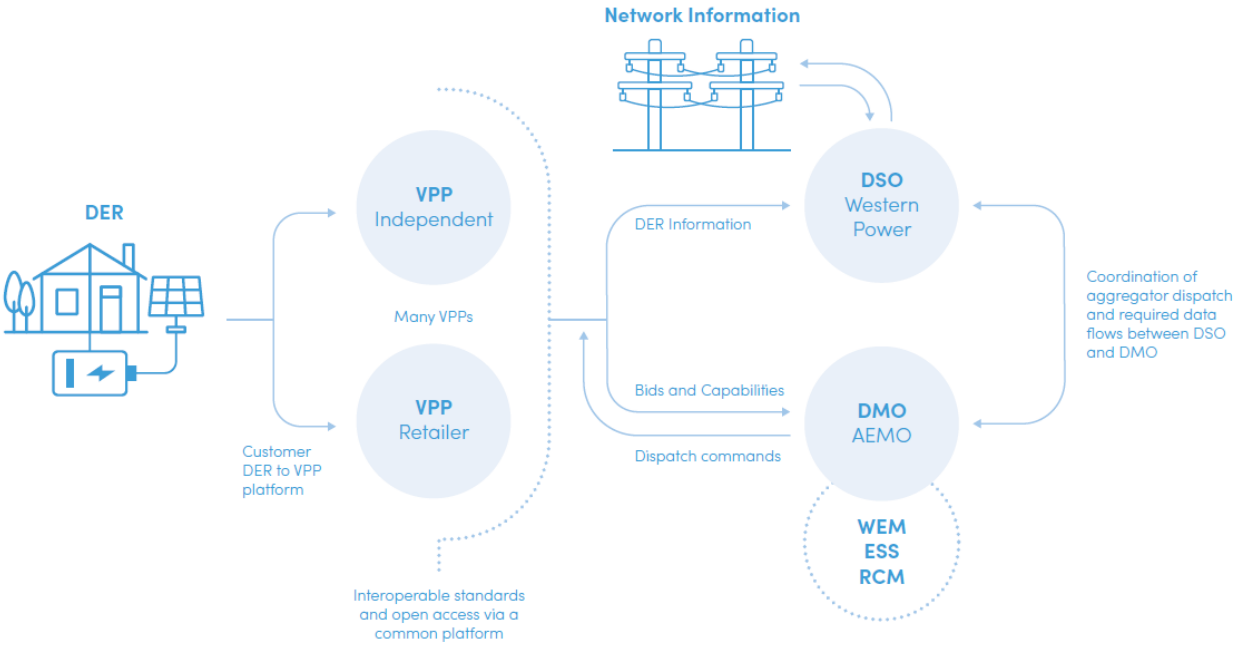
- There is only one network operator in the SWIS which operates at both the transmission and distribution levels. The creation of a separate, independent DSO to coordinate the distribution network would be inefficient as it would add costs and complexity.
- The small size of the SWIS (in terms of customer numbers) could limit the potential for a sophisticated network support services market.
- The small size of the WEM means that duplication of functions in a second market operator to issue dispatch requests to aggregators of distributed resources would add additional costs to electricity supply that are likely to exceed benefits.

The proposed implementation of the Hybrid Model in the SWIS will see the existing network operator (Western Power), and power system and market operator (AEMO) evolve to deliver expanded functions associated with a DSO and DMO respectively[29].

It is considered that changes would extend existing capability and not result in separate or distinct business units within these organisations.

Consideration needs to be given to how the role of retailers will change when the existing retail business model of providing energy based on high volume with low margin is eroded by the ability of customers to self-supply most energy needs.

Figure 3: A possible DSO/DMO model for WA



Under this model, the individual customers have a relationship with an aggregator (for instance a VPP provider), who may be an existing retailer, or a separate non-retailer energy services provider. In order to offer DER services into energy, capacity and / or ESS markets, aggregators will need to

[29] This approach was outlined at a high level in the *DER Roadmap*, pp. 44-45, available at: https://www.wa.gov.au/government/distributed-energy-resources-roadmap

become market participants, or partner with a market participant. Some aggregators may choose not to participate in the market but to only offer network support services.

Information about customer DER is passed from various aggregators to the DSO. The DSO takes this information and combines it with the information it receives from its enhanced network monitoring capability to map constraints and power quality across the distribution network. The DSO can use this information to procure network support services[30] from aggregated DER[31] where it is cost efficient.

This information, including information about DER which is providing ESS, is also passed to AEMO to help it understand the overall status of the power system, undertake forecasting and coordinate generation (and load) resources for dispatch in the wholesale market, and to manage system security.

The potential for a market for network support services provided to the network operator is being considered. However, the requirement to transition to a real-time market for these services (i.e. a real-time market for services to Western Power) will be assessed in the future, and the DER Roadmap does not envisage trials for this before 2024.

The full implementation of DSO, DMO and aggregator roles have several prerequisite actions, including:

- defining and allocating functions, roles, responsibilities and operational data sets;
- developing market, technical, customer and regulatory requirements;
- developing a market interaction hierarchy and dispatch philosophy for DER;
- developing an implementation plan for DSO, DMO and aggregator functions;
- developing improved inverter standards (specifically the communications capability component);
- greater visibility of the distribution network and DER capabilities / status;
- the deployment of AMI;
- demonstrating performance of DER under real operating conditions; and
- establishing commercial arrangements.

Many of these prerequisites are being addressed through other DER Roadmap actions or Energy Transformation Strategy work packages.

Where, through the experience of Project Symphony or other assessment, it is identified that there is a need to depart from or vary the implementation of the hybrid model to improve efficiency or reduce complexity for the SWIS, then that option will be taken.

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30 Network support services are services that aggregated DER can offer to the network operator. DER Roadmap Action 23 will implement changes to the *Electricity Networks Access Code 2004* (including the introduction of a new chapter 6A) that will improve the ability of Western Power to procure these alternative options. Further information can be found at https://www.wa.gov.au/government/announcements/energy-transformation-strategy-proposed-changes-the-access-code-open-public-comment

31 In some instances, it may be appropriate for the DSO (Western Power) to contract for network support services directly, for example with large commercial or industrial customer.

3.4 Whole-of-system optimisation

Whole-of-system optimisation in the presence of large volumes of *active DER* to deliver lowest-cost energy is achievable where power system operations can be co-optimised with the market.

This raises the question of how energy from DER should be captured in the existing market processes. Currently households and small businesses have the right to connect DER generation systems up to technical limits set out in connection agreements. Energy that is surplus to local need is usually automatically exported into the grid without regard for the wholesale market and can act as a market distortion. This is one of the driving factors behind negative pricing events at certain times of the year.[32]

As the volume of energy generated by DER grows, the level of demand served through the WEM will reduce, and should it reach a certain minimum level will start presenting very challenging system stability issues.

Constraining the output of DER is, of itself, not the long-term solution. The more efficient approach is to establish mechanisms for DER to compete with other forms of generation, including large scale renewables, to provide energy services to maintain the stability of the system. Incorporating and managing DER in the market pricing and dispatch processes should result in better whole-of-system optimisation and pricing outcomes.

Achieving whole-of-system optimisation requires coordination between:

- the DSO (Western Power) which uses the DSO platform to coordinate distribution-connected resources and resolve localised issues, for example distribution constraints, where they exist;
- the System Operator which holds the single Market Platform and uses its centralised dispatch system to balance total supply and demand; and
- the DMO as an extension of the current Market Operator function and which leverages the single Market Platform for the coordination of market processes. This includes the dispatch of registered facilities comprising aggregated DER, based on price offers and availability within the confines of network limits (distribution and transmission), and the settlement of these resources.

This level of co-ordination will also enable market participants, such as aggregators, to manage the complexity of delivering value to the market, network and their customers.

[32] AEMO, *Quarterly Energy Dynamics Q4 2019*, p. 37, and *Quarterly Energy Dynamics Q3 2019*, p. 34 https://aemo.com.au/energy-systems/major-publications/quarterly-energy-dynamics-qed

4. New Roles

This section contains information on the expected functions and roles of the DSO, DMO and aggregators as well as issues that need to be addressed.

4.1 Distribution System Operator (DSO)

A Distribution System Operator (DSO) enables access to the network, operates and develops an active distribution system comprising networks, generation, demand, and other flexible distributed energy resources (DER).

A DSO, with visibility of power flows, constraints and DER on the network, will be required to manage the network within technical limits, identify when network issues emerge and act to manage these issues in an efficient manner. To do this, the DSO will need to see the flow of power across the distribution network in real time.

Where an issue on the network emerges, the DSO can enter into contracts with aggregators which can provide network support services if such services have a lower cost than augmenting the network. Aggregated DER that provides a service to the DSO[33], and the consumers who own the individual DER components within the aggregation, would expect to be compensated for the network support services provided.

There is also a requirement to ensure DER interacts with the broader system (i.e. at a transmission system level) to avoid any action on the distribution network causing disruption. The DSO should create and publish 'Operating Envelopes'[34] that describe any constraints on the distribution network.

Where a transmission or distribution network issue has emerged, and a DER aggregator has been instructed to alleviate the issue, these instructions must be incorporated into communications between DSO and DMO to provide visibility for system operation and market purposes. This ensures that the power system at all levels remains secure at least cost.

As identified in the DER Roadmap, in the high-DER future, the DSO role is a natural extension to Western Power's role as the regulated monopoly distribution and transmission network service provider.[35]

It is efficient to augment and extend Western Power's functions in regard to network operations, planning and asset management into a DSO role to support the optimal use of active DER on the distribution network and delivery of secure, sustainable and affordable electricity as part of whole-of-system optimisation. Some of these responsibilities are extensions to the distribution network of activities already undertaken by Western Power at the transmission level.

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33 In some cases, larger DER may contract directly rather than via aggregation, for example very large commercial or industrial customers.

34 Operating envelopes indicate to customers the export and / or import limits that they must operate within for the safe and secure operation of the network. To update the envelopes, data needs to be collected in near real time. Algorithms are then executed to define the network state, based on the data. Constraints determined by these algorithms would then be communicated, based on standard protocols.

35 *DER Roadmap*, pp. 44-45, available at https://www.wa.gov.au/government/distributed-energy-resources-roadmap

Table 2: Proposed responsibilities of the DSO

	Responsibility
D1	Determine technical arrangements for the connection of DER.
D2	Review and approve connection applications for DER assets. This includes assessment of network capacity and requirements within a given area.
D3	Manage the commercial and technical control of DER connections, as allowed by the signed connection agreement and regulatory frameworks. Note - currently the commercial contract for connection to the network is via retailer as per linear contracting relationship.
D4	Collate information on DER and provide it to AEMO for the purposes of establishing, maintaining and updating a DER register. Note - the DER register will only gather static information when initially implemented.
D5	Develop static and/or dynamic constraint equations at the distribution level that describe the transfer limits of the network. Note - the depth of visibility required is still to be determined.
D6	Provide a static and/or dynamic operating envelope to aggregators/retailers/AEMO for all active DER (at the connection point). Note - the specifications of the dynamic operating envelope are yet to be developed.
D7	Plan, install and manage links to aggregators/retailers/AEMO to disseminate information about the static and/or dynamic operating envelopes at a specific location or interface.
D8	Create and/or administer systems, such as a DSO Platform, to enable the visibility of power flow across the distribution network, and to provide visibility of, and means of managing, issues on its network in real time when they emerge. This will also support the DSO where distribution network issues have emerged, and an aggregator has been engaged by the DSO to alleviate the issue. The consequential actions must be addressed by the System Operator (AEMO) as part of whole-of-system operation. This will ensure the power system at all levels is securely and reliably operated and maintained.
D9	Develop processes within the DSO platform that allow the network operator (DSO) to request network support services where needed and available to meet network support requirements.
D10	Provide information on the deployment of network support services to allow the Market Operator (DMO) to consider the impact of these services on the broader power system.
D11	Planning network investments that deliver economic benefit.

4.1.1 DSO issues and policy questions

The following issues have been identified as related to DSO functions.

- **Network Monitoring -** Consideration of the need for network monitoring devices at critical points of the network over and above any network visibility provided by advanced meters.

The cost and benefit of deep visibility versus representative sampling should form part of this consideration.

- **Platform Development -** Evaluate what type of platform(s) and interfaces would be required between the network operator, market operator and aggregators.
- **Operating Envelopes -** Regarding the communication of operating envelopes, consideration needs to be given to its implementation and content, for example:
  - What is the most appropriate instrument to define it (e.g. Technical Rules)?
  - For which parties is the information intended (e.g. aggregators, AEMO)?
  - What level of detail is required (e.g. NMI, zone substation)?
  - What frequency is required (e.g. every 5 minutes)?
- **Procurement -** Transparency around the processes and appropriate market interactions when a DSO obtains network support services needs to be considered.
- **Network vs private assets -** Transparency around the interaction of network-owned assets and third-party aggregator schemes providing constraint relief needs to be considered.
- **DER access and connection agreements -** Agreement needs to be reached on the level of access able to be provided, the contracting arrangements for such access (noting the current linear contracting relationship[36]) and the need for dynamic connection agreements[37] (including how DER, subject to dynamic connection arrangements, will be operationally discharged via aggregators).
- **Dynamic connection agreements -** Agreement needs to be reached on the scenarios and contingencies that a dynamic connection agreement will cover, the interaction between the DSO and DMO when such contingencies occur, and the role of the aggregator.
- **Capacity market -** The interaction of aggregated dynamic connection agreements and the capacity market needs to be considered.
- **Network charging -** Requirement for specific use-of-system charges for bi-directional customers needs to be examined. Some jurisdictions have raised concerns about the disparity between grid scale generators and DER in terms of how access is provided and charged for.[38] However, by far the majority of DER is co-located with small-use customer load and these customers already contribute to network costs as part of existing distribution tariffs, noting that network tariffs associated with small-use customers are currently structured differently to large connections and are averaged across the customer base.
- **Equity in curtailment -** Consideration needs to be given to ensure that DER which is managed directly is not unfairly disadvantaged. Currently there are no guidelines or processes to assist aggregators in treating all DER providers equitably. There is also a need to ensure that non-contestable customers are treated fairly.
- **Reliability and market services -** It should be considered how the hierarchy of DER response can be governed (e.g. network needs first, market second).

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[36] In the WEM, for most electricity consumers, the retailer holds the access contract with the network (Western Power) on behalf of customers. This is known as a linear contracting relationship, as distinct from the NEM where customers have a direct contractual relationship with the distribution network operator.

[37] Dynamic Connection Agreements (DCAs) are the mechanism through which dynamic limits can be implemented, unlocking benefits for customers, networks and other parties. deX, *Application and deployment of Dynamic Connection Agreements for distributed energy resources (DER),* p. 6, available at: http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/GreenSync%20attachment%20deX%20Discussion%20Paper%20-%20Dynamic%20Connect%20Agreements%20%28DCAs%29.pdf

[38] Further exploration of this issue can be found at: https://arena.gov.au/knowledge-bank/deip-access-and-pricing-reform-package-outcomes/

- **Understanding autonomous responses -** Separate work is underway to improve autonomous inverter functions (e.g. volt-watt, volt-var, frequency-watt). Devices with these capabilities will respond regardless of operating envelope or communications availability. The DSO will need an understanding of the level and effects of these responses and include these outcomes in how it manages the network.
- **Communications infrastructure and common communications protocols -** These will be important for visibility, orchestration and management of connected devices and disseminating information to aggregators. Consideration is needed of required availability, performance, and end-to-end response times (e.g. latency) of device response to meet network use cases.
- **Communication standards -** Consideration needs to be given to where standards associated with communication interfaces should be located (i.e. Australian standards, connection agreements, technical rules or another instrument).
- **Communications reliability -** Consideration needs to be given to times when there may be a disruption to the communications network that is used by DER, i.e. how will a high DER network / system be managed in the event communications are reduced or unavailable. This issue also applies to the DMO.

Question D1: What processes or arrangements should be used or created to register an aggregator that provides network support services to the DSO (Western Power)?

Question D2: Should different 'use of system' charges apply for DER customers? If so, how should the costs and benefits of DER be accounted for?

4.2 Distribution Market Operator (DMO)

A market operator that is equipped to operate a market that includes small-scale devices aggregated and able to be dispatched at appropriate scale.

In the SWIS, AEMO as the Market Operator schedules, dispatches and settles the Wholesale Energy Market and its various components including energy, ESS and reserve capacity. When DER is participating in the market to provide these services, AEMO would be co-ordinating the dispatch of the aggregated DER in line with the participation requirements of the market, along with larger-scale registered facilities. This ensures the security and reliability of the whole electricity system and enables co-optimised dispatch, inclusive of aggregated distribution-level DER.

As installations that can provide network support services become more widespread, there may be the need to create a market for the provision of network support services. As the role of DER evolves in the energy market, the DMO would:

- administer platforms to enable access for aggregators to the wholesale markets for energy, capacity and ESS;
- operate and manage the platform to ensure that participants meet market participation requirements and provide information transparency, scheduling and dispatch, and market settlement; and
- interface with the DSO to ensure distribution network issues are resolved in an efficient and coordinated manner.

Importantly, a market operator is independent of any market participant, network operator or resource owners so that:

- the market is operated in a manner that is fair and impartial;
- DER (and other resources) can be utilised in the most efficient manner; and
- all trading (including any off-market third-party activities) at the distribution level is aligned with the market, and power system security and reliability objectives.

For clarity, there is no intention to create a second coordinated market specific to DER for the provision of energy or ESS at the distribution level: i.e. the existing market will not be split into transmission and distribution level markets, which is the IDSO model outlined by OpEN[39].

In the SWIS high-DER future, managing offers from aggregated DER into the wholesale energy market is a natural evolution of AEMO's role as market operator.

The DMO functionality is an extension of the existing wholesale market optimisation. This extended functionality facilitates the efficient operation of the market by integrating the dispatch and settlement of DER to maintain the security and reliability across the electricity system.

Participation in the WEM comes with many obligations, from regular facility testing to prudential obligations. Incorporating DER will require changes as many of the existing processes are not designed to apply to facilities that are aggregated collections of small size resources.

Work being undertaken by the Energy Transformation Taskforce to update the registration and participation framework in the SWIS, contemplates DER participation and enables greater flexibility in the provision of WEM services. Market participants can register one or more facilities with each facility having a classification and being of one or more sub-types.[40]

Even with the proposed changes, incorporating aggregated DER into existing market registration classes will require further work. For example, the existing demand side programme facility class, comprising larger aggregated commercial and industrial customers, is set up to address peak requirements through the reserve capacity mechanism. It is anticipated that in the future this service could also be provided by aggregated distribution connected storage as well as aggregated response from household and small business DER.

The Energy Transformation Taskforce *Information Paper: Energy Scheduling and Dispatch*, highlights that under the security-constrained economic dispatch model (SCED) to be implemented, information about the location of generation is essential. For larger generators, AEMO can easily identify the network connection point where power will be injected into the system (or in the case of a large-scale battery or load, withdrawn).

Identification is more complicated for aggregated DER as it could be connected at multiple points. Existing guidelines for aggregation assume the aggregation of relatively large facilities that are co-located. While aggregated DER remains small, its impact on the system would mean that location is less important. However, as the size of the resources under aggregation grows, it is likely to become necessary to understand where on the network that DER is located and factor this into scheduling and dispatch processes.[41]

Aggregated DER may have greater effects on the distribution network if it is dispatched in a small geographic area, which would increase the importance for the DSO (Western Power) to know which DER 'facility' was being dispatched.

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[39] See EA Technology *Open Energy Networks Project report*, pp. 16-18, available at: https://www.energynetworks.com.au/resources/reports/ea-technology-open-energy-networks-project/

[40] Energy Transformation Taskforce *Registration and Participation Framework in the Wholesale Electricity Market,* p. 13, available at: https://www.wa.gov.au/government/document-collections/taskforce-publications

[41] The discussion here on demand side response has many parallels with proposed SCED arrangements. Energy Transformation Taskforce *Energy Scheduling and Dispatch Paper,* pp. 66-67 available at: https://www.wa.gov.au/government/document-collections/taskforce-publications

This will ensure that AEMO and the DSO are able to have certainty around the capabilities of each aggregated DER facility or VPP and how it will affect the transmission and distribution system.

It is worth noting that the Energy Transformation Taskforce has already endorsed some relevant market design decisions associated with market registration of aggregated DER:

- Minimum threshold for registration of aggregated DER facilities – "The nameplate rating of a DER facility will be defined as the maximum injection capability of the facility if all generating components were generating at full capacity with no load."[42]
- Definition of electrical location for aggregated DER facilities – "For DER facilities, the electrical location is the relevant zone substation (TNI) that the distribution network containing the DER facility is connected to in normal network configuration."[43]

Table 3: Proposed responsibilities of the DMO

	DMO Responsibility
M1	Leverage and / or administer a market platform(s) to enable generators, customers, aggregators and other third parties to access value in the energy market, the Reserve Capacity Mechanism, Essential System Services (such as frequency control) and network control services that may be required in the future.
M2	Register aggregators and aggregated facilities for the purposes of market participation and provision of services (such as network control services) under the WEM Rules.
M3	Ensure that registered market participants meet participation requirements under the WEM rules; e.g. meet appropriate testing, prudential, and technical requirements.
M4	Co-ordinate with the DSO and aggregators to dispatch active DER in the market.
M5	Operate and manage the wholesale electricity market platform(s) to enable settlement inclusive of services provided by aggregated DER in the WEM. Note - the exact requirements for metering and settlement to be determined.
M6	If / when a centralised market for network support services is established, settlement of DER dispatched to provide network support services.
M7	Providing information to the DSO (Western Power) on opportunities for investments within the distribution network which would alleviate constraints that may deliver market benefit.

4.2.1 DMO issues and policy questions

The following issues have been identified as related to the operation of a market that includes DER:

- **Local conditions on the distribution network are dynamic -** They alter in response to weather patterns (cloud cover), or changes in load – people coming home from work in the evening and / or changes in local commercial and / or industrial electricity use. Publication of operating envelopes / downstream DER availability by the DSO will help DER providers and AEMO to

[42] Energy Transformation Taskforce *Registration and Participation Framework in the Wholesale Electricity Market,* p. 18, available at https://www.wa.gov.au/government/document-collections/taskforce-publications

[43] Ibid, p. 19

better understand local distribution conditions and how these will affect dispatch of resources and wider system constraints.

- **Market registration -** Given the rapidly changing capabilities of DER, consideration needs to be given to how aggregated DER is registered in the WEM. Existing classifications may not be suitable, noting that some work has already been undertaken in this area.

- **Capturing DER generation in energy markets -** Currently energy generated at small customers premises, particularly that purchased by Synergy (under REBS and other purchase agreements) but also by other contestable retailers, is settled outside the WEM. It is not offered and dispatched in accordance with market processes or need and does not reflect the market price of energy at time of generation. This acts as a distortion in the WEM and limits the ability of customers to participate in markets. Synergy is forced to absorb the financial implications of any net imbalance associated with this 'spilled' energy. Growth forecasts for rooftop solar PV are such that total generation from this source, in the absence of significant investment in storage, new loads or other actions, could exceed underlying demand on some days before the end of the decade.

- **Facility visibility -** For services provided by large generators, there are resilient and high-quality communications and metering in place (via SCADA) that provide AEMO with visibility of whether and how generators are responding to dispatch instructions. In the absence of a high-resolution facility meter, and appropriate communications, AEMO may have no certainty that aggregated platforms have provided the requested services. Consideration also needs to be given as to how aggregated DER can be metered and settled in accordance with existing timeframes, including adjustments that may occur over weeks or months. Alternative arrangements may need to be evaluated.

- **Capacity market -** The capacity market requires that participants undergo regular testing to ensure that facilities can meet performance obligations. Applying the existing processes to DER is not practical. However, AEMO needs to have certainty that aggregated facilities can deliver on their promise. Consideration needs to be given to how or whether this can be achieved at a reasonable cost

- **Meter Data -** To enable third-party aggregation or service provision, greater access may be required to customer meter data. This raises the need to resolve issues around the provision of metering data to multiple parties. This topic is explored in more detail in section 6.

- **Distribution loss factors -** Loss factors are normally applied to generators or large loads to account for network line losses between the location of electricity generation and consumption. Energy associated with distributed resources is usually near load and can address local power issues such as voltage. This raises the question around how loss factors should apply to aggregated DER. Consideration needs to be given to how transferrable existing processes related to loss factor application are to a VPP or aggregated facility which consists of many small distributed resources.

- **Communications infrastructure and common communications protocols -** These are important for visibility, orchestration and management of connected devices and disseminating this information to aggregators. Decision needs to be made on the most appropriate regulation instrument, i.e. Australian standards, connection agreements, technical rules or another instrument.

Question M1: Taking into consideration how the future registration of aggregated DER is outlined in the *Registration and Participation Framework in the Wholesale Electricity Market* paper, are additional changes required to incorporate aggregated DER in the WEM?

Question M2: Should energy exported from DER be more explicitly integrated into the WEM?

Question M3: Monitoring and compliance for participation in energy, capacity and ESS markets need to be considered for aggregated DER. How should aggregated DER be monitored and measured for compliance?

Question M4: What performance standards should apply to aggregated DER facilities?

Question M5: Are any additional arrangements needed to incorporate aggregated DER facilities into the new scheduling and dispatch process (SCED)?

Question M6: Other than for device level communications, what other communication is required to manage aggregated DER? For example, communications between the aggregator and the DSO (Western Power) or AEMO.

4.3 Aggregators

A party which facilitates the grouping of DER to act as a single entity when engaging in markets (both wholesale and retail) or selling services to the DSO (network operator).

The management of active DER systems will require them to be communications enabled, typically via a customer's home internet, although there may be benefits in using some of the functionality of the communications network put in place by Western Power as part of its AMI rollout.[44] In most cases, it is expected that active DER installations will be managed by aggregators on a simple 'set and forget' basis.[45]

It is not expected that small-use customer DER will be participating directly in markets, but that their participation will be via an aggregator. Larger customers with DER may choose to register as a market participant directly. The experience with demand side aggregation services[46] is indicative of how larger customers may approach aggregation of other forms of DER.

Aggregated DER is often referred to as a 'Virtual Power Plant' or VPP. Aggregators are expected to develop portfolios of DER under contracts with DER owners and may be able to provide a range of services to the energy system. These services include:

- energy offers in the WEM;

[44] Enabling suitable functionality within AMI may require upgrades to the communication infrastructure.

[45] Grid Impact, offered by Powershop in the NEM, is an example of a 'set and forget' consumer product that uses aggregated DER to provide market services. More information available at: https://www.powershop.com.au/join-grid-impact/

[46] Demand Response is a resource which can currently be offered the Reserve Capacity Mechanism. Given the growing ability and need for DER to provide upward as well as downward demand response, there is no real rationale for defining demand response as a distinct service or limiting access to the capacity market for smaller DER under aggregation, including the export of energy from storage, if it can meet technical requirements.

- ESS (frequency control, system restart)[47] in the WEM, where DER's cost for providing these services can compete with that of traditional providers (generators and interruptible loads);
- demand-side management for the provision of reserve capacity in the Reserve Capacity Mechanism[48] or to reduce customer bills; and
- network support, i.e. voltage support or local distribution peak shaving, where this is more economic than network augmentation.

In the first instance[49], existing retailers are ideally placed to enable active DER participation due to their direct relationship with customers who have already invested (or will invest) in DER. This may be in partnership with a third-party equipment supplier or energy services provider.

Operators of larger embedded networks[50] where there is the potential for coordinated DER could contract with retailers or participate in the existing WEM markets (capacity, energy and ESS) directly if they see value.

Alternatively, an aggregator might be a third-party, such as the operator of a VPP or another energy services provider, a party other than the customer retailer.

At the interface between customers with DER and energy markets, aggregators will be responsible for developing products that appropriately compensate customers for the use of their DER commensurate with the market value of the services.

Consideration needs to be given to whether and how these new energy services to customers should be regulated.

Given that the retailer currently holds the network access agreement on behalf of small-use customers, where third-party aggregators want to participate in the market for the supply of DER services there will need to be a mechanism that enables an allocation of proportional costs, responsibilities and obligations associated with this network access to third-party aggregators. It also raises the question of how the impact of the operation of aggregated services could be metered and settled.

Table 4: Proposed responsibilities of the Aggregator

	Aggregator Responsibility
A1	Aggregate, monitor and manage a portfolio of individual DER via customer contracts.
A2	Develop and maintain appropriate systems for information gathering and to support management of contracted DER.
A3	Enter into bilateral contracts with the DSO (Western Power) for provision of network support services.

47 System restart using DER is further complicated where the communications network is dependent on external power.

48 Noting further work is required before aggregated DER can be included in the Reserve Capacity Mechanism.

49 WEM Rules could be changed to allow 'multiple trading relationships', whereby a customer can benefit by offering services to the market via an aggregator while retaining a relationship with its Retailer for energy supplied to it though the grid, although this may not be straightforward to implement. Changes may also be required within Western Power's Applications and Queuing Policy.

50 Embedded networks are private electricity networks which may serve multiple premises and are located within, and connected to, a distribution or transmission system through a parent connection point (and an associated "master meter"). It also buildings with multiple occupants such as shopping centres or apartment buildings.

A4	Submit offers to AEMO for provision of market services by aggregated DER.
A5	Respond to instructions as per contractual agreements within the market or by the DSO in line with applicable Operating Envelopes. Note - An aggregator may perform optimisation of DER within its portfolio.
A6	Develop customer products and contracts that reflect adequate compensation for market services (including energy) or network support services and apply appropriate customer protections. Note - whether multiple parties can contract with a single customer for different services need to be resolved.
A7	Managing DER to provide customer services.

4.3.1 Aggregator issues and policy questions

The following issues have been identified as related to aggregators.

- **Contestability -** In the SWIS, government policy has been to regulate energy prices for most small-use customers using below 50MWh of energy per year with Synergy as the sole retailer. However, providers of aggregation services to small-use customers would effectively disrupt the intent of these policies.[51] Consideration needs to be given to how the current government policy should apply to aggregation services provided to small-use customers who are covered by this policy.

- **Customer choice of aggregator -** Aggregation of customer DER will require improvements in the capability of DER behaviour to be modified remotely. This is captured in work under the DER roadmap actions two and three. Where a technology solution is put in place by an aggregator to achieve this capability, consideration needs to be given to ensuring that contestable consumers are not effectively locked-in to that aggregator (or retailer providing aggregation services) through contractual obligations or proprietary equipment.

- **Regulation of new business models -** Currently there are no regulatory frameworks that apply for aggregation of DER. For example, there is a need to consider the relationship of VPP operating within embedded networks or microgrids with retailers and to ensure that appropriate customer protections are in place. DER Roadmap actions 34 and 35 that relate to new business models will explore some of the issues associated with this and work is already underway as part of the EPWA licencing and exemptions regulatory review to understand what a new framework may look like. [52]

- **Access to meter data -** Even once appropriate regulatory arrangements are in place to cover new business models, such as third-party aggregators, there are currently limitations on these businesses' access to customer meter data.

    - Meter data is currently gathered by Western Power for most small-use customers[53] (contestable and non-contestable). Consideration needs to be given to whether there is a need to improve access by third parties and customers to this data and how it can be

[51] See https://www.plicoenergy.com.au/ as an example of an alternative energy services provider in Western Australia.

[52] More information available at: https://www.wa.gov.au/organisation/energy-policy-wa/review-of-licensing-and-exemption-regulatory-framework

[53] Western Power does not always gather or hold meter data for customers within embedded networks but holds the information for the master meter at the point of network connection.

done, noting that the historic data already provided by Western Power[54] may not meet emerging needs.

- Western Power's AMI deployment will initially capture customer energy imports and exports on a 30-minute basis. This capability could be upgraded in the future to allow for 5-minute data but will have cost implications for communications as well as data storage at the meter and within Western Power and Aggregators.
- Other methods of capturing customer data, including behind the meter data on DER operation. currently exist as part of solutions provided by third parties[55], but this information is not suitable for billing or market settlement purposes.

Question A1: What aggregation options or models could deliver the most efficient outcome for the system and consumers?

Question A2: Are there any current barriers to DER aggregation? If so, what are they and how could they be overcome?

Question A3: What should be the key elements of a regulatory framework for aggregation?

Question A4: Should aggregators be able to participate in all WEM market segments in order to stack the value of available DER services?

Question A5: Have stakeholders experienced difficulties in accessing consumer meter data for the purpose of providing DER services? If so, what were those difficulties and how did they limit opportunities to unlock the value of DER?

[54] More information available at: https://westernpower.com.au/faqs/metering/metering-data/as-a-third-party-entity-can-i-retrieve-metering-data-for-a-customer/

[55] For example, https://www.solaranalytics.com/au/how-it-works

5. Customers

Customers consume electricity as an end product and are the reason that all other segments of the energy supply system exist.

Customers are at the heart of the electricity supply system and have traditionally been the recipients of one-way flows of energy. Their impact on supply has, until recently, been limited to voluntarily change in the timing or level of their demand.

With the rise of DER, particularly the installation of rooftop solar PV and increasingly behind the meter storage, customers are no longer passive consumers. They have also become passive suppliers of energy into the system. The combination of thousands of micro-generators can, as is clearly evident in the SWIS, have significant effect on the grid, other users and larger power generators.

The DER Roadmap outlines a plan to unlock the potential for DER to move from a fleet of passive micro-generators into active and coordinated participants. This new regime will for the most part apply to new DER installations[56], but in some instances existing installations could be upgraded. For many customers, especially those with DER, this will mean changes to how they have interacted with the electricity supply system to date.

Historically in the SWIS, for most small-use customers the only choice around their energy use was whether to turn a switch on or off. In a high-DER future many more choices will be available even without any change to the contestability threshold.

In creating opportunities for customers to engage with energy markets and to provide services from their DER, decisions will need to be made around how energy is used within their homes and businesses. What type, size and configuration of DER is best for their needs? Do they buy it outright or enter into an energy services arrangement? Should locally generated energy be used now or stored for later? What services can they offer to the network operator or markets (via aggregation)?

New business opportunities will become available to guide customers and to provide them with energy services. It is anticipated that the traditional relationship a customer has with equipment installers and retailers will also evolve as the role of aggregation matures.

Importantly, customers may choose not to participate in an aggregation scheme, but to simply use DER for their own needs. It will be important to allow this choice while still giving the network and system operators the capability to manage DER at times of network or system stress and emergencies. The DER of customers who choose not to participate in aggregation will still need to be visible to the DSO and Market Operator for forecasting purposes[57] and it will still need to respond in an emergency either by autonomous action or at the request of the system operator or the DSO.

Consideration needs to be given to whether customers who choose not to participate in aggregation need to have limits placed on their ability to export energy, in order to manage the impact on the system. This is in addition to the autonomous inverter settings being implemented under the DER Roadmap (in coordination with national actions on DER standards) and will become increasingly important if large volumes of DER remain outside aggregation.

[56] Technical capabilities of existing installations are likely to limit the ability to participate in aggregation without upgrades.

[57] The behaviour all DER, even that which is not exporting can still influence the electricity system when considered in large numbers.

As networks become more saturated with DER, it is anticipated that the way retail customers export energy generated from distributed solar PV systems will need to be examined, just as large generators are expected to respond to network constraints[58] and market signals.

To ensure greater equity of access to DER there may be a need to communicate to customers the need to act as 'good citizens'. Just as people don't drive on the footpath when roads are busy but reduce speeds, there may be a need to accept dynamically adjusting exports from DER at peak solar PV generation times to ensure that more DER can be connected overall. In this way, no customer would unreasonably be prevented from installing DER to reduce their energy costs because of network capacity allocation being taken up by connections which 'got in first'.

Issues of equity are explored further in section 6.

However, just as the road networks are expanded or augmented when they become too congested, the network operator should still have incentive to invest in new capacity and not overly resort to constraining distributed generation.

Question C1: Should a customer with new or upgraded DER be required to participate in an aggregation scheme to mitigate the risk of a significant proportion of DER in the SWIS remaining 'passive'? If yes, what should be the trigger for such a requirement? If not, why not?

Question C2: What provisions need to be made for customers who make the choice to participate in aggregation services, for example to limit their energy export while enabling them to use their DER for their own purposes?

Question C3: If the application of dynamic operating envelopes results in temporary limits on customer DER exports, what measures should be put in place to ensure that this does not unnecessarily limit DER output in preference to other alternatives such as load management or other generation sources?

That is, what criteria should apply to the network operator's assessment of when to undertake a network enhancement to remove constraints that prevent the export of DER energy and to maximise the ability of small DER owners to participate equally with other energy resources?

[58] In line with the future market design under constrained access.

6. Other Issues

This section talks to issues that are related to the establishment of a DSO, DMO and Aggregators but require more detailed discussion.

6.1 Multiple trading relationships

Traditionally in the SWIS it is the retailer who manages the energy supply arrangements with electricity consumers on the distribution network, including the provision of customer protection requirements (such as ombudsmen schemes, etc). As noted in section 4.3, aggregated DER provided into the WEM by parties that are not the retailer may require new regulatory arrangements. In addition to this, metering and settlement arrangements do not contemplate having multiple parties transact at a single connection point (for example, having one party responsible for supply to the customer, and potentially another party responsible for energy exported to the grid). This concept is typically referred to as 'Multiple Trading Relationships'.

This raises the question whether there is a need to establish the ability to have trading relationships between a customer and multiple service providers.

Historically, there is some precedent for this in the WEM with commercial and industrial demand side programs being managed by third parties who participated in the capacity market and had contractual arrangements with customers to request changes to their energy consumption separate from retail supply arrangements.

Question G1: Would aggregated DER providing services into the WEM require changes to metering and settlement arrangements?

If so, how could this be implemented without multiple meters at a customer site and the associated costs?

6.2 Equity of DER dispatch

There are two main issues related to the equity of DER dispatch.

1. Customers who own DER should have access to, and are not unreasonably restricted from, providing services to the market.
    - There is a risk that an aggregator may limit customers' ability to participate in an aggregation scheme, for example by selecting only those who have favourable load profile or other technical or location characteristics.
    - This could mean placing an obligation on Synergy to make available a basic level of aggregation service for all new DER connections that are configured to export power into the grid. This would be similar in concept to the default retailer and deemed contract concepts under the *Electricity Industry (Customer Contracts) Regulations 2005*.

Question G2: How can we ensure equity of access of DER to markets? That is, how can the greatest number of customers be allowed to install DER and provide services, if they choose? How could this be implemented?

Question G3: As tariffs (import and export) and other incentive mechanisms evolve to consider active DER, is it reasonable to require that, where practicable, non-contestable customers can access services provided by aggregators? If so, how could this be achieved?

2. When customers are participating in an aggregation scheme, there is a risk that the aggregator may call upon customers or groups of customers disproportionately more or less than others.
    - This could result in disproportionate impacts for groups of customers. It could result in greater wear and tear on customer equipment beyond the level they are being compensated for or result in windfall gains as compared to other similar customers. This is a bigger concern for households or small businesses that may not fully understand how their DER equipment is being used.

Question G4: Should there be guidelines or rules around how DER within aggregator schemes, other factors being equal, are dispatched?

6.3 Emergency conditions

Separate from voluntary participation in aggregation, the DSO and AEMO have a need to be able to modify the behaviour of customer DER in emergencies (where there is a threat to safety, stability or security at a local or system level).

For example, a storm or bushfire may result in the need to change the way that certain DER behaves in order to prevent outages or prevent unsafe conditions. It could also include turning off some DER generation while maintaining load as part of controlled restarts following outages. This need could be managed locally or apply across the whole system.

The WEM Rules provide AEMO the power for this intervention in emergencies[59], and Western Power has an existing obligation to ensure the safe operation of the network. These provide the authority to act, but consideration needs to be given as to how this is put into effect.

Question G5: Should the DSO (Western Power) or the System Operator (AEMO) be able to issue instructions directly to end-user DER in the presence of a network reliability risk or system security risk, or should all instructions come via an aggregator?

6.4 Dispatch of Western Power assets and contracts

Section 3 briefly identified that there is a need to clarify which entity has the responsibility for dispatch of assets (such as batteries) owned by Western Power.

[59] Wholesale Electricity Market Rules 3.4 and 3.5, available at: https://www.erawa.com.au/rule-change-panel/wholesale-electricity-market-rules

While amendments to the *Electricity Industry Act 2004* and *Electricity Networks Access Code 2004* are being made to better facilitate Western Power's utilisation of storage and other alternative services, it is not envisaged that Western Power would be using these assets to participate directly in markets. This is in line with existing restrictions on Western Power.

Where these assets are leased to a third party, such as an aggregator, this third-party might offer services, such as energy or ESS, into the market. This would be resolved by partitioning the DER capability and allocating it separately for network use and market access. Only the portion of the asset associated with providing network support would be included within the regulated assed base. This is the approach taken under proposed access code changes.

A potential conflict may emerge where a threat to system security, for example low operational load, can be resolved by either the DSO using owned or contracted DER assets or by the System Operator dispatching ESS.[60] Clarity is needed on who has responsibility for resolving these types of issues.

Any use of DER by the DSO should be for the purposes of addressing specific network needs and should not replicate services that can, or should, be provided via the WEM.

Views are sought on who should have the responsibility for dispatch of assets owned by Western Power, such as batteries, to address system support needs.

Question G6: Who should be responsible for the dispatch of DER owned by Western Power to address network support needs?

[60] While no ESS currently exists in the WEM to address low load conditions there will likely be the need to create one. AEMO has flagged the need for a 'Demand Recovery Reserve' in South Australia to address this problem when the South Australian grid is islanded in conditions like those anticipated to be faced by Western Australia in coming years. *Minimum operational demand thresholds in South Australia* p5

7. Next steps

The high-level milestones are as follows:

- Public consultation and virtual industry forum (August 2020)
- Initial position paper and implementation plan for DSO / DMO / Aggregator (December 2020 / January 2021)

Glossary

Term	Definition
Active power	The power which is actually consumed or utilised in an AC Circuit is called True power or Active Power or real power. It is measured in kilo watt (kW) or MW. It is the actual outcomes of the electrical system which runs the electric circuits or load.
AMI	Advanced Metering Infrastructure AMI typically includes smart meters (that measure bidirectional energy flows, in shorter time intervals), upgraded communications networks (to transmit large volumes of data), and requisite data management systems.
Aggregator	A party which facilitates the grouping of DER to act as a single entity when engaging in power system markets (both wholesale and retail) or selling services to the system operator(s).
API	Application Programming Interface A set of functions and procedures allowing the creation of applications that access he features for data of an operating system, application, or other service.
Behind the meter	Any technology located on the customer's side of the customer-network meter.
Contestable Customers	Customers that consume greater than 50MWh of electricity per annum, who can choose their electricity retailer.
DER	Distributed energy resources, or 'DER', are smaller–scale devices that can either use, generate, or store electricity and form a part of the local distribution system, which serves homes and businesses. DER can include renewable generation, energy storage, electric vehicles (EVs), and technology to manage load at the premises. These resources operate for the purpose of supplying all or a portion of the customer's electric load and may also be capable of supplying power into the system or alternatively providing a load management service for customers.
DERMS	Distributed Energy Resource Management System The software or platform which facilitates the coordination of DER. DERMS can receive information and send instructions to DER, which can enable load and voltage management or other services.
Dispatch	Dispatch refers to the instructions from AEMO to generators delivering power to the system. Dispatch instructions are provided in the form of generation, timing and ramp rate information. AEMO dispatches generation with consideration for the prices offered by generators, network limitations, and system requirements.
Distribution Storage	Storage attached in directly to the distribution network as distinct from storage connected behind the meter at a customer site.
DMO	Distribution Market Operator A market operator that is equipped to operate a market that includes small-scale devices aggregated and able to be dispatched at appropriate scale.

DSO	Distribution System Operator A Distribution System Operator (DSO) enables access to the network, securely operates and develops an active distribution system comprising networks, demand, and other flexible distributed energy resources (DER). Expanding of the network planning and asset management function of a DNSP, the DSO enables the optimal use of DER of distribution networks to deliver security, sustainability and affordability in the support of whole system optimisation.
Embedded Network	Embedded networks are private electricity networks which may serve multiple premises and are located within, and connected to, a distribution or transmission system through a parent connection point (and an associated "master meter"). It also buildings with multiple occupants such as shopping centres or apartment buildings.
ESS	The term Essential System Services (previously referred to as Ancillary Services) capture all services needed to maintain power system security and reliability.
EV	Electric Vehicle.
Franchise customer	In the SWIS Synergy is the sole retailer for small-use non-contestable customers that are not within an embedded network or microgrid (for example in an apartment or caravan park).
Frequency response	Primary frequency response is available relatively quickly to arrest the rapid decline of frequency and establish a temporary stable operating state. Secondary frequency response is characterised by system-wide control, typically through coordinated changes to the setpoints of multiple facilities.
Front-of-the-meter	Any infrastructure located on the distribution network side of the customer meter (i.e. not behind the meter).
Hosting capacity	DER hosting capacity is defined as the typical amount of DER that can be connected to a distribution network without requiring network augmentation while the network (and the electricity system as a whole) remains within its technical limits.
Microgrid	Small-scale power grids that can either operate independently of a main electricity network or complement it to improve reliability.
Network constraints	When a section of an electricity network approaches its technical limits.
Network Support Services	Services provided to the network operator to assist in maintaining stable and safe network operations.
Non-contestable Customers	Non-contestable customers are those customers on the SWIS who consume 50 MWh or less of electricity per annum and includes most residential households and small businesses in Western Australia. Synergy is the only electricity Retailer able to supply non-contestable customers directly connected to the Western Power network.
Operating Envelope	Operating envelopes indicate to customers the export and/or import limits that they must operate within for the safe and secure operation of the network. To update the envelopes, data needs to be collected in near real time. Algorithms are then executed to define the network state, based on the data. Constraints determined by these algorithms would then be communicated, based on standard protocols.

NSP	Network Service Provider.
PPA	Power Purchase Agreement.
REBS	Renewable Energy Buyback Scheme.
SCADA	Supervisory Control and Data Acquisition, a computer system for gathering and analysing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation.
Solar PV	Solar photovoltaic generation systems.
SWIS	South West Interconnected System.
System restart	System Restart Service allows parts of the power system to be re-energised by black start equipped generation capacity following a full (or partial) black out.
Time-of-use tariff	A retail tariff structure that includes different variable charges for energy depending on the time of day the energy is consumed by the customer.
Under-Frequency Load Shedding	UFLS schemes are emergency mechanisms that are designed to arrest a fall in frequency.
Volt-watt response	The volt-watt response mode reduces the inverter power output when needed in order to prevent exceeding the voltage limits. If this mode is not enabled the inverter may experience frequent nuisance tripping when the network is lightly loaded.
Volt-var response	Volt-var function smooths the grid voltages by using the customer's inverter to absorb reactive power from the grid when voltage levels rise. Further to this, when voltages fall below (V2) 220V, the volt-var mode will cause the customer's inverter to generate reactive power to support the grid voltage.
VPP	Virtual Power Plant. VPPs are the notional entities comprised of aggregated and managed DER components, which can provide generation, managed load (up or down) and system support functions and participate in energy markets (like traditional generators).
V2G	Vehicle to grid. An electric vehicle to grid system allows an electric vehicle to send power (i.e. discharge its battery) to the grid or to manage charging of its battery in response to changing grid conditions.

Appendix A: Summary of proposed Roles and Responsibilities

The following table provides a consolidated list of the proposed responsibilities of each entity as outlined in each section.

Consolidated list of Proposed roles and responsibilities

Role	Ref	Responsibility	Instrument
DSO	D1	Determine technical arrangements for the connection of DER.	
DSO	D2	Review and approve connection applications for DER assets. This includes assessment of network capacity and requirements within a given area.	
DSO	D3	Manage the commercial and technical control of DER connections, as allowed by the signed connection agreement and regulatory frameworks. Note – currently the commercial contract for connection to the network is via retailer as per linear contracting relationship.	
DSO	D4	Collate information on DER and provide it to AEMO for the purposes of establishing, maintaining and updating a DER register. Note – the DER register will only gather static information when initially implemented.	
DSO	D5	Develop static and / or dynamic constraint equations at the distribution level that describe the transfer limits of the network. Note – the depth of visibility required is still to be determined.	
DSO	D6	Provide a static and / or dynamic operating envelope to aggregators / retailers / AEMO for all active DER (at the connection point). Note – the specifications of the dynamic operating envelope are yet to be developed.	
DSO	D7	Plan, install and manage links to aggregators / retailers / AEMO to disseminate information about the static and/or dynamic operating envelopes at a specific location or interface.	

DSO	D8	Create and / or administer systems, such as a DSO Platform, to enable the visibility of power flow across the distribution network, and to provide visibility of, and means of managing, issues on its network in real time when they emerge. This will also support the DSO where distribution network issues have emerged, and an aggregator has been engaged by the DSO to alleviate the issue. The consequential actions must be addressed by the System Operator (AEMO) as part of whole-of-system operation. This will ensure the power system at all levels is securely and reliably operated and maintained.
DSO	D9	Develop processes within the DSO platform that allow the network operator (DSO) to request network support services where needed and available to meet network support requirements.
DSO	D10	Provide information on the deployment of network support services to allow the Market Operator (DMO) to consider the impact of these services on the broader power system.
DSO	D11	Planning network investments that deliver economic benefit
DMO	M1	Leverage and / or administer a market platform(s) to enable generators, customers, aggregators and other third parties to access value in the energy market, the Reserve Capacity Mechanism, Essential System Services (such as frequency control) and network control services that may be required in the future.
DMO	M2	Register aggregators and aggregated facilities for the purposes of market participation and provision of services (such as network control services) under the WEM Rules.
DMO	M3	Ensure that registered market participants meet participation requirements under the WEM rules; e.g. meet appropriate testing and prudential requirements, and technical requirements.
DMO	M4	Coordinate with the DSO and aggregators to dispatch active DER in the market.
DMO	M5	Operate and manage the wholesale electricity market platform(s) to enable settlement inclusive of services provided by aggregated DER in the WEM. Note – the exact requirements for metering and settlement to be determined.

DMO	M6	If / when a centralised market for network support services is established, settlement of DER dispatched to provide network support services.
DMO	M7	Providing information to the DSO (Western Power) on opportunities for investments within the distribution network which would alleviate constraints that may deliver market benefit.
Aggregator	A1	Aggregate, monitor and manage a portfolio of individual DER via customer contracts.
Aggregator	A2	Develop and maintain appropriate systems for information gathering and to support management of contracted DER.
Aggregator	A3	Enter into bilateral contracts with DSO (Western Power) for provision of network support services.
Aggregator	A4	Submit offers to AEMO for provision of market services by aggregated DER.
Aggregator	A5	Respond on command as per contractual agreements with the marketplace or DSO in line with advised Operating Envelopes. Note - Aggregator may perform optimisation of DER within its portfolio.
Aggregator	A6	Develop customer products and contracts that reflect appropriate and representative compensation for market services (including energy) or network support services and meet appropriate customer protections. Note - whether multiple parties can contract with a single customer for different services need to be resolved.
Aggregator	A7	Manage DER to provide customer services.

Appendix B: Summary list of questions

The following table provides a consolidated list of the questions in each section

Ref	Question
Question D1	What processes or arrangements should be used or created to register an aggregator that provides network support services to the DSO (Western Power)?
Question D2	Should different 'use of system' charges apply for DER customers? If so, how should the costs and benefits of DER be accounted for?
Question M1	Taking into consideration how the future registration of aggregated DER is outlined in the *Registration and Participation Framework in the Wholesale Electricity Market* paper, are additional changes required to incorporate aggregated DER in the WEM?
Question M2	Should energy exported from DER be more explicitly integrated into the WEM?
Question M3	Monitoring and compliance for participation in energy, capacity and ESS markets need to be considered for aggregated DER. How should aggregated DER be monitored and measured for compliance?
Question M4	What performance standards should apply to aggregated DER facilities?
Question M5	Are any additional arrangements needed to incorporate aggregated DER facilities into the new scheduling and dispatch process (SCED)?
Question M6	Other than for device level communications, what other communication is required to manage aggregated DER? For example, communications between the aggregator and the DSO (Western Power) or AEMO.
Question A1	What aggregation options or models could deliver the most efficient outcome for the system and consumers?
Question A2	Are there any current barriers for prospective DER aggregators? If so, what are they and how could they be overcome?
Question A3	What should be the key elements of a regulatory framework for aggregators?
Question A4	Should aggregators be able to participate in all WEM market segments in order to stack the value of available DER services?

Question A5	Have stakeholders experienced difficulties in accessing consumer meter data for the purpose of providing DER services? If so, what were those difficulties and how did they limit opportunities to unlock the value of DER?
Question C1	Question C1: Should a customer with new or upgraded DER be required to participate in an aggregation scheme to mitigate the risk of a significant proportion of DER in the SWIS remaining 'passive'? If yes, what should be the trigger for such a requirement? If not, why not?
Question C2	What provisions need to be made for customers who make the choice not to participate in aggregation services, for example to limit their energy export while enabling them to use their DER for their own purposes?
Question C3	If the application of dynamic operating envelopes results in temporary limits on customer DER exports, what measures should be put in place to ensure that this does not unnecessarily limit DER output in preference to other alternatives? That is, what criteria should apply to the network operator's assessment of when to undertake a network enhancement to remove constraints that prevent the export of DER energy and to maximise the ability of customers to participate equally?
Question G1	Would aggregated DER providing services into the WEM require changes to metering and settlement arrangements? If so, how could this be implemented without multiple meters at a customer site and the associated costs?
Question G2	How can we ensure equity of access of DER to markets? That is, how can the greatest number of customers be allowed to install DER and provide services, if they choose? How could this be implemented?
Question G3	As tariffs (import and export) and other incentive mechanisms evolve to consider active DER, is it reasonable to require that, where practicable, non-contestable customers can access services provided by aggregators? If so, how could this be achieved?
Question G4	Should there be guidelines or rules around how DER within aggregator schemes, other factors being equal, are dispatched?
Question G5	Should the DSO (Western Power) or the System Operator (AEMO) be able to issue instructions directly to end-user DER in the presence of a network reliability risk or system security risk, or should all instructions come via an aggregator?
Question G6	Who should be responsible for the dispatch of DER owned by Western Power to address network support needs?

Appendix C: Examples of Technical Responsibilities

The following table provides a summary of the types of events or technical issues that could arise, who would have responsibility and what governance arrangement would be in place.

List of possible events and responsible entity

Event	Impacts	Responsibility	Regulatory Instrument
Voltage drop sufficient to present a risk to system stability.	System security	AEMO (DMO)	WEM Regulations and Rules (power system security)
Localised voltage issues due to increasing DER penetration.	Reliability	WP (DSO)	
Localised thermal issues (network level).	Reliability	WP (DSO)	
Impact to special protection schemes such as UFLS due to increasing levels of DER.	System security	AEMO (DMO) - design criteria and design approval, verifier of performance. WP (DSO) – collaborate with design, asset installation and maintenance to meet design spec.	WEM Rules, Technical Rules
Impact to System Restart plans due to increasing DER penetration.	System security	AEMO (DMO) - design criteria and design approval, verifier of performance. WP (DSO) – collaborate with design, asset installation and maintenance to meet design spec.	WEM Rules

Appendix D: Legislative framework in the SWIS

The legislative framework underpinning the regulatory framework for the SWIS is extensive and complex. The following table provides a summary of the existing legislation and subordinate rules and regulations that materially influence DER and the implementation of a DSO/DMO and Aggregators.

Key Legislative Instruments in the SWIS

Legislative instrument	Description	Relevance to DSO/DMO/Aggregation
Electricity Industry Act 2004 **(EIA)**	Provides the overarching regulatory framework for electricity, including access to network infrastructure, operation of the wholesale market and protections for customers. The EIA is supported by a series of codes, rules and regulations.	The EIA provides the governing framework for the regulation and operation of the electricity supply chain. As such, it ultimately influences every facet of DER.
Electricity Networks **Access Code** 2004	Provides the framework for the regulation of certain electricity networks, including Western Power in the SWIS, by the Economic Regulation Authority (ERA). The objective of the Access Code is to promote the economically efficient investment in, and operation and use of, networks and services of networks in Western Australia, to promote competition.	Among other things, the Access Code governs: • connection, which will influence the ability to connect DER to the distribution network and the standards that the equipment must meet in order to connect; • the structure of network tariffs, which will influence efficient investment in and use of DER by its owner/operator – efficient price signals are required to optimise investment in DER and incentivise participation in relevant markets; and • network planning and operation, which will influence the ability and incentives for Western Power to use DER as an alternative to network investment. This will depend on how Western Power is able to recover its DER-related costs compared to network investment.

Technical Rules	Sit under the Access Code. The Technical Rules detail the technical requirements to be met by: 1. Western Power; and by Users who connect facilities to the transmission and distribution systems which make up the Western Power Network. Prospective Users or existing Users who wish to connect facilities (or modify existing connections) to the transmission and distribution systems must first submit an access application to Western Power in accordance with the Access Code.	Set out the detailed technical requirements that DER is required to meet to connect to Western Power's network. Allows Western Power to refuse a small system connection if it considers the power system performance standards will not be met as a consequence of the operation of the power system.
Code of Conduct for the Supply of Electricity to Small Use Customers	Regulates and controls the conduct of retailers, distributors and electricity marketing agents who supply electricity to residential and small business customers to provide consumer protections.	Adherence to the Code of Conduct is limited to licensed participants. The Code therefore does not apply to commercial activities that are outside the scope of an electricity licence, which includes certain DER services (e.g. Virtual Power Plant products).
Electricity Industry **Metering Code**	Sets out the rights, obligations and responsibilities of participants associated with the measurement of electricity and the provision of metering services, the rules for the provision of metering installations at connection points, and the rules for the provision of metering services, standing data and energy data.	The Metering Code will impact the type of meter required for DER, the data that must be collected and to what standard/level of granularity. The Metering Code also governs access to data, which will be important for customers and third parties seeking to optimise the use of DER.
Electricity Act 1945	Technical and safety issues relating to electrical installation, are governed by the *Electricity Act 1945* and supporting Regulations	All electrical work, including design, construction, operation and maintenance, must be carried out in accordance with the Act and associated regulations. Includes the installation of DER. The Act also specifies the permissible network voltage band.
Electricity Industry (Licence Conditions) Regulations 2005	Imposes obligations on certain licence holders e.g. in relation to the purchase of renewable energy from certain customers and requiring compliance with certain codes	Gives effect to the requirement for Synergy to purchase electricity generated through small renewable energy systems.
Wholesale Electricity Market Rules	Govern the market and the operation of the SWIS, including the wholesale sale and purchase of electricity, Reserve Capacity, and Ancillary Services	Determines the value of DER in the various components of the wholesale market, and conditions for participation in that market.