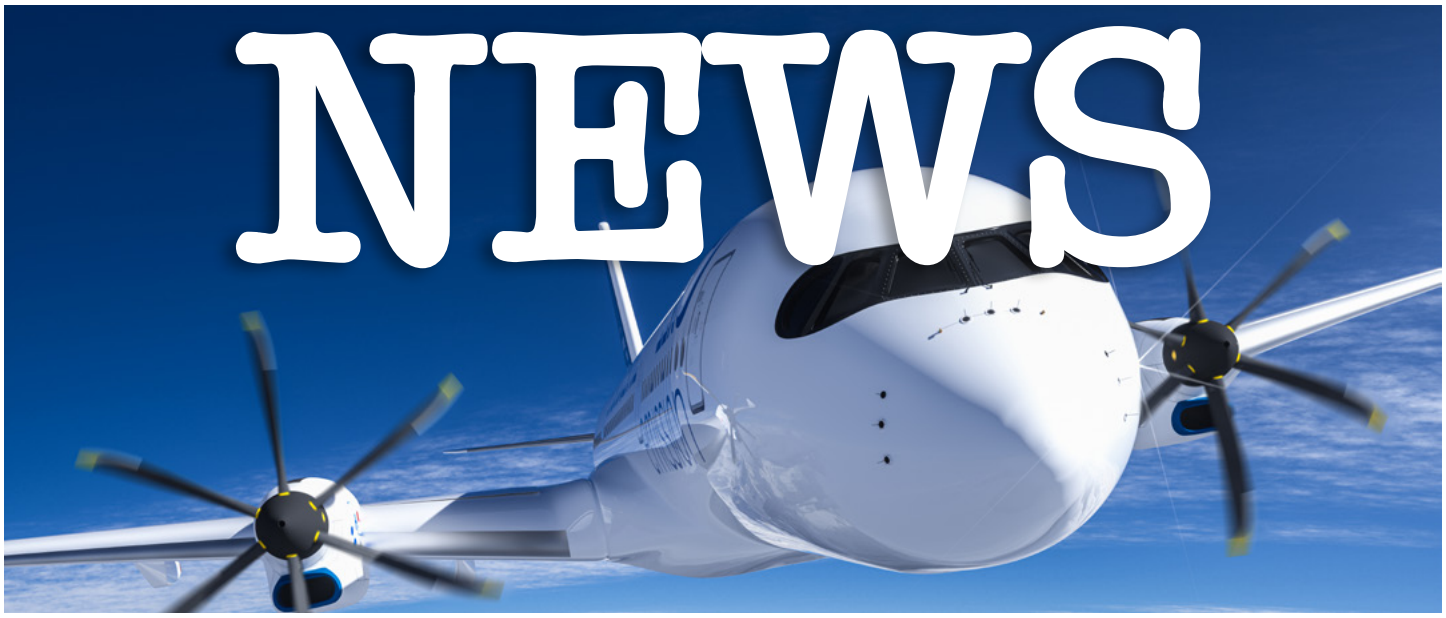
Li-S Energy

MAY 2023



LI-S ENERGY CELEBRATES 45% INCREASE IN VOLUMETRIC ENERGY DENSITY

Our battery scale up has reached a significant breakthrough recently with our R&D team delivering their first 20-layer battery cells utilising our third-generation (GEN3) semi-solid state lithium sulfur technology. These new cells have been produced in our semi-automated Phase 2 facility in Geelong, Victoria.

Initial test results demonstrate the key benefits of the GEN3 Li-S Energy battery system over our second-generation (GEN2) lithium sulfur cells include:

- a 45% improvement in volumetric energy density, reaching 540Wh/l, as a result of a lower porosity cathode material;
- gravimetric energy density of over 400 Wh/kg, through our optimised cathode material composition; and
- enhanced safety with use of a low flammability electrolyte.

In addition to high gravimetric energy density which delivers a lighter weight battery, the volumetric energy density (the energy stored for a given cell volume) is also important for our target industries. It offers the potential to significantly reduce the physical size of the battery packs needed for the same energy stored.

In practical terms this means that our cells are now the same physical size as existing Li-ion batteries but half the weight. Using a low-flammability electrolyte, combined with our patent protected BNNT and Li-nanomesh in the cell construction also enhances safety by reducing dendrite formation and the risk of thermal events.

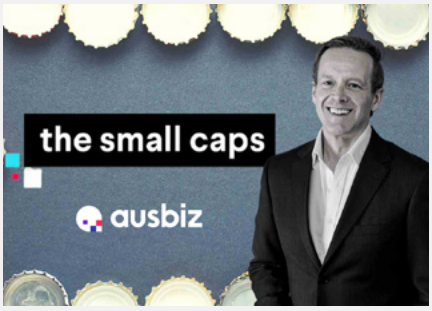
Our development team is currently working to develop the cell cycle testing and characterisation results for an industry standard cell datasheet. Based on enquiries to date we anticipate this will be of significant commercial interest to high value partners in sectors such as drones and eAviation where we already have established collaboration partners.

Based on growth forecasts for the drone and eAviation markets by international research organisations IDTechEX[1,2] and Precedence Research[3], we estimate that the combined eAviation and drone battery market will exceed A$48 billion per year by 2035.

In addition to the GEN3 semi-solid-state Li-S cells, we continue to progress our R&D on full-solid-state electrolytes in a co-funded project within the ARC Research Hub for Safe and Reliable Energy at Deakin where we jointly aim to create a full-solid-state Li-S battery.

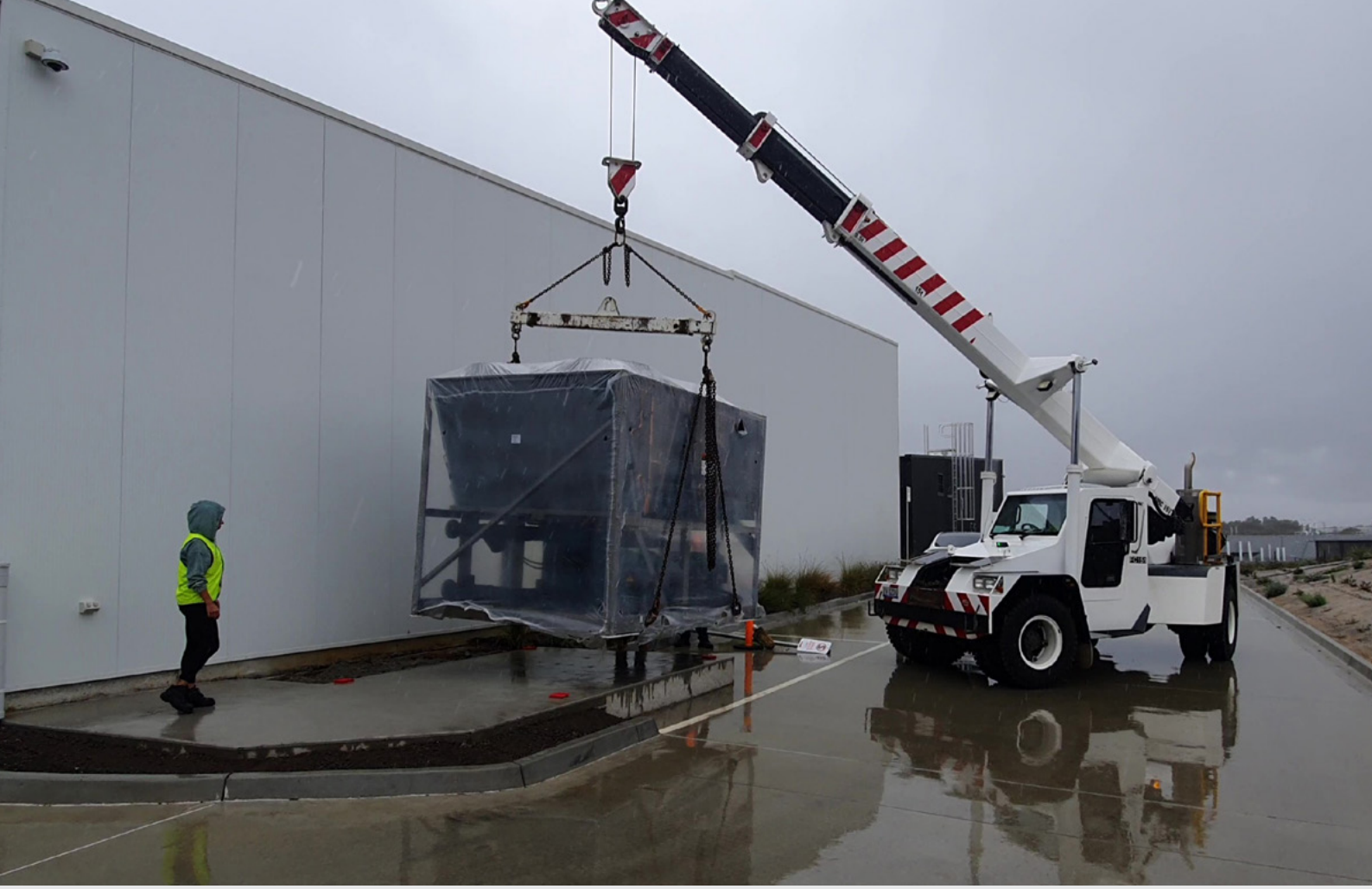
LI-S IN THE MEDIA

Watch & listen to interviews on what our recent 45% cell size reduction means for the future of electric aviation and road transportation.



Watch now ►

Listen now ►



2MWH PRODUCTION PLANT IN CONSTRUCTION

Our Phase 3, 2MWh automated battery production facility is now under construction in Geelong, Victoria. When finished later this year, the facility will scale up our production capacity to over 1000 high-quality commercial sized cells per week, enabling large scale customer trials and creating additional production IP for our IP portfolio.

A key infrastructure piece for the facility is our new 220 square metre dry room. Potentially the largest in Australia, the dry room's sole purpose is to eliminate moisture from the internal atmosphere. The dry atmosphere enables our automated anode production equipment and teams to operate at full capacity without the restriction of inert gas enclosures or glove boxes.

Starting construction on a new facility is always an exciting moment! The image above shows the dry room chiller being installed on-site next to one of our manufacturing bays. The chiller will work with our European built dehumidifiers to dry the atmosphere to less than 50 PPM (parts per million) of water vapour. This dry air is circulated into the dry room through a maze of sealed ducting and filtration systems.

Our Australian dry room engineering team, HumiScope, is expected to start dry room assembly next month as soon as the custom-designed fireproof wall and roof panelling arrives on-site.

In parallel, our technical team has recently been in Asia and Europe finalising Phase 3 production equipment selection, enabling our manufacturing line to be installed as soon as the dry room has been commissioned.

Powered by clean solar energy from the Waurn Ponds solar farm, our 2MWh production facility also minimises our carbon footprint while we scale up the production of cleaner, greener, lighter and more energy dense batteries that have the potential to deliver a signifcant reduction in future global carbon emissions.

Cover story references:

[1] *Source IDTechEX Report: Solid-State and Polymer Batteries 2021-2031*

[2] *Source Precedence Research – Unmanned Aerial Vehicle (UAV) Drones Market 2022 – 2027*

[3] *Source IDTechEX Report : Manned Electric Aircraft: Smart City and Regional 2021-2041*

MAKING CONNECTIONS AROUND THE WORLD

With future customers and partners largely based overseas, our international engagement is vital to grow our partner base and develop global commercialisation pathways.

During March, senior members of our team held meetings with key industry participants across the UK, Europe, USA and Asia.

In the UK we were pleased to meet the CEO and team at the UK Battery Industrialisation Centre, a unique facility where emerging battery companies can trial their chemistries at a Gigafactory scale. Together with the Warwick Manufacturing Group — a premier battery R&D facility — the UK offers a vibrant battery development ecosystem.

In Europe our CEO met with one of the largest European battery manufacturers to assess giga-scale manufacturing potential, plus leading European eAviation and drone OEMs.

In the USA we were pleased to meet with another major aircraft manufacturing company on the east coast, before spending the day in Seattle with Magnix, our current eAviation partner. Magnix CEO and VP Energy Systems welcomed us to their new facility, just metres from Boeing's Everett Production Facility, and emphasised their commitment to our ongoing project. We also attended the 40th International Battery Seminar in Orlando FL — meeting leaders in the EV industry, battery developers and US Government agencies.

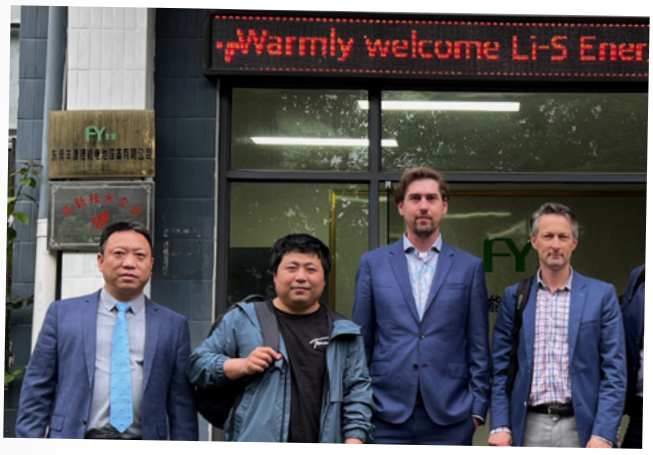
Finally to Asia, where our scientific and production teams performed on-site due diligence on shortlisted Phase 3 production line equipment vendors and visited their customers to see the equipment in operation.

We look forward to keeping you up to date with progress!

Dr Finniear met with our aviation partner, Magnix, in Washington to progress our joint projects

Our CEO, CTO and our Chairman met with UK BIC and Warwick Manufacturing Group in the UK

CEO, Dr Lee Finniear, in Florida at the 40th Annual International Battery Show



Our R&D team met with a number of equipment manufacturers in Asia to finalise suppliers for our new 2MWh facility

LEAD BATTERY SCIENTIST FROM APPLE INC.
APPOINTED AS R&D MANAGER

With great people central to our success, we're thrilled to announce we've appointed Dr Paul Bayley as Research & Development Manager.

Dr Bayley spent six years as a lead battery scientist at Apple, Inc. in Cupertino USA, where he was responsible for leading battery development projects for advanced lithium metal and lithium-ion batteries for future Apple products. During this time, he developed a deep understanding of the challenges and opportunities involved in developing innovative battery technologies for consumer electronics. He was also instrumental in leading research efforts aimed at improving the performance and safety of lithium metal batteries.

Dr Bayley's expertise in battery development and research is further bolstered by his PhD in Ionic Liquid Electrolytes for Lithium Metal Batteries from Monash University, and his work with Maria Forsyth at Deakin University.

He also spent four years at the University of Cambridge, where he was awarded a Marie Curie Fellowship and worked with the world-renowned battery scientist Professor Dame Clare P Grey.

Dr Bayley (left) in Asia recently with Operations Manager Tim Hanley (centre) and CEO Dr Lee Finniear

Based in Waurn Ponds, Geelong, Victoria, Dr Bayley brings with him a wealth of experience in battery development and research. Reporting to the CTO, Dr Steve Rowlands, Dr Bayley will be responsible for accelerating our Australian and international R&D programs, enhancing our R&D processes, and scaling the throughput of high-quality test and trial cells being produced on our new Phase 2 production line.

NEW SOLID-STATE BATTERY PROJECT BOOSTED BY $750,000 PARTNER FUNDING

Earlier this year we were proud to share we had received over $750,000 in partner funding to support our solid-state lithium sulfur battery cell development project.

Our GEN3 semi-solid-state lithium sulfur technology already delivers impressive performance and we intend to deliver these at commercial scales. One of our longer-term goals, however, is to create a full-solid-state lithium sulfur cell.

The promise of full-solid-state batteries is being pursued by a number of companies and research institutions using conventional lithium ion cathodes. They aim to improve energy density, safety and charge rates. However, due to challenges with performance and manufacturability, solid state batteries have yet to reach mass manufacture.

Our solid-state Li-S development project aims to pair solid-state technology with a sulfur based cathode, to deliver the benefits of solid-state electrolytes while also eliminating the heavy metals associated with lithium-ion cathodes, creating a greener alternative solid-state battery cell.

The three-year, $1.23M project is being performed in collaboration with the ARC Research Hub for Safer Energy (SafeREnergy). Li-S Energy will invest $450,000 into the project, with SafeREnergy and Deakin University contributing $360,000 and $417,617 respectively.

CEO, Dr Lee Finniear commented:

"This exciting step into solid-state lithium sulfur batteries is a key progression of the work being undertaken by our research and development team. Our lithium sulfur and lithium metal cells have been scaled up progressively over the last 12 months. Now the opportunity to integrate solid state technologies has the potential to add significant additional performance and safety advantages to our future commercial cells.

I would like to commend both the ARC Research Hub and Deakin University for their collaboration and significant contribution to this important project. I expect this to enable our battery technology to be even more attractive in its future commercial deployment."

Batteries 101

NEW TO THE INDUSTRY OR NEED TO BRUSH UP ON YOUR KNOWLEDGE? THERE'S A LOT OF 'TECH TALK' IN THE BATTERY WORLD, SO OUR COLUMN **BATTERIES 101** WILL HELP US ALL BY DETAILING KEY COMMON BATTERY TERMINOLOGY AND CONCEPTS.

Volumetric energy density and **gravimetric energy density** are two different ways of measuring the energy density of a battery.

Volumetric energy density is the amount of energy that a battery can store per unit volume, typically expressed in watt-hours per litre (Wh/L).

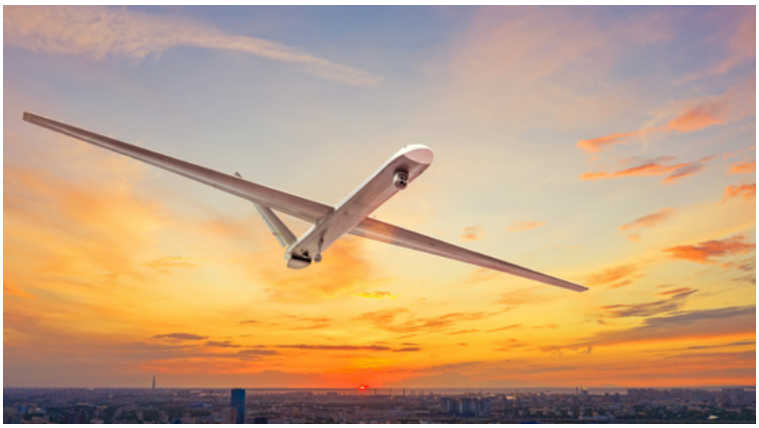
Gravimetric energy density, on the other hand, is the amount of energy that a battery can store per unit mass, typically expressed in watt-hours per kilogram (Wh/kg).

A battery with a high volumetric energy density can store its energy in a small volume, making it useful for applications where space is limited. For example, it is useful in electric vehicles, aerospace and consumer electronics, to minimise space requirements.

A battery with a high gravimetric energy density stores its energy in a very lightweight cell, making it useful for applications where weight is critical, for example, in electric aviation, drones and some EV markets where reducing weight adds range and payload to these applications.

Li-S Energy's latest GEN3 lithium sulfur cells have demonstrated a gravimetric energy density in excess of 400Wh/kg and a volumetric energy density of 540Wh/l, combining the benefits of both low weight and highly compact batteries, making them ideal for a range of high-performance applications.

Batteries with high volumetric energy density are useful when space is limited, such as in large commercial EVs.



Batteries with high gravimetric energy density are useful when weight is limited like in drones.

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