



# MINING IN ONTARIO:

## The Latest Trends and Industry Outlook

*State of the industry report prepared by the Ontario Mining Association  
in partnership with the Ministry of Northern Development & Mines with  
data and economic analysis by Hickling Arthurs Low Corporation.*







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# ONTARIO MINING: A FOUNDATIONAL INDUSTRY FOR THE 21<sup>ST</sup> CENTURY AND BEYOND

**Foreword by Chris Hodgson**  
Ontario Mining Association President

Mining produces the essential and irreplaceable components of daily life and modern technology, as well as the building blocks of innovation. Everything from life-saving medical devices to planet-saving green technologies depends on minerals and metals. The mining sector has exceptional potential to contribute to the economic development of Ontario, provided good policy and governance frameworks are in place.

The history of Ontario demonstrates that mining can transform people's lives and communities for the better. The major mineral discoveries and mine development of the 20<sup>th</sup> century underpinned Ontario's rise to the status of Canada's most populous and wealthiest province, and supported

*“mining can  
transform  
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*“Realising mining’s full potential to contribute to sustainable economic and social progress requires the collaborative action of government, companies, and society.”*

Canada’s development as an industrialized and globally competitive nation.

While directly responsible for the rise of northern communities such as Timmins and Sudbury, the industry affects all parts of the province. Even though many residents do not make the connection, Toronto is a city built on mining – and not just in terms of its infrastructure. Over 50% of the public mining companies globally are headquartered in Canada and more than half of capital investment in the mining business went through the Toronto Stock Exchange (TSX).

Although the value fluctuates with commodity price changes, the value of Ontario’s mining production is the highest in Canada – \$10.8 billion in 2015, despite challenging market conditions. The sector makes significant tax contributions to all levels of government, which pay for public priorities like health care, education and infrastructure, supporting Ontarians’ standard of living. Mining offers versatile and rewarding careers, and is actively working to attract an increasingly diverse workforce. Wages in the mining industry are 67% higher than the average industrial wage in Ontario. With links to other industries and sectors in the economy (including manufacturing, engineering, education, legal services, transportation, construction, environmental management and geological surveying/analysis, among others), mining contributes an economic multiplier effect. In some parts of the province, especially in the Far North, mineral resource development is critical to creating high-value jobs and entrepreneurial opportunities.

Worker health and safety is a top priority. Over the past 30 years, Ontario miners have built a robust safety culture, achieving a 96% improvement in lost-time injury frequency. While this makes Ontario one of the safest mining jurisdictions in the world and mining one of the safest industries in the province, our focus remains fixed on achieving zero harm.

Moreover, Ontario miners are working hard on improving their capacity as environmental stewards by adopting effective management strategies and

technologies to reduce the environmental impact of operations. Much effort is being devoted to making Ontario's mines energy efficient – the industry has a low carbon footprint, which will become smaller over time, allowing Ontario to produce some of the lowest-carbon commodities in the world. With society shifting away from fossil fuel dependence and relying on more alternative energy sources, global use of mining products will only grow.

*“After all, by improving the conditions for mining to invest and flourish in Ontario, we will accelerate progress towards the achievement of our economic and social development goals, leveraging Ontarians’ innovation and leadership potential.”*

As a place known around the world for its safety and environmental leadership, efficiency, productivity and corporate social responsibility, Ontario has every opportunity to be not just a model mining jurisdiction, but also an indispensable link in the world's mineral supply chain. The province's mining industry is evolving to meet society's changing needs and expectations, as well as our own exacting standards. From adopting lower emission and renewable energy technologies to developing the world's first fully electric mine, innovation is the key to ensuring the industry's global competitiveness and future success. Ontario's mining companies understand the

imperative to challenge the industry status quo – about half of Ontario's mines introduced innovations in 2014. As Ontario moves toward a low-carbon, innovation and knowledge-based economy in the 21st century and beyond, mining will continue to play a crucial role.

Realizing mining's full potential to contribute to sustainable economic and social progress requires the collaborative action of government, companies, and society. Mining companies function in a fiercely competitive and increasingly mobile global market, and Ontario mining companies' profitability is challenged by the combination of falling or stagnant global commodities prices and rising input

costs. The industry still feels the effects of the global downturn in commodity markets – an extended period of lower prices and volatile demand for many commodities has resulted in a significant impact on earnings, balance sheets and investor perceptions of the industry.

Regrettably, there is evidence that Ontario is not as competitive as we used to be. In particular, our jurisdiction has high labour and energy costs, which limit revenue potential and dampen investment, especially in difficult economic times. Notwithstanding those challenges, mining creates more economic value (as measured by GDP) for the energy used than most other industries. Unlike in traditional manufacturing, however, an extremely long timeline and large capital expenditures are needed to discover a viable ore deposit and bring it into production. A complex regulatory environment results in a particularly expensive and time-intensive process.

To overcome these challenges, it is important to understand and benchmark our current contributions, strengths and failings while identifying new opportunities and drivers to enhance Ontario’s competitiveness. After all, by improving the conditions for mining to invest and flourish in Ontario, we will accelerate progress toward the achievement of our economic and social development goals, leveraging Ontarians’ innovation and leadership potential.

This economic study uncovers fundamental information to tell our story and help us visualize our collective potential. We encourage readers to weigh the information, learn more about Ontario mining at [oma.on.ca](http://oma.on.ca) and contribute to creating a shared vision for the mining industry, helping to unlock its productivity and sustainability leadership potential.



**\$10.8 BILLION**

The value of Ontario's mining production in 2015 is the highest in Canada.

**LEADER IN CANADA**

Ontario is the largest producer in Canada of gold, nickel and platinum group metals, second in copper, and a leader in non-metal minerals including diamonds, salt and key structural materials.

**ECONOMIC BENEFITS OF A MINE STAY LOCAL**

38% of mine spending occurs locally (totaling more than \$1B in 2015), \$35.4 million in property tax collected, and an industry payroll in excess of \$1.6 billion inducing new local spending.

**AVERAGE WEEKLY WAGE: 67% HIGHER**

than the average industrial wage in the province and has increased at twice the rate of inflation over the last decade. Productivity in terms of value added per employee is \$460,000 in Ontario, beating out the Canadian average.

**SAFETY: 96% IMPROVEMENT**

Ontario is one of the safest mining jurisdictions in the world and mining is one of the safest industries in Ontario.

**ONTARIO MAINTAINS ITS LEAD**

Mineral exploration and deposit appraisal expenditures by senior and junior companies declined over the last few years, however Ontario led all Canadian provinces and territories in 2015.

**900 SUPPLY AND SERVICE COMPANIES**

employ more than 40,000 people and have an estimated direct economic impact of \$6.6 billion.

**LOW CARBON ECONOMY**

Ontario mining creates more economic value for the energy it consumes than most other industries, and with lower GHG emissions.

**\$103 MILLION**

spent on environmental protection, reclamation and decommissioning.

**ADVANCED GREEN TECHNOLOGIES**

adoption has been well above the Ontario average however longer term, innovation is needed to drive cost reductions and continue to position Ontario as a sustainability leader.

**78,800 MINERAL PRODUCTION EMPLOYEES**

Thirty nine major mines directly employing 16,100.

**\$90 MILLION CONTRIBUTED TO INDIGENOUS GOVERNMENTS AND COMMUNITIES**

There are more than 122 active agreements related to exploration and mine development in Ontario.

**BENEFITS TO MANY OTHER INDUSTRIES**

Mining spurs entrepreneurial activity and significant spinoff to sectors across the economy. Toronto serves as the global centre for mining financing.

**LABOUR FORCE: 11.2% INDIGENOUS**

Mining is the largest private sector employer of Indigenous Canadians.

**KEY FACTORS**

01

MINES AND  
MINERAL OPERATIONS

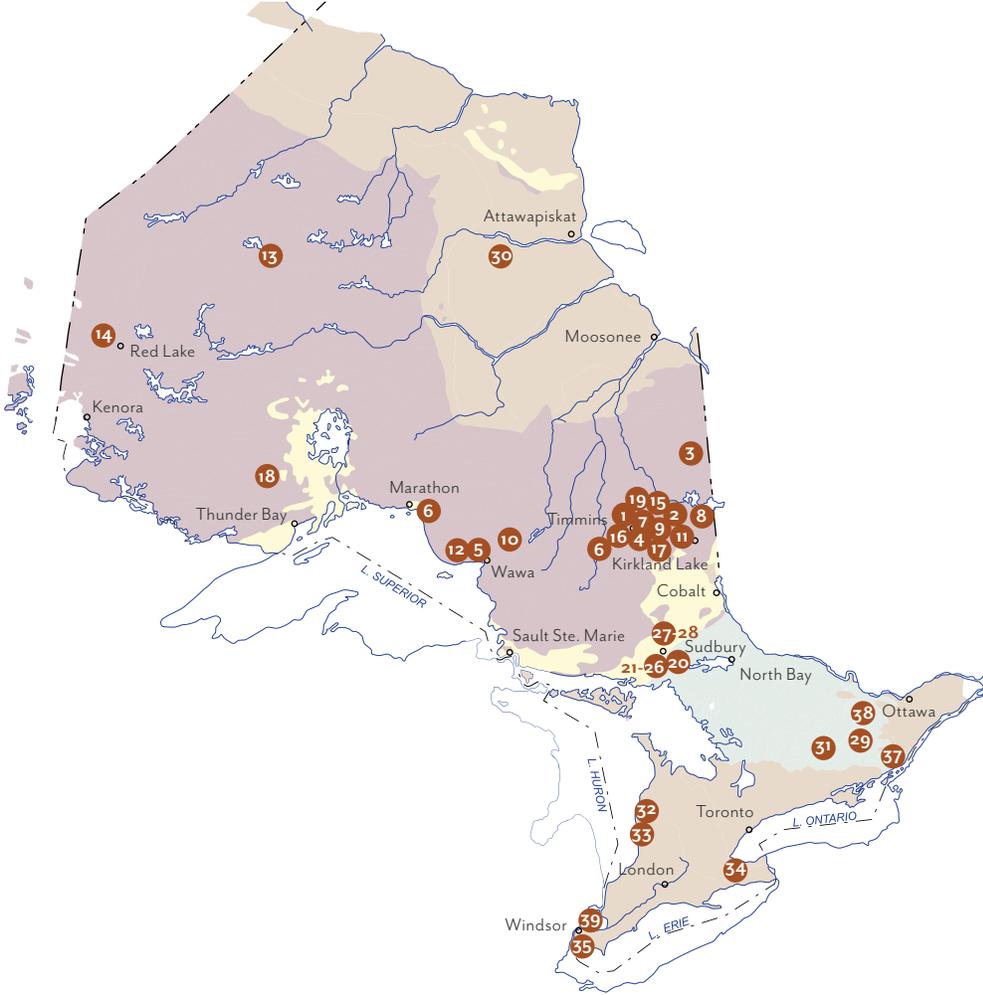


Ontario's enviable geology provides for mining across all parts of the province. Communities such as Windsor, Goderich, Perth, Sudbury, Timmins, Red Lake, Kirkland Lake, Marathon, North Bay and Attawapiskat all have mining as an important contributor to their local economies. In some parts of the province, especially in the Far North, mineral resource development is critical to creating employment and entrepreneurial spin-off opportunities. As the largest private sector employer of Indigenous people, mining contributes significantly to the well-being and development of remote communities. It is also an important driver in urban centers that are far away from any actual mines.

With the TSX and TSX Venture Exchange (TSXV), Toronto is the mine financing capital of the world. *The Prospectors and Developers Association of Canada* hosts the largest mining conference in the world every year, contributing millions of dollars to the municipal economy.

Ontario’s mineral base is diverse. The province hosts 18 active precious metal [gold and the platinum group of metals (PGMs)] mines, eleven base metal (nickel, copper, zinc) mines and ten operations producing diamonds, salt and other non-metal minerals (Table 11).

**FIGURE 11: ONTARIO MINING OPERATIONS**



**TABLE 11: ONTARIO MINING OPERATIONS**

Map #	Name	Company
Ontario Precious Metal Mines		
1	Bell Creek Mine	Tahoe Resources Inc
2	Black Fox Mine	Primero Mining Corp.
3	Detour Lake Gold Mine	Detour Gold Corp.
4	Dome Mine	Goldcorp Inc. – Porcupine Gold Mines
5	Eagle River Mine	Wesdome Gold Mines Ltd.
6	Hemlo Mine	Barrick Gold Corp.
7	Hollinger Mine	Goldcorp Inc. – Porcupine Gold Mines

Map #	Name	Company
8	Holloway – Holt Mine	Kirkland Lake Gold Inc.
9	Hoyle Pond Mine	Goldcorp Inc. – Porcupine Gold Mines
10	Island Gold Mine	Richmont Mines Inc.
11	Macassa Mine	Kirkland Lake Gold Inc.
12	Mishi Gold Mine	Wesdome Gold Mines Ltd.
13	Musselwhite Mine	Goldcorp Inc.
14	Red Lake Gold Mines	Goldcorp Inc.
15	Taylor Mine	Kirkland Lake Gold Inc.
16	Timmins West Mine	Tahoe Resources Inc.
17	Young – Davidson Mine	Alamos Gold Inc.
18	Lac des Iles Mine	North American Palladium Ltd.
Ontario Base Metal Mines		
19	Kidd Creek Mine	Glencore PLC
20	Sudbury Operations: Morrison Mine	KGHM International Ltd.
21-26	Sudbury Operations: Coleman Mine Copper Cliff North Mine Creighton Mine Garson Mine Stobie Mine Totten Mine	Vale S.A.
27-28	Sudbury Operations: Nickel Rim South Mine Fraser Mine	Glencore PLC
29	Tomclid Iron Mine	Ferromin Inc.
Ontario Major Non-Metallic Operations		
30	Victor Diamond Mine	De Beers Canada Inc.
31	Blue Mountain Operations (nepheline syenite)	Unimin Canada Ltd.
32	Goderich Brine Field (salt)	Sifto Canada Inc.
33	Goderich Mine (salt)	Sifto Canada Inc.
34	Hagersville Mine (gypsum)	CGC Inc.
35	Ojibway Mine (salt)	The Canadian Salt Company Ltd.
36	Penhorwood Mine (talc)	Imerys Talc
37	St. Lawrence Mine (wollastonite)	Canadian Wollastonite
38	Tatlock Quarry (calcium carbonate)	OMYA Canada Inc.
39	Windsor Brine Field (salt)	The Canadian Salt Company Ltd.

*Throughout the report, reference is made to British Columbia, Quebec, Nevada and Western Australia. Where possible, Ontario indicators are shown in comparison to these mining jurisdictions, which are similar to Ontario and with which Ontario operations directly compete for investment.*

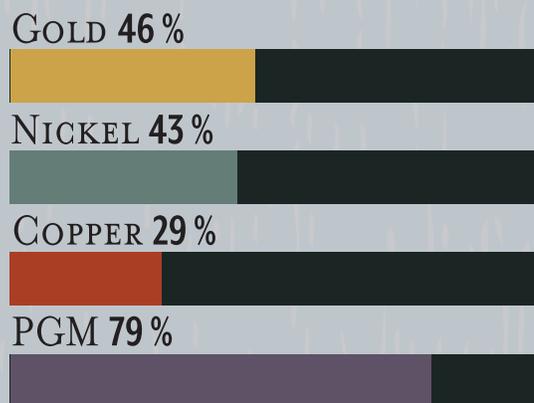
02

MINERAL  
PRODUCTION

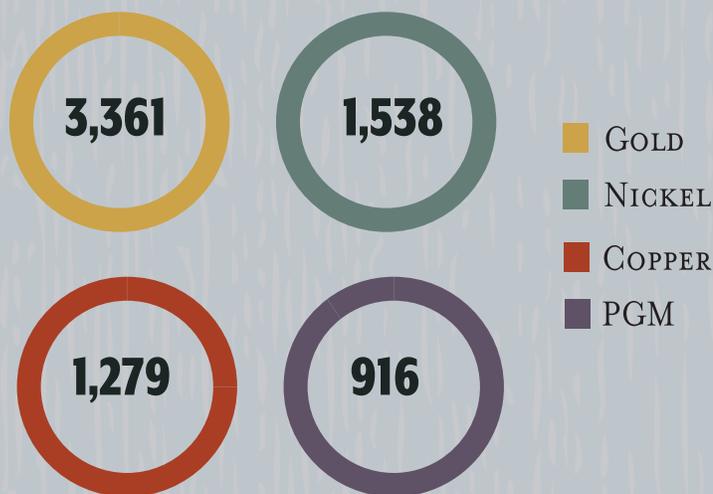
Mining produces the *essential and irreplaceable components of daily life and modern technology*, as well as the building blocks of innovation. Everything from lifesaving medical devices to planet-saving green technologies depends on minerals and metals.

# Mine PRODUCTION

## Percentage of Canada's Production in Ontario

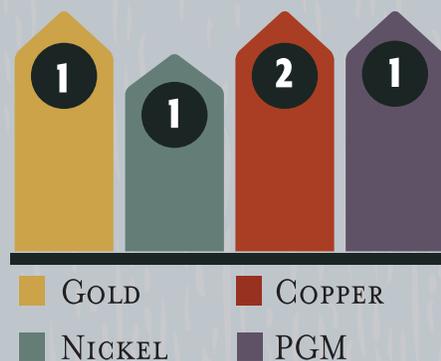


## Value of Ontario's Production in 2015 (CAD \$ millions)



In eight of the last ten years, *Ontario was first in Canada* in the production of metallic minerals, and first in the last ten years in the production of non-metallic minerals.

## Ontario's rank in Canada



Ontario led all Canadian jurisdictions in mineral production in 2015. The province's mineral production was valued at \$10.8 billion, representing 32.9% of Canada's metallic minerals and 19.6% of Canada's non-metallic minerals and, more than 50% of the metal mined in Ontario is processed in Ontario.<sup>1</sup> Overall, Ontario had the greatest share of mineral production in 2015, accounting for 25% of the Canadian total.<sup>2</sup> The top four minerals by value were gold, nickel, copper and the PGMs. As shown in *Table 21*:

- ➔ Ontario's top mineral was **gold**, with a value of \$3.4 billion. Ontario ranks first in Canada for gold production and Canada ranks fifth in the world.
- ➔ **Nickel** was Ontario's second mineral with a value of \$1.5 billion. Ontario ranks first in Canada for nickel production and Canada ranks fourth in the world.
- ➔ **Copper** ranked third with a value of \$1.3 billion. Ontario ranks second in Canada (BC is first) and Canada ranks ninth in the world.
- ➔ The **Platinum Group of Metals (PGMs)** ranked fourth with a value of \$900 million, Ontario ranks first in Canada and Canada ranks third in the world.

TABLE 21: ONTARIO'S TOP FOUR MINERALS AND RANK BY VALUE<sup>3</sup>

Mineral	Value of Ontario's Production in 2015 (CAD \$ millions)	Ontario's Rank in Canada	Percentage of Canada's Production in Ontario	Canada's Rank in the World
Gold	3,361	1	46.1%	5
Nickel	1,538	1	42.8%	4
Copper	1,279	2	28.5%	9
PGM	916 <sup>4</sup>	1	79.3%	3

## 2.1 Ten-Year Performance

Ontario's mineral production contributed significantly to the economy over the past 10 years, notwithstanding a challenging and volatile global metal price environment.

*Figure 21* shows Ontario's production of key metal and non-metal minerals and structural materials over the past 10 years. Key metal minerals include gold, nickel, copper, and PGMs; key non-metal minerals include diamond, salt and structural materials.

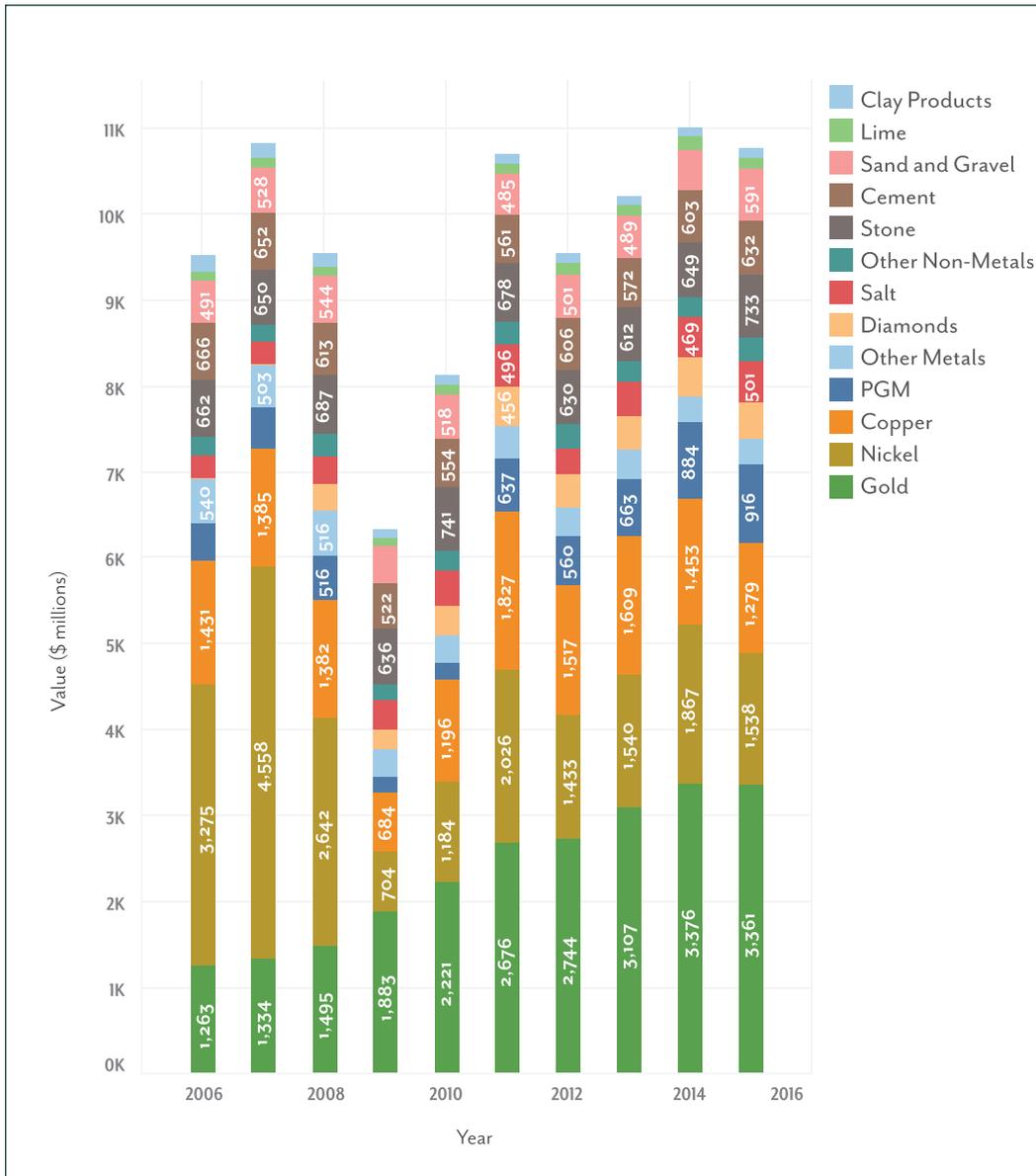
1 Ministry of Northern Development and Mines (MNDM)

2 Ontario Production Fact Sheet, MNDM

3 HAL: Natural Resources Canada (NRCan) (2016), *Annual Statistics: Preliminary Estimate of the Mineral Production of Canada, by Province, 2015*; and International Organizing Committee for the World Mining Congresses (2016), *World-Mining-Data, Volume 31, Minerals Production*

4 Ontario Production Fact Sheet, MNDM

FIGURE 21: ONTARIO MINERAL PRODUCTION<sup>5</sup>



In eight of the past ten years, Ontario was first in Canada in the production of metallic minerals and first in the ten years in the production of non-metallic minerals, as shown in Figure 22. Ontario's production of metallic minerals declined from \$7.9 billion in 2014 to \$7.4 billion in 2015, reflecting the global slump in commodity prices. In a market-based economy, economic cycles are an inherent reality, and mining is both cyclical and capital-intensive. Although the sector is vulnerable to cyclical risk, the products of mining are essential and demand for minerals and metals never goes away – sooner or later, a market correction causes commodity prices to strengthen. Indeed, even though the switch to growth is incomplete, Ontario's production of non-metallic minerals increased from \$3.1 billion in 2014 to \$3.4 billion in 2015.

FIGURE 22: VALUE OF MINERAL PRODUCTION BY JURISDICTION<sup>6</sup>



The ten-year performance of Ontario’s top three minerals – gold, nickel and copper – is shown in Figure 23, as follows:

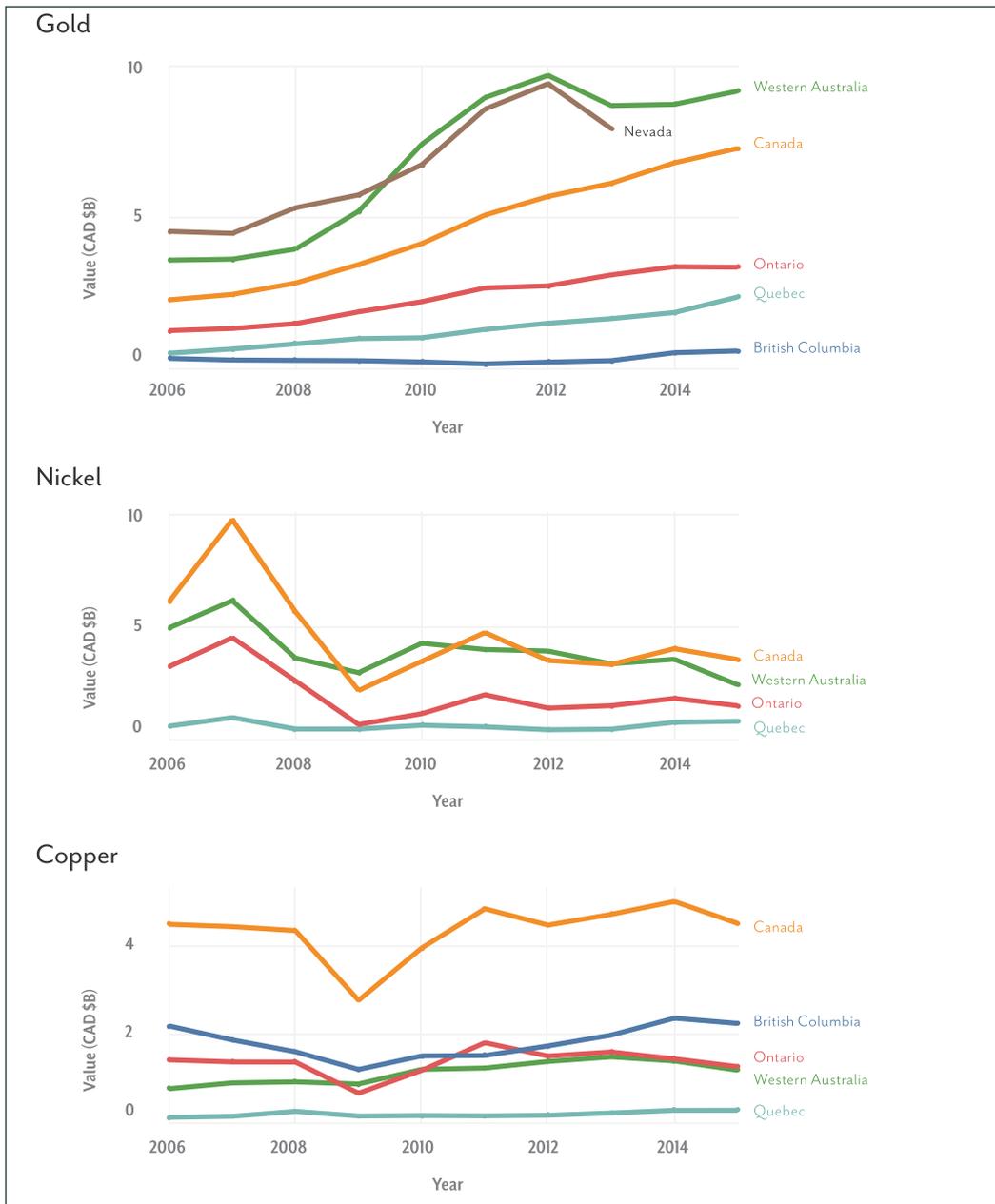
- ➔ **Gold:** The value of gold production increased steadily in all jurisdictions covered by this report – including Ontario, Quebec, BC, Canada, Nevada and Western Australia - over the past ten years. The value of Ontario’s production increased from 2006 to 2013 and remained the same from 2014 to 2015 at \$3.4 billion.

<sup>6</sup> HAL: NRCan, Annual Statistics of Mineral Production. The Bank of Canada commodity price index (BCPI) is a chain Fisher price index of the spot or transaction prices in U.S. dollars of 26 commodities produced in Canada and sold in world markets.

➤ **Nickel:** The value of nickel production decreased in all jurisdictions over the last ten years, with the exception of Quebec, which remained more or less the same. Ontario's production of nickel declined from \$3.3 billion in 2006 to \$1.5 billion in 2015.

➤ **Copper:** The value of copper production has remained about the same over the past ten years, with the exception of Western Australia and Quebec, which experienced a slight increase. The value of Ontario's production of copper was \$1.4 billion in 2006 and \$1.3 billion in 2015.

**FIGURE 23:**  
VALUE OF PRODUCTION BY JURISDICTION OF ONTARIO'S TOP THREE MINERALS<sup>7</sup>

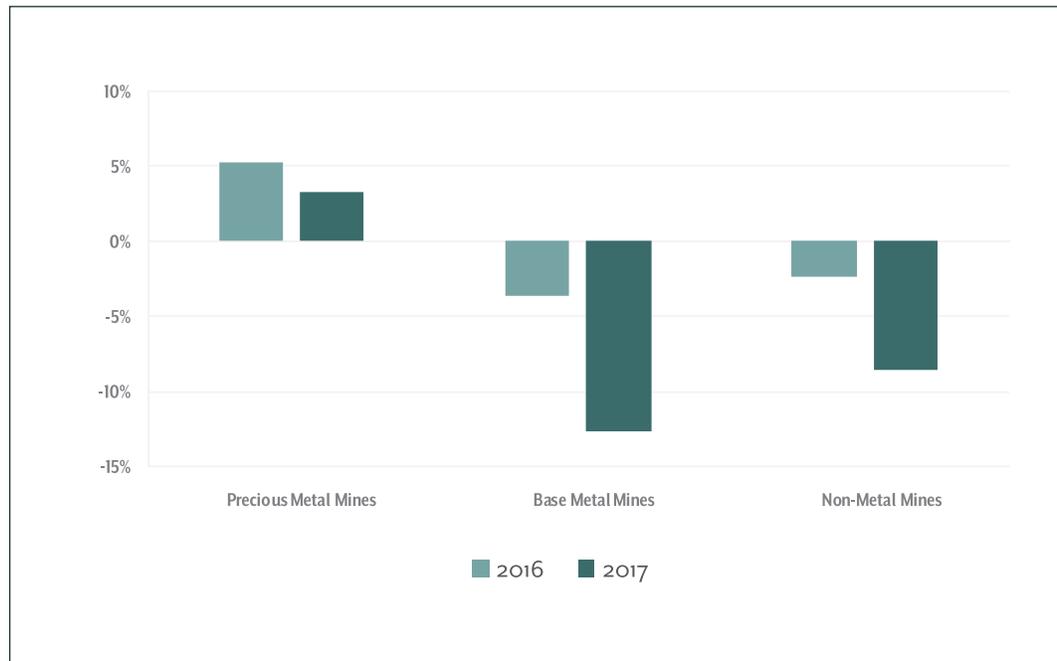


7 HAL: (1) NRCan, Annual Statistics of Mineral Production; (2) U.S. Geological Survey and the Nevada Bureau of Mines and Geology; (3) Government of Western Australia, Department of Mines & Petroleum.

## 2.2 Future Production

Ontario mining companies have a wide range of views on how the value of Ontario mining production will change in the future with the average expected change (weighted for value of production) shown in *Figure 24*. Overall, the outlook for precious metals is more optimistic than for base metals and non-metallic minerals. This correlates with the commodity market forecast that predicts metal prices will increase by 4% in 2017, as most markets continue to rebalance.<sup>8</sup>

FIGURE 24: EXPECTED PRODUCTION VALUE CHANGE<sup>9</sup>



Ontario is the Canadian leader in mineral production, accounting for 25% of Canada's total production in 2015. Over the past decade, Ontario ranked first in the production of metallic minerals for eight of the 10 years, and first in the production of non-metallic minerals every year. Key metal minerals include gold, nickel, copper, and PGMs while top non-metal minerals include diamonds, salt and structural materials.

<sup>8</sup> HAL: World Bank (October 2016), Commodity Market Outlook. A World Bank Quarterly Report.  
<sup>9</sup> HAL: survey of Ontario mining companies conducted for this study. 2016 end of year data not available at time of publishing.



03

ECONOMIC IMPACT OF  
MINING



## LOCAL BENEFIT

More than **\$90 million** to local Indigenous governments and communities.

**38%** of all mine purchasing occurs *near the mine.*

**\$35.4 M** in property taxes funds local public priorities.

**4 vibrant mining clusters** and *mine financing capital* of the world.

Mining is a *key contributor to the Ontario economy*, as well as an *engine for regional development* and value-add generation.

Industry payroll in excess of **\$1.6 billion** drives employee spending in the community.



Mining is a key contributor to the Ontario economy and an engine for regional development and value-added generation. Ontario mineral production has exceeded \$10 billion for the past four years. The industry helps sustain other sectors, bolsters economies at the local, provincial and national levels, and contributes tax revenue that funds Ontario's public policy priorities like roads, schools, hospitals, community centres and electrical grids.

As a cyclical industry whose selling price is set on world markets, federal and provincial corporate tax payments vary greatly from year to year. In 2011 while commodity prices were high, the federal and provincial corporate taxes collected were approximately \$313 million while in 2015 they were closer to \$53 million<sup>10</sup>. Property tax revenues in the Ontario mining sector have grown from \$31.9 million in 2011 to \$35.4 million in 2015<sup>11</sup> and the Ontario mining tax collected \$131 million in 2015<sup>12</sup>. Chapter 4 will outline the salaries that induce spending in our communities and payroll taxes which totaled more than \$138 million in 2015. A thriving Ontario mineral sector holds the potential to quite literally help dig Ontario out of debt.

The tables and figures in this section apply a regional input output model and economic multipliers to analyze the impact of Ontario's gross output that extend beyond the mine including on GDP, employment, and wages and salaries at the national and provincial levels including direct, indirect and induced impacts in all industries.<sup>13</sup>

- Direct Effects are associated with revenues of mining companies. Indirect Effects result from supporting industries supplying goods and services to mining companies. Induced Effects result from household spending of the income earned in mining.
- Full-Time Equivalent (FTE) is based on the application of multipliers derived from the economic model-that is, the direct employment values are a model result and not the sum of the employment at the establishments collected in the survey for this study.<sup>14</sup>

## 3.1 Ontario Mineral Production Economic Results

Ontario's \$10.8 billion in mineral production in 2015 almost doubles in value to \$18.5 billion when indirect and induced benefits are accounted for (*Table 31 and Figure 31*). Ultimately, Ontario's mineral production including indirect and induced impacts provides for more than \$12 billion in Canadian GDP. On the employment side, total employment for the mineral sector is 78,800.

10 MNDM.

11 HAL: 2011 and 2016 surveys of Ontario mining companies conducted for this study.

12 MNDM.

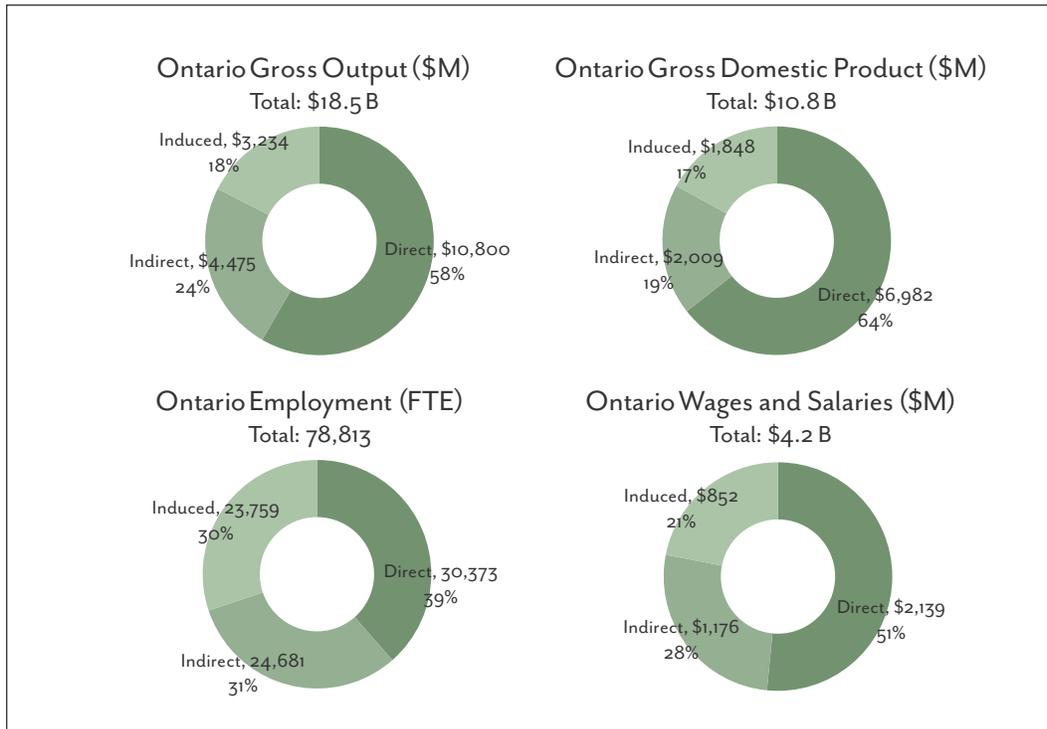
13 HAL: all results in this section come from an input-output economic analysis using inputs from a survey of major Ontario mines conducted for this study

14 Note that throughout the report, FTE and employee numbers differ where models versus survey results are used and where support activities for mining are included or excluded.

**TABLE 31: ONTARIO MINERAL PRODUCTION ECONOMIC RESULTS**

	Direct	Indirect	Induced	Total
<b>Ontario</b>				
Gross Output (\$M)	\$10,800	\$4,475	\$3,234	\$18,509
Gross Domestic Product (\$M)	\$6,982	\$2,009	\$1,848	\$10,839
Employment (FTE)	30,373	24,681	23,759	78,813
Wages & Salaries (\$M)	\$2,139	\$1,176	\$852	\$4,166
<b>Ontario's Impact on the Rest of Canada</b>				
Gross Output (\$M)	-	\$1,185	\$1,323	\$2,507
Gross Domestic Product (\$M)	-	\$608	\$684	\$1,292
Employment (FTE)	-	4,799	9,071	13,870
Wages & Salaries (\$M)	-	\$294	\$339	\$634
<b>Total for Canada</b>				
Gross Output (\$M)	\$10,800	\$5,660	\$4,557	\$21,016
Gross Domestic Product (\$M)	\$6,982	\$2,617	\$2,532	\$12,131
Employment (FTE)	30,373	29,480	32,830	92,683
Wages & Salaries (\$M)	\$2,139	\$1,470	\$1,191	\$4,800

**FIGURE 31: ONTARIO MINING ECONOMIC RESULTS SUMMARY**



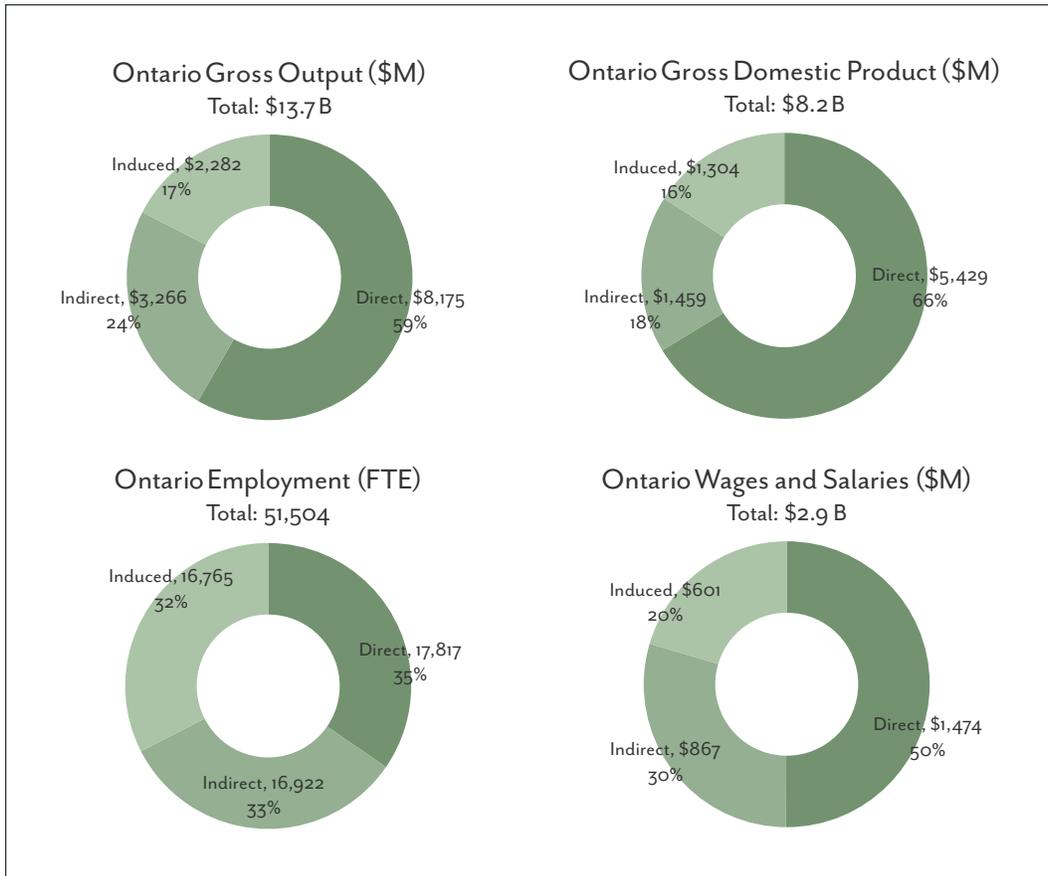
## 3.2 Major Mineral Operations Economic Results

Table 32 and Figure 32 examines the portion of the \$10.8 billion output that can be attributed to the metal and major non-metal mineral operations shown on the map in Figure 11 (ie. excludes sand and gravel pits). Similar to the analysis above, the direct, indirect and induced impacts in all industries and regions are shown in Table 32. The economic impact at a local level (census division) is examined in the next chapter. Overall, the metal and major non-metal mineral operations are responsible for direct mining gross output of \$8.2 billion resulting in further indirect and induced revenues totalling \$13.7 billion. The value-added portion of these revenues resulted in a direct contribution to Ontario's GDP of \$5.4 billion, and further indirect and induced contributions totalling almost \$8.2 billion for the provincial economy. Total employment for the industry was estimated at 51,500. Wages and salaries earned by those Ontario workers totalled \$2.9 billion.

TABLE 32: ONTARIO METAL AND MAJOR NON-METAL PRODUCTION ECONOMIC RESULTS

	Direct	Indirect	Induced	Total
<b>Ontario</b>				
Gross Output (\$M)	\$8,175	\$3,266	\$2,282	\$13,723
Gross Domestic Product (\$M)	\$5,429	\$1,459	\$1,304	\$8,192
Employment (FTE)	17,817	16,922	16,765	51,504
Wages & Salaries (\$M)	\$1,474	\$867	\$601	\$2,941
<b>Ontario's Impact on the Rest of Canada</b>				
Gross Output (\$M)	-	\$819	\$931	\$1,750
Gross Domestic Product (\$M)	-	\$416	\$481	\$897
Employment (FTE)	-	3,353	6,383	9,737
Wages & Salaries (\$M)	-	\$205	\$239	\$444
<b>Total for Canada</b>				
Gross Output (\$M)	\$8,175	\$4,085	\$3,213	\$15,473
Gross Domestic Product (\$M)	\$5,429	\$1,875	\$1,785	\$9,089
Employment (FTE)	17,817	20,275	23,148	61,240
Wages & Salaries (\$M)	\$1,474	\$1,072	\$840	\$3,385

**FIGURE 32: ONTARIO METAL AND MAJOR NON METAL ECONOMIC RESULTS SUMMARY**

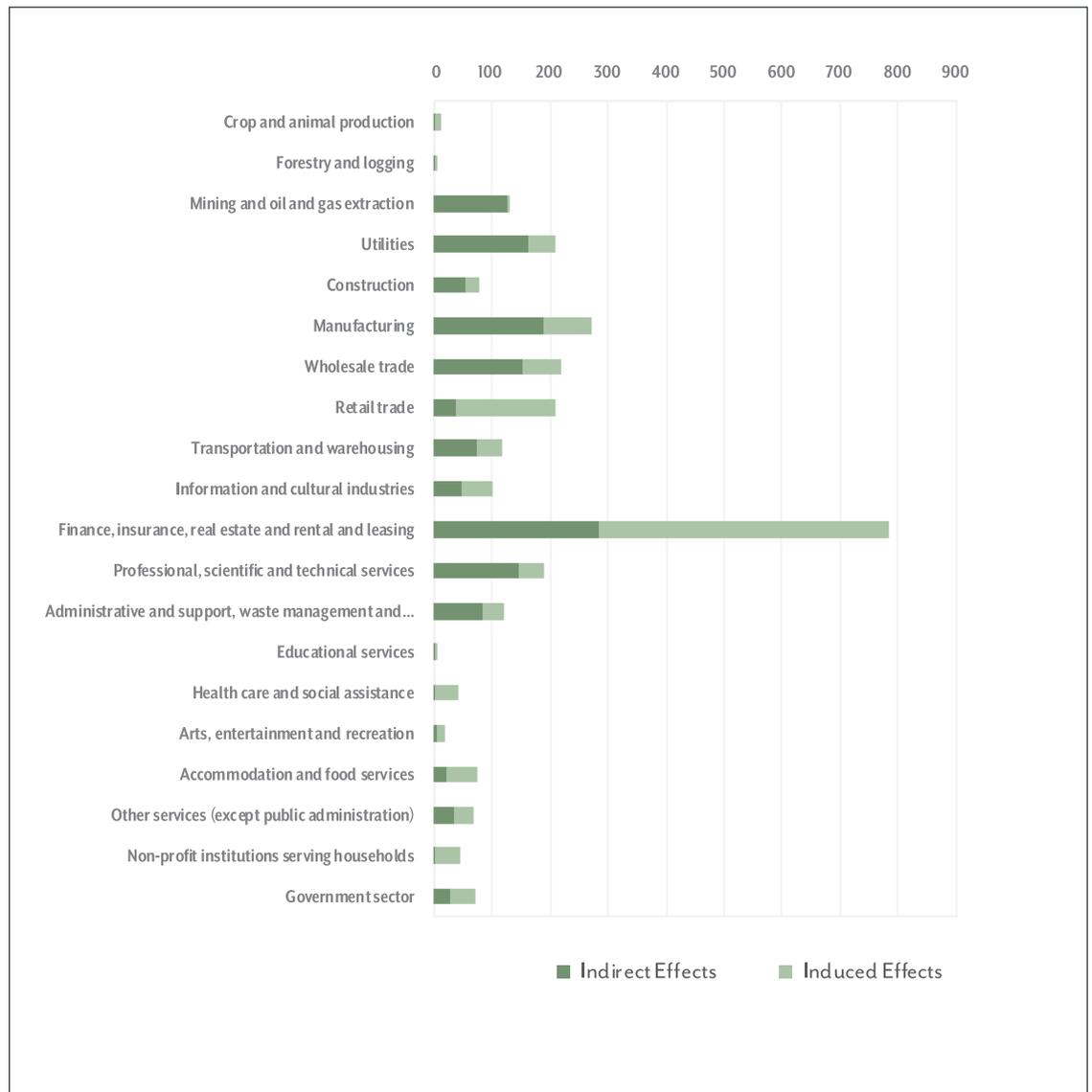


While 90% of the mining GDP stays inside Ontario, the impact of mining in Ontario extends beyond the provincial borders to benefit the rest of Canada. *Figure 33* also shows the value of Ontario mining on different economic indicators throughout Canada.

### 3.3 Mining's Impact on Other Industries

The impact of mining in Ontario extends to many of the other industries as a result of the interactive nature of the various sectors in the economy. *Figure 33* shows the impact of Ontario mining on the gross domestic product of other Ontario industries. By far the biggest impact is felt in the finance, insurance, real estate and rental and leasing sector, where induced and indirect effects total almost \$800 million. Mining is also a significant contributor to manufacturing GDP with an impact totalling almost \$300 million.

FIGURE 33: THE IMPACT OF ONTARIO MINING ON THE GDP OF SELECTED ONTARIO INDUSTRIES (\$M)<sup>15</sup>



15 HAL: based on direct mining gross output of \$8.2 billion



04

THE VALUE OF  
MINING: BUILDING  
ONTARIO COMMUNITIES



TABLE 41: CONTRIBUTION OF MINING SECTOR TO COMMUNITIES<sup>17</sup>

Census Division	Gross Output (\$M)	Gross Domestic Product (\$M)	Employment (FTE)	Wages and Salaries (\$M)	Tax Revenue (\$M)
Algoma	\$213	\$121	837	\$50	\$29
Cochrane	\$2,543	\$1,555	8,371	\$527	\$343
Essex	\$219	\$122	918	\$62	\$32
Frontenac	\$13	\$7	52	\$3	\$2
Greater Sudbury	\$4,202	\$2,890	10,558	\$690	\$585
Haldimand-Norfolk	\$32	\$18	117	\$7	\$4
Huron	\$424	\$235	1,704	\$119	\$61
Kenora	\$1,498	\$856	4,928	\$307	\$192
Lanark	\$66	\$37	248	\$14	\$9
Peterborough	\$135	\$76	547	\$29	\$18
Sudbury	\$62	\$35	228	\$13	\$8
Thunder Bay	\$688	\$390	2,773	\$164	\$93
Timiskaming	\$586	\$331	2,269	\$139	\$78

TABLE 42: REGIONAL EMPLOYMENT (FTE)

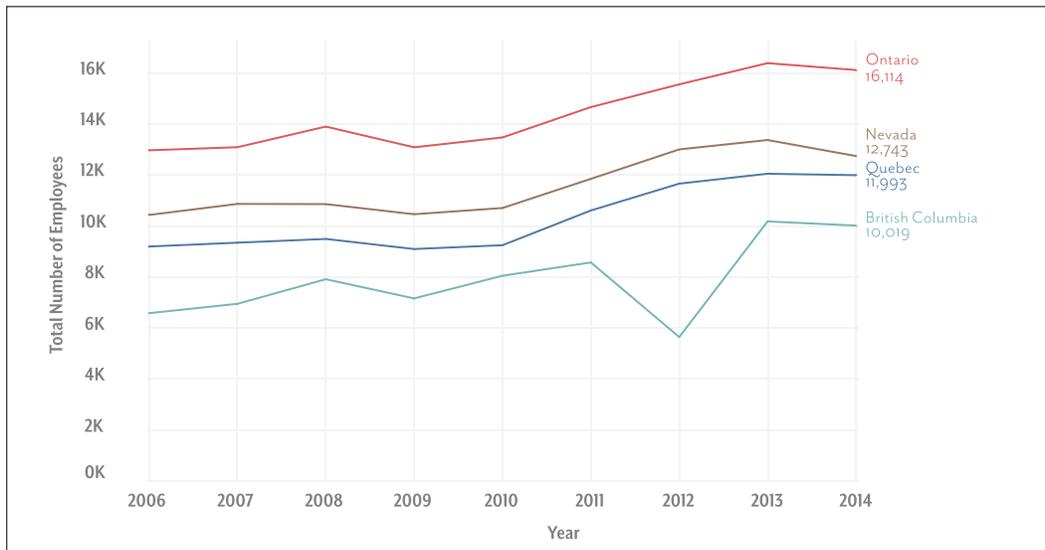
Census Division	Employment (FTE)			
	Direct	Indirect	Induced	Total
Algoma	475	178	183	837
Cochrane	4,945	1,588	1,839	8,371
Essex	454	218	246	918
Frontenac	27	14	11	52
Greater Sudbury	4,828	2,995	2,735	10,558
Haldimand-Norfolk	68	28	22	117
Huron	919	367	418	1,704
Kenora	2,740	1,169	1,019	4,928
Lanark	143	58	47	248
Peterborough	282	151	114	547
Sudbury	136	48	44	228
Thunder Bay	1,466	644	663	2,773
Timiskaming	1,335	476	458	2,269

<sup>17</sup> HAL: The columns are not totalled in Tables 41 and 42 as the data represents an incomplete picture of mining impacts. While the data represents direct, indirect, and induced impact of the major mines in the census division, it does not include the impact on the rest of Ontario/Canada or the impact of non-major mines.

## 4.2 Workforce

There are more than 120 occupations that make up the mining industry<sup>18</sup> and Ontario consistently employs more people in metal and non-metal mining than Quebec, BC and Nevada, over the past ten years, as shown in *Figure 42*. In 2014, Ontario employed 16,100 compared with Nevada at 12,740, Quebec at 12,000 and BC at 10,000.

FIGURE 42: TOTAL NUMBER OF DIRECT EMPLOYEES, METAL AND NON-METAL MINING<sup>19</sup>



Expectations for change in employment numbers over the next two years, weighted by employment size, forecast a slight increase of about 2.5% for precious metal mines, essentially no change for base metal mines, and a significant decrease of almost 10% for non-metal mines.<sup>20</sup>

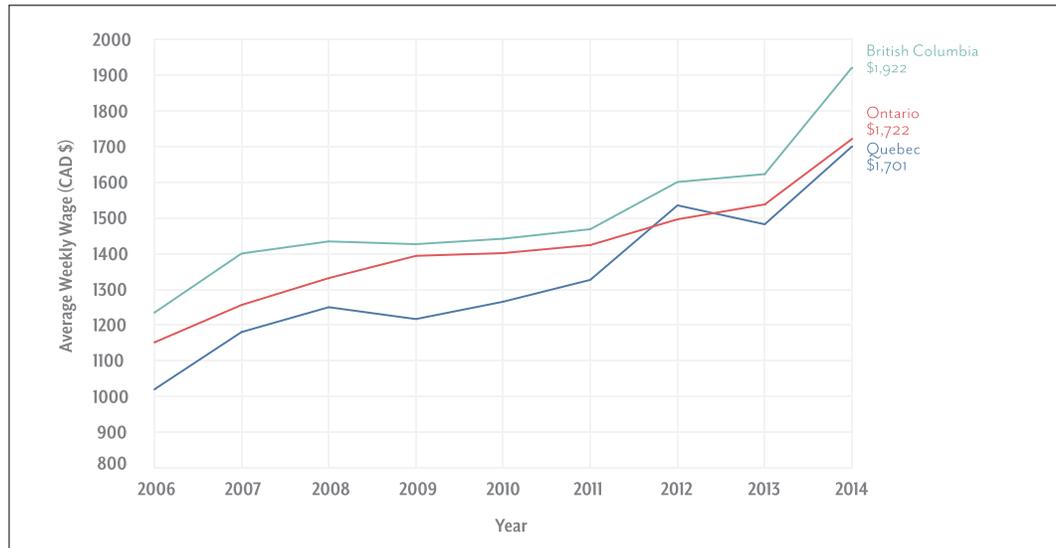
The wages in Ontario's mining sector are competitive with other jurisdictions. The average weekly wage for metal and non-metal mining employees in Ontario has been lower than BC's but higher than Quebec's over the past ten years, as shown in *Figure 43*. In 2014, the average weekly wage was \$1,922 in BC, \$1,722 in Ontario and \$1,701 in Quebec.

18 Mining Industry Human Resource Council

19 HAL: Source: (1) NRCan, Employees and Their Earnings, Metal Ore and Nonmetallic Mineral Mining and Quarrying, by Industry and Province; (2) Nevada Department of Employment, Training and Rehabilitation: Research and Analysis Bureau Quarterly Census of Employment and Wages.

20 HAL: survey of Ontario mining companies conducted for this study.

FIGURE 43: AVERAGE WEEKLY WAGE, METAL AND NON METAL MINING SECTOR<sup>21</sup>



Labour makes up about 41% of the costs of a mining operation.<sup>22</sup> An industry payroll in excess of \$1.6 billion<sup>23</sup> generates hundreds of millions of dollars annually in personal income tax revenues for government coffers. Payroll taxes such as Employer Health Tax, Workplace Safety and Insurance Board premiums, Employment Insurance and Canada Pension Plan totalled more than \$138M in 2015.<sup>24</sup> Benefits make up 13% of employee pay and they are distributed as 22% taxable and 78% non-taxable.<sup>25</sup>

In Ontario, mining and mining support activities workers consistently earned a higher average weekly wage over the period from 2001-2015, compared with workers in construction, manufacturing, motor vehicle parts manufacturing, forestry, and wood products manufacturing, as shown below in *Figure 44*. In 2015, the average weekly wage for mining workers was \$1,611 and \$1,815 for mining support workers, compared to \$963 for the average industrial worker. The average weekly wage in Ontario mining is 67% higher than the average industrial wage in the province and has increased at twice the rate of inflation over the past decade.<sup>26</sup>

High-value mining jobs are distributed across Ontario, with the bulk of regional distribution in the Sudbury areas (42%). The mining workforce in Ontario is primarily between the ages of 36 and 55, male, non-unionized and non-Indigenous, and located in northeastern Ontario. Ontario mines have broadened the presence of underrepresented groups, such as women and Indigenous people, which account for 10% and 11% of the workforce respectively. However, greater representation is still needed.

21 HAL: Statistics Canada, Weekly hours of hourly paid employees, average, by industry, CANSIM, table 281-0033

22 HAL: survey of Ontario mining companies conducted for this study.

23 HAL: Natural Resources Canada, Mineral Industries Statistics.

24 HAL: survey of Ontario mining companies conducted for this study.

25 HAL: survey of Ontario mining companies conducted for this study.

26 HAL: Statistics Canada. Table 281-0027 - Survey of Employment, Payrolls and Hours (SEPH), average weekly earnings by type of employee, overtime status and detailed North American Industry Classification System (NAICS).

FIGURE 44: AVERAGE WEEKLY EARNINGS BY INDUSTRY, ONTARIO<sup>27</sup>

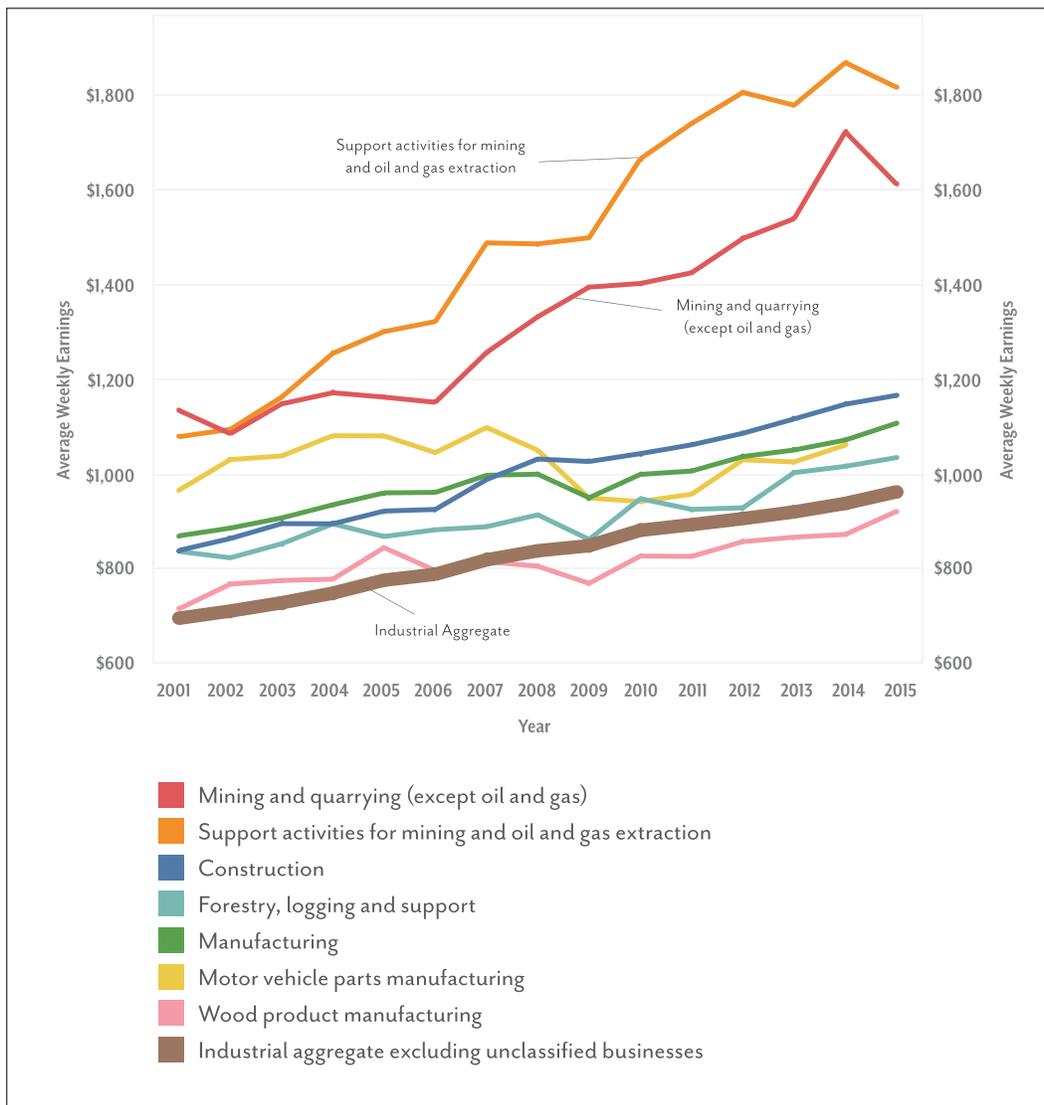


Figure 45 illustrates the characteristics of the Ontario mining workforce in terms of:

- Regional distribution: More than 40% of the workforce is located in Sudbury, followed by northeastern Ontario accounting for approximately 32%, northwestern Ontario for roughly 16% and southern Ontario for about 11% of the workforce.
- Age: The majority of the workforce is between 36 and 55 in age accounting for roughly 56% of the workforce, followed by workers under 35 at 24%, and workers 56 and over at 20%.
- Indigenous status: Represents roughly 11% of the workforce.
- Gender: 10% of the workforce is female.
- Union status: Represent roughly 41% of the workforce.

27 HAL: Statistics Canada Table 281-0027 - Survey of Employment, Payrolls and Hours (SEPH), average weekly earnings by type of employee, overtime status and detailed North American Industry Classification System (NAICS), annual (current dollars).

FIGURE 45: WORKFORCE CHARACTERISTICS, METAL AND NON-METAL MINES<sup>28</sup>

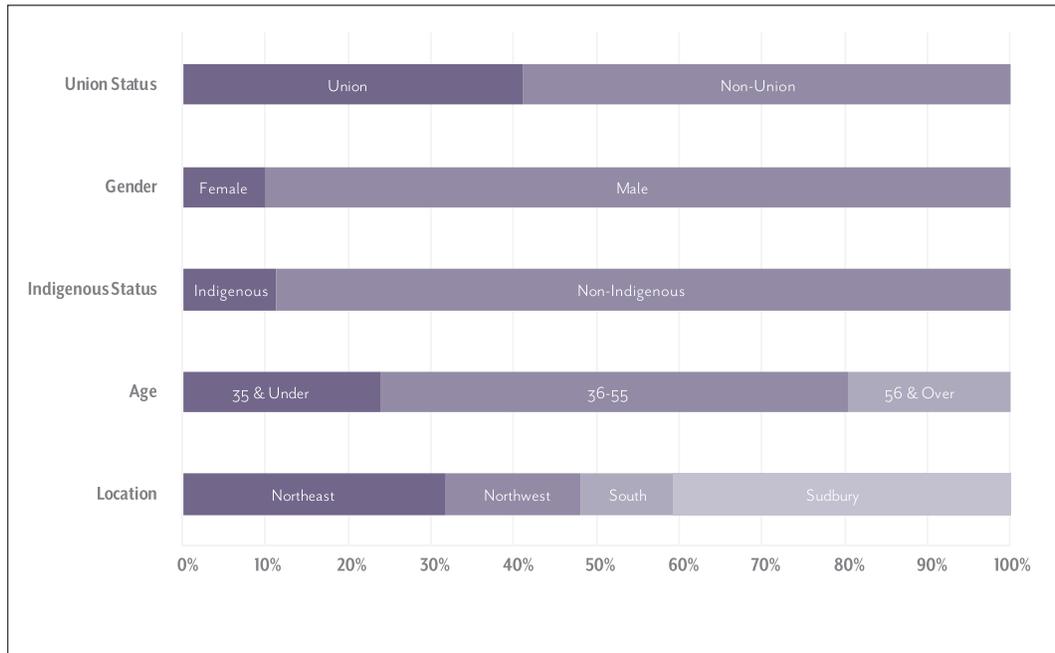
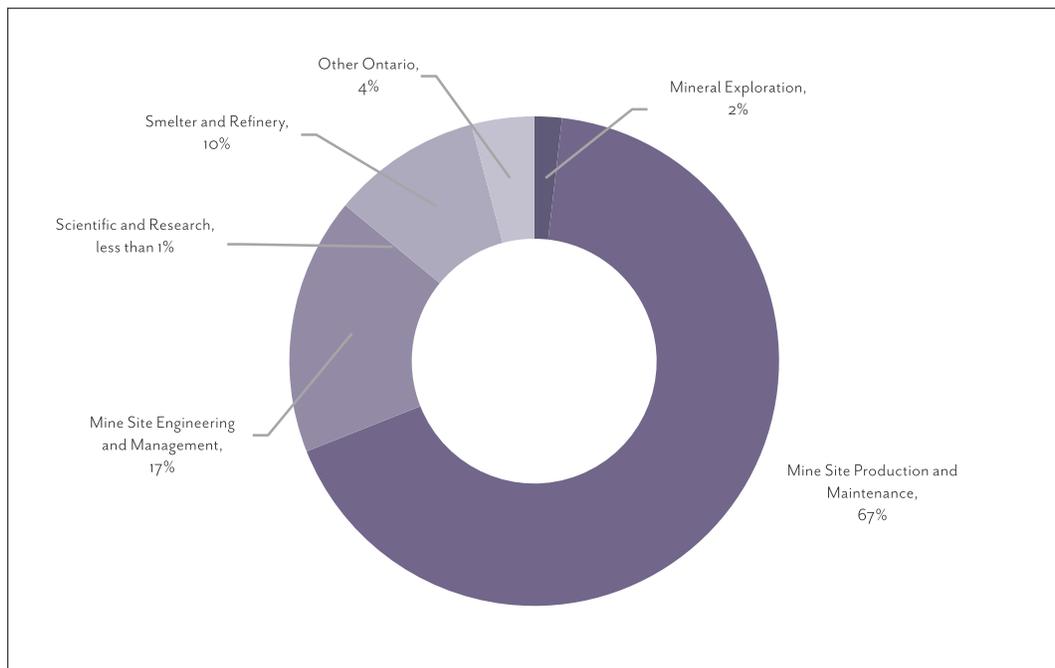


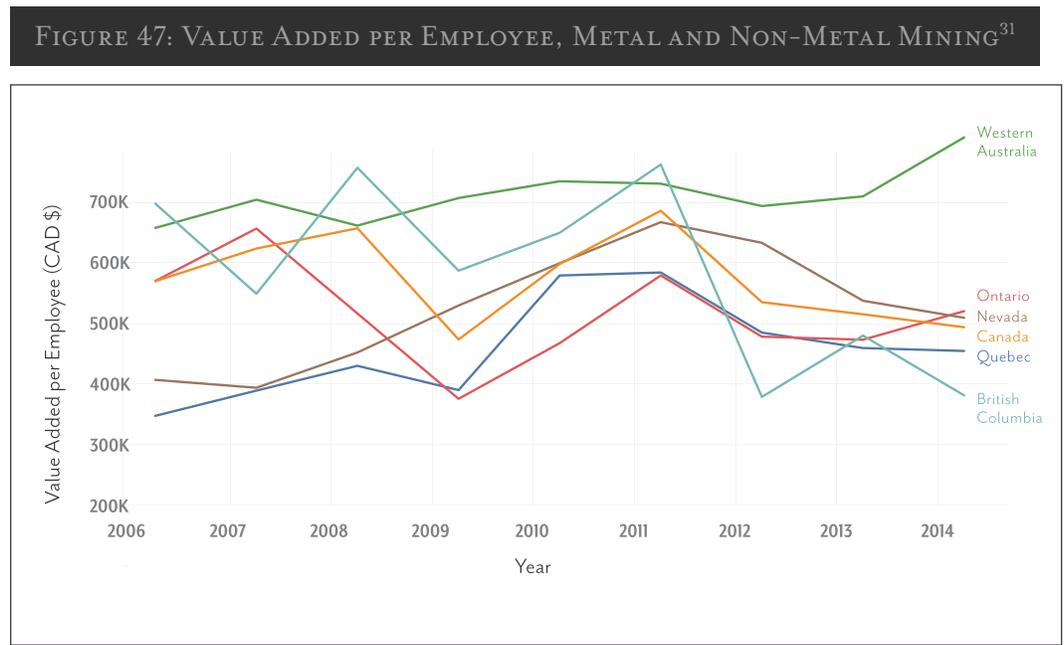
FIGURE 46: EMPLOYEE PAY DISTRIBUTION, METAL AND NON-METAL MINES<sup>29</sup>



<sup>28</sup> HAL: survey of Ontario mining companies conducted for this study.  
<sup>29</sup> HAL: survey of Ontario mining companies conducted for this study.

Ontario’s mining sector recognizes the challenges associated with attracting and retaining a skilled workforce. The Mining Industry Human Resources (MiHR) Council has a mandate to identify and address human resource and labour market challenges facing the Canadian minerals and metals sector. The OMA collaborates with MiHR along with organized labour, contractors, educational institutions, industry associations and Indigenous groups to understand labour market trends, identify opportunities and develop solutions. OMA members noted that they experience some or significant difficulty recruiting for engineers, trades such as electricians, mechanics and millwrights as well as in the field of health and safety.<sup>30</sup>

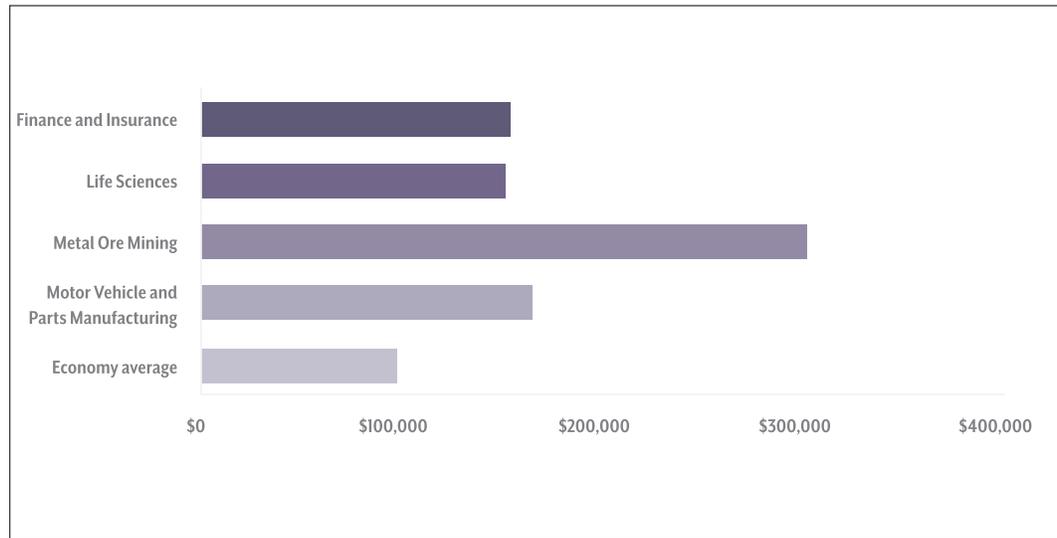
Figure 47 shows productivity, in terms of value added per employee, in various jurisdictions for the Metal and Non-Metal Mining sector. Over the past ten years, Ontario’s productivity has been lower than the Canadian average, except in 2014 when Ontario (\$460K/employee) edged out the Canadian average (\$433K/employee). In 2016, Ontario also edged out Nevada (\$448K/employee) but, like other jurisdictions, was far behind Western Australia (\$747K/employee). According to the Australia Productivity Commission, this increase in productivity is due to an “increase in the use of open-cut mining along with a general increase in the scale and automation of mining equipment”.



Ontario’s Panel on Economic Growth & Prosperity recommends that to “improve productivity and close the prosperity gap, Ontario must focus on its strengths and grow its high-wage, innovative, export-oriented industries”. In the metal ore mining industry, workers are three times more productive than the average – largely a result of the high levels of capital per worker.<sup>32</sup>

30 HAL: survey of Ontario mining companies conducted for this study.  
 31 HAL: (1) NRCan, Principal Statistics, Metal Ore and Nonmetallic Mineral Mining and Quarrying, by Industry and Province; (2) U.S. Geological Survey and the Nevada Bureau of Mines and Geology; (3) Government of Western Australia, Department of Mines & Petroleum  
 32 Ontario’s Panel on Economic Growth & Prosperity (Dec 2016)

FIGURE 48: ANNUAL GDP PER WORKER



## 4.3 Community Partnerships

Modern mining companies take a partnership approach to community relations. Through proactive communication, they address concerns and engage communities in the process of creating sustainable value at the local level. This approach builds understanding and trust, while helping to identify opportunities for making a positive difference in people's lives.

Although important in any community, this participatory model is imperative in remote areas, where mining serves as an important factor in improving socio-economic circumstances and stimulating a diversified local economy that will flourish throughout the life of the mine and well beyond.

Further, respectful, mutually-beneficial relationships with Indigenous communities are crucial to the Ontario mining industry. *Figure 49* shows the location of the 122 active agreements in Ontario, including many exploration agreements with junior companies.

Mining is the largest private-sector employer of Indigenous Canadians, accounting for about 6% of the total mining labour force, while Indigenous people account for 3% of the Canadian population.<sup>33</sup> In Ontario, Indigenous employment accounts for 11.2% of total mining jobs (see *Figure 45*) – up from 9.7% in 2011.<sup>34</sup>

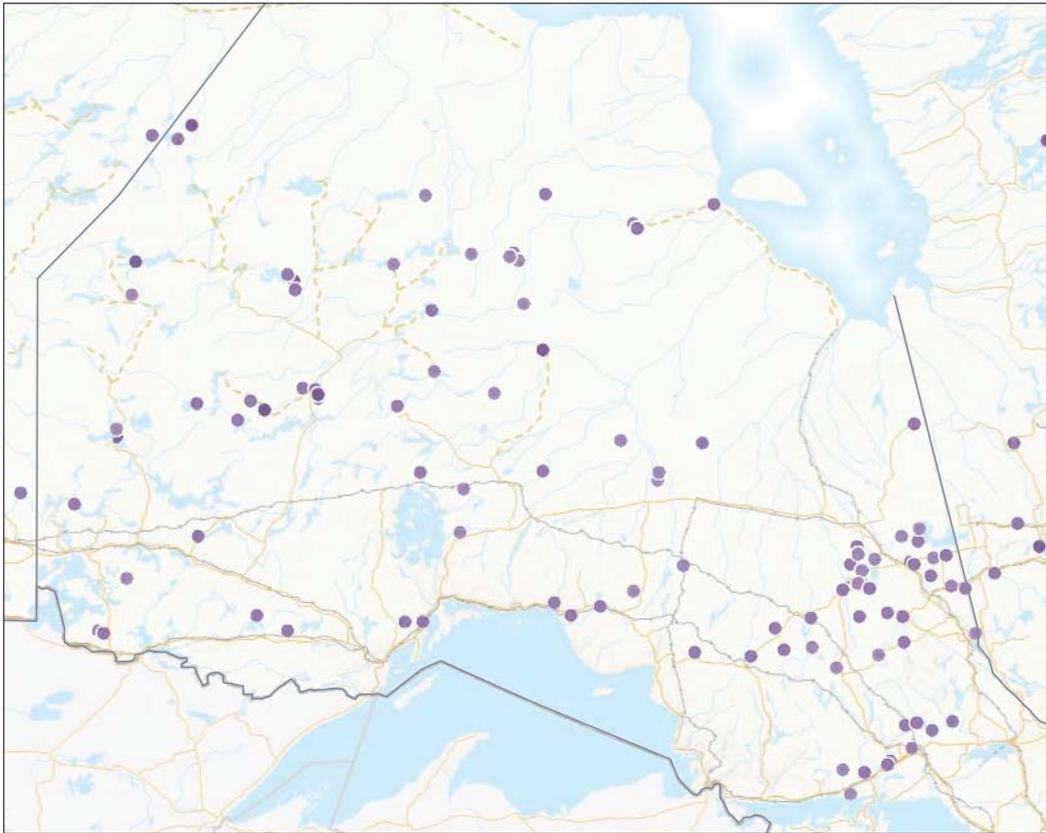
In 2015, Ontario mining companies contributed more than \$90 million to local Indigenous governments and communities.<sup>35</sup> Many of these contributions come as part of Indigenous mining agreements that cover a range of provisions related to financial payments, employment and training programs, community and social programs, donations and/or contributions, etc.

<sup>33</sup> Mining Association of Canada Facts-and-Figures 2016 pg 57

<sup>34</sup> HAL: survey of Ontario mining companies conducted for this study and OMA report, Dynamic and Dependable

<sup>35</sup> HAL: survey of Ontario mining companies conducted for this study.

FIGURE 49: ACTIVE ONTARIO INDIGENOUS MINING AGREEMENTS<sup>36</sup>

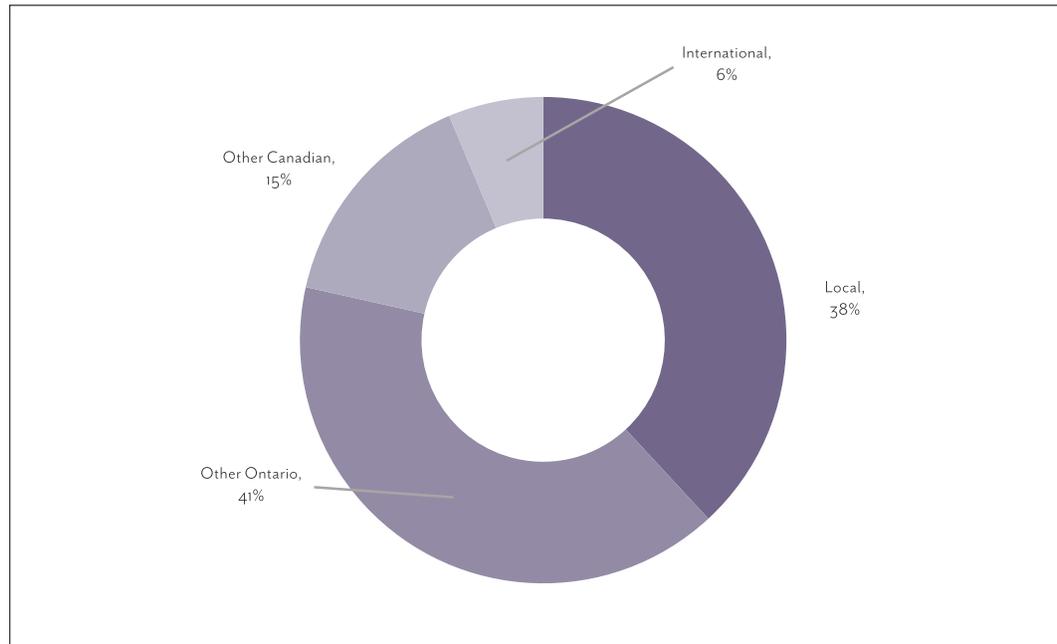


## 4.4 Mining Clusters

Ontario's mines make purchases of more than \$1 billion, from local suppliers.<sup>37</sup> As shown in Figure 410, Ontario mines source 38% of their supplies and services locally (up from 31% in 2011) and another 40% inside Ontario. This local demand is instrumental in creating and supporting local clusters of related industries. There is a growing recognition that interrelated firms and industries achieve a measure of competitive advantage by being geographically concentrated in certain locations. A key element of this competitive environment are clusters of firms engaged in traded and untraded relationships with each other, with public and private suppliers of specialized services, knowledge inputs and infrastructure, and with governments and customers.

<sup>36</sup> HAL: NRCan (March 2016), The Atlas of Canada – Indigenous Mining Agreement  
<sup>37</sup> HAL: survey of Ontario mining companies conducted for this study.

FIGURE 410: ONTARIO MINES SUPPLIER LOCATIONS<sup>38</sup>



The advantages enjoyed by firms in clusters include traditional external economies of scale, (such as shared physical infrastructure), efficiency gains from reduced transaction costs and access to specialized labour. Other advantages are based on the transfer of knowledge, including the movement of skilled labour and inter-firm collaboration and networking.

Clusters have attracted the attention of policy-makers based on the belief that public institutions and regulations have a strong influence on cluster dynamism, thereby having a discernible and measurable impact on the prosperity of local economies.<sup>39</sup>

Employing the most recent data from Statistics Canada's National Household Survey (using the definition of mining clusters provided by the Local Indicators Database for Economic Analysis) and the Cluster Atlas of Canada<sup>40</sup> provides evidence for mining clusters in Canada.

This study identified 12 mining and quarrying clusters across 12 different census metropolitan areas (CMAs) or city-regions, as defined by Statistics Canada - five in Quebec, four in Ontario (Figure 411 and Table 43) and three in British Columbia.<sup>41</sup> This is not to suggest considerable mining activities do not exist in other areas of these three provinces, just that these are the 12 CMAs with both large enough and significant enough concentrations of employment in mining to be considered clusters. However, the individual clusters vary considerably in size and the degree of geographic concentration of employment in the cluster, as reflected in the location quotient (LQ) for that CMA. LQ is the measure of a region's industrial specialization.

38 HAL: survey of Ontario mining companies conducted for this study.

39 HAL: Porter et al., 2000; Thomas Andersson, Sylvia Swagg Serger, Jens Sorvik, and Emily Wise Hansson. *The Cluster Policies Whitebook*. Malmö, Sweden: International Organisation for Knowledge Economy and Enterprise Development, 2004; OECD. *Competitive Regional Clusters: National Policy Approaches*. OECD reviews of regional innovation. Paris: Organisation for Economic Co-operation and Development, 2007.

40 Determined with the Canadian cluster calculator, part of the Local IDEAs database at the Munk School of Global Affairs at the University of Toronto. At the request of Industry Canada, this database was updated and used to create the Cluster Atlas of Canada in 2014. National household survey data is 2011.

41 HAL: Cluster analysis performed for this study.

FIGURE 41: MINING AND QUARRYING INDUSTRY CLUSTERS IN ONTARIO

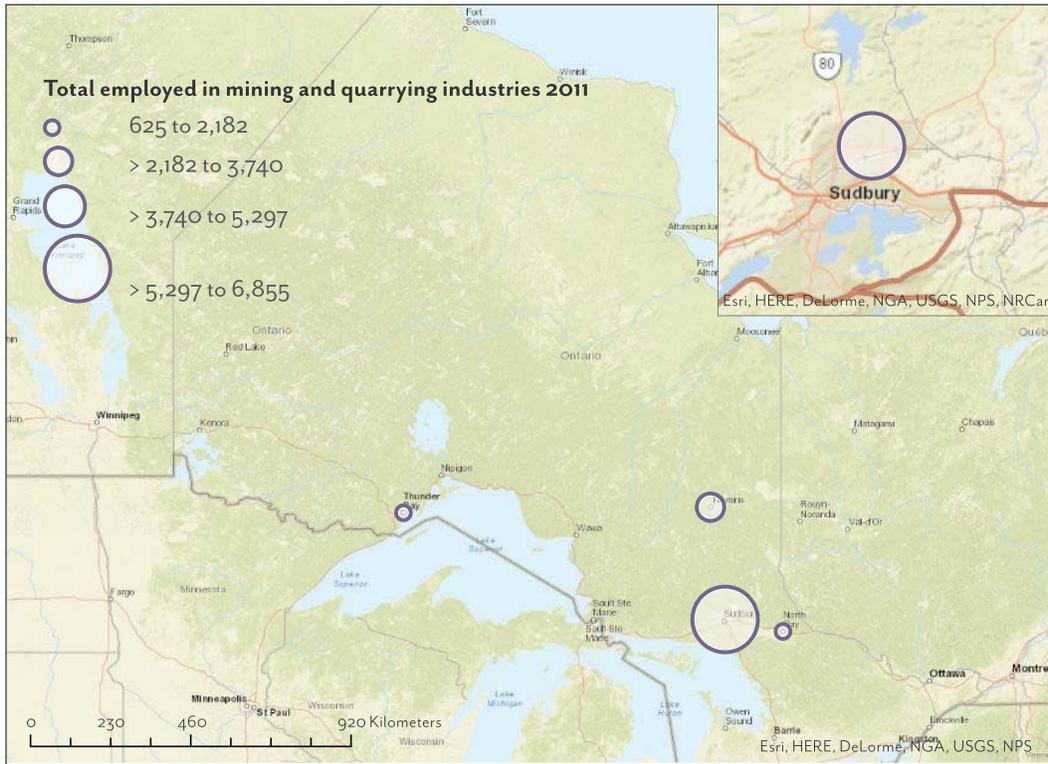


TABLE 43: MINING AND QUARRYING INDUSTRY CLUSTERS IN ONTARIO

Name	Number of Persons Employed 2006	Number of Persons Employed 2011	Change in Employment	Establishment Count 2011	LQ	Average Income in Industry 2011
North Bay	315	625	310	14	0.63	\$77,619
Greater Sudbury	5,525	6,855	1,370	59	16.79	\$78,763
Timmins	2,260	3,100	880	43	25.70	\$91,440
Thunder Bay	405	755	350	34	2.08	\$70,954

The largest cluster in Canada by far is found in the Greater Sudbury region, which employed more than 5,000 people in metal mining alone in 2011. Yet, interestingly, Sudbury did not have the highest concentration of employment in mining across Canada; that title belongs to the Timmins CMA, where the 25.7 LQ was considerably higher than that for any of the other clusters in the country. All four Ontario clusters grew in employment between the 2006 and the 2011 censuses. The mining cluster in the Greater Sudbury region experienced the largest overall growth while at the same time Timmins also had the highest average income of any of the 12 mining clusters in the three provinces at \$91,440.

In addition to its mines, Ontario also has a cutting-edge mine supplier and service sector. The Canadian Association of Mining Equipment and Services for Export reports that Ontario benefits from approximately 900 companies employing more than 40,000 personnel and having a direct economic impact of \$6.6 billion.<sup>42</sup>

Mines deliver a significant contribution to the communities around them by providing high wage jobs and supporting a supply and service economy. In 2014, Ontario mines employed 16,100 people at an average wage of \$1722 per week - 67% higher than the average industrial wage in the province. Mining is the largest private sector employer of Indigenous Canadians, who represent 11.2% of the mining workforce in Ontario, and mining companies contribute roughly \$90 million to Ontario's Indigenous governments and communities annually. Ontario's mines source 78% of their supplies and services inside the province, purchasing more than \$1 billion from local suppliers.

*Industry payroll  
in excess of \$1.6B.  
Payroll taxes of  
\$138M.*

*Leading edge  
supply and service  
sector.*

*90% of GDP  
stays inside Ontario.*

*Mines operating in  
Ontario directly employ  
16,100 with total mineral  
production employment of 78,800.  
Indigenous employment accounts for  
11.2% of total mining jobs up from 9.7%  
in 2011.*

*Mines  
in Ontario make purchases  
of more than \$1 billion from  
local suppliers.*

*At  
\$1,611, the average weekly  
wage for mining workers is 67%  
higher than the average industrial  
wage, increasing at twice the rate  
of inflation over the last  
decade.*

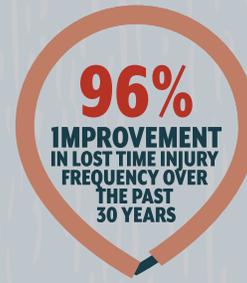
*While  
digging up minerals  
and metals, Ontario miners  
unearth people's potential by  
offering economic and social  
benefits that help Ontario  
communities thrive.*

# 05

MINING VALUES:  
HEALTH, SAFETY  
& THE ENVIRONMENT



## **SAFETY:**



**INVESTED MORE THAN \$46 MILLION ON HEALTH AND SAFETY INITIATIVES WITH ANOTHER \$11 MILLION FOR TRAINING.**

**ONTARIO IS ONE OF THE SAFEST MINING JURISDICTIONS IN THE WORLD AND MINING IS ONE OF THE SAFEST INDUSTRIES IN ONTARIO**

*It is not just about what and how much we mine, but about guiding values - health, safety, environment. Moving beyond compliance in areas such as energy management, water management, climate change adaptation and mine closure and reclamation can provide a competitive advantage.*



**MINING CREATES MORE ECONOMIC VALUE FOR THE ENERGY IT USES THAN MOST OTHER INDUSTRIES**



**AN ESTIMATED \$103 MILLION ON ENVIRONMENTAL PROTECTION, RECLAMATION AND DECOMMISSIONING.**

**ALREADY PART OF THE LOW CARBON ECONOMY. ONTARIO'S MINING INDUSTRY HAS LOWER GHG EMISSIONS THAN MOST OTHER SECTORS. MINING ACCOUNTED FOR ONLY 3.3% OF INDUSTRIAL GHG EMISSIONS IN 2013**

Mining is a dynamic industry that is continually evolving to meet society’s changing needs and expectations. For Ontario companies, their business is not just about what and how much they mine, but about their guiding values. In addition to contributing to the development and enhancement of local economies, Ontario miners prioritize employee health and safety and have achieved impressive gains in this area. Continuing to foster healthy and inclusive workplaces is fundamental to sustainable productivity improvements.

To continually re-earn their social licence to operate, miners also focus on minimizing the impact of their activities on the environment by adopting innovative technologies and approaches. Moving beyond compliance in areas such as energy management, water management, climate change adaptation and mine closure and reclamation is viewed not just as a corporate social responsibility objective, but as a potential competitive advantage.

## 5.1 Worker Health and Safety

Safe production is fundamental to Ontario mineral operations. The industry embraces the use of an integrated approach to the management of health, safety and the economic, technical and social processes of its businesses. Success is a direct consequence of the sector’s commitment to maintaining the highest health and safety standards possible. The ultimate goal for any Ontario mining company is to achieve a zero-incident work environment. To that end, mining companies devote themselves to promoting an ingrained workplace safety culture by training employees, engaging in risk management, measuring performance, rewarding achievement, sharing information and adopting best practices.

The OMA and its members collectively pursue zero harm in all business endeavours, seek to strengthen the Internal Responsibility System and to achieve reasonable, science-based legislation and regulation that enhances employee safety and supports production. In 2015, companies invested more than \$46 million in health and safety initiatives, plus another \$11 million for training.<sup>43</sup>

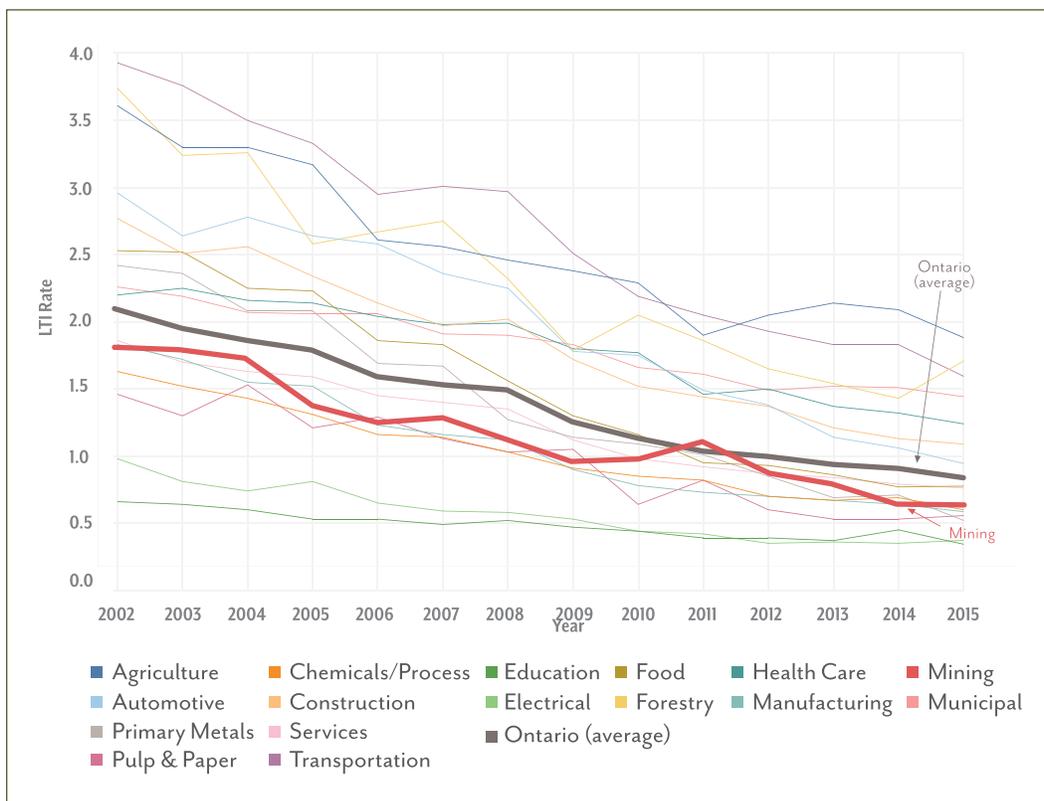
In 2014-2015, the Ontario government, in cooperation with the Ontario mining industry and labour, conducted a comprehensive underground mining health, safety and prevention review

*Ontario is one of the safest mining jurisdictions in the world and mining is one of the safest industries in Ontario, achieving a 96% improvement in lost time injury frequency over the past 30 years*

led by Ontario’s Chief Prevention Officer (CPO). The review examined a number of topics to help ensure an even stronger and safer underground mining sector, with the CPO receiving expert advice and strategic input from an advisory group of industries, labour, and health and safety representatives. The final report contained 18 recommendations that are being implemented by the Ministry of Labour and other health and safety system partners, including the OMA and Workplace Safety North.

The Workplace Safety and Insurance Board (WSIB) compiles and issues annual statistical reports regarding injury and illnesses, calculating a lost-time injury (LTI) rate based on claims created when “a worker suffers a work-related injury/disease which results in being off work past the day of accident, loss of wages/earnings or a permanent disability/impairment”. The WSIB classifies the industries shown in Figure 51 as Schedule 1 employers and indicates their 2015 LTI average rate was 0.85. Of these 16 industries, seven had LTIs above this rate, and nine were below. In 2015, mining performed better than the LTI industry average, with a rate of 0.63 – down from 1.81 in 2002 (see Figure 52). Ontario is one of the safest mining jurisdictions in the world and mining is one of the safest industries in Ontario, achieving a 96% improvement in lost time injury frequency over the past 30 years<sup>44</sup>.

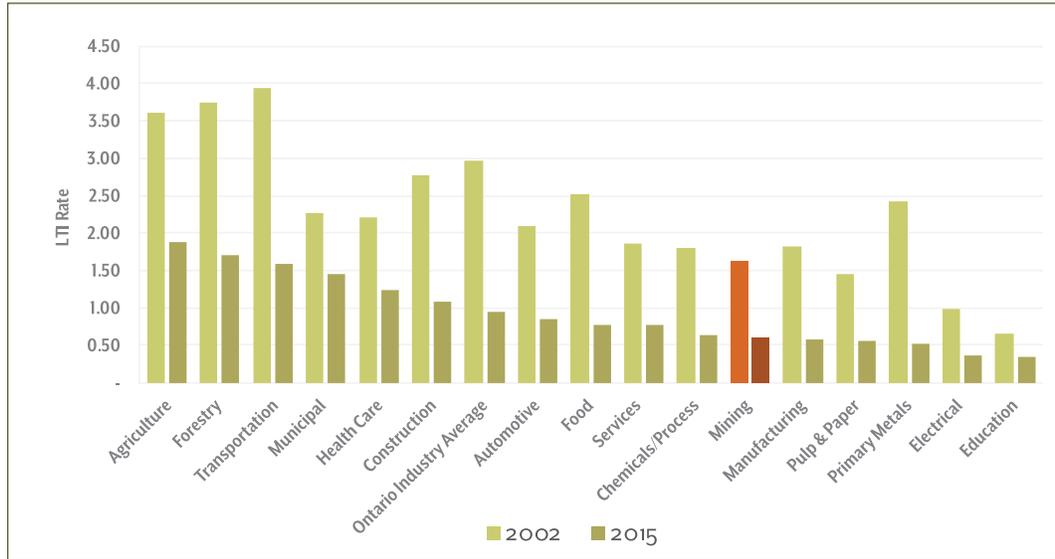
FIGURE 51: LOST TIME INJURY RATES BY INDUSTRY SECTOR<sup>45</sup>



44 Workplace Safety and Insurance Board

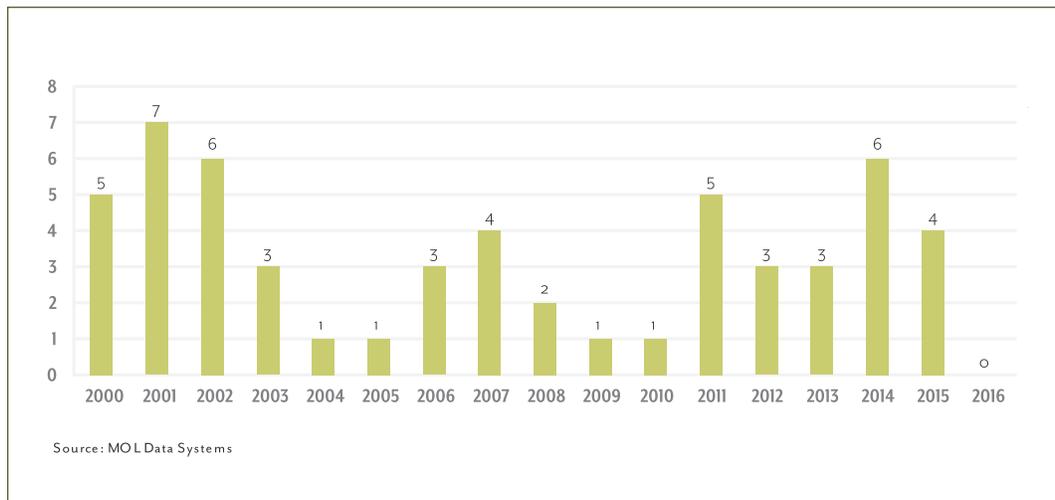
45 Workplace Safety and Insurance Board Enterprise Information Warehouse. Note on Schedule I: Workplace insurance coverage is compulsory for any business or industry named in Schedule I, Regulation 175/98. Employers included in Schedule I must contribute to the insurance fund.

**FIGURE 52:**  
**ONTARIO LOST TIME INJURY RATES BY INDUSTRY SECTOR, 2002 AND 2015<sup>46</sup>**



In 2016, Ontario’s mining industry met its zero-fatality objective. This is a significant achievement, marking yet another step toward achieving zero harm - the top priority for all Ontario miners.

**FIGURE 53: MINING FATALITIES IN ONTARIO, 2000–2016<sup>47</sup>**



<sup>46</sup> Workplace Safety and Insurance Board, 2016  
<sup>47</sup> Ontario Ministry of Labour

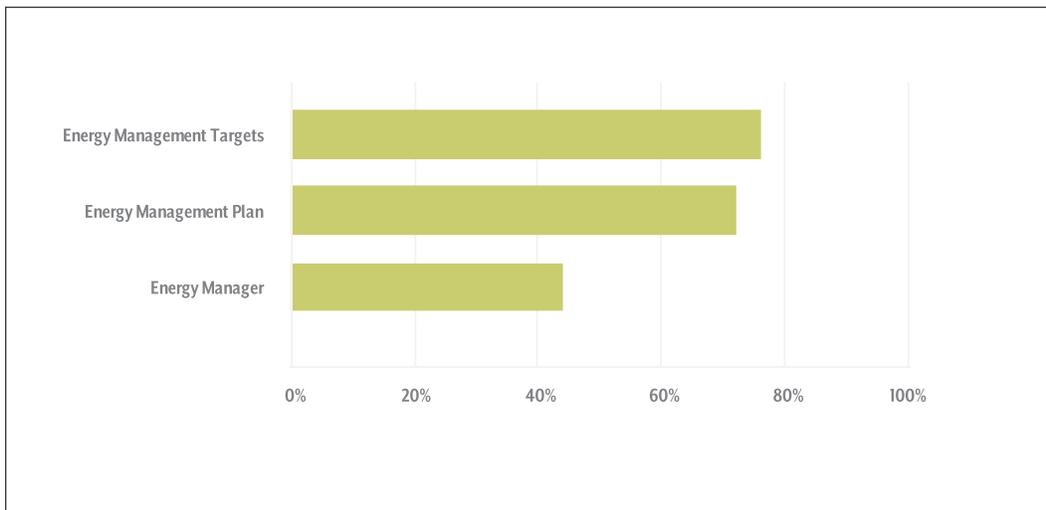
## 5.2 Sustainable Economic Development

The goal and commitment of Ontario mining companies is to minimize the temporary disruption of the environment during exploration and production, and to maximize the restoration of ecosystems at the end of the mine life. Throughout the province, companies are adhering to the highest standards in areas such as water conservation, energy consumption, reduction of GHG emissions, metal recycling and the preservation of biodiversity. In 2015, companies spent an estimated \$103 million on environmental protection, reclamation and decommissioning, up from \$62 million in 2011.<sup>48</sup>

Underground equipment traditionally has been powered by diesel engines and required complex, expensive ventilation and cooling systems. In fact, these systems represent the largest underground energy cost. Eliminating diesel in underground mines in Ontario represents the single-largest opportunity to reduce the carbon footprint and also offers opportunities to expand worker safety and improve the economies of mineral deposits. In addition, the ongoing adoption of clean technologies for mining will position Ontario as a leader in the mining innovation and sustainability space, attract next generation talent to the industry and support the supply and services sector in Ontario to improve mine efficiency.

The industry has a keen focus on energy conservation and efficiency as well as opportunities to move to energy sources with less of an environmental impact. As shown in *Figure 54*<sup>49</sup>, Ontario mining companies took steps in 2015 to better manage their energy consumption by establishing energy management targets, developing energy management plans, or designating energy managers. By the end of 2016 - through the implementation of the Independent Electricity System Operator Energy Manager program - the number of energy managers had doubled and with it, the establishment of plans and targets.

FIGURE 54: ENERGY MANAGEMENT INITIATIVES

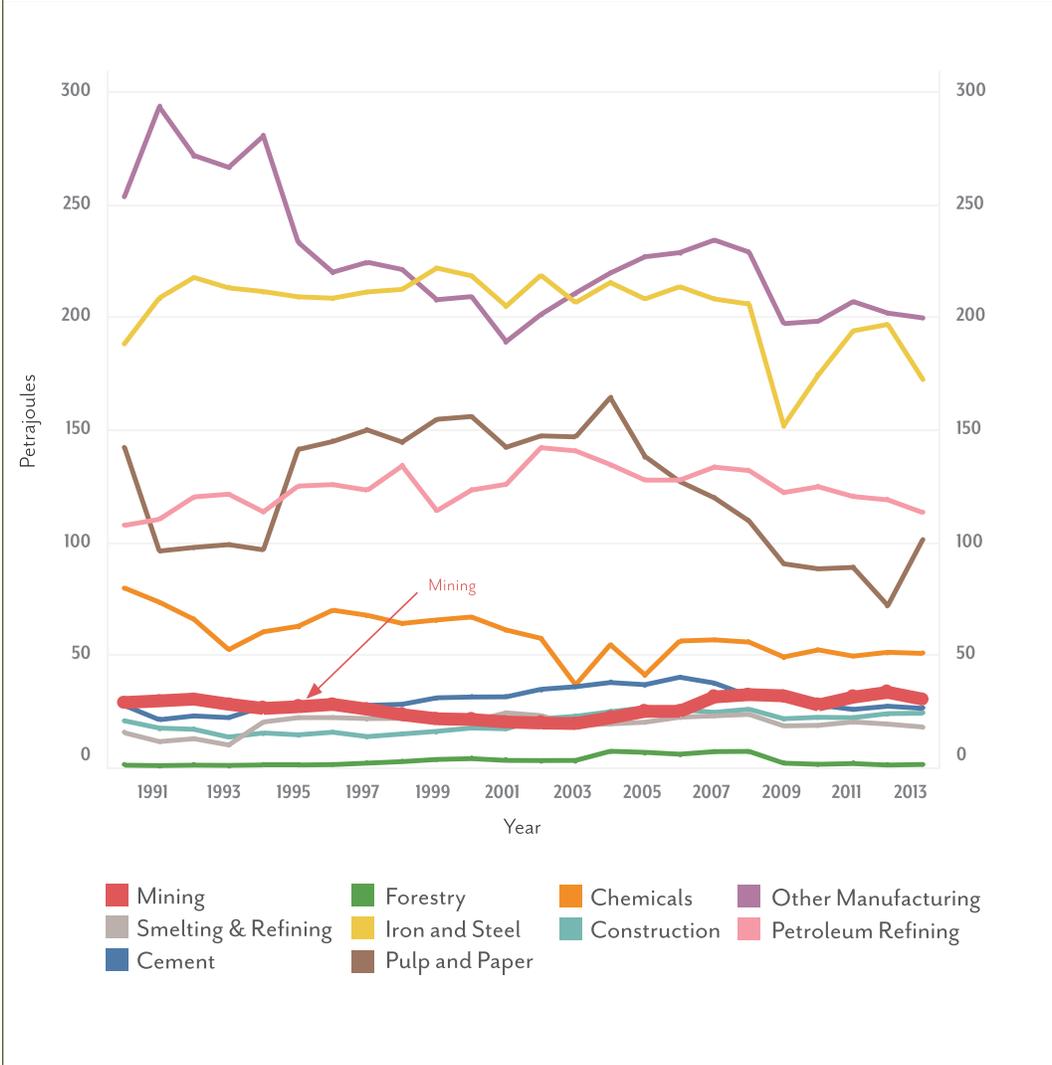


48 HAL: 2011 and 2016 surveys of Ontario mining companies conducted for this study.

49 HAL: survey of Ontario mining companies conducted for this study.

The Ontario mining industry used less energy over the 1991-2013 period compared to the iron and steel, petroleum refining, pulp and paper, chemicals and “other manufacturing” industries, as shown in Figure 55.

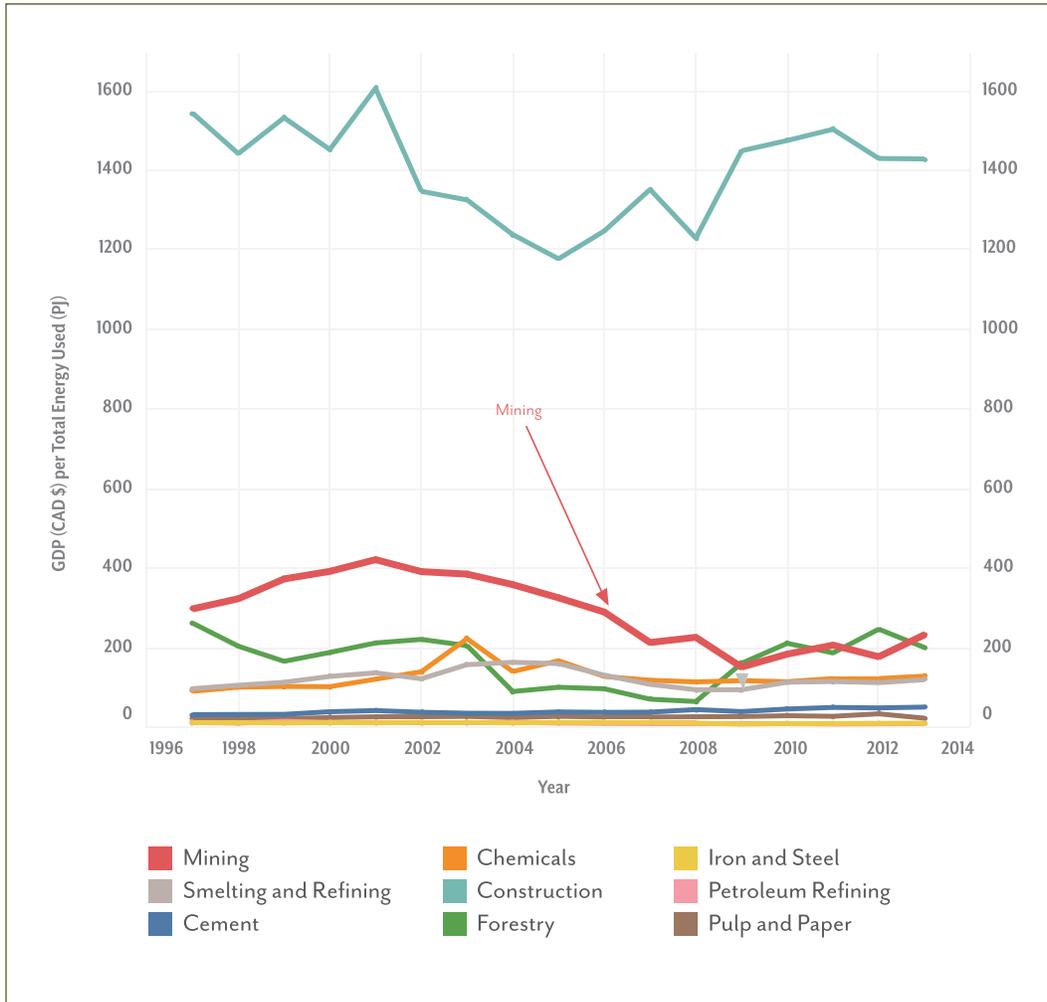
**FIGURE 55: ONTARIO ENERGY USE BY INDUSTRY (PJ)<sup>50</sup>**



50 HAL: NRCAN, Comprehensive Energy Use Database. Note that smelting and refining includes a broader group than just the OMA members.

Further, mining creates more economic value for the energy it uses than most other industries do. Compared with the same group of industries, with the exception of construction, Ontario's mining industry contributes roughly the same value added to the economy (as measured by GDP) for the amount of energy used as forestry does, but more than chemicals, petroleum refining, cement, pulp and paper, and iron and steel (Figure 56).

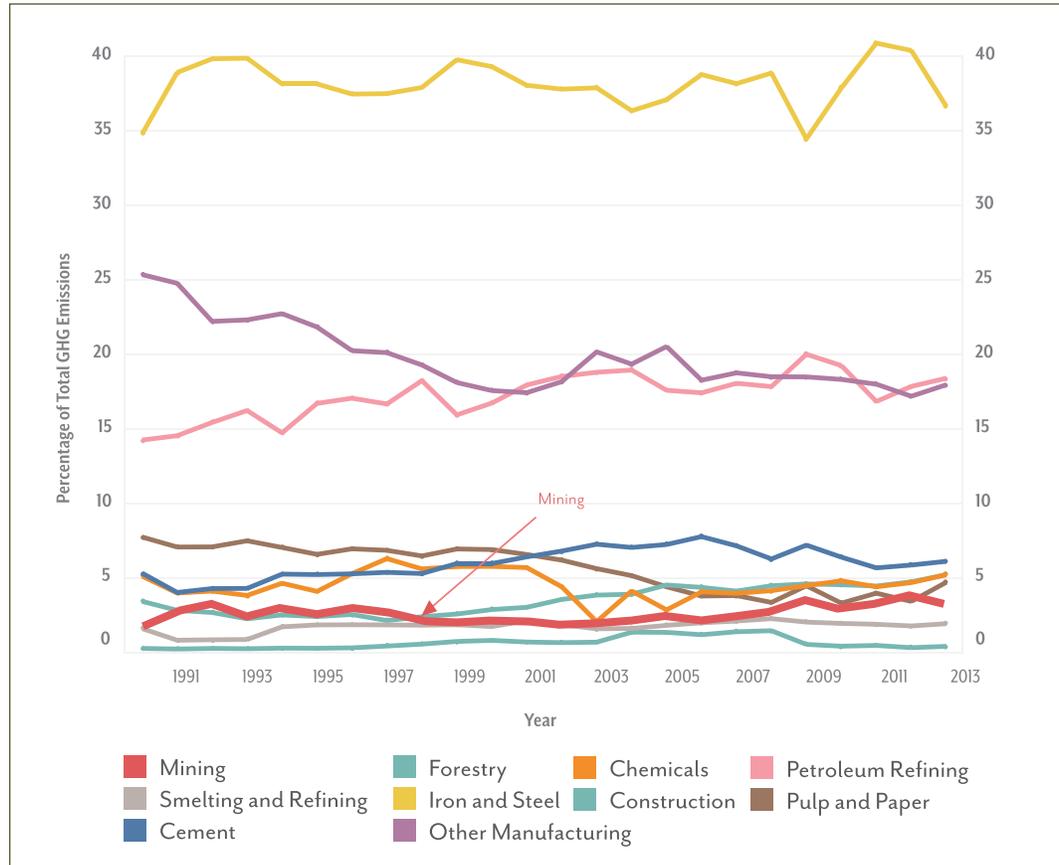
FIGURE 56: ONTARIO GDP PER ENERGY USED (PJ) BY INDUSTRY<sup>51</sup>



51 HAL: (1) NRCan, Comprehensive Energy Use Database; and (2) Statistics Canada, Table 379-0030 - Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), provinces and territories

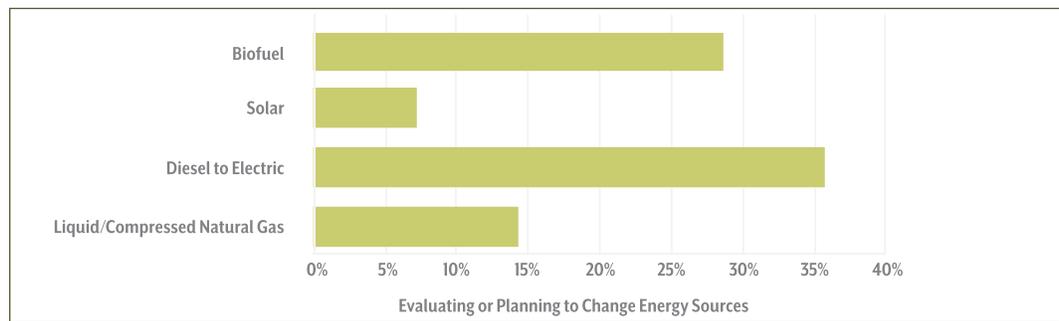
Moreover, when compared against the same group of industries, Ontario's mining industry has lower GHG emissions than iron and steel, petroleum refining, "other manufacturing", cement, chemicals, and pulp and paper (as shown in *Figure 57*) and accounted for only 3.3% of industrial GHG emissions in 2013.

**FIGURE 57: ONTARIO INDUSTRY GHG EMISSIONS<sup>52</sup>**



Many Ontario mining companies are investigating opportunities to change their energy sources to cleaner and greener sources. *Figure 58* shows the percentage of Ontario mining companies that are investigating such changes for a variety of potential energy sources.<sup>53</sup>

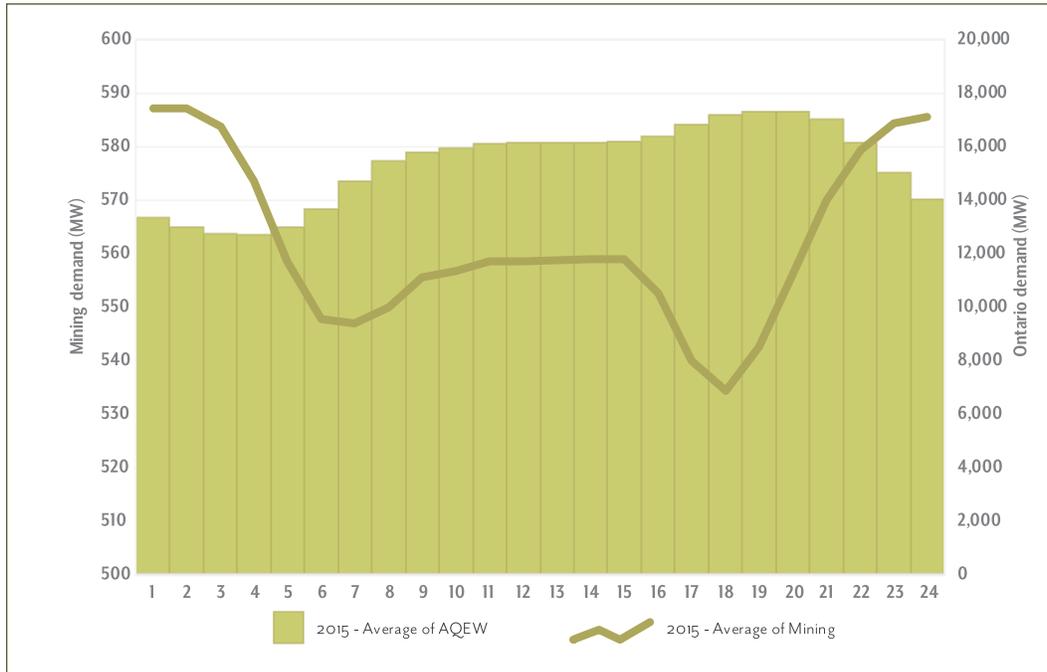
**FIGURE 58: INTENTIONS TO CHANGE ENERGY SOURCES**



<sup>52</sup> HAL: NRCan, Comprehensive Energy Use Database.  
<sup>53</sup> HAL: survey of Ontario mining companies conducted for this study.

The mining sector is reducing costs and contributing to Ontario’s efforts to drive down costly peak hydro generation by using more electrical load during off-peak periods. *Figure 59* compares mining electricity grid draw with Ontario’s total load, indicating mining demands drops during the times when Ontario’s overall demand rises.

**FIGURE 59: AVERAGE DAILY LOAD PROFILE FOR ONTARIO MINING AND TOTAL PROVINCIAL DEMAND, 2015 IN MEGAWATTS (MW)<sup>54</sup>**

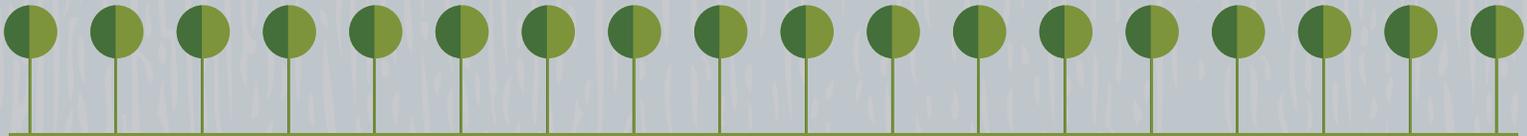


Ontario miners continue to improve on the gains made in employee health and safety and environmental stewardship. LTI rates have declined dramatically over the past decade and are now below the average of seven industries, making Ontario one of the safest mining jurisdictions in the world. Investments in environmental protection, reclamation and decommissioning are increasing – surpassing \$100 million in 2015 - while energy management remains a top priority. Ongoing initiatives, such as investing in safety training, eliminating diesel in underground mines and moving to battery electric vehicles will position Ontario’s mining industry as a global leader in health, safety and sustainability.

<sup>54</sup> AITIA Analytics. AQEW – is the allocated quantity of energy withdrawn by market participants and represents the verified Ontario demand values derived from loss-adjusted and totalized metering data.

06

INVESTMENT:  
THE KEY TO  
THE FUTURE



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## ONTARIO'S MINING AND QUARRYING INDUSTRY HAS ADOPTED **ADVANCED GREEN TECHNOLOGIES** AT RATES WELL ABOVE ONTARIO'S INDUSTRY AVERAGE

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### THE FUTURE

*To compete globally, there is a critical need to lower investment risk by being more transparent, clear, effective and efficient and by addressing public policy challenges and incentivizing growth.*

**Mining companies are facing new challenges** as declining returns at current depths are forcing companies to mine deeper, significantly increasing extraction costs.

**New mines drive development** along the production chain, transforming and improving productivity and wages in many other industries .

Exploration and deposit appraisal expenditures in Ontario have declined over the last few years. **Initial projections for this year are positive.**

**Innovation, productivity gains and research and development** are key to building on our historical global leadership in mining.

**Investment** is required to maintain **healthy mineral reserve levels** and keep the sector competitive and capable of contributing to the Ontario economy.

Ontario mining provides the minerals and metals that are **the building blocks of a clean green economy.**

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**HYDRO COSTS KEEP ONTARIO AT A COMPETITIVE DISADVANTAGE.**

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Investment is required to maintain healthy mineral reserve levels and keep the sector competitive and capable of contributing to the Ontario economy.

As a high-wage/high-cost jurisdiction, it is critical that Ontario offers a low level of regulatory risk for investors to increase capital inflows into the mining sector. To compete globally, there is a critical need to lower investment risk by being more transparent, clear, effective and efficient and by addressing public-policy challenges and incentivizing growth.

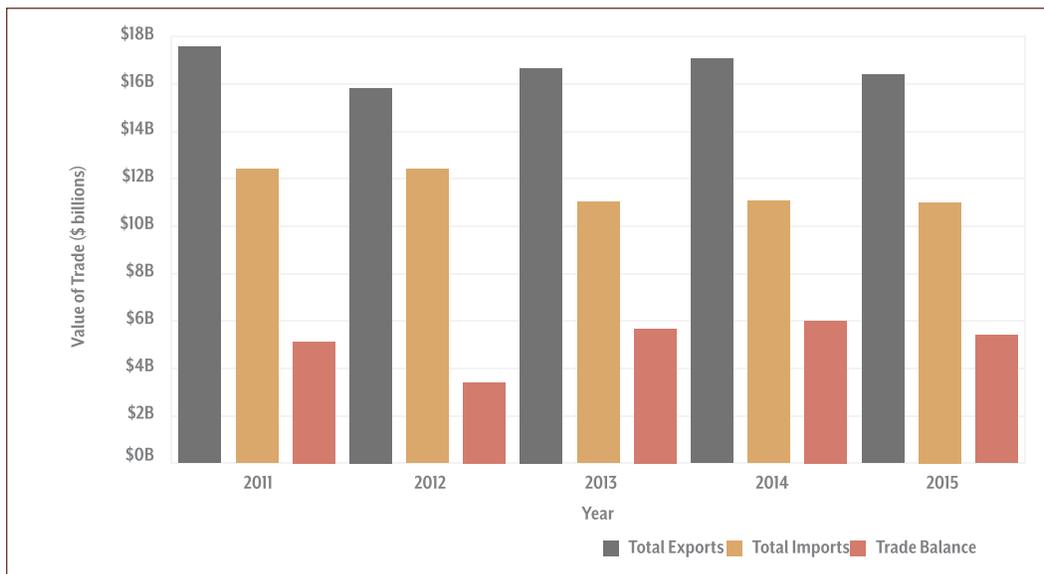
Previous investments helped position Ontario as the major producer of metals and minerals in Canada. Ontario is second after Saskatchewan in total Canadian mine investment (at \$2.9 billion in 2015<sup>55</sup>) including expenditures on exploration and deposit appraisal and mine complex development.

Nonetheless, there are signs of vulnerability requiring counteractive measures to maintain industry growth. An extended period of lower commodity prices and volatile demand for many commodities has resulted in a significant impact on earnings, balance sheets and investor perceptions of the sector. Investors' risk tolerance has declined, particularly with regard to the high risk stage of mineral exploration. Even at the operations stage, mining companies face new challenges as declining returns at current depths are forcing companies to mine deeper, thus significantly increasing extraction costs.

According to PricewaterhouseCoopers (PwC), the top 40 global mining companies operated at a collective US\$27 billion net loss in 2015, with market capitalization falling by 37%, effectively wiping out all the gains made during the commodity supercycle of 2001-2011. Together, they experienced \$53 billion in impairments, and wrote off the equivalent of 32% of the capital expenditures (capex) made since 2010. Focus on cost control continues, with a 17% drop in operating costs, but economic headwinds also have not abated.<sup>56</sup>

Figure 61 shows how the Ontario mining industry fared in its trade with other countries from 2011-2015. Although the balance of trade was relatively stable, exports dipped from \$17.6 billion in 2011 to \$16.4 billion in 2015. Overall, trade by the mining sector is positive for Ontario: imported materials increase jobs while exports generate new wealth.

FIGURE 61: MINING AND QUARRYING TRADE FOR ONTARIO<sup>57</sup>



## 6.1 Exploration Spending

Geologists believe that Ontario has a significant amount of untapped mineral potential, especially given that the mix of commodities required is changing with the development of new cleantech industries. Nevertheless, the ore in existing mines is finite. In order to keep turning Ontario's natural resource potential into jobs and sustainable wealth, the mining cycle must keep robust by encouraging exploration that can lead to new discoveries and introducing regulatory efficiencies to accelerate the process of developing these discoveries into mines. New mines drive development along the production chain, transforming and improving productivity and wages in service industries and ultimately bolstering creative industries throughout the province, enabling a self-reinforcing upward cycle of innovation and growth.

The level of spending on exploration and deposit appraisal is an indicator of the financial health of the mineral exploration sector. Gauging spending levels also assists in predicting the future of Canada's mineral production. Natural Resources Canada (NRCan) differentiates exploration spending between junior and senior companies, where:

- ➔ A senior company normally derives its operating income from mining or other business segments rather than from the issuance of shares.
- ➔ A junior company is neither a producing company (a senior company) nor the recipient of operating income from production or from some other business segments. Its principal business is exploration, for which it is raising funds primarily through the issuance of treasury shares.

Mineral exploration and deposit appraisal expenditures by both senior and junior companies in Ontario have declined over the past few years, as shown in Table 61 (\$ millions). Over the 2011-2015 period, exploration and deposit appraisal expenditures declined by 41% for senior companies and by 90% by junior companies, for an overall decline of 63%. This downward

trend in exploration expenditures results from the 32% decline in commodity prices over the same period. The sharper decline in exploration expenditures by junior companies reflects the difficulty raising funds when commodity prices are falling. Total spending for 2017 is projected at \$486 million, suggesting a positive upwards trend.<sup>58</sup>

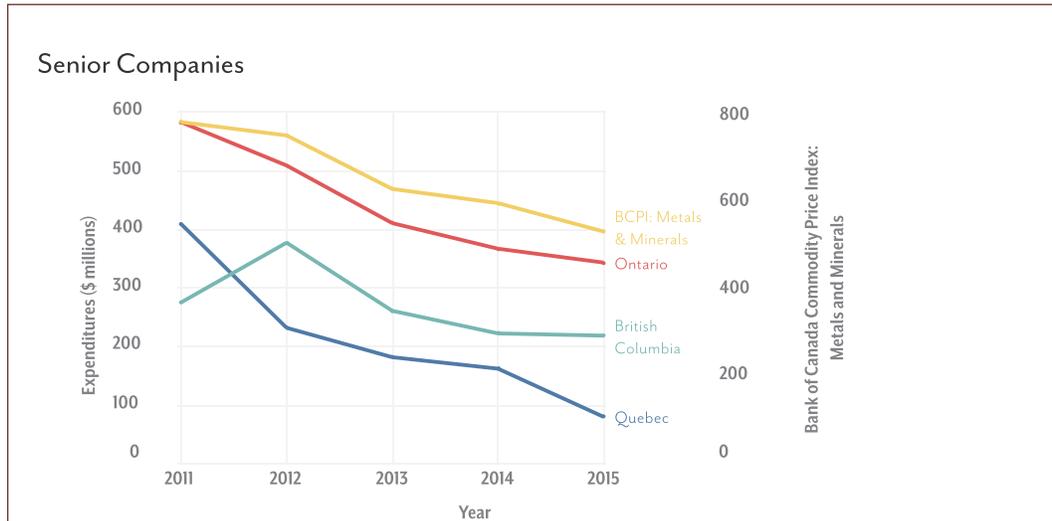
**TABLE 61:**  
**EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES (\$ MILLIONS)<sup>59</sup>**

	2011	2012	2013	2014	2015
Senior Companies	\$583.4	\$509.3	\$410.9	\$367.2	\$343.5
Junior Companies	\$484.3	\$452.2	\$151.1	\$101.0	\$49.8
Total: Junior & Senior	\$1,067.7	\$961.5	\$562.0	\$468.2	\$393.3

Figure 62 shows that despite a decline in expenditures by senior companies in Ontario from approximately \$580 million in 2011 to \$340 million in 2015, Ontario still spent more than Quebec and BC. In 2015, expenditures by senior companies in Ontario were more than four times higher than their expenditures in Quebec (at \$80 million) and roughly 55% higher than BC (at \$220 million).

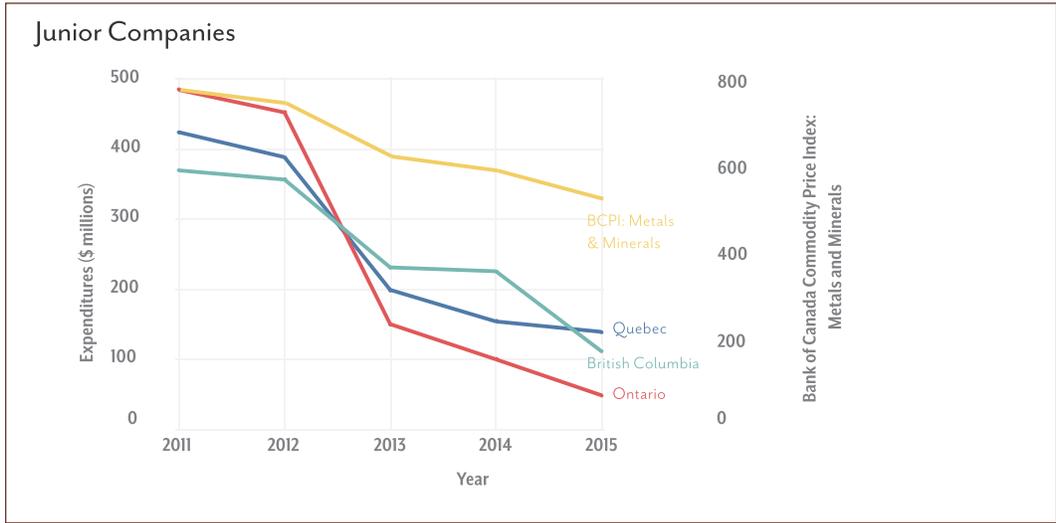
Expenditures by junior companies in Ontario declined dramatically from approximately \$480 million in 2011 to \$50 million in 2015. In 2011, expenditures by junior companies in Ontario were comparatively higher than their counterparts in Quebec and BC, but by 2015 were comparatively lower.

**FIGURE 62A: MINERAL EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES: ONTARIO, QUEBEC, BC<sup>60</sup>**



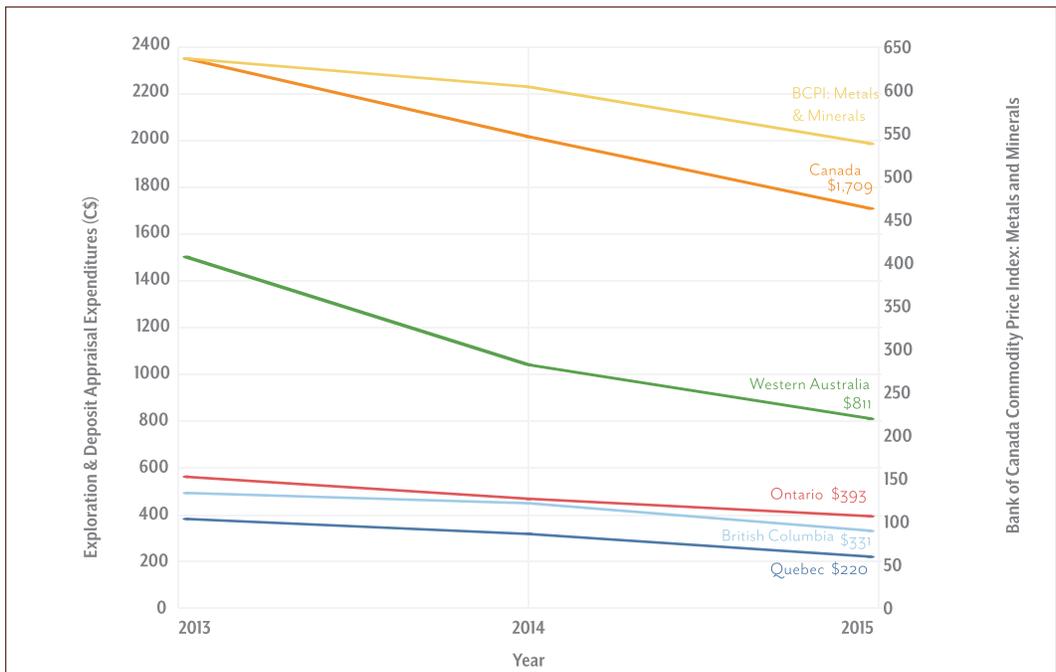
58 MNDM  
 59 HAL: NRCan, Exploration Plus Deposit Appraisal Expenditures, by Junior and Senior Companies, by Province and Territory. \$393 was preliminary data with revised number \$440.2 released March 2017.  
 60 HAL: NRCan, Exploration Plus Deposit Appraisal Expenditures, by Junior and Senior Companies, by Province and Territory

FIGURE 62B: MINERAL EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES: ONTARIO, QUEBEC, BC



For an international comparison of mining jurisdictions, Western Australia experienced a similar decline in mineral exploration and deposit appraisal expenditures, as noted in *Figure 63*. In 2013, companies in Western Australia expended roughly the equivalent of C\$ 1.5 billion, but by 2015, expenditures fell by almost half of the equivalent of C\$ 800 million.

FIGURE 63: MINERAL EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES: CANADA, ONTARIO, QUEBEC, BC, AND WESTERN AUSTRALIA (SENIOR & JUNIOR COMPANIES)<sup>61</sup>

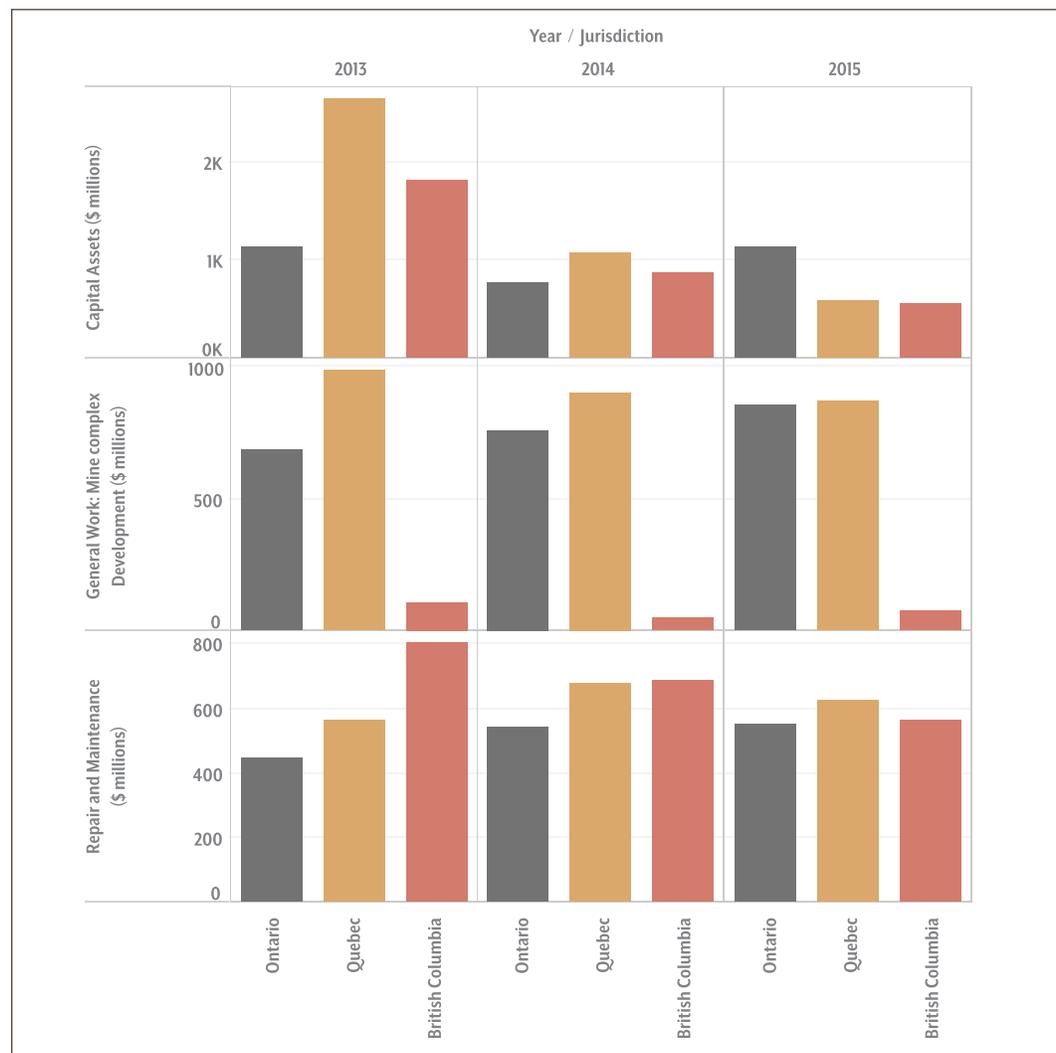


61 HAL: NRCan, Total Mineral Resource Development Investments, by Province and Territory; and Government of Western Australia, Department of Mines & Petroleum, 2015-16 Economic Indicators Resources Data. Note: The state of Western Australia accounted for 60% of Australia's exploration and deposit appraisal expenditures in 2015.

## 6.2 Capital Spending

Capital spending is a barometer of how confident managers and investors are about current production capacity and future demand. In addition to exploration spending, NRCan provides data on mine complex development work, capital assets, and repair and maintenance expenditures, as shown in *Figure 64*.

FIGURE 64: EXPENDITURES ON CAPITAL ASSETS, GENERAL WORK AND REPAIR & MAINTENANCE: ONTARIO, QUEBEC AND BC (SENIOR & JUNIOR COMPANIES)<sup>62</sup>

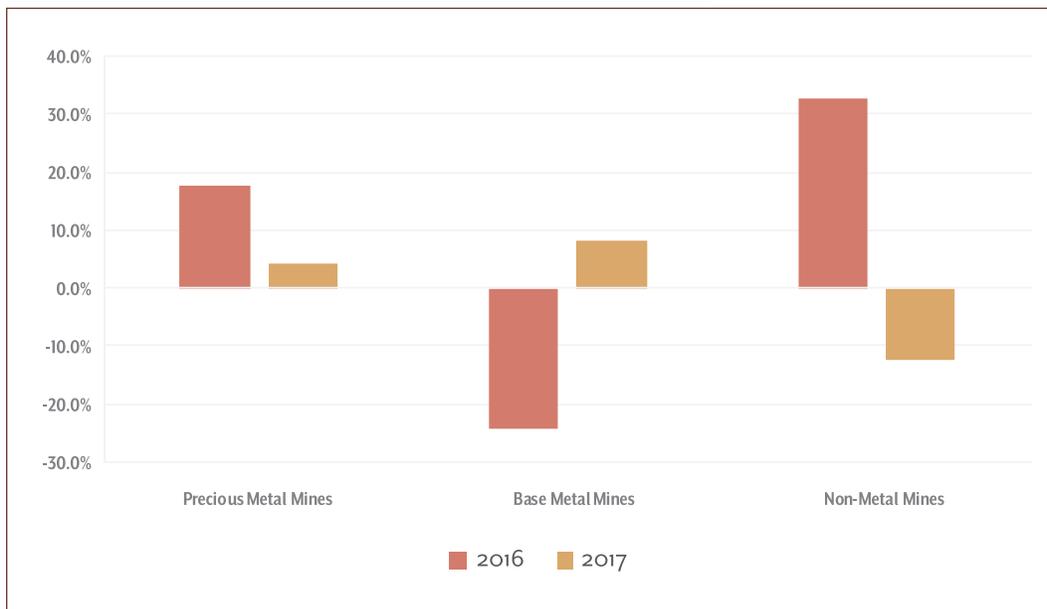


From 2013 to 2015, spending on general work, including surveys, feasibility studies and environmental activities and on repair and maintenance increased slightly in Ontario. Spending on capital assets, including non-residential construction, machinery and equipment, remained roughly the same.

In 2015, Ontario mining companies spent considerably more on capital assets (\$1,136 million) than their counterparts in Quebec (\$653 million) and BC (\$588 million). General work reached \$919 million in Quebec and \$825 million in Ontario compared to \$79 million in BC, while repair and maintenance expenditures were similar across all three provinces. Investments of this strength during a period of low commodity prices is positive for Ontario's economy while at the same time, increasing competitiveness and better positioning the sector to maintain strength during future commodity downturns.

The expectations of Ontario mining companies for future capital spending are mixed as shown in Figure 65.<sup>63</sup> While capital spending is expected to increase for both precious and base metal mines in 2017, non-metal mines will see a decrease. Overall, capital spending on construction (including mine expansion) is 22.6% of total production spending and capital spending on machinery and equipment is 9.3%.<sup>64</sup>

FIGURE 65: EXPECTED CAPITAL SPENDING CHANGE



63 HAL: survey of Ontario mining companies conducted for this study.

64 HAL: survey of Ontario mining companies conducted for this study.

## 6.3 Investment Financing

Mining requires significant investment, and one source of that money is public financing. Toronto is the world's strategic hub for mine financing and related legal, accounting, engineering and geological expertise. Toronto is the mining finance capital of the world: the TSX and the TSXV list more mining companies than any other exchange, are first among exchanges worldwide in equity capital raised, and are home to almost 50% of the world's public mining companies.<sup>65</sup> The city's unique position is bolstered by a robust cluster of world-leading mining financing expertise, including a large analyst community that covers junior and senior mining companies. In 2016, the TSX/TSXV collectively raised \$9.3 billion in new mining equity capital, ranking first for equity capital raised globally, as shown in *Table 62* and 57% of global mining financings were done on the TSX and TSXV.

TABLE 62: ACTIVITY ON THE TSXV AND TSX<sup>66</sup>

2016	TSXV	TSX	TSXV and TSX
Number of Issuers	976	230	1,206
QMV (C\$)	17,849,296,244	261,627,199,534	279,476,495,778
New Listings	29	11	40
Equity Capital Raised (C\$)	2,553,125,257	6,815,642,864	9,368,768,121
Number of Financings	1,295	245	1,540
Volume Traded	27,683,313,073	35,905,954,944	63,589,268,017
Value Traded (C\$)	7,377,005,690	255,851,177,188	263,228,182,877
Number of Trades	3,635,557	63,720,723	67,356,279

## 6.4 Future Opportunities

Ontario boasts vast mineral potential; however, it takes a great deal of capital, effort and time to discover a viable ore deposit and bring it into production. Only about one mineral exploration project in ten is taken to the drill stage, and one drill program in 1,000 finds a viable mineral deposit; hence, fewer than one project in 10,000 becomes a mine. It typically takes ten to 15 years of exploration, data analysis, planning and financing to bring a mine into production. With that in mind, the advanced exploration projects shown in *Figure 66* have the most potential to be the next engine for regional development and value-added generation<sup>67</sup>.

<sup>65</sup> Toronto Stock Exchange

<sup>66</sup> Source: TSX Mining Website: <https://www.tsx.com/listings/listing-with-us/sector-and-product-profiles/mining>. Quoted Market Value (QMV).

<sup>67</sup> MNDM

FIGURE 66: ADVANCED MINERAL PROJECTS IN ONTARIO 2017



One region of particular interest is the ‘Ring of Fire’ located 540 kilometres northeast of Thunder Bay (Figure 67). This 150 km<sup>2</sup> section of the James Bay Lowland has mineral potential estimated at \$60 billion, including the largest deposit of chromite ever discovered in North America and significant deposits of nickel, copper, gold and platinum.<sup>68</sup>

The Ring of Fire has the potential for long-term mining development on the scale of the Sudbury Basin. In 2014, the Ontario Chamber of Commerce estimated that the first 10 years of development within the region could generate up to \$9.4 billion of GDP, nearly \$2 billion in government revenue and create up to 5,500 jobs annually. Within the first 32 years of the development, the Ring of Fire will generate more than \$25 billion in economic activity across numerous sectors in Ontario.<sup>69</sup>

68 Ministry of Finance (April 28, 2014), Ontario Investing in the Ring of Fire

69 Ontario Chamber of Commerce, (2014) Beneath the Surface

FIGURE 67: LOCATION OF THE RING OF FIRE BELT<sup>70</sup>



## 6.5 Improving Competitiveness

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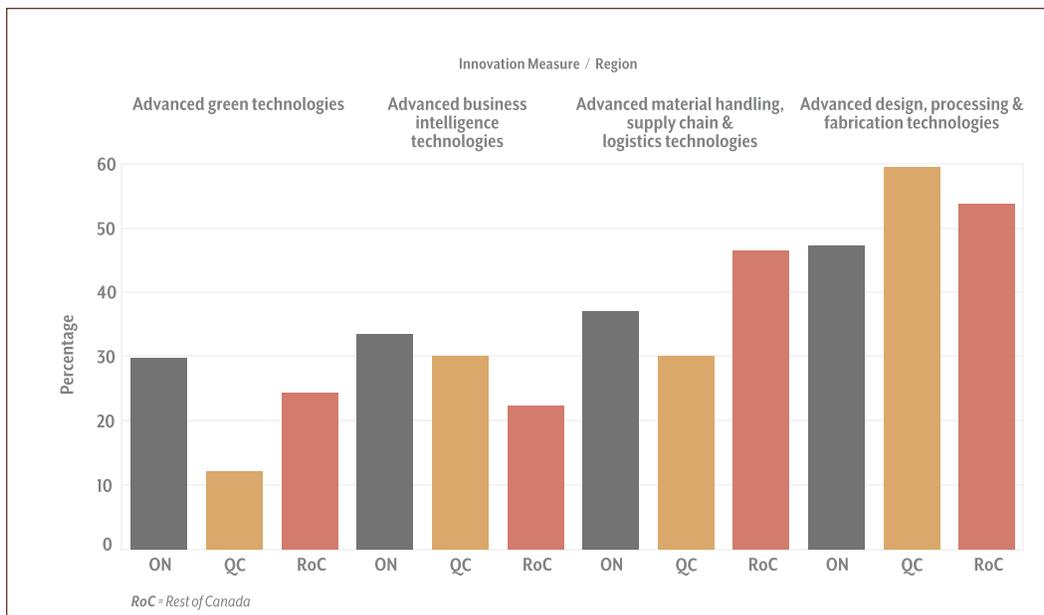
The recent downturn in global markets offers some important lessons for the Ontario mining sector - among them, **the need to go beyond natural competitive advantages and develop innovative strengths. Innovation is widely considered to be an important determinant of global competitiveness and future success.** Increasingly, mining industry leaders, governments, investors and academics are rallying behind this notion.

## 6.5.1 The Importance of Innovation and Research & Development

Mining companies have long understood the imperative to invest in new technologies, processes and management systems to increase productivity, protect the environment, eliminate fatalities and enhance health and safety. While improvement in these areas remains a critical priority, mining companies recognize that the key to uncovering accelerated gains is to integrate innovation at all levels of operations, making it part of the business culture. Companies are leveraging knowledge from other industries and exploring the benefits of battery storage, electric vehicles, digitalization, automation, smart-control technologies, ventilation on demand, 3D printing, artificial intelligence, virtual and augmented reality and other leading edge technologies that could potentially transform how mining professionals work, communicate and collaborate.

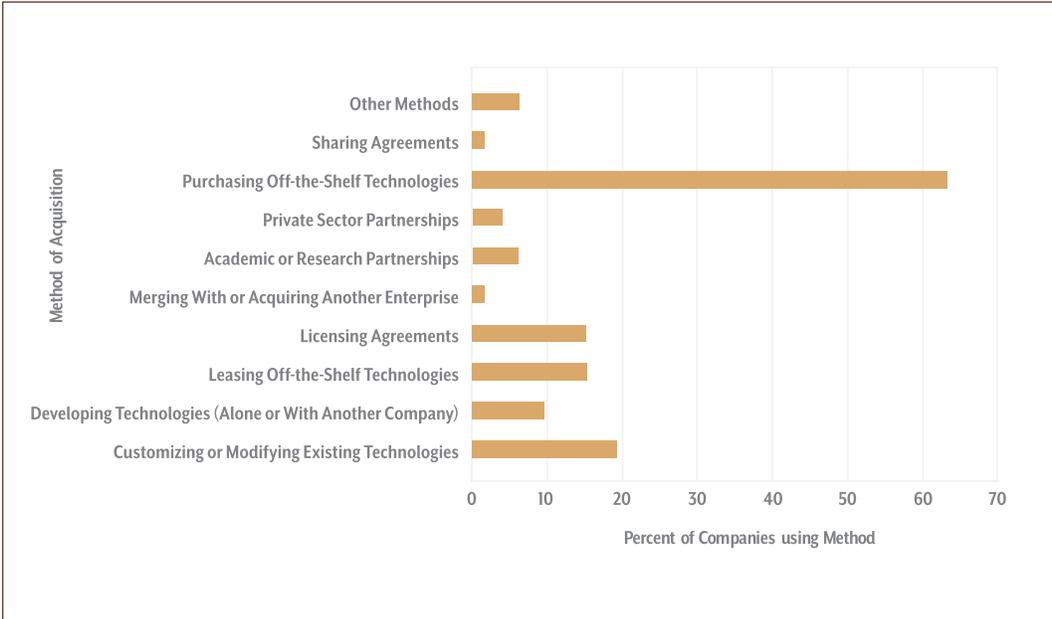
The Statistics Canada's Survey of Advanced Technology provides information on advanced technology use by industry in four areas: environment; business intelligence; material handling, supply chain and logistics; and design and information control, and processing and fabrication. Figure 68 shows the Mining and Quarrying industry's application of these four technology areas. The Ontario mining industry leads in advanced green and business intelligence technologies but lags the rest of Canada in using advanced material handling, supply chain and logistics technologies along with design and information control and advanced processing and fabrication technologies.

FIGURE 68: ADVANCED TECHNOLOGY USE BY MINING AND QUARRYING<sup>71</sup>



The mining industry in Ontario is receptive to new methods, according to the Statistics Canada survey. As shown in *Figure 69*, more than 60% of companies purchased and 25% leased off-the-shelf advanced technologies (e.g. equipment or software) in 2014. Others acquired new licenses or partnered with either their peers or with academic or research organizations to integrate new technology. More than 20% of mining companies customized or modified their existing technology.

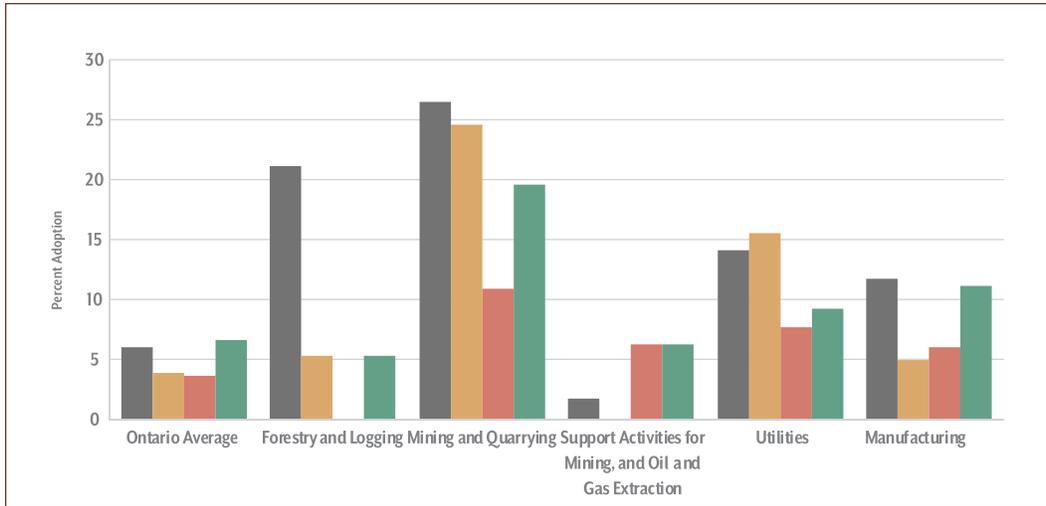
**FIGURE 69: MINING INDUSTRY ACQUISITION OR INTEGRATION OF NEW TECHNOLOGIES BY METHOD IN 2014<sup>72</sup>**



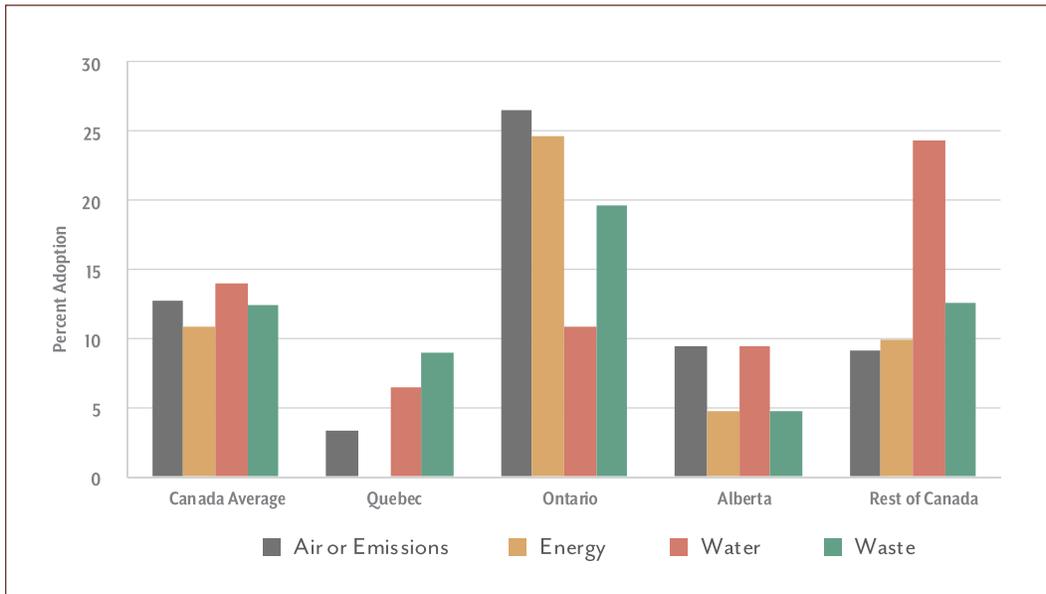
BATTERY STORAGE **ELECTRIC VEHICLES**  
**DIGITALIZATION** AUTOMATION **SMART**  
**CONTROL TECHNOLOGIES** VENTILATION  
ON DEMAND 3D PRINTING ARTIFICIAL  
**INTELLIGENCE** VIRTUAL AND  
**AUGMENTED REALITY** AND OTHER  
**LEADING EDGE TECHNOLOGIES**

As Figure 610 shows, Ontario's mining and quarrying industry has adopted advanced green technologies at rates well above Ontario's industry average. Figure 611 compares the adoption of advanced green technologies across jurisdictions and illustrates that Ontario's mining and quarrying industry adopts green technology (apart from water technologies) at higher rates than other jurisdictions.

**FIGURE 610: ADOPTION OF ADVANCED GREEN TECHNOLOGIES ACROSS INDUSTRIES - ONTARIO<sup>73</sup>**



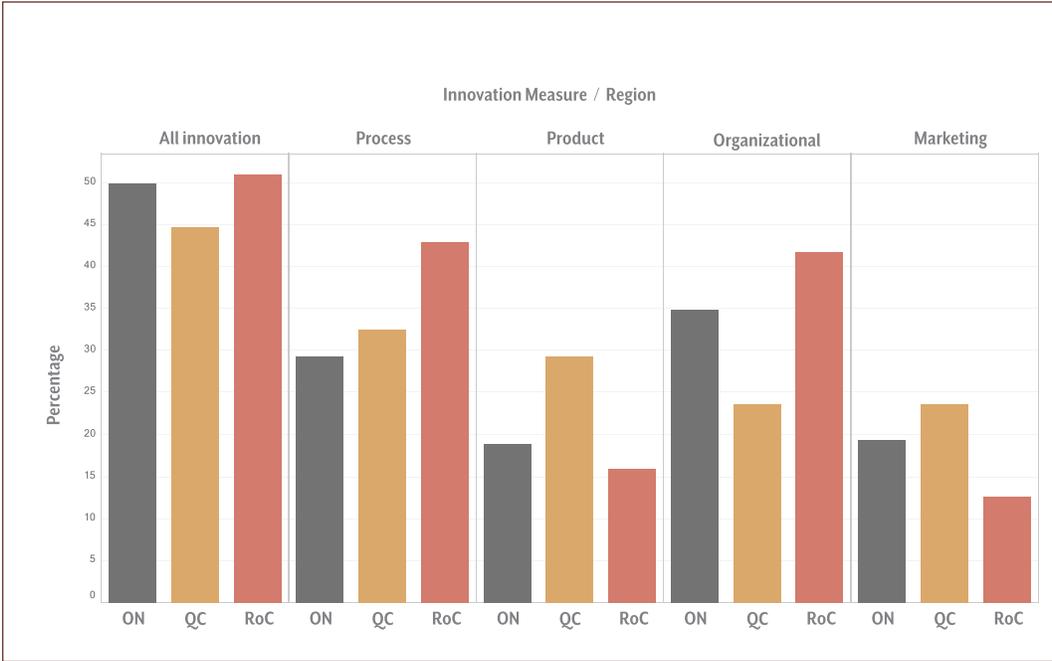
**FIGURE 611: ADOPTION OF ADVANCED GREEN TECHNOLOGIES BY MINING AND QUARRYING INDUSTRY<sup>74</sup>**



73 Statistics Canada, Survey of Advanced Technology, CANSIM 358-0405. Ontario average includes industries not shown in the chart.  
 74 Statistics Canada, Survey of Advanced Technology, CANSIM 358-0405

Another approach to innovation goes beyond technology. *Figure 612* shows the percentage of companies adopting innovation in their processes, products, organizational structure and marketing. About half of the Ontario industry is innovating in this regard, comparable to the rest of Canada and slightly ahead of counterparts in Quebec.

**FIGURE 612: INNOVATION IN MINING AND QUARRYING<sup>75</sup>**



Notwithstanding the current level of R&D investments, the mining industry cannot work in isolation. Entering alliances and pooling ideas, talent and resources will help to identify groundbreaking solutions to endemic issues. Mining innovation hubs, such as the Canada Mining Innovation Council (CMIC), the Centre for Excellence in Mining Innovation (CEMI) and the Mining Innovation Rehabilitation and Applied Research Corporation (MIRARCO), are offering opportunities for greater collaboration among industry leaders, government, academia and technology startups. These and other strategic partnerships will drive the industry forward.

Longer-term, innovation can position the Ontario mining industry as a leader on such critical issues as health and safety, environmental performance and sustainability, climate change and clean energy usage. Cleaner practices and sustainable processes adopted by mines can be replicated in other sectors, enabling industry, government and other stakeholders to jointly accelerate the pace and scope of innovation and beneficial societal outcomes.

Investment is crucial to maintaining a healthy mining industry and exploration, the key to finding new resources, has declined dramatically. From 2011 to 2015, when commodity prices were falling, exploration spending in Ontario by junior and senior companies dropped from more than \$1 billion to just under \$400 million. Though the fall was less dramatic, R&D spending also declined, while spending on capital assets, including construction, machinery and equipment, remained stagnant from 2013 to 2015.

By embracing innovation, Ontario's mining industry has the opportunity to build on its legacy of success and become more competitive. A survey of mining companies reveals that while Ontario firms are receptive to new technologies and lead Canada in the use of green and business intelligence technologies, they lag in other areas' such as material handling, design and processing. Several new collaborative initiatives are bringing together some of the best minds in industry, government and academia to solve these innovation challenges. These initiatives will help Ontario's mines move into a new age of operations that is both highly productive and beneficial to employees and the communities around them.

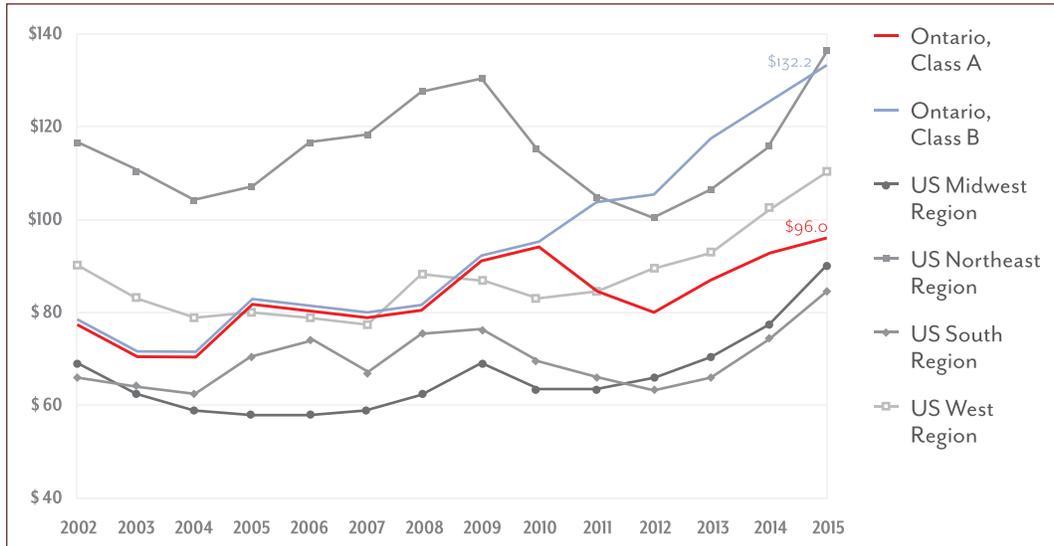
## **6.5.2** The Impact of Electricity Prices

Chapter 5 presented the energy and greenhouse gas profile of Ontario's mining sector along with efforts around conservation and demand management. The section highlights the important role energy cost - and, more particularly electricity costs - play in competitiveness. Energy makes up 11-15% of the costs of a mining operation<sup>76</sup> with processes like ventilation, grinding, and hoisting / loading / hauling being the primary drivers. At refining and smelting operations where there is value added to the ore body, energy costs as a percentage of total costs can double. In today's globalized business reality, it is common practice for companies to ship ore to locations where processing is most economical. Ultimately, high power costs reduce mine life, decrease flexibility with regard to new developments and may lead to value-added processing relocating elsewhere.

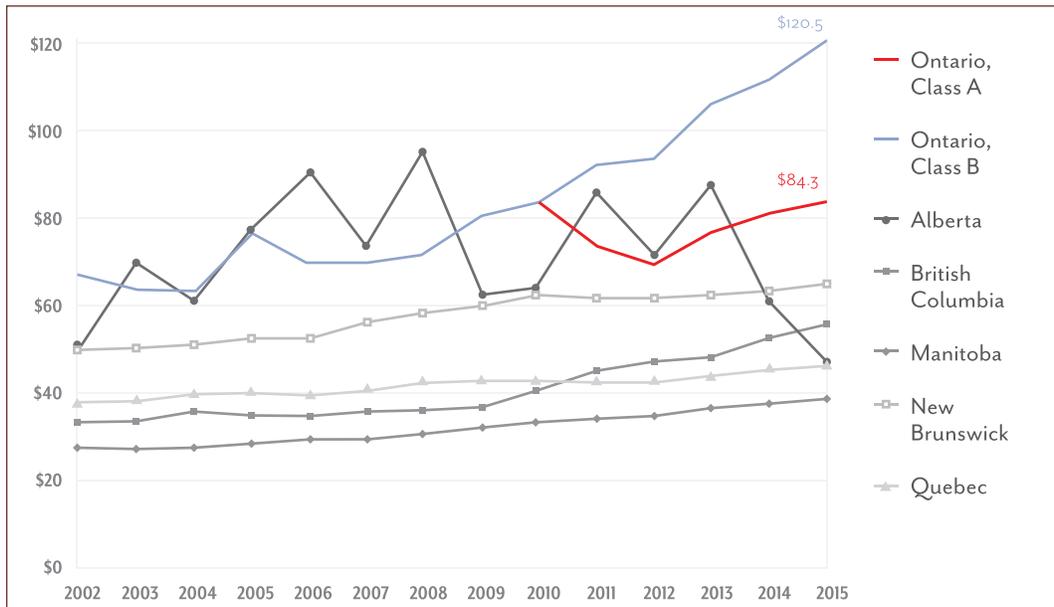
Mining operations in Ontario include both fully integrated value chain miners and smaller mining companies. In all cases, electricity rates are the key to maximizing the value of our mineral resources and attracting capital for expansions, upgrades and new mine development. With commodity prices set by global markets, miners are price takers. They cannot pass along increased operating costs like energy costs, making extraction costs per ounce or per tonne a key factor in determining site viability.

A benchmarking analysis, shown in *Figure 613* and *Figure 614*, by the Association of Major Power Consumers in Ontario compared Ontario's industrial rates with those in other Canadian provinces as well as selected US markets. The analysis shows that Ontario has the highest industrial rates in Canada and one of the highest industrial rates in North America.

**FIGURE 613: AVERAGE DISTRIBUTION CONNECTED DELIVERED PRICE OF POWER FOR INDUSTRY IN ONTARIO VS US MARKETS (NOMINAL CDN\$ / MWH)<sup>77</sup>**



**FIGURE 614: AVERAGE TRANSMISSION CONNECTED DELIVERED PRICE OF POWER FOR INDUSTRY IN CANADA (NOMINAL CDN\$ / MWH)<sup>78</sup>**

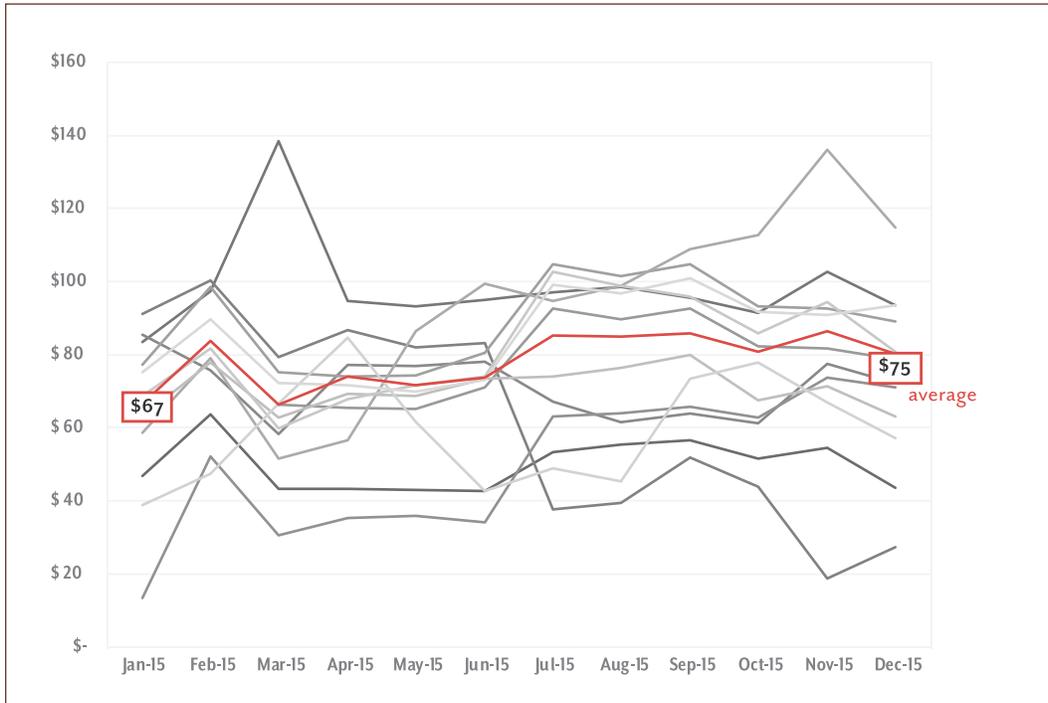


77 Association of Major Power Consumers, 2015 Benchmarking Report

78 Association of Major Power Consumers, 2015 Benchmarking Report

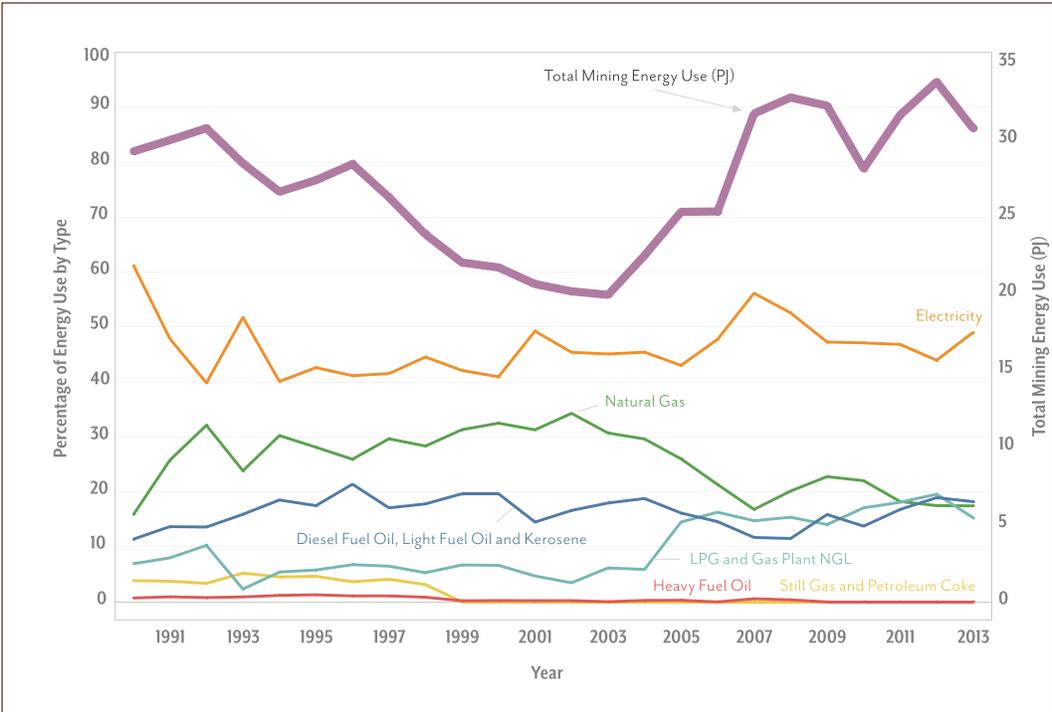
Figure 615 shows the monthly average prices at 13 Ontario mines in 2015. While prices vary considerably by mine, the average cost for electricity at \$75 / MWh is higher than the average industrial price in Northern Ontario of \$63 / MWh reported by the Ontario Energy Report<sup>79</sup>. This price includes the Northern Industrial Electricity Rebate (NIER). The NIER has been of vital importance to the mining sector since the government originally implemented the rebate in 2010.

**FIGURE 615: AVERAGE DELIVERED COST OF ELECTRICITY AT 13 ONTARIO MINES INCLUDING NIER REBATE (\$/MWh)<sup>80</sup>**



An examination of the energy use by type indicates that the use of electricity by Ontario’s metal and non-metal mining industry has declined from 61% of total energy used in 1991 to 49% in 2013, as shown in *Figure 616*. In 2013, electricity accounted for 49% of the 31 Petajoules (PJ) of energy consumed by Ontario’s metal and non-metal mining sector, followed by diesel, light fuel and kerosene at 18%, natural gas at 17%, and liquefied petroleum gas (propane) at 15%.

**FIGURE 616: PERCENTAGE OF ENERGY USE BY TYPE, METAL AND NON-METAL MINING, ONTARIO<sup>81</sup>**



Given the high proportion of operating costs that go toward energy, mining companies are increasingly turning to innovation to uncover efficiency gains to enhance shareholder value. Mining companies also understand the important link between energy use and climate change. By effectively managing energy use, companies are able to reduce GHG emissions, achieve more efficient production, decrease their draw from energy grids, and save a significant amount on direct operating costs.

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Clearly, innovation – in energy usage and in other areas – can drive more than cost reductions. It can help mining companies mitigate and manage risks, strengthen business models, attract investment and foster more effective community relations. It can help mining supply and service companies enhance their value to the industry by developing new products and services, and broaden their prospects by sharing their expertise with the world.

Longer term, innovation can put the Ontario mining industry in a leadership position on such critical issues as health and safety, environmental performance and sustainability, climate change and clean energy usage. Mining already produces the building blocks of innovation, given that minerals and metals are essential, irreplaceable components of modern technology—

81 HAL: NRCan, Comprehensive Energy Use Database.

from lifesaving medical devices to hybrid cars and advanced energy technologies. Mining can enhance its value further by becoming a sustainability leader among industries while achieving the government's objectives for carbon reductions, environmental stewardship and establishing an innovative green economy. Cleaner practices and sustainable processes adopted by mines can be replicated in other sectors, enabling industry, government and other stakeholders to jointly accelerate the pace and scope of innovation and beneficial societal outcomes.

# A. APPENDIX

## 1.1 HAL Information Sources and Methods

The study utilized secondary data, primary data from a survey of Ontario mining companies, an economic input-output model of the Canadian economy, and an industry cluster analysis model.

**Secondary data** was collected from the following sources:

Canada:

- Natural Resources Canada (NRCan), Mineral Industries Statistics <http://sead.nrcan.gc.ca/MIS/MIS.aspx>
- Natural Resources Canada (NRCan), Annual Statistics of Mineral Production <http://sead.nrcan.gc.ca/prod-prod/ann-ann-eng.aspx>
- Natural Resources Canada (NRCan), Comprehensive Energy Use Database [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive\\_tables/list.cfm](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm)
- Statistics Canada, Survey of Advanced Technology CANSIM 358-0455

Australia:

- Government of Western Australia, Department Mines & Petroleum, 2015-16 Economic Indicators Resources Data and Major Commodities Resources data <http://www.dmp.wa.gov.au/About-Us-Careers/Latest-Statistics-Release-4081.aspx>
- Australian Bureau of Statistics, Mining Operations and Mineral and Petroleum Exploration <http://www.abs.gov.au/Mining>

USA:

- U.S. Geological Survey and the Nevada Bureau of Mines and Geology, Nevada State Minerals Information <http://minerals.usgs.gov/minerals/pubs/state/nv.html>
- US Department of Commerce, Bureau of Economic Analysis, Regional Data [http://www.bea.gov/iTable/index\\_regional.cfm](http://www.bea.gov/iTable/index_regional.cfm)
- Nevada Department of Employment, Training and Rehabilitation: Research and Analysis Bureau, Nevada Labor Market Information <http://nevadaworkforce.com/>
- Nevada Mining Association <http://www.nevadamining.org/>

International:

- International Organizing Committee for the World Mining Congresses, World-Mining-Data <http://www.wmc.org.pl/?q=node/49>

Primary data consisted of a survey administered to Ontario Mining Association (OMA) members in November 2016. Responses were received from 27 out of 31 metal mines and the 5 largest out of the 9 major non-metal mines in Ontario.

The analysis of the economic impacts of the Ontario mining industry was performed using Statistics Canada input-output data. Results were calculated for direct, indirect and induced impacts at the national, regional, and local levels.

The analysis of mining clusters in Canada was performed using the Local IDEAs (Indicator Database for Economic Analysis) database at the University of Toronto.

## 1.2 Industry Scope

This analysis focused on major mining operations in Ontario – the mines shown on the map in Chapter 1, although some analysis includes small gravel and sand quarries and similar operations. These mines comprise essentially all of the metal mines and major industrial mineral operations in Ontario.

## 1.3 Economic Impact Methodology

The economic impact analysis used a regional input-output model and economic multipliers to determine the total economic contribution of Ontario’s metal mines and major industrial mineral operations. The results were calculated at the national, provincial, and census division levels for mine production in 2015.

The following results were calculated<sup>82</sup>:

- **Gross Output:** The gross output generated by the industry is the goods and services that are produced within an establishment that become available for use outside that establishment, plus any goods and services produced for own final use.
- **Gross Domestic Product:** The value added from the goods produced. This metric equals the sum of the factor incomes (wages and salaries, supplementary labour income, mixed income and other operating surplus) plus indirect taxes on production less subsidies on production and products.
- **Employment:** Results for employment are based on Full-Time Equivalents after adjustments for part-time and seasonal workers. Employment information presented here is based on the application of the multipliers derived from the economic model. That is, the direct employment values are a model result and not the sum of the employment at the establishments collected in the survey for this study.
- **Wages and Salaries:** Employment earnings consisting of monetary compensation and payments-in-kind (e.g., board and lodging). Other forms of compensation included here are commissions, bonuses, tips, directors’ fees, taxable allowances, and the values of stock options of corporations. Bonuses, commissions, and retroactive wages are recorded in the period paid rather than earned. Wages and salaries are recorded on a gross basis, before deductions for taxes, employees’ contributions to employment insurance, and private and public pension plans.
- **Taxes:** taxes include components paid to federal, provincial, and municipal levels of government:
- **Indirect Taxes on Products:** This is the sum of taxes levied on goods and services beyond the producers’ price valuation level. They are paid by business on their current purchases and by final users such as households on all their expenditures. Examples include the Goods and Services Tax (GST), the Harmonized Sales Tax (HST), provincial sales taxes, federal excise taxes, import duties, and fuel taxes.

- **Indirect Taxes on Production:** These taxes include fees and surcharges incurred during the production of the goods and services and are levied by all three levels of government. Examples of federal taxes include capital taxes levied against corporate entities and Canada Deposit Insurance Corporation premiums. Provincial taxes include (personal and commercial) motor vehicle license fees, land transfer taxes, and capital taxes. Local taxes include real property taxes, developers' lot levies and deed transfer taxes.
- **Personal Income Tax:** federal and provincial income taxes paid by industry workers. Income taxes are dependent on an individual's family situation; the estimates calculated are sensitive to employment income and size of community.
- **Residential Property Tax:** residential property taxes paid by industry workers. Residential property taxes are based on one's place of residence instead of one's income and are therefore calculated separately by census division.
- **Subsidies:** Government subsidies are considered here as 'negative' taxes. Subsidies are government expenditures and thus are considered negative revenue from the perspective of government accounts.

The economic impact analysis traces flows of money from mine revenues, first to other businesses supplying goods and services to mining operations, and finally to households earning income by working in mining operations and governments through various taxes and charges on mines, businesses and households:

- **Direct Effects** are associated with revenues of mining companies.
- **Indirect Effects** result from supporting industries supplying goods and services to mining companies – for example, the provision of drilling services to a mine.
- **Induced Effects** result from household spending of the income earned in mining. Employees at mining companies spend the income they earn on housing, utilities, groceries, and other consumer goods and services. This generates sales, income and employment throughout the economy.

A chain reaction of indirect and induced spending continues, with subsequent rounds of additional spending gradually diminished through savings, taxes, and expenditures made outside the country. This economic ripple effect is measured by an economic model, which uses a series of 'multipliers' to provide estimates of the number of times each dollar of direct spending cycles through the economy in terms of indirect and induced output. By means of indirect and induced effects, changes in mining revenue can impact virtually every sector of the economy in one way or another.

Indirect and induced effects are sometimes collectively called secondary effects. The total economic impact of the mining industry is the sum of direct, indirect, and induced effects within a region. Any of these impacts may be measured as gross output, value added (gross domestic product), employment, wages and salaries, or tax revenue.

## 1.4 Cluster Analysis Methodology

The methodology used for the cluster analysis is based on geographic patterns co-location of employment in specific industries (4-digit NAICS codes) in Census Metropolitan Areas and Census Agglomerations (CAs) in Canada. Each individual case must meet three criteria to be considered a specialized cluster:

**Scale:** Defined as the sum of local employment, which must be greater than 1,000;

**Specialization:** the percent share of local employment in the defined industries, which must be greater than the percent share of these industries (location quotient > 1);

**Scope:** the location quotient at least half of the component industries must be greater than 1.

Using those criteria, a total of 12 clusters specializing in mining and quarrying were identified in Ontario, Quebec, and BC. These clusters specialize specifically in the coal mining industry (code 2121), metal ore mining (code 2122), and non-metallic mining and quarrying (code 2123). Data on the support activities for mining and gas (code 2131) were also included in this analysis.

The NAICS definitions of these industries are:

**Code 21 Mining and Quarrying Industry (except oil and gas):** This comprises establishments primarily engaged in mining, beneficiating or otherwise preparing metallic and non-metallic minerals, including coal.<sup>83</sup>

**Coal mining (NAICS code 2121)** - Establishments primarily engaged in mining bituminous and lignite coal by underground mining, and auger mining, strip mining, culm bank mining, and other surface mining. This includes mining operations and preparation plants (i.e., “cleaning plants”).

**Metal ore mining (NAICS code 2122)** - Establishments primarily engaged in mining metallic minerals (ores), include ore dressing and beneficiating operations, whether performed at mills operated in conjunction with mines, or custom mills operated separately. Mills include operations that crush, grind, wash dry, sinter, leach ore, or perform gravity separation or flotation operations.

**Non-metallic mining and quarrying (NAICS code 2123)** - Establishments primarily engaged in mining or quarrying non-metallic minerals, except coal. This includes preparation plants that crush, grind, and wash.

**Support activities for mining and gas (NAICS code 2131)** - Establishments primarily engaged in providing support services for mining and quarrying of minerals and for the extraction of oil and gas. This also includes establishments engaged in the exploration for minerals and traditional prospecting methods (e.g., taking samples, geological assessments of prospective sites).<sup>84</sup>

The data presented in Table B-1 below then also provides the total employment for all 4 digit NAICS code in the mining cluster for each CMA.

Data for each of these 12 clusters were examined using the following variables:

**Number of persons employed in industry in 2006** – The number of persons employed in the industries coal mining (code 2121), metal ore mining (code 2122), non-metallic mining and quarrying (code 2123), support activities for mining and gas (code 2131) in 2006.

**Number of persons employed in industry in 2011** – The number of persons employed in the industries coal mining (code 2121), metal ore mining (code 2122), non-metallic mining and quarrying (code 2123), support activities for mining and gas (code 2131) in 2006.

83 (Source: NAICS website <http://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=118464&CVD=118465&CPV=21&CST=01012012&CLV=1&MLV=5>).

84 The Statistics Canada data for this 4 digit category combines support activities for both mining and oil and gas. It is possible to disaggregate the support activities at the 6 digit level, but this would require a special run of the Statcan data and would likely result in the suppression of some of the data for confidentiality reasons. For these reasons we have used the 4 digit level TNAICS codes for this analysis.

**Change in number of persons employed in industry between 2006 and 2011** – The change in the absolute number of persons employed in the coal mining (code 2121), metal ore mining (code 2122), non-metallic mining and quarrying (code 2123), support activities for mining and gas (code 2131) industries between 2006 and 2011.

**Establishment Count 2011** – Establishment Count is defined by Canadian Business Patterns (CBP) is the number of establishments created in the coal mining (code 2121), metal ore mining (code 2122), non-metallic mining and quarrying (code 2123), support activities for mining and gas (code 2131) industries and which are recorded on the Business Register.

**LQ** – The measure of a region’s industrial specialization in the coal mining (code 2121), metal ore mining (code 2122), non-metallic mining and quarrying (code 2123), support activities for mining and gas (code 2131) industries.

**Average Income in Industry 2011** – The average income of persons employed in the coal mining (code 2121), metal ore mining (code 2122), non-metallic mining and quarrying (code 2123), support activities for mining and gas (code 2131) industries.

TABLE B-1: DATA ON MINING CLUSTERS IN CANADA

Name	Industry Code Definition	Number of Persons Employed in Industry 2006	Number of Persons Employed in Industry 2011	Change in Number of Persons Employed in Industry Between 2006-2011	Establishment Count 2011	LQ	Average Income in Industry 2011
Quebec							
Saguenay	Coal mining	0	0	0	0		0
Saguenay	Metal ore mining	330	455	125	1		84,631
Saguenay	Non-metallic mining and quarrying	35	145	110	5		87,115
Saguenay	Support activities for mining and oil & gas	50	85	35	9		64,215
Saguenay	Total (or average) for mining and quarrying industries	415	685	270	15	1.87	78,657
Sept-Iles	Coal mining	0	0	0	0		0
Sept-Iles	Metal ore mining	650	805	155	1		*
Sept-Iles	Non-metallic mining and quarrying	25	55	10	6		*
Sept-Iles	Support activities for mining and oil & gas	30	50	20	4		*

Name	Industry Code Definition	Number of Persons Employed in Industry 2006	Number of Persons Employed in Industry 2011	Change in Number of Persons Employed in Industry Between 2006-2011	Establishment Count 2011	LQ	Average Income in Industry 2011
Sept-Îles	Total (or average) for mining and quarrying industries	705	910	185	11	15.25	*
Trois-Rivières	Coal mining	0	0	0	0		0
Trois-Rivières	Metal ore mining	10	35	25	0		*
Trois-Rivières	Non-metallic mining and quarrying	20	0	30	6		*
Trois-Rivières	Support activities for mining and oil & gas	35	35	0	2		*
Trois-Rivières	Total (or average) for mining and quarrying industries	65	70	55	8	0.28	0
Val-d'Or	Coal mining	0	0	0	0		0
Val-d'Or	Metal ore mining	970	1170	200	5		91,229
Val-d'Or	Non-metallic mining and quarrying	25	35	10	1		87,585
Val-d'Or	Support activities for mining and oil & gas	455	975	520	50		79,608
Val-d'Or	Total (or average) for mining and quarrying industries	1450	2180	730	56	17.81	86,140
Rouyn-Noranda	Coal mining	0	0	0	0		0
Rouyn-Noranda	Metal ore mining	1055	1325	270	4		83,295
Rouyn-Noranda	Non-metallic mining and quarrying	55	60	15	0		78,475
Rouyn-Noranda	Support activities for mining and oil & gas	550	845	295	33		74,187
Rouyn-Noranda	Total (or average) for mining and quarrying industries	1660	2230	580	37	16.01	78,652

Name	Industry Code Definition	Number of Persons Employed in Industry 2006	Number of Persons Employed in Industry 2011	Change in Number of Persons Employed in Industry Between 2006-2011	Establishment Count 2011	LQ	Average Income in Industry 2011
Ontario							
North Bay	Coal mining	0	0	0	0		0
North Bay	Metal ore mining	0	25	25	0		94,421
North Bay	Non-metallic mining and quarrying	40	55	15	2		34,553
North Bay	Support activities for mining and oil & gas	275	545	270	12		103,884
North Bay	Total (or average) for mining and quarrying industries	315	625	310	14	0.63	77,619
Greater Sudbury	Coal mining	0	110	110	0		66,223
Greater Sudbury	Metal ore mining	4440	5110	670	7		87,963
Greater Sudbury	Non-metallic mining and quarrying	310	290	20	4		80,433
Greater Sudbury	Support activities for mining and oil & gas	775	1345	570	48		80,433
Greater Sudbury	Total (or average) for mining and quarrying industries	5525	6855	1370	59	16.79	78,763
Timmins	Coal mining	40	20	20	0		0
Timmins	Metal ore mining	1490	1935	445	3		92,137
Timmins	Non-metallic mining and quarrying	110	290	180	5		101,342
Timmins	Support activities for mining and oil & gas	620	855	235	35		80,843
Timmins	Total (or average) for mining and quarrying industries	2260	3100	880	43	25.70	91,440
Thunder Bay	Coal mining	0	0	0	0		0

Name	Industry Code Definition	Number of Persons Employed in Industry 2006	Number of Persons Employed in Industry 2011	Change in Number of Persons Employed in Industry Between 2006-2011	Establishment Count 2011	LQ	Average Income in Industry 2011
Thunder Bay	Metal ore mining	230	355	125	3		89,377
Thunder Bay	Non-metallic mining and quarrying	35	150	115	4		50,002
Thunder Bay	Support activities for mining and oil & gas	140	250	110	27		73,485
Thunder Bay	Total (or average) for mining and quarrying industries	405	755	350	34	2.08	70,954
<b>British Columbia</b>							
Kamloops	Coal mining	15	35	20	0		60,075
Kamloops	Metal ore mining	910	1430	520	2		87,359
Kamloops	Non-metallic mining and quarrying	30	30	0	3		83,286
Kamloops	Support activities for mining and oil & gas	275	260	-15	27		117,286
Kamloops	Total (or average) for mining and quarrying industries	1230	1755	525	32	7.27	87,000
Prince George	Coal mining	0	35	35	0		67,389
Prince George	Metal ore mining	80	115	35	0		93,366
Prince George	Non-metallic mining and quarrying	25	0	-25	2		73,989
Prince George	Support activities for mining and oil & gas	190	215	25	21		61,212
Prince George	Total (or average) for mining and quarrying industries	295	365	70	23	0.87	73,989
Fort St. John	Coal mining	0	25	25	0		34,991

Name	Industry Code Definition	Number of Persons Employed in Industry 2006	Number of Persons Employed in Industry 2011	Change in Number of Persons Employed in Industry Between 2006-2011	Establishment Count 2011	LQ	Average Income in Industry 2011
Fort St. John	Metal ore mining	0	0	0	0		0
Fort St. John	Non-metallic mining and quarrying	0	10	10	4		0
Fort St. John	Support activities for mining and oil & gas	1660	1380	-720	251		80,717
Fort St. John	Total (or average) for mining and quarrying industries	1660	1415	-685	255	0.65	57,854
* Data not available at the 4-digit NAICS code level							

*The cover of this Report contains photographic samples of the following Ontario mined materials (from top to bottom): (1) high purity quartz, (2) nickel, (3) purple fluorite, white albite and pyrite in a quartz vein, (4) pegmatite drilled as a target for silica, (5) gold, (6) graphite.*

*Image page 4: Goldcorp.*

*Image page 13: Nickel Rim, Sudbury, [www.miningindustrialphotographer.com](http://www.miningindustrialphotographer.com).*

*Image page 23: Karel Creek, Detour Gold.*

*Image page 31: Control Room, Vale, Sudbury.*

