# FROM THE GROUND UP
# IGNITING INNOVATION
# IN CANADA'S MINERAL SECTOR

*The Canadian Mineral Sector innovates at every stage in the life cycle of a mine.*

***Industry**, **academia**, and **government scientists** and **engineers** across Canada are generating innovations in the mineral sector that will contribute to the discovery, development, operation, and closure of Canada's current and future mines.*

**These innovations will produce:**

- **JOBS**
- **BUSINESS OPPORTUNITIES**
- **COMMUNITY BENEFITS**

**FOR CANADIANS**

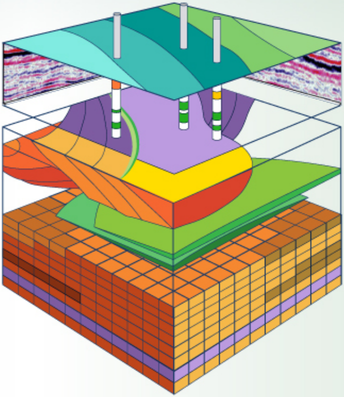
# INNOVATION AND **DISCOVERY**

## THE TARGETED GEOSCIENCE INITIATIVE (TGI)

Finding new mineral resources remains a challenge; new deposits are found at increasing depth in often-complex geological terrain. Geologists require **new geological models** and **advanced technologies** to find them.

By utilizing the best examples of ore systems from across Canada, TGI provides the industry with **new geoscience knowledge** and **innovative techniques**, which will increase the

*effectiveness of deep exploration for Canada's key economic minerals.*



## MAPPING AND MINERAL ANALYSIS

### 3-D MAPPING TECHNOLOGY

combined with **geophysical and geological modeling of rock propertie**s, offers an unparalleled image of an ore system from its source rocks to the surface deposit.

*It can also lead to a more efficient and effective mine site*

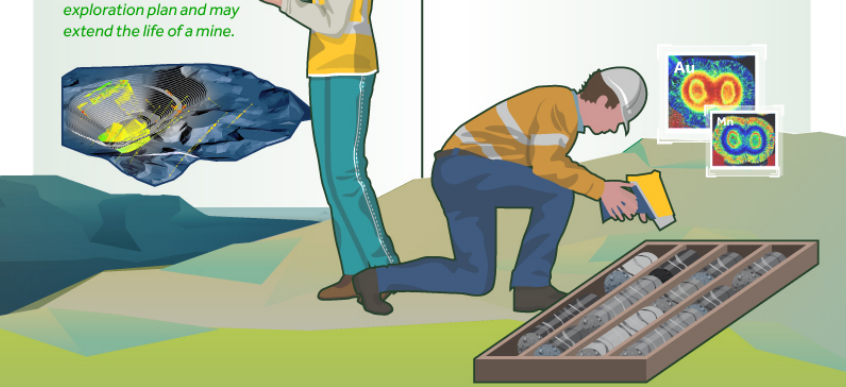
### LIBS

**LASER INDUCED BREAKDOWN SPECTROSCOPY**

portable equipment enables geologists for the first time to **directly detect mineralization** in real time and on-site.

*Mapping the individual elements of mineral crystals provides information on the geological evolution and potential mineral endowment of the field site.*

*exploration plan and may extend the life of a mine.*



## MACHINE LEARNING

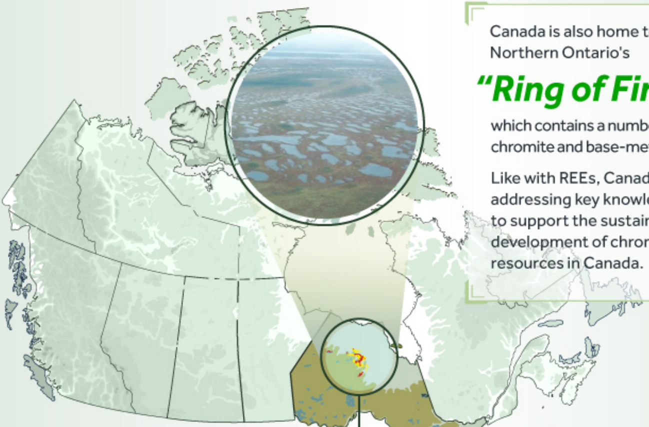
Analyzing repositories of **geophysical maps**, **geological maps**, and **geochemical and rock property data** can help answer the question

***Where to explore?***

# MADE IN CANADA

**Rare earth elements (REEs)** are found in just about every type of high-tech device from **smart phones** to **electric vehicles**.

*Canada has some of the more* ***advanced REE projects*** *in the world, and is conducting R&D to close research gaps to bring these high-demand resources to market.*



Canada is also home to Northern Ontario's

## *"Ring of Fire"*

which contains a number of chromite and base-metal deposits.

Like with REEs, Canada is addressing key knowledge gaps to support the sustainable development of chromite resources in Canada.

*Source: Natural Resources Canada*

**CHROME**

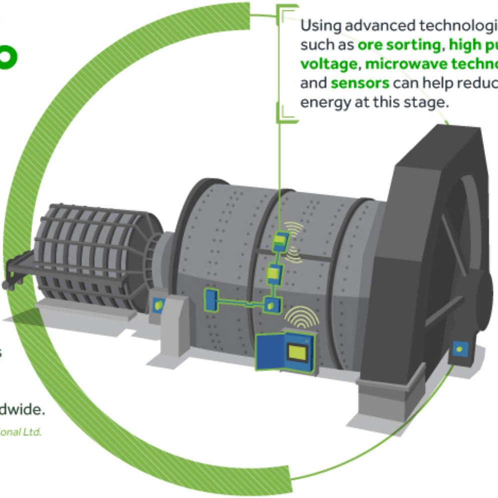
is an essential ingredient of stainless steel, which is used in everyday items such as kitchen appliances, utensils, and medicinal/dental tools.

# INNOVATION FOR PRODUCTIVITY

## ENERGY EFFICIENCY

Extracting minerals through comminution –
the process of crushing and grinding rock into smaller pieces –

*is the most energy intensive stage of the mining process.*



**53%**

of a mine site's electricity consumption comes from

**CRUSHING AND MILLING**

*Source: AT Mineral Processing*

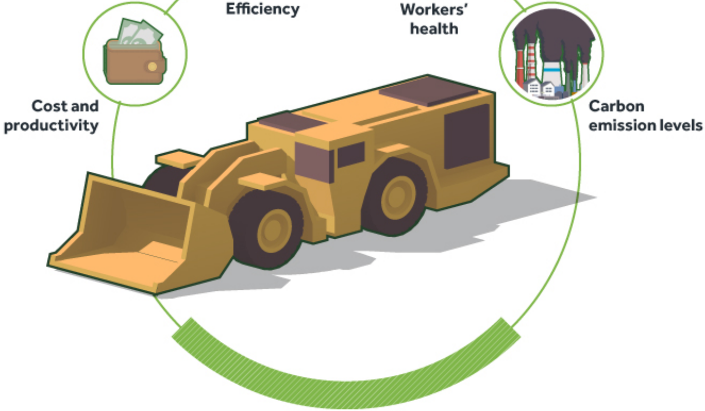
Using advanced technologies such as **ore sorting**, **high pulse voltage**, **microwave technologies**, and **sensors** can help reduce energy at this stage.

This represents up to **3%** of all electric power generated worldwide.

*Source: CEEC International Ltd.*

## ALTERNATIVE ENERGY

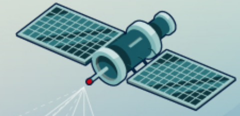
Replacing diesel power in underground mines with vehicles powered by **hydrogen fuel cells and battery-electric power** will help improve:



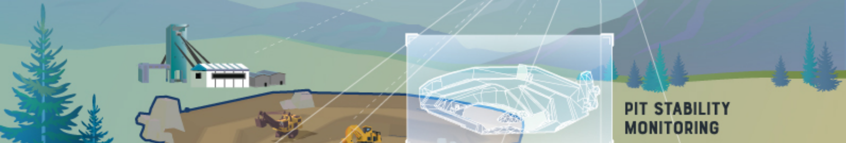
Switching to hydrogen-based technology could reduce the greenhouse gases footprint of an underground mine by up to **25%**

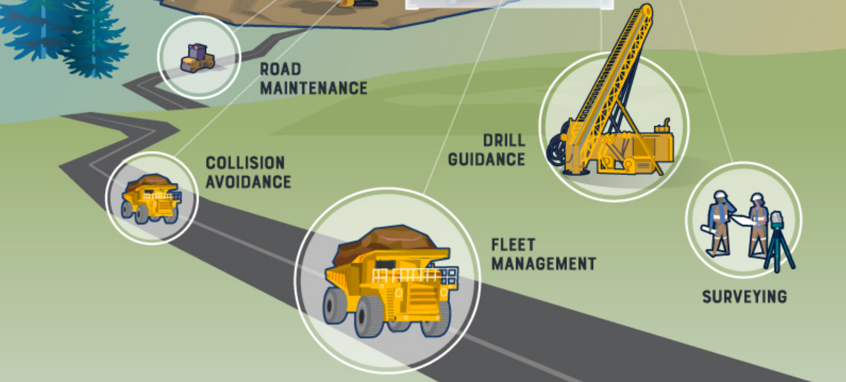
## GPS+ AND THE CONNECTED MINE

High-accuracy GPS can vastly improve **mining safety**, **productivity**, **efficiency** and **environmental management** by enabling increasingly precise and automated operations.



### AREAS THAT CAN BENEFIT FROM THIS INCLUDE





**AUTONOMOUS VEHICLES ALSO PROVIDE A HOST OF BENEFITS**

- INCREASED SAFETY
- INCREASED EFFICIENCY
- REDUCED FUEL CONSUMPTION
- REDUCED MAINTENANCE COST

# INNOVATION FOR SUSTAINABILITY & RESILIENCE

## WATER MANAGEMENT

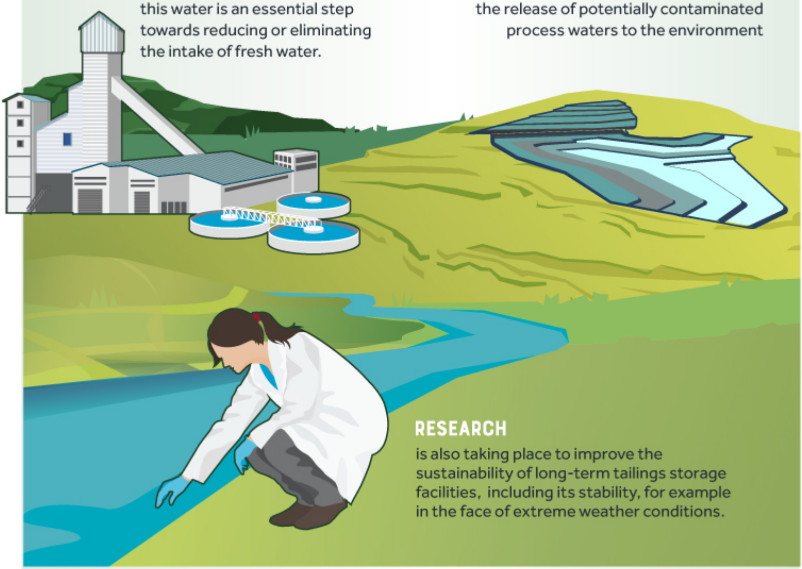
*Water is crucial to mining and is required at nearly every step of the process.*

**RECYCLING**

**THIS MINIMIZES**

this water is an essential step towards reducing or eliminating the intake of fresh water.

the release of potentially contaminated process waters to the environment



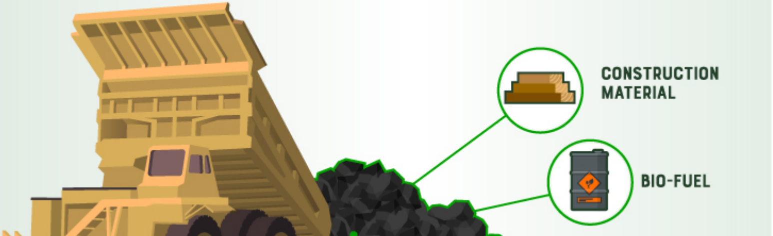
**RESEARCH**

is also taking place to improve the sustainability of long-term tailings storage facilities, including its stability, for example in the face of extreme weather conditions.

## MINING VALUE FROM WASTE

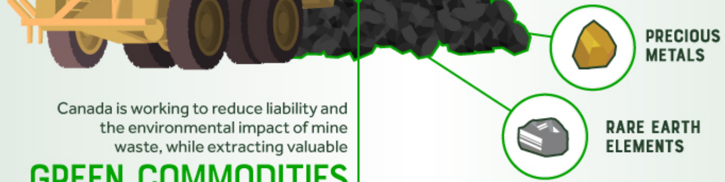
Canadian mines generate **200-250 million tonnes** of tailings waste annually.

There is a **significant amount of value** that can be recycled and extracted from a mine's waste, including



**CONSTRUCTION MATERIAL**

**BIO-FUEL**

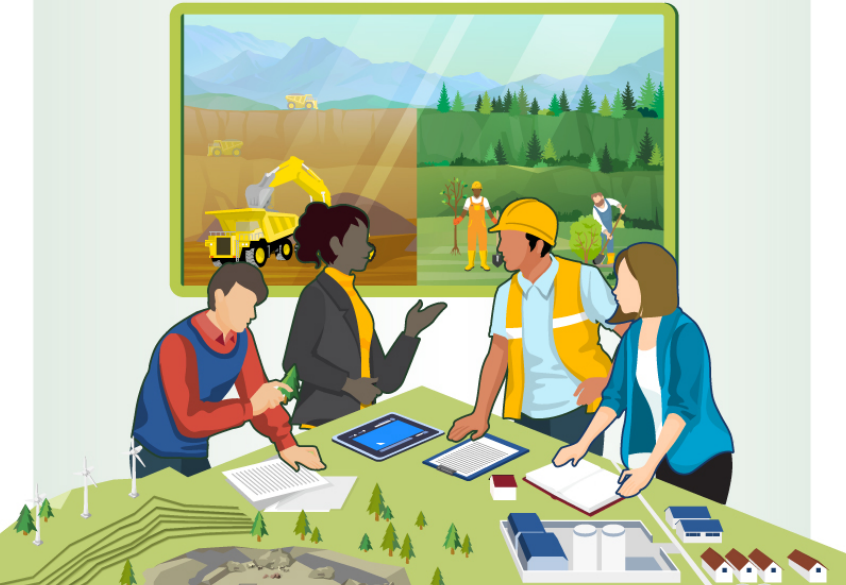


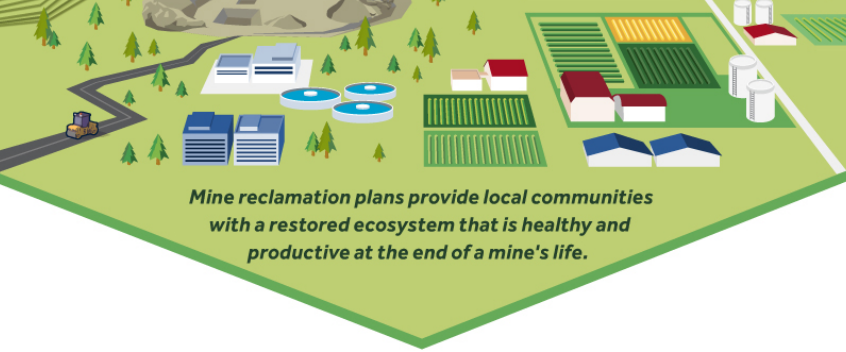
Canada is working to reduce liability and the environmental impact of mine waste, while extracting valuable

## GREEN COMMODITIES

## ECOSYSTEM RESTORATION AND RESILIENCE TO CLIMATE CHANGE

Best practice guidelines are being developed through collaboration between academia and industry to ensure land reclamation establishes healthy and productive ecosystems, and that future climate conditions are continually evaluated across the mining cycle.





*Mine reclamation plans provide local communities with a restored ecosystem that is healthy and productive at the end of a mine's life.*

Brought full circle, these best practices and continuous technological innovations are helping the country's resource industry to

***deliver tangible benefits to all Canadians.***

*presented by*

THE CANADIAN MINERALS AND METALS PLAN

LE PLAN CANADIEN POUR LES MINÉRAUX ET LES MÉTAUX

*Funded by*
*Natural Resources*
*Canada*

*Financé par*
*Ressources naturelles*
*Canada*

Canada

The Government of Canada is looking for game-changing solutions to reduce energy use in comminution – the crushing and grinding of rock. The $5 million Crush It! Challenge is an open call for innovators to submit their innovations and ideas to demonstrate the best solution with the most potential to transform energy use in Canada's mining industry.

*For more information visit* ***impact.canada.ca***

Learn how you can participate at **MinesCanada.ca** and join the conversation using **#yourCMMP**