



Canada's Green Mining Initiative



**Workshop on Best Practices on
Mining Policies and Technologies
Brussels – June 2014**



Natural Resources
Canada

Ressources naturelles
Canada

Canada



Presentation Overview

- Introduction to Canada's Green Mining Initiative:
 - Objectives and Benefits
 - Definition and Scope
- Research Priorities and Approach
- Results and current research
- Next Steps





Green Mining Initiative: Background

- Reducing the environmental effects of mining and related activities is an important challenge for the sector:
 - Closely tied to the sector's public image.
 - Sector must continue to improve to ensure it remains responsible, competitive and productive.

- New scientific research, regulatory oversight, and industry actions have led to continuous improvements in the sector's environmental performance in Canada:
 - Overall energy consumption by the metal mining and smelting industries reduced by 16.7% (1990-2008);
 - SO₂ reduction of 63% (1988-2006); and,
 - Metal ore mining GHG emissions reduction of 21% (1990-2007).



Issues for Consideration

- Need for proactive, innovative technological solutions to advance sustainable mining to address:
 - future regulatory standards,
 - air pollutants,
 - water effluents, and
 - to counter the effects of climate change.
- Endorsed by the Mines Ministers from the federal, provincial and territorial governments in 2009 to accelerate the research, development and deployment of green mining technologies.



The Green Mining Initiative (GMI) is an NRCan-led pan-Canadian initiative designed to increase environmental performance and productivity by reducing energy emissions and water usage, improving mine waste management and increasing mine health and safety.



Green Mining Initiative: Objectives & Benefits

Objectives

- ✓ Sustain an environmentally responsible mining sector
- ✓ Contribute to an economically competitive mining sector
- ✓ Improve workers' safety and productivity
- ✓ Promote innovation in the mining sector
- ✓ Create market opportunities for green mining technologies

Benefits

- ✓ Reduction of operating costs
- ✓ Enhancement of equipment efficiency
- ✓ Ease Regulatory Compliance
- ✓ Improving industry's image

Concrete integrated solutions that will position Canada's mining sector at the forefront of competitiveness, sustainability & innovation





Definition & Scope

Accelerated R&D of green mining technologies and practices to improve environmental performance and innovations through NRCan's laboratories and industry partnerships.

The initiative looks at the entire mining lifecycle through four comprehensive pillars:

1. Footprint Reduction: Minimize waste and quantity of contaminants produced, and reduce the consumption of energy and water

2. Innovation in Waste Management: Develop better treatment and management technologies in waste processing, utilization and disposal

3. Mine Closure and Rehabilitation: Improve the remediation and reclamation of mining impacted lands, mine sites and ecosystems

4. Ecosystem Risk Management: Develop improved technologies for metal hazard and risk management; monitoring environmental effects and assessing metal toxicity





Research & Development Priorities

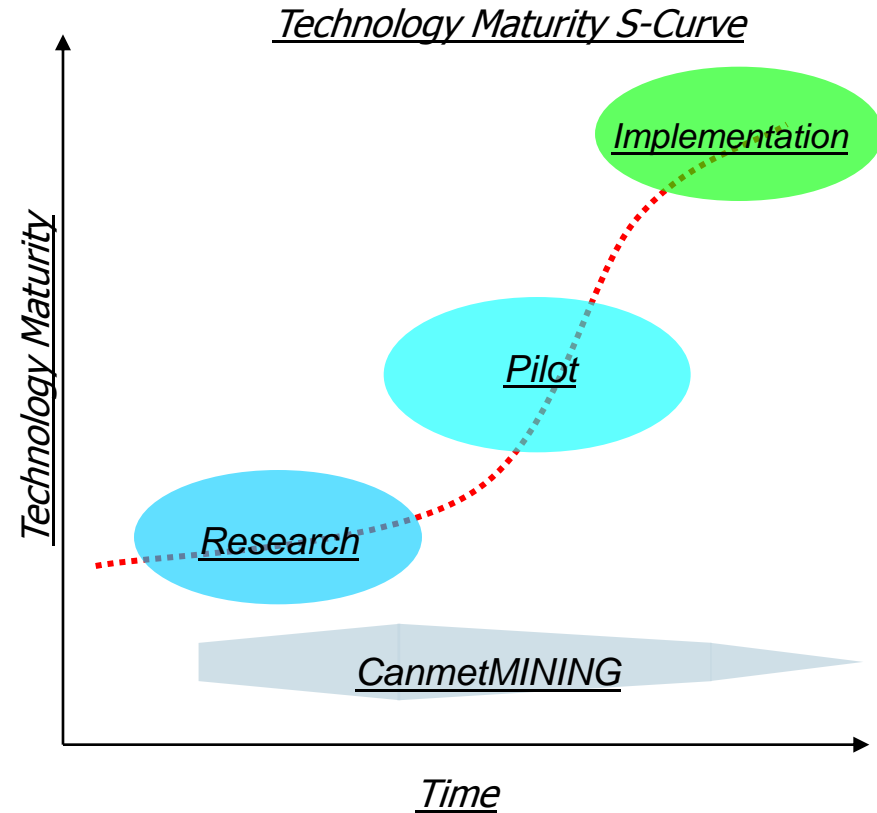
Seven cross-cutting R&D priorities support the GMI's four pillars:

- 1. Mining Extraction Innovation:** mitigating risks for mining at increased depth, and improving underground mining processes.
- 2. Clean Water:** water usage in mining and milling through recycling, removal of process contaminants, and focus on water and effluent management.
- 3. Mining Environmental Management:** develop, improve, evaluate and demonstrate technologies for environmental stewardship, includes tailings management, transfer of Canadian expertise and technologies internationally.
- 4. Energy Efficiency in Mining and Milling:** energy efficiency research activities (i.e., extraction and milling processes, alternative-energy vehicles, ventilation practices).
- 5. Critical and Strategic Metals Processing:** the processing of critical and strategic metals and the environmental risks associated with their development.
- 6. Responsible Northern Mineral Development:** the development of treatment and waste management technologies for the North.
- 7. Radioactive Waste Management:** technical solutions for the long-term storage and disposal of radioactive and nuclear waste.



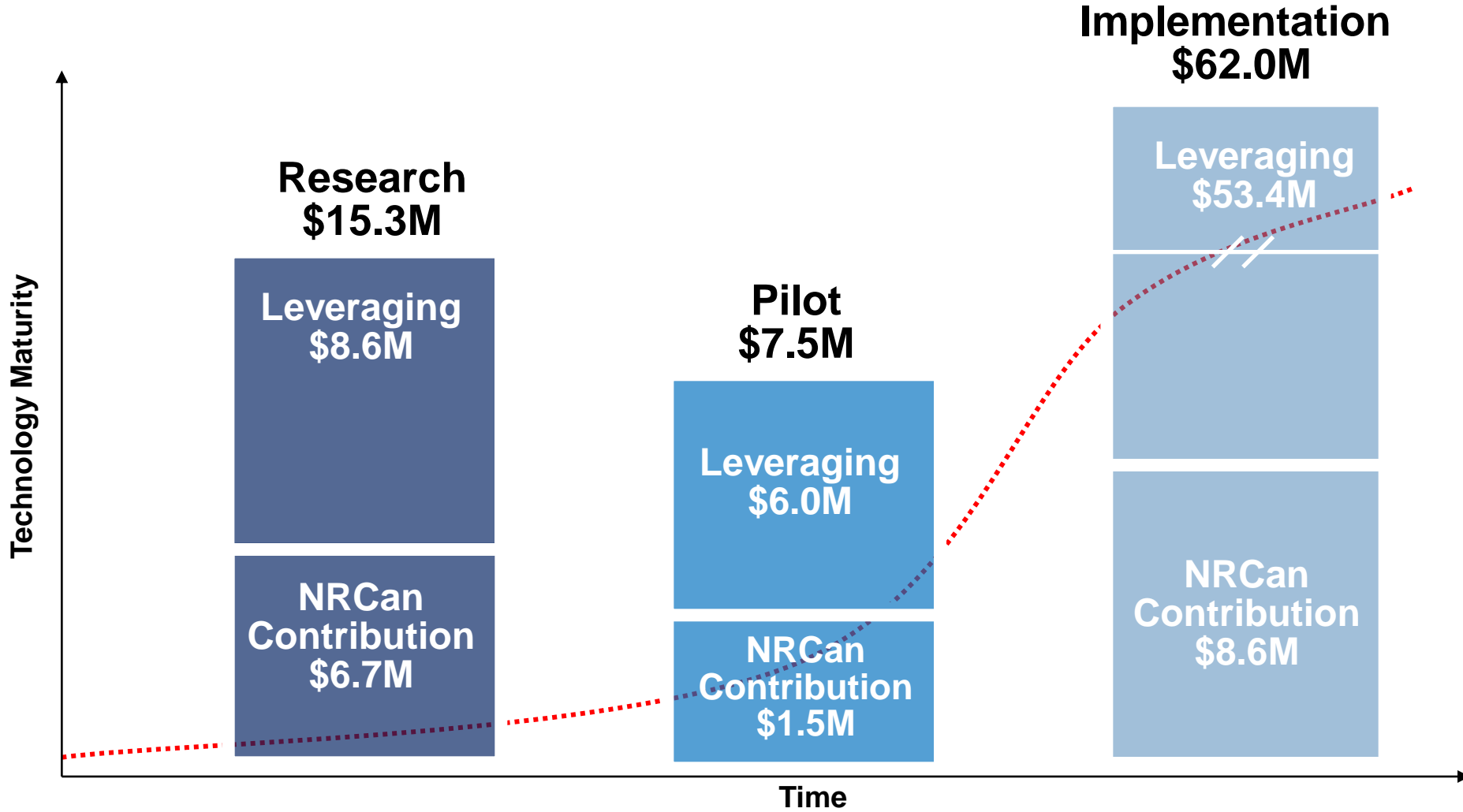
Approach to Innovation

- Collaboration for success:
 - Work with industry and academia to address pressing needs,
 - Partnership to remove barriers to adoption,
 - Access to cross-sectoral expertise.
- Ensure alignment with government and industry priorities for relevance.
- Focus on technology transfer and implementation to translate R&D work into innovation.





Green Mining Initiative: Industry Support



NRCan's Contribution: \$ 16.8M + Industry Leveraging: \$ 68M = \$84.8M Total Funding



Green Mining Initiative: Some Results

- Optimizing energy consumption and improving productivity with the development and commercialization of a **real-time, full speed wire-rope integrity testing apparatus**.
- Developed **new leaching process** for gold and silver recovery: Adopted by the industry with significant productivity gains.
- Development of protocols for **science-based classification of metals**: Zinc classification.
- Improving **energy efficiency of underground mines** by demonstrating concept of automated ventilation systems: Reduced environmental footprint.
- Discovery & **development of a new binder** for use in mine backfill: eliminates the use of GHG emitting components (i.e., Portland cement).





Green Mining Initiative: Current Projects

<i>R & D Priority</i>	<i>Project</i>	<i>Partners</i>	<i>Timing</i>
Mining Extraction Innovation	Hoist Rope Technology Development	Whitehill Mfg., Meglab, Agnico-Eagle, Iamgold	2010-2020
Clean Water	Hybrid Process for Treatment of Process and Discharge Water Streams in Oil Sands Operations	CanmetENERGY, University of Ottawa, Environment Canada, manufacturing companies and oil sands operators	2012-2017+
Mining Environmental Management	Waste-Activated Alternative Bnder Technology	Vale Canada Limited	2005-2020
Energy Efficiency in Mining & Milling	Automated Control of Mine Ventilation Networks	Vale, Glencore, CEMI, Bestech, Simsmart, Environment Canada	2010-2015
Critical and Strategic Minerals Processing	Canada's Rare Earth Elements Resource Potential	GeoMega	2012-2020
Northern Mineral Development	Gaps, Barriers & Opportunities Report	CanmetMINING	2010-2020
Radioactive Waste Management	Recovery Processes	Atomic Energy of Canada Ltd.	2010-2020



Green Mining Initiative: Moving Forward

- NRCan is reviewing the program to **assess its impacts** and determine path forward & actions required.
- Where should **research and development investment & collaboration** be undertaken in the future?
- **Measuring success:** are new technologies economically viable and what are the social and environmental benefits?
- Formal mechanisms of **communication & dissemination** of results.
- Examination of the **real and perceived barriers** to adoption of new technologies.





Specific Project Information

ANNEX



Mining Extraction Innovation: *Hoist Rope Technology Development*

- **Objective:** Energy efficiency and productivity enhancement in a mine hoisting process
- **Impact:** Extension of wire-rope life, enhanced maintenance practice and introduction of lighter, synthetic ropes
- **Technology deployed:** Contiscan (Meglab), synthetic ropes with built-in rope wear technology
- **Partners:** Whitehill Mfg., Meglab, Agnico-Eagle, Iamgold



2010 2012 2014 2016 2018 2020

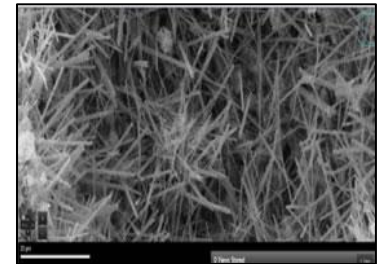
Meglab's Contiscan

Synthetic Ropes



Best Practices in Mining Environmental Management:¹⁵ *Waste-Activated Alternative Binder Technology*

- **Objective:** Cost-effective, environmentally friendly alternative to Portland cement in mine backfill
- **Impact:** 50% reduction in backfill binder costs, increased backfill strength, reduced surface footprint and the ultimate replacement of Portland cement in backfill
- **Technology deployed:** CanmetMINING Alternative Binder Technology is patented internationally
- **Partners:** Vale Canada Ltd.



2005 2008 2011 2014 2017 2020

Discovery of the Invention

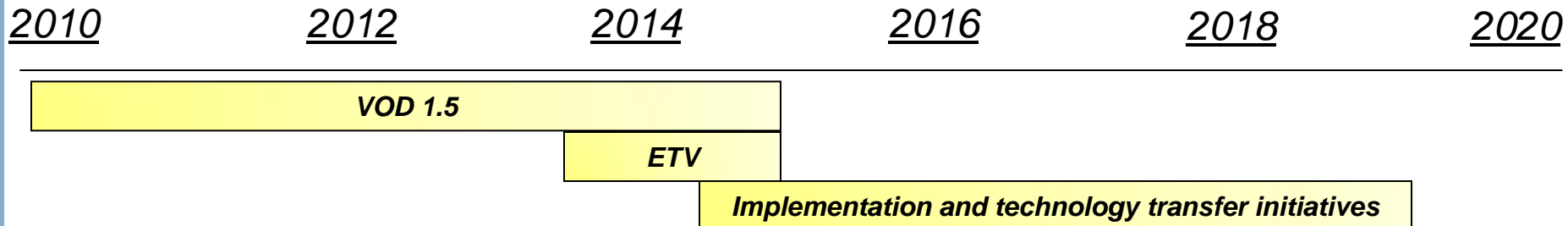
Refinement of the binder recipe

*Partnership with Vale for Business Case
and Underground Trial*

Develop binders with new partners

Energy Efficiency in Mining and Milling: *Automated Control of Mine Ventilation Networks*

- **Objective:** Energy efficient use of available ventilation resource
- **Impact:** Energy savings, GHG reduction and/or enhanced production flexibility (additional headings using same air volumes)
- **Technology deployed:** Energy management systems, including sensors, monitors and controls for the automation of ventilation networks
- **Partners:** Vale, Glencore, CEMI, Bestech, Simsmart, Environment Canada



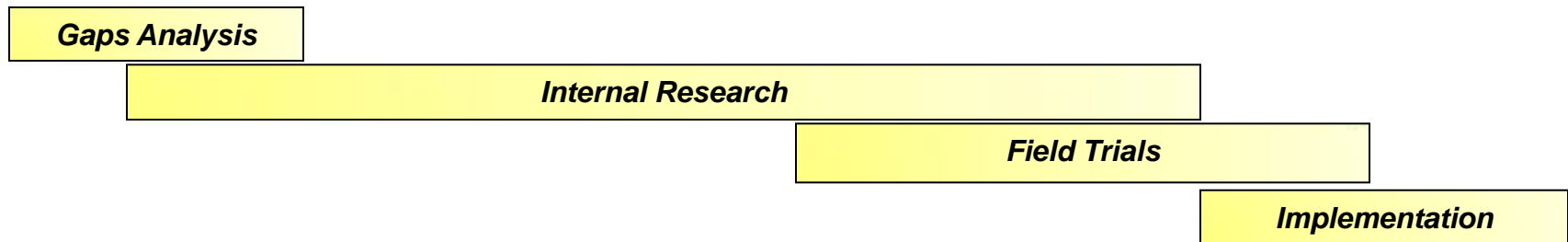


Northern Mineral Development: *Gaps, Barriers and Opportunities Report*

- **Objective:** Provide information required to develop and implement green mining technologies for the North
- **Impact:** Identification of the major technical and scientific challenges of mining in the North
- Report findings supports the initial scoping exercise and the following streams:
 - Mine Waste Management
 - Ecosystem Protection
 - Remediation of Contaminated Sites
 - Mine Design



2010 2012 2014 2016 2018 2020





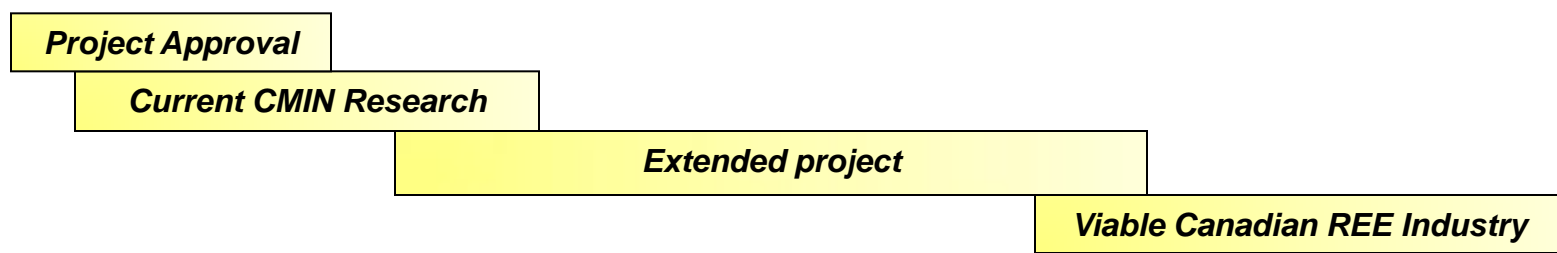
Critical Metals:

Canada's Rare Earth Elements Resource Potential

- **Objective:** To stimulate the development of a productive strategic metals industry in Canada
- **Impact:** Fundamental research in mineralogical characterization, physical separation, hydrometallurgical processing and environmental implications. Certified reference materials available for critical metals, and formation of the Canadian Rare Earth Elements Network (CREEN)
- **Technology deployed:** Research in Progress
- **Partners:** GeoMega



2010 2012 2014 2016 2018 2020



- **Objective:** Hydromet used to extract key elements from radioactive waste
- **Impact:** Reducing the liability and the disposal cost of radioactive waste
- **Technology deployed:** Recovery processes for radioactive and nuclear wastes
- **Achievements:** A technology achieving key elements solubilisation of close to 99%
- **Partners:** Atomic Energy of Canada Ltd.

