

Circular Economy in Copper Smelting and Refining

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Circular Economy in the Mining Sector
Discussing Opportunities Available for Mining Companies

Eco Mining Concept

Agenda

I Context:

Some Numbers in copper.

Copper movements

Circular metals Cu/Pb/Zn

II EcoMetales Actual picture and Future

Value Recovery from waste (liquids/solids).

Flue dust treatment and Scorodite Process
Projects

III Opportunities

Water

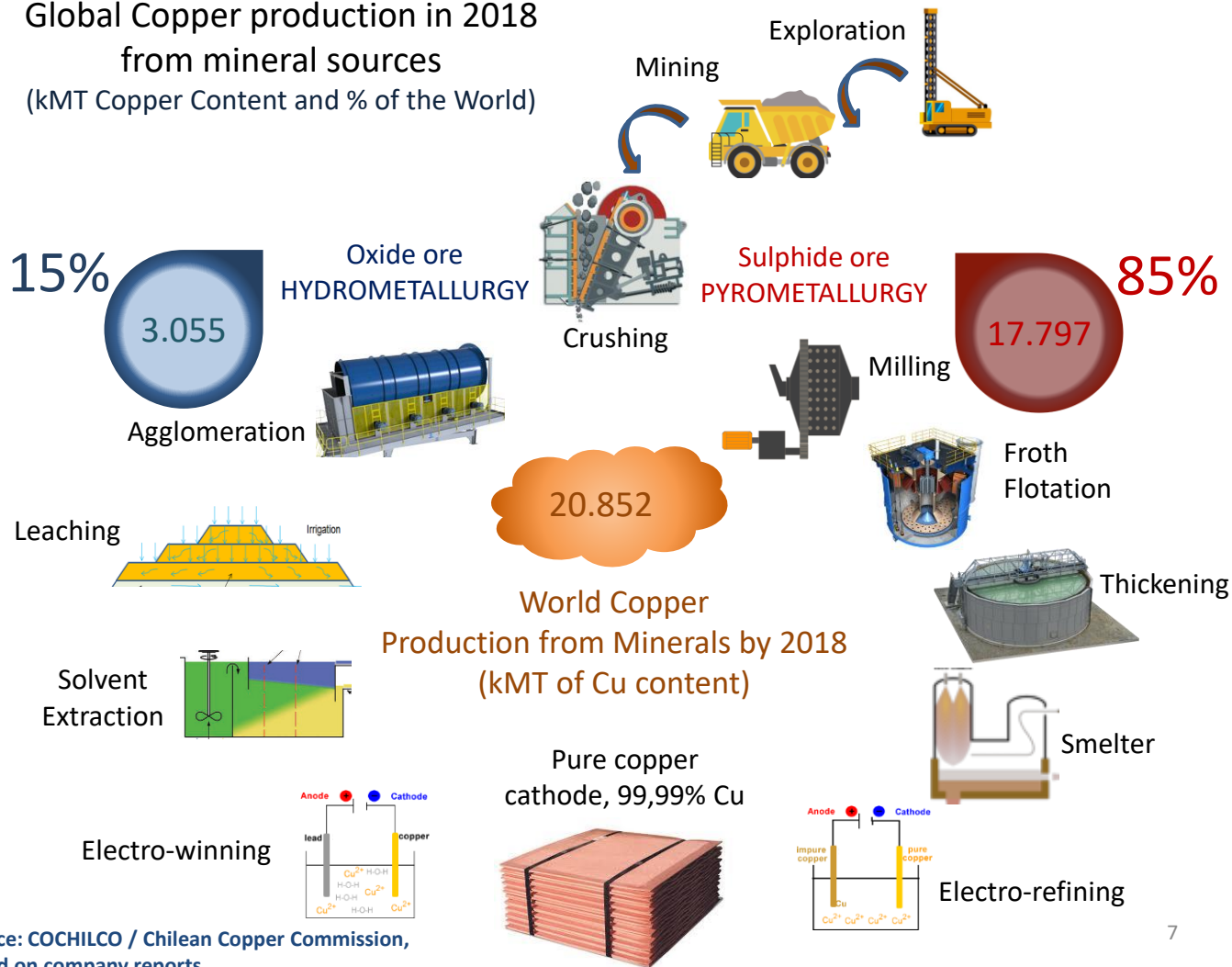
Tires

Tailings

Context

Cu^0

Global Copper production in 2018 from mineral sources (kMT Copper Content and % of the World)



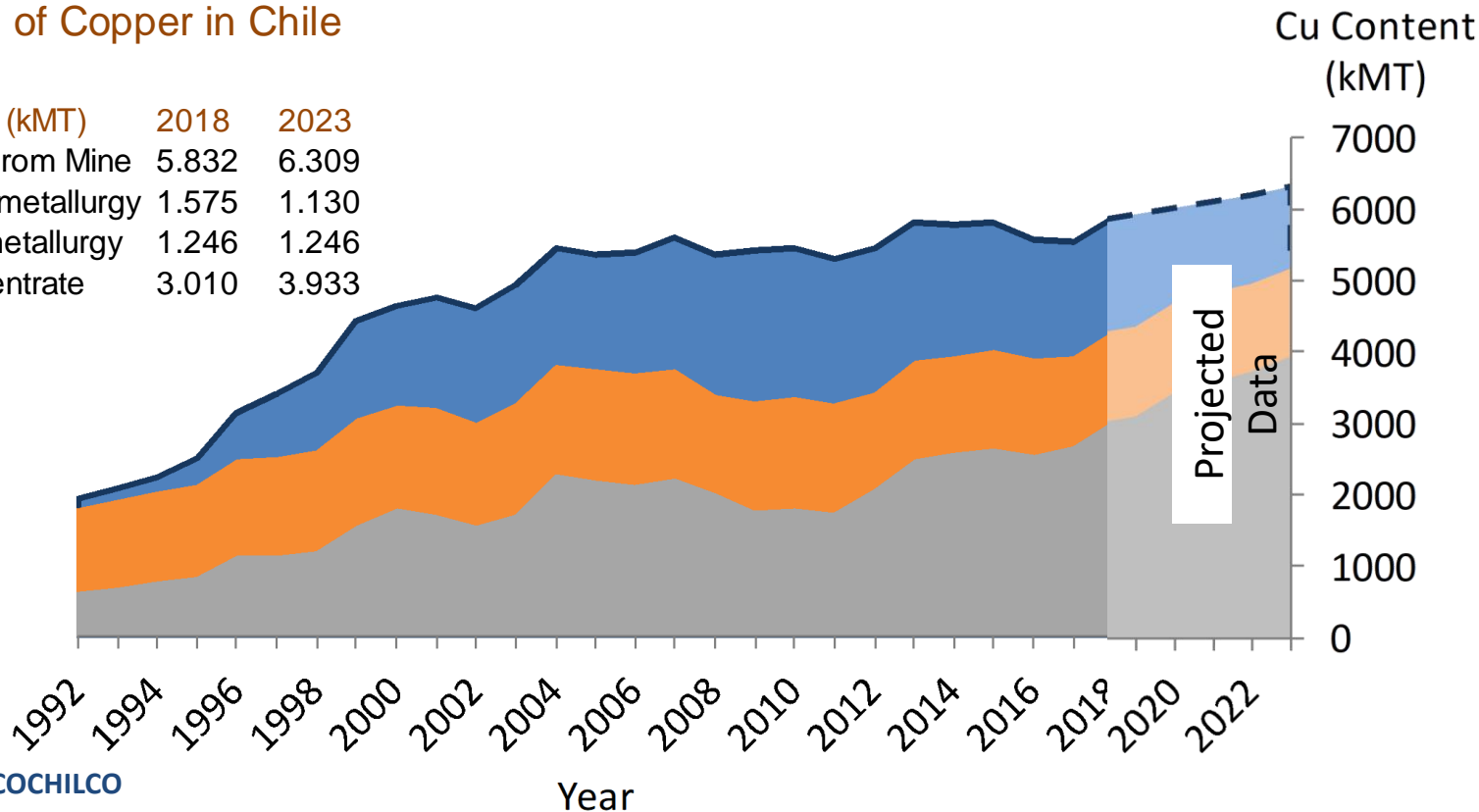
Source: COCHILCO / Chilean Copper Commission,
based on company reports

Chilean Copper Production 1992-2018 and projection 2019-2023

(kMT Copper Content)

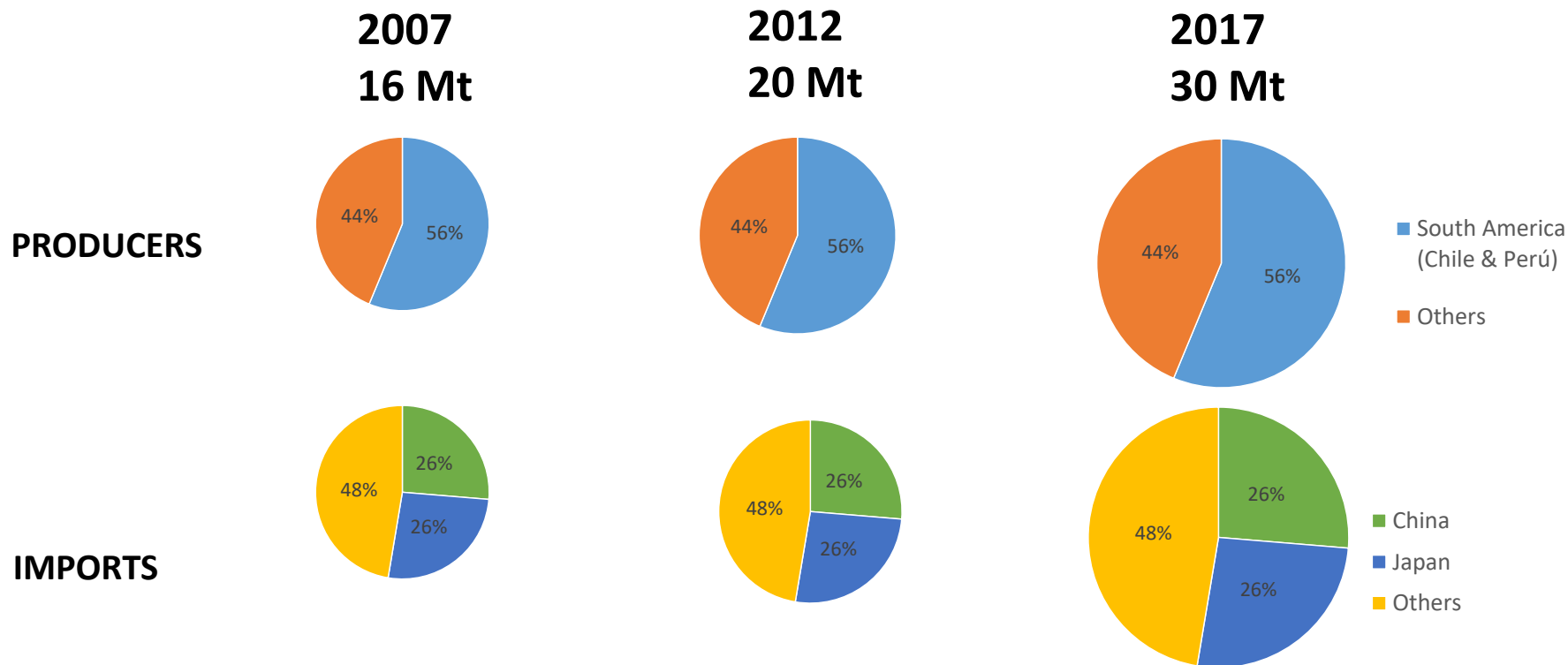
Production of Copper in Chile by 2018

Route (kMT)	2018	2023
■ Total from Mine	5.832	6.309
▢ Hydrometallurgy	1.575	1.130
▢ Pyrometallurgy	1.246	1.246
▢ Concentrate	3.010	3.933



Source: COCHILCO

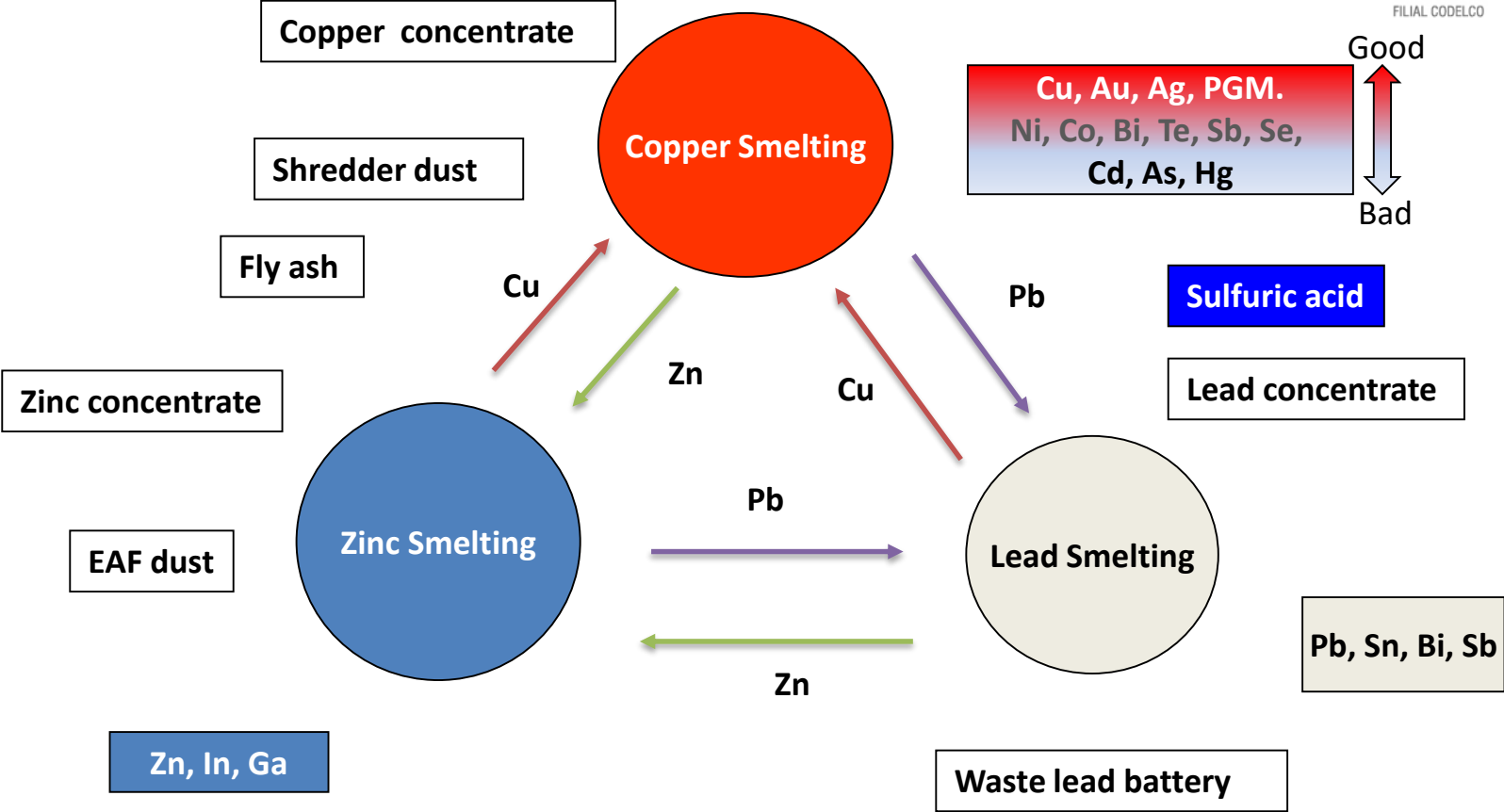
Copper concentrate market



Promoting EV: <https://twitter.com/ThinkCopperEU/status/1272786097177866246>

Source: ICSG

Base & Minor Metals recovered from Primary and Secondary Resources in Non-Ferrous Industry



Source: Voisin L. et all. Todaiforum 2018

More than 20 metals can be recovered except RE, W, Mo, V, Mn, Cr, Nb, Ta and Li

EcoMetales

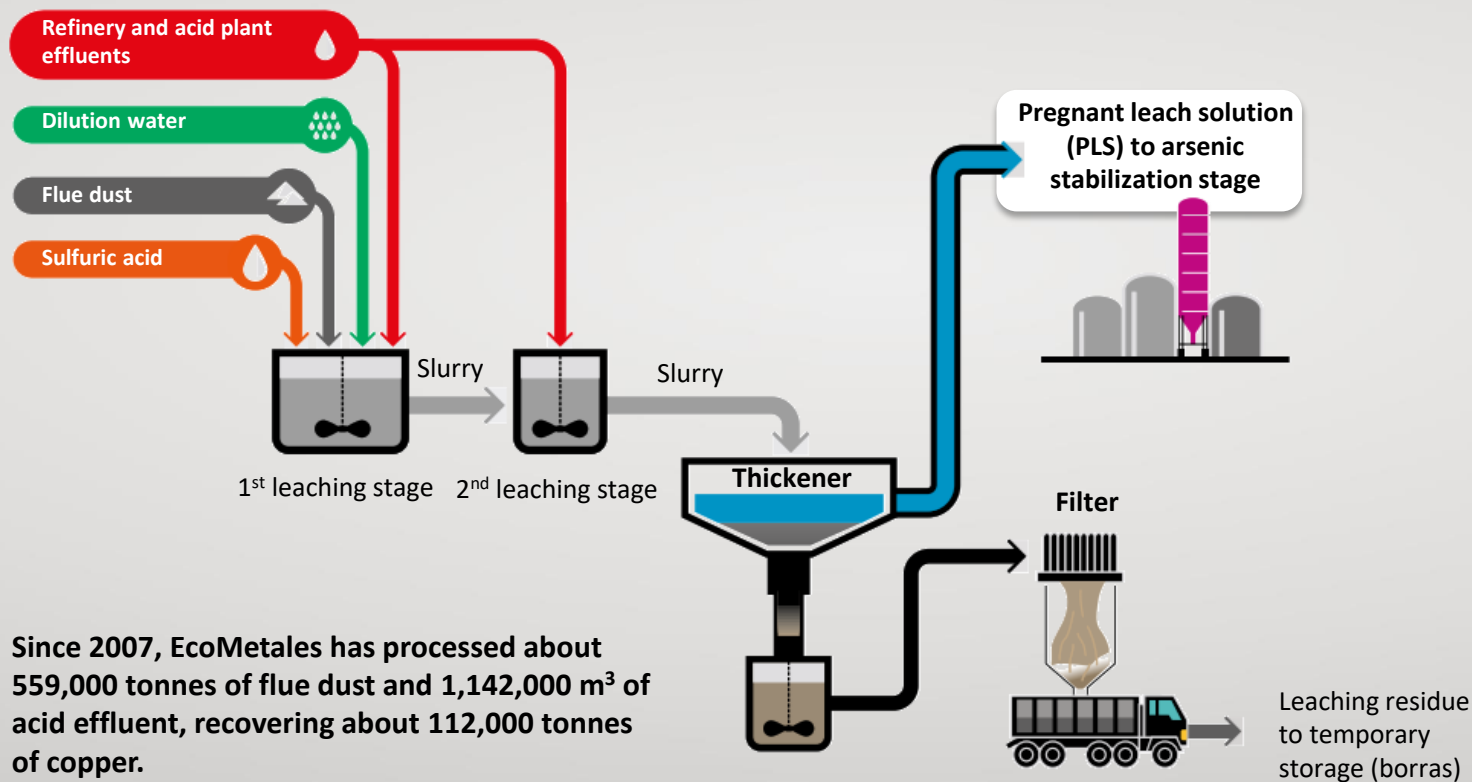
Actual picture and Future

Our mission

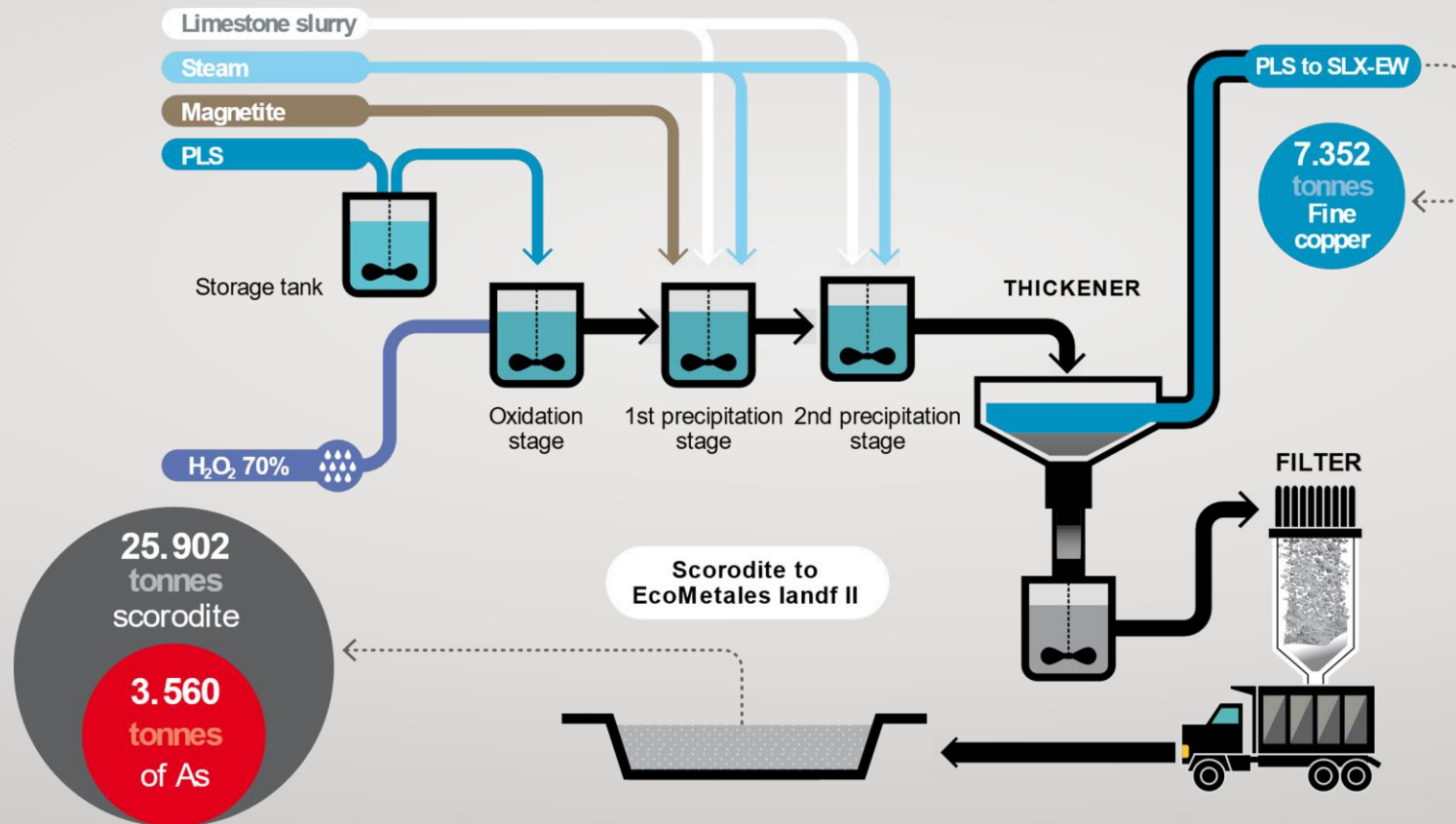


- ▶ ECL is a 100% subsidiary of CODELCO, established to implement environmental solutions and metal recovery processes in the mining industry
- ▶ Since 2007, EcoMetales has processed about 559,000 tonnes of flue dust and 1,142,000 m3 of acid effluent, recovering about 112,000 tonnes of copper.
- ▶ More than 20,000 tonnes of arsenic have been disposed as scorodite since 2013.

Flue dust leaching technology



Arsenic and antimony abatement technology



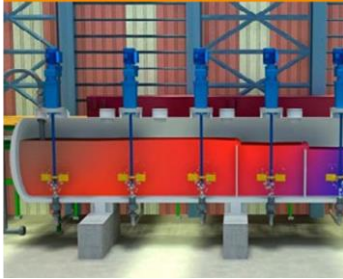
Actual Projects

Waste Valorization Recovery of Ge and Ag



- Leached residue: Process for recovery of Ge & Ag at pilot scale.
- Patent pending.

PLCC Plant Pressure Leaching of Copper Concentrates



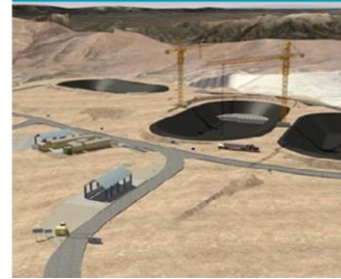
- Leaching of dirtiest Copper Concentrates, at high temperature and high pressure.
- Leverage with existing facilities SX/EW.
- Feasibility study completed
- Continuation decision in hands of CODELCO

Tailings valorization



- Project co-financed with CORFO.
- Focus in recover valuable elements from Tailings.
- Process OK
- End 2020 bench scale test will be finished.

DET Plant Improvement of arsenical waste handling at DET



- Reduce the arsenic waste produced and develop a new hazardous waste landfill inside the industrial area.
- Feasibility study completed.
- Environmental permits approved, under review by ministry committee

Ferric commercialization Ferric solution produced from magnetite



- Pre-feasibility studies concluded.
- First industrial application of the product already conducted

Opportunities

Short to medium term opportunities



- Water / ZLD



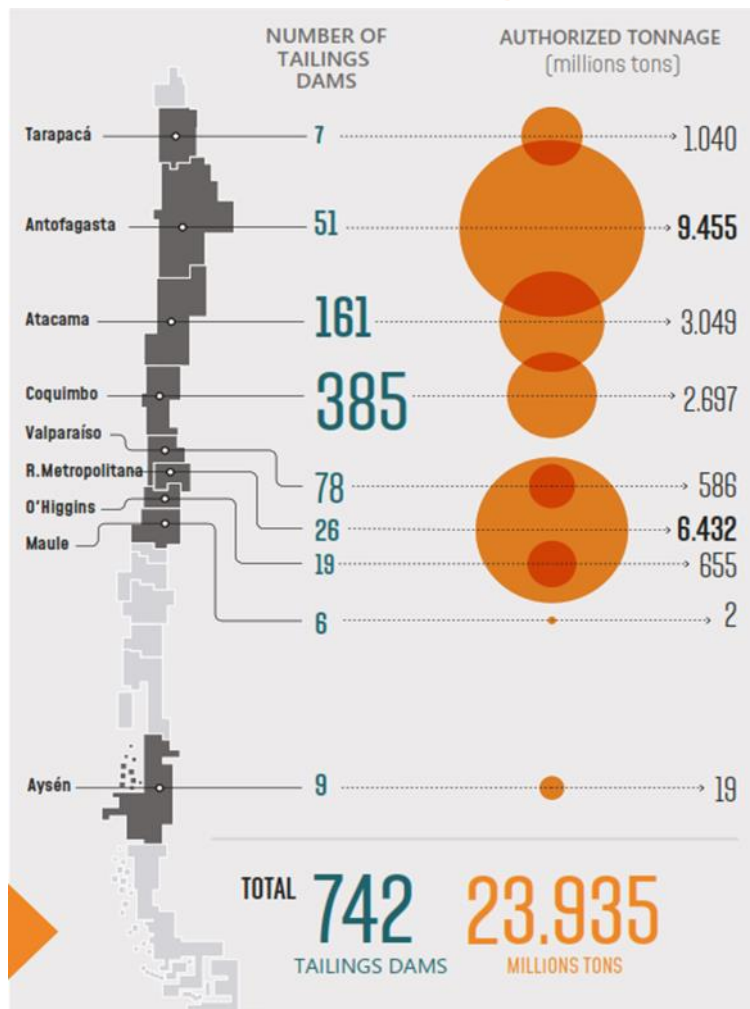
- Tailings



- Tires

CORFO + JRI + EcoMetales: Recovering value from tailings

To a circular mining



www.relavesconvalor.cl

It can increase competitiveness, especially in medium and small mining.



There are known and efficient processing technologies.



Remediates environmental liabilities and reduces the volume of the tailings.



Facilitates facilities closure processes: reduces costs, and can even contribute resources.



Decreases risks of built out-of-standard tailings contamination.



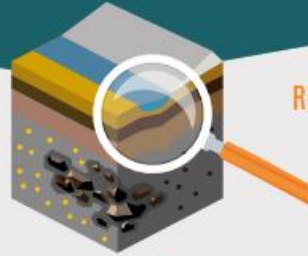
The availability of land for other uses increases.



HOW TO RECOVER VALUE FROM TAILINGS

I Characterization

What do they contain
and how is the minerals
matrix presented?



RESULT: TO KNOW THE
MATRIX OF THE
TAILINGS AND
INTERPRET IT.

II Processes identification



RESULT:
DESIGN OF A
PROTOTYPE OF
PROCESSES TO
RECOVER VALUE
FROM TAILINGS.

III Prototype validation

To date, its have
recovered species
such as:

Fe

Cu

REE



RESULT:
VALIDATED
PROTOTYPE AT
BANK LEVEL,
SCALABLE IN
SEMI INDUSTRIAL
EQUIPMENT.

PRODUCTOS DE REE OBTENIDOS



SX de
REE



Precipitación
de Oxalatos
de REE



Oxalatos de
REE
Deshidratado
s



Calcinas de REE
(La, Ce y Nd)



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