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OPEC for Lithium?

By: Paul Harris



The Lithium "Triangle"

In late 2022, several Latin American governments floated the idea of creating an OPEC-style cartel for lithium, supposedly as a means to control (restrict) supply and increase government take from a commodity whose prices are riding high on the back of growing demand from lithium-ion batteries for electric vehicles.

Argentina, Chile and Bolivia expressed interest in the idea as part of a growing wave of resource nationalism in the battery metals space, which includes the formation of state lithium companies and a desire to attract downstream processing and manufacturing rather than just exporting raw materials.

The model, OPEC (Organization of the Petroleum Exporting Countries), is a cartel of 13 countries which account for an estimated 44% of global oil production and 81.5% of the world's proven oil reserves and whose decisions to increase or decrease output have a direct impact on prevailing oil prices.

While Latin America is an important source of lithium, these governments may be overplaying their hands as there appears to be little appetite, or need, for a similar organization in the lithium space.

For Andrew Miller, COO at London's Benchmark Mineral Intelligence, with lithium prices at record levels for the past 18 months due to limited supply, the lithium space needs more production to meet exponentially growing demand and government policies that facilitate this rather than potentially create additional obstacles through production quotas.

"An OPEC for lithium is a few steps down the road from what many suppliers are looking at, certainly from a consumer perspective. Many consumers are building their business models around aligning with [lithium suppliers] because this is a specialist product with little standardization. Those consumers don't just want to ensure they have access to lithium units. They need to ensure they have the right type of lithium, so they work with suppliers to build long-term relationships. An OPEC -type structure on the supply side would be prohibitive to them," said Miller.

The OPEC concept overlooks the fundamental difference between oil, a bulk commodity, and lithium, a specialty chemical. Different lithium chemistries and specifications do not lend themselves to being managed as a homogenous commodity. A wide range of lithium chemicals and formulations are produced specifically for the needs of individual consumers, resulting in a lack of price consistency or supply standardization. This has been a challenge impeding lithium maturing into a more organized market, which Benchmark, with its lithium price indices, seeks to foster by providing price discovery and transparency for the industry.

State companies

Governments have sensed an opportunity to increase their take from the funding flooding into the lithium space, with some declaring lithium a strategic resource

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OPEC for Lithium? (cont.)

to do so. Last year, Mexico and Chile established state lithium companies, and Chile's state copper company Codelco has also been tasked with the exploration and development of lithium sources. Miller views this as problematic for government's aims to attract new investment and the development of downstream activities to their shores.

Mexico nationalized its lithium resources in April 2022 and created state-owned company LitioMx with exclusive rights to explore, extract and refine lithium, similar to how state oil company Pemex long enjoyed a petroleum monopoly in the country. LitioMx is under the control of the Secretariat of Energy (Sener) rather than the country's geological survey raising questions about the technical expertise it has to fulfil its task. Similar questions have been asked about copper producer Codelco's ability to operate in the lithium sector in Chile.

Governments are not known for rapid action or investment, which Miller says is the opposite of what the market currently needs. "The lithium industry's biggest challenge is the speed of capital entering new projects. Any talk around an international organization aligned with this idea of unifying the approach between countries in the lithium triangle slows the pace of capital down. Indeed, the pace of change highlights the disadvantage of brine assets; their much longer lead time to develop. We are in a market all about pace and how quickly you can bring lithium units to market," said Miller.

The rapid growth of the lithium sector means that Latin America, while still a vital source of the mineral, it is far from being the dominant supplier it was a decade ago, and the market has somewhat cast-off its former advantageous position. Interventionalist government policies may only seek to further alienate investors from the region and steer them to other geographies.

"The global distribution of lithium supply sees just under half the world's supply come from Latin America, but there are established markets in Australia and China building capabilities, and Africa is coming onto the scene with new projects. The world of lithium supply is growing quickly and diversifying around the world. The lithium industry was built around Latin America for so long, but now you can be competitive with higher production costs. You don't need to be at US$3000/t like SQM. The safe money is probably shifting away from South America to some extent, where there is political uncertainty," said Miller.

Investor worries about state participation are highlighted by the comportment of Codelco in the Maricunga Salar. Tasked with exploring the salar where private exploration companies are also active, in October 2022, Codelco asked the Mining Ministry to extend the area of its special operations contract to the whole salar, arguing that concessions issued before 1979 do not include lithium as a concessional mineral. Codelco argues that private companies have no rights to lithium. "In the analysis of the Maricunga project, Codelco identified the existence of relevant legal uncertainty regarding the right to explore and exploit lithium that mining properties established before 1979 would have. The consultation made to the Ministry seeks to clear up said uncertainty for all those interested," said Codelco. A decision is pending.

One of the private entities potentially impacted is local company Simco, which has indicated it would file an international lawsuit against the state over the expropriation of its properties in the Maricunga salt flat if Codelco's view is upheld. Australia's Lithium Power International (LPI), considering a US $700 million investment in the salar, is another company unlikely to shy away from a fight. It is now Codleco's main competitor in the Maricunga Salar after having consolidated the concessions previously held by joint venture partner Bearing Lithium and Salar Blanco. During the administration of Sebastian Piñera, Salar Blanco, in which LPI then held a 50% stake, sued Chile to block Codelco from exploiting the salar.

"Countries trying to secure their foothold and maybe nationalizing some assets could be troublesome. We are in a period for lithium where the amount of money flowing into this market has to accelerate rather than decelerate. You have the risk of government intervention and a more aggressive stance from some governments towards lithium holding back capital from flowing into those markets. Private companies are hesitant about what is happening as they do not know if the role of the government will be mining-friendly or open for business," said Miller.

Added value

A clear driver behind the OPEC concept is that Latin governments want to add value to their lithium sources and claim more financial benefits. Chile and Bolivia have taken steps to attract investors to develop downstream, added-value lithium products and cathode ecosystems. For example, in Chile, contract negotiations with SQM and Albemarle in recent years saw the incorporation of

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OPEC for Lithium? (cont.)

clauses under which the companies would provide a quantity of lithium at below-market pricing for domestic downstream companies to use. However, this has yet to attract downstream companies to Chile. The saga of negotiations between SQM and Albemarle with state agency Corfo were widely broadcast and slowed the country's ability to respond with new investment to the market's growing needs. This delay and uncertainty saw both companies invest in other countries and allowed Australia and Argentina to firmly establish themselves in the market.

Bolivia has also sought foreign investors to develop processing options for its lithium resources, but its state participation requirements have limited the number of interested parties.

"The issue is that many downstream steps are most efficiently produced closest to your end market. There will only ever be so much of an EV market in South America, so they are constrained by where the demand is. Much talk around nationalization is to the detriment of what could be done regarding value-added processing, which is holding back commitments to build processing capabilities domestically. In Chile, you have two of the biggest lithium producers, and both have question marks over where they take things next," said Miller.

Other practical aspects are also a factor. Producing lithium carbonate from South American salars is a more viable product than lithium hydroxide, the preferred feedstock for some battery companies, as it can be more easily transported and has a longer shelf life. "If you keep lithium hydroxide too long or transport it the wrong way, you ultimately have to reprocess it, so there is not much value in producing much of that if it has to go into China on the other side of the world. The challenge many governments face is not just how they position themselves, but how to incentivize partners in the right parts of the world," said Miller.

Geopolitics

Partnering with the right parts of the world is becoming more challenging as critical minerals such as lithium increasingly become geopolitical footballs. The West, increasingly aware of a potential strategic vulnerability to China's dominant position in the production and consumption of many battery minerals and related downstream technologies, is looking to curtail the Asian nation's influence in the minerals space in the American hemisphere in what is becoming a modern take on the Monroe Doctrine.

In November 2022, Canada ordered Chinese companies to divest from three battery metals companies, citing national security. "While Canada continues to welcome foreign direct investment, we will act decisively when investments threaten our national security and our critical minerals supply chains, both at home and abroad," said Canada's Industry Minister Francois-Philippe Champagne.

Sinomine was asked to sell its investment in Power Metals, Chengze Lithium was asked to divest from Lithium Chile, and Zangge Mining was required to exit Ultra Lithium. Of note is the supra territorial aspect: Lithium Chile does not have any mineral projects in Canada but in Chile. It just happens to be listed on a Canadian stock exchange.

This exposes a paradox: in the absence of investment from North America, many junior Canadian explorers and developers have had to seek investment from further afield to develop their mineral projects, which has opened the door to China and other countries to position themselves. The US government is starting to address this through new funding mechanisms such as those included in the 2022 Inflation Reduction Act. However, to what extent projects in Latin America may be eligible must be clarified.

"Much of the money that has gone into lithium projects has come from China. Isolating parts of the supply chain will be a trend, and whether we like it or not, politically, it is happening in many parts of the world. It does raise the question of what does that do to the short-term feasibility of building out the supply chain," said Miller.

The answer may be seen in one of the biggest trends over the past 12 to 18 months, the increasing involvement of the automotive industry in the minerals supply chain. "Consumers are waking up to the fact that they need this material, and that they have to align closer to their potential suppliers through joint ventures or direct investments. You have major automotive companies, the people that have the money, now looking at early-stage developers," said Miller.

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Yellow SiC: Renewable Hydrogen via Direct Unassisted Photocatalysis

One must jump in the ***SiC & More*** *Time Machine* and travel back about 130 years and visit the lab of a scientist by the name of Edward G. Acheson to appreciate the ongoing development of SiC, which also occurs in nature as the extremely rare mineral moissanite. Acheson was in his western Pennsylvania lab "playing" with mixtures of clay and carbon in an arc-type laboratory furnace attempting to convert the carbon to that glamorous and coveted form known as "diamond".

Although Acheson failed to produce diamond, he recognized that he had unearthed an unusual material that had diverse industrial applications. The creativity and vision of companies such as Carborundum Co., Wacker Chemie GmbH, ESK-SiC, CUMI and others have continued to develop applications for SiC such as diesel particular filter substrate, refractory, advanced ceramic tiles for a space shuttle, slicing silicon wafer, super abrasives, and semiconductors.

Enter ***YellowSiC*** with a cubic crystal structure of ultra-high purity silicon carbide (3C SiC) serving as a catalyst for renewable hydrogen via direct unassisted photocatalysis.



New German silicon carbide start-up raising capital to commercialize hydrogen generation

Yellow SiC Group, a Berlin-based climate-tech start-up, is commercializing a new technology capable of splitting water into hydrogen and oxygen in a one-step process using only sunlight.

Such direct and unassisted photocatalysis (i.e. without external power) is enabled by a cubic crystal structure of ultra-high purity silicon carbide (3C SiC) serving as a catalyst.

The silicon carbide is yellow, hence the name ***YellowSiC***. The company has a patented process for the manufacturing of ultra-pure 3C SiC and is now ready to scale this process and build a pilot hydrogen generation facility.

The company's IP has been developed by co-founder and CTO Professor Siegmund Greulich-Weber, a world-renowned specialist in silicon and silicon carbide, who was previously Professor of Physics at Paderborn University. The co-founder and CEO is Dr Christopher Hoefener, a former leading private equity investor, who studied physics, math and engineering.

YellowSiC expects to generate 100% green hydrogen at 2¢/kwh in sunny countries such as Dubai, and 6¢/kwh in less sunny countries such as Germany. Each 150ha hydrogen generation plant is expected to save 56,000 tonnes of CO2 year. The company plans to open its first pilot hydrogen generation plant in Osnabrück in Lower Saxony in early 2025.

"We want our first plant to be here in Germany so that we can have a material impact on our energy crisis," said Christopher Hoefener. "We always wanted our technology to produce renewable hydrogen at a competitive price in countries that aren't particularly sunny."

In addition to generating hydrogen, ***YellowSiC*** will also sell its silicon carbide to the rapidly growing ingot wafer industry.

"We expect to be generating revenues in the short term from the sale of silicon carbide as a drop-in commodity for the wafer industry," said Hoefener.

Learn more about this innovative technology on the short video located at: www.yellow-sic.com

Since its foundation last year, the company has raised €4m from investors including PVS Invesments, con|energy, Vireo Ventures, and the founders themselves. The company is advised on its capital-raise by the London-based specialist investment bank, Leif Capital, and expects to announce further investments soon.

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Brown Fused Aluminum Oxide

In issue #95 of ***SiC & More*** we mentioned that BFA prices had dropped about 10% since late summer. During November 2022, a trader told ***SiC & More***, "Don't expect a freefall in BFA prices from China because domestic demand is way down. Several large BFA producers have already significantly scaled back production. Between issues related to COVID, environmental pressure, and lower steel production, the BFA industry is a bit upside down."

Not much has changed since November with prices on BFA either flat or a bit softer. A trader also told ***SiC & More*** in issue #95, "I will be keeping an eye on China's steel industry. I believe China's steel capacity utilization will have a profound effect on BFA supply and demand and pricing as we enter Q4 and another New Year." That was an interesting observation considering China's raw steel production is expected to contract about .8% in 2022 compared to 2021 and was 3% less in 2021 compared to 2020. According to reliable sources, the Chinese ferrous metals industry is the largest consumer of BFA in the world. Consider that 3% of a billion tons per year of raw steel is 30,000,000, which is about 1/3 of what will be produced in the U.S. in an entire year. That is a lot of steel and a lot of BFA.

If you couple the last two years of reduced BFA consumption in the Chinese steel industry with excess inventory of BFA crude in both the EU and U.S. and you can see why prices have softened a bit. The U.S. imported 68,404 m/t of BFA in 2020, 104,778 m/t in 2021, and 148,357 m/t in 2022 with slowing demand.

On the other hand, over the past 10 days, a trader told ***SiC & More***, "If China's stimulus efforts become a reality you can expect the steel industry to show growth. If that happens, there will be a scramble for BFA and fluorspar just to name a couple of commodities. In other words, watching China's raw steel production is as important as keeping an eye on China's BFA smelter's capacity utilization."

When asked what to look for in 2023, a processor said, "We currently have too much expensive inventory. Raw material purchases will be kept to a minimum. We expect raw material prices FOB China to continue to soften quarter over quarter, however, we won't be reducing prices to the end-use markets until we work our way through this inventory and we have way too much inventory."

Checking in With Leonardo Curimbaba

Due to the history and diverse nature of the Curimbaba Group, it is always interesting and inspiring to visit with Managing Director Leonardo Curimbaba.

For a quick review, the Curimbaba family involvement in producing fused minerals dates to 1961 with its initial bauxite mining and processing venture. Over its 60-plus year history, the group has proven, that due to judicious ownership and acute business management, one can not only survive difficult times but grow and even prosper. The Curimbaba name has become synonymous with bauxite, aluminum oxide, proppant, and silicon carbide amongst other industrial minerals and value-added products.

Regarding Sublime and SiC, Leonardo believes that the SiC furnace plant in South Africa will operate at about the same production level as 2022. During the summer of 2022, in order to meet customer demand, Sublime restarted transformer group #1 after about six (6) months of repairs and sitting idle for a few years.

As far as aluminum oxide is concerned, Leonardo commented, "We are running at about 80% capacity with WFA representing 30% and BFA around 70%. When we evaluate only the mix between BFA and WFA without considering other fused minerals."

When asked about bauxite prices, Leonardo added, "In Brazil, the calcined bauxite is more expensive in 2023 than previous year due to the cost of fuel, freight, and labor."

Leonardo also confirmed that the cost of energy (kWh) on the free market in Brazil is currently inexpensive but most companies that are electricity intensive operate with long-term agreements.

SiC & More will check in with Leonardo again as we approach the end of Q1 to get his outlook for Q2 and the balance of the year regarding SiC and AO supply & demand.

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BRAZIL: Energy, Macroeconomics, Commodities & Politics

By: Francisco Batista



a) Energy: The weather forecasts of 3Q22 and resulting rainy season means the hydro reservoirs are at very high levels (southeast/center-west: 66%; South: 87%, Northeast: 75% and North: 85%) and energy forward prices are very low: 2023 at R$ 70/MWh (US$ 14/MWh) and 2024 at R$ 90/MWh (US$ 18/MWh). Grid costs are high and will remain at this level for at least the next four (4) years as a consequence of the thermal dispatch during the drought of 4Q21 - 2Q22. It is still unclear what the approach of the new administration will be regarding the existing subsidies in the electric sector that impact heavily in the composition of the grid cost.

b) Macroeconomics: Luiz Inacio Lula da Silva' (Lula) victory in the elections with an approach of increasing federal spending and expanding even more the current budget's deficit has refrained central bank from decreasing the interest rate. It is too early to know if the current rate of 13.75% will be enough to keep inflation in check under the new administration's reality or not. GPD forecast from the 100 largest financial institutions in Brazil (called *Focus Report*) is at +0.77% and the average exchange rate is at R$ 5.3/US$ 1.

c) Commodities: The exchange rate remains high (currently at R$ 5.21/US$ 1), energy prices have been stabilized in a very low level and this combination is stimulating exports even more. Investments in increasing commodity output capacity are being reported in every segment of these industries in Brazil.

d) Politics: The new president of Brazil (Lula), took office on January 1, 2023 and has been fulfilling every negative economic expectation he created during his campaign, especially regarding overspending and increasing the federal budget's deficit. Lula is also threatening to revert the most important economic and administrative reforms made by the last two administrations, which is likely to result in even bigger government spending and fiscal deficit. Since the result of the elections there have been protests in every major city in the country against Lula's victory, based on allegations of election fraud. Protesters were also claiming they would not let Lula take office because of his criminal track record and a controversial Supreme Court decision that freed Lula from jail time. On January 8, 2023 (Sunday), some of these protesters stormed the Presidential Palace (Lula had not moved in yet), the Supreme Court and the Congress in Brasilia, the capital city. The riot only lasted a couple of hours and almost 1,000 protesters were arrested by the National Guard. It was a total *deja vu* of the January 6, 2022 storm of the US congress. There have been many accusations from Lula's staff against the local police (responsible for the security of the capital of Brazil) and the military that are seemingly aligned to former president Bolsonaro. The former president was accused and is being investigated of being the mastermind behind these protests and the storm of the government sites although all his public announcements since he lost the elections were in the opposite direction. The situation in the country is now calmer and heading to a mutual understanding between the leftist new administration and the military which, although many unproven accusations, have never had any direct involvement in the movements against the elections, the democracy or Lula taking the office of the President. As of now, the democratic institutions have prevailed and this matter seems to be resolved.

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Global SiC Prices

Supposedly, after watching back-to-back home runs by his teammates Mickey Mantle and Roger Maris, Yogi Berra was quoted as saying, "It's déjà vu all over again!"

In January 2017 and again in 2018, Chinese producers attempted to spike prices by several hundred dollars per ton using a combination of factors as justification for the increases. Here we are, after several years of COVID, a broken global supply chain, and global commodity shortages brought on by a host of COVID-related issues, "it's déjà vu all over again" as China recites old reasons for increasing prices. With China in their heating season complimented by the Chinese New Year, currency exchange, and environmental issues, we note that SiC prices actually rebounded by about $25 ton in late December compared to mid-November.

However, a trader recounted the experiences of 2017 and 2018 by saying, "The efforts to increase prices tend to be short term and tend to effect SiC consumers in Korea and Japan where, due to transit time, they maintain smaller inventories than in EU or most certainly the U.S. After the supply debacle of 2021 and a good part of 2022, processors across the globe filled the supply pipeline and purchased excess inventory. If the Chinese producers believe they can spike prices in January or February of this year they are sadly mistaken. Supply exceeds demand on a global scale and economic forecasts are not exciting so prices will at least remain stable. I know processors that are still sitting on the most expensive SiC in history with prices having dropped by 10-20% and some global economies slowing down."

To further illustrate the events of 2018, the following are excerpts from the March 2018 issue (#72): "As a result of the Korean and Japanese January and February purchase prices, the Chinese asking price for 90% SiC for metallurgical applications was nearly $1,100/ton FOB NOLA whereas SiC processors were bidding closer to $820-850/ton. For #1 refractory grade the Chinese were asking nearly $1,500/ton against offers in the $1,250-1,300/t range."

One of the most dynamic factors that contributed to the 2021/2022 run-up in global SiC prices was the cost of kWh. In issue #95 of *SiC & More* a producer said, "Electricity has been at better levels as expected. Cannot say cheap prices but it was allowed us to produce stocks at relatively low prices." The energy variable is the one that can most dramatically affect the production cost of a ton of SiC. Worldwide energy prices are significantly lower than 6-12 months ago.

SiC & More believes the comments from a North American SiC processor in late November 2022 hold true as we move forward into 2023. "End-use market prices for abrasive, refractory, and metallurgical SiC won't see price reductions during Q4 2022 and will only see them in Q1 2023 if processors get nervous holding high-priced inventory with demand being soft and interest rates continuing to climb. Many of us are sitting on the most expensive SiC unit in history. Prices in the respective end-use markets will drop but I don't believe it will be over the short term. Look for some price erosion as we work our way through 2023."

In short, unless there is another worldwide economic meltdown, don't expect price increases for SiC products during 2023. As Yogi would say, *The future ain't what it used to be*.



Pictured above is the newest and most efficient of Navarro SiC in Leon Province, in Mansilla de las Mulas, a village crossed by The Way of Saint James (Camino de Santiago) that is walked by thousands of pilgrims every year. Navarro produces half of all their SiC at this facility surrounded by the lovely countryside.

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COSTS TO PRODUCE SIC





The following numbers are somewhat generic and simply meant to illustrate not just the trials and tribulations of operating a high-energy consuming facility but help explain the recent price fluctuations for SiC products. The following are in U.S. dollars to produce one ton of crude SiC. It's necessary for readers to understand the following numbers are not only generic but represent only crude and not value-added SiC.

	2020/2021	2021/2022
Energy Consumption	350.00	1,050.00
Raw Material Mix	100.00	175.00
Labor	150.00	150.00
All Other Operating Costs	190.00	190.00
Environmental & SGA	90.00	90.00
Estimated Total Cost to Produce a ton of SiC	**880.00**	**1,655.00**

The difference between the two columns illustrates almost a 100% increase, however, that still doesn't capture the difficulties that faced SiC producers in some parts of the world the past 12 months. For example, some producers don't know there energy costs from one day to the next. Quite literally, in just a few days, kWh prices can fluctuate from 5 cents per kWh to 25 cents and even more.

Assuming 7,000 kWh necessary to produce a net ton of SiC, the second column energy consumption price of $1,050 (15 cents per kWh) was often times 25 cents or $1,750 ton just for energy. In some parts of the world, prices went to nearly 40 cents per kWh forcing SiC furnace plants to temporarily cease production.
As we entered 2023, the situation had improved in regard to the average cost of electricity in most areas of the world. However, some producers still don't know the price of kWh until the day before production begins, i.e., "Day-Ahead Pricing". This makes planning and organizing production nearly impossible not to mention the challenges of providing a customer with a price per ton for any reasonable duration.

Although this is not the situation in all parts of the world, the globe has shrunk enough over the past 30 years to know that there is a trickle-down effect of the aforementioned energy dilemma that impacts every SiC end-use market in all areas of the world.

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