CANADIAN MINING LABOUR MARKET OUTLOOK 2019

MINING INDUSTRY
HUMAN RESOURCES COUNCIL

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CONSEIL DES RESSOURCES HUMAINES
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This project is funded in part by the Government of Canada.

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INTRODUCTION

The Mining Industry Human Resources Council (MiHR) conducts research into Canada's mining labour market, with the objective of uncovering the important human resources trends that are relevant to Canada's mining industry. Each year, MiHR produces the Canadian Mining Labour Market Outlook*, a national report that provides analyses and forecasts pertaining to the mining labour market in Canada.*

The 2019 edition of the *Canadian Mining Labour Market Outlook* builds on this foundation. The objectives of this report are as follows:

Provide a brief economic update on the mining industry in Canada, including the latest trends and a 10-year forecast.

Provide a profile of the mining labour force, using the most recent (2016) census data, to identify changes and potential trends in labour market supply.

Investigate three topics of special interest to the mining industry. MiHR has chosen to spotlight (1) the potential impact of automation on the mining workforce, (2) the emergence of STEM skills in the mining industry (referring to Science, Technology, Engineering, and Math), and (3) post-secondary enrolment in mining engineering programs.

Overall, this report offers an update to familiar analysis found in MiHR's previous outlook reports on the Canadian mining labour market in addition to new discussions on relevant topics that were previously unexplored.

REPORT OVERVIEW

Section 1 of this report sets the stage for the analysis. It clarifies MiHR's definition of the mining industry in Canada and indicates the key data sources that were used to provide information on sub-sectors within the industry. Section 2 provides an economic outlook for Canada's mining industry, using key indicators including commodity prices, gross domestic product (GDP), employment and unemployment, and investment. Section 3 provides a profile of the mining industry's labour force; with distribution by economic region, age, education, and cultural identity (Indigenous people, immigrants and visible minorities), and a closer look at the representation of women in mining. Section 4 provides an update to MiHR's forecast for hiring requirements and available talent, covering the years 2019 to 2029. Section 5 focuses on three topics of particular interest to the mining industry in Canada: the potential impact of automation on the mining workforce; the emergence of STEM skills in the mining industry; and post-secondary enrolment in mining engineering programs.

EXECUTIVE SUMMARY

Cautious Economic Recovery and Growth

The economic outlook for the mining industry in Canada appears to be improving after a period of significant slowdown. Recent trends, across a range of indicators (in concert), present a picture of an industry in recovery.

- In recent years, a sustained cool-down in prices for most commodities resulted in a slowdown for the mining industry. Since 2016, however, most commodities have shown signs of recovery and growth.
- Support services is usually the first mining sub-sector to be impacted by a recession — and the last to recover. This sub-sector experienced heavy losses in GDP from 2012 to 2016, but levelled out in 2017, signaling a possible recovery for Canada's mining industry.
- Unemployment rates in *mining, quarrying, and oil and gas extraction* (NAICS 21) returned to historically lower levels in 2017, and are lower than the rate for all industries. Vacant job positions grew substantially in certain sub-sectors (e.g. *extraction & milling* and *support services*), suggesting that mining operations were expanding heading into 2018.

Women Continue to be Underrepresented in Mining

According to 2016 census data, women make up 48% of the Canadian labour force, but they account for only 16% of the mining labour force (similar to 2011 census data). Although the share of women has increased in recent years in several mining related occupations, the mining industry has yet to realize comparable gains.

The low representation of women in mining is both an occupational and industry-level issue. In general, occupations that are mining-specific demonstrate the lowest representation of women. Yet, even in occupations in which the mining industry outpaces other industries (e.g. construction managers), the overall share of women remains low.

In 2016, the share of women in selected occupations in science, technology, engineering and math (STEM) was almost 21% across all industries, compared to 16% in the mining industry. For non-STEM occupations, the gap is even wider (34% vs. 11%).

10-Year Labour Market Forecast: Increases in Retirements and Modest Employment Growth

The industry is expected to need to hire roughly 97,450 workers over the next 10 years (2019 to 2029). Industry retirements are expected to increase, while employment growth is anticipated to experience a modest increase over the next decade (about 5% under a baseline scenario). Retirements are expected to account for most of the exits. The three broad occupational categories particularly affected by retirements will be: (1) supervisors, coordinators, and foremen; (2) support workers; and (3) trades occupations. Production occupations are expected to have the largest hiring requirement, with almost one-quarter of the total hiring requirement in the industry.

In 2029, the majority of mining employment is expected to be in the *extraction & milling* sub-sector (49%), followed by *primary metal manufacturing* (24%), *support services* (14%), and *exploration* (13%). The largest segment of the employment growth is expected to come from *support services* (33%) and *extraction & milling* (29%).

Impact of New Technologies on the Mining Workforce

Today's mining accesses deeper, narrower, and more complex deposits — these activities necessitate the use of new, more sophisticated and innovative technologies at all stages of the mining cycle. Over the last decade, the industry's investment in capital stock greatly outpaced employment growth, indicating a shift in the production mix and a trend of capital intensification in mineral extraction.

There is a need for research on the impact of new technologies on the mining industry's operations and labour force, now and in the future. What new skills will mining workers require in the future? Which tasks will be automatable, eliminated and/or created? To address these and other critical gaps in information, MiHR is embarking on a two-year study, "The Changing Nature of Work in Mining: Impact on the Canadian Mining Labour Force."

Increased Demand for Mining Workers with STEM Skills

Increased adoption of new technology in the mining industry has increased the demand for mining workers with specialized STEM skills. The share of STEM-related occupations in mining increased from 14% in 2001 to 20% in 2011, hovering at 18% in 2016. Engineers are the most sought-after category of STEM worker as over half of all STEM-related workers in the mining industry are in the engineering disciplines.

The proportion of STEM workers in the mining industry is highest in *exploration* (39%), followed by *extraction & milling* (15%), *primary metal manufacturing* (14%), and *support services* (14%). The high share of STEM occupations in the *exploration* sub-sector reflects the importance of scientific and technical skills required in the mine discovery phase. The relative share of STEM skills decreases as the mine goes into production and non-STEM occupations become more prominent.

Need For Higher Enrolment in Post-Secondary Mining Engineering Programs in Canada

MiHR's projected gap analysis for professional and Physical Sciences Occupations and technical occupations indicates the mining industry will likely face major hiring challenges for engineering-related occupations if current trends continue. High enrolment in engineering programs, particularly in mining/mineral engineering programs, is critical to ensuring there is a reliable source of engineering graduates entering the industry.

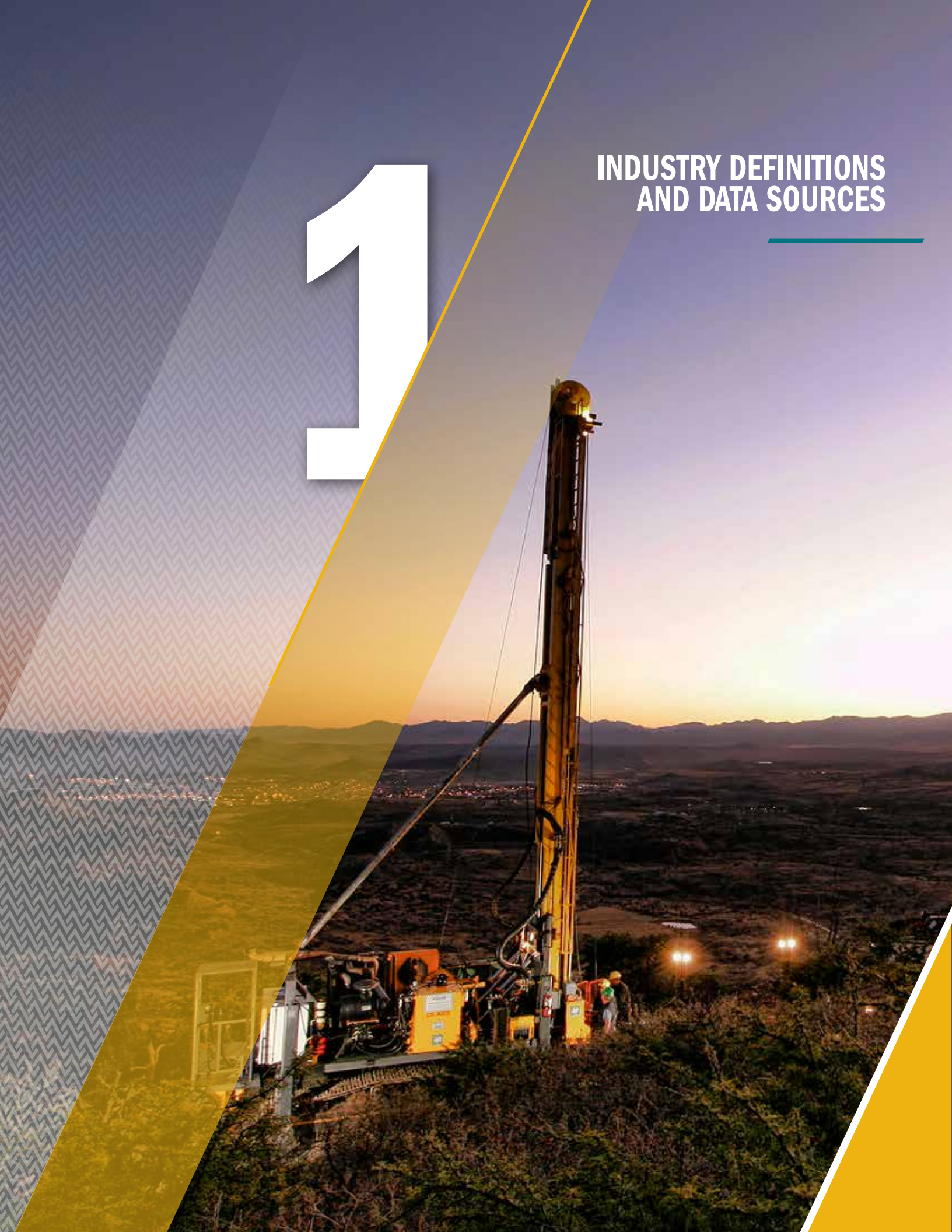
Undergraduate enrolment in accredited engineering programs in Canada more than doubled over a 20-year period, from 40,700 in 1996 to roughly 84,450 in 2016. Mechanical, civil and electrical engineering are consistently the most popular programs; over half of all engineering students enrolled in one of these three disciplines.

Enrolment rates are much lower in mining/mineral (1.5%), materials/metallurgical (1.1%), and geological (0.9%) engineering programs. Between 2015 and 2016, enrolment in undergraduate mining engineering programs dropped by 12%, the largest enrolment decline of all engineering programs.

THE ECONOMIC OUTLOOK FOR THE MINING INDUSTRY IN CANADA APPEARS TO BE IMPROVING AFTER A PERIOD OF SIGNIFICANT SLOWDOWN. RECENT TRENDS, ACROSS A RANGE OF INDICATORS (IN CONCERT), PRESENT A PICTURE OF AN INDUSTRY IN RECOVERY.

1

INDUSTRY DEFINITIONS AND DATA SOURCES



DEFINITIONS

MiHR defines the mining industry as inclusive of activities that fall within the following four sub-sectors:

- **Exploration:**

  Encompasses activities focused on the discovery of minerals and other commodities in the earth;

- **Extraction & Milling:**

  Describes the activities at operating mines across Canada, including both surface and underground mining operations; includes on-site processing activities;

- **Support Services:**

  Includes the activities of organizations providing *support services* for a wide range of mining activities, usually on a contract or fee basis;[1] and

- **Primary Metal Manufacturing:**

  Consists of activities that are directly downstream from *extraction & milling*, including smelting and refining of ferrous and non-ferrous metals.

Wherever possible, MiHR uses data and information that adhere to MIHR's definition of the mining industry. This includes sector-level data based on the North American Industry Classification System (NAICS), and occupational data according to the National Occupational Classification (NOC) system. These two standardized frameworks are summarized ahead.

North American Industry Classification System (NAICS)

MiHR has aligned its definition of the industry to a set of NAICS codes (see Appendix A for a detailed description). The NAICS assigns a code number that describes economic and business activity at the industry level. Under NAICS, assignment to a specific industry is based on primary activity, enabling the grouping together of establishments with similar activities. A code with more digits denotes a higher level of specificity. In certain instances, however, data based on 3- and 4-digit NAICS codes may be limited or unavailable. In such cases, MiHR uses the next best option; for example, the broader, 2-digit level *NAICS 21 – Mining, quarrying, and oil and gas extraction* is often used to describe mining-related trends in Canada.

In particular, the oil and gas extraction sector challenges MiHR's industry definition. Currently, MiHR considers *non-conventional oil extraction* (NAICS 211114) to account for oil sands mining activities. This NAICS code likely includes other activities that are not relevant to mining (e.g. offshore drilling and shale oil production).[2] As a result, all the analyses (except forecasting) in this report exclude *non-conventional oil extraction*. MiHR's labour market forecasting includes *non-conventional oil extraction* in order to provide a comprehensive labour market forecast and remain consistent with forecasting found in MiHR's previous national outlook reports.

1 *Support services* are those required for mine construction, extraction, processing and exploration activities.

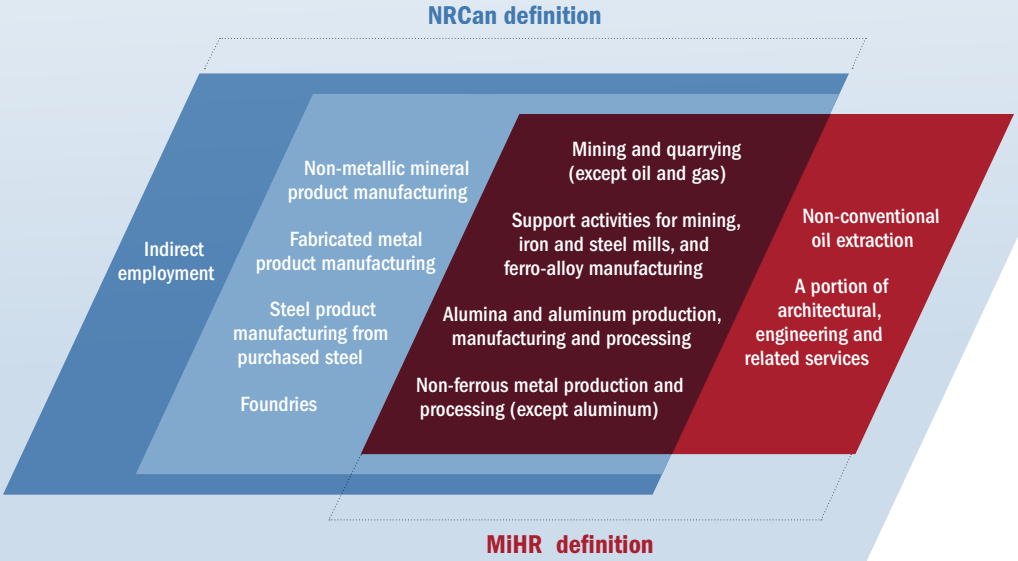
2 Note: *NAICS 211142* was introduced under Statistics Canada's 2017 NAICS realignment to capture oil sands mining activities. MiHR plans to align its definition of oil sands mining to this NAICS code once data are made available.

HOW MIHR'S INDUSTRY DEFINITION IS DIFFERENT

MiHR's definition of the mining industry does not perfectly align with definitions used by Natural Resources Canada (NRCan), the Mining Association of Canada (MAC), and other organizations that produce labour market and employment information related to mining. In contrast to NRCan, MiHR excludes certain aspects of downstream manufacturing and indirect employment from its definition (Figure 1). Consequently, MiHR's employment estimates tend to be lower, closer to about 200,000 workers, compared to NRCan's estimate of roughly 400,000 workers (including direct and indirect employment).

FIGURE 1

Comparison of MiHR and NRCan definitions of the mining industry



Source: *Mining Industry Human Resources Council, 2018*

National Occupational Classification (NOC) System

Occupational analysis in this report follows the National Occupation Classification (NOC) system to report on labour market activity. The NOC is a standardized framework for categorizing occupations. Statistics Canada uses the NOC code system to provide information on labour market and employment outcomes across industries and sub-sectors. Occupations are each assigned a NOC code consisting of 1 to 4 digits, and a corresponding occupational title.[3]

From the NOC system, MiHR has identified (and tracks) 70 "selected occupations" which MiHR considers the most relevant to the mining industry (see Appendix A). These range from occupations involved in production and operations (e.g. heavy equipment operators) to those in professional and Physical Sciencess (e.g. geologists), among others. Data can be limited or unavailable for certain 4-digit NOC codes (as with the NAICS system). In such cases, MiHR relies on data for broader NOC codes, which represent more inclusive occupational data.

Each digit in a NOC code conveys specific information. For example, the first digit denotes a broad level of occupational skill type whereas the second digit indicates a category of skill level. Further digits (third and fourth) designate a more specific occupation within the NOC hierarchy. In this report, MiHR presents information aligned to skill level categories defined within the NOC code system,[4] but utilizes its own broad occupational categories to better reflect the mining industry. These broad occupational and skill level categories are listed as follows:

3 For more information on NOC codes, see the Government of Canada website at http://noc.esdc.gc.ca/English/NOC/Matrix2016.aspx?ver=16

4 For Statistics Canada's classification structure for the NOC skill levels, see: http://www23.statcan.gc.ca/imdb/SBV_p3VD.pl?Function=getVD&TVD=136582

Broad Occupational Category

- Trades Occupations
- Production Occupations
- Supervisors, Coordinators and Foremen
- Support Workers
- Professional and Physical Sciences Occupations
- Techical Occupations
- Human Resources and Financial Occupations

Skill Level Category

- Skill level A (Management):
  Occupations usually require university education.
- Skill level A (Professionals):
  Occupations usually require university education.
- Skill level B:
  Occupations usually require college education or apprenticeship training.
- Skill level C:
  Occupations usually require secondary school and/or occupation-specific training.
- Skill level D:
  On-the-job training is usually provided for occupations.

KEY DATA SOURCES

This report uses data from a variety of public and private sources, to provide key information on variables of interest including demographic characteristics (e.g. age, education, diversity) and economic and behavioural factors (e.g. commodity prices, gross domestic product, employment). Data sources that were central to this analysis (shown in Appendix B) include the following:

Census (Statistics Canada):[5]

The census provides a wide range of information on Canada's population, including topics related to labour market activities. While it is a relatively more detailed source of data, the census is produced once every five years. The most recent census was produced in 2016. MiHR requested customized data from Statistics Canada (for 2006, 2011 and 2016) in order to deliver analyses aligned to MiHR's definition of Canada's mining industry.

Labour Force Survey (LFS) (Statistics Canada):

The LFS covers topics related to labour market activities in Canada for the population 15 years of age and over (e.g. employment, unemployment, labour force participation). This survey is conducted monthly and therefore provides the timeliest data (that are also publically available). MiHR often uses this data to provide information on labour force trends in a particular region (e.g. unemployment and part-time employment), but the data are often at a broader 2-digit NAICS rather than MiHR's preferred 3-digit level (e.g. NAICS 21 instead of NAICS 212).

System of National Accounts (SNA) (Statistics Canada):

MiHR uses available up-to-date employment data from the SNA for labour statistics, to further enhance MiHR's understanding of labour market outcomes. The SNA combines employment data from various surveys such as the LFS, the Survey of Employment Payrolls and Hours (SEPH) and the Census/National Household Survey (NHS).

Commodities Price Forecasts (World Bank):

MiHR routinely updates the historical and forecasted mineral prices as a key input in its demand forecasting model. The World Bank is among the leaders in price forecasting and analysis, and updates its outlook for several mined commodities on a quarterly basis.

Other Data Sources:

MiHR uses a variety of other data sources throughout this analysis and where appropriate, notably the Conference Board of Canada (CBOC) and Statistics Canada's Job Vacancy and Wage Survey (JVWS).

5 The 2016 census marked the reinstatement of the mandatory long-form census, which had been temporarily dropped in favour of the voluntary National Household Survey for the 2011 census.

2

ECONOMIC OUTLOOK

The mining industry is a strong contributor to economic activity and employment opportunities across Canada. Yet, mining is characteristically volatile and cyclical. A significant surge in mining development occurred during the early 2010s, followed by a prolonged downturn lasting beyond the middle of the decade.

The economic outlook of the mining industry in Canada appears to be improving, based on recent trends across a range of indicators. Presented here are the most recent data on commodity prices, GDP, employment and unemployment, and investment. In concert, they present a picture of an industry in recovery.

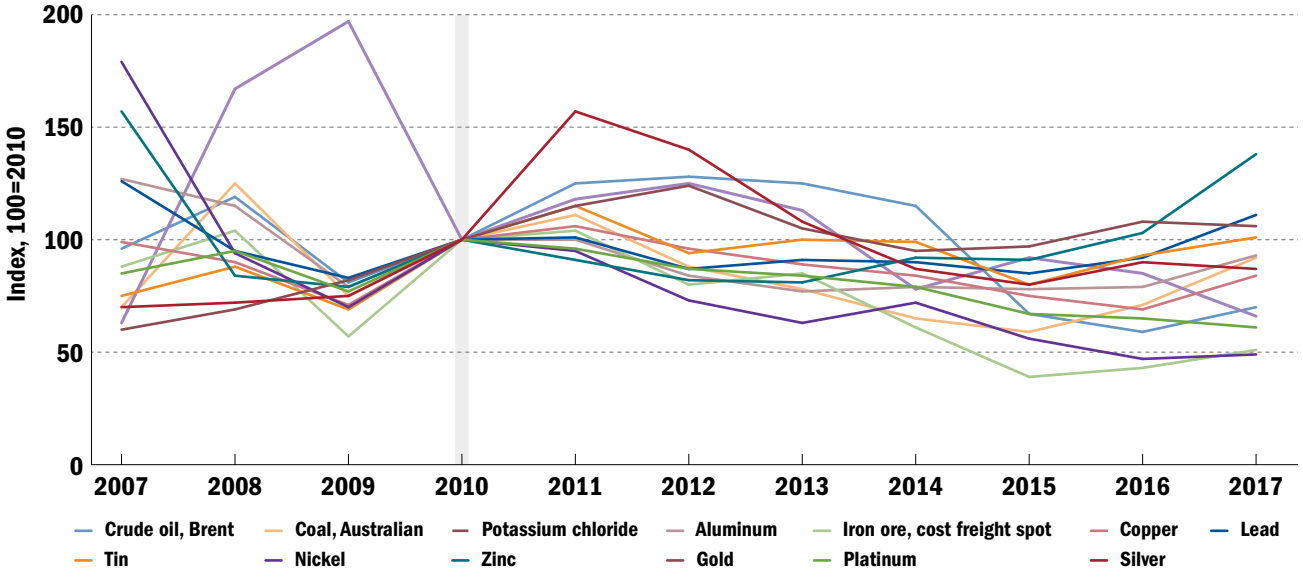
COMMODITY PRICES: REBOUND IN 2017

Cyclical movement in the industry is best exemplified through commodity prices: price increases spur investment in mine development, higher production levels and increased labour demand. When prices decrease, however, employers curtail their investment in new mine development and production, and, in turn, labour demand.

In recent years, commodity prices have experienced wider fluctuations. Following the 2008–2009 recession, the mining industry in Canada entered a boom cycle that lasted until about 2012. What followed was an unprecedented cool-down in prices for most commodities, especially evident in 2015 and 2016, resulting in a slowdown for the Canadian mining industry. However, since 2016 there have been signs of recovery and growth for most commodities in the industry (Figure 2).

FIGURE 2

Growth indices of real prices by commodity (2007–2017)



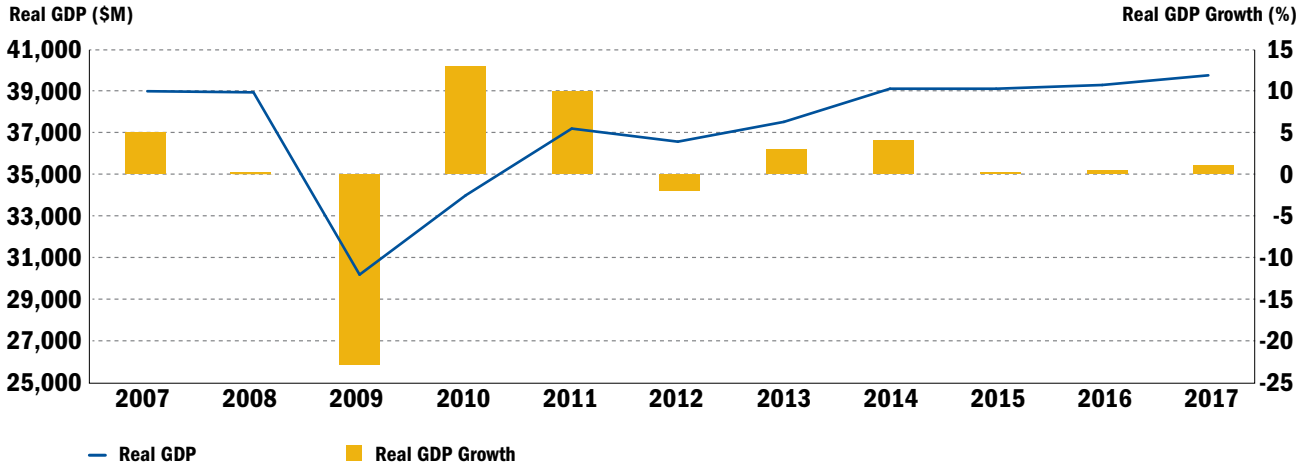
Sources: *Mining Industry Human Resources Council, World Bank (Commodities Price Data), 2018*

GDP: GROWTH IN 2017 AFTER A MAJOR SLOWDOWN

Gross Domestic Product (GDP) measures the value of goods or services produced over a given period of time. As MiHR's 2015 national outlook report noted, real GDP in Canada's mining industry has grown in each of the last three decades (notwithstanding the major drop stemming from the global recession in 2009). Positive real GDP growth in the mining industry in 2010 and 2011 (about 13% and 10% respectively) was relatively large, followed by modest growth in 2013 and 2014 (about 3% and 4% respectively), and a slowdown with negligible GDP growth in 2015. Despite these fluctuations, the industry posted positive growth in 2017 (about 1%) – an early indication of a rebound from 2015 (Figure 3).

FIGURE 3

Mining industry real GDP growth (excluding exploration*) (2007–2017)



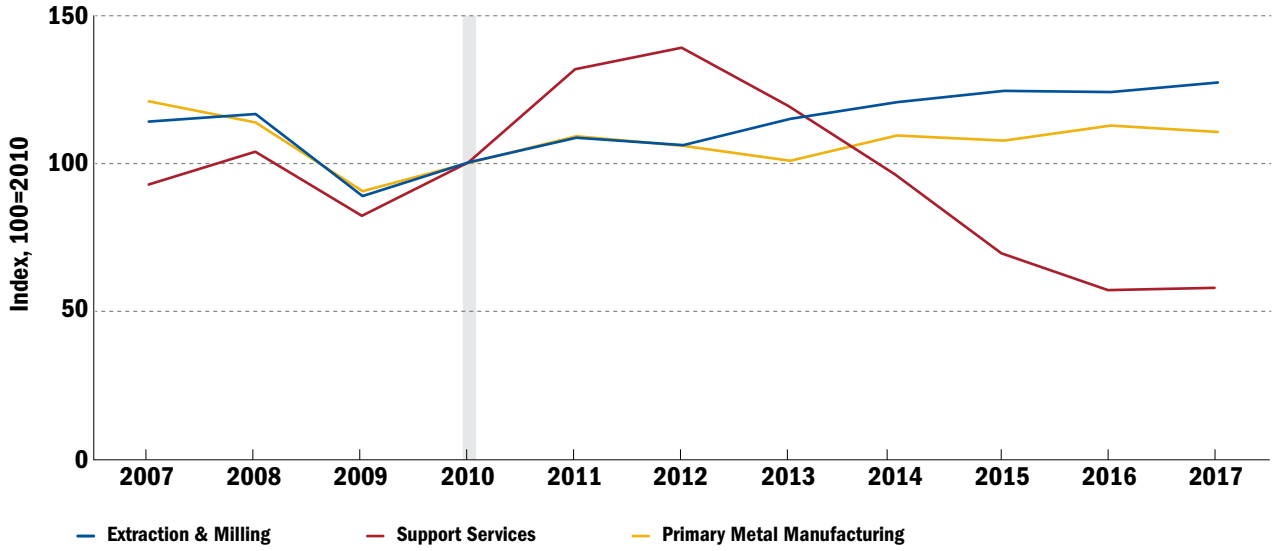
Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*
*Exploration excluded in this definition of the mining industry due to data limitations on GDP in this sub-sector.

GDP: DROP IN THE SUPPORT SERVICES SUB-SECTOR

A closer look at real GDP by sub-sector reveals important shifts in industry growth over the last decade (Figure 4). *Support services* is especially sensitive to economic fluctuations; between 2012 and 2016, the sub-sector experienced a substantial loss, but levelled out in 2017. As such, a recovery in the industry bodes well for *support services* because it is often the first sub-sector to be impacted by a recession, and the last to recover. *Extraction & milling*, on the other hand, has shown stable growth (Figure 4); in 2017, the sub-sector made up roughly 66% of the mining industry's real GDP (Figure 5).

FIGURE 4

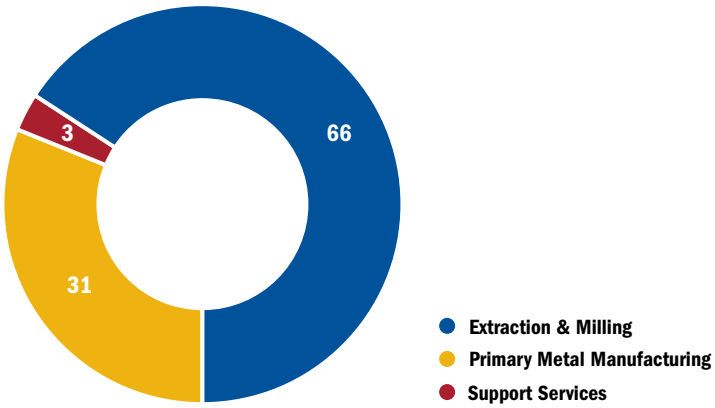
Growth indices of mining real GDP by sub-sector (excluding exploration*) (2007–2017)



Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*
*Exploration excluded in this definition of the mining industry due to data limitations on GDP in this sub-sector.

FIGURE 5

Share of mining real GDP by sub-sector (excluding exploration*) (2017) (%)



Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*
*Exploration excluded in this definition of the mining industry due to data limitations on GDP in this sub-sector.

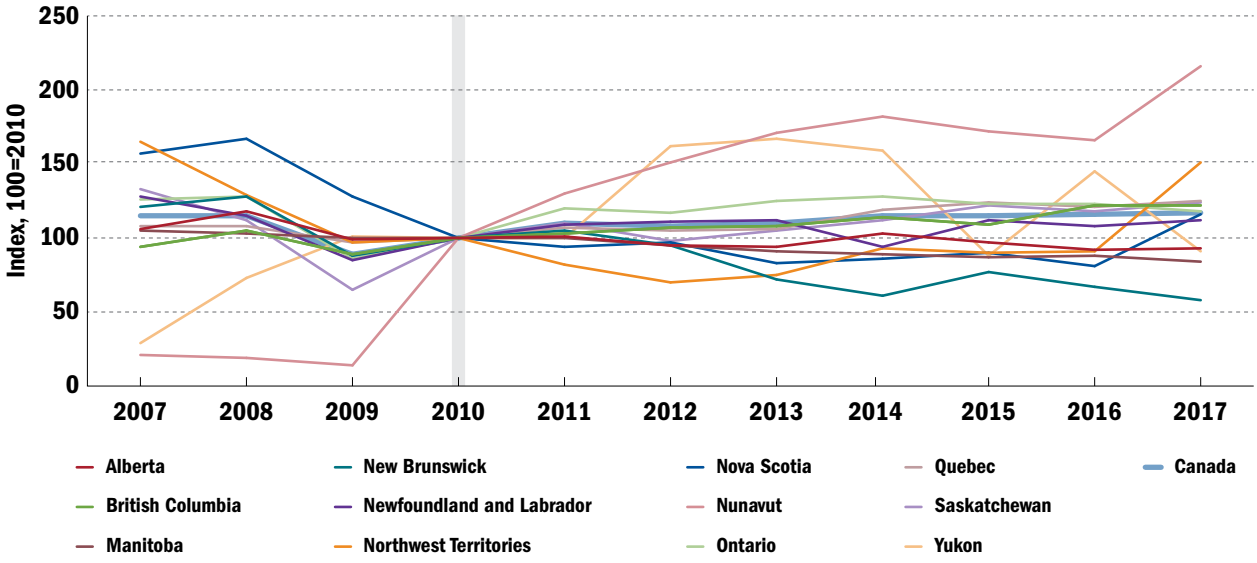
GDP: SIGNIFICANT MINING GROWTH IN THE NORTH

Over the past decade, Canada's north has experienced momentous growth in mining, particularly in Nunavut. From 2007 to 2017, growth in real GDP was relatively strong in each of the territories, especially Nunavut (Figure 6).

This momentum is further echoed in the main commodities that are mined in the territories. In particular, diamond mining (found primarily in the Northwest Territories) demonstrated the most vigorous GDP growth within the *extraction & milling* sub-sector since 2012 (Figure 7). The GDP for most types of commodities grew from 2016 to 2017, except for coal mining; copper, nickel, lead and zinc ore mining; and other metal ore mining.

FIGURE 6

Growth indices of mining real GDP (excluding exploration*) by province and territory (2007–2017)

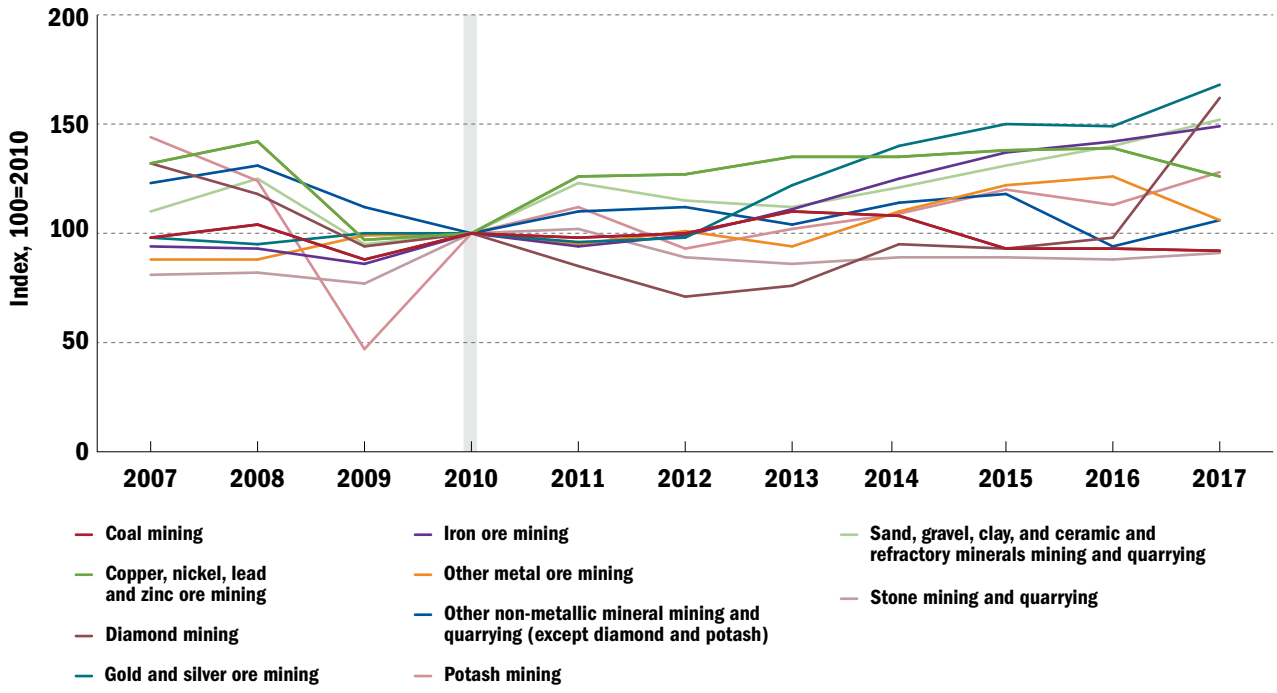


Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*

*Exploration excluded in this definition of the mining industry due to data limitations on GDP in this sub-sector.

FIGURE 7

Growth indices of extraction & milling real GDP by commodity type (2007–2017)



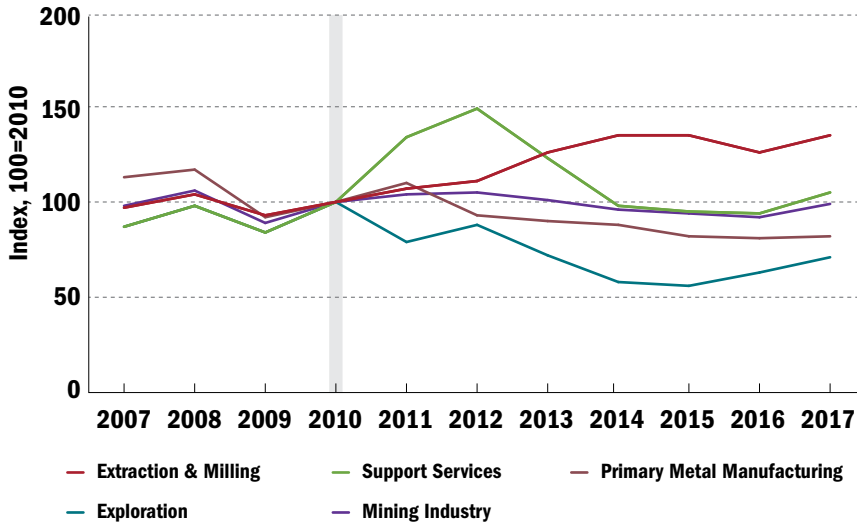
Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*

EMPLOYMENT: EXTRACTION & MILLING IS DRIVING GROWTH

Employment in the mining industry has modestly increased over the last decade, but growth has not been consistent across sub-sectors. The *extraction & milling* sub-sector has displayed the greatest employment growth (Figure 8). Conversely, employment in *support services* sharply contracted from 2012 to 2016 — further indication that this sub-sector is especially sensitive to economic fluctuations. Employment in *primary metal manufacturing* has gradually declined since 2012, an indication that the sub-sector's role as an employer in Canada's mining industry has diminished in recent years.

FIGURE 8

Growth indices of employment by mining sub-sector (2007–2017)



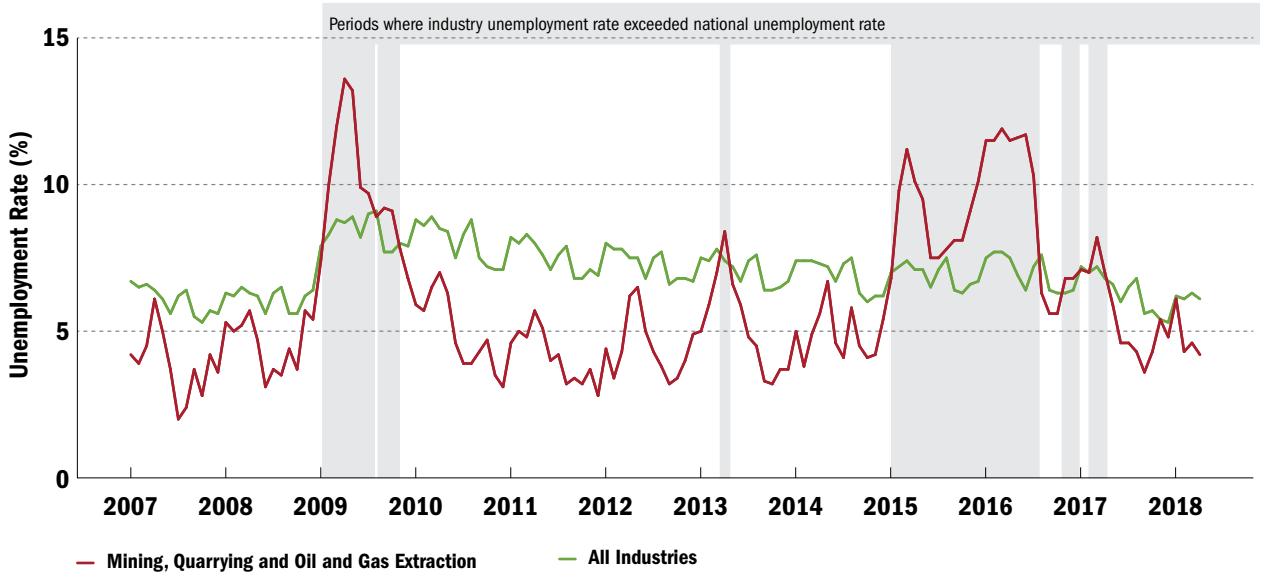
Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*

UNEMPLOYMENT: RESTORED TO HISTORICALLY LOWER LEVELS

After a prolonged period of relatively high unemployment rates in *mining, quarrying, and oil and gas extraction* (NAICS 21), unemployment rates have returned to normal levels in 2017, at about 4%, and are lower than the rate for all industries (Figure 9). This trend is a further sign that the industry has been in recovery mode; however, low unemployment does not necessarily equate with a growing labour supply in the industry.

FIGURE 9

Unemployment rates in mining, quarrying and oil and gas extraction (NAICS 21) (Jan 2007–Apr 2018)



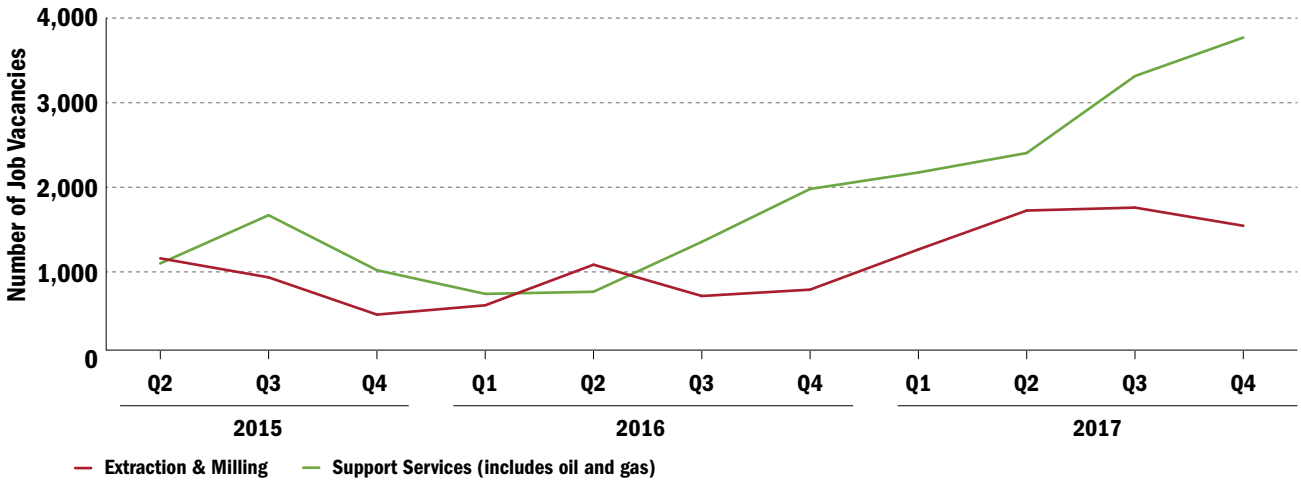
Source: *Mining Industry Human Resources Council, Statistics Canada (Labour Force Survey), 2018*

JOB VACANCIES: OPENINGS ON THE RISE

The number of vacant job positions in certain sub-sectors grew substantially in 2017, subsequent to stagnant growth in 2015 and 2016 (Figure 10). Job vacancies for *extraction & milling* increased from about 700 in the final quarter of 2016 to over 1,500 vacancies in the final quarter of 2017. Increases were particularly acute for *support services*, reaching about 3,800 vacancies in the final quarter of 2017 — another signal that mining operations were expanding their pace heading into 2018. MiHR's 2017 national outlook report noted that 87% of reported vacancies were permanent, full-time positions.

FIGURE 10

Job vacancies in extraction & milling and support services* (Q2 2015–Q4 2017)



Sources: *Mining Industry Human Resources Council, Statistics Canada (Job Vacancy and Wage Survey), 2018*

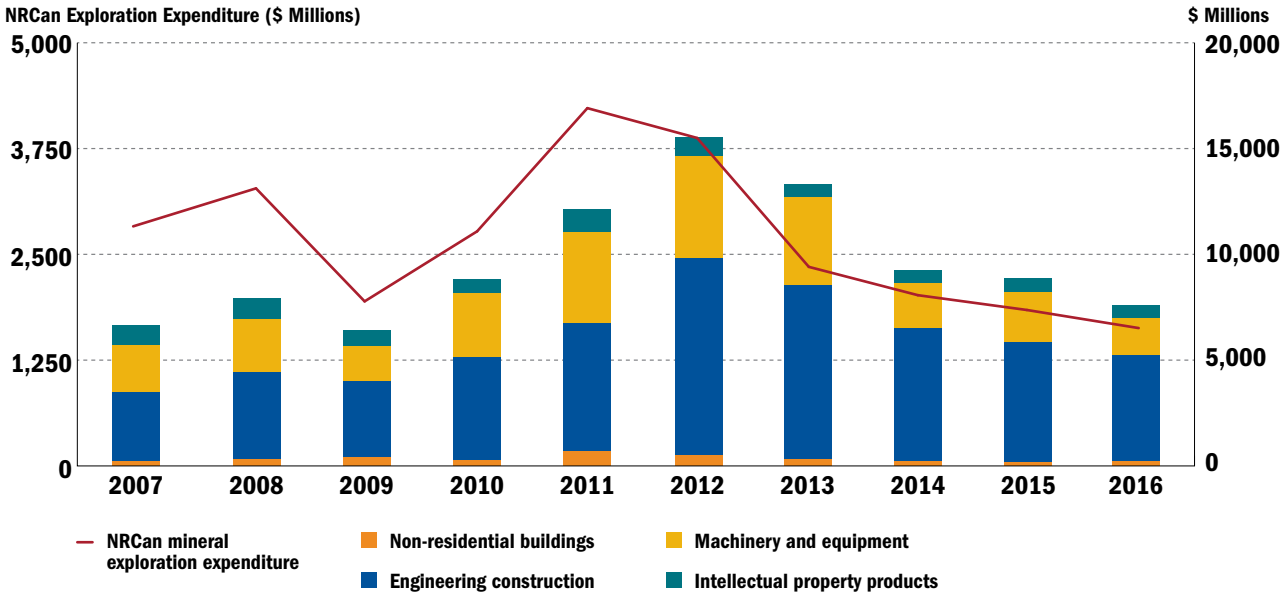
*Statistics Canada's Job Vacancy and Wage Survey reports at the 3-digit NAICS level; therefore support services represents NAICS 213 Support Activities for Mining and Oil and Gas Extraction, and not the sub-industry NAICS 21311B Support Activities for Mining.

INVESTMENT: MINING AND EXPLORATION INVESTMENT HAS SLOWED

Investment in extraction capital (fixed assets such as machinery and equipment and non-residential buildings) and in exploration activities impacts the growth in mining development and employment in Canada's mining industry. In 2012, annual investment in *extraction & milling* peaked at roughly $15.6M. Spending in *exploration* peaked in 2011, at about $4.2M, and subsequently slowed down each year up to 2016 (Figure 11), likely because of weakening commodity prices. However, as noted earlier in this report, commodity prices started to rebound in 2017, which may serve to strengthen investor confidence and spending.

FIGURE 11

Investment in exploration and extraction & milling (2007–2016)



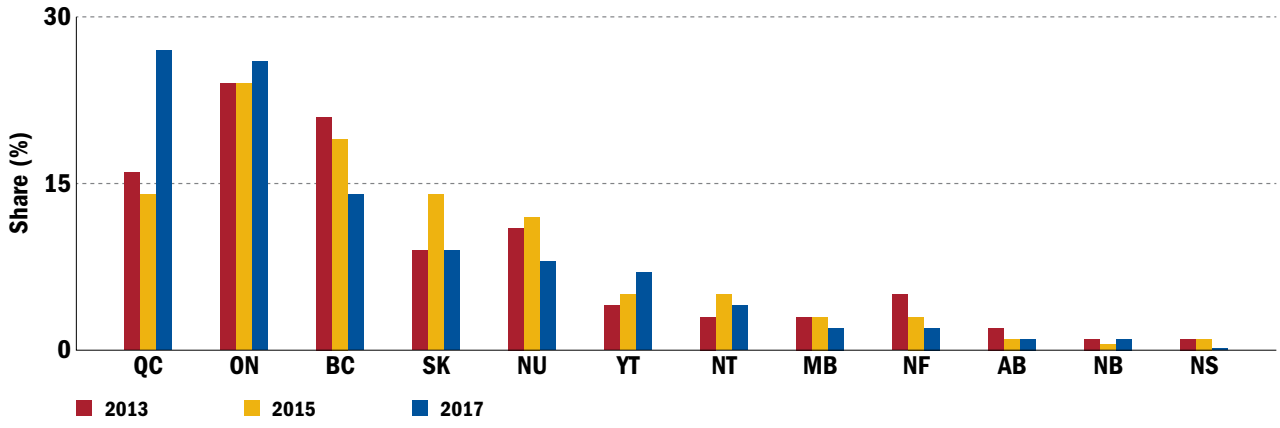
Source: *Mining Industry Human Resources Council, Statistics Canada (Stock and Consumption of Fixed Non-residential Capital) and Natural Resources Canada (Survey of Mineral Exploration), 2018*

EXPLORATION SPENDING: A SPIKE IN QUEBEC

In 2017, 27% of investment in Canada's *exploration* sub-sector was concentrated in Quebec, up from 14% in 2015 (Figure 12). Ontario's investment in *exploration* is also high relative to other provinces and territories, at 26% in 2017. British Columbia's share of *exploration* expenditure has subsided in recent years, from 21% in 2013 to 14% in 2017.

FIGURE 12

Share of mineral exploration spending by province and territory (2013, 2015, 2017)



Source: *Mining Industry Human Resources Council, Natural Resources Canada (Survey of Mineral Exploration), 2018*

3

PROFILE OF CANADA'S MINING LABOUR FORCE

To develop a profile of the mining labour force, MiHR investigated the key trends that characterize the people engaged in Canada's mining labour market. Much of the analysis is conducted across three census periods (2006, 2011, 2016), and looks at geographic distribution, demographic attributes (e.g. age and education), cultural identity (Indigenous people, immigrants and visible minorities), and the representation of women.

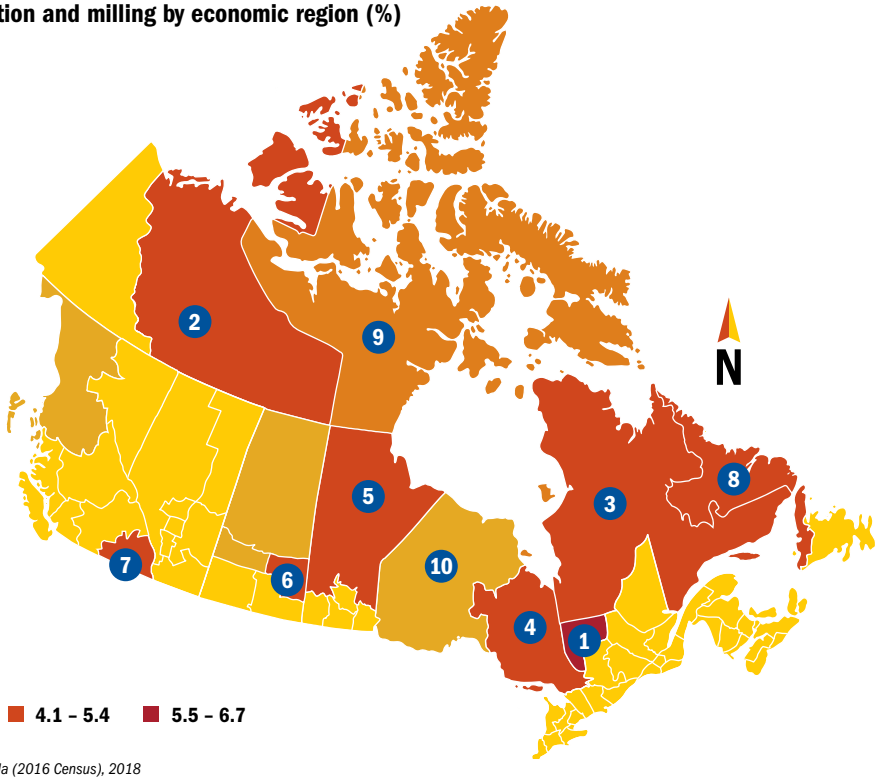
GEOGRAPHY: MINING LABOUR FORCE FOUND ACROSS CANADA

To illustrate how the mining labour force is spread across the country, the share (or concentration) of the labour force (by place of residence) in the *extraction & milling* sub-sector is shown for each of Canada's *Economic Regions* (Figure 13); comprised from a grouping of census divisions, an economic region provides a standard geographic boundary for analyzing regional economic activity. Specifically, the thematic map highlights the top 10 largest shares in Canada, according to Statistics Canada's 2016 Census, and a corresponding table reports the associated data (Table 1).

The mining labour force is found in all corners of Canada; however, much of it is concentrated in remote, less densely populated areas, particularly in the northeastern parts of the country (Ontario, Quebec and Newfoundland). Notably, the Abitibi-Témiscamingue region in Quebec has the highest concentration of mining industry labour force participants (at 6.7%) and the second largest mining labour force in total size (4,900) after Northeast Ontario (11,900).

FIGURE 13

Concentration of labour force in extraction and milling by economic region (%)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

TABLE 1

Top economic regions by share of labour force in extraction & milling (2016)

Rank	Geography	Share of Total Labour Force in Extraction & Milling (2016)	Size of Labour Force in Extraction & Milling (2016)*
1	Abitibi-Témiscamingue, Quebec [2465]	6.7%	4,890 (2)
2	Northwest Territories	5.0%	1,160 (19)
3	Côte-Nord and Nord-du-Québec, Quebec [2480 2490]	4.7%	3,105 (5)
4	Northeast, Ontario [3590]	4.5%	11,895 (1)
5	Parklands and North, Manitoba [4670 4680]	4.5%	2,295 (8)
6	Yorkton-Melville, Saskatchewan [4740]	4.4%	1,860 (11)
7	Kootenay, British Columbia [5940]	4.2%	3,135 (4)
8	West Coast-Northern Peninsula-Labrador, Newfoundland and Labrador [1030]	4.1%	2,035 (10)
9	Nunavut	3.5%	520 (36)
10	Northwest, Ontario [3595]	2.4%	2,635 (7)
	Average for all Economic Regions	1.0%	1,071

Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

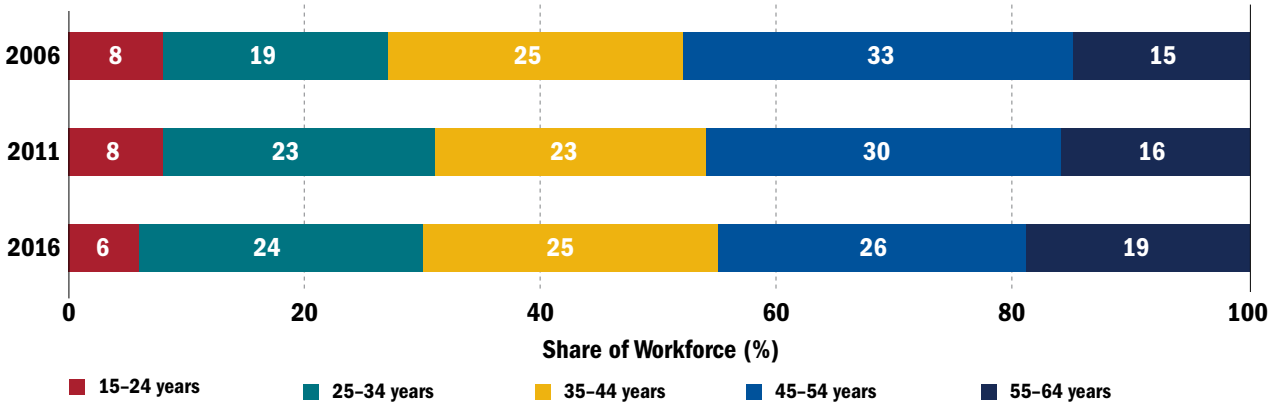
** Size of labour force rankings among all 69 economic regions are shown in parentheses.*

AGE: AN INCREASE IN WORKERS AGES 55 TO 64

The age distribution of the mining workforce has changed over the past three census periods (Figure 14), with a notable shift among mid-career workers (45 to 54 years) moving toward an older workforce category (55 to 64 years). In 2016, the 45- to 54-year-olds continued to represent the highest share of the mining workforce (26%). Over the past three census periods, that share has been decreasing, and currently is only a few percentage points higher than the share of 35- to 44-year-olds (25%) and 25- to 34-year-olds (24%). In contrast, the youngest cohort (15 to 24 years) has consistently represented only 6% to 8% of the mining workforce over the same time frame.

FIGURE 14

Age distribution of mining workforce (2006, 2011, 2016)



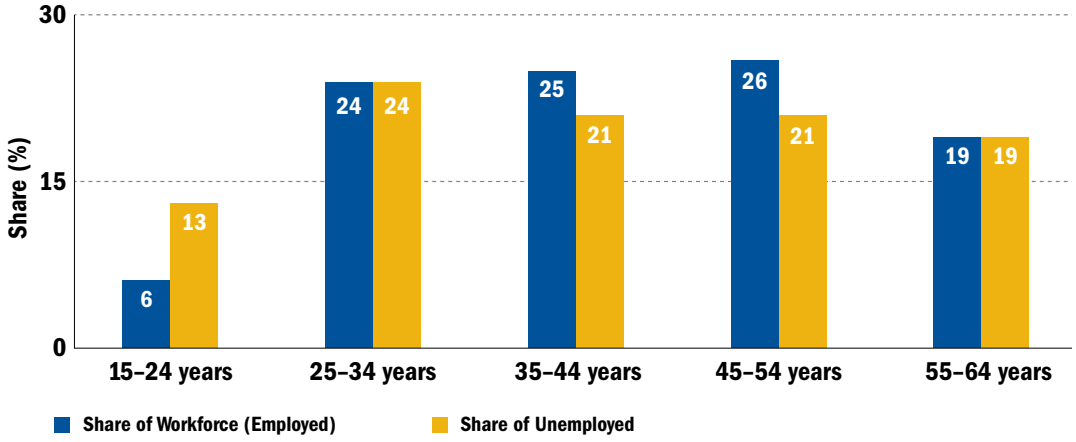
Source: *Mining Industry Human Resources Council, Statistics Canada (2006 Census, 2011 NHS, 2016 Census), 2018*

AGE: DISPARITY BETWEEN EMPLOYED AND UNEMPLOYED

Labour market outcomes normally vary by key age groups and this trend is further evident in Canada's mining labour market. The youngest cohort (15 to 24 years) demonstrated the greatest disparity in the share of employed (6%) versus unemployed (13%) in 2016 (Figure 15). LFS data for 2007 to 2017 further demonstrate that changes in unemployment rates in *mining, quarrying and oil and gas extraction (NAICS 21)* mostly affect the youngest cohort (Figure 16).

FIGURE 15

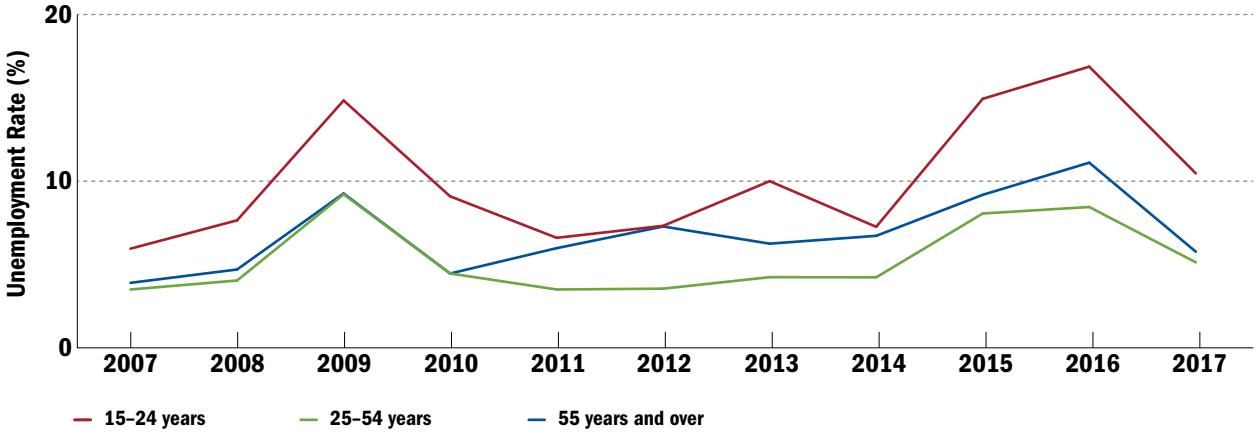
Age distribution of mining workforce and mining unemployed (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

FIGURE 16

Unemployment rates in mining, quarrying and oil and gas extraction (NAICS 21) by age group (2007–2017)



Source: *Mining Industry Human Resources Council, Statistics Canada (Labour Force Survey), 2018*

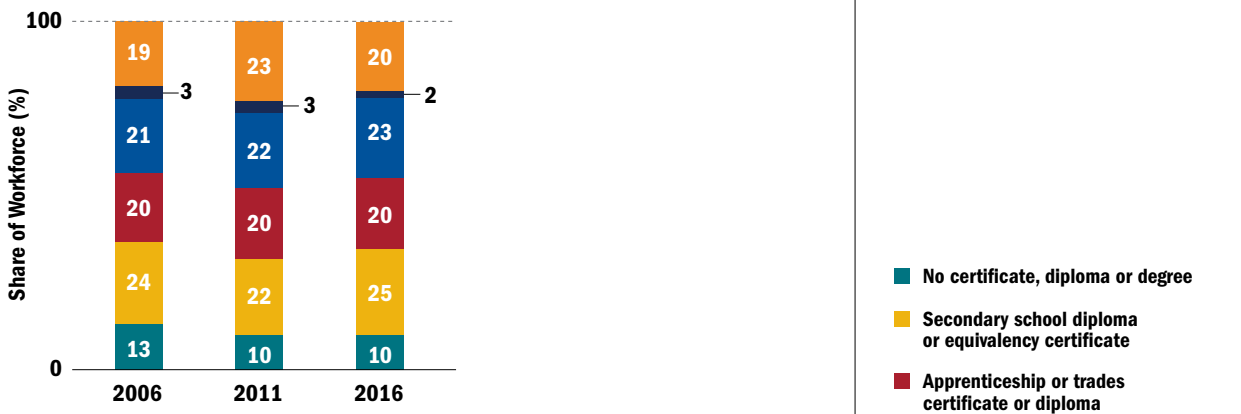
EDUCATION: AN INCREASINGLY EDUCATED WORKFORCE

The mining workforce is becoming more educated. Although the share of the workforce for each category of formal education has remained relatively constant over the past three census periods, the share of the mining workforce with no certificate has diminished, from 13% in 2006 to 10% in 2016. Conversely, the share of the mining workforce with a high school diploma and the share with a university credential at a bachelor level or above have both increased (Figure 17).

The mining industry draws significantly more workers with an apprenticeship, trades certificate or diploma, at 20% compared to 11% for all industries (Figure 18) in 2016.

FIGURE 17

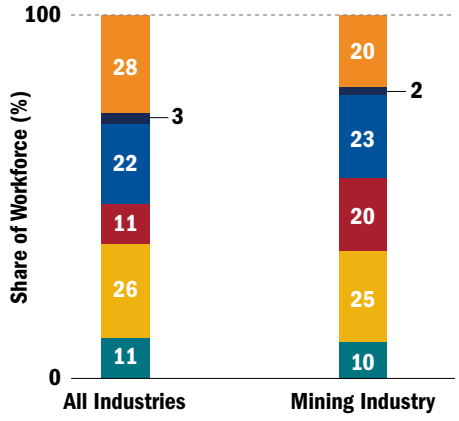
Educational profile of mining workforce (2006, 2011, 2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2006 Census, 2011 NHS, 2016 Census), 2018*

FIGURE 18

Educational profile of the workforce, all industries vs mining industry (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

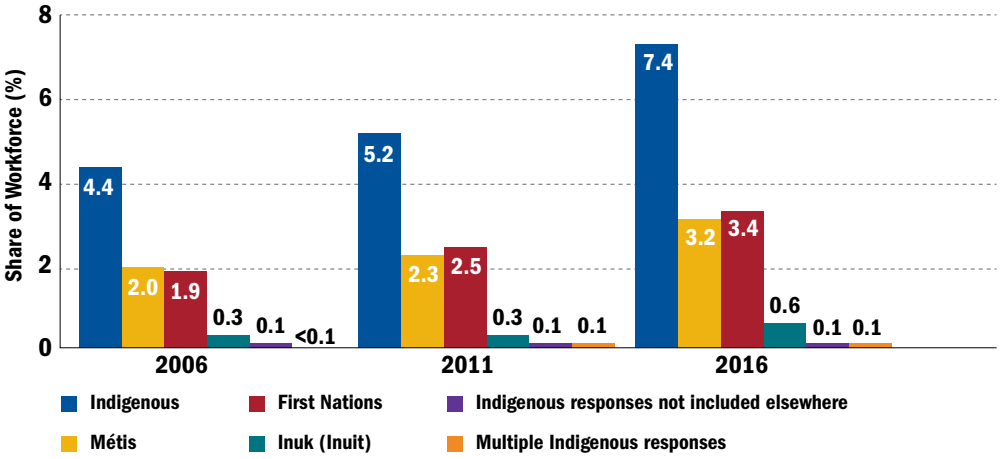
INDIGENOUS PEOPLE: RECENT GROWTH IN THE MINING WORKFORCE

Indigenous people in Canada comprise three main groups: First Nations, Métis and Inuit. In 2016, they accounted for 5% of the total population, up from about 4% in 2006, and 3% in 1996. Since 2006, the Indigenous population in Canada has grown by 43% – more than four times the rate of the non-Indigenous population – and is expected to reach more than 2.5 million over the next two decades.[6]

Indigenous people represented close to 7% of the mining workforce in Canada in 2016 (Figure 19), up from roughly 5% in 2011. Most of the Indigenous people in the mining industry are either Métis or First Nations. Figure 20 shows that Indigenous people are better represented in the mining industry (7%) than in all industries (4%). Interestingly, the share of the mining workforce that is Métis nearly doubles the share found in all industries.

FIGURE 19

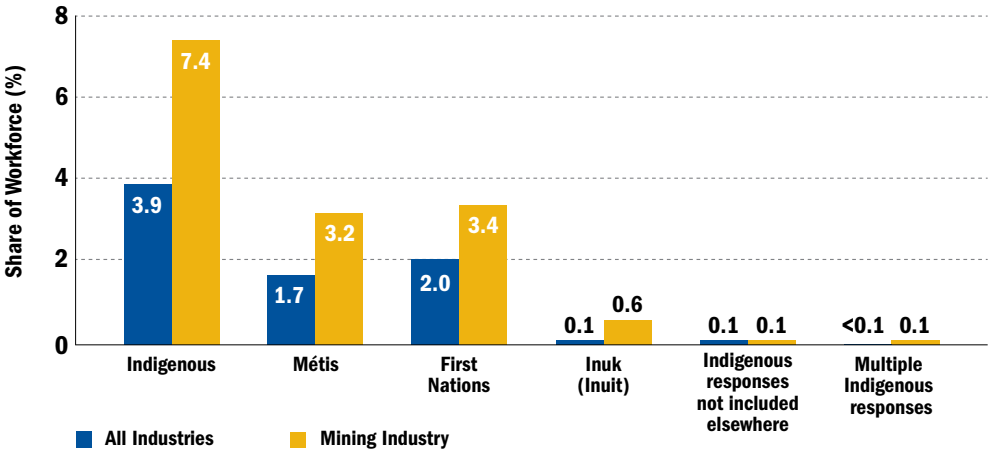
Representation of Indigenous people in the mining workforce (2006, 2011, 2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2006 Census, 2011 NHS, 2016 Census), 2018*

FIGURE 20

Representation of Indigenous people in the workforce, mining industry and all industries (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

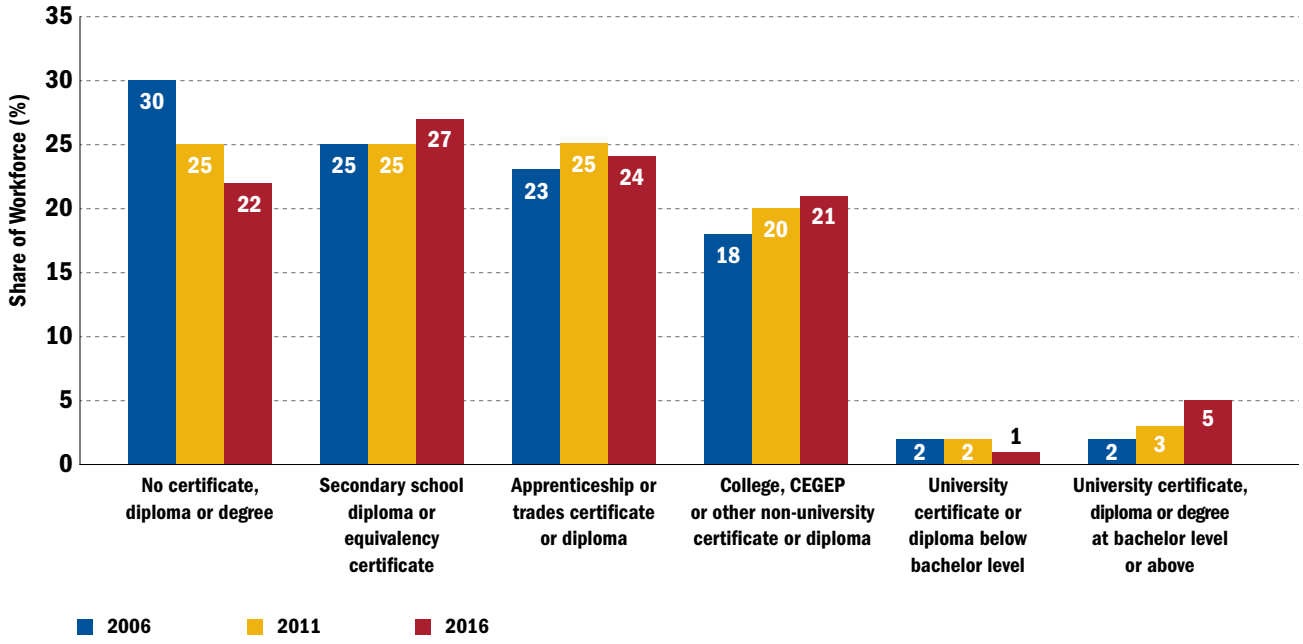
6 Statistics Canada, "Aboriginal peoples in Canada: Key results from the 2016 Census," *The Daily* (Oct. 25, 2017), retrieved at https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025a-eng.htm

INDIGENOUS PEOPLE: MORE ARE PURSUING A FORMAL EDUCATION CREDENTIAL

Indigenous people in the mining workforce are increasingly pursuing a formal education credential. In 2006, 30% had no certificate, diploma or degree; by 2016, that rate fell to 22%. From 2006 to 2016, the share of Indigenous people in the mining workforce with a college, CEGEP or other non-university certificate or diploma rose by 3 percentage points, as did the rate for those with a university certificate, diploma or degree at bachelor level or above (Figure 21).

FIGURE 21

Education profile of Indigenous people in the mining workforce (2006, 2011, 2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2006 Census, 2011 NHS, 2016 Census), 2018*

IMMIGRANTS AND VISIBLE MINORITIES: ON THE RISE IN MINING

Census data from 2016 demonstrate that immigrants and visible minorities in Canada each make up one-fifth of the country's total population. Of the visible minority population,[7] 3 in 10 were born in Canada. Statistics Canada projects that the immigrant share of Canada's population could reach between 25% and 30% by 2036; Canada's visible minority population is expected to be even higher, between 31% and 38%.[8]

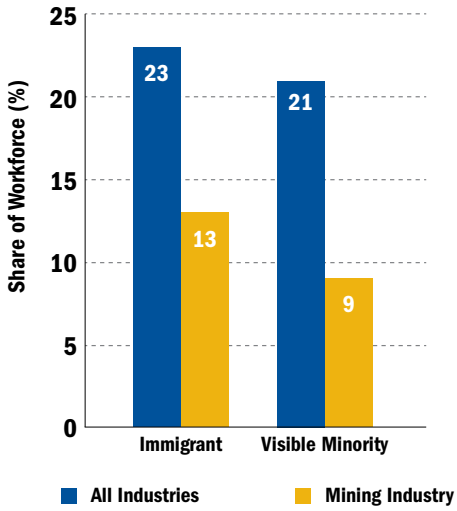
In 2016, the representation of immigrants (13%) and visible minorities (9%) in the mining workforce (Figure 22) were both lower relative to all industries (23% and 21% respectively). Concurrently, the share of the mining workforce that are immigrants has been modestly increasing (Figure 23), from 12% in 2006 to 13% in 2016. Similarly, the share of visible minorities in mining is smaller relative to immigrants, but the gap is closing; the share of visible minorities in the mining workforce grew from 7% in 2006 to 9% in 2016.

7 Canada's *Employment Equity Act* defines visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour." See Statistics Canada, "Visible Minority and Population Group Reference Guide, Census of Population, 2016," https://www12.statcan.gc.ca/census-recensement/2016/ref/guides/006/98-500-x2016006-eng.cfm

8 Statistics Canada, "Immigration and ethnocultural diversity: Key results from the 2016 Census," *The Daily* (Oct. 25, 2017), https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025b-eng.htm

FIGURE 22

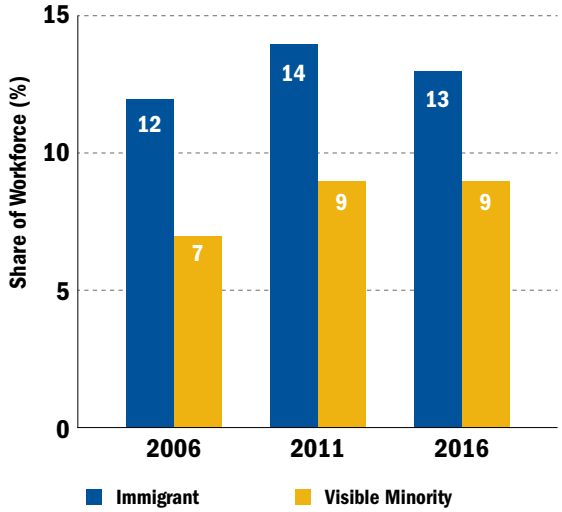
Representation of immigrants and visible minorities in the workforce, mining industry and all industries (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

FIGURE 23

Representation of immigrants and visible minorities in the mining workforce (2006, 2011, 2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2006 Census, 2011 NHS, 2016 Census), 2018*

WOMEN IN MINING: A DEEPER LOOK AT REPRESENTATION

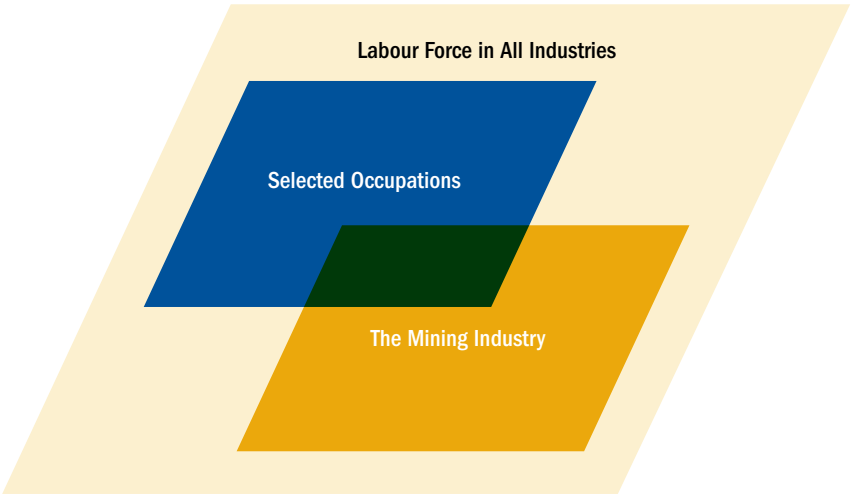
This section of the report offers a detailed analysis of the representation of women in Canada's mining labour force. The analysis builds on a similar analysis found in MiHR's 2016 national outlook report, with updated data from the 2016 census.

How does MiHR Calculate Representation?

As visualized in Figure 24, MiHR's understanding of women's representation in the Canadian mining labour force is considered from a number of different lenses. Analyses have historically focused on the representation of women in the mining industry compared to that of all industries. This report goes further by investigating the representation of women in the four mining sub-sectors, and in the broad occupational categories and selected occupations detailed earlier in this report. In particular, the analysis aims to recognize whether the share of women is mining-specific, or largely dictated by overall trends in the occupation. Looking at the representation of women from an industry, sub-sector and occupational perspective allows for a more nuanced discussion of the gender gap within the mining industry.[9]

FIGURE 24

Representation in the labour force



Source: *Mining Industry Human Resources Council, 2018*

9 The representation of women is a useful measure — it can signal several factors that may be contributing to lower representation numbers — but it does not cover all aspects related to diversity and inclusion in the mining industry.

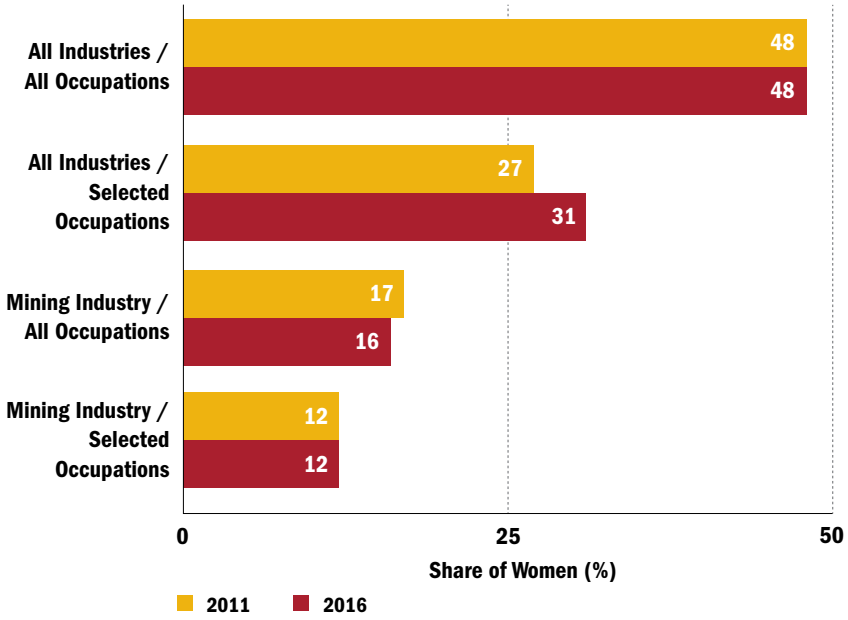
Women Continue to be Underrepresented In Mining

According to 2016 census data, women make up 48% of the Canadian labour force. By comparison, women account for only 16% of the mining labour force (Figure 25), or roughly the same proportion that was indicated by the 2011 census.

Although the representation of women has remained relatively unchanged, there is indication of a momentum shift. For the selected occupations, women's representation has increased across all industries in recent years, from 27% in 2011 to 31% in 2016 (Figure 25). However, the mining industry has yet to realize these gains since the share in these occupations has remained constant, at 12% in both 2011 and 2016. This trend points to potential opportunities for the mining industry to increase its representation among the selected occupations. Overall, the findings from MiHR's previous research remain constant – the industry continues to struggle with underrepresentation of women.

FIGURE 25

Representation of women in the labour force, mining industry and all industries, selected occupations and all occupations (2011 and 2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2011 NHS, 2016 Census), 2018*

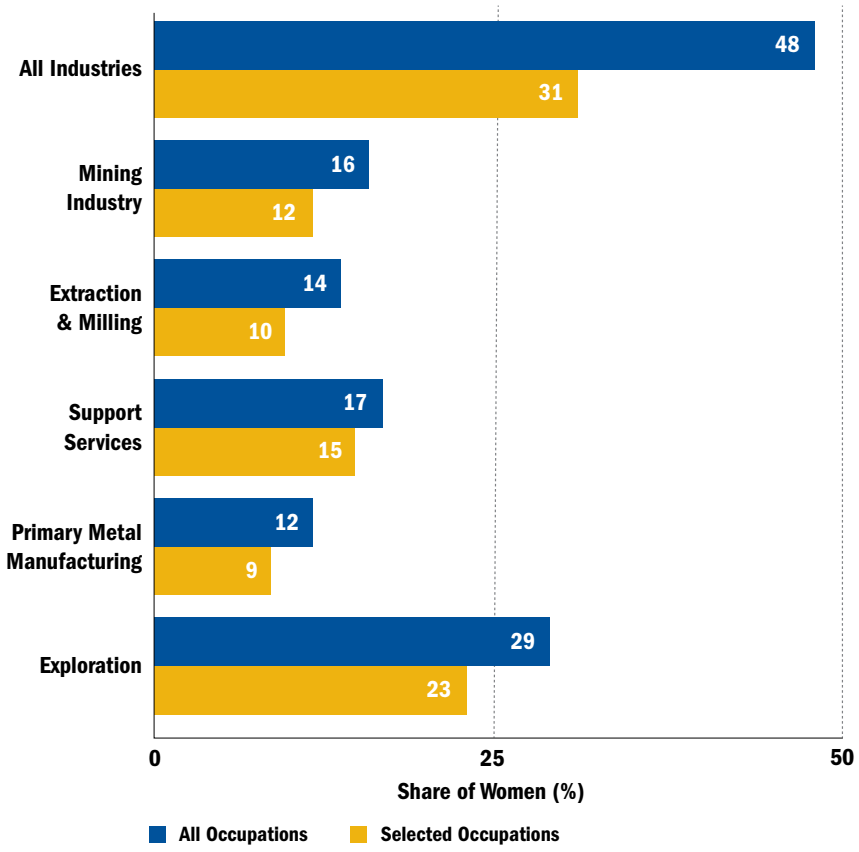
Building a Critical Mass of Women: Mining Exploration is Leading the Way

Figure 26 shows the representation of women across mining sub-sectors, illustrating which sub-sectors are outperforming the industry average (16%). For all occupations in *extraction & milling* and in *primary metal manufacturing*, women represent 14% and 12% respectively, indicating that the representation of women is smallest in these sub-sectors. Conversely, women make up 29% of all occupations and 23% of selected occupations in the *exploration* sub-sector, making it the sub-sector with the highest representation of women in the mining industry.

These are interesting percentages, especially considering that higher shares of women may become self-sustaining after reaching a critical mass. Within this context, the *exploration* sub-sector may be closer to a tipping point that could lead to unlocking the benefits of gender diversity.

FIGURE 26

Representation of women in the mining labour force by sub-sector (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

Fewer Women in Lower Skilled Occupations

Statistics Canada's classification of NOCs by skill level provides another lens to investigate the representation of women in the mining labour force. Each occupation can be classified into five distinct skill level groups, which further describe the type of training required to perform on the job. Skill categories are listed as follows:

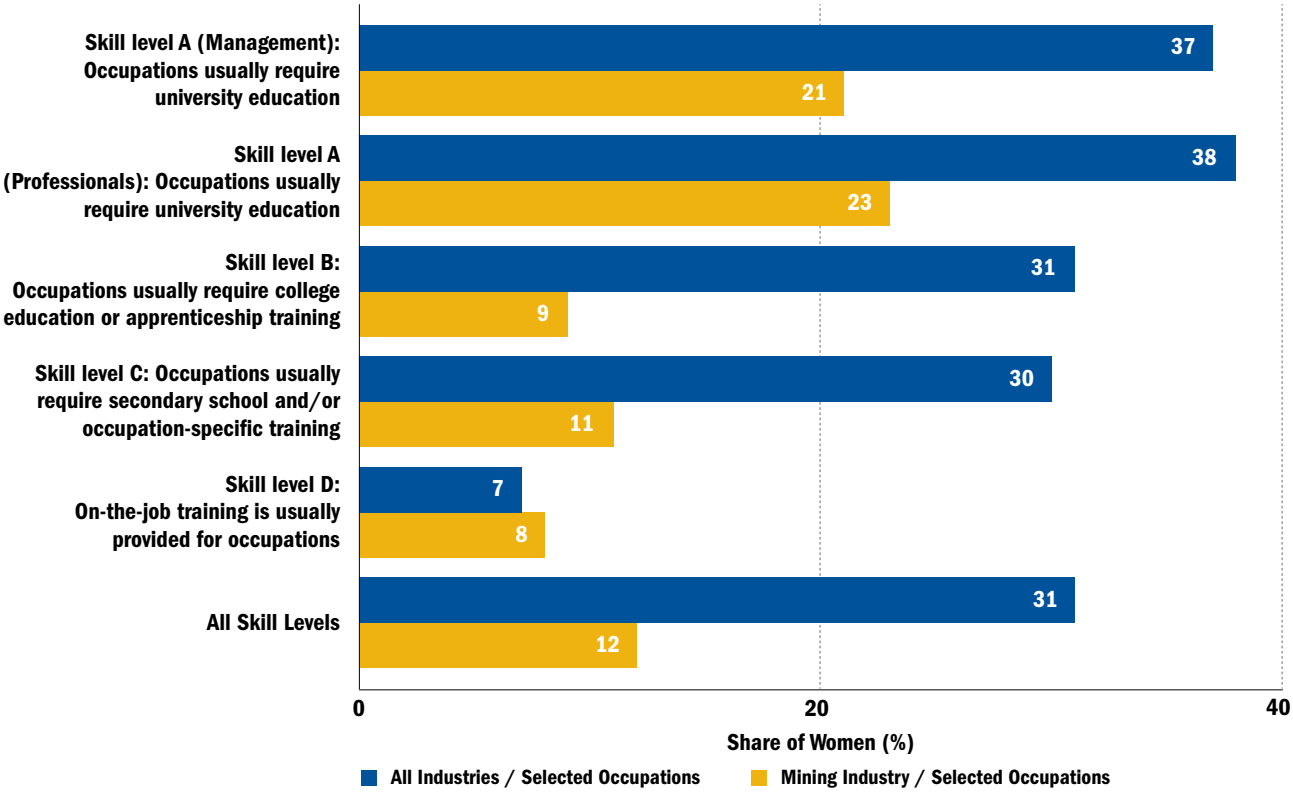
- **Skill level A (Management):** Occupations usually require university education (e.g. Construction managers);
- **Skill level A (Professionals):** Occupations usually require university education (e.g. Mining engineers);
- **Skill level B:** Occupations usually require college education or apprenticeship training (e.g. Heavy-duty equipment mechanics);
- **Skill level C:** Occupations usually require secondary school and/or occupation-specific training (e.g. Underground mine service and support workers);
- **Skill level D:** On-the-job training is usually provided for occupations (e.g. Mine labourers).

Considering selected occupations, Figure 27 shows specific differences between the mining industry and all industries under each of the five defined skill level categories. For instance, women make up about 37% of Skill level A occupations (Management), yet only 21% within the mining labour force. As a result, the mining industry is attracting a substantially reduced share of women within this particular skill level. These gaps can also be seen in other skill levels.

Notably, representation in Skill level D occupations (usually requiring on-the-job training) drops significantly in all industries (7%), including the mining industry (8%). For Skill level D occupations, the mining industry is drawing from a very small number of women, and this indicates that more universal efforts are needed to attract more women into the selected occupations with low skill entry-barriers.

FIGURE 27

Representation of women in the mining labour force by skill level (2016)



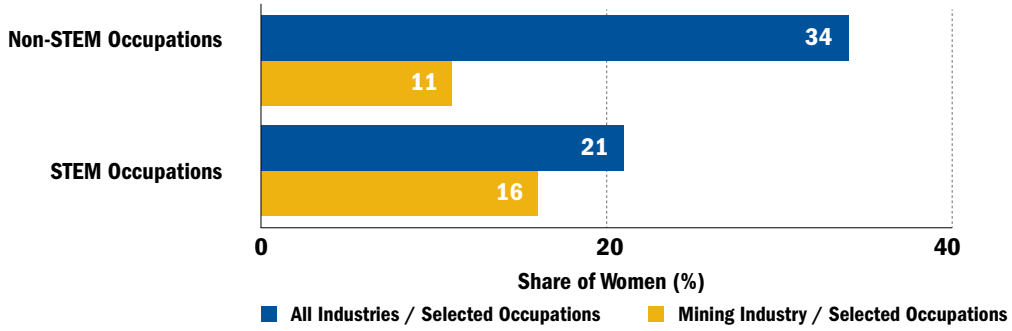
Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

An Even Wider Divide in Non-STEM Occupations

For selected occupations in science, technology, engineering and math (STEM),[10] women represent almost 21% across all industries (Figure 28); however, this share reduces to 16% in the mining industry. Interestingly, non-STEM occupations display a greater gap between all industries and the mining industry (34% vs 11%), which draws an interesting discussion point: while there is much focus on STEM occupations, additional mining-specific outreach for non-STEM related occupations may also be required to increase the likelihood of mining being an industry of choice for women pursuing non-STEM related careers.

FIGURE 28

Share of women in the labour force by STEM and non-STEM occupations (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

10 See Appendix B for a list of STEM occupations in the mining industry tracked by MiHR.

Low Representation Both an Occupational and Industry-Level Issue

For occupations where women are especially underrepresented, it is informative to identify whether the issue is at the general occupational level, or specific to the mining industry. Such distinctions can serve to inform the most effective strategies to improve numbers for the occupation inclusively (through cross-industry collaborative efforts), or for the industry itself (through better competition with other industries). Similarly, identifying where mining is outperforming other industries may highlight promising practices within the industry and provide further information on removing barriers to participation and employment.

For broad occupational categories, women are especially scarce in *trades occupations* (2%), *production occupations* (7%) and *supervisors, coordinators and foremen* (10%), regardless of the industry (Figure 29). By comparison, women represent nearly two-thirds of support workers, human resources and financial occupations.

In 45 of the 70 occupations tracked by MiHR, women make up less than 20% of the labour force. In general, occupations that are mining specific (i.e. where the industry has a greater share of the labour pool) also demonstrate the lowest representation of women. A similar dynamic occurs across each of the four mining sub-sectors. Using all other industries as a benchmark, the mining industry would need to increase representation by at least 1% in 45 of the 70 occupations to reach par with other industries; the average increase needed is roughly 5%, but as high as 27%.

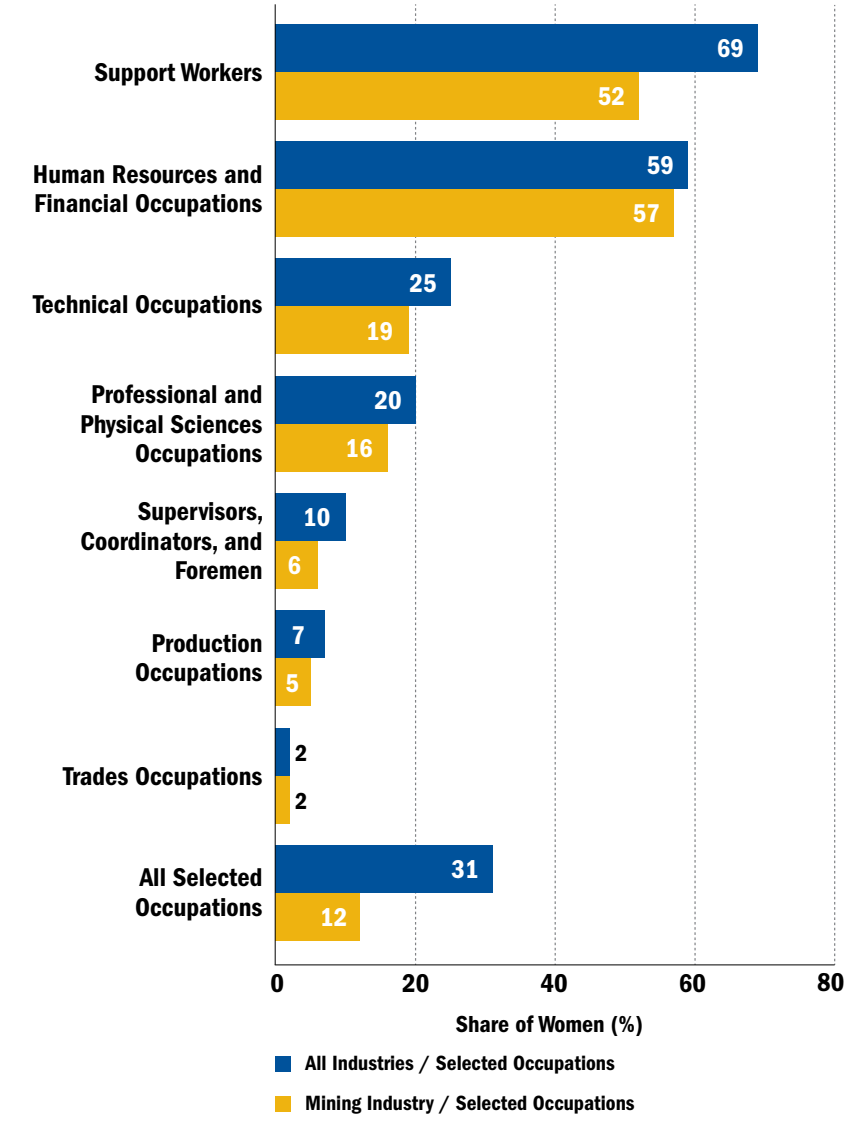
Table 2 reports the top 10 selected occupations with the largest gaps in the share of women relative to other industries; the three largest gaps include *production logistics coordinators* (27%), *human resources managers* (14%) and *dispatchers* (14%). However, as this report highlights, there are different, nuanced stories about the representation of women that need to be understood.

For example, women are well represented in the category *human resources* and *financial occupations*, both in the mining industry and all industries (Figure 29). However, for *human resources managers* specifically, the mining industry lags behind other industries by a difference of 14% (Table 2). This finding indicates a potential gap in the representation of women in leadership positions in the mining industry, despite showing a competitive representation of women in *human resources and financial occupations* as a whole.

Table 3 reports the representation of women among selected occupations where the mining industry is outperforming other industries, such as *financial and investment analysts* (-12%) and *other professional engineers* (-5%). In these occupations, the mining industry is performing well relative to other industries, but this finding does not necessarily indicate strong representation in these occupations overall. For example, the mining industry is outpacing other industries in attracting *construction managers* who are women, but the overall share remains low.

FIGURE 29

Share of women in the labour force by broad occupational category (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

TABLE 2

Selected occupations with largest gaps in share of women (2016)

4-Digit NOC occupation		Difference in Representation of Women (other % — mining %)
1523	Production logistics coordinators	27%
0112	Human resources managers	14%
1525	Dispatchers	14%
1526	Transportation route and crew schedulers	10%
0111	Financial managers	9%
1121	Human resources professionals	9%
2112	Chemists	9%
2263	Inspectors in public and environmental health and occupational health and safety	8%
2121	Biologists and related scientists	7%
2255	Technical occupations in geomatics and meteorology	7%

Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

TABLE 3

Selected occupations with lowest gaps in share of women (2016)

4-Digit NOC occupation		Difference in Representation of Women (other % — mining %)
1112	Financial and investment analysts	-12%
2148	Other professional engineers, n.e.c.	-5%
7203	Contractors and supervisors, pipefitting trades	-4%
7371	Crane operators	-4%
2142	Metallurgical and materials engineers	-4%
7511	Transport truck drivers	-3%
2234	Construction estimators	-3%
0711	Construction managers	-3%
7372	Drillers and blasters – Surface mining, quarrying and construction	-3%
2231	Civil engineering technologists and technicians	-2%

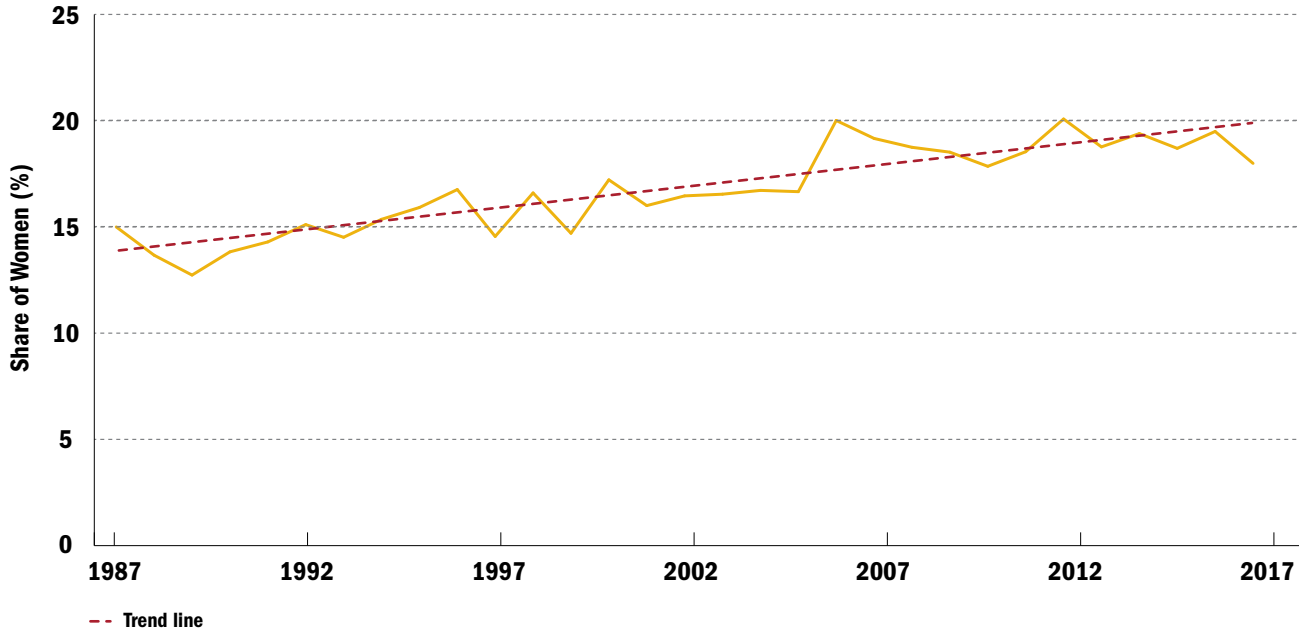
Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

Longer Term Gains for Women in Mining

Even as women continue to be underrepresented in the mining industry, over the last three decades the representation of women in *mining, quarrying and oil and gas extraction* (NAICS 21) has been gradually growing, albeit at a modest rate (Figure 30). This picture of growth demonstrates that a long-term horizon, potentially an entire generation, will be needed to realize significant increases.

FIGURE 30

Representation of women in mining, quarrying and oil and gas extraction (NAICS 21) (1987–2017)



Source: *Mining Industry Human Resources Council, Statistics Canada (Labour Force Survey), 2018*

4

FORECASTING FOR CANADA'S MINING LABOUR MARKET

MiHR's labour market forecasting aims to discover the key areas where the mining industry will face labour market challenges, particularly in ensuring there is a sustainable labour source that can meet the competitive demands of the industry. MiHR's yearly update of its forecasting takes account of the most recent data inputs and makes any required improvements to the existing modelling framework (i.e. data sources and methodology).

MiHR's forecasting is centred on three main research questions:

1. ***What will be the mining industry's labour demand in the future?***
   MiHR's forecasting of industry employment provides an estimate of the demand for labour in the mining industry (i.e. the optimal employment level) over the next decade (2019–2029).

2. ***What workforce adjustments will be required to achieve the optimal level of industry employment?***
   The industry's employment level, at any given time, is sustained by ongoing recruitment efforts. MiHR's forecast of hiring requirements estimates the cumulative workforce adjustments that will be necessary to maintain the optimal level of employment over the next decade. This forecast considers the factors that drive recruitment decisions, namely: (1) the need to expand or contract due to changes in economic conditions, and (2) the need to replace workers who have exited the industry.

3. ***How difficult will it be to meet the required workforce adjustments?***
   The industry's ability to meet its hiring requirements will depend on whether there is a sufficient number of new workers (i.e. graduates, immigrants, etc.) entering mining-related occupations. A healthy labour market will draw enough entrants to offset future hiring needs. MiHR's forecast of the available talent is an estimate of the number of entrants by broad occupational category.

1. FUTURE LABOUR DEMAND

Central to MiHR's analysis of the mining labour market is a forecast of industry employment over a 10-year horizon. MiHR uses an econometric model to project changes in employment over the forecast period. This model takes into account the movements of relevant explanatory variables (such as mineral prices and GDP) and observes their effects on employment. Future changes in employment over the next decade are then estimated using various leading forecasts and intelligence for key explanatory variables.

Three Employment Scenarios

MiHR uses three economic scenarios — contractionary, expansionary and baseline — to generate employment forecasts. These three scenarios are designed to capture the industry's underlying volatility relative to changes in the economy, and the potential impact of these changes on employment levels for the forecast period. Each forecast scenario represents a cumulative workforce adjustment that will be required to meet the ever-changing demand for workers (i.e. net change in employment).

MiHR's baseline scenario uses various data sources (such as World Bank, Conference Board of Canada, System of National Accounts, etc.) to inform current trends and forecasts for prices and other input variables, and has adjusted these variables to reflect either a contractionary or an expansionary scenario.

Mining Employment Outlook

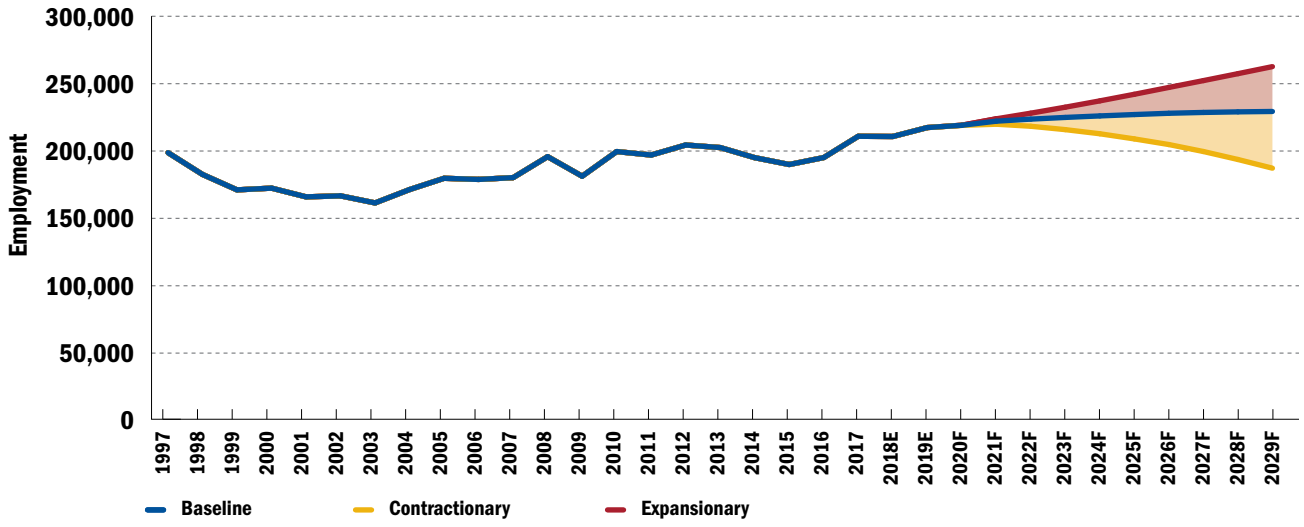
Figure 31 illustrates the overall mining industry employment outlook (historical and forecasted) for the three forecast scenarios. In 2019, about 217,040 workers[11] are projected to be employed in the mining industry, a modest employment increase of roughly 3% from 2018. Under the baseline scenario, MiHR projects that the mining industry will employ 228,970 workers in 2029.

If the industry follows the expansionary scenario, employment in the mining industry is projected to increase to 262,250 workers by 2029. However, under a contractionary scenario, employment in the mining industry is projected to decrease to 186,890 workers by 2029.

11 In the 2017 national report, MiHR reported a total industry employment of 189,000 for 2017, whereas the current report estimates industry employment at 210,570 for 2017. This difference is attributed to the use of 2016 census data, which tend to be greater than previously reported System of National Accounts data. In Figure 31, employment data from the System of National Accounts were anchored and adjusted to fit the census numbers.

FIGURE 31

Historical and forecasted employment in the mining industry* (1997–2029)



Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts, 2001 Census, 2006 Census, 2011 NHS, 2016 Census), 2018*
** Includes non-conventional oil extraction (NAICS 211114).*

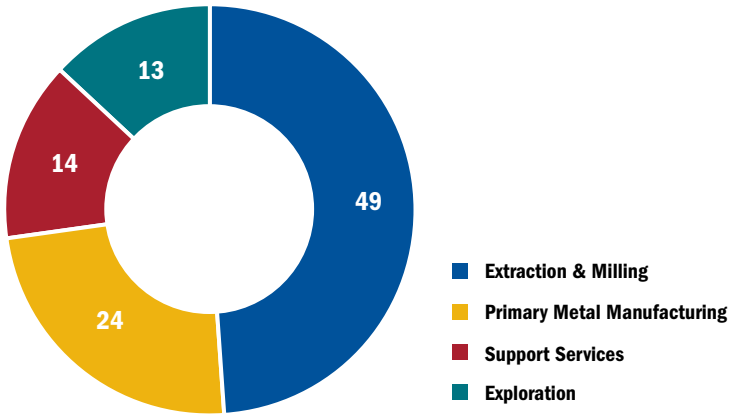
Employment Outlook by Mining Sub-sector

In 2029, the majority of mining employment (Figure 32) will be in *extraction & milling* (49%), followed by *primary metal manufacturing* (24%), *support services* (14%), and *exploration* (13%).

Figure 33 shows the share of net change in employment by mining sub-sector, both for 2016–2019 and the 10-year forecast period (2019–2029). From 2016 to 2019, *extraction & milling* is responsible for the largest share of the industry's employment growth, at 39%, followed by *primary metal manufacturing* (27%), *exploration* (19%), and *support services* (15%). MiHR expects that the largest segment of the employment growth over the 10-year forecast period will come from *support services* (33%) and *extraction & milling* (29%).

FIGURE 32

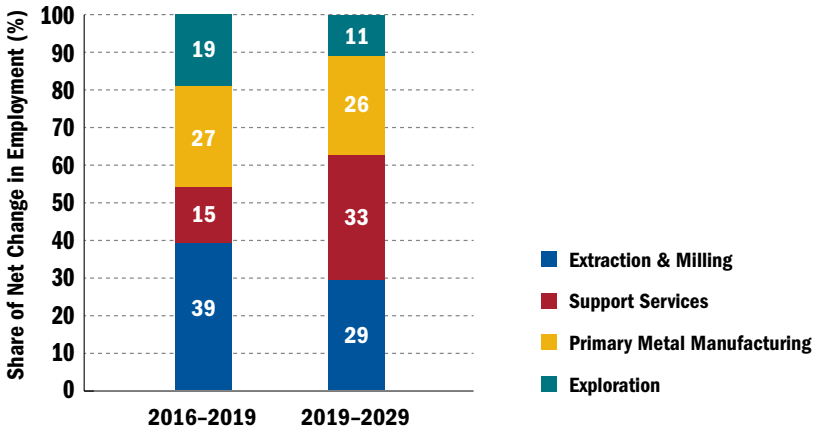
Share of employment by sub-sector*, baseline scenario (2029) (%)



Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts, 2016 Census), 2018*
* Extraction & Milling includes non-conventional oil extraction (NAICS 211114).

FIGURE 33

Share of net change in employment by sub-sector*, baseline scenario (2016–2029)



Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts, 2016 Census), 2018*
* Extraction & Milling includes non-conventional oil extraction (NAICS 211114).

2. WORKFORCE ADJUSTMENTS

MiHR considers two main factors that contribute to workforce adjustments in the mining industry: *net change in employment* and *exits*. Net change in employment describes changes in labour demand due to industry expansion or contraction. Exits refer to individuals leaving Canada's mining industry, either through retirement, out-migration, or other avenues.

Net Change in Employment

Table 4 shows the forecasted net change in employment for each broad occupational category. Under the baseline scenario, overall employment in the industry is expected to increase by 5% (an additional 11,930 workers) over the forecast period. Under the expansionary scenario, the industry's overall employment is expected to grow by 21% (an additional 45,210 workers). The contractionary scenario projects a 14% decline in employment (a loss of 30,150 workers).

Over the next decade, workers in *production occupations* will be most in-demand (among the broad occupational categories). Under the baseline scenario, the industry will need to employ 2,540 more people in this occupational category; under an expansionary scenario, the industry will need 10,580 more workers in *production occupations*.

TABLE 4

Forecast scenarios of cumulative net change in mining employment* by broad occupational category (2019–2029)

	Contractionary	Baseline	Expansionary
Human Resources and Financial Occupations	-1,020	370	1,460
Professional and Physical Sciences Occupations	-2,220	900	3,310
Supervisors, Coordinators, and Foremen	-2,150	760	3,050
Support Workers	-1,320	560	2,040
Technical Occupations	-1,750	730	2,670
Trades Occupations	-3,410	1,260	4,990
Production Occupations	-7,580	2,540	10,580
Other Occupations[12]	-10,710	4,820	17,120
All Occupations	**-30,150**	**11,930**	**45,210**

Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts, 2016 Census), 2018*
** Includes non-conventional oil extraction (NAICS 211114)*

12 *Other Occupations* refers to a large group of 4-digit NOC occupations not necessarily exclusive to mining operations, and outside the critical occupations targeted in this analysis, but employed by the industry nonetheless (e.g. registered nurses, light duty cleaners, security guards, etc.).

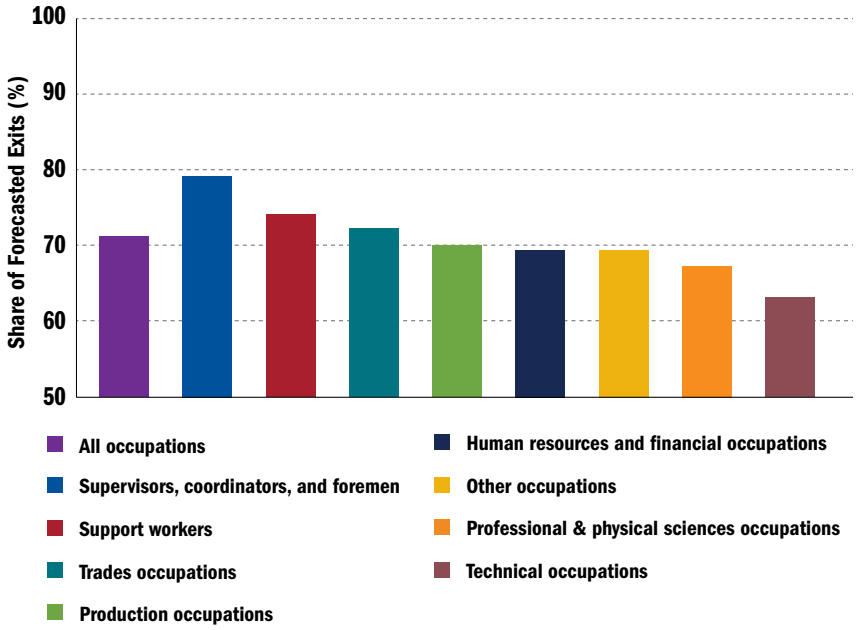
Industry Exits

Employee exits are a common and ongoing occurrence for all industries and the mining industry is no exception. Workers exit the mining labour force for various reasons. MiHR's forecasting captures two main categories of mining industry exits: (1) retirements and (2) non-retirement separations.[13]

Figure 34 shows the proportion of forecasted mining industry exits due to retirement for each broad occupational category. The top three categories most affected are (1) *supervisors, coordinators, and foremen*; (2) *support workers*; and (3) *trades occupations*, each with over 70% of projected exits stemming from retirement over the next decade.

FIGURE 34

Retirements as share of forecasted exits in the mining industry by broad occupational category, baseline scenario (2019–2029)



Source: *Mining Industry Human Resources Council, 2018*

Hiring Requirements

Employee exits create hiring pressures for the industry, but these pressures may differ by occupation. MiHR's forecast of hiring requirements gauges the human resources efforts (i.e. hiring effort) required to ensure that, over time, the forecasted employment level (shown in Figure 31) is attained.

Table 5 presents industry-wide hiring requirements for the forecast period, under the three economic scenarios described earlier in this report. The projected 10-year cumulative hiring requirements are as follows: 97,450 workers for the baseline scenario; 135,230 workers for the expansionary scenario; and 49,890 workers for the contractionary scenario. The majority of hiring requirements will come from replacing exiting workers.

13 Non-retirement separations refer to exits for reasons other than retirement, such as moving to another industry, moving out of the country, or dropping out of the labour force altogether.

TABLE 5

Cumulative hiring requirements* by forecast scenario (2019–2029)

	Net Change in Employment	Replacement Requirements		Cumulative Hiring Requirements
		Retirement	Non-Retirement	
Contractionary	-30,150	56,240	23,790	49,890
Baseline	11,930	60,200	25,320	97,450
Expansionary	45,210	63,440	26,580	135,230

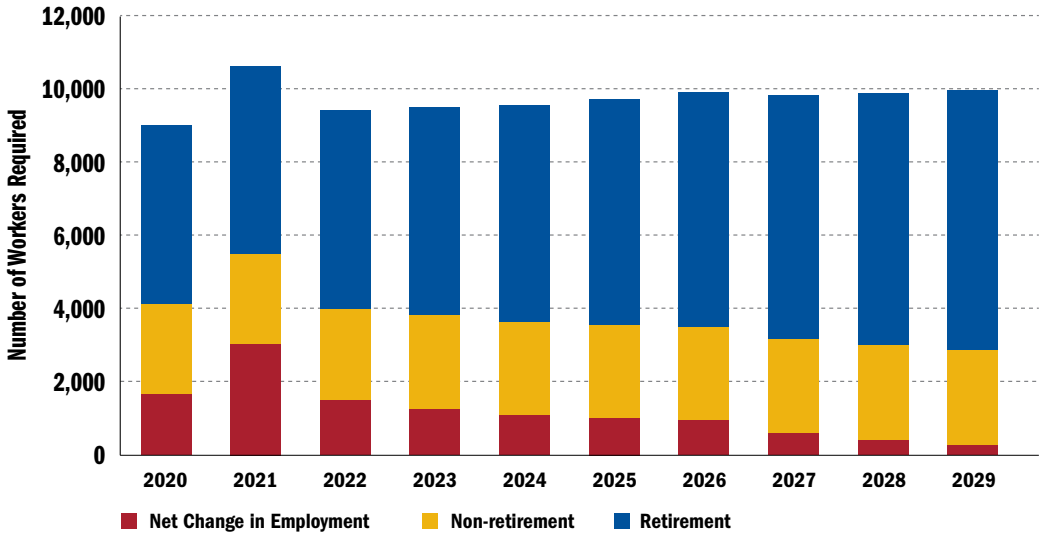
Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts, 2016 Census), 2018*
** Includes non-conventional oil extraction (NAICS 211114).*

Year-Over-Year Hiring Requirements

Figure 35 shows the year-over-year hiring requirements for 2020 to 2029, under the baseline scenario. Both 2020 and 2021 show expansion in employment for the mining industry, with employment gains projected at roughly 1,690 in 2020 and 3,040 in 2021. Employment growth in the industry is expected to gradually slow while industry retirements are expected to increase. The average yearly hiring requirement is projected to be roughly 9,750 over the period.

FIGURE 35

Forecast of annual hiring requirements*, baseline scenario (2019–2029)



Source: *Mining Industry Human Resources Council, 2018*
** Includes non-conventional oil extraction (NAICS 211114).*

3. RELATIVE DIFFICULTY OF WORKFORCE ADJUSTMENTS

The level of effort required to secure reliable labour sources can vary by occupation, depending on specific factors including the occupational training needs, the timing of hiring, and the natural flow of entrants to the occupation. Such factors will have a lesser or greater impact on the effort (and resources) required to address an occupation's imminent hiring needs.

MiHR's forecast of available talent investigates whether new entrants to mining-related occupations can adequately offset future hiring needs. A shortfall of new entrants points to potential risks for mining operations; a thin labour supply can derail projects, drive up the cost of finding workers, and ultimately undermine an operation's ability to continue to run competitively.

Industry Entrants

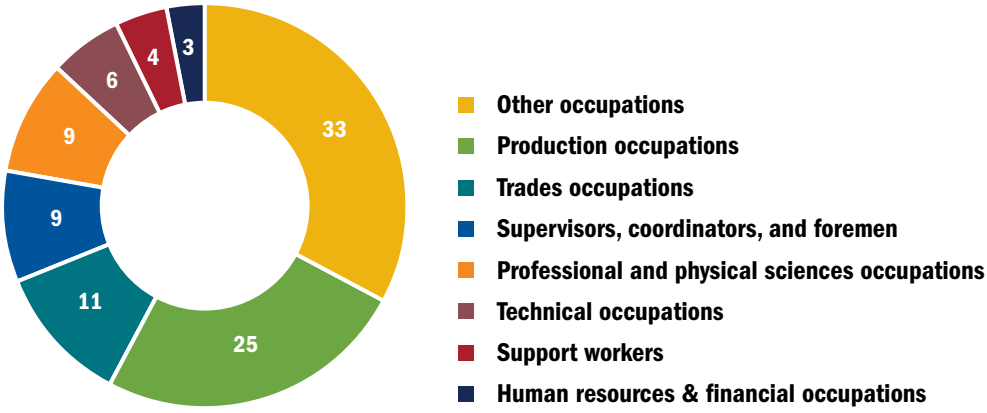
Entrants to mining-related occupations are essential to the industry's labour supply and its capacity to meet the forecasted hiring requirements. MiHR's model of available talent provides a forecast of new entrants to the mining labour market for the 70 mining-related occupations of interest (see Appendix A for a complete list). The forecast captures new entrants from a variety of entry points including school-to-work transition, immigration, industry migration, and returning to the labour force after a temporary leave, among others.

For each occupation, the model first projects the total new entrants that all industries will compete for, and then predicts the proportion that the mining industry will successfully attract over the forecast period. This proportion varies among occupations, depending on how specific an occupation is to the mining industry. The share that the mining industry is predicted to attract is based on historical patterns, taking into account other industries drawing from that same occupational pool. The model does not make any assumptions about future developments, such as the introduction of new training programs or changes to immigration policies.

Figure 36 shows the breakdown of forecasted new entrants by broad occupational categories. MiHR expects that from the pool of new mining entrants, 25% will be in *production occupations*, 11% in *trades occupations,* and 9% in *supervisors*, *coordinators*, and *foremen* occupations.

FIGURE 36

Share of new entrants by broad occupational category (2019–2029) (%)



Source: *Mining Industry Human Resources Council, 2018*

Sharing Talent with Other Industries

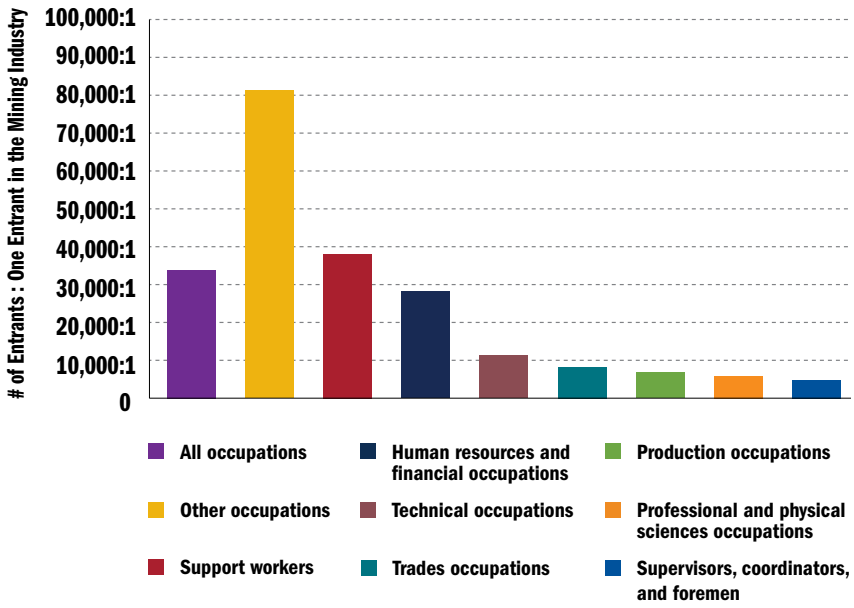
For all the occupations considered in this report, the mining industry competes with other industries for the same pool of available talent. Of workers who pursue a mining-related occupation, only some will actually enter the mining industry. The ability of the industry to attract talent can vary from one occupation to another.

MiHR gauges the mining industry's capacity to attract new entrants (Figure 37) by estimating the talent "sharing ratio" for each broad occupational category. This ratio expresses the number of new entrants across all industries that will be needed to attract one entrant to the mining industry. For instance, a sharing ratio of 10,000:1 suggests that 10,000 new entrants from all industries are needed in order for the mining industry to fill one vacancy. A sizable sharing ratio is less favorable for mining stakeholders looking to develop talent specific to the industry — there is indication that developing workers for that occupation will be relatively inefficient and competition with other industries will likely erode the available flow of new entrants.

All occupations (shown in Figure 37) has a sharing ratio of 33,900:1, which suggests that 33,900 new entrants are needed in all industries in order to attract one new entrant to the mining industry. *Other occupations* has the highest sharing ratio of new entrants, which is unsurprising given that this category refers to a large group of occupations not imperative to mining operations, but employed by the industry. The category *support workers* has the second highest sharing ratio of new entrants (37,900:1). Workers in these two broad occupational categories may be among the most difficult to recruit and retain for the mining industry.

FIGURE 37

Sharing ratio of new entrants with other industries by broad occupational category (2016)



Source: Mining Industry Human Resources Council, 2018

Gap Analysis

As previously discussed, the term net change in employment describes changes in labour demand due to industry expansion or contraction, and the net adjustment needed to ensure the workforce will remain at an optimal level to meet production targets and support industry growth. Exits consider those leaving Canada's mining industry, either through retirement, out-migration, or other avenues. Collectively, net change in employment and exits represent a need to hire or replace workers.

MiHR's gap analysis consolidates the hiring requirements and available talent forecasts into one comparative analysis of broad occupational categories under the baseline scenario. As Table 6 shows, a hiring gap exists if the industry's hiring needs exceed the number of new entrants over the forecast period. The right-hand column in the table shows the projected gap in each occupational category — the gap is especially prevalent in (1) *trades occupations*; (2) *production occupations*; and (3) *supervisors, coordinators, and foremen*. In combination, these three occupational categories represent a gap (hiring requirements less entrants) of 5,940 workers in the next decade.

TABLE 6

Forecasted hiring gaps in the mining industry* by broad occupational category, baseline scenario (2019–2029)

	Net Change in Employment	Exits	Total Hiring Requirements	Entrants	Gap Analysis and Hiring Challenge
Human Resources and Financial Occupations	370	2,660	3,020	2,780	-250
Professional and Physical Sciences Occupations	900	7,340	8,240	6,850	-1,390
Supervisors, Coordinators, and Foremen	760	7,820	8,590	6,860	-1,730
Support Workers	560	4,300	4,860	3,460	-1,400
Technical Occupations	730	4,780	5,510	4,750	-760
Trades Occupations	1,260	9,660	10,920	8,810	-2,110
Production Occupations	2,540	19,430	21,970	19,870	-2,100
Other Occupations[14]	4,820	29,530	34,340	26,830	-7,510
All Occupations	**11,930**	**85,520**	**97,450**	**80,200**	**-17,250**

Source: *Mining Industry Human Resources Council, 2018*
** Includes non-conventional oil extraction (NAICS 211114).*

Gap Intensity and Labour Market Tightness

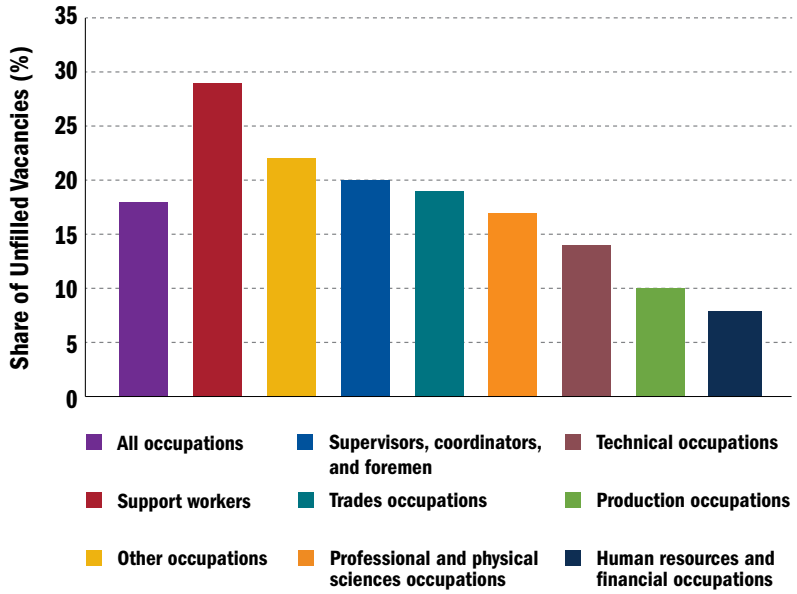
For each broad occupational category, MiHR reports the "gap intensity" — the share of hiring needs that is projected to remain unsatisfied. An occupation becomes more gap-intensive as the proportion of unmet hiring needs increases. In other words, the higher the gap intensity, the greater the number of vacancies that are expected to remain unfilled given the forecast of new entrants.

All of the broad occupational categories are projected to have a portion of unfilled hiring needs. Figure 38 shows the gap intensity share for each category. Support workers have the highest share, at 29%. For all occupations the gap intensity share is 18%.

14 Other Occupations refers to a large group of 4-digit NOC occupations not necessarily exclusive to mining operations, and outside the critical occupations targeted in this analysis, but employed by the industry nonetheless (e.g. registered nurses, light duty cleaners, security guards, etc.)

FIGURE 38

Hiring gap intensity by broad occupational category, baseline scenario (2019–2029)



Source: *Mining Industry Human Resources Council, 2018*

A high gap intensity is a sign of labour market tightness. A tight labour market can result from a shortfall of available workers or from a robust demand for workers (or a combination of both factors). In either case, employers' demand for workers has outpaced supply, likely causing wages to rise and unemployment to fall as employers become more willing to pay for labour inputs.

The hiring that will be needed to address industry expansion (i.e. net change in employment) is positive for all broad occupational categories; the majority of hiring pressure, however, is expected to come from forecasted exits, which are comparatively greater than changes in employment demand.

Among the forecasted exits, retirement accounts for the greatest share at roughly 71%. For mining employers and other stakeholders, a substantial number of exits are indicative of the potential cost associated with replacing exiting workers. This commonly involves a combination of advertising, interviewing, selecting, onboarding and training an individual to meet both the company standards and regulatory requirements. The process can be time-consuming, especially in tight labour supply situations. Compounding this challenge is the limited ability of employers to recruit workers to remote locations that are far from the amenities regularly found in larger population centres.

Entries, on the other hand, indicate the opportunity to neutralize the pressures and costs associated with hiring; that is, the burden of replacing a worker lessens if there is an abundance of qualified candidates. Yet, as Table 6 demonstrates, the forecast of entries for each broad occupational category is not sufficient to completely alleviate the hiring pressures generated by net change in employment and exits, resulting in occupational gaps in each category. This result indicates that the industry has a thin labour supply that will be challenged to match its forecasted employment needs.

5

SPOTLIGHT ON KEY MINING TOPICS

INTRODUCTION TO SPECIAL TOPICS

For more than 15 years, MiHR has systematically monitored the mining industry's labour market with a mandate to identify and address the human resources and labour market challenges facing the Canadian minerals and metals sector. Highlighted throughout this report are several key factors that will affect the mining labour market in the future.

The purpose of this section is to introduce three topics of interest to MiHR's mining stakeholders: (1) the impact of automation on mining's labour force, (2) the prevalence of STEM workers in mining, and (3) trends in post-secondary enrolment in mining engineering programs.

Topic One: The Potential Impact of Automation on Mining Labour Force

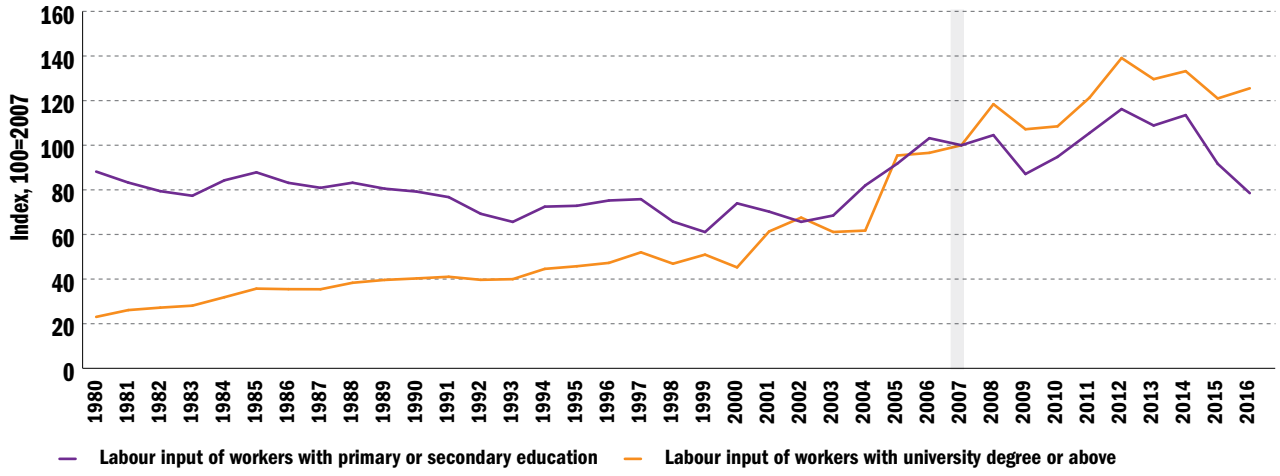
New Technologies and the Global Workforce

Globally, and across all industries, new technologies are rapidly shifting the way people work as well as the educational requirements and skills needed to enter the workforce. The mining industry is no exception. Figure 39 highlights the shift towards more educated workers in *mining, quarrying and oil and gas extraction* (NAICS 21) over the past few decades.

The shift in skills and educational requirements are not limited to the mining industry. A recent study by the McKinsey Global Institute estimates that between 75 million and 375 million people worldwide will need to change occupations and acquire new skills to adapt to the changes brought on by automation by the year 2030. Specifically identified are the need for advanced IT and programming skills; jobs requiring these skills are anticipated to grow as much as 90% from 2016 to 2030.[15]

FIGURE 39

Labour input of workers in mining, quarrying and oil & gas extraction (NAICS 21) by education level (1980–2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (Productivity Measures and Related Variables), 2018*

Canadian governments have also recognized the importance of innovation to national prosperity, which includes a strong mining sector. For example, NRCan has recently announced the Canadian Minerals and Metals Plan, which is intended to keep mining at the leading edge, with a focus on innovation. As well, the Canadian Federal Budget 2017 announced the federal government's Innovation and Skills Plan, which aims to build Canada as world leaders in innovation.[16]

Taken together, these federal plans affirm that innovation in mining is a priority for Canada, and specifically for the mining labour force of the future.

15 McKinsey Global Institute, Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation, December 2017

16 Government of Canada, Budget 2017, https://www.budget.gc.ca/2017/docs/bb/brief-bref-en.html#section1

Can automation and innovation improve productivity?

"What steps should mining companies take to ensure that they continue to improve their productivity? In the short term, they will need to guard against relaxing their discipline on capital and operating expenditures (including head counts) in the face of the demand and pricing rebound.

Mining companies have to ensure that they extract each ton of dirt at the best possible cost, so that they can pocket a greater portion of the higher prices currently seen in the market as demand gains momentum."

Source: *McKinsey&Company, "Productivity across the global mining sector is beginning to improve," June 2018*

The Shift to Automation in Mining: The Imperative for Change

Recently, much has been published on Canadian mining companies shifting to and/or expressing an interest in the use of new and advanced technologies — such as driverless trucks, drones and artificial intelligence[17] — to facilitate greater efficiencies in day-to-day operations. Despite the numerous reported benefits and anticipation of emerging technological advancements, the mining industry has been relatively cautious in its integration of new technologies.

In part, the cautious adoption of new technology is driven by numerous factors, including the requirement to make substantial capital investments, lengthy wait times post-ordering equipment or systems, the return on investment (ROI) given the remaining life of a mine, and the potential effect on local community employment and related agreements.

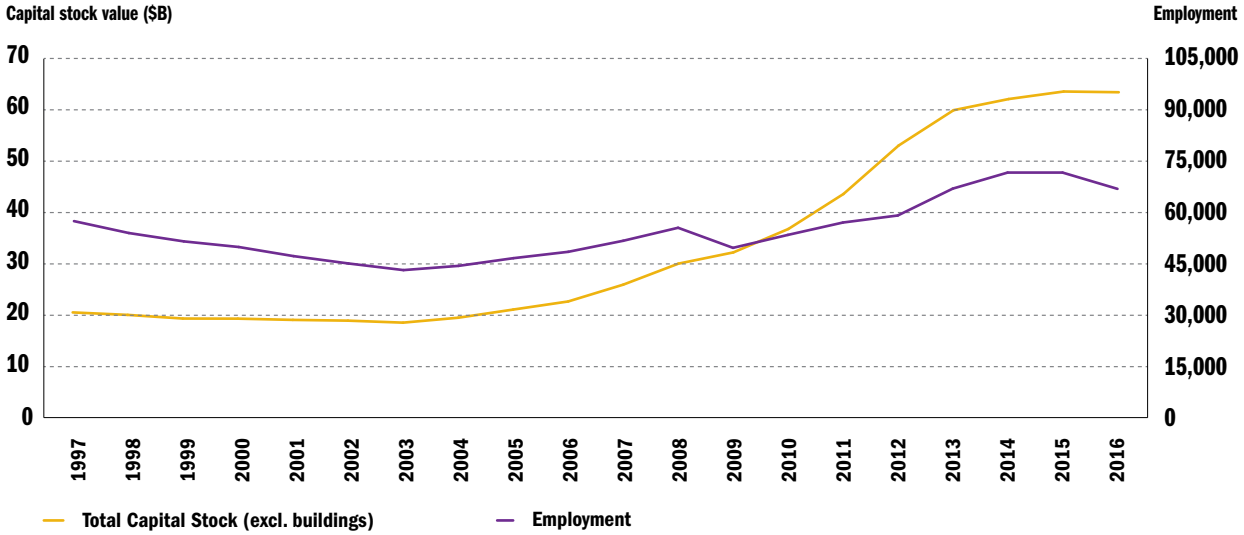
However, the adoption of new technology is not unprecedented in mining. Advances in equipment (e.g. scaled-up haul trucks, remotely operated vehicles) have already altered the demand for labour across the industry (in both labour size and the specific qualities that workers possess). For instance, from 1989 to 1997, the workforce shrunk significantly, by 27%, and has not since recovered — partly the result of permanent technological advancement.[18]

Evidence of the mining industry's adoption of new and more expensive advanced technologies and equipment are reflected by a substantial rise in annual investment over the last decade, leading to an increase in capital dollars spent per worker. Figure 40 compares the value of capital stock and the number of employees in *extraction & milling* over the past three decades. The growth of capital stock has greatly outpaced employment growth since the mid-2000s, indicating a shift in the production mix and a trend of capital intensification in mineral extraction over the past decade.

The mining workforce's interaction with capital has likely also changed over the past decade, suggesting that companies may have started to substitute labour in favour of advanced machines and equipment. For instance, switching to higher capacity haul trucks reduces the number of drivers required to move the same amount of product as before. With larger-scaled and more sophisticated equipment, companies may require workers who possess updated skills, educational requirements and experience.

FIGURE 40

Total capital stock and employment in extraction and milling (1997–2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts; Stock and Consumption of Fixed Non-residential Capital), 2018*

17 J. Schwartz, H. Stockton, K. Monham, "Forces of change: The Future of Work," Deloitte Insights (Nov. 9, 2017), https://www2.deloitte.com/insights/us/en/focus/technology-and-the-future-of-work/overview.html

18 Labour Force Survey (MiHR custom order), 2018

Long-Term Impact Suggests Strengthened Operational Efficiencies

New technologies have the potential to provide organizations with increased operational efficiencies, gains in productivity, healthier and safer workplaces, and demonstrable efforts to embrace corporate social responsibilities. Today's mining accesses deeper, narrower, and more complex deposits — these activities necessitate the use of new, more sophisticated and innovative technologies at all stages of the mining cycle.

The mining industry is experienced in managing conditions that are challenging and ever-changing, and is thus well-positioned to engage more deeply with innovation and technology. As the industry begins to engage with new and emerging technologies, it remains unclear how these technologies will affect its operations and labour force, both now and in the future. More specifically, clarification is needed on what technologies are currently in use by companies, how technological change is adopted and managed, the success of using new technologies, and especially how the use of new technologies will impact the mining workforce, particularly in terms of new and requisite skills for the future.

Understanding Automation and Innovation in Mining: Next Steps

Along with market volatility, workforce demographics and productivity, MiHR is incorporating analytics around innovation into its labour market information. This research will support a more robust understanding of the Canadian mining labour market, with a focus on the skills and knowledge needed to drive the industry forward in the digital age.

A strengthened understanding of innovation and automation in mining will greatly benefit the industry but it will also improve MiHR's capacity to provide accurate, timely and relevant labour force analyses. For example, new analysis of occupations may yield an understanding of which tasks will be automatable, eliminated and/or created, and the projected potential impacts on the labour force over time.

To do this, MiHR is embarking on a two-year study on the impacts of technology, automation and innovation on the Canadian mining workforce. Entitled "The Changing Nature of Work in Mining: Impact on the Canadian Mining Labour Force," MiHR's in-depth study aims to explore the overarching effects of technology on the mining workforce of the future and to strengthen our understanding of the industry's projected future occupational composition and skills mix.

Topic Two: STEM and the Canadian Mining Workforce

Understanding STEM

Both Statistics Canada and the Organisation for Economic Co-operation and Development (OECD) affirm that science, technology, engineering, and mathematics (STEM) occupations are an important driver of overall employment growth and potential contribution to a country's competiveness and economic prosperity.[19]

> *Given the scope and nature of their labour market activities — for instance, by engaging in research and development or other knowledge-enhancing activities — STEM graduates are considered key inputs of the national innovation system (Statistics Canada, 2013).*

Though STEM is often characterized as educational programs or occupations, STEM is also related to the skills shared by people in STEM-related fields of training or work. In 2015, the Council of Canadian Academies (CCA) published a report on the future impact of STEM skills in Canada. Directed by a panel of experts, the study describes three types of skills that define STEM: fundamental skills, practical skills and advanced skills. CCA defines STEM skills as "the set of core knowledge, skills, and capacities typically used or acquired in STEM occupations and/or acquired in STEM fields of study and programs. In this context, skills are understood to include what labour economists might refer to as competencies, knowledge, skills, and abilities."[20]

Though the CCA report recognizes that not all STEM skills are acquired through formal tertiary education, a practical analysis of STEM skills seems to require a connection to, or mapping of, categories of education or field of study. This is also the case for determining which occupations are STEM occupations. For instance, the CCA study defines a STEM-intensive occupation as "one where at least 50% of workers in the occupation have their highest level of education in a STEM field [of study]."

STEM and Mining

Employers in Canada's mining industry need individuals who are skilled in science, technology and engineering, and math. Each phase of the mining cycle depends on people with STEM skills including discovering and assessing the quality of a mineral deposit; planning, engineering and constructing mining facilities and equipment; and determining the best methods for managing and operating a mining project and properly closing and reclaiming a mine site.

Table 7 summarizes the mining-relevant, STEM-intensive occupations identified by the CCA study (given as three-digit NOC codes) and the mining-related occupations that MiHR tracks through ongoing research (given as four-digit NOC codes).[21] MiHR estimates that approximately 18% of Canada's mining workforce in 2016 was employed in STEM-related occupations (Table 8); engineers were the most sought-after category of worker.

19 Statistics Canada, *The Daily* (Dec. 18, 2013) (multiple citations), https://www150.statcan.gc.ca/n1/pub/75-006-x/2013001/article/11874-eng.htm#n2

20 Council of Canadian Academies (CCA), *Some Assembly Required: STEM Skills and Canada's Economic Productivity: The Expert Panel on STEM Skills for the Future*, 2015

21 MiHR's research for the mining industry typically tracks 70 occupations at the 4-digit NOC level. Among these occupations, 20 (or 28%) belong to CCA's STEM-intensive categories (as shown in Table 7).

TABLE 7

STEM-intensive occupations relevant to the mining industry[22]

	STEM-intensive occupations (3-digit NOC)		Occupations tracked by MiHR (4-digit NOC)
021	Managers in engineering, architecture, science and information systems	**0211**	Engineering managers
211	Physical Sciences professionals	**2112**	Chemists
		2113	Geoscientists and oceanographers
		2115	Other professional occupations in Physical Sciencess
212	Life sciences professionals	**2121**	Biologists and related scientists
213	Civil, mechanical, electrical and chemical engineers	**2131**	Civil engineers
		2132	Mechanical engineers
		2133	Electrical and electronics engineers
		2134	Chemical engineers
214	Other engineers	**2141**	Industrial and manufacturing engineers
		2142	Metallurgical and materials engineers
		2143	Mining engineers
		2144	Geological engineers
217	Computer and information systems professionals	**2171**	Information systems analysts and consultants
221	Technical occupations in Physical Sciencess	**2211**	Chemical technologists and technicians
		2212	Geological and mineral technologists and technicians
223	Technical occupations in civil, mechanical and industrial engineering	**2231**	Civil engineering technologists and technicians
		2232	Mechanical engineering technologists and technicians
		2233	Industrial engineering and manufacturing technologists and technicians
224	Technical occupations in electronics and electrical engineering	**2241**	Electrical and electronics engineering technologists and technicians

Source: *Mining Industry Human Resources Council, Council of Canadian Academies, 2018*

22 Note: The list of STEM-intensive occupations offers a practical means for examining STEM occupations in the mining industry, but it is not necessarily inclusive of all occupations that utilize STEM skills and training.

TABLE 8

Breakdown of mining workforce by STEM occupations (2016)

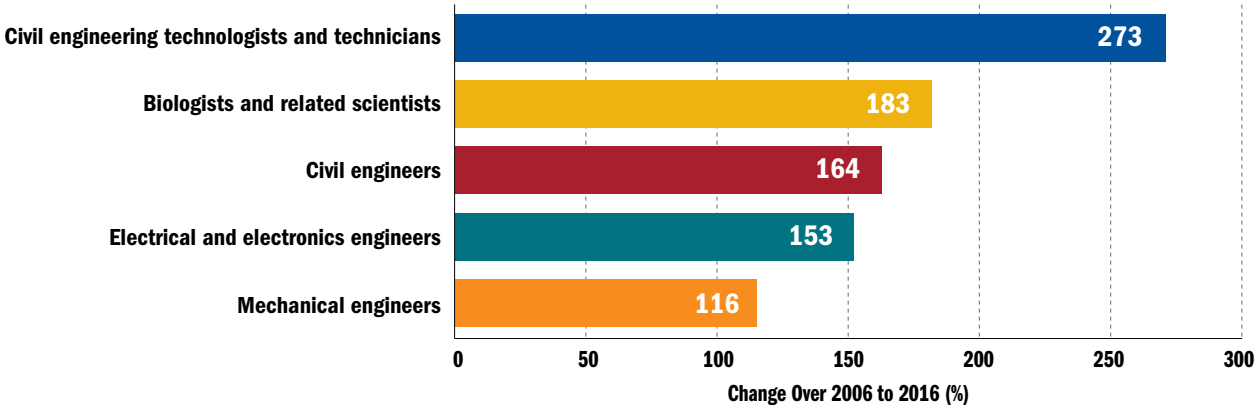
STEM by Category	Mining Industry	Extraction & Milling	Support Services	Primary Metal Manufacturing	Exploration
Science Professionals	4%	5%	5%	<1%	9%
IT Professionals and Technologists	4%	4%	4%	5%	5%
Engineers	10%	6%	5%	9%	25%
STEM Total	18%	15%	14%	14%	39%
Non-STEM Total	82%	85%	86%	86%	61%

Source: *Mining Industry Human Resources Council, Statistics Canada (System of National Accounts), 2018*

Figure 41 shows the top five fastest-growing STEM-intensive jobs in the mining industry over the past decade, providing further evidence that engineering-related occupations are becoming increasingly important to the mining industry (consistent with Table 8). Given the projected gap intensities for *professional and Physical Sciences Occupations and technical occupations* (Figure 38), the mining industry will likely face hiring challenges for engineering-related occupations if these trends continue.

FIGURE 41

Top 5 fastest-growing STEM-intensive occupations by share of mining workforce (2006–2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2006 Census, 2016 Census), 2018.*

Figure 42 shows the share of STEM-intensive occupations in the mining workforce by sub-sector. The proportion of STEM workers is highest in *exploration* (39%), followed by *extraction & milling* (15%), *primary metal manufacturing* (14%), and *support services* (14%). The high share of STEM occupations in the *exploration* industry is reflective of the importance of scientific and technical skills required in the mine discovery phase. The relative share of STEM skills decreases as the mine goes into production and non-STEM occupations become more prominent.

STEM Fueling Technological Change and Innovation in the Mining Industry

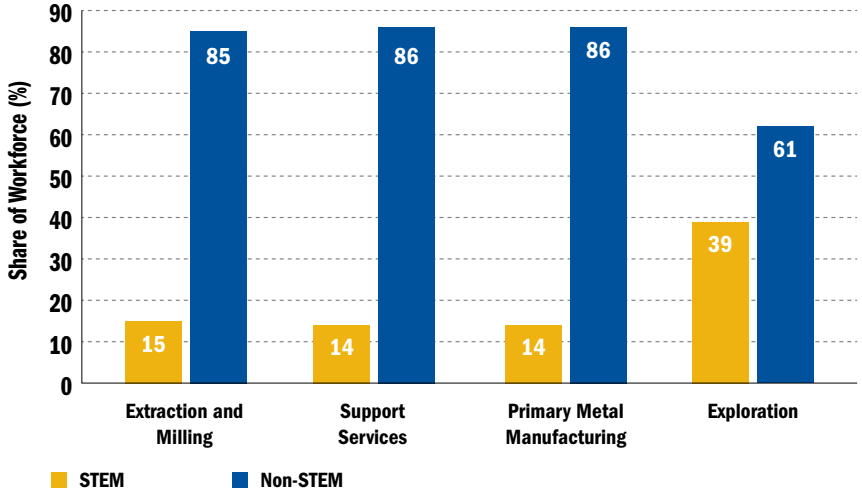
Innovation and the adoption of new technologies are changing the way that companies perform industrial and manufacturing processes. The World Economic Forum predicts that the current wave of automation, robotics and artificial intelligence will make STEM skills vital for long-term economic sustainability and growth.[23] The mining industry is transforming as a result of increased investments in automation, IT infrastructure and other advanced technologies.

Given the current business and technological climate, STEM skills may play a vital role in maintaining the competitiveness and productivity in capital intensive industries such as mining.

Newly developed mines are becoming more technologically advanced than older mines and have features like underground Wi-Fi and Radio-Frequency Identification (RFID) technology to track workers and equipment, automated scoops and haul trucks, and access to real-time planning and data analytics software. The increased adoption of technology in the mining industry has resulted in an increased need for workers with specialized STEM skills. The share of STEM-related occupations in mining increased from 14% in 2001 to 20% in 2011, hovering at 18.4% in 2016 (Figure 43). Most of the gains in STEM-related occupations are associated with increases in engineering occupations.

FIGURE 42

Share of workforce in STEM-intensive occupations by mining sub-sector (2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2016 Census), 2018*

As the OECD notes, technological change may lead to significant job destruction in the coming years as new technologies are able to take on an increasing number of tasks.[24] However, many high-skilled technical occupations may experience increased demand, as the tasks performed in these occupations are complements to technology rather than substitutes for it. New technologies can allow mining companies to re-evaluate the feasibility of developing deposits that were previously deemed inaccessible or uneconomic, creating new jobs for the mining industry.

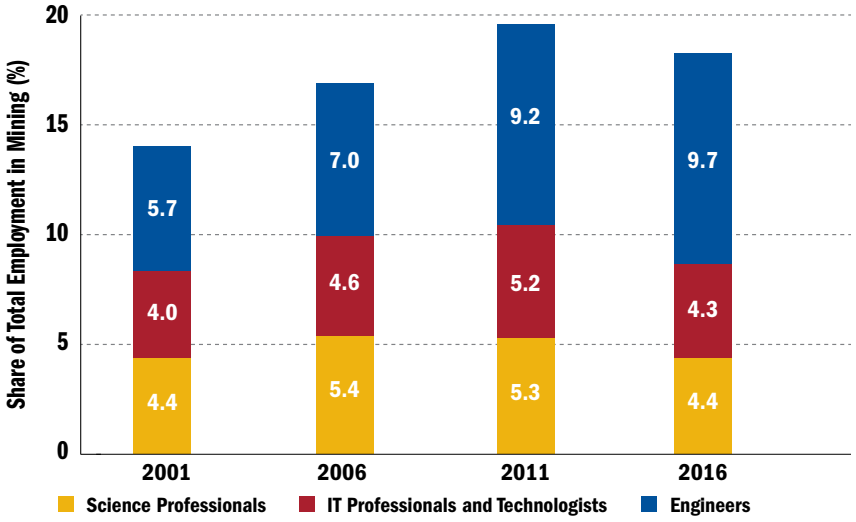
A well-rounded, skilled labour force requires opportunities for workers to acquire training, which can entail a considerable investment from the employer. Work-integrated learning can help to bridge this gap. By offering educational programs with the opportunity to develop hands-on skills, companies and post-secondary institutions can better prepare students for life after graduation. These opportunities can help students not only improve their technical skills, but allow them to acquire soft skills by performing tasks such as negotiation, supervising, monitoring and leading.

23 World Economic Forum (2016), Global Insight Report: *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*, http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

24 OECD (2018), "Transformative Technologies and Jobs of the Future." Background Report for the Canadian G7 Innovation Ministers' Meeting, Montreal, Canada, 27-28 March 2018, https://www.oecd.org/innovation/transformative-technologies-and-jobs-of-the-future.pdf

FIGURE 43

Trends in STEM-related employment in mining (2001–2016)



Source: *Mining Industry Human Resources Council, Statistics Canada (2001 Census, 2006 Census, 2011 NHS, 2016 Census), 2018*

Topic Three: Post-Secondary Enrolment in Mining Engineering Programs in Canada

Mining engineers are integral to mining operations, ensuring the safe and efficient planning and development of new mines as well as the expansion of existing mines. They apply scientific and technological principles to the surrounding environment, maximizing ore extraction while ensuring safe and environmentally responsible operating conditions. Mining engineers are vital in all stages of the mining cycle. They conduct feasibility studies before a mine is developed, oversee mining production throughout operation, and are an integral part of the mine closure and rehabilitation processes.[25] This section explores the particular enrolment trend in engineering programs that are relevant to Canada's mining industry.

STEM and Undergraduate Enrolment in Mining Engineering Programs

Half of all STEM-related occupations in the mining industry are in the engineering disciplines (Table 8), emphasizing the importance of high student enrolment in engineering programs for the mining industry. Of significant interest to MiHR are mining or mineral engineering programs — as most of the graduates will end up working in the mining industry.

According to Engineers Canada, undergraduate enrolment in accredited engineering programs has more than doubled over a 20-year period,[26] from 40,700 in 1996 to roughly 84,450 in 2016, representing an annual growth rate of about 4% (Table 9). This is encouraging, as demand for STEM skills is expected to grow with the increasing advances in technology, automation and artificial intelligence.

Mechanical, civil and electrical engineering are consistently the most popular programs, with over half of all engineering students enrolled in one of these three disciplines (Figure 44). Enrolment in mining or mineral, materials or metallurgical, and geological engineering programs was much lower (1.5%, 1.1%, and 0.9%, respectively). Between 2015 and 2016, undergraduate mining engineering programs experienced a drop of 12% in enrolment, the largest decline of all engineering programs. Anecdotally, this drop was (in part) due to students deciding to pursue other fields of study in response to poor mining labour market conditions and/or perceptions of mining-related work.

25 Job profiles of mining engineers are available at https://www.prospects.ac.uk/job-profiles/mining-engineer

26 Engineers Canada, *Canadian Engineers for Tomorrow – Trends in Engineering Enrolment and Degrees Awarded 2016*, https://engineerscanada.ca/reports/canadian-engineers-for-tomorrow-2016#undergraduate-enrolment-u

TABLE 9

Total undergraduate enrolment by engineering program (2012–2016)

	2012	2013	2014	2015	2016	Annual % Change (2015–2016)
Mechanical	14,490	15,370	17,090	18,170	18,890	4%
Civil	11,680	11,960	11,970	12,610	12,380	-2%
Electrical	10,460	10,560	11,410	11,780	11,710	-1%
Chemical	5,520	5,830	6,080	6,350	6,340	0%
Computer	3,520	3,870	4,110	4,850	5,470	13%
Software	2,570	2,970	3,620	4,110	4,710	14%
Engineering Physics	2,890	3,080	3,220	2,890	3,300	14%
Industrial or Manufacturing	1,860	1,960	2,430	2,510	2,810	12%
Mining or Mineral	**1,050**	**1,300**	**1,430**	**1,420**	**1,250**	**-12%**
Materials or Metallurgical	810	890	790	1,000	950	-5%
Geological	670	730	760	790	750	-5%
Other	14,100	13,940	14,330	15,930	15,890	0%
Total	69,610	72,450	77,230	82,410	84,450	2%

Source: *Mining Industry Human Resources Council, Engineers Canada, 2018*

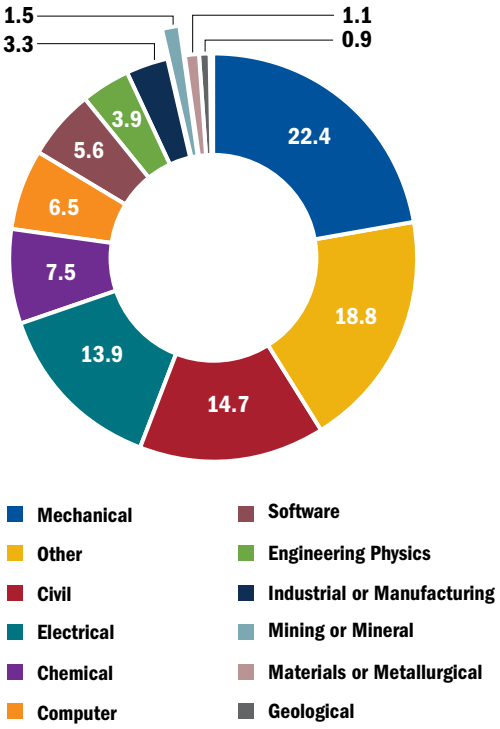
Graduate Studies in Mining Engineering

In 2016, total enrolment in graduate engineering programs was approximately 23,000 students, with 352 students (1.5%) in mining engineering. This suggests that pursuing graduate degrees in engineering is just as common for mining engineer students as for other engineering students; the proportion of enrolments in mining engineering programs does not change between undergraduate and graduate studies.

A large increase in mining engineering graduate enrolments occurred from 2013 to 2014, and enrolments have been increasing steadily since 2014 (Figure 45). Again, there are several anecdotal reasons related to the labour market suggested for this increase, but more research is needed to fully comprehend this trend.

FIGURE 44

Share of undergraduate enrolment by engineering program (2016) (%)



Source: *Mining Industry Human Resources Council, Engineers Canada, 2018*

Women Enrolled in Engineering Programs

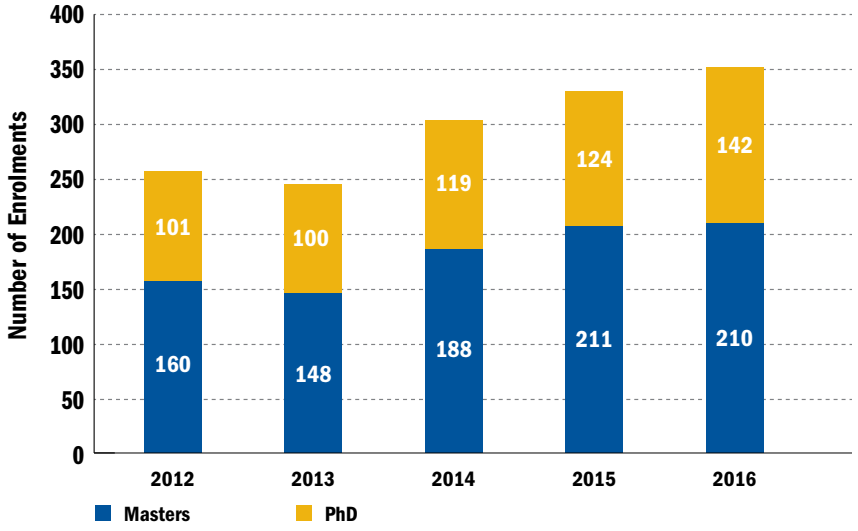
As Statistics Canada has observed,[27] over the past few decades women have made significant advances in university participation, including program areas that had previously been more populated by men. STEM program enrolments, however, are still mostly populated by men. Among women who choose to pursue a degree in STEM, most do so in biology or science programs, resulting in fewer women in engineering, computer science and mathematics programs.

The overall enrolment share of women in engineering programs is 21%. As Figure 46 shows, enrolment of women in engineering programs is highest in geological (37%), chemical (37%), and materials and metallurgical (30%). Mining engineering is among the engineering programs with the lowest proportion of women enrolled at the undergraduate level (15%), highlighting the need for the mining industry to encourage more women to enroll in mining engineering programs. The number of women enrolled at graduate-level mining engineering programs almost doubles to 27%, suggesting that women are more likely to pursue graduate studies in this field.

As demand for highly skilled workers in STEM increases, the ability to attract, recruit and retain more women in mining becomes increasingly important, especially given that women make up only 16% of workers in the mining industry (See Figure 25). Previous research on barriers, challenges and recommendations relating to this topic are summarized in MiHR's 2016 report, *Strengthening Mining Talent's Alloy — Exemplary Practices in Inclusion.*

FIGURE 45

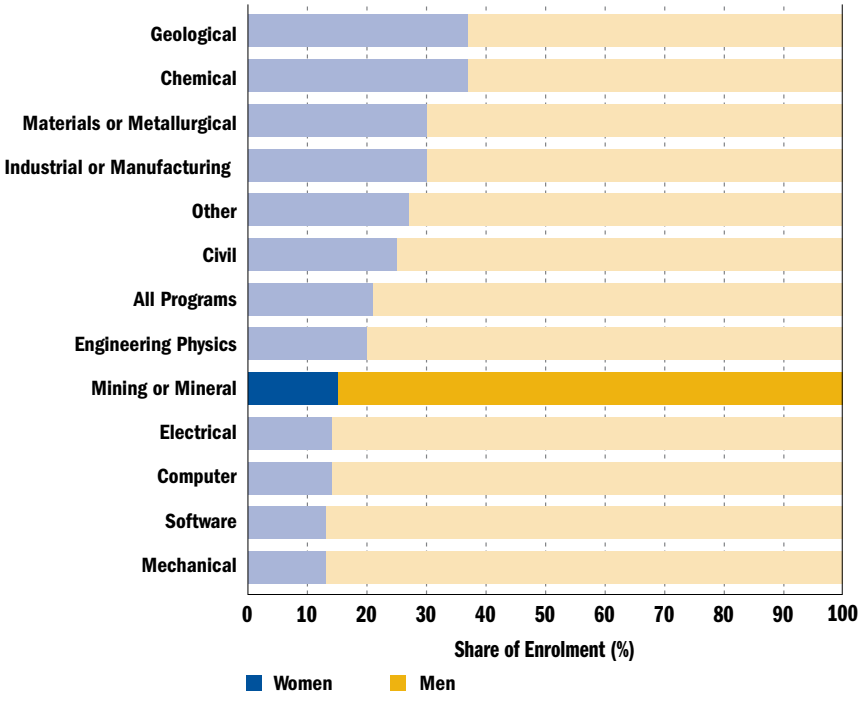
Total enrolment in graduate mining/mineral engineering programs (2012–2016)



Source: *Mining Industry Human Resources Council, Engineers Canada, 2018*

FIGURE 46

Undergraduate engineering program enrolment by sex (2016)



Source: *Mining Industry Human Resources Council, Engineers Canada, 2018*

27 Statistics Canada, *The Daily* (2013)

APPENDICES

APPENDIX A

Industry Classification

NAICS codes are used by statistical agencies throughout North America to describe economic and business activity at the industry level. The system features a production-oriented framework whereby assignment to a specific industry is based on primary activity, enabling the grouping together of establishments with similar activities. MiHR uses the following NAICS codes to define the mining industry:

Extraction & Milling

NAICS 2121 (Coal mining): This industry group comprises establishments primarily engaged in mining bituminous coal, anthracite and lignite by underground mining, and auger mining, strip mining, culm bank mining and other surface mining.

NAICS 2122 (Metal ore mining): This industry group comprises establishments primarily engaged in mining metallic minerals (ores). Also included are establishments engaged in ore dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served, or at mills, such as custom mills, operated separately.

NAICS 2123 (Non-metallic mineral mining and quarrying): This industry group comprises establishments primarily engaged in mining or quarrying non-metallic minerals, except coal. Primary preparation plants, such as those engaged in crushing, grinding and washing, are included.

NAICS 211114 (Non-conventional oil extraction):[28] This industry group comprises establishments primarily engaged in producing crude oil from surface shales or tar sands or from reservoirs in which the hydrocarbons are semisolids and conventional production methods are not possible.

Support Services

NAICS 21311B (Support activities for mining): This industry group comprises establishments primarily engaged in providing *support services*, on a contract or fee basis, required for the mining and quarrying of minerals. Establishments engaged in the *exploration* for minerals are included. Exploration includes traditional prospecting methods, such as taking ore samples and making geological observations at prospective sites. Note that this NAICS code combines NAICS codes 213117 (Contract drilling (except oil and gas)) and 213119 (Other support activities for mining).

Primary Metal Manufacturing

NAICS 3311 (Iron and steel mills and ferro-alloy manufacturing): This industry group comprises establishments primarily engaged in smelting iron ore and steel scrap to produce pig iron in molten or solid form.

NAICS 3313 (Alumina and aluminum production and processing): This industry group comprises establishments primarily engaged in extracting alumina.

NAICS 3314 (Non-ferrous metal (except aluminum) production and processing): This industry group comprises establishments primarily engaged in smelting, refining, rolling, drawing, extruding and alloying non-ferrous metal (except aluminum).

Exploration

NAICS 5413 (Architectural, engineering and related services): This industry group comprises establishments primarily engaged in providing architectural, engineering and related services, such as structure design, drafting, building inspection, landscape design, surveying and mapping, laboratory and on-site testing, and interior, industrial, graphic and other specialized design services. Note that only a portion of this NAICS code relates to geosciences, surveying and mapping, and assay laboratories)

Occupation Classification

Listed on the following page are the 70 NOC codes that MiHR uses to define the occupations that are considered to be important to the mining industry in Canada. Note that the occupation titles listed following are those used in the Statistics Canada system.

28 Excluded in all analyses in this report except for forecasting (Section 4).

Table A-1: List of National Occupational Classification (NOC) codes

NOC Code	Title
Production Occupations	
8231	Underground production and development miners
7511	Transport truck drivers
7521	Heavy equipment operators (except crane)
8614	Mine labourers
7452	Material handlers
7611	Construction trades helpers and labourers
8411	Underground mine service and support workers
9411	Machine operators, mineral and metal processing
9231	Central control and process operators, mineral and metal processing
9611	Labourers in mineral and metal processing
7372	Drillers and blasters - Surface mining, quarrying and construction
7612	Other trades helpers and labourers
7371	Crane operators
9241	Power systems and power station operators
Trades Occupations	
7312	Heavy-duty equipment mechanics
7271	Carpenters
7251	Plumbers
7252	Steamfitters, pipefitters and sprinkler system installers
7311	Construction millwrights and industrial mechanics
7242	Industrial electricians
7237	Welders and related machine operators
Professional and Physical Sciences Occupations	
2132	Mechanical engineers
2133	Electrical and electronics engineers
2113	Geoscientists and oceanographers
2143	Mining engineers
2121	Biologists and related scientists
2131	Civil engineers
2148	Other professional engineers, n.e.c.
2144	Geological engineers
2134	Chemical engineers
2142	Metallurgical and materials engineers
2141	Industrial and manufacturing engineers
2115	Other professional occupations in Physical Sciencess
2112	Chemists
Human Resources and Financial Occupations	
1111	Financial auditors and accountants
0112	Human resources managers
1112	Financial and investment analysts
0111	Financial managers
1121	Human resources professionals
Support Workers	
2263	Inspectors in public and environmental health and occupational health and safety
1241	Administrative assistants
2261	Non-destructive testers and inspection technicians
6322	Cooks
1411	General office support workers
1525	Dispatchers
1523	Production logistics coordinators
9415	Inspectors and testers, mineral and metal processing
2262	Engineering inspectors and regulatory officers
1526	Transportation route and crew schedulers
2234	Construction estimators
Technical Occupations	
2253	Drafting technologists and technicians
2231	Civil engineering technologists and technicians
2212	Geological and mineral technologists and technicians
2241	Electrical and electronics engineering technologists and technicians
2154	Land surveyors
2243	Industrial instrument technicians and mechanics
2211	Chemical technologists and technicians
2254	Land survey technologists and technicians
2232	Mechanical engineering technologists and technicians
2171	Information systems analysts and consultants
2233	Industrial engineering and manufacturing technologists and technicians
2255	Technical occupations in geomatics and meteorology
2221	Biological technologists and technicians
Supervisors, Coordinators, and Foreman	
8221	Supervisors, mining and quarrying
0811	Managers in natural resources production and fishing
0711	Construction managers
7203	Contractors and supervisors, pipefitting trades
0211	Engineering managers
9211	Supervisors, mineral and metal processing
7301	Contractors and supervisors, mechanic trades

APPENDIX B

List of Main Data Sources

Table B-1: List of main data sources used in MiHR's analyses

Data	Description
MiHR's Custom Cross-tabulation (NHS/Census)	This was purchased by MiHR from Statistics Canada's National Household Survey/Census for 2006, 2011, and 2016. It is aligned with MiHR's definition of the mining industry and covers a selected set of NAICS and NOC codes. It is used to describe the demographic characteristics of the mining labour force, as well as in the forecasting exercise.
MiHR's Custom Cross-tabulation (LFS)	This was purchased by MiHR from Statistics Canada's Labour Force Survey on an ongoing basis. It is aligned with MiHR's definition of the mining industry and covers a selected set of NAICS codes. It is used to describe the demographic characteristics of the mining labour force, as well as in the forecasting exercise.
Statistics Canada (LFS)	MiHR's research often turns to publically available Labour Force Survey data for information regarding labour force trends in a particular region (e.g., unemployment and part-time employment, among other characteristics of the labour force). These are often reported for broader NAICS codes than MiHR's custom cross-tabulation (for example, they provide data for NAICS 21 instead of the three-digit NAICS 212).
Other Statistics Canada Products	MiHR often also relies on other public information from Statistics Canada: Among these are the System of National Accounts, Canadian Business Patterns, Survey of Employment Payroll and Hours, and the Job Vacancy and Wages Survey.
NRCan	Natural Resources Canada provides information on several mining-related topics, including *exploration* spending and the value and type of minerals that are produced in Canada. NRCan also has a list of mining projects by type (e.g., producing mines, *exploration* and advanced development projects by region).
Industry Canada	Industry Canada provides useful information on mineral exports, exporting regions and other industry-specific variables.
World Bank	MiHR commonly uses the historical and forecasted mineral prices as a key input in its forecasting model. The World Bank updates its outlook for several commodities on a quarterly basis.
Other Sources	MiHR is continually looking for data that may be relevant to the mining labour force.

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