



Application and deployment of Dynamic Connection Agreements for distributed energy resources (DER)

A discussion paper

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Introduction

Our energy system is changing at a rapid pace as consumer-owned devices and distributed energy assets – large and small – play an increasingly significant role in our energy ecosystem.

The continued rollout of solar PV, battery storage, electric vehicles and other types of Distributed Energy Resources (DER) present challenges to Distribution Network Service Providers (DNSPs). These challenges were not contemplated when our networks were designed and constructed.

There are a number of mechanisms that networks may use to address the issues introduced by DER that vary in cost and effectiveness. To date, these mechanisms have largely been limited by technological as well as regulatory factors. However, the capability for DNSPs to manage their networks through existing avenues are reaching their limits.

We posit that a change in approach is required that delivers cost effective outcomes while providing customer choice and flexibility.

One of the key challenges and limitations with the current approach to DER is that the vast majority of customers are connected to the network with static connection limits. Dynamic Connection Agreements (DCAs) represent a critical tool to help address the above issues through a transition to dynamic limits.

DCAs may be used in isolation or in conjunction with other strategies.

They establish a framework which delivers:

- Physical protection of the network
- Flexibility in policies for allocation of network capacity
- Markets for network capacity
- Provision of data to inform operation and planning
- Consumer choice and pathways to future market service provision and network support contracts.

DCAs offer a range of benefits to consumers, system operators and policymakers, as well as other energy market participants. This paper explores the concept of DCAs, provides an overview of the key benefits and presents some open questions for consideration and discussion by industry.

Supporting the Distribution System Operator transition

Advent of small-scale assets

Rapid emergence of customer-side energy investments in solar PV, battery storage and electric vehicles, drives a movement away from centralised, directional, bulk generation and distribution and towards a more distributed energy system.

Small-scale assets are typically used for on-site self-consumption needs, with excess energy exported to the network. This is starting to change; smart, small-scale energy assets can now generate, store and consume energy in response to price signals to achieve preferred outcomes for consumers and/or to optimise efficiency and asset utilisation across the system.¹

This transformation towards small-scale assets participating more directly in the energy system poses a disruptive force to established industry stakeholders. Some tech vendors and innovative retailers now have product offerings that provide customers with the capability to actively participate in the market providing services to the market or to networks.

Imperative of collaboration

Significantly, this transformation necessitates a deeper understanding and engagement by all stakeholders as many key energy assets are no longer owned and operated by the traditional entities in our sector. Collaboration between stakeholders is essential to manage the cost and equity issues associated with this transformation.

This need is especially acute for distribution networks. While these networks must continue to enable customer connections, there are limited options available for them to manage the increasing numbers of distributed energy resources (DER). To best serve consumers, we must work together as an industry to increase the efficacy of the tools and strategies available.

¹ Consider VPP projects across Australia such as: South Australia (SAPN Salisbury Battery Trial, Simply Energy VPPX, AGL VPP, Tesla VPP); Victoria (Origin VPP, United Energy VPP, Mornington Community Grid Project); NSW (Ausgrid VPP); ACT (Canberra VPP); Tasmania (CONSORT VPP); Queensland (CSIRO VPP, Ergon VPP), Western Australia (Dunsborough Community Energy Project); and multi-state (REPOSIT VPP, Sonnen Community, Networks Renewed Project)

Managing distributed energy resources

The majority of customers have a large degree of flexibility and control over the way that they use electricity, with the freedom to decide what to connect at their premises and when. Until recently, customers' energy consumption patterns had been, for the most part, consistent and predictable. This meant that networks were able to model with a reasonable degree of confidence. They have used these models in the construction and operation of their networks, to ensure that customer energy needs were met over many decades.

The advent of DER has resulted in significant changes to customer consumption patterns with the ability to generate, store and consume energy in new ways with a range of new device classes. Networks currently have limited visibility over the DER installed by their customers² and, more importantly, over how these DER behave and affect the network. As DER grow in number and type, this is resulting in the emergence of adverse network conditions (such as under/over voltages and thermal overloads). Under Australia's regulatory regime, it is the responsibility of the networks to identify, and take action to resolve these conditions.

In certain cases, network issues may be resolved through operational activities and expenditure (OPEX). These might include network reconfiguration or transformer tap changes. However, in many situations, network augmentation – adding more poles, wires or widgets to the network – is seen as the only viable option.

One of the key challenges with the current regulatory framework is that, in most cases, the customers that are contributing to the need for the augmentation are not directly exposed to the costs associated with it. This has been the case with the growth in air-conditioners and is a criticism now levelled at solar PV owners. In essence, all customers pay for the costs of upgrading the network poles and wires, regardless of whether they benefit from the investment or not.

Preliminary analysis by network companies in Australia indicates that the costs of investment to provide all customers with the freedom to connect and use DER with no restrictions would result in massive increases to network charges to all customers.

Some in the industry consider that solar owners should be charged more reflectively for their impact on the network.³ However, if the costs of such investment were to be accurately reflected in an individual customer's connection/service charges, it is likely that this would significantly affect a customer's return on investment for their purchase of a DER. Such an outcome would also (likely) exacerbate the lack of trust between customers and energy companies.

Irrespective of the issues regarding cost-sharing, there is general consensus that while appropriate in certain situations, undertaking augmentation to provide all customers with ultimate freedom would lead to an untenable increase in costs.

Static limits are now being used as a tool by distribution networks to mitigate the scale of augmentation required.

² Network visibility over DER connected to their systems is being addressed (to an extent) through the AEMO DER Registry initiative. This Registry will 'go live' in late 2019 and will contain static information. Victorian distribution businesses can also access smart-meter data to detect, analyse and derive the behaviour of customers' DER.

³ <https://www.energynetworks.com.au/news/energy-insider/sun-setting-electricity-export-charging-ban>

Static Connection Limits

From basic services for residential connections all the way through to large generators at the transmission level, Connection Agreements are a well understood concept: they set the standards and terms of access for connection to the network. Connection Agreements are essential for ensuring that customers do not behave in ways that may affect the ability of the network or market operator to deliver safe and reliable services to all customers.

To manage the impact of DER, many Australian networks impose static restrictions on the size of system that may be connected, or amount of power that may be exported.

In large scale connections, Connection Agreements will specify detailed technical settings and performance requirements that the customer's system must comply with. In smaller distribution network level connections, Connection Agreements define basic electrical and physical connection requirements.

Where a customer wants to connect a DER (solar PV system or battery), a Connection Agreement will define (or refer to guidelines that define) basic electrical settings and other requirements for connection to the distribution network⁴. It should be noted that such a process does not yet exist for electric vehicle charging connections.

To manage the impact of DER on their networks, many Australian networks impose static restrictions on the size of system that may be connected, or amount of power that may be exported from the connection point. For some distribution networks, there is a threshold point (based on the asset, its location, or both) for whether a DER connection is accepted with no changes, or requires a more detailed negotiation and assessment regarding the parameters of any export limit.

However, as these limits are generally calculated on coarse rules-based approaches, they rarely capture and reflect the actual hosting capacity at a particular network location. This means that the amount of DER allowed to connect may be more than the actual capacity, which may result in violation of operational limits at certain points in time. Alternatively, the amount of DER allowed may be less than the actual capacity, which would result in an unnecessary restriction on the capacity of the assets that the customer may install.

⁴ While consumer cannot be charged distribution use of system charges for exporting electricity that has been generated by the consumer to the grid, the DNSP may nonetheless charge the consumer for the provision of connection services; National Electricity Rules, rule 6.1.4

Moving to Dynamic Limits

As the network state varies significantly throughout the day, so too does the hosting capacity of the network. This means that even if the calculated limit perfectly aligns with the hosting capacity in worst-case network conditions, for the vast majority of time this limit will be overly conservative.

If static connection agreements remain as the standard approach for customer connections, significant network capacity will remain unutilised, leading to inefficient outcomes for all consumers.

Although there are currently low numbers of batteries and electric vehicles connected to the network, it is inevitable that these DER will present similar challenges. As with solar PV, while static limits provide a mechanism for protecting the network, there is a risk that this approach will result in significant underutilisation of network capacity.

Clearly a better approach is required. It must be economically efficient - avoiding or deferring costly network augmentation where possible. It must be socially equitable - providing appropriate signals to customers to lower their DER potential to impact the network.

We propose that a transition from static to dynamic limits is a critical and necessary change to achieve these outcomes. As a starting point, dynamic limits will benefit customers, allowing them to install larger capacity DER (increasing network utilisation) while ensuring DNSP confidence in the ability to maintain the network within defined operational limits.

We expect that as the capability and maturity of systems evolve, so too will the sophistication of limit implementations, unlocking additional value for customers. As network providers improve visibility and understanding of their network conditions, they can (potentially) be less conservative, but also more granular in their allocation of limits, allowing additional energy to be exported and consumed.

Dynamic limits lay the foundations for capacity markets, in which customers may have the capability to buy additional capacity from other customers that are willing to sell their capacity.

We expect that as the capability and maturity of systems evolve, so too will the sophistication of limit implementations, unlocking additional value for customers.

Dynamic Connection Agreements

Dynamic Connection Agreements (DCAs) are the mechanism through which dynamic limits can be implemented, unlocking benefits for customers, networks and other parties.

The essential elements of a DCA are:

1. Customer consent – explicit agreement via the connection agreement, which increases customer access to the network in exchange for provision of services.
2. Provision of specified services, which at a minimum include:
 - Telemetry data from the DER to the network; and
 - Reducing DER output in response to DNSP specified limits, to maintain the network within specified operational limits.

This document does not define the full nature or extent of these, or other services that may be provided through a DCA. However, by focussing on services, there is an explicit emphasis on the outcomes required, rather than the particular mechanism through which the outcome is delivered.

Considerations of site level vs. resource level DCAs

Preliminary feedback is that DCAs should define the limits of operation with respect to the customer connection point. That is; the limits specify the real and reactive power that the customer may draw from or provide to the network. This ensures that the customer is provided with the greatest flexibility in what devices they may use and when, as well as giving technology vendors the freedom to innovate as to how this achieved. While this is the preferred approach for allocation of dynamic limits, it does present certain challenges.

In particular, the capability to influence energy resources to maintain site level load and generation below a specified limit generally requires a home energy management system (HEMS). Although becoming increasingly common, a minority of DER connected to the network is connected with a HEMS. The requirement to have a HEMS would reduce the accessibility of DCAs to customers that can access this technology type.

To reduce the barrier to entry for participation in a DCA, there are options in terms of implementation that may be used as an interim approach. For example, customers with only one generation source may be eligible for an export only DCA that references the output of that generation source. This would open up the eligibility of a DCA to any customer that owns a DER that is capable of receiving and responding to limits.

DCA Implementation

The DCA is achieved through physical and digital connection of the asset and digital registration in a system that manages customer consents and facilitates service provision between the network and the customer.

Through digital asset registration, a number of other benefits may be delivered to a range of parties through access to data or services. In the Australian context, to achieve outcomes that best align with the National Electricity Objective, DER should be registered in a system that facilitates these interactions. The permissions and priority for access – that are supported by DCAs – should be defined by the consent provided by the parties, and an appropriate policy/rule-based framework defined by an appropriate regulatory body.

DCAs and Operational Envelopes

In July 2019, the Open Energy Networks Project published an interim report: Required Capabilities and Recommended Actions. This report provides an evidence-based approach to inform the direction of the Distribution System Operator (DSO) transition, identifying key milestones and actions to enable the transformation. In this report, the maturation of operational envelopes is identified as a critical action to be taken in enabling the DSO transition; both in technical detail as well as the guidelines for how they are calculated and used.⁵

The Required Capabilities and Recommended Actions report is an excellent first step in stimulating activity in this space. Acknowledging that the Open Energy Networks Project will be publishing findings relating to each of the four proposed models later this year (which we presume will direct further definition of actors and relationships), we posit that the responsible network is the only feasible party to define any kind of operational limits on customers' DER behaviour. The implication is that the connection agreement between the DNSP and the customer must change and evolve to allow DNSPs to prescribe and update dynamic limits.

DCAs facilitate the delivery of operational envelopes by ensuring that the consent is in place for the provision of telemetry and response to specified limits.

⁵ AEMO – ENA Open Energy Networks (2019). Required Capabilities & Recommended Actions Report

Progressing Dynamic Connection Agreements

While DCAs provide a mechanism for dynamic limits to be specified, there are a number of options and decisions to be made in relation to the particulars of implementation.

This paper does not define or specify a preference for any of these but is intended to initiate discussion to progress towards the most suitable outcome for all parties.

We are keen to understand stakeholder views with respect to the following questions:

1. To address the challenges being faced by distribution networks and customers, do you agree that DCA are a necessary evolution of customer connections?
2. What should be considered in the rules and policies which determine allocation of network capacity across customers?
3. Should customers be entitled to some “protected capacity” that they always have access to, and should the network be augmented to provide that capacity?
4. On the assumption that connection point (NMI) level limit specification delivers optimal outcomes for both networks and consumers, but there are costs and limitations around the required technical capabilities, is an interim solution that delivers some but not all value appropriate?
5. What might be considered in a relationship between DCAs and tariffs (if anything)?
6. What actions should the sector be taking to shape and implement DCA?

To spark further discussion on these questions and the potential application of dynamic connection agreements, we will be engaging with partners and stakeholders through October 2019.

To get in touch and share your views, please head to <http://info.dex.energy/dca-discussion-feedback> to answer the questions listed above.

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Level 3, 469 La Trobe St, Melbourne VIC 3000 Australia
+61 3 9008 5986 | hello@dex.energy | <https://dex.energy>