

DMIA Case Study

*Eagle Farm – Solar PV and BESS Trial
(WP 4 – Large Commercial Pilot)*



Part of Energy Queensland

Project outline

There is growing demand from Commercial and Industrial (C&I) customers to connect Solar PV systems above 100kW to the electricity distribution networks. Some of these systems are being installed with Battery Energy Storage Systems (BESS) and Energex are investigating the benefits and risks associated with increasing levels of Solar PV and BESS penetrations on its distribution network.

The objective of this trial is to gain a better understanding of the engineering, regulatory and customer challenges when installing and integrating commercial scale Solar PV and BESS.

It was initially proposed to demonstrate a simple Solar PV and BESS AC coupled system, however this was expanded to include Demand Management functions (DRED AS4755.3.5) and full Island off-grid capability. To achieve this a third-party integration platform was developed to manage energy flows between the Solar PV, BESS and to regulate both the import and export level of the grid supply at the NMI connection point. The Energex Eagle Farm Distribution Centre is an operational site and has provided a valuable test bed and learning opportunity supporting the Commercial Scale Solar PV and BESS Integration Trial.



Project outcomes / findings

The trial involved the design, installation and commissioning of the following equipment at the Energex Eagle Farm Distribution Centre:

- 150 kW Solar PV System (3 phase).
- 250 kW, 488 kWh Tesla Powerpack BESS (Gen 1 Lithium, 3 phase).
- Full Off-Grid Island operation with Solar PV/ BESS third party integration (Tesla first).
- Development of an off-grid protection scheme to mitigate low fault level capacity during Island operation.
- Demand Management DRED functionality to AS4755.3.5 including zero, partial and full export capability of PV and BESS (World first).
- Registration of a Clean Energy Regulator (CER) Power Station (Energex's first registered Renewable PS).
- The system was operational on 16 Oct 2018 and has delivered continuous service since including:
 - Site peak demand reduction to pre-determine NMI target kVA.
 - Significant site energy and demand billing reduction from Solar PV generation (\$5 - \$10k per month – no feed-in tariff applies).

The trial identified several key findings:

- Existing Building Codes and AS & NZ Standards lacked reference to the installation or construction requirements for Commercial Scale BESS.
- Insurance and Fire Industry specialists lacked experience and knowledge to manage risk associated with Lithium chemistry BESS. This resulted in the construction of the Solar BESS installation away from the existing building envelope and services including the construction of fire rated isolation walls.
- Integrating with a third-party platform for the control of both Solar PV and BESS Inverter systems required significant effort and financial cost. All testing had to be completed with external generation sources and load banks to mitigate damage during initial testing phases (>\$20k cost increase).
- Initial off-grid or island operation with Solar PV/ BESS proved unstable and resulted in multiple inverter firmware and additional operational testing to stabilise output from synchronised BESS and Solar PV systems.
- In island or off-grid operation the BESS system failed to deliver either short term over-load kVA or nameplate kVA rating output of the BESS inverter resulting in a de-rating of the inverter output capacity.
- While operating in island or off-grid mode an additional secondary protection scheme was required to mitigate the reduced fault levels as the BESS could not deliver adequate fault clearance current to trip the downstream final sub-circuit breakers.
- All transitions from grid to island or island to grid required a 'black' change-over of up to 60 seconds.
- If the BESS failed to return to mains or faulted during transition, then a 'black' Start Process had to be undertaken to initiate BESS start-up, this required a separate UPS supply and operator intervention.
- Power quality was continuously monitored throughout the commissioning and trial stages with periodic trips occurring on the Solar BESS protection scheme. This was result of external network or customer related events.
- A regulatory waiver was required to allow a Distributed Network Service Provider (DNSP) to own and operate the Solar PV and BESS for this trial.
- The power station registration process with the CER for the 150kW Solar PV system follows similar process to Solar PV broad acre installation.
- The CER Solar Large Generation Certificate's for installation of Solar PV systems > 100kW require annual renewable generation reporting to receive renewable certificate benefits. The more common STC's for Solar PV <100kW is funded at commissioning and doesn't require any on-going reporting.
- The Solar PV and BESS trial requires advanced system knowledge to maintain and operate safely. There are multiple sources of supply and the system has the ability to re-form a BESS and solar islanded supply source when the grid supply is lost or isolated.

More information

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