

Political Risk Assessment

Canadian Rare Earth Element Industry: Risks and Mitigations

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Executive Summary

Canada is well-positioned to be one of the leading suppliers of Rare Earth Elements ('REEs') to help economies transition to greener technologies. Canada's stringent environmental laws and projected deposits of REEs permit businesses from either the primary or secondary sectors to invest in a safe, reliable, and business-friendly climate destined for markets in Canada, the United States, or overseas.

The report begins with a description of REEs and their application in new green technologies as economies continue to transition from dirtier sources of energy. It also looks at the potential environmental risks of the extraction process and ways to mitigate those effects on local environments. Next, the report analyzes the current projected reserves and the economic potential of tapping into these for the production of green technologies.

The report then describes local political risks of REE extraction. It first focuses on relationship-building

with local Indigenous communities in order to develop a partnership model and legislative framework that recognizes Indigenous leadership, experience, and needs when extracting REEs. In addition, the report looks at the supply chain challenges that have been highlighted by the global COVID-19 pandemic, with a focus on a US-Canada partnership on the development of a robust and domesticated supply chain that taps into primary and secondary sector technology and investment as an alternative to extant supply chains across the Pacific.

Finally, the report looks at a case study of Pallinghurst, a private equity group which has partnered with the Québec Government to invest \$500M in the former Nameska lithium mine. This study highlights the current risks and mitigation strategies for companies looking to invest in REE extraction processes in Canada and future opportunities for growth within this sector.



Figure 1: Picture of Namaska Lithium Mine

Background: What are REEs?

REEs are 17 elements on the periodic table which include scandium, yttrium, and the lanthanides. REEs range in rarity with the most common REE, cerium, being the 25th most common element to lutetium, the 61st rarest element. While their general abundance is not rare, deposits of REE are concentrated in specific and limited locations making their extraction difficult.¹

Applications of REEs

The conductive and magnetic properties of REEs put them at the core of industries ranging from defense, magnetics, industrial catalysts, and sensors. For instance, they are critical to neodymium magnets, petroleum refining, and automobile catalytic converters. More importantly, their use is essential in enabling new technologies in the growing renewable and battery sectors necessary to transitioning economies to reach net zero targets.²³

Mechanisms of REE Production

The extraction of REEs is concentrated in a handful of countries. China controls 90% of extraction and supply of REEs. Given its importance in manufacturing and industry and quotas placed on their export, this has led countries to invest in exploring new deposits and expanding the few mines outside of China. Apart from China, countries with significant REE deposits are Australia, India, and Canada.⁴ Thus, with the need for alternate suppliers to fuel future industries, exploration for new deposits has increased leading to significant market activity, and political need to back finding new deposits.

Extraction of REEs

There is no single method that applies across extracting all REEs as methods differ based on the deposit size, and type. Refinement of REEs is more difficult with specialized equipment concentrated in areas with significant on-going extraction such as China and Australia, requiring new refinement facilities or significant investment to develop new methods and extraction sites.⁵ However, Canada has a significant

repository of knowledge in existing extraction professionals and research at universities, offering a large knowledge and talent pool for potential entrants.⁶ Thus, the technical environment is ripe in Canada for private sector actors to develop new extraction operations.

Environmental Impacts

There are three primary environmental considerations by industry: Carbon emissions, water management, and general wastage. The environmental impact of REE extraction varies based on material, however as surface level deposits deplete, extraction of deposits at deeper depths increases. As a result, larger tailing and waste storage facilities are expected. Further, in areas around REE mining operations, accumulation of REE residues are found at a higher rate in water and humans causing potential health damage and illness. However, newer technologies and industry trends may reduce environmental impacts.⁷ With the threat of climate change high on political and businesses, new mining regulations to limit environmental harm may be prioritized. Additionally, the mining industry as a whole must contend with additional climate regulations such as carbon taxes, increasing risks, and operational costs in the industry.⁸

The establishment of REE production facilities in Canada may introduce severe environmental risks and concerns. Environmental risks associated with REE production are classified by risks to the surrounding land and natural biota, including risks to human health. While REE elements do not pose a significant threat to the environment or human health prior to extraction, the production of REEs affects the geochemical behaviour of each element, thus causing the elements to become toxicants.⁹ The outsized impact on the geochemical behaviours of REEs could increase their ability to migrate within a region.¹⁰ Therefore, REE production may introduce unprecedented environmental risks to Canada. As rare earth extraction is a fairly new industry for the state, the Canadian government and government contractors must adopt specific protocols

focused on environmental sustainability and human health in affected regions.

The mining of REEs can change the physicochemical conditions of a region's soil and water, harming the natural biota of an area.¹¹ The process of extracting REE generates a considerable amount of *tailings*.¹² *Tailings* are the leftover material and substances stemming from the mining extraction process.¹³ REE tailings are often radioactive due to the presence of thorium and thus pose a risk for safe disposal to the surrounding region.¹⁴ Therefore, the safe disposal of radioactive material is critical in ensuring environmental and human safety in the surrounding region. Further, other prominent environmental and health concerns of REE production are caused by REE accumulation, radiation exposure as caused by tailings, invasion of different species through changes in the region, and biota and environmental diversity loss.¹⁵ REE production risks to a region's environmental sustainability by altering the region's makeup.¹⁶ Further, the production of REE extraction requires high energy consumption and results in mass pollution.¹⁷ Air emissions and water discharge are some of the most significant environmental concerns of REE production.¹⁸ To

mitigate political risk from potential radioactive exposure caused by REEs, tailings, and air and water pollution, the Canadian government should focus on safe disposal practices prior to the development or construction of REE facilities. Decisions regarding location, construction and management are all relevant to creating a safe disposal strategy. In turn, the Canadian government must work with a plethora of geoscientists, engineers, environmental scientists as well as those living in the surrounding regions to devise a safe disposal strategy that protects environmental and human safety.

REE production in Canada runs the political risk of food insecurity and famine for those living in regions surrounding production facilities. The most prominent risk to human health of REE production is through ingestion and direct exposure.¹⁹ Residents living in the surrounding area of an REE production facility are at risk of inhaling REE dust and consuming food or other edible biotas with high levels of REE content. REE substances can disperse into local soils and waterways, thus infecting an edible biota in the region. Introducing acidity to previously stable REEs can increase the mineral's ability to migrate in a region.²⁰ In turn, this can result in an increase in REEs found in soil and edible

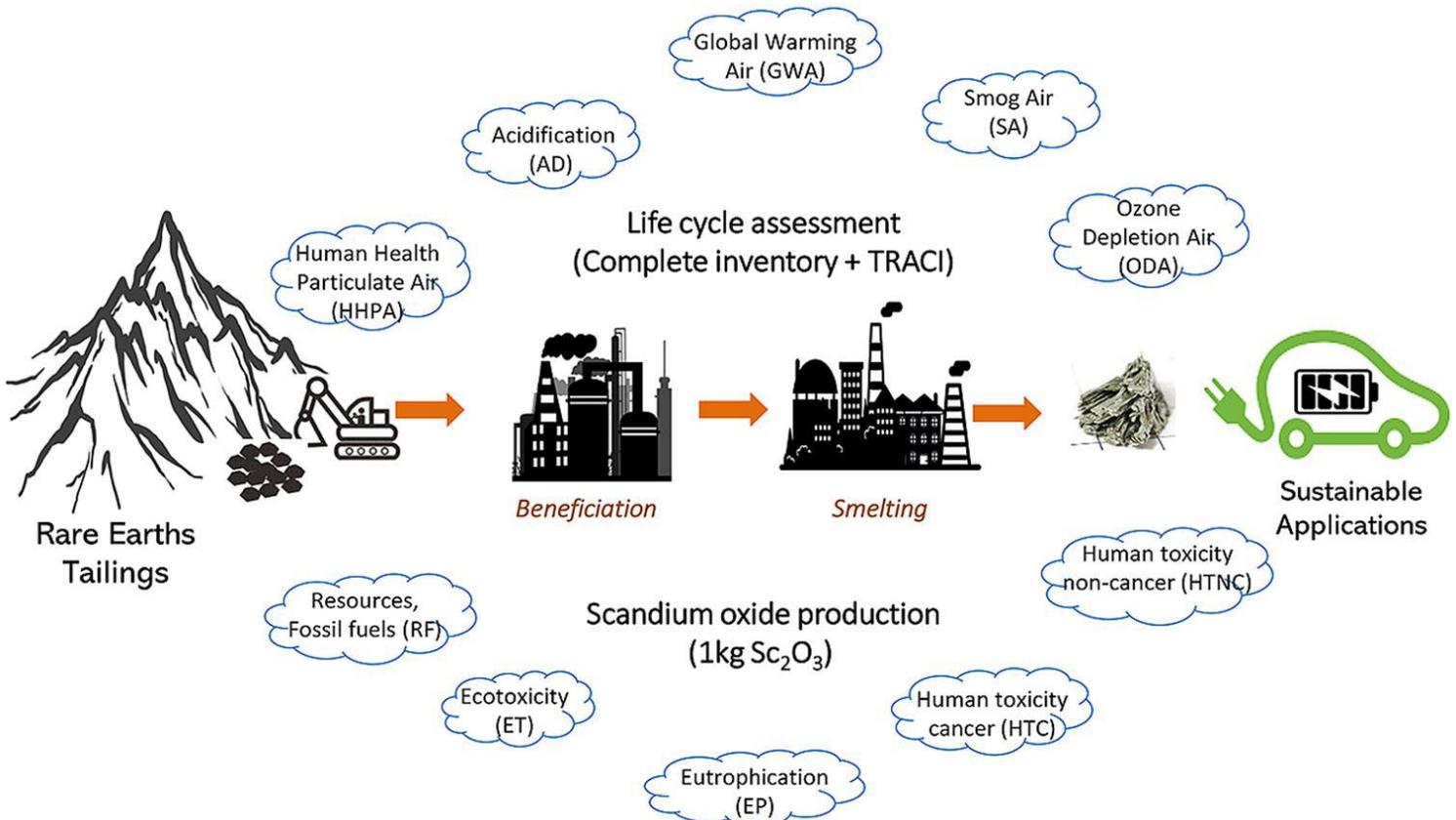


Figure 2: Environmental Effects from Scandium Oxide Production of Bayan Obo Mine

crops near REE production facilities. Studies have found the consumption of REEs has had negative effects on digestive enzymes, which have subsequently led to malabsorption and indigestion.²¹ These effects of REE consumption are worse for children and animals.²² Thus, the Canadian government must warn residents to avoid ingesting food products grown locally in the region to protect those living in regions near REE production facilities. Further, the government should continuously monitor soils and waterways near production facilities to ensure the safety of those in the region. Finally, the Canadian government should provide settlements to any individuals whose livelihood or their economic position has been harmed by the creation of REE production facilities.

Occupational exposure to those who work in REE production facilities is the most significant risk to human health. REE dust and radiation both pose a major risk to those working with plants.²³ Workers in REE production facilities are at risk through respiratory, skin and ocular exposure.²⁴ Human exposure to REEs has been reported to induce pneumoconiosis.²⁵ Exposure to REEs can also have negative neurological effects and can cause impaired cognitive functions.²⁶ To protect those working in production facilities, the Canadian government should subsidize protective equipment, such as high-grade respiratory and ocular protection equipment, and implement regularly scheduled health checks. To mitigate the political risk of REE production, the Canadian government should emphasize ensuring the health and safety of those working in production facilities.

REEs in Canada

There is untapped potential for REE extraction with Canada's REEs alone accounting for an estimated 7% of all raw global resources and 40% of total REEs. Canada's first REE extraction project began in June 2021 and there are 11 projects being explored. The cost of each mine is expected to range between 105 million to 200 billion dollars depending on mine conditions and investment.²⁷ There is high potential for future investment as Canada is home to a significant existing mining industry that has expertise in mineral extraction, as well as a stable investment environment. With a

heavy concentration of REE mining located outside of the country, and trends of increasing territorialism with countries being reliant on internal supply chains, government support high for new REE mines is expected to be high.²⁸

The Potential for REEs

The industrial applications of REE's provide strong commercialization potential for companies and are a strategic resource for countries. With governments pledging to reach net-zero targets, private sector solutions are key in that transition. Most prominently, the demand for electric vehicles is expected to grow thirty times by 2040, and wind, and solar energy generation is expected to significantly increase. Overall, the market for REEs is expected to have a compounded annual growth rate of over 4%.²⁹

For REE growth globally, China remains the largest consumer of REEs, with demand exceeding the runner up, the United States, by over 30%. Coupled with the large deposits in that country, growth in the REE sector globally will continue to depend on Chinese economic fortunes and resource policy. With Chinese markets and manufacturing trending towards more internal consumption rather than export, this may result in less REE supply for global demand.³⁰

Finally, in Canada with the dependence on REEs growing and high industry growth rates, private sector actors will continue searching for new deposits and extraction methods. However, with political trends turning toward dependence on domestic production, political support may be influential in determining the outcome of the industry. With American and Chinese governments providing subsidies to their industries, the Canadian government may follow to accelerate innovation within the sector and enable companies to compete on costs.³¹ This could accelerate the exploration and development of minerals, potentially decreasing political risk to changing regulations as governments rush to supply critical minerals to avoid supply chain shocks caused by the COVID-19 pandemic.³² Thus, REE extraction is expected to grow significantly in line with demand for future technologies, and with government support the industry can expect to see additional growth.

Indigenous Partnerships and Rare Earth Extraction

The REE industry in Canada has significant economic potential but also poses substantial risks to Indigenous communities. Firstly, the development of REE production often takes place on Indigenous home territories. Without proper consultation and approval with Indigenous peoples, REE projects threaten Indigenous communities' unique land rights. Secondly, REE development poses a health risk which disproportionately affects Indigenous groups.

The Wolf Lake and Eagle Village Algonquin First Nations were opposed to Quebec's investment in a REE project because the provincial government did not consult the two groups.³³ Their stance was further supported by the Assembly of First Nations of Quebec and Labrador Chiefs' Assembly. The two communities held that the project had "the potential for significant negative effects on their Aboriginal rights and title, environment and culture and have never provided consent for the project to move to the development phase."³⁴ This is a significant risk as Canada and Quebec legally have the duty to consult and accommodate these First Nations for project approvals due to the assertion of Indigenous rights and title.

Involving Indigenous Communities in REE Projects

Involving Indigenous communities is imperative in REE mining projects. Legally, governments must obtain Indigenous approval for projects. Indigenous title is the right to land and the right to the use and jurisdiction of ancestral territories, recognized by the Canadian legal system.³⁵ This right stems from Indigenous peoples' relationship with their territories. The Government of Canada has "a duty to consult, and where appropriate, accommodate Indigenous groups when it considers conduct that might adversely impact potential or established Aboriginal or treaty rights."³⁶ According to the Supreme Court decisions in *Calder et al. v. Attorney-General of British Columbia* regarding Indigenous land-title claims, constitutional law on Indigenous nations in Québec also have to respect

ancestral and treaty rights, as well as the duty to consult and accommodate Indigenous peoples.³⁷

To mitigate this risk, it is imperative that mining laws, regulations, and strategies be enforced and Indigenous stakeholders must be consulted in the process. The Nechalacho project exemplifies the success of this mitigation strategy. Cheetah Resources Corporation signed with Det'on Cho Nahanni Construction Company, an Indigenous construction company in Yellowknife. Collaborating with Indigenous communities is also an opportunity for Indigenous individuals to participate in economic development while upholding environmental stewardship. For the first time in the Northwest Territories (NWT) and Canada, an Indigenous-led institution would oversee mining operations. Ndilo Chief Ernest Betsina supported this move: the goal of his Dene First Nation government is to achieve a balanced approach, "[recognizing] the need for economic prosperity, while at the same protecting [their] land, water and wildlife in order to maintain [their] traditional activities."³⁸

Moreover, REE mining has high risks for Indigenous communities' health and wellbeing. REE can enter the human body in three ways: ingestion, inhalation, and dermal contact. Ingestion is when REE-contaminated food and drinking water and medicine is consumed, inhalation is when airborne dust containing REE particles are inhaled, while dermal absorption occurs through exposure to REE dust, such as bathing using REE-contaminated water.³⁹ REEs can cause human health problems such as issues with organ function. As such, REE pose a high risk for public health, especially since there are few proven mitigation strategies that Canada can employ. However, REE mining projects tend to be far from population centers. Along with strict mining waste management laws, there may be limited health risks for the general public. Despite this, Indigenous peoples are disproportionately affected by REE projects as hazardous substances can contaminate surrounding soil and water. Indigenous peoples, compared to other groups, rely more heavily on local ecosystems for their day-to-day life, such as in their food, medicine, and traditional activities.⁴⁰ REE

mining can potentially lead to health risks in nearby areas that are used for hunting, fishing, trapping, and food gathering.⁴¹

The Kipawa project, a proposed REE mine site, is an example of this. It is located on the traditional lands of two First Nations groups in western Quebec and presents a threat to the long-term sustainability of food and medicine sources, not a risk. Firstly, an increase in REE projects will lead to an increase in REE rich areas, threatening Indigenous territories and their communities' health. Secondly, Canadian Indigenous peoples use over 500 medicinal plant taxa. With the Kipawa project, species used for traditional medicines would likely be contaminated by REE and increase health risks for Indigenous peoples.⁴² To mitigate this risk, governments and mining corporations should consult Indigenous stakeholders to ensure that the

collection of food and medicine sources avoid contaminated areas.

Furthermore, individuals working in the REE industry are most vulnerable to the risk to human health that is associated with REE production. Workers at large must be protected with sufficient environmental quality monitoring and occupational radiation protection in order to reduce the risk to workers.⁴³ This is especially important regarding Indigenous workers; as mining projects capitalize on Indigenous territories, Indigenous workers should be employed in these projects to ensure stewardship, accountability and economic prosperity as mentioned before. Additionally, more research, like the community-based environmental program IMALIRIJIT, should be conducted to better understand the health impacts of REE projects on human health, and Indigenous communities particularly.

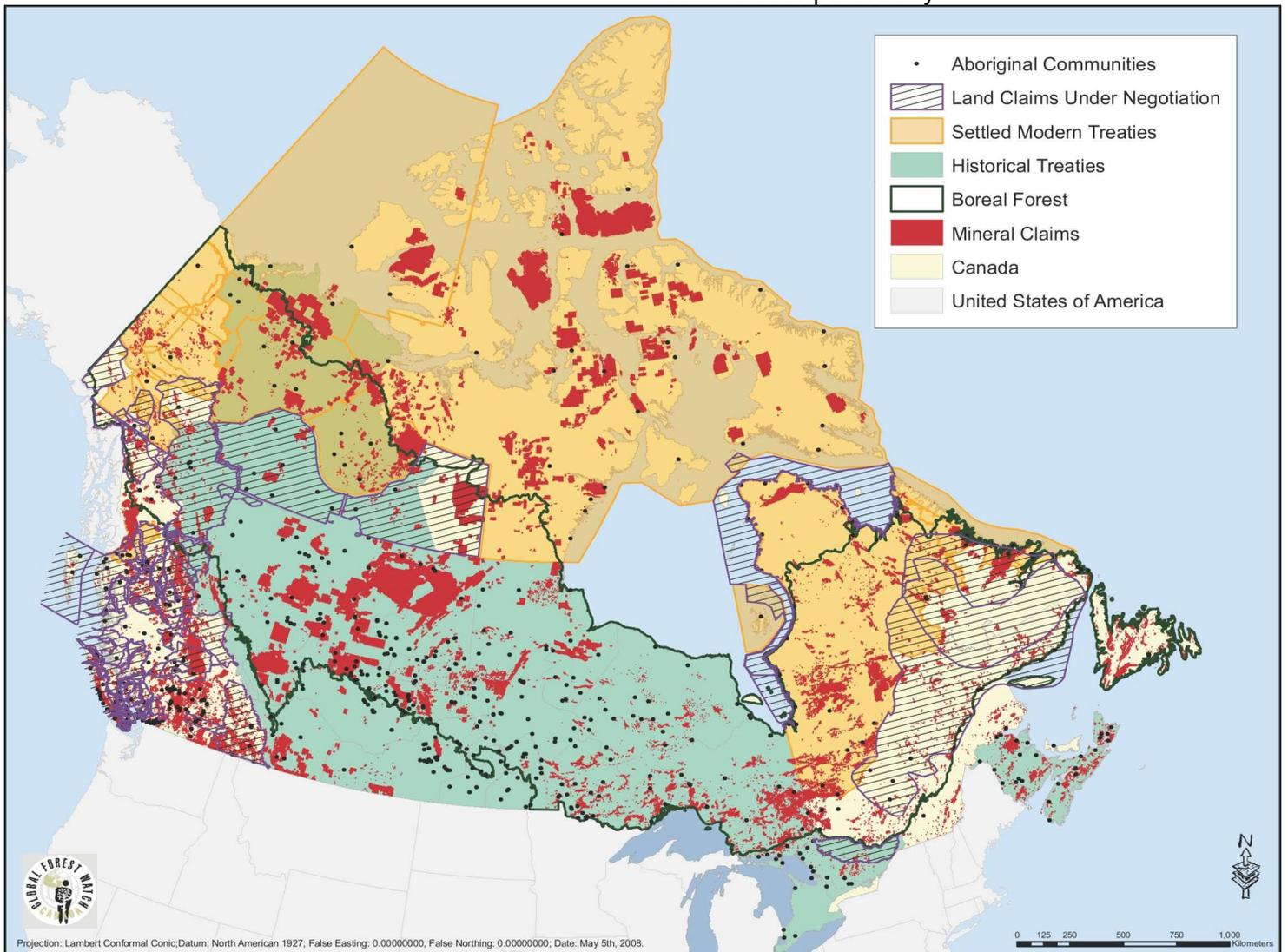


Figure 3: Map of Canada Overlaid with Indigenous Communities, Natural Resources, and Treaty Territories

Canada-US Supply Chains

Canada is already behind on creating an electric vehicle ('EV') supply chain, as Europe and Asia have already established the necessary supply chains. Establishing a supply chain with the United States is the most likely option to ensure North America is keeping pace with the rest of the world.⁴⁴ However, this deal could have consequences for Canada, leaving the nation further behind in the grand scheme of EV production.

Canada is at risk for remaining in the primary sector of production because it's likely that the United States would be Canada's major importer of REEs and opportunity for secondary sector growth would be limited in this arrangement. The primary sector of production involves direct resource extraction but misses out on the secondary and tertiary sectors that include production using primary resources, such as REEs. Canada's manufacturing sector has seen a downturn in secondary levels of industry since the 1970s, and the American investment in Canada's REE extraction would further contribute to this statistical trend.⁴⁵ Canada would then likely be locked into a commitment with the United States to provide REEs, once again limiting the potential for any opportunities to create any secondary-level methods of production, cementing Canada's place in the global supply chain.⁴⁶

Canada agreement. Compromising investments into the secondary industries involved with EV production doesn't necessarily take away from primary production, and as such, it makes sense for Canada to focus its initial investments on resource extraction and the primary industries, with the secondary industries likely following suit in due time.

Mitigation Strategies to Offset Risk from Primary Sector Production

Canada is not likely to transform and focus resources on becoming more impactful in its secondary industries in a small-time frame, and as such, denying a US-Canada trade agreement to bolster secondary Canadian industries would be a mistake. Focusing on Canada's manufacturing sectors to ensure that Canada does not fall even further behind the United States is less beneficial considering how most Canadian industries are primary industries that focus on raw material extraction and export. Disregarding Canada's secondary industries to facilitate a deal with the United States is not ideal, however focusing investments on the primary industries to form a potential agreement is more beneficial for the future of Canada's infrastructure in the EV industry.

A clear benefit to making this partnership with the United States is that an American monopoly on Canadian REEs would compete directly with that of China, which produces more than 95% of the world's REEs and holds the title of the dominant global producer.⁴⁷ American investment in Canada is mutually preferred, as the hundreds of millions invested would benefit both countries with new jobs, rather than outsourcing to South America or China.⁴⁸ Canada being dependent on the United States, Canada's long-standing ally, contributes to far less political risk, than if Canada were to sign lithium exports away to foreign investors/countries, who may experience more political turbulence than the United States.⁴⁹

The Yale Environment Review suggests that policymakers should be cautious of taking in foreign direct investment from a country like China for natural resource sectors, and as such, would make the US

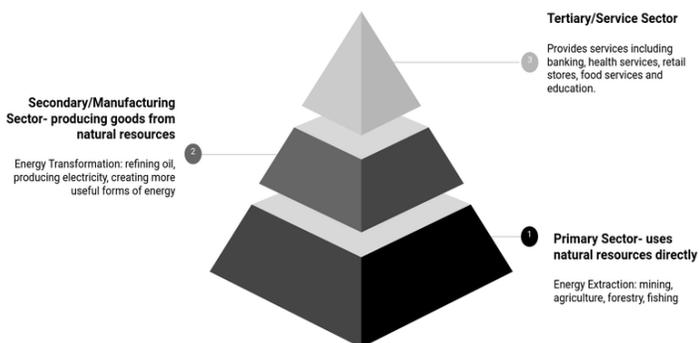


Figure 4: Production Sectors

Focusing on the primary sector allows Canada to attract investors into that industry instead of trying to spread it out over multiple different manufacturing sectors. Canada has two of the largest logging and energy industries in the developed world. Canada's expertise and economic focus on the primary industries would be greatly beneficial for a potential US and

supply chain that much more appealing for Canada.⁵⁰ Regardless of Canada's manufacturing position in the EV industry, it's more important for Canada to maintain and foster their primary industries, and after those primary industries are established for EVs, Canada's secondary industries can be established.

COVID-19 Pandemic and Its Effects on Canada-US Relations

In the past two years, the world was hit by multiple surges of COVID-19 virus cases. The outbreaks of the virus have negatively affected the many supply chains throughout the world. Nearly every industry was negatively impacted by the COVID-19 lockdowns, social distancing measures, and outbreaks.⁵¹ The addition of COVID-19 to the global landscape cannot be ignored as it has a major impact on how Canada and the United States do business. This disruption has lasted years with no calculated end in sight, which carries significant political risk as jumping into a trade deal with hundreds of millions of dollars and jobs on the line during the pandemic could easily lead to failure.

South America is home to the "lithium triangle" a region within three countries, Argentina, Bolivia, and Chile with exceptionally high amounts of lithium.⁵² As we have seen with the South American lithium triangle, the quickly developing South American sector is experiencing "low prices, delayed investment and production interruptions caused by the COVID-19 pandemic." The severity of the COVID-19 pandemic is high, and as such could cause significant delays in Canada's extraction of REEs.⁵³ Countries in the Lithium Triangle already had sufficient lithium exporting industries and infrastructure prior to the COVID-19 pandemic, however, Canada's lithium structure is still in its infancy.⁵⁴ Canada's hunger for primary sector expansion coupled with the ongoing issues due to COVID-19 is a cause for concern as the more developed lithium triangle is facing issues. The issues taking place in the lithium triangle could very well

appear domestically in Canada, especially as the COVID-19 pandemic progresses.

Mitigation Strategies

Although detrimental to many areas of the global supply chain, the COVID-19 pandemic encourages the United States and Canada to work together more closely. While the rest of the world's supply chains are currently in a state of disarray due to supplies shortages, shipping delays, and global employment shortages, the Canada-US supply chain would be strengthened. This is because the United States would not need to rely on outsourcing from a country like China that has a more unstable political and economic climate. China's socialist market economy and the potential ability for lithium assets to be nationalized is a gamble on its own. The United States could more easily come to an agreement with Canada on import and export production of lithium since they are both politically and economically similar.

Now more than ever Canada and the United States must come to an agreement on COVID-19 cross border regulations and procedures to minimize the risk of failure, as well as to ensure the safety of the industry. The COVID-19 pandemic creates a unique opportunity for Canada and the United States to become even closer, as the pandemic is proving to be extremely demanding on foreign exports and imports especially from countries who are so different politically and economically from the United States and Canada. The COVID-19 pandemic has created a necessity for domestic supply chains within Canada and the United States as both countries suffered from shortages of medical supplies and other crucial goods and materials during the early months of the pandemic.⁵⁵ In this regard, the nurturing of domestic supply chains between Canada and the United States is an extremely important factor and it will allow the United States to survive during a future crisis which might constrict global supply chains.

Case Study: Pallinghurst

Pallinghurst is a private equity group based out of the UK that specializes in mineral mining investments.⁵⁶ They have recently decided to start investing in the minerals necessary for lithium ion battery production, beginning in Canada, specifically in Quebec, because of favourable geography and ethics concerns in other locations.⁵⁷ Over the past few years, they've invested over 500 million USD in two mining and material processing projects in the province and have stated they think they will end up investing over 1 billion USD in the near future.⁵⁸

Pallinghurst invested heavily into a company that went bankrupt, Nemaska, that had rights to the Whabouchi mine in Quebec, a mine with one of the world's richest deposits for Spodumene, a mineral containing lithium.⁵⁹ Pallinghurst has split ownership of Nemaska 50/50 with Investment Quebec, a crown corporation intended to increase investment into Quebec.⁶⁰ Nemaska went bankrupt due to a number of reasons. It had a lack of capital on hand to deal with the slump of volatile prices for lithium caused by a decreased demand for electric vehicles (EVs), it underestimated how much of an investment was needed to commence mining operations, and it had to deal with the large distance from its desired end market, China.⁶¹

Pallinghurst has already solved the issue of proximity to their desired end market, choosing to focus more on the US and European market for lithium rather than China, which lessens the chance of supply chain risks.⁶² As a large private equity group and having split the investment with the government of Quebec, this has given Pallinghurst the ability to dispense larger amounts of capital into Nemaska than before.

Risk: The Volatility of Lithium Ion Battery Prices

With the use of lithium in batteries for things such as EVs and mobile devices, lithium has shifted from a relatively unknown element used to help cure mental illnesses such as manic depression, to an element that a vast majority of people around the world



Figure 5: Namaska Lithium Mine

use daily.⁶³ Volatility in markets increased with the explosion in popularity of the battery. Prices have trended upwards for the past two years with the price having doubled since October 2021.⁶⁴ There is also an expectation by analysts that this incredibly high price isn't sustainable due to new firms who have invested in mines and processing facilities in the past few years.⁶⁵ Once these firms start mining or processing with those facilities in the near future, the increase of supply will cause prices to drop and only mostly larger operations that have effectively cut costs will survive. Pallinghurst is established as an investor in mining operations around the world, but might still fall victim to being new to the lithium market and not being able to operate as efficiently as needed to combat price volatility.

Mitigation Strategies

Pallinghurst can take steps to lessen the risk of volatile lithium prices before the mine is fully operational. Firstly, selling futures contracts, which have seen more and more popularity in the markets and could help establish a more stable price in general, would help hedge the company against unforeseen sudden drops and allow them to stabilize themselves for the first few years of entering this market. Secondly, now that they've partnered with the government of Quebec, the government has a stake and is interested in both getting a return on its investment as well as collecting on the financial benefits of having another

successful mining project. This means that Investment Quebec is more likely to grant them assistance with favourable terms through debt and equity financing or through their other investment programs should Pallinghurst need some extra capital to keep the Nemaska mine producing lithium.

Risk: The Ties of Lithium and Cobalt

Cobalt is one of the primary metals in lithium ion batteries.⁶⁶ Since both lithium and cobalt are needed for these batteries, the demand for lithium is tied to the demand for cobalt. Roughly two thirds of cobalt is mined in the Democratic Republic of Congo (DRC), where the practices by which it is mined have recently come under more international scrutiny due to environmental and human rights concerns.⁶⁷ This, as well as the DRC's political instability and problems with corruption have increased the risk for supply chain issues with cobalt.⁶⁸

In addition, over half of all cobalt is processed in China, which could prove problematic to other countries, due to a large distance from their mining centers and their future end markets.⁶⁹ It is also estimated that with current levels of growth, if the growth of cobalt reserves does not significantly increase, the static reach of reserves will decrease to problematic levels, inducing a supply crisis.⁷⁰ These risks pose a problem to Pallinghurst which has to account for a possible cobalt supply crisis in the future, but there is little that can be done other than technological advances that aid the world shift towards cobalt-free lithium batteries.

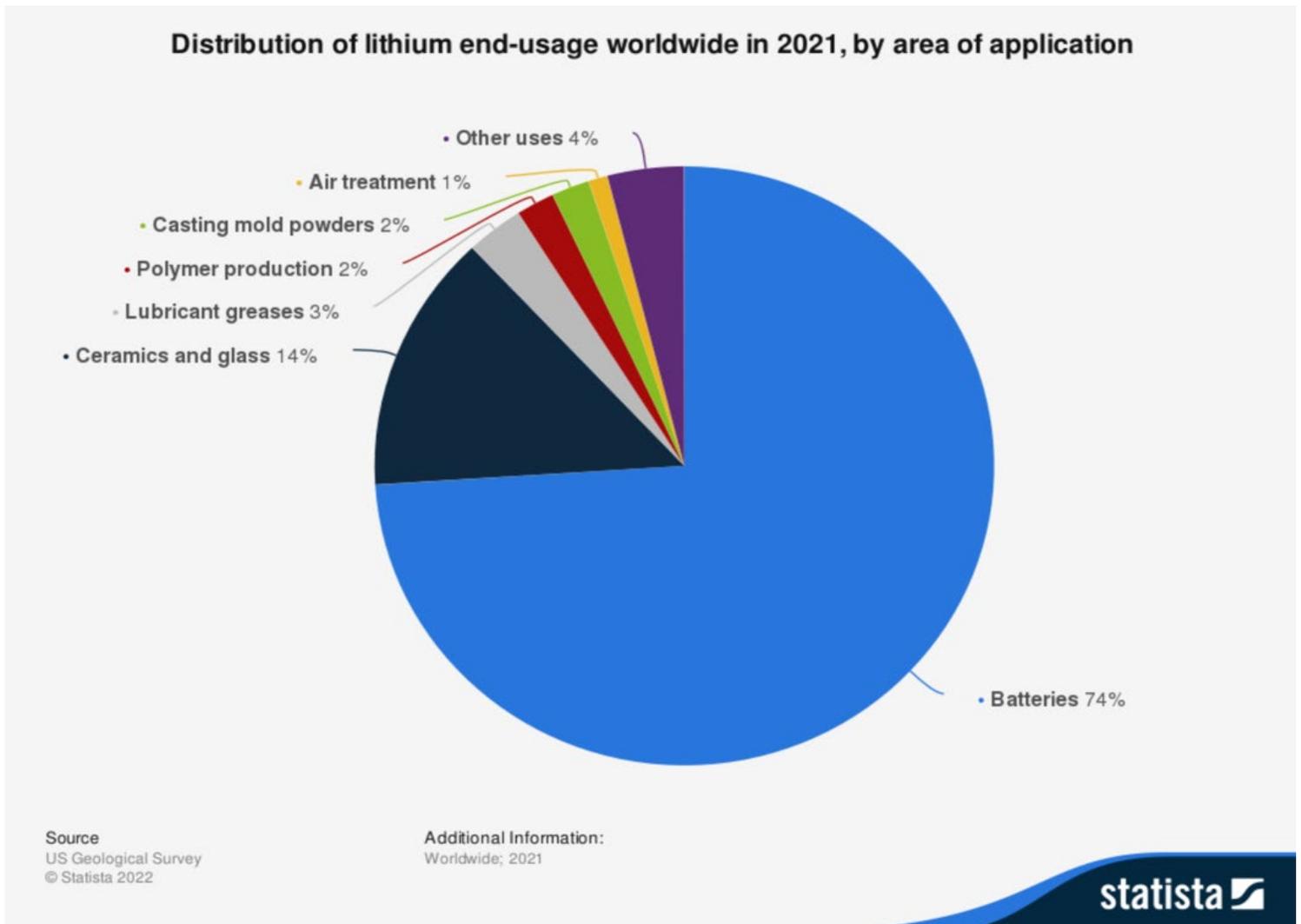


Figure 1: Distribution of Lithium End-Usage Worldwide

Figures

Figure 1. “Nemaska Chooses Becancour for Lithium Plant.” Canadian Mining Journal, June 2, 2021. <https://www.canadianminingjournal.com/news/nemaska-chooses-becancour-for-lithium-plant/>.

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