INTERNATIONAL MINERALS INNOVATION INSTITUTE

DEMOday 2025 Technology Needs

For/From Innovative Solutions Providers

Clean Heating Solutions for Shafts

In Saskatchewan, the cold ambient surface temperatures require mines to use air heating. In the potash industry, it is primarily to prevent shaft freeze up including utilities such as water that are entering the mine via the shaft. One of the ways shafts are heated is direct firing, where fossil-fueled burners are mounted within the air stream that is being directed underground. While both propane and natural gas are easy to transport and relatively clean burning, they are sources of GHG emissions. Alternatives are being sought:

- Clean heating solutions to both efficiently and safely heat the shafts in potash operations.

Carbon Capture, Utilization and Storage (CCUS)

Endorsed by leading climate organizations, including the IPCC and the IEA, CCUS is recognized as a vital component in the fight against climate change. Consequently, there is growing interest among potash producers in CO2 utilization technologies, particularly in the areas of carbon capture and utilization (CCU) and carbon dioxide removal (CDR). CCU technologies aim to convert CO2 into value-added products, such as chemicals, fuels, and building materials, while CDR technologies aim to permanently remove CO2 from the atmosphere and store it in geological formations or other storage mediums. Potash producers in Saskatchewan currently use natural gas to generate steam and run dryers in operations.

IMII's interest is two-fold:

- Innovative utilization technologies for carbon that could be captured from potash operations.
- Innovative sequestration technologies that don't rely on indefinite ongoing monitoring to ensure there is no release of captured carbon from potash operations.

Technologies should demonstrate a path to addressing existing concerns with respect to the high energy requirements and costs of existing CCU technologies and the scalability and feasibility of CDR technologies.

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Corrosion Mitigation/Prevention

Corrosion in the potash industry is a significant challenge due to the corrosive nature of the material itself. High pressures, temperatures, fluid velocities, abrasion, erosion, and the presence of corrosive chemicals and by-products contribute to corrosion problems during potash production.

IMII is therefore on the hunt for new technologies which could prevent corrosion or mitigate its effects. An example of such technologies or solutions (but not limited to them) may allow the potash industry to:

- Improve upon metal-metal exchange corrosion mitigation.
- Better understand impacts of sacrificial metals and alloys in the industry.
- Identify and adopt cathodic protection developments and enhancements.
- Undertake evaluations of newer alloys and substitute metals for potash mining environments.

Electrification or Battery Applications

Fueling mining processes, equipment, and power generation with low-carbon or decarbonized electricity is one potential pathway to further reducing the mineral industry's carbon footprint. Saskatchewan's potash and uranium industries already use electricity in their mining equipment, ore transport and other key processes and are looking forward to SaskPower's efforts to lower the carbon footprint of its electricity generation.

More, however, can be done if the technology is there. To this end, IMII is looking for:

- Technologies which may further offer the opportunity to replace fossil fuel sources of heat with electricity.
- Newer battery technologies for industrial electric mobile equipment used in potash and/or uranium mining environments.

Electrical Load Smoothing

Did you know there are several challenges to managing fluctuations in electrical loads in industrial operations such as mines and mills? If so, you may have a solution that meets our need:

- Cost-effectively smoothing large electrical loads (e.g. hoist motors) for mine/mill to address peak loading

Energy Efficiency

The minerals industry is continually evolving and adapting to new technologies and societal expectations, with several trends shaping the industry's future. Saskatchewan's operations are looking to enhance energy efficiency as they continue their effort towards sustainability. To these ends, IMII's potash members are looking for new and innovative:

- Resource conservation technologies, which use less of or substitute in something better for things like chemicals, water, etc., to improve energy efficiencies.
- Efficient area (as compared to point source) heat recovery technologies.
- Technology that can be retrofitted to existing process dryers to promote better energy efficiency while still achieving the desired moisture content.

Geological Mapping in the Potash Industry

Developments in artificial intelligence and other digital technologies are presenting new opportunities in mapping practice. Are you among those who have seen such opportunities (e.g., neural networks, support vector machines, and decision trees used to estimate subsurface temperatures, predict rock and fluid properties, and identify optimal drilling locations, machine learning-based field geological mapping, deep learning AI models perform high-precision geological object recognition and generate geological maps comparable to or even surpassing the accuracy of field surveys, new generation AI algorithms for mineral prospectivity mapping emphasize interpretability and domain cognitive consistency)? If so, we are looking for solutions which support the:

- Use of newer techniques and methods to be able to effectively map out new developments with AI and advanced platforms, or programs which consider the use of fixed remote sensing and monitoring systems to aid in development mapping and for planning purposes.

LiDAR Scan Technology

Are you aware of all the potential uses for LiDAR scan technology in the mining and mineral industry (including but not restricted to surveying, mapping and worker safety). If so, please look at the following needs:

- Deploy LiDAR using a drone or handheld device or attached to mobile piece of equipment (such as a personnel carrier) that has millimeter accuracy to monitor and measure tunnel deformation. Accuracy sub 5 millimeter would be even better. The solution also needs to easily convert point cloud data into useable 3D data to show

excavation movement and deformation. Overall, the solution should be easy to use, offer easy data processing and provide an easily interpreted finished product.

- New and innovative technologies and software that leverage LiDAR data to monitor for movement, subsidence, degradation, above and below ground.

Machine Learning

Recent developments in smart mining technology, including machine learning (ML), have enabled the production, collection, and sharing of a large amount of data in real time. Research has demonstrated that ML studies have been actively conducted in the mining industry since 2018, mostly for mineral exploration. There is, however, increased interest in applying ML techniques to mineral processing and automation, and mine reclamation.

This interest is somewhat tempered by the challenges of deploying ML in the industry. While projects with applied researchers are being pursued, the industry is looking for:

- Solution pathways which may make machine learning more accessible to minerals subject matter experts, so they can apply it in their work rather than having to rely on data analytic experts that don't know the applications in a complex industry like mining. Such pathways could include advances in scientific understanding or knowledge bases to enhance problem-solving capacity to respond to specific problems in mining.

Microgeneration – On Site

This is not a call for combined heat and power generation technologies already on the market. Instead, we are looking for out of the box thinkers with technologies that could be applied/adapted/deployed from within a mine or mill that take advantage of the movement of large volumes of air and water in such operations. For example,

- Microgeneration technologies could include air source & ground source heat pumps, small-scale hydroelectric systems, micro wind turbines, micro-CHP, and fuel cells.
- Other energy recovery technologies outside of waste heat (a topic all its own below).

Mobile Equipment

The mining and minerals industry relies on mobile assets to transport both people and materials around a site. Sites can be quite large and can vary greatly in the environments in which they operate – on surface and underground, in new areas with uneven surfaces to purpose-built roads. Distances can also vary greatly from meters to kilometers. Mobile equipment may also

be driven by operators or operated autonomously. A wide range of challenges. The operational efficiency of these mobile assets directly impacts productivity and cost management.

Given the reliance on mobile assets, IMII's minerals industry members are looking for new technologies such as these:

- Navigation assisted terrain detection technologies able to provide warning/guidance for evading large bumps or voids while operating mobile equipment.
- Technologies which could monitor the location and status of such assets when the communication infrastructure associated with the mine/mill is not readily available.
- Newer EV concepts on larger equipment that can generate enough horsepower to be an effective substitute for heavy duty applications which recognize that irregular usage patterns and performance requirements may not allow for regular charging.

Production Efficiency

Technologies can offer the opportunity to improve efficiencies including those related to productivity, allowing a minerals operation to increase throughput and lower costs. Saskatchewan's potash industry is seeking innovative technologies capable of improving productivity on the mine site. Technologies of current interest are those which:

- Could fully automate conveyor belt and/or mine face sampling of potash ores, or at other potential points early in the milling process (e.g., grinding).

Remote Sensing

Remote sensing in mining usually involves using satellite or aerial imagery to monitor and manage mineral exploration and production. Key applications include identifying potential mineral deposits by providing information about minerology and geology, assessing environmental impact by monitoring land and emissions. When applied to equipment, remote sensing could also monitor infrastructure health. IR sensors and multispectral and hyperspectral cameras can be used for such applications.

IMII's members, however, have other desired applications and are in the hunt for:

- Technologies that can be adapted to provide rock mechanics data and/or geophysical information of the roof or walls of drifts.
- Technologies (digital or otherwise) that could be developed and deployed to routinely gather data on the integrity of shafts and shaft lining in a safe and efficient way to minimize the manual collection of such data and the time dedicated to data collection.

- Technologies that could be developed and/or deployed to improve the gathering of information as to the condition of ropes and attachments.

Safety Solutions

We wouldn't be in the mining and minerals industry if we didn't share our members' commitment to safety. We are always looking for new and innovative safety technologies, and this year are in the hunt for:

- Technologies for the detection and suppression of potential mobile equipment fires – be they diesel or battery powered.
- Technologies or techniques which could be deployed to detect when a potash mine sidewall in a drift needs to be addressed or scaled.
- In-line saturation monitoring systems which can be deployed in tailings or pond structures, ideally to provide real-time and accurate information on stability.

Tailings Management (Potash)

Tailings are a byproduct of mining, consisting of the processed rock or soil left over from the separation of the commodities of value from the rock or soil within which they occur. Saskatchewan's potash industry share in the larger industry's commitment across Canada to responsibly manage tailings and any associated water. In so doing, they seek to prevent impacts to human health and safety, the environment, and infrastructure. To do so, tailings are managed in engineered facilities that are planned, designed, constructed, operated, closed and maintained in the long-term post-closure period (i.e., throughout the facility life cycle) in a manner consistent with the need for responsible management.

Consistent with a further commitment to continuous improvement, Saskatchewan's potash industry is looking for:

- Alternative technologies that will promote a smaller footprint and reduce potential environmental impacts.
- Technologies which may assist in reducing potential spills from the associated water.

Waste Heat Recovery

The mining industry, known for its energy-intensive operations, is constantly seeking ways to improve efficiency and reduce environmental impact. One innovative solution gaining traction is the implementation of Waste Heat Recovery Systems (WHRS). These systems capture and repurpose heat that would otherwise be lost to the environment, turning it into a valuable

energy resource. For DEMOday 2025, the potash industry is looking for new and innovative technologies that can be applied within its sector to capture heat from boilers (from steam generation), dryers (natural gas fired), and possibly compressors and pumps from within mills or ventilation systems from underground mines. The interest could include:

- Efficient area (as compared to point source) heat recovery technologies
- Technology that can be retrofitted to existing potash process dryers to promote better energy efficiency while still achieving the desired the moisture content
- Technology to cost effectively recover heat from finished potash product (which can range in temperature from 80 to 180 degrees C)
- Technologies which offer opportunities for low grade heat capture from potash without a large heat differential
- Technologies with the potential for heat recovery from "dirty" sources (e.g., potash dryer stacks which may contain dust or other particulates)

Water Solutions (Potash)

Water is used extensively in potash mining operations for various purposes such as generating steam, cooling equipment used during processing activities and transporting minerals through pipelines. Potash production also requires large quantities of freshwater for dissolving salts during solution mining processes. As an industry, Saskatchewan's potash producers shared a common interest in reducing freshwater use and minimizing water inventories in tailings management areas. To these ends, they are looking for:

- Smart industrial-scale water management solutions to help it responsibly manage the consumption and release of water from its operations.
- Technology that could produce higher grade concentrates at similar recoveries reducing the need for leach water
- Technologies that could use less fresh water for dryer exhaust particulate removal

Utilize Low-Grade Heat or Heat Sources

This may look a little like the technology needs under waste hear recovery, and it is, but it is also broader and comes at the challenge from a little different angle as it adds in heat sources. Research suggests that approximately half of the global primary energy consumption is wasted in the form of low-grade (i.e., low temperature) thermal energy, that low-grade heat sources possess the potential to play a pivotal role in sustainable energy systems, revolutionizing our approach to energy generation and utilization, and that low-grade thermal energy utilization has

emerged as a promising frontier in energy research and technology development. We hope that is the case as we are looking for such promising technology developments in the forms of:

- Technologies or processes which would allow the industry to effectively utilize low-grade heat or heat sources with low/no GHG emissions for mine and/or mill processes or air/space heating (e.g., innovative power cycles and heat pumps, thermoelectric generators, and thermal energy storage solutions).

Open Category

Open innovation offers opportunities to reduce development costs, spread risks and bring innovations to market more quickly. Coined by Berkeley professor Henry Chesbrough, the term “open innovation” refers to the collaboration between companies, individuals and public agencies to create innovative products and services and, in the process, share its risks and rewards.

So, if you are open to open innovation and working with IMII and its members to advance your innovation, please apply with:

- Any brilliant new technology or idea for a technology that doesn’t neatly fit into any of the categories above but demonstrates a potential solution to address an industry need.