S&C ELECTRIC COMPANY
Excellence Through Innovation

141 Osborne Street
South Yarra VIC 3141
Australia

Therese Grace
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Our Ref: JC 2018-070 | 18 May 2018

Dear Ms. Grace,

S&C Electric Company comments on Discussion Paper: Coordination of generation and transmission investment

S&C Electric Company welcome the opportunity to provide written comments on the Discussion Paper covering the Coordination of Generation and Transmission Investment. Our comments will mainly focus on the treatment of electricity storage and its connection to the transmission system.

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 the “wires and poles” activities of the networks, but has delivered over 8 GW wind, over 1 GW of solar and over 45 MW of electricity storage globally, including batteries in Australia and New Zealand. We have also deployed over 30 microgrids combining renewable generation, storage and conventional generation to deliver improved reliability to customers.

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 Energy Market Commission on the treatment and potential of emerging technologies and approaches.

Yours Sincerely

Dr. Jill Cainey
Global Applications Director
Email: jill.cainey@sandc.com
Mobile: 0467 001 102

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Australia

Comments

Demand side

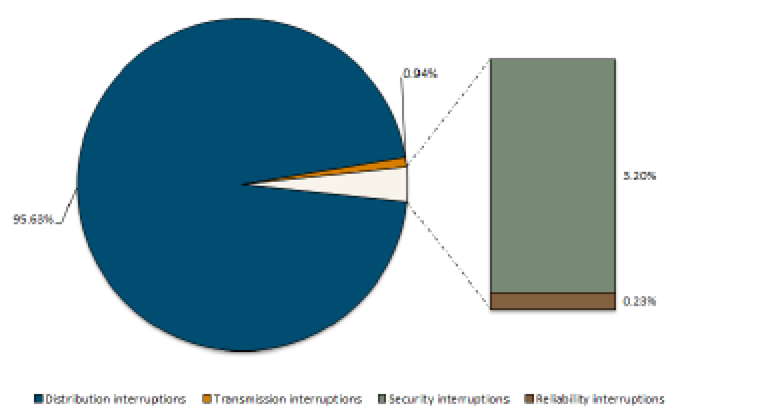
The demand side, particularly at the commercial and industrial (C&I) scale, are a great resource for supporting the wider system. Small-scale (domestic) demand-side, while a significant aggregated capacity, is difficult to coordinate and orchestrate. The demand side and the role of aggregation in the UK is a significant source of ancillary services for the System Operator (National Grid), but programmes to facilitate the participation of the demand side in the UK (e.g. http://powerresponsive.com/, run by National Grid) focus entirely on the C&I sector.

Aggregators provide flexible demand ("turn down" and "turn up") and access to behind-the-meter generation (typically diesel generation sets), but find that it is more cost effective to work with large customers, who have the resources to understand and monitise energy management, plus secure participation from senior management. Trials to explore demand side response from domestic customers has indicated problems with initial engagement, sustained engagement, response times, the requirement to "opt out" and small loads. The considerable effort needed to secure and maintain participation makes domestic demand side uneconomic (Low Carbon London indicated that domestic flexibility cost 20-40 times more per kW than a typical diesel generator, and this excluded the cost of the enabling technologies required to secure a domestic response).

Additionally, Distributed Energy Resources (DERs) can only deliver a service to the system, if the distribution network is reliable. Any outage, even less than a minute, will result in the disconnection of any inverter connected device. Voltage fluctuations may also result in the disconnection of DERs, meaning that those assets are not there at a critical time for the system.

Given the figure recently published in another AEMC paper (Direction Paper: Reliability Frameworks Review, 17 April 2018, page 13):

Figure 2.1 Sources of supply interruptions in the NEM: 2007-08 to 2016-17



Source: AEMC analysis and estimates based on publicly available information from: AEMO's extreme weather event and incident reports and the AER's RIN economic benchmarking spreadsheets.

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Reliability on the distribution system appears to be a significant issue and means that addressing the potential for a security issue on the system (3.2% in the above plot) by relying on distribution connected assets, may not be helpful.

Demand charges and system use

Investment and funding of networks is based on demand requirements. In an environment where demand is falling, securing investment for new or upgraded networks is difficult. Generation and load both "use" the system and with small-scale generators now exporting, resulting in cost to the NSP due to reverse power flows and voltage issues (remembering that small-scale DERs do not attract a connection charge) a more equitable approach to charging network users, whether load or export is needed.

Congestion

If generators don't pay to the use the system, then accepting congestion seems to be a natural consequence. Current arrangements require a fee to connect, but then the generator may not be able to export due to congestion and is constrained off.

If generation wants a guarantee to export full or near full capacity, then that is a paid for service that could be delivered by the NSP, a "use of system" charge would cover carriage of the generated electricity and failure to carry that electricity may result in a penalty on the NSP. Use of a system is in both directions (see above). The notion that all connecting generation is "good" because it meets demand and so should be facilitated by removing use of system costs is outdated.

The generation industry needs to work hard to come up with workable solutions to congestions and investment in new transmission lines. Generators can't complain about insufficient network and then say they can't share information due to competitive reasons when working together with other generators and/or TNSP would result in lower cost connections and lower costs to the end consumer.

There is a great deal of publicly available information on renewable generation projects, even at the early stages. It would be helpful to know what is the minimum information that competitors would need to share to facilitate collaboration? This could be a subset of the information required by the TNSP (which is likely to have more detailed information related to individual connection requests).

REZs would be a waste of time, even at the level of just providing information, if renewable generators are not prepared to collaborate with each other and TNSPs to facilitate transmission investment. Without transmission investment, there will be no new generation built in a newly designated REZ.

"Clustering" is an interesting concept, but again it is difficult to see how this will work without some level of collaboration between generators and the TNSPs.

Treatment of Electricity Storage

Energy storage versus electricity storage definition

Care is needed in how "energy storage" is defined in the electricity system. Energy storage encompasses a broad range of technologies, of which "electricity storage" is just one. A number of energy storage

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technologies are processes that use electricity and convert that electricity into a different energy vector, taking that energy out of the electricity system (e.g. hot water tank where energy is stored as hot water, hydrogen generation where energy is stored as hydrogen). These energy storage approaches can be treated in the electricity system as load or demand.

Electricity storage is energy storage where electricity is ***temporarily*** converted to another energy (chemical for a battery, potential energy for pumped hydro), before being reconverted to electricity.

The UK and Europe have recognised this distinction in electrical system terms, with a specific electricity storage definition:

For example in the UK:

- Electricity Storage in the electricity system is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy.
- Electricity Storage Facility in the electricity system means a facility where Electricity Storage occurs.

This definition is then helpful in managing the issue of use of system charges, since only a proportion of the electricity that is ***not*** returned to the system (due to the efficiency of the storage process), is actually “demand” or “end use” (the electricity is removed from the system and retained).

End-use consumer

Electricity storage is not an “end-user” of electricity, as it temporarily stores electricity before subsequent release back to the system, where the final “end-user”, the customer, uses the electricity. By treating electricity storage as an “end-user”, any use of system charges and some climate change levies are levied twice on essentially the same electricity, once on entry to the store and again at the customer.

Electricity storage will retain some electricity, since electricity storage technologies are not 100 % efficient. Batteries can be over 85 % efficient, but each technology has different efficiencies, that will impact on the degree to which electricity is retained.

In the UK Ofgem and the Government are exploring approaches to use of system costs and some options ignore the inefficiency, but others would levy the use of system charge on the electricity not exported. Metering in the UK requires an import and export meter on large-scale electricity storage.

For the purposes of the UK Climate Change Levy, where electricity storage was not defined as not being an “end user” and therefore attracted the levy on imports, HMRC has provided guidance that the Levy should not be applied to imports for electricity storage (https://www.gov.uk/government/publications/excise-notice-ccl13-climate-change-levy-reliefs-and-special-treatments-for-taxable-commodities/excise-notice-ccl13-climate-change-levy-reliefs-and-special-treatments-for-taxable-commodities).

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The European Industry, Research and Energy (ITRE) Committee have provided advice to the European Parliament on the treatment of energy storage in the EU "Third [Energy] Package": http://www.europarl.europa.eu/committees/en/itre/events-hearings.html?id=20160421CHE00111. I will provide a private (member-only) paper from the European Association for the Storage of Energy that reviews the February 2018 vote by the ITRE committee on amendments to the Electricity Market Design files. The analysis gives an indication of how storage should be defined and treated.

The EU Commission has released various papers on the treatment of storage: https://ec.europa.eu/energy/en/topics/technology-and-innovation/energy-storage (see bottom of webpage for link to "Energy Storage – the role of Electricity", which gives the general approach for electricity storage in the EU).

While electricity storage is not an end-user, it is a load on the system and ensuring that the operation of electricity storage, when charging, does not have negative impacts on the wider system is critical for the System operator.

In the UK, National Grid is developing a new Grid Code to cover the operation of transmission connected electricity storage (GC0096: https://www.nationalgrid.com/uk/electricity/codes/grid-code/modifications/gc0096-energy-storage). This new Code covers hybrid sites and will detail the requirements for any connecting storage asset. It was found that generation Grid Codes did not adequately cover the operation of utility-scale electricity storage. A large capacity battery can "swing" from full import to full export in under a second, creating an impact on the system that is essentially double the rated export capacity of the battery.

See also the discussion below of Use of System Charging.

Technically "Generation" in Australia

In the most straightforward sense, Australia has already determined that electricity storage is "generation". In other jurisdictions, this is not the case or not certain (e.g. UK). If electricity storage is generation, then it should be treated as generation for all other purposes. If electricity storage cannot be treated as generation because it sometimes acts as load, then it should not be defined as generation and should be defined as a separate asset class, as is suggested in Europe ()

Use of System Charging

Ofgem undertook a Targeted Charging Review and a significant Charging Review have set up A Charging Future Forum to review charging in the evolving electricity system: https://www.ofgem.gov.uk/publications-and-updates/targeted-charging-review-significant-code-review-launch. Ofgem decided not review charges as applied to electricity storage, because it felt the industry was better placed to modify the relevant codes. Scottish Power has submitted two rule changes to exempt electricity storage from Balancing System Use of System (BSUoS) charges, via modification to the Connection and Use of System Code (CUSC): CMP280 and CMP281 (https://www.nationalgrid.com/uk/electricity/codes/connection-and-use-system-code/modifications/creation-new-generator-tnuos (TNUoS) and

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https://www.nationalgrid.com/uk/electricity/codes/connection-and-use-system-code/modifications/removal-bsuos-charges-energy (BSUoS), respectively).

Scottish Power owns legacy pumped hydro assets in the UK and contends that the construction of new pumped hydro or conversion of hydroelectric generation to pumped hydro is hampered by the potential for "double charging" of Use of System charges. It has never been clear whether the application of "works power" to pumped hydro encompassed the electricity used to pump or not. "Works power" is exempt from Use of System charges in the GB system and covers the electricity necessary to successfully operate a (fossil fuel) generation plant of any type.

However, in the GB system it is possible to avoid the TNUoS charges through the "Triad" system. The level of TNUoS charges in the GB system is set on the cost of operating the transmission system on the three highest use days of the year (typically evening peak in winter). The "Traid" days are determined ex-post, so there is some skill needed in forecasting the time and date of the three events. If an entity can ensure they are exporting on these three occasions, then their liability for TNUoS may be set to zero. For generators this is relatively easy to achieve and storage, including pumped storage, may be able to ensure that they only export at these times. However, electricity storage that is providing a frequency service, may need to import during a "Triad" as part of it's contracted requirement, therefore resulting in a liability for TNUoS.

Balance between fairness and incentivising "good" behaviour

Currently, Use of System regimes typically favour generation over demand, that is charges are levied on demand/load. Since electricity storage can act as both a load and export, then a balance must be struck between fairness (avoiding double charges in the system) and incentivising behaviour that supports system operation (which may require load or export, depending on the system need).

Both generation and demand "use" the system and so charges should be levied on both types of use. This would allow the setting of charges that would drive good behaviour (e.g. excess generation is just as much of a system problem, as high demand). This would require the development of an entirely new charging regime, but would also support the decentralised evolution of the electricity system.

Since electricity storage does not consume all of the electricity stored, but temporarily holds it before exporting, charging the import on a electricity storage device and then charging the genuine end-user again, results in double charging on the bulk of the electricity. This is not fair to either the operator of the electricity storage device to the end consumer, since the end consumer will essentially bear the burden of the double charging.

Due to the efficiencies of electricity storage, some of the imported electricity is lost during storage (the exact percentage lost is very dependent on the storage technology). This loss could be treated as "works power" (described above) or Use of System charges could be levied on the lost electricity.

It could be argued that by charging electricity storage for the lost electricity, this would incentivise the development of more efficient electricity storage technologies. However, care is needed, since long duration, typically slow acting, electricity storage is likely to be less efficient that short duration, typically fasting acting, electricity storage. Currently, commercial interest is greatest in using batteries (short

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duration, fast acting) for frequency services, but in the future inter-seasonal or long duration storage is likely to be needed to manage capacity issues. By applying charges to the lost electricity, this may disincentivise long duration storage development and technologies.

Hybrid Facilities

It is highly likely that large-scale electricity storage will be partnered with renewable generation and this is the model largely being pursued in Australia. In the UK, the Government has recognized this partnership and the potential for it to deliver electricity storage on to the system at lowest cost to the end consumer, by ensuring that the new Contracts for Difference explicitly acknowledge storage and provide guidance on metering, plus Ofgem have provided guidance on the renewable generation incentive schemes it administers on behalf of the Government (renewable obligations).

The critical issue is to ensure that any electricity storage, which may be charged from “black” generation sources (non-renewable energy), does not export through any meter that is used to determine the value of a renewable incentive.

In practice large-scale electricity storage in the UK is metered both on the import and export side (regardless of location in the system, and also allows any lost electricity to be determined). For electricity storage on a renewable site, this metering is especially critical.

Depending on incentive legislation and connection arrangements in Australia, there may also be issues with the definition of a renewable site and or connection and retro-fitting electricity storage to such a site may cause complications in the application of incentives or modifications to connection agreements. This needs to be resolved quickly to ensure projects are not delayed by uncertainty. For instance, in the UK, a site in receipt of the Renewable Obligation, would have had its incentives suspended while a review was performed on the appropriateness of incorporating electricity storage. This would be a large risk that many investors would not support. Guidance on how to incorporate electricity storage (via test cases) has allowed this process to be expedited, reducing risk.