S&C ELECTRIC COMPANY
Excellence Through Innovation

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Claire Richards
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Our Ref: JC 2017-013 3 July 2017

Dear Claire,

S&C Electric Company response to the Distribution Market Model Draft Report (SEA0004)

S&C Electric Company welcomes the opportunity to provide a response to the Distribution Market Model Draft Report, which explores how to facilitate the engagement of distributed energy resources in the wider system and markets.

S&C Electric Company has been supporting the operation of electricity utilities in Australia for over 60 years, while S&C Electric Company in the USA has been supporting the delivery of secure electricity systems for over 100 years. S&C Electric Company not only supports "wires and poles" activities but has delivered over 8 GW wind and over 1 GW of solar globally. S&C Electric Company has been actively engaged in deploying Battery Energy Storage Systems for over 10 years, supporting a full range of business models and using a range of battery technologies, at the kW and MW scale, and currently has 76 MW/189 MWh in operation. In Australia, S&C projects include the Ergon Grid Utility Support System in Queensland, which reduces peak loads and provides voltage support on rural Single Wire Earth Return lines and the 2 MW battery for PowerCor in Victoria.

S&C Electric are particularly interested in facilitating the development of markets and standards that deliver secure, low carbon and low cost networks and would be very happy to provide further support to the Australian Market Energy Commission on the treatment and potential of these technologies.

Yours Sincerely

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Introduction:

We welcome the assessment of the AEMC of the role Distributed Energy Resources can play in our future networks in supporting the system.

There are some *conflicts* between various programmes, such as the AER's DMIS and DMIA, and some of the proposals in this report. Some of the proposals are likely to result in *increased costs* to the end consumer, such as the requirement to reinforce to allow more DERs to contact and these increased costs are likely to fall on those less able to avoid or pay, and the suggestion of the role of an "Optimiser".

Summary of Response

1. There are limits on the services that behind-the-meter or DN-connected DER can provide to the system at lowest cost and care is needed to ensure that the approach takes a realistic view of costs and benefits.

2. Markets are not a perfect tool to deliver wide-scale change, particularly when the existing market, as in Australia, is not "level" (free from interference, such as incentives).

3. DER owners, those that have invested in the DER, will always have priority over the use of the asset. This means operation of the asset may be contrary to system need and there may be other, more cost-effective approaches, that will deliver wider system benefits.

4. Requiring DNSPs to reinforce their networks to support the delivery of system services to the either the market operator or the TNSP will increase the costs to end consumers. It will also unfairly place a greater burden of the reinforcement costs on those that do not own and operate DER, and these consumers are also less likely to be able to avoid import based network charges nor gain from the income earned by providing system services.

5. The requirement for an "Optimiser" to coordinate the operation of DER resources is a role that is best assigned to the DNSP. There is a great deal of overlap in the planning and management requirements of any "Optimisation Body" and there will be the potential for conflict between the role of the DNSP and the "Optimising Body" the DNSP and in other jurisdictions the DNSP is transitioning to a System Operator role (e.g. GB), which allows the DNSP to better manage development and connections, while having a role in service procurement, development and system balancing.

6. Without the appropriate enforcement of "notifiable technologies", by requiring all relevant connectees to notify their distribution networks, it will be difficult for both the DNSPs and AEMO (and market/system operators outside the NEM) to forecast and model generation and supply. This is already challenging at all system levels and impacts on control and management.

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7. We support the Commission's proposal that the deletion of clause 6.1.4 of the NER be explored to ensure that the owners and operators of DERs are exposed to the impact of their operation (time- and location-based) on the network.

8. The development of Australian and International Standards will have an impact on the uptake of behind-the-meter batteries. See our response to question 5 below.

9. The development of technical standards, such as connection requirements would be beneficial, and would be best developed nationally to ensure consistency across Australia. See also the response to question 6.

General Comments

The Role of the Market

Markets undeniably have an impact on uptake of DER and how it operates, but where markets are not level and completely free from incentives (as is the case with the market in Australia) much careful assessment is needed before assuming that yet another market "tool" will deliver desired outcomes.

Who has priority over a DER?

As clearly stated behind-the-meter assets have been funded by the asset owner (typically the householder, but not always). This rightly means the asset is optimised for that owner, regardless of the wider system impact and cost. Ensuring that the value that the owner wants to see can be delivered by the wider market will be difficult and will be a balance between the impact cost of using an asset (e.g. a battery) to deliver a service versus the price the "system" is willing to pay for that service. Various innovation projects (UK) indicate that (a) the cost of engaging domestic-scale assets to provide a service is very high (e.g. GBP2000-4000/kW of demand-side response: UKPN Low Carbon London: http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/) and (b) the value of the service, or what the system is prepared to pay for that service, to the owner is low (e.g. GBP48 per year for 15 support events, per household, where all appliances, including electric vehicles and heat pumps, provided the services: NPG Customer-Led Network Innovation: http://www.networkrevolution.co.uk/ and GBP 25 per year per electric vehicle for full control of electric vehicle charging: NGET Frequency Response from Electric Vehicles and Heat Pumps: http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Technology-reports/). While this should not prevent the development of arrangements that would facilitate the participation of DER in providing system services, more work is needed on the disconnect between the value of a service (the price paid) versus the impact on the asset or the drive to participate.

Much more work is needed on using "shared services" from a single asset. The UK Energy Networks Association continue to lead work on the sharing of services between the DNOs and TSO:

http://www.energynetworks.org/assets/files/news/consultation-responses/Consultation%20responses%202016/Demand%20Side%20Response%20Concept%20Paper_revised.pdf

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Initial conclusions were that the DNO should have priority on the use of an asset connected to their network due to locational need. The TSO can often secure a service that is independent of location, although the need for reactive power management is increasingly critical and very location dependent.

Reinforcement

We do not support the requirement that DNSPs be obliged to reinforce their networks to allow DERs to provide services to AEMO or the TNSPs.

It may be prohibitively expensive to reinforce the distribution network to facilitate the participation of distribution-connected DERs in the NEM. That is, the cost of reinforcing the distribution network may far out-weigh the whole system benefits of the DER providing services. (e.g. NGET EFR service, that has uniformly been provided by DN connected batteries, that required the asset to be 100 % available, forcing connections in unconstrained parts of the DN and the creation of "EFR-only" assets, which will not be able to deliver any other service, potentially resulting in stranded assets).

It also favours DER-owners over non-DER owners, with the latter receiving little or no benefit from any reinforcement, yet having to pay for the reinforcement. Non-DER owners are less likely to be able to avoid import-based costs and will not have the option to receive an income from providing services to offset increased network charges.

On one hand the AER seeks to encourage DNSPs to explore non-network solutions, such as DERs, to constraint management, while the AEMC will potentially require DNSPs to mitigate constraints in traditional ways, so that DERs can earn more money for their owners. The requirement to reinforce needs to be assessed very carefully to ensure that it passes current investment tests and doesn't increase the cost to the end consumer.

The deployment of non-network approaches to network constraints, as proposed by the AER may need to be supported by regulatory change around security standards, so that non-network approaches are able to count towards security of supply (e.g. electricity storage).

The "Optimiser" versus the DNSP

We do not support the conclusion that DNSPs should not be the optimiser or have a role in optimising DER connection and services.

In the earlier AEMC Distribution Market Model Approach Paper (AEMC, Distribution Market Model, Approach paper, 1 December 2016, Sydney) in the Executive Summary it was stated that "This may mean that distribution systems need to be more actively managed, like transmission systems are currently.". That being the case, the role of "optimizer" is analogous to AEMO's role for the transmission system and the AEMC seems to proposing a range of mini-AEMOs to operate at the distribution level.

Or perhaps the "optimizer" role will not be an independent regulated body like AEMO, but a commercial entity, which raises other issues around consumer protection and cost. It is not clear how an "Optimiser" would be funded or if it is a similar role to an "aggregator", building portfolios of services and then selling them to the DNSP (perhaps TNSP and AEMO).

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The creation of a new entity in the electricity system creates another, inefficient and cost increasing, layer and this new entity could have very real and negative impacts on the operation of the distribution system, as well potentially conflicting with the role of the DNSP. Quite clearly the responsibilities of the "optimiser" will be onerous and has many elements of the responsibilities currently assigned to the DNSPs, such as network planning and network control and a very close relationship would be needed between any "optimiser" and the DNSP.

Other jurisdictions have given this role to the DNSP, for example in the GB system Distribution Network Operators are likely to transition to Distribution System Operators (e.g. GB transition of DNOs to DSOs).

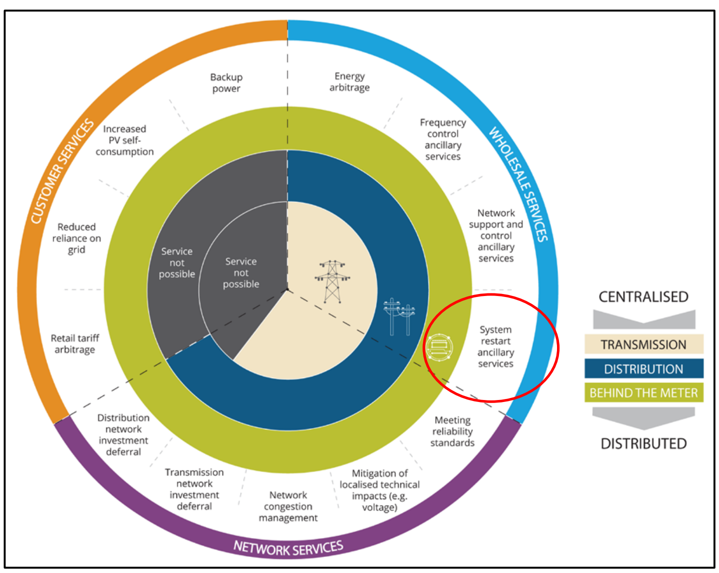
Recent work from the Energy Networks Association (ENA-UK) on the role of Distribution Network Operators and the transition to Distribution System Operators: http://www.energynetworks.org/news/press-releases/2017/june/energy-industry-defines-future-of-electricity-networks-in-major-step-towards-smart-grid.html

A useful document on the role of the Distribution System Operator in the GB system from Ofgem: https://www.ofgem.gov.uk/ofgem-publications/86255/roleofthedsoslides.pdf

Much of this current draft report talks about the difficulties of "balancing" the system, of ensuring that generation matches demand, to avoid the technical consequences of not achieving balance. If DNSPs have to effectively manage their system, on a moment to moment basis, then they need to have a high degree of control and the "Optimiser" is a barrier to effective control.

Rocky Mountain Institute diagram

The diagram used after the Rocky Mountain Institute (October 2015, used on page 17 of the AEMC report) is technically incorrect.



Customer owned and operated behind-the-meter electricity storage (batteries), particularly at the domestic-scale, would not be able to provide a "black start" capability in any jurisdiction and a number of

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other services would be complex to provide, requiring reinforcement (e.g. FCAS and ancillary services – see discussion above under "Reinforcement") and/or may need regulation changes to meet NSP requirements (e.g. reliability standards).

A better understanding is needed of just exactly what and how customer owned and operated electricity storage can achieve.

- What is the true cost impact on networks, both distribution and transmission of allowing assets at the bottom of the system to deliver services to the Market Operator (or transmission system)? What is the true cost impact of using a behind-the-meter battery or electric vehicle battery (so called V2G) on the life of the battery? See: Dubarry et al., Durability and reliability of electric vehicle batteries under electric utility grid operations: Bidirectional charging impact analysis, *Journal of Power Sources*, 358, 39–49, 1 August 2017.
- What is the true cost impact of controlling the charging of a behind-the-meter battery or electric vehicle battery (so called G2V) on the life of the battery? See above reference.
- Does the value that the network would be prepared to pay a customer to use their asset reflect what the customer would want or need to fully compensate them for the lost use of the asset or the impact on the life of the asset?
  Do domestic-scale batteries coupled with roof-top solar PV ***really*** save consumers money on their energy expenditure? That is does electricity storage make more economic sense than delay/programmable start appliances, solar thermal and thermal (heat/cold) storage? E.g. Fares ad Webber, The Impacts of storing solar energy in the home to reduce reliance on the utility, *Nature Energy* 2, Article number: 17001 (2017). doi:10.1038/nenergy.2017.1.
- Can electricity storage be delivered onto the system in a more cost effective way, than relying on domestic-scale behind-the-meter batteries?

  UKPN's Low Carbon London innovation project showed that domestic customers had a 24% response rate in the demand-side response program. This means that any aggregator hoping to deliver a 1 MW FCAS response needs to hold 4.5 MW of domestic batteries.

  A domestic system is currently about 7 kW and costs AUD15-20K. This means an aggregator will need to contract with 650households to guarantee delivery of the 1 MW. Those householders will have spent 650 x $15,000 = $9.8-13M combined to deliver that guaranteed 1 MW of response.

  A utility could deploy a 1 MW battery, which would precisely and efficiently deliver a 1 MW FCAS service. The cost of that utility-owned 1 MW battery would be $2-3M. So potentially, "the system" could get 3-5 MW of batteries for the cost needed to guarantee delivery of 1 MW of response from domestic behind-the-meter batteries. That utility cost or some of it (some of the income from services would offset the cost of the asset) would be passed on to end consumers.

  This is why CSIRO-ENA Electricity Network Transformation Roadmap (p39), which states "Increased penetration of customer owned generators and electricity storage systems which, if

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left unmanaged may impact the supply and demand balance in distribution networks"… and "On current projections, investment in battery storage is likely to reach a critical mass before 2030 and without appropriate incentives or orchestration, mass scale battery charging profiles could lead to export/import imbalance in distribution networks or new peak demand events…".

The case for domestic-scale batteries delivering system security at lowest cost, has not been successfully made. It is likely that Commercial and Industrial (C&I) scale behind-the-meter batteries will make more economic sense, in terms of the impact that asset will have on the energy costs of the C&I customer and the ability to deliver a service. This is because any battery owned and operated by C&I customers is at a larger-scale, so easier to engage and incentivise, since C&I customers can be exposed to time-variable network charges/energy costs.

What a market can realistically achieve

If a market were perfect, it might be able to deliver the outcomes envisaged, but markets in Australia are not perfect, since incentives take the market away from a level position.

For instance, the current FiT regimes for solar PV, take no account of the time of export. This causes system problems at midday that have been well described in the paper. Minimum demand was not described and many networks overseas and in Australia are experiencing issues with minimum demand at midday (limits the options for control measures). A FiT that was time varying, essentially incorporating the true value of that electricity at the time of export, would mean that the tariff would have a low value at midday and a higher value at peak. This would likely drive self-consumption or storage at midday, with the potential for storage to discharge at system peak.

So, market signals are a blunt tool to drive behaviour, as in the case of FiTs, but without sophistication lead to other system issues, which have to be corrected.

Care is also needed to ensure that a market approach can deliver a secure, low carbon system at lowest cost. There are other approaches (which may currently not be permitted under regulations) that could deliver the system and security desired at much lower cost to the end of consumer.

Clearly regulating in a very rapidly changing landscape is challenging, but regulating out a role for DNSPs in all DER activities is unlikely to deliver the desired system for consumers (E.g. https://arena.gov.au/news/smarter-grid-regulations-needed-to-support-demand-management-and-cut-costs-for-energy-users/).

Note that in Europe, TNSPs and DNSPs may own and operate electricity storage, at the discretion of the national regulator. NSPs must seek a non-network solution competitively, but if no tenders are received or the tenders can only deliver at highest cost, then the NSP may own and operate electricity storage themselves. The key is that the approach taken must result in the lowest cost for the end consumer, which is consistent with AEMC goals and so it is disappointing to see the complexities, via ringfencing, around NSP ownership and operation of electricity storage.

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Response to Questions

1. Do stakeholders consider that there are any other barriers to the development and implementation of cost-reflective network tariffs? How material are these barriers? Are there other means for them to be addressed?

   No comment.

2. Do stakeholders consider that there are any 'missing markets' or 'missing prices' beyond those that will be implemented through cost-reflective network tariffs? If so, what are these?

   No comment.

3. Do stakeholders consider that an open access regime will continue to be appropriate in an environment of increasing uptake of distributed energy resources and more constraints on distribution networks? If not, what principles or considerations should be taken into account in determining whether a different access regime is more appropriate?

   An open access regime only works if there is appropriate investment in developing networks. We welcome the proposal in the Finkel Review for Renewable Energy Zones for the transmission network, which would facilitate the connection of large-scale renewable generation, but it would be good to extend the scheme to the distribution network, so that DNSPs can invest ahead of need.

4. Is there support for the Commission's proposal that the deletion of clause 6.1.4 of the NER be explored?

   Yes. It is critical that renewable generation contributes meaningfully to its impact on the system, rather than continuing to socialise the cost to all end-consumers. All other types of generation contribute to system security and it is time that DERs at all scales contributed to security costs.

   However, care is needed in the treatment of electricity storage, which could incur charges on both the demand and export side (the UK regulator suggested in its recent Targeted Charging Review (https://www.ofgem.gov.uk/publications-and-updates/targeted-charging-review-consultation) that electricity storage be exempt from some aspects of Balancing System Use of System Charges). But, in general, all DERs, including electricity storage, should see relevant network use charges to incentivise “appropriate” system-supporting behaviour – that is charges should ensure that system users act in a way that minimise the costs of operating that system.

5. Are there any other aspects of the development of Australian standards that are relevant and should be considered?

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AS 5139 "Electrical Installations – Safety of battery systems for use with power conversion equipment" draft is currently out for consultation. While the definition of Lithium Ion batteries as "fire hazard 1 – self-sustaining" may restrict the deployment of domestic-scale batteries, it is appropriate that the safe management of Lithium ion batteries is addressed. Lithium ion batteries are inherently safe, that is, they very rarely start fires. However, house fires and bushfires are common and so any domestic scale electricity storage system that incorporates Lithium ion batteries should effectively demonstrate that batteries are protected from the encroachment of an external fire. This will ensure maximum protection to both householders, neighbours and emergency services.

6. Do stakeholders see value in the AEMC (or other party) reviewing the technical requirements that DNSPs apply to the connection of distributed energy resources?

   In as much that all DNSPs have differing approaches, it would be good to see a consistent national approach to connection requirements. This is nearly impossible to achieve in Australia, given the complex nature of electricity regulation, which involves Federal and State Governments and a variety of regulating bodies.

   For instance, in South Australia for large-scale renewable generation we have the unwelcome intrusion of three entities: The State Government, Essential Services Commission of South Australia (ESCOSA) and the Office of the Technical Regulator (OTR), all having an influence on connections and while some of the proposed requirements may be supported by AEMO, some are not.

   We support the Finkel Reviews call for a more coordinated national approach to electricity. It will not be possible to deliver Australia's commitments to international climate change mitigation targets and also deliver a secure low cost system, without national coordination and oversight.

   We would direct the AEMC to the work undertaken by the UK DNOs on the connection of electricity storage, as an example of connection requirements:

   http://www.ukpowernetworks.co.uk/internet/en/our-services/list-of-services/electricity-generation/storage-connections/

   http://www.energynetworks.org/electricity/futures/energy-storage/energy-storage-further-information-request.html

   We would also encourage the enforcement of notifiable technologies, that is, no DER should be connected, without the knowledge of the relevant DNSP and we welcome the proposal from COAG of a Register for Batteries, but we suggest that this Register should encompass other DERs.

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The issue is encouraging installers and owners to notify their DNSP. It should not be possible to contract to an aggregator or deliver system services directly, without registering the DER and home insurers may well be another route to requiring the registration of DERs.

Visibility of a DER to DNSPs, TNSPs and AEMO will be critical in ensuring a well-managed and cost-effective system. So some standard on the technical information that needs to be transparently shared with parties who need to manage systems should be developed. This also includes a signal that a DER is “available” (or not available) to provide system services.