WHAT IS GEOTHERMAL?

Geothermal energy is heat from the Earth. It's clean, sustainable and carbon neutral.

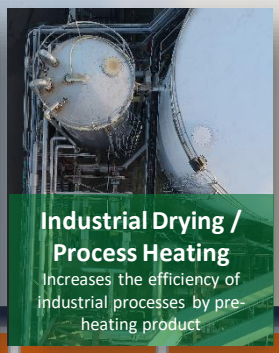
Geothermal resources range in depth and temperatures, from shallow ground fluids to hot steam accessed by drilling wells beneath the Earth's surface.

The hotter reservoirs can be used to produce electricity, while the moderate reservoirs are a ready source of natural heat, without burning fossil fuels.

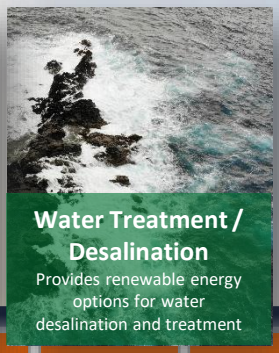
BEYOND ELECTRICITY, HOW CAN IT BE USED?

Geothermal can be used in a variety of ways depending on temperature and locations:

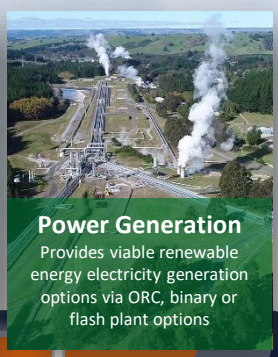
Heating & Cooling
Provides low-cost option of keeping consistent temperatures year-round



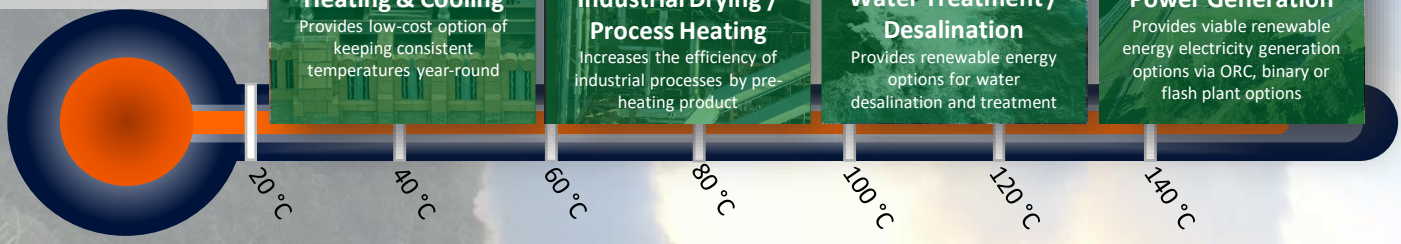
Industrial Drying / Process Heating
Increases the efficiency of industrial processes by pre-heating product

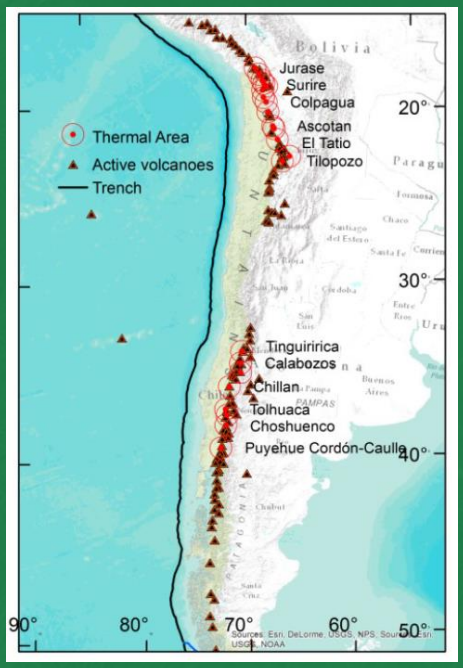


Water Treatment / Desalination
Provides renewable energy options for water desalination and treatment



Power Generation
Provides viable renewable energy electricity generation options via ORC, binary or flash plant options





GEOTHERMAL POTENTIAL: CHILE

Chile is home over 10% of the world's active volcanoes. Geothermal exploration identified over 300 geothermal areas in 2 major zones, north of Santiago and south of Santiago.

The northern zone has >90 deg C hot springs and is home to the only geothermal powerplant in South America Cerro Pabellon. Temperatures in this zone ranges from 110- > 260 °C. The central-southern zone has >300 hot springs and temperatures are between 150-300 °C.

Chile has a wide range of potential geothermal uses including power generation, industrial applications, agriculture (greenhouse and aquaculture) and heating/cooling.

Figure 1: Map of the Geothermal Areas in Chile

GEOTHERMAL OPPORTUNITIES IN MINING

Mines are energy intensive operations leading to high energy costs, especially in remote regions that lack infrastructure. The mining industry is aware of the need to shift towards cleaner energy sources to reduce its environmental impact. Geothermal is a reliable source and often overlooked as an energy option for the industry. Minerals such as precious metals can be found in similar geological settings as geothermal. For mines located in areas of high geothermal potential, the energy source provides options for cost reduction and green tax benefits.

- Hot fluids can be used for raffinate heating in copper production and enhanced heap leaching for the extraction of gold and silver.
- Underground mines must deal with higher ventilation loads; which can be provided by geothermal power generation.
- Geothermal fluids can also provide energy for space heating in colder climates or for water desalination in areas of water scarcity.
- Geothermal energy helps in reducing a mine's environmental impact and Greenhouse Gas (GHG) emissions improving sustainable development and relationships in the community.

Factors affecting the successful integration of geothermal energy in a mining development are:

- Presence of a resource
- Price of alternate energy infrastructure
- Distance of source to the site
- Potential for coproduction or minerals extraction
- Availability of communities and industries in the vicinity of the mine
- and industries in the vicinity of the mine

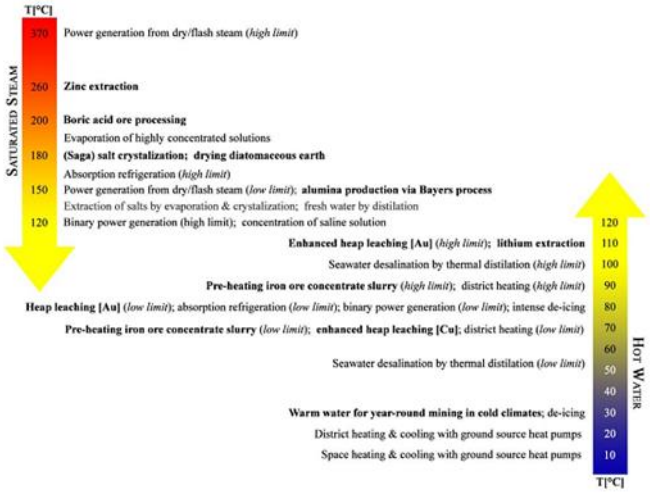


Figure 2: Geothermal application in the mining process based on temperatures

CASE STUDY: GEOTHERMAL USE IN MINING

Chile has large mineral resources and geothermal resources providing a unique opportunity for several geothermal applications.

The **Lihir Gold Mine in Papua New Guinea** has similar mineral, geological and geothermal resources as Chile, which helps to illustrate the advantages of developing geothermal resources at a remote mine site.

A series of wells were drilled which identified geothermal reservoirs ranging from 240 to 300 deg C.

These resources were used to develop a 6MW geothermal powerplant in 2003 resulting in savings of $200,000 USD/month. In 2005, a larger 30MW geothermal plant was developed with projected annual **savings US$14 million** in 2006.

Today, the powerplant's capacity is 56 MWe, providing ~75% of the operation's power needs and **US$40 million in savings** from offsetting heavy fuel oil consumption. US$4.5 million was also generated from sales of carbon credits on the global market (~280,000 tons greenhouse gases per year).

These savings were felt directly by the client, Newcrest Mining, but also indirectly by gaining local community support with the utilization of renewable energy and reduction of water use.

GEOTHERMAL FOR HEAP LEACHING

Heap leaching is commonly used to efficiently recover metallic minerals. Adding heat (70-110°C) to this solution (enhanced heap leaching) has been shown to accelerate mineral extraction, increase gold extraction rates by 5-17 % and copper extraction rates by 1.2 % per °C increase in the heap solution temperature. In Nevada (USA) several gold/silver mines successfully use geothermal fluids (82-99°C) in enhanced heap leaching. With Chile's geothermal resources, enhanced heap leaching seems like an obvious choice