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MINING

Magazine

Mining's Data-driven Future



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Striking a Balance:

Designing Mine Sites with Less Carbon-intensive Energy Infrastructure



By Debra Johnson, Senior Advisor, Mining, Minerals & Metals, and Ericka Wicks, Regional Sector Lead, Energy Transition and Renewable Energy, Stantec

We expect to see global mining activity increase over the coming years because it must increase to support the growing volume of critical minerals and metals required for decarbonization and reaching our ambitious net zero goals. For example, Lithium is used in batteries. Cobalt and graphite are needed for electric vehicles (EVs). Copper and zinc are required for renewable technologies like solar panels and wind turbines.

What does that mean? It means we must expand current mines as well as build new ones if we hope to drive the energy transition forward. But this leads us to another challenge: How can we power our mines sustainably? It shouldn't come as

much of a surprise that mines consume a lot of energy, and that energy must be reliable. Traditionally, that's led to heavy fossil fuel use and accompanying greenhouse gas (GHG) emissions.

How can we increase mining activity while reducing overall emissions? We do it by embracing sustainable energy solutions at mine sites and pushing for robust environmental stewardship. That's why mine sites are increasing their focus on renewable energy, alternative sources of energy, and energy storage solutions. These efforts not only help reduce emissions but they also present economic benefits and opportunities for innovation within the mining industry.

NOT A “ONE-SIZE-FITS-ALL” APPROACH

There are many ways to configure cleaner energy infrastructure. It's not a cookie-cutter approach – what works at one mine site may not be effective or a fit at another. For example, mines situated near a river may have the potential to generate hydroelectricity, whereas a mine site in the desert can leverage bountiful solar energy.

This is one example of why mining companies looking for low-carbon energy solutions often realize that not all options are suited to them. The good news? There are alternatives for mines to achieve an optimized mix of clean firm power. Mines can consider alternative forms of renewable energy, as well as carbon capture technologies. They can also pair new technologies and energy-storage systems with these energy sources to achieve their goals.

Beyond using a cleaner energy source, improving energy efficiency and reducing consumption are also crucial for reducing carbon emissions. Fortunately, the industry is advancing a growing number of innovative solutions. In addition,

solutions exist to overcome mining's traditional barriers to adoption.

One helpful approach? Combined heat and power plants (CHPs). CHPs generate electricity and thermal energy (heat) at the same time. Also known as cogeneration, mine operators can reuse the heat that would otherwise be lost. There are various uses for that heat. These include creating steam for electricity generation, heating buildings, supplying processes that require heat, or operating steam chillers for cooling.

Another option involves on-site microgrids and distributed energy resources (DERs). By using these, a mine can reduce or eliminate reliance on third-party power. Microgrids offer greater flexibility and higher efficiency rates. This helps balance renewable power generation with traditional energy sources. As an added benefit, mines may be able to send excess electricity back to nearby power grids. This may supply host communities with energy that is more sustainably sourced than what they have today.

Advancements in energy-storage technologies, such as battery energy storage systems (BESS), are revolutionizing

the way mines manage their energy needs. Combining renewables with BESS is an example of DERs, which encompass both the software and hardware needed to generate electricity and control loads. Generally, DERs and BESS must be complemented by other energy sources. This helps to meet the mine's energy and reliability needs.

The good news is that technology is improving and costs are decreasing because of the global focus on the energy transition.

GENERATING RENEWABLE ENERGY

Hydropower is one of the most advanced forms of renewable power. In fact, many mines get energy from hydropower already. Microturbine technologies can also harness energy from liquid gravity flows within a mine. This allows them to generate even more renewable energy. Pumped storage hydro allows for energy storage from renewable sources and strategic use during lower-rate periods. Our teams use tools to monitor and manage the significant water flows found at many mine sites. This creates a potential dual benefit of improved water and energy resource management.

Solar power is another great option. It can work especially well at mines with large expanses of already disturbed land. Why? Using reclaimed areas lessens the need to disturb even more land. While a site needs favourable solar radiation, configurations have been built to work in snow-covered arctic regions. Floating solar arrays are also viable options for water reservoirs on mine sites. When paired with energy and tailing storage facilities, solar can also provide power even when the sun isn't shining.

Generating wind power can augment a mine's energy supply and reduce emissions. It can offer a practical way to take advantage of un-mineable land on or near mine sites. However, a thorough evaluation of a site's wind potential and compliance with local and federal regulations are essential when planning for wind power. Like solar, wind is an intermittent resource that benefits from being paired with energy storage.

Often, one or more of these options are feasible. While hydropower depends more

SASKATOON OFFICE

P: 306 933-3010

F: 306 242-3156

E: nrtinquiry@nrtlp.com

WINNIPEG OFFICE

P: 204 235-4013

F: 204 233-2929

E: dpetrie@nrtlp.com

PRINCE ALBERT TRAINING CENTER

P: 306 922-2221

E: rmihilewicz@nrtlp.com



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on geography, solar and wind are a little more modular and can be leveraged at any site with favourable conditions. But what about other alternative sources of energy?

ALTERNATIVE SOURCES OF ENERGY

An interesting form of energy production, which is generally new in the context of mining, is hydrogen. Hydrogen is the most abundant element in the universe. It also releases no GHG emissions upon combustion. Hydrogen can be generated from renewable energy sources, known as green hydrogen. Other lower emitting forms of hydrogen are emerging as well, such as pink hydrogen, which is generated from nuclear power, or turquoise hydrogen, which is produced from methane pyrolysis.

Another intriguing option is biogas. While biogas is not a new concept, its use is growing as technologies improve and costs decrease. Biogas is produced when organic matter breaks down without the presence of oxygen. Then it can serve as fuel to power mining operations more sustainably. It also reduces physical waste at landfills in the process.

As mines go deeper, they extract materials and brines from the earth's mantle. This exposes sources of high-temperature brines, superheated rock, and hot air. We can utilize these resources in different ways to harness geothermal energy. Many brines and ores will require cooling to deliver the ideal temperatures and chemistry for mineral extraction. This drop in temperature can support geothermal power generation.

Finally, let's turn to nuclear power. Nuclear is becoming a bigger part of the conversation with the evolution of small modular reactors (SMRs) for commercial use. SMRs can provide a strong, clean baseload generation capacity and complement renewable energy sources. And like the name suggests, they can be modular. This allows mine sites to use them to power remote locations at a scale that works for them. This modularity supports the ability to increase power capacity as the mine expands or its community's needs grow.

A BRIGHTER FUTURE FOR THE MINING INDUSTRY

It's exciting to see that mining companies now have more solutions



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at their disposal than ever before. They have the tools to utilize lower-carbon forms of energy. At the same time, they may need help navigating the process of doing so. That's where we can help. We bring a holistic approach to these challenges. Our mining experts team with our energy specialists to create the right solution configured to the mine's needs. Additionally, our team's North American Funding Program regularly tracks funding available for mining. Mining operations should consider how these funding programs might enhance the financial viability of their projects.

Adopting low-carbon energy options not only reduces GHG emissions but it can also lower operating costs. It also provides energy independence in regions where energy is scarce, unreliable, or hard to access. As the demand for more mining continues to grow, more new mines must be developed. Since these mines are often in remote areas, local communities in these areas may benefit from improved access to the power infrastructure that the project brings. In tandem with strong community engagement and economic reconciliation strategies, delivering lower-cost, cleaner power to host communities may help foster greater acceptance and support for mining operations.

This boost in the mining industry is more than a trend. It is set to last. Various government funding programs support critical minerals. They also support the energy transition and modernizing energy infrastructure. Things like green premiums are also being considered. Green premiums are extra value for lower-carbon minerals. They are not yet built into commodity markets, but they could set apart metals coming from countries and companies that prioritize responsible production.

Avoiding penalties is also an incentive to act. Countries like Canada, Australia, and others are implementing carbon taxes or penalties for GHG emissions. So, mining operations should assess these future costs when evaluating energy projects. It's complex to weigh the costs and benefits of a mine's low-carbon energy strategy. Having a qualified team, a robust understanding of the regulatory environment, and strong engagement with stakeholders will be key.

Most mine operators aspire to be responsible when they extract resources. After all, they live on the planet too. They and their shareholders typically want to be stewards of the environment and play their role in decarbonization. By using these low-carbon solutions, alternative sources of energy, and energy storage, mine sites will support a more sustainable future. **M**

DEBRA JOHNSON ENGAGES COLLABORATIVELY WITH MINING COMPANIES TO EXCEED THEIR CARBON NEUTRALITY AND NET ZERO GOALS. SHE PROACTIVELY LEVERAGES HER EXPERIENCE AND STANTEC'S SOLUTIONS TO ADVANCE TRIPLE BOTTOM LINE MINING INITIATIVES AND DRIVE SCALED INNOVATION. HER GOAL IS TO ADDRESS MINING'S SUSTAINABILITY ISSUES USING NOVEL APPROACHES TO POWER, WATER, ENERGY TRANSITION, AND MINE DESIGN.

ERICKA WICKS IS AN EXPERIENCED LEADER WITH BUSINESS DEVELOPMENT, FUNDING, PROGRAM DEVELOPMENT AND MANAGEMENT, AND ENVIRONMENTAL SUSTAINABILITY AND ENERGY EXPERTISE. IN HER ROLE AS A REGIONAL SECTOR LEADER FOCUSING ON THE ENERGY TRANSITION AND RENEWABLE ENERGY FOR EASTERN CANADA, SHE SUPPORTS ENERGY TRANSITION STRATEGY EVOLUTION, DRIVES REGIONAL BUSINESS DEVELOPMENT PURSUITS, AND CONTRIBUTES TECHNICALLY TO AND MANAGES PROJECTS.