

CHILE, LÍDER MUNDIAL EN MINERÍA VERDE

FORO CHILENO-ALEMÁN DE MINERÍA Y RECURSOS MINERALES
SANTIAGO, 2 DE NOVIEMBRE DE 2022

Dr. Ing. Marcela Angulo G.
Directora Universidad de Concepción en Santiago
Vicepresidenta de Minnovex
Miembro de Cesco



Fundación
Encuentros
del Futuro



CONGRESO
FUTURO

What we understand by "minería verde" or green mining?



Low emissions



Reduced waste



Water efficient



Energy efficient



Protects and regenerates
biodiversity



Intensive in knowledge and promotes
cluster development



Contributes to local
development

The Green Mining Commission (2021)



Interdisciplinary
group from the
mining ecosystem



Virtual meetings

+150

Experts

+1 year

More tan 1 year of
technical sessions

PNM 2050

Aligned and
complementary

Work axes

1.

Decarbonization,
market access

2.

Water resources and
climate change
adaptation

3.

Biodiversity

4.

Concentrates processing,
secondary mining,
recycling

5.

Financing R&D and innovation – Strategic investment

Some Goals

Decarbonization, market access

- Trazable copper production: 70% in 2025; 100% in 2030.
- Increase participation of local companies in technology development (10% in 2030, 20% in 2040, 30% in 2050, above base line).
- Reduce emission intensity by 50% in 2030 (big mining companies).
- Carbon neutrality by 2050.

Biodiversity

- Open acces platform of biodiversity information by 2025.
- Economic evaluation of prioritised nature-based solutions by 2025.
- Real time monitoring systems implemented in sensitive ecosystems by 2030 (Andean and high Andean wetlands, aquifers, salt flats).
- Mitigation and restoration program fully implemented by 2030.

Water resources and CC adaptation

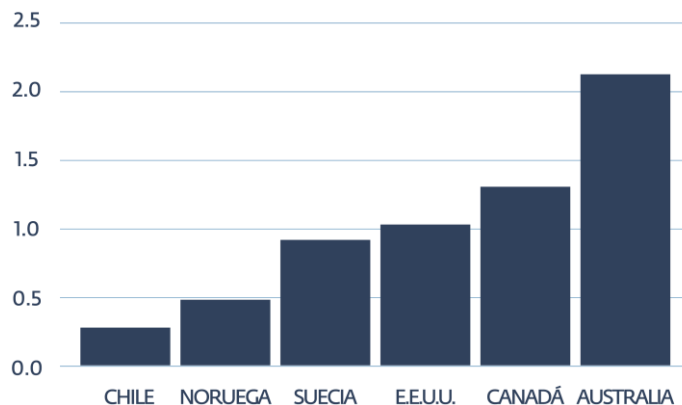
- Trazability of water consumption: 100% by 2030.
- Ecosystems impacted by mining water extraction are evaluated by 2030, mitigated by 2040, fully recovered by 2050.
- Collaborative approach to desalination, use of best practices and best available technologies to minimize environmental impacts.
- Program for climate change adaptation implemented by 2030 and regional expansion by 2040.

Concentrates processing, secondary mining and recycling

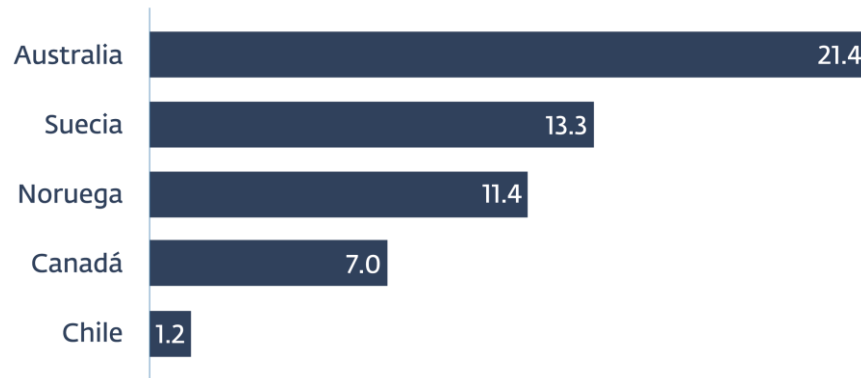
- Remediation of all closed or abandoned tailings with risk to environment and population by 2040.
- Reduce, reuse and recycle 100% of waste with recycling potential by 2040.
- To develop a new capacity of Smelting and Refinery (FURE), in the first quartile of costs & best environmental performance by 2030.
- Chile as a global R&D and innovation pole in minerals and

FINANCING R&D AND INNOVATION – STRATEGIC INVESTMENT IN GREEN MINING

R&D intensity in mining, 2015



Number of people in R&D
(for 1000 workers)



FINANCING R&D AND INNOVATION – STRATEGIC INVESTMENT IN GREEN MINING

STRENGTHENING R&D, INNOVATION AND ADVANCED HUMAN CAPITAL

- Promote use of mining royalty (copper and lithium) to mission oriented R&D and innovation in sustainability.
- Creation of a public Innovation Fund
- Leverage private investment in R&D and innovation in green mining.

Innovation Fund

1.000
US\$ millions
in 10 years

- Fund for R&D and innovation in sustainable solutions
- Fund for industrial validation/pilot projects for green&sustainable technologies.
- Fund for advanced human capital.



Reference : SIF - Net Zero Accelerator Canada
\$ 3 mil millions during 5 years to accelerate decarbonization and industrial transformation.

FINANCING R&D AND INNOVATION – STRATEGIC INVESTMENT IN GREEN MINING

STRENGTHENING STRATEGIC INVESTMENT IN GREEN MINING

- Mechanisms of support and incentives for private investment.
- New approaches to collaborative Projects that captures synergies and economies of scale (water desalination, green hydrogen, smelting&refiney, secondary mining and circular economy).
- Incentives and clear legal framework to promote innovation in mininmg projects.

Sustainable Economy
and Green
Investment Fund

1.000
US\$ millions
en 10 años

- Grants for pre-investment studies in projects with local content.
- Credit Guarantees.
- Financing to financial intermediaries.
- Venture Capital Funds.



Reference CEFC Australia
Fund AU\$ 10.000 millions for green financing

INSTITUTIONAL FRAMEWORK



Articulación Pública:



ALTALEY

Corporación Alta Ley can provide technical support and multistakeholders governance

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CASE OF INNOVATION

The "zero-emission and zero-slag" oxidation - reduction technology by
Universidad de Concepción

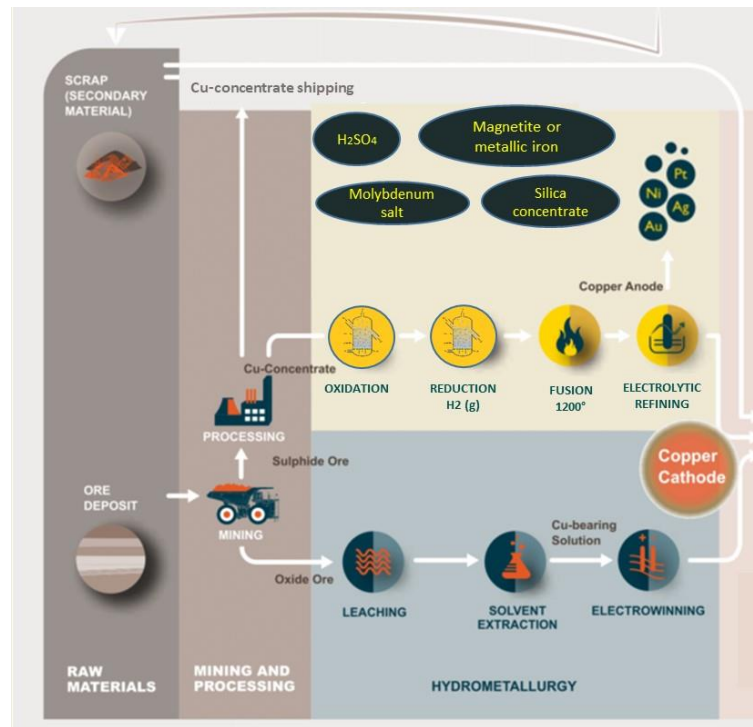
A NEW PARADIGM TO COPPER CONCENTRATES PROCESSING



Universidad de Concepción

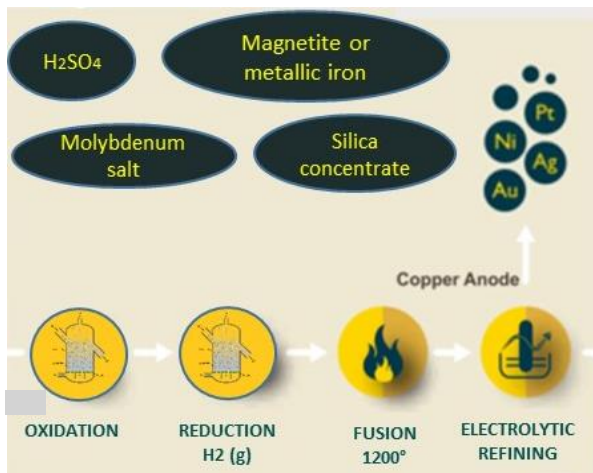
The "zero-emission and zero-slag" oxidation - reduction technology

- The new process is a **disruptive oxidation-reduction technology** that operates in solid / gas systems at 800-850°C in closed reactors with zero emissions.
- The process **valorizes all the constituents of the concentrate**, generating commercial products such as magnetite, molybdenum salt and silica concentrate, generating zero slags.
- It consumes **50% less energy** and uses **green hydrogen** in the reduction stage, with a **zero carbon footprint** and a surplus of clean energy (1,3xconsumption).
- The process **integrates confirmed unit operations** minimizing technological risk. Current technology development is **TRL 5**. Development plan includes a **pilot plant** (2023-2025) and a **demonstration scale plant** (2026-2028).



Adapted from European Copper Institute, 2016.

A NEW PARADIGM TO COPPER CONCENTRATES PROCESSING



TECHNICAL AND ENVIRONMENTAL ADVANTAGES

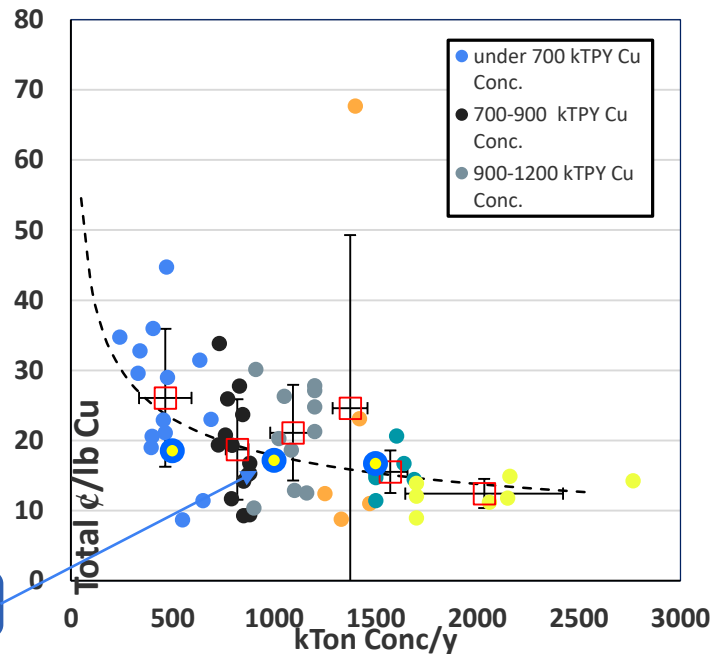
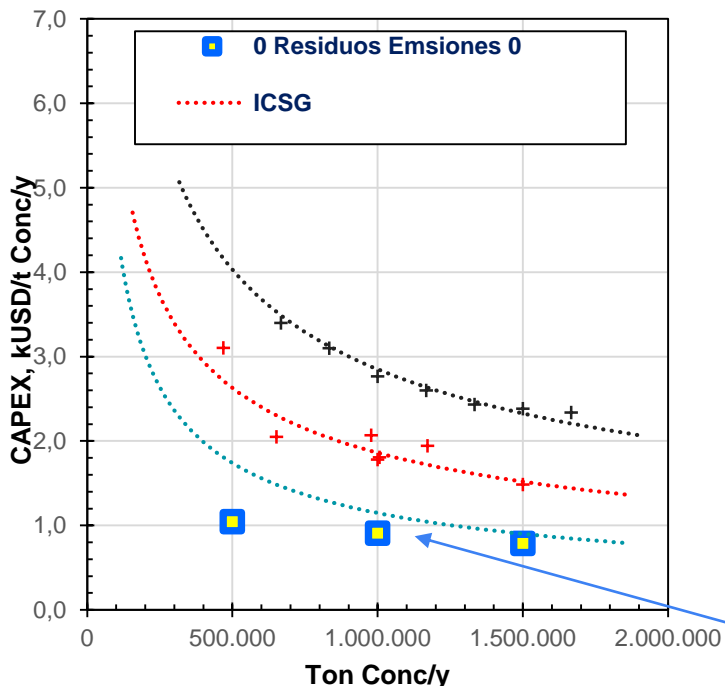
- ✓ Captures over 99% of SO_2 and As.
- ✓ Recovers over 98,5% of copper and over 80% of molybdenum.
- ✓ Generates commercial products of iron and silica.
- ✓ Zero slag.
- ✓ Produces energy surplus (1,3 x consumption).
- ✓ Zero carbon footprint and carbon credits.
- ✓ Almost zero water consumption.
- ✓ Minimizes safety risk for workers.
- ✓ Allows integration mine-concentration plant- processing, providing full carbon footprint traceability
- ✓ Production of sulphuric acid *in situ* allows valorization of secondary resources

A NEW PARADIGM TO COPPER CONCENTRATES PROCESSING

ECONOMIC ADVANTAGES



- 3 plant sizes have been evaluated: 500 kTon / year, 1MMTon / year and 1.5MTon / year - **in all cases, UdeC technology is competitive in capex and opex.**
- Opex calculation does not include the income (“credits”) associated to co-products magnetite, molybdenum and silica concentrate; if included, opex will be in the range of **de 12-16 c/lb Cu.**



Technological Infrastructure and Capabilities



Panoramic view of the pilot plant

Pilot Plant Dr. Igor Wilkomirsky
Faculty of Engineering
Universidad de Concepción



Fluidized Bed Pilot Roasting
Reactor



Fluidized Bed Pilot H₂
Reduction Reactor

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