Investing in the future

Raw materials
Li chemicals
Batteries
Recycling

Lithium Australia NL

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Managing Director
ASX: LIT

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Lithium Australia NL

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COMPETENT PERSON'S STATEMENT

The information in this report that relates to reporting of Exploration Results is based on and fairly represents information and supporting documentation prepared by Adrian Griffin, a member of the Australasian Institute of Mining and Metallurgy. Mr Griffin is a shareholder in, and managing director of, LIT and has sufficient experience relevant to the style of mineralisation and type of deposit under consideration. He is qualified as a Competent Person as defined in the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. *Mr Griffin consents to the inclusion in this report of the matters based on information in the form and context in which it appears.*

Sustainability: the key to the future

The new and rapidly evolving energy market is being driven by low emissions, renewables and a requirement for battery storage of electricity to provide power on demand.

Energy storage and mobile power applications rely heavily on lithium-ion batteries, currently the cheapest and most efficient means of storing power.

Lithium Australia seeks to maximise resource utilisation within the energy storage sector via a suite of sustainable technologies for the battery industry.

Already, Lithium Australia's technologies are advancing well towards commercialisation – the Company's active R&D programmes are now at the pilot-testing stage, along with product evaluation by industry participants in the battery industry.

- Global portfolio
- SiLeach® + LieNA® processes
- VSPC battery materials
- Re-birthing of spent batteries/e-waste

Lithium Australia's business divisions

Raw materials

Lithium Australia's portfolio of exploration and resource projects encompasses diverse styles of mineralisation and mineralogy, with the potential to supply spodumene as conventional lithium concentrates, as well as lithium obtained from less conventional sources, to the lithium chemical industry.

The Company's ability to capitalise on unorthodox sources of lithium, such as mine waste not otherwise used for such production, equates to much better utilisation of available raw materials. Moreover, potential by-products can include tin, tantalum, tungsten, caesium, potash, silica, beryllium, rubidium and rare earths.

Lithium chemicals

Lithium Australia has developed low-energy processes to recover lithium from silicates without roasting while potentially delivering a range of valuable by-products. Those processes include the Company's 100%-owned proprietary technology:

- SiLeach®, which recovers lithium and other metals from lithium-bearing micas such as lepidolite and zinnwaldite, and
- LieNA®, which recovers lithium from spodumene.

Battery materials

Lithium Australia's 100%-owned subsidiary, VSPC Limited, has produced some of the most advanced cathode powders known at its pilot plant in Brisbane, Australia. Chinese battery manufacturers are currently evaluating these powders, which have already been extensively pilot-tested in-house. The Company is also assessing anode technologies that may enhance the performance of lithium-ion batteries.

Recycling

Lithium Australia is well advanced in its quest to develop a flowsheet for the recovery of ***all*** metals from spent lithium-ion and alkaline batteries. The Company's goal is to dovetail such technology with VSPC cathode powder production in order to rebirth battery cathodes, and in so doing eliminate a number of the process steps usually required to produce new cathode materials. With only about 9% of lithium-ion batteries currently recycled globally, Lithium Australia's goal is to not only reduce the consumption of finite raw materials for battery manufacture but also prevent the environmental contamination that occurs when batteries are disposed of in landfill.

Raw materials

Resource base

Right now, more lithium is discharged in waste streams than ever reaches the supply chain. Such waste streams include:

- micas liberated during the recovery of tin, tantalum and tungsten;
- micas separated during the refining of clay minerals, and
- contaminated spodumene concentrates, or spodumene that is too fine to be used commercially.

While Lithium Australia is strongly focused on materials discharged in waste streams, it also has an interest in stand-alone lithium deposits, or lithium-containing deposits considered polymetallic. The Company's wholly-owned Sadisdorf deposit (a dormant tin mine in Saxony, Germany) is a good example of the latter in that tin mineralisation is enveloped by a greisen (altered granite), within which the alteration takes the form of pervasive lithium micas (see Figures 1 and 2).

Figure 1. Location of Lithium Australia's German prospects.

Raw materials

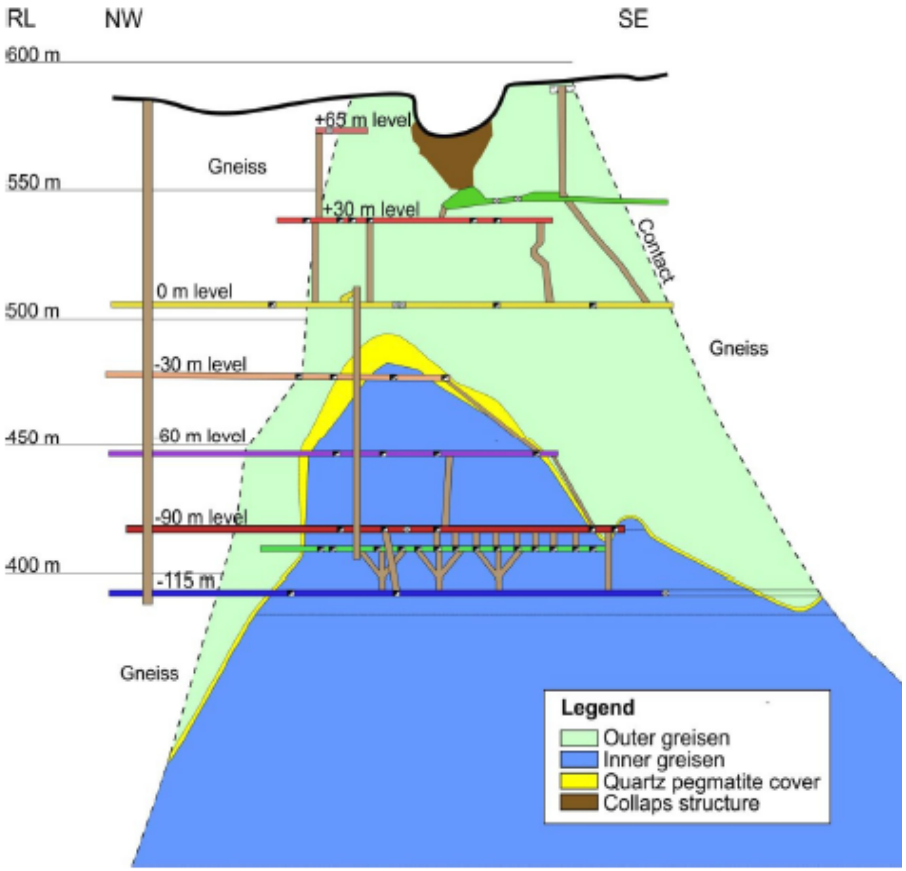


Figure 2. Historic section of Lithium Australia's Sadisdorf project.

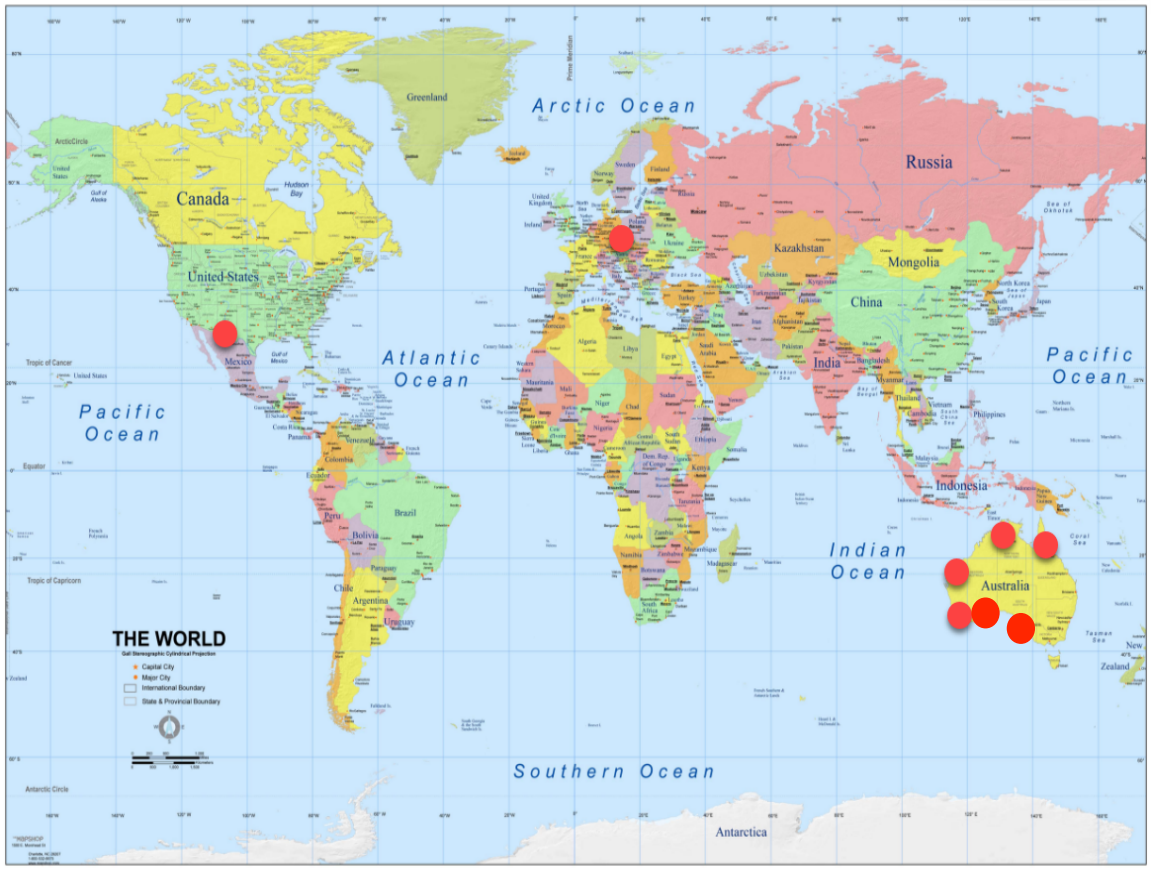


Figure 3. Areas covered in Lithium Australia's resource portfolio.

Resource development programme – 2019

Lithium Australia's principal tenet is that of sustainability – utilising waste products from other operations. That said, security of supply also factors strongly in the Company's decisions relating to future investment in the downstream lithium chemical business, and its resource base and exploration assets will in due course provide that. In 2019 Lithium Australia will initiate exploration programmes on areas of known lithium mineralisation in Western Australia (at Lepidolite Hill and Youanmi) and implement a pre-feasibility study (PFS) on the Sadisdorf project.

Rising tin prices augur well for the future of Sadisdorf, as does Lithium Australia's ability to process lithium micas (previously considered a waste product of tin mining there) into lithium chemicals. Once lithium is recovered from the Sadisdorf micas, it can be used in the production of cathode powders, but without being initially processed into lithium hydroxide, that step being one of the more challenging in the production of battery materials.

The Sadisdorf PFS will consider:

- mining;
- tin recovery;
- lithium mica recovery;
- SiLeach® processing of the lithium mica, and
- production of cathode materials using VSPC technology.

Implementation of both the SiLeach® and VSPC technologies will not only reduce exposure to mining costs but also facilitate the establishment of a very conservatively sized production unit (nominally 5000 tonnes per annum of cathode powder), a strategy designed to maximise the value of the process steps in the battery production cycle. Preliminary modelling indicates that this will sustain a lucrative supply into lithium-ion battery markets, specifically as lithium-iron-phosphate (LFP) cathode materials.

While the PFS aims to demonstrate that this approach (i.e. exploiting a single deposit – in this case Sadisdorf – specifically to generate cathode materials) is achievable, Lithium Australia's aim overall remains that of sourcing feed from third-party waste discharge sources. To that end, the Company is negotiating the supply of 'waste' mica from third parties in Europe as a feed source for the production of lithium-ion battery powders there. Indeed, the very reason Lithium Australia is establishing such a strong and viable resource base overall is to ensure security of supply.

Lithium chemicals

Lithium extraction processes

Lithium Australia has developed two proprietary processes to recover lithium from silicates without the need for roasting[1]. Both have the potential to revolutionise lithium processing by not only providing a low-energy method of producing lithium chemicals but also capitalising on waste streams that would otherwise remain unused. Those processes are:

- SiLeach® for the recovery of lithium from mica and other silicate minerals, and
- LieNA® for the recovery of lithium from spodumene.

SiLeach®

SiLeach® can process lithium micas without roasting (low energy footprint) to produce lithium chemicals as well as a range of valuable by-products, among them alkali metal salts, silica (as an amorphous solid or sodium silicate) and, most importantly, sulphate of potash (SOP), a common fertiliser.

SiLeach® has been extensively pilot-tested at the Australian Nuclear Science and Technology Organisation (ANSTO) facilities at Lucas Heights in New South Wales, Australia. During 2018, the Generation 2 SiLeach® pilot plant operated using feed material recovered from mine waste in the Kalgoorlie region of Western Australia. While SiLeach® can produce lithium carbonate as the primary product, lithium phosphate has become the production chemical of choice, in that process conditions are improved and the end product contains lower levels of impurities. In addition, lithium phosphate is compatible with VSPC's cathode powder production technology. Moreover, when lithium phosphate is used in the production of LFP cathode powders, there is no need to use more expensive lithium hydroxide as a feed material.

[1] Lithium Australia also has certain exclusive rights to the LMax® process owned by Lepidico Ltd.

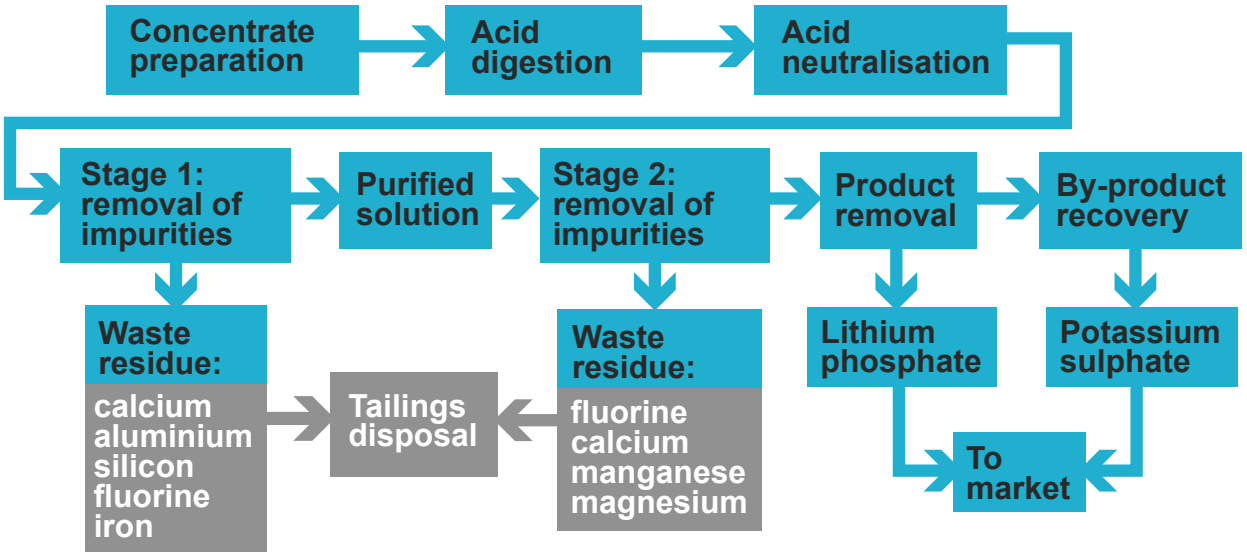
SiLeach®

In 2019, the Generation 2 SiLeach® pilot plant will be superseded by the Generation 3 version.

The latter will incorporate all process steps on a continuous basis, and will also include a polishing step to further enhance product quality.

That final product will again be tested via the production of LFP lithium-ion batteries at VSPC 's Australian facility.

SiLeach® process steps



LieNA®

Lithium Australia is also the developer and sole owner of the LieNA® process, designed specifically to overcome the shortfalls inherent in lithium recovery from spodumene using conventional 'conversion' processes.

Shortcomings of conventional spodumene processing

Conventional 'conversion' processes that recover lithium from spodumene – roasting to effect a phase change from α to β spodumene, an acid bake and a water leach – are energy-intensive and create issues with respect to the considerable amounts of sodium sulphate produced. Indeed, disposal of the latter may be the Achilles heel of any widespread expansion of the process. Roasting takes place in rotary kilns with counter-current gas flow, and these are very sensitive to feed-particle size. This sensitivity results in the relatively large particle size of commercial spodumene products; undersize particles report to tailings during the spodumene concentration process as they are not amenable to roasting. As a consequence, most yields from hard-rock spodumene production are less than 70% lithium and often as low as 50%. The principal constraining factors for conventional conversion processes, then, are:

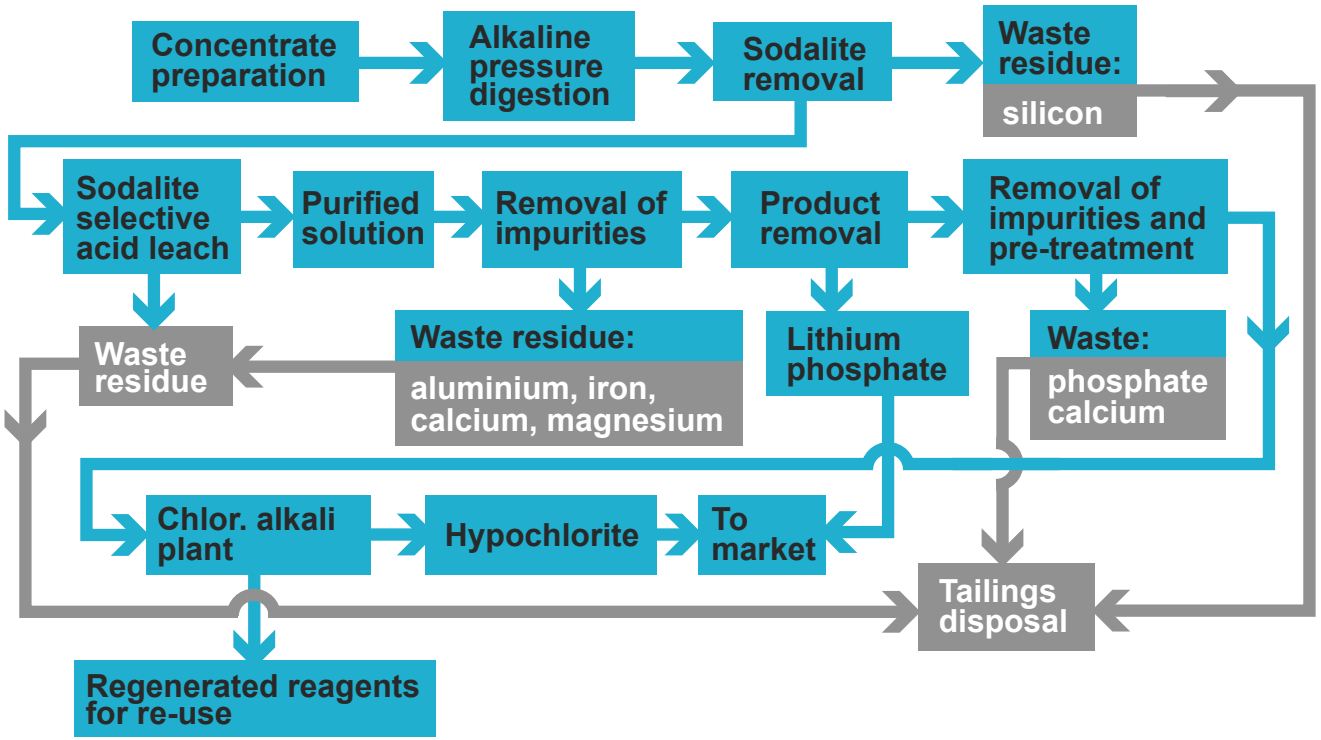
- disposal issues relating to the by-products inevitably produced during the production of lithium carbonate/ hydroxide, and
- poor resource utilisation, resulting from an inability to process fine spodumene concentrates.

Advantages of the LieNA® process

LieNA® is a caustic conversion process designed specifically to recovery lithium from spodumene without roasting (low energy). The technology results in a phase change that occurs in caustic solution at an elevated temperature in a manner analogous to the conventional conversion of α to β spodumene, but the solid product produced during the LieNA® phase change is readily leachable. Moreover, much of the reagent (caustic soda) used in the LieNA® process is recyclable.

LieNA®

LieNA® process steps



To summarise, the advantages of LieNA® compared to the current and competing technology are:

- lower energy consumption;
- a smaller footprint;
- its suitability for fine feed;
- the minimal amounts of sodium sulphate by-product produced, and
- the fact that much of the critical processing reagent is recycled.

The LieNA® process has been bench-scaled by ANSTO, with preliminary commercial assessment indicating that further development work is warranted. Honing of final product synthesis, refining, and recycling of reagents will continue during 2019, the aim being to progress to continuous pilot testing in 2020.

Batteries

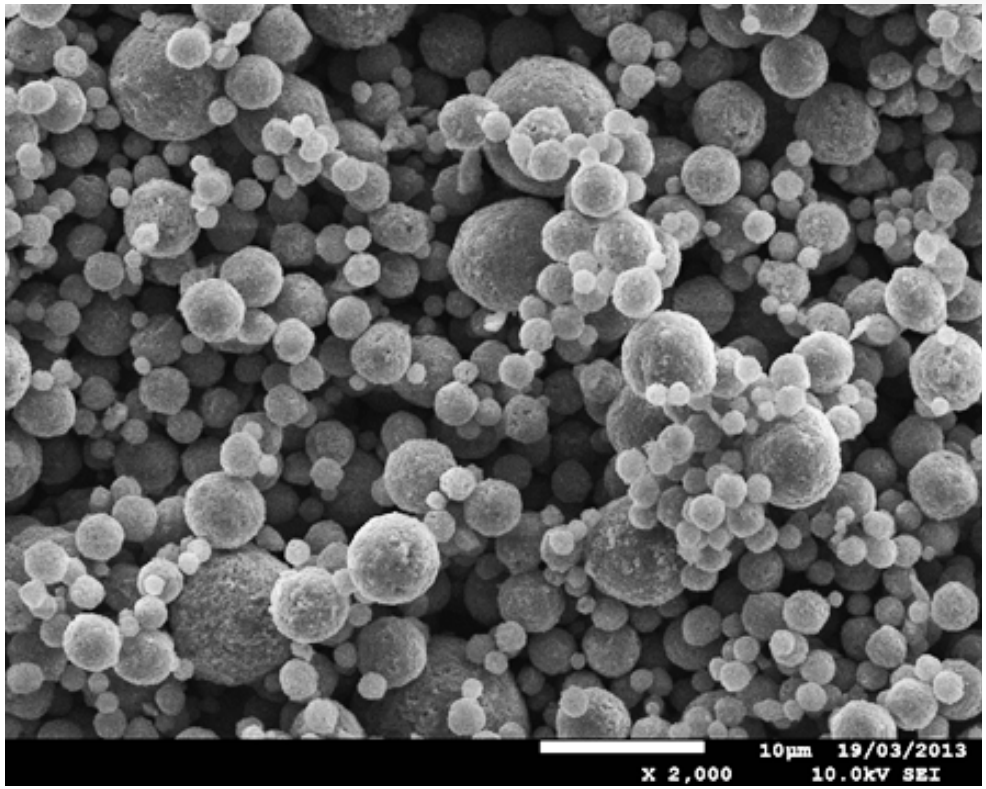
VSPC Limited

A wholly-owned subsidiary of Lithium Australia, VSPC has 15 years' operating experience, with a focus on the production of low-cost, high-performance cathode powders for lithium-ion batteries. Lithium Australia aims to deploy its VSPC technology globally, to ensure the sustainable production of high-performance battery materials.

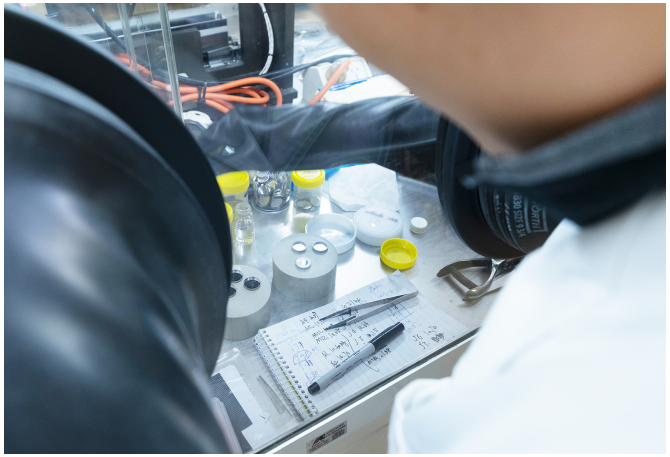
To that end, VSPC has assembled a skilled workforce and currently owns three families of international patents covering the manufacture of battery cathode powder.

VSPC's R&D facility comprises:

- a pilot plant for the production of cathode powders;
- an electrochemical laboratory;
- lithium-ion cell-making facilities, and
- comprehensive battery-testing facilities.



Batteries



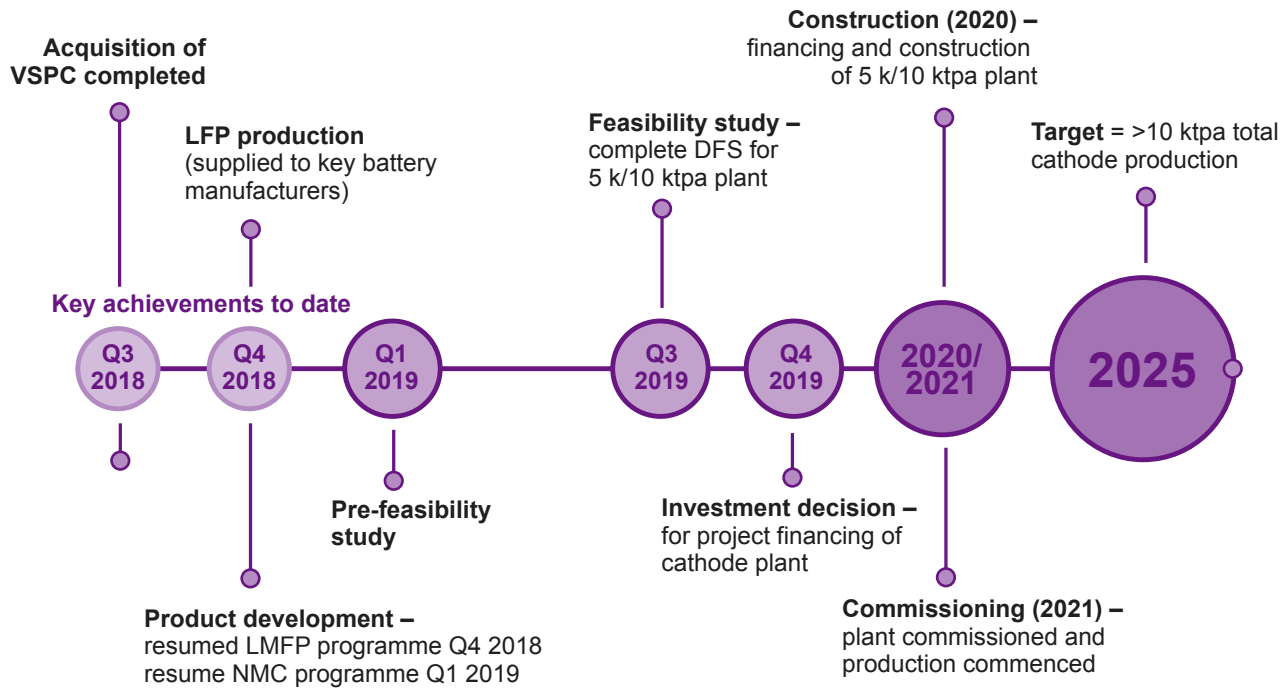
VSPC's cathode powder manufacture is based on simple nanotechnology. The cathode powders are precipitated directly from solution in a single process, ensuring very precise controls on chemical composition and particle size not attainable via the use of any other manufacturing technique. Indeed, the process has produced some of the most advanced cathode powders available, which are currently being tested by battery manufacturers in China.

Relative to other process methodologies, VSPC technology is characterised by:

- high-quality, consistent products – including independently proven, high-quality $LiFePO_4$ powder – at a lower cost;
- more precise formulation of complex metal oxide/phosphate materials;
- high material efficiencies (no recycling of intermediate products to achieve high metal yields);
- flexibility of scale (using conventional equipment typical of the pharmaceutical and ceramic industries);
- flexibility in composition (providing a pathway to alternate cathode material chemistries);
- flexibility in powder morphology, and
- the ability to process a range of raw materials (for lithium, that includes lithium phosphate, lithium carbonate and lithium hydroxide).

Batteries

VSPC commercialisation plan



Anode technology

Improving performance remains at the forefront of lithium-ion battery storage technologies ('range anxiety', for example, is still an impediment to completely phasing out internal combustion engines in transport applications).

In the past few years, the development of advanced cathode materials (including VSPC cathode powders) has gone some way towards improving battery performance, but anodes too will prove fertile ground in this regard. Lithium Australia is currently evaluating a number of anode technologies with the potential to offer significant gains in battery performance.

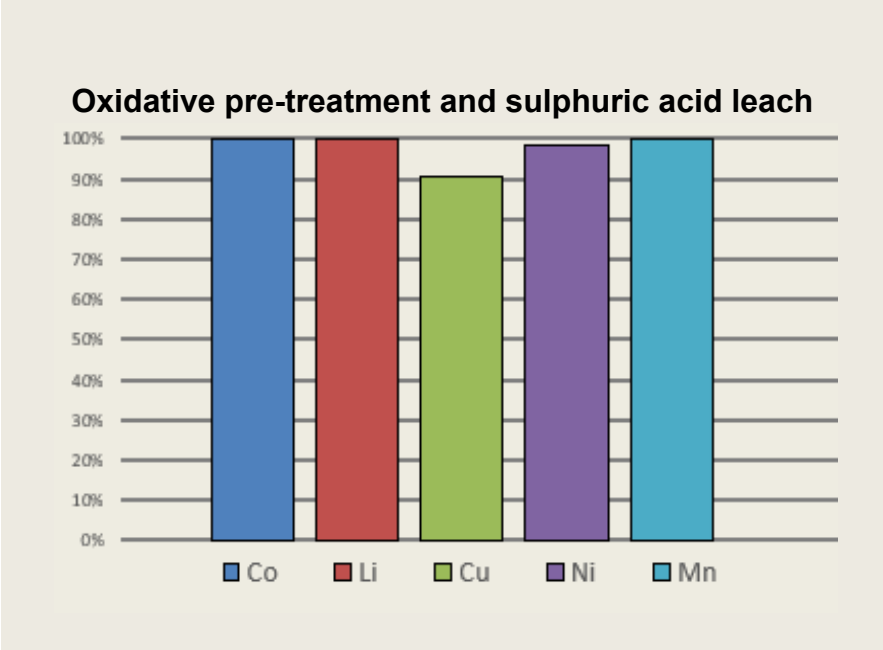
Recycling

With resource availability an issue in the burgeoning energy storage sector, security of supply must also form a prime component of national energy management. Despite concerns about the availability of battery metals (lithium and cobalt in particular) in the not-too-distant future, at present only about 9% of lithium-ion batteries are recycled globally. In fact, in Australia the figure is less than 3%, an alarming statistic given the rate of adoption of energy storage technology there.

Lithium Australia recognises that recycling of spent batteries is part of the long-term solution to supply security. The Company is also concerned by the adverse environmental impacts inherent in disposing of such materials in landfill, not to mention the contained value of the material within the batteries at the time of disposal, material which could be utilised.

Where recycling does occur – principally in Europe, China and South Korea – the focus is on reclaiming cobalt, with none of the lithium retrieved. In contrast, Lithium Australia is working with a number of universities to develop technology capable of recovering ***all*** the metals from spent batteries.

To date, intensive research programmes have resolved many of the issues associated with metal recovery, and Lithium Australia plans to pilot-test these processes in 2019.



Laboratory metal recoveries from spent lithium-ion batteries.

Development plan – 2019

Lithium Australia NL

Lithium Australia's development plan for this year includes:

- constructing and operating a Generation 3 SiLeach® pilot plant;
- taking the Sadisdorf project to pre-feasibility;
- completing feasibility for VSPC, and
- further evaluating resources on land the Company owns.

Lithium Australia is seeking partners for the commercial development of its various enterprises.

Each of the Company's business units has the potential to contribute significantly to a more sustainable energy future, greatly improving resource utilisation to meet the burgeoning demands of the energy storage and electric vehicle industries.

Strategic partnerships will accelerate Lithium Australia's journey to commercialisation of its critical technologies and offer great opportunities for new investors.

Notes

Lithium Australia – corporate snapshot

ASX-listed: ticker LIT, LITCE

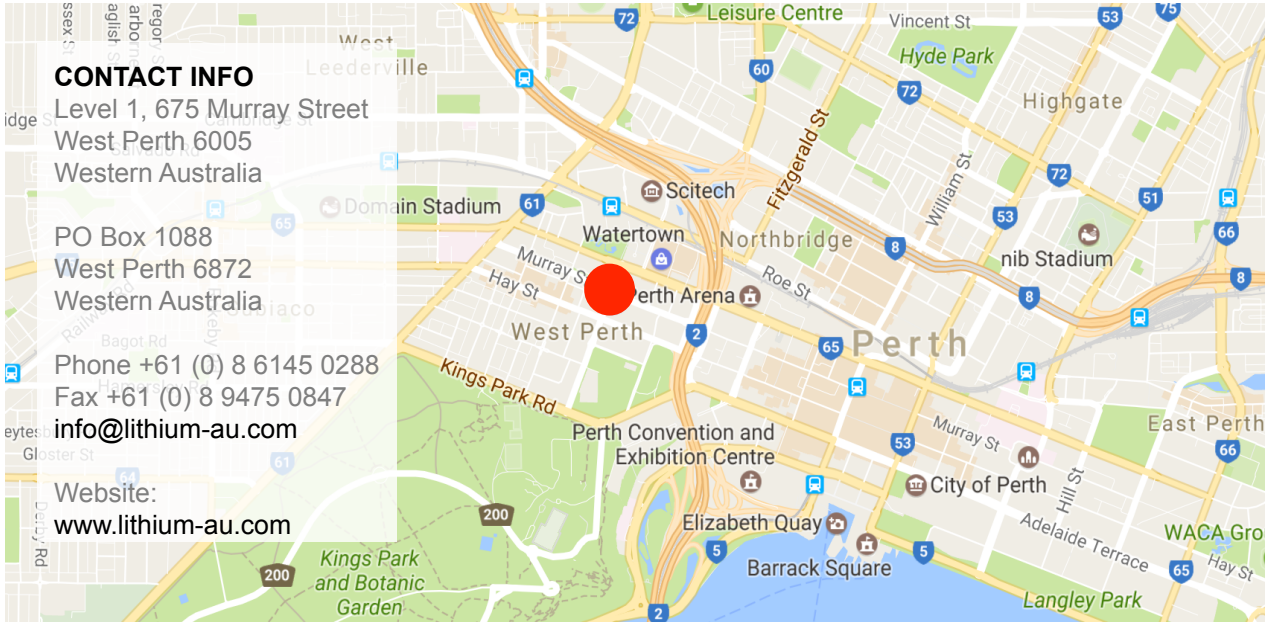
Lithium Australia NL

George Bauk
(non-executive chairman)
Expert in specialty metals, particularly rare earths – project management, marketing and financing.

Adrian Griffin
(managing director)
Exploration, production, mine management and processing technology.

Bryan Dixon
(non-executive director)
Corporate, finance and mine development.

Price (AU$) as at 29/1/19	**0.09**
Market capitalisation (AU$)	**42 M**
Shares outstanding (LIT)	**464 M**
Partly paid shares (LITCE)	**170 M**
Cash position at 31/12/18 (AU$)	**10.95 M**
Debt position at 31/12/18 (AU$)	**5.0 M**



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Top 10 holders at 25 Jan 2019	**26.08%**
JP Morgan Nominees	5.74
TIN International AG	4.60
Accuity Capital Investment Mgmt	3.23
Citicorp Nominees Pty Ltd	2.41
HSBC	2.21
Neil Griffin	2.01
Adrian Griffin	1.85
Parkway Minerals NL	1.58
Resource & Land Management PL	1.31
MCN Investments Pty Ltd	1.14