Government of **Western Australia**
Energy Policy WA

Low Load Responses – Distributed Photovoltaic Generation Management

Discussion Paper

19 October 2021

Working together for a **brighter** energy future.

Contents

Glossary

Term	Definition
AEMO	Australian Energy Market Operator
DER	Distributed Energy Resources. These 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, and technology to manage load at a premises.
DPV	Distributed Photovoltaic. This refers to distribution-connected rooftop solar systems, including those installed at residential premises as well as larger commercial sites.
ETAC	Electricity Transfer Access Contract
ETS	Energy Transformation Strategy
kW	Kilowatt
Load	A load can refer to a connection point at which electricity is delivered, or the amount of electricity required at that connection point from the power system. For the purposes of this paper, load is used interchangeably with “operational demand”.
MW	Megawatt
MWh	Megawatt hours
PV	Photovoltaic. The technology by which rooftop solar systems produce electricity.
SWIS	South West Interconnected System
WEM	Wholesale Electricity Market

1 Introduction

Western Australians are embracing distributed energy resources (DER) at record rates. These small-scale devices include batteries, electric vehicles, and distribution-connected rooftop solar photovoltaic (known as DPV) systems.

This uptake presents significant opportunities for customers to both produce and use low-cost, low-emissions electricity generation. However, the unprecedented speed and scale of DPV uptake is also making the power system increasingly challenging to manage.

In 2019, the Australian Energy Market Operator (AEMO) identified serious risks to the power system and forecast that, if action was not taken, the continued uptake of rooftop solar PV could lead to widespread blackouts as early as 2022.

To respond to these risks, the State Government initiated a comprehensive program of work under its Energy Transformation Strategy (ETS). The ETS provides a vision for the future of the South West Interconnected System (SWIS), with a redesigned Wholesale Electricity Market (WEM) that better facilitates large-scale renewables and storage and a plan for the safe and efficient integration and participation of DER in the power system.

This vision will ensure that customers in the SWIS can continue to install DPV, batteries, and other DER to help manage their electricity bills and contribute to the de-carbonisation of the power system. Importantly, in time, customer devices will play a central role in the power system.

Since the commencement of work under the ETS in May 2019, the energy transformation has accelerated. A record amount of DPV systems was installed in 2020, and forecasts from AEMO indicate this rate is likely to continue.[1]

While work continues under the ETS to transition to our future power system, evolving and emerging interim challenges need to be managed to enable the continued installation of DPV and large-scale renewables.

The most significant immediate challenge is managing power system security during times when customers' electricity demand from the grid (known as load) is very low. This challenge is growing as more DPV is installed on the system.

On 28 September 2021, AEMO released its *Renewable Energy Integration – SWIS Update* report, outlining the risks of declining levels of demand, including heightened threats to power system security.

In this report, AEMO presents a priority recommendation to:

"As soon as practically possible, enable the capability to manage newly installed and upgraded DPV (i.e., for output reduction and/or curtailment) on instruction from AEMO to a third party to assist in managing power system security and reliability in all emergency operational conditions, including during extreme low system load conditions and black start, as a measure of last resort (i.e., backstop capability)."[2]

This recommendation is made by AEMO as an alternative to "disconnecting a distribution feeder or substation", which would interrupt power supply to all associated connection points. AEMO notes that urgent action is required to manage DPV output as an emergency fallback, and that the capability for all new and upgraded DPV generation to be remotely reduced or curtailed should be implemented "as soon as practically possible". This capability to remotely manage generation from DPV systems is referred to as DPV Management.

DPV Management capability only reduces or curtails DPV generation – importantly, power supply to customer premises is not interrupted.

[1] AEMO 2021, *2021 Wholesale Electricity Market Electricity Statement of Opportunities*

[2] AEMO 2021, *Renewable Energy Integration – SWIS Update*, Executive Summary

To allow AEMO to maintain system security during extreme low load events, Energy Policy WA is assessing the introduction of DPV Management capability in the SWIS.

The intent of introducing DPV Management is to facilitate greater amounts of low-cost, low-emissions renewable generation to be connected to the SWIS, while managing the emerging risks to the network and power system.

1.1 Purpose of this paper

This Discussion Paper is providing information to stakeholders on the proposed implementation model for DPV Management in the SWIS and is seeking input on its implementation.

Stakeholder views are welcomed on the management methodologies identified, as well as any practical considerations for implementation, including for installers, manufacturers and customers. Specific questions have been provided in Section 4 to assist stakeholder responses.

Under the proposed approach, DPV Management would be introduced through changes to the Western Power *Network Integration Guideline – Inverter Embedded Generation* (known as connection guidelines). Western Power is expected to be releasing a new version of the connection guidelines in November 2021.

The changes would outline new DPV Management requirements for systems of Synergy customers with a generating capacity not exceeding 5 kilowatts (kW). The requirements are outlined in section 3.3 below, and would include a system meeting an approved method for DPV Management as outlined in section 4.3.

For systems with a capacity exceeding 5kW, anticipated changes to the connection guidelines would contain limits to energy exported by these systems, reducing the impact of these systems. These limits are to be accompanied by improvements to the application process allowing greater system size in some circumstances. Together, these changes would permit greater amounts of DPV while managing the risks to the power system

Please note that Western Power will be undertaking separate consultation on proposed updates to its connection guidelines, anticipated to occur in November 2021.

1.2 Making a submission

Energy Policy WA welcomes feedback on the information outlined in this paper.

Feedback can be submitted in the following ways:

1. Email your written submission to submissions@energy.wa.gov.au
2. Contact info@energy.wa.gov.au to arrange a discussion
3. Post your written submission to Energy Policy WA at Locked Bag 11, Cloisters Square, WA 6850
4. Register to attend a virtual Industry Forum at: info@energy.wa.gov.au

Feedback on this Discussion Paper closes at 5.00pm (WST), Friday 12 November 2021.

In the interests of transparency and to promote informed discussion, submissions will be published 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.

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 Background

2.1 Low load issues

Low load events typically occur on mild, sunny days when total customer energy requirements are low, and output from DPV generation is high. These conditions typically occur in the SWIS during Autumn and Spring on weekends and holiday periods when demand from businesses is relatively low and air-conditioning is unnecessary for most customers.

To manage the power system, electricity supply and demand must be balanced. As demand from the grid decreases during low load periods, fewer large, controllable 'synchronous' generators are dispatched to provide energy.

However, these large generators currently play an important role in supporting the power system, providing stabilising electrical frequency on the grid, helping the power system ride-through disturbances (such as through transmission line outages), and responding rapidly to sudden changes in demand.

In the absence of technologies such as large-scale energy storage, AEMO (in its role as system operator), requires enough of this controllable generation to be online to maintain the stability of the power system. Maintaining sufficient quantities of conventional generation online to provide these services can be challenging under low load conditions. As a result, when there is a large amount of uncontrolled generation from DPV systems and low customer demand for energy from the grid, conventional generators may not be able to operate and the power system becomes vulnerable to unexpected events.

In the SWIS, accelerating uptake of DPV in 2020 heightened these risks. Installed capacity increased by over 300 megawatts (MW) in 2020, contributing to minimum operational demand on the system dropping to lower levels than anticipated. That is, low load conditions and low load issues are occurring sooner than expected.

On 28 September 2021, AEMO released its *Renewable Energy Integration – SWIS Update* report. It confirms the persistence of changing power system conditions including:

- increasing generation and load volatility;
- continued decrease in minimum level of low system load through record uptake of DPV systems;
- impacts on the operation of protection systems due to reducing operational demand (load);
- the displacement of traditional generation sources by DPV and utility-scale renewable generation; and
- a greater spread of Wholesale Electricity Market Balancing Prices.

AEMO also identifies that, as minimum load decreases, there are fewer combinations of facility dispatch which can keep the power system secure. Below system load levels of 600 MW, these options materially decrease, such that AEMO considers it a zone of "heightened power system security threat".[3]

The report identifies evolving and emerging short-term risks to the power system presented by continuing, unmanaged rooftop solar PV uptake. While these risks will be managed in the longer-term through the initiatives being delivered under the ETS, more immediate responses are required to manage risks to power system security.

AEMO provides 13 recommended actions, including 3 priority actions. One priority action (Recommended Action 5) is to:

"As soon as practically possible, enable the capability to manage newly installed and upgraded DPV (i.e., for output reduction and/or curtailment) on instruction from AEMO to a third party to assist in managing power

[3] AEMO 2021, *Renewable Energy Integration – SWIS Update*, Executive Summary

system security and reliability in all emergency operational conditions, including during extreme low system load conditions and black start, as a measure of last resort (i.e., backstop capability).”[4]

This recommendation is made by AEMO as an alternative to “disconnecting a distribution feeder or substation”, which would interrupt power supply to all associated connection points. AEMO notes that urgent action is required to manage DPV output as an emergency fallback, and that the capability for all new and upgraded DPV generation to be remotely reduced or curtailed should be implemented “as soon as practically possible”. This capability is referred to as DPV Management.

2.2 DPV management as a response

DPV refers to the smaller, distribution-network connected rooftop solar PV systems like those installed on residential rooftops, as well as larger systems located on commercial premises.

In 2020, South Australia introduced the ability to manage DPV generation at times of urgent system need through its *Smarter Homes* package of reforms.[5]

DPV Management can reduce or curtail DPV generation only – power supply to a premises is not interrupted by this capability. This is considered preferable to the alternative suggested by AEMO of distribution feeder or substation disconnection and subsequent loss of power supply for customers.

AEMO has now identified the need for a similar DPV management response to be available in the SWIS. Energy Policy WA is exploring how to introduce this capability for all new and upgraded rooftop solar PV systems in the SWIS as soon as practically possible.

DPV Management presents a last resort measure to help protect the power system in emergency operating conditions including during extreme low load events. In the SWIS, these events (and therefore the need for DPV Management) are expected to occur infrequently and for short periods. In South Australia, which has higher penetration of DPV but has the benefit of interconnection with other States in the National Electricity Market, DPV Management has been used once by AEMO since it was introduced a year ago.

Energy Policy WA remains firmly focussed on implementing actions to allow the active participation of DER in the power system in the medium-term through the implementation of the DER Roadmap. The long-term vision for this transformation is unchanged and avoiding disruptions to the power system caused by low load events will help keep the journey on a smooth pathway.

3 DPV Management in the SWIS

Energy Policy WA is preparing for the introduction of DPV Management for the SWIS to respond to emerging and evolving near-term risks presented by the continuing rapid installation of DPV, consistent with the priority recommended action identified by AEMO.

3.1 Aim

The aim of implementing DPV Management is to mitigate the risks to power system security posed by low load events in the SWIS by enabling the capability to remotely reduce or curtail generation from DPV systems as a last resort measure to maintain system security.

It is intended that the ability to manage low load events, supported by DPV Management, will allow more rooftop solar PV to be installed overall safely, and increase the amount of energy available from this source outside these events. This benefits customers through opportunities to manage their energy costs and contribute to the decarbonisation of the electricity sector.

[4] AEMO 2021, *Renewable Energy Integration – SWIS Update*, Executive Summary

[5] Government of South Australia, 2021, Regulatory Changes for Smarter Homes.

While DPV Management is primarily focused on mitigating short-term risks at times of low load, the capability to remotely communicate with DER is highly aligned with the future participation of customer devices to provide electricity services for payment.

3.2 Timeframes

The AEMO *2021 Wholesale Electricity Market Electricity Statement of Opportunities* (2021 WEM ESOO) outlines that low load records are being reached frequently, and DPV installation rates are continuing to increase. In its *Renewable Energy Integration – SWIS Update* report, AEMO recommends DPV Management be implemented as soon as practically possible.

To ensure there is sufficient capacity available to provide a response if it is needed in coming years, DPV Management capabilities need to be implemented for all new and upgraded DPV systems as soon as possible.

It is proposed that the DPV Management technical requirements will apply to new or upgraded DPV systems with generating capacity of 5kW or less from mid-February 2022. In other words, these systems will need to demonstrate they can meet Western Power's connection guideline requirements for remote DPV Management capability.

It is proposed that larger systems will be subject to export limits (see 3.3 below), however, these may come into effect prior to mid-February 2022.

3.3 New requirements

To implement DPV Management as a response to manage power system security, it is proposed that all new and upgraded DPV systems with generating capacity of 5kW or less will have the technical capability to be turned down or off in response to a remote signal.

All customers with a new and upgraded DPV systems without an off-take agreement with their retailer will be export limited to 1.5kW or 5% of rated capacity. Almost all Synergy residential customers will have access to an off-take agreement through the Distributed Energy Buyback Scheme, and will therefore be able to install systems capable of generating up to 5kW. Industry engagement will be undertaken by Western Power on export limit changes upon the release of Western Power's updated connection guidelines, planned for mid-November.

In addition to this technical requirement, in the circumstance where DPV Management is required, Synergy (as the customer's electricity retailer) would act as an 'authorised agent' to send a remote signal to a customer's DPV system. Under the proposed implementation model, Synergy would do this under its obligations to respond to a direction from Western Power under the Technical Rules. Western Power would only provide this direction in response to a formal direction from AEMO. Further information on this model is provided in Section 4.

At the commencement of these requirements, Synergy will be the only retailer required to demonstrate its ability to meet the DPV management obligation. This is because Synergy is the sole retailer for small-use customers on the SWIS. However, in future, other electricity retailers may be required to develop and demonstrate DPV Management capability.

4 Proposed implementation model

4.1 Guiding principles

The proposed DPV Management model has been developed to allow power system risks to be managed while supporting the continued installation of rooftop solar PV.

This model is consistent with the long-term vision laid out in the DER Roadmap, where DER is integral to a safe, reliable, and efficient electricity system.

The following principles have been adopted by Energy Policy WA in considering how the preferred model might be deployed:

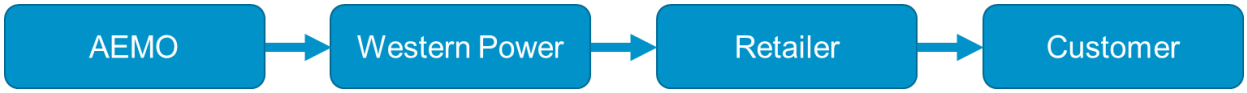
- DPV Management should only be called upon as one of the last resort measures to keep the system secure.
- Small-use customers should, where possible, be the last to be affected by DPV Management being deployed, and the impacts of DPV Management should be equitably distributed amongst customers with DPV Management capability.
- Preferably, technology solutions should support zero exports from DPV to the grid, as well as zero generation.
- DPV Management is considered a system security response. As such, customers subject to DPV Management will not be compensated in the event it is triggered.

- This is consistent with treatment of large generators in similar circumstances, the approach taken in the Horizon Power service area and reflects the benefit to all customers (including those with DPV being managed) of not being subject to a system disturbance or loss of power.
- Market-driven incentives for turning down output from DPV are being considered as part of DER Roadmap actions to better integrate DER.

Development of this model also considers the introduction of DPV Management in South Australia, to ensure any requirements for the SWIS are made simple for technology providers to meet and help build a consistent national approach.

4.2 Low load response hierarchy model

At a high level, the proposed implementation model for DPV Management, as expressed by hierarchy of instruction, would take place as follows:



This model was developed by Energy Policy WA after considering the existing legislative and regulatory frameworks that are in place in Western Australia, and those that will be implemented in coming years as part of changes to the WEM as part of the broader ETS. It also considers the structure of the electricity industry in Western Australia where a single network business (Western Power) transports electricity to the majority of customers and a single retailer (Synergy) provides electricity services to most customers with DPV, including almost all residential customers.

In Western Australia the retailer holds the contractual relationship, or Electricity Transfer Access Contract (ETAC), with the network operator on behalf of most small-use electricity customers. This is known as a linear contracting model. It contrasts with the regulatory framework present in South Australia where both the retailer and network operator have a direct contractual relationship with small-use electricity customers.

The approach selected for the SWIS is designed to be flexible to changes in regulatory and technological environment and is intended to support future DER participation in the power systems where paid services may be provided.

AEMO and Western Power will develop detailed functional guidelines and operational processes to deliver a response under this model.

4.2.1 AEMO

AEMO is responsible for power system operations in the SWIS.

When there is an identified current or future power system risk, it is empowered under the WEM Rules to take necessary actions to maintain system security and return the power system to a normal operating state.

AEMO will continue, in accordance with the WEM Rules, to take the actions required to ensure system security is maintained and respond to the prevailing conditions. To respond, actions available to AEMO include:

- engaging with Western Power to switch out transmission lines to manage voltage;
- procurement of additional Essential System Services to manage contingency sizes and volatility;
- dispatching market generators out of merit, which may include constraining specific generators on or off; or
- directing a Rule Participant to take appropriate actions according to the relevant operating state.

Once it has exhausted all options available to it, AEMO has the authority to direct Western Power (as the network operator) to take further action within the distribution network. At present, Western Power's options in this circumstance are limited, and include the manual tripping of distribution feeder(s) with relatively large amounts of DPV generation. This would interrupt supply to all customers in the area, including those without DPV.

4.2.2 Western Power

Western Power, as the transmission and distribution network operator, has a responsibility to assist AEMO with maintaining power system security.

Under the proposed DPV Management model, Western Power would work with AEMO and other relevant parties to identify and provide distribution network-level responses that could increase load on the power system to help manage system security.

This approach would ensure that all other options to manage system security would be exhausted before deploying DPV Management.

To deliver the required technical capability, Western Power would implement, through its connection guidelines, a requirement for DPV systems (with generating capacity of 5 kW or less) to have the ability to be remotely turned down or off. The allowable methods at commencement of the DPV Management measures are listed in section 4.3.1.

Western Power would also implement requirements and processes to allow this capability to be tested from time to time.

4.2.3 Synergy

In Western Australia, Synergy holds the ETAC with the Western Power as the distribution network operator on behalf of its small-use electricity customers. This linear contracting relationship means that Synergy is responsible for meeting contractual obligations regarding the use of the network by its customers.

The current threshold for electricity retail contestability means that Synergy is the sole retailer for most small-use customers on the SWIS (those who use under 50 megawatt hours (MWh) per year, which includes most residential customer connections). Rooftop solar PV installed by Synergy's customers represents over 80% of the total installed DPV capacity in the SWIS and captures most households and small businesses.

Using Synergy as the 'authorised agent' to deliver the device level response will leverage the existing, linear contracting relationship between Western Power, Synergy, and the DPV customer.

On receiving an instruction from Western Power, Synergy would be responsible for triggering the capability within its DPV customer portfolio. Synergy would have flexibility to implement a technical solution (within those approved by Western Power) that meets its needs and those of its customers.

Synergy would be responsible for ensuring that its customers maintain ongoing capability for their DPV systems to be remotely disconnected/reconnected and potential requirements for compliance. Synergy would also be responsible for maintaining any systems and processes required to trigger this capability, and test it from time to time.

While the proposed DPV Management obligations will only apply to Synergy, other electricity retailers may be required to develop DPV Management capability in future. At such a time, Energy Policy WA would work with other retailers to determine the date at which DPV Management obligations might apply.

4.2.4 Customer

The DPV Management technical requirements would apply to new or upgraded solar PV systems (with generating capacity of 5 kW or less) from mid-February 2022. Most residential customers install inverter systems of this size, and systems must be of this size in order to participate in the Distributed Energy Buyback Scheme, which provides payment for energy exported to the grid.

Introduction of DPV Management capability for individual systems would take place as part of the application and installation process. Customers would work with Synergy and installer to identify the appropriate DPV Management solution for their circumstances (see section 4.3.1 for possible DPV Management methods). Depending on the DPV installation, there may be multiple options for implementing DPV Management for a given customer.

It is proposed that the DPV Management solution would need to be decided upon at the time of application for a new or upgraded DPV system.

After mid-February 2022, any customer application for a relevant system (i.e. with generating capacity of 5kW or less) must comply with DPV Management requirements. It is proposed that there be a short grace period for DPV systems with an application submitted prior to mid-February, but installed before mid-March, to account for customers who may be inadvertently affected by delays to installation.

Customers who deliberately, through action or inaction, prevent their equipment from meeting the ongoing requirements will be at risk of having the equipment disconnected under Western Power's Technical Rules.

4.2.5 Installers and equipment suppliers

Installers and electrical contractors would need to ensure that new and upgraded DPV systems meet Western Power technical requirements. This includes ensuring that systems could meet any requirement to communicate with retailer DPV Management platforms needed to demonstrate remote access and control capability (the timing for the application of these requirements will differ depending on whether the retailer is Synergy).

As discussed above, after mid-February, any customer application for a relevant system (i.e. generating capacity of 5kW or less) must comply with DPV Management requirements. It is proposed that there be a short grace period for DPV systems with an application submitted prior to mid-February, but installed before mid-March, to account for customers who may be inadvertently affected by installer delays.

Installers would be responsible for communicating these deadlines to new customers, and ensuring that customers with applications submitted prior to mid-February have their systems installed prior to mid-March.

Energy Policy WA will work with installers, equipment manufacturers and relevant peak bodies to consider the best approach to support installers with customer communication tools and any additional training requirements.

Feedback is welcomed on the proposed approach, and any training requirements or other considerations pertinent to installers.

4.3 DPV Management implementation

4.3.1 Approved methods for DPV Management

Under the proposed implementation approach, systems with generating capacity of 5kW or less must comply with DPV Management requirements.

Functional guidelines have been developed by Western Power to outline how DPV systems can demonstrate that they meet the requirement for remote disconnect/reconnect capability.

A summary of the approved methods which might apply to most small household systems is provided below.

The minimum functionality includes the ability for systems to be remotely disconnected from, and reconnected to, the grid. In addition, it is recommended that systems are configured to enable reduction of exported real power to zero power (0kW).

Proposed methods for DPV Management include a:

- Western Power meter configuration and wiring solution;
- communication channel to an inverter system such that the inverter can receive a signal (e.g. via broadband, Wi-Fi or 4/5G cellular communications);
- communication channel to a device, such that the device can receive a signal from an authorised agent (Synergy, the retailer); or
- device connected to the Demand Response Mode port of an inverter (i.e. a Gateway device) causing the inverter to disconnect or cease to generate on receipt of a signal from an authorised agent (Synergy, the retailer).[6]

4.3.2 Validation requirements

Western Power has also developed validation principles associated with implementing remote disconnect/reconnect capability – these requirements apply to Synergy, but will inform the information that may be needed from installers. Synergy will develop and provide information to installers prior to the commencement of DPV Management requirements.

At a high level validation requirements could include:

- Upon installation of customer equipment, Synergy must confirm the system's DPV Management capability with Western Power, as required.
- Synergy may be required, from time to time, to complete a test of remote management functionality.
- Synergy needs to demonstrate ongoing remote management capability and take action to restore that capability if it is lost (where customer equipment is no longer able to show that it meets the remote management functionality it is at risk of being disconnected by Western Power until that functionality is restored).
- Synergy shall take reasonable efforts to monitor availability of equipment under its management so that it can provide Western Power and AEMO with information about the number and capability of systems available to assist with planning for, and responding to, low load events.

4.4 Questions

Feedback is sought on the information in the discussion paper and the introduction of the DPV Management as outlined above. Questions are provided below to assist stakeholders in preparing their responses to this paper.

a) Are there any practical considerations Energy Policy WA should have regard for in implementing the proposed DPV Management model?

b) What mechanisms should be used to provide information to consumers about DPV Management events and what form should this information take?

c) What sort of customer support information should be made available by Synergy to assist customers to maintain compliance with remote communication – for example, if a Wi-Fi connection needs to be re-established?

d) What assistance or training might be provided for installers to help meet requirements for validation, at the point of installation, and on an ongoing basis?

e) Energy Policy WA will assist customers and installers in providing fact sheets and other communication tools to support the changes. Do you have any suggestions for information that you would like included within these fact sheets?

f) Do you have any other questions, or comments?

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Energy Policy WA
Level 1, 66 St Georges Terrace, Perth WA 6000
Locked Bag 11, Cloisters Square WA 6850
Telephone: 6551 4600

www.energy.wa.gov.au

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