Mining Sector Performance Report 2011-20

Energy and Mines Ministers' Conference
Newfoundland and Labrador
July 2022

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Preface

The 2022 edition of the *Mining Sector Performance Report* (MSPR) examines the economic, social, and environmental performance of the Canadian minerals industry from 2011 to 2020, and benefits from the insight, comments, and review from a multi-stakeholder external advisory committee, the provinces and territories, industry associations, and industry members. The report was prepared by the Intergovernmental Working Group on the Mineral Industry for submission to the 2022 Energy and Mines Ministers' Conference in July 2022 in Newfoundland and Labrador.

The 10-year range of interest in this edition of the report is consistent with that of the previous edition in 2019. That edition focussed on 2008-2017, which represented a backward shift of one year compared with previous editions. The two-year gap between the most recent data and publication of the MSPR enables capturing a more complete set of data.

The report focuses on:

- The domestic activities of the sector;
- National-level indicators and, when possible and relevant, data by jurisdiction; and
- Describing performance trends rather than determining causality among metrics.

For the purpose of this report, the terms *minerals sector* and *minerals industry* are used interchangeably and comprise the following North American Industry Classification System (NAICS) codes:

- NAICS 212 – mining and quarrying (excluding oil and gas);
- NAICS 327 – non-metallic mineral product manufacturing;
- NAICS 331 – primary metal manufacturing; and
- NAICS 332 – fabricated metal product manufacturing.

For some indicators (e.g., Gross Domestic Product, employment, investment), additional data related to the mineral exploration subsector are available and included in sector totals.[1] This is noted in the text when relevant.

The data generally excludes oil sands activity, which would fall under Code 211120 – Crude Petroleum Extraction (crude petroleum from oil sand). In addition, data and analysis considerations are explained where applicable to provide the reader with an understanding of specific data constraints.[2] Relevant data are complete to year-end 2020 unless otherwise noted.

[1] Within Statistics Canada's *System of National Accounts*, data related to a special tabulation titled NAICS 21311B – support activities for mining are available. This special classification is an aggregation of NAICS 213117 – contract drilling (except oil and gas) and NAICS 213119 – other support activities for mining, and captures establishments engaged in mineral exploration and drilling, and service companies operating on a fee or contract basis. This subsector does not include mining industry suppliers that service multiple sectors (e.g., transportation, construction, finance, legal, etc.)

[2] For example, nominal values are used for most indicators as data in real terms are unavailable due to the lack of a mineral-specific deflator. As such, trends highlighted in the report for some indicators (e.g., production and exports) reflect price fluctuations.

Introduction

Canada's wealth of natural resources makes up a fundamental part of the economic and social fabric of the country and its history. The minerals industry is a past, present, and future contributor to Canada's growth and prosperity in all regions of the country. Mining and minerals are crucial social and economic drivers that support the solidarity and enable the independence of many rural, remote, and northern communities. It would be impossible for our society to sustain itself without the contribution of mined products to fields including electronics, transportation, and energy among many others. Canada is working to position itself as a world leader in providing raw materials and critical minerals to support growing domestic and international interest in new and emergent technologies in the green technology, electric vehicle, and energy storage industries.

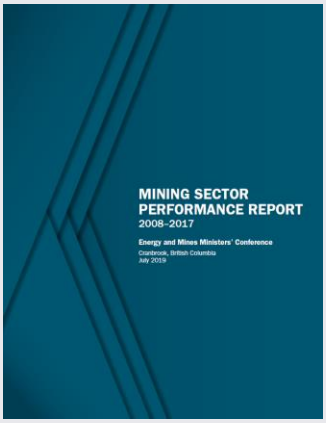
Canada's abundant reserves relative to other jurisdictions place it among the richest in resources globally, producing more than 60 minerals and metals at 200 mines and 6,500 pits and quarries. It ranks among the world leaders for key commodities including potash, uranium, gold, primary aluminum, nickel, and diamonds. Significantly, given Canada's world-leading clean electricity grid, Canada's production of many of these materials is among the least carbon-intensive globally. In addition to these natural resources, Canada's storied history in the sector has led to the nation becoming a world leader in the knowledge, skills, and innovation that have facilitated the prosperity it has enjoyed.

With the economic prosperity that mining brings to Canadians comes a responsibility to operate in an environmentally sustainable and conscious manner. There are costs and risks associated with the wealth generated by the minerals sector. The possibility of habitat loss, accidental tailings releases, greenhouse gas generation, and the legacy of orphaned and abandoned mines are examples of potential consequences of a natural resource-based industry allowed to operate unchecked. In order to measure progress and identify gaps in these areas, federal, provincial, and territorial governments have collaborated with stakeholders from academia, industry, and Indigenous and non-governmental organizations to produce this report.

The Mining Sector Performance Report (MSPR) is presented to federal, provincial, and territorial Mines Ministers every three years and has three objectives:

1. To provide Canadians with a common understanding of the sector's performance based on credible and reliable data;
2. To identify areas where improvements have been made and where progress is still needed; and
3. To inform development of priorities for collaborative work being carried out by the federal-provincial/territorial Energy and Mines Ministers' Conference and the Intergovernmental Working Group on the Mineral Industry.

Box 1: Mining Sector Performance Report, 2008-2017



Presented to Canada's Mines Ministers at their annual conference in August 2019, the report examined the economic, social, and environmental performance of the minerals sector from 2008 to 2017.

To achieve these objectives, the current report measures the performance of 23 indicators over the period 2011-2020.[3] The indicators are generally the same or similar to those used in previous editions so that trend comparisons can remain as consistent as possible. Where data sources differ from previous reports, this is highlighted in the text.

Performance indicators were selected on the basis of: (i) international mineral performance reporting practices; (ii) input from provinces and territories; (iii) consultation with an external advisory committee composed of individuals from academia, industry, and Indigenous and non-governmental organizations; and (iv) data availability.

The structure of previous editions of the MSPR was based on a set of desired performance outcomes for the minerals sector drawn from the Whitehorse Mining Initiative (1993)[4] and the Mining, Minerals and Sustainable Development North America initiative[5] multi-stakeholder frameworks.

While the overall structure of the current edition of the MSPR remains unchanged, the conceptual basis for the MSPR now draws from several key frameworks and initiatives influencing Canada's minerals and metals sector. These frameworks include the Canadian Minerals and Metals Plan (CMMP)[6] and the UN's

[3] As with the 2019 Edition, the data time sets for this report were shifted back by one year compared to pre-2019 editions. The original decision to do so was based on advisory committees' feedback to facilitate data collection and reduce chances of error based on late-arriving data.
[4] At the 1992 Mines Ministers' Conference in Whitehorse, Yukon, ministers agreed to become co-sponsors and trustees of a process called the Whitehorse Mining Initiative. This multi-stakeholder process included representatives from five sectors of society: the mining industry, senior governments, labour unions, Aboriginal peoples, and the environmental community. The initiative concluded with the Leadership Council adopting a signed Accord on September 13, 1994, which expressed a vision of "a socially, economically, and environmentally sustainable, and prosperous mining industry, underpinned by political and community consensus."
[5] The Mining, Minerals and Sustainable Development (North America) initiative was established by the World Business Council for Sustainable Development as one of a number of projects being supported by the Global Mining Initiative. It was formed as an independent process of multi-stakeholder engagement and analysis with the objective of "identifying how mining and minerals can best contribute to the global transition to sustainable development.
[6] At the 2019 Prospectors and Developers Association of Canada (PDAC) conference, federal, provincial and territorial mines ministers, along with industry and Indigenous representatives, launched the **Canadian Minerals and Metals Plan (CMMP)**. A bold new vision for Canada's minerals and metals sector, the CMMP includes targets and actions for governments, industry and stakeholders to support a competitive, sustainable and responsible industry that adapts to the realities of the modern economy.

Sustainable Development Goals[7] in addition to the Mining, Minerals and Sustainable Development North America initiative. The CMMP in particular was instrumental in further articulating the targets and outcomes of the minerals sector described by the desired performance outcomes and associated indicators of the current MSPR.

The CMMP and its Action Plans are framed by six strategic directions (Box 2) with measurable economic, environmental, and social targets, each of which can be aligned with the different sections of the MSPR. This alignment serves to reinforce the MSPR's desired outcomes, update the conceptual framework of the MSPR, and inform the organization of performance indicators into the sections discussed below.

Box 2: Aligning Desired Performance Outcomes with the Canadian Minerals and Metals Plan

The Canadian Minerals and Metals Plan (CMMP) includes six strategic directions – listed below – with measurable economic, environmental, and social targets. The Mining Sector Performance Report (MSPR) includes performance indicators grouped within three chapters: Economic Performance, Social Performance, and Environmental Performance.

Historically, each chapter of the MSPR was framed by a desired performance outcome chosen by the Intergovernmental Working Group responsible for the report's development. This edition of the MSPR presents an updated framework for positioning the Canadian minerals sector by matching the desired performance outcomes with the CMMP's strategic directions.

Economic Development and Competitiveness

Canada's business and innovation environment for the minerals sector is the world's most competitive and most attractive for investment.

Global Leadership

A sharpened competitive edge and increased global leadership for Canada.

Communities

Communities welcome sustainable mineral development activities for the benefits they deliver.

Advancing the Participation of Indigenous Peoples

Increased economic opportunities for Indigenous Peoples and supporting the process of reconciliation.

[7] The United Nations' Sustainable Development Goals are a collection of 17 global goals set by the United Nations General Assembly in 2015. The SDGs are part of Resolution 70/1 of the United Nations General Assembly: "Transforming our World: the 2030 Agenda for Sustainable Development."

The Environment

The protection of Canada's natural environment underpins a responsible, competitive industry. Canada is a leader in building public trust, developing tomorrow's low-footprint mines and managing the legacy of past activities.

Science, Technology and Innovation

A modern and innovative industry supported by world-leading science and technology—across all phases of the mineral development cycle.

The report is organized into four sections:

- **Section I** provides an overview of the key **global trends** and developments currently shaping the operating context of the minerals sector; and
- **Sections II**, **III**, **and IV** present the minerals sector's **economic, social, and environmental** performance based on the selected indicators, respectively.

This report is designed to present the reader with the long-term trends of selected indicators for social, environmental, and economic performance. While considering these trends, it is critical to bear in mind that these three pillars are interwoven, and the reader must consider the data herein as a whole to assess the performance of the mining industry.

Finally, it is also important to note that this report was developed in collaboration with federal, provincial, and territorial governments, and in consultation with an external multi-stakeholder advisory committee. As such, all data, findings, and broad conclusions contained in this report have been reviewed by a range of stakeholders.

Section I: Canada's Minerals Industry Operates in a Dynamic and Evolving Global Context

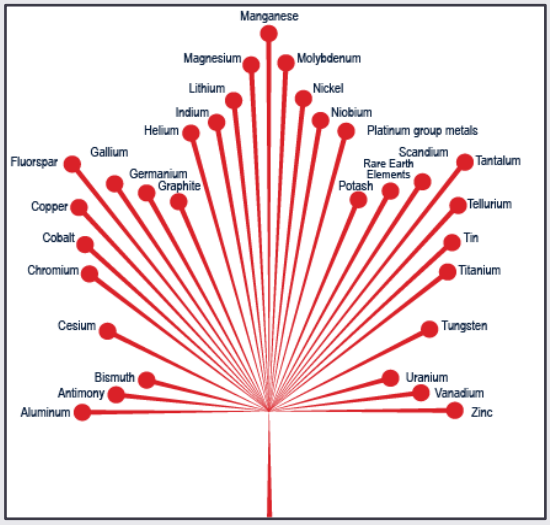
Global economic trends influence Canada's minerals industry[8]

After a strong rebound in 2021, the global economy is entering a significant slowdown amid new threats including COVID-19 variants and Russia's invasion of Ukraine. Beyond the suffering and humanitarian crisis from the Ukraine crisis, the entire global economy will feel the effects of slower economic growth and faster inflation.

Concerns around access to critical minerals supply has prompted several countries to develop industrial strategies and establish their domestic industries. Canada is working on a "mines to manufacturing" approach to leverage its mineral production and add value by producing refined and processed materials that are key inputs for clean technologies and other advanced manufacturing value chains (e.g., batteries). This approach would not only address critical minerals security issues but also spur job creation and economic growth post-pandemic (Box 3).

Box 3: Canada's Critical Minerals List[9]

There is no global definition of critical minerals. Critical minerals are country-specific and their 'criticality' may change with time based on supply and demand, and as societal needs shift. NRCan has defined criticality for Canada from working with experts across the department and with other government departments and in consultation with provinces and territories, and exploration companies, mining and manufacturing industries and associations.



On March 11, 2021, the Government of Canada announced Canada's Critical Minerals List, which includes 31 minerals considered essential to the sustainable economic success of Canada and our allies.

[8] This chapter is current as of April 19, 2022.
[9] https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/critical-minerals/23414

The Canadian critical minerals list was developed using a criteria-based approach that recognizes Canada's vast mineral endowment, potential for future discoveries and export opportunities, while also ensuring our national security and highlighting the potential to build valuable domestic manufacturing (e.g., battery supply chains).

The critical minerals list aligns with the Canadian Minerals and Metals Plan to foster a competitive ecosystem across all aspects of the mineral industry and to position Canada to thrive when economies look to grow following the global pandemic.

The list provides greater certainty and predictability to industry, investors, provinces and territories, and Canada's international partners on Canada's mineral priorities. It enables policy-makers to target and address key points in supply chains, including recycling and reprocessing capacity in support of a circular economy. It is part of a broader international effort to achieve both supply chain security and sustainability goals.

Russia's invasion of Ukraine increases the risk of the global economy enduring a hard landing in 2022 and 2023:

- The destruction caused by the war will ensure that Ukraine's economy contracts in 2022 and well beyond. It could take decades to rebuild and recover economic output.
- Squeezed by the most stringent economic sanctions it has ever faced, Russia will likely also enter a recession this year.
- Russia's invasion of the Ukraine could be pivotal in initiating a new era for global trade dynamics in minerals and metals, which is expected to favour greater regionalisation or localization with a focus on shorter supply chains and reliable trade partners.
- The International Monetary Fund (IMF) forecasts global economic growth to slow from 6.1% (real GDP, annual change) in 2021 to 3.6% in 2022 and 3.6% next year.
- The IMF projects that China, by far the world's largest consumer of minerals and metals, will see growth decelerate from 8.1% in 2021 to 4.4% in 2022, before rebounding to 5.1% in 2023.
- Weaker growth in China's economy has wider ramifications for Asia and for commodity exporters such as Canada. The combination of more transmissible variants and a zero-COVID strategy entail the prospect of more frequent lockdowns and less private consumption in China. The possibility of a marked and protracted downturn in the highly leveraged property sector – and its possible impacts on house prices, consumer spending and public finance – is a notable downside risk to China's economic outlook and its demand for minerals and metals.

On a more positive note, the energy transition will transform the demand for and supply of most minerals over the near and longer term. Countries accounting for more than 70% of today's global gross domestic product have committed to net-zero GHG emissions, implying a massive acceleration in clean energy deployment. As with other advanced economies, Canada has set a target of net-zero emissions by 2050.

An energy system powered by clean energy technologies requires significantly more minerals, notably:

- Nickel, cobalt, lithium, manganese, and graphite for batteries
- Rare earths for wind and EV induction motors
- Copper, silicon, and silver for solar panels
- Copper and aluminum for electrical networks
- Aluminum for the light-weighting of vehicles

Minerals supply could struggle to keep pace with the world's climate ambitions. Analysts forecast that adoption of electric vehicles will have a significant impact on the metals produced in Canada and around the world. This will require thousands of tonnes of refined nickel, cobalt, lithium, graphite, and manganese to manufacture the batteries needed for these vehicles. Battery manufacturers around the world are seeking reliable sources of these minerals in politically stable jurisdictions such as Canada. Canada's traditional metals are forecast to benefit as well since copper is critical for electric motors and charging infrastructure. Electric-vehicle batteries require pure (clean) nickel, of which Canada is a leading source, to process into nickel sulphate.

Expectations for socially conscious and environmentally responsible mining continue to rise

The minerals sector continues to progress in performing resource development activities in a more responsible and sustainable manner. Industry associations have established principles, programs, and guidelines underscoring the importance for companies to engage in a meaningful manner with host communities; to contribute to community development and social well-being; to apply ethical business practices; to respect human rights; to protect the environment; to adopt responsible governance and management systems; to commit to project due diligence and risk assessment; and to safeguard the health and safety of workers and local populations.[10] The concept of Environmental, Social, and Governance (ESG) criteria continues to gain importance in investment decision-making across a range of Canadian industries including mining (Box 17). Notably, Canadian mining has been at the forefront of this trend since 2004 when the Mining Association of Canada launched the Towards Sustainable Mining Standard as the first mining-focused facility level, and independently assured mining ESG standard with Community-of-Interest oversight in the world.

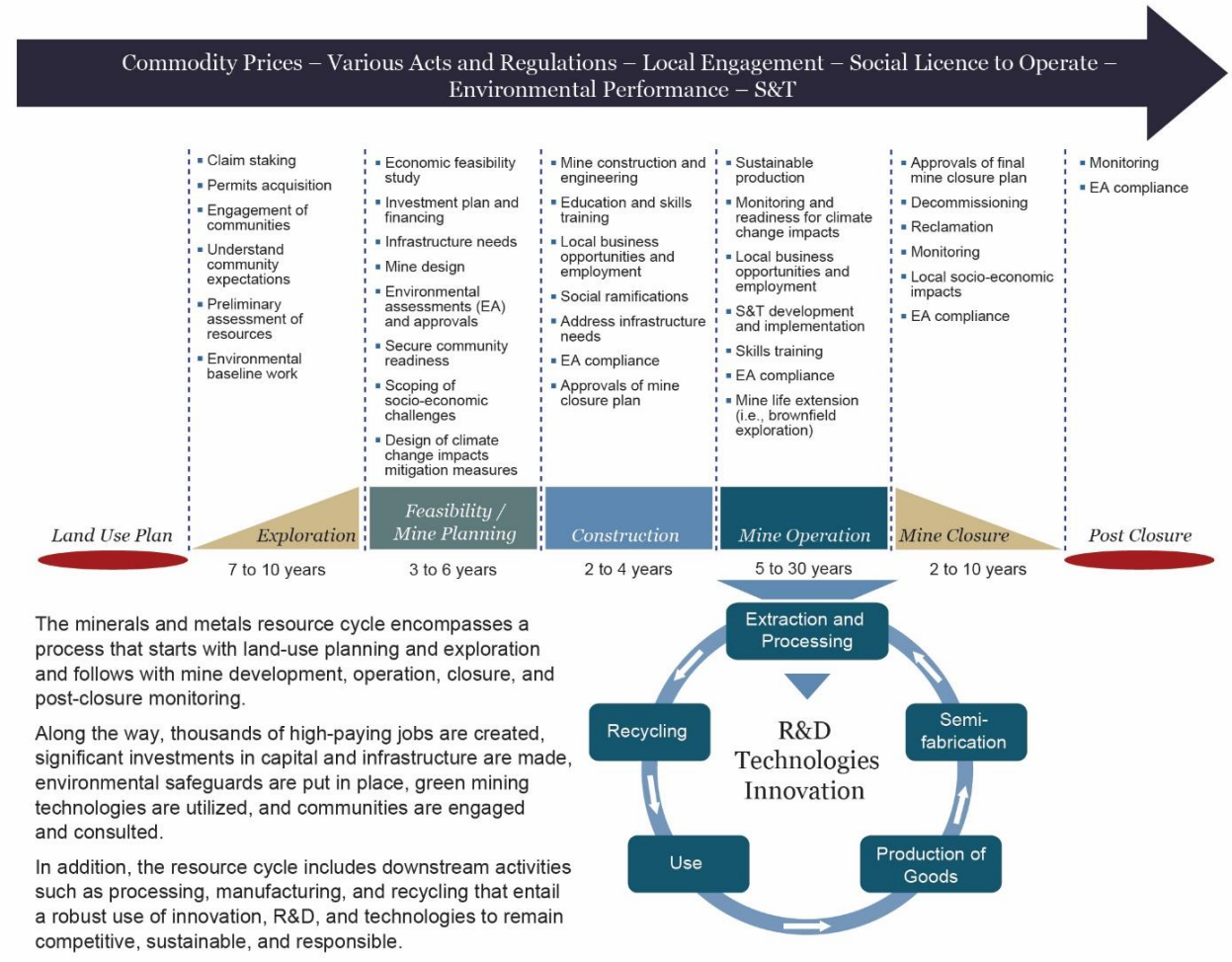
Experience shows that employing responsible and respectful business practices, such as engaging local and Indigenous communities in meaningful collaboration early and incorporating traditional and community knowledge into project design, can facilitate a more effective review process, and ultimately supports sustainable resource development, including maximizing benefits to local communities.

[10] See: https://www.minescanada.ca/en/content/what-canadian-minerals-and-metals-plan; http://www.nrcan.gc.ca/mining-materials/policy/8690; http://www.pdac.ca/programs/e3-plus; and http://mining.ca/towards-sustainable-mining.

The COVID-19 pandemic has had a substantial impact on employment, the environment, and the way many businesses, including those engaged in mining and exploration, operate. The medium-to-long term affects of the pandemic remain to be seen. However, seemingly anomalous trends in data for 2020 are apparent throughout this report and may well suggest early consequences of the global pandemic on the Canadian mining industry.

The mineral development continuum is dynamic (Figure 1). A responsible and sustainable development life-of-project approach to mineral development has become an essential condition for companies and host governments at all stages to avoid project delays and disruptions, to create supportive conditions for long-term socio-economic benefits, and to maintain investor interest.

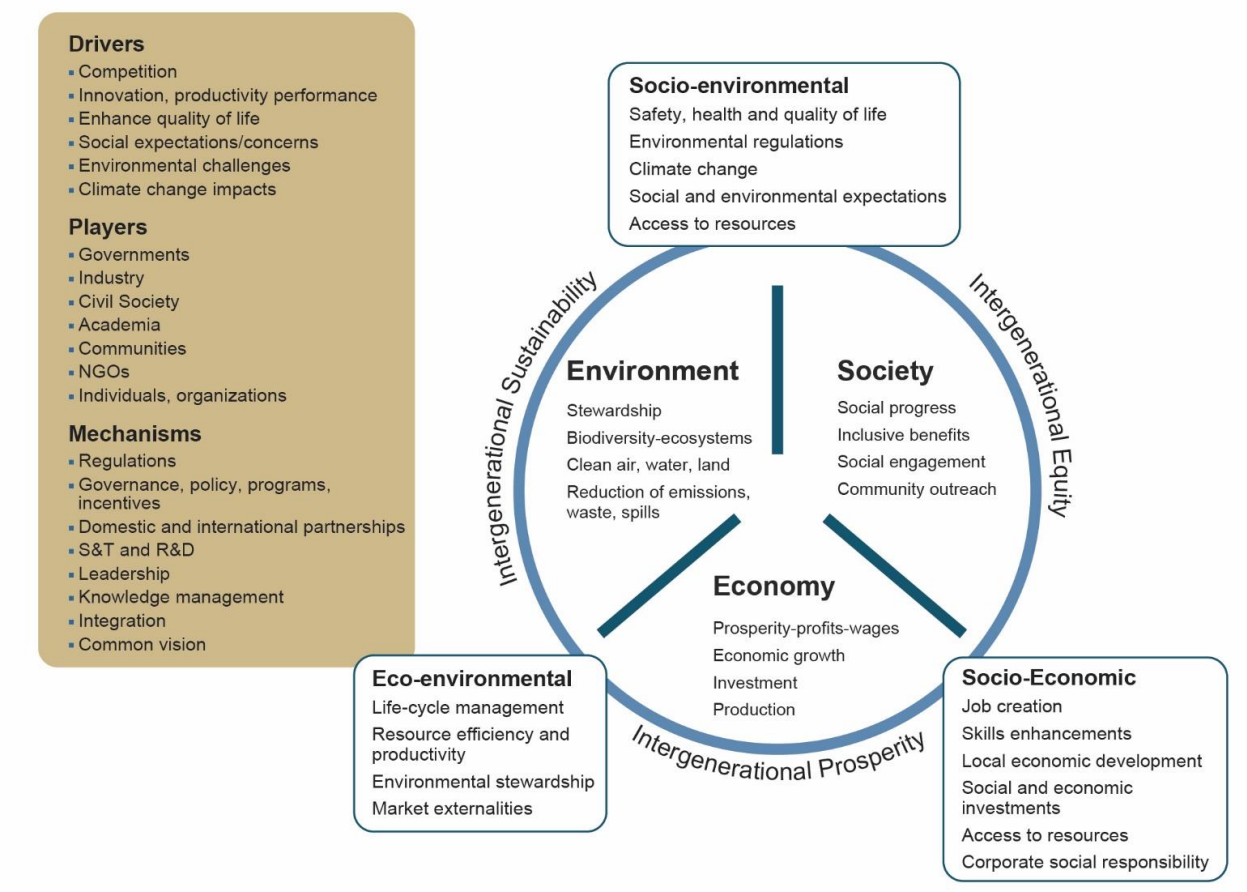
Figure 1: Mineral Development Continuum



Concerns about climate change will continue to have profound impacts on society, economic growth, and the way natural resources are developed in new and in some cases, more environmentally-sensitive areas. Societal concerns regarding water availability, greenhouse gas (GHG) emissions, and climate change, to name a few, are not only challenges, but also opportunities that will fuel innovation and the leveraging of emerging technologies to improve the exploration, development, extraction, processing,

and marketing of the mineral resources needed to realize long term economic, social, and environmental goals (Figure 2). Greater recycling capacity and throughput will be increasingly demanded by ESG investors to reduce pressure on sourcing of raw materials, establish the circular economy, and shift to more energy- and materials-efficient production.

Figure 2: Elements of a Responsible and Sustainable Approach

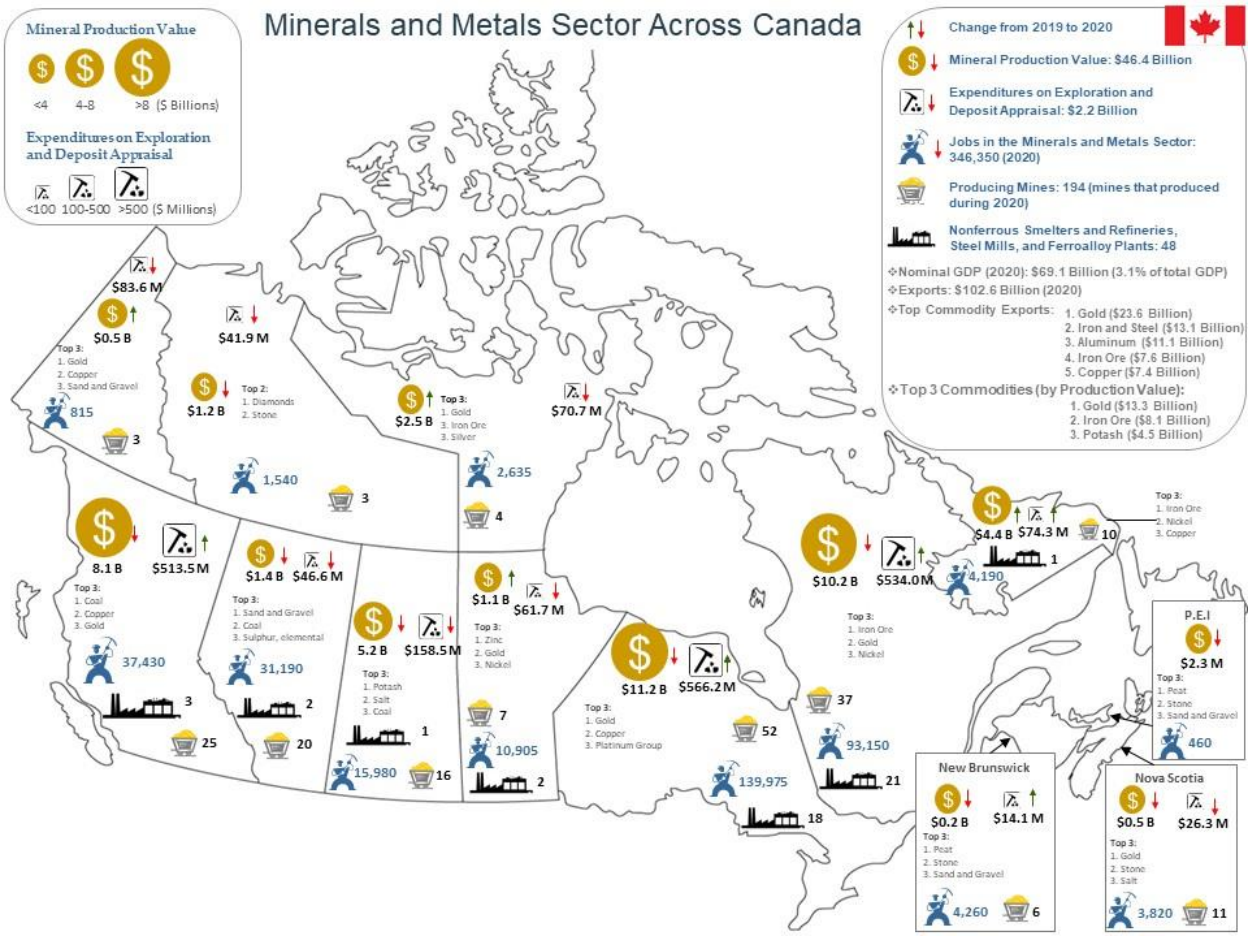


Canada's mineral resource advantage

Canada's minerals industry is a crucial contributor to Canada's economic health (Figure 3). In 2020, the minerals sector:

- Accounted for $70 billion in nominal Gross Domestic Product (GDP) (3.4% of total Canadian GDP);
- Directly employed approximately 377,000 workers, with a presence in every region of the country; and
- Contributed $16 billion to Canada's trade balance.

Figure 3: The Minerals Sector in 2020 – A Pan-Canadian Industry



Data were current as of March 17, 2022.

Sources: Developed by the Minerals and Metals Sector of Natural Resources Canada (NRCan); Statistics Canada.

Note 1: GDP data consist of mining (except oil and gas), nonmetallic mineral product manufacturing, primary metal manufacturing, and fabricated metal product manufacturing (NAICS 212+327+331+332). Employment data consist of mining (except oil and gas), support activities for mining, nonmetallic mineral product manufacturing, primary metal manufacturing, and fabricated metal product manufacturing (NAICS 212+21311B+327+331+332). Export values are for **domestic exports**, which consist of the exports of all goods grown, produced, extracted, or manufactured in Canada leaving the country for a foreign destination. For a map of producing mines and smelters across Canada, see https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=327950

Employment data is derived from Statistics Canada Table 36-10-0489-01: Labour statistics consistent with the System of National Accounts (SNA), by job category and industry

Note 2: Cement is excluded from the top three commodities as it is a manufactured product.

In addition, the sector:

- Contributes directly to the economic vitality of communities, especially in remote and northern communities with few alternative economic drivers, and remains an important employer of Indigenous Peoples, employing approximately 16,000;
- Is a capital-intensive, high-tech industrial sector that plays an important part in Canada's role in advanced technology use and development;
- Is an industry that consistently adds to Canada's balance of trade, contributing nearly $111 billion over 10 years (2011-20); and

- Produces more than 60 minerals and metals, and ranks among the top-producers of many critical minerals such as potash, uranium, nickel, aluminum, and cobalt (Table 1).

Table 1: Canadian Global Production Ranking, by Volume, 2020

Commodity	Global Rank
Potash	1st
Niobium	2nd
Diamonds	3rd
Platinum group metals	3rd
Aluminum (primary)	4th
Uranium	4th
Titanium	4th
Indium	4th
Gold	5th
Tellurium	5th
Nickel	6th
Salt	6th
Cobalt	6th
Iron	8th
Zinc	9th
Graphite	10th
Copper	11th

Sources: Natural Resources Canada; U.S. Geological Survey.

With its massive land area, and diverse geological settings, Canada has a strong foundation to support future minerals industry-based prosperity. Canada is a global economic, social, and environmental leader with world-class geoscience knowledge and education systems; a public policy framework that supports responsible mineral development; a skilled labour force; and an ecosystem for innovation in the sector. These attributes provide Canada with immense possibilities to meet future global commodity demand for the energy transition and to strengthen its international standing as a major producer of minerals and metal products.

Box 4: The Canadian Minerals and Metals Plan

In 2018 and 2019, Natural Resources Canada and the provinces and territories held a national conversation on mining. This conversation culminated in the launch of the Canadian Minerals and Metals Plan (CMMP) – a framework to guide a competitive, future-looking minerals and metals industry.

The CMMP is the result of close collaboration between federal, provincial, and territorial governments, and was informed by extensive cross-country engagement with Indigenous peoples, innovation experts, private companies, industry associations, non-governmental organizations, academia, and youth (totalling 146 in-person engagement activities, and 2,070 written submissions).

The CMMP focuses on six strategic directions organized by thematic priorities, as well as targets and areas for action for supporting a competitive, sustainable, and responsible minerals and metals industry (see figure below).

To operationalize the CMMP, Mines Ministers launched the first in a series of Action Plans with Action Plan 2020, – introducing six Pan-Canadian initiatives to achieve the targets indicated in the CMMP's strategic directions, and highlight the commitments and investments made by governments and industry. An Update to Action Plan 2020 was released in the fall of 2020 to consider the impacts of the COVID-19 pandemic on Canada's mining industry and chart a path to recovery, followed by Action Plan 2021.

The CMMP and its corresponding Action Plans offer a cohesive policy framework to achieve the long-term success of the sector, and position Canada as the leading mining nation. This generational initiative will raise Canadians' awareness of the importance of the minerals sector, respond to ongoing and emerging challenges, and help position Canada for opportunities offered by an evolving economy.

Section 2: Economic Performance

The Canadian minerals sector makes valuable contributions to the country's economy, both directly and indirectly through the vast and skilled supply chains and service providers that help to sustain the activities of the sector. Many of Canada's rural, remote, and northern communities rely heavily on mining as a primary economic activity. Large cities, such as Toronto and Vancouver, also benefit from important economic contributions from the industry, as important financial hubs and the home for many exploration and mining companies.

As discussed in Section 1, the current conceptual basis of the MSPR draws on several key frameworks and initiatives influencing Canada's minerals sector. For previous editions, the Intergovernmental Working Group responsible for the development of the MSPR chose the following desired outcome to frame the economic performance of the sector:

> ***Maintain and enhance the vitality of the sector, ensuring its long-term viability and competitiveness, so it can continue to make an economic contribution to the local, regional, national, and global economies of the future.***

While this outcome is still relevant, the launch of the Canadian Minerals and Metals Plan (CMMP) in 2019 and Action Plan 2020 (Box 4) have further articulated the targets and outcomes for the minerals and metals sector. [11,12] Therefore, the frameworks on which this edition is based include the CMMP, the United Nation's Sustainable Development Goals,[13] and the Mining, Minerals and Sustainable Development North America initiative.[14]

The following strategic directions of the CMMP were selected to support and frame the desired outcomes for the economic performance of the sector:

- **Economic Development and Competitiveness**
    - Canada's business and innovation environment for the minerals sector is the world's most competitive and most attractive for investment
- **Global Leadership**
    - A sharpened competitive edge and increased global leadership for Canada
- **Science Technology and Innovation**
    - A modern and innovative industry supported by world-leading science and technology—across all phases of the mineral development cycle

[11] "At the 2019 Prospectors and Developers Association of Canada (PDAC) conference, federal, provincial and territorial mines ministers, along with industry and Indigenous representatives, launched the **Canadian Minerals and Metals Plan (CMMP)**. A bold new vision for Canada's minerals and metals sector, the CMMP includes targets and actions for governments, industry and stakeholders to support a competitive, sustainable and responsible industry that adapts to the realities of the modern economy."

[12] https://www.minescanada.ca/sites/default/files/cmmp-actionplan2020_rev52_feb_29_2020-a_en.pdf

[13] The United Nations' Sustainable Development Goals are a collection of 17 global goals set by the United Nations General Assembly in 2015. The SDGs are part of Resolution 70/1 of the United Nations General Assembly: "Transforming our World: the 2030 Agenda for Sustainable Development."

[14] The Mining, Minerals and Sustainable Development (North America) initiative was established by the World Business Council for Sustainable Development as one of a number of projects being supported by the Global Mining Initiative. It was formed as an independent process of multi-stakeholder engagement and analysis with the objective of "identifying how mining and minerals can best contribute to the global transition to sustainable development."

The indicators chosen to measure the sector's performance related to these outcomes are:

- **Value of mineral production** – Measures the value of commodities produced based on current market prices. It helps determine the sector's vitality as it is linked to the revenues and incomes generated.

- **Gross Domestic Product (GDP)** – Nominal GDP measures the market value of all final goods and services produced by a sector. It is one of the primary indicators used to measure economic performance and the contribution of a sector to the economy. Real GDP is adjusted for inflation. This indicator measures the sector's direct contribution to the economy's total GDP.

- **International trade** – International trade is the exchange of capital, goods, and services across international borders or territories. Trade is critical to Canada's minerals sector (as the majority of production is exported) and to the country's prosperity, fuelling economic growth, supporting jobs, raising living standards, transferring technologies, and providing affordable goods and services.

- **Exploration and deposit appraisal expenditures** – Mines have a finite life. Exploration activity is necessary to find mineral deposits that support future mining development and downstream production in Canada. Exploration spending is a key measure of the health of the sector. Measuring spending levels in exploration and deposit appraisal activity provides an indication of the future potential for mineral production and downstream activities.

- **Public geoscience expenditures** – Public geoscience broadly refers to geological, geophysical, and geochemical data, information, and knowledge provided by governments as a public good. The availability of high quality data and information is widely acknowledged as one of Canada's competitive advantages in attracting mineral exploration. It enables informed decision-making by grassroots exploration companies regarding their exploration activity. Assessing public geoscience expenditures provides an indication of government efforts to support early-stage mineral exploration.

- **Capital expenditures** – Capital expenditures are made by companies to purchase or upgrade physical assets such as property, equipment, or buildings (and including mine complex development). They help to improve an industry's productivity. Measuring trends in capital expenditures provides an indication of the future competitiveness of a sector.

- **Business expenditures on Research and Development (BERD)** – Innovation improves the productivity and competitiveness of firms as well as the minerals sector overall. Research and development expenditures indicate the extent to which firms are committed to improving production processes and are pivotal to the innovation performance of any industry.

- **Government revenues** – Government revenues from the minerals sector are collected through taxes and royalties. Measuring these types of payments to governments shows the sector's direct contribution to government finances.

Synopsis

The economic performance of Canada's minerals sector over the 10-year period from 2011 to 2020 has shown a decline with respect to many economic indicators, which is consistent with global mineral and metal price trends. The medium and long term impacts of the COVID-19 pandemic on the sector remain

to be seen, but the immediate effects were clearly negative in 2020. However, and as this chapter will describe in detail, while many indicators declined over the ten-year period, several have started trending upward again over the short term and in conjunction with rising mineral and metal prices. Looking forward, the sector shows optimistic signs that these upward trends may continue as demand is set to grow with the clean energy transition.

Highlights

- Starting from a 10-year high of $51.3 billion in 2011, there was a downward trend in **value of mineral production** until increasing again from $41.0 billion in 2016 to $49.1 billion in 2018 and then decreasing to $46.4 billion in 2020. This represents an overall decline of 9.6% between 2011 and 2020.
- **GDP** in Canada's minerals sector increased by 7.8% between 2011 and 2020 with an average annual growth rate of 0.9%. The minerals sector's GDP was $64.6 billion in 2020 compared to $59.9 billion in 2011. A sharp decline of 6.5% between 2019 and 2020 is likely due to industry slowdown and restrictions during the COVID-19 pandemic.
- The value of Canada's **mineral and metal exports** was $106.8 billion in 2020 compared to $100.2 billion in 2011 (6.6% increase). The minerals sector is one of the few industrial sectors that consistently makes a positive contribution to Canada's overall balance of trade, totaling nearly $160.3 billion since 2011.
- **Government expenditures on public geoscience** were $130.0 million in 2020/21 representing a 19.0% decrease compared to 2011/12 largely due to restrictions on field activity during the global COVID-19 pandemic. Notably, expenditures decreased 8.6% between 2018/19 and 2020/21, representing a before and after estimate of the pandemic's effect. There was an 11.3% decrease in expenditures between 2011/12 and 2018/19.
- In 2020, **exploration and deposit appraisal expenditures** in Canada decreased by 4.2% to $2.2 billion – the second consecutive year of decline. Expenditures were $4.2 billion in 2011, representing a 48% decline towards the $2.1 billion value in 2020. Gold remains the leading commodity, but exploration companies are increasingly focused on energy transition and battery minerals such as lithium and cobalt.
- **Capital expenditures** in the minerals sector experienced a 30% decrease from $17.1 billion in 2011 to $12.0 billion in 2020. Preliminary intentions for 2021 show a modest increase in capital expenditures in the minerals sector to $12.7 billion.
- Canada's mining, support services, and mineral processing industries' **business expenditures on research and development (BERD)** totalled $538 million in 2020, representing a decline of 17.5% over the ten-year period beginning in 2011.

- Between 2010 and 2019, the minerals sector generated $10.5 billion in corporate **income tax revenue** for Canadian governments with annual revenues ranging from $718 million (2013) to $1.78 billion (2011) and an additional $16.1 billion in mining taxes and royalties for Canadian governments. **Resource royalties and taxes** paid to the provinces and territories declined by 15.3% over the last 10 years; in 2010, they generated a total of $1.96 billion compared to $1.66 billion in 2019.

Indicators at a Glance (2011-2020 unless otherwise indicated)	
Value of Mineral Production	-0.9% average annual decrease
Gross Domestic Product	+0.9% average annual increase
International Trade	A. +0.89% average annual growth in exports B. Consistently positive contribution to balance of trade
Public Geoscience Expenditures	-2.1% average annual decrease
Exploration and Deposit Appraisal Expenditures	-5.2% average annual decrease
Capital Expenditures	-2.7% average annual decrease
Business Expenditures on Research and Development	+2.2% average annual increase
Government Revenues **(2010–2019)**	+2.1% average annual increase

Improved Performance
> +1.0%

Limited Change
Between +1.0% and -1.0%

Decline in Performance
< -1.0%

Value of Mineral Production

Highlights

- The COVID-19 pandemic and the associated restriction measures had significant impacts on global mineral production in 2020, and Canada's mineral production declined by 8% compared to the previous year to $43.9 billion. In the year following the start of the pandemic, the mining industry faced multiple challenges including slow global growth, supply disruptions and fluctuating exchange rates.
- The total value of Canadian mineral production in 2020 was 13.8% lower relative to 2011. Starting from a 10-year high of $50.9 billion in 2011, there was a downward trend in value of mineral production until generally increasing again from $41.0 billion in 2016 to $47.7 billion in 2019.
- Mineral production value was consistent with the Bank of Canada's minerals and metals price index, which declined 15.2% between 2011 and 2020. Starting from a 10-year high of 734.29 in 2011, the index trended downward until increasing again from 496.90 in 2016 to 522.43 in 2020.
- Ontario was the leader in terms of value of mineral production in 2020 as well as 2011 and 2016.
- Quebec, Ontario, and British Columbia collectively account for almost two-thirds of Canada's total mineral production.

Definition

The value of mineral production is a calculation of the volume of extracted commodities at the current price of the commodity.[15] It includes metallic and non-metallic minerals and coal.

Rationale

Monitoring mineral production value over time helps determine the vitality of the mineral extraction sector as it is linked to the revenues being generated.

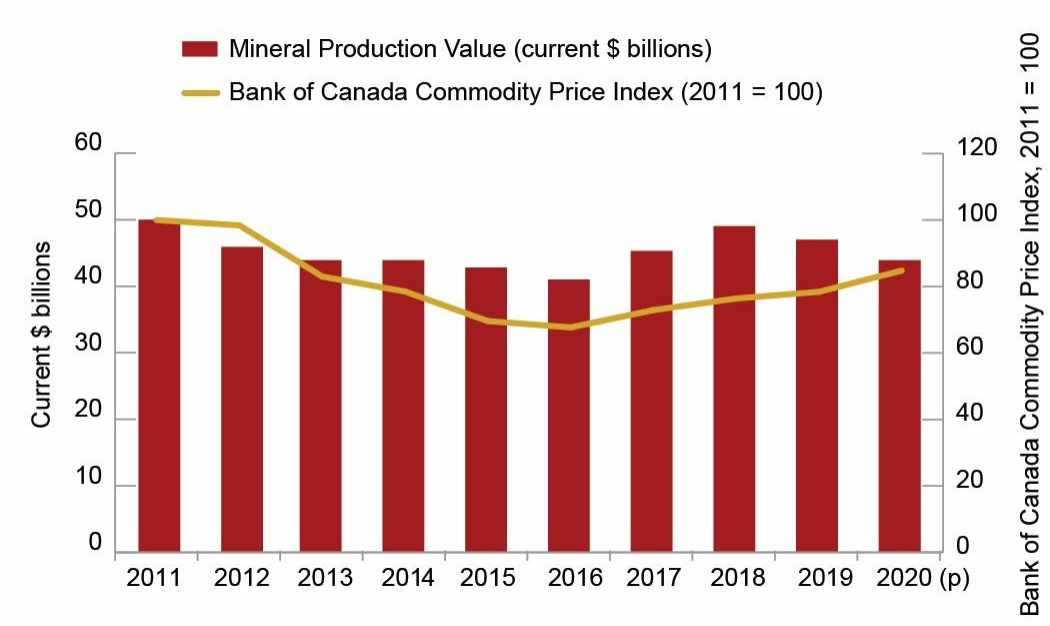
Analysis

The preliminary value of mineral production in Canada for 2020 was $43.9 billion. Over the decade spanning from 2011 to 2020, the value of production was at a 10-year peak in 2011 at a value of $50.9 billion and subsequently declined to a low of $41.0 billion in 2016. It recovered gradually until 2019, when it reached $47.7 billion, but declined again to $43.9 billion in 2020 due to the impacts of the COVID-19 pandemic.

[15] Details regarding the methodology used in computing the mineral production of Canada can be located at https://mmsd.nrcan-rncan.gc.ca/prod-prod/ann-ann-eng.aspx.

The value of mineral production fluctuates as a result of changes in the quantity of production from mines and the respective prices of the mineral and metals they produce, which are set on global markets. Events that can impact these values includes mine openings and closings, strikes and lockouts, surging demand from developing countries, such as China, weather events or most recently, pandemics.

Figure 4: Value of Canadian Mineral Production, 2011-2020 (p)



Sources: Natural Resources Canada; Statistics Canada; Bank of Canada.
(p) Preliminary.

From 2011 to 2020, the Bank of Canada's Metals and Minerals Commodity Price Index (BCPI) has fluctuated significantly. This is a result of volatility in commodity prices over the decade. After the 2008-2009 recession, prices increased significantly, reaching peak levels in 2011. After 2011, BCPI declined 32.3% by 2016. BCPI increased steadily between 2017 and 2020. The index in 2020 was 622.43 for metals and minerals, representing a 25.3% increase relative to the 10-year low of 496.90 in 2016.

Table 2: Canada's Top Ten Metallic and Non-metallic Mineral Products, by Value of Production, 2011 and 2020 (p)

	Unit of Measure	2011		2020 (p)	
		Quantity	$ Value (millions)	Quantity	$ Value (millions)
Gold	t	102	4,143	182	12,321
Iron ore	kt	36,504	5,944	60,060	5,610
Coal	kt	67,113	7,472	40,792	3,958
Copper	kt	552	4,819	476	3,860
Potash (K20) (1)	kt	10,686	7,569	13,410	3,736
Nickel	kt	211	4,787	167	2,834
Platinum group	t	22	750	31	1,818
Sand and gravel	kt	222,288	1,560	181,471	1,729
Stone	kt	161,729	1,592	141,201	1,633
Diamonds	000 ct	10,752	2,509	15,036	1,542

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary

(1) Note: shipments of potash to Canadian potassium sulphate plants are not included in this table.

The value of individual major metals and non-metals commodities varied significantly between 2011 and 2020. The production value for four of Canada's commodities; gold, platinum group metals, sand and gravel, and stone increased by 197.4%, 142.4%, 10.9%, and 2.5%, respectively. In addition, the production volume for gold and platinum group metals increased by 78.5% and 38.7% respectively relative to the beginning of the decade.

During the same 10-year period, potash production increased by 25.5%, while the value of production decreased by 50.6%. This decline in the value of shipments was mainly due to lower prices caused by global oversupply, particularly from Russia and Belarus, and lower demand due to the economic downturn caused by the pandemic. The price of potash was between US$200 and US$245 per tonne in 2020, a 26.0% decrease compared to 2019. Other commodities experiencing large price declines between 2011 and 2020 included coal (-47.0%), nickel (-40.8%), diamonds (-38.5%), and copper (-20.1%). A low Canadian dollar relative to the U.S. dollar provided a small amount of reprieve for domestic producers because most raw mineral products are priced in U.S. currency.

Although iron production has almost doubled from 36,504 kilotonnes in 2011 to 60,060 kilotonnes in 2020, the value of production declined by 5.6% due to lower prices resulting from oversupply and lower Chinese demand. However, iron prices surged in 2021.

Coal had declined in both production and value by 2020. Compared to 2019, production and value of coal shipments declined by 21.2% and 29.6% respectively. While Canada produces both thermal and metallurgical coal, the latter had the largest impact on production value. Since a cyclical high in 2011, the export price of metallurgical coal declined by over 55% until 2016. The price partially recovered in 2016 due to mine disruptions in Australia and various cutbacks in production in China.

In 2020, Canadian mines produced 41 million tonnes of coal (about 55% metallurgical and 45% thermal), a year-over-year decrease of 21% and the lowest volume since 1982. Coal prices were also low for most of the year, which contributed to a decrease in the value of coal production by 30% to $4.0 billion. This

is largely due to the Canadian government's implementation of plans to phase out coal-fired electricity generation by 2030 and a commitment to net-zero emissions in the electricity sector by 2035.[16] Despite the downward trend in overall production, metallurgical coal remains an important mineral and accounts for most of the value of production of coal of $4.0 billion in 2020 or the third-most valuable mined commodity in Canada.

Box 5: Thermal Coal

The Canadian coal industry traditionally produced coal for use in metallurgical applications (e.g., coking, steelmaking) and thermal applications (e.g., electricity generation). In 2018, the Government of Canada announced final regulations to phase-out traditional coal-fired electricity by 2030.[17]

Coal is one of the most greenhouse-gas-intensive sources of electricity. Coal-fired power plants account for almost 40% of the world's electricity. This reality makes carbon pollution from coal electricity a leading contributor to climate change. As a result, phasing out traditional coal power is one of the most important steps in tackling climate change.

Canada is demonstrating international leadership on phasing out thermal coal and is co-leading the Powering Past Coal Alliance (PPCA), alongside the United Kingdom.[18] With over 165 members, the PPCA is the world's leading coalition seeking to accelerate clean growth and climate protection through the rapid phase-out of unabated coal power-generation.

The Government of Canada released a policy statement on thermal coal mining in June 2021, which indicates that

"the Government considers that thermal coal projects are likely to cause unacceptable environmental effects within federal jurisdiction and are not aligned with Canada's domestic and international climate change commitment."[19]

Canada also announced at the COP26 Summit in November 2021, that it is working to end thermal coal exports from and through Canada by 2030.[20] Canada would be the first country in the world to ban thermal coal exports on the basis of environmental impacts and greenhouse gas emissions.

[16] https://www.canada.ca/en/environment-climate-change/news/2021/11/canada-and-the-world-move-closer-to-powering-past-coal-with-more-climate-ambition-at-cop26.html
[17] https://www.canada.ca/en/services/environment/weather/climatechange/canada-international-action/coal-phase-out.html
[18] https://www.poweringpastcoal.org
[19] https://www.canada.ca/en/environment-climate-change/news/2021/06/government-of-canada-releases-policy-statement-on-future-thermal-coal-mining-projects-and-project-expansions.html
[20] https://www.canada.ca/en/environment-climate-change/news/2021/11/canada-and-the-world-move-closer-to-powering-past-coal-with-more-climate-ambition-at-cop26.html

These actions aim to deter future thermal coal development in Canada and help ensure that any future coal production meets federal standards for environmental protection.

Canada's clean growth and climate change plan, acknowledges the importance of a just and fair transition to support Canadian workers. This is why it is committed to the ongoing development of legislation and principles for a fair transition, which is intended to support workers and communities in the shift to a low-carbon future.

With the phasing out of coal-fired electricity, energy produced by coal will be eliminated by 2030. That said, coal will continue to be used for metallurgical processes.

In 2020, Ontario led all jurisdictions with a mineral production value of $11.2 billion (Table 3). It was followed closely by Quebec at $10.2 billion and British Columbia at $8.1 billion. These three provinces combined accounted for 64% of Canada's total mineral production value in 2020. Quebec's production value increased by 20% overall between 2011 and 2020 and 26% between 2016 and 2020. British Columbia saw an overall decrease of 10% between 2011 and 2020, but a 21% increase occurred between 2016 and 2020. Ontario stayed relative stable with a 5% increase in production between 2011 and 2020.

Gold and iron ore were the top commodities by value mined in Quebec, accounting for 34% and 27% of the total, respectively. In Ontario, gold production accounted for almost half (47%) of the total value.

Table 3: Value of Mineral Production, by Jurisdiction, 2011, 2016, and 2020 (p)

Province or Territory		2011	2016	2020 (p)
Alberta	Value of production (000)	2,696,459	2,654,693	1,386,121
	% of total	5.3%	6.5%	2.99%
British Columbia	Value of production (000)	8,981,532	6,703,844	8,118,973
	% of total	17.5%	16.3%	17.51%
Manitoba	Value of production (000)	1,793,888	1,417,533	1,089,511
	% of total	3.5%	3.5%	2.35%
New Brunswick	Value of production (000)	1,334,924	374,841	181,748
	% of total	2.6%	0.9%	0.39%
Newfoundland and Labrador	Value of production (000)	5,072,866	2,697,184	4,368,034
	% of total	9.9%	6.6%	9.42%
Northwest Territories	Value of production (000)	2,138,340	1,507,441	1,236,933
	% of total	4.2%	3.7%	2.67%

Nova Scotia	Value of production (000)	238,347	240,893	525,236
	% of total	0.5%	0.6%	1.13%
Nunavut	Value of production (000)	427,322	700,094	2,454,968
	% of total	0.8%	1.7%	5.29%
Ontario	Value of production (000)	10,685,247	10,692,318	11,195,534
	% of total	20.8%	26.1%	24.14%
Prince Edward Island	Value of production (000)	2,747	5,712	2,305
	% of total	0.0%	0.0%	0.00%
Quebec	Value of production (000)	8,465,486	8,113,375	10,183,030
	% of total	16.5%	19.8%	21.96%
Saskatchewan	Value of production (000)	9,100,784	5,536,566	5,168,286
	% of total	17.7%	13.5%	11.15%
Yukon	Value of production (000)	367,419	391,124	457,947
	% of total	0.7%	1.0%	0.99%
Total	**Value of production (000)**	**51,305,360**	**41,035,618**	**46,368,626**

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary.

Data Considerations

It is important to note that the value of mineral production is displayed in current dollars (not adjusted for inflation). Given this, the BCPI is included on the graphs, and the volume and value produced are noted, to highlight the impact commodity price fluctuations have on the value of mineral production. Data for 2020 is considered preliminary and subject to adjustment in future.

Gross Domestic Product

Highlights

- The real GDP of the minerals sector increased by 7.8% from 2011 to 2020, with an average annual growth rate of 0.9% across the period.
- A decrease of 6.5% between 2019 and 2020 due to the COVID -19 pandemic reflected a decline in real GDP contribution by all four subsectors within the total minerals sector (mining and quarry except oil and gas, non-metallic mineral product manufacturing, primary metal manufacturing, and fabricated metal product manufacturing).
- Prior to 2019, the minerals sector's real GDP had shown a steady increase between 2011 and 2018, increasing 15.3% by 2018.
- The increase was largely driven by the mining and quarrying (except oil and gas) subsector, as value added in this industry grew 27.4% between 2011 and 2018.
- Over the last five years, the minerals sector's contribution to Canada's total GDP has remained steady at approximately 3.5%.

Definition

GDP represents the total dollar value of all finished goods and services produced by a given jurisdiction or industry. GDP includes only final goods and services; it does not include intermediate goods and services used to make another product. Real GDP is adjusted for inflation whereas nominal GDP is expressed in current dollars.

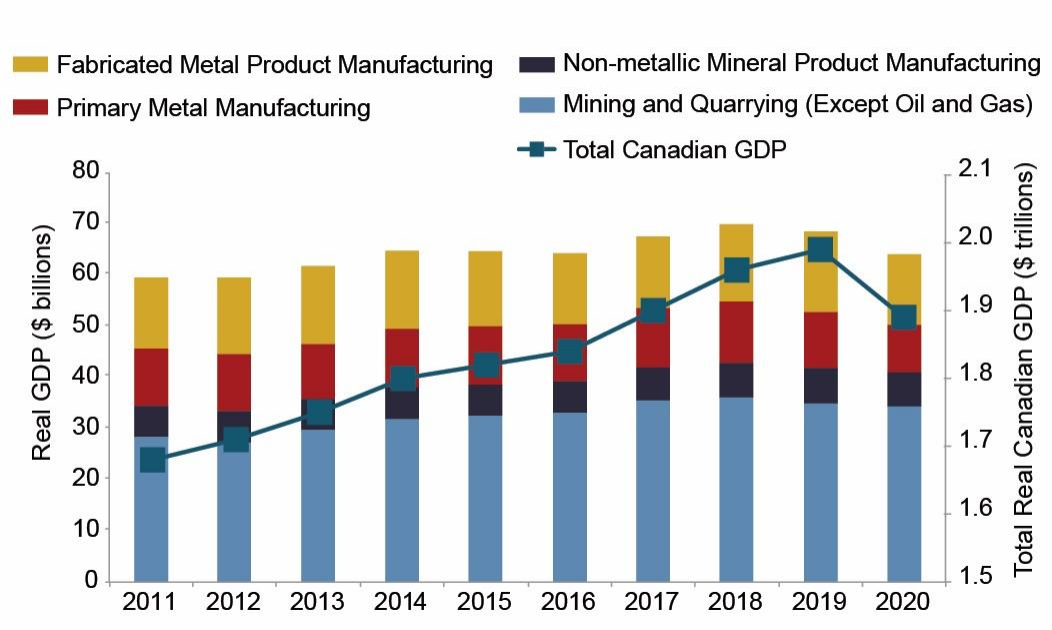
Rationale

GDP is a widely used economic indicator to evaluate the size and health of an economy and to measure the relative economic contribution of an industry sector or subsector. Real GDP data are used to remove the effects of price variations and inflation over time to determine the extent of output gains or losses within an industry.

Analysis

In 2020, the minerals sector's real GDP was $64.6 billion, representing a 7.8% increase from the 2011 value (Figure 5). The sector has experienced an upward trend in GDP and relatively stable year-over-year changes, only posting declines in 2016, 2019 and 2020. The sector experienced a significant drop of 6.5% in 2020 due largely to the COVID-19 pandemic (Box 6). Prior to the pandemic, the sector had experienced larger gains, increasing its GDP to a peak of $70.4 billion in 2018 from $59.92 billion in 2011, representing a 17.5% increase. The sector's share of Canada's total GDP remained stable at 3.5% to 3.6% over the period of 2011 to 2019, but declined to 3.4% in 2020.

Figure 5: Minerals Sector Real Gross Domestic Product, 2011-20



Source: Statistics Canada.

Box 6: COVID Impacts on the Canadian Mining Industry

The minerals sector is highly globalized and dependent on mineral and metals prices, making it vulnerable to disruptions from COVID-19 and related shocks. The beginning of the pandemic saw decreases in global economic activity, reduced demand, and impacts on mineral and metal prices worldwide. These effects disrupted mining supply and production, causing a decrease in Canadian minerals sector employment and GDP. After the initial shock, markets stabilized throughout 2020 and employment and production started rebounding in June 2020. Commodity prices and employment levels had both regained some strength by 2021.

Although there have been mandated shutdowns in many sectors, mining activities have generally been permitted to continue throughout the pandemic. Mine sites have employed preventative measures to ensure worker safety and manage the risk of COVID-19 transmission, including physical distancing, monitoring workers for symptoms, promoting hygiene and protection, and engaging with local leaders and Indigenous peoples. Despite this, there have been outbreaks in mines across the country, which have been consistent in terms of frequency with the overall trend of COVID cases in Canada's population.

Outbreaks result in mine suspensions and disruptions to their operations that have affected local communities who are often highly dependent on the mines for employment. This is particularly true for those in rural and northern areas and among Indigenous populations where the sector is a source of well-paying jobs and a key economic driver.

With new variants of COVID-19 such as omicron, which is highly transmissible, mine sites and their employees will continue to face challenges and disruptions. However, the industry is now accustomed to managing risks and minimizing the occurrence and transmission of COVID-19.

At the sub-sector level, mining and quarrying (except oil and gas) experienced a 21.1% increase in real GDP from 2011 to 2020. This sub-sector experienced the largest growth over the period, followed by non-metallic mineral and product manufacturing which increased by 11.0% from 2011 and 2020. Both primary metal manufacturing and fabricated metal product manufacturing experienced decreases from 2011 to 2020, posting 16.4% and 1.2% decreases, respectively. Prior to the pandemic, all sub-sectors except primary metal manufacturing posted double-digit growth rates from 2011 to 2019. In 2020, the pandemic caused all four sub-sectors to decline, with fabricated metal product manufacturing hit the hardest with a 12.7% decrease from 2019 to 2020.

International Trade

Highlights

- The COVID-19 pandemic and associated restriction measures had significant impacts on global trade – Canada's merchandise exports declined by 12% in 2020 compared to the previous year.
- The value of Canada's minerals sector exports declined by 2.6% in 2020 relative to 2019 to $106.8 billion, but increased 6.6% relative to $100.2 billion in 2011
- The minerals sector routinely makes a positive contribution to Canada's overall trade balance, contributing a surplus of nearly $161 billion between 2011 and 2020.

Definition

International trade is a measurement of the exchange of capital, goods, and services across international borders or territories. Trade variables include: *domestic exports* (goods grown, extracted, or manufactured in a territory, including goods of foreign origin that have been materially transformed in the territory); *imports* (all goods that have crossed into a territorial boundary, whether for immediate use or to be stored in bonded Customs warehouses); *re-exports* (the export goods of foreign origin that have not been materially transformed in a territory); and *total exports* (the sum of domestic exports and re-exports). Balance of trade is measured by subtracting imports from total exports.

Rationale

Canada's is an open economy that depends heavily on foreign markets and international trade to support the nation's economy and help sustain a high standard of living for its citizens. A positive trade balance contributes to Canada's prosperity as it fuels economic growth, creates jobs, supports high living standards, fosters the adoption of innovation and new technologies, and provides affordable

goods and services. Trade is critical to the minerals sector as mineral commodities are bought and sold on global markets.

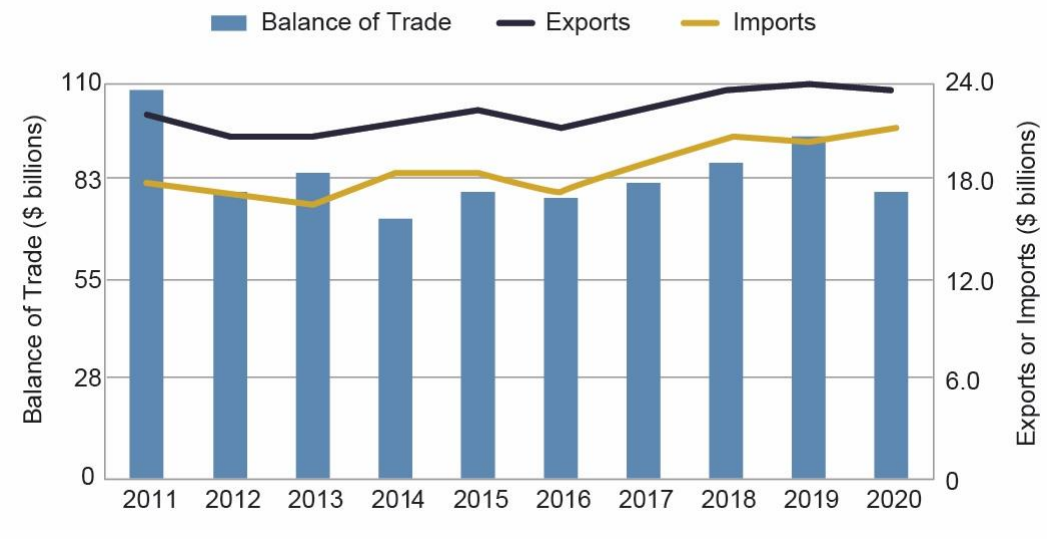
Analysis

The value of Canada's minerals and metals exports,[21] which include ores, concentrates, and semi- and final-fabricated mineral products was $106.8 billion in 2020, representing 21.4% of the country's total merchandise export value. The minerals sector is one of the few industrial sectors that consistently makes a positive contribution to Canada's overall balance of trade, totaling nearly $160.3 billion since 2011.

In 2020, the country's mineral commodity trade balance remained strong as Canada continued to maintain significant trade surpluses with the United States, United Kingdom, and the EU. The global recession of 2008 and 2009 led to a very significant decline in the trade surplus, but it rebounded in 2011 to a near-record level of $23.6 billion. The mineral industry's trade balance fluctuated for three consecutive years beginning in 2012 largely due to depreciation of Canadian currency against the U.S. dollar. However, from 2014 through 2019, the trade surplus trended upward from $11.6 billion to $20.3 billion, an increase of 75.0%.

The COVID-19 pandemic and associated restrictive measures had a significant impact on global trade in 2020 and Canada's merchandise exports declined by 12% from the previous year. In 2020, the value of Canada's minerals sector exports also declined relative to 2019, but by a lesser amount of 3% to $15.2 billion.

Figure 6: Minerals Sector Trade, 2011-20

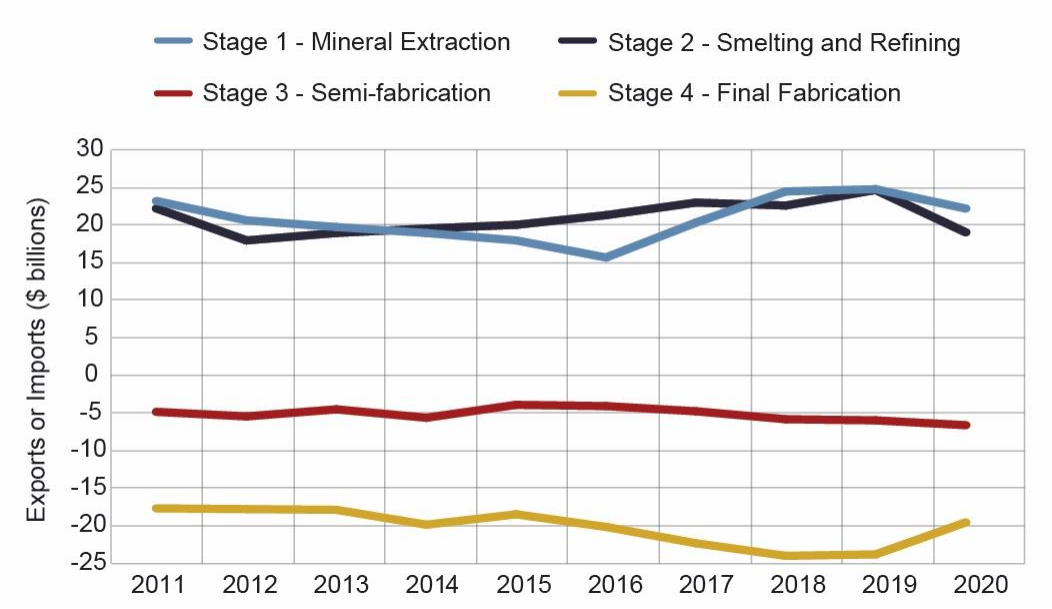


Sources: Natural Resources Canada; Statistics Canada.

[21] For this section, "exports" refer to domestic exports. Total exports, which include re-exports, is used only when calculating the balance of trade.

A closer examination at the subsector level reveals Canada's strength in mineral extraction and smelting and refining. Canada generally runs large and positive trade balances in *Stage 1 – mineral extraction* and *Stage 2 – smelting and refining*. Trade balances in *Stage 3 – semi-fabrication* tend to be neutral or slightly negative while trade balances for *Stage 4 – final fabrication* are usually large and negative (Figure 7).

Figure 7: Minerals Sector Balance of Trade, by Stage of Production, 2011-20



Sources: Natural Resources Canada; Statistics Canada.

Table 4 shows the top five commodities exported by Canada's minerals sector in 2011 and 2020 by value. The value of gold exports increased significantly during this period. The price of gold reached a record high of over $2,000 US per ounce in 2020 as investors were attracted to the metal as a safe haven during a period of significant economic turmoil and uncertainty resulting from the pandemic. The price of gold has since declined, but still remains at historically high levels. The price of gold was $1,897.77 per ounce by the end of 2020. Over two-thirds of Canada's gold exports are destined for the United Kingdom, as London is a global centre for gold trading.

Table 4: Top Five Mineral Commodities Exported by Canada, by Value, 2011 and 2020

2011		2020		
Commodity	**($ billions)**	**Commodity**	**($ billions)**	**Main Destination (2020)**
Gold	18.3	Gold	23.6	U.K. (64.5%)
Iron and steel	12.6	Iron and steel	11.4	U.S. (86.7%)
Aluminum	9.9	Aluminum	9.4	U.S. (84.1%)
Coal	8.3	Iron ore	7.7	China (36.6%)
Nickel	6.7	Copper	7.4	U.S (45.3%)
Total exports	**95.9**	**Total exports**	**102.6**	n.a.

Sources: Natural Resources Canada; Statistics Canada.
n.a. Not applicable; U.K. United Kingdom; U.S. United States.

Table 5 shows the value of Canadian minerals sector exports by commodity group and jurisdiction. By value of production, metal ores and manufactured products comprise the majority of Canada's exports by far. It increased from 75.9% in 2011 to 81.3% in 2020. Since reaching a peak in 2011 at 8.7% of total exports, coal and coke exports declined to 4.8% by 2020. This is in part due to increasing metal prices (i.e., gold) and steep decline of the value of coal exports in 2020. Variation in exports of non-metallic minerals and manufactured products was very low. It fluctuated between 13.9% and 16.9% between 2011 and 2020.

Table 5: Export by Commodity Group

Year	Coal and Coke Products	Metallic Ores and Manufactured Products	Non-metallic Ores and Manufactured Products	Total
	(current $000)			
2011	8,365,848	72,787,480	14,765,971	95,919,299
2012	6,767,200	67,511,673	13,802,998	88,081,871
2013	5,805,851	67,986,352	13,107,130	86,899,333
2014	4,524,093	71,756,807	13,297,049	89,577,949
2015	3,815,643	72,659,715	15,519,457	91,994,816
2016	4,749,580	71,101,381	12,851,699	88,702,660
2017	7,094,128	76,110,928	14,184,978	97,390,034
2018	7,920,675	80,225,413	16,182,743	104,328,831
2019	7,487,291	82,634,267	15,901,578	106,023,136
2020	4,911,160	83,420,270	14,285,080	102,616,509

Source: Natural Resources Canada; Statistics Canada.

Table 6 shows the majority of Canada's mineral trade flowed to and from Ontario, Quebec, and British Columbia, whose export values may include the value of raw material imported from other provinces. In 2020, Ontario accounted for 47.3% of exports, Quebec for 24.1%, and British Columbia for 11.7%.

Mineral and metal exports also represented a sizeable proportion of total exports from many provinces and territories. For example, minerals and metals accounted for 99.9%, 99.9% and 95.6% of the total value of exports of the Northwest Territories, Nunavut, and Yukon, respectively.

Table 6: Canada's Mineral Exports, by Jurisdiction and Commodity Group,* 2011 and 2020**

Province/ Territory	Coal and Coke Products		Metallic Ores and Manufactured Products		Non-metallic Ores and Manufactured Products		Total	
	2011	2020	2011	2020	2011	2020	2011	2020
	(current $000)							
Alberta	950,705	521,662	2,528,828	2,239,233	862,762	571,262	4,342,294	3,332,156
British Columbia	7,131,588	4,106,406	5,122,479	7,223,915	724,564	724,853	12,978,631	12,055,174
Manitoba	-	-	2,058,741	702,691	211,886	300,243	2,270,626	1,002,933
New Brunswick	-	-	469,417	278,792	444,666	244,064	914,083	522,856
Newfoundland and Labrador	-	-	3,000,806	3,183,939	20,647	9,210	3,021,453	3,193,150
Northwest Territories	-	-	75,887	257	2,009,159	1,242,618	2,085,046	1,242,874
Nova Scotia	-	4,272	198,107	239,770	52,275	121,035	250,382	365,077
Nunavut	-	-	609	1,224,884	295	8	904	1,224,892
Ontario	282,580	263,031	40,422,670	45,368,215	2,358,745	2,867,982	43,063,996	48,499,228
Prince Edward Island	6	28	4,876	17,122	4,489	5,751	9,370	22,900
Quebec	968	2,247	17,634,309	22,663,926	1,582,632	2,061,696	19,217,909	24,727,869
Saskatchewan	-	13,513	1,124,078	205,936	6,493,844	6,136,344	7,617,921	6,355,793
Yukon	-	-	146,674	71,591	8	15	146,682	71,606
Canada	8,365,848	4,911,160	72,787,480	83,420,270	14,765,971	14,285,080	95,919,299	102,616,509

Sources: Natural Resources Canada; Statistics Canada.

- Nil.

Exports are recorded under the jurisdiction where the commodity exits the country. As such, they may not correlate with where the commodity was mined. At this disaggregated level, the tracking of inter-provincial/territorial transactions is more difficult and there is therefore greater room for misallocation among jurisdictions.

* Natural Resources Canada's Trade Retrieval and Aggregation System allows for aggregation by Harmonized System (HS) codes (HS 8 for exports and HS 10 for imports). The advantage to aggregating by HS code is that it captures specific products, providing more complete data across all NAICS codes.

** Some provincial and territorial export numbers may include value from raw materials imported from other provinces as products are only captured once they cross international boundaries. For example, a Stage 1 product (nickel concentrate from Newfoundland and Labrador) is transported to Ontario for smelting. In Ontario, it is transformed into a Stage 2 product and exported. Because the final stage of manufacturing occurred in Ontario, the product would be captured as a Stage 2 product originating in Ontario.

Data Considerations

Trade data at Natural Resources Canada is collected and disseminated using stages that differ slightly from NAICS codes. *Stage 1 – mineral extraction* involves the discovery of ore, ore extraction, and processing to the concentrate stage. Scrap material, ash, and tailings are included in this category. *Stage 2 – smelting and Refining* refers to the metallurgical extraction process, the product of which is a relatively pure mineral, metal, or alloy. Some of the activities related to this stage are smelting and refining, roasting, calcining, direct reducing, and leaching. Products classified under this stage include powders, flakes, dusts, cathodes, ingots, pig, blocks, and plates. *Stage 3 – semi-fabrication* involves the manufacturing or processing steps required to bring products to a semi-finished or semi-fabricated stage or form, or to a state for use as input in other industries. Products related to Stage 3 include rods, plates, sheets, thin strips, pipes, rails, wires, metal-based structural forms, and a number of chemicals and compounds. Ingot moulds are also included. *Stage 4 – final fabrication* includes products of Stage III that have undergone further processing, such as elements produced by the metal framing industry, hardware items, tools, and cutlery. This stage includes products such as pipe fittings, forged and cast parts, grinding balls, and rail parts.

Exploration and Deposit Appraisal Expenditures

Highlights

- Exploration and deposit appraisal expenditures in Canada decreased 8.5% to reach $2.1B in 2020, the second consecutive year of decline.
- Australia surpassed Canada as the leading destination for exploration budgets in 2019 and 2020.
- Ontario was the leading jurisdiction in 2020 in terms of spending, followed by Quebec and British Columbia. These three jurisdictions together accounted for 74% of total exploration and deposit appraisal expenditures.
- Gold remains the leading commodity.

Definition

Exploration expenditures refer to the investments allocated to search for and discover a previously unknown mineral deposit, or to re-evaluate a known, but previously non-economic deposit. Deposit appraisal expenditures refer to investments needed in determining the economic viability of a mineral deposit. Exploration and deposit appraisal activities range from regional reconnaissance to the delimitation and definition of specific mineral deposits using a number of tools such as prospecting, mapping, geochemical and geophysical surveys, drilling and deposit modelling.

Box 7: Mineral Resources vs. Reserves

International standards for the reporting of mineral resources, mineral reserves and exploration results developed rapidly with the globalization of the mining industry, but standards sometimes differ between countries and regions.

The Canadian Institute of Mining Metallurgy and Petroleum (CIM) Definition Standards on Mineral Resources and Reserves establish definitions and guidance on the definitions for mineral resources, mineral reserves, and mining studies used in Canada. Based on these standards:[22]

- ***Mineral Resources*** are a concentration or occurrence of solid material of economic interest in such form, quality, and quantity that it has a reasonable prospect of economic extraction. Mineral Resources are sub-divided, in order of increasing level of geological knowledge and confidence, into inferred, indicated and measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.
- ***Mineral Reserves*** are the economically mineable portion of a measured and/or indicated resource demonstrated by at least a prefeasibility study. Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proven Mineral Reserves. A Probable Mineral Reserve has a lower level of confidence than a Proven Mineral Reserve.

Rationale

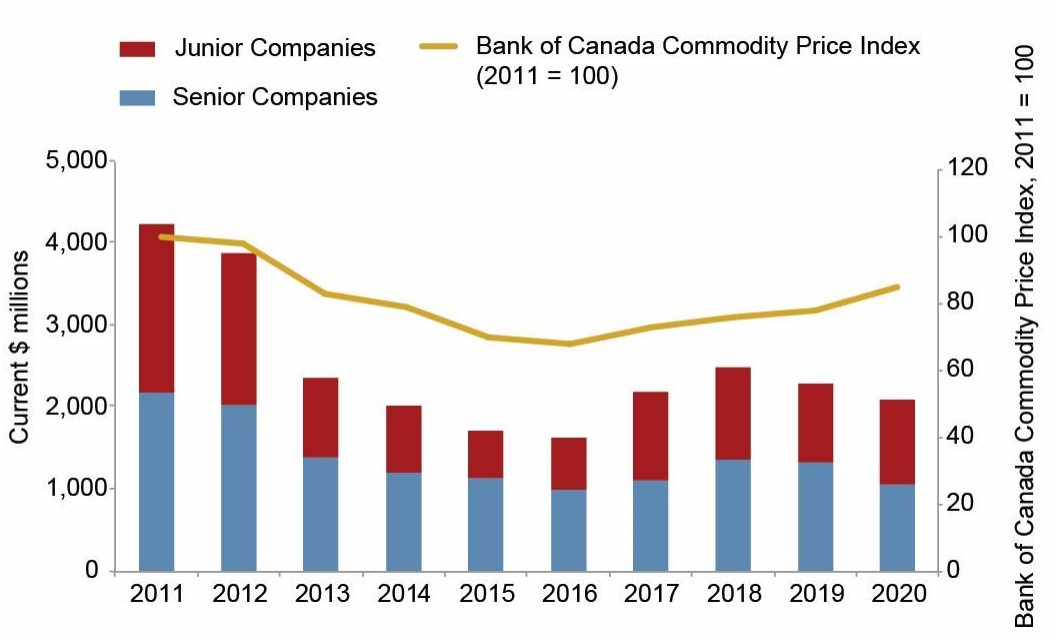
Mineral exploration activity to discover new mineral deposits and to advance the development of known deposits is vital to sustain mineral production to meet the future needs of society. It is also the foundation of a minerals sector with the potential to remain an important engine of economic growth in many regions of Canada. Without sufficient levels of investment in exploration and deposit appraisal, mine production and the downstream activities of the mine life cycle (smelting, refining, manufacturing) could be jeopardized.

[22] Canadian Institute of Mining, Metallurgy, and Petroleum Standards on Mineral Resources and Reserves, https://mrmr.cim.org/en/standards/canadian-mineral-resource-and-mineral-reserve-definitions/.

Analysis

Trends in exploration and deposit appraisal expenditures are a barometer of the health and future success of the mining industry.[23] As shown in Figure 8, Canada's mineral exploration sector moved from a decreasing to an increasing trend over the last 10 years. Expenditures showed a steady decrease from $4.2 billion in 2011 to $1.6 billion in 2016 during a period of declining mineral prices. During the same period and alongside overall reduced mineral exploration investments, Canadian mining jurisdictions felt the impact of lower grassroots exploration spending, delayed investment plans at advanced projects, and a reduced number of active projects and companies. However, exploration spending began to recover in 2020, reaching $2 billion spurred-on by metal price increases from 2017 to 2020.

Figure 8: Exploration and deposit appraisal expenditures, by company class, with the Bank of Canada Metals and Minerals Commodity Price Index



Sources: Natural Resources Canada; Bank of Canada.
(p) Preliminary.

Mineral exploration activity is highly correlated with commodity prices (Figure 8). Over the last decade, minerals and metals prices fluctuated significantly, reaching historic highs in 2011 followed by a period of persistent decreases ending in 2016. Figure 8 also underlines the important role that junior mining companies play in the discovery and development of mineral deposits in Canada.[24] Total junior company expenditures remained above the $2 billion level for all years except 2015 and 2016. Exploration

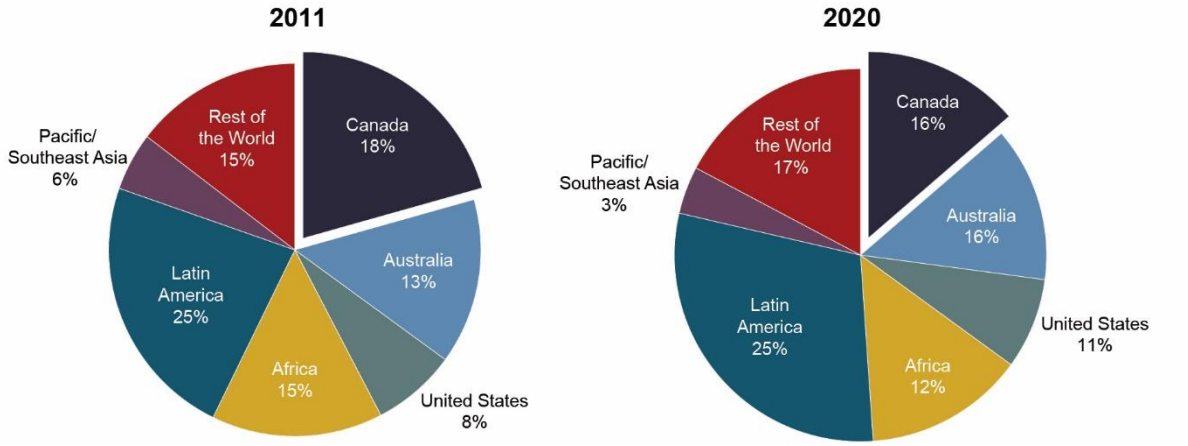
[23] *Exploration* is defined as the search for, discovery, and first delimitation of a previously unknown mineral deposit or the re-evaluation of a sub-marginal or neglected mineral deposit in order to enhance its potential economic interest based on delimited tonnage, grade, and other characteristics. *Deposit appraisal* reflects the steps undertaken to bring a delimited deposit (by definition drilling, comprehensive tests, and planning) to the stage of detailed knowledge required for an exhaustive and complete feasibility study that will fully justify and support a production decision and the investment required (Source: Natural Resources Canada, http://sead.nrcan.gc.ca/expl-expl/RG-GR-eng.aspx).
[24] *Junior companies* are neither a producing company (i.e., a senior company) nor the recipient of operating income from production or other business segments. A junior's principal business is mineral exploration, for which it is required to raise funds through the issuance of treasury shares. *Senior companies* normally derive their operating income from mineral extraction or other business segments (they need not be mining companies) rather than from the issuance of shares (Natural Resources Canada: http://www.nrcan.gc.ca/mining-materials/statistics/8854).

activities by Canada's juniors began to recover in 2016 after reaching their lowest levels in 12 years. This trend continued into 2020, with spending increasing by 28% to almost $1 billion. Juniors' share of total exploration and deposit appraisal spending peaked in 2007 at 67%, but decreased in subsequent years and has remained below 50% since 2011. In 2020, spending by junior companies accounted for 49% of total exploration and deposit appraisal expenditures. Expenditures by senior mining companies surpassed the $2 billion level in 2011 and again in 2012. However, their spending decreased in subsequent years, falling below the $1 billion mark in 2016, a level not seen since the global economic crisis in 2009. Senior company expenditures increased by almost 7.0% from 2016 to 2020 to reach $1 billion.

Its diverse and rich endowment of mineral resources has helped make Canada a top exploration target throughout this past decade with an estimated US$1.3 billion budgeted for exploration in 2020. Canada was the world's leading exploration jurisdiction from 2011 to 2018. Canada's share of global exploration fell from just over 18% in 2011 to 15.5% in 2020. From 2019 to 2020 Australia surpassed Canada as the top exploration target.

Based on the combined rankings of all provinces and territories in the Fraser Institute's Annual Survey of Mining Companies for 2020, Canada declined in standing to second most attractive region for mining investment, behind Australia in the top spot. [25] Three jurisdictions ranked among the top 10 globally in the 2020 survey: Saskatchewan (3rd), Quebec (6th), and Newfoundland and Labrador (8th). Despite Canada's high standing, the Fraser Institute has brought forward evidence suggesting that the permitting process has grown longer and less certain for a number of Canadian jurisdictions over the last 10 years, especially in the North. [26]

Figure 9: Canada's Share of Global Exploration Spending, 2011 and 2020



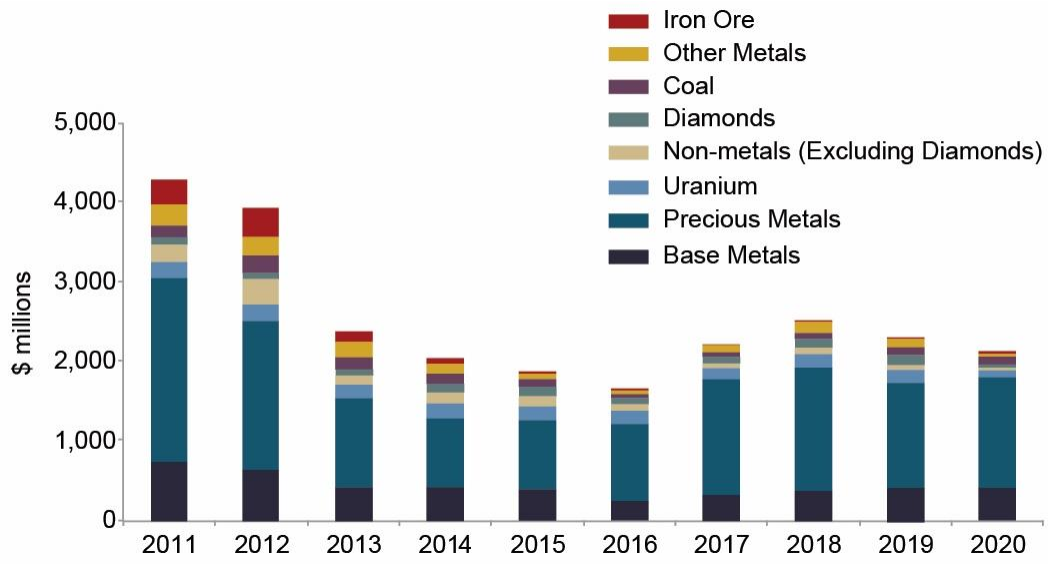
Source: SNL Metals & Mining.

Gold led exploration activity in Canada from 2011 to 2020. In terms of spending, precious metals accounted for just over 65% of total spending in 2020, the same level as 2017, which was the highest ratio in over 25 years. Jurisdictions with established gold camps including Quebec, Ontario, British

[25] https://www.fraserinstitute.org/sites/default/files/annual-survey-of-mining-companies-2020.pdf
[26] "Permit Times for Mining Exploration in 2017", the Fraser Institute, 2018

Columbia, Nunavut, and Yukon were the main beneficiaries of this increase for precious metals. Base metals were the second most attractive commodity group accounting for 19.1% of the total. Spending for iron ore experienced the largest increase in percentage terms in 2020, increasing by 84.7% to $32M. Iron ore prices increased to a nine year high driven by anticipation of tight supply due to COVID-19 pandemic restrictions and lower seaborne supply.

Figure 10: Exploration and Deposit Appraisal Expenditures, by Commodity Group, 2011-2020



Source: Natural Resources Canada.
(p) Preliminary.

In terms of regional allocations, exploration and deposit appraisal expenditures since the 2000s have been concentrated in Ontario, Quebec, and British Columbia (Table 7). Ontario took the lead in 2020 and accounted for 26% of the total expenditures. The overall trend for most jurisdictions between 2011 and 2016 was decreased exploration and deposit appraisal spending. Exploration spending recovered in 2017 for many jurisdictions and exploration in 2018 and 2019 experienced moderate increases except for the North where Nunavut and the Northwest Territories declined significantly. Small increases in spending were seen for 2020 in the stronger mining jurisdictions including British Columbia, Quebec, and Ontario. Some provinces and territories experienced declines, likely due in part to the restrictions associated with the global COVID-19 pandemic that impacted exploration activity during key periods of the exploration season. Note that expenditures data for 2020 is considered preliminary and may be subject to adjustments in future.

Table 7: Exploration and Deposit Appraisal Expenditures, by Province and Territory, 2011, 2016, and 2020

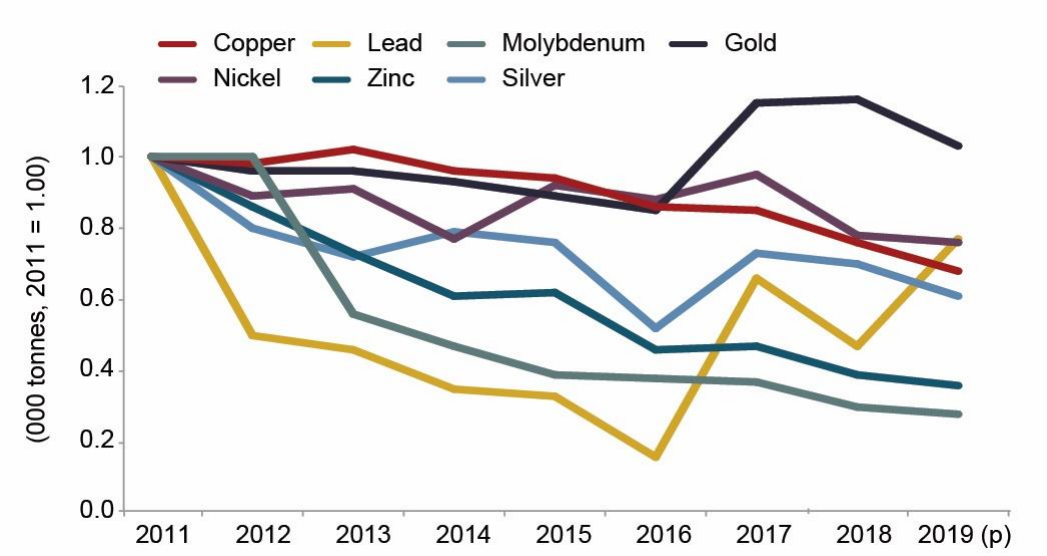
Province/Territory	2011	2016	2020 (p)
	(constant 2020 $million)		
Canada	4,741	1,742	2,191
Alberta	53	18	47
British Columbia	723	248	514
Manitoba	157	51	62
New Brunswick	30	15	14
Newfoundland and Labrador	176	27	74
Northwest Territories	105	78	42
Nova Scotia	15	6	26
Nunavut	601	219	71
Ontario	1,197	422	566
Quebec	935	318	534
Saskatchewan	375	245	159
Yukon	372	97	84

Source: Natural Resources Canada.
(p) Preliminary.

Reserves

Mineral exploration and deposit appraisal activities are critical to restocking Canada's metal resources, which provide a pipeline of potential reserves. Reserves are indicators of the short-term potential metal supply as well as an important indicator of the diversity and strength of the extractive sector. Generally, base-metal reserves had been on a long-term decline for nearly three decades but began increasing again in 2004 with improving prices driven by demand in Asian markets resulting in steady increases and additions to some of Canada's mineral reserves. Gold and copper saw the most increases and remain at high levels. (Figure 11).

Figure 11: Canadian Reserves of Select Metals, 2011-19



Source: Natural Resources Canada.

The robust demand and high metal prices until 2011 led to the development of new mines or the expansion of existing mines, fueling additions to Canada's metal reserves. In the 10-year period from 2011 to 2020, gold reserves increased by over 30%, copper reserves declined slightly by 7% and all other metals generally declined into 2020. Sustained mineral and metal prices and a positive outlook brought on by the rollout of vaccines, government stimulus, and increased demand for metals for the green transition contributed to reserve increases in 2020 for copper, silver, and gold. Many Canadian mines were temporarily shut down during the first wave of the COVID-19 pandemic; however, easing restrictions, new safety protocols, and testing allowed reopening in early summer 2020. Going forward, supply and transportation bottlenecks or new pandemic restrictions could affect timely mineral supply to markets.

Canada has an opportunity to supply the critical minerals that are necessary for an energy transition to feed both domestic and global supply chains. Progress on land access, regulatory efficiency, enabling infrastructure, and meeting other challenges facing the industry will facilitate the Canadian minerals sector's ability to satisfy these new demands.

Public Geoscience Expenditures

Highlights

- Total government expenditures on public geoscience were $130.0 million in 2020/21 representing a 19.0% decrease compared to 2011/12 and largely due to restrictions on field activity during the global COVID-19 pandemic.
- Federal government expenditures on public geoscience accounted for 43.8% of total expenditures in 2020/21 with the provinces and territories accounting for the remaining 56.2%.
- The Northwest Territories and Nunavut each experienced substantial expenditure increases of 156.3% and 94.2% from 2011/12 to 2020/21 respectively.

Definition

Public geoscience broadly refers to geological, geophysical, and geochemical data, information, and knowledge provided by governments as a public good. The availability of such data and information has long played an important role in fostering a strong mineral investment climate in Canada and is widely acknowledged to be one of Canada's competitive advantages in attracting mineral exploration, which has contributed to the country's standing as a leading exploration target and mineral producer.

Rationale

The availability of public geoscience data and analysis enables exploration companies to make informed decisions regarding their exploration plans. With a better understanding of geological environments through pre-competitive maps, databases, tools, and models, mineral exploration can focus on areas of higher prospectivity and a reduction in investment risk. Assessing public geoscience expenditures provides an indication of government efforts to support mineral exploration. In addition to benefiting industry, it also signals a general commitment to science and evidence-based decision-making. Public geoscience can be used in land management, and conservation and infrastructure planning.

Analysis

In 2020/21, total public geoscience expenditures were $130.0 million, a 5.6% decrease compared to $137.7 million in 2019/20. This is a relatively small decrease for a period strongly impacted by the COVID-19 pandemic. However, expenditures were $160.5 million in 2011/12, representing a 19.0% decrease over the 10-year period ending in 2020/21. Total public geoscience expenditures reached a 10-year peak of $173.4 million in 2015/16 before decreasing towards the low of $130.0 million in 2020/21.

Federal government expenditures (i.e., Natural Resources Canada) in 2020/21 totaled $57 million, representing 43.8% of total expenditures. On average, the federal government accounted for just under one half or 48.4% of total expenditures between 2011/12 and 2020/21 (Table 8). Federal government expenditures ranged from 43.8% to 52.6% of total expenditures during the same period.

Table 8: Public Geoscience Expenditures, 2011/12 to 2020/21 ($000s)

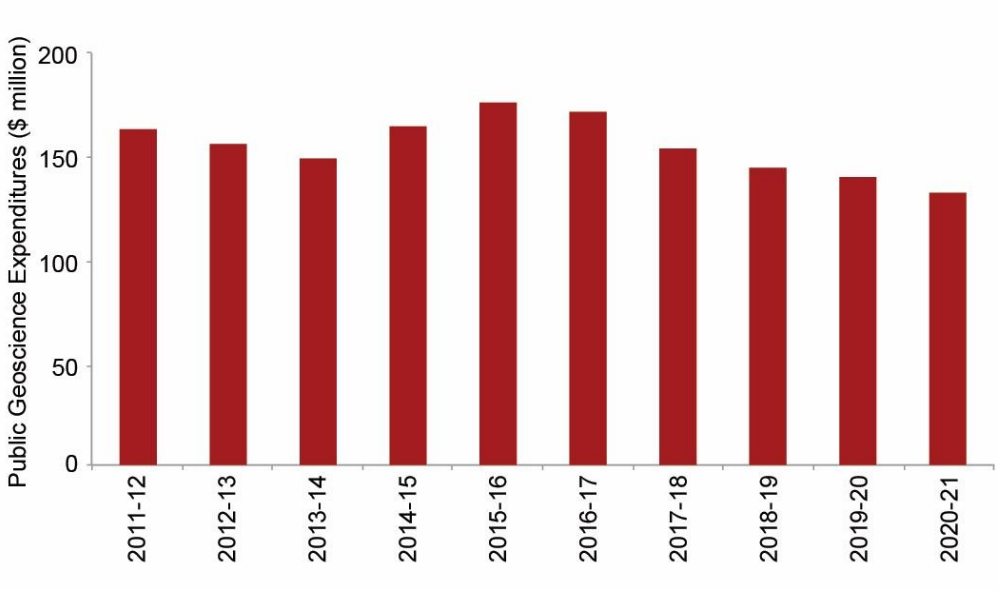
Jurisdiction	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21 (p)
British Columbia	2.9	2.9	2.6	3.2	3.7	3.8	4.0	4.1	4.4	4.2
Alberta	7.1	7.9	7.2	7.5	7.5	8.0	7.6	7.0	8.1	8.5
Saskatchewan	4.4	4.4	4.5	4.3	4.6	4.5	4.9	5.5	5.6	5.5
Manitoba	5.6	5.4	5.9	4.8	4.8	4.9	4.6	4.0	3.7	4.0
Ontario	19.3	19.3	18.4	17.8	16.8	18.1	17.8	16.4	14.5	12.3
Quebec	18.7	15.3	15.3	14.9	18.3	15.9	17.5	15.0	13.6	13.8
New Brunswick	2.2	2.2	2.0	3.2	2.8	2.8	2.7	2.8	3.2	3.1
Nova Scotia	2.5	3.1	2.5	2.6	2.5	2.7	2.6	2.8	2.8	2.9
Newfoundland & Labrador	6.1	6.1	5.7	5.5	5.5	5.2	4.9	4.6	4.6	4.2
Yukon Territories	5.2	5.2	4.9	5.0	5.0	4.8	5.3	4.4	4.9	4.6
Northwest Territories	2.3	5.2	4.2	7.0	10.2	7.0	6.5	6.4	7.4	5.8
Nunavut	2.1	2.8	2.4	3.2	3.0	2.4	3.0	3.0	3.0	4.1
Natural Resources Canada	82.1	73.8	70.9	83.1	88.7	88.9	69.8	66.3	61.9	57.0 (p)
Total	**160.5**	**153.6**	**146.5**	**162.1**	**173.4**	**169.0**	**151.2**	**142.3**	**137.7**	**130.0**

Sources: Natural Resources Canada; Committee of Provincial and Territorial Geologists.
(p) preliminary

Public geoscience expenditures in the Northwest Territories increased substantially during the period 2011/12 to 2020/21. The Territory saw year-over-year increases of over 50% in expenditures in 2012/13 and 2014/15 reaching a high of $10.2 million in 2015/16. Similarly, in Nunavut, expenditures increased during the same years, but at a more modest rate before increasing again 2020/21 to $4.1 million. From 2011/12 to 2020/21 expenditures in the Northwest Territories increased by 156.3% compared to an increase of 94.2% in Nunavut.

Many jurisdictions saw relatively flat or downward trending expenditures between 2011/12 and 2020/21. Spending by the federal government, here represented by Natural Resources Canada, decreased at an average of four times the rate of expenditures in the provinces and territories. Spending by Natural Resources Canada reached a 10-year low of $57.0 million in 2020/21 (Figure 12). Note that the $57.0 million value includes notional expenditures.

Figure 12: Natural Resources Canada Public geoscience expenditures 2011-2020



Sources: Natural Resources Canada.

Capital Expenditures

Highlights

- Capital expenditures in the minerals sector, including support activities for mining, experienced a 30% decrease between 2011 ($17.1 billion) and 2020 ($12.0 billion).
- Capital expenditures in the minerals sector experienced an overall decline following a 10-year high in 2012.
- In the mining and quarrying subsector, which on average accounts for 71% of the total investment value, spending decreased 29% between 2011 ($12.2 billion) and 2020 ($8.63 billion), and has been trending downward overall since a record high in 2012.
- Preliminary intentions for 2021 show a modest increase in capital expenditures in the minerals sector ($12.7 billion).

Definition

Capital expenditures include costs associated with procuring, constructing, or upgrading physical assets such as property, buildings, and machinery and equipment.[27]

[27] Detailed information regarding the compilation and dissemination of capital investment data can be located at https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=2803

Rationale

Information on capital spending provides a useful indication of market conditions both in the economy as a whole and in particular industries. In addition, information on the relative size of planned expenditure programs, particularly for industrial sectors, gives an indication of the views management hold on future market demands in relation to present productive capacity.

Analysis

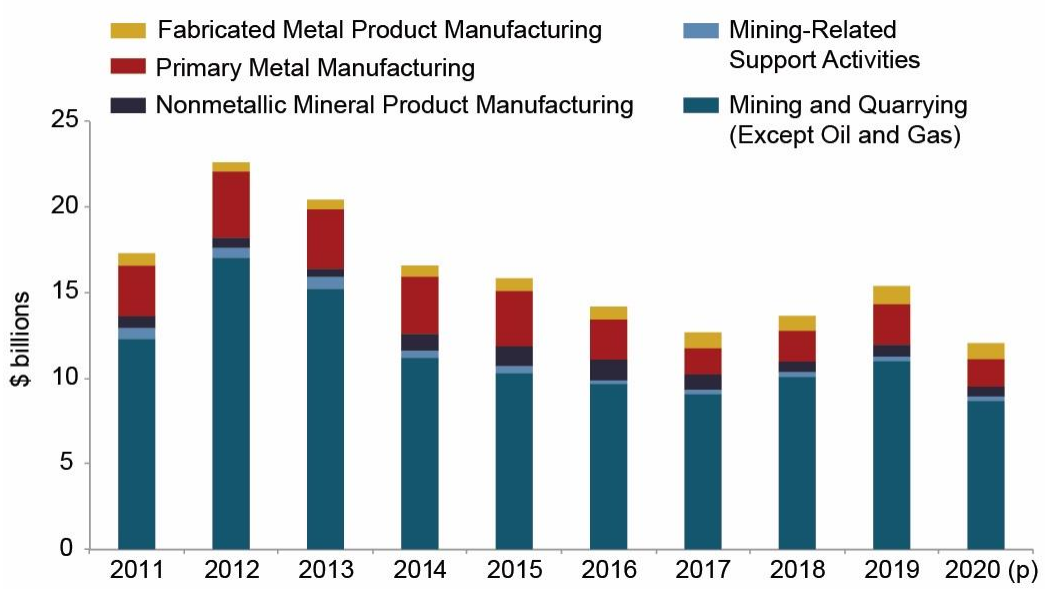
Capital investment in the minerals sector, including support activities for mining, decreased 30.0% from $17.1 billion to $12.0 billion over the decade 2011 to 2020 (Figure 13). There was a 10-year high of $22.5 billion in 2012, which was followed by a steady decrease towards $12.6 billion in 2017 as the sector reacted to global economic conditions, reduced demand, and oversupply issues for some commodities.

A slight rebound in the two subsequent years saw a secondary peak of $15.3 billion in 2019 before a further decline to reach a 10-year low of $12.0 billion in 2020. Preliminary capital expenditure intentions for 2021 suggest there may be a modest rebound to $12.7 billion.

Despite the significant challenges imposed by the COVID-19 pandemic in 2020, a decline had been projected to occur before the pandemic and coincides with the transition of several gold projects out of the capital intensive construction phase and into production.

In response to the COVID-19 pandemic, minerals sector capital expenditures (CAPEX) for 2020 were revised down by 9% compared to the spending intentions that had been reported just prior to the pandemic. The downstream mineral-processing and fabrication industries were almost exclusively responsible for the decline.

Figure 13: Minerals Sector Capital Expenditures, by Subsector, 2011-20



Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary

Investment is closely linked to mine capacity, which is in turn dependent on various other factors whose influence changes over time.[28] Factors that tend to reduce capacity are permanent closures, temporary shut-downs, and the erosion of some mines' ability to produce without a direct change in capacity (such as ore depletion). Elements leading to an increase in capacity are re-openings of mines that were temporarily closed, expansion of existing mines, and new mines reaching production. Mining company executives make decisions on these factors based on their estimates of future commodity prices and supply and demand conditions. Firms tend to curtail expenditures when market conditions are unfavourable and accelerate investment plans when the outlook improves.

Capital expenditures in the mining and quarrying subsector account for the bulk of total sector investment expenditures, accounting for an average of 71.3% of total mineral investment expenditures between 2011 and 2020. Mining projects are large-scale operations that have extended lead times and entail a sizeable upfront investment in machinery, equipment, infrastructure and site preparation that can extend over multiple years. Furthermore, one or more mines moving from the capital-intensive construction stage to the production stage can affect industry-wide CAPEX trends.

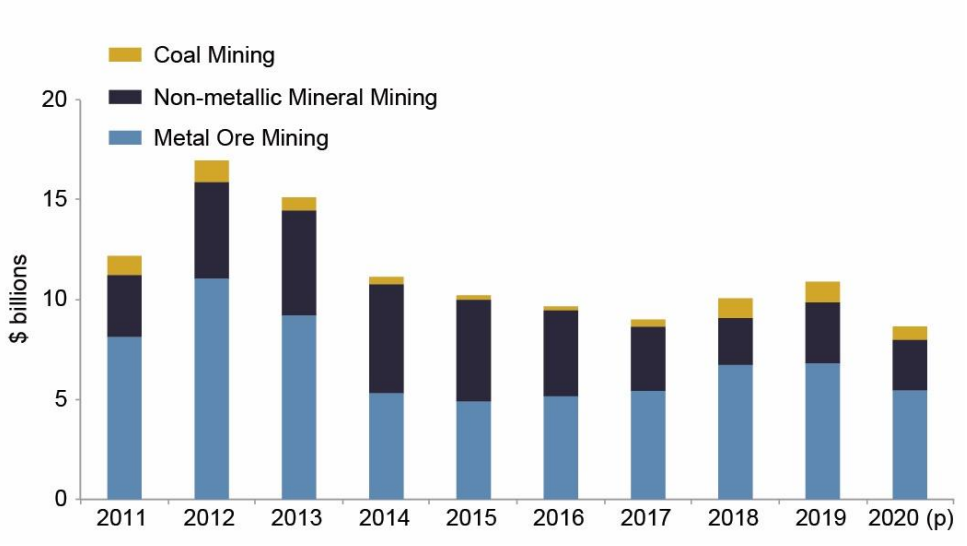
As shown in Figure 13, capital expenditures in the mining and quarrying subsector decreased 29.0% from $12.2 billion in 2011 to $8.63 billion in 2020. The peak reached a decade ago was largely driven by rapid growth in China and other emerging economies. Supply eventually caught up with demand, causing minerals and metals prices as well as CAPEX to subside. Commodity prices began to rise again after 2016, albeit much more gradually than earlier in the decade, and mining industry CAPEX also rose, up to 2019.

Spending trends varied by commodity group:

- Expenditures in the metallic ore extraction subsector decreased by 33.0% between 2011 and 2020.
- In the non-metallic ore extraction subsector, capital investment spending decreased by 18.4%. In the coal extraction subsector, capital investment in 2020 (preliminary) was $683 million or 29.7% lower than it was in 2011 ($972 million).
- Coal extraction expenditures in 2020 represented a 34.4% decrease compared to 2019: from $1.04 billion to $683 million. A 10-year high of $1.09 billion was achieved in 2012 and a 10-year low of $206 million in 2016. The Government of Canada is phasing out coal-fired electricity by 2030. However, Canada is also an important global producer of metallurgical coal, which is used in the production of steel and will continue to be produced past 2030.

[28] Crowson, Phillip, 2008, *Mining Unearthed*, United Kingdom: Aspermont.

Figure 14: Mineral Extraction Capital Expenditures, by Commodity Group, 2011-20



Source: Statistics Canada.
(p) Preliminary; (i) Intentions

The downstream mineral processing and manufacturing industries contributed $4.11 billion (26.9%) to minerals sector capital investment in 2019 while preliminary results show a contribution of $3.10 billion in 2020 (25.9%). Over half of this investment (57.2% or $2.35 billion in 2019 and 51.7% or $1.60 billion in 2020) is attributable to primary metal manufacturing. From 2011 to 2020, investment in the primary metal manufacturing and the non-metallic mineral product manufacturing subsectors experienced a decline of 45.4% and 15.7%, respectively. Investment in the fabricated metal product manufacturing subsector experienced an increase of 27.9% during the same period.

Data Considerations

As of 2015, Statistics Canada updated its methodology related to the capital investment account system. As a result, expenditures related to mineral exploration are no longer classified under "capital investment, construction," but instead under "intellectual property." Historical data have been updated to reflect this change.

Research and Development

Highlights

- Business expenditures on research and development (BERD) within Canada's mining, support services, and mineral processing industries totaled $538 million in 2020.
- While the minerals sector's BERD declined by 17.5% between 2011 and 2020, preliminary data for 2021 show a rebound of 9.7% to $590 million compared to 2020.
- R&D personnel in the minerals sector numbered 3,988 employees in 2019 representing a decrease of 46.5% relative to a 10-year peak of 7,449 employees in 2015.

Definition

R&D encompasses all activities undertaken to discover or develop new processes or products. R&D expenditures are defined as expenditures for R&D work performed within the company, including work financed by others. R&D is used as a proxy to measure innovation, which is essential to the long-term competitiveness of the sector.

Rationale

R&D plays a key role in innovation. R&D activity is pivotal to the innovation performance of an industry and demonstrates firms' commitment to new or improved production processes. R&D is important for a company and industry to remain competitive, minimize costs, and improve profitability in the long term.

Analysis

Constantly evolving conditions in mining drive innovation by leveraging emerging technologies to meet long term economic, social, and environmental goals. Collaboration and forward thinking are required to appropriately respond to the challenges faced by the natural resource sectors.

Economically, innovation is important to enhance productivity, address skilled labour shortages, solidify global competitiveness, and develop the technologies necessary to extract mineral resources in more technically challenging conditions.

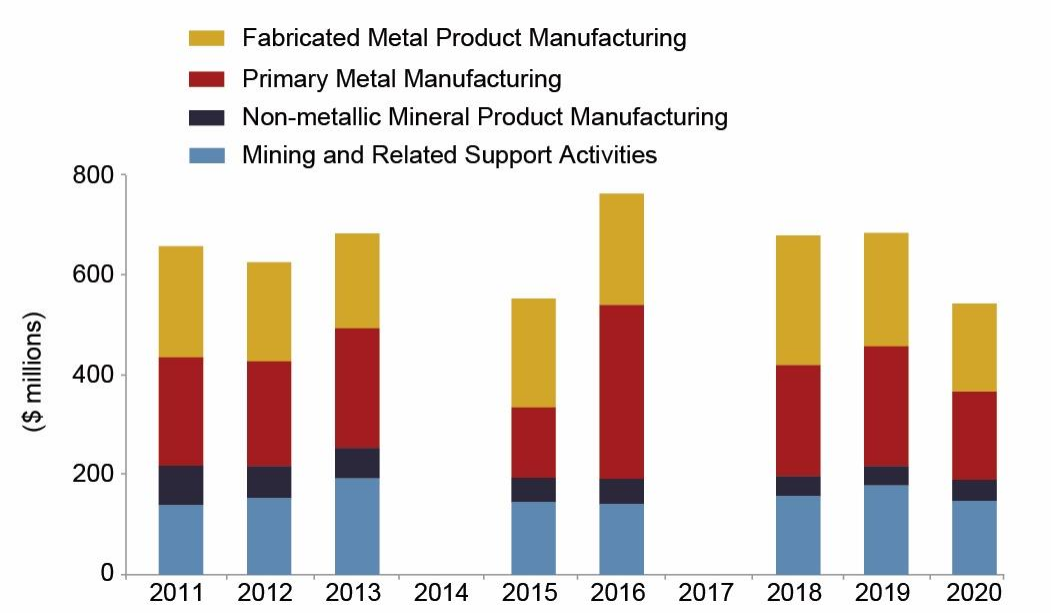
Socially, innovation is important to maintain social licenses to operate; minimize community disruption or opposition; improve the image of mining through green technologies, practices, and processes; and establish the early engagement of communities with a goal of achieving mutually beneficial relationship.

Environmentally, innovation is important to mitigate the adverse impacts of climate change on the minerals sector; develop new technologies and materials that are safer; reduce greenhouse gas emissions; promote energy efficiency; minimize the environmental footprint; and better manage the resources required to operate.

Canada's minerals sector BERD totaled $538 million in 2020 (Figure 15).[29] This represents a 17.5% decrease relative to 2011 when total BERD was $652 million. A 10-year high of $756 million occurred in 2016 compared to a minimum of $408 million in 2015. Preliminary data for 2021 suggests a slight rebound to $590 million total BERD representing a 9.7% increase.

The primary metal manufacturing subsector accounted for 32.5% of total BERD in 2020, reaching $175 million. Primary metal manufacturing data is only available between 2014 and 2021 (see *Data Considerations* below). That subsector's BERD was $344 million in 2014, decreasing to $214 million by 2020. The mining and related support activities subsector contributed $146 million or 27.1% of total BERD in 2020. However, the subsector showed an overall increased contribution from 21.2% to 27.1% of total BERD between 2011 and 2020 ($138 million to $146 million). Non-metallic mineral product manufacturing BERD decreased from $78 million to $42 million between 2011 and 2020, representing a 46.2% decrease overall. That subsector's relative contribution to total BERD also declined over the same period from 12.0% to 7.8%. BERD in the fabricated metal product manufacturing subsector decreased 20.8% from $221 million to $175 million between 2011 and 2020. Fabricated metal product manufacturing contributed between 27.8% (2013) and 52.9% (2015) of total minerals sector BERD between 2011 and 2020.

Figure 15: Minerals Sector Business Expenditures on Research and Development, by Subsector, 2011-20

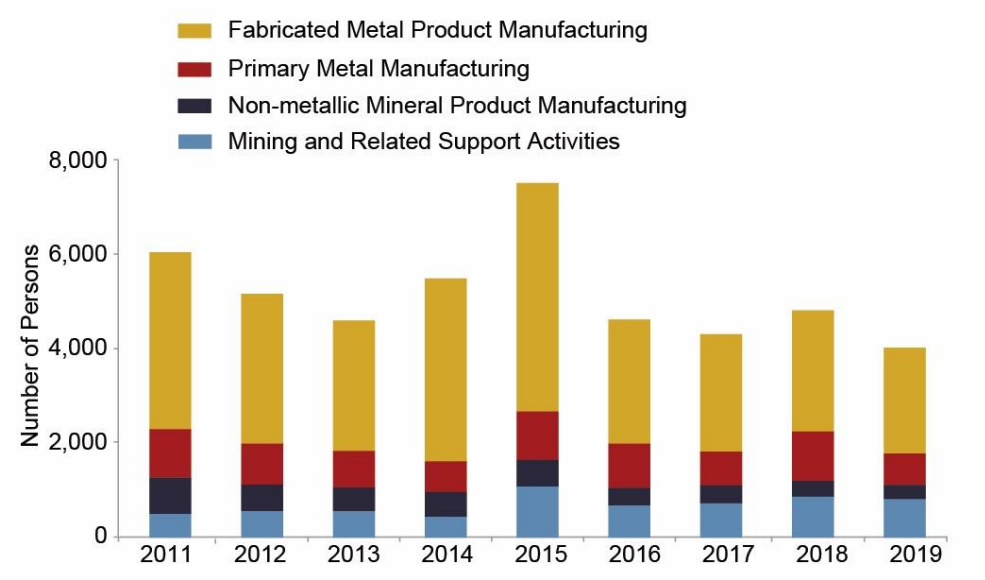


Source: Statistics Canada.
NB: subsector data was unavailable for years 2014 and 2017.

[29] Statistics Canada's dataset groups NAICS codes 212 (mining and quarrying, except oil and gas), 213117 (contract drilling, except oil and gas), and 213119 (other support activities for mining, including exploration, excluding surveying for oil and gas).

A total of 3,988 R&D personnel were working in Canada's minerals sector in 2019, the most recent year for which statistics are available (Figure 16). This represents a decrease of 33.5% from the 5,993 personnel employed in 2011 and a 46.5% decrease from a 10-year peak of 7,449 personnel in 2015. The fabricated metal product manufacturing subsector dominates the other three subsectors in terms of R&D personnel, contributing between 53.3% and 70.6% of total personnel in 2018 and 2014, respectively.

Figure 16: Minerals Sector Research and Development Personnel, by Subsector, 2011-19



Source: Statistics Canada.

Data Considerations

Statistics Canada's data for BERD and R&D personnel contain several years with gaps or missing subsector data because of the application of confidentiality rules and/or data quality issues. Data contained in this section are only presented for years where the data were available for all subsectors.

Starting with the 2014 reference year, several aspects of the Annual Survey of Research and Development in Canadian Industry have been redesigned, including concepts, methodology, collection methods, and data processing systems. Readers should exercise caution when comparing data for the periods prior to 2014 to those of subsequent years. In particular, primary metal (ferrous) and primary metal (non-ferrous) were discontinued as standalone subsector categories by Statistics Canada as of 2016. The Primary Metal Manufacturing subsector category is now used instead and was calculated as the sum of primary metal (ferrous) and primary metal (non-ferrous) subsector data for years prior to 2016.

Government Revenues

Highlights

- Between 2010 and 2019, the minerals sector generated $10.5 billion in corporate income tax revenue ($5.8 billion to the federal government and $4.7 billion to provincial and territorial governments) and an additional $16.1 billion in mining taxes and royalties for Canadian governments.
- Mining taxes and royalties paid to governments by the mineral extraction industry decreased 15.3% over a 10-year period from $1.96 billion in 2010 to $1.66 billion in 2019. The decline and overall trend is consistent with mineral and metal prices and the value of mineral production.

Definition

Government revenues from the minerals sector include corporate income taxes, mining taxes, and royalty payments to provincial and federal governments. This section includes corporate income tax data over the 10-year period of 2010 to 2019. Provincial mining and royalty tax data are from 2010/11 to 2019/20.

Rationale

Taxes and royalties paid to governments are a significant part of the sector's contribution to the national economy and a way for present and future Canadians to receive revenue from the extraction of mineral resources and share in the country's mineral wealth.

Box 8: Extractive Sector Transparency Measures Act

The *Extractive Sector Transparency Measures Act* (the Act) came into force on June 1, 2015 and delivers on Canada's commitment to support global efforts to strengthen transparency and accountability in the extractive sector. Its purpose is to deter corruption in the global extractive sector by making government revenues from natural resources transparent to the public.

The Act requires certain entities that are engaged in the commercial development of oil, gas, or minerals to annually report specific payments made to all governments in Canada and abroad. Reported payments are those of $100,000 or more that fall within specific categories of revenue streams associated with exploration and extraction of oil, gas, or minerals (e.g., taxes, royalties, fees). Since June 1, 2017, the Act includes payments made to Indigenous governments in Canada. Canada's reporting requirements are aligned with similar transparency measures implemented in the EU, UK, and Quebec, and substitution has been put in place to enable companies operating in more than one of these jurisdictions to prepare one single report.

The Act was developed in response to a commitment that Canada made at the 2013 G8 Leaders' Summit where leaders agreed to raise global standards of transparency in the extractive sector, reduce the potential for corruption, and ensure that citizens benefit fully from the extraction of natural resources. Since 2013, NRCan has engaged with stakeholders for input on how to best implement the Act.

Between June 15, 2015 (when the Act came into force) and December 31, 2020, over $570 billion has been reported by nearly 1,100 entities on operations across 133 countries. This includes approximately $63 billion paid to federal, provincial, municipal, and Indigenous governments in Canada, $25 billion of which has been attributed to taxes. Payment information is contained within individual, consolidated, and substituted reports that are linked on the NRCan website at: https://www.nrcan.gc.ca/mining-materials/estma/18198.

As a result of this wealth of data, Canada is recognized as a leader in promoting transparency and accountability in the extractive sector both at home and around the world.

Payments to payees in Canada reported under the Extractive Sector Transparency Measures Act by category, 2015-20

Category	Payments ($ billion) (2015-20)
Taxes	25.38
Royalties	29.85
Fees	5.97
Production entitlements	0.05
Bonuses	1.02
Infrastructure improvement payments	0.29
Total	**62.56**

Note: Payment categories are defined by the Extractive Sector Transparency Measures Act. Data reflects reports received with a financial year-end between June 15, 2015 (when the Act came into force) and December 31, 2020.

Analysis

The minerals sector in Canada benefits from one of the most internationally competitive and attractive tax regimes for mining and mineral exploration companies. This is attributable to having the third lowest statutory corporate income tax rate and lowest marginal effective tax rate among the G7 countries. Among global mining jurisdictions, Canada offers a competitive mining taxation regime including: profit-based royalty systems, generous carry-forward and carry-back provisions, and mineral and exploration tax incentives such as flow-through shares (FTS).[30]

[30] http://www.nrcan.gc.ca/mining-materials/taxation/mining-taxation-regime/8892#lnk16.

As shown in Table 9, the Government of Canada has reduced the corporate income tax rate from 18% in 2010 to 15% in 2019. In addition, Ontario, Quebec, and Yukon also reduced their corporate income tax rates while Alberta, British Columbia, New Brunswick, and Newfoundland and Labrador increased their rates after 2010.

Table 9: Canadian Federal and Provincial/Territorial Corporate Income Tax Rates, 2010 and 2019

Jurisdiction	Tax Year 2010	Tax Year 2019
Federal	18.0%	15.0%
Alberta	10.0%	11.5%
British Columbia	10.5%	12.0%
Manitoba	12.0%	12.0%
New Brunswick	11.5%	14.0%
Newfoundland and Labrador	14.0%	15.0%
Northwest Territories	16.0%	16.0%
Nova Scotia	11.5%	11.5%
Nunavut	12.0%	12.0%
Ontario	11.0%	10.0%
Prince Edward Island	16.0%	16.0%
Quebec	11.9%	11.6%
Saskatchewan	12.0%	12.0%
Yukon	15.0%	12.0%

Source: Natural Resources Canada.

Generally, mining taxes and royalties in Canada are based on net income rather than revenue, although six provinces[31] have a two-tier system in which a small percentage of operating income is taxed before taxing the net income.

Also of note is Canada's unique FTS mechanism allowing a principal business corporation to obtain financing for expenditures on mineral exploration and development in Canada. FTS investors can receive a 100% tax deduction for the money invested in FTS for exploration and 30% for development. This incentive was enhanced by the Government's extension of the 15% Mineral Exploration Tax Credit on eligible expenses to March 31, 2024 (e.g., costs related to prospecting and carrying out geological, geophysical, or geochemical surveys conducted at or above the surface of the earth). Several provinces

[31] Alberta, British Columbia, New Brunswick, Newfoundland and Labrador, Nova Scotia, and Quebec.

also offer additional tax credits or deductions to FTS investors to encourage exploration investment in their jurisdictions.[32]

Box 9: Canadian Mining

Canada has the lowest effective tax rate among the G7 countries and one of the lowest effective tax rates among global mining jurisdictions. Key features of Canadian mining taxation include:

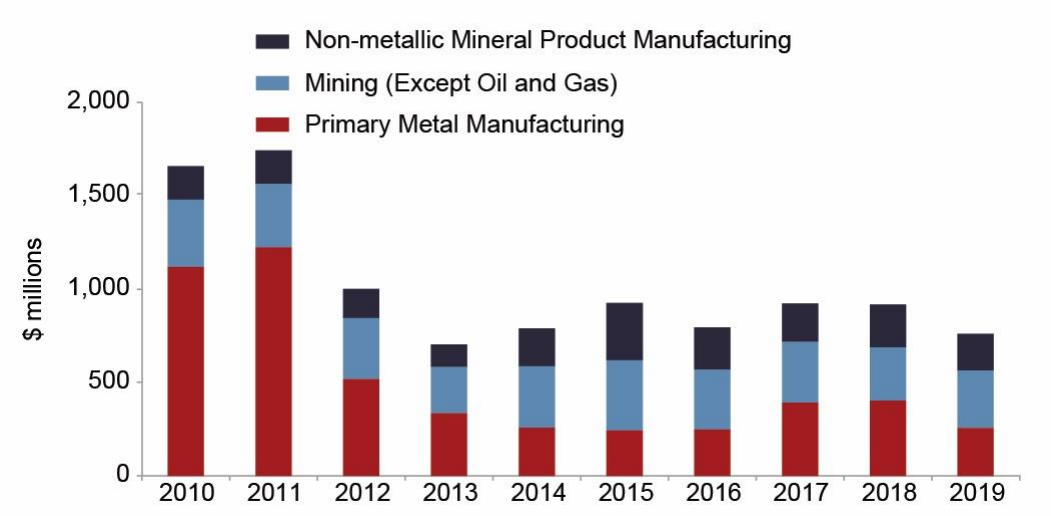
- Flow-through Shares (FTS) that encourage raising exploration funds and mineral exploration in Canada, a sector that accounts for an estimated 30,000 jobs including men, women, and Indigenous peoples.[33]
    - In 2020, FTS raised $911 million in equity funds for mineral exploration and mine development. The industry estimates that two-thirds of the equity funds for mineral exploration in Canada was raised via FTS.
- Canada recently proposed a 30% Mineral Exploration Tax Credit for select critical minerals that aims to increase the rate of discovery for those that contribute to key clean technology inputs.
- Canadian mining taxes and royalties are mainly profit-based: operating losses can be carried back three years and forward 20 years; exploration expenses are at least 100% deductible; fast write-offs for all categories of expenditures shorten the capital payback period and reduce investment risk; and, most provinces and territories have a processing allowance to encourage downstream benefits to remain in Canada.

Mining companies paid $16 billion in mining taxes and royalties to the provincial and territorial governments between 2010 and 2019 in addition to substantial local economic contributions such as wages, local procurement, and infrastructure that can accompany industry activity. The payments were shared with local communities via the Resource Revenue Sharing scheme adopted by most provinces and territories, or used for schools, hospitals, social welfare, and other programs.

Corporate income tax paid to governments by the minerals sector in Canada fluctuated significantly between 2010 and 2019, reaching a high in 2011 of $1.78 billion and a low of $718 million in 2013 (Figure 17).[34] The trend is mostly consistent with metal prices and the value of mineral production. After reaching a 10-year high of $1.78 billion in 2011, corporate taxes paid dropped substantially in 2012 and again in 2013 to reach a 10-year low of $718 million. Corporate income tax has remained below $1 billion since 2013 with lower peaks of $944 million and $981 million in 2015 and 2018, respectively. Tax paid was $776 million in 2019.

[32] British Columbia, Manitoba, Ontario, Saskatchewan, and Quebec
[33] Canadian Mineral Exploration HR Outlook 2020, MiHR, https://mihr.ca/wp-content/uploads/2020/03/Canadian-Mineral-Exploration-HR-Outlook_EN_WEB.pdf
[34] Data for NAICS 332 – fabricated metal product manufacturing are not available in a disaggregated manner.

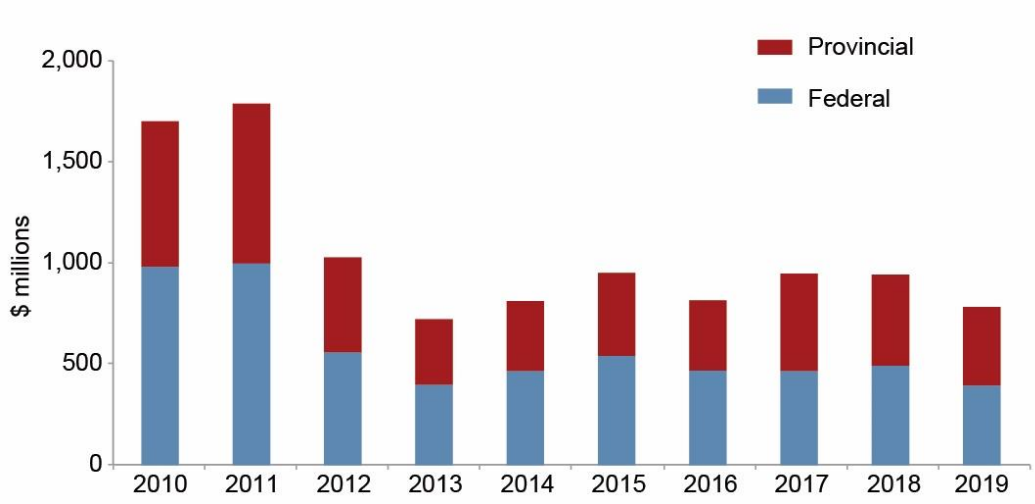
Figure 17: Minerals Sector Corporate Income Tax Paid, by Subsector, 2010-19



Source: Statistics Canada.

Between 2010 and 2019, the minerals sector generated $10.5 billion in corporate income tax revenue for Canadian governments (Figure 18). This included $5.8 billion to the federal government and $4.7 billion to provincial and territorial governments. With federal corporate income tax rates holding steady at a low of 15% since 2012, the provinces and territories contributions to total corporate income tax revenues has been relatively high for all mineral subsectors in recent years. For example, the share of provincial and territorial corporate income tax relative to total corporate income tax increased from 42% in 2010 to 51% in 2017.

Figure 18: Minerals Sector Corporate Income Tax Paid to Federal-Provincial Governments, 2010-19



Source: Statistics Canada.

Mining taxes and royalties paid to governments by the mineral extraction industry have declined by 15% over the last 10 years (Table 10). These payments reached a peak of $2.4 billion in 2011 due to increased payments from all provinces and territories except Alberta and British Columbia. Payments dropped to approximately $1 billion in 2013 before recovering in subsequent years. They reached $1.89 billion in 2018 before experiencing a slight decline to $1.66 billion in 2019/20.

Table 10: Royalties, Mining Taxes, and Similar Payments to Provinces and Territories, 2010 to 2019

Province/ Territory	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
	(current $ millions)									
Newfoundland and Labrador	228.1	317.4	136.0	160.4	95.4	70.0	60.0	93.4	234.6	85.8
Nova Scotia	1.8	2.5	1.6	1.4	1.1	1.4	1.3	2.5	4.4	4.8
New Brunswick	44.4	66.0	31.0	22.7	41.3	13.6	2.8	5.3	6.4	2.7
Quebec	323.6	352.2	207.3	56.8	90.1	175.1	99.1	166.4	290.7	308.8
Ontario	176.1	213.4	117.5	18.6	159.0	69.1	60.4	101.7	93.3	98.7
Manitoba	45.9	66.9	42.4	13.1	7.2	14.1	4.3	3.6	12.7	12.7
Saskatchewan	626.0	834.2	725.9	661.0	896.5	944.5	546.1	615.1	802.7	840.7
Alberta	31.0	29.0	-3.0	16.0	16.0	14.0	26.2	12.0	12.8	12.0
British Columbia	364.5	358.3	150.2	106.5	89.7	103.1	258.7	483.7	404.7	250.5
Yukon	4.2	5.4	4.0	2.4	3.0	1.6	2.3	2.3	2.0	2.0
Northwest Territories and Nunavut	108.9	132.2	58.1	28.3	127.8	76.5	64.1	36.5	25.0	39.4
Canada	**1,954.5**	**2,377.4**	**1,471.0**	**1,087.3**	**1,527.1**	**1,482.9**	**1,125.4**	**1,522.5**	**1,889.4**	**1,661.5**

Source: Natural Resources Canada.

Data Considerations

Although not captured by statistics in this section, it is important to note that minerals sector contributions to government revenues extend beyond corporate income tax and royalties. Minerals sector activity drives other economic activity that contributes to indigenous communities through impact benefit agreements and government revenue, including: sales taxes on goods and services purchases, employee income taxes, contributions to the Canada Pension Plan and the Quebec Pension Plan, and property taxes to municipalities.

Section 3: Social Performance

The activities of the minerals sector are industrial in nature and can have a tremendous impact on local communities and Canadian society as a whole. Outputs of the sector are key components in the production of many different goods and services that benefit Canadians on a daily basis. Mineral exploration, development, and production provide direct and indirect economic and social benefit. This economic activity can improve quality of life through direct and indirect employment, education and training, improved access to infrastructure, and community development projects.

Mineral projects can lead to undesirable outcomes such as increased cost of living.[35] Communities that become reliant on exploration and mining as drivers of the local economy can be especially vulnerable to adverse impacts once operations close. Major adverse social impacts following closure could include: loss of employment and income; reductions in tax revenues and associated funding decreases for infrastructure and social programs; loss of workers to other fields or locations; and declining local secondary economic activity, including services that support the local minerals sector and its employees.

Box 10: Effective Community Engagement

Mining jurisdictions around the world look to Canada for examples on how to form mutually beneficial partnerships with Indigenous Peoples and support successful community engagement during all stages of the mineral development cycle. Meaningful proponent-led engagement can be a foundation on which to build common understanding. It supports incorporation of Traditional Indigenous Knowledge and values into project planning, local workforces and economies, drives sustainable development over many socioeconomic factors, and secures a competitive advantage by providing reassurance to investors and members of the public. Community engagement is also a feature of Towards Sustainable Mining's international standard for sustainable mining (Box 18).

As just one example, Sabina Gold & Silver Corporation embarked on a comprehensive community engagement program during the environmental assessment phase of their Back River gold project in Nunavut, Canada. Their campaign considered the cultural, traditional and socio-economic impacts of the project on the local communities and developed an approach that aligned with formal requirements for community involvement in resource development as outlined in the Nunavut Agreement. The Kitikmeot Inuit Association (KIA) secured leadership roles in land ownership and management, issuance of permits, and establishment of Inuit Impact and Benefit Agreements while Sabina worked with Elders, the KIA, harvesters and communities to develop 'best in class' caribou protection measures, which garnered support from the Nunavut Impact Review Board and led to the approval of the project.[36]

[35] Natural Resources Canada, 2003, *The Social Dimension of Sustainable Development and the Mining Industry*, http://www.publications.gc.ca/site/eng/9.686723/publication.html.

[36] *Effective Community Engagement during the Environmental Assessment of a Mining Project in the Canadian Arctic*, Environmental Management, 2021 (https://link.springer.com/content/pdf/10.1007/s00267-021-01426-5.pdf).

Several aspects of effective community engagement were noted:

- **Early and sustained engagement using a culturally-appropriate approach,** including distribution of materials written in the region's two distinct dialogues, the use of traditional Inuit place names, and scheduling meetings that did not conflict with harvesting or other important community events.
- **Meaningful incorporation of community perspectives**, such as making significant changes to the project design to mitigate impacts on local caribou migration and calving habits (based on Traditional Indigenous Knowledge provided by local communities).
- **A focus on long-term relationships and benefits for the region**, including establishment of a Regional Wealth Creation initiative to create long-term jobs outside of mining that expand and diversify the Kitikmeot economy.

The outcomes and indicators in this section of the report were developed to help assess the minerals sector's social performance. Based on a review of various multi-stakeholder frameworks, the overall desired outcomes chosen to frame social performance are:

> ***Develop Canada's mineral resources in order to provide tangible benefits for current and future generations, including local communities in the proximity of mineral activities such as prospecting and exploration, development, extraction, and closure and reclamation.***[37]
>
> ***Conduct engagement processes to ensure local and affected communities have the opportunity to meaningfully participate in the development of resources that could influence their future.***

The following strategic directions of the Canadian Minerals and Metals Plan were selected to further articulate the targets and outcomes for the social performance of the sector:[38]

- **Global Leadership**
  - A sharpened competitive edge and increased global leadership for Canada
- **Communities**
  - Communities welcome sustainable mineral development activities for the benefits they deliver

[37] It is noted that while they are not discussed here, negative environmental impacts can also have social consequences such as affects on quality of life, life expectancy, and others.

[38] Refer to Section 1 for a full explanation of the alignment of the Canadian Minerals and Metals Plan and the Mining Sector Performance Report.

- **Advancing the Participation of Indigenous Peoples**
    - Increased economic opportunities for Indigenous Peoples and supporting the process of reconciliation

The indicators[39] chosen to measure the sector's performance related to these outcomes are:

- **Employment** – Employment, including Indigenous employment, in the mineral industry provides income security through wages and salaries, an improved standard of living, and the acquisition of transferable skills. Measuring the sector's employment level helps assess one of the most important socio-economic contributions provided to communities located in all regions of the country, from large urban centres to rural, northern, and remote areas.

- **Gender Diversity** – the measurable representation of worker diversity within the sector. It is an important indicator for assessing the effectiveness of industry efforts to remove unintended barriers that may prevent increased female representation in the sector's labour force.

- **Agreements between mineral companies and Indigenous communities or groups** – Agreements, which can range from a Memorandum of Understanding (MoU) to an Impact Benefit Agreement (IBA), have helped secure benefits for local Indigenous communities and businesses, and provide clarity and certainty for exploration and mining companies. Monitoring the number of agreements is one possible metric of the mineral industry's efforts in developing partnerships with communities and earning and maintaining the positive relationship with local stakeholders needed to operate. It is important to note that the nature and magnitude of benefits will be different in each case as will the quality and depth of the agreement.

- **Government funding for public participation in impact assessments** – Impact assessments (formerly referred to as environmental assessments) examine a comprehensive list of potential impacts in natural resource development, including the cumulative effects of a proposed project, measures to mitigate those effects, and concerns and comments raised by the public. Funding to support participation by the public and Indigenous communities in impact assessments is one potential indicator in gauging efforts to ensure concerns are considered during regulatory processes.

- **Workplace health and safety** – Measured as the occupational injury rate, both fatal and non-fatal. Monitoring these rates helps determine the minerals sector's level of performance in ensuring safe practices and healthy work environments.

- **Mine openings and closures** – Mine openings and closures can result in significant socio-economic impacts, both positive and negative, including changes in employment, government revenues, population, and socio-economic activity in the local area.

- **Strikes and lockouts** – Strikes and lockouts are the result of friction between employees and the employer. Regardless of the reason for the labour disruption, they can have a negative impact on the industry, the workers, and the local community.

[39] The authors acknowledge that the indicators presented in the report are currently insufficient to measure all of the positive and negative social impacts of the minerals sector. The search for relevant data and new indicators for subsequent editions of the report is an ongoing priority.

Box 11: Land Use Planning

Land use planning (LUP) is a responsibility of the provinces and territories and a process by which stakeholders come together to define different land use allocations or uses to meet the economic, social, and environmental needs of the people. The main motivations for LUP is to improve land management, the coherence of land uses, or the desire to reorient current land use patterns due to changing circumstances. Important drivers of change in Canada are new land use planning processes associated with modern treaties and agreements with Indigenous people.

Public land is of limited supply and has many potential competing uses. Therefore, provinces and territories must involve a variety of stakeholders in their land use planning processes and at different stages of development and consultation to provide local knowledge of the current situation and building buy-in for the land use decisions.

The fundamental challenge of LUP is to incorporate an informed and balanced assessment of competing land use options, which are sometimes geographically limited to a particular location. Mines can only be located where there is a natural concentration of elements or minerals (i.e., mineral deposits). Likewise, species at risk rely on habitats with unique ecological values and properties that support life. Habitat can also be linked to cultural livelihoods and food security for local communities. LUP will also need to address how those same habitats as well as access to mineral resources may be affected by climate change.

Stakeholders can include provincial and territorial governments and their delegates, local and Indigenous communities, resource development companies, environmental advocates, land owners, and interest groups. It is important to note that in addition to being stakeholders, Indigenous peoples are also rights holders in the context of LUP. LUP may have planning objectives at different scales of land under provincial or territorial responsibility. Therefore, land allocation decisions may occur at various levels: provincial or territorial, regional or municipal, or community.

In Canada, as mentioned above, LUP is a provincial and territorial responsibility except in Nunavut, where the federal government retains land and resource co-management responsibilities and in the Northwest Territories where it is working with the territorial government to finalize regional land use plans.

In July 2021, the Nunavut Planning Commission released an updated Draft Land Use Plan, covering 21% of Canada's land mass, Canada's largest jurisdiction, and representing some 2.1 million square kilometres of land and water.[40] The 2021 Nunavut Draft Land Use Plan sets out guidelines for the use and responsible development of resources within the Nunavut Settlement Area and is also designed to:

- Protect critical wildlife habitat for caribou, migratory birds, walrus, polar bear, and whales that are under threat because of climate change and other factors;

[40] https://www.nunavut.ca/land-use-plans/draft-nunavut-land-use-plan

- Identify priority community areas of interest;
- Support economic development opportunities including the potential Manitoba - Kivalliq infrastructure corridor;
- Provide for grandfathering of existing mineral rights; and
- Provide certainty for landowners and users about where and when projects and economic activities can take place.

The various land use designations in planning require compromise among stakeholders to reach consensus on land uses and not adversely affect, among other things, potential development, protection, conservation and access to land, or to make changes that create uncertainty about future land use and access. This consensus among stakeholders is essential as some land use restrictions may become binding.

Mining as a land use can be viewed as particularly contentious, despite the relatively small footprint of mining; Canadian mines occupy approximately 0.02% of Canada's land surface – much less than for activities such as forestry or agriculture.[41] While associated infrastructure for the transportation and power needed to support mining can extend the land use needs of the industry, they can often also serve the needs of local communities. However, the larger areas covered by mineral titles for the exploration phase that can also affect land use planning.

Synopsis

Overall, trends in the minerals sector's social performance have been variable between 2011 and 2020. While total employment has fallen just over 2% over this period, Indigenous employment as percent of the overall minerals sector workforce increased from 6.3% to 7.6% over the same period. Workplace health and safety improved, showing lower rates of both fatal and non-fatal worker injuries. In contrast, the number of new agreements signed per year between companies and Indigenous communities or groups decreased. Public funding for participation in Impact Assessment processes for mining-related projects experienced a negative average annual growth rate between 2014/15 and 2019/20 and mine closures exceeded openings between 2011 and 2020.

[41] https://www.nature.com/articles/s41597-020-00624-w

Highlights

- In 2020, 364,350 people were directly **employed** in mining, mining-related support activities, and the mineral processing sector in Canada, a decrease of 2.2% over 2011 levels. Negative average annual growth rate of -0.2% is likely due to the COVID-19 pandemic, employment otherwise trended upwards during the 10-year period.

- **Indigenous employment** in the minerals industry increased from 6.3% in 2011 to a peak of 9.6% in 2019 before receding to 7.6% in 2020.

- While the number of **women employed in the sector** declined by 5,200 individuals over the past 10 years, the proportion of women employed has remained relatively constant, declining less than one percent. The percentage of women working in the mining and quarrying subsector (excluding oil & gas) increased from 12% to 15% over the same period. The wage gap between men and women in the mining and quarrying subsector (excluding oil & gas) narrowed to 2% in 2020, from a peak of 15% in 2012.

- More than 260 new **agreements between companies and Indigenous communities or groups** were signed between 2011 and 2020. The number of new agreements per year decreased from 43 to nine between 2011 and 2020. There were 412 active agreements in place as of December 31, 2020.

- In terms of **government funding for public participation in the Impact Assessment process**, in 2019/20, the Impact Assessment Agency of Canada's (IAAC) Participant Funding Program (PFP) disbursed a total of $3,011,476 compared to $2,200,000 in 2010/11 (+36.9%). A total of 52 projects were supported in 2019/20 by PFP compared to 28 in 2010/11 (+85.7%). Ten projects were related to the mining industry in 2019/20 and received $384,693 compared to 18 projects and $741,487 in 2014/15 (the first year for which data is available) representing a 44.4% decrease in projects and 48.1% decrease in funding.

- **Workplace health and Safety** improved with rates of both fatal and non-fatal occupational injuries in the minerals sector declining by 56.5% and 26.3% from 2011 to 2019, respectively.

- Between 2011 and 2020, 54 new **mines opened**, and 24 mines **reopened**. During this same period, 37 mines **closed** and 61 operations were **suspended**.

- Between 2011 and 2020, the total number of **strikes and lockouts** decreased from 12 to 4 (-66.7%). The resulting total person-days not worked decreased 93.3% during this period with the exception of a 10-year high in 2018 as significant labour disruptions occurred at select mineral processing facilities.

Indicator (2011–2020) (unless otherwise specified)	
Employment	-0.2% average annual decrease
Indigenous Employment	+3.7% average annual increase
Indigenous Agreements*	-8.9% average annual decrease
Public Funding for Participation in Impact Assessment Process **(mining-related projects 2014/15-2019/20)**	-8.8% average annual decrease**
Gender Diversity **(% women employed in minerals sector)**	+0.5% average annual increase
Workplace Health and Safety* **(2011-2019)**	-4.8% average annual decrease (fatal) -3.3% average annual decrease (non-fatal)
Mine Closures and Openings*	9.9 average closed/suspended operations per year 7.8 average opened/re-opened operations per year (26.9% difference)
Strikes and Lockouts*	-4.7% average annual decrease

Improved Performance > +1.0%

Limited Change Between +1.0% and -1.0%

Decline in Performance < -1.0%

* Note that the number of agreements provides only a partial picture of performance – the quality and depth of each individual agreement and the benefits described therein is equally important.

** Performance cannot be determined based on this metric. Please refer to the *Data Considerations* subsection for this indicator for more information.

*** Negative average annual growth rate in some performance indicators implies improvement.

Employment

Highlights

- There were 364,350 people employed in mining, mining-related support activities, and the mineral processing sector in Canada in 2020, a decrease of 2.2% over 2011 and 7.2% over 2019. The slightly negative average annual growth rate for the 10-year period of -0.2% is attributable to the steep decline in 2020 that was due to the COVID-19 pandemic, otherwise employment generally trended up during the period.
- Recent job losses were more substantial in support activity sectors and downstream sectors while conversely, employment numbers rose in mining and quarrying.
- Annual compensation increased on a year-over-year basis and reached $106,177 on average compared to the national value of $68,759 for all industries.[42]

Definition

Employment is the number of individuals directly employed by establishments classified within the mining, mining-related support activities, and mineral processing subsectors.[43]

Rationale

Stable employment provides income security that can result in improved quality of life and the acquisition of transferrable skills. In addition, employment leads to consumption and spending in the local community (usually in services and retail) where people live, which drives local economic development and improved quality of life, often resulting in better health. In addition, there is a positive correlation between employment and Gross Domestic Product (GDP) growth, which can lead to increased living standards.[44]

Analysis

In Canada, minerals sector jobs, including mining, mining-related support activities, and mineral processing, employed 364,350 people in 2020. This represents one in every 48 Canadian jobs or 2% of the national working population. From 2011 to 2019, employment in the minerals sector was on an upward trend, increasing by 5.4% between 2011 and 2019. The total number of people employed in this sector was at its highest level in 2019 with 392,825 individuals. However, in 2020 due to the COVID-19 pandemic there was a loss of 28,475 jobs from 2019, a decrease of 7.2%. This fall was slightly less than

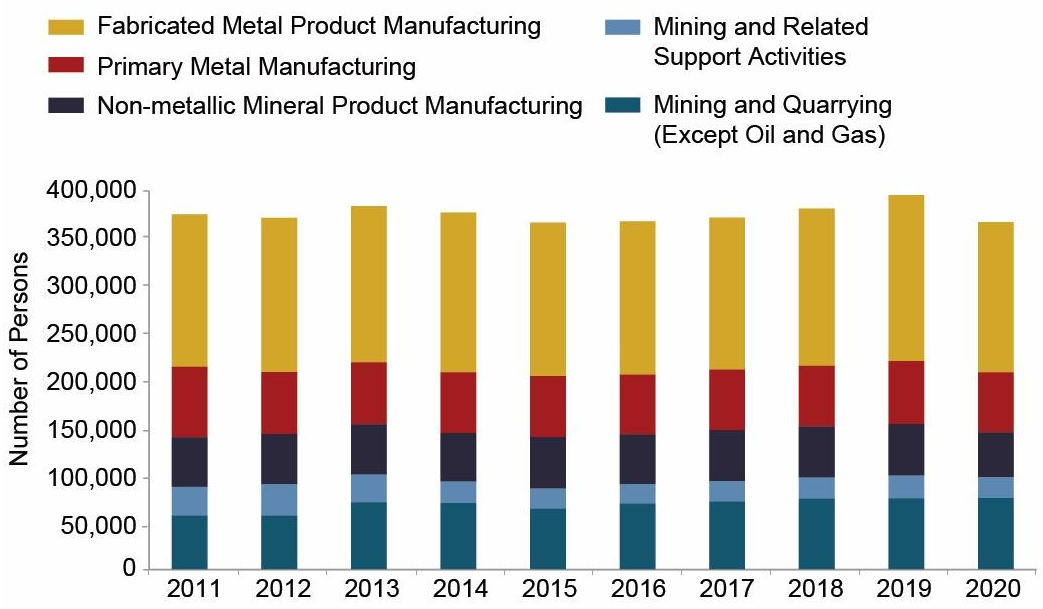
[42] The total annual compensation per job for the minerals sector is a weighted average of NAICS 212 – mining and quarrying (except oil and gas); NAICS 21311B – mining-related support activities; NAICS 327 – non-metallic mineral product manufacturing; NAICS 331 – primary metal manufacturing; and NAICS 332 – fabricated metal product manufacturing.

[43] Statistics Canada's Labour Statistics within the Canadian System of National Accounts provides aggregated data for NAICS 213117 – contract drilling (except oil and gas) and NAICS 213119 – other support activities for mining, which taken together, comprise activities related to mineral exploration and development.

[44] Daly, Mary C., et al., 2014, *Interpreting Deviations from Okun's Law*, Federal Reserve Bank of San Francisco: Economic Letters, http://www.frbsf.org/economic-research/publications/economic-letter/2014/april/okun-law-deviation-unemployment-recession/.

the decrease in employment in the wider economy in 2020 due to the COVID-19 pandemic, which fell by 9.4% between 2019 and 2020 (Figure 19).

Figure 19: Mining, Mining-Related Support Activities, and Mineral Processing Employment, 2011-20



The recent employment decline in the minerals sector is concentrated in the support activities and downstream manufacturing sections. The largest percent decrease is found in the support activities subsector, which dropped by 27.5%. This equates to a total of 8,285 lost jobs. Downstream manufacturing saw the largest number of jobs lost, losing 18,445 jobs between 2011 and 2020, a decrease of 6.4%. Within the downstream manufacturing subsectors, the primary metal manufacturing subsector saw the largest percent decrease of 15%. Smaller declines occurred in the non-metallic mineral product manufacturing and the fabricated metal product manufacturing subsections, which dropped by 9.0% and 1.6% respectively. Counter to the general trend, employment growth of 32.8% was observed in the mining and quarrying subsector, up to 74,450 jobs in 2020 from 56,045 in 2011.

These types of fluctuations are generally the result of a number of factors influencing the mining and other associated sectors and subsectors such as volatile commodity prices, market cycles, and global economic trends. These factors can lead to the opening and closing of mines and plants, which will affect employment. Certainly, the COVID-19 pandemic has had a major impact on employment in the minerals sector for the last years described by this report.

Compensation in the minerals sector remains among the most lucrative in the Canadian economy. As of 2020, the national average for all industries was $68,759. The average for the minerals sector was $106,177, which is 54.4% higher than the national average. Since 2011, compensation has risen by 16.6% and has been on an upward trend year-over-year during this decade with the exception of 2016 when it fell by 2.1%.

The Canadian Mining Labour Market 10-year Outlook 2020 produced by the Mining Industry Human Resources Council (MiHR) estimates that the mining sector in Canada will need approximately

79,680 new workers over the next decade in a baseline market status scenario.[45] This number rises to 113,130 in an increasing scenario and drops to 49,880 in a decreasing scenario. It is expected that the number of people retiring from this industry will account for the majority of new hiring needs. Projections indicate that the largest hiring gap is expected to occur in the extraction and milling subsector. In occupational categories, the largest gaps are in supervisors, coordinators, superintendents, and support workers. In addition, with advances in technology and the move towards zero emissions, there will be an increased need for personnel with advanced science, technology, engineering and mathematics (STEM) expertise. However, the number of new students enrolling in mining engineering at the undergraduate level fell by 33% from 2015 to 2019, which is among the highest drops for engineering program streams.[46]

Efforts are needed to account for these employment gaps. The Mining Association of Canada's *Facts and Figures 2021* report detailed four strategies to aid these efforts:[47]

- Promote the industry to women, youth, Indigenous people and non-traditional worker groups
- Develop programs that bring back retired workers, retain older workers and increase mentoring
- Improve educational programs and employer-provided training
- Introduce standards for key occupations to facilitate domestic worker mobility and skills recognition

Data Considerations

Data are from Statistics Canada and are Labour statistics consistent with the System of National Accounts (SNA). This dataset reconciles information from the Survey of Employment Payroll and Hours and the Labour Force Survey (LFS), along with information from the Census and administrative data sources (i.e., Canada Revenue Agency T4 tax slips). This allows for the capture of such categories as self-employment, which in turn allows for a more complete employment value estimate.

[45] MiHR's definition of the mining industry excludes certain aspects of downstream manufacturing and indirect employment. Consequently, MiHR's employment estimates tend to be lower.
[46] Mining Industry Human Resources Council, 2021, *Mining Year in Review: National Outlook 2021,* https://mihr.ca/wp-content/uploads/2021/03/MIHR-National-Outlook-LMI-Report-2021-E-web.pdf
[47] The Mining Association of Canada, 2022, *Facts and Figures 2021*, https://mining.ca/download/36715/

This dataset also disaggregates industry categories in a manner that enables the reporting of employment for the mining-related support activities subsector, which includes mineral exploration activities and contract drilling. It is important to note that this industry category is not inclusive of all mineral exploration employment since it does not capture the numerous professional services (i.e., geological, financial, legal) contracted by the mineral exploration industry, which are classified to other industries.

Indigenous Employment

Highlights

- For the period of 2011 to 2020, indigenous employment accounted for an average of 7.6% of the employment in the mining industry and 3.6% in the broader minerals sector. Comparatively, Indigenous employment accounted for an average of 3.0% of the total employment in all industries for the same period.
- Indigenous employment in the mining industry increased from 6.3% in 2011 to a peak of 9.6% in 2019, but receded to 7.6% in 2020. The decline in 2020 is likely attributable to the COVID-19 pandemic.
- In 2020, just under half of Indigenous employment was concentrated in the mining and quarrying subsector (42.5%), down from 48.4% in 2011.
- Census 2016 results indicated 21.3% higher Indigenous employment in the minerals industry compared to 2016 Labour Force data.

Definition

The Labour Force Survey (LFS) measures the Indigenous population using the concept of Indigenous identity. A person has an Indigenous identity if he or she reports as identifying with at least one Indigenous group, for example, North American Indian (First Nations person), Métis, or Inuit. This is based on the individual's own perception of his/her Indigenous identity.[48]

Rationale

Governments and the minerals sector have recognized the value of attracting and retaining Indigenous participation in the sector's labour force. Potential for increased Indigenous employment remains strong. The Indigenous population in Canada is younger and growing at a faster rate than the general population. With a number of producing mines and exploration properties located within 200 km of Indigenous communities, Indigenous peoples across the country are ideally positioned to access employment opportunities and other benefits in the mining industry. In addition, providing training and

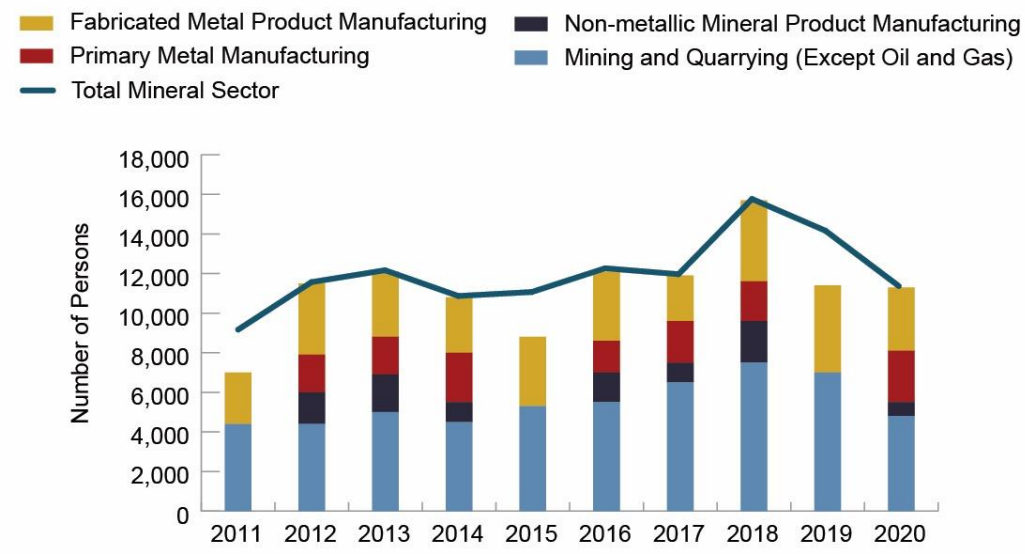
[48] https://www150.statcan.gc.ca/n1/pub/71-543-g/71-543-g2020001-eng.htm

transferable skills development is an important element of economic reconciliation and may lead to greater labour market participation for Indigenous peoples.

Analysis

The numbers of Indigenous peoples employed in the minerals sector fluctuated considerably between 2011 and 2020, with the lowest number in 2011 at 9,100 before climbing again in successive years, with some variation, to reach a 10-year high of 15,700 in 2018 (Figure 20). Note that employment data for the primary metal manufacturing and non-metallic mineral product manufacturing subsectors was not available for 2011, 2015, and 2019. The minerals sector saw the largest growth rates from 2017 to 2018, increasing by 31.9%. Employment levels dropped sharply in 2019 and 2020. Employment decreased by 19.9% to 11,300 in 2020 as the sector was impacted by COVID-19 disruptions.

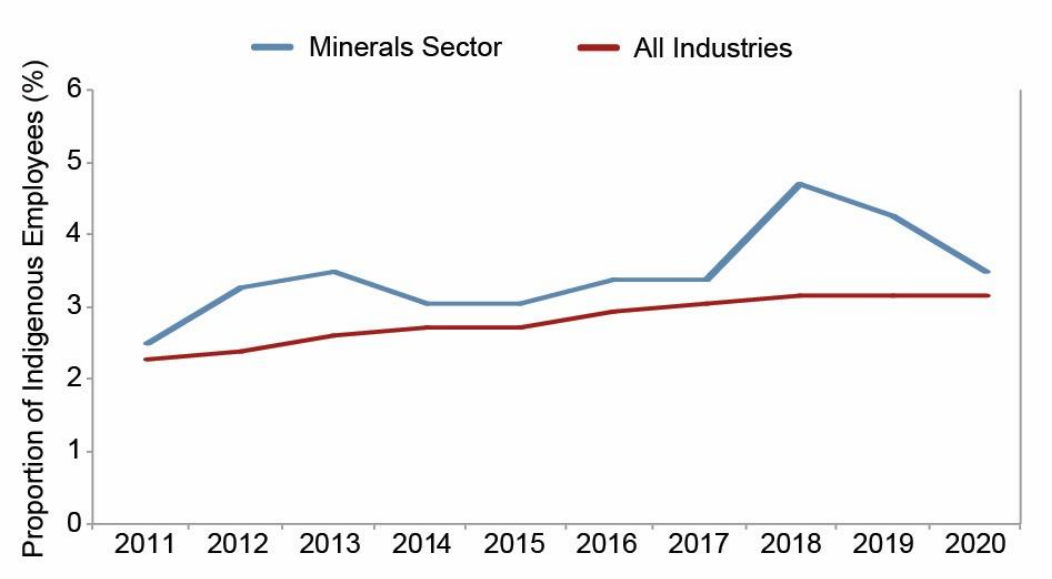
Figure 20: Minerals Sector Indigenous Employment, 2011-20



Source: Statistics Canada.

The proportion of Indigenous individuals working in the minerals sector also fluctuated between 2011 and 2020, but experienced an overall increase from 2.7% of the sector workforce in 2011 to 3.3% in 2020 (Figure 21). The 2.7% proportion in 2011 also represents the 10-year low in terms of proportion of Indigenous individuals working in the sector. The proportion experienced some growth after 2011 towards a value of 3.4% in 2017 before a steep increase to 4.4% in 2018. A decrease in Indigenous individuals as a percent of total individuals employed in the minerals sector was seen after 2018, reaching 3.8% in 2019 and then 3.3% in 2020.

Figure 21: Indigenous Individuals as Percent of Total Employees in the Minerals Sector and all industries, 2011-20



Source: Statistics Canada.

In 2020, Indigenous employment in the minerals sector was mostly concentrated in the mining and quarrying subsector, representing 42.5% of total Indigenous mineral industry employment, down from 48.4% in 2008. The 24.2% increase in total sector employment between 2011 and 2020 was largely due to increases in fabricated metal product manufacturing and primary metal manufacturing employment. Employment increases in these two subsectors were partially offset by a decrease in employment in the mining and quarrying and non-metallic mineral product manufacturing subsectors.

Box 12: Indigenous Skills Training and Participation in Mining

Indigenous Peoples, businesses, and communities are fundamentally linked to the competitiveness and sustainability of Canada's minerals sector. Indigenous participation and the inclusion of local and Traditional Indigenous Knowledge improves project design and certainty around land-use and land access, and reduces investor risk. Participation also helps to create a more positive and predictable climate for investment. Below is a list and description of some of the initiatives that work towards expanding economic and social benefits for Indigenous communities through skills development and training.

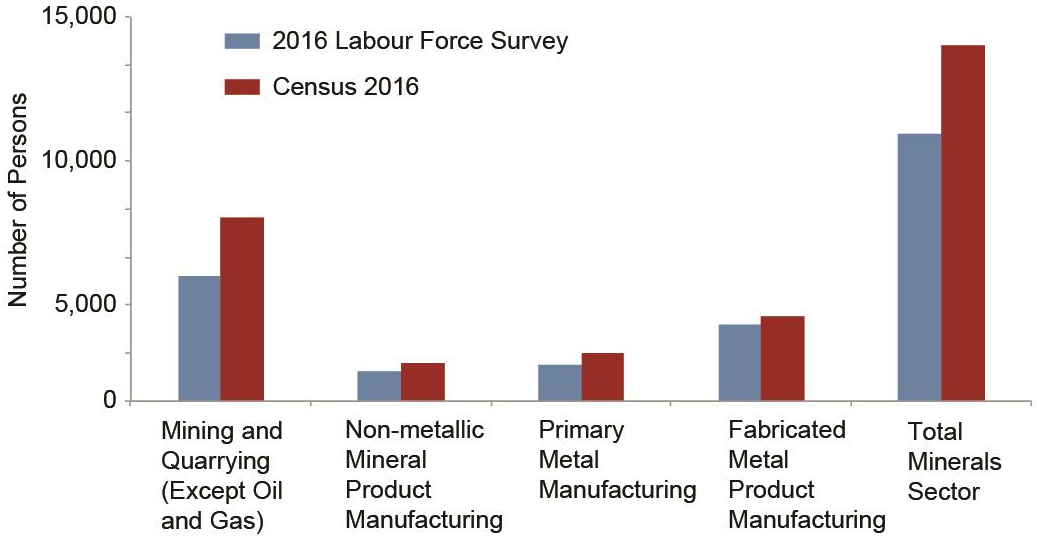
- **Council for the Advancement of Native Development Officers (Cando)** – A national Indigenous organization involved in community economic development. Cando is working with the Canadian Minerals and Metals Plan (CMMP) Secretariat at Natural Resources Canada to deliver mining webinars educating Indigenous land managers, Economic Development Officers, and community leadership on the mining lifecycle and Indigenous procurement in the mining industry.

- **The Mining Industry Human Resources Council (MiHR)** – An independent, non-profit organization that leads collaboration among mining stakeholders to identify and address human resource and labour market challenges facing the industry. They offer training and certification programs including Mining Essentials, a pre-employment skills training program for Indigenous peoples looking to work in the mining industry, and online Indigenous Awareness Training geared towards employees and industry stakeholders to build understanding and respectful relationships across cultures to support reconciliation in communities, the mining workplace and supply chains.
- **Mining Matters** - A charitable organization supported by government, foundation grants, and donations from corporations and individuals. They travel to communities across Canada to deliver a range of programs in earth sciences and the mining and exploration sectors. They offer educator workshops, camp and school programs, and community engagement events, while emphasizing the important role that Indigenous communities play in resource stewardship, management and development.
- **Waubetek Centre of Excellence for Indigenous Minerals Development** – A learning and research hub (still under development at the time of writing) for First Nations- and Indigenous-owned businesses in North America. It works to share knowledge on opportunities, risks, and best practices in minerals development.
- **NORCAT** – A leader in skilled labour training and development in mining technology and innovation. It offers skilled labour training and development programs, services, and resources designed to enhance the productivity and safety of workers in the mining industry.
- **Canadian Institute of Mining, Metallurgy and Petroleum (CIM**) – The leading not-for-profit technical society of professionals in the Canadian minerals, metals, materials, and energy industries. They offer professional development courses for workers in the mining industry.
- **Mine Training Society Northwest Territories** – A unique partnership between Indigenous governments, public government, and the mining industry in the Northwest Territories. Their mission is to support Indigenous people and Northerners in finding long-term mining employment through training programs and career support.
- **B.C. Centre of Training Excellence in Mining (CTEM)** – A virtual hub facilitating collaborative and innovative training solutions for the industry and B.C. communities. It helps industry, students, communities, and trainers meet their employment needs by determining industry skills requirements, facilitating training, and supporting partners. It is funded through grants from the government of British Columbia with additional support from partners.
- **Technical colleges** across Canada also offer programs, certificates, and diplomas in mining training.
- **The First Nations Major Projects Coalition (FNMPC)** – A collective group of First Nations, both elected and hereditary, who have made the decision to come together to advance their shared interests of gaining ownership in the major projects taking place in their territories.

This report compares employment data for 2016 according to the LFS to same year data from Statistics Canada's Census 2016 as census data is collected and released every five years. Census 2021 data is scheduled to be released in November 2022. The Census data is considered more accurate than the LFS and is available at higher levels of detail or granularity with a trade-off of less frequent publication of new data.

As seen in Figure 22, Census 2016 indicates total minerals sector employment of 14,800 or 21.3% higher than the 12,200 calculated by the LFS. Subsector employment results for 2016 are similarly higher for the Census, ranging from 1.0% (fabricated metal product manufacturing) to 38.9% (mining and quarrying (except oil and gas)) greater than LFS data. The reasons for this difference are described in the *Data Considerations* section below.

Figure 22: Comparison of Census and LFS Minerals Sector Indigenous Employment Results, 2016



Source: Statistics Canada.

Data Considerations

The Indigenous employment numbers presented in this section are sourced from Statistics Canada's Labour Force Survey (LFS). National Labour Force Survey estimates are derived using the results of the LFS in the provinces. Territorial LFS results are not included in the national estimates, but are published separately.[49] Specifically, while the LFS calculates employment for Canada's three territories and includes Indigenous identity questions, it employs a different methodology than that used for the provinces. The LFS excludes persons living on reserves and settlements. As such, the data included in this section are not comprehensive and may underestimate the number of Indigenous individuals employed in the minerals sector. Some data was suppressed for reasons of privacy and so breakdowns of employee numbers were not available for certain subsectors (Figure 20).

[49] https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3701

Gender Diversity

Highlights

- The number of women employed in the minerals sector totalled 47,600 in 2020, a decrease of 5,200 employees from its 2011 level. However, the proportion of women employed in the sector has remained relatively consistent, declining less than one percent over the same period.
- In the mining and quarrying (excluding oil & gas) subsector, the number of women in the workforce has increased from 8,700 to 9,400 from 2011 to 2020. The percentage of women employed in the subsector has also increased from 12% to 15%.
- The wage gap between men and women in the mining and quarrying subsector (excluding oil & gas) narrowed to 2% in 2020, from a peak of 15% in 2012.
- Additional progress is required and efforts are underway to reduce the barriers for women's recruitment, retention, and career advancement in the minerals sector. Current conversations are looking beyond diversity towards equity, inclusion, and accessibility.

Definition

Gender diversity is equitable or fair representation of people of different genders. It most commonly refers to an equitable ratio of men and women, but may also include people of non-binary genders.[50]

Rationale

Gender diversity is a key measure of the minerals sector's social performance. Higher participation rates of women in the workforce has multiple positive socio-economic impacts including poverty reduction, and positive effects on health and child development. Low employment levels for women can have a negative impact on economic growth and gender equality.

Several studies have identified positive correlations between the proportion of women employed at all levels of an organization and better organizational performance,[51] as well as positive correlations between gender diversity on boards of directors and in senior executive positions and better financial performance,[52] decision-making[53] and governance.[54] Furthermore, research shows that lack of gender

[50] Sharon E. Sytsma (2 February 2006). Ethics and Intersex. Springer Science & Business Media. pp. 38–. ISBN 978-1-4020-4313-0.
[51] Women in Mining Canada. 2010. *Ramp-UP: A Study on the Status of Women in Canada's Mining and Exploration Sector*, http://0101.nccdn.net/1_5/1f2/13b/0cb/RAMP-UP-Report.pdf
[52] See: WIM (UK) and pwc. 2015. *Mining for Talent 2015: A Review of Women on Boards in the Mining Industry 2012 – 2014*, www.pwc.co.uk/industries/mining/insights/mining-for-talent-2015.html
[53] See: Women in Mining Canada. 2016. Welcoming to Women. An Action Plan for Canada's Mining Employers, http://wimcanada.org/wp-content/uploads/2017/01/WIM-NAP-book-full.pdf
[54] See: Hunt, Vivian; et al. 2018. *Delivering through Diversity*. Mckinsey & Company, https://www.mckinsey.com/~/media/mckinsey/business%20functions/organization/our%20insights/delivering%20through%20diversity/delivering-through-diversity_full-report.ashx; Hunt, Vivian, et. al., 2015, *Why Diversity Matters*, France: McKinsey & Company, https://www.mckinsey.com/~/media/mckinsey/business%20functions/organization/our%20insights/why%20diversity%20matters/diversity%20matters.ashx.

diversity could have an impact on a firm's productivity and profitability. Companies in the lowest quartile of measures on gender diversity are more likely to underperform their industry peers on profitability.[55] Research also suggests that more women in mining jobs improves health and safety outcomes and reduces wear and tear on equipment and related costs.[56]

Qualitative research on women's employment in natural resources sectors suggests that establishing a 30% critical mass of women in executive roles and board representation is essential to establish supportive institutional environments.[57]

Challenges and barriers remain in order to recruit and retain women in mining. McKinsey & Company released a report in 2021, on *Why women are leaving the mining industry and what mining companies can do about it.*[58] The report, which was based on a survey that received 1,000 response across 52 countries, found that the principal reasons for women leaving the mining industry are feeling that work is no longer intellectually challenging and that there are fewer advancement opportunities than there are for their male colleagues. Women who return to school to further their expertise feel that their academic skills are underutilized and undervalued, negating their investment in advanced education. Women are most likely to be uncertain about leaving or planning to leave the industry before they reach middle management, while resignations are more prevalent among technical and senior manager roles, as well as consultants. Therefore, early support in women's careers can be critical to increasing diversity in the sector.

Box 13: Equity, Diversity and Inclusion in the Mining Industry

The Canadian mining industry faces an equity, diversity, and inclusion (EDI) challenge. Women and visible minorities account for disproportionately small parts of the mining workforce with research showing additional barriers to entry for Indigenous women. The Mining Industry Human Resources Council (MiHR) found that women do not have positive perceptions of mining as an inclusive industry.[59]

The inclusion concept goes beyond gender parity. For the mining workforce to be truly inclusive, resources and investments are necessary to ensure hiring practices are representative of all individuals regardless of race, ethnicity, sex, age, disability, sexual orientation, or gender expression – from entry-level to management positions.

[55] Hunt, Vivian; et al. 2018. *Delivering through Diversity*. Mckinsey & Company.
[56] Welcoming to Women: An Action Plan for Canada's Mining Employers, Women in Mining Canada, 2016
[57] Baruah, Bipasha. (2018). *Barriers and Opportunities for Women's Employment in Natural Resources Industries in Canada.*
[58] McKinsey & Company (2021). Why women are leaving the mining industry and what mining companies can do about it.
[59] *Gender Equity in Mining Works: Case Study Report*, Mining Industry Human Resources Council, 2018

Companies increase the talent levels and different perspectives that can drive innovation and market disruption by supporting an inclusive and diverse workforce.[60] Better EDI outcomes are directly linked to higher economic performance due to an increase in accountability, oversight, and the implementation of best governance practices. [61] Top quartile organizations in racial and ethnic diversity are 35% more likely to have financial returns above their national industry medians.[62] Companies with diverse workforces benefit from lower debt levels, encourage stricter adherence to health and safety protocols leading to increased productivity, and record more satisfied employees.[63, 64]

Canadian governments, the mining industry, and the mining supply and services sector are making progress in EDI in mining through several initiatives, including:

- The Mining Association of Canada (MAC) and its members issued a formal statement in 2020 encompassing several actions focused on ensuring discrimination, racism, and sexism have no part in Canada's minerals sector. MAC's Towards Sustainable Mining program implements updated standards on Indigenous and Community Relationships to ensure management and employees receive training in intercultural competency, conflict resolution, human rights, and anti-racism.[65]
- The Mining Industry Human Resources Council (MiHR) offers the Gender Equity in Mining Works (GEM Works) program, which provides organizations with proven and industry-developed tools to help eliminate systemic barriers to gender inclusion in the workplace.[66] They also offer Mining Potential, a work readiness skills training program for women, youth and newcomers; online Intercultural Awareness Training focused on the value of inclusive and diverse workplaces to help drive organizational change; and the new Safe Workplaces For All project focused on research, design, and evaluation of public legal education and information (PLEI) materials to build sector capacity to support company knowledge of, and response to, workplace sexual harassment and violence.
- Under the Communities strategic direction of the Canadian Minerals and Metals Plan (CMMP), the Canadian government works collaboratively with provinces and territories, industry, Indigenous Peoples, academia, and other stakeholders to increase diversity within the mining industry and towards a target of women making up 30% of the mining workforce by 2030.[67]

[60] *Unleashing the Power of Inclusion: Attracting and Engaging the Evolving Workforce*. Deloitte, 2017.
[61] *Welcoming to Women: An Action Plan for Canada's Mining Employers*. Women in Mining Canada, 2016.
[62] *Diversity Matters*, McKinsey & Company, 2014.
[63] Credit Suisse Research Institute, 2012.
[64] *Welcoming to Women: An Action Plan for Canada's Mining Employers*. Women in Mining Canada, 2016.
[65] https://mining.ca/towards-sustainable-mining/
[66] https://mihr.ca/inclusion-diversity/gender-equity-in-mining-works-gem-works/
[67] https://www.minescanada.ca/en

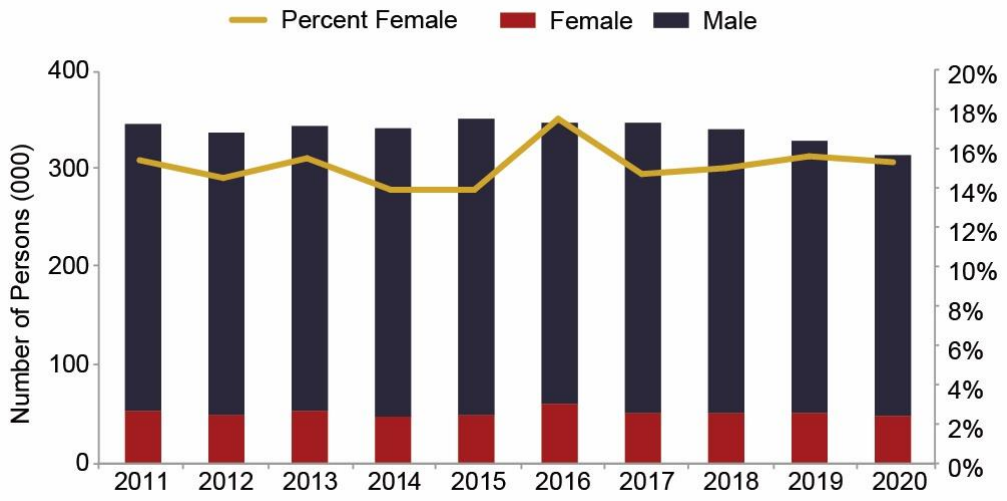
- The Prospectors and Developers Association of Canada (PDAC) released *Gender Diversity and Inclusion: A Guide for Explorers*, which provides information and tools for exploration and mining companies that are new to understanding issues and efforts related to gender, diversity, and inclusion.[68]

Organizations including Women in Mining Canada and Aboriginal Women in Mining offer evidence-based and gender-specific job readiness programs and resource toolkits designed to reduce barriers and increase representation.

Analysis

Figure 23 shows employment trends by gender for the total minerals sector from 2011 to 2020.[69] This sector comprises four subsectors under the North American Industry Classification System (NAICS 2012): mining and quarrying (excluding oil & gas), non-metallic mineral manufacturing, primary metal manufacturing, and fabricated metal product manufacturing.

Figure 23: Minerals Sector Employment by Gender, 2011-20



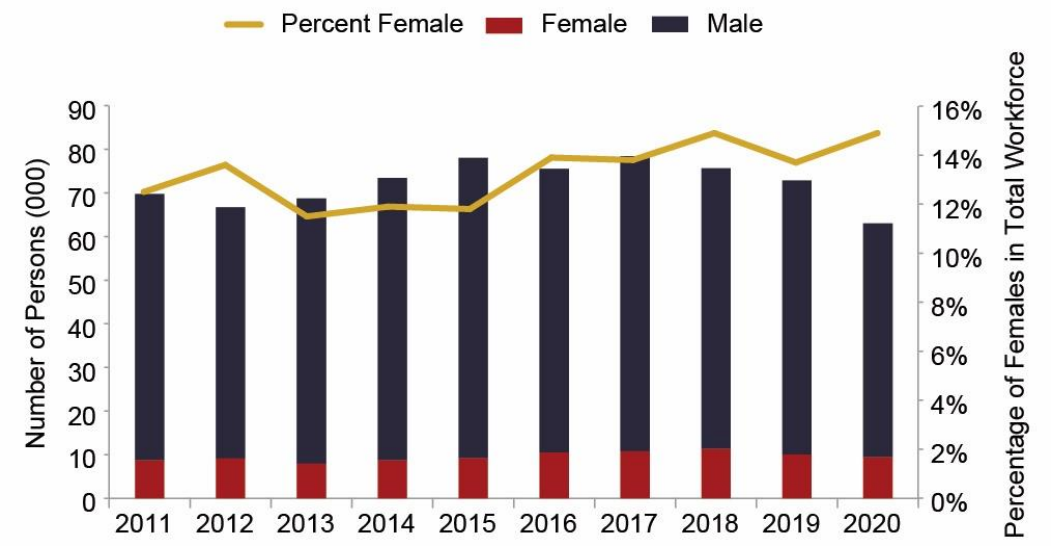
Source: Statistics Canada.

The total number of women employed in the minerals sector declined over the 10-year period shown, from 52,800 in 2011 to 47,600 in 2020, with a peak in 2016 of 60,000. However, the proportion of women employed in the sector remained stable in this period, which indicates the decline in women's employment in the sector was consistent with the general trend of declining employment overall.

Focusing on the mining and quarrying subsector (excluding oil & gas), the number of women employed rose from 8,700 in 2011 to 9,400 employees in 2020 representing an 8.0% increase. Figure 24 shows the employment trends by gender for this subsector.

[68] https://www.pdac.ca/priorities/responsible-exploration/diversity-and-inclusion/gender-diversity-and-inclusion-guidance-document
[69] Statistics Canada's custom tabulation for gender employment in the minerals sector.

Figure 24: Mining and Quarrying (Excluding Oil and Gas) Employment, by Gender, 2011-20



Source: Statistics Canada.

The proportion of women employed in the mining and quarrying (excluding oil & gas) subsector started at 12.5% in 2011, with a steady increase that reached 15% in 2020. Due to the smaller sample size, the variability in this figure is higher than that of the total minerals sector, which is explained further in the data considerations section below.

Relative to most other sectors of the Canadian economy, the minerals sector as a whole had a lower participation of women in the workforce throughout the reference period. In comparison, women consistently represented around 47% of the all industries total workforce in the 2011-2020. Furthermore, women represented 13% of the labour force in construction, 21% in forestry and logging, 28% in utilities and 28% in manufacturing in 2020.

With respect to senior management positions, the minerals industry continues to rank in the lowest quartile for the number of women as directors and executive officers. There was little change in the number of women directors in the mining industries. In 2020 and 2021, 18% and 19% of directors were women in the mining industry, respectively.[70] This is a notable increase from 2017,[71] in which 9% of directors were women. Between 2016 and 2017, the percentage of women executive officers in mining companies remained at 13%, and the percentage of women on the boards of mining companies declined from 13% to 9%.[72] Between 2020 and 2021, the percentage of women executive officers in mining companies grew marginally from 14% to 15%.[73]

[70] MacDougall, A. et al. (2021). Report: 2021 Diversity Disclosure Practices – Diversity and leadership at Canadian public companies. Osler, Hoskin & Harcourt LLP.

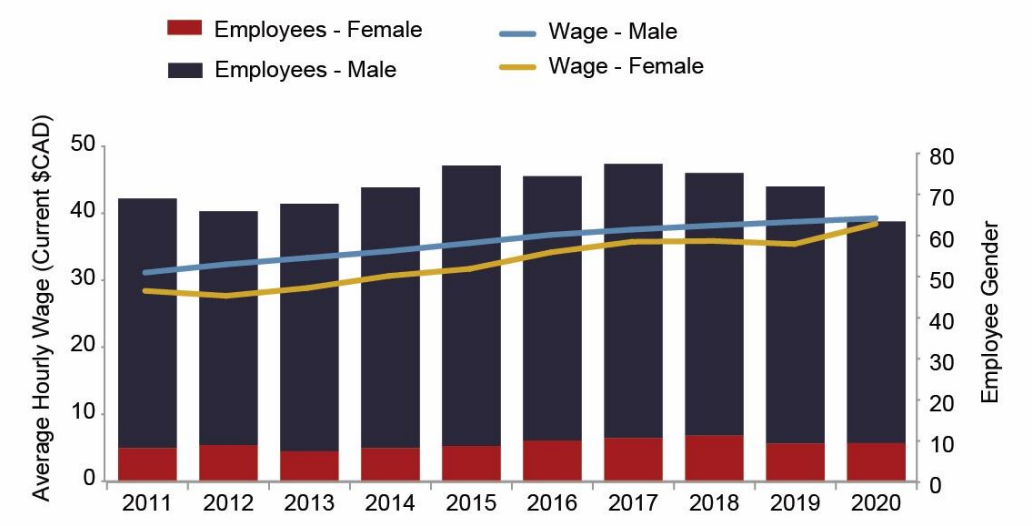
[71] Since 2014, Canadian provinces and territories (except Alberta, Prince Edward Island and Yukon) introduced "comply or explain" legislation requiring publicly traded companies to report on their gender diversity policies and the representation of women in board or senior executive positions (Baruah, Bipasha. (2018). *Barriers and Opportunities for Women's Employment in Natural Resources Industries in Canada).*

[72] MacDougall, A. et al. (2018). *Diversity Disclosure Practices: Women in leadership roles at TSX-listed companies.* Osler, Hoskin & Harcourt LLP.

[73] MacDougall, A. et al. (2021). Report: 2021 Diversity Disclosure Practices – Diversity and leadership at Canadian public companies. Osler, Hoskin & Harcourt LLP.

Data suggests that progress was made in terms of narrowing the pay gap between men and women in Canada's mining industry. Figure 25 shows that the wage gap between men and women in the mining and quarrying subsector (excluding oil & gas) narrowed to 2% in 2020, from a peak of 15% in 2012.

Figure 25: Mining & Quarrying (Excluding Oil & Gas) Employment and Wages, by Gender, 2011-20



Source: Statistics Canada.

Despite progress in some areas, gender diversity and violence issues persist. The Pauktuutit Inuit Women of Canada's 2021 report, *Addressing Inuit Women's Economic Security and Prosperity in the Resource Extraction Industry,* shed light on workplace sexual harassment and violence experienced by Inuit women in Canadian mines in the north.[74] The study also found that Inuit women are often supporting large households with salaries that are lower than men and non-Indigenous women. The report identified that Inuit women want to work in the industry, but actions are needed to improve parity and safety. Violence can have long-lasting and negative health, social and economic effects that span generations, which can lead to cycles of violence and abuse within families and communities.[75]

Additional progress is required and efforts are underway to reduce the barriers for women's recruitment, retention, and career advancement to achieve a more diverse workforce in the sector.

Governments, industry and other stakeholders are responding to diversity challenges through actions to pursue gender equality, increase the number of women and visible minorities in the mining sector, and advance Indigenous participation. Improving outcomes for underrepresented groups at mine sites will depend on sustained efforts from industry, including the Mining Association of Canada's ongoing work to develop mandatory equity, diversity, and inclusion requirements for its members in the Towards Sustainable Mining (TSM) program.

A number of organizations, such as the Mining Industry Human Resources Council (MiHR), Women who Rock, and Women in Mining Canada (WIMC), are making efforts to increase career awareness to attract

[74] Pauktuutit Inuit women in Canada. (2021) https://www.pauktuutit.ca/project/addressing-inuit-womens-economic-security-and-prosperity-in-the-resource-extraction-industry/.
[75] Natural Resources Canada. (2021) Joint Declaration for a Canada free of Gender-Based Violence (GBV).

women to the industry, particularly in the Science-Technology-Engineering-Mathematics (STEM) fields. They are also working to change workplace culture to retain female talent and to create mentorship and networking opportunities to support the advancement of female employees.

In 2016, WIMC, with the support of Status of Women Canada, developed the National Action Plan for Canada's Mining Employers.[76] The Plan was informed by leading mining organizations that established a Gender Advisory Committee. It is a resource for employers to transform their workplaces and industry to include women in the workplace and achieve new business benefits. To date, it represents Canada's most comprehensive gender diversity framework for the mining sector, includes a thorough analysis of challenges, and recommends strategies to overcome them and steps to implement change.

Other organizations are seeking to close the gap in gender-disaggregated data in the industry. In 2021, the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development announced their Women and Mine of the Future (WMF) Project. It will establish a baseline in select countries (including Canada) on the gender of workers in large-scale mining. It will also assess impacts of global trends for women in mines and supply chains; assess gaps and challenges preventing participation of women in mining and supply chains; and provide guidance and technical support to address gender inequality and harness opportunities for women in mining across the value chains.[77]

In partnership with provinces, territories, Indigenous Peoples, non-government organizations, and industry, Natural Resources Canada has developed the Canadian Minerals and Metals Plan (CMMP), aiming to make Canada the world's leading mining nation. The CMMP has set an aspirational target of 30% women in the mining sector by 2030 and is supporting several initiatives to help mobilize a more diverse and inclusive exploration and mining sector and achieve this target. They include:

- The Prospector's and Developers Association of Canada's Gender Diversity and Inclusion: A Guide for Explorers, released in 2019 to help companies understand issues and implement efforts related to gender, diversity and inclusion.
- The Canadians of Mining campaign to highlight the variety of individuals and career opportunities in the mining sector with the view of attracting more women.
- Mining workshops to raise awareness of gender equity issues and a mining career awareness strategy in partnership with the Mining Industry Human Resources Council.
- Increasing Indigenous procurement and business activities, so Indigenous Peoples, especially Indigenous women, can play a bigger role in the mining services and supply sector.
- Provincial and territorial support for non-profit initiatives focused on women in mining (e.g., Yukon and Saskatchewan).

The CMMP and subsequent Action Plans provide targets and identify ongoing and future initiatives that further develop and enhance the opportunities for women in the Canadian minerals sector.

[76] Women in Mining Canada. (2017) WIM Canada National Action Plan.
[77] Dischinger, Barbara. (2021) Establishing Baseline Data for Women and Mine of the Future. Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development.

Data Considerations

Data for this section was obtained from Statistics Canada using a custom data filter on the Labour Force Survey (LFS) in order to disaggregate employment in the mining industry from the oil & gas sector. The LFS estimates are based on a sample drawn from the Canadian labour force and the results are therefore subject to sampling variability. As a result, estimates for smaller sectors and subsectors drawn from the LFS can display a higher degree of variability than the numbers drawn from the survey overall.

Agreements between Mineral Companies and Indigenous Communities or Groups

Highlights

- More than 260 new agreements were signed in Canada between 2011 and 2020.
- On average, slightly more agreements were signed during exploration stages of projects compared to following stages.
- There were 412 active agreements in place in Canada as of December 31, 2020.

Definition

Agreements between mining companies and Indigenous communities or groups have become common practice in Canada. These legally binding agreements can set out the terms for how a company and community will work together and establish a framework for cooperation and collaboration and are separate and distinct from treaty agreements with provincial and territorial governments or the Government of Canada (Box 14) ("government agreements"). While early agreements were more transactional in nature, modern agreements go beyond financial payments to also compensate for potential adverse impacts of any mining activity or project on a territory with a recognized right or credible claim. These agreements, treaties, or arrangements with various terms and conditions on mining development, as well as agreements with mining companies, have become a means of facilitating the participation or collaboration of Indigenous communities in the mining sector. These agreements are generally confidential and can be implemented at any stage of the mine development process. Each agreement is unique and reflects the needs and interests of the community, the circumstances of the mining activity, and does not supersede any other obligations to communities. The quality, depth, and number of active participants of each agreement also varies.

Box 14: Treaties with Indigenous Peoples

Treaties between the Crown (represented by the Government of Canada and the provincial or territorial government) and Indigenous groups are solemn agreements that set out promises, obligations, and benefits for all involved parties.[78] Aboriginal and treaty rights are recognized and affirmed in Section 35 of the *Constitution Act*, 1982. They are a key part of the *United Nations Declaration on the Rights of Indigenous Peoples*, which is being implemented by the Government of Canada and some provincial and territorial governments. There are 70 historic treaties with First Nations and approximately 25 modern treaties with Indigenous groups in Canada. Some of these treaties include self-government among other components and may include provisions for resource opportunities and participation in land and resource management decisions.

Agreements with mining companies are usually negotiated privately between the parties involved and their provisions are confidential. Typically, agreements contain provisions for employment and training, business opportunities through set-aside contracts and joint ventures, social and cultural considerations, environmental monitoring, profit sharing, and other provisions. These can be negotiated at multiple stages of the mineral development sequence (i.e., from exploration to mine development) and can be revisited as a project advances.

Rationale

Signed agreements between mining companies and Indigenous communities or groups at the exploration and development stages (i.e., construction, operation, closure, post-closure) play an important role in shaping the terms by which mineral activity can occur within the traditional territory of an Indigenous group and when such activities may have an impact on Indigenous or treaty rights.

Partnerships between mining companies and Indigenous communities have become the preferred practice for mining companies operating in Canada. They provide exploration and mining proponents with increased certainty through a framework and tools for socio-economic engagement and meaningful relationships with Indigenous communities. Failure to reach an agreement, or the lack of one, can have negative implications for project development, the viability of an exploration or extraction company, socio-economic opportunities for local communities and their residents, and the promotion and maintenance of meaningful relationships with communities.

Analysis

More than 260 agreements were signed in Canada between 2011 and 2020. The total number of agreements signed between 2011 and 2020 was greater than in the preceding 10-year period (264 agreements for 2011-2020 compared to 232 for 2001-2010). This is especially notable given there were only nine agreements signed in 2020, representing a 10-year low. The impact of the COVID-19

[78] https://www.rcaanc-cirnac.gc.ca/eng/1100100028574/1529354437231

pandemic on the mining industry may be the cause of the low numbers of agreements in 2020 between mine developers and Indigenous communities.

There was a clear trend of decreasing numbers of agreements in Canada for the 2011-2020 period. A peak of 49 newly signed agreements per year occurred in 2012 and 2013, but was followed by a decreasing trend towards the 10-year low of nine agreements in 2020.

It should be noted that not all signed agreements remain active indefinitely. Replacement agreements are signed, operations can end, or a decision is made to end the agreement. As of December 31, 2020, there were 412 active agreements in place throughout Canada. Ontario had the highest number of active agreements as of 2020 at 137 agreements or 33% of the total for Canada. British Columbia had 93 active agreements or 23% of the total.

On average during the 2011-2020 period, 52% of agreements were signed at the exploration stage compared to 48% in the post-exploration stage. Exploration stage agreements ranged between five and 30 per year between 2011 and 2020 while post-exploration agreements ranged from four to 25 over the same period. The number of exploration stage agreements were almost three times higher than post-exploration agreements in 2015.

Natural Resources Canada has produced and distributed guides, toolkits, and information products to promote partnership and dialogue among Indigenous communities, the mineral industry, and governments to promote mutual understanding and benefits. These are available online.[79] As the provinces and territories are responsible for natural resource development within their jurisdictions, they have also produced documentation for mining companies based on their own legal and regulatory frameworks.

Data Considerations

These data were collected through a systematic search through public records, including news releases and company and community web sites. They do not include oil and gas operations and should be viewed as estimates only.

[79] https://www.nrcan.gc.ca/our-natural-resources/indigenous-natural-resources/indigenous-participation-mining-activities/indigenous-participation-mining-information-products/7817.

Funding for Public Participation in Environmental Review and Impact Assessment Processes

Highlights

- In 2019/20, the Impact Assessment Agency of Canada's (IAAC) Participant Funding Program (PFP) disbursed a total of $3,011,476. The program provided $218,455 to 33 recipients to facilitate public participation in the Impact Assessments (IA) of 17 projects and $2,793,021 to 132 recipients to facilitate Indigenous participation in IAs for 35 projects.
- A total of 52 projects were supported in 2019/20 by PFP of which 10 were related to the mining industry. These 10 mining projects received $384,693 in funding from the IAAC.
- The number of projects and groups requesting funding largely determines how much funding is provided each year and does not necessarily reflect industry performance. However, overall benefits of consultation, funding, and public participation in Impact Assessment are a positive for the minerals sector.

Definition

An Impact Assessment (IA) examines the potential positive and negative effects of a proposed project. In so doing, it considers a comprehensive list of potential factors and proposes measures to mitigate a project's adverse effects. This includes components of follow-up programs for projects that are allowed to proceed. These follow-up programs verify the accuracy of an IA and effectiveness of any mitigation measures.[80]

The Participant Funding Program (PFP), administered by the Impact Assessment Agency of Canada (IAAC),[81] is designed to support public engagement and Indigenous consultation during assessments. It provides funding at stages throughout the process and includes implementation of follow-up programs.

[80] https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/basics-of-impact-assessments.html
[81] https://www.canada.ca/en/impact-assessment-agency/services/public-participation/funding-programs/participant-funding-program.html

Box 15: The Impact Assessment Act

On August 28, 2019, the Impact Assessment Act 2019 (IAA) came into force.[82] IAA replaced the Canadian Environmental Assessment Act 2012 and created the Impact Assessment Agency of Canada (IAAC).

The IAA requires assessments that look at both positive and negative environmental, economic, social, and health impacts of potential projects.[83] This includes rules protecting the environment, fish, and waterways. IAA respects Indigenous rights and strengthens public trust in resource development decisions. It ensures projects can proceed while protecting the environment, creating jobs, and growing the Canadian economy. Major mining projects are subject to the IAA, in addition to applicable provincial processes.

The IAAC is a federal body accountable to the Minister of Environment and Climate Change. It delivers comprehensive impact assessments allowing informed decision-making on major projects and in support of sustainable development.

Canadian Environmental Assessment Act 2012	Impact Assessment Act
No early planning and engagement phase	Mandatory early planning and engagement phase. This means early dialogue with Indigenous peoples, provinces, the public, and stakeholders.
Three responsible authorities conduct environmental assessments	A single government Agency leads assessments and coordinates Crown consultations, with Indigenous peoples.
Availability, accessibility and integration of science and knowledge varies Indigenous knowledge is not consistently considered	Decisions are guided by science, evidence, and Indigenous knowledge. An open science and data platform, and plain-language summaries of facts supporting assessments. Mandatory consideration and protection of Indigenous knowledge. Federal and independent reviews of science.
Legislated timelines	Legislated but flexible timelines maintained for impact assessments and extended to the planning phase.
Environmental assessments focus only on minimizing adverse environmental effects	A basis in the principle of sustainability. Assessments include positive and negative environment, economic, social and health impacts, as well as gender-based analysis to support decision-making. Project impacts on Indigenous peoples and rights is required.
Indigenous participation in reviews driven by Duty to Consult	Engagement and participation at every stage with the aim of securing consent through recognition of Indigenous rights and interests. Indigenous governments have greater opportunities to exercise powers and duties under the Act.

[82] https://laws.justice.gc.ca/eng/acts/I-2.75/index.html
[83] https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/impact-assessment-process-overview.html

Rationale

The public's participation in the IA process helps ensure the views of Canadians are meaningfully considered in the planning of natural resource development projects. It increases the inclusion of local and Traditional Indigenous Knowledge in assessments and improves knowledge and understanding of the public's concerns and potential issues. Section 75 of the *Impact Assessment Act,* 2019 (IAA) requires that a funding program be established to facilitate the public's participation in consultation activities. [84] Funding for public participation in IAs supports an open and balanced assessment process and strengthens the quality and credibility of federal assessments.

Analysis

The PFP consists of two funding components: the Regular Funding (RF) and the Indigenous Funding (IF) streams. While RF provides financial assistance to individuals and organizations, including Indigenous groups, to participate in public participation opportunities, the IF is meant specifically for Indigenous groups and triggers the duty to consult (Box 16) from the Government of Canada for IF participation and provides funding to prepare for and participate in Indigenous consultation and participation activities.

Box 16: Duty to Consult

Depending on the province or territory involved, a variety of applications for rights, permits or authorizations may be required depending on the nature of the mining activity. However, any application for a permit, right or authorization may trigger a duty to consult. The purpose of the duty to consult and, where appropriate, accommodate is to balance the interests of Indigenous peoples with those of society and to protect the established or potential Aboriginal and treaty rights of the Indigenous peoples of Canada. [85] These rights are recognized and affirmed by section 35 of the Constitution Act, 1982. The courts have emphasized the honour of the Crown (as represented by the federal, provincial and territorial governments) as the source of the duty to consult and accommodate.

The duty to consult ultimately rests with the Crown, but it may delegate procedural aspects of that duty to industry proponents. Although mine developers are not necessarily subject to the duty to consult and accommodate Indigenous communities, they may collaborate at certain stages of the process where their presence is useful for the smooth running of the consultation and to explain technical aspects of a mining project.

[84] https://laws.justice.gc.ca/eng/acts/I-2.75/index.html
[85] https://www.rcaanc-cirnac.gc.ca/eng/1331832510888/1609421255810

The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) is a comprehensive international human rights instrument on the rights of Indigenous peoples around the world. Through 46 articles (including on lands, territories and resources) it affirms and sets out a broad range of collective and individual rights that constitute the minimum standards to protect the rights of Indigenous peoples and to contribute to their survival, dignity and well-being.[86] The Declaration references "free, prior and informed consent" (FPIC), which emphasizes the importance of recognizing and upholding the rights of Indigenous peoples and ensuring that there is effective and meaningful participation of Indigenous peoples in decisions that affect them, their communities and territories. On June 21st, 2021, the *United Nations Declaration on the Rights of Indigenous Peoples Act* received Royal Assent and became law. This Act provides a roadmap for the Crown and Indigenous peoples to work together to implement the Declaration based on lasting reconciliation, healing, and cooperative relations. Some provinces and territories are also working to align their legislation with UNDRIP principles.

The Mining Association of Canada's *Towards Sustainable Mining* (Box 18) initiative addresses the importance of the industry's commitment to ongoing engagement and respectful relationships with Indigenous communities and provides guidance for implementing them on the ground.[87] A core component of the program is the Indigenous and Community Relationships Protocol, which is designed to facilitate strong relationships through effective engagement and decision-making processes. It establishes good practice that includes striving to achieve free, prior and informed consent (FPIC) before proceeding with development where impacts to rights may occur and includes protections for cultural heritage.

In 2019/20, the Agency's PFP disbursed a total of $3,011,476. It provided $218,455 to 33 recipients to facilitate public participation in IAs of 17 projects and $2,793,021 to 132 recipients to facilitate Indigenous participation in the IAs of 35 projects. In total, there were 52 funded projects in 2019/20, 10 of which were mining related. Those 10 mining projects generated $384,693 in IA participation funding (Table 11).

[86] https://www.justice.gc.ca/eng/declaration/index.html
[87] https://mining.ca/towards-sustainable-mining/

Table 11: CEAA/IAAC Funding for Public Participation in the IA Process, 2010/11-2019/20[1]

Fiscal Year	Regular Funding[2]			Indigenous Funding[2]			Mining-Related	
	Funding	Projects	Recipients	Funding	Projects	Recipients	Funding	Projects
2010-11	$300,000	15	35	$1,900,000	13	67	n.a.	n.a.
2011-12	$1,100,000	18	59	$4,300,000	24	140	n.a.	n.a.
2012-13	$381,197	23	50	$1,612,471	27	90	n.a.	n.a.
2013-14	$517,555	22	51	$2,000,768	27	91	n.a.	n.a.
2014-15	$162,990	14	32	$1,595,464	27	74	$741,487	18
2015-16	$124,875	13	30	$1,203,775	25	59	$598,790	19
2016-17	$231,114	13	38	$1,771,808	20	59	$697,607	10
2017-18	$140,666	12	22	$1,294,884	21	47	$638,719	12
2018-19	$168,777	13	22	$2,666,031	31	77	$730,111	17
2019-20	$218,455	17	33	$2,793,021	35	132	$384,693	10

[1] Source: Impact Assessment Agency of Canada

[2] These values represent **all** projects funded through the IAAC; e.g., mining, hydro, oil and gas, marine, etc.

While the IAAC leads the review of major projects, it works collaboratively with the Canadian Nuclear Safety Commission (CNSC) to review any projects also subject to regulation under the Nuclear Safety and Control Act. Once an IA decision is made for an applicable project, the CNSC becomes the lead for Crown consultation activities. CNSC works with IAAC on all public participation and Indigenous consultation activities and IAAC provides and administers participant funding until issuance of an IA decision.[88]

Other Jurisdictions

The desired approach of IAs can be summarized as 'one project, one assessment'. The goal is reduced duplication and increased efficiency and certainty. The IAAC promotes collaboration with other jurisdictions to support a single IA process for major projects. The IAAC leads each IA and coordinates with provinces and territories to determine the best approach. This approach is laid out in a Cooperation Plan that is shared with the project proponent and posted publicly.[89] In addition, regional assessments are carried out under the IAA to better understand the regional context of projects and provide more comprehensive analyses that can inform future project IAs. Regional assessments are undertaken cooperatively with the provincial, territorial, and Indigenous jurisdictions that have responsibilities within the region.[90] The Regional Assessment in the Ring of Fire Area will be the first regional assessment under the IAA and was posted on the IAAC Registry in 2020.

In addition to government efforts to promote public participation in the IA process by administering PFPs, mineral companies are important facilitators in enabling public participation in the review of their projects. Fostering participation is a critical step toward achieving public confidence in a given project as it enables a better understanding of concerns and issues related to the project and allows for the

[88] https://nuclearsafety.gc.ca/eng/resources/environmental-protection/impact-assessment-act-presentation.cfm

[89] https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/impact-assessments-canada-faq.html

[90] https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/regional-assessment-impact-assessment-act.html

opportunity to take those issues into account to develop a more environmentally and socially responsible project.

Data Considerations

Data from government PFPs and similar programs provides only a partial perspective of funding for public participation in impact review processes for the minerals sector. Mining company efforts to solicit and incorporate public feedback into project design are critical components to obtaining public acceptance of a project and allow for the development of a more responsible mineral project. However, aggregate funding provided by companies is not currently available.

Workplace Health and Safety

Highlights

- Rates of both fatal and non-fatal occupational injuries in the minerals sector declined by 56.5% and 26.3% from 2011 to 2019, respectively.
- The fatal injury rate has fluctuated significantly between 2011 and 2019. It was at its highest rate in 2011 at 9.3 fatalities per ten thousand (10k) jobs and its lowest in 2019 at 4.0 per 10k jobs.
- Non-fatal injuries have also fluctuated significantly between 2011 and 2019. Rates reached a nine-year low in 2014 with 147.9 non-fatal injuries per 10k jobs and a high point of 219.3 per 10k jobs in 2011.

Definition

Workplace health and safety is expressed as either the fatal or non-fatal injury rate per 10,000 workers in the minerals sector. The rate is calculated by dividing the count of fatal or non-fatal injuries by the number of employees in the sector and each subsector and multiplying by a factor of 10,000.

Rationale

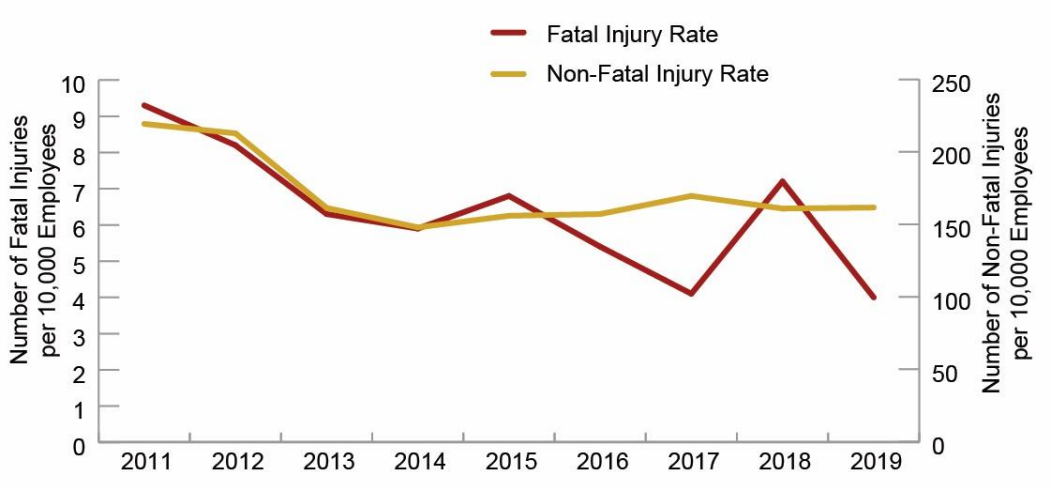
A safe and healthy work environment is among the most important social issues for workers and local communities.

Analysis

The minerals sector in Canada has improved its performance in providing safe work environments and demonstrated an overall downward trend in rates of injury, both fatal and non-fatal, over the nine-year period between 2011 and 2019 (the most recent year for which data is available).

The rate of fatal injuries per 10,000 employees fell from 9.3 in 2011 to 4.0 in 2019 (Figure 26). During this same period, the non-fatal injury rate also dropped, decreasing from 219.3 to 161.6 per 10,000 employees.

Figure 26: Total Compensated Fatal and Non-Fatal Injury Rate in the Minerals Sector, 2011-19



Sources: Natural Resources Canada; Association of Workers' Compensation Boards of Canada; Statistics Canada.

At the subsector level, performance improvements are also apparent. The metal ore mining subsector has made substantial improvements in health and safety as demonstrated by falling fatal injury rates, which decreased 42.1% from 8.0 per 10,000 employees in 2011 to 4.6 in 2019. The non-metallic mineral and mining quarrying subsector's fatal injury rate decreased by 35.3% between the years 2011 and 2019 from 14.7 to 9.5. The coal mining subsector is the only subsector which saw an increase in fatal injuries, rising 13% from 7.0 in 2013 (the earliest year for which data is available) to 8.0 in 2019.

For non-fatal injury rates, all subsectors saw their rates fall between 2011 and 2019, with non-metallic mineral mining and quarrying subsector decreasing from 297.4 to 213.8 injuries per 10,000 workers between 2011 and 2019 (-28.1%). Non-fatal injury rates for the metal ore mining subsector decreased from 181.0 to 135.8 injuries per 10,000 workers between 2011 and 2019 (25.0%). The rate for the coal mining subsector decreased from 169.9 to 144.7 over the same period (-14.9%).

Labour unions and industry associations have played an important role in improving worker health and safety by encouraging the sharing of best practices, developing industry standards, and providing third-party auditing and external verification. Examples include the Mining Association of Canada's *Towards Sustainable Mining Safety and Health Protocol* (2020) and *Crisis Management Protocol* (2018),[91,92] Unifor's Mines, Metals and Minerals Workplaces and COVID-19 information hub,[93] and the Prospectors and Developers Association of Canada published a *Health and Safety in Exploration Toolkit* and *Field Safety Pocket Guide*.[94]

The Prospectors and Developers Association of Canada (PDAC) also runs a comprehensive health and safety program in support of improving safety in the exploration industry. PDAC offers a short course on health and safety at its annual Convention and performs outreach at industry conferences to promote

[91] https://mining.ca/resources/guides-manuals/tsm-safety-and-health-protocol-2020/
[92] https://mining.ca/towards-sustainable-mining/protocols-frameworks/crisis-management-and-communications-planning/
[93] https://www.unifor.org/resources/our-resources/mines-metals-and-minerals-workplaces-and-covid-19
[94] https://www.pdac.ca/priorities/responsible-exploration/e3-plus/toolkits/health-and-safety

exploration health and safety. The program also includes an annual survey in collaboration with the Association for Mineral Exploration, compiling health and safety statistics provided by companies and publishing an annual safety report and set of guidelines. The most recent report, published in 2021 and including results for 2020,[95] showed little change in lost-time injury frequency rates between 2019 and 2020. There were 0.51 incidents per 200,000 hours in 2020 compared to 0.49 in 2019. Companies continue to give attention to worker health and safety. Survey results indicated a small decrease in companies reporting health and safety programs and policies (both at 96% down from 100% and 99% in 2019, respectively). There were increased rates of safety discussions at worker meetings (56% in 2012, 91% in 2019, 100% in 2020) and board meetings (66% in 2012, 72% in 2019, 91% in 2020).

In 2013, the Mining Association of Canada's (MAC) *Towards Sustainable Mining* (TSM) standard introduced a *Safety and Health Protocol* to help reinforce the culture of safety that has been a focus of both employees and employers in the mining sector. This protocol includes five performance indicators: (1) Commitments and Accountabilities; (2) Planning and Implementation; (3) Training, Behaviour and Culture; (4) Monitoring and Reporting; and (5) Performance. Members are assessed on systems and targets in place, with grades ranging from C (no management systems in place) to AAA (Excellence and Leadership).

The 2021 TSM Progress Report includes results for 67 mining facilities across Canada belonging to 32 member companies. In 2021, 96% of the facilities were rated A or higher for indicator 1, compared to 98% in 2019 and 95% going back to 2013 (the first year of reporting). Indicator 2 increased from 95% in 2019 to 96% in 2021 for facilities ranked A or higher (2013 performance was at 91%). Indicator 3 decreased slightly from 94% in 2019 to 92% in 2021 but increased from 88% in 2013. Indicator 4 was steady between 2019 and 2021 at 92% but increased from 78% in 2013; and indicator 5 dropped from 98% to 89% between 2019 and 2021 due in part to 5 facilities moving from AA or AAA to B following a fatality (in 2013, indicator 5 was at 94%).

Governments also have a critical role to play in promoting and improving worker health and safety in the minerals sector. In January 2014, Ontario's Chief Prevention Officer (CPO), working in collaboration with an advisory panel and six working groups, launched a comprehensive review of the health, safety, and prevention issues related to underground mining in the province. As of March 2018, the Prevention Office under the CPO's direction has completed most of the 18 recommendations tabled in the Mining Health, Safety and Prevention Review (2015).[96] The Canadian Minerals and Metals Plan (CMMP) acknowledges the value that Canadians place on public health and safety and highlights other areas critical to health and safety such as worksite ventilation, diversity, and regulatory innovation.[97]

[95] Prospectors & Developers Association of Canada, 2021, Results from the 2020 Canadian Mineral Exploration, Environment, Health & Safety Survey, *https://www.pdac.ca/docs/default-source/priorities/responsible-exploration/programs---h-s---safety-surveys/2021-ehsannualreport-2020-survey.pdf?sfvrsn=d5456f9f_0*

[96] Office of the Chief Prevention Officer, 2015, *Final Report: Mining Health, Safety, and Prevention Review*, http://www.labour.gov.on.ca/english/hs/pubs/miningfinal/.

[97] https://www.minescanada.ca/en

Data Considerations

The data from the Association of Workers' Compensation Boards of Canada's National Work Injury /Disease Statistic Program reports lost-time claims and fatalities accepted for compensation by one of the 12 Canadian Workers' Compensation Boards or Commissions. This does not include all worker compensation claims, as claims with no time loss are not included.[98]

Mine Openings and Closures

Highlights

- Between 2011 and 2020, 54 mines opened and 24 re-opened.
- During this same period, 37 mines closed and 62 operations were suspended.

Definition

This indicator is defined as the number of mines that closed, suspended, opened, or re-opened operations during a given period.

[98] See: http://awcbc.org/?page_id=4025.

Mine Opening
A mine is considered open when the operating company announces it has achieved commercial production or when it is reported as such by the regulating jurisdiction.

Mine Re-Opening
A mine re-opening refers to the opening of a mine that had previously been closed or suspended.

Mine Suspension
A mine is considered to have suspended its operations when its ore-extracting operations have indeterminately ceased for reasons such as production no longer being economically viable due to commodity price fluctuations, depletion of higher-grade ore with a reasonable probability that operations will resume once the situation is resolved, and in rare instances when there are safety issues. Strikes and lockouts are excluded because of their unpredictable nature.

Mine Closure
A mine is considered closed when its ore-extracting activities have ceased indefinitely with no clear intention of resuming operations in the foreseeable future. A mine can also be considered closed when the operating company announces its closure or when it is reported by the regulating jurisdiction as closed. Mine closure is usually due to the depletion of mineable reserves. Closure comes with the responsibility of remediation at the end of a mine's life.

Mine Reclamation
Mine reclamation is a term used to describe the process of restoring mined land to a satisfactory state. It aims to eliminate unacceptable risks to the public, limit the spread of contaminants, restore sites to a visually-acceptable condition, and return developed sites to a condition compatible with future use. Although the process of mine reclamation occurs at the end of the mining cycle, the planning of mine reclamation activities occurs prior to a mine being permitted or started and gradual restoration during operation is encouraged.

The framework for site reclamation and remediation includes a requirement that companies provide full funding of their future obligations up front. This reduces the likelihood of future insolvency and the negative impact mine failures have on the economy.

Source: Natural Resources Canada.
Toward Financial Responsibility in British Columbia's Mining Industry, Union of British Columbia Indian Chiefs
Financial guarantee provisions of mining-related legislative provisions in Quebec. https://mern.gouv.qc.ca/mines/restauration-miniere/les-dispositions-legislatives/

Rationale

Mine closures and openings can result in significant socio-economic impacts, both positive and negative, including changes in employment, government revenues, population, and economic activity in the local area. Monitoring is important given the potential for significant impacts on local communities.

Analysis

The dynamic nature of the mining industry results in fluctuating numbers of mines opening and closing each year. Mines may close at the end of their planned mine life based on the availability of the resource and they may re-open, suspend, or close prematurely based on price fluctuations or for a variety of other factors (e.g., input costs, natural disasters, etc.)

Between 2011 and 2020, approximately 37 mines closed and 62 operations were suspended (Table 12), while 54 new mines opened and 24 re-opened.[99] Of these 54 new mines, 32 are precious metals mines that opened between 2011 and 2020. Strong gold and silver markets, lower corporate taxes and future gold prices forecasted to remain above $2,000/oz, created ideal conditions for development of precious metal.[100]

Table 12: Mine Openings and Closings in Canada, 2011-20

Year	Precious Metals				Base Metals				Other Minerals or Metals			
	Opening	Re-Opening	Suspension	Closing	Opening	Re-Opening	Suspension	Closing	Opening	Re-Opening	Suspension	Closing
2011	7	1	2	1	2	3	2	0	1	1	5	1
2012	5	1	3	0	1	3	4	2	0	0	1	1
2013	3	1	2	0	2	0	2	3	1	0	1	2
2014	1	0	3	3	4	1	1	0	1	0	7	0
2015	3	0	4	2	1	1	2	3	1	1	3	0
2016	1	2	1	0	1	0	2	0	1	1	3	5
2017	5	0	0	1	0	0	2	0	3	2	0	0
2018	2	0	0	1	0	1	1	1	2	3	3	1
2019	5	0	0	3	0	1	1	0	1	1	1	3
2020	0	0	0	2	0	0	0	1	0	0	5	1
Total	32	5	15	13	11	10	17	10	11	9	29	14

Source: Natural Resources Canada.

[99] Natural Resources Canada. Note: These figures are additive and do not exclude operations that may have re-opened in later years.
[100] Wood Mackenzie Ltd, Dataset: 2021 Q2

Strikes and Lockouts

Highlights

- Between 2011 and 2020, the total number of strikes and lockouts in the minerals sector varied, but experienced an overall decrease of 66.7% from 12 to four.
- The number of person-days not worked as a result of strikes or lockouts also decreased by 93.3% during this period with the exception of a 10-year high in 2018 as significant labour disruptions occurred at select mineral processing facilities.

Definition

The International Labour Organization defines a strike as a temporary work refusal or slowdown by employees designed to limit production to attain key demands from employers. A lockout is defined as a total or partial temporary closure of places of employment, or the hindering of the normal work activities of employees, by employers, to resist key demands from employees.[101]

Rationale

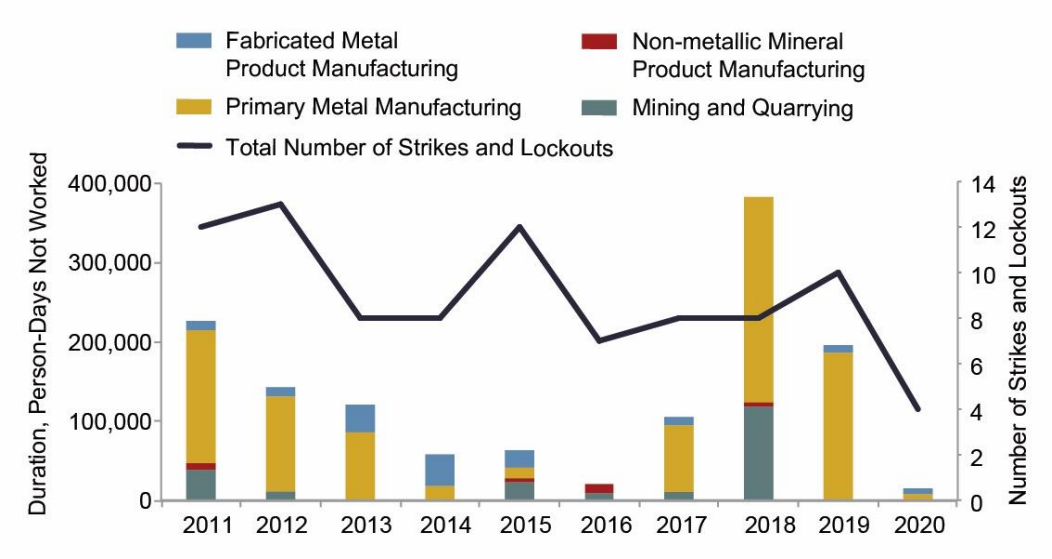
Strikes and lockouts can occur for a variety of reasons, including disagreements over wages, benefits, social programs, or work conditions. Regardless of the reason for the strike or lockout, it has an impact on the industry, workers, and the local community. Strikes and lockouts threaten the stability of the relationship between labour and industry and have the potential to affect both investment and employees' decisions to remain in the sector. As well, they may have an impact on the public image of the company and industry.

Analysis

According to data from Employment and Social Development Canada, the total number of strikes and lockouts in the minerals sector decreased between 2011 and 2020 from 12 to 4 or 66.7% (Figure 27). There was some variation in the total during the 10-year range, however, there was an overall decreasing trend in strikes and lockouts. There was also an overall decline in person-days lost due to strikes and lockouts during this period from 222,135 person-days not worked in 2011 to 14,940 person-days not worked in 2020. However, within this overall decrease was a 10-year high of 376,320 person-days not worked in 2018 due to labour disputes at smelting, refining, and steel manufacturing facilities. In addition, the large drop in lockouts and strikes and person-days not worked in 2020 would be expected given disruptions in the wider minerals sector resulting from the COVID-19 pandemic.

[101] International Labour Organization, 1993, *Resolution Concerning Statistics of Strikes, Lockouts and Other Action Due to Labour Disputes*, http://www.ilo.org/global/statistics-and-databases/standards-and-guidelines/resolutions-adopted-by-international-conferences-of-labour-statisticians/WCMS_087544/lang--en/index.htm.

Figure 27: Minerals Sector Labour Stoppages, 2011-20



Source: Employment and Social Development Canada, Workplace Information Directorate, Labour Program.

Section 4: Environmental Performance

Previous chapters in this report explored how the minerals sector contributes to Canada's well-being through economic and social performance. This can occur via many avenues, including GDP growth, better availability of public geoscience, and investments in research and development. Benefits are also realized through increased employment and other opportunities secured for Indigenous communities through agreements with mineral companies. Advances within the mining industry, such as improved workplace health and safety, greater transparency via the *Extractive Sector Transparency Measures Act*, and increased numbers of partnerships, including those with Mining Industry Human Resources Council to offer on-the-job training and internships, can contribute to better well-being for Canada and Canadians. These economic and social benefits can be accompanied by challenges arising from the environmental impacts on local and regional ecosystems that can occur at any phase of a minerals sector operation and along the value chain from exploration to development and extraction, processing, manufacturing, and closure.

The public image and reputation of the minerals sector are closely linked to its environmental performance. Legacy issues related to orphaned and abandoned mines and concerns over impacts to water, air, mine waste, and greenhouse gas (GHG) emissions are a growing public concern. Minimizing and mitigating environmental risks and impacts continue to be a central focus for the minerals sector.

Sustainability in mining practices has become increasingly relevant for companies seeking to operate in Canada and around the world. In Canada, the mining industry is subject to various federal, provincial, and territorial legal requirements that set high minimum standards of environmental performance. The Mining Association of Canada's *Towards Sustainable Mining*® (*TSM*®) initiative, introduced in 2004, lays out a set of principles and performance requirements governing the key activities of any company operating in the sector as a step towards responsible environmental practices. The Prospectors & Developers Association of Canada's *e3 Plus: A Framework for Responsible Exploration* provides guidance for exploration companies to enhance their performance, including in the area of environmental stewardship. *TSM* and *e3 Plus* are examples of initiatives that can help the minerals sector maintain its position as an important economic contributor in Canada while simultaneously protecting the environment and remaining responsive to societal expectations.

These and other sustainability initiatives represent the efforts being undertaken within the sector to set a global example of what can be achieved in terms of environmental sustainability and responsible development. They build from and attempt to move beyond the standards set by federal, provincial, and territorial legislation and assure Canadians that real progress in environmental protection is being made. At a national level, the minerals sector already has some of the world's lowest greenhouse gas emission intensities thanks to a clean energy grid, high-grade orebodies for some commodities, and continued investments in clean technology.

This chapter will examine a set of indicators and outcomes to better understand and quantify the sector's performance in addressing these environmental challenges. [102] An examination of the various

[102] It is important to differentiate between mineral exploration impacts, which tend to be less invasive, and those of mineral development, extraction, and processing activities, which are typically more substantial. The indicators within this section are weighted toward mining activities due to 1) the less intrusive nature of mineral exploration activities, and 2) data availability. Guidance such as the Prospectors & Developers Association of Canada's *e3 Plus* has been developed to assist mineral exploration companies minimize their environmental footprint and impact on the environments in which they operate.

multi-stakeholder frameworks used in developing this report led to the following statement of desired environmental performance outcomes:

> ***Practise responsible mineral exploration, development, and operations, and support public policies that are predicated on maintaining a healthy environment and, upon closure, ensuring that mine sites remain safe and physically and chemically stable in the long-term, and positioning them for a post-closure land use determined with communities (e.g., returning them to viable, self-sustaining ecosystems, converting them to some other industrial or economic activity).***
>
> ***Ensure institutional governance frameworks are in place to provide certainty and confidence that mechanisms exist for governments, industry, communities, and residents to avoid or mitigate adverse environmental effects.***

The following strategic directions of the Canadian Minerals and Metals Plan were selected to further articulate the targets and outcomes for the environmental performance of the sector:[103]

- **Global Leadership**
  - A sharpened competitive edge and increased global leadership for Canada
- **Communities**
  - Communities welcome sustainable mineral development activities for the benefits they deliver
- **The Environment**
  - The protection of Canada's natural environment underpins a responsible, competitive industry. Canada is a leader in building public trust, developing tomorrow's low-footprint mines and managing the legacy of past activities
- **Science Technology and Innovation**
  - A modern and innovative industry supported by world-leading science and technology—across all phases of the mineral development cycle

The indicators chosen to measure the sector's performance as it relates to this statement are:

- **Waste rock and tailings disposal** – Mineral extraction and processing creates substantial quantities of waste materials that must be carefully and responsibly managed to reduce and mitigate both physical risks (i.e., risk of failure of tailings management facilities) and chemical risks that can lead to discharge of contaminants and other undesirable substances to surface waters. Effective management of waste rock and tailings at mining operations is an important environmental and safety consideration in safeguarding the long-term health of local and regional ecosystems.

[103] Refer to Section 1 for a full explanation of the alignment of the Canadian Minerals and Metals Plan and the Mining Sector Performance Report.

- **Mine effluent and releases to surface water** – Water on mine sites can become contaminated as a result of coming in contact with mine wastes (e.g., tailings and waste rock) as well as other disturbed areas of a mine site, such as open pit and underground mine workings. Water can become contaminated as a result of its use in ore processing and the associated use of chemical reagents in processing. Water is carefully managed on mine sites and treated as needed before release to protect aquatic environments. Unintended releases of contaminants to surface water can occur as a result of a number of factors, such as system upsets in effluent treatment systems, spills or accidents, or extreme precipitation events. Monitoring releases of contaminants to surface water gives insight to the sector's performance in limiting its impact on local aquatic ecosystems. This indicator tracks performance using the *Metal and Diamond Mining Effluent Regulations* (MDMER) and the National Pollutant Release Inventory (NPRI).

- **Air emissions** – Mining and associated smelting and refining activities can result in air emissions that contain a range of pollutants, including nitrogen oxides (NO_x), sulphur oxides (SO_x) and particulate matter (PM_{10} and $PM_{2.5}$). These air emissions can affect local, regional, and national ecosystems, contribute to smog, acid rain, and poor air quality. They may influence human and ecosystem health. Analyzing air emission trends provides an indication of how the minerals sector is performing with respect to reducing air pollution.

- **Energy consumption and efficiency** – Energy costs have a strong influence on business performance and global competitiveness in the energy-intensive minerals sector. There are economic, social, and environmental incentives to improve energy efficiency, lower energy-related operating costs, and reduce environmental impacts, including greenhouse gas (GHG) emissions and other contributors to climate change.

- **Greenhouse gas emissions** – GHGs trap heat in the Earth's atmosphere, contributing to climate change. Climate change presents both risks, such as flooding and increased incidence of forest fires, and opportunities, such as reduced snow and ice cover in exploration areas. Monitoring changes in the minerals sector management of GHG emissions demonstrates the sector's efforts to mitigate any potential current and future impacts of climate change.

- **Environmental expenditures** – Measuring the level of environmental expenditures in the minerals sector gives an indication of the level of capital that has been committed to complying with Canadian or international environmental regulations, agreements, and voluntary commitments.

- **Orphaned and abandoned mines** – Canada faces the legacy and liability of environmental impacts, human health concerns, and the restoration and clean-up costs resulting from orphaned and abandoned mines. Current provincial and territorial legislation puts the onus on developers to submit mine closure plans describing decommissioning, site rehabilitation, and financial surety for any proposed operation; however, many legacy sites remain. Legislation, financial securities for site remediation for future rehabilitation costs, and assessment initiatives and programs to remediate and rehabilitate orphaned and abandoned mine sites can demonstrate the sector's commitment to ensuring healthy ecosystems are maintained following closure of an operation.

Box 17: ESG Investing and the Minerals Sector

ESG investing refers to the practice of incorporating environmental, social, and governance (ESG) considerations into the investment decision-making process to reduce risk and promote sustainable economic activities and projects. Each aspect of ESG consists of:

- Environmental: physical risks from climate change, greenhouse gas (GHG) emissions, energy use, waste management, water management, and biodiversity.
- Social: supply chain efficiency, human rights, equity, diversity and inclusion in the workplace, employee health and safety, and community relations and safety.
- Governance: integrity of a company's corporate activities and leadership, transparency, ethics, and board composition.

ESG criteria help companies, investors, governments, and NGOs to measure risk, maximize long-term financial returns, and measure sustainable business practices by assessing operations' risk associated with environmental, social, and governance issues. Companies that do not incorporate good ESG practices face the risk of losing their social license to operate in the minerals sector.[104,105]

ESG is playing an increasingly important role in guiding investment decisions in global capital markets. In the natural resources sector, ESG presents an opportunity to attract the capital needed for the energy transition and low-carbon projects. However, it equally presents a challenge – firms will need to continue to pursue commitments related to ESG, such as emissions reductions targets, investments in clean technology, and commitments to community well-being.

Canadian mining companies report on their ESG performance indicators through a number of standards and reporting frameworks. The ESG frameworks most often used in the minerals sector include: (1) Task Force on Climate-related Financial Disclosures (TCFD), (2) Sustainability Accounting Standards Board (SASB), and (3) Global Reporting Initiative (GRI).

The Canadian mining industry has also contributed to creating and promoting standards that support ESG considerations. In 2004, The Mining Association of Canada (MAC) launched Towards Sustainable Mining (TSM), a globally-recognized sustainability program to help mining companies evaluate and manage social and environmental risks (Box 18).[106] The investment community is increasingly considering TSM as a measure of ESG performance in the mining sector.

In addition, there are a variety of mining-specific standards including the Initiative for Responsible Mining Assurance (IRMA), Copper Mark, e3Plus and the Excellence in Environmental Stewardship Toolkit,[107] and the Responsible Jewelry Code of Practice. These and other assurance systems have differing levels and scopes of performance standards as well as governance systems ranging from industry-operated to multi-stakeholder managed. The issue of focus and degree of rigour in assurance are criteria that investors consider when assessing the relevance of any system as a tool for due diligence.

[104] https://www.mining.com/web/esg-seen-as-biggest-risk-to-mining-industry/
[105] https://www.ey.com/en_gl/news/2020/09/license-to-operate-remains-top-mining-risk-with-high-impact-risks-a-close-second
[106] https://mining.ca/towards-sustainable-mining/
[107] https://www.pdac.ca/priorities/responsible-exploration/e3-plus/toolkits/environmental-stewardship

Synopsis

Environmental performance of the minerals sector has generally undergone continual improvement between 2011 and 2020.

Measures of releases to surface water, air emissions, and greenhouse gas emissions all showed marked improvement over this period. Energy consumption, energy intensity, and environmental expenditures also showed improvement. Where there were suggestions of stagnation in performance of specific parameters within an indicator, these were often offset by substantial improvements in most other parameters.

The analysis of this chapter also revealed areas for improvement in the environmental performance of the minerals sector. Releases to water of manganese and selenium increased over the period studied. While the release of greenhouse gas emissions has improved over the last 10 years, emissions have largely remained stable since 2013. Improvements were seen for some emissions including sulphur oxides, nitrogen oxides, and $PM_{2.5}$.

There are data limitations in assessing environmental performance in areas such as orphaned and abandoned mines and protected areas. However, governments have been working in collaboration with communities to expand and strengthen programs that address the environmental performance of the minerals sector.

Highlights

- Reported quantity of NPRI substances contained in **waste rock and tailings** increased by 119.3% from 2011 to 2020, reflecting a larger number of mines reporting and ongoing trend towards larger-scale mining. The quantity of NPRI substances present in waste rock and tailings is not a meaningful indicator of risk or impact: to understand risk, site-specific knowledge is needed about the physical and chemical characteristics of mine waste and how that waste is being managed.
- In terms of **effluent discharge**, the number of mines subject to *Metal and Diamond Mining Effluent Regulations* (MDMER) increased 29.5% from 112 to 145 operations between 2011 and 2019. Between 98% and 100% of reported data for arsenic, copper, cyanide, lead, nickel, radium 226, zinc, and high pH were within authorized limits.
- Minerals sector releases to **surface water** of metals reported to the NPRI decreased by 12.4% over the period 2011 to 2020. Decreases were recorded for copper, mercury, nickel, and vanadium discharges, while increases were recorded for zinc, manganese, cadmium, and cobalt.
- Minerals sector **air emissions** for three criteria air contaminants decreased between 2011 and 2020. Emissions of SO_x (sulphur oxides), NO_x (nitrogen oxides), and $PM_{2.5}$ (particulate matter less than 2.5 micrometres) decreased by 59.1%, 14.6%, and 3.0%, respectively. Emissions of PM_{10} increased by 12.3% between 2011 and 2020. Emissions per reporting facility decreased for SO_x (-63.9%) and NO_x (-21.5%) over the same period, while PM_{10} increased (+21.4%) and $PM_{2.5}$ stayed relatively stable (-2.1%).

- The minerals sector used 9.7% of Canada's total energy in 2017 compared to 9.2% in 2014. Sector **energy consumption** decreased 3.6% between 2008 and 2017 from 828.7 petajoules (PJ) to 798.8 PJ. **Energy intensity** – describing how much energy is consumed to produce one unit of output and expressed as terajoules (TJ) per dollar – decreased 7.8% between 2011 and 2018.
- In 2018, the minerals sector emitted 48.7 million tonnes (Mt) of **greenhouse gas** (GHG), 0.444 Mt (-0.9%) below the 2011 level. GHG emissions were relatively flat between 2011 and 2018, averaging 47.4 Mt (± 1.7 Mt). Between 2017 and 2018, there was a small drop in GHG emissions, decreasing 0.8% or 0.403 Mt in the one year. GHG intensities (a ratio of GHG emissions to GDP) were below 2011 levels and displayed an overall downward trend for all minerals sector subsectors.
- Between 2010 and 2018, the minerals sector's **environmental capital expenditures** experienced a substantial increase of 122.8% from $475 million to $1.06 billion while environmental operating expenditures increased by 4.2% from $1.08 billion to $1.13 billion. Capital expenditures increased by 162.7% between 2010 and 2012 before decreasing by 51.3% between 2012 and 2016. Capital expenditures rebounded between 2016 and 2018 increasing by 74.3%. Operating expenditures rose by 17.4% from 2010 to 2014 before decreasing 11.2% between 2014 and 2018.
- Canada's Mines Ministers directed the **National Orphaned and Abandoned Mines** Initiative (NOAMI) in 2019 to explore expanding its mandate to reflect new and emerging issues, including climate-related risks and examining mining value from waste as a potential approach to reduce public liability. Although NOAMI and its Secretariat will wind down in 2022, the important guidance documents that NOAMI produced and the web-based NOAMI Inventory of Orphaned and Abandoned Mines will be preserved and continue to inform the reclamation and closure work that remains at legacy sites across Canada.

Indicator (2011–2020) (unless otherwise specified)	
Waste and Tailings Disposal	+7.1% average annual increase in reported quantity of NPRI substances per facility*
Mine Effluent and Discharges to Surface Water	-0.4% average annual decrease in percent of MDMER-submitted data within authorized limits
	+3.3% average annual increase in total number of mines subject to MDMER (2011-19)*
	+1.5% average annual increase in the reported quantity of NPRI substances released to surface water*t
Air Emissions**	-9.5% average annual decrease (tonnes SO_x/facility)
	-2.4% average annual decrease (tonnes NO_x/facility)
	+0.3% average annual increase (tonnes $PM_{2.5}$/facility)
	+4.2% average annual increase (tonnes PM_{10}/facility)
Energy Consumption and Intensity**	-2.0% average annual decrease in energy consumption (2011-18)
	-3.3% average annual decrease in energy intensity (2011-18)
GHG Emissions (2011-18)	-4.0% average annual decrease in GHG emissions intensity
Environmental Expenditures (2010-18)	+13.8% average annual increase in environmental protection expenditures
Orphaned and Abandoned Mines	Cannot be determined*

Improved Performance > +1.0%

Limited Change Between +1.0% and -1.0%

Decline in Performance < -1.0%

* Performance cannot be determined based on these metrics as these quantities do not provide direct evidence of environmental performance. Please refer to the *Data Considerations* subsection for this indicator for more information.

t Does not include 2014 due to anomalously high data that year resulting from the Mount Polley spill.

** Negative average annual growth rate in some performance indicators implies improvement.

Waste Rock and Tailings Disposal

Highlights

- Quantity of National Pollutant Release Inventory (NPRI) substances in tailings and waste rock reported by mining facilities in 2020 was 119.3% higher than 2011, increasing from 590,845 tonnes to 1,295,903 tonnes. This excludes unconsolidated overburden, stable/inert constituents of tailings, and inert waste rock.
- Manganese and its compounds were the most abundant substances measured in tailings and waste rock in 2020, comprising an average of 50.2% (±3.8%) of all measured substances.
- The number of facilities reporting substances to NPRI increased from 96 to 99 between 2011 and 2020.

Definition

There are two major forms of solid waste that are generated by mines: tailings and waste rock. Waste rock is removed in order to access ore and is not processed.[108] Tailings are the residual material that remains after economic minerals have been recovered by physical separation or other methods. They are a mixture of finely ground sand- to silt-sized waste minerals, water, residual reagents, and products of various chemical reactions that may take place following tailings disposal.[109]

Rationale

Mineral extraction and processing generates significant volumes of tailings and waste rock. Tailings pose physical risks if the structures built to contain them (e.g., dams) fail and release large volumes of tailings, other solid materials, and water. This type of physical risk is exemplified by the failure of a tailings management facility at the Mount Polley Mine in British Columbia that occurred in 2014. Tailings and waste rock also pose chemicals risks – water in contact with these wastes can become acidic or contaminated with metals and other elements (e.g., arsenic, selenium) as a result of chemical interactions with minerals in the tailings or waste rock. Water in contact with these wastes can be contaminated by cyanide at mines that use cyanide for ore processing, ammonia at mines that use explosives, and other substances. Tailings and waste rock are carefully managed to eliminate or reduce these risks.

Analysis

The Environmental Code of Practice for Metal Mines (Environment Canada, 2009) recommends environmental management practices to mitigate environmental concerns associated with the management of waste rock and tailings at each stage of the mine life cycle. Other documents from a

[108] Environment Canada and Climate Change Canada, 2017, *National Pollutant Release Inventory*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=4A577BB9-1.
[109] See: http://www.nrcan.gc.ca/mining-materials/publications/13924.

range of sources, including the Mine Environment Neutral Drainage (MEND) Program, the Mining Association of Canada, and the Canadian Dam Association provide a wide range of guidance on managing the physical and chemical risks associated with tailings and waste rock. Management of tailings and waste rock falls primarily under provincial/territorial jurisdiction, and in addition to establishing legal requirements, some provinces and territories also provide additional and relevant guidance.

In 2009, the National Pollutant Release Inventory (NPRI) began collecting information on the quantities of substances deposited in tailings management facilities and waste rock piles. Reporting requirements for tailings and waste rock were applied retroactively to 2006 for certain types of mining operations. NPRI monitors the quantities of 236 substances and substance groups in tailings and waste rock produced each year. This analysis includes mineral, metal, and diamond mines as well as coal. Oil and gas extraction is excluded.[110]

It is important to emphasize that NPRI data on the quantities of substances in tailings and waste rock do not provide a measure of the release of these substances to the environment. Tailings and waste rock are managed on site at mine facilities and are not released unless a failure occurs. In addition, these data do not provide a meaningful indication of the risk of release of these substances to the environment. This is because NPRI data do not provide:

- Information needed to assess risk on a site-specific basis, such as the physical characteristics and chemical or mineralogical composition of the tailings or waste rock including chemical or mineral forms in which NPRI substances occur; and
- Information regarding how tailings, waste rock, and associated water are managed to prevent or control any releases from tailings and waste rock to the air in the form of dust or to surface water.

The data considerations subsection included below further describes potential limitations of the NPRI data. Ongoing discussions with respect to this indicator will attempt to improve the way in which this data is presented in future editions of the Mining Sector Performance Report.

Under NPRI, pits and quarries with production of <500,000 tonnes are exempt from reporting. Open pit mines are not included in the definition of a pit or quarry and are subject to reporting requirements. Exclusions apply to unconsolidated overburden, inert waste rock, and stable or inert constituents of tailings.

NPRI lists 236 substances and substance groups to be reported in tailings and waste rock, subject to exemptions and thresholds prescribed in the legislation. However, this section focuses on reported quantities (in tonnes or kilograms) for a much smaller set of substances, consistent with the substances described in Section 4.2 on releases to surface water.

The number of facilities reporting waste rock and tailings to NPRI increased 3.1% between 2011 and 2020 from 96 facilities to 99 facilities. Note that this analysis does not include facilities that reported zero tonnes of waste rock and tailings. There was a 10-year low of 88 facilities in 2015 and a high of

[110] Data was retrieved based on North American Industry Classification System (NAICS) codes: 212 Mining and quarrying (except oil and gas), 327 Non-metallic mineral processing sector, 331 Primary metal manufacturing, and 332 Fabricated metal product manufacturing. Code 212 included diamond mining under 2123 Non-metallic mineral mining and quarrying.

99 facilities in 2018 and 2020. Total quantity of NPRI substances in waste rock and tailings increased 119.3% from a 10-year low of 590,845 tonnes in 2011 to 1,295,903 tonnes in 2020, for all substances combined. Tailings contributed between 70.0% and 97.4% of total quantity of NPRI substances in waste rock and tailings. The increase in quantity of NPRI substances reported in tailings and waste rock between 2018 and 2020 in Table 13 and Figure 28 somewhat mirrors an increase in numbers of reporting facilities between 2017 and 2020 from 91 to 99.

Table 13: Quantities of NPRI Substances (tonnes) Reported in Tailings and Waste Rock, 2011-2020

Year	Tailings			Waste Rock			Total Quantity of NPRI Substances in Tailings & Waste Rock	Number of Reporting Facilities
	Onsite*	Offsite**	Total	Onsite*	Offsite**	Total		
2011	571,370	3,863	575,233	15,589	22	15,611	590,845	96
2012	592,298	2,326	594,624	31,680	14	31,694	626,318	95
2013	633,316	5,103	638,419	125,297	7	125,304	763,723	93
2014	608,061	2,231	610,292	102,230	17	102,247	712,539	95
2015	676,659	1,786	678,446	79,612	35	79,647	758,093	88
2016	723,547	1,644	725,192	128,718	13	128,731	853,922	94
2017	793,434	1,916	795,350	168,979	35	169,014	964,364	91
2018	799,541	1,595	801,135	145,746	7	145,753	946,888	99
2019	749,295	1,384	750,679	289,901	3	289,904	1,040,583	98
2020 (p)	902,917	4,576	907,493	388,403	6	388,410	1,295,903	99

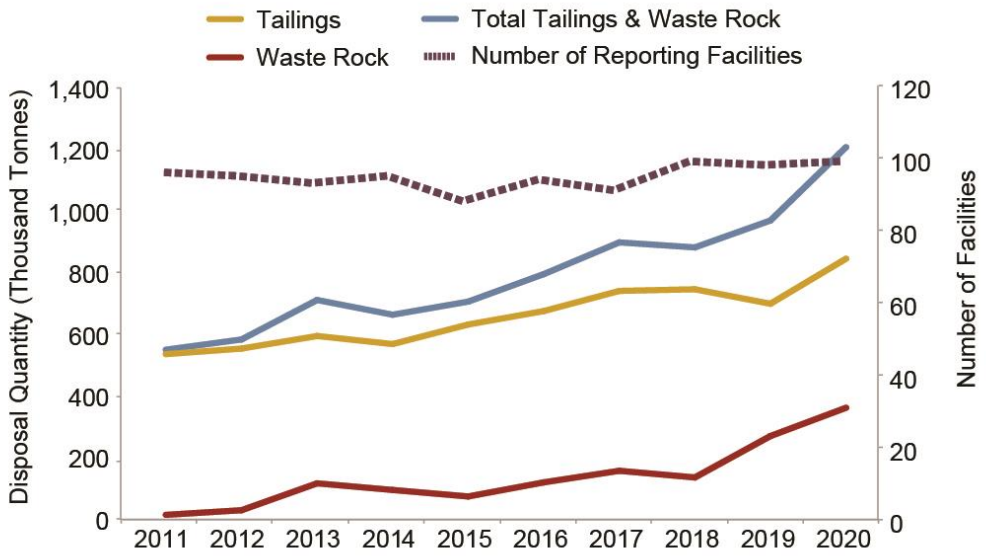
Source: National Pollutant Release Inventory

(p) – preliminary data

* Discharge of a substance to the environment within the physical boundaries of the facility. This includes releases to air, surface waters and land. Routine releases (e.g., fugitive releases) and accidental or non-routine releases (e.g., spills) are included. Releases do not include on-site or off-site disposals or off-site transfers for recycling (ECCC, *Guide for Reporting to the National Pollutant Release Inventory 2020 and 2021*)

** Includes total quantities transferred off the facility site for final disposal (ECCC, *Guide for Reporting to the National Pollutant Release Inventory 2020 and 2021)*.

Figure 28: Quantities of NPRI Substances (tonnes) in Tailings and Waste Rock, 2011-20



Source: National Pollutant Release Inventory
(p) – preliminary data

Metal ore mining accounted for between 80.2% and 95.1% of the total reported quantity of NPRI substances in tailings and waste rock between 2011 and 2020 (Table 14). Tailings and waste rock from copper, nickel, lead, and zinc mines contained the majority of reported NPRI substances between 2011 and 2019[111] making up an average of 29.8% of the total. This was followed tailings and waste rock from gold and silver mines at an average of 24.6% and iron ore mines at 23.3% of the total. The reported quantities of NPRI substances in tailings and waste rock from coal mining was the lowest, representing between 1.2% and 4.2% of total reported quantity.

[111] The most recent year for which a breakdown by product was available.

Table 14: Reporting Quantities (tonnes) of NPRI Substances in Tailings and Waste Rock by Mineral and Metal Category, 2011-20

Year	Coal	Iron	Gold & Silver	Copper, Nickel, Lead & Zinc	Other Metal Mines	Total Metal Mines	Non-metallic Mineral Mining & Quarrying	Total Quantity of NPRI Substances in Tailings & Waste Rock
2011	24,779	152,300	58,628	162,553	100,309	473,790	67,416	590,845
2012	22,240	162,461	70,282	196,476	121,147	550,367	36,671	626,318
2013	21,574	212,085	143,466	188,669	167,623	711,843	29,153	763,723
2014	19,648	170,483	159,896	218,597	119,233	668,210	23,202	712,539
2015	15,317	195,662	169,798	269,328	86,154	720,942	20,687	758,093
2016	18,157	213,533	213,005	274,036	111,774	812,348	22,302	853,922
2017	21,803	203,096	287,771	275,316	143,983	910,167	30,598	964,364
2018	16,493	152,384	349,996	286,401	105,540	894,321	34,568	946,888
2019	23,239	186,866	467,709	288,476	32,433	975,484	29,965	1,040,583
2020 (p)	15,836	-	-	-	-	1,231,035	17,829	1,295,903

Source: National Pollutant Release Inventory
(p) – preliminary data

Between 2011 and 2018, there was a 50.0% increase in total reported NPRI substances in tailings and waste rock from 484,911 tonnes to 727,443 tonnes (Table 15). The number of reporting facilities increased 3.1% from 96 to 99 over the same period. Total reported quantity of NPRI substances then increased 20.7% after 2018, reaching 878,117 tonnes by 2020. The number of reporting facilities changed from 99 in 2018, to 98 in 2019, and back again to 99 in 2019. Manganese and its compounds were the most abundant substances reported in tailings and waste rock every year between 2011 and 2020, comprising an average of 50.2% (±3.8%) of total reported quantity of NPRI substances. The total reported quantity of many substances increased between 2011 and 2020, generally mirroring production volumes for many of metals over the same period.

The reporting quantity of cyanide increased 21.7% overall between 2011 and 2020, from 265 tonnes to 322 tonnes. This aligns with an increase in tailings from gold and silver mines. Starting from 265 tonnes in 2011, cyanide reporting quantities increased by a factor of 3.5 to 946 tonnes in 2013 before decreasing to 768 tonnes in 2014. Reporting quantities of cyanide then increased 50.7% to a 10-year high of 1,157 tonnes in 2017. Reporting quantities decreased rapidly by 72.2% after 2017 to reach a

value of 322 tonnes in 2020. It was noted that three mines accounted most of the 2017 total of reporting quantity of cyanide (1,025 tonnes). Increasingly, large mines are using in-plant destruction of cyanide and by 2020, those same three mines reduced the combined total to 212 tonnes.

While reporting quantities of most substances have increased, the quantities of lead (-27.3%), selenium (-4.0%), and zinc (-4.7%) decreased between 2011 and 2020. Of reported substances in Table 13, quantities of arsenic, chromium, and mercury saw the largest increases between 2011 and 2020 of 203.8%, 278.2%, and 202.5%, respectively. Annual reported quantities of each of those substances was also highly variable. Arsenic varied between 18,372 tonnes and 101,094 tonnes with an average of 36,557 tonnes (±26,646 tonnes) per year. Chromium varied between 16,520 tonnes and 140,915 tonnes with an average of 42,026 tonnes (±35,454 tonnes) per year. Mercury varied between 8 tonnes and 48 tonnes with an average of 20 tonnes (±12 tonnes) per year. Thallium saw an increase of 254.7% between 2014 (the earliest reported year) and 2020 from 42 tonnes to 149 tonnes. The increase in reported quantities of cobalt in 2016 was a result of the substance moving from Group 1A to Group 1B of NPRI reporting with the reporting threshold dropped from 10 tonnes to 50 kg. This likely resulted in more facilities reporting cobalt in tailings and waste rock. It is important to understand that these are absolute quantities and are highly dependent on changes in mining tonnages and ore types year to year, as explained in the Data Considerations section below.

Table 15: Total Reported Mass (in tonnes) of Selected NPRI Substances in Tailings and Waste Rock Produced Annually from 2011 to 2020

Substance	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 (p)
Antimony	297	368	243	131	92	162	237	226	443	555
Arsenic	22,525	19,268	19,472	18,372	22,714	21,358	22,424	101,094	49,907	68,435
Cadmium	198	224	172	207	193	173	196	297	294	361
Chromium	16,520	21,031	20,830	22,813	26,254	29,956	45,087	34,368	140,915	62,483
Cobalt	3,779	4,063	5,589	5,959	5,436	8,945	9,959	9,189	9,417	10,155
Copper	54,826	67,701	94,129	93,696	85,853	102,406	128,644	114,490	117,789	116,180
Cyanide	265	707	946	768	840	1,009	1,157	628	614	322
Lead	22,234	26,454	16,169	9,631	11,624	16,019	16,379	15,152	18,425	16,160
Manganese	220,368	247,148	329,163	297,491	332,567	356,081	380,015	325,810	383,239	444,928
Mercury	16	8	14	27	8	11	10	21	33	48
Nickel	43,882	44,588	51,146	52,150	49,855	52,512	57,818	51,900	51,005	48,111
Selenium	818	681	1,198	1,050	957	1,026	1,191	1,053	786	786
Thallium	-	-	-	42	103	98	132	124	129	149
Vanadium	10,109	11,575	18,876	21,923	21,747	29,890	26,200	13,544	11,879	24,514
Zinc	89,075	53,835	50,515	36,650	42,344	48,711	54,163	59,548	69,901	84,931
Total	**484,911**	**497,652**	**608,461**	**560,911**	**600,587**	**668,359**	**743,612**	**727,443**	**854,775**	**878,117**

Source: National Pollutant Release Inventory
(p) – preliminary data

To help drive improvement in the way that mining companies manage risks associated with tailings management, the Mining Association of Canada (MAC) has comprehensive requirements and guidance for tailings management as part of the Towards Sustainable Mining® (TSM®) initiative (Box 18). The Global Industry Standard on Tailings Management co-produced by The International Council on Mining & Metals, United Nations Environment Programme, and Principles for Responsible Investment lays out a set of principles for mine operators with a goal of safe tailings management, zero harm to people and the environment, and zero tolerance for human fatality.[112]

[112] https://www.icmm.com/en-gb/guidance/environmental-stewardship/global-industry-standard-on-tailings-management

Box 18: Update on Towards Sustainable Mining – Tailings Management

Mine tailings can pose physical and chemical risks and must be carefully managed to prevent impacts to health and safety, the environment, and infrastructure. Tailings are managed in engineered tailings facilities which have long service lives and are subject to continual change. These characteristics, together with the range of risks to be managed, make tailings management challenging. It requires not only good planning and design at the outset, but ongoing application of good engineering practice. Furthermore, it requires an integrated approach that includes: engagement with communities; a risk-informed approach; designing and operating for closure; implementing operation, maintenance, and surveillance activities; and, implementing oversight mechanisms such as independent review.

A 2021 report from British Columbia's Chief Mines Auditor provided additional insight into the elements required for the implementation of tailings dam safety protocols.[113] It underscores the need to take a systemic approach that links the language of law and policy with operational capacity, data management systems, and enforcement commitments.

Effective implementation of such an integrated approach is dependent on good governance, which underpins how all decisions related to tailings management are made. Good governance is founded on corporate accountability and a commitment to responsible tailings management, and implementation of a tailings management system. A tailings management system is the umbrella under which planning and implementation of all activities related to tailings management are integrated. Ultimately, it is a tool to support decision-making from a responsible tailings management perspective.

The Mining Association of Canada (MAC) has provided leadership since 1998, when the 1st Edition of *A Guide to the Management of Tailings Facilities* (the Tailings Guide) was introduced, outlining principles for good governance and a tailings management system. Recognizing a gap regarding day-to-day implementation, MAC introduced the 1st Edition of *Developing an Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities* (the OMS Guide) in 2003 and has since updated it regularly (most recently in 2021).

Tailings management is integral to *Towards Sustainable Mining®* (*TSM®*), an international standard for responsible mining launched by MAC in 2004 and adopted by industry associations in Finland, Argentina, Botswana, the Philippines, Spain, Brazil, Norway, Australia, and Colombia.[114] TSM has also been adopted in Canada by the Association Minière du Québec. TSM provides tools to drive performance and ensure that key mining risks are managed responsibly.

[113] https://news.gov.bc.ca/releases/2021EMLI0042-001170
[114] https://mining.ca/towards-sustainable-mining/

The *TSM Tailings Management Protocol* translates key themes in the Tailings Guide and OMS Guide into specific requirements for tailings management. The Protocol was first introduced in 2004 and was strengthened in 2017. A Table of Conformance, first introduced in 2017 and expanded in 2019, ensures detailed and rigorous measurement of performance against the criteria in the Protocol.

The requirements and guidance for tailings management developed by MAC provides a foundation for responsible tailings management and managing risk with a goal of minimizing harm, and are recognized as best practice. Implementation is mandatory for MAC members for their Canadian operations, and the Guides are widely used internationally. However, there is always room for improvement, and MAC continues to seek ways to further improve the Protocol and Guides to drive ongoing improvements in the management of tailings across the mining industry.

A recent report from British Columbia's Chief Mines Auditor in 2021 provided insight to implementing tailings dam safety protocols.[115] It underscores the need for a systemic approach linking language of law and policy with operational capacity, data management systems, and enforcement commitments. It also recommends regular updates to the regulatory framework to reflect best standards, practices and regulations, pointing to recent initiatives such as the Global Industry Standard on Tailings Management, as well as Safety First: Guidelines for Responsible Mine Tailings Management, both released in 2020.

Data Considerations

NPRI information is a starting point for identifying and monitoring sources of pollution in Canada. The information collected by qualified mining facilities is reported to the NPRI and is used to help determine if regulatory or other action is necessary to ensure reductions. Only facilities reporting non-zero tonnes of tailings and waste rock were included in this analysis. Although NPRI reviews data for inconsistencies and errors, some inaccuracies and reporting errors may occur, such as reporting quantities manufactured, processed or otherwise used instead of quantities released and reporting of inappropriate units and decimal errors. The NPRI provides Canadians with annual information on industrial, institutional, commercial, and other releases and transfers in their communities.

NPRI reporting requirements for on-site waste rock and tailings disposal came into effect in 2009. Facilities were asked to report retroactively for 2006 through 2008, and there may be some errors in the estimation of historical levels. There have also been several changes in reporting requirements. These changes may impact values and trends for some substances. The 2006–08 requirements were applicable only to mining and oil sands facilities that generated or disposed of tailings or waste rock from the processing of bitumen, coal, diamonds, potash, or metals. The 2009–10 requirements applied to all facilities that generated or disposed of tailings and waste rock, subject to certain exemptions and exclusions. In addition, some facilities do not meet any threshold that would trigger tailings and waste rock reporting requirements for an NPRI substance (e.g., certain potash and coal mines).

[115] https://news.gov.bc.ca/releases/2021EMLI0042-001170

Every effort was made to clean and vet this data. Some remaining anomalous data points could be due to reporting artifacts, changes in reporting methodologies, or changes in compliance rates with NPRI requirements, both positive and negative. Ongoing work in this area will result in the continuous improvement of the NPRI as a data source to provide credible trends over time.

2020 data is preliminary, and the reviewed data will be released following the release of this report.

Mine Effluent and Releases to Surface Water

Highlights

- The number of mines subject to the **Metal and Diamond Mining Effluent Regulations** (MDMER, formerly the Metal Mining Effluent Regulations MMER) increased from 112 in 2011 to 145 in 2018, an increase of 29.5%. The total number of exceedances decreased 8.1% from 74 to 68 over the same period.
- Between 98% and 100% of reported data for arsenic, copper, cyanide, lead, nickel, radium 226, zinc, and high pH were within authorized limits from 2011 to 2019.
- There were 12 times between 2011 and 2019 when less than 98% of an individual year's aggregate reported data were within authorized limits: total suspended solids (six times), low pH (one time), and fish toxicity (five times).
- Surface water releases of 14 metals by metal and diamond mines that were reported to the National Pollutant Release Inventory (NPRI) decreased 12.4% over the 2011 to 2020 period. Significant variation in net precipitation and peak flows at sites led to highly variable annual releases.
- For the sector as a whole, decreases were recorded for antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium, and zinc releases between 2011 and 2020, while increases were recorded for cobalt and manganese.

Definition

Environment and Climate Change Canada (ECCC) is responsible for administering and enforcing the Metal and Diamond Mining Effluent Regulations (MDMER) and formerly the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act*, which prohibits the release of deleterious substances to waters frequented by fish unless otherwise authorized via regulations.[116] In 2018, the MDMER replaced the 2002 MMER. The MMER applied to all metal mines (except placer mines), milling facilities, and hydrometallurgical facilities with effluent flow rates of 50 m^3/day or more and that deposited a deleterious substance in any water or place defined by the Regulations. The MMER/MDMER prescribe maximum authorized effluent concentrations for arsenic, copper, cyanide, lead, nickel, zinc, radium-226, and total suspended solids. The Regulations also prescribe an upper and lower limit for effluent pH.

[116] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/sources-industry/metal-diamond-mining-effluent/guide-process-listing-water-bodies-fish-schedule-2.html

Effluent must also pass a test to demonstrate that it is not acutely lethal to fish (rainbow trout are used as the test species).

The MDMER extended application to include diamond mines and introduced more stringent effluent quality limits that came into effect in June 2021. Facilities must submit quarterly and annual reports to the Minister of the Environment detailing effluent monitoring results as well as information on any instances of non-compliance with limits for release of deleterious substances, effluent pH, and acute lethality test results.[117,118] The MMER/MDMER also include comprehensive requirements for monitoring in the water bodies into which effluent is released. This includes regular water quality monitoring and conducting monitoring every three years of fish and small organisms such as insect larvae that fish eat.

The following enforcement measures are available in response to alleged violations of the *Fisheries Act* and/or its Regulations, including the MDMER, and the *Canadian Environmental Protection Act*'s National Pollutant Release Inventory (NPRI) requirements:[119]

- Warnings
- Directions for remedial or preventative action to be taken by an alleged offender. (Specific to the Fisheries Act)
- Ministerial orders
- Court injunctions
- Prosecution, which may result in the imposition of fines, penalties, and/or court orders on conviction

In contrast to the MMER/MDMER, any facility that meets the NPRI's reporting requirements is required to report their pollutant releases, disposals, or transfers.[120] This includes the release of a substance to the environment within the physical boundaries of the facility such as releases to air, surface water, and land. There are three main factors that determine if a facility has to submit an NPRI report:

1. The activities that take place at the facility
2. The total number of hours worked at the facility
3. The substances manufactured, processed, otherwise used, or released to the environment at the facility

[117] https://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/page-3.html#h-684816
[118] https://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/page-2.html#h-684726
[119] https://www.canada.ca/en/environment-climate-change/services/environmental-enforcement/publications/compliance-enforcement-policy-fisheries-act.html
[120] https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/requirements-fact-sheet.html

Reporting to NPRI is mandatory under the *Canadian Environmental Protection Act, 1999*. Routine reporting of releases and accidental or non-routine releases (e.g., spills and leaks) for over 300 substances is included under NPRI. The MMER/MDMER on the other hand, were created under Section 36(3) of the *Fisheries Act* and apply to releases to water. This section focuses on releases to surface water of arsenic, cadmium, lead, nickel, selenium, and nine other metals.

Rationale

Mining often involves managing substantial volumes of water including rain and snow that falls on mine sites as well as groundwater pumped from surface and underground mine workings. Some fresh water is drawn for use in ore processing, although this is minimized through recycling of water used in processing. This water can become contaminated during ore processing or by contact with mine workings, mine waste (e.g., tailings and waste rock), on-site roads, and other mine site infrastructure.

Contact with mine waste can pose a particular challenge. Depending on the minerals present in these wastes, chemicals used in ore processing and other potential sources of contaminants, the water coming in contact with the waste could potentially become acidic or be contaminated by metals or other substances (e.g., cyanide from ore processing, ammonia from explosives). If released without proper treatment, this water could affect water quality and the health of aquatic ecosystems. Water and mine wastes are managed carefully to limit the potential for water to become contaminated. For example, tailings that could generate acid can be kept saturated with water to limit their exposure to oxygen, an essential ingredient in the chemical reactions that cause acidity and release of metals into the water. Ore processing facilities that use cyanide to recover gold often use treatment processes to destroy the cyanide before tailings are transferred to management facilities. In addition, clean water including runoff from nearby slopes is diverted away from mine sites to prevent it from becoming contaminated. Water from mine sites that is to be released to the environment is treated as needed to reduce concentrations of all contaminants to safe levels. As per the requirements in the MMER/MDMER, all released water is monitored. Monitoring of the water bodies into which the water is released is also done.

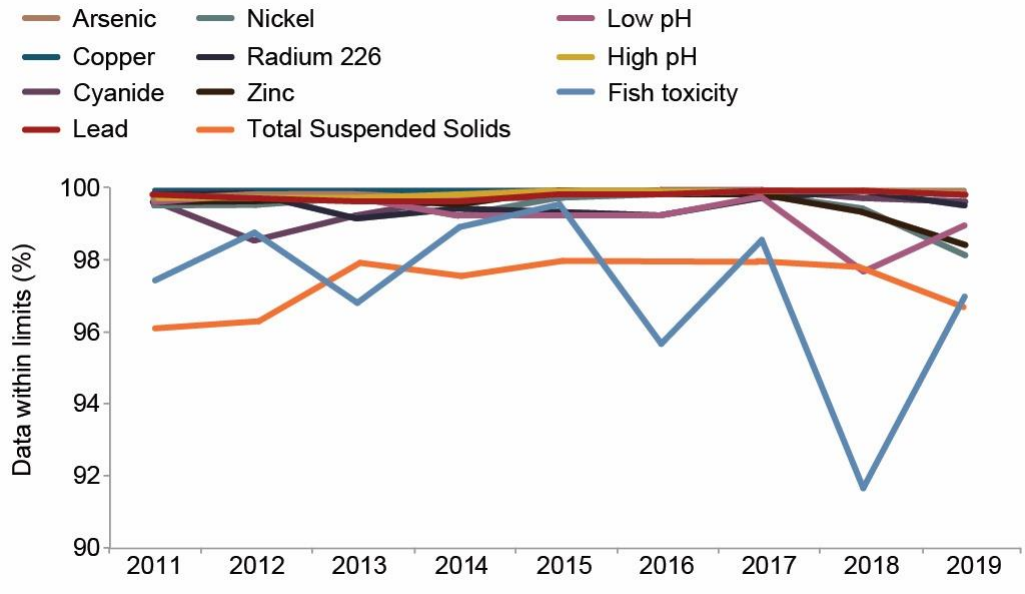
Groundwater protection and monitoring is an important consideration, but releases to groundwater are not reported to the NPRI and are not regulated under the MMER/MDMER. The Environmental Code of Practice for Metal Mines recommends environmental management practices to mitigate identified environmental concerns, including potential impacts on groundwater resources.[121] Risks can be minimized by implementing measures to prevent pollution such as environmental management planning and implementation of management programs for water quality, tailings, and waste rock.

[121] *Environmental Code of Practice for Metal Mines,* Environment Canada, 2009.

Analysis

Between 2011 and 2019 (the most recent year for which data was available), 98% to 100% of reported results for arsenic, copper, cyanide, lead, nickel, radium 226, zinc, and high pH were found to be within authorized limits according to MMER/MDMER (Figure 29). There were six years (2011-2014, 2018-2019) when less than 98% of reported results on total suspended solids were within the authorized limit. A nine-year low of 96.1% of total suspended solids results being within the authorized limit occurred in 2011. In 2018, a nine-year low of 97.7% of reported results being within the authorized limit for low pH occurred. This was the only time less than 98% of reported low pH results was within the limit. There were five years where less than 98% of reported results for fish toxicity were within authorized limits. A nine-year low of 91.6% of fish toxicity results being within the limit occurred in 2018.

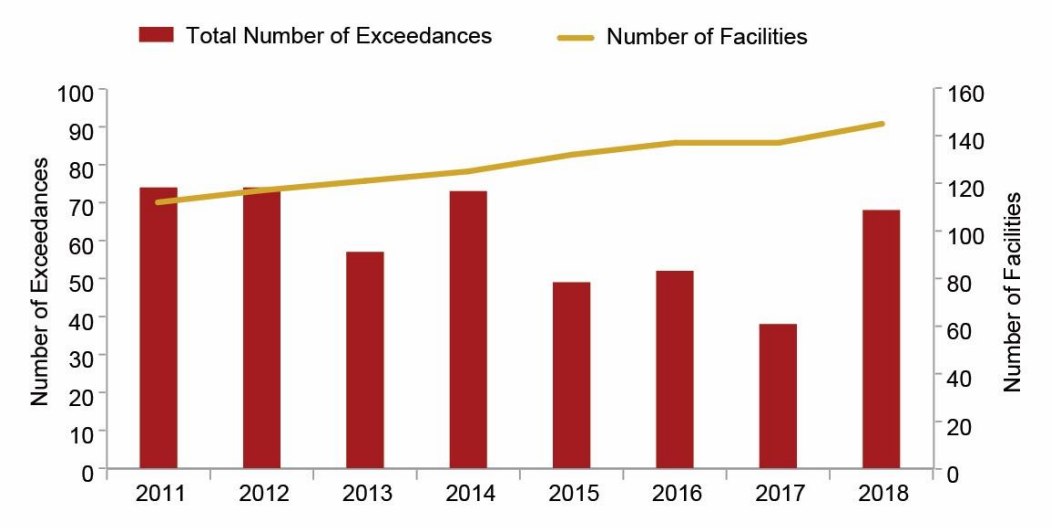
Figure 29: Percentage of MMER/MDMER regulatory results submitted within authorized limits, 2011-19



Source: Environment and Climate Change Canada (2021) Canadian Environmental Sustainability Indicators: Metal and diamond mining effluent quality.

Despite a steady increase in the number of mines subject to the MMER/MDMER, there has been a trend towards a decreasing number of annual exceedances of limits for deleterious substances and pH (Figure 30). The number of reporting facilities demonstrated a steady increase of 29.5% from 112 to 145 facilities between 2011 and 2018. The increase between 2017 and 2018 shown in Figure 30 is partly due to the introduction of the MDMER and expansion of scope to include diamond mines. The number of exceedances decreased 8.1% from 74 to 68 over the same period.

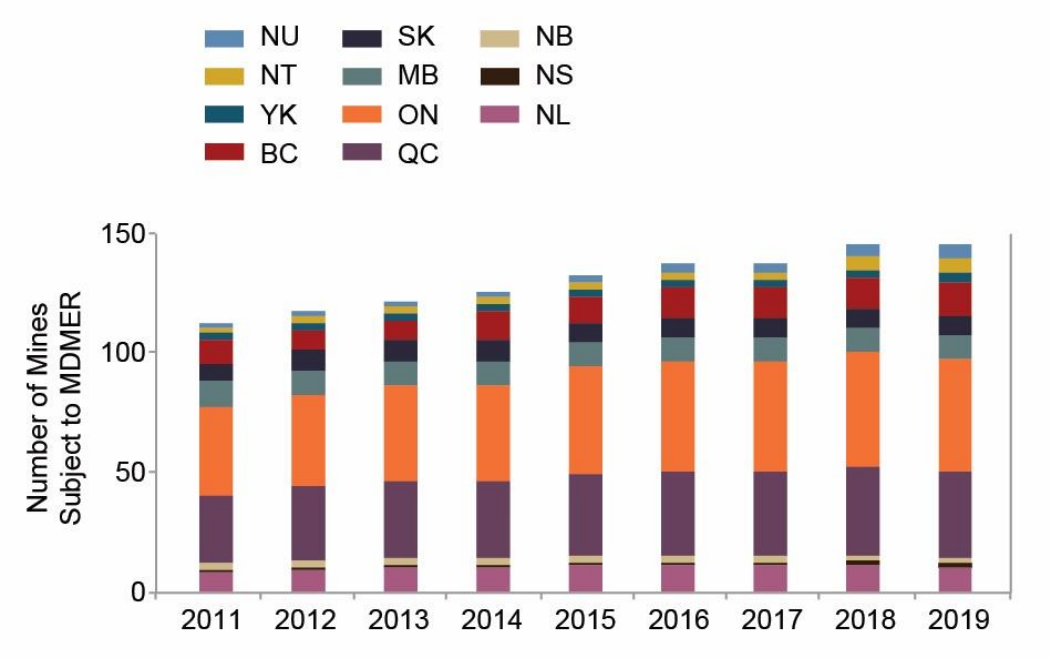
Figure 30: Number of Exceedances and Number of Reporting Facilities Subject to MMER/MDMER, 2011-18



Source: Environment and Climate Change Canada. *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*. NB: MMER/MDMER annual reports separated "Other Metals" to its own category as of 2014. Note: acute lethality results are not included here.

Nunavut and the Northwest Territories each more than doubled the number of reporting mines from two to six between 2011 and 2019 (Figure 31). It is noted that much of the increase for the Northwest Territories is due to diamond mines becoming subject to the MDMER and not an increase in the number of mines. Other provinces and territories saw increases in the number of reporting mines: Newfoundland and Labrador (25%), Quebec (29%), Ontario (27%), Saskatchewan (14%), British Columbia (40%), and Yukon (33%). New Brunswick and Manitoba experienced a decrease in the total of mines subject to MMER/MDMER from three to two (-33%) and 11 to 10 (9%), respectively, between 2011 and 2019 while Manitoba saw a 9% decrease from 11 to 10 mines subject to MMER/MDMER over the same period.

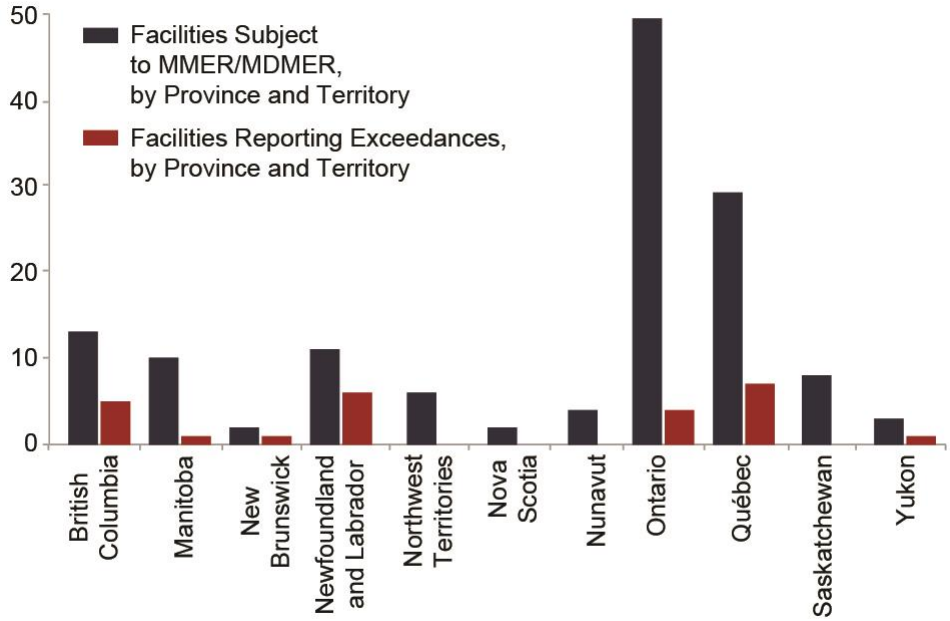
Figure 31: Number of Mines in Canada Subject to MMER/MDMER by Jurisdiction, 2011-19



Source: Environment and Climate Change Canada (2021) Canadian Environmental Sustainability Indicators: Metal and diamond mining effluent quality.

Quebec (42), British Columbia (6), and Newfoundland and Labrador (6) had the highest numbers of MMER/MDMER exceedances in 2018, together accounting for 79.4% of total exceedances (Figure 32). The remaining exceedances were concentrated in Ontario (5) and New Brunswick (5). Total suspended solids accounted for 35 of the 68 exceedances reported in 2018. While most mining facilities have only a single final release point (63% of 145 mines), there were 37% of mines subject to the MMER/MDMER in 2018 that reported having more than one final release point.

Figure 32: Regional Distribution of Reporting Facilities and Exceedances, 2018



Source: Environment and Climate Change Canada, *Status Report on the Performance of Mines Subject to the Metal and Diamond Mining Effluent Regulations in 2018.*
Note: does not include acute lethality results.

Data reported to the NPRI for the period between 2011 and 2020 reveal significant variation over time. Total releases for each substance integrates changes in the volume of effluent released and changes in the concentrations of substances in that effluent. Significant variation in net precipitation can impact effluent volume and is an important driver of variations in annual releases on a site-specific basis. Effluent quality is usually less variable, but total annual releases can increase over a short period of time due to a major spill or a comparatively long time due to an ongoing leak at one or more sites. The most singular result was due to the breach of a tailings dam at the Mount Polley mine in 2014. Data for 2014 has been restated to correct errors in releases from all other mines and total releases.

Excluding the 2014 Mount Polley incident, key changes include mercury releases decreasing from 0.1 tonnes in 2011 to zero between 2015 and 2020. There was a 9.9% decrease in zinc releases from 50.3 tonnes in 2011 to 45.3 tonnes in 2020. Manganese increased 44.0% from 88.8 tonnes in 2011 to 127.8 tonnes in 2020. A very large increase in chromium from 0.3 tonnes in 2017 to 51.2 tonnes in 2018 was followed by a decrease to 1.4 tonnes in 2019. The 2018 spike in chromium was due to a single facility reporting 51.0 tonnes in 2018 and then 0.0018 tonnes in 2019. Between 2011 and 2020, there were decreases in the releases of antimony (-74.5%), arsenic (-29.1%), cadmium (-25.5%), copper (-46.7%), lead (-57.7%), nickel (-66.8%), selenium (-12.7%), and vanadium (-68.4%). Cobalt releases doubled from 1.5 tonnes to 3.1 tonnes over the same period. This doubling is at least partly attributable to a 2016 change in NPRI reporting requirements that resulted in more facilities reporting cobalt releases. The total mineral industry releases of 14 metals declined by 12.4%. Note that aggregate results may obscure trends that reflect changes in product mix, ore types, or regional geology.

Table 16: Mineral Industry Releases to Surface Water by Substance (Tonnes), 2011-20

Year	Arsenic (and its compounds)	Cadmium (and its compounds)	Lead (and its compounds)	Nickel (and its compounds)	Selenium (and its compounds)	Other metals (and compounds)*
2011	4.2	0.6	4.9	75.9	17.9	162.0
2012	4.4	0.6	6.2	50.9	22.9	155.3
2013	6.1	0.7	5.5	28.0	22.6	248.9
2014	264.0	4.4	138.6	253.3	52.3	40,524.2
Mount Polley	*259.1*	*3.8*	*134.2*	*223.7*	*33.0*	*40,386.4*
All Others	*4.9*	*0.6*	*4.3*	*29.6*	*19.4*	*137.8*
2015	3.2	0.4	3.3	28.7	14.5	154.1
2016	4.2	0.5	3.3	25.1	13.6	103.1
2017	3.9	0.6	2.9	23.3	18.6	133.2
2018	3.3	0.6	2.6	19.7	15.5	212.5
2019	3.7	0.5	2.7	21.4	14.3	206.9
2020	3.0	0.4	2.1	25.2	15.6	186.3

Source: Environment and Climate Change Canada, National Pollutant Release Inventory.

*Includes: antimony, chromium, cobalt, copper, manganese, mercury, thallium, vanadium, and zinc.

Data considerations

This section uses data collected under MDMER (formerly MMER) as reported to ECCC. The data is self-reported by the regulated community and is therefore limited by what has been reported to ECCC. As mines that do not report are not included in the data, the data may not be fully representative of water quality at mining operations across Canada. Similarly, as it is self-reported, data from the most recent years are not yet fully validated and may be subject to change. Note that closed mines and mines on long-term care and maintenance can be subject to the MDMER. The regulations apply for at least three years after mines cease production and some companies opt to have their mines remain subject to the MDMER.

The substances included under MDMER are arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids, and radium 226. The Regulations also set a minimum (low pH) and maximum (high pH) level for the pH of released effluent. Fish toxicity is also included and refers to tests of effluent on mortality rate for fish.

NPRI reporting of releases to surface water provides insight on the industry's performance in limiting releases of NPRI substances to the environment, but does not suggest the presence or absence of risk to aquatic ecosystems. Releases can be underestimated or overestimated as a result of the procedure for estimating releases when analytical results are below the Method Detection Limit (MDL).

Effects on the health of fish, other organisms, and aquatic ecosystems depend upon chemical speciation, environmental concentrations, conditions that modify toxicity, and exposure as well as other factors. A great deal of other data and information are available for Canadian mines and used by regulators, businesses, communities, and other stakeholders to assess risks and priorities for action. In some cases,

a better understanding of the complex interaction between ecosystems is required to assess long-term, cumulative impacts on local and regional environments.[122]

NPRI 2020 data are preliminary and the reviewed data were scheduled for release following the preparations for this report.

Air Emissions

Highlights

- Minerals sector air emissions for three criteria air contaminants decreased between 2011 and 2020. Emissions of SO_x (sulphur oxides), NO_x (nitrogen oxides), and $PM_{2.5}$ (particulate matter less than 2.5 micrometres) decreased by 59.1%, 14.6%, and 3.0%, respectively.
- Minerals sector emissions of PM_{10} increased by 12.3% between 2011 and 2020.
- Emissions per reporting facility decreased for SO_x (-63.9%) and NO_x (-21.5%) over the same period, while PM_{10} increased (+21.4%) and $PM_{2.5}$ stayed relatively stable (-2.1%).

Definition

Air pollution can affect Canadians' health and the environment. Emissions of sulphur oxides (SO_x), nitrogen oxides (NO_x), particulate matter with a diameter less than 10 micrometres (PM_{10}), and particulate matter with a diameter less than 2.5 micrometres ($PM_{2.5}$) contribute to smog, poor air quality, and acid rain.

Rationale

Air pollution problems result from pollutants released by human activities, natural processes, and from interactions among pollutants. Air pollutant concentrations in the environment are influenced by the quantity of pollutants released, distance from sources, and weather. Some pollutants can affect air quality hundreds to thousands of kilometres from sources.

The minerals sector is a source of air emissions including SO_x, NO_x, and PM_{10} and $PM_{2.5}$. Exposure to SO_x and NO_x can reduce lung function and increase susceptibility to allergens in people with asthma. SO_x and NO_x are precursors of fine particulate matter ($PM_{2.5}$) and contribute to formation of acid rain and smog.

[122] Bruce, James P., et. al., 2013, *The Sustainable Management of Groundwater in Canada*, http://wedocs.unep.org/handle/20.500.11822/18051.

Analysis

Base metal smelters process sulphide mineral concentrates and are the largest source of domestic SO_x emissions. Substantial emissions can also emanate from electricity generating plants, refineries, and paper and pulp facilities.[123] In the case of mining operations not connected to an electrical grid—as is the case for many mines operating in northern and remote areas—large quantities of emissions can be output by the diesel generators used to produce electricity. Smaller minerals sector SO_x sources include combustion of fuels that contain sulphur. NO_x is generated by fuel combustion in industrial processes and transportation equipment. Sources of direct PM_{10} and $PM_{2.5}$ emissions include crushing and fragmentation processes and transportation. $PM_{2.5}$ can be transported over long distances, while effects of coarser particles (including most PM_{10}) are local.

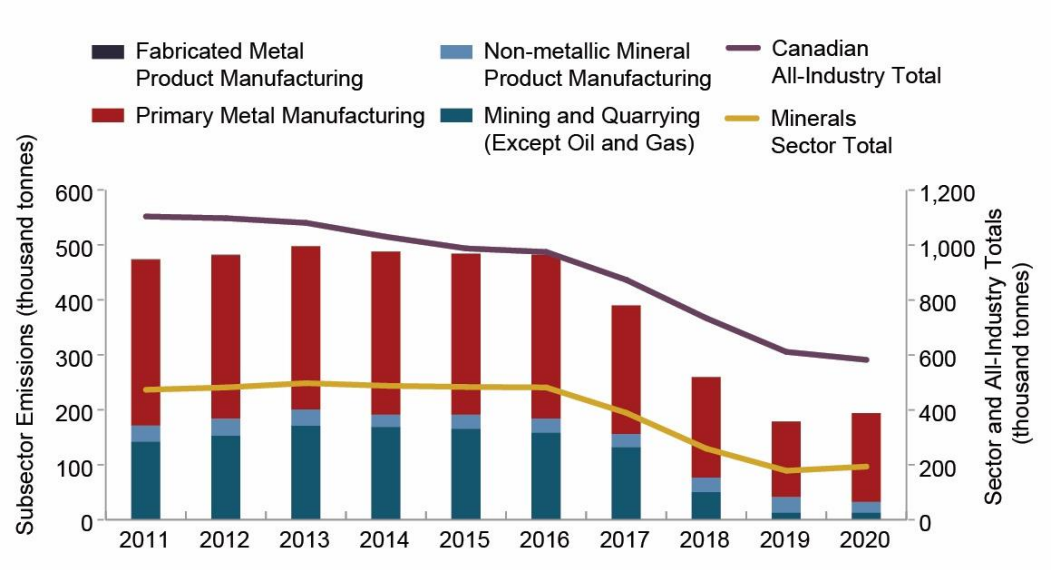
Smelter SO_x emission reductions were an early priority to reduce impacts of acid rain. Mineral industries emitted 48.4% of total SO_x emissions in Canada in 1990, and emissions from those industries were cut by 51.6% between 1990 and 2008. Sulphur dioxide ($SO_{2(g)}$) emission reductions at smelters accounted for most of the SO_x emission reductions.

Between 2011 and 2020, the minerals sector reduced emissions of SO_x by 59.1% from 473,442 tonnes to 193,701 tonnes (Figure 33). Smelter emissions and reductions have historically driven SO_x emission trends in the mining and quarrying and primary metal manufacturing subsectors. Figure 37 shows tonnes of SO_x emissions per reporting facility per year. The 59.1% drop in overall SO_x emissions for the minerals sector can be compared to a 63.9% decrease from 4,466 tonnes per facility to 1,614 tonnes per facility over the same period. Most of the decrease in emissions per facility happened between 2016 and 2020 when they declined 67.8% from 5,019 tonnes per facility to 1,614 tonnes per facility.

The Primary Metal Manufacturing subsector (i.e., including smelter and refineries) accounted for 83.4% of total SO_x emissions of the minerals sector in 2020, but saw large reductions after 2011, falling 46.5% from 301,773 tonnes to 161,484 tonnes. The mining and quarrying (except oil and gas) and fabricated metal product manufacturing subsectors saw the largest reductions in terms of percentage between 2011 and 2020, decreasing 91.3% and 99.9%, respectively. The rapid decrease in emissions from the mining and quarrying (except oil and gas) subsector between 2016 and 2020 correspond to a steep decline in SO_x emissions from a single facility, which stopped altogether by 2019. High emissions were reported by the fabricated metal product manufacturing subsector in 2011, 2012, and 2019, which resulted from intermittent and large sulphur dioxide releases from a single facility. Non-metallic Mineral Product Manufacturing accounted for 10.3% and mining and quarrying (except oil and gas) accounted for 6.3% of the SO_x emissions of the minerals sector in 2020.

[123] The Conference Board of Canada, 2016, *Sulphur Oxides Emissions*, https://www.conferenceboard.ca/hcp/provincial/environment/sox.aspx?AspxAutoDetectCookieSupport=1.

Figure 33: Minerals Sector Emissions of SO_x (thousands of tonnes), 2011-2020

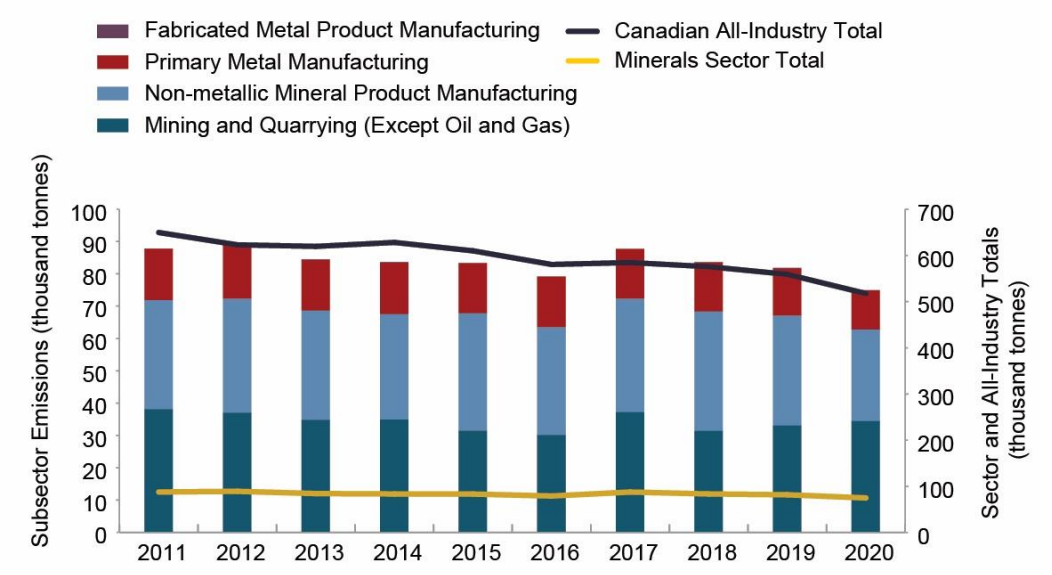


Source: Environment and Climate Change Canada, National Pollutant Release Inventory.

There was a 14.6% reduction in NO_x emissions from the minerals sector between 2011 and 2020 from 87,797 tonnes to 74,943 tonnes (Figure 34). However, the minerals sector share of the total NO_x emissions for all industries increased stayed relatively stable at an average of 14.1% (±0.6%) over the same period. There was a steady 21.5% decrease in tonnes of NO_x emissions per facility between 2011 and 2020 from 424 tonnes per facility to 333 tonnes per facility (Figure 37).

The contribution of NO_x emissions to the total minerals sector by each subindustry was also relatively stable between 2011 and 2020. Mining and quarrying (except oil and gas) and non-metallic mineral product manufacturing were the largest contributors at an average of 41.0% (±2.5%) and 40.6% (±2.1%) of total sector emissions of NO_x per year between 2011 and 2020, respectively. Mining and quarrying (except oil and gas) emissions fell from 38,161 tonnes to 34,393 tonnes between 2011 and 2020 representing a 9.9% decrease. Non-metallic mineral product manufacturing decreased 15.9% from 33,681 tonnes in 2011 to 28,317 tonnes in 2020 Primary metal manufacturing contributed an average of 18.3% (±0.9%) of total sector emissions per year over the same period. Its NO_x emissions decreased 23.7% from 15,894 tonnes to 12,120 tonnes between 2011 and 2020. Fabricated metal product manufacturing was a much lower contributor, emitting an average of 0.11% (±0.07%) of total sector NO_x between 2011 and 2020. That subsector's emissions decreased 55% from 61.4 tonnes to 27.7 tonnes (a 10-year low) between 2011 and 2016. Fabricated metal product manufacturing emissions then increased four-fold to 113.3 tonnes by 2020.

Figure 34: Minerals Sector Emissions of NO_x (thousands of tonnes), 2011-2020



Source: Environment and Climate Change Canada, National Pollutant Release Inventory.

SO_x and NO_x emission reductions at primary processing sites stem in part from federal, provincial, and territorial government regulatory initiatives, including the implementation of the Environmental Performance Agreements for base metals smelting and refining with the objective of implementing the base level industrial emissions requirements (BLIERs) for emissions of sulphur dioxide and particulate matter.[124] Reductions were achieved through various measures including investments in site improvements and upgrades, changes in activity levels, capacity rationalization and closures, and the application of new technologies.

Variations in emissions for the Mining and Quarrying industry may be due in part to the elimination of exemptions for quarries and open pit mines, changes in responsibility for reporting emissions from off-road vehicles, and methodological changes. Other contributing factors may include changes in mining method, ore grade, and waste volumes, new equipment, improved engines, and pollution controls.

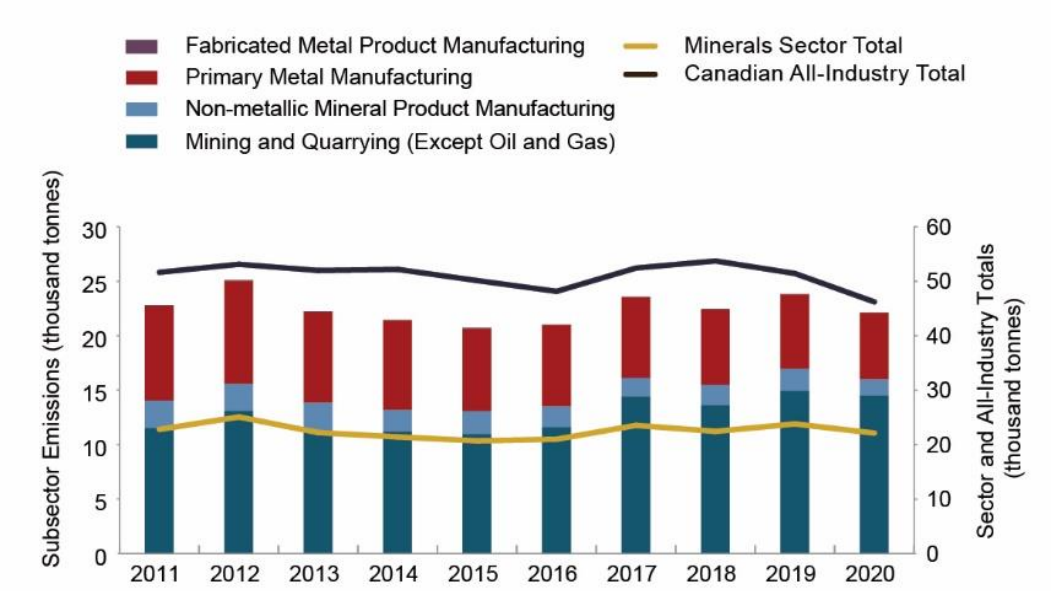
Direct $PM_{2.5}$ emissions of the minerals sector remained fairly stable between 2011 and 2020, decreasing 3.0%, but increased as a share of total all industry $PM_{2.5}$ emissions by 3.7% from 44.1% to 47.9% (Figure 35). There was little change in emissions of $PM_{2.5}$ per facility between 2011 and 2020 (Figure 37). Emissions per facility decreased 2.1% between 2011 and 2020 with an average emissions per facility of 49.8 ± 3.7 tonnes $PM_{2.5}$ per facility.

Mining and quarrying (except oil and gas) made up the largest share of $PM_{2.5}$ emissions at 65.5% in 2020 and saw the largest increase in emissions from 2011 to 2020, increasing 26.2% from 11,490 tonnes to 14,500 tonnes. Primary metal manufacturing accounted for 27.5% of minerals sector $PM_{2.5}$ emissions in 2020, with total emissions decreasing 30.1% between 2011 and 2020 from 8,712 tonnes to 6,087 tonnes. Non-metallic mineral product manufacturing saw the largest decreases in $PM_{2.5}$ emissions

[124] https://www.canada.ca/en/environment-climate-change/services/environmental-performance-agreements/base-metal-smelters-overview.html

between 2011 and 2020, falling 41.5% from 2,540 tonnes to 1,487 tonnes. Fabricated metal product manufacturing contributed only 0.24% of total minerals sector emissions in 2020. That subsector's $PM_{2.5}$ emissions fell 12.9% from 61.9 tonnes to 53.9 tonnes between 2011 and 2020. Emission levels and trends reflect the significance of mobile sources for Mining and Quarrying and stationary sources in downstream product manufacturing subsectors, as well as other factors noted above. Substantial SO_x emission reductions and direct $PM_{2.5}$ emission reductions reduced minerals sector impacts on ambient $PM_{2.5}$ concentrations.

Figure 35: Minerals Sector Emissions of $PM_{2.5}$ (thousands of tonnes), 2011-2020

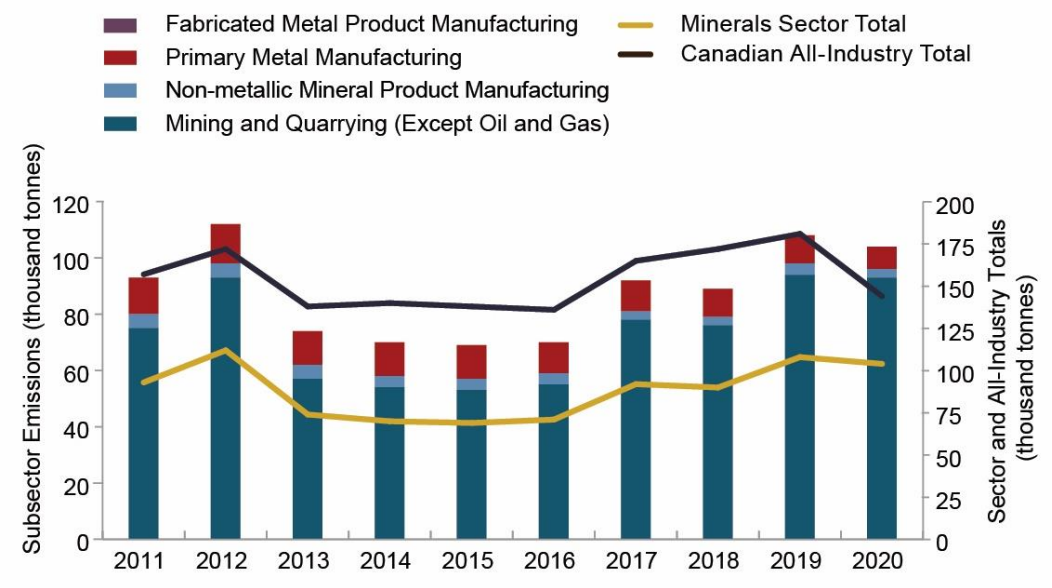


Source: Environment and Climate Change Canada, National Pollutant Release Inventory.

Minerals sector emissions of PM_{10} increased by 12.3% between 2011 and 2020 (Figure 36). Emissions per facility of PM_{10} varied between 2011 and 2020, while increasing overall by 21.4% from 172.5 tonnes per facility to 209.4 tonnes per facility (Figure 37). There was a 10-year maximum of 235.4 tonnes per facility in 2012 and a low of 143.4 tonnes per facility in 2016, which was followed by a steady increase towards 209.4 tonnes per facility in 2020.

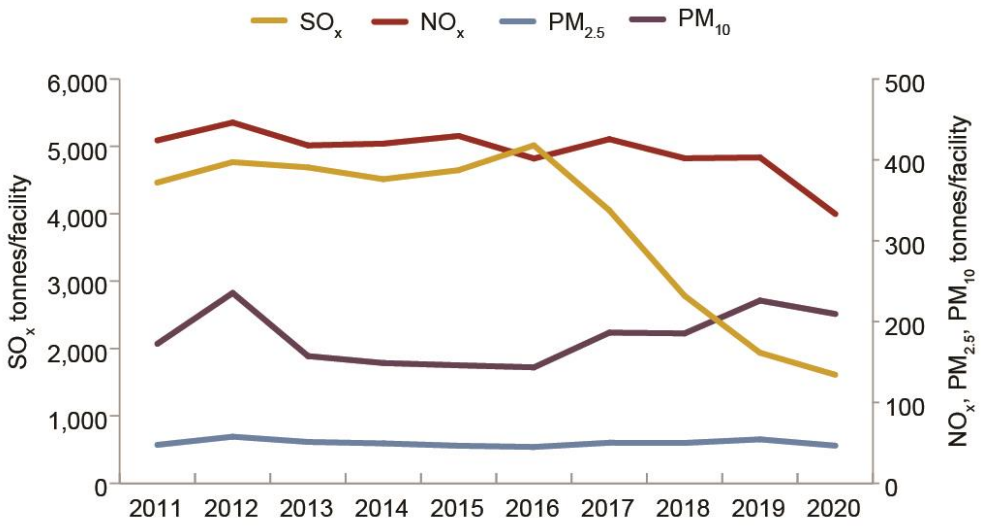
The mining and quarrying (except oil and gas) subsector was the largest source of PM_{10}, contributing 80.8%, 78.4%, and 89.8% of total minerals sector emissions in 2011, 2016, and 2020, respectively. The subsector's PM_{10} emissions also increased 24.8% from 74,866 tonnes to 93,398 tonnes between 2011 and 2020. The primary metal manufacturing subsector was the second highest contributor, adding between 7.5% and 17.4% of total sector emissions between 2011 and 2020. However, primary metal manufacturing PM_{10} emissions also fell by 37.6% from 12,544 tonnes to 7,828 tonnes between 2011 and 2020. The non-metallic mineral product manufacturing subsector emitted 2.7% to 6.6% of total minerals sector PM_{10} while also experiencing emissions decreases of 46.4% from 5,155 tonnes to 2,765 tonnes between 2011 and 2020. While fabricated metal product manufacturing increased emissions of PM_{10} by 0.6% from 69.5 tonnes to 69.9 tonnes between 2011 and 2020, it contributed less than 0.5% of the total minerals sector PM_{10} emissions over the same period.

Figure 36: Minerals Sector Emissions of PM_{10} (thousands of tonnes), 2011-2020



Source: Environment and Climate Change Canada, National Pollutant Release Inventory.

Figure 37: Minerals Sector SO_x, NO_x, $PM_{2.5}$, and PM_{10} Emissions per Reporting Facility, 2011-20



Source: Environment and Climate Change Canada, National Pollutant Release Inventory.

Data Considerations

The data used in this section are from the National Pollutant Release Inventory (NPRI) and the values for 2020 are preliminary and subject to revisions. For more information on the NPRI, consult the guide on Using and interpreting data from the National Pollutant Release Inventory. [125]

[125] https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/using-interpreting-data.html

Greenhouse Gas Emissions

Highlights

- In 2018, the minerals sector emitted 48.7 million tonnes (Mt) of greenhouse gas (GHG), 0.444 Mt (-0.9%) below the 2011 level.
- GHG emissions were relatively flat between 2011 and 2018, averaging 47.4 Mt (± 1.7 Mt). Between 2017 and 2018, there was a small drop in GHG emissions, decreasing 0.8% or 0.403 Mt in the one year.
- For the past five years, the minerals sector has represented on average 6.2% of Canada's total GHG emissions each year.
- GHG intensities were below 2011 levels and displayed an overall downward trend for all minerals sector subsectors.

Definition

Greenhouse gases (GHGs) trap heat in the earth's atmosphere and contribute to climate change. Major sources include fossil fuel combustion and process emissions. Fuel combustion emits gaseous carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Process emissions of CO_2 and other gases arise from decomposition of carbonate minerals, use of reducing agents to produce metals from oxides, transformation of iron into steel, and other manufacturing processes[126].

Rationale

Climate change due to GHG accumulation in the atmosphere is a domestic and international issue. Environmental, economic, and social impacts occur in Canada and at a global scale. Businesses are vulnerable to climate change impacts on transportation, communication, infrastructure, operations, and long-term reclamation.[127] Temperature shifts present risks (e.g., flooding, forest fires) and opportunities (e.g., access to markets via new shipping routes, less snow and ice cover for exploration), now and in the future, so the mineral industry must assess, plan for, and adapt to changes in climate. Monitoring the management of GHG emissions is an important component in assessing efforts to mitigate current and future impacts.

[126] GHG emissions are expressed in carbon dioxide equivalents (CO_2e). Emissions from industrial processes and product use were excluded in prior reports. Historical data was restated to include all sources. Process emissions are particularly significant sources of GHG emissions for Primary Metal Manufacturing and Non-metallic Mineral Product Manufacturing.

[127] Warren, F.J. and Lemmen, D.S. (eds.), 2014, *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptations*, http://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2014/16309.

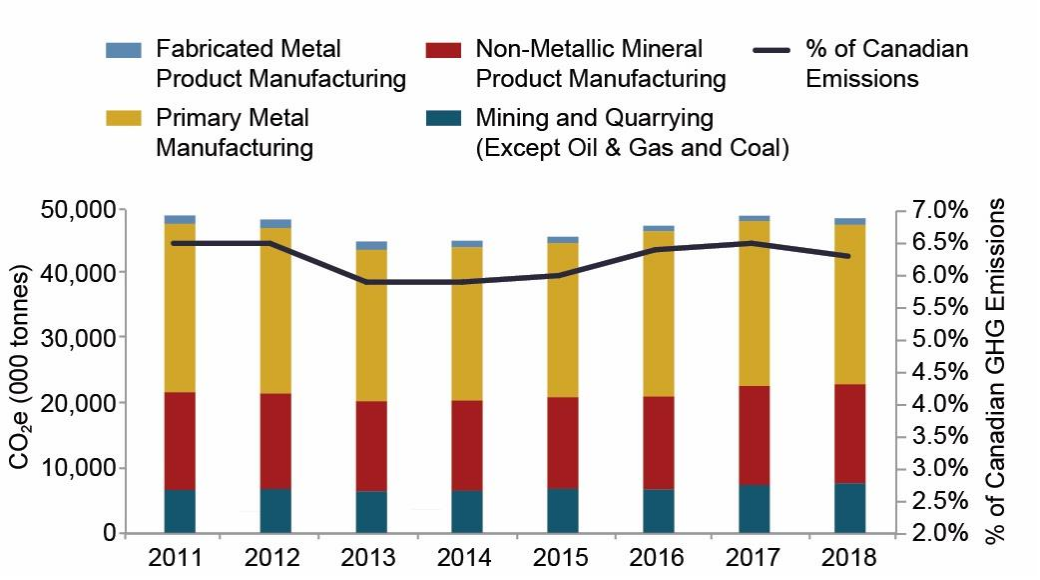
Analysis

The minerals sector has represented an average of 6.2% of Canada's total GHG emissions each year for the past five years. GHG emissions result mainly from fossil fuel use in heavy equipment, for heat and power generation in remote regions, and industrial processes. Changes over time reflect changes in output, product mix, and development of new mines in remote regions where electricity is not available.

In 2018 (the most recent year for which a complete dataset was available), minerals sector GHG emissions were 48.7 Mt, or 0.444 Mt (-0.9%) below 2011 levels (Figure 38).

2018 GHG emission levels were: Primary Metal Manufacturing, 24.7 Mt; Non-metallic Mineral Product Manufacturing, 15.3 Mt; Mining and Quarrying, 7.7 Mt; and Fabricated Metal Product Manufacturing, 0.9 Mt. Sources included reagent and electrode consumption in iron and steel, aluminum, other non-ferrous metal, and ferroalloy production; process heat and decomposition of carbonate minerals in cement and lime production; fuel combustion in heavy equipment, generation of heat and power at remote mines, cogeneration of heat and electricity at a solution mine; drying of mine products; heating of ventilation air at underground mines; and melting, alloying, forming, and joining processes for fabricated metal products.

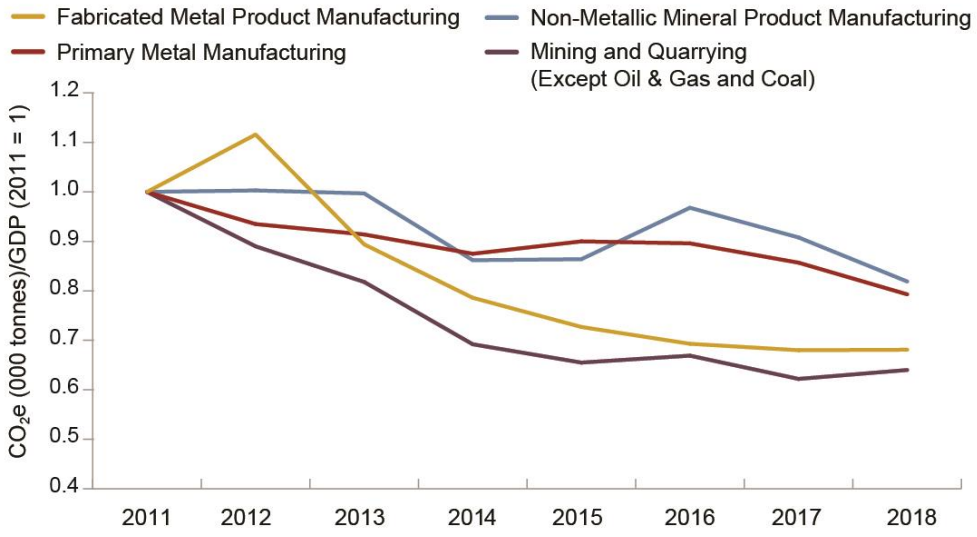
Figure 38: Minerals Sector GHG Emissions, 2011-18



Sources: Canadian Energy and Emissions Data Centre; Statistics Canada.

The intensity of 2018 minerals sector GHG emissions (a ratio of GHG emissions to GDP) was below the 2011 level for all subsectors. All subsectors displayed a downward trend since 2011. GHG emission intensity changes between 2011 and 2018 were: Primary Metal Manufacturing, -12.1%; Non-metallic Mineral Product Manufacturing, -11.9%; Mining and Quarrying (excluding Coal), -13.3%; and Fabricated Metal Product Manufacturing, -30.8% (Figure 39).

Figure 39: Minerals Sector GHG Emission Intensity (GHG/GDP), 2011-18 (2011 = 1)



Source: Canadian Energy and Emissions Data Centre. Statistics Canada

Since its launch in 2004, the Mining Association of Canada's (MAC) *Towards Sustainable Mining* (TSM) standard has included an *Energy and GHG Emissions Management Protocol* that, among other requirements, includes criteria to establish and meet facility level energy and GHG targets. In 2020, TSM replaced this standard with a new climate change protocol to focus action on contributing to meeting the goals of the Paris Climate Accords and facilitate alignment with reporting recommendations from the Task Force on Climate-Related Financial Disclosure. This new protocol establishes three performance indicators: (1) Corporate Climate Change Management; (2) Facility Climate Change Management; and (3) Facility Performance Targets and Reporting. Members are assessed on systems and targets in place, with grades ranging from C (no management systems in place) to AAA (climate change mitigation, scenario planning and adaptation are integrated into a broader sustainable business strategy).

The 2021 TSM Progress Report includes results for 67 mining facilities across Canada belonging to 32 member companies. In 2021, 73% of the facilities were rated A or higher for indicator 1 (facilities that have implemented energy and GHG management systems consistent with the requirements of the protocol), compared to 81% in 2019 and 58% in 2013 (2013 was the first year of reporting on the current protocol, data prior to that is available but not comparable). Indicator 2 (facilities that have internal and external reporting systems for energy and GHGs) was stable at 84% in 2021 compared to 83% in 2019 and 84% in 2013 for facilities ranked A or higher, and indicator 3 (facilities that have established and met performance targets) increased from 34% in 2013 to 53% in 2019 and 62% in 2021.[128]

[128] The Mining Association of Canada, 2021, *Communities and People: Aggregate Performance*. This information should be used with discretion as the report had not yet been finalized.

Data Considerations

Two datasets were used to express minerals sector GHG emissions as a percentage of Canada's overall emissions. Subsector and total industrial GHG emissions were sourced from the Canadian Energy and Emissions Data Centre. The 2018 values were used because 2019 data for mining and quarrying is not available from the Canadian Energy and Emissions Data Centre. That data, which is sourced from Statistics Canada, has not been released beyond the reference year 2018. The Statistic Canada "Physical Flow Account for GHG emissions" dataset is the source for Total Canada emissions.

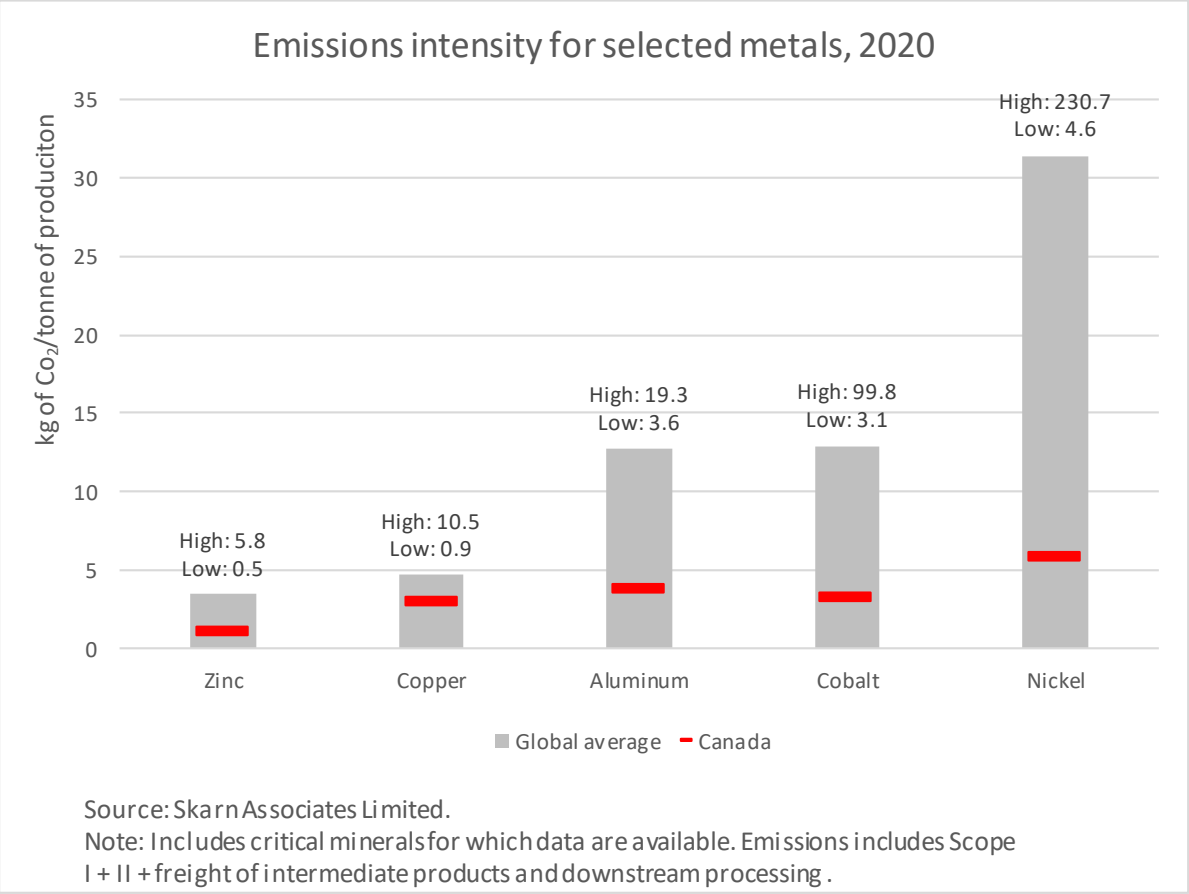
Box 19: Mine electrification and climate change targets support the Canadian minerals sector's low-carbon advantage

In 2021, mining companies around the world announced commitments to decarbonize and prioritize net-zero targets in line with the Paris Accord and the Science Based Target Initiative. The mining industry contributes 4% to 7% of global greenhouse gas emissions with a substantial portion of this stemming from the use of diesel in mining fleets and electricity in mineral processing activities. Electrification of mine sites and substituting out diesel fuels in mining operations will be central to achieving the net-zero commitments.

Canada's minerals sector is well-positioned to take leadership in sector emissions reduction. At a national level, it already has some of the world's lowest greenhouse gas emission intensities due to a clean energy grid, high-grade orebodies for some commodities, and continued investments in clean technology. Canadian companies like Teck Resources, Agnico Eagle Mines Ltd., Barrick Gold Corp., Cameco, Copper Mountain, and Foran Corp., to name just a few, have made net-zero commitments and are making investments to get there. Canada's leadership is further demonstrated by actions such as the Mining Association of Canada's release of a new Towards Sustainable Mining (TSM) Climate Change Protocol in 2021 (Box 18) that focuses on aligning the minerals sector's actions on mitigation and adaptation with both the *Paris Climate Accords* and the recommendations of the *Task Force on Climate-Related Financial Disclosures*.[129] Further investments into a clean energy grid, continued electrification of mine sites, and adoption of innovative solutions such as fuel cell and small modular reactor technologies, and mineral carbonization to sequester carbon dioxide from the atmosphere promise to help maintain Canadian leadership into the future.

The Canadian minerals sector's strong environmental, social, and governance (ESG) profile and low emissions profile position it for future trade and investment, driven by manufacturer preferences and government regulations in support of more responsibly sourced and sustainable production. Enhanced supply chain transparency and innovations in traceability promise to help demonstrate the Canadian advantage in the coming decades.

[129] https://www.canadianminingjournal.com/news/canadian-miners-commit-to-climate-action-with-new-guidelines-from-mac/



Source: Skarn Associates Limited.
Note: Includes critical minerals for which data are available. Emissions includes Scope I + II + freight of intermediate products and downstream processing.

Energy Consumption and Efficiency

Highlights

- In 2018, minerals sector energy consumption was 836.6 Petajoules (PJ), 50.2 PJ (-6.4%) below 2011 levels.
- An eight-year low of 746.0 PJ in 2015 was followed by a rapid increase of 12.2% to 2018.
- The minerals sector accounted for an average of 9.5% (± 0.3%) of total Canadian energy use each year between 2011 and 2018.
- Minerals sector energy intensity decreased 7.8% between 2011 and 2018, while energy intensity for all industries decreased 13.2%.
- Following an eight-year low in 2015, minerals sector energy intensity increased 7.3% by 2017, while energy intensity for all industries declined by 2.2%. However, between 2017 and 2018 the minerals sector's energy intensity fell by 2.7% compared to 2.2% for all industries.

Definition

Energy consumption is defined as the energy used from all sources in a given year. Energy intensity is the ratio of energy consumption to output. The output measure used to calculate energy intensity in this case is Gross Domestic Product (GDP) in millions of 2012 dollars.

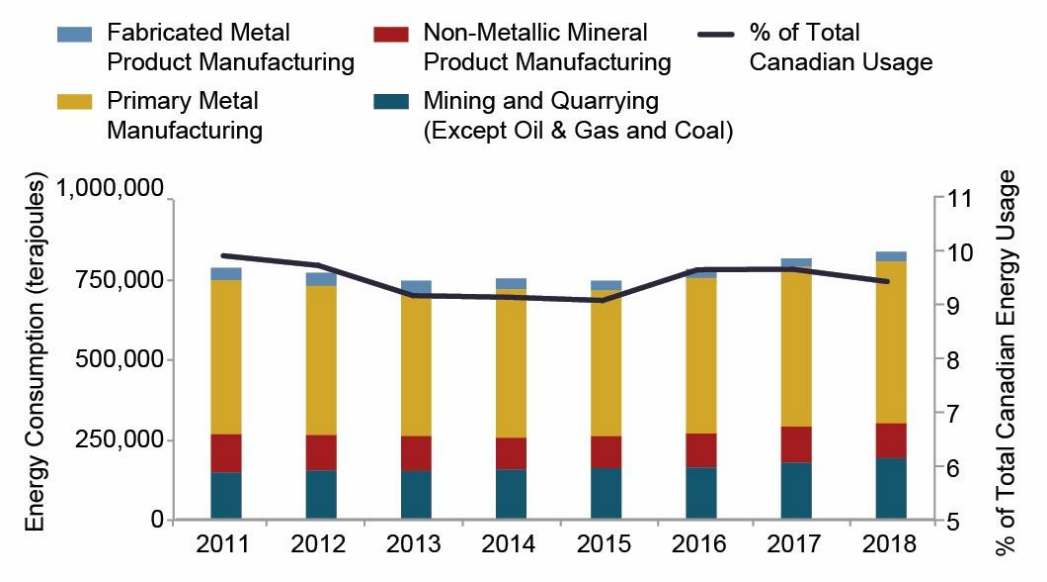
Rationale

Minerals sector activities are energy-intensive and energy cost is an important determinant of business performance and global competitiveness. Improving energy efficiency reduces operating costs and environmental stressors and impacts, including the direct and indirect greenhouse gas (GHG) emissions that contribute to climate change.

Analysis

The minerals sector accounted for 9.4% of total Canadian energy use in 2018, down slightly from 9.9% in 2011. Total 2018 energy use by the minerals sector was 836.6 Petajoules (PJ). Subsector use in 2018 was as follows: Primary Metal Manufacturing, 505.7 PJ (60.4%); Mining and Quarrying (excluding Oil and Gas Extraction and Coal Mining), 192.2 PJ (23.0%); Non-metallic Mineral Product Manufacturing, 108.1 PJ (12.9%); Fabricated Metal Product Manufacturing, 30.6 PJ (3.7%) (Figure 40).

Figure 40: Minerals Sector Energy Consumption, 2011-18



Sources: Canadian Energy and Emission Data Centre, Statistics Canada

Minerals sector energy intensity decreased from 71.7 MJ/$million to 66.1 MJ/$million (-7.8%) between 2011 and 2018, while energy intensity for all industries decreased from 15.1 MJ/$million to 13.1 MJ/$million (-13.2%).

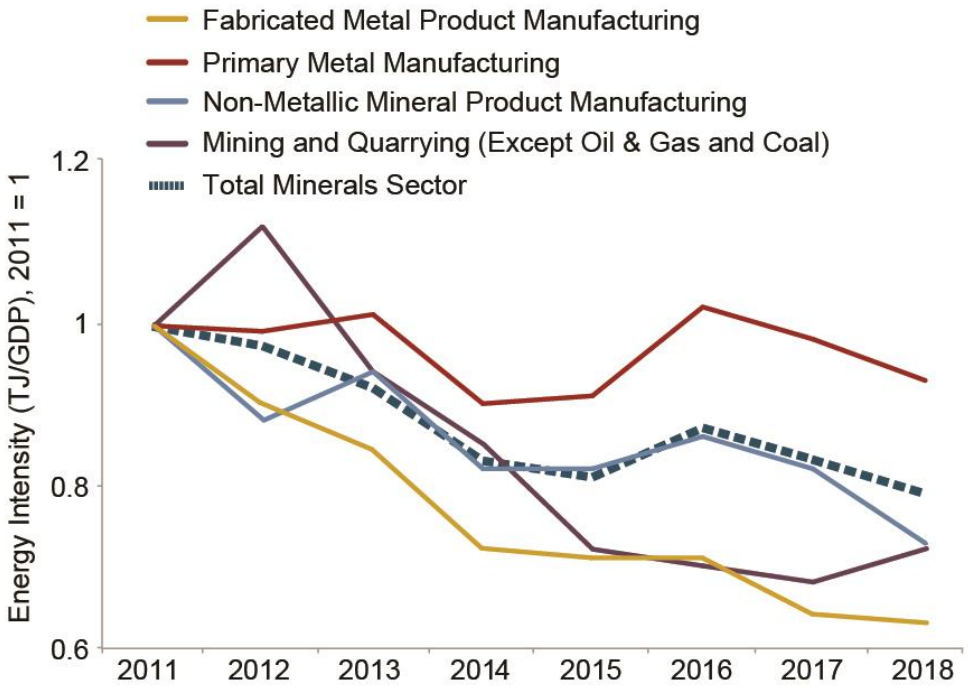
Between 2011 and 2018, energy intensity decreased in all minerals subsectors. Primary Metal Manufacturing decreased -0.7% from 42.70 MJ/$million to 42.40 MJ/$million between 2011 and 2019. Mining and Quarrying decreased -8.7% from 6.57 MJ/$million to 6.00 MJ/$million over the same period.

Between 2011 and 2019, Non-metallic Mineral Product Manufacturing decreased -19.4% from 19.60 MJ/$million to 15.80 MJ/$million. Fabricated Metal Product Manufacturing decreased -32.1% from 2.80 MJ/$million to 1.90 MJ/$million between 2011 and 2018. Changes in subsector intensity are influenced by changes in product mix, production levels, exchange rate, technology, and site openings and closings. Energy intensity for all industries declined by 13.2% over the same period (Figure 41).

Fuel options differ among products, processes, and locations. Electricity is preferred where available, affordable and appropriate (e.g., when heat as a by-product of energy generation for a given process is not needed or desirable). In Primary Metal Manufacturing, electricity is the dominant fuel especially for some energy intensive smelting and refining processes. Solid fuels are used as reducing agents and electrodes are carbon-based, while natural gas keeps metal liquid and prevents re-oxidation. In Non-metallic Mineral Product Manufacturing, natural gas and solid fuel supply heat needed to produce lime, cement and other products. In Mining and Quarrying, current open pit and most underground mines use diesel-powered mobile equipment, while electricity is used for underground mine ventilation and ore processing. Some mines, such as Borden in Ontario, are prioritising the use of battery electric vehicles. Copper Mountain Mine in British Columbia has developed an electric trolley-assist to reduce the amount of diesel used hauling ore from the bottom of their open pit.

Mines in remote regions often lack access to the electricity grid and natural gas. As a result, most remote mines rely on diesel generators to supply heat and electricity. Liquefied natural gas may be used at a new diamond mine with road access while reliance on diesel at some remote sites is being reduced by the integration of wind power and energy storage technologies.

Figure 41: Minerals Sector Energy Intensity (GDP), 2011-18 (2011 = 1)



Sources: Canadian Energy and Emission Data Centre. Statistics Canada

Governments and industry have identified energy as a target for improvement for the industry going forward and have been working on a variety of initiatives to improve energy-use practices. NRCan's Crush It! Challenge is one example of a federal-level incentive driving innovation in one of the most energy-intensive areas of mining (Box 20).

Box 20: Impact Canada Crush It! Challenge

In 2018, Natural Resources Canada launched the **$10 million Crush It! Challenge** to help accelerate technology breakthroughs to reduce energy use in comminution (i.e. the crushing-and-grinding of rock), which is one of the most energy intensive processes of the mining industry. Addressing energy efficiency of comminution provides a unique opportunity for Canada to leverage its research and development ecosystem to help enhance the competitiveness and environmental performance of its mining industry.

A total of 65 applications were received by January 2019, and a technical review committee from Natural Resources Canada evaluated projects to select 12 semi-finalists. In March 2019, the semi-finalists delivered their pitches to a Challenge Jury comprised of external experts in mining, mineral processing, innovation, and technology integration. The Challenge Jury recommended six finalists, who each received $860,000 to develop, test, and validate their technology over 24 months.

In May 2021, finalists delivered detailed technical reports to Natural Resources Canada, which underwent a two-phase review and evaluation process by a technical review committee and Challenge Jury. The Crush It! Challenge has resulted in the development of six technologies that represent a 'step change' in comminution.

The name of the grand prize winner will be announced at the Prospectors & Developers Association of Canada (PDAC) convention in 2022, and will receive a $5 million grant to support commercialization of their technology.

Finalists and Technology	Description
Canada Mining Innovation Council: MonoRoll - Conjugate Anvil Hammer Mill (CAHM)	The MonoRoll is a novel grinding machine designed to fracture rock more efficiently, without the need for grinding media or water. This technology revolutionizes grinding by using two ridged surfaces that rotate as a pair to create semi-confined compression.
Canada Mining Innovation Council and the University of Toronto: CanMicro	CanMicro combines microwave-assisted comminution and multi-sensor ore sorting technology to selectively break particles and sort waste from value minerals, resulting in unprecedented energy reduction potential.
COREM: High Pressure Grinding Rolls (HPGR)	This project aims to demonstrate the energy efficiency potential of the mature HPGR technology with the addition of hydrocyclones, as an alternative for conventional ball mill comminution circuits.
COREM: IntelliCrush	A novel approach, IntelliCrush utilizes machine learning to aid the integration of new equipment models from available data, developing an intelligent system to configure crushing and grinding circuits to reduce energy consumption in comminution.
Envisioning Labs and Rockburst Technologies: Transcritical CO_2 Pulverization (TCO_2)	TCO_2 technology offers the potential to transform traditional comminution, using compression force of CO_2 in a high pressure vessel to cause explosive shattering of ore, eliminating the need for crushing-and-grinding.
*Jenikie and Johanson: Selective Heat Ore Treatment (SHOT)	SHOT is a dry pre-treatment process aimed at recovering more target mineralization at a higher rate, resulting in a transformational reduction in energy usage in grinding and milling ores. This innovative technology applies high-intensity microwave energy, creating micro-fractures at the mineral-grain boundaries to more easily free valuable minerals.

* Note: This finalist became ineligible for the Challenge grand prize due to constraints arising from the COVID-19 pandemic.

Data Considerations

Two datasets were used to express minerals sector energy use as a percentage of Canada's overall emissions. Subsector energy use is sourced from the Canadian Energy and Emissions Data Centre. 2018 values are used because 2019 data for mining and quarrying is not available from the Canadian Energy and Emissions Data Centre as the data, which is sourced from Statistics Canada, has not been released beyond the reference year 2018 at the time of writing. The Statistic Canada "Supply and demand of primary and secondary energy" dataset is the source for total industrial and Total Canada energy use.

Environmental Expenditures

Highlights

- Between 2010 and 2018, the minerals sector's environmental capital expenditures experienced a substantial increase of 122.8% from $475 million to $1.06 billion while environmental operating expenditures increased by 4.2% from $1.08 billion to $1.13 billion.
- Capital expenditures increased by 162.7% between 2010 and 2012 before decreasing by 51.3% between 2012 and 2016. Capital expenditures rebounded between 2016 and 2018 increasing by 74.3%.
- Operating expenditures rose by 17.4% from 2010 to 2014 before decreasing 11.2% between 2014 and 2018.

Definition

Environmental expenditures are defined as all capital (investment) and operating (current) expenditures incurred by businesses to comply with current, and anticipate future, Canadian and international environmental regulations, conventions, or voluntary agreements. Expenditures are sub-divided by Statistics Canada into environmental monitoring, environmental assessments and audits, reclamation and decommissioning, wildlife and habitat protection, waste management and sewerage services, pollution abatement and control processes (end-of-pipe, including waste management), pollution prevention processes, fees, fines and licences, and others.

Rationale

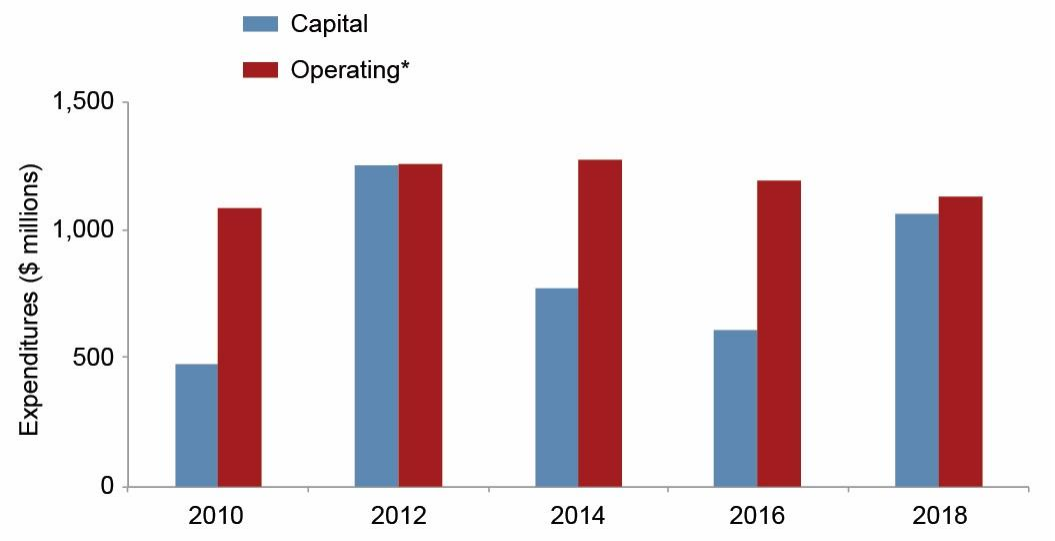
Expenditures on environmental protection provide an indication of the level of commitment and investment the industry is making to protect the environment and maintain healthy ecosystems. They also reflect the desire of Canadian and international governments to protect the natural environmental via regulation that requires or incentivizes these types of expenditures.

Analysis

Between 2010 and 2018, the minerals sector's capital expenditures on environmental protection jumped from $475 million to $1.06 billion, while operating expenditures increased from $1.08 billion to $1.13 billion (Figure 42). In 2010, the minerals sector accounted for 10.7% of Canada's total capital expenditures and 21.7% of operating expenditures, while in 2018, the sector's share for capital expenditures increased to 27.9% and the share for operating expenditures decreased to 19.2%. Of note, the minerals sector reduced capital expenditures by more than half in 2016 compared to 2012, receding from $1.25 billion to $607 million, and spending for operating expenditures were also reduced from $1.25 billion to $1.19 billion. However, the sector saw large increases in capital expenditures from

2016 to 2018, jumping to $1.06 billion. Conversely, operating expenditures fell slightly to $1.13 billion.[130] Significant variations in capital spending occurs as large and capital intensive projects are initiated and completed over the course of one or a few years.

Figure 42: Environmental Protection Expenditures in the Minerals Sector, for Select Years 2010-2018

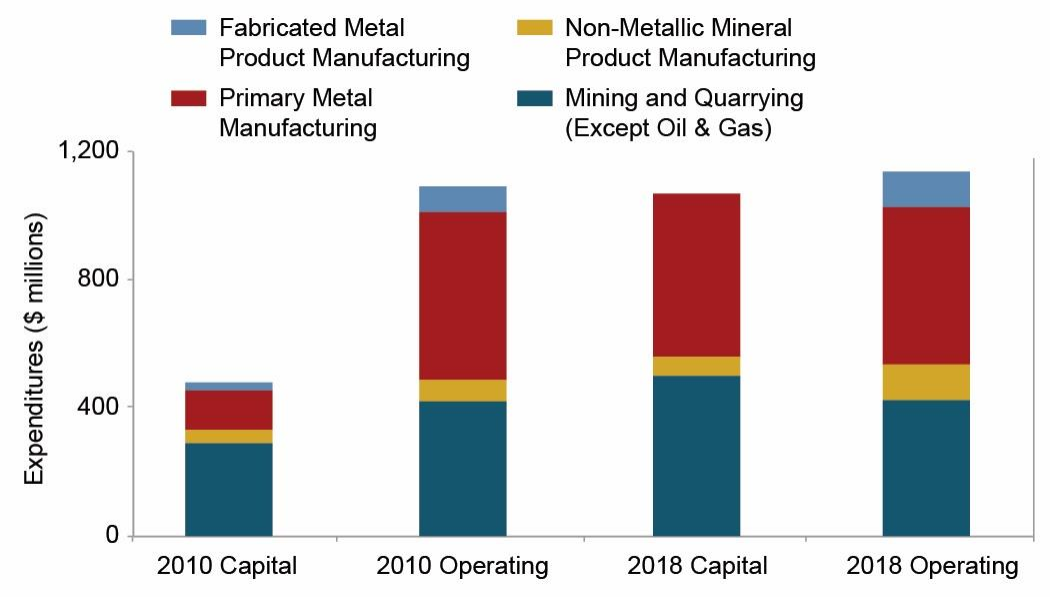


* Fees, fines and licences expenditures are excluded from operating expenditures.

In 2010, the mining and quarrying subsector accounted for the largest share of capital expenditures (60.3%) followed by the primary metal subsector at 25.6%. By 2018, however, the primary metals subsector had surpassed the mining and quarrying subsector in capital expenditures, with 47.6% of the minerals sector's capital expenditures on environmental protection. In 2010, 48.0% of the operating expenditures belonged to the primary metal subsector and in 2018, the subsector remained as the largest share of operating expenditures, accounting for 43.1% (Figure 43). The fall in the subsector's share in 2018 was primarily due to the increasing share of operating expenditures accounted for by non-metallic mineral product manufacturing, which increased from 6.1% in 2010 to 9.8% in 2018.

[130] Statistics Canada, Environmental Protection Expenditures in the Business Sector.

Figure 43: Environmental Protection Expenditures, by Subsector, 2010 and 2018



NB: Capital expenditures for Fabricated Metal Product Manufacturing in 2018 were too unreliable to be published.

Data Considerations

It is important to note that the data on environmental expenditures for the fabricated metal product manufacturing subsector were unavailable for certain years. Capital expenditures data by type of activity for each subsector were also suppressed to meet confidentiality requirements or were too unreliable to be published for select years.

Orphaned and Abandoned Mines

Highlights

- Many provinces and territories have developed programs or allocated funding to tackle orphaned and abandoned mines within their jurisdictions.
- The National Orphaned/Abandoned Mines Initiative (NOAMI) as a multi-stakeholder Advisory Committee has reached its potential and fulfilled its original mandate.
- Although NOAMI and its Secretariat will wind down in 2022, the important guidance documents that NOAMI produced and the web-based NOAMI Inventory of Orphaned and Abandoned Mines will be preserved and continue to inform the reclamation and closure work that remains at legacy sites across Canada.

Definition

Orphaned or abandoned mines are mines for which the owner cannot be found or for which the owner is financially unable or unwilling to remediate the site. Canada's long mining history has left many abandoned exploration and mine sites that require varying degrees of rehabilitation.[131]

Rationale

Abandoned mines pose environmental, health, safety, and economic risks to local communities, the mining industry, and governments. Abandoned mines also represent a significant liability to the Crown. Today, mining legislation in all Canadian jurisdictions requires mine developers to submit mine closure plans that describe how the site will be rehabilitated throughout its life cycle, how it will be decommissioned when mining activities end, and to post a financial surety to ensure these activities are carried out.[132]

Analysis

Many jurisdictions have developed programs or allocated funding to remediate and reclaim orphaned and abandoned mines. Federal, provincial and territorial governments were invited to provide information and data about the management of orphaned or abandoned mines within their respective jurisdictions. Their responses are presented as follows:

[131] https://noami.org/intro_e.php

[132] Standards and requirements vary. These are not a guarantee of the obligations that a company may incur (e.g., may not be financial surety for 100%) but, rather, an assurance of compliance with the defined closure plan.

Federal, Provincial and Territorial Initiatives

Federal Government – Crown-Indigenous Relations and Northern Affairs

The Northern Contaminated Sites Program, within Crown-Indigenous Relations and Northern Affairs (CIRNA) is responsible for the management of contaminated sites, including abandoned mines in Yukon, the Northwest Territories and Nunavut.

Since 2020, the Northern Contaminated Sites Program has received funding from two sources: the Northern Abandoned Mine Reclamation Program, which has allocated $2.2 billion over 15 years to manage the remediation of eight abandoned mines in Yukon and the Northwest Territories; and the Federal Contaminated Sites Action Plan, a horizontal initiative led by Environment and Climate Change Canada and Treasury Board Secretariat, which provides $188 million over five years towards CIRNA's remaining portfolio of contaminated sites.

As of 2021, 61 sites are classified as high priority for action within CIRNA's portfolio of contaminated sites (N.W.T. = 36, Nunavut = 18 and Yukon = 7). Between 2015 and 2020, the Program spent $964 million on assessment, remediation, care and maintenance, and long-term monitoring of current and former mineral exploration sites. The program's budget was approved for $254 million for fiscal year 2021-2022. Giant Mine and Faro Mine are the two largest active remediation projects and are in the process of developing a remediation strategy and implementing a care and maintenance strategy.

Yukon

In 2003, the Government of Canada and the Government of Yukon signed the Yukon Northern Affairs Program Devolution Transfer Agreement. Under this agreement, responsibility for managing resources in Yukon was transferred from the federal government to the territorial government. In the Devolution Transfer Agreement, there are seven mine sites, called Type II, identified as having, or potentially having, unfunded environmental liabilities. Some are abandoned, and others have resumed operations under various arrangements. Funding for remediation of historical liabilities at abandoned Type II sites is the responsibility of the Government of Canada.

Out of the Type II sites, five are considered abandoned, including Faro, Clinton Creek, Ketza River, Mount Nansen and Keno Hill. These sites are in various stages of remedial planning. Mount Nansen and Keno Hill are slated to be remediated by private industry through a sale arrangement led by the Government of Canada. The Government of Canada also funds the Faro Mine Remediation Project and leads the care and maintenance, site monitoring, consultation, remediation plan design and regulatory process for the project. The Government of Yukon is responsible for overseeing care and maintenance and remediation planning at the Clinton Creek and Ketza River sites.

Mine sites that were permitted after the Devolution Transfer Agreement came into force are the responsibility of the Government of Yukon in the event of abandonment. Government of Yukon is currently responsible for one such site, the Wolverine Mine, which was abandoned in 2019. Government of Yukon oversees care and maintenance activities at the Wolverine mine, including water treatment, and has expended $19 million to date. Of the $19 million, $10.5 million has been recovered from security furnished by the former operator.

Northwest Territories

The Giant Mine Remediation Project is a closure and remediation project for the Giant Mine Site, an abandoned gold mine, within the municipal boundaries of the City of Yellowknife. The Giant Mine Remediation Project is co-managed by the Governments of Canada and the Northwest Territories.

The Giant Mine Remediation Project addresses the long-term containment and management of the arsenic trioxide waste, long-term water management and the demolition and removal of all buildings on the surface, and the remediation of surface areas including the tailings ponds at the former Giant Mine site in Yellowknife. Active remediation activities began in 2021 and are anticipated to be carried out over a period of approximately ten years followed by the long-term care of a designated core area remaining under the management of Canada.

British Columbia

In response to recommendations of an Auditor General's Report, British Columbia (B.C.) established the Crown Contaminated Sites Program (CCSP) in 2003. CCSP manages prioritized contaminated sites, including historic mine sites, on Crown land for which there is no existing responsible person or permitting agency. CCSP uses a science-based, risk-ranking methodology to confirm and prioritize sites based on the contamination risk they pose to human health and the environment. As of March 2018, 87 historic mine sites have been investigated, of which 48 have been determined to be low risk where no immediate action is required, 19 have been remediated, and 15 are under investigation or already undergoing remediation. Remediation undertaken complies with the *Environmental Management Act*, the Contaminated Sites Regulation, and the Hazardous Waste Regulation.

The Provincial Contaminated Sites Secretariat is a committee with representatives from ministries with responsibility for the management of contaminated and potentially contaminated sites. In addition to providing a coordinating function, the Secretariat serves as a forum for members to discuss the Public Sector Accounting Board Standard 3260 financial reporting requirements adopted in 2015, to help ensure a consistent approach to reporting liability associated with the remediation of contaminated sites.

In 2019 the BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI) initiated the Abandoned Mines Branch (AMB). Under the regulatory authority of s.17 of the *Mines Act*, the mandate of the AMB is to mitigate protect public safety and eliminate or mitigate risks to human health, safety, and the environment at historic mines. Since inception, the AMB has developed a risk-based criteria to prioritize work, compiled historic records, and initiated an inventory and assessment program with site visits to more than 20 historic mines. The AMB is also overseeing work at four abandoned tailings storage facilities.

Saskatchewan

The Government of Saskatchewan enacted legislation in 2007 to implement an Institutional Control (IC) Program for the post-closure management of decommissioned mine and mill sites on provincial Crown land. The IC Program allows sites to be returned to Crown control if conditions are met. It has garnered international attention, and NOAMI has identified the program as the most advanced Canadian regulatory regime that addresses all aspects of site relinquishment and an important component in preventing the abandonment of sites in the future.

Project CLEANS (Clean-up of Abandoned Northern Sites) is a multi-year, multi-million dollar project aimed at assessing and reclaiming northern uranium sites, including the Gunnar mine, Lorado mill, and 35 associated sites in northern Saskatchewan managed by Saskatchewan Research Council.

In 2006, the governments of Saskatchewan and Canada signed a Memorandum of Agreement to share equally in the costs to clean-up the Gunnar mine and satellite sites. In 2014, the Government of Saskatchewan established an additional liability of $222 million to fund the remaining remediation required at the sites and to date has spent over $215 million on remediation activities. Encana Corp. contributed to a liability fund held by the Government of Saskatchewan and used to clean-up the Lorado mill portion of the project. Remediation is complete at the Lorado mill and 18 satellite sites as on-site work continues at Gunnar mine and four additional satellite sites.

Aside from Project CLEANS, the Government of Saskatchewan has identified a liability of $30.4 million for the remediation of six non-uranium sites in northern Saskatchewan as a commitment to address abandoned mine sites on Crown land and reduce the overall number of contaminated sites. Recently completed remediation activities at the Newcor abandoned mine site near Creighton will reduce the overall liability for the six non-uranium sites by approximately $1.5 million. Further assessment and corrective action planning are advancing for the remaining sites.

It is intended that once remediation is complete and the legacy sites are environmentally sound, they will be transitioned into the IC Program and maintained by the Government of Saskatchewan into perpetuity.

Manitoba

In 2000, Manitoba established the Orphaned and Abandoned Mine (OAM) Site Rehabilitation Program to address the public safety and environmental health concerns associated with orphaned and abandoned mine sites. In November 2019, the OAM Site Rehabilitation Program was transferred to Manitoba Conservation and Climate (now Manitoba Environment, Climate and Parks) to support mandate and policy alignment as the department works to advance a cleaner and greener Manitoba. There are 153 sites within the Orphaned and Abandoned Mines Rehabilitation Program. According to a recent assessment carried out by the OAM program there are six sites identified as high-risk sites with the remainder being identified as low to moderate risk. Currently, the OAM Program is identifying priority sites to further reduce risks to the environment and human health. Recent investments include $45 million to advance remediation at Ruttan mine site and $50 million to support the long-term care and monitoring at orphaned and abandoned mine sites. In fall 2021, earthwork construction at Sherridon mine site was completed. Monitoring and maintenance will continue to occur at Sherridon, as a major milestone for the program. Manitoba is committed to building upon this momentum and continues to advance efforts to support economic growth and ensure environmental protection and human safety at mining legacy sites in the province.

Ontario

Ontario established its Abandoned Mine Rehabilitation Program (AMRP) in 1999. AMRP has an annual budget of $5 million that supports rehabilitation of physical mine hazards. There are approximately 2,400 sites for physical mine hazard remediation under Crown responsibility. To date, Ontario has spent more than $145 million rehabilitating over 80 of the province's highest priority abandoned mine sites physical hazards.

Ontario's Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) is also responsible for the environmental remediation of 46 contaminated sites under Ontario's Contaminated Sites program. The ministry has conducted work totaling approximately $50 million at these sites in the past five years alone.

In 2021-2022, the ministry led 75 investigation and rehabilitation projects at 26 abandoned mine sites.

Quebec

In Quebec, the Ministère de l'Énergie et des Ressources naturelles (MERN) oversees the reclamation and environmental monitoring of abandoned mine sites when the sites are on public land and the owner is unknown or insolvent, or when the sites are voluntarily reclaimed by the government. Since 2006, the MERN has invested $206.7 million in the reclamation, security, maintenance and monitoring of abandoned mine sites. On March 31, 2021, the MERN estimated at $1.05 billion the costs related to environmental liability for mine sites. This amount includes $716.3 million for currently abandoned mine sites and $290.9 million for mine sites for which the MERN may have to take action in the future given the precarious financial state of the owners. In addition and as of March 31, 2021, Quebec has 400 abandoned mine sites, including 223 abandoned mineral exploration sites, 174 abandoned mining sites and 3 quarries and sand pits. The MERN develops and publishes an annual work plan in which it presents the work it plans to do to reduce the environmental liabilities related to abandoned mine sites in its care. Furthermore, it has made progress updates available to the public since 2020. The next iteration of the MERN work plan will be aligned with the new frame of reference on the management of contaminated sites for which the government is responsible, which was developed by the Quebec government.

Newfoundland and Labrador

Orphaned and abandoned mines (OAM) in Newfoundland and Labrador range from exploration adits to large-scale former producing mines. OAM resulted from mining operations between the late 1800s up to 1990s until the province enacted the Mining Act in 2000. The Act requires rehabilitation and closure planning plus financial assurance to cover these costs in the event of an unplanned closure. OAM create both potential safety risks and environmental liabilities associated with management and remediation. The province reports on this liability through the Impacted Sites Liability Assessment Program that identifies 69 OAM sites in Newfoundland and Labrador.

Since 2000, Newfoundland and Labrador has spent over $34 million on OAM sites for remediation and safety activities. The Newfoundland and Labrador government has allocated $150,000 per year for OAM site safety maintenance and dam monitoring. Larger remediation or dam repair projects typically require a request for special funding.

The province recognizes tailings dams as a major safety and environmental risk associated with OAM sites. The province has been focused on meeting and implementing the Canadian Dam Association (CDA) Dam Safety Guidelines for the 21 tailings dams located at six OAM sites throughout Newfoundland and Labrador. An OAM Dam Risk Registry was developed to identify, characterize and assess the significance of identified risks to prioritize the remediation work. As a result, approximately $700,000 was secured for repairs to four tailings dams at the former Buchans mine site during 2021 based on risk assessments and CDA Dam Safety Guidelines.

Nova Scotia

There are more then 8,400 abandoned mine openings (AMO) in Nova Scotia, many of which are located on Crown land. An inventory of these openings was started in 1993, and in 2001 the AMO Remediation Program was initiated in Nova Scotia. The program is managed jointly by the Geoscience and Mines branch and Regional Services branches of Department of Natural Resources and Renewables (NRR). It is overseen by the executive directors of the Geoscience and Mines, Regional Services and Land Services branches of NRR. Rehabilitation for mines found on Crown land falls under the purview of two departments: NRR, together with the Department of Nova Scotia Environment and Climate Change, who handle site reclamation regarding environmental impacts. NRR also responds to potential physical hazards to public safety on Crown land sites exclusively. Over the last 20 years the program has invested about $930,000 to remediate the most hazardous openings on Crown land. In the 2020-21 fiscal year, about $55,000 was spent on five former mine sites.

In April 2020, Version 8 of the Nova Scotia AMO Database was released. It is an update to the 2017 release and provides updated information (e.g., hazard rating, coordinates) on more than 1,200 mine openings, including approximately 850 newly identified mine openings. This database is available on-line.

National Orphaned/Abandoned Mines Initiative

The National Orphaned/Abandoned Mines Initiative (NOAMI) is a national multi-stakeholder program established in 2002 at the request of Canada's federal, provincial and territorial Mines Ministers to assess issues and make recommendations for implementation in orphaned and abandoned mine site reclamation programs across Canada.

Over the past 20 years, NOAMI has built up a strong national and international reputation. Several countries are using NOAMI as a model to develop their programs for their legacy mine sites (Australia, United States). The initiative has successfully produced a number of important guidance documents and reports to assist Canadian stakeholders in both the cleanup of abandoned mines and their prevention. In 2017, the program delivered on one of its key objectives, as laid out in 2002, with the launch of the web-based NOAMI Inventory of Orphaned and Abandoned Mines. [133] The interactive map-based inventory allows users to view information about sites as provided by the various Canadian jurisdictions and to connect directly to their databases where possible.

In 2019, Canada's Mines Ministers directed NOAMI to explore expanding its mandate to reflect new and emerging issues, including climate-related risks and examining mining value from waste as a potential approach to reduce public liability. In response, the Canadian Minerals and Metals Plan - Action Plan 2020 introduced a pan-Canadian initiative to re-imagine NOAMI.

NOAMI as a multi-stakeholder program has reached its potential and fulfilled its original mandate. Although NOAMI and its Secretariat will wind down in 2022, the important guidance documents that NOAMI produced, as well as the web-based NOAMI Inventory of Orphaned and Abandoned Mines will be preserved and continue to inform the reclamation and closure work that remains at legacy sites across Canada.

[133] https://noami.org/intro_e.php

In place of NOAMI, an annual Orphaned/Abandoned Mine Workshop is being developed to facilitate information sharing, diverse and inclusive engagement, and broad collaboration on challenges related to orphaned and abandoned mine reclamation by gathering governments, practitioners, industry, Indigenous Peoples, environmental non-government organizations, and academics into one place.

Conclusion

Continual improvement of the economic, social, and environmental performance of the minerals sector is important to its image, reputation, and potential for long-term success in Canada. The objective of this report was to quantify and describe the sector's performance over the last 10 years, including its successes, information and data gaps, and areas with further room for improvement. The information contained in the preceding chapters was compiled to support the efforts of industry, governments, civil society, and academia in ensuring that Canada benefits from a sustainable and responsible mineral resource sector.

The COVID-19 virus was first identified in late 2019 and the ensuing global pandemic had major impacts on the minerals sector in Canada and abroad. Repercussions of these impacts can be seen in the 2020 data for many of the indicators presented in the preceding report. Economic downturn, supply-chain disruption, and loss of employment were just some of the effects seen worldwide as the virus spread. The minerals sector in Canada was tested as were other sectors in the rest of the world. The realities of the pandemic will continue to challenge Canadian industry for years to come. It is likely that a full accounting of the disruption to the minerals sector and supply chains will not be possible for several more years. The next edition of this report (to be published in 2025) will likely be better-positioned to present a retrospective look at the pandemic's influence on the Canadian minerals sector from 2019 onward.

Canada's minerals sector continues to demonstrate improvement over time with respect to many of the economic, social, and environmental indicators that were analyzed and presented in this report. The sector makes a significant contribution to Canada's economy as well as those of the provinces and territories. Companies operating in the minerals sector are often major contributors to the local economy in Canadian communities that play host or are adjacent to their operations. Socially, the sector continues to make strides in community engagement efforts, highlighted by the number of agreements signed between mineral companies and Indigenous communities or groups. New data sources allowed a more comprehensive examination of gender diversity and inclusion in the current report. New information showed the wage gap between men and women in the mining and quarrying subsector narrowed to 2% in 2020, down from a peak of 15% in 2012. It is hoped that future reports can continue to expand the analysis of these and related topics, as more comprehensive data on diversity remains a gap. Environmentally, the minerals sector continues to make efforts to minimize greenhouse gas emissions, lowered its energy consumption, and shows ever greater efficiency in its energy intensity. The sector as a whole has demonstrated success in maintaining compliance with increasingly stringent water-quality standards under the Metal and Diamond Mining Effluent Regulations (formerly the Metal Mining Effluent Regulations).

Products extracted and manufactured by the minerals sector are used in critical infrastructure such as highways, communication networks, and housing. Mined products are used in everyday products like electronic devices, toothpaste, and the fertilizers that increase crop yield and plant resistance to disease. These and innumerable other items are essential to modern life. Canada's recent

announcement of its *Critical Minerals List* (2021) of 31 minerals recognizes the export opportunities and security requirements that are closely-tied to outputs of the minerals sector. These and other minerals are fundamental inputs of clean energy technology and green products including electric vehicle batteries, solar panels, and wind turbines, which all rely on minerals and metals generated by the sector.

The sector continues to make far-reaching contributions to Canada's socio-economic vitality. Providing income to individuals through quality well paying employment, creating and sustaining economic opportunities, and generating prosperity that extends from rural and remote communities, to cities, and every corner of the country.

Environmental, social, and economic sustainability is an ever-increasing area of concern both domestically and internationally. The rapidly changing landscape of geopolitics and trade will inevitably have an affect on Canada's minerals sector as will climate change. Continued competitiveness of the sector and the appeal of Canada as a location of choice for exploration and mining investment requires sustained investment and advances in productivity and innovation. This includes investment in identifying, collecting, and publishing new and more comprehensive data. Trustworthy and publicly-available data resources are crucial in quantifying these and other emerging issues and are critical in understanding and anticipating the future performance and challenges of the sector.

Issues – including the global COVID-19 pandemic, geopolitical tensions, increasing demand due to population growth, supply chain security, enhancing economic opportunities for Indigenous communities throughout the mineral development cycle, attracting and retaining highly skilled personnel, employing innovative practices and emerging technologies, and attaining the investment necessary to capture the full potential of Canada's minerals and metals resource advantage – will continue to influence the sector's successes and areas for improvement and warrant careful and ongoing attention. Future editions of the MSPR will define and analyze new economic, social, and environmental indicators so that the minerals sector's performance may be better monitored and evaluated.