Performance Metrics for Distributed Energy Resources Export Services

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Abstract

Distribution Network Service Providers (DNSPs) are responsible for connecting solar and other Distributed Energy Resources (DER) to the network, setting limits on the size of systems and the amount of power that can be exported to the network, and managing the upstream capacity of the network. These are referred to as 'export services'. Following on from the Access, pricing and incentive arrangements for distributed energy resources rule change process, DNSPs are required to consider export services as part of their core services, integrate export services into planning and regulatory proposals, and the Australian Energy Regulator (AER) is tasked with exploring the viability of a Service Target Incentive Scheme for to incentivise improvement in export service quality. To facilitate these developments, *performance metrics for export services* are needed to ensure that networks are operating efficiently and to understand and communicate the service level that customers are receiving or should expect to receive. To this end, this paper presents a set of proposed metrics for *understanding and communicating the quality of export services*. Due to the length limit, this abstract only presents key highlights of the developed work.

Introduction

Harnessing all benefits from DER can only be possible if DERs are efficiently integrated into power systems. In addition to the technical requirements, efficient integration must also consider other fundamental elements such as the regulatory framework. The regulatory framework was built on a centralised structure developed many years ago. This traditional framework was designed based on large power stations and consumers who could not export energy to the grid. But, with the increasing penetration of DER customers, the conventional regulatory framework needs to evolve to accommodate them as the prevalence of DER increases. For example, one necessary distinction to unlock opportunities and address challenges is to adequately acknowledge that distribution networks provide two distinct services to customers: (i) *consumption services*, which are the traditional service of supplying energy downstream to customers, and (ii) *export services*, which are related to the upstream energy services from DER customers to other customers or the market. Since export services were not explicitly defined in the NER, there was some ambiguity in legislation and regulatory frameworks around export services.

Within this context, the number of DER connected to the electricity network in Australia has grown under a regulatory framework developed for a one-way energy flow network, resulting in various interpretations and strategies to define and manage export services provided to customers. This situation creates a potential risk for DNSPs to be unable to fairly manage customers' rights to export energy to the grid, complicating network investment decisions. A wide range of stakeholders identified the need for a change through a review of access and pricing reform options to efficiently integrate more DER that enable a two-way electricity network (AEMC, 2021).

Considering export services as part of the fundamental services provided by DNSPs and the underlaying operating, planning and regulatory implications, raise the need to develop a systematic approach to estimate, benchmark and communicate the level of export services that DNSPs are providing to customers. In this context, performance metrics for export services can serve as a valuable tool. Traditionally, performance metrics for consumer services have been an efficient tool to ensure that networks are operating efficiently, implement financial rewards or penalty arrangements, and to understand and communicate the service level that customers are receiving. DNSPs being able to measure, benchmark and communicate the quality of export services they provide to their customers is also expected to unlock a range of uses for DER customers and developers as well as policy makers and regulators, for example (DEIP, 2020):

1. DNSP customers:
   - to understand the expected level of export service they might receive from their DER,
   - to receive appropriate advice from developers/retailers/aggregators of DER systems about which DER system(s) and associated export service levels, which are suitable for them, and
   - to engage with network operators about export service levels.

2. DER system suppliers:
   - to provide appropriate advice to their customers about the expected quality of network export services from their network operator and suitable DER systems.

3. Policy makers, regulators and the market operator:
   - to monitor and benchmark the quality of export services provided to customers,
   - to establish service incentive arrangements for export services to provide incentives for DNSPs to provide efficient levels of export services.
   - to provide transparency and oversight of what is happening on LV networks through a common strategic approach to measure and benchmark export service performance levels, to underpin fair and equitable network policy settings and regulations.

The overarching aim of this paper was to develop and test metrics for understanding and communicating the quality of export services. As networks reach 'zero' hosting capacity according to the traditional network hosting capacity definitions, it becomes vital to communicate with customers, regulators and industry about the level of export service quality received and to examining examine strategic and collaborative approaches to providing third party access to, and/or mapping of, network hosting capacity for DER.

Methodology

As a result of the conducted literature review, a set of (i) assessment criteria and (ii) use cases were developed to define what a successful approach to understanding and communicating DER export service quality looks like. This covered issues such as data accessibility, the accuracy of representation, interpretability, fairness, ability to facilitate higher DER uptake, ability to reduce total curtailment, regulatory outcomes (including unintended consequences), and applicability to different use cases or network types. The assessment criteria were then applied to a long-list of metrics to score options and develop a proposed short-list.

Use cases

To clarify the required applications, the following set of discrete ‘use cases’ was developed across three primary use case categories for which export service quality metrics are required:

1) **Customer communication:** To allow DNSPs to have conversations with customers regarding the expected level of export service, network offerings and customer choices. Sub-

use cases include current customers with DER, connection applicants planning new DER investments (or their industry representatives such as solar installers, retailers and aggregators) and broader stakeholder conversations with regard to managing investments in export service quality.

2) **Regulatory compliance:** The Australian Energy Regulator (AER) is currently working towards monitoring, benchmarking and incentivising the quality of network export services. Metrics are required to support the setting of incentives for optimal quantity, cost, and quality of export services via a potential extension to the Service Target Performance Incentive Scheme (STPIS). Metrics are also required to bring export services into annual benchmarking reports that compare network productivity, as well as to underpin jurisdictional service standards that address inequitable customer export service outcomes.
3) **DNSP grid operation & planning:** Metrics are required to monitor and improve operational performance and to support the development of business cases to quantify the costs and benefits of export service quality maintenance or improvement projects.

Short-list

The proposed list was ultimately prioritised into four 'headline' metrics, as presented below:

Table 1. Proposed headline metrics for export services

Name	Summary
Total utilised DER generation	Ideally, this metric is measured directly from customer telemetry, which is currently available for dynamic export customers in South Australia. For other customers, however, it would need to be calculated from estimated potential DER generation, minus the estimated volume of curtailment. This metric is considered the best overarching indicator of desirable service performance because it aligns well with what customers value from DER, is not affected by changes in customer consumption (e.g. metric does not decline if people charge their EVs during the day) and reflects all strategies to accommodate more DER (tariffs and incentives, flexible export limits, network improvements etc). As the DNSP does not have full control over how much DER is connected, this places some limits on its application.
Duration of full export access	Measures the annual percentage of time (or can be expressed in minutes) customers experience unconstrained access up to the maximum export limit set in their connection agreement. This metric is used to define and communicate the network export availability dimension of export service product offers. This metric subtracts periods of voltage-related curtailment (which generally includes V-W and V-VAr curtailment, or occasionally in extreme circumstances, voltage tripping) and dynamically signalled export limitation, measured as the periods the customer sits at their dynamic export limit. Static export limitations (in cases where the customer has chosen to install a system larger than the static export limit) are not counted in this metric, as the maximum agreed connection limit is being met.
Export service	This metric measures a network's delivery on contractually agreed export service level offers defined through metric ,"Duration of full export access" (e.g., did flexible exports customers receive full export capacity up to 10kW 97% of the time?)

levels achieved	
Volume of curtailment	This metric estimates the total volume of energy curtailed by i) voltage-related curtailment, as well as curtailment during periods when customers reach their (ii) static export limits or (iii) dynamic export limits. The estimate is calculated using expected DER generation based on DER register and climate data. Customers and industry parties can use these figures to calculate the Financial Impact of Curtailment (in $/yr) based on prevailing consumption rates and feed-in-tariffs, or DNSPs can calculate the economic impact of curtailment based on the Customer Export Curtailment Value (CECV). As each type of curtailment is calculated separately, this enables industry parties to place a higher value on the loss of behind-the-meter generation from voltage-related curtailment, for example.

Conclusion

This paper presented a shortlist of performance metrics to measure and communicate export quality services. Four metrics have been short-listed as valid indicators to measure export service levels, and the link with real use-cases have been assessed. While this paper has laid a solid foundation for export service quality metrics, further work is required to address emerging challenges, such as developing methods to overcome network visibility issues, and developing methods to accurately estimate DER curtailment.

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References

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