DER Visibility and Monitoring Best Practice Guide

Use Case Summary and Context

Public Release Version 1.0

01. Executive Summary

Australia leads the world in the deployment of rooftop solar, with 21% of premises having installed solar and 220,000 new solar systems being added each year[1]. While this increasing growth in distributed energy resources (DER) and their energy generation is contributing to lower electricity costs for consumers and lower carbon emissions, there are several challenges to the continued growth of the industry.

Key challenges facing the clean distributed energy resources industry today are to:

- Equitably and cost effectively increase the DER hosting capacity of the electricity networks while maintaining grid reliability; and
- Increase the quality of DER systems (solar PV, batteries, etc) being installed, and hence their safety, longevity and the total renewable energy generated.

The key barrier to addressing the first of these challenges, as detailed in recent reports (noted in Section 3.3) is increased DER operational visibility being made available to appropriate stakeholders.

To help address these issues a DER Visibility and Monitoring Best Practice Guide has been developed. This Guide addresses the above key challenges by:

1. Having a common data specification that provides the DER visibility required to address the network hosting objective. Technology providers would make this data set available to third parties on commercially negotiated terms. This would enable regulatory bodies, DNSPs, academics and other parties to procure and combine data from multiple sources to meet their network modelling and visibility needs.
2. Providing DER owners with near real-time energy usage and generation information that will increase the system uptime and optimise its performance. In addition to providing direct benefits to the DER owner, this would enable an accurate assessment of real world performance by industry.

02.
Data Use Case Summary

Table 1 - Overview of data use cases included in the Best Practice Guide

Use	Parameters required (at site)	Key user group
Network state estimation and performance	Voltage	Networks, AEMO
Fault identification	Voltage and current	Networks, AEMO, customers
DER hosting capacity	Voltage, active/reactive power generated/consumed	Networks, regulators, customers
Compliance	Active/reactive power generated, voltage	Customers, regulators, networks
Constraint management	Capacity, voltage active/reactive power generated/ consumed	Networks, AEMO
Constraint reporting	Capacity, voltage active/reactive power generated/ consumed	Networks
Orchestrating DER	Capacity, voltage active/reactive power generated and consumed	Networks, AEMO, VPP operators
Asset owner information on own DER	Static data, site active imported/exported, site active generated/consumed, time	Customers

03.
Increasing DER Hosting Capacity

3.1. Network Requirements

In developing the guide, two key questions we needed to answer were:

1. What are the current and impending network issues that require improved network LV visibility?
2. What data is required for each of these issues?

A review of local[2] and international[3,4,5] experience and discussion with Australian Distribution Network Service Providers (DNSPs) identified six key network problem domains and their associated value streams flowing from improved DER visibility. These can be grouped across three time domains: operational timescales, at planning and scheduling timescales, and over the long term.

Operational timescales, of minutes to days:

- Network state estimation and performance - energy flows on the network to identify network capacity and constraints and manage network operations.
- Fault identification – identifying and resolving network asset faults before or during the event (e.g. damaged powerlines, high impedance faults).

Scheduling and planning timescales, of days to months or a few years:

- LV feeder DER hosting capacity – accurately determining the hosting capacity of each feeder for new DER on that feeder.
- Operational actions such as voltage target adjustments and tap changing
- DER compliance with performance requirements.

Long term, developing future capability in:

- Dynamic constraint management and efficient regulation of the increasing penetration of DER.
- Orchestrating DER participation in wholesale markets.

3.2. Data Requirement Summary

The required parameters, their sampling rates and sampling densities for each are listed in Table 1. While the consensus on sampling densities is that more data is better, but the minimum densities that can feasibly improve current practices are reported.

Table 2 - Sampling rates and densities for eight key LV visibility value streams

Issue	Value stream	Parameters required (at NMI)	Measure interval	Update rate	Sampling density
1.	Network state estimation and performance	Voltage (assumes voltage and current available at substation)	5-10 min	Real time (could be monthly)	>2% of premises, greater fidelity at higher density, ideally 75% of "nodes"[6]. 20% required for MV.
2.	Fault identification	Voltage and current	1-5 min	Real time	>2% of premises. Note millisecond likely required for broken neutral
3.	DER hosting capacity	Voltage, Active/Reactive Power generated and consumed	5 min	Monthly	2 sites per feeder, with greater certainty/ redundancy from greater coverage
4.	DER compliance	Active/Reactive Power generated, Voltage	5-10 min	Monthly	>20% DER, with greater accuracy and compliance at near 100% coverage
5.	Constraint management	Capacity, Voltage Active/Reactive Power generated and consumed	10s – 5 min	Real time	Participating DER
5.1	Constraint reporting	Capacity, Voltage Active/Reactive Power generated and consumed	10 min	Weekly/ Monthly	At least 1 customer per LV feeder, more increases accuracy
6.	Orchestrating DER	Capacity, Voltage Active/Reactive Power generated and consumed	10s – 5 min	Real time	Participating DER. Note that full orchestration will require 1min or better

3.3. Network Reports

Open Energy Networks, AEMO and ENA

https://www.energynetworks.com.au/sites/default/files/open_energy_networks_-_required_capabilities_and_recommended_actions_report_22_july_2019.pdf

In June 2018, AEMO and Energy Networks Australia opened a consultation on the "Open Energy Networks" project to identify how best to transition to a two-way grid that allows better integration of DER to deliver better outcomes for all customers. This report was drafted to provide stakeholders with an overview of key content developed through the detailed research and engagement phases of the program, and details what the program has determined as required capabilities and actions that will be needed to underpin the integration of a high DER future.

The Interim Report Required Capabilities and Recommended Actions outlines what the energy system needs to ensure the massive growth of solar and storage can be properly integrated into our grid for maximum customer benefit. These required capabilities include:

- Enabling distribution network service providers (DNSPs) to improve network visibility – i.e. **know where DER are installed and how they behave in real-time** so the local distribution network and the wider system can be managed. For example, the export capacity of a solar and storage system needs to be known, as well as how fast the battery can respond to a signal to switch from charging to discharging.
- Defining network constraints or 'operating envelopes' so customers can be advised how much electricity they can export and/or import from the grid. These operating envelopes define the limits that customers' DER must operate within for the safe and secure running of the network and the overall electricity system. For limits to be established, **real-time data must be collected and communicated**, based on standard protocols.

"High levels of DER penetration can result in distribution networks becoming constrained. Given distribution networks' limited visibility, they are equally limited in capacity to manage constraints, so restrictions of DER output become necessary. In extreme cases, DER export ability may be limited as part of their connection agreement or connection could be rejected altogether to ensure that network performance is maintained".

"To access DER's full benefits, it must be well coordinated and resources properly optimised. Optimisation refers to the management of the real-time operation of DER, so that each customer's assets respond in a coordinated way to meet various system needs. This supports the essential power system needs for visibility, predictability and controllability."

"A summary of the key outputs established from the OpEN stakeholder consultation to-date includes a consensus that **better network visibility and hosting capacity information** is of value to all stakeholders across the value chain (including household customers)".

"As part of the Open Energy Networks program, the CSIRO was engaged to undertake cost-benefit Analysis to estimate the potential net benefits if the required capabilities were implemented. This modelling indicates that by providing the required capabilities (network visibility and communications etc.) more than $1 billion dollars in benefits could be delivered by 2035. The full integration outlined in the 2017 Electricity Network Transformation Roadmap also identified about $1 billion dollars in benefits."

Energy Australia

https://arena.gov.au/assets/2019/03/energy-australia-demand-response-project-performance-report.pdf

The EnergyAustralia ARENA sponsored DR program includes the installation of high quality circuit-level monitoring. According to EnergyAustralia, **"Our ability to monitor operational technology allowed early identification of issues and understand the 'health' of assets in the field"**.

GreenSync

https://arena.gov.au/projects/decentralised-energy-exchange/

GreenSync's Decentralised Energy Exchange (deX) is a market-enabling digital platform that aims to provide electricity networks with better coordination and control of the increasing volume of distributed energy resources (DER) in the electricity grid.

Consumer owned devices registered with deX will be visible to network and market operators and can be contracted for grid services

GreenSync anticipates that "Networks will gain visibility of behind-the-meter generation, allowing them to **forecast more accurately, control DER to dispatch, or contract DER for other grid services**, such as voltage and frequency management, in line with dynamic network conditions." And also that "deX will enable higher shares of renewable energy to be connected to the grid while ensuring electricity is secure, reliable and available where and when needed."

SA Power Networks

https://arena.gov.au/projects/advanced-vpp-grid-integration/

The SAPN ARENA sponsored advanced VPP grid integration project will employ monitoring of customer solar and battery systems and "aims to show how higher levels of energy exports to the grid from customer solar and battery systems can be enabled through dynamic, rather than fixed, export limits, and to test the value this can create for customers and Virtual Power Plant (VPP) operators."

Dynamic Limits

https://arena.gov.au/projects/dynamic-limits-der-feasibility-study/

The Dynamic Limits ARENA sponsored feasibility study will explore implementing dynamic distributed energy resources (DER) export limits to better manage voltage and thermal constraints on the electricity network

This project will require monitoring of DER, and according to Dynamic Limits "The use of a control scheme implementing dynamic limits is expected to reduce network constraints, increase overall network utilisation and alleviate the need for network capital investment"

Energy Queensland

https://www.energynetworks.com.au/sites/default/files/peter_price_-_energy_queensland.pdf

Energy Queensland expects the benefits from investment in LV network (visibility) to include Predictive management of broken neutrals, Improved power quality through LV visibility and active network management, Efficient outage management, LV fault detection (LV wire on the ground), Automated network voltage investigations, and Detect asset deterioration (preventative maintenance, not waiting for failure).

Australian Energy Market Operator

https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Reports/2016/AEMO-FPSS-program----Visibility-of-DER.pdf

This report from AEMO states in detail what the impact of not improving LV network visibility will have on AEMO's ability to maintain a secure and reliable power system

"The energy market has been undergoing a transformational change which has seen an increase in distributed energy resources (DER) such as rooftop photovoltaics (PV). These systems provide opportunities to manage the power system in new ways, particularly with advanced metering and digital technologies. However, if their uptake is not holistically managed, these systems, in aggregate, can have a material and unpredictable impact on the power system and its dynamics due to their cumulative size and changing characteristics."

"If the opportunities presented by DER are not taken up in a coordinated way, large penetrations of DER that are being installed "behind the meter" (BTM, meaning on customers' premises) are likely to be "invisible" to AEMO. This **lack of visibility affects AEMO's ability to quantify and manage the operational impacts of DER on the power system.**"

"A lack of visibility of DER will impact AEMO's ability to Maintaining power system security and Delivering market efficiency effectively, resulting in the power system being operated increasingly inefficiently, with asset under-utilisation, less informed investment decisions, and ultimately increased costs borne by consumers."

“Changes in the energy market and technology development are giving more power to consumers to choose how their electricity demand is met. This has resulted in a large uptake of rooftop PV, and it is anticipated that other DER, such as energy storage, will become more cost-effective for consumers in the near future. Frameworks to capture this uptake require implementation now to make sure they are in place for any DER entering the market. Once installations have been made, the information becomes very difficult to collect.”

“Load response to system disturbances is important to the ability to manage power system security, as AEMO needs to understand how load, in aggregate, will respond to these events. Many DER are connected to the network via power electronic inverters which are programmed to disconnect from the network if voltage or frequency reaches certain thresholds. Without visibility of how these DER are pre-set to respond, AEMO cannot plan efficiently for contingency events, and will not know whether large penetrations of DER will present challenges to preventing blackouts, or in the worst case, a black system following non-credible or multiple credible contingency events. In the near future, **AEMO will specifically need to quantitatively assess the ability of the system to withstand “protected events” and to maintain frequency within standards.**”

“International system operators have estimated the benefits of having visibility of DER for operational load forecasting. **These studies found that these benefits outweighed the costs of establishing the data collection processes.**”

“AEMO has completed a comprehensive stocktake of the current operational processes it performs to manage power system security, as well as identifying any future developments that may be required, such as incorporating new technologies in forecasting and planning functions. The specific data requirements will vary for each technology, and each component within the DER system.

Broadly, AEMO requires:

- Static data on location, capacity, and the technical characteristics of the systems, in particular the inverters interfaced to the network.
- **Real time, or at least five-minute, DER output data**, aggregated at the connection point level for operational forecasts.”

“These information gaps affect all AEMO’s operational processes, from real-time dispatch to longer-term planning. Broadly, the range of impacts will be:

- To mitigate potential system security risks, AEMO would need to apply more conservative limits on the technical envelope than the limits that would be applied if there were more certainty around load behaviour. This would result in more stringent constraints in the dispatch process, creating market inefficiencies that would end up having economic consequences for both consumers and participants. It will also make it more challenging to plan short-term outages and network augmentation needs.

- The inability to accurately forecast the increased variability in load will create greater requirements for FCAS.
- The efficacy of emergency frequency control schemes such as under frequency load shedding (UFLS) will be unknown without knowledge of the DER inverter trip settings. This undermines AEMO's ability to operate the power system within the FOS.
- Inaccuracies in medium- and long-term planning processes will distort the signals sent to the market on future power system needs, creating the risk of either under- or over-investment in infrastructure.

These impacts will result in an inefficient market and increased costs to consumers."

3.4. Network Value from DER Visibility

In general, the use of LV data at operational and scheduling and planning leads to improved SAIDI and SAIFI (system average interruption duration index, and frequency index, respectively). Improved performance on these indices leads to greater DNSP revenue under the AER's incentive-based regulation schemes, the Efficiency Benefit Sharing Scheme (EBSS) and Service Target Performance Incentive Scheme (STPIS).

In addition, value streams 3, 4 and 5 (fault dentification, DER hosting capacity and DER compliance), add value to the networks planning processes through improved scheduling of asset maintenance and replacement. This allows DNSPs to abide by legislative and regulatory obligations, but with a reduced risk of high-cost maintenance. In particular, more replacement capital expenditure actions can be treated under the Condition-Based Capex Program, from both the Planned and Reactive replacement programs, by using LV data to monitor asset condition. Where possible, this is the preferred approach of AER[7]. Improved asset monitoring can be used to extend the lifetime of high-value assets that are otherwise scheduled for replacement, thereby improving economic outcomes. Likewise, asset monitoring can be used to better predict failures of assets allocated to the Reactive replacement program, and avoid the safety and reliability concerns, and economic losses that come with reactive replacement of failed assets.

Finally, it is widely understood, although not yet in common practice, that DER installed behind the meter (BTM) will be able to provide voltage and congestion management solutions to distribution networks, and to participate in system-level service via orchestration and/or aggregation. At the network level, harnessing DER in this way provides economic value to the DNSP by avoiding and deferring asset network augmentation replacement. At the system level, DER participation in wholesale energy and services markets has the potential to realise a significant market benefit by reducing system-wide costs of ramping, peaking and stability services. Sub-circuit measurement will be necessary to model, forecast and control solar PV and DER loads such as hot water, air conditioning and pool pumps.

3.5. Consequences of Poor LV Network Visibility

A report from AEMO[8] outlines their concerns were poor LV network visibility to continue with increasing DER penetration. Summarised, these key concerns are:

- To mitigate potential system security risks, AEMO would need to apply more conservative limits on the technical envelope than the limits that would be applied if there were more certainty around load behaviour. This would result in more stringent constraints in the dispatch process, creating market inefficiencies that would end up having economic consequences for both consumers and participants. It will also make it more challenging to plan short-term outages and network augmentation needs.
- The inability to accurately forecast the increased variability in load will create greater requirements for FCAS.
- The efficacy of emergency frequency control schemes such as under frequency load shedding (UFLS) will be unknown without knowledge of the DER inverter trip settings. This undermines AEMO's ability to operate the power system within the FOS.
- Inaccuracies in medium- and long-term planning processes will distort the signals sent to the market on future power system needs, creating the risk of either under- or over-investment in infrastructure.

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1 APVI Market Analysis, May 2019, APVI

2 Energy Queensland, Distribution network transformation to support DSO evolution, March 2019

3 Vattenfall, Low voltage monitoring, Swedish Smart Grid Forum, 2019

4 http://upgrid.eu/?p=1297

5 https://ide4l.eu/

6 Energy Queensland

7 As outlined in the AER Draft Industry practice application note – Asset replacement planning, September 2018.

8 AEMO, Visibility of Distributed Energy Resources – Future Power System Security Program, January 2017

Online

e: admin@DERmonitoring.guide

w: www.DERmonitoring.guide

AEMC

ETRConsultations@sa.gov.au

23rd July 2020

Australian Energy Market Commission (AEMC) Draft Determination on the Australian Energy Market Operator (AEMO) Distributed Energy Resources (DER) Technical Standards rule change.

Solar Analytics welcome the opportunity to provide input to AEMC on the above.

Solar Analytics (SolA) is an Australian company founded by solar industry veterans, scientists, developers and passionate photovoltaic (PV) experts. We design, develop and supply intelligent rooftop solar and energy management solutions for residential households and commercial businesses. With 35 staff and 50,000 customers across Australia, we are the leading independent provider of rooftop solar management in Australia. With the largest fleet of real time solar + energy consumption in Australia, we provide energy data to seven DNSPs, AEMO, ESB and other energy regulators.

Solar Analytics supports the approach proposed in the draft determination and the inclusion of DER Technical Standards in the National Electricity Rules. However, this approach needs to address the following:

- Include the requirement to comply with the industry supported https://www.dermonitoring.guide/ for data standards in the first AS4777 update (refer next section). Supporting files from website attached

- Align with the Project Evolve etal IEEE 2030.5 interoperability work for data transmission for future updates.

Solar Analytics Pty Ltd
ABN: 92 165 351 511

Suite 9 / 245 Chalmers Street, Redfern NSW 2016
Ph. 1300 651 137
www.solaranalytics.com.au

solar analytics

DER Visibility and Monitoring Best Practice Guide

As both AEMO and most DNSPs have stated, visibility of the DER is of critical and urgent importance (refer to DER Guide website for references). Over the past 12 months an industry led best practise guide for providing visibility and monitoring of DER has been developed. This guide has now been published and is supported by all of the key industry bodies – https://www.dermonitoring.guide/.

The key benefits of doing this are:

- Provides enhanced visibility to SAPN, AEMO and other industry bodies to ensure network security
- Harmonised data set available to energy market planners and regulators to manage the transition to a two way energy market
- Facilitates the effective transition to dynamic export and a two-way market
- Provides value to consumers through the provision of real time granular data and insights

Regards

Stefan Jarnason
CEO

Attachments:

- DER Best Practise Visibility and monitoring Guide
- DER Best Practise Visibility and monitoring FAQ
- Data use cases

Solar Analytics Pty Ltd
ABN: 92 165 351 511

Suite 9 / 245 Chalmers Street, Redfern NSW 2016
Ph. 1300 651 137
www.solaranalytics.com.au

Distributed Energy Resources (DER) Visibility and Monitoring

Best Practice Guide

Public Release Version 1.0

Table of Contents

01.
Introduction

Australia leads the world in the deployment of Distributed Energy Resources (DER), with 21% of premises having installed DER and 220,000 new systems being added each year[1].

At present rates of installation, Australia will have around 45-50% of generation installed behind the meter within ten years.

While this increasing DER penetration is contributing to lower electricity costs for consumers and lower carbon emissions, there are a number of key challenges to this continued growth and deliver value for consumers.

1.1 Context

Increasingly, today's smart energy technologies such as remote monitoring devices and solar and battery inverter systems have built-in capabilities to collect vital data from these many DER installations, and to communicate it in near real-time via the internet.

The key challenges facing the distributed energy industry today are:

1. Equitably and cost effectively increasing the DER hosting capacity of the electricity networks while maintaining grid reliability and benefits for all energy consumers, and
2. Increasing the quality of rooftop solar systems being installed, and hence their safety, longevity and the renewable energy generated.

The key barrier to addressing the first of these challenges, as detailed in recent reports[2] is increased DER operational visibility being made available to industry stakeholders. This lack of data is hampering the efficient transition to a low-cost, high renewable penetration electricity system.

The major challenges from this lack of data will be – or is being – felt most acutely in the low voltage networks. It is these network businesses that are also likely to benefit most from being able to access standardised data and information about newly installed DER.

To support the interests of consumers and the system, a key component will be consistent static and dynamic information, accessible for both consumers and other authorised entities. This Guide establishes such a data set.

1 APVI Market Analysis, May 2019, APVI

2 Refer to DER Monitoring Best Practise Guide Use Cases V1.1 for references

1.2 Purpose & Objectives

This Guide has been developed to deliver benefits for DER consumers, all electricity consumers, energy regulators, and energy industry participants.

This Guide has two key objectives, with targeted outcomes

Objective	Target outcomes
1. To establish a common static and dynamic (near) real time data set collected for new DER installed behind the meter on the low voltage electricity network.	Provide consistent data required to equitably and cost effectively increase network hosting capacity for DER. Enable regulatory bodies, DNSPs, academics and other parties to procure and combine data from multiple sources to meet their network modelling and visibility needs – subject to appropriate commercial arrangements.
2. To increase confidence in the quality and performance of DER through the provision of this real time system performance data to DER owners and authorised industry entities.	Enables consumers and industry participants have consistent information sources to ensure and evaluate optimal operation and system quality.

1.3 Scope and Application

This Guide will apply to data collection and provision from new grid-connected DER installed in Australian locations, behind the meter according to the National Electricity Rules (NER) that are capable of generation.[3] DER generation information is defined in Chapter 10 of the NER as standing data in relation to a small generating unit. A small generating unit is a generating unit:

- With a nameplate rating less than 30 MW; and
- Which is owned, controlled or operated by a person that AEMO has exempted from the requirement to register as a Generator in respect of that generating unit in accordance with clause 2.2.1(c).

For clarity, this Guide does not require the inclusion of any demand side participation information.

The Technology Provider that provides the monitoring equipment and software assumes the responsibility for the acquisition of the data set and provision of this data set to third parties on commercially negotiated terms. This may be provided directly to the third party or through intermediaries.

3 Data capture applies to new installations only and will not apply retrospectively to other systems that may exist on the same site.

02.

General Requirements

2.1 General Data Requirements

Both the static data set and the dynamic data set are designed to align with the AEMO DER Register and VPP data specification by using the site NMI and System ID fields (if available) as they can provide unique joining fields for a future integration or data analysis. This integration will simplify the registration for the solar installer, avoid duplication of data, and increase the accuracy and value of the data collected.

Following the convention of the AEMO DER Register, DER generation information is provided in a 3-level database structure, and includes information that is:

- Aggregated at the NMI level to provide total capacity and export capacity for the site
- Aggregated at the AC Connection level, where devices are linked together to form a DER Installation, and can provide separation of device types and technologies
- At a device level, where technical details and capacities of individual devices are recorded.

DER generation information is made available electronically via either Application Programming Interface (API) link with an application or via web interface. Further technical details on the use of the API and web interface will be set out in a technical guide[6].

2.2 Static Data Requirements

The static data is data related to the DER system that does not change or is changed infrequently when changes are made to the system or settings. This static Data Set is the minimum set of data that is required for the purposes of this Guide.

A small number of fields are listed as optional where the data is potentially required only for a particular technology type, or, may not be immediately availa ble at the time of installation.

This static data set may be collected in isolation, however this data collection would ideally support and be aligned with the DER Registration process such that the data is only collected once. This data may also be used to support grid connection applications with the relevant network.

The below table lists the data fields required. The "In DER Register" column indicates if the data is included in the DER Register.

4 https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/Pilots-and-Trials

5 https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/DER-Register-Implementation

6 The organisations that endorse this Guide aim for this technical guide to be aligned with the AEMO DER Register and VPP data specification and any future standards developed by Open Energy Networks or API Technical Working Group or other relevant body so that the industry has a single common data format protocol.

Table 1. Required Static Data Elements

Required Data Point	Description	Units	Notes	In DER Register
System ID	Unique identifier for each connection point where DER installation is (required since NMI can be restricted PID)	Alpha-numeric	Required for new installations and what is monitored by tech vendor (generated by Tech Vendor)	No
Location	Postcode, statistical area, feeder or address depending on privacy and use	Alpha-numeric	AEMO retrieves this information from NMI	No
System type	Type of DER (solar, battery, ev etc) for each DER	Pick list	Must be able to generate power to be classified as DER. Type is from AEMO VPP definitions	No
Technology Provider	Organisation name of the Technology Provider (company that provides the Data Set)	Alpha-numeric	Alignment with AEMO VPP Data - device manufacturer, device model (hardware), and device control box (third party software etc.)	No
Remote access/ connection	Details of type of monitoring attached to site/DER. Should specify type of comms (if any), and if any remote control is available	Y/N, Type (WiFi, 4G, Ethernet, etc)	Type of comms available, remote control available? Note if not connected by customer choice	No
Approved capacity	Approved small generating unit capacity as agreed with NSP in the connection agreement, expressed in kVA	Numeric (kVA)	Can be distinct or equal to an export limitation	Level 1
Solar Retailer	Solar/DER Retailer company name and ABN	Alpha-numeric	Entity accountable for the installation, modification or removal of the DER. Accredited installer is optional.	Level 1
Site details	Site details and controls contained in DER Register	Alpha-numeric	Eg protective controls, # phases or export limits. (Refer to Appendix 4.3)	Level 1
Commiss-ioning date	The date that the DER installation is commissioned	Date		Level 2

Table 2. Optional Static Data Elements

Optional Data Point	Description	Units	Notes	In DER Register
NMI (optional)	Unique identifier for each connection point where DER installation is. Without NMI checksum	Alpha-numeric	Only required for new installations and what is monitored by tech vendor	Level 1
AC Connection ID (optional)	Unique identifier for each AC Connection or Group in a DER installation	15 digit numeric	Optional or sourced via AEMO generated (Refer to diagrams in Appendix 4.2). Can be same as AEMO Dispatchable Unit Identifier (DUID)	Level 2
Equipment details (optional)	Equipment details contained in DER Register	-	Eg Inverter mode (Refer to Appendix 4.3)	Level 2
Equipment settings (optional)	Equipment settings contained in DER Register	-	Eg Voltage settings (Refer to Appendix 4.3)	Level 2
Device ID (optional)	Unique identifier for a single DER device or a group of DER devices with the same attributes	15 digit numeric	Optional or sourced via AEMO generated	Level 3
Device details (optional)	Device details as contained in DER Register	Alpha-numeric	(Refer to Appendix 4.3)	Level 3

2.3 Dynamic Data Requirements

The dynamic data is data related to the DER system that changes frequently depending on the system and grid operating conditions. This dynamic Data Set supports the purpose of the Guide to address visibility and monitoring of performance. This data set has been established to accord with industry requests and specific applications that deliver benefits to all parties.

This dynamic data set is linked to the static data set by the NMI and AC Connection ID fields.

- All data is collected at 5 minute intervals and made available in (near) real time.
- Site-level data is required to be captured using hardware that is accurate to class 1 (1% variance).
- DER level data is required to be captured using hardware that is accurate to class 4 (4% variance).

Dynamic data elements are split into required and optional elements in the two tables below.

Table 3. Required Dynamic Data Elements

Required Data Point	Description	Units	Notes
Site Gross Load - Active/Reactive power	Total Active/Reactive power consumed by the customer (equals Imported + ∑DER generation – Exported - ∑DER consumed). Per phase is preferred with combined acceptable	kW/kVAr	Max, Min, Average
Site Active/Reactive exported power	Active/Reactive power exported from the site. Per phase is preferred with combined acceptable	kW/kVAr	Max, Min, Average
Site Active/Reactive imported power	Active/Reactive power imported from the grid to the site. Per phase is preferred with combined acceptable	kW/kVAr	Max, Min, Average
DER Generation - Active/Reactive power	Active/Reactive power generated by each DER. Per phase is preferred with combined acceptable	kW/kVAr	Max, Min, Average
DER Consumption - Active/Reactive power	Active/Reactive power consumed/stored by each DER. Per phase is preferred with combined acceptable	kW/kVAr	Max, Min, Average
Site Voltage	AC voltage over the period– measured at meter board. Recommended per phase with 10sec measurement interval	V	Max, Min, Average
Time	Accepted date format are yyyy-MM-ddThh:mm:ss or yyyy-MM-ddThh:mm:ss.sss	UTC	Date and time matched to AEMO VPP data (ISO 8601 format)

Table 4. Optional Dynamic Data Elements

Optional Data Point	Description	Units	Notes
Site Active/Reactive energy imported (optional)	Active/Reactive energy imported to the site. Per phase is preferred with combined acceptable	kWh	Cumulative
Site Active/Reactive energy exported (optional)	Active/Reactive energy exported from the site. Per phase is preferred with combined acceptable	kWh	Cumulative
DER Active/Reactive energy consumed (optional)	Active/Reactive energy consumed by the resource. Per phase is preferred with combined acceptable	kWh	Cumulative
DER Active/Reactive energy generated (optional)	Active/Reactive energy generated by the resource. Per phase is preferred with combined acceptable	kWh	Cumulative
Battery SOC (optional)	Battery state of charge (usable)	Wh	Max, Min, Average
Frequency (optional)	Frequency (10 sec or shorter measurement interval). At least two decimal places	Hz	Max, Min, Average and Instantaneous

2.4 Customer Data Visibility

A combination of the Static and Dynamic Data collected from the customer will be available to the customer though common interfacing, namely via website or mobile application.

All of the Static Data will be available to the customer. Customers will also have access to at least the following Dynamic Data (as defined in Table in section 2.3):

- Site Active energy or power imported
- Site Active energy or power exported
- Site Active energy or power generated = Sum of all DER Active energy generated
- Site Active Gross Load or Site Active energy consumed = Site Active energy generated + Site Active energy imported -Site Active energy exported
- Time

The Dynamic Data will be available in 5 min or shorter intervals and made available in (near) real time. Historical data (where available) will also be available to the customers.

2.5 Data Security and Privacy

Data collected from the system owners or customers' DER will most likely contain personally identifying information (PII). Australian consumer law addresses the collection and storage of PII data. All Technology Providers conforming with this Guide collect and appropriately manage customer data today in accordance with requirements where they operate. All Technology Providers comply with the collection, storage and any use of data to meet customer expectations, all applicable local, state and federal consumer law and privacy regulations.

Consistent with Customer Terms and Conditions, privacy provisions must be addressed in accordance with Australian Privacy Laws.

For the purposes of this Guide, any data management must abide by requirements of the relevant Australian jurisdiction. This includes security of data 'in flight', authentication, authorisation for data provision, access, data storage, use and misuse of the data.

2.6 Customer Terms and Conditions

The collection of data from DER owners must comply with relevant local, state and national legislation. The collection must also incorporate explicit customer consent for it to be collected in the first place and provided to third parties.

This Guide requires that customers are given the option to opt-in to provision of data that provides static and dynamic information (separate to the DER Register data capture).

To address customer consent, a data collection statement from the Technology Provider must be provided seeking consent to the collection of personal information for the purposes of active monitoring. The data collection statement must purposefully comply with the Australian Privacy Principles set out in the Privacy Act 1988. In addition, a Privacy Policy must be available on request. A check box must be ticked to finalise DER data collection by the Technology Provider, the Solar Retailer or the installer on behalf of the customer.

2.7 Exceptions and Non-compliance

This Guide allows exceptions and a level of non-compliance due to an expectation there may be a reason why a particular data set is not being, or cannot be, provided.

Initially, non-compliance can be noted with a valid reason. This includes lack of customer consent or other technical reasons that preclude the provision of the data.

2.8 Communications

Data flows from Technology Providers on behalf of individual sites/DER ("cloud communications") is expected to have high quality, consistent availability at the fleet level. This is important to ensure that sufficient data is available for consumers and industry participants to meet the objectives of this Guide.

Each Technology Provider is responsible for the maintenance of the site to cloud communications and the availability of the cloud for API data services. It is recommended that each Technology Provider maintains an availability of at least 90%, calculated as follows

$$\text{Monthly Availability} = \frac{\text{Average \# 5 Min Periods Reported per Site}}{\text{\# 5 Min Periods in Month}} \%$$

Notes:

- A reported period is a period where the data is sent from the site to the Technology Vendor and made available
- In a 30 day month there are 12x24x30 = 8,640 x 5 min periods
- The average # periods reported in the month includes all sites registered (pro-rata or excluded for sites commissioned in that month)
- Excludes any exempt sites
- Will include null or zero values for systems that are not energised

This Guide does not include any individual site communications uptime availability target ("site communications") since individual site communication reliability will vary according to a number of factors which are outside the control of the Technology Provider.

Further technical details on the provision and use of the API and web interface will be set out in a technical guide and harmonised with evolving industry standards. This includes requirements for real time availability, access, protocols, and verification. The specific commercial agreement between the parties would specify any agreed Service Level Agreements (SLAs) and other terms and conditions of the provision of the data.

2.9 Third Party Data Access

For clarity, data collected under this Guide is controlled by the Technology Provider and made available commercially to approved data users according to Privacy and Customer Terms and Conditions agreed with the DER owner.

2.10 AEMO DER Register – data alignment

The DER visibility and monitoring data sets proposed in this Guide align with key data fields in the AEMO DER Register and AEMO VPP Data specification. By aligning key data points which are consistent (today), the intent is to ensure that there is potential for a future integration pathway or data provision pathway for the AEMO DER Register, VPP data specification and other yet to be established standards in Australia.

2.11 Compliance with the law

This Guide co-exists with relevant state or federal legislation, including Australian Consumer Law (Cth) (ACL) (Schedule 2 of the Competition and Consumer Act 2010). These laws are not replaced or restricted by this guide. This Guide applies to the extent that it is consistent with all existing state and federal legislation and regulation. Where the Guide is found to be inconsistent with any existing state or federal legislation or regulation, that regulatory obligation will take precedence to the extent of the inconsistency. Compliance with this Guide does not guarantee compliance with any legislation.

3. Governance

3.1 Product Conformance

This Guide is a voluntary guide. A Technology Provider may elect to have some or all of their products conform with this Guide. Conformance is determined by self-assessment by the Technology Provider. This requires:

- Stating the equipment collects the required data fields (or will within 6 months)
- Being listed as conforming on the Guide website www.DERmonitoring.guide.

This may be done by providing the equipment information and a conformance statement to the Guide administrator admin@DERmonitoring.guide.

Complaints against a Technology Provider who has publicly stated that they endorse or conform with this Guide are handled by through normal industry avenues.

3.2 Administration

This Guide has been developed by a leading group of Technology Providers in consultation with energy regulators, DNSPs, academic institutions, consumer and industry organisations. These Technology Providers include Edge Electrons, Enphase, Fronius, GreenSync, Redback, SMA, Solar Analytics, SwitchDIN, Tesla and WattWatchers. These organisations do not automatically endorse or conform with this Guide.

Any enquiries regarding this Guide can be sent to admin@DERmonitoring.guide. Further informatimn is available at www.DERmonitoring.guide.

3.3 Guide Updates

This Guide is intended to be updated based on changes to the operating and regulatory environment of the DER industry. Updates to the Guide can be proposed by contacting admin@DERmonitoring.guide.

The intent of this data set is to ensure the least amount of information is collected to deliver the largest impact. Updates will be assessed according to two key criteria:

- The Technology Provider can cost effectively obtain the data
- There is clear use-case and value to users of the data

4.

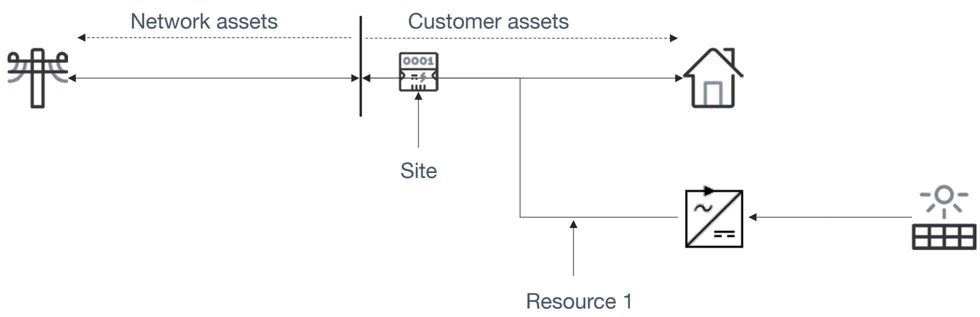
Appendix

4.1 Glossary and Definitions

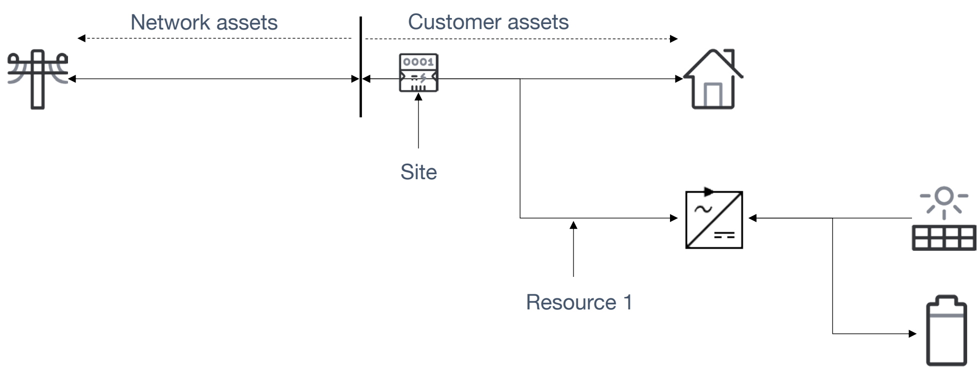
API	Application Programming Interface
Data Set	Combination of Static Data Set and Dynamic Data Set
DER	Distributed Energy Resources
DER Owner	Residential or commercial customer who owns one or more DER
Dynamic Data Set	This is a set of data specified in this Guide that is related to the DER system that changes frequently depending on the system and grid operating conditions
DNSP	Distribution Network Services Provider. May also be referred to as Network Services Provider (NSP)
Static Data Set	This is a set of data specified in this Guide that is related to the DER system that does not change or is changed infrequently when changes are made to the system or settings
(Solar) Retailer	Clean Energy Council Approved (Solar) Retailer (authorised by the ACCC) who commits to responsible sales & marketing and industry best practice in the solar and storage industry.
(Solar) Accredited Installer	Clean Energy Council accredited installer that signs the installation form
Technology Provider	Entity that collects the Data Set and makes it commercially available to third parties according to customer terms and conditions and explicit customer consent

4.2 DER Monitoring Installation Example Diagrams

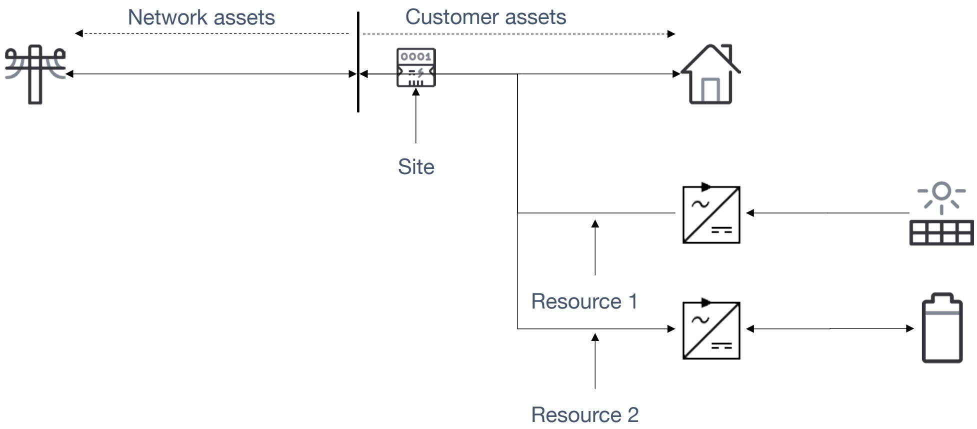
Solar only



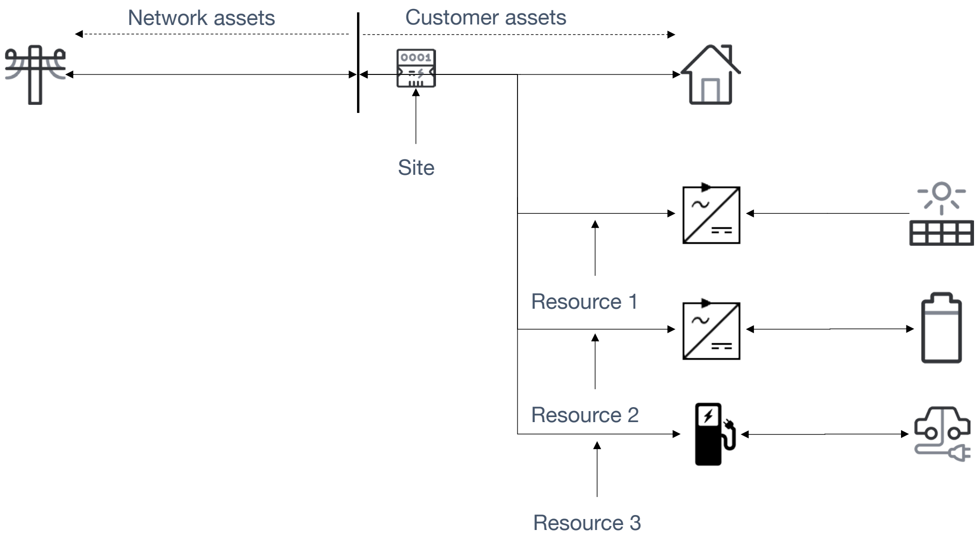
DC coupled solar and battery



AC coupled solar and battery



AC coupled solar and battery and EV



Online

e: admin@DERmonitoring.guide

w: www.DERmonitoring.guide