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[All redactions in the document have been done in line with Art.4.1(b)]

# Canada's Mining Innovation Ecosystem

Bilateral Dialogue on Raw Materials, Brussels  
16 November, 2018

[REDACTED], Director Science Policy Integration, CanmetMINING  
Government of Canada

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# Presentation Outline

- Innovation policies and priorities
- Canadian Mining Innovation Ecosystem
- CanmetMINING: Green Mining Innovation
- Looking to the future



# Government of Canada Agenda

- Focus on clean technology and innovation
- Take action on climate change, reduce carbon pollution
- Protect freshwater
  - Investments in wastewater technologies
  - More robust environmental assessments

Ensure that our resource sector remains a source of jobs, prosperity, and opportunity within the context of a world that increasingly values sustainable practices and low carbon processes.



# Government of Canada Science Objectives

- **New Vision for Science:**
  - Strengthen science;
  - Strengthen evidence-based decision making; and
  - Strengthen the culture of curiosity in Canada
- **Greening Government Strategy:**
  - Government of Canada will transition to low-carbon and climate-resilient operations, while also reducing environmental impacts beyond carbon



D [redacted]  
Chief Science Advisor of Canada

# Investing in Innovation

## Investing in mining innovation

**\$155 million** to fund clean technology projects in energy, mining and forestry

**\$75 million** for clean technology challenges, including \$10M for mining

## Investing in clean technology

**\$1.26 billion** for clean technology businesses

**\$400 million** to develop and demonstrate new clean technologies

## Supporting researchers

**\$1.7 billion** to support researchers through granting councils and research institutes

**\$2.8 billion** for federal government science and technology facilities

**\$1.3 billion** in new laboratories, equipment and infrastructure

**\$573 million** for access to advanced computing and big data resources

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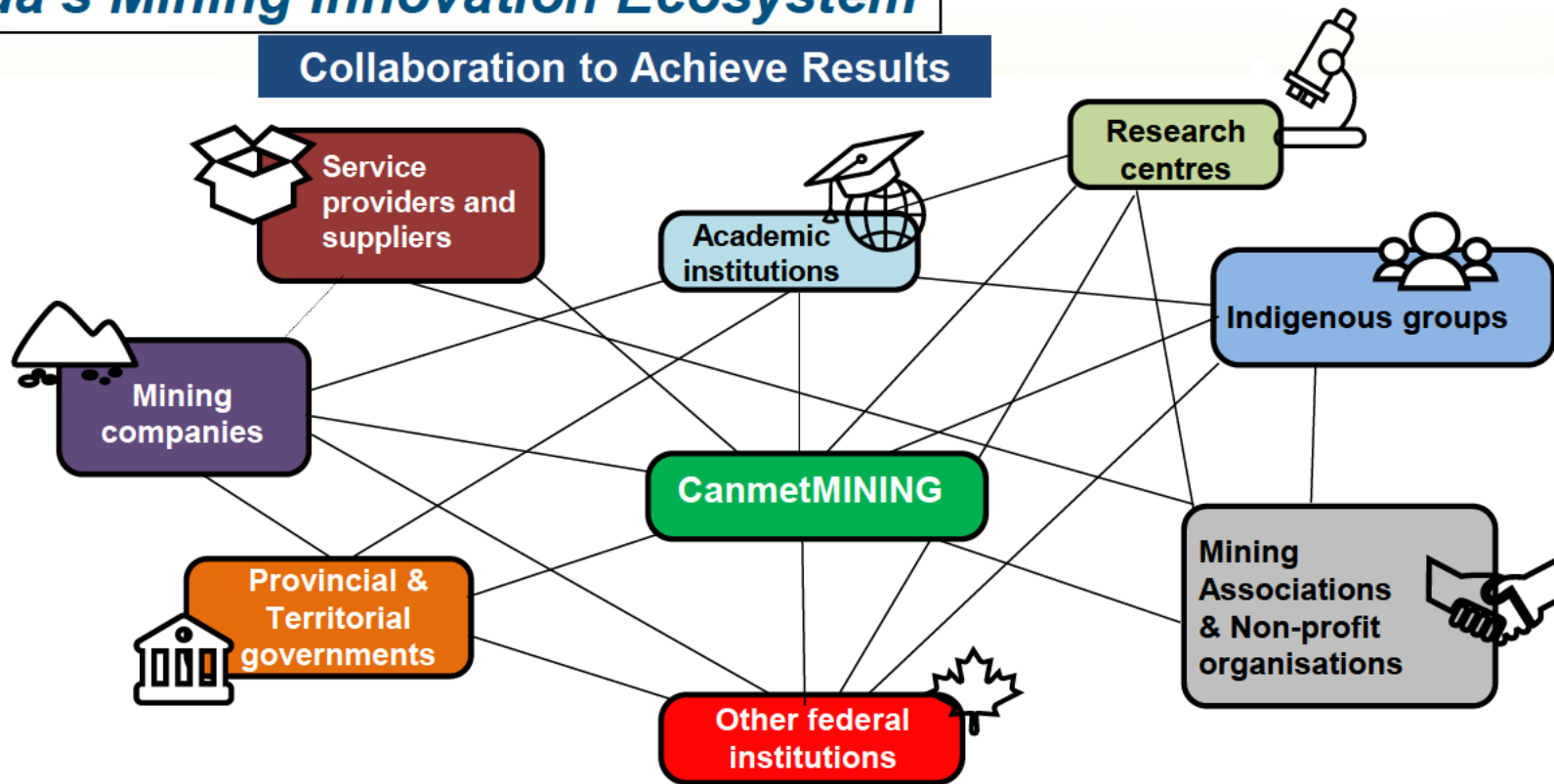
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*\*Investments from Budgets 2017 and 2018*

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# Canada's Mining Innovation Ecosystem

## Collaboration to Achieve Results



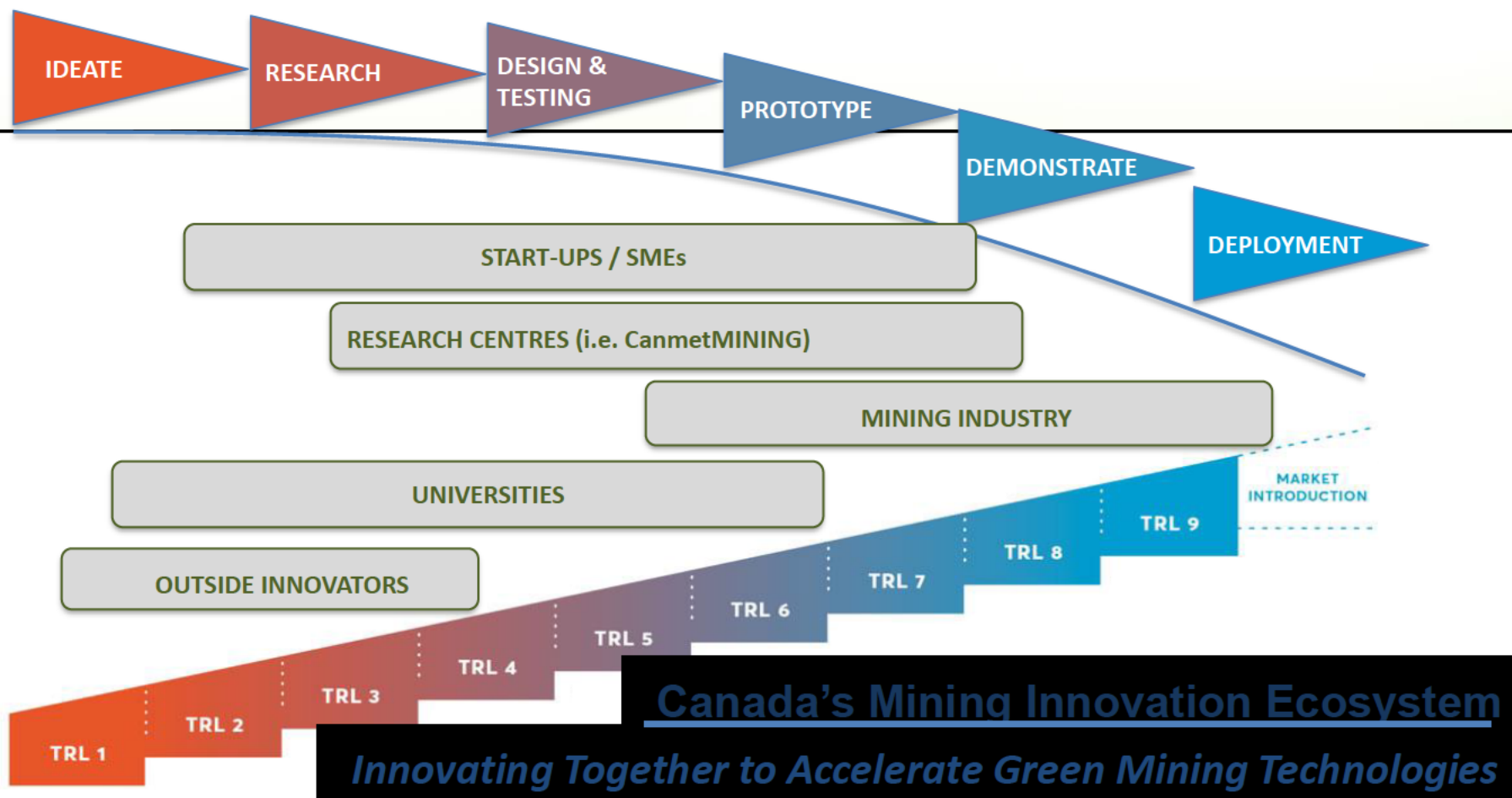
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# The Concept of Green Mining

Mining that provides the raw materials needed by society and that leaves behind only clean water, rehabilitated landscapes and healthy ecosystems



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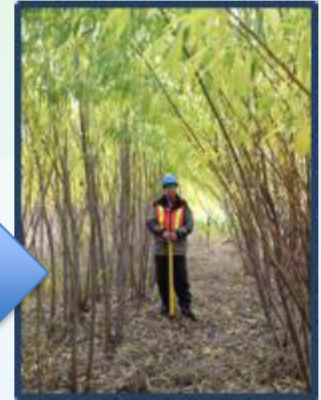
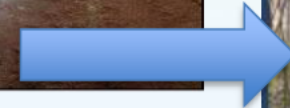
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# How is Mining is Going Green?

By:

- Improving overall energy efficiency
- Lowering water consumption
- Improving waste management techniques
- Planning for closure/rehabilitation
- Working more closely with communities
- Investing in innovation



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# Key Canadian Initiatives that Support Green Mining



**Towards Sustainable Mining<sup>®</sup>**



**Towards Zero Waste Mining**



**SustainMine: Environmental Impact**

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# Green Mining Innovation

*Economically Competitive and Environmentally Sensitive*



## Addresses Industry Priorities and Challenges

- Improving energy efficiency and reducing greenhouse gases
- Minimizing wastes
- Increasing productivity
- Expanding mineral resource potential

## Aligned with the Government of Canada's Agenda

- Clean technology
- Climate change
- Watershed protection
- Economic competitiveness of the natural resources sector

## Contributes to the Public Good

Supports:

- Environmental assessments
- Scientific evidence for regulatory development
- Water quality
- Tailings management



# *As the federal leader on Green Mining Innovation, CanmetMINING innovates across the mining sequence...*

Economic Competitiveness

Environmental Performance



Exploration and development



Mineral Extraction



Mineral Processing



Closure and Rehabilitation

Goal: de-risk green mining technologies to accelerate their deployment and commercialization

## *...to reduce energy, waste and water, and address climate change*

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# Key GMI Initiatives: Hydrogen Power – a cost-effective alternative to diesel power in underground mines



## Hydrogen power

An alternative to diesel power  
in underground mines

CanmetMINING, in collaboration with mining and energy industries, academic institutions and regulators, is participating in:

- Hydrogen power research and testing
- Developing codes and standards for H<sub>2</sub> installation in mines
- Demonstrating and implementing the technology in mines



A switch to hydrogen-based technology could reduce the GHG footprint of an underground mine by up to 25%, save energy, and improve air quality in underground mines.

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# Key GMI Initiatives: Mining Value from Waste

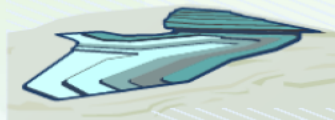
Transitioning to a circular economy

## BENEFITS

- ↓ liability
- ↓ environmental impact
- Community benefits (jobs, energy)
- Low energy/ greenhouse gas process

### MINE WASTE

High liability  
Environmental and social risk  
High metal content



### REPROCESSING

Low energy demand  
process



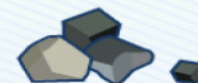
### METAL RECOVERY

Rare earth elements,  
gold, nickel, cobalt, etc.



### BIO-FUEL PRODUCTION

Community energy  
Energy for operation  
By-products from bioenergy



### RESIDUES

By-product potential  
e.g., Construction  
materials

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# Key GMI Initiatives: Water Management in Mining and Mineral Processing <sup>15</sup>

CanmetMINING works with water management companies to:

- evaluate, de-risk and improve water treatment processes & technologies
- introduce technologies from other sectors for mining applications

## BENEFITS

- Improve recovery and reuse of water in mineral processing
- Reduce freshwater intake
- Reduce contaminants discharge
- Positive impact on process economics



# Clean Growth Program

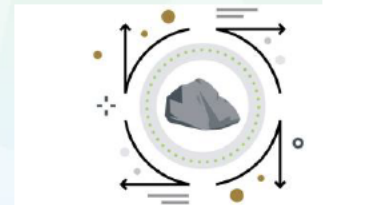
- \$155 million investment in clean technology R&D and demonstration projects: energy, mining and forestry.
- Program covers 5 focus areas:
  - Reducing greenhouse gas and emissions
  - Minimizing landscape disturbances and improving waste management
  - Producing and using advanced materials and bioproducts
  - Producing and using energy efficiently
  - Reducing water use and impacts on aquatic ecosystems
- Working to advance emerging clean technologies toward commercial readiness





# Crush it! Challenge

- The Challenge:
  - To find a more efficient rock processing technology
- Prizes for ground-breaking clean technologies:
  - Selected small-scale innovators will be awarded \$10,000 each to help prepare and present their ideas to the Challenge Jury at #DisruptMining at PDAC in March
  - Up to 6 finalists will receive up to \$800,000 each to starting building and testing their cleantech mining solution.
  - A Challenge Jury will pick the biggest energy breakthrough in crushing and grinding rocks to receive a \$5 million grant.



# Looking to the Future

## New innovations and applications:

- Mine automation/robotics
  - Access deeper resources/improve efficiencies
- Artificial intelligence
  - Big data analytics, reduced costs, improved productivity
- Application of genomics
  - Biogeochemical approach to water treatment and improved metal recoveries



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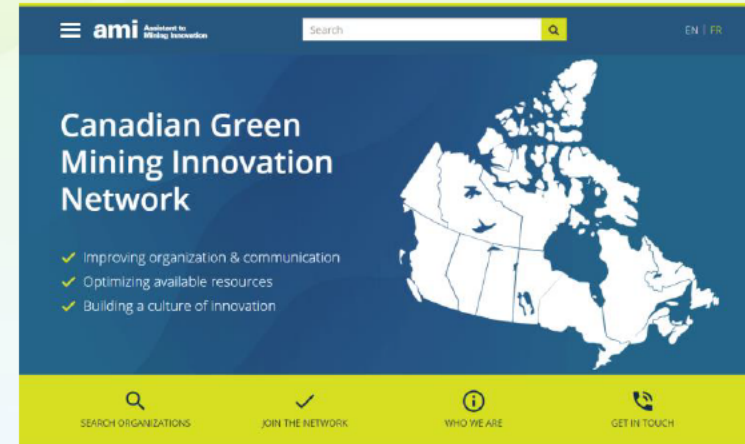
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# Innovation Built on Collaboration

- Innovation can be accelerated by bringing partners together to share the risks and benefits of investments in R&D
- New platform for collaboration:

[www.ami-aim.ca](http://www.ami-aim.ca)



[www.ami-aim.ca](http://www.ami-aim.ca)



**Canada is developing a comprehensive minerals and metals plan to foster a competitive, sustainable and responsible minerals and metals industry adapted to the realities of the modern economy to the benefit of all Canadians**

**Its vision calls for Canada to be a leader in mining-related science, technology and innovation**

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# Annex

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Transform Mining Towards a Zero Waste Industry

*by 2027...*

*50% reduction - energy use*

*50% reduction - water use*

*50% reduction - environmental footprint*

## 5 Strategic Themes: Reduce Cost & Risk of Innovation



### **FINDMINE: Exploration**

Increase Discovery Rate at Lower Cost



### **DEEPMINE: Heat & Rock Stress**

Reduce Technical Risk



### **VALUEMINE: Mine Productivity**

Improve Performance, NPV & ROI



### **SUSTAINMINE: Environment & Sustainability**

Improve Environmental & Social Impact



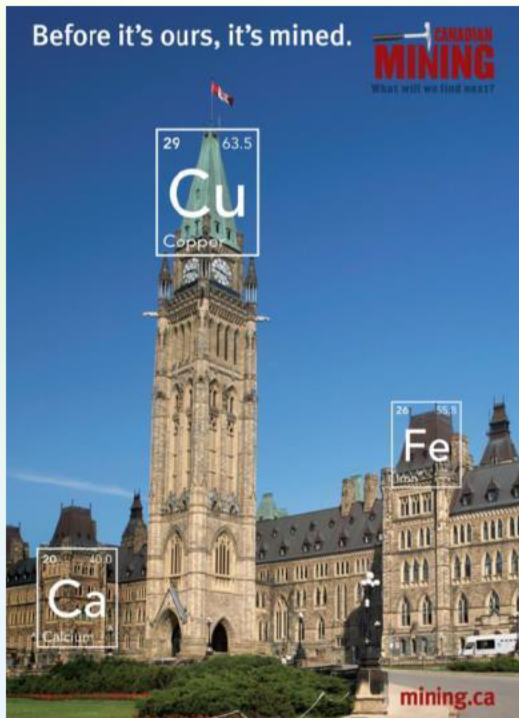
### **BIZMINE: Mining Business**

Business Analysis & Commercialization

Mine Productivity  
below 2.5km  
\$35 million Program

The logo for the Ultra Deep Mining Network (UDMN) features a stylized 'U' with a downward-pointing arrow inside it, above the acronym 'UDMN' and the full name 'ULTRA DEEP MINING NETWORK' in smaller letters below.





- Mining Association of Canada initiative
- Designed to drive performance and ensure responsible risk management by members.
- Improves environmental and social performance beyond regulations:
  - Environmental Footprint (tailings, biodiversity, water).
  - Energy Efficiency (energy use, GHG emissions).
  - Community and People (community and indigenous engagement, safety & health, crisis management).
- Performance measured at facility-level.
- Monitored by external advisory panel.
- Results are externally-verified.
- Encourages excellence and continuous improvement.

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# Towards Sustainable Mining- Social & Environmental Excellence



**2018 – Vale:** Sudbury Biodiversity Program that Restores Land and Waterways. Growing hay on tailings reduces dust, provides habitat for insects and birds as well as a crop.



**2018 – IAMGOLD:** Selling scrap metal to support women entrepreneurs in Burkina Faso. The sales have fostered economic diversity to make and sell peanut butter, an important food staple.



**2016 – Glencore:** in 1 year wind power energy at Raglan mine saved 2.1 million litres of diesel and reduced greenhouse gas emissions by 5.85 kilotons.

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