ARENA Insights Forum Presentation Summaries & Key Points – Large-Scale Projects Stream

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Australian Government
Australian Renewable Energy Agency

ARENA

Background

During the past seven years, ARENA has invested $1.4 billion in accelerating Australia's uptake of renewable energy. One of the greatest returns we have on this investment is a wealth of knowledge that can help shape new business models and key market reforms in the energy sector.

Sharing knowledge effectively to fast track industry development is central to ARENA's mandate. Guided by this, ARENA brought together 200 people from across the energy industry to share project insights and discuss topical themes.

The Forum was held on 25 June 2019 and was split into two streams: large scale projects and distributed energy resources. This summary presents the key messages and discussions during the large scale projects stream, which focused on large-scale energy storage, high penetration grids and forecasting. Links to presentations on the ARENA Knowledge Bank are provided throughout.

SESSION 1: LARGE-SCALE ENERGY STORAGE: SERVICES AND VALUE STREAMS

Key takeaways:

- Batteries and other energy storage technologies are proving they can provide many dynamic system support services; the next step is turning these services into a bankable business model for investment.
- The Five Minute Settlement Rule Change coming into effect in July 2021 is expected to provide additional opportunities for large-scale battery systems (LSBS).
- AEMC cannot change the rules without the engagement from external parties so there is an ongoing need to work with large-scale project developers and other stakeholders to ensure the rules meet the needs of the industry.

Christiaan Zuur, Director, AEMC – System services – Security needs in a transitioning system

- AEMC has five priority areas for energy market reform: generator access and transmission pricing; system security; integrating distributed energy resources; digitalisation of energy supply; and aligning financial incentives with the physical needs.
- AEMC cannot make rules without a rule change request from external parties and is encouraging industry to submit rule change requests.
- In response to the AEMO Power System Requirements report, AEMC is working with stakeholders on how to update the market rules to value and measure the provision of grid support services. Many of these grid support services are an inherent "by-product" of synchronous generators' operations, and there is a continued need for these services to be provided as the synchronous generators are retired.
- Batteries and other energy storage technologies such as concentrated solar thermal (CST) and pumped hydro energy storage (PHES) are proving they can provide many system support services.
- Being a rule maker, AEMC has to manage the trade off between deciding what should be mandated versus voluntary – there is a fine balance to be struck.

Harriet Floyd, Senior Advisor, Aurecon – Large scale battery storage: services and value streams

- The installed Australian large-scale battery systems (LSBS) are either currently providing, or can potentially provide, critical grid support services. Some of these services are provided by the batteries for free, since no market exists for these services.
- To maximise revenue for LSBS, rule changes will be required such as:
  - Allowing a LSBS to register as a bidirectional generator in the NEM will help with speeding up the grid connection process
  - Creating stronger market signals to design and install additional software in projects to respond to certain services.

- The variability of the services which the LSBS are exploring shows battery project developers/owners have not yet settled on their preferred and most bankable value stream/s.
- SRAS service requires LSBS to have a fair amount of capacity reserved which is a limitation that might not stack up when trying to also tap into other service options.
- While batteries are not the only large-scale storage option, they have been able to provide a premium service in FCAS markets.
- With the Five Minute Settlement Rule Change to come into effect in July 2021, it is expected this will provide additional opportunities for LSBSs.
- Knowledge sharing from the current fleet of LSBS is critical to the growth of the industry since most of the projects are doing something for the first time, and sharing the lessons from the current projects will reduce the risks for future projects.
- Modelling in relation to the FCAS market and at what point and when the market has reached capacity has not been conducted. Modelling will be important as it has the potential to devalue the market and create a risk for investors in new projects.

Panel Q&A Key Takeaways

Panel Facilitator: Susan Mallan (Energy Industry Advisor)

Panel Members: James Harding (Genex Power), Dave Johnson (AGL), Maria Cahir (Tesla), Dietmar Tourbier (CSIRO)

- The Five Minute Settlement Rule Change will benefit technologies with fast start capability such as batteries and PHES.
- Having the ability for energy storage projects to register as bidirectional generators in the NEM will be useful for project developers/owners.
- It's critical that we move towards a market which allows for and rewards the provision of specific services, and the market can then decide which technologies to use to meet the service needs.
- The FCAS market has been incredibly hard to predict and FCAS is not currently a bankable revenue stream for project owners.
- The decision by developers to install synchronous condensers for projects to assist with AEMO's system security concerns in relation to new solar PV projects demonstrates where the market is right now. It can be seen as the 'easy' and cheap(er) option to quickly satisfy investors and AEMO, despite a battery likely being a better (but slower and more expensive) solution.
- The long construction times and high capital costs of PHES projects, combined with the uncertainty about what the market might look like by the time the project is constructed, make it hard to create a bankable business model. These factors mean it is very difficult go merchant (as opposed to locking in a PPA).
- The transition to higher renewable energy fractions is inevitable – but there are multiple avenues to get there; at this point it is impossible to predict the path.

SESSION 2: HIGH PENETRATION GRIDS: LESSONS AND OPPORTUNITIES FROM OFF-GRID AND FRINGE-OF-GRID PROJECTS

Key takeaways:

- Off-grid hybrid projects provide energy consumers with a way to gain stronger independence in their energy security and long term affordability while also providing an opportunity to lower their carbon footprint.
- There is a continued need to support local community involvement and education of the projects to avoid the mentality of "build, neglect and re-build".
- Projects in remote locations are expensive and take a long time to access which increases the importance of remotely monitoring and recording all aspects of the system performance to identify issues quickly.
- Demonstration off-grid and fringe-of-grid projects allow innovative technologies to be trialled at a material scale, with (actual/local) high renewable penetration. These can then be replicated elsewhere.

Sam Latz, Project Manager, Power and Water Corporation – The Solar Energy Transformation Program (SETuP) – lessons and opportunities for high renewables mini-grids

- Sam Latz discussed the progress of the SETuP progress, operational and community engagement learnings.
- The project has abated the use of 3.5 million litres of diesel to date which is significant considering the Northern Territory spends $30 million a year on diesel.
- SETuP started with the goal of achieving a 15% diesel saving at each site, which was then expanded to include one site achieving a 50% diesel savings at Daly River (with the inclusion of 2MWh of Li-ion batteries).
- There have been many lessons learnt from the program, including:
  - Long lead times for obtaining land leases
  - Site contamination issues, including identification of asbestos at one of the sites
  - The logistical challenges of procurement and delivery to remote sites
  - Challenges in project construction in regard to the extreme summer heat
  - The importance of minimising single points of failure for remote sites, including having multiple spare parts on site
  - Local engagement and employment of "job ready" individuals are integral for gaining a social license
  - Reduce number of moving parts to reduce operations and maintenance costs.
- For future sites, PWC has started:
  - Installing prefabricated, portable solar PV which they have found has minimised the construction time, and reduced overall capital and operational costs. This solution has proven to improve the flexibility and speed of construction – a critical factor for off-grid renewable solutions
  - Investigating expanding the role of batteries in the hybrid off-grid mix.

Harry Fernandez, Director, APAC Energy Services, Cardno & Brian Iwaszczyn, Asset Manager, Lakeland Solar and Storage – Lakeland Solar and Storage Project – lessons and opportunities

- In 2015, the project was a world first concept of a fringe of grid solar and storage project.
- Commissioning challenges included:
  - Creating and trialling three different dynamic models for the plant through the course of conducting connection studies, negotiation of GPS, commissioning and generation.
  - Due to a lack of modelling resources in Australia, the PSCAD and PSSE models had to be sent to Canada to be created.
- O&M lessons:
  - With no on-site technician, remote visibility and monitoring of all equipment is critical. The entire plant can potentially be offline for several days if a problem is not quickly or correctly identified.
  - Ensure that there is detailed inventory and asset records kept, including logging the precise location and any maintenance of each panel and other pieces of equipment. This allows faster identification of issues, and warranty claims to be processed more smoothly.
  - Ensure that the regularity of panel cleaning is determined through a cost benefit analysis. All sites are different depending on rainfall, dust and pollution factors.
- Ongoing challenges:
  - The project was expected to have the ability to seamlessly island the township of Lakeland, in case the grid goes down. However, due to the configuration of the battery, the islanding cannot occur seamlessly. Lakeland is trialling different solutions to overcome this issue.

Panel Q&A Key Takeaways

Panel Facilitator: Inka Heile (juwi Renewable Energy)

Panel Members: Ray Massie (Hydro Tasmania), Keith Barker (EDL), Anna Bruce (UNSW), Lachlan McLeod (Ekistica)

- Off-grid and fringe-of-grid projects face different challenges, however the common challenge is the remoteness factor.
  - In off-grid projects the key challenge is often integrating the new technologies with the existing infrastructure (usually diesel generation), creating a highly technical challenge.
  - Fringe: connection negotiations and costs but a clean slate project in a sense – more market challenges than technical.
- Islandling mode for projects bring both opportunities like protecting supply in events like natural disasters and reducing transmission CAPEX and OPEX expenditure to fringe locations and challenges over who had control on the islanding switch and the economic decision to choose to install inslanding.
- There is a misconception that hybrid grids are less reliable than diesel supported grids: the Coober Pedy hybrid grid (with wind, solar and battery technologies) is now more reliable than before.
- Need to overcome the "build, neglect and rebuild" mentality which has occured on projects in some remote locations and islands. A lot of investment put into EPC but not necessarily in continued O&M. Suggest that there is more to be done on building the skills based capacity to be able to handle the onsite upgrades to the grid and how to operate the system.
- Three common lessons of offgrid projects, which were first identified over 20 years ago by Dr Bob Lloyd, and are still relevant: poor installation; lack of quality operations and maintenance; and lack of local training.
- There are many examples of large-scale off-grid projects in Australia with high renewable energy fraction (REF), however achieving 100% REF in off-grid locations will be difficult.
- Low load diesel engines are critical to maximising the REF.
- Prediction that fringe of grid projects will be "trimmed off" as there a growing incentive to leave the grid for a reliable self sustained solution onsite.
- Slowly changes in attitudes of "project norms" for remote projects as stakeholders begin to better understand the unique nature of remote projects.
- Lessons learnt from developing countries could feed back into the development of offgrid projects here in Australia.

SESSION 3: FORECASTING IN A CHANGING ENERGY SYSTEM

Key takeaways:

- The accuracy of weather data across the NEM is a key input to forecasts which enable AEMO to better manage supply and demand, which is at the core of their role as operators of the NEM.
- As the share of renewable energy on the grid continues to grow, the supply of electricity to the grid will become more reactive to the changes in the weather. As a result, more granular weather data, and more accurate forecasts based on that data, will be key to managing variability in Australia's electricity system.
- As the behaviour of DER is determined by human behaviour as well as weather, to accurately account for the impact of DER such as EVs will also require more accurate predictions of human behaviour.
- Five-minute ahead wind and solar generation forecasting technology supported by ARENA funding are providing a bottom-up perspective on the generation output of renewable energy generators. In combination with AEMO's new self-forecasting capability for semi-scheduled plants, this could provide a more nuanced approach for accounting for the supply of renewables into the grid. A trial for this capability is underway.

Ellise Harmer, Team Lead, Operational Forecasting, AEMO – Intra-day Forecasting

- Weather modelling to predict both the supply and demand profiles is becoming more important with more renewable energy entering the NEM, and there is a requirement for more granular weather data.
- AEMO uses multiple sources of weather data to create demand forecasts between 8 days ahead to 5 minutes ahead.
- Many meteorological sensors are not very close together (locationally) which makes it difficult for AEMO to create accurate forecasts – in particular for the 4-6 hour forecasting period.
- For wind farms, AEMO notes a similar level of accuracy in its 4 hours ahead forecast to its 2 days ahead forecast.
- Future improvements may be achieved by:
  - Seeking to obtain more observations, including meteorological data from renewable energy sites, to create lead indicators for the 4-6 hour 'gap'.
  - Allowing project owners to self-forecast their energy output to allow AEMO to refine their supply forecasts.
- Now-casting
  - Using observations in "clever places" tracking fronts and clouds.
  - Creating an automatic reaction function.
  - Sea breeze monitoring needs to be improved to reduce guessing in modelling.
- Ambient temperature is also important to track as it affects the demand side of the NEM. AEMO can expect a change in demand within five minutes a drop in temperature due to air conditioners not having to work as hard in cooler conditions.

Jo Hume, General Manager, Fulcrum3D – Fulcrum3D Solar and Wind Forecasting for the NEM

- Fulcrum3D has two ARENA-funded projects, collectively exploring the potential for wind and solar farms to provide their own, more accurate, forecasts of their energy output, which will be fed directly into AEMO's central dispatch system as a self-forecasting trial.
- Fulcrum3D has installed CloudCAMs on Kidston Solar Farm and will install SODARs and masts on the Clements Gap, Crowlands and Taralga wind farms.
- The trial will in the first instance examine the potential for the provision of site-specific forecasts for use in market dispatch. Ultimately, this capability has the potential to allow semi-scheduled generators to provide ancillary services with a greater degree of accuracy due to better knowing their forecasted generation, and to reduce causer-pays FCAS costs.
- Early results and lessons learned from the trials include:
  - Project partners are key! This has been a critical element in getting the projects to its current stage.
  - The SODARs are easy to move around, allowing optimisation of the device location as more data is collected.
  - Installing multiple CloudCAMs on different parts of the same site provides vastly different perspectives of the clouds. As a trial, Fulcrum deliberately installed more cameras than might be required in the future to increase the amount of data coming from the trial.
  - Managing large amounts of data through the API and modelling the plant are proving to be challenging but rewarding exercises.
  - The technology itself is withstanding the harsh environments well (extreme heat, winds and rain).

Panel Q&A Key Takeaways

Panel Facilitator: Lucy Cooper (ARENA)

Panel Members: Mick Fell (Energeia), Mike Davison (AEMO), Jo Hume (Fulcrum3D), Matthew Jeppesen (Proa Analytics), Jonathon Dyson (Greenview Strategic Consulting).

- Forecasting supply and demand in the 5 minute to 8 day ahead range can be used to improve power system security and reliability at low cost. Forecasting may also be used in conjunction with demand management techniques on the demand side to defer the cost of upgrading system infrastructure.
- There will always be a level of error and risks taken in forecasting, as nothing is ever going to be able to perfectly predict reality.
- Forecasting the behaviour of DER such as batteries and demand response is challenging as human behaviour, and aggregators such as brokers/retailers are difficult to predict. When you can't forecast, visibility and scheduling of key system elements can help to minimise uncertainty and error.
- The biggest challenge in EV forecasting is the uncertainty about how many EVs will be on the road in the coming years, which is affected by vehicle availability and consumer behaviour.
- There are two options for the networks in relation to EV charging – they can either allow unmanaged charging, or enforce managed charging – the difference in which can have a five-fold impact on peak demand.
- Forecasting battery output will become more difficult and important as more batteries enter the grid. A large-scale battery might show full availability but no one knows exactly when it will discharge (or charge) – it will depend on the algorithm and market/system conditions. So the risk is that batteries might start charging and discharging in unison, creating huge ramping issues for the grid. To manage this issue, the future system may continue to restrict ramp rates to limit fast discharging and charging during price-related events.
- Early evidence in the self-forecasting trial indicates that a CloudCAM could feasibly pay itself off within a year from the savings from the Causer Pays factor. In off-grid systems, CloudCAMs can improve diesel generator efficiency, increase diesel savings and also improve battery round trip efficiency and cycling.