



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

A submission to Finance Canada for Budget 2016

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Executive Summary

The Canada Mining Innovation Council is prepared to fully execute on the Towards Zero Waste Mining™ innovation strategy for the mining sector. The TZWM™ strategy will reduce energy and environmental waste, reduce green house gas emissions, assist the industry move to more sustainable practices and technologies and will stimulate technology innovation in Canada.

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.

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. As a sector, the mining industry is the single largest employer of Indigenous Canadians.

Mining also 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 technology products, many of which are adopted by the mining industry.

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

Although not widely appreciated, the Canadian mining industry is highly technical and provides opportunities for collaboration among other critical sectors such as information technology, automation, and biotechnology. 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.

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



Canada Mining Innovation Council: Fundamentally Transforming Mining

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, as well as 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 pre-competitive challenges of the industry across Canada. 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. Project participants include academia, start-ups, SMEs, engineering and consulting firms, technology companies and mining companies. Our technical groups, comprised of senior leaders from these organizations, define the key pre-competitive issues of the industry and create technology roadmaps defining the future technology requirements 10-20 years away.

The CMIC open innovation business ecosystem model is unique in the natural resources sector and harnesses innovation and leverages assets nationally and internationally to create solutions. This highly collaborative innovation model is a first in the industry and surmounts the challenges hampering productive innovation partnerships between mining companies, suppliers and academia. It also provides for rapid technology development, reduces barriers to the adoption of technology, and significantly reduces financial risk for all collaborators.

The first CMIC project is the largest geoscience consortium in North America with over 50 organizations participating.

Towards Zero Waste Mining™

With industry leaders across Canada, CMIC created Towards Zero Waste Mining™, an 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 10-20 years, with an integrated focus on the productivity, energy and environment. The approach ensures a gradual progression and adoption of innovative technologies, promoting more efficient and sustainable operations and reducing the environmental impact of mining projects.

Program Implementation

CMIC is currently 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 new mining projects, adds potential new project elements and accounts for multi-million dollar investments being made by companies. This will be 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 on the initial stages of larger, consortia-based project 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 and interest or where there are many organizations working on various elements yet need to be provided coordination and direction 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 Clean Technology and Climate Change

The Government of Canada has recently committed to investing \$200 million annually to create sector-specific strategies that support innovation clusters and clean technologies. CMIC's Towards Zero Waste Mining™ strategy is the solution to deliver on this promise for Canada's mining industry. CMIC is also supported by the Mining Association of Canada, the national voice of the Canadian mining industry.

Many of the CMIC technology initiatives are directly related to clean technology and climate change. For example, our underground mining portfolio aims to move the industry away from the traditional drill and blast production cycle to continuous, smart mining approach. This will reduce the use of diesel and energy in general, move to more sustainable forms of energy and clean technology solutions and reduce greenhouse gas emissions. Importantly, the health and safety of workers underground will be significantly improved by reducing the use of diesel underground.

Further, the amount of waste material being hauled to the surface will decrease significantly through the use of new technology to sort and transport ore. Our processing portfolio is targeting an increase in energy efficiency of 45% in the comminution, or grinding circuits of the mining industry. We are identifying and co-developing promising technologies for waste energy recovery and conservation in existing operations as well as developing new grinding technologies. Realizing our goal of 45% energy efficiency will cut global electricity consumption by 1-2%.

These programs will have a profound impact on greenhouse gas emissions from the minerals industry because they explicitly require the development and adoption of new clean technologies.

In addition to supporting innovation and the development of clean technology, the projects in CMIC's Environment portfolio address several other key priorities of multiple Ministries. For Natural Resources Canada, this includes strengthening the environmental assessment process, significantly enhancing environmental monitoring 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, will directly support the Open Government initiative.

CMIC Recommendation for Budget 2016

An accelerator funding mechanism for CMIC is required that will provide an efficient and effective mechanism to leverage current and future industry investments, reverse the trend of Canadian mining companies investing in innovation overseas and build a sustainable mining industry for the future.

Development of the program streams included in the CMIC TZWM™ roadmap will require a five-year, \$50 million investment by the federal government. Industry itself, as an indication of its commitment to responsible resource development across Canada, will provide a mix of matching funding and in-kind contributions, to ensure Canada leads the charge in developing a world-class sustainable mining sector.

CMIC has the proven track record of success, industry buy-in, and research-to-field expertise to hit the ground running. The TZWM™ roadmap aligns and can deliver on the Government's commitments to invest in innovation and clean technologies.

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

TOWARDS ZERO WASTE MINING COST ESTIMATES

PROJECT	Total Budget (\$M)	Contributions		
		GoC	CMIC / Industry Cash	Partners (Cash + Inkind)
Exploration-Accelerated Targeting Undercover	\$ 18.0	\$ 10.0	\$ 1.0	\$ 5.0
Real Time Water Quality Sensor Package	\$ 4.8	\$ 2.4	\$ 0.4	\$ 1.6
Mining Industry Knowledge Hub	\$ 11.7	\$ 7.0	\$ 0.6	\$ 1.6
Closure Criteria	\$ 2.4	\$ 2.2	\$ 0.1	\$ 0.1
Real-Time Continuous Underground Mining	\$ 31.0	\$ 17.6	\$ 2.2	\$ 11.3
Energy Efficient Comminution	\$ 21.7	\$ 10.8	\$ 1.5	\$ 7.2
TOTAL	\$ 89.6	\$ 50.0	\$ 5.8	\$ 26.7

Total Industry Contribution = \$ 39.6
 Total Industry Percentage = 44%
 Government of Canada = 56%