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CHILE MINING 2023

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Consejo Minero is a trade association that brings together the largest mining companies operating in Chile. We drive competitive and sustainable development for the Chilean mining industry thus contributing to our country's growth.

We bring mining closer to people letting them know its reality, challenges, and contributions in a transparent manner. We collaborate in the process of drafting modern, efficient, and stable public policies that will eventually govern the mining industry of the future and its environment. Furthermore, we help overcome sectoral challenges associated with human capital and water resources, among others.

Visit **consejominero.cl** to obtain updated figures and relevant information regarding the Chilean mining industry.

CONSEJO MINERO

Dear Reader,

The first half of 2023 was a transformative period for the Chilean mining industry. On May 10th, the Chilean legislature approved the new royalty bill, defining the latest state of taxation for the mining industry. Additionally, after years of delay, the government announced the new National Lithium Strategy, clarifying the structure of the future Chilean lithium industry and opening the country to develop new lithium projects. This sweeping regulatory and legislative reform has redefined the industry, providing the legal certainty Chile needed to take advantage of the growing demand for battery metals.

Global Business Reports conducted more than 130 interviews with leaders in Chile to gain a holistic understanding of the state of the Chilean mining industry and how these new policies will affect future growth. Neither the National Lithium Strategy nor the royalty bill are perfect in the eyes of industry figures, but across the board, the sentiment was that of relief and enthusiasm that, at long last, companies and investors have the clarity needed to move forward.

Sustainability was the central focus across the mining industry. As new legislation globally, such as the US Investment Reduction Act, drives the electrification transition, requirements include sustainable sourcing of materials. In this landscape, certification is increasingly important, and major mining companies are investing intensely in environmentally friendly practices, both internally and along the complete value chain.

Incorporating advanced technologies has gained momentum as a response to Chile's challenges in labor, falling ore grades, and low productivity. Mines are increasingly shifting to fully automated equipment, using artificial intelligence and other data technologies, and remote monitoring from centers in Santiago. These have benefits in increased cost efficiency, lowered carbon footprints, and reduced labor requirements.

The *Chile Mining 2023* report, part of our GBR Series, delves into these and other topics, providing a comprehensive annual guide to the companies in Chile's mining value chain. It offers an update on regulatory and legislative activities, current operations and projects, and the latest industry trends in one of the world's most important and advanced mining jurisdictions.

We are grateful for the participation of our interviewees and partners, and we thank you for choosing *Chile Mining 2023* as your guide to the Chilean mining industry.

Alfonso Tejerina
Director and General Manager
GBR

Use QR code to read the digital interactive version of this report.

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Interviews for the report were conducted between February and June 2023.

Edited by Mungo Smith.

Graphic design by Özgür Ergüney and Kaori Asato.
Cover design by Gonzalo da Cunha.

A Global Business Reports Publication

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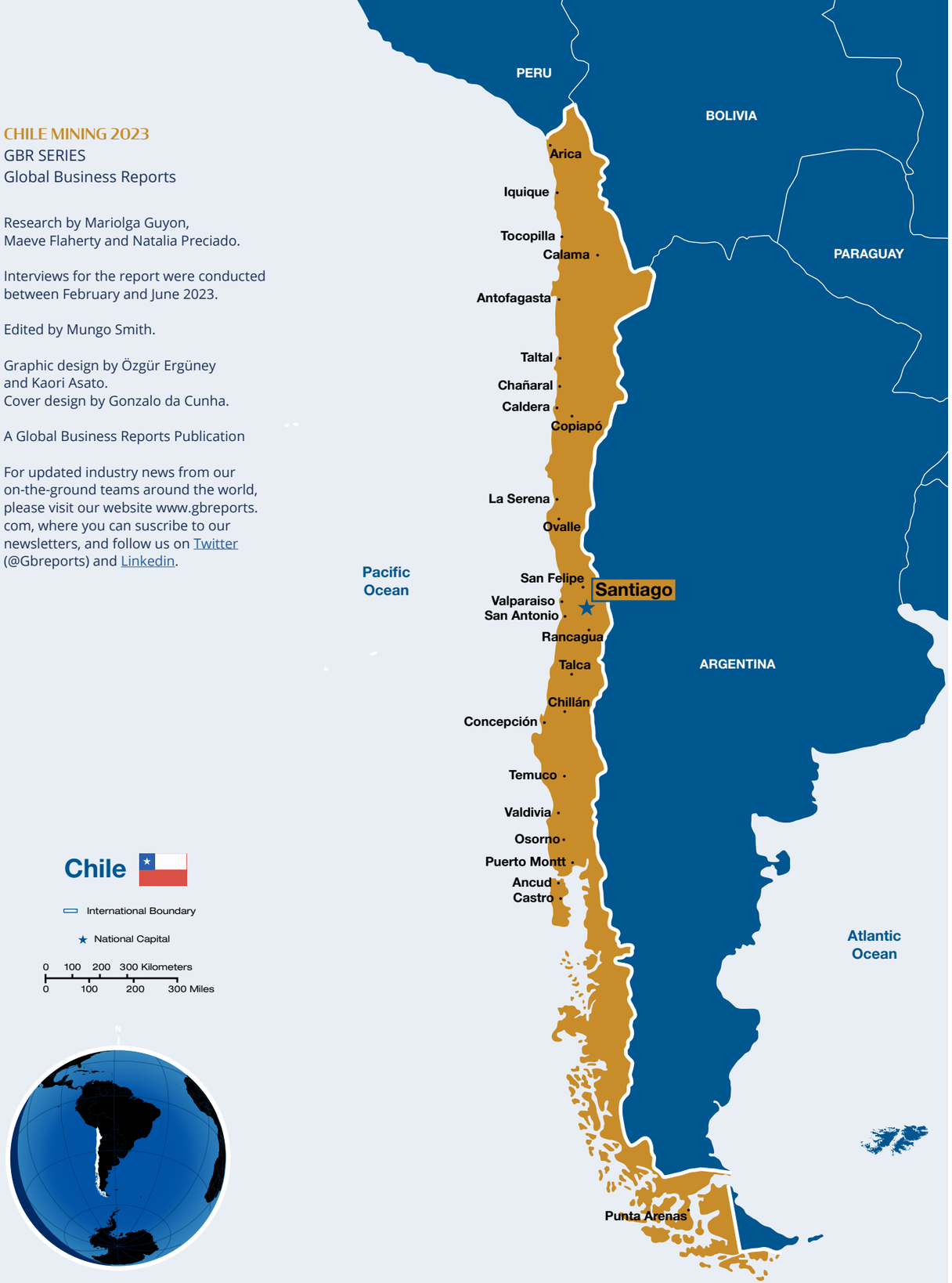

Mining in Chile

Productivity challenges, royalty reform, overview of Chile's largest copper mines, and the new lithium policy

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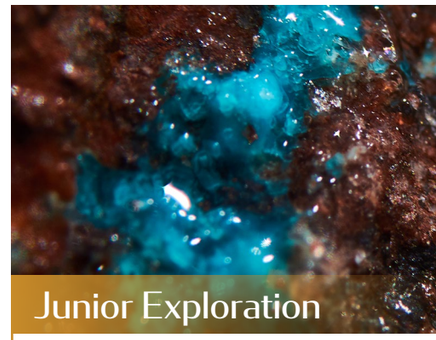

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Investment climate, early and advanced projects, direct lithium extraction possibilities

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Digitalization, automation, electrification, process optimization, asset monitoring

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INTRODUCTION TO CHILE

"Our institutional framework favors mining. Unlike other Latin American countries, we have institutions such as Enami, that support small and medium scale mining and promote formality and good practices."

Miguel Zauschkevich Domeyko,
President,
Chilean Mining Chamber

Image by Sebastian Silva at Unsplash

Chilean Mining's New Regime

The Chilean government offers new regulatory clarity

Image by Seungki at Adobe Stock

According to recent data from the US Geological Survey, Chile has the largest copper reserves of any country by a wide margin. The country has 190 million metric tons (t) as of 2022, nearly double the reserves of second-placed Australia. The reserves guarantee copper production for the next century at the current extraction rate.

The most significant factor inhibiting Chile's full-throttle development of its already strong and established copper industry has been a lack of legal certainty. As a result, the country dropped significantly in the Fraser Institute's index of economic freedom, from 13th in 2019 to 33rd in 2022. Wary of civil unrest and regulatory uncertainty, investors have hesitated to move into Chile. However, as one CEO explained, the Fraser Institute's index is based on perception, not reality. Investors may have developed a negative perception of Chile, but this does not mean that the country is risky.

Pablo Peñaranda, director of business development at Black & Veatch, stated: "It has been forecasted that by 2031 at least US$74 billion in investment will be required for the Chilean mining industry to keep up with demand. However, approximately 60% of mining professionals and executives believe achieving this investment is not probable."

If the investment flowed in, the industry could utilize it. Peñaranda continued: "There are enough resources and capacity to develop at least three new greenfield projects every year."

The moment for that increase in investment has come, both for copper and lithium. After years of a lithium industry in limbo, on April 21st, President Gabriel Boric announced Chile's National Lithium Strategy, providing the rules and regulations of the lithium industry. Two weeks later, on May 10th, 2023, after nearly five years of uncertainty, the Chilean senate approved the final form of the long-awaited royalty bill.

In a sector hampered by uncertainty, the mining industry was prepared to accept and handle nearly anything so long as the rules of the game were clear. Now, these rules exist, and Chile is well positioned to attract investment and develop in the context of regulatory and fiscal certainty.

The royalty reform is limited at last

In early September 2022, President Gabriel Boric's proposed new constitution came to a referendum and was defeated soundly. The mining industry breathed a sigh of relief as the proposed constitution would have dramatically dampened investor enthusiasm. The proposals included a change to water use, which would be regulated via authorizations rather than property rights; the prohibition of mining near glaciers without a clear definition for a glacier, potentially prohibiting projects such as Codelco's Andina; plurinational governance that would dramatically increase permitting requirements and the number of players involved in any given project; and a change in mining concessions for administrative approvals.

The constitutional referendum's failure averted a major crisis for the industry, but the industry has spent much of 2022 and early 2023 concerned about changes to the royalties system. On May 10th, Chilean lawmakers approved the final version of the royalty bill, and now it only awaits signature by President Boric.

The royalty bill establishes a maximum tax of 47% for companies that produce more than 80,000 tons of copper annually (t/y) and a flat-rate ad valorem tax of 1% on miners that produce more than 50,000 t/y. Additionally, they will have an 8 to 26% tax depending on their operating margin.

The new tax rate, which takes effect on January 1st, 2024, is undoubtedly a noticeable increase. At present, Chilean mining companies are taxed at a rate of between 41% and 44%, which is similar to competitors such as Peru. And indeed, that ad valorem component is viewed harshly, as when prices are low, mines can generate a loss with the tax and low profits. However, the bill includes wording clarifying that firms with operating profits in the negatives will not pay the ad valorem tax.

This increased tax will certainly provide the government with a rapid increase in cash. It is expected to generate approximately an additional US$1.5 billion a year for the Chilean state. Uniquely for a country where the vast majority of social spending is concentrated in the Santiago metropolitan region, nearly US$450 million will be directly distributed to regional governments. Of that, US$225 will be dedicated to productivity and development, focused on increasing regional economic activity and innovation. US$55 million will be distributed to mining communities directly involved with mining, focusing on improving ports, tailings dams, and other mining-related areas, aiming to compensate for the external negatives of mining. The last US$170 million will be dedicated to territorial equity, focused on supporting the most vulnerable areas in the country, with approximately 300 communities identified as recipients.

However, many industry leaders argue that more development within the mining sector, not higher taxes, would increase the state's coffers and enable the Boric administration to fund its ambitious social plans. The short-term gains in funding by increasing the government's cut of private sector profits will be less than the government could have gained by mining-friendly policies that incentivized an expansion in mining and the taxation to match. Manuel Viera, CEO of Metaproject, explained: "It is vital to find the equilibrium point at which the government can maximize the funds it raises for social development and ensure that a mine is still sufficiently profitable for the owners."

The industry is committed to paying its fair share. "Mining was always willing to assume a higher tax burden and has never refused an expectation of paying more taxes. Often in the political world they say that mining has always refused to pay, but this is not true," emphasized Joaquín Villarino, executive president of the Consejo Minero.

He noted, however, the squeeze on mining from all sides: "Costs have also increased dramatically due to lower ore grades, more difficulty accessing water, greater distance from the airport, and other factors. Profits are continuously shrinking."

A strong, supported mining sector means a strong Chile. Sergio Demetrio, president of the Instituto de Ingenieros de Minas, said: "Chile is a mining country. Mining is an industry that drives development, not only because of the income and jobs it generates but also because it generates a value chain that benefits various sectors of the economy."

It is this strong value chain for which Chile stands out, and that makes Chile an attractive place for investment. The country has a skilled workforce and a vast network of support services, paired with a rare degree of governmental stability, making it a comparatively simple country to mine. Now that the legal certainty is here, the future for Chilean mining is bright.

Productivity remains a challenge

The current state of the Chilean mining industry is shaped by more than just mining-specific legislation. President Boric and his supporters have seized upon their electoral mandate as an opportunity to make wide-ranging transformations to the current Chilean system. Alicia Domínguez, energy and mining leader at Ernst & Young Chile, said the industry is also impacted by other reforms beyond the tax reform. Domínguez stated: "The pension reform and the discussion of the new constitution are also flanks of normative discussion, generating spaces of uncertainty."

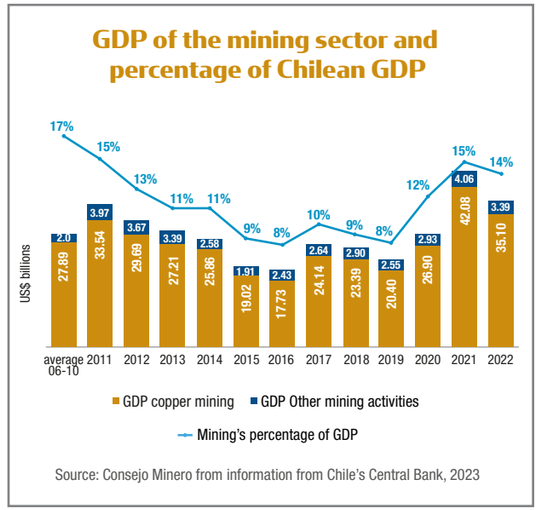
"The conversation in the mining industry primarily revolves around the royalty bill, but to discuss reforms, we need to put everything on the table, including labor, pensions, and health," Philippe Hemmerdinger, president of APRIMIN, agreed, noting, however, that the government's wide-ranging reforms have met with significant resistance: "The government came in with a revolutionary program, but over the past year, the country has communicated that it is not willing to accept such drastic constitutions or reforms."

Considering the broader public pushback, the greatest success for the government among these reforms is the 40-hour bill. Currently, Article 22 of the Chilean Labor Code allows for a 45-hour work week, divided into a minimum of five days and a maximum of six. The new bill will reduce the maximum weekly working hours to 40, comparable to the OECD average. However, Chile's worker productivity in terms of average hourly contribution to the GDP is below the OECD average. According to OECD data, in 2020, each Chilean worker contributed US$30.4/hour to Chile's GDP. Of the 39 member states, Chile ranks 36th at this productivity level, with productivity well below the OECD average of US$54.5/hour.

Productivity per dollar spent is a significant challenge for the country and the mining industry. On the one hand, this is a nationwide problem – despite the country's stability, the education system has low levels of achievement in English, math, and other areas. On the other hand, it is also specific to the mining industry. Germán Millán, a partner at PwC, explained: "Compared to mining jurisdictions such as South Africa, Australia, and Canada, we have much lower productivity and outcome levels per person for every dollar spent on the workforce."

This lack of productivity has resulted in slower local capability development in the services industry. Millán continued: "A significant proportion of the mining services value chain is international players with a local presence rather than locally developed companies. In jurisdictions like Australia, a great part of mining services providers are Australian companies."

Chilean mining's productivity problem provides a window of opportunity for an industry-wide rethink of systems and processes. Historically, the mining industry has been comparatively risk-averse and slow to innovate. Now, however, necessity is opening doors. New technologies and innovative approaches are filtering through the industry on all levels of the Chilean mining value chain, from camp construction to drilling, building a more efficient mining sector. ■



Source: Consejo Minero from information from Chile's Central Bank, 2023

> The government is committed to designing and implementing policies that ensure the long-term sustainability of mining.

Marcela Hernando

Minister of Mining*
GOVERNMENT OF CHILE

What is the government's position on mining?
Chile's geological potential represents an excellent opportunity to supply minerals that are critical for global decarbonization. Like other mineral-producing countries, we seek to play a leading role in supplying key materials for the energy transition through environmentally friendly mining. The government is committed to designing and implementing policies that ensure the long-term sustainability of mining.

What are the main aspects of the recently announced National Lithium Strategy?
The National Lithium Strategy seeks to promote Chile's prosperity and develop a sustainable industry. All this goes hand in hand with technological innovation. With these objectives in mind, the government decided to ensure state participation in the entire industrial cycle by creating the National Lithium Company and the CORFO Committee for the Productive Transformation of Lithium. It also seeks to increase productive capacities through the Public Institute of Lithium and Salt Technology and Research, as well as the development of public-private alliances for the exploration of the resource.

To ensure political and social sustainability, we will promote the participation of the territories and communities across the lithium value chain. In terms of environmental sustainability, we will demand the use of new technologies, such as the direct extraction of lithium (without evaporation) and brine re-injection. These measures will modernize the industry's institutional framework in accordance with the country's challenges and objectives.

Our lithium vision is not limited to the short term; we think of it as a transversal state policy to maximize long-term benefits. Therefore, the National Lithium Company must be constituted through a political agreement, through a law ratified by Parliament, and with the collaboration of all the main stakeholders.

Currently, we can act as if the National Lithium Company were already constituted, that is, through Codelco, Enami, CORFO, the ministries, and the state administrative branches. The Lithium Institute will be consolidated as of 2023, but in the long term, the National Lithium Company will act as the regulatory body for issues related to investment, exploration, and exploitation of the salt flats.

How has the debate on the Mining Royalty Law evolved?
The government tried to maintain a constant dialogue with the private companies to define the conditions of the Royalty Law. The ministry was a mediator and promoter of dialogue between the mining companies and the Ministry of Finance. We observed acceptance of this law, especially among foreign companies.

The approval of this mining royalty is favorable for the country, as it will benefit many of the country's municipalities through three specific funds that will provide the regions with resources to meet the various needs of the citizens.

How is the Ministry of Mining addressing the issue of productivity?
The recent government decision to approve Los Bronces Integrado project illustrates the government's efforts to enhance production. Mining companies are prioritizing the expansion of existing deposits, but it remains important to promote exploration. We are beginning to see a rebound after the pandemic, with a 7% growth in exploration spending in 2022.

Permitting is another factor we are addressing to expedite new projects. Specifically, we strive to avoid duplication of functions and reduce red tape requirements.

What are the main trends in the Chilean mining industry labor market?
The government is making significant changes in the labor market, such as the 40-Hour Law. Digitalization and automation technologies also entail a reconversion of the labor dynamics, especially in large-scale mining. Despite the decline in operator demand due to automation, new technologies lead to more value-added jobs and a reduced risk for workers. In this context, educational institutions must adapt to the new dynamics of the labor market.

How can Chile balance environmental protection and the growing demand for critical minerals?
Chilean engineers have a great capacity to develop innovations aimed at minimizing the environmental impact of mining operations. Some examples of this are the implementation of desalination plants and the use of renewable energies in the north of the country.

Could you give a final message?
Our mineral wealth is a product of geological anomalies, but the country also offers an economically and politically enabling environment. We have an open economy and many international treaties, as well as a strong rule of law and stable institutions. These factors make Chile a unique jurisdiction and a crucial player in the global energy transition. ■

*On 16 August 2023, Aurora Williams replaced Marcela Hernando as Minister of Mining.

> Chile needs a long-term vision for the mining industry and a continuous design of public policies that promote the adequate extraction of critical minerals for the global energy transition.

Joaquín Villarino

Executive President
CONSEJO MINERO

What were the main highlights of 2022 for the Chilean mining industry?
2022 was marked by two major milestones. The first agenda of the mining sector was the constitutional discussion, leading up to the referendum, which was rejected on September 4th 2022. The second was the new royalty bill. In parallel, I was very involved in discussions around labor, environment, electrification, and other major themes impacting the industry.

Can you take us through the process and impact of the royalty bill that was recently approved?
It has taken us significant energy to modify the royalty bill since it was first presented in the Congress, by trying to change the dramatic increase first proposed into a more reasonable one that wouldn't sacrifice our global competitiveness.

The original bill gave a total tax burden of more than 80%; the load established in the bill finally approved reaches 44.7%, which, although it is higher than the world average, is within a reasonable range (today, mining has a complete tributary requirement of approximately 38%, including all taxes, royalties and additional).

Mining was always willing to assume a higher tax burden, despite what politicians sometimes claim, however, costs have also increased dramatically due to lower ore grades, more difficulty accessing water, and other factors. Profits are continuously shrinking.

How does infrastructure impact the energy transition?
Political motives are taken into more consideration rather than the technical ones. The temptation for the government is to pass costs onto the industrial sector and mining customers. However, when you add this to labor costs and higher tributary costs, the result is a major burden that inhibits the industry's development.

Nevertheless, 50% of the electrical energy used by mining comes from renewable sources, and it's estimated that by 2030, 90% of mining power supply will come from renewable sources.

Chile has a fundamental lack of transmission lines. We have invested in solutions to increase the capacity of renewable energy generation, but we do not have the infrastructure to bring that energy to the final consumer. We are having significant problems obtaining permits for these transmission lines that would enable this change in the energy matrix to materialize.

What is your outlook for the lithium market in Chile?
There is a global consensus that the boom in demand for lithium will not last forever. Like any mineral, lithium is a cyclical resource. Therefore, it is crucial that Chile takes advantage of its lithium reservations to meet the growing demand and become a major world supplier.

What factors have affected productivity in the mining industry?
First, the inefficiency of the permitting process is an issue. Second, the natural process of declining ore grades inevitably reduces productivity. Third, there are labor-related problems, such as a lack of competence and efficiency among the workforce and poor organization within companies. We also need to redesign work models to include more women in every step of the industry. The Consejo Minero is implementing the "Ser Minería" project to attract talent, and we are also working with Fundación Chile and the Consejo de Competencias Mineras and ELEVA to upgrade the skills of the workforce.

The fourth obstacle to productivity is the slowdown in project progress due to external uncertainties. Chile needs a long-term vision for the mining industry and a continuous design of public policies that promote the adequate extraction of critical minerals for the global energy transition.

How has the mining sector dealt with water scarcity in Chile?
The industry has made three main advances in water management: the reuse of water in mining processes, the reduction of water consumption, and the use of alternative sources, such as salt water. Currently, 30% of the water used by industry is salt water, and we expect this percentage will increase up to 50% by 2030. Also, around 76% of the water used in mining processes is recirculated. However, there are broad misconceptions about the environmental impact of desalination plants, so we must provide information about the positive impact that desalination plants have on sustainable development.

What are the main objectives of the Consejo Minero?
The main objective of Consejo Minero is to continue promoting a sustainable and productive industry. Also promoting a serious and evidence-based public debate on mining. Finally, we aim to raise awareness of the social and economic contribution of the mining industry to the country. ■

The conversation in the mining industry primarily revolves around the royalty bill, but to discuss reforms, we need to put everything on the table, including labor, pensions, and health.

Philippe Hemmerdinger

President
APRIMIN

Can you describe APRIMIN's role in the mining industry?
APRIMIN is the association of industrial suppliers of the mining sector. Our 131 members have total invoices between US$17 to US$20 billion, representing close to 80% of sales in the Chilean mining sector. The mining sector represents 10% of Chile's GDP, but when you include the entire value chain, it is closer to 26%, demonstrating the extent to which mining is the engine of Chile's economy.

Every March, we set objectives for the short and long term, and then carry out those objectives in committees. For example, we have an education committee that collaborates with the Consejo Minero's CCM Council of Mining Competencies, which gives us the resources to train our people. Currently, there is a disconnect between education and the need – many geologists are graduating when what we need are more engineers and data scientists to handle digital transformation and remote operations. The education committee gathers information and responds to these types of concerns. We also have a projects committee, and a productivity and approvals committee, among others. Our system enables our members to take the best practices from the industry and incorporate them. In addition, we promote the professionalization of contractors, developing industry-wide standards. This ensures stable employment and development.

How has the current government impacted the mining industry?
The government came in with a revolutionary program, but over the past year, the country has communicated that they are not willing to accept such drastic reforms. The most critical success the government has had is the 40-hour work week. This is manageable for us, particularly because remote work allows for labor to be better distributed. However, these regulations will change the number of people required for a project or contract, and we are trying to make up the difference in hours with proportional vacation days. What nobody talks about is the impact of this reform on productivity. Going from 45 to 40 hours is a drop in productivity by 8%. Productivity in Chile keeps dropping.

The conversation in the mining industry primarily revolves around the royalty bill, but to discuss reforms, we need to put everything on the table, including labor, pensions, and health.

What is your stance on the current royalties situation?
An investor can only invest if the rules are clear. Our position as the world's largest copper producer comes from the clear rules of the game and incentives provided in the 1990s. However, we have a tax reform every two to three years that imposes more royalty payments for copper exploitation.

The idea of a tax that is a margin on sales rather than profits is a punishment and a disincentive, as some businesses must dig through harder rock or have more costs getting materials to port. Instead of collecting more taxes, the country will place a greater tax that will generate a small increase in income but destroy the industry. Moreover, it will scare away investors.

How can secondary mining benefit the industry?
Chile's market share in copper has dropped. We used to have 33% or 34% of the world's copper production, and today we are at 26%. Demand will keep growing, and we will keep dropping because we do not have new projects. But in secondary mining, we have a potential of 50-60 million tons of copper to recover that are in the tailings, mineralized dump and foundry slags. That's 10 years of production readily available, and new technologies like ore sorting or tailings recovery are available.

What is the greatest challenge facing Chile's renewable energy industry?
Infrastructure. Our port infrastructure in the north and center of the country is good, but the port infrastructure that Magallanes needs for its green hydrogen production in the south needs to be created. We need the infrastructure and the state to set the rules and norms for green hydrogen. We must develop shared-preference infrastructure and shared corridors.

How can the mining industry become more gender diverse?
We are still below 20% in gender inclusion. We need a lot of talent. Digital transformation allows women to work remotely and be present in the sector without negatively affecting their family life. You can see in our hiring policies and our selection processes that we are driving forward in gender equality, with hiring policies that are directed towards hiring more women. ■

The Race for Copper and Lithium: Will Chile be a contender?

Expert Opinion Article by Francisco Acuña
Principal Consultant, Mining & Metals, CRU

Tipping point for Chilean copper output
In 2007, Chile was responsible for 36% of the world's copper mine production while Peru and Africa accounted for 8% and 6% respectively. Last year, these numbers were 24%, 11% and 15%; and by 2027 we forecast 25%, 11% and 17%. How those numbers will be impacted by the approval of the new royalty bill and the announcement of the new lithium framework remains to be seen.

The short-term future of Chile's capacity to sustain and grow its copper production capacity will depend in two factors: Codelco's ability to correct course and perform as expected; and the forward movement of uncommitted projects as regulatory uncertainties ease. In 2022, Codelco saw its worst performance in over a decade, representing the tipping point of a steady drop in production since 2010 (13% drop of annual production 2022 respect to 2010). In order to correct course, operations must overcome disruptions and new projects such as the Teniente New Mining Level Project and Rajo Inca Project must move forward as planned. If Codelco can accomplish these goals, then in five years the company could reach a historic production level of over 2 million tons of refined copper per year.

Beyond Codelco, the pipeline of projects for the next 5 years are mostly brownfield expansions and approximately 50% of the potential production is not yet committed. However, the environmental approval of Los Bronces Expansion boosted the sector confidence that the current administration is taking a more reasonable approach to approvals. Simultaneously, the new clarity on royalties means that industry players can finally evaluate the financial performance of new projects with a degree of regulatory certainty. Thus we could expect projects to get to board approval levels in the short term, which is something the country needs if it wants to retain the copper crown.

Words to actions, still an uncertain outcome for lithium
Global lithium demand will almost reach one million tons annually by 2023. Furthermore, for the 2022-2027 period CRU expects to continue to see impressive growth rates: 18.5% compound annual growth rate in lithium demand (in terms of lithium carbonate equivalent, LCE). For the same period, however, Chilean committed production is expected to grow by only 6% CAGR growth, while Argentina, for example, will experience a 46% CAGR growth in the period. This means that in 5 years, committed annual production in Chile and Argentina would reach 289 kton LCE and 232 kton LCE respectively, but for the same period Argentina also has potential uncommitted projects for an additional 258 kton LCE, while Chile's potential pipeline we estimate to be only 80 kton LCE.

As the world increases it decarbonizations efforts, lithium and other battery metals will continue benefiting from soaring increases in demand and positive price environments. However, growth will be shaped by a third factor, regulatory support, which leads to uneven development across jurisdictions.

The lithium triangle is an excellent example of the impact of regulation. Argentina's positive regulatory environment for lithium mining has translated in double digit growth. On the other hand, Chile's uncertain framework and increasingly state-centric focus has resulted in stagnated growth, while Bolivia's state-controlled industry has failed to even start competing.

While it has been wrongly stated that lithium is being nationalized in Chile, this does not mean that the government, and particularly the executive branch, will in fact become central players in the development of the industry. The mining code in Chile excludes lithium as a substance subject to exploration or exploitation under a mining concession right. Therefore, there are no actual current private right owners who could be subject to a hypothetical nationalization (except for mining concessions granted under the 1932 code). In this context the lithium industry has already been under "state-control", as there is no regulatory certainty to obtain a lithium special permit. The recent announcement doesn't materially change the landscape, although sets stronger guidelines that it will at least remain unchanged.

The current contracts that SQM and Albemarle have to operate in the Atacama Salar have resulted in record royalty payments to the Chilean government, as the higher 40% tax rate over revenues applies for lithium prices over 10,000 $/t LCE (limit well below prices in the last two years and to our mid-term forecast). However, the new model the Government is pursuing through renegotiation of the SQM contract, expiring in 2030, is a joint venture structure in which the state will own no less than 50% of the new entity. While this is a sign that the Government is looking for its state-owned lithium company to work and invest alongside private companies, still offers no clarity in how this could translate in a higher government take or in a boost of new lithium capacity.

With great power comes great responsibility
The Chilean government is increasing the tax burden for copper miners and is compelling lithium miners to negotiate with the acting administration (leading to concerns about a lack of consistent rule of law, as negotiations will be subject to changes every term). In order for these new policies to support mining development in the long term, the country must provide sufficient stability and exceptional conditions in order to maintain and gain competitiveness. Geological endowment must be paired with long-term stable conditions in order for the industry to invest and operate. As such, regulators must find the right formulas to achieve these conditions, focusing on pressing issues for the industry such as efficient permitting processes and continuing to foster the conditions to attract investment. ■

PRODUCTION AND DEVELOPMENT

"Decreasing ore grades presents a challenge. Mines are getting deeper, distances are getting longer, and associated costs are increasing."

Iván Arriagada,
CEO,
Antofagasta PLC

Image courtesy of Glencore

Copper Production and Development

A steady stream of development activities counteracts low ore grades

Image courtesy of AMSA

Chile's production levels fell in 2022, reflecting larger productivity issues. On February 3rd, 2023, Cochilco announced a monthly drop in copper production of 0.5% for December of 2022, to 495,800 t/m. This short-term drop was part of a full-year decline of 5.3% in copper production on a year-to-year basis, to a total of 5.33 million t/y produced in 2022. This includes a 10.1% drop in output from Codelco and a 9.4% fall from Collahuasi on a yearly basis, although Escondida's yearly output rose by 4.2%.

The outlook for next year is more positive: Cochilco estimates that in 2023, copper production will grow by 7.5% to 5.7 million t/y. Several brownfield projects are expected to be completed this year, increasing production. Yet from a more long-term viewpoint, production levels are unsatisfactory.

A government report, viewed by Reuters, showed that copper output is expected to peak at 7.14 million t/y in 2030, two years later than expected due to project delays (a decade ago, the regulator had predicted a 7.62 million t/y peak in 2028). This projection for the future reflects the present reality; production is below where it should be as productivity lags. After the 2030 peak, production is expected to drop, because mines will close and there are insufficient greenfield projects coming up to replace them.

However, across the Chilean mining sphere, significant investment in expansion and development projects demonstrates the momentum that exists behind copper in Chile today. At the heart of this investment in mine growth is Teck's Quebrada Blanca Phase 2, which announced first copper in March of 2023, and is continuing to advance the commissioning and ramp-up process to full production through 2023. "QB2 is the flagship of our copper growth strategy and will double our consolidated copper production when it reaches full capacity with the operation targeted to achieve 285,000 to 315,000 t/y copper production in 2024 – 2026," explained Jonathan Price, CEO. "What is also very exciting is that QB2 uses only approximately 18% of the 2022 reserves and resource tonnage so there is significant potential for future expansion."

Teck is moving ahead full throttle. In addition to QB2, it has a suite of development projects worldwide in Peru, Mexico, Canada, the U.S., and others. In Chile, in addition to QB2, the company is involved in the Quebrada Blanca Mill Expansion (QBME) project, which will increase concentrator throughput by approximately 50% by adding an identical, semi-autogenous grinding line. The company expects to complete QBME's feasibility study, initiated in mid-2022, during the second half of 2023, and a permanent application was submitted to the Chilean regulator in 2023 and accepted for review. "QBME is expected to be a significant contributor to our near-term copper growth portfolio with potential first production as early as 2026," said Price.

Antofagasta Minerals is currently in the commissioning stage for its desalination system and fourth milling line at Los Pelambres, expecting to complete the project by year-end, allowing Pelambres to operate at increased capacity and utilize desalinated water from 2024 onwards. Iván Arriagada, CEO of Antofagasta, described the project as a necessary response to the drought that has ravaged the central part of Chile and stated: "This project is crucial as it provides a source of seawater for running Los Pelambres, enabling it to operate at full capacity independently of continental water sources."

The company is also intending to expand operations at Centinela by building a second concentrator, which would allow the company to increase copper production to close to 900,000 t/y of fine copper across both Los Pelambres and Centinela.

Codelco is carrying out a significant number of development activities across its various projects, with the aim of counteracting reducing ore grades. Production in 2022 dropped by 10.6% compared to 2021, while production costs rose by 24.6%. André Sougarret, CEO of Codelco, described the challenge of carrying out projects in the current economic environment: "Delays have generated greater demands on our current operations, generating little flexibility and assets with greater maintenance needs, resulting in operational discontinuities and treatment of lower-quality minerals in terms of copper content and by-products.

The company is prioritizing projects that will benefit production, ramping up structural projects. Additionally, Codelco has adopted a variety of digital and automation technologies, including fleets of remotely controlled equipment at El Teniente.

At Escondida, results approved by 4% over the previous year in 2022, while production at Pampa Norte increased by 13%, a rise that Rag Udd, president Americas at BHP, attributed to the new Spence concentrator opened in 2020. BHP continues its forward momentum

in the country. Udd said: "We are also working on the design of new projects, such as a new concentrator at Escondida, leveraging new technologies in sulphide leaching, and implementing innovations in tailings management."

Meanwhile, Capstone Copper's Mantoverde development project to enable Mantoverde, an open pit copper-gold mine in the Atacama region, to transition from its historic oxide mining to sulphide copper mining, is moving forward on-time and on-schedule. The ramp-up is expected to commence late in 2023. As of late March 2023, the project's progress stood at 83%. This transformative shift is part of the industry-wide focus on developing brownfield efforts to extend the mine life of mines. "At Mantoverde, sulphide reserves in the mine plan represent only approximately 20% of overall resources, indicating the opportunity for both mine life extension and expansion," said John MacKenzie, CEO. "We are advancing studies to increase the throughput capacity from 32,000 to up to 45,000 kt/d (MVDP optimized), while also evaluating an even larger increase in the throughput capacity (perhaps double MVDO optimized) via Mantoverde Phase II."

For Capstone, the area is ripe with opportunity. The company is advancing an updated feasibility study at the neighboring Santo Domingo project, with results expected to be announced by year-end 2023. Additionally, it is evaluating a district cobalt plant for Mantoverde-Santo Domingo, which may unlock cobalt production from the region while producing a by-product of sulphuric acid, which can then be used internally in the leaching of the oxide copper ore to lower operating costs. In a period of intense costs-related pressures, exploring opportunities that can bring down costs in the long-term provides a positive outlook for the future.

In the large mining sphere, interest from global companies continues despite Chile's current challenges, demonstrating the country's enduring reputation as a stable and reliable copper producer. At the end of March 2023, Lundin Mining announced that it will purchase a majority stake in the Caserones copper-molybdenum mine

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> We will be a strategic company in the fight against climate change that demands more and more copper and lithium.

André Sougarret

CEO
CODELCO

Could you provide an update on Codelco's operations over the past year?
Throughout 2022 and 2023, we have continued advancing in our strategy to redevelop our largest mines, positioning them to continue contributing to Chile over the next 50 years. Due to the complexity and magnitude of these projects, particularly in the context of a challenging local and global environment, these initiatives have suffered from implementation delays.

These delays have generated greater demands on our current operations, leading to little flexibility and assets with greater maintenance needs, resulting in operational discontinuities and treatment of lower-quality minerals in terms of copper content and by-products.

To face this transitionary situation, we are focused on prioritizing projects that will benefit production, complying with mining development plans and ramping up structural projects.

How does Codelco achieve efficient water management?
Our goal is to reduce our consumption of continental water by 60% per ton of treated ore by 2030. We are steadily advancing with three specific measures: innovative solutions to improve process efficiency, a contract for the construction of a desalination plant for the Chuquicamata, Ministro Hales, and Radomiro Tomic divisions of the Northern District, and the latest generation of water recirculation from tailings deposits.

We have already defined a new Water Resources Strategy 2035, whose objective is to take care of the basins identified as water-stressed by the authorities. In these areas, we will only use natural brackish continental waters and water reutilized from mining activities. Fresh water will remain at the complete disposal of the communities.

How does Codelco plan to support lithium production growth in the country?
It is a tremendous responsibility to contribute to developing two minerals considered critical for the global energy transition. We will be a strategic company in the fight against climate change that demands more and more copper and lithium, which means that the world's eyes will be watching us.

We have the skills and experience in mining, commercial, legal, and financial matters, as well as a strong appetite to be a leader in the mining of the future. We will focus on ensuring that Chile grows in production and recovers its position as one of the largest lithium producers, ensuring that the State benefits from this cycle of high prices.

Could you discuss steps toward the company's 2050 decarbonization goals?
To advance our 2050 decarbonization goal, we have developed agreements for 100% renewable energy supplies with our existing energy suppliers. These renegotiations have made it possible to guarantee 70% decarbonization of our energy matrix by 2026, and we will continue in this line to achieve 100% clean energy by 2030.

In addition, we are advancing to incorporate 100% electric equipment for underground mines by 2030, and participating in initiatives to develop green hydrogen.

Likewise, as we promote the reduction of the carbon footprint of our suppliers. Together with the Alta Ley Corporation, the Association of Industrial Mining Suppliers (APRIMIN), and the National Mining Society (SONAMI), we developed www.huellaminera.cl, a platform to measure the emissions associated with inputs and products we receive from providers.

What technological innovations are you incorporating into your processes?
We have incorporated automated drilling, loading, and mineral transport machinery. For example, in the El Teniente Division, we have complete fleets of remotely controlled equipment, such as crushers and automated trucks, which are operated from the Integrated Operations Center (CIO) in Rancagua, 50 km from the mine.

How does Codelco support development in the local communities?
Among other activities, we have a program to attract and develop local suppliers and modify our internal supply regulations based on best practices to encourage local purchasing. "Together we act locally" allowed us to reach a record figure of US$248 million in local purchases in 2022.

Our new territorial strategy also promotes local labor. Our "Together we play local" program strengthens employability through job fairs, intermediation with contractor companies, and links to municipal employment offices.

To contribute to the education and formation of human capital, we developed the "Together We Learn Local" program with 12 educational establishments in our area of influence to improve students' academic results.

Finally, through our "Together We Are Local Water" initiative, we support agreements between communities and their respective municipal hydraulic works areas to improve the infrastructure of rural drinking water systems. ■

> Chile has provided stability and institutional certainty, two essential elements for developing a business that is capital intensive.

Rag Udd

President Americas
BHP

Can you provide an update on BHP's recent operations in Chile, including the performance of Spence's new concentrator?
We are always looking for alternatives and innovations to improve the competitiveness and performance of our operations. A great example is the Spence concentrator, which has progressively improved performance since it started operating in December 2020.

We are also working on the design of new projects, such as a new concentrator at Escondida, leveraging new technologies in sulphide leaching, and implementing innovations in tailings management.

Could you share production highlights at Escondida and Pampa Norte over the past year?
We have successfully navigated a very challenging external context in 2022. In terms of production, Escondida's results improved by 4% over the previous year, and it continues to be the largest copper mine globally. Pampa Norte's production rose by 13%, thanks in part to the new concentrator.

How does BHP handle water shortages and drought across Chile?
In Chile we have a long history of using seawater to supply our operations. 15 years ago we invested ~US$4 billion to transition Escondida to desalinated water, and we built the first desalination plant in Chile in 2005.

Escondida operates solely with desalinated water, and we have ceased extracting water from high Andean aquifers at Escondida. Plants such as Spence and its concentrator now also operate with desalinated water.

We see responsible water management as an urgent task for the mining industry and society as a whole.

How do you incorporate advanced technologies in your operations?
Technology and innovation have an important role to play in mining, and we are always exploring new options to improve our processes.

At the moment, we are making progress on the responsible automation of our sites through equipment autonomy and remote operations centers. In addition, through open innovation methodology, we have launched several international challenges to find disruptive solutions for application in our operations. We are also assessing options for using artificial intelligence.

End users are focused on a low carbon footprint and minimal environmental impact at all points along the value chain. How is BHP reducing its emissions and improving its sustainability metrics?
Decarbonizing the mining value chain is an important task for the entire industry. We have a great opportunity ahead: to collaborate in reducing emissions, improving ESG standards, and making mining an increasingly sustainable activity.

In the case of BHP, progress in Scope 1 and Scope 2 has allowed us to significantly reduce our emissions and move forward on our operational decarbonization commitments, thanks to decisions such as supplying our operations with clean energy or moving towards electrifying our truck fleet. Regarding Scope 3 emissions, we are focused on building alliances to contribute to decarbonizing processes such as maritime transit.

As one of the major natural resources companies in the world, we know that we have a great responsibility to provide the commodities that the world needs to move forward on decarbonization, address climate change, and enable the energy transition.

What is the socioeconomic impact of BHP's operations on local communities?
Rather than impact, I would speak of contribution. When BHP arrives in a territory, our priority is to be able to make a contribution to the people and generate shared benefits. That is what BHP calls Social Value.

It is worth mentioning that as a company we are aware that we have not always done it as well as we could have, but we have learned. Those lessons make us improve every day to minimize potential impact and to continue building a mutually beneficial relationship with local communities.

In your opinion, what are the main pros and cons of operating in Chile in comparison to other mining jurisdictions?
We are proud of our activity in Chile during 30 years and would love to remain working here and contributing to the country. Chile not only has great geological conditions, but also a rich workforce, skilled professionals and excellent suppliers. We deeply appreciate the reception from the communities in the Antofagasta region. This is a wonderful mining country.

During these years, Chile has provided stability and institutional certainty, two essential elements for developing a business that is capital intensive. The country is facing now a period of increasing social demands and changes, but we have seen these demands are starting to be solved in an institutional and democratic manner. ■

Antofagasta is well positioned to grow and develop the company based on our mineral inventory, meaning we can supply the extra copper the world needs at a time when it is most required.

Iván Arriagada

CEO
ANTOFAGASTA PLC

Could you provide an update on Antofagasta's recent operations?
Antofagasta's main operations, four of them in Chile, are running according to our plans. The water system and the fourth milling line at Los Pelambres are almost complete. This project provides a source of seawater for Los Pelambres, and will bring our usage of recirculated water or water from the sea to around 90% by 2025.

Can you discuss potential improvements at Centinela?
Our growth strategy is primarily based on our ability to grow organically, focusing on two main districts, Los Pelambres and Centinela. Centinela, in northern Chile, has a large mineral inventory, and we plan to build a second concentrator to increase production by about 170,000 t/y of fine copper. Centinela, operational since 2011, is a well-established, innovative, and sustainable operation. It runs on renewable energy, uses a fleet of autonomous trucks, and employs thickened tailings, which is relatively novel in the copper industry. After board approval, we hope to increase our production potential to close to 900,000 t/y of fine copper by combining efforts at Los Pelambres and Centinela. These opportunities make us well positioned to grow and develop the company based on our mineral inventory, meaning we can supply the extra copper the world needs at a time when it is most required.

How do decreasing ore grades impact Chile?
This presents a challenge – mines getting deeper, distances getting longer, and associated costs increasing. We have been implementing various strategies to counteract these effects. Firstly, we have transitioned our energy sources from fossil fuels to renewable energy, which has environmental benefits and provides a structural cost advantage. Our mines, particularly Los Pelambres and Centinela, yield by-products, including gold, molybdenum and silver. Hence, we strive to recover as much as possible of these minerals. We built a plant for a molybdenum recovery at Centinela and have plans to expand that to extract all metals found alongside copper, ultimately enhancing our competitiveness. Finally, we are transforming the way we mine copper by establishing remote operating centres, rolling out autonomous vehicles and introducing more digital technology. All these innovations help lower our costs and compensate for lower grades. One point to add is that at Antofagasta we have permanently moved to a hybrid way of working, which in our experience has led to higher levels of productivity at lower cost, as well as improving work-life balance for our people.

What is Antofagasta's approach to community engagement?
Community engagement is a cornerstone of our operations, and creating value for communities is pivotal. We have engaged with them and established partnerships over time, learning to come together and resolve disagreements constructively whenever they arise. One example of our efforts is the inauguration of a center for technical education at Los Vilos, near Los Pelambres, which provides local higher education where previously there weas none. We also launched a medical services center in one of the communities, reducing the need for residents to travel long distances for emergency medical services or treatment. Our most innovative community project is around digital skills, where we train people and provide the tools to help people make better use of digital technologies.

Could you provide an overview of Antofagasta's strategies over the next few years?
At Antofagasta, safety remains our top priority; we are proud of our excellent safety performance and are committed to maintaining this standard. Our strategic focus is on organic growth projects, such as the completion of the desalination project at Los Pelambres and looking towards making a decision on the construction of the second concentrator at Centinela. These growth initiatives are crucial as we have the permits, teams, and mineral resources necessary for expansion.

Sustainability is another crucial component of our strategy. We are committed to reducing CO2 emissions further, and this year, we plan to report more granular data on Scope 3 emissions, considering setting a target for them as well. Working closely with our communities is also central to our strategy, focusing on projects that deliver social value. Overall, we aim to continue developing our business through organic growth and meeting the increasing global demand for copper. ■

We see an opportunity to leverage and advance leaching to enable us to grow our production profile with the minimum capital possible.

Joshua Olmsted

President and COO-Americas
FREEPORT MCMORAN

Can you give an overview of the recent activities at Freeport-McMoRan's El Abra mine?
The construction of our new leach pad has gone well, and we are currently finalizing and demobilizing the last of the contract workforce. We have been placing material on the leach pad for some time already, and our operation has been running well, returning to a 24/7 operation for the first time since the pandemic.

How can the mining industry take advantage of copper in waste?
Leaching is a relatively low-cost production driver, and we see an opportunity to leverage and advance leaching to enable us to grow our production profile with the minimum capital possible. Freeport-McMoRan's advantage is that we have decades of stockpiled material at our mines. We have been leaching some of this material and obtained a percentage of copper from those stockpiles. With traditional leaching technology, you could typically only extract 15% to 60% of the copper, depending on the mineralogy of the copper contained in the rock. We have approximately 38 billion pounds of copper still sitting in our stockpiles that previously were deemed unrecoverable.

This is a massive resource for us to go after with new leaching technologies, whether data analytics, artificial intelligence, or additives. At El Abra, we have identified an opportunity to use the same technology used in a third-party pilot study at one of our North American operations. We are defining the capital needs now and are hopeful to start construction of an on-site catalyst facility by the end of 2023 and see incremental copper production in 2024 or 2025.

Will El Abra utilize desalinated water in the future?
At El Abra we are still fed by continental water, but our water rights will expire toward the end of this decade. As part of our larger sulfide project, we had always contemplated the construction of a desalination plant. We are progressing with the permits and authorizations required to build a desalinization plant to serve the current El Abra operation.

What is Freeport-McMoRan's approach to utilizing innovative technologies and automation?
Freeport-McMoRan has been leveraging data, digitization, and innovation for some time. However, we have been disciplined about the fact that we do not want to innovate or automate just for technology's sake. Rather, the incorporation of technologies needs to be about driving value and improving the business. In 2018, we started leveraging AI and data analytics to help us optimize and maximize our production and efficiencies in the milling side of the business, which has since moved to other parts of the business.

How does the company prioritize ESG?
Freeport-McMoRan has been focused on all elements of ESG for a long time. For example, we built a new water treatment plant when we constructed the Cerro Verde mills. This plant was a win-win because it provides the city of Arequipa with treated water, and at the same time, allows us to have water available for our operations.

We work extensively on community development initiatives and are particularly proud of our DreamBuilder program. DreamBuilder is a free online, entrepreneurship training program that equips women with the skills and confidence needed to become financially independent business owners. This program has reached more than 134,000 women around the world, including 9,000 in Chile. In 2022, we organized a conference in Chile for program graduates to hone their business skills, including sales techniques, female leadership and digital marketing.

We also are extremely proud of our work with the Antofagasta Industrial Association in building the Don Bosco Technical School in Calama, supporting the technical education of high school students seeking to enter the mining industry.

What is Freeport-McMoRan's strategy in Chile over the next few years?
We have continued to progress engineering and feasibility type studies around the sulfide deposit at El Abra to identify the best path forward and decide when we want to activate the next phase. This robust resource creates the opportunity for a great future for El Abra and Freeport-McMoRan.

On a larger scale, our primary strategy is to leverage the assets that we currently own. Our push to leach our stockpiles is one facet of this strategy. We intend to stay focused on copper, leveraging our solid and pre-existing assets. ■

Teck is well positioned to help meet the growing demand for copper with an unrivalled suite of growth projects that could add more than 1.5 million t/y to our current copper equivalent production.

Jonathan Price

CEO
TECK RESOURCES LIMITED

Can you provide an update on Quebrada Blanca Phase 2 (QB2)?
We announced first copper at QB2 in March 2023, and are continuing to advance commissioning and ramp-up to full production through 2023. QB2 is the flagship of our copper growth strategy and will double our consolidated copper production when it reaches full capacity with the operation targeted to achieve 285,000 – 315,000 t/y copper production in 2024 - 2026. What is also very exciting is that QB2 uses only approximately 18% of the 2022 reserves and resource tonnage, so there is significant potential for future expansion.

What updates do you have on operations at Carmen de Andacollo?
The operation produced 38,600 t of copper in 2022, while overcoming some weather-related challenges. We expect 2023 production expected to be in the range of 40,000–50,000 t, increasing to 50,000–60,000 t/y for 2024 to 2026.

What is Teck's strategy for continued growth?
Teck is well positioned to help meet the growing demand for copper with an unrivalled suite of growth projects that could add more than 1.5 million t/y to our current copper equivalent production. This is anchored by our QB2 project, alongside other projects that are in various phases of development in Peru, Mexico, Canada, the US, and elsewhere in Chile.

This includes our Quebrada Blanca Mill Expansion (QBME) project which will entail an increase in concentrator throughput of approximately 50%, with the addition of one identical, semi-autogenous grinding line. The feasibility study for QBME, that was initiated in mid-2022, is expected to be completed in the second half of 2023. A permit application was submitted to the Chilean regulator in early 2023 and accepted for review. QBME is expected to be a significant contributor to our near-term copper growth portfolio with potential first production as early as 2026.

How is Teck utilizing desalinated water?
QB2 includes the first large-scale use of desalinated water at a mining operation in the Tarapacá region of Chile. A major challenge which our talented team has addressed is distance – the water must be pumped from the sea to the QB2 site, 164 kilometers away, and 4,300 meters in height.

How does Teck utilize advanced technologies?
Teck's business transformation program is delivering significant value by renewing our technology infrastructure, looking at opportunities for automation and robotics, connecting our data systems to enable broad application of advanced analytics and artificial intelligence, and empowering our employees. Last year, we announced that technology initiatives we have implemented are expected to generate approximately US$1.1 billion in recurring, annualized benefits. There are a number of examples across our operations – I'll highlight two here.

At our Carmen de Andacollo and Quebrada Blanca (QB) sites in Chile, our teams are developing and implementing a Digital Tailings Management System (DTMS) to support the use of digitally connected surveillance technologies to help monitor our tailings storage facilities. It will allow the use of data analytics for tailings facilities management aspects including geotechnical monitoring, construction and operations. And at QB2, our team is creating a full, ultra-realistic and detailed digital recreation of our operations in a digital environment. That way, we can test productive scenarios and gain experience and learning before putting them into practice in the real world.

What is the socioeconomic impact of Teck's mining portfolio in the region?
In 2021, for example, our operations created or sustained approximately 82,360 jobs across Chile, and made payments totalling US$2.2 billion to Chilean suppliers. We also generated US$680 million in taxes and government revenues to national, regional, and municipal governments across Chile. In total, Teck's global operations contributed US$3.0 billion to Chile's GDP.

One example of putting our work in Chile is our long-standing partnership with the UN Women Originarias programme. In 2022, we extended our partnership by investing an additional US$5 million to empower more Indigenous women in northern Chile.

What are Teck's priorities for the next years?
We are well-positioned to capitalize on the strong demand for copper generated by the accelerating transition to a low-carbon economy. The foundation of our portfolio is our high-quality, low-cost and long-life operations, which are located in well-established mining jurisdictions. ■

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from Japan's Nippon Mining & Metals. The deal, valued at US$950 million, demonstrates the Canadian company's confidence in the country. In a statement, Lundin's chief executive, Peter Rockandel, said: "The initial controlling interest increases our exposure to what we believe is a growing top-tier copper mining district."

For brownfield expansion to fill the gap of the lack of incoming greenfield projects in the country, the Chilean regulators must provide those companies with the necessary approvals. At Glencore's Lomos Bayas, the necessary approvals came through for the mine's operational continuity project. "This investment of US$254 million will extend the useful life of Lomos Bayas, allowing copper cathode production of approximately 80,000 t/y," said Andrés Souper, general manager of Glencore Chile. He continued: "This will utilize new mining resources in the leaching and supply phases of the plant from 2024 to 2029, and will enable us to utilize existing facilities throughout the useful life of the project."

Lomos Bayas is an example of the potential of Chilean mines, even in a time of decreasing ore grades. The mine has always had comparatively low-grade ore, and when it initiated operations, it was expected to have a useful life of only 12 years. As of 2023, the mine is going on 25 years in operation, and still growing. Souper described: "This anniversary demonstrates our ability to adapt to changes in the industry by incorporating new technologies and establishing innovative projects and programs."

The rate of innovation and advancement across the mining sector is such that the industry can, and will, continue to adapt to challenges and ensure continued profitability as copper demand increases. Mines are taking steps to improve processes not only to improve costs, but also to meet increasingly strict standards. At the Caserones mine, SCM Minera Lumina Copper Chile (MLCC) has built on its renewable energy PPA signed with Enel in 2022 by initiating the transition to electric powered trucks in the mine, with the preliminary study expected to conclude in July 2023. In early 2023, Lundin Mining acquired 51% of MLCC, and the new agreement offers further room for development. Gonzalo Araujo Alonso, CEO of MLCC, said of the acquisition: "One of the considerable advantages of this transaction is that we can integrate and learn from the other mines that Lundin has, and from our site, we can provide our own know-how to them."

As different mining companies continue to incorporate new and diverse processes into their operations, the opportunities to exploit synergies to advance effective and sustainable mining continue to grow.

Despite investor concerns, majors in Chile maintain notable confidence in the jurisdiction. Indeed, Udd of BHP lauded the continued reliability of the country: "During our 30 years here, Chile has provided stability and institutional certainty, two essential elements for developing a business that is capital intensive. The country is now facing a period of increasing social demands and changes, but we have seen these demands are starting to be solved in an institutional and democratic manner."

Turning to tailings

As mining companies return to the drawing board, seeking to find opportunities to increase production output, a surge in interest in secondary mining is sweeping the international mining industry. Historic extraction processes were unable to capture significant amounts of minerals, resulting in waste that is full of copper all over the world. With today's technology, that copper is waiting to be unlocked.

Indeed, Amerigo Resources' Minera Valle Central project has been recovering copper from copper tailings since 1992. MVC produces around 30,000 t/y of copper, roughly equivalent to a mid-sized copper mine. "We had solid operational results in the first quarter of 2023 from Minera Valle Central (MVC), with a production of 16.5 million pounds of copper and 300,000 pounds of molybdenum," explained Aurora Davidson, CEO of Amerigo Resources. "Over the last three years, our operational results at MVC have become highly consistent, which is extremely important in our industry given that we always need to deal with changes in commodity prices."

Chile has immense resources sitting in tailings dams, and as copper demand increases, it is these tailings dams that hold the key to maintaining production. Davidson sees secondary mining as central to Chile's future. She said: "Given that Chile is the world's largest copper producer, and each copper mine produces tailings, the opportunities for economically recovering copper through secondary mining in this country are apparent, and the time will come when they are pursued."

Freeport McMoRan is looking at its tailings dams worldwide, in partnership with multiple technological partners, including Jetti, with the intention of implementing new leaching technologies to extract copper from Freeport's decades of stockpiles. "With traditional leaching technology, you could typically only extract 15% to 60% of the copper, depending on the mineralogy of the copper contained in the rock," said Joshua Olmsted, president and COO – Americas at Freeport McMoRan. "We have approximately 38 billion pounds of copper still sitting in our stockpiles that previously were deemed unrecoverable."

Freeport McMoRan has already started a pilot study at one of its North American operations, working on several operational initiatives both internally and with external partners. The company has identified El Abra as an area of opportunity to use the same technology. Olmsted said: "We are defining the capital needs now and are hopeful to start construction of an on-site catalyst facility by the end of 2023 and see incremental copper production in 2024 or 2025.

In the context of the ordinarily exceptionally large timelines of any major project to increase copper production, this is a remarkably speedy and easy way to maximize the mine's existing resources.

As leaching processes continue to improve with greater investment in innovation, the momentum behind secondary mining will only increase, bringing a more sustainable and green way to dramatically increase output at a time when the world is in desperate need of greater production. ■

> When Lomas Bayas began operations, its projected useful life was only 12 years. Today, we are about to celebrate our 25th anniversary, demonstrating our ability to adapt to changes in the industry.

Andrés Souper

General Manager
GLENCORE CHILE

Please provide an overview of Glencore's recent operations and updates on production?
Glencore has two operations in Chile: Complejo Metalúrgico Altonorte, which is a smelter, and Compañía Minera Lomas Bayas. We also have a 44% stake in the joint venture Compañía Minera Doña Inés de Collahuasi, which is managed independently.

2022 was a year of excellent success at both Altonorte and Lomas Bayas. Altonorte broke a record, processing 1,105,482 t/y of new concentrate while complying with the environmental objectives established by the authorities regarding emissions and air quality, with a particular emphasis on carbon output.

At Lomas Bayas, the Chilean Environmental Assessment Service (SEA) approved the mine's operational continuity project. This investment of US$254 million will extend the useful life of Lomas Bayas, allowing copper cathode production of approximately 80,000 t/y. In terms of production, Lomas Bayas produced 72,616 t/y of fine copper, and Collahuasi produced 571,000 t/y.

How are decreasing ore grades impacting Glencore?
Glencore in Chile has vast experience in low grade ore, as it has always been our focus. When Lomas Bayas began operations, its projected useful life was only 12 years. Today, we are about to celebrate our 25th anniversary, demonstrating our ability to adapt to changes in the industry by incorporating new technologies and establishing innovative projects and programs.

Our operational continuity project will allow Lomas Bayas to continue growing. This will utilize new mining resources in the leaching and supply phases of the plant from 2024 to 2029 and will enable us to utilize existing facilities throughout the useful life of the project.

How is Glencore navigating pressures on water availability?
Complejo Metalúrgico Altonorte is currently almost entirely fed with treated wastewater from the city of Antofagasta. Additionally, the foundry has developed important innovation projects to become more efficient in freshwater usage. For example, our current smelter slag cooling system seeks to reduce the consumption of water during that stage of the process.

At Lomas Bayas, we use water from the Calama basin, but we are actively developing a plan to transition to non-continental water and ceasing to use our water rights. We plan to source our water from a sewage treatment plant in Antofagasta. Last, Collahuasi has already awarded the design and construction of a desalination plant in Puerto Patache, in the Tarapacá Region, which will have an initial capacity of 1,050 liters per second.

What is your perspective on profitability for producers at the moment?
The current scenario is challenging due to a variety of factors: the fall in production (due to less activity in the national mining sector); the increase in costs; and, finally, the instability of the copper price, which has fallen a little more than 5% in the last year.

This has also been influenced by the negative impact of the taxation of the main private mining companies in the country, all in the midst of the debate on the mining royalty project, which was recently approved to become a law.

However, the world is embarking on a process of change driven by the energy transition. From this perspective, the market will continue to be attractive.

How does Glencore prioritize environmental stewardship?
We are transitioning to the use of green energy contracts. We understand that most of our demand is long term, allowing us to project the use of non-conventional renewable energies (ERNC). We are working on the efficiency of the operation and the electrification of our haulage equipment. We are beginning to use trolleys in our Chilean operations, while increasing the use of automation, which has benefits in efficiency and – as a consequence – reduction of emissions.

Aside from having Scope 1, 2, and 3 emission reduction goals, we have short-term goals: a 15% reduction in emissions by 2026 (compared to our 2019 baseline), a 50% reduction by 2035, and, finally, 100% by 2050.

Has Glencore introduced any advanced technologies?
In Chile, in Lomas Bayas, the Autonomous Trucks project is under development. The strategy considers the incorporation of equipment and technology so that the CAEX can operate autonomously, directed from control rooms, reducing exposure risk by 90%.

In the pilot stage, which begins in November 2023, four Autonomous Trucks (AHS) will be operating. Subsequently, it will be increased to 12 trucks and then, depending on the results, a total of 27 AHS will be in operation at Lomas Bayas in 2025. ■

John MacKenzie

CEO
CAPSTONE COPPER

Can you provide an overview of the operations of Capstone Copper in Chile?
Capstone Copper owns two producing mines and one fully permitted project in Chile. On a consolidated basis, we produce approximately 180,000 t/y of copper, with growth at our Mantoverde mine in Chile that will result in an increase in copper production to approximately 260,000 t/y at significantly lower costs by mid-2024. Our next leg of growth is at our fully permitted Santo Domingo project only 35 km away from Mantoverde, and it is expected to increase our consolidated copper production to around 380,000 t/y with lower costs.

Can you discuss the status of the Mantoverde Development Project?
Construction at MVDP remains on-time and on-budget (US$825 million estimated total project Capex), with nearly 3 million t of sulphide ore stockpiled (grading approximately 0.60% copper and 0.11 g/t gold) to date, ahead of our ramp-up commencing late in 2023.

Capstone is also evaluating a district cobalt plant for Mantoverde that may unlock cobalt production from the region while producing a by-product of sulphuric acid, which can then be used internally in the leaching of our oxide copper ore to lower operating costs. The company is evaluating various opportunities with the potential to become one of the largest and lowest cost battery grade cobalt producers in the world.

How does Capstone Copper support development and employment in local communities?
We are a proud employer of over 1,600 people in Chile and we recognize that we have an even greater impact on a much larger population through our operations. Our community efforts are focused on technical/mining training, educational programs and scholarships, social investments in local communities, and developing projects with local businesses.

What is Capstone Copper's strategy and goals for the near future?
2023 is a pivotal year for Capstone, as we expect to complete MVDP construction in Q4, setting the stage for a doubling of consolidated cash flow and positioning us well for future growth. ■

Gonzalo Araujo Alonso

CEO
SCM MINERA LUMINA COPPER CHILE

What is your perspective on the regulatory landscape?
The mining industry is operating under higher standards in Chile and globally. The ICMM, for example, is promoting a series of policies and compliance criteria. The most well-known one is the GISTM for tailings. We intend to achieve that standard this year.

Environmental regulations are here to stay, and that is as it should be. There are higher standards in terms of transparency. For example, all the information we collect about water quality is available on our website.

Can you describe MLCC's approach to water management?
Water has always been one of the most critical issues for Caserones, as we are located in the Atacama desert. Therefore, water is essential both in terms of supply and quality.

We use our water very efficiently. We have a hovercraft that moves on top of the tailings, allowing us to reduce the tailings ponds and evaporation. This is critical for us because our main bottleneck in terms of production today is water availability.

What is your strategy for the coming year?
Our priority is always safety, and we will continue focusing on maintaining our good record of preventing any serious injuries. Second, we aim to achieve our production targets. We were low in the first three months, but we have plans to catch up and expect that by December, we will be aligned with our expectations of 150,000 t/y of copper. We are above targets in molybdenum production, which was excellent news because prices were very high for molybdenum in Q1 2023. In terms of development, we will complete our stabilization process and achieve design capacity.

The other significant activity will be the integration with Lundin [following Lundin's acquisition of a 51% stake in SCM Minera Lumina Copper Chile], with many opportunities to optimize synergies and exchange best practices. Now we can learn from other Lundin mines, and from our site, we can provide our know-how to them as well. ■

Aurora Davidson

CEO
AMERIGO RESOURCES

Can you describe Amerigo's results over 2023?
We had solid operational results in the first quarter from Minera Valle Central (MVC), with a production of 16.5 million pounds of copper and 300,000 pounds of molybdenum. Over the last three years, our operational results at MVC have become highly consistent, which is extremely important in our industry, given that we always need to deal with changes in commodity prices.

How is secondary mining an area of opportunity for Chile?
Market studies have shown that significant gaps between demand and supply can be expected in the case of copper. One of the opportunities to reduce this gap will be through secondary mining, which MVC has successfully done since 1992 by recovering copper from copper tailings. With annual copper production of around 30,000 tonnes, MVC's production is roughly that of a mid-sized copper mine.

How is Amerigo working to increase women in leadership?
At Amerigo, the CEO and CFO are women. At MVC, 10% of the workforce is female. We need to increase that number and also reach a point where women are the best candidates for leadership positions. We are tackling this in the hiring process by ensuring that at least one woman is interviewed for every job posted. This is laying the groundwork for more diverse hiring over time.

Second, we have a sponsorship program exclusively for women workers to level the playing field in the organization. Each of the six Amerigo/MVC management team members, including me, has sponsored an MVC worker in 2023. We meet with them once or twice a month. Some are interested in technical sponsorship, while others are interested in leadership and management guidance. The idea is to understand the driving concerns of female workers at MVC and maintain an open-door policy.■

Soledad Jeria

General Manager, Business Development
RIO TINTO

How has demand changed over the past year?
With the decarbonization challenge of the world, we are experiencing a massive increase in demand. According to McKinsey, the copper mining industry needs to deliver an additional 10 million t/y by 2030. To meet this challenge, together with the current challenge we are experiencing in Chile, where assets are aging, ore grades are declining, and production is falling, technology becomes a key enabler to meet this increase in demand. At Rio Tinto, we are fully committed to this by developing our leaching technology and working to implement coarse flotation technology that substantially increases our current recovery processes.

Demand has become more environmentally conscious, and with this, our clients are demanding us to be as sustainable as possible, with the environment, with the community, and with our civil society. In this regard, Rio Tinto, at its Kennecott asset, was the first one to obtain the Copper Mark certificate. Copper Mark is an assurance framework that promotes the responsible production of copper.

Can you describe operations at Escondida last year?
Ore grades are declining substantially, the pit is getting deeper, and as with most aging pits, geotechnical stability becomes more of an issue. Escondida has well understood the challenges, and critical decisions are coming ahead that will define the growth pathway of the asset.

The teams right now are focused on opening optionality, maintaining the production levels, and the competitiveness of Escondida in the copper industry.

What are the pros and cons of Chile as a jurisdiction?
Although there have been significant changes in Chile over the past two years, the country is an attractive place for mining investments. More can be done to facilitate exploration initiatives, provide for longer-term tax invariability, streamlining the environmental approval process for new projects and expansions, as well as development of a strategy for broad access to water desalinization. The human resource capabilities of mining companies, contractors, and suppliers are world class. ■

Lithium Production and Development

The Chilean government offers new regulatory clarity

Image courtesy of Albemarle

2023 has been a historic year for Chile's lithium industry. After over a decade of delays, President Boric's administration announced the new National Lithium Strategy on Friday, April 21st, finally giving the mining world clarity on the game's new rules. This announcement was the major step needed to unlock the Chilean lithium industry.

However, the National Lithium Strategy is unpopular among the larger business community. Central is the requirement that the state takes a majority stake of 50.01% of shares in all private companies working in lithium development. For Boric, this fulfilled a key campaign promise, and he has sold it to his constituents as a major nationalization of the lithium resources.

The immediate plan is for Codelco, the state-owned company that is the world's largest copper producer, and the other state companies, CORFO and ENAMI, to partner with private companies. That role will then transition to a state-owned National Lithium Company, which is to prioritize the industry while balancing a focus on the environment.

The law is widely seen by players in the Chilean lithium sector as poorly communicated to the public and international investors. Major international newspapers headlined Chile's new "nationalization" of lithium, and markets responded. In the immediate aftermath of the announcement, shares in SQM and Albemarle, which have concessions due to expire in 2030 and 2043, respectively, plunged.

The market reaction to the new law missed a central fact: lithium has always been nationalized in Chile. The Chilean constitution has long defined lithium as a strategic, state-owned mineral due to its potential use in nuclear fusion. For Boric, a resource-nationalist narrative oriented around taking control of the industry, complete with a #LitioPorChile (#LithiumForChile) hashtag, plays well with his constituents. Still, the reality of the framework contained no surprises to players within the space.

Jamil Sader, CEO of Monumental Minerals, a lithium exploration company, explained that the strategy has been communicated poorly to the general public, saying: "Many investors are worried that Chile will be taking projects away from companies or there will be forced sales of projects. We know that this will not happen. Mining companies and foreign investments are protected by Chilean law and international treaties."

Indeed, the National Lithium Strategy is an excellent step for the industry. For a long time, no new lithium projects have been able to move beyond the exploration phase due to the lack of rules and clarity. The entire industry has been aware that the state would play a significant role in producing the already state-owned mineral but has been frozen while waiting for the country to decide what that role is. In a public statement, Cristóbal García-Huidobro, CEO of Lithium Power International, put the broader sentiment of the industry into words: "This is good news for the country. The policy determines clear general guidelines, which will give way to various projects in the existing salt flats network, incorporating the necessary competition in the industry and accelerating the processes of innovation and adoption of new standards for the lithium projects in Chile."

There is a general understanding that lithium belongs to the state and that the profits from lithium must be utilized to fund the nation's development. However, the inefficiencies of state-run mining organisations concerns players across the industry. Hemmerdinger of APRIMIN explained: "Government figures show that in lithium SQM and Albemarle paid US$3.1 billion to exploit their deposits and another US$1.9 billion in direct taxes, so a total of US$5 billion was paid to the government, with zero government investment. On the other hand, the government invested US$52 billion in Codelco, and it generates US$2 billion in taxes every year. The country could invest US$52 billion to make US$2 billion, or zero to US$5 billion."

Codelco will be the central player in the new lithium regime. André Sougarret, CEO of Codelco, expressed confidence about Codelco's ability to move lithium production forward: "We have the skills and experience in mining, commercial, legal, and financial matters, as well as a strong appetite to be a leader in the mining of the future," and added: "We will focus on ensuring that Chile grows in production and recovers its position as one of the largest lithium producers, ensuring that the State benefits from this cycle of high prices."

High taxes are seen by many as more efficient than state ownership, and the private sector would have preferred a model in which lithium producers paid the majority of the profits as a royalty to the present model of state involvement in production.

For the major producers, however, the National Lithium Strategy is not too concerning. Albemarle, in particular, is more protected as its contract does not run out until 2043. Ignacio Mehech, country manager of Chile of Albemarle, told us: "This policy doesn't negatively impact our operations. Born from a state association 43 years ago, we are experienced with and quite comfortable in public-private associations."

Both Albemarle and SQM will, however, have to come to the table with the government or risk losing the entirety of the company when their leases expire.

For Albemarle, the new framework is an opportunity to expand. "Should the state allow, we are interested in exploring growth alternatives in other regions within Chile, leveraging the technologies we are developing," said Mehech.

SQM's position is more challenging. Their lease expires in 2030, only seven years away, so their bargaining position is not as secure. However, there are two more elections before 2030, and Boric is notably unpopular, with approval ratings of 29% in late April 2023, according to a poll by Cadem. There is plenty of time for political winds to shift in favor of the major lithium producer.

And indeed, SQM's economic position remains strong. In March 2023, SQM announced that it had earmarked US$3.4 billion in new Capex by 2025, to boost lithium carbonate production capacity from 180,000 t/y to 210,000 t/y. This investment is no surprise considering the soaring profits the Chilean company experienced during last year's lithium price boom. In 2022, SQM's income amounted to US$3.9 billion, a transformational growth compared to 2021's US$585.5 million.

The lithium plan as it stands currently is not guaranteed to reach law. Boric does not have a majority in the National Congress, which must approve the move, and that lack of a majority will lead to negotiations that may change the law significantly before it reaches his desk for final signature.

The urgency of a push in the lithium industry cannot be overstated. Substitution of the mineral is expected to take place within the next twenty years. Therefore, the window to exploit lithium is limited.

For the state of the world, this forward movement is vital. 60% of the world's lithium reserves are located in the lithium triangle of Chile, Argentina, and Bolivia. "The lithium moment is undeniably now," Mehech said, continuing: "In the previous year, the demand was around 500,000 t, but by 2025, we anticipate it will exceed 1,800,000 t. Production in Chile must ramp up to meet future demand."

Globally, the importance of Chilean lithium is continuously gaining steam. Currently, the race for electrification is one that China is handily winning, with the country buying 70% of lithium compounds and supplying 70% of lithium production, despite holding less than 7% of the world's lithium reserves. Six of the world's top 10 lithium battery makers are in China. Recently, the West has awoken to the need to pursue involvement actively. In January, for example, German Chancellor Olaf Scholz visited Chile and Argentina to reduce reliance on China and improve Europe's resource independence.

SQM and Albemarle are both poised to benefit significantly from demand driven by the US Inflation Reduction Act (IRA). The EV subsidy is oriented around the origin of the "critical minerals," which includes lithium, and 40% of these battery minerals must be sourced from the US or a free trade partner to qualify for the subsidy. By 2029, that percentage will reach 80%.

Chile and the US have had a bilateral free trade agreement since 2005. Of the 10 countries that qualify to supply these battery metals, Chile and Australia are the two biggest lithium producers. According to the US Environmental Protection Agency, 67% of light vehicle sales and 46% of medium-sized vehicle sales are expected to be electric by 2032. The US market has limited options for sourcing, and Chile is poised to reap the benefits.

On May 23, 2023, SQM and Albemarle signed agreements to supply Ford with lithium. In a statement, SQM declared that it would supply lithium hydroxide and battery-grade lithium carbonate, although it did not clarify how much. Albemarle announced it will provide over 100,000 t/y of lithium hydroxide, enabling Ford to produce about three million batteries from 2026 to 2030. The wave of demand for battery metals is beginning, and with regulatory clarity, Chilean lithium will play a crucial part. In a context of a world desperate to reduce the emissions from hydrocarbons and other fossil fuels, it is likely that the new clarity will attract considerable investment into Chile's lithium industry in the near future. ■

»Our ultimate goal is to sustainably supply the high-quality lithium that the world needs. Albemarle is focused on improving our existing operations and shaping the new era of lithium in Chile.«

Ignacio Mehech

Country Manager Chile
ALBEMARLE

Could you provide a review of Albemarle's activities in 2022?
Albemarle's activities in 2022 have been substantial and varied. We inaugurated the expansion of La Negra chemical plant in Chile, doubling our lithium carbonate production to an impressive 85,000 tons annually. A unique feature of this plant is a thermo-evaporator, a voluntary addition that allows us to minimize water consumption during production, reducing it by up to 30% per kg of lithium produced. The installation of this device at a lithium production plant is an pioneer idea, showcasing Albemarle's commitment to sustainability. Further, we are set to inaugurate another installation in Salar de Atacama that will improve lithium recovery from reservoirs without additional water or chemical use (Lithium Recovery Initiative). This innovation will allow us to achieve our production target of 85,000 tons in the coming years.

How are you incorporating direct lithium extraction in your operations?
We have conducted extensive research into direct-extraction technologies for several years, holding patents since 2017. These technologies present a new era for lithium, offering selective recovery and the ability to reintroduce the brine back into the ground. However, these technologies also come with challenges. For instance, they demand considerable energy, so we have ensured that our energy comes from renewable sources. Direct Lithium Extraction also requires a significant amount of water, necessitating an alternative source to preserve our sustainable water usage record. Hence, we have entered an agreement with Cramsa to bring up to 500 liters per second of desalinated seawater to the Salar de Atacama basin by 2027 (pending permits and construction). The final challenge lies in re-injecting the brine back into the Salar, a process that is still being studied for an industrial scale use. We are currently testing this process and hope to have our first conclusions by the end of 2023.

How does the company prioritize technological innovation?
Our situation is a unique opportunity as it is aligned with the government's national policy, which encourages industry growth through direct-extraction technologies. Our contracts and permits allow us to operate until 2043, so we can produce while transitioning to new technologies, assuming we surmount all the challenges. No other company in the world can claim this position. Having produced lithium in Chile for 43 years, we are leading the innovation of new processes and remain committed to being the best globally. The recent agreement with Cramsa is a testament to our forward-thinking, collaborative approach. We believe that other companies could also benefit from this desalination project, without needing to build new desalination facilities.

What are the implications of the National Lithium Strategy?
Despite some industry uncertainty, we are confident that our contract is secured until 2043. The policy does not negatively impact our operations. Instead, it presents us with an opportunity to grow within Chile. Moreover, the policy has sparked interest in other sectors, with many industry voices keen to partner with the state to exploit other salars. Our operation in Chile was born out of a state association 43 years ago, so we are experienced in and quite comfortable with public-private associations. In fact, should the state allow it, we would be interested in exploring growth alternatives in other regions of Chile, leveraging the technologies we are developing.

Can you share your perspective on the future demand and pricing of lithium?
The lithium moment is undeniably now. The demand was around 500,000 tons in 2021, but by 2025, we anticipate it will exceed 1,800,000 tons and by 2030 we project a demand of 3.7 million tons. This remarkable growth needs to be met with adequate supply. That is why Albemarle is keenly exploring new opportunities globally, including in Chile.

What are Albemarle's goals for the rest of 2023?
One of our primary initiatives this year is the inauguration of the Lithium Recovery Initiative in the Atacama Salar. This unique venture does not exist in any other lithium operation in the world. It's crucial for us because it will enable us to reach La Negra's capacity of 85,000 tons in the following years. Additionally, we are investing in developing new direct lithium extraction technologies. In support of this, we are focusing on securing water supply, connecting with the national electricity system to have renewable energy for our operations, and piloting re-injection and advancing direct extraction technologies. Our ultimate goal is to supply the high-quality lithium that the world needs sustainably. Albemarle is focused on improving our existing operations and shaping the new era of lithium in Chile. ■

JUNIOR EXPLORATION

"There are currently 22 million t/y of copper production in the world, which is expected to increase to 28 million t/y by 2030; essentially, that is as if the world added another Chile. The aggressive projections on demand are impressive, and supply will be the bottleneck for copper, so copper is a significant investment area in our portfolio."

Martín Valdés,
Partner and Head of Private Equity Fund VII,
Resource Capital Funds

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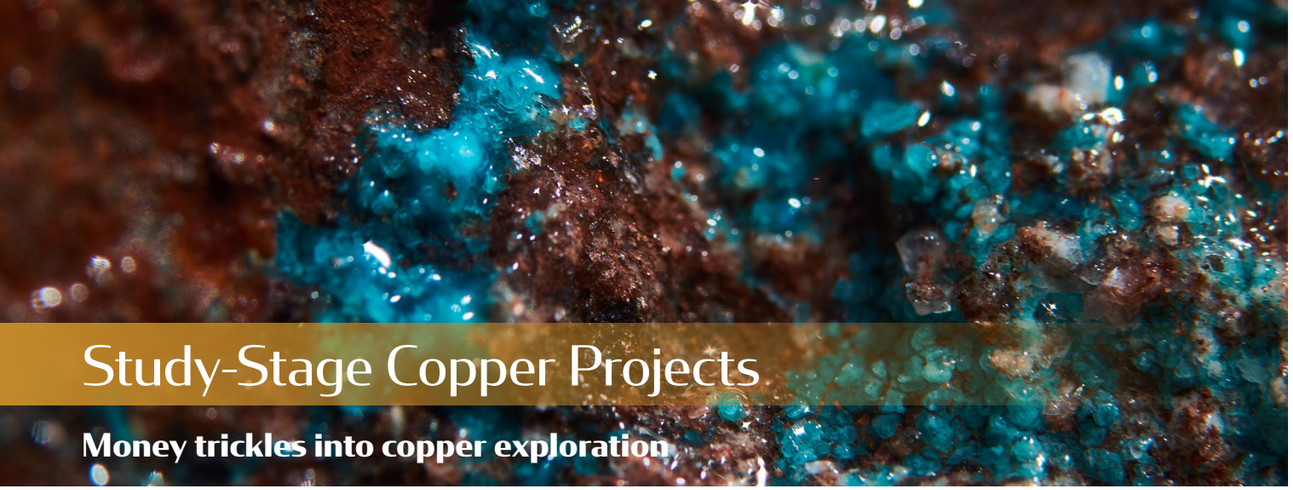
Image courtesy of Torq Resources



Study-Stage Copper Projects

Money trickles into copper exploration

Image courtesy of AMSA

Government regulation in Chile is currently set up to manage massive projects with intensive permitting systems. The extent of requirements can be unnecessarily challenging for study stage and exploration projects. Nolan Peterson, CEO of World Copper (TSXV: WCU), said: "There needs to be an understanding that a junior company has to be more adaptable and agile during the exploration phase. Now, if we want to do a small drill program, we permit it as if it is a big drill program. That means we might as well throw in everything we could conceivably want to do for the next five years to get it over with."

The permitting system is not set up according to the needs of juniors and small mining.

However, the small-scale mining sector still has significant room to grow and develop. "Altiplano has the utmost confidence in Chile, particularly in the small-scale mining space where we operate, at under 5,000 tons per month. The government and the permitting process is very supportive of this business," said Alistair McIntyre, CEO of Altiplano.

Altiplano Metals (TSXV: APN) has been underground at Falleron since 2018, mining copper at a grade of approximately 1.8%, which is excellent considering that the average global grade for new copper projects coming into production is around 0.5%. Altiplano's new processing facility is in the final commissioning phase, providing a significant value-add for the company, reducing its processing costs by 40% and shipping by 70%.

"With a focus on ESG, we have designed a system that will reduce water consumption by 75% by utilizing a dry stack tailings process, meaning that we will not need a conventional tailings dam that communities find intrusive and has the potential to be environmental liabilities," explained McIntyre.

The system uses magnetic separation to remove iron, producing less tailings and generating a second income stream, and the final tailings will contain apatite, a phosphorous mineral that can be sold as an output to the agricultural and construction industries. McIntyre continued: "With a focus on water reduction and tailings management, it will be the first of its kind in the Chilean small scale mining sector."

In February of 2023, Los Andes Copper (TSXV: LA) announced the results of its PFS for the Vizcachitas project, the cumulation of four years of technical and engineering studies and additional drilling. The results of the PFS include a measured and indicated resource increase of 16% to 134.8 billion pounds of copper, 84 million pounds of molybdenum, and 11 million ounces of silver, with an inferred resource increase of 130% to 15.4 billion pounds, including more than 13.747 billion pounds of copper and 495 million pounds molybdenum.

The project is rare among juniors for its infrastructural advantages, located in the fifth region in central Chile. Santiago Montt, CEO of Los Andes Copper and President Minera Vizcachitas, explained: "Unlike the operations in the north of Chile, which require Capex to develop highways, energy systems, and other infrastructure, at Vizacachitas we can more simply connect to the national energy grid 60 km away from the project and connect to the point of water delivery only 90 km away. These are critical factors in lowering the Capex of a project." Montt added: "Chile stands out not just because of its reserves but because of its human capital. There are vast numbers of people with the expertise to work in mining operations."

The company works with local universities to develop workers from the local region, and Montt stated: "As companies carry out exploration and mine planning, the region also needs to start developing the human capital so that the opportunities that the project will bring are kept in the region."

In 2022, World Copper carried out a successful drill program in the Mancha Amarilla area, south of the main Escalones resource, with the intention to extend the resource for expansion in the future. The Escalones deposit is notable for a very thick oxide layer, up to 300 meters in some places, with higher-grade copper blocks in this layer. As oxides are easier to permit and process than sulfide deposits, and do not create concentrate and require tailings storage, they are significantly more attractive. Aware of the value of the Escalones deposit, World Copper purchased Zonia, a project in Arizona that can be permitted in under four years, with the intention of using the smaller project in the US to generate cash flow which will be used to continue the development at Escalones. Zonia is on a rapid path towards development and is the short-term focus of the company. Peterson explained: "In Chile, at Escalones we will start permitting for the next phase of development, which is continuing to drill there to start thinking about a pre-feasibility study or feasibility study."

Volatile investor sentiment has been a challenge in the industry, which tends to operate cyclically. Over the past few years, there was severe underinvestment in the mining industry, but in large part, enthusiasm is returning. The norm, as Hayden Locke, CEO and president of Marimaca Copper (TSXV: MARI), explained, is that big companies make money first as commodity prices rise, and then the money trickles down to the exploration phase. That shift has yet to completely occur. He said: "Most of the money is still coming from traditional retail investors keen on a higher risk-reward ratio. However, we are seeing an uptick in majors' interest in putting money to work in exploration and finding new projects."

Marimaca Copper is aiming to deliver a resource upgrade, moving permits forward and compressing the timeline to first production, with the aim of delivering a permit application towards the end of 2023. After over 140,000 meters drilled, Marimaca has high confidence in its resource estimate, with recent drilling results focused on infill rather than extensional drilling. These infill drill results exceeded expectations. In this context, there is plenty of room for positivity industry wide. Locke said: "Cash is not yet falling from trees, but it is available now, and if you have a strong project and team, you can find it." ■

» Mid-size operations are more aligned with how the world envisions its mining industry in the future, and this is particularly applicable to Chile and its recently issued 2050 National Mining Policy.

Arturo Prieto,
CEO, Minería Activa

» **Distinct alteration, mineralogical and elemental values, patterns, and ratios can now determine where you are in a porphyry copper molybdenum mineralizing system. Computer modelling using proprietary algorithms have been developed using this research.**

Tony Harwood,
CEO, Montero Mining and Exploration Ltd. «

» We want to grow on an operational level and expand within the region where the Farellón project is located. I want to expand our production profile and grow through acquisitions to improve on a revenue-generating business.

Alastair McIntyre,
President and CEO, Altiplano Metals «

RJ

CN

Raymond Jannas and Craig Nelsen

RJ: CEO
CN: Board Chair
ATEX RESOURCES INC

Can you provide an update on your activities at the Valeriano project?
RJ: Our Phase II drilling program was a proof of concept that yielded 1,160 m at 0.78% copper equivalent, including 550 m at 1.03% copper equivalent, which was a radical change in 2022, showing the continuity of the high grade in what we refer to as the Central Zone. Phase III has been expanding our knowledge: with drill hole 11B, we hit 1,343 m with 0.73%, a game-changer identifying a new area with a high grade in what we are calling the Western Zone. Phase III is still ongoing, and we are expanding the size of our resource. It is an extensive property that is still open on all sides. One very positive aspect of Phase III is our new contractor, GeoDrill, which has allowed us to reach objective depth and position on all the holes that we have programmed, and we are hoping to get at least 12,000 m by the end of the season.

What makes ATEX Resources an attractive stock for investors?
CN: When you look at some of our competitors, including Filo Mining, they are having similar success, and their market caps are 10 to 20 times the market cap of ATEX. It is the recognition of the size of this asset and the fact that Filo has a market cap of around US$3 billion, roughly 15 times our current market cap. It looks like an equally viable project with a relatively low market cap.

RJ: We have not reached the amount of those because we have so few holes in the porphyry. Our competitors have a tremendously higher number of holes. Our advantage is that we are rapidly going in that direction, allowing us to advance this program much faster. I expect to see another increase in our share price with continued success.

What is your perspective on the current regulatory landscape?
CN: It has improved in some areas and degenerated in others. Some of the permitting decisions made by the government have seemed somewhat arbitrary. We are careful to communicate well with the regulators in Chile. We plan to submit a DIA in the fall of 2023. The local indigenous communities are a significant focus for us, and we seek to develop a plan they are on board with from the beginning.

RJ: Regulations could be clearer. We are going through a regulatory process that must be done smartly. Chile is a mining country and will continue to be, and the government has realized that, but we are still going through the tax process and a new constitutional process. Investors will be more hesitant until these issues are defined and a clear regulatory framework is established.

What factors have positioned ATEX Resources for success?
CN: Reshaping the Board of Directors into an independent governance body was a big step in differentiating ATEX. Our largest shareholder, Pierre Lassonde, has also been a huge cheerleader of the group, with an incredible network of investors. Pierre coming into the project de-risked the capital side.

What is your strategy going forward?
RJ: Our strategy is to understand the size and grade of our project. This will be an underground operation, without a doubt. The mineralization starts too deep to be open-pit, and when you are an underground operation, you need a higher-grade ore body. Given that, we are focused on finding high-grade zones and assuring the forward momentum of the project. It would be helpful to have a strategic partner with the view of taking this forward. In the short term, we will continue drilling and deepening our understanding of the size of the deposit.

CN: We will need to raise more funding. We will probably require between US$50 to US$100 million to get the project towards a pre-feasibility study. Still, this project is a fairly rare beast in terms of its grade tonnage curve, which makes us a likely acquisition target. At ATEX Resources, we focus on ensuring that we take this forward socially and environmentally consciously, aiming to operate under good governance and transparently as we continue to develop the project. ■

» Our first goal is to secure and present investment opportunities to the market. By that, I mean strategic investors and major players who can JV with us or support the development of our projects. «

Nolan Peterson

CEO
WORLD COPPER

What updates have occurred at World Copper over the past year?
The market has been turbulent and challenging for many companies, but we have continued advancing. Last year, we carried out a drill program at our Mancha Amarilla area, south of our main Escalones resource, intending to extend the resource for expansion. For our purposes, it was a successful program. We drilled along the western flank of the Mancha Amarilla and proved that the mineralization continued and that the oxide potential was as thick as the primary resource. We observed that the higher-grade copper was towards the east, which sets us up for future development. It is the equivalent of discovering a new copper porphyry. It just happens to be beside the existing copper porphyry.

At our Zona project in Arizona, we sold a royalty stream of .5% to Electric Royalties for CAD$2 million, bringing in some cash and a vote of confidence that we are on the right track and can quickly get Zonia into production. We also updated the mineral resource estimate there, intending to at first expand what it has, without doing more drilling. We have taken that deposit to over a billion dollars of copper in the ground. We are in active discussions with other groups to bring in development capital.

What differentiates Escalones from other projects in the area?
Large deposits characterize Chile's copper. Copper porphyry has two components: an oxide cap and a sulfide layer below. The oxide cap is limited to how much sulfide material was oxidized over thousands or millions of years. That leads to these porphyries having extensive sulfide layers, especially in Chile, and extends these projects to have 30 – 60-year mine lives with high processing capacity.

We noticed that at our Escalones project, the oxide layer was very thick. Instead of being 75 to 150 m thick, it was 300 m thick in some places. The higher-grade copper blocks for this particular porphyry were in this oxide layer. Oxides are much easier to process than sulfide deposits, require easier metallurgically, and require less infrastructure and a lower CAPEX. They are easier to permit, they use less water, they don't create a concentrate, and you don't need a tailings storage facility. For major mining companies to invest a large amount of money, many would rather go for a larger deposit even if it has significant risks and less attractive economic ratios. With Escalones, we have been focusing on making it a stellar oxide deposit. It is the largest copper oxide deposit in Chile right now in terms of copper in the ground.

How could Chilean permitting and regulation better facilitate development?
Chile is a mining country, so there is a lot of support for exploration. The country has many camp services, engineers, a well-educated workforce, and a strict rule of law, among other benefits.

Right now, Chile is set up for massive projects, with permitting processes to ensure minimal environmental impact. In my experience, as it has impacted World Copper, a one size fits all approach does not work well. There needs to be an understanding that a junior company has to be much more adaptable and agile during the exploration phase. We can't commit to things on a five-year development timeline – at Escalones, for example, we plan six months out. There needs to be an understanding in the permitting process that we are not building a mine or having a massive permanent impact. Now, if we want to do a small drill program, we permit it as if it's a big drill program. That means we might as well throw in everything we could conceivably want to do for the next five years to get it over with in one effort. But that's not how our industry is set up to operate, nor how it is done in Canada or the US. In Chile, companies got away with too much before, and the government needed to clamp down, but now the pendulum has swung too far in the other direction.

What is World Copper's strategy for the rest of the year?
Our first goal is to secure and present investment opportunities to the market. By that, I mean strategic investors and major players who can JV with us or support the development of our projects. ■

Hayden Locke

President and CEO
MARIMACA COPPER

Could you provide an update of Marimaca Copper Operations?
Marimaca now has completed significant metallurgical test work, and we are in our sixth phase, which is about operational readiness and optimization.

Most of our recent drilling results were about infill drilling rather than extensional drilling, looking for a higher degree of geological understanding. When you infill drill a deposit, you typically find that a project gets worse. At Marimaca, it has been the complete opposite. The infill drilling results exceeded our expectations. It underpins a substantial resource upgrade, capturing additional copper tons.

What is your plan to supply water to the mine?
We had a strong view that due to the water scarcity of the Antofagasta region, if we wanted to build a sustainable mine, we couldn't do so using the standard methods. We looked into using recycled water from the thermoelectric plants in Mejillones.

We structured a contract in which we pay an annual option fee to secure a portion of their water supply, which will supply enough for the entire life of the mine as it is currently envisaged.

What differentiates the Marimaca Copper project?
The primary differentiating factor is location. Often, mines are remote or located in challenging areas in terms of a high levels of biodiversity, glaciers, community issues, and so on. Marimaca is in the low coastal range of Chile, close to the coast allowing us to use seawater, and we don't need to build a desalination plant, which saves an enormous amount of capital cost. Additionally, we are close to Antofagasta but far enough not to directly impact any stakeholders. This lowers the execution risk and financing risk for this project, making our timelines to first copper significantly shorter than our peers. At this stage, we're targeting to submit our permit applications in early 2024, and commencing construction in 2025 and be in copper production by the end of 2026. ■

José Ignacio Silva

Executive Vice President
HOT CHILI

Could you update us on recent operations at Hot Chili?
The last year has been quite intense, primarily focused on the exploration and development of the Costa Fuego project. This venture encompasses 3.5 million t of fine copper contained in our current resource. Our aim has always been to yield more than 100,000 t/y of CuEq over several years. This would make Costa Fuego one of the new top tier mines in in Chile's vast mining landscape developed not by a major. The Costa Fuego project is the outcome of 13 years of relentless work, merging our first production project, Productora, with around 250 million tons of resources, with the 2019 option and later executed Cortadera project, currently holding about 750 million tones of resource (both projects at about 0,47 CuEq). This amalgamation has multiplied our production by four, with four production companies situated in a hub intended for joint processing. We have improved the project's infrastructure, securing critical routes, community engagement, services, surface rights, maritime concessions, and electrical connection rights, amongst others. Costa Fuego is situated in a favorable jurisdiction, boasting an existing port and potential access to renewable energy.

What are your next steps in terms of permitting?
The next step involves the release of the PEA, preliminary to the PFS that we will soon start over Costa Fuego. We already have a PFS for Productora, now we are combining Productora and the Cortadera projects (also, a smaller but high-grade deposit called San Antonio is also involved). We plan to complete the PFS for Costa Fuego in Q3 2024 and soon after submit our environmental application for the mine.

What are your main goals looking forward?
Our plans are to conclude our PEA as soon as possible, and then shift our focus to PFS, DFS and construction. Chile remains a very favourable legal jurisdiction. ■

Alastair McIntyre

President and CEO
ALTIPLANO METALS

Can you provide us with an update on your current operations?
We've been working in Chile for over five years now focusing on copper and gold. We've been underground at Farellon since effectively 2018 where we have concentrated on development and grade control measures with great results. As we go deeper at Farellon, the grades and width of the vein have improved. Mining grades at our current levels are about 2 to 2.25%, and I'm very pleased with that result.

What is the status of your processing facility?
Our processing facility is completing the commissioning phase and will begin the final startup phase in late March. We are excited to begin processing at El Peñón as the mill will provide a significant value-add for our product. We will reduce our processing costs by 40% and shipping costs by 75% while getting a high-value concentrate returned from the mill that we can sell at market, creating an opportunity to get greater value, including some gold sales. We also get contained iron from the material. An iron oxide copper-gold system contains about 35% to 40% iron ore, and we can capture this iron at our mill through a secondary processing stream.

With a focus on ESG, we have designed a system that will reduce water consumption by 75% by utilizing a dry stack tailings process, meaning that we will not need a conventional tailings dam that the communities find intrusive and have the potential to be environmental liabilities.

What are your goals for 2023?
We aim to complete building our processing plant to produce a value-added product, which will be fully operational in the next few months. We want to grow on an operational level and expand within the region where the Farellón project is located. I want to expand our production profile and grow through acquisitions to improve on a revenue-generating business. ■

Santiago Montt

CEO
LOS ANDES COPPER

Can you discuss the results of your pre-feasibility study (PFS)?
The PFS demonstrates that Vizcachitas is a world-class, tier-one copper-molybdenum asset. Our measured and indicated resource increased by 16% to 14.8 billion ib of copper, 84 million lb of molybdenum and 11 million oz of silver, while our inferred resource increased by 130% to 15.4 billion lb, including 13.747 billion lb of copper. Based only on measured and indicated resources, Vizcachitas will have a 26-year mine life.

One of the most significant changes from our PEA to the PFS is that we changed the plan from utilizing groundwater to desalinated water.

What are the benefits of the Vizcachitas project?
The project is in the fifth region in central Chile, an area with good infrastructure. We can simply connect to the national energy grid 60 km from the project and connect to the point of water delivery only 90 km away.

What is your strategy for 2003/4?
Our priority is to work on the optimizations identified in the PFS. We have a significant tonnage of inferred resource where the historical drill holes are not deep. We are planning to drill deeper holes in these areas to upgrade the inferred resource to measured and indicated, enabling us to include this tonnage in the mine plan and ultimately add them to the reserves. This has the potential to increase the life of mine and lower the operating costs and strip ratio. Vizcachitas remains open to the east and west, and we plan to do further drilling to extend the deposit in these directions. Finally, we intend to drill some deep holes to demonstrate that mineralization continues at depth, as in the other copper porphyries within the same metallogenic belt. This mineralization would provide the potential for a future underground mine. To execute this optimization plan, we are currently finalizing the completion of certain conditions required by the environmental court. ■

Early-Stage Copper Projects

The quest for the next Escondida

Image courtesy of Torq Resources

Despite significant enthusiasm for copper early in 2023, copper prices have fluctuated drastically in response to global financial uncertainty. These fluctuations are no surprise to industry leaders interviewed for this report, and copper projections are overwhelmingly positive. "Over the next six months, we will see some price fluctuation in copper, most likely in the range of US$3.85 to US$4.50 per pound," said Alastair McIntyre, president and CEO of Altiplano Metals. "Once the Federal Reserve makes its decision to stop or slow the pace of rate hikes, then you will see the US$ further weaken and copper prices back over US$4.50."

Pampa Metals (CSE: PM) recently closed on a US$2.2 million raise, enabling the company to drill its priority project, Block 4. For the company, which has a portfolio of seven projects, Block 4 and the Buenavista Target have become their priorities. As Pampa drills, it is participating in the essential contribution of junior companies to the country – greenfield exploration. In recent years, majors have almost exclusively focused on brownfield exploration and expanding their existing mines. "The unwillingness of large producers to explore afield is why I think junior explorers are essential – they are focused on the early stage of exploration and the pre-discovery or immediately post-discovery," said Tim Beale, vice president exploration at Pampa Metals.

Torq Resources (TSXV: TORQ) has been very busy in 2022 and the first half of 2023 at its Margarita iron-oxide-copper-gold and Santa Cecilia copper-gold projects. At Margarita, Torq conducted its first drill program on the property, making a discovery of 0.94% copper and 0.84% g/t gold, which extended to 800 m long in a second drilling program. At Santa Cecilia, a project that has historical discoveries from decades ago, they put boots on the ground to prepare for drilling and targeting in December 2022. At Santa Cecilia, the company plans a total of 15,000 m as part of the first phase of drilling, to reach completion by May of 2024, while at Margarita it intends to drill an additional 4,000 m starting in June of 2023. "The company is planning to have a drill turning more or less continuously for the next 12 – 14 months," Michael Henrichsen, chief geological officer, stated.

Atex Resources' (TSXV: ATX) Phase II drilling program was a proof of concept, yielding 1,160 m at 0.78% copper equivalent, including 550 m at 1.03% copper equivalent, and the on-going Phase III has been about expanding the company's knowledge of the resource and expanding the size. The company is 12 holes into the deposit, and all are significantly mineralized. "We will probably require between US$50 to US$100 million to get the project towards a pre-feasibility study," said Craig Nelsen, board chair of Atex Resources. "Still, this project is a fairly rare beast in terms of its grade tonnage curve, which makes us a likely acquisition target," he added.

Raymond Jannas, Atex's CEO, explained: "In the short term, we will continue drilling and deepening our understanding of the size of the deposit. It would be helpful to have a strategic partner with the view of taking this forward."

The company, aware of the strength of its offering, is actively working to move it forward. Despite discussion of low ore grades and more challenging geology across the industry, it is clear that there are immense copper reserves in Chile waiting to be exploited.

Concessions landscape in transition: Law 21,420

In November of 2022, law 21,420 was submitted. Although covering several areas, the law would primarily impact the mining industry by changing the concessions system. At the moment, companies pay an annual payment for a patent with the right to explore or exploit. The changes would increase the grant term from two years to four years; however, renewal would no longer be an option. Although patents would remain indefinite, there would be stronger requirements for the companies to demonstrate that the value of the patent was being increased. Additionally, the amount of the license would increase from 1/50 Universal Transverse Mercator (UTM) to 3/50 UTM. The value of licenses is maintained only for those that demonstrate effective work.

The Cámara Minera and smaller mining players have come out strongly against the law. Zauschkevich Domeyko, president of the Cámara Minera, stated: "Multiplying the value of the patent by four would imply the bankruptcy of small mining and would put medium mining in trouble. Although we were able to get the authorities to postpone the implementation of this law for one year until 2024, there is still a need for further discussion on these issues."

Tim Beale, VP exploration at, Pampa Metals highlighted the potential impact of the law, saying: "The increase in fees for maintaining ground represents a significant further increase in costs, which will be problematic because some companies will simply not be able to afford to pay those fees."

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>
> **Tim Beale, VP Exploration, Pampa Metals**

The risk that the increase in fees could lead certain juniors to failure is a legitimate one. However, although the law would be challenging for exploration companies, many members of the mining community see it as a step forward. Alicia Domínguez, mining and energy leader at Ernst & Young, argued: "The changes may be positive in certain aspects because the current legislation allows people to hold onto the land without exploring."

Indeed, Henrichsen, chief geological officer at Torq Resources, described Chile's land tenure system as one of the barriers to entry in the country: "One of the ways the government could incentivize exploration would be to require companies to spend money on their ground to fulfill set work expenditure requirements instead of allowing land to remain dormant for long periods of time."

Chile has been the world's largest copper producer for a very long time, but it still has significant land with high potential for important discoveries. This modernization of the law could help combat Chile's productivity problem. "The biggest challenge is increasing production," Domínguez said. "There will not be new mining projects if we do not incentivize exploration. So, these changes in concessions may be an incentive for new exploration." ■

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Our future drill plans for Santa Cecilia include a total of 15,000 meters, which we should complete by May 2024. In addition, we plan to drill an additional 4,000 m at Margarita.

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Michael Henrichsen

Chief Geological Officer
TORQ RESOURCES

Can you give an update on Torq Resources' recent activities?
Torq Resources has been active on both its Santa Cecilia gold-copper and Margarita IOCG projects in Chile. Margarita is a greenfield project in the Coastal Cordillera belt that hosts Lundin Mining's Candelaria mine and Capstone Copper's Mantoverde and Santo Domingo deposits. It is an area that was overlooked for many years, and we are pleased to have not only conducted the first drill program on the property, but to have made a discovery with an intercept of 90 m of 0.94% copper and 0.84 g/t gold. We have since conducted a second drill program on the project and extended the discovery to an 800 m long mineralized system. It's a great start to a greenfield discovery and we see excellent growth potential for the project as we have identified a number of additional targets with similar characteristics to the discovery. In addition, the infrastructure on the Coastal Cordillera belt is fantastic – you can work 12 months a year as the elevation is low, it's about 65 km from Copiapo, and there is power and extensive road networks – all contributing to excellent conditions for exploration.

At Santa Cecilia, the situation is slightly different because the project already has historical discoveries on it, and we are the first to launch a modern comprehensive exploration program. We obtained our community agreement for the project in late 2022, spanning the seven years of our option agreement and allowing us to commence our on-site exploration. We put boots on the ground for the first time in December 2022 and immediately began our surface programs to prepare for drilling and targeting. The project has mainly sat dormant over the past thirty years, except for two holes that were drilled in 2012, one of which intercepted 925 m of 0.21 g/t gold, 0.27% copper and 82 ppm molybdenum. This intercept was immediately below an epithermal gold system that was drilled in the late eighties. The gold – copper porphyry system below is what we're following up on because of its immense potential. We have also found multiple porphyry centers that look similar to the project's immediate neighbor, the Norte Abierto project, which is comprised of the Caspiche and Cerro Casale gold–copper porphyry deposits owned by Newmont and Barrick.

Our future drill plans for Santa Cecilia include a total of 15,000 m as part of the first phase of drilling, which we should complete by May of 2024. In addition, we plan to drill an additional 4,000 m at Margarita, primarily on new targets starting in mid to late June of this year. So, the company is planning to have a drill turning more or less continuously for the next 12 – 14 months.

What are your views on the current regulatory framework for junior companies operating in Chile?
Chile is an important mining country with a well-established set of rules, and as a junior exploration company our experience has been that if you follow these rules, you can move forward with executing your business plan in a timely fashion. While there has been a change in government and a referendum on the new constitution in 2022, we saw a very clear democratic process play out, which gave us a lot of confidence and reassurance. We will have to see how the taxation policies move forward, but there are currently no concerns from our viewpoint. As metal prices rise, there is the potential for all countries with mining sectors to increase their taxes on producers, and Chile is no different.

What is Torq Resources' strategy and vision moving forward?
Our vision is to realize the value of our projects through comprehensive and expertly targeted drill programs. We do not plan on building a mine or becoming a producer, we are here to make discoveries, and our strategy is thus to drill, discover, and maximize the exit value. We are now well on our way down that path with active exploration ongoing at both our projects, and we can expect to announce drill results from both Santa Cecilia and Margarita starting in the last half of 2023. We are excited to expand our projects over the next 12 months, and we are well-positioned to continue to drill and produce positive results over the coming year. ■

Lithium Exploration and Development

Geopolitical trends drive high demand

Image courtesy of Albemarle

For many years, the lack of clarity concerning the lithium policy has placed lithium exploration companies in an extremely challenging situation. "In the time that Wealth Minerals (TSXV: WML) has been waiting, of the 17 companies that were in the space when we started, nearly 15 are out now because they decided not to continue pursuing Chile as an investment destination for lithium or they could not afford the administrative costs of maintaining the company," said Marcelo Awad, executive director of Wealth Minerals.

One need only look across the border to see the missed opportunity. Unlike Chile, Argentina has actively courted foreign investment in lithium, and according to JP Morgan, it is expected to go from supplying 6% of the world's lithium in 2021 to 16% by 2030. In this scenario, Chile will be bumped from its perch as the No.2 lithium producer in the world by 2027.

For lithium exploration companies, the new announcement by the government is a boon to the sector. Steve Cochrane, CEO of Lithium Chile (TSXV: LITH), described the new lithium strategy as encouraging for future lithium production: "We have acquired over 110,000 hectares of lithium rich projects across the country; the creation of a state-owned lithium company would create a vehicle that could joint venture with companies like ours to advance these projects for the mutual benefit of both parties."

Lithium Chile has multiple priority projects defined for its 2023 exploration program in Chile. The company has received community approval for a four well exploration program on the Salar de Llamara, which it expects to begin during the second half of May 2023. Cochrane said: "This is an exciting opportunity for us; Llamara is a 35,500-hectare property with historic drill results showing lithium grades up to 343 mg/i."

The company is also advancing other projects in Chile, including the Los Morros property and its 2,500-hectare property in Aquas Calientes. With the regulatory challenges now cleared up, it has fielded numerous expressions of interest for JVs and purchases from companies seeking to enter the Chilean lithium sector.

Investors who have previously flocked to Argentina see an opportunity in Chile. The activity in Argentina has resulted in skyrocketing prices for a land position, often over US$5,000 for a hectare, with the country pricing itself out of the market. If a company gets a property in Argentina, it must then manage a year-long waitlist for a drill rig and deal with Argentina's chaotic import-export regulations. In this context, Chile, with clear rules and plenty of drilling companies and experienced workers, is a superior option.

And, beyond that, Chile's lithium mineralization is remarkable. Wealth Minerals, a junior that is actively moving forward with its community pre-agreement towards a four-hole drilling program at its Ollague project, received excellent geological news. The government asked SQM to complete an assessment of the 300,000 hectares of the Atacama Salar, and SQM drilled a hole right on the edge of Wealth Minerals' salar. SQM's results support Wealth Minerals' 600-meter-thick anomaly. Awad stated: "In the publication of their results, they proved that there was an average of 1,250 ppm of lithium concentrate. This is one of the highest concentrations in the world."

The looming demand makes it an excellent time for investment in the Chilean lithium sector. With a significant number of consumer plants expected to be up and running by early 2025, the demand from battery manufacturers will jump noticeably. Policy developments in the US and Europe could further increase demand. Cochrane noted: "There are already rumors that the US will outlaw the internal combustion engine. Many political factors could accelerate the process and increase the supply-demand imbalance."

Chile has to potential to play a leading role as a sustainable and safe producer of battery metals. Awad said: "I think Chile has a moral commitment to the world to supply critical minerals. This is a highly environmental government, and on an ideological level, Chile must commit to helping the world."

Direct Lithium Extraction

It is highly improbable to produce a metal with zero emissions, but the positive impact of the finished products of lithium and copper in the energy transition outweighs the local impacts when mining is practiced in an environmentally centered and community conscious manner. In this push for a more environmentally friendly production, many technology companies and major mining companies are investing intensely in research and development to improve lithium extraction methods.

Rio Tinto, for example, is actively investing in DLE. The company is already working to deploy DLE at Rincon Project in Argentina. Soledad Jeria, general manager, business development for Rio Tinto, said: "The DLE technology uses a se-

lective absorption resin, and when compared to competitive technologies in the market, the key differentiators are that DLE takes place at ambient temperature (no need to heat the brine), and the resin is cleaned with fresh water, not acid."

The new lithium framework is notable for its push to use advanced technologies that are more environmentally friendly, including direct lithium extraction (DLE) rather than evaporation ponds, which use significantly more water. However, DLE has never been tested at scale; in South America, it is only active in one pilot plant in Argentina, which uses a combination of evaporation and DLE.

DLE is a lithium production technique in which brine is reinjected back into the salt flats. This process utilizes significantly less water, which is crucial in a land defined by droughts and water scarcity. The technique has many potential benefits, but has not been tested commercially at scale, so to demand that all future projects utilize a technically challenging and comparatively unknown production process is a risk.

Eramet Group (ETR: ER7), a French mining company, has an advanced DLE project in Argentina, with a pilot working for three years and a plant currently in construction and expected to produce next year. The company holds 10 patents for its proprietary direct lithium technology. Eramet is actively seeking to enter Chile and has carried out mapping of different salars to understand possibilities in the region. Of its Argentinian DLE plant, Hubert Porte, Chairman of the board for ERAMET Chile, stated: "Of all the companies, we are the closest to industrial production. It will produce 24,000 t/y of carbonate lithium by the end of May 2024."

Some studies have demonstrated that a combination of evaporation and DLE uses less water than DLE alone, with pre-concentration improving the optimal range to reach low Capex, water, and power usage. "Most DLE companies that we have looked at have an optimal range of lithium concentration of between 200-300 mg/l lithium where their processes are most efficient," said Cochrane. "DLE is the way of the future, and people have embraced it, but a perfect solution has yet to be found."

However, DLE projects are already being pursued in Chile. CleanTech Lithium (FRA: T2N) has planned since its beginning to produce via DLE. CleanTech's CEO Boitano spoke enthusiastically of the technology's benefits, saying: "The recovery of the resin level is around 95%. The traditional method in the Lithium Triangle requires seven evaporation pools in a batch process, which takes over 315 days, while with DLE, it takes less than 24 hours. DLE has an extremely high recovery rate, lower Capex, takes a shorter time to market, uses significantly less water, and leaves a smaller footprint on the area."

This all-in bet on DLE is risky, forcing investors to either depend on an unfamiliar technology, or stay out of the Chilean lithium market entirely. It will undoubtedly dissuade some investors from participating. That being said, demand for lithium is so high that investors needed only clarity to engage, and after years of delay, that clarity is here, and the game is on. If DLE can be successfully implemented at scale across the country, Chile will be a leader in green lithium production. ■

» As one of the largest land holders in the junior mining sector, Lithium Chile is encouraged by the recent announcement by President Boric in respect to the future of lithium in Chile. «

Steve Cochrane

CEO
LITHIUM CHILE

What are the recent highlights for Lithium Chile?

As one of the largest land holders in the junior mining sector, Lithium Chile is encouraged by the recent announcement by President Boric in respect to the future of lithium in Chile. We have acquired over 110,000 hectares of lithium rich projects across the country; the creation of a state-owned lithium company would create a vehicle that could joint venture with companies like ours to advance these projects to the mutual benefit of both parties.

Lithium Chile has defined several priority projects as part of its 2023 exploration program in Chile. The company has garnered community approval to drill a 4-well exploration program on the salar de Llamara, which we anticipate beginning the second half of May. Llamara is a 35,500-hectare property with historic drill results showing lithium grades up to 343 mg/l.

We are actively putting the pieces in place to advance some of our other projects in Chile. Brine sampling on our Los Morros property shows lithium grades of up to 700mg/l, with a low magnesium impurity. Following permitting, the company intends to advance this project with a 3-4 well exploration program.

Detailed surface brine, sediment and rock sampling took place in January on our 2,500-hectare property in Aquas Calientes. Prior government sampling returned lithium values of up to 380 mg/l from surface brine pools. The company has existing permits on part of the claims for borax mining which we believe will benefit the company's overall permitting process.

Can you describe investor interest in your properties?

We expect the regulatory environment to change in Chile, as evidenced by the recent announcement from the Boric Government on creating a state-owned Lithium company to work with the private sector in attracting investment and advancing Chile's lithium production. We have received many expressions of interest, JV's and offers from companies who have come to Chile and been told that we have the best exploration package in the country.

What do you foresee for the supply-demand dynamics of lithium?

The unpredictable part of lithium pricing is how quickly governments will move to mandate electric transportation. There are already rumors that the US will outlaw the internal combustion engine. Many political factors could accelerate the process and increase the supply-demand imbalance.

For all the money that has been poured into Argentina in the past five years, there are still only two producing mines, with two more forecasted to come onstream before the year ends. Prices will continue to be volatile, as commodity prices are, but we are going to see that range move up as demand for EVs increases.

What is your perspective on the regulatory push for DLE?

The only commercial plant utilizing DLE in South America is in Argentina, and they use a combination of evaporation and DLE. Ideally, DLE uses less water, but we have found in some of the studies that we have done that there is less water usage if you pre-concentrate. A combination of some evaporation and some DLE may provide the benefit of using less water than one or the other. Most DLE companies that we have looked at have an optimal range of lithium concentration of between 200-300 mg/l lithium where their processes are most efficient. We have also run tests on preconcentration of the brines to see what impact higher lithium levels have on things like Capex, Opex, and water usage. This research is ongoing. DLE is the way of the future, and people have embraced it, but a perfect solution has yet to be found. It will work itself out, but it will take some time.

Why does Lithium Chile stand out?

We are far and away the cheapest lithium company at this gestation period of any listed company on the market. Prices are correcting, and there will be carnage in the lithium industry for the latecomers because the pricing will not support their pipe dream. If you look for actual value, we have one of the largest land portfolios in the junior sector, we have a reported lithium resource of 2.587 million t LCE that will be updated in our 43-101 technical report by the end of April or early May. We are building a real resource and a real company, and that value is not reflected in our market cap. ■

> **Lithium mining will bring taxes and royalties to the government at a massive scale, dramatically increasing the quality of life for all Chileans.**

Marcelo Awad

Executive Director, Chile
WEALTH MINERALS

Can you update us on recent developments for Wealth Minerals?
At the Ollague project, we recently developed an excellent pre-agreement with the community, enabling us to proceed with a four-hole drilling program. The geological information we have about the deposit is encouraging. Simultaneously, we were having discussions with neighboring companies that also have concessions. Wealth Minerals controls 8,200 hectares, which is sufficient to develop a project, but by adding concessions, we could together increase the yearly output of the deposit. We intend to do it independently, but we are open to a joint venture if an adjacent company is interested.

At the Atacama project, we have been working for 3 to 4 years with different communities claiming lands in our concessions. Three communities are claiming ancestral ownership of the land. We have had excellent discussions with them and are progressing in formulating a pre-agreement.

Can you describe any positive geological news?
The government asked SQM to complete an assessment of the 300,000 hectares of the Atacama Salar. They collected geological information, the water balance, the impact of the brines, and so on, producing a not-yet finalized but very comprehensive document. One of the spots where they drilled a hole was right on the border of our Salar, 1,000 meters deep. They proved that there was an average of 1,250 ppm of lithium concentrate. That is one of the highest concentrations in the world. That proves that our geophysics made 4 years ago is right because we found an anomaly about 600 meters thick, which is supported by the drilling SQM conducted right on our border.

What do you offer the communities?
Our main offer to the local communities is for them to become part of the joint venture at no cost, giving them 5%. The agreement is still under discussion, but we are progressing in that direction. An advantage is that as the communities get involved in the project, they gain a fuller sense of the challenges and realities of lithium mining and can experience the dedication and consideration we are putting in.

What can Chile do to incentivize investment in lithium?
We have waited over six years for the government to announce clear rules and regulations for the private sector's involvement in lithium operation and production. In the time that Wealth Minerals has been waiting, of the 17 companies that were in the space when we started, nearly 15 are now out because they decided not to continue pursuing Chile as an investment destination for lithium or they couldn't afford the administrative costs of maintaining the company.

We expect a forthcoming announcement clarifying the rules and believe it will most likely allow the private sector to form joint ventures with state-owned companies.

How do you view the supply and demand dynamics of lithium?
I would estimate that the long-term representative price is around US$40,000/t. However, based on the market analysis and information available, I foresee a shortage that may last a few years, between 2025 and 2030. In that period, we will again see the prices rise.

Why must Chile commit to a strong lithium industry?
As we produce lithium for the electricity transition, part of that development in the electricity transition will be used to produce lithium. So, there is a positive feedback loop in play. I think Chile has a moral commitment to the world to supply critical minerals. We have the second-largest known lithium reserves in the world and the largest known copper reserves; two out of the four critical metals for the transition. This is a highly environmental government, and on an ideological level, Chile must commit to helping the world.

Producing a metal with zero emissions or no environmental challenges is impossible. However, you can balance the good that the finished products of lithium and copper do for the global transition. In that case, it significantly outweighs the footprint and the minor local environmental impacts in a more environmentally focused mining industry. Furthermore, on a practical level, lithium mining will bring taxes and royalties to the government at a massive scale, dramatically increasing the quality of life for all Chileans. ■

Hubert Porte

Chairman of the Board
ERAMET CHILE

Would you elaborate on Eramet's work in DLE?
We are currently building a large project in Argentina. It will begin to produce next year. Of all the companies, we are the closest to industrial production. It will produce 24,000 tons of carbonate lithium by the end of May 2024. We hope to double production in the long term.

What is Eramet's presence in Chile?
So far, we have carried out an exhaustive mapping of different salars. We have also met with all our counterparts, both public and private. The lithium framework still needs to be clarified. We decided to create a subsidiary, which will be created in May of 2023.

What is your opinion on the National Lithium Policy?
Precisions are needed for a good understanding of this strategy. What are the government's expectations regarding mutual contributions in public/private partnerships? Furthermore, it is urgent that the government announces its classification of strategic salars and protected salars.

Why is Eramet well-positioned to operate in Chile?
Atacama is a geological anomaly on a worldwide scale, something extraordinary that you cannot find anywhere else. In 2023, we would like to choose one or two places to run an exploration program. ■

Aldo Boitano

CEO
CLEANTECH LITHIUM

How has CleanTech Lithium developed over the past few years?
We are determined to be the greenest lithium producer in the world, utilizing greener DLE technology and renewable energy to power production and our operations.

CleanTech Lithium is currently adding two simultaneous drilling campaigns and starting to work on the PFS of Laguna Verde. We will have a scoping study of Francisco Basin in a few months, our second project.

Can you describe the benefits of using Direct Lithium Extraction technology?
DLE has an extremely high recovery rate, lower CapEx, takes a shorter time to market, uses significantly less water, and leaves a smaller footprint on the area.

Beyond DLE, how are you incorporating sustainability?
Instead of using forced evaporation in the final process, we will use a membrane condensation approach. For our energy uses, we will also use renewable energy and purchase carbon offsets for what cannot be done with renewables.

What is CleanTech Lithium's strategy for next year?
Over the next year, we would like to produce over one tonne per month of battery grade lithium. We are looking to have both scoping studies and both pre-feasibility studies finished. The completion of the hydrological model is another target. ■

Jamil Sader

CEO
MONUMENTAL MINERALS

Can you give an update on Monumental Minerals' activities in Chile over the past few years?
In 2022, Monumental Minerals signed a letter of intent to acquire a 50.01% interest in the Salar de Turi project from Lithium Chile. Regarding Laguna Blanca, our planning concerning logistics, community, and environment is also moving along well. The project has excellent geology and technical aspects; therefore, increasing the land package by 130% made sense. The property now consists of exploration concessions totaling 12,425 hectares, and we have the entire Salar on the Chilean side to work on.

What is your perspective on the new lithium framework in Chile?
What has been announced has been communicated poorly. Many investors are worried that Chile will be taking projects away from companies or there will be forced sales of projects. We know that this will not happen.

Overall, I believe that the government's strategy and intention is good and they want to provide clarity and a roadmap for lithium production – we support positive change. However, I think the government needs to officially address the confusion and concerns shared by industry and investors alike and shed light on how the strategy will benefit the mining industry. ■

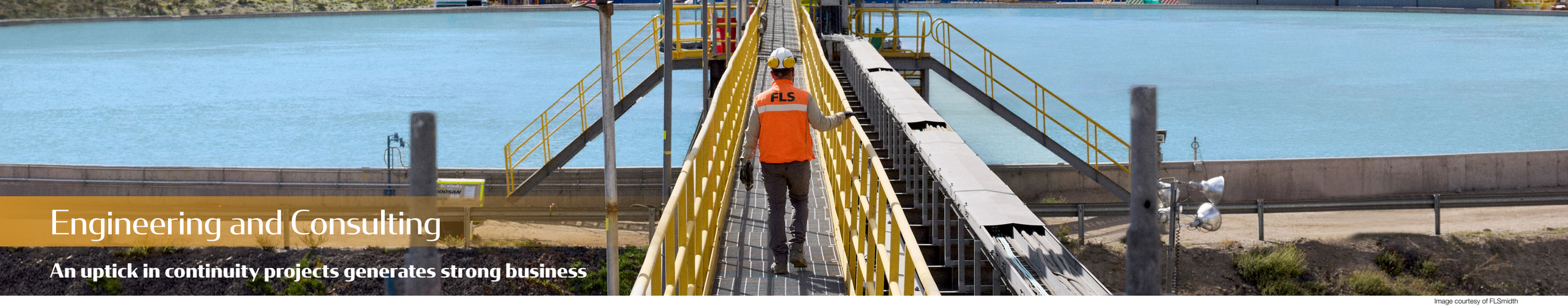
ENGINEERING, CONSTRUCTION AND CONSULTANTS

GBR SERIES • CHILE MINING 2023

Image courtesy of Ausenco

"The recent approval of the royalty regulation is a significant step towards providing clear expectations for companies investing in Chile. It is a boundary condition that we must consider for new projects and adapt current projects to it. "

Agustín Cabañas,
General Manager,
R&Q Ingeniería



Engineering and Consulting

An uptick in continuity projects generates strong business

Image courtesy of FLSmidth

Engineering, construction, and consulting firms have had a busy 2022, despite the lack of new projects. With a need to optimize operations and expand existing mines, mining companies have a slate of projects for which they need extensive support.

"After the release of restrictions by health authorities, we observed a very high activity in Stay-In-Business projects (SIB), from mining companies catching up on expenditures that were deferred (everyone was holding on to their cash)," confirmed Patricio Maguire, mining & metals director Latam lead of digital transformation at Turner & Townsend.

The demand for development projects has been a boon for engineering and consulting firms. Ausenco, for example, experienced steady demand and started 2023 with a robust backlog. The company is working on the EPC contract for Mantoverde, planning to finalize construction during Q3 2023 and then begin the commissioning process. It is also carrying out studies and engineering services for a variety of major mining companies, including the implementation of the Spence concentrator upgrade.

Across the board, clients are seeking engagement with new technologies and a reworked approach to engineering and consulting. Claudio Lesch, president South America at Ausenco, stated: "Our clients expect a new approach to projects, focused on introducing new technologies to lower the carbon footprints of the mines and to increase the cost effectiveness of the projects."

This forward-looking approach must be incorporated from the very beginning, at the study stage, and carried on throughout the project. Tailings is one area where companies must comply with extremely strict regulations. Juan Ríos, general manager of WSP, said: "The area that has adopted more standards, restrictions, and regulations in the last 20 years is tailings management, both in filtered and conventional tailings. Specifically, the standards imply greater precision in the basic studies required for tailings management, as well as more multidisciplinary work."

Hugo Andrade, CEO of Shimin Ingeniería, which has operations in both Brazil and Chile, noted that Chile has significantly stricter regulation and, therefore, safer tailings dams than Brazil. Brazil, reeling from the Brumadinho collapse, is changing its tailings completely. "Currently, solutions in Brazil are filtering everything and transitioning to dry tailings deposits," stated Andrade. "However, this is extremely expensive, so much so that it could dramatically raise production costs. I do not expect the Chilean mining industry to transition to dry tailings en masse for a long time."

Rosario Urrutia, country manager at Stantec, agreed that although conventional tailings waste significant water, such a switch will be slow: "Other alternatives, such as thickened tailings, considerably reduce water consumption. However, these trends involve significant investment as they imply fundamental engineering and energy consumption challenges."

Conventional tailings also come with a significant regulatory and technical burden. Juan Castaño, CEO of the engineering and consulting firm Amphos 21, explained: "In Chile, the authorities require companies to assess the impact of water tailings to groundwater. To do than, numerical models must be developed to quantify the origin of the water in the aquifers, i.e., which is the volume of water infiltrating from the tailings and which is that of the original aquifer groundwater. Amphos 21 has the technology to classify the water under the tailings deposits so that our clients know with certainty which water they have the right to exploit and recover, to be reused in the production circuit."

Castaño noted that dry tailings reduce the risk of contaminants in groundwater.

JRI Ingeniería was awarded three major engineering projects for tailings dams during the second half of 2022, one of the many companies benefiting from this focus on this area. Highlighting the technological development in tailings, Iván Rayo, general manager of the company, described new trends in the area including the use of tailings for other purposes like construction and the move to reprocess tailings for increased extraction. "We are developing a geo-polymers project, which consists of the production of cement from tailings and polymers. This project is in addition to an initiative carried out by the Pontificía Universidad Católica de Chile to use tailings in brickmaking. In this sense, the main challenge is to make these initiatives sufficiently attractive from an economic point of view that they can be produced on an industrial scale."

The potential to make tailings useful provides a vital alternative to the current status quo. The key focus is on making these projects economically viable at large scale. Projects such as these have the potential to be transformational. Seven billion tons of mine tailings are generated each year globally. Restoration techniques are a major focus due to their environmental benefits. Recycling techniques, in which waste is reintroduced to serve as a raw material for other products, has significant benefits for employment, environment, and costs. Copper waste has been used both in brick production and in road and highway pavement by using copper ore tailings as an additive mixture in concrete preparation. Copper slag can also be used for roof tiles, mine filling, and other granular materials. As investment flows into these projects, both in Chile and globally, the potential to reuse metal waste opens a new door to sustainable operations. ■

> Many of our projects in the public water sector have been stopped because investors are waiting to see what happens with the new constitution, leading to a water supply deficit that is over a decade old. Water is scarce in Chile, but the government isn't taking appropriate action to handle the problem.

Pascual Perazzo,
Regional Commercial Director,
Carpi Tech

> **Expediting the permitting process would help dramatically. Today, lots of projects are expansions or smaller projects, which take less time to bring to production through the permitting process.**

Claudio Lesch

President South America
AUSENCO

How has demand changed over the past year?
We have experienced a steady demand over the past year. We started 2023 with a robust backlog and portfolio of mining projects in development. Ausenco has a strong presence in South America and in Chile in particular, with a Santiago office of about 1,000 employees.

One of our main projects is the EPC contract for the Mantoverde project, where we are entering the final year of execution. We plan to finalize construction during Q3, and then start commissioning the ramp-up process. The project is on schedule and is a priority during 2023.

Ausenco is also carrying out several key studies and engineering services for the main mining companies. Among them we can highlight the implementation of the Spence concentrator upgrade, and the recent award of a new contract for the study of a new copper concentrator plant at Escondida. We are also developing the detailed engineering for the surface works for Los Bronces underground of Anglo American, and we are pleased that the project was approved recently by the government. We also carry out many commissioning projects in the region and are currently providing commissioning services for Teck's Quebrada Blanca and AMSA´s Inco projects in Chile. Ausenco has many service agreements with major companies, with a portfolio of approximately 30 projects in Chile at different stages of development.

What do your clients demand in this current environment?
The grade of metals is dropping significantly, and at the same time the demand for metals and battery metals required decarbonize the world is increasing. Therefore, our clients expect a new approach to projects, introducing new technologies to lower the carbon footprints of the mines and to increase the cost effectiveness of the projects. Ausenco has always been a new adopter of new technologies which help to reduce the energy and water consumption, change the way the process waste is disposed, decrease the footprint of the projects, and minimize the impact on the environment and local communities. We take those ideas and concepts into our studies to guide the project execution and commissioning. One of our differentiating factors is that we are a multi-service company, and our focus is 100% in mining.

How does Ausenco plan to take advantage of the lithium boom?
Five years ago, we put together a very strong team in lithium. Our goal is to continue to strengthen our lithium capabilities, particularly in Direct Lithium Extraction technologies.

Can you describe the current regulatory situation?
The approval of Los Bronces Undergound project was a very positive sign that the government is interested in promoting investment. Everybody in the industry recognizes the need to comply with environmental and community requirements. However, the complete permitting process is cumbersome, which is one of the reasons that projects take so long to mature. The world needs base metals and battery metals for the energy transition, and the gap is huge. Expediting the permitting process would help dramatically. Today, lots of projects are expansions or smaller projects, which take less time to bring to production through the permitting process.

How is Ausenco supporting its clients in water access and water management?
We are supporting our clients with the introduction of enhanced process technologies which reduce water consumption significantly, in addition to improving mineral recoveries and diminishing energy costs.

We are also supporting our clients in gaining access to seawater for their operations, instead of continental water. Our pipeline consulting group is a recognized world leader in the design of pipeline systems and has been involved in the development of the most relevant pipeline projects in Chile.

What is your focus on digitalization?
With the advent of autonomous fleets, automatic controls for process plants and infrastructure, and the availability of platforms and communications systems, a great deal of data is generated from operations. These data need to be collected, prioritized, transformed, and shared at different levels in the organization to improve the decision making and help to define the optimum operational strategy.

We are currently working together with some partners to develop algorithms to carry out data mining, simulate mining operations by using twin models for mines, plants, and processes, and use machine use learning techniques to turn data into information to enable us to forecast and improve operations. ■

Manuel Viera

CEO
METAPROJECT

How do you serve the industry?
Our services are geology and geomechanics, mining engineering, processes, smelting and refining, multidisciplinary engineering, construction administration, works supervision, forensic engineering, technical audits, infrastructure designs, renewable energy, oil and gas, supply services, mining operations management. A particular strength of Metaproject is risk management. Our goal as a company is to be a one-stop shop, providing our clients with every single service they need.

How does Metaproject plan to grow?
For the medium term, our focus is on opening new international markets, in Asia, Africa, Europe, in countries such as Kazakhstan, South Africa, Russia, among others. Our new business model forces us to participate in the market for plant maintenance services, topography services, sustainability services and water quality measurements; we also support extended virtual reality and artificial intelligence. We will focus on EPC contracts, and BOT intermediate there is a good business

Our plan is to continue growing with new offices abroad with the Chilean experience, with planetary sustainability adding social and economic value for our clients. ■

Agustín Cabañas

General Manager
R&Q INGENIERÍA

Could you elaborate more on the kinds of projects R&Q Ingeniería has been involved in?
For instance, we've been working on the underground Chuquicamata project, which continues with the construction of its new phase. We provide a diverse range of services to these mega projects, such as creating reports for investment authorization, quality assurance, project management, and the full suite of that controls EPCM contract management. Our involvement begins from the initial stages of execution and extends to delivering extensive support to various project teams. Moreover, we have recently expanded our operations to include Peru. Our portfolio of projects showcases our versatility and proficiency in handling a wide array of responsibilities.

We are presently involved in the Quebrada Blanca project, supporting the construction management in various work areas. We also have a long-standing engagement with the Andes Norte New Mine Level project of Codelco, participating from the construction of early works, such as the construction platforms of the tunnels, to providing engineering services during construction. We are involved in the INCO project of Los Pelambres of Antofagasta Minerals, which includes desalination plants, propulsion, and processing plants. Our engagement in these major projects demonstrates our capability and commitment to our work. ■

Pablo Peñaranda

Director of Business Development
BLACK & VEATCH

Can you give an overview of Black & Veatch's history in Chile?
Black & Veatch stands out in Chile for our capabilities and experience in seawater desalination projects. We have been engaged from the first desalination plant, to almost every desalination and seawater conveyance projects developed and executed in the country. We are also looking at helping our mining clients with other sustainability and infrastructure-related solutions. Besides mining, we also provide a variety of engineering solutions related to other markets, such as green hydrogen & ammonia, electromobility, LNG, renewable energy and data centers.

What are the company's main goals for 2023?
Over the past three years, we have been building approximately two gigawatts of renewable energy in the Americas every year, and we want to continue this effort. We also want to expand our involvement in the green hydrogen and ammonia segment.

Our goal is to grow organically throughout the region and expand our variety of services and solutions to the market. Black & Veatch has managed to mitigate the various challenges over the past years, and 2022 was an excellent year for the company. Black & Veatch reached record revenue and annual stock price performance. ■

Iván Rayo

General Manager
JRI INGENIERÍA

Can you introduce JRI Ingeniería?
JRI is a Chilean company with about 480 employees, including more than 280 civil engineers. JRI began by offering services in the field of concentrator plants, but over time has expanded its range of services for the different phases of engineering of mining operations.

JRI has four business units: underground mining, mineral processing plants, long-distance pipelines, and tailings disposal and management. The company now cover the entire value chain of mining projects.

How was 2022 for JRI Ingeniería?
2022 was a very intense year; we completed our business plans with good results. We worked mainly on brownfield projects, consisting of expansions and operational optimizations. In the first half of 2022, we made great progress on Rajo Inca, a structural project to Codelco were we have been working on for seven years, and where we started ground engineering last year. We also worked on the Diamante underground project of Codelco.

In the second half of 2022, we were awarded three major engineering projects for tailings dams. In addition, we focused on promoting digitized engineering with the BIM (Building Information Modeling) methodology. This technology allows us to integrate all data relevant to project design into a digital files.

How does JRI advance innovation in tailings?
We have a research center (CIMS-JRI) dedicated to studying tailings and optimizing water consumption. For example, we are conducting technical studies to transport tailings with less water. We are also working on the densification of tailings, which includes the engineering of their transport, pumping, and design of tailings deposits according to their physical characteristics, as well as the costs and benefits of densification. Finally, we are developing the geo-polymers project, Corfo, which consists of the production of cement from tailings and polymers. This project is in addition to an initiative carried out by the Pontificia Universidad Católica de Chile to use tailings in brickmaking. ■

JR

CP

Juan Ríos and Carolina Pérez

JR: General Manager
CP: Mining Manager
WSP

Can you introduce WSP?
JR: WSP is one of the world's leading professional services companies; in mining we have a robust offer that includes Mine Engineering & Stability, Mineral Processing, Environmental, Social & Governance (ESG); Mine Closure, Mine Water; Mine Waste and Mine Infrastructure. We have an innovation team that is constantly working on the development of new technologies to offer effective solutions to our clients.

CP: It is important to mention that we work in engineering and procurement, but not directly in the execution of projects. We currently work for mining companies, such as Codelco in Rajo Inca, but also with EPC companies in the detailed engineering phase.

What are the main challenges for consulting firms in Chile?
CP: Among the main challenges are the continuous changes in the regulatory apparatus of mining activities related to our services, for example, the current regulations in the GISTM.

The area that has adopted more standards, restrictions, and regulations in the last 20 years is tailings management. These changes in norms and standards have an impact on engineering work. Specifically, the standards imply greater precision in the basic studies required for tailings management, as well as more multidisciplinary work. Therefore, more resources need to be invested in engineering and design to minimize the risks associated with tailings.

How can WSP help mining companies improve water management?
CP: We work in both surface water and groundwater management. We have a strong group specializing in hydrology and hydrogeology. Chile has developed very advanced methods for water optimization based on the experience of the country in copper processing.

How are the green hydrogen markets evolving in Chile?
JR: We are currently working on the first phase of two green hydrogen projects. We believe that this segment will develop over the next few years and, consequently, demand will start to grow as production does. ■

Chile's Challenges Continue

"The primary struggle for the industry is that environmental requirements and community demands are making projects significantly more complex. The mining industry has lost the trust of the general populace."

Hugo Andrade,
CEO, Shimin Ingeniería

"Through machine learning algorithms, geologists can look for better opportunities and question their deductive models, which are often incomplete."

Juan Ignacio Guzmán,
CEO, GEM

"Mining companies focus on reducing waste and extending mine life, so sustainability has to be considered from the design stage. We are working with partners on making circular solutions and measuring their circularity."

Fernando González-Valdés,
Founder and General Manager, ICP Ingeniería

"The mining industry has to rethink how they work with the state, the education system, local authorities, and local communities to develop its value chain and the talent of its workforce."

Germán Millán,
Partner, PWC Chile

"Not only the Royalty bill impacts the mining industry, but the other reforms under discussion as well, especially the tax reform, the pension reform and the discussion of the new constitution are also flanks of normative discussion that strongly impact the industry, generating uncertainty as well. "

Alicia Domínguez,
Tax Consulting Partner – Chile, Ernst & Young

"In 10 years, the need for desalinated water in mining operations will double or triple compared to current capacity. From the project management point of view, while technology has matured significantly, the long pipe and power line routes make the environmental and community matters a complex project on itself."

Patricio Maguire,
Mining & Metals Director for Chile &
Digital Transformation Lead for LatAm, Turner & Townsend

Water and Environment

Desalination plant development takes off

Image courtesy of Amerigo Resources

Chile is currently reaching a crisis point: wracked with drought, it is burdened by continuously increasing water demand and less water to meet that demand. In that context, the government is rejecting new freshwater concessions for mining. All water usage going forward is expected to be desalinated.

However, despite continuous innovation to reduce water usage, there is still a dramatic need for water from the mining industry. "Demand will increase for water because of the operations situation today, in that some oxide operations are reducing in grade," explained Daniel Caro, CEO of Bermad Fluid Solutions. "They will be replaced by traditional flotation and concentrate processes. These processes are more demanding in terms of water."

According to ACADES, there are 24 desalination plants currently in operation in Chile, and 75% of the production of desalinated water is used by the mining industry. According to the state copper commission, Cochilco, demand from the copper sector for desalinized water will increase by 167% in 2023 compared to 2021. There are multiple desalination projects currently in development, among them Codelco's US$1 billion Distrito Norte plant, Antofagasta Minerals' US$2.2 billion INCO plant, and Teck's plant for the Quebrada Blanca 2 expansion.

Engineering and constructing desalination plants is extremely complex. "The supply of desalinated water depends on several factors such as flow capacity, site conditions, technology selection, location of the water delivery which, in the case of mining operations, are usually at high altitudes and longer pipelines, therefore leading to higher energy costs and higher Capex that significantly influence the water cost," said Rubén Muñoz, lead practitioner desalination at CDM Smith.

Desalination is a major portion of a mining project's Capex; as much as US$1 billion out of a US$3 or US$4 billion copper project. Today's desalination industry in Chile has two typical contract structures. In the first, the mining companies themselves fund the construction of a desalination plant, thus owning the plant and the water production. The second option is a BOOT (build-operate-own-transfer) mechanism, in which a private sector group finances, designs, constructs, owns, and operates the plant; it then sells the water to the mining company. At a certain designated point years down the line, the mining company gains ownership of the project.

Desalinated water production is an area of opportunity for mining companies to improve relationships with the local communities, utilizing their own water assets to support the community water needs. Pablo Peñaranda, Latin America business development director at Black & Veatch, explained: "The plant owners can decide whether to sell additional water production to a city or community, which is often encouraged by the mining company as part of their ESG efforts."

A study by the environmental sciences center (EULA) at the Universidad de Concepción and the Mileno Socio-ecological Coastal Institute (SECOS) determined that as little as 4.5% of the coastline between the Santiago metropolitan region and the Arica y Parinaco region are "highly appropriate" locations for desalination plants, while 60% of that area was "little" or "not" appropriate. However, 17 plants are either in operation or planned in areas considered inappropriate.

The challenges do not stop with the plant itself. David Alaluf, general manager at Endress + Hauser Chile, explained: "We have had water desalination plants for 20 years or more, but these plants are technologically challenging, requiring corrosion-resistant systems. We must process the water and bring it up to an altitude of 3,500 m over distances of 250-300 km. That requires massive amounts of piping and complex pumps, valves, and instrumentation to monitor the process."

Desalination provides a point of collaboration between mining companies and the local populations, enabling dialogue and demonstrating the value-add mines can bring to their surrounding areas. However, water projects for private industry cannot compensate for greater government investment in improving water access. Pascual Perazzo, regional commercial director of Carpi Tech, a company that offers both a proprietary waterproofing solution for tailing dams and solutions for the public water sector, noted the chilling impact of government policy on investment in the water sector. Of their concessionary projects in the public water sector, he said: "Many of these projects have been stopped because investors are waiting to see what happens with the new constitution. Many of these have been frozen for the last seven years, leading to a water supply deficit that is over a decade old."

As the country continues to require more water, while available continental water continuously decreases, the mining industry has an opportunity to demonstrate its utility and societal contributions by taking a leadership role in the construction of desalination plants. By bringing water to remote or particularly dry regions, mines can reduce their groundwater consumption while simultaneously supporting local water access, filling an essential and concerning government and public sector gap. ■

"I observe two main issues that are driving demand for our services: first, water management, and second, mine closure, because a growing number of mines in Chile are in the last phase of their life cycle."

Rosario Urrutia

Country Manager
STANTEC

Can you introduce Stantec?
Stantec has been operating in Chile for seven years after acquiring MWH Global in 2016, and provides three groups of services for mining companies: engineering, environmental, and permitting. Some of our solutions are specifically related to water and tailings management, but we cover a wide range of solutions for the mining industry.

What areas have experienced higher demand?
Chile is in a phase where there is a lack of new projects, so we are focusing on expanding, upgrading, or revising current projects. Specifically, I observe two main issues that are driving demand for our services: first, water management, because mining companies must optimize their water consumption in times of prolonged drought; and second, mine closure, because a growing number of mines in Chile are in the last phase of their life cycle. There are more demanding requirements for mine closures today compared to when the mines started operations.

How has the permitting process evolved in the last few years?
At the beginning of some projects, there were no environmental regulations. Regulations were gradually incorporated over many years, and we are still in a process of adaptation. There is still great concern among the population about the negative effects of mining projects, and many project rejections, even though they meet the requirements, are due to fears and prejudices; it is generally believed that the environmental and social costs of mining are higher than the benefits. For this reason, we are working hard to give mining projects a more sustainable perspective.

Can you describe Stantec's strategy to reach net zero?
For some years, we have been preparing sustainability reports in which we set goals in this regard annually. With the pandemic, emissions were reduced, but with the return to face-to-face activities, our carbon increased again. Our goal is to maintain pandemic levels of emissions. To achieve this, we are certified to the ISO standards for quality, environment, and safety.

We developed Net Zero Mining – a holistic service offering that helps mining companies meet their Environmental, Social and Governance (ESG) obligations. Through this service we help our clients to reduce energy demand and utilize clean sources of energy, as our experts guide them on their paths to net zero emissions.

However, it is not a simple journey. Mining companies have to go against the industry-wide preference for being "first to be second" and plan to integrate technologies and processes that are not yet widely accepted or perhaps commercially available. That's where we come in. We constantly see a lot of requests to help clients figure out how to implement technologies to move forward towards their net zero goals.

To aid with this, we have strong technical knowledge of several disciplines, like water management, for example, where we have worked on desalination plants to reduce water waste and avoid impacting surrounding communities.

We're happy to say that our efforts, both internally and with our clients, have borne fruit. Stantec has ranked #7 in the world, and #1 in our peer grouping on Corporate Knights' Global 100 Most Sustainable Companies, making this list for the fourth year in a row. For context, companies in the Global 100 represent the top one percent in the world for sustainability performance.

We're also being recognized as a climate leader by the CDP (formerly the Carbon Disclosure Project) with an A-score for the fifth consecutive year. This ranking assesses climate strategy, governance, emissions management and reductions progress.

What steps do you take to center inclusion?
We have established gender and inclusion committees at Stantec to promote inclusion and equity, focusing on gender. We have also formed alliances with companies that address these issues, such as "Working Women," and we plan to attract female and young employees from universities. We seek to include women in our company, taking a gender perspective into account. For example, we implemented special measures to support mothers or pregnant women. All these efforts have translated into the best inclusion indicators; in Chile, about 42% of our workforce are women. Stantec also supports other social sectors that were historically excluded, such as people with disabilities. In addition, thanks to teleworking, we have hired employees from other regions outside Santiago, which is also an essential component of inclusion. ■

Juan Castaño

CEO
AMPHOS 21

Can you introduce Amphos 21?
Amphos 21 provides engineering and consulting services related to water resources management and environmental impact reduction. Amphos 21 has currently 80 employees in Chile. In December 2020, we became been part of the RSK group of companies.

Can you describe the main services the company offers?
Our main activity is related to hydrogeological studies whose purpose is to help our clients with the quality and quantity of groundwater. These studies require conceptual and numerical modeling with we accomplish through the use of different software. Amphos is pioneering the use of machine learning models to help water resource management through the use of existing available data. Our team is also expert in field work, helping mining companies in site investigations, data analyses and tailored solutions both from day to day and long-term strategic outcomes.

How was 2022 for Amphos 21?
Our main clients last year in Chile were Codelco, Mantos Blancos and EMSA. We also developed several projects for Gold Fields, BHP, Albemarle, Collahuasi, etc. Our biggest project last year was in the Maricunga salt flat, where Codelco's subsidiary, EMSA, is studying the lithium potential of the salt flat. The work includes the supervision of the drilling process of the wells to extract the brine and the assessment of the lithium reserves.

What is your involvement in the lithium sector?
For lithium extraction, we develop conceptual and numerical models to define the lithium reserves contained in the brine. The traditional process involves the evaporation of the brine to obtain lithium. This process requires large volumes of water. We are currently seeking for the implementation of membrane filtration solutions, so that the water can be reinjected in the salt flat without evaporation, while lithium is recovered thanks to the membranes. CORFO also has a very active department looking for international partners to develop technologies to reduce the environmental impact through water reuse. ■

RM GV

Rubén Muñoz and Gonzalo Vergara

RM: Lead Practitioner Desalination
GV: Project Manager
CDM SMITH

Could you provide an overview of CDM Smith's scope in Chile and the main highlights over the past year?
RM: We have engaged in long-term relationships with mining clients covering the full cycle of projects from conceptual and design stage up to construction supervision, commissioning, and operation support. We have long relationship providing owner´s engineer support for the contract delivery model of build operates own and transfer (BOOT) for BHP, and recently we have started another owner´s engineer BOOT contract for a desalination plant with Codelco. We are working on desalinated water supply pre-feasibility studies for different mining operations which main goal is to reduce their freshwater consumption from conventional sources.

GV: Last year we started working on a water supply project for green hydrogen in Magallanes. In this case, the water needs to reach ultra-high purity levels, and we have a lot of expertise in this area.

What trends are you seeing in desalination?
RM: Recently we have seen a trend towards developments of multi-purpose desalination projects that aim to provides a water supply solution to the mining operations, to the local communities and some cases to agriculture.

GV: In 2018, Cochilco stated that Chile's mining industry used 0.6 cubic meters of water per ton of copper produced, and today it is 0.36 cubic meters, so the reduction has been significant.

What are the main pillars of your strategy for 2023?
RM: Our strategy is to double-down our leadership in seawater desalination in Chile. Our second pillar is to increase our exposure to projects at the early stages. Additionally, we want to continue our strong work on engineering design, and finally we want to expand our portfolio of services related to green hydrogen, where we have two active projects in Chile and others project at early stages in other countries. ■

Construction and Contractors

In-house skill development programs become commonplace

Image courtesy of AMSA

The Chilean mining and construction sectors require an immense amount of labor. According to Statista, the Chilean mining industry directly employs 221,000 people. The construction sector, meanwhile, is estimated to employ 8.7% of the country's labor force, with a market size of US$42.6 billion in 2021 according to Global Data. Finding skilled workers has become a significant challenge.

This talent shortage is leading construction companies to develop in-house capacity building. STRABAG and Züblin Chile, for example, requires skilled operators capable of handling advanced equipment. Mario Theurl, managing director, explained: "We conduct extensive training and hire employees without industry experience. STRABAG and Züblin is willing to train our employees from scratch."

The Chilean education system does not focus enough on apprenticeships or developing hard skills, requiring companies to step in and take on that burden.

Companies must also expand beyond traditional hiring pools. One such way is to actively incorporate women. Thiess, for example, runs an apprenticeship program in collaboration with local institutes that allows for on-site training. Darrell White, executive general manager Americas, said: "This program focuses on empowering diverse candidates, and we're proud that half of this year's maintenance cohort is female."

The government could take certain steps to alleviate this challenge. Currently, the immigration system is not supportive of the need for talented labor. With many countries in Latin America having extensive mining industries, there is a large, trained workforce within the region. Adolfo Sicilia, CEO of OSSA Chile, Perú, Ecuador, Argentina, a worldwide tunneling company, noted: "They cannot come to Chile because of bureaucratic barriers. For example, bringing a machine driver from Colombia to Chile takes eight to 10 months, which is a barrier for companies."

Automation provides possibility

Automation and technological advancement are filling the labor gap. When there is insufficient labor, the simplest, if challenging, answer is to alleviate the need for workers entirely. Sandro Tavonatti, CEO of Sigdo Koppers (SKIC), said: "In response to changing labor demands, where experienced construction specialists are aging and younger professionals prefer to avoid working in underground mining conditions indefinitely, we actively seek alternatives to reduce manual labor."

In part, the rapid shift to automation has been driven by the Covid-19 pandemic. Forced to determine how to continue operations, many construction and mining companies invested in automation to a never-before-seen extent. Although the industry was already moving in that direction, the pandemic demonstrated that a dramatic shift in work towards automated processes was possible.

The more automated a mine is, the less workhours are needed per employee. Automation technology is rapidly developing, but the workforce challenge is here to stay. Automation is not an immediate answer. Sicilia stated: "Automation will change the industry, but that major shift will be visible in over 10 to 15 years, slower than we would like. That is why there will continue to be a workforce gap this decade."

» Automation will tend to replace repetitive and risky jobs, which does not imply a reduction in the demand for labor. There will be a labor reconversion towards maintenance and training in new technologies and strategic decision-making.

Eduardo Cossio Chirinos, CEO, INCIMMET «

The digital revolution begins

In construction, the move towards a more technologically advanced industry has historically been particularly slow. "Construction is the fourth least digitalized industry among 100 industries. When it comes to adopting technologies, there is an extent to which resistance is cultural. If something worked in the past, construction workers tend to keep it the same," said Maguire of Turner & Townsend.

This delay in adaptation of digital tools is something of which STRABAG and Züblin is aware. The construction company has an innovation manager, who works internally and externally to find solutions to improve efficiency and communication in different areas, including technology to remotely monitor tunnels. However, not all digital tools the company has tested have changed productivity levels, explained Mario Theurl, managing director of STRABAG and Züblin Chile: "Our strategy to ensure meaningful change is that when we introduce a different technology, we ask three times how we can ensure that our employees can use it to improve productivity and safety and how it is linked to our profit equation."

Improved data collection enables construction companies to improve their decision-making and their ability to prevent issues ahead of time. Thiess, for example, focuses on maximizing productivity while protecting assets through digital tools. Utilizing data collection technologies to monitor the need for maintenance prevents the productivity losses of asset failure. White of Thiess explained: "We gave a reliability team in Chile, with support from Brisbane as needed, which pulls digital data from our assets daily. This team then analyzes each asset in operation and utilizes the information gained to guide how we operate our assets to best facilitate asset protection."

Utilizing data collection technologies to monitor the need for maintenance prevents the productivity losses of asset failure.

For Edyce, a Chilean company which manufactures and assembles steel structures for industrial buildings and offers a diversified range of industrial services, to compete with foreign companies a strong investment in technological advancement is vital. Tomás Fischer, CEO, said: "Machine learning and the Internet of Things are important tools to monitor and optimize our operations. Since acquiring these kinds of technologies, our productivity has increased by around 15 to 20%." ■

» **We can contribute to the green future of Chile while simultaneously providing cleaner energy to the mining industry; this is aligned with both our sustainability goals and market demand.** «

Mario Theurl

Managing Director
STRABAG AND ZÜBLIN CHILE

Can you provide an update on your main activities in Chile?

STRABAG and Züblin combine the expertise of both companies to focus on mining, civil engineering and renewable energy projects, like hydropower and wind farms. In Chile, we have an expert team of about 5,500 employees. We are one of the most experienced underground contractors in the world. Our expertise in mechanized tunneling, gained in civil projects, is unusual in mining and has enabled us to bring new technologies to the industry and improve performance and safety.

One of our most significant contracts at the moment is at Chuquicamata in Northern Chile, Codelco's largest open pit mine in the world, where we are expanding our portfolio with vertical tunnelling. We are in the process of building a shaft with a depth of 650 meters; one of the deepest shafts being built in the country.

What are the main challenges of working underground?

Our priority and main concern are always the safety of our workers. However, the statistics say the most common injuries in the mining industry are caused by interactions between people and machines. The limited space is a challenge in terms of safety, which is why we have taken an active role in the protection of our personnel, in line with our goal of zero accidents from the start.

How do you deal with talent shortages?

To face this challenge, we conduct extensive training and consider hiring employees without industry experience. We are willing to train our employees from scratch. We are confident in our capacity to develop our employees and provide them with excellent upward mobility in Chile or others countries.

What would you consider the biggest challenge for the sector?

Sustainability is a main priority for our company and for the industry. Our clear goal is reaching carbon-neutrality by 2040. The company has a variety of targets to achieve that. In terms of suppliers, we seek environmentally friendly ones. In our internal sphere, we aim to electrify our equipment, so we are working hard with clients and suppliers to enable this switch.

However, logistics is still a challenge in electric mobility, especially underground. These vehicles run on batteries, and it is necessary to adapt the mine configuration to the electrical equipment's needs and vice versa. The idea is to switch to environmentally friendly equipment and at the same time keep or increase productivity. I´m convinced that this is possible.

How do you innovate?

Technological development in the construction industry as a whole has been slower than in other sectors. In our case, we have an innovation manager, who engages within the company and externally to determine needs and seek solutions with the help of our full workforce. We use digital technologies to be more efficient and facilitate communication in different areas, and we are incorporating tunnel monitoring technologies on our computers.

Acquiring tools that help us work more productively and safely is worthwhile. However, some innovations in digitalization and automation have not significantly increased our productivity. Therefore, we need to ensure that the tools we use help us work more efficiently or solve a particular problem, rather than implementing a technology simply because it's fashionable and digital. Our strategy to ensure meaningful change is that when we introduce a different technology, we ask three times how we can ensure that our employees can use it to improve productivity and safety and how it is linked to our profit equation. Our people have to be convinced in the first place that it makes sense and that adds value to their tasks.

What are your goals for 2023?

We are expanding our services to the renewable energy sector, where there is significant energy and momentum. We are currently building two wind farms in northern Chile, one of which is the largest in Latin America. In this way, we can contribute to the green future of Chile while simultaneously providing cleaner energy to the mining industry; this is aligned with both our sustainability goals and market demand. Chile has unique opportunities for renewable energy, which align with the needs of the country's crucial mining sector. We are actively engaged in participating and growing in this space. Green energy is the future. ■

Sandro Tavonatti

CEO
SIGDO KOPPERS (SKIC)

Can you describe recent projects Sigdo Koppers has worked on?
Sigdo Koppers is working on two outstanding Teck projects for Quebrada Blanca 2 (QB2), one in the port and another in the flotation segment of the mine, and undertaking significant projects for Codelco, BHP, and Collahuasi, and we also look forward to participating in QB3 if it comes to fruition.

What do you see as a significant challenge?
One of the significant challenges we face is managing our largest backlog in the 63-year history of our company. We have the necessary skilled labor to execute projects, but ensuring operational capacity remains an enormous challenge. While there are tremendous opportunities, we must prioritize responsibility and excellence towards our clients.

Can you describe the benefits of new technology?
We have embraced a diverse range of digital tools and advanced solutions, including artificial intelligence. Operating at altitudes of 5,000 meters, where both personnel and equipment face immense pressure, demands innovative approaches. The ability to remotely conduct operations while ensuring engineering precision and adherence to quality standards has become indispensable.

Descending and returning from an underground mine can often consume up to three hours. To address this, we have integrated the Spot Robot developed by Boston Dynamics into our operations. This tireless worker eliminates the need for breaks or snacks, resulting in remarkable optimization of tasks and processes.

How can the country improve its renewable energy usage?
We are actively engaged with our clients in the development of two of Chile's largest wind parks: Horizonte for Colbún and Loma Alta for Engie. However, the primary hurdle we face is in energy transmission, primarily due to permit-related delays. To tackle this challenge, we have a subsidiary solely dedicated to accelerating engineering efforts on these projects. Transmission lines are an EPC sector in which we possess extensive expertise, having been heavily involved in the construction of approximately 80% of Chile's transmission lines. ■

Tomás Fischer

CEO
EDYCE

Can you introduce EDYCE?
EDYCE is a Chilean company with 70 years of history. Its main activity is the fabrication and assembly of steel structures for industrial buildings. Today, EDYCE offers not only the manufacture of steel structures and the construction of large projects, but also industrial services and integral solutions for industry. Diversification has been one of the most critical aspects of our growth strategy in recent years.

What were the main milestones achieved by EDYCE in 2022?
2022 was an important year for EDYCE. We completed some of our most emblematic projects that we started working on a few years ago. For example, Quebrada Blanca II, where we worked for three years. Despite contextual problems, such as the pandemic and the social outbreak of 2019, we were able to complete it successfully last year. Another project we completed was the INCO project for Minera Los Pelambres.

Additionally, desalination plants are in high demand in the country. Apart from participating in the INCO desalination plant, one of the largest in the world, we want to consolidate our position as a specialist in this regard. Finally, we have recently debuted in the reinforcement of underground tunnels with products made of steel that are very efficiently processed in our plants.

What are the main trends in the demand for your services in the mining industry?
Fortunately, the market is shifting towards more integrated solutions. Modularization services have been one of the most demanded in recent times, which has allowed us to close agreements with large mining companies. We do not only export structures for other companies to assemble but also large modules with other mechanical components and conveyor belts. This allows us to offer diverse integrated solutions.

We work in lithium with SQM. I believe that green hydrogen will follow lithium as a highly demanded material. We have already worked on building a plant for a pilot project with HIF in southern Chile. ■

»We are the first service provider in the world to operate a mostly autonomous mine, and the knowledge gleaned from that operation will be transferred to Chile as soon as is commercially and technologically viable.«

Darrell White

Executive General Manager - Americas
THIESS

Can you update us on Thiess' activities and operations?
In 2015, we entered the Chilean market where we first started operations with Antofagasta Minerals at Centinela. We have continued to work with Centinela as a trusted partner ever since, in addition to providing services to other clients in the region over the past eight years.

Thiess can carry out both drill and blast design planning, the execution of the drilling, and each step of operations leading up to mine closure and land rehabilitation. We also carry out long-term and operational life planning as part of our standard scope.

As part of project execution in Chile, our client is responsible for the engineering, and load and shoot, while our scope includes drilling of the holes, as well as short-term planning. The client carries out long-term planning — we take those plans and deliver operational, short-term planning in conjunction with their team, serving as a truly integrated partner. We also carry out material movement, load and haul, and asset management maintenance of our equipment.

How was 2022 for Thiess?
2022 was an excellent year for us. We continued to grow our business optimization efforts, having made significant improvements in recent years, heavily focused on safety. We are leaders in safety at the Centinela operation and received an award this year as the company with the highest safety performance. We also recently opened a facility in Antofagasta — our Innovation, Training, and Technology Center (ITTC), where we maintain and rebuild our assets. This year, we will bring in third parties and build the capability to provide maintenance services and rebuilds on our clients' fleets. The center is also used as a training center in collaboration with community institutions in Northern Chile.

How do you manage industry-wide workforce recruitment and retention challenges?
Our approach is to invest in the communities where we operate to provide the training necessary for new industry entrants to thrive and grow within Thiess. In Northern Chile, we run a maintenance apprenticeship program in collaboration with local institutes, enabling onsite training. This program focuses on empowering diverse candidates, and we're proud that half of this year's maintenance cohort is female.

What tendencies in demand for your service do you observe in Chile?
In Chile, we primarily find opportunities in drilling, load and haul operations, maintenance services, asset hire and short-term mine planning. Our clients here tend to carry out the long and medium-term planning, focusing on their asset and ensuring that they are in control of how the commodity is extracted in order to meet downstream process requirements. We have the ability to meet those specific demands. Moving forward, with communities and stakeholders' growing expectations of the mining industry to deliver good ESG performance, we foresee increased environmental requirements in rehabilitation.

How does Thiess utilize data?
We have a reliability team in Chile, with support from Brisbane as needed, which pulls digital data from our assets daily. This team then analyzes each asset in operation and utilizes the information gained to guide how we operate our assets to best facilitate asset protection. This process also alerts us to maintenance requirements and other critical tasks.

What is Thiess' approach to automation?
As mines become increasingly technologically advanced, automation is critical to the mining sector in Chile and will likely only become more so. At Thiess, our autonomous journey began over 10 years ago in Australia, where we are now commissioning the first service-provider-led, mostly autonomous mine in the world, which will utilize an autonomous truck fleet in addition to autonomous drills. We are the first service provider in the world to ever operate a mostly autonomous mine, and the knowledge gleaned from that operation will be transferred to Chile as soon as is commercially and technologically viable.

What are the main goals for Thiess for the rest of 2023?
Our primary goal is always to fulfill current contracts, meet and exceed our clients' expectations, and then leverage that success and position ourselves for future opportunities. Another target is to continue extending our accident-free hours, which we consider a tremendous achievement. We are also working to progress the opportunity to introduce autonomous assets to the country in the drilling space. Another key focus area is sustainability and emissions reduction, which shape every decision we make in our business plan. ■

Adolfo Sicilia

CEO of Chile, Perú, Ecuador, Argentina
OSSA

Can you provide an update on OSSA's main activities in Chile?
OSSA is a worldwide tunneling company, born over 70 years ago in the coal mines of northern Spain. We expanded into infrastructure across Europe, and we now work all over the world. We have a strong presence in Latin America, working in Mexico, Panama, Costa Rica, and Guatemala, over 12 years in Peru in mining and civil works, and Chile. Chile is our primary market in Latin America.

OSSA participated in various civil works here, including the Line 6 and Line 3 metro tunnels in Santiago. In mining, we work with Antofagasta, Codelco, and others. Our largest project has been in Chuquicamata, where we started in 2012. Today, we tunnel nearly 1,000 meters per month in that project, with the consistent commitment to safety required in big mining.

What is the future of underground mining?
Underground mining is the present and the future. All mines will transfer to underground mines for several reasons. First, with mines so big and ore grades decreasing, it is more profitable to build a subterranean mine. Second, in the future, environmental issues and the population's desires will prohibit mining companies from new open-pit mines. Public opinion will only allow for underground mines. Regulation and revenues will drive that shift in parallel.

Can you discuss the biggest challenge facing the country and the industry?
In my opinion, the biggest challenge for the industry is to form new workforce. There are not enough specialized workforce and an insufficient workforce overall, which is driving automatic processes and avoidance of workforce.

What regulations would you call for to handle workforce challenges?
In terms of specialized and prepared labor, allow them to come to Chile. There are many countries in Latin America with workforces that are trained in mining and adjacent industries. Still, they cannot come to Chile to work because of bureaucratic barriers. ■

Fernando Vivanco

General Manager
MASTER DRILLING

Could you describe Master Drilling's activities in Chile?
Master Drilling is recognized as the largest vertical development contractor globally, with a presence in over 26 countries, including Chile, where we have held market leadership for over 25 years. We have solidified our dominant position through our contracts, such as the significant one in Chuquicamata, where we are responsible for all vertical developments. We have also cultivated longstanding relationships with El Peñon.

Our operations over the past year have been diverse and robust. For instance, we have maintained contracts with Codelco Teniente through subcontracts with main contractors and our direct contract with Codelco in Chuquicamata, where we are developing all the vertical developments. We also handle civil works related to this project and other ancillary services.

How has Master Drilling been advancing in the area of sustainable operations?
To ensure sustainability, we focus on effective problem-solving, frankness with our clients, and the growth and development of our people. Employee retention and safety are critical aspects for us. To that end, we also leverage technology to improve efficiency and safety while reducing exposure to risks.

How is Master Drilling managing labor challenges?
We have established training centers in several countries we operate in, including Chile. In conjunction with substantial investment in continuous training and upskilling, these centers have become our primary means of addressing the challenge of needing more qualified personnel.

What are your expectations for the coming year?
2022 was a landmark year for us, probably the best in our history. We are quite optimistic about our growth prospects. We foresee an increase in underground operations; as we have mentioned, that's a space where we excel. Therefore, we are developing new business units. We are also looking at technology companies that can provide complementary services to mining. ■

Guillermo Ibarra

General Manager
SYSTRA-SUBTERRA

Can you introduce Systra-Subterra?
Subterra Ltda recently become part of Systra Subterra which has office in Spain, Peru, and Colombia, although we have also carried out work in other countries. Systra-Subterra in Chile is mainly involved in road infrastructure and urban trains. We have built almost all the road tunnels constructed in Chile over the last 15 years. In the mining sector, we have participated as consultants in the construction of tunnels in Collahuasi and have also assisted construction companies in the repair of geological faults.

Can you describe your specific areas of expertise?
In open-pit mining, we are mainly involved in supervising slope excavations, while underground we do the design and supervise tunnel excavation work, shafts and caverns.

In recent months, we were working on the study for the expansion of the Dolores tunnel for Los Bronces. We are involved in the development of desalination plants for mining industry. We are expert advisors in the geological evaluation of the project's outfalls and intakes.

How will the shift to underground mining change engineering demands?
The transition to underground mining in Chile is imminent. Underground mining is more sustainable than open-pit mining, and less impactful on the environment.

We have been collaborating on exploratory studies for safe and sustainable underground development. In Chile, the use of technologies for underground works is still incipient, so we, as a global company, can contribute a lot with our international experience in design, consulting, and support of projects with tunnel boring machines. The mechanized processes allow us to avoid the use of workers in the excavation fronts, which has an impact on the reduction of risks during the works and decreases the probability of stoppage during the development of the works. ■

EQUIPMENT AND TECHNOLOGY

"Typically, copper recovery has been focused on the coarsest fractions, resulting in a significant loss of the finer particles that end up in tailing dams. However, new technology allows us to expand the recovery range and include the coarser and finer fractions."

Claudio García Bernal,
CEO,
FLSmidth South America

Image courtesy of ABB

The Evolution of Mining Equipment

Electrification and automation improve productivity

Image courtesy of Komatsu

In early March 2023, a group of the world's largest copper producers came together and publicly pledged to reach net zero emissions by 2050. The group, including Codelco, BHP, Glencore, and Freeport McMoRan, intend to reach this goal by turning to renewable energy, becoming more efficient, and utilizing scrap collection.

Progress is being made, although the speed of progress must rapidly increase. In 1990, the average emission intensity of refined copper production was 5.4 t carbon dioxide equivalent (CO_2e) per t of copper, while by 2018, that number had dropped by 13.4% to 4.6 t CO_2e. Central to this shift is transformative innovations in the equipment and technology segment.

As equipment becomes more technologically advanced, the increased efficiency of the machines has enabled dramatic reductions in energy use.

Even as trends in electrification, automation, and circular economy have become more popular, the way in which mining companies engage with equipment and technology providers has shifted as financing has become less steady. "Previously," explained Andrés Osorio, CEO of STM, "the client would commit up front to a complete project, beginning to end, and be willing and able to advance significant sums to carry out not only the engineering design but also the purchases, and so on. Now, however, they are focused on reducing risk in their investment."

To respond to this, STM now allows clients to commit to smaller project segments rather than the complete project.

Simultaneously, equipment providers have had to manage the ongoing, if somewhat abated, logistics challenges that sent costs skyrocketing over the pandemic, with containers prices rising steeply from US$2,500 to upwards of US$20,000. In this sense, long-term contracts were less of a boon. Jaime Balboa, CEO of SCV, stated: "It was particularly challenging for us because we have long-term contracts, where the conditions often cannot be changed. An increase of 100 – 150% in transport costs without the ability to pass those price increases on was difficult."

The challenging logistics situation gives an advantage to companies that produce and design within the country and are, therefore, less vulnerable to the vagaries of the supply chain. Prowinch, for example, offers customized equipment for clients made in Chile by Chilean engineers. "The Chilean industry needs to invest in creating complex technology," said Agostino Mattoli, regional CEO of the company. "We must rely on something other than the rest of the world, as some challenges and issues are specific to Chile."

The energy is electric

Across the board, innovations in electrification are redefining mines. Sandvik recently launched machines that are both electric and automated. Ricardo Pachón, Vice President Sales Area Andean & South Cone at Sandvik, described: "Previously, we had electric equipment, but it was impossible to automate them. Now, we can effectively have a fully electric and automated mine."

Epiroc, too, has made dramatic strides in electrification. In 2022, the company introduced its first electric underground machines into Codelco's El Teniente, which managing director John Swift described as "an enormous success for us, Codelco, and, frankly, the future of Chilean mining."

Major companies are investing full throttle in the area. Komatsu Cummins, for example, is developing a power agnostic truck project. "We are working towards fully electric, automated underground equipment'," said Darko Louit, Cummins CEO.

The shift to electric equipment must be paired with a focus on reliability. At Expomin, XCMG showcased three electric machines, including a 27-ton excavator, a 60-ton off-road truck, and a front loader. Julio Piña Alegría, commercial director of XCMG, highlighted the importance of efficiency in terms of maintenance costs: "Companies must reduce costs to be more competitive, and our new generation of electric equipment enables our clients to manage costs while improving sustainability metrics."

Many mining companies are electrifying personnel transportation fleets. Andes Motor, a Chilean distributor of international commercial vehicle brands, in addition to providing the majority of electric city buses to Santiago, to company is a leader in electric vehicles for the mining sector. "We just sold the first electric Sany mining machine in Chile," said Luis Izquierdo, CEO. "In the mining industry, there is a significant need to transport people, for which mines want to use electric vehicles."

As prevalent as electrification has become, it is not the only option for green energy under consideration in the mining industry. With a burgeoning green hydrogen industry in Mejillones, Chile is poised to become a leader in green hydrogen, improving both its sustainability and energy independence. Cummins recently launched Accelera, a subsidiary, to unify its green hydrogen operations. The company already has five plants worldwide dedicated to electrolyzer production. Miguel Flores, general manager Chile and West South America at Cummins, said: "Within Chile, we have a dedicated position for an executive focused on hydrogen, ensuring we stay focused on decarbonization."

Towards asset-centered operations

Central to a shift towards the circular economy is changing how companies think about their inputs. SKF is currently launching its RecondOil Box, a product with a patented process to recondition industrial oils so that they never need to be replaced. "The goal is for our clients to stop viewing oils as a consumable and shift to seeing them as an asset that can be regenerated rather than changed," said Carlos Lahura, managing director of the Andean region at SKF.

Turning oil into a service business model centered around changing the oil rather than disposing of it lowers CO_2 emissions.

Hilti, too, is focused on encouraging the client to rethink how they utilize the company's tools with a circular economy mindset. Alfonso González, sales director Energy, Mining, and Industry, said: "We aim to transform the current situation in which a client changes a lithium battery and then disposes of it. In our business model, we tell our clients to use our tools as if they are rented, and when they are finished using the tool or the contract is over, we take the device back and extract every reusable element."

This focus on reusing equipment is central to creating a more sustainable industry. The carbon emissions of creating a new piece of equipment from scratch are dramatically higher than maintaining and recycling machinery. Marcelo Celis, general manager of Robert Bosch Chile and Rexroth Chile, pointed out: "Every company across Chile is trying to go carbon neutral. It is a priority across the industry. An effective way to reach that goal is to focus on modernizing existing equipment rather than purchasing entirely new."

However, once a piece of equipment can no longer be repaired, it must be recycled to lower the carbon emissions of the company. In many cases, the equipment company leads the charge on this push. Michelin, for example, recycles tires from their customers and then converts those waste products into new tires. "Michelin currently has a strong focus on sustainability and circular economy, so we recently installed a recycling plant in Chile," said Rafael Santo, general manager for Chile, Peru, and Bolivia at Michelin. "We already have tires for cars and light trucks composed of 45% recycled material, and one of our goals is that 100% of our tires will be recycled by 2050." ■

Darko Louit

CEO
KOMATSU CUMMINS CHILE

Would you provide an update on Komatsu's operations in the region in 2022?
As a regional unit, we are responsible for direct and wholesale distribution across Latin America, from Mexico to Chile, except for Brazil. That implies we have presence in 20 countries, either through Komatsu-owned or third-party distributors. This 2022 was a good year for Komatsu Latam, with growth in most lines of business, and with a very interesting pipeline of projects for increasing and improving our value offer to the market. We have made some changes in the business structure, putting an enhanced focus on technology, through a new regional unit where we have concentrated development efforts on automation, emissions reductions, remote monitoring, diagnostics and data analytics for equipment maintenance and operation optimization.

Can you describe your partnership with Codelco?
In early 2022, we reached an important milestone, that is the confirmation of a trial of the TBM at Chuquicamata in 2025. Komatsu is close to finalizing the manufacturing of the machine, which was developed after several years of joint work with Codelco to utilize a continuous excavation method as an alternative to the traditional drill and blast.

What are some other standout solutions Komatsu offers?
Komatsu has a considerable portfolio of new products and technologies aimed at supporting our strategic pillars of safety, sustainability, automation, and digitization. In terms of underground mining, we are working towards fully electric, automated underground equipment. In addition, automation in open pit mining is also an essential part of future development. In Chile, we have operations of autonomous truck fleets in several sites across the country, and we are in the process of deploying remote-controlled loading equipment as well.

In what way will automation transform labor in the mining industry?
There will be a transition in terms of the skill sets that the industry will demand. ■

Miguel Flores

General Manager Chile and West South America
CUMMINS

What are the benefits of your training and inclusion efforts?
We have two training centers, one in Calama and the other in Coquimbo, where we train technicians on a simulated 360-ton truck including an HHP Cummins engine. The program enables the users to learn in a controlled environment all the necessary tasks to ensure the operational continuity of our equipment at site, while at the same time achieving the best safety standards. Advanced training is one way we provide a quality service for the mining industry.
It is not just about quality & safety but also about inclusion. For example, we have a program to train women in technical areas, enabling them to develop specialties and enter the mining industry. We have already certified four women who are actively employed in mining operations.

What drives Cummins' focus on sustainable technologies?
Cummins is working on improving drivelines for lower fuel consumption, automation, and renewable fuels. This is part of a long-term strategy called Destination Zero, which aims to reduce carbon emissions as technology advances. In the Chilean market we have engines with the technology and fuel efficiency needed to reduce emissions and costs at work sites, such as the MCRS platform engines, which offer more power and greater durability than their HPI predecessors, while achieving lower fuel consumption, lower emissions, requiring less maintenance and considerably reducing life-cycle costs. This year, we launched Accelera, a new brand of Cummins' New Power business segment, bringing together everything to do with the zero emission solutions that includes battery systems, fuel cells, ePowertrain systems and electrolyzers.

What are Cummins' goals for the coming year?
Safety, diversity and leadership will be our priority. People bring the most important value to our company. The second goal is to become an active partner in the energy transition towards zero emissions. The last focus is on operational excellence. ■

Ricardo Pachón

Vice President Sales Area Andean & South Cone
SANDVIK CHILE

How does Sandvik support the Chilean mining sector?
In Chile, we have a team of about 500, with our headquarters in Santiago, a service center in Calama, and a service center in Copiapó that opened on April 20th, 2023. We offer state-of-the-art technology for the mining sector, serving both underground and open pit mines.
We have an extremely close relationship with Codelco, with several automation projects ongoing. We also have several projects in development, with a completion horizon of approximately four years.

What trends in demand have you observed?
There are two significant trends. The first is an intense focus on emissions reductions and reducing carbon footprints. Reducing the carbon footprint means substantial interest in electric vehicles and, if using diesel, significantly more efficient vehicles. The other trend is towards automatization. Chile is at the vanguard of this trend in the region, and what we do in Chile is soon replicated in other countries.

What is your approach to workforce challenges?
It's a complicated issue. Sandvik has created partnerships with universities, creating a program called Sandvik School. We select individuals through our partnerships with universities, giving them a direct pathway into our company in diverse areas.

What are the benefits of your new automated and battery-powered equipment?
Sandvik recently launched our first loader that is both wholly electric and completely automated. Previously we had electric equipment, but it was impossible to automate them. Now, we can effectively have a fully electric and automated mine. We performed some tests in mines around the world with excellent results. They are now in the commercial launching phase. The first of these machines will be arriving in Chile by the end of Q3, and we are already adapting our installations in Santiago to receive this equipment and have it working in mines by the end of the year. ■

Julio Piña Alegría

Commercial Director
XCMG GROUP

Could you give us a brief overview of XCMG's operations in Chile?
We have this factory office and a mining branch in Copiapó, and soon we will have one in the Antofagasta region. XCMG also has distributors in Punta Arenas and Coquimbo, allowing us more coverage in different areas of Chile.

Would you highlight the benefits of your offerings?
We have a vast portfolio of equipment for construction and mining. In the mining context, we are constantly pushing to ensure that the brand and equipment align with the new mining fundamentals. By this, I mean the transformation of mining towards a more sustainable and environmentally friendly practice. At Expomin 2023, we are showcasing three electric machines: a fully electric 27-ton excavator, a 60-ton off-road truck, and a front loader.

What is the role of new technologies like digitalization and automation in the future of mining?
The fundamental role of advanced technologies is in safety, both protecting people and the environment. Most equipment will run autonomously to prevent human contact with the equipment, reducing safety risks. A non-contaminating mining sector was little more than a dream 20 years ago, but now, a truly clean mining industry is materializing. We foresee the potential for a mining sector with zero emissions by 2040 to 2050.

What is XCMG's competitive edge when it comes to autonomous technology?
XCMG is the world's third-leading mining equipment supplier, and we understand that the trend for autonomous technology is here to stay. Today we provide autonomous equipment both for open-air and underground mining. We are competitive with the market leaders. Our philosophy, which we have had for 80 years, has always been to compete and be number one. XCMG is a company owned by the Chinese state, so the same vision China has as a country is the company's brand vision. ■

Felipe Fossatti

Commercial Director
MULTISERVICE GRÚAS

How can virtual reality improve equipment safety?
Our machines have various essential safety devices and sensors that are continuously monitored to minimize human error. We are implementing a new project in March of 2023 focused on safety. We are developing an innovative simulator using virtual reality that imitates situations involving our machines, allowing our personnel to familiarize themselves with challenging conditions before they occur. This innovative approach allows us to offer the safest service for our clients.

What makes Multiservice Grúas stand out?
Multiservice Grúas is differentiated by our highly trained staff, who has vast experience in the field. It is more than just the technology of the equipment that matters to our clients. Our cranes are, indeed, very high-tech. However, a machine of this caliber requires a robust and organized structure around it that is well-integrated within the structure of the company and the project.

As a 34 year old company, our objective is to reach 100 years. We want to position ourselves so that our clients keep betting on us and betting on our history and what we represent. ■

Agostino Mattoli

Regional CEO LATAM
PROWINCH

As a global company founded in Chile, how does Prowinch serve the mining industry?
We initially focused on winches and gradually grew and expanded into different areas. We developed our presence in South America before expanding to the United States eleven years ago. Prowinch offers different types of products, all dedicated to pulling or lifting: Winches, Cranes, Overhead Cranes, Wire Rope Hoists, Chain Hoists, and other essential tools of the trade. Initially, we primarily sold equipment, but we began designing and manufacturing our own units very early in our history. We constantly developed this ability; today, we hold patents for designs and technological solutions for deep mines.

What is your growth strategy?
Chile will always be an important location for us. This is where we have a majority of our knowledge base, our human resources team, and most of our engineers. So today, we continue expanding in Chile and focusing on developing our presence in the US in terms of customers. Opportunities to grow in the US are more advantageous because of the huge size of the market.

However, Prowinch was founded in Chile. We will always have a presence here, and it will always be our home. ■

RS

CG

Rafael Santo and Christian Garrote

RS: General Manager Chile, Peru & Bolivia
CG: Regional Sales Manager Mining Chile & Bolivia
MICHELIN

Can you introduce Michelin in Chile?
RS: Michelin currently has a strong focus on sustainability and circular economy, so we recently installed a recycling plant in Chile. We already have tires for cars and light trucks composed of 45% recycled material, and one of our goals is that 100% of our tires will be recycled by 2050.

How does Michelin contribute to productivity?
RS: We launched the 70/70 R57 X MINE L4 tire for loaders. It is three times more durable than most tires on the market and will allow more tons of material to be transported per hour.

CG: In addition, we have incorporated technologies, such as the MEMS system, that allow us to monitor tire conditions, as well as the work environment to identify the zones where the truck experiences the greatest complications while operating.

What are your strategic objectives for the rest of 2023 and next year?
CG: We seek to continue innovating and developing new products to better serve the mining market. An example is the recent launch of the largest radial tire for front loaders in the mining industry, the 70/70 R57 X MINE L4. ■

Luis Izquierdo

CEO
ANDES MOTOR

Can you introduce us to Andes Motor?
Andes Motor is celebrating 10 years in the automotive industry in Chile. We are a young company, but we have had explosive growth. We have already sold over 4,000 units, and we have a comprehensive portfolio. Any client needing a commercial vehicle can come to us and find a vehicle ranging from small trucks and cargo vehicles to large mining machinery. Recently, we started experimenting in niches such as cranes and port equipment. We offer a broad variety of machines to our clients in the mining industry.

How important are electric vehicles in your portfolio?
Andes Motor has a wide variety of machinery for mining, and we are expanding our offerings with electric machines. We just sold the first electric Sany mining machine in Chile. The product has already entered the country and will begin operations next month. We already had electric trucks and mini trucks actively in use across the country, so the first electric Sany mining machine is an excellent step.

We see very high demand in the personnel transportation area. In the mining industry, there is a significant need to transport people, for which mines want to use electric vehicles. We currently have the highest number of electric vehicles operating in the country, and in the public sector we supplied over 1,300 electric city buses for Santiago.

What differentiates Andes Motor's service?
We have a specialized team for selling electric vehicles because the expertise and information are different when selling an electric vehicle compared to the expertise needed to sell a traditional combustion engine. Our ability to advise the client comes from this specialized attention and expertise. ■

John Swift

CEO
EPIROC

What updates do you have on Epiroc's activities over the past year?
Over the past year, Epiroc introduced the first electric underground machines into Codelco's El Teniente, which has been an enormous success for us, Codelco, and, frankly, the future of Chilean mining. Second, we advanced our deep relationship with our customers, focusing on mine optimization through the whole value chain. And third, we underscored our commitment to a circular economy as the first company in Chile to have our circular tire plan approved.

What challenges are facing the mining industry today?
The challenges are twofold. The first is talent and workforce, both in terms of recruitment and retention. The second is the social license to operate.

Where do you see the most significant opportunities?
The biggest opportunities that we see right now are in electromobility. Mines moving underground creates more focus on ESG and a demand from the public for sustainability, both leading to electromobility. Automation is the other key factor. Epiroc has a strong surface and underground automation platform, and now offers surface autonomous haul trucks. The service we offer is agnostic to the brand of equipment.

What differentiates Epiroc?
Our broad offering spans the entire value chain. For example, Epiroc now works with ore body analysis that an OEM would not carry out historically. Our tools are traditionally a consumable type of business; now, with digital offerings and data analytics, we have moved into more solid planning and predictive planning. Epiroc has purchased many companies over the past couple of years, expanding how we define ourselves and, more importantly, how the industry defines OEMs. As a result, we are taking a much broader view of how we can help. It's not about widgets but how the company can take data and produce helpful information to ensure the customer gets greater productivity without greater expense. ■

Comminution and Material Handling

Optimization of processes reduces energy usage

Image courtesy of TAKRAF

Comminution – the grinding, blasting, and crushing or ore – is at the center of mining operations. As ore grades have consistently dropped, the need for more effective recuperation of ore has directed attention to the potential for optimization of material handling. Investment has followed.

Indeed, Latin America is an excellent market for material handling companies. South America is the fastest-growing market for Hofmann Engineering, and in 2022, the company grew by over 50% in turnover compared to the previous year. Hofmann Engineering provides a variety of products including girth gears and pinions for mill gearing, electric rope shovel transmissions, roll assemblies and gearboxes for HPGR, and in the past year, expanded into hydraulic excavator critical components and the crushing market.

As part of the company's rapid expansion within Chile, in June 2023 it will test the new multi-axle, CNC controlled floor borer with a 50-ton rotary table. Simão Antunes, general manager of South American operations at Hofmann Engineering, stated: "We have a 20-year plan for expansion in Chile and plan to fully complete the first phase out of three by the end of 2023, allowing us to manufacture the HPGR rolls locally and provide critical and heavy precision machining services for manufacturing and refurbishing of critical components for the mining industry."

Weir Minerals is a global company that offers services for the mill circuit, including pulp pumps, hydrocyclones, traction devices, among others. The company is focused largely on transfer pumps, although also offering a value-added mill circuit line, which is focused on maximizing recovery while minimizing energy and water use.

Weir takes a collaborative approach to the industry. It has an agreement with Eriez, allowing Weir Minerals to optimize ore recovery through coarse particle flotation, as well as an alliance with STM in incorporate vertical mills in existing and greenfield facilities, improving the efficiency of the process. "Our customers' expectations have motivated Weir to join forces with Eriez and STM to come up with an optimized flow sheet considering our Enduron HPGR, our CAVEX2 cyclones, the Eriez CPF (coarse particle flotation cells) and STM vertical mills," said Martin Brenner, regional managing director of Weir Minerals LATAM. "We are ready to offer these solutions and have seen a high interest in the market to upgrade existing facilities."

» In Chile, there are many challenges related to the labor market, with high records of absenteeism and difficulties in hiring that make it difficult for many companies to fulfill their contractual responsibilities.

José Castillo,
Managing Director Chile,
Rema Tip Top

«

For Metso, the merger of Metso and Outotec, Latin America is a very important region, representing 20% of the company's sales. Chile is home to the company's largest casing plant. The company was very busy over the course of 2022, counteracting the logistics challenges of global interdependence by investing in local capabilities.

Metso has benefited from the desire of major mines to upgrade. For example, Metso recently won a contract with Collahuasi for a specific floatation cell that minimizes energy consumption while maximizing ore recovery. Additionally, it recently worked with Codelco to upgrade the company's 40-year-old crushers to maximize efficiency. "The mining industry is showing great interest in increasing its energy efficiency, and many companies have turned to Metso to optimize the production of their plants," said Eduardo Nilo, president for South America at Metso Outotec.

The comminution process consumes more than half of the energy used by the mining industry, according to the Coalition for Energy Efficient Comminution. "I think one of the biggest challenges is the sustainability of operations," said Christian Pastén, regional business development manager at Glencore Technology. "Lower ore grades mean operations need greater efficiencies."

Glencore Technology offers a range of technologies that optimize productivity in material processing, including ISASMELT, a smelting furnace installed in Peru and the Jameson Cell, a flotation device that can recover fine and coarse particles, which has been in Collahuasi since 2019 and Centinela since the end of 2022. Pastén explained: "Minerals have lower grades, and so higher volumes are needed to get the same results. Our equipment means an operation can process more feed with less capital cost."

Sustainability is now a driving force within the material handling space. FLSmidth recently introduced the HPGR Pro, a highly sustainable high-pressure grinding roll technology. In 2019, the company introduced MissionZero, a sustainability commitment program. Claudio García Bernal, CEO of FLSmidth South America, said: "Our new strategy, starting in 2023, focuses on full lifecycle solutions that align with MissionZero's sustainability commitments, while delivering measurable improvements in customer economics as well as building customer loyalty and collaboration."

Reducing a company's carbon footprint is not only a matter of checking a few boxes, shifting to renewable energy and commissioning electric trucks. It requires an examination of the complete mining system. For example, conveyor belts are more energy efficient that trucks, providing an opportunity for bulk materials transport providers. Sergio Zamorano, CEO of FAM Minerals & Mining Latin America – part of Boehmer Group, said: "There is significant demand for transformational engineering projects to reduce the carbon footprint of existing mines and move into continuous handling."

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Considering the current consolidation in the supplier market, we believe there is a tremendous opportunity.

Andrés Costa

Managing Director Chile & Peru
TAKRAF GROUP

What is the history of TAKRAF Group in Chile?
We are headquartered in Germany with offices around the world and have been operating in Chile for approximately 25 years. We have been involved in major mining projects in the region, managing projects both in Chile and Peru. Our clients range from end customers to project offices and engineering companies.

What are your key products?
We operate under two brands: TAKRAF, which is our traditional brand focused on mining, material handling and comminution machinery; and DELKOR, which specializes in solid-liquid separation. We also carry out engineering projects in transportation. One of our flagship projects to date is Chuquicamata Subterranea, where we developed the world's most powerful conveyor system, with 58 MW of total installed drive power. We offer a wide range of solutions to our customers, from large integrated systems to individual machines, various maintenance concepts and spare parts. In the case of DELKOR, we have a long tradition in separation systems, and are constantly seeking new alternatives and aiming to be at the forefront of technology.

How do you utilize advanced technologies?
In recent years, we have made all of our equipment available with remote control options or remote monitoring capabilities. We have also successfully developed our BQR flotation cells and a sizer, which has demonstrated tremendous benefits as an alternative to a gyratory crusher for hard rock applications. Currently, we are implementing notable improvements in terms of digitization and control of our thickeners.

How do your services improve mine productivity and efficiency?
When depositing material, for example, when a spreader is operating, we have incorporated monitoring systems to enable independent and automated deposition by the operator. By improving the depositing process, we minimize the need for additional equipment, reducing risk and the number of operators.

What are the sustainability and efficiency benefits of DELKOR?
We are one of only two companies globally that offer a complete and integrated dry stacking solution. Our products provide sustainability and safety benefits in various areas. For instance, in transportation systems we focus on intelligent belt conveyor power regeneration and the use of more efficient motors, significantly reducing energy consumption. We have achieved energy consumption reductions of up to 35%. Additionally, application of our advanced dewatering solutions can enable up to a 94% water recovery rate. Lastly, our new generation DELKOR BQR flotation cells, equipped with our latest MAXGen mechanism, achieve superior metallurgical performance.

What is the biggest challenge facing the Chilean mining industry currently?
As an industry, we have a social responsibility to communicate the importance of our contribution to the country's economy and development. Without minerals, society cannot exist, and there can be no electromobility. If we fail to make society understand this, we are not fulfilling our role. Furthermore, we have a responsibility to engage in responsible mining, with responsible consumption of supplies and a carbon footprint that is environmentally friendly. Chile will have to play a major role in the Electric Vehicle (EV) metals transformation. In this regard, both suppliers and end customers can make a significant impact.

What is the importance of Chile and Latin America for TAKRAF Group?
Chile has historically been one of the most important regions for TAKRAF Group. We have undertaken the most significant projects and carried out the largest works in the region for many years. Naturally, we are monitoring the developments in Latin America with some degree of concern, as we observe a complex market in Chile, Peru, and neighboring countries. Meanwhile, other markets not involved in the Russia-Ukraine conflict, such as Australia, and countries in Africa and Asia, are strengthening and attracting more interest. However, the potential we have as a region for the future is tremendous. With a bit more stability, I am confident that we will regain our position of leadership.

What is the company's strategy for the upcoming year and what are its objectives?
Considering the current consolidation in the supplier market, we believe there is a tremendous opportunity. We have a new CEO who brings a wealth of industry experience, and we are developing a strategy to capitalize on the opportunities left by competitors and develop a solid aftermarket market, enabling us to support our customers throughout the complete lifecycle of our products. Our focus is on organic growth. ■

There is a generation shift, and many younger people with more interest in advanced technologies are now in positions of power.

Andrés Osorio

CEO
STM

How does STM support the mining industry?
STM has been delivering bulk material handling solutions for more than 50 years. Our equipment is 100% tailor made. We work under the OEM model, that is, we have in-house engineering, and based on the specific requirements requested by our clients, we integrate the different suppliers to deliver a solution that fully satisfies their needs.

We principally manufacture in-plant conveyor belts and belt feeders. We also supply overland conveyor belts, ship loaders, and tripper conveyors. And when necessary, our in-house engineering team works to improve older systems to make them more efficient.

Can you provide an update on STM's operations over 2022?
At the beginning of 2022, the year looked quite promising for STM, but it took a while for that progress to materialize. However, in the last part of the year, we experienced an explosion in projects. Those projects were primarily brownfield; historically, we have had more greenfield projects, and today the majority are brownfield. However, there has been a noticeable drop in new projects compared to previous years.

We focus on the Chilean and Peruvian markets and have a solid customer base in Chile. One of our competitive advantages is that our supply chain is locally integrated, and we supply different components regionally.

Has negative investor sentiment impacted your projects?
Due to regulatory uncertainty and the challenges in gaining investment, clients approach decision-making and project decisions differently. Previously, the client would commit up front to a complete project, beginning to end, and be willing and able to advance significant sums to carry out not only the engineering design but also the purchases, and so on. Now, however, they are focused on reducing risk in their investment. Therefore, we have adapted our business model to allow clients to commit to smaller project segments to respond to this.

How can Chile incentivize investment?
A vital step would be for the government to streamline and simplify the process of permitting and environmental authorizations. In the Anglo American Los Bronces project and others, we have witnessed the ramifications of uncertain permitting after years of intense effort to meet regulatory expectations. The time it takes to receive an individual permission has increased to four or five years, which delays all process steps.

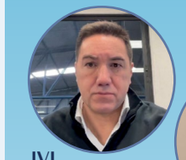
How do you utilize digital tools?
Integrating advanced technologies that improve conveyor belt productivity is our central challenge. One of our providers just finished developing an exciting technology for us that enables continuous oversight of rollers and pulleys operations, allowing the client to have complete information. Additionally, advanced technology can avoid or reduce fire risk. Last year in the mining industry, there were at least three or four fires that I know of. Many of these fires were caused by conveyor belt components overheating, and these sensors identify overheating before it turns into flames.

Why do you see more momentum in the mining technology space?
There is a generation shift, and many younger people with more interest in advanced technologies are now in positions of power. I am optimistic that we will see significant investment in technology and a broader willingness within the industry to adapt to and incorporate new innovations that improve productivity.

How do your products lower carbon footprints?
Using conveyor belts to transport materials rather than trucks is noticeably more energy-efficient, lowering the carbon footprint of the mine. The mine utilizes less energy with every truck that is not on the road. Our processes are optimized and engineered to ensure the individual client receives the highest possible benefits. STM does not just pull a product off the shelf but offers individualized services with our designers that precisely fit the client's needs.

What is your focus for the coming year?
STM continuously identifies how we can improve our support for our clients. As a result, we are significantly more agile and adaptable than many others in the industry. For example, we carried out a ship loading project when a ship loader collapsed suddenly in nine months when other providers would have taken up to two years to do it because their operations are located outside of South America.

We have always focused on staying as close to the client as possible and will continue investing in that. STM will also continue to prioritize process optimization in everything that we do. ■



JVL

MVV

Joerg Von Loebenstein and Martín Villaseca Vaccaro

JVL: Engineering Manager
MVV: Marketing Manager
TECNIPAK

Could you provide a summary of Tecnipak's recent operations?
JVL: Tecnipak provides components for mineral transport systems and processing plants, and has primarily focused on three key areas: increasing the durability of our components, enhancing the autonomy and automation of our products, and contributing to increase productivity in mineral processing plants. Furthermore, we have been making our products more self-governing to reduce the need for regular interventions, thus making mining operations more streamlined and productive.

What is Tecnipak's footprint in Chile and beyond?
JVL: We have a broad presence internationally and have been expanding in various countries, particularly Canada and Australia. In Chile, we have expanded our infrastructure in Santiago, with an area of approximately one and a half hectares comprising production spaces, warehouses, and offices. We also have an office in Calama.

Can you describe the benefits of your new autonomous scraper?
JVL: The scraper incorporates a load sensor, allowing it to apply and de-apply autonomously depending on the load in the belt.

MVV: The key advantages are to reduce the need for human intervention, thereby eliminating the risks. Furthermore, there are performance advantages that come with autonomous operation.

How do you foresee the mining industry managing productivity challenges?
JVL: Mining operations need to depend less on human intervention, and we need to provide monitoring and control through technology across the entire mining production chain.

What are your key objectives for 2023?
MVV: Our most immediate objective for 2023-2024 is internationalization. We have products that significantly improve mines' operational efficiency and believe these solutions are needed worldwide. With our technology in operation in Canada, Australia, and Peru, we have already made some strides toward this goal. We actively seek partners in various countries and participate more aggressively in international events to gain wider recognition. ■

Sergio Zamorano

CEO Latin America
FAM MINERALS & MINING – PART OF BEUMER GROUP

How does FAM Minerals & Mining support the Chilean mining industry?
Historically, we focus on mobile equipment, such as mobile bridges, specializing in conveyor systems and loading technologies. We also provide services, including maintenance, supply, and reconstruction projects. We design, manufacture, supply, modify, and so on. We have a well-established office in Chile with a staff of around 260 people.

Can you discuss Beumer Group's acquisition of FAM Minerals & Mining?
In May of last year, Beumer Group acquired FAM. Unlike other buyouts, we have maintained our identity. Beumer Group is a 1.2 billion Euro a year group, with a division called "conveyor and loading", now part of FAM that sells products such as pipe conveyors and pioneered horizontally-curved conveyors as far as 1971. However, Beumer Group did not have a significant mining presence, so we fit exceptionally well. Beumer Group brings strong expertise in digitalization and remote monitoring, enabling us to leap forward into a digital process with remote assistance.

How is FAM Minerals & Mining working to advance the mining industry?
The mining mentality needs to focus on energy efficiency, and we help our clients improve their energy usage. The best way of saving energy is by reducing consumption. Even if you change your generation method from oil to wind, your new green system will still have a large generation footprint, so reducing consumption is crucial.
Transport systems are largely overdesigned. To maintain safety, applying today's technology is vital. The mining industry is 20 years behind other industrial sectors. The information has been there, but the mining mentality has historically not been focused on innovation. As an industry, we need to change the mentality to design for the future, and FAM Minerals & Mining is an active part of that transformation. ■

» Our developments are aimed at optimizing the plants with more compact and effective concentrators and making them more efficient. Minerals have lower grades, and so higher volumes are needed to get the same results.

**Christian Pastén,
Regional Business Development Manager,
Glencore Technology** «

» We have many automation solutions that have implications for optimizing energy use. For example, our solutions minimize energy consumption and maximize the productivity of conveyors, pumps, motors, mills, or hydro cyclones.

**Felipe Cabrera,
Country Manager,
Emerson** «

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Terra Nova Technologies, meanwhile, is responding to the push towards sustainability not just by offering in-pit crushing and conveyance systems that reduce the need for trucks, but also by enabling component reusage for material handling systems. “Many of the stacking systems in the region have reached the end of their lifecycle, and our customers, rather than replacing them, are requesting services such as modification and upgrades to extend the life of the systems and increase their energy efficiency,” explained Ignacio Fernández, general manager LATAM at Terra Nova Technologies.

Operating in the Chilean jurisdiction is unique compared to other mining jurisdictions. José Castillo, managing director of Rema Tip Top Chile, said: “The fundamental difference is the cheer scale of operations. Chuquicamata, Los Bronces, and so on are mines that operate at a scale nearly unmatched.”

The intense scale of these mines results in demand for giant material handling machinery. Castillo continued: “That makes this a unique market because the giant conveyor belts require specific procedures to maintain operational continuity. Scheduling and planning changes or repairs to giant belts require complicated engineering utilizing precisely engineered high-tonnage systems. Significant risk is involved when a company gets involved in engineering dynamic loads for conveyor belt change out, for example. Our company is an expert in managing that risk. Maintaining production is a significant part of our value package and is where we provide a differentiated service. “ ■

Martin Brenner

Regional Managing Director
LATAM
WEIR MINERALS

Can you introduce Weir Minerals?
We primarily offer services for the mill circuit, with hydrocyclones, hoses, valves, traction devices, and all types of pumps. Our pulp pumps are our most important product. For the crushing process, we work with HPGR, screens, secondary crushers, as one of the top two providers in the market, as well as integrated crushing plants that are highly energy efficient. We also offer services related to tailings management, focused on water recovery and transport. Our pumps are capable of transporting material under high pressure and over long distances of up to 500 km.

In Chile, we have a large production center in Santiago and service centers in Iquique, Calama, Antofagasta, Copiapó, and Santiago.

How does Weir Minerals incorporate sustainability in its operations?
We work on sustainability through green energy contracts as well as the installation of solar plants and implementations of programs to reduce energy consumption. Our goal is to reduce our carbon footprint by 50% at the latest 2030 worldwide. In Chile we have already achieved a 40% reduction through different initiatives driven mainly by our own employees. Additionally, we are working together with our customers in recovering from the mines the high chrome parts to melt them in our foundries reaching circularity levels above 50%. Lastly, we actively work on gender equality and social inclusion.

What are your objectives for 2023?
We have understood that our customers expect to reduce energy and water consumption while processing more ore to cope with the increasing copper demand so necessary to electrify our world. Our customers' expectations have motivated Weir to join forces with Eriez and STM to come up with an optimized flow sheet considering our Enduron HPGR, our CAVEX2 cyclones, the Eriez CPF (Coarse Particle Flotation) cells and the STM vertical mills. We expect to have several pilot plants running and the first go decisions still during 2023. ■

Eduardo Nilo

President South America
METSO OUTOTEC

Can you introduce us to Metso Outotec?
Metso Outotec was created out of the merger of Metso and Outotec. However, the company recently announced that it will retake the Metso name. Our largest foundry plant in the region is Sorocaba, which can supply steel elements to Chile and Peru, and Chile is home to the largest casing plant.

Can you give us an overview of Metso's activities in 2022 and early 2023?
2022 was a strong year for the company. Over the last two years, global supply demonstrated the risks of interdependence on a global level due to logistical complications. In this context, we started to expand our local capabilities by investing in expansion of facilities and starting our recycling and repair capabilities, and also increasing the pump and casing production.

Another interesting subject is highly efficient equipment with planet positive impact. As an example, we recently won a contract with Collahuasi for a type of flotation cell to minimize energy consumption and maximize ore recovery. We have also worked with Codelco to upgrade crushers.

What kind of sustainability initiatives has Metso taken?
Mill liners generate large amounts of waste. Metso has therefore developed initiatives to recycle them. This year we installed a recycling plant, and our goal is to reuse 100% of the rubber. We have also set a goal to be carbon neutral by 2030, and have already started installing solar panels in many of our facilities. Metso has also started to work with small local companies on the reuse of our waste.

One example to highlight is with El Teniente mine, one of Codelco's divisions. We have retired more than 80 tons of used mill liners from that operation that will be used as raw material for the elaboration of new liners for El Teniente´s plant, helping them to achieve their environmental KPI's. ■

» High commodity prices are giving a new lease of life to the mining industry, and we expect that projects that were suspended or are on standby will soon be progressing again. «

Roberto Montiglio

General Manager - Andean Region,
and Global T.U Manager for Spares and Services
HAVER & BOECKER NIAGARA

Can you introduce Haver & Boecker and describe the company's areas of focus?
Haver & Boecker's mining division (knows as Haver & Boecker NIAGARA) produces technologies and solutions related to the classification and separation of solid materials – mainly vibrating screening machines, screening media (rubber and PU), and wire mesh. We have two main product lines related to condition monitoring, industry 4.0, and IoT. One is a traditional condition monitoring system where you install sensors on the machine to collect data, and the other, which is currently very successful, especially in light of the pandemic situation, is a remote monitoring system that sends data to a cloud network every five minutes, seven days a week, 365 days a year. This data is then analyzed through a machine learning system to inform decision making and predict mechanical problems up to four weeks in advance.

What are the main benefits of Haver & Boecker Niagara's vibrating screens?
Haver & Boecker Niagara has two centers of excellence in the Americas – one in Brazil, which is mainly focused on large linear motion vibrating machines from our German side of the business; and one in Canada, close to Niagara Falls, which is focused on the original W.S Tyler machines that are more medium to small sized. Haver & Boecker Niagara manufactures T-class and F-class vibrating screens which rotate in a circular motion rather than linear, with the difference being that the T-class has two bearings and the F-class four in the main shaft. The benefits of having four bearings is that you have a fixed amplitude of movement, which is an ideal solution for challenging screening applications requiring consistent performance, load independence and minimal vibration transmission into the structure. The four-bearing shaft assembly thus enhances positive circular motion, ensuring the most effective screening action.

What types of companies do you supply products to and what services does the company offer?
We work with everyone along the mining lifecycle – from directly with mining companies to contractors and EPCM firms. We are focused on keeping the total cost of ownership (TOC) as low as possible for our customers so they can attain the most benefit. From our Chilean office, we serve all South American countries that speaks Spanish, but approximately 80% of our business in the mining industry is in Chile and Peru.

Our sales and services relate to new machines, replacement machines, condition monitoring technologies, and services and spare parts. We provide our customers all components and spare parts to keep their machines in top condition. We also have a refurbishment division where we completely disassemble old machines, replace parts that need to be replaced, repair parts that can be repaired, and reassemble the machine. We guarantee that our refurbished machines are as good as new, and customers then basically have a new machine while saving near 40% on costs.

Which challenges have you noticed in the manufacturing of material handling machines recently?
The high price cycle combined with inflation and supply chain delays is impacting the industry as cost for materials such as steel needed to manufacture material handling equipment has also increased, leading to higher cost of equipment for our customers. From November 2021 to April 2022, we saw international steel prices increase by approximately 50% in some markets, including North America, which is a key hub for us.

What potential do you see for Haver & Boecker Niagara's growth in the mining sector in the years ahead?
High commodity prices are giving a new lease of life to the mining industry, and we expect that projects that were suspended or are on standby will soon be progressing again. In the Chilean market, we have seen the need for getting new projects online, and most Peruvian projects are keeping on track. Over the past three years, Haver & Boecker has seen great success with new machines in the Peruvian market, but this has not been same in the Chilean market, maybe due to the pandemic, the international situation, and the current geopolitical situation in the country creating uncertainty and putting the mining industry on standby. We however expect a relaunch of the Chilean market in the near future, especially in light of high copper prices and expected increased demand which will require increased production capacity. ■

Claudio García Bernal

CEO
FLSMIDTH SOUTH AMERICA

Can you give us a brief introduction to FLSmidth?
Our mining business has two core segments. The first is capital assets, which includes all aspects of sales, construction, and manufacture of capital assets such as mills, crushers, etc. The second is services, which includes aftermarket, spare parts, consumables, maintenance, and other related services.

What is your footprint here in Chile?
More than 2,000 people work with us in the region, both in manufacturing plants and in our Service Centres. We have facilities in Antofagasta (Chile) and Arequipa (Peru); also in Santa Lucia, for testing, and Belo Horizonte (Brazil). We have installed a monitoring station in Chile to control the throughput and behaviour of our customers' equipment and support them in analysing improvement opportunities for their on-site equipment. We monitor not only the machine's health for maintenance but the entire process of the asset as part of a whole package, allowing us to advise on recovery, treatment levels, downtimes, and a comprehensive list of the behaviour of our equipment. ■

PM

RM

Patricia Michels and Rodrigo Morales

PM: CEO
RM: Technical Director
TECPROMIN

Could you introduce our readers to TecProMin?
PM: TecProMin provides self-developed technologies, engineering, research and development. We also engage with foreign technological partners, to complement our portfolio of services. By collaborating, we can locally manufacture the products they create.

How can the mining industry improve productivity?
RM: To make accurate and swift decisions, automation tools that monitor the unit operations of a production chain are essential. Embracing technological advances, especially in process automation, is crucial for optimizing production.

What are TecProMin's strategy and goals for 2023?
RM: The primary short to medium-term goal is to consolidate geographical diversification. We have managed to cover Latin America comprehensively and aim to consolidate this expansion by providing quality service and support to our offices and clients across the region. The long-term strategy is to diversify our business lines in the North American market, while continuing to consolidate our presence in Europe, Asia, and Oceania. ■

César Garrido

CEO
SIDERÚRGICA HUACHIPATO

Can you introduce Siderúrgica Huachipato?
Our value proposition is aimed at the mining, infrastructure and automotive's spare parts segments, through a differentiated portfolio of products and services that enable better performance in the final application, waste circularity and lower Scope III emissions for our customers.

Huachipato offers products that are differentiated by two key factors. First, we deliver superlative quality products by utilizing special alloys, raw materials and technology that enhance the steel's attributes, resulting in less steel consumption during the comminution process and infrastructure projects. Our high-quality steel optimizes processes and subsequently leads to fewer emissions.

Additionally, as an integrated steelmaking plant that is closest to mining operations in Chile and Peru, we significantly minimize the carbon footprint of our customers in Scope III compared to imported products.

Huachipato seeks to boost a circular model of steel usage in mining, adding value not just to the final client in the mining sector, but also to the larger ecosystem of Chile.

What differentiates Siderúrgica Huachipato from its competitors? Our differentiating factor is that we have redesigned our steel to minimize consumption and CO2 emissions, and we also implement steel recycling practices to optimize the mining ecosystem. ■

Technology and Innovation

The mine of the future: automated

Image courtesy of SQM

Automated mines, controlled remotely, are the mines of the future. There are multiple benefits: the fewer people in the mine itself, the less risk of accidents and safety issues; the ability to control mines remotely allows the workforce to be based in cities rather than the wilderness, improving workforce retention; and operating machinery remotely allows for one person to handle multiple machines, improving productivity.

The recent push for automation in Chile is demonstrative of a renewed interest in innovation following the slow period of the pandemic. Cristophe Boinelle, director of MC System, a company that offers sensors and automation technology that can be incorporated in pre-existing machinery, said of the pandemic period: "Compared to Europe, Chile's local mindset tends to avoid investing in technology during times of crisis. We anticipate this mentality will change in the next few years, particularly as investors and mines face a new workforce crisis."

Zauschkevich Domeyko, president of the Cámara Minera, highlighted the industry's role in advancing automated technologies: "The mining industry has been a pioneer in automation, particularly in fluid flow regulation processes. There is also a trend in large-scale mining to automate conveying and crushing equipment. Although these investments are more likely to be considered for large-scale mining, the technology will become cheaper over time."

Handling the wide variety of new automation technologies and equipment offerings is a complex endeavor. Alicia Domínguez, mining and energy leader at Ernst & Young, explained: "One of the digital services we provide consists of implementing integrated centers of operations, from which the client can remotely operate the complete chain of mining operations."

Highlighting the importance of fiber optics for real-time communication in the future of mining, César Ortega, CEO of Telemining, said: "The mining of the future will be almost completely automated, with no personnel underground. We need communications networks that can report in real-time to operators outside the mine, 100 km away."

Automation is transforming the industry at all points along the value chain. MJ Gerüst, a scaffolding manufacturer, is actively investing in automating its offerings. "Our integrated technological system allows us to run an operation with less labor. The process is automated, which reduces costs," explained Christian Abt, area sales manager South America at the company.

Desalination plants are another area where Chilean mining companies expend a significant amount of Capex. Therefore, the cost savings enabled by automation are in high demand. Felipe Cabrera, country manager at Emerson, stated: "In recent months, demand has been driven primarily by desalination plant automation and the need to optimize copper mining productivity in the face of declining ore grades, particularly in older mines."

Emerson was contracted to automate the desalination plant and aqueduct for water transport for Minera Los Pelambres' Inco project and has also worked on the automa-

tion of Collahuasi's desalination plant. The company is currently working on a desalination plant with Codelco.

In the perception of some companies, the dial has swung too far towards automating everything at the expense of recognizing the need for on-site service. Roberto Montiglio, director of the Andean region at Haver & Boecker, said: "Covid convinced people that everything can be done remotely; unfortunately, that is untrue. Many customers resist on-site visits, making returning to normal an issue."

Haver & Boecker offers a no-cable, wi-fi enabled conditioning monitoring system that operates 24 hours daily, but still utilizes skilled technicians on-site to ensure continued operations.

Technology for increased efficiency

When Escondida, the world's largest copper mine, started production in 1990, it had a grade of approximately 2.5% to 3% copper. The reserve grade today is around 0.5%. These declining grades are mirrored at mines across Chile and are leading to a shift underground, forcing an intense investment in improving efficiencies throughout the process to maintain profits.

How companies go about improving efficiencies has changed. "Historically, there has been significant investment in enlarging machinery and processes to improve efficiency: bigger mills, bigger conveyor belts, and so on. We have reached the limit of growing the size of equipment and mills because, at a certain point, the mechanical components will generate more failure points than benefits," stated Óscar San Román, country manager at Yokogawa.

Now, increases in efficiency will come out of optimizing processes and reducing downtime. Rodrigo Díaz, CEO of High-Res, a company that provides advanced coating products utilizing plasma technology to reduce wear and tear on machinery, explained: "For many companies in the copper industry, when the price of copper falls, they lose business. However, when it is low, we have higher sales rates because mining companies are more focused on improving efficiencies and maximizing their use of resources."

To fill the niche for extraction technology, MineSense provides a service that measures ore grade at the extraction point, giving mining companies visibility to understand their deposit better and redirect haul trucks at the beginning of the process. Claudio Toro, executive vice president said of negotiations with a customer: "Based on our calculations, our technology can create the equivalent of a new mine for this client – around 85,000 t/y of metal – if ShovelSense is implemented in about 50% of the fleet."

New technology must focus not just on greater extraction, but on maximizing the recuperation of ore from the beginning of the extraction process to the plant. Indeed, increased productivity requires a dramatic investment in technology oriented at the point of extraction. For that, a digital and geoscientific approach to geological modeling is vital. Seequent offers advanced software for geological modeling. Ignacio Torresi, executive vice president of Latin America, explained that its geological modeling data enables mining companies to make better informed decisions about ore and waste, ensuring that the operation is more profitable and sustainable. The incorporation of a wide variety of software products requires a holistic approach to data management. "Not just one solution but workflows allow companies to break informational silos, integrating teams and provide a holistic view of the analysis and creation of geological modeling, which allows mining companies to be more efficient," said Torresi.

As important as technology solutions are at the point of extraction, increased efficiencies along the value chain shave off costs. Jonathan Vergara, general manager of Solentec, a company that offers digital surveys and 3D models to support engineering companies, noted the immense resources required to process data after the data collection stage. However, that focus on data processing allows for noticeable savings. Vergara said of their topographic surveys utilizing laser scanners: "We can carry out survey work in just two weeks. This results in a reduction of exposure risk for our field staff, time savings, and cost reductions."

Water is an area of high expense for the mining industry. Jairo Sarmiento Bugueño, CEO of Sattel, which offers innovative technologies for the mining sector including the SCIC solution, a wireless control system for water tankers that automates the process of loading water, explained: "The system controls the water flow, ensuring that the truck is filled to 100% of its capacity with no water overflow."

Disruptive technologies, particularly in the data collection and processing area, enable mines to counteract the major challenges of low ore grades. With more information, business leaders can make better decisions. This approach to informed innovation guides the industry on a path to profitability. ■

» The shift we see in technological development is from increasing size and scale of operations to increasing efficiency and improving processes. «

Óscar San Román

Country Manager
YOKOGAWA CHILE

How does Yokogawa serve the Chilean mining industry?

Yokogawa operates in three primary areas: field instrumentation, automatization systems, and professional services. Social well-being has been our focus since our origin in 1915, when we first started using technology to improve quality of life throughout society, focused on improving the industrial sector as the best route to a better society. Our instruments improve information collection and prediction capacity plants, which we use to enhance automatic control processes. We provide all the necessary services to support this process. In addition, Yokogawa offers consulting services and calibration services to enable our clients to use this data to make operational and business decisions.

What is the future of technological advancement in the mining industry?

Historically, there has been significant investment in enlarging machinery and processes to improve efficiency: bigger mills, bigger conveyor belts, and so on. We have reached the limit of growing the size of equipment and mills because, at a certain point, the mechanical components will generate more failure points than benefits. Today, we have reached the limits of growth via size and now focus on reducing the failure points of these assets and optimizing processes. Downtime can cause a major mine hundreds of thousands of dollars an hour. We contribute by using advanced technology and data to reduce failures and downtime, providing confidence in continuous operations. The shift we see in technological development is from increasing size and scale of operations to increasing efficiency and improving processes.

Can you provide an example of a proprietary innovation?

In Chile, Yokogawa has a dedicated team led by a civil engineer with more than 30 years of experience in mining processes that carries out the development process to provide advanced controls for critical mining processes.

One such technology is an advanced sensor utilizing fiber optics for conveyor belts. Yokogawa's value-add in this technology is our proprietary algorithm, created at Yokogawa Chile, which we have since shared with Yokogawa worldwide. This algorithm handles millions of data points provided by thousands of rollers on the conveyor belt, each generating heat contact points. Our sensor allows the client to accurately identify a trouble point, preventing serious accidents.

Are there any threats the mining industry is insufficiently prepared for?

We also do operational security for communications. Cyber-attacks are a part of business worldwide, across industries, although not extensively in Chile yet. However, the trend is increasing, with hackers taking control of plants such as electricity distribution. A mining production plant is exceptionally vulnerable to this sort of looting, especially in OT communications. We provide communications security, ensuring that hackers cannot take over control of the mine. There needs to be greater recognition of the vulnerabilities of mines to this costly and disruptive type of attack.

What can the Chilean mining sector do to support technological development?

There is a generational shift in engineers in the industry, with many millennials in their thirties now handling vital parts of the plants. This generation is more willing and open to experimentation because they have grown up with advanced communications and high-level technological solutions. Twenty years ago, it was tough to innovate in industries such as mining and gas. There was a sense that because operations had always been done a certain way, they always would be, compared to other industries in which innovation is a constant focus. New engineers come with unique perspectives and an openness to change.

Can you discuss Yokogawa's strategy for the coming year?

Yokogawa has been carrying out acquisitions and partnerships with other companies on a global level, with a strategic focus on reaching zero emissions as a company. On another side, we are diversifying our presence in different segments, investing in specific areas where we see the potential for growth, such as pharmaceuticals and water treatment solutions. We always keep our eyes on the future. Yokogawa has a strong hardware portfolio and, as a company, continuously investigates and develops expertise in new industries. Our vision is to develop technologies to improve the quality of life, ranging from enhancing water and energy management to helping prepare for future pandemics, taking charge of the constant changes of paradigms in the whole world.■

Reconciliation reduces variability in feeding the mill, reducing the cost of water, energy, and reagents per tonnage. We also minimize the impact on communities by reducing dilution, as this lowers the tailings per ton of metal produced.

Claudio Toro

Executive Vice President
MINESENSE TECHNOLOGIES

Can you discuss the benefits of the technological solutions MineSense Technologies offers?
ShovelSense provides a measurement of ore grade at the extraction point. We are the only company in the world offering this service, which provides customers with flexibility and the highest value. When screening and diverting occur downstream, the mining company has less flexibility and decision-making capacity, thus limiting the benefits of this technology. ShovelSense gives the operator the correct information to redirect the haul trucks at the beginning of the process.

The alternative is a block model with very low accuracy. That process requires the mine operators to drill holes, get samples, and send samples to the lab. The resulting ore grade will represent a block of 10x10x10 or larger, with no information about the ore grade between holes. Depending on the type of deposit, if the hole has significant heterogeneity, veins of potentially very rich metals will not be visible. As a result, copper and other metals are sent to waste. We grant the visibility that is otherwise lacking.

How does this ShovelSense work?
The minimum unit of measurement is a packet. We measure the ore grade packet to packet, load the trucks, and calculate the average ore grade per truck. If the ore grade in a truck is under the cut-off, we send it to waste. Otherwise, we send it to the processing plant. The benefits depend on the size of the mine and the type of metals we are recovering, but it can be 10-25% of trucks we re-road. This can translate to anywhere between 15 to 500 million dollars of yearly savings.

We are currently negotiating with a customer. Based on our calculations, our ShovelSense technology can create the equivalent of a new mine for this client – around 85,000 tonnes of metal a year – if ShovelSense is implemented in about 50% of the fleet. Minimal CapEx generates a very high level of benefits.

How does this technology improve conveyor belt systems?
We use the same sensors downstream on conveyor belts. After the primary crusher, the material moves on the conveyor belts. We typically deploy these sensors between the primary and secondary crushers, before the mill. In addition, we do mineral traceability and real-time online reconciliation. MineSense Technologies has had significant success in Copper Mountain, Canada, where we have a complete set of sensors from mine to mill. Reconciliation reduces variability in feeding the mill, thus reducing the cost of water, energy, and reagents per tonnage. We also minimize the impact on communities by reducing dilution, as this reduces the tailings per tonne of metal produced. These downstream benefits come from mixing ShovelSense with BeltSense.

Can you discuss the strategy behind your USD$42 million raise with JPMorgan?
JPMorgan invested in us for our technological ability to impact sustainability through improved efficiency. This money will allow us to expand. We are doubling the number of people this year, especially in this region of South America, the Middle East, Europe and Africa, and Asia-Pacific (specifically Indonesia).

MineSense Technologies will spend a significant portion of the raise on R&D. We are working on two additional sensors. Our vision has expanded to characterizing ore in the bucket. We will add sensors to measure hardness, for example, in conjunction with ore grade and measured particle size. We will be offering the option to mix different types of sensors depending on the needs of each mine.

How does your technology improve sustainability metrics?
We help customers get environmental approvals faster. Our technology helps reduce tailing, which is critical in its impact on communities and the environment. The next generation of technology will be geared toward selective mining. Selective mining means that open-pit surface mining will have to be more innovative. A mine will no longer consist of one big pit but of many smaller pits. Smaller pits require smaller trucks and smaller shovels, which will be efficient thanks to the data we can provide.

Can you provide us with an overview of your strategy and goals for the next year?
Our strategy is to get close to the customers, so we have decided not to grow in Vancouver anymore and to spend every penny near the customers in Chile. We will do the same in centers in Peru and Brazil, spending the money in the countries that produce copper.

Our vision is to cover the Americas, Europe, the Middle East, and Africa in the next three years. For example, today, we have 80% of the market share of the copper industry in Canada, which is not sustainable; few companies can go over 60%, so there is a high probability that as competition increases, our market share there will be lower. Therefore, by deploying in parallel, we plan to diversify by increasing our share to 60% in every single country in the next three years. ■

Jorge Abraham

Country Division Manager – Process Industries, and Mining Lead
ABB

Can you describe some recent highlights of ABB's operations?
In recent years, we have worked on essential mining projects, such as Quebrada Blanca 2 and Gold Fields, supplying all the electrification and automation for their mining operations. In the case of Quebrada Blanca 2, a deposit that recently produced its first copper production, we implemented a remote operation 1,700 km away with a fiber optic connection and supplied 6 GMD (Gearless Mill Drive) mills. In addition, we implemented remote monitoring via LTE technology with a satellite link at the GoldFields' project. We also support Albemarle's lithium production with our technology. ABB is a diversified company with technological offers for copper, gold, and lithium plants.

What are the main technological trends in the mining industry?
The most important trend in recent years has been operations centers. The implementation of those centers has accelerated with the pandemic. Tools such as satellite communication technologies, fiber optics, and 5G have helped to implement remote work on a massive scale. The main mining clients, including Teck, are already operating remotely.
Another notable trend in the industry is digitization, the use of digital twins, data collection, and mathematical modeling. These tools are used to simulate processes, predict production after a change in the production process, and train personnel before the plant is in operation. These technologies help projects minimize control logic errors and improve start-up times.

What are ABB's main goals for 2023?
The main objective is to continue growing with our clients and import technological developments from our centers of excellence to Chile. We also seek to continue working with universities and research centers to develop new technologies that meet the specific needs of our Chilean clients.

Finally, a central pillar of the company is creating a healthy work-life balance for all our employees. ■

Ignacio Torresi

Executive Vice President, Latin America
SEEQUENT

Can you describe recent highlights for the company?
We were a startup company based in Christchurch, New Zealand. At the end of 2013, the commercial results in Chile and Latin America justified opening a local commercial entity. Since then, the business has acquired various technology companies with subsurface applications and beyond geology into geophysics, geotechnical analysis, and data management. Today our portfolio includes suites as Leapfrog, Geosoft, Imago, MX Deposit, GeoStudio, Plaxis, AGS and others. We also pioneered cloud applications, specifically designed for the subsurface and geoscientists. In mining we moved from exploration to resource geology and grade control, by equipping our modeling solutions with resource estimation capabilities.

Can you describe the changes resulting in Seequent's acquisition by Bentley?
In 2021, we were acquired by Bentley Systems. Bentley handed over to Seequent its pre-existing portfolio Plaxis, GINT, and Open Ground, making Seequent the words largest provider of geotechnical solutions, so we now provide software for multiple sectors like mining, civil infrastructure, environmental and energy.

What is the strategy for Seequent for the coming year?
When I started in this role last April, we were in the integration process within Bentley Systems, and the transition was our main priority. Now, we are facing a very different macroeconomic and international scenario. As a result, we are looking and expanding our workforce in the region, hiring multiple professionals in different areas. We have hired 12 people since I started, focused on bringing in a new generation of professionals to the Latin American team to focus on emerging segments, including energy and civil engineering. Energy is more of a long-term goal for us. In Brazil, we have already succeeded in opening up the market and diversifying, and we are starting to do the same here. Over the next 12 to 24 months, we will expand our operations in Colombia, Ecuador, Argentina and Central America. ■

> We innovate by testing our ideas with the customer in real time and using that information to improve our customers' decision-making capabilities.

Jairo Sarmiento Bugueño

CEO
SATTEL

Can you describe the history of Sattel?
Sattel was created to provide new and innovative technologies for the mining industry, focused on increasing efficiency, safety, and productivity. We were founded with the need to develop solutions to industry issues; one of our first challenges was at Anglo American, where they were looking to reduce electrical incidents to improve the availability and reliability of the fleet along with safety in their operations. Our PDA (Protector of Auxiliary Devices) solution was born and is now installed in more than 1,000 pieces of mining equipment throughout Chile.

Our main clients are BHP Escondida, Anglo American, the Antofagasta Minerals group, Lundin Mining, etc. In addition, the company is present in the Peruvian market with two active projects in Southern Copper and Quellaveco. We also have a presence in Brazil with our local dealer Besc Global and in the Australian market after a suggestion from BHP's innovation area due to the success of our PDA project in their Escondida operation in Chile, where we established a technology transfer alliance with a local supplier Elite. Sattel has a team of almost 100 employees, and we continue to grow.

Can you describe the advantages of your products?
Sattel offers several core products focused on providing technology solutions. For example, at Kinross, Antofagasta Minerals Zaldivar, Gold Fields, Manto Verde, and other major mines, we have installed our Mine Access Control System (SICAM), which allows the company to control with hard barriers the access to restricted areas of the mining operations, such as the mine area. The system tracks the worker from the moment he enters the bus to go to the mine until the moment he returns home.

We have also promoted and installed our SCIC solution; a wireless control system for water tankers, fully automating the process of loading water into the tanker. The system controls the water flow, ensuring that the truck is filled to 100% of its capacity with no water overflow.

What is your presence in the lithium industry?
We have recently conducted a pilot at the SQM plant for level monitoring of the trucks that transport brine from Salar de Atacama to the plant. The pilot was a success and SQM has already asked us to install the solution in the entire fleet. Other companies in the lithium sector have also asked us for the same solution. There is much room to improve efficiency and develop better operational practices in the lithium industry.

Can you describe your work on solar-powered trailers?
The trailers we manufacture are fully hybrid, with the ability to use solar energy for their travel. Sometimes customers prefer cheaper products, but the cost-benefit analysis does not always make sense due to environmental issues and operating costs. Our offerings are more efficient and environmentally friendly and reduce refueling logistics.

What is your innovation process?
For Sattel, innovation is a daily process that stems from the needs of our customers. If our customer has a problem, he calls us, and we work to solve it. That problem can be operational or related to efficiency. Whatever it is, we focus on solving it.

Often, we look to do a local pilot. Based on the results of the pilot, we discuss options with the client and then determine what can and should be implemented further. We innovate by testing our ideas with the customer in real-time and using that information to improve our customers' decision-making capabilities. It's a customized innovation process.

Can you tell us about Sattel's strategy for the rest of the year?
Our priority for 2023 and 2024 is to consolidate Sattel as a technology company that is both positioned in the industry and present in the Peruvian and Brazilian markets, which are markets that open up an infinite field of opportunities. Consolidating our presence in these countries does not mean that we focus exclusively on them. We are sure that the same problems in Chile are also present in other mining markets such as Canada, US, etc. Our solutions are useful throughout the sector and in companies worldwide, and our intention is to consolidate our strength in the current regions, always recognizing the value we can bring to the mining industry worldwide. ■

Marcelo Celis

General Manager
ROBERT BOSCH CHILE AND REXROTH CHILE

How does Bosch Rexroth use digital tools to support customer activities?
With our ODiN and CMp of Bosch Rexroth, we collect information through our IoT-enabled remote monitoring, the data goes to the cloud and through a machine-learning algorithm in real-time can issue a system behavior to prevent and predict system failure. In conjunction with Bosch Mining, we offer technologies such as cameras for smart visualization, belt sensors and smart lock-out that are becoming the standard in the industry.

How do your solutions improve productivity for your clients?
A good example is our CB / CBM motors that are essentially maintenance-free. The mean-time-between-failures is longer than other gearing solutions, with a significant extended average useful life above 80,000 hours. They are equipped with spider control systems that allow the unit to deliver exactly the speed and torque required by the process.

Can you describe Bosch Rexroth's approach to the circular economy?
We can retrofit mining equipment rather than dispose of it. We are also very focused on technology for electrification. We intend to use electrification technology to retrofit existing fuel-powered mining equipment with our e-Lion portfolio. ■

Rodrigo Couto

President Mining Division
LATAM
HEXAGON

How has demand changed over the past year?
Over the past year, our priority has been a "Power of One" approach, in which we have the same environment for automation across the board. This allows us to connect different partners and suppliers, delivering the correct information to the right place at the right time. Our technology is agnostic because we are an open company, not an OEM supplier.

Can you discuss your work with Codelco?
For Codelco, we implemented a fleet management system over the last three years. They already use the HxGN MineProtect Collision Avoidance System (CAS), so we collected data from the fleet administration system and combined it with the collision avoidance system. We used artificial intelligence to manipulate that data to make it more meaningful for decision-making. Codelco has the Center of Operational Intelligence (CIO). We define KPIs highlighting the level of safety moving forward. The next step will be the HxGN MineProtect Vehicle Intervention System (VIS), ensuring that if the driver does not act during a collision, the system activates the brake and intervenes automatically, avoiding the accident. This is EMESERT Level 9 intervention, and Hexagon is the only company worldwide with that level of autonomy. ■

Eduardo Coloma

CEO
MAPTEK

Can you introduce us to Maptek?
We develop software and hardware to provide solutions to the mining industry, from exploration onwards. In recent years we have seen an increased demand for our products in the mining production segment, where collecting data through sensors and then analyzing them can increase productivity.

What are some examples of applications of your products in the mining industry?
In the exploration area, we use statistical models to quantify more accurately what is in deposits. We have also recently launched Vulcan GeologyCore, which focuses on automated vein modeling. Streamlining this is a game changer for geologists, as vein modeling is typically an intensive manual process.

The most exciting tool now involves AI. Maptek launched DomainMCF several years ago. It combines machine learning technology with cloud computing to speed up results and allow geologists to analyze more data for recommending investment or resource model actions. BlastLogic targets continuous improvement in drill & blast practice. Digitizing blast data at a granular level and delivering it in near real time makes it available for making decisions around environmental and community initiatives. One of our recent operational solutions targets material resource tracking for monitoring the movement of materials from in-situ rock to stockpiles. Digital tools are key to making operations more efficient. ■

Equipment Components

A flood of business driven by underground mining

Image courtesy of Valmet

As water management continues to be central to effective mining operation, the pumps and valves segment is gaining significant business. At the end of 2021, more than 50% of Chile's population lived in an area with severe water scarcity. For the mining industry to have good relations with local communities, reducing consumption of continental water is essential. The mining industry has an opportunity to improve its communication with the general public by emphasizing the myriad ways in which it can support the development of water access.

Central to this shift is the strong pipes, valves, and wear protection industry. The industry continues to advance, offering innovative solutions that support closed water systems, ensuring that not a single drop is wasted. Valmet has developed an extensive line of flow control equipment for valves, including software that allows for precise flow control. Gonzalo Silva, regional manager flow control business line at Valmet, stated, "Valmet has focused on leakage control, which can cause environmental impact and can lead to a loss of money in the process."

The importance of the pipes and valves segment is also increasing as mining moves underground, dramatically increasing the exposure of mining to flooding risks. Flooding in underground mines has the potential to be catastrophic in terms of safety. "Open-pit mines have a significant safety advantage regarding exposure to flooding risks," said Rodrigo Sosa, CEO of Sulzer Chile, which is seeing growing demand for its pump equipment as mines increasingly expand underground operations. "When a mine has people working in a tunnel, the company must ensure their safety. As mining moves underground, mining companies must adapt to a different risk profile, and flooding is one of those risks."

An ocean of opportunity for pipes and valves

Valmet has increased its presence in Chile. In 2022, Valmet opened an office in Antofagasta, allowing it to work in mining operations such as Collahuasi, Escondida, and Centinela. Valmet, aware of the opportunity in desalination, is actively working on new technological developments to adapt their valves to meet the needs of the segment. Silva identified the growing desalination industry as a major business driver: "This is an area of great potential. However, this process requires special equipment with high corrosion resistance, which translates to higher input costs."

Sulzer, too, is moving strongly in the desalination segment. The company supplies desalination plants with equipment including pumps, filters, and monitors, out of its Chilean operations, which serve as the company's hub in Latin America. Transporting and utilizing freshwater is simple because pipes and valves can be constructed out of common materials. "Corrosion is the greatest problem encountered," said Sosa. "Seawater requires corrosion-resistant equipment materials such as duplex, super duplex, and austenitic cast steels."

The segment has even greater future demand to look forward to, as future projects are expected to increase current desalination capacity by 130% by 2031. 66% of the copper industry's water consumption in the Antofagasta region will be supplied by desalinated water, with the region having the most desalination plants in the nation. ■

» After acquiring the Flowrox portfolio, we expect to double our revenues from the mining industry by 2023 and boost our flow control line with local stock. «

Gonzalo Silva

Regional Manager Flow Control Business Line
VALMET

Can you introduce Valmet?
Valmet has five business areas. The first division covers the pulp and energy segment. The second division covers the segment of manufacturing equipment for paper production. The third business line includes a complete range of services and processes for each stage of the life cycle, from spare parts, maintenance, field services, process upgrades, etc, and the fourth line comprises the automation business, which includes automation solutions for a wide range of process industries. Finally, the fifth line includes the flow control segment; we have a complete portfolio of valves that allow us to offer integrated solutions for the flow control process. Chile is a strategic country because it represents an important market for our flow control business line. In 1997, we started working for the mining industry on a small scale, but we expanded over time and were finally able to start direct flow control operations in 2022, after opening our second service center in Chile, in Antofagasta. Valmet nowadays works in the main mining operations in Chile and Peru, such as Collahuasi, Escondida, Centinela, Los Pelambres, Antamina, Las Bambas, and others.

How important is mining for Valmet?
When we were Neles, we acquired the complete portfolio of the Finnish company Flowrox, which consisted of valves and pumps in high demand in the mining industry for crushing and grinding processes. Now mining represents 35% of our market in Chile and it is a key industry for us. However, we still have considerable growth potential thanks to all the solutions we have developed in recent years.

There is a trend to minimize the use of groundwater, so there is a great demand for our products and solutions to transport water from the desalination plant to the mine. This is an area of great potential; however, this process requires special equipment with high corrosion resistance, which translates into higher input costs. These trends have prompted Valmet to work on new technological developments to adapt our valves to the industry's new requirements. We also offer solutions for mineral processing, energy, chemical plants, and electricity, among other process industries.

How can valves impact efficiency in the mining processes?
Valmet has focused a lot on leakage control, which can cause environmental impact and can lead to financial losses in the process. In this regard, Valmet has developed flow control equipment for valves, such as intelligent positioners that allow for more precise flow control. In addition, we have developed software platforms to identify the factors in the controllers that are affecting the efficiency of the flow process.

How are you incorporating digitalization?
Our valve automation offering ranges from limit switches to actuators and intelligent valve controllers with third generation diagnostics, which collect data on the operation and condition of pumps, valves, and other components to analyze the variables affecting the process and offer alternatives for improvements and optimization. Preventive maintenance can result in 70% savings on corrective maintenance. With this technology, customers can monitor not only the function of the valves but also the conditions of the control loops, allowing them to assess how these components are working, even in extreme process environments.

What differentiates Valmet from other companies?
We have a solid presence in the south of Chile, with our service center, and now also in Antofagasta. Our goal is to continue expanding our presence throughout the country. Finally, Valmet has a broad portfolio of products that enable us to provide solutions for the different needs of the industry, for example for handling tailings and other materials. We have peristaltic pumps that can be more effective than centrifugal pumps for conveying large quantities of materials in some specific applications. We also supply filter fabrics that can be used in the treatment of minerals and tailings.

What are your main goals for the rest of 2023?
After acquiring the Flowrox portfolio, we expect to double our revenues from the mining industry by 2023 and boost our flow control line with local stock. We will also launch API6D valves, which are in high demand by the mining industry. Another important objective is the development of a digital workspace called Valmet Customer Portal to integrate all the detailed information about the valves and equipment on a single platform, always with a focus on improving our customers performance. ■

Alfonso González

Sales Director Energy, Mining, and Industry
HILTI

What core products does Hilti offer the mining industry?
We serve our clients with products, software and services through engineering and digital services (BIM / 3D modelling) during the design phase, until the construction with a unique solution in terms of power tools and accessories. We also provide solutions, including fire seals, steel fastening, and anchoring, which are very attractive to the mining sector due to their safety applications.

What trends in the mining industry have you observed?
We see that the mining industry is digitizing quickly. This has led to a boom in extraction and productivity. Mining has advanced by leaps and bounds in technology, but the productivity of construction has not increased in the same way. We utilize digitalization to improve processes, helping our customers make their projects more efficient, productive, and, most importantly, safer.

What innovative services do you offer?
One of our central areas of development is the circular economy. We aim to transform the current situation in which a client changes a lithium battery and then disposes of it. In our business model, we tell our clients to use our tools as if they are rented, and when they are finished using the tool or the contract is over, we take the device back and extract every reusable element. Hilti also offers solutions to reduce CO2 emissions, the usage of steel, and the need for welding. We have modular products that allow for assembly that reduce welding to a minimum.

Can you tell us about the benefits of your cordless products?
Under the name of NURON, we launched more than 80 products at the same time, all of them battery-powered in a single 22 Volts platform.

We have demonstrated that even heavy applications like concrete demolition and cutting can be powered by batteries. ■

Simão Antunes

General Manager
South American Operations
HOFMANN ENGINEERING

What is your presence in the South American market?
South America is the fastest-growing market for Hofmann Engineering. In the fiscal year 2022, Hofmann Engineering grew by over 50% in turnover in Chile compared to the previous year. Hofmann Engineering is continuously gaining new clients and diversifying our product areas.

What products are you particularly excited about?
In Chile, we have product areas that have been our core business for many years, such as girth gears and pinions for mill gearing, electric rope shovel transmissions, complete roll assemblies and gearboxes for HPGRs, but in the last year, we entered in the hydraulic excavator critical components and in the crushing market, selling several fully forged cone crusher heads for the Chilean market. We invented this product, manufacturing the crusher heads and utilizing a one piece forging, to be fully machined and with polished/shot peened critical areas.

When will you begin producing HPGRs in Chile?
In June 2023, we will test the new state of the art multi axle, CNC controlled floor borer with a 50 ton rotary table that will be installed in Chile. We have a 10 year plan for expansion in Chile and plan to fully complete the first phase out of three by the end of 2023, allowing us to manufacture the HPGR rolls locally and provide critical and heavy precision machining services for manufacturing and refurbishing of critical components for the mining industry.

What is your strategy for 2023?
Growth is mainly dependent on the timing of the execution of projects and we believe 2023 will be a good year. Chile still has many good opportunities, so we are diversifying our customer database and we are both strengthening our existing product lines and implementing new ones. ■

Reinventing the mining industry

"The acceleration of digital transformation processes has pushed mining companies to change how they operate, focusing on developing systems for digital process control."

David Alaluf, General Manager – Chile, Endress+Hauser

"The cloud computing enables us to give information about the health of industrial assets, allowing an analyst to examine the data and determine at one point the machine is expected to fail. The product incorporates machine learning technology, providing a more thorough and advanced understanding of the health of the processes."

Carlos Lahura, Managing Director, Andean Region, SKF

"After the pandemic, there is a greater understanding of respirators and masks. Breathing protection is incredibly important in mining. Every mine has silica dust in the air which can give silicosis, a very serious illness. We have worked with the government on a national program for the eradication of silicosis."

José Sanzana, Regional Division Leader - Personal Safety Division -South America, 3M

"It is vital that we, as a country, focus on the specific steps taken to develop the country economically and identify the sustained investment required to take advantage of growth potential. Chile has clear goals, and we need to determine how to educate the populace and develop the country as a whole in a clear and organized way. "

Jaime Balboa, CEO, SCV

"Open-pit mines have a significant safety advantage regarding exposure to flooding risks. When a mine has people working in a tunnel, the company must ensure their safety. As mining moves underground, mining companies must adapt to a different risk profile, and flooding is one of those risks."

Rodrigo Sosa, CEO, Sulzer Chile

"Over time, we have seen the need to expand into other areas of Chile through existing and new clients, as well as new markets. In 2010, our tools were instrumental in the rescue of trapped Chilean miners, accurately mapping a mine's geospatial location when no other technology could."

Orlando Ramírez, CEO, Stockholm Precision Tools

SERVICE PROVIDERS

"Chile boasts a strong logistics infrastructure that supports its economy, including ports, airports, highways, and warehouses. Additionally, Chile has diversified its energy generation mix, leveraging new renewable energy facilities to mitigate its reliance on fossil fuels, and increase its sustainability."

Tomás Valenzuela,
Mining and Energy VP,
Agunsa

Image courtesy of Odfjell Terminals

Drilling and Blasting

Innovation focused on efficiency

Image courtesy of Hexagon

In the drilling industry, the current focus is on safety and optimization, all while sustainably producing more at a lower cost. Drilling companies and their providers are making internal efforts to contribute to these aims. "Mining is rooted in a physical medium. You can build software and automatize, but the final objective is to obtain a mineral from a rock as efficiently as possible with the least environmental impact," emphasized Trinidad Carmona, sales and marketing director at DrillCo.

Javier Varela, CEO of Drillco, explained that pressure on the drilling sector comes from multiple directions. "On the one hand, service providers are experiencing pressure in terms of inflation and higher costs for raw materials; on the other hand, there are more intense demands from mining companies for us to lower our costs to reduce their operational expenses," Varela said. "Finding that balance is a challenge that requires the industry to emphasize collaboration and innovation, increasing the value proposition at all levels."

Ignacio Bello, general manager of Diamantina Christensen, is also aware that the primary concern in the industry is productivity. In response to this priority, the manufacturing company offers high-performance drilling products such as diamond core bits with higher penetration rates and longer life spans. Bello emphasized the specificity of requirements for the segment: "Bit selection depends on the drill operators' requirements and the drill rig's capacity. Underground mining also demands different types of products; for example, the length of the rods is different."

Automation is one of the most critical trends in the mining industry to address safety and efficiency challenges. Contractors and service providers across the value chain are moving in this direction. Automated drilling has near-limitless potential to optimize mining operations. Daniel Misiano, CEO of MBI Global, highlighted three main advantages of automation: "The priority is safety, a critical topic in South America. Second, automated drilling allows us to attract women to work in mining. Third, automated drilling provides excellent cost savings."

As a result, many companies are beginning to move strongly into automation. However, Misiano recognizes that the industry can be conservative when it comes to the adoption of technology. It is not just a cultural resistance to automation adoption but also a practical one. Daslav Curkovic, vice president of business development at Pro Drilling, explained: “Some drilling is carried out in extremely harsh environments and requires manual operation and handling, so that in some cases, particularly in exploration drilling, automation is not feasible."

Automation has been slow to make its way in the exploration drilling segment, but some companies are starting to implement it in large mining operations. Gregory Duncan, general manager of Major Drilling Chile, pointed out: "Some major mining companies, such as BHP and Codelco, require very specialized drilling equipment for their sites, including 100% hands-free rod handlers on their drills."

Major Drilling is, therefore, actively working on integrating automated drills into its operations. "We have a 100% hands-free drill being tested in Suriname right now. Once that testing period concludes, we will send three or four to Chile, so we will soon have eight to ten drills operating in Chile," Duncan stated.

» Chile has solid and stable institutions that make investments safer than emerging mining regions, making it more appealing to develop brownfield and greenfield projects. The country has the potential to be a source of new technologies.

Ricardo Capanema, Global Marketing and Business Development Director, Solvay «

Automation has even more potential safety improvements for blasting operations, which are among the most dangerous and complex activities in mining, with numerous fatalities due to flying rock, dust, and lack of blast area security. ENAEX has recently taken a decisive step to reverse this trend, carrying out the world's first wholly robotic and teleoperated blast. "This year, we are starting an operational trial at the largest underground mine in the world, El Teniente. In March 2023, we began to implement this project to demonstrate our solution's capabilities and features in a challenging environment," mentioned Marco Ruiz Hernández, ENAEX robotics director.

Increasing the efficiency of the drilling process requires more than technical improvements. It is not enough to attach more bells and whistles to a gadget. Drilling companies' executives also emphasize the need to go back to the drawing board, to the very identity of the material itself, to determine the optimal way to advance. In a period when minerals are more often behind harder rock or in more challenging areas, this building block approach to drilling provides a necessary foundation.

Trinidad Carmona described the material science focus of DrillCo's international research partnerships: "Our investigative approach focuses not just on improving the mechanics of our machines, but on improving our understanding of rock behavior and the fundamental nature of rocks. Studying a rock means knowing how it breaks and what happens during that process – developing a deep knowledge of the behavior of the rocks."

In this line, real-time data collection and analysis are some of the tools geologists use to understand rock conditions better and optimize the drilling process. Orica, for example, recently acquired Axis to move forward in this regard. "This acquisition allowed us to improve guidance in the drilling process, as well as to capture information on rock conditions that can support a better characterization of the deposits," Óscar Castañeda, Senior Manager Technology Projects LATAM / Innovation & Technology, Orica, stated.

Sustainability is another growing concern in drilling and blasting operations. Companies are turning to green energy sources in the quest for safe and sustainable blasting. By building an ammonia plant, ENAEX is trying to minimize the footprint of its blasting operations. As vice president of innovation and marketing, Pablo Wallach said: "We have dramatically reduced our footprint, and producing green ammonia is the key to continued reductions."

Héctor Palma, general general manager for Chile of Famesa Explosivos, agrees that, in addition to productivity, stricter environmental standards represent another major challenge for the mining sector. The introduction of the ecological line SAN-G APU is a clear example of the company's efforts to support sustainability and efficiency. "SAN-G APU is a gasified emulsion alternative that not only has a positive impact on the environment but also has a higher effective energy level than similar products on the market, improving fragmentation and maximizing productivity," Palma said.

Laboratories and chemicals tackle water

In a country where water is increasingly costly, mining companies demand effective water treatment products at all stages of the extraction process. Jorge Marchant, vice-president of mining Latin America at Mathiesen, explained: "There are two areas where water usage can be influenced – continued improvement of the metals recovery with our flotation reagents products, and through our rheology flocculants and standard flocculants to recover water at the thickener stage and put it back into the process."

Ricardo Capanema, global marketing and business development director of mining solutions at Solvay, a specialty chemicals company, highlighted areas of innovation for water waste reduction in lithium processing. "The typical method for lithium extraction is evaporation. However, since this involves excessive water consumption, we have developed a solvent extraction technology that does not require evaporation and can extract lithium from brine in real time," Capamena said.

Noracid, Chile's leading sulfuric acid producer, has developed a range of new technologies to improve processes in instrumentation, vibration, and temperature. The company, based in Mejillones Bay, has ten years of experience perfecting the process of sulfuric acid production by combustion. Warner Wartznauer, the CEO, explained: "Our two major innovations are a liquid sulfur decanter, which has worked well because sulfur needs to be extremely clean before the process begins, and an osmosis process to turn seawater into freshwater."

The chemicals segment is a key participant in an industry wide push to ensure that water usage at all levels becomes increasingly efficient, responding to the needs of the Chilean mining sector. Across the board, investment in chemicals for the mining industry has driven improvements in mineral processing, desalination, and water treatment. ■

Tomás Buttazzoni

CEO
TECHNOSTEEL

Can you update us on Technosteel's operations over the past year?

Last year was a highly productive and record-breaking one for Technosteel, despite supply chain disruptions, high raw material costs, and labor shortages. We managed to achieve high production levels and expanded our exports into eight countries, including newcomers Australia, Indonesia, and Zambia. In terms of technology, we made strategic investments to enhance our critical processes. Notably, we introduced new robotic cells for the manufacturing of drill rods and multitask machines for metal milling. We also revamped our factory layout, creating a safer and more productive workspace. Since last year, we have established direct contracts with four mining operations in Chile and through our partnerships, have extended our reach to at least 10 other mining operations and contracts in Chile, Argentina, Brazil, and Peru.

What are the benefits of your products?

At Technosteel, we aim to be the number one manufacturer of drill rods and pipes for exploration, diamond drilling, blasting, reverse circulation, and DTH in South America. Our 20,000 square meter plant in Santiago is central to this vision. We maintain a robust customer and product support system, often working closely with mine sites and customers on product improvement and problem-solving initiatives. One of our strengths lies in our stringent quality control processes. We have an in-house metallurgical laboratory operated by a university, ensuring that our raw materials and final products maintain the highest quality.

How does Technosteel support your clients' water management efforts?

We've partnered with Baker Hughes to introduce the H-Pump system in Chile. This new line of pumping system presents an efficient alternative to the traditional API 610 standard widely used in the mining sector.

Last year, we embarked on an intensive campaign to raise awareness about this innovative technology. ■

The industry is relatively conservative. Although there have been some excellent improvements in productivity, I would say that a global lack of qualified labor has driven the shift from mechanical to automated drills.

Daniel Misiano

CEO
MBI GLOBAL

Can you describe the growth of MBI Global in South America?

MBI Global was founded 1992 as a distributor in the exploration consumables field. Over the years, it expanded into the manufacturing sector. In 2011, we developed a global orientation regarding our manufacturing of drilling consumables, starting with our first international office in Santiago. We have also opened up an office in Lima and taken on new distributors in Brazil and Colombia. Now, in 2023, we are pleased to say that MBI Global not only services and manufactures drilling consumables for core drilling exploration but that we have also merged with a company called Versadrill, which specializes in the manufacturing of surface and underground core drills and geotechnical drills.

We also manufacture in Santiago, with a partner who manufactures our drill rods for the South American market. 95% of our sales are to drilling services companies. 70% of our sales are consumables, and 30% are capital equipment.

How is MBI Global responding to the move toward automation?

The industry is relatively conservative. Although there have been some excellent improvements in productivity, I would say that a global lack of qualified labor has driven the shift from mechanical to automated drills. We saw a perfect opportunity to implement the automation of drilling, which addresses three specific needs. The first priority is safety, a critical topic in South America. Second, automated drilling allows us to attract women to work in mining. Third, automated drilling provides excellent cost savings. MBI Global has observed that with our automated package, drilling companies can benefit from substantial savings in the cost of consumables that reduce downtime and improve the quality of the core.

What differentiates MBI Global?

The first differentiating factor is that we have our own in-house programmers. Depending on what the mining houses require and the data offered, we are now inviting rock mechanics and geotechnical engineers and the mining engineers underground, simply because the information that we gather when we hit an ore zone gives a better understanding of the rock formation and the rock characteristics, which in the end helps for mine planning. The second benefit of our automated build packages is that you can use only one operator.

How is automation changing labor in the drilling industry?

We are in for at least a generation of a lack of qualified labor, and then we hope the situation to get back on track. At the same time, we must be fully in line and in sync with automation, developing it as far as possible, particularly for exploration drilling.

More automation will also attract more women to the field, filling that current labor void. Learning to become a driller is quicker with an automated than a traditional drill. We have a customer in Quebec who has been using our automated drill package for the last two years. Training on the automated drill is normally between six to twelve weeks, depending on the person's ability to take control. Whereas on the hydraulic machine, you start as a helper or an offsider, do that for at least a year or two, and then the master driller will once in a while allow the offsider to train. We have two women working underground in Quebec for one of our customers, and they run drills on their own and are equally successful.

What is your strategy for the near future?

We are incorporating a systematic approach to the South American market by using a strategy addressing the neighboring countries where we are situated. We are currently in Chile and have an excellent relationship with Argentina, so that will be one of our focus areas. We have several countries in and around the area where we are working to expand. South America has a high impact on the global innovation showcase. MBI Global wants to show our presence and commitment with regards to those countries and the territory. Lastly, we intend to showcase our autonomous drill packages, which will be very successful for both underground and surface drilling for the markets. ■

> This year, our primary goal was to have 90% of our drill rigs in operation. We have been successful, and currently, nearly all of our equipment is in use.

Daslav Curkovic

Vice President of Business Development
PRO DRILLING

How has demand changed over the past year?
Pro Drilling was founded in 2012 at the height of the exploration boom. The company began in exploration, and then entered major mining as an operator for Anglo American and others. In 2013, there was an economic downturn in the mining industry, and we were obliged to diversify ourselves with new clients such as BHP, Collahuasi, and various exploration projects. We began using a diamond rod handling system, the latest technological leap in our industry at that time, and defined a standard for Pro Drilling, regardless of whether or not our clients always required them.

We work primarily in copper, and we have recently entered iron. We also conduct drilling for water purposes, including perforation for water wells. We are a company that can offer the complete package related to drilling. This is an advantage because large mining companies want to work with fewer contractors who can be more efficient throughout the process.

Over the past year we have seen an increase in demand for drilling services in the industry and expectations going forward look promising.

Is the drilling industry adopting new technologies?
Our industry, exploration, is the area with the least technological development in comparison to the majority of other services and activities carried out in mining. This is because the works are carried out in extremely harsh environments and require manual operation and handling. The incorporation of automation has moved slowly in exploration drilling.

The standard has always been that a drilling rig has an operator with two assistants. A few years ago, we transitioned to an operator and one assistant due to local industry demands in other countries. We continue working while waiting for new developments and technology to help us be more efficient; we are always open to trying new technology and contributing to development, but there have not been significant technological advances. There have certainly been data capture and management advances, but not drilling itself.

How did the pandemic impact Pro Drilling?
The coronavirus had a major impact on us because when there are critical situations, exploration is the service that can be reduced or stopped first. The priority was the production of copper from operational projects, but over the past year, we have returned to normal.

On a cultural level, Covid was a significant shift, particularly for the workforce. People got used to being at home and spending more time with family, and many decided to look for new work that situated closer to home. Labor has therefore been a major challenge.

What is the current state of investment in exploration in Chile?
The ore grades have lowered, and the extraction costs have increased, which is a challenge for exploration. Nevertheless, investment in exploration increased by 30% in 2022 compared to 2021, and we expect this to increase over the next few years. We see excellent signals because the large companies recognize that continuing to invest in exploration is the only way to find new deposits to counteract declining ore grades. Unfortunately, new deposits and discoveries are high in the mountains or close to the border, making exploration and the path to production more difficult.

How does Pro Drilling prioritize safety?
First, we have workers who have faith in the company, and second, our clients trust us. We decided to use the diamond rod handling system because rod handling was one of the most critical risks. We can drill holes of 2,000 meters. Therefore, we decided to use the diamond rod handling system as the company standard. Our priority is to utilize tools that prevent harm, provide safety for our workers, provide stability in our service, and benefit our clients. Chile is a benchmark for other countries in terms of safety.

What is your expectation for 2023?
This year, our primary goal was to have 90% of our drill rigs in operation. We have been successful, and currently, nearly all of our equipment is in use. This has been an excellent situation for us, particularly because several of these projects will not be impacted by the winter in the mountains. We only have 20% of our contracts exposed to the winter, so this will be a great year. ■

Ignacio Bello Marambio

General Manager
DIAMANTINA CHRISTENSEN

Can you introduce Diamantina Christensen?
Our core business is the development and manufacture of products for drilling and exploration. The company has plants in Chile and Peru where we produce drill rods, accessories and spare parts, and diamond products. We also offer products for reverse circulation drilling, such as adapters and RC rods. We are part of Geotec Group, and we supply our products to Geotec Boyles Bros. and Geotec Peru.

What are the main demand trends in Chile?
Drilling companies, prioritize productivity, such as drilling more meters per shift. We help them increase productivity by offering them high-performance products. We focus on increasing the life cycle of our bits, especially since a single bit change can take a full day. Selecting the right products (technical assistance) is a key factor that aims in this direction.

During the pandemic, we made investments to upgrade our diamond product line, introducing state of the art furnaces, which allows us to manufacture a high-performance bit. However, bit selection depends on the specific ground conditions and requirements of the drill operators and the capacity of the drill rig. Underground mining also demands different types of products; for example, the length of the rods is different. Diamantina Christensen can also supply these needs.

Recently we have doubled our production capacity of diamond products. The company is trying to cover a wider range of ground conditions with a fewer series, since we used to manufacture a different type of bits for each project. This allows us to be more productive and cost efficient.

What are your strategic objectives for 2023?
Diamantina Christensen is focused on optimizing our processes and manufacturing products that our customer needs and demands, so we can increase our market share in these competitive scenarios. We constantly pursue efficiency increases, not only in cost efficiency but also in productivity. ■

Javier Valera and Trinidad Carmona

JV: CEO
TC: Sales & Marketing Director
DRILLCO

What differentiates Drillco?
JV: Drillco is a Chilean company providing drilling supplies in Chile. Of our 200 employees worldwide, 120 are in Chile.

Can you describe the pressures currently shaping the industry?
JV: Mining faces new challenges, notably lower grades, so the entire industry focuses on improving overall productivity. There are two challenges on this front: on the one hand, service providers are experiencing pressure in terms of inflation and higher costs for raw materials; on the other hand, there are more intense demands from mining companies for us to lower our costs to reduce their operational expenses. Finding that balance is a challenge that requires the industry to emphasize collaboration and innovation, increasing the value proposition at all levels. When grades decrease, the only way to increase productivity is through advanced technology, and that is where Drillco can provide innovative solutions to the industry.

How can the industry develop?
TC: The demand in the next 20 years is expected to increase noticeably, meaning that our country is likely to continue to see investment. Chile has the relevant infrastructure and logistics to make it an excellent player in the future of mining, as long as the correct decisions are made.

We need to create a more collaborative mining process. Mining processes tend to be fragmented, with one segment not communicating with the other. For example, the person working in the plant doesn't understand improvements in the field, where those improvements originated or how can they impact their specific operation.

Additionally, the mining industry needs to move to a sustainable way of producing minerals, one that is respectful of the environment (both nature wise and community wise), sustainable, and completely safe for its participants. We as Drillco are contributing actively to a move sustainable and productive industry on the base of our technological developments. ■

Óscar Castañeda

Senior Manager Technology Projects LATAM / Innovation & Technology
ORICA

What are the main products offered by Orica to the mining industry?
To improve exploration activities, we recently acquired Axis. This acquisition allowed us to improve guidance in the drilling process, as well as to capture information on rock conditions which can support with a better characterization of the deposits. We are currently looking for all this information to be collected in real-time through the drill string.

In the production stage, we developed Rhino, a technology that consists of sensors that are placed on the drill string to capture data on the hardness of the rock. This information allows us to optimize the blasting design to have a better rock property than can maximize value on the comminution process.

In blasting, we have a wide range of emulsions with different energy levels that are defined according to the type of rock in the wells. The 4D is part of our blasting design chain, 4D™is our latest bulk explosives system that enables the real-time tailoring of explosives energy to geology across a blast.

What is your approach to technological innovation?
We have five research centers worldwide, and about 200 engineers, mathematicians, and scientists focused on the search for new solutions. We also have regional technical teams that allow us to be permanently close to our customers and work hand in hand in the development of new solutions.

What are the main developments to increase safety?
Regarding safety, our WebGen technology does not require any cables, it is a wireless detonator, which allows greater operational flexibility when there are complex environmental or community conditions. Most notably, however, it minimizes worker exposure during operation. Our next challenge is to implement this technology in underground mining. ■

MRH

PW

Marco Ruiz Hernández and Pablo Wallach

MRH: ENAEX Robotics Director
PW: VP Innovation and Marketing
ENAEX

How does ENAEX serve current industry priorities?
PW: A huge driver of the mining industry continues to be sustainability, so ENAEX has actively been developing solutions for that area. In addition, with the global trend towards electrification, there is a broader recognition of the role that some metals will play in the future.

Our ammonium nitrate plant in Mejillones is one of the cleanest AN plants in the world. We are also developing a green ammonia project in Chile called HyEx and for it we are partnering with Mitsui and Antofagasta Minerals on our pilot plant and, and for the green hydrogen part, we are working with Engie. We expect a final investment decision on the first phase by December. If that result is positive, we will have the first phase of our project running by early 2026.

What are you doing at present to provide green and blue ammonium?
PW: ENAEX is also certifying our existing ammonium nitrate plant in Cachimayo, Perú, which already manufactures clean ammonium nitrate using green hydrogen from electrolyzers. We are adding some additional equipment to the nitric acid part to reduce the carbon footprint further, and certifying the whole process, with the expectation of producing the first tons of certified clean ammonium nitrate by the end of the year. In parallel, we are starting to import blue ammonia from the US. We want to start generating impact in the industry and understanding the actual demand for greener blasting products, which we will utilize in our decision-making for our larger projects.

Can you describe your work in robotic and autonomous blasting?
MR: Last year, ENAEX made the world's first truly robotic and teleoperated blast, a significant milestone. This year, we are starting an operational trial at the largest underground mine in the world, which is El Teniente. In March 2023, we begun to implement this project to demonstrate the capabilities and the features of our solution in a challenging environment. ■

Infrastructure and Logistics

The need for an efficient setup

Image courtesy: Tecno Fast

In the logistics and infrastructure segments, companies must improve their efficiency. Jean Pierre Brunel, commercial manager of Odfjell Terminals, considers high congestion at Chilean ports one of the most significant challenges to efficient material transport. Mejillones, the main port of entry to Antofagasta, is particularly congested.

Technology plays a vital role in streamlining the loading and unloading process. Brunell explained that automation allows for greater efficiency and reduces the risk to people and the environment. The company works with hazardous chemicals, making safer operations a significant priority. "Automation has a positive impact on both worker safety and the environment, as it reduces the probability of chemical spills," Brunel concluded.

Increasing demand for productivity also goes hand in hand with better standards to promote inclusion and social development. ESG is about more than protecting the natural environment; it also has a robust human development component. As more social groups experience the benefits of mining in the country, the industry becomes more sustainable.

Florencia Márquez, CEO of Axinntus, a company specializing in industrial services, highlighted the company's progress on this front: "When I arrived, there were only 6% women, and now that figure has increased to 11%. We want women to be present in all parts of the operations, including machinery and technical areas."

The industry has undoubtedly improved in gender equality; however, according to Chochilco, by 2023, women only represent around 12% of the sector workforce, and most work in non-operational areas.

> Chile used to be a low-cost country to extract copper, and the country's various challenges have made the industry more expensive. As a result, mining companies must invest more in technology, workers, and others, but that pushes companies to look for cost efficiencies elsewhere.

Florencia Márquez Zambrano, CEO, Axinntus

The modular construction segment can be an ally for circular economy and sustainability. Pablo Rosales, CEO of Tarpulin, highlighted the company's investments to incorporate circular economy practices: "We have partnered with DEX to manufacture modular floors made from recycled plastics here in Chile. This floor can hold up to 1,000 t of pressure per square meter and is a modular solution to replace concrete in temporary projects."

Tecno Fast is another modular construction company that has taken significant steps to reduce its carbon footprint. Rodrigo Prado, general manager of Tecno Fast, stated: "We are currently working on programs to reduce waste, recycle, and supply approximately 85% of our plants with solar energy;

finally, we have recently focused on carrying out an accurate measurement of our carbon footprint to provide us with the information necessary to reduce our carbon output."

Internally, Nexxo is also going forward in the utilization of technology and alternative sources of energy to reduce its carbon footprint. "We have a water footprint management policy in our matrix, which has led to positive results in optimizing water consumption. We have also achieved significant improvements in energy consumption. In addition, we have integrated renewable energy, particularly solar energy, into our facilities," Ignacio Pérez, general manager of Nexxo, commented.

Tomás Valenzuela, vice president of mining and energy at Agunsa, emphasized that although Chile possesses a solid infrastructural base and diversified energy generation matrix, the country could build upon these strengths for a more adaptable logistics industry. Valenzuela said: "There remains room for improvement in developing a robust rail network and creating cost-effective alternatives to unexpected events or calamities. Recently, major fires broke out in two of Chile's largest bulk ports, disrupting operations for mining and energy companies and highlighting the critical importance of diverse and flexible supply chains."

Facilitating smooth supply chains is particularly necessary to support Chile's burgeoning green hydrogen industry, which will support a greener mining industry. Valenzuela noted: "Chile's potential and advantages make green hydrogen and ammonia increasingly popular."

However, developing these projects will require significant public and private investments in infrastructure. Hemmerdinger of APRIMIN considers infrastructure the most considerable factor inhibiting a renewable energy sector: "Our port infrastructure in the north and center of the country is good, but the port infrastructure that Magallanes needs for its green hydrogen production in the south needs to be developed. When I talk about port infrastructure, I mean the infrastructure required to receive basic supplies."

It is crucial, however, that every single hydrogen project does not come with its own infrastructure construction. Hemmerdinger explained: "We must develop shared-preference infrastructure and shared corridors. We need shared use of ports, as well, because the more that ports and other infrastructure are shared, the more sustainable the industry is."

The disconnect between the quality of infrastructure in the north and the south is noticeable. It is an issue requiring the government's conscientious attention for the logistics industry to serve all areas equally.

However, primarily based in the north, the mining industry benefits from high-quality and thorough infrastructure. Chile's logistics industry is comparatively strong and adaptable; excellent infrastructure and logistics differentiate the Chilean mining industry from other competitors in the region and are a tangible demonstration of the country's long history of stability and high levels of development. ■

Ignacio Pérez

General Manager
NEXXO

Can you introduce Nexxo?
Nexxo is a service company with 43 years in the market. We started offering cleaning services for the petrochemical sector and then, due to the growth of the mining sector in Chile, we ventured into the mining industry. According to 2022 data, 57% of our sales are in the mining sector, 30% in the petrochemical industry, and the rest in other sectors. We expect to achieve a share of around 67% in the mining sector in 2024. Over the last six years, we have expanded our service portfolio, including operational and mechanical maintenance services, while retaining our strength in specialized services. Our first major mechanical maintenance contract was awarded in Chuquicamata, and in 2022, we signed two more contracts in this area in Candelaria.

What are the main trends in demand for your services in Chile?
In addition to mechanical maintenance, there are many opportunities in Chile for tailings management and maintenance. We have a strategic alliance with another Echeverria Izquierdo Group company, Pilotes Terratest, which operates in the tailings segment. We are in the process of signing a contract with Kinross to manage the tailings facilities at the La Coipa mine.

What kind of initiatives have you taken to promote sustainability in your operations?
At Nexxo, we have a sustainability plan based on five pillars, two of which are focused on reducing our carbon footprint and another on reducing water consumption. We have a water footprint management policy in our matrix, which has led to positive results in optimizing water consumption. We have also achieved significant improvements in energy consumption. In addition, we have integrated the use of renewable energy, particularly solar energy, into our facilities. Having sustainable operations is one of our main goals at Nexxo. ■

> **Fortunately, since we have had so much to do, we have reached the point where we can negotiate by volume, and evidently anticipate purchases, while increasing our levels of inventory to have a greater certainty.**

Rodrigo Prado

General Manager
TECNO FAST

What have been the main milestones achieved by Tecno Fast in 2021 and 2022?
Tecno Fast has had a very dynamic few years with a lot of activity and growth in all our business lines. We focused on finishing the Quebrada Blanca 2 project. We also finished the camp and auxiliary infrastructure for Gold Fields' Salares Norte project, and a special remark for the camp of Rajo Inca, Codelco, where we are not just building and renting the camp, but we are operating it, which is an entirely complete service, including administration, maintenance, operation and food and cleaning services. In Peru we have been working successfully in Yanacocha. In our newest division, Tecno Fast Montajes we have been very busy, also working in Quebrada Blanca.

Our rentals line of business for commercial and industrial renting also saw a lot of activity, growth, and high utilization for Chile and Perú.

The most remarkable issue of the year was the acquisitions of Triumph Modular in Boston, USA, and then Alco Rental Services in Barcelona, Spain. Both companies are dedicated to renting modular infrastructure.

In an era of rising inflation, supply chain delays and high logistics costs, how is Tecno Fast dealing with these challenges to maintain cost efficiency?
Fortunately, since we have had so much to do, we have reached the point where we can negotiate by volume, and evidently anticipate purchases, while increasing our levels of inventory to have a greater certainty. There are three pillars to overcome supply chain challenges: the first is to anticipate, the second is a close relationship with suppliers, and third is volume.

What opportunities do you see for renewable energy projects?
Tecno Fast has worked very closely with solar and wind power projects, and we see a lot of opportunities in this space. We have developed several camps with Enel. Collaboration with the renewable energy sector is very important because it will allow mining to have access to lower energy costs and be able to move towards greener copper.

Can you elaborate on Tecno Fast's plan to become a carbon-neutral company?
Some three years ago, we began the project to become carbon neutral. We turned our main plant in Santiago to one that is powered by solar panels. 85% of the power we use in our plants now comes from solar. We also undertook a huge process of automatization and modernization with cutting edge technology, which improves our energy efficiency. We are now trying to make our plants and hotels self-sufficient in energy terms, using power sources that would allow us to be carbon neutral.

Can you give examples of the latest technologies being utilized by Tecno Fast?
We have incorporated cutting edge technology in the factory, including automatizing the entire fabrication process of the modular structures. Two years ago, we incorporated German technology for everything that is wood construction, and now we are setting up an automatization line for light steel structures. With this, we have not just automatized production processes but we have widened the catalogue of solutions that we offer. Historically, we delivered solutions in wood, but now we can deliver them in light steel as well. Automation makes processes more efficient and accurate when it comes to schedules and use of materials, which allows for improved productivity and quality.

What opportunities do you see in Chile's mining sector in the coming years?
We expect a lot of activity in the mining market in coming years, including a camp for Collahuasi of around 6,000 beds, as well as the Centinela project. From a business perspective, we see opportunities in delivering value-added products – not just delivering the camp but also managing, administering, operating it and adding services. This is supported by the digitalization of our processes and the use of data.

Tecno Fast has over 30 years' experience in the market and has been a pioneering and leading company for all of this time, which is not an easy task. Our professionalism, close relationships with clients and partners, and our agility and capacity for innovation, have been key to this. ■

Pablo Rosales

CEO
TARPULIN

Can you provide an overview of Tarpulin and the company's operations in Chile?
Tarpulin is a modular construction company serving Chile's industrial market. Our recurrent business is to sell or rent temporary buildings used for general warehouses, offices, dining rooms, etc. Our mining clients mostly buy the products instead of renting.

Can you explain how Tarpulin works in partnership with mining clients?
We collaborate with our mining clients to understand their needs and design and engineer a solution technically compliant and as economically as possible. The contracts can be approached in two different ways. The first is that we carry out the building's design, engineering, construction, and assembly "Turn-Key". The second option is that Tarpulin provides the design and supplies the building to be constructed by another contractor but under our supervision. Chilean mining clients are often located in extreme climate conditions, requiring exceptionally high standards of quality, safety and environmental considerations.

What is Tarpulin's strategy for 2023?
We are working intensely with mining companies in the lithium industry, an industry that will be extremely important for Chile moving forward. Our strategy is to remain differentiated from our competitors by delivering high-end solutions and products. ■

Tomás Valenzuela

Mining & Energy VP
AGUNSA

Can you give an overview of Agunsa's operations and milestones achieved in 2022?
AGUNSA has experienced a significant increase in its earnings in the last two years due to mining contracts with well-known companies such as Codelco, Teck, Anglo American, Antamina, SQM, BHP, Capstone Copper, Orica, among others. To support our clients, we have established new logistics mining centers in strategic locations and added new services to our portfolio.

What trends in demand have you seen over the past two years for Agunsa's services?
As a logistics company we focused on safe and efficient operations, promoting diversity, and reducing our carbon footprint and water consumption. We have recently received a sustainability-linked financing of US$70 million from the International Finance Corporation (IFC), making us the first logistics company in Chile receive this type of financing. AGUNSA is committed to reducing freshwater consumption and increasing gender equality by boosting the representation of women in high executive positions. Currently, 46% of our workforce is female, and at Pozo Almonte's new logistics mining facility, 100% of the staff are from the local community, and 75% are women, demonstrating our commitment and alignment to these causes. ■

Jean Pierre Brunel

Commercial Manager
TERQUIM / ODFJELL TERMINALS

Can you introduce ODFJELL Terminals?
ODFJELL is a Norwegian group specializing in the transport, storing and handling of chemicals. In Chile, the group observed a need for port logistic infrastructure, so 49 years ago, we started operations in the San Antonio Port as part of a concession of the public company Empresa Portuaria San Antonio. There, we have 22 tanks to store multipurpose chemicals and, in 1998, we were awarded a contract with Codelco for sulfuric acid storage with a capacity of 40,000 tons.

In 2011, the company opened its second port terminal in Mejillones, where we operate seven tanks with a capacity of 17,000 m3 to serve mainly mining companies like BHP and AMSA. Following this strategic orientation, last year our board approved the construction of a Terminal for storage sulfuric acid in Mejillones (two tanks, each with a capacity of 20,000 tons).

What is your main strategy for 2023?
Beginning with San Antonio, we have a major investment plan for the maintenance of our infrastructure. In Mejillones, our focus is on growth. The first step in our growth strategy was our sulfuric acid project where we already have the environmental permits to build four tanks in total, reaching 80,000 t of capacity in the future. ■

ESG and Renewable Energy

Permitting continues to hamper growth

Image courtesy of AMSA

ESG is a priority across the mining industry as companies strive to lower their carbon footprint and environmental impact. In the face of increasingly high expectations from the general public and stringent regulatory requirements, the mining industry is going all in on steps to lower the industry's carbon footprint and water usage.

The stringent ESG requirements and long permitting processes to reach production are identified across the board as the greatest challenge to incentivizing investment in the country. In addition, the country's ideological approach to permitting is a major area of concern for the industry.

In January 2023, Chile's Committee of Ministers officially denied permits for Andes Iron's US$2.5 billion Dominga project on environmental grounds. However, the decision was seen as purely political within the mining industry. Rejecting the Dominga project was a campaign promise of President Boric, and he expressed his distaste for the project in his first speech after winning the election.

In a press conference, Nicolas Grau, the Minister of the Economy, rejected claims that the decision would dampen enthusiasm, saying: "When you see the wide range of investment projects that are being developed in the country, you see that this protection of the environment, and more specifically our contribution to the fight against the climate crisis, outside of being an obstacle, will be an opportunity and a catalyst for both national and foreign investment."

Providing room for positivity in the industry, the Chilean Committee of Ministers approved the environmental permit application for Anglo American's US$3 billion Los Bronces Integrated Project (LBIP) on April 18, 2023. The environmental regulator had previously rejected the project in May of 2022. The mine, one of the two largest copper operations owned by Anglo American, is over 150 years old and running out of high-grade ore.

Speaking of the approval of Los Bronces, Mauricio Mazuela, General Manager of Hitachi Energy Chile, said: "I think we are seeing more dynamism on the part of the government, which leads us to be more positive in terms of potential growth because I believe the government has realized that Chile will play an essential role in global electrification."

Today, any project seeking approval must provide thorough evidence of its environmental metrics. Aclara Resources is in the process of turning its PEA into a PFS for the Victoria Norte rare earths project. Ramón Barúa Costa, CEO, emphasized the project's environmental approach, highlighting that 95% of the water will be recirculated, and the remaining 5% will be obtained from municipal wastewater.

However, an ESG-centered mine plan is not just about what happens while the mine is active but also what is left behind. Barua Costa said: "There is no crushing, milling, or tailings dam because the extraction process does not create liquid or solid residue. The mine closure process is also crucial, and we have committed to revegetating closed areas as we move forward with native species of trees and flora."

Many mines in Chile are reaching the end of their life cycle, generating demand for mine closure operations. In 2009, the government first required companies to offer a conceptual closure plan from the beginning of their operations, and since then, regulations have become significantly stricter. Rosario Urrutia, country manager at Stantec, said: "Mine closure is a complex and multidisciplinary issue involving both engineering and environmental aspects."

Renewable Energy

On March 16, Chile and Peru formed an alliance to develop a roadmap to promote green hydrogen usage in mining as part of the industry-wide drive towards a carbon-neutral industry. Green hydrogen is one of a variety of renewable energy sources contributing to the Chilean mining industry's shift towards cleaner energy. Chilean mining companies' clean power purchase agreements signed during 2022 totaled 40% of their total energy consumption, with that rate estimated to reach 65% in 2025.

Green hydrogen, wind, and solar are rapidly increasing, but they are only some renewable opportunities reaching

» There is an issue with the energy transmission systems, which are insufficient to transport energy from the north to the south. This results in significantly higher energy costs in the south of Chile.

Raúl González Rojas,
CEO,
Saesa Innova

«

the market. Each of these areas needs a dramatic increase in investment to meet demand, and there are a significant and encouraging number of projects in the Chilean pipeline.

The government could facilitate that pipeline of projects through a variety of steps. Ignacio Mackenna, commercial director at Abastible, called for the government to promote energy exchange with Argentina, saying: "There is cheap and abundant energy in Argentina on the other side of the mountain range, and if the government facilitates the energy exchange, it will alleviate energy pressure."

A renewable energy matrix is complex, and as mines move towards renewables, they must prioritize flexibility. For example, solar power is only generated during the daytime, requiring any mining project using solar also to provide alternative energy sources.

Aggreko offers mobile and modular energy solutions that incorporate various energy sources. Currently, the company is in the testing stages of its new energy system at Gold Fields' Salares Norte project, which combines solar and traditional energy sources. José Rodríguez Monje managing director of Chile and Peru at Aggreko, explained: "The extent to which renewable energy solutions form part of the matrix depends on the weather conditions and other variables."

Mauricio Mazuela, General Manager of Hitachi Energy Chile, acknowledged the complexity of a green energy matrix: "We must push for solutions that address the intermittency of renewable energy parks. Renewable energy alone is not a complete solution because everything must contribute to a stable electrical supply. I believe the country is complying with commitments made at COP. A virtuous circle between the private sector and society drives renewable energy production."

For a country with abundant natural resources and ambitious renewable energy targets, Chile still has a long way to go. "The so-called non-traditional green energy makes up approximately 20% of the energy matrix, while coal power generation still runs at about 38%. The goal is to reduce that 38% to zero by the decade's end," stated Germán Millán, partner at PwC.

"The government is an excellent facilitator of this shift, but there are still some gaps in this support," said Rodríguez Monje, who believes that staffing in the regulatory area is one such challenge: "The regulatory agency (SEC) requires certifications for all energy installations," Monje explained. "However, we see an unattended need to speed up the process."

A shift to renewable energy would be transformative not just for the mining industry, but for the country at large. Sergio del Campo, representative director of Sonnedix Chile, said: "As the participation of renewable energy increases in the larger energy matrix, Chile's independence from shocks in the world economy increases. If Chile can primarily generate power through renewable resource it will be less affected by global economic cycles, causing less inflation and more financial independence." ■

José Rodríguez Monje

Managing Director, Chile & Peru
AGGREKO

How has demand changed over the past year?
All mining operations are currently moving towards a clean energy transition, and we provide complete energy solutions to meet the individual needs of each operation.

Can you discuss your work for Gold Fields at Salares Norte?
The project is located in a remote area with no existing energy infrastructure or options, so we support the client by engineering and developing the energy solution. It combines solar and traditional energy sources (PV), with the possibility of integrating battery energy storage systems.

How can the government facilitate the energy transition?
The government is an excellent facilitator of this shift, but there are still some gaps in this support. Today, our electrical network is becoming one of the most economical in the region due to the penetration of the network. If there is more investment and support from the government, that will continue.

What is the role of remote monitoring in your operations?
We utilize remote monitoring, providing remote solutions to our customers so that they have complete visibility that everything is working as it should. Aggreko dedicates significant internal training for this, ensuring that our people have the requisite skills to utilize these tools. Monitoring a plant that is six hours away and at extremely high altitudes is not simple; many factors must go according to plan, starting with the internet signal. We can monitor our machines in Santiago and from our base in Argentina, where we have a center available to our customers.

Can you discuss Aggreko's strategy for the coming few years?
Our strategy is to prioritize long-term and medium-term solutions. The goal is to understand the specific needs of the customers and being present all along the way. Another major area is that we are continuing to aggressively pursue are our hybrid solutions, developing individualized systems to lower the emissions of our clients. ■

Mauricio Mazuela

General Manager Chile
HITACHI ENERGY

How does Hitachi Energy create innovative technologies for the energy transition?
Our tools bring together a technological response to the energy transition and our environmental commitment. We have stayed at the forefront of technological advancement to make a robust electrical network with a portfolio of solutions for the energy transition. We also offer asset management software, which optimizes asset fleets. We have a digital solution called Lumada, that works with assets based on the management of people and plants.

Can you describe the benefits of your offerings?
We are engaging in modularizing systems for energy, allowing for quick responsiveness and flexibility. Another benefit is that the repair rate of assets is low with our tools because we can predict the need for maintenance with our asset analysis.

How important is mining for Hitachi?
Mining represents almost half of our turnover, although that number fluctuates depending on the year. However, mining is a highly stable segment and reliable area for us. The challenge is that mining projects approvals are very slow to reach construction and production, and a new project takes many years. However, operational improvement projects are an area of opportunity. ■

Sergio del Campo

Representative Director
SONNEDIX CHILE

What is the history of Sonnedix in Chile?
Sonnedix set the ground in Chile with a pilot project to see the feasibility of a solar photovoltaic (PV) plant in 2015. Since then, that pilot would lead the way to what would become our largest project constructed worldwide: Sonnedix Atacama Solar (170 MWp). We saw high solar irradiation in the Atacama Desert, a stable regulatory framework in the energy sector, and a good history of macroeconomic management in the country. With this 450-hectare solar PV plant, we contribute to the development and solar identity of the Province of Tamarugal by generating clean, sustainable, and renewable energy for the region.

As we continued to develop and build projects across Chile, we have increased operations from 7 MW in 2015 to being on track to reach more than 700 MW by mid-2023.

Can you discuss the evolution of Sonnedix into hybridization?
In October 2022, we announced that Sonnedix acquired over 290 MW of renewable energy projects from ARCO Energy, one of Chile's largest independent renewable power producers. The acquisition marked a milestone toward hybridization - transitioning from a solar-independent power producer to a renewable energy producer, adding wind assets to our portfolio. ■

Luis David Rodríguez and Daniel Fellhandler

LDR: Executive VP Andean Region, South America
DF: Deputy Manager Director
TOTALENERGIES

What is the history and key operations of TotalEnergies in Chile?
LDR: TotalEnergies has been present in Chile since 2005. It initially started its activities in the lubricants and special fluids specialty, mainly drilling fluids. It acquired a solar plant in Atacama with a capacity of 190 MW, which was later expanded with six smaller-scale plants, currently totaling around 215 MW of installed capacity. It also has a subsidiary called Total Eren, which is mainly focused on green hydrogen projects in the Magallanes and Mejillones areas.

Can you describe the energy landscape of Chile and how government policy is influencing this area?
DF: Transmission is an infrastructure challenge. The country is working on improving it, which is expected to expand investment opportunities, especially in renewable projects.

What strategies and goals do you have in Chile in 2023?
LDR: TotalEnergies is contributing to an increased presence of natural gas from Argentina in Chile, which represents a significant opportunity for electric decarbonization. ■

COMPANY	WEBSITE
3M	https://www.3mchile.cl/3M/es_CL/inicio/
Abastible	https://abastible.cl/
ABB	https://new.abb.com/south-america/
Aclara Resources	https://www.aclara-re.com/
Aggreko	https://www.aggreko.com/es-co
Agunsa	https://agunsa.com/
Albemarle	https://www.albemarlelitio.cl/
Altiplano Metals	https://apnmetals.com/
Amerigo Resources	https://mineravallecentral.cl/
AMPHOS 21	https://en.amphos21.com/
Andes Motors	https://www.andesmotor.cl/
Antofagasta Minerals	https://www.aminerals.cl/
APRIMIN	https://aprimin.cl/site/
ATEX Resources	https://www.atexresources.com/
Ausenco	https://ausenco.com/
Axinntus	https://www.axinntus.com/
Bermad Fluid Solutions	https://www.bfschile.com/
BHP	https://www.bhp.com/es
Black and Veatch	https://www.bv.com/
Bosch Rexroth	https://www.boschrexroth.com/es/cl/
Cacheq	N/A
Camara Minera	https://camaraminera.cl/
Capstone Copper	https://capstonecopper.com/
Carpitech	https://www.carpitech.com/
CDM SMITH	https://www.cdmsmith.com/es/
Cleantech Lithium	https://ctlithium.com/
Codelco	https://www.codelco.com/
Consejo Minero	https://consejominero.cl/
CRU	https://www.crugroup.com/
Cummins	https://www.cummins.cl/
Diamantina Christensen	https://www.diamantinachristensen.com/
Drillco	https://www.drillco.com/es/
EDYCE	https://www.edyce.com/
Emerson	https://www.emerson.com/es-cl
Enaex	https://www.enaex.com/cl/es/
Endress + Hauser	https://www.cl.endress.com/es/
EPIROC	https://www.epiroc.com/es-cl
ERAMET Group	https://www.eramet.com/en
EY	https://www.ey.com/es_cl
FAM - Member of BEUMER Group	https://www.beumergroup.com/
FAMESA	https://www.famesa.cl/
FLSmidth	https://www.flsmidth.com/en-gb/services/service-centres/chile
Freeport McMoRan	https://www.elabra.cl/

COMPANY	WEBSITE
GEM	https://www.gem-mining-consulting.com/
GLENCORE	https://www.glencore.com/
Glencore Technology	https://www.glencoretechnology.com/es
Haver & Boecker	https://haverniagara.com/
Hexagon	https://hexagonmining.com/
High -Res	https://high-res.cl/hr/
Hilti	https://www.hilti.com.br/
Hitachi Energy	https://www.hitachienergy.com/latam/es
Hofmann Engineering	https://www.hofmannengineering.com/
Hot Chili	https://www.hotchili.net.au/
ICP Ingeniería	https://icpingenieria.cl/
Instituto de Ingenieros de Minas de Chile	https://www.iimch.cl/
JRI	https://www.jri.cl/
Komatsu	https://www.komatsulatinoamerica.com/chile/
Lithium Chile	https://lithiumchile.ca/
Los Andes Copper	https://losandescopper.com/
Lumina Copper	https://www.caserones.cl/
Major Drilling	https://www.majordrilling.com/
Maptek	https://www.maptek.com/cl/
Marimaca Copper	https://marimaca.com/es/
Master Drilling	https://www.masterdrilling.com/
Mathiesen	https://www.grupomathiesen.com
MBI Global	https://www.mbi.cl/EN/
MC Systems	https://www.mcsystem.cl/
Metaproject	https://www.metaproject.cl/
METSO	https://www.mogroup.com/es/
Michelin	https://www.michelin.cl/
Mineria Activa	https://mineriactiva.com/
MineSense	https://minesense.com/
Ministry of Mines	https://www.minmineria.cl/
MJ Gerust	https://www.andamiosgerustchile.cl/
Montero Mining	https://monteromining.com/
Monumental Minerals	https://monumentalminerals.com/
Multiservice Grúas	https://www.multiservicegruas.com/
Nexxo	https://www.nexxo.cl/index
NORACID	https://noracid.cl/
Odfjell Terminals	https://www.odfjell.com/
OHLA	https://ohla-group.com/
ORICA	https://www.orica.com/
OSSA	https://ossaint.com/es/
Pampa Metals	https://pampametals.com/
Prodrilling	https://www.prodrilling.com/
Prowinch	https://prowinch.cl/

COMPANY	WEBSITE
PWC	https://www.pwc.com/cl/es.html
R&Q Ingenieria	https://www.ryq.cl/
RCF	https://resourcecapitalfunds.com/
Rema Tip Top	https://www.rema-tiptop.cl/
Rio Tinto	https://www.riotinto.com/
Saesa Innova	https://www.saesainnova.cl/inicio
Sandvik	https://www.home.sandvik/es-la/
Sattel	http://www.sattelchile.cl/
SCV	https://www.empresas-scv.com/
Seequent	https://www.seequent.com/
Shimin	https://shimin.cl/
Siderúrgica Huachipato	https://www.capacero.cl/
Sigdo Koppers	https://www.skic.com/
SKF	https://www.skf.com/cl
Solentec	https://www.solentec.cl/
Solvay	https://www.solvay.com
Sonnedix	https://www.sonnedix.com/
STANTEC	https://www.stantec.com/es
STM	https://stmcorp.cl/
Stokholm Precision Tools	N/A
Subterra	https://subterra-ing.com/en/
Sulzer	https://www.sulzer.com/en
TAKRAF	https://www.takraf.com/
Tarpulin	https://www.tarpulin.cl/
Teck	https://www.teck.com/es/
Tecnipak	http://www.tecnipak.com/
Tecno Fast	https://tecnofast.cl/
Technosteel	https://www.technosteel.cl/
Tecpromin	https://www.tecpromin.cl/new/
Telemining	https://www.telemining.cl/
Terra Nova Technologies	https://www.tntinc.com/
Thiess	https://www.thiess.com/es-cl
Torq Resources	https://torqresources.com/
Total Energies	https://totalenergies.com/chile
Turner & Townsend	https://www.turnerandtownsend.com/
VALMET	https://www.valmet.com/
Wealth Minerals	https://wealthminerals.com/
Weir Minerals	https://www.global.weir/
World Copper	https://worldcopperltd.com/
WSP	https://www.wsp.com/es-co/
XCMG	https://xcmg.cl/
Yokogawa	https://www.yokogawa.cl/
Zublin & STRABAG	https://www.strabag.cl/

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We would like to thank all the executives and authorities that took the time to meet with us.

Also, special thanks to:

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