PARTNERING TO ENHANCE ONTARIO'S CRITICAL MINERALS AND MATERIALS INDUSTRY

ONTARIO'S UNIVERSITIES

Critical minerals and materials are important for Ontario's economy as they contribute to economic growth, job creation, support clean technology and renewable energy sectors, while also driving innovation and research.

Below are just some of the many ways universities across the province are partnering with industry and local communities to train highly skilled talent, work towards reducing negative environmental impact and deliver ground-breaking innovations that attract investment to our province - critical components to establishing Ontario as a leader in the critical minerals and materials industry.

Supporting research and innovation

Mining is often an inherently disruptive practice which warrants careful consideration of environmental impacts in the short-term and long-term. A researcher at **Carleton University** is helping manage these impacts by providing predictive timelines for settlement of tailings from mining operations and oil sands, a key indicator of when remedial work on affected lands can begin.

Reducing greenhouse gas emissions (GHG) is a critical step to reducing Ontario's environmental impact and combatting climate change. Researchers at the **University of Guelph** have developed a novel approach to convert methane, one of the most prominent GHGs, into methanol, which has many potential industrial applications, including in chemical and fuel cell production.

As the world continues its transition to low-carbon electricity sources, it is critical to develop a comprehensive understanding of the environmental impacts of new technologies at all stages of their life cycle. **Ontario Tech University** is working to conduct life cycle assessments of the environmental impacts and costs of technologies used to supply low-carbon electricity such as small modular reactors and lithium-ion batteries, including the extraction of their composite materials and their end-of-life disposal.

Mitigating the environmental impacts of mining is an important consideration in the sector, particularly as the impacts of climate change become increasingly apparent around the world. Researchers at **Trent University**'s PowerGeolab are leading the industry in developing innovative practices such as a new method which uses mine waste and tailings to sequester CO_2, simultaneously mitigating the direct impacts of mining activities and removing greenhouse gases from our atmosphere.

Mining is an extremely costly endeavor, with expenses ranging from land purchases, to the purchase of equipment and materials, to remedial efforts post-extraction. Researchers at the **University of Waterloo**'s Water Institute are developing an approach to evaluate the costs associated with environmental regulations on mining firms, allowing government and industry to adequately plan for optimal economic and environmental outcomes when planning operations and drafting regulations.

Critical minerals are playing an increasingly crucial role in the modern world, providing essential components for many of the consumer electronics which have become integrated in our day-to-day lives. Researchers at **Western University** are taking the search for these precious resources to new lengths, providing their expertise to support the Khepri Asteroid Mining Mission, which explores the potential for space resource utilization.

Ontario relies on state-of-the-art facilities and equipment to conduct the research and innovation which attracts investment to drive our economy forward. The **University of Windsor** is equipped with Element and Heavy Isotope Analytical Laboratories which allow their researchers to drive ground-breaking innovations in critical materials engineering research.

Furthering industry partnerships

As new technologies become integrated in the operations of all major industries, cybersecurity is becoming an increasingly significant consideration for businesses everywhere – including mining operations. **Algoma University** has provided a forum for industries to share best practices by co-hosting a cybersecurity talent strategy workshop with representatives from a range of disciplines, including mining, healthcare, government and education.

Ontario is one of a number of regions where critical minerals are sourced, and many mineral producing states are impacted by fragility, conflict and violence resulting from the high demand for these resources. In response to these issues, **OCAD University**'s Strategic Innovation Lab (sLab) partnered with the International Institute for Sustainable Development to support research into the matter and develop recommendations for policymakers to mitigate the negative impacts of the critical minerals industry abroad.

In order to assess how CSR challenges are addressed and develop best practices for how mining companies can contribute to sustainable development on local and national scales, **Toronto Metropolitan University**'s Corporate and Social Responsibility (CSR) Institute is conducting research in collaboration with three Canadian mining companies with operations in developing countries.

Developing a highly skilled workforce

Resource exploration and extraction is a complex practice, requiring highly skilled engineers to ensure projects are carried out effectively and with appropriate consideration for health, safety and sustainability. **Laurentian University** is providing students with the skills they need to drive innovation and growth in the critical minerals sector through their Mining Engineering program, which includes opportunities for in-class and hands-on co-operative learning.

As Ontario seeks to establish itself as a leader in electric vehicle (EV) and battery manufacturing, **McMaster University**'s engineering grads are helping the industrial sector find greener solutions. Four of the university's engineering alumni work at global engineering consultancy Hatch, where they are driving innovation in areas such as resource extraction and hydrometallurgy, developing diverse practices to ensure the sustainability of Ontario's EV manufacturing sector at all stages of the supply chain.

Responsible mining and materials production draws on highly skilled experts with a range of specializations including engineering, geology and ethics, among others. **Nipissing University**'s Environmental Management program provides students with a strong background on best practices which can be applied to mining and other environmentally sensitive fields, with courses ranging from natural resource management, impact assessments, and Indigenous relations.

Like many highly technical industries, positions within the mining sector often require direct, hands-on experience that cannot be gained in a classroom alone. **Queen's University** is providing their students with opportunities to gain direct experience in the mining industry through co-op opportunities with companies across Canada, giving the workers of tomorrow essential skills and experiences that will serve them in their future careers.

Many advanced industries, including the tech and automotive manufacturing sectors, rely on the conversion of raw critical minerals into usable materials. The **University of Toronto**'s Materials Science and Engineering department offers opportunities to learn about sustainable materials processing, turning inorganic wastes into critical materials, recycling lithium-ion batteries, and recycling rare earth elements through innovative processes that will improve the sustainability of our critical industries now and into the future.

As Ontario works to cultivate a comprehensive domestic EV manufacturing sector, developing and maintaining strong supply chains will be critical to ensuring that our province has the capacity required to support this emerging industry. **Wilfrid Laurier University** is addressing this need by educating students on the complexities of supply chain management through a 12-month program which combines in-class learning with real world fieldwork in collaboration with industry.

The future of Ontario's mining and critical minerals industries is largely dependent on our ability to develop and secure highly skilled business leadership. **York University**'s Schulich School of Business has collaborated with leaders in the mining industry to develop the Global Metals and Minerals specialization, a world-class business program which seeks to build the next generation of leaders in the global metals and minerals industry.

Strengthening Indigenous relations

Fostering strong relationships with Indigenous and First Nations communities is vital in the mining industry. With a focus on respecting Indigenous communities and land in which they are based, **Brock University** graduate Hans Matthews, a geologist, a member of the Wahnapitae First Nation and President of the Canadian Aboriginal Minerals Association plays a critical role in fostering partnerships between the mining industry and Indigenous communities.

Lakehead University's Centre of Excellence for Sustainable Mining and Exploration leads sustainable practices in critical rare mineral mining in Ontario's Ring of Fire. With cross-disciplinary experts from 16 departments, and partnerships with local communities, the center examines the environmental, social, and economic impacts of resource development. The university develops innovative technologies for eco-friendly mining, prepares students for the industry, and prioritizes collaboration with First Nations and Métis groups. By integrating innovation, research and partnerships, Lakehead University is shaping a responsible and sustainable future for critical rare mineral mining in the region.

To help establish a respectful system of conduct for the industry to follow in interactions with Indigenous communities, researchers at the **University of Ottawa** are working in partnership with the community to better learn and understand the perspectives and concerns of Indigenous women on the subject of mining.