INTERNATIONAL LITHIUM ASSOCIATION (ILiA)

THE LITHIUM VOICE

The journal of the International Lithium Association (ILiA)

Volume 12, 2025
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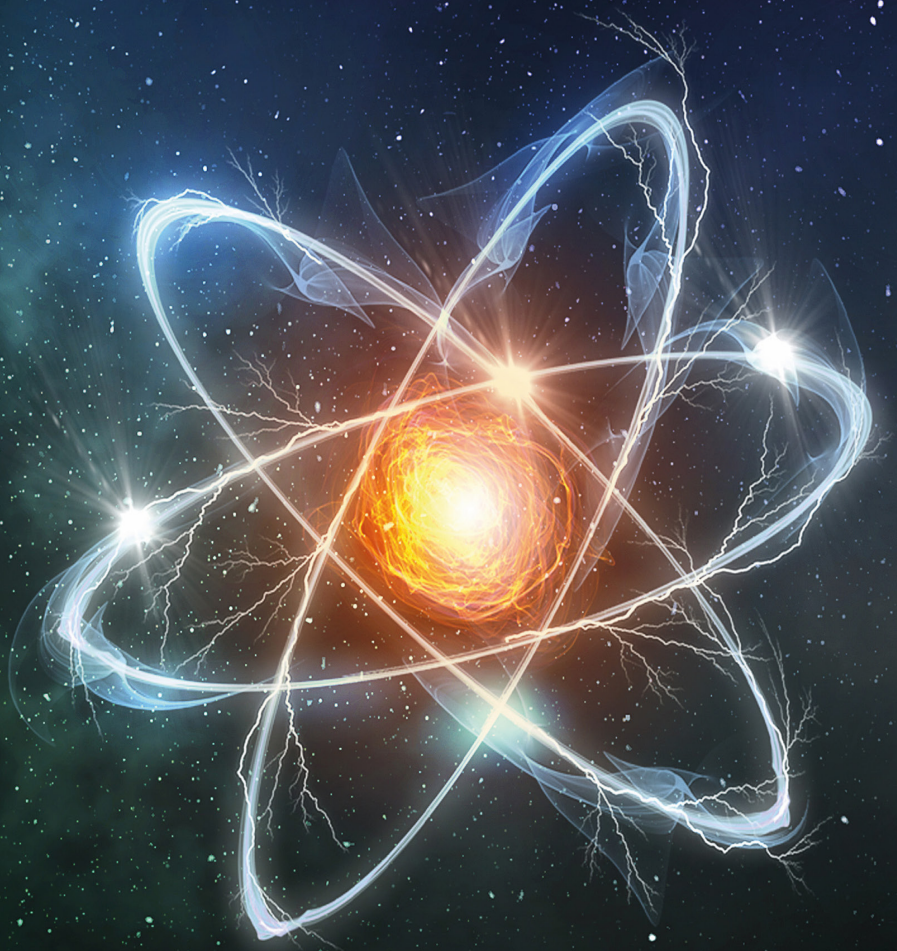
PCF Stamps of Verification

Lithium comes of age (part 2)

In conversation with Carlos Diaz

THE LITHIUM ATOM
SMALL, BUT MIGHTY



ILiA Connections

In August ILiA's Martin Ma gave a keynote presentation at the 10th World Battery & Energy Storage Industry Expo in Guangzhou, China. His presentation included an introduction to ILiA's Product Carbon Footprint Guidance.

During London Metal Exchange (LME) Week 2025 ILiA supported a Lithium Networking Lunch as part of Argentina Day. The event was attended by both industrial and political leaders, including Dr Luis Lucero, Argentina's Secretary for Mining (right).

ILiA's Roland Chavasse visited Albemarle's plant and mine at Kings Mountain in North Carolina to learn more about the history of lithium production in the USA.

In September ILiA hosted a networking dinner for members and guests in Lisbon, Portugal. It was held to coincide with the European Battery Raw Materials Conference 2025.

After attending Lithium Business 2025 ILiA's Astrid Karamira visited AMG Brasil's mine in the State of Minas Gerais, Brazil. The mine produces tantalum-niobium minerals, as well as lithium-containing spodumene.

In September Jorge Mora represented ILiA at the Lithium in South America conference in Catamarca, Argentina. The event, hosted by Panorama Minero, is the leading lithium industry conference in Argentina and rotates between the provinces of Salta, Jujuy and Catamarca.

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FSC FORESTS FOR ALL FOREVER

The *Lithium Voice* magazine is published by International Lithium Association Ltd registered in the UK (#13299086) at 209 High Road, London N2 8AN, UK.

Chair's WELCOME

Welcome to the 12th edition of *The Lithium Voice*, where we continue to explore the fascinating history of lithium.

Long before its role in powering electric vehicles and shaping the modern energy transition, during the Cold War lithium played a deterrent role in the arms race and an enabling role in the space race. This duality reminds us that lithium is not just a material of the future, but one with a history too. The same atomic properties that once advanced groundbreaking atomic research are now being applied to create cleaner, more efficient uses of electrical power. The story of lithium is one that runs through many of the most significant technological developments of the twentieth century.

Within the Association, this spirit of transformation continues to guide our mission. Over the past quarter, ILiA has strengthened its collaborative efforts with members and global stakeholders, ensuring that as lithium demand grows, so too does our shared commitment to responsibility, safety, and innovation across the value chain. An example of this is the rapid uptake of the Association's Product Carbon Footprint Guidance by mines and refineries around the world.

In this edition our interview is with Carlos Diaz, the Executive VP for Lithium at SQM. He shares his vision for a lithium industry that is fully aligned with sustainability goals, one where innovation across extraction, processing, and recycling drastically reduces the environmental impact of mining.

This message is echoed in the *Spotlight on Sustainability* which discusses how Ganfeng Lithium is sensitively developing a lithium extraction project at the Salar de Llullaillaco in Salta Province, Argentina, which it shares with three species of flamingos.

Together, we are shaping an industry that is as dynamic and resilient as the element itself, one that continues to energise not just the global economy, but the imagination of what's possible and conversations in many industries. The future is bold and exciting, and we are writing it together.

Anand Sheth
Founding Chairman

Feature

STAMPS OF VERIFICATION

How ILiA's Product Carbon Footprint Guidance continues to shape sustainability reporting in the lithium industry

In March 2024, ILiA launched its guidance for *Determining the Product Carbon Footprint of Lithium Products*, the first of its kind for the lithium industry (the 'Guidance', see https://lithium.org/guidance/).

It was well-received by industry participants and by December 2024, several leading lithium companies had benchmarked their Life Cycle Assessments (LCAs) and Product Carbon Footprints (PCFs) using this Guidance. However, a question remained: how could ILiA prevent someone fraudulently claiming their LCA/PCF was compliant?

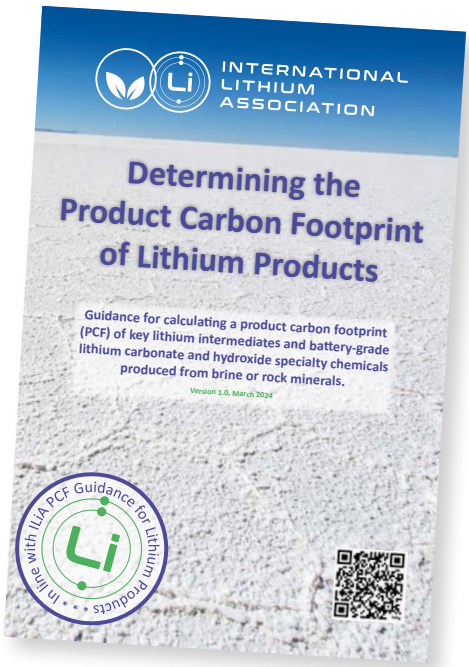
To address this concern, ILiA developed a system of verification by approved independent LCA/PCF experts. When a PCF is verified to be compliant with ILiA's Guidance it is awarded a unique numbered Stamp in recognition.

The first Stamps were issued in early 2025, and to date seven have been awarded (see page 5), including reports from mines in Australia, and refineries in China, the US and Australia.

Appreciation of ILiA's Guidance is not just limited to industry either. At the International Standards Organisation (ISO) a multinational working group called TC333 is using ILiA's Guidance for the foundation of future ISO standards on calculating a lithium PCF.

Why get verified?

Speaking to *The Lithium Voice*, the early Stamp adopters were clear that the most common reason to verify their PCF was driven by customer demand. As electric vehicle (EV) battery manufacturers increasingly scrutinise the carbon footprint of their supply chains, it is becoming essential that industry participants use equivalent PCF methodologies; "comparing apples with apples", as one early adopter phrased it.



Aligning a PCF report with ILiA's Guidance provides a standardised methodology combined with an independent third-party verification, which users see as essential for credibility and trust. As Mark de Boer from Albemarle Corporation explained, "PCFs are only meaningful if they can be trusted and compared within an industry, which is what the ILiA Guidance facilitates."

The value and business impact of the Stamp

The ILiA PCF Guidance and associated Stamp are designed to be a simple yet powerful tool to demonstrate professionalism and transparency as a signal of trust.

Some of the early adopters of the PCF Stamp emphasise its importance in customer relationships, noting that the Stamp gives clients confidence in the integrity of a company's data, which is increasingly vital for sustainability disclosures and regulatory compliance. For example, Lara Jefferson from SQM Australia Pty stated that "Having the ILiA PCF Stamp signals to stakeholders that our carbon footprint data has been calculated using a robust, standardised methodology and is independently verified."

Looking ahead: the future of the Stamp

ILiA intends that, in the longer term, the Guidance will evolve in line with industry developments. As Mark de Boer explained, 'Standard-setting organisations could use its content, while benchmarking groups like Benchmark Mineral Intelligence may base their lithium industry carbon curve on alignment with ILiA's framework".

Other early adopters agreed and suggested that the Guidance could become the normal expectation across the lithium supply chain.

They foresee customers requesting a lithium PCF report with a Stamp as part of standard procurement criteria, recognising it as a mark of environmental accountability and data reliability.

As Lara Jefferson at SQM Australia said, "Customers will increasingly request the ILiA Stamp. It will play a central role in enabling transparent, comparable, and verified carbon footprint disclosures."

There are also the ISO initiatives to consider. The Japanese Industrial Standards Committee (JISC) has been promoting the development of an ISO standard for the calculation of lithium products' carbon footprints based on the ILiA Guidance. A second, parallel proposal by the Chinese delegation at ISO is to expand the scope of the ILiA Guidance to additionally include a calculation model for recycled (secondary) lithium products.

How to get the ILiA Stamp

Any organisation conducting an LCA or PCF can engage an ILiA-accredited verifier to confirm the alignment of their report with ILiA's PCF Guidance. Upon successful verification, ILiA awards a Stamp for the specific LCA/PCF report, which the awarded organisation can use when discussing the carbon footprint of the lithium product(s) defined in that report.

ILiA Approved Verifiers

Name	Company	Country	Languages	Accredited until
Phoebe Whattoff	Minviro	Australia	English	May 2028
Rob Rouwette	start2see	Australia	English, Dutch	May 2028
Dai Young	SGS	China	Mandarin, English	September 2028
Qi Shengrui	Botree Recycling Technologies	China	Mandarin, English	September 2028
Wang Yingying	Botree Recycling Technologies	China	Mandarin, English	September 2028
Wu Bin	Botree Recycling Technologies	China	Mandarin, English	September 2028
Sebastien Taillemite	Ecovamed	France	English, French	May 2028
Joris Šimaitis	Minviro	United Kingdom	English, Lithiuanian	May 2028
Lorraine Amponsah	Loram Consulting and Advisory	United Kingdom	English	May 2028
Sophie Myers	Minviro	United Kingdom	English	May 2028

LCA/PCF reports that are verified to meet ILiA's PCF Guidance (October 2025)

Stamp No.	Organisation	Site/Project	Location	Product	Type of Operation	Practicioner of LCA Study	Date of LCA verification	Verifying company	Name(s) of verifier(s)	Name of LCA/PCF report	Date of LCA/PCF report	Date of SLS confirm-ation
001.0	Tesla, Inc.	Corpus Christi	Texas, USA	Lithium hydroxide monohydrate	Refinery	Tesla	Oct-24	Minviro Ltd	Lorraine Amponsah, Sophie Myers	Prospective Product Carbon Footprint Of Corpus Christi Refinery Lithium Hydroxide Monohydrate Product	Oct-24	Mar-25
002.0	Talison Lithium Pty Ltd	Greenbushes	Western Australia, Australia	Spodumene concentrates	Mine site	Life Cycle Logic	Nov-24	start2see	Rob Rouwette	Life Cycle Assessment of Talison Lithium Pty Ltd, Spodumene Concentrate Products	Nov-24	Mar-25
003.0	Albemarle Corp.	Xinyu plant	Jiangxi Province, China	Lithium hydroxide monohydrate	Lithium conversion plant	Albemarle Corporation	Nov-24	Ecovamed	Sebastien Taillemite	Jiangxi Albemarle Lithium Co., Ltd. Lithium Hydroxide Monohydrate	Nov-24	Mar-25
004.0	Albemarle Corp.	Qinzhou plant	Guangxi Province, China	Lithium hydroxide monohydrate	Lithium conversion plant	Albemarle Corporation	Mar-25	Ecovamed	Sebastien Taillemite	Guangxi Albemarle Lithium Co., Ltd. Lithium Hydroxide Monohydrate	Mar-25	Mar-25
005.0	SQM Australia Pty	Earl Grey	Western Australia, Australia	Spodumene concentrate	Mine site	Minviro	Aug-25	Loram Consulting and Advisory	Lorraine Amponsah	Life Cycle Assessment Study of SQMi's Battery Grade Lithium Hydroxide Monohydrate Production	Jul-25	Sep-25
006.0	SQM Australia Pty	Kwinana Plant	Western Australia, Australia	Lithium hydroxide monohydrate	Refinery	Minviro	Aug-25	Loram Consulting and Advisory	Lorraine Amponsah	Life Cycle Assessment Study of SQMi's Battery Grade Lithium Hydroxide Monohydrate Production	Jul-25	Sep-25
007.0	Liontown Resources Limited	Kathleen Valley	Western Australia, Australia	Spodumene concentrate	Mine site	Minviro	Sep-25	Loram Consulting and Advisory	Lorraine Amponsah	Life Cycle Assessment Study of Liontown's Spodumene Concentrate Production	Sep-25	Oct-25

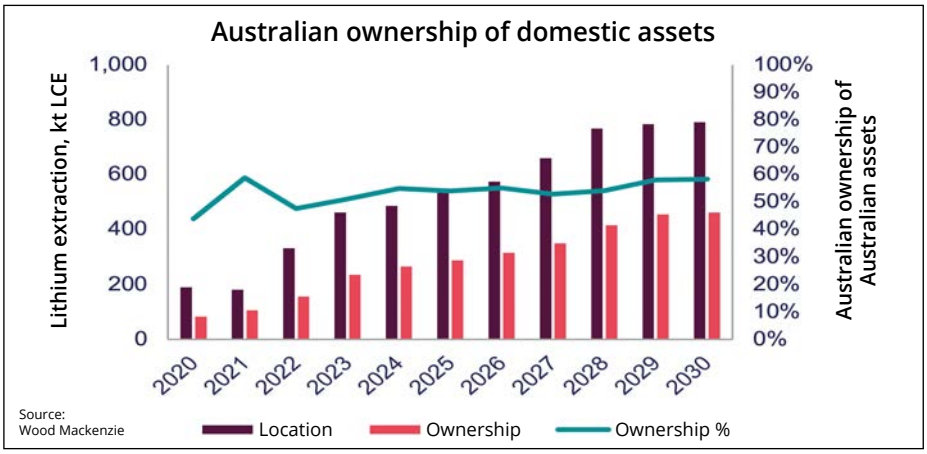
View from AUSTRALIA

From Allan Pedersen, Research Director for Wood Mackenzie

The lithium industry has long grappled with questions of demand origins and supply adequacy. Shifting geopolitical dynamics now add a critical dimension: resource ownership. While geographical location remains paramount, ownership structures increasingly matter as companies incorporated in one jurisdiction develop assets in another.

Australian companies have consistently played a pivotal role in global lithium supply. In 2020, Australian firms controlled 19% of global extracted lithium volumes, led by Mineral Resources and Pilbara Minerals. Talison operated under joint Tianqi Lithium and Albemarle ownership, with no Australian stake.

By 2025, Australian companies will control 18% of the extracted lithium globally. Despite partial Australian participation in Greenbushes via IGO, this ownership has been offset by increased production from assets owned by other nations in a broadening number of jurisdictions. This dynamic has minimised the impact of Australian asset growth on overall ownership percentages.



Wood Mackenzie forecasts Australian company ownership will rise to 21% by 2030. This growth reflects overseas investments, including Vulcan Energy's German project, commencing production alongside domestic expansion.

International expansion accelerates

Australian companies are increasingly investing beyond domestic borders. Measured by production volume, Australian investments in overseas lithium extraction will surge from zero in 2020 to 8% in 2025 and 28% by 2030. This international expansion complements continued domestic growth.

Domestic asset ownership evolves

Australian assets remain central to global lithium supply, with continued output growth forecast from existing and new operations. Ownership structures have evolved significantly across the industry.

Australian ownership of domestic assets jumped in 2021 when IGO acquired a stake in Talison. Subsequent dilution occurred, though ownership remained above historic levels. New assets, including Kathleen Valley and Mt Holland, will drive Australian ownership growth. Domestic asset ownership will exceed 53% and reach 58% by 2030.

Geography meets capital

Asset location follows geology, not geopolitical preferences. Resource-rich countries seek to participate in decarbonisation, create employment and boost prosperity. However, they require investors with capital, expertise and market access to develop resources effectively.

Chinese companies will continue influencing the lithium industry through domestic and international investments across Australia, South America and Africa. Australian companies, leveraging strong mining heritage, are expanding both domestically and internationally. This ensures Australia's continued prominence on the global lithium map from both geographical and ownership perspectives.

Wood Mackenzie expects this dual approach to sustain Australian companies' significant role in the evolving lithium landscape through 2030.

View from Australia represents the opinions of Wood Mackenzie and does not reflect the opinions of ILiA.
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Wood Mackenzie

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Lens Metals & Mining,
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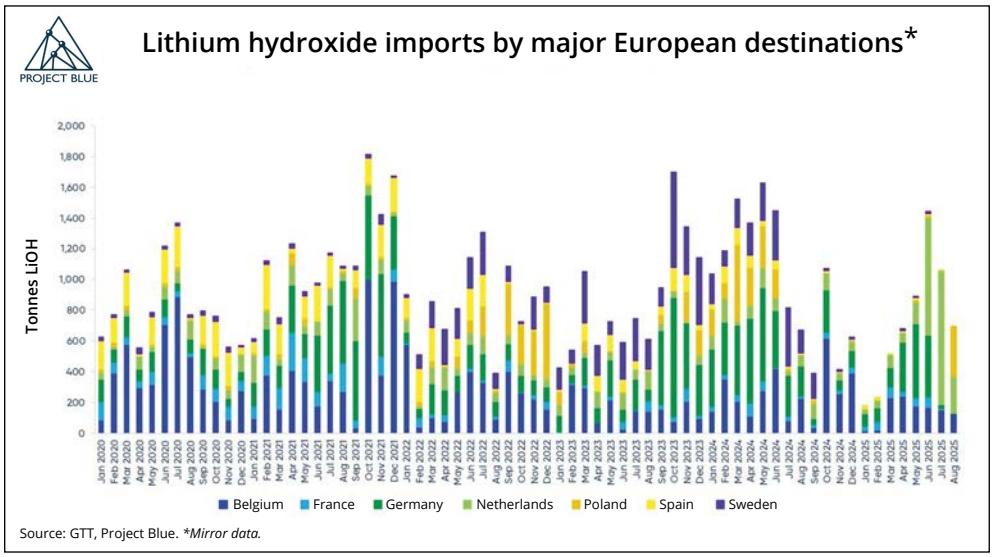
View from EUROPE

From Jordan Roberts of Project Blue

The trade of lithium hydroxide in Europe has seen an increase in activity following improved demand over the previous two quarters. Poland's imports of 326t (gross) in August, represented the largest volume since Q1 2024, signaling a potential inventory rebuild after a significant period of destocking. Prior to July 2025, Poland's total imports totaled just 32t (gross).



Source: GTT, Project Blue. **Mirror data.*

Increased trade within Europe can also be attributed to a surge in Sweden's lithium hydroxide exports to the Netherlands, likely reflecting Northvolt's administrators liquidating stockpiled material following the company's collapse. The Netherlands is likely a natural entrepot trade destination, being home to major chemical traders such as Traxys and Umicore (via Belgium/Netherlands), with material being purchased and to Rotterdam for onward redistribution.

At Savannah Resources's Barosso project, the approval process continues for the second land easement which has to date delayed the progress of the Definitive Feasibility Study (DFS). The DFS is now scheduled for completion in H1 2026, with expected first production deferred from end-2027 into 2028.

In the last quarter Savannah Resources also published an updated mineral resource estimate for the Barosso project, increasing resources to 39.9Mt at 1.06% Li_2O, a 22% rise in contained lithium compared with the 2023 estimate. Measured and indicated categories now make up 86% of the total resource estimate (up from 63%), which are equivalent to the entire previous resource estimate. The contained Li_2O of approximately 422,000t (>1Mt LCE) makes the Barroso project Europe's largest spodumene lithium resource.

In the UK, Cornish Lithium has secured GBP35 million (USD46 million) in new equity, designed to advance the company's Trelavour Lithium project towards a construction decision and its Cross Lanes Geothermal Lithium Project towards commercial drilling. The funding is sourced from existing institutional investors, with GBP31 million of the total provided by the UK's National Wealth Fund (NWF), and GBP4 million from existing investor, TechMet. A key outcome of the funding will be the completion of a feasibility study for the Trelavour Lithium Project.

In Portugal, Lifthium continues to progress the lithium chemical project in Estarreja. The 300 tpy demonstration plant continues to produce material for qualification by downstream customers. Construction of the commercial 28 kt per year LiOH plant is scheduled for 2026, with first production expected in 2028.

Vulcan Energy Resources has signed a binding offtake agreement with Glencore to supply 36-44kt of lithium hydroxide over an initial eight-year period. The agreement includes a take-or-pay structure with mixed pricing mechanisms. This deal completes the company's Phase One offtake portfolio and opens opportunities for further European partnerships, including potential deals with automakers. This agreement seemingly replaces the volumes that formed part of a binding agreement with Volkswagen which was signed in 2021.

View from Europe represents the opinions of Project Blue and does not reflect the opinions of ILiA.
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PROJECT BLUE

View from CHINA

From Maria Ma of SMM Information & Technology Co., Ltd

Increased supply variables and new policies, coupled with dual drivers of supply-demand shift and sentiment, led to price movements

Historic lithium carbonate supply-demand balance and price trend

In July, improved market sentiment, fewer lepidolite mine supply disruptions, and steady demand pushed prices up by over 10%. In August, leading mines in Jiangxi Province suspended production, cutting lepidolite supply by nearly 50%, which accelerated price gains - rising nearly 20% month-on-month (MoM). By September, the industry entered its traditional peak season. Although spodumene supply partly offset the lepidolite shortfall, stronger demand growth drove significant destocking. After the earlier surge, prices faced technical correction pressure and gradually returned to fundamentals, declining 6% MoM in September.

Policy adjustments: continued industry support and standardization

In the new energy vehicle (NEV) sector (which included electric and hybrid vehicles), multiple Chinese provinces reintroduced vehicle replacement subsidies in August, using varied distribution methods. This supported steady NEV sales growth:

(1) Chongqing allocated subsidies of RMB 200 million in August and RMB 100 million in September, following a "first-come, first-served" principle until funds were exhausted.

(2) Yunnan Province, starting August 12th 2025, set monthly, weekly, and daily limits on subsidies based on national and provincial fund allocation. Individual buyers of new NEVs were eligible for a subsidy of RMB 10,000 per vehicle.

Policies in the energy storage system (ESS) sector spurred industry growth.

The National Development and Reform Commission (NDRC) and the National Energy Administration (NEA), China's key bodies for energy policy and planning, published the *Special Action Plan for Large-Scale Construction of New-Type Energy Storage (2025–2027)*, targeting 180 GW cumulative installed capacity by 2027. New installations over three years are expected to exceed 100 GW, driving about RMB 250 billion in direct investment. Capacity electricity pricing policies were also implemented in multiple provinces, securing revenue for standalone ESS. These policy measures stimulated continuous growth in end-user energy storage demand.

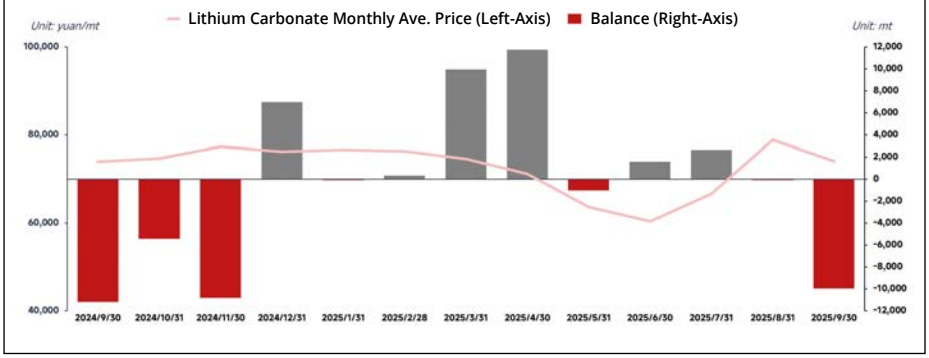
Supply variables and inventory structure shift

In Q3, lepidolite mines in Yichun, Jiangxi Province, continued to face supply disruptions due to ore rights reviews. However, domestic lithium chemical supply showed strong elasticity. Lithium carbonate output reached new monthly highs in this quarter, led by the spodumene segment. Non-integrated producers were active in toll processing, and spodumene-sourced lithium carbonate accounted for 65% of total output. Although lepidolite-based production fell by nearly 50%, the overall Chinese lithium industry operating rate increased due to the strength of spodumene production.

Conclusion

In Q3 2025, lithium carbonate prices surged then pulled back, while on the supply side, although lepidolite supply remained tight, spodumene production reached record levels. On the demand side, robust performance in power batteries and ESS led the market into a destocking phase, supporting upward price momentum.

Review of China's Monthly Average Lithium Carbonate Prices and Supply-Demand Balance



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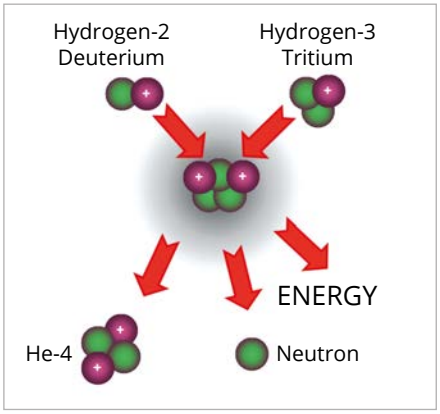
Feature

LITHIUM COMES OF AGE (PART 2) 1954 – 1976

This is the fourth article in our series exploring the historical development of the lithium industry. In this article we look at the period from the mid-1950s to the mid-1970s, a time that saw lithium used in fusion weapons, but also to improve many millions of lives and save three in particular.



When, in 1932, scientists split a lithium atom into two helium atoms, it was the first time humans had ever transformed one element into another (see *The Lithium Voice* #11). And just two decades later lithium atoms would be split apart again, but this time with rather different results.

1950s and 1960s: Thermonuclear threats and deterrents

On 1st March 1954, on the remote Bikini Atoll in the Pacific Ocean, US Operation Castle began with the Castle Bravo test. This was the latest in a long series of US nuclear tests, but what made it unique was that it was the first ever attempt to detonate a hydrogen fusion (thermonuclear) bomb.

Unlike previous fission atomic bombs which split uranium or plutonium atoms to release energy, in a hydrogen bomb an initial fission reaction creates the conditions of extreme heat and pressure that triggers a secondary, more powerful fusion reaction.

Typically, the fusion reaction in hydrogen bombs involves fusing the heavy hydrogen isotopes deuterium (^{2}H or D) and tritium (^{3}H or T) to form helium, and, in doing so, releasing vast quantities of energy.

At the Bravo test, the fuel used for the fusion reaction however, was a newly developed solid-fuel, lithium deuteride (LiD), formed of 40% isotope ^{6}Li and 60% isotope ^{7}Li. Why lithium? Because within microseconds of the fission reaction starting the LiD was split into deuterium and – by bombarding ^{6}Li with neutrons until it broke – tritium, which then reacted together to form helium, more neutrons and pure energy.

In fact, the energy released by the Bravo test shocked those who observed the test. Its fireball expanded to almost 6 km (four miles) wide within one second of detonation and the flash was seen in Okinawa, Japan, some 4,000 km (2,600 miles) away. With an estimated explosive power of 15 megatons, it was 2.5 times larger than expected. Today we know it was not only the largest explosive weapon that the US has ever detonated, but also the worst radiological disaster in US testing history.

Not to be outdone, the USSR, China, France and the UK raced to develop their own hydrogen bombs. The dubious prize for the largest hydrogen bomb explosion ever was 'won' by the USSR in October 1961. Tsar Bomba ("King Bomb"), was the largest man-made explosion ever made, with an estimated force of ~50 megatons.

Fortunately for the world, when faced with the terrifying reality of mutually assured destruction politicians on both sides of the Cold War became more cautious and in August 1963 the USA and the USSR signed the Partial Nuclear Test Ban Treaty, banning nuclear tests in the atmosphere, outer space, and underwater.

One important legacy of the nuclear arms race was the development of mines and facilities to provide lithium for LiD in several countries. Two such facilities were established at Kings Mountain and Bessemer City, both in North Carolina, USA, and today owned by Albemarle Corp. and Rio Tinto, respectively.

The Castle Bravo test, March 1st, 1954
(Image: Shutterstock])

Bilderling RD-301 Rocket Engine.

(Image: Museum of Space and Missile Technology Saint Petersburg, Russia)

1960s: A possible rocket fuel?

In the 1960s, as well as the nuclear arms race, a 'space race' was in full swing, too. Many novel experiments were undertaken, hoping to gain an edge in rocketry and space craft. And this included the use of lithium as a propellant for rockets.

According to the "Tripropellant Engine System Study" (1969) Rocketdyne, then part of North American Rockwell Corporation in California, USA, developed a prototype rocket engine which primarily burned liquid hydrogen and fluorine, but which injected liquid lithium into the combustion chamber as an "afterburner".

This prototype engine produced a specific impulse (a measurement of how efficiently a rocket engine uses its propellant to generate thrust) of 542 seconds , still regarded as the highest specific impulse ever achieved for any chemical rocket motor.

Parallel to Rocketdyne's research, investigations into the use of lithium as a rocket propellant was also taking place across the Atlantic at the pioneering Glushko Design Bureau "OKB-456" near Moscow (today part of NPO Energomash). At least four experimental rocket engines using lithium were built: the RD-301, RD-302, RD-303 and RD-350.

However, neither the US nor the USSR ever developed these engines beyond prototypes, perhaps because of the incredibly dangerous nature of the fuel components – both separately and, even more so, in combination.

1970s: lithium improves many lives on Earth and saves three in space

In the early 1970s lithium demonstrated life-saving values in two uses in particular, one general and one specific. Medicinal lithium carbonate was increasingly prescribed, helping hundreds of thousands of patients around the world with mental health challenges, while as an air-cleaner lithium hydroxide saved the lives of three astronauts who "had a problem".

Lithium in medicine

Lithium carbonate's medicinal properties were first recognised for the treatment of bipolar disorder, specifically for the control of manic episodes, by the pioneering work of the Australian psychiatrist John Frederick Cade in the 1940s (see *The Lithium Voice* #4). However, it took until the 1960s to see it registered as a medicine in Europe, while it was only on April 6th, 1970, that it was approved by the US Food and Drug Administration (FDA).

From the 1970s onwards lithium carbonate revolutionised the management of psychosis and was instrumental in changing the way we view and understand mental illness. Millions of patients have benefited from this treatment and in 1977 its effectiveness was recognised by the World Health Organisation (WHO), when it added lithium carbonate to its Model List of Essential Medicines for the treatment of bipolar disorders.

The benefit is not limited to the control of manic episodes, either. In his book *Lithium: A doctor, a drug and a breakthrough*, Walter Brown noted that "about 6% [of people with bipolar disorder] die by suicide, a rate of suicide 10 to 20 times higher than that of the general population... [and that] dozens of studies have shown that lithium treatment produces a notable decrease in suicide – about a 10-fold reduction." By lowering the patients' risk of suicide, lithium helps to reduce the loss and trauma that such tragedies cause.

For bipolar patients, their families and communities, lithium is a truly essential element.

Lithium in space

The week after the US FDA approved medical lithium, the Apollo 13 mission took from NASA's Kennedy Space Center in Florida, USA.

continued on page 12

A Saturn V launch vehicle takes off for a NASA Apollo mission.

(Image: Shutterstock)

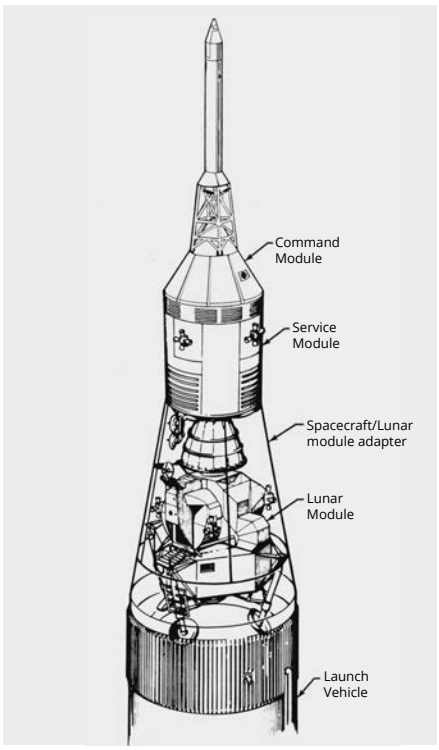
continued from page 11

The mission proceeded perfectly to plan for the first two days. The spacecraft left Earth orbit on schedule and was heading towards the moon, but suddenly disaster struck.

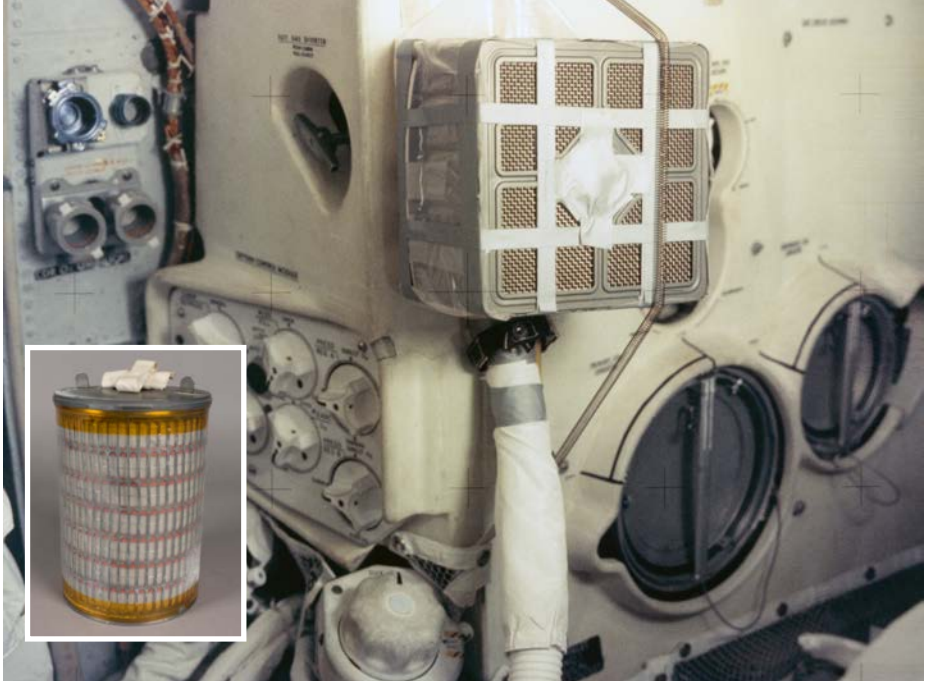
Shortly after 22:08 US Eastern Standard Time on April 14th, 1970, astronaut Jack Swigert aboard Apollo 13 contacted NASA Mission Control in Houston, Texas, with the words: "OK, Houston, we've had a problem here."

An oxygen tank in the service module had exploded during routine testing and within minutes two of the three fuel cells (FCs) that combined oxygen with hydrogen to supply electrical power went offline. Not only that, but when Commander James A. Lovell looked out of the window he could see gases venting into space; not only the craft's electrical system was damaged, but also its life-support system!

Faced with few alternatives, the three astronauts left the larger Command Module "Odyssey" and moved into the much smaller Lunar Module "Aquarius" to use it as a lifeboat, to preserve power and resources while the spacecraft looped around the Moon and returned to Earth for an emergency re-entry. However, the crew were not safe yet. As the craft emerged from behind the Moon and began its journey back to Earth the carbon dioxide alarm suddenly activated.



The Apollo launch configuration for a lunar landing mission. *(Image: NASA)*



Main: The Apollo 13 "mailbox", a jerry-rigged contraption to purify the air using a rectangular LiOH canister from the Command Module. *(Image: Shutterstock)*

Inset: A cylinrical LiOH Canister used in the Lunar Module.
(Image: Smithsonian National Air and Space Museum / Shirleyj)

Normally Apollo's life support system absorbed carbon dioxide from the air using lithium hydroxide (LiOH) filters to maintain a breathable atmosphere. However, the life-support system in the Lunar Module was designed to deal with the amount of carbon dioxide produced by two people, not three. With all three astronauts using the Lunar Module as a lifeboat, the filters could not remove carbon dioxide fast enough and unless they could find a solution the astronauts would suffocate before they returned to Earth. They were in serious danger, poisoning themselves with every breath.

The first idea was to take the filters from the Command Module and use them in the Lunar Module but this didn't work; the canisters holding the filters in the Command Module were rectangular and they didn't fit the cylindrical filter-holders in the Lunar Module. The challenge was quite literally one of square pegs and round holes.

It was only through the ingenuity of the engineers at NASA Mission Control that disaster was averted. The team on Earth directed the astronauts to build an ingenious contraption from a Command Module rectangular LiOH hydroxide filter, plastic sheeting, spare hoses from a spacesuit, and lots of duct tape. The 'mailbox', as they called it, looked bizarre, but worked perfectly and undoubtedly saved their lives and the mission.

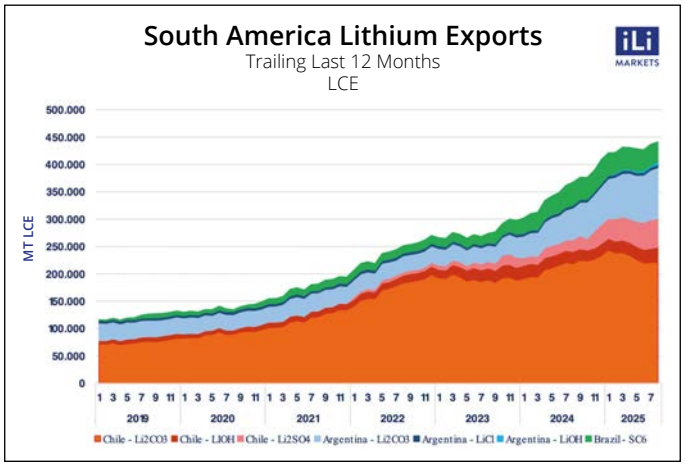
Exactly one week after launch, the crew of Apollo 13 splashed down safely in the South Pacific Ocean, cold, tired, and extremely thirsty, but alive. Several key decisions had helped them to survive and lithium hydroxide was front and centre.

An elephant enters the room

We close this chapter about the history of lithium in the mid-1970s, just as a young chemist working at Exxon in the US is about to publish an innovative new design for a rechargeable lithium-based battery. His name was Stanley Whittingham and in a future *Lithium Voice* we will explore how his discovery changed the course of history.

View from SOUTH AMERICA

From Daniel Jiménez of iLiMarkets



During Q3 the South American lithium space has seen a mix of steady progress and persistent challenges across Chile, Argentina and Brazil, while Bolivia remained inactive.

In **Chile**, the government's lithium framework is slowly taking form. Chile's Ministry of Mining completed the 3rd Indigenous Consultation under the National Lithium Strategy in the Salar Agua Amarga. The process resulted in nine unanimous agreements on land use, contractor duties, and community benefits. So far, twelve consultations have been carried out nationwide, with eight completed and four ongoing, giving the way for new Special Lithium Operation Contracts (CEOLs) with new actors. In the case of the SQM – Codelco deal, after the required indigenous consultation process is completed, the final pending issue is the approval by the China's State Administration for Market Regulation. According to China's ambassador to Chile, Chinese authorities will carefully evaluate the deal's impact on the country's lithium supply chain and industrial competition. Why is Chinese approval required? Antitrust regulations are given as the reason.

In parallel, the Ministry of Mining has submitted to the General Controller the decree establishing the requirements and conditions for the CEOL to be signed with project developers in Quillagua East sector. This private project joins the one in the Quillagua North sector, which was submitted in September, along with the decree establishing the requirements and conditions for the CEOL that will enable the development of a lithium project in Quillagua Sur. The contractor for the latter will be selected through a public tender.

Argentina continued to show strong activity. The province of Salta has issued the Environmental Impact Statement for the Rincón Lithium project (Rio Tinto) in Argentina. The Rincon project is now cleared to move into its next phase following a thorough technical, legal, and social review led by the provincial Secretariat of Mining and Energy.

Furthermore, Lithium Argentina announced the execution of a framework agreement with Ganfeng Lithium to establish a new joint venture, consolidating Ganfeng's Pozuelos-Pastos Grandes project with Lithium Argentina's Pastos Grandes project (85% owned) and the Sal de la Puna project (65% owned), collectively named "PPG". Ganfeng will hold 67% and Lithium Argentina 33% of PPG. The production target for the whole project is 150k tpy LCE.

Meanwhile, Lithium South announced a Letter of Intent with POSCO to sell them 100% of Hombre Muerto for USD 62 million. POSCO is the only owner and operator of the Sal de Oro lithium project in the Hombre Muerto Salar making the acquisition a way to consolidate resources. Finally, Zijin Mining started production at its Tres Quebradas lithium project, which has a Phase 1 capacity of 20k tpy of LCE. Argentina is currently the most dynamic lithium jurisdiction in the region.

In **Brazil**, development continues at a steady pace. Sigma Lithium reaffirmed its plan to triple its production by 2030, prioritizing spodumene concentrate over lithium sulphate. Companhia Brasileira de Lítio and Lithium Ionic advanced expansion works in Minas Gerais. Brazil's production is expected to rise gradually through the decade, supported by solid investment.

In **Bolivia,** legal uncertainty and political tensions continue to delay cooperation with Chinese and Russian investors. Despite its massive lithium resources, the country still lacks industrial-scale chemical production. The recent election of centrist Rodrigo Paz as Bolivia's president is raising cautious optimism that the country could invite more international investment after years of stalled developments under socialist rule.

Overall, South America's lithium industry continues to evolve steadily, though the region still faces delays linked to low prices and regulatory uncertainty.

View from South America represents the opinions of iLiMarkets and does not reflect the opinions of ILiA.

View from ASIA (excluding China)

From Zihao Li, Senior Price Reporter, Fastmarkets

Focus on South Korea

As trade tensions escalate between the US and China, South Korean players along the global battery supply chain are strategically pivoting away from traditional Chinese suppliers. This shift aligns with the United States' One Big Beautiful Bill Act (OBBBA), which limits eligibility for certain clean energy tax credits involving Prohibited Foreign Entities (PFE).

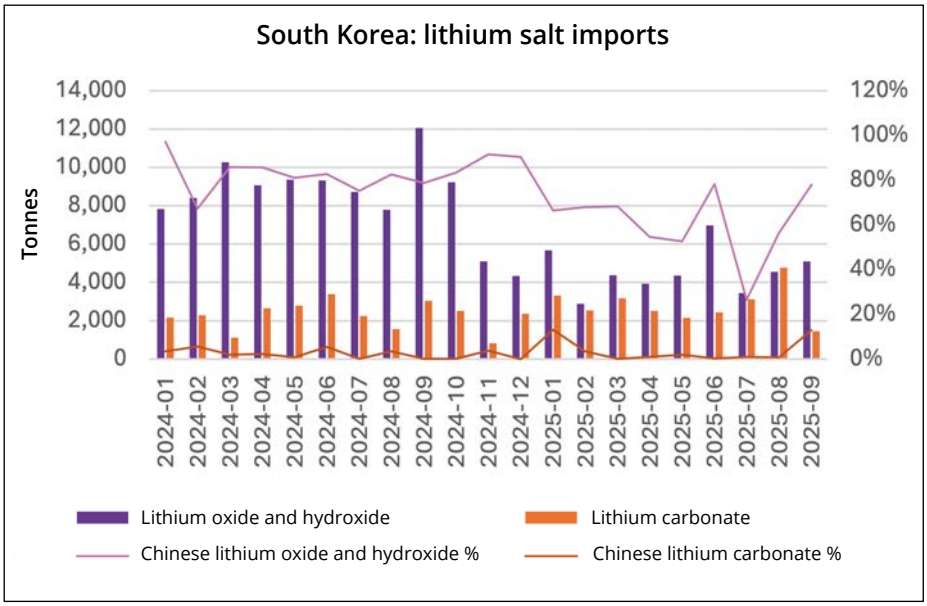
Between January and September 2025, South Korea's imports of lithium oxide and hydroxide plummeted to 41,281 tonnes, halved from 82,796 tonnes during the same period in 2024. This sharp decrease reflects a broader stagnation in the global electric vehicle (EV) market.

The reduction in reliance on Chinese lithium hydroxide has become particularly pronounced as South Korean firms deepen collaboration with US companies, distancing themselves from Chinese lithium sources to comply with OBBBA.

Posco Future M began shipping high-nickel NCMA cathode materials in July to Ultium Cells, a US-based joint venture between LG Energy Solution and General Motors.

SK On also secured up to 6,000 tonnes of lithium hydroxide from EcoPro Innovation in July for use in its US battery plants.

In a strategic investment, Toyota Tsusho acquired a 25% stake in LG-HY BCM in September, a joint venture involving South Korea's LG Chem and China's Huayou Cobalt.



This transaction reduced China's Huayou Cobalt ownership in the venture from 49% to 24%, positioning LG-HY BCM to qualify for tax credits under US regulations, which exclude eligibility if Chinese ownership exceeds 25%.

South Korean players are diversifying their offerings amid slowing EV demand. There is growing interest in lithium iron phosphate (LFP) batteries, driven by the energy storage systems (BESS) market and lower-end EV models.

Growing concerns about reliance on Chinese LFP are driving demand for South Korean LFP batteries, creating new market opportunities for South Korean players.

Samsung SDI announced plans in July to begin mass production of energy storage batteries in the US within the year, while expanding into the budget EV segment by diversifying its battery chemistries to include LFP..

In July, SK On signed a memorandum of understanding with L&F to supply LFP cathodes for the North American market, strengthening its entry into the growing BESS sector.

L&F said in July that it planned to establish phased production capacity for LFP cathode materials, eyeing an annual output of up to 60,000 tonnes, a response to surging LFP demand from the BESS sector.

In September, SK On agreed to supply up to 7.2 gigawatt-hours of BESS to Flatiron Energy projects across New England through 2030, beginning with a 1 GWh installation in Massachusetts.

In the broader context, South Korean imports of lithium carbonate rose to 25,445 tonnes in the first nine months of 2025, up from 21,255 tonnes year-on-year, while imports from China constituted only a minor fraction of total volumes.

In conclusion, South Korea's players are navigating a transformative period amid uncertain geopolitical dynamics and shifting battery demand. Their strategic pivot away from Chinese sources, combined with diversification into LFP technologies, illustrates a proactive effort to ensure compliance with US regulations while positioning South Korean producers for future growth in both the EV and energy storage markets.

View from Asia (excl. China) represents the opinions of Fastmarkets and does not reflect the opinions of ILiA.

View from NORTH AMERICA

From Adriana Carvalho, Associate Director, Metals Pricing, Americas, S&P Global Commodity Insights

Trade tensions heat-up, supply urgency spikes

As trade talks and tensions between the US and China escalated at the beginning of Q3, the US Department of Energy (DOE) redefined its approach to industrial investment through a revised agreement with Lithium Americas Corporation, the Canada- and Nevada-based developer of the Thacker Pass lithium project. This reflects the DOE's efforts to strengthen domestic production capabilities for strategic materials.

Under the new arrangement, the DOE's Loan Programs Office (LPO) will acquire equity warrants equivalent to 5% of Lithium Americas and another 5% in the joint venture with General Motors (GM). GM holds a 38% stake in the Thacker Pass joint venture.

Once operational in 2028, Thacker Pass is projected to produce approximately 40,000 tpy of battery-grade lithium carbonate in Phase 1, targeting 160,000 tpy with potential expansions. To achieve the full capacity, an additional USD9.4 billion in capital expenditure is projected, particularly for the sulfuric acid plant, which is crucial for clay extraction-based lithium mining.

Most US lithium resources are found in unconventional deposits, including clays, micas, and geothermal and abandoned oil well lithium brines.

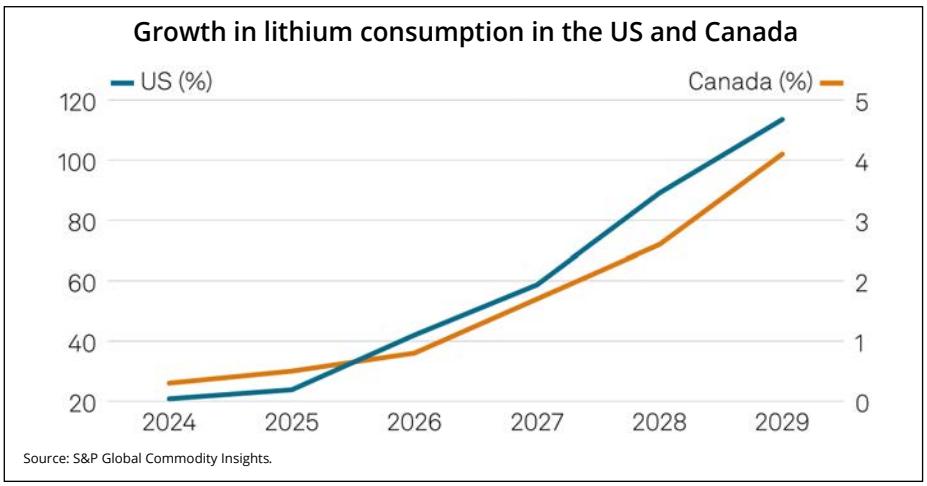
"The US government heavily supports domestic mining, though it does not support the entire battery industry," said Lukasz Bednarski, principal research analyst at S&P Global Commodity Insights.

"It's a complex supply chain, so if we want to see cooperation between the northern and southern hemispheres, refiners and cathode material production facilities must be present," he added.

Several battery manufacturing projects have recently been suspended or canceled in the region, underscoring significant challenges facing the sector.

The US Inflation Reduction Act, intended to stimulate domestic battery production, was scrapped, and the recently announced One Big Beautiful Bill Act (OBBBA) further impacted the battery manufacturing industry. Combined with ongoing volatility in raw material prices and persistent supply chain disruptions, these factors have created a difficult investment environment.

Battery makers struggle with high production costs and low yields during the ramp-up stage of new factories, which becomes financially draining if prolonged. This comes amid lower-than-expected demand for EVs, which has further pressured the industry. In response, many firms are restructuring their business models and strategies, focusing on cost reduction, operational efficiency, and securing stable supply chains to better weather the market's volatility.



Fuel to fire

US President Donald Trump's proposal for a 10% tariff increases on Canadian goods, announced on October 25th, complicates the sourcing of these critical materials.

Renewed trade frictions with China have led to its expanding export controls over rare earth and lithium-ion battery (LIB) products and equipment.

The new list issued on October 9th includes supplies of current-generation LIB technology that the US may import from China, including precursors for nickel-cobalt batteries and cathode manufacturing equipment.

View from North America represents the opinions of S&P Global Commodity Insights and does not reflect the opinions of ILiA.

Platts® S&P Global Commodity Insights

In conversation with CARLOS DIAZ

Executive VP Lithium at SQM

What drives you when it comes to lithium, and what is your vision for its future?

Lithium is at the heart of the global energy transition, powering everything from electric vehicles to renewable energy storage. My motivation is to ensure this transition is not only fast and efficient, but also responsible and lasting.

By 2035, I envision a lithium industry fully aligned with sustainability goals – where innovation across extraction, processing, and recycling drastically reduces environmental impact.

With lithium demand projected to triple by 2035, the sector must evolve in parallel: adopting new technologies, strengthening circularity, and building transparent, resilient supply chains.

Chile has a unique opportunity to lead this transformation. With vast reserves, strong institutions, and a growing innovation ecosystem, it can set a global benchmark for developing strategic resources that benefit both people and planet.

What makes the Salar de Atacama so special for lithium production?

Located in the Lithium Triangle, the Salar de Atacama hosts the world's richest lithium brine, offering exceptional efficiency and scalability. Compared to other salars it has a warm, dry climate and relatively low altitude enabling faster evaporation, making it one of the planet's most productive and sustainable sources of lithium.

SQM was the first lithium producer to achieve the IRMA75 accreditation. How does SQM work to meet ESG guidelines and lower its environmental footprint?

Sustainability is central to SQM's operations. We continuously innovate to meet the highest standards, and our IRMA75 accreditation reflects that commitment.

In Chile, we produce lithium chloride from brine in the Salar de Atacama using solar evaporation, an energy-efficient process. The lithium chloride is refined into carbonate and hydroxide at our Antofagasta facility – the world's largest lithium refinery. We also produce lithium sulphate from high-sulphate brines, recovering previously unused streams and enhancing operational flexibility.

Independent life-cycle assessments confirm that our lithium has among the lowest carbon footprint globally, while responsible water management is key in the arid Atacama. By 2028, we aim to cut brine extraction by 50%, while progressively moving toward the complete elimination of continental water use, supported by our Salar Futuro innovation roadmap. We've already reduced over one-third of authorized brine extraction and halved water pumping.

Our hydrogeology team has studied the Salar de Atacama for nearly 30 years, operating over 225 hydrogeological and 300 biotic monitoring points. Data from this network is publicly available at www.sqmsenlinea.com. IRMA75 validates our progress and pushes us to keep improving – because sustainability leadership means continuous evolution through collaboration and openness.

How does SQM engage with local communities? What initiatives are in place?

Our relationship with the local communities around the Salar de Atacama is based on collaboration, respect, and shared benefit. We focus on education, local development, culture, agriculture, health, and inclusion, engaging in more than 30 local working groups.

One example is AMA (Asociación de Mujeres Atacameñas) – an advisory group of Atacameña women, supported by SQM, that addresses systemic barriers faced by Lickanantay women across four pillars: health, productive development, culture, and care for land and water. We've committed USD 3.24 million to support AMA's work.

Another initiative is our mobile dental clinic program, launched in 2021, which now includes three fully equipped mobile units rotating

Carlos Díaz welcomes King Philippe and Queen Mathilde to SQM's lithium refinery in Antofagasta during the Belgian state visit to Chile.

(Image: © SQM 2025)

among Atacameño communities, providing high-quality dental care.

Through our CORFO lease agreement, SQM allocates 1.7% of annual sales to the Antofagasta Regional Government and to nearby municipalities for public investment. Indigenous communities in the Salar receive USD 10–15 million annually for sustainable projects.

We also drive local employment and procurement: over 200 workers from Indigenous communities – around 14% of our workforce – are employed in our Salar operations.

How will the innovations to reduce water use that you mentioned add value in Chile?

Water stewardship is both an environmental and operational priority. By optimizing water use and improving efficiency, we produce more lithium with fewer resources, strengthening both sustainability and competitiveness. We've implemented extensive water recirculation systems – treating and reintegrating all process water – to minimize freshwater use.

The Salar Futuro initiative underpins our future operations (2031–2060) in partnership with Codelco. It aims to ensure continuity while transitioning to advanced, resource-efficient, low-carbon technologies.

The project incorporates innovations such as forced and mechanical evaporation systems, membrane-based filtration, direct lithium extraction (DLE) technologies and brine reinjection. Some are already in use at our Antofagasta refinery and they are expected to boost yields by up to 10% next year.

How does SQM ensure that the value from lithium production is shared locally?

Value sharing is central to our model. In 2022, SQM contributed over USD 5 billion to public funds, including USD 3.3 billion in lease payments to CORFO – distributed among national, regional, and local governments, and Indigenous communities.

We also invest in regional development, local suppliers, and innovation. A highlight is the Lithium I+D+i Center at Universidad Católica del Norte, a hub for research and talent development in lithium battery technologies.

How do you see the future of lithium mining?

The future depends on operating sustainably and adapting to rapid change. As demand grows, mining must become more efficient, transparent, and resilient.

In a complex geopolitical landscape, reliable producers and trusted partnerships are essential. SQM stands out as both a top global supplier and a sustainability frontrunner, collaborating across the value chain to build a circular lithium economy.

Battery recycling will become increasingly vital. Unlike fossil fuels, lithium can be recovered and reused – supporting a regenerative energy system.

Do you have advice for new lithium developers?

Entering the sector today requires thinking beyond extraction. Success depends on trust, responsibility, and continuous improvement.

1. Engage early with communities. Build genuine relationships and listen from the start.
2. Set ambitious sustainability goals. Credibility comes from measurable progress on water, carbon, and biodiversity.
3. Be transparent. Align with national priorities and international standards – transparency is both ethical and strategic.
4. Invest in innovation. Emerging technologies like DLE, advanced water treatment, and battery recycling are reshaping the industry.

Carlos Díaz during ceremony "Pago a la Pachamama" (offering to Mother Earth) marking the start of the school year at the Toconao Educational Complex, together with the school community and local authorities.

(Image: © SQM 2025)

SQM was a founding member of ILiA. How do you see the Association's role evolving, and what message do you have for its members?

Since we helped found the Association in 2021, we've seen ILiA grow into a central voice for the lithium industry, connecting producers, refiners, recyclers, and innovators. With demand accelerating, ILiA's role as a unifying platform for sustainable, transparent growth is more crucial than ever.

My message to members is simple: stay engaged, be transparent, and think long term. ILiA provides a vital network for building partnerships and driving the collaborative work needed to scale successfully.

What's your favourite application of lithium beyond batteries?

Probably ceramics and glass – especially induction cooktops. Not because I'm a chef, but because it shows lithium's versatility. It's in satellites, medical devices, and even pharmaceuticals.

In glass and ceramics, lithium improves thermal shock resistance, lowers melting temperatures, and enhances durability. It's a reminder that lithium isn't just a "battery metal" but a material that quietly powers modern life.

SPOTLIGHT ON SUSTAINABILITY

Conservation of high-Andean flamingos at the Mariana Project

One of the main sources of lithium are the salars (salt flats) found in the high Andes Mountains of South America. In Argentina lithium is already produced from several salars (salt flats), including the Salar de Llullaillaco in Salta Province, where Ganfeng Lithium operates.

Images: © Ganfeng Lithium - LatAm - 2025

Andean flamingos feeding in a wetlands that are found in the northern sector of the Salar de Llullaillaco (Callacao), Salta Province, Argentina.

This part of the world is also home to three flamingo species of exceptional ecological and conservational significance: the Andean flamingo, James's flamingo, and the Chilean flamingo. These remarkable birds inhabit the saline lagoons on the margins of salars above 3,500 meters elevation, an extreme environment. Flamingos depend on water quality and availability, which makes them vital bioindicators of environmental integrity in high-altitude wetlands. To better understand how lithium miners protect and accomodate these birds, we spoke to Carrie Wang from Ganfeng Lithium.

"At Litio Minera Argentina (LMA), a wholly owned subsidiary of Ganfeng Lithium, we have implemented a comprehensive High-Andean Flamingo Conservation Plan as a cornerstone of our environmental management strategy at the Mariana Project, situated in the Salar de Llullaillaco, Salta Province, Argentina." She explains that the programme was developed in partnership with environmental consultancies, local communities, and regulatory authorities. It aims at monitoring, preserving, and advancing scientific understanding of these emblematic Andean species.

The conservation plan integrates technology with field science. Through analysis of over a decade of satellite imagery, researchers have mapped water and snow patterns sustaining the salt flat's biodiversity, providing crucial insights into the temporal dynamics of these fragile ecosystems. Detailed studies of microbial communities and small invertebrates have identified the trophic foundation supporting flamingo populations, revealing the intricate connections between microscopic life in the salars and these fascinating birds. Multispectral drone surveys combined with artificial intelligence have pinpointed areas of peak biological activity, revealing when and where the salt flat offers optimal food resources.

As Wang points out: "This convergence of data has enabled a paradigm shift in conservation strategy – from protecting broad zones to safeguarding functionally critical ecological nuclei essential for flamingo feeding, resting, and breeding."

The initiatives carried out under the Mariana Project's Andean Flamingo Conservation Plan are also featured in the Group's 2024 Integrated Sustainability Report. Its inclusion underscores the company's global commitment to biodiversity conservation and to strengthening relationships with local communities across its areas of operation.

Image: © Ganfeng Lithium - LatAm - 2025

Technical team conducting biodiversity monitoring activities in the vicinity of the Mariana Project.

THE CURRENT

Catch up with ILiA's work at a glance

New project: Species Sensitivity Distribution (SSD)

The "Species Sensitivity Distribution (SSD)" project is a new research project that has been launched by ILiA to analyse the chronic effects of lithium in freshwater (such as rivers and lakes) with the goal of creating a comprehensive toxicity data set which will support an appropriate regulatory framework in Europe, the USA and around the world.

Historically lithium is a relatively data-poor substance, compared to many other elements, because until recently the global market was considerably smaller than it is today – in both tonnages produced and the number of participants. Looking ahead, the global lithium industry is forecast to grow considerably (1.3Mt LCE this year to up to 5.2Mt LCE by 2040, according to the *Lithium 2040* report commissioned by ILiA in May 2025), which makes it even more important that this relative lack of data is addressed without delay.

Who benefits?

Everyone benefits when regulators are enabled to create an appropriate regulatory system which minimises risks to people and the environment while allowing responsible industrial activity to take place.

The reverse also holds true: when comprehensive data about a substance are lacking, regulators' ecological risk assessments understandably adopt a cautious approach, typically defaulting to very low estimates for 'safe' thresholds, known as Environmental Quality Standards (EQS), Water Quality Criteria (WQC) or Predicted No-Effect Concentrations (PNECs).

This is already being seen in Germany, Belgium and the Netherlands, where proposals are in the range of 10-20 µg Li/L (parts per billion), below or close to the levels found in many natural fresh waters (see *The Lithium Voice* #8).

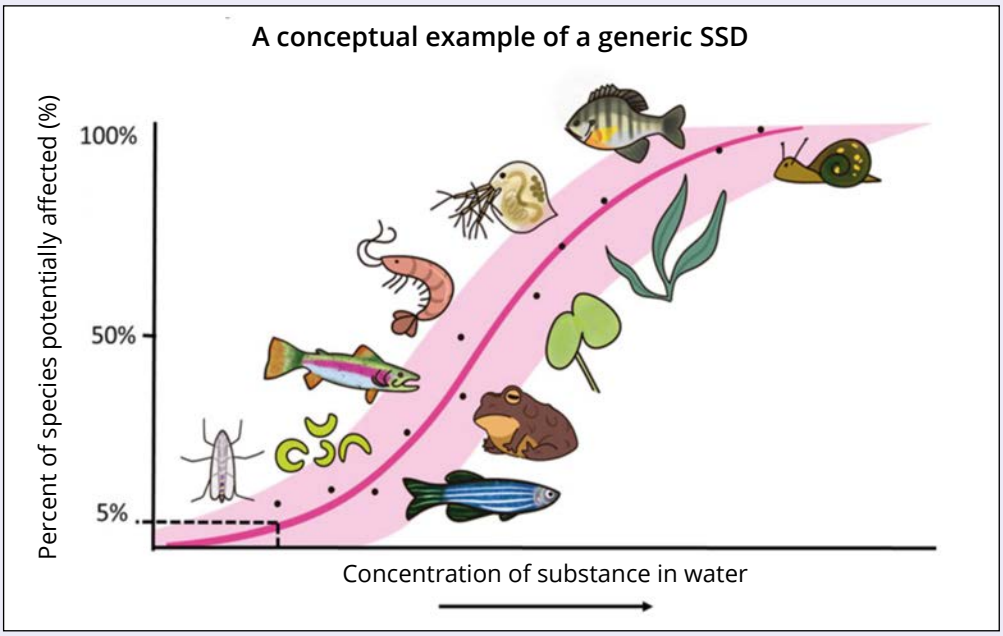


Image: Health Canada 2025

What is an SSD?

An SSD is a statistical approach used in ecological risk assessment to estimate the toxicity of a chemical to a range of species (typically at least 10) representing multiple species taxonomic groups (for example, fish, invertebrates, plants).

A key output of the statistical approach is the Hazard Concentration for 5% of species (HC5), which is the concentration of a substance estimated to affect only 5% of species.

Typically, deriving a 'safe' threshold using the SSD approach requires the following steps:

1. Compiling and assessing the quality of toxicity data
2. Fitting a SSD to the toxicity data, and deriving the HC5
3. Assessing the remaining uncertainty which may lead to the application of an Assessment Factor
4. Deriving the final 'safe' threshold

Looking ahead

The SSD project is a considerable undertaking and the project which ILiA is managing is not expected to publish results before early 2027. Further updates will be provided in due course.

Regulators and industry participants who are interested in learning more about the planned lithium SSD process and timeline, or to join the project consortium, should contact the Secretariat through **info@lithium.org.**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