UNIVERSITY OF TORONTO

Powering the Future: *Critical Minerals, Energy and AI in Ontario's Innovation Economy*

Discussion Summary
New Frontiers for Policymakers
May 14, 2025

Discussion Summary

The critical minerals, energy and artificial intelligence sectors are central to the future of global economies. With strengths in each area, Ontario is positioned to grow and benefit from discovery and commercialization at the intersection of these sectors. On May 14, 2025, researchers, teaching and industry experts highlighted several applications and the next steps required to scale innovation.

The session focused on the opportunities and challenges of developing and integrating artificial intelligence applications to mining exploration and energy distribution. While each sector taps into different industry partners and faces specific challenges, shared themes emerged:

Investments are needed to advance commercialization of high-impact research

University-based research provides the foundation for innovation in mining and energy. At U of T, the Mining Futures initiative and the Grid Modernization Centre are key examples of translational research in action. These initiatives align research goals with industry needs while supporting startups and providing simulation platforms to de-risk new technologies. However, moving from early research to scaled deployment stalls due to gaps in funding and private investor hesitancy. The energy and mining sectors typically adopt innovations only at later Technology Readiness Levels (TRL 6+), leaving early-stage, high-impact discoveries underutilized.

A change in industry mindset, growing recognition for commercialization as a research output and public investments can bridge this commercialization “valley of death.”

Research Translation requires a coordinated ecosystem

A coordinated ecosystem brings together regulators, utilities, academia, and private industry. Models of co-ordination participants noted include the Vector Institute, the University of Toronto’s Climate Positive Energy initiative (CPE), and national industry collaboration programs such as Mitacs. For example, the Grid Modernization Centre, arising from the CPE research team, received $10M in federal support (NRCan, FedDev Ontario) and secured $12.6M from 50 partners including Hydro One, Siemens, and Hatch.

Through the Centre, SMEs evaluate grid-compatible technologies through real-time simulators; critical for modernizing a grid expected to manage rapidly increasing loads.

Developing an AI-capable workforce is essential

Programs like Vector’s FastLane support SMEs by providing access to AI training, expertise, and ecosystem connections, helping build talent pipelines for startups and legacy firms alike.

U of T’s Civil & Mineral Engineering programs now integrate direct field experiences, guest lectures, and internships to build leadership and technical fluency among students. Mitacs-supported internships ensure students are exposed to live industry challenges, building a skilled and agile workforce.

Data science and AI training embedded in engineering curricula provide students a functional understanding of how technologies impact mining and energy systems.

Challenges + solutions

Mining

Ontario's mining sector is rich in resources and global in reach, hosting nearly half of the world's publicly listed mining companies. Addressing challenges and developing solutions with local and surrounding communities will position the sector for sustainable growth. The issues identified included: slow permitting, legacy liabilities (abandoned mines), workforce upskilling and capital risk aversion.

The University of Toronto's Mining Futures program aims to solve the complexity of problems by collaborating with and supporting the needs of early-stage and established companies such as Vale Canada Inc. AI applications in the sector are also growing, from core logging automation to predictive maintenance. New approaches to every aspect of mining, from exploration to maintenance, are being commercialized by researchers driven to become entrepreneurs. Examples include Kore Geosystems (co-founded by U of T professor Sebastian Goodfellow) or global company Earth AI.

The Mining Futures initiative aligns research with industry's 'wicked challenges.'

Energy

Ontario's grid must significantly increase capacity by 2050 to meet industrial and transportation electrification demands. But the infrastructure was designed for stable loads, not AI-driven, high-variability demands. Data centres consume 10x more power than traditional systems and swing between 30–90% of peak demand. Managing demand is made even more complex by Ontario's fragmented grid, with 64 distribution utilities and separated transmission and generation operations, hampering coordination.

The Grid Modernization Centre (GMC) enables pre-deployment testing and de-risking technology integration while offering regulatory bodies insight into future planning needs. Digital twins and predictive analytics can reduce the need for costly infrastructure expansions prior to testing, and by lowering costs and risk, the GMC encourages cooperation between small utilities and major grid operators.

The Grid Modernization Centre (GMC) supports simulation/testing and interdisciplinary R&D.

Artificial Intelligence in Mining and Energy

AI can significantly enhance productivity and safety across sectors, but first, it must overcome barriers to adoption: These include workforce uncertainty about the impact of automation on job security, interoperability of applications, and high and inefficient energy consumption. Over a third of initiatives to integrate AI technology fail to scale due to complex system integration issues and poor user experience design, for example.

At the same time, solutions are being developed. With support from programs like FastLane, SMEs are deploying AI to improve grid forecasting, maintenance, and business operations. In mining, enhancing complex decision-making is predicted to be an important source of productivity increases in the future.

The Vector Institute's Fast Lane program actively supports Canadian small and medium-sized enterprises (SMEs) in adopting and accelerating AI through technology enablement, training services, talent services, and ecosystem access.

Recommendations

Ontario can lead in AI-driven innovation in critical minerals and energy - two sectors foundational to global sustainability and economic competitiveness. To do so, the discussion raised several strategies that governments and stakeholders can adopt:

Champion coordinated ecosystems: Support models that bring together academia, government, and industry (e.g., GMC, Mining Futures) to solve collective challenges.

De-risk early-stage innovation: Expand funding programs and incentives to support technologies below TRL 6, and foster public-private commercialization pathways.

Support workforce transformation: Invest in AI and sustainability training at undergraduate and professional levels to build a future-ready workforce.

Enhance grid resilience: Accelerate support for simulation and test-bed facilities to modernize the grid, including regulatory adaptation and creative financing.

Align incentives: Encourage IP creation, interoperable standards, and academic research partnerships with industry that promote commercialization and cross-sector impact.

Thank you to all participants and to the research presenters: Professor Lesley Warren, Director and Chief Principal Investigator, Mining Futures; Sebastian Goodfellow, Assistant Professor, Associate Chair, Professional Programs and Learning Platforms Department of Civil & Mineral Engineering, Founder, Kore Geosystems; Junaid Ebadi, Vector Institute, Shatha Qaqish, Executive Director, Climate Positive Energy and Shah Nawaz Ahmed, Business Unit Head Digital Grid, Smart Infrastructure, Siemens.

The event was part of the New Frontiers for Policymakers series, bringing together researchers and decision-makers to explore solutions to urgent public policy challenges.

Government Relations Office
Simcoe Hall, 27 King's College Circle, Room 5
Toronto M5S 1A1
gro.utoronto.ca

UNIVERSITY OF TORONTO

DEFY GRAVITY