



WHY SOLAR IS A GOOD FIT FOR MINES: A CODELCO CASE STUDY

When Energia Llaima's General Manager Ian Nelson began discussing thermosolar power with Codelco, a northern Chilean copper mine in the Antofagasta region, he offered a novel business model. A Chilean-Danish consortium of Energia Llaima and Sunmark would invest over \$26 million in creating the Pampa Elvira Solar plant and would assume all operational, technical and investment risks for the project; Codelco's Gabriela Mistral division simply had to sign on to purchase an agreed-upon amount of energy each year. "We told them, 'If we don't produce the energy you need, you just don't pay us,'" says Nelson.

"We realized that we had to change the way the business was done," he explains. Nelson knows that it's difficult to convince a mine operator to give the green light for a new renewable technology. "They don't know if it works," he says. "And they're worried they'll be punished if it fails."

Renewable Options

For the past several years, Codelco has relied solely upon diesel fuel for its copper electro-winning process. With a commitment to replace 85% of all diesel fuel used with 51,800 thermal megawatt hours of thermosolar, Codelco stands to save the expense of almost two months of fuel annually.

At first, Nelson, who spent much of his career managing a natural gas distributor, was skeptical whenever he saw a mining company exploring solar energy.

Over time, Nelson began investigating different solar technologies when he traveled abroad. He recognized that solar energy suits the mining industry particularly well because mines have a concentrated demand for heat and their sites are typically spacious (land is often a constraint for other businesses). On the other hand, the fact that mines are so dusty and often experience very high winds poses a challenge for solar energy providers.

The consortium will use solar panels to collect energy that is then stored in a 4,000,000 liter tank that's 17 meters high and 17 meters wide. The energy will be kept in a thermal battery with up to 48 hours of reserve energy, explains Nelson. That means that Codelco has two-to-four times the heat capacity necessary to operate its copper electro-winning process. He points out that while the mine will continue to have three boilers, additional money can be saved over time by removing one or two of the back-up boilers.

When Nelson initially approached Codelco, he felt solar would be a good solution for the copper electro-winning process. Electro-winning involves placing copper in a bath and running an electric current through the water to form an electrolytic reaction; copper sticks to the cathodes and the result is 99.999% pure copper. To be successful, electro-winning requires highly concentrated temperatures, often in the 50-60 degree Celsius range.

If energy demand from the Gabriela Mistral division ever decreased, the consortium has a plan for safely handling the huge reserve of energy. The heat would be kept on the thermal battery during the day, and at night the company would run the system backwards to dissipate the heat.

Nelson highlights Sunmark's vast experience on the field based on many decades designing and building large-scale district heating systems. For these systems, the heat delivery conditions are even more stringent than in the mine because families depend on thermosolar for heating their homes in harsh climates such as in Denmark or Norway.



Making the Case for Renewables

Energia Llaima and Sunmark are highlighting the practical advantages of thermosolar energy. Nelson points out that Codelco's existing boilers won't be replaced but instead the sensors will be tricked into turning off the diesel supply after they detect a sufficiently high temperature. Were the thermosolar energy source ever to cease working, the heaters would kick in and be powered by diesel fuel. Sunmark's proven control software handles all the plant's operational variables and 24-hour surveillance from Denmark allows a secure and efficient operation.

The consortium endeared itself to the managers of the Codelco mine by agreeing to not only supply solar energy but also to assume responsibility for heater maintenance. "Heaters are like the orphaned child in the corner-- no one is taking much care of them," says Nelson. "In the mining industry, most heaters are in a pitiful state."

Using solar energy also helps mines burnish their image. "Mines want to be the good guys in the neighborhood. They want to look clean, but it's hard for them because of what they do," says Nelson. Once the Pampa Elvira Solar plant is up and running, Codelco will see a reduction in greenhouse gases equivalent to 15,000 tons of carbon dioxide per year. The reduction in diesel usage also means that 250 fewer trucks will be on the road annually.

In the end, though, what convinces most mines to try renewables is cost. "If you can't promise savings," says Nelson, "you have to work really hard to get things going." For Codelco, the cost argument was convincing, especially given the high price of diesel.

Beyond the dollars saved is the opportunity to better anticipate energy costs because Codelco will be purchasing thermosolar at a fixed price. Nelson points out that mines frequently buy options to secure energy costs but that the "option" is already built into this business model at no additional cost. Solar energy also provides peace of mind that isn't available with diesel because diesel supplies in Latin America are often interrupted by strikes or road blockades.

Although cost is critical, Nelson is convinced that the business case works best when it is made holistically. "We're taking something that bothers you and saving you money," he says, noting that the savings relative to diesel can range from 7-45% depending on several different aspects, including contract length, radiation level, and plant location. "And we're putting a green side on this. You'll be self-sustainable."

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IAN NELSON,
Energia Llaima



The Build and Implementation

Before choosing the Energia Llaima and Sunmark consortium, the mine went through an international bidding process that included six separate bidders, evaluating each based on financial health and the technical expertise of the team.

Codelco signed a contract with the consortium in September 2012 and anticipates that the electro-winning process will largely be powered by thermosolar energy by September 2013. Nelson notes that in Chile, building didn't start until the end of January 2012 because of the onerous training and security demands for all personnel. Nelson likens getting approvals for machinery and staff to enter Chile to "sending a man to Mars."

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For Nelson, an important lesson for any renewable energy provider is to continue to innovate. He is currently researching hydroelectric energy, as well as electro-winning processes that use liquids with lower boiling temperatures than water.

Finally, Nelson emphasizes the importance of taking the time to understand mining companies and how they are run. "Mining companies are not really energy companies. The way decisions are made is completely different," he says. "You have to know what are the things you can and cannot do, and you have to be prepared to handle failures along the way." Even though progress can come slowly, his advice is: "Try anyway."



THOUGHT LEADERSHIP HATCH ATTRACTIVE ECONOMICS AND COST SAVINGS: WHY MINES ARE TURNING TO RENEWABLES

This thought leadership piece provides insights from Rob Lydan and Michel Carreau of Hatch's renewable energy team. The two offer perspectives for mining companies on the economics of wind and solar energy, the challenges of integrating hybrid power solutions, and the 10-20% potential cost savings from moving towards alternative energy solutions.

"Up until quite recently, if you asked miners to describe renewable power, you'd often hear words like 'unreliable,' 'expensive,' and 'risky,'" says Rob Lydan, Director, Solar and Wind, at Hatch. Lydan acknowledges that for many years, solar, wind, hydro, and other forms of renewable energy were intriguing but seemed too expensive and too cutting-edge for the comfort of the mining industry-- but that's all begun to change.

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Hatch

Over the past few months, the capital costs for renewables have continued to drop considerably. Consequently, many renewable solutions are now less expensive than diesel. "Wind power in a remote mining installation can reduce your cost of energy by 10-20%," says Michel Carreau, Hatch's Director of Renewable Power.

At the same time, the ability to engineer a hybrid renewable solution that is highly reliable has increased. With proper implementation and education, Carreau and Lydan are convinced that a hybrid renewable energy system can work just as reliably as running diesel gensets on their own.