

An energized future

To combat climate change and to assuage investors, mining and exploration companies are making strides to deploy alternatives to traditional fossil fuels to power their operations

By Alexandra Lopez-Pacheco and Amanda Graff

In 2015, a few weeks before the COP21 United Nations Climate Change Conference in Paris, France, began, the International Council on Mining and Metals (ICMM), whose members represent the world's leading companies in the mining and metals industry, issued a short statement on its position on climate change that called for a "measured transition" to reduce global emissions with a greater use of renewable energy and other cost-effective low-emissions technologies as well as improved energy efficiency.

A lot has changed in six years.

By contrast, the statement ICMM released just before the COP26 summit in Glasgow, Scotland, was a far longer, more detailed roadmap accompanied by an open letter from the member companies' CEOs. They announced their collective commitment to decarbonization with the goal of net zero Scope 1 and 2 greenhouse gas (GHG) emissions by 2050 or sooner and encouraged their customers and suppliers to work with them in decarbonizing their value chains.

Today the conversation has shifted from the risks of decarbonizing too aggressively to the risks of making the transition too slowly. It has revolutionary-scale implications for the natural resources we will require and for how they will be extracted.

As the suppliers of the metals and minerals needed for the green-energy technologies at the centre of global decarbonization, the mining industry will be on the frontlines pushing the new industrial revolution forward. But as an energy-intensive, high-emissions industry that relies heavily on fossil fuels, it is one that will need to risk new strategies and technologies to serve the cause. There are, however, a growing number of operations that have taken the risk and are winning new ground.

The first three-megawatt wind turbine was installed at the Raglan nickel mine in 2014. Glencore and Tugliq added a second in 2018. Courtesy of Tugliq

The decarbonization mind shift

“A mind shift is needed across nearly every industry,” said Theo Yameogo, EY Americas mining and metals leader. “Between increasing external pressures, impacts felt from the COVID-19 pandemic and global commitments made at the recent COP26 event, we are at a point of no return. While many are playing the game of wait and see – until global standards are set and enforced – companies need to act now and mobilize behind a decarbonization strategy so that they aren’t left behind in the fight for talent, capital and assets.”

Mining leaders see the writing on the wall. Global mining executives surveyed this year between June and September for EY’s annual Top 10 Business Risks and Opportunities for Mining and Metals in 2022 pushed decarbonization up from last year’s fourth place to second behind environmental and social issues.

On the other side of the equation, EY’s survey of institutional investors this year found 86 per cent are choosing companies that have aggressive carbon-reduction strategies or a low-carbon footprint.

The decarbonization revolution is poised to bring profound changes to the financial sector as well. The Glasgow Financial Alliance for Net Zero (GFANZ) was founded in April 2021. Seven months later, at COP26, more than 450 financial institutions in 45 countries committed over US\$130 trillion of private capital through GFANZ to help drive a net-zero economic transformation. But that is just one of the many initiatives, which include climate-related reporting, climate-risk management and climate-related investment returns, to decarbonize the world’s financial sector and its investments.

“Manufacturers, consumers and investors have a vested interest in ensuring raw materials are responsibly sourced,” said Martin Turenne, president and CEO of FPX Nickel, a Vancouver-based junior mining company developing the Decar Nickel District project. “As a result, carbon-neutral thinking is becoming the new normal in order for miners to obtain the social and environmental licences required to operate.”

An electrifying future

By all accounts, electricity will increasingly turn the motors in mining operations as they journey towards decarbonization.

“We must switch to renewables at scale, electrify everything we can electrify, work across our entire value chain and accelerate the development of new technology,” said Jakob Stausholm, Rio Tinto’s chief executive officer, at the company’s Capital Markets Day on Oct. 20, 2021. The company has committed direct investments of US\$7.5 billion in decarbonization from 2022 to 2030.

The mining industry is capital intense, which also makes it averse to innovation risk. But the electrification of mines

would not even be contemplated today if the industry had not already collaborated with mining equipment manufacturers in seizing emerging battery electric technologies to enable the electrification of mining vehicles over the last decade and a half. Early adopters such as Kirkland Lake Gold’s Macassa Mine in northern Ontario, which began operating battery electric vehicles (BEVs) in 2011, have contributed to the advancement of the electrification of mining equipment many in the industry are embracing.

Only five years after Macassa’s venture into BEVs, Newmont set the ambitious goal of making its Borden Lake mine in Ontario one of the first all-electric underground mines in Canada. More recently, Glencore’s Onaping Depth project similarly designed for a state-of-the-art battery electric mining fleet. There are also greenfield projects in development, such as Giga Metals’s Turnagain nickel-cobalt project in British Columbia, that are planning to connect to the provincial grid and exploring the potential of an electrified mining fleet.

Even older brownfield projects with few years of mine life left, which cannot justify a complete overhaul of their diesel equipment, have options to do their part to move towards electrification.

“If going full battery electric is not what you want to do,” said Al Poole, chief designer, electrical at Stantec, “there are hybrid kits that can be installed into a diesel machine so when the machine needs that extra boost of power, the diesel power kicks in but otherwise it runs on battery. Or you can use a [trolley assist] system. You can [even] start with your smaller support vehicles. There are options out there.”

Canada has an abundance of hydropower, with the provinces of Ontario, Quebec, British Columbia, Manitoba and Newfoundland and Labrador as top producers. This is not only facilitating the electrification of mining operations in Canada, but it is also positioning them for a global competitive advantage as producers of low-GHG metals.

Wind and solar

Mines in remote regions or in countries with a high dependence on electricity produced by burning fossil fuels have to turn to wind and solar energy to reduce their GHGs. A decade ago, neither was seen as a particularly promising alternative to diesel by both mine developers and operators.

One of the junior miners early to adopt solar energy was Canadian-based Avalon Advanced Materials in 2009 at its then exploration camp at the Nechalacho rare earth elements deposit.

“As a result of our work, more and more exploration sites are using solar power,” said Mark Wiseman, Avalon’s vice-president of sustainability, whose company installed solar power at its camp in the Northwest Territories to reduce its reliance on its diesel-powered generator.

“Energy is expensive in remote locations, as fuel often needs to be shipped in drums by boat or plane,” said Wiseman. “Weather can also be a challenge – we were facing long, cold winters with little sun, followed by hot summers. We were curious as to whether we could effectively operate a renewable energy system in this type of environment.”

It turned out that the renewable energy system was quite effective.

The company analyzed where diesel was being used the most. Camp-tent heating was identified as one of the main uses of diesel at the site, with a cost of roughly \$500,000 over three years, so Avalon made that the focus of its solar experiment, which included a rechargeable battery system back-up power supply for the diesel generator. By charging batteries with solar power, the generator could be periodically shut down while the camp ran on batteries. Electrically controlled heaters require only 0.7 litres of diesel every hour on high, as compared to two litres per hour for the diesel generator. At 15 heaters per day, greenhouse gas emissions were reduced by almost 1.3 tonnes in tent heating alone. Furthermore, operating efficiencies lowered heating costs by 90 per cent, resulting in a payback period of 11 days on the cost of new heaters. Other savings included a lower risk profile, fewer man hours, and a reduced safety risk related to handling heavy barrels of diesel.

Another early adopter of solar power was Iamgold, which installed a US\$12 million five-megawatt plant comprised of more than 16,000 panels in 2014 at its Rosebel open-pit mine in Suriname. Then in 2018, Iamgold commissioned a US\$25 million 15-megawatt solar plant with 130,000 photovoltaic panels at its Essakane gold mine in Burkina Faso. The solar power replaced the need for six million litres of fuel annually and reduced the mine’s emissions by 18,500 tonnes of CO₂ a year.

“Iamgold recognizes that climate change is one of the greatest challenges we are facing today and requires action,” said Daniella Dimitrov, Iamgold’s executive vice-president and chief financial officer. “Our decision to achieve net-negative emissions was based on that assessment, and in line with our ‘Zero Harm’ vision of pursuing sustainable mining.”

When Glencore partnered with Tugliq Energy to install a three-megawatt wind turbine at its Raglan nickel mine in the Nunavik region of northern Quebec in 2014, there were many

skeptics because successful industrial wind projects in northern climates were rare. With the addition of a second wind turbine in 2018, the project set a new landmark in harvesting wind energy in harsh, northern climates. The turbines now generate around 10 per cent of the mine’s power, eliminating the cost of four million litres of diesel every year and the 12,000 tonnes of CO₂ emissions burning it would have produced. Tugliq is working with Glencore to identify the next step for clean energy integration and further decarbonisation at the mine site.

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Beyond wind, Glencore and Tugliq are also experimenting with solar energy. According to an article written by Marc-Antoine Dufour, energy efficiency engineer at Raglan Mine, construction of a solar park at the Mine 2 site was completed in July 2021. The system has a total of 108 monofacial and bifacial solar panels that “capture solar radiation reflected off the snow” and generate 40 kilowatt-peak of energy. “The power generated by the cells will be converted from direct to alternating current through an inverter, in order to be integrated into the 25-kilovolt distribution network and help power the Katinniq site, as well as the Mine 2, Mine 3, Qakimajurq, PM8H and PM14 sites.”

Around the world, a growing number of mining operations are now looking to combine both wind and solar power to replace fossil-fuel-based energy generation – and lay the foundation for future electrification of their operations. Rio Tinto, for example, is planning to decarbonize its Pilbara region iron ore network by replacing a natural gas power plant with one gigawatt of wind and solar power, which will cut one million tonnes of CO₂ emissions and eventually help fully electrify Rio Tinto’s Pilbara system, including all trucks, mobile equipment and rail operations.

Courtesy of Wärtsilä



Iamgold was an early adopter of solar power, installing plants in Suriname in 2014 and Burkina Faso (pictured above) in 2018.

Companies that have added renewable wind and solar projects to their energy mix have opened the door to a future in which mines can generate all their energy needs with a microgrid powered entirely by renewables that leverage advanced battery storage to provide energy-supply stability. The technology is not quite there yet, but it is getting close.

In early November 2021, South African-based Gold Fields announced the official opening of a hybrid renewable microgrid at its Agnew Gold Mine in a remote area some 1,000-kilometres northeast of Perth in Western Australia. Built in partnership with the energy company EDL, the \$98 million microgrid provides the mine with a daily average of 50-60 per cent of its energy from renewables. Under the right weather conditions, the microgrid's renewables have provided as much as 85 per cent of the mine's energy.

This performance is an enormous leap forward. Prior to the integration of a lithium-ion battery-based energy-storage system from Saft, with a total of 13 megawatt power and an energy storage capacity of four megawatt hours, the microgrid's solar and wind energy only managed to provide 10 per cent of the mine's power requirements. EDL believes it can improve its lithium-ion battery technology to increase the penetration of renewables and is exploring the use of adding hydrogen to the mix.

New old energies on the block

The world is going to need a lot more electricity to replace fossil fuels. Neither hydrogen nor nuclear power are new renewable-energy technologies, but both are being aggressively explored and developed as solutions to decarbonize. Some countries such as Spain are betting heavily on green hydrogen energy to achieve carbon neutrality by 2050. (Green hydrogen is created via electrolysis, with renewable energy fueling the production process.)

Within mining, Anglo American and others are exploring how the element could power haul trucks in the future. The company will be trialling a hybrid-hydrogen-fueled haul truck at Mogalakwena mine in South Africa. If all goes well, the company plans to have a fleet of 40 haul trucks fueled by solar-power-made hydrogen at the mine in 2024.

Stantec's Poole said he is watching the development of hydrogen-fueled haul trucks with interest because it can be deployed quickly to help miners decarbonize. In his opinion, hydrogen fuel could be a quick solution to help reduce haul-truck emissions through the decarbonization transition.

"It's not new technology," he said. "In a past life, I was working for a company where we were doing some testing and pilot runs on a hydrogen fuel cell for a transport truck and it was a very interesting project, but they couldn't find any buyers."

In Canada, a world leader in nuclear technology, small modular reactors (SMRs) – a new class of smaller, portable and scalable reactors than the 19 large-scale reactors that currently generate some 15 per cent of the country's electricity – have been identified by the federal and provincial governments as pivotal to decarbonization.

"Every nation has a different set of challenges when trying to reach net zero," said John Gorman, president and CEO of the Canadian Nuclear Association. "In the Canadian context, we already have a pretty clean electricity system, but it also means, unlike the U.S. and other countries, we can't find our savings by just cleaning up the electricity

sector. Our challenge is how do we decarbonize heavy industries such as mining."

Canada's SMR Roadmap and Action Plan, developed by the federal and provincial governments in collaboration with Indigenous groups, communities, the private sector and innovators such as Mining Innovation, Rehabilitation, and Applied Research Corporation (MIRARCO) is already being implemented. Currently, 12 different SMR technology companies are undergoing the review and licensing process with the Canadian Nuclear Safety Commission. One of them is U.S.-based NuScale Power, which recently signed a memorandum of understanding with consulting firm Piela Business Engineering and Polish copper and silver mining company KGHM. The partnership will explore if KGHM's current coal-fired plant can be incrementally replaced by NuScale's SMR technology.

Diane Hughes, vice-president of marketing and communications for NuScale, explained the SMRs' decarbonization benefits. "A 924-megawatts electric NuScale plant would cut emissions by more than eight million tonnes of CO2 per year as compared to coal, which is essentially the equivalent of taking 1.7 million cars off the road."

The only thing that is certain is change

The coal-powered industrial revolution transformed mining and the world. We may be on the threshold of an equally transformative time. But as during any period of transition, uncertainty will dominate. "Between product development, technology, policy and regulation, there are many gaps to fill. And these factors are evolving quickly," said EY's Yameogo. "Companies cannot afford to wait for clarity to arrive and must start to put action to words to meet ambitious carbon commitments. For many, this will start with truly understanding what net zero means for them. Every decarbonization roadmap will look different, but through active scenario planning, companies can better ensure uncertainty, flexibility and adaptability are woven in from the get-go."

The speed of advancements in renewable energy technologies is accelerating each day. "Sometimes it's advancing quicker than the manufacturer can build [products] or the mining companies can implement them," said Poole. "So, by the time they've decided on something and they're about to buy the equipment and get it installed and start using it, the next generation is already starting to show up."

Working with OEMs that are flexible and offer solutions to address this challenge is more critical than ever, said Poole, as is a very thorough and holistic analysis of the impact of new technologies across an operation. BEVs underground, for example, don't just reduce diesel fuel costs, they also help to reduce ventilation costs because they do not emit particulates.

As well, he said, developing a modularized strategy for a step-by-step implementation of renewable energy solutions offers a sound way to move forward. The point is to take steps towards decarbonization and be a "good climate citizen," he said.

As with all the mines that have already acted as early adopters and technology risk takers, and helped nudge the industry forward, every step a mining operation takes towards decarbonization today is also helping pave the way for tomorrow's improved technologies and for a net-zero mining industry by 2050. 