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

mining innovation

The 70-20-10 Rule of Innovation

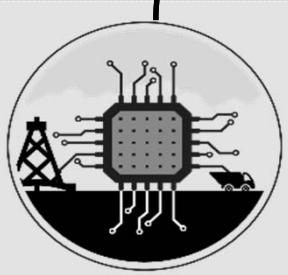
70%

Operational Improvements

20%

Radical Efficiency

10%



Technology

Business Models

Transformative

Source: Adapted from Clareo

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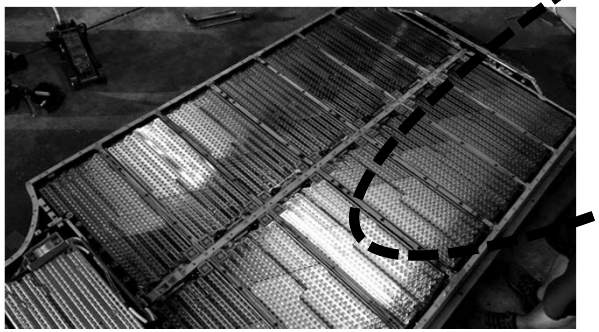
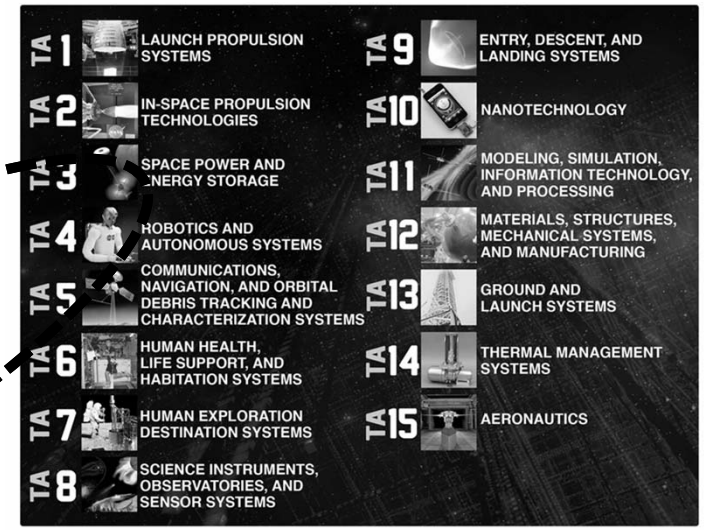
CMIC's 4 Component Business Model

Business ecosystem



Platforms

Open innovation



Roadmaps

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Innovation Enablers

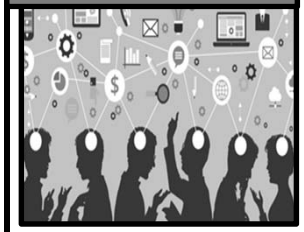
One Integrated Digital Platform

- 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

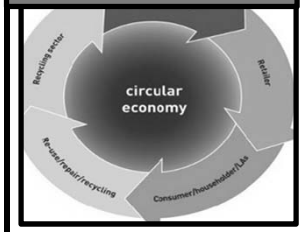


- Open data and standards
- Knowledge Hubs
- Open innovation IP management

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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Environment Roadmap

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

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”

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Paradigm Shifts

Current Paradigms

- Active water treatment (**"pump and treat"**) in perpetuity
- **Closure management in perpetuity** with decades-long asset retirement obligations (AROs)
- **Wet tailings and large tailings impoundments** with periodic failures
- **Closed data** with little to no availability / shared access to environmental information
- **"Grab sampling"** for water quality monitoring
- **Innovation silos** and environment operating in isolation to other groups

Another Way?

- **Closed-loop** operations
- Fully **passive systems** for water treatment / management
- "Walk-away" closure / design for **relinquishment**
- Producing dry, **benign tailings** (*i.e.* dirt) towards **eliminating tailings**
- **Open data hubs** of environmental information
- **Remote, real-time monitoring**
- **Whole-system approach** to environmental management

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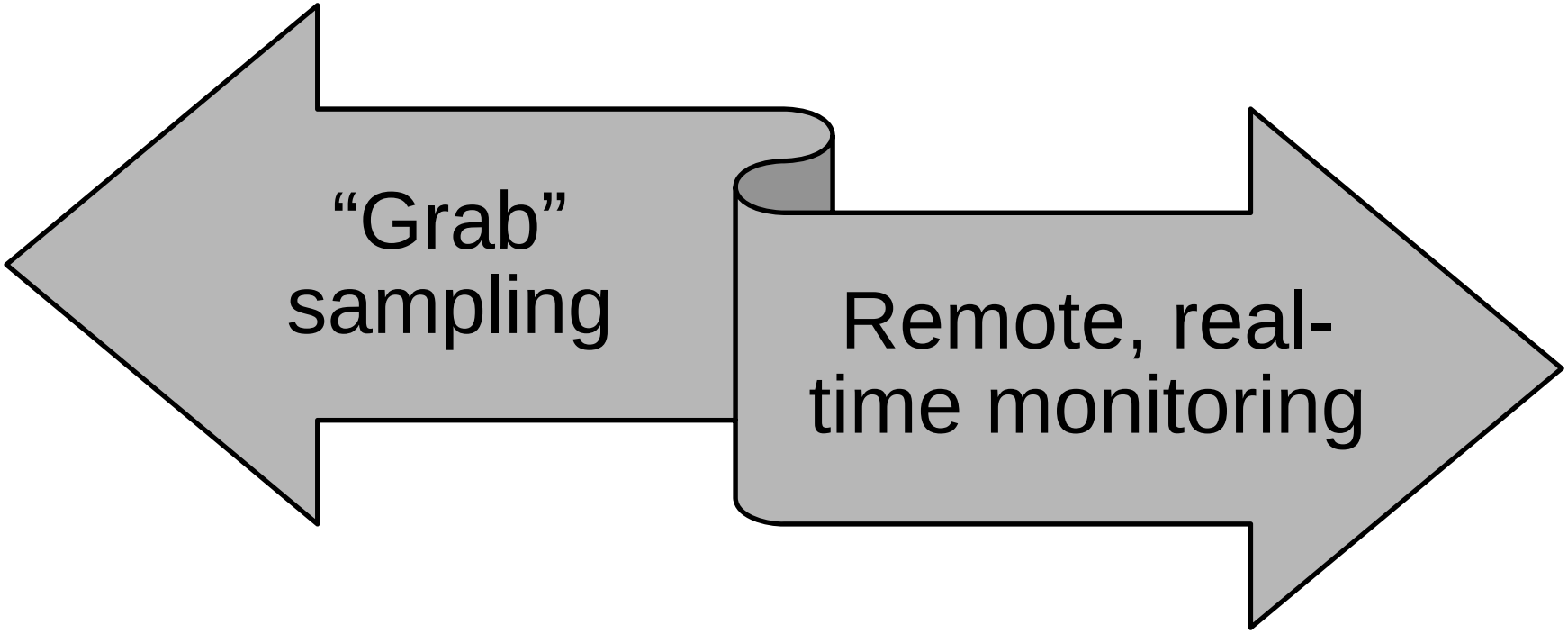
Technology Platform Innovation



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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

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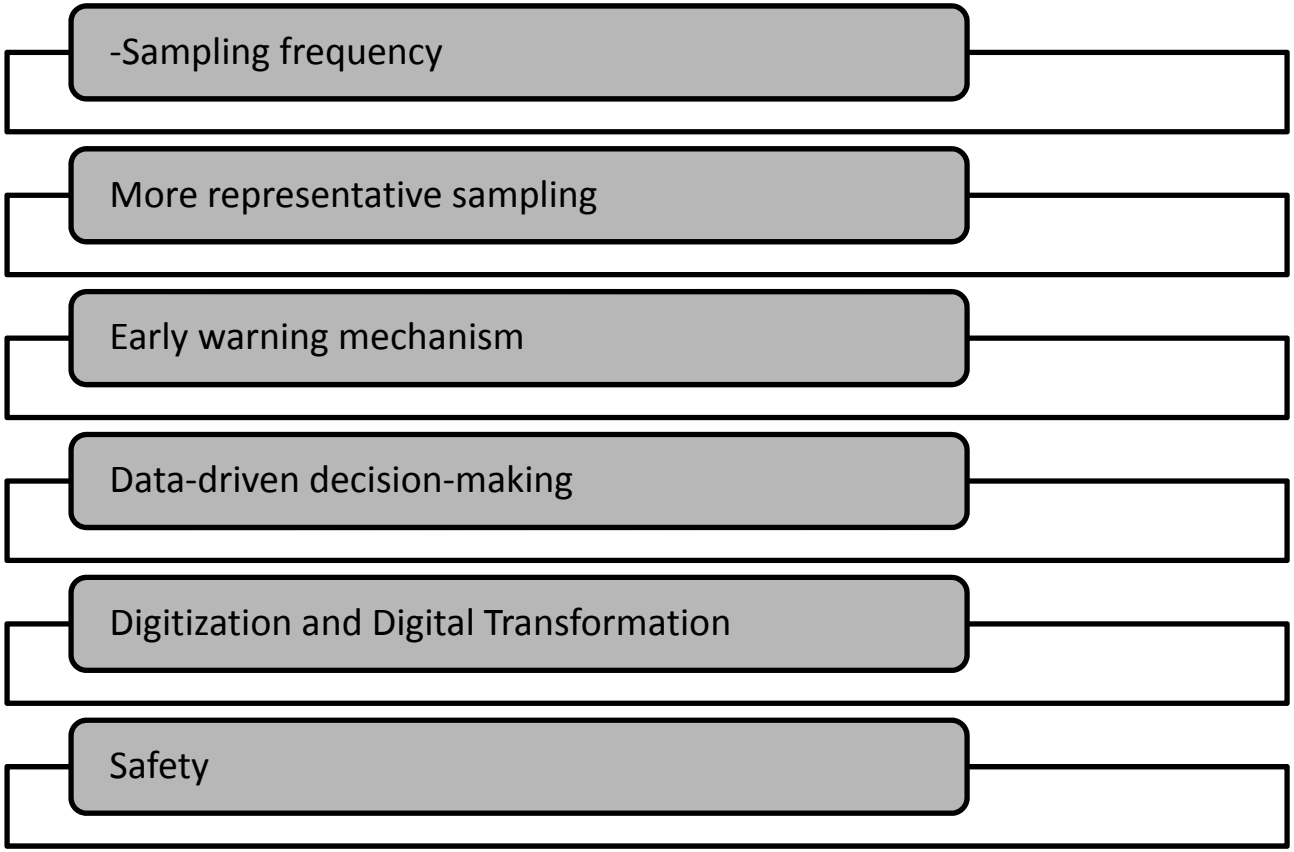
Value Proposition



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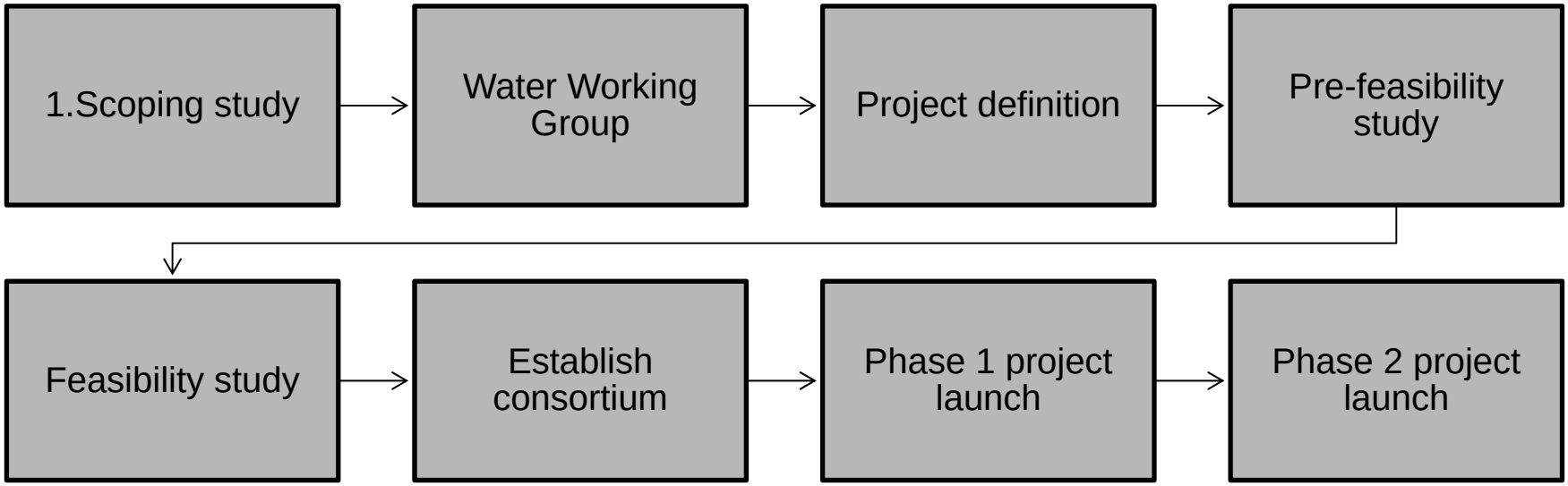
Project Development



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Feasibility Study

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

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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

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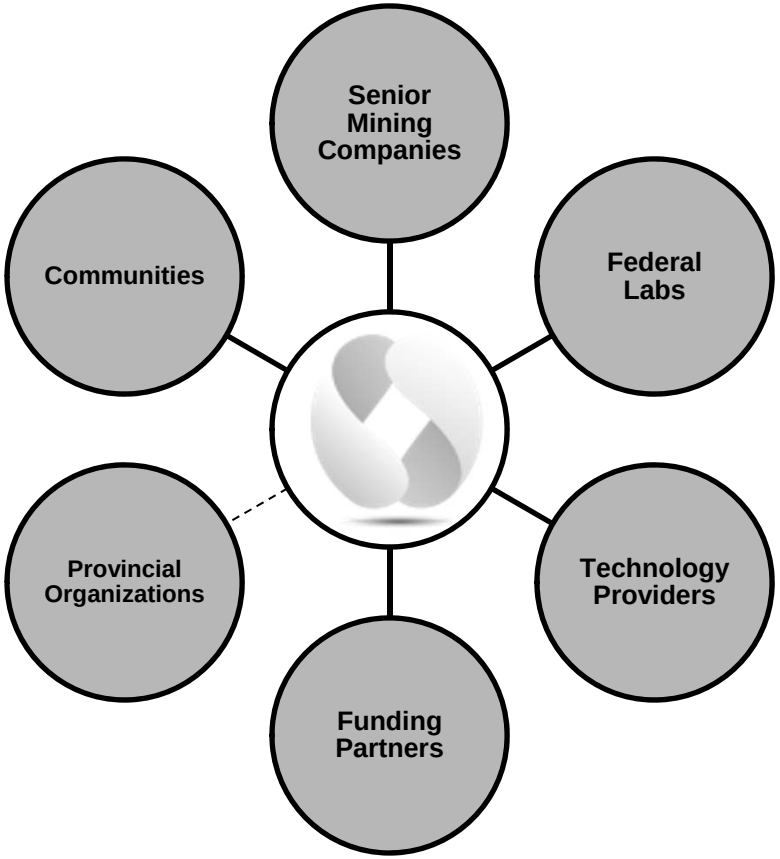
Sensors Consortium and Partnerships



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

Accelerating technology deployment at mine sites

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Phase 1

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

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Phase 2

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

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THANK YOU!