



# **TOWARDS ZERO WASTE MINING: FUNDAMENTALLY TRANSFORMING CANADA'S MINERAL SECTOR**

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## **EXECUTIVE SUMMARY**

The Canada Mining Innovation Council is prepared to fully execute on the Towards Zero Waste Mining (TZWM) innovation strategy for the mining sector. With government support, the TZWM strategy will reduce energy use and environmental waste, reduce greenhouse gas emissions, move the industry to even more sustainable practices, and stimulate technology innovation in Canada.

TZWM also presents an unprecedented opportunity for Aboriginal businesses and entrepreneurs to partner with the mining industry in the development and commercialization of new environmental services and clean technologies.

Mechanisms to fund TZWM do not exist and the appropriate type and level of support from the Government of Canada is urgently required. The TZWM roadmap requires a five-year, \$50 million investment by the federal government, which will be matched by industry.

***By partnering on TZWM, government and industry can make Canada a leader in mining innovation and sustainability, address climate change, and move towards a lower carbon economy.***

## **CANADA'S MINING INDUSTRY**

Mining accounts for 19.6% of Canada's exports, over \$54 billion (3.4%) of its GDP and has provided an average of \$7.1 billion annually in royalties and corporate income tax to the federal, provincial and territorial governments since 2003. The sector provides 380,000 direct Canadian jobs and supports nearly one million indirect jobs. Mining is the most critical factor with regards to expanding economic growth and skilled employment in Canada's North. The mining industry is also the largest private sector employer of Indigenous Canadians on a proportional basis.

Mining provides the raw materials that enable other sectors of our economy to flourish, including high-tech, transportation, aerospace and defence, manufacturing and clean tech. These raw materials are crafted into new technologies, many of which are then adopted by the mining industry.

***Thus, mining acts as an anchor for many of our technology sectors.***

The Canadian mining industry is highly technical and provides opportunities for collaboration with other critical sectors such as information technology, automation, and biotechnology/genomics. The industry desperately needs innovation but adoption is hindered by its capital-intensive nature and current stress related to low prices and the need to improve sustainability.

The Canadian mining industry's greatest challenges are how to reduce energy consumption, recover waste energy, decrease the environmental footprint of a mine,



develop and adopt new technology, and create new clean jobs while facing volatile commodity markets, increasing costs and significant competition from other jurisdictions as well as to continue to attract bright new graduates into the industry.

In other words, the overriding challenge is how to transform mining into a zero waste industry.

### **CANADA MINING INNOVATION COUNCIL**

There is considerable investment in research, development and innovation (RDI) in the mining industry that has been supported by a network of RDI centres, government laboratories, and academia. However, the 7,000 plus programs currently deployed, fund primarily research at academic institutions and lack focus on mining or natural resources in general. The result is a severely fragmented innovation continuum, coupled with a lack of any national-scale coordination of government, academic and industry RDI efforts and funding. Naturally, this has impeded the development and commercialization of new technology for the industry.

The Canada Mining Innovation Council (CMIC) is a national non-profit organization that is fundamentally transforming mining by coordinating and focusing RDI programs and efforts to address common challenges of the industry across Canada, solve them and move them into practice. Established in 2009, its 75 plus members encompass the innovation continuum from mining and minerals and other industries such as high tech, clean tech, and aerospace and defence.

In 2016, we signed a strategic partnership agreement with FPIInnovations in five defined technical areas and are now designing joint projects. We are also exploring opportunities with Canada's Oil Sands Innovation Alliance (COSIA). These efforts are aimed at developing a longer term natural resources innovation strategy.

CMIC project participants include mining companies, academia, start-ups, small medium enterprises (SMEs), engineering and consulting firms and technology companies. Our technical groups, comprised of senior leaders from these organizations, define the key common issues of the industry and create technology roadmaps defining the technology requirements for the next 10-20 years.

CMIC employs an open innovation ecosystem business model that is unique in the natural resources industry. The approach harnesses innovation and leverages talent, knowledge, intellectual property and existing technology from industries inside and outside of mining to create Canadian-based solutions. This highly collaborative innovation model is a first in the industry and surmounts challenges hampering productive innovation partnerships between mining companies, suppliers and academia. Technology development, deployment and wide-scale adoption is accelerated by taking advantage of and leveraging existing global assets in an open and shared intellectual property framework with an entire supply chain. It also provides technology test beds,

reduces barriers to the adoption of technology and significantly reduces the financial risk for all collaborators.

Over the last century, the Canadian mining sector including industry, government and academia has developed world-leading subject matter expertise and an outstanding global reputation. Based on this foundation, Canada starts with a substantial comparative advantage innovating in the mining sector. To make use of this Canadian competitive advantage requires the co-ordination of innovation initiatives provided by CMIC.

### **TOWARDS ZERO WASTE MINING**

With industry leaders across Canada and the Mining Association of Canada, CMIC created Towards Zero Waste Mining, which is the prime innovation strategy for the industry. We developed a business case, created technology roadmaps, identified transformational targets and are developing ground-breaking projects. TZWM is stimulating technology innovation in Canada to achieve zero waste in the industry within 20 years, with an integrated focus on productivity, energy and the environment. The approach provides a gradual progression and adoption of innovative technologies, promoting more efficient and sustainable operations and reducing overall environmental effects of mining projects.

CMIC technology programs are directly related to clean technology and climate change, and designed to enable the mining sector to significantly reduce energy costs, improve productivity, enhance global competitiveness and significantly reduce GHG emissions. For example:

- The Exploration portfolio is aimed at increasing targeting effectiveness leading to better ore reserve definition. This will decrease the environmental footprint of exploration and minimize waste extraction during mining, and decreases the costs of processing and tailings management.
- The Underground Mining portfolio will move the industry away from the traditional drill and blast production cycle to a continuous, all-electric, smart mining approach. CMIC is developing projects across Canada through advanced technology for mechanical cutting, ore haulage, electrification and the use of advanced information communication technology.
- The Processing portfolio is targeting an increase in energy efficiency of 45% in the comminution, or grinding circuits, of the mining industry. Comminution consumes approximately 3-4% of the world's energy and up to 50% of the total energy consumed at a mine site. The net impact will be an 18% reduction in energy use (26.25 petajoules) by Canadian mines.
- The Environment portfolio address several key priorities, including strengthening

the environmental assessment process (i.e. closure criteria project), significantly enhancing environmental monitoring (i.e. sensors project), and enabling project proponents to select the best technologies available to reduce environmental impacts. CMIC's *Mining Industry Knowledge Hub* project, which involves the democratization of environmental data, directly supports the Government of Canada's Open Data initiative.

CMIC's projects also prioritize the development of highly-qualified personnel (HQP) through the continuum of undergraduate to postgraduate trainees (master, doctoral, post-doctoral). The innovation ecosystem requires that human capital, at all levels, be leveraged to solve complex problems and CMIC aims to facilitate the interactions of diverse multi-disciplinary teams that will bring together the power of business, analytics, environmental sciences, engineering and resource management to promote innovation in the sector.

***This will enable the development of HQP that will help shape the Canadian mining industry of the future.***

#### *Program Implementation*

CMIC is using six different models for project implementation that account for industry needs and existing efforts and assets. These project models include:

1. **CMIC-managed research consortia:** Our current exploration project is the largest geoscience consortia in North America, addressing explicit research needs for the industry.
2. **Project integration/coordination:** This clusters existing mining projects, adds potential new project elements and accounts for multi-million dollar investments being made by companies. This is one component of our underground mining program.
3. **Technology Demonstration:** This accounts for new technology that is not developed far enough and is typically too costly for a single company to test. In the case of energy efficient processing we are examining 3-5 new technologies in this genre.
4. **CMIC Directed, Partner Delivered:** These projects typically occur in the initial stages of larger, consortia-based projects to prove an idea or provide a baseline of data, information and models on which we need to proceed. We have partnered with CANMETMining to deliver initial studies on low grade waste energy and with Geoscience BC, who is delivering the pilot for our *Mining Industry Knowledge Hub* project.
5. **CMIC Instigated with "Ecosystem" Participation:** These are either very difficult

technical challenges that have broad applicability or where there are many organizations working on various elements, but coordination and direction are lacking to solve a real industry need. Real-time, remote water quality sensors and low grade waste energy recovery are example projects. Existing organizations include Sustainable Technology Development Canada, Canadian Water Network, the Southern Ontario Water Consortium and the World Intellectual Property Organization.

6. **Mini-Consortia:** Evolve around needs of a select group of companies and include two nascent projects in genomic-based sensors for environmental monitoring and hybrid air vehicles for alternative transportation.

## **PARTNERING WITH GOVERNMENT ON INNOVATION, CLEAN TECH AND CLIMATE CHANGE**

The TZWM strategy is aligned with the Government of Canada's ambitious Innovation Agenda and its priorities with respect to protecting the environment, addressing climate change, and providing new economic opportunities for Aboriginal peoples. The federal government announced strong support for innovation in Budget 2016. This includes, but is not limited to, a \$1 billion commitment over four years, beginning in 2017-18, to support clean technology development in mining and other natural resource industries.

***CMIC is seeking a five-year, \$50 million investment by the federal government, which will be matched by industry, to accelerate implementation of the TZWM innovation strategy.***

Through TZWM, CMIC and its partners have identified vast opportunities for innovation that will not only transform mining processes, but will result in significant advancements in energy efficiency and reductions in GHG and CO<sub>2</sub> emissions. These areas include:

- Replacing diesel-powered equipment with electric or renewable continuous mining technology to reduce energy use and potentially carcinogenic emissions for underground mines.
- Capturing lost energy by recovering heat loss (representing 95% of energy used) in mineral processing.
- Developing and deploying new environmental management technologies to minimize waste (tailings), treat waste water, track water quality in real-time and accelerate reclamation.
- Improving ore reserve definition during exploration to minimize waste extraction during mining and decrease the costs of processing and tailings management.

Government support will catalyze industry's innovation investments, expediting change and enabling the industry to turn these promising opportunities into proven technologies



and economic growth for Canada.

The development and deployment of new technologies are capital intensive, and government support is especially critical as the industry continues to navigate through a volatile commodity market.

TZWM will help achieve the government's vision of making Canada a centre of global innovation. As a global industry, the mining technologies developed through TZWM will have the potential to be exported internationally.

***By investing in TZWM, together we will...***

- Significantly reduce mining's environmental footprint, including energy consumption. GHG and CO2 emissions, tailings discharge and water use.
- Build Canadian and Aboriginal business expertise in clean, energy-efficient and sustainable technologies that will be deployed in Canadian mines and globally.
- Increase foreign direct investment in Canada by international technology companies.
- Make Canada a centre of mining innovation.

Thank you for the opportunity to present this proposal to Finance Canada and we look forward to further discussions.