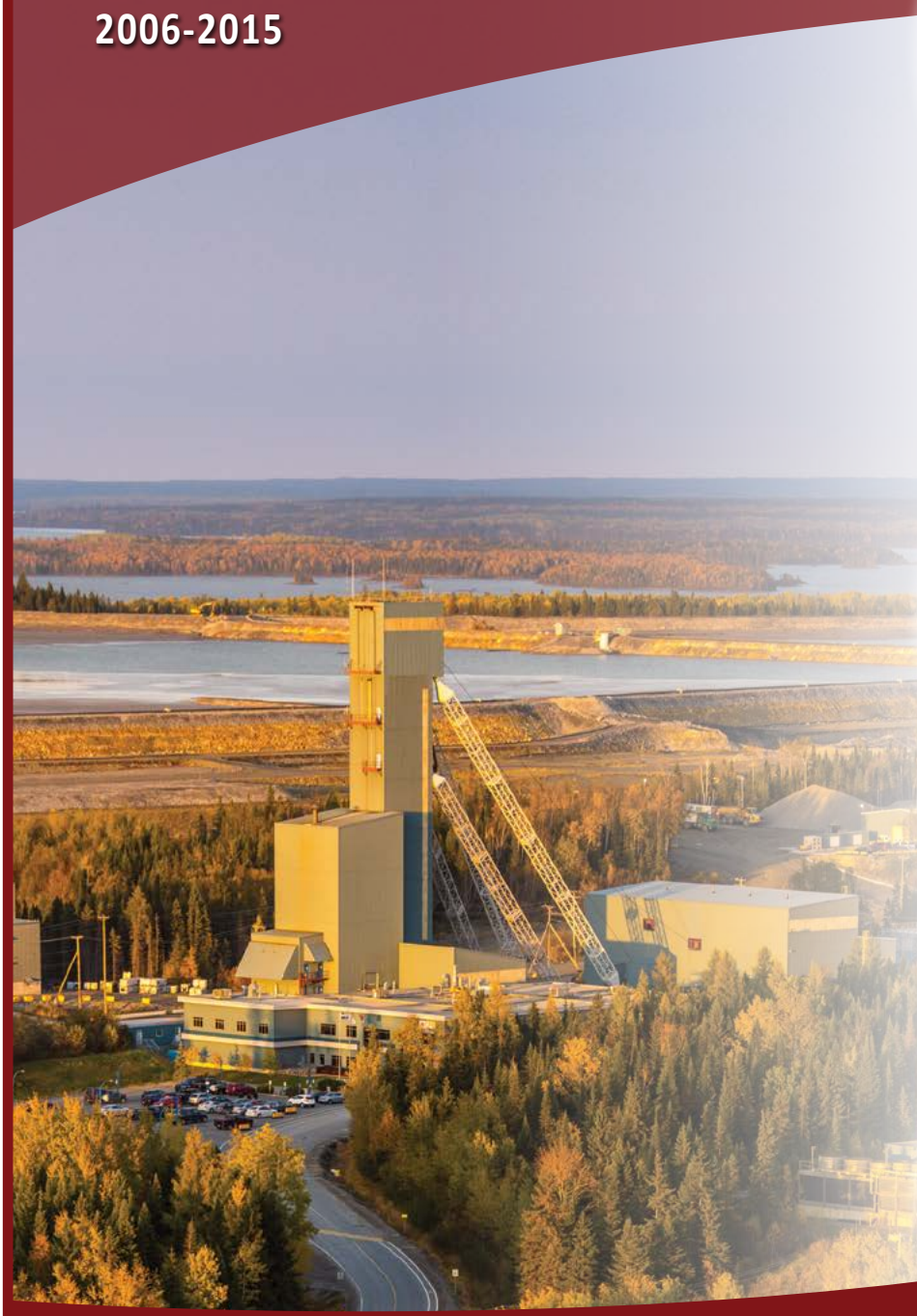
MINING SECTOR PERFORMANCE REPORT

2006-2015



Energy and Mines Ministers' Conference
Winnipeg, Manitoba
August 2016

MINING SECTOR PERFORMANCE REPORT

2006-2015

Energy and Mines
Ministers' Conference
Winnipeg, Manitoba
August 2016

Cover photos used with permission:

Agnico Eagle Mines Limited's LaRonde mine.
Diavik diamond mine wind farm, Diavik Diamond Mines (2012) Inc.

Cat. No. M31-15 (Print)
ISSN 2291-9384

Cat. No. M31-15E-PDF (Online)
ISSN 2291-9341

Aussi disponible en français sous le titre :

Rapport sur la performance du secteur minier 2006-2015

Table of Contents

PREFACE

The 2016 edition of the *Mining Sector Performance Report* examines the economic, social, and environmental performance of the Canadian mineral industry from 2006 to 2015, and benefits from insight, review, and comments 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 Energy and Mines Ministers' Conference in August 2016 in Winnipeg, Manitoba.

The report focuses on:

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

For the purpose of this report, the terms *mineral sector* and *mineral 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 – nonmetallic mineral product manufacturing;
- NAICS 331 – primary metal manufacturing; and
- NAICS 332 – fabricated metal product manufacturing.

For some indicators (i.e., gross domestic product, employment, investment), additional data related to the mineral exploration subsector are available and included in sector totals.[1] In these cases, this is highlighted in the text.

The data exclude oil sands activity. In addition, data and analysis considerations are explained where applicable to provide the reader with an understanding of specific data constraints.[2] Data are current to May 2016.

[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 (i.e., production and exports) reflect price fluctuations.

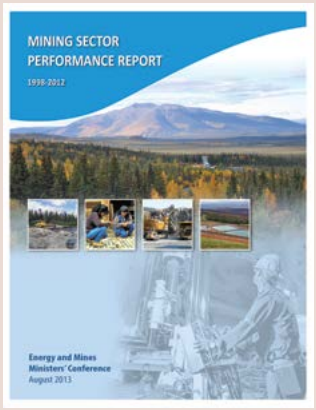
INTRODUCTION

Canada is a resource-rich nation and the country's economic health is inextricably linked to the discovery and development of natural resources. In particular, the mineral industry has been a significant contributor to Canada's growth and prosperity, providing jobs and economic opportunities in all regions of the country and supporting the economic and social cohesion of many rural, remote, and northern communities. Today, the mineral industry remains an important part of daily living, supplying crucial building blocks for everyday products such as electronic devices, cars, and even toothpaste, which are essential to modern living. Moreover, mined products are vital inputs into clean energy and green technologies such as wind turbines, fuel cells, and new battery technologies, which are destined to become key drivers of Canada's future economy.

Canada remains one of the world's leading mineral nations, producing more than 60 minerals and metals and ranking among the global leaders for the production of a host of key commodities, including potash, uranium, gold, primary aluminum, nickel, and diamonds. Canada's vast endowment of minerals and metals provides it with immense possibilities to meet global commodity demand, to solidify its international standing as a major mining jurisdiction, and to play a leadership role in the development of tomorrow's global mineral industry. However, the opportunity to further leverage the country's mineral wealth and transform it into long-lasting prosperity for all Canadians comes with a responsibility to operate in an environmentally sustainable and socially responsible manner.

In the conduct of its activities, the mineral industry has a significant impact on the Canadian economy, society, and environment in all regions of the country. Maintaining awareness of the sector's economic, social, and environmental performance is essential to articulate progress, to highlight improvements, to share best practices, and to identify gaps and areas that need additional attention to maintain Canada's minerals and metals resource advantage and public confidence in this activity. As such, federal, provincial, and territorial governments have collaborated with stakeholders from academia, industry, and Indigenous and non-governmental organizations to produce this report.

Box 1: Mining Sector Performance Report 1998-2012



Presented to Canada's Mines Ministers at their annual conference in August 2013, the report examined the economic, social, and environmental performance of the mineral sector from 1998 to 2012.

www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/mineralsmetals/files/pdf/MSP-report-eng.pdf.

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 taken place and where progress is still needed; and

3. To help inform the development of priorities for the collaborative work being carried out by the federal-provincial/territorial Energy and Mines Ministers' Conference and the Intergovernmental Working Group on the Mineral Industry.

To achieve these objectives, the current report measures the performance of 25 indicators over the period 2006-15.[3] Except for the addition of two new indicators (expenditures on public geoscience, and discharges to surface and groundwater), the indicators are similar to those utilized in previous reports. In some instances (i.e., employment), data sources differ from previous reports and, in these cases, are highlighted and explained.

[3] Due to data availability, flexibility is required as, in some cases, the latest available data are for 2013 or 2014.

In general, the 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.

Drawing from the Whitehorse Mining Initiative[4] and the Mining, Minerals and Sustainable Development North America initiative,[5] several "desired performance outcomes" were identified to complement the conceptual framework for the MSPR with assessable goals (Box 2). Both government and industry have a role to play in improving the sector's performance, which is why government actions are included in the report (e.g., National Orphaned/Abandoned Mines Initiative, Metal Mining Effluent Regulations, land-use planning, and others).

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 mineral sector; and
- **Sections II, III, and IV**, respectively, present the mineral sector's **economic, social, and environmental** performance based on the selected indicators.

While the report monitors the sector's performance across three pillars – economic, social, and environmental – these are inherently interconnected. For example, profitable mines can generate significant positive social outcomes; poor environmental practices can create significant financial liabilities and annul a social licence to operate; and robust worker health and safety procedures can contribute to enhanced productivity.

Box 2: Desired Performance Outcomes

Economic

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

Social

Develop Canada's mineral resources in order to provide tangible benefits for current and future generations, including local communities in proximity to exploration and mineral activities.

Conduct engagement processes to ensure local and affected communities have the opportunity to participate in the development of resources that could influence their future.

Environmental

Practise responsible mineral exploration, development, and operations, and support public policies that are predicated on maintaining a healthy environment and, upon closure, returning mine sites and affected areas to viable, self-sustaining ecosystems.

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.

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.[6] As such, all data, findings, and broad conclusions contained in this report have been reviewed by a range of stakeholders.

[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] Members of the External Advisory Committee for the MSPR included: Ben Chalmers (The Mining Association of Canada); James Cooney (Canadian Business for Social Responsibility); Wes Cragg (Canadian Business Ethics Research Network, York University); Hevina S. Dashwood (Brock University); Hans Matthews (Canadian Aboriginal Minerals Association); Shirley Neault (Hudbay Minerals Inc.); Richard Smith (Global Partnership Solutions); Scott Vaughan (International Institute for Sustainable Development); Lesley Williams (Prospectors & Developers Association of Canada); and Alan Young (Materials Efficiency Research Group/Canadian Boreal Initiative). These representatives lent their expertise to the development of the report by proffering invaluable insight and advice regarding performance indicators, relevant research, case studies, best practices, and report content.

SECTION I: CANADA'S MINERAL INDUSTRY OPERATES IN A DYNAMIC AND EVOLVING GLOBAL CONTEXT

Global economic trends influence Canada's mineral industry

As with the overall economy, Canada's mineral industry is influenced by global economic trends. The success of mineral exploration and producing companies is dependent on underlying supply and demand fundamentals that affect current and future commodity prices. After rising dramatically for almost a decade, chiefly because of unprecedented growth in demand from China, the prices of most major mineral commodities have fallen dramatically since 2011, as highlighted by a nearly 40% drop in the Bank of Canada's Metals and Minerals Commodity Price Index.[7]

These price declines have had a significant impact on Canada's mineral industry. Capital investment activity in 2015 was down 34.0% relative to 2012 levels and is expected to fall further in 2016. Similarly, exploration and deposit appraisal spending – a key barometer of the health of the mineral industry and an indicator of future mineral production – has fallen for five consecutive years, representing an overall decline of nearly 60% between 2011 and 2015, with additional decreases expected in 2016.

In the short term, pessimism regarding overall global growth remains. In April 2016, the Bank of Canada revised its global economic growth forecasts to 3.0% for 2016 and 3.4% in 2017, both downgraded from January's estimates.[8] The International Monetary Fund also revised its global growth projections downward in April to 3.2% for 2016 and 3.5% in 2017, reflecting a weakened outlook for commodity-exporting countries, oversupply of many key commodities as a result of the upswing of the mid-to-late 2000s, and a moderate slowdown in growth from emerging economies.[9] The World Bank is also forecasting slower-than-expected growth in most emerging and developing economies through 2017, which, over the last 10-15 years, have been the main drivers of mineral commodity demand.[10] China, the world's largest market for mined products, is expected to heavily influence the global mineral industry as it transitions away from an export- and investment-driven economy to one focused on domestic consumption, including services.

In the longer term, emerging and developing economies are expected to continue to drive global growth, and by extension, the demand for mineral commodities, along with more modest growth from advanced economies.[11] While a number of risks related to ongoing adjustments in the global economy remain, the global recovery is expected to strengthen toward the end of 2017 and beyond as the result of a gradual normalization of conditions in a number of stressed economies, the successful rebalancing of China's economy, and a pickup in commodity export activity.

Rising expectations for improved social consciousness and environmental performance

The ability to obtain and maintain a social licence to operate is becoming increasingly imperative in order to successfully undertake mineral development and production activities. Local communities and stakeholders expect to be engaged in more meaningful ways and to be included as partners in mineral resource development opportunities. Moreover, priorities are shifting, with stronger emphasis being placed on the importance of joint decision-making models between companies and local communities and resource-sharing agreements between governments and local communities (Box 3). Such arrangements can deepen collaboration, improve community readiness to maximize socio-economic benefits, and enhance public confidence in government and industry efforts to operate in a responsible and sustainable manner.

[7] See http://www.bankofcanada.ca/rates/price-indexes/bcpi/.

[8] Bank of Canada, 2016, *Monetary Policy Report* – April 2016, http://www.bankofcanada.ca/wp-content/uploads/2016/04/mpr-2016-04-13.pdf.

[9] International Monetary Fund, 2016, *World Economic Outlook (WEO): Too Slow for Too Long*, http://www.imf.org/external/pubs/ft/weo/2016/01/pdf/text.pdf.

[10] World Bank, 2016, *Commodity Markets Outlook – January 2016: Special Focus: Weak growth in emerging market economies: What does it imply for commodity markets?*, http://pubdocs.worldbank.org/pubdocs/publicdoc/2016/1/874761453766994105/CMO-Jan-2016-Special-Focus.pdf.

[11] International Monetary Fund, 2016, *World Economic Outlook (WEO): Too Slow for Too Long*, http://www.imf.org/external/pubs/ft/weo/2016/01/pdf/text.pdf.

Box 3: Government Resource Revenue Sharing Agreements

Resource revenue sharing agreements between governments and Indigenous communities are becoming increasingly important in providing Indigenous communities with greater opportunities to participate in all stages of the mineral development cycle and to strengthen their ability to share in the resource wealth within their traditional territories. Moreover, such agreements, by enhancing and clarifying benefits to Indigenous communities, can result in increased certainty for project proponents.

Government resource revenue sharing arrangements currently exist in Canada's three northern territories, Quebec, and Newfoundland and Labrador, where they were developed in the context of land claims agreements. In October 2008, British Columbia (B.C.) became the first province to announce direct revenue sharing with Indigenous communities for new mining projects. The B.C. initiative is implemented on a project-by-project basis and places a strong focus on local community development. To date, the Province has signed 23 Economic and Community Development Agreements with affected Indigenous communities for new mine projects.[12] In January 2016, Manitoba committed to share up to 25% of the mining taxes paid by new mines with local Indigenous communities,[13] making it the second province to directly share mining revenue with communities.

Over the past two decades, progress has been made to undertake mineral resource development activities in a more responsible and sustainable manner. Key industry associations have established principles, programs, and guidelines that make explicit the importance of, and requirement 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.[14] Experience shows that employing responsible and respectful business practices, such as engaging local and First Nation 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 (Box 4).

From a financing perspective, investors are placing additional importance on social and environmental performance. Mineral exploration and mining company social and environmental practices and risks, specifically as they relate to local community engagement, are increasingly factored into investment decisions. Moreover, over 80 financial institutions, including all of Canada's big-five banks, have adopted the *Equator Principles*, a credit risk management framework for determining, assessing, and managing social and environmental risks in project finance transactions.[15]

Box 4: Inclusion, Engagement, and Meaningful Indigenous Relationships

The Halfmile mine, owned by Trevali Mining Corporation, is located within a highly sensitive environment straddling two major watersheds in New Brunswick, including one renowned for Atlantic salmon. Project approval, received in January 2012, was preceded by early and active engagement with Mi'kmaq First Nation communities that enabled the company to minimize impacts on surrounding environments by incorporating Traditional Indigenous Knowledge into their development plans. In addition, a Memorandum of Understanding between the company and nine bands included employment opportunities, financial benefits, hiring of a Mi'kmaq benefits administrator to identify and promote First Nations' opportunities, a student summer employment program, and educational scholarships. The company also worked with the provincial government and the community college to develop a common-core mining program for First Nations, whose graduates were then hired by Trevali. The approach for this small underground mine development project, even though in a highly sensitive location, was successful due to Trevali's proactive development of collaborative, respectful relationships with First Nations, government, and the local community.

[12] http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations-negotiations/economic-and-community-development-agreements.

[13] http://news.gov.mb.ca/news/index.html?item=37320.

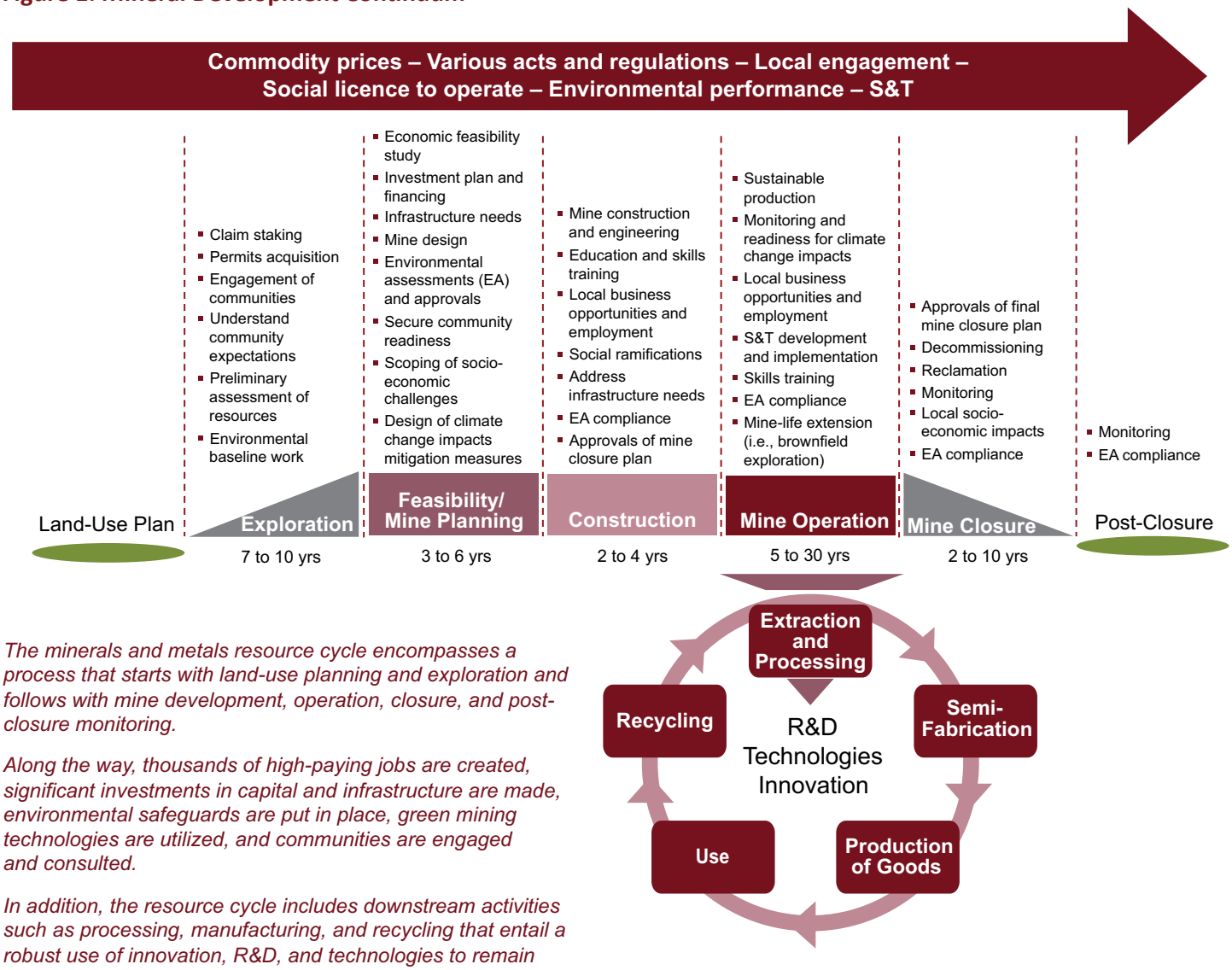
[14] See http://www.nrcan.gc.ca/mining-materials/policy/government-canada/8698; http://www.nrcan.gc.ca/mining-materials/policy/8690; http://www.pdac.ca/programs/e3-plus; and http://mining.ca/towards-sustainable-mining.

[15] http://www.equator-principles.com/.

The mineral development continuum is dynamic (Figure 1), and 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.

In addition, increasing concerns about climate change will continue to have profound impacts on societies, economic growth, and the way natural resources are developed in new, and perhaps more environmentally sensitive, areas. Societal concerns regarding water availability, greenhouse gas (GHG) emissions, and climate change, to name a few, are not only challenges; they are also opportunities that will fuel innovations 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).

Figure 1: Mineral Development Continuum

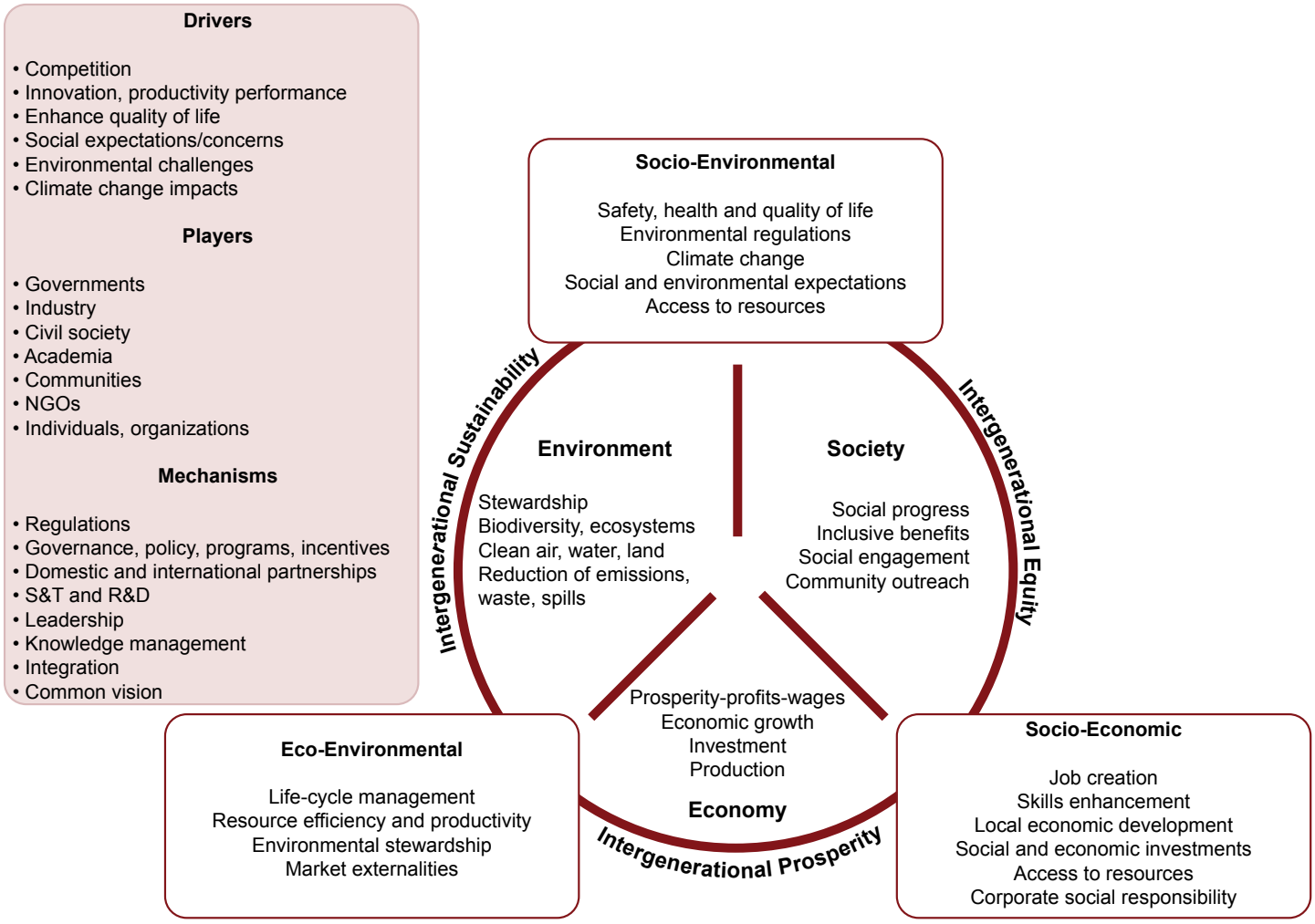


The minerals and metals resource cycle encompasses a process that starts with land-use planning and exploration and follows with mine development, operation, closure, and post-closure monitoring.

Along the way, thousands of high-paying jobs are created, significant investments in capital and infrastructure are made, environmental safeguards are put in place, green mining technologies are utilized, and communities are engaged and consulted.

In addition, the resource cycle includes downstream activities such as processing, manufacturing, and recycling that entail a robust use of innovation, R&D, and technologies to remain competitive, sustainable, and responsible.

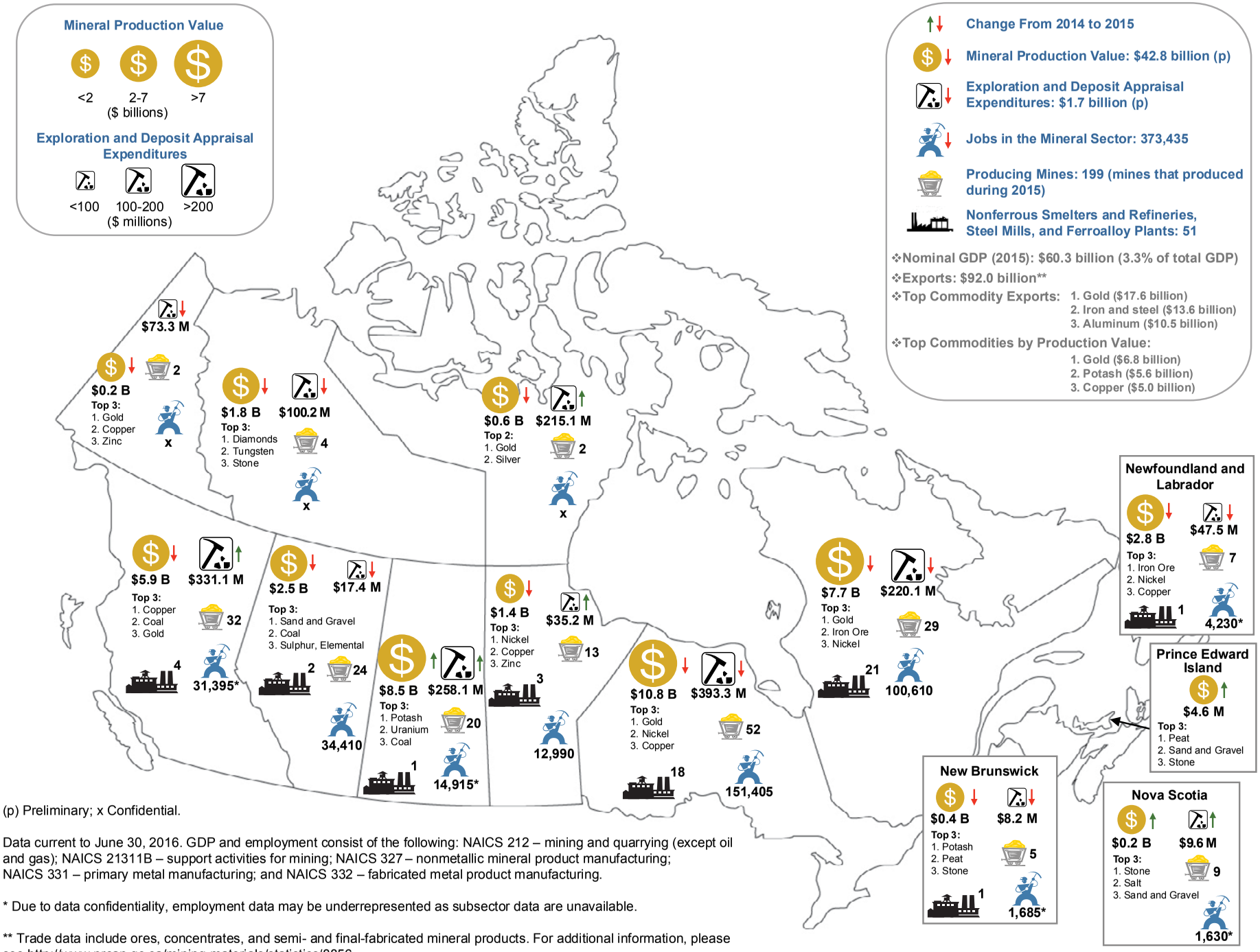
Figure 2: Elements of a Responsible and Sustainable Approach



Canada's mineral resource advantage

Even in an economic downturn, Canada's mineral industry remains a vital contributor to the country's economic well-being (Figure 3). In 2015, the sector:

- Accounted for $60.2 billion in nominal gross domestic product (GDP) (3.2% of total Canadian GDP), with $27.9 billion in mineral extraction and mining-related support activities and $32.3 billion in downstream mineral processing and manufacturing;
- Directly employed approximately 373,000 workers, including mining-related support activities, with a presence in every region of the country; and
- Contributed $16.2 billion to Canada's trade balance, including $92.0 billion in merchandise exports (19.1% of total exports).



(p) Preliminary; x Confidential.

Data current to June 30, 2016. GDP and employment consist of the following: NAICS 212 – mining and quarrying (except oil and gas); NAICS 21311B – support activities for mining; NAICS 327 – nonmetallic mineral product manufacturing; NAICS 331 – primary metal manufacturing; and NAICS 332 – fabricated metal product manufacturing.

* Due to data confidentiality, employment data may be underrepresented as subsector data are unavailable.

** Trade data include ores, concentrates, and semi- and final-fabricated mineral products. For additional information, please see http://www.nrcan.gc.ca/mining-materials/statistics/8856.

Figure 3: The Mineral Sector in 2015 – A Pan-Canadian Industry

In addition, the sector:

- Contributes directly to the economic vitality of communities, particularly in remote and rural areas, and remains an important employer of Indigenous Peoples, employing approximately 10,300 in 2015;
- Is a capital-intensive, high-technology-driven industrial sector that plays an important role in Canada's knowledge economy as a purchaser, developer, and facilitator of advanced technologies;
- Is one of the few industrial sectors that consistently adds to Canada's balance of trade, contributing nearly $172 billion since 2006;
- Hosts more than 200 principal producing mines and 50 smelters, refineries, and steel mills; and
- Produces more than 60 minerals and metals, and ranks among the top producers of many key commodities such as potash, uranium, nickel, aluminum, and cobalt (Table 1).

Internationally, Canadian exploration and mining companies continue to maintain a strong presence with Canadian mineral exploration and mining assets abroad worth $169.7 billion invested in over 100 countries (2014). Canadian mineral industry associations and companies have been recognized domestically and internationally for their leadership in operating according to the principles of corporate social responsibility (CSR). However, the continual promotion and commitment to CSR principles are necessities if Canada is to maintain its international standing. To that end, initiatives such as Canada's new CSR strategy for the extractive sector[16] and the commencement of the *Extractive Sector Transparency Measures Act*,[17] which reinforces Canada's continuing commitment to promoting accountability and transparency in the mineral sector, help strengthen the country's positon as a global mining leader.

Canada has a strong foundation to support future mineral industry-based prosperity. The country's mineral resource advantage resides in a vast and diversified geological endowment whose conversion into a meaningful socio-economic contribution is achieved through a combination of world-class geoscience knowledge; technological innovation; a dynamic junior mining sector; cost-effective and environmentally/community-conscious mine operators, and adaptable suppliers of equipment and services; an effective and responsive government policy and regulatory framework; strong industry and academic institutions; an internationally competitive mineral taxation regime; a skilled work force; and transportation infrastructure and gateways to major global markets. These attributes provide Canada with immense possibilities to meet future global commodity demand and to strengthen its international standing as a major producer of minerals and mineral products.

Table 1: Canadian Global Production Ranking, by Volume, 2015

Commodity	Global Rank
Potash	1st
Uranium	2nd
Nickel	2nd
Platinum group metals	3rd
Cobalt	3rd
Aluminum (primary)	3rd
Diamonds	4th
Salt	4th
Tungsten	4th
Gold	5th
Copper	8th
Iron ore	8th
Zinc	9th
Silver	10th

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

[16] In 2014, a new CSR strategy for the Canadian extractive sector was released by the Government of Canada that imposes new, harsher consequences on companies who refuse to adhere to endorsed CSR best practices and dispute resolution processes. See Government of Canada, 2014, *Doing Business the Canadian Way: A Strategy to Advance Corporate Social Responsibility in Canada's Extractive Sector Abroad*, www.international.gc.ca/trade-agreements-accords-commerciaux/assets/pdfs/Enhanced_CS_Strategy_ENG.pdf.

[17] The *Extractive Sector Transparency Measures Act* came into force on June 1, 2015, and requires extractive entities to publicly disclose, on an annual basis, specific payments made to all governments in Canada and abroad for financial years beginning after June 1, 2015. Payments made to Indigenous governments in Canada are subject to a two-year deferral period ending June 1, 2017. Additional information on the Act can be located at http://www.nrcan.gc.ca/mining-materials/estma/18180.

SECTION II: ECONOMIC PERFORMANCE

Canada's mineral sector is a significant contributor to the country's economic well-being. It contributes directly to the economic viability of numerous communities across Canada in rural and remote areas, not only in large urban centres. Beyond mineral operations, the sector contributes significant spin-off benefits to the Canadian economy. The Canadian mineral sector has contributed to the development of, and is now supported by, a network of over 3,000 equipment and service suppliers (drilling contractors, equipment manufacturers, consulting firms, and suppliers of legal and financial services). Many of these firms followed Canadian mining companies abroad and have become global leaders in their fields.

Drawing from the Whitehorse Mining Initiative and the Mining, Minerals and Sustainable Development multi-stakeholder frameworks, the Intergovernmental Working Group committee responsible for the development of this report 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 make an economic contribution to the local, regional, national, and global economies.

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

- **Value of mineral production –** The value of mineral production measures the volume of commodities mined at the current value of the commodity. It helps in determining the vitality of the sector as it is linked to the revenues generated.
- **Real Gross Domestic Product (GDP) –** Real GDP measures the market value of all final goods and services created within 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.
- **International trade –** International trade is the exchange of capital, goods, and services across international borders or territories. Trade is critical to the mineral sector, and to Canada's prosperity, fueling economic growth, supporting jobs, raising living standards, transferring technologies, and providing affordable goods and services.
- **Public geoscience –** 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 is widely acknowledged to be one of Canada's competitive advantages in attracting mineral exploration as it enables grassroots exploration companies to make informed decisions regarding their exploration activity. Assessing public geoscience expenditures provides an indication of government efforts to support early-stage mineral exploration.
- **Exploration and deposit appraisal expenditures –** As mines have a finite life, exploration activity is necessary to find mineral deposits to support future mining developments and downstream production in Canada. Exploration spending is the key barometer of the health of the sector, and measuring spending levels in exploration and deposit appraisal activity provides an indication of the future potential for mineral production and downstream activities.
- **Capital expenditures –** Capital expenditures are made by companies to purchase or upgrade physical assets such as property, equipment, or buildings. They help improve an industry's productivity performance. Measuring trends in capital expenditures helps provide an indication of the future competitiveness of a sector.
- **Research and development (R&D) –** Innovation is needed to improve the productivity and competitiveness of the mineral sector. R&D expenditures could 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 mining sector are collected through taxes and royalties. Measuring these payments to governments helps determine the direct contribution of the sector to government finances and some of the compensation received from the extracted resources.

Synopsis

The mineral sector's economic performance over the 10-year period from 2006 to 2015 was mixed. The global economic recession that occurred in 2008 and 2009 brought an abrupt halt to the upward trajectory that most indicators had shown in previous years. An unexpected quick turnaround in 2010 and 2011, when prices for a number of key commodities reached record levels, has been followed by substantial economic headwinds over the last five years. This has led to declines for a number of indicators, and only a few have returned to their pre-recession levels. As a result, year-over-year comparisons may overlook the volatility that characterized the last decade. Looking ahead, continued pessimism in the global market could put downward pressure on key economic indicators in the short term before they start climbing alongside a possible market rebound toward the end of 2017 and into 2018.

Highlights

- The mining sector's **value of mineral production** grew from $34.2 billion in 2006 to a record high of $50.9 billion in 2011, and then trended downward to settle at $42.8 billion in 2015. The global economic downturn, continued depressed global markets, and slowing commodity demand were the main factors behind this latest decline.

- The mineral sector's **GDP** has declined 6.3% over the last 10 years, driven predominantly by downstream manufacturing subsectors. The GDP of the mining and quarrying subsector increased 9.1% over 2006 values.

- Overall, the value of Canada's **mineral and metal exports** increased 28.6% over the last 10 years, but the 2015 value is 4.2% lower than the record level set in 2011. The mineral sector routinely makes a positive contribution to Canada's overall **balance of trade**, contributing over $171 billion over the last decade.

- **Government expenditures on public geoscience** in 2012/13 were $161.2 million, a 3.5% increase over 2004/05 and 9.7% below the peak spending level of $178.5 million attained in 2010/11.

- **Capital investment** in the mineral sector more than doubled between 2006 and 2015. However, the 2015 value of $15.3 billion represents a 30.0% decrease from the record $21.9 billion spent in 2012.

- **Exploration and deposit appraisal expenditures** increased substantially from 2006 to 2011, reaching a record $4.2 billion in 2011. However, expenditures have decreased in each year since and, in 2015, were an estimated $1.7 billion, a loss of 59.6% since 2011. Preliminary indications for 2016 suggest this downward trend will continue. Despite the current economic climate, Canada remains the world's most attractive destination for mineral exploration investment, accounting for almost 14% of total global exploration budgets.

- Canada's mining, support services, and mineral processing industries' **business expenditures on research and development** (BERD) totaled $677 million in 2013, a 10.2% decline relative to 2007. Despite this overall trend, expenditures have trended upward over the last few years.

- Between 2005 and 2014, the mineral sector paid $16.7 billion in corporate income taxes. Taxes paid fluctuated wildly as the sector's profitability was tied to global economic conditions. Similarly, resource royalties and taxes paid to the provinces and territories fluctuated throughout the period. The 2014/15 value of $1.5 billion represents a 42.6% increase over 2005/06, but a 37.5% decrease over the record payments made in 2011/12.

Indicator (2006-15) **(unless otherwise specified)**	
Mineral Production Value	
Gross Domestic Product	
International Trade	
Public Geoscience Expenditures (2004/05 to 2012/13)	
Exploration and Deposit Appraisal Expenditures	
Capital Expenditures	
Research and Development (2007-13)	
Government Revenues (2005-14)	

Improved Performance | Limited Improvement | Decline in Performance

Value of Mineral Production

Highlights

- Canada's mineral production recovered from the impact of the global economic recession in 2008 and 2009 with values reaching an all-time high of $50.9 billion in 2011, but has since been trending downward.
- Despite lower prices for most mineral commodities, the total value of Canadian mineral production in 2015 was $42.8 billion, only slightly lower (-2.6%) than the 2014 value of $43.9 billion. The mining industry continued to face headwinds that included slower global growth and excess supply for most minerals, which were partly offset by favourable exchange rates.
- Ontario is the perennial leader in terms of mineral production value, accounting for between 20% and 28% of total Canadian production during the last 10 years, and accounting for a quarter of the value in 2015.

Definition

The value of mineral production is a calculation of the volume of extracted commodities at the current price of the commodity.[18] It includes metallic and nonmetallic minerals, and coal.

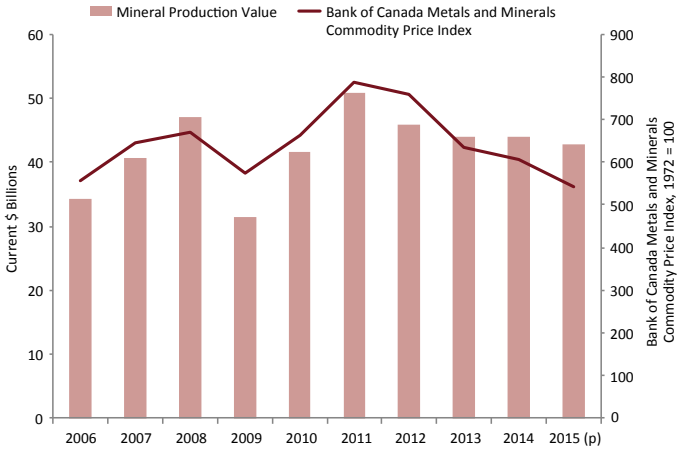
Rationale

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

In 2015, the preliminary value of Canada's mineral production reached $42.8 billion, a 24.9% increase over 2006. However, as seen in Figure 4, Canada's mineral production value fluctuated considerably during the 10-year period. The global recession of 2008 and 2009 put a stop to rising commodity prices that had been driving mineral production values upward since the early 2000s. Production values rebounded in subsequent years, reaching a record high in 2011, as a result of multiple factors that had a positive effect on prices, including economic growth from emerging countries, notably China; low interest rates; and the quantitative easing policies in some developed countries. Since then, however, domestic mineral production values have receded as global growth has slowed and many minerals are in excess supply.

Figure 4: Value of Canadian Mineral Production, 2006-15 (p)



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

Between 2006 and 2015, the Bank of Canada's Metals and Minerals Commodity Price Index[19] (BCPI) fluctuated considerably, reflecting the volatility in commodity prices over the last decade. Although the BCPI in 2015 was nearly at the same level it was 10 years ago, it had lost almost a third of its value after reaching a record high in 2011. Commodities that experienced the greatest price decline, over 50% during the period, include coal, iron ore, nickel, and silver. Exchange rates offered some reprieve as the lower value of the Canadian dollar relative to the U.S. dollar was favourable for domestic producers as most raw mineral products are priced in U.S. currency.

Trends for individual commodities varied during the 10-year period. The production values of copper, gold, and potash, some of Canada's key commodities, have risen. Gold's production volume increased by almost

[18] Details regarding the methodology used in computing the mineral production of Canada can be located at http://www.nrcan.gc.ca/mining-materials/markets/canadian-minerals-yearbook/8364.

[19] The Bank of Canada Metals and Minerals Commodity Price Index comprises: gold (Handy and Harman base price, New York); silver (Handy and Harman base price, New York); nickel (London Metal Exchange [LME] cash settlement); copper (LME cash settlement); aluminum (LME cash settlement); zinc (LME cash settlement); potash (standard potassium chloride, spot price, f.o.b. Vancouver); lead (U.S. Bureau of Labor Statistics – Producer Price Index); and iron ore (U.S. Bureau of Labor Statistics – Producer Price Index).

50% and its value more than tripled during the last decade. Similarly, potash's production volume climbed 33.2% while its value also nearly tripled.

Although both coal and iron ore show positive trends for the overall period, recent price declines have significantly curtailed the production value of these commodities. Iron ore lost two-thirds of its production value since a peak reached in 2011 because of lower prices resulting from oversupply and declining Chinese demand. For the three most recent years, Canada's overall coal production value declined 20.0% per year as prices receded. Although Canada produces both thermal and metallurgical coal, the latter had the largest impact on production value. Since a cyclical high in 2011, the realized export price of metallurgical coal has declined by over 55%. Despite this, coal remains an important mineral with a total production value of $3.1 billion in 2015, ranking it as the fifth most valuable commodity mined in Canada.

Lead and zinc experienced some of the most substantial reductions in both their value and volume of production for the period as a result of mine closures and curtailments.

Table 2: Value of Mineral Production, by Jurisdiction, 2006, 2011, and 2015 (p)

Province or Territory	Unit	2006	2011	2015 (p)
Alberta	Value of production ($000)	1,580,258	2 ,696,459	2,574,520
	% of total	4.6%	5.3%	6.0%
British Columbia	Value of production ($000)	5,990,584	8,981,532	5,903,544
	% of total	17.5%	17.7%	13.8%
Manitoba	Value of production ($000)	2,089,006	1,793,888	1,354,769
	% of total	6.1%	3.5%	3.2%
New Brunswick	Value of production ($000)	1,538,565	1,334,924	400,249
	% of total	4.5%	2.6%	0.9%
Newfoundland and Labrador	Value of production ($000)	3,029,847	4,634,162	2,770,171
	% of total	8.9%	9.1%	6.5%
Northwest Territories	Value of production ($000)	1 ,638,172	2,139,644	1,790,566
	% of total	4.8%	4.2%	4.2%
Nova Scotia	Value of production ($000)	322,850	238,347	212,250
	% of total	0.9%	0.5%	0.5%
Nunavut	Value of production ($000)	31,595	427,322	567,188
	% of total	0.1%	0.8%	1.3%
Ontario	Value of production ($000)	9,524,218	10,698,072	10,761,271
	% of total	27.8%	21.0%	25.2%
Prince Edward Island	Value of production ($000)	5,040	2,747	4,629
	% of total	...	...	...
Quebec	Value of production ($000)	4,559,856	8,465,486	7,674,555
	% of total	13.3%	16.6%	17.9%
Saskatchewan	Value of production ($000)	3,876,777	9,100,784	8,505,318
	% of total	11.3%	17.9%	19.9%
Yukon	Value of production ($000)	46,339	367,419	246,936
	% of total	0.1%	0.7%	0.6%
Total	**Value of production ($000)**	**34,233,107**	**50,880,785**	**42,765,966**

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary; ... Amount too small to be expressed.

In each of the last 10 years, Ontario was the leading jurisdiction in terms of mineral production value, accounting for between 20% and 28% of total Canadian production value during the period. In 2015, the province posted a value of $10.8 billion, representing 25.2% of Canada's total. Saskatchewan, Quebec, and British Columbia were the next leading jurisdictions in terms of production value. Together, these four jurisdictions accounted for over three-quarters of Canada's total mineral production value in 2015 (Table 2).

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 that commodity price fluctuations have on the value of mineral production.

Gross Domestic Product

Highlights

- Between 2006 and 2015, the mineral sector's real GDP declined 5.8%.
- The decline was driven by the downstream manufacturing industries as value added in the upstream mineral extraction industry grew 10.0% over 2006.
- Over the last five years, the 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.

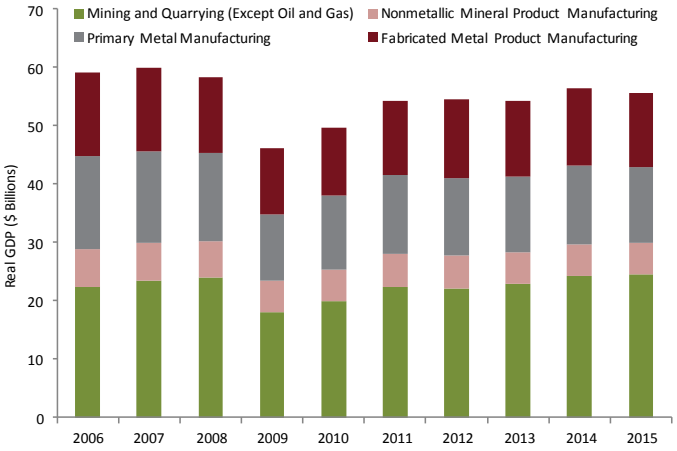
Rationale

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. Real GDP data are used to remove the effects of price variations to determine the extent of output gains or losses within an industry.

Analysis

In 2015, the mineral sector's real GDP was $55.6 billion, a 5.8% decline from the 2006 value (Figure 5). The sector experienced a significant year-over-year decline of 21.2% in its GDP in 2009 as a result of the global economic recession. Since then, the sector's GDP has grown 20.6%, but has yet to reach pre-recession levels. Overall, the sector's share of Canada's total GDP declined from 4.1% in 2006 to 3.4% in 2015, but has remained stable at this level for the second part of the period.

Figure 5: Mineral Industry Real Gross Domestic Product, 2006-15



Source: Statistics Canada.

At the subsector level, mining and quarrying experienced a 10.0% increase in real GDP from 2006 to 2015, highlighting the strength of Canada's mineral extraction industry. This subsector was hit particularly hard by the economic downturn in 2009, with GDP falling 23.9% year over year. The subsector rebounded, with GDP climbing 35.4% since 2009 and standing at $24.6 billion in 2015, accounting for 44.4% of the sector's total value added, up from 37.9% in 2006.

International Trade

Highlights

- Between 2006 and 2015, the mineral sector's exports increased 28.8%, reaching $92.0 billion in 2015.
- The sector routinely makes a positive contribution to Canada's overall trade balance, contributing a surplus of nearly $172 billion over the last 10 years.
- Gold has become Canada's leading mineral export with a value of $17.6 billion in 2015, more than triple its 2006 value, as the result of dramatic price increases over that period.

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 of 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.

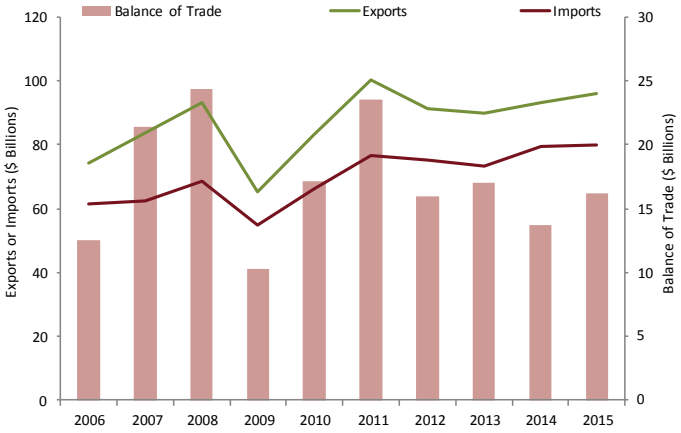
Rationale

Canada is an open economy that depends heavily on foreign markets and international trade to support the nation's economy and to 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 also critical to the mineral sector as mineral commodities are bought and sold on global markets.

Analysis

The value of Canada's mineral and metal exports,[20] which include ores, concentrates, and semi- and final-fabricated mineral products, was $92.0 billion in 2015, or 19.1% of the country's total merchandise export value. Over the last decade, mineral exports have increased 28.8%. As with other metrics, they grew substantially from 2006 to 2008 before falling dramatically in 2009. Exports rebounded in subsequent years, reaching a record $95.9 billion in 2011 before declining again in 2012 and 2013. The value of exports has trended upward in the two most recent years, largely due to the depreciation of Canada's currency versus the U.S. dollar (Figure 6).

Figure 6: Mineral Sector Trade, 2006-15



Sources: Natural Resources Canada; Statistics Canada.

The mineral sector is one of the few industrial sectors that consistently makes a positive contribution to Canada's overall balance of trade, totaling nearly $172 billion since 2006. The sector's trade surplus nearly doubled between 2006 and 2008 from $12.5 billion to $24.3 billion, coinciding with the dramatic run-up in demand from emerging markets and rising commodity prices. Following the global recession of 2008 and 2009, the trade surplus fell 57.8% to $10.3 billion in 2009 before rebounding to a near record $23.6 billion in 2011. The mineral industry's balance of trade fell for three consecutive years beginning in 2012, but still remained over $10 billion in each year, before climbing in 2015 to $16.2 billion.

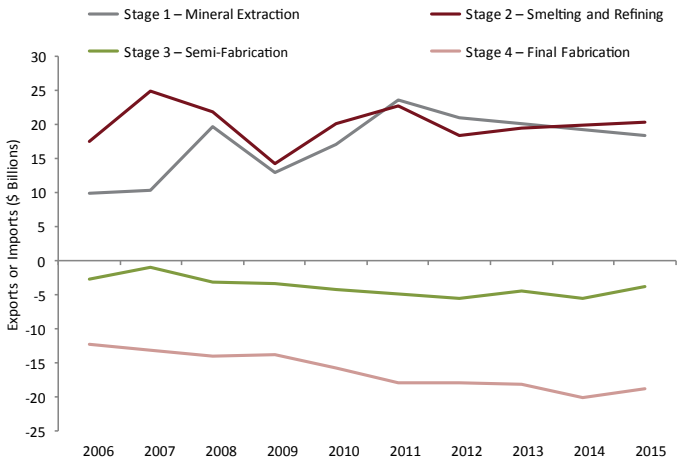
A closer examination at the subsector level reveals Canada's relative strength in mineral extraction and smelting and refining. Traditionally, Canada runs large, positive trade balances in *Stage 1 – mineral extraction*

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

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). This reflects Canada's natural resource wealth, its comparative advantage in mineral extraction, and changing geographic patterns with respect to manufacturing locations.

Table 3 shows the top five commodities exported by Canada's mineral sector in 2006 and 2015 by value. During this period, the value of gold exports increased over threefold. As a result, gold is now Canada's most valuable mineral commodity export. Over half of Canada's gold exports are destined for the United Kingdom as London is the global epicentre for gold trading.

Figure 7: Mineral Sector Balance of Trade, by Subsector, 2006-15



Sources: Natural Resources Canada; Statistics Canada.

Table 3: Top Five Mineral Commodities Exported by Canada, by Value, 2006 and 2015

2006		2015		
Commodity	**$ billions**	**Commodity**	**$ billions**	**Main Destination (2015)**
Iron and steel	14.5	Gold	17.6	U.K. (53.5%)
Aluminum	12.4	Iron and steel	13.6	U.S. (87.4%)
Copper	6.4	Aluminum	10.5	U.S. (89.3%)
Nickel	6.1	Copper	6.9	U.S. (45.2%)
Gold	5.6	Potash	6.9	U.S. (52.6%)
Total exports	**71.4**	**n.a.**	**92.0**	**n.a.**

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

Table 4 shows the value of Canadian mineral sector exports by commodity group and jurisdiction. By value of production, metal ores and manufactured products comprised by far the majority of Canada's exports (between 74.4% and 82.7% from 2006 to 2015). Coal and coke exports have fallen 54.4% since 2011 as the result of reduced global demand for metallurgical coal and subsequent mine closures.

The majority of Canada's mineral trade flows to and from Ontario, Quebec, and British Columbia, whose export values may include the value of raw material imported from other provinces. In 2015, Ontario accounted for 47.3% of exports, Quebec for 22.6%, and British Columbia for 10.8%. Mineral and metal exports also represent a sizeable proportion of total exports from many provinces and territories. For instance, minerals and metals accounted for 99.8% and 95.8% of the total value of exports from the Northwest Territories and Yukon, respectively.

Table 4: Canada's Mineral Exports, by Jurisdiction and Commodity Group,* 2006 and 2015**

Province/ Territory	Coal and Coke Products		Metallic Ores and Manufactured Products		Nonmetallic Ores and Manufactured Products		Total	
	2006	2015	2006	2015	2006	2015	2006	2015
	(current $000)							
Alberta	380,207	364,365	2,335,329	1,979,125	663,927	584,272	3,379,464	2,927,762
British Columbia	2,847,406	3,088,939	4,874,559	5,948,330	625,947	927,654	8,347,912	9,964,923
Manitoba	32	-	2,024,422	1,555,646	165,857	293,700	2,190,312	1,849,346
New Brunswick	-	-	379,955	279,272	352,406	435,231	732,361	714,503
Newfoundland and Labrador	-	-	1,157,701	1,654,554	12,721	31,213	1,170,421	1,685,767
Northwest Territories	-	-	21,655	28,389	1,584,312	1,813,854	1,605,967	1,842,242
Nova Scotia	19	-	165,827	212,308	141,674	77,040	307,520	289,348
Nunavut	-	-	430	865	423	80	853	945
Ontario	176,280	287,043	28,210,765	40,328,246	2,398,872	2,896,305	30,785,917	43,511,594
Prince Edward Island	-	-	2,682	19,413	4,642	6,819	7,324	26,235
Quebec	18,945	1,123	17,857,636	19,091,245	1,631,744	1,728,403	19,508,326	20,820,772
Saskatchewan	8,620	74,345	985,832	1,438,319	2,336,572	6,717,819	3,331,025	8,230,483
Yukon	-	-	32,520	103,793	88	924	32,608	104,717
Total	**3,431,511**	**3,815,819**	**58,049,314**	**72,639,505**	**9,919,186**	**15,513,314**	**71,400,010**	**91,968,637**

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 are 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 3 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.

Public Geoscience Expenditures

Highlights

- Government expenditures on geoscience in 2012/13 were $161.2 million, a 3.5% increase over 2004/05, but a 9.7% decline since a peak of $178.5 million in 2010/11.
- Federal government expenditures on geoscience account for approximately one half of total expenditures in any given year, with the provinces and territories accounting for the remainder of this investment.
- Both Quebec and Ontario experienced notable expenditure increases of 66.2% and 51.1%, respectively, from 2004/05 to 2012/13.

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. By having a better understanding of geological environments through pre-competitive maps, databases, tools, and models, mineral exploration can be focused on areas of higher prospectivity, and investment risk can be reduced. Assessing public geoscience expenditures provides an indication of government efforts to support mineral exploration.

Analysis

In 2012/13 (the latest year for which data are available for all jurisdictions), total public geoscience expenditures were $161.2 million, a 3.5% increase over the 2004/05 value of $155.8 million. Federal government expenditures in 2012/13 totaled $76.3 million, representing 47.3% of total expenditures. Over the period, the federal government routinely accounted for approximately one half of total expenditures (Table 5).

Public geoscience expenditures in Quebec and Ontario climbed significantly during the period 2004/05 to 2012/13. In Quebec, expenditures in 2012/13 were $19.5 million, 66.2% higher than in 2004/05. Similarly in Ontario, expenditures in 2012/13 were $19.3 million, 51.1% higher than in 2004/05. In recent years, however, expenditures in both jurisdictions have trended downward, as was the case for many governments implementing budgetary control measures.

Table 5: Public Geoscience Expenditures, 2004/05 to 2015/16 (p)

Province/ Territory	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16 (p)
	($ millions)											
Alberta	5.1	6.5	8.3	11.7	11.7	11.3	7.3	7.1	7.9	..	..	..
British Columbia	27.8	2.6	3.9	14.9	4.0	4.3	14.9	2.8	3.9	4.0	6.2	8.6
Manitoba	5.1	5.1	5.1	5.3	5.7	6.1	5.9	5.6	5.4	5.9	4.8	4.8
New Brunswick	2.4	2.3	2.3	2.4	2.4	2.4	2.2	2.2	2.2	2.0	3.2	2.9
Newfoundland and Labrador	4.0	3.6	4.0	5.1	5.1	5.7	5.7	6.1	6.1	..	5.5	..
Northwest Territories	3.6	3.6	3.6	3.5	3.6	2.3	2.6	2.3	5.2	4.2	7.0	..
Nova Scotia	2.0	2.1	2.1	2.2	2.4	2.4	2.5	2.5	3.1	2.5	2.6	2.5
Nunavut	2.6	2.6	3.0	3.8	2.5	2.7	2.8	2.6	2.8	..	..	..
Ontario	12.8	18.9	19.0	18.5	18.7	18.9	19.3	19.3	19.3	18.4	17.8	..
Quebec	11.8	11.3	10.1	16.3	16.8	14.4	18.8	18.7	19.5	15.1	13.2	..
Saskatchewan	3.5	3.4	3.5	4.2	4.8	4.5	4.0	4.4	4.4	..	4.3	4.6
Yukon	4.5	5.4	4.5	5.7	6.0	6.9	6.4	5.2	5.2	..	5.0	..
Natural Resources Canada	70.6	70.9	77.8	84.0	88.3	92.3	86.0	80.3	76.3	70.8	82.7	88.4
Canada	**155.8**	**138.4**	**147.1**	**177.5**	**172.0**	**174.2**	**178.5**	**159.1**	**161.2**	**..**	**..**	**..**

Sources: Natural Resources Canada; Committee of Provincial and Territorial Geologists.
(p) Preliminary; .. Not available.

Exploration and Deposit Appraisal Expenditures

Highlights

- Since a peak spending level of $4.2 billion in 2011, exploration and deposit appraisal expenditures have fallen for five consecutive years.
- Canada remains the world's most attractive exploration destination, attracting almost 14% of global exploration budgets in 2015.
- Ontario and British Columbia ranked as the top two jurisdictions, followed by Saskatchewan, which climbed into the top three in spending for the first time since 2009, and Quebec. These four jurisdictions accounted for 70.4% of total spending.

Definition

Exploration expenditures refer to the investments allocated to search for and discover a previously unknown mineral deposit, or to re-evaluate a sub-marginal or neglected mineral deposit. Deposit appraisal expenditures refer to investments involved in determining the economic viability of a mineral deposit.

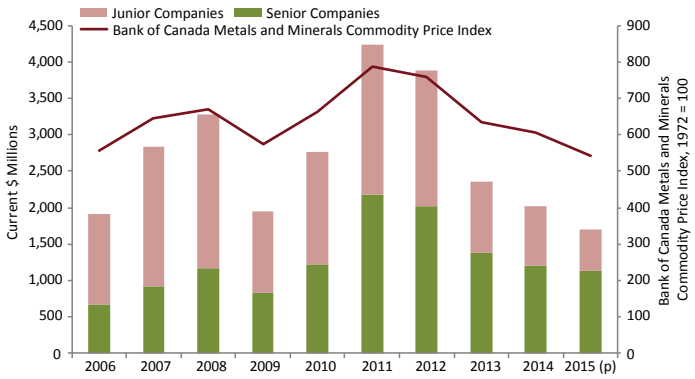
Rationale

Mineral exploration and deposit appraisal activity is critical to the long-term sustainability of Canada's mineral industry. These activities lead to the replenishment of Canada's mineral resources and reserves, and feed the pipeline of potential new mines. Without sufficient levels of investment in exploration and deposit appraisal, mine production and the downstream activities of the mine life cycle (smelting, refining, and manufacturing) could be jeopardized.

Analysis

One of the key measures by which the performance of the exploration sector can be gauged is through trends in exploration and deposit appraisal expenditures.[21] As shown in Figure 8, Canada's mineral exploration sector has experienced significant turbulence over the last 10 years. The global recession of 2008 and 2009 put a halt to the prodigious upward trajectory of spending that had begun mid-decade. Expenditures rebounded in 2011 and 2012, coinciding with an unexpectedly quick recovery following the recession. Expenditures have declined in each year since and are expected to decline further. This persistent downward trend coincides with a period of declining prices across a broad range of mineral commodities, an enduring dim market outlook, unfavourable capital markets for financing mineral exploration, and, as a result of these circumstances, the adoption of measures by companies to trim costs and focus efforts on core assets.

Figure 8: Exploration and Deposit Appraisal Expenditures, by Company Class, With Bank of Canada Metals and Minerals Commodity Price Index, 2006-15 (p)



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

The impacts on the sector include a significant reduction in the number of active mineral projects (down one-third from the 2011 peak) and a number of projects reporting only minimal expenses related to maintaining mineral claims and leases in good standing and head-office expenditures aimed at keeping the corporate entity alive. This underscores the ongoing struggle to conduct work programs that advance projects into later stages of development.

Figure 8 also illustrates Canada's unique industry structure. Canada is known for its large contingent of junior mining companies[22] – the largest in the world – which traditionally account for the majority of exploration and deposit appraisal activity in Canada. These companies propelled increased exploration and deposit appraisal investment in the years preceding the economic downturn, accounting for upwards of 60% of total expenditures at times. Their combined expenditures broke the $2 billion barrier in 2008 and 2011, while their share of total spending hovered around 65% in 2007 and 2008. Over the last five years, however, the current downturn, highlighted by a 48% drop in junior company spending in 2013, has brought their share of total activity to less than 35% – a level not seen since the early 2000s.

Figure 8 also highlights the strong correlation between commodity prices and exploration activities; that is, mineral and metal prices are the primary driver of exploration and deposit appraisal spending. At a time when commodity demand from major markets, particularly China, wanes, keeping prices depressed, accessing the required financing to conduct exploration work programs will remain challenging.

Its strong mineral potential has helped make Canada the world's leading exploration target throughout this past decade, including 2015 when it attracted 13.5% of global exploration expenditures.[23] This is down, however, from 20.9% in 2006 (Figure 9). Canada's policies toward mineral development continue to reinforce the country's reputation as a favourable destination for investment. As articulated in the Fraser Institute's Annual Survey of Mining Companies,[24] Canadian provinces and territories consistently rank among the world's most attractive jurisdictions for mineral exploration and development. In each year

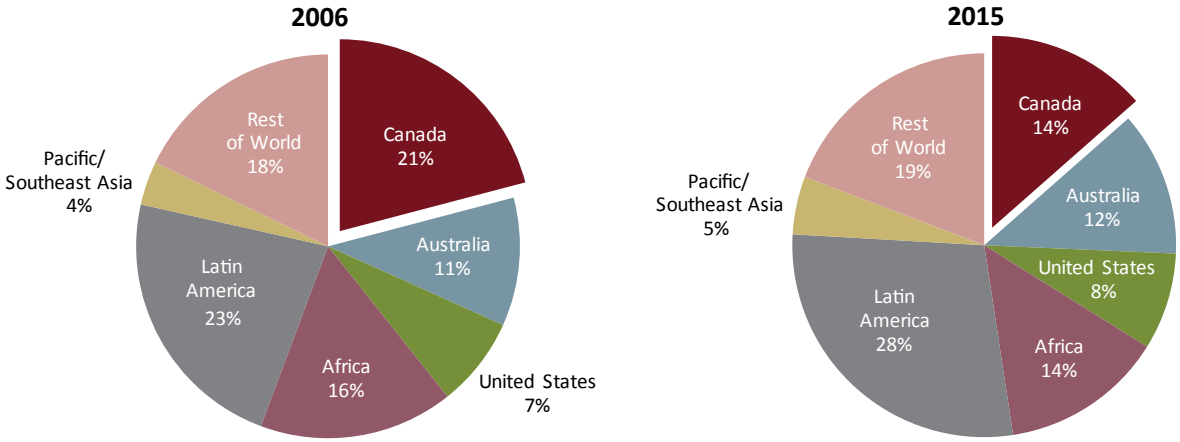
[21] *Exploration* is defined as the search for, discovery, and first delimitation of a previously unknown mineral deposit or the re-evaluation of a sub-marginal or neglected mineral deposit in order to enhance its potential economic interest based on delimited tonnage, grade, and other characteristics. *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).

[22] *Junior companies* are neither producing companies (senior companies) nor recipients of operating income from production or from some other business segments. Their principal business is mineral exploration, for which they are 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 (Source: Natural Resources Canada, http://www.nrcan.gc.ca/mining-materials/statistics/8854).

[23] SNL Metals & Mining, 2015, *Corporate Exploration Strategies 2015: Exploration Budgets by Location.*

[24] https://www.fraserinstitute.org/studies/annual-survey-of-mining-companies-2015.

Figure 9: Canada's Share of Global Nonferrous Exploration Spending, 2006 and 2015



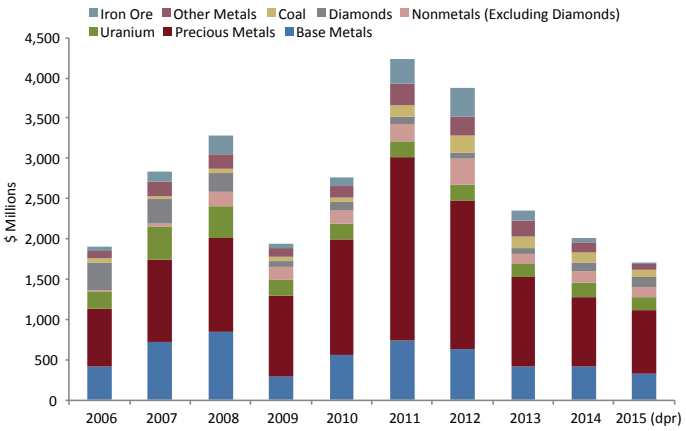
Source: SNL Metals & Mining.

from 2006 to 2014, at least 6 Canadian jurisdictions were ranked among the top 15. In the 2015 survey, 4 jurisdictions ranked among the top 15 globally: Saskatchewan (2nd), Quebec (8th), Yukon (12th), and Ontario (15th). In the long term, it is expected that Canada's potential for resource development and competitive mineral investment climate will continue to generate significant levels of investment in exploration across the country and for a broad range of mineral commodities.

Precious metals (predominantly gold) were by far the most important commodity group in terms of exploration expenditures from 2006 to 2015, routinely accounting for over one half of expenditures in a given year. In more recent years, however, some other commodity groups, including potash and nonmetals such as graphite and lithium, have emerged as important exploration targets (Figure 10).

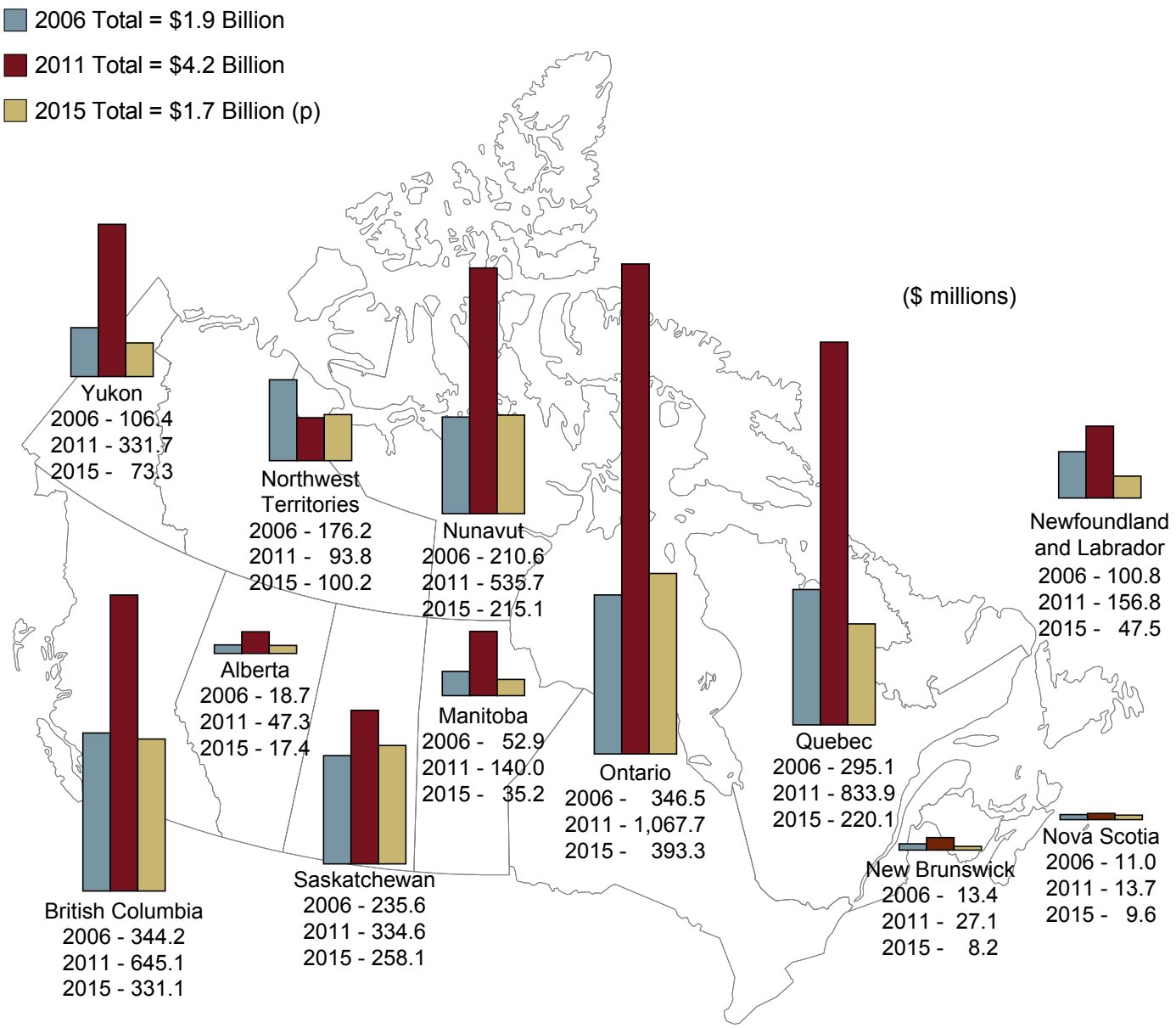
In terms of regional allocations, during the mid-2000s, exploration and deposit appraisal expenditures were concentrated in Ontario, Quebec, and British Columbia, a landscape that remained relatively unchanged to 2014. In 2015, Saskatchewan displaced Quebec within the top three and preliminary estimates for 2016 show Saskatchewan climbing to second place behind Ontario. Adjusted for inflation, every jurisdiction experienced negative average annual growth in exploration and deposit appraisal spending from 2006 to 2015. It should be noted that the minerals and metals industry is highly cyclical and a comparison between the upward trending market of 2006 and the depressed one of 2015 downplays the dramatic increase in expenditures leading into 2008 and the quick rebounds and historic spending levels reached in 2011 and 2012.

Figure 10: Exploration and Deposit Appraisal Expenditures, by Commodity Group, 2006-15



Source: Natural Resources Canada.
(p) Preliminary.

Figure 11: Exploration and Deposit Appraisal Expenditures, by Province and Territory, 2006, 2011, and 2015



Source: Natural Resources Canada.
(p) Preliminary.

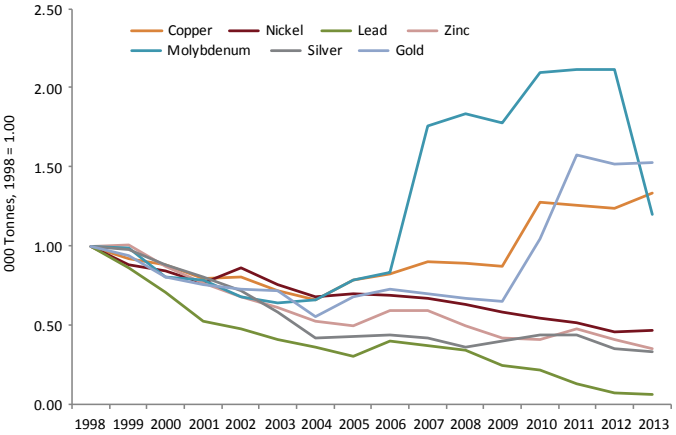
Reserves

Mineral exploration and deposit appraisal activities are critical to restocking Canada's metal reserves, which represent an important indicator of the strength of the extractive sector and provide an indication from where Canada's future mineral production may occur. Base-metal reserves had been on a long-term decline for nearly three decades, with copper, nickel, lead, and zinc experiencing substantial declines leading into the early to mid-2000s (Figure 12).

The robust demand and high metal prices leading into the late 2000s 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 2004 to 2013, gold reserves nearly tripled, copper reserves doubled, and molybdenum reserves increased 81.2%. Despite the opportunity created by the strong demand for commodities, reserve of nickel, lead, and zinc continued on a downward trend into 2013.

Given the prevailing economic headwinds that have resulted in reduced commodity demand and a resultant slowdown in mineral project advancement, it is possible that metal reserves gained over the last 10 years could be erased should projects fail to advance along the development continuum.

Figure 12: Canadian Reserves of Select Metals, 1998-2013



Source: Natural Resources Canada.

Box 5: Mineral Resources vs. Reserves

Resources: 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. It can be classified as inferred, indicated, or measured.

Reserves: The economically mineable portion of a measured and/or indicated resource demonstrated by at least a prefeasibility study. It can be classified as probable or proven.[25]

Going forward, exploration in remote and northern regions might prove to be the solution if Canada wishes to maintain its position as the leading destination for global exploration investment and to replenish its mineral reserves. Working in these areas, however, comes with a number of challenges, such as a lack of enabling infrastructure to support mineral development (Box 6).

Box 6: Enabling Infrastructure in Northern and Remote Regions

To leverage the considerable mineral potential of northern and remote regions, enabling infrastructure gaps – transportation, power, and communication – will need to be addressed. Companies operating in these regions face cost premiums estimated at 2.5 times higher than at similarly sized mines in the South,[26] which are almost entirely attributable to infrastructure costs. These additional expenses inhibit mineral development and can make otherwise economically viable projects cost-prohibitive.

Stornoway Diamond Corporation is currently constructing Quebec's first diamond mine, 350 km north of Chibougamau, in the Otish Mountains region of the province. An integral component enabling the development of the Renard diamond project was the extension of Route 167, which provides all-season access to the mine. Construction of the road, completed in 2013, was funded through a unique partnership between the company and the Province, which saw the Province build the first 143-km portion of the road as a two-lane gravel highway while Stornoway built the remaining 97 km as a single-lane mining road using a credit facility, provided by the Province, to be amortized over 15 years. The road-extension project mitigates operational and environmental risks by providing year-round access; supports long-term production at the mine, contributing to Quebec's economic prosperity; and may lead to future opportunities for development.

[25] Canadian Institute of Mining, Metallurgy, and Petroleum Standards on Mineral Resources and Reserves, http://web.cim.org/standards/menupage.cfm?sections=177&menu=178.

[26] Association of Consulting Engineering Companies of Canada, et al., 2015, *Leveling the Playing Field: Supporting Mineral Exploration and Mining in Remote and Northern Canada*, http://mining.ca/sites/default/files/documents/Levelling_the_Playing_Field.pdf.

Capital Expenditures

Highlights

- Capital expenditures in the mineral sector, including support activities for mining, nearly doubled between 2006 ($7.8 billion) and 2015 ($14.9 billion).
- Since a record high in 2012, however, capital expenditures in the mineral sector have declined in successive years.
- In the mining and quarrying subsector, which typically accounts for over 70% of the total investment value, spending nearly doubled between 2006 and 2015, but has been trending downward since 2012.
- Preliminary intentions for 2016 show a further decrease in capital expenditures in the mineral sector.

Definition

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

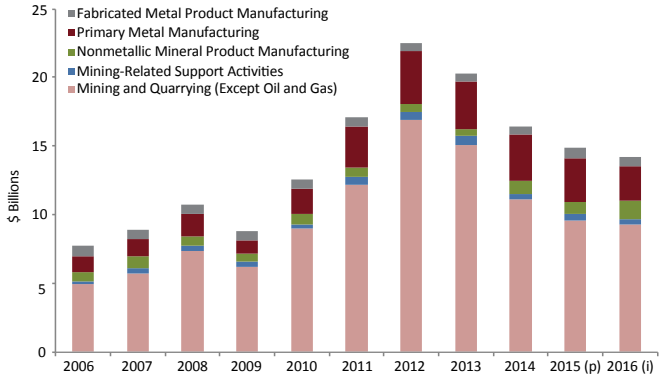
Rationale

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 mineral sector, including support activities for mining, climbed between 2006 and 2008 as companies ramped up development to meet growing commodity demand. Capital spending then dropped 17.9% in 2009 in response to the 2008 and 2009 global recession, but quickly rebounded to reach a record high of $22.5 billion in 2012 (Figure 13). Since this high, expenditures have decreased in successive years to $14.9 billion in 2015 as the sector reacted to global economic conditions, reduced demand, and oversupply issues for some commodities. Preliminary intentions for 2016 show a further reduction to $14.2 billion, which would represent 5.9% of Canada's total capital investment intentions.

Figure 13: Mineral Sector Capital Expenditures, by Subsector, 2006-16



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

Capital expenditures in the mining and quarrying subsector account for the bulk of total sector investment expenditures, typically accounting for approximately 70% of total mineral investment expenditures. Investment is closely linked to mine capacity, which is in turn dependent on various factors whose influence changes over time.[28] Factors that tend to reduce capacity are permanent closures, temporary shut-downs or closures, 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' milling capacity, 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.

As shown in Figure 14, capital expenditures in the mining and quarrying subsector increased 93.6% from 2006 to 2015. In the nonmetallic ore extraction subsector, capital investment spending more than

[27] Detailed information regarding the compilation and dissemination of capital investment data can be located at http://www.statcan.gc.ca/pub/61-205-x/2014000/technote-notetech2-eng.htm.

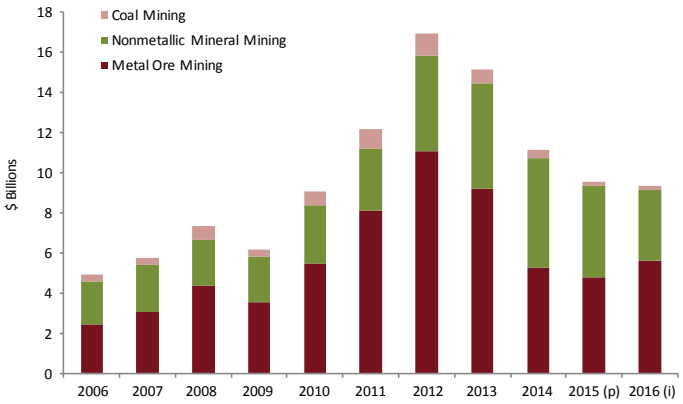
[28] Crowson, Phillip, 2008, *Mining Unearthed*, United Kingdom: Aspermont.

doubled during this period, largely as the result of spending in potash mining, while it nearly doubled in the metallic ore extraction subsector, led by substantial spending increases in precious metals mining. In the coal extraction subsector, capital investment in 2015 was $206.9 million, 43.1% lower than 2006 levels.

However, comparisons between 2006 and 2015 overlook the significant downward trend in spending that occurred between 2012 and 2015 as a result of companies adjusting their plans to economic conditions. Overall, capital expenditures in the mining and quarrying subsector fell 43.5% to $9.6 billion. In the commodity subsector, capital expenditures decreased 80.9% in the coal extraction subsector, 56.9% in the metallic ore extraction subsector, and 4.5% in the nonmetallic ore extraction subsector.

Preliminary indications for 2016 show expenditure decreases in the coal extraction subsector and the nonmetallic ore extraction subsector of 6.6% and 23.2%, respectively. Capital investments in the metallic ore extraction subsector are expected to increase 17.7% as the result of expenditure increases in both precious metals mining and nickel-copper mining.

Figure 14: Mineral Extraction Capital Expenditures, by Commodity Group, 2006-16



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

The downstream mineral processing industries contributed $4.9 billion (33.8%) to mineral sector capital investment in 2015 and were expected to contribute $4.5 billion in 2016. Over half of this anticipated investment ($2.6 billion) is attributable to primary metal manufacturing. From 2006 to 2015, investment in the primary metal manufacturing and the nonmetallic mineral product manufacturing subsectors experienced notable growth of 178.9% and 35.2%, respectively. Investment in the fabricated metal product manufacturing subsector experienced more modest gains of 5.5% 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. Additional information regarding Statistics Canada's methodological updates is available at http://www23.statcan.gc.ca/imdb-bmdi/document/2803_D16_T9_V1-eng.htm.

Research and Development

Highlights

- Canada's mining, support services, and mineral processing industries' business expenditures on R&D (BERD) totaled $677 million in 2013.
- While the sector's BERD declined by 10.2% between 2007 and 2013, they rose 9.2% during the latter part of the period.
- R&D expenditures in the mining and related support activities subsector almost tripled from 2007 to 2013.

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 is important because it plays a key role in the innovation process. R&D activity demonstrates the extent to which firms are committed to new or improved production processes and is pivotal to the innovation

performance of any industry. R&D is important for a company and industry to remain competitive, minimize costs, and improve profitability in the long term.

Analysis

Weak markets and a challenging operating environment have established the imperative for the mineral sector to develop new ideas and to innovate by leveraging emerging technologies and improving how companies explore, extract, and transform resources in order to realize sustainable and long-term economic, environmental, and social goals. Collaboration and forward thinking will be required in order to effectively and efficiently respond to the challenges faced by the natural resource sectors.

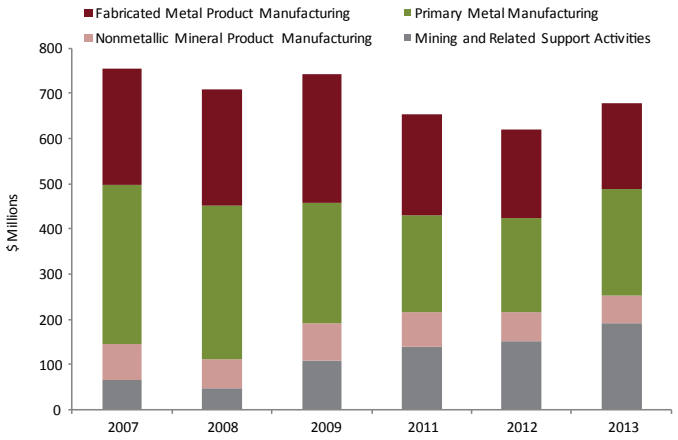
Economically, innovation is important to enhance productivity, address skilled labour shortages, develop the technologies necessary to extract mineral resources in more difficult conditions (e.g., frontier mining, deep mining), and enhance profitability and efficiency throughout the mineral cycle. Environmentally, innovation is important to mitigate and adapt to the adverse impacts of climate change on the mineral sector, develop new technologies and materials that are safer, lessen greenhouse gas emissions, promote energy efficiency, minimize the environmental footprint, and improve resource management (i.e., more efficient water, energy, and infrastructure utilization) throughout the mineral cycle. Socially, innovation is important to gain legitimacy in resource development; minimize community disruption or opposition; improve the image of mining through green technologies, practices, and processes; and establish the early engagement of communities through new social practices to improve external relations, mutual understanding, and inclusive benefits.

Canada's mineral sector BERD totaled $677 million in 2013 (Figure 15), the latest year for which statistics are available.[29] The mining and quarrying subsector accounted for almost a third of the value, reaching $191 million. While the sector's 2013 BERD have decreased 10.2% relative to the peak reached in 2007, they almost tripled for the mining and quarrying subsector during the same period, increasing from $67 million in 2007 to $191 million in 2013.[30]

Although Statistics Canada indicates that mining and quarrying subsector BERD data are unreliable for the most recent years, the estimated values point towards a declining trend.

The primary metal manufacturing industries, which include ferrous and nonferrous materials, have experienced a decrease in R&D expenditures for the past decade. From a high of $351 million in 2006, spending declined to $234 million in 2013. These decreases in expenditures were mostly attributable to R&D expenditures related to nonferrous materials. As well, in 2013, the fabricated metal products industries invested $199 million in R&D, a 13% decline since 2006. This industry has seen a steady and notable increase in expenditures, from $57 million in 1997 to $285 million in 2009, before investments trended downwards.

Figure 15: Mineral Sector Business Expenditures on Research and Development, by Subsector, 2007-13



Source: Statistics Canada.

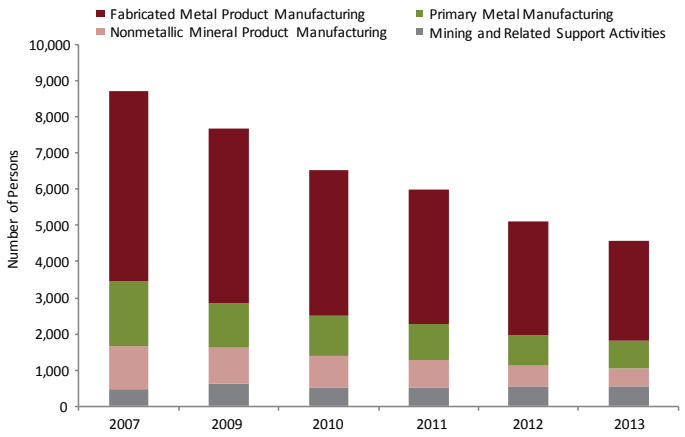
A total of 4,560 R&D personnel were working in Canada's mineral sector in 2013, the latest year for which statistics are available. There was a noticeable upward trend in persons employed in R&D in the mining and quarrying subsector, with a peak of 636 personnel reached in 2009.[31] The trend has since subsided and stood at 550 personnel in 2013 (Figure 16).

[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).

[30] For a number of years, Statistics Canada's data on BERD are either unavailable or too unreliable to be published, hence the comparison between select years where data are available.

[31] Data for 2008 for the primary metal (ferrous) subsector are unavailable.

Figure 16: Mineral Sector Research and Development Personnel, by Subsector, 2007-13



Source: Statistics Canada.

Data Considerations

Statistics Canada's data for BERD contain several years with gaps as a result of the application of confidentiality rules and/or data quality issues. Data on BERD contained in this section are only presented for years where the data were available for all subsectors.

Government Revenues

Highlights

- Between 2005 and 2014, the mineral sector generated $16.7 billion in corporate income tax revenue for Canadian governments ($10.3 billion for the federal government and $6.4 billion for provincial/territorial governments).
- Mining taxes and royalties paid to governments by the mineral extraction industry have grown 42.7% over the last 10 years and were $1.5 billion in 2014/15.

Definition

Government revenues from the mineral sector include corporate income taxes, mining taxes, and royalty payments to provincial and federal governments. Corporate income tax data in this section are from 2005 to 2014 while provincial mining and royalty tax data are from 2005/06 to 2014/15.

Table 6: Canadian Federal and Provincial/Territorial Corporate Income Tax Rates for Mining, 2005 and 2015

Jurisdiction	Tax Year 2005	Tax Year 2015
Federal	26.0%	15.0%
Alberta	11.5%	11.0%
British Columbia	12.74%	11.0%
Manitoba	15.0%	12.0%
New Brunswick	13.0%	12.0%
Newfoundland and Labrador	14.0%	14.0%
Northwest Territories	14.0%	11.5%
Nova Scotia	16.0%	16.0%
Nunavut	12.0%	12.0%
Ontario	12.0%	10.0%
Prince Edward Island	16.0%	16.0%
Quebec	8.9%	11.9%
Saskatchewan	10.0%	10.0%
Yukon	15.0%	15.0%

Source: Natural Resources Canada.

Rationale

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

Analysis

The mineral 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 the second lowest statutory corporate income tax rate in the G7 countries, profit-based royalty systems, carry-forward and carry-back provisions, and mineral and exploration tax incentives such as flow-through shares (FTS).[32] As shown in Table 6, the Government of Canada reduced the corporate income tax rate from 26.0% in 2005 to 15.0% in 2015. In addition, six provinces and territories have also reduced their corporate income tax rates since 2005.

Generally, the mining taxes and royalties in Canada are based on net income rather than revenue, although

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

six provinces[33] have a two-tier system in which a small percentage of operating income is taxed before taxing the net income.

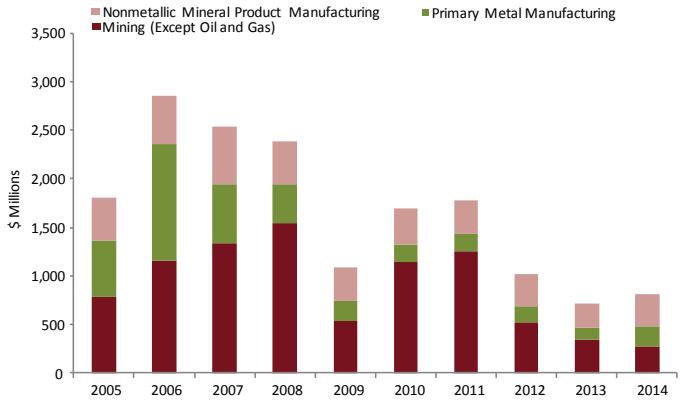
Also of note is Canada's unique FTS mechanism that allows a principal business corporation to obtain financing for expenditures on mineral exploration and development in Canada. FTS investors can receive a 100% tax deduction for the amount of money invested in FTS for exploration and 30% for development. In addition, this incentive has been further enhanced by the Government's extension until March 31, 2017, of the 15% Mineral Exploration Tax Credit on eligible expenses (for example, costs related to prospecting, and carrying out geological, geophysical or geochemical surveys conducted from or above the surface of the earth). Furthermore, several provinces (British Columbia, Manitoba, Ontario, and Saskatchewan) are also offering additional tax credits or deductions to FTS investors to encourage exploration investment in their jurisdictions.

Corporate income tax paid to governments by the mineral sector in Canada fluctuated significantly between 2005 and 2014, reaching a high in 2006 of $2.9 billion (Figure 17).[34] Corporate taxes paid dropped substantially in 2009 before rebounding in 2010 and 2011. Levels declined again in recent years, to $814 million in 2014, as the result of a global commodity slowdown in response to reduced demand and oversupply issues.

Between 2005 and 2014, the mineral sector generated $16.7 billion in corporate income tax ($10.3 billion to the federal government and $6.4 billion to provincial/territorial governments) (Figure 18). With federal corporate income tax rates declining over the last 10 years, the provinces and territories have had an increasing share of corporate income tax revenues in recent years from all mineral subsectors. For instance, in the mining and quarrying subsector, the share of provincial/territorial corporate income tax to total corporate income tax increased from 29.7% in 2005 to 47.7% in 2014.

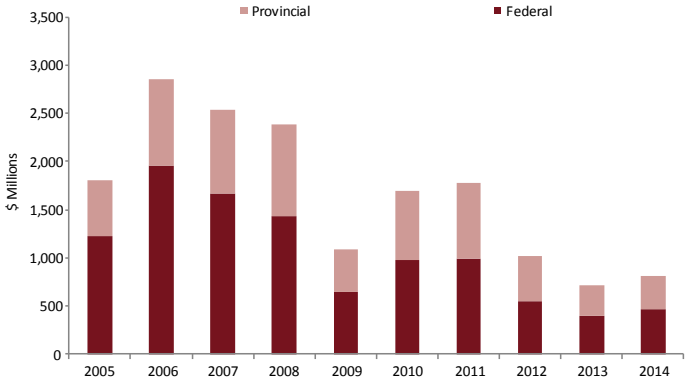
Furthermore, mining taxes and royalties paid to governments by the mineral extraction industry have grown by 42.7% over the last 10 years (Table 7). These payments reached a peak of $2.7 billion in 2008/09, at the height of the commodity super-cycle, before receding in the wake of the global recession. They rebounded in subsequent years and in 2014/15 were $1.5 billion.

Figure 17: Mineral Sector Corporate Income Tax Paid, by Subsector, 2005-14



Source: Statistics Canada.

Figure 18: Mineral Sector Corporate Income Tax Paid to Federal-Provincial/Territorial Governments, 2005-14



Source: Statistics Canada.

Data Considerations

Although it is not captured with statistics in this section, it is important to note that mineral sector contributions to government revenues extend beyond just corporate income tax and royalties. Mineral sector activity drives other economic activity that contributes to 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.

Going forward, additional data to complement this section will become available as a result of the *Extractive Sector Transparency Measures Act* (Box 7).

[33] Alberta, British Columbia, New Brunswick, Newfoundland and Labrador, and Nova Scotia currently have a two-tier mining royalty system. In May 2013, the Government of Quebec announced a new mining tax regime effective January 1, 2014. Companies will pay the higher of a minimum mining tax on value of production, which will vary from 1% to 4%, or a tax on profits ranging from 16% to 22.9%.

[34] Data for NAICS 332 – fabricated metal product manufacturing are not available in a disaggregated manner.

Table 7: Royalties, Mining Taxes, and Similar Payments to Provinces and Territories, 2005/06 to 2014/15

Province/ Territory	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
	(current $ millions)									
Newfoundland and Labrador	21.0	121.5	276.6	216.9	84.8	228.1	317.4	136.0	160.4	95.4
Nova Scotia	2.0	2.3	2.3	2.6	1.7	1.4	2.5	1.6	1.3	1.3
New Brunswick	21.2	129.9	133.9	37.2	43.0	44.4	66.0	31.0	22.7	36.3
Quebec	52.8	52.1	59.8	5.7	116.3	323.6	352.2	207.3	56.8	110.1
Ontario	56.8	156.6	236.7	79.8	20.5	176.1	213.4	117.5	18.6	159.0
Manitoba	41.8	100.0	104.1	49.7	14.6	45.9	66.8	42.4	13.0	7.1
Saskatchewan	534.9	373.1	714.0	1,797.2	113.0	626.0	855.1	726.6	661.6	920.7
Alberta (coal)	11.0	13.0	14.0	36.0	31.0	31.0	29.0	-3.0	16.0	16.0
British Columbia	229.3	303.4	202.5	324.4	292.1	364.5	358.3	150.2	106.5	89.7
Yukon	1.2	1.4	1.9	2.0	2.3	4.2	5.4	4.0	2.4	1.5
Northwest Territories and Nunavut	78.0	18.9	64.0	112.7	91.5	108.9	132.2	58.1	28.3	61.0
Canada	**1,050.1**	**1,272.2**	**1,809.7**	**2,664.2**	**810.9**	**1,954.2**	**2,398.3**	**1,471.6**	**1,087.7**	**1,498.1**

Source: Natural Resources Canada.

Box 7: Extractive Sector Transparency Measures Act

The *Extractive Sector Transparency Measures Act* came into force on June 1, 2015. The Act delivers on Canada's international commitments to support global efforts to strengthen transparency and accountability in the extractive sector by introducing new reporting obligations for companies engaged in oil, gas, or mineral activities. The Act requires extractive entities to publicly disclose, on an annual basis, specific payments made to all governments in Canada and abroad for financial years beginning after June 1, 2015. Payments made to Indigenous governments in Canada are subject to a two-year deferral period ending June 1, 2017.

The Act applies to entities that are subject to Canadian law and engaged in the commercial development of oil, natural gas, or minerals. The payments to be reported are those of CAN$100,000 or more and that fall within specific categories of revenue streams commonly associated with exploration and extraction of oil, natural gas, or minerals (i.e., taxes, royalties, fees). Payments will be required to be reported by payee and on a project-level basis.

Canadian extractive companies already operate in a transparent and responsible manner, and the Act reinforces Canada's leadership by aligning with international transparency standards. Given this alignment with reporting requirements in other jurisdictions, the Act provides a level playing field for companies operating domestically and abroad. The Act includes a substitution provision to minimize the reporting burden for reporting entities with similar obligations in multiple jurisdictions.[35]

[35] Natural Resources Canada has developed a set of information and guidance products to assist extractive entities in navigating the reporting process. For more information, see http://www.nrcan.gc.ca/ESTMA.

SECTION III: SOCIAL PERFORMANCE

The activities of the mineral sector contribute to a variety of social impacts, both positive and negative. Mineral exploration, development, and production can provide significant employment opportunities and direct and indirect economic spinoffs. This economic activity has the potential to improve quality of life through improved employment prospects and potential business ownership through the development of small business enterprises to support the sector, educational or vocational opportunities, transportation and energy infrastructure, work for local businesses, and other community development levers. However, mineral operations can also bring change to a community's identity and can lead to increases in undesirable outcomes, such as increased cost of living.[36] In addition, communities that depend on exploration and mining to sustain their economies can be especially vulnerable to adverse social impacts when a mine closes. Transparency, engagement, and communication with local communities must be ensured throughout the mineral development cycle to foster relationships built on trust and mutual respect. Failure to do so can have a negative impact on a project and on a mineral company's profitability, competitiveness, and reputation, as well as on the long-term sustainability of surrounding communities.

The outcomes and indicators in this section of the report have been developed to help assess the mineral 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 proximity to exploration and mineral activities.

Conduct engagement processes to ensure local and affected communities have the opportunity to participate in the development of resources that could influence their future.

The indicators[37] chosen to measure the sector's performance related to these outcomes are:

- **Employment (Indigenous and non-Indigenous)** – Employment in the mineral industry provides income security, an improved standard of living, and the acquisition of transferrable 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.

- **Agreements between mineral companies and Indigenous communities or groups** – Agreements 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 gives an indication of the mineral industry's efforts to earn and maintain a social licence to operate.

- **Government funding for public participation in environmental assessments** – Environmental assessments examine a comprehensive list of potential impacts in natural resource development, including the cumulative effects of the proposed project, measures to mitigate those effects, and concerns and comments raised by the public. Funding to support public participation in environmental assessments is an important indicator in gauging efforts to ensure public concerns are heard during regulatory processes.

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

- **Workplace health and safety** – Workplace health and safety is measured as the occupational injury rate, both fatal and non-fatal. Monitoring it helps determine the mineral sector's level of performance in ensuring safe and healthy work environments.

[36] 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.

[37] The authors acknowledge the indicators presented in the report are not currently sufficient to measure all of the social impacts of the mineral sector, positive or negative. Finding more pertinent data for the next edition of this report will remain a priority.

- **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 economic activity in the local area. Monitoring is important given the potential for significant impacts on local communities. That said, the concept of "mining communities" is changing as many new mines are developed in more isolated areas that require "fly-in, fly-out operations," particularly in the North. These operations draw from several communities rather than from one nearby town, changing the more traditional view of "mining communities" and potentially making the ramifications of closures on communities more widespread, but potentially less intense.

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

Synopsis

Overall, the mineral industry's social performance was variable between 2006 and 2015. Employment dropped substantially in the wake of the economic recession and, while it has been trending upward over the last couple of years, it has yet to reach pre-recession levels. The employment decline has primarily been in the metal manufacturing subsectors; employment in upstream activities, including mineral exploration and extraction, increased dramatically over this period. Since 2007, Indigenous employment has increased, as has the number of agreements signed between mineral companies and Indigenous communities. The sector has made significant strides in providing a stable and safe work environment, but additional effort is required to increase gender diversity in the sector's labour force.

Highlights

- The number of people **employed** in the mining, mining-related support activities, and mineral processing sector fell from 401,825 in 2006 to 373,435 in 2015, a reduction of 7.1%. Most of these losses can be attributed to downstream manufacturing subsectors, while gains were experienced in upstream subsectors.

- Between 2007 and 2015, the number of **Indigenous Peoples employed** in the mineral sector increased from 9,200 to 10,300, a 12.0% gain.

- The number of **agreements signed between exploration and mining companies and Indigenous communities or groups** has increased significantly over the last 10 years with a total of 374 agreements signed.

- The total **number of women** employed in the mining and quarrying and oil and gas extraction sector was approximately 56,200 in 2015, up 6,800 from 2006, but the **proportion of women employed** has declined slightly.

- Between 2005 and 2014 (the latest year for which data are available), the **rate of fatal and non-fatal injuries** per 10,000 employees within the mineral industry has fallen substantially.

- Between 2006 and 2015, there were 60 **mine openings** and 41 **re-openings**, while 35 mines **closed** and 76 were **suspended**.

- Between 2006 and 2015, there was a decrease in the total number of **strikes and lockouts** within the mineral sector. The number of person-days not worked also decreased during this period; however, there were significant labour disruptions at select mineral processing facilities in 2009 and 2010.

Indicator (2006-15) (unless otherwise specified)	
Employment	
Indigenous Employment (2007-15)	
Indigenous Agreements	
Regulatory Participation	Incomplete Assessment
Gender Diversity	
Workplace Health and Safety (2005-14)	
Mine Closures and Openings	
Strikes and Lockouts	

Improved Performance | Limited Improvement | Decline in Performance

Employment

Highlights

- The number of people employed in the mining, mining-related support activities, and mineral processing sector in Canada was 373,435 in 2015, a decrease of 7.1% over 2006.
- Employment in the mineral exploration and extraction subsectors grew while job losses were most notable in downstream manufacturing activities.
- The total annual compensation per job has been increasing since 2006, reaching $87,267 in 2015.[38] This compares very favourably to the national average of $59,008 per job.

Definition

Employment is the number of individuals directly employed by establishments classified within the mining, mining-related support activities,[39] and mineral processing sector.

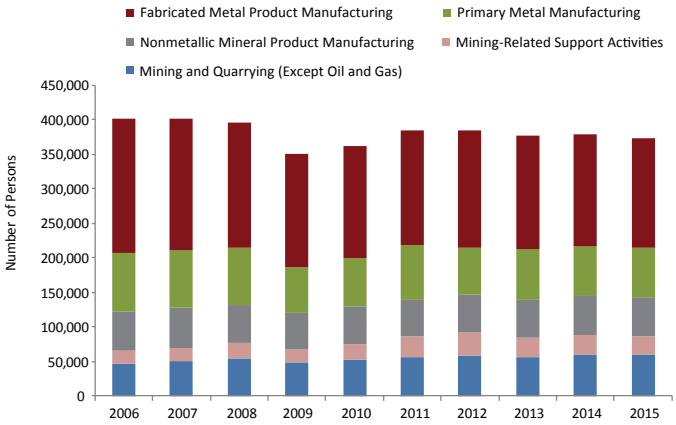
Rationale

Employment provides increased income security that can result in improved quality of life and the acquisition of transferrable skills. In addition, employment can lead to higher consumption and spending in the local community (usually in services and retail), which drives local economic development and improved quality of life, often resulting in better health. As well, there is a positive correlation between employment and gross domestic product growth,[40] which can lead to improved living standards.

Analysis

In 2015, 373,435 individuals were employed in the mining, mining-related support activities, and mineral processing sector in Canada, representing 1 in every 49 Canadian jobs. However, employment levels in the sector declined by approximately 28,000 between 2006 and 2015, representing an overall decrease of 7.1% (Figure 19).

Figure 19: Mining, Mining-Related Support Activities, and Mineral Processing Employment, 2006-15



Source: Statistics Canada.

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

[39] 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.

[40] 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 majority of this decline has occurred in the downstream mineral processing subsectors. During this period, employment in the fabricated metal product manufacturing subsector fell 18.0%, followed by the primary metal manufacturing subsector (-16.3%), and the nonmetallic mineral product manufacturing subsector (-1.1%). Ontario's mineral manufacturing subsector was hit particularly hard, as a total of over 33,000 jobs were lost, mostly in the fabricated metal product manufacturing stage. British Columbia and Quebec also experienced notable mineral processing employment losses during this period.

Such decreases in mineral processing can be attributable to a number of factors, including demand cycles, operating capacity, technological advancements, aging and closing Canadian facilities, and increased foreign competition for feedstock to process.[41]

In the mineral extraction subsector, employment increased from 2006 to 2015, by 27.1%, to a high of over 60,000, while it increased 45.3% in the mining-related support activities sector, which includes select mineral exploration activities.

In terms of compensation, jobs in the mineral industry remain some of the highest paying in Canada. In 2015, the total annual compensation per job for the industry as a whole was $87,267, a 29.6% increase over 2006 and nearly $30,000 higher than the all-industry average.

Going forward, the mineral industry faces a number of human resources challenges. According to the Mining Industry Human Resources Council (MiHR), the sector will require approximately 106,000 new workers over the next decade to address retirement, attrition, and sector growth. This shortage will be compounded by the anticipated wave of retirements of the industry's skilled core workers. By 2024, the MiHR forecasts that more than 50,000 skilled employees will retire from the sector, resulting in a significant loss of industry knowledge and expertise.[42]

Moving forward, it will be important to continue to monitor efforts to address these anticipated skilled labour shortages.

Box 8: Mining Industry Human Resources Council's National Mining Worker Certification Program

The MiHR has launched Canada's first and only national mining worker certification program, the Canadian Mining Certification Program (CMCP), which, to date, has certified over 1,000 workers. The CMCP is designed to recognize and certify the skills and competencies of workers in undesignated occupations in the mineral sector.

The program initially developed standards for four priority occupations: underground miner, surface miner, minerals processing operator, and diamond driller. In January 2014, the MiHR received funding from Employment and Social Development Canada to expand the program to develop standards for the roles of frontline supervisor, industry trainer, and hoist operator.

The CMCP is an important tool in helping companies attract, develop, and retain skilled employees, while ensuring that workers who participate and have been certified under the CMCP have a professional credential that is recognized throughout the mineral industry in Canada and that can be used to demonstrate their transferrable skills to other industries.

Data Considerations

The 2013 edition of this report assessed employment trends using Statistics Canada's Survey of Employment, Payrolls, and Hours (SEPH). In 2012, Statistics Canada began publishing a more comprehensive measure of employment through the System of National Accounts. This dataset reconciles information from both SEPH and the Labour Force Survey (LFS), along with information from the Census and administrative data sources (i.e., Canada Revenue Agency T4 tax slips). As a result, it better captures categories such as self-employment, which in turn allows for more complete employment value estimates.

This dataset also disaggregates industry categories in a manner that enables the reporting of employment for the mining-related support activities subsector, which includes select mineral exploration activities like contract drilling. It is important to note, however, that this industry category is not inclusive of all mineral exploration employment as it is unable to adequately capture the numerous professional services (i.e., geological, financial, legal) associated with the mineral exploration industry that are spread across other industry classifications.

[41] The Mining Association of Canada, 2015, *Facts and Figures 2015*, http://mining.ca/sites/default/files/documents/Facts-and-Figures-2015.pdf.

[42] Mining Industry Human Resources Council, 2015, *Canadian Mining Industry Employment, Hiring Requirements and Available Talent – 10-Year Outlook*, http://www.mihr.ca/en/publications/National_Outlook.asp.

Indigenous Employment

Highlights

- Indigenous employment in the mineral industry increased 12.0% from 2007 to 2015.
- In 2015, nearly half of Indigenous employment was concentrated in the mining and quarrying subsector, up from 29.3% in 2007.

Definition

The 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.[43]

Rationale

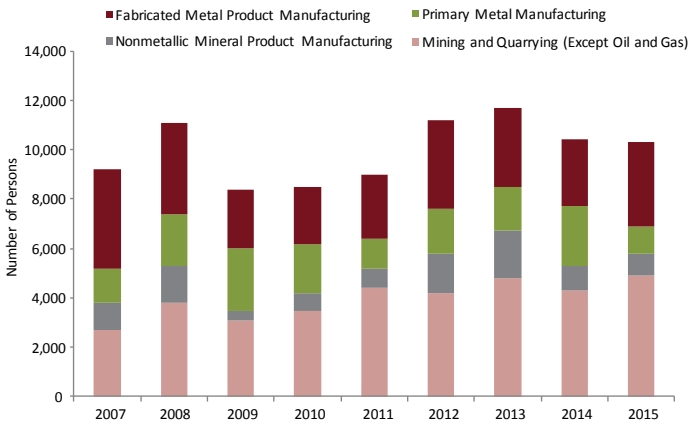
Governments and the mineral industry have recognized the potential for greater Indigenous participation in the industry's labour force. Canada's Indigenous population is younger and growing at a faster rate than the general population, and a number of Indigenous communities are located in close proximity to producing mines and exploration properties, making local hiring an attractive solution to sourcing human resources. Moreover, providing training and transferrable skills development is an increasingly important element of obtaining and maintaining a social licence and may lead to greater labour market participation for Indigenous Peoples.

Analysis

Between 2007 and 2015, the number of Indigenous Peoples employed in the mineral sector fluctuated considerably, hitting a low of 8,400 in 2009 before climbing in successive years to reach a high of 11,700 in 2013 (Figure 20). Employment levels declined to 10,300 in 2015 as the industry as a whole recalibrated and refocused activities in light of the prevailing economic conditions.

[43] www.statcan.gc.ca/pub/71-588-x/71-588-x2011003-eng.htm.

Figure 20: Mineral Sector Indigenous Employment, 2007-15



Source: Statistics Canada.

In 2015, Indigenous employment in the mineral sector was mostly concentrated in the mining and quarrying subsector, representing 47.6% of total Indigenous mineral industry employment, up from 29.3% in 2007.

Box 9: Native Women's Association of Canada's Strategic Partnership Agreement

In February 2015, the Native Women's Association of Canada, in partnership with Indigenous and Northern Affairs Canada, released a report identifying barriers having an impact on Indigenous women's participation in Canada's resource extraction sector and articulating opportunities to alleviate or eliminate such obstacles. Using information from a survey and an engagement session, the report identified four significant barriers: work-life conflicts, such as being the primary caregiver and lack of support from family and/or partner; unappealing, unsafe, or male-dominated work environments; stereotypes related to sexism, wage gaps, and unfriendliness or violence in the workplace; and lack of job supports, such as childcare, housing, and training/experience.

To combat these barriers and to help increase Indigenous women's participation in the extractive sector, the report offered a number of recommendations: development of a collaborative communication strategy to increase awareness of natural resource sector opportunities and its positive contributions to local and Indigenous communities; adoption of additional support mechanisms related to child care and family obligations; implementation of educational strategies to tackle sexism and violence in the workplace; and appropriate skills training, educational programs, and career path policies aimed at Indigenous women.

Data Considerations

The Indigenous employment numbers presented in this section are sourced from Statistics Canada's LFS. Although the LFS produces employment estimates for Canada's three territories and includes Indigenous identity questions, it employs a different methodology than the one used for the provinces. The LFS also 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 Peoples employed in the mineral sector. Moreover, owing to differences in methodologies, data prior to 2007 are not included in this section as they cannot be compared with more recent data.

Gender Diversity

Highlights

- The number of women employed in the mining and quarrying and oil and gas extraction sector was approximately 56,200 in 2015, up by 6,800 from 2006.
- However, the proportion of women employed in the sector has decreased slightly over this period.
- Despite some progress, significant effort is still required to reduce the barriers for women's participation in the mineral industry's labour force and to achieve a more balanced level of employment between both genders.

Definition

Gender diversity is the measurable representation of women employed in a given industry.

Rationale

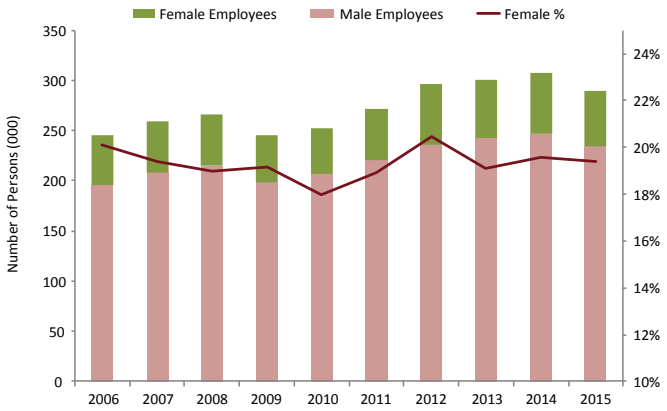
Gender diversity is an important social performance measure. It has been shown that increases in education, quality of life, or health for women not only benefit women, but also their families as the link between an improvement in the situation of women and an improvement in the family situation is strong. Also, from a company perspective, several studies have identified the linkages between a critical mass of women in the work force and in leadership positions with an organization's improved financial performance and governance.[44] A lack of gender diversity could have an impact on a firm's productivity and profitability.

Analysis

Figure 21 shows the employment trends by gender for mining and quarrying and oil and gas extraction[45] and the proportion of female employees over the last 10 years. While the number of female employees has increased during this period, the proportion of female employees has remained relatively flat at around 20.0%, well below the all-industry average of roughly 47.5%.

Relative to other sectors of the Canadian economy, the mining and quarrying and oil and gas sectors are underperforming in terms of gender equality in the labour force. The sector ranks in the lowest quartile with respect to female representation, ahead of only the construction; fishing, hunting, and trapping; and forestry sectors.

Figure 21: Mining and Quarrying and Oil and Gas Employment, by Gender, 2006-15



Source: Statistics Canada.

With respect to senior management positions in the mining sector, a recent report[46] highlights a noticeable improvement in gender diversity in these roles in recent years. In 2014, nearly 8.0% of board positions of 500

[44] Hunt, Vivian, et. al., 2015, *Why Diversity Matters* [online], France: McKinsey & Company; and Desvaux, Georges, et. al., 2007, *Women Matter: Gender Diversity, a Corporate Performance Driver* [online], France: McKinsey & Company.

[45] Statistics Canada's CANSIM Table 282-0008 groups mining and quarrying, and oil and gas extraction into one sector. Data for downstream mineral processing activities are unavailable in a disaggregated manner relevant to this report.

[46] Women in Mining (UK) and Pricewaterhouse Coopers, 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.

mineral companies were female, a full 3.0% improvement from 2012. However, there remains significant work to be done in removing the remaining barriers for women in the industry. Based on current trends, it will take a further 25 years for the top 100 mining companies to reach the 30.0% critical mass of women in senior positions that has been found to have the maximum positive impact on company performance.[47]

In 2010, the MiHR and Women in Mining Canada[48] partnered to produce a report that highlighted not only the underrepresentation of women in the mineral exploration and mining sector work force, but also the wage gap between men and women and several of the barriers that women face in careers in the mineral industry. A more recent study from the Centre for Women in Politics and Public Leadership at Carleton University[49] also found that women are underrepresented in mineral sector employment and that the sector compares unfavourably to other key economic sectors with respect to female work force representation. In both reports, a male-dominated work culture, limited opportunities for advancement, lack of flexible work arrangements, and insufficient support for family care were cited as some of the barriers women continue to face in careers in the mineral sector.

As a result, significant progress is required to reduce the barriers for women's participation in the mineral industry's labour force and to achieve a more balanced level of employment between both genders.

Data Considerations

The data for this section are from Statistics Canada's LFS, which groups the mining and quarrying subsector with that of oil and gas extraction. The trends in these data should be viewed with a degree of caution as the inclusion of oil and gas extraction may skew the numbers.

[47] Kramer, V.W., Konrad, A.M. and Erkut, S., 2006, *Critical Mass on Corporate Boards: Why Three or More Women Enhance Governance*, Wellesley Centres for Women's Publications Office, http://www.wcwonline.org/pubs/title.php?id=487.

[48] 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.

[49] Beckton, C., and Ozkan, U., 2012, *The Pathway Forward: Creating Gender Inclusive Leadership in Mining and Resources – A Report*, http://carleton.ca/cwppl/wp-content/uploads/Women-in-Mining-2.5.pdf.

Agreements Between Mineral Companies and Indigenous Communities or Groups

Highlights

- Over 480 agreements have been signed in Canada since 1974 for over 300 projects, and approximately 380 remain active.
- A total of 374 agreements have been signed over the last 10 years.
- The share of agreements for exploration-stage projects has been steadily rising, from 23.1% of all agreements signed prior to 2006 to 65.5% of all agreements signed between 2006 and 2015.

Definition

Agreements between mining companies and Indigenous communities or groups are, for the most part, privately negotiated agreements that typically contain provisions for employment and training, business opportunities through set-aside contracts and joint ventures, social and cultural considerations, environmental monitoring, funding arrangements, and other provisions. These can be negotiated at multiple stages of the mineral development sequence (i.e., exploration, mine development) and can be revisited as a project advances.

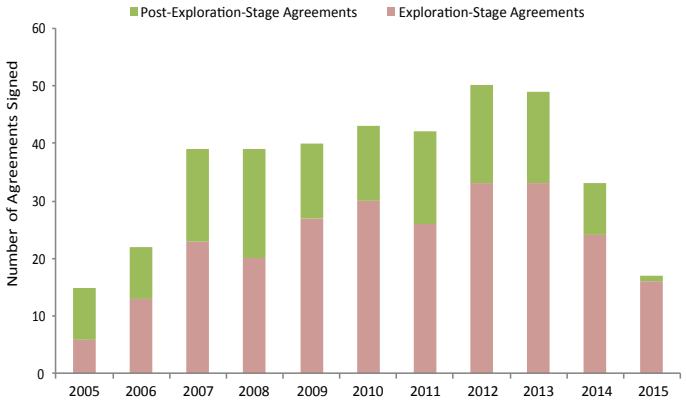
Rationale

Agreements between mining companies and Indigenous communities or groups at the exploration and development stages (i.e., construction, operation, closure, and post-closure) play an important role in shaping the terms by which mineral activity can occur within the traditional territory of a First Nation, Inuit, or Métis group, and/or when such activities may have an impact on Indigenous or treaty rights. Agreements can help secure benefits for local Indigenous Peoples, communities, and businesses, and can provide exploration and mining proponents with increased certainty through a framework and tools for engagement and relationship-building (Box 10). Failure to reach an agreement, or the lack of an agreement, can have adverse impacts on the development of a project, the sustainability of an exploration or mining company, and socio-economic opportunities for local communities and their residents.

Analysis

Over 480 agreements have been signed in Canada since 1974 for over 300 projects. Since the 1990s, there has been a notable increase in the number of agreements; a total of 374 were signed between 2006 and 2015 (Figure 22), compared to just over 100 prior to 2006, as this became a common practice in the Canadian mineral sector. However, not all of these signed agreements remain active as replacement agreements are signed, operations end, or a decision is made to end the agreement. As of December 31, 2015, there were approximately 380 active agreements across Canada.

Figure 22: Number of Agreements Signed Between Mineral Companies and Indigenous Communities or Groups, 2006-15



Source: Natural Resources Canada.

Box 10: Importance of Meaningful Partnerships With Indigenous Communities

Goldcorp's Porcupine Operation

In 2014, Goldcorp's Porcupine operation (Timmins, Ontario) signed a Resource Development Agreement with four local First Nation communities: Mattagami First Nation, Wahgoshig First Nation, Matachewan First Nation, and Flying Post First Nation. The agreement improves collaboration between the company and local Indigenous communities, and defines long-term benefits such as training, employment, business and contracting opportunities, and a consultation framework for future regulatory permitting.

In addition, Goldcorp's Porcupine operations have worked in partnership with Indigenous Knowledge Guardians from across Canada, university researchers, and social advocacy groups to form the Anishanaabe Maamwaye Aki Kiigayewin (AMAK) Institute. The result of three years of meaningful collaboration among the partners, AMAK's goal is to explore models and approaches to incorporating both scientific data and Indigenous Traditional Knowledge, in a meaningful way, into the design, planning, and monitoring stages of the mining and reclamation processes.

Agnico Eagle Mine's Northern Operation

As part of its Inuit Impact and Benefit Agreement for the Meliadine project in Nunavut, Agnico Eagle Mines has undertaken a number of initiatives to support sustainable jobs and careers for the local Inuit population. The company has developed work readiness programs for new recruits and career path planning for its Inuit work force, with a focus on transferrable skills, such as for truck drivers and heavy equipment operators. Moreover, approximately one-third of its local mine work force is drawn from the Inuit of the Kivalliq region of Nunavut.

The company has also formed a partnership with the Kivalliq Mines Training Society and the Nunavut Arctic College to develop an apprenticeship program for training Inuit employees in skilled trades. The program combines on-the-job learning and in-school instruction to provide education and training in employees' trade program of choice. By the completion of the program, each apprentice is able to challenge their Journeyman and Red Seal exams. The company currently offers the apprenticeship program for seven different trades: chef, carpenter, millwright, electrician, heavy-duty equipment technician, welder, and plumber.

In 2014, three Inuit employees successfully completed the pre-trades assessment program. One Inuk female enrolled as an apprentice chef, one Inuit male enrolled as a carpenter's apprentice, and one Inuit male enrolled as a millwright apprentice. In June 2015, the millwright apprentice successfully earned his Red Seal certificate as a millwright, becoming the first to complete an apprenticeship with the company. There are currently 17 active apprentices registered in the program.

The share of agreements for exploration-stage projects has been steadily rising, from 23.1% of all agreements signed prior to 2006 to 65.5% of all agreements signed between 2006 and 2015 (Figure 22). Exploration-stage agreements establish positive working relationships and build mutual understanding between communities and the exploration company (Box 11). These agreements can provide a framework for negotiating more detailed agreements as a project advances through the development stage towards production (i.e., an operating mine).

Box 11: Early Engagement – e3 Plus: A Framework for Responsible Exploration

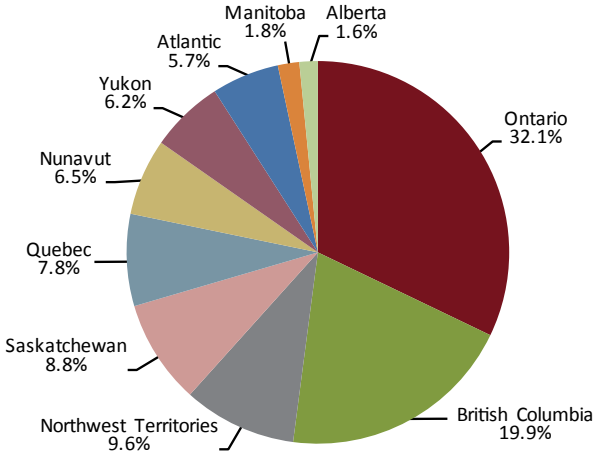
The Prospectors & Developers Association of Canada (PDAC) developed e3 Plus as an information resource to help exploration companies voluntarily improve their social, environmental, and health and safety performance. The first phase of e3 Plus was completed in March 2009 and included principles, guidance, and three Internet-based toolkits; it represented the first time that comprehensive guidance on responsible exploration had ever been produced. Recently, the PDAC began a renewal initiative to enhance the usability of the available information, to develop new guidance on priority issues, and to improve disclosure of environmental, social, and governance issues and performance at the exploration stage. Based on stakeholder interviews that articulated the increasing importance of community engagement practices, the PDAC's first new guidance, released in 2015, covered this area. Titled *First Engagement: A Field Guide for Explorers*, the guide aims to be a practical and straightforward resource to support geologists, project managers, or any site-level employees in establishing strong and positive company-community relationships.

The number of agreements for development-stage projects[50] has been moderately increasing during most years of the review period, but the share these agreements account for has declined from 76.9% of agreements signed prior to 2006 to only 34.5% of agreements signed between 2006 and 2015. Typically, development-stage projects tend to have detailed, contractual agreements with specific targets such as Impact and Benefit Agreements, Socio-Economic Agreements, and Participation Agreements.

The number of active agreements varies by province and territory with the majority of them in Ontario (32.1%) and British Columbia (19.9%) (Figures 23 and 24). The Northwest Territories, Saskatchewan, and Quebec follow with each having a share between 7% and 10%, respectively, of total active agreements. Nunavut, Yukon, and the combined Atlantic provinces each account for approximately 6% of the active agreements. The remaining active agreements are in Manitoba (1.8%) and Alberta (1.6%). The small share of active agreements in some jurisdictions can be attributed to lower levels of mineral activity, such as in Prince Edward Island, or to activities not captured in this analysis, such as in Alberta, which has mainly oil and gas operations.

There are some noteworthy provincial trends within the types of agreements signed. For instance, 74.2% of all agreements signed in Ontario are for exploration-stage projects. An explanation for this may be that Ontario is perennially the leading jurisdiction for mineral exploration expenditures, and mineral exploration activity is increasingly accompanied by agreements with communities.

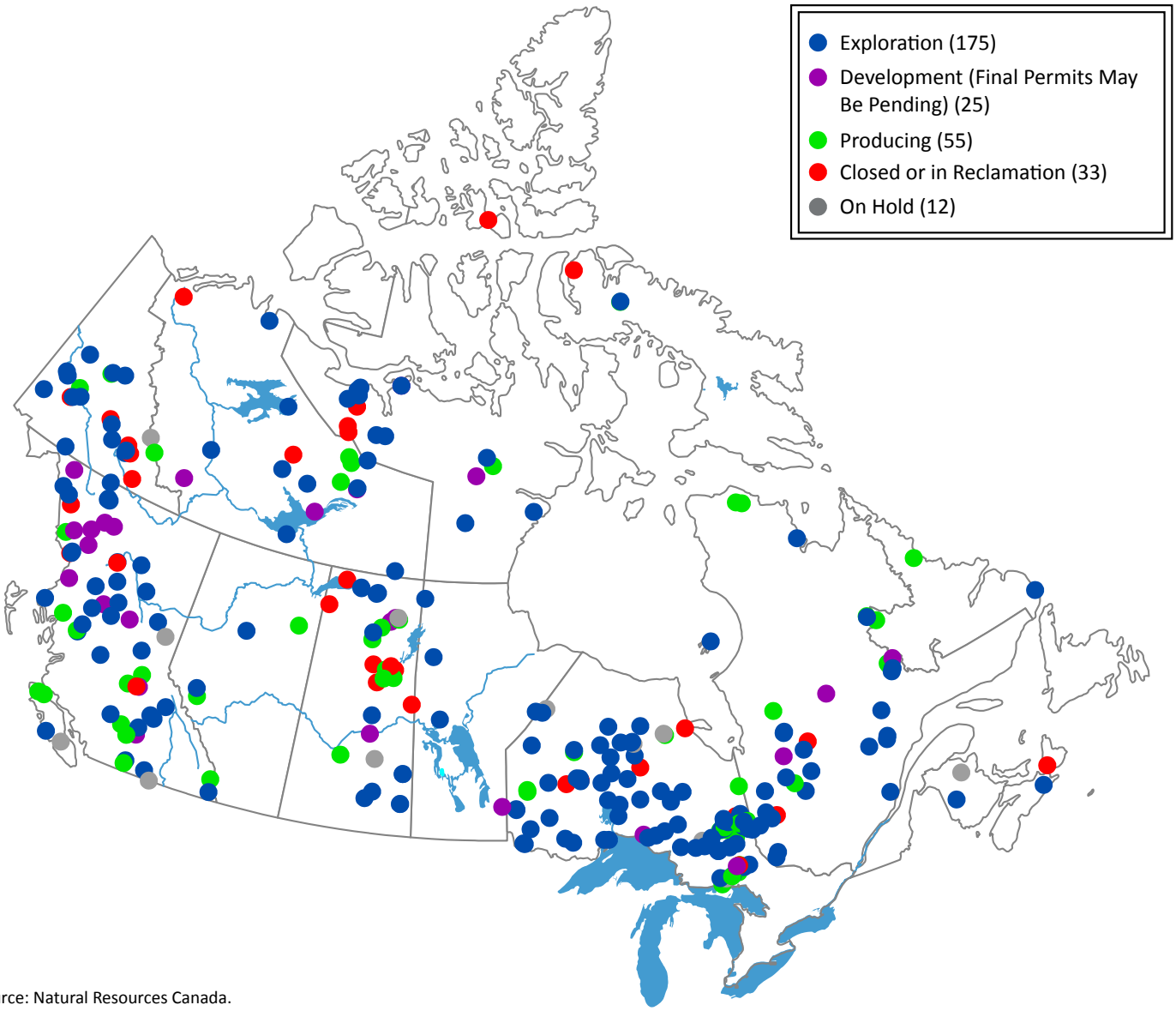
Figure 23: Distribution of Active Agreements Across Provinces and Territories, 2015



Source: Natural Resources Canada.

[50] For the purpose of categorizing agreements, development-stage projects are those that have received environmental assessment approval and are undergoing on-the-ground activity. This includes mines under construction, in operation, and reclaimed sites.

Figure 24: Agreements by Development Stage, 2015



Source: Natural Resources Canada.

Natural Resources Canada has produced and disseminated guides, toolkits, and information products to promote partnerships and dialogue among Indigenous communities, the mineral industry, and governments to facilitate mutual understanding and benefits. These can be found at http://www.nrcan.gc.ca/mining-materials/aboriginal/bulletin/7817.

Data Considerations

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

Funding for Public Participation in Environmental Review Processes

Highlights

- In 2014/15, the Canadian Environmental Assessment Agency's Participant Funding Program (PFP) disbursed a total of $1,758,454. It provided $162,990 to 32 recipients to facilitate public participation in the environmental assessments (EAs) of 14 projects and $1,595,464 to 74 recipients to facilitate Indigenous participation in the EAs of 27 projects.
- Mineral industry companies are key enablers of public participation in the environmental review process. However, assessing the sector's performance in this metric requires further effort in order to systematically capture a quantifiable indicator of the sector's contributions to support public participation.

Definition

EAs examine a comprehensive list of potential factors in natural resource development, including the cumulative environmental effects of a proposed project, measures to mitigate those effects, and concerns and comments raised by the public.

The PFP, administered by the Canadian Environmental Assessment Agency (the Agency),[51] is designed to support public participation by providing financial support to individuals, non-profit organizations, and Indigenous communities to participate in the federal EA process. It is used in this section as a proxy to gauge efforts to encourage public participation in the regulatory process.

Rationale

The public's participation in the EA process helps ensure the views of Canadians are meaningfully considered. It also has several other benefits, such as increasing the inclusion of local and traditional knowledge in environmental studies and improving knowledge and understanding of concerns and potential issues. Sections 57 and 58 of the *Canadian Environmental Assessment Act*, *2012* require that a funding initiative be established to facilitate the public's participation in consultation activities.

[51] www.ceaa.gc.ca/default.asp?lang=En&n=8A52D8E4-1.

Analysis

The PFP consists of two funding components: Regular Funding (RF) and Indigenous Funding (IF). While the 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 provides funding to "prepare for and participate" in Indigenous consultation activities.

In 2014/15, the Agency's PFP disbursed a total of $1,758,454. It provided $162,990 to 32 recipients to facilitate public participation in the EAs of 14 projects. It provided $1,595,464 to 74 recipients to facilitate Indigenous participation in the EAs of 27 projects.

Along with the PFP, the *Canadian Environmental Assessment Act, 2012* requires the Canadian Nuclear Safety Commission and the National Energy Board to establish participant funding programs that provide opportunities for the public, Indigenous groups, and other stakeholders to participate in regulatory processes under their respective authority.

Provinces and Territories

All provinces and territories allow for a degree of public participation in their respective EA processes. Given that the environment is a shared jurisdiction, the federal government has signed bilateral agreements with Alberta, British Columbia, Manitoba, Newfoundland and Labrador, Ontario, Quebec, Saskatchewan, and Yukon for the coordination of the EA processes for projects that are subject to the EA legislation of both jurisdictions. To the extent possible, these agreements contain commitments to facilitate public participation in the EA processes. In the case of coordinated EA processes, the public may access funding from both the PFP and, if available, equivalent provincial/territorial programs, to support their participatory activities related to the project review.

In addition to government efforts to promote public participation in the EA process by administering PFPs, mineral companies are important facilitators in enabling public participation in the review of their projects (Box 12). 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 provides an opportunity to take those issues into account to develop a more environmentally and socially responsible project.

Box 12: Company Efforts to Facilitate Public Participation in Environmental Review Processes

Since 2006, Seabridge Gold has been proactive in providing opportunities for the public to comment on its KSM project in northwestern British Columbia. Over the past eight years, the company has provided more than 220 community workshops and meetings, conducted 16 site tours, and hosted 28 public forums. Such consultative activities have enabled Seabridge to incorporate valuable public feedback, including Traditional Indigenous Knowledge, into its project design.

Such feedback has also led to the development of programs and initiatives to facilitate community readiness for mineral development. To date, the company has invested $400,000 in job readiness for community members in northwestern British Columbia and has donated $100,000 to the Aboriginal Mine Training Association, which provided skill upgrades to adult participants; and also donated $300,000 to Northwest Community College for its Introduction to Trades program, readying high school students to participate in trades training.

In addition, far in advance of provincial regulatory requirements, the company committed to establishing an Independent Geotechnical Review Board to provide independent, expert oversight regarding the design, construction, operational management, and ultimate closure of the tailings management facility and water storage dam.

As a result of such proactive engagement initiatives, underpinned by a commitment to provide opportunities for public comment, Seabridge has been able to negotiate a comprehensive Benefit Agreement with the Nisga'a Nation under which the Nisga'a Nation will support development of the KSM mine, participate in economic benefits from the project, and importantly, provide ongoing advice regarding potential impacts from the project and the effectiveness of mitigation measures set out under the environmental assessment decisions. Seabridge has also established an environmental agreement with the Gitanyow Wilps to fund certain programs related to wildlife, fish, and water quality monitoring. Finally, due in large part to Seabridge's outreach efforts, the project has been endorsed by The Gitxsan Hereditary Chiefs.

Source: http://ksmproject.com/.

Data Considerations

Data from government PFPs and similar programs provide a very limited indication of public participation in the EA process governing the mineral sector. Mineral 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. Moving forward, it will be imperative to develop a more robust indicator to enable a quantitative measurement of companies' efforts to facilitate public participation in the review of major mining projects.

Workplace Health and Safety

Highlights

- The rate of fatal and non-fatal occupational injuries in the mineral sector declined substantially from 2005 to 2014.

Definition

Workplace health and safety is measured as the injury rate, both fatal and non-fatal, in the mineral sector.

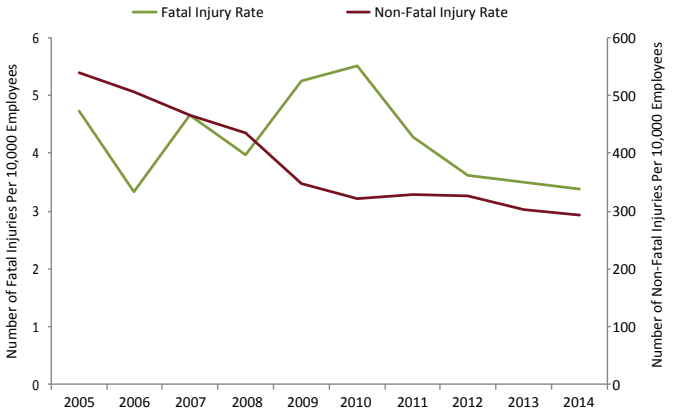
Rationale

A safe and healthy work environment is one of the more important social issues for workers and local communities.

Analysis

The mineral sector in Canada has improved its performance in providing safe work environments and has seen a significant improvement in its injury rate, both fatal and non-fatal, over the last 10 years. For fatal injuries, the rate per 10,000 employees fell from 4.7 in 2005 to 3.4 in 2014 (Figure 25). During this same period, the non-fatal injury rate fell from 538.2 per 10,000 employees to 293.8 per 10,000 employees.

Figure 25: Total Compensated Fatal and Non-Fatal Injury Rates in the Mineral Sector, 2005-14



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

At the subsector level, the performance improvements are also apparent. The mineral extraction subsector has made substantial improvements in fatal injuries, falling from 19.3 per 10,000 employees in 2005 to 6.8 in 2014. For non-fatal injuries, both subsectors saw their rates fall by at least 40% over the last 10 years.

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. In February 2016, the Saskatchewan Mining Association (SMA) held a Mine Safety Summit during which participants discussed specific case studies and appropriate emergency responses, and shared best practices regarding activities, responses, and conditions associated with eliminating or minimizing serious injury or fatality. In addition, the SMA also holds an annual Emergency Response/Mine Rescue Skills Competition in which teams participate in a host of mine rescue scenarios. Such an event highlights and reinforces the skills required to perform rescue operations in a mining environment, motivates participants to train intensively so that rescue operations become ingrained, encourages teamwork in such environments, enables the evaluation of the effectiveness of emergency response programs, and allows the sharing of best practices among participants.

Governments also have a critical role to play in promoting and improving worker health and safety in the mineral industry. In January 2014, Ontario launched a comprehensive review of the health, safety, and prevention issues related to underground mining in the province. Working in collaboration with an advisory group and six working groups, the Chief Prevention Officer (CPO) tabled a report in April 2015 that made 18 recommendations focusing on hazard prevention, new technologies and change management, and skills and training. Eleven of the recommendations have been implemented or are under way, while an additional four will require regulatory change.[52]

The PDAC and the Association for Mineral Exploration British Columbia produce an annual health and safety report for the mineral exploration sector that provides details on the frequency, severity, and cause of incidents within the exploration sector. The most recent report,[53] published in 2015, shows that the frequency of lost-time incidents reached a record low in 2014; however, the topic of health and safety is generally only raised at board meetings once an incident has occurred. Proactively discussing safety at all board meetings is an important leading indicator of a commitment to a culture of safety within a company.

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 twelve Canadian Workers' Compensation Boards/Commissions. This does not include all workers' compensation claims as claims with no time loss are not included.[54]

[52] Office of the Chief Prevention Officer, 2015, http://www.labour.gov.on.ca/english/hs/pubs/miningfinal/.

[53] Prospectors & Developers Association of Canada, 2015, *Canadian Mineral Exploration Health & Safety Annual Report 2014*, http://www.pdac.ca/pdf-viewer?doc=/docs/default-source/default-document-library/2014-h-amp-s-annual-report.pdf.

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

Mine Openings and Closures

Highlights

- Between 2006 and 2015, 35 mines closed and 76 suspended operations.
- During this same period, 60 mines opened and 41 re-opened.

Definition

This indicator is defined as the number of mines that close, suspend, open, or re-open operations during a given time frame.

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 a fluctuating number of mines opening and closing. 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 a variety of other factors (e.g., input costs, natural disasters).

Between 2006 and 2015, approximately 35 mines closed and 76 suspended operations (see Table 8), while 60 new mines opened and 41 re-opened.[55] Of note, China's transition from an economy focused on infrastructure investment to one driven by consumption and services has reduced global demand for metallurgical coal, a required input in steel manufacturing, leading to a number of recent metallurgical coal mine closures in Canada.

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 or depletion of higher-grade ore with a reasonable probability that operations will resume once the situation is resolved. 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 is 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.

Source: Natural Resources Canada.

[55] Natural Resources Canada. Note: These figures are additive and do not exclude operations that may have re-opened in later years.

Table 8: Mine Openings and Closures in Canada, 2006-15

Year	Precious Metals				Base Metals				Other Minerals or Metals			
	Opening	Re-Opening	Suspension	Closure	Opening	Re-Opening	Suspension	Closure	Opening	Re-Opening	Suspension	Closure
2006	1	4	–	1	–	3	–	–	4	–	–	–
2007	2	2	1	4	2	5	–	–	2	1	–	1
2008	4	–	3	1	3	–	10	–	1	–	1	3
2009	3	1	1	1	1	3	11	1	–	–	1	2
2010	2	4	1	1	1	4	1	–	1	1	3	2
2011	7	1	2	1	2	3	2	–	1	1	5	1
2012	5	1	3	–	1	3	4	2	–	–	1	1
2013	3	1	2	–	2	–	2	3	1	–	1	2
2014	1	–	3	3	4	1	1	–	1	–	7	–
2015	3	–	5	2	1	1	2	3	1	1	3	–

Source: Natural Resources Canada.
– Nil.

Strikes and Lockouts

Highlights

- Between 2006 and 2015, the total number of strikes and lockouts decreased.
- The number of person-days not worked as a result of strikes or lockouts also decreased during this period.
- However, significant labour disruptions occurred in 2009 and 2010 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.[56]

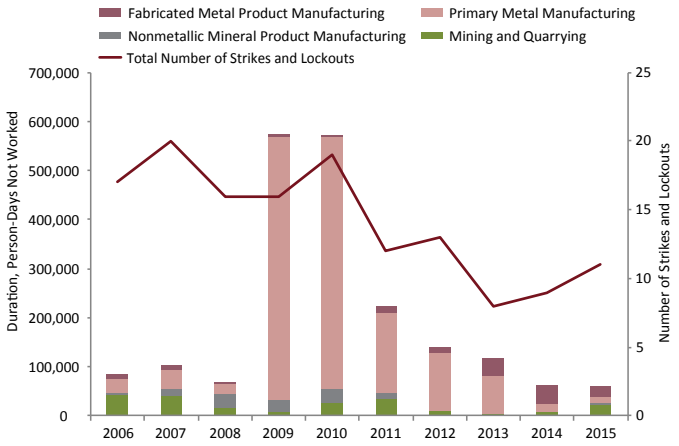
Rationale

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 mineral sector decreased between 2006 and 2015 (Figure 26). There was also an overall decline in person-days lost because of strikes and lockouts during this period. However, such analysis overlooks large labour disputes in 2009 and 2010 that occurred at smelting and refining and steel facilities.

Figure 26: Mineral Sector Labour Stoppages, 2006-15



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

[56] 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.

SECTION IV: ENVIRONMENTAL PERFORMANCE

Mineral sector operations can potentially have significant environmental impacts on both local and regional ecosystems. Minimizing or mitigating these impacts are two of the most important challenges facing the sector. The industry's public image and reputation are closely linked to its environmental performance as societal concerns over water, air, mine waste, greenhouse gas (GHG) emissions, and legacy issues related to orphaned and abandoned mines continue to rise. Sustainable mining practices have become increasingly relevant for companies that seek to operate in Canada. In this regard, initiatives such as Towards Sustainable Mining (TSM), developed by The Mining Association of Canada (MAC), can guide responsible environmental practices by providing a set of principles and performance indicators that govern key activities of companies in the sector. Such initiatives can help the mineral sector sustain its position as an important economic contributor while protecting the environment and remaining responsive to societal expectations.

The outcomes and indicators in this section were developed to assess the mineral sector's[57] performance in addressing these concerns and environmental challenges. From the assessment of the various multi-stakeholder frameworks in developing the report, the desired outcomes chosen to frame environmental performance are:

Practise responsible mineral exploration, development, and operations, and support public policies that are predicated on maintaining a healthy environment and, upon closure, returning mine sites and affected areas to viable, self-sustaining ecosystems.

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

- **Waste and tailings management** – Effective management of waste rock and tailings is an important environmental and safety issue in safeguarding the long-term health of local and regional ecosystems. Assessing the sector's performance in waste management provides an indication of its efforts to minimize the adverse environmental effects of its operations.

- **Water quality** – Water quality is fundamental to support safe drinking water for human health and ecological processes that support fish, vegetation, wetlands, and other wildlife. Assessing the trends in water quality using the Metal Mining Effluent Regulations (MMER) data provides an indication of the performance of the sector in minimizing impacts on local ecosystems.

- **Discharges to surface and groundwater** – Discharges to water can occur in a number of ways, including seepage through mine wastes, containment breaches, and the release of uncontrolled storm water. Responsible water management practices are critical to protecting water bodies and environments surrounding mineral operations. Assessing discharges to surface and groundwater provides an indication of how the industry is performing with respect to preventing or minimizing contamination in nearby water bodies.

- **Air emissions** – Emissions of nitrogen oxide (NO_x), sulphur oxide (SO_x), and particulate matter (PM_{10} and $PM_{2.5}$) from operations have an impact on local, regional, and national ecosystems. These air pollutants contribute to smog, acid rain, and poor air quality, affecting human health and the health of ecosystems. Tracking trends in air emissions provides an indication of how the sector is performing with respect to reducing air pollution.

- **Greenhouse gas emissions** – Greenhouse gases (GHGs) act as a shield that traps heat in the earth's atmosphere. Monitoring the mineral sector's management of these emissions is necessary to minimize environmental and climate change impacts.

- **Energy consumption and efficiency** – Mineral industry activities are energy intensive, which represents a significant cost to the company and contributes to GHG emissions. Improving energy efficiency reduces overall operating costs and is an important component in limiting the industry's environmental impacts.

[57] 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 mineral 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 explore.

- **Environmental expenditures** – Measuring the level of the sector's environmental expenditures provides an indication of its efforts to improve the environmental performance of its operations.

- **Land-use planning** – The preservation of ecosystems is one method for governments, stakeholders, and Indigenous communities to work together to minimize adverse environmental effects for current and future generations.

- **Orphaned and abandoned mines** – The legacy of orphaned and abandoned mines' environmental liability, human health concerns, and costs of clean-up is a serious issue facing Canada. Assessing initiatives and programs to remediate orphaned or abandoned mine sites to healthy ecosystems is critical to understanding progress in this area.

Synopsis

For the most part, the environmental performance of the sector gradually improved between 2006 and 2015. The sector's compliance with water quality regulations remains high, and it made strides in improving air emissions. However, following the global recession of 2008 and 2009, mineral industry activity rebounded quickly, leading to increases in GHG emissions and energy intensity numbers in most subsectors in successive years to 2012 before retreating once again. In 2014, the Mount Polley mine dam breach in south-central British Columbia resulted in significant discharges to surface and groundwater and led to a number of industry and government initiatives and recommendations to improve the safety of tailings management facilities. It is important to note that there are limited data available to measure the evolution of the performance for protected areas and orphaned and abandoned mines, but governments, in collaboration with affected communities, continue to strengthen programs related to these metrics.

Highlights

- Between 2006 and 2009, reported levels of **tailings and waste rock** were relatively consistent despite fluctuations in mineral production activity. However, year-over-year levels increased 21.7% in 2010 during the economic rebound, before falling 9.6% in 2011 as mineral activity slowed. Levels increased 27.8% and 18.7% in 2012 and 2013, respectively, before decreasing 18.6% in 2014. Levels in 2014 were 29.3% higher than in 2006, due in part to the arrival of large-tonnage operations, the extraction of lower-grade materials, and the development of deeper mines.

- In 2013, 121 mines were subject to the MMER, up from 73 in 2004. Between 2004 and 2013, the mining sector achieved a compliance rate of over 99% for most prescribed elements with only a few sporadic exceedances of limits for some elements. Of note, the total number of exceedances has decreased in recent years from 130 in 2008 to 57 in 2013.

- The period between 2005 and 2013 experienced an overall reduction in mineral **discharges to surface and groundwater**. However, in 2014, levels increased substantially and were almost wholly attributable to the Mount Polley dam breach.

- Between 2005 and 2014, the mineral sector made progress in reducing emissions of **SO_x** (-41.1%), **NO_x** (-18.0%), and **$PM_{2.5}$** (-2.0%). However, during this period, **PM_{10}** levels nearly doubled. Furthermore, emissions of NO_x, $PM_{2.5}$, and PM_{10} increased in the mining and quarrying subsector.

- In 2014, the mineral sector emitted 31.5 million tonnes (Mt) of **GHGs**, a decline of 2.6 Mt (7.7%) relative to 2005 levels. The largest reduction in GHG emissions occurred in 2009. There has been a slight increase in GHG emission levels since 2009.

- Between 2005 and 2014, there was a decline in **energy intensity** (the ratio of energy consumption over GDP) for nonmetallic mineral product manufacturing (-9.8%) and fabricated metal product manufacturing (-5.3%). However, both mining and quarrying and primary metal manufacturing experienced an increase of 18.1% and 6.7%, respectively. Most recently, the energy intensity in all of the subsectors, with the exception of primary metal manufacturing, decreased between 2013 and 2014.

- Between 2002 and 2012, the mineral sector's **environmental expenditures** (capital and operating) increased from $1.3 billion to $2.5 billion.

- Most provinces and territories have worked collaboratively with industry and communities in the establishment of **land-use plans** designed to conserve land and protect valuable ecosystems. The work undertaken varies considerably, but the overall goal of protection and land-use certainty appears to be consistent.

- Canada's federal, provincial, and territorial governments have spent more than $1 billion in the past 12 years to manage **orphaned and abandoned mine sites** and to prevent/eliminate future abandonment.

Indicator (2006-15) (unless otherwise specified)	
Waste Rock and Tailings Disposal (2006-14)	
Water Quality (2004-13)	
Discharges to Surface and Groundwater (2005-13)	
Air Emissions (2005-14)	
GHG Emissions (2005-14)	
Energy Consumption and Efficiency (2005-14)	
Environmental Expenditures (2002-12)	
Land-Use Planning	Incomplete Assessment
Orphaned and Abandoned Mines	Incomplete Assessment

 Improved Performance

 Limited Improvement

 Decline in Performance

Waste Rock and Tailings Disposal

Highlights

- The level of tailings and waste rock remained relatively unchanged between 2006 and 2009 despite fluctuations in mineral production activity.
- Year-over-year levels increased 21.7% in 2010 during the economic rebound before falling 9.6% in 2011 as mineral activity slowed. Levels increased 27.8% and 18.7% in 2012 and 2013, respectively, before decreasing 18.6% in 2014.
- Levels in 2014 were 29.3% higher than in 2006, driven by substantial increases in waste rock, due in part to the arrival of large-tonnage operations, the extraction of lower-grade materials, and the development of deeper mines.

Definition

There are two main types of solid waste by mines: tailings and waste rock. Tailings are the by-products that remain following the extraction and recovery of valuable minerals from mine operations. They are generated by a milling process and are a mixture of finely ground sand- to silt-sized rock particles, water, and processing reagents.[58] Waste rock is rock that is removed in the mining process to provide access to the ore and is not further processed.[59]

Rationale

The management of waste and tailings created by mining activity has a significant impact on the objective of maintaining a healthy environment.

[58] See http://www.nrcan.gc.ca/mining-materials/publications/13924.

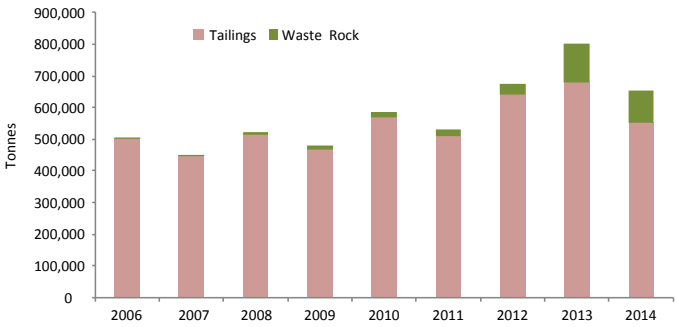
[59] Environment and Climate Change Canada, 2016, *National Pollutant Release Inventory*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=4A577BB9-1.

Analysis

In 2009, the National Pollutant Release Inventory (NPRI)[60] began collecting information on the management of substances deposited in tailings management facilities and contained in waste rock piles. The reporting requirements for tailings and waste rock were applied retroactively to 2006 for certain types of mining operations.

In 2014, 98 mining and other types of facilities reported on tailings and waste rock. However, some metal ore and coal mines did not report. The amount of substances disposed of in tailings and waste rock varied little between 2006 and 2009. However, there was a marked increase between 2009 and 2013 as reported substances in the disposal of tailings and waste rock increased 67.0% between these years.[61] Such increases are due in part to the arrival of large-tonnage operations, the extraction of lower-grade materials, and the development of deeper mines. Between 2013 and 2014, the level of tailings and waste rock decreased 18.6%, bringing the total back to 2012 levels (Figure 27). This drop is attributable to the closure of a mining facility in British Columbia and to changes in the production levels of another mining facility in Newfoundland and Labrador. In 2014, the percentage of NPRI substances in tailings and waste rock as a share of total releases, disposals, and transfers was 14.2% (12.2% for tailings and 2.0% for waste rock).[62]

Figure 27: Tailings and Waste Rock Disposal, 2006-14



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

Within the mining and quarrying subsector, metal ore mining accounted for at least 85% of all tailings and waste rock disposals in each year between 2006 and 2014, led by iron ore mining and base-metal mining (Table 9). With respect to nonmetallic mining, both diamond mining and coal mining accounted for substantial disposals of tailings and waste rock.

When natural water bodies that are frequented by fish are to be used to store metal mine tailings, specific authorization under the MMER is required. Between 2002 and 2009, five whole or partial natural water bodies were approved by the federal government to be used as tailings impoundment areas. The government had also added ten other water bodies to the MMER to reflect existing facilities operating prior to these regulations. Since 2009, eight more

Table 9: Tailings and Waste Rock Disposal (Tonnes) by Subsector, 2006-14

Subsector	2006	2007	2008	2009	2010	2011	2012	2013	2014
Metal mining	391,855	377,044	442,116	404,880	535,441	459,305	599,244	750,743	608,823
Iron ore mining	131,814	110,776	141,173	126,100	168,584	152,300	162,461	212,085	170,483
All other metal mining	260,041	266,268	300,943	278,781	366,857	307,005	436,782	538,658	438,339
Nonmetal mining	38,235	16,112	16,627	28,033	42,759	66,381	36,672	29,153	23,526
Diamond mining	37,825	15,575	16,080	19,622	22,724	13,896	18,386	19,820	22,618
All other nonmetal mining	409	536	548	8,410	20,035	52,485	18,286	9,333	908
Coal mining	28,539	28,551	23,213	20,377	3,854	937	22,970	21,574	19,648
Grand total	**458,628**	**421,707**	**481,956**	**453,290**	**582,054**	**526,623**	**658,885**	**801,471**	**651,997**

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

[60] In 2009, the Federal Court ruled that Environment Canada should collect and publish information in relation to releases and transfers to tailings and waste rock disposal areas by mining facilities.

[61] Total reduced sulphur has been excluded from these totals.

[62] Environment and Climate Change Canada, 2015, *Overview of Reviewed Facility-Reported Data of the National Pollutant Release Inventory (NPRI),* https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=386BAB5A-1.

water bodies have been approved to be used as tailings impoundment areas under Schedule 2 for the Mount Milligan (British Columbia), Jolu Central Mill (Saskatchewan), and Detour Lake (Ontario) projects.[63]

To assist mining companies evaluate and manage their environmental and social responsibilities, MAC established the Tailings Management Protocol under the TSM initiative in 2004 (Box 13). The protocol assesses MAC members on their level of management system implementation of tailings management policies and commitments; tailings management systems; assigned accountability and responsibility for tailings management; annual tailings management reviews; and operation, maintenance, and surveillance manuals. Member performance is based on the systems and targets in place, with grades ranging from C (no systems in place) to A (comprehensive systems developed and implemented) to AAA (excellence in leadership). Since 2006, the percentage of members with "A" performance or better has increased, reaching over 90% in 2014 and demonstrating MAC members' high adherence to the tailings management guides.[64] In 2015, the TSM Advisory Panel's terms of references were renewed to maintain its relevance and increase dialogue between the industry and its communities of interest.

Data Considerations

In interpreting the data, it is important to note that the totals for tailings and waste rock do not take into account changes in the breakdown of substances in the disposals. For example, if the amount of mercury in tailings decreases while the amount of other less innocuous substances increases, this would lessen the environmental impact, but would not be captured in the overall totals. Also, as the requirements came into effect in 2009 and facilities were asked to report retroactively for 2006 through 2008, there may be some errors in the retroactive reporting. There have also been changes in reporting requirements for 2006-08 and 2009-10. The 2006-08 requirements are applicable only to mining and oil sands facilities that generated or disposed of tailings and/or waste rock from the processing of bitumen, coal, diamonds, potash, or metals, while the 2009-10 requirements apply to all facilities that generated or disposed of tailings and waste rock. It should also be noted that not all mining facilities meet the new tailings and waste rock reporting requirements (e.g., certain potash and coal mines).

[63] Government of Canada, 2016, *Metal Mining Effluent Regulations*, http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/.

[64] The Mining Association of Canada, 2015, *Towards Sustainable Mining Progress Report 2015*, http://mining.ca/towards-sustainable-mining/tsm-progress-report-2015.

Box 13: TSM Update – Waste and Tailings Management

TSM is an industry-wide initiative developed by MAC that aims to enable MAC members to operate in the most socially, economically, and environmentally responsible way. The program is mandatory for all MAC members and requires participants to report on six performance elements, including responsible tailings management.

Following the Mount Polley tailings dam breach, MAC initiated an internal review of its tailings management program, including its tailings management requirements under the TSM program and the three associated tailings management guides. In addition, MAC commissioned an independent, multi-stakeholder task force comprising engineering and tailings experts, civil society, and First Nations representatives to review its tailings management requirements and guidance.

In December 2015, the independent task force tabled its report and recommendations for enhancing TSM's tailings management requirements and guidance. A total of 29 recommendations were made, 19 of which were considered priority recommendations and were designed to further strengthen TSM's tailings management requirements and guidance and to assist MAC's members reach their goal of zero failures.

Source: www.mining.ca/sites/default/files/documents/Report-TSM-Tailings-Review-Task-Force.pdf.

Water Quality

Highlights

- While the number of mines subject to the MMER has increased since 2004, the number of exceedances of prescribed limits has declined by 24.0% from 2004 to 2013.
- Between 2004 and 2013, base-metal mines accounted for 38.3% of the exceedances.

Definition

The water quality measure in this report is defined by the mining sector's compliance with the MMER.

Rationale

Mineral extraction activity produces a large amount of waste. Water used in the mining process and precipitation permeating mine tailings can become contaminated with metals, process reagents, and other undesirable constituents. If not contained and managed properly, the impacts on water quality can continue for decades after extractive activities have finished. Measuring compliance with the MMER provides insight on the industry's performance in maintaining healthy ecosystems.

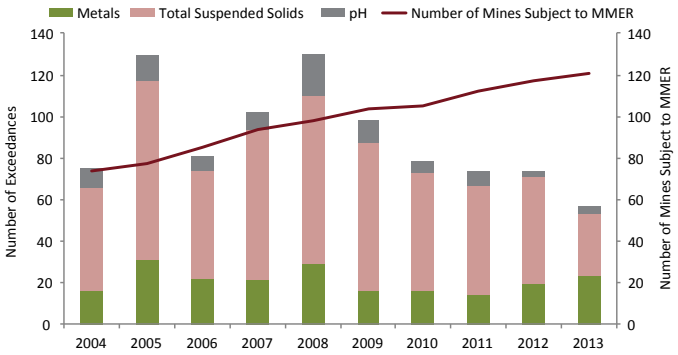
Analysis

Environment and Climate Change Canada (ECCC) is responsible for administering and enforcing the MMER[65] under the *Fisheries Act*. These regulations provide for the authorization to deposit deleterious substances into fish-frequented water bodies under specific circumstances and require that effluent limits be met and that effluent not be acutely lethal.[66] The regulations also allow for the deposit of tailings and waste rock into a tailings impoundment area located in fish-frequented water bodies, for which a regulatory amendment under the MMER is required to list that water body in the regulations.[67]

From 2004 to 2013, there was an overall pattern of decrease in the number of exceedances across various substances. While the number of exceedances reported for total suspended solids made up the bulk of exceedances between 2004 and 2013, these had fallen to 30 in 2013, 40.0% lower than 2004 levels. At the same time, the compliance rate for total suspended solids increased from 95.3% in 2004 to 97.9% in 2013. Most of the exceedances occurred at select problematic facilities for which appropriate remediation measures and technical solutions are being examined and/or implemented.

In 2013, 121 mines were subject to the MMER, up from 77 in 2005. Despite the consistent annual increase in the number of facilities subject to the MMER, the number of reported exceedances[68] over prescribed limits declined from 75 in 2004 to 57 in 2013, a decrease of 24.0%. However, year-over-year variability existed for the number of exceedances throughout this period (Figure 28).

Figure 28: Distribution of MMER Exceedances by Substance, 2004-13



Source: Environment and Climate Change Canada, *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*.

Furthermore, between 2004 and 2013, the mining sector achieved a compliance rate of over 99% for several prescribed elements (arsenic, copper, nickel, zinc, radium-226, cyanide, lead). Zero exceedances were reported for lead and only a few exceedances were reported for cyanide (12). The majority of exceedances between 2004 and 2013 were in the iron ore and base-metal subsectors. Both reported large fluctuations in the number of exceedances, particularly from 2005 to 2007 (Figure 29). Since 2007, the total number of exceedances experienced a steady decline.

[65] The MMER set out effluent limits on releases of arsenic, copper, cyanide, lead, nickel, zinc, radium-226, and total suspended solids. The regulations apply to all metal mines, with the exception of placer mines. Coal and diamond mines are currently excluded.

[66] The MMER require effluent monitoring and reporting, and environmental effects monitoring.

[67] Environment and Climate Change Canada recently completed a multi-stakeholder 10-year review of the MMER and is developing proposed amendments that include more stringent effluent limits for several substances, including technology-based limits for new mines, and streamlining of the environmental effects monitoring requirements. The amendments would also expand the scope of the regulations to diamond mines, providing regulatory certainty to that sector. A separate regulatory approach is under development for the coal mining sector.

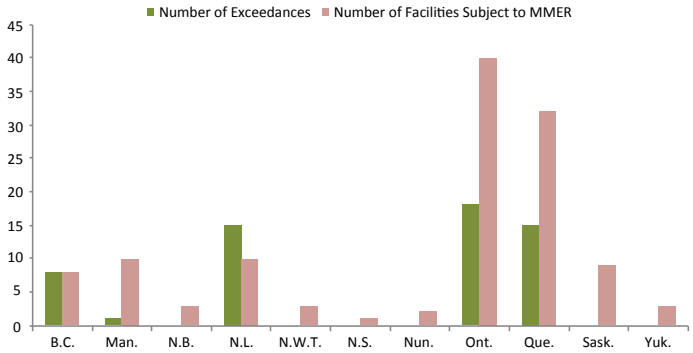
[68] The MMER impose limits on releases of cyanide, stringent requirements for total suspended solids, an upper pH limit, and prohibit the discharge of effluent that is lethal to fish. An exceedance is any discharge above these requirements and/or limits.

Figure 29: MMER Exceedances by Subsector, 2004-13

Source: Environment and Climate Change Canada, *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*.

In terms of regional distribution, Ontario (18), Newfoundland and Labrador (15), and Quebec (15) had the highest number of MMER exceedances in 2013 and collectively accounted for 84.2% of total exceedances (Figure 30). The remaining exceedances were concentrated in British Columbia (8) and Manitoba (1).

Figure 30: Regional Distribution of Facilities and Exceedances, 2013



Source: Environment and Climate Change Canada, *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*.

Provincial governments and industry associations have undertaken a number of initiatives to support and encourage responsible water management practices within the mineral sector. For instance, in 2014, the British Columbia Ministry of Environment approved the Elk Valley Water Quality Plan developed by Teck Resources that will guide future regulatory decision-making regarding water quality and mining in the Elk Valley (Box 14). In February 2015, the International Council on Mining & Metals launched a guidance document advocating for a broader approach to water management.[69] The document outlines a comprehensive and systematic methodology to assist mineral companies adopt "outside-the-fence" water catchment-based management practices that reorients focus beyond operational water supply challenges to broader considerations of water management across an entire river basin.

Box 14: Teck Resources Water Quality Plan, Elk Valley

In November 2014, the British Columbia Ministry of Environment approved the Elk Valley Water Quality Plan as proposed by Teck Resources of Vancouver. The plan was developed to remediate water quality effects of past coal mining and to guide future mining development. It was developed in collaboration with a Technical Advisory Committee that included representatives from Teck, the Ktunaxa Nation Council, the U.S. Environmental Protection Agency, the state of Montana, ECCC, other agencies, and an independent scientist. Public input was received in three phases of consultation activities undertaken with Elk Valley communities.

Under the terms of the Plan, which is designed to reverse concentrations of contaminants in the Fording and Elk rivers, Teck will undertake aquatic monitoring, water-quality testing, and various water management measures to reduce levels of contaminants in the water. Teck is investing over $700 million in the Plan, with two, and perhaps three, water treatment facilities, the first of which reached full operational capacity in February 2016.

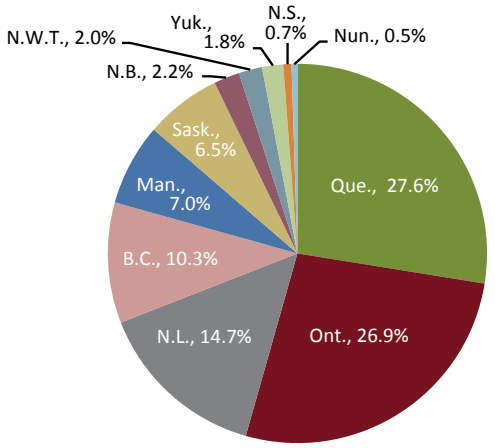
Under the MMER, mine effluent is required to be non-acutely lethal to rainbow trout. Figure 31 shows the regional distribution of acutely lethal effluent tests to rainbow trout for each jurisdiction. Acute lethality means that an effluent results in a mortality rate of more than 50% of the species to which it is subjected within 96 hours of exposure. Between 2004 and 2013, for both rainbow trout and *Daphnia magna*,[70] the total number of tests undertaken for lethality increased while the total number of failures decreased.

[69] International Council on Mining & Metals, 2015, *A Practical Guide to Catchment-Based Water Management for the Mining and Metals Industry*, http://www.icmm.com/publications/water-management-guide.

[70] A marine invertebrate (a freshwater flea) used in laboratories to test eco-toxicity.

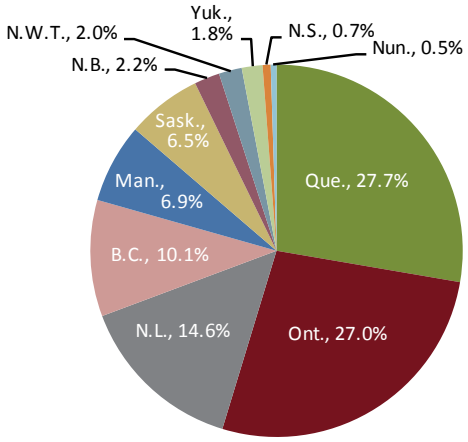
Between 2004 and 2013, Quebec accounted for 27.6% of total acutely lethal effluents to rainbow trout while Ontario and Newfoundland and Labrador accounted for 26.9% and 14.7%, respectively. Figure 32 shows the regional distribution of acutely lethal effluent tests to *Daphnia magna*; Quebec also had the highest percentage of lethal tests between 2004 and 2013, at 27.7%, while Ontario and Newfoundland and Labrador accounted for 27.0% and 14.6%, respectively.

Figure 31: Regional Distribution of Acutely Lethal Rainbow Trout Tests, 2004-13



Source: Environment and Climate Change Canada, *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*.

Figure 32: Regional Distribution of *Daphnia Magna* Acutely Lethal Tests, 2004-13



Source: Environment and Climate Change Canada, *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*.

Discharges to Surface and Groundwater

Highlights

- The period between 2005 and 2013 experienced an overall increase (1.8%) in mineral sector discharges to surface and groundwater, with notable year-to-year variability.
- Following the 2008 and 2009 recession, a decline in mineral activity led to a reduction in total discharges in 2010. Discharges increased in 2011, fell in 2012, and increased again in 2013.
- In 2014, substantially increased discharge levels for all substances were almost wholly attributable to the Mount Polley dam breach in British Columbia.

Definition

Discharges to surface and groundwater are defined as the disposal (direct discharge, leaks, and spills) of heavy metals and mining waste into the surrounding water bodies as a result of mineral extraction. Mineral discharge substances discussed in this section include arsenic, cadmium, lead, nickel, selenium, and other metals.[71]

Rationale

Mineral extraction and processing activities produce significant amounts of waste materials that need to be contained and managed properly. Subaqueous disposal, which involves the placement of waste materials under a water cover, can be an effective treatment for remediation of mine wastes. However, if waste materials are not contained and managed properly, acidity and heavy metals could be released into surrounding surface and groundwater. Such substances could have a long-term detrimental impact on the surrounding ecosystems.[72] Monitoring discharges to surface and groundwater provides insight on the industry's performance in limiting the impact of its activities on surrounding ecosystems.

[71] Other metals include: antimony, chromium, cobalt, copper, manganese, mercury, thallium, vanadium, and zinc.

[72] Crowe, Allan S., et al., 2015, *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*, Environment and Climate Change Canada, http://www.ec.gc.ca/inre-nwri/default.asp?lang=En&n=235D11EB-1&offset=13&toc=sh.

Analysis

According to the NPRI, the period between 2005 and 2013 was variable with respect to mineral industry discharges to surface and groundwater. Discharge levels fell in successive years to start the period, and then climbed in 2008 and 2009 before falling in 2010 as mineral activity slowed in the wake of the global economic recession. Between 2011 and 2013, the industry gathered momentum with an improving global economy, resulting in a 24.2% increase in the level of discharges to surface and groundwater (Table 10).

Between 2005 and 2010, the base-metal substances nickel and zinc accounted for the largest proportions of the total mineral industry discharges at 20.5% and 27.7%, respectively. Arsenic accounted for 14.4% of mineral industry discharges in 2005, but has decreased considerably since then to 1.8% in 2013. Manganese discharges increased substantially over the period, accounting for over 50% of all mineral industry discharges by 2013. In 2012 and 2013, selenium discharges increased dramatically, accounting for 7.4% of total discharges in 2013.

In 2014, all discharge substances to surface and groundwater grew to alarming levels because of the Mount Polley dam breach in British Columbia (Table 10 and Box 15). As a result, in 2014, the total mineral sector discharges accounted for 96.8% of the total industrial discharges in Canada, compared to 18.1% in 2013.

Data Considerations

The NPRI requires reporting of the quantities of a wide range of substances released to surface water and focuses on total discharges (e.g., effluent, leaks, and spills) for specified substances.

Changes to the NPRI reporting requirements partially account for year-to-year variations. For additional information, please see Environment and Climate Change Canada's *Guide for Using and Interpreting NPRI Data*.

Monitoring discharges to surface and groundwater provides insight on the industry's performance in limiting the impact of its activities on surrounding ecosystems. However, a better understanding of groundwater science and the complex interaction between ecosystems is required to adequately assess the long-term, cumulative impacts of discharges on local and regional environments.[73]

Table 10: Mineral Industry Discharges to Surface and Groundwater, by Substance (Tonnes), 2005-14

Year	Arsenic	Cadmium	Lead	Nickel	Selenium	Other Metals*	Total Mineral Industry
2005	43.7	1.0	7.8	62.6	2.0	187.5	**304.5**
2006	33.3	1.1	6.3	45.3	2.4	172.8	**261.2**
2007	18.5	1.4	4.9	30.1	2.8	132.5	**190.2**
2008	39.8	0.7	6.7	42.6	1.8	165.0	**256.6**
2009	4.9	1.1	5.3	31.0	3.2	223.4	**268.9**
2010	4.1	0.7	4.5	23.1	2.2	158.8	**193.5**
2011	4.2	0.6	4.9	75.9	17.9	161.9	**265.4**
2012	4.4	0.6	6.2	50.9	22.9	141.0	**226.0**
2013	5.6	0.7	5.5	27.8	22.6	247.7	**310.0**
2014	264.0	4.4	138.6	253.3	52.3	42,208.3	**42,902.9**
Mount Polley	259.1	3.8	134.2	223.7	33.0	40,386.4	**41,040.1**
All others	4.9	0.6	4.3	29.6	19.4	1,821.9	**1,880.7**

Source: Environment and Climate Change Canada, National Pollutant Release Inventory.
*Includes antimony, chromium, cobalt, copper, manganese, mercury, thallium, vanadium, and zinc.

[73] Bruce, James P., et. al., 2013, The Sustainable Management of Groundwater in Canada, http://www.scienceadvice.ca/en/assessments/completed/groundwater.aspx.

Box 15: Mount Polley Tailings Dam Breach

On August 4, 2014, the dam enclosing the tailings storage facility (TSF) at the Mount Polley mine, a copper-gold mine located in the Central Interior of British Columbia, failed. Over the next 16 hours, the failure led to a progressive breach of the perimeter embankment of the dam, releasing over 21 million cubic metres of water and mine tailings into the surrounding environment and watercourses.

Shortly after the breach, the Chief Inspector of Mines began an investigation into the breach and its causes. This was one of three investigations that included the Independent Expert Engineering Investigation and Review Panel Report on Mount Polley, which was released in January 2015, and the Conservation Officer Service investigation, which is still ongoing. The Chief Inspector's investigation was the largest and most complex of its kind in more than a century of regulated mining in British Columbia.

Both the independent panel and the Chief Inspector of Mines' investigations found that the dam failed because the strength and location of a layer of clay underneath the dam was not taken into account in the design, construction, and management of the TSF. The investigations also noted that weak practices on the mine site increased the risk of dam failure and exacerbated environmental consequences from the breach.

The two completed investigations into the Mount Polley TSF failure have resulted in 26 recommendations aimed at preventing similar incidents from occurring in the future. On January 30, 2015, the Independent Expert Engineering Panel completed its investigation and made seven recommendations. On December 17, 2015, the Chief Inspector of Mines presented the findings of his investigation and made 19 recommendations directed toward the mine operator, the industry, professional organizations, and the regulator to prevent such incidents in the future and to build a safer, more sustainable industry.

On June 24, 2015, the Minister of Energy and Mines announced a Code Review to determine how best to implement the seven Independent Expert Engineering Panel recommendations. It is anticipated that work on the Code Review will be completed by spring 2017, with the tailings portion of the Review expected to be in force by mid-2016. Additionally, on February 25, 2016, the British Columbia Ministry of Energy and Mines introduced amendments to the *Mines Act* to improve mine safety, including administrative monetary penalties to support compliance and enforcement, and additional measures to strengthen permitting requirements. The Government of British Columbia will continue to work with industry and professional organizations on implementing other recommendations.

A Letter of Understanding between the Province and Soda Creek Indian Band and Williams Lake Indian Band was negotiated shortly after the incident and outlines a collaborative approach to jointly address aspects of the tailings breach. The British Columbia Ministry of Environment leads the response for environmental monitoring, impact assessment, mitigation, and remediation of the affected area and is working closely with First Nations, local governments, provincial and federal agencies, and public representatives. To date, Mount Polley Mining Corporation has completed over $67 million in remediation at the site, including the repair and armoring of the bank of Hazeltine Creek. First Nations have provided assistance in site remediation and have planted indigenous species at the site.

Source: www.gov.bc.ca/mountpolleyinvestigation.

Air Emissions

Highlights

- The mineral sector's air emissions for most of the pollutants decreased between 2005 and 2014. Of note, SO_x emissions decreased 41.1% while NO_x emissions decreased 18.0%. However, the level of emissions of PM_{10} increased substantially with 2014 levels nearly twice as high as those in 2005.
- Between 2005 and 2014, the mining and quarrying subsector experienced an increase in emissions of three pollutants: NO_x, PM_{10}, and $PM_{2.5}$.

Definition

Air emissions are defined as the release of pollutants into the atmosphere. Air pollutants discussed in this section include sulphur oxide (SO_x), nitrogen oxide (NO_x), particulate matter respirable (PM_{10}), and fine particulate matter ($PM_{2.5}$).

Rationale

Emissions of these pollutants pose environmental health risks as they contribute to smog, acid rain, ground-level ozone, and poor air quality, and have adverse effects on human health.

Analysis

According to the NPRI, between 2005 and 2014, the mineral sector continued to make progress in reducing emissions of SO_x (-41.1%), NO_x (-18.0%), and $PM_{2.5}$ (-2.0%). However, PM_{10} emission levels in 2014 were nearly twice as high as in 2005 (Table 11).

At the subsector level, emissions of each pollutant have consistently declined in nonmetallic mineral product manufacturing, primary metal manufacturing, and fabricated metal manufacturing. However, emissions of three pollutants increased in the mining and quarrying subsector: NO_x levels increased 41.3% between 2005

Table 11: Mineral Sector Air Emissions (Tonnes), 2005, 2010, and 2014

Year	SO_x	NO_x	PM_{10}	$PM_{2.5}$
Mining and Quarrying (Except Oil and Gas)				
2005	202,205	24,607	13,566	5,233
2010	212,551	36,001	64,562	12,599
2014	168,487	34,766	53,262	11,144
Nonmetallic Mineral Product Manufacturing				
2005	46,328	57,026	6,568	3,978
2010	25,271	34,609	4,189	2,149
2014	22,483	32,635	4,262	1,984
Primary Metal Manufacturing				
2005	579,431	20,001	16,249	12,504
2010	264,210	14,923	12,208	8,533
2014	296,299	15,995	12,095	8,181
Fabricated Metal Product Manufacturing				
2005	682	224	262	107
2010	583	115	100	64
2014	488	99	141	80
Total Sector Emissions				
2005	**828,646**	**101,857**	**36,645**	**21,821**
2010	**502,615**	**85,649**	**81,060**	**23,346**
2014	**487,758**	**83,496**	**69,760**	**21,388**

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

and 2014, PM_{10} levels nearly quadrupled, and $PM_{2.5}$ more than doubled. In the mining and quarrying subsector, the main direct sources of air emissions are diesel engines used in haulage, drilling, maintenance, personnel transportation, and heating and cooling. PM emissions are largely a result of dust created in the crushing and fragmenting processes and transportation. The majority of SO_x emissions are produced by smelting and refining activities. The decline in SO_x and NO_x emissions can be attributed in part to federal and provincial/territorial government regulatory initiatives, such as the implementation of the Canada-Wide Acid Rain Strategy for Post-2000,[74] as well as agreements with the United States on SO_x emission caps.[75] The decline can also be attributed to the use of low-sulphur fuels, technological upgrades, pollution controls for base-metal smelters, and facility closures.

Data Considerations

Changes to the NPRI reporting requirements partially account for year-to-year variations, namely between 2005 and 2006. For additional information, please see Environment and Climate Change Canada's *Guide for Using and Interpreting NPRI Data*.

Greenhouse Gas Emissions

Highlights

- In 2014, the mineral sector emitted 31.5 million tonnes (Mt) of GHGs, a decline of 2.6 Mt (-7.7%) relative to 2005 levels.
- The mineral sector accounted for 4.3% of Canada's total GHG emissions in 2014 compared with 4.6% in 2005.
- Since 2009, GHG emissions have increased 12.9% (3.6 Mt).

Definition

GHGs include methane (CH_4), chlorofluorocarbons (CFC), and carbon dioxide (CO_2). These gases act as a shield that traps heat in the earth's atmosphere and contribute to climate change.

[74] Signed by federal, provincial, and territorial energy ministers in 1998, it provides a framework for the long-term management of acid rain in Canada. Among other things, it requires regular reporting on SO_2 and NO_x emissions and forecasts. See http://www.ccme.ca/files/Resources/air/acid_rain/1998_acid_rain_strategy_e.pdf.

[75] Transboundary pollution is a significant source of air pollution.

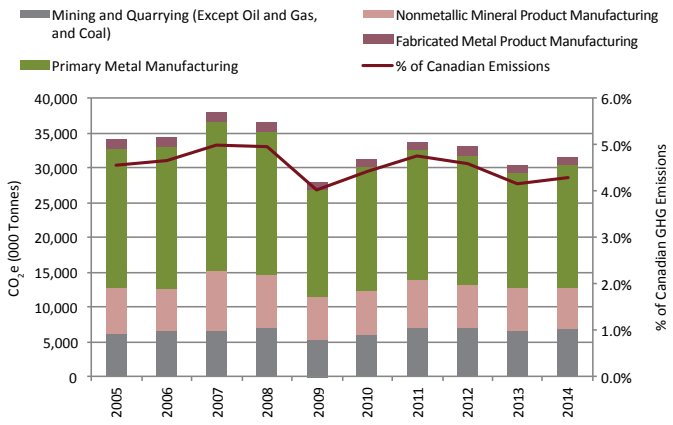
Rationale

Climate change, as a result of GHG accumulation in the atmosphere, has emerged as one of the most important environmental, economic, and social issues extending beyond local and national boundaries. A number of industry sectors, including the mineral industry, are vulnerable to climate change impacts related to transportation, communication, infrastructure, operations, and long-term reclamation efforts.[76] Temperature shifts as a result of climate change present both risks (e.g., flooding, forest fires) and opportunities (e.g., access to markets via new shipping routes, less snow and ice cover for exploration) to current and future mineral operations in Canada. The mineral industry must continuously assess, plan for, and adapt to changes in the climate, and monitoring the mineral sector's management of GHG emissions is an important component in assessing industry efforts to minimize environmental and climate change impacts.

Analysis

The vast majority of GHGs emitted by the Canadian mineral sector are linked to energy use by heavy equipment, power generation, and process furnaces. In 2014, the mineral industry emitted 31.5 Mt of GHGs, a decline of 2.6 Mt (-7.7%) relative to 2005 levels (Figure 33). Overall, the mineral sector accounted for 4.3% of Canada's total GHG emissions in 2014, compared to 4.6% in 2005.

Figure 33: Mineral Sector GHG Emissions, 2005-14

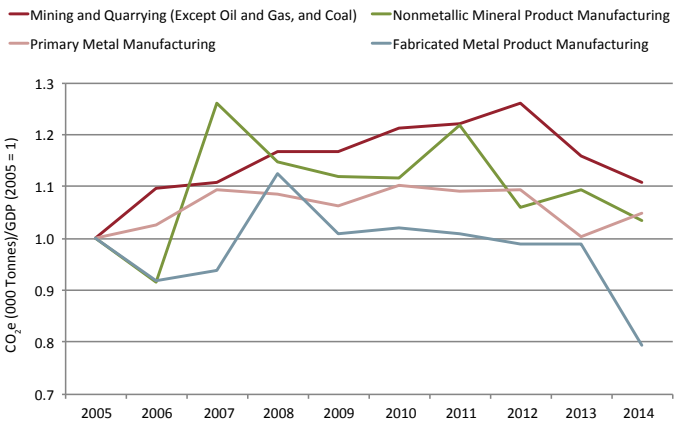


Sources: Canadian Industrial Energy End-Use Data and Analysis Centre; Environment and Climate Change Canada.

[76] 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.

At the subsector level, between 2005 and 2014, there was an increase in GHG emissions intensity (a ratio of CO_2 equivalent over GDP) for mining and quarrying (10.7%), primary metal manufacturing (5.0%), and nonmetallic mineral product manufacturing (3.3%), and a decrease for fabricated metal product manufacturing (-20.6%) (Figure 34).

Figure 34: Mineral Sector GHG Emissions Intensity (GDP), 2005-14



Source: Canadian Industrial Energy End-Use Data and Analysis Centre.

MAC has worked with its members to develop a voluntary Energy Use and GHG Emissions Management Protocol as a component of its TSM initiative (Box 16).[77] This protocol, originally developed in 2004, was revised in 2013. Within this protocol, three performance indicators have been established: (1) energy use and GHG emissions management systems; (2) reporting systems; and (3) performance targets. The members are assessed on the systems and targets in place with grades ranging from C (no systems in place) to A (comprehensive systems developed and implemented) to AAA (excellence in leadership). According to the 2015 TSM progress report, in 2014, the year-over-year percentage of facilities at a level A or higher increased by 17% and 23% for indicators (1) and (3), respectively.[78]

Data Considerations

Two different datasets were used in measuring the mineral sector's GHG emissions as a percentage of Canada's overall emissions. As the Canadian Industrial Energy End-Use Data and Analysis Centre database does not provide a total value for all emissions, ECCC's NPRI was used to provide the value for total Canadian emissions.

[77] The Mining Association of Canada, 2016, *Energy and GHG Emissions Management*, http://mining.ca/towards-sustainable-mining/protocols-frameworks/energy-and-ghg-emissions-management.

[78] The Mining Association of Canada, 2015, *Towards Sustainable Mining Progress Report 2015*, http://mining.ca/towards-sustainable-mining/tsm-progress-report-2015.

Box 16: Towards Sustainable Mining – Energy Use and GHG Emissions Management

In 2002, MAC adopted a climate change policy statement detailing members' commitments to the environment by improving energy efficiency and reducing GHG emissions. Additionally, with the launch of the TSM initiative in 2004, MAC introduced the Energy Use and GHG Emissions Management Protocol to assist member facilities in monitoring and ultimately reducing their energy consumption and GHG emissions. Subsequently, in 2009, MAC endorsed the International Council on Mining and Metals' policy on climate change, recognizing that comprehensive and sustained global action is required to reduce the scale of human-induced climate change.

The MAC protocol consists of three indicators that seek to confirm a facility's establishment of a comprehensive system for energy use and GHG emissions. For this protocol, a facility must show that its management system includes assigned accountability from senior management and demonstrate that mechanisms are in place to ensure energy use data are reviewed regularly and well integrated with operator activities.

Facilities are also expected to provide energy awareness training and to incorporate systems to track and report energy use and GHG emissions data for both internal and external reporting. Finally, the protocol seeks to confirm that facilities establish and meet performance targets for their energy use and GHG emissions.[79]

In 2013, MAC revised the protocol to combine energy use and GHG emissions into one management system. The change acknowledges that in the mineral sector, facilities produce GHGs primarily through the burning of fossil fuels for energy. The revised protocol also incorporates additional variables related to materiality and size of facility, reporting levels for facilities or business units, and multi-year performance targets.[80]

In 2016, MAC acknowledged the importance of supporting an efficient approach to addressing climate change by issuing principles for climate change policy design. These include support for a broad-based carbon pricing scheme, the need for revenue neutrality, and the importance of balancing meaningful emissions reductions while maintaining economic competitiveness.

[79] See http://mining.ca/towards-sustainable-mining/protocols-frameworks/energy-and-ghg-emissions-management.

[80] For more information, see http://mining.ca/documents/tsm-progress-report-2015.

Energy Consumption and Efficiency

Highlights

- The mineral sector's energy consumption remained relatively consistent between 2005 and 2014, accounting for approximately 9-11% of total Canadian energy use.
- Between 2005 and 2014, there was a decline in energy intensity for both nonmetallic mineral product manufacturing (-9.8%) and fabricated metal product manufacturing (-5.3%). However, both mining and quarrying, and primary metal manufacturing experienced an increase of 18.1% and 6.7%, respectively. Most recently, the energy intensity in all of the subsectors, with the exception of primary metal manufacturing, decreased between 2013 and 2014.

Definition

Energy consumption is defined as the energy used from all sources during a given year. Energy intensity is the ratio of energy consumption over output. In this section, GDP is used as the output to calculate intensity.

Rationale

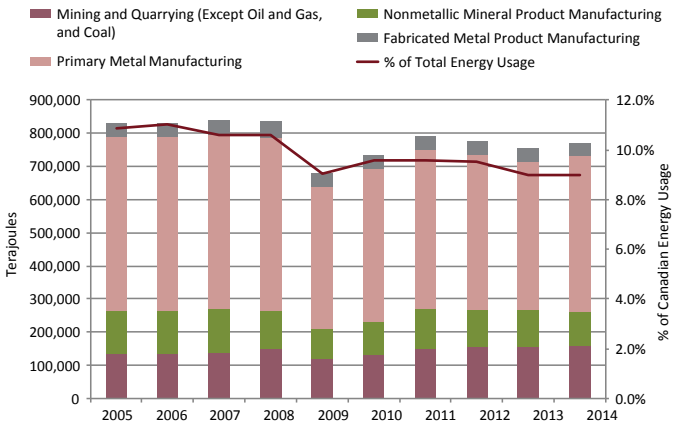
Mineral industry activities, including heavy equipment usage, power generation, and process furnaces, are energy intensive. Improving energy efficiency reduces overall operating costs and is an important component in limiting the industry's environmental impacts. Trends in energy intensity provide an indication of the resource efficiency of the sector.

Analysis

Among the energy efficiency challenges facing the mineral sector is the fact that older, deeper mines require more energy to access and extract the minerals. Mineral operations in remote regions, especially in the North, also face a particular energy challenge given their lack of access to the energy grid, forcing companies to rely on sometimes less efficient and more costly sources of energy generation. In addition, the transformation of ores and concentrates into usable products at metallurgical operations requires significant amounts of energy, adding to the energy challenges facing the sector.

Overall, energy use in the mineral industry is trending downward. Energy use in 2014 was 7.2% lower than 2005 levels (Figure 35). Between 2005 and 2008, the industry accounted for approximately 11.0% of total Canadian energy use annually, but since 2009, that share has been decreasing and was 9.0% in 2014.

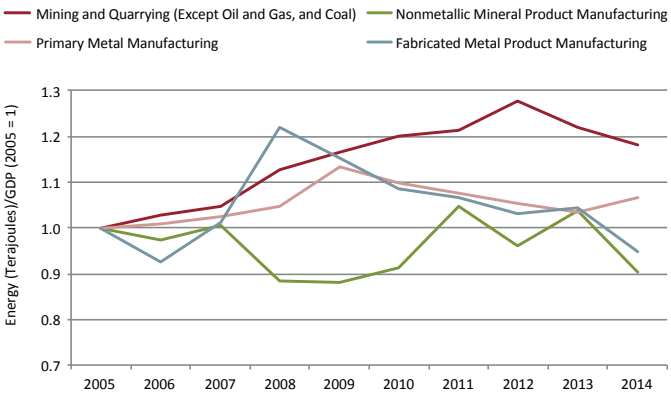
Figure 35: Mineral Sector Energy Consumption, 2005-14



Sources: Canadian Industrial Energy End-Use Data and Analysis Centre; Environment and Climate Change Canada.

At the subsector level, between 2005 and 2014, there was a decline in energy intensity (a ratio of energy consumption over GDP) for nonmetallic mineral product manufacturing (-9.8%) and for fabricated metal product manufacturing (-5.3%), while in the mining and quarrying and primary metal manufacturing subsectors, energy intensity increased by 18.1% and 6.7%, respectively. Of note, there has been an increase in the energy intensity of each subsector in the last 10 years. Most recently, between 2013 and 2014, energy intensity levels began to decline (Figure 36).

Figure 36: Mineral Sector Energy Intensity (GDP), 2005-14



Source: Canadian Industrial Energy End-Use Data and Analysis Centre.

In MAC's most recent TSM progress report, over 60% of its members had comprehensive energy use reporting systems, up from 34% in 2006, and close to 40% of the members had established energy intensity targets, up from less than 20% in 2006.

Governments and industry have identified energy as a key challenge for the industry going forward and have been working together on a variety of initiatives to improve energy-use practices (Box 17).

Data Considerations

As with GHG emissions, two different datasets were used in measuring the sector's energy usage as a percentage of Canada's overall energy use. The Canadian Industrial Energy End-Use Data and Analysis Centre database provides only total industrial energy use; therefore, Statistics Canada data on supply and demand of primary and secondary energy were used for the overall energy use.

Box 17: Glencore's Wind Farm and Industrial Storage Facility, Raglan Mine

One of the most significant challenges faced by mine operators in northern and remote regions is having access to low-cost, reliable electricity and energy. Because of the extreme location and sparse population in these areas, it is not always possible for operators to access hydro-electric or natural gas infrastructure. In these cases, companies must rely on their own resources to generate power, typically with diesel generators.

Located near the tip of Ungava Peninsula in northern Quebec, Glencore's Raglan nickel-copper mine lacks access to the provincial power infrastructure and relies on diesel fuel, shipped in by boat, to power the mine. In an effort to reduce costs – energy represents the second-largest cost at the site – and to improve environmental performance, Glencore, in partnership with Tugliq Energy and with funding from both levels of government, is developing Canada's first industrial-scale wind power and energy storage facility at the mine site.

In 2014, the company completed construction of a 120-metre-high wind turbine, the largest in Quebec. The 3-megawatt (MW) wind turbine is on its way to achieving savings estimated at over $40 million in fuel, operation, and maintenance over its 20-year life. At the end of the first half of 2015, the turbine had already saved 1.7 million litres of diesel and displaced the equivalent of 4,383 tonnes of CO_2 emissions. The wind turbine will eventually be coupled with a 1.8-MW wind energy storage facility – the first of its kind in the Canadian Arctic. Based on the success of this pilot project, Glencore will consider installing additional turbines that could generate up to 12 MW of energy. Moreover, the company wants to share the results and expertise of its R&D investment with 14 local Nunavik villages that are currently not connected to the electrical grid.

Environmental Expenditures

Highlights

- Between 2002 and 2012, the mineral sector's environmental capital expenditures quadrupled while environmental operating expenditures increased 32.8%.
- Both types of expenditures increased significantly from 2006 to 2008 before declining in 2010. In 2012, capital expenditures experienced the largest increase from $475 million to $1.2 billion.

Definition

Environmental expenditures are defined as all capital (investment) and operating (current) expenditures incurred by businesses to comply with current, and anticipated 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.

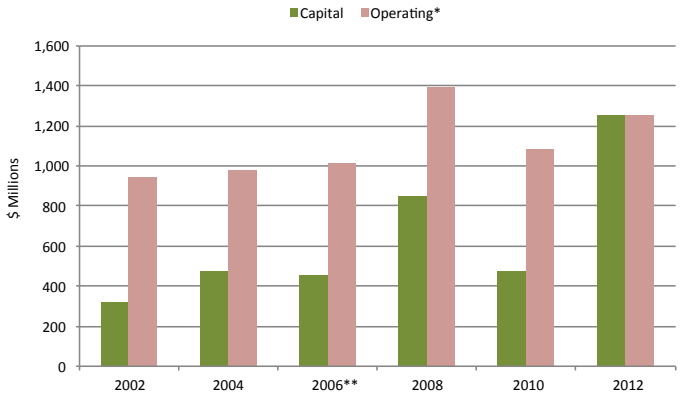
Rationale

Expenditures on environmental protection provide an indication of the level of commitment the industry is making to protect the environment and maintain healthy ecosystems.

Analysis

Between 2002 and 2012, the mineral sector's capital expenditures on environmental protection increased from $321 million to $1.2 billion, while operating expenditures increased from $943 million to $1.3 billion (Figure 37). In 2002, the mineral sector accounted for 10.9% of Canada's total capital expenditures on environmental protection and 25.2% of operating expenditures. The sector's share increased to 23.7% for capital expenditures and decreased to 22.6% for operating expenditures in 2012. Of note, the mineral sector's capital expenditures more than doubled between 2010 and 2012, growing from $475 million to $1.2 billion, while operating expenditures increased at a moderate rate from $1.1 billion to $1.3 billion.[81] As with many of the economic indicators, these expenditures fell following the global recession in 2008 and 2009.

Figure 37: Environmental Protection Expenditures in the Mineral Sector, 2002-12

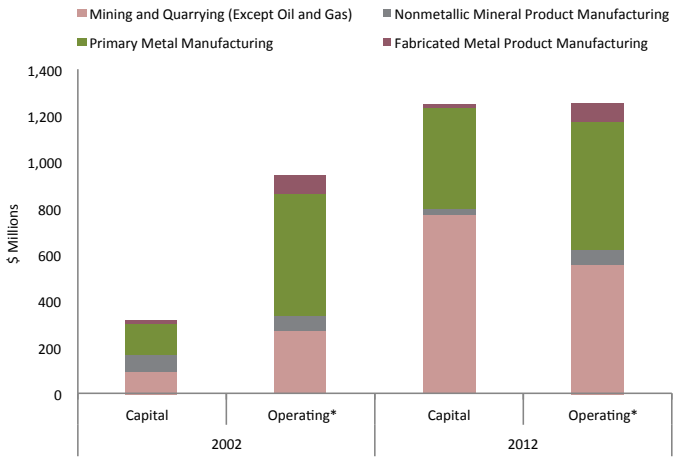


Source: Statistics Canada.
* Fees, fines and licence expenditures are excluded from operating expenditures.
** In 2006, the capital expenditures on environmental protection for the Fabricated Metal Product Manufacturing Subsector were too unreliable to be published.

In 2002, the primary metals subsector accounted for the largest share of both capital (43.6%) and operating (54.9%) expenditures on environmental protection in the mineral sector (Figure 38). By 2012, however, the mining and quarrying subsector had surpassed the primary metals subsector in capital expenditures, accounting for 61.8% of the mineral sector's capital expenditures on environmental protection. Further, the operating expenditure share for the mining and quarrying subsector increased from 28.7% in 2002 to 44.4% in 2012. The primary metals subsector retained the same share of operating expenditures (44.4%) on environmental protection in the mineral sector in 2012. The bulk of the primary metals subsector's operating expenditures was spent on pollution abatement and control processes (35.6%), waste management and sewerage services (34.1%), and pollution prevention processes (18.6%).

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

Figure 38: Environmental Protection Expenditures, by Subsector, 2002 and 2012



Source: Statistics Canada.
* Fees, fines and licence expenditures are excluded from operating expenditures.

Box 18: New Gold's DNA Barcoding Pilot Study

Mining operations are required to track the impact of their activities on biodiversity and to demonstrate the effectiveness of their site restoration programs. However, there is currently no systematic approach to rapidly quantify a mine site's baseline diversity or to track shifts in response to environmental disturbance. However, New Gold Inc. has partnered with the Biodiversity Institute of Ontario to explore the potential of DNA barcoding to track the progress and success of site remediation efforts and to expedite environmental impact assessments.

A pilot study at the company's New Afton site, near Kamloops, British Columbia, explored the outcomes of mass arthropod sampling and DNA barcoding. The pilot program included activity on four unique sites and resulted in the identification of over 4,000 species. Such baseline data will provide a comprehensive understanding of the trajectory arthropod communities take during mine development, operation, and reclamation, and will support company efforts to monitor the mine's impact on the ecosystem. The company intends to continue this monitoring program throughout the life of the mine and into closure.

Data Considerations

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

Land-Use Planning

Definition

Land-use planning is the process to evaluate and regulate land use in an appropriate and efficient manner. The goal of land-use planning is to reduce the possibility of conflict between competing land uses by designating preferential uses for specific areas.

Rationale

Governments have long planned the use of public land to promote human settlement, facilitate economic development, and protect natural resources. The absence of up-to-date land-use plans over large areas of Canada, however, is becoming an issue as the pressure to develop or conserve resources increases. Conservation groups, for example, have long objected that the mineral tenure and free entry system, prevalent in most Canadian jurisdictions, allows mining companies to register mineral claims and acquire mineral tenure on most lands regardless of other possible land uses. This approach, developed as an incentive to encourage mineral exploration, has in the past affected the protection of areas that are important for environmental or cultural reasons and can lead to conflict.

Analysis

Land-use planning in Canada generally falls under the responsibility of provincial/territorial governments. In recent years, some governments (Ontario, Quebec) have made changes to mining titles legislation to balance the competing pressures for surface and sub-surface resources. Most provinces revised their land-use policies and planning acts in the 1980s and 1990s. British Columbia has been a leader in this area and, as of 2012, more than 90% of the province was covered by four regional plans, 23 sub-regional Land and Resource Management Plans, and over 100 watershed-scale

Sustainable Resource Management Plans.[82] Further, the Province has made agreements with First Nations groups such as the Taku River Tlingit First Nation to create new protected areas and to provide resource development opportunities (Box 19). For its part, Alberta has established a Land-Use Framework to address the cumulative impacts of multiple industrial developments on its ecosystems.[83] Similarly, Nova Scotia established the *Environmental Goals and Sustainable Prosperity Act* in 2007, which included a process for land-use planning with a legislated target of legally protecting 12% of its land by 2015. With the recent designation of more than 100 properties as wilderness areas, natural reserves, and parks, Nova Scotia reached its land-use planning goal by the end of 2015.[84]

Box 19: Taku River Tlingit Land and Resource Management and Shared Decision-Making Agreement

In 2011, British Columbia signed a Land and Resource Management and Shared Decision-Making Agreement with the Taku River Tlingit First Nation (TRTFN) that enshrined a collaborative approach to the management of land, water, and resources within the traditional lands of the TRTFN. Under the terms of the agreement, British Columbia and the TRTFN agreed to endorse and implement the culturally and ecologically sustainable management framework outlined in the Atlin Taku Land Use Plan. The agreement also outlines a shared decision-making framework that includes a government-to-government forum for strategic dialogue and interaction; an engagement model, which articulates clear and definitive engagement activities based on proposed activities; and other joint initiatives, structures, or processes to ensure decisions are undertaken in a collaborative manner. All parties agreed that such agreements provide improved transparency, certainty, and clarity to project proponents, and encourage investments related to resource development that benefit all stakeholders.

At the national level, one important initiative in recent years has been the Boreal Caribou Recovery Strategy,[85] an overarching national set of guidelines for the protection of woodland boreal caribou. The strategy identified general regions that contain critical habitat across northern Canada and included a no-disturbance threshold of 65% of existing critical habitat. Indigenous communities, governments, industry stakeholders, environmental non-governmental organizations, and academia across Canada were consulted in the development of this strategy, resulting in over 192 technical submissions. Under the *Species at Risk Act*, the Minister of the Environment must report on the implementation of this strategy and the objectives every five years. The Minister has the ability to place a Protection Order to protect the caribou and the habitat that would shut down all activities that may cause disturbance in a given region. This would have a profound effect on affected resource industries and communities. Many provincial and territorial jurisdictions are currently conducting studies and developing range plans under deadlines to meet the ECCC requirements and prevent such an action.

Ontario

Ontario is working jointly with First Nations on community-based land-use planning as part of the Far North land-use planning initiative (the Initiative) under the legislative foundation of the *Far North Act, 2010*. The Initiative includes two other elements: (1) developing the Far North land-use strategies; and (2) science and information to support planning. In 2015, Ontario launched the next phase in the development of a Far North land-use strategy that will guide planning and inform decision-making to work toward environmental, social, and economic objectives as set out in the *Far North Act*.[86]

The *Far North Act* prohibits staking or the establishment of a new mine in the Far North if there is no community-based land-use plan for the area. The Initiative also results in withdrawals of mining rights under the *Mining Act* across a large area in the Far North of the province. An amendment to the *Mining Act* (Section 31[2]) accommodates withdrawal of areas of spiritual and cultural significance. It applies across the entire

[82] Government of British Columbia, 2012, *Mid-Term Timber Supply*, https://www.for.gov.bc.ca/hfp/mountain_pine_beetle/mid-term-timber-supply-project/land%20use%20planning%20overview.pdf.

[83] See https://landuse.alberta.ca/PlanforAlberta/LanduseFramework/Pages/default.aspx.

[84] See http://novascotia.ca/news/release/?id=20151229002 and http://novascotia.ca/parksandprotectedareas/plan/progress/.

[85] Environment and Climate Change Canada, 2012, *Recovery Strategy for the Woodland Caribou, Boreal Population (Rangifer tarandus caribou), in Canada, Species at Risk Act* Recovery Strategy Series, http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=2253.

[86] See https://news.ontario.ca/mnr/en/2015/09/ontario-reaches-milestone-in-far-north-land-use-planning.html.

province and not just in the Far North. Under the Far North land-use planning initiative, First Nations groups work with the Ontario Ministry of Natural Resources to prepare local community-based land-use plans. When completed, these plans will become part of Ontario's land-use policy, identifying what type of activities, including resource development, would be permitted and where. Ontario expects this process to take between 10 and 15 years to complete.

Yukon

Yukon has a regional land-use planning process governed by Chapter 11 of the *First Nation Final Agreement*.[87] In this process, the Yukon government, First Nations, stakeholders, and residents work together to develop blueprints to guide the future use and development of land in their area. To date, a regional land-use plan has been completed for the North Yukon and Peel Watershed regions. Land-use planning for the Peel Watershed region, which encompasses about 14% of Yukon, was conducted between 2004 and 2011. In 2014, the Yukon government and the First Nations governments approved an alternative land-use plan that applies to public lands in this region.[88]

Yukon also has a number of territorial and national park interests where land has been designated for park purposes. There are also other areas identified and managed for habitat or other wildlife/natural values through various management tools. Lands have also been withdrawn from disposition as part of continued discussions with three First Nations that have not settled final comprehensive agreements with the government.

Data Considerations

As land-use planning falls within provincial/territorial jurisdiction[89] and varies across the country, it is very difficult to provide a national picture of land-use planning in Canada with respect to the mineral sector.

[87] See www.emr.gov.yk.ca/lands/regional_land_use_planning.html.

[88] See http://www.emr.gov.yk.ca/rlup/peel-watershed-regional-land-use-planning.html.

[89] With the exception of Yukon (Yukon government), Northwest Territories (federal), and Nunavut (federal).

Orphaned and Abandoned Mines

Highlights

- Canada's federal, provincial, and territorial governments have spent more than $1 billion in the past 12 years to manage abandoned mines and to prevent the occurrence of new ones.

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.[90]

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 and how it will be decommissioned when mining activities end, and to post a financial surety[91] to ensure these activities are carried out.

Analysis

Canada's federal, provincial, and territorial governments have spent more than $1 billion in the past 12 years to manage abandoned mines and to prevent the occurrence of new ones.

To address the problem of orphaned and abandoned mines, Canada's federal, provincial and territorial Mines Ministers requested that a multi-stakeholder advisory committee be set up to study issues towards remediation of these sites. In 2002, the National Orphaned/Abandoned Mines Initiative (NOAMI) was created with representatives from governments, industry, Indigenous communities, and civil society.

[90] National Orphaned/Abandoned Mines Initiative (NOAMI), 2015, *NOAMI Performance Update 2009-2015*, http://www.abandoned-mines.org/wp/wp-content/uploads/2015/08/NOAMI-2015-UPDATE-ENG-WEB.pdf.

[91] 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.

Since it began, the various jurisdictions have taken significant steps to address orphaned and abandoned mines through either regulations or voluntary initiatives. Today, while the potential for new orphaned and abandoned mines is very low, NOAMI continues to work toward eliminating any future abandonments, and Canadian jurisdictions are constantly striving to improve the management and rehabilitation of existing properties through new and innovative approaches.

NOAMI is currently developing a high-level roadmap for managing long-term liabilities and issues related to the return of lands to the Crown. This includes developing a decision-making process that follows the progression of actions and identifies the key issues and questions that should be addressed for relinquishment of a site. To date, several important tools and guidance documents have been produced to assist jurisdictions and industry in determining whether a site should be brought under government jurisdiction or remain the responsibility of the operator.

At the core of NOAMI lie two major strengths. One is that the initiative is multi-stakeholder in nature and the other is that it is truly national in its reach. Funding and other valuable resources are provided by the mining industry, several provinces and territories, and the federal government. It is a pan-Canadian effort that has made tremendous progress in addressing issues related to orphaned and abandoned mines in this country.

Federal and Provincial Initiatives

Federal Government – Indigenous and Northern Affairs Canada

The Northern Contaminated Sites Program (NCSP), within Indigenous and Northern Affairs Canada (INAC), was created in 1991 to manage remediation of contaminated sites across the North. In 2005, the Federal Contaminated Sites Action Plan was established by the federal government. This program committed $3.5 billion over a 15-year period for the assessment and remediation of contaminated sites under the federal government's responsibility, which include abandoned mines in Yukon, the Northwest Territories, and Nunavut.

As of April 1, 2016, over 1,000 contaminated sites in the North had been assessed by the NCSP, of which 97 were classified as high priority for action. Remediation has been completed at 48 sites across the three territories. Work is ongoing at 76 sites, including 2 of the highest priority northern sites: the Giant mine in the Northwest Territories and the Faro mine in Yukon. In the case of the Faro mine, INAC works very closely with the Government of Yukon.

British Columbia

British Columbia established the Crown Contaminated Sites Program (CCSP) in 2003, based on a report by the Office of the Auditor General seeking improvements in the management of contaminated sites. The mandate of the CCSP is to identify and remediate high-risk contaminated sites located on Crown land where no responsible person can be identified and where the responsibility for remediation falls to the province. Remediation undertaken complies with the *Environmental Management Act*, the Contaminated Sites Regulation, and the Hazardous Waste Regulation.

To date, 82 sites have been investigated, of which 48 have been determined to be low risk where no immediate action is required, 18 have been fully remediated, and 16 are under investigation or undergoing remediation. Orphaned/abandoned mine sites comprise about 95% of the contaminated sites within the CCSP portfolio.

As of March 31, 2016, the Province of British Columbia had recognized contaminated site liabilities totaling $508 million. Of this, over $192 million has been spent on site remediation. Significant remediation projects include the Britannia mine, where acidic water is being treated at a high-density lime treatment plant.

Manitoba

In 2000, Manitoba established the Orphaned/Abandoned Mine Site Rehabilitation Program to address the environmental, health, and public safety concerns of orphaned and abandoned mines in the province. Within this program, 149 former mine sites were identified, including 5 high-priority sites (Lynn Lake, Sherridon, Gods Lake, Snow Lake, and Baker Patton) and 31 high-hazard sites. To date, 30 of 31 high-hazard sites have been remediated, with the one remaining site to be completed in 2016. Manitoba is now addressing lower-priority sites, largely in response to communities and government concerns, and has remediated 10 low- to moderate-risk sites. As of March 31, 2016, the Province had spent $214.8 million on orphaned and abandoned mine-site rehabilitation.

Box 20: Farley East Tailings Management Area Remediation

The Farley nickel-copper mine operated from 1953 to 1976 while the on-site mill operated until 2002. In 1998, the 250-hectare Farley East Tailings Management Area (ETMA), containing approximately 25 million tonnes of tailings, was identified as "high-risk" by the Province of Manitoba, based on environmental degradation and public health and safety concerns expressed by First Nations and the nearby town of Lynn Lake.

In 2001, Manitoba established a Technical Advisory Committee comprised of medical advisors; public health, environment, and mining officials; community and First Nations representatives; and consulting companies to compile and analyze community and technical input.

From 2001 to 2006, a number of extensive environmental investigations, including a Human Health and Environmental Risk Assessment, were conducted, which led to the development of a comprehensive rehabilitation plan for the ETMA. Over $75 million has been spent to remediate the site, including the development of a comprehensive drainage system to divert clean rain and melt water around the ETMA, a system to treat contaminated groundwater, a number of revegetation areas, a multi-layer geotechnical cap for the tailings, and a new wetland to remove contaminants from the ETMA runoff. In 2014, remediation work on the area was completed and the site is now in a five-year monitoring program.

Newfoundland and Labrador

Orphaned and abandoned mines (OAM) in Newfoundland and Labrador are mostly historic and predate the province joining Confederation in 1949, and all of the sites predate the *Mining Act* of 2000. These properties, ranging from exploration sites to large-scale former producing mines, can pose safety risks to the public and some have environmental issues.

Newfoundland and Labrador has spent over $30 million on OAMs in recent years. In 2002, the Hope Brook mine site returned to the Province after the Royal Oak Mines bankruptcy. The government rehabilitated the site, addressing both environmental issues and safety at a cost of $21 million and continuing ongoing monitoring and maintenance costs. The Hope Brook case provided the final impetus leading to the implementation of the *Mining Act*, which requires an acceptable rehabilitation and closure plan with 100% financial assurance in place before a project can commence. Newfoundland and Labrador has also implemented a program of dam safety reviews and repairs of tailings dams at OAM with the goal of bringing the dams to Canadian Dam Association standards.

Nova Scotia

There are approximately 7,500 abandoned mine openings (AMO) in Nova Scotia, about 2,200 of which are located on Crown land. The Abandoned Mine Opening Remediation Program was created in 2001 and, as of December 2015, had invested about $760,000 to remediate the most hazardous of these openings. To date, 689 AMOs have been remediated through the program, including all of the most hazardous (inescapable) mine openings. The work has been conducted on 40 different mine sites.

In May 2016, the Department of Natural Resources released Version 6 of the Nova Scotia AMO Database. This is an update to Version 5, released in November 2013, which contains about 150 newly discovered AMO and updates to 2,400 records in the database. This database is available online at http://novascotia.ca/natr/meb/geoscience-online/about-database-amo.asp.

Ontario

Ontario established its Abandoned Mine Rehabilitation Program in 1999. From September 1999 to March 2016, $142.4 million was spent on rehabilitating Crown-held mine sites. Rehabilitation has been conducted on more than 80 of the highest-priority abandoned mine sites. The largest of these sites is the Kam Kotia mine, near Timmins, where more than $75 million has been spent to date. As of March 2015, rehabilitation of the site was more than 75% complete.

Saskatchewan

In 2007, the Government of Saskatchewan enacted legislation 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 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 future abandoned sites. The IC Program accepted six sites into the IC Registry in 2009 and performed the scheduled inspections on the sites in 2014. A number of sites are under assessment for acceptance in 2016 and the regulatory regime is under review to further enhance the effectiveness and sustainability of the Program.

Project CLEANS (Cleanup of Abandoned Northern Sites) is a multi-year, multi-million-dollar project aimed at assessing and reclaiming the Gunnar mine, Lorado mill, and 36 satellite sites in northern Saskatchewan. In 2006, the governments of Saskatchewan and Canada signed a Memorandum of Agreement to share equally in the costs to clean up the Gunnar and satellite legacy uranium sites in northern Saskatchewan. Encana Corp. contributed to a liability fund held by the Government of Saskatchewan that will be used to clean up the Lorado portion of the project. The Saskatchewan Research Council is managing Project CLEANS.

Data Considerations

One of the initial goals of NOAMI was the development of a national inventory of orphaned and abandoned mines. Work on a national web-based inventory, using a feature-based classification and portal, has continued and the release of the inventory can proceed once approval is received from the various jurisdictions. When it becomes available, this inventory will provide a Canada-wide perspective on the number, status, and features of orphaned and abandoned mines and will allow a better understanding of the situation and the development of appropriate policies to address them.

CONCLUSION

The performance of Canada's mineral sector has improved across many of the economic, social, and environmental indicators measured in this report. Economically, the sector continues to make a significant contribution to Canada, the provinces and territories, and a number of regions. Socially, the sector is making strides in community engagement efforts, highlighted by the increased number of agreements signed between mineral companies and Indigenous communities or groups, while governments are moving forward in recognizing these groups as partners in the mineral development cycle. Environmentally, the mineral sector has made considerable progress in reducing greenhouse gas emissions and energy consumption, and in maintaining compliance with stringent water-quality standards. However, incidents such as the Mount Polley mine dam breach can erode public confidence in the sector and can overshadow notable efforts to improve the environmental performance of the industry.

The sector continues to be a significant contributor to the socio-economic vitality of Canada that translates into thousands of jobs, significant economic opportunities, and prosperity that extends to numerous remote communities, cities, and the furthest corners of the country. The mineral industry is crucial to the everyday life of Canadians. Mined products are required to build critical infrastructure such as highways, communication networks, and housing, and are critical inputs in everyday products such as electronic devices, toothpaste, and other items essential to modern life. In addition, clean energy and "green" products, including hybrid-electric vehicle batteries, solar panels, and wind turbines, rely on minerals and metals as fundamental building blocks.

The objective of this report is to articulate the sector's performance over the last 10 years to gain a better understanding of successes, gaps, and areas requiring further attention. The mineral sector understands its environmental and social performance is a critical component to its image, acceptance, reputation, and long-term success in Canada, and recognizes the need for continual improvement. It is hoped that the information compiled in this report will help industry, governments, civil society, and academia to better develop priorities and strategic directions to ensure that Canada continues to benefit from a sustainable and responsible mineral resource sector.

Moving forward, it is important to note that some gaps remain in measuring the sector's progress relative to the outcomes presented in this report. Competitive pressures, environmental concerns, and social expectations are becoming the most prevalent topics in the domestic and international arena. Advances in productivity and innovation will be critical to attain, maintain, and enhance the sector's competitiveness, environmental sustainability, and social acceptance. The assessment of these issues will become critical in understanding the performance of the mineral industry over time.

In addition, certain issues will require ongoing attention, such as 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. Continuous multi-stakeholder collaborative work will therefore be essential to develop additional indicators and to gather the data needed to evaluate improvements in monitoring the sector's performance.

Notes