REMOTE, REAL-TIME MONITORING IN MINING

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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
The 70-20-10 Rule of Innovation

70%  
Operational Improvements

20%  
Radical Efficiency

10%  
Technology  
Business Models  
Transformative

Source: Adapted from Clareo
CMIC’s 4 Component Business Model

Business ecosystem

Open innovation

Platforms

Roadmaps
Innovation Enablers

- **One Integrated Digital Platform**
  - Sensors, connectivity and data capture
  - Predictive analytics and artificial intelligence
  - Short-interval control
  - Digital twin for integrated design, planning, scheduling and production

- **Flexible Mine Design**
  - Modularization, interoperability, plug and play

- **Open Collaboration**
  - Open data and standards
  - Knowledge Hubs
  - Open innovation IP management

- **Autonomous Mining**
  - Remote control, mechanization, autonomy & automation

- **Circular Economy**
  - Design out waste and pollution
  - Keep products and materials in use
  - Regenerate natural systems

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[Logo: canada mining innovation council]
## Environment Roadmap

<table>
<thead>
<tr>
<th>Themes</th>
<th>1-3 Years Industry Needs Assessment</th>
<th>3-5 Years Technology Acceleration</th>
<th>5-10 Years Commercialization</th>
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<tbody>
<tr>
<td><strong>Tailings</strong> (benign tailings, <em>in situ</em> treatment)</td>
<td>Technology roadmaps, TRL* assessment, RDI* coordination, project definition</td>
<td>Reduction in contaminant loadings; contaminant removal; ARD management; ML management; saleable waste products</td>
<td>Technology scale-up and broad uptake by industry</td>
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<tr>
<td><strong>Water</strong> (volumes, process management, discharge, monitoring)</td>
<td>Linking CMIC technical groups and tailings technology clusters to develop whole-system approaches</td>
<td>Water re-use / recycling; closed-loop / zero-discharge operations; treatment with resource recovery; real-time monitoring</td>
<td>25% reduction in tailings disposal and treatment costs; widespread reduction in environmental footprint</td>
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<tr>
<td><strong>Closure</strong> (&quot;walk-away&quot; technologies / systems; relinquishment)</td>
<td>Mapping technology development / management approaches to optimize water consumption and treatment</td>
<td>Passive systems; natural landform / applied geomorphology; bio- and phyto-remediation; standardized framework for relinquishment</td>
<td>25% reduction in water management costs and liabilities; widespread reduction in water consumption</td>
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<tr>
<td><strong>Environmental Data Management</strong> (access, analysis, preservation)</td>
<td>Iterative stakeholder consultation process to determine industry, regulatory, and government requirements</td>
<td>Predictive modeling for rehabilitation and reclamation scenarios; integration with existing modeling software; pilot-scale databases of environmental data</td>
<td>25% reduction in closure liabilities, provisions and bonding requirements; frameworks for long-term stewardship reduce risk of abandoned / orphaned mines and associated liabilities</td>
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<td>Analytical tools for determining environmental effects / impacts; scaled-up databases in major mining jurisdictions</td>
<td>Improved accuracy of predicted and actual environmental performance, costs and liabilities; comprehensive, national data portals linked to environmental data</td>
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Water and Mining

- Establish baselines
- Devise management strategies
- Track impacts / performance
- Ensure long-term stewardship of water resources
- “One cannot manage what one cannot measure”
## Paradigm Shifts

<table>
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<th>Current Paradigms</th>
<th>Another Way?</th>
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<tbody>
<tr>
<td>• Active water treatment (&quot;pump and treat&quot;) in perpetuity</td>
<td>• Closed-loop operations</td>
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<tr>
<td>• <strong>Closure management in perpetuity</strong> with decades-long asset retirement obligations (AROs)</td>
<td>• Fully passive systems for water treatment / management</td>
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<tr>
<td>• <strong>Wet tailings and large tailings impoundments</strong> with periodic failures</td>
<td>• “Walk-away” closure / design for relinquishment</td>
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<tr>
<td>• <strong>Closed data</strong> with little to no availability / shared access to environmental information</td>
<td>• Producing dry, <strong>benign tailings</strong> (<em>i.e.</em> dirt) towards eliminating tailings</td>
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<td>• “Grab sampling” for water quality monitoring</td>
<td>• <strong>Open data hubs</strong> of environmental information</td>
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<tr>
<td>• <strong>Innovation silos</strong> and environment operating in isolation to other groups</td>
<td>• Remote, real-time monitoring</td>
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<td>• <strong>Whole-system approach</strong> to environmental management</td>
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Technology Platform Innovation

“Grab” sampling

Remote, real-time monitoring
Grab Sampling

- Predominant method of sampling across sector
- Costly and time consuming
- Transport / sample degradation errors
- Safety risks, especially in remote locations
- “Snapshot” of water quality
Value Proposition

- Sampling frequency
- More representative sampling
- Early warning mechanism
- Data-driven decision-making
- Digitization and Digital Transformation
- Safety
Project Development

1. Scoping study → Water Working Group → Project definition → Pre-feasibility study

Feasibility study → Establish consortium → Phase 1 project launch → Phase 2 project launch
Feasibility Study

- State of play
- Ideal sensor package
- Technical design specifications
- Technology scan
- Gap analysis
- Key gap → sensors detecting metals
Why Collaborate?

- Pool and leverage investments
- Share risks for technology development
- Share results and data
- Attract matching funding and strategic partnerships
- Accelerate technology deployment at mine sites
Sensors Consortium and Partnerships

Leveraging skills, expertise, and resources from across the mining innovation ecosystem

Accelerating technology deployment at mine sites
Phase 1

- Heavy metal sensors
- Demonstration, validation, and customization
- TRL 5/6
- New technology platforms
- Pair mining companies with technology providers
Phase 2

- **Consortium scale-up**
  - Increase consortium size
  - Expand project activities
  - New partnerships with technology companies
  - New funding pools available
THANK YOU!