

# LITHIUM OUTLOOK

Can EV battery metal  
continue its incredible  
bull run?



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### [www.aspermont.com](http://www.aspermont.com)

Published by Aspermont Media, 1 Poultry, London, EC2R 8EJ, UK.

Subscription records are maintained at Aspermont Media Ltd, 21 Southampton Row, London, WC1B 5HA

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# Contents

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<b>Introduction</b>	<b>4</b>
Red Dirt Metals	5
Argentina Lithium & Energy	8
<b>Whitepaper</b>	<b>11</b>
Bradda Head	17
Cypress Development Corp	20



# Lithium continues surge as EV makers scramble for supply

**The lithium market has so far defied doomsday predictions from a number of big investment banks, continuing the incredible bull run that began in 2020 when the electric vehicle boom took off.**

And what a run it has been, with prices of lithium concentrate, lithium hydroxide and lithium carbonate transactions almost tripling in the past year alone. In certain quarters, such as an auction platform run by an Australian lithium miner, the price gains have been even more impressive.

What began as an EV story has increasingly turned into a story of supply security, as policymakers and companies operating up and down the lithium-ion battery value chain have begun to understand the importance of securing raw materials. This sense of urgency has become more palpable since the UK and EU decided to ban internal combustion engine vehicle sales by 2030 and 2035 respectively, and the US and China set goals of having EVs account for 50% and 40% of all new vehicle sales respectively by 2030.

This report looks at the movers and shakers in the lithium market, including the companies down the


value chain that are taking steps to secure lithium concentrate, the exclusive group of producers currently dominating lithium mining and refining, and the companies that are next in line to make the transition from developers to producers.

We also profile four emerging companies conducting exploration and development work across the three main lithium deposit types (brine, hard rock, and clay) and operating in North America, South America and Australia.

“Policymakers and companies operating up and down the lithium-ion battery value chain have begun to understand the importance of securing raw materials.”

**Nadav Shemer, *Mining Journal***





# Red Dirt rockets towards mining in 2023

Only acquired in late 2021, and with a maiden lithium resource recently released, Red Dirt Metals has moved at lightning speed on its Mt Ida lithium project in Western Australia

Red Dirt has recently raised \$55 million to develop its Mt Ida Lithium Project and accelerate further exploration at the recently acquired Yinnetharra Lithium Project.

Situated just 230km northwest of Western Australia's mining capital Kalgoorlie, Mt Ida could hardly have a better address, given the sealed roads, rail and port access in one of the most favourable exploration and mining jurisdictions on the planet.

Despite the project's relative youthfulness, potential offtake partners are already being assessed in the light of the imminent production of this battery metal, for which there is both huge appetite and a long-term future.

"Since we published the resource, it is now about achieving three objectives – and everything in the business is focused on them," said Red Dirt executive chairman David Flanagan. "The first one is to be mining direct shipping ore by the end of calendar 2023.

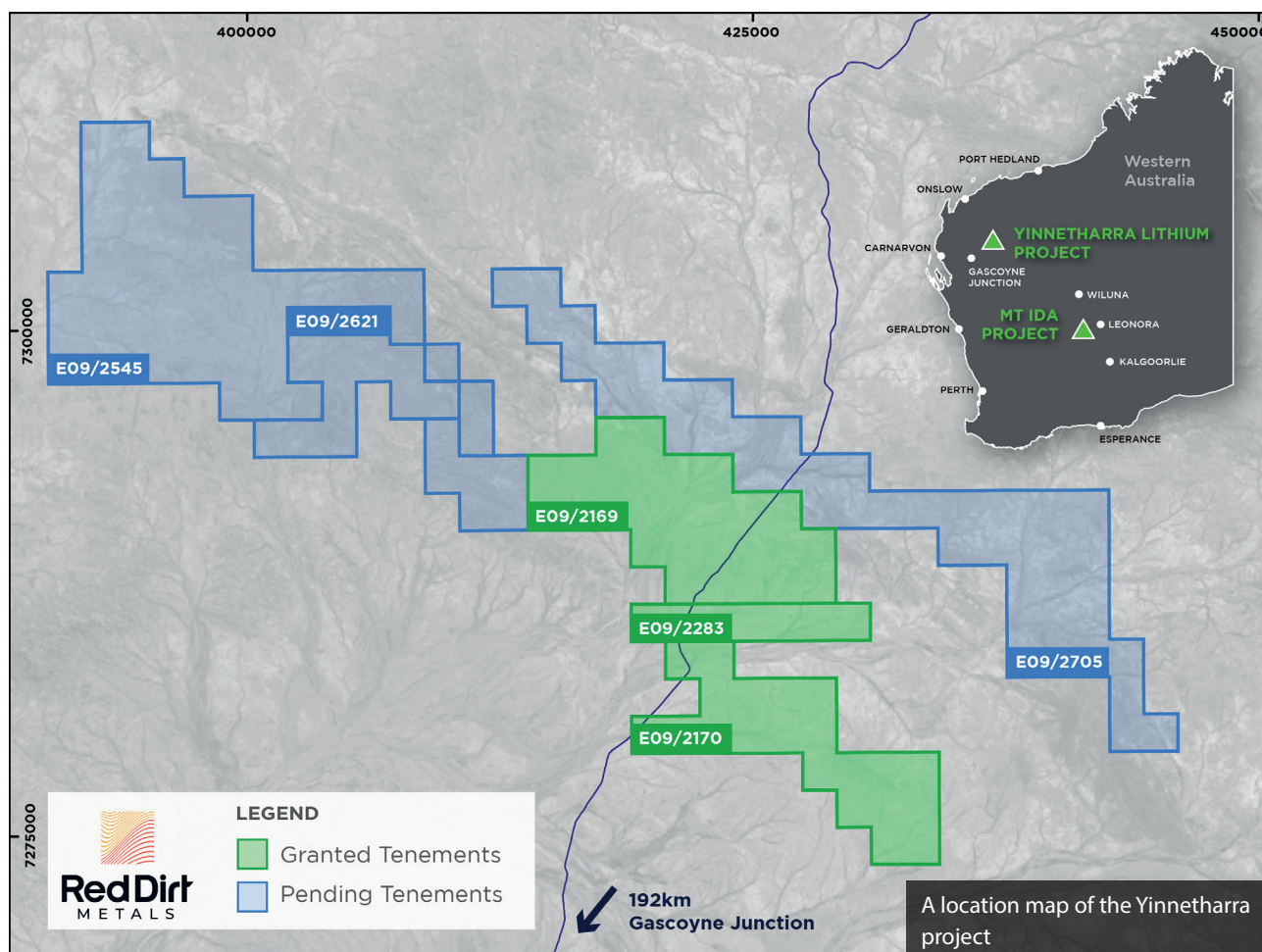
"And while that is running, the second to-do item is focusing on stage two, which deals with the technical studies you need to do before you start constructing a hybrid heavy liquids separation concentration plant to produce a lithium concentrate.

"The third objective is growth. We bought the Yinnetharra lithium project from Electrostate – and we just love it, we are so excited about it, it is an absolute monster. To put it into context, we have got about 13Mt at 1.2% lithium oxide at our Mt Ida project and the outcrop there is the



Red Dirt executive chairman David Flanagan





size of a kitchen table. At Yinnetharra, we have got some outcropping mineralised pegmatites which are 700m long and 60m wide.

The Yinnetharra project is also in Western Australia, 120km northeast of Gascoyne junction, spanning about 520sq.km. “The drill rig starts drilling at Yinnetharra in mid-November and we have 150 holes permitted there,” Flanagan said. “We will probably only get a couple of thousand metres drilled before Christmas.”

Even though Mt Ida is essentially viewed as being prospective for gold, the belt has in the past been tested for a host of other battery minerals, as well as nickel.

“From this point on, we are going to do all the things you normally do to build a mine. We will lodge our application for mining approval in early February and I am already interviewing people to fill positions right now. We are also talking to our offtake customers,” Flanagan said.

Flanagan believes that the appetite and demand for lithium completely overshadows the iron ore crazy days when the world could not get enough of the steel-making metal. As former MD of Atlas Iron, he speaks from experience when he says that “right now, there is twice as much interest coming inbound for lithium as we had for

“Right now, there is twice as much interest coming inbound for lithium as we had for iron ore back in the day”

iron ore back in the day.”

He says that Red Dirt has received several unsolicited approaches for lithium offtake and that “some even get grumpy if you don’t want to give them a mandate and sign an offtake agreement.” Flanagan is unapologetic, however. “What we intend to do is get properly informed on the offtake options then do our very best to do the very best deal for shareholders,” he said. “We are not going to wait forever and leave offtake to the last minute. But we need to be informed so that we can make good decisions.”

In terms of the current state of play for the company, the most important milestones achieved during, and



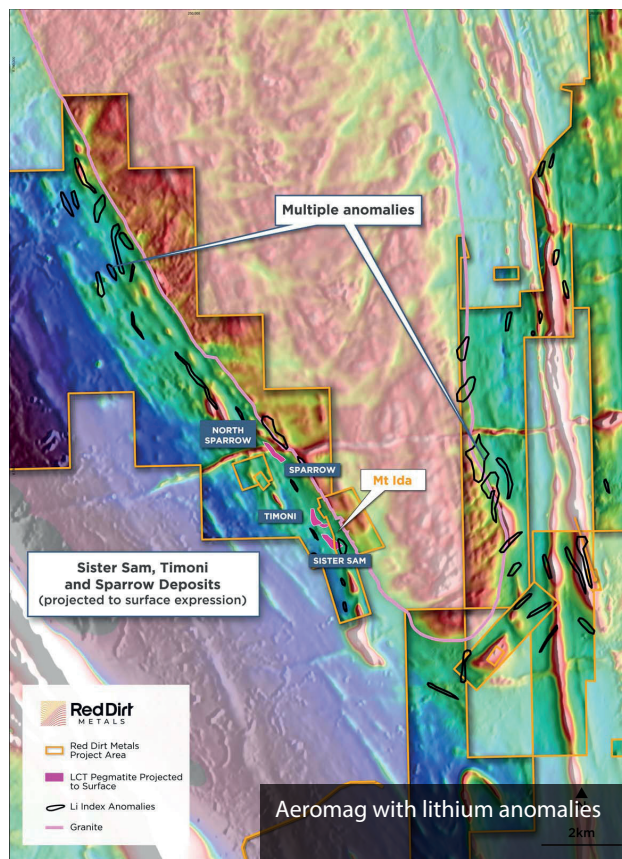
subsequent to, the September quarter were the release of a maiden lithium resource for Mt Ida and the acquisition of Yinnetharra.

The lithium resource estimate comprises 12.7Mt at 1.2% lithium oxide and 207 parts per million (ppm) tantalum pentoxide, reported above a cut-off grade of 0.55% lithium oxide. This includes 3.3Mt at 1.4% lithium oxide and 246ppm tantalum pentoxide, representing 25% of the total mineral resource is in the indicated category.

Red Dirt says that the rapid definition and release of this maiden resource just over 12 months since the project acquisition is testament to the incredible work that the team has done and that block models have been delivered to engineering consultant MineGeoTech to undertake scoping study level analysis of open pit and underground mining scenarios.

ValMax has been contracted to run a high level mining operating cost estimate analysis (pit to port) for a direct shipping ore operating scenario for Mt Ida. The study will include a typical two-stage development strategy, including DSO, followed closely by concentrate exports. However, unofficial back-of-the-envelope calculations suggest that the figure for a rail-port-boat shipment could be as little as \$70 per tonne.

Jewel in the crown, however, was the acquisition of Yinnetharra, where 54 mapped pegmatites have been



identified supported by rock chip sampling, RC drilling and anomalous lithium soils.

Red Dirt is also fortunate to be in a very strong cash position, with pro-forma cash amounting to over \$65 million upon completion of the recent capital raising.



Lithium-caesium-tantalum pegmatite displaying coarse spodumene drilled by Red Dirt in hole YNRD005 at the Malinda Prospect within the Yinnetharra project

**Red Dirt Metals – at a glance**

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**Directors:**  
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**Quoted shares on issue:**  
 416.1 million

**Market capitalisation (at \$0.46):**  
 A\$191 million

**Major shareholders:**  
 Waratah Capital Advisors – 10.67%



## Experienced Argentina explorers turn their attention to lithium opportunities



The Grosso Group made its name through the discovery of some of Argentina's biggest silver, uranium and gold deposits. Their latest venture, Argentina Lithium & Energy targets the key battery metal

When the Covid-19 pandemic shut down the global economy in 2020, Grosso Group spied opportunity among the uncertainty. The Vancouver-based firm moved swiftly to acquire nearly 60,000ha of concessions in the salt flats of northern Argentina. The resulting company, Argentina Lithium & Energy, offers investors exposure to an exploration play in an established lithium basin led by a management team with vast in-country experience and a history of major discoveries.

"Argentina experienced a severe lockdown, nobody could buy or sell properties and there was very little competition for projects," said Nikolaos Cacos, director for Grosso Group and Argentina Lithium & Energy's President and CEO. "With the wonders of Zoom technology and our in-country presence of our talented team, we were able to identify and acquire a portfolio of projects in an attractive salar with established resources. Argentina is underexplored and one of the best places in the world to make significant discoveries."

The company's flagship project is Rincon West, close to the border with Chile and Bolivia and at the heart of the Lithium Triangle, the region that is home to around half of the world's lithium reserves. In July 2021 an adjacent project developed by Rincon Mining published a resource estimate of 5.8Mt of measured and indicated lithium carbonate equivalent and a further 6Mt of inferred resources. Eight months later the project was acquired by Rio Tinto for \$825 million. On the eastern side of the salar, Argosy Minerals, which holds a similar sized land package to Argentina Lithium & Energy, is advancing its

own 245,000t project towards production. The Australian company doubled its share price over the course of 2022, reaching a market capitalisation of A\$800 million.

With its own market cap hovering around \$25 million, the management of Argentina Lithium & Energy believes it is well placed to follow the path taken by Argosy. Under Miles Rideout, the experienced, Argentina-based vice president of exploration, the company completed Transient Electromagnetic surveys over two thirds of the



Argentina Lithium & Energy's president & CEO and Grosso Group director, Nikolaos Cacos

main photo: Josefina Di Pietro





Drilling at the Rincon West project

photo: Josefina Di Pietro Rincon West project, identifying targets for its first five-hole drill programme on the project. Results from four of those holes had come in by early November.

“What’s interesting is that the results, both in terms of grades and intersections, are very much along the lines of those published by Rio Tinto and Argosy Minerals,” Cacos noted. “We’re working quickly towards publishing of maiden resource in April or May of 2023 and we’re targeting an ultimate resource equal to, or larger than, the one registered by Argosy.”

The rapid advancement of direct lithium extraction technology has revolutionised the industry, bypassing the need for time-consuming evaporation processes and making it possible to extract lithium from deposits of around 90 milligrams per litre. Grades from the second drill hole at the Rincon West project registered from 337 to 367mg/L. Rio Tinto plans to use direct lithium extraction at its Rincon project. “We’re looking to mimic that,” Cacos said. “The new technology makes medium grade deposits from 300 to 380mg/L very profitable and allow them to move to production much quicker than in the past.” There are no significant infrastructure hurdles to overcome. Rincon West and the company’s other assets are all accessible by road and lie in close proximity to a rail line that leads to a deep-sea port on the Chilean coast.

Argentina Lithium & Energy’s second project, Antofalla North, is on a different salar, 100km to the south of Rincon West. US firm Albemarle, the world’s largest

lithium producer, has a project it says is one of the largest deposits in Argentina, although the private company has not published a public resource estimate. With 15,800ha of land claimed or under option, Argentina Lithium & Energy’s land package at Antofalla North is three times that of Rincon West and a drill programme of up to six holes is set to begin in 2023.

Argentina Lithium & Energy also owns two early-stage exploration projects, Pocitos and Incahuasi, with over 40,000ha of land under claim in two exciting but as-yet-unestablished salars. “Because we have a much larger land position at Antofalla North, we expect this project could have even more potential than Rincon West,” Cacos said. “Pocitos and Incahuasi are more risky right now, in the sense that there are no established players nearby, but we’ll focus our efforts on them after we have pushed forward Rincon West, which represents the best chance of a quick return for our investors.”

The Grosso Group has a long history of doing just that. The company has been present in the Argentine mining industry since 1993, developing a strong local network and fostering an understanding of the country’s often turbulent political and business climate. The company has made a number of significant discoveries in the country during that time but four stand out. Two silver-lead discoveries, Chinchillas and Navidad, became producing mines following their acquisition by SSR Mining and Pan American Silver respectively. The Gualcamayo gold project was bought by Yamana and is now owned by Mineros SA.





photo: Josefina Di Pietro

Geologists conducting initial evaluation of lithium brine samples

The Amarillo Grande uranium deposit, meanwhile, is being developed by Blue Sky Uranium, another Grosso Group company. It's an impressive return from a country that has been off the radar for many mining investors.

"Argentina is the world's eighth largest country by landmass and has seen almost no exploration, while Chile, a sliver of land, has built a highly developed mining industry," Cacos said. "The Grosso Group recognised the huge opportunity for discoveries and has built up a track record of major successes over the last 30 years. We recognise the huge potential of the lithium industry and, given the opportunities inherent in Argentina, we're well on the way to adding a lithium discovery to our roster of successes."

In November 2022, the company announced a C\$6 million private placement, which will fully fund its exploration throughout 2023. According to Cacos, retail investors have shown strong interest in the financing and the company has received inquiries from institutional investors looking to acquire more sizeable positions. With the Chinese government targeting electric vehicles to make up 40% of sales by 2030, as well as a popular push towards electrification in western countries, Cacos expects the current surge in lithium prices to remain strong, where previous booms had petered out. If Argentina Lithium & Energy can find a resource and move the market cap to

the \$500 million or more mark it would mark a natural exit point, he said.

"The Grosso Group companies are excellent explorers, we've been able to demonstrate that by making truly world class deploy discoveries," he said. "Lithium is the new oil and just as many millionaires were made from the Alberta and Texas oilpatches, the same thing is happening now in Argentina."

#### Argentina Lithium & Energy – at a glance

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##### Directors:

Joseph Grosso, Nikolaos Cacos, John Gammon

##### Market capitalisation:

C\$25 million (at press time)

##### Quoted shares on issue:

90.79 million



# Critical battery metal continues bull run amid supply security fears



If there were an award for the commodities forecast that most missed the mark in 2022, then Goldman Sachs would surely receive a nomination for its premature declaration of an end to the lithium bull market.

In a research note published in May, the investment bank wrote that “fundamental mispricing” had generated an outsized supply response and predicted that supply would begin to outstrip demand in 2022. It forecast sharp corrections – about 10% by the end of 2022 and a further 60-70% in 2023 – in prices for lithium carbonate (Li<sub>2</sub>CO<sub>3</sub>) and lithium hydroxide (LiOH), the two lithium chemicals used in lithium-ion battery-cell manufacturing, as well as for lithium concentrate (Li<sub>2</sub>O) from hard-rock spodumene resources. After the price didn’t go the way it expected, it doubled down on its bearish position in November, adjusting its timeline to show the market going into surplus in 2023.

The lithium market has in fact so far defied doomsday predictions from Goldman Sachs and fellow investment banks Credit Suisse and Morgan Stanley, continuing the incredible bull run that began in late 2020, albeit at a slowing pace. Spodumene concentrate prices were up

10% since the Goldman forecast and 181% year-on-year in October 2022, and lithium chemicals were up by similar percentages, according to Benchmark Mineral Intelligence, a specialist in pricing of lithium-ion battery raw materials that tracks more than 90% of global lithium transactions.

Prices of sales on Pilbara Minerals’ BMX platform – which the Australian miner uses to auction off spodumene not already committed to buyers under offtake contracts, and which has brought much-needed transparency to the market – were up 44% from the time of the initial Goldman forecast and 265% year-on-year to \$8,575/t (on a standardised 6% Li<sub>2</sub>O-equivalent basis) in November 2022, more than triple Goldman’s predicted 2022 average price of \$2,800/t.

Albemarle and Sociedad Química y Minera de Chile (SQM), the world’s two biggest producers of lithium concentrate and chemicals, both reported receiving higher prices in their September quarter reports, with SQM revealing a quarterly average lithium chemicals price of \$56,000/kg, up 4% from the previous quarter and 600% from one year earlier.

#### Lithium’s rapid expansion makes it difficult to forecast

In an early-2022 Bloomberg survey of six leading lithium forecasters, estimates for how the market will look in 2025 ranged from a 13% deficit to a 17% surplus. Projections for the market’s size diverged sharply too, with demand forecasts ranging from 502,000t to 1.3Mt of lithium carbonate equivalent (LCE). (Roughly 7-8t of 6% spodumene concentrate is required to produce 1t of lithium carbonate.)





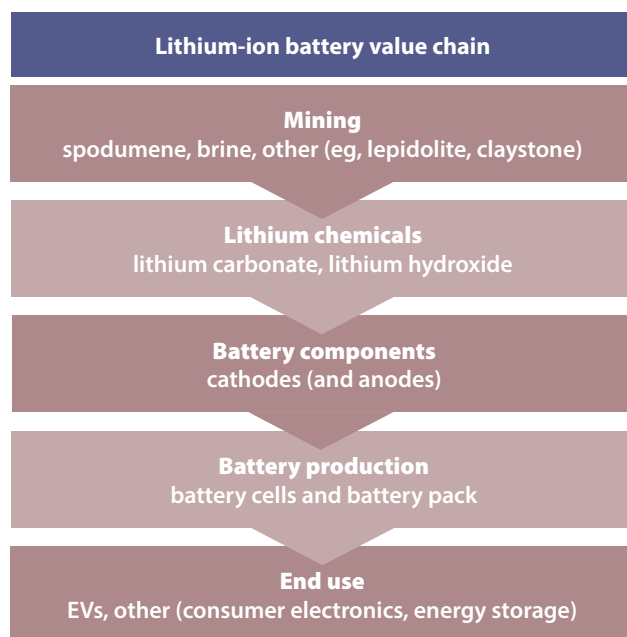
Greenbushes lithium mine, Western Australia

The gulf between these forecasts reflected lithium’s status as “a small market on the cusp of seismic expansion,” Bloomberg noted. It said the average forecast had annual growth at more than 20% for both supply and demand between 2021 and 2025. By comparison, mature markets such as copper typically see 2-4% growth rates.

Benchmark Mineral Intelligence, one of the most bullish lithium forecasters, says the lithium market will balance over the next few years but will not see a structural over-supply before 2025. It further forecasts that lithium demand will reach 2.4Mt LCE in 2030, which it says will require \$42 billion of investment between now and 2028 to supply.

In a written response to Goldman Sachs’ May 2022 paper, Benchmark suggested that the investment bank’s bearish position stemmed from a lack of understanding of the nature of the lithium market. It said Goldman’s errors included overrating new lithium projects from China, which “are low quality” compared to Australian and other alternatives; overestimating the speed at which lithium hydroxide refining facilities will come online, which “rarely goes to plan”; overlooking the fact that a lot of lithium chemical capacity is being used to reprocess material that does not meet downstream specifications, which “eats up existing capacity” and fails to address the underlying market shortfall; and overlooking the impact that higher inflation, supply bottlenecks and the need for new technologies to develop new lithium supply will have on incentive prices.

Additionally, Benchmark wrote that the spot market price in China does not represent the true price of lithium in the



Sources: Visual Capitalist, Australian Office of the Chief Economist, Small Caps

market and that it is often not the true price being paid by Western battery majors.

“In these markets we expect to see a gradual ramp-up in contract deals being settled with increasingly flexible, and more frequent, pricing mechanisms,” Benchmark wrote.

Similarly, the major producers have all forecast continuing tightness in the market, with SQM noting that in addition to strong demand growth from the electric vehicles (EV) market, new lithium supply has been “delayed and slow to come online”.



**Supply security has become a major driver**

Lithium demand is intertwined with demand for battery-electric and plug-in hybrid electric vehicles, most of which use lithium-ion batteries.

Global EV sales are expected to reach 10.6 million in 2022, 57% more than in 2021, according to Sweden-based consultancy EV-volumes.com.

Moreover, policymakers in many of the world's largest economies have passed laws to ban or phase out the sale of internal combustion engine (ICE) vehicles in the not-too-distant future. The UK and EU have confirmed they will ban ICE vehicle sales in 2030 and 2035 respectively. California, the largest automotive market in the US – and an example for Massachusetts, Virginia, Washington and various other states with so-called “trigger laws” that require them to follow California on emissions regulations – will also institute a ban on ICE sales in 2035. The Biden administration has set a goal for EVs to account for half of all new vehicle sales in the United States by 2030. China – the world's biggest car market – is aiming for EVs to account for 40% of all new vehicles sales by 2030.

As Western policymakers have moved to action on EVs and other technologies viewed as critical to reducing emissions, they have also woken up to the stranglehold that China – which they increasingly see an adversary – has on critical mineral supply chains.

China only accounts for around 13% of global lithium mine production, placing it far behind the two dominant

producers, Australia and Chile, which account for around 52% and 25% of production respectively. Furthermore, China accounts for only 8% of current reserves, placing it behind Chile, which holds 42%; Australia, which holds 26%; and Argentina with 10%.

However, as is the case with various other critical minerals, China dominates the midstream and downstream parts of the lithium value chain. It accounts for 44% of all lithium carbonate and hydroxide production, 78% of cathode production (and 91% of anode production, which is mostly graphite-based), and 70% of lithium-ion battery-cell production, according to Benchmark.

Nowhere was the fear over critical minerals more evident than in the Canadian government's November 2022 decision to order Chinese companies to divest holdings in three junior lithium companies. The move followed what the government said was a “multi-step national security review process, which involves rigorous scrutiny by Canada's national security and intelligence community”. It impacted Canadian companies – Power Metals Corp, Ultra Lithium and Lithium Chile – that are planning to develop lithium deposits in Canada, Argentina and Chile respectively. The move did not apply to numerous other Canadian lithium companies with major Chinese shareholders, such as Argentina-focused Neo Lithium, which counts CATL, the world's largest lithium-ion battery manufacturer and a supplier to Tesla and other EV manufacturers, as an 8% shareholder.

In the US, three new laws – the Bipartisan Infrastructure



Salinas Grandes salt desert



## “President Biden has also ordered the US Department of Defense to consider lithium, cobalt, graphite, nickel and manganese as essential to national security under the Cold War-era Defense Production Act”

Law, the CHIPS & Science Act, and the Inflation Reduction Act – will together invest more than \$135 billion in securing American EV supply chains, including critical minerals sourcing and processing and battery manufacturing. In October 2022, the US Department of Energy announced the first set of projects funded by the Bipartisan Infrastructure Law to expand domestic manufacturing of batteries for EVs and the electrical grid. The funding includes support for development of enough battery-grade lithium to supply approximately 2 million EVs per year, two-and-a-half times more than the estimated 800,000 EVs that will be sold in the United States in 2022.

President Biden has also ordered the US Department of Defense to consider lithium, cobalt, graphite, nickel and manganese as essential to national security under the Cold War-era Defense Production Act. Under the order, the Pentagon will be authorised to use funds to pay for feasibility studies for proposed mines or to finance production of critical minerals by-products from mines whose primary output is of non-critical minerals.

Furthermore, the Inflation Reduction Act will require a certain percentage of battery minerals to come from a country with which the US has a free trade agreement or to be recycled in North America, with the requirements to ramp up through to 2027. This is likely to benefit Canada and Australia in particular, as American think tank the Brookings Institution noted.

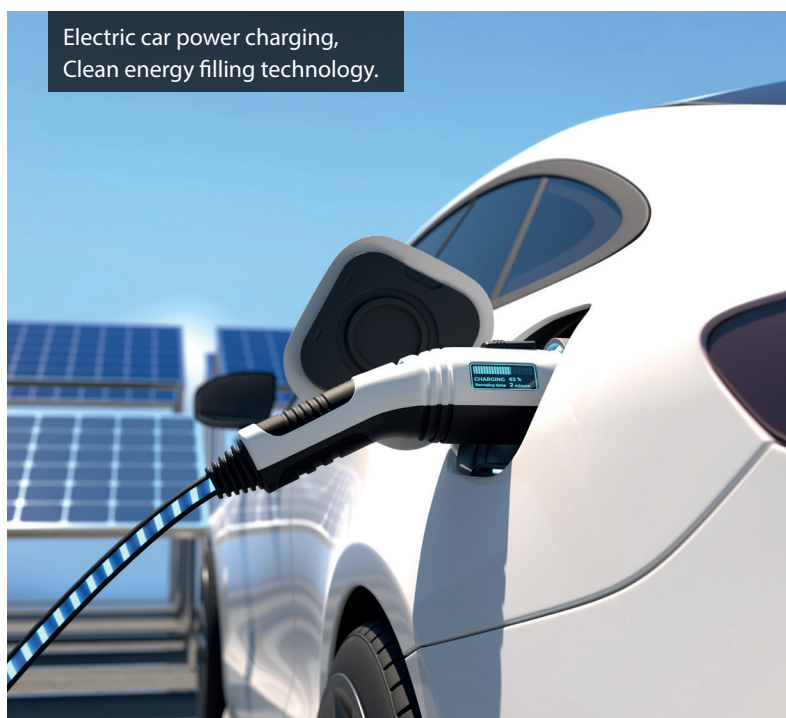
In June 2022, the US formed the Minerals Security Partnership (MSP) with Australia, Canada, Japan, South Korea, the UK and several EU countries, with the aim of bolstering supply of critical minerals including lithium.

In the EU, European Commission president Ursula von Leyden used the occasion of her October 2022 State of the Union address to announce a new legislative proposal, the Critical Raw Material Act. She declared that “lithium and rare earths are already replacing gas and oil at the heart of our economy” and said that the legislation would move to address risks to supply stemming from China’s control of the global processing industry.

### Securing a place in the value chain

Australia will receive a lot of attention for how it acts, given its close security ties to the United States (which include membership of the Quad security dialogue, alongside the US, India and Japan; AUKUS security pact, alongside the US and UK; and the aforementioned Minerals Security Partnership) and its status as a key supplier to Chinese companies that dominate the lithium-ion battery value chain.

Chinese lithium chemical giants Jiangxi Ganfeng Lithium and Tianqi Lithium produce some lithium at home but source a lot from abroad, Australia in particular. Ganfeng has a 50% interest in the Mount Marion joint venture in Western Australia alongside Mineral Resources, and long-term offtake agreements with Pilbara Minerals’ Pilgangoora mine in Western Australia and Core Lithium’s Finiss mine in the Northern Territory. Tianqi owns 51% of a JV with IGO that holds 51% of the Greenbushes mine in Western Australia (with Albemarle owning the other 49%), the world’s largest large source of hard-rock spodumene. The Tianqi-IGO JV also owns the Kwinana lithium hydroxide







Serrania del Hornocal mountain,  
Jujuy province, Argentina

processing plant. Other companies with stakes in or offtake agreements with Australian lithium producers include CATL, Great Wall Motor Company – which is one of China's largest EV manufacturers – and General Lithium, another major producer of battery-grade lithium chemicals.

Chinese firms also have substantial positions in lithium companies in Chile – where Tianqi has a 22% stake in SQM – and Argentina, further emphasising the challenge facing Western policymakers and automakers looking to secure supply.

Automakers outside China have been slow to invest in battery manufacturing, with the exception of Tesla, which has a battery gigafactory in Nevada in conjunction with Panasonic, and plans for several more factories in coming years, and which is also exploring the feasibility of building a lithium hydroxide refinery in Texas. But this is changing, as shown by the example of General Motors' deal with South Korea's POSCO Chemical to establish a factory in Canada to process cathode active material.

Given tight mineral supplies, automakers are now increasingly following the lead of Tesla and securing agreements directly with mine developers as part of their strategies to secure lithium and other battery raw materials. For example, Ford recently signed a binding agreement to receive 150,000Mtpa of spodumene concentrate over a five-year period from Australian mine developer Liontown Resources (which also has agreements with Tesla and Korean battery maker LG Energy).

Automakers may even one day purchase stakes in lithium

mines, as Tesla chief Elon Musk has hinted at and as Canaccord Genuity head of mining research Reg Spencer predicted recently to SP Global. Owning lithium mines is one way EV makers can mitigate their exposure to high lithium prices by ensuring security of supply, Spencer was quoted as saying. It also makes their batteries cheaper to produce, as they would effectively be paying for the cost of lithium production, which is about seven times cheaper per tonne than paying for lithium carbonate or lithium hydroxide, he noted.

#### Where will new production come from?

The market has woken up to the need for lithium raw material, with 53 projects currently in the post-preliminary economic assessment phase, according to figures from S&P Global.

However, progress has been slow, and only one company succeeded in making the transition from developer to producer in 2022: Core Lithium. In doing so, it joined an exclusive group of lithium producers comprising Albemarle, SQM, Tianqi, Ganfeng, Allkem, Livent, Pilbara Minerals, Mineral Resources (through two Australian JVs with Albemarle and Ganfeng) and IGO (through its Tianqi JV).

All but two of these miners also operate lithium chemicals production facilities in their own right or in JVs with other lithium miners or downstream partners. Most, if not all, have been busy expanding their lithium chemicals capacity. For example, Albemarle this year opened a third plant at its La Negra facility in Chile, which produces battery-grade lithium carbonate from concentrate produced at its Salar de Atacama lithium brine operation in Chile. The MARBL JV (Albemarle 60%, Mineral Resources 40%) achieved first production this year at the Kemerton





Petalite sample, an important mineral for obtaining lithium

plant in Western Australia, which produces lithium hydroxide from raw material received from Albemarle's spodumene offtake from the Greenbushes mine. The partners have also agreed to explore a potential new 50/50 JV to own additional lithium conversion assets outside of Australia.

Of the two miners that don't yet have refining operations, Pilbara Minerals is aiming to have refining capabilities in 2024, when it is anticipating production at a South Korean lithium hydroxide facility it is building in a joint venture with POSCO. Core Lithium has received an A\$6 million (\$4 million) grant from the Australian government to assess the feasibility of building a lithium hydroxide plant in Darwin.

Meanwhile, the following companies are next in line to become lithium producers:

- **Lithium Americas:** Construction of the integrated Caucharí-Olaroz 40,000t/pa lithium carbonate brine operation is nearing completion and is about to be spun out into a separate company with Lithium Americas holding 44.8%, Ganfeng Lithium 46.7% and Argentinian state-run miner JEMSE 8.5%. Meanwhile, the Thacker Pass project in Nevada is aiming to become the world's first lithium claystone mine. It has secured all permits to commence construction in 2023, and is targeting 40,000t of lithium carbonate in phase one and 80,000t of lithium carbonate production in phase two.

- Sigma Lithium: Pilot-scale production of lithium concentrate has taken place at the Grota do Cirilo

spodumene project in Brazil since 2018. It is looking to begin producing 270,000t/pa of lithium concentrate in 2023 and ramp up to 531,000t/pa in 2024 or later.

- **Liontown Resources:** A final investment decision has been made on the Kathleen Valley spodumene project in Western Australia, with a target of around 500,000t/pa of lithium concentrate over an initial mine life of 23 years starting in 2024.

- **Sayona Mining:** Construction of the North America Lithium operation (NAL), a brownfield open pit mine with a concentrator acquired by Sayona (75%) in August 2021 in partnership with Piedmont Lithium (25%), is well underway, with first production of lithium concentrate expected in the March quarter 2023. Sayona is eyeing an eventual 220,000t/pa of lithium concentrate from its Abitibi Hub, combining NAL and the nearby greenfield Authier project.

- **Argosy Minerals:** The company has advised that 98% of development works have been completed on the integrated Rincon Lithium project and it expects to begin its 2,000t/pa lithium carbonate brine operation in the March quarter 2023.

Other near-term hopefuls include Ioneer, Lake Resources, Piedmont Lithium, Standard Lithium, and Vulcan Energy Resources.

### Conclusion

Mining is a capital-intensive and risky business and as a result it has taken the market time to catch up with the extraordinary lithium bull run precipitated by the sudden boom in electric vehicles.

A small number of producers are now reaping the benefits of the price surge, giving them the ability to finance further expansions while late-stage development companies look to enter and capture their share of the growing market.

If the action from the last two years is any indication, there will continue to be a raft of joint venture deals as players at the top of the value chain attempt to seize advantage of this bull market and as end users scramble for supply.

There remains a lot of disagreement about how long this bull run will last and as to when supply will eventually surpass demand. However, one thing is for certain: thanks to its starring role in the electric vehicle story and in the green transition more generally, lithium will be one of the more interesting mineral commodities to watch in the years to come.

*Disclosure: The author holds shares in Pilbara Minerals and Core Lithium*



## Bradda Head eyes Arizona pegmatite prize



### AIM and TSXV-listed junior is confident of being quick to market with its hard rock lithium project in Arizona

Strong lithium prices and rising concern in the US about a looming shortage of the key battery metal mean excitement is building around Bradda Head's San Domingo lithium hard rock deposit outside Phoenix, Arizona.

The project is one of a number held by the London and Toronto-listed junior in a portfolio also featuring sedimentary and brine deposits – all located in the southwestern United States.

But it is the hard rock – or pegmatite – asset which Bradda Head CEO Charles FitzRoy sees as a potential game-changer.

“That’s what’s really going to differentiate us from the other clay juniors. A lot of the clay guys have some good projects of good size and resource and they’re moving forwards, but we’ve got, potentially, a viable pegmatite. If we demonstrate we’ve got the size and scale there we need, we’re going to get in production much quicker than some of the clay projects up in Nevada,” FitzRoy told Mining Journal.

“Pegmatites are a proven technology; they’re understood very well. It’s smaller capital costs; all these things which make it easier for us, as a junior, to get into production and get funded. The clay assets are great, but they’re still developing the technology, and you need higher capex. So that’s why the pegmatites for us are really the game changer, and we’re really excited,” he added.

Bradda Head is set to complete a 30-hole diamond core drilling programme at San Domingo in the January quarter, after which the company will design a follow-up programme. FitzRoy said the plan was to start a preliminary economic assessment “as soon as we can”, subject to the success of the current drill programme.

While San Domingo may prove to be the jewel in Bradda Head's lithium crown, the company has made promising strides of late with its clay – or sedimentary – assets, particularly the Basin project – also located in Arizona. The company updated its mineral resource estimate (MRE) for Basin East at the end of March, which signalled a 65% increase in contained lithium carbonate equivalent (LCE) tonnes.

The exploration target across the entire Basin project now equates to 1-6Mt of LCE. FitzRoy said the company planned to publish a further updated MRE for Basin by the end of the year.



Bradda Head CEO Charles FitzRoy





Basin overview looking East towards Bagdad copper mine

While all the company's projects are at an early stage, FitzRoy is keen to plan ahead. A timeframe of around five years for the brine and clay projects was realistic, he said, while San Domingo would hopefully come online "slightly sooner".

A processing plant close to San Domingo would make sense, especially as other miners in the area may be interested in a potential pooling of resources. "We have neighbours nearby who might be keen to push forward with these sorts of discussions," FitzRoy said.

#### Cashed up

Bradda Head is well placed financially, having raised £9.88 million via a pair of placings in the UK and North America in April. "Our cash gets us to the end of next year," FitzRoy said. "It depends what we spend it on and obviously depends how things go. But we've got enough funds to be able to do our drilling on our pegmatites and drill the clays."

The company also has more funds to draw on courtesy of a royalty deal struck with Lithium Royalty Corp in December 2021. The staggered deal saw Bradda Head earn US\$2.5 million on signing, with further tranches of \$2.5 million and \$3.0 million to follow should the company obtain a 1Mt LCE, and 2.5Mt LCE resource respectively across its Arizona clay claims.

Following the updated Basin MRE this quarter, first order of business in 2023 will be a further resource update for the

**"If we demonstrate we've got the size and scale there we need, we're going to get in production much quicker than some of the clay projects up in Nevada"**

asset – likely in the January or March quarters – along with results from San Domingo.

Moreover, the company is poised to drill on its brine assets in Nevada, while it will shortly release more information about additional brines in Texas and Pennsylvania. "We're just in the process of strengthening [them] up before we start speaking to the market about it," FitzRoy said.

#### Permitting hurdle

Further down the line, one key risk for juniors looking to get projects off the ground in the US is the laborious permitting process.





Sonic drilling at Basin

FitzRoy said the company had built a strong relationship with local permitting offices and noted there had been no issues so far in securing drilling permits. However, he conceded that moving towards permitting a mine would represent a different proposition.

“We are working with an environmental consultancy on water conservation initiatives,” he said. “We’re also doing a baseline study and a lot of things will come out of that baseline study: ways we can help with alien plants, for example. There are a lot of initiatives in place in Arizona where removing alien plants, which are not helpful for water, is a big thing.”

Engagement with local stakeholders has also been a priority, with the company unveiling a community website mid-November to provide a direct link to host communities surrounding the company’s projects. “Our aim is to ensure all local stakeholders are kept updated on our activities and have an effective way to communicate with us,” FitzRoy said.

With questions already being raised about the environmental impact and carbon footprint of lithium projects in Latin America and Africa, FitzRoy believes his company’s geographical focus and strong ESG credentials will prove highly beneficial.

“Another key thing is making sure you have a carbon footprint as low as possible, because while the market wants lithium, we are moving into a greener economy whereby everything will have a carbon footprint content and having that carbon footprint assigned to it, you’re going to get a premium for your lower carbon footprint lithium,” he said.

“Comparing a project in somewhere like Africa with a North American project – if you’re producing and then shipping it all around the world to process it, who knows what energy mix is going into that production?”

“I think there are a lot of things that separate us from other projects around the world, but one big element is our location and that we will be processing it in the US for the US end market, together with the fact that we’re going be working towards keeping that as low a carbon footprint as possible,” he said. “And that premium will be assigned to projects with that element to them.”

### Bradda Head – at a glance

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Charles FitzRoy

Denham Eke

Ian Stalker

#### Major shareholders

James Mellon; 16.67%

Zenith Minerals Limited; 11.25%

Electrification and Decarbonization AIE LP; 7.27%

Nigel Wray; 5.22%

Lithium Royalty Corp; 4.99%



# Cypress Development advances Nevada lithium project towards production

Successful trials of a four-part conventional processing strategy and a forthcoming feasibility study give new impetus to Cypress Development Corp's Clayton Valley soft rock project

To date the focus of most investment dollars in the rapidly growing global lithium industry has been on hard rock miners, many located in Australia, and the brine deposits in South America's lithium triangle. However, processing methodologies focused on extracting the key battery metal from clay deposits are developing rapidly and today several soft rock deposits are in advanced stages of development. Following promising early results from its pilot study, Cypress Development Corp is set to release a feasibility study for its Clayton Valley project in Nevada in the first half of 2023.

"You can look at sedimentary clay deposits today as being almost equivalent to copper oxide deposits 30 or 40 years ago," said Cypress Development CEO Bill Willoughby. "People disregarded them but along came solvent extraction and made them profitable. That's what we're trying to do at Cypress, to take the clay all the way to pure lithium battery-grade deposits on site, bypassing the conversion plant."

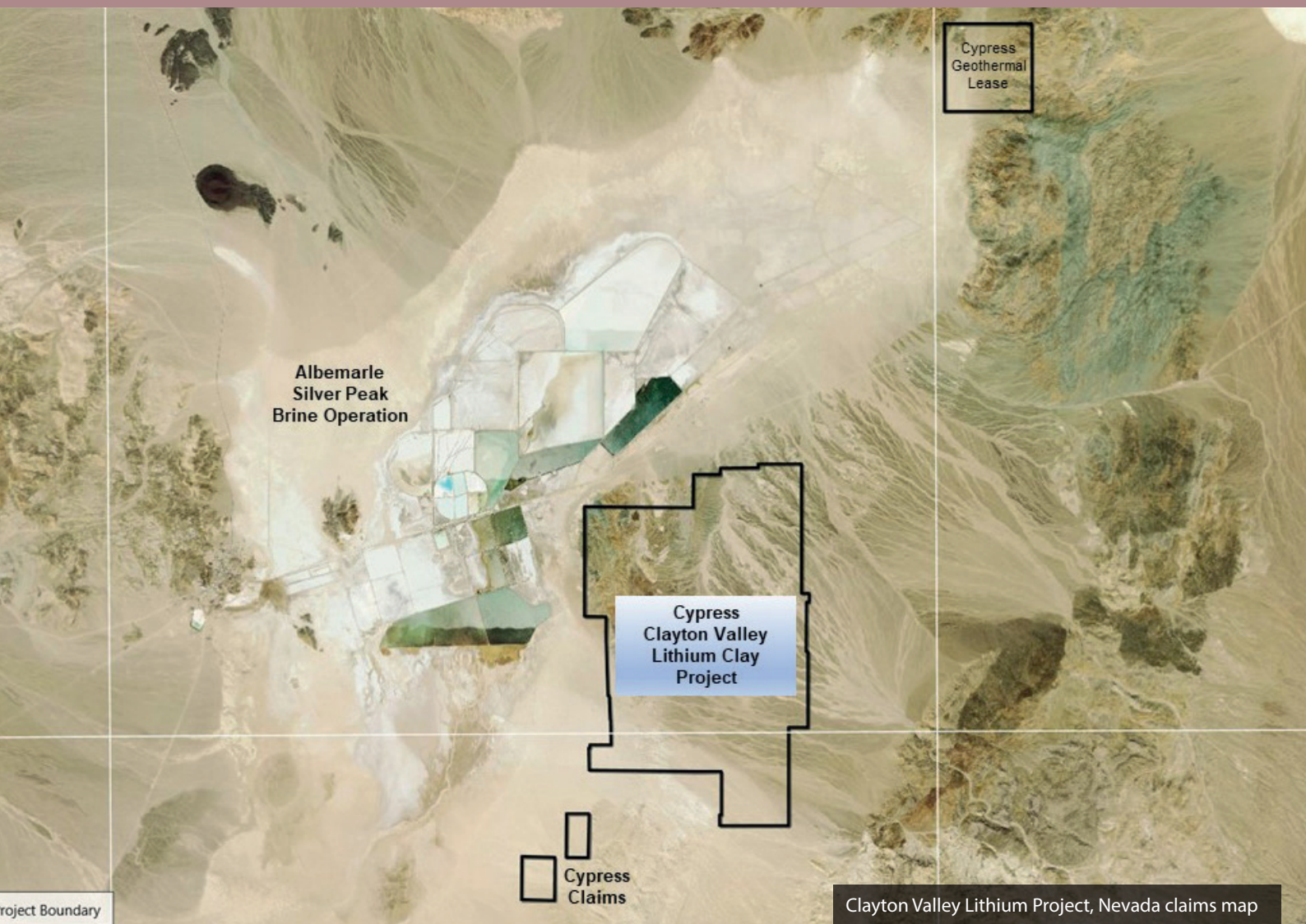
Willoughby took the helm of Cypress Development in 2017 at a time when the company was completing its first drill campaign at Clayton Valley and he was impressed by early samples, some of which contained 3000 parts per million lithium. The property abuts the Silver Peak lithium brine operation to the north, which was acquired

by Albermarle in 2015, and the potential of the project was confirmed in the company's March 2021 prefeasibility study (PFS). The robust PFS indicated an After-Tax NPV (8%) of US\$1.03 Billion and IRR of 25.8% using US\$9,500/tonne Lithium Carbonate Equivalent (LCE). Working with a resource of 6.3Mt of indicated LCE and a further 1.28Mt of probable reserves, the PFS envisaged a 15,000t per day operation, producing 27,000lb a year of LCE over a 40-year life of mine.



Cypress Development CEO, Bill Willoughby





Clayton Valley Lithium Project, Nevada claims map

Processing for the plant in the PFS was based on the usage of sulfuric acid. However, due to skyrocketing prices of sulfur attributed to a bottleneck stemming from access, management at Cypress decided to move in a new and greener direction and optioned to use hydrochloric acid as an alternative. The team at Cypress, found that not only can they produce hydrochloric acid on site, but the new leaching process created easier filtration and led to better washing of the tails and required less process water to be utilized.

Over the course of 2020 and 2021, with lithium prices and stocks in the sector soaring, Cypress was able to raise C\$45 million. This was sufficient to complete the construction of a pilot plant while still leaving enough in the coffers to take the project through to feasibility and much of the permitting process set to begin in 2023. “We raised money at a very fortunate time,” Willoughby said. “We’ve used our money in the most efficient way possible and our cash position is still very good as we move forwards on the feasibility study.”

That study will break the lithium processing into four units. In October 2022 the company signed an agreement with

thyssenkrupp nucera to design a chlor-alkali electrolysis plant to provide hydrochloric acid and sodium hydroxide, a neutralising agent. That will allow Clayton Valley to switch to a hydrochloric acid leaching process and run a direct lithium to product (DLP) technology based on ion exchange that the company acquired from Onyx in 2021. The resulting concentrate solution is refined using a process developed by Vancouver-based Saltworks Technologies. Furthermore, in September 2022, Cypress announced that the company had produced 99.94% LCE using this process at its pilot plant, comfortably above the 99.5% grade required by battery companies.

“We split the process into four components and we contracted world-renowned engineering companies,” Willoughby said. “This is not an unconventional process, it’s an assembly of four standard and accepted processes and the testing at our pilot plant shows that they can work together.”

Further proof of concept could come from the Rhyolite Ridge and Thacker Pass projects owned by Ioneer and Lithium Americas respectively. Both are clay deposits located in Nevada and the former already has a feasibility



study in place, helpingioneer's shares soar from A10c in September 2020 to A56c at the time of writing. "We've scaled our project in similar ways, but these deposits have different mineralogy and acid requirements to ours and we didn't want to face challenges with sulphur supply, which is why we went for the chlor-alkali process," Willoughby explained. "Our stock is undervalued where it sits today and when one of those projects enters the construction stage, I think we'll see the entire picture change."

Cypress continues to improve its understanding of the deposit. Results from an eight-hole sonic drilling program that were released in August included a 70.1m intersection of 1,336ppm lithium. "One of the benefits of a clay deposit is that you can define a resource quickly with a minimum number of drill holes," Willoughby said. "There's a great deal of continuity in grades across the deposit and in neighbouring projects, meaning we don't have to do too much infill drilling."



Lithium enriched drill core from Clayton Valley Project, Nevada

The company has also expanded its footprint in the region. In May it acquired the neighbouring Enertopia property for \$1.1 million and three million shares. "It was a property position that we felt was strategic," Willoughby explained. "It allowed us to add about half a mile to the trend and it means that we can run a shallow depth over the life of the mine. It means we can use track excavators and conveyor haulage on the project and minimize the amount of rubber tire on wet clay."

Nevada ranked third in the Fraser Institute's 2021 ranking of global mining jurisdictions, but water supply remains a key question for many projects. Cypress acquired water rights to the project in 2021 and has addressed the issue by designing Clayton Valley around a low-water-usage leach tank and a dry stack tailings facility. Willoughby believes the company will face fewer licensing issues than other companies in the state.

"Our stock is undervalued where it sits today and when one of those projects enters the construction stage, I think we'll see the entire picture change."

"We're hoping that we can get the permitting done in 18 months. We've done a lot of baseline work and that's a key step to getting the decision for the federal licence," he said. "There are a number of state permits that can be accomplished in the meantime, and we are looking at construction dates maybe three years from now."

Willoughby says that Cypress Development has the technical nous to bring the project through to development but would consider joint ventures with larger companies under the right conditions. He also points to the growing number of federal grants offered to producers of strategic minerals under the updated US Defense Production Act as a potential source of funding for the project. And with hard rock projects facing rising costs at their conversion plants, he says that clay projects could soon become attractive alternatives.

"Clay deposits carry the stigma of being unconventional," he said. "But there's nothing in our process that's unconventional. At some point we're going to crack the clay code."

#### Cypress Development Corp – at a glance

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##### Directors

Cassandra Joseph, Bryan Disher, Ken Owen, William Willoughby, Don Myers, James G Pettit

##### Market capitalisation

C\$155.32 million (at press time)

##### Quoted shares on issue

146.53 million





## LITHIUM OUTLOOK

Can EV battery metal  
continue its incredible  
bull run?

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