SUDBURY INTEGRATED NICKEL OPERATIONS



Glencore Sudbury INO

How Onaping Depth nickel project in Sudbury, Ontario, will be one of the first electric mines in the world

Presented by Peter Xavier, Vice President

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Glencore in Canada

Our Canadian facilities form a significant part of Glencore's global business. Our sites span seven provinces and we employ 7500 people.

Our assets include nickel, copper, coal and zinc mining operations and projects; agricultural facilities; and a consulting business.

We are one of the world's largest producers of refined nickel with fully integrated operations

One of the world's largest recyclers and processors of nickel and cobalt-bearing materials.

Sudbury Impact in 2017

JOBS

1,300 Permanent employees, and more than 500 contractors

CAPITAL INVESTMENT* \$150 M

On sustaining and expansionary investment

*in Canadian dollars

INDIRECT JOBS 8,000

TOTAL WAGES & OPERATION SPEND* \$514 m



Glencore in Canada's contribution to the Canadian economy in 2017.

SPEND

\$5.8 B*

ON CANADIAN GOOD

Our most significant economic contribution comes from our core business activities: employing people, sourcing from local communities, and paying taxes to our host governments.



JOBS

7,500

DIRECT EMPLOYMENT



WAGES

\$658 M*

ANNUAL WAGES AND SALARIES PAYMENTS





TAXES & ROYALTIES

\$212 M*

DAID TO COVEDNMENTS



CAPITAL INVESTMENT

\$425 M*

UN SUSTAINING AND EXPANSIONARY INVESTMENT VCROSS OUP CANADIAN



COMMUNITIES \$2.4 M*

Global Nickel Operations



SUDBURY INTEGRATED NICKEL OPERATIONS

17.84

Sudbury Operations Overview and Sustainability

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Sudbury Integrated Nickel Operations



Safety, Environment & Risk Quality, Coaching & Integrated Systems











Environmental Performance

- ISO 14001 certified
- Smelter emissions reduction initiatives
- Downward trend in water, energy and GHG targets
- Land reclamation









Community Engagement

SUDBURY INTEGRATED NICKEL OPERATIONS * GLENCORE COMMUN

Indigenous Partnerships

Wahnapitae First Nation

(Participation Agreement signed in 2008) Information Sharing / Consultation Infrastructure Projects Human Resources and Environmental Working Groups Water Sampling and Environmental Monitoring Cultural Support and Capacity Building

Sagamok

(Memorandum of Understanding signed in 2011) Information Sharing / Consultation Community and Infrastructure Project Support

Métis Nation of Ontario

(Memorandum of Understanding signed in 2015) Information Sharing / Consultation Community and Infrastructure Project Support

Atikameksheng Anishnawbek

(Memorandum of Understanding signed in 2017) Information Sharing / Consultation Support on cultural events, education and training Initiatives, environmental and/or infrastructure projects



Open Houses and Career Days



Cultural Awareness and Support



Water Sampling Activity with Wahnapitae First Nation

MoU signed with Atikameksheng Anishnawbek



Open Houses



SUDBURY INTEGRATED NICKEL OPERATIONS ^ GLENCORE COMPARY

- Proactive participation in various community initiatives and programs.
 - Investment of approximately \$17 million over past 10 years
 - Active management involvement on several community boards
 - Community surveys
- Continued partnership in the following five giving areas:
 - Environment
 - Economic Development/Livelihoods
 - Health
 - Education
 - Locally/regionally relevant projects



Northern Water Sports Centre



Community Open Houses

Technology and Innovation Our Future Mines



SUDBURY INO 2022

ADAPTING FOR A DEEP MINING FUTURE WHILE ACHIEVING OPERATIONAL EXCELLENCE

PILLARS OF OUR STRATEGY

OUR LICENSE TO OPERATE

Manage our HSEC objectives & regulatory challenges and continue the journey towards zero harm.

OUR PEOPLE

Focused on our priorities and developing the skills to achieve them.

EXCELLENCE IN OUR OPERATIONS

Deliver and exceed expectations to achieve the performance required for deep mining.





OUR ABILITY TO ADAPT

We need to innovate and utilize

new technologies to secure our

BUILDING OUR FUTURE

Achieve full approval, build two mines and the Process Gas Project on an aggressive timeline and on budget.

Our Future Mines

Sustainably Designing for Depth



Sudbury Operations Craig Mine – Onaping Depth Project





Craig Mine – Onaping Depth Project





- Feasibility Study Completed in end of 2016
- Received project approval of US\$700m in Dec 2017
- Bottom up mining approach supported by a single shaft development
- 100% battery electric operated mobile fleet



Battery Electric Vehicle



GLENCORE

ONAPING

DEPTH PROJECT

Onaping Depth Project Battery Electric - Benefits



100% battery electric operated mobile fleet

- Energy efficiency
- Ventilation savings (lower flow)
- Cooling system savings
- Improved health benefits
- Increased opportunity to improve production profile



Onaping Depth Project Battery Electric - Benefits

Eliminated:

- Return Air Ventilation Ramp
- Fresh Air Raise
- (3) Ventilation Fans
- (5) Ore Passes (replaced w/ battery electric haul trucks regenerating power down ramp

Annual GHG emissions reductions (metric tonnes CO₂-equivalent/yr)*:

- Diesel: 17,130 tCO₂e/yr
- Reduction: 44%
- Battery: 9,620 tCO₂e/yr

* Energy Design review

| | Diesel | | Battery Electric |
|--------------------------|----------------------------------|------|---------------------------------------|
| Ventilation | 300 m³/s | -4C | % 180 m³/s → |
| Shaft Diameter | 6.5 m | -23 | % 5.0 m |
| RAR Diameter | 5.0 m | -24 | % 3.8 m |
| Refrigeration | BAC = 19.2 MWr CSC = 25.3 MWr | -319 | BAC = 13.3 MWr CSC = 17.5 MWr → |
| Ventilation Fan Power | 10,900 kWe | -44 | % 6,100 kWe → |
| Peak Refrigeration | 3,300 kWe | -30 | % 2,300 kWe → |
| Total Power | 14,200 kWe | -41 | % 8,400 kWe → |

Onaping Depth Project Battery Electric – Equipment Trials and Availability







Regulations – Ontario 96cfm/hp

Use "air quality" regulations

Uncertainty of Supply, Performance and Cost of BEV Fleet

<u>Supply</u>

Stay in regular contact with OEM's on their roadmaps

<u>Performance</u>

Buy units and get first hand experience – Our first unit was a personnel carrier(2015) – many other types since Get OEM's to perform duty cycle simulations of proposed equipment Run tests at sites to validate performance Create a network of Mining Companies and organizations to share experiences

<u>Cost</u>

Have an appropriate premium allowance based on vehicle class/size

Mine Design

One must design the mine around the BEV's capabilities and needs

Things to Consider - BEV Mine Design



- Take advantage of re-generation
- On board vs off board chargers
- Battery swapping vs batteries stay in vehicle
- Charge rate of batteries 1/2C to 10C
- Battery chemistries
- Charging Strategy (fixed vs opportunity)
- Parking and Charging locations
- Charging Management Systems individual vehicle and for fleet
- Rent or Buy batteries
- Battery disposal
- Power Quality



- Get involved with GMG (Global Mining Guidelines Group) and CMIC (Canadian Mining Innovation Council)
- Battery Electric Vehicle Underground Working Group







Significant Health and Wellness benefits

Significant reduction in ventilation requirements

Compounded if refrigeration is required

Lots of effort and incredible interest in BEV's over the past several years

- However, still at its infancy
- Much to learn and many differing views on what success looks like

Our beliefs

- Safer
- Duty can be met, at what cost?
- Operators must design and operate around BEV capabilities
- We must collaborate to accelerate BEV's and BEV Mines

