MINING INDUSTRY HUMAN RESOURCES COUNCIL

Preparing for the Future:

Mining Labour Market Outlook for British Columbia

2016 – 2026

Association for Mineral Exploration

CENTRE OF TRAINING EXCELLENCE IN MINING

MABC
MINING ASSOCIATION OF BRITISH COLUMBIA

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For more information, on this report contact:
Center of Training Excellence in Mining
info@bc-ctem.ca
Or visit the website at: www.bc-ctem.ca

For information pertaining to the labour market modelling and forecasting contact:
Mining Industry Human Resources Council
research@mihr.ca
Or visit the website at: www.mihr.ca

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AME Association for Mineral Exploration

BCSSGA

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MABC MINING ASSOCIATION OF BRITISH COLUMBIA

Industry partners are: Association for Mineral Exploration British Columbia, British Columbia Stone, Sand and Gravel Association, Centre of Training Excellence in Mining, and Mining Association of British Columbia

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Project Steering Committee:

- Paul Allard, British Columbia Stone, Sand and Gravel Association
- Dave Bazowski, previous BC Mining HR Task Force
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- Don Bragg, Prospector
- Sherry Campbell, Sherry Campbell Consulting, Project Manager
- Bryan Cox, Mining Association of British Columbia
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- Barbara Kirby, Mining Industry Human Resources Council, Senior Director, Labour Market Information
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- Tracey Sexton, Association for Mineral Exploration British Columbia
- Steven Thurmeier, Teck Resources Limited
- Jill Tsolinas, Centre of Training Excellence in Mining, Steering Committee Chair

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- BC Geological Survey
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- Canadian National Aboriginal Power and Energy Association
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- ERM Group Inc.
- Finning International Inc.
- Golden Predator Corp.
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Message from the Partners

Over the next 10 years, the robust and dynamic mining industry in British Columbia will need to hire an estimated 7,000 to 20,000 employees, representing between 25 and 65 percent of its current workforce. A key finding in this report is the requirement to improve access to qualified workers. Additionally, innovative approaches to recruit, train and retain a skilled workforce becomes increasingly necessary as the sector poises for growth.

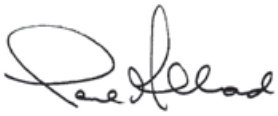
The report's findings outline opportunities to create a more sustainable workforce while its recommendations underline the importance of sector, educational and government partners to act collectively to build lasting strategies that will support the continued success of the provincial industry.

We, as project partners, would like to thank the BC government for funding the project, as well as the Steering Committee members and the many stakeholders who provided their knowledge and experience to research, develop and deliver this comprehensive report.

Sincerely,

Jill Tsolinas,
Steering Committee Chair;
and Executive Director,
Centre of Training Excellence
in Mining

Gavin C. Dirom,
President and CEO
Association for Mineral
Exploration British Columbia



Paul Allard,
Executive Director
BC Stone, Sand and Gravel
Association

Karina Briño,
President and CEO
Mining Association of
British Columbia

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Executive Summary

The Government of British Columbia, Ministry of Jobs, Tourism, and Skills Training (JTST) has provided funding to the Association for Mineral Exploration BC (AME) who, together with project partners from the Center of Training Excellence in Mining (CTEM), the Mining Association of BC (MABC) and the BC Stone, Sand and Gravel Association (BC SSGA), have contracted the Mining Industry Human Resources Council (MiHR) to conduct labour market analysis and forecasting for the BC mining industry. For this project, MiHR was responsible for the analysis of current conditions affecting the mining labour market in BC; an overview of the existing mining workforce in the province; participating in the stakeholder consultation workshops; developing forecasts of industry hiring requirements under three future scenarios; and forecasting future labour market outcomes with a focus on a range of mining activities including exploration, extraction, milling, secondary processing, mining support activities, contracting and aggregate operations. This report provides an update to the mining labour forecasts undertaken in 2012, when MiHR was contracted by AME, under the former BC Mining HR Task Force (see *British Columbia Hiring Requirements and Available Talent Forecasts — Exploration, Mining and Stone, Sand and Gravel, 2012).*

MiHR's labour market analysis and forecasting is supplemented by primary data collected from BC-based stakeholders through surveys, consultation workshops and discussions with associations, employers, unions, educators and workers/entrepreneurs associated with the mining, quarrying and exploration industries in the province. The report culminates with a summary of the research results, key findings and recommendations.

Mining in BC

As one of the world's largest clusters of exploration and mining companies, BC is recognized as a centre of excellence in mining and mining-related fields. Not only does the province possess a rich base of natural deposits and producing mines, Vancouver is also an international centre for industry head offices and mining support services such as geological research, business administration, finance, management, engineering and environmental consulting. Vancouver hosts more than half of Canada's mineral exploration companies.

Mining is a critical part of BC's economy and a key employer in the province. The mining industry provides full-time, high paying jobs and lucrative business opportunities for suppliers and service providers across the province. Flanked by the

The mining industry in British Columbia will face significant challenges in meeting all of their future hiring requirements, driven largely by the need to replace workers who are leaving the industry, whether they are retiring or leaving the sector, the province or the labour force altogether. The overall hiring requirements within the next 10 years will range from 7,000 up to nearly 20,000 workers.

Pacific Ocean, BC offers easy access to global markets. Mine operations benefit from tax incentives and a well-developed infrastructure, including low-cost electricity, an integrated road and rail network and large deep-water ports. Exploration benefits from an extensive geoscience database, a web-based mineral tenure system, and investment incentives such as the BC Mining Exploration Tax Credit and the BC Mining Flow Through Share Tax Credit.

The Ministry of Energy and Mines estimates the total value of mine production for 2015 at $6.3 billion, including coal, copper, industrial minerals, aggregate, gold, molybdenum, silver, zinc, and lead. Coal remained the highest value mined product in British Columbia, comprising about 51 per cent of the total output, followed by copper (approximately 28 per cent). At the start of 2016, mine closures reduced the number of operating metal mines to seven and coal mines to five. Industry employers in BC have provided company-based data that suggests mining is entering a period of recovery, with two new mines expected to open in 2017 and a number of projects that were closed since 2011 are evaluating re-opening.

Factors that will influence the demand for commodities and the future of mining in BC include: global population growth, life expectancy, the modernization of infrastructure, technology, and the movement to 'green' energy sources. The increasing demand on commodities will impact infrastructure, services, clean and sustainable products, and will also increase dialogue on the 'green economy.'

Provincial Support

The BC government's 2011 Jobs Plan highlights that the mining sector is providing significant opportunities for all British Columbians. It states that "mining produces enormous revenues for our province, especially our hospitals and schools. Mining in British Columbia generates wealth and economic benefits for BC families like few other industries."

The BC Jobs Plan is a living, evolving strategy document. The Plan's Four-Year Progress Update continues to feature the important contribution the mining sector makes to our provincial and national economy. It looks ahead to support the implementation of BC's Skills for Jobs Blueprint by improving mine apprenticeship opportunities for BC students and for BC First Nation communities. It also highlights efforts to finalize mineral tax revenue and land-and-water-rent sharing agreements with BC First Nations to share benefits and encourage the development of mining and clean energy (http://engage.gov.bc.ca/bcjobsplan/economy/progress-reports/).

Premier Christy Clark's Ministry Mandate Letter (July 2015) to Bill Bennett, Minister of Energy and Mines generated the mandate to work with the Ministry of Aboriginal Relations and Reconciliation on the mining dialogue with First Nations and to John Rustad, Minister of Aboriginal Affairs and Reconciliation to increase the number of First Nations people participating in apprenticeship and skills training programs.

Based on data from mining employers and the formal employment commitments documented in agreements between companies and BC First Nations groups, [relative or proportional] employment of Aboriginal peoples at BC mining operations continues to be significantly higher than in other sectors.

According to MiHR's mining labour force data, BC Aboriginal peoples have a larger representation in the mining labour force (about seven per cent) than the overall labour force (about five per cent). BC has seen an increase in Aboriginal peoples' involvement through focused, industry-relevant training programs and project-specific impact benefit agreements, resulting in an increase in participation. Some BC employers are reporting that the representation of Aboriginal peoples in their workforce at certain sites exceeds 33 per cent.

Objectives of this Study

A significant part of this project is dedicated to the analysis and discussion of topics relevant to the mining labour market in BC, including economic and demographic trends that shape and impact the hiring decisions of mining employers in the province. MiHR's analysis aims to highlight the prevailing trends that will create potential challenges for employers. The analysis includes the economic factors affecting the mining industry in the province over the next decade as well as occupational and demographic characteristics such as the age, education and diversity profiles of BC's mining labour force. The analysis provided by MiHR is strongly supplemented by consultation with industry associations, employers and stakeholders to help frame the context for the forecasts and recommendations in this report.

Results of this Study

This report considers the impact on employment for the mining sector over the next ten years based on three possible scenarios: contractionary, baseline and expansionary. The baseline scenario uses the current trends and forecasts for key commodity prices along with interest rates, exchange rates and capital stock. These forecasts are sourced from leading economic organizations including the World Bank and other financial/economic institutions. MiHR then constructs the contractionary and expansionary scenarios by adjusting the underlying forecasts to account for lower and higher outcomes.

Employment in mineral extraction activities in BC has grown by over four times between 2004 to 2015. In 2016, total employment in the industry in BC is estimated at 30,600 workers. Under the expansionary scenario, total employment would grow to almost 35,000 workers by 2026, whereas under the contractionary scenario, total employment would drop to 25,000 workers. The baseline scenario results in a small downward adjustment to total employment in mining, with around 30,000 workers employed in 2026. The baseline scenario provides a status quo analysis based on the current state of the mining industry, using cautious forecasts from the World Bank and other leading economic forecasters for future commodity prices, interest and exchange rates and for other factors such as capital stock. As such, MiHR's baseline scenario is considered a conservative foundation for the analyses and forecasts in this report. Industry leaders also acknowledged during interviews and consultation sessions that they take a cautious approach to providing growth estimates during a downturn.

Regardless of which scenario is considered, the mining industry in BC will face significant challenges in meeting future hiring requirements, driven largely by the need to replace workers who are leaving the industry, whether they are retiring or leaving the sector, the province or the labour force altogether. The overall net hiring requirements within the next 10 years will range from around 7,000 to nearly 20,000 workers, depending upon market conditions. In contrast, MiHR's available talent forecast projects that the total number of new entrants into the mining industry (graduates, immigrants and interprovincial migrants) in selected occupations over the next decade will not exceed 8,000 people. In the face of these forecasts and the expected developments in the sector over the next few years, the mining industry will struggle to fill vacancies and to retain skilled workers unless more can be done to provide focused support and education and training programs to help secure a more robust labour supply in the most critical occupations.

The occupational gaps in the MiHR research, which were validated by industry stakeholders, depict a critical need in professional and physical science occupations and technical occupations with supervisors, coordinators, and foremen also showing a significant gap. In addition, although work done over the past decade to increase trades training has reduced the disparity between available talent and hiring requirements, a gap remains. BC educational institutions are not able to train sufficient workers to support the current or predicted future increase in mining or sub-sector related activities over the next 10 years.

The five occupations with the largest hiring requirements for each of the industry sub-sectors include:

Extraction and Milling	Stone, Sand and Gravel	Exploration	Support Services
Heavy equipment operators (NOC 7521)	Heavy equipment operators (NOC 7521)	Engineers/Geoscientists*	Geologists (NOC 2113)
Underground production and development miners (NOC 8231)	Truck drivers (NOC 7511)	Drillers (NOC 7372)	Underground production and development miners (NOC 8231)
Truck drivers (NOC 7511)	Supervisors, mining and quarrying (NOC 8221)	Land surveyors (NOC 2154)	Heavy equipment operators (NOC 7521)
Heavy-duty equipment mechanics (NOC 7312)	Heavy-duty equipment mechanics (NOC 7312)	Chemical technicians (NOC 2211)	Truck drivers (NOC 7511)
Supervisors, mining and quarrying (NOC 8221)	Geologists (NOC 2113)	Drafting technicians (NOC 2253)	Mining engineers (NOC 2143)

** Includes NOC codes 2131, 2132, 2133, 2148, 2144, and 2113*

It is clear from the current and forecasted data reported by MiHR and validated by industry stakeholders that the industry is due for an upturn in growth starting in 2017 and spanning the next 10 years. Global economic drivers appear to be leading to another period of higher commodity prices and increased global demand and this is expected to impact mining employment in BC. Industry stakeholders and leading mining employers offered valuable insight to the forecasts of hiring requirements.

Labour Market Challenges for Mining

Numerous overarching themes emerged from the research, stakeholder consultations, employer interviews and Steering Committee input (comprised of industry leaders and stakeholders). Themes include:

- Retaining displaced workers during a downturn in the industry and maintaining their connection during an upswing when labour demands become high
- Reducing the loss of workers from the industry, especially at a time when retirement levels are high, to minimize the loss of knowledge and specialized skills
- Identifying transferable skills as they pertain to skilled workers for mining occupations and potential to work in other industries and sectors
- Assessing skills and providing opportunities for upgrading skills in local communities
- Recognizing and adapting skills required in the mine lifecycle due to changes in technology and innovation
- Understanding and adapting to the competition for skills from other industries, provinces and countries
- Optimizing workforce diversity as a valuable resource of workers for the mining industry, including increasing participation by underrepresented groups such as women and immigrants and creating more opportunities for Aboriginal peoples in the sector

Key Findings and Recommendations

The key findings for the mining labour market in British Columbia are a result of a review of research, both primary and secondary data, and direct consultation with mining associations, employers, education partners, mining workers and other stakeholders. The Steering Committee leveraged these key findings as support for the recommendations.

Key findings include:

1. THE STRUGGLE TO ATTRACT AND RETAIN WORKERS

The mining industry is highly volatile, experiencing cycles of downturns followed by upswings during which there are marked changes in the demand for skilled workers. The industry has experienced a downturn into 2016 with predictions for an upswing to start in 2017. This study considers that workers who were laid off during the downturn may behave in a number of different ways: some may choose to leave the industry and go to another sector; some may choose to pursue further education; some could migrate to mining jobs in other provinces while others may choose to remain within the BC mining labour force, continuing their job search within the province. In addition, employers indicated that when the upswing occurs and new mines open, there will be a rapid increase in hiring requirements. The combination of a sharp

increase in demand, coupled with limited availability of talent could lead to a crisis in the BC mining labour market over the next few years, in the absence of programs aimed to address the potential shortages.

2. THE NEED TO ATTRACT NEW SKILLED WORKERS TO THE INDUSTRY

The industry, even in a baseline scenario, will face demand for skilled workers due to the increasing number of retiring workers in addition to those exiting the workplace for other reasons. The hiring requirements between 2017 and 2026 under the baseline scenario will be for an additional 14,000 workers. With a projected upswing starting in 2017, this demand could increase to as many as 20,000 workers in an expansionary scenario and will result in an even wider gap between industry's needs and inflow of new talent. Even in a contractionary scenario, with increased numbers of mine closures and fewer new mines opening, industry would still require 7,000 workers to replace those exiting the mining workplace due to retirement or other reasons. In other words, the industry's need for skilled workers will persist, regardless of the volatile labour market.

3. THE OPPORTUNITY TO LEVERAGE DIVERSE POPULATIONS

The mining industry in BC continues to excel in the inclusion of Indigenous people in their workforce, exceeding the accomplishments in other sectors. BC has seen an increase in Aboriginal peoples' involvement through focused industry-specific training programs and impact-benefit agreements. However, there is still more that can be done to improve the mining sector employment outcomes for Aboriginal communities. The focus should continue to be on the opportunities for shared prosperity from mining and exploration activities.

In contrast, there has been only a marginal increase in the proportion of women and skilled immigrants in the mining workforce compared to the 2012 study. Despite a higher concentration of immigrants in BC's labour force, and the influx of internationally trained professionals to the province, there has not been a corresponding increase in the engagement of skilled immigrants in the mining workforce.

Although individual employers have made significant gains in the number of women employed at their mines through targeted engagement strategies, the mining industry generally struggles to retain the female workforce, especially in non-traditional roles and occupations.

There is a need to continue efforts to diversify the workforce in mining, ensuring that current engagement initiatives are continued, while developing new strategies to boost representation of these key labour groups.

4. ADAPTING THE WORKPLACE ENVIRONMENT TO RETAIN SKILLED WORKERS

It is acknowledged that the industry cycles and the demand for skilled workers requires strategies to improve retention of employees and provide networking opportunities for displaced workers throughout the mine life cycle. In addition, strategies for maintaining a connection with mining sector workers during periods of layoffs and downsizing is key to sustaining a pipeline of skilled workers that can be re-engaged as soon as the anticipated upswings occur.

The following two key recommendations encompass the key findings of the research.

Recommendation 1:

Strengthen collaborative partnerships between employers and government to support labour market information collection and strategies for attraction, retention and transition of mining workers through mine life cycles.

Recommendation 2:

Build upon findings to develop strategies to address critical job vacancies and support a sustainable workforce.

1. Introduction

British Columbia's (BC) mining industry is one of the largest in Canada. Not only does the province possess a rich base of natural deposits and producing mines, it is also a major centre for mining activities and a hub for a variety of mining operations, head offices and service providers. Mining is also a critical part of BC's economy and a key employer in the province; in 2015, the industry directly employed close to 30,000 workers.

Flanked by the Pacific Ocean, BC offers easy access to global markets. Mine operations benefit from tax incentives and a well-developed infrastructure, including low-cost electricity, and an integrated road and rail network with large deep-water ports. Exploration benefits from an extensive geoscience database, a web-based mineral tenure system, and investment incentives such as the BC Mining Exploration Tax Credit and the BC Mining Flow Through Share Tax Credit.

The Ministry of Energy and Mines estimates the total value of mine production for 2015 at $6.3 billion, including coal, copper, industrial minerals, aggregate, gold, molybdenum, silver, zinc and lead. Coal remained the highest value mined product in BC, comprising about 51 per cent of the total output, followed by copper (approximately 28 per cent). The province also participates in international investment missions showcasing mineral and coal opportunities.

Mining development will continue to stimulate economic opportunities for BC. Much of the future development expected and projected by industry stakeholders will depend on its ability to attract and retain key talent. Even with the cautious economic outlook adopted in MiHR's industry-wide forecast, the industry is expected to face labour market challenges in the coming years. In particular, access to a skilled workforce including youth, Aboriginal peoples, immigrants, inter-provincial migrants and women remains an underlying challenge that – despite ever-fluctuating economic conditions – can undermine the overall competitiveness of BC's mining industry in the long-run.

The mining labour market analysis in this report builds on the 2012 report produced by MiHR: *British Columbia Hiring Requirements and Available Talent Forecasts – 2012.* It is intended to identify the key characteristics that shape and influence BC's mining labour market and to diagnose potential risks that threaten the industry's capacity to reach its potential level of growth over the next 10 years. The labour market analysis and forecasts are further augmented with the addition of other primary and secondary data collected and analyzed by the BC Steering Commitee members. The insights from

this research has been used by project partners, the Steering Committee members and other industry stakeholders to inform key strategies or collaborative partnerships to address the human resources (HR) challenges in the mining labour market.

Labour Market Information (LMI) provides the necessary intelligence needed by individuals and organizations to make informed decisions. Whether you are an individual looking for a career or you work for a mining/exploration company, contractor, supplier, government department, educational institution, training organization or industry association, having accurate and timely LMI to guide your decisions is critical. In addition, mining employers, education institutions and government all use LMI as a basis to identify, plan and develop creative and collaborative HR strategies to address industry and cross-sectoral labour market challenges.

The Mining Industry Human Resources Council's (MiHR) ongoing research continues to identify human resources (HR) trends that challenge the mining industry. This report provides a custom region-specific analysis and a variety of forecasts that focus on BC's mining labour market including mineral exploration, mining and aggregate operations.

BC industry research has been conducted in tandem with MiHR's research and analysis of statistical data to engage with government, mining associations, employers, educational institutions, regulatory bodies and mining workers. Consultation sessions have included multi-stakeholder workshops as well as employer interviews and focus groups with displaced and retired mining workers.

In this report, MiHR develops and presents forecasts of employment, hiring requirements and available talent for the province's mining industry over a 10 year horizon (2016–2026). The projected gaps between hiring requirements and available talent are provided for selected mining-related occupations with recommendations for meeting key HR challenges.

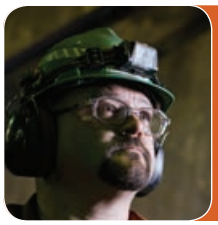
Report Overview

The Government of British Columbia, Ministry of Jobs, Tourism, and Skills Training (JTST) has provided funding to the Association for Mineral Exploration BC (AME) who, together with project partners from the Center of Training Excellence in Mining (CTEM), the Mining Association of BC (MABC) and the BC Stone, Sand and Gravel Association (BCSSGA), have contracted MiHR to analyze current conditions in the mining labour market in BC and to forecast future labour market outcomes with a focus on a range of mining activities including exploration, extraction, milling, secondary processing, mining support activities, contracting and aggregate operations.

This report provides an update to the mining labour market study undertaken in 2012, when MiHR was contracted by AME, under the former BC Mining HR Taskforce. Since the publication of the 2012 report the mining industry has experienced a significant downturn, while more recently, a number of new projects have also entered the permitting stages. As a result, the industry stakeholders have stepped forward in this study to update their outlook for future labour market developments and outlook for the future. This collaborative approach has also provided important input to the findings and recommendations developed in this report to address the future labour market needs in the mining industry in BC.

This report is organized as follows:

- **Section 1:** provides a brief introduction and report overview.
- **Section 2:** discusses MiHR's definition of the mining industry and the list of data sources used in this report, including primary data that has been collected from mining stakeholders in BC.
- **Section 3:** presents an economic overview for BC and discusses the relevance to the province's mining industry.
- **Section 4:** describes the mining industry in BC, including a description of the minerals being explored for and produced and the behavior trends of operations over time (e.g. employment size, spending patterns, the use of capital, machines and equipment, etc.).
- **Section 5:** examines BC's mining labour market in more depth, covering topics such as age, mobility and diversity.
- **Section 6:** presents MiHR's forecasts of employment, hiring requirements and available talent, and offers an analysis of the labour market pressures facing mining-related occupations in BC.
- **Section 7:** summarizes and highlights a number of key HR concerns and labour market challenges for the mining industry such as retention of and maintaining connection with displaced workers and provides the context for Section Eight (findings and recommendations).
- **Section 8:** summarizes the report findings and describes the major labour market issues and challenges facing BC's mining industry and employers. The report concludes with a discussion of the key findings, potential opportunities and recommendations to address HR challenges and build a competitive mining industry in BC over the next 10 years and beyond.



2. Information, Intelligence and Resources

Industry Definition and Scope

MiHR defines the mining industry as including all phases of mining development: prospecting and exploration; construction and development; extraction; processing, and reclamation, closure, and care-and-maintenance. The forecasts presented in this report rely on industry-level data collected and aggregated through Statistics Canada using North American Industry Classification Codes (NAICS) and National Occupational Classification (NOC) codes to define the mining industry and its workforce.

Specifically, MiHR uses NAICS categories to describe four mining sectors: *Exploration, Extraction & Milling, Support Services, and Fabrication & Manufacturing.* In addition, NOC categories are used to describe 70 occupations that are relevant to the mining industry. A full description on the NAICS and NOC codes included in the forecasts are in Appendix A.

The Mining Cycle

BC's mining industry is made up of a wide range of activities from exploration to reclamation. Each plays a role in the entire process – from discovering and extracting minerals – to delivering them to an end user, or for further processing down the line. MiHR's definition of the mining industry groups these activities into defined sectors that span the entire timeline of the process (commonly referred to as the 'mining life cycle'). Much of MiHR's analyses rely on information that is aligned with these defined sectors; as such, MiHR frequently uses industry-level data (from Statistics Canada), which is collected and disseminated through specific NAICS codes. Each phase of BC's mining life cycle is captured under the following industry sectors:

Exploration: denotes activities focused on the discovery of metals, minerals and other commodities such as coal. Most of BC's exploration is active in base and precious metals, namely copper, molybdenum, zinc, lead, gold and silver (among others). Coal and aggregates (i.e. stone, sand and gravel products) tend to be near the surface and therefore usually do not have a need for large-scale exploration projects. This sector encompasses the range of exploration activities from small-scale exploration to advanced development exploration. Exploration projects can be as basic as a one-day walk with no equipment or as robust as a multi-month long program with drills within a camp setting; an individual project's workforce can range from just one to a couple of dozen employees.

Extraction and Milling: primarily describes all activities at operating mines in the province, including both surface and underground mining operations. This includes removing the commodity from the ground as well as the primary processing (crushing, separation, etc.) that occurs in on-site mills. This sector also covers all types of commodities that are extracted (excluding oil and gas extraction). BC is a significant producer of metallurgical (or steel-making) coal but is also home to metal and mineral mining (notably copper, zinc and molybdenum among others). Mining operations range in size; in BC they are usually among the larger employers with a workforce of over 500 people on average.

Stone, Sand and Gravel: is usually considered under 'Extraction and Milling' but has been separated out for the purpose of this report due to its prominence in BC. This sector includes the many pits/quarries in the province producing these aggregate products often used in construction and building projects (among other uses). This sector is unique compared to other types of mining operations; quarries are commonly located near cities or ports to reduce transportation costs and have comparatively low extraction costs as deposits are typically close to the earth's surface. Aggregate projects are also generally small, privately-owned operations, requiring less than a dozen employees.[1] Note that data on aggregates can be difficult to separate from other mined commodities. Data sources are often reported for "industrial minerals" which may include other extracted commodities in addition to stone, sand and gravel/(aggregate) products.

Support Services: includes the activities of organizations providing support services for the mining industry. Given that these organizations are typically not the primary owner/operators of a project, their services are usually purchased on a contract or fee basis. This sector counts all forms of support services, including those required for extraction, quarrying and processing to exploration activities, such as taking ore samples and making geological observations at prospective sites. As such, support services cover a wide range of organizational types and sizes. BC is home to one of Canada's largest support services sectors: Canadian Business Patterns data shows the province has the highest share (about 37 per cent) of establishments categorized under "contract drilling" (except oil and gas) – NAICS 213117 and other support activities for mining – NAICS 213119.

Fabrication and Manufacturing: consists of activities that are directly downstream from 'Extraction & Milling.' This sector includes activities in smelting iron ore, aluminum production and in smelting, refining, rolling, drawing, extruding and alloying other non-ferrous metals. There are two main smelters operating in BC in 2016.

The "mining industry" refers to any industry activity belonging to the set of industry sectors described above. Even though each of these sectors is classified by specific NAICS codes (a detailed list is given in Appendix A), depending on the specific topic that is being considered, it is not always the case that the analyses are perfectly covered under these NAICS codes. For example, in some cases, it is necessary to use data for 'NAICS 21 Mining, quarrying and oil and gas extraction' to describe mining related trends in a specific region as the data at the three to four- digit NAICS level (which would allow exclusion of oil and gas activities) is limited or unavailable.

1 *For more information on Aggregate products, please visit the British Columbia Stone, Sand and Gravel Association's (BCSSGA) website: http://www.gravelbc.ca/aggregate/faq.html*

Key Data Sources

MiHR relies on a variety of data inputs, mining industry intelligence and other information to produce labour market analyses and forecasting for Canada's mining industry. As described, MiHR uses data from Statistics Canada throughout its reporting and as inputs in its forecasts, including a custom data cross-tabulation from Statistics Canada that is aligned with MiHR's definition of the mining industry and selected occupations. Other Statistics Canada information comes from the 2011 National Household Survey, the 2006 and 2011 Censuses, the Labour Force Survey, the Survey of Employment Payroll and Hours, Canada Business Patterns and the Job Vacancy and Wages Survey.

This study utilizes additional information sources, including Natural Resources Canada (NRCan), PricewaterhouseCoopers (PwC), the Conference Board of Canada and the World Bank. In addition, wherever possible, provincial sources of data were used including data from the BC Ministry of Jobs, Tourism, and Skills Training (JTST), Ministry of Energy and Mines (MEM) and other organizations. These sources provide information on a wide range of factors that are relevant to the mining industry and its labour market, including outlooks/forecasts for international commodity prices, exchanges rates and interest rates; they also provide labour market statistics, inventory of mining projects in operation and under development, reporting on notable economic and labour force trends, and information on demographic factors that impact the mining labour force.

A list of the main data sources and their description is given in Appendix B.

Industry Consultations and Primary Industry Research

A key component of data collection and information gathering for this study was the implementation of primary research with industry stakeholders. The activities undertaken in this project included six stakeholder group consultation sessions with diverse representation to gain insight and understanding of the state of mining in BC. Furthermore, the primary data collection allowed the researchers to validate the analysis and forecasts presented in this report. The information collected included input on anticipated future growth, estimated future recruitment and employment requirements, retention and other key labour market challenges, identification of talent/skills gaps, along with expectations about current and future mining activities in British Columbia. Industry stakeholders also provided valuable insight into issues relating to workforce diversity and other key HR issues for the mining industry in BC. Listed below are the stakeholder sessions held in May 2016 and the session profile.

Overview of stakeholder sessions

Date of Session	Session Type	Length of Session (hrs)	Number of Participants
May 5	Workshop (in-person)	3.0	9
May 5	Teleconference consultation	2.0	6
May 6	In-person luncheon	1.5	7
May 6	In-person dinner	1.5	7
May 24	In-person or teleconference luncheon session	1.5	3
May 30	In-person or teleconference luncheon	1.5	5

The variety of session formats ensured a cross-section of the mining industry that included employers and HR representatives, industry and educational organizations with specific programs leading to mining employment, labour and immigrant support organizations and consultants, job-seekers and past mining employees (who are currently not in the mining workforce). A complete list of participants in the stakeholder sessions is included in the Acknowledgements of the report.

In May 2016, MEM collected employment data from a sample of 13 operating mine sites in British Columbia and two projects in the advanced development (pre-construction) phases that are expected to go into operation in 2017. The data collected included employment of both direct employees as well as contractors for each of the past five years (2011 through 2016). The historical employment data collected by MEM for each of the 13 operating mines in the MEM sample is presented in Section Four of the report (see Figure 15).

The MEM data was also used by the BC project managers as a basis for interviewing individual employers to validate and enhance the primary data by adding estimates of employment at corporate offices as well as expectations about future employment levels at these 13 sample operating mine sites over the coming decade.

Furthermore, the researchers polled a selection of companies that are anticipating eight new mine projects in the permitting and/or pre-construction phase in the province, to ascertain their expectations about future hiring requirements (both contractors and direct employees). It should be noted that these eight projects were selected from a list of 27 major mining projects that are currently in the consultation/approvals stage and at this time it is not possible to predict which of these projects will proceed to the permitting and pre-construction (advanced development) phase or, indeed, progress to become producing mines. Appendix D contains a full analysis of the data collected through the MEM survey and further enhanced through the employer interview process.

BC's industry associations (the project partners) added valuable input on exploration activities, education and training programs, mining operations and aggregate activities and the current and anticipated growth of these key subsectors of the mining industry. In addition, the project partners provided valuable insights into the current and future state of the mining industry in BC. The Mining Suppliers Association of BC also provided input that increases understanding of this important component area of the mining industry. Finally, the project Steering Committee and the Partner group met frequently throughout the project and provided critical guidance and input on industry activities and developments relevant to the study. Input from these groups has been crucial in shaping targeted recommendations and identifying future opportunities for development.

Challenges and Limitations

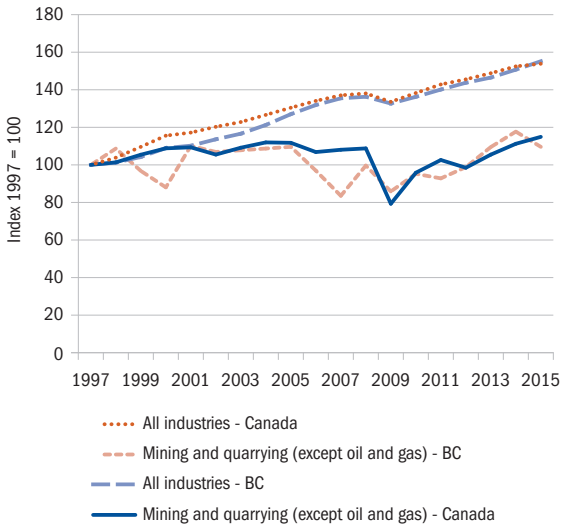
As described in this section and in Appendix B, the researchers have relied on a variety of data sources from publicly available national and provincial data, as well as primary data collection with individual employers. MiHR's custom data cross-tabulation of Statistics Canada data allows the analysis of key demographics and other mining-specific workforce information, as defined by the industrial and occupational codes that define the broader industry in the province. The custom cross-tabulation is based on the most recently available Census data (2011). Data from the 2016 Census period are not expected to be available until late 2017. In addition, changes to the 2011 Census data collection process — the elimination of the mandatory long-form Census used in 2006 and substitution of the voluntary National Household Survey (NHS 2011) — likely had an influence on some of the key workforce characteristics. Consider for example that a reported increase in the proportion of the mining workforce that holds a post-secondary degree, diploma or certificate reflect those who voluntarily chose to complete the NHS compared to those chosen at random to complete the mandatory long-form Census in 2006. This may make comparisons between the 2012 BC Labour Market report and the present research more difficult to interpret.

With respect to the primary data, while a majority of employers who participated in the primary data collection undertaken for this report (industry consultation workshops, BC Ministry of Energy and Mines employment survey with operating mines within the province and individual employer interviews) stated that they see signs of recovery in 2016 and that they hold a more optimistic outlook, it is likely that their reported expectations about future employment in the industry are understandably cautious, in light of the most recent industry slump. Furthermore, while BC's major mining companies provided rough estimates of future employment at their existing sites (including two advanced development projects) and for up to eight new projects potentially to come into production, they were unable or did not feel comfortable to forecast changes beyond three years (2017–2020). A full analysis of this primary data is included in Appendix D.

3. Economic Overview for British Columbia's Mining Industry

BC's economy is one of the largest in Canada. The province is widely recognized as a hub to a variety of industries and marketplaces around the world. In 2015, BC's gross domestic product (GDP) ranked fourth highest among the provinces (at roughly $209 billion according to Statistics Canada). The province's output has also grown steadily over the last two decades. Figure 1 shows growth indices[2] for real GDP in BC and Canada. As the figure illustrates, real GDP growth has been comparable to that of Canada. From the start of the 2000's until 2015, the province's real GDP has grown by roughly 42 per cent (or 2.4 per cent compounded annually) marking the second largest increase among the provinces. Looking forward, BC's economy is expected to grow further in the coming years.

Figure 1: Growth indices of real GDP in Canada and BC (1997–2015)



Source: Statistics Canada. Table 379-0030 – Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), provinces and territories, annual (dollars), CANSIM (database), (2016) and Statistics Canada. Table 379-0031 – Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), monthly (dollars), CANSIM (database), (2016)

Economic growth depends heavily on the strength and capacity of the labour force. As one of Canada's most populated provinces, BC is also home to a sizable labour force at about 2.5 million participants – the third largest among the provinces (and 13 per cent of Canada's overall labour force). Labour market statistics obtained from BC Stats[3] indicate the unemployment rate in the province was roughly 6.2 per cent in 2015, which was below the average for Canada (6.9 per cent). BC has also been one of the stronger performers in employment growth, increasing by 1.2 per cent in 2015. Growth accelerated in early 2016 and as of May 2016 is 3.6 per cent larger than May of the previous year. These outcomes – along with the above-mentioned growth in output – characterize BC as a strong contributor to Canada's economy.

2 *A growth index allows a comparison between variables of different scales by creating a common starting value, typically set at 100. This allows comparison between the variables in terms of how they have changed over time.*

3 *Monthly labour market statistics can be found on BC Stats website (http://www.bcstats.gov.bc.ca). These statistics are continually prepared by BC Stats and utilize data from Statistics Canada's Labour Force Survey.*

While the vital signs of BC's overall economy are positive, the performance of individual industries can be varied. BC's mining industry, in particular, has not evolved in a similar manner as the province's overall economy. The next section examines how BC's mining industry has performed within a number of factors, and highlights key trends that are specific to the industry.

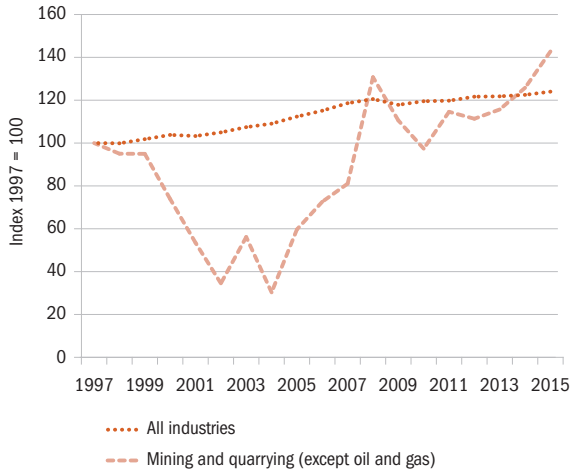
Long-term Recovery for Mining and Quarrying in BC

A distinct pattern emerges in BC's mining industry over the last two decades. The earliest years in this time period – from about the late 1990's to the mid 2000's – can be characterized as a relatively modest time for the industry. Factors such as GDP/output, spending and employment were generally at their lowest levels during this period. Since 2008/2009, however, the industry experienced a wave of growth and development.

This recent momentum is illustrated by the growth of GDP visualized in Figure 1. Prior to the mid-to-late 2000's BC's mineral extraction sector was outpaced by other industries in the province. Yet, the sector has since recovered; between 2009 and 2015, real GDP in mineral extraction has grown by over four per cent compounded annually – almost 60 per cent greater than the growth rate for all industries over the same period.

Employment in mining and quarrying has also surged since the mid-2000's following a significant period of decline. Figure 2 illustrates the recovery of employment in BC's extraction sector, which grew by over four times from 2004 to 2015. This shift signifies the increasing importance of mining in the province – but also the labour market pressures associated with acute growth.

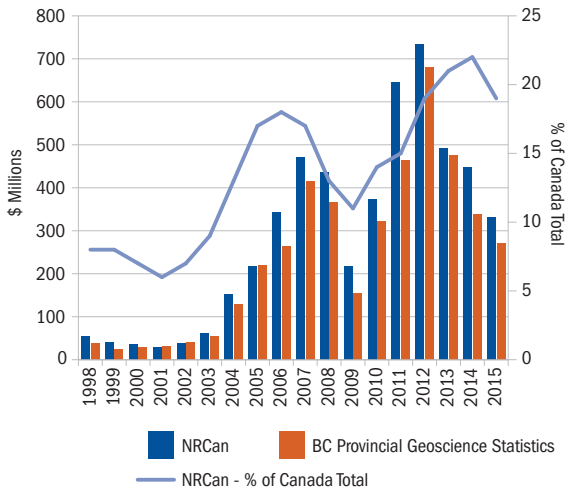
Figure 2: Growth indices of employment in BC (1997–2015)



Source: Statistics Canada. Table 282-0008 – Labour Force Survey estimates (LFS), by North American Industry Classification System (NAICS), sex and age group, annual (persons unless otherwise noted), CANSIM (database), (2016)

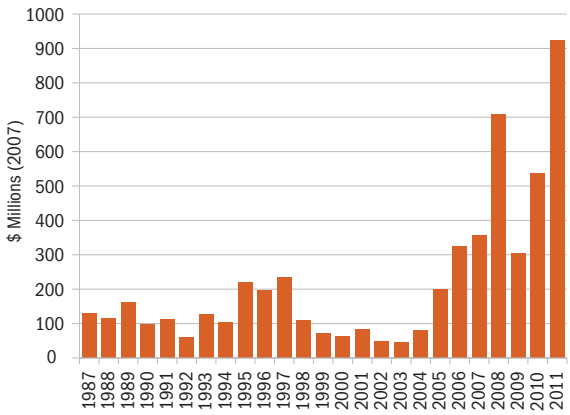
Exploration spending in BC has also grown significantly since the mid-2000's, echoing a similar pattern to that of mining activity, re-emerging around that time period. Figure 3 highlights exploration spending as per NRCan and BC Provincial Geoscience Statistics. As shown in the figure, exploration spending in the province (according to NRCan) has increased from $63 million in 2003 to $734 million in 2012. With the increase BC's exploration sector has evolved into one of the largest in Canada; the province's share of Canada's total exploration expenditures has risen considerably from six per cent in 2001 to 19 per cent in 2015.

Figure 3: Mineral exploration spending in BC (1998–2015)



Source: Natural Resources Canada. BC Ministry of Energy and Mines (MEM, – Exploration Spending, (2016)

Figure 4: Annual investment in mineral extraction capital (1987–2011)



** Note that this data series ended in 2013 but investment data ended in 2011 due to suppression.*

Source: Statistics Canada. Table 031-0002 – Flows and stocks of fixed non-residential capital, by North American Industry Classification System (NAICS) and asset, Canada, provinces and territories, annual (dollars), CANSIM (database), (2016)

In a similar trend, investment in mineral extraction capital in the province also spiked in the mid-2000's. Extraction capital refers to the fixed assets – primarily the machinery and equipment – that are used in mineral extraction operations. While a portion of this investment is replacement of assets that have depreciated, the latest surge has boosted the overall value of capital utilized in BC's mining industry. As Figure 4 shows, investment in extraction capital totaled $925 million in 2011, 20 times greater than the level of capital investment in 2003.

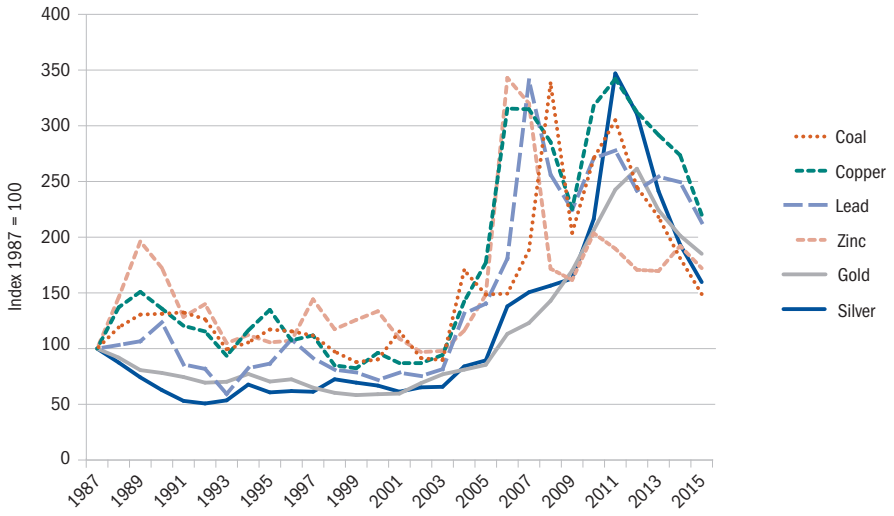
The recent growth in a number of indicators – such as the industry's output (as measured by real GDP), employment, exploration spending and capital investment – collectively show that BC's mining industry has gained strength and vitality over the last few decades. However, the question still remains: what are the factors behind this latest wave of mining development? The trends described thus far have been dramatic and have occurred close to the same time period; hence, they seem to be the product of certain underlying influences. The next section investigates the factors and circumstances that have stimulated mining activity in the province.

A Shift in Mineral Prices in the 2000's

BC's latest wave of mining growth coincided with a significant upward shift in commodity prices. Figure 5 depicts price indices for a selection of commodities mined in the province.[4] As shown in the figure, the price movements are relatively insignificant from the early 1990's until the 2000's; then from around 2005 and onward, certain prices began to grow well beyond their historical levels; and the swings in prices became relatively larger. This acceleration is often referred to as the "super-cycle": characterized as the hyper-growth and wider fluctuations observed for commodity prices. As a result of favorable price movements – and a growth spurt in mining development – the mining industry has emerged as a significant segment of the province's overall economy.

The recent shift in prices also reflects the global demand for minerals, particularly from Asian markets. Figures 6 and 7 show that China's consumption of metallurgical coal and refined metals has rapidly increased since the early 2000's (though coal consumption has stabilized in the last few years). The rise in consumption is the result of China's emergence as an industrialized country, its large population, fast growing middle class and growing demand for goods that contain mined minerals. The effect of this is felt in BC's mining industry; not only are Asian markets among the province's largest trading partners, but a rise in demand places an upward pressure on mineral prices, which in turn benefits mining development in the province.

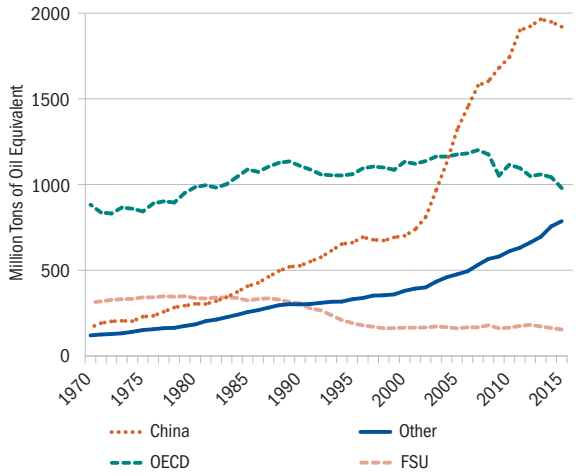
Figure 5: Price indices for key commodities in BC (1987–2015) (Super-cycle)



Source: World Bank. World Bank Commodities Price Forecast (Constant U.S. Dollars), (2016)

4 *Molybdenum is also a key commodity in BC, which is not featured in Figure 5 due to the scale effects that it would have on the graph. Molybdenum price data can be found on the International Molybdenum Association (IMOA) website: http://www.imoa.info/molybdenum/molybdenum-market-information.php. Overall, the molybdenum price has shown a dramatic increase (consistent with the aforementioned super-cycle) followed by a deep drop in 2008/2009. Since then the price has remained near former (pre-super cycle) levels.*

Figure 6: World coal consumption (1970–2015)

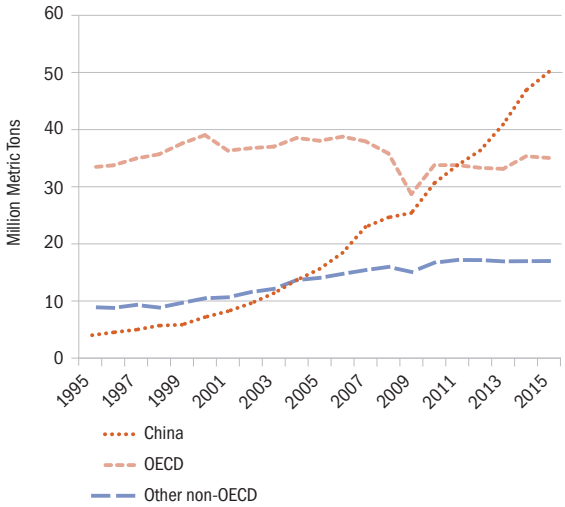


** Note that this figure includes demand for both thermal and metallurgical coal*

*** Note OECD refers to the Organization for Economic Cooperation and Development, which is a collective of member countries focused on promoting economic prosperity worldwide; FSU refers to the collective of countries that belonged to the Former Soviet Union*

Source: BP Statistical Review of World Energy, (2016)

Figure 7: World refined metal consumption (1995–2015)



** Note OECD refers to the Organization for Economic Cooperation and Development, which is a collective of member countries focused on promoting economic prosperity worldwide*

Source: World Bureau of Metal Statistics, (2016)

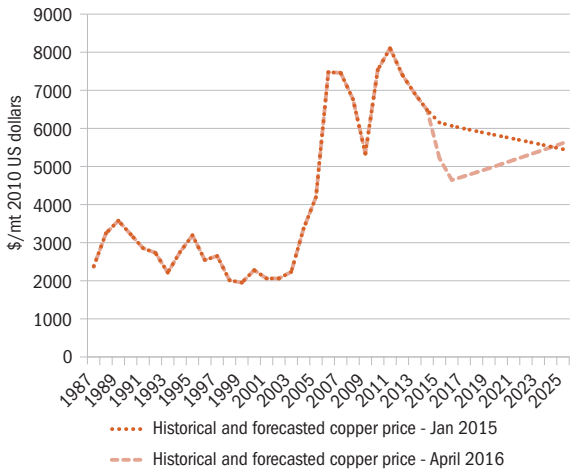
Overall, BC's mining industry has experienced a long-term rebound that began as mineral prices have fundamentally shifted upward over the last two decades. In spite of this, the industry has recently experienced a downturn, marked by greater and sharper movements in prices. These more recent developments are highlighted in the next section. Additionally, industry stakeholders (participating in industry consultations) have further indicated that the cost to explore, develop and extract has increased due to rising costs for machinery and labour, as well as the time and labour associated with permitting and engagement with communities.

A Recent Slump in the Mining Industry in BC

Though BC's mining industry has experienced long-term growth in a number of key factors (GDP, employment, investment and exploration spending), in the short-term, many of these same factors have contracted, and echo the performance of the overall mining industry in Canada. This latest slump has followed a steady drop in mineral prices that started around 2011 and can be seen in Figure 5. Moreover, several price forecasts used by MiHR have been adjusted downward to reflect the current economic climate since early 2015. For example, as shown in Figure 8, the April 2016 forecast of prices for copper has been reduced from the same forecast made in 2015; yet, despite this predicted correction, the revised forecast suggests a long-term outcome that is similar to the 2015 forecast.

In the wake of the fall in commodity prices that began around 2011, mining activities in BC have slowed down. In order to manage the downturn, several operations have made adjustments to reduce their operating costs, efforts that commonly entail scaling back production, suspending /closing operations, and /or reducing the size of their workforce or the number of hours worked. As reported by MABC, 16 mining operations are on care-and-maintenance (as of late 2015) as commodity prices continued to drop.[5] In spite of this, 2016 has seen a leveling of commodity prices and the start of a resurgence of mining activities in the province. New growth has projects in care-and-maintenance evaluating re-opening, with two new mines planning the end of the development phase and commencement of operations in 2017.

Figure 8: Historical and forecasted copper prices (1987–2025)



Source: World Bank. World Bank Commodities Price Forecast (Constant U.S. Dollars), (2016)

The downturn experienced over the past four or five years has also stalled exploration activities in BC; as is illustrated in Figure 3, exploration spending in the sector steadily declined from $734 million in 2011 to $331 million in 2015. This contraction is largely due to weakening commodity prices and a cautious investment community, especially as exploration activities rely heavily on the ability to finance drilling programs amid fluctuating mineral prices.

Junior companies have particularly felt the impact of contraction in the sector. Natural Resources Canada describes a "junior" exploration company as "small, flexible, and specialized in higher-risk, early-stage exploration activities" which "usually has no operating revenue and relies on equity financing." The activities of these smaller enterprises represent much of the "green-field" exploration that takes place in a region. As illustrated in Figure 9, junior companies accounted for 34 per cent of exploration spending in 2015 — marking a steady decline from 57 per cent just four years earlier in 2011. Given that the activities of junior mining companies are especially sensitive to market conditions and prices, junior company spending typically indicates the prevailing mood among investors. For instance, the drop in spending by juniors in 2014 and 2015 is a signal that investors are not convinced that mineral prices deliver a sufficient return on their investment; 2016 has shown renewed investor confidence with commodity prices starting to recover and with a selection of projects receiving funding for exploration activities.

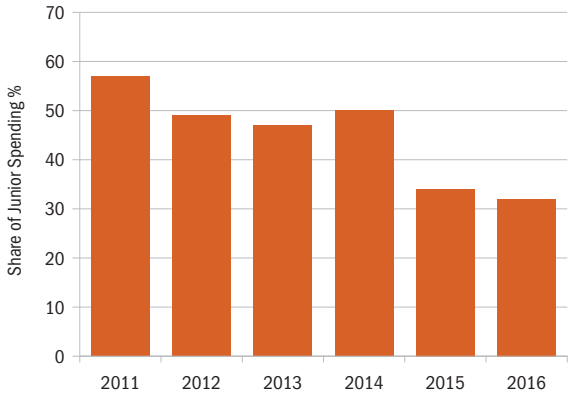
5 *Please see: http://www.miningassociationbc.com/*

Future mining projects depend on the discovery and exploration of new deposits. As such, current exploration activities are an indicator of upcoming mining development. Reduced exploration has a potential longer-term impact on the mining sectors, especially those that exist downstream from exploration activities (e.g. extraction and mining support services). If this trend were to continue over an extended period, this could have a dampening impact on later stages of the mining cycle (extraction, milling and other processing activities), and ultimately the future of mining development in the province.

With the slowdown from 2011 to 2015 the prospects of participants in BC's mining labour force have also been adversely impacted as employers have been increasingly challenged to maintain the production and employment levels when mineral prices were higher. Figure 10 shows unemployment rates (as a three-month average) since the beginning of 2013. As the figure highlights, the average unemployment rate in BC's mining extraction sector has spiked from roughly 5.2 per cent in October of 2014 to about 14.6 per cent in April of 2015, outpacing the unemployment rate in the overall labour force. The unemployment rate has since decreased but has maintained higher levels; the average rate is about 9.5 per cent in June of 2016.

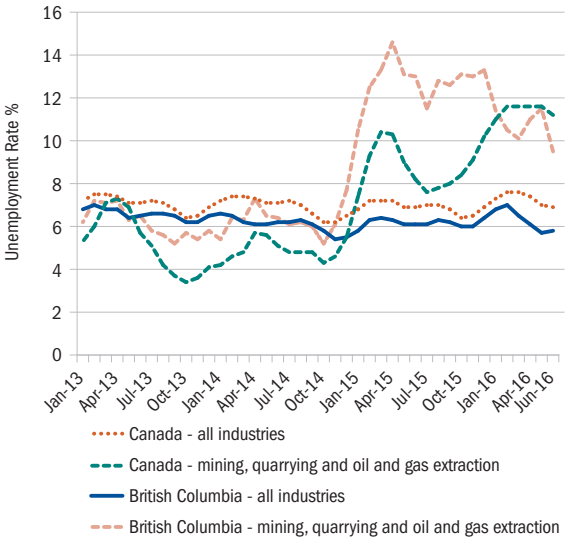
However, the recent unemployment surge is not unprecedented. Figure 11 shows the longer-term picture for unemployment in BC; over the last three decades, the unemployment rate in the province's extraction sector has frequently endured sharp increases. From the longer-term perspective, unemployment in the mining sector is characteristically volatile and is subject to corrections that appear even more dramatic in the short-term view.

Figure 9: Share of junior companies' exploration spending in BC (2011–2016)



Source: Natural Resources Canada. "Exploration Plus Deposit Appraisal Expenditures, by Junior and senior Companies by Provincial and Territory, 2011-2014 Annual, 2015 Preliminary Estimates and 2016 spending intentions," (2016)

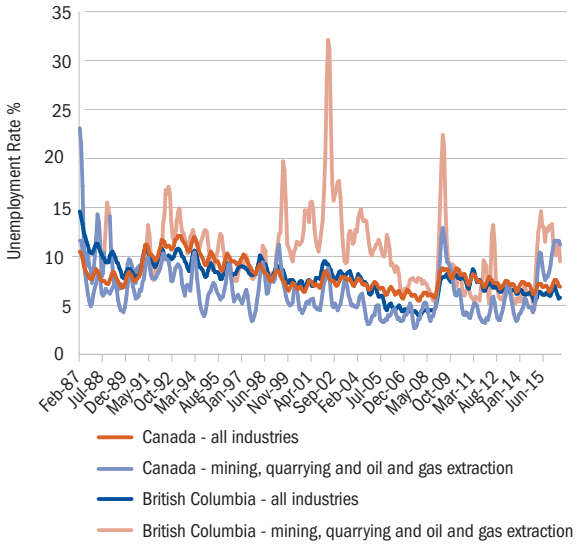
Figure 10: Unemployment rates in Canada and BC, three month moving average (January 2013-June 2016)



Source: Statistics Canada. Table 282-0007 – Labour force survey estimates (LFS), by North American Industry Classification System (NAICS), sex and age group, unadjusted for seasonality, monthly (persons unless otherwise noted), CANSIM (database), (2016)

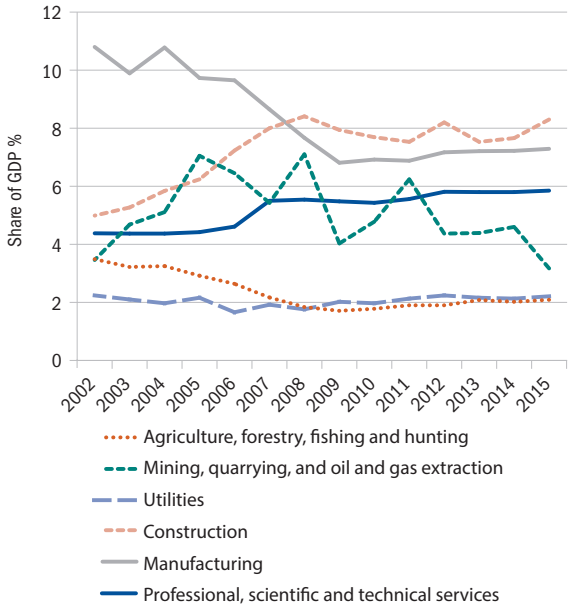
The industry's volatility is further demonstrated in Figure 12, which shows how various sectors have contributed to the province's overall GDP. While certain industries display a somewhat stable trend line (either in decline or moving upward), the trend in mineral extraction is relatively cyclical in nature, suggesting an inherent sensitivity to prevailing economic conditions resulting in more volatile increases or decreases in activity.

Figure 11: Unemployment rates in Canada and BC, three month moving average (February 1987-June 2016)



Source: Statistics Canada. Table 282-0007 — Labour force survey estimates (LFS), by North American Industry Classification System (NAICS), sex and age group, unadjusted for seasonality, monthly (persons unless otherwise noted), CANSIM (database), (2016)

Figure 12: Industry share of GDP in BC (2002–2015)



Source: Statistics Canada. Table 379-0028 — Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), provinces and territories, annual (percentage share), CANSIM (database), (2016)

Overall, the mining industry's recent performance should be weighed against the longer-term trends. That is, it is difficult to use current production or commodity price levels to predict the longer-term position of industry when one considers the volatility that has come to be considered typical of the mining industry for several decades.

Mining development in BC will need to overcome certain challenges that frequently impede mining projects from moving to the next stage, or at all. According to industry stakeholder interviews and consultations, these challenges include limited access to infrastructure (e.g. roads, housing, etc.), added costs and time associated with the environmental assessment and permitting processes and the formation of agreements with local Aboriginal communities, among others.

The central limiting factor for mining development – and a key focus in this report – is the employers' ability to access a qualified pool of workers. A shortage of appropriately skilled workers poses a potential risk to mining operations, given that a thin labour supply has the potential to derail projects, drive up the cost of finding workers and ultimately undermine an operation's ability to function competitively. Furthermore, industry stakeholders have highlighted an important challenge associated with maintaining a connection with workers who have been laid off during the recent downturn, which will become especially important as the mining sector moves into a period of recovery and expansion. The forecasting and analysis provided in this report highlight the gaps between the number of workers the industry needs to hire and the number forecast to be available over the next 10 years.

Summary of the Economic Overview for BC's Mining Industry

In summation, the economic outlook for BC's mining industry is characterized as follows:

- Historically, BC has been one of Canada's strongest economic performers. From the start of the 2000's until 2014, the provincial real GDP grew steadily, marking the second largest increase among the provinces. BC is also home to the third largest labour force in Canada. Recently its labour market has shown positive results with solid employment growth and lower unemployment compared to other provinces.

- While the vital signs of BC's overall economy are positive, the province's mining industry has not evolved in a similar manner. The years leading up to the mid-2000's were relatively modest for the BC mining industry as GDP/output, spending and employment were generally at their lowest levels. Since then, however, the industry has experienced a wave of growth and development.

- BC's latest wave of mining growth paralleled a significant upward shift in mineral prices around the middle of the 2000's (often referred to as the "super-cycle"). Favorable mineral price movements resulted in a growth spurt in mining development in the province. The shift in prices also reflects the global demand for minerals, particularly from Asian markets, which has been felt in BC's mining industry given that Asian markets are among the province's largest trading partners.

- Since 2011/2012, BC's mining industry has been in a downturn, along with the rest of the mining industry in Canada, following a drop in mineral prices. Several World Bank price forecasts used by MiHR have been adjusted downward to reflect the current economic climate since early 2015. Yet, despite the correction, each revised forecast reveals a long-term trend that is similar to the previous forecast.

- In the wake of the recent fall in prices, mining activity in BC has slowed down. Several operations have adjusted their capacity to manage through the downturn. The recent climate has also hindered exploration spending in BC. Junior exploration companies have particularly

felt the impact of weakening commodity prices and a cautious investment community; their declining share of spending in the sector is indicative of the recent market conditions and the prevailing mood among investors in exploration enterprises.

- The latest slowdown – spanning from around 2011 to 2016 – has also reduced prospects for participants in BC's mining labour force as employers have been increasingly challenged to maintain the same production and employment levels as when mineral prices were higher. As such, the unemployment rate in BC's mining and mineral extraction sector has outpaced the unemployment rate in the overall labour force.

- Mining is cyclical in nature and is subject to corrections that appear dramatic in the short-term view. This is evident in variables such as unemployment as well as output/GDP. Overall, the short-term trends (such as the recent downturn) should be weighed against the longer-term trends such as the upward shift of several mineral prices, as well as the recent trend toward increased volatility of the industry.

- The long-term (10 year) outlook points to a steady recovery for BC's mining industry that will retain certain prices close to their post super-cycle levels. In any event, mining development in BC will need to overcome certain challenges that frequently impede mining projects from moving to the next stage, or at all. The most notable limiting factor for mining development is the employers' ability to access a qualified pool of workers, which poses a potential risk to mining operations and can ultimately undermine an operation's ability to function competitively in the face of a period of recovery.

4. Mining Operations in British Columbia

This section highlights key trends and characteristics of mining operations in BC, including an examination of the key minerals being produced and explored, employment characteristics, regional traits, spending/investment behaviour and export activities that characterize the province's mining industry (and by extension its labour market). There are several diverse mining projects in BC:

- **Mining operations:** According to the BC Ministry of Energy and Mines, in 2015 there were 15 operating metal and coal mines, three mines under construction, two pre-application (permitting) mining projects, 32 closed mines, and 20 mines on care-and-maintenance for a total number of 72 mine operations and projects in BC.
- **Exploration projects:** Statistics from the BC Ministry of Energy and Mines (BC Geological Survey) indicate there were 194 exploration projects in the province in 2015, which is considerably down from 300 projects reported for 2012.[6]
- **Stone, sand and gravel operations:** BC is also a hub for stone, sand and gravel mining and quarrying. The recent construction boom in BC has increased the demand for this type of mining production. The BC Stone, Sand and Gravel Association reports that there are 725 gravel mines in BC, of which 675 are currently in operation.
- **Manufacturing operations:** Fabrication and manufacturing is another essential function of certain mining operations in BC. It primarily includes establishments that are engaged in smelting, refining of ferrous and nonferrous metals from the ore. Currently there are two major smelters operating in BC involved in the smelting of aluminum, lead and zinc.

Tables 1a and 1b summarize the employment in various mining sectors; the first table shows 2015 employment estimates as reported by the BC Ministry of Energy and Mines (using data from Statistics Canada);[7] the second table depicts MiHR's 2016 employment estimates for the industry sectors covered in the forecast of this report. Note that these are also based on employment data from Statistics Canada. Each table provides a different breakdown for the mining industry, yet both estimates are close to 30,000 for total industry employment.

6 *Note that a summary of exploration statistics from the Ministry of Energy and Mines (BC Geological Survey) was accessed from the government of BC website (Regional Highlights in Exploration): http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/exploration-in-bc/regional-highlights-in-exploration*

7 *http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/further-information/statistics/employment*

Table 1a: Summary of mining employment statistics for BC (2015)

Mining Employment Statistics	Estimated Employment in 2015	Sector Breakdown
Metal mining	5,370	17%
Coal mining	3,600[e]	12%
Industrial minerals & construction aggregates	740*	2%
Exploration	3,530	11%
Mineral refining & smelting	4,880	16%
Downstream mineral processing	12,600**	41%
Total	**30,720**	**100%**

Source: BC Ministry of Energy and Mines estimate. Employment data for coal mining is not available from Statistics Canada due to suppression and confidentiality requirements.

** 2013 estimate. 2015 employment data for non-metallic mineral mining and quarrying (industrial minerals and construction aggregates) is not available from Statistics Canada due to confidentiality requirements.*

*** Employment data for non-metallic mineral product manufacturing, a subset of downstream mineral processing, is not available from Statistics Canada due to confidentiality requirements. As a result, total employment numbers in downstream mineral processing as well as total sector employment are underestimated.*

Source: Statistics Canada. Table 383-0031 — Labour statistics consistent with the System of National Accounts (SNA), by province and territory, job category and North American Industry Classification System (NAICS), annual, CANSIM (database), (2016)

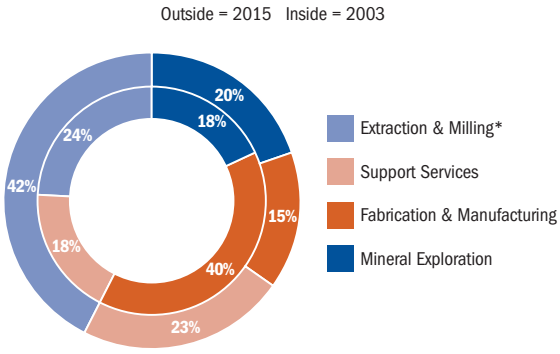
Table 1b: Summary of mining employment statistics for BC (2016)

MiHR's Estimated Mining Employment Statistics (by sector)	Estimated Employment in 2016	Sector Breakdown
Extraction & milling	11,430	37%
Stone, sand & gravel	790	3%
Support services	8,100	26%
Fabrication & manufacturing	4,010	13%
Mineral exploration	6,260	20%
Total	**30,590**	**100%**

Source: Mining Industry Human Resources Council, (2016)

Figure 13 shows that the composition of employment in mining sub- sectors has changed between 2003 and 2015. Notably, extraction & milling has increased in relative size of employment in the industry, whereas fabrication and manufacturing has significantly dropped.

Figure 13: Employment in mining sub-sectors in BC (2003 vs 2015)



** Note that in this figure Extraction and Milling includes employment for stone, sand and gravel*

Source: Mining Industry Human Resources Council, (2016)

A Snapshot of Operating Mines in BC

In this report, MiHR has produced an employment forecast for BC's mining industry that is based on employment data obtained from Statistics Canada. At the same time, MEM has produced and shared mining employment statistics for the province (from 2011 to 2016[8]). This data specifically covers employment and contractor information for a sample of 13 operating mines in the province, as well as employment estimates for two upcoming mines (currently anticipated to start operating in 2017). The sample includes operations that mine precious and base metals and coal but does not cover quarries or industrial minerals projects.

Table 2 lists the 15 projects in the sample – including the operating and upcoming major mines reported by MEM. The analysis in this section uses only this sample data and is used to provide a snapshot of mining operations in BC.

Table 2: Sample of operating and upcoming mines in BC (2016)

Brucejack Gold*	Fording River	Huckleberry**	New Afton
Coal Mountain	Gibraltar East	Line Creek	Red Chris
Copper Mountain	Greenhills	Mount Milligan	Silvertip *
Elkview	Highland Valley	Mount Polley	

** Mines in development*

*** Huckleberry mine was placed on "care-and-maintenance" in August 2016*

Source: BC Ministry of Energy and Mines (MEM). Employer Survey, (2016)

8 *Data for 2016 is as of May in 2016*

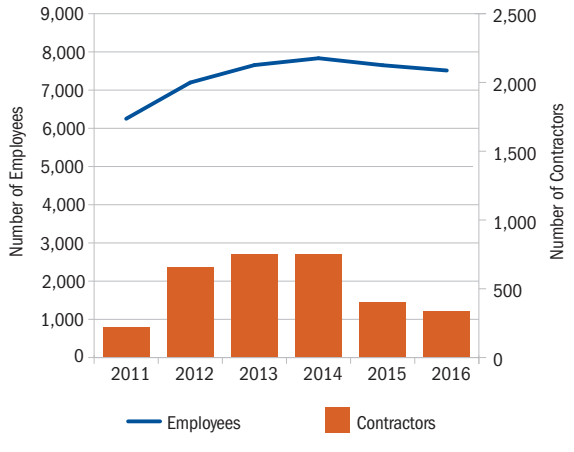
Of the 13 operating mines in BC, the majority are open pit or surface mines (12 of 13), only one is underground; six of 13 have a concentrator (i.e. a facility or apparatus used to produce a mineral concentrate). These mine site characteristics can have a relative impact on the size and skills of the workforce needed in operations.

The average number of employees at the sample sites was approximately 590 in 2015. This indicates an increase from average employment per site in 2011 (at 570). From 2012 to 2014, 11 of 13 operations increased their employment levels to some degree, though this has since decreased in 2015 and 2016. Figure 14 shows the total number of employees amongst the sample operations collectively from 2011 to 2016.

Also highlighted in Figure 14 is the use of contractors among the operations surveyed. Contractors refer to the companies and/or individuals that serve as part of operations but are not considered as direct employees. The number of contractors has varied from 2011 to 2016 and their pattern roughly resembles direct employment; growth from 2011 to 2014 was matched by a sharper decrease in 2015, at which point, the number of contractors was cut by almost half (at 46 per cent). This decline was mainly the result of the Red Chris mine, which began commercial production in 2015. Contractors typically make a larger proportion of a mining organization's workforce during the construction phase and their use tends to drop off once the site goes into full production.

This analysis does not include metal and coal mines in care-and-maintenance since 2011. Consequently, based on this sample, total mine employment in the province is underestimated and the decline in total employment from 2014 to 2016 is also understated. Furthermore, this data only looks at employment at existing operations and new mines in development and doesn't account for total employment or changes in employment at stone, sand and gravel operations or exploration sites.

Figure 14: Total number of employees and contractors in sample of 13 operating mines in BC (2011–2016)



Source: BC Ministry of Energy and Mines (MEM). Employer Survey, (2016)

In addition to the sample of operating mines and two new sites, the researchers were provided with the BC inventory of major mining projects. An analysis of the 60 mine projects listed showed that about 27 projects are in the consultation/approvals phase (prior to tender/pre-construction). It should be noted that only a few of the projects listed indicate the expected start dates of the projects so it is not possible to accurately predict how many (or which ones) will become operational in the next decade. Of the 27 projects in the consultation/approvals stage, over one third (10 projects) are underground mines, two of which would also include an open pit. This is in contrast to the single underground

mine currently operating in the province. This may suggest that there is a possibility that underground mining activities can be expected to increase over the coming decade.

As outlined in Appendix D, the research team interviewed a sample of eight project owners from amongst the 27 projects list as being in the consultation/approvals phase. Based on the responses to these interviews, employment at these new sites, assuming all eight go into operation between 2017 and 2026, the next decade, could potentially add another 2,800 new jobs. It should be noted that, as with BC existing mine operators, employers at these eight potential new mine projects, were reluctant (or unable) to forecast their expected employment needs further than 2019/2020.

Regional Breakdown for Mining Activities in BC

BC's mining activities are spread throughout the province, though each region supports a unique mix of activities; MiHR's regional analysis is aligned with the five mining regions used by the BC Ministry of Energy and Mines (MEM).[9] Note that these regions differ from those used in MiHR's 2012 BC report (Statistic Canada's economic regions). This regional modification was primarily prompted by the availability of data as well as maintaining uniformity with MEM's regional boundaries for mining development.

Given that each regional mining scene is unique, MiHR has evaluated the extent to which various industry sectors are active in each region. Specifically, the regional breakdown uses data from MEM, MABC, the Canadian Mines Handbook and Natural Resources Canada to measure the scope and variety of mining activities in each region. This breakdown also considers factors such as the mining activities in each region, as well as production, spending and employment data to ensure that the results are robust and account for a variety of aspects. As primary characteristics of each region are likely to persist in the near future, a regional profile is useful for understanding the labour market challenges that are specific to each region.

The five regions are characterized as follows:

The Northeast/Central Region (includes the two sub-regions of Northeast and Omineca):
A relatively high share of BC's exploration activities is found in this region. The BC Ministry of Energy and Mines (BC Geological Survey) provides statistics on BC's exploration sector, including the regional expenditures in exploration.[10] According to these statistics, the Northeast/Central region accounted for about 35 per cent of all exploration spending in the province from 2012 to 2015, and about 26 per cent of reported projects.

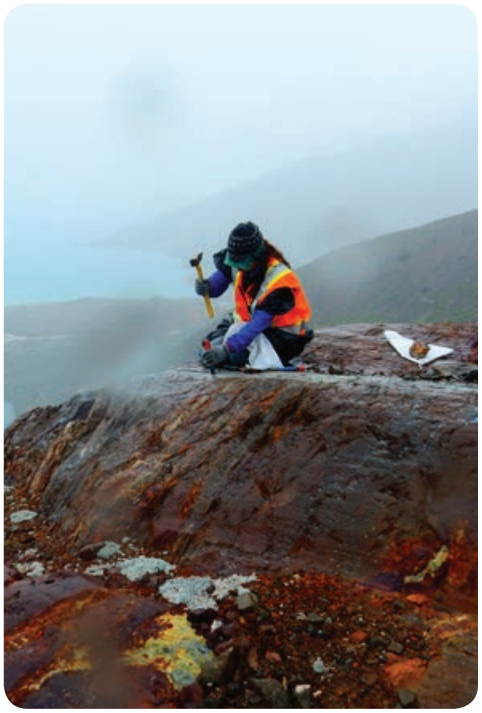
9 *For a visual representation of MEM's Mining regions, please see: http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/further-information/regional-offices*

10 *Please see: http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/exploration-in-bc/regional-highlights-in-exploration*

MEM has provided a detailed list of exploration projects in each region in 2016. Among the coal and metal projects listed in the Northeast/Central region, about 16 per cent are categorized as *mine-evaluation*; about 10 per cent are considered to be *advanced exploration*; about 52 per cent are considered to be *early stage exploration*; and about 23 per cent are considered to be *grass roots* or *green field exploration*. Copper, gold, zinc, coal and silver are included among the main commodities that are explored for in this region.

In contrast, operating mines are less prominent in the Northeast/Central region, which accounts for only seven per cent of the 2016 coal and metal mining operations for which MEM provided employer data (see previous section), and about six per cent of the reported employees. Copper and gold are the main commodities that are produced in this region. There are also several operations in this region on care-and-maintenance; MABC has identified 15 coal and metal operations on care-and-maintenance in the province in 2015, five of which are coal operations in the Northeast Central region.

The Northwest Region (includes the Skeena region): This region is largely characterized by its high share of exploration activities. Statistics from the BC Ministry of Energy and Mines (BC Geological Survey) show the Northwest region accounted for about 43 per cent of the province's exploration spending from 2012 to 2015 – which was the greatest share among the five regions. The region also featured about 26 per cent of the reported projects over the same period.



Among the list of coal and metal projects provided by MEM for the Northwest region, about six per cent are categorized as *mine-evaluation*; about 39 per cent are considered to be *advanced exploration*; about 28 per cent are considered to be *early stage exploration*; and about 27 per cent are considered to be *grass roots exploration*. The commodities explored for in this region are mostly gold and copper with some silver.

Mining operations are also present in the Northwest region; of the 2016 operating coal and metal mining operations for which MEM provided employer data (see previous section), 27 per cent are located in this region; yet these operations account for only 13 per cent of the reported employees. Copper, gold, molybdenum, silver, lead and zinc are among the commodities that are produced. Of the 15 coal and metal operations that MABC has classified as being on care-and-maintenance in 2015, three are located in this region (all of which are metal producers). The region is also home to a smelter that produces aluminum.

The South Central Region (includes the two sub-regions of Cariboo and Thompson/Okanagan):
A number of BC's operating mines are found in this region. Of the 2016 coal and metal mining operations for which MEM provided employer data (see previous section), 33 per cent are located in the South Central region; these operations account for 39 per cent of reported employees. Mining operations in the region primarily produce copper and gold with some molybdenum and silver. There are relatively fewer operations on care-and-maintenance; MABC identified two metal mines with this operational status for 2015.

Conversely, this region features a relatively smaller share of exploration activity. According to statistics from the BC Ministry of Energy and Mines (BC Geological Survey), the South Central region accounted for about nine per cent of the province's exploration spending – and about eight per cent of the projects – from 2012 to 2015. The main commodities that are explored for in this region include copper, gold and molybdenum.

The South Central region is also the location for a number of industrial mineral operations, which encompasses those producing aggregate products. Of the industrial mineral operations in the province identified by MABC in 2015, 30 per cent are found in this region.

The Southeast Region (includes the Kootenay/Boundary region):
This region displays a high measure of mining extraction activities, accounting for 33 per cent of the 2016 coal and metal mining operations for which MEM provided employer data (see previous section); these operations also account for the highest share of reported employees (at 42 per cent). Coal is the leading commodity produced in this region, and this is the primary location of coal producers in the province. There were also relatively fewer operations on care-and-maintenance; MABC identified one metal mine with this operational status for 2015. The region is also home to a smelter that produces lead and zinc.

This region supports a moderate share of BC's overall exploration activity. From 2012 to 2015, the Southeast region accounted for 25 per cent of projects, but only eight per cent of exploration spending in the province, as per statistics from the BC Ministry of Energy and Mines (BC Geological Survey). Coal, copper and gold are the main commodities explored for in this region.

Industrial mineral operations – including those producing aggregate products – are also relatively common in the Southeast region. Of the industrial mineral operations in the province identified by MABC in 2015, 24 per cent are found in this region.

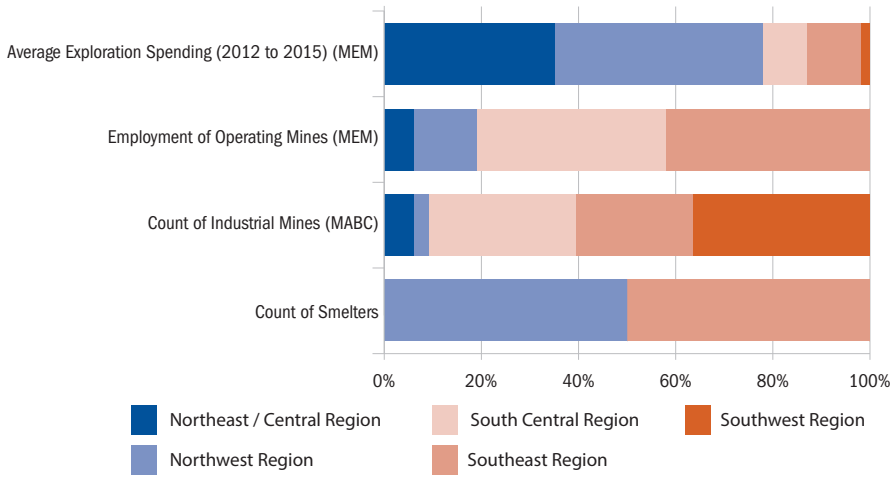
The Southwest Region (includes the two sub-regions of South Coast and West Coast):
This region is comparatively unique in BC's mining landscape. Given the Southwest region has the largest population among the regions, and is home to the major population centers (i.e. Vancouver), it is also the primary location of various mining corporate-offices and business. The region also supports a large share of industrial mineral operations (including those producing aggregate products). Of the industrial mineral operations in the province identified by MABC in 2015, 36 per cent are found in this region.

Operating mines, on the other hand, are not as common in this region; of the 2016 coal and metal mining operations for which MEM provided employer data (see previous section), none are located in the Southwest region. Still, the region features mining operations that are on care-and-maintenance. MABC identified two mines (one coal and one metal) with this operational status for 2015. The Southwest region also has a small share of exploration activity. According to statistics from the BC Ministry of Energy and Mines (BC Geological Survey), the region accounted for only two per cent of the province's overall exploration spending.

Figure 15 summarizes the regional differences in BC's mining industry. Specifically, the figure highlights for each sector a selected metric that conveys the distribution of activity among the five regions. As shown in the figure, each mining sub-sector tends to be concentrated in region(s) of the province. For instance, mining operations are common to the Southeast and South Central regions; the largest share of industrial mineral operations[11] are found in the Southwest region; there are two main smelters in the province existing in the Northwest and Southeast regions. Lastly, the majority of exploration activity is found in the northern regions of BC (i.e. the Northeast/Central and Northwest regions).

An understanding of each region's unique characteristics – including the types of mining development projects and their relative position in the mining cycle – can help to inform expectations about current and anticipated labour market pressures as well as provide the appropriate context for the labour market forecasts provided in this report.

Figure 15: Regional activity in BC's mining industry, by industry sector (2016)



Source: BC Ministry of Energy and Mines (MEM), BC Geological Survey, (2016)

BC Ministry of Energy and Mines (MEM), Employer Survey, (2016)

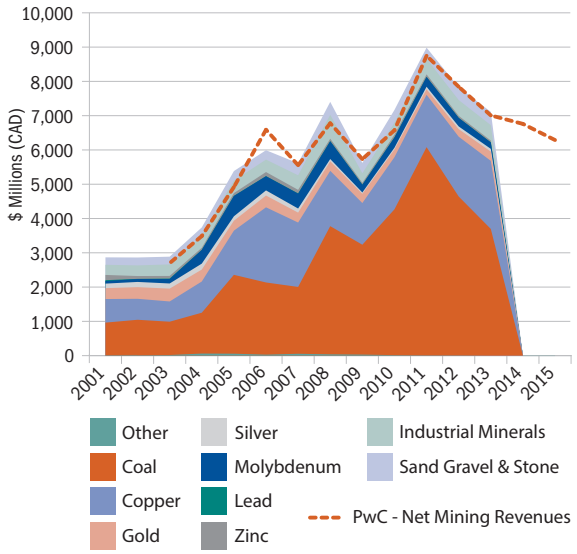
Mining Association of British Columbia (MABC) Mines Map: http://www.miningassociationbc.com/#

11 *Note that this analysis utilizes data for industrial minerals as opposed to aggregates since the latter category is difficult to separate from other non-metallic commodities. In this case, industrial minerals include both stone, sand and gravel/aggregate production in addition to other industrial minerals.*

Regional trends are particularly evident in BC's exploration sector, which has a significant presence in all major regions of the province. The decrease in BC's exploration spending (roughly 60 per cent from 2012 to 2015) has impacted the northern regions. Notably, exploration expenditures in the Northwest and Northeast/Central regions have collectively dropped from about $560 million in 2012 to about $190 million in 2015; additionally, the number of projects reported for these regions has fallen from 171 to 86 projects over the same period. The significance of this decrease is also underlined by the relative size of the projects. In the northern regions, the average expenditures per project were roughly $2.6 million from 2012 to 2015 (compared to $0.8 million in the southern regions collectively). Even as spending levels have declined, the northern regions still dominate exploration expenditures in BC.

The Rise in Value of Production in BC

Figure 16: Production mix (by value) in BC (2000–2013) and net mining revenues (2003–2015)



Source: Natural Resources Canada. BC Ministry of Energy and Mines – Production Data Archive, (2016) and PricewaterhouseCoopers Canada– The Mining Industry in British Columbia. Annual Reports (2011–2015), http://www.pwc.com/ca/bcminingsurvey, (2016)

BC is home to several mined commodities. These primarily include both metallic and non-metallic minerals as well as coal and stone, sand and gravel products. As illustrated in Figure 16, the nominal value of mineral production[12] (including coal and aggregate production) has grown from $2.9 billion in 2001 to $7 billion in 2013 – a rise that was mainly driven by the increase in prices over this period.[13] Based on data from PricewaterhouseCoopers on mining revenues in the province – also shown in Figure 16, MEM estimates that the value of production in 2015 was approximately $6.3 billion.

Coal: Production in coal represents most of the growth with an increase that accelerated around 2003. Thus, the production mix in the province has also shifted, placing more weight on coal production than before: In 2013, coal comprised 52 per cent of total production value, a significant increase from 28 per cent in 2000. Among the list of operating mines (as of May 2016) provided by MEM, five out of 13 are coal producers (predominantly metallurgical coal).

12 *Note that Figure 19 reports on "mineral production" values consistent with reporting from Natural Resources Canada (NRCan), whereby statistics also include coal production and stone, sand and gravel production. These are commodity products that may not be considered to be "minerals", but are considered under "mineral production" in this figure.*

13 *Note that data for 2014 and 2015 is not provided in Figure 19 as it has been suppressed by NRCan to meet the confidentiality requirements of the Statistics Act.*

Base Metals: Base metals represent a significant portion of BC's production portfolio (most notably in copper, molybdenum, lead and zinc). Copper production, in particular, accounts for roughly one quarter of the overall production value. Molybdenum is another important metal in BC. The province is one of the major low cost producers, and the only province where primarily molybdenum mines are prevalent. Among the list of operating mines (as of May 2016) provided by MEM, seven out of 13 are primary producers of copper; three of which are also secondary producers of molybdenum. There are currently a number of primarily molybdenum producers on care-and-maintenance. Therefore, the provinces' molybdenum production in BC has the potential to significantly expand, depending on growth in demand for molybdenum products.

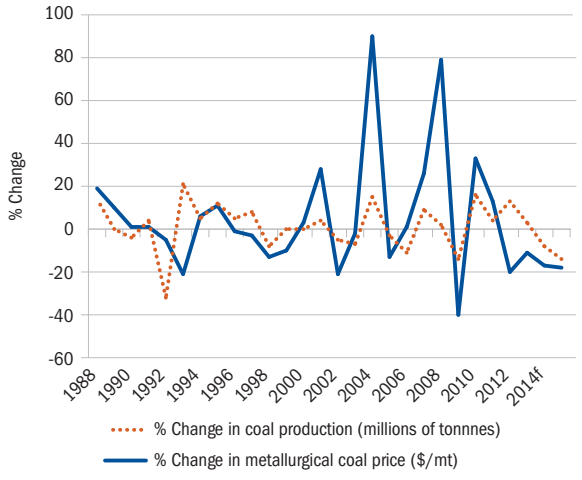
Precious Metals: BC's production includes precious metals (primarily gold and silver). From 2005 to 2013, these metals represented between three to five per cent of the total production value. Among the list of operating mines (as of May 2016) provided by MEM, two out of 13 are primary producers of gold. There are two projects near completion that would expand the production of gold and silver in the province.

Stone, Sand and Gravel: BC has a robust production of aggregate products that are essential to the construction of buildings, roads and several other types of projects and primary uses. As such, aggregate production tends to be close to population centres (i.e. cities and towns) and active where construction projects are more prevalent. Production in stone, sand and gravel has remained relatively consistent, with between four and five per cent of the value of total production from 2008 to 2013. Note that data for aggregates is often reported as part of industrial minerals. This is not the case in Figure 19, which shows separate production values for industrial minerals, specifically referring to other non-metallic minerals except for stone, sand and gravel.

The Impact of Prices on Production

Production is strongly connected to price movements. For example, as Figure 17 demonstrates, changes in BC's coal production (by volume) correspond to variations in the price for metallurgical coal. Though production changes tend to be less severe than price changes, they frequently move in the same direction. This pattern also extends to the workforce, especially as production volumes depend on workforce capacity.

Figure 17: Changes in coal production in BC versus metallurgical coal price (1988–2015)

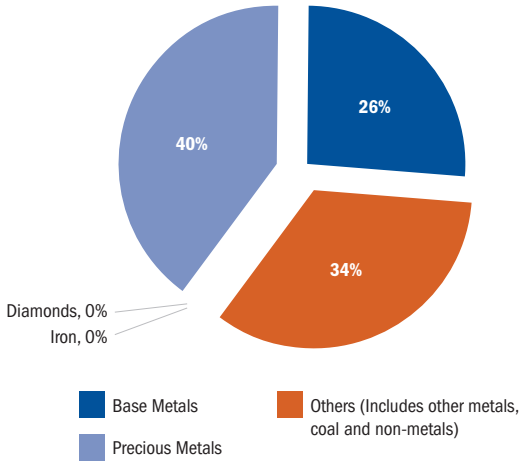


Source: BC Ministry of Energy and Mines. Coal Production in B.C. "British Columbia Geological Survey Coal "Geology Page", (2016), U.S. Energy Information Administration, Price of Metallurgical Coal, (2016)

Exploration Activities Spread Across Commodities

While coal accounted for over half of BC's mineral production value in 2013, exploration spending has been relatively spread over a variety of other mining commodities. As Figure 18 shows, precious metals (e.g. gold) and base metals (e.g. copper) accounted for a significant percentage of the province's exploration expenditures in 2014. Existing exploration expenditures provide a rough indication of the type of discoveries and mining projects that could develop in the province's near future. The prominent spending in precious metals and base metals suggest that these types of minerals are likely to play a leading role in the future.

Figure 18: Exploration spending mix in BC (2014)

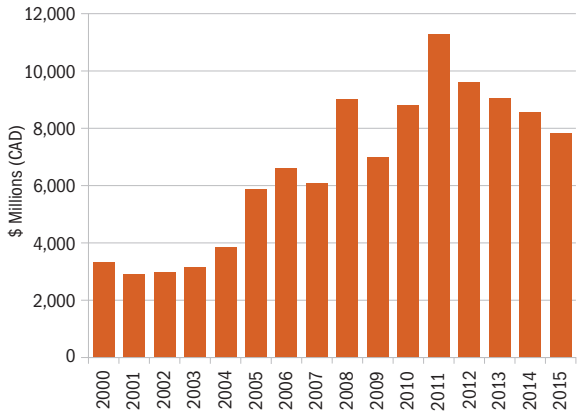


Source: Natural Resources Canada. "Exploration Plus Deposit Appraisal Expenditures, by Junior and Senior Companies by Provincial and Territory, 2011-2014 Annual, 2015 Preliminary Estimates and 2016 spending intentions," (2016)

Mining Exports and International Trade in BC

BC's mining industry depends greatly on export revenues generated from international trade. Statistics from Industry Canada show domestic mining exports[14] accounted for about 22 per cent of the provincial total (by value) in 2015. Moreover, as Figure 19 demonstrates, mining exports in the province have more than doubled since the early 2000's – from $3.2 billion in 2003 to $7.8 billion in 2015.

Figure 19: Value of domestic mining exports in BC (2000–2015)

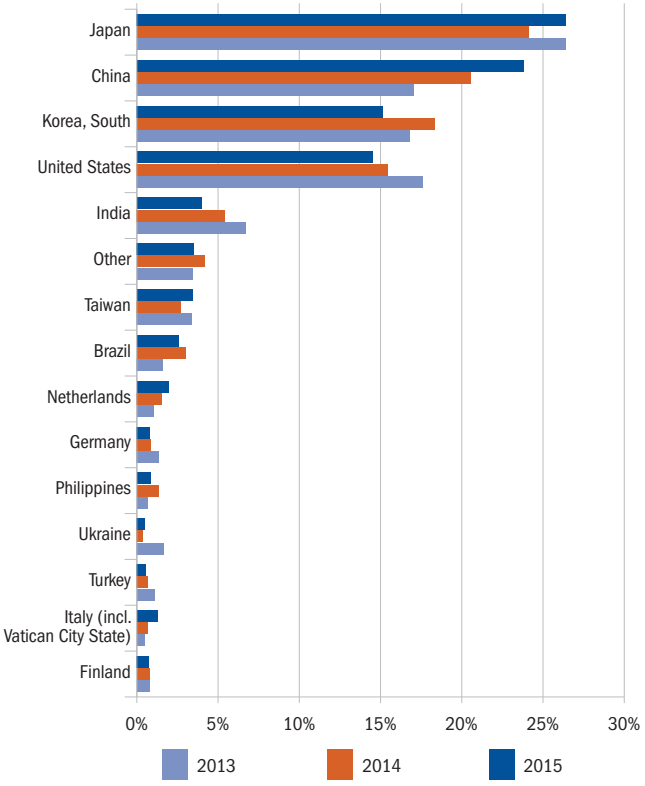


Source: Industry Canada. Import, Export and Investment (Trade Data Online database), (2016)

14 *Note that the analysis on exports reflects domestic exports, as per Industry Canada's definition: "Domestic exports consist of the exports of all goods grown, produced, extracted or manufactured in the country (Canada) leaving the country (through customs) for a foreign destination. Exports of imported merchandise which has been substantially enhanced in value are also included." Also, exports refer to exported goods reflected under NAICS codes 212,213, and a part of 331, aligned to MiHR's definition of the mining industry.*

Figure 20 highlights the primary destinations of BC's domestic mining exports (by value share) for 2013, 2014 and 2015. On average, Japan, China and South Korea accounted for the largest share of the mining exports in BC, followed by the United States among other countries. Notably, the share for China has decreased over the three years, while the shares for the United States and India have increased. Overall, a continued demand for certain minerals from Asian markets will have a relevant impact on BC's mining industry and its connections with international trading partners. For mining employers, an established and diverse network of trading partners stabilizes the demand for their mineral products and the ability to keep the workforce at full-capacity.

Figure 20: Destinations of domestic mining exports (by value share) from BC (2013, 2014 and 2015)



Source: Industry Canada. Import, Export and Investment (Trade Data Online database), (2016)

** Includes NAICS codes 212,213, and a part of 331, aligned to MiHR's definition of the mining industry in Appendix A.*

It is important to note that although BC's domestic exports unavoidably include products that may have originated in other provinces, the key trends shown in Figures 19 and Figure 20 can be expected to reflect the patterns for products originating from BC's mining industry.

BC's mining industry is a significant exporter of metallurgical coal (also known as steel-making coal). According to Natural Resources Canada,[15] this type of coal represents nearly all of Canada's coal exports, which mainly come "from coal mines in BC with smaller volumes from mines in Alberta." Furthermore, Natural Resources Canada states that "the majority of these exports were shipped by sea through coal terminals in Vancouver." The Port Metro Vancouver reported 25.7 million metric tonnes of metallurgical coal was shipped internationally in 2015, with the top destinations being Asian markets including South Korea, Japan and China.[16] This represents 73 per cent of coal products, and nearly 20 per cent of all cargo leaving the port.

15 *Please see: http://www.nrcan.gc.ca/mining-materials/markets/commodity-reviews/2012/14377*

16 *Please see: http://www.portvancouver.com/wp-content/uploads/2016/02/2015-statistics-overview.pdf*

Higher Capital Intensity in Extraction

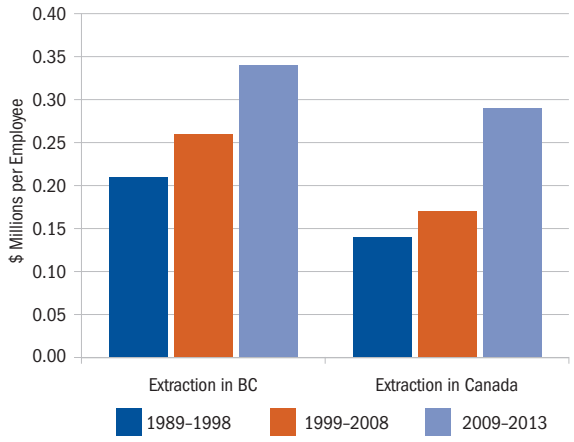
Mining extraction capital refers to the fixed assets — the buildings, machinery and equipment and the intellectual property — that are used in mineral extraction operations. The mining industry naturally uses significant capital inputs in its production process, together with extensive labour inputs (i.e. workers). Note that, for the purpose of this section "capital" specifically refers only to the machines and equipment used in extraction activities.

As discussed in Section 3, investment in mineral extraction capital has significantly grown in BC. As a result, the overall value of mineral extraction capital has also increased from approximately $1.4 billion in 2003 to $5 billion in 2013. This growth in capital stock is a sign that BC's mineral extraction sector has become increasingly capital intensive. This is further supported by PwC annual survey data, which show that mining capital expenditures have grown by a factor of 24 from 2003 to 2011 (or from $117 million to $2,943 million). Annual expenditures on capital have since dropped but have remained at relatively higher levels in 2015 (at $1,240 million).

At the national level, MiHR has found the ratio of capital dollars per worker has increased dramatically in the extraction sector since the end of the last decade. The capital dollars per worker ratio has also increased in BC. As Figure 21 demonstrates, the province's extraction sector is relatively more capital intensive than for Canada and has steadily increased over time.

This trend suggests that the workforce's interaction with capital has also changed over the past decade. With the higher ratio of capital dollars per worker and larger-scaled and more sophisticated equipment, companies may require workers who possess updated skills, or even a different skill-set altogether. Industry stakeholders confirmed that increased capital expenditures include not only replacement of existing machinery but upgrading and the purchase of new "high-end" technologies, requiring upskilling of workers.

Figure 21: Capital per worker in the extraction sector (1989–2013)



Source: Statistics Canada. Table 031-0002 — Flows and stocks of fixed non-residential capital, by North American Industry Classification System (NAICS) and Asset, Canada, provinces and territories, annual (dollars), CANSIM (database), (2016).

> "With the move to more sophisticated technology, this doesn't necessarily mean requiring fewer employees — it is not about eliminating a person but increasing the efficiency of equipment or vehicles."
>
> *Source: Industry Stakeholder, May 2016 Consultations*

Summary of Mining Operations in BC

In summation, mining operations in BC are found to have the following characteristics:

- BC's mining industry supports a wide range of activities, including numerous mining operations and exploration sites spread across the province. The vast majority of mining operations are open pit (or surface) mines although there is evidence that underground activities may increase in the coming decade, based on the major mining projects inventory for BC.
- Employment in the mining industry is roughly 30,000, and extraction activities represent a significant (and increasing) share of industry workers. Average employment in mining operations has modestly increased since 2011, though the use of contractors has fallen from 2014 to 2015. It is likely that the decrease in contractor employment is related to mines moving into production from the construction phase.
- Over the last decade, mining operations in the province have expanded in coal production; furthermore, exploration operations in the province have supported the discovery of a wide variety of minerals. These trends coincide with a general upward price shift for a number of minerals that are relevant to BC's mining industry.

- Mining exports account for a significant share of BC total exports (at roughly 21 per cent in 2015). Moreover, mining exports in the province have more than doubled since early 2000 to 2015. Japan, China and South Korea accounted for the largest share of the mining exports in BC, followed by the United States among other countries.
- The value of mineral extraction capital (e.g. buildings, machinery and equipment and the intellectual property) has increased. As such, the value of machines and equipment per worker has increased significantly in the province's extraction sector. This trend points to the increasing emphasis on the scale or sophistication of the equipment that is being employed by companies and used by workers.

5. British Columbia's Mining Labour Force Profile and Trends

Identifying and fostering all potential sources of labour to ensure access to a sufficient supply of appropriately skilled workers will support the competitiveness and growth of the mining industry, both provincially and nationally. This is important for the BC mining industry as they face a future upsurge in growth after a prolonged downturn. Mining employers (as well as those in other sectors) need a continuous flow of individuals through the "talent pipeline" to ensure that they have a sufficient pool of skilled and qualified workers to meet hiring requirements. During market contractions, there will be increased pressures for job-seekers and students to pursue training and careers outside the sector and it is therefore critically important for employers to remain connected to students, job-seekers and unemployed workers to ensure that there is a critical mass of workers available to fill positions when the inevitable upswing occurs.

This section takes a closer look at the underlying characteristics of the mining labour force in BC. The discussion includes topics such as the age, mobility, education and diversity profiles of the province's mining labour force. This discussion aims to strengthen the understanding of the mining labour force and how it relates to the potential pressures facing the province's mining industry. The 2012 BC LMI report analyzed and reported on demographic data from the most recently available Census at the time of publication (2006 Census data) and the current study presents analysis and data based on 2011 Census data. Data from the 2016 Census year is not expected to become available until mid to late 2017.

Mining employers need a continuous flow of individuals through the "talent pipeline" to ensure they have a sufficient pool of qualified workers to meet future hiring requirements and support competitiveness and growth in the mining industry in British Columbia.

Shifts in the Age Profile of the Mining Workforce

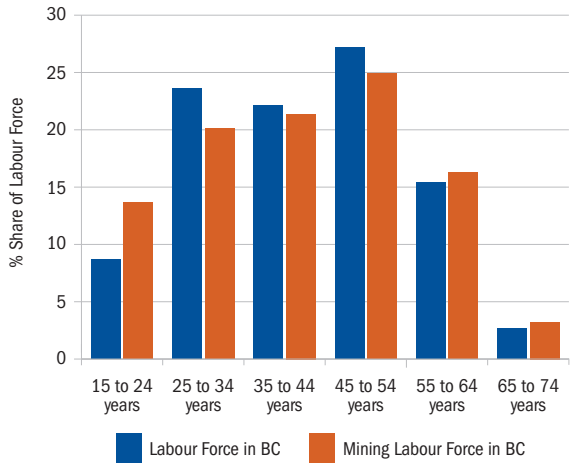
BC's mining labour force is comprised of people from several generations, each bringing a diverse background and experience to the industry. However, certain gaps are evident within the age profile in the mining labour force, when compared to the overall labour force in the province.

As illustrated in Figure 22, compared to BC's overall labour force, the age profile for the mining industry shows a greater share of 25 to 34 year olds, and at the same time, a relatively low share of 15 to 24 year olds. Figure 25 also points to a dip in the age profile of mining workers at the 35 to 44 year old cohort, which is not observed in the same category in the overall labour force. It should be noted that a similar pattern emerges in the mining labour force at the national level (see MiHR's *Canadian Mining Industry Employment, Hiring Requirements and Available Talent: 10 Year Outlook, 2015,* Figure 29, p. 30).

The 2012 BC LMI study reported that the share of 25 to 34 year olds in BC's mining labour force was about 18 per cent, and this has risen to about 24 per cent in the current study. Conversely, the share of 15 to 24 year olds reported in 2012 was about 12 per cent, and this decreased to about nine per cent, as per the most recently available Census data.

These trends suggest that BC's mining industry has struggled to attract youth – those in the 15 to 24 year old group, noting that for the mining industry, this is more likely to reflect 18 to 24 year olds given employer and regulatory requirements. This could present challenges in the talent pipeline in the future. On the other hand, an improved representation among 25 to 34 year olds is positive to the extent that this category contains relatively young individuals who are career-oriented and who typically possess education/training beyond high school. This surge in the 25–34 year old age group may be an indicator that efforts by BC employers to attract younger workers to the industry over the past decade or so have started to pay off. As such, understanding the characteristics of the age profile may provide clues for addressing HR challenges in the future, especially around promoting training that leads to careers in mining.

Figure 22: Age distribution of the labour force in BC



Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

A relatively older mining workforce means that retirement rates are estimated to be slightly higher in BC than the rest of Canada; the annual retirement rate in the BC mining industry is projected to increase from 2.1 per cent in 2017 to 3.0 per cent in 2026.

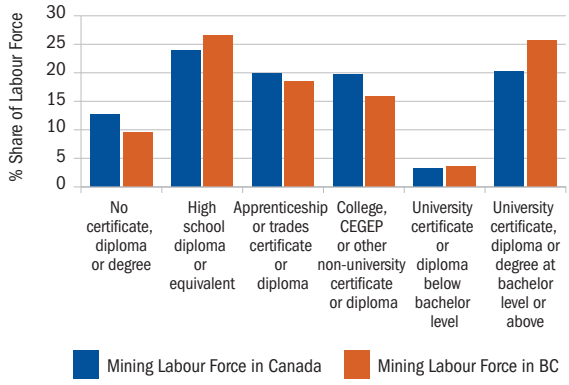
Fewer People with No Certificate, Diploma or Degree in BC's Mining Industry

A key challenge for mining stakeholders is maintaining the ability to align the skills of their labour pool with the skills needed by the industry. As such, the educational profile of the industry can demonstrate how different educational backgrounds are concentrated in the mining labour force, as well as help to identify gaps and opportunities to prepare the local labour force for positions that are in high demand.

Figure 23 compares the education levels in the mining labour force in BC with that in Canada. Relative to Canada, a smaller share of BC's mining labour force has no certificate, diploma or degree. Instead, there is a higher concentration of people who hold a high school diploma or a university degree, indicating that employers in the province have a greater dependence on occupations that require higher levels of education.

BC's mining labour force shows a lower proportion of workers who hold an apprenticeship or trades certificate or diploma, however, this proportion is expected to increase significantly when the new 2016 Census data is released as industry stakeholders reported on highly successful programs aimed particularly at engaging more Aboriginal peoples in apprenticeship programs. In addition, industry stakeholders noted a trend toward major employers increasing their requirements for Red Seal qualifications for the tradespeople they employ.

Figure 23: Education levels, mining labour force, Canada and BC



Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

> "In the past we could handle a process of training over time; we now need technological skills and capabilities to be able to monitor equipment, so hiring with lower education is decreasing and the need for skills is going up."
>
> *Source: Industry Stakeholder, May 2016 Consultations*

Diversity in BC's Mining Industry

Labour diversity describes the extent that people from different backgrounds, genders and ethnicities are employed by a specific industry. An apparent shortfall or mismatch in diversity in a workforce can point to missed opportunities, and even a malfunctioning labour market, especially if an underrepresented group has the necessary skills and experience that would be a benefit to the industry.

MiHR examines three groups that are relevant to diversity in the mining industry: Aboriginal peoples, women and immigrants. These groups are examined because their presence in the mining labour force tends not to match their distribution in the overall labour force or in the general population. This mismatch may indicate that each group faces unique challenges, including systemic barriers, to participation.

"The time is now for leadership by the mining industry to capitalize on the untapped potential of women as resources in the mining sector. In the near future, the Canadian mining industry will face significant competitiveness challenges, notably labour shortages and productivity issues. Increasing the participation and advancement of women in the industry would be one solution towards overcoming these challenges, as women constitute a significant portion of the skilled workforce."

Source: The Pathway Forward: Creating Gender Inclusive Leadership in Mining and Resources, Carleton University, 2012, p. 32.

In May 2016 MiHR published a suite of studies that examined, at a national level, workforce diversity and inclusion in the Canadian mining labour force. The suite consists of four reports: Aboriginal peoples, women and immigrants plus a comprehensive summary report highlighting diversity issues in the Canadian mining industry. A companion report also highlights examples and case studies of promising practices in diversity and inclusion (publication pending, 2016). *Strengthening Mining's Talent Alloy: Exploring Diversity and Inclusion* (MiHR, 2016) outlines some key findings as follows:

Most employees interviewed for the research reported that they see evidence that their employers are trying to create a work environment that is welcoming to all.

Few respondents, though, could point to concrete actions being taken to foster inclusion, although many noted that focus is placed on engaging Aboriginal peoples and less emphasis is placed on attracting immigrants to the industry.

Employees from all three groups reported that, while they generally find the mining workplace is team oriented and mostly respectful, there are many that still describe challenges relating to getting equitable access to opportunities, "fitting in" in the workplace and having their qualifications recognized.

Each individual study within the *Strengthening Mining's Talent Alloy* suite highlights the importance of a personal connection to an industry network for women, immigrants and Aboriginal peoples in providing access to inside knowledge about the industry and better access to employment and career advancement opportunities in the industry.

One of the strongest conclusions of this report series is that even though industry is increasingly recognizing the value of creating inclusive workplaces, there's a lot more that needs to be done. The recommended next steps include identification of priority areas for focus, and more in-depth needs analysis and developing targeted and impactful solutions.

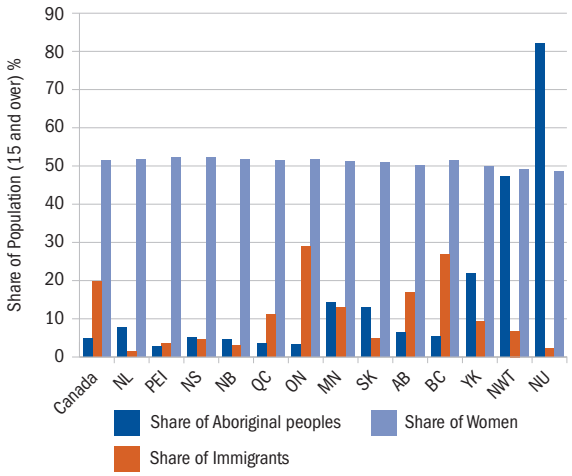
Diversity in BC's Population

In order to investigate whether a mismatch exists, a natural starting point is to recognize how a particular group is represented in the general population – thus forming a realistic expectation for the labour force and mining labour force.

Figure 24 highlights the percentage of Aboriginal peoples, immigrants and women found in the working-age populations (15 years and over) across each province and territory. As shown in the figure, BC is home to a significant share of immigrants, comprising about 27 per cent of the provincial working age population; second only to Ontario, at about 29 per cent.

Meanwhile, BC's share of Aboriginal peoples is on par with that of Canada overall (at roughly five per cent). Thus, an effort to boost labour force participation in the province among these groups is likely to be bound by these thresholds. In contrast, women comprise between 48 and 52 per cent of the population in all provinces and territories.

Figure 24: Diverse groups among provincial populations



Source: Statistics Canada, 2011 National Household Survey, Statistics Canada Catalogue no. 99-010-X2011026, (2016)

Statistics Canada, 2011 National Household Survey, Statistics Canada Catalogue no. 99-011-X2011029. (2016)

Statistics Canada. 2012. Age and Sex 2011 counts for both sexes for Canada provinces and territories, Age and Sex Highlight Tables. 2011 Census. Statistics Canada Catalogue no. 98-311-XWE2011002, (2016)

Diversity in BC's Mining Labour Force

In this report, the analysis of diversity principally examines the extent to which a particular group is represented in the mining labour force, and how that compares to the labour force overall. Since the labour force can be divided a number of ways (e.g. by industry, by occupation), there are also several ways to evaluate how diversity is represented in the labour force, depending on the frame of reference. Figure 25 illustrates the possible division of the labour force for the purpose of this analysis.

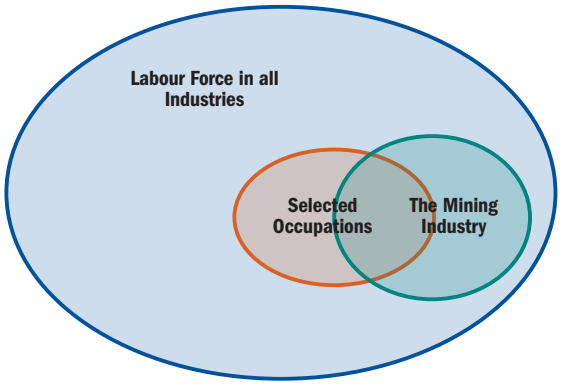
The diagram highlights the following subsets of the labour force:

- Labour force in all industries*
- Labour force in selected occupations* in all industries
- Labour force in the mining industry
- Labour force in selected occupations* in the mining industry

** Note: "All industries" refers to the general labour force in all NAICS codes reported in the province of British Columbia and "selected occupations" means occupations that have been chosen as those most relevant to the mining industry. A complete list of occupations included in this analysis is listed in Appendix A.*

This section reports on the representation of diversity groups for each of these categories, and in certain cases, for individual occupations.

Figure 25: The mining labour force visualized



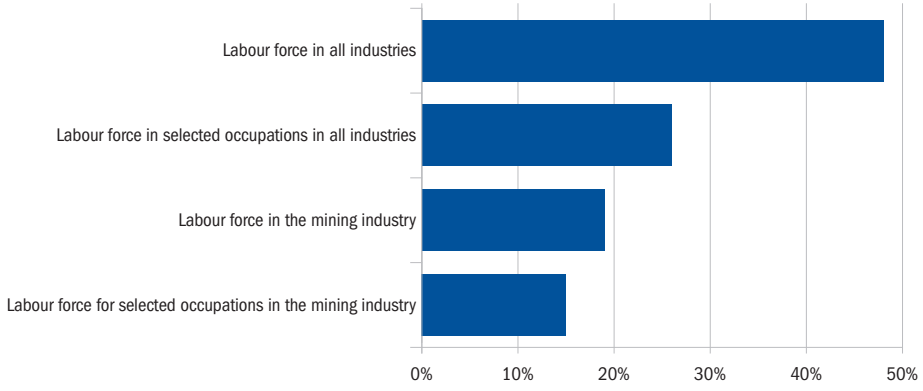
Source: Mining Industry Human Resources Council, (2016)

Key aspects of the BC mining industry include a unique culture and network of relationships that can be enhanced with efforts to improve diversity in the workforce. Stakeholders reported the importance of linking diverse populations to opportunities in the industry for improved recruitment outcomes.

Women: Low Levels of Representation in Mining

Women are commonly recognized as being underrepresented in Canada's mining industry, and BC is no exception. As shown in Figure 26, women represent 48 per cent of BC's general labour force, and only 19 per cent of the mining labour force. In other words, there is about one man for every woman in the general labour force, but over five men for every woman in the mining labour force. This proportion has not changed significantly since MiHR's 2012 BC mining labour market study, which then found that women represented about 18 per cent of the mining labour force. This nominal improvement underlines the importance of long-term programs to increase the engagement of women with the mining industry. In addition, these statistics emphasize the need for ongoing efforts to promote gender equity in the mining industry while recognizing how challenging it is to produce swift transformations to the overall mining labour force.

Figure 26: Share of women in BC's labour force



Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

"Individual employers have shared success stories of gender equity and increasing the number of women in their workforce."

Source: Industry Stakeholder, Steering Committee June 2016

Despite a very small change in the representation of women in the overall mining labour force, some of the larger mining employers in BC indicated that targeted gender equity programs have boosted the representation of women in the workforce at individual mine sites. During the May 2016 industry consultations, many employers who participated described the concrete programs and changes to policies they are taking to enhance the participation of women in the mining workforce. Case studies describing some of these successful programs are described in MiHR's 2016 publication, *Strengthening Mining's Talent Alloy: Exemplary Practices in Inclusion*.

Looking only at the labour force in selected occupations, Figure 26 reveals that women are better represented in the labour force across all industries at 26 per cent compared to the mining industry (15 per cent). This result indicates that – even within the same occupations – the mining industry has underperformed against other industries in attracting women to the labour force.

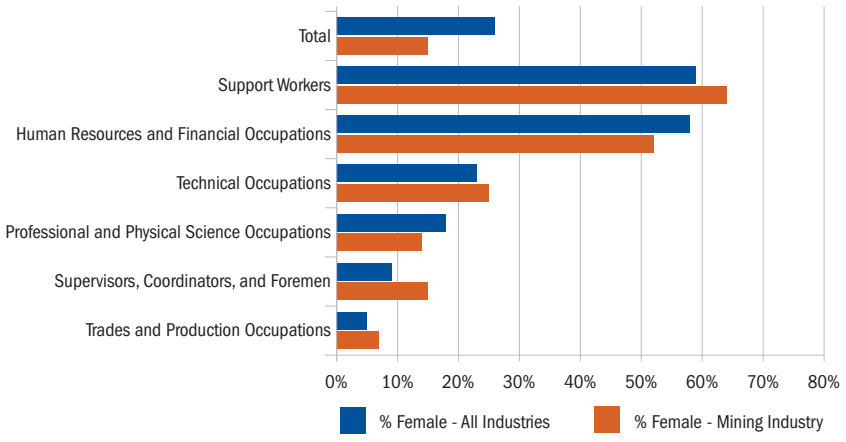
Women are better represented in the Supervisor, Coordinator and Foremen occupations than in other industries in BC (Figure 27).

Women in Occupational Categories

Even though the mining industry has underperformed in selected occupations, within certain occupational categories the share of women is small regardless of whether the focus is on the mining industry or all industries. Figure 27 compares the share of women across broad occupational categories, in both the mining industry and in all industries. While there are discrepancies, the share of women is mostly inherent to each occupational category. For example, the relatively small share observed in trades and production occupations is a characteristic of those types of occupations, notwithstanding the mining-specific factors that may also limit participation among women.

Still, it is important to note that, given that the selected occupations are those with the most relevance to the mining industry, these observations are inevitably partial to mining-specific barriers to women's participation. Nevertheless, the figure suggests that other industries tend to experience similar low levels of representation of women because of general lower participation in the selected occupations. The low number of women employees in the selected occupations is not only a challenge for the mining industry, other industries in BC's economy also struggle to attract women into these occupations as well. As such, the strategies to attract women into mining require a broader focus on attraction first into trades and production level occupations.

Figure 27: Share of women by occupational category*



** Note: the specific occupations that fall into each occupational category are listed in Appendix A, Table A-1*

Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

MiHR's 2016 publication *Strengthening Mining's Talent Alloy: Exploring Gender Inclusion* used 2012 Labour Force Survey data to assess the participation of women in a variety of natural resources sectors for Canada. The analysis showed that utilities and oil and gas industries have a higher proportion of women in their workforce – around 25 per cent. The same study found mining (inclusive of extraction, support services and mineral production) had approximately 1/6 or 17 per cent; female representation for mining which is almost the same as those in the 'fishing, hunting and trapping' sector.

While it is not currently known if BC's natural resources sectors exhibit similar levels and patterns of gender participation, the mining industry may be able to collaborate across sectors and capitalize on the successes of other natural resource industries and identify opportunities to increase the representation of women in their workforce.

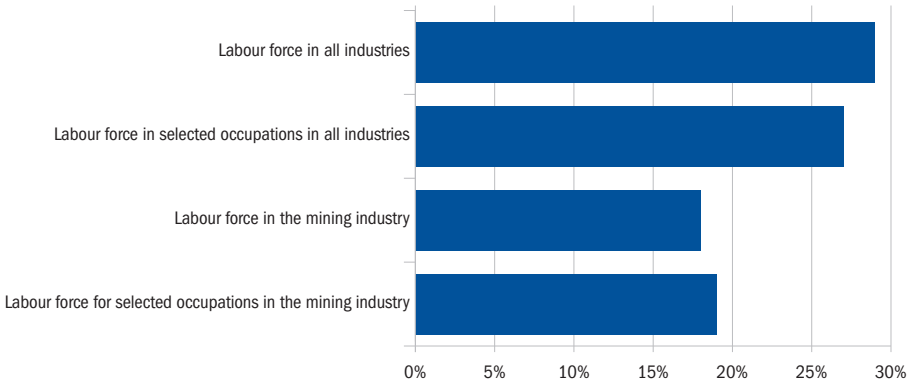
This same study also points to some specific challenges around gender equity within the mining workforce. These include:

- The historical context of women's participation in the mining sector – as recently as 1978, women were prohibited from working in underground mines. These ingrained attitudes are difficult to reverse.
- Different perceptions about and experiences in mining workplaces for women, compared to men. For example, women are more likely to report witnessing or experiencing workplace harassment and put-downs than men, especially in a field or site-level setting.
- Women are more likely than men to report that they expect to leave the sector within five years, which highlights the need for industry to consider feasible and practical retention strategies aimed at retaining women who are currently employed in the industry
- Work-life balance is an issue for all members of the mining workforce, including women.
- Accessing industry networks is a challenge for women in the industry – many report problems in finding out about opportunities and feel limited in the ability to advance in their careers within mining.

Immigrants: Limited Representation Regardless of Occupation

Immigrants represent an untapped source of labour supply for the mining industry; in addition to bringing international experience and new perspectives to Canada, immigrants also tend to have higher levels of educational attainment.[17] However, the mining industry has traditionally underperformed in attracting immigrants. As shown in Figure 28, immigrant workers make up nearly a third (29 per cent) of BC's total labour force. By comparison, they represent only 18 per cent of the mining labour force in the province. This result is comparable to MiHR's 2012 BC mining labour market study, which found that immigrants made up approximately 18 per cent of the province's mining labour force and 29 per cent of the total labour force. The contrast is further echoed in Figure 28 of this report, in which immigrants make up 27 per cent of BC's working age population. Consequently, this gap represents an opportunity for the mining industry to increase the overall representation of skilled immigrants in the province.

Figure 28: Share of immigrants in BC's labour force



Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

17 *According to MiHR's 2015 national report, the percentage of immigrants without a certificate, diploma or a university degree is lower than that for Canadian-born workers.*

While immigrants are a diverse group themselves of age, industry expertise, gender, language skills, region of origin and other aspects, the majority of those who immigrate to BC are professional and managerial by occupation.

Source: Report from British Columbia Immigration Taskforce, Minister of State for Multiculturalism, May 2012.

By 2031, it is anticipated that BC's population will grow primarily as a result of immigration and an estimated one third of job openings will be filled by immigrants, so improving alignment of immigration programs is critical.

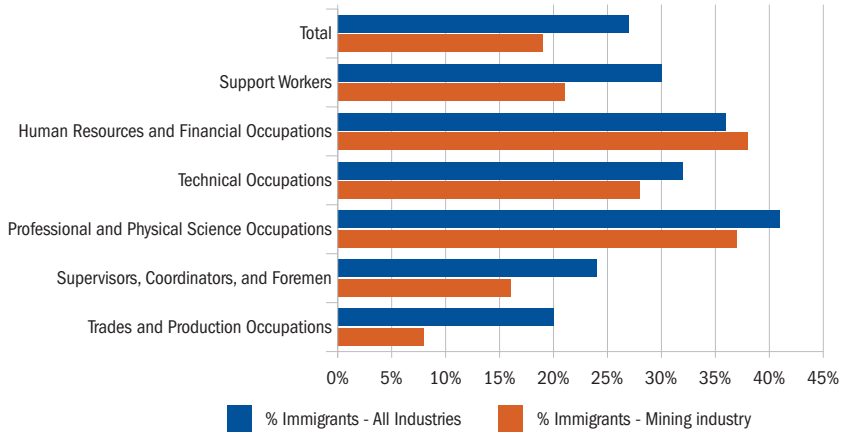
Source: Skilled Immigrant Recruitment and Retention for the BC Mining Industry, Phase One Report, January 2014.

Focusing on selected occupations, immigrants represent 27 per cent of the labour force in all industries, and only 19 per cent of the labour force in the mining industry. Similar to women, this result indicates that – even within the same occupations – the mining industry has underperformed against other industries in attracting immigrants to the labour force.

Immigrants in Occupational Categories

Within occupational categories immigrants also demonstrate a weaker attachment to the mining industry. As Figure 29 shows, mining is outpaced in most occupational categories – employing a lower share of immigrant workers – most notably in the trades and production occupations. Importantly, other industries have demonstrated a stronger ability to attract immigrants into these occupations. This would suggest that the underperformance among immigrants is – to an extent – a challenge that is specific to the mining industry. In contrast, the lack of representation among women seems to be more a reflection of generally lower participation in specific occupational categories.

Figure 29: Share of immigrants by occupational category*



** Note: a list of the specific occupations included in each of the occupational categories is provided in Appendix A, Table A-1*

Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

MiHR's May, 2016 publication *Strengthening Mining's Talent Alloy: Exploring Immigrant Inclusion* examined the workforce barriers faced by immigrants in the mining sector. The study found that other resource sectors currently outpace mining in their inclusion of immigrants. For example, in 2012 immigrants represented 24 per cent of the workforce in the oil and gas sector and 26 per cent of the workforce in the utilities sector. In the Canadian mining sector, immigrant workers made up 18 per cent of the workforce.

This research indicated specific concerns around:

- Lack of Canadian workplace experience
- Difficulties in having foreign credentials recognized in Canada
- Challenges in validating workplace experience outside of Canada
- Difficulties in connecting immigrants with the mining workforce community
- Poor cross-cultural sensitivity in mining workplaces

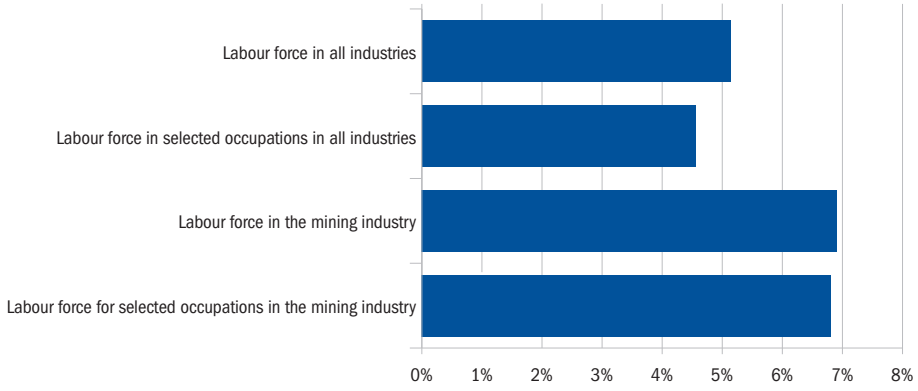
The report also highlighted the challenges for newly arrived immigrants in relation to their access to credit, housing and family support services.

Aboriginal Peoples: Outperforming Other Industries

As mining operations are often located near to Aboriginal communities and/or on traditional lands, Aboriginal participation in the labour market provides an obvious benefit both to the mining operations and to the surrounding communities. The proximity of many mining operations to indigenous communities creates the opportunity for those communities to share the prosperity that results from socially responsible mine development in BC.

Conventionally, Aboriginal peoples have been strong participators in the mining industry. As shown in Figure 30, this holds true in BC where Aboriginal peoples have a greater representation in the mining labour force (about seven per cent) than the overall labour force (about five per cent). In Figure 28 of this report, Aboriginal peoples make up about five per cent of BC's working age population. By comparison, MiHR's 2012 BC mining labour market study found that Aboriginal peoples represented about five per cent of the province's mining labour force and about three per cent in the total labour force. The difference signifies a continuing increase in representation among Aboriginal peoples, but with roughly the same positive gap between the mining labour force and the overall labour force.

Figure 30: Share of Aboriginal peoples in BC's labour force



Source: Statistics Canada. Census of Canada, 2011, custom cross-tabulation, (2014)

The BC Aboriginal Mine Training Association (operational from 2009 to 2014) partnered with Aboriginal communities and industry to develop and deliver job-relevant training for Aboriginal people to enter the mining sector. The value of investing in training Aboriginal people extends beyond the individual and the dollars are returned to families, communities, industry and government.

Programs are needed that are built on "principles of flexibility, adaptability and responsiveness…and demonstrate a practical and effective way to bridge the gap between First Nations communities and industry."

Source: PricewaterhouseCoopers Report on the BC Aboriginal Mine Training Association Program, July 2013

When examining the selected occupations relevant to mining, this pattern is repeated, further highlighting the strong participation among Aboriginal peoples in the mining labour force. Yet, there are still significant opportunities and room for growth for the employment of Aboriginal peoples, with consideration of the disproportionate number who either have no certificate, diploma or degree, or simply do not participate in the wage economy.

"Since 2007, the numbers of Aboriginal people [in BC] taking trades training has doubled."

Source: Industry Training Authority (ITA), Aboriginal Initiatives Skills Training Plan, 2015–18. 2015

During consultation, a number of stakeholders mentioned specific programs at their workplace which target increased numbers of Aboriginal workers. One employer stated that they have successfully boosted the proportion of their workforce who are Aboriginal to over 33 per cent.

Source: Industry Stakeholder, Employer Interviews 2016

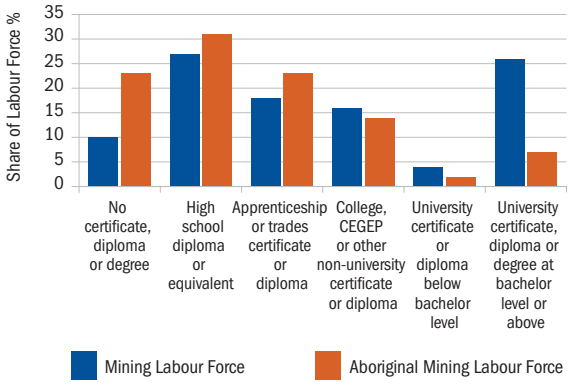
Figure 31 compares educational attainment among Aboriginal and non-Aboriginal peoples in BC's mining labour force. The proportion of Aboriginal peoples without a certificate, diploma or degree is considerably higher than for non-Aboriginal peoples. This imbalance points to potential limitations for Aboriginal peoples looking to expand their career prospects in the province's mining industry; it is also a reflection of the educational attainment in BC's overall Aboriginal population, in which roughly 33 per cent are without a certificate, diploma or degree (more than double that of non-Aboriginal peoples at 16 per cent).[18]

According to Canada's 2011 National Household Survey, 18.2 per cent of Aboriginal peoples are between the ages of 15 and 20, the age group poised to enter the workforce over the next five years.

Source: Statistics Canada, 2011 Census data; CANSIM, Aboriginal Statistics, Demographics, Table 1.

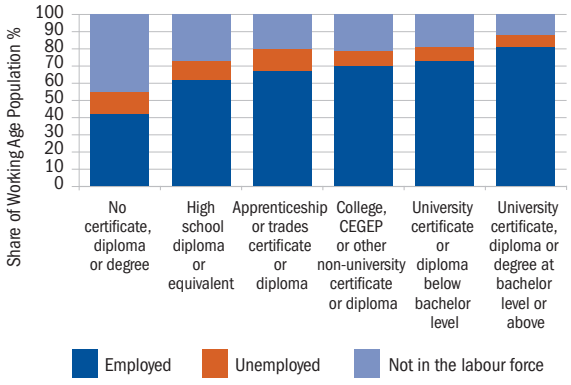
Educational attainment is one factor related to labour force participation; those with no certificate, diploma or degree are less likely to participate in the labour force. Equally, participation is significantly boosted among those with a certificate, diploma or degree. Figure 32 demonstrates this pattern for Aboriginal peoples in BC (between 25 and 64 years).

Figure 31: Education levels in BC's mining labour force, total and Aboriginal peoples



Source: Statistics Canada. Census of Canada, 2011, Custom cross-tabulation, (2014)

Figure 32: Labour market outcomes among Aboriginal peoples in BC, 25 to 64 years



Source: Statistics Canada, 2011 National Household Survey, Statistics Canada Catalogue no. 99-012-X2011039, (2016)

18 *See NHS Data tables, catalogue number 99-012-X2011039*

In addition, a significant number of Aboriginal peoples in BC do not participate in the labour force. According to Statistics Canada, labour force participation among BC's Aboriginal population (ages 25 to 64) was roughly 72.4 per cent in 2011 — compared to 79.7 per cent among the non-Aboriginal population. Therefore, more than one out of four Aboriginal people of working age are not participating in the labour force. Given that mining operations tend to exist close to Aboriginal populations, their non-participation has the deepest impact on employers looking to hire a local workforce.

MiHR's 2016 publication *Strengthening Mining's Talent Alloy: Exploring Aboriginal Inclusion* assessed and reported on the barriers, opportunities and experiences of Aboriginal peoples working in Canada's mining industry. Some of the study's key findings included:

- A general perception that Aboriginal peoples are poorly represented in professional and managerial roles
- Almost half of the employees interviewed reported that they intend to leave the industry in the next five years, citing a variety of reasons including: 1) they are being actively recruited by other sectors, 2) they believe their jobs in the mining industry are coming to an end because of mine closures and/or lay-offs and 3) for personal/family reasons, especially for fly-in, fly-out operations
- More than half of the research participants stated that they believe it is harder for Aboriginal peoples to succeed in the mining industry
- A majority of survey respondents said that their employers are taking concrete actions to employ more Aboriginal peoples

The report concludes that even though Canada's mining industry is doing a better job than most industries at engaging Aboriginal peoples, much more can be done. Concrete actions need to be taken to create customized career advancement strategies for Aboriginal workers as well as creating effective, industry-wide approaches to retention.

Summary of BC's Mining Labour Force Profile and Trends

BC's mining labour force is found to have the following characteristics:

- Certain gaps are evident within the age profile of BC's mining labour force. Notably, the profile for the mining industry shows a greater share of 25 to 34 year olds, and at the same time, a relatively low share of 15 to 24 year olds. Behind this pattern are a number of potential factors, which include the underlying (and unobserved) demographic trends that have impacted the representation among these categories in the mining labour force.

- Relative to Canada, BC's mining labour force shows a higher concentration of those with either a high school diploma or a university degree, indicating that employers in the province have a greater dependence on occupations that require these types of education.

- BC's population has a unique composition in terms of diversity. The province is home to a relatively large share of immigrants (at about 33 per cent of the working age population), whereas the share of Aboriginal peoples is on par with that of Canada overall (at roughly five per cent). Thus, an effort to boost labour force participation in the province among these groups is likely bound by these thresholds.

- Aboriginal peoples are strong participators in BC's mining industry. They have a greater representation in the mining labour force (about seven per cent) than the overall BC labour force (about five per cent). Yet, ensuring that all Aboriginal peoples have access to employment opportunities is still a challenge, especially considering the disproportionate number who either have no certificate, diploma or degree, or simply do not participate in the wage economy.

- Women are underrepresented in BC's mining industry. In 2011, women represented 48 per cent of BC's general labour force, and only 19 per cent of the mining labour force. This proportion has not changed significantly since MiHR's 2012 BC mining labour market study. Furthermore, in some occupations, there is an opportunity for mining to attract more women, based on the experience in other industries in BC, especially in the STEM (Science, Technology, Engineering and Math) occupations. It should be noted that within certain occupational categories the share of women is small regardless of whether the focus is on the mining industry or all industries.

- Immigrants represent an untapped source of labour supply for BC's mining industry. They make up nearly a third (29 per cent) of BC's total labour force compared to only 18 per cent of the mining labour force. Considering the higher levels of immigration in BC, especially amongst people with relevant training and experience, there is an opportunity for the mining industry to develop targeted recruitment strategies to make the best use of this underutilized potential labour pool.

6. MiHR's Labour Market Forecasts for British Columbia

Why are Labour Market Forecasts Important?

Labour market forecasts are tools to help industry stakeholders — employers, job-seekers, governments and education/training organizations — to understand both historical trends and potential future needs, which then inform a variety of decision making processes.

Mining industry employers can use labour market forecasts to support their strategic workforce planning, helping them to anticipate and mitigate the risks posed by the highly cyclical nature of the sector and ensure that they are making the best possible use of their workforce, both now and in the future. For job-seekers, labour market forecasts can improve understanding about the various positions available within the sector — the number of jobs that are available, where these positions are located and what skills are required for the occupations — and feed into the process for deciding the type of education programs to pursue at the secondary and post-secondary level and where to invest their job-seeking efforts.

For governments, labour market forecasts support evidence-based policy and spending decisions for investment in skills development and training to maximize strategic growth in sectors. In addition, decisions that lead to support of industry sectors may result from the analyses and forecasts. Finally, training and education institutions use labour market forecasts to plan future programming and to ensure that their graduates have the rights skills to meet industry's current and future labour requirements.

How are the Forecasts Developed?

MiHR's labour market forecasting for the mining industry is based on three main forecasts: forecast of industry employment, forecast of industry exits, and forecast of industry entrants. Other forecasts that are described (such as the hiring requirements forecast) are derived from these three fundamental forecasts. The three fundamental forecasts are discussed below following an explanation of challenges and limitations of preparing forecasts.

Challenges and Limitations

As described in Appendix B and in the forecasting sections below, MiHR's econometric model relies on the historical relationship between a dependant variable (in MiHR's case employment in the mining industry) and a variety of explanatory variables[19]. Inputs for the explanatory variables in MiHR's employment model include forecasts for commodity prices, interest rates, and capital stock. MiHR uses external sources for these forecasts including the World Bank, the Conference Board of Canada and several key financial and economic analysis firms. Despite a strong mathematical framework, a volatile input variable (external forecast) can significantly affect the accuracy of output. For example, overly pessimistic or optimistic commodity price forecasts can have a significant impact on the employment forecast. Furthermore, "shocks" such as a sudden fall in the price of a commodity like oil or the introduction of a new technology are difficult to model and forecast. To account for potential volatility over the 10 year forecast period, MiHR's analysis includes three scenarios, where the baseline scenario depicts the relevant economic scenario that is prevalent at the time of the forecast, and contractionary and expansionary scenarios show two alternative potential outcomes (increase or decrease in growth beyond baseline).

19 *In basic terms, an explanatory variable refers to a variable that has a degree of influence over another. In other words, it can "explain" another variable — usually the "dependent" variable because its outcome depends on the manipulation of the explanatory variable. In this case, mining employment is considered to be the dependent variable and several other variables jointly serve as explanatory variables.*

Forecasting Industry Employment

At the centre of MiHR's labour market analysis for the mining industry is a forecast of industry employment over a 10 year horizon. Specifically, MiHR uses an econometric model to project employment throughout the forecasting period. This model considers the historical movements of relevant explanatory variables tied to the size of the workforce and their observed effect on employment in the industry. Future changes in employment over the next decade are then estimated using various leading forecasts and intelligence for key explanatory variables.

MiHR takes into account a number of variables to construct a long-term forecast of employment in the industry. These variables regularly include (but are not exclusive to): commodity prices, the capital stock (i.e. the value of machines and equipment), GDP, exchange rates, interest rates and other factors that influence the industry's ongoing activities and employment levels. The specific impacts of these variables are summarized in Appendix C.

The employment forecasts are generated using three alternative economic scenarios. These three scenarios are developed to capture the underlying volatility in the economy and to show how alternative outcomes for the explanatory variables could impact future employment outcomes. The baseline scenario uses the current trends and forecasts for prices and other input variables by organizations (such as the World Bank's commodity price forecasts). The contractionary and expansionary scenarios are constructed by adjusting the underlying forecasts to account for higher and lower future values for these variables.

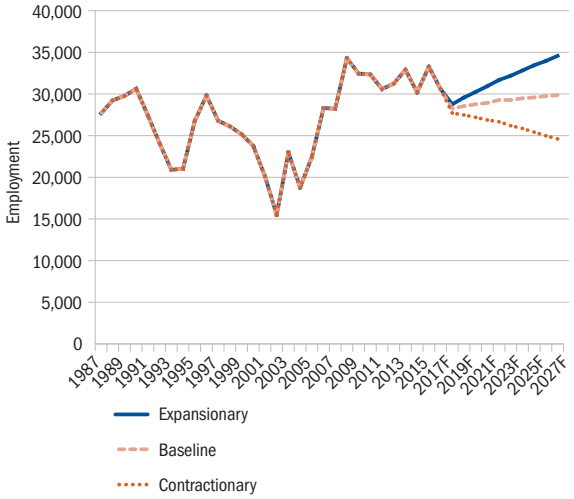
Challenges and Limitations

It should be noted that while the economic scenarios developed by MiHR do not explicitly evaluate and rank the probability of individual mine projects going into production over the next decade, the use of a range of potential future outcomes for factors such as commodity prices implicitly captures the likelihood of future production and employment aspects related to projects in advanced development stages. For example, consider the impact of change in commodity prices on the timing and feasibility of a project going into production. Assuming that all permitting and regulatory requirements have been met, an individual project will likely go into production sooner in the face of upward pressure on the price of the commodity to be mined and, conversely is more likely to be delayed in the face of a decrease in the relevant commodity price. The acceleration or deceleration of projects moving into production will also be influenced by other factors such as the availability of investment capital and interest rates. Furthermore, the future supply of qualified workers to both build and operate the mine can, on its own, become a limiting factor to expansion of mining activities within the province.

Employment Forecast in BC's Mining Industry, 2016–2026

Figure 33 shows employment in BC's mining industry for the period between 1987 and 2026. Employment is forecasted from 2017 to 2026 under the three scenarios. In 2016, total employment in the industry is estimated to be approximately 30,600 workers. Under the expansionary scenario, total employment would grow to almost 35,000 workers by 2026, whereas under the contractionary scenario, total employment would drop to 25,000 workers. The baseline scenario results in a small downward adjustment to total employment in mining, with around 30,000 workers employed in 2026. In consultation sessions with industry stakeholders, participants indicated that the industry is showing signs of picking up — including investment and upgrading of infrastructure, significant project funding and fewer worker-layoffs.

Figure 33: Forecast of mining employment in BC by scenario (1987–2026)



Source: Mining Industry Human Resources Council, (2016)

In 2016, total employment in the industry under the baseline scenario is estimated to be approximately 30,600 workers. Under the expansionary scenario, total employment would grow to almost 35,000 workers by 2026, whereas under the contractionary scenario, total employment would drop to 25,000 workers. The baseline scenario results in a small downward adjustment to total employment in mining, with around 30,000 workers employed in 2026.

Forecast of Industry Exits

MiHR estimates the rate at which people are anticipated to exit the mining labour force over the forecast horizon. The approach for this analysis is described below. There are several reasons that a person may leave the labour force, and exits are viewed as a naturally ongoing process within a specific region. Therefore, an "exit" refers to an event in which a person leaves the BC mining labour force either because they moved (1) physically out of the province, (2) to an employer in another industry, or (3) out of the labour force altogether.

MiHR considers two separate categories for exits, described below:

Retirement: MiHR estimates the expected retirement rate for each year in the forecast period. MiHR uses a retirement model that is similar to methodologies used to estimate life expectancy; in this case, MiHR's retirement model estimates average "working-life expectancy." The likelihood that a worker is participating in the labour force in a given year depends on a number of factors. MiHR's retirement model considers average age, education attainment and labour force participation in the previous year.

Specifically, MiHR's retirement model starts with an estimate of how an average individual is expected to participate in the labour force over the course of their lifetime for a given set of characteristics (e.g. age and educational attainment). This estimate is not mining specific and is derived from publicly available Statistics Canada National Household Survey (NHS) data. As a hypothetical example, given a person is 35 years old and has a university degree, they are 75 per cent likely to be in the labour force.

Then, using MiHR's custom data cross-tabulation on 2011 NHS data, MiHR develops an estimate of the mining labour force by both age and education. The retirement model projects the expectations of participation onto the 2011 estimate of the mining labour force. The model then compiles exits that are expected to occur as the mining labour force progresses through the forecast period and participation behaviour. The retirement rate for a particular year is calculated by dividing the number of exits in a given year by the total workforce at the beginning of the year.

Non-retirement Separation: This factor describes exits from the mining labour force that are not related to retirement. Non-retirement separation captures the movement of workers in and out of the mining workforce, looking at behaviours such as emigration, inter-sectoral mobility, injury and mortality. For the purposes of this study, the non-retirement separation rate has been assumed to be three per cent per year, based on information from MiHR's 2015 National Employer LMI survey, as well as migration and mobility statistics from Statistics Canada and other sources.

Challenges and Limitations:

Both retirement and non-retirement exits are the result of individual worker's choices and circumstances. Modelling how a group of individuals will behave in light of different economic scenarios is not possible. As decribed, MiHR uses a "working-life expectancy" approach to modelling retirements in the industry. The estimates for non-retirement separation are not modelled in the same manner rather, the rate is assumed.

Hiring Requirements Forecasts

Using the forecasts of industry employment and exits, MiHR also develops a forecast of hiring requirements, which gauges the human resources efforts (i.e., "hiring effort") that will be required to ensure the forecasted employment level (shown in Figure 33) is attained over time. MiHR considers two main causes for industry employers to hire or adjust the size of their workforce:

1. Industry expansion or contraction: in a period of increased mining activity, resulting growth in employment represents the industry's need to hire workers to fill newly created positions; conversely a contraction represents the need to shed jobs and incumbent workers. The hiring requirements forecast reports *net change in employment,* or the cumulative adjustments (positive and negative) to the industry's employment over the forecasting period.

2. Replacing exiting workers: workforce exits are a common reality that all employers must manage. Whether a worker has decided to retire, go back to school or move to another part of the country, their departure creates pressure for employers to replace them. Thus, employers are faced with hiring decisions that do not necessarily result directly from the business cycle but from the choices that individuals in the workforce make.

The hiring requirements model reports 'replacement requirements', or the cumulative need to replace the exiting workforce over the forecasting period. For simplicity, MiHR's hiring requirements assumes that employers will choose to replace all workers who leave, rather than substituting more machinery/technology or offering overtime to the remaining employees to make up for those lost through attrition.

Why are Hiring Requirements Important?

Whether a position is available because of a business expansion or because an employer has chosen to replace a worker who leaves, the hiring process is associated with costs including: advertising, interviewing, selecting, onboarding and training an individual up to the company standards. Furthermore, the process can be time consuming, especially in tight labour supply situations. For this reason, MiHR publishes a hiring requirements forecast which describes the total number of workers that employers will need to hire or let go, either from industry expansion/contraction or to replace those who leave the industry. The forecasts of hiring requirements are reported as cumulative totals over the next decade.

Table 2 shows MiHR's hiring requirements forecast for BC's mining industry over the next 10 years (2017–2026) under the three economic scenarios described above. The 10 year cumulative hiring requirements are projected to be 13,705 workers under a baseline scenario; 19,770 workers in an expansionary scenario; and 6,975 workers in a contractionary scenario. The most significant hiring requirements are anticipated to come from replacing exiting workers.

Comparatively, MiHR's 2012 BC mining labour market study reported 10 year cumulative hiring requirements at 16,770 workers under a baseline scenario; 19,860 workers in an expansionary scenario; and 13,340 workers in a contractionary scenario. Overall these estimates are consistent with the forecast that is presented in Table 2 with the 2012 forecast also highlighting replacement requirements as the leading driver of hiring needs. The main difference in Table 2 is shown in the baseline and contractionary scenarios, which captures an economic outlook that is significantly more pessimistic compared to the 2012 study.

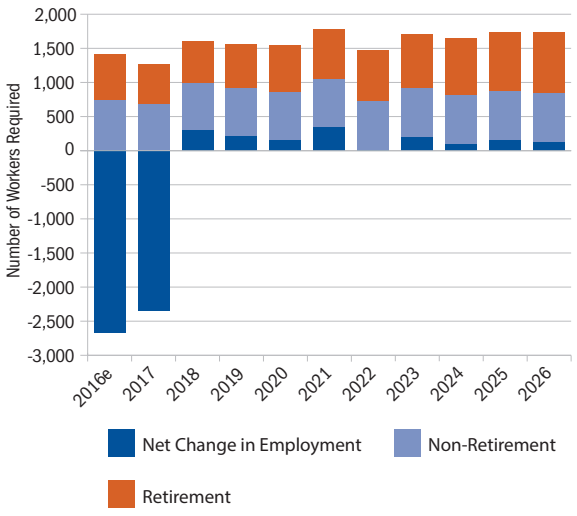
Table 2: BC cumulative hiring requirements forecast by scenario (2017–2026)

	Net Change in Employment	Replacement Requirements		Cumulative Hiring Requirements
		Retirement	Non-Retirement	
Contractionary	-5,985	6,670	6,295	6,975
Baseline	-730	7,415	7,015	13,705
Expansionary	3,980	8,105	7,690	19,770

Source: Mining Industry Human Resources Council, (2016)

Figure 34 provides a year-by-year breakdown of the hiring requirements under the baseline scenario. The annual hiring requirements average about 1,380 per year; though the industry is anticipated to shed almost 2,300 jobs between 2016 and 2017. Despite early losses, MiHR's forecasts show the industry improving after 2017 and over the forecast horizon. Replacement requirements will continue to drive the volume of new hires over the next 10 years.

Figure 34: BC cumulative hiring requirements forecast by year, baseline scenario (2016–2026)



Source: Mining Industry Human Resources Council, (2016)

Tables 3a, b and c show the projected hiring requirements by industry sub-sector (under the three economic scenarios). With about 6,890 hires over the coming decade in the contractionary scenario, the extraction and milling, stone, sand and gravel sectors collectively account for a significant share of the hiring requirements forecast.

Notably, employment in the mineral exploration sector is forecasted to drop roughly 1,400 jobs in the next 10 years. About three quarters of this loss is projected in the first three years of forecast (from 2016 to 2019) and reflects the downward adjustment in a number of the World Bank price forecasts. For example, the forecast for copper prices (See Figure 8 in this report as an example) shows an adjustment that has extended the recent fall in prices by a couple of years. Following the immediate drop in employment, the exploration sector is projected to remain relatively stable under a baseline scenario. By comparison, the expansionary scenario shows a stronger recovery following the early drop; in the last half of the forecast the sector is expected to grow by roughly 450 workers.

Table 3a: BC cumulative hiring requirements forecast by sector, baseline scenario (2017–2026)

	Estimated Employment in 2016	Net Change in Employment	Replacement Requirements		Cumulative Hiring Requirements
			Retirement	Non-Retirement	
Extraction and Milling	11,430	175	2,920	3,320	6,415
Stone, sand and gravel	790	10	200	230	440
Support services	8,100	85	1,600	1,585	3,270
Fabrication and manufacturing	4,010	445	1,410	880	2,730
Mineral exploration	6,260	-1,440	1,285	1,005	850
Total	**30,590**	**-725**	**7,415**	**7,020**	**13,705**

** Note columns may not add perfectly due to rounding.*

Source: Mining Industry Human Resources Council, (2016)

Table 3b: BC cumulative hiring requirements forecast by sector, contractionary scenario (2017–2026)

	Estimated Employment in 2016	Net Change in Employment	Replacement Requirements		Cumulative Hiring Requirements
			Retirement	Non-Retirement	
Extraction and milling	11,430	-2,405	2,530	2,900	3,025
Stone, sand and gravel	790	-135	175	200	240
Support services	8,100	-1,200	1,450	1,445	1,695
Fabrication and manufacturing	4,010	445	1,410	880	2,730
Mineral exploration	6,260	-2,690	1,105	870	-710
Total	**30,590**	**-5,985**	**6,670**	**6,295**	**6,980**

** Note columns may not add perfectly due to rounding.*

Source: Mining Industry Human Resources Council, (2016)

Table 3c: BC cumulative hiring requirements forecast by sector, expansionary scenario (2017–2026)

	Estimated Employment in 2016	Net Change in Employment	Replacement Requirements		Cumulative Hiring Requirements
			Retirement	Non-Retirement	
Extraction and milling	11,430	2,560	3,290	3,715	9,565
Stone, sand and gravel	790	145	225	255	625
Support services	8,100	1,195	1,735	1,710	4,640
Fabrication & manufacturing	4,010	445	1,410	880	2,730
Mineral exploration	6,260	-360	1,450	1,130	2,215
Total	**30,590**	**3,985**	**8,110**	**7,690**	**19,770**

** Note columns may not add perfectly due to rounding.*

Source: Mining Industry Human Resources Council, (2016)

For this report, MiHR has reported the baseline scenario as the primary vehicle for diagnosing labour market challenges in BC's mining labour market. Despite the use of the conservative scenario, challenges are still evident, especially concerning the industry's labour supply limitations. For example, the employment contraction observed in Table 3a is more than offset by the replacement requirements, which indicate an overall need to hire people to replace those who are expected to leave the industry over the next decade. In each of the sectors, replacement requirements are the main driver of hiring pressures. Thus, the impact of retirements and other separations is an issue that consistently affects each industry sector.

Table 4 highlights BC's cumulative hiring requirements forecast for the mining regions over a two, five and 10 year period (for three scenarios). This forecast incorporates the regional analysis discussed previously in Section 4 of this report.

Table 4: Cumulative hiring requirements forecasts by region, three scenarios for 2, 5 and 10 years (2017–2018, 2017–2021 and 2017–2026)

	Contractionary			Baseline			Expansionary		
	2 years	5 years	10 years	2 years	5 years	10 years	2 years	5 years	10 years
Northeast / Central Region	-240	-220	30	-90	160	1,390	60	500	1,630
Northwest Region	-20	600	1,720	220	1,190	3,140	440	1,750	4,280
South Central Region	-300	630	1,840	50	1,570	3,630	390	2,450	5,870
Southeast Region	-20	1,400	3,330	360	2,430	5,240	730	3,370	7,700
Southwest Region	-20	10	70	-10	70	320	20	120	300
All Regions*	**-630**	**2,440**	**6,890**	**540**	**5,420**	**13,705**	**1,610**	**8,190**	**19,770**

** Note columns may not add perfectly due to rounding.*

Source: Mining Industry Human Resources Council, (2016)

Table 5 shows the occupational breakdown of the hiring requirements forecasts for three scenarios, based on 70 selected mining related occupations, as defined by the National Occupation Classification (NOC) codes. The detailed list of occupations is provided in Appendix A and forecasts of occupation-specific hiring requirements can be found in Appendix E.

The occupational analysis can help target industry efforts for attracting and recruiting as well as informing the setting of policy and the planning of education and training programs to focus on occupations and skills sets that are in highest demand. Table 4 shows that trades and production occupations are anticipated to have the largest hiring requirements over the next decade. Among these occupations, employers will face pressure to recruit and train heavy equipment operators, truck drivers, underground production and development miners, construction millwrights, industrial mechanics and heavy-duty equipment mechanics.

Table 5: BC cumulative hiring requirements forecast by occupational category, three scenarios for, 2, 5 and 10 years (2017–2018, 2017–2021 and 2017–2026)**

	Contractionary			Baseline			Expansionary		
	2 years	5 years	10 years	2 years	5 years	10 years	2 years	5 years	10 years
Trades and production occupations	-205	775	2,220	165	1,725	4,345	510	2,605	6,275
Professional and Physical science occupations	-55	280	805	50	615	1,575	195	945	2,290
Human resources and Financial occupations	-15	75	210	15	170	430	50	255	620
Support workers	-10	50	155	10	120	305	30	180	440
Technical occupations	-40	185	530	35	410	1,040	125	615	1,490
Supervisors, Coordinators, and Foremen	-30	140	390	30	305	770	90	460	1,115
All other occupations	-270	920	2,670	225	2,065	5,240	620	3,120	7,540
Total*	**-625**	**2,425**	**6,980**	**530**	**5,410**	**13,705**	**1,620**	**8,180**	**19,770**

** Note: columns may not add perfectly due to rounding*

***Note: the individual occupations included in each occupational category are listed in Appendix A (Table A-1) and forecasts of occupation-specific hiring requirements are found in Appendix E (Table E-1)*

Source: Mining Industry Human Resources Council, (2016)

The five occupations with the largest hiring requirements for each of the industry sub-sectors include:

Extraction and Milling	Stone, Sand and Gravel	Exploration	Support Services
Heavy equipment operators (NOC 7521)	Heavy equipment operators (NOC 7521)	Engineers/Geoscientists*	Geologists (NOC 2113)
Underground production and development miners (NOC 8231)	Truck drivers (NOC 7511)	Drillers (NOC 7372)	Underground production and development miners (NOC 8231)
Truck drivers (NOC 7511)	Supervisors, mining and quarrying (NOC 8221)	Land surveyors (NOC 2154)	Heavy equipment operators (NOC 7521)
Heavy-duty equipment mechanics (NOC 7312)	Heavy-duty equipment mechanics (NOC 7312)	Chemical technicians (NOC 2211)	Truck drivers (NOC 7511)
Supervisors, mining and quarrying (NOC 8221)	Geologists (NOC 2113)	Drafting technicians (NOC 2253)	Mining engineers (NOC 2143)

** Includes NOC codes 2131, 2132, 2133, 2148, 2144, and 2113*

Forecast of Available Talent

To fully understand labour market pressures, the hiring requirements model must be balanced with an estimate of the number of workers expected to become available to fill those positions. For selected occupations, MiHR's available talent forecasts project the total number of new entrants to BC's labour market.

For each occupation considered, the model estimates the cumulative pool of new workers (entrants) that will become available to all industries over the forecast period — and then determines the portion that will enter the mining industry. The proportion of new entrants that are expected to enter the mining industry is based on historical patterns.

The model considers new labour market entrants from a variety of sources, including:

- School-to-work transition
- Interprovincial and international migration
- Other potential entrants, such as those returning to the labour force after a temporary leave

Challenges and Limitations:

The mining-specific available talent forecast is based solely on historical performance and does not make any assumptions about future developments, such as the introduction of new training programs or changes to immigration policies. Furthermore, since the assessment of available talent relies strictly on demographic patterns and not on external forecasts of economic variables, the available talent forecasts do not include expansionary and contractionary scenarios.

Table 6 shows the cumulative available talent for all 70 occupations combined over two-, five-, and 10 year time horizons. The forecast anticipates approximately 189,835 new entrants for selected occupations in BC over the next 10 years. Of these new entrants, the BC mining industry can expect to attract 7,945 workers, assuming the sector's historical share of new entrants into these occupations remains the same moving forward.

By comparison, MiHR's 2012 BC mining labour market study reported approximately 188,000 new entrants for selected occupations in BC over the next 10 years. Of these new entrants, the mining industry is expected to attract about 7,400 workers which closely compares to the result in Table 6.

Table 6: BC available talent forecast for selected occupations, two, five and 10 years (2018, 2021 and 2026)

	2 years	5 years	10 years
Total entrants for selected occupations (all industry sectors)	37,370	93,945	189,835
Mining's share of entrants for selected occupations	1,675	4,025	7,945

Source: Mining Industry Human Resources Council, (2016)

Table 7 shows the cumulative available talent for broad occupational categories over the next 10 years. In addition, the table shows the proportion of this available talent that the mining industry has historically attracted. This is used to calculate the number of workers expected to be available to address hiring needs in the industry.

Table 7: BC available talent forecast by occupational category (2017–2026)

	Total New Entrants All Sectors	Mining's Historic Share of New Entrants	Mining's Share of New Entrants
Trades and Production occupations	73,070	6%	4,310
Professional and Physical science occupations	22,360	6%	1,230
Human resources and Financial occupations	28,980	2%	480
Support workers	32,950	2%	560
Technical occupations	22,890	3%	740
Supervisors, Coordinators, and Foremen	9,590	7%	650

Source: Mining Industry Human Resources Council, (2016)

Talent Gaps and Hiring Requirements

MiHR's available talent forecast is commonly compared with the hiring requirements forecast to produce a gap-analysis for the occupations that are considered. Given that available talent is an occupation-based forecast, an occupation-level hiring requirements forecast is used to provide an appropriate comparison. A specific occupation is said to have a gap if hiring requirements exceed available talent over the forecast period; in this event, there is an indication that mining employers will struggle to find the workers they are projected to need in the long-term. A gap signifies a risk to mining operations given that a thin labour supply has the potential to derail projects, drive up the cost of finding workers and ultimately undermine an operation's ability to run competitively.

MiHR's gap-analysis focuses specifically on the gap between the projected hiring requirements (vacancies) and available talent (new entrants). The two abovementioned forecasts are taken independently of one another (e.g. hiring requirements forecast does not affect the available talent

forecast and vice versa). Therefore, the gap analysis does not make assumptions about strategies and policies (or shifts in school enrollment etc.) that are yet to be instigated. Instead, the gap-analysis assumes the "status quo" will continue, and is aimed at exposing potential labour pressures as they are expected to evolve based on conditions that exist today.

Table 8 compares the hiring requirements and available talent forecasts for six occupational groups.

Table 8: BC gap analysis by occupational category, baseline scenario (2017–2026)

	Cumulative Hiring Requirements	New Entrants – Mining's Share	Gap
Trades and Production occupations	4,345	4,310	-35
Professional and Physical science occupations	1,575	1,230	-345
Human Resources and Financial occupations	430	480	50
Support workers	305	560	255
Technical occupations	1,040	740	-300
Supervisors, Coordinators, and Foremen	770	650	-120

Source: Mining Industry Human Resources Council, (2016)

Although the 2016 to 2026 forecast found several occupational gaps under the baseline scenario, many of the reported gaps disappear under the contractionary scenario. Note that this outcome does not necessarily suggest that these occupations are without labour market challenges. In the mining industry, these challenges are often associated with "labour market thinness." A labour market becomes "thicker" as the number of employers and candidates for employment increases. Therefore, a "thin" labour market – described as having fewer employers and employee candidates in a given space – is more likely to be challenged to match employees with employers.

A thin labour market (and notably, a thin labour supply) is less able to react to and accommodate different phases of the full economic cycle. Nevertheless, during an economic downturn, a thin labour supply is less obvious and tends to be discounted, as workers are less in-demand. Over the long-term, industry will need to maintain a pipeline of skilled workers, to avoid more serious labour market challenges and skills shortages when the market recovers. For many of the occupations considered, an overall lack of labour supply is the underlying challenge for the industry. While economic conditions – and therefore the demand for workers – are expected to fluctuate over time, labour supply challenges remain

> **The cumulative effects of multiple industries' demand for specific occupations will increase as large infrastructure developments continue, particularly in the northeast where you have mines looking at potentially re-opening, the Site-C hydro project, along with LNG and forestry."**
>
> *Source: Industry Stakeholder, Employer Interview 2016*

relatively consistent throughout the cycles. As a result, short-term economic conditions can present a risk of exposure for occupations with a thin labour supply or an inherent sensitivity to changes in labour supply.

Gap Sensitivity to Changes in Labour Supply

The impact that a downturn has on labour supply and the inflow of new workers is uncertain, given that individuals may respond to the downturn in a number of ways (e.g. going back to school, changing careers or moving to another region/industry). However, to the extent that a weak economic climate may have affected industry's access to new workers, reduced enrollments in mining-related programs or generally discouraged workers in the industry, Table 9 provides a picture of how vulnerable an occupation may be to a decrease in available talent.

Table 9 shows key occupations that do not exhibit a gap under a contractionary scenario[20] and measures the sensitivity to changes in the supply of new workers. The first column shows the mining industry's share of each occupational talent pool; the second column shows the share that the industry needs to fulfill their hiring requirements; and the third column assigns an index to the sensitivity of the gap between hiring requirements and available talent. A high value for the sensitivity index implies that the occupation is especially sensitive to changes in the supply of new workers and indicates that employers will struggle to find workers to fill vacancies in the event of an upswing in the industry.

For example, in the BC mining workforce, truck drivers, heavy equipment operators and mechanics/millwrights are highly gap-sensitive; if, over the coming decade, one in three new entrants in these occupations chooses to work in an industry other than mining, a shortage of workers emerges, even in a contractionary scenario. By comparison, the occupations of underground production and development miners or geological and mineral technologists and technicians are less sensitive, with deceases of almost 60 per cent of new entrants over a 10 year period required before a gap emerges.

The gap sensitivity index shows the degree to which mining employers are vulnerable to a change in the inflow of new workers in specific occupations, and may help point to some key areas in which mining stakeholders can focus their efforts, especially around informing and influencing decision-making by career seekers.

20 *The contractionary scenario forms the basis for the sensitivity analysis since the objective is to identify occupations that (1) may not have an apparent gap but are (2) vulnerable or at risk of being exposed to a gap during a downturn due to sensitivities in the labour supply. Under the baseline scenario, this type of sensitivity would be difficult to detect as a certain occupation may already exhibit a gap and is thus already exposed to a thin labour supply.*

Table 9: Gap-sensitivity for various occupations, contractionary scenario (2017–2026)

	Mining's Historical Share of New Entrants	Mining's Required Share	Sensitivity Index
Construction millwrights and industrial mechanics (except textile)	10%	7%	66
Truck drivers	4%	3%	61
Heavy-duty equipment mechanics	11%	7%	60
Heavy equipment operators (except crane)	15%	9%	58
Industrial electricians	17%	9%	54
Primary production managers (except agriculture)	26%	14%	54
Supervisors, mining and quarrying	86%	42%	49
Welders and related machine operators	6%	3%	46
Geological and mineral technologists and technicians	41%	19%	46
Underground production and development miners	88%	36%	41

Source: Mining Industry Human Resources Council, (2016)

** Note that the table only presents occupations with hiring requirements of 100 and over so that comparisons are on a similar scale*

The relative sensitivity to labour supply changes also differs between the major categories of occupations. As Table 10 reveals, certain occupational categories have a lower tolerance for a drop in new entrants, namely professional and physical science occupations as well as technical occupations.

Table 10: Gap-sensitivity by occupational category*, contractionary scenario (2017–2026)

	Mining's Historical Share of New Entrants	Mining's Required Share	Sensitivity Index
Trades and Production occupations	6%	3%	51
Professional and Physical science occupations	6%	4%	65
Human resources and Financial occupations	2%	1%	44
Support workers	2%	0%	28
Technical occupations	3%	2%	72
Supervisors, Coordinators, and Foremen	7%	4%	60

**Note: A complete list of all occupations included in each occupational category is provided in Appendix A, Table A1*

Source: Mining Industry Human Resources Council, (2016)

Gap-intensive Occupations: Unfilled Vacancies

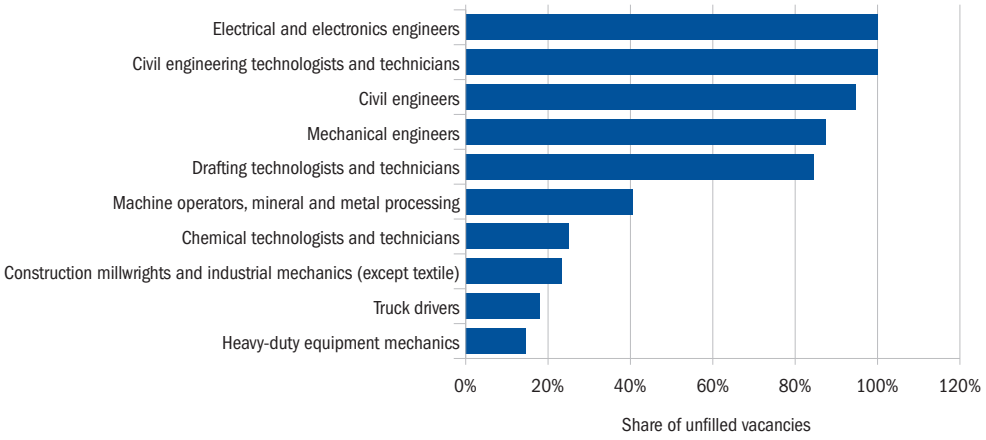
MiHR's occupational analysis identifies occupations that are expected to face significant labour market pressures. However, because the labour market factors for each occupation are unique, each may face a distinct set of challenges. As a result, comparing occupational gaps is difficult, to the extent that each gap is the result of a unique set of circumstances and pressures for that occupation.

What may be a significant labour market gap in one occupation may not be in another occupation. For example, a forecasted gap in a specific occupation may be a substantial burden for mining stakeholders in terms of finding, training and developing workers. Yet, in another occupation, the same size of gap may be relatively easier to overcome depending on the characteristics of that occupation. How can mining stakeholders determine whether an occupation has a significant labour market gap?

One way to evaluate occupational gaps is to calculate the share of hiring needs that will remain unsatisfied, in accordance with MiHR's forecasts of new entrants. For example, consider a specific occupation that has a hiring requirement of 1,000 and a gap of 100 workers; accordingly, 10 per cent of the vacant positions cannot be filled, even if all new talent available to mining is hired. The situation is potentially more problematic if the occupation instead has a hiring requirement of 500 workers; in this case, 20 per cent of the hiring needs are not met — a stronger indication that this occupation will experience labour shortages in the coming years. As the proportion of unfulfilled hiring requirements increases, the occupation becomes more gap-intensive. Occupations with the greatest gap intensities represent a higher concern, in terms of employers' ability to fulfill future hiring requirements and stay competitive in the long-term.

Figure 35 shows the occupations with the highest gap intensity, based on MiHR's baseline scenario. Notably, "technicians" and "engineers" are commonly referenced among the occupations listed in the figure. Figure 35 suggests that, for machine operators, mineral and metal processing approximately 40 per cent of industry's hiring requirements (vacancies) will remain unfilled, even if mining hires all the newly available talent available to industry employers. This represents a significant gap and represents a challenge not only to employers but to educators and government to address.

Figure 35: Top gap-intensive occupations, baseline scenario (2017—2026)



Source: Mining Industry Human Resources Council, (2016)

** Note that the table only presents occupations with hiring requirements of 100 and over so that comparisons are on a similar scale.*

Sharing Talent with Other Industries

MiHR's gap-analysis for occupations allows mining stakeholders to make informed decisions about training and developing new workers for jobs in the industry; however, in reality, not all people that enter a mining-related occupation will ultimately enter the mining workforce. For all the occupations considered in this report, the mining industry shares a talent pool with other industries. As a result, the degree to which talent is available may vary from one occupation to another.

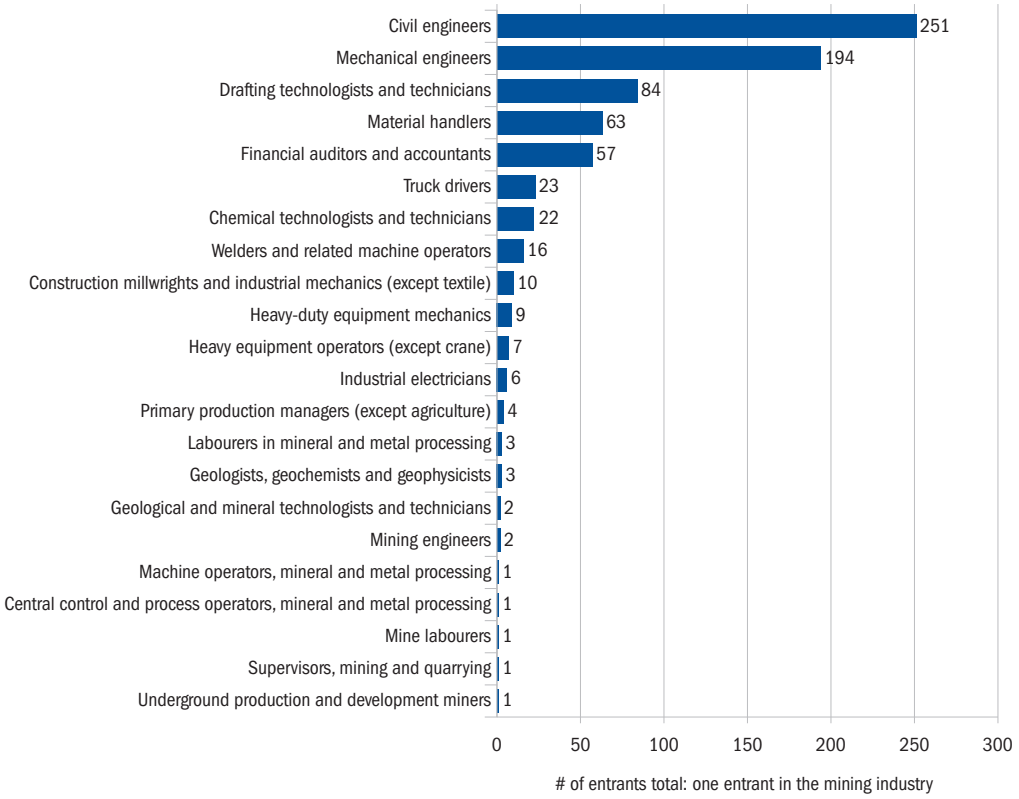
To the extent that the mining industry shares a talent pool with other industries, an effort to erase an occupational gap may actually end up benefiting other industries. For instance, consider that an occupation has a reported gap of 1,000 workers, and the mining industry has historically attracted 80 per cent of workers in that occupation: merely finding and developing 1,000 new workers is not enough to address the gap in the mining workforce, since the industry is expected to attract only 800 workers from this pool (or 80 per cent). To address the gap — for the sole interest of the mining industry — at least 1,250 new entrants in the occupation are required — of which the mining industry is expected to capture 1,000 (80 per cent).

Therefore, a reported gap is not necessarily filled with new entrants on a one-to-one basis. Depending on the mining industry's ability to attract new entrants, each occupational gap reported by MiHR has a "sharing rate" that may compound the need for a larger talent pool. In the above example, additional new entrants are needed to ensure the mining industry has a large enough talent pool to draw upon.

Figure 36 presents the sharing rates for various occupations. The sharing rate describes the number of entrants the mining industry will need to ensure that employers can fill all of their future vacancies. For instance, a sharing rate of 10:1 suggests that the industry will need 10 new entrants in that occupation, to fill one vacancy. Figure 36 shows that for each civil engineer needed by the mining

industry, 251 new entrants are required. Meanwhile, for every underground miner required for mining, only one new entrant to the labour market is needed. A larger sharing rate is less favourable for mining stakeholders looking to develop talent specifically for the industry — as it indicates that developing workers for that occupation will be relatively inefficient.

Figure 36: Rates of sharing new entrants with other industries for selected occupations (based on historical trends)



Source: Mining Industry Human Resources Council, (2016)

** Note that the table only presents occupations with hiring requirements of 100 and over so that comparisons are on a similar scale.*

Identifying High-Priority Occupations for the Mining Industry

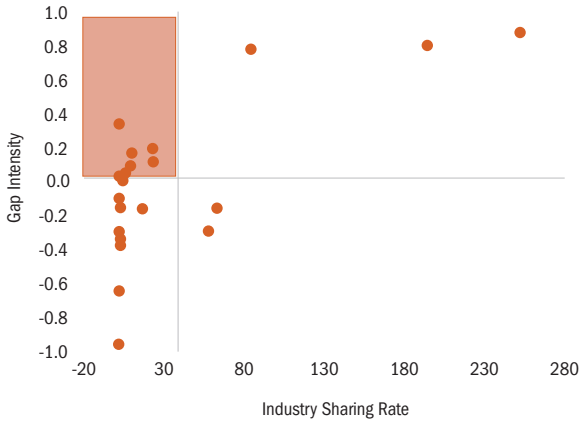
The occupational characteristics covered in this section can also be combined to classify which occupations are especially at risk for certain labour market issues. For instance, Figure 37 illustrates for every occupation:

1. the gap intensity on the vertical axis – defined as the share of hiring requirements (vacancies) that remain unfilled (have a gap); and
2. the industry sharing rate on the horizontal axis – defined as the number of new entrants in all industries required in order to obtain one new entrant in the mining industry.

These two measurements jointly reveal which occupations possess both a significant gap and a greater return for the mining industry on training and development. The occupations fitting this description are found in the top left quadrant in the graph. They include:

- Primary production managers (except agriculture) (NOC 0811)
- Chemical technologists and technicians (NOC 2211)
- Industrial electricians (NOC 7242)
- Construction millwrights and industrial mechanics (except textile) (NOC 7311)
- Heavy-duty equipment mechanics (NOC 7312)
- Heavy equipment operators (except crane) (NOC 7521)
- Truck drivers (NOC 7511)
- Central control and process operators, mineral and metal processing (NOC 9231)
- Machine operators, mineral and metal processing (NOC 9411)

Figure 37: High priority occupations for the mining industry



Source: Mining Industry Human Resources Council, (2016)

7. Challenges, Key Findings and Recommendations

The mining labour market in British Columbia is facing a number of challenges that are presented in this report. The key findings and recommendations are a result of extensive consultation with industry stakeholders to provide suggestions to manage these challenges and positively impact labour market functioning in BC's mining industry.

Challenges:

Implementing Long-term HR Development Strategies

Maintaining mining industry attachment for displaced workers: There is a need to offset the loss of experienced and skilled workers who may become discouraged during an industry downturn and choose to leave the sector. This may mean both providing support for these employees to transition to other sectors temporarily and creating opportunities for unemployed workers to maintain their connection with the mining industry through training opportunities or skills upgrading programs.

Identifying and recognizing transferable skills: Training program design needs to take into consideration the skills that may be transferable between other sectors and mining. Care should be taken, especially in those occupations that are highly vulnerable to a decrease in new entrants, to ensure not only a sufficient supply of workers for the mining industry, but also to recognize the need to develop a sufficient labour pool in occupations that are shared with other sectors.

The changing skills requirements for the mining life cycle: It is important to consider the different HR and skills requirements of different phases of the mining life-cycle. For example; during the construction phase of a mine, many projects employ larger numbers of contractors while operational mines are more commonly managed and run by direct employees of the company. While there are similarities between the skills of development miners and production miners, the transition of workers from the construction phase to the production phase of a mine may require some training and skills upgrading. As a project transitions from a construction phase to an operating mine, it can be difficult to determine the most efficient way to support transition of the workforce while considering the mine life cycle of the project.

Changes in technology and innovation and the impact on skill requirements: Innovation and the use of new technology in the industry will change the nature of many mining occupations and their skills requirements in the future. Upskilling and training programs will be needed more than ever. The challenge is to anticipate the needs of employers and workers as each try to keep pace with evolving mining technologies to remain competitive in the industry. This will make education and industry partnerships critical to ensuring a sufficient talent pipeline to support future mining development in BC.

Competing sectors and industries for workers in mining occupations: Mining industry stakeholders in BC have expressed concern that emerging industries such as Liquefied Natural Gas (LNG) may threaten the mining industry's ability to find and retain skilled workers. In late 2015 and early 2016, the LNG industry anticipated the creation of more than 100,000 new jobs as a result of expansion of LNG operations in Northern BC, however, recent announcements have suggested that a number of these projects will be delayed given a drop in global natural gas prices.

A Volatile and Vulnerable Exploration Sector

- Just as today's mining operations were initiated with past mineral exploration activities, future mining projects will also depend on the discovery and exploration of new mineral deposits. As such, current exploration activities are an indicator of potential future mine development.
- Exploration companies are especially sensitive to market conditions and prices. Due to the recent fall in commodity prices, many firms are challenged to raise the necessary capital to expand, or in some cases even continue, their exploration activities.
- Junior companies are especially sensitive to market fluctuations. The sharp decline in spending by juniors indicates that exploration companies have felt the impact of weakening commodity prices and this is compounded by a cautious investment community.
- The over-sensitivity to market conditions offers challenges to people aspiring to work in the exploration sector; some have become underemployed or have turned to other types of work not related to their specific skill-sets.
- The volatility in the exploration sector creates challenges to retain or re-attract skilled workers who have become disengaged and to provide stable employment that will enable new workers to progress along their learning curve. This fails to facilitate the long-term development of a skilled human resource pool that will be equipped to seize industry opportunities when they arise.

Leveraging Diversity in Employment in Mining

- Far fewer women are represented in BC's mining labour force compared to the overall labour force and the general population.
- Low female participation is common in mining regions across Canada, suggesting that women in general face barriers that limit their participation in mining-related occupations.
- There are a larger proportion of Aboriginal mining workers who do not hold a high school diploma than amongst the non-Aboriginal mining workforce.

- Almost 25 per cent of the Aboriginal mining workforce are qualified tradespeople who hold an apprenticeship/trades certification. This exceeds the proportion of non-Aboriginal mining workers who hold trades qualifications (18 per cent). This reflects the strong performance of Aboriginal peoples in trades training initiatives under the Industry Training Authority (ITA).
- Immigrants are underrepresented in the mining industry's labour force, comprising only 18 per cent of all workers in the industry. One third of the provincial population in BC are immigrants and they make up 29 per cent of BC's overall labour force (all industries).
- While the proportion of immigrants in the trades and production occupations in all industries in the province is more than 20 per cent, immigrants comprise less than 10 per cent of the mining labour force in those occupations (as shown in Figure 29).
- Despite evidence at the national level that immigrants tend to hold higher levels of formal, post-secondary education, training and experience, they are significantly underrepresented in the professional and physical sciences as well as in technician and technology occupations in the mining sector, compared to the same occupations in all industries in BC.

> **"The focus on 'Canadian experience' combined with other biases employers may harbour not only costs employers their competitive edge, but it can cost them the opportunity to be innovators in their field."**
>
> *Source: Fiona Macfarlane, IEC-BC Board Member quote from IECBC 2016 Employer Forum Final Report, March 2016.*

Expectations About Workplace Flexibility and Work-life Balance

- MiHR's research has found that younger people — particularly those in the 25–34 year old age cohort — make up a relatively greater share of BC's mining labour force and in the province's overall labour force. It is also noted that there is a smaller proportion of workers from the mining workforce in the 35–44 year old age range, a pattern that is not evident in the general labour force in BC.
- Industry stakeholders pointed out that younger workers in BC's mining industry may have different expectations regarding their working arrangements including the amenities provided by employers, flexible work schedules and opportunities for mobility and promotion within the organization.
- In addition, workers with families and a close community may seek workplace flexibility. This can impact the engagement of Aboriginal workers as well as women and men with family responsibilities.
- MiHR's research at the national level has shown that work-life balance is a challenge for workers in the mining industry including youth and retiring workers as well as men and women who are raising families or caring for the elderly.

The Importance of Collaborative Partnerships in Maintaining Accurate and Responsive Labour Market Information

- Despite a sophisticated data collection and analysis system for labour market information in Canada, it is often difficult to collect and analyze current data specific to the BC labour market, especially in mining (including exploration, stone, sand and gravel and mining support services) but also across sectors. This information is needed to support the development of strategic and collaborative partnerships to solve joint labour market issues.

This study has highlighted for our industry employers and stakeholders the need to remain current and responsive to labour needs and to work with government, professional associations, educational institutions and communities to leverage the supply of skilled workers. In addition, there is a need to remain informed on inter-provincial mobility and access to skilled immigrant communities and to examine more carefully the availability of talent given competition for skilled workers in a variety of occupations that provide cross-sector visibility.

Key Findings

The key findings for the mining labour market in British Columbia are a result of a review of research, both primary research and secondary data, and direct consultation with mining associations, employers, education partners, mining workers (both employed and unemployed) and other stakeholders. The Steering Committee leveraged these key findings as support for the recommendations.

Key findings include:

1. THE STRUGGLE TO ATTRACT AND RETAIN WORKERS

The mining industry is highly volatile, experiencing cycles of downturn followed by upswings during which there are marked changes in the demand for skilled workers. The industry has experienced a downturn into 2016 with predictions for an upswing to start in 2017. This study considers that workers who were laid off during the downturn may behave in a number of different ways: some choose to leave the industry and go to another sector; some may choose to pursue further education; some will migrate to mining jobs in other provinces while others may choose to remain within the BC mining labour force, continuing their job search within the province. In addition, employers indicated that when the upswing occurs and new mines open, there will be a rapid increase in hiring requirements. The combination of a sharp increase in demand, coupled with limited availability of talent could lead to a crisis in the BC mining labour market over the next few years, in the absence of programming aimed to address the potential shortages.

Potential opportunities that could be explored include:

- Develop collaborative forum of government, employers, regulators and education institutions to collect annual data and to address in a timely manner the skills and occupational needs of industry
- Conduct best practice research of similar initiatives for retention and transition programs in other industries/sectors

- Government, employers and training organizations jointly develop skills transferability map across mining occupations and sectors that will support the ability of workers to transition to new roles within mining or to similar roles in other industries
- Government to include the BC mining industry and occupations under JTST's Community Transition Services Program to increase training initiatives for upgrading and identification of transferable skills.

- Provide opportunities at employer sites for people transitioning into exploration work in the sector to develop their specific skill-sets – even if full-time employment is not possible.
- Conduct a BC industry-wide workforce planning initiative to develop strategies that better address the challenges of the cyclical industry and retention of skilled workers.
- Develop programs for career development, reskilling and the efficient transition of skilled workers throughout their careers.
- Improve skills recognition and assessment of current workers as well as for those who are transitioning from other industries or who come to BC from other parts of Canada or from other countries. Improvements to the availability of information and tools to support assessment of national and international equivalencies, credentials and skills recognition will support employer access to skilled workers, both in Canada and around the world.

- Develop a framework to evaluate changes in technology and innovation and assess the impact on the need for new skills and training. This information will provide data to influence the development of training programs and funding and will better address labour market needs before they occur.
- Develop training and apprenticeship programs to facilitate workforce transition: from mine construction to production mining, from basic mining technology to advanced technology and from roles in mining to similar jobs in related industries.
- Develop targeted skill-upgrading programs to existing employees, displaced workers and potential new entrants related to the introduction of new mining techniques or technologies
- Foster stronger partnerships between education providers and employers for internships and exposure to the industry and mine life cycles.
- Foster collaboration of mine training centres across Canada to leverage promising practices and avoid duplication of efforts.

2. THE NEED TO ATTRACT NEW SKILLED WORKERS TO THE INDUSTRY

The industry, even in a baseline scenario, will face demand for skilled workers due to the increasing number of retiring workers in addition to those exiting the workplace for other reasons, including the perception of unstable employment in the industry. The hiring requirements between 2017 and 2026 under the baseline scenario will be for an additional 14,000 workers. With a projected upswing starting in 2017, this demand could increase to as many as 20,000 workers in an expansionary scenario and will result in an even wider gap between industry's needs and the inflow of new talent. Even in a contractionary scenario, with increased numbers of mine closures and fewer new mines opening, industry would still require 7,000 workers to replace those exiting the mining workplace due to retirement or other reasons. In other words, the industry's need for skilled workers will persist, even in the face of a volatile labour market.

Potential opportunities that could be explored include:

- Develop an outreach campaign with employers and education institutions to improve awareness of the career and advancement opportunities in mining for all groups, including the underrepresented groups such as youth, women, immigrants and Aboriginal peoples.
- Survey current new entrants including inter-provincial and international migrants, those in the 25–34 year old age group, and exiting employees to understand factors affecting attraction and retention in the mining industry.
- Develop knowledge transfer programs at industry sites to create a bridge of development between senior employees and new entrants including mentorship, advanced training and development.
- Develop international training partnerships to provide an additional supply of trained workers to the BC mining industry, and to align mine training programs and curriculum in BC, Canada and abroad.

3. THE OPPORTUNITY TO LEVERAGE DIVERSE POPULATIONS

The mining industry in BC continues to excel in the inclusion of indigenous people in their workforce, exceeding the accomplishments in other sectors. BC has seen an increase in Aboriginal peoples' involvement through focused industry-specific training programs and impact-benefit agreements. However, there is still more that can be done to improve the mining sector employment outcomes for Aboriginal communities. The focus should continue to be on the opportunities for shared prosperity from mining and exploration activities.

In contrast, there has been only a marginal increase in the proportion of women and skilled immigrants in the mining workforce compared to the 2012 study. Despite a higher concentration of immigrants in BC's labour force, and the influx of internationally trained professionals to the province, there has not been a significant increase in the engagement of skilled immigrants in the mining workforce.

Although individual employers have made significant gains in the number of women employed at their mines through targeted engagement strategies, the mining industry generally struggles to retain the female workforce, especially in non-traditional roles and occupations.

There is a need to continue efforts to diversify the workforce in mining, ensuring that current engagement initiatives are continued, while developing new strategies to boost representation of these key labour groups.

Potential opportunities that could be explored include:

- Increase exposure and access to mining-related occupations for women
  - Review industry classifications for occupations to ensure they are inclusive of women.
  - Encourage and foster female role models in all capacities of the industry.
  - Increase exposure of women to various production and trades occupations to improve the pipeline of women who may consider occupations required by the mining industry.
  - Educational institutions work in collaboration with employers to track outcomes of female graduates who complete programs relevant to mining occupations for better information on what factors contribute to improved attraction to the industry.
- Increase representation of Aboriginal peoples in the mining workforce by providing community-based training
  - Offer skills upgrading including foundational skills required to work in the industry (for example, MiHR's Mining Essentials program).
  - Develop a community-based training approach to manage the issues around leaving the community and improve employment outcomes with alternative methods of delivery of training.

- Improve access to employment information for immigrants

  - Develop recruitment programs with government, industry associations and employers that undertake strategies to attract skilled immigrants with professional, managerial and technical skills relevant to the BC mining industry.
  - Provide immigrant communities and supporting organizations with relevant and up-to-date information about the mining industry, including foreign credential recognition, requirements to work in specific occupations, availability of jobs within the industry, location of jobs and information about what it means to work in mining in the Canadian and BC context.
  - Increase communication with immigrant communities and provide specific resources for immigrant communities that highlight working conditions for immigrants in the Canadian mining industry, such as MiHR's video "This Home of Mine" which is available on the Explore for More YouTube channel.
  - Facilitate industry networks for immigrants with employers, education and community organizations including virtual career fairs and professional networks for skilled immigrants in mining.
- Improve employer access to the skilled immigrant labour pool
  - Provide best practices and scenarios using recruitment and retention tools to employers to streamline and allow the process of recruiting immigrants in the industry to be more efficient.
  - Foster stronger partnerships between mining industry employers and the agencies that serve immigrant communities to improve the flow of qualified applicants for employment.

4. ADAPTING THE WORKPLACE ENVIRONMENT TO RETAIN SKILLED WORKERS

It is acknowledged that the industry cycles and the demand for skilled workers requires strategies that continue to improve retention of employees. In addition, strategies for maintaining a connection with mining sector workers during contractionary periods is key to sustaining a pipeline of skilled workers that can be re-engaged as soon as the anticipated upswings occur.

Potential strategies that could be explored include:

- Provide support to employers with best practice research and practical programs that allow employers better access to tools, programs and policies that can be customized to individual workplaces.
- Monitor and measure the impact of these tools and strategies on recruitment and retention in the mining industry.

Recommendations

The following two key recommendations encompass the key findings in this report. The recommendations focus on collaborative approaches to addressing the key labour market challenges faced by the mining industry in the province and creating timely solutions and programs that will result in a more responsive mining labour market in BC.

Recommendation 1:

Strengthen collaborative partnerships between employers and government to support labour market information collection and strategies for attraction, retention and transition of mining workers through mine life cycles.

Recommendation 2:

Build upon findings to develop strategies to address critical job vacancies and support a sustainable workforce.

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 where assignment to a specific industry is based on primary activity, enabling it to group together 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.

Stone, Sand and Gravel (usually counted as a subset of Extraction & Milling)

- 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.

Support Services

- NAICS 2131 Support activities for mining and oil and gas extraction. 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 and for the extraction of oil and gas. Establishments engaged in the exploration for minerals, other than oil or gas, are included. Exploration includes traditional prospecting methods, such as taking ore samples and making geological observations at prospective sites.

Fabrication & 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).

Mineral 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 NAIC code relates to Geosciences, Surveying and Mapping, and Assay Laboratories.

Occupation Classification

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

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

NOC Code	Title
Production and Trade Occupations	
8231	Underground production and development miners
7511	Transport truck drivers
7521	Heavy equipment operators (except crane)
7312	Heavy-duty equipment mechanics
I214	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

NOC Code	Title
9611	Labourers in mineral and metal processing
7372	Drillers and blasters – Surface mining, quarrying and construction
7612	Other trades helpers and labourers
7271	Carpenters
7251	Plumbers
7371	Crane operators
7252	Steamfitters, pipefitters and sprinkler system installers* (Sprinkler system installer in SK is a separate trade from steamfitters and pipefitters)
9241	Power engineers and power systems operators
7311	Construction millwrights and industrial mechanics
7242	Industrial electricians
7237	Welders and related machine operators
Professional and Physical Science 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 sciences
2112	Chemists
Human Resources and Financial Occupations	
1111	Financial auditors and accountants
112	Human resources managers
1112	Financial and investment analysts
111	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

NOC Code	Title
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 Foremen	
8221	Supervisors, mining and quarrying
811	Managers in natural resources production and fishing
711	Construction managers
7203	Contractors and supervisors, pipefitting trades
211	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 and 2011. 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 publicly available Labour Force Survey data for information regarding labour force trends in a particular region (e.g. unemployment, or part-time, 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 also often relies on other public information from Statistics Canada: Among these include *Canadian Business Patterns, the Survey of Employment Payroll and Hours,* the *Job Vacancy and Wages Survey* (among others).
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 and exporting regions, among 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.
Canadian Mines Handbook	MiHR purchased a subscription to the Canadian Mines Handbook (2016), which provides a list of all the major mining projects and development occurring in Canada for the year. This data set provides a summary for each project, that may include factors such as employment levels, commodities sought, reserves, etc.
Other Sources	MiHR is continually looking for data that may be relevant to the mining labour force. For example, in British Columbia, BCStats would provide a relevant, provincial source of information that could feed into the demographic and economic profile of MiHR's report for BC as well as validate MiHR's other data sources. Other potential data sources include but are not limited to the BC Major Projects Inventory, The Mining Association of Canada (MAC), PricewaterhouseCoopers (PwC), and the Conference Board of Canada.

In addition to the secondary data sources listed, the researchers have conducted a series of primary data collection exercises, including the following:

1. Industry stakeholder consultation workshops: Five workshops held in person or by teleconference with a total of 32 participants including employers, employee (and former employees), association representatives, partner organizations, job-seekers, immigrant serving organizations, Aboriginal community representatives and relevant government organizations.
2. BC Ministry of Energy and Mines (MEM): conducted a telephone/email survey of 13 operating mines and two advanced development projects in the province to collect employment data (direct employees and contractor) for these operations over the past five years.
3. The research team conducted 10 telephone interviews with leading employers in the province to review employment data collected by MEM and gather any additional data available including accounting for employees at corporate head offices located in Vancouver and future hiring expectations, if available.

APPENDIX C

MiHR's Employment Forecast: Summary of Main Variables

MiHR uses a number of variables to construct its 10 year forecast of employment for the mining industry. These variables regularly include (but are not exclusive to): commodity prices, the capital stock (i.e. the value of machines and equipment), gross domestic product (GDP), the productivity of labour, exchange rates, interest rates and other factors that influence the industry's ongoing activities and employment levels. The specific impacts of these variables are discussed below.

Commodity Prices:
Prices have a significant impact on the viability of mining operations. An increase in price generally translates to greater profits for mining companies, as well as higher returns for investors, particularly in the mineral exploration sector. As such, prices are a catalyst for mining activities.

As prices move above the cost of extraction, newly viable mining projects emerge and existing operations may look to expand their production capacity to capitalize on the higher price; these activities require an expansion of the workforce. Therefore, commodity prices are positively correlated with employment in the industry. This relationship also applies to negative price movements. As prices begin to drop, mining activities tend to slow down, and this in turn may lead to reduced hours of work and/or layoffs. As commodity prices are constantly in flux, the size of the workforce can also change accordingly, although there are often lags between price changes and workforce adjustments. It should be noted that employers may choose to ignore short-term price adjustments in the interests of maintaining production levels and remaining competitive over the long run.

The Canadian mining industry is currently enduring a prolonged period of depressed commodity prices.

Capital Stock:
The stock of capital refers to the fixed assets — the buildings, machinery and equipment — that are used in mining operations. The mining industry naturally uses significant capital inputs in its production process, together with extensive labour inputs (i.e. workers).

Changes to the capital stock can have an ambiguous effect on employment. The addition of capital can increase the need for workers, to the extent that workers are required to interact with it. For example, a new truck requires a driver. On the other hand, with advancements in technology, additional capital can act as a labour substitute. For example, a larger-scale truck reduces the number of drivers needed. Finally, more sophisticated machinery may change the skills requirements for the operator.

In the last decade, mineral extraction operations in Canada have utilized more capital (in value terms) than ever before. A higher ratio of capital dollars for every worker indicates that the industry has become more capital-intensive and that the workforce's interaction with capital has changed; thus, the recent surge in capital has not necessarily meant a parallel increase to the industry's level of employment.

Gross Domestic Product (GDP):
Gross Domestic Product (GDP) measures the value of goods or services produced over a given period. A rise in GDP can be the result of many factors, including an increase in prices (above general inflation) and additional capital or labour inputs (number of workers and hours worked), among other influences. Generally, an increase in GDP corresponds to an increase in production and employment levels. In other words, given that production increases are typically made possible with more workers, changes to GDP provide a gauge on the ongoing adjustments to the industry's employment.

Real GDP in Canada's mining industry has grown in each of the last three decades — even with the significant economic turbulence that suppressed growth in the late 2000s.

Labour productivity:
Labour productivity describes the value of output that is produced for every input of labour. This measure indicates how labour is being used to produce output over time; it is commonly expressed as real GDP divided by the number of hours worked or the value of output per hour of work. Many factors can influence labour productivity: the skills and composition of the workforce; the arrival of new technologies; and additional capital in the form of larger-scaled machines and equipment. Each of these factors can affect the way workers are utilized and how they interact with the capital inputs in the process. If labour productivity rises, it is not obvious whether the increase was primarily due to an increase in output or a decrease in workers (or hours). As a result, a change in labour productivity does not explicitly suggest a corresponding change in employment.

Labour productivity in Canada's mining industry has increased from previous decades. While the cause of this increase is difficult to quantify — or even specify — the effect echoes a combination of factors, including increased and larger-scaled capital, evolving technologies and even hyper-increases in mineral prices.

Interest Rates:
Interest rates have an ambiguous effect on employment in the industry. On the one hand, a decrease in interest rates makes it less expensive to borrow money. For a mining enterprise looking to finance its activities, an adjustment to the interest rate can therefore affect the optimal mix of capital and labour inputs the company decides to use in its operations.

Interest rates also provide a barometer of the performance of the overall economy. High interest rates over a long period of time signal that the economy is robust — given that businesses are keen on borrowing to further their endeavours. As a result, a sustained increase in interest rates is, in general, positively correlated with employment growth in the mining industry. Interest rates are determined by a number of factors, notably, the Bank of Canada's monetary policy governing the supply of money in the country. Currently, interest rates are exceptionally low by historical standards. The low rates coincide with a slower economy, which has, in turn, initiated a reduced cost of borrowing.

Exchange Rate:
Canada's exchange rate denotes the relationship between the Canadian dollar and another foreign currency — most commonly, in terms of US dollars. Canada's resource-based economy is primarily

made up of exporters. A depreciation of the Canadian dollar makes exports relatively cheaper for a buyer in another country, thus making Canadian exports more attractive and in-demand. For Canada's mining industry, this could mean a potential increase in the number of workers needed to sustain mining activities. Even for those exporters who receive payment in US dollars, a depreciating Canadian dollar makes their wage bill and other operational costs of production in Canada, less expensive in the short term.

The exchange rate in Canada (specifically the Canada-US rate) has fallen significantly over the past couple of years. While this movement is considered favourable to exporting sectors of the economy, including the mining industry, it is still not evident that mining operations will significantly alter their production capacity or levels of employment in response to short-term movements in the exchange rate.

Table C-1 summarizes the effects that each of the above-mentioned variables has on employment in Canada's mining industry.

Table C-1: Summary of factors impacting mining industry employment

	Production	Exploration Activity	Employment	Current Status
Commodity Prices	A price increase makes production more profitable, leading to an increase in employment. A price decrease has the opposite effect.	A price increase produces a higher return for investors in the mineral exploration sector and increases exploration activities and employment. A price decrease has the opposite effect.	A price increase generally leads to an increase in employment. A price decrease has the opposite effect.	The Canadian mining industry is currently experiencing sharp decreases for a number of key commodity prices.
Capital Stock	An increase in the capital stock increases production levels and vice versa.	An increase in exploration's capital stock increases exploration activities and vice-versa, though this sector is less capital-intensive than the mineral extraction sector.	An increase in the capital stock has an ambiguous effect: • An increase in employment to the extent that workers are needed to interact with the additional capital. • A decrease in employment to the extent that technological advancements in capital replace the need for labour.	In the last decade, mineral extraction operations in Canada have utilized more capital (in value terms) than ever before.

	Production	Exploration Activity	Employment	Current Status
GDP	Generally, an increase in extraction-related GDP corresponds to an increase in production. A decrease has the opposite effect.	Generally, an increase in exploration-related GDP corresponds to an increase in exploration activities. A decrease has the opposite effect.	Generally, an increase in mining GDP corresponds to an increase in employment. A decrease has the opposite effect.	Real GDP in Canada's mining industry has grown in each of the last three decades — even with the significant economic turbulence that suppressed growth in 2008–2009.
Labour Productivity	Assuming that employment remains constant, an increase in labour productivity corresponds to an increase in production. A decrease has the opposite effect.	Assuming that employment remains constant, an increase in labour productivity corresponds to an increase in exploration activity. A decrease has the opposite effect.	A change in labour productivity does not explicitly suggest a corresponding change in employment.	Labour productivity in Canada's mining industry has increased from previous decades.
Interest Rates	An adjustment to interest rates has an ambiguous effect: • To the extent that it makes it more or less expensive to borrow, this can affect the level of production. • High interest rates over a long period of time signal that the economy is robust and that production will be greater.	An adjustment to interest rates has an ambiguous effect: • To the extent that it makes it more or less expensive to borrow, this can affect the level of exploration activities. • High interest rates over a long period of time signal that the economy is robust and that exploration activities will be greater.	An adjustment to interest rates has an ambiguous effect: • To the extent that it makes it more or less expensive to borrow, this can affect the mix of capital and labour inputs an operation uses. • High interest rates over a long period of time signal that the economy is robust and that industry employment will be greater.	Interest rates are exceptionally low by historical standards.
Exchange Rate	A depreciation of the Canadian dollar makes Canadian exports more attractive, potentially leading to an increase in production.	A depreciation of the Canadian dollar makes Canadian exports more attractive. However, exploration is less affected, as it does not export goods to the same degree as the mineral extraction sector.	A depreciation of the Canadian dollar makes Canadian exports more attractive — and for Canada's mining industry — a potential increase in the number of workers needed to sustain mining activities.	The exchange rate in Canada (specifically the Canada-US rate) has fallen significantly over the past couple of years.

Table C-2 summarizes the variables and the data sources that are frequently used in MiHR's employment forecasting. Of course, other variables may also be considered and included, depending on the individual demands of each forecast.

Table C-2: Common variables under consideration for an employment forecast

Employment Forecast	
Industry employment	MiHR's Custom data cross-tabulation from Statistics Canada's *Labour Force Survey* for selected NAICS codes*
Mineral prices	World Bank Commodities Price Forecasts
Mining GDP growth	Statistics Canada's *Canadian System of National Economic Accounts* for selected NAICS codes (CANSIM 379-XXXX)
Measures of labour productivity	Statistics Canada's *Labour statistics consistent with the System of National Accounts* (SNA) for selected NAICS codes (383-XXXX)
Investment in capital stock (i.e. machines, equipment, buildings)	Statistics Canada's *Flows and stocks of fixed non-residential capital* for Selected NAICS codes (CANSIM 031-XXXX)

APPENDIX D

Analysis of Primary Employment Data — Existing Sites and New Sites in Development

Background:

As part of this Labour Market Outlook study, the BC Ministry of Energy and Mines (MEM) collected employment data from a sample of 13 operating mine sites in British Columbia and two projects in the advanced development (pre-construction) phases that are expected to go into operations in 2017. The data collected included employment of both direct employees as well as contractors for each of the past five years (2011 through 2016). The historical employment data collected by MEM for each of the 13 operating mines in the MEM sample is presented in Section 4 of the report (see Figure 14).

The MEM data was also used by the researchers as a basis for interviewing individual employers to validate and enhance the primary data by adding estimates of employment at corporate offices as well as expectations about future employment levels at these 13 sample operating mine sites over the coming decade.

Furthermore, the researchers polled a selection of mining companies that are anticipating eight new mine projects moving into the permitting and pre-construction phase in the province in the near future to ascertain their expectations about future hiring requirements (both contractors and direct employees). It should be noted that these eight projects were selected from a list of 27 major mining projects[21] that are currently in the consultation/approvals stage and at this time it is not possible to predict which of these projects will proceed to the permitting and pre-construction (advanced development) phase or, indeed move on to become producing mines.

Despite this uncertainty, this appendix analyzes the data collected and points out the observed trends and expectations about mine development and the impact it may have on mining industry employment in the next few years. This information helps to set the context for interpreting MiHR's econometric forecasting contained in Section 6 of this report.

21 See http://www2.gov.bc.ca/gov/content/employment-business/economic-development/industry/bc-major-projects-inventory

Operating Mines and Advanced Development Projects:

Table D-1 and Figure D-1 shows the data collected by MEM and further enhanced and validated by the researchers with employers at the 13 mines operating in BC in May of 2016 and two new projects expected to go into operation in 2017. As per this data, total employment at the sample sites in 2016 was approximately 7,200 employees, comprised primarily of direct employees (89 per cent), with a much smaller proportion of contractors (five per cent) and office staff (five per cent).

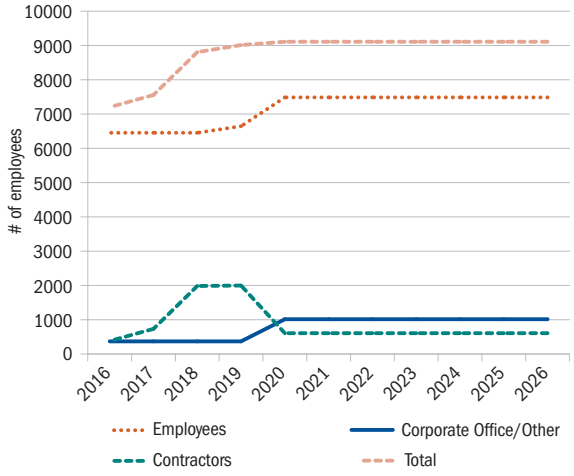
Looking at future expectations, the sample employers expect total employment to increase steadily from 7,200 in 2016 to a high of 9,100 by 2020. This increase in employment is expected to be mostly comprised of more intensive use of contractors during the period from 2017 to 2019, accounting for between 10 and 25 per cent of total employment. This pattern demonstrates that employers tend to depend on contractors and mining suppliers to a greater extent during the construction phases of mining. Beginning in 2019, employers project that the number of direct employees will increase from 6,453 in 2018 to almost 7,500 in 2020.

Table D-1: Employment at operating mines and advanced development projects in BC, 2016–2026

Year	Employees	Contractors	Corporate Office/ Other	Total
2016	6,453	379	369	7,201
2017	6,453	734	369	7,556
2018	6,453	1,984	369	8,806
2019	6,645	1,998	369	9,012
2020	7,486	608	1,015	9,109
2021	7,486	608	1,015	9,109
2022	7,486	608	1,015	9,109
2023	7,486	608	1,015	9,109
2024	7,486	608	1,015	9,109
2025	7,486	608	1,015	9,109
2026	7,486	608	1,015	9,109
Total	**78,406**	**9,351**	**8,581**	**96,338**

Source: BC Ministry of Energy and Mines sample employer survey, 2016 and BC Employer interviews, (2016)

Figure D-1: Employment at operating mines and advanced development projects in BC, 2016–2026*



** Note: n = 15 (2 advanced development projects and 13 operating mines)*

Source: BC Ministry of Energy and Mines sample employer survey, 2016 and BC Employer interviews, (2016)

Challenges and Limitations

While BC employers at existing mine sites and advanced development projects were able to estimate their changing employment needs in the near term (a three year period from 2017–2020), they were unable or unwilling to predict changes to this picture beyond that time. It should also be noted that this analysis only includes ongoing operation and potential new mines expected to go into construction and operation in the near future and does not account for those mines which may be nearing end of life (exhaustion of ore body) nor those which may face the need to curtail operations or temporarily suspend production for other reasons (such as workplace accidents or incidents or labour disputes). Furthermore, this data does not account for the other sectors covered by the MiHR forecasts including stone, sand and gravel operations or exploration activities and therefore does not account for total mining employment within the province (as MiHR's hiring requirements forecasts do). Nevertheless, this sample data does suggest that the short-term outlook for future employment at some existing operations over the next couple of years is comparatively positive.

Exploration Projects:

In addition to the sample of mine projects shown above, the researchers also interviewed the owners of eight of the 27 major mine projects in the "consultation/approval" stages described in Section 4 of this report. Owners of these properties were asked to estimate their expectations around their employment needs at these sites over the coming decade. Note: the two advanced development projects included in the previous section of this Appendix D are not included in this analysis.

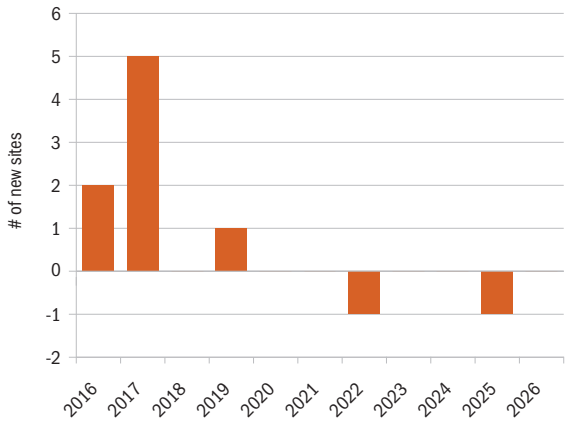
Table D- 2 and Figure D-2 show the potential number of new mining projects (in the sample of eight projects) anticipated to move into production in the coming decade.

Table D-2: Potential new mines and projected employment in BC, 2016–2026

Year	New Mine sites operating	Employees for Operations	Construction	Total	Number of new sites
2016	2	1,250	1,940	3,193	2
2017	7	1,910	4,500	6,416	5
2018	7	2,180	1,800	3,990	0
2019	8	2,495	1,800	4,305	1
2020	8	2,830		2,840	0
2021	8	2,830		2,840	0
2022	7	2,830		2,840	-1
2023	7	2,830		2,840	0
2024	7	2,710		2,720	0
2025	6	3,124		3,134	-1
2026	6	3,124		3,134	0

Source: BC Employer Interviews, (2016)

Figure D-2: Number of new sites becoming producing mines, 2016–2026

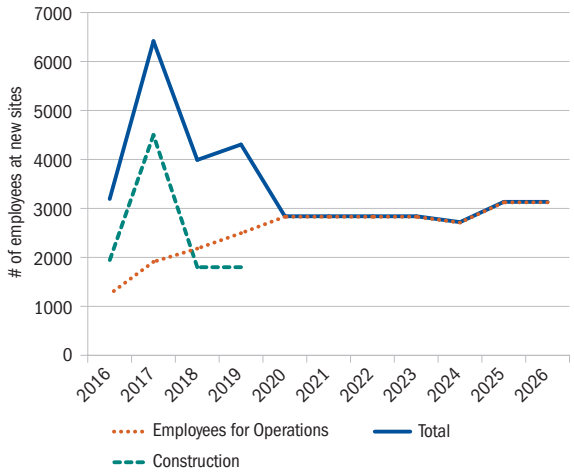


Source: BC Employer Interviews, (2016)

As shown in Figure D-2, BC employers report that two additional sites will move into the "permitting and pre-construction phase" in 2016 and another five projects in 2017. Subsequent development on one new project emerges in 2019 and the forecasts show that two projects will close – one in 2022 and one in 2025.

It is not possible to gauge the extent to which external factors such as fluctuating interest rates, exchange rates or commodity price movements will advance the future outlook for these individual projects. Nevertheless, should this pattern of development for these projects prevail, Figure D-3 shows the pattern of employment projected by these employers. Figure D-3 again illustrates the inability or unwillingness of sector employers to project their employment needs beyond the next three to four years. The figure also illustrates that site owners/employers at these locations will have a high reliance on mining contractors to support the activities at the site during the construction phase and that subsequent phases of activity will involve more direct employees of the company.

Figure D-3: Projected employment at potential emerging mining projects in BC, 2016–2026



Challenges and Limitations

These projects were selected at random from a list of 27 mining development projects that are currently in the consultation/approval phase. There is currently no reliable way to predict the feasibility of each individual project nor to consistently forecast when any of these projects can be expected to move from the consultation/approval phase into the "permitting and pre-construction phase."

APPENDIX E

Occupation-by-occupation Hiring Requirements

Table E-1 provides BC's cumulative hiring requirements forecast for selected occupations over a 10 year period (for three scenarios). Specifically, the forecast is given for 70 selected mining related occupations, as defined by the National Occupation Classification (NOC) codes. The detailed list of occupations and their NOC codes is provided in Appendix A.

Table E-1: BC cumulative hiring requirements forecast for selected occupations, three scenarios for 10 years (2017–2026)**

	Contractionary 10 years	Baseline 10 years	Expansionary 10 years
Trades and Production Occupations			
Heavy equipment operators (except crane)	370	725	1,045
Truck drivers	320	635	915
Underground production and development miners	310	610	880
Construction millwrights and industrial mechanics (except textile)	185	365	530
Heavy-duty equipment mechanics	175	340	490
Welders and related machine operators	120	235	340
Mine labourers	110	220	315
Industrial electricians	105	200	290
Machine operators, mineral and metal processing	95	185	265
Central control and process operators, mineral and metal processing	85	165	240
Material handlers	75	145	205
Labourers in mineral and metal processing	65	125	180
Power engineers and power systems operators	45	85	120
Steamfitters, pipefitters and sprinkler system installers	30	60	90
Crane operators	30	60	85
Drillers and blasters – Surface mining, quarrying and construction	30	55	80
Underground mine service and support workers	25	45	70
Construction trades helpers and labourers	25	45	70
Other trades helpers and labourers	10	25	35
Carpenters	10	20	30
Plumbers	0	0	0
Total	**2,220**	**4,345**	**6,275**

Professional and Physical Science Occupations			
Civil engineers	195	380	550
Geologists, geochemists and geophysicists	190	370	535
Mining engineers	130	260	375
Mechanical engineers	85	160	235
Electrical and electronics engineers	60	120	175
Other professional engineers, n.e.c.	30	55	80
Geological engineers	25	45	70
Metallurgical and materials engineers	20	40	60
Chemical engineers	15	35	50
Biologists and related scientists	15	30	45
Other professional occupations in physical sciences	15	30	45
Industrial and manufacturing engineers	15	30	40
Chemists	10	20	30
Total	**805**	**1,575**	**2,290**
Human Resources and Financial Occupations			
Financial auditors and accountants	125	250	360
Financial managers	35	70	100
Human resources managers	25	50	75
Specialists in human resources	20	45	65
Financial and investment analysts	5	15	20
Total	**210**	**430**	**620**
Support workers			
Inspectors in public and environmental health and occupational health and safety	50	95	140
Secretaries (except legal and medical)	35	75	105
Non-destructive testers and inspection technicians	20	40	60
Dispatchers and radio operators	10	25	35
Construction estimators	10	20	25
Production clerks	10	20	25
Administrative clerks	5	10	15
Engineering inspectors and regulatory officers	5	10	15
Cooks	5	5	10
Inspectors and testers, mineral and metal processing	5	5	10
Transportation route and crew schedulers	0	0	0
Total	**155**	**305**	**440**

Technical Occupations			
Geological and mineral technologists and technicians	155	310	445
Drafting technologists and technicians	100	195	280
Chemical technologists and technicians	60	120	170
Civil engineering technologists and technicians	60	120	170
Land surveyors	40	75	110
Industrial instrument technicians and mechanics	25	45	65
Mapping and related technologists and technicians	20	45	65
Information systems analysts and consultants	20	40	55
Electrical and electronics engineering technologists and technicians	20	35	50
Mechanical engineering technologists and technicians	10	20	30
Land survey technologists and technicians	10	20	30
Industrial engineering and manufacturing technologists and technicians	5	10	10
Biological technologists and technicians	5	5	10
Total	**530**	**1,040**	**1,490**
Supervisors, Coordinators, and Foremen			
Supervisors, mining and quarrying	180	355	515
Primary production managers (except agriculture)	125	245	350
Supervisors, mineral and metal processing	45	85	125
Engineering managers	25	50	75
Construction managers	15	35	50
Contractors and supervisors, mechanic trades	0	0	0
Contractors and supervisors, pipefitting trades	0	0	0
Total	**390**	**770**	**1,115**

** Note: columns may not add perfectly due to rounding*

***Note: the individual occupations included in each occupational category are listed in Appendix A (Table A-1)*

Source: Mining Industry Human Resources Council, (2016)

Photos in the report were provided by the Association for Mineral Exploration British Columbia, College of the Rockies, Mining Industry Human Resources Council, and SMS Equipment Inc. Special thanks to the unknown and known photographers which include: Kevin Burt, Matt Fraser, Brian Kornichuk, Courtney Opper, Milada Pardovicova, Clinton Smyth, Josie Speed, and Dave Thompson.

"The BC mining industry is on the cusp of requiring 7,000 to 20,000 new entrants. This critical need opens an opportunity for stakeholders to be innovative and adaptive in ensuring a diverse workforce is available to sustain the future competitiveness of the BC mining industry."

Jill Tsolinas, Executive Director,
Centre of Training Excellence in Mining