



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

ISES

International Conference on Solar Heating and Cooling for Buildings and Industry CONFERENCE 04 - 07 NOVEMBER

March 10th, 2020

JM Cardemil - SERC Chile

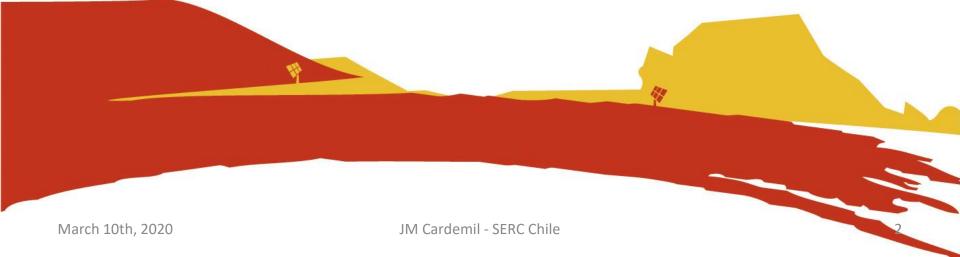
ISES Webinar ISES Infographics Solar Thermal Heat for Industry Processes March 10th, 2020



Solar Thermal Heat for Mining Processes

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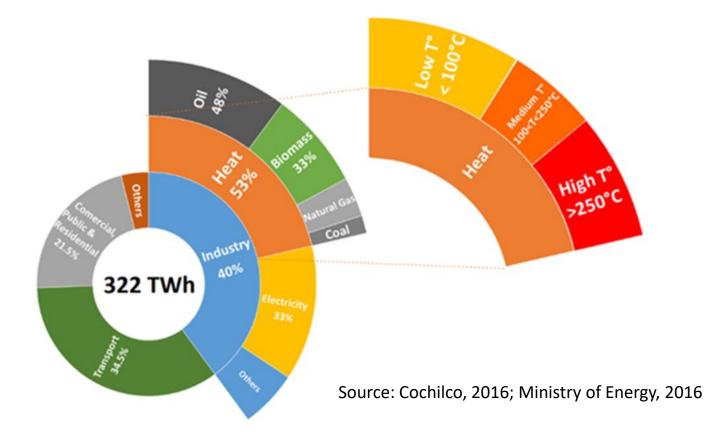


Agenda

- 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





Heat consumption in industrial Processes

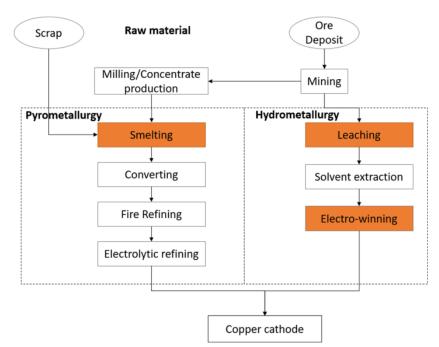
March

MINING			WOOD				FOOD				
								Meats	Food products	on pre	eparati and servati of
							Fish, crustaceans and mollusks		Millin starch		Anima I foods
								Bakery	Tobacc	Wi	. No.
							Dairy products	Sugar and starches	o Others	Al	00
							GLASS	METAL PRO	DUCTS	СНЕ	MIC
Coppor			Paper and colluloco					Iron and steel industry	Metallic product s for structur al use	product nitrog s for comp structur	
Copper		Paper and cellulose			Others	Other	R H	h	S P		
								MACHI	ELECTRO	NICS	TEX
		Lithium and					Concrete, cement and plaster articles	Mac Agr hine cult ry ur	equipme		Tan () \\/ ► -
Various mines		Saltpeter	Wood pulp, paper and cardboard	cardboar d	ers Wood	planing . F W <mark>'</mark>	Cemen Cl	Mi <u>s</u> r	_	0 in	int g
FOOD ELECTRON		ICS ENERGY WOOD		DOD	MACHINERY						
	PRECIOUS METALS	MINING	OTHERS		PLASTIC AN		ND RUBBER 📕 METAL PRODUCTS				
	CHEMICAL PRODUCTS	TEXTILE	TRANSPO	DRT	GL/	ASS AND	CERAMICS				
.0th, 2020			JM Cardemi	I - SERC	Chile						



Copper Mining Processes

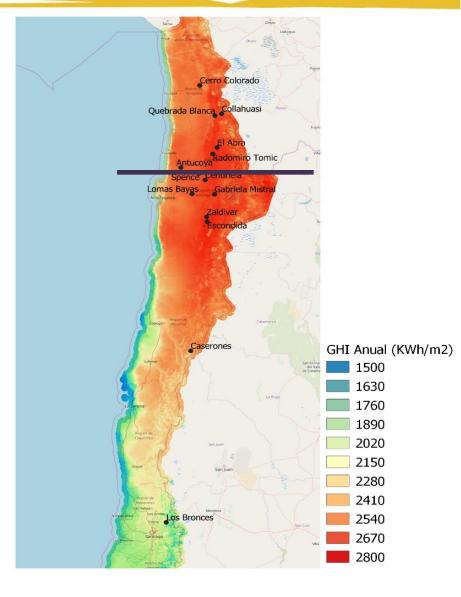
- The production process depends on the raw materials being processed: sulfides, or oxides.
- Both processes used heat in different temperature ranges.
 - Sulfide processing is called pyrometallurgy.
 Two processes where heat is used: smelting coppe (>1000 °C), and drying.
 - Oxide processing is called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



Source: European Copper Institute, 2018



Particular Features





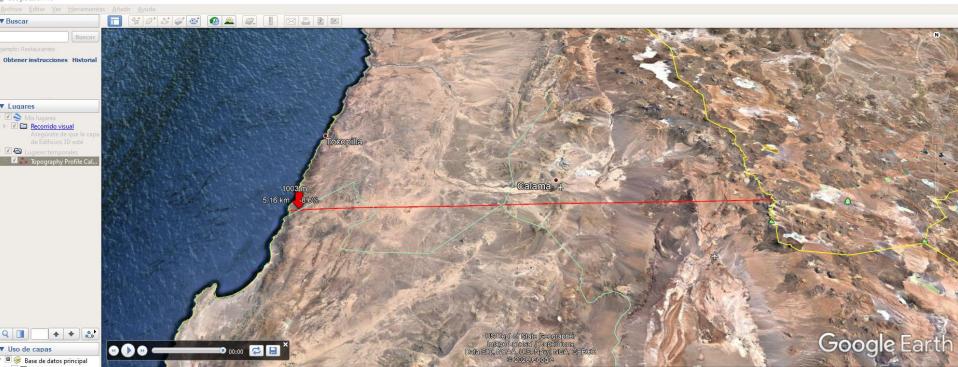


▼ Buscar

▼ Lugares Mis Mis 🕨 🗹 🖾 <u>Recorrido visual</u> 🗹 😂 Lugares temporales

Q 🔳

▼ Uso de capas





🕫 🗏 🎯 Base de datos principal Fechas de imágenes: 12/13/2015 22º36'08.86" S 70º13'07.84" O elevación 1003 m alt. ojo 277.92 km Gráfico: Mín., Prom., Máx. Elevación: 18, 2403, 5419 m Totales del rango. Distancia: 250 km Ganancia/Pérd. de elev.: 9531 m, -4130 m Inclinación máx.: 50.5%, -22.9% Inclinación prom .: 5.2%, -2.7%

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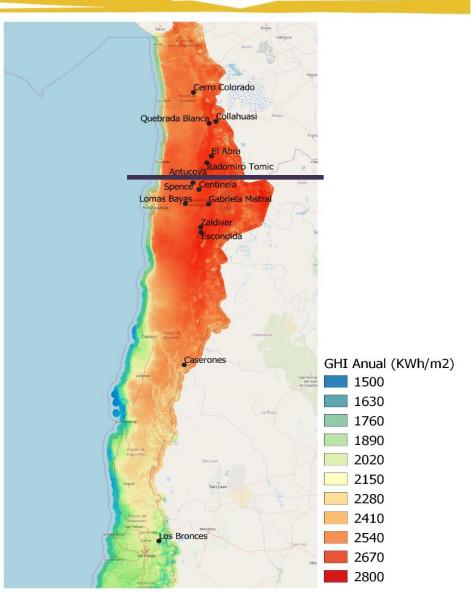
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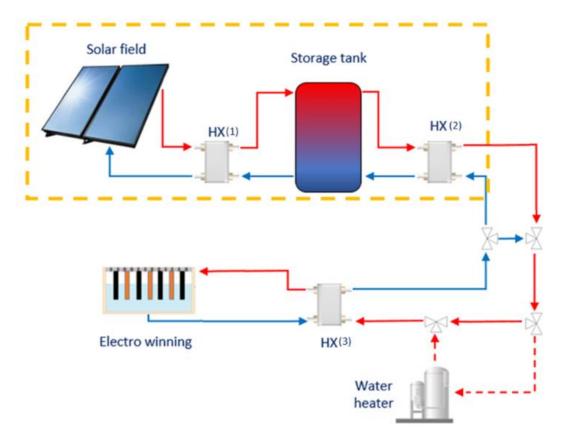
Particular features

- 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 (m ²)	16,742			
Storage size (m ³)	300			
Annual heat production (MWh _{th})	24,845			
Solar Fraction	55.60%			
Fuel savings	55%			
CO ₂ e 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				







Source: https://ellaimasolar.cl/

- SERC Chile

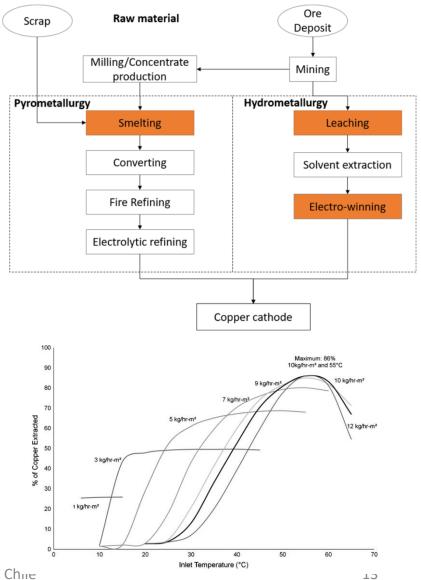


New Opportunities

Leaching ۲

Solution (PLS) heating ۲

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



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Challenges....

• Water usage







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

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