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SOLAR ENERGY RESEARCH CENTER



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ISES SWC 2019
SOLAR WORLD CONGRESS
04 - 07 NOV, 2019
SANTIAGO, CHILE

International Conference
on Solar Heating and Cooling
for Buildings and Industry

SHC 2019
CONFERENCE 04 - 07 NOVEMBER
SANTIAGO, CHILE

ISES Webinar

ISES Infographics Solar Thermal Heat for Industry Processes

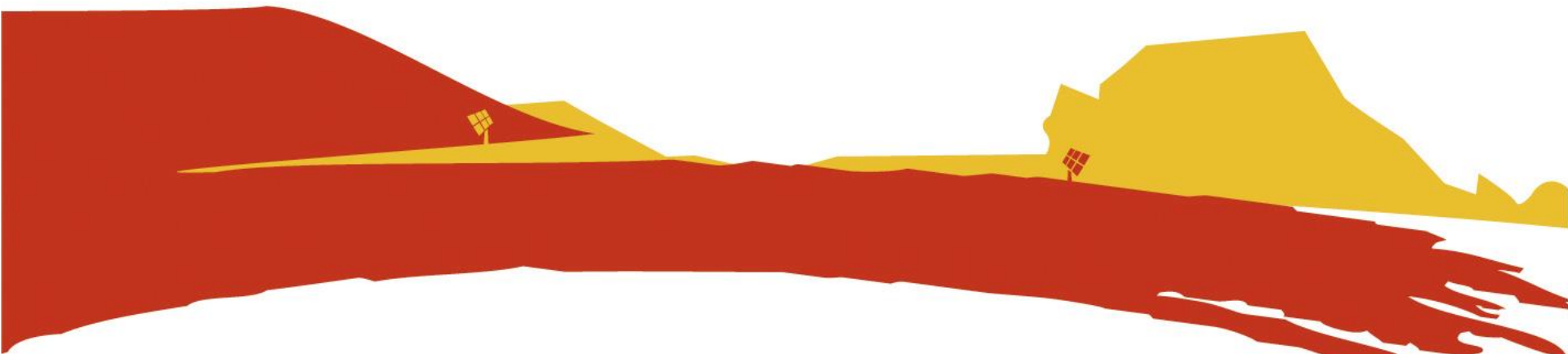
March 10th, 2020



Solar Thermal Heat for Mining Processes

José M. Cardemil

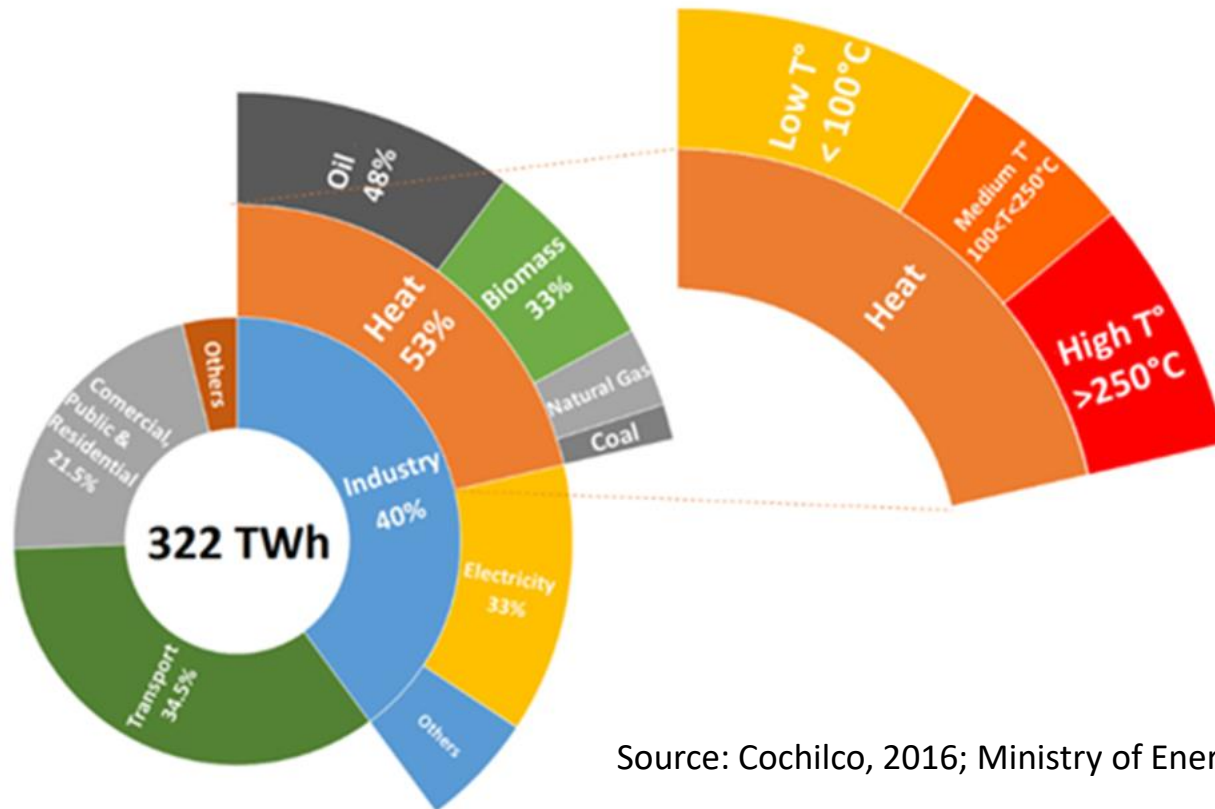
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Agenda

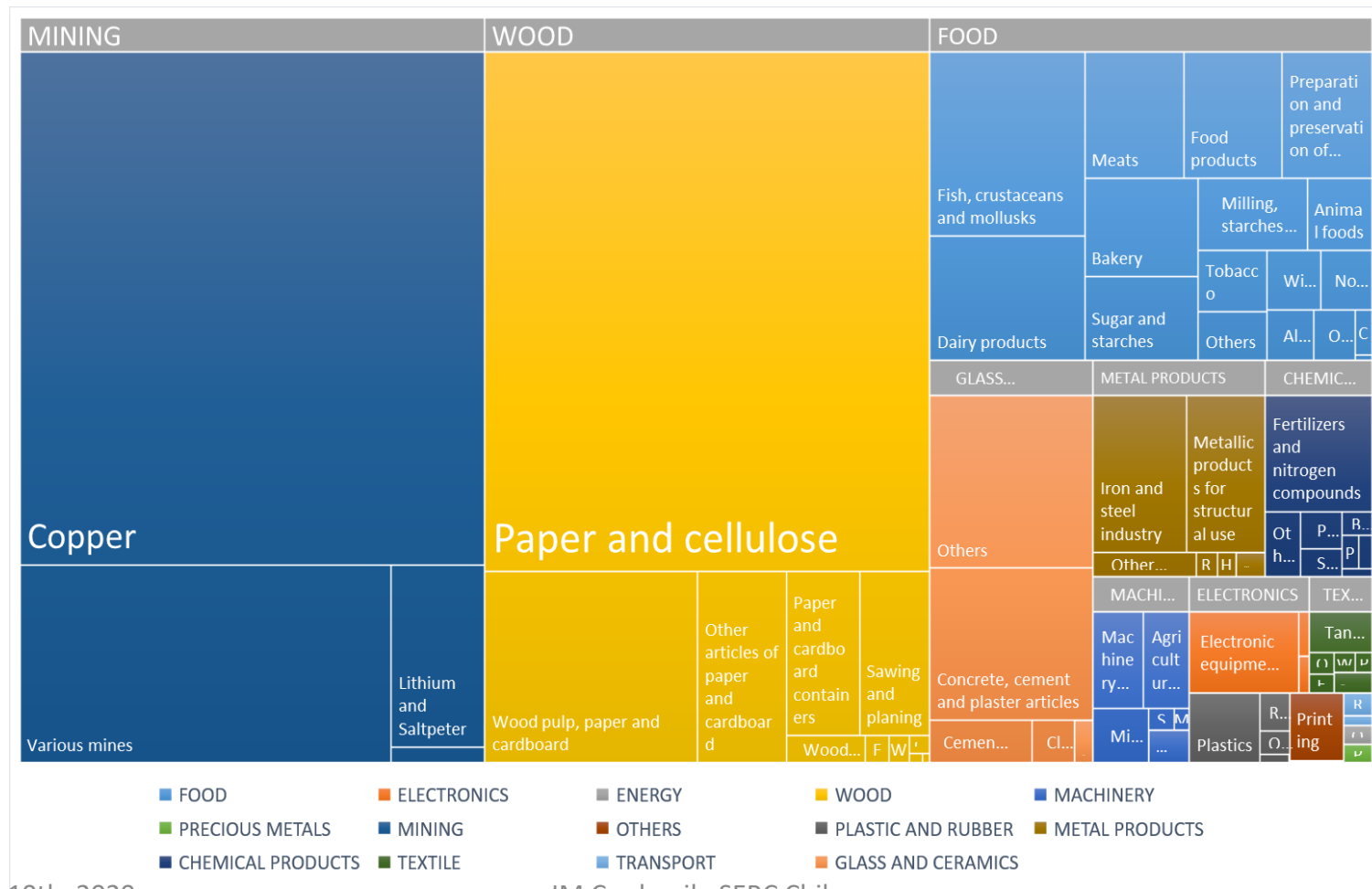
1. Energy Consumption in Chile
2. Heat Consumption for industrial processes
3. Location of mining facilities
4. Copper Mining Processes
5. Process Integration
6. Plants currently in operation
7. New opportunities
8. Challenges

Energy consumption in Chile



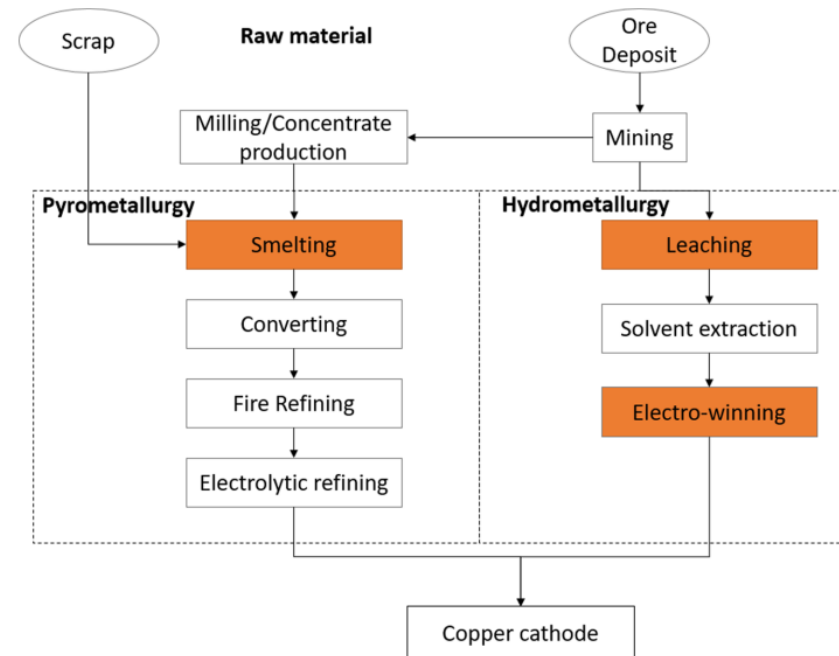
Source: Cochilco, 2016; Ministry of Energy, 2016

Heat consumption in industrial Processes



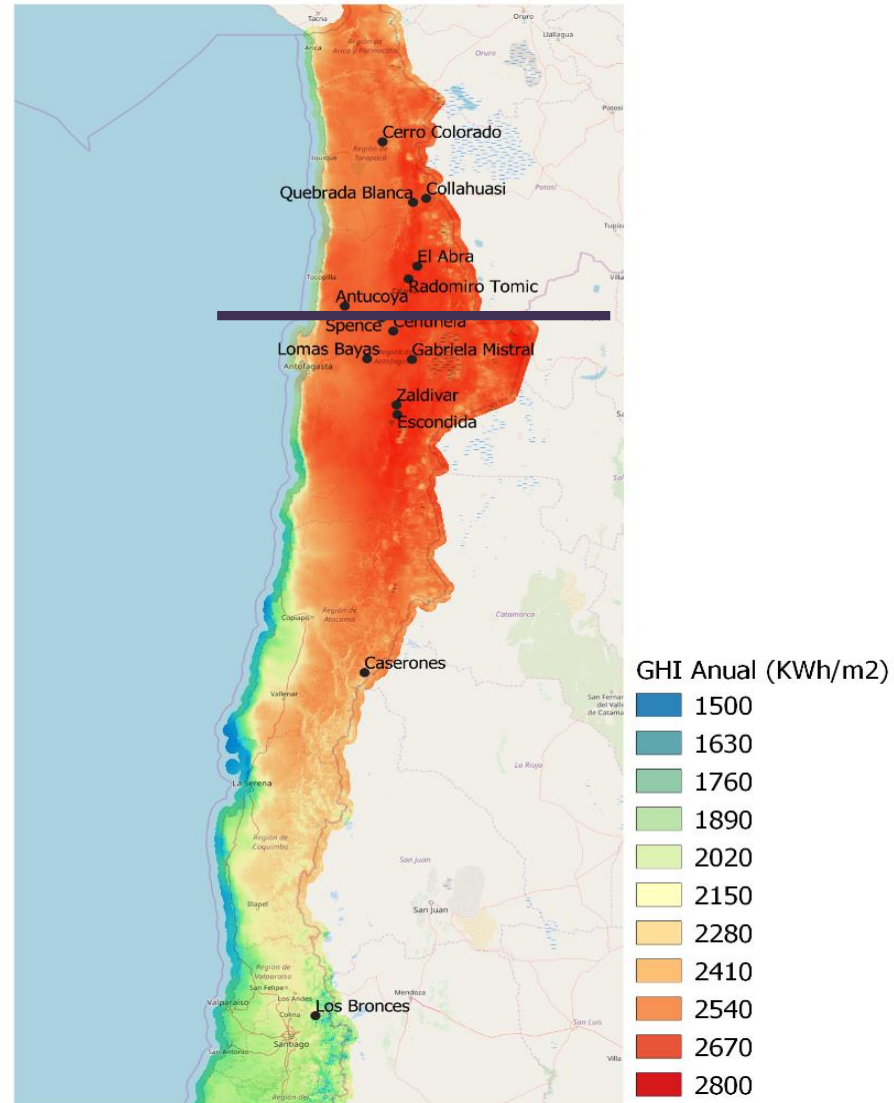
Copper Mining Processes

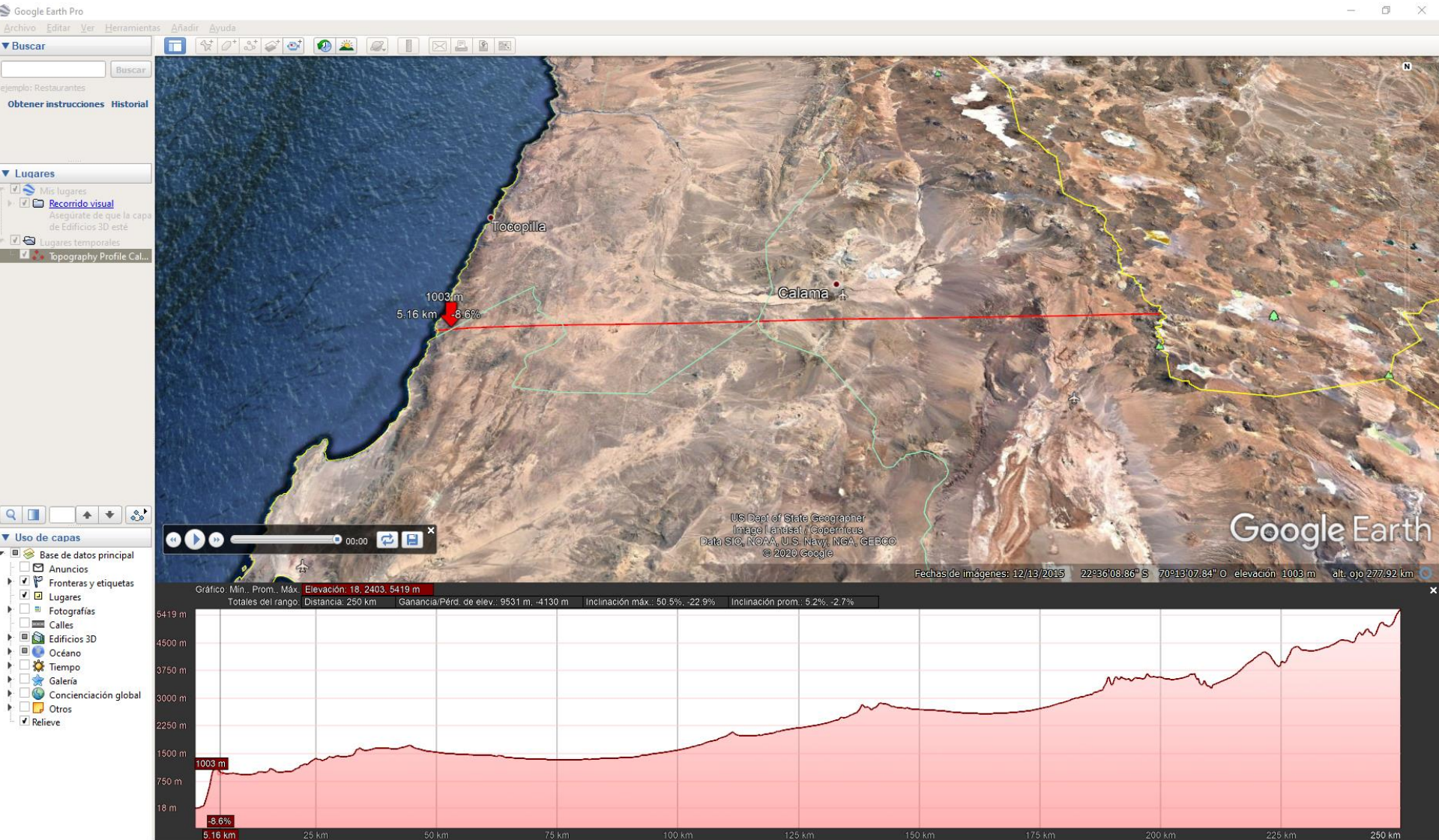
- The production process depends on the raw materials being processed: **sulfides**, or **oxides**.
- Both processes used heat in different temperature ranges.
 - **Sulfide** processing is called pyrometallurgy. Two processes where heat is used: smelting copper (>1000 °C), and drying.
 - **Oxide** processing is called hydrometallurgy. Heat is used for the EW process and for Leaching. (45 - 55°C)



Source: European Copper Institute, 2018

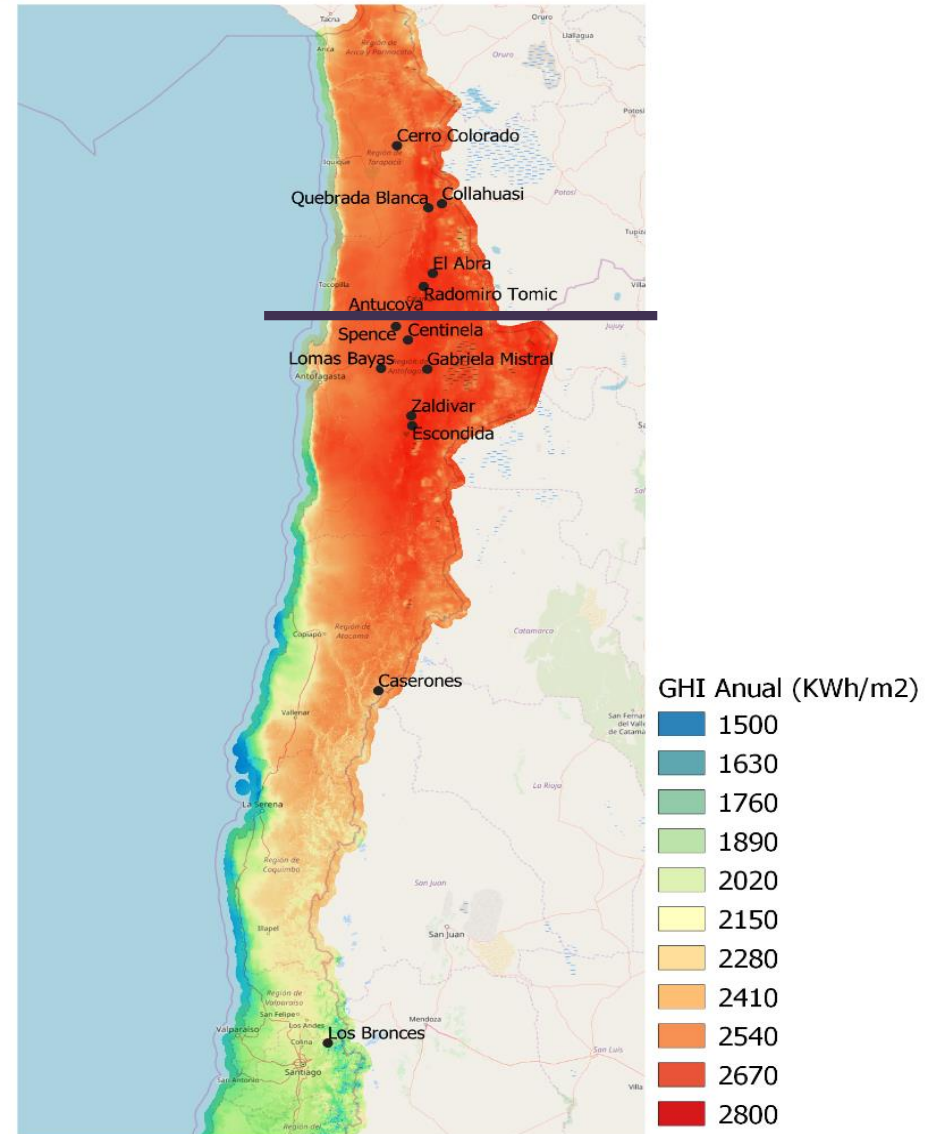
Particular Features



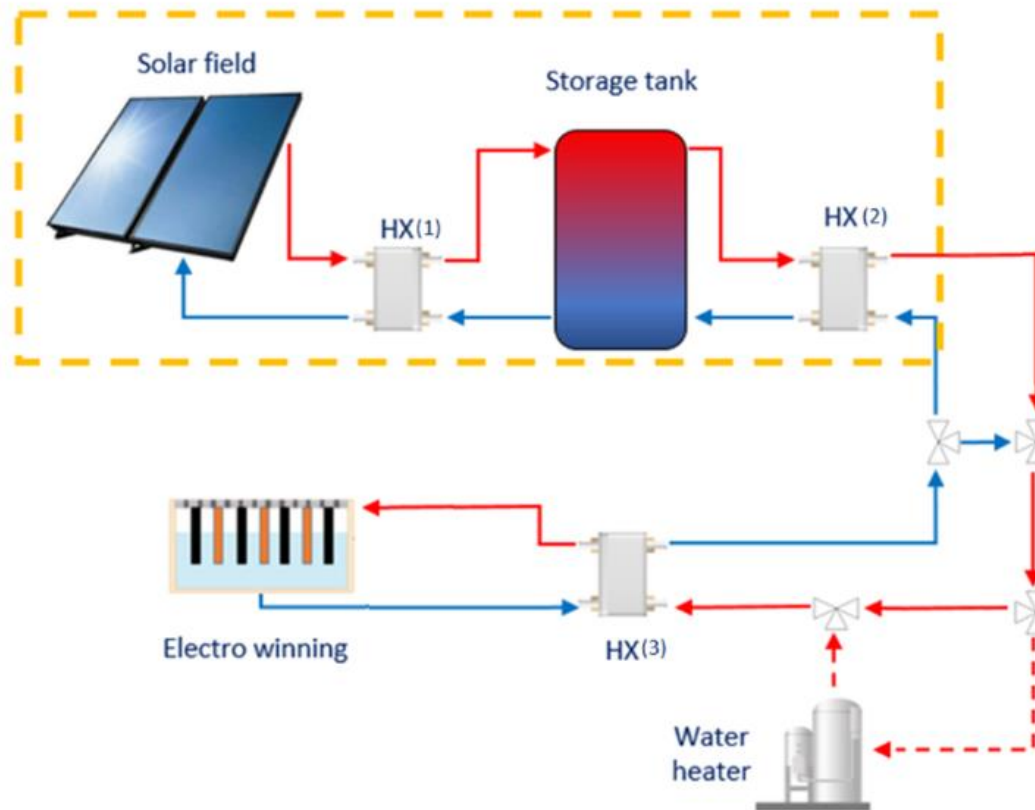


Particular features

- Copper Mining facilities are located in areas with
 - High altitude
 - High solar availability
- Chile does not produce significant fossil resources
 - Using diesel has also high transportation costs.



Process Integration



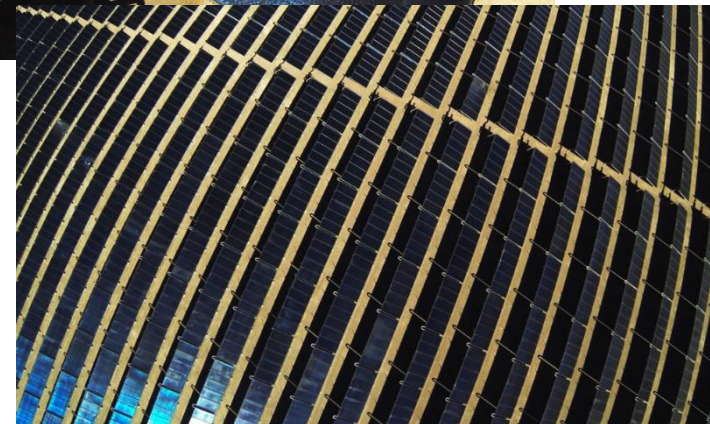
Centinela Mining Co.

Collector	PT-1
Working fluid	Pressurized water
Solar field surface (m²)	16,742
Storage size (m³)	300
Annual heat production (MWh_{th})	24,845
Solar Fraction	55.60%
Fuel savings	55%
CO₂e emission savings (ton)	7,951
Yearly sum of DNI (MWh)	~53,058



Gaby Mining Company – Pampa Elvira Solar

Collector	HT Heat Boost 35-10
Solar field surface (m ²)	39,300
Storage size (m ³)	4,300
Annual heat production (MWh _{th})	54,000
Solar Fraction	55.83%
Fuel savings	80%
CO ₂ e emission savings (ton)	15,000
Yearly sum of DNI (MWh)	~97,500

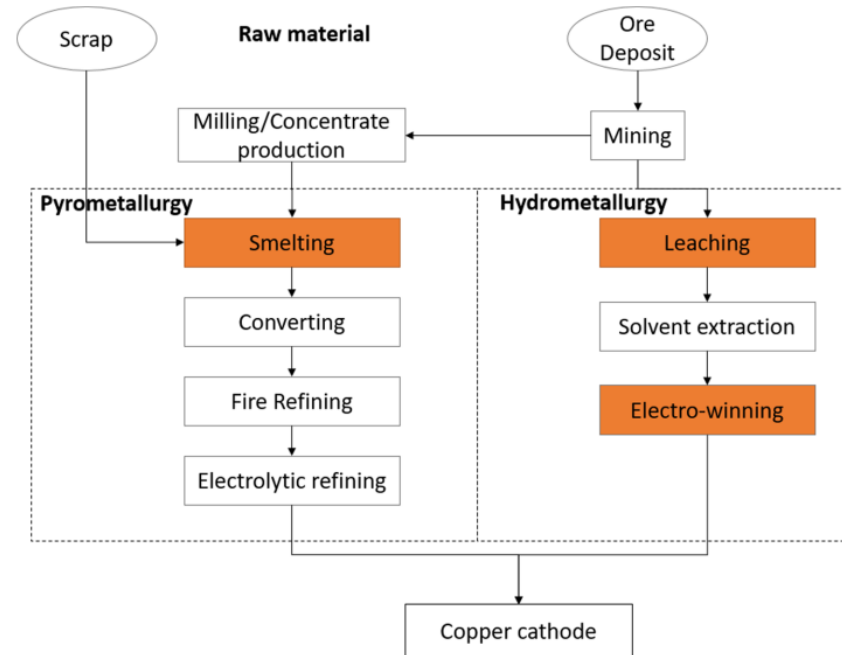


- SERC Chile

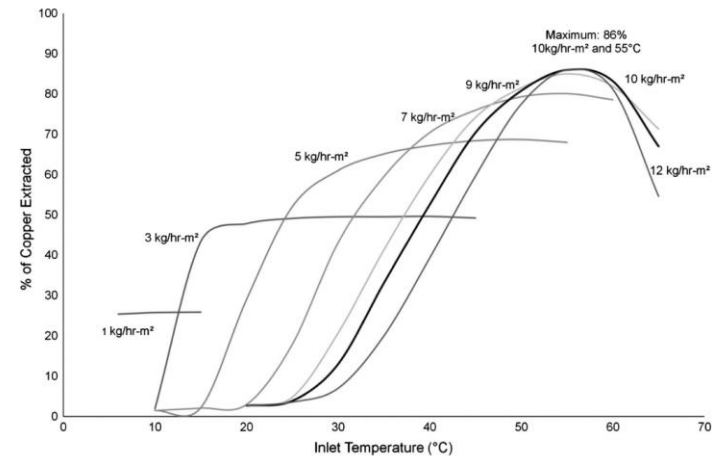
Source: <https://ellaimasolar.cl/>

New Opportunities

- Leaching
- Solution (PLS) heating



Murray, C., Platzer, W., & Petersen, J. (2017). Potential for solar thermal energy in the heap bioleaching of chalcopyrite in Chilean copper mining. *Minerals Engineering*, 100, 75–82. <https://doi.org/10.1016/j.mineng.2016.09.022>



Challenges....

- Water usage
- Soiling



Thanks!!

- More information...

Quiñones, G., Felbol, C., Valenzuela, C., Cardemil, J. M., & Escobar, R. A. (2020). Analyzing the potential for solar thermal energy utilization in the Chilean copper mining industry. *Solar Energy*, 197 (October 2019), 292–310.

<https://doi.org/10.1016/j.solener.2020.01.009>

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