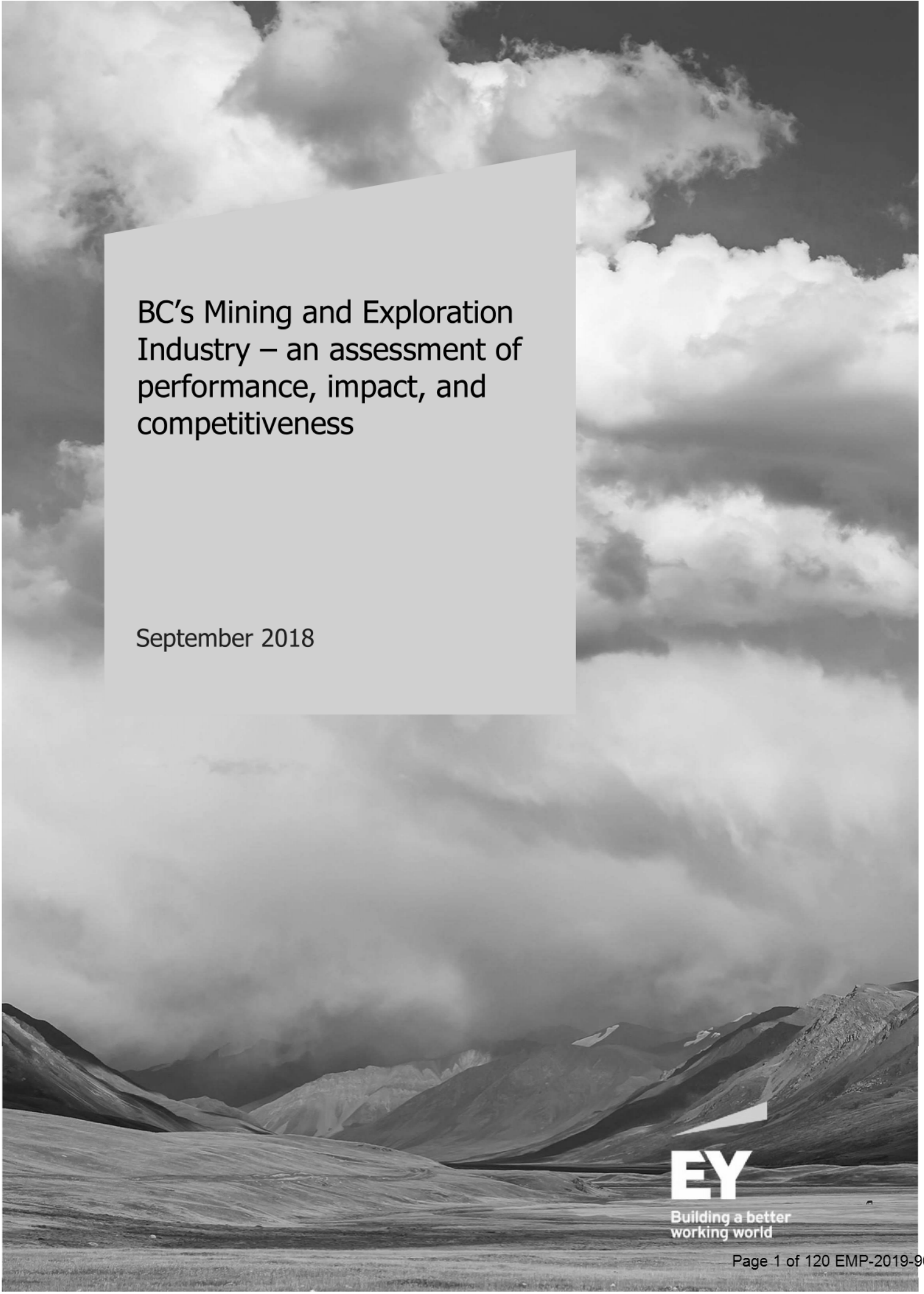


BC's Mining and Exploration Industry – an assessment of performance, impact, and competitiveness

September 2018

Building a better working world

CONTENTS

DEFINED TERMS

Term	Description
BC	British Columbia
C&M	Care and maintenance
CH	Chile
Equivalent carbon dioxide (CO_2e)	A measure to describe how much global warming a given type of greenhouse gas may cause, using the equivalent amount of carbon dioxide (CO_2) as a reference.
EA	Environmental Assessment
EITE industries	Emissions-intensive, trade exposed industries
GDP	Gross Domestic Product
Greenhouse Gas Emissions	The emission into the earth's atmosphere of various gases, especially carbon dioxide that contribute to the greenhouse effect and as a result, global warming.
MAC	Mining Association of Canada
Met coal	Metallurgical coal
Ministry	The Ministry of Energy, Mines and Petroleum Resources
NRCan	Natural Resources Canada
ON	Ontario
QC	Quebec
QLD	Queensland, Australia
ROI	A measure of the expected return on an investment relative to the risk of that investment, over a specific period
RDI	Research, development and innovation
Scope 1 ("Direct") GHG emissions	As defined by the GHG Protocol, Scope 1 (also known as "direct" emissions), occur from sources that are owned or controlled by the company, for example, stationary combustion emissions, and emissions from process and/or mobile equipment
Scope 2 ("Indirect") GHG emissions	As defined by the GHG Protocol, Scope 2 (also known as "indirect" emissions") account for the GHG emissions from the generation of purchased electricity consumed by the company. Scope 2 emissions physically occur at the facility where electricity is generated.
Task Force	BC Mining Jobs Task Force
WA	Western Australia

EXECUTIVE SUMMARY

The Ministry of Energy, Mines and Petroleum Resources (Ministry) has established a BC Mining Jobs Task Force (Task Force) to identify measures to make BC the most attractive jurisdiction for investment in Canada while ensuring a sustainable sector that provides employment opportunities for British Columbians. To support the Task Force, the Ministry engaged Ernst and Young LLP (EY) to undertake a review of the performance and competitiveness of the province's mining sector.

In mining, a jurisdiction's attractiveness is based on investors' perceptions of investment conditions in one jurisdiction relative to another. Investment conditions reflect the quality of a jurisdiction's geology, maturity of infrastructure, the availability of skilled labour, the transparency and predictability of the regulatory framework, fiscal policy, and public acceptance among others. Favourable investment conditions drive greater returns, and greater returns attract increased investment.

In this report, we use a driver-based approach to identify what levers government can influence to improve investment conditions in BC to make it a more attractive mining jurisdiction. Specifically, we look at how BC performs across three major drivers of investment returns in the sector (geology and geography, fiscal policy, and regulatory framework) and compare this performance to the following jurisdictions: Chile, Queensland (Australia), Western Australia, Ontario, and Quebec. These jurisdictions have been selected as they compete with BC for investment across the metallurgical coal, copper, and gold industries – BC's major commodities that, together, industries represent 98% of the production value of major commodities in the province.

Findings

Notwithstanding BC's rich mineral endowment, the comparator jurisdictions generally hold an advantage over BC with respect to geology and geography. Each of these jurisdictions benefit from the favourable economics that result from attractive geology (grade, depth, scale of deposits) and geography (proximity to infrastructure and end-markets), or a combination of both. Although this advantage may diminish over time as easily accessible, high grade deposits are depleted, it does put a ceiling on how competitive BC can be in the near-term given the substantial influence of geology and geography on investment returns in the sector.

One strategy government can take to make the province more attractive in the near term is to lower income and sector specific taxes and/or increase/extend existing incentives to improve mining and exploration investment returns. The question is how much further the government would be willing to go to support the industry as the province's fiscal policy concerning the mining industry is already competitive on a global basis, particularly with regards to offering incentives to encourage exploration.

However, one area of taxation that the province is not competitive in is its treatment of carbon. Although the BC government has proposed some targeted support to industry to alleviate competitiveness concerns related to the BC carbon tax through the *Clean Growth Incentive Program*, mining companies operating in BC currently and will continue to pay substantially more than their competitors in other jurisdictions. Government could consider implementing allowances similar to those in Ontario and Quebec although this strategy must be considered within the

context of the province's emissions reduction objectives, government revenue requirements and expectations of carbon pricing changes worldwide. Recycling carbon tax revenues back to industry for emissions reduction projects, as is proposed in the *Clean Growth Incentive Program*, is critical to not only help the industry prepare for a low-carbon future but also to support competitiveness. The province could consider further expanding their support for emissions reduction projects to include revenues accrued from the carbon tax below $30/tonne.

The government could also increase its investment in actions to increase the transparency, consistency and coordination between various levels of government of the regulatory framework governing the sector in BC. This includes providing further clarity on the requirements related to the EA process to project proponents and relevant consultants; improving the coordination of processes and feedback received by different provincial bodies and federal agencies; allowing for innovation to mitigate impacts; and providing support to proponents to understand requirements related to indigenous consultation. Some of the changes proposed in the government's working paper related to the EA revitalization process touch on these subjects. These changes would provide a more efficient, predictable, and effective regulatory framework to encourage investment by decreasing investment risk.

The above actions - lowering taxes, offering greater incentives, and improving the regulatory framework - would increase the attractiveness of BC to investors; however, it is unclear that such actions would be enough to make B.C. "the most attractive jurisdiction for investment in Canada".

There is, however, opportunity for the province to invest now to position BC as Canada's leader of the 'mining industry of the low carbon future'. The industry is rapidly transforming due to a number of disruptive technological, social, and demographic forces and this rapid pace of change means that the mining industry five, ten, and twenty years into the future will look considerably different than it does today.

Looking ahead, demand for metals and minerals produced in BC will in part be driven by the emergence of the low carbon future. At the same time, the economic supply of these commodities in BC and abroad will be challenged by decreasing grades and deeper mines if current mining and processing processes do not advance. In the absence of new technologies, lower grades and deeper mines will contribute to a greater environmental footprint as more material will need to be extracted and processed to maintain existing production levels. This means greater energy consumption, water usage, carbon emissions, and mining waste. A larger environmental footprint will not only impact the economics of mining projects but will also exacerbate industry's social license challenges. If this scenario eventuates it could become a significant barrier to a strong, healthy mining industry in BC.

Globally, industry, government, and academia have recognized the urgency to find solutions to the industry's looming environmental footprint challenge. Significant investments have been made in research, development, and innovation (RDI) in energy efficiency, water management, reduced emissions, and less wasteful mining. For example, the Canadian Mining Innovation Council's (CMIC) "Toward Zero Waste" mining innovation strategy aims to stimulate technology

innovation in Canada to achieve zero waste in the industry within 10-20 years, with an integrated focus on the productivity, energy and environment[1].

The provincial government has the opportunity to invest in a tailored-for-BC RDI strategy that will aim to accelerate innovative solutions to challenges facing the BC mining industry. Once proven, these solutions can be exported to larger global markets. Through a 'BC Mining Innovation Strategy', the province can become Canada's leader in mining and exploration RDI, commercialization and adoption of step-change innovation to attract investment, create new jobs, and position BC for the mining industry of the future.

There are a number of models available to implement such a strategy with the most proven approach being the supercluster model, or innovation hub, through which multiple stakeholders from across government, industry, mining equipment and technology providers, and academia can connect and collaborate to find solutions to specific industry challenges. Globally, there are a number of mining innovation hubs in operation including the following (these are described in detail in the body of this report):

- Sustainable Intelligent Mining Systems (European Union)
- Kalgoorlie-Boulder Innovation Hub (Australia)
- International Center of Excellence in Mining (Chile)
- Quebec Exploration and Processing Hubs

The recently proposed pan-Canadian supercluster initiative, CLEER, (Clean, Low-energy, Effective, Engaged and Remediated) also provides a good model for the province to consider. The overarching objective of the supercluster was promote industry responsible, sustainable growth through mining innovation with a focus on water use, energy intensity and environmental footprint, key challenge areas facing BC's mining industry.

Conclusion and next steps

The province's goal to become the most attractive jurisdiction for investment in Canada is ambitious. Bold action is required to achieve this objective; incremental tactics will only have a marginal impact. A BC Mining Innovation Strategy and mining innovation hub represents an opportunity to change the future of BC's mining industry and not only make the industry more attractive to investors, but to all British Columbians.

Although preparation of a business case for a BC Mining Innovation Strategy and mining innovation hub is outside the scope of this report, we have put forward a suggested approach to conduct a cost-benefit analysis for the concept in the final section of this report.

[1] CMIC is a national non-profit organization that coordinate and focuses research, development, and innovation programs to address industry challenges. CMIC has 75 plus members from mining and minerals and other industries such as high tech, clean tech and aerospace and defence. Project participants include academia, start-ups, SMEs, engineering and consulting firms, technology companies and mining companies

1. THE CONTRIBUTION OF MINING AND EXPLORATION TO THE BC ECONOMY

The mining and exploration industry is a foundational industry to the Province of British Columbia. For generations, mining has generated jobs and prosperity for BC families in every region of the province. In 2017, mining, exploration, and related sectors contributed approximately $6 billion to the province's GDP and provided jobs for nearly 40,000 British Columbians[2].

Industry	Jobs
Metal Mining	3,420
Coal Mining	4,745
Industrial minerals and construction aggregates	1,345
Exploration	4,125
Total Direct Exploration and Mining Employment	**13,635**
Mineral refining and smelting	4,990
Downstream mineral processing	19,815
Total Direct Minerals Economy Employment	**24,805**
Total Sector Employment	**38,440**

Table 1: 2017 B.C. Minerals Sector Employment (Stats Canada)

Mine sites directly provide thousands of full time jobs with salaries well above the provincial average. Indirectly, the mining services and supply sector of BC provides further high-paying full- and part-time employment in areas such as geological research, business administration, finance, management, engineering and environmental consulting, making mining an integral part of the BC labour economy.

	2010	2011	2012	2013	2014	2015	2016	2017
Earnings[3]	92,000	96,600	105,900	107,700	120,900	113,000	112,500	116,000

Table 2: Average earnings of mine-site full-time employees in BC (Stats Canada)

[2] Includes industrial minerals & construction aggregate industry. Refer to Appendix 1 and 2 for underlying analysis of Metal & Coal mining workforce and economic contribution respectively
[3] Average annual salary and benefits

2. THE COMPETITIVENESS OF BC'S MINING AND EXPLORATION INDUSTRY

The mandate of the Task Force is to provide recommendations to government make B.C. the most attractive jurisdiction for investment in Canada to grow the province's economy and create new jobs. For purposes of example, it is estimated that one new, fully-operational coal mine would have a total economic impact of almost $700 million, contribute $420 million in GDP to the BC economy, and create 1,700 direct and indirect jobs in the province (Table 3).

($ millions)	Direct	Indirect	Induced	Total
Output	493.6	118.6	78.5	690.7
GDP	306.0	64.3	52.0	422.3
Employment (No. of FTEs)	639	594	488	1,720

Table 3: Economic impact of an additional Coal mine in BC, 2017 (Nominal 2017 prices, source: EY Analysis)

The GDP impact range of 1 an additional metals mine is between $158.8 million (from a gold or silver mine) and $213 million (from a copper mine) (Table 4).

($ millions)	Min	Max	Direct	Indirect	Induced
GDP	158.8	213.5	47%	29%	24%

Table 4: Economic impact of an additional metals mine in BC, 2017 (Nominal 2017 prices, source: EY Analysis)

2.1 ATTRACTIVENESS DEFINED

The attractiveness of a jurisdiction is determined from the perspective of the investor. Investors compare the expected risk-adjusted returns of investment opportunities across the globe, and will invest in projects that offer the greatest risk-adjusted ROI (a measure of the expected return on an investment relative to the risk of that investment, over a specific period). All things being equal, jurisdictions that offer the greatest returns are the most attractive.

In the mining industry, jurisdictional attractiveness is synonymous with competitiveness and can be measured. The most common metric used to evaluate the competitiveness of a jurisdiction is its share of exploration investment (for exploration competitiveness) and its share of mineral production (for operational competitiveness) with competitiveness typically measured at a national or global level.

Although BC is highly competitive at a national level in the production of metallurgical coal and copper, the province is a relatively small player globally (Figure 1)[4].

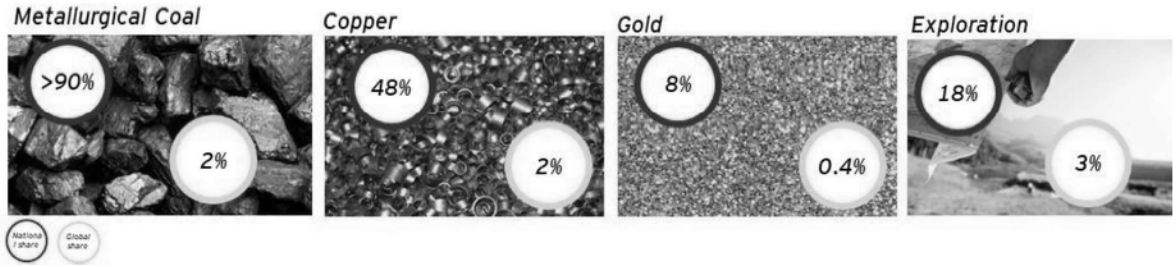


Figure 1: BC's national and global share of production and exploration investment (2017)

2.2 DRIVERS OF ROI

In the following sections of this report, we use a driver-based approach to identify what policy government can make or actions it can take to improve investment conditions that in turn will increase BC's attractiveness to investors.

2.2.1 ROI explained

ROI is a function of the expected cash flows, investment horizon, and risk of an investment. Each of these factors are dependent on a number of underlying 'drivers'. Example drivers include market conditions, cost of capital, operator performance, and access to labour and infrastructure.

[4] BC's most important metals and minerals in terms of production value are metallurgical coal, copper, and gold. Together, these three commodities represent 98% of value of major commodities mined in the province

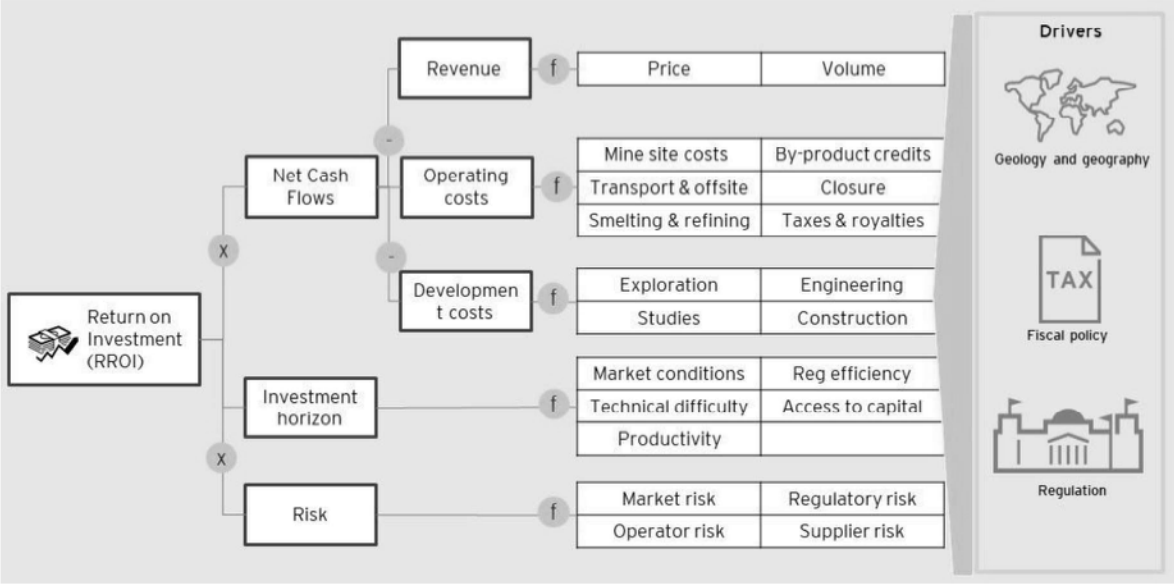
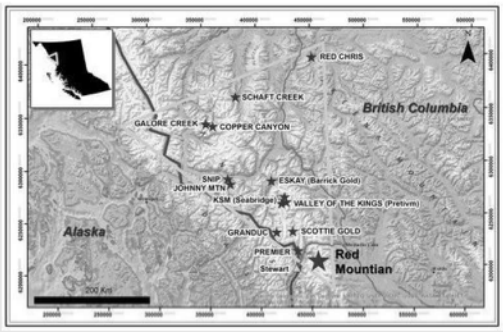


Figure 2: Drivers of ROI

A practical example of how underlying drivers influence ROI, using infrastructure as an example, is described in Figure 3

Infrastructure and ROI: BC's Golden Triangle



For more than 150 years, the area of northwestern BC known as the *Golden Triangle* has been a hub for prospectors. The area is known for its geological quality and has had a number of high-grade gold mines operate in the region over the past century, including the Eskay Creek mine which was Canada's highest grade gold mine when in operation.

The area was highly prospected up until the late 1990's when the economics of mining and exploration in the region was not feasible given low gold prices and the high costs of operating in the remote region due to its remote location and lack of infrastructure.

In recent years, however, the region has been opened up as a result of a significant investment in infrastructure made by the BC government including:

- Completion of a $700 million high-voltage transmission line to the Golden Triangle. The Northwest Transmission Line goes 335km from Terrace to Bob Quinn Lake, and north to the Red Chris mine

- Paving of the Stewart-Cassiar highway north from Smithers (Hwy 37)
- Opening of ocean port facilities for export of concentrate in Stewart
- Completion of a three dam, 277 MW hydroelectric facility located 70km northwest of Stewart

These investments have greatly improved the economics – and ROI – of mining and exploration in the region through lower energy, fuel, transport and electricity costs among others. This has triggered a resurgence of interest from investors in the Golden Triangle, with two new gold mines opening and juniors positioning themselves for the next discovery.

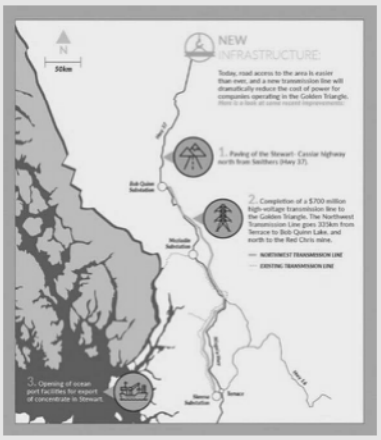


Figure 3: Infrastructure and ROI

2.2.2 Drivers analyzed

Our evaluation has focused on the following three major drivers of ROI:

- Geology and geography: geology refers to the grade, depth, width, and size of deposits. Geography refers to proximity to infrastructure and end-markets. Together, geology and geography are significant drivers of ROI
- Taxes and incentives: income taxes, mining specific taxes, royalties, incentives, and allowances
- Regulatory framework: mining and exploration projects are governed by many layers of legislation and regulation. Regulatory permitting and approvals can be lengthy, unpredictable, and opaque causing uncertainty and increasing investment risk

2.3 GEOLOGY AND GEOGRAPHY

The geology and geography of a mineral deposit drive a significant proportion of mining and exploration investment requirements, operating costs, and ROI. The unalterable nature of these two major drivers limits the degree to which government can take action to improve investment returns.

In this section we first describe the relationship between geology, geography, and ROI and then compare BC's mineral geology and geography with other jurisdictions from the perspective of an investor.

2.3.1 The influence of geology and geography on ROI in mining and exploration

The geology and geography of a deposit dictate the investment required to explore for new deposits and develop and operate new mines. The attributes of a deposit, including depth, grade, size, and width determine the type of new mine to be built (i.e.: underground or open pit) and processing requirements. In turn, the type of mine and plant operations will drive labour requirements, energy intensity, fuel consumption, consumable usage and other major drivers of cost.

The geography of a deposit considers its proximity to infrastructure and end-markets. A significant cost premium is incurred the more remote a mine is, with mines located further away from infrastructure requiring greater investment in the development of power plants, winter roads, permanent roads, housing, and the transport of workers to and from the mine camp. Although not directly related to BC, a recent study has found that the cost of building new mines is up to 2.5 times higher in northern Canada than in the rest of the country[5].

The location of a mine relative to infrastructure and end-customers also has a significant bearing on the costs of outbound logistics (the processes involved in the movement of product from the mine to the customer). These include overland transport costs, port costs, and shipping costs.

The relationship between deposit geology and geography with mining and exploration investment requirements and cost is presented in Figure 4.

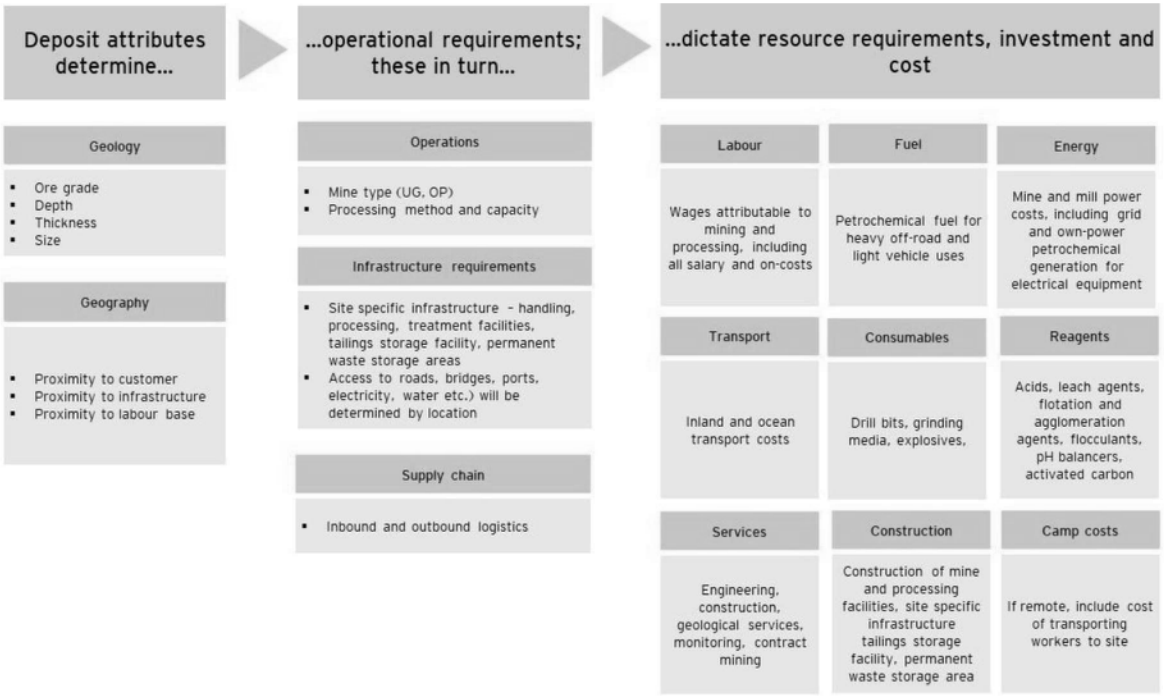


Figure 4: Relationship between deposit characteristics and investment requirements

[5] 2017 report, the Mining Association of Canada and the Prospectors and Developers Association of Canada.

2.3.2 Metallurgical coal

Metallurgical coal is a significant contributor to BC's economy, providing billions of dollars in annual revenue, and thousands of jobs. Coal currently represents over half of the total mineral production revenues in the province and is B.C.'s largest single export commodity. The majority of metallurgical coal produced in B.C. is exported to Asia for steel making (Table 5).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Japan	1,955	1,504	1,625	1,927	1,552	1,281	907	833	968	1,648
South Korea	1,174	859	1,008	1,707	989	984	743	622	880	1,337
China	121	586	833	721	1,385	1,270	845	561	720	921
EU	1,043	551	790	1,113	656	470	422	339	405	841
India	0	0	0	72	161	183	190	172	448	652
USA	27	37	109	225	146	52	20	82	19	144
ASEAN[6]	0	6	0	0	0	0	0	10	21	140
Total	5,395	4,261	5,255	7,131	5,679	4,823	3,660	3,163	4,212	6,617

Table 5: Value of BC coal exports by destination, $m (2008 – 2017)

2.3.3 BC's competitive performance

BC and Queensland, Australia compete directly in the seaborne coking coal export market and the supply of metallurgical coal to Asian steelmakers. In this section we look at how the geology and geography of the metallurgical coal mines in BC and Queensland compare and how this impacts the relative competitiveness of the two jurisdictions.

Overall, Queensland's metallurgical coal mining industry is considerably larger than BC in terms of production (Table 6) with the Australian state producing approximately ten times the metallurgical coal of BC annually.

Jurisdiction	Unit	2012	2013	2014	2015	2016
Queensland	(Mt)	263.2	269.2	251.4	243.6	240.7
BC	(Mt)	31.1	30.5	27.4	25.7	24.2
BC share of Canada	(%)	97.9%	89.7%	84.4%	97.0%	93.2%
BC share of global	(%)	3.0%	2.8%	2.5%	2.4%	2.2%
Global	(Mt)	1,026	1,085	1,116	1,088	1,083

Table 6: Coking coal production by jurisdiction, 2012 – 2016

However, on a by-mine basis, BC and Queensland operate a number of larger scale mines (Queensland has five of the world's nine largest coking coal mines, BC two of the top eleven (Table 7)).

[6] Brunei Darussalam, Cambodia, East Timor, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam.

Rank	Project	Location	Current Controlling Company(s)	Production (Mt)
1	Blackwater	Queensland	Mitsubishi Corp., BHP Billiton	15.5
2	Goonyella Riverside	Queensland	Mitsubishi Corp., BHP Billiton	12.1
3	Raspadskaya	Russia	PJSC Raspadskaya	11.4
4	Yuzhkuzbassugol	Russia	Evraz Plc	11.0
5	Peak Downs	Queensland	Mitsubishi Corp., BHP Billiton	10.9
6	JSW SA Mines	Poland	Jastrzębska Spółka Węglowa SA	10.7
7	Bachatsky	Russia	Ural Mining &amp	10.0
8	Saraji	Queensland	Mitsubishi Corp., BHP Billiton	9.6
9	Curragh	Queensland	Coronado Coal Group	9.0
10	Fording River	BC	Teck Resources Ltd.	8.3
11	Elkview	BC	Teck Resources Ltd.	6.2

Table 7: World's largest coking coal projects

2.3.3.1 Competitiveness analysis

In a 2018 study of the competitiveness of the Australian metallurgical coal industry[7], the performance of ten major metallurgical coal producing countries was evaluated overall and at each stage of the metallurgical coal value chain (Figure 5).

Figure 5: Metallurgical coal value chain

Overall, Canada (a proxy for BC, producer of more than 90% of Canada's metallurgical coal) ranked eighth overall and Australia (Queensland) ranked third (Figure 6).

Country	Competitiveness Rank
China	1
South Africa	2
Australia	3
United States	4
Russia	5
Indonesia	6
Colombia	7
Canada	8
Vietnam	9
Mozambique	10

Figure 6: Metallurgical coal competitiveness leaderboard

[7] National Energy Resources Australia (NERA), in association with Accenture

With respect to the first two stages of the value chain (extraction and preparation), the study found the two jurisdictions have similarly high cost structures. In fact, BC and Queensland have the highest extraction and preparation costs of the surveyed jurisdictions. This is primarily due to high labour costs (Queensland had the highest labour costs, followed by BC) - a result of structural factors such as high education and training levels. High labour costs in BC and Queensland are somewhat offset by higher productivity levels than the other jurisdictions (Figure 7).

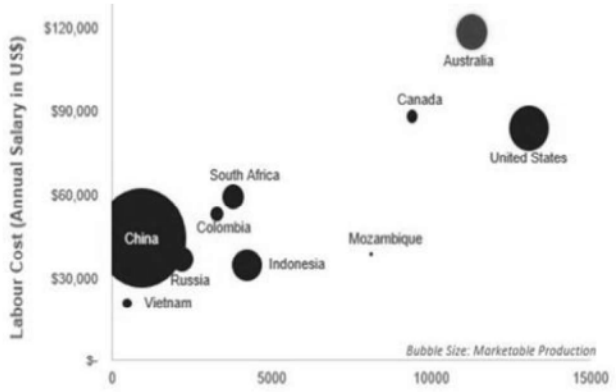


Figure 7: Labour productivity (marketable tonne per employee), Wood Mackenzie, Hays Research, Accenture Research

An important insight from the study is the cost advantage in the third and fourth stages of the value chain that Queensland has over BC due to the proximity of its coal mines to shipping ports and end-markets. Transport costs across these two stages is a significant cost factor in the industry, accounting for between 25% - 40% of the cost for seaborne coal. Transport costs include both inland transport (primarily rail) and shipping costs (including port and seaborne shpping costs)

2.3.3.2 Rail costs

Rail transport costs are largely influenced by distance (geography), rate, and service levels. In terms of distance. Queensland has a geographical advantage over BC in this aspect with most of its mines operating within close proximity to port and rail infrastructure. The average distance from mine to port in Queensland of 206 km is among the lowest in the world, whereas the distance of BC's coal fields to export ports is ~1,000km.

In both jurisdictions, rates and service levels are negotiated directly by coal producers in with monopoly (Queensland) and duopoly (Canada) rail service providers. It is industry's perspective that the uncompetitive structure of the rail service market has contributed to excess rates and/or inadequate service levels in both jurisdictions; however, data is not publically available to evaluate the relative competiveness between BC and Queensland across rates and service levels.

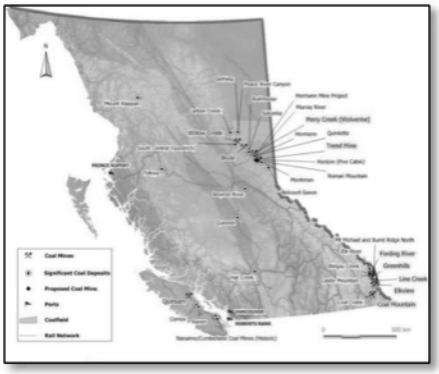


Figure 8: BC coal fields

Figure 9: Queensland coal fields

2.3.3.3 Port costs

Australia also benefits from port costs that are among the lowest in the world, adding on average, US$3.6 per tonne shipped[8]. The combination of quality port and rail infrastructure, along with short distances mean Australia's cost per tonne for land based transportation of US$7.1/t ranks third of the ten largest metallurgical coal producers (BC ranks ninth).

2.3.3.4 Shipping costs

Shipping costs are primarily driven by distance, with Queensland's benefitting from its closer proximity to each of the world's four largest coal importers: China, Japan, India and Korea (Table 8), leading to lower shipping costs (Figure 10).

	China	Japan	Korea	India
Vancouver	10,200	8,038	8,100	11,900
Prince Rupert	9,500	7,300	7,400	11,200
Gladstone	6,600	6,700	7,300	9,200
Mackay	6,300	6,400	6,900	8,900

Table 8: Distance from BC and Queensland ports to major coal importers (km)

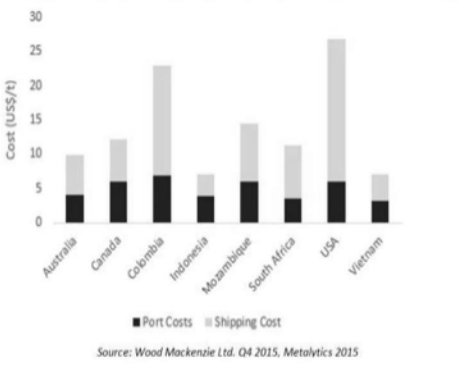


Figure 10: Port and shipping costs, US$/tonne, Wood Mackenzie, Metalytics

Overall, when costs across the value chain are totaled, Queensland has a cost advantage over BC (Figure 11), with the variance primarily explained by the impact of geography.

[8] The study does not provide port cost data for BC coal ports. Discussions with BC industry participants suggest coal port costs are significantly hgher in BC compared to Queensland.

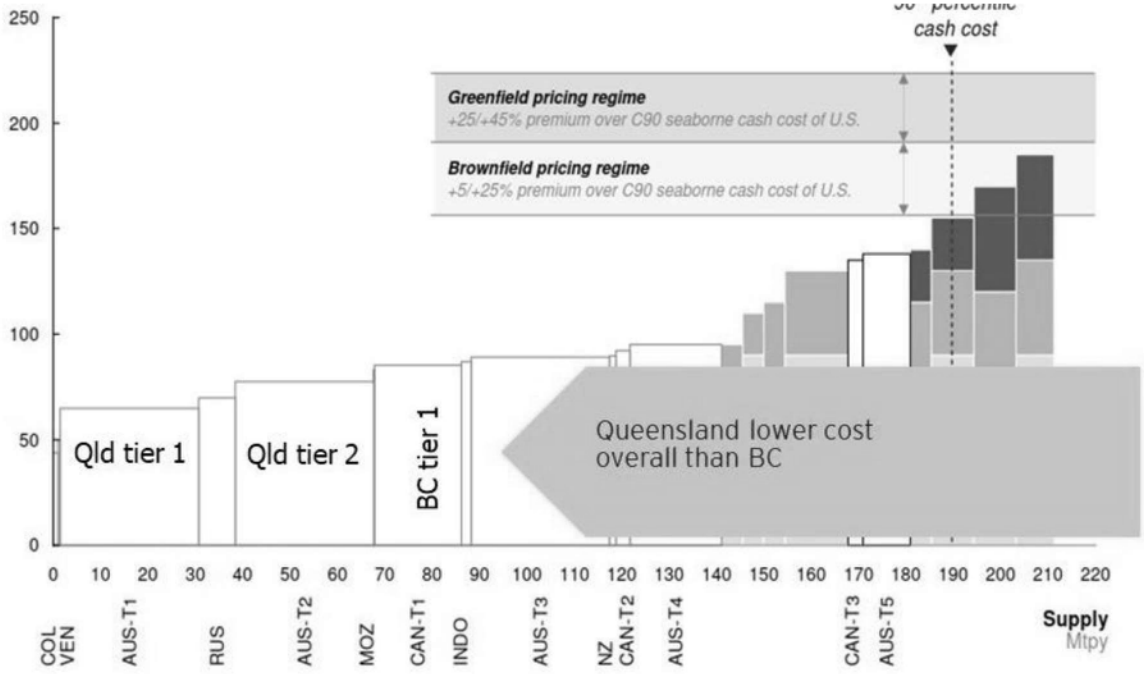


Figure 11: Washed seaborne coking coal cost curve, US$/FOB t, Wood Mackenzie

2.3.4 Copper

British Columbia is the leading producer of copper in Canada, accounting for approximately 48% of the metal produced in Canada. Globally, BC is a much smaller player, accounting for 2% of global production. Chile, on the other hand, is the heavyweight of global copper production, representing almost 30% of 2016 production.

	Unit	2012	2013	2014	2015	2016
Chile	(t)	5,433,900	5,776,000	5,761,100	5,772,100	5,552,600
BC	(t)	230,686	275,098	316,590	372,385	342,147
BC % of Canada	(%)	39.7%	42.2%	47.1%	52.1%	48.4%
BC % of global	(%)	1.4%	1.5%	1.7%	1.9%	1.7%

Table 9: Copper production in BC and Chile, 2012-2016 (t), World Mining Database

2.3.4.1 Supply chain

Copper is BC's fifth largest export. The majority of copper ores and concentrates produced in BC are transported by truck and/or rail to port and shipped to Asia for smelting and refining (Table 4). Chile exports approximately US$40 billion of copper each year, with approximately half of the copper it exports shipped as concentrate and the other half as refined copper cathodes. Most of Chile's copper is exported to Asia (~62%) with the rest to Europe (17%) or the Americas (Brazil and USA).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Japan	738	430	699	950	952	925	1,003	1,118	986	858
China	155	298	410	426	487	822	842	718	796	712
South Korea	143	192	145	251	202	183	634	642	492	675
India	46	21	51	49	83	176	275	351	258	245
Asean	96	126	185	84	90	74	112	50	90	0
Philippines	96	126	185	84	90	74	112	50	90	0
EU	0	0	0	0	0	0	0	0	40	49
USA	1	6	0	0	0	0	0	0	0	0
Total	1,179	1,073	1,490	1,783	1,912	2,249	2,916	2,988	2,729	2,639

Table 10: Value of BC copper exports by destination, $m (2008 – 2017)

2.3.4.2 Mining and processing

There are currently five primary-copper mines operating in BC. A sixth copper-primary mine, Huckleberry mine closed in 2017 but is expected to re-open in 2019. Annual copper production of BC's copper mines is presented in Table 11. These values include copper by-product produced at BC's gold mines (copper is produced in conjunction with another metal when mined in BC, most often mined as a co-product with gold).

Mine	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Au (koz)	Ag (koz)	Mo (t)
Highland Valley	119.3	118.2	98.5	97.3	116.3	113.2	121.5	151.4	119.3	92.8	0.0	0.0	4,218
Gibraltar	34.9	31.9	41.9	37.6	40.7	55.1	61.9	64.0	60.4	64.0	0.0	0.0	1,196
Copper Mountain	--	--	--	10.0	25.7	30.0	36.7	35.2	37.6	34.4	23.6	277.0	0.0
Red Chris	--	--	--	--	--	--	--	26.5	37.9	33.9	33.4	133.2	0.0
Mount Polley	27.4	15.4	15.8	12.0	15.3	17.5	11.1	3.6	11.5	8.7	48.0	36.6	0.0
Huckleberry	16.9	20.8	20.6	19.4	15.9	18.7	15.4	19.6	9.3	--	0.8	0.0	30
Total Cu-primary	198.4	186.3	176.8	176.4	214.0	234.5	246.7	300.4	276.0	233.7			
Cu by-product	28.6	27.2	26.4	7.1	16.7	40.6	69.9	72.0	66.1	65.4			
Total Cu	227.0	213.4	203.2	183.5	230.7	275.1	316.6	372.4	342.1	299.1			

Table 11: Copper production (kt), 2008 – 2017 and by-product production (2017) by mine

The average copper mine in BC produced approximately 50,000 tonnes in 2017. In contrast, Chile has seven of the world's ten largest copper mines with each of these mines producing more copper each year than the total amount of copper produced in BC. Being the world's top copper mining location, the world's largest miners are present in the country. These include Anglo American, BHP Billiton, Freeport McMoRan, Glencore, Rio Tinto, and Teck Resources. The Chilean miners are led by state-owned Codelco; a major operator being the world's largest copper producer.

The economics of Chilean copper mines benefit from grades that are superior to those grades found in BC. Copper mines and deposits are often categorized by the average proportion of copper contained in the ore at the site; this is also known as the ore grade. Higher-quality mines have higher ore grades, and lower-quality mines have lower grades. Chile, the world's largest producer of copper, benefits from significant scale and higher grades relative to BC (Figure 12).

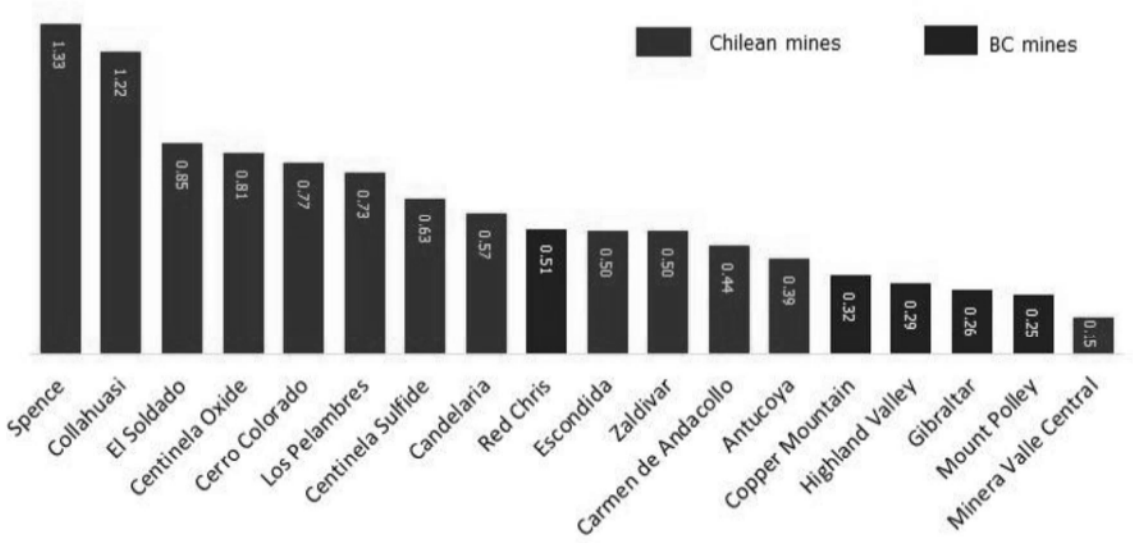


Figure 12: Millhead grades of select copper mines in Chile and BC (g/t)

When copper has a high grade, it takes relatively less effort to extract a pound of copper from the ground; less ore has to be dug out, which reduces input costs for the mining company. This is evident in a comparison of the costs of energy and reagents needed produce a pound of copper between Chile and BC (Figure 13).

2.3.4.3 Treatment charges (TC), refining charges (RC), and shipping costs

In BC, ore is processed on site and the resulting copper concentrate is hauled by truck from the mine to a load out facility, where it is loaded on to rail cars and transported to port. At port, the concentrate is loaded onto bulk carriers and shipped overseas (primarily Asia) for smelting and refining.

In Chile, after extraction, copper is processed at the mine site (and sometimes due to the relative density of sites in some places, the ore is processed at another nearby site) then transported by pipeline or rail to a refinery or directly to port.

On average, total TCRC charges and shipping costs are lower in Chile compared to BC, although there is considerable variation across the mining operations in both jurisdictions (Figure 13).

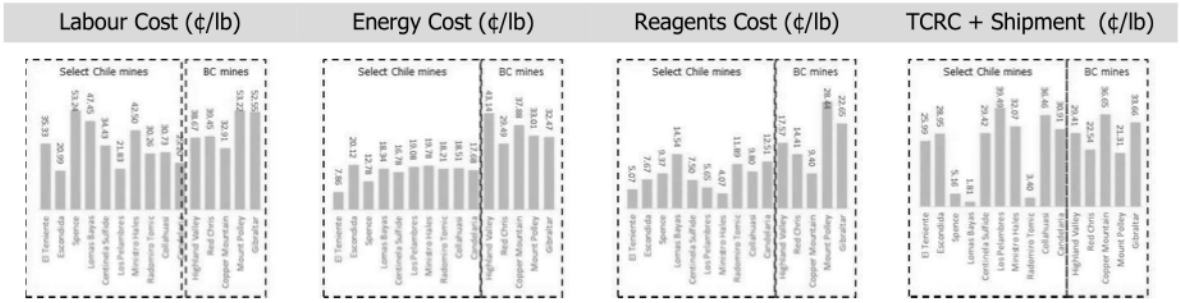


Figure 13: Cost composition comparison, Chile and BC (S&P Market Intelligence)

2.3.4.4 Cash cost of production

When the component costs of production are summed, Chilean mines generally have an overall cost advantage over BC (Figure 14) with much of this variance attributable to the geology of Chilean copper. Overall, Chile's average cost production is US$1.35/lb with the top performers (Escondida, CODELCO Radomiro Tomic, Collahuasi) closer to US$1.15/lb.

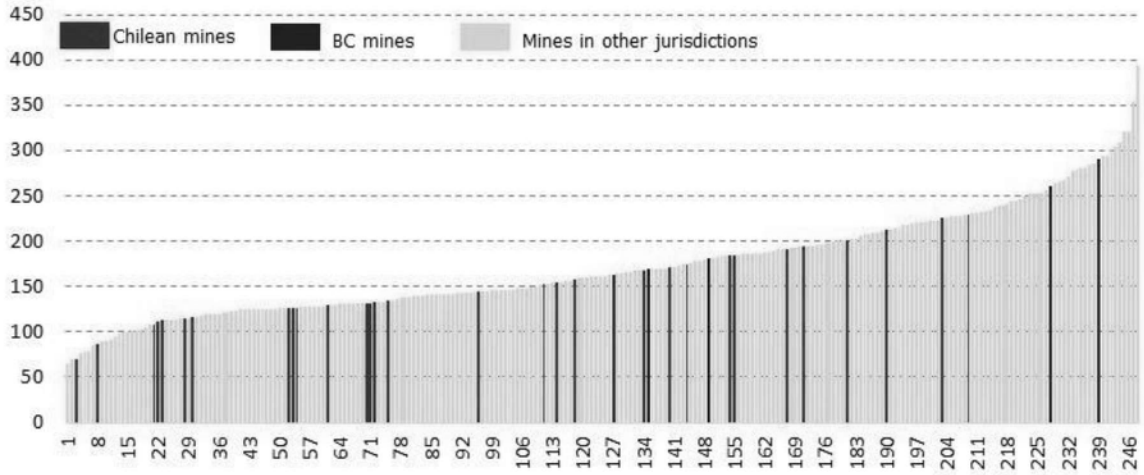


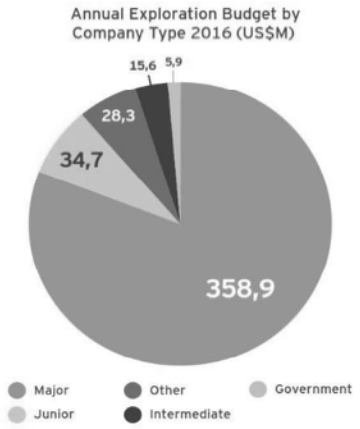
Figure 14: Global Copper Production Cost Curve (Ranked on Total Cash Cost, ¢/lb)

2.3.4.5 Exploration

Whereas Chile's copper industry is dominated by mining majors, three of BC's four copper producing companies are mid-tier producers. A comparison of the average market value of copper miners in BC and Chile is presented in Table 12.

Companies with Copper operations in BC		Companies with Copper operations in Chile	
Company	**Market Cap (US$m)**	**Company**	**Market Cap (US$m)**
Teck Resources	$13,333	Rio Tinto	$84,392
Taseko Mines Limited	$176.1	BHP Billiton Group	$78,843
Copper Mountain Mining Corp	$161.2	Glencore plc	$59,135
Imperial Metals Corporation	$111.9	Anglo American plc	$26,003
		Freeport McMoRan	$20,500
		Teck Resources	$13,333
		Barrick Gold Corporation	$12,258

Table 12: Market capitalization of mining companies with operations in BC and Chile (US$m, August 2018)



The scale of Chile's copper resource base in of itself drives significant levels of investment. For example, investment in exploration in the country has increased from US$100m a year in 2004 to as high as US$1b in 2012 (but has fallen to approximately $400 million to $500 million annually). Chile is now home to the world's largest copper reserves with 210Mt or approximately 30% of the total global estimate of 720Mt (source USGS). Unlike in BC, the vast majority of exploration in Chile is done by the majors. This is in part due to their greater access to funding and also due to their commitment to mine-site exploration programs alongside existing operations. The need for the majors to explore and develop reserves places Chile at an advantage over BC in terms of investment levels. Looking forward, Chile's mining project portfolio up to 2025 is valued at more than US$49b and includes 37 projects.

2.3.4.6 Future trends in Chilean copper

Notwithstanding the success of Chile's copper industry, the industry is faced with a number of challenges, notably declining grades and water scarcity. Solutions to these challenges are expected to almost double the industry's energy requirements by 2025[9].

Declining grades

While Chile has the world's richest reserves of copper, grades are falling at its very large but aging copper mines, making it difficult to maintain production levels and putting pressure on costs. For example, from 2005 to 2015, copper production rose by an average of 0.6% per year, while labor productivity fell by 42%. Chile's decreasing productivity is mainly due to declining copper grades, which have forced companies to mine more tons and increase processing capacity to maintain production levels. Ore grades have been in a state of steady decline, falling from 1.13% in 2002 to 0.61% in 2015[10].

Water

A principal issue in continuing the efficient and responsible development of the mining sector is the use and management of water resources. Access to water is a major issue in Chile, with the bulk of copper production coming from the Atacama Desert. To resolve the issue of water scarcity, mining companies have been building desalination plants, but the high cost of energy required to transport water up to the mine sites increases the overall mining costs. At the same time, declining grades require more water to be used in processing, a trend that can be seen in Figure 15.

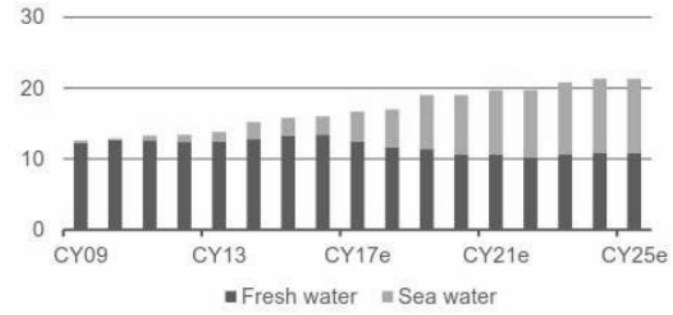


Figure 15: Water use in copper mining in Chile (m3/second), BHP Billiton

It is estimated that in 2027, seawater will provide 46% of the total water required for the copper mining industry[11]. As part of this trend, an increasing number of miners are building their own desalination plants (Figure 16).

Renewable energy

[9] The Chilean Copper Commission (Cochilco)
[10] Consejo Minero
[11] Cochilco

Year of initiation	Stage	Company	Name	Sector	Region	Desalinitation Plant Capacity (lts/sec)	Direct Sea Water Capacity (lts/sec)
-	Closed	Antofagasta Minerals	Michilla	Med Min Cu	Antofagasta	75	25
-	Operating	Enami	Planta J.a. Moreno (Taltal)	Med Min Est Cu	Antofagasta	-	15
-	Operating	Las Cenizas	Las Cenizas Taltal	Med Min Cu	Antofagasta	9	12
-	Operating	Mantos De La Luna	Mantos De Luna	Med Min Cu	Antofagasta	-	78
-	Operating	Pampa Camarones	Pampa Camarones	Med Min Cu	Arica Y Parinacota	12.5	-
-	Operating	Antofagasta Minerals	Centinela (Esperanza + El Tesoro)	Gran Min Cu	Antofagasta	50	780
-	Operating	Bhp Billiton	Escondida - Planta Coloso	Gran Min Cu	Antofagasta	525	-
-	Operating	Antofagasta Minerals	Antucoya	Gran Min Cu	Antofagasta	20	280
-	Operating	Lunding Mining	Candelaria	Gran Min Cu	Atacama	300-500	-
-	Operating	Mantos Copper	Mantoverde	Gran Min Cu	Atacama	120	-
-	Operating	KGHM INT.	Sierra Gorda	Gran Min Cu	Antofagasta	63	1,315
2017	Operating	Bhp Billiton	Escondida EWS	Gran Min Cu	Antofagasta	2,500	-
2018	In execution	Antofagasta Minerals	Encuentro	Gran Min Cu	Antofagasta	20	-
2020	In execution	Codelco-Chile	Planta Desaladora Distrito Norte	Estatal	Antofagasta	1,630	-
2018	Feasibility	Antofagasta Minerals	Los Pelambres Ampliación Marginal I y Ii	Gran Min Cu	Coquimbo	400	-
2018	Feasibility	Lunding Mining	Candelaria 2030	Gran Min Cu	Atacama	500	-
2019	Feasibility	Capstone	Mining Santo Domingo	Gran Min Cu	Atacama	2.5-290	389
2019	Feasibility	Copec	Diego De Almagro	Med Min Cu	Atacama	-	315
2019	Feasibility	Bhp Billiton	Spence Growth Option	Gran Min Cu	Antofagasta	800-1,600	-
2019	Feasibility	Andes Iron Spa	Dominga	Iron ore	Coquimbo	450	-
2021	Feasibility	Mantos Copper	Desarrollo Mantoverde	Gran Min Cu	Atacama	350	-
2021	Feasibility	Teck	Quebrada Blanca Hipógeno	Gran Min Cu	Tarapacá	1,300	-
2024	Feasibility	Antofagasta Minerals	Encuentro Sulfuros	Gran Min Cu	Antofagasta	-	*

Figure 16: Desalination plants in Chile (EY research)

The lack of freshwater sources in northern Chile is not the only water issue for companies. The local community's concern over the declining supply of water for human consumption has created hostility toward mining operations, despite the fact that mining only accounts for about 5% of water use in the country.

Energy consumption and cost

The impact of declining grades and water scarcity will drive up energy consumption. While it is difficult to project the energy demands of the mining industry in Chile as many of the projects and desalination plants that will be built in the future are currently in the prefeasibility stage. The main consumer of electricity at a mining operation is the concentrator plant; however, looking to 2027, desalination plants will use up to 14% of the total energy required for the mining industry[12].

Despite the expected growth in consumption, Chile's mining companies are beginning to benefit from now-cheaper renewable power. Up until 2014, nearly all of Chile's national public and private energy contracts went to gas, diesel, hydroelectric, and coal generators.

Wind and solar firms slowly began submitting competitive bids for power contracts. By August of 2016 these providers accounted for almost half of tendered energy in a government auction to

[12] The Chilean Copper Commission (Cochilco)

supply Chile's public grid from the 2020. The renewables firms undercut bids by traditional producers by more than 70 percent in some cases. Mining customers are reviewing their contracts and looking to seize the moment and take advantage of a buyer's market. For example, some mines have been paying in excess of $100 per megawatt-hour on their most expensive contracts, while wind producers have offered 24-hour power for prices as low as $38 on Chile's public grid[13].

Lower-cost renewable energy will also benefit many of the large mining companies in the north of Chile not connected to the grid who have decided to build and operate their own power stations. Many of these firms have turned to renewable energy to provide their power needs. Figure 17 details some of the current renewable energy projects by Chilean mining companies.

Company	Project	Energy	Power (MW)
Barrick	Punta Colorada	Wind	20
Codelco-Chuquicamata	Photovoltaic solar plant	Solar	1
Codelco-Gabriela Mistral	Pampa Elvira Solar	Solar-thermal	32
Los Pelambres	El Arrayán	Wind	150
Collahuasi	Pozo Almonte Solar	Solar	25
CAP	Amanecer	Solar	100
Antofagasta Minerals	Cerro Dominador	Solar CSP	110

Figure 17: Renewable energy projecs by Chilean mining companies (EY research)

2.3.5 Gold

Gold is Canada's most valuable mined mineral, with a production value of $8.4 billion in 2016. In that year, Ontario and Quebec combined for 80% of the country's mined gold production. BC is the third largest gold producing province in Canada, accounting for 8% of country's 2016 gold production.

	Unit	2012	2013	2014	2015	2016
W. Australia	(kg)	181,290	187,450	194,740	194,620	197,260
Ontario	(kg)	48,013	59,217	75,447	70,394	73,262
Quebec	(kg)	28,619	35,046	41,131	49,717	50,636
BC	(kg)	4,529	6,016	10,838	12,364	13,175
% of Canada	%	4.2%	4.5%	7.1%	7.6%	8.0%
% of global	%	0.2%	0.2%	0.4%	0.4%	0.4%

Table 13: Gold production in BC, Ontario, Quebec, and Western Australia, 2012-2016 (t), World Mining Database

[13] https://www.reuters.com/article/us-chile-energy-renewables-idUSKBN13W2L9

2.3.5.1 Mining and processing

There are currently three primary-gold mines operating in BC, including the recently opened Brucejack mine in the province's north (Table 14).

Mine	2011	2012	2013	2014	2015	2016	2017	Ag (koz)	Cu (kt)
Mt. Milligan	0.0	0.0	19.9	177.6	218.1	204.5	222.6	0.0	24.3
Brucejack	0.0	0.0	0.0	0.0	0.0	0.0	152.5	179.2	0.0
New Afton	0.0	36.8	87.2	104.6	105.5	98.1	86.2	300.0	41.1
Kemess South	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bonanza Ledge	0.0	0.0	0.0	23.7	0.0	0.0	0.0	0.0	0.0
Bralorne	0.0	4.0	6.2	3.5	0.0	0.0	0.0	0.0	0.0
QR	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Au-primary	19.6	40.8	113.3	309.4	323.6	302.6	461.2		
Au by-product	67.4	87.4	88.2	74.8	77.9	126.3	105.8		
Total Au	87.0	128.2	201.5	384.2	401.5	428.9	567.0		

Table 14: Gold production (koz), 2008 – 2017 and by-product production (2017) by mine

BC's gold mines are generally small in scale, with average production of 150,000 ounces in 2017. For comparison, there are eight gold mines in Ontario and Quebec that produce more than 230,000 ounces, and five gold mines in Western Australia that produce in excess of 360,000 ounces annually (Figure 18).

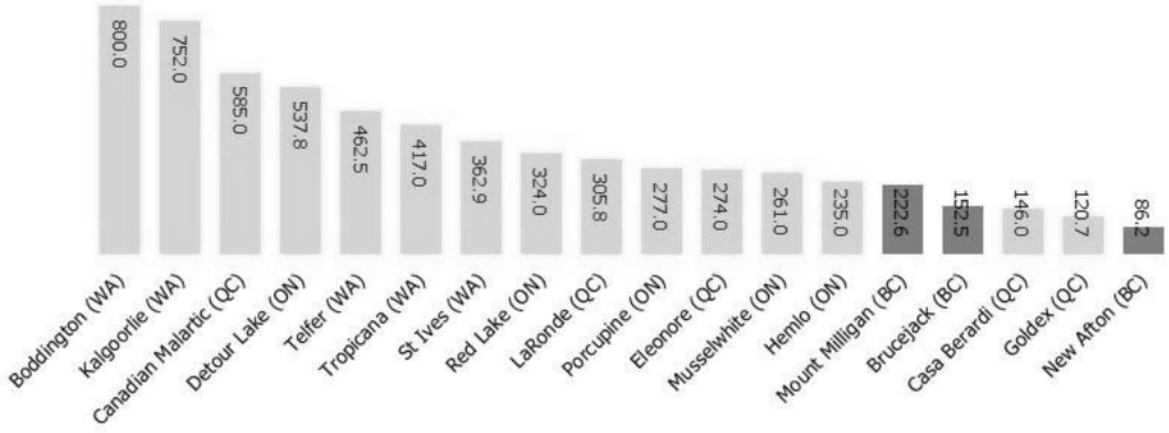


Figure 18: Gold production of select mines, koz (2017)

Being top gold mining jurisdictions, the world's largest gold miners are present in Eastern Canada (Quebec and Ontario) and Western Australia. These include Agnico Eagle Mines Ltd, AngloGold Ashanti Ltd, Barrick Gold Corp, Gold Fields Ltd, Goldcorp, Newcrest Mining Ltd, and Newmont Mining Corp (Table 15).

BC		Ontario		Quebec		Western Australia	
Company	**Market Cap (US$)**	**Company**	**Market Cap (US$)**	**Company**	**Market Cap (US$)**	**Company**	**Market Cap (US$)**
Pretium Resources Inc.	$1,500	Goldcorp Incorporated	9,370	Agnico Eagle Mines Ltd	$7,990	Newmont Mining Corp.	$16,500
Centerra Gold Incorporated	$1,200	Barrick Gold Corp.	$11,900	Goldcorp Incorporated	$9,370	Barrick Gold Corp.	$11,900
New Gold Inc.	$560	Detour Gold Corp.	$1,400	Hecla Mining Co.	$1,400	Newcrest Mining Ltd.	$10,700
Imperial Metals Corp	$111					AngloGold Ashanti Ltd	$3,300
						Gold Fields Ltd.	$2,000

Table 15: Market capitalization of mining companies with operations in BC, Ontario, Quebec, and Western Australia (US$m, August 2018)

The economics of gold mines are impacted by grade. With the exception of the Brucejack mine in BC's north, the gold mines of Eastern Canada and Western Australia benefit from superior grades than those found in BC (Table 16).

Project	Jurisdiction	Millhead grade
Red Lake	Ontario	16.180
Macassa	Ontario	14.100
Brucejack	British Columbia	9.400
Gwalia	Western Australia	9.100
Island	Ontario	9.020
Eagle River	Ontario	7.900
Halls Creek	Western Australia	7.890
Vivien	Western Australia	7.720
East Kundana	Western Australia	7.600
Paulsens	Western Australia	7.200
Musselwhite	Ontario	7.170
Taylor	Ontario	6.900
Elder-Tagami	Quebec	6.600
Agnew/Lawlers	Western Australia	6.500
Westwood	Quebec	6.140
Cracow	Queensland	5.920
Casa Berardi	Quebec	5.726
Mount Carlton	Queensland	5.710
Beaufor	Quebec	5.500
Jundee	Western Australia	5.500
Canadian Malartic	Quebec	1.038
Detour Lake	Ontario	0.900

Duketon Northern Operations	Western Australia	0.900
Mt Rawdon	Queensland	0.860
Edna May	Western Australia	0.820
Telfer	Western Australia	0.800
Boddington	Western Australia	0.789
New Afton	British Columbia	0.650
Mount Milligan	British Columbia	0.640

Table 16: Millhead grades of select gold mine in Ontario, Quebec, Western Australia, and BC (2016, g/t)

As with copper, when gold has a high grade, less resources are required to extract and produce the metal. This is evident in a comparison of the costs of energy and reagents needed to produce an ounce of gold in BC compared to Western Australia and Eastern Canada (Figure 19).

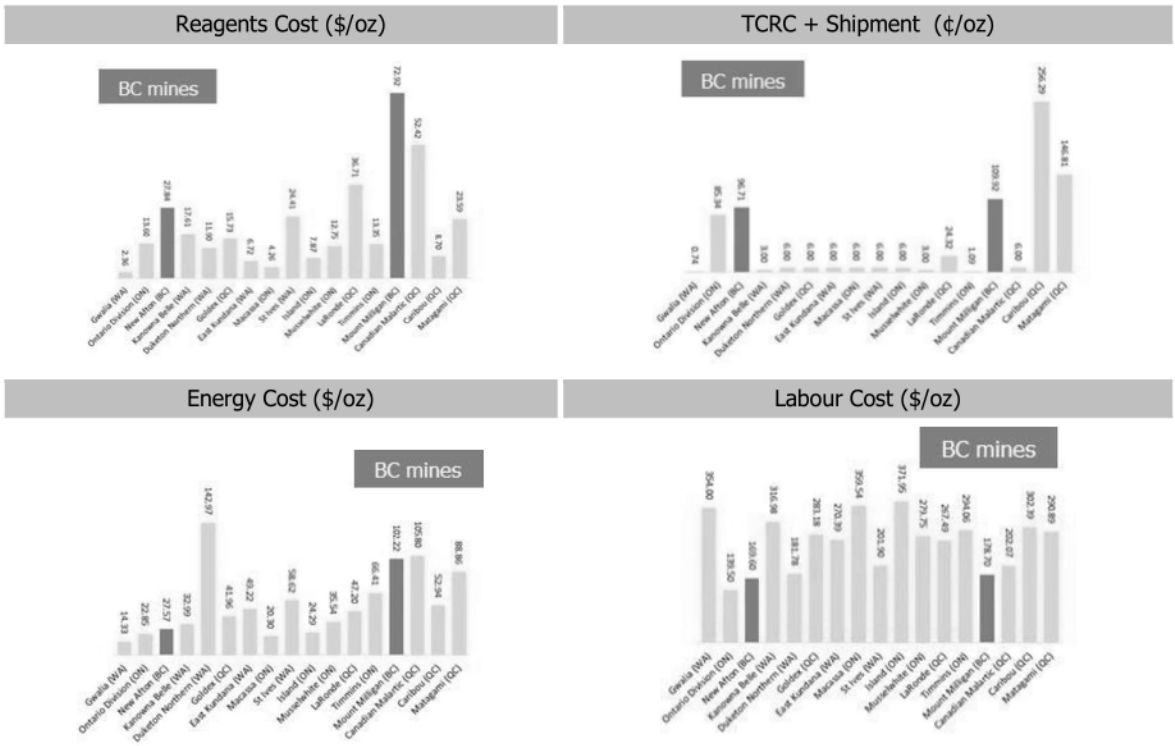


Figure 19: Cost composition comparison, Western Australia, Ontario, Quebec, & BC (S&P Market Intelligence)

2.3.5.2 Cash cost of production

As with copper, the geology of BC's gold mines put the province at a disadvantage relative to Eastern Canada and Western Australia. Overall, these other jurisdictions have a cost advantage over BC (Figure 20).

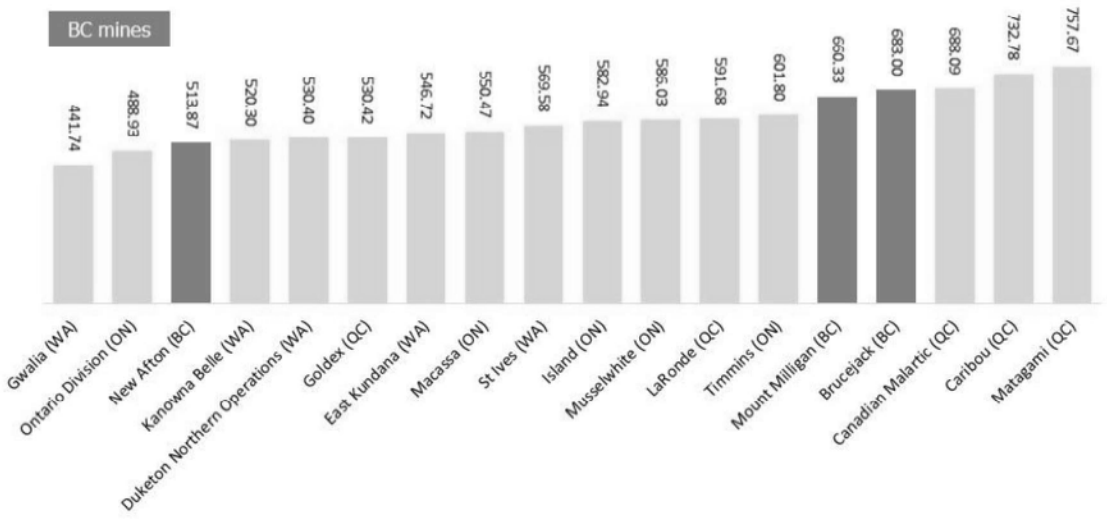


Figure 20: Gold cash cost of production, select mines ($/oz, 2016 (Brucejack 2017), (S&P Market Intelligence)

2.4 TAXES AND INCENTIVES

In the sections below we have compared the corporate income tax rates, mining rates and incentives aimed at investments in new mines and exploration offered by BC against the selected jurisdictions.

The fiscal policy of a jurisdiction influences mining and exploration investment levels. On one hand, taxes and royalties imposed by government decrease mining and exploration investment returns. Conversely, governments can use incentives to attract investment.

Taxes imposed by government decrease mining and exploration investment returns; if the tax burden is too high, a project can become uneconomic even though it may have excellent fundamentals

We have evaluated and contrasted taxes and incentives of a number of jurisdictions against BC to determine the competitiveness of BC's mining fiscal regime

In summary, the complexity of different tax regimes across each jurisdiction does not allow for a straight 'apples-to-apples comparison'. Applicable taxes, tax rates, royalties, and incentives vary by production levels, production value, revenue, income, commodity, and quality of commodity

With that being said, the following generalities apply:

- BC's fiscal regime as it applies to exploration and mine development is competitive.
- In terms of extraction, the taxes that apply to operating mines are in line with other jurisdictions.
- Where BC is not competitive; however, is the application of the carbon tax to the mining sector in BC. Note that currently, BC does not provide any support to emissions intensive industries in the province and carbon taxes collected in BC are not recycled back into the mining industry to help it transition to a lower-carbon future. While this is likely to change with the province's newly announced *Clean Growth Incentive Program,* BC mining companies will continue to pay substantially more in carbon taxes than its competitors.

2.4.1 BC's fiscal regime

The following is intended to provide a high level summary of BC's fiscal regime as it applies to mining and is not intended to be comprehensive but highlights key aspects of BC's regime.

The fiscal regime applicable to the mining industry in Canada consists of a combination of income taxation at the federal level, and income taxation and mining taxes, duties or royalties at the provincial/territorial level. Mining taxes, duties or royalties (hereinafter referred to as mining taxes for simplicity) represent a third level of taxation, separate and distinct from federal and provincial/territorial income taxes. These mining taxes are levied by the provinces/territories of Canada and are intended to compensate the province/territory for the extraction of non-renewable resources.

The federal tax rate applicable to a mining corporation operating in BC is 15% and the BC provincial income tax rate is 12%, resulting in a combined corporate income tax rate of 27%.

To encourage exploration in the province the BC provincial income tax provides for a refundable tax credit referred to as the BC mining exploration tax credit (BC METC) targeted at individuals

or corporations conducting exploration in the province. In addition, BC offers a tax credit to individuals who invest in flow-through shares of corporations conducting grass-roots exploration in BC, referred to as a the BC mining flow-through share (BC MFTS) tax credit.

The BC METC applies to certain qualifying exploration conducted in the province related to the exploration for base and precious metals, coal and some industrial minerals. The credit is calculated as 20% of qualified mining exploration expenses and can increase to 30% for qualified exploration undertaken in prescribed Mountain Pine Beetle affected areas. The BC METC is set to expire for any exploration expenditures incurred after December 31, 2019.

The BC MFTS tax credit is non-refundable and is calculated as 20% of eligible BC flow-through mining expenditures.

BC imposes its mining tax under the *Minerals Tax Act* and applies to income earned from mining operations in the province on a mine by mine basis. The tax is imposed in two stages as follows:

- 2% of net current proceeds derived from the operation of the mine (NCP Tax), and
- 13% of Net Revenue derived from the operation of the mine

The NCP Tax is a form of minimum tax and is creditable against the 13% Net Revenue tax. The 13% Net Revenue tax is the primary tax which is only collected when revenues exceed prescribed operating costs, qualifying capital costs and a normal return on investment over the life of the mine. To encourage new mine development there is a New Mine Allowance which provides for an additional allowance of one-third of certain of the capital costs of new mines and expansions that begin commercial production before January 1, 2020.

The BC METC and BC MFTS tax credit are the main fiscal instruments identified to encourage grass-roots exploration in the province. The New Mine Allowance is the primary incentive granted to encourage development of new mines in the province.

2.4.2 Corporate income tax rate comparison

From a corporate income tax perspective, the BC provincial income tax rate at 12% is slightly higher than Ontario (11.5%) and Quebec (11.7%), however, it is not significantly out of line and is generally at or below the rates applicable across the rest of Canada.

Furthermore, the combined Federal and BC Provincial tax rate is lower than the general income tax rate in Australia (30%) and equal in rate compared to the 27% corporate income tax rate in Chile which applies to most mining companies in Chile.

It is noted that in August 2018 Chile proposed a new regime that abolishes the two separate tax rates and the proposed tax rate will be 25%.

	Canada			Australia		Chile	USA	
	BC	**ON**	**QC**	**WA**	**QLD**		**AK**	**NV**
General corporate income tax rate (CIT)[14]	27.0%	26.5%	26.70%	Federal CIT only: 30%		Federal CIT only: ▪ 25% (fully integrated regime) ▪ 27% (partially integrated regime) New proposed regime introduced August 2018 with a single 25% CIT rate	21% to 30.4%	Federal CIT only: 21%
Federal CIT rate	15.0%						21%	
Provincial/ State CIT rate	12.0%	11.5%	11.7%				0% - 9.4%	

Table 17: Overview of the corporate income tax rates, as per September 1, 2018

BC's corporate income tax rate is comparable to most other jurisdictions in which mining activities take place:

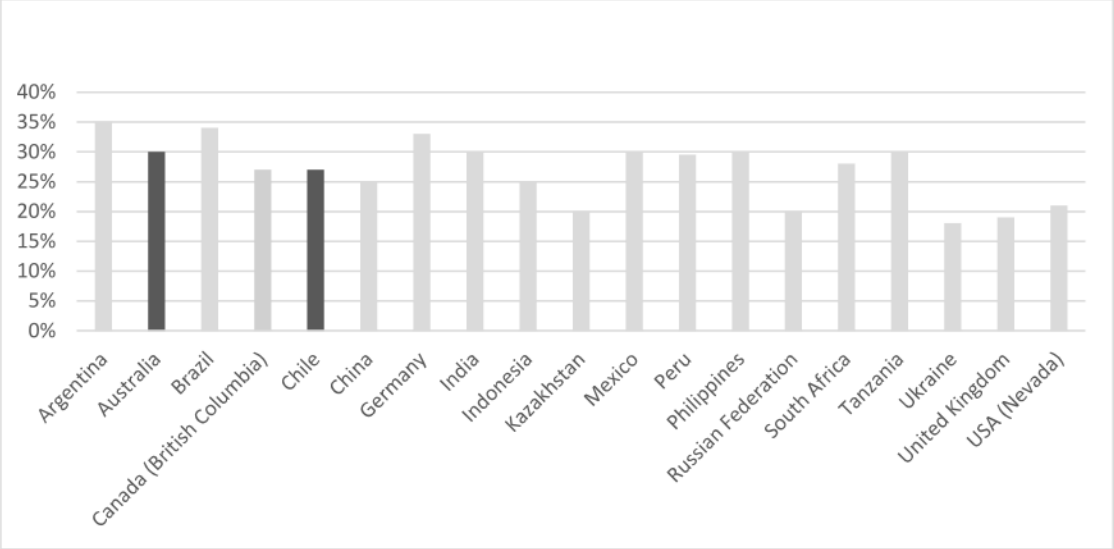


Figure 21: Overview of the corporate income tax rates, as at February 1, 2018

[14]2018 federal and state /provincial combined

2.4.3 Mining taxes

All provinces and territories in Canada levy a third tier of mining tax intended to compensate for the extraction of non-renewable resources. Similar regimes apply in most resource rich countries, including in Australia and Chile. There is a significant variation in regulations, both in specified statutory tax rates and in the base determination of income subject to the mining tax, which varies from the taxable income concept followed for income taxes.

Most of the Canadian provinces follow a basic net profits methodology valuing production effectively at the mine gate, but details of the methodologies used to determine net profits differ significantly. Some provinces also include a net revenue methodology within their respective mining tax system, usually as a combination revenue and profit based system. Chile's system follows a similar net profits methodology by starting with taxable income and making certain adjustments. The two Australian states in the study on the other hand follow a net revenue system rather than a net profits methodology.

As a result the calculation of mining taxes is difficult to compare tax rates or respective regimes given the broad spectrum of how these different jurisdictions choose to levy the mining tax, not just within Canada but across other mining jurisdictions. The table below presents some of the salient features of the respective regimes for comparison purposes. In the section that follows we have highlighted some of the incentives embedded within the respective regimes.

	Canada			Australia		Chile	USA	
	BC	**ON**	**QC**	**WA**	**QLD**		**AK**	**NV**
Base & precious metals	Two stage tax system. Minimum tax of 2% on "net current proceeds" Final 13% tax levied on "net revenue".	10% on taxable profit derived in Ontario in excess of $500,000 Rate reduced to 5%	Levied at progressive rates ranging from 16% to 28% depending on profit margin. Minimum tax ranging from 1% to 4% of Mine	2.5% of royalty value (The first 2,500 ounces of gold metal produced by each gold royalty project per annum are exempt)	Variable rate between 2.50% and 5.00% (varying in 0.02% increments) of value, depending on average metal prices	Rate varies between 0% - 14% depending on amount of annual sales If annual sales exceed equivalent	No tax if income is $40,000 or less, 3% over $40,000$ 1500 plus 5% over $50,000 and $4,000 plus 7% over $100,000	Sliding scale depending on profitability

Coal		for "remote" mines	Mouth Output Value	A royalty of A$1 per tonne (indexed annually) for domestic coal, and 7.5% of the value for export coal.	Average price per tonne for period: Up to and including $100 - 7% of value Over $100 and up to and including $150 First $100 - 7% of value, balance - 12.5% of value More than $150 First $100 - 7% of value Next $50 - 12.5% of value Balance - 15% of value. Rate to be calculated separately for domestic (within Queensland) and non-domestic sales	to 50,000 refined copper tons, rate varies from 5% to 14% depending on mining operation al margin.		

Table 18: Overview of the mining / minerals tax rates

2.4.4 Tax incentives

In the table below we have outlined the main tax incentives identified in BC and the jurisdictions selected. The focus has been on tax incentives aimed at exploration and development both at the provincial income tax and mining tax level. The incentives identified have focused on the provincial level of government as federal incentives would be the same across Canadian jurisdictions and are considered outside the scope of what can be influenced. The table below summarises the main incentives and allowances identified.

Jurisdiction	Exploration incentives (income tax)	Exploration incentives - shareholders (income tax)	New mine/ Expansion incentives	Capex depreciation rates (Mining taxes)	Processing Allowance (Mining taxes)
British Columbia	20% - 30% Refundable tax credit (BC METC) [1+4]	Tax credit of 20% for flow-through share investment	New Mine Allowance equal to 133% on Capex [4]	100% via single pool of costs	No
Ontario	-	Refundable tax credit of 5% for flow-through share investment	First $10M of profits exempt for 3/10 years [2]	30% (but can be up to 100% of income for a new mine)	Yes
Quebec	12% - 28% Refundable tax credit 18.75% - 38.75% for "Northern" projects	Additional deductions of up to 20% to investor in flow-through share	Incentive deduction for mines located in Near North $2M & Far North $5M [3]	30%	Yes
Queensland **W. Australia**	-	Refundable tax offset or additional franking credits for investments by Australian resident shareholders in junior exploration companies	Accelerated depreciation available for certain expenditures	Fully expensed	N/A
Chile	Expenses amortized over six years period	N/A	Accelerated depreciation available	Expensed	N/A

[1] Available on certain qualifying exploration expenses
[2] Extended to 10 years for remote mines
[3] Can be carried forward for 36 months
[4.] Expires on January 1 2020

Table 19: Tax incentives

BC's exploration incentives compare favourably against the selected jurisdictions with the BC MFTS tax credit being the highest flow-through tax credit when compared with Ontario and Quebec's incentives. In fact, only Manitoba's flow through tax credit at 30% exceeds BC's MFTS tax credit across Canada's provinces and territories. Australia has recently announced a federal incentive to encourage greenfields mineral exploration in Australia via the Junior Minerals Exploration Incentive ("JMEI"). Broadly, the JMEI allows junior resource corporations to transfer tax losses to exploration credits that may be passed on to Australian resident investors either as a franking credit or a refundable tax offset depending on the investor profile. The JMEI is targeted at encouraging junior mineral exploration with the exploration credits capped each year. This incentive shares some parallels with Canada's flow-through share scheme but as noted above the level of assistance is capped annually.

BC's refundable METC stands out against Ontario where there is no equivalent incentive. Quebec offers a similar refundable tax credit for exploration, however the rate of the credit at 28% for non-operating corporations is higher than BC's base rate of 20%. BC's 30% rate for areas impacted by the mountain pine beetle compares favourably to the above rate, however Quebec's rate for projects located in remote Northern areas is substantially higher at 38.75%.

On the mining tax front, we have observed that both Ontario and Quebec provide additional incentives for development in the northern areas of those provinces to further encourage investment. For example, Ontario reduces its mining tax rate from 10% to 5% for mining operations that are eligible to be treated as a remote mine. For Ontario mining tax purposes the 3 year mining tax holiday for a new mine is expanded to be 10 years for new mines opened in remote locations. In Quebec an additional allowance in computing net profits is allowed for a mine located in Northern Quebec and the quantum of the allowance varies between $2 million and $5 million depending on where the mine is located. By contrast BC provides the New Mine Allowance regardless of where the new mine is located in the province.

Although not an exploration or development incentive we observed that both Ontario and Quebec's mining tax regime provide for an additional deduction for a processing allowance. The processing allowance is typically allowed to effect a proportional allocation of the net profits between mining and processing activities. BC's regime does not contain a similar feature.

No significant exploration or development tax incentives similar to BC's incentives were identified for Australia or Chile.

While BC's exploration and development incentives compare favourably with the selected jurisdictions, one area of concern is that two of the main incentives aimed at exploration and development of new mines, being the BC METC and the New Mine Allowance, have sunset dates and are set to expire at the end of 2019 which may negatively impact future competitiveness.

2.4.5 Carbon Pricing

There is clear evidence that carbon pricing, either in the form of a carbon tax or as a cap-and-trade program, is an effective means to change individual and business behaviour, reduce GHG emissions, and drive the development and adoption of technologies that will play a key role in the low-carbon economy. In fact, analysis has shown that although BC's total GHG emissions

have increased in recent years, annual GHG emissions in BC would be 5% to 15% higher if the carbon tax was not in place[15].

However, for emissions intensive, trade-exposed (EITE) industries, such as the mining industry in BC, carbon pricing can become a barrier to competitiveness. This is because not all jurisdictions have implemented carbon policies, and the ones that have, have done so to different levels of stringency.

Significant differences in carbon prices could lead mining production and investment to move from jurisdictions with higher carbon prices towards jurisdictions with weaker or non-existent carbon pricing policies. 'Carbon leakage' refers to when economic activity simply relocates to other jurisdictions and produces identical or more carbon emissions than they would in a jurisdiction with carbon pricing. This would result in no change or an increase in global net GHG emissions – an undesirable outcome that should be avoided. As a result, many supporters of a carbon tax also support targeted, transparent and temporary support to EITE industries in order to not only avoid economic and job losses, but to also avoid carbon leakage[16].

2.4.6 Carbon pricing comparisons to other jurisdictions

While comparisons to mining jurisdictions that do not have pricing in place is straight forward, direct comparisons between carbon pricing schemes can be difficult, since schemes cannot be compared based on the stated price of the carbon tax alone. This is because each system is designed differently, affecting the policy's overall stringency and the true carbon tax paid by individuals and business. In many cases, the specific details of each system, including details such as allowances provided to industry, are not made public. As a result, we cannot know the exact carbon tax paid by industry in some jurisdictions.

The carbon tax schemes present or proposed in BC, QC, ON, Australia and Chile are summarized in the table below and described in more detail in Appendix 5. It is important to note that all jurisdictions with carbon pricing proposed or in place have some mechanism to support EITE industries, albeit to varying levels.

The Government of BC is currently consulting on a *Clean Growth Incentive Program* which will provide important measures to address competitiveness issues facing the mining industry in BC. However even with targeted support, BC mining companies who demonstrate best-in-class emissions performance will continue to pay at a minimum $30/tonne on the vast majority of their emissions. Currently, this is substantially more than what BC's mining competitors pay in other jurisdictions.

Jurisdiction	Stated carbon price, 2019	Stated carbon price, 2022	Policy design description for industry	Impact on carbon tax paid by industry
BC	$40/tonne	$50/tonne	An industrial incentive worth up to 100% of the carbon tax paid beyond $30/tonne is available to companies, depending on how their	Best-in-class facilities with leading emissions performance will pay

[15] This estimate draws from several analyses which isolate the impacts of the carbon tax from other factors. See Canada's EcoFiscal Commission (2018). *Clearing the Air: How carbon pricing helps Canada fight climate change*

[16] Canada's Ecofiscal Commission (2015). *Provincial carbon pricing and competitiveness pressures*

			GHG intensity compares to a global benchmark *(this proposed incentive is currently in draft form)*	$30/tonne from 2019 onwards Facilities with higher emissions intensity relative to the benchmark will pay more than $30/tonne from 2019 onwards
QC	~$18-20/tonne	~$20-$22/tonne	Emitters exposed to foreign competition receive the majority of emissions units free of charge. Historically, this has covered the majority of their emissions.	True carbon price paid by industry per tonne CO_2e is significantly lower than the stated price when emissions allowances are considered
ON (federal backstop)	$20/tonne	$50/tonne	The direct carbon price only applies to a portion of a covered source's of emissions that exceed a certain number of allowed emissions. The benchmark will be set to 80% and 90% for specific industries. However, the price incentive will apply to all emissions, as facilities can earn surplus credits that they can sell if they emit less than their regulatory limit.	True carbon price paid by industry per tonne CO_2e is significantly lower than the stated price when emissions allowances and surplus credits are considered
Chile	$5	$5	Chile's tax targets the power sector. While this may have residual impacts to the cost of power for some mining operations, it is not a direct tax on industry	$0
Australia	$0	$0	No tax on industry	$0

Table 20: Comparative carbon prices

As a simplified example of how the federal backstop compares to the BC carbon tax, one can estimate how much a facility that emits 100,000tCO_2e/year and has average emissions performance would pay in Ontario compared to BC[17]. In BC, this company would pay the $30 carbon tax on all of its emissions, equating to at minimum $3M/year in carbon taxes and potentially more, depending on how the facility performs against the international benchmark. The equivalent facility in Ontario would only pay the carbon tax on 20% of its emissions or roughly 20,000tCO_2e/year, amounting to full carbon tax payments of $400,000 in 2019 (at $20/tonne) and $1M in 2050 (at $50/tonne).

2.4.7 Revenues from carbon taxes

Carbon pricing, whether through a carbon tax or cap and trade system, can generate substantial revenue for governments which can then be recycled back towards other priorities. For example, revenue recycling can be used to improve overall economic performance, address household

[17] This is a simplified example. Results for facilities with above-average or below-average emissions relative to the benchmarks will differ.

fairness and business competiveness concerns and/or support environmental goals[18]. A description of how carbon pricing revenues are recycled in BC, QC and ON is included below.

Jurisdiction	Revenue recycling of carbon price	Revenues used to support EITE industry
BC	► Targeted support for low- and middle- income families ► Funding for *Clean Growth Strategy*, which includes the *Clean Growth Incentive Program* for industrial emitters, to further reduce GHG emissions	► Revenues from industrial carbon taxes will be invested in a *Clean Industry Fund* to help facilities implement emissions reduction projects where additional funding is needed to justify the business case
Quebec	► All auction proceeds go to the *Quebec Green Fund* and are earmarked for financing of the different initiatives contained in the 2013-2020 Climate Change Action Plan, which aims to reduce GHG emissions	► The *Quebec Green Fund* has funded a number of initiatives for industry, including an analysis of the risks and vulnerabilities in the mining sector related to climate change ► Other indirect but relevant funding for mining includes support for carbon capture and storage and supported technological innovation to reduce GHG emissions.
Ontario (federal backstop)	► The federal backstop will return direct revenues to the jurisdiction of origin (in this case, Ontario). The Ontario Government has not indicated what it intends to use the funds for.	► In July 2018 the Ontario government, led by newly elected Doug Ford, closed the former *GreenON* industries program, a program that would have helped to fund GHG reduction projects of large emitters. No information has been released to date on planned GHG reduction initiatives for industry to replace the *GreenON* fund. ► Under the federal OBPS, facilities that emit less that the annual limit will receive surplus credits for the difference between the limit and its reported emissions, which can be sold and/or used by facilities that exceed annual limits in order to meet their compliance obligation.

Table 21: Carbon tax revenue recycling comparisons

Canada's Ecofiscal Commission has performed Computable General Equilibrium (CGE) modelling to identify the benefits and trade-offs to different approaches to revenue recycling among Canadian provinces. In particular, the Commission identified that providing transitional support to industry (as is the case in all three provinces) will result in less GHG reductions. However this is outweighed by the positive impacts to competitiveness and the economy more broadly. Additional investments in clean technology, as QC provides and as BC is proposing, will likely lead to positive environmental impacts through further GHG reductions and improved emissions performance, which can also improve business competitiveness.[19]

[18] Canada's Ecofiscal commission (2016). *Choose Wisely: Options and Trade-offs in recycling carbon pricing revenues*
[19] *Ibid,* pg.30

2.4.7.1 Other GHG reduction initiatives

While carbon pricing can provide revenue to support emissions reduction initiatives, some jurisdictions choose to fund environmental programs through other means. While these examples are limited in jurisdictions without carbon pricing, it should be noted that the Australian government has an emissions reduction fund to provide incentives for Australian businesses and others to adopt new practices and technologies to reduce GHG emissions.

The Australian government is currently funding one emission reduction activity specific to mining. *The Coal Mine Waste Fund* supports projects that destroy the methane component of coal mine waste gas to carbon dioxide using flares, electricity production devices or flameless oxidation devices.

2.4.8 Carbon Pricing - Looking Forward

Carbon tax competitiveness pressures are expected to change over time as cap and trade and other carbon pricing schemes are implemented globally. Studies undertaken by the Carbon Pricing Leadership Coalition suggest that in order to meet the United Nations Paris Agreement climate goal of keeping global warming within 2 degrees Celsius, a global carbon price of $40-$80 a tonne in 2020, rising to $50-$100 tonne by 2030, will be required[20]. Although we have not yet seen widespread adoption of carbon pricing to date, over 70 national and subnational jurisdictions now price carbon and that number is expected to increase in the coming years[21].

Any provincial support for EITE industries should be revisited as global carbon pricing evolves. Likewise, revenue recycling approaches should be periodically reviewed for effectiveness. If successful, government revenue from carbon pricing should decrease over time as consumers and business switch to cleaner fuels and other alternatives and reduce their GHG emissions.

2.5 REGULATORY FRAMEWORK

Given the significant, upfront capital outlays and long-lead times to develop mines and move them into production in order to generate cash inflows, mining investments are inherently high risk. The regulatory framework governing a mining investment (public policy, regulation, and permitting) can further compound this risk. All things being equal, sector investors prefer jurisdictions with regulatory systems that are characterized by what the Mining Association of BC refers to as the three C's: clarity, consistency and coordination between various levels of government[22]. Clarity, consistency and coordination allow for better project planning and more accurate cash flow projections.

The regulatory framework consists of a number of federal and provincial acts, regulations, and statutes relevant to mining operations in BC such as those identified below (Table 22). The framework is complex, has multiple layers, and can be difficult for investors to navigate – which may deter investment. Interestingly these challenges are common to the other jurisdictions

[20] Bloomberg (2017). *World carbon price seen needing to increase sevenfold by 2020*
[21] World Bank (2018). *Carbon pricing dashboard*
[22] Mining Association of British Columbia (2018). *One Province, One Economy: Ensuring B.C. Maintains a Competitive Advantage*

analyzed in this report - not surprising given the nature and impact of mining operations on communities and the environment.

Regulations and Important Statutes	Regulator / Administrator
Environmental Assessment Act	Environmental Assessment Office
Environmental Management Act	Ministry of Environment
Health, Safety and Reclamation Code for Mines in BC	Issued under the Mines Act
Heritage Conservation Act	Ministry of Small Business and Revenue
Land Act	Ministry of Agriculture and Lands
Local Government Act	Ministry of Community Services
Mineral Tenure Act	Ministry of Energy, Mines and Petroleum Resources
Mines Act	Ministry of Energy, Mines and Petroleum Resources
Mining Right-of-Way Act	Ministry of Energy, Mines and Petroleum Resources
Motor Vehicle Act	Ministry of Transportation
Transportation Act	Ministry of Transportation
Water Act	Administered by the Water Stewardship Division of the Ministry of Environment
Canada Water Act	Environment Canada
Fisheries Act	Fisheries and Oceans Canada
Navigable Waters Protection Act	Fisheries and Oceans Canada
Canadian Environmental Assessment Act -	Canadian Environmental Assessment Office

Table 22: Select listing of acts, regulations, and statutes relevant to mining in BC

A significant component of the regulatory framework in BC is the Environmental Assessment (EA) process, which applies to major projects proposed in the Province to ensure that any environmental, economic, social, heritage and health effects that may occur over the lifetime of the project are assessed and that public input is considered to ensure that no adverse effects are missed[23]. The clarity of EA requirements and the length of time required to complete the Environmental Assessment process impact regulatory clarity, consistency and coordination and factor into the overall competitiveness of the BC mining industry.

2.5.1 Current state of the EA process

BC's EA process is set out by the *Environmental Assessment Act*, assented to May 30, 2002, and is administered by the Environmental Assessment Office (EAO), a neutral regulatory agency within the BC government. There are three stages to the assessment: pre-application, application

[23] Government of British Columbia (2018). *Environmental Assessments*

review and the decision stage. During the pre-application phase, the EAO consults with indigenous groups, all levels of government and the public in order to determine what should be considered in the assessment. Application Information Requirements are issued by the EAO before a formal application is submitted. The application evaluation, review and decision periods have legislated timelines that must be adhered to[24].

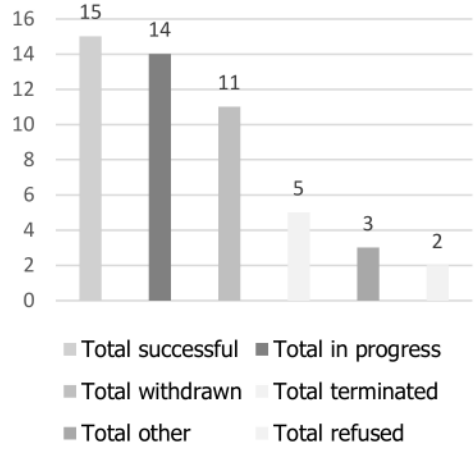
Once the application review is completed, two provincial ministers will decide whether to issue an Environmental Assessment Certificate (EAC), refuse to issue an EAC or order that further assessment be carried out. The two deciding ministers are the Minister of Environment and Climate Change Strategy and the minister responsible for the project. For a mine, this is the Minister of Energy, Mines and Petroleum Resources. If an EAC is issued, it allows the project to proceed with permitting[25]. Very few projects that complete the EA process are refused an Environmental Assessment Certificate because the EA is meant to be an iterative process between the EA advisory working group and the project proponent, to ensure that all issues are addressed appropriately. A project is rarely referred to provincial ministers prior to addressing outstanding issues, but would likely be withdrawn from EA by the proponent or the EA terminated.

Over the past 10 years (2008-August 2018), 50 mining projects have participated in the EA process and are either still in progress or have had a successful, unsuccessful or other decision made. These projects are all listed in the Province's EAO Project information & Collaboration (EPIC) system[26]. EY conducted an analysis of these projects to better understand the current state of the EA process. For a full list of the information analyzed, refer to Appendix 9.

2.5.1.1 Applications and decisions for mining projects over the past decade

Figure 22 shows the outcomes of the 50 proposed mining projects from August 2008 to August 2018. Of the total, 15 Environmental Assessment Certificates have been granted for mining projects since 2008, these are the successful projects. 16 mining projects were either withdrawn from EA or the EAs were terminated, and two mining projects were refused an EAC by the ministers, making them unsuccessful. Three others experienced unique ("other") circumstances: in one case, further assessment was required; in another it was determined that the project was not able to be reviewed by the EAO; the other project's certificate expired due to inactivity. 14 proposed projects remain in the EA process. Note that these "in progress" projects may also include projects where the EA has been inactive for a long time but have not formally been terminated or withdrawn.

[24] EAO (2018). *Environmental Assessment Roadmap*
[25] Government of British Columbia (2018). *The Environmental Assessment Process*
[26] Government of British Columbia (2018). *EPIC – Environmental Assessments*



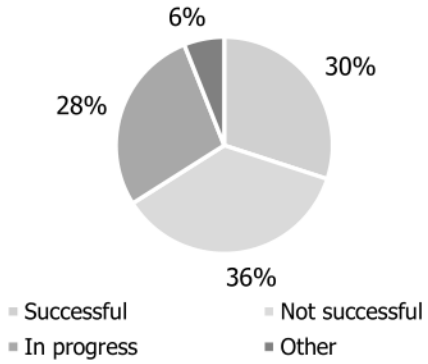


Figure 22: Proposed mining projects 2008- Aug 2018 ***Figure 23: Proposed mining projects (%), 2008- Aug 2018***

Overall, slightly more projects have been unsuccessful rather than successful in obtaining an Environmental Assessment Certificate. It is important to note that for those projects which were withdrawn or terminated, this was not always due to the inability to comply with EA requirements. For example, projects could be indefinitely stalled due to metal prices and other economic conditions which factor into the proponent's decision to continue to pursue an Environmental Assessment Certificate.

Environmental Assessment Certificates were only refused in two cases, for the Ajax Mine and the Kemess North Copper-Gold Mine. The reasons cited for the refusal of the Ajax Mine certificate were significant adverse effects to Indigenous heritage and to the current use of lands and resources for traditional purposes, as well as the existence of fifty-three residual and cumulative adverse effects across the five pillars assessed by the EAO (environmental, economic, social, heritage and health), of which 21 were of moderate-to-high magnitude[27]. For the Kemess North Copper-Gold Mine, the decision was made in light of the EA panel's conclusion that the project, as proposed, would not be in the public interest and that the benefits provided by the project were outweighed by the risks of significant adverse environmental, social and cultural effects[28].

[27] Government of British Columbia (2017). *Information Bulletin: Ajax open-pit copper and gold mine not granted an environmental assessment certificate*
[28] Government of British Columbia (2017). *News Release: Panel Recommendation Accepted on Kemess North Project*

2.5.1.2 Amount of time spent on EA process per proposed project

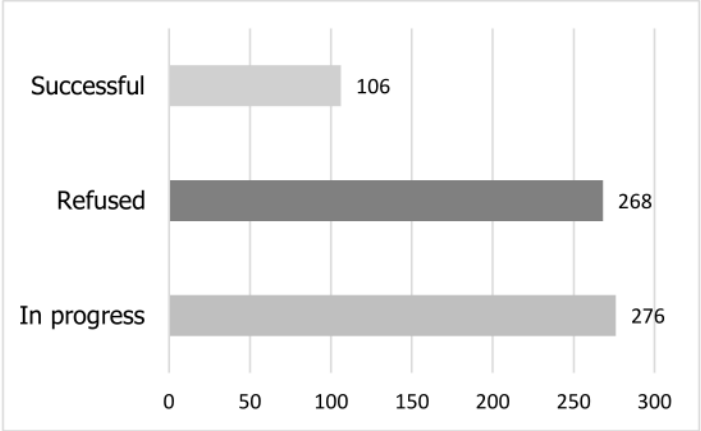


Figure 24: Average length of time (weeks) for EAO proposed projects, 2008-Aug 2018

The data in

Figure 24 emphasizes that in order for projects to be successful, measures should be taken to mitigate any challenges and issues from the outset. The longer the EA process, the less likely the proponent is to be granted an Environmental Assessment Certificate.

The length of the EA process does not seem to be directly tied to the length of time it takes for a mine to develop to operations. EY conducted desktop research to determine which of the 15 projects granted Environmental Assessment Certificates in the past ten years have successfully proceeded to operations. There are six projects in total that have moved into operation:

- Baldy Ridge Extension (Teck)
- Fording River Operations Swift (Teck)
- Brucejack Gold Mine (Pretium Resources)
- Line Creek Operations Phase II (Teck)
- Roman Coal Mine (Peace River Coal) – care and maintenance only[29]
- Mt. Milligan Copper-Gold (Thompson Creek Metals)

Reasons for other projects not moving forward are numerous. For example, some projects obtained a BC Environmental Assessment Certificate but were unable to[30], or only recently able to[31], obtain approval from the Canadian Environmental Assessment Agency (CEAA). Other projects appear to be halted due to the slump in coal prices in recent years, while others are actively pursuing permitting, according to company websites[32].

2.5.2 Identified challenges with the EA process

[29] BC Mine Information, *Trend-Roman Mine Overview*
[30] Taseko, *New Prosperity*
[31] HD Mining, *December 13, 2017, Federal Government Minister of the Environment - Decision Statement*
[32] Examples include Burnco, *Homepage,* and Giscome Lime Project, *Giscome Lime Project*

In order to better understand any underlying challenges experienced by both government and proponents with the EA process, EY conducted interviews with representatives from both government and the mining industry. Mining representatives included proponents who have been both successful and unsuccessful in the EA process in BC. Through the interviews, several challenges were identified. Many of these challenges impact the success of projects in receiving an environmental certificate, and also impact EA process timelines. The challenges identified include:

- Lack of clarity and/or understanding of requirements
- Indigenous consultation
- Process delays and overlap between BC EA process and permitting; as well as provincial and federal assessments
- Creating space for innovation

2.5.2.1 Lack of clarity and/or understanding of EA requirements

It was expressed in the interviews that the EA requirements can be unclear or misunderstood by proponents for a variety of reasons.

- *Lack of clarity from government on what is required for the proponent to submit and to what level of detail*

Although Application Information Requirements are approved prior to submitting a formal application, the level of detail that the proponent is required to submit can be difficult to define. For example, if a proponent is using a traditional waste management method, less detail may be required than if they plan to execute a new technology or method. Similarly, proponents may not provide sufficient information on critical issues that they perceive to be of less importance. This can result in additional back and forth between the proponent and the working group on the details of the application.

- *Lack of understanding from the proponent of stakeholder concerns and their responsibility to address them*

The EAO considers stakeholder perspectives through public consultation and comment on the proponent's application. Proponents, in particular companies with less experience in BC, may not always adequately address stakeholder concerns which can lead to multiple requests for further information from the EA advisory working group before the issues are resolved. Some project proponents have expressed frustration at the consultation process and the ability of some groups to stop the project, even if other affected stakeholders are supportive. More proactive engagement between the project proponent and affected stakeholders, and clear guidance from the government early on about expectations and requirements for community support may lead to a faster resolution.

- *Lack of consistency in advice quality provided by consultants to proponents and involvement of consultants in government efforts to clarify the process*

A vast array of consultants are retained by proponents to develop the EA applications and responses, with varying levels of experience, knowledge and expertise. From a sample of 10 of

the applications submitted by project proponents, eight different consulting companies were listed as supporting the EA process. Proponents will often rely on the advice of their consultants when preparing their application and responding to the working group's feedback. Although the government has made efforts to engage with consultants who act as the proponent's advisors, some consultants may not adequately understand the requirements of the EA process, further delaying the EA.

2.5.2.2 Indigenous consultation

A key element to successfully navigating the EA process is early, effective engagement with affected Indigenous groups. Without seriously considering adverse impacts to traditional territories and taking concrete steps to mitigate them, proponents will not be successful in their applications. The key issue identified by government interviewees in this area is that proponents may not engage early enough with Indigenous stakeholders. For those proponents who struggle with how to approach Indigenous consultation, clear guidance from the government on when to engage, how to engage, and who to engage with could be helpful to become more successful in this area.

On the other hand, experienced, successful proponents may have meaningfully engaged with indigenous peoples and have an agreement, such as an Impact Benefit Agreement, in place prior to entering the EA process. Some proponents expressed a desire for government consultation periods to be altered in length if agreements were already in place, however EAO has confirmed that consultation periods are based on the Crown's duty to consult.

2.5.2.3 Coordination between EAO and other federal and provincial agencies and ministries

- *Process delays and overlap between provincial and federal environmental assessment processes*

If a project falls under both provincial and federal environmental assessment responsibility, the two governments will either carry out a single, cooperative environmental assessment (referred to as a coordinated EA) where the province and federal government share a common EA advisory working group, or BC will administer an EA process that meets both the federal and provincial EA requirements (referred to as a substituted EA). In both cases, the provinicial and federal governments retain their respective decision-making powers.

Mining proponents have noted that in the case of coordinated EAs there can be process delays associated with the subject areas where there is overlapping provincial and federal statutory responsibility, for example water quality and fish habitat.

The provincial and federal information requirements in these areas are developed and issued at the start of an EA, during the pre-Application period. However, in the case of coordinated EAs, additional requirements that are identified during review may be communicated at different times by the provincial and federal government representatives. For example, additional information may be requested in the later stages of the BC EA process due to additional information requests made by the federal government. To expedite the EA process, the two governments should strive

to align as much as possible on overlapping subject matter to ensure that the proponent receives consistent, timely information about project requirements and expectations.

- *Coordination between provincial ministries and other bodies*

During the EA process, a project proponent may receive feedback from various provincial government ministries. The EAO and the advisory working group track government feedback and proponent responses on an issues tracking table, however some project proponents felt that feedback could be better coordinated between ministries so that it is received in a more timely and coordinated manner. Confirming communication preferences and developing a communication plan at the outset of the EA could help to facilitate efficient communication in a manner that works for both EAO and the proponent.

Similarly, it was suggested during the interviews that there are further synergies that can be implemented between the EA and permitting. Although the BC government has made efforts to promote efficiencies between agencies, there may be further opportunities to facilitate synchronous permitting and improve information-sharing between the EAO and permitters to maximize efficiencies between the two processes.

2.5.2.4 Creating space for innovation

In both government and industry interviews it was expressed that traditional impact mitigation measures are much easier for advisory EA working group members to accept than new and innovative, but unproven, solutions. In some cases, this can make it difficult for less experiened, junior proponents to successfully obtain an EAC. Traditional mitigation measures may be too expensive to implement, however new measures can be costly to prove effective, and there are limited opportunities to test new and innovative ways to address impacts. For experienced, larger proponents, this can be equally frustrating as they continue to press forward and introduce new technologies and strategies in the sustainability space. On the other hand, the EAO must balance the possible risks stemming from a failure in any new and unproven technology on communities and the environment.

2.5.3 Looking forward: The EA revitalization process

In June 2018 the Province announced a review of BC's Environmental Assessment Process to ensure that Indigenous legal rights are respected and the public's expectation of a strong, transparent process is met[33]. Changes to the BC environment assessment process are focused on:

- Enhancing public confidence by ensuring impacted First Nations, local communities and governments and the broader public can meaningfully participate in all stages of environmental assessment through a process that is robust, transparent, timely and predictable;
- advancing reconciliation with First Nations; and

[33] Government of British Columbia (2018), *Environmental Assessment Revitalization*

- protecting the environment while offering clear pathways to sustainable project approvals by providing certainty of process and clarity of regulatory considerations including opportunities for early indications of the likelihood of success.

If the EA Process is revitalized to clarify requirements and expectations, it should alleviate some of the challenges identified in this report and potentially lead to faster project approvals. In June 2018 the Province released a discussion paper which outlined potential adjustments to the EA process, including implementing a "readiness gate" that proponents will need to pass through prior to formally submitting an application which will include earlier engagement with stakeholders.

The Province is also committed to EA revitalization as part of the commitment to implement the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and the Truth and Reconciliation Commission's Calls to Action, which includes recognizing Indigenous nations as decision-makers in their territories. Proposed changes will seek to enable consensus-based decision making with Indigenous nations at a technical level throughout the EA process and recognize decisions made by Indigenous governing bodies at key junctures. A time-bound alternative dispute resolution process will be available in situations where consent is not secured.

2.5.3.1 Federal environmental assessment process review

In June 2016, the Government of Canada launched a comprehensive review of the federal environmental assessment process and in February 2018 announced proposed changes stemming from the review. The new proposed *Impact Assessment Act* will replace the *Canadian Environmental Assessment Act, 2012* and includes significant changes to the federal environmental assessment process. The proposed new system includes a new mandatory early planning and engagement phase to facilitate early dialogue with indigenous peoples, provinces and the public to identify and discuss issues earlier. Legislated timelines will also be reduced due to efficiencies created through early planning and engagement. This new planning stage and resultant efficiencies promise to allow more coordination with the provinces to support one project assessment and avoid duplication.

Other changes include the development of a single government agency to lead assessments and coordinate crown consultations, the mandatory consideration of science, evidence and indigenous knowledge and a broadening of the scope of assessments to include positive and negative economic, social and health impacts.

2.5.4 Regulatory comparisons to other jurisdictions

It is important to note that all regulatory regimes face some challenges to providing clarity, consistency and coordination. Environmental and social license challenges are unique to each jurisdiction, and governments have chosen to respond to these challenges accordingly. Australia, Quebec and Chile have recently updated or are proposing to update their environmental assessment processes to provide more clarity and consistency to the EA process in their respective jurisdictions. The key developments in each of these jurisdictions are summarized below.

- **Increasing opportunities for community consultation.** Australia, Chile and Quebec have all recently updated or are proposing to update legislation to provide more opportunities for early and meaningful consultation with communities. In the case of Chile and Quebec, this includes legislated timeframes for consultation before impact assessments are carried out; while Australia has a legislated requirement for the development of social impact management plans in consultation with affected communities as part of a proponent's environmental assessment submission.
- **A risk-based approach to environmental assessment.** Australia and Quebec have streamlined their assessment approach to ensure government efforts are focused on projects that have significant environmental impacts by decreasing the administrative requirements for low-risk projects. As a result, these governments can to allocate more assessment and permitting resources to those projects which have higher environmental impacts.
- **A broader consideration of impacts.** Australia's environmental assessment process includes a broader consideration of socio-economic impacts, while the Quebec government recently introduced a "climate test" into the EA assessment to consider a projects' GHG performance and energy decisions.

2.5.4.1 Chile

Under Chilean regulation proposed projects, including mining projects with production above 5,000 tonnes of mineral ore/month, are required to undertake an environment impact assessment. The majority of proposed mining projects do so through the government's Environmental Impact Evaluation System (Sistema de Evaluacion de Impacto Ambiental, or "SEIA").

Projects evaluated through SEIA are able to obtain select environmental permits concurrently as they make their way through SEIA. Consequently, environmental issues arising from permits are reviewed through the SEIA and projects that have successfully received their environmental licence cannot be denied permits based on environmental grounds. While the ultimate aim is to provide an integrated "one window" system (referred to as "ventanilla unica") to obtain all relevant permits, in reality the system is only partially integrated since other sectorial permits must be filed for separately[34].

The Chilean congress is currently reviewing proposed updates to SEIA with the aim to protect the environment, improve civil participation processes, provide regulatory certainty, standardize processes and optimize associated timelines[35]. Proposed changes include the introduction of advance civil participation and dialogue opportunities which would take place over a period of 18 months in advance of formally entering the SEIA. In addition, the draft legislation proposes allowing proponents to obtain sectorial permits concurrently through the SEIA one window system, which would fully integrate the EA and permitting processes.

2.5.4.2 Queensland

Under Queensland's *State Development and Public Works Organisation Act 1971 (SDPWO Act)* projects which involve local state and federal governments, have significant environmental,

[34] Chambers and Partners, *Chile Practice Guide: Environmental Impact Assessment and Permitting*

[35] Gobierno de Chile, Servicio de Evaluacion Ambiental (2018). *Consejo de Ministeros para la Sustentabilidad revisó proyecto de Ley que reforma el Sistema de Evaluación de Impacto Ambiental*

economic and social effects, and/or significant infrastructure requirements can be declared a "coordinated project". The majority of these projects require an Environmental Impact Statement (EIS) which is evaluated by Queensland's Coordinator-General.

Queensland updated its impact assessment legislation in 2014 to better define the points at which the Coordinator-General decides on the adequacy of EIS information[36]. Prior to the amendments, proponents were required to give an EIS to the Coordinator-General, who could request supplementary information before preparing an evaluation report. Proponents are now required to prepare a draft EIS which can be accepted as the final EIS following a public consultation period. If the Coordinator-General decides that further information is required, that information must be provided by the proponent before the Coordinator-General accepts the draft EIS as the final EIS and prepares an evaluation report.

Queensland's revised EIS process is informed by Queensland's *Regulatory Strategy*, which has shifted the government's focus from setting and applying standards (assessment) to monitoring and responding to performance (compliance)[37]. Under the regulatory strategy, the risk of serious environmental impacts informs how the department responds. For low-risk proposals, if the proponent provides adequate information their EIS will be accepted and approvals are aligned with industry-wide prescribed standards as well as environmental compliance codes. Each major industry sector is served by a government business centre which is dedicated to assessing and deciding permit applications and delivering compliance activities. According to the Queensland government, this approach delivers more certainty and consistency in approval conditions, quicker approvals, more opportunities to innovate with respect to environmental solutions, and reduced compliance costs[38].

In 2017, the Queensland government passed the *Strong and Sustainable Resource Communities Act 2017 (SSRC Act),* which includes a legislative requirement for a social impact assessment to be undertaken for all projects requiring an EIS. For any significant social impacts that are identified, proponents are required to develop a social impact management plan that is monitored and reported on. This requirement helps to ensure that community concerns are considered and adequately addressed by project proponents. Refer to Appendix 4 for further information on Queensland's requirements relating to social impacts.

2.5.4.3 Quebec

On March 23, 2017, Quebec's National Assembly passed the new *Environment Quality Act* in an effort to provide Quebec with a clear, predictable and optimized authorization scheme that meets the highest environmental protection standards[39]. The new approach, which will come into force on December 1, 2018, is based on a project's level of risk in order to focus government assessment and permitting resources on projects that have major environmental impacts. Activities are classified as high, moderate, low or negligible environmental risk. While high risk projects will continue to be subject to environmental assessment process, moderate- low- and negligible risk activities will have less administrative requirements and more streamlined permitting processes. Under the new scheme, moderate risk activities will be provided a single

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[36] State of Queensland (2015). *2014 Changes to the State Development and Public Works Organisation Act 1971*

[37] Queensland Government (2018). *Regulatory Strategy*

[38] *Ibid*

[39] Gouvernement du Quebec (2018). *Environmental Assessments*

ministerial authorization for projects following review, thereby avoiding multiple permit applications and approvals. Low- and negligible-risk activities can fill in a declaration of compliance to meet the requirements, or in some cases are exempt from the permitting process entirely.

A significant change to environmental impact assessment process for high risk projects is the creation of a public register which is intended to provide the public with more thorough information of proposed projects earlier in the environmental assessment process[40]. Any person, group or municipality may, during the 30-day public consultation period, submit observations to the Minister of Environment and Climate Change on issues that they feel should be addressed in the project's impact assessment statement. The Minister will then determine which issues should be taken into account in the impact assessment, which will be published in the environmental register.

The government will also take into account considerations related to climate change and greenhouse gas emissions in its assessment decisions. Project proponents whose estimated GHG emissions exceed a set threshold will be required to demonstrate that its project is optimized from a GHG emissions perspective and justify the selected technology, processes and energy sources that are used.

2.5.4.4 Ontario

Ontario's EA process is in many ways similar to BC's current environmental assessment process, including legislated timeframes for government review and a public comment period. Environmental assessments must be prepared and carried out according to an approved terms of reference. During the preparation of the terms of reference, project proponents are required to consult with government agencies and interested parties to identify concerns related to proposed project as well as the information and level of detail required.

To help proponents understand consultation requirements, Ontario has identified minimum requirements for proponents to follow based on the complexity and environmental sensitivity of the project. Consultation requirements are generally more stringent for situations where projects are complex, the environmental setting of the project is sensitive to change, the significance of potential environmental effects are high, and/or the expected level of controversy is high.

Once projects have received an environmental certificate, permits and authorizations are required before construction and operation of a project.

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[40] *Ibid*

3. MEASURES TO INCREASE THE COMPETITIVENESS OF BC'S MINING AND EXPLORATION INDUSTRY

Notwithstanding BC's rich mineral endowment, the comparator jurisdictions generally hold an advantage over BC with respect to geology and geography. Each of these jurisdictions benefit from the favourable economics that result from attractive geology (grade, depth, scale of deposits) and geography (proximity to infrastructure and end-markets), or a combination of both. Although this advantage may diminish over time as easily accessible, high grade deposits are depleted, this limits strategies available to the provincial government to increase the competitive position and serves as a ceiling concerning how competitive BC can be in the near-term.

The provincial government could take action to lower income and sector specific taxes and/or increase/extend existing incentives to improve mining and exploration investment returns to attract investment. The question is how much further the government would be willing to go to support the industry as the province's fiscal policy as it concerns the sector is already highly competitive on a global basis, particularly with regards to offering incentives to encourage exploration.

One area of taxation that the province is not competitive in concerns the treatment of carbon. Although the BC government has proposed some targeted support to industry to alleviate competitiveness concerns related to the BC carbon tax through the *Clean Growth Incentive Program,* mining companies operating in BC will continue to pay substantially more than their competitors in other jurisdictions. Government could consider implementing allowances similar to those in Ontario and Quebec although this strategy must be considered within the context of the province's emissions reduction objectives, government revenue requirements and expectations of carbon pricing changes worldwide. Recycling carbon tax revenues back to industry for emissions reduction projects, as is proposed in the *Clean Growth Incentive Program,* is critical to not only help the industry prepare for a low-carbon future but also to support competitiveness. The government could consider further expanding their support for emissions reduction projects to include revenues accrued from the carbon tax below $30/tonne.

The government could also increase its investment in actions to increase the efficiency, transparency, and predictably of the regulatory framework governing the sector in BC. This includes providing further clarity on the requirements related to the EA process to project proponents and relevant consultants; improving the coordination of processes and feedback received by different provincial bodies and federal agencies; allowing for innovation to mitigate impacts; and most importantly providing support to proponents to understand requirements related to indigenous consultation. Some of the changes proposed in the government's working paper related to the EA revitalization process touch on these subjects. These changes would provide a more efficient, predictable, and effective regulatory framework to encourage investment by decreasing investment risk.

The above actions - lowering taxes, offering greater incentives, and improving the regulatory framework - would increase the attractiveness of BC to investors; however, it is unclear that such actions would be enough to make B.C. "the most attractive jurisdiction for investment in Canada".

3.1 TRENDS SHAPING THE INDUSTRY

There is, however, opportunity for the province to invest now to position BC as Canada's leader of the 'mining industry of the low carbon future'. The industry is rapidly transforming due to a number of disruptive technological, social, and demographic forces and this rapid pace of change means that the mining industry five, ten, and twenty years into the future will look considerably different than it does today. Key trends that will shape the future of mining include the world's progression to a lower carbon economy, declining grades, and rapid innovation. These are briefly described below.

3.1.1 The lower carbon economy

Demand for metals produced in BC will continue to increase as developed economies advance, developing countries industrialize, new technologies are created, and the low carbon future emerges. A 2017 World Bank report concluded that the increased use of low carbon technologies in the areas of wind, solar and energy storage will serve to increase the demand for mineral and metal products. The impact of wind, solar and energy storage on demand for BC commodities is explained in Table 23.

Clean energy vehicles	Solar power	Wind energy
▪ Can require up to four times the amount of copper as a standard combustion engine and more than 600 kg of metallurgical coal (for steel making) ▪ Aluminum is used in breaks and casings of the components of an electric car. BC produces one of the lowest carbon footprint aluminum in the world	▪ There can be up to 50 kg of copper per megawatt of capacity in a solar cell ▪ A typical solar panel can require up to 20g of silver; BC is Canada's largest producer of copper and second largest producer of silver	▪ Average wind turbine requires about 260 tonnes of steel made with 170 tonnes of metallurgical coal ▪ The average 2Mw wind turbine can require up to 5 tonnes of copper

Table 23: Impact of lower carbon economy on demand for BC resources (Mining Association of BC)

This trend presents the opportunity for BC to aspire to become a leading supplier of sustainably-sourced minerals and metals to enable the low carbon economy.

3.1.2 Declining grades

Globally, ore grades have demonstrated a continuous downward trend. For example:

- The average grade of copper ore mined has declined by 1.8% per year over the past 12 years to 0.59% in 2017; and
- In the past ten years, gold reserve grades has decreased by 35%. Production grade has declined by 31% across all mine types from just under 2 g/t in 2005 to the 1.30 level in 2015.

As grades decline, mining companies have been forced to mine at greater depths, mine more tons, and increase processing capacity to maintain existing production current levels. This leads to an increase in waste produced, greater energy consumption, more water usage (for processing), higher carbon emissions, and increases the industry's environmental footprint. This also lowers productivity and increasing the operating costs of a mine.

Looking forward, as the world's most lucrative deposits are depleted, new projects will be even deeper, more metallurgically complex and/or lower grade. For example, the average grade of discovered but undeveloped copper is approximately 0.9% copper equivalent—compared to 1.2% copper equivalent for those in production.

As a producer of many metals that will be foundational to the low carbon economy, BC has the opportunity to invest now in the development of technologies and processes to enable the economic extraction of low grade ores in a sustainable and responsible way. This means reduced energy consumption, the recovery of waste energy, less water consumption, reduced emissions, and a decrease in the environmental footprint of a mine. This opportunity is aligned to the Zero Waste Mining innovation strategy for the mining sector being led by the Canada Mining Innovation Council[41].

3.1.3 Rapid innovation

As global technology accelerates, mining companies are investing in opportunities to rethink every aspect of the mining industry. A key area of this investment has been toward digital as mining and mining tech companies seek to use new technologies to support efforts to improve profit and performance.

Digital goes beyond adopting technology, it is a continuous form of disruption to existing (or new) business models, products, services or experiences, enabled by data and technology across the enterprise. Looking forward, digital will be increasingly important in resolving many of the sector's most pressing issues (Figure 25).

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[41] Zero Waste Mining innovation strategy led by the Canada Mining Innovation Council that targets reduced energy consumption, recovery of waste energy, decreased environmental footprint of a mine, the development and adoption of new technology, and the creation of new clean jobs

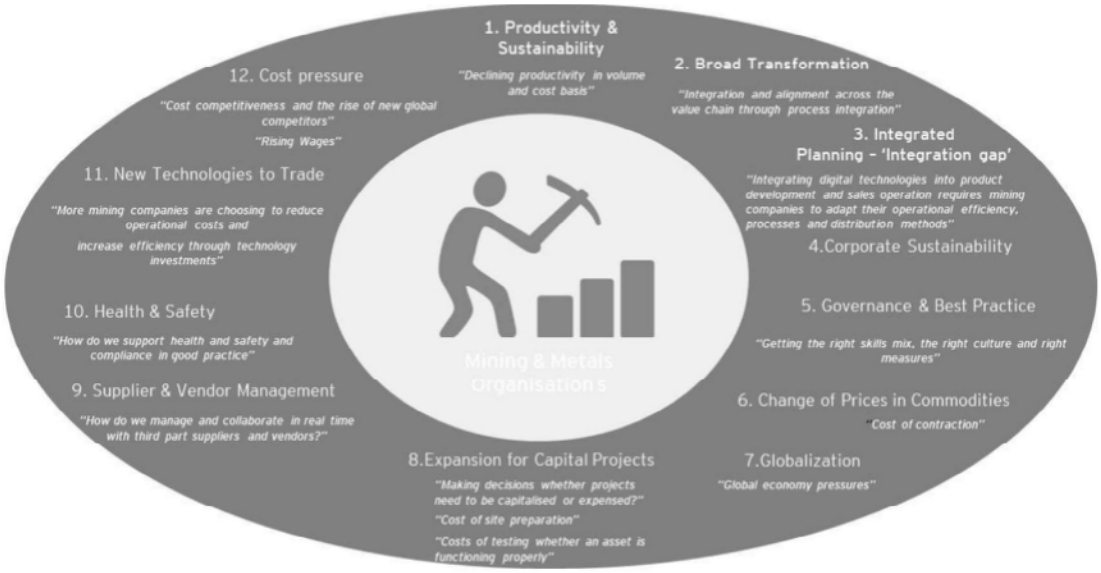

Figure 25: Top challenges for Mining and Metals Organizations

This trend provides an opportunity to build greater collaboration between BC's mining industry and its strong emerging technology sector to develop solutions to BC's mining industry challenges. BC has a number of high-tech clusters in a number of areas that are highly relevant to the mining industry including cleantech and wireless communications. Partnerships are already emerging with Teck Resources being a partner in one of the largest technology superclusters: the B.C.-based Digital Technology Supercluster. This supercluster will facilitate improved data collection, sharing and visualization – enhancing confidence in resource sector project planning and assessments for proponents, Indigenous peoples, government and communities.

3.2 A BC MINING INNOVATION STRATEGY?

Government could launch a "BC Mining Innovation Strategy" to position BC as Canada's leader of the mining industry of the future. The strategy would accelerate innovative solutions to BC specific challenges and leverage the aforementioned industry trends and, once proven, these BC-based solutions could be exported to larger, global markets. This would make BC the leader in commercialization and adoption of step-change innovation in Canada's mining industry, create jobs, and attract investment.

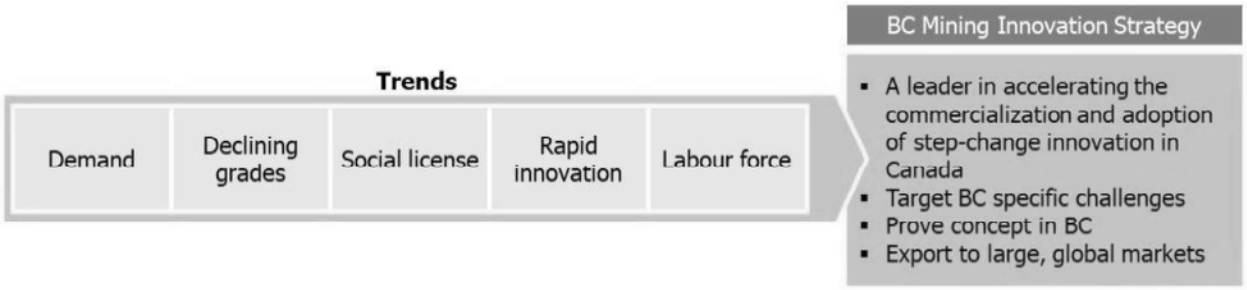

Figure 26: BC Mining Innovation Strategy

A BC Mining Innovation Strategy would target strategic focus areas identified and agreed through consultation with industry (including explorers, miners, and mining equipment, technology and services providers), government, academia, the general public, mining communities and First Nations, and other relevant stakeholders. Specific initiatives would then be built around these focus areas to drive a step change in the way the BC mining industry deals with key industry challenges.

Notwithstanding the need for consultation and collaboration, we have put forward three strategic focus areas in response to both macro industry trends and BC specific sector challenges.

3.2.1 Water management

Ensuring the efficient use of water and the protection of water quality are essential in the mining industry for both the social licence and the regulatory licence to operate. Due to the large volumes of water used for mining processes (e.g.: processing of copper and washing of metallurgical coal, BC's two most important commodities), there is potential to affect water quality, which in turn can affect other water users.

The importance of using water efficiently and maintaining water quality is paramount to a strong BC mining industry. BC can demonstrate leadership in water stewardship by including water management as a strategic focus area of a BC Mining Innovation Strategy. The strategy would include all aspects of mine water management, including hydrology, hydrogeology, diversion, containment, conservation, minimization of water-quality impacts, seepage interception and treatment.

3.2.2 Metal leaching and acid rock drainage

The most significant environmental impact of a mine is the extractive waste it produces, mainly 'tailings'. Tailings are a fine-grained residue that remain after the separation of minerals and metals from their ore in a processing facility. Tailings are deposited in the vicinity of the mine and are pumped together with process water to large ponds, known as tailings impoundments, where the tailings settle. Excess water from these impoundments is routed to a clarification impoundment and from there the water is often recirculated to the process in the processing facility.

Mining waste has different characteristics depending on the type of ore being mined. BC's mines are primarily sulfuric ores - the waste from the mining of sulfide ores can cause serious environmental problems due to their content of iron sulfides such as pyrite and pyrrhotite. When mining waste containing iron sulfides is allowed to lie unsheltered and comes under the effects of weather and wind, it will crumble through an oxidation process. This weathering results in the release of an acidic and often metal-rich leachate into the surrounding environment, known as Acid Mine Drainage (AMD).

Preventing the impacts from metal leaching and acid rock drainage (AMD) is a highly important, costly and time-consuming environmental issue facing the British Columbia mining industry. Finding solutions to this challenge should be a focus of the BC Mining Innovation Strategy.

A 2013 report by Hatch Limited for the Canadian Mining Innovation Council identified the following technology gaps concerning AMD; these could be considered by stakeholders as focus areas of the innovation strategy:

- Mine hydrology and geochemistry and the ability to predict effluent chemistry;
- Characterization and prediction of waste rock seepage chemistry, including waste rock hydrology and hydrogeology and the behaviour of weakly reactive and marginally potentially acid generating waste rock;
- Blending of waste rock and/or tailings for hydrological or geochemical reasons;
- Availability of alternatives to soils as cover materials for reactive tailings;
- Understanding of the long-term performance of all technologies, and particularly dry covers;
- Ability to characterize, predict, and manage the behaviour of chemical elements occurring in neutral drainage.

3.2.3 Energy intensity and GHG emissions

As a producer of many metals that are critical to the low carbon economy, finding solutions to develop technologies and processes to enable the economic extraction of low grade ores in a sustainable and responsible way can be a focus of the BC Mining Innovation Strategy. This

includes identifying ways to reduce energy consumption, recover waste energy, and reduce emissions. This investment in energy efficiency will become increasingly important as ore grades decrease and/or mining depths increase leading to higher energy requirements per unit of production and potentially increased GHG emissions.

3.3 STRATEGY IMPLEMENTATION

There are different models to implement an innovation strategy. One model is to encourage industry investment in research, development, and innovation (RDI) by industry through incentives and direct investment. A second model is to fund post-secondary and other research institutions to undertake RDI. Alternatively, the province could consider launching a mining innovation hub through which multiple stakeholders connect and collaborate to find solutions to BC-specific resource challenges. Each of these models, discussed below, vary by degree of collaboration and investment.

3.3.1 Incentives and direct investment

Notwithstanding that government already offers competitive corporate tax rates and incentives to the mining industry (see list below for examples), the province could always increase incentives to encourage RDI by industry at a relatively modest cost.

- The small business venture capital tax credit;
- BC scientific research & experimental development tax credit;
- The BC mining exploration tax credit; and
- The B.C. mining flow-through share income tax credit

For example, Western Australia's Innovative Drilling incentive supports explorers through a competitive program which offers $5 million per year of co-funding to innovative exploration drilling projects.

Additional incentives would surely be welcome by the investment community, particularly for capital constrained start-ups and emerging companies in the mining equipment, technology, and services sector (METS). However, it is difficult to conclude that incentives alone would trigger a step-change in mining sector RDI in BC to make the province the leader in commercialization and adoption of step-change mining innovation in Canada.

3.3.2 Fund post-secondary RDI

Government could allocate direct funding to post-secondary and other research to find solutions to BC-specific challenges such as water management, AMD, and energy efficiency.

Historically, RDI in mining and exploration without collaboration with industry has led to poor adoption rates by industry.

3.3.3 Mining innovation hub

The most involved model for the province to implement an innovation strategy is through the launch of a mining innovation hub – or supercluster. A hub would consist of a consortium of stakeholders from industry (both mining sector and non-mining sector), METS, labour, academia, and government that would connect and collaborate to find solutions to BC-specific challenges facing the mining industry.

The concept of an innovation hub is not new. A number of hubs are operating in Canada and globally, including those below. These examples have been put forward as examples of what a BC-based mining innovation hub could look like.

3.3.3.1 The CLEER (Clean, low-energy, effective, engaged, and remediated) Supercluster

The CLEER mining supercluster, was a proposed mining innovation hub, jointly led by the Canada Mining Innovation Council (CMIC) and the Centre for Excellence in Mining Innovation (CEMI), and supported by more than ninety mining related organizations including Goldcorp, Barrick, Teck, Glencore, Vale, and the University of British Columbia[42]. The overarching objective of the supercluster was to be able to help the mining industry to produce minerals in a more responsible and sustainable way with a focus on water use, energy intensity and environmental footprint (key challenge areas facing BC's mining industry), with targets of a 50% reduction in each area by 2027. This would be achieved by engaging with anchor mining companies and the METS sector to accelerate collaborative innovation, stimulate investments exceeding $5 billion, grow the number of SMEs, improve industry productivity, initiate export pathways, and create more than 100,000 jobs.

Although the proposal for funding was ultimately rejected, CLEER's objectives and goals are very much in lined with transformation the industry for the future.

[42] Although short-listed as a final contender for funding under the Federal Government's Innovation Superclusters Initiative, the CLEER proposal was ultimately unsuccessful

3.3.3.2 Sustainable Intelligent Mining Systems (SIMS)

The SIMs European hub, funded by the European Commission, is a consortium of mining companies, equipment and system suppliers, and universities that aims to boost development and innovation in mining through joint activities aimed at creating "Sustainable Intelligent Mining Systems".

SIMS tests and demonstrates new technologies with the overarching objective of strengthening European competitiveness in the mining sector by contributing to lower production costs, minimized environmental impact and minimized mining waste, safer and more attractive working conditions, and highly automated and flexible mining operations. In parallel, SIMS works to increase the acceptance and understanding of mining in Europe, focusing on the social license to operate through communication with society and relevant stakeholders.

SIMS works by joining relevant actors and shortening the time to market for new technologies and processes. Member of the consortium put forward 'work package' proposals that target specific mining and exploration challenges. If a proposal is approved, funding is granted and the work package is conducted jointly by industry leaders, academics, and other subject matter experts at actual operating mines, exploration projects, or other working environments. For purposes of example, examples of two active work packages are presented in Table 24.

Communication and Positioning Work Package
This work-page demonstrates state-of-the-art communication and positioning technology, for use in a mining environment. A versatile, integrated, and highly adaptable network will support communication needs and a variety of techniques will support positioning needs, for all use cases and applications throughout the demonstration mine. Use cases that the communication and positioning should support include real-time people interactions, safety, collection and transmission of sensor and process data, process control, remote operation of machines/vehicles/robots, monitoring, collecting position/location data, other Internet of Things (IoT) machine-type communication, etc.
Battery Powered Mining Equipment Work Package
This work package will demonstrate state-of-the-art clean mobile-mining technology from Epiroc in use in a mining environment. This technology will enable a diesel-free underground mine using mobile machinery powered by battery technology. It will physically demonstrate machines and part of the infrastructure needed for battery powered machines, together forming a solution for (part of) a diesel-free mine. The machines can also be a platform for demonstration of automation solutions where machines interact with each other, mine infrastructure and persons through a modern communication network. The target demonstration mine is Agnico Eagle's Kittilä mine in Finland.

Table 24: Example SIMS work packages

3.3.3.3 Kalgoorlie-Boulder Innovation Hub (Australia)

This Australian hub, funded by the Cooperative Research Centre for Optimizing Resource Extraction (CRC ORE) is a collaboration

between academics, mining services and supply companies, and miners that aims to nurture and progress new mining technologies to revolutionize the way gold and other mineral deposits are exploited for maximum profitability and minimum environmental impact. The location of the hub was selected because of its proximity to several operating mine sites and a range of geological and mineralization styles. Other objectives of the hub include:

- Promote collaboration between all industry stakeholders in the Kalgoorlie-Boulder region (a major mining region in Western Australia), to solve common problems within the mining sector that ultimately improve the economic viability of the industry;
- Demonstrate new technology and innovations in a non-commercial independent environment;
- Provide a pipeline of technologies and methodologies to deliver direct value to operations, suppliers and the community.
- Focus on nurturing innovations and translate leading Australian mining research into real economic outcomes for the region and the country.

Over time, the hub seeks to become a pipeline of technology development that delivers real value to current operations, a mechanism to develop a skilled workforce for the industry, and a centre of excellence for technical knowledge transfer.

3.3.3.4 International Center of Excellence in Mining (Chile)

SMI ICE Chile
The International Centre of Excellence in Chile

In 2013, Chile's Corporación de Fomento de la Producción (CORFO), the Chilean government's economic development organization dedicated to promoting innovation and growth solicited proposals for "International Research and Development Centers of Excellence (ICE)" with a goal of developing R&D centers across a variety of industries and establishing Chile as an innovation hub. Four proposals from multinational companies were ultimately accepted; Emerson (Mining), Pfizer (Life Sciences), GDF Suez (Renewable Energy) and Telefonica (IT and Telecommunications).

Emerson has since established its International Center of Excellence in Santiago to support research and development of products and applications to benefit both Chilean and global mining companies. Research is being conducted in the following areas:

- Developing next generation expert systems to improve mineral processing productivity;
- Applying techniques from other industries to improve mine efficiency and safety;
- Developing new techniques to improve both mechanical and process reliability

3.3.3.5 Quebec Exploration and Processing Hubs

In its 2009 Mineral Strategy, the Québec government stated that technological innovation and the development of new processes would help the industry in Quebec face both environmental and technical challenges while improving its competitiveness. In this regard, it granted financial assistance to a number of organizations, including the following:

- The Mineral exploration research consortium (CONSOREM) based at Université du Québec à Chicoutimi. CONSOREM is a mineral research group focusing on mineral exploration geotechnologies in Québec that provides to industry concepts and modern mineral exploration techniques toll optimise the discovery of new deposits in resource areas and highly qualified specialists in mineral exploration.
- COREM is the largest organization in Canada totally devoted to mineral processing R/D. The organization provides a wide range of mineral processing and analytical services to companies that explore and develop ore bodies and transform or recycle mineral substances.
- The MISA (Mines, Innovations, Solutions and Applications) Group is a network of experts actively engaged in advancing equipment and innovative services to ensure the sustainable and responsible development of the mining industry in Quebec. MISA is the organization officially recognized by the Québec government to oversee the development of the Underground Techno-Mines niche of excellence under the ACCORD (action concertée de coopération régionale de développement) program for Abitibi-Témiscamingue

3.3.4 Important considerations

Looking forward, a business case to evaluate the cost and benefit of a BC Mining Innovation Strategy will be required to inform a government go/no-go decision. Although out of scope of this report, key areas of the business case are briefly described in Table 25.

Element	***Description***
Purpose	Define the reason for which the strategy exists. Each element of the strategy must be aligned to this purpose
Focus areas	Outline the scope of the strategy. Considerations include challenges specific to mining in BC, what areas of the mining value chain to include, what stages of the mining life cycle, commodities to include, etc.
Targets	Define and establish baseline metrics for key focus areas Set targets and goals Establish time horizon
Governance	Map out governance and accountability model. Determine who has ultimate responsibility for strategy success
Stakeholders	Map stakeholders impacted by the strategy and develop an engagement strategy

Operating model	Determine how the strategy will be implemented, for example a hub, investment in RDI, incentives or a combination of each. Evaluate what resources and capabilities will be required to operate the strategy
Estimate costs	Build out cost model based on operating requirements
Funding model	Determine sources of funding to cover start-up and on-going costs
Benefits	Evaluate strategy benefits including economic impact and jobs created Consider qualitative benefits

Table 25: Elements of a business case

APPENDIX 1: LABOUR DEMOGRAPHICS

With over 45% of the world's mining companies headquartered in Vancouver[43] and over $8 billion in mine production value produced in 2017, the mining industry is a key employer in BC.

Profile of the Mining Labour Market

After the commodities downturn through 2013 to 2016, mining employment in BC has rebounded and grown, exceeding initial growth predictions with almost 3,000 jobs gained since 2016 (Table 26). Mine sites directly provide numerous full time jobs with salaries well above the provincial average, and downstream mineral refining and smelting is a major employer set to grow as the market expands. Beyond the scope of this report, the mining sector also employs approximately another 20,000 people in the industrial minerals and downstream processing sectors.

	2010	2011	2012	2013	2014	2015	2016	2017
Employment data								
Metal Mining	3,605	3,320	3,955	4,705	5,515	2,815	2,915	3,420
Coal Mining	3,620	3,875	3,725	4,725	4,285	4,135	4,350	4,745
Exploration	3,450	6,205	6,170	4,690	3,605	3,470	3,295	4,125
Total Direct Employment	**10,675**	**13,400**	**13,850**	**14,120**	**13,405**	**10,420**	**10,560**	**12,290**
Mineral Refining + Smelting	5,274	5,527	4,982	4,463	3,821	3,982	3,694	4,990
TOTAL SECTOR EMPLOYMENT	**15,949**	**18,927**	**18,832**	**18,583**	**17,226**	**14,402**	**14,254**	**17,280**
Earnings data								
Average Annual Salary + Benefits (C$)	92,000	96,600	105,900	107,700	120,900	113,000	112,500	116,000

Table 26: BC Mining Sector Employment, 2010-2017 [44]

Indirectly, the robust mining services and supply sector of BC provides further high-paying full- and part-time employment in areas such as geological research, business administration, finance, management, engineering and environmental consulting, making mining an integral part of the BC labour economy.

The mining industry in BC is made up of a generally older workforce, with 20.2% of workers age 55 and over. Programs such as MineralsEd BC, a teacher-industry partnership created to foster awareness of minerals, mining and geoscience at the elementary school level aimed at increasing

[43] Mining Intelligence, Vancouver is the World's Mining Capital

[44] Statscan Table 36-10-0489-01, Number of Jobs by NAICS industry 1 2

youth interest in the industry appear to have been successful, with a recent upswing in 15-24 year old entrants to the mining workforce.

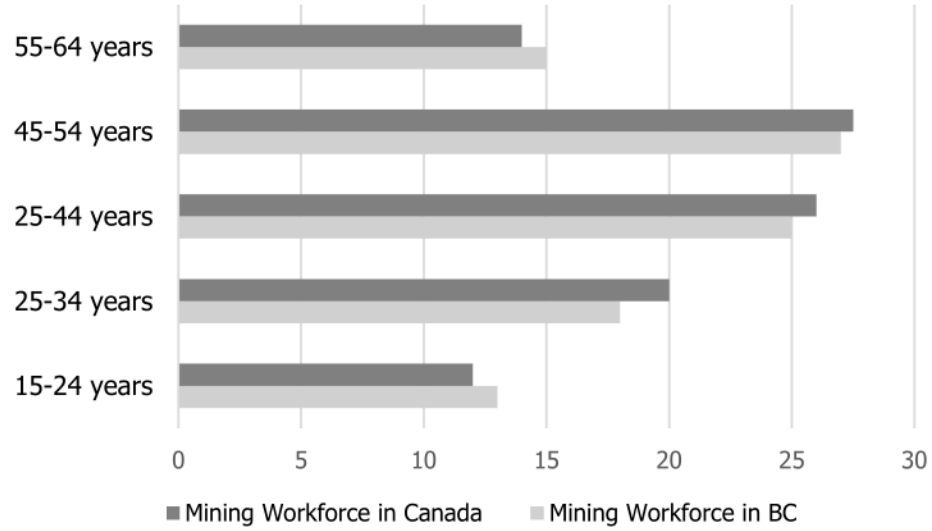

Figure 27 Age Distribution of the Labour Force in BC

Over 25% of mining jobs require a university degree or higher, and fewer than 10% are accessible to those without a certificate, diploma or degree.

Mining employment has traditionally and still remains largely restricted to a single demographic, with approximately 80% of the workforce made up of non-aboriginal men, and representation of women, immigrants and Aboriginal peoples which doesn't match that of the general workforce in BC. BC has historically performed better than the national mining industry (see

Figure 28 below) in employment across these demographics. Each of these demographics are discussed in further detail in the sections below.

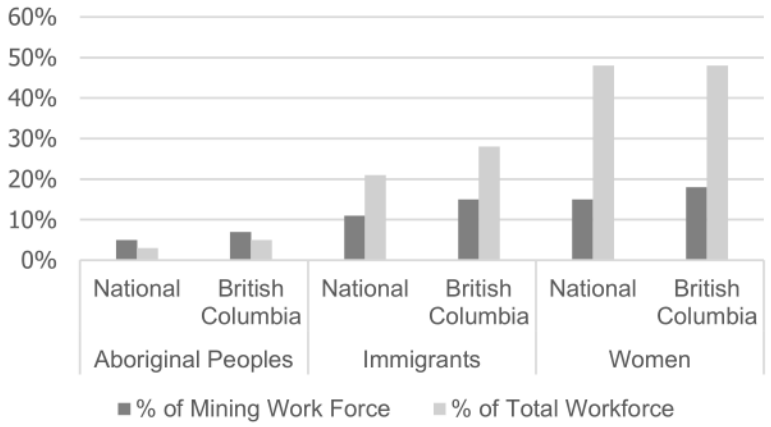

Figure 28 - Demographics of the BC Mining Sector[45]

Aboriginal Peoples

Aboriginal peoples have long been strong participants in the mining industry, with many BC mine sites located close to Aboriginal communities and traditional lands, and historic ties of shared prosperity and labour participation. The BC mining industry outperforms both other industries in BC and the overall Canadian mining industry with indigenous representation at close to 7% of the mining workforce, compared to the approximately 5% in all industries in BC and the national average of 6% in the Canadian mining workforce.

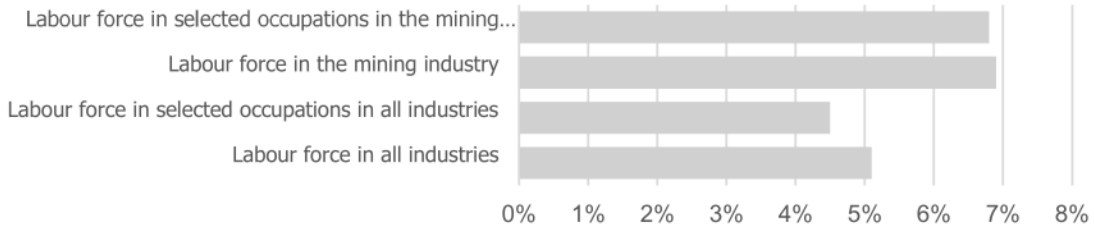

Figure 29 Share of Aboriginal Peoples in BC's Labour Force[46]

Within the Aboriginal workforce, the percentage of workers without a certificate, diploma or degree is significantly higher (33%) than that of the general BC labour market (16%). Programs such as the BC Aboriginal Mine Training Association and the Industry Training Association (ITA) Indigenous Peoples in Trades have been undertaken to provide skills training programs and employment preparation, and these programs appear to be having an impact. Within the BC

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[45] https://www.workbc.ca/getmedia/f7c01e3e-ea59-416b-90aa-2725ebb9c250/Mining_Labour-Market-Outlook-Report-for-BC_Feb-2017.pdf.aspx

[46] Statistics Canada, Census of Canada, 2011

workforce, about 25% of the Aboriginal mining workforce are qualified tradespeople and the number of Aboriginal people taking trades training has more than doubled since 2007. Major mining employers have also creating targeted recruitment campaigns, with one major mining company seeing an increase of the proportion of their workforce who are Aboriginal to over 33%[47].

Immigrants

BC has a larger immigrant population than any province save Ontario, with immigrant workers making up 30% of the total BC labour force. However, the mining industry's share of immigrant workers is only 18%, indicating an under-represented and underutilized source of labour. This discrepancy is not unique to BC, as there are several challenges that impact the sector's ability to recruit immigrants, such as remote work sites disconnected from immigrant communities, lack of recognition of foreign credentials, and poor cross-cultural sensitivity in mining workplaces. BC's involvement of immigrants in the mining workforce remains higher than the national average of 16%.

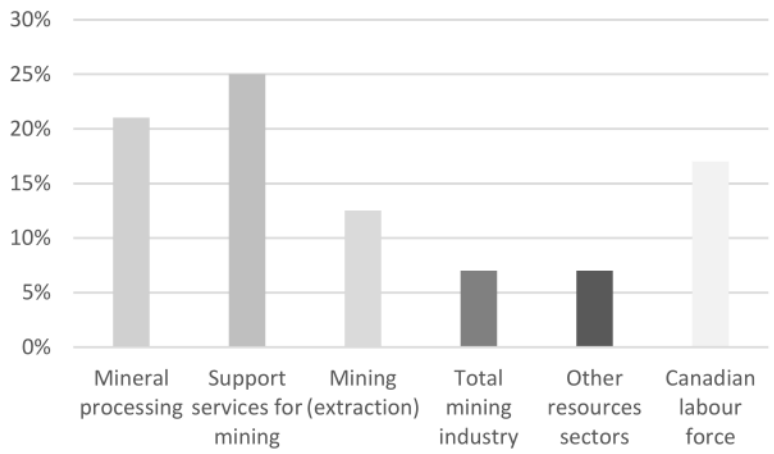

Figure 30 Immigrants as a percentage of the workforce [48]

While many of the immigrants entering BC have attained high levels of education in their home countries, they often end up working in jobs unrelated to their previous training, with only a 22% match rate of occupation to knowledge and training, the second-worst provincial match rate in the country[49]. Given the mining industry's technical demands and high educational requirements, skilled immigrant labour could be an excellent source for meeting the growing demands of the

[47] MiHR, Preparing for the Future: BC Mining Labour Market Outlook, 2016
[48] MiHR, Strengthening Mining's Talent Alloy: Exploring Immigrant Inclusion, 2016
[49] http://www.statcan.gc.ca/pub/75-001-x/2010102/article/11121-eng.htm

industry. As can be seen in Figure 31, BC mining lags behind all other industries in immigrant employment in almost all occupational categories.

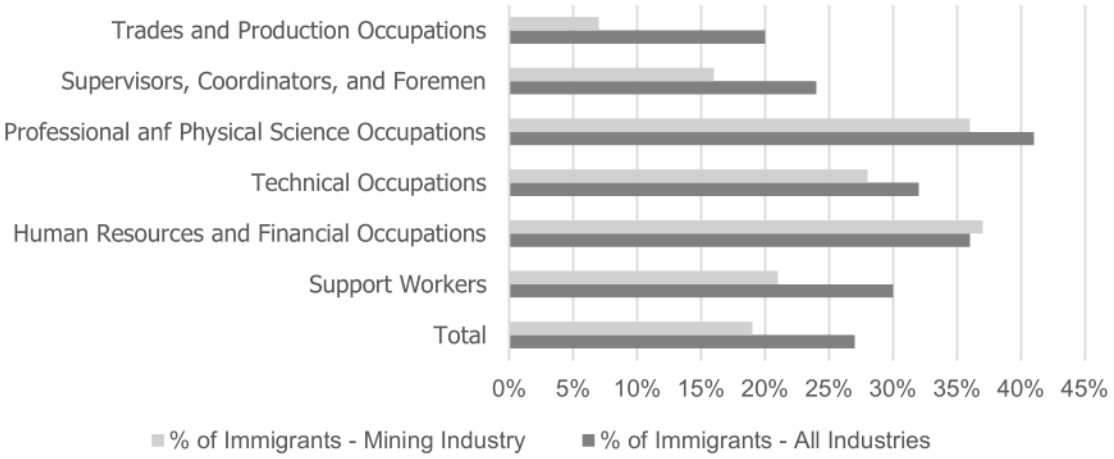

Figure 31 Share of Immigrants by Occupational Category[50]

Several industry and government backed programs exist to encourage and support immigrant participation in the BC mining industry. For example, the BC Skilled Immigrant Info Center hosts an industry profile on mining[51], which provides a guide for immigrants on the demands and opportunities in the BC mining sector, and ITA BC runs a mining training program specifically for immigrants interested in entering mining relevant trades[52].

[50] MiHR, Preparing for the Future: BC Mining Labour Market Outlook, 2017
[51] https://pwp.vpl.ca/siic/industry-profiles/industry-profile-mining/
[52] http://www.itabc.ca/immigrants-trades/overview

Women

While BC outperforms the national mining industry standard for employment of women, the mining industry still lags behind the general labour force rates for employment of women, at roughly 16% compared to the general labour market rate of 47%. The highest concentrations of women in the mining workforce are found in administrative or clerical positions (19%) and mid-level management (16%). Less than 1% of the women employed in the BC mining industry are in roles such as mine supervisor or apprentice tradesperson. Roles with the highest vacancies – heavy equipment operators, tradespeople and labourers – also have the lowest rates of female participation, with less than 5% of these jobs being filled by women.

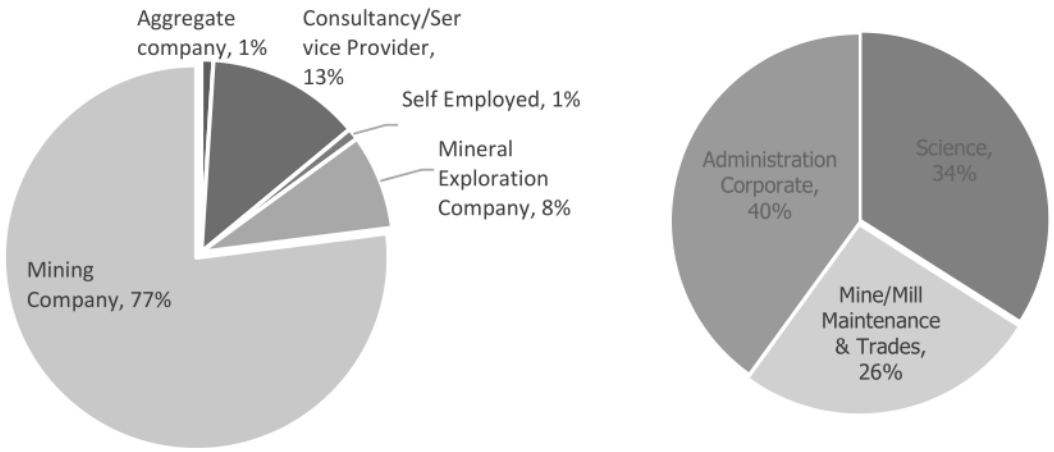

Figure 32 Cross-section of Industry Women, Women: An unmined resource, HoweGroup 2011

Women's participation in the mining workforce has been steadily climbing however, with many companies instituting policy changes in response to the findings of the previous BC Mining HR Task force, creating programs that foster diversity, and initiating targeted hiring campaigns to increase female workforce participation. Data from one of the largest producers in the province shows continued growth, outpacing the current national average of female employment in mining of 14%.

Year	2012	2013	2014	2015	2016	2017	2018 Q2
Female %	13.7%	14.2%	14.0%	14.4%	14.8%	16.6%	17.7%
Male %	86.3%	85.8%	86.0%	85.6%	85.2%	83.4%	82.3%

Table 27: Mine A, All employee types by year and gender

Year	2012	2013	2014	2015	2016	2017	2018 Q2
Female %	12.5%	13.2%	13.3%	13.5%	13.9%	15.4%	16.1%
Male %	87.5%	86.8%	86.7%	86.5%	86.1%	84.6%	83.9%

Table 28: Mine A, Regular full-time employee types by year and gender

Market Forecast

With mine production projected to expand, the workforce demands will similarly rise, with a projected net hiring requirement of almost 20,000 workers, based on projections of growth, retirement, and industry exits.

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

Table 29: BC Cumulative hiring requirements forecast by scenario (2017-2026)[53]

These projections are based on the assumption that for each worker who leaves, the industry will choose to replace them with another worker, rather than substituting more machinery or technology, or offering overtime to remaining workers. Major changes in mining technology, particularly within the last two years, indicate that this practice may no longer be the standard. Projections are mixed on the impact this will have on overall labour market demands, with some forecasting a net elimination of jobs due to the adoption of equipment such as automated trucking, with other analysis indicated that the net number of jobs would stay the same, simply shifting from labour to technology jobs.

This shift to new technologies could offer both opportunities and challenges to the industry. Remote operation work that does not require travel to remote mine sites could open up employment amongst both youth and women, who have cited the isolation and lack of work/life balance on mine sites as barriers to entry[54], and increase the number of roles available in areas like data analytics, opening up urban labour markets. At the same time, many of the jobs replaced by automation have traditionally been filled by the local labour supply of mining communities and Aboriginal peoples. The increased level of technological literacy required for entry-level mining jobs subsequently decreases the possibility of practical on-the-job training. Finally, many of the skills needed for these roles will not be mining specific, allowing recruitment efforts beyond mining

[53] Mining Industry Human Resources Council, (2016)
54 Center for Training Excellence in Mining, Women: An Unmined resource, 2011

specializations but increasing the competition for skilled workers with other industries such as construction. As the mining workforce shifts at least in part to a technology workforce, they will be competing with demands for 47,000 workers across the sector by 2021[55].

55 WorkBC, Tech Talent BC Report 2016

APPENDIX 2: ECONOMICS

This document reports the methodology and results of an economic impact assessment ("EIA") of the BC mining industry. To construct the EIA, we identify all variable and fixed costs that are directly associated with the business activities of the BC mining industry. In particular, we are interested in identifying three types of expenditures:

- ***Operating expenditures*** ("OPEX"): OPEX are the financial expenses a mining company incurs through its business operations related to mining. This includes salaries and wages, machinery, mining extraction operation, exploration operations, taxes, etc.
- ***Capital expenditures*** ("CAPEX"): CAPEX are financial expenses used by a mining company to acquire, upgrade, and maintain physical assets such as machinery, industrial buildings, or equipment. CAPEX is often used to undertake new projects or investments by the firm. This type of financial investment is also made by companies to maintain or increase the scope of their operations.
- ***Number of full-time equivalent employees*** ("FTEs"): FTEs is the number of employees on full-time schedules plus the number of employees on part-time schedules converted to a full-time basis. More specifically, FTE is calculated as the product of the total number of employees and the ratio of average weekly hours per employee to average weekly hours per employee on full-time schedules. The FTE of a company will therefore be lower than the number of its employees on full and part-time schedules, unless it has no part-time employees.

In evaluating the expenditures incurred by the mining industry, we further categorize expenditures under two distinct types of mining operations:

- ***Exploration and development***: Expenditures includes activities of greenfield exploration and exploration of properties under development.
- ***Extraction and processing***: Expenditures includes activities associated with the operations of open pit mines, concentrators, support processing facilities, waste rock and tailings management facilities.

In what follows, we will in detail discuss the operations undertaken at each stage and estimate the associated mining expenditures.

Exploration and development

Based on a survey of 219 firm related to exploration and development across all regions of BC, the operating expenditures in 2017 are estimated to amount to nearly $246 million CAD. The operating expenditures are spend on grassroot explorations (~4%), early stage evaluations (~31%), evaluations (~23%), advanced explorations (~38%) and mine lease (~4%), cf. Figure 33. Similarly the capital expenditures in 2017 are estimated to be nearly 1.16 billion CAD, which include expenditures in mine complex development (~81%), exploration (~11%), and deposit appraisal (~8%), cf. Figure 34.

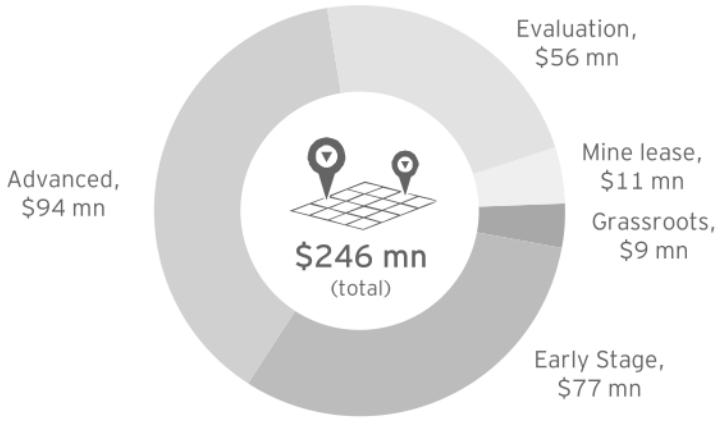

Figure 33: Operating expenditures associated with exploration and development, nominal 2017 prices ($CAD m)

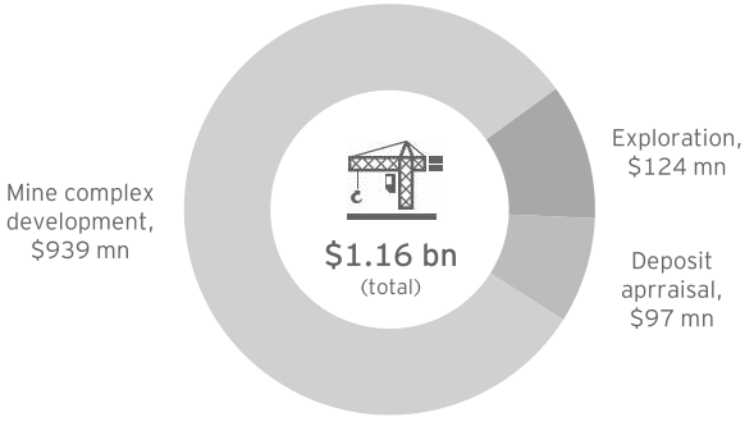

Figure 34: Capital expenditures associated with exploration and development activities, nominal 2017 prices, ($CAD)

Extraction and processing

We have conducted a review of the data currently available based on publicly available sources, e.g. SNL database, Government of British Columbia website, Statistics Canada, Natural Resources Canada, Ministry of Energy, Mines and Petroleum Resources website, and EY's British Columbia Mineral and Coal Exploration Survey data for 2017. Based on this information, we have identified 18 BC mines that was fully or partially operational throughout 2017, cf. Table 30.

Name	Region	Primary commodity	Secondary commodities
Bonanza Ledge	South Central	Gold	-
Brucejack	Northwest	Gold	Silver
Brule	Northeast	PCI Coal	-
Coal Mountain	Southwest	Met Coal	-
Copper Mountain	South Central	Copper	Gold, Silver
Elkview	Southwest	Met Coal	-
Fording River	Southwest	Met Coal	-
Gibraltar	South Central	Copper	Moly
Greenhills	Southwest	Met Coal	-
Highland Valley Copper	South Central	Copper	Moly
Line Creek	Southwest	Met Coal	-
Mount Polley	South Central	Copper	Gold, Silver
Mt. Milligan	North Central	Gold	Copper
Myra Falls	Southwest	Silver	Copper, Zinc, Lead
New Afton	South Central	Gold	Copper, Silver
Red Chris	Northwest	Copper	Gold, Silver
Wolverine	Northeast	PCI Coal	-

Note: The Quinsam Mine on Vancouver Island resumed production of thermal coal in october 2017 after a prior 20 month suspension. Due to limited data availablility, we have not considered this mine in our assessment.

Table 30: Operational BC mining facilities, 2017

The above identified BC mines produce a wide variety of commodities including gold, silver, copper, molybdenum and coal. Based on publicly available information on the production volume of each mine combined with estimates on marginal cash costs of production, we estimate the operating expenditures in 2017 to amount to nearly $4.2 billion CAD, while the capital expenditures amount to approximately 843 million CAD, cf. **Error! Reference source not found.** and **Error! Reference source not found.**.

Assessing the Economic impacts

To analyze the economic impact of the operating and capital expenditures associated with the BC mining industry, we will conduct a comprehensive EIA using detailed data from Statistics Canada as well as the expenditure data presented above, and combine it with our own proprietary EY

economic model (i.e., Economic models founded on the principles of the Input-Output model). As such, our analysis will allow us to capture the impact of the mining industry's business activities to the province of British Columbia.

Using the framework of our Input-Output model, we capture the mining activities' impacts on the BC economy via three distinct impacts; direct, indirect and induced impacts. These impacts individually, and collectively, represent how the industry's activities ripple throughout the economy (Figure 35).

More specifically, we define the impacts as follows:

- The *direct impact* includes the 'incremental' economic impact supported directly by the BC mining industry's business activities. By incremental, we refer only to the directly supported economic impacts from the operating and capital expenditures of mining-related activities that represent additional value-add to the economy.
- The *indirect impact* includes the economic impact from the incremental business activities arising from supporting the business activities of the mining industry. The indirect effect includes, for example, businesses providing maintenance and repairs, in addition to businesses in the construction and supply industries, as well as a number of upstream suppliers in the BC economy.
- The *induced impact* includes the potential supported economic impact that occurs when employees associated with mining-related activities and contractors spend their wages in the BC economy. The induced activity are primarily service related in industries such as retail trade, transport, accommodation, restaurants, housing and finance.

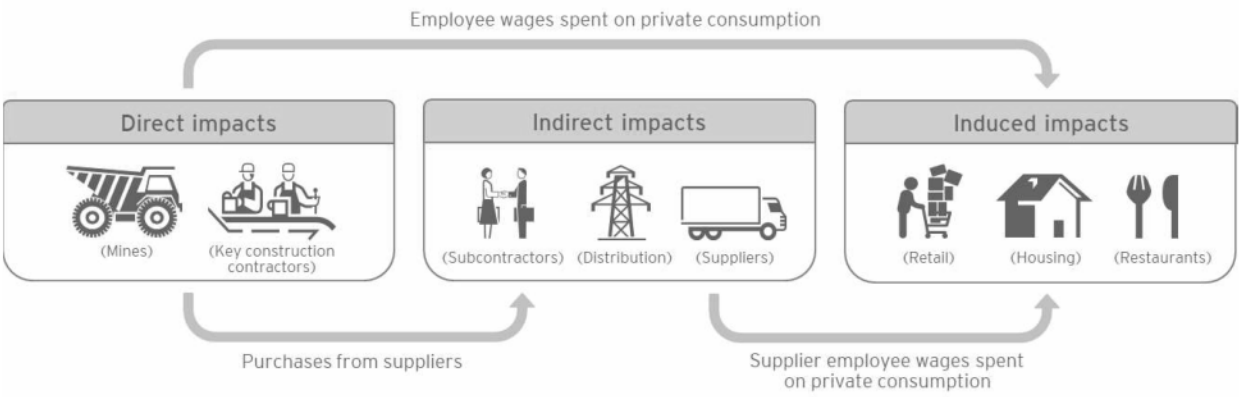

Figure 35: Direct, indirect and induced impacts of BC's mining industry

A static interprovincial input-output ("I-O") model will be used to assess the economic impact supported by the BC mining industry to the BC economy. This method is selected due to its flexibility in providing a reliable, cost efficient way to assess regional impacts. In particular, the I-O model first translates direct impacts into indirect and induced economic impacts, which collectively will define the total economic impact for the province of BC. We will express the economic impacts in terms of the following metrics:

- *Gross output*: The gross output is the broadest measure of economic activity and measures the total value of goods and services produced by a company/industry/country. For example, a company's gross output is equivalent to its total revenues.
- *Gross Domestic Product* ("GDP"): GDP, or local value added, is a measure of the value of all final goods and services produced in a specific region
- *Full-time equivalent employment* ("FTEs"): The number of FTEs measures the number of employees on full-time schedules plus the number of employees on part-time schedules converted to a full-time basis.

For this EIA, the total economic impacts related to the BC mining activities will be estimated using Statistics Canada's most recent interprovincial economic multipliers from 2013. Each of these multipliers is a number that describes the size of the total economic impacts for a given activity. For example, a multiplier of 1.2 suggests that the total economic impact (in dollars) to the BC province for every dollar spent by the mining industry in a given sector equals to 1.2 dollars. Statistics Canada's I-O model is used by both public and private sector organizations and other researchers and is based on widely accepted methodology for estimating these types of economic linkages.

Table 31 presents the specific economic multipliers used for the GDP assessment for each category and commodity. Similar multipliers are obtained for Gross output and employment.

Category	ID name	Direct	Type I	Type II
Exploration & development	Support activities for mining	0.61	1.30	1.62
Extraction and processing:				
Au and Ag	Gold and silver ore mining	0.34	1.96	2.90
Cu, Pb and Zn	Copper, nickel, lead and zinc ore mining	0.46	1.47	1.77
Coal	Coal mining	0.62	1.21	1.38
Molybdenum	Other metal ore mining	0.27	1.91	2.51

Note: The direct, type I and type II multipliers are specific to the province of BC; the Type I muliplier describes the resulting direct and indirect impact for every $1 spent, while the Type II multiplier describes *total* impact for every $1 spent, which includes the direct, indirect and induced effects. Hence, Type II will always be larger than Type I since it includes the induced impacts.

Source: Statistics Canada 2013 interprovincial Input-Output multipliers.

Table 31: Indicative 2013 GDP multipliers for the BC mining industry, by category

Based on the industry specific economic multipliers above, we estimate the economic impact based on the primary commodity for each mine and their associated expenditures. For example, the total economic impact to the BC province supported by the local mining industry amounts to $9.7 billion CAD, cf. Table 32. The total economic impact of $9.9 billion in gross output is comprised of $6.4 billion in direct impact, indirect impacts of $2.0 billion and $1.5 billion in induced impacts. In other words, the BC mining industry's business activities support an additional $3.5 billion output to the BC economy.

Considering the GDP contribution, the BC mining industry directly contributes $3.6 billion CAD in GDP to the BC economy and supports an additional $2.1 billion CAD in indirect and induced impacts.

Lastly, the BC mining industry directly employs approximately 12,522 BC employees and supports an additional 20,242 through the indirect and induced impacts to the BC economy.

($ millions)	Direct	Indirect	Induced	Total
Output	6,417	2,031	1,457	9,906
GDP	3,614	1,121	953	5,688
Employment (No. of FTEs)	12,522	11,181	9,061	32,765

Table 32: Summary of the economic impact of the BC mining industry, 2017

Incremental Impact of an Additional BC Coal Mine

As requested for this EIA, we further estimate the potential economic impact of introducing an additional coal mine within the province. In doing so, we consider the average operating and capital expenditures in 2017 associated with the seven existing and fully-operational coal mines in the province, i.e. Brule, Coal Mountain, Elkview, Fording River, Greenhills, Line Creek, and Wolverine. Based on the same survey and publicly available information used above, the average operating expenditure for the seven coal mines amounts to $ 365.0 million CAD and the average capital expenditures $ 128.6 million CAD. Based on the economic multipliers presented in Table 31 associated with coal mining, we estimate the following impacts:

($ millions)	Direct	Indirect	Induced	Total
Output	493.6	118.6	78.5	690.7
GDP	306.0	64.3	52.0	422.3
Employment (No. of FTEs)	639	594	488	1,720

Table 33: Economic impact of an additional Coal mine in BC, 2017

The total economic impact to the BC province supported by an additional and fully-operational coal mine amounts to $691 million CAD, cf. Table 33. The total economic impact of $691 million in gross output is made of $494 million in direct impact, indirect impacts of $119 million and $79 million in induced impacts. In other words, an additional coal mine introduced to the BC mining industry supports an additional $691 million in output to the BC economy.

Considering the GDP contribution, the additional coal mine would directly contribute $306 million CAD in GDP to the BC economy and supports an additional $116 million CAD in indirect and induced impacts.

Lastly, the additional coal mine would directly employ approximately 639 BC employees and supports an additional 1081 through the indirect and induced impacts to the BC economy.

APPENDIX 3: EMISSIONS INTENSITY

An important aspect to consider when measuring the performance of the BC mining industry is **greenhouse gas (GHG)** emissions intensity. For the purposes of this study, emissions intensity refers to the average **Scope 1 emissions** rate of **carbon dioxide equivalent (CO2e)** relative to production (represented in tonnes). Emissions intensity provides a normalized way to compare and understand energy and emissions performance since emissions change relative to mining activity and production.

All mining operations in British Columbia emitting over 10,000 tonnes of CO_2e (tCO_2e) per year are required to report their emissions to the Province per the *Greenhouse Gas Emission Reporting Regulation 2016.* Operations emitting over 25,000 tCO_2e/year are required to have their emissions reports externally verified (audited). Reported emissions include all Scope 1 emissions, which includes all emissions controlled by the company within the boundary of the operation.

Scope 1 emissions intensity for BC's mining industry were calculated on a per facility basis from 2010 to 2015 (the years for which data is currently publically available). Calculated emissions intensities are represented separately for coal mines and metal mines due significant differences in mining processes and emission sources, as described in the sections below.

All coal mines in BC that meet the reporting threshold have reported their emissions to the Province and as such, a comprehensive calculation of emissions intensity for coal mines was performed. However, some metal mines that meet the emission threshold have not reported their emissions. Available emissions data for metal mines from 2010 to 2015 represents between 70-83% of all metal mine production in the province, depending on the reporting year.

As discussed in section 1, metal and coal mines have also opened and closed in BC during the 2010-2015 period. Some mines also did not consistently report emissions during this period. To account for any distortion of overall emissions intensity resulting from mines where data is not available for the entire study period, additional analysis was undertaken for only for those mines that have been operating and reported emissions during the entire 2010-2015 period.

Emissions intensity variations

It is important to note that emissions intensity will vary mine to mine, year to year, for a variety of reasons. Changes to emissions intensity could result from:

- *Ore grade:* Higher grade ore requires less energy for processing, while lower grade ore requires more processing, impacting emissions. Ore grade can vary mine to mine, and can also vary over the life of mine.

- *Other metallurgical properties:* specific properties including the level of oxidation, mineral texture and hardness influence the amount of energy needed for crushing and the type and intensity of additional metallurgical processing required.

- *Mining processes and equipment:* Mining processes vary significantly depending on the metal or material being produced, as well as for open pit and underground mines. Materials requiring more processing will generally result in more emissions. The efficiency of stationary and mobile equipment can also vary mine to mine.

- *Pit size/mine footprint:* As mines age and the pit or underground mine increases in size, haul trucks need to go further to extract the rock, thereby using more fuel and increasing emissions.

Coal Mine Emissions Intensity

For coal mines, Scope 1 emissions comprise emissions relating to general stationary combustion occurring at site (e.g. emissions from combustion engines for large equipment or heating for site buildings), mobile equipment that is part of the facility (e.g. emissions from transport vehicles such haul trucks), and fugitive emissions associated with the release of methane from coal that is exposed to the atmosphere during mining.

Total emissions intensity for coal mining from 2010 to 2015 ranged from 0.049 to 0.065 tCO_2e for every tonne of coal produced. When compared over time, emissions intensity increased slightly from 2010 to 2012 and remained fairly consistent from 2013 to 2015.

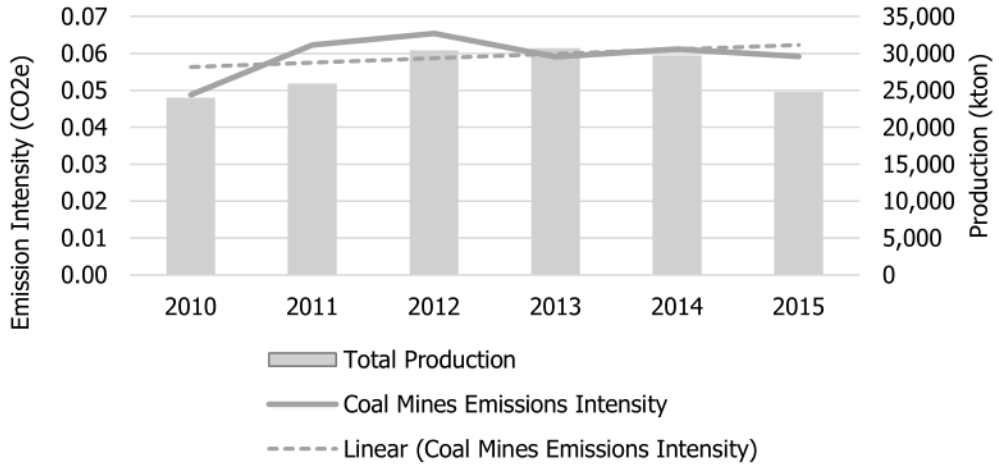

Figure 36: All coal mines - emissions intensity

It is important to note that fugitive emissions associated with the release of methane from coal exposed to the atmosphere make up approximately 25% of total emissions, depending on the mine. These emissions will be fairly consistent over time, relative to production since there is little operators can do to reduce these emissions save for reducing their stock piles. When analyzing emissions intensity for coal mines excluding fugitive emissions, a downward trend line demonstrates decreasing emissions intensity relative to production over time.

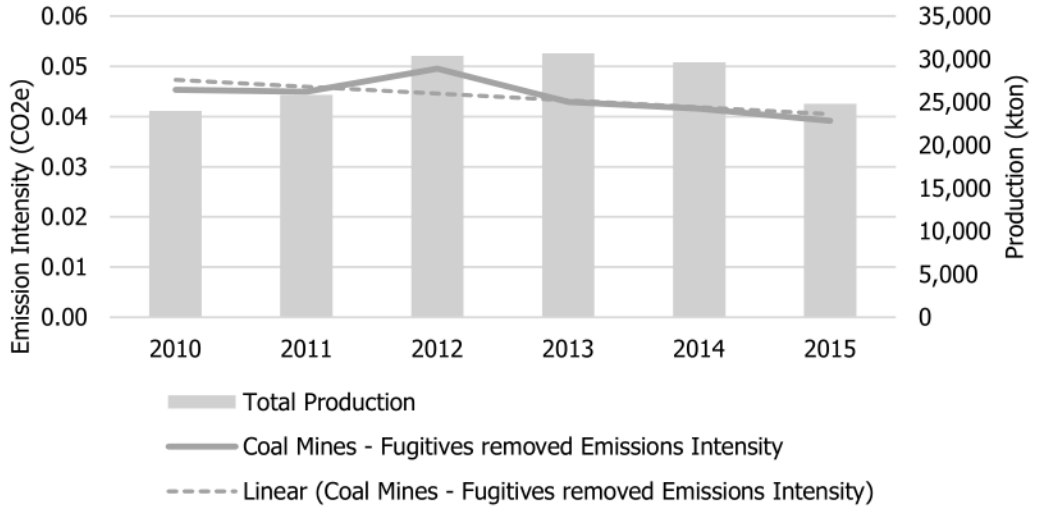

Figure 37: All coal mines - emissions intensity, fugitives removed

The number of coal mines that reported emissions during the 2010-2015 period ranged from a peak of ten coal mines in 2013-2014, to just six coal mines in 2015. To account for variations in emissions intensity from mine to mine, the data is also presented below for the five largest mines that operated and consistently reported emissions during the 2010-2015 period. When broken down by mine, trends in emission intensity are less apparent and appear to very mine-specific. Emission intensity has remained fairly consistent over time for some mines, and has decreased slightly for others.

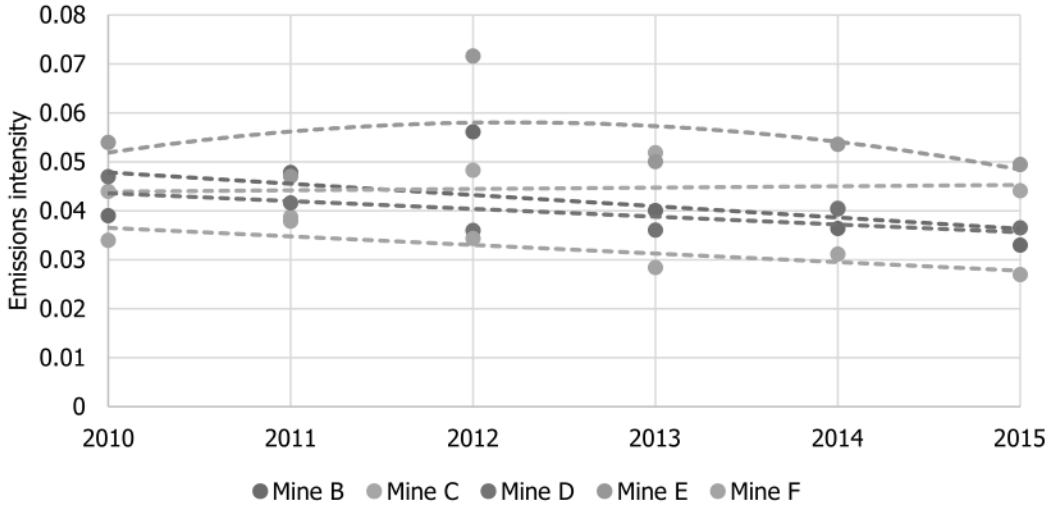

Figure 38: Emissions intensity by mine - fugitives removed

Metal Mine Emissions Intensity

Metal mines operating in BC that have reported emissions produce copper, gold, silver, lead, zinc and molybdenum. Metal mining is generally more energy intensive than coal mining due to the energy use during beneficiation. Like coal mines, metal mine Scope 1 emissions include emissions from general stationary combustion and mobile equipment (e.g. haul trucks). However, little to no fugitive GHG emissions are emitted from these processes, mine faces or stockpiles.

Since emissions intensities differ depending on the metal produced, an analysis was performed for copper mines only[56] to compare emissions intensity among mines and identify emissions intensity trends specific to copper, which is the primary metal produced in BC. Copper mine emissions ranged from a high of 1.52 to a low of 1.26 tCO_2e per tonne of copper produced over the 2010 to 2015 period. The emissions intensity for the copper mines trends down with time.

[56] Mines were considered copper-producing if the majority metal produced was copper. By-products such as gold and silver produced were converted to tonnes of copper equivalent and included in total production numbers.

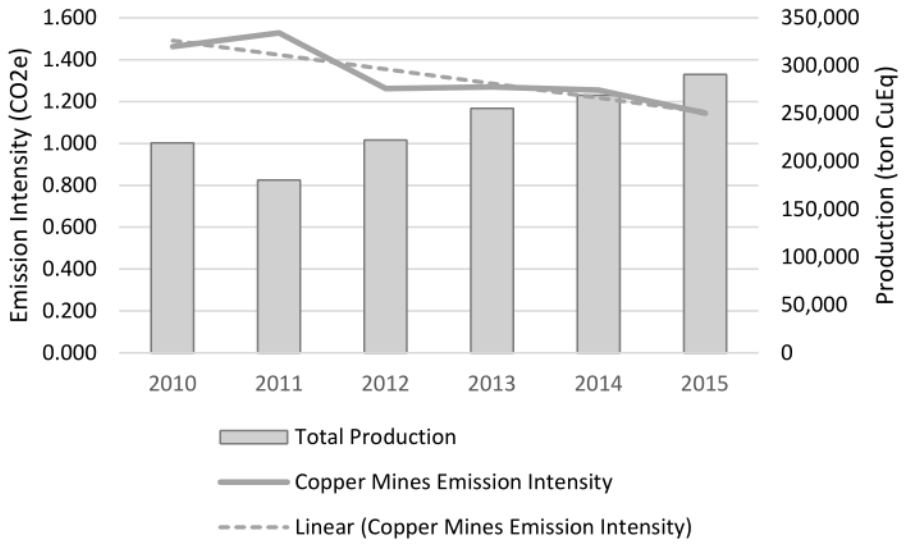

Figure 39: Copper mines - emission intensity

It should be noted that New Gold's New Afton mine opened in 2012 and is significantly less emissions intensive than the other operating copper mines in BC. As a result, when New Afton's emissions are included in the calculation of total emissions intensity, the emissions intensity for all BC copper mines decreases significantly. This may explain the downward trend in emissions intensity after 2012. However, when examining the emissions intensity for the three copper mines that operated and reported emissions for the entire 2010-2015 period, trends in emissions intensity are not apparent. Emissions intensity for one mine has remained largely flat, decreased slightly for another, and increased significantly for another.

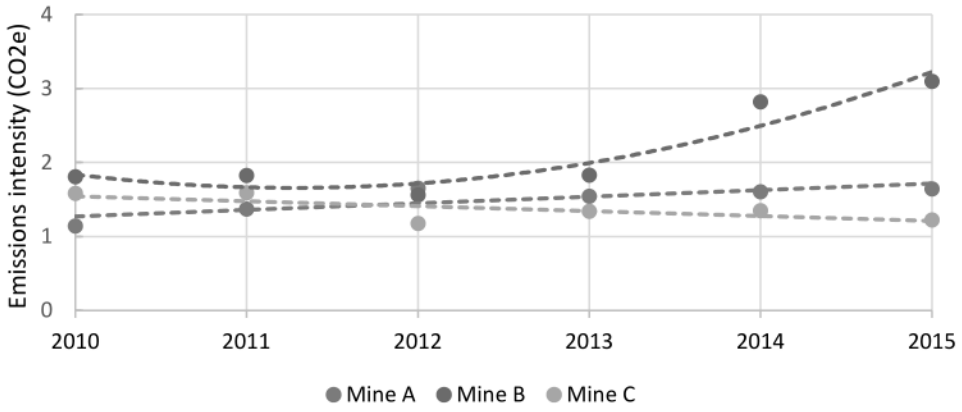

Figure 40: Copper mines emissions intensity - by mine

Emissions intensity trends and expectations for future performance

As seen in the calculations above, emissions intensity can vary over time, mine to mine, for a variety of reasons. Some mines may become more emissions intensive over time as ore grades degrade and the mine increases in size - even if that mine has implemented more energy efficient processes or upgraded their equipment to become more fuel efficient. As a result, emissions intensity as calculated above does not necessarily explain if the industry is becoming more energy efficient. In order to fully understand if the BC mining industry is becoming more efficient, baseline emissions data must be examined to understand what emissions would have been under a business as usual scenario (without any improvements to energy efficiency). This data is currently not publically available. The absence of this data and the lack of any identified trend in emission intensity also makes it difficult to anticipate how emissions intensity will trend in the future.

We do know that a number of mining companies in BC have implemented various energy savings and emissions reductions initiatives over the 2010-2015 period, and that these initiatives are likely to continue in future. Mining companies may choose to invest in energy efficiency initiatives for a variety of reasons, including cost savings. For example, a number of mines in BC converted liquefied natural gas (LNG) as fuel for their haul trucks, replacing full diesel usage with a diesel/LNG blend. LNG is both a cleaner and more cost-effective fuel compared to diesel. Recent changes to the *BC Greenhouse Gas Reduction (Clean Energy) Regulation* now also provide further incentive for mining companies to switch more of their haul trucks to LNG, as the government has implemented a program to incentivize up to 75% of the total incremental cost of conversion. The proposed *Clean Growth Incentive Program for Industry* will also provide additional funds for emissions reduction initiatives.

As technology advances and less intensive processes and equipment become more economically viable, we can expect emissions to decrease relative to a business as usual scenario. In particular, the electrification of mining (both mining equipment and power supply) is expected to take hold given the significant savings in energy, fuel and maintenance costs. The subsequent improvement in GHG emissions performance is also expected to be considerable, especially in those cases where electricity comes from renewable and green power sources.

Comparing carbon intensity of mining in BC to other jurisdictions

In order to understand if the carbon intensity of the mining industry in other jurisdictions could be calculated and compared to BC industry emissions intensity, EY reviewed what emissions data and information is readily available in other jurisdictions. To calculate carbon intensity, comprehensive facility- or industry-level Scope 1 emissions data must be reported and be publically available, as it is in BC. A summary of the emissions reporting requirements for mining industry and the availability of comparable emissions data in each jurisdiction is outlined in the table below.

Jurisdiction	Facility-level emission reporting regulation in place?	Reporting threshold (tonnes of CO2e/year)	Comparable emissions data to BC publically available?	Explanation
BC	✓	10,000		Comprehensive, Scope 1 emissions are available by facility, from 2010-2015.
Yukon	✓	10,000 for the 2017 year; 50,000 prior to 2017	×	The Yukon does not have a provincially-mandated emissions reporting regulation, however, mining operations in the territory are required to report to Canada's Greenhouse Gas Reporting Program (GHGRP). Since the emissions reporting threshold prior to the 2017 reporting period was higher than BC, historical provincial data may not be comprehensive and comparisons would not be possible. Provincial and facility comparisons from 2017 onward will be possible; however, the data is not yet publically available.
Ontario	✓	10,000	×	The requirements and scope of *Ontario regulation 143/16: Quantification, reporting and verification of greenhouse gas emissions* (which came into effect in 2017) and its predecessor, *Ontario Regulation 452/09 Greenhouse Gas Emissions Reporting* (which came into effect in 2010) are similar to BC's reporting framework, however facility and mining specific data is not publically available.

				Comparable emissions data will be available for 2017 onward through the federal GHGRP, however the data is not yet publically available.
Quebec	✓	10,000	×	The requirements and scope of *Quebec regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere* emissions is similar to BC's reporting framework, however facility and mining specific data is not publically available. Comparable emissions data will be available for 2017 onward through the federal GHGRP, however the data is not yet publically available.
USA*	✓	25,000	×	The United States Environmental Protection Agency (EPA)'s Greenhouse Gas reporting Program only covers underground coal mines. Coal surface mines and other mines are not covered by the program. Publically available data related to emissions of the mining industry at the national- and state-level are estimated using models.
Chile	×	N/A	×	Chile does not have any facility- level reporting requirements. Publically available data related to emissions of the mining industry are estimated using models.
Australia**	✓	25,000 for facilities and/or 50,000 for corporations	×	Australia's *National Greenhouse and Energy Reporting Act (NGER)* requires controlling corporations that meet facility level or corporate thresholds to report their emissions each year. Total Scope 1 and 2 emissions per controlling corporation are published. Australia also publishes Scope 1 emissions by industry, including a breakdown for coal mining and metal ore mining. However, a detailed breakdown of emissions sources and facilities covered is not provided.

* Nevada and Alaska do not have state-specific emission reporting requirements. Applicable mining facilities in these jurisdictions are covered by the USA EPA GHG reporting program.
**Western Australia and Queensland do not have state-specific emissions reporting requirements. Applicable mining facilities in these jurisdictions are covered by the NGER.

Table 34: Emissions reporting requirements in key jurisdictions

Although the Governments of Ontario and Quebec gather comparable Scope 1 emissions data for the mining industry in their provinces (and also notably require external verification for facilities emitting over 25,000 tCO_2e – an added level of scrutiny ensuring the quality and robustness of the data), historical and current facility-level emissions data is not publically available. Industry-level data is not disaggregated for the mining industry.

Certain mining operations across Canada (including select facilities operating in the Yukon, which does not have its own provincial reporting requirement) are also covered by Canada's *Environmental Protection Act 1999,* which requires facility-level emissions reporting through the national Greenhouse Gas Reporting Program (GHGRP). Although facility-level information has been published for 2016, the GHGRP's previously established reporting threshold was 50,000 tCO_2e/year. Since mines emitting under this threshold were not required to report, the data may not be comprehensive. However, the Government of Canada recently lowered the threshold for reporting to the GHGRP to 10,000 t CO_2e/year for the 2017 reporting period. As a result, Canadian comparisons in carbon intensity across provinces and territories (and by facility) will be possible for 2017 onwards once this data becomes publically available. Comparisons should note that although Environment and Climate Change Canada reviews the data submitted to the GHGRP and conducts quality checks for compliance purposes, the information reported does not need to be verified by a third party and may not be as accurate as the information reported to the Province of BC.

The Governments of Chile, the United States, and the States of Nevada and Alaska do not have comprehensive facility-level reporting requirements for the mining industry. While industry or sector-specific emissions data is included in these countries' national GHG inventories, these emissions are calculated using modelling tools. As a result, comprehensive and robust data does not exist to calculate comparable carbon intensity for the mining industries in these jurisdictions.

Australia's *National Greenhouse Gas and Energy Reporting Act* (NGER) requires controlling corporations[57] with facilities that emit more than 25,000 tCO_2e/year to report their emissions. Similarly, corporations who emit more than 50,000 tCO_2e/year (with or without triggering facility thresholds) are required to report for all of its facilities. Corporate-level Scope 1 and 2 emissions are published with some exceptions[58] and Scope 1 data is also made available by industry and state, including a breakdown for coal mining and metal ore mining. However, the data is not broken down by facility or by source. As a result, one cannot be certain of all the facilities that report (especially given the higher emissions threshold) and therefore know what production numbers the emissions should be compared against. Therefore carbon intensity cannot be reliably calculated for Australia.

[57] Australia's Clean Energy Regulator defines a "controlling corporation" as a constitutional corporation that does not have an Australian incorporated holding company.

[58] Corporate emissions information may not be published if corporations: 1) do not meet reporting thresholds; 2) do not meet publication threshold; 3) have not submitted their report in time for publication; or 4) have applied under section 25 of the NGER Act to have all or part of its greenhouse gas emissions and energy consumption totals withheld from publication.

Comparing scope 2 (indirect) emissions

Although carbon intensity comparisons to other jurisdictions have not yet been completed, some assumptions can be made around the anticipated results should such a study be undertaken. As described in the previous section, Scope 1 emissions intensities, including emissions intensity relating to stationary combustion and mobile equipment, will likely vary from mine to mine and year over year, largely based on the mine plan. As a result, different jurisdictions may not show clear trends in their Scope 1 emissions intensities.

Scope 2 emissions intensities, on the other hand, could vary significantly jurisdiction to jurisdiction depending on the local source of electricity. Mines use electricity for processes such as crushing and grinding; pumping water and other solutions; and conveying. For example, scope 2 emissions intensities for a mining company would be lower if their electricity was sourced primarily from and clean and renewable sources, including hydro, rather than fossil fuels such as natural gas, oil or coal. The overall mix of fossil fuels also needs to be considered, since different fossil fuels result in varying concentrations of greenhouse gas emissions (natural gas being a "cleaner" fossil fuel, with less carbon emissions relative to other fossil fuels such as coal).

In order to understand the anticipated results of Scope 2 emissions intensities across mining jurisdictions, EY identified the composition of the electrical grid in each jurisdiction. However, it is important to note that some mines are not connected to the grid and rely on other sources for their electricity (most often diesel generators, which would be accounted for in their Scope 1 emissions).

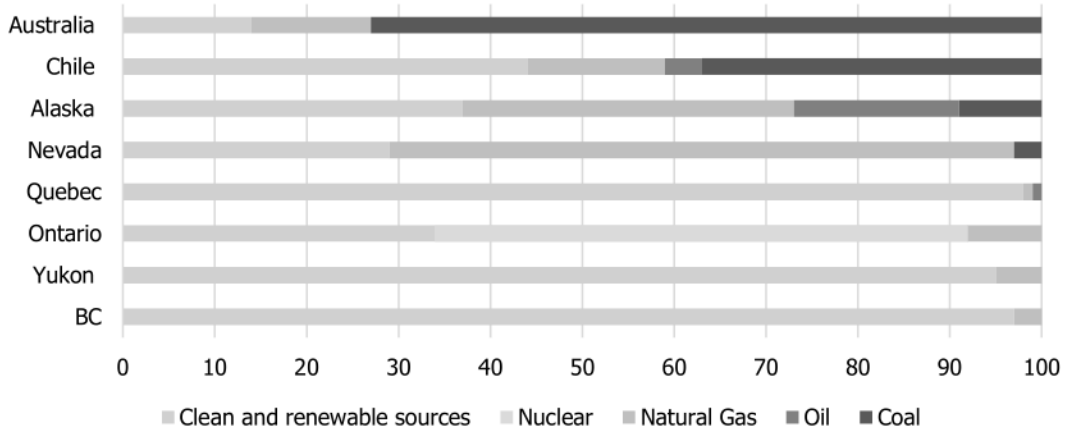

Figure 41: Electricity by source

BC benefits from abundant clean energy sourced for electricity, primarily from large hydroelectric projects. In BC, over 97% of electricity comes from clean or renewable sources, with the remaining 3% coming from natural gas and other sources. This is comparable to other Canadian provinces and territories including Yukon and Quebec, both of which rely heavily on

hydroelectricity. Ontario's electricity, while more carbon intensive than BC and Quebec, is also relatively low in carbon since it is sourced from 60% nuclear (a low carbon form of energy), 30% hydroelectricity (clean) and 10% natural gas.

However, when compared to other international jurisdictions such as Nevada, Alaska, Chile and Australia, British Columbia stands out for its clean electricity grid. Nevada's grid is 68% natural gas, which although has a lower carbon emissions relative to other fossil fuels, still has much higher carbon emissions than BC's clean grid. Both Alaska and Chile have a diverse electricity grid comprised of a mix of sources, including clean and renewable resources, but the majority of these grids are still comprised of fossil fuels including natural gas, coal and oil. The starkest contrast between electricity grids is in comparing BC's electrical supply with Australia's, where electricity is sourced overwhelmingly (73%) from burning coal.

Another way to understand the impact of electricity sources on Scope 2 emissions is to look at the emission factors, or average amount of CO_2e discharged into the atmosphere for each kWh of electricity, in each of the jurisdictions. As demonstrated in the table below, emissions for electricity generation in all other jurisdictions are higher than in BC, with the exception of Quebec. In the case of Queensland, Australia, electricity emissions are 78 times higher than in British Columbia. As a result, Scope 2 emissions for mining in BC will be far less intensive than Scope 2 emissions for mining in these jurisdictions, and particularly Australia.

Country	Province, State or Territory	Emission factor for electricity generation (gCO_2/kWh)[59]
Canada	BC	10
	YT	48
	ON	40
	QC	1.6
US	NV	183
	AK	199
Chile	Chile (national)	Varies by region – between 355 and 895
Australia	Queensland	780
	Western Australia	720

Table 35: Emission factors for electricity generation

[59] Emission factors are for 2015, with the exception of Chile, where emission factors are provided for 2011. Sources: Canada's National Inventory Report, U.S. Energy Information Administration, Pontifica Universidad Catolica de Chile, Government of Australia.

APPENDIX 4: COMMUNITY WELL-BEING

Socio-economic impacts of mining

Mining development can cause positive, negative, direct and indirect impacts to nearby communities. Negative impacts can include population influx and migration, social and cultural disruption, strain on housing stock, strain on public infrastructure and services, increased crime and substance abuse, inequitable distribution of wealth and poor child development and education outcomes. Positive socio-economic benefits, such as employment rates, salaries, and higher standards of living can lead to significant positive impacts but can also have negative impacts if improperly managed. To avoid, mitigate and improve the social outcomes of mining development governments can take a variety of approaches.

Socio-economic effects management plans

The environmental assessment process is the primary tool for governments to consider if, where and how a development is appropriate for a particular context and to ensure that projects proceed without adversely disturbing ecosystems, communities and economies. However, unlike many environmental components, for which environmental protection plans and follow-up monitoring are often legally prescribed, traditionally there have been few regulatory requirements or policies guiding proponents in the management of socio-economic impacts[60]. In recent years, socio-economic effects management plans (SEEMPs) and other conditions to Environmental Certificates can fill this gap and offer a means for government to use the project approval process to identify, appraise and mitigate adverse social impacts on communities. These plans and conditions can also provide an important framework within which all stakeholders, including government, the mining industry and the community, can have input into the decision making process[61].

SEEMPs in British Columbia

BC's EA process ensures that environmental, economic, social, heritage and health effects that may occur during the lifetime of a major project are thoroughly assessed. The EAO scopes EAs on a case-by-case basis, taking into consideration the unique aspects of each project and the context in which it is being proposed (e.g., proximity to communities, size of workforce). In cases where substantial socio-economic effects are associated with a project, the EAO can require project proponents to develop and implement plans to monitor and manage socio-economic effects, as a legally binding condition of the Environmental Assessment Certificate (EAC)[62]. To date, such conditions have been applied to over ten EACs. For example, such conditions have been recommended for a number of projects including mining projects such as the Baldy Ridge Extension, Red Mountain Underground Gold, Kemess Underground and Brucejack Gold Mine.

Five LNG project EACs also include relevant conditions requiring the certificate holders to produce socio-economic effects management plans (SEEMPs). These conditions were developed to address a very unique situation wherein the projects proposed concurrent construction schedules

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[60] Bohlken et al (2017). *Socio-economic effects management planning in British Columbia, Canada- A new era*

[61] Franks and Varclay (2013). *Social Impact Management Plans: Innovation in corporate and public policy*

[62] Other conditions and plans range from requiring ongoing information-sharing with local stakeholders to requiring an adaptive management approach to monitoring the efficacy of social economic effects mitigations set out in the Application.

that would require large temporary workforces, at times in close proximity to smaller rural communities. These five conditions were intended specifically to address the potential impacts of the construction workforces on local infrastructure and services and were designed to meet the following three objectives:

- monitoring adverse effects,
- adaptive management if required, and
- facilitation of broader discussion to ensure information sharing amongst environmental assessment certificate holders, service providers and First Nations.

The Ministry of Community, Sport and Cultural Development (now referred to as the Ministry of Municipal Affairs and Housing) has developed guidelines for preparing a SEEMP for community-level infrastructure and services related to LNG projects. For these projects, the purpose of a SEEMP is to clarify the proponent's role in identifying, communicating, quantifying and mitigating socio-economic effects on community-level services and infrastructure that are directly related to the construction of their project. SEEMPs aim to not only help mitigate adverse impacts on community infrastructure but also provide clarity and engagement opportunities for all parties regarding the timing of project activities and mitigation plans. Project proponents must engage early and on an ongoing basis with local government, indigenous groups and government agencies that will be affected by the project construction and development. The organizations engaged, their level of engagement, and the engagement approach may vary depending on the project-specific infrastructure and services effects identified[63].

SEEMPs generally include details on the proponent's engagement approach; a consolidated list of the effects and mitigations on community-level infrastructure and services as referenced in the SEEMP condition; a description of the monitoring approach and how results will be shared; and a description of the reporting approach.

Certificate Holders must prepare SEEMP reports at intervals appropriate to the project, including at the completion of project construction which summarizes the process and outcomes of the SEEMP. SEEMPs are intended to be adaptable to new project information, changed project plans and changes in external factors and can be amended with approval by EAO.

The EAO approves or accepts each SEEMP or SEEMP-like plan, as set out in the condition, and ensures Certificate Holders comply with their conditions and the processes set out in the plans including adaptive management processes. In regard to the LNG SEEMPs, the Ministry of Municipal Affairs and Housing supports the EAO by providing recommendations to EAO on the adequacy of the SEEMP as well as guidance and advice to Certificate Holders and other organizations engaged in the SEEMP process.

Other SEEMP-like conditions, like those recommended for Baldy Ridge, Kemess Underground and Brucejack gold mine vary, depending on the potential for social effects, largely emphazing sharing information with local stakeholders and Indigenous groups and responding to issues with varying degrees of monitoring and reporting.

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[63] BC Government, Ministry of Community, Sport and Cultural Development, *Guidelines for Preparing a Socio-Economic Effects Management Plan for Community-Level Infrastructure and Services related to LNG projects*

The Province's EA revitalization process, which is described in Section 2.5.3, includes recommendations for increased requirements for social impact assessment, although it does not include specific recommendations to social conditions and monitoring plans.

SEEMPs jurisdictional scan

EY undertook a jurisdictional scan to identify requirements for SEEMPs or similar in other jurisdictions and found that while most EA processes require proponents to identify and mitigate social impacts related to environmental factors (for example, health impacts), legislated requirements for the development of SEEMPs are not prevalent in most mining jurisdictions. The most relevant example is Queensland, which has required mining proponents to identify, manage and monitor social impacts from 2008. The requirements and characteristics of social impact management plans (SIMP) in Queensland and SEEMPs in BC have been summarized in the table below. Queensland SIMP requirements have also been described in more detail in the following section.

	Required for all major projects in EA assessment	Requires a social impact assessment	Focused on any relevant social impacts identified	Facilitates engagement with affected stakeholders	Identifies impacts and mitigations	Requires proponents to monitor and report on progress	Identifies shared responsibility for impact mitigation
Queensland SIMP	✓	✓	✓	✓	✓	✓	✓
BC SEEMP	× *To date, SEEMPs have only been required for LNG projects in northern BC*	× *Impacts are identified during the application review stage*	× *Focused primarily on impacts to community infrastructure*	✓	✓	✓	× *EAO does not have authority to impose conditions on other government agencies*

Table 36: SEEMPs in BC and SIMPs in Queensland

Other notable approaches to identifying and mitigating community impacts have also been identified. In addition to Quebec's development of an environmental register (discussed in Section 2.4.4), the Australian states of New South Wales and Victoria require community engagement plans and the development of consultative committees. These examples are discussed in detail in the follow section.

It should be noted that South Africa also requires social and labour plans to be developed for all mines operating in the country. This requirement has been implemented with limited success and for that reason will not be described in detail. In addition, EY observed that many leading mining companies already have their own internal functions to manage and monitor social impacts. The International Finance Corporation (IFC) also requires environmental and social management plans for all projects they finance. This study focuses on government-led requirements only.

Social impact management in Queensland – History

Queensland requirements relating to social impact assessment and management have evolved since the state first required all mining and petroleum industry proponents undertaking new or expanded resource projects to develop a social impact management plan (SIMP) in 2008. The purpose of the SIMP was to establish the roles and responsibilities of proponents, government, stakeholders and communities throughout the life of the project in the mitigation and management of social impacts and opportunities during construction, operation and decommissioning of major resource development projects. Proponents were responsible for identifying impacts and undertaking monitoring, while responsibility for mitigation actions could be shared with other stakeholders including government agencies. However, the initial SIMP guidelines were very prescriptive and in July 2013 a new social impact assessment (SIA) guideline was developed. This guideline was less prescriptive and more focused towards outcome-focused conditions and commitments.

The SIA guideline was updated a third time in 2018, in accordance with the *Strong and Sustainable Resource Communities Act 2017 (SSRC Act),* which was developed in response to a government review panel's recommendations aimed at further improving the outcomes from large resource projects for workers and regional communities. In addition to requiring large resource projects to employ people from nearby communities and prevent discrimination against residents when employing for the project, SSRC included a legislative requirement for SIA to be undertaken for all projects being assessed under the *Environmental Protect Act 1994* as part of the Environmental Impact Statement (EIS) process. Previously, conditions could only be imposed on large and complex projects being assessed under the *State Development Public Works Organisation Act 1971*.

Queensland SIA requirements & structure

According to the 2018 guidelines, SIA must consider the full lifecycle of the project and address the following key matters: community and stakeholder engagement, workforce management, housing and accommodation, local business and industry procurement, and health and community well-being.

A SIA should provide a clear understanding of the potential impacts of the project and must also consider impact significance and potential cumulative effects. Once potentially significant social impacts have been identified, the proponent, in consultation with potentially impacted communities and other stakeholders, must develop a SIMP which is to be documented in the SIA and submitted along with the EIS application. A SIMP should include detail on the proposed management measures, timeframes for implementation, roles and responsibilities, stakeholders and potential partnerships.

Proponents are required to monitor the implementation of their SIMP throughout the project lifecycle. Monitoring aims to track progress and assess the appropriateness and effectiveness of the management measures; assess the actual project impacts against the potential impacts identified in the SIA; and facilitate engagement, consultation and collaboration with stakeholders.

A SIA expertise function resides in the office of the Coordinator-General which manages the SIA evaluation and conditions the EIS process. The Coordinator-General helps to convene cross-agency reference groups; considers stakeholder submissions on the SIA report, and evaluates and decides on the adequacy of the SIA. The government can also impose conditions to manage

a social impact, require compliance reporting by proponents, and perform monitoring and enforcement of ongoing compliance.

Other practices to identify and mitigate impacts

In addition to conditions and plans to manage social impacts, governments can encourage community consultation to mitigate impacts through other means associated with the environmental assessment and other permitting processes.

In New South Wales, Australia, the Department of Planning and Environment can decide if a Community Consultative Committee (CCC) should be established for a specific project, either early in the assessment process or following approval through the conditions of approval for the project. If a proponent's community engagement strategy accords with best practices, there may not be a need for a CCC.

Consultative Committees provide a forum for discussion between proponents and representatives of the community and local council on issues directly relating to a specific project. The committees allow the community to seek information from the proponent and give the proponent feedback on the development and implementation of projects to assist with the delivery of balanced social, environmental and economic outcomes. Committees are comprised of an independent chairperson, community and council representatives and up to three representatives from the proponent, including the person with direct responsibility for environmental management of the project.

In Victoria, Australia, the *Mineral Resources (Sustainable Development) Act* specifies that licensees have a duty to consult with their community across the entire lifecycle of a licence. The Act also requires that community engagement plans are prepared to document the commitments that a mining company or prospective licensee has made to engage with the community. Community engagement plans must clearly identify relevant communities and describes how, when and what engagement will occur and forms part of the mining work plan that is approved by government. It should include proposals to:

- identify communities likely to be impacted by mining activities of the licensee
- identify community attitudes and expectations with respect to mining
- provide information to the community
- receive feedback from the community
- analyse community feedback and consider community concerns
- register, document, and respond to complaints and other communications from members of the community

Community engagement plans are subject to the same approval processes as a new work plan or work plan variation and are monitored by an Earth Resources Regulation Inspector.

Other best practices to support community well-being following the EA process include legislative requirements for workforce make-up, community participation in environmental monitoring, and targeted funding to resource communities. These practices are identified below.

Jurisdiction	Description of program	Details

Queensland	*The Strong and Sustainable Resource Communities Act 2017,* which commenced in March 2018, bans major mining operations of 100 employees or more from flying in 100% of their workforce. It also prevents discrimination against locals when recruiting and terminating workers through amendments to the *Anti-Discrimination Act* 1991and prioritizes local and regional recruitment, then recruitment of workers who will relocate and live in nearby communities.	Mines may be required to provide relevant information regarding its operational workforce. The Coordinator-General can require owners of large resource operations to submit an operational workforce management plan to ensure the project does not have a 100% FIFO workforce. If a person feels they have been discriminated against during the recruitment or termination process because they are a resident, the person may lodge a complaint with the *Anti-Discrimination Commission of Queensland.*
Quebec	In 2015, the Government of Quebec amended the *Regulation respecting mineral substances other than petroleum, natural gas and brine* to ensure greater social acceptability around mining projects. The amendments stated that mining companies must establish a monitoring committee to foster the involvement of the local community within 30 days after a lease being issued. The committee must be maintained until all the work set out in the rehabilitation and restoration plan related to the mining lease has been completed.	Committees must include at least one representative of the municipal sector, one representative of the economic sector, one member of the public and one representative of a first nations communities consulted by the Government with respect to the project, where applicable. All members must be from the region in which the mining lease is granted and a majority of them must be independent from the lessee.
Western Australia	The Pilbara Cities Program uses mining royalties to benefit isolated communities in the Pilbara region, which host a significant proportion of Australia's natural resource developments. Due to recent mining and related industrial activities, the Pilbara region has undergone a period of rapid population growth, and there are not housing, services, and infrastructure amenities to meet demand. The government of Western Australia committed $1.7 billion through Royalties to Regions Pilbara Cities Initiative to revitalise the region and prepare for long-term growth and sustainability. Investment is directed towards four key areas: community projects and engagement, land availability and development, economic diversification and infrastructure coordination.	To date, $1.4 billion has been invested in projects that are in progress or completed in the areas of community infrastructure, housing support, health, education and town revitalisation. In October 2015, the Pilbara Regional Investment Blueprint was released, which builds upon the success of the Pilbara Cities Initiative and formalizes the aspirations for continued growth and prosperity. The blueprint is a roadmap to achieve a new vision for the region, with a population target of 200,000 by 2050.
Chile	The city of Calama, located in Antofogasta, is recognized as the mining capital of Chile. However, the city suffers from the impacts of mining, with high socio-economic inequalities and poor quality of life. To address these challenges, the Calama Plus program was formed, supported by the local government and 10 companies. The initiative, planned from 2012-2025, considers projects in the areas of infrastructure and urban development, environmental protection, local heritage, and educational improvement. All projects are intended to stimulate a more sustainable and livable community. Similarly, Antofogasta was seen as an unattractive city. Despite being close to many mines, workers preferred to live elsewhere and to travel to Antofogasta for	Calama Plus is now developing several of the projects identified. In 2014, Creo Antofogasta developed a social baseline and created a master plan for sustainable urban development, with a completion data of 2035.

	rotating work periods. Creo Antofagasta is another public-private initiative, supported by the local government and over 60 organizations and companies, including mining organizations, to engage local citizens and make the city of Antofagasta an inclusive, sustainable, clean city. Both initiatives were spearheaded by a large mining company, which then built an alliance with the local government.	

Table 37: Best practices to support community well-being, following EA and permitting process

APPENDIX 5: CARBON TAX

BC Carbon Tax

BC's broad based carbon tax, which applies to the purchase and use of fossil fuels, was implemented in 2008 and is a key component of the Province's plan to meet its GHG reduction targets. The tax is currently set at $35/tonne and will rise by $5 a year until 2021 (to $50/tonne).

Originally, the tax was designed to be revenue neutral, and as such corporate and income taxes were lowered when the carbon tax was put in place. However *Budget 2017 Update,* which included the announcement of planned carbon tax increases to 2021, also eliminated the requirement for the carbon tax to be revenue neutral[64]. The corporate tax cut was rescinded and increased to pre-2008 levels of 12%. Revenue from carbon tax now supports low- and middle-income families and funds other programs and initiatives, including a proposed *Clean Growth Incentive Program* to help support large industrial emitters, including mining in BC[65].

The Province is currently consulting on the *Clean Growth Incentive Program* (which is part of a larger clean growth strategy that will be released in the fall). The program includes two initiatives:

- A performance benchmark will be established based on the lowest emitting facility in that sector. An industrial incentive worth up to 100% of the carbon tax paid beyond $30/tonne will be paid out, depending on how well their GHG intensity compares to the benchmark. The benchmark has yet to be set.
- A Clean Industry Fund that invests revenues from industrial carbon taxes directly into emission reduction projects. Initial investments from the fund will help facilities to implement emissions reduction projects where additional funding is need to justify the business case.

Quebec Cap and Trade

Quebec's cap and trade system is intended for companies in the industrial and electricity sectors that emit over $25,000 tCO_2e per year. The system is linked with California's carbon market and is collectively known as the Western Climate Initiative carbon market.

Cap and trade systems are designed differently from carbon taxes in that they are a trade–based method to price carbon. The government of Quebec sets a cap on the total number of emissions units that are put in circulation each year. The cap is dropped gradually each year to encourage emissions reductions. In this system, the carbon price is determined at quarterly auctions and is influenced by supply (the cap) and demand. To date, there have been a surplus of emissions allowances that has resulted in a carbon price that has followed the floor price, which is set annually and escalates at 5% plus inflation. The current price is approximately $20/tonne. Increases are expected to follow the floor price until sometime in the mid-2020s, when cumulative allowance shortages are expected to occur, triggering an increase in the price off the floor[66].

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[64] Ministry of Finance, *Building a Better BC for Everyone*
[65] *Ibid*
[66] ICF Consulting (2017). *Long-term carbon price forecast report*

In Quebec, EITE industries receive most of the emissions units they need free of charge. Specific data on the amount of free allowances that are allocated to each company is not publically available, but it is very likely that the current average carbon price paid by EITE industries on all emissions is far less than the stated price of $20/tonne once free allowances are considered. While the number of free units allocated will drop each year through to 2023 to encourage emitters to further cut GHGs, Quebec has stated that future decreases in GHG allowances will be modulated according to the evolution of carbon pricing on a global scale (e.g. if carbon pricing worldwide stagnates, free allowances will stay more or less at the same level; on the other hand, if carbon pricing initiatives increase worldwide, free allowances may continue to decrease)[67].

Ontario – Federal Backstop

On July 3, 2018, Ontario revoked its existing cap-and-trade regulation and prohibited the trading of emission allowances. Additionally, Premier Doug Ford announced that Ontario would intervene in Saskatchewan's court reference case challenging the federal government's right to impose a carbon tax on provinces that don't comply with its climate change plan[68]. While the court reference case has yet to be heard, EY analysis has been conducted on the assumption that Ontario will be covered by the federal carbon price backstop, which is in draft form and is expected to come into effect on January 1, 2019.

The proposed federal backstop includes an output-based pricing system (OBPS) for industrial facilities that emit 50,000 tCO_2e or more per year, with opt-in capability for smaller facilities with emissions below the threshold. The OBPS only applies the carbon pollution price to the portion of a covered sources of emissions that exceeds a certain number of allowed emissions. Annual emissions limits will be based on the activities a facility undertakes and represent best-in-class performance. Originally, the government proposed setting the benchmark at 70% of average emissions performance, but the benchmark was adjusted to 80% following industry consultation feedback related to competitiveness concerns[69].

Facilities that emit less than its annual limit will receive surplus credits from the Government of Canada. Facilities that exceed their annual emissions limits can either:

- pay the carbon price, which will be set at $20/tonne in 2019 rising to $50 tonne in 2022;
- use eligible carbon offset credits;
- use surplus credits received for facilities that emitted less than their regulated limits.

Australia and Chile

In 2012, Australia implemented a carbon tax. The scheme covered industrial emitters and was designed as a carbon tax that would convert to a cap-and trade program after three years. However in 2014 the Liberal-National coalition government led by Tony Abbott repealed the carbon tax. There are no plans to re-introduce a tax at the time of writing. Moreover, Australia's

[67] Government of Quebec (2018) *Quebec's cap and trade system in brief*
[68] CBC News (2018). *Ontario joins Saskatchewan in opposing federal carbon tax plan*
[69] CBC News (2018). *Liberals plan to soften carbon tax plan*

mining companies can take advantage of fuel tax credits for fuel used in heavy vehicles such as diesel, further reducing the cost of fuel in Australia[70].

Chile has a minimal carbon tax of $5/tonne specifically targeting the power sector, with a focus on generators operating thermal plants. While the tax may impact the cost of power to some mining operators, it is not a direct tax on industry.

[70] Commonwealth of Australia (2018) *Fuel schemes: Mining*

APPENDIX 6: GEOLOGICAL SPEND

We have attempted to identify the annual expenditure of geological surveys across five jurisdictions. Data was only available for 3 of the five jurisdictions – Ontario, Quebec, and Queensland (Table 38).

Jurisdiction	Agency	Description	Annual Spend
BC	British Columbia Geological Survey	The Survey has 28 staff and is headquartered in the provincial capital, Victoria, with a second office in Vancouver to serve the mineral exploration industry.	
QC	Ministère de l'Énergie et des Ressources naturelles du Québec	Headquartered in Québec City, and with a staff of 200 people	$15.5M, (88% coming from royalties and the rest from general government budgets)
ON	Ontario Geological Survey (OGS), a branch of the Ministry of Energy, Northern Development & Mines	The Survey has 115 staff and is headquartered in Sudbury; eight satellite offices throughout the province serve the mineral exploration industry.	~$20 million (2018 – 2019)
Chile	Servicio Nacional de Geología y Minería (SERNAGEOMIN)		$200 million
Queensland	Geological Survey of Queensland		n/a
Western Australia	Geological Survey of Western Australia (GSWA)		n/a

Table 38: Geological survey annual expenditure (provided direct by geological surveys)

APPENDIX 7: TAXES AND ROYALTIES

A. Mining Tax Regimes

The mining industry is a highly cyclical and capital-intensive. As there is a long lead time between the initial investment and commercial production, the Canadian federal and provincial (mining) tax systems generally treat exploration and other intangible mining expenses generously.

The Canadian mining tax regime allows mining companies to recover most of their initial capital investment before they need to pay significant taxes. The federal and provincial income tax regimes also include generous loss carry-over rules that help mitigate the negative financial effects of fluctuating prices. A full analysis of the respective mining tax systems is beyond the scope of this report, however below we have provided a summary of the mining tax regimes in BC and the other jurisdictions selected for this report.

British Columbia

The British Columbia Mineral Tax Act (BCMTA), together with the mineral tax regulations (the regulations), imposes BC mineral taxes on income earned from mining operations in the province. Under the BCMTA, a person that is an operator must pay a tax on a mine-by-mine basis in respect of each fiscal year of the mine.

The mineral tax under the BCMTA is imposed in two stages:

- 2% of the operator's net current proceeds derived from the operation of the mine; and
- 13% of the operator's net revenue derived from the operation of the mine.

The 2% tax on net current proceeds is a form of minimum tax in that any mine that is more than covering its current operating costs is subject to this tax. If a mine is not recovering its operating costs, the tax will be zero and no tax is payable. The 2% tax on net current proceeds is deductible as a credit against the 13% net revenue tax in the current year or in future years. In fiscal years when there is no net revenue, the 2% tax on net current proceeds is added to the cumulative tax credit account and carried forward to subsequent fiscal years with an allowance for interest.

The primary tax is the 13% net revenue tax, which is collected only when the operator's revenue exceeds its operating costs, qualifying capital costs, and a normal return on investment over the life of the mine. This is achieved by incorporating all allowed deductions, both operating and capital, into a single deduction pool with carry-forward provisions. Due to the credit mechanism mentioned above, only one tax or the other is paid.

Ontario

The Ontario Mining Tax Act (OMTA), together with the Mining Tax Regulations, imposes Ontario mining taxes. Ontario mining taxes are generally based on profits generated from production from mines in Ontario and are imposed on every operator of a mine in Ontario for a taxation year.

A tax rate of 10% is applied to an operator's taxable mining profits in computing mining taxes. This rate is reduced to 5% for mining operations that are eligible to be treated as a remote mine. The first $500,000 of annual mining profits are exempt from mining tax. In addition, Ontario

provides a tax holiday on the first $10 million of mining profits, effective for the first 3 years from production start-up, extended to 10 years for remote mines.

Mining profits are generally determined as revenue less operating expenses, deductions for capital (via depreciation allowances), exploration and development expenses and a processing allowance.

Quebec

Mining tax in the province of Quebec is imposed under the Quebec Mining Tax Act (QMTA). Generally, Quebec mining tax is owed, for a fiscal year, by every operator in respect of its annual profit from mines situated in Quebec for that fiscal year. Every operator must pay, for a fiscal year, duties equal to the greater of its mining tax on its annual profit and its minimum mining tax, as follows;

- mining tax on annual profit levied at progressive tax rates ranging from 16% to 28%, based on the operator's profit margin; and
- a minimum mining tax whose basis is the mine-mouth output value (MMOV)

Profit margin is calculated by dividing annual profits by the gross value of output (revenue) from the mine.

Mining profits are generally determined as revenue less operating expenses, deductions for capital (via depreciation allowances), exploration and development expenses and a processing allowance.

An operator's minimum mining tax is equal to the aggregate of the following amounts:

- The rate of 1% multiplied by the lesser of all amounts each of which is the operator's MMOV for the fiscal year in respect of each mine it operates during that year, and its reduced-rate taxable amount (i.e., the first $80 million of MMOV); and
- The rate of 4% multiplied by the amount, if any, by which the aggregate of all amounts each of which is the operator's MMOV in respect of each mine it operates during the fiscal year exceeds its reduced-rate taxable amount (i.e., the amount in excess of $80 million of MMOV).

MMOV is calculated as gross value of output (revenue) less prescribed deductions similar to the calculation of mining profits but limited to expenses incurred that relate to output value at the mine-mouth activities.

- To encourage development in northern regions of Quebec the provincial mining tax regime allows mines located in designated areas of the province to claim an incentive deduction in computing annual mining profits once the mine reaches production. This allowance equals the lesser of: an operators annual earnings from the mine; and
- $2 million for "Near North" mines and $5 million for "Far North" mines

Western Australia

Mineral royalties for Western Australia are collected under either the *Mining Act 1978 (WA)* or various State Agreement Acts which have been negotiated for major resource projects.[71]

State Agreements are contracts between the Western Australian Government and proponents of major resource projects, and are ratified by an Act of State Parliament. The State Agreements specify the rights, obligations, terms and conditions for the development of a project, and establish a framework for ongoing relations and cooperation between the State and the project proponent.

Western Australia uses two systems of mineral royalty collection:

- Specific rate – calculated as a flat rate per tonne produced (applied only to bulk materials and coal that is not exported); and
- Ad valorem – calculated as a proportion of the 'royalty value' of the mineral or at a percentage of the contained metal or mineral value for some commodities such as nickel and rare earths.
    - The royalty value is broadly calculated as the quantity of the mineral in the form in which it is first sold, multiplied by the price in that form, less any allowable deductions.
    - The nickel and rare earths royalties are calculated based on the value of the mineral contained in the product sold.

Western Australia has a three-tiered royalty rate structure, comprising of:

- a 7.5% rate for minerals subject only to limited processing prior to sale;
- a 5% rate for minerals processed to and sold as concentrates; and
- a 2.5% rate for minerals processed to and sold as a metal.

Queensland

Mining tax for Queensland are imposed under the Mineral Resources Act 1989. Depending on the mineral, the royalty rate payable under the Mineral Resources Regulation 2013 is either a percentage of the value of the mineral or a flat rate per tonne.[72]

For base metals and precious metals the rate is a variable rate between 2.50% and 5.00% (varying in 0.02% increments) of value, depending on average metal prices

For coal an average price per tonne for the particular period is calculated:

Average price per tonne for period (i) Up to and including $100 - 7% of value; (ii) Over $100: and up to and including $150 - First $100 - 7% of value, balance - 12.5% of value (iii) More than $150: First $100 - 7% of value, next $50 - 12.5% of value, balance - 15% of value. The rate is calculated separately for domestic (within Queensland) and non-domestic sales.

Chile

The fiscal regime that applies in Chile to the mining and metals industry consists of a combination of corporate income tax (CIT) and the specific tax on mining operations. The corporate income

[71] Government of Western Australia, Department of Treasury https://www.treasury.wa.gov.au/Treasury/Publications/State_Taxes/

[72] Queensland Government, https://www.business.qld.gov.au/industries/mining-energy-water/resources/minerals-coal/authorities-permits/payments/royalties/calculating/rates

tax rate depends on the elected tax regime. For fiscal year 2018 onward, its rates are 25% for the attributed system or 27% for the semi-integrated system.

The specific tax on mining activities is levied on mining companies and is applicable to the operational mining income of the taxpayer. The rate varies depending on the amount of the annual sales and the mining operational margin of the taxpayer:

- If annual sales are less than the equivalent of 12,000 refined copper tons: exempt
- If annual sales are more than 12,000 but less than to the equivalent of 50,000 refined copper tons: 0.5 to 4.5%
- If annual sales exceed the equivalent to 50, 000 refined copper tons: effective rate varies from 5% to14%, depending on the mining operational margin. Mining operational margin is defined as the ratio of the net operating mining income divided by the mining revenues.

B. Incentives

We have highlighted the key incentives in BC and have indicated other key incentives that we have found in Ontario and Quebec. Western Australia, Queensland and Chile allow for certain basic incentives such as accelerated depreciation, however, they do not provide incentives similar to the incentives provided in Canada.

Exploration phase

Overview of the key incentives that BC provides in relation to the exploration phase:

- In addition to the federal tax credit, BC allows for a 20% non-refundable tax credit for flow-through shares.
    - For several decades now, resource companies have been able to issue flow-through shares to finance their exploration activities. Flow-through shares have long been a preferred method for many corporations that may otherwise have found it difficult to raise financing. Under the flow-through share regime, a resource company may obtain financing for exploration and development by offering investors shares that give the investors the opportunity to obtain the benefit of tax deductions associated with exploration and development expenditures. In most cases, the tax deductions are considered more valuable to the investors than to the corporation incurring the expenditures. Junior mining companies issue flow-through shares to finance their exploration and development activities. However, larger corporations may also issue flow-through shares.
- The BC Mining Exploration Tax Credit ("BC METC") is a cash refundable tax credit of 20% on qualified mining exploration expenses in the province of BC. A higher rate of credit of 30% is available to exploration in areas affected by the mountain pine beetle, which covers approximately 85% of BC.

Other Jurisdictions

Overview of the key incentives that other provinces and jurisdictions provide in relation to the exploration phase:

- Ontario provides a 5% refundable tax credit on flow through shares for Ontario resident individuals who purchased eligible flow-through shares from a corporation that has a permanent establishment in Ontario.
- Quebec offers a refundable tax credit for eligible exploration expenses. To qualify, companies must have an establishment and operate a business in Quebec. Quebec provides a distinction between operating and non-operating corporations.
    - For non-operating corporations the rate of the refundable tax credit is 28% of eligible exploration expenses incurred by non-operating corporations (38.75% when expenses are incurred in Québec Near-North and Far-North);
    - 12% for corporations operating a mineral resource (18.75% when expenses are incurred in Québec Near-North and Far-North).

- In Chile, exploration expenses are considered as organization and start-up expenses, which may be amortized for up to six years starting from the date expenses were incurred or when the company earns income from its main activity.
- In Australia, the Junior Minerals Exploration Incentive (JMEI) encourages greenfields mineral exploration in Australia. JMEI allows companies that participate to transfer tax losses to exploration credits. These credits may be passed onto Australian resident shareholders as either a franking credit or refundable tax offset depending on the investor profile. Although not part of the tax regime in Queensland and Western Australia, the following programs provide incentives for mining exploration:
    - In Queensland, the Strategic Resources Exploration Program[73] is aimed to boost exploration and support for resource development projects. The program funding is helping to expand resource exploration and development for gas and minerals in North West Queensland.
    - In Western Australia, the Exploration Incentive Scheme (EIS) is a State Government initiative to encourage exploration in Western Australia for the long-term sustainability of the State's resources sector.[74] The goal is to stimulate increased private sector resource exploration, leading to new mineral and energy discoveries. supports five high-level programs, including: (1) innovative exploration drilling (2) geological surveys (3) 3D prospectivity mapping (4) encouraging exploration through cover (5) promoting strategic research with industry.

Incentives for operation, new mine development and existing mine expansion

- The BC New Mine Allowance. The purpose of the new mine allowance is to encourage new mine developments in BC. In addition to the inclusion of 100% of the costs mentioned below, the allowance also provides for an inclusion to the cumulative expenditure account ("CEA") account of an additional one-third of the following costs:
    - costs of capital assets acquired, including amounts paid or payable under a capital lease or the rental cost of capital assets, for the purpose of the production of minerals from a mine, or for the distribution of the mineral product from that mine, and used directly in the administration of that particular mine; and
    - costs incurred, before the mine came into commercial production, for the purpose of bringing the mine into commercial production, including costs for clearing, removing overburden, stripping, sinking a mine shaft, and constructing an entry to an underground mine.

Other Jurisdictions

[73] https://www.dnrme.qld.gov.au/mining-resources/initiatives/strategic-resources-exploration-program

[74] http://www.dmp.wa.gov.au/Petroleum/Exploration-Incentive-Scheme-2251.aspx

- In Ontario, the mining tax treatment differs if it is determined that an operator is performing work in respect of a remote mine. The key criteria to be considered to be a remote mine is that it is at least 30 kilometers between the pit's mouth of the mine and the nearest all-weather road or railway suitable to meet the transportation requirements of the mine.
    - If a mine is considered to be an open mine then a 5% tax rate (versus 10% for non-remote mines) is applied to an operator's profit from all remote mines in which the operator has an interest.
    - A 10-year mining tax holiday (versus a 3-year mining tax for non-remote mines) applies for new mines opened in remote locations in Ontario after January 1, 2001, subject to an exemption limit of $10 million for each new mine.
- In Ontario, an operator may generally reduce its taxable mining profits by claiming a processing allowance where the processing facilities are situated in Canada. Processing means, with respect to mineral substances, any form of beneficiation, concentrating, smelting, refining, fabricating of metallic mineral substances, manufacturing of non-metallic mineral substances, and any combination of these processes. The annual processing allowance is based on the cost of processing assets and the degree of processing achieved and is calculated as a percentage of capital cost. The processing allowance is 15% of the operator's profit otherwise determined if the operator does not own the processing asset and sells output that has been processed by another person (i.e., the processing has been outsourced). If the operator owns processing assets and sells output, in a taxation year, which has been processed, the operator is entitled to claim a processing allowance of not less than 15% and not more than 65% of the profit otherwise determined.
- In Quebec, an operator that carries on processing activities in the province of Quebec may deduct a processing allowance in computing its annual earnings. Processing activities are those that involve the concentration, smelting, or refining of a mineral substance, and include activities involving pelletization, the production of powder, or the production of steel billets, and, hydrometallurgy activity.The processing allowance is initially determined on the basis of the rates of return calculated on the capital cost, for the operator, of each property that is an asset used in processing (a processing asset) during the fiscal year and is in the operator's possession at the end of that fiscal year. Generally, a processing asset is a depreciable property located in the province of Quebec and is either a processing plant, equipment used entirely (or almost entirely) for processing mineral substances, or property used mainly to supply water or energy to a processing plant.The processing allowance varies depending on the activities of the operator. To further stimulate ore processing in Quebec, the processing allowance percentage of the capital cost of property was increased for fiscal years that begin after December 31, 2013. The processing allowance ranges from 10% - 20%.
- As mentioned above, Australia's mining companies can take advantage of fuel tax credits for fuel used in heavy vehicles such as diesel, further reducing the cost of fuel in Australia.

APPENDIX 8: TRAINING PROGRAMS

The mining industry is a highly cyclical and capital-intensive. As there is a long lead time between the initial investment and commercial production, the Canadian federal and provincial (mining) tax systems generally treat exploration and other intangible mining expenses generously.

Program	Institution	Location	Type
Advanced Diploma in GIS Applications	VIU	Nanaimo, Online	Advanced Diploma
Applied Science: Engineering Certificate	Capilano	North Vancouver Campus	University Block Transfer, University Course Transfer
Chemistry: Bachelor of Science Degree - Major	TRU	Kamloops Campus	Bachelor's Degree, University Course Transfer
Civil Engineering Bridge Advanced Diploma	Camosun	Interurban Campus	Advanced Diploma, University Block Transfer, University Course Transfer
Civil Engineering Technology Access Certificate	Camosun	Interurban Campus	Certificate
Civil Engineering Technology Diploma	OC	Kelowna Campus	Diploma, University Block Transfer, University Course Transfer
Civil Engineering Technology Diploma	Camosun	Interurban Campus	Diploma
CNC Machinist Technician Diploma of Trades Training	BCIT	Burnaby Campus 3700 Willingdon Avenue Burnaby, BC	Diploma
Earth and Environmental Sciences: Bachelor of Science Degree - Major or Honours	UBC-O	Kelowna BC	Bachelor's Degree
Earth and Ocean Sciences: Bachelor of Science Degree - Major	UBC	Point Grey Campus - Vancouver BC	Bachelor's Degree
Earth Sciences: Bachelor of Science Degree - Major or Honours	SFU	Burnaby	Bachelor's Degree
Earth Sciences: Bachelor of Science Degree - Major or Honours	UVic	Victoria BC	Bachelor's Degree
Engineering (First-Year) Transfer Program	UFV	Abbotsford + some courses in Chilliwack	University Course Transfer
Engineering First-Year University Transfer Program	OC	Kelowna, Pentiction, Salmon Arm, Vernon, Online	University Course Transfer
Engineering Transition Diploma	Capilano	North Vancouver Campus	Diploma, University Block Transfer, University Course Transfer
Engineering University Transfer Certificates	Selkirk	Castlegar Campus	Certificate, University Course Transfer
Engineering University Transfer Program	Columbia	Vancouver	University Course Transfer
Engineering: Bachelor Degree	UVic	Victoria BC	Bachelor's Degree

Engineering: Bachelor of Applied Science Degree	UBC-O	Kelowna BC	Bachelor's Degree
Environmental Design: Bachelor Degree	UBC	Point Grey Campus - Vancouver BC	Bachelor's Degree
Environmental Engineering Technology: Bachelor of Technology	BCIT		Bachelor of Technology
Environmental Engineering: Bachelor of Applied Science Degree	UNBC	UNBC (Prince George Campus) + UBC (Point Grey Campus)	Bachelor's Degree
Environmental Protection Technology Diploma	Kwantlen	Langley Campus	Diploma, University Block Transfer, University Course Transfer
Environmental Science: Bachelor of Science Degree - Major or Honours	SFU	Burnaby	Bachelor's Degree
Environmental Sciences: Bachelor of Science Degree - Major or Honours	UBC	Point Grey Campus - Vancouver BC	Bachelor's Degree
Environmental Studies Certificate	COTR	Cranbrook and Online	Certificate, University Block Transfer, University Course Transfer
Environmental Technology Diploma	Camosun	Lansdowne Campus	Diploma, University Block Transfer, University Course Transfer
Excavator Training Program	CNC	Fort St. James and Vanderhoof Campuses	Statement of Completion
Fundamentals of Engineering Certificate	VIU	Nanaimo	University Course Transfer
Geographic Information Science: Bachelor of Science Degree - Major or Honours	SFU	Burnaby	Bachelor's Degree
Geographic Information Systems Advanced Diploma	BCIT	Burnaby Campus 3700 Willingdon Avenue Burnaby, BC	Advanced Diploma
Geographic Information Systems Advanced Diploma	BCIT	Burnaby Campus 3700 Willingdon Avenue Burnaby, BC	Advanced Diploma
Geographic Information Systems Advanced Diploma	Selkirk	Castlegar Campus	Advanced Diploma
Geographic Information Systems: Bachelor Degree (GIS)	Selkirk	Castlegar Campus	Bachelor's Degree
Geographic Information Systems: Bachelor of Technology	BCIT	Accelerated:	Bachelor of Technology
Geological Sciences: Bachelor of Science Degree - Honours	UBC	Point Grey Campus - Vancouver BC	Bachelor's Degree
Geophysics: Bachelor of Science Degree - Major or Honours	UBC	Point Grey Campus - Vancouver BC	Bachelor's Degree
Heavy Duty Equipment Technician Foundation Certificate	CMTN	Terrace	Certificate, Trades Foundation Program

Heavy Duty Equipment Technician: Apprenticeship	OC		Apprenticeship, ITA Credential
Heavy Duty Equipment Technician: Apprenticeship	NLC		Apprenticeship, ITA Credential
Heavy Duty Equipment Technician: Apprenticeship	TRU		Apprenticeship, ITA Credential
Heavy Duty Mechanic: Apprenticeship	BCIT		Apprenticeship, ITA Credential
Heavy Duty: Apprenticeship	NIC		Apprenticeship, ITA Credential
Heavy Equipment Operator Certificate	VIU	Nanaimo	Certificate
Heavy Mechanical Foundation Certificate	TRU	Kamloops, Williams Lake	Certificate, Trades Foundation Program
Heavy Mechanical Foundation Certificate	NIC	Campbell River (Vigar Road)	Certificate, Trades Foundation Program
Heavy Mechanical Foundation Certificate	COTR	Cranbrook	Certificate, Trades Foundation Program
Heavy Mechanical Trades Foundation Certificate	VCC	Annacis	Certificate, Trades Foundation Program
Heavy Mechanical Trades Foundation Certificate	VIU	Nanaimo	Certificate, Trades Foundation Program
Heavy Mechanical Trades Foundation Certificate	CNC	Prince George	Certificate, Trades Foundation Program
Heavy Mechanical Trades Foundation Certificate	Camosun	Interurban Campus	Certificate, Trades Foundation Program
Heavy Mechanical Trades: Apprenticeship	CNC		Apprenticeship, ITA Credential
Industrial Mechanic (Millwright)/Machinist Foundation Certificate	CNC	Prince George, Mackenzie, Quesnel	Certificate, University Course Transfer
Industrial Mechanic (Millwright): Apprenticeship	CNC		Apprenticeship, ITA Credential
Industrial Mechanic/Millwright: Apprenticeship	Kwantlen		Apprenticeship, ITA Credential
Industrial Mechanics (Millwright): Apprenticeship	COTR		Apprenticeship, ITA Credential
Machinist Foundation Certificate of Trades Training	BCIT	Burnaby Campus 3700 Willingdon Avenue Burnaby, BC	Certificate
Machinist: Apprenticeship	BCIT		Apprenticeship, ITA Credential
Machinist: Apprenticeship	CNC		Apprenticeship, ITA Credential
Millwright Foundation Certificate of Trades Training	BCIT	Burnaby Campus 3700 Willingdon Avenue Burnaby, BC	Certificate
Millwright Harmonized Foundation Certificate	CMTN	Houston, Kitimat	Certificate, Trades Foundation Program
Millwright/Industrial Mechanic Citation	Kwantlen	Cloverdale Campus	Citation, Trades Foundation Program
Millwright/Industrial Mechanic: Apprenticeship	CMTN		Apprenticeship, ITA Credential

Millwright/Machinist Certificate	Selkirk	Nelson (Silver King) Campus	Certificate, Trades Foundation Program
Millwright: Apprenticeship	NLC		Apprenticeship, ITA Credential
Millwright: Apprenticeship	BCIT		Apprenticeship, ITA Credential
Mining Engineering Bridge Advanced Diploma	Camosun	Interurban Campus	Advanced Diploma, University Block Transfer, University Course Transfer
Mining Industry Certificate	CNC	Burns Lake, Fort St. James, Mackenzie, Prince George, Vanderhof	Certificate
Natural Resource Science: Bachelor Degree or Honours	TRU	Kamloops	Bachelor's Degree, University Course Transfer
Natural Resources and Environmental Technology Diploma	CNC	Prince George	Diploma, University Block Transfer, University Course Transfer
Natural Resources Management: Bachelor of Science Degree	UNBC	Prince George Campus	Bachelor's Degree
Occupational Health and Safety Certificate	BCIT		Certificate
Occupational Health and Safety Diploma of Technology	BCIT		Diploma
Operations Management (Industrial Engineering Option) Management Certificate	BCIT	Burnaby Campus 3700 Willingdon Avenue Burnaby, BC	Certificate
Physical Geography: Bachelor of Science Degree - Major or Honours	UFV	Abbotsford, Chilliwack (limited offerings)	Bachelor's Degree, University Course Transfer
Plant Operator Certificate	Selkirk	Silver King Campus	Certificate
Science University Transfer Program	Columbia	Vancouver	University Course Transfer
UTP Stage II: Engineering Science Program	FIC	Burnaby	University Course Transfer

APPENDIX 9: ENVIRONMENTAL ASSESSMENT PROCESS DATA

Name	Proponent	Status	In operation?	Date documented in EPIC	Decision Date	Time Elapsed (weeks)	Source
Harper Creek	Harper Creek Mining Corporation	Terminated	No	21/10/2011	13/07/2018	351	Link
Burnco Aggregate	BURNCO Rock Products Limited	Certificate Issued	No	16/12/2014	18/03/2018	170	Link
Kootenay West Mine	CertainTeed Gypsum Canada Inc.	Certificate Issued	No	18/02/2013	25/01/2018	257	Link
Ajax Mine	KGHM Ajax Mining Incorporated	Certificate Refused	No	11/01/2012	13/12/2017	309	Link
Ruby Creek Molybdenum	Global Drilling Solutions Incorporated	Certificate Expired	No	17/05/2006	10/09/2017	591	Link
Echo Hill Coal	Hillsborough Resources Limited	Withdrawn	No	01/10/2012	13/04/2017	236	Link
Kemess Underground	AuRico Metals Incorporated	Certificate Issued	No	11/01/2016	15/03/2017	61	Link
Giscome Quarry and Lime Plant	Graymont Western Canada Incorporated	Certificate Issued	No	22/09/2014	14/12/2016	116	Link
Baldy Ridge Extension	Teck Coal Limited	Certificate Issued	Yes	17/09/2015	19/09/2016	53	Link
Hills Bar Aggregate Quarrying	Qualark Resources Incorporated	Withdrawn	No	14/07/2003	26/07/2016	680	Link
Horizon Mine Coal	Peace River Coal Incorporated	Terminated	No	26/07/2006	26/07/2016	522	Link
Bear River Gravel	Glacier Aggregates Incorporated	Withdrawn	No	01/03/2006	05/07/2016	540	Link
Lodgepole Coal Mine	Cline Mining Corporation	Withdrawn	No	06/01/2006	05/07/2016	548	Link
Meadows Quarry	Meadows Quarry Group	Not Designated Reviewable		Not applicable	03/05/2016	Not applicable	Link
Raven Underground Coal	Compliance Coal Corporation	Terminated	No	01/06/2012	04/04/2016	200	Link
Kutcho Copper-Zinc-Silver-Gold Mine	Kutcho Copper Corporation	Withdrawn	No	21/12/2012	29/03/2016	171	Link
Schaft Creek Mine	Teck Resources Limited	Withdrawn	No	07/02/2011	23/03/2016	267	Link
Sustut Copper	Doublestar Resources Limited	Withdrawn	No	28/03/2003	07/03/2016	675	Link
Murray River Coal	HD Mining International Limited	Certificate Issued	No	01/09/2013	01/10/2015	109	Link
Fording River Operations Swift	Teck Coal Limited	Certificate Issued	Yes	07/11/2014	10/09/2015	44	Link
Morrison Copper/Gold	Pacific Booker Minerals Incorporated	Further Assessment Required	No	21/05/2009	07/07/2015	320	Link
Brucejack Gold Mine	Pretium Resources Inc	Certificate Issued	Yes	02/05/2014	26/03/2015	47	Link
KSM	Seabridge Gold Incorporated	Certificate Issued	No	01/02/2011	29/07/2014	182	Link

Line Creek Operations Phase II	Teck Coal Limited	Certificate Issued	Yes	07/10/2011	25/09/2013	103	Link
Chu Molybdenum Mine	TTM Resources Incorporated	Withdrawn	No	12/05/2010	18/07/2013	166	Link
Mount Klappan Coal	Fortune Coal Limited	Withdrawn	No	30/11/2006	12/04/2013	332	Link
Kitsault Mine	Avanti Kitsault Mine Limited	Certificate Issued	No	06/10/2011	18/03/2013	76	Link
Roman Coal Mine	Peace River Coal Incorporated	Certificate Issued	Yes (care and maintenance only)	12/05/2009	14/12/2012	187	Link
Wapiti Power Development	AESWapiti Energy Corporation	Withdrawn	No	14/09/2006	08/06/2012	299	Link
Central South Mine	Xstrata Coal Canada Limited	Withdrawn	No	08/09/2010	20/05/2012	89	Link
Davidson	Tompson Creek Metals Company Incorporated	Terminated	No	27/06/2008	10/01/2012	185	Link
Prosperity Gold-Copper	Taseko Mines Limited	Certificate Issued	No	20/01/2009	04/01/2010	50	Link
Cariboo Gold	International Wayside Gold Mines Limited	Terminated	No	29/04/2005	29/04/2009	209	Link
Mt. Milligan Copper-Gold	Thompson Creek Metals Company	Certificate Issued	Yes	01/05/2008	16/03/2009	46	Link
Hermann Mine	Conuma Coal Resources Limited	Certificate Issued	No	13/12/2006	24/09/2008	93	Link
Kemess North Copper-Gold Mine	Northgate Minerals Corporation	Certificate Refused	No	30/10/2003	07/03/2008	227	Link
Aley Mine	Aley Corporation Limited	In Progress	No	14/09/2014	Not applicable	204	Link
Arctos Anthracite	Arctos Anthracite Joint Venture	In Progress	No	02/04/2013	Not applicable	280	Link
Bingay Main Coal	Centermount Coal Limited	In Progress	No	20/11/2012	Not applicable	299	Link
Blackwater Gold	New Gold Incorporated	In Progress	No	15/04/2014	Not applicable	226	Link
Carbon Creek Coal Mine	Cardero Coal Limited	In Progress	No	18/02/2013	Not applicable	286	Link
Coal Mountain Phase 2	Teck Coal Limited	In Progress	No	26/02/2016	Not applicable	128	Link
Crown Mountain Coking Coal	NWP Coal Canada Limited	In Progress	No	26/04/2018	Not applicable	16	Link
Gething Coal	Canadian Kailuan Dehua Mines Co. Ltd.	In Progress	No	15/11/2006	Not applicable	613	Link
Michel Creek Coking Coal	CanAus Coal Limited	In Progress	No	01/08/2015	Not applicable	158	Link

Red Mountain Underground Gold	IDM Mining Limited	In Progress	No	27/09/2016	Not applicable	98	Link
Ruddock Creek Mine	Ruddock Creek Mining Corporation	In Progress	No	30/05/2014	Not applicable	219	Link
Sechelt Carbonate	Pan Pacific Aggregates Limited	In Progress	No	23/11/2005	Not applicable	664	Link
Spanish Mountain Gold	Spanish Mountain Gold Limited	In Progress	No	14/07/2011	Not applicable	370	Link
Sukunka Coal Mine	Glencore plc	In Progress	No	23/10/2012	Not applicable	303	Link

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