CSIS BRIEFS

Mining for Defense

Unlocking the Potential for U.S.-Canada Collaboration on Critical Minerals

By Christopher Hernandez-Roy, Henry Ziemer, and Alejandra Toro

FEBRUARY 2025

THE ISSUE

China's near monopolistic control of many critical minerals, which are essential for both for consumer products and defense production, represents an unacceptable risk to the national security of the United States at a time of heightened geopolitical tension. Canada, which already supplies the United States with large quantities of certain essential metals, is well positioned as an alternative source for many of the critical minerals controlled by China, thus contributing to North American national and economic security. Bolstering cooperation on critical minerals for the defense industry furthermore offers a way for both countries to find common ground amid frustrations surrounding trade and security.

INTRODUCTION

Bound together by a range of factors—including a shared history; deep cultural, economic, and institutional ties; and the Five Eyes alliance, NATO, and the North American Aerospace Defense Command (NORAD)—the United States and Canada have ample opportunities to forge a closer security and defense partnership, especially with respect to industrial cooperation. Canada, the world's second-largest country by landmass, has significant amounts of many of the world's **critical minerals**, as well as a specialized labor force, mining companies, a favorable business ecosystem, and advanced democracy, human rights, and governance standards. These could allow the scaling up of minerals exploration, extraction, processing, manufacturing, and recycling. In addition, Canada has been part of the U.S. defense industrial base since 1993. It has also been an essential U.S. industrial partner during periods of heightened geopolitical tensions and global conflict. With enhanced cooperation and new incentives, Canada could be well poised to solve at least some of the critical mineral supply chain vulnerabilities the U.S. defense industrial base faces. Indeed, the two countries recognized the importance of collaborating when they finalized the **Canada-U.S. Joint Action Plan on Critical Minerals Collaboration** in January 2020 during President Donald Trump's first administration.

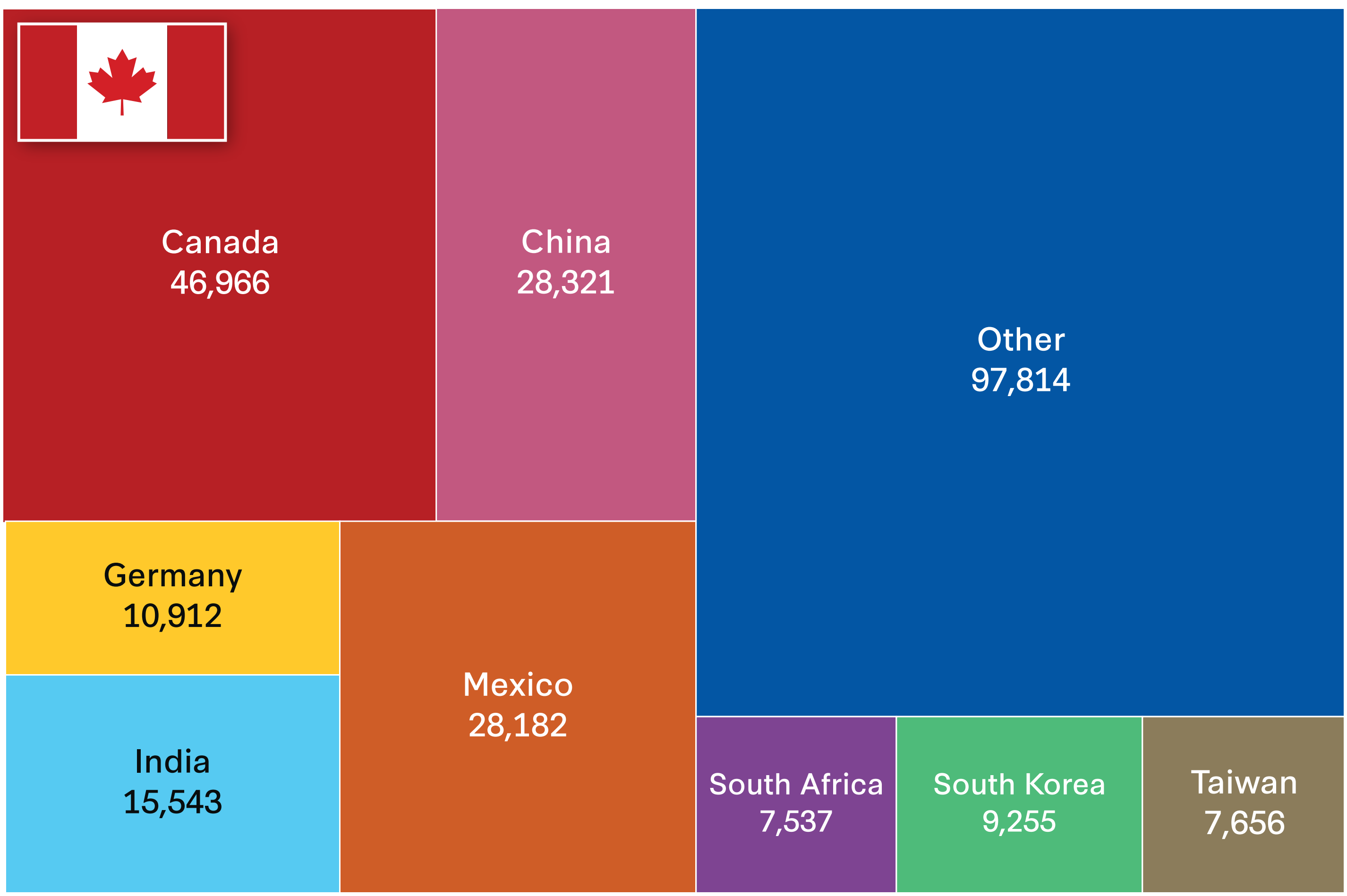
The world at the start of 2025 is vastly different than it was in early 2020. There are mounting signs the global order has entered a new prewar period in global international relations. As during the worldwide conflict that raged from 1939 to 1945, when a largely democratic coalition of countries fought Nazi Germany, fascist Italy, and militarist Japan, the Russian war of aggression against Ukraine pits a coalition of democratic countries supporting Ukraine against a like-minded group of authoritarian states, including Russia, China, Iran, and North Korea. This new group of authoritarians has been called the "**Axis of Upheaval**," and they strive to create an alternative to the current international order dominated by the United States and its allies. The origins of this new axis predate the Russian invasion of Ukraine, but the conflict has deepened and accelerated cooperation among its members, largely as an effort to thwart U.S. sanctions and collectively challenge the West. While fears of a trade war have rattled U.S.-Canada relations, cooperation between the two countries remains essential to **safeguard** North American prosperity in the face of rising threats.

The storm clouds on the horizon of today's threat environment are readily apparent. This—and the fact that U.S. military support for conflicts in Ukraine and the Middle East has strained munitions and equipment stockpiles—has laid bare the need to reinvigorate the country's defense industrial base, which has **atrophied** since the end of the Cold War. According to the results of a series of CSIS wargames, the United States would likely run out of some weapons, such as long-range precision-guided munitions, in **less than a week** in the event of a confrontation with China over Taiwan. Given this reality, rebuilding the U.S. defense industrial base for deterrence—or, if necessary, to effectively fight a conventional great power war—means securing enough critical minerals domestically and from stable, reliable partners and allies to avoid the chokehold China has on these minerals.

THE PAST IS PROLOGUE

By the end of June 1939, France had capitulated to Germany, and Britain had left a staggering amount of **equipment** behind in France, including **half its tanks**. Britain urgently placed hundreds of millions of dollars in contracts in Canada to help replenish its stocks. What followed was an unprecedented industrial revolution for Canada, with a war economy that became integrated with that of the United States, even before the latter entered the conflict in late 1941. The basis for that integration was established through the **Hyde Park Declaration**, signed by President Franklin Delano Roosevelt and Canadian Prime Minister Mackenzie King in April 1941. The agreement **stated** that

Figure 1: Top U.S. Minerals and Metals Import Partners, 2023 (USD, millions)



Source: "Minerals and Metals," USTIC DataWeb/Census, Accessed February 16, 2024, https://www.usitc.gov/research_and_analysis/tradeshifts/2023/minerals.

each country should provide the other with the defense articles it is best able to produce and coordinate their production. King **said** the declaration would "have a permanent significance in the relations between Canada and the United States" and involved "nothing less than a common plan for the economic defense of the western hemisphere."

Tim Cook in his 2024 book ***The Good Allies*** argues that Canada's ability to complement U.S. industrial output and provide vast sums of raw materials, including critical minerals, was Canada's greatest wartime contribution to Allied victory (though Canadian soldiers who fought alongside their American counterparts on D-Day might disagree). During the war, aluminum output increased a thousandfold as Canada produced **40 percent** of Allied aluminum, which was vital for aircraft production, with **a third** of the aluminum going to the United States. Canada also contributed **95 percent** of the Allied nickel output, used for armor plating in tanks and antiaircraft guns; 75 percent of Allied asbestos; 20 percent of Allied zinc; 15 percent of Allied lead; and 12 percent of Allied copper. The country also produced **refined uranium** for the Manhattan Project from ore mined in Canada, the United States, and what is now the Democratic Republic of the Congo (DRC). Now, as it did then, Canada can contribute to North American security and prosperity through its abundance of critical minerals.

FIVE KEY MINERALS FROM CANADA

The defense industry consumes a staggering number of materials. Indeed, the Defense Logistics Agency **reports** 63 different materials of interest, ranging from copper to rubber to carbon fiber. The authors began this study by consulting several documents, including the Mineral Commodities Summaries from the U.S. Geological Survey (USGS), Natural Resources Canada, and **research papers** on defense-critical minerals, identifying a list of 10 critical minerals for closer analysis. Of these 10, the report focuses its analysis on five key minerals, characterized by their relevance to the defense industry, reliance on foreign adversaries for supply, and the potential for Canada to become an alternative provider for the U.S. defense industry.

This paper accordingly focuses on gallium, niobium, rare earth elements, cobalt, and tungsten for three reasons. First, all these minerals are found or are already produced in appreciable quantities in Canada, making them prime targets for increased bilateral cooperation. Second, with the exceptions of niobium and cobalt, a U.S. adversary (primarily China) controls most of the primary production of these minerals. In the cases of **niobium** and **cobalt**, while the People's Republic of China (PRC) does not have major domestic reserves, Chinese firms have achieved a troubling degree of **control** over the mines that produce these miner-

Table 1: Defense Mineral Risk Comparison

Mineral	Defense Industry Relevance?	Reliance on Foreign Adversary?	Available Canadian Supply?
Gallium	High	Yes	Yes
Niobium	High	Somewhat	Yes
REEs	High	Yes	Yes
Cobalt	High	Somewhat	Yes
Tungsten	High	Yes	Yes
Bismuth	Moderate	Yes	Yes
Antimony	High	Yes	Somewhat
Titanium	High	Yes	Somewhat
Indium	Moderate	No	Yes
Magnesium	Low	No	No

Source: CSIS analysis.

als as well as downstream processing and refining. Finally, all these minerals are highly relevant to defense technologies and have few, if any, available substitutes.

GALLIUM

Gallium is a soft, silvery-white metal mainly produced as a by-product of processing bauxite (for aluminum). The remainder is from zinc-processing residues. Its primary use is in **gallium nitride semiconductors**, key components of computers and cell phones. It is also used in optoelectronic devices, which include laser diodes, light-emitting diodes (LEDs), photodetectors, and solar cells. In the **defense sector**, gallium nitride semiconductors are used in **electronic warfare**, advanced radar jamming systems, air and missile defense radar, satellites, and other communications equipment.

Gallium has not been mined in the United States since 1987, and only one company in New York recovers and refines high-purity gallium from imported primary low-purity gallium metal and new scrap. According to the **USGS**, "China accounted for approximately 89 percent of worldwide primary low-purity gallium production capacity" in 2023, as well as **98 percent** of worldwide primary production. China's monopoly on gallium production led the USGS to conclude it was the critical mineral **most at risk** for supply chain disruption.

In an effort to impair China's capability to produce advanced semiconductors that can be used in weapons systems, artificial intelligence, and advanced computing, the Biden administration imposed a series of export bans of chips and equipment to China, with the **most recent** occurring on January 13, 2025. In response, the Chinese government imposed **export restrictions** in August 2023 on gallium and germanium, and the result was a **sharp rise** in gallium prices and fears of a shortage. Then, in December 2024, it **banned the sale** of gallium, germanium, antimony, and so-called superhard materials to the United States. As a result, the United States needs to urgently find alternative sources of gallium.

Neo Performance Materials, headquartered in Toronto, Ontario, is currently the **only gallium producer** in North America, with a facility located in Peterborough, Ontario, where it uses recycling to retrieve the metal. But Canada has the potential to produce considerably more of the metal, especially given the country's long history of aluminum production. As part of a research and development program, the mining company Rio Tinto is assessing the potential for extracting gallium from alumina tailings at its refinery in Saguenay–Lac-Saint-Jean, Quebec. The company hopes to begin producing 3.5 metric tons of gallium per year, which could rise to 40 metric tons annually once a commercial-scale plant is constructed. This would represent **5 to 10 percent** of current world gallium production.

NIOBIUM

Niobium is a lightweight, ductile metal mainly used as an alloying element to improve the strength, durability, and resistance to corrosion of multiple materials. It is also highly resistant to wear and heat, with a **4,491°F** melting point. Nearly **90 percent** of niobium is used in the production of high-strength low-alloy steels, where adding just a **tiny amount** can increase the steel's strength by over 30 percent and significantly reduce its weight. In other applications, niobium-based superalloys and their superconductive characteristics are crucial to various **defense uses**, such as jet and rocket engines, superconductive wires and cables, heat sinks, heat exchangers, and battery cell components. Niobium is also used in **hypersonic weapons**, which can exceed **five times** the speed of sound, **allowing** them to avoid detection and defensive countermeasures.

The United States has not produced niobium **since 1959**. Brazil, by contrast, produces **82 percent** of the world's niobium, concentrated in two mines. The first, and by far the largest, is the Araxá deposit in Minas Gerais, owned by Companhia Brasileira de Metalurgia e Mineração (CBMM), in which a consortium of primarily Chinese mining companies has held a minority 15 percent stake since 2011. The second mine is a deposit in Goiás that is owned and operated by **CMOC** (formerly China Molybdenum Company Limited), a major Chinese-owned critical minerals mining and trading company. Canada follows Brazil as the world's second-largest producer, with **10 percent** of global production. The **Niobec mine** in Quebec, owned by Magris Resources, is Canada's sole producer at the moment. It is a vertically integrated manufacturing facility and produces different grades of ferroniobium that it sells directly to steel producers worldwide alongside **niobium-zirconium alloy wire**, which is **used in** consumer products, medical devices, and machinery as well as wiring harnesses, sensors, and communication systems in aircraft and spacecraft, due to its light weight and high strength. The Niobec facility is operated entirely with renewable electricity.

Canada also has several untapped reserves of niobium, with various mining projects at different stages of development. These include Taseko Mines' **Aley Project** in northeastern British Columbia, which, according to the company, is one of the largest undeveloped niobium deposits in the world and could produce over 10 percent of global niobium output (as measured in 2023). Eventually, the company says it could become the second-largest niobium producer in the world. Other projects include the two **NioBay Metals** projects (at James Bay in northern Ontario and Crevier in Quebec) and the **Prairie Lake** project in Ontario, owned by Nuinsco Resources. There is also Auking Mining's **Myoff Creek** project in south-central British Columbia, which has rare earth oxides (see below) and is in an exploration stage, despite being a site of interest for 40 years.

The United States currently imports **66 percent** of its niobium from Brazil and 26 percent from Canada. To help restart niobium refining (but not mining) at home, the U.S. Department of Defense (DOD) awarded a **$26.4 million** grant in September 2024 to Global Advanced Metals to make high-purity niobium oxide at its refining facility in Boyertown, Pennsylvania. The refinery could take advantage of **Section 45X** of the Inflation Reduction Act, which provides a 10 percent tax credit to businesses that produce critical minerals in the United States, whether from domestic or imported ores. Existing and future niobium mining operations in Canada could perhaps reap some of these savings by refining some of their ore in the Pennsylvania facility, especially given their geographic proximity.

RARE EARTH ELEMENTS

Rare earth elements (REEs) consist of a group of 17 chemically similar metallic elements. They are known for their unique magnetic, luminescent, and electrochemical properties, making them indispensable in the production of various **advanced technologies**. Their applications include critical defense uses such as precision-guided munitions, missile systems, and laser targeting systems.

REEs, despite their name, are relatively abundant in the Earth's crust; however, they are rarely found in concentrated, economically exploitable deposits and are often dispersed among other minerals. As a result, REE extraction and separation processes are highly complex, costly, and **environmentally taxing**, often involving extensive chemical treatments. REE production is concentrated in a limited number of mines globally, with China accounting for over **60 percent** of mined production, followed by the **United States**, Myanmar, Australia, Thailand, and India. Globally, **85 percent** of rare earth processing capacity is in China; it produces over 90 percent of high-strength rare earth permanent magnets and supplies 50 percent of the high-performance magnets often used in electric vehicles and wind turbines. In October 2024, China took **greater control** of the REE supply chain by obliging its exporting companies to provide the government with detailed, step-by-step tracings of how shipments of these metals are used in Western supply chains. As such, it is crucial for the United States to lessen its dependency on China regarding REEs. To do so, it should focus on Canada, which holds some of the **largest REE reserves** in the world and is expanding its ability to process these elements.

The **Saskatchewan Research Council** (SRC) is a provincial government-owned corporation and Canada's second-largest research and technology organization. SRC recently constructed the Rare Earth Processing Facility near Saskatoon and is using state-of-the-art Canadian automated technology in metal smelting to produce REEs. Once fully operational in early 2025, the facility will produce approximately **400 metric tons** per year of neodymium and praseodymium metals for the production of rare earth magnets, enough to build 500,000 electric vehicles. It is the only facility in North America producing REE metals at a commercial scale and one of only seven outside of Russia and China. In addition, two other REE commercial-scale demonstration facilities are active in Quebec. The **Sorel-Tracy scandium demonstration plant**, built by Rio Tinto, is producing high-purity scandium oxide, making it the first North American producer of this critical mineral. **Scandium oxide** plays a key role in the manufacturing of military aircraft components, armor materials, and high-strength materials for munitions. The other facility is the **Saint-Bruno-de-Montarville rare earth recycling demonstration plant** outside of Montreal, owned by **Geomega**, which is a scalable and sustainable means of recycling up to 4.5 metric tons of waste rare earth metals from magnets destined for scrapyards or landfills.

COBALT

Cobalt is a silver-gray critical mineral known for its conductive and ferromagnetic properties, high melting point (**2,723°F**), and ability to retain strength at elevated temperatures. One of its main uses is in manufacturing rechargeable lithium-ion batteries, but it is also used in the **defense sector** in temperature-resistant alloys for jet engines, magnets for stealth technology, electronic warfare, and alloys for munitions.

Like REEs, cobalt is relatively abundant in the Earth's crust, but there are only a limited number of economically viable deposits. It is generally extracted as a by-product of nickel and copper mining rather than mined as a primary product. Over **70 percent** of cobalt production is concentrated in the DRC, which has a history of severe human rights violations in mining operations. Other **producers** include Russia, Australia, the Philippines, Cuba, and Canada. Although China is not among the main producers, **Chinese firms** control 54 percent of DRC cobalt production and 80 percent of the world's cobalt refinery capacity, leading to near monopolistic control over the global cobalt supply chain. Because of this, the USGS lists cobalt as the critical mineral with the **third-highest risk** for supply chain disruption.

Fortunately, while the United States is **76 percent** import dependent on cobalt, it does not source most of the metal from China, **relying instead** on Norway, Canada, Finland, Japan, and other countries. While Canada has the third-largest global reserve and is the world's fourth-largest producer of cobalt, that production represents only **2.2 percent** of global output. The DOD recognized the importance of Canada as a greater potential source of cobalt production when it awarded **$6.4 million** to Fortune Minerals in May 2024 through the Defense Production Act (DPA). Natural Resources Canada will support the company with **$5.6 million** committed. Fortune Minerals is building the vertically integrated **NICO** cobalt-gold-bismuth-copper project, including a mine and a mill in Canada's Northwest Territories, which will produce a bulk cobalt concentrate for shipment to a refinery that the company plans to construct in **Alberta**. The project also includes more than 10 percent of global bismuth reserves along with a significant amount of gold, which will help ensure profitability against possible cobalt and bismuth price volatility. Bismuth is also a critical mineral at risk of supply chain disruption and has multiple uses for defense purposes, for instance, as a **propellant** in rockets, as a coolant in defense **thermoelectrics** and some types of small **nuclear reactors**, and as **shielding** in other reactors.

Another DPA Title III grant was made in August 2024, when the DOD awarded **$20 million** to Electra Battery Materials to complete an industrial-scale hydrometallurgical plant and establish production of cobalt sulfate at the company's facility in Temiskaming Shores, Ontario. In June 2024, the Canadian government announced a $3.6 million award to Electra. The **hydrometallurgical facility** will be the only facility of its kind in North America, supplying cobalt sulfate to the electric vehicle market, but it could also meet defense industrial needs. Another project that has received **support** from the Canadian government, the Province of Ontario, and Vale Energy Transition Metals is the **Mining Innovation Rehabilitation and Applied Research Corporation project**, which seeks to recover nickel and cobalt from mine tailings from Vale and Glencore mines near Greater Sudbury, Ontario. This would recover valuable critical minerals while reducing the long-term social and environmental costs associated with mine waste.

TUNGSTEN

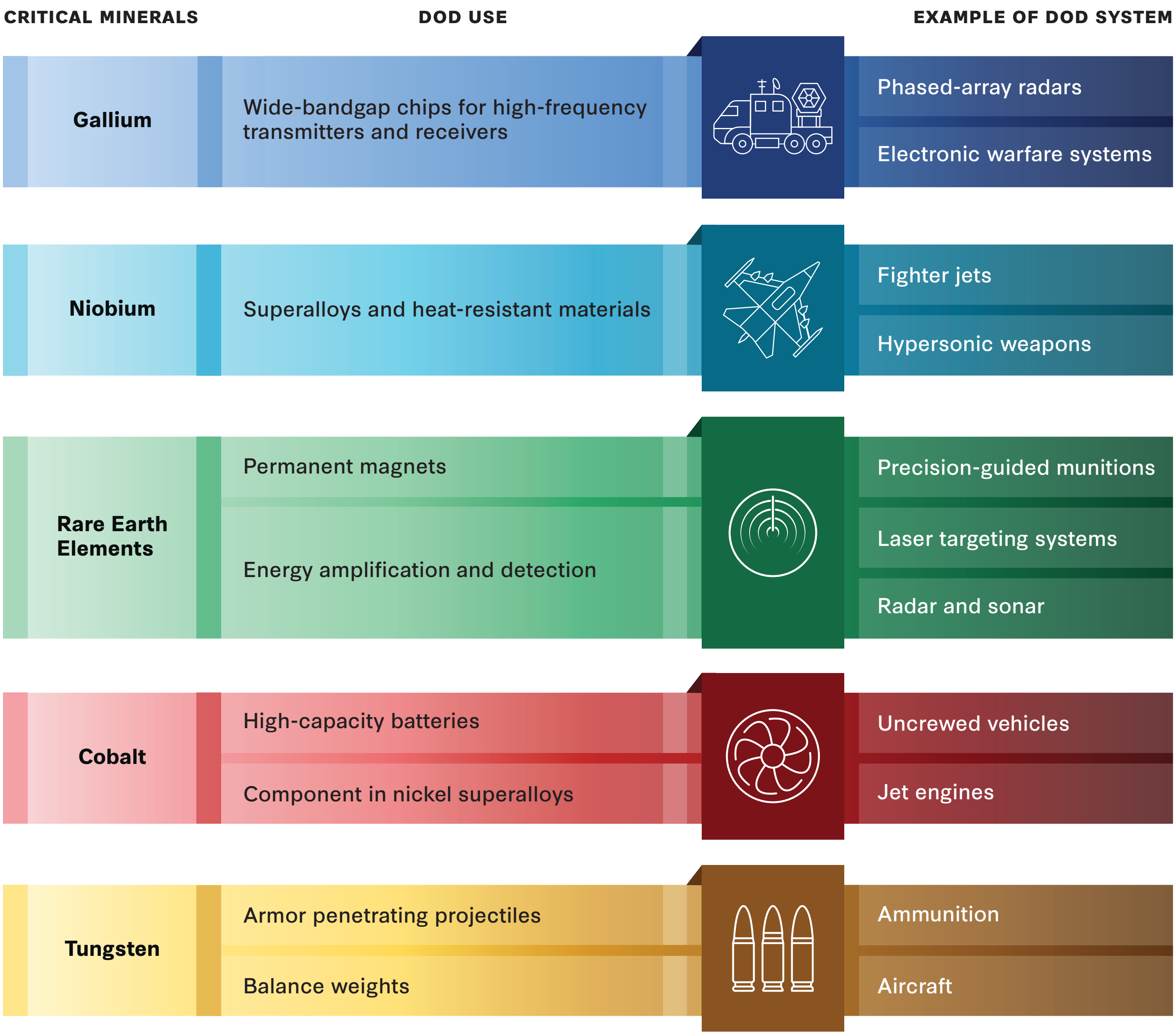
Tungsten is a critical mineral known for having the highest melting point of all known metals (**6,177°F**), the lowest **vapor pressure**, and the highest tensile strength. Often combined with carbon to form tungsten carbide, it is an exceptionally dense and hard material—significantly harder than steel. Its density and hardness make it ideal for **defense applications** like armor-penetrating munitions, rocket nozzles, turbine blades, and balance weights.

Tungsten is the rarest of the minerals analyzed in this paper, highlighting its strategic value. Globally, there were about **78,000 metric tons** of tungsten produced in 2023. Over 85 percent of the production and processing **occurs in China**, which holds over 54 percent of the world's tungsten reserves and is the largest tungsten consumer. The United States depends entirely on imports for tungsten, a key supply chain vulnerability.

Developments in tungsten mining and processing have taken on heightened importance. On December 11, 2024, the Office of the United States Trade Representative (USTR) **announced** a 25 percent tariff on tungsten imports from China. The USTR imposed the tariff following a period of **public comment** in which arguments asserted that the increase was vital to the security and resilience of domestic supply chains for key U.S. industries, including aerospace, automotive, defense, medical, and oil and gas, because it would stimulate greater domestic production. Most recently, following the Trump administration's imposition of 10 percent tariffs on China, the PRC retaliated by announcing **export controls** on five critical minerals with defense applications, including tungsten as well as bismuth, indium, molybdenum, and tellurium.

The United States now faces the urgent task of significantly increasing domestic tungsten production. Guardian Metal Resources plans on **acquiring** the idle Tempiute Tungsten Mine and Mill, located in south-central Nevada less than 240 km north of Las Vegas. Formerly known as the Emerson Mine, it operated intermittently over the last century, most recently under Union Carbide from 1977 to 1987. It closed after China flooded the tungsten market, leading to a plunge in prices. Initiatives such as this, however, should be complemented by mining projects in Canada, which is home to the **Mactung Project** in Canada's Northwest Territories and Yukon, the world's largest high-grade tungsten deposit. Its owner, Fireweed Metals, is conducting technical and environmental studies before beginning operations in the coming years. In December 2024, the DOD announced a **$15.8 million grant** to accelerate the development of the project by performing metallurgical test work, conducting a feasibility study, and completing other activities necessary to support a construction decision. Meanwhile, the **Sisson tungsten-molybdenum project** in the Canadian province

Figure 2: Illustrative Uses of Critical Minerals in Department of Defense Systems



Source: CSIS analysis based on information contained in "Materials of Interest," Defense Logistics Agency, https://www.dla.mil/Strategic-Materials/Materials/.

of New Brunswick is closer to getting shovels in the ground. It has engaged with First Nations since 2010 and has received federal and provincial environmental permits. The project's owners, Northcliff Resources and the Todd Corporation, are currently focused on obtaining construction and operating permits, offtake agreements, and project financing, and they hope to begin construction in December 2025.

SKETCHING A SUPPLY CHAIN

Securing critical minerals does not mean merely digging more of the necessary metals out of the ground in Canada; it requires thinking critically about mining, processing, offtaking, and recycling. The challenge for both Washington and Ottawa is therefore how to expeditiously scale up all parts of the supply chain, as well as leverage cross-border efficiencies to complement national action.

Mining

A key roadblock to new mining is permitting. According to S&P Global, it takes an average of **29 years** from first discovery to first production in the United States. Canada fares little better, at an average of **27 years** (including 10 to 15 years just to obtain a **permit**). During that time, mining projects can be tied down in fierce legal battles, subject to lengthy and expensive reporting requirements, and enmeshed in partisan politics at both the federal and provincial levels. To be sure, robust environmental regulations and requirements that companies obtain the so-called social license to mine from affected communities are welcome and help to significantly reduce the **local externalities** caused by mining projects. Nevertheless, current permitting timelines are simply untenable to meet today's supply chain challenge.

Further challenges manifest for companies seeking to finance new mining. Especially for minerals with niche defense applications like niobium or tungsten, the players involved tend to be smaller entities. Large mining conglomerates such as BHP, Rio Tinto, and Anglo American tend to focus their investments on minerals with a large and well-defined market, like copper. Comparatively smaller firms, therefore, face steep uphill battles to secure the requisite capital to begin developing a deposit. Fluctuations in price can further impede progress, making it unprofitable to continue operating a given mine—an especially risky possibility given China's ability to manipulate markets through overproduction. Combined, these factors mean new projects face a highly contingent period between permitting and first production, likened by one analysis to the "**valley of death**" that technology startups often face. More remote projects face even steeper barriers, as operators need to finance their own infrastructure, including power plants, road, rail, and air connections, which can drive up capital and operating costs **significantly**.

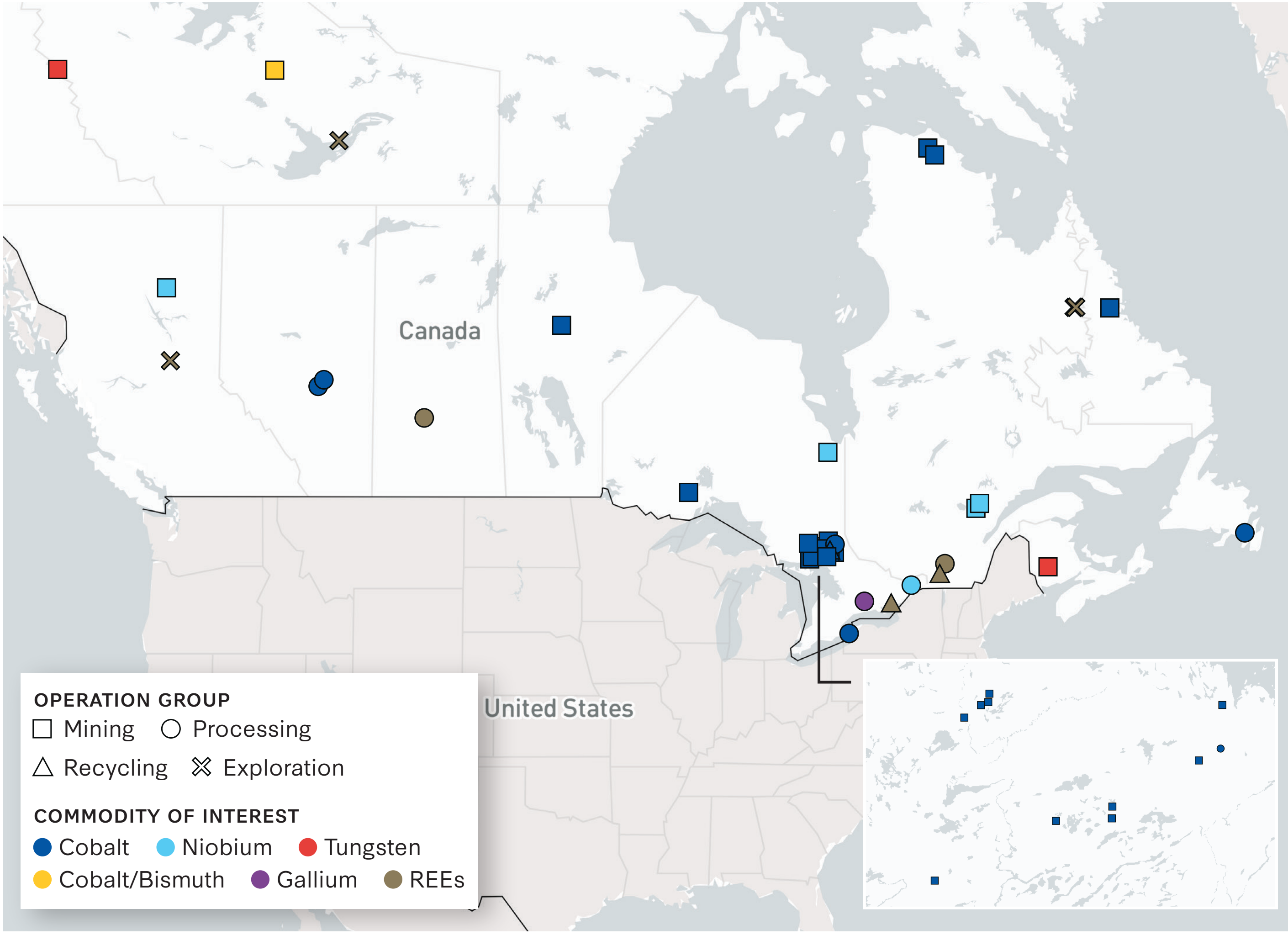
There is no shortage of cases in Canada where critical mineral mining projects have cleared the requisite regulatory hurdles to begin development only to flounder when it comes to financing. The Mactung Project on the border of Yukon and the Northwest Territories is one such example. Feasibility studies and environmental assessments were completed by 2014, but the mine has lain fallow since. Only the DOD's award and the parallel Natural Resources Canada investment have helped the project move forward with development. While this is a positive signal to investors, Fireweed Metals will likely need to raise **hundreds of millions** of dollars more to begin development on the Mactung Project in earnest.

In other cases, insufficient financing incentives can turn opportunities into strategic liabilities. In 2021, Australian-based mining company Vital Metals began REE extraction near Nechalacho in Canada's Northwest Territories. However, the company soon made headlines for **partnering** with Chinese firm Shenghe Resources to offtake the entire supply of REEs mined from the Nechalacho project, meaning a project intended to loosen Beijing's grip on the global REE supply could instead strengthen it. From a business standpoint, the move made sense: REE extraction is a complicated and costly process. Absent government support, partnering with a Chinese company was likely the only way Vital could expect to turn a profit. However, after roughly three years of rising concern over China's critical minerals plays, Vital ultimately **struck a deal** with the Saskatchewan Research Council to process its output instead. Even today, the project's future remains uncertain, as the mine struggles to pay back high initial capital costs, **hindering** its ability to raise additional funding. More robust early backing for promising critical minerals projects could have elided this issue and allowed Canada to focus on expanding its rare earth industry rather than become bogged down in political back-and-forth.

Processing

Processing refers broadly to the physical or chemical means by which ores and concentrate extracted from a mine are transformed into a mineral product useable by manufacturers further down the supply chain. In some cases, process-

Figure 3: Locations of Selected Critical Mineral Projects



Source: "Canada's Minerals and Mining Map," Natural Resources Canada, https://atlas.gc.ca/mins/en/index.html. Elaborated with data from authors' research based on multiple sources cited throughout this report.

ing can also be used to separate minerals typically found commingled in the same deposits. Gallium, as mentioned, is typically produced as a **by-product** of bauxite processing to create aluminum. Similarly, most REEs require complicated and advanced separation processes to recover sufficient quantities of each desired element.

Another major bottleneck on the processing side is energy. Rio Tinto's five aluminum smelters in Quebec are supplied by six hydroelectric power plants with an installed capacity of over **3 gigawatts**, enough to power more than 2.5 million homes. Bringing new processing facilities online, therefore, is not nearly as simple as constructing the facilities and installing the requisite equipment; it entails building new energy infrastructure. This further inflames environmental tensions around processing, as the cheapest and most readily available power sources often rely on **oil and gas**. However, Canada's remarkably green power grid could help buck this trend. In 2022, **70 percent** of Canada's electricity came from renewables, the vast majority from hydropower. In some provinces, like Quebec, this figure soars to nearly **99 percent**, though water supply remains a persistent challenge.

Unlike the United States, which has shuttered many of its refineries, Canada has a robust smelting and refining industry, including a competitive aluminum industry centered in Quebec and Teck Resources' **Trail Smelter** in British Columbia, one of the few major producers of germanium outside of China. Renewed focus on processing infrastructure may also create opportunities for Canadian provinces not traditionally involved in the minerals supply chain to rise in prominence. Saskatchewan has sought to carve out a niche for itself with the SRC's Rare Earth Processing Facility, working to develop homegrown REE processing expertise, which it promises is free from reliance on PRC technology and is potentially more efficient and cleaner than China's processing methods. **Alberta**, meanwhile, lacks sizeable deposits of critical minerals but has cheap and plentiful energy thanks to its storied oil industry, making it an attractive candidate for new processing infrastructure.

Finally, processing may be an area for increased cross-border cooperation with the United States. By mining in one country and processing in another, the two countries can achieve greater efficiencies than they might otherwise. One example is the DPA-backed **Jervois cobalt mine** in Idaho, which could benefit from the Fortune Minerals refinery that will be built in neighboring Alberta.

Offtaking

Once it is established that metals can be mined and processed economically, the final step to realizing new supply lies in connecting primary producers to end users, referred to here collectively as offtakers. In the case of the defense industry, two critical factors determine the effectiveness of increasing geopolitical security at this stage of the supply chain—namely cost and quality. Cost is a key determinant. While many defense contractors have made strides to de-risk their supply chains for primary materials, if alternate sources cannot deliver a competitive price, shifting this balance is not possible through market forces alone. The challenge of China's overcapacity is on full display, as it can overproduce certain bespoke minerals to such a degree that it **depresses** global prices and makes it unprofitable for other countries to compete. This, in turn, leads to a dearth of production outside China and helps cement Beijing's de facto monopoly on certain materials. The United States has contemplated implementing **price supports** for certain minerals to help them compete with a glut of Chinese production. However, the specific contours of such an effort remain uncertain for now.

The second main determinant for successful supply chain relocation at the offtaking stage is the quality and purity of the processed mineral. Especially when it comes to defense technology and high-end applications such as aerospace parts, permanent magnets, and radars, any material needs to meet **stringent requirements** for purity. Accordingly, manufacturers hesitate to trade reliable, vetted suppliers for new entrants—even if current suppliers are located in countries with elevated levels of geopolitical risk. Especially if new Canadian suppliers are neither cost competitive nor extensively vetted, inserting them into the supply chain for some of the most complex and demanding manufacturing processes will be a challenge. While there is every reason to believe Canadian producers, with their rich background in mining and refining, highly trained workforce, and leading engineering institutes, can meet the demands for quality and purity, closer intergovernmental coordination can play a role in helping connect new producers with would-be offtakers.

Recycling

The final element in a strengthened supply chain for defense-critical minerals is what happens to these materials once the products they are found in have completed their life cycle. Recycling not only helps hedge against geopolitical disruptions in supply but also reduces the need for new mining and its environmental consequences. Furthermore, given the overall small quantities of metals the DOD uses, recycling can go a long way to meeting demand. The U.S. Defense Logistics Agency has already **made strides** in boosting **domestic recycling capacity**, particularly for germanium and aircraft superalloys. Canada's **critical minerals strategy** emphasizes recycling and the circular economy, and its private sector has birthed some startups with ambitious plans for recovering critical minerals at a commercial scale. Kingston-based **Cyclic Materials**, for instance, is focused on REE recycling, while Toronto firm Li-Cycle has become a **global leader** in lithium recycling, with other plants located in New York and Alabama.

The other side of this coin, however, is that recovering specialized mineral inputs from military equipment can require similarly specialized and technically intensive processes. With commercial recycling companies largely focused on recovering lithium from consumer batteries and electronics, more efforts need to be focused on recycling niobium, tungsten, and gallium, like the Neo Performance Materials plant in Peterborough. One avenue for closer public-private and U.S.-Canada cooperation in recycling is in REEs. In the fall of 2024, the Canadian government announced a nearly **CAD 5 million** (approximately $3.5 million) investment in Cyclic Materials to support the development of a demonstration plant that would produce rare earth oxides from recycled materials. Promising developments also come from recovering REEs from mine tailings. Researchers in **Alberta** and **Saskatchewan** have indicated progress in collecting valuable minerals from tailings, which, if brought to scale, could not only help Canada scale up its REE production but also further minimize some of the worst environmental externalities caused by mining.

POLICY RECOMMENDATIONS

Action is sorely needed across the entire defense minerals supply chain. However, for an industry where timelines are often measured in years, if not decades, effective prioritization is key. Greater alignment between Canada and the United States regarding which types of minerals and segments of the supply chain to focus on will be essential, similar to the division of efforts during World War II.

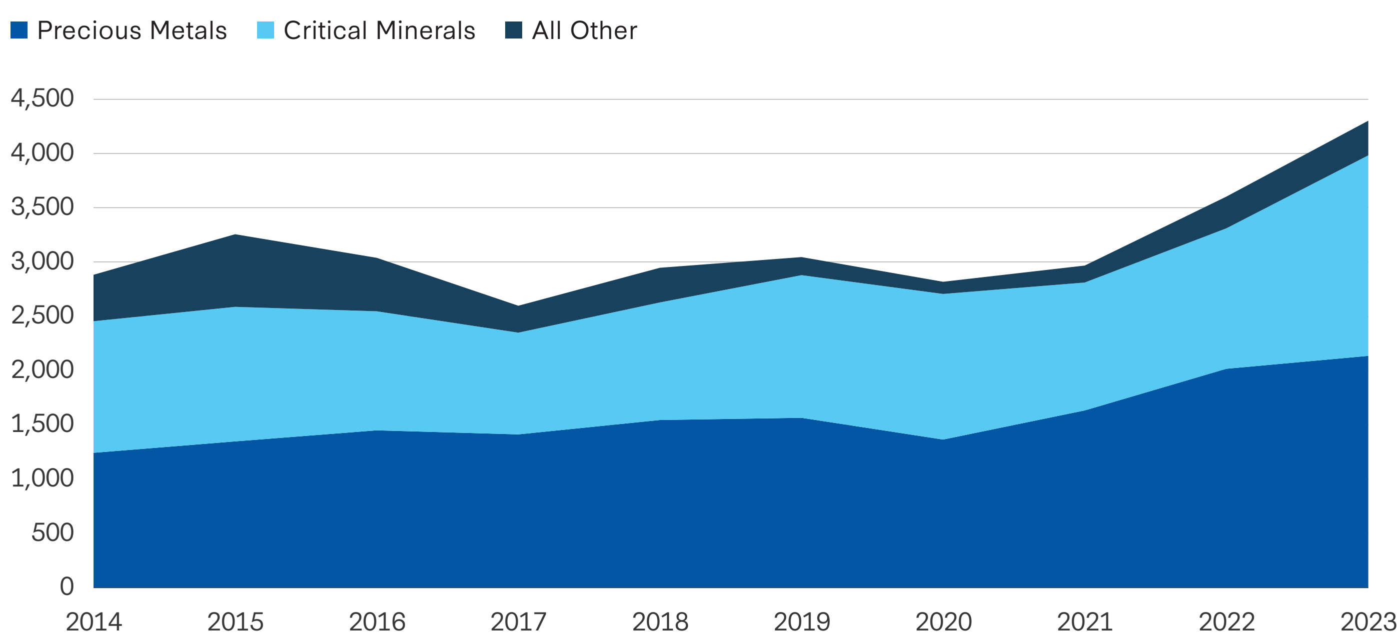
1. Establish a Canadian DPA Title III.

The first step to closer U.S.-Canada alignment should be establishing a Canadian financing instrument for defense-critical minerals akin to DPA Title III. The DPA is a U.S. law that empowers the federal government to mobilize resources from the private sector to serve exigent national security needs. **Title III** of the act is principally an investment program, which the U.S. government can employ to catalyze projects that "create, maintain, protect, expand, or restore" industrial base activities. Since 1993, Canada has been considered part of the U.S. industrial base for the purposes of DPA Title III investments. However, only recently has this partnership begun to see meaningful cross-border investments take shape.

At present, the DPA has allocated approximately $63.4 million to **five critical minerals projects** in Canada, with the Canadian government putting up roughly $35.9 million in matching funds. These are encouraging developments but a far cry from the funding needed if North America hopes to reorient vital supply chains away from adversaries. Furthermore, with the Trump administration focused on **bolstering** the U.S. domestic minerals supply, the onus will likely shift to Canada to take the lead on investing in its mining sector development.

Standing up such an initiative would present a strong signal to the minerals industry that Canada is ready to pull its own weight and would give the Canadian government a powerful instrument to channel investments in defense minerals. Such an initiative need not be cost-prohibitive either: a Canadian DPA Title III would not require paying the whole cost of a new mine or processing facility but merely require signaling a government stake in the project and letting private sector investment make up the rest. The **CAD 3.8 billion** (approximately $2.7 billion) allocated over eight years in the 2022 Canadian federal budget to support implementation of the Canadian critical minerals strategy is considerably less than the **CAD 6.3 billion** (approximately $4.4 billion) it cost the Canadian government to suspend some sales taxes over the winter holidays. It is also less than its plan to send checks for CAD 250 (approximately $175), totaling **CAD 3.8 billion**, to **18.7 million** individual Canadians who earned less than CAD 150,000 (approximately $104,000) in 2023. Resources like these could be instead channeled into helping dozens of critical minerals proj-

Figure 4: Expenditures on Mine Development in Canada



Source: "At a glance: Canadian mineral exploration and development survey," Natural Resources Canada, https://natural-resources.canada.ca/mining-statistics/exploration/at-a-glance.

ects get off the ground. A Canadian DPA Title III equivalent would also be one step to begin addressing long-standing **U.S. concerns** over Canada's failure to meet its NATO obligations on defense in a manner that would pay dividends for Canada's economy more broadly.

2. Include a Critical Minerals Chapter under the USMCA.

The **United States–Mexico–Canada Agreement** (USMCA), signed in 2018, includes a provision for a review process to occur by July 2026, during which each of the three participating countries is supposed to signal its intention to continue with the agreement or not. While both Canada and Mexico initially hoped this would be a simple review with not much change, it has become increasingly clear over the past year that the United States sees the review, rather, as an opportunity for a more thorough renegotiation of the agreement. The Trump administration has indicated that it intends to push for **accelerating** the timetable for renegotiation, likely in 2025, to address points of friction it has with both its trading partners.

Renegotiation of the USMCA offers the opportunity to resolve existing problems, expand the agreement, and begin thinking about it not simply as a trilateral trade agreement but also as a long-term strategic economic security framework. One area of expansion could be a new USMCA chapter on critical minerals that **addresses** financial support from governments to open new mines and processing facilities, expedites permitting for mineral projects, coordinates action to stabilize prices, and incentivizes long-term investment in the sector.

3. Develop patient capital for mining investment.

While a Canadian equivalent to DPA Title III would serve as a crucial short-term measure, locking in North American critical minerals security requires cultivating an investment environment prepared to offer sustained backing as companies navigate the "valley of death" of launching a new minerals project. Loan-guarantee programs offer one opportunity to build this kind of patient capital. One relevant example is the **UFK program** in Germany, through which the German government secures a percentage of the overall financing for a given critical materials project. These guarantees make new mineral projects far more palatable to commercial investors, who feel secure knowing they can recoup most of their investment in a worst-case scenario. The U.S. Export-Import Bank and Export Development Canada can work together to devise realistic loan guarantees depending on the criticality of a particular mineral project, reducing the chances that the bottom falls out from beneath new mining projects before they can begin production.

4. Incentivize public and private sector stockpiling.

Stockpiling is a key mechanism through which the United States and its allies can insulate themselves from coercive minerals diplomacy. Unfortunately, the U.S. National Defense Stockpile (NDS) has fallen to historic lows since the end of the Cold War. According to the Congressional Research Service, current NDS reserves would **supply** "less than half of estimated strategic and critical materials shortfalls for military requirements" in a best-case crisis scenario. The NDS urgently needs expanded purchasing power, but this is only half the equation. The United States should **incentivize** companies to maintain their own stockpiles of critical materials as part of a move to harden supply chains. U.S. and Canadian governments could consider financial incentives like tax breaks for minerals purchased but not consumed by companies in a given year. Consideration should also be given to creating a Canadian strategic stockpile of defense-critical minerals. Potentially, such investments could count toward Canada's NATO commitments on defense spending, though care should be taken to identify which minerals make the most sense from a strategic and market standpoint when launching such an initiative.

5. Increase bilateral cooperation to identify priority projects.

The Canada-U.S. Joint Action Plan on Critical Minerals, launched under the first Trump administration, provides a **useful starting point**, but it could be strengthened in important ways. First, both countries should acknowledge the unique challenges of mineral supply for defense industrial purposes, in addition to conversations around energy transition requirements and advanced technology. Second, a more thorough undertaking should be launched between the two countries to map and identify priority geologies and projects on both sides of the border to meet their respective mineral demands. This cooperation must go beyond the federal level to include Canadian provincial governments, given their crucial role in permitting and project development. Ontario Premier Doug Ford's **proposal** to launch a new mineral security alliance to work on fast-tracking investments to national security-relevant projects represents one such step in the right direction. Given the long timelines associated with mining projects, time is of the essence to pick investments that will bear fruit soon enough to mitigate the effects of coercive resource diplomacy by adversaries. U.S.-Canada cooperation in this regard could provide a model for multilateral engagement with allies on minerals security policy, allowing the United States and its allies to rapidly identify which countries and projects are best prepared to backstop demand for a particular mineral or set of minerals. Starting in North America with two close neighbors and critical partners is a necessary first step.

6. Invest in enabling infrastructure for mining.

Discovering a new deposit of critical minerals means little without the infrastructure to develop it, including lodging, transport connections, and power supply. Particularly in Canada's northern and Arctic regions, historical underinvestment has left these areas with a paucity of core infrastructure. This not only hinders mining activity but also jeopardizes Canadian security and sovereignty in the high north, as acknowledged in Canada's **Arctic defense strategy**. Mining could provide one solution, as new projects help lay the groundwork for a stronger northern logistics network that can support both local economies and military operations, should the need arise. While the Canadian government has committed some **CAD 218 million** ($152 million) over 20 years to Arctic defense infrastructure development, channeling support to buy down the costs of enabling infrastructure at mining sites in the high north could yield even faster gains. Canada should also strengthen mechanisms for participation by local, especially Indigenous, communities in the vicinity of proposed mining projects to ensure these populations can tap into the benefits of new infrastructure investment. ■

Christopher Hernandez-Roy *is the deputy director and senior fellow with the Americas Program.* ***Henry Ziemer*** *is an associate fellow with the Americas Program.* ***Alejandra Toro*** *is a former intern with the Americas Program.*

The authors would like to thank Photinie Koutsavlis, Heather Exner-Pirot, and Abigail Hunter for their thoughtful comments and review. The authors also thank the CSIS publications and iLab teams—especially Phillip Meylan, Hunter Hallman, Kelsey Hartman, Madison Bruno, and Julia Huh—for editing, design, and production. All opinions and errors should be understood to be solely those of the authors.

This report is made possible by the generous support of Taseko Mines Limited.

Cover Photo: Charly Triballeau/AFP/Getty Images