RENEWABLES

Lithium Ion Battery Testing and performance

November 2022

ENGINEERING | STRATEGY | ANALYTICS | COMPLIANCE

About ITP

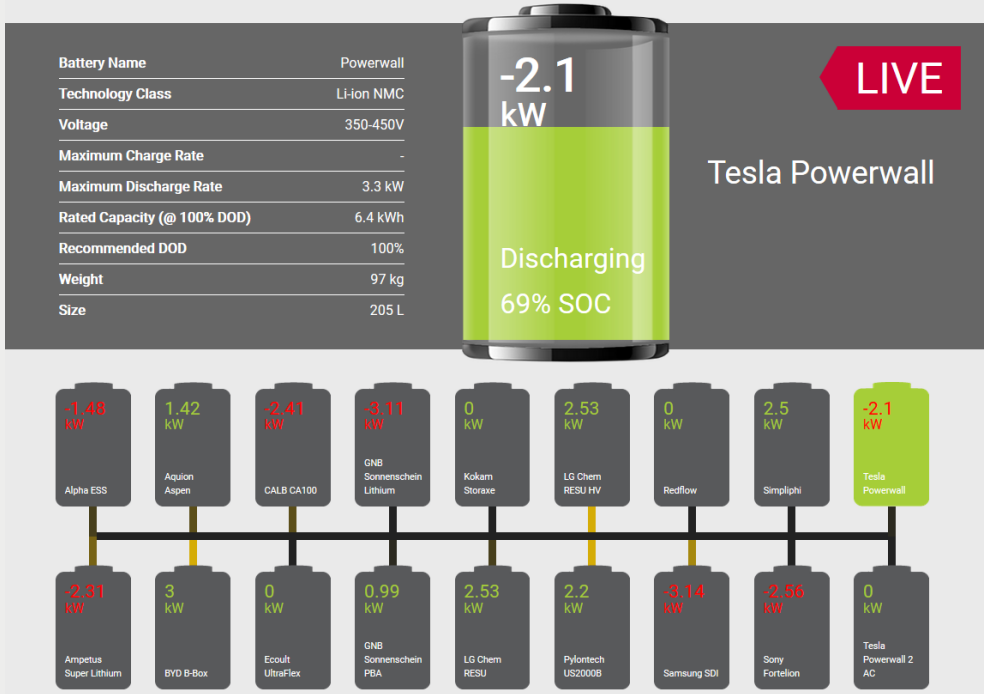
- ITP Renewables provides renewable energy consulting services throughout Australia and Oceania, including engineering, strategy and compliance, and energy sector analytics.
- We provide a unique combination of experienced renewable energy engineers, specialist strategic advisors and experts in economics, financial analysis and policy. Our experts have professional backgrounds in industry, academia and government.
- We are proud to be part of the global ITPEnergised Group, providing independent and trusted advice since 1981 (UK) and 2003 (Australia).

About ITP - Storage

- ITP specialises in battery performance testing and analysis, as well as designing and implementing storage projects and programs.
- For 35 years we have been specifying battery energy storage for remote RE / diesel hybrid mini-grids around the world.
- Recently, with rapidly falling battery prices, we have extended this expertise to on-grid applications, using a range of battery technologies.

Battery Test Centre objectives

- Expose residential-scale battery packs to accelerated cycling in hot temperature conditions
- Compare performance against manufacturers' claims:
  - Procurement
  - Installation
  - Commissioning
  - Capacity retention
  - Round-trip efficiency
- Disseminate results to public via website and 6-monthly public reports



Testing methodology

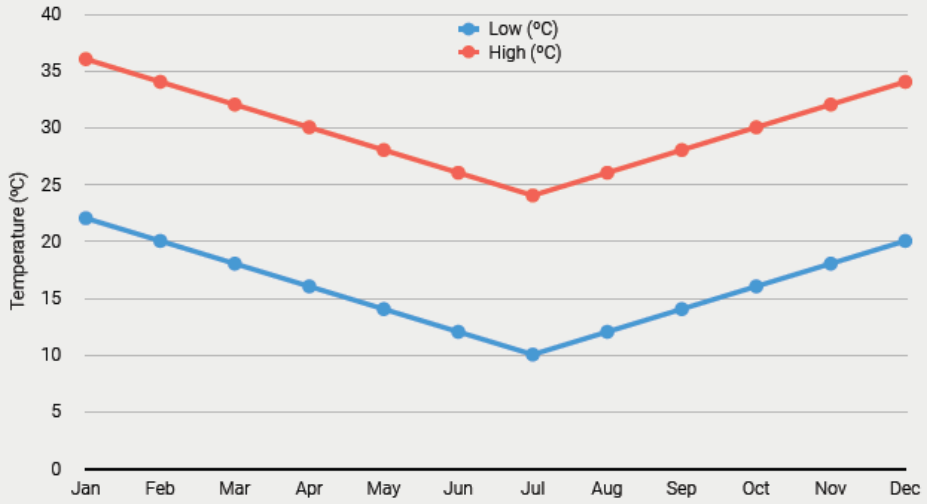


Figure 1: Daily hot and cold cycle temperatures throughout the year

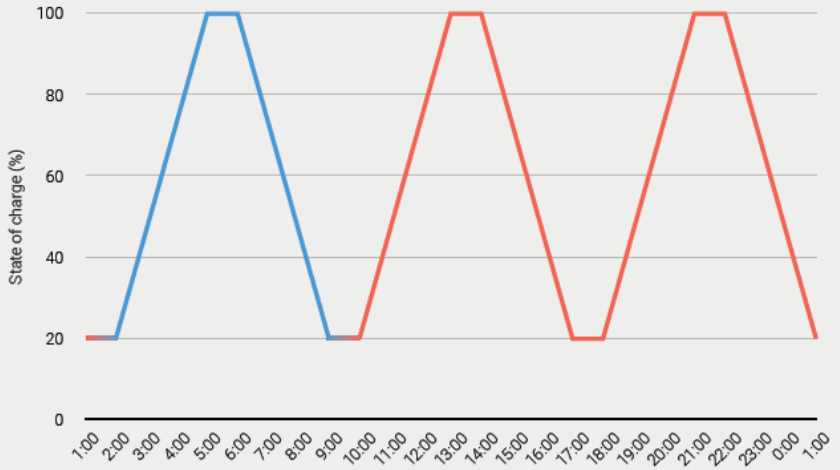


Figure 2: Summer temperature regime and charge regime

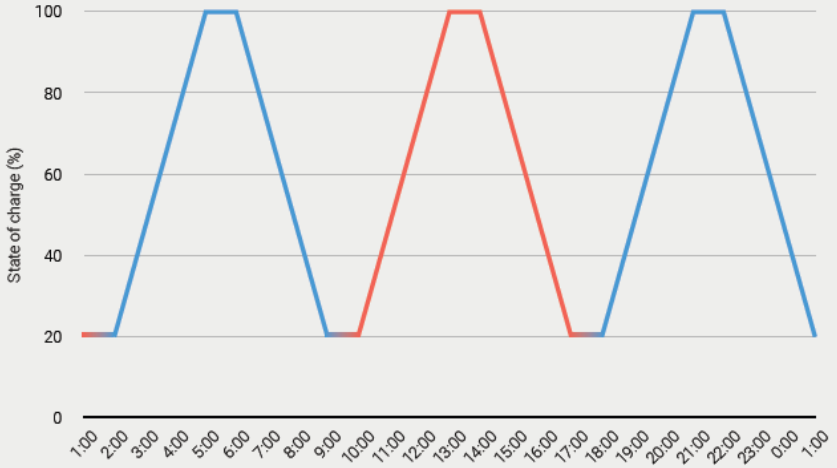


Figure 3: Winter temperature regime and charge regime

Batteries under test

Phase 1 – August 2016

Product	Chemistry	kWh nom. capacity
CALB CA100	LFP	10.24
Ecoult UltraFlex	Lead Carbon	14.8
GNB Sonnenschein	Lead Acid	14.4
Kokam Storaxe + ADS-TEC BMS	NMC	8.3
LG Chem RESU 1	NMC	9.6
Samsung AIO	NMC	10.8
Sony Fortelion	LFP	9.6
Tesla Powerwall 1	NMC	6.4

Phase 2 – July 2017

Product	Chemistry	kWh nom. capacity
Alpha ESS M48100	LFP	9.6
Ampetus Super Lithium	LFP	9.0
Aquion Aspen	Aqueous Hybrid Ion	17.6
BYD B-Box	LFP	10.24
GNB Lithium	NMC	12.7
LG Chem RESU HV	NMC	9.8
Pylontech US2000B	LFP	9.6
Redflow ZCell	Zinc-Bromide Flow	10.0
SimpliPhi PHI 3.4	LFP	10.2
Tesla Powerwall 2	NMC	13.5

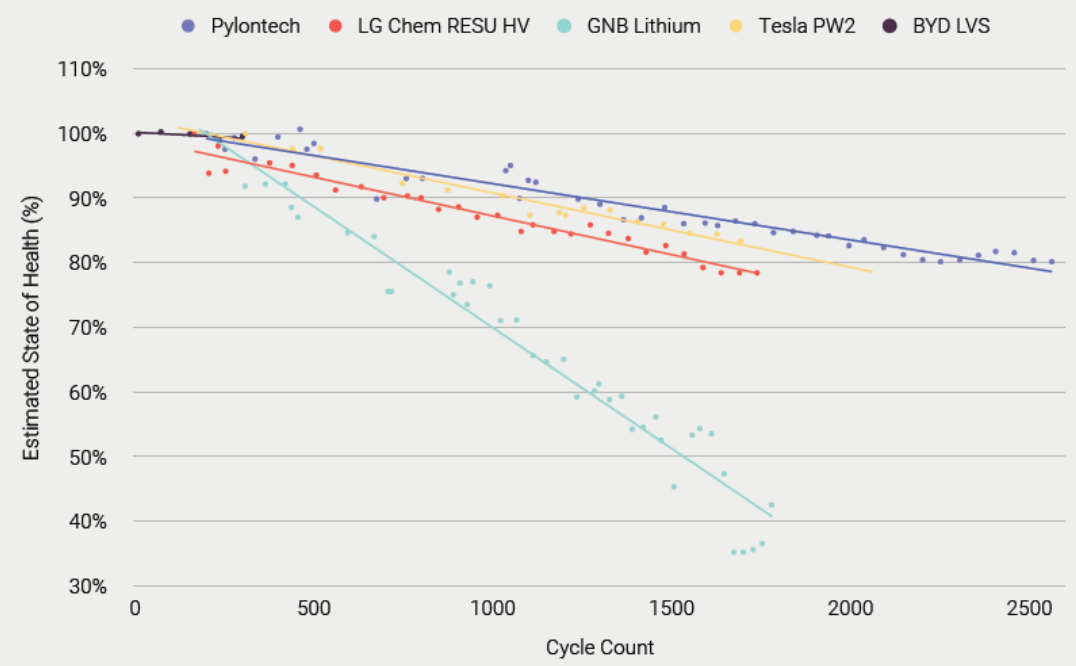
Phase 3 – Dec 2019

Product	Chemistry	kWh nom. capacity
BYD B-Box HV	LFP	10.2
DCS PV 10.0	LFP	10.0
FIMER REACT 2	NMC	8.0
FZSoNick	Sodium Nickel Chloride	9.6
PowerPlus LiFe Premium	LFP	9.9
SolaX Triple Power	NMC	12.6
sonnenBatterie	LFP	10.0
Zenaji Aeon	LTO	9.6
BYD B-Box HV	LFP	10.2
DCS PV 10.0	LFP	10.0

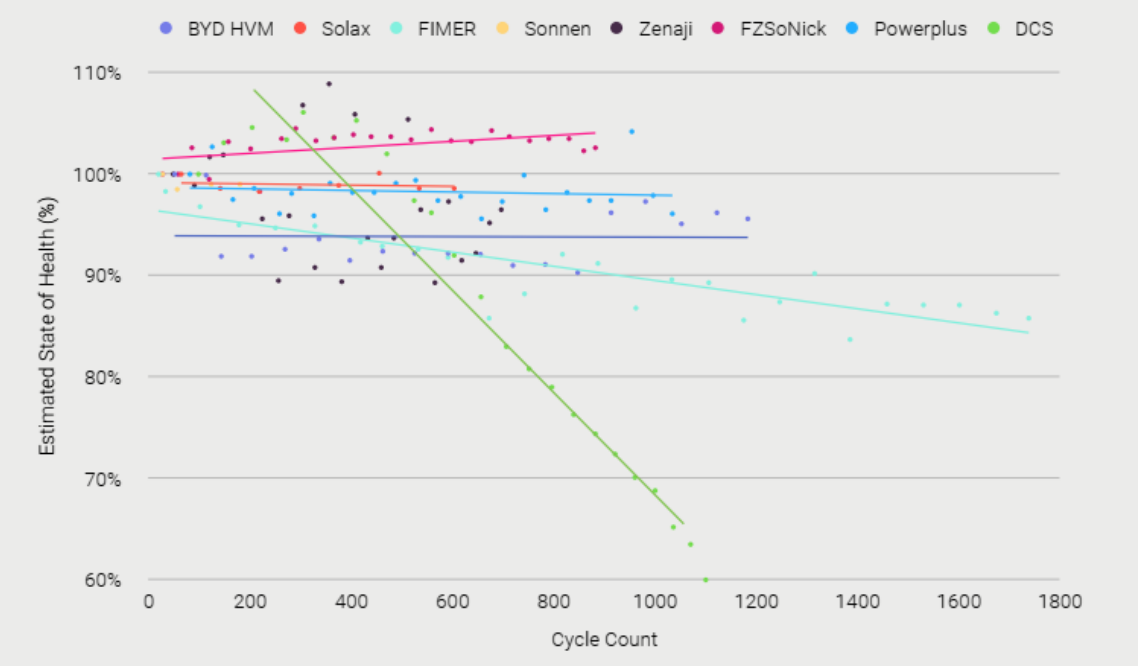
Lithium Iron Phosphate	LFP
Lithium Nickel Manganese Cobalt	NMC
Lithium Titanate	LTO

Performance results

Phase 2

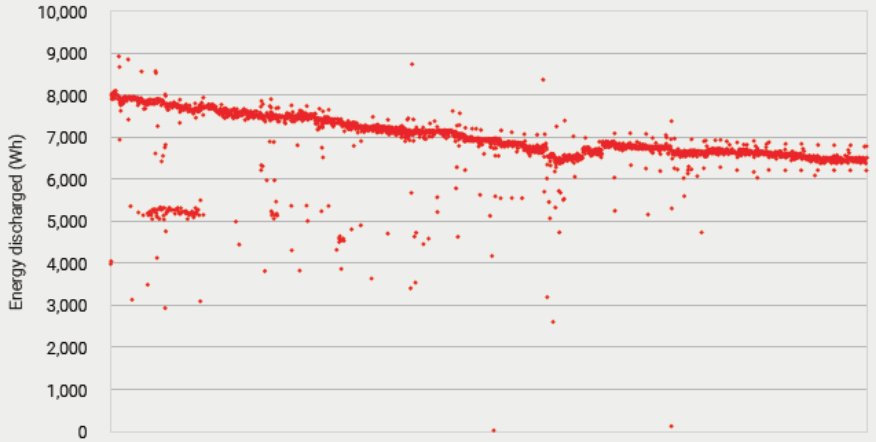


Phase 3

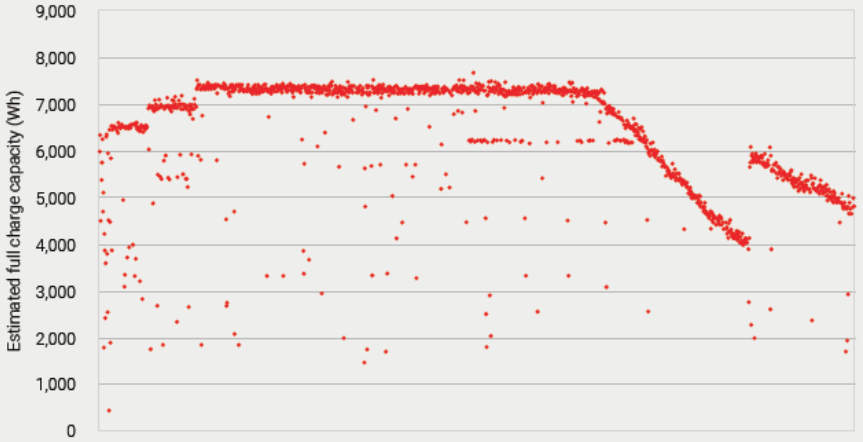


Performance results

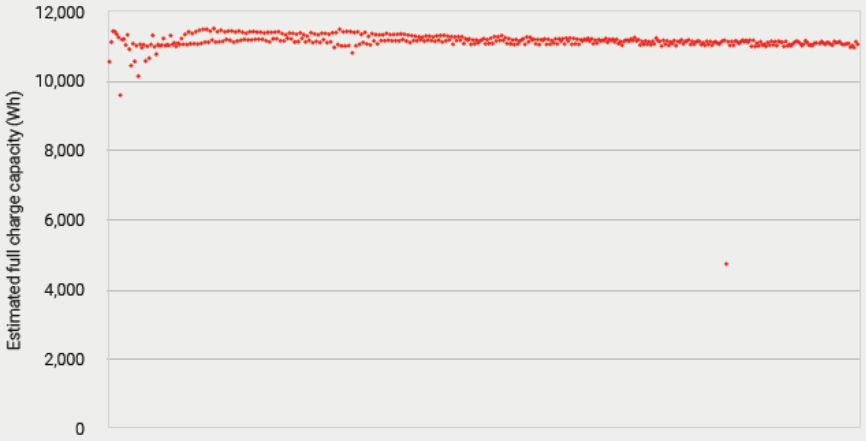
Phase 1 LFP – 3,330 cycles



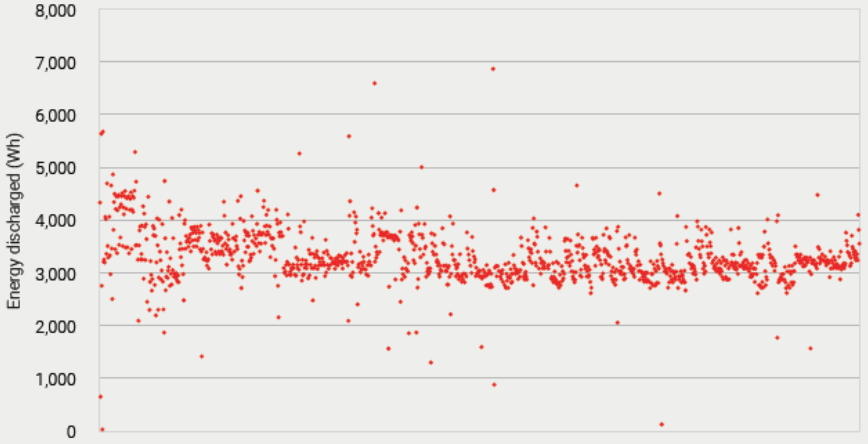
Phase 3 LFP – 1,100 cycles



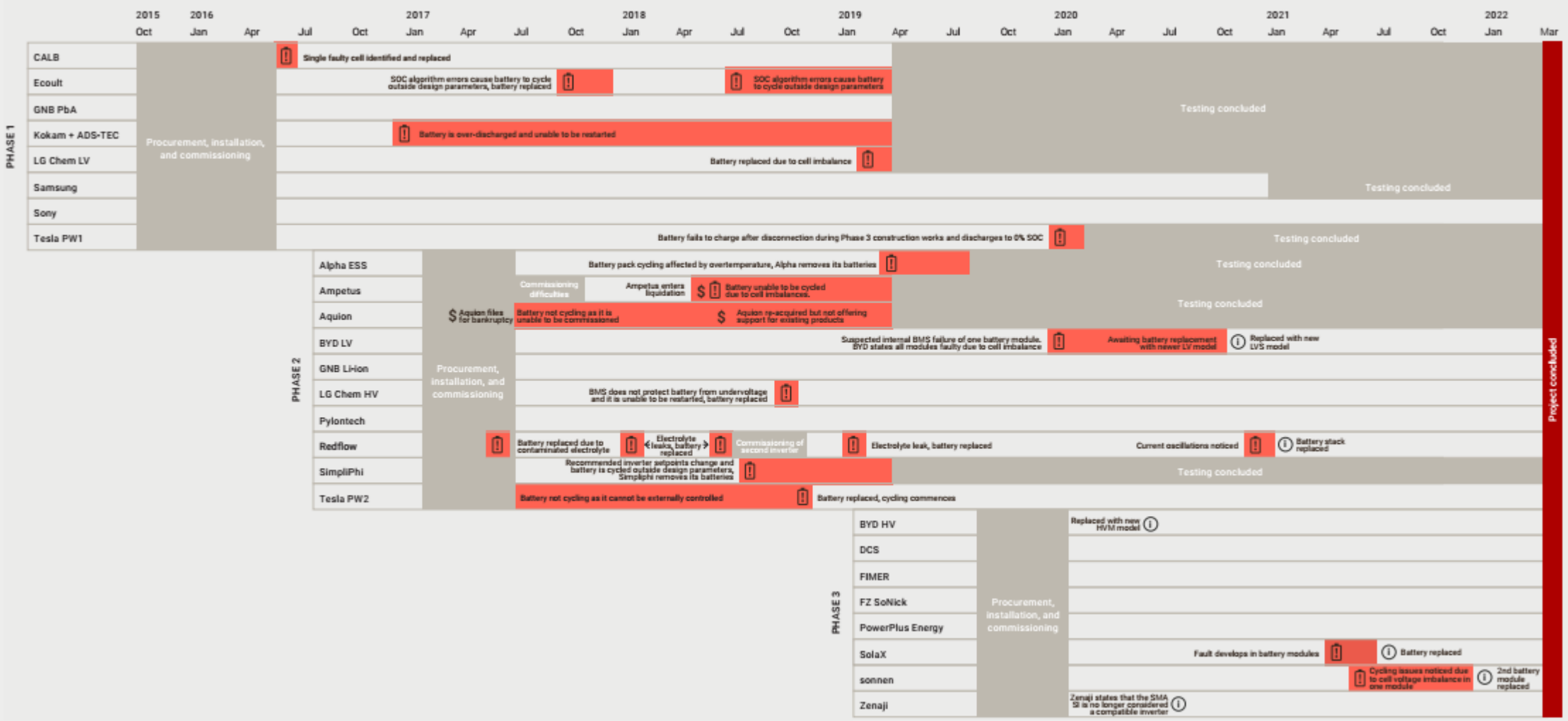
Phase 2 zinc-bromine flow – 450 cycles



Phase 3 LTO – 540 cycles



Operational summary



Lessons learned

- Some batteries retaining capacity well and broadly meeting expectations
- However, capacity degradation and reliability issues apparent with many batteries, demonstrating the need for improvements in:
  - Battery management
  - Integration & control
  - Technical sales & sales support
  - Monitoring and post-sale support
- Further price reductions also required for mass-market uptake

Quality through testing

- All reports available at www.batterytestcentre.com.au
- ITP has recently led the design of the Distributed Energy Resources Lab with project partners ANU, UNSW Canberra and Evoenergy and funded by the ACT Government
  - A fail-safe testing environment of a simulated distribution network into which users can connect a collection of commercial and custom devices
  - The aim is to develop protocols for multi-technology solutions to avoid early technology lock-in, streamline research and development and maximise the number of products which can be used across Australian networks.

Batteries in the Pacific

Batteries in the Pacific

Niue – Lithium-Ion, 2019, 3MWh

Use of batteries

- Long-term storage (eg to run overnight without diesel)
- Goal – minimize diesel use

- Grid support services on existing grid
- Usually short-term, rapid response
- Enable better use of grid-connected renewables

Niue / MFAT

Providing 15-20% of Niue's base electricity demand.

Niue already had 500 kW of solar but systems were regularly switched off to manage loads on the network. The challenge was to find a way to increase the use of existing and new solar generation together with diesel generation to build a more reliable energy network for the island of Niue.

Solution:

Vector Powersmart installed 600 kWp of solar PV to increase the renewable generation on the island. We then added a 3.15 MWh battery energy storage system (BESS) and Vector Powersmart's own energy management system (EMS) which balances all energy sources. The system was financed by the Ministry of Foreign Affairs and Trade (MFAT)

The BESS and EMS makes curtailing the solar generation unnecessary. The BESS instantaneously responds to changes in solar generation through its demand response capability.

Niue now has a more reliable energy network and uses less fossil fuels.

Niue, Pacific Islands

600kW Solar + 3MWh BESS

Solar + BESS + Energy Management

2019

vector powersmart

Aitutaki / ADB

Avoiding diesel generation to save $200k/annum .

The Cook Islands Government set renewable energy targets in 2010 to move the energy sector to renewable electricity. Aitutaki was solely reliant on diesel generation for electricity, which is expensive, has high maintenance costs and is not environmentally friendly.

Solution:

Working with local utility Aitutaki Power and the Asian Development Bank (ADB), Vector Powersmart designed and installed a 737 kWp solar PV and 500kWh battery storage system to smooth solar loads and provide energy stability.

Aitutaki Power now saves around $200,000 per year from reduced diesel supply and generator maintenance. The solar power combined with the battery has reduced the number of generators on the island from three to one.

- Aitutaki, Cook Islands
- 737 kW solar + 500kWh BESS
- Solar + BESS
- 2019

vector powersmart

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