MINING SECTOR PERFORMANCE REPORT

1998-2008

September 2010

FINAL REPORT OF THE

FEDERAL, PROVINCIAL AND TERRITORIAL SOCIAL LICENCE TASK GROUP

SUBMITTED TO THE

2010 ENERGY AND MINES MINISTERS' CONFERENCE

Statement by the Mining Sector Performance Review External Advisory Committee

The *Mining Sector Performance Report* was developed in consultation with an external advisory committee. Advisory committee members, comprised of representatives from industry, academia, provincial governments, Aboriginal and non-governmental organizations, were asked to speak as individuals with experience and knowledge of the industry rather than on behalf of their respective organizations.

Advisory committee members were invited to:

1. Help shape the parameters of the performance review project, including the scope of work, workplan, stakeholder engagement approach, and draft outlines;
2. Suggest names of experts who should be contacted;
3. Identify relevant research or documentation;
4. Review and comment upon all relevant documents produced; and
5. Suggest ways in which the performance review findings could be utilized.

Three meetings of this advisory committee and one multi-stakeholder workshop were held between October 2009 and July 2010 to seek formal feedback on the project's progress and findings. This input was invaluable in generating an evidence-based evaluation of the social, environmental and economic performance of the mining sector.

The advisory committee supports the broad conclusions of the report.

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Executive Summary

The objective of this *Mining Sector Performance Report* is to provide an evidence-based analysis of the Canadian mining sector's economic, environmental and social performance over the past decade. The information in this report is organized around four broad themes related to environmental, economic, and social performance, as well as reporting and monitoring. The body of evidence, however, is incomplete, with more quantitative information available about economic and environmental performance than social performance. This report reflects this limitation and, while it identifies the areas where improvements have taken place and areas where progress is still needed, it also documents gaps that need to be filled to support more complete performance reporting in the future. Additionally, the report acknowledges the impact the cyclical nature of commodity prices might have on performance and how economic, environmental and social performance are all inter-related.

Economic Performance

As one of the world's largest mining nations, Canada's mining sector continues to contribute to the economic prosperity of the country. From 1998 to 2008, the minerals and metals sector increased production, exploration, and research and development (R&D) expenditures, exports, and government revenues through taxes and royalties. While mining accounted for $95 billion in exports in 2008 the contribution of the minerals and metals sector to the overall economy has been slowly declining since 2000 and stood at 3.3% of GDP in 2008. This decline reflects an increase in Canada's GDP rather than a drop in the contribution of the minerals and metals processing industries. The industry consistently employed over 350 000 persons, most in high-skilled, high-paying jobs. Employment decreased by 7% despite higher growth in weekly wages compared to the national average. The industry has one of the best labour productivity records of any sector, largely due to ongoing investments in research and high technology. In 2008 there were about 200 mines operating across Canada, excluding clay, peat, stone, and gravel quarries.

Environmental Performance

The Canadian mining industry has faced a number of difficult environmental issues in the past, particularly in relation to acid rock drainage from tailings and waste rock, abandoned mines, and air emissions. These issues led federal, provincial and territorial governments to tighten their environmental regulations and to launch initiatives to improve the performance of the sector.

As a result of these efforts, the industry has met environmental standards for water effluent and acid rock drainage, reduced its energy intensity, reduced greenhouse gas (GHG) emissions per unit of production, and significantly reduced releases of air pollutants, mainly NOx, SOx, and particulate matter. The sector has also begun to address legacy issues concerning orphaned and abandoned mines through the multi-stakeholder National Orphaned/Abandoned Mines Initiative, direct expenditures for contaminated sites, reclamation and decommissioning, and the requirement for closure plans (including financial surety) at the mine development stage. Today, the management of tailings impoundment areas and land-use remain the most challenging environmental issues facing the Canadian mining industry.

Social Performance

Over the past 10 years, there has been a growing focus on the impact the sector can have on the economic and social well-being of communities. While performance indicators in this area are difficult to track, social performance is growing in importance. Mining companies have become Canada's largest private-sector Aboriginal employer, more projects benefit local communities, worker health and safety is among the best of all industries in Canada, and the duration and impact of strikes and lockouts have diminished. Despite these improvements, lack of engagement at early stages can result in opposition to development, and an income gap exists for women and Aboriginal workers. Furthermore, capacity challenges exist in communities to adequately engage in consultation, and no accepted roles, responsibilities, and procedures exist to fulfill the Crown's duty to consult Aboriginal groups.

The Mining Association of Canada and the Prospectors and Developers Association of Canada have given priority to improving the industry's social responsibility efforts. Some companies have established community advisory groups to help address issues of local development, community health and safety, and environmental protection. While still in the early stages of development, companies have begun to integrate social considerations more directly into project planning and facility operations.

Monitoring and Reporting

The last decade has seen an emergence of transparency initiatives with voluntary environmental and social reporting becoming standard among the larger mining companies operating in Canada. The Mining Association of Canada was the first mining association worldwide to implement external verification of its members' performance (against its *Towards Sustainable Mining* framework). The Prospectors and Developers Association of Canada has developed *e3 Plus: A Framework for Responsible Exploration*, which will provide a means by which the social, environmental, and health and safety performance of junior mining companies can be reported and monitored.

Notwithstanding these and other initiatives, there is no recognized standard reporting mechanism for sustainability indicators in Canada. This absence has a direct impact on the ability to gather quantifiable data to measure performance improvements (including for this report) and raises credibility issues for the industry. This is also compounded by the fact that not all companies participate in these initiatives.

SUMMARY OF PERFORMANCE

ECONOMIC

INDICATOR	TREND			SUMMARY
Production		▲▼		As commodity prices began to rise in 2002, the value of Canadian production more than doubled by 2008; contribution to GDP, however, declined slowly to 3.3%
Exploration expenditures	▲			From 1998 to 2008, exploration expenditures have grown by more than 400%
Employment			▼	Employment in the mining and mineral processing sector decreased by 7% between 1998 and 2008; wages are higher than the national average
Exports	▲			Doubling of exports to more than $95 billion from 1998 to 2008
Research and development	▲			Investments of $731.3 million in 2006, compared to $473.6 million in 1998
Government revenues and expenditures	▲			Government revenues almost tripled to $939 million from 2002 to 2007; royalties increased from $433.5 million to over $3 billion during the same period; government expenditures in mining also increased, particularly for geoscience, environmental assessments, and reclamation

SUMMARY OF PERFORMANCE

ENVIRONMENTAL

INDICATOR	TREND			SUMMARY
Water quality and acid rock drainage (ARD)	▲			Over 90% compliance for federal *Metal Mining Effluent Regulations* (introduced in 2002); further study is required for environmental effects monitoring on fish and fish habitat
Tailings management		▲▼		No numerical data, but the National Pollutant Release Inventory will begin publishing tailings and waste data in 2010; the use of natural water bodies for tailings impoundment areas remains controversial
Energy consumption and efficiency	▲			Significant improvements in energy intensity from 1998 to 2008, with primary metal and mineral manufacturing decreasing by approximately 10% and 40%, respectively
GHG emissions		▲▼		Emissions of carbon dioxide equivalent fell per unit of production for all portions of the mining sector; however, there were absolute value increases due to production
Air emissions	▲			Between 1997 and 2007, the mining sector (as a whole) made significant progress in reducing emissions of SOx (by 24%), NOx (by 32%), PM 10 (by 23%) and PM 2.5 (by 42%)
Land-use planning		▲▼		Majority of jurisdictions have developed land-use planning initiatives (through legislation, strategic plans, frameworks and policies); inadequate long-term monitoring, however, makes it difficult to evaluate the impact of mining operations on biodiversity
Orphaned and abandoned mines	▲			No public inventory; however, all Canadian jurisdictions now require mine developers to submit mine closure plans, including financial surety; over $1 billion spent by governments on contaminated sites and over $120 million spent per year by industry on reclamation and decommissioning
Environmental expenditures	▲			From 1997 to 2006, environmental expenditures increased from $796.1 million to $960.9 million and from $420.9 million to $453.6 million for operating and capital, respectively

SOCIAL

INDICATOR	TREND			SUMMARY
Duty to consult and accommodate Aboriginal groups		▲▼		Remains a challenging issue for governments, companies and Aboriginal groups; First Nations, Métis, Inuit, and governments have developed or are working on action plans, guidelines or policies to provide clarity
Outreach and engagement		▲▼		Opportunities for engagement have improved with environmental assessments, community outreach officers, Memoranda of Understanding with Assembly of First Nations; however engagement activities can be contentious when communities oppose a project
Aboriginal benefits	▲			Aboriginal employment in mining grew to 7.5% in 2006; 91 impact and benefits agreements were signed from 1998 to 2008 across Canada

SUMMARY OF PERFORMANCE				
SOCIAL				
INDICATOR	TREND			SUMMARY
Training and skills	▲			While there was an increase in Aboriginal employment, Aboriginal workers continued to be predominantly employed in the trades, transport, and equipment operating areas; there are many initiatives from government and industry to improve skills
Gender equality		▲▼		Women represent 14% of the mining sector workforce, an increase of 3% from 1996; gender income gap remains an issue
Worker health and safety	▲			Non-fatal injury rate dropped by 45% between 1999 and 2007; it is among the best in Canada in the heavy industrial sector
Mine closure		▲▼		66 mines closed from 1998 to 2008; moving away from building new communities; socio-economic agreements often contain closure clauses
Strikes and lockouts	▲			Decline in impact of lockouts and strikes (in duration person-days)
MONITORING AND REPORTING				
INDICATOR	TREND			SUMMARY
Monitoring and reporting		▲▼		No standard set of sustainability indicators exist in this sector; however, national and international reporting mechanisms have emerged; lack of consistent indicators will encumber further efforts to quantify improvements
Improvement (▲), some change (▲▼), worse (▼)				

Introduction

Canada is one of the world's leading mining countries and ranks among the largest producers of minerals and metals. Mines, quarries, and primary metal and mineral manufacturing facilities (the mining sector) are distributed across every province and territory, producing a wide range of products essential to modern life. Through this industrial activity, the sector affects the economic, environmental and social outcomes through factors such as employment, trade balance, air emissions, water quality, development opportunities, and relations with Aboriginal communities.

At their annual meeting in September 2009, federal, provincial and territorial Mines Ministers tasked officials with developing a retrospective performance report on the mining sector. Natural Resources Canada, along with provincial partners from Newfoundland and Labrador, Nova Scotia, Saskatchewan, and Quebec, led a collaborative, multi-stakeholder, research project to examine the economic, social and environmental performance of the mining sector in Canada and determine whether improvements have been made over the last 10 years.

This project was necessarily selective given the Canadian mining industry is large, heterogeneous, operates in 13 very different jurisdictions spanning the world's second largest country, and is also active internationally. As a broad generalization, the concept of sustainable development has been evolving over the last 10 years which has led to a disproportionate amount of quantitative economic information compared to environmental and social performance in particular.

The indicators presented in this report reflect this disparity in the availability of evidence. They were selected on the basis of (i) international mining performance reporting practice (Annex), (ii) the input of an external advisory committee composed of individuals from academia, industry, Aboriginal and non-governmental organizations, and (iii) the availability of data. Where available, quantitative performance improvements were reported. Where no empirical evidence was found, key initiatives or events were used to illustrate activity and case studies were also used to round out the story. The report also recognizes that the mining sector experienced a peak in commodity prices during this time period (1998-2008) that may have influenced performance. The report itself focuses on:

- The domestic rather than the international activities of the mining sector;
- National-level indicators rather than comparisons among provinces and territories;
- Reporting on performance rather than determining cause;
- The mining development stage of the life cycle, recognizing the importance of exploration, smelting and refining[1] (recycling and re-use were not considered); and
- Minerals and metals mining, excluding oil sands and coal development.

The report focuses on the 10-year period from 1998 to 2008; however, given the availability of data, some flexibility was applied. The report also recognizes that improvements in performance result from the collective actions of various stakeholders, including provincial, Aboriginal and federal governments, non-governmental organizations, and industry.

While the report includes performance information under three broad themes (economic, environmental and social), in reality these are closely inter-woven. Profitable mines can generate large local social benefits, poor environmental practices can create significant financial liabilities, and robust worker health and safety procedures can contribute to enhanced productivity and the bottom line. These

[1] This report used the following Statistics Canada codes to describe the entire mining sector: NAICS 212000 (Mining and Quarrying - not Oil, Gas and Coal), NAICS 327000 (Nonmetallic Mineral Product Manufacturing) and NAICS 331000 (Primary Metal Manufacturing).

inter-relationships need to be kept in mind as one reviews the individual performance indicators presented in this report.

Context

The performance of the Canadian minerals and metals sector is influenced by the broader external context in which it operates. This section describes this context briefly as background to the description of economic, environmental and social performance of the sector. It also acknowledges the cyclical nature of commodity prices and its impact on the sector's performance.

In 1998, the Bre-X gold scandal had just rocked the Toronto Stock Exchange (TSX) and millions of pension dollars were lost. As a result, the disclosure requirements were revised for all mining companies listed on the TSX with the introduction of National Instrument (NI) 43-101 in 2001, which set reporting standards for the disclosure of mineral projects across Canada. Since then, NI 43-101 has supported fair and efficient capital markets by enhancing the accuracy and integrity of disclosure in the mining sector and providing investors with a higher level of protection.

The years 1998 to 2002 were marked by relatively slow economic growth. In 2003, however, strong global economic performance, particularly in China, drove demand for metals and mineral commodities and resulted in faster growth for the mining and mineral processing industries. This period also created its own challenges for the sector as large increases in energy prices and the rapid appreciation of the Canadian dollar (which reached parity against its U.S. counterpart for the first time in 31 years in 2007) reduced profits. Despite lower revenues due to a stronger Canadian dollar and higher operating costs, companies improved their balance sheets and corporate earnings continued to grow.

The rising global demand for minerals and metals also encouraged several large mergers and acquisitions during this period. In 2006 and 2007, foreign-based mining companies acquired three Canadian mining icons (Inco Ltd., Falconbridge Ltd., and Alcan Inc.).

In reaction to the environmental, economic and social challenges facing the industry, the federal, provincial and territorial governments across Canada responded by updating their resource and mining development strategies in the early 2000s. Ten out of the thirteen provinces and territories in Canada established mining plans and resource strategies to promote a globally competitive and sustainable mining sector by addressing factors such as rising operating and processing costs, exploration incentives, land access issues, mining regulations and permitting, environmental and worker protection, public perception, and relationships with Aboriginal Peoples. In addition, in 2003, the federal government amended the *Canadian Environmental Assessment Act* and, in 2007, organized multi-stakeholder National Roundtables on Corporate Social Responsibility and the Canadian Extractive Sector in Developing Countries, and established the Major Projects Management Office.

Over the past 10 years, the Supreme Court of Canada issued several rulings that clarified the obligations of the Government to consult with and accommodate Aboriginal Peoples[2] whose rights and title may be affected by mining operations or other resource development activities.

The global economic slowdown brought the solid economic performance of these industries to a halt. Today however, the outlook for the mining and mineral processing industries is optimistic. Commodity prices, fueled by a gradually improving economy, are expected to increase and mineral exploration is also expected to increase.

[2] The term Aboriginal Peoples refers collectively to First Nations, Métis, and Inuit.

Economic Performance

Mining has made a contribution to the Canadian economy for over 100 years, and Canada has earned itself a place as a leading operator, service and equipment provider and supplier of mineral commodities worldwide. The mining industry contributed $40 billion to Canada's GDP in 2008, employing over 350 000 workers in mineral extraction, smelting, fabrication, and manufacturing.[3] It is estimated that some 3 000 suppliers provide equipment, consumables and expertise to the industry, including hundreds of manufacturing, engineering, geotechnical, environmental and financial firms. The mining and mineral processing sector employs more Canadians than the forestry or energy sectors.

The Canadian mining sector is both a major investor abroad and a major recipient of foreign direct investment. Canada represents the world's largest equity market for mineral exploration and mining, and Canadian companies account for almost 40% of global exploration spending. The sector underwent substantial change over the last decade as a result of the acquisition of several major Canadian companies (viz., Inco Ltd., Falconbridge Ltd., and Alcan Inc.), a rapid increase in commodity prices, and the 2008-09 recession.

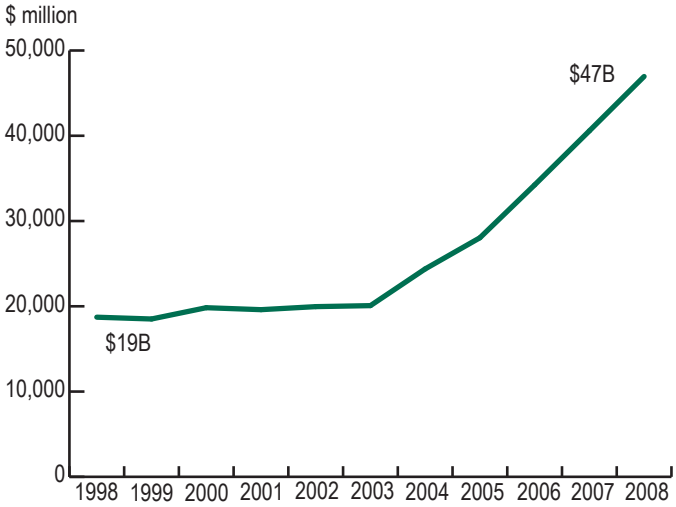
Indicator 1: Production

Canadian mineral sales grew considerably from 1998 to 2008 in every province and territory except Nunavut and Prince Edward Island. In 2008, 80% of Canada's mineral production was concentrated in Ontario (20%), Saskatchewan (18%), British Columbia (16%), Quebec (13%), and Newfoundland and Labrador (11%).[4]

From 1998 to 2002, the value of mineral production in Canada was relatively flat, reaching around $19 billion per year (Figure 1). As commodity prices began to rise in 2002, driven by increased global demand, the value of Canadian production more than doubled by 2008. However, among the natural resource sectors, minerals and metals suffered the most from the 2008-09 global recession.

Mining is one of Canada's best developed industry clusters

Figure 1: Value of Canadian mineral production



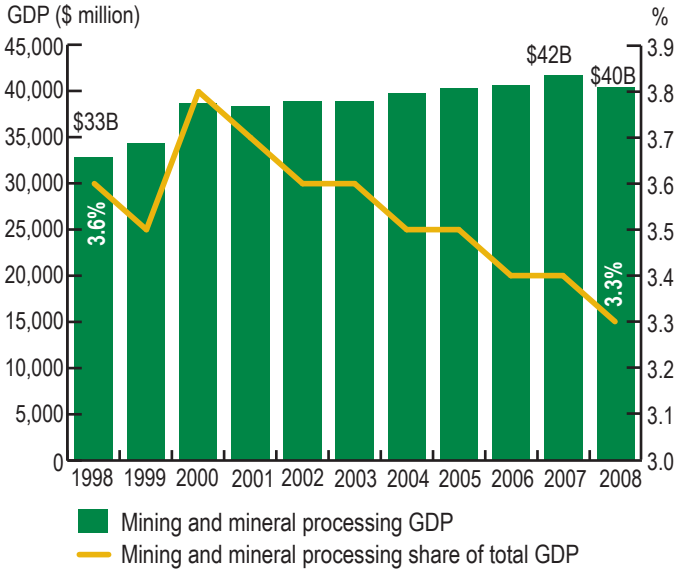
Source: Natural Resources Canada

[3] *Canadian Minerals Yearbook: 2008 Review and Outlook*, http://www.nrcan.gc.ca/smm-mms/busi-indu/cmy-amc/2008cmy-eng.htm.

[4] Statistics Canada.

The contribution of the minerals and metals sector to the overall economy has been slowly declining since 2000 and stood at 3.3% of GDP in 2008. This decline reflects an increase in Canada's GDP rather than a drop in the contribution of the minerals and metals processing industries. During this period, the GDP of the mining and mineral processing sector grew from $33 billion to $40 billion in 2008, an increase of 23% (Figure 2).

Figure 2: Mining and mineral processing



Source: Statistics Canada

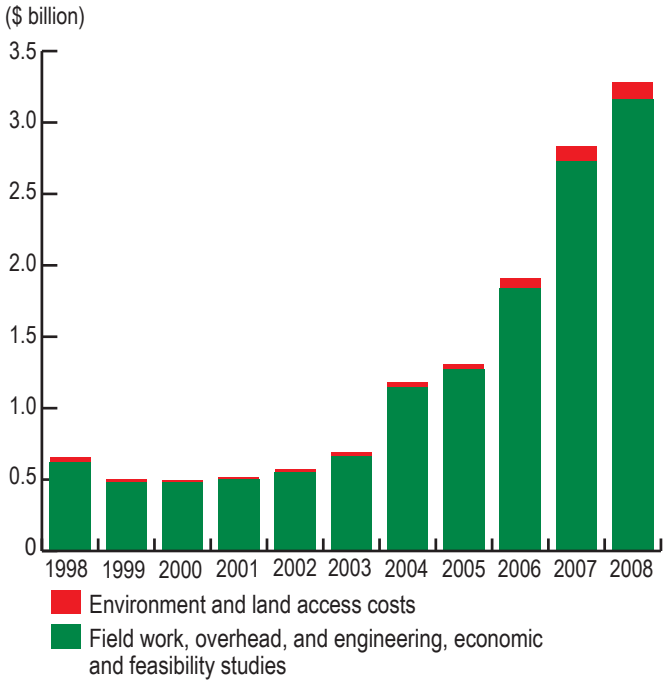
Indicator 2: Exploration expenditures

In 2008, Canada had a record year for mineral exploration. From 1998 to 2008, exploration expenditures have grown by more than 400%.[5] Since 2003, the average annual growth rate in exploration was almost 40%, driven mainly by the commodity boom. Canada's share of worldwide exploration has also grown and Canada has become the preferred destination for mineral exploration in the world. In 2008, Canada led the world in attracting mining exploration, accounting for 17% of global expenditures.[6] This leadership was the result of a number of factors, including a vibrant junior exploration sector and favourable mineral tax policy.

The recent global economic downturn, however, depressed exploration expenditures in the second half of 2008, although there were signs of recovery by 2010.

In addition to the growth in exploration from 1998 to 2008, the environmental and land access costs associated with exploration increased from $35 million to almost $120 million (Figure 3) – environmental expenditures include environmental characterization, impact studies and assessment, permitting, protection and monitoring, and site restoration. Land access costs include those related to establishing impact and benefits agreements, socio-economic agreements, and the costs of rights of way, damages, and permits for exploration and deposit appraisal work, including all associated legal fees. The exploration boom of the last decade stands in contrast with the historical lows in the late 1990s and early 2000s, which contributed to a significant decline in the reserves of most base and precious metals in Canada (Figure 4).

Figure 3: Exploration and deposit appraisal expenditures in Canada

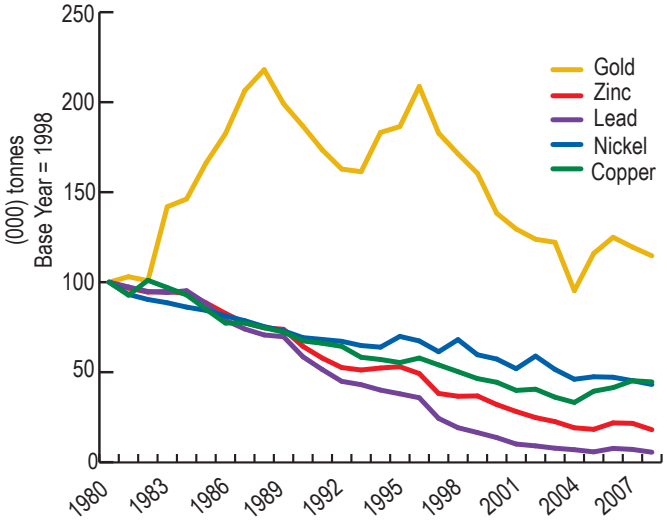


Source: Natural Resources Canada, from the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.

[5] *Canadian Minerals Yearbook: 2008 Review and Outlook*, http://www.nrcan.gc.ca/smm-mms/busi-indu/cmy-amc-eng.htm.

[6] Statistics Canada.

Figure 4: Canadian reserves of selected major metals



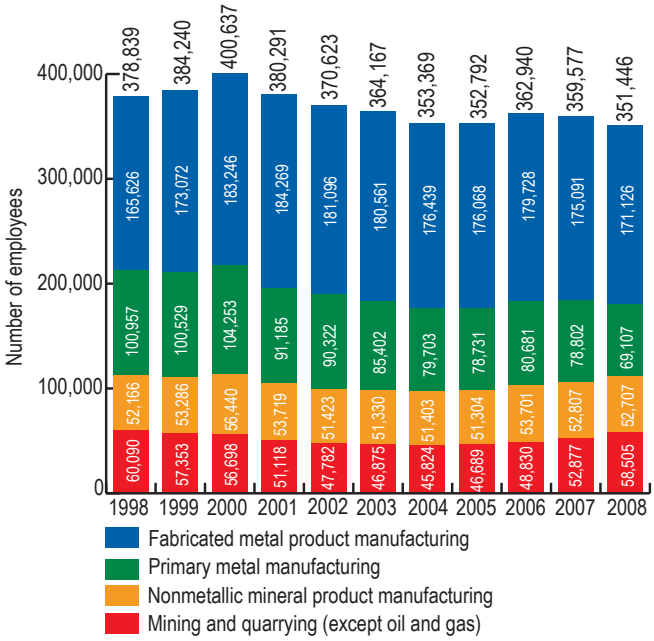
Source: Natural Resources Canada, *Canadian Minerals Yearbook NRCan, 2003-2006, Review and Outlook*

Indicator 3: Employment

Employment in the mining and mineral processing sector decreased by 7% between 1998 and 2008 largely as a result of job losses in primary metal manufacturing where employment shrank by 32% (Figure 5). In 2008, around 80% of the jobs in the mining and mineral processing sector were concentrated in Ontario, Quebec, British Columbia, and Alberta.[7] The 2008 recession hit all commodity producers hard, including the Canadian mining industry. Across Canada, 38 mines closed or reduced operations, resulting in 15 000 permanent and temporary layoffs with additional job losses among suppliers (several of these facilities have since re-opened).

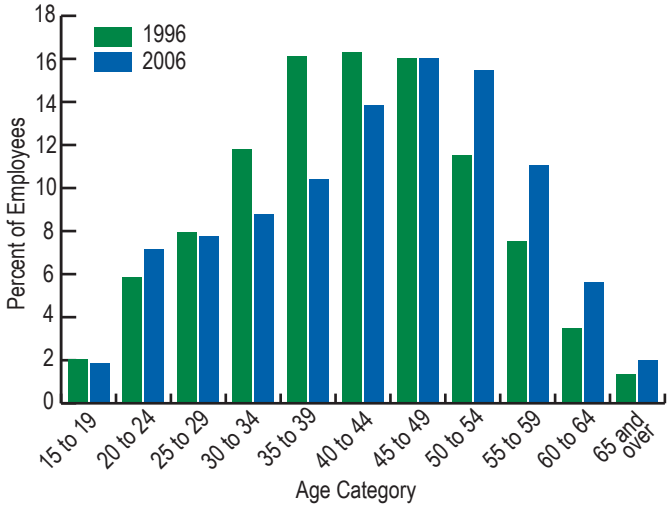
Workers in the industry are among the highest paid in Canada. The average weekly wage rose from $1053 in 1998 to $1357 in 2008 (compared to a national average of $606.32 in 1998 to $810 in 2008).[8] Despite these high wages, the sector has a recruitment gap left over from the downsizing phase that occurred in the late 1980s and 1990s that will widen as a high proportion of the mining workforce reaches retirement age in the next 10 to 15 years (Figure 6).

Figure 5: Mining and mineral processing employment



Source: Statistics Canada

Figure 6: Age composition of the Canadian minerals and metals industry



Source: Statistics Canada, Census 1996 and 2006

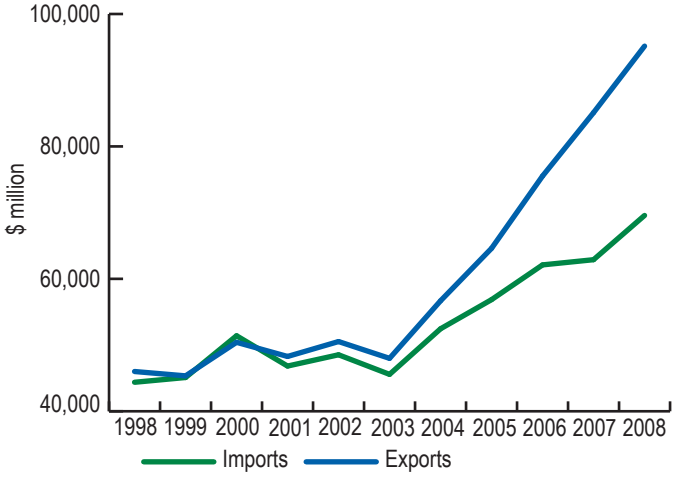
[7] Statistics Canada.

[8] Statistics Canada, average weekly wages (including overtime) for hourly rated employees in the mining and mineral manufacturing industries, 1996-2007.

Indicator 4: Exports

Canada is one of the world's leading exporters of minerals and metal products with exports doubling between 1998 and 2008 from $46 billion to more than $95 billion and contributing almost $80 billion since 1998 to Canada's trade balance (Figure 7).[9] The United States continues to be the main destination of Canada's mineral and metal exports, accounting for about two-thirds of exports in 2008.

Figure 7: Mining and mineral processing exports and imports



Source: Natural Resources Canada

Indicator 5: Research and development

Canadian mining companies invested $731.2 million in research and development in 2006, an increase from $472.6 million in 1998 (Table 1).[10] R&D is important to support mining exploration in more challenging environments, extraction in deep underground mines, the development of lower-grade ore deposits, and to improve environmental management.

In its Pan-Canadian Mining Research and Innovation Strategy (2008), the Canadian Mining Innovation Council notes several challenges related to R&D such as innovation and commercialization in the mining sector, including the fragmentation of research efforts, shortages of engineers and scientists, and inadequate linkages between industry needs and public R&D capacity.

Nevertheless, Canada's mining industry remains among the most productive in the world. Canada, for example, leads the world in output per worker in underground zinc mines and open-pit copper mines. The Centre of Living Standards and Statistics Canada[11] report that annual labour productivity grew during the decade 1997 to 2006 as follows:

- All Canadian industries: 1.5% per year;
- Manufacturing sector: 2.1% per year;
- Mineral extraction: 1.8% per year;
- Nonmetallic mineral product manufacturing: 1.6% per year;
- Primary metal manufacturing: 4.8% per year; and
- Fabricated metal product manufacturing: 1.2% per year.

Table 1
R&D actual dollar expenditures in the Canadian mining industry ($ million)

	1998	2006
Nonmetallic mineral products	14.6	54.0
Basic metals	163.0	247.0
Iron and steel	17.6	15.0
Nonferrous metals	145.4	232.0
Fabricated metal products	132.0	183.2
Total	472.6	731.2

[9] *Canadian Minerals Yearbook: 2008 Review and Outlook*, http://www.nrcan.gc.ca/smm-mms/busi-indu/cmy-amc-eng.htm.

[10] OECD (2009), Research and Development Expenditure in Industry 1990-2007.

[11] Ibid, p. 38.

Indicator 6: Government revenues and expenditures

Driven by the rise in global commodity prices, the mining sector made a growing contribution to government revenues over the past decade. According to a report commissioned by the Mining Association of Canada, corporate income taxes (excluding the oil sands) almost tripled to $939 million between 2002 and 2007 while royalties increased from $433.5 million to over $3 billion during the same period.[12] These revenues are offset in part by government expenditures in support of the metal mining industry (e.g., geological surveys, remediation of abandoned mines, R&D support).

In 2002, the Pembina Institute and MiningWatch Canada estimated that total expenditures by British Columbia, Ontario, the Yukon, Quebec, and the federal government, for the 2000/01 fiscal year in support of the mining industry were approximately $666 million. This was a slight increase from $638 million in 1994 and 1995.[13] Although no similar study has been conducted recently, federal and provincial government expenditures have increased for environmental assessments and for the remediation of abandoned mines and mineral exploration.

[12] http://www.mining.ca/www/media_lib/MAC_Documents/Briefs/English/entrans.pdf.

[13] Pembina Institute and MiningWatch Canada (2002), *Looking Beneath the Surface: An Assessment of the Value of Public Support for the Metal Mining Industry in Canada.*

Environmental Performance

The mining sector can have, and has had, a significant impact on the environment.

- *Exploration* can involve the construction of temporary roads and camps, blasting, drilling, and trenching.
- *Production* entails the processing of large quantities of rock to access the ore. An open-pit mine also requires the removal of large quantities of overburden and results in a permanent alteration of the landscape. The production process often entails the creation of large amounts of tailings, some of which may be acidic and detrimental to the environment.
- *Smelting* requires large amounts of energy to separate metals from impurities in the feedstock material and is often a significant source of air pollution.
- *Mine closure* may involve a large land reclamation effort and sometimes the long-term management of tailings ponds. In the past, many Canadian mines were simply abandoned, leaving an environmental and financial liability.

Over the past 10 years, new scientific research, regulatory systems, oversight, and industry actions have led to continuous improvements in the sector's environmental performance. Nonetheless, reducing the environmental impacts of the minerals and metals industries will continue to be one of the most significant and important challenges. Concerns are rising regarding water and mine waste management while legacy issues such as abandoned mines still have an impact on the sector. The industry's public image is closely tied to its environmental performance.

Indicator 1: Water quality and acid rock drainage

Liquid effluents generated at mining operations can include mine water, process effluent, and contaminated surface drainage such as acid rock drainage (ARD). ARD occurs when sulphide minerals found in tailings, waste rock, open-pit walls or underground workings oxidize to form an acidic effluent.[14] The production rate of ARD is determined by various factors including oxygen supply, temperature, pH, bacterial activity, mineral surface area, and crystal structure.

Metal leaching and ARD can have significant negative impacts on the environment if not adequately managed. According to the Mining Association of Canada, "acidic drainage remains the most serious environmental issue facing the mining industry, government and the public, with potential liability reaching hundreds of millions of dollars."[15]

To address this issue, NRCan and the Mining Association of Canada jointly funded the Mine Environment Neutral Drainage multi-stakeholder initiative to develop new technologies to prevent and control acid rock drainage. This information is shared widely through its publications, such as its most recent *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials*.[16]

In addition to research and development, in 2002, the federal government introduced the *Metal Mining Effluent Regulations* (MMER), replacing the 1977 *Metal Mining Liquid Effluent Regulations,* to impose new limits on releases of cyanide, a more stringent requirement for total suspended solids, and an upper pH limit, and to prohibit the discharge of effluent that is acutely lethal to fish. The MMER apply to all metal mines that exceed an effluent flow rate of 50 m^3 per day (about 100 mines). MMER reports are released annually.[17]

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[14] In some cases, metal leaching can also occur under neutral conditions.

[15] The Mining Association of Canada, TSM Progress Report 2009, p 18.

[16] http://www.abandoned-mines.org/pdfs/MENDPredictionManual-Jan05.pdf.

[17] http://www.ec.gc.ca/Publications/default.asp?lang=En&n=8B8C8B5B-1&xsl=idolsearchguirenderer%2Cresult&xml=8B8C8B5B-3474-4E6C-A0F9-30E38ACC9227&searchoffset=1&searchfunction=basicsearch&fieldfilter=any&searchstring=metal+mining+effluent+regulations&language=en&submit=Search.

The change in regulatory requirements in 2002 does not make it possible to compare data prior to 2003. Thus from 2003 to 2008, mining facilities:

- Maintained an over 99% compliance rate for arsenic, copper, cyanide, lead, nickel, zinc, radium 226, and pH;
- Improved compliance for total suspended solids from 92.1% to 93.8%;
- Achieved 95% non-mortality for fish (the mortality of *Daphnia magna*,[18] however, increased from 5.8% to 8.4%); and
- Recorded an increase in exceedances over regulatory limits from 106 to 130, primarily due to total suspended solids.[19]

In addition to the effluent restrictions, the 2002 regulatory amendments added a requirement for environmental effects monitoring to determine whether mine effluent affects fish, fish habitat, or the usability of fisheries resources, and to evaluate the effect of effluents on the environment and the adequacy of regulated limits for environmental protection. Preliminary program results indicate adverse impacts from mining effluents for fish (significant reductions in condition and relative liver size) and in particular for benthic invertebrates (significant reductions in density and taxon richness).[20] Further rounds of data collection will provide a more comprehensive picture of metal mining effluent effects in Canada.

Indicator 2: Tailings management

When sulphide minerals in tailings (i.e., specific wastes left when metals are recovered from ore) are exposed to air, they become acidic and can pose serious long-term challenges to the environment. To control acid rock drainage, tailings can be stored under water either on land in a man-made impoundment or in a natural water body. While on a case-by-case basis, using a natural water body can be the best technical storage option due to its long-term geological stability, it remains a controversial practice that has generated much public opposition. Environmental groups and members of the public have repeatedly criticized both the mining industry's alleged predisposition to choose natural water bodies to store tailings over a more thorough analysis of alternative disposal options and the federal government for allowing this practice.

When natural water bodies frequented by fish are used for metal mine tailings storage, specific authorization is required to list the natural water body on Schedule 2 of the MMER. Between 2002 and 2009, the federal government approved the use of five whole or partial natural water bodies as tailings impoundment areas out of ten projects that underwent an environmental assessment. In addition, the government has added ten other water bodies (six lakes and four streams) to the MMER since 2002 to reflect existing facilities operating prior to the new regulations.

Kemess North and Doris North

Divergent perspectives can exist on the use of tailing impoundment areas in lakes. In 2007, a joint federal-provincial review panel recommended against the Kemess North project because it involved the loss of the lake, which holds important spiritual values to the Gitxsan Nation and the creation of a long-term legacy of environmental management obligations to protect downstream water quality.

Meanwhile, for the Doris North project, there was a view from the Kivalliq Inuit Association that on-land tailings could harm water quality and caribou. In 2008, Tail Lake was approved for use as a tailings impoundment area for the Doris North project.

Sources:
Kemess North
http://www.acee.gc.ca/050/documents/23469/23469E.pdf

Doris North
http://www.gazette.gc.ca/rp-pr/p2/2008/2008-07-09/html/sor-dors216-eng.html

[18] A marine invertebrate (a fresh water flea) used in laboratories to test eco-toxicity.

[19] See Environment Canada (2007) National Assessment of Phase 1 Data from the Metal Mining Environmental Effects Monitoring Program (http://www.ec.gc.ca/esee-eem/default.asp?lang=En&n=3D80AB10-1) for information on the Environmental Effects Monitoring Program.

[20] Environment Canada (2007) National Assessment of Phase 1 Data from the Metal Mining Environmental Effects Monitoring Program.

An environmental assessment, public consultation, and the preparation of a fish habitat compensation plan must precede any such use of a tailings impoundment area. While an environmental assessment is required, some groups argue these proposals have the potential for significant adverse environmental effects and merit, at minimum, a Comprehensive Study-level environmental assessment. This was one argument MiningWatch used to challenge the federal government's approval of the Red Chris mine. Furthermore, an audit completed in October 2008, concludes that the Department of Fisheries and Oceans (DFO) "lacks information on fish stocks, quantity and quality of fish habitat, contaminants in fish, and overall water quality"[21] and therefore DFO "still cannot determine the extent to which it is progressing toward the 1986 Fish Habitat Policy's long-term objective of a net gain in fish habitat"[22].

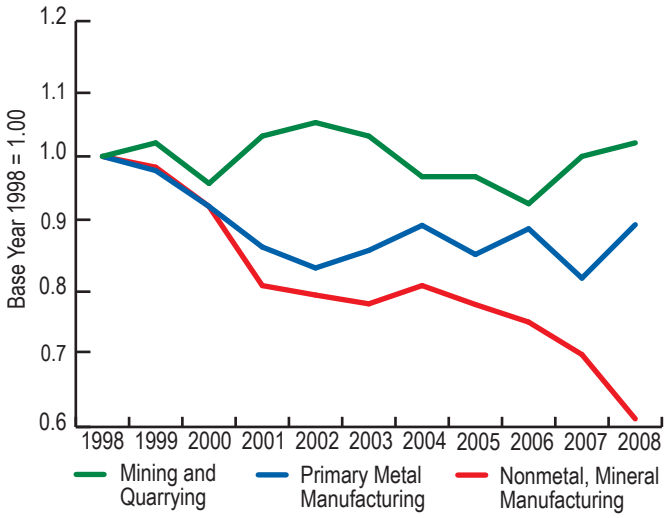
In 2009, the Federal Court ruled that Environment Canada should collect and publish information in relation to releases and transfers to tailings and waste rock disposal areas by mining facilities.[23] With this new requirement, facilities now report not only the quantities of listed substances released to the environment from the mine, but also the quantities of substances contained in the waste rock and tailings disposed of at the mine or transferred off site for disposal. Preliminary tailings and waste rock data from facilities were released on the National Pollutant Release Inventory in August 2010 and will be published annually.

Indicator 3: Energy consumption and efficiency

Among the energy efficiency challenges facing mine sites is older and deeper mines require more energy to access and extract the minerals. Mining operations in northern Canada also face a particular energy challenge given the lack of electrical grid capacity and limited infrastructure.

Overall, the minerals and metals sector showed significant energy efficiency improvements between 1998 and 2008. The biggest improvements in energy intensity (a ratio of energy consumption over mineral production) can be seen in primary metal and mineral manufacturing, with decreases of approximately 10% and 40%, respectively (Figure 8).[24] While mining and quarrying remained relatively stable with a slight increase of 2%, a period of decline did take place between 2003 and 2006.[25] These data may indicate a steep change in energy efficiency technologies during this time period for primary manufacturing, but not for mining and quarrying.

Figure 8: Trend in energy intensity



Source: Energy Use and Production - Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), Development of Energy Intensity Indicators for Canadian Industry 1990-2007. Simon Fraser University. January 2009

[21] Commissioner of the Environment and Sustainable Development (2009) Spring Report, http://www.oag-bvg.gc.ca/internet/English/parl_cesd_200905_01_e_32511.html.

[22] Ibid.

[23] *Canada Gazette* (2009), Vol. 143, No. 49: http://www.gazette.gc.ca/rp-pr/p1/2009/2009-12-05/html/notice-avis-eng.html.

[24] CIEEDAC (2010), *A Review of Energy Consumption and Related Data: Canadian Mining and Metal Smelting and Refining Industries, 1990 to 2008.*

[25] Ibid.

While this 10-year period demonstrates performance improvements in energy efficiency, data from the Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC) indicate improvements began almost 20 years ago. Between the years 1990 and 2008, the metal mining and smelting[26] industries reduced their overall energy consumption by 16.7%.[27]

This trend does hide wide variations among Canadian jurisdictions, attributable in part to the differences in the cost of energy. Mining operators in jurisdictions where energy costs are low may be less likely to invest in energy efficiency technologies than their peers in jurisdictions where energy costs are high.

Governments and mining associations across Canada recognize the importance of improving energy efficiency, given the significance of energy costs in operating expenses, and are working together to develop more energy-efficient technologies. The Canadian mining industry has been evaluating a number of renewable sources of energy over the last decade, including wind, geothermal, and solar power. Some companies have several decades of experience exploiting hydro-powered electricity generation (e.g., Vale's operations in Sudbury, Ontario and Teck's Trail Smelter Complex[28] in Trail, British Columbia). On the other hand, mining lower-grade ore deposits may contribute to higher energy requirements.

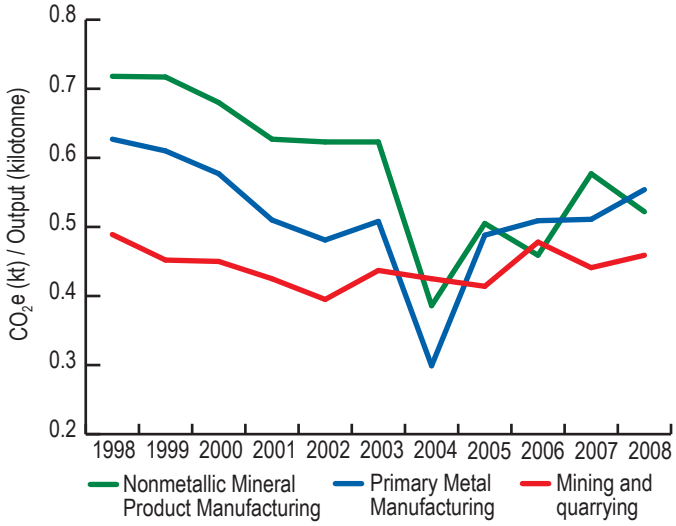
Indicator 4: GHG emissions

Climate change, as a result of the accumulation of greenhouse gases (GHG) in the atmosphere, has emerged as the most serious environmental issue of the 21st century. The vast majority of GHG emissions in the Canadian mining and mineral processing sector are linked to energy use of heavy equipment, power generation, and process furnaces.

While the mining sector accounts for approximately 6.9% of Canada's total GHG emissions (in 2008), the GHG emissions for the mining sector (mining to primary manufacturing) increased by 1017 kilotonnes between 1998 and 2008, primarily attributed to the increase in production.[29]

Taking into account the increase in production, the intensity (CO_2 equivalent per unit of production) for mining, primary metal and mineral manufacturing emissions declined between 1998 and 2008 (Figure 9). The most dramatic improvement was in nonmetallic mineral manufacturing down by 27%, while metal manufacturing and mining declined by 12% and 6%, respectively.[30]

Figure 9: Trend in GHG emissions in the mining sector



Source: Adapted from CIEEDAC data

[26] NAICS 212200 and 331410 were used to define the metal mining and smelter industries, and therefore exclude iron and steel smelting.

[27] CIEEDAC (2010), *A Review of Energy Consumption and Related Data: Canadian Mining and Metal Smelting and Refining Industries, 1990 to 2008*.

[28] http://www.teck.com/Generic.aspx?PAGE=Operations+Pages%2FZinc+Smelters+%26+Refineries+Pages%2FTrail.

[29] CIEEDAC (2010), *A Review of Energy Consumption and Related Data: Canadian Mining and Metal Smelting and Refining Industries, 1990 to 2008.*

[30] Ibid.

Climate Change Adaptation

Some of the challenges of climate change for the mining sector include greater impediments to access resources and higher costs for operation and development. For example, decreasing water availability would force gravel quarries to curtail production, warmer temperatures would lead to ice road closures, and heavy rains and extreme weather conditions would shut down access roads.

The warming of permafrost can cause particular damage by destabilizing surrounding infrastructure. Thermosyphons, shown along a dam at the Ekati diamond mine in the photograph above, are an example of how the sector is adapting. The thermosyphons ensure that the dam, used at the mine both for drainage diversion and tailings containment, remains frozen and stable all year round.

Source:
http://gsc.nrcan.gc.ca/landscapes/details_e.php?photoID=671

While the 1998 to 2008 GHG data indicate an improvement in emissions per unit of production, the CIEEDAC reports overall GHG emissions for metal mining and smelting have decreased by 47.6% since 1990, attributed mostly to reductions from metal smelting and refining.[31]

In August 2009, the David Suzuki Foundation published a report recognizing the significant progress in reducing GHG emissions by the mining sector. However, it also highlighted the vulnerability of the sector to the consequences of climate change and the need to adapt.[32] The report concluded with recommendations to the mining industry and government on how to address the impacts of climate change, including improved climate modeling and more effective communication of the potential risks posed by climate change. While some operating mines are not yet proactively planning for climate change in their operations, the considerations attached to a changing climate are often included in the environmental assessment process for new mining projects.

Indicator 5: Air emissions

Activities from mining operations produce a number of air emissions, among them nitrogen oxide (NOx), sulphur oxide (SOx), and particulate matter (PM 10 and PM 2.5). These emissions pose environmental and health risks, i.e. NOx and SOx are acid rain causing, and NOx, SOx, and particulates are contributors to smog.

At the mining stage, 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 emissions, especially sulphur dioxide, are created at the smelting and refining stage.[33]

According to the National Pollutant Release Inventory, between 1997 and 2007, the mining sector as a whole made significant progress in reducing emissions of SOx (by 24%), NOx (by 32%), PM 10 (by 23%) and PM 2.5 (by 42%) (Table 2). While each segment of the sector reduced SOx and PM 2.5 emissions, mining and

[31] Ibid.

[32] David Suzuki Foundation (2009), *Climate Change and Canadian Mining: Opportunities for Adaptation*, Ottawa, Ontario, http://www.davidsuzuki.org/publications/reports/2009/climate-change-and-canadian-mining-opportunities-for-adaptation/index.php.

[33] In 2007, SO_2 emissions from smelting and refining were 623 744 tonnes, while mining and rock quarrying totalled only 5105 tonnes. Source: National Pollutant Release Inventory, http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98- , recovered March 19, 2010.

Table 2: Air emissions data from 1997-2007								
	Mining and Rock Quarrying				Mineral Products			
	SOx ▼	NOx ▼	PM 10 ▲	PM 2.5 ▼	SOx ▼	NOx ▼	PM 10 ▼	PM 2.5 ▼
1997	42371	34508	36959	14683	2261	1811	1101	681
2002	5282	22751	32944	12745	1601	1433	1133	701
2007	5105	14959	39096	11923	913	534	925	621
	Iron Ore Mining				Nonferrous Smelting and Refining			
	SOx ▼	NOx ▲	PM 10 ▼	PM 2.5 ▼	SOx ▼	NOx ▲	PM 10 ▼	PM 2.5 ▼
1997	31757	10296	14557	6021	777702	3368	13414	8634
2002	12513	7002	4506	1834	762067	4737	8143	5927
2007	17101	14485	5536	2218	623744	3819	5185	2727

▲ indicates an increase in emissions from 1997 to 2007; ▼ indicates a decrease in emissions from 1997 to 2007.

Source: National Pollutant Release Inventory, http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98

quarrying increased their emissions of PM 10 by nearly 6%, and iron ore mining and smelting and refining increased their NOx emissions.

Increasingly stringent government regulatory requirements have been the main driver in reducing air emissions. In 1998, federal, provincial and territorial Energy and Environment Ministers signed the *Canada-Wide Acid Rain Strategy for Post-2000* to provide a framework for the long-term management of acid rain in Canada.[34] In 2000, the Canadian Council of Ministers of the Environment endorsed the Canada-Wide Standards for PM and ozone, setting provisions for PM and ozone and outlining the implementation of continuous improvement, pollution prevention, and "keeping-clean-areas-clean" programs. Environment Canada's cleaner fuel requirements have also contributed to the decline in NOx and SOx emissions.

Indicator 6: Land-use planning

The goal of land-use planning is to reduce the possibility of conflict between competing land uses by designating preferential uses for specific areas. 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 exploration stakes on most lands regardless of other possible land uses. This approach, developed as an incentive to encourage mine development, has in the past affected the protection of areas important for environmental or cultural reasons[35] and can lead to conflict.

Some governments (e.g., Ontario, Quebec) have made changes to their mining titles legislation to balance competing interests in surface and sub-surface resources. Most provinces revised land-use policies and planning acts in the 1980s and 1990s to better protect their environment and natural resources. British Columbia was a pioneer in this area, and as of 2008, approximately 85% of the province was covered by 26 strategic land-use plans.[36] For its part, Alberta has established a Land-Use Framework

[34] http://www.ccme.ca/assets/pdf/1998_acid_rain_strategy_e.pdf.

[35] Environmental Commissioner of Ontario, (2007), "Developing Priorities: The Challenge of Creating a Sustainable Planning System in Northern Ontario," *Reconciling our Priorities, ECO Annual Report, 2006-07.* Toronto: The Queen's Printer for Ontario, p.72.

[36] Forest Practices Board (2008), *Provincial Land-Use Planning: Which Way From Here?,* http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs/450886/sr34_ml.pdf.

to address cumulative impacts of multiple industrial developments on its ecosystems. [37] In addition, Nova Scotia established a process for land-use planning, with a legislated target of legally protecting 12% of its land by 2015.[38]

Traditional Knowledge

Traditional Knowledge (TK) has played an important role in the assessment and operations of the Diavik diamond mine in the Northwest Territories. Diavik used information from background studies plus comments made during meetings and visits to the proposed mine site with Aboriginal representatives and Elders in preparing its environmental impact statement.

During the operation phase, Aboriginal representatives were involved in the design of studies and monitoring activities and participated in the collection of data, mostly through the activities of the Environmental Advisory Review Board (the Board). The Board established a Traditional Knowledge Panel in July 2003 to assist in the application and consideration of Traditional Knowledge, and to ensure that TK was appropriately incorporated into the planning and management of the mine. The TK panel provided advice on how to implement Fisheries and Oceans' No Net Loss policy for the management of fish habitat, and provided advice on implementing and monitoring the fencing requirements at the Diavik mine. In response to a panel recommendation, Diavik changed its environmental management plan to increase the monitoring regime during the caribou migration.

Despite these and similar initiatives, Canadian "biodiversity is being lost and will come under increasing pressure as land is converted to urban and industrial use, the integrity of ecosystems is compromised by industrial pollution and invasive alien species and a changing climate challenge the capacity of species and ecosystems to adapt or in some cases survive."[39] Mining has the potential to affect biodiversity throughout the life cycle of a project, both directly and indirectly. Direct or primary impacts can result from land clearance or direct discharges to water bodies or the air. Indirect or secondary impacts can result from social or environmental changes caused by mining operations and are often harder to identify immediately.[40] Inadequate long-term monitoring, however, makes it difficult to evaluate the impact of operations on biodiversity.

Besides land-use planning, the majority of Canadian jurisdictions use environmental assessments to review the potential impacts of major projects, including certain mining operations, to ensure only those projects that can be carried out in an environmentally, economically and socially sustainable manner proceed to implementation. In such assessments, governments and industry are increasingly considering the Traditional Knowledge[41] of Aboriginal Peoples. Such knowledge can lead to more appropriate environmental management practices.

[37] Canada's Fourth National Report to the United Nations Convention on Biological Diversity, p.55, http://www.cbd.int/doc/world/ca/ca-nr-04-en.pdf.

[38] Government of Nova Scotia, http://www.gov.ns.ca/nse/protectedareas/protecting.nova.scotia.2015.asp.

[39] Government of Canada, (2009), Canada's Fourth National Report to the United Nations Convention on Biological Diversity, p. 133.

[40] ICMM, *Good Practice Guidance for Mining and Biodiversity,* p.12, http://www.icmm.com/page/1182/good-practice-guidance-for-mining-and-biodiversity.

[41] Traditional Knowledge is place-based knowledge that local people accumulate through their observations of the environment.

Indicator 7: Orphaned and abandoned mines

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 led to an estimated 10 000 plus abandoned exploration and mining sites that require varying degrees of rehabilitation.[42] The most serious environmental issues posed by abandoned mines are acid rock drainage and metal leaching from underground workings, open-pit mine faces and workings, waste rock piles, and tailings impoundment areas.

To address these issues, governments, industry and civil society created the National Orphaned/Abandoned Mines Initiative (NOAMI) in 2002. NOAMI is jointly funded by the federal, provincial and territorial governments, the Mining Association of Canada, and the Prospectors and Developers Association of Canada. In the eight years since it was established, NOAMI has examined ways to foster community engagement, analyzed regulatory and institutional barriers, identified funding approaches for clean-up or management of liabilities, and developed guidelines to review the relevant legislative, regulatory, and policy frameworks.[43]

Abandoned mines represent a liability to the Crown. Three provincial and federal Auditor General reports highlighted the liability of contaminated sites: $180 million in British Columbia, $555 million in the three territories, and $70 million in Manitoba.[44] While the exact number of orphaned or abandoned mines reclaimed during the last decade is not known, Canada's federal, provincial and territorial governments spent close to $1 billion since 2002 to manage these sites and prevent new ones (Table 3).

Models for funding the remediation of abandoned mines

More than a decade after the Britannia mine closed in 1974, Britannia Beach was designated a National Historic Site by Parks Canada in 1988. The Britannia Mine Remediation Project, led by the Province of B.C., with support from the Government of Canada and the University of British Columbia, was launched in 2001. The majority of the funding came from the province and $30 million was obtained from a settlement with previous operators of the mine. The remediation of the mine site included construction of a water treatment plant and the transformation of Britannia Beach into a popular destination for both tourists and locals.

In the late 1990s, the Kativik Regional Government (KRG) and the Inuit-owned Makivik Development Corporation (MDC) initiated community-oriented identification and remediation of some sites considered by local northern Quebec communities as dangerous. In 2007, the Fonds Restor-Action Nunavik (FRAN) was created to finance remediation activities under the management of the KRG and MDC. FRAN proceeded by approaching as many mining companies as possible in order to raise enough money to achieve its main goal of cleaning the major sites. More than 30 companies collectively contributed over $1.5 million while the Government of Quebec pledged $3 million. As a result, an agreement was signed by the Ministère des Ressources naturelles et de la Faune, the KRG, MDC, and FRAN to clean up 18 abandoned mine exploration sites in Nunavik.

Sources:
Britannia Mine, http://www.agf.gov.bc.ca/clad/britannia/index.html

FRAN., http://www.nrcan.gc.ca/smm-mms/abor-auto/pdf/stu-etu-eng.pdf, p. 41.

[42] National Orphaned/Abandoned Mines Initiative (2009), 2002-2008 Performance Report, p.5, http://www.abandoned-mines.org/pdfs/NOAMIPerformanceReport2002-2008-e.pdf.

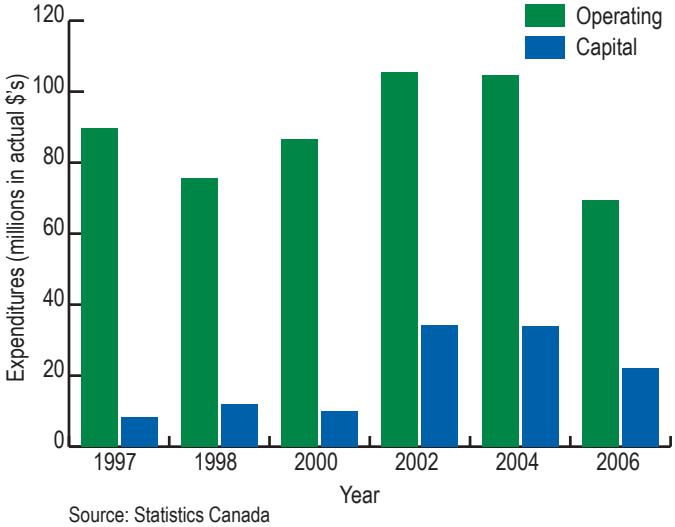
[43] National Orphaned/Abandoned Mines Initiative (2009), *2002-2008 Performance Report*.

[44] National Orphaned/Abandoned Mines in Canada, *A Toolkit of Funding Options (2006).*

According to Statistics Canada, the mining, primary metal and nonmetallic mineral industries spent, on average, $90 million in operating expenditures and $20 million in capital per year on reclamation or decommissioning activities (Figure 10).[45]

Today, mining legislation in all Canadian jurisdictions requires mine developers to submit mine closure plans that describe how the site will be rehabilitated throughout its life cycle, how it will be decommissioned when mining activities end, and to post a financial surety to ensure these activities are carried out.

Figure 10: Reclamation and decommissioning expenditures in the mining, primary metals and nonmetallic minerals industries for the years 1997-2006



Source: Statistics Canada

Table 3 Selected jurisdictional initiatives on abandoned mines
BRITISH COLUMBIA
The Crown Land Opportunities Restoration Branch (CLRB) was established in 2003 to address a broad range of contaminated sites, including many abandoned mine sites. Since 2001, the B.C. government has committed over $221.35 million to the remediation and management of contaminated sites.
MANITOBA
The Mine Closure Regulation requires that environmental liabilities incurred during mining operations be financially secured to cover future remediation costs. In addition, mine closure plans and financial security must be filed and approved prior to a permit being granted for a new mine. In 2006, Manitoba established a provincial environmental liability account for orphaned and abandoned mines. To date, the Province has spent over $20 million on orphaned and abandoned mine-site rehabilitation.
ONTARIO
Ontario established its Abandoned Mine Rehabilitation Fund (AMRF) in 1999. Between 1999 and 2008, $88 million was spent on rehabilitating the highest priority Crown-held mine sites.

[45] Statistics Canada: Environmental protection expenditures in the business sector for years 1998, 2000, 2002, 2004 and 2006. All expenditures were referenced in actual dollars.

Table 3 Selected jurisdictional initiatives on abandoned mines (Continued)
QUEBEC
According to a recent government inventory, more than 45 contaminated mining sites fall under Quebec's responsibility. Restoration began in 2007 and will extend over 10 years. The rehabilitation cost for contaminated mining sites is estimated at $320 million (as of March 2010).
NEWFOUNDLAND AND LABRADOR
The Province proclaimed its *Mining Act* in 2000 to require provision of rehabilitation and closure plans, together with financial assurance, prior to any mine approval. It has also spent $34 million on mine rehabilitation to date, including five major mine sites.
INDIAN AND NORTHERN AFFAIRS CANADA
Over $570 million has been spent on the management of contaminated sites from 2002 to 2008.

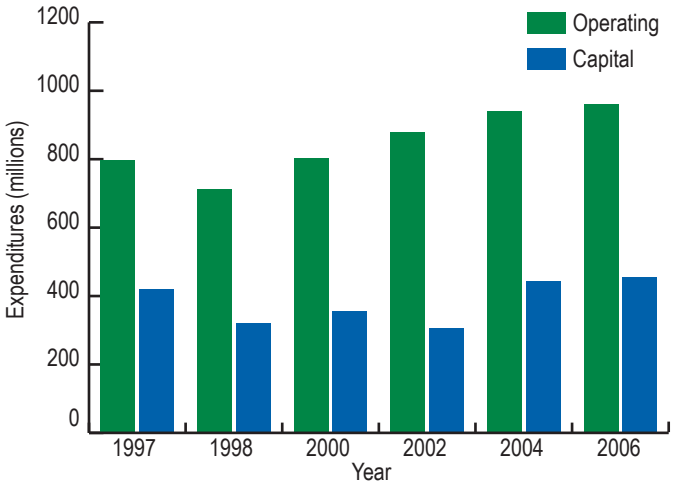
Source: NOAMI Performance Report, 1998-2008, http://www.abandoned-mines.org/pdfs/NOAMIPerformanceReport2002-2008-e.pdf.

Indicator 8: Environmental expenditures

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

Between 1997 and 2006, environmental expenditures increased from $796.1 million to $960.9 million and from $420.9 million to $453.6 million for operating and capital, respectively (Figure 11).[46] During this time, capital expenditures for pollution abatement and control processes for mining and quarrying increased from a low of $31 million (in 1997) to over $200 million (in 2006), while this type of expenditure for primary metals fell from $319 million to $77 million.[47] Relative to other business sectors in 2006, the combined mining, primary metals and nonmetallic minerals industries shared 12% and 22% of the total capital and operating expenditures, respectively, spent in Canada, second only to oil and gas extraction.[48]

Figure 11: Environmental protection expenditures in the mining, primary metals and nonmetallic minerals industries



Source: Statistics Canada, Catalogue No. 16F0006XIE

[46] Statistics Canada: Environmental protection expenditures in the business sector for years 1998, 2000, 2002, 2004 and 2006. All expenditures are noted in actual dollars. Catalogue No. 16F0006XIE. http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=16F0006X&lang=eng.

[47] Ibid.

[48] Ibid.

Social Performance

Mining can give rise to a variety of social impacts, both positive and negative. Mining exploration and development can provide jobs in economically marginal areas and lead to spin-off benefits such as improved training opportunities, enhancements to infrastructure (e.g., water treatment, schools and hospitals) and energy supplies, and improved communications. Mining activities may also affect population growth and change the size and make-up of the population, household structures, and age profile. They can have an impact on the workforce, female and youth employment, and educational attainment. They may lead to increases in crime or anti-social behaviour, the cost of living, and traffic. They can also change a community's social character and identity, as well as community cohesion and attachment. Communities that come to depend on mining to sustain their economies are especially vulnerable to negative social impacts when the mine closes.

The nature and significance of a mine's socio-economic impacts depends upon a number of factors, such as:

- *Location*: A community in a remote location is less likely to be economically diversified and is more dependent on a single industry. This makes remote communities more vulnerable to the economic cycles of a mining operation. Communities that are too dependent on a mine can become ghost towns when the mine closes.
- *Scale*: A large operation will have greater socio-economic impacts, both positive and negative, than a small operation. Similarly, a single operation will have fewer effects than several developments (whether mining or not) undertaken at the same time.
- *Duration of operations*: A short-lived mine may exceed a community's ability to take full advantage of the opportunities it presents as it takes time to receive technical training or create new businesses. Longer-life operations, on the other hand, not only provide the time for communities to benefit, but can also provide the stability needed to start up related service companies (*viz*., the growth of mining-related service companies in Sudbury, Ontario).

These factors make it difficult to develop meaningful aggregate social indicators related to mining and help explain why fewer quantitative measures exist here than in either the economic or environmental domains. The following section focuses primarily on initiatives or events that have occurred over the last 10 years related to the various social indicators; it also provides context rather than substantiating improvements. When available, quantitative evidence is provided.

Indicator 1: Duty to consult and accommodate Aboriginal groups

The duty to consult is based on obligations of the Crown with respect to established or potential Aboriginal or treaty rights of the Aboriginal Peoples of Canada, recognized and affirmed in Section 35 of the *Constitution Act*, 1982. The Crown's legal duty to consult Aboriginal groups stems from its unique relationship with Aboriginal Peoples and must be discharged in a manner that upholds the honour of the Crown and promotes the reconciliation of Aboriginal and non-Aboriginal interests. The landmark Haida,[49] Taku River [50] and Mikisew Cree[51] Supreme Court decisions in 2004 and 2005 have defined the scope of the Crown's legal obligation to consult Aboriginal groups.

[49] http://scc.lexum.umontreal.ca/en/2004/2004scc73/2004scc73.html.

[50] http://scc.lexum.umontreal.ca/en/2004/2004scc74/2004scc74.html.

[51] http://scc.lexum.umontreal.ca/en/2005/2005scc69/2005scc69.html.

In response, the Government of Canada launched an Action Plan on Consultation and Accommodation with Aboriginal Peoples in 2007.[52] Several provinces (e.g., Manitoba, British Columbia, Nova Scotia, Ontario, Quebec and Saskatchewan) have also developed their own guidelines or policies for consultation with Aboriginal Peoples specific to exploration and mining. Ontario will be the first Canadian jurisdiction to require prospectors to take an awareness program, which will include information on Aboriginal and treaty rights, before they obtain or renew their licences.[53]

Some provinces have also funded capacity-building initiatives such as Alberta's First Nations Consultation Capacity Investment Program (2009)[54] and Saskatchewan's grants to help First Nations and Métis communities map their traditional territories and consult with the Province about the management of natural resources.[55] Ontario introduced a New Relationship Fund in 2008 to help Aboriginal communities and organizations build capacity to participate in meaningful consultation and engagement with government and the private sector.[56]

For their part, some exploration and mining companies have developed corporate codes of conduct and policies concerning activities on or near Aboriginal traditional territories, some with consultation guidelines. Members of the Mining Association of Canada will begin reporting on Aboriginal and Community Outreach in 2012.[57]

Some Aboriginal groups have developed their own consultation guidelines (e.g., *Mineral Exploration in Nitassinan: A Matter of Respect: Innu Nation Guidelines for the Mining Industry*[58]). First Nations in Saskatchewan are also developing a consultation process to ensure established rights are respected. [59]

Notwithstanding these policies and guidelines, several Aboriginal groups have challenged recent court decisions asserting the Crown has not fulfilled its obligation to consult and accommodate Aboriginal groups. Driven in part by a series of court challenges and continuing disagreement about the scope of this obligation, the development of accepted procedures applying the Crown's duty to consult remains a challenging issue for governments, industry and Aboriginal Peoples.[60] Other concerns articulated by Aboriginal communities are capacity issues, insufficient funding to support meaningful participation in consultations, absence of a willingness to work government-to-government, and no specific requirement to consult or accommodate Aboriginal Peoples during the exploration and staking phase.

Indicator 2: Outreach and engagement

Government practices

The environmental assessment process under the *Canadian Environmental Assessment Act* (CEAA) has increasingly become the primary public engagement mechanism used by the federal government to consult

[52] News Release (2007), *Government of Canada Moves Ahead With Action Plan to Consult First Nation, Métis and Inuit Groups,* http://www.ainc-inac.gc.ca/ai/mr/nr/s-d2007/2-2948-eng.asp.

[53] Government of Ontario, Ministry of Northern Development and Mines, Ontario's Modernized Mining Act: Aboriginal Consultation.

[54] Government of Alberta, http://www.aboriginal.alberta.ca/581.cfm.

[55] Government of Saskatchewan, http://www.fnmr.gov.sk.ca/Consultation-Fund/.

[56] Government of Ontario, http://www.aboriginalaffairs.gov.on.ca/english/policy/nrf/nrf.asp.

[57] Towards Sustainable Mining – Update, January 2010, http://www.mining.ca/www/media_lib/TSM_Publications/TSM_Update_Bulletin/MAC_TSM_Update_Bulletin_Jan_25_2010_FINAL.pdf.

[58] http://www.miningwatch.ca/sites/miningwatch.ca/files/Innu_guidelines.pdf.

[59] Federation of Saskatchewan Indian Nations.

[60] See NAN calls for consent on Ring of Fire studies, April 15, 2010, in Wawatay News on-line, http://www.wawataynews.ca/archive/all/2010/4/15/NAN-calls-for-consent-on-Ring-of-Fire-studies_19663.

the public on proposed mining projects. Parliament amended the Act in 2003 to increase the opportunities for public input by:

- Establishing the Canadian Environmental Assessment Registry to provide more timely access to information to the public;
- Providing expanded opportunities to participate in Comprehensive Studies and broadening the Participant Funding Program for Comprehensive Studies; and
- Incorporating community and Aboriginal Traditional Knowledge in assessments.

In addition to regular consultation requirements under the CEAA, the *Metal Mining Effluent Regulations* (MMER) also require the public be consulted when a proponent applies to use a water body as a tailings impoundment area.

In the Yukon, the *Environmental and Socio-economic Assessment Act* requires the proponent to undertake community consultations for large-scale projects in addition to government obligations to consult First Nations. The smaller-scale projects also require a public review period that provides communities with an opportunity to provide input. Other initiatives include work on a First Nations/Community Toolkit for Engagement by Industry. The toolkit is currently being developed by the Yukon government in partnership with industry, First Nations, and community representatives.

Industry practices

Public expectations about the mining industry's transparency and community engagement have increased considerably in the past decade. As a result, external outreach has become an increasingly important practice in the Canadian mining industry both domestically and abroad. Public opinion research suggests that, while industry practice is increasingly meeting the concerns of local stakeholders, it is not satisfying the general public.[61]

Community engagement practices vary considerably

Community engagement practices vary considerably, as do the outcomes of engagement, even among cases under the same regulatory regime. The failure of Platinex Inc. to explore and develop a mine on the traditional lands of the Kitchenuhmay-koosib Inninuwug (K.I.) First Nation in Northern Ontario is an instance where inadequate engagement led to strained community relations. Although dialogue was initiated in 1999, there was no agreement between the parties and conflict escalated to protests and court challenges (regarding Section 35 of the *Constitution Act and Ontario's Mining Act*). Following the rulings, relationships were too strained to resume the process and a settlement with the Government of Ontario was reached to abandon the project.

A more proactive and successful consultation strategy was implemented throughout De Beers' Victor mine development. Formal consultation began early with the Attawapiskat First Nation in 1999, upon the direction of the Mushkegowuk Council, which was solicited for information and advice on the consultation of surrounding First Nations. Three additional First Nations (Moose Cree, Kashechewan, and Fort Albany) with overlapping traditional territory were also consulted and agreements unique to each community were negotiated once their claims were confirmed. While essential to the success of this project's development, the commitment and willingness to invest the necessary time in community relations in this case are beyond Ontario's regulatory requirements, which focus more on the environmental impacts of a mine.

Based on Canadian Business Ethics Research Network case study: http://www.businessethicscanada.ca /research/projects/workspaces/cura_project/case_studies/

[61] Environics Research Group (2009), *Granting a Social Licence to Operate: Public Opinion and Mining in Remote/Rural Communities*, Ottawa, Ontario.

While government mandates some form of community outreach (e.g., open houses, public comment periods, participation agreements), many are voluntary. Many large companies, for example, have added community liaison officers within their organizations to participate in community consultations or to help facilitate information-sharing with the community and other stakeholders. Some companies also involve the local community in the environmental monitoring of operations.

The Mining Association of Canada's (MAC) *Towards Sustainable Mining* (TSM) Community of Interest Advisory Panel[62] is an example of external outreach and engagement by an industry association. The panel includes representatives from labour, Aboriginal organizations and communities, NGOs, mining communities, and the investment sector. It meets twice a year to help MAC members and communities improve the industry's performance, facilitate dialogue between the industry and communities, and help shape TSM initiatives.

e3 Plus: A Framework for Responsible Exploration is an initiative by the Prospectors and Developers' Association of Canada (PDAC) to provide exploration companies with guidance and best practices in social responsibility, environmental stewardship, and health and safety.[63] *e3 Plus* provides principles, guidance, and web-based toolkits to help companies manage their responsibilities, including guidance about engaging Aboriginal communities in Canada.

Over the last 10 years, the mining sector has made progress in engaging Aboriginal communities early in the process and negotiating terms and conditions of development, with the creation of community advisory committees and use of impact and benefits agreements. This is exemplified in the two Memoranda of Understanding with the Assembly of First Nations and the mining sector (MAC and PDAC[64]) to further First Nations' employment and business opportunities. Three Aboriginal individuals have also been elected to the PDAC Board of Directors. The Mining Information Kit[65] is a product of a partnership between the Government of Canada, PDAC, MAC, and the Canadian Aboriginal Minerals Association designed to inform Aboriginal communities across Canada about the stages of the mining cycle, from early exploration to mine closure.

The mining sector has been less successful at developing approaches to deal with communities that oppose a particular project, for example, an Aboriginal community wishing to prevent mining in a traditional hunting territory. The reconciliation of divergent rights – the right to explore or develop a mine versus the community's right to manage its traditional territory – remains an issue in several regions of Canada.

Indicator 3: Aboriginal benefits

In Canada, mining exploration and development increasingly take place in areas on or near Aboriginal communities as accessible mineral deposits in southern Canada become depleted. In the last decade, the mining industry has become the largest private sector employer of Aboriginal people. Between 1996 and 2006, the number of Aboriginal people employed in the mining sector grew from roughly 2600 to over 4500, representing a 43% increase (Figure 12). In recent years, companies have undertaken targeted initiatives to engage the Aboriginal labour force and to establish partnerships with communities. Aboriginal persons hold 408 jobs at the Ekati diamond mine in the Northwest Territories,[66] while half of the Voisey's Bay

[62] http://www.mining.ca/www/Towards_Sustaining_Mining/Community_of_Interest_Panel/Community_of_Interest_Panel.php.

[63] *e3Plus – A Framework for Responsible Exploration,* http://www.pdac.ca/e3plus/.

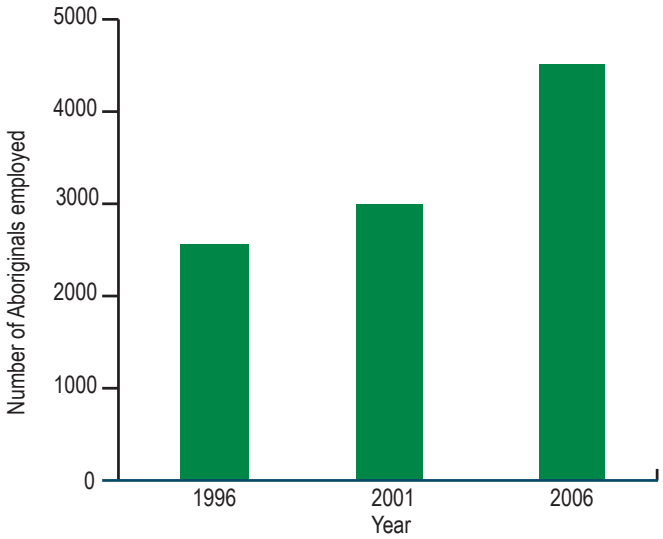
[64] The Assembly of First Nations signed MOUs with PDAC and MAC in 2008 and 2009, respectively, http://www.pdac.ca/pdac/misc/pdf/080304-afn-pdac-mou-signed.pdf.

[65] *Mining Information Kit for Aboriginal Communities,* http://www.pdac.ca/pdac/advocacy/aboriginal-affairs/2006-mining-toolkit-eng.pdf.

[66] Mining Industry Human Resources Council, (2005), *Prospecting the Future, Meeting the HR Challenges in the Canadian Minerals and Metals Industry,* http://mihr.ca/en/publications/MiHRPublications.asp.

nickel mine labour force in Labrador is Aboriginal.[67] At the newly opened Meadowbank gold mine in Nunavut, 35% of the workforce is Inuit.

Figure 12: Aboriginal People in the mining workforce

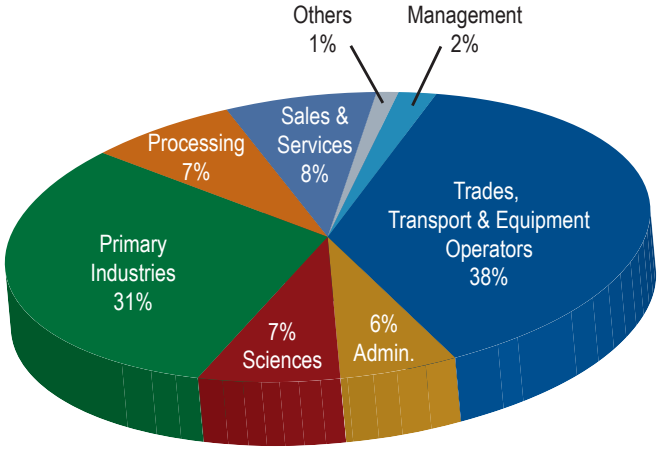


Source: Statistics Canada, Census 1996, 2001, 2006

Depending on future exploration levels, the number of new mine openings, and employee retirements, the mining industry is expected to need between 28 000 and 71 000 new workers over the next decade.[68] The fact that some 1200 Aboriginal communities are located within 200 kilometres[69] of producing mines and active mineral exploration projects could lead to significant future employment and capacity-building opportunities for Aboriginal people, including women and youth. These opportunities range from the provision of catering and accommodation services during early exploration to direct employment at the mine during construction and operation, to spin-off opportunities such as transportation, road maintenance, and environmental monitoring during operations and following mine closure.

While Aboriginal workers represented 7.5% of the mining employment in 2006, they were predominantly concentrated in the trades, transport, and equipment operators sector (38.0%) and in the occupations unique to the primary industry (31.0%) (Figure 13).[70] The proportion of Aboriginal people in management remained relatively unchanged from 2001 at 2.0%.[71] Data from the 2006 Census showed that 45.3% of First Nations, Métis and Inuit are employed in mining aged 25 to 64 had post-secondary qualifications, compared to 59.1% of non-Aboriginal people (Figure 14). In 2006, Aboriginal Peoples earned approximately $18 000 less than their non-Aboriginal counterparts, compared with a gap of approximately $12 200 in 2001.[72]

Figure 13: Proportion of Aboriginal work force in mining by occupation, 2006



Source: Statistics Canada, Census 2006

[67] NRCan (2010), Aboriginal Engagement: Aboriginal Engagement in the Mining and Energy Sectors, http://www.nrcan.gc.ca/mms-smm/abor-auto/eng-eng/tal-hyd-eng.htm.

[68] Mining Industry Human Resources Council, (2005), *Prospecting the Future: Meeting Human Resources Challenges in the Canadian Minerals and Metals Industry,* http://mihr.ca/en/publications/MiHRPublications.asp.

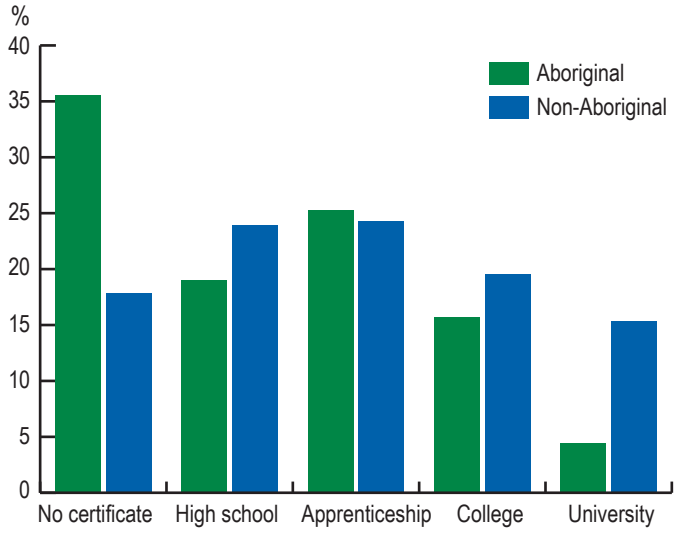
[69] NRCan (2009) Info Bulletin - *Mining Development,* http://www.nrcan.gc.ca/mms-smm/abor-auto/htm/dev-exp-eng.htm.

[70] Statistics Canada, Census 2006.

[71] Statistics Canada, Census 2001 and 2006.

[72] Ibid.

Figure 14: Proportion of Aboriginal workforce in mining by level of education, 2006

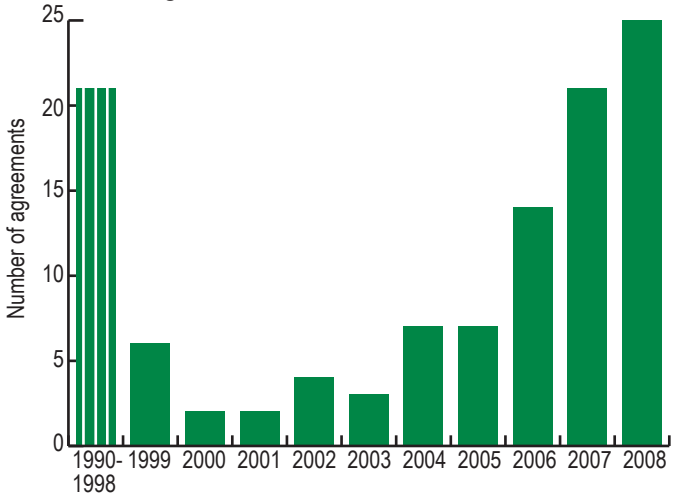


Source: Statistics Canada, Census 2006

Aboriginal engagement and agreements

Over the last decade, industry-Aboriginal relationships have evolved in important ways. Between 1998 and 2008, Aboriginal organizations and mining companies negotiated and signed 91 agreements[73] designed to secure both benefits for Aboriginal communities and certainty for exploration and mining companies. While only 21 agreements were signed between 1990 and 1998, a total of 25 were signed in 2008 (Figure 15).[74] Agreements take many different forms[75] and may include preferential hiring practices for Aboriginal workers, training, educational and apprenticeship opportunities, economic development and business opportunities, social, cultural and community support programs, the protection of areas of spiritual or cultural significance, and compensation for adverse environmental effects. In rare cases, equity participation or royalty payments may be included. Revenue-sharing programs are seen as one mechanism to share benefits.

Figure 15: Number of agreements between mining companies and Aboriginal communities or governments



Source: NRCan, Map of Agreements Between Mining Companies and Aboriginal Communities or Governments

In some cases mining companies have developed their own policies, programs and agreements with Aboriginal communities located at or near exploration or mine sites. Because the terms of individual agreements are often confidential, it is not possible to quantify their full impact or comment on their terms.[76]

In certain cases, governments have implemented or initiated measures, such as resource revenue-sharing, to enable Aboriginal communities to broaden and strengthen their economic base. British Columbia has implemented measures to share resource mining revenues[77] with affected First Nations communities

[73] NRCan (2010), *Map of Agreements Between Mining Companies and Aboriginal Communities or Governments.*

[74] This figure only accounts for the first agreement signed for each project and thus may understate the increasing trend. One mining project may, for instance, elicit several agreements with one community throughout the development process or a company may sign agreements with several communities in various years. The total number of distinct agreements signed from 1998 to 2008 was 165.

[75] Depending on the stage of the project, these agreements include letters of intent, exploration agreements, cooperation agreements, memoranda of understanding, impact and benefits agreements, participation agreements, surface lease agreements, monitoring agreements and others, NRCan (March 2010), *Map of Agreements Between Mining Companies and Aboriginal Communities or Governments.*

[76] Archibald Ritter Canada: From *Fly-In, Fly-Out to Mining Metropolis.*

[77] http://www.amebc.ca/land-use/resource-sharing-gov-release.pdf.

to support community development and assist them in achieving their social and economic goals. In 2008, Ontario announced plans to develop a system of Resource Benefits Sharing with Aboriginal communities.

Indicator 4: Training and skills

In order to more fully support the participation of Aboriginal Peoples in the mining sector, access to better education and skills training is key. The federal Aboriginal Skills and Employment Partnership (ASEP) program is geared to providing Aboriginal people with the skills needed to participate in economic opportunities such as mining, construction, fisheries, tourism, and hydro development. ASEP supports multi-year training strategies developed by Aboriginal organizations and industry employers, through a collaborative approach of Aboriginal, private-sector, and provincial, territorial partnerships. A 2009 evaluation of the program concluded that ASEP addressed the needs of both Aboriginal communities and industry.[78]

Promoting professional development

Alcan (now Rio Tinto) developed a Masters of Business Administration program for some of its Kitimat Aboriginal employees as a way of promoting professional development and retaining employees. The offering of this university-level program (from Simon Fraser University) provided an opportunity for local Aboriginal people to receive training close to home and to support the new management roles they are assuming as a result of benefit-sharing agreements with the private sector and governments.

Source:
http://business.sfu.ca/files/pdf/newsletter_archive/enewsletter_winter_2002.pdf

The 2009 federal budget set aside $100 million over three years for the ASEP program and another $75 million in a two-year Aboriginal Skills and Training Strategic Investment Fund to increase Aboriginal participation in the paid labour force.

In Saskatchewan a Multi-Party Training Plan[79] has been established with funding from the two levels of government and industry. The mines advise the workforce committee what types of jobs are required, the communities identify candidates, and the education facilities provide a trainer and course materials. A number of companies are also offering pre-employment training programs.

Mine-related training

De Beers Canada and Human Resources and Skills Development Canada's James Bay Employment and Training Strategy offers skills development programs, on-the-job work experience, and long-term employment opportunities at De Beers' Victor diamond mine project in northern Ontario. Regional communities and partners collaborate in providing mine-related training in fields such as truck driving, chef training, trades apprenticeships, office skills, and hazardous materials management. This strategy aims to maximize Aboriginal participation in the estimated 600 construction-related jobs and 375 mine operation jobs at Victor.

Source:
www.hrsdc.gc.ca/en/employment/aboriginal_training index.shtml

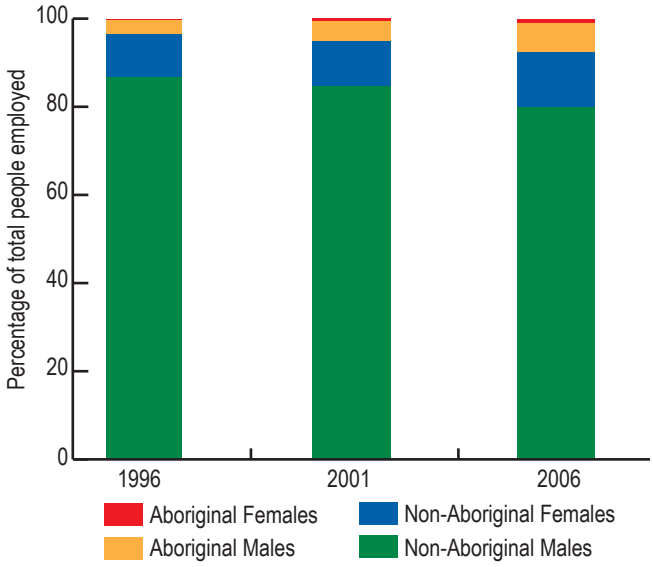
[78] Human Resources and Skills Development Canada (May 2009), Formative Evaluation of the Aboriginal Skills and Employment Partnership Program.

[79] http://www.gov.sk.ca/news?newsId=df225cc0-c5b3-435a-befe-d35d9fd11dae.

Indicator 5: Gender equality

In 2006, women represented 14% of the mining sector's workforce, an increase of 3% over the 1996 level[80] (Figure 16). The representation of women in this sector is the lowest of all the primary industry categories and well below the overall labour force participation rate of 47.4%.[81] In addition to being under-represented in most mining sector occupations (Figure 17), women also earn an average of 32% less than their male counterparts, a greater gender income gap than the average labour force.[82]

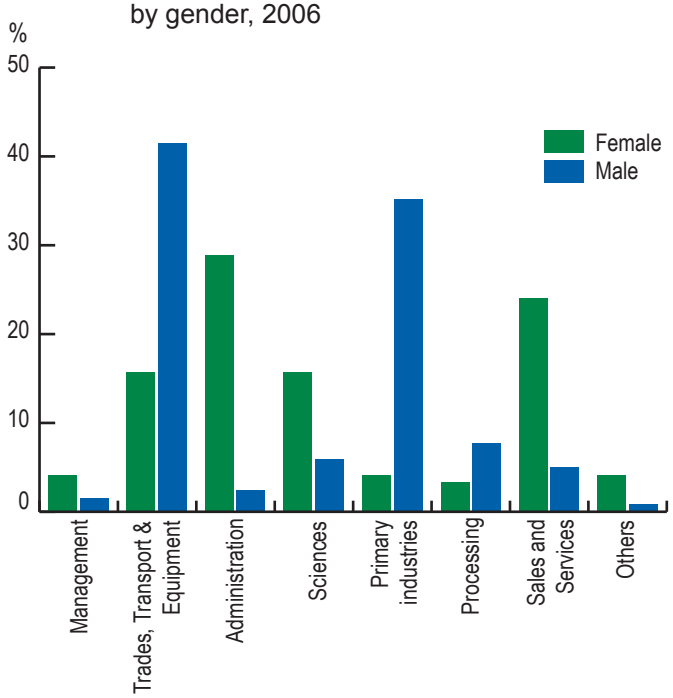
Figure 16: Workforce characteristics



Source: Statistics Canada, Census 1996, 2001, 2006

For Aboriginal employment specifically, women accounted for only 14.0% of all Aboriginal employees in the mining sector in 2006, which was a slight increase from 11.5% in 2001.[83] Aboriginal women in mining were more likely than Aboriginal men to have post-secondary qualifications, but earned average incomes of approximately $15 500 less than men. Aboriginal women working in the mining industry are mostly employed in business, finance and administration (28.5%), sales and services (23.6%), and natural and applied sciences (15.5%).[84] Less than 1% (0.6%) are in management.

Figure 17: Occupations of Aboriginal workforce by gender, 2006



Source: Statistics Canada, Census 2006

Indicator 6: Worker health and safety

Ensuring healthy and safe working conditions at the mine site is often the first social impact identified by residents and workers. Miners and community leaders want assurances that work on the site will be safe and that emergency measures will be effective. The health and safety of all individuals at a site, from workers to visitors, are basic requirements of any development.

Canada's mining sector has transitioned into one of the most safety-conscious industrial sectors. All Canadian jurisdictions require companies to train their employees in accordance with occupational health and safety regulations.[85] Today, mining is as safe as forestry and agriculture, as evidenced by significant declines in injury rates over the last 10 years (Figures 18 and 19).

[80] Women in Mining Canada (February 2010), *Ramp-Up: A Study on the Status of Women in Canada's Mining and Exploration Sector, pg. 9,* http://www.mihr.ca/en/publications/resources/Ramp-UPFinal2010.pdf.

[81] Ibid.

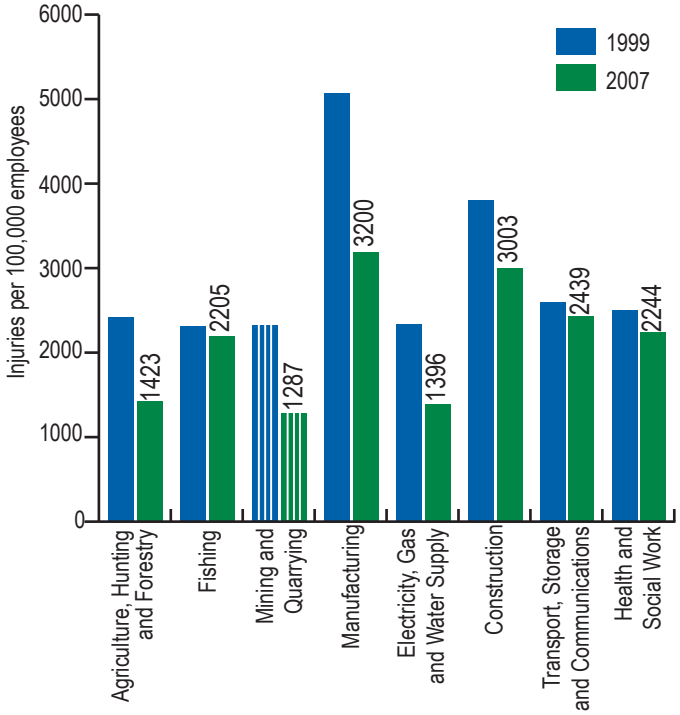
[82] Ibid.

[83] Statistics Canada, Census 2001 and 2006.

[84] Ibid.

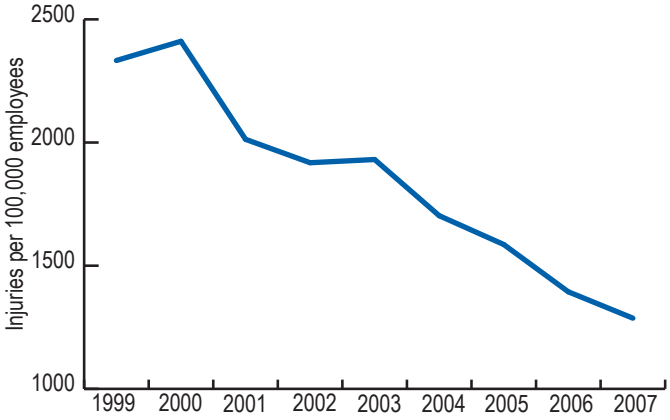
[85] Association of Workers' Compensation Boards of Canada.

Figure 18: Rate of injury by industry



Source: Adapted from International Labour Organization LABORSTA database

Figure 19: Total compensated non-fatal mining and quarrying injuries in Canada



Source: adapted from International Labour Organization LABORSTA database

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. MAC's *Towards Sustainable Mining*, for example, will begin reporting member companies' health and safety performance in 2013, after approving a framework and protocol in 2009.[86]

The control of diesel emissions, a major health concern in underground mining, has commanded the attention of North American regulators since the mid-1990s as mines become deeper, more mechanized, and limits to exposure become more strict.[87] As a result, there have been significant advancements in diesel engine technology over the past 15 years. The Canadian mining industry has adopted these new technologies and updated or developed emissions reduction programs. The U.S Environmental Protection Agency's program to reduce emissions from future non-road diesel engines by 90% by 2014[88] is also likely to influence the setting of regulatory exposure limits in Canada.

Improving underground air quality

Natural Resources Canada is working with industry partners on the development of new technologies designed to reduce air emissions in mining operations:

- Testing biodiesel in underground mines using Selective Catalytic Reduction (SCR) technology to mitigate the increased nitorgen dioxide with biodiesel emissions;
- Real-time measurement of diesel particulate matter in underground mines, which targets problem areas and processes, and enables better ventilation management practices;
- The development and evaluation of a diesel-electric hybrid loader for underground mining;
- The development and evaluation of fuel cell vehicles for underground mining – a "zero" emissions technology solution.

Source: http://www.nrcan.gc.ca/mms-smm/tect-tech/sat-setmec-mec-eng.htm

[86] The Mining Association of Canada.

[87] McGinn, S. (2007). *Controlling Diesel Emissions in Underground Mining Within an Evolving Regulatory Structure in Canada and the United States of America.*

[88] http://www.epa.gov/nonroaddiesel/.

Indicator 7: Mine closure

The number of mines operating in Canada is not static with new mining projects opened and others closing. Mines may close on schedule based on the availability of the resource, prematurely based on price fluctuation or other financial constraints, or be extended due to new exploration around the mining camp. Between 1998 and 2008, approximately 66 mines were closed and 59 suspended (Table 4).[89] Mine closures result in obvious socio-economic impacts, including the loss of employment and tax revenue, possible population decline, and depreciated housing values in neighbouring communities.

The mining industry is moving away from building new communities to support new mining operations[90] and shifting instead towards long-distance commuting, including fly-in, fly-out operations, as more deposits are discovered and developed in remote locations.

Table 4: Opening and closing of mines in Canada, 1998-2008

YEAR	NEW MINES			RE-OPENED			SUSPENDED			MINES CLOSED		
	Precious Metals	Base Metals	Other Minerals	Precious Metals	Base Metals	Other Minerals	Precious Metals	Base Metals	Other Minerals	Precious Metals	Base Metals	Other Minerals
1998	1	1	3	3	0	1	2	6	1	3	4	1
1999	1	1	4	2	2	0	9	2	0	5	5	3
2000	0	1	1	4	0	0	4	1	2	2	1	2
2001	1	0	1	0	0	0	6	1	1	3	1	3
2002	1	0	0	4	2	2	1	0	2	1	4	1
2003	0	0	2	0	1	0	4	1	3	0	0	1
2004	1	2	4	2	1	4	0	0	1	6	3	2
2005	0	1	2	2	4	1	1	0	0	2	3	0
2006	3	1	2	4	4	0	0	0	0	0	0	1
2007	1	2	3	2	3	0	0	0	0	4	0	0
2008	4	1	1	0	3	1		11			5	

Source: Natural Resources Canada, *Canadian Minerals Yearbook, 1998-2008*, http://www.nrcan.gc.ca/smm-mms/busi-indu/cmy-amc-eng.htm.

[89] These figures are additive and do not exclude operations that may have been re-opened in later years.

[90] The last community specifically constructed to support a mine was Tumbler Ridge, British Columbia, in 1984 to support the Quintette and Bullmoose mines, which subsequently closed in 2000 and 2003, respectively.

Models used by companies to help communities sustain the benefits of mining post closure

The Diavik Socio-Economic Monitoring Agreement between Diavik Diamonds Inc. and the Government of the NWT (1999) includes provisions to:

- "encourage the development of sustainable businesses that will not be uniquely dependent on the Project";
- "provide outplacement counselling, family adjustment, and pension and savings plans seminars in the affected communities upon closure."

Source:
http://www.iti.gov.nt.ca/Publications/2007/Diamonds/diavik_sema.pdf

In 2008, the mining company Osisko contributed over $3 million to a special fund to promote the sustainable development of its host community, the town of Malartic. The fund will finance economic development projects, bursaries, and infrastructure improvements to improve the quality of life of area residents.

Source:
http://www.osisko.com/en/community/femo_03112008.html

While long-distance commuting can be seen as a mitigation strategy for certain impacts of mine closure, such as population loss, it can lead to other adverse impacts. For example, permanent communities near the mine may gain less in terms of jobs and business opportunities. The time miners spend away from families and communities can also strain relationships and lead to family breakdown.[91]

The Government of the Northwest Territories requires follow-up programs in the form of socio-economic agreements for major resource development projects such as a mine. These agreements reflect the commitments and predictions made by the company during its environmental assessment and include a definition of respective roles and responsibilities.[92] Socio-economic agreements are in place for the BHP Ekati mine, the Diavik diamond mine, and De Beers' Snap Lake project.

Industry is becoming more involved in managing the adverse impacts at closure. MAC developed a Mine Closure Framework in 2008 as part of its *Towards Sustainable Mining* initiative, which includes the commitment to work with communities to develop closure plans and strategies and to help them develop plans for long-term economic development.[93]

[91] Mining, Mineral, and Sustainable Development, (2002). "Local Communities and Mines", *Breaking New Ground – MMSD Final Report*.

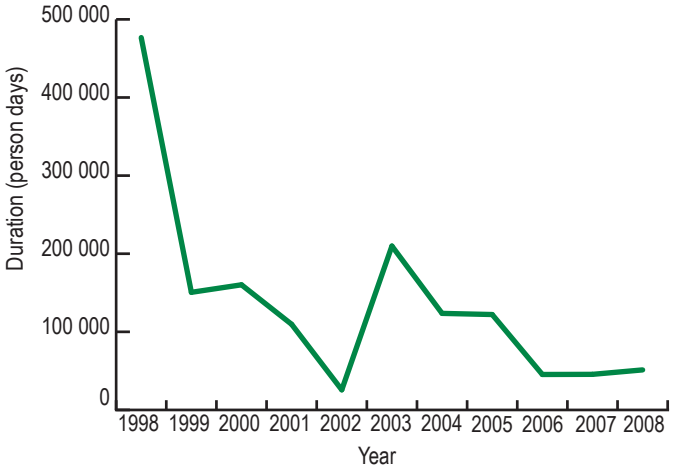
[92] Government of NT Industry, Tourism and Investment - Mining, Oil & Gas: Socio Economic Agreements. http://www.iti.gov.nt.ca/mineralsoilgas/socioeconomicagreements.shtml

[93] MAC, *Towards Sustainable Mining*: Mine Closure Framework.

Indicator 8: Strikes and lockouts

According to data published by Human Resources and Skills Development Canada's Workplace Information Directorate, during the years 1998-2008, there was a general decline in lost person days as a result of strikes and lockouts (Figure 20). While this may appear to be a positive trend, the timing of strikes could also coincide with the length of collective agreements.[94] Strikes and lockouts are the result of grievances between employees and the employer. Grievances arise for a variety of reasons including disagreements regarding competitive wages, benefits, dismantling social programs, deteriorating conditions of work, and health and safety.

Figure 20: Strikes and lockouts in person days



Source: Human Resources Development Canada, Workplace Information Directorate 1998-2008

[94] While outside the scope of this report, in 2009/10, Canada experienced the longest mining strikes in Canadian history.

Monitoring and Reporting

Unlike other sectors (e.g., forestry), mining has not yet identified a full set of sustainability indicators to measure trends and performance. While several overlapping reporting frameworks exist, the information available ranges substantially in form and quality. Quantitative time-series exist in some areas while, in others, the information is only qualitative or anecdotal.

Mining companies have had to report on various aspects of their economic, environmental and social performance to government for many years. Over the last decade, reporting requirements have taken different forms (e.g., the creation of independent monitoring agencies associated with northern diamond mines) or increased (e.g., environmental effects monitoring). Most noteworthy has been the increased public demand for transparency and the trend towards voluntary reporting as a source of competitive advantage. A company can use performance information to benchmark itself against its competitors, communicate with its stakeholders, and manage risks. Consistent data facilitate comparisons over time, across sectors, and between companies.

One major change for companies during this time period was the creation of National Instrument (NI) 43-101, which was introduced in 2001 after an extensive review of factors that contributed to financial scandals in the mining sector in the 1990s. The regulation establishes reporting standards for public disclosure of material changes in the technical status of mineral exploration and mining companies listed on stock exchanges in Canada.

The regulation has resulted in significantly enhanced mineral resource reporting and has contributed to improved corporate governance, better technical accountability, and increased access to financing.

At the international level, the Global Reporting Initiative (GRI)[95] sets the standard for comprehensive public reporting. In 2009, the GRI released the *Mining and Metals Sector Supplement* to define reporting requirements for mining companies.[96] Several Canadian companies participate in the GRI, the Carbon Disclosure Project, or the Cyanide Management Code. At the national level, MAC requires its members (in 2010, 26 companies in total) to report on the following performance indicators:

- Crisis Management;
- Energy and Greenhouse Gas Emissions Management;
- External Outreach; and
- Tailings Management

MAC has four new performance elements currently under development: Biodiversity Conservation Management, Safety and Health,[97] Mine Closure, and Water and Mining. MAC is the first mining association in the world to implement external verification of performance.

[95] http://www.globalreporting.org/Home.

[96] The Mining and Metals Sector Supplement expands the focus to include: Biodiversity; Emissions, Effluents and Waste; Labour; Indigenous Rights; Community; Artisanal and Small-Scale Mining; Resettlement; Closure Planning; and Materials Stewardship.

[97] Reporting for Biodiversity Conservation Management and Safety and Health will begin in 2012.

Industry voluntary codes

MAC's *Towards Sustainable Mining* (TSM) initiative is a stewardship initiative aimed at increasing public trust in its ability to manage the environmental and social issues important to Canadians. It includes performance indicators and targets in the areas of tailings management, energy use and greenhouse gas management, external outreach, and crisis management. TSM is developing indicators related to engagement with Aboriginal communities, which will add a clear social dimension to the initiative.

TSM also includes regular third-party compliance audits. In 2003, the first year the verification system was in use, 10 MAC members had their Towards Sustainable Mining performance results externally verified. Since full implementation in 2007, an annual rotation has been followed, with each company undergoing a third-party compliance audit every three years. Laggards and leaders are easily discernable and MAC continually strives to encourage all companies to replicate the actions of industry leaders.

Source:
http://www.mining.ca/www/Towards_Sustaining_Mining/index.php

The e3Plus: A Framework for Responsible Exploration initiative by the Prospectors and Developers Association of Canada is designed as a framework for responsible mineral exploration that assists exploration companies to improve their social, environmental, and health and safety performance and to integrate these three aspects into all of their exploration programs. It is supported by specific guidance on a variety of areas including human rights, ethics, environmental protection, and worker health and safety.

Source:
http://www.pdac.ca/e3plus/

The emergence of international and domestic reporting initiatives signals the growing realization among companies that reporting is an integral aspect of doing business today. While the advancements should be acknowledged, it is also important to recognize that there are no set standards for reporting. This can be seen in the variety among the discourse mechanisms and reporting initiatives outlined in the Annex.

Conclusion

This report has examined the mining sector's performance between 1998 and 2008 using selected economic, environmental and social indicators. In general, the performance of the industry has improved even though it remains uneven across the industry and across the country. As in all industries, leaders and laggards exist. Laggards are a great concern to the mining industry because it recognizes that the industry's social licence to operate is directly related to the public's perception of the worst performers. Four broad themes emerged from the collection of this data:

Interconnectivity

While the report categorizes performance against the pillars of sustainable development, this presentation is arbitrary and does not recognize the many inter-relationships among these performance elements. Strong social performance can boost economic performance by increasing labour productivity. Weak environmental performance may preclude a company from gaining social licence to operate. Strong economic performance can fund environmental improvements and more expansive benefits-sharing. Over time, the competitiveness of the mining sector will depend on its ability to generate integrated solutions.

Significant environmental progress

One cannot report on the industry's performance without noting the significant progress in environmental protection. The mining sector, through multi-stakeholder initiatives, regulatory and financial instruments, and science and technology has demonstrated its environmental commitment through reductions in energy intensity, air emissions, and GHG emissions, as well as increases in environmental expenditures, including remediation and decommissioning. This change in performance has taken place against a backdrop of rising public expectations which has challenged the industry to extend its practices beyond regulatory compliance to environmental stewardship. These are most obvious in land-use planning, biodiversity, and the use of natural water bodies as tailings impoundment areas.

Emerging social progress

While quantifiable social indicators such as the number of impact and benefits agreements negotiated, Aboriginal employment, and injury rates demonstrate improvements, these numbers do not reflect the real complexity in this area. In the past, the social performance of the mining sector was measured narrowly using, for example the number of jobs created. This is no longer the case. While one can point to several areas of significant progress i.e. the industry becoming a leader in worker health and safety and the generation of important economic benefits for Aboriginal groups the record is less impressive in other areas as evidenced by the lack of women employed, and the concentration of Aboriginal employees in the lower-paying occupations.

Availability of data

This report has noted important information gaps that prevent a comprehensive evaluation of the sector's performance over the last decade. In some cases, the data exist but are aggregated inconsistently making comparisons or analysis difficult. In other cases, the absence of quantitative information necessitates the use of qualitative or anecdotal information. Finally, in some instances, there are no agreed–upon metrics to measure performance.

Sectors that have invested in performance measurement (e.g., forestry) have seen the benefits that the development of agreed-upon indicators can yield in assessing and managing performance in each of these areas.

Annex: Sustainability Frameworks

Indicators	WB	MMSD	e3+	EV	EQP	EITI	FRM	GRI	GHG	ICMM	IFC	TSM	UNGC	VP	Total
Environmental Performance															
GHG emissions	■	■		■	■		■	■	■		■	■			9
Energy efficiency/use		■		■	■		■	■			■	■			7
Air emissions	■	■		■	■		■	■			■	■			8
Water quality/use	■	■	■	■	■		■	■			■				8
Biodiversity/ecosystem impacts		■	■	■	■		■	■		■	■	■			9
Soil/erosion		■									■				2
Waste management	■	■	■	■	■		■	■		■	■	■			10
Orphaned/ abandoned/ closed mines (site reclamation)	■	■		■	■		■	■		■	■	■			9
Optimization of Socio-economic Impacts															
Aboriginal participation		■	■	■			■	■			■	■			7
Community investment			■	■			■	■		■		■	■		7
Wealth generation and distribution		■	■	■			■	■			■				6
Worker health and safety		■	■	■			■	■		■	■	■	■	■	10
Social impacts of new mine			■	■	■		■	■		■		■			7
Gender issues/ diversity		■					■	■							3
Socio-economic impacts of mine closure		■		■			■	■			■	■			6
Transparency and Accountability															
Reporting on enviro/social indicators	■	■	■	■	■	■	■	■	■	■	■	■	■	■	14
Monitoring/verification systems		■	■	■	■	■	■	■	■	■	■	■	■		12
Enforcement (responding to compliance failures)				■				■							2
Grievance and dispute resolution mechanisms		■	■	■	■		■	■			■				7
Community Engagement															
Community engagement practices of companies/industry		■	■	■	■	■	■	■		■	■	■	■		11
Community engagement practices of governments						■									1
Other Indicators															
Recycling	■	■		■			■	■		■		■			7
Emergency preparedness		■		■						■	■	■			5
Noise pollution		■		■			■				■				4
Protect cultural property/heritage	■		■		■						■				4
Security	■		■				■							■	4
Dust management	■							■							2

Fourteen sustainability frameworks with varying scopes and jurisdictions were analyzed to help determine the areas of focus for the report. This analysis provided insight, indentifying relevant areas for research and reporting.

- **WB** – World Bank: Base Metals and Iron Ore Mining
- **MMSD** – Breaking New Ground: Mining, Minerals & Sustainable Development
- **E3+** – e3Plus: Environmental Excellence in Exploration
- **EV** – Enduring Value
- **EQP** – Equator Principles
- **EITI** –Extractive Industries Transparency Initiative
- **FRM** – Framework for Responsible Mining
- **GRI** – Global Reporting Initiative
- **GHG** – Greenhouse Gas Protocol
- **ICMM** – ICMM: Sustainable Development Framework
- **IFC** – International Financial Corporation: Environmental and Social Standards
- **TSM** – Towards Sustainable Mining
- **UNGC** – United Nations Global Compact
- **VP** – Voluntary Principles on Security and Human Rights