British Embassy
Santiago

Strengthening UK-Chile Ties:

Enhancing ESG Standards in the Critical Minerals Supply Chain

SFA Oxford

consulting analysts in tomorrow's commodities and technologies

Chile's Role in Powering the Global Green Transition

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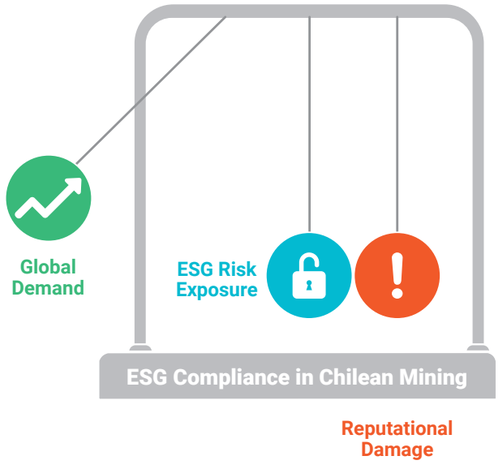
Chile's Role in Powering the Global Green Transition

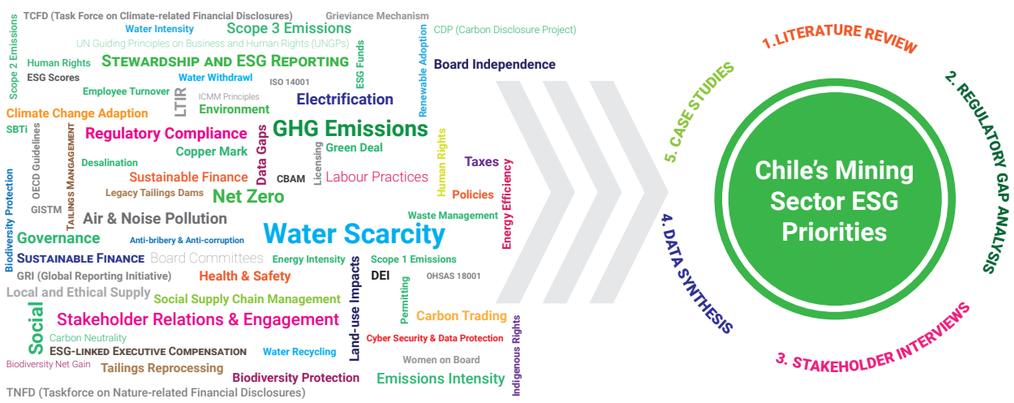
Introduction: Strengthening ESG Standards in Chile's Mining Sector

Chile holds a pivotal position in the global supply of energy transition minerals (ETMs), particularly lithium and copper, which are indispensable for renewable energy technologies, electric vehicles, and battery storage. As a well-established mining hub with a long history of resource extraction, Chile has already embedded key sustainability principles into its regulatory framework and mining norms. However, with rising ESG expectations from investors, governments, NGOs, and the public, the country faces increasing pressure to further strengthen its ESG frameworks and on-site sustainability applications. By doing so, Chile can reinforce its global competitiveness, attract responsible investments, and secure its position as a leading supplier of responsibly sourced critical minerals.

Recognising Chile's strategic role in the global ETM supply chain, the British Embassy Santiago commissioned SFA (Oxford) to assess the country's ESG landscape in the mining sector. This study aims to establish a baseline of ESG practices, evaluate regulatory frameworks, identify strengths and areas for improvement, and explore opportunities for UK-Chile collaboration in strengthening responsible mining practices.



Chilean lithium and copper producers are already facing growing pressure to meet stricter ESG requirements to maintain market access. Failure to address public scrutiny and demonstrate robust ESG credentials poses significant risks, including potential loss of global market share, reputational damage, and diminished investor confidence. At the same time, emerging ESG regulations worldwide are shaping market dynamics, making ESG compliance an economic imperative for mining jurisdictions like Chile.

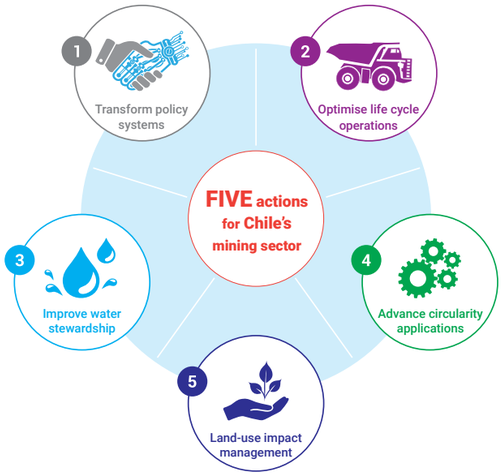


To gain a comprehensive understanding of Chile's ESG readiness, SFA conducted extensive research, complimented by interviews with key stakeholders to complete a deep dive into material ESG priorities. These consultations engaged a diverse range of participants, including mine operators, government regulatory authorities, academia, NGOs, and local communities. Their input provided valuable real-world perspectives on Chile's current ESG initiatives, best practices, and challenges. By running a collective content analysis on stakeholder insights, **eight key ESG themes were identified**:

1. ESG regulations
2. Climate Change and Decarbonisation
3. Water Management
4. Tailings Management
5. Social Licence to Operate
6. Biodiversity
7. Gender Equality, and
8. Sustainable Investment and Innovation

To address these key ESG risks and challenges, a structured **five-step action plan** was developed to strengthen Chile's position as a global leader in responsible mineral production. This framework leverages stakeholder feedback and industry best practices to drive meaningful improvements in ESG performance. These actions are:

1. **Transform Policy Systems** – Strengthening regulatory frameworks and governance mechanisms to ensure robust ESG compliance and enforcement. This includes aligning national policies with international ESG standards, enhancing corporate transparency, and integrating ESG criteria into Chile's licensing and permitting processes.
2. **Optimise Life Cycle Operations** – Promoting Chile's sustainable mining practices across the entire mineral extraction and processing value chain. Key focus areas include energy efficiency, electrification, responsible tailings management, and emissions reduction initiatives.
3. **Improve Water Stewardship** – Addressing water scarcity and resource efficiency in Chile by implementing innovative water recycling, desalination, and watershed protection measures. Given Chile's arid climate and high-water stress, proactive water management is essential to securing a social licence to operate.
4. **Advance Circularity Applications** – Accelerating the adoption of circular economy principles, including waste reduction, secondary material recovery, and tailings reprocessing. These circularity strategies can unlock economic value while reducing environmental footprints.
5. **Enhance Land-Use Impact Management** – Strengthening biodiversity protection, ecosystem restoration, net gain initiatives and community engagement strategies to mitigate negative land-use impacts. This involves integrating environmental and social impact assessments further into decision-making processes and promoting collaborative land-use planning.



The British Embassy Santiago will continue to support deeper engagement between the UK and Chile on ESG and critical mineral strategies. This partnership plays a crucial role in strengthening bilateral ties, fostering policy development, and driving ESG excellence across the world.

By leveraging the UK's expertise in ESG governance, sustainable finance, and mining innovation, Chile can accelerate its transition towards a more responsible and competitive mining industry. The implementation of this five-point plan addressing the eight key themes provides a clear roadmap for achieving this transformation, ensuring Chile remains a global benchmark for ESG leadership in the critical minerals supply chain.

UK and Chile Forge Strategic Alliance for Net-Zero

A landmark Memorandum of Understanding (MoU) has forged a powerful alliance between the United Kingdom and Chile, uniting their efforts to advance the energy transition and achieve net-zero goals. Signed on 3 October 2024, this strategic partnership between the Ministry of Energy of the Republic of Chile and the Department for Energy Security and Net Zero of the United Kingdom establishes a collaborative framework dedicated to climate action, energy security, and sustainable development, with a shared commitment to achieving net-zero emissions by 2050.

The MoU outlines specific sectors where the UK and Chile will work together to accelerate their energy transition objectives. Each focus area targets a crucial aspect of the transition and seeks to leverage the unique strengths of both nations, Chile's vast renewable energy potential and critical mineral resources, and the UK's advanced technology and expertise. The main areas of cooperation include:

Low Carbon Hydrogen and Derivatives: The MoU highlights a commitment to growing the low-carbon hydrogen sector, particularly green hydrogen, with both nations recognising its critical role in reducing emissions. Chile's potential as a major producer of green hydrogen, due to its favourable renewable energy conditions, is especially valuable in this partnership. Both countries aim to cooperate on standards, training, financing, and demand creation, especially as co-leaders of the Clean Hydrogen Mission under Mission Innovation.

Renewable Energy with a focus on Offshore Wind: Recognising the UK and Chile's strong capabilities in renewable energy, the MoU emphasises joint efforts on offshore wind projects. This includes sharing expertise and best practices to support the development of Chile's offshore wind sector and fostering commercial partnerships.

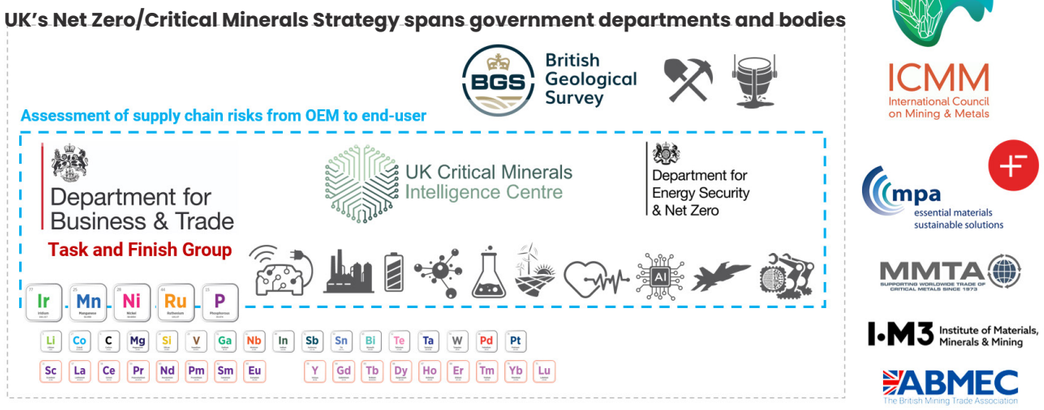
Carbon Pricing: Both nations acknowledge the significance of carbon pricing mechanisms, such as emissions trading systems, to support their Paris Agreement commitments. They will exchange technical information and best practices to drive the development of carbon pricing instruments.

Energy Security and Climate Resilience: The MoU addresses the impacts of climate change on energy security and supply quality. Working together, the UK and Chile aim to create secure and resilient energy systems, supported by Chile's natural resources and the UK's technology for clean energy supply chains.

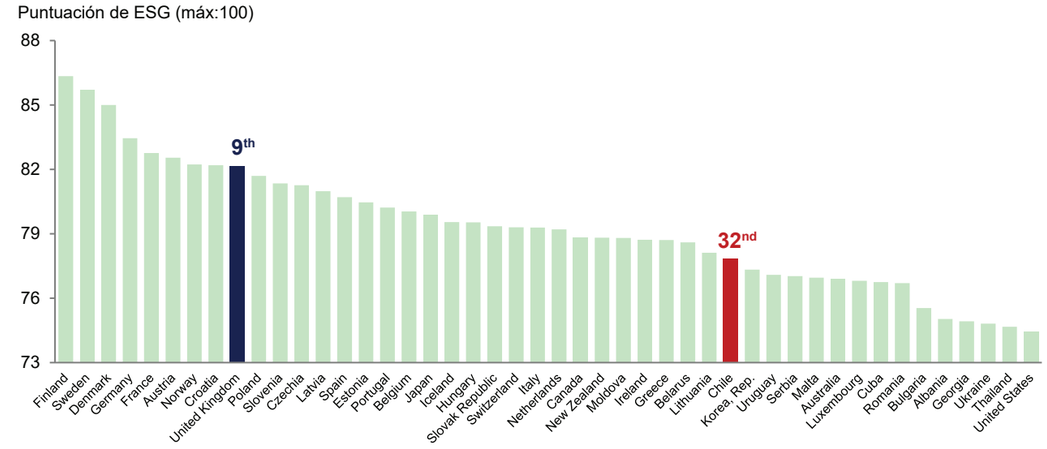
Additional Areas of Energy Cooperation: The MoU also includes provisions for exploring further areas of mutual interest and allows both countries to adapt their efforts to emerging opportunities and challenges, potentially involving the private sector.

The MoU encourages the exchange of scientific and technical information, expert training, and the creation of partnerships between academic institutions, research bodies, and the private sector. It also promotes the organisation of conferences and workshops to strengthen bilateral cooperation and drive innovation in the energy sector.

UK's Net Zero/Critical Minerals Strategy spans government departments and bodies



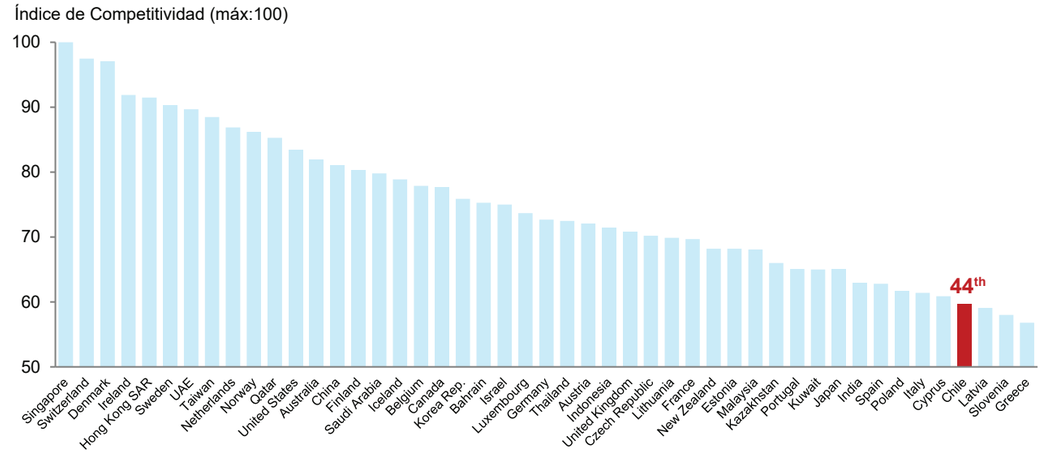
Benchmarking UK and Chile for ESG



Source: SFA (Oxford), Sachs, J.D., Lafortune, G., Fuller, G. (2024). The SDGs and the UN Summit of the Future. Sustainable Development Report 2024.

Chile ranks in the top 20% percentile globally, positioned 32nd on ESG scores. While this ranking reflects notable progress, it highlights substantial opportunities for improvement. Collaboration with the UK, which sits 9th, offers a valuable benchmark to strengthen Chile's environmental, social, and governance frameworks, potentially boosting its ESG score and aligning it more closely with global leaders. Strategies such as strengthening governance can reduce socio-environmental conflicts and improve institutional efficiency, while scaling renewable energy solutions can lower environmental impact and drive sustainable development. Additionally, enhancing institutional development will foster transparency and accountability, addressing social challenges.

Chile's attractiveness based on Competitiveness Index



Source: SFA (Oxford), IMD World Competitiveness Ranking (2024).

Chile currently ranks in the top 66th percentile, indicating there is room for further progress. However, the country demonstrates notable strengths, ranking 21st in international investment, reflecting strong economic performance, and in public finance, highlighting government efficiency. Key challenges include strengthening governance by reducing legal uncertainty to boost investment and economic growth, increasing productivity with the adoption of new technologies and AI (IMD, 2024).

Chile: A Global Leader in Energy Transition Minerals

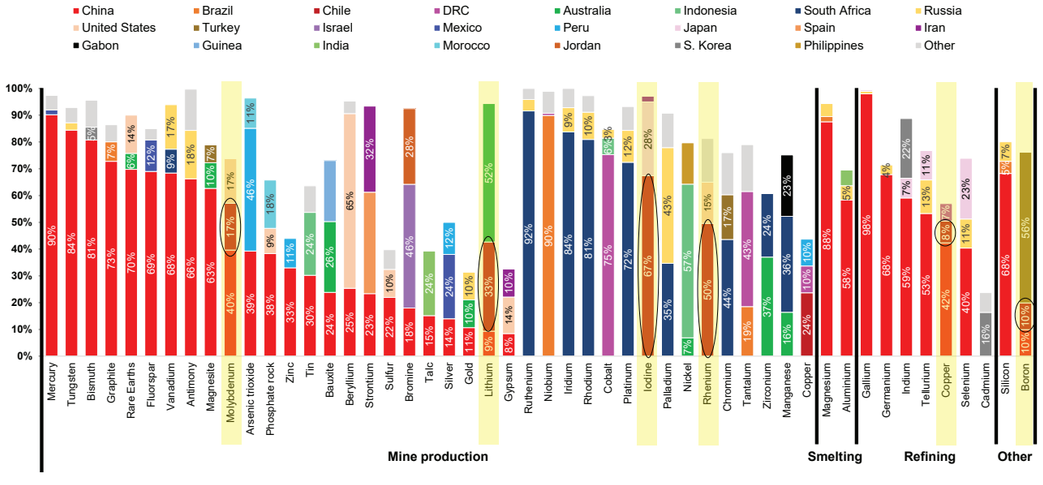
Chile holds a critical position in the global supply chain of energy transition minerals (ETMs), providing essential resources such as copper, lithium, and molybdenum that enable the shift toward low-carbon technologies. As the world accelerates its transition to clean energy, the demand for these minerals has surged, positioning Chile as an indispensable player in meeting global decarbonisation goals.

With its vast mineral wealth, Chile is not only a key producer but also a trusted partner for countries and industries driving green initiatives. Copper, of which Chile produces 30% of global output, is vital for renewable energy infrastructure, electric vehicles (EVs), and power grids. Meanwhile, lithium production, primarily sourced from Chile's high-altitude brine deposits accounted for 22% of global LCE supply in 2023, and plays a pivotal role in battery technologies essential for energy storage and EVs. The country's advanced mining industry, coupled with a strong regulatory framework, provides a stable foundation for continued leadership in the global energy transition.

Beyond its mineral production, Chile has demonstrated a commitment to sustainable mining practices. The industry is increasingly integrating renewable energy, adopting desalination solutions for water efficiency, and enhancing community engagement programs to ensure inclusive development. These efforts reinforce Chile's reputation as a responsible mining hub and a benchmark for ESG (Environmental, Social, and Governance) excellence in the critical minerals sector.

The global demand for critical minerals is expected to rise significantly, with estimates projecting an increase of 4–6 times by 2040. As one of the world's most important sources of lithium and copper, Chile has a unique opportunity to shape the global ESG agenda and set high standards for responsible resource extraction. Enhancing ESG performance not only strengthens Chile's position in international markets but also ensures long-term sustainability by balancing economic growth with environmental protection and social responsibility.

Top 3 Global Producers by Critical Minerals



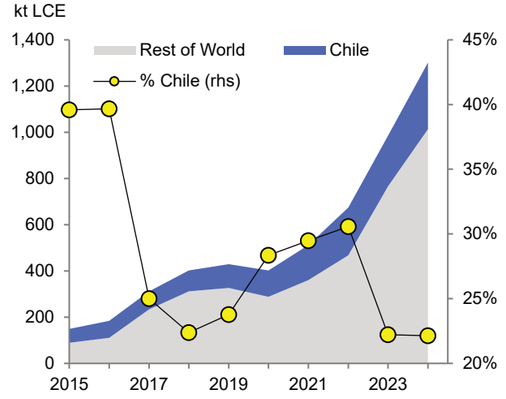
Source: SFA (Oxford), USGS

As of 2023, Chile remains the world's largest copper producer and the second-largest lithium producer, holding 24% and 33% of the global market capitalisation in mine production (metal content), respectively. In 2023, copper exports accounted for approximately 9.7% of Chile's GDP and contributed to around one-third of government revenue. However, Chile's share of global ETMs has been steadily declining. Over the past two decades, Chile's copper mine production and refined copper in global markets has decreased, from approximately 38% and 19% to 23% and 10%, respectively. This trend is largely driven by a surge in output from other regions, advancements in recycling technologies, declining ore grades, and the need for deeper, more resource-intensive mining operations. These factors, in turn, have heightened the operational and financial ESG risks already present in the sector.

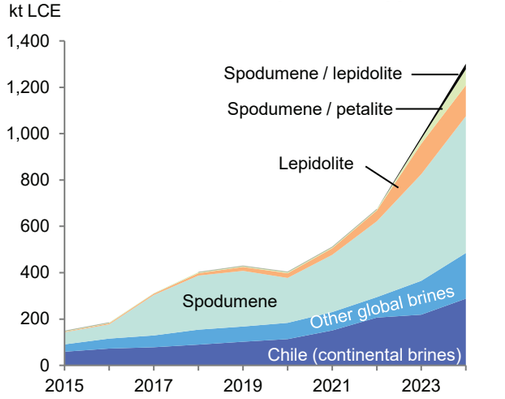
When examining current global lithium supply routes, Chile remains a key resource holder alongside Argentina and Australia. However, despite strong production growth, Chile's share of the global market continues to decline. Between 2015 and 2024, its lithium output rose fivefold, from 59 kt to 288 kt, yet its share of global lithium carbonate equivalent (LCE) production fell from 39.6% to 22.1%. In contrast, global LCE output surged elevenfold, from 90 kt in 2015 to 1,013 kt in 2024, driven by new supply sources such as spodumene, lepidolite, and petalite deposits.

Attempting to remain competitive, whilst retaining market share risks exacerbating existing ESG challenges. Despite its vast reserves, Chile's future market leadership will depend on sustainable production, regulatory stability, and excellence in ESG performance.

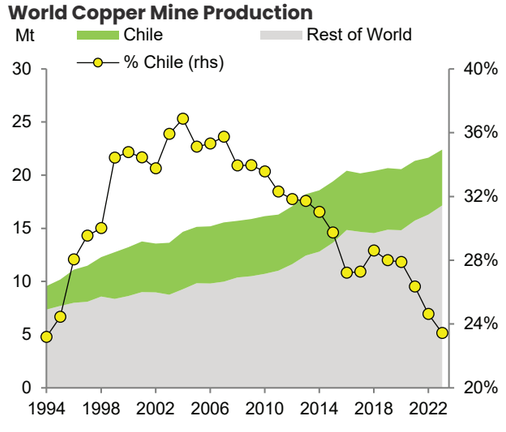
World Lithium Production



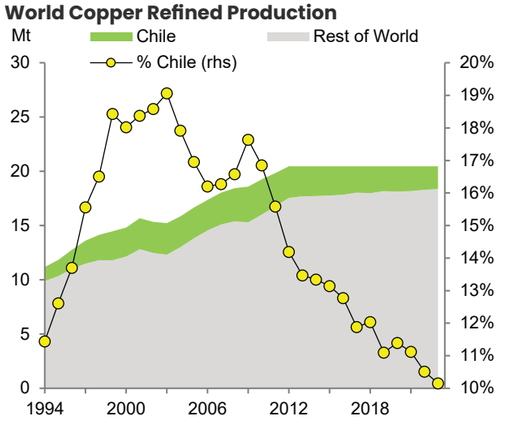
World Lithium Production by Mineral Type



World Copper Mine Production



World Copper Refined Production



Source: SFA (Oxford), Cochilco

Antofagsta faces the greatest ESG challenges as the largest copper producing region in Chile

Due to limited domestic refining capacity, up to 50% (refined equivalent) of Chile's copper exports over the past decade have been shipped as copper concentrates. When examining Chile's regional copper concentrate production, the northern regions of Tarapacá, Antofagasta, Atacama, and Coquimbo emerge as key producers, hosting some of the country's largest and most productive mines.

Among these, Antofagasta consistently leads in output. It is home to several major copper operations, including Escondida, Spence, Radomiro Tomic, and Centinela, all of which significantly contribute to the region's dominant position within Chile's copper industry. The Antofagasta Region, Chile's mining hub, produced 2.9 million tonnes of copper in 2023, alongside 302 kt of lithium products and 17.8 kt of molybdenum. It accounts for 87% of Chile's total copper cathode production and 46% of its copper concentrate output, making it the single most important contributor to Chile's global dominance in copper markets, attracting substantial foreign investment and supporting thousands of jobs across the mining sector.

Water scarcity and environmental constraints are prompting significant investments in desalination and seawater pipelines, especially in Antofagasta and Tarapacá.

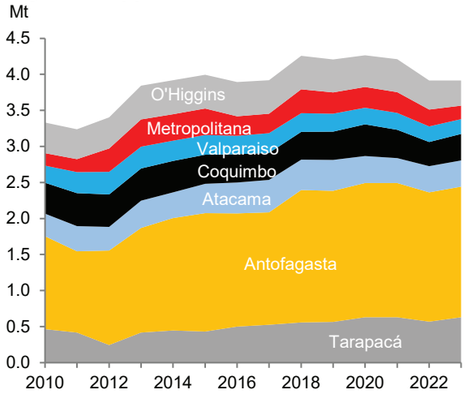
Labour and community tensions are more pronounced in the northern Chile, requiring companies to strengthen social licence strategies.

There has been a steady decline in copper mining grades in Chile from 2000 to 2022 across all processing methods. The national average copper grade fell from 1.38% in 2000 to just 0.58% in 2022. Heap leach operations experienced the sharpest decline, reaching 0.44%, while concentrator plants fell to 0.69%. A drop of just 0.1% in ore grade can significantly increase operational expenditure, presenting a major challenge for mining operations. This issue has been further exacerbated by inflationary pressures that started in 2021, and reflected in the recent financial results of base metals mining companies.

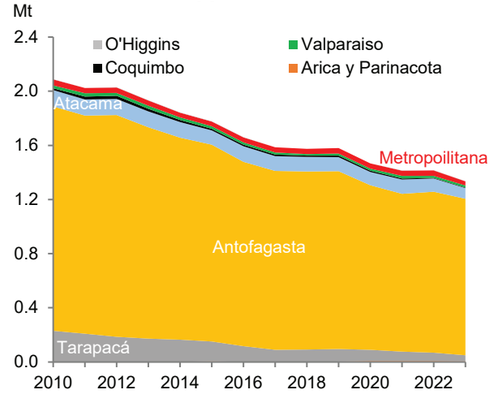
While rising operational costs may not traditionally fall under the ESG umbrella, they have profound implications for business sustainability, and can indirectly intensify environmental and social risks. In parallel, cost-driven operational instability, such as abrupt start-stop decisions, can reduce long-term accountability and oversight, potentially leading to short-term actions with lasting environmental and social consequences.

Chile is the second largest producer of molybdenum with a 17% share of the global market. In line with broader operational and financial trends observed in copper and lithium, Chile's share of molybdenum production peaked at 25.8% in 2008 but has been steadily declining since. This decline has brought Chile's market share close to its lowest point in the past two decades, despite the fact that global molybdenum production has continued to rise.

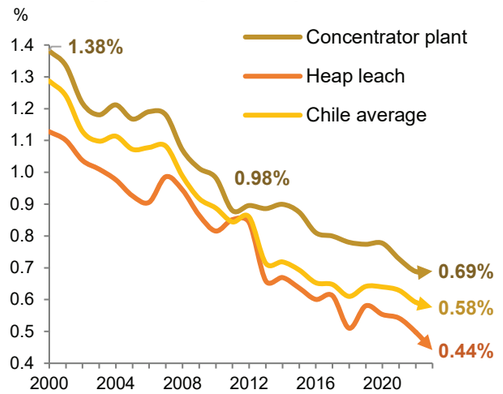
Regional Copper Concentrates Production



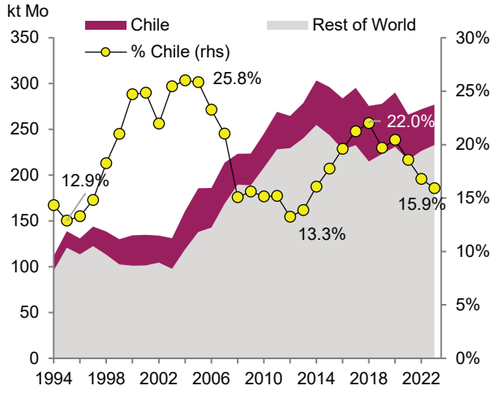
Regional SX-EW Copper Cathode Production



Chile Copper Mining Grade by Process

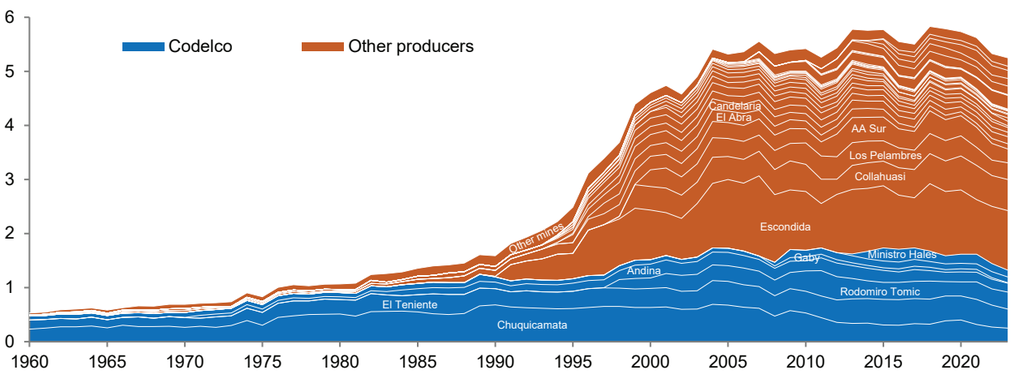


World Molybdenum Production



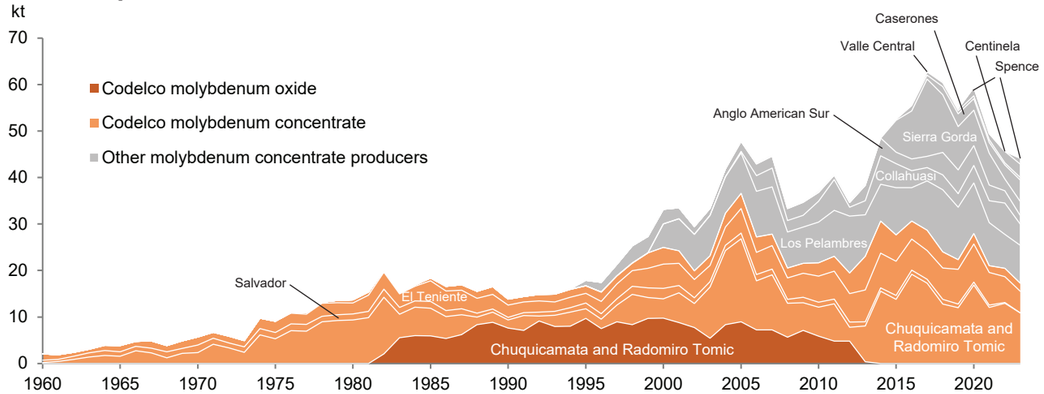
Chile's Copper Mine Production

Mt Cu content



Chile's Molybdenum Mine Production

kt



Source: SFA (Oxford), Cochilco

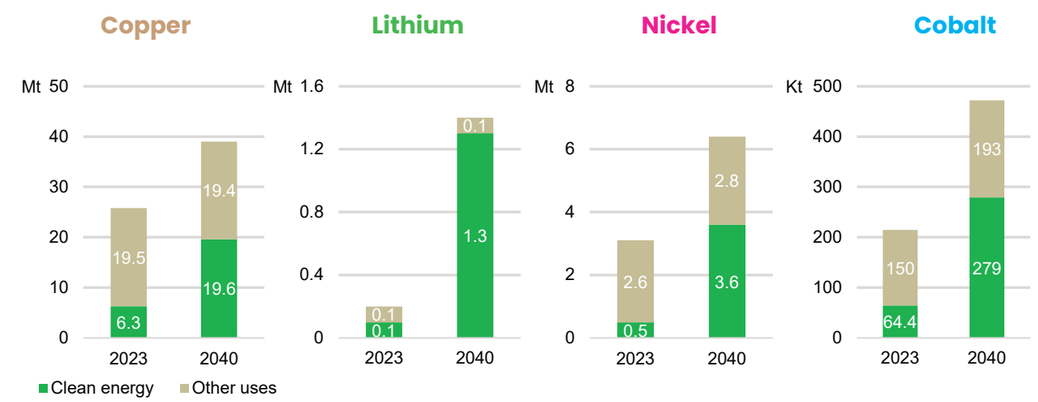
The Global Demand for Energy Transition Minerals Drives Investment into Chile

The shift to sustainable energy has created an unprecedented surge in demand for critical minerals. Between 2023 and 2040, copper demand is projected to increase by 50%, while lithium, nickel, and cobalt consumption will grow exponentially due to their essential role in clean energy applications. The global market for ETMs, currently valued at USD 325 billion, is expected to more than double, requiring strategic investment in supply chain resilience.

Chile's mining industry is well-positioned to respond to this demand, leveraging its established infrastructure, skilled workforce, and regulatory stability. The country has attracted significant foreign direct investment, supported by a network of Free Trade Agreements (FTAs) that enhance its competitiveness in global markets. Key mining regions, such as Antofagasta and Atacama, host world-class operations managed by leading companies, including Anglo American, BHP, Codelco, and SQM, ensuring a steady supply of high-quality resources.

Despite global competition, Chile remains a preferred destination for mining investment due to its strong legal framework and commitment to sustainability. The government's National Lithium Strategy aims to enhance state participation in lithium projects while ensuring adherence to international ESG standards. Additionally, initiatives such as green hydrogen development, tailings reprocessing, and electronic permitting systems further position Chile as an innovation hub in sustainable mining practices.

Financial institutions are increasingly investing in mining companies with strong ESG practices through purpose-made ESG funds, green loans, and sustainability-linked bonds. This trend offers new funding mechanisms and encourages adopting ESG practices across the industry. Research into the investment of global ESG funds, including EU Taxonomy Article 8 and Article 9 funds, examined allocations to Chile's listed mining companies and their international competitors. There is a clear link between mining companies with strong ESG performance and their ability to attract investment from global funds, signalling market confidence in their contribution to the energy transition.



Source: SFA (Oxford), IEA

ESG and Sustainability Fund Investment Attractiveness

When it comes to attracting ESG funds, Newmont and Antofagasta stand out among the top-performing 10%. Albemarle, Rio Tinto, Freeport-McMoRan, Anglo American, Lundin, and KGHM are all receiving above-average ESG fund allocations compared to their peers. In contrast, BHP, Glencore, and SQM are lagging behind their Chilean and global counterparts in attracting ESG investment. Companies such as Vale and Taseko continue to face challenges with ESG fund inclusion, likely due to ongoing sustainability concerns.

Rank	Company name	ESG funds	EU Article 8 Funds	EU Article 9 Funds	Fondos ESG Totales
1.	Newmont	1,870	1,545	39	3,454
2.	**Antofagasta**	**1,349**	**1,066**	**38**	**2,473**
3.	**Albemarle**	**1,312**	**1,080**	**37**	**2,429**
4.	**Rio Tinto**	**1,224**	**1,083**	**16**	**2,323**
5.	**Freeport-Mcmoran**	**1,115**	**959**	**11**	**2,085**
6.	**Anglo American**	**1,074**	**908**	**10**	**1,902**
7.	**Lundin Mining**	**946**	**803**	**26**	**1,775**
8.	Ivanhoe	873	714	28	1,615
9.	Mineral Resources	817	619	19	1,455
10.	Gangfeng Lithium	814	664	7	1,485
11.	KGHM	756	684	8	1,448
12.	Tianqi Lithium	695	558	6	1,259
13.	Group Mexico	675	581	5	1,251
14.	Southern Copper	634	542	9	1,185
15.	Pilbara Minerals	623	458	11	1,092
16.	**BHP**	**547**	**445**	**2**	**994**
17.	First Quantum	526	425	3	954
18.	Jiangxi Copper	499	419	1	919
19.	Glencore	424	365	2	791
20.	Zijin Mining	398	325	0	723
21.	Arcadium Lithium	305	245	13	563
22.	**SQM**	**221**	**155**	**8**	**384**
23,	Ero Copper	175	169	1	345
24.	Hudbay Minerals	171	149	1	321
25.	Captone Liontown	166	145	2	313
26.	Liontown	119	93	1	213
27.	Vale	93	68	3	164
28.	Taseko	37	20	0	57

Source: SFA (Oxford). Note: Bloomberg data on 23rd January 2025. Article 8 funds promote environmental or social characteristics, while Article 9 funds have sustainable investment as their core objective. Both funds must comply with Do No Significant Harm principles, Minimum Safeguards, and Principal Adverse Impact criteria.

Chilean Mining Companies are Leading from the Front in Setting Sustainability Targets

As global ESG expectations evolve, **Chile has the opportunity to set new benchmarks for sustainable mining**. Addressing key ESG challenges, such as water resource management, tailings management, community engagement, and carbon neutrality will enable Chile to enhance its competitiveness and solidify its role as a global leader in responsible mineral production.

The leading mining companies operating in Chile have **set sustainability targets** and outlined strategic decarbonisation pathways to align with global environmental goals. These initiatives have evolved significantly over time, beginning with early commitments made in the aftermath of the 2016 Paris Agreement. Initially, companies focused on setting broad sustainability objectives, acknowledging the urgent need to address climate change and mitigate environmental impact.

Over the subsequent years, these companies have progressively **refined their strategies**, adopting more ambitious targets and integrating ESG principles into their core business models. Central to these efforts is the commitment to achieving net-zero carbon emissions by 2050, a goal that underscores the sector's dedication to long-term sustainability and responsible resource extraction.

The decarbonisation timeline highlights **critical ESG focus areas**, including energy transition strategies, water stewardship, biodiversity conservation, and community engagement. These areas represent key pillars of sustainability, reflecting how Chile's mining sector is actively addressing the environmental and social implications of its operations.

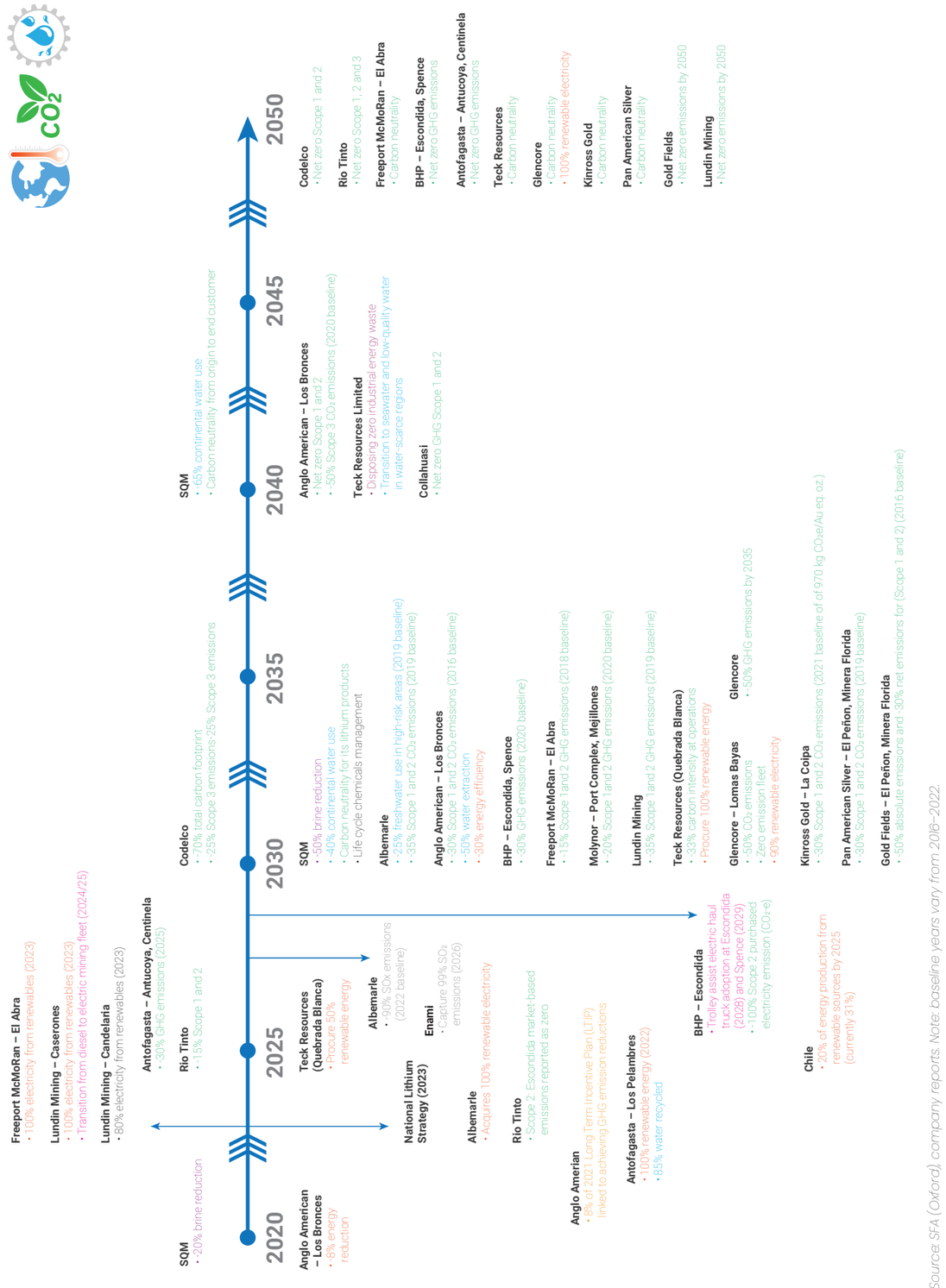
Mining companies have **committed to progressive carbon emission reductions in Scope 1, 2, and 3 emissions**, with net-zero targets becoming standard across the industry by 2040-2050. Early commitments, such as Rio Tinto's -15% Scope 1 and 2 reduction by 2025 and BHP's -30% GHG reduction by 2030, set the foundation for sector-wide decarbonisation. By 2040, leaders are targeting net-zero Scope 1 & 2 emissions, with full industry-wide net-zero alignment, including Codelco, Freeport-McMoRan, Antofagasta, and Glencore, expected by 2050.

With Chile's mining sector operating in water-scarce regions, managing freshwater use is a top ESG priority. **Notably, SQM has a target to reduce the use of brine by 50%, continental water by 40% by 2030**. Anglo American and BHP are investing in seawater usage and lower-quality water sources, with Molymet and Lundin Mining targeting a 25%-35% freshwater reduction in high-risk areas by 2030. These commitments will be key in preserving natural water reserves while ensuring long-term mining sustainability.

Mining operations are transitioning toward 100% renewable electricity, with Albemarle, Antofagasta, and Lundin Mining achieving this by 2023. Electrification efforts include diesel fleet replacements, such as BHP's electric truck rollout by 2029. This shift is vital for reducing Scope 1 emissions and aligns with Chile's broader decarbonisation strategy and integrate renewable energy use.

Miners are **embracing waste management** and industrial process optimisation to minimise environmental impact. Enami's commitment to capturing 99% SO2 emissions by 2026, Gold Fields' reduction of absolute emissions by 50% by 2050, and Glencore's full transition to renewable electricity highlight the industry's growing focus on tailings management, emissions capture, and closed-loop systems for sustainability.

The **Chilean government, NGOs, and local stakeholders are committed to improving sustainability practices**, Chile can lead the global energy transition.



Source: SFA (Oxford), company reports. Note: baseline years vary from 2016–2022.

Tackling ESG Hurdles – Fast-Track Solutions for Impact

8 Key ESG Challenges Faced by the Chilean Mining Sector from Industry Stakeholders

Chile's mining sector can streamline ESG regulations and align more closely with international standards. Challenges such as water management, tailings management, and biodiversity conservation can drive innovation through stronger policies and climate-adaptive strategies. Progress in indigenous rights, gender equality and sustainable technologies offers a promising path forward. With increased government support and investment, Chile is well-positioned to lead on ESG performance and set a global benchmark.

1) ESG Regulations

- Chile's mining sector faces complex, fragmented permitting processes. While international standards shape ESG practices, misaligned regulations and unclear national frameworks pose challenges.

2) Climate Change & Decarbonisation

- Mining companies are targeting carbon neutrality by 2040, but the shift to electric vehicles and biofuels is hindered by high costs, limited scalability, and insufficient government subsidies.

3) Water Management

- Water scarcity is a critical issue, with companies shifting towards desalination.
- Clearer regulations on desalination impacts, including plant and pipeline siting, are needed, while effective water management is key to positive relations with indigenous communities.

4) Tailings Management

- Tailings pose high risks from dam failures, contamination, and extreme weather. Companies are adopting climate-resilient designs and monitoring, but past incidents highlight the need for stronger oversight and regulation.

5) Social Licence to Operate

- Mining companies prioritise engaging local and Indigenous communities through co-designed solutions and transparency. However, Chilean law lacks clarity on Indigenous land rights and collective protections and, unlike some countries, does not require Free, Prior, and Informed Consent (FPIC).

6) Biodiversity

- Mining near sensitive ecosystems like salars, wetlands and glaciers demands extensive research and investment. Companies integrate biodiversity into sustainability efforts but face challenges from limited data and the need for significant private funding.

7) Gender Equality

- Mining companies are promoting female employment and pay equity, but remote operations and fly-in, fly-out work hinder progress, requiring ongoing efforts and potential government support.

8) Sustainable Investment & Innovation

- Companies are self-funding innovative projects like blue carbon initiatives and decarbonisation technologies, with limited government support.
- Greater international collaboration, research funding, and pilot scheme support are required.

Source: SFA (Oxford)

From Strategic Opportunities to Measurable Outcomes

• Streamline permitting processes to reduce delays and facilitate alignment with international frameworks. • Government can incentivise ESG compliance and promote stakeholder knowledge sharing.	**1) ESG Regulations**
• Increase renewable energy integration by improving infrastructure and reducing connection costs. • Support research and pilot projects on green technologies, promoting stakeholder knowledge transfer. • Promote the adoption of low-carbon technologies through tax incentives or subsidies.	**2) Climate Change & Decarbonisation**
• Establish shared desalination infrastructure among companies. • Fund research on brine reinjection impacts and life-cycle assessments via government or partnerships. • Introduce stricter water use regulations while supporting sustainable water management solutions.	**3) Water Management**
• Implement advanced tailings techniques like dry stacking and incentivise reprocessing through legislation. • Promote global best practices (e.g., GISTM) and foster innovation through public-private partnerships. • Mandate regular monitoring and transparent reporting of tailings facilities.	**4) Tailings Management**
• Establish standardised region-specific consultation toolkits aligned with ILO 169 standards. • Promote government-mediated benefit-sharing frameworks to ensure equitable resource distribution. • Develop ESG and sustainable mining education programs to build trust and foster collaboration.	**5) Social Licence to Operate**
• Mandate lifetime biodiversity monitoring and promote net gain mining operations. • Foster research partnerships to develop innovative biodiversity management solutions. • Enforce land-use planning regulations that balance mining needs with ecosystem preservation.	**6) Biodiversity**
• Provide incentives for companies to hire and retain women, especially in remote operations. • Partner with educational institutions to promote STEM careers among women at an early stage. • Develop programs for female leadership and mentorship within the mining sector.	**7) Gender Equality**
• Foster public-private partnerships to de-risk investments in new operations and renewable technologies. • Facilitate access to advanced technologies and build local innovation and sustainability capabilities. • Establish dedicated funds or incentives to improve ESG practices.	**8) Sustainable Investment & Innovation**

Source: SFA (Oxford)

The findings from research and stakeholder engagements highlight 8 key ESG themes and offer actionable insights to help strengthen Chile's energy transition minerals mining industry. By drawing on its expertise in sustainable mining and ESG best practices, the UK can serve as a valuable partner to Chile, driving shared progress toward a low-carbon future. This partnership presents an exciting opportunity to enhance ESG performance, foster innovation, and create lasting mutual benefits for both countries.

Selected Critical Minerals Regions in Chile

Tarapacá Region: Heavy Reliance on Groundwater Resources

The Tarapacá Region in northern Chile has long played a central role in the country's mining industry. As Chile's second-largest copper-producing region, it produced 673 kt of copper and 4.6 kt of molybdenum in 2023, second only to Antofagasta. In addition to copper, the region has historical ties to nitrate extraction and growing interest in lithium and precious metals.

Major operations such as Collahuasi and Quebrada Blanca drive economic growth while advancing sustainability and ESG practices. Innovations such as seawater desalination and renewable energy integration are helping address water scarcity and environmental concerns. These advances are vital to ensuring that the region's mining legacy remains both responsible and profitable amid evolving industry challenges.

Collahuasi, jointly operated by Anglo American and Glencore, is one of the world's largest copper mines. With estimated reserves of 3.93 billion tonnes of ore at a grade of 0.66% copper, it achieved record production levels, extracting approximately 630 kt of fine copper in 2021. Expansion plans include a US$3.2 billion investment aimed at increasing annual production to 710 kt.

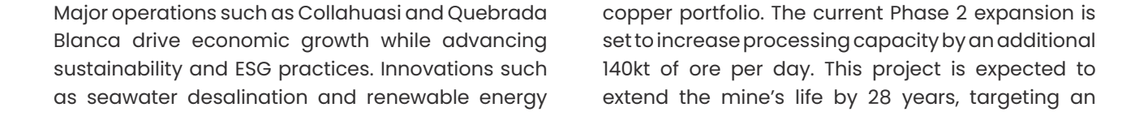
Collahuasi contributes significantly to the local and national economy, accounting for 65.62% of the region's GDP and 2.52% of Chile's overall GDP (2021). The mine has transitioned to 100% renewable electricity and is targeting carbon neutrality by 2040, reducing Scope 1 emissions through technologies such as trolley-assisted trucks and synthetic fuels. The C20+ desalination project, due to be operational by 2026, will secure a sustainable water supply with a 1,050 l/s capacity, complementing a 79% water recycling rate.

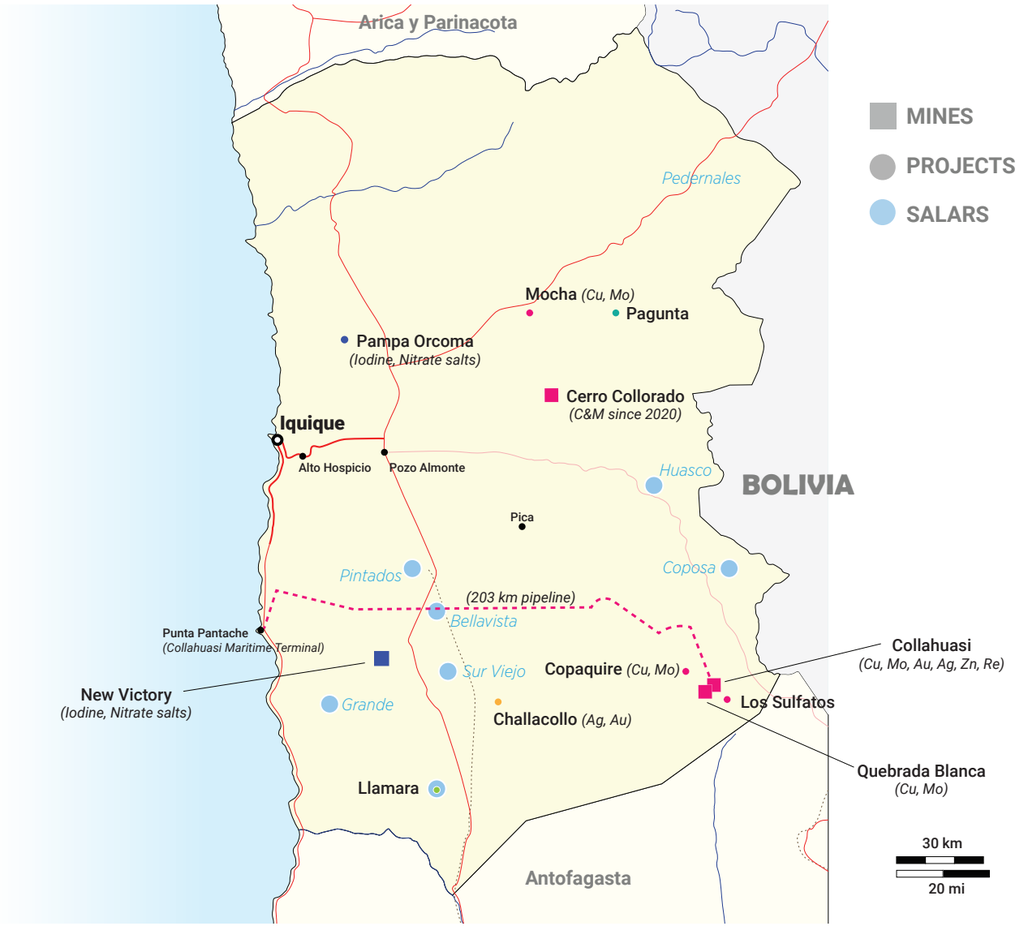
ESG governance at Collahuasi includes supplier evaluations, ethical compliance, and AI-driven safety systems. Community engagement initiatives support local employment, women's health, and entrepreneurship. Waste reduction strategies have achieved a 78.5% recycling rate, and biodiversity programmes focus on wetland restoration and native species replanting.

Operated by Teck Resources, the Quebrada Blanca mine is another pivotal asset in Chile's copper portfolio. The current Phase 2 expansion is set to increase processing capacity by an additional 140kt of ore per day. This project is expected to extend the mine's life by 28 years, targeting an annual production of approximately 316kt of copper during the first five years of operation, further strengthening its role in sustaining Chile's copper output. Significant investments have been made to modernise infrastructure and improve resource efficiency.

In the Tarapacá Region, beyond the well-known challenge of limited continental water resources and the pressures stemming from mining activity, other prominent ESG risks include improper waste handling, inadequate wildlife protection, and broader concerns related to ecological degradation. In response, Teck Resources continues to invest in state-of-the-art water management technologies, biodiversity protection, and is firmly committed to proactive community engagement and emissions reductions.

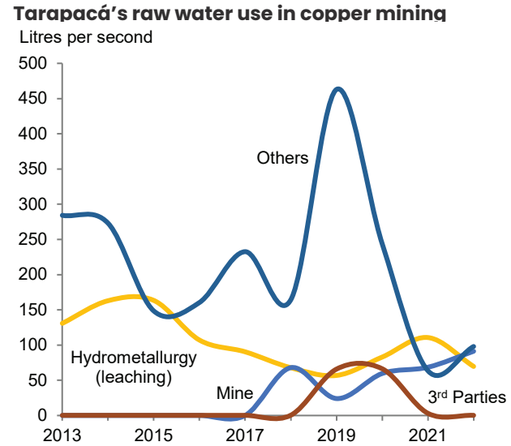
The Tarapacá Region remains a cornerstone of Chile's economic and industrial strength. Major operations such as Collahuasi and Quebrada Blanca demonstrate the region's capacity for high-volume copper production, innovation, and responsible mining. Despite ongoing challenges such as water scarcity, regulatory pressures, and the legacy of environmental impacts from nitrate mining, the region continues to balance economic development with sustainability, setting a high benchmark for the future of mining in Chile.



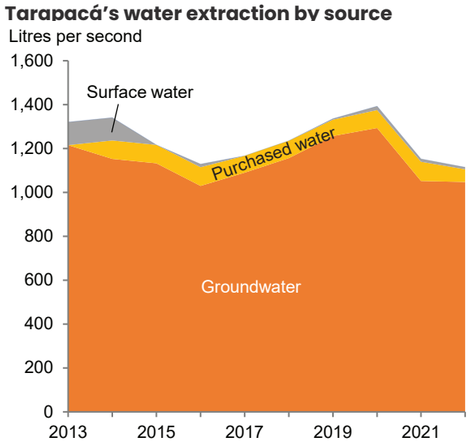


Source: SFA (Oxford)

Tarapacá's raw water use in copper mining



Tarapacá's water extraction by source



Source: SFA (Oxford), Cochilco

Antofagasta Region: Mass Adoption of Desalination Tackling Water Scarcity in World's Largest Copper Mines

The Antofagasta Region, Chile's mining hub, produced 2.9 million tons of copper in 2023, alongside 302 kt of lithium products and 17.8 kt of molybdenum. The region accounts for 87% of Chile's total copper cathode production and 46% of its copper concentrate output, making it the single most important contributor to the country's dominance in global copper markets. A key asset in this region is the Salar de Atacama, of the world's most renowned lithium resources. Major industry players, SQM and Albemarle, operate here. Antofagasta contributes nearly 60% of the nation's copper exports and over 15% of GDP, driving substantial foreign investment and supporting thousands of jobs across the industry.

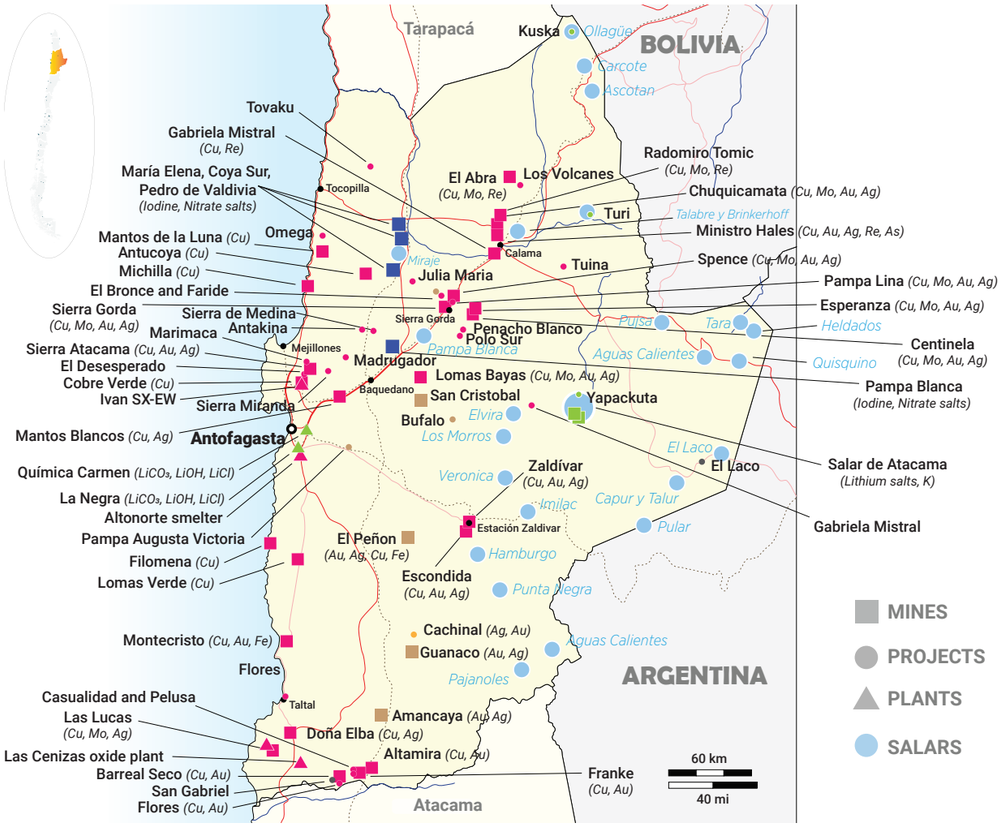
Escondida mine plays a central role in the region. Operated by BHP, Escondida increased its copper production by 16% in 2023, reaching 1.278 million tonnes, securing a 23.2% share of Chile's total copper output. It has eliminated groundwater extraction and transitioned to 100% desalinated seawater use by 2020, a decade ahead of schedule. This $3.4 billion investment in desalination facilities secures water supply while minimising environmental impact. The mine also operates on 100% renewable energy and has committed to reducing its Scope 1 and 2 greenhouse gas emissions by 30% by 2030.

Radomiro Tomic, a key Codelco operation, has an annual output exceeding 300 kt of copper. The mine is advancing its sustainability strategy with a 70% renewable energy target by 2026 and piloting trolley-assisted trucks to cut emissions by 10%. Low-carbon explosives have reduced emissions by 40% compared to conventional methods. Water management is a priority, with plans for a desalination plant to reduce freshwater dependence. However, workplace safety remains a risk shared by the whole mining sector, with a fatal accident in March 2024 prompting new safety measures.

Chuquicamata, one of the oldest copper mines which produced 248 kt of copper in 2023, is undergoing a transition to underground mining at a cost of over $5.7 billion. An additional $1.3 billion was allocated in 2023, with $720 million already approved to upgrade its infrastructure to ensure it can reach its 140 kt per day production rate by 2030. This investment is required to extend the mine life by up to 50 years, though full completion is not expected until 2025. Safety concerns have also emerged, with regulatory sanctions and worker fatalities recorded during construction. However, the mine is integrating enhanced sustainable practices, including stricter health safety management systems, transition to 100% electromobility, thickened tailings management, and the upcoming Caleta Viuda desalination plant to reduce inland water use.

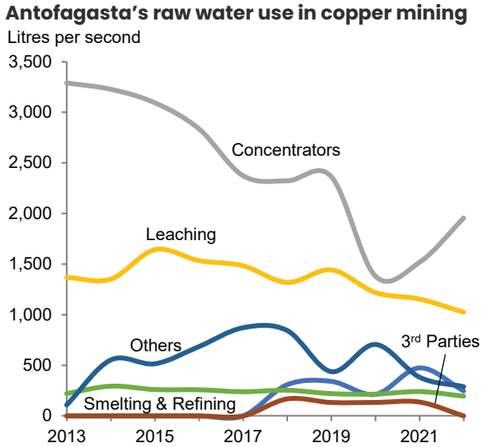
Centinela, operated by Antofagasta Minerals, produced 242 kilotonnes of copper in 2023 and is expanding with the $4.4 billion Centinela Second Concentrator project. This initiative will increase production by 170 ktpa. The mine has fully transitioned to seawater for operations, eliminating reliance on freshwater through a 145-km aqueduct, and runs entirely on renewable energy. The mine is equpped with AI-driven fleet management, and has employed electric vehicles to support its goal of a 50% emissions reduction target by 2035.

The Antofagasta Region remains at the forefront of Chile's mining industry, balancing economic growth with sustainability. Companies operating in the region are making significant investments in water management, renewable energy, and emissions reduction to mitigate environmental risks. While regulatory pressures and social challenges persist, proactive ESG strategies and technological innovation, ensure that the region continues to set global standards for mining.

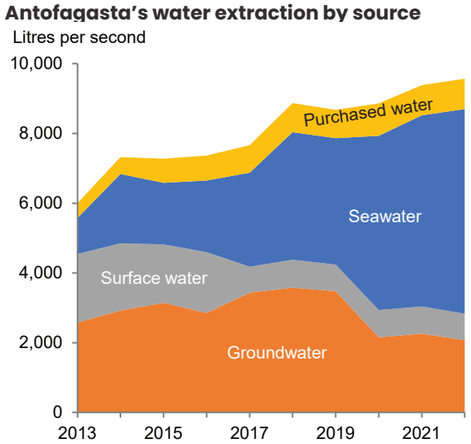


Source: SFA (Oxford)

Antofagasta's raw water use in copper mining



Antofagasta's water extraction by source



Source: SFA (Oxford), Cochilco

Salar de Atacama: Navigating Indigenous Rights Conflicts at the Heart of Chile's Lithium Boom

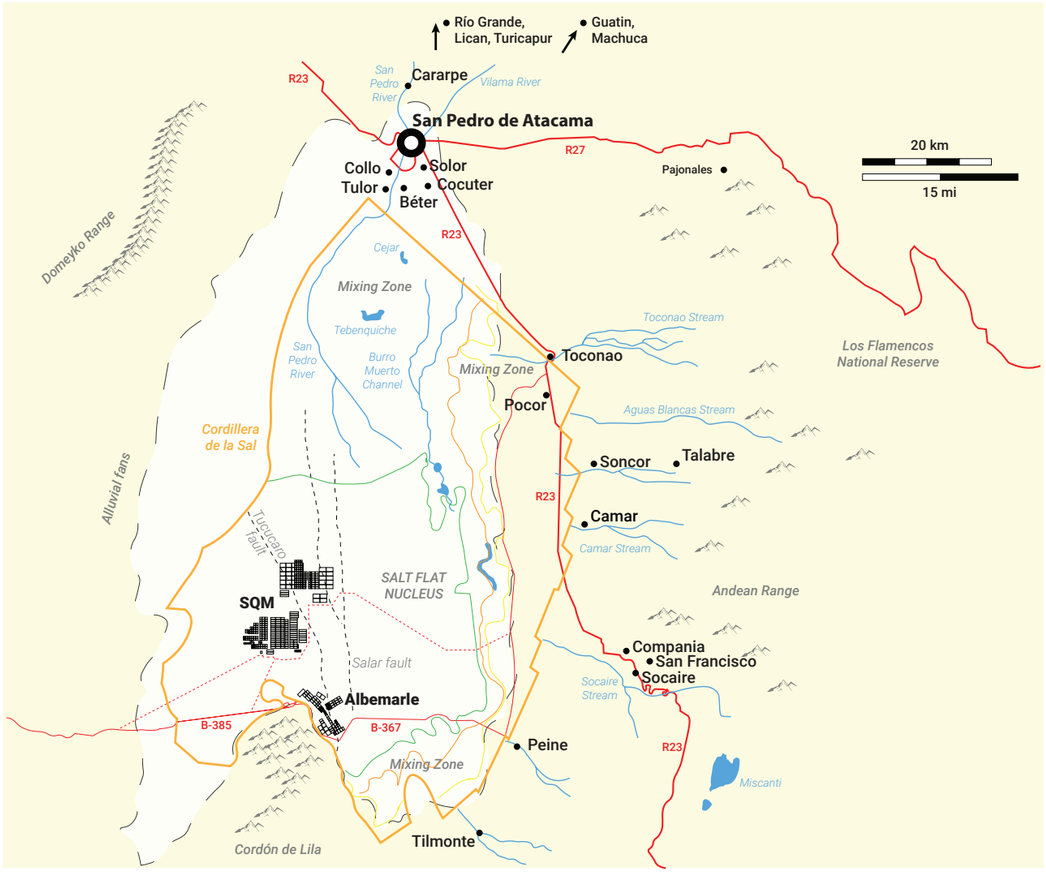
The Salar de Atacama accounts for nearly 90% of Chile's lithium production. This salt flat is globally recognised for its high lithium concentrations and evaporation rates, making it one of the most efficient sources for lithium extraction. Unlike other minerals in Chile, lithium is classified as a non-concessible resource, meaning that extraction rights are granted through Special Operating Contracts (CEOLs) by Supreme Decree from the President of Chile. Currently, the Salar de Atacama is exclusively operated by two producers, SQM and Albemarle, which together produced 302 kt of lithium products (carbonate + sulfate + hydroxide) in 2023. Their contracts with the Chilean government have been renegotiated, extending Albemarle's rights until 2043 and SQM's until 2030, alongside revised agreements that include increased royalties (6.8%–40%) and mandatory R&D investments.

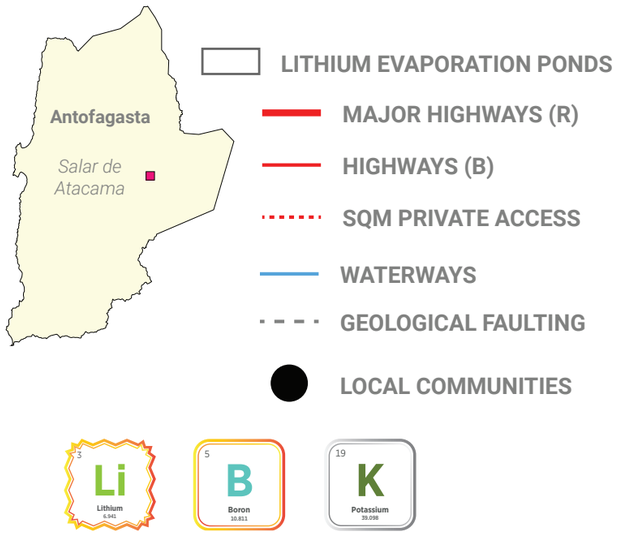
SQM's Química Carmen processing plant near Antofagasta, has an annual production capacity of 200 kt of lithium carbonate and 40 kt of lithium hydroxide. SQM has faced ongoing criticism for its environmental footprint, particularly due to excessive groundwater extraction, which affects local water tables and exacerbates drought conditions in the Atacama Desert. In response, SQM has committed to reducing brine extraction by 50% and freshwater consumption by 65% by 2030. SQM has also pledged to achieve carbon neutrality for lithium production by 2030 and across all operations by 2040, aligning its sustainability goals with international environmental standards.

Albemarle's lithium extraction from the Salar de Atacama is processed at the La Negra facility near Antofagasta, which includes advanced lithium carbonate conversion and water recycling technology. Albemarle has set ambitious ESG targets, including achieving net-zero carbon emissions by 2050, reducing its carbon intensity by 35% by 2030, and cutting freshwater consumption in high-risk areas by 25% within the same timeframe. Under its revised contract, Albemarle has secured the right to extract an additional 262 kt of lithium metal equivalent, reinforcing its long-term presence in Chile's lithium sector while focusing on responsible water management.

The Salar de Atacama mining industry faces significant ESG challenges, particularly concerning water scarcity, ecosystem degradation, and Indigenous community rights. Both SQM and Albemarle operate in the same water basin as local communities, drawing groundwater from depths of 200 to 1,000 metres, which has led to concerns over declining water availability. In response to these issues, Chile's government has launched the National Lithium Strategy (NLS), aiming to increase lithium production by 70% by 2030 while implementing stricter environmental regulations and Indigenous consultation frameworks. The NLS's key initiatives include the adoption of direct lithium extraction (DLE) technology, designation of protected salt flats to protect biodiversity, and mandatory compliance to international standards such as the Extractive Industries Transparency Initiative (EITI).

Looking ahead, the future of lithium production in the Salar de Atacama will be defined by balancing economic expansion with conservation. As global demand for lithium continues to rise, Chile is positioning itself as a leader in responsible lithium extraction through regulatory reforms, technological innovation, and strengthened community engagement. Investments in green energy, improved water efficiency, and Indigenous participation will be critical in ensuring that the region remains a key pillar of the global energy transition while maintaining environmental and social responsibility.





Source: SFA (Oxford), GoogleEarth

Atacama Region: Balancing ESG Challenges in Chile's Most Densely Packed Mining and Processing Hub

The Atacama Region, located in northern Chile, is a critical mining hub, contributing significantly to the country's mineral production. It is Chile's third-largest mining region, producing 444 kt of copper, 4.8 kt of molybdenum, 10.3 million tonnes of iron ore, 6.1 kt of gold fine content and 94.3 kt of silver fine content annually. Additionally, Atacama leads the country in industrial minerals production, exceeding 1 mtpa.

Mining remains the region's economic backbone, generating substantial export revenues and employment. The region also plays an essential role in lithium production due to its proximity to the Salar de Atacama, with well-established infrastructure and logistics hub for the lithium industry.

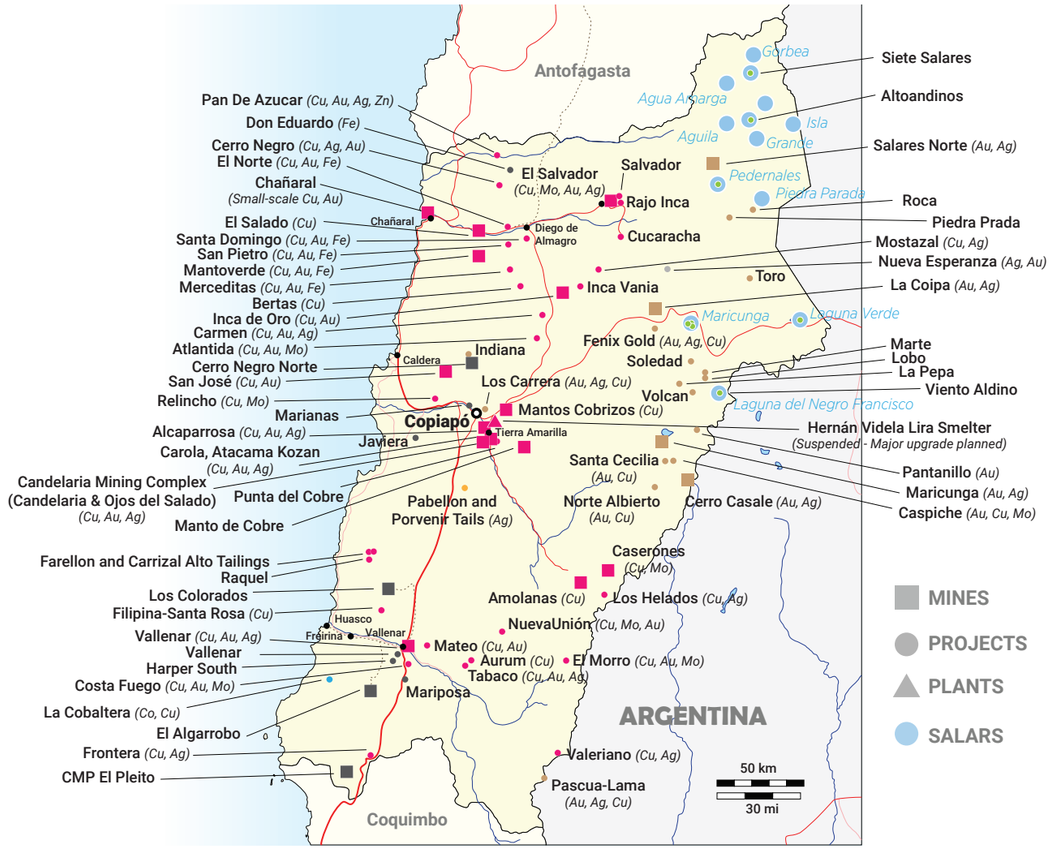
The Candelaria Copper Mining Complex, operated by Lundin Mining, produced 152 kt of copper and 89.700 koz of gold in 2023 as the largest mining complex of the region. Candelaria runs on 80% renewable electricity, reducing Scope 2 emissions, and relies entirely on desalination and recycling. It achieved Copper Mark certification in 2023. However, environmental concerns persist, particularly following the 2022 Alcaparrosa mine sinkhole, which led to a $3.41 million fine and permanent closure in 2025.

Codelco's El Salvador mine, another major copper producer, is undergoing a $1.2 billion expansion through the Rajo Inca project, extending the mine's life while enhancing operational efficiency and environmental compliance. El Peñón, a high-grade underground gold and silver mine operated by Yamana Gold, remains a key contributor to the region's precious metal output, employing modern exploration techniques to extend its reserves. CAP Minería's Los Colorados mine plays a significant role in Chile's iron ore industry, providing high-quality raw materials for domestic and international markets. However, these operations face increasing scrutiny over their environmental footprint, particularly regarding water use and emissions reduction.

The 2010 San José Mine collapse in Atacama, which trapped 33 miners underground for 69 days, was a pivotal moment for Chile's mining industry. The incident exposed critical governance failures, including weak safety regulations, inadequate mine inspections, and poor emergency preparedness. The disaster prompted significant regulatory reforms, leading to increased safety inspections, higher penalties for non-compliance, and improved geotechnical risk assessments. While these measures have strengthened governance, concerns persist over smaller and mid-tier mining operations that may still operate under substandard safety conditions.

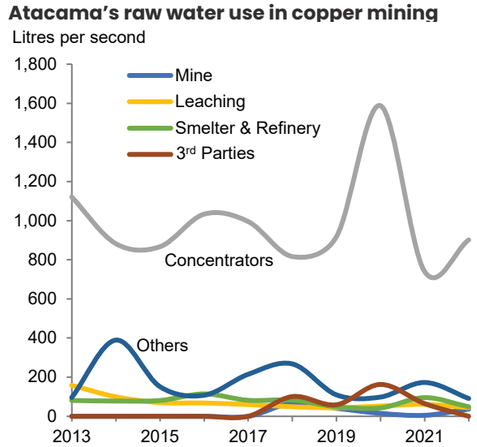
The Atacama Region faces severe ESG challenges, particularly water scarcity and biodiversity risks, as mining operations compete with local communities for limited resources. Desalination plants are essential but struggle to meet demand, heightening social tensions. Industry stakeholders are working to address these legacy issues through new approaches. The Chilean government's National Lithium Strategy (NLS) prioritise addressing these ESG challenges specific to lithium mining in the Atacama Region as well.

Regulatory frameworks now mandate stricter environmental impact assessments and tailings management to mitigate contamination. To sustain its global mining leadership, the region must balance resource development with environmental and social sustainability, ensuring community participation in decision-making. Ongoing investments in sustainable mining technologies and governance improvements will be crucial as regulatory and market demands evolve.

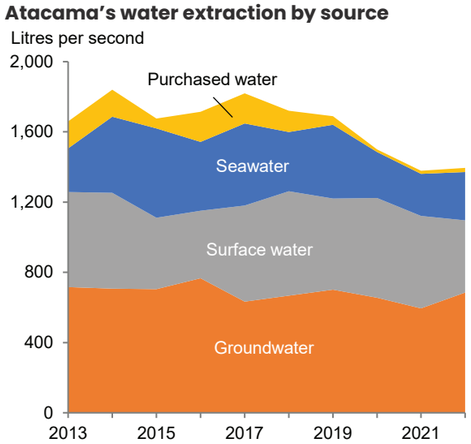


Source: SFA (Oxford)

Atacama's raw water use in copper mining



Atacama's water extraction by source



Source: SFA (Oxford), Cochilco

Coquimbo Region: Strong Dependence on Scarce Freshwater Amid Fragile Ecosystems and Limited Infrastructure

The Coquimbo Region, located in central-northern Chile, has a diverse mining sector dominated by copper, iron ore, and gold production. Unlike the larger mining regions of Antofagasta and Atacama, Coquimbo's mining industry is characterised by medium-scale and artisanal operations, alongside larger projects. In 2023, the region produced 367,500 tons of copper, 8.2 kt of molybdenum, 1.1 million tons of iron, 71.2 kt of silver, and 3 kt of gold concentrates, while also leading in the extraction of over 700 kt tons of industrial minerals. Mining plays a crucial role in Coquimbo's economy, contributing to exports, employment, and regional infrastructure. However, the industry faces significant ESG challenges, particularly regarding water scarcity, community relations, and environmental management.

Los Pelambres Mine, owned 60% by Antofagasta Minerals and 40% by a Japanese consortium, is the largest copper operation in Coquimbo and in 2023 it produced 319.6 kt of copper, 8.1 kt tonnes of molybdenum, and 46.6 koz of gold, benefiting from improved ore processing efficiency. The mine operates at an altitude of 3,100 metres, with ore transported via a 13 km conveyor for processing and later shipped from Los Vilos port.

ESG challenges at Los Pelambres primarily revolve around water scarcity, tailings management, and community engagement. To address these, a 400 litres-per-second (l/s) desalination plant was completed in 2023, with plans approved to expand capacity to 800 l/s by 2027, aligning with Antofagasta's goal of sourcing 90% of its water from seawater or recycled sources. The Phase 1 expansion added a fourth concentrator line, increasing processing capacity to 190,000 tonnes per day (tpd), with further plans to reach 205 ktpd.

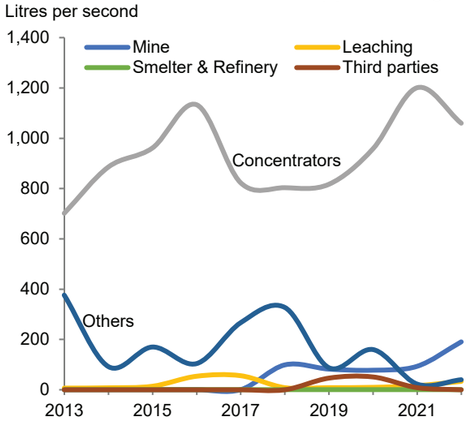
Los Pelambres mine operates on 100% renewable energy, while electrification initiatives include trials of electric haul trucks and auxiliary equipment. Biodiversity conservation efforts cover 27,440 hectares, with reforestation projects at Los Quillayes tailings facility and marine conservation efforts near the port. Los Pelambres received the Copper Mark certification in 2022, confirming its commitment to responsible mining and the UN Sustainable Development Goals (SDGs).

Beyond Los Pelambres, Coquimbo hosts several other key mining operations. The Andacollo Mine, operated by Teck Resources, is an important copper-gold operation, producing concentrates and cathodes. El Romeral, run by CAP Minería, plays a major role in Chile's iron ore industry, supplying both domestic and export markets. However, these operations face significant ESG risks, particularly groundwater depletion, emissions, and tailings management. Coquimbo's reliance on surface and groundwater for mining increases tensions with local communities, as no significant shift toward desalinated water use has been observed. Regulatory pressures have intensified, requiring enhanced water management and lower emissions.

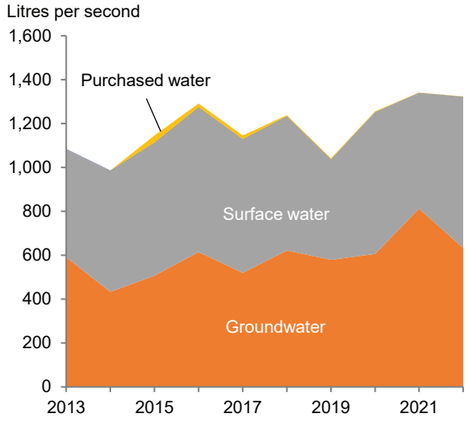
The Coquimbo Region exemplifies the delicate balance between mining development and environmental sustainability. Investments in desalination, renewable energy, and biodiversity restoration reflect the industry's response to ESG challenges. Community engagement programmes, ethical labour policies, and innovation in water management will be key to securing the region's long-term viability as a responsible mining hub.

Source: SFA (Oxford)

Coquimbo's raw water use in copper mining



Coquimbo's water extraction by source



Source: SFA (Oxford), Cochilco

Chile's ESG Challenges, Solutions, Case Studies and Best Practices

As Chile's mining industry navigates an evolving global landscape, sustainability, regulatory alignment, and innovation are becoming increasingly critical. Strengthening ESG standards, addressing climate-related challenges, improving water and tailings management, and fostering social acceptance are all essential to ensuring long-term investment confidence and responsible resource development.

Additionally, advancing gender equality, promoting biodiversity conservation, and accelerating sustainable investment and innovation will shape the sector's future. However, several challenges hinder ESG progress in Chile's mining sector, creating uncertainty for investors and industry stakeholders.

The following sections outline key challenges and opportunities across eight critical areas for Chile's mining industry:

1) ESG Regulations

Chile boasts a globally respected mining regulatory framework. However, evolving ESG expectations present opportunities to enhance regulatory efficiency and align with international standards. Chile's mining sector has undergone rapid transformation, driven by a robust ESG regulatory structure anchored in the National Mining Code and the Environmental Impact Assessment System (SEIA). Recent initiatives, including the Mining Royalty Law (2024) supporting economic redistribution to mining communities, the National Lithium Strategy, the New Tailings Agenda (2025-2026), updated cybersecurity laws, and improved pre-investment consultations, reinforce this progress. Key issues and potential opportunities include:

- **Investment stability is at risk with sharp policy changes like the National Lithium Strategy (NLS)**. Bipartisan agreements would enhance investor confidence and long-term planning.
- **ESG adoption is investor-led rather than by regulation, leading to inconsistencies**. Stronger enforcement could create a level playing field. While high ESG standards exist, enforcement remains uneven. An independent regulator with auditing powers, third-party verification, and a balanced system of incentives and penalties could enhance compliance. **Indigenous consultation varies by case**, complicating stakeholder management and delaying projects. Clear, standardised guidelines would improve engagement and reduce legal uncertainties. **The absence of Free, Prior, and Informed Consent (FPIC) in Chilean law contributes to unresolved Indigenous land rights issues**. This gap adds further complexity to project development and stakeholder negotiations.
- **Overlapping mandates across government entities can lead to regulatory complexities**. Enhancing inter-agency coordination could help align frameworks and improve clarity. Additionally, streamlining permitting processes through a centralised digital system could enhance efficiency.
- **Enhancing the public-private partnership to bridge ESG regulatory gaps**, improve governance in the mining sector, and align national regulations with international frameworks, while addressing regulatory complexities and inefficiencies, particularly in permitting and environmental assessments that pose operational risks.
- **Voluntary ESG adoption leads to uneven implementation.** Standardised compliance mechanisms aligned with global best practices would create uniformity across operators.
- **Stronger ESG compliance requirements for water management and tailings disposal**, though enforcement mechanisms remain weak.
- **Smaller mining companies struggle with ESG compliance due to resource constraints**. Standardised compliance mechanisms would help bridge disparities.
- **Limited access to environmental and operational data restricts stakeholder oversight**. A national mining transparency platform would improve data accessibility and accountability.

Best Practice Examples in ESG Regulations for Chile's Mining Sector

The following case studies on Tailings Management, Cybersecurity Regulations, Australia's Critical Minerals Tax Incentives, and the UK's Biodiversity Net Gain Framework highlight impactful global practices for strengthening Chile's mining sector. These examples offer clear strategies to enhance regulatory efficiency, drive innovation, and reinforce Chile's global leadership.

Strengthening Tailings Management

Chile's approach to tailings dam management has evolved significantly, driven by progressive regulations focused on safety and sustainability. Building upon the National Plan for Tailings Deposits for Sustainable Mining (2021), the Tailings Agenda 2025–2026 introduces structured governance frameworks, circular economy incentives, and enhanced monitoring mechanisms. It prioritises stakeholder engagement, risk mitigation, and explores economic opportunities through tailings reprocessing and reuse. Key initiatives under this agenda include digitalising tailings inventories, providing regulatory incentives for reprocessing, and establishing clear legal frameworks for managing abandoned sites. Strengthening these measures ensures Chile maintains ESG leadership and sustainable tailings governance.

Cybersecurity Regulations for Mining Operations

Recognising the critical importance of cybersecurity in mining, Chile has established itself as a regional leader in digital risk management. Under the Framework Law on Cybersecurity and Critical Information Infrastructure (2024), mining is designated as an essential service, requiring companies to implement robust security measures. The National Cybersecurity Policy 2023–2028 further promotes collaboration between public and private sectors to enhance infrastructure resilience and data protection. In response, major mining firms have proactively established the Mining Cybersecurity Corporation, reinforcing sector-wide resilience. These advancements position Chile as a global model for digital security in resource industries.

Australia's Mineral Production Tax Incentives

On 11 February 2025, the Australian Parliament passed legislation introducing two major tax incentives, the Critical Minerals Production Tax Incentive (CMPTI) and the Hydrogen Production Tax Incentive (HPTI) under its 'Future Made in Australia' policy.

The CMPTI provides a 10% refundable tax offset for eligible processing and refining costs of critical minerals such as lithium, cobalt, and rare earth elements, while the HPTI offers a refundable tax offset of $2 per kilogram of renewable hydrogen produced for up to 10 years. Together, these incentives promote domestic processing, reduce import dependency, and improve economic resilience.

Chile can look to Australia's approach as a useful policy example to attract greater investment in downstream industries. By adopting similar tax incentives for lithium and copper processing, Chile can bolster supply chain security.

Advancing Biodiversity Protection

The UK's Biodiversity Net Gain (BNG) framework, which mandates at least a 10% biodiversity increase through structured restoration and offset measures, incentivises proactive conservation and provides a valuable model for integrating biodiversity protection into Chile's mining regulations. Developers follow a clear hierarchy: first minimising on-site impacts, then offsetting residual losses through biodiversity credits, and finally resorting to government-issued credits only if necessary.

Chile could adapt this framework to complement its existing environmental impact assessment processes aligning with international best practices. Implementing a similar system would reinforce Chile's environmental commitments.

2) Climate Change and Decarbonisation

As the global push for net-zero emissions accelerates, the mining industry faces increasing pressure to decarbonise. Given the energy-intensive nature of mineral extraction, reducing carbon emissions is a significant challenge, yet it remains important for ensuring long-term sustainability and global competitiveness. In Chile, mining companies have set ambitious carbon neutrality targets, but progress is hindered by regulatory gaps, infrastructure limitations, and the high costs of alternative energy solutions.

Several key challenges and opportunities are shaping Chile's mining sector decarbonisation pathway:

- **The mining sector's decarbonisation efforts remain largely voluntary**, as there are no formal mandates requiring emissions reductions at the permitting stage. Integrating decarbonisation commitments into permitting processes would ensure emissions reductions become a core component of project development. Encouraging sector-wide collaboration on decarbonisation strategies would enhance knowledge sharing and best practice implementation.
- **Reliance on diesel-powered mining trucks remains a major barrier to decarbonisation**, as alternative fuel solutions are still costly and inefficient. Expanding renewable energy infrastructure and improving transmission links to mining operations would enhance access to low-carbon energy.
- **Minerals processing have high and increasing energy demands**, and transitioning to renewable energy is constrained by infrastructure limitations, particularly in connecting remote sites to clean power grids. Transportation is also a significant barrier to achieving net-zero targets. Targeted incentives for solar, wind, green hydrogen, and battery-electric fleets would accelerate adoption.
- **The lack of a standardised framework for Scope 3 emissions measurement, which account for indirect carbon impacts along the supply chain makes carbon accounting difficult**. Establishing clear reporting mechanisms and engaging suppliers in emissions reduction efforts would enhance transparency and accountability.
- **The cost of transitioning to low-carbon technologies often falls entirely on companies due to limited government incentives.** This financial burden is especially challenging for mid-sized and smaller mining operations when shifting to electric or hydrogen-powered fleets. Strengthening public-private partnerships and providing financial support could help alleviate these challenges, and accelerate their adoption.
- **Extreme weather events such as droughts and floods increasingly disrupt mining operations**, requiring adaptive strategies to mitigate climate risks. Collaborative research and investment in resilience strategies would better prepare companies for these challenges.
- **Strengthening partnerships with global stakeholders would facilitate technology transfer and investment in low-carbon solutions**, supporting Chile's mining sector in achieving its climate goals.

Effective decarbonisation and adoption requires stronger policies, targeted incentives, and closer industry-government collaboration. Accelerating the transition to renewable energy and sustainable practices will not only reduce Chile's mining sector's environmental impact and climate risks but also position it as a global leader in mining.

Codelco's Scope 3 Emissions Accounting – A Best Practice

Codelco aims to reduce its Scope 3 emissions by 25% by 2030, with a focus on strategic operational inputs. This includes indirect emissions from the value chain (suppliers) and builds upon the Corporation's previous commitment to cutting its total carbon footprint by 70% by 2030. **Scope 3 emissions make up more than 60%** of Codelco's total emissions, covering those generated before materials reach the mining operation, as well as those produced after products, such as cathodes, are sold and processed by end customers.

Codelco's Scope 3 GHG emissions calculation tool is a groundbreaking initiative aimed at **increasing transparency** in the mining sector. Scope 3 emissions, those generated across the entire supply chain are among the hardest to measure and reduce. This tool plays a vital role in advancing decarbonisation efforts. By establishing a standardised, verifiable approach to Scope 3 emissions reporting and ensuring its widespread adoption, the Codelco's tool enhances accountability, improves tracking accuracy, and promotes more sustainable supply chains, bringing Chile's mining industry closer to its decarbonisation goals.

One of the key strengths of the tool is its alignment with international standards, ensuring credibility and consistency in emissions reporting. It follows the **NCh-ISO 14067** framework for product carbon footprint assessments, incorporates the **ICA Carbon Neutrality Roadmap**, and adheres to the **ICMM Scope 3 Guide**, which sets out best practices for emissions tracking in the mining industry. This alignment makes the tool a reliable benchmark for the sector, allowing mining companies to integrate it seamlessly into their sustainability strategies.

To maintain accuracy and prevent greenwashing, Codelco's tool includes **third-party data verification**, ensuring that emissions reports are both reliable and comparable across suppliers. Additionally, **training programmes** have been implemented to help suppliers develop the technical expertise required to measure and report their emissions effectively. These initiatives enhance data quality and foster a culture of environmental responsibility throughout the mining value chain.

A significant milestone in the tool's development has been its **integration into Chile's national GHG accounting framework**. Through collaboration with Huella Chile and Corporación Alta Ley, Codelco's methodology has been adopted as a national standard for emissions tracking in the mining industry. The Consejo Minero, Chile's national mining association, has also endorsed the tool, further reinforcing its credibility and encouraging its widespread adoption.

The impact of the tool is already evident. **Reported Scope 3 emissions in the mining sector increased from 52 $ktCO_2e$ in 2021 to 6,333 $ktCO_2e$ in 2023**. This rise reflects an improvement in emissions tracking rather than an actual increase in emissions, demonstrating how the tool has enhanced data collection and reporting accuracy. Additionally, by requiring key suppliers, such as those providing **steel milling balls, lime, explosives, reagents, and fuels** to report emissions using this tool, Codelco has significantly improved **supply chain emissions transparency**.

Beyond individual company efforts, Codelco's tool has also **influenced national policy**. Its incorporation into Chile's Huella Chile initiative aligns government regulations with industry needs, creating a unified approach to emissions reduction. Furthermore, it supports the broader objectives of **Chile's National Mining Policy 2050** and complements the carbon neutrality commitments of major mining companies **such as Anglo-American, BHP, and Antofagasta Minerals**.

3) Water Management

Water scarcity poses a significant challenge for Chile's mining sector, particularly in arid regions where mining operations cannot depend solely on surface- or groundwater extraction, and increasingly rely on desalination. While desalination provides a viable alternative to groundwater extraction, its high costs, regulatory uncertainties, and environmental concerns require careful management. Strengthening policies, enhancing industry collaboration, and promoting sustainable practices will be essential to ensuring long-term water security.

Chile is among the most water-stressed countries globally, with water availability declining by 10–37% over the past three decades. The country's copper and lithium mining sector, concentrated in arid northern regions, is a major consumer of limited freshwater resources, with 94% of operating mines and 93% of planned projects located in areas of high or very high water scarcity risk. Mining operations in these regions account for approximately 80% of available water use, exacerbating tensions with local communities and regulators. While desalination offers a more sustainable alternative, its adoption is often constrained by costs of $5–8/m³, significantly higher than the $0.5–1/m³ cost of groundwater extraction. Additionally, evolving regulations on desalination and brine discharge contribute to operational uncertainty.

Key challenges and opportunities in water management include:

- **Water scarcity and climate variability**, including droughts and shifting rainfall, are driving greater reliance on desalination and sustainable water solutions, requiring adaptive and resilient management strategies.
- **Enhancing regulatory clarity, enforcing adoption of sustainable water policies, and industry collaboration on desalination, brine reinjection, and water allocation** will help manage water risks, ensuring equitable access, and support responsible usage, and ensure long-term environmental and operational stability.
- **Managing operational costs and environmental concerns** around water use remains a priority, particularly in balancing groundwater extraction with conservation efforts.
- **Public and investor pressure for ESG** compliance is driving mining companies to adopt more transparent and responsible water management practices.
- **Engagement with Indigenous communities** is key to addressing concerns over brine reinjection and its potential impact on hydrogeological systems.
- **Protecting fragile ecosystems**, such as the Atacama Desert, requires stringent water management to ensure long-term ecological balance.
- **Developing shared desalination infrastructure** could optimise water use and reduce costs, but better coordination and investment are needed.
- **Advancing water recycling and brine reinjection technologies** is critical for long-term sustainability but requires stronger financial and regulatory support.
- **Improving hydrological data-sharing, real-time monitoring, and predictive modelling** will enhance water resource management and risk mitigation across mining regions.

Clearer regulations, stricter enforcement of sustainable water policies, and improved collaboration are critical for managing water risks effectively while ensuring long-term environmental and operational stability.

BHP Escondida – Best Practice in 100% Desalination Water Supply

BHP's Escondida mine in Chile sets a benchmark for sustainable water management, demonstrating how large-scale mining can **transition to 100% desalinated water with a $3.4 billion investment in a 2,500 l/s desalination plant at Puerto Coloso, Antofagasta commissioned in 2018**. Facing water scarcity and ESG pressures, BHP's strategic shift proves that responsible water stewardship is viable.

BHP's **Water Stewardship Strategy** focuses on sustainable sourcing, efficiency, and stakeholder engagement. Key initiatives include replacing groundwater with desalination, maximising water efficiency through recycling and reuse, promoting sustainable governance via collaboration, and enhancing transparency through public reporting. The elimination of continental freshwater extraction at Escondida highlights BHP's long-term commitment, supported by phased investment in desalination infrastructure.

Before desalination, Escondida's heavy groundwater reliance sparked significant regulatory and community backlash. The mine had long extracted water from the Monturaqui, Tilopozo, and Punta Negra aquifers, key sources for local ecosystems and communities. In 2023, **Chilean authorities fined BHP $8.2 million** for environmental damage linked to excessive groundwater extraction at Escondida, the largest water-related fine in the nation's history. Local communities and environmental groups protested against groundwater depletion, citing ecosystem degradation and water insecurity, particularly in Ramsar-protected wetland areas.

These regulatory and social pressures accelerated BHP's desalination investment, reinforcing the necessity of sustainable water sourcing to maintain its operating licence and corporate reputation.

Escondida's transition to 100% desalinated water **sets a precedent for responsible mining** in water-scarce regions. The desalination plant encompassed two 42-inch pipelines to transport water to an elevation of 3,200 meters above sea level, along with four high-pressure pumping stations, a reservoir at the mine, and high-voltage electricity infrastructure to power the system, and the builds upon BHP's first 525-l/s plant, commissioned in 2006.

Large-scale mining can **eliminate groundwater reliance**, reducing environmental and social conflicts; desalination, despite high costs, Transparent stakeholder engagement is essential for sustainable water management.

Looking ahead, **desalination has the potential to transform Chile's mining and public water sectors**. Lessons from Escondida's large-scale implementation can help lower CAPEX and OPEX, drive broader adoption, and support water-stressed regions beyond mining. Expanding shared infrastructure could reduce financial and ESG risks while encouraging policy incentives for investment and permitting. As water scarcity intensifies, **BHP's model offers a blueprint** for sustainable mining, enabling operators to future-proof operations while upholding environmental and social responsibility.

Source: IM-Mining

Source: BHP

4) Tailings Management

Chile's mining industry, particularly its copper sector, faces significant ESG challenges related to tailings management. With 795 tailings deposits nationwide, 475 inactive and 176 abandoned, tailings storage facilities (TSFs) pose long-term risks, including soil contamination, acid mine drainage (AMD), biodiversity loss, and dam failure hazards. Historically, economic constraints led to the widespread use of upstream dam construction, contributing to major failures such as the 1928 Barahona and 1965 El Cobre collapses. More recently, global incidents like the 2019 Brumadinho disaster have heightened regulatory scrutiny and the demand for safer, more sustainable solutions.

Chile's mining sector generates ~600 million tonnes of tailings annually, yet waste remains largely an environmental liability. Regulatory gaps, technical challenges, and limited incentives prevent large-scale adoption of circular tailings applications.

Effective tailings management is critical to minimising environmental risks and ensuring the long-term sustainability of Chile's mining sector. However, historical tailings, climate change-driven threats, and regulatory inconsistencies present ongoing challenges. Strengthening monitoring, improving enforcement, and leveraging international expertise can enhance industry best practices and mitigate risks.

Key challenges and opportunities in tailings management include:

- **Financial and regulatory barriers present major obstacles, as high costs and fragmented enforcement limit the adoption of sustainable tailings management solutions**. Promoting tailings reprocessing and providing financial support could drive sustainable waste management.
- **Climate change and infrastructure resilience pose increasing concerns**, as extreme weather events heighten tailings dam failure risks, necessitating more resilient infrastructure. Increased investment in predictive risk management and real-time monitoring can enhance geotechnical stability.
- **Environmental and social concerns require proactive strategies and transparency, as acid mine drainage, facility closure planning, and public perception issues continue to impact the industry**. Leveraging international expertise, shared infrastructure, and proactive community involvement can build industry resilience and trust.
- **The implementation of best-practice tailings management frameworks, such as the Global Industry Standard on Tailings Management (GISTM), is progressing but requires further alignment across operators**. Expanding the GISTM framework implemnentation can enhance best practices.
- **Reprocessing tailings for valuable minerals presents a key opportunity to advance circular economy practices, particularly relevant to Chile's resource-based economy**. Providing targeted incentives and fast-tracked permits for legacy tailings dams will advance Chile's circular economy goals.
- **Strengthening regulatory oversight of tailings storage facilities would enhance long-term environmental protection.** Enhancing regulatory enforcement and risk assessment frameworks would strengthen environmental safeguards.
- **Public perceptions of tailings management have been shaped by past incidents, underscoring the importance of transparency and proactive communication**. Engaging communities in tailings management planning would build trust and support social licence to operate.
- **Risk-based planning for tailings facility closure could enhance long-term environmental and social outcomes.** Developing mandatory closure planning guidelines that incorporate risk assessments, long-term monitoring commitments, and community input would ensure responsible decommissioning and post-closure land use.

A stronger regulatory framework, increased investment in advanced waste disposal solutions, and greater international collaboration will enhance tailings management, reducing environmental risks social risks and improving industry resilience.

Best Practices in Tailings Management in Chile

Innovations in risk mitigation, economic value creation, circularity applications and policy shifts are driving improvements. Strengthened governance, real-time risk monitoring, tailings reprocessing, and circular economy initiatives are transforming waste into economic opportunity.

Chile has advanced its tailings management strategy under **Tailings Agenda 2025/2026**, focusing on dam safety and risk assessment, reprocessing tailings for mineral extraction, and driving circular economy applications. These approaches mitigate ESG risks while unlocking economic value.

While Chile has improved TSF regulations, **enforcement remains inconsistent**, and climate risks further complicate safety management. Many legacy TSFs lack ownership clarity, making risk mitigation and remediation difficult. In response, Chile has launched publicly accessible tailings databases and advanced monitoring tools.

Following investor-led pressure after Brumadinho, the Global Tailings Management Initiative (GTMI) commissioned the **UK's Satellite Applications Catapult** to create an open-access, satellite-mapped database of global TSFs. In 2025, Chile's National Geology and Mining Service (Sernageomin) launched the country's **first national TSF database**, mapping all known tailings facilities. This initiative integrates AI-powered monitoring and predictive risk assessments, improving transparency, emergency planning, and regulatory oversight.

Chile's **tailings deposits contain valuable metals**, including copper, REEs, and cobalt, yet remain largely underutilised. High capital costs, technical challenges, and unclear regulatory frameworks hinder large-scale adoption of reprocessing technologies.

EcoMetales, a subsidiary of Codelco, is at the forefront of tailings reprocessing for copper, iron, and rare earth elements (REEs). By recovering valuable minerals from waste, the company reduces environmental contamination while enhancing resource efficiency. In collaboration with Chile's economic development agency, Corfo, EcoMetales co-finances projects that demonstrate the technical and economic feasibility of tailings reprocessing, fostering innovation in sustainable mining.

SecMinTec, a German-Chilean partnership between Freiberg University and Universidad de Concepción, is developing hydrometallurgical technologies to extract cobalt, nickel, and REEs from inactive tailings. Beyond resource recovery, the initiative tackles acid mine drainage (AMD) using slag leaching and ion-exchange technologies, offering a sustainable solution to one of mining's most persistent environmental challenges.

Anglo American & Chile's Public Works Ministry – Mining Waste Roads: Anglo American pioneered the construction of a 500-metre road near the Los Bronces mine using over 95% tailings and slag. Conducted in collaboration with Chile's General Directorate of Public Works, this project demonstrated the feasibility of repurposing mining waste for infrastructure applications. The success of this pilot has prompted further research into scaling the approach for road networks, airport runways, and other public works.

5) Social License to Operate

Maintaining a strong social license to operate is essential for the long-term success of Chile's mining sector. Community trust and acceptance are built through equitable economic benefit-sharing, transparent governance, and meaningful engagement with Indigenous groups. However, historical grievances, inconsistent consultation, and local employment challenges continue to fuel opposition to mining projects. Strengthening transparency and fostering inclusive community partnerships will be key to ensuring sustainable operations.

Key challenges and opportunities in securing a social license to operate include:

- **Greater transparency in environmental and economic impacts** is essential to reinforcing trust and securing long-term operational stability with the potential to leverage digital technologies for real-time impact monitoring.
- **Public trust in large mining firms remains lower than in mid-sized operators**, underscoring the importance of enhanced governance and accountability measures that could differentiate companies through responsible leadership.
- **Profit-sharing with Indigenous groups is increasing**, but greater transparency in distribution is needed to build confidence and accountability offering a chance to establish clearer, standardised frameworks for equitable economic participation.
- **Community concerns linked to past economic inequalities** highlight the need for more transparent and inclusive benefit-sharing frameworks, creating opportunities for innovative economic partnerships that drive sustainable community development.
- **Addressing cumulative social and environmental impacts** by considering broader regional effects rather than isolated project-level assessments can enhance long-term planning and multi-stakeholder collaboration for sustainable regional development.
- **Strengthening community resilience to economic fluctuations** through diversification strategies can reduce dependence on mining revenues.
- **Gaps in Indigenous engagement and consultation** provide an opportunity to develop more structured and equitable partnerships.
- **Increasing the accessibility and responsiveness of corporate social responsibility (CSR)** initiatives can improve local engagement and trust, with opportunities to co-develop programmes that directly address community needs and aspirations.
- **Targeted investment in workforce development and training** initiatives can address local hiring challenges due to skills shortages.
- **Integrating local perspectives into project design and decision-making processes,** as well as A growing corporate focus on social value strategies can help align mining operations long-term success is closely tied to community well-being and local priorities.

Strengthening these areas will not only mitigate risks but also unlock long-term value for all stakeholders. Open dialogue, fair resource distribution, and inclusive decision-making will drive innovation, foster stability, and ensure a more sustainable and prosperous future for the industry and local communities alike.

Kuska Lithium Project – Indigenous Rights Best Practice

Drawing on its Canadian experience in Indigenous engagement, Wealth Minerals has developed a forward-thinking framework for sustainable resource development in Chile. The Kuska Lithium Project exemplifies this approach, **optimising Indigenous rights management through pre-investment benefit-sharing, stakeholder collaboration, and governance inclusion**.

Chile's mining sector, particularly lithium and copper extraction, has long struggled to maintain a Social Licence to Operate (SLO). Indigenous communities frequently contest resource exploitation, citing concerns over land and water. While Chile's legal framework mandates pre-investment consultations under ILO 169, it often lacks the flexibility needed for meaningful collaboration. This **rigid, risk-focused approach** leaves legacy issues unresolved and fails to establish structured benefit-sharing, fostering mistrust, conflicts, and project delays.

The Kuska Lithium Project redefines best practice by **prioritising early Indigenous engagement, transparent governance, and long-term benefit-sharing**. Unlike many Chilean mining projects that engage Indigenous communities reactively, Wealth Minerals took a proactive approach, integrating Indigenous participation from the outset. The company addressed key concerns such as water rights and benefit-sharing early in project planning. Although Chile lacks constitutional Free, Prior, and Informed Consent (FPIC) provisions, Wealth Minerals voluntarily upheld and applied FPIC principles, ensuring Indigenous stakeholders played a meaningful role in decision-making, strengthened SLO and mitigated legal and reputational risks that have stalled other mining developments.

A key pillar of Kuska is its **pioneering joint venture with the Quechua Indigenous Community of Ollagüe (CIQO)**, embedding Indigenous representation in governance. Under this agreement, CIQO holds a 5% free-carried interest, ensuring direct economic participation, while Indigenous representatives sit on the Board of Directors, shaping project decisions rather than serving token roles. This structured model fosters trust, aligns community interests with long-term project sustainability, and significantly reduces the risk of disputes and delays.

The Kuska Lithium Project demonstrates how global best practices in Indigenous engagement and ESG risk management can be adapted to local contexts. While it does not replace Chile's formal consultation process, it **offers a constructive way** to navigate what is often a bureaucratic, slow, and conflict-prone system. By adopting a proactive, partnership-driven model, the project has shown that more stable outcomes are possible. This approach could also serve as a blueprint for sustainable resource development in other regions facing similar Indigenous rights challenges.

Beyond its immediate impact, Kuska highlights the business case for **integrating Indigenous communities into project planning and governance**. Through its transparent approach in sharing the Kuska agreement, the company is paving the way for broader adoption of this model, fostering greater trust and stability in Chile's mining sector.

6) Biodiversity

Preserving biodiversity is a critical challenge for Chile's mining sector, particularly in ecologically sensitive areas such as glaciers, salt flats, the Atacama Desert, and high Andean wetlands. While regulatory frameworks mandate conservation efforts, inadequate biodiversity mapping, weak enforcement, and limited government incentives place much of the responsibility on mining companies. Strengthening reclamation policies, enhancing scientific collaboration, and aligning with global biodiversity commitments will be essential for sustainable resource development. Long-term environmental commitments from both industry and government are crucial to preventing ecosystem degradation.

Key challenges and opportunities in biodiversity management include:

- **Mining operations near ecologically sensitive areas** require significant environmental mitigation measures, reclamation policies and long-term conservation commitments to prevent lasting damage and ensure ecological stability.
- **Enhancing biodiversity mapping and monitoring** through advanced data collection, including eDNA technology, can improve compliance and conservation effectiveness to meet with regulatory mandates.
- **Stronger government incentives**, such as tax benefits and biodiversity investment frameworks, would encourage industry participation in large-scale conservation efforts, easing the burden currently placed on mining companies.
- **Aligning the mining sector with global biodiversity commitments**, including Chile's pledge under the Kunming-Montreal Global Biodiversity Framework to protect 30% of its land and sea by 2030, requires proactive industry engagement.
- **Sustainable water and tailings management**, supported by stricter policies on groundwater conservation and waste containment, is critical to limiting ecosystem degradation.
- **Effective habitat conservation and species protection** depend on stronger reclamation policies and sustained environmental commitments from both industry and government.
- **Collaborating with international research institutions** offers opportunities to refine biodiversity assessment models and develop more effective conservation strategies.
- **Global partnerships in biodiversity monitoring and ecosystem management** could support Chile's broader conservation objectives.

Enhancing biodiversity management through robust policies, scientific collaboration, and global best practices will enable Chile to achieve sustainable mining while protecting its unique ecosystems. With the right strategies in place, the sector can contribute to a future where economic development and ecological preservation go hand in hand.

Anglo American's eDNA Biodiversity Monitoring Technology

Anglo American, a global leader in mining, has set a new benchmark for biodiversity conservation through its adoption of **environmental DNA (eDNA) technology**. In partnership with NatureMetrics, the company has integrated eDNA biomonitoring across its global operations to enhance biodiversity impact assessment, mitigation, and restoration efforts. This initiative strengthens environmental stewardship and serves as a replicable model for the Chilean mining sector, offering a scalable and cost-effective solution for biodiversity assessments.

As part of its biodiversity strategy, Anglo American has pioneered the use of eDNA technology, implementing NatureMetrics' biomonitoring solutions across multiple sites worldwide, including its Woodsmith polyhalite project in the UK. **eDNA technology enables non-invasive biodiversity assessments** by extracting genetic material from water and soil samples, allowing for real-time species monitoring, including rare and endangered species with high accuracy.

Anglo American has deployed eDNA technology across **different stages of the mining lifecycle**. During exploration, baseline biodiversity assessments in **Australia** and **Germany** provide crucial insights into existing ecosystems before mining begins. In Peru and Brazil, continuous biodiversity monitoring ensures that environmental changes are tracked throughout active mining phases. Additionally, in **South Africa**, eDNA supports post-mining ecological recovery, guiding habitat restoration efforts. At the Woodsmith project alone, eDNA analysis identified 522 distinct taxonomic groups of invertebrates and 67 groups of vertebrates, significantly enriching biodiversity knowledge and conservation strategies.

eDNA data plays a crucial role in **shaping site-specific biodiversity management plans**, moving beyond generic restoration blueprints. By continuously monitoring biodiversity throughout the mine lifecycle, companies can adopt adaptive management strategies that respond effectively to environmental changes. This **data-driven approach** enables proactive mitigation of biodiversity risks, reducing unforeseen environmental impacts and ensuring responsible resource extraction.

Anglo American actively contributes biodiversity data to the eBioAtlas initiative, a global biodiversity databank supporting conservation science. Additionally, Anglo American collaborates with local environmental organisations to **develop regional genetic reference libraries**, improving biodiversity monitoring accuracy.

With Chile committed to protecting 30% of its land by 2030 under the Kunming-Montreal Global Biodiversity Framework, effective biodiversity monitoring tools like eDNA could play a crucial role in bridging biodiversity assessment gaps. Anglo American's initiative offers a valuable model for Chilean miners to help meet their conservation commitments.

7) Gender Equality – Diversity, Equity, and Inclusion

Advancing gender equality in Chile's mining sector presents a significant opportunity to foster a more inclusive and innovative industry. While challenges persist, growing awareness of diversity, equity, and inclusion (DEI) is driving momentum for change. Strengthening workplace policies, increasing government support, and integrating DEI progress into corporate governance will accelerate meaningful transformation and create a more equitable future for all.

Recognising the value of gender diversity, many companies are taking steps to improve representation, retention, and career progression for women in mining. With stronger commitments, targeted initiatives, and industry-wide collaboration, the sector can overcome systemic barriers and unlock the full potential of a diverse workforce.

Key challenges and opportunities in advancing gender equality include:

- **Enhancing corporate governance by linking DEI metrics to executive incentives** will drive sustained commitment and meaningful change across the industry.
- **Consistently implementing mandatory industry-wide DEI training** while expanding gender-sensitive policies can help shift mindsets, overcome ingrained biases and resistance, and accelerate meaningful progress in workplace inclusion.
- **Government engagement in gender equality is growing**, with opportunities to strengthen enforcement and direct support for industry-wide progress.
- **Enhancing entry pathways, retention strategies, and career progression for women** in mining will help address underrepresentation, while challenging traditional mindsets and unconscious biases that hinder advancement.
- **Expanding recruitment initiatives, leadership, and sponsorship programs** will help increase career opportunities for women in mining.
- **Addressing pay gaps and improving career advancement**, particularly in operational and field-based roles, will improve retention and inclusivity, particularly for women in technical and leadership positions.
- **Implementing family-friendly policies**, such as expanded parental leave, childcare support, and hybrid work models, can help address the challenges of mining's remote locations and long shifts, improving retention and workplace inclusivity.
- **Strengthening anti-harassment policies and ensuring gender-specific personal protective equipment (PPE)**, such as properly fitted helmets, gloves, and workwear, will enhance workplace safety, creating a more secure and inclusive environment for women in mining.
- **Promoting STEM education and scholarship programs for women** will strengthen the talent pipeline, fostering greater female participation in the sector.

Greater workplace inclusivity, improved career development initiatives, and stronger accountability at both corporate and governmental levels will drive meaningful progress toward diversity and gender equality in the mining sector.

Advancing Gender Equality in Chile's Mining Industry

Numerous gender equality initiatives are being implemented by key stakeholders to reshape the perception of mining in Chile, a sector historically dominated by men. Central to these efforts is **Chile's National Mining Policy 2050** (PNM2050), which sets ambitious gender diversity targets, aiming to increase female participation in the mining workforce to 20% by 2030 and 35% by 2050. By aligning corporate gender strategies with national objectives, PNM2050 ensures that gender diversity remains a long-term priority.

BHP became Chile's first mining company to **exceed 40% female workforce representation** in 2024. Its gender diversity strategy includes proactive recruitment policies, prioritising female candidates for technical and leadership roles, along with workplace infrastructure improvements such as gender-inclusive workspaces and family-friendly facilities. Additionally, BHP enforces strong internal DEI policies, conducts regular pay equity audits, and offers structured career development pathways for women. Through these commitments, BHP demonstrates how a strategic approach to gender diversity can drive meaningful progress in the mining industry.

Another significant initiative is the **Mining Industry Decalogue for Women's Inclusion**, established in 2018 by Chile's National Woman and Mining Roundtable. Led by the Ministry of Mining and the Ministry of Women and Gender Equality, this collaborative effort brings together mining companies, trade unions, and private associations to improve working conditions, increase female participation, and elevate women's representation in leadership roles. The Decalogue promotes the Chilean Standard NCh3262 on gender equality and work-life balance, encourages female representation in trade unions, works to eliminate selection biases, and expands professional development opportunities for women.

Since its inception, the Decalogue has achieved key milestones. In 2019, efforts focused on promoting mining careers for women through **high school engagement and internship programs**. By 2020, best practices for gender equality were introduced, emphasising female labour inclusion during post-pandemic economic recovery. In 2021, 28 organisations signed a national agreement to annually measure gender equality progress, ensure at least 30% female representation in industry panels, and implement affirmative action strategies to further gender inclusion.

The "**100 Inspiring Women of Chilean Mining**" initiative by Women in Mining Chile (WIM Chile) is another powerful campaign that celebrates female professionals in the industry, from engineers to executives. By publicly recognising female leaders, this initiative challenges stereotypes, encourages greater participation, and provides role models for the next generation of women in mining. WIM Chile also supports women's career growth through training programs, mentorship initiatives, leadership development, and technical skill-building workshops, fostering a more inclusive industry.

Additionally, the **Alianza CCM-Eleva**, a partnership between Chile's Mining Council and Fundación Chile, plays a crucial role in monitoring gender inclusion within the mining sector. By publishing regular gender participation reports, this initiative provides data-driven insights, helping policymakers and companies track progress and identify areas that require further improvement.

8) Sustainable Investment and Innovation

Sustainable investment and technological innovation are crucial for the future of Chile's mining sector, particularly as global markets increasingly favour ESG-compliant products. While there is growing investor pressure to adopt greener practices, key innovations in low-carbon extraction, water recycling, and circular economy models remain underfunded or lack scalability. Strengthening international collaboration, improving access to financing, and fostering technology transfer will be essential for advancing sustainable mining practices.

Key challenges and opportunities in sustainable investment and innovation include:

- **Underfunding of green mining technologies, such as Direct Lithium Extraction (DLE)**, is limiting their widespread adoption and slowing industry transformation. High desalination costs, driven by limited scaling and elevated capital and operational expenditures, remain a key barrier. Overcoming these constraints is essential for more sustainable mineral production.
- **Investor demand for ESG-compliant mining products** is driving sustainability efforts across the sector, shaping investment decisions and corporate strategies.
- **Promising pilot projects in carbon sequestration and water recycling** demonstrate potential, but scalability remains a challenge due to financial and technical constraints.
- **Limited technology transfer and commercialisation** highlight the need for stronger partnerships with international R&D institutions to accelerate innovation.
- **Mining companies continue to seek government support for sustainable investments**, yet subsidies and financial incentives remain scarce.
- **Opportunities for international collaboration in knowledge-sharing, financing, and policy development** could help bridge funding gaps and advance sustainable innovation.
- **Strengthening circular economy models within the mining industry** can reduce waste, improve resource efficiency, and enhance overall sustainability outcomes.
- **Expanding local R&D capabilities in sustainable mining technologies** can reduce dependence on foreign solutions and foster homegrown innovation.
- **Enhancing collaboration between universities**, mining companies, and government institutions can accelerate the development of breakthrough technologies.
- **Scaling up investment in decarbonisation technologies,** such as green hydrogen and electrification, can support the transition to low-carbon mining operations.
- **Creating a regulatory environment that supports innovation** by simplifying permitting processes for ESG-driven projects can encourage faster technology adoption.
- **Leveraging AI, automation, and real-time analytics** accelerates mining's digital transformation, enhancing efficiency, safety, and environmental management.
- **Bridging funding gaps for ESG startups, offering tax incentives for green mining**, and establishing innovation hubs can drive sustainable solutions, accelerate low-carbon technologies, and foster collaboration among academia, industry, and policymakers.

Investment in green technologies, stronger innovation partnerships, and the adoption of circular economy principles will establish Chile as a leader in sustainable mining while meeting the growing global demand for responsibly sourced minerals.

UKEF's Role in Sustainable Copper Production and Best Practices

The UK can play a critical role in mitigating sustainability finance challenges by providing technical expertise, investment facilitation, and regulatory guidance. The UK's strengths in **green finance, ESG investment strategies, and financial risk mitigation** position it well to help Chile's mining sector overcome sustainability finance barriers.

UK Export Finance (UKEF) is the UK government's export credit agency, providing finance and insurance to support UK exporters and their international buyers. **UKEF operates by offering guarantees, loans, and insurance products to facilitate trade and investment** while ensuring that no viable UK export fails due to lack of finance or insurance. It plays a crucial role in enabling large-scale sustainable projects, particularly in sectors like mining, by addressing financial barriers and mitigating investment risks.

In October 2024, the UK government approved the use of UKEF to finance critical minerals projects, recognising their importance for industrial growth and the global net-zero transition. **UKEF now offers financial support for overseas projects supplying critical minerals** such as copper, lithium, and cobalt, essential materials for low carbon economy industries like renewable energy generation and transmission, electromobility and aerospace. UKEF financing enables foreign mining projects to adopt advanced processing technologies, ensuring efficient, low-carbon production that aligns with sustainability goals.

For Chile's mining sector, UKEF presents an effective sustainable finance mechanism that can **accelerate green transitioning**. It can help fund renewable energy-powered mining operations, finance the adoption of cutting-edge ESG technologies, and provide export credit guarantees that de-risk sustainable investment projects. UKEF's ability to unlock capital for large-scale projects can facilitate Chile's transformation into a leader in sustainable mining practices while maintaining its critical position as a global minerals supplier.

A compelling example of **UKEF's impact in sustainable mining is its recent €12.6 million guarantee to Almalyk Mining and Metallurgical Complex** in Uzbekistan. This financing supported the acquisition of fully automated specialist machinery from the Scottish multinational Weir for one of Central Asia's largest copper-production facilities. By facilitating access to capital, this initiative enabled the deployment of state-of-the-art water processing technology, improving efficiency and reducing environmental impact.

UKEF's support for Almalyk Mining ensures continued access to critical minerals while enhancing production sustainability.

For Chile, the world's largest copper producer, UKEF could offer similar financing solutions to drive next-generation copper production. By supporting investments in advanced extraction, automation, and green energy-powered mining solutions, UKEF can help Chilean mining companies secure funding for **high-tech, low-carbon production systems** such as the use of renewable energy, electrification of equipment, AI driven energy efficiency systems, advanced desalination and waste water reuse. This would allow Chile to maintain its leadership in critical mineral supply while reducing ESG risks and increasing long-term competitiveness in global green supply chains.

Conclusions: Short-to-Medium Term Opportunities for Chilean Partners

The UK can play a strategic role by offering ESG expertise, funding, and technological solutions to address identified challenges. Environmental risks such as water scarcity and resource competition in Chile's arid northern regions (Tarapacá, Antofagasta, Atacama, and Coquimbo) threaten sustainable mining operations. These regions, already under pressure for water resources, also face risks from legacy tailings sites impacting local communities. Expanding renewable energy and advanced water management technologies presents a significant opportunity to mitigate these challenges.

Social factors add complexity, particularly regarding stakeholder engagement. Coexistence with local and Indigenous communities involves navigating concerns over water scarcity, land use, and benefit-sharing. Addressing gender equality challenges (DEI) is also crucial. Modern stakeholder engagement frameworks, drawing on global best practices in water efficiency and renewable energy can help mitigate conflicts and strengthen community relationships.

By addressing ESG challenges, Chile and the UK can strengthen global partnerships, enhance ESG performance, and ensure sustainability in Chile's mining sector. Key opportunities include training, capacity-building for mining personnel, and integrating long-term sustainability objectives into operational strategies. Balancing profitability with ESG leadership is essential for sustainable economic success.

Effective water management and robust tailings strategies are vital for environmental resilience. Addressing social tensions is equally important for securing the sector's long-term sustainability. The UK offers valuable expertise, funding access, and technology-driven solutions. Strengthening ESG frameworks will boost Chile's global competitiveness and market access.

UK Export Finance supports critical mineral projects, fostering long-term value. Joint initiatives will advance sustainable mining, strengthen supply chains, and accelerate the low-carbon transition, positioning Chile and the UK as leaders in sustainable resource governance. SFA's collaboration with the British Embassy in Santiago underscores this commitment, driving Chile's policy and ESG development.

Sustainable Investment and Innovation

- Facilitate **access to sustainable finance mechanisms**.
- Guide on **ESG financial risk management** and **reporting practices**.

Gender Equality – DEI

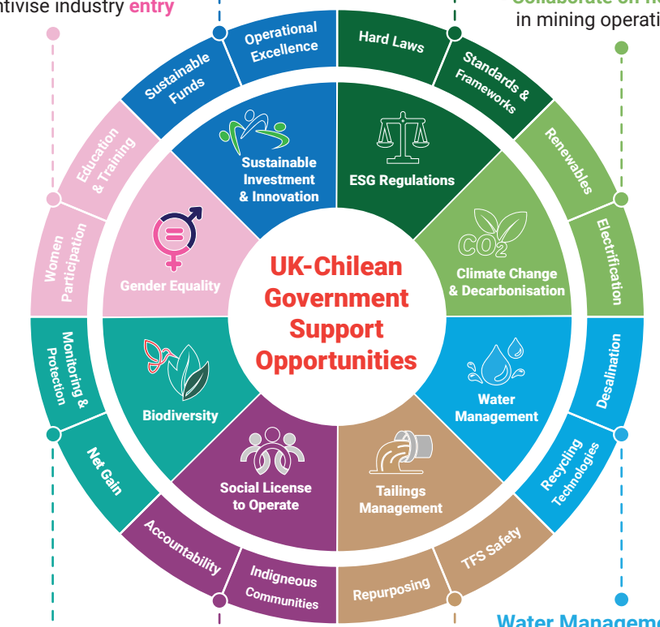
- Help **develop strategies for promoting gender diversity** in male-dominated industries.
- Collaborate on **initiatives to address barriers to women's participation in mining**.
- Provide **funding and scholarship opportunities for women in STEM higher education** to incentivise industry **entry and retention**.

ESG Regulations

- **Simplify processes** for ESG-compliant projects.
- Introduce **fast-track approvals** for low environmental impact projects.
- Facilitate **capacity-building for regulators**.

Climate Change and Decarbonisation

- Provide **tax breaks** for solar, wind, and green hydrogen integration.
- **Support renewable energy grids** to reduce operational costs.
- Knowledge sharing on **emissions trading systems**.
- **Collaborate on fleet electrification** in mining operations.



Biodiversity

- Collaborate on **innovative biodiversity monitoring solutions, offset programs** and **habitat restoration techniques**.
- Share expertise on **integrating biodiversity considerations** into mining operations.

Water Management

- Research **collaboration on water-efficient mining technologies**.
- Sharing **best practices in water engineering** and management.
- **Provide reliable impact data of new vs. incumbent technologies** to support ESG-sound financial decisions.

Social Licence to Operate

- Share experience in **stakeholder engagement, conflict resolution**, and **human rights due diligence**.
- **Benchmark** practices against **global approaches**. Help **develop a national-level Indigenous relations management playbook**.

Tailings Management

- Provide **geotechnical and operational expertise** on **tailings dam safety and monitoring systems**.
- Facilitating **knowledge transfer** on the adoption of the highest **tailings management standards**.

Source: SFA (Oxford)

Acknowledgements: Empowering UK-Chile Partnerships

SFA (Oxford) and the British Embassy in Santiago extend their sincere thanks to the many Chilean mining industry stakeholders, representatives, policymakers, and experts who generously shared their time, knowledge, and perspectives through interviews and consultations to support the British Government. Their expertise and first-hand experience provided essential context and depth to the baseline understanding of Chile's ESG practices and supported the gap analysis to identify unmet needs. This strategic approach will enable focused UK programming, engagement, and advocacy, enhancing the design of multi-year critical mineral initiatives and positioning the UK as a preferred partner in Chile.

From November 2024 to January 2025, interviews were conducted with senior industry figures to develop a comprehensive overview of ESG practices, performance, regional challenges, and opportunities for the UK to support Chile across the critical minerals supply chain.

We also express our deep appreciation to ICC Abogados, a leading Chilean law firm, and our colleagues there. Their guidance and expertise were instrumental in engaging key industry stakeholders, particularly where English proficiency was a consideration for interviewees. ICC Abogados' robust understanding of Chilean mining and environmental laws, as well as the country's most recent policies and strategies related to its net-zero ambitions, helped ensure research that was highly relevant to the real-life challenges and key ESG themes shaping Chile's mining sector.

SFA collated research from hundreds of sources, and benchmarked leading players in Chile's mining sector, regulatory landscape, ESG challenges, and available stakeholder data from Cochilo.

These collective insights provide the mining industry with a strategic foundation to align Chile's ESG practices with evolving international standards, enhance competitiveness in key export markets, and explore opportunities for UK technical assistance and commercial support. In the short to medium term, this will strengthen the Chile-UK energy transition partnership, ensuring alignment with international expectations and best practices.

Aligning Chile's mining sector with international ESG benchmarks demands a rigorous, data-driven evaluation. To support this, a tailored ESG scoring approach has been developed, combining qualitative insights from stakeholder interviews with quantitative data analysis. The framework, based on 46 key ESG metrics drawn from industry best practices and Chile's most pressing sustainability priorities, enables company-specific benchmarking of the country's leading copper and lithium producers against global peers. The assessment highlights critical sustainability gaps and areas for improvement.

Evaluating these challenges, pinpointing root causes, operational constraints, and other factors that limit effective ESG implementation will support improvements to achieve greater compliance with local and international standards. In this spirit, SFA looks forward to continue supporting the British Embassy in Santiago with its long-term endeavours, assisting Chilean partners in navigating opportunities with UK support, and collaborating with British Embassies worldwide to help British companies take a leading role in sustainable mining and resource governance.

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