INTERNATIONAL LITHIUM ASSOCIATION (ILiA)

THE LITHIUM VOICE

The journal of the International Lithium Association (ILiA)

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ILiA's Ten Principles

A bright future for lithium metal

Joint industry position on the proposed RMOA by ANSES

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Chair's WELCOME

Welcome to the 9th edition of The *Lithium Voice,* in which we examine one of the most fundamental atomic properties of lithium – its flame colour.

From celebratory fireworks to life-saving emergency flares, the brilliant scarlet-red emitted by lithium (though it is grey as a metal) has a surprising number of applications.

This quarter marked a landmark for the Association as we publish our **Ten Principles**. This is the culmination of 6 months of consultations with members and stakeholders on what responsible business conduct in the lithium value chain means to them.

The lithium value chain is growing rapidly and in coming years many new resources will be developed in diverse regions of the world to meet the increasing demand for lithium. One of the potential challenges for any fast growing industry is how to ensure that new entrants appreciate the norms and consumer expectations. We recognise that it is important that the high standards of the current industrial lithium producers and industry are upheld and our intention is that the **Ten Principles** will provide leadership to the entire lithium value chain on this topic.

This issue discusses the technological developments in lithium metal, and its various uses, especially in increasing the energy density of lithium batteries. I'd like to thank Ganfeng Lithium, a Founding Member, and one of the largest lithium metal producers, for sharing their experience and outlook on solid state lithium batteries and different uses. I'm sure you'll find it very informative and interesting.

We are pleased to announce that in May, for the first time, ILiA will host an international lithium pavilion at CIBF battery conference in Shenzhen, China. This is one of the world's biggest battery conferences that includes companies from the whole supply chain including raw material suppliers. Come and meet us in Hall 10 and join us during the networking events.

Anand Sheth
Founding Chairman

Feature

THE COLOUR OF LITHIUM

All over the world fireworks are a popular way to celebrate important occasions including birthdays, the new year and public holidays, but did you know that many of the red fireworks are based on lithium?

What is the colour of lithium? White? Silver-grey? Purple? Green?

Well, in different forms of lithium all of these colours are possible. In metallic form lithium is a shiny silver-grey colour, similar to most other metals (see page 8). In its carbonate form lithium is a brilliant white crystalline powder which looks very similar to table salt.

The main lithium-containing minerals, spodumene, petalite and lepidolite, show a remarkable variety of pinks, greens, purples, and pale grey-yellows (the inspiration for ILiA's colour palette), while some of the more exotic minerals, for example tourmaline-rubellite, are truly spectacular.

There is more to the colour of lithium than meets the eye. And wait, we only scratching the surface!

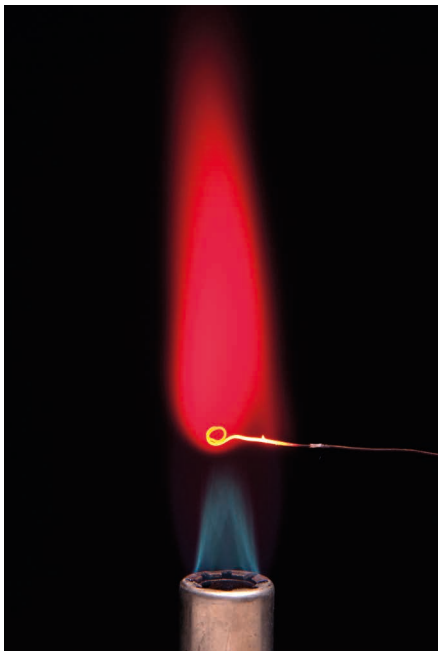
The burning question

Have you have ever sat around a campfire at night watching the wood slowly burn and noticed unusually coloured flames? Perhaps there was some metal litter thrown into the fire? What you witnessed was probably the subject of optical emissions spectroscopy, or the science of different metallic elements burning with different coloured flames.

In chemistry, the 'flame test' is an old but reliable way of testing for the presence (or absence) of different elements, especially alkali metals such as lithium, sodium and potassium. Each of these metals burns with a unique colour signature, clearly visible to the human eye.

The reason that different elements appear to burn with different colours is down to their fundamental atomic properties.

When an atom is heated its outer electrons move into a higher state of energy and the atom becomes 'excited'. If the atom is allowed to cool down again it will return to its usual 'ground' state and emit some energy in wavelengths that appear as visible light.



Lithium ions react in the flame of a Bunsen burner. Lithium is unusual as it reacts with both the oxygen to form lithium oxide (Li_2O) and nitrogen to form lithium nitride (Li_3N).

(Image: Charles D. Winters / Science Source)

Because each element has a different atomic structure, the emission spectrum for each type of element is unique and universally consistent. Most emit more than one wavelength of visible light, the dominant wavelength determining the unique flame colour seen with a naked eye.

For example, copper produces a blue flame, calcium an orange flame, sodium a yellow flame, and barium a green flame. For the emission spectrum of lithium, the strongest line is at ~670.8 nanometres (nm) and a second at ~610nm, which together appear as a brilliant crimson-red flame.

This is the colour of lithium.

Seeing lithium atoms for the first time

It was crude flame tests that arguably first prompted and then later confirmed the discovery of lithium.

In the days before the invention of dynamite mining often involved building a fire directly on an ore body, heating the rocks and then rapidly quenching them with water. This would cause the hot rock to crack and splinter into manageable lumps that could be removed and processed. This fire quench (or fire-setting) method of mining was in use at an iron ore mine on Utö island in Sweden in the late 18th century when it was visited by a Brazilian polymath, Joze Bonifacio de Andrada e Silva.

It is said that Andrada was shown a white mineral which gave off an intense red flame when it was thrown into a fire. Fascinated, he collected a sample for analysis and later demonstrated that it was a previously unrecorded mineral. This was the mineral petalite. (However, since petalite was an

unwelcome impurity in Utö's iron ore deposit, it seems plausible that those early miners would have cursed whenever they saw red flames appear in the fires that they built in the mine!)

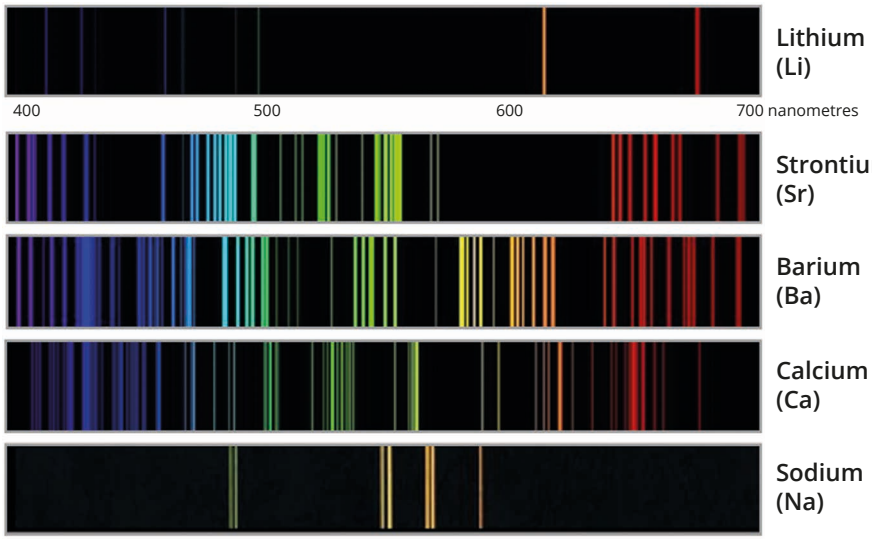
Two decades later a young Swedish scientist called Johan Arfwedson demonstrated that petalite contained a previously unknown element and named it lithium. The discovery was independently confirmed a year later when a German chemist, Christian Gottlob Gmelin, observed that the new element burned with an intense crimson-red flame, a colour which had never seen before in laboratory flame tests.

Practical applications

Today flame tests are still widely used due to their simplicity and reliability. A basic flame test can play a useful role in analysis, for example field testing crude mineral samples. They are also excellent for inspiring the next generation of young chemists in school science classes.

The principle behind flame testing also forms the basis for two highly technical analytical techniques, as Jeremy Brown, Group Technical Development Manager at Alfred H Knight, explained. "In Flame Atomic Absorption Spectroscopy (FAAS), a flame at ~2700°C (4890°F) excites lithium's electrons and a specific amount of light is absorbed, allowing for the determination of lithium content of a sample. In Ion Coupled Plasma Optical Emission Spectroscopy (ICP-OES), a plasma at ~10,000°C (18,000°F) excites the electrons to a higher state and then as they return to a ground state, they emit specific wavelengths. Detecting and measuring the intensity of those emissions across multiple wavelengths enables precise quantitative analysis of a sample."

The emission spectra of lithium and selected elements



Having fun and saving lives

Fireworks are undoubtedly the most visible use of the emission spectrum of lithium and probably one which we have all witnessed, although perhaps without realising it. The fact that different elements burn with different colours is fundamental to fireworks; to make yellow fireworks add sodium salts, for blue add copper, for orange add calcium and so on.

Traditionally red fireworks were mostly made using strontium salts – strontium also has a strong emission spectrum in red wavelengths – but in the last decade there has been a growing trend to replace it with lithium due to concerns in the US and elsewhere about the effect of traces of strontium on human health. An added advantage of using lithium salts in pyrotechnics is that by modifying the recipe slightly, pinks and oranges can also be produced.

However, the practical applications of lithium as a red pyrotechnic colorant are not purely for fun, they save lives too.

Red emergency flares have a long history of attracting attention in times of distress. Historically these too were based on strontium salts, but are seeing a move towards lithium, especially in the United States where work was led by the U.S. Army Research Laboratory in partnership with the Ludwig Maximilian University in Germany. While electronic red lights (using lithium batteries) are increasingly popular, pyrotechnical flares are still widely used and have a number of applications, including as location beacons in military exercises and as emergency 'SOS' flares for ships and mountaineers.

Lithium minerals, salts and applications come in a multitude of colours, but one stands out as representing a fundamental, inimitable property of lithium: scarlet-red. This unique colour not only helps geologists to identify lithium in minerals, but brings joy to millions of children watching firework displays and even helps to save lives too.

Not many elements can say that!

ILiA'S TEN PRINCIPLES

In November 2024, after wide consultation with ILiA's global membership, the Executive Committee took a significant step towards supporting responsible business conduct in the lithium value chain by adopting Ten Principles of responsible production and sourcing.

The journey begins

We face a highly dynamic and rapidly growing global lithium market where well-established players come together with new and less experienced actors.

New entrants to the industry frequently ask what are the norms of business in the lithium industry? What does ILiA stand for when it comes to responsible business conduct? What are the values and beliefs our members embrace as they strive towards creating a sustainable future?

To help maintain the existing high standards in the industry, ILiA members decided that it was relevant and necessary for the Association to develop guiding principles for responsible business conduct.

Lead by the Responsible Production and Sourcing Subcommittee (RPSS), the plan to develop a number of good practice principles took shape over the course of six months and involved the entire membership.

The principles were developed by the subcommittee and honed by the Executive Committee before consultations with the members and stakeholders took place.

The final set of principles is not legally binding, but they are a guide to the expectations of how ILiA member companies conduct their business around the world.

The ten principles are about embracing responsible and ethical practices.

Marie-Alice Small, Pilbara Minerals and Chair of ILiA's Responsible Production and Sourcing Subcommittee

As Marie-Alice Small, Group Manager Sustainability at Pilbara Minerals and Chair of the RPSS explains, "The Ten Principles are about embracing responsible and ethical practices. We saw a win-win opportunity in establishing these principles, which not only set expectations for best practices but also support enhancing trust in how our industry contributes positively to communities."

The Ten Principles cover key areas of accountability regarding the environment, social responsibilities to human rights, labour and host communities, as well as governance aspects including anti-corruption and antitrust.

Many ILiA members already subscribe to international sustainability schemes and mining standards, so it was decided to align ILiA's Ten Principles with existing frameworks as far as possible. Chief among them were the principles of the UN Global Compact, with further inspiration coming from the International Council on Mining and Metals (ICMM), the UN International Labour Organization (ILO) and other international organisations in the mining sector.

José Miguel Berguño, Senior VP Corporate Services & Sustainability at SQM told the *Lithium Voice*, "At SQM, we are proud to align with the ILiA Ten Principles. We see these principles as foundational to the responsible and ethical development of our industry and resonating with SQM's commitment to sustainable mining practices that prioritise the well-being of our surrounding communities and the future of the Salar [de Atacama in Chile, where SQM produces lithium]."

How the Ten Principles are applied

As good corporate citizens, ILiA members are already committed to acting legally in the jurisdictions

where they operate, upholding and following the letter and spirit of all applicable laws, maintaining a high standard of business ethics, and having due regard to the health, safety, environment, human rights, good governance and welfare of the community. Where an alleged breach of these principles is brought to the attention of ILiA it will be investigated by the Executive Committee. Material breaches or unwillingness to address grievances may result in suspension or potentially termination of membership.

The Ten Principles will be reviewed by ILiA Executive Committee every two years, with the next review scheduled to take place in Q4 2026. This is to ensure that they are consistent with expectations of members and stakeholders.

The Ten Principles*:

1. Environment

Members will respect the environment at all times and will comply with all relevant legislation in their countries of operation and encourage the development and adoption of environmentally friendly technologies to responsibly manage our resources.

2. Climate Change

Members seek to play an active role in efforts against climate change, including to reduce their carbon footprint in support of the United Nations Framework Convention on Climate Change.

3. Forced and Child Labour

There shall not be any use of forced labour, and members advocate for the eradication of the worst forms of child labour. Members adopt responsible practices throughout supply chains to prevent and address forced labour and child labour.

4. Community

Respect the rights of project related communities and commit to meaningful and transparent consultation and include Indigenous Peoples' rights to participate in decision-making on matters that affect them and be guided by the principles of free, prior and informed consent (FPIC).[1]

5. Non-discrimination

No person shall be subject to any discrimination in employment, including hiring, salary, benefits, advancement, discipline, termination, or retirement, based on gender, race, religion, age, disability, sexual orientation, nationality, political opinion, or social or ethnic origin.

6. Health and Safety

Members promote well-being and provide a safe and healthy working environment to prevent accidents, injury and psychosocial hazards to health arising out of, linked with, or occurring in the course of work or as a result of the operation of employer facilities.

7. Freedom of Association and Collective Bargaining

Members recognise and respect the right of their employees to engage in or refrain from protected concerted activities.

8. Fair and inclusive work practices

Every employee shall be treated with respect and dignity. Members promote safe, healthy and respectful workplaces that are free from psychological harm including bullying, harassment, discrimination and violence, including gender-based violence.

9. Responsible Finance Practices

Members shall avoid contributing to geopolitical conflict, comply with high standards of anti-money laundering practice, and combat illegal financing practices.

10. Antitrust Bribery and Corruption

Members comply at all times with the ILiA competition law compliance guidelines and all relevant antitrust and competition laws applicable to their business. Members are committed to compliance with all applicable laws on bribery and corruption within their jurisdictions.

The road ahead

As the lithium industry grows over the next decade it is expected that many new resources will be developed in diverse regions of the world. Throughout this period of growth it is important that the high standards of the current industrial lithium producers continue to be the norm of the industry and that new producers appreciate and adhere to the Ten Principles described here. Candice Dix, ESG Assurance Manager at Rio Tinto Group explained, "We support the introduction of the Ten Principles for ILiA members, focusing on ethical, sustainable, and socially responsible lithium mining practices for the industry."

At ILiA we look forward to expanding our work on this topic and will endeavour to continue to represent the industry in a way that does not shy away from taking responsibility. Together, we can achieve a more responsible and sustainable future.

[1]ILiA recognises that in some countries, alternative terms to "Indigenous Peoples" are preferred by those to whom the term refers; including "Tribal Peoples" or "First Nations". ILiA rejects any discrimination related to culture or identity and respects the diverse terms groups use for self-identification in alignment with ICMM's position statement on this subject: https://www.icmm.com/en-gb/our-principles/position-statements/indigenous-peoples

* https://lithium.org/ilia-10-principles/

Feature

A BRIGHT FUTURE FOR LITHIUM METAL

Lithium, like sodium and potassium, is never found in nature as pure metal and most applications for lithium use it as a lithium compound. However, recent developments in lithium metal batteries could require large-scale lithium metal production in coming years.

A silver-grey metal

Lithium is the lightest metal in existence, with a density of only 0.534 grams per cubic centimetre. This is around half the density of water and an ingot of lithium metal would float on top of water. However, if lithium metal doesn't have a protective coating it will react with the water vigorously, transforming itself into lithium hydroxide and generating hydrogen gas in the process. Do not try this at home.

Lithium is a silvery-white alkali metal (group 1 in the periodic table) which is soft enough to be easily cut with a kitchen knife. Once cut, however, it will quickly start to turn black as it reacts with the oxygen in the air.

For a light, soft metal lithium is remarkably malleable and ductile. If it is handled in a protective atmosphere, for example in a chamber of unreactive argon gas, lithium can be drawn into fine wires or pressed into sheets that are surprisingly robust.

Historically lithium metal was used in an alloy of lead ('Bahnmetall') and more recently in aluminium- and magnesium-based alloys for aircraft, aerospace and the military vehicles.

Another traditional use was in non-rechargeable batteries, which come in a range of sizes, including small button cell used domestically in car key fobs and elsewhere (pictured below), and the batteries for surgically implanted heart pacemakers that are required to operate for at least five years without replacement.

The current market for lithium metal is small compared to that for lithium carbonate and hydroxide. According to David Merriman, a lithium analyst at Project Blue, the global production of lithium metal in 2024 was under 3% of the total lithium market, and was mostly produced in China.

However, the market for lithium metal is growing rapidly and shows great potential thanks to advances in next-generation solid-state lithium batteries that are being developed for electric vehicles (EVs), energy storage, and other related fields. Many analysts predict that these batteries will require a great deal of lithium metal in the future and several companies are already investing in new capacity to prepare for the expected demand.

Producing lithium metal

For an element which never occurs in nature in its pure form, it's not surprising to learn that producing lithium metal is challenging. In fact, it took almost 40 years after the discovery of lithium by Johan August Arfvedson in 1817 for enough lithium metal to be produced to measure its properties with confidence. This was done by two scientists independently, Robert Bunsen in Germany and Augustus Matthiessen in the UK, using electrolysis of molten lithium chloride in 1855.

Lithium metal was produced at an industrial-scale for the first time in 1923 at a plant in Langelsheim, Germany (now part of Albemarle Corporation). Production here used molten salt electrolysis too, but mixed potassium chloride with lithium chloride to obtain a mixture with a lower melting temperature (see *Lithium Voice* #4).

Today the smelting and purification technology of high-quality lithium metal is still a complex and delicate process because of the chemically active nature of lithium and the many technical challenges in the purification process. The first stage is (still) electrolysis of molten salt in highly controlled conditions. Once the lithium salts are in the electrolyser the temperature, current density and electrolyte composition are carefully controlled to achieve the target the purity, crystalline form and efficiency levels.

Subsequent stages of production include thermal insulation and sedimentation, precision filtration (or low-temperature distillation), and low-temperature moulding to produce high-purity metal lithium ingots.

Several companies are actively involved in developing improved lithium metal techniques. ILiA member Ganfeng Lithium has recently developed an oil-free vacuum melting production process to produce high-purity lithium metal which achieves a purity of 99.95% Li, with a good consistency and excellent surface quality.

In a parallel development Ganfeng Lithium has developed a first ever low-temperature vacuum distillation purification technology for the production of battery-grade lithium metal which has reduced the preparation energy consumption by 50% at the company's plants in Jiangxi, Qinghai and other Provinces in China.

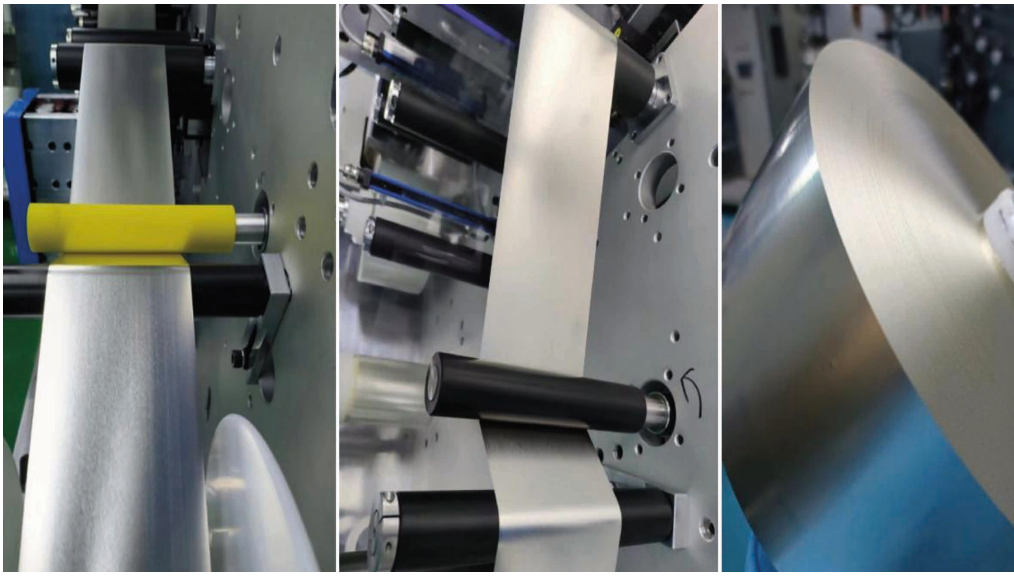
Lithium metal in batteries

Recent trends in the battery industry display a steady transition from semi-solid to all-solid materials. While in parallel, anode materials are evolving from being based on graphite, to being based on silicon or lithium metal.

These next-generation battery technologies improve energy storage and transport dramatically and could even transform the global energy system. According to Keiji Otsu, President of Honda R&D Co., Ltd, solid-state batteries are "an innovative technology that will be a game changer in this EV era", and such a change will require unprecedented quantities of very thin lithium metal foil.

Exciting developments

One example of a high-end lithium metal product which has been specifically developed for solid state batteries is an ultra-thin foil just 0.02mm thick, which is less than half the thickness of a human hair. These remarkable foils are produced by Ganfeng Lithium using ternary gas protection, vertical extrusion and multi-stage continuous rolling - a process which pushes extrusion and rolling technology to the limit in order to avoid shearing the soft lithium foil.



Ultra thin lithium strip. *(Images: Ganfeng Lithium Group Co., Ltd)*

Ganfeng Lithium is developing a range of next-generation battery products that includes a high-energy solid-state lithium battery made with lithium metal anodes. Recently the company, working with the FunLithium R&D Center, successfully developed a high-energy lithium metal battery with an energy density of 420Wh/kg and a cycle life of more than 700 charges, and initially developed a product with an energy density of 500Wh/kg. Such a battery could bring unprecedented range upgrades to electric vehicles and extend the battery life of wearables and drones considerably.

Elsewhere in the industry a plethora of firms are investing in lithium metal battery technologies:

- At the US laboratory of Pure Lithium in Charlestown, MA, they are creating a battery with a pure lithium metal anode paired with a vanadium cathode to create a safe, affordable lithium metal battery.
- In late 2024, for the first time, Honda Motor Co., Ltd unveiled a demonstration production line for -solid-state batteries in Sakura City, Japan.
- SES AI (previously Solid Energy Systems) states that it is making significant progress in lithium metal anode technology.
- In China the state-owned automotive manufacturer SAIC Motor is developing an electric vehicle powered by batteries that use lithium metal with Qingtao Energy Development.
- Tianqi Lithium and Welion New Energy have joined forces to develop pre-lithiated negative electrode materials, lithium metal cathode and lithium base alloy cathode materials for solid-state batteries.

From the origin of the universe to essential applications of modern industry, lithium has vast potential. Until now most applications of lithium have used lithium carbonate, hydroxide and chloride, or the pure minerals. However, with new technological breakthroughs, both in the lithium battery sector and in lithium metal production, a wide range of new applications for lithium will be seen, making an even brighter future for a very special element.

ILiA appreciates the technical assistance of Ganfeng Lithium Group Co., Ltd in creating this article.

View from SOUTH AMERICA

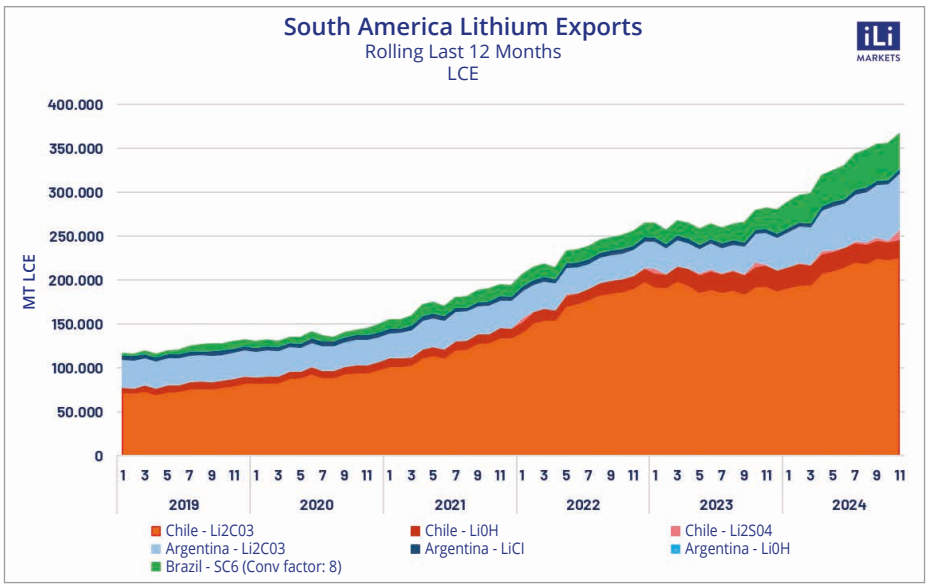
From Daniel Jiménez of iLiMarkets

Since our last newsletter, we have seen several important developments in the lithium space in South America.

Starting in **Chile**, the government announced a process to assign Special Lithium Operation Contracts (CEOLs) at six salt flats: Salar Coipasa, Ollagüe, Ascotán, Piedra Parada, Agua Amarga, and Laguna Verde. Indigenous consultations for these projects began in October, with the goal of securing social and environmental compliance.

Following the same lines, Chile has also opened new non-brine areas for lithium exploration, targeting six areas in the Tarapacá and Antofagasta regions. These types of deposits are clays or geothermal brines which would require alternative extraction techniques. The Ministry of Mining has extended the deadline to March 7th, 2025, for submissions from parties interested in accessing the simplified process to request a CEOL. As for producers, Albemarle has formally disputed SQM's environmental permits in the Salar de Atacama, arguing that SQM's operations account for over 70% of the environmental impacts in the area. Both companies continue to seek environmental permits for their extraction operations.

In **Argentina**, Rio Tinto has announced the acquisition of Arcadium Lithium for USD6.7 billion, securing a leading position in the global lithium market. The deal provides Rio Tinto with Arcadium's vertically integrated lithium operations Fenix and Olaroz and includes projects like Rincon in Argentina and Nemaska in Canada. Some of these assets are low-cost productions and at Fenix production uses a hybrid direct lithium extraction (DLE) process.



The acquisition provides significant knowledge base to Rio Tinto and aligns with Rio Tinto's energy transition strategy, leveraging Arcadium's resource base and expansion plans to more than double lithium output by 2028.

Regarding other producers, Lithium Argentina achieved its 2024 production target of 25,000 MT of lithium carbonate from the Caucharí-Olaroz operation, including 8,500 MT in Q4. The company plans to increase production to 30 -35,000 MT in 2025.

Eramet, after acquiring full ownership of the Centenario project by buying 49.9% of Tsingshan for USD 699 million, reported commencement of production at its newly commissioned plant, which is expected to produce 24,000 MT annually by mid-2025.

Meanwhile, Posco started production of lithium hydroxide at its Hombre Muerto Project. The name plate capacity of the project is 25,000 MT, with an investment exceeding USD800 million and exports have started. During 2025 Argentina should add three new producers: Eramet, Zijin and Ganfeng's Mariana, bringing the total number of producing assets to seven.

Moving on to **Brazil**, Sigma Lithium reported producing 60,000 MT of lithium concentrate in Q3 2024, slightly exceeding its target. Sales volumes reached 57,000 MT, generating USD34 million in cash flow and reducing the company's debt. Construction of Plant 2 continued, backed by a financing agreement with BNDES.

On other projects, Lithium Ionic Corporation increased the mineral resource estimate for its Baixa Grande Project by 32%, identifying 6.52 million MT of measured and indicated resources. The company also secured a Letter of Interest (LOI) from the U.S. Export-Import Bank for USD266 million in debt financing, supporting the full CAPEX of its Bandeira Project. Production is expected to begin within two years.

In **Bolivia**, Yacimientos de Litio Bolivianos (YLB) signed agreements with Eau Lithium (Australia), Tecpetrol SA (Argentina), and Geolith Actaris (France) to conduct trial lithium production at the Coipasa, Pastos Grandes, and Empexa salt flats. These trials, lasting 90-120 days, will determine the companies' eligibility for formal contracts. Additionally, Bolivia finalized a USD1 billion agreement with Hong Kong CBC Investment Limited, a subsidiary of CATL, to construct two lithium industrial complexes in the Uyuni salt flat. The facilities will use DLE technology to produce 35,000 MT of lithium carbonate annually.

Across South America, these developments highlight the need for financing projects to boost the supply chain. Argentina had most of the developments during 2024, with several projects starting at the close for 2024, followed by Brazil with projects receiving financing to start construction. Finally, Chile and Bolivia are trying to boost the production through Private-State cooperation.

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

iLi MARKETS

THE CURRENT

Catch up with ILiA's work at a glance

Round table of experts

In early March 2025 a group of world-leading epidemiologists and toxicologists will meet in London, UK, for independent discussions concerning lithium and classification. This project is part of the Association's ongoing efforts to gather experts' opinions and share scientific data regarding lithium with industry, the scientific community and regulators.

This program has been generously supported by Albemarle Corporation, Arcadium Lithium, Ganfeng Lithium, Imerys Lithium France, LevertonHELM Ltd, Rio Tinto, Sibanye Stillwater Ltd, SQM and the Association. The output from the expert roundtable will be discussed in a future edition of the *Lithium Voice*.

RMOA updates by industry and regulator

In the *Lithium Voice #8* we shared a summary of the joint industry position statement concerning the risk management option analysis (RMOA) proposed by the French regulator ANSES. Following popular request the full text is published in this edition (see page 16). ILiA met with ANSES in early February for a productive conversation about next steps.

Meanwhile, the industry RMOA has reached its final stages and is about to be finalised. The lithium industry believes that classifications should be based on clear, compelling and comprehensive scientific evidence. The industry RMOA will help regulators and industry participants to better understand the life cycle of lithium and its three most commonly used salts. This project is generously underwritten by ILiA's Core Members.

Product Carbon Footprint (PCF) guidance for lithium products is available free in English, Spanish and Chinese on our website

ILiA's landmark guidance on calculating the PCF of your lithium products is freely available as part of the Association's mission to share relevant information about the lithium industry as widely as possible. All three editions are available from **www.lithium.org**.

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View from EUROPE

From David Merriman of Project Blue

Vulcan's CLEOP *(Image: Uli Deck, ARTIS-Photographie)*

The lithium industry within Europe suffered significant setbacks in late 2024, as the development of key downstream companies faltered or was redirected to other industries.

The bankruptcy of Northvolt in Sweden in November, which removed a strategic potential customer for lithium products within Europe, highlights the difficult competitive environment other cathode active material manufacturers based in the EU are facing.

The refocus of FREYR Battery to target the North American market for both batteries and solar cells, after the purchase of Trina Solar's facility in Texas also represents the disappearance of another potential lithium consumer within Europe. Some existing European cathode manufacturers are currently leveraging manufacturing capabilities in Asia to meet European demand, rather than utilise local capacity, because of production costs within the region.

If the bankruptcy of Northvolt wasn't bad news enough for the European lithium industry, Northvolt's 2021 joint venture with GALP to construct the Aurora Lithium conversion facility in Portugal has also broken down. GALP was unable to lock in a new development partner for the facility, with plans to construct the 35,000 tpy battery-grade lithium hydroxide (LiOH) facility being cancelled in November 2024. The cancellation of Aurora Lithium removes a potential spodumene concentrate consumer for European suppliers, though processors such as AMG Lithium in Germany and Liftium Energy in Portugal provide other options.

Despite the headwinds faced by some industry participants, positive developments at European lithium projects have also been reported. Vulcan Energy Resources achieved first production of lithium hydroxide at its Central Lithium Electrolysis Optimisation Plant (CLEOP) in Frankfurt-Höchst, Germany, though it subsequently announced that scheduled full scale production of 24,000 tpy LiOH from the facility has been pushed back to 2027.

Vulcan has also received significant funding and access to finance in late 2024, agreeing an EUR879 million (USD922.9 million) conditional debt commitment letter with Export Finance Australia and a group of seven commercial banks in December, and receiving EUR100 million (USD106.7 million) from the German Economic Ministry in November. The funding is targeted at financing Vulcan Energy's geothermal energy and lithium brine 'Lionheart Phase 1' project in Germany. Elsewhere in Germany, budding lithium-ion battery recycling company Tozero announced it has raised EUR11 million (USD11.7 million) in funding to develop a 30,000 tpy battery processing facility recovering lithium from black mass.

European Metals expanded scheduled development plans at the Cinovec lithium project in the Czech Republic, targeting the production of 41,600 tpy LiOH at the proposed mine and refinery, which will be assessed in an on-going feasibility study. In Portugal, Savannah Resources signed a non-binding letter of interest for financing with German export credit agency Euler Hermes and announced the acceleration of development plans at the Barroso project, which is targeting commissioning and commercial production of lithium mineral concentrates by end 2027. Critical Metals Corp reported Austria's Carinthian state had waivered the requirement for an Environmental Impact Assessment to be reported for the Wolfsberg lithium project in Austria, which is also targeting production of lithium mineral concentrates by late 2027. In France, Livista Energy announced it has selected La Havre as the site for its proposed lithium refinery, which aims to produce 40,000 tpy lithium compounds from 2028.

Overall, 2024 has seen a meaningful downgrade of forecast lithium demand growth within the European battery sector. Despite market headwinds and EU regulation pressures resulting in some casualties, the European industry continues to develop capacity at the mining, refining, and recycling stages of the supply chain into 2025.

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

PROJECT BLUE

View from NORTH AMERICA

From Adriana Carvalho, Senior Managing Editor, Metals
S&P Global Commodity Insights

Tariffs & geopolitics: a mixed bag for North American lithium sector

Lithium remains at the centre of mineral geopolitics and trade, particularly as China and the US leverage trade actions to assert their resource and technological dominance.

On February 1st, US President Donald Trump announced 25% across-the-board tariffs on imports from Mexico and Canada, and a 10% tariff on all goods from China. Canadian energy resources, including critical minerals, would carry a 10% rate.

The US, Mexico, and Canada agreed on February 3rd to a 30-day delay on the implementation of tariffs to allow for further negotiations. Critical minerals and battery producers in the region have warned that even a 10% levy on imports of lithium, nickel, and other key battery metals could rattle investors' confidence and raise prices for consumers in North America.

Additionally, the extent to which Trump can rescind the United States' electric vehicle (EV) tax credit – as has been threatened – remains uncertain. While fully repealing the credit requires congressional approval, Trump has the authority to modify eligibility guidelines, such as altering domestic manufacturing or sourcing requirements, which could reduce the number of vehicles eligible for incentives.

Sourcing requirements under the US EV tax credit were designed to accelerate supply chain decoupling from China, fostering investment in critical mineral production both domestically and in trade-friendly jurisdictions such as Mexico and Canada. And while the new administration's "Unleashing American Energy" executive order aims to boost fossil fuels production, it also calls for advancing domestic mineral production through steps such as expediting permitting processes.

However, the US has the second-longest average mine development period in the world. S&P Global Commodity Insights analysis indicates that mines commencing operations since 2002 required an average of 16 years to develop from discovery to first production. This timeline can extend to 29 years when accounting for mines not yet in production but expected to do so over the next decade.

Analysts say while Trump's tariffs could raise input costs for US battery producers, they could also generate exploration investment, and his American energy order could speed up permitting and ease regulatory bottlenecks. At the same time, though tariffs could raise input costs, they could also enable miners to realize higher prices and reduce project risk for lenders, underwriters and investors, analysts contend. Still, industry sources claim trade actions and retaliations will likely lift overall costs and inflation.

The US Federal Reserve left interest rates unchanged following its first policy meeting of 2025, and consumer sentiment could quickly turn negative, pressuring personal spending that drives demand for passenger EVs and consumer electronics, which dominate lithium consumption.

US passenger EV sales accounted for between 9% and 11% of new car sales in 2024, the lowest among top markets despite a USD7,500 federal tax credit, data from S&P Global Mobility shows.

China makes moves to protect lithium technology

On January 2nd, China proposed adding lithium extraction, refining, and advanced lithium-iron-phosphate (LFP) battery technologies to its list of restricted technology exports. These restrictions are not outright bans, but strategic measures aimed at directing technology transfers to more welcoming jurisdictions, the government contends.

China is the global leader in LFP battery technology and possesses well-established expertise in lithium refining. Restrictions on LFP battery technology transfer may significantly impact the US, as both US and global automakers seek to leverage China's expertise in large-scale lithium-ion battery production, particularly for more cost-effective and safer LFP chemistries.

In contrast, the US's lithium resource endowment and development focus on novel deposits requires research and development beyond current technologies, including extraction from clay, geothermal sources, and oilfield brines.

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

View from AUSTRALIA

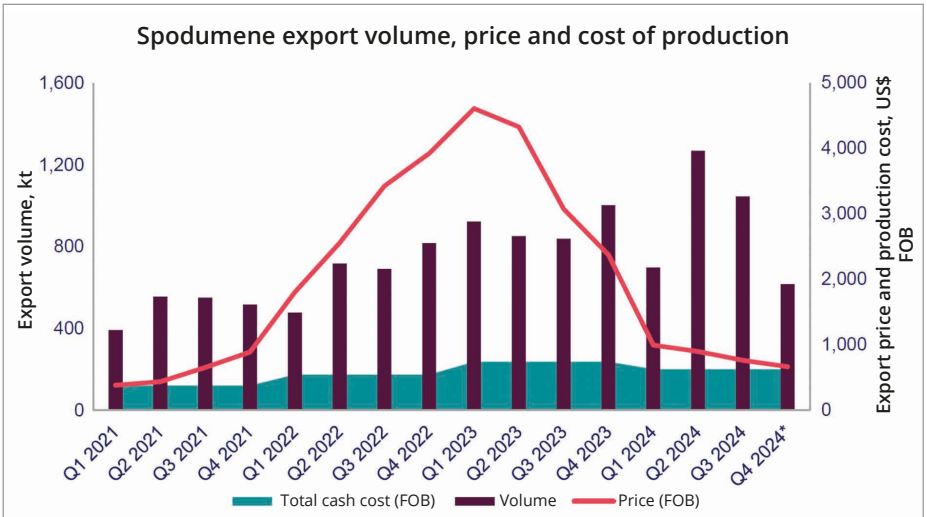
From Allan Pedersen of Wood Mackenzie

The export of lithium, and spodumene concentrate in particular, from Australia has flourished significantly in recent years as the overall lithium industry has evolved. Still, the effects of the current 'lithium winter' have reached the country's shores.

For decades, Australia has been a key source of minerals and metals used to advance global industries. Since 2016, spodumene concentrate has shown robust gains and is increasingly adding to the Australian export landscape, with growth rates exceeding those of many other products.

The market shortage in 2021 and 2022 led to calls for increased lithium production to meet the insatiable demand from the rechargeable battery sector. Australian projects and producers responded and we saw export figures explode. As demand growth rates have slowed and supply has increased from all sources, the market has moved towards an oversupply, and prices have dropped, resulting in the export value from Australian producers decreasing. We are starting to see export prices converge with the cost of production in Australia.

We observed spodumene concentrate exports from Australian producers climbing as prices grew, with rising output from existing producers and new participants such as Core Lithium and Liontown Resources. The new production came with a new cost structure and the overall production cost increased, but these cost increases came as prices started to decline. During 2023 and 2024, we witnessed export prices descending to a level where they converged with the high-level cost curve.



This convergence has resulted in some assets struggling to produce a meaningful margin, and once again, Australian producers have had to make difficult decisions to ensure continuity. Core Lithium's Finnis mine was the first to be affected by the events, announcing that the mine would go on care and maintenance and that it would process the last ore in June 2024. Mineral Resources has put the Bald Hill mine on care and maintenance, and Pilbara Minerals has put the higher-cost Ngungaju asset on care and maintenance. In contrast, the larger Pilgan asset continues production. Arcadium Lithium has announced that the Mt Cattlin mine will enter a stage of care and maintenance in 2025. We also note that Liontown Resources has revamped its schedule and will focus on higher margin ore to minimise cost and optimise margins. All lithium producers will undoubtedly focus on cost savings wherever possible to ride out the winter and look forward to spring.

While the industry's long-term outlook remains strong and attractive, the current market is challenging for Australian spodumene producers. Still, management teams are experienced in the resources industry and will have a strong tool kit to get through the tough times with cost savings, restructured mine plans and strong strategic partnerships with offtake partners. In addition, the Western Australian government has stepped in to assist through various schemes, including waiving port charges and mining tenement fees for lithium miners during ramp-up.

View from Australia represents the opinions of Wood Mackenzie and does not reflect the opinions of ILiA. ILiA member benefits include exclusive quarterly webinars with Allan regarding the lithium market. Contact ILiA for details.

Feature

JOINT INDUSTRY POSITION ON THE RMOA PROPOSAL ON THREE LITHIUM SALTS BY ANSES

Key messages

- **Lithium is essential for the global energy transition. While its use in lithium-ion batteries is the most known, uses in other products are also essential and often irreplaceable.**
- **International disagreements remain on the classification as toxic to reproduction.**
- **Important data gaps should be filled before reaching conclusions on other endpoints and on the actual risks. The lithium industry is ready to cooperate to fill those data gaps.**
- **Appropriate safety measures can and should be developed now to tackle risk where it may occur. Risk management measures should be based on sound and robust scientific data, as disproportionate risk management measures based on incomplete data would undermine the decarbonization effort of the EU and its competitiveness.**

Our industries, representing companies active in the value chains of lithium production, non-ferrous metals, grease and lubricants, electric vehicles, batteries, mining and frits for ceramics, welcome the opportunity to comment on the proposal for a Risk Management Option Analysis (RMOA) on the uses of lithium metal and three of its salts (carbonate, chloride and hydroxide) developed by ANSES [the French Agency for Food, Environmental and Occupational Health & Safety]. Developing an RMOA early in the process is good regulatory practice, which helps the industry in anticipating and planning appropriate RMOs to protect workers and the environment while reducing regulatory uncertainty. However, considering the limited available scientific and exposure data, we believe that some of the measures proposed in the ANSES draft could have significant impacts on the development of the EU lithium industry, on EU's strategic autonomy and its overall competitiveness in several crucial sectors.

"The lithium industry is ready to cooperate with authorities to fill data gaps, assess actual risks, and develop appropriate safety measures to protect workers, the general population, and the environment."

Lithium is essential for the global energy transition. Lithium is recognized as a strategic raw material under the Critical Raw Materials Act, mostly because it is essential and irreplaceable in battery energy storage systems. Lithium-ion batteries are increasingly being used in small portable devices, stationary energy storage applications, and of course electric vehicles. Different lithium salts are also used in other key applications, such as grease thickeners for lubricants (used for instance for wind power turbines), ceramic frits and complex inorganic colour pigments, specialty glass (cooktop stoves, electronic device covers), semiconductors, pharma (i.e. for mood disorder treatment), purification systems, military, medical devices (breathing assistance systems), cement, building products for insulation, and many more. Some of these uses obviously fit the conditions highlighted in the EUC communication[1].

Given the current very limited footprint of lithium production and use in Europe, it can be assumed that, in general, the presence of lithium in the environment in Europe is of almost exclusive natural origin.

1 - https://op.europa.eu/en/publication-detail/-/publication/90926c62-0365-11ef-a251-01aa75ed71a1/language-en

This joint statement was submitted in December 2024 as part of a public consultation.

Lithium occurs in the environment at very different concentrations depending on the geological characteristics of each region. In developing Environmental Quality Standards (EQS) at EU level, it will be important to take into account the wide variability of natural background levels.

Three lithium salts have been evaluated by the Risk Assessment Committee (RAC) of the European Chemicals Agency (ECHA) for their presumed negative effects on human reproduction. RAC proposed a repro 1A classification for the three salts, based mostly on data from the medical field. These exposure conditions in the latter are not comparable to the normal use of lithium compounds, whether in industrial conditions, by professionals or consumers, or even for general population (e.g., in terms of doses and exposure routes). Internationally, there are differing opinions (e.g. UK, Australia, Canada, Argentina, USA) on the causality between lithium exposure and negative health effects. In the absence of a global scientific consensus, it is unlikely that other countries/regions will adopt the same classification despite using the same criteria of the UN's Globally Harmonized System of Classification and Labelling of Chemicals (GHS). This could result in a competitive disadvantage for EU companies on the global market.

Concerns are also raised on possible adverse effects as an endocrine disruptor, environmental effects on aquatic life, and other health effects at very low exposure levels (environmental concentration), even for the general population. These concerns are relatively new, and their reliability suffers from limited availability of robust datasets and studies. ANSES recognizes that little data is available in general, and that gathering additional data will be needed to assess actual risks and develop proportionate safety measures. Data gaps are particularly relevant to the effects at low exposure levels.

Considering these limitations, additional data should be gathered before drawing conclusions on actual risks for human health, the environment, and general population. The lithium industry is ready to cooperate with authorities to fill those data gaps, assess actual risks, and develop appropriate safety measures to protect workers, the general population, and the environment. For instance, study proposals on effects on aquatic life could be launched relatively soon to refine the environmental dataset.

The industry supports the prioritization of lithium among the substances for which an Occupational Exposure Limit (OEL) should be derived in the coming years. In addition, we note that some mining activities and large battery manufacturing plants have been added to the scope of the Industrial Emissions Directive, which result in the development of Best Available Technologies.

However, we would like to stress that setting up unreasonably low limits based on unproven concerns would be disproportionate, and it would unnecessarily harm an industry that is fundamental for the decarbonization effort of the EU. At this stage, the only possible conclusion on the effects of low exposure levels is that further studies are needed.

Risk management measures should be based on sound and robust data. A key limitation in the development of risk management measures is the actual number of existing, running plants and mines in the EU. Regarding lithium, significant focus is on ongoing and future projects, which intrinsically affects the available actual data that can be provided now, e.g. on exposure.

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This data limitation, and the resulting reliability and completeness aspects will be crucial to discuss, and expertise on processes (or analogy with processes developed elsewhere) to be brought in.

If new classification proposals are to be launched, a parallel assessment of appropriate risk management measures should be undertaken to facilitate implementation. Similarly, restrictions on uses or even Substance of Very High Concern (SVHC) identification and authorization proposals under REACH would be disproportionate compared to the actual risks, also considering the regulatory precedents of other metals and shortcomings of the authorisation process highlighted in the framework of the upcoming REACH revision.

Socio-economic considerations are not part of the hazard assessment of substances. However, this RMOA proves that a classification does have socio-economic consequences. Besides, the setting up of risk management measures must take into account the socio-economic impact. In the case of lithium and its salts, there is a concrete risk of further disadvantaging the EU lithium industry against other regions, but also the downstream sectors and their security of supply.

More generally, there is a high risk of stigmatization of lithium, with negative effects on the achievements of the targets on mining, refining, and recycling strategic raw materials in the EU included in the Critical Raw Materials Act. These measures could also negatively impact the mandatory recycled content targets and material recovery rates set out in the Batteries Regulation, and potentially on electrical vehicle (EV) adoption.

In conclusion, risk management measures should be based on sound and robust scientific data, as disproportionate risk management measures based on incomplete data would be detrimental to the decarbonization effort of the EU, and it would be in direct contradiction with the need to boost the EU competitiveness, as recently highlighted by the Draghi report, the mission letters of the new Commissioners, the Antwerp Declaration, and the French President Emmanuel Macron.

The final recommendations of ANSES should therefore take these elements into account, and refrain from suggesting risk management measures not supported by adequate data on risks, exposure, and emissions. The lithium industry acknowledges the limitations of some datasets and remains ready to cooperate with ANSES and authorities at large to generate more data to assess the actual risks and set up appropriate risk management measures. Industry is also carrying out its own industry RMOA exercise and will share the main outcomes.

2025 Mercedes-Benz G 580 with EQ Technology electric SUV.

Photo credit: Mercedes-Benz USA

SPOTLIGHT ON SUSTAINABILITY

Holding meaningful stakeholder consultations

Most Europeans are not used to mining operations in their neighbourhood. This can pose additional challenges to companies currently developing lithium mines in France, Germany, Portugal, UK and Serbia. In this edition's sustainability spotlight we take a closer look at how Imerys has been handling community outreach regarding their future lithium mine in Allier, France.

Image: Imerys

One of the 43 stakeholder events held by Imerys during 2024.

During 2024 Imerys hosted 43 public events that were attended by over 3,500 participants from the local communities. Over the course of five months Imerys openly discussed and debated the opportunity to build the first lithium mine in France. To obtain its mining permits, Imerys's subsidiary EMILI (Exploitation de Mica Lithinifère par Imerys) invited an independent party, the National Commission of Public Debate (CNDP), to organize a nation-wide public debate informing all citizens about the project's impacts and benefits. It has also allowed stakeholders to ask questions and to voice opinions. This process is mandatory in France for industrial projects with a potential environmental impact.

Imerys produced a document explaining the different components, risks, impacts and benefits of developing a lithium mine, but also discussed the opportunity costs of not doing so. The different events, organized and moderated by CNDP, required a core team of 10 to 15 Imerys experts to answer questions from the public on infrastructure, water and tailings management, chemicals, local jobs and benefits of the IRMA standard. The process was exhaustive with over 500 questions submitted via the online platform.

The debate was a valuable opportunity for Imerys to establish constructive relationships with all stakeholders. "These intense but respectful exchanges were an opportunity for the team to present the project in its entirety. It's a rewarding exercise for everyone", says Daniela Liebetegger, Social Sustainability Director for Imerys's lithium projects. "The public needed to be informed, to understand and to be able to express their fears and feel heard", she added.

The engagement process led to several refinements in the project at Allier. While the elements defined before the debate contributed to a project committed to responsible mining, with hindsight some technical questions regarding the progress of the studies or the actual design were raised too early. One strength of such a debate is that it starts early on, when certain choices have not yet been made.

Imerys has listened carefully to the community and made several changes to the project to make it more acceptable to the affected population. Looking ahead, consultations will continue between Imerys and stakeholders, accompanied by CNDP, in line with the IRMA mining standard. As Liebetegger points out, "Beyond legal considerations, Imerys has done its utmost to propose an exemplary and robust project, and is constantly seeking to minimise its impacts."

Image: Imerys

ILiA Connections

Education and networking are two of the Association's core values. We strongly believe that helping people connect and better understand the lithium value chain reduces opacity, encourages investments and is good for business. To discover more, subscribe to our free monthly newsletter about global events, our activities and regulatory updates.

ILiA was part of a delegation from industry lead by Eurometaux that visited the European Parliament in Strasbourg, France, to discuss critical raw materials and supply chain challenges in the EU. (Image: Eurometaux)

During the Future Mineral Forum in Riyadh, Saudi Arabia, ILiA's Roland Chavasse shared a panel with (left to right) Ken Hoffman (McKinsey), Daniel Abdo (Sigma Lithium), Raju Daswani (Fastmarkets), Eng. Turki Al Babtain (Deputy Minister of Mining Development, Ministry of Industry and Mineral Resources of Saudi Arabia), and Frank Li (Tianqi Lithium). (Image: Beacon Events)

ILiA's Founding Chairman, Anand Sheth, gave a keynote speech at the 2024 China International Lithium Industry Conference in Sichuan Province, China. (Image: China Nonferrous Metals Industry Association)

In December ILiA hosted an end-of-year networking dinner for members and guests in London, UK. It was held to coincide with the Resourcing Tomorrow conference and wearing party hats was not compulsory!

In December the ISO Technical Committee 333 (Lithium) held its annual meeting in London, UK. Regulators and industry participants joined the meeting from all over the world. (Image: cuiyan@cnsmq.com)

ILiA's Jorge Mora attended the International Conference on Lithium, Industrial Minerals and Energy in Antofagasta, Chile, where he spoke on challenges and opportunities in the lithium industry. (Image: Celimin)