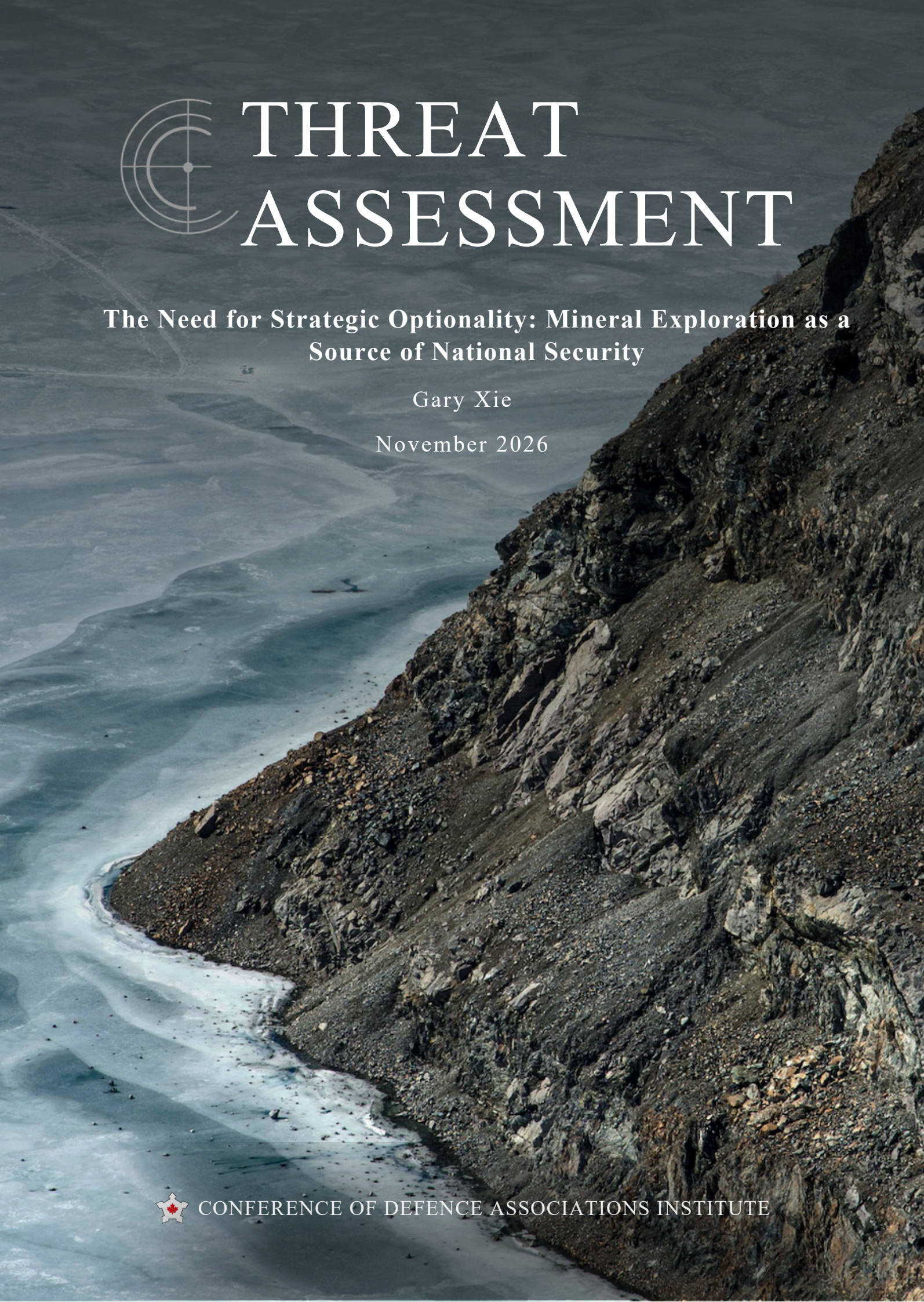


THREAT ASSESSMENT

The Need for Strategic Optionality: Mineral Exploration as a Source of National Security

Gary Xie

November 2026

CONFERENCE OF DEFENCE ASSOCIATIONS INSTITUTE

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About the Author

Gary Xie is the Director of Policy at the Association for Mineral Exploration (AME), Canada's leading voice for the mineral exploration and development sector. His work connects critical minerals with capital markets and industrial policy in a changing global economy. Gary's work has been featured in policy publications, including the 2026 International Monetary Fund (IMF) working paper: Institutions for Industrial Policy: The Foundation of Economic Development.

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On the Cover

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"Exercise TIREUR INCLINÉ"
5th Canadian Mechanized Brigade Group snipers recover shooting targets in a closed mine iduring Exercise TIREUR INCLINÉ in Thetford Mines, Québec on March 11, 2016.
Photo: Sgt Marc-André Gaudreault, Imaging Services, Valcartie

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Introduction

For decades, access to minerals was left primarily to market forces. However, as geopolitical competition continues to rise, competing nations leverage their control over mineral supply chain as a source of coercion, deterrence, and influence. As a result, Canada's access to minerals has become increasingly tied to its national security. NATO formally recognized this dependency between mineral access and national security in 2024 when the alliance identified 12 defence-critical raw materials: aluminum, beryllium, cobalt, gallium, germanium, graphite, lithium, manganese, platinum, rare earth elements, titanium, and tungsten.[1] In July 2026, Canada and 11 other NATO Allies went further, launching a multinational initiative focused on acquiring, storing, transporting, and managing critical raw materials and components for defence production.[2]

The link between mineral supply and national security will only intensify as geopolitical uncertainty continues to unfold. Prime Minister Mark Carney recognized this importance in his Davos speech, where he noted that "multilateral institutions…are under threat. As a result, many countries [see the need to] develop greater strategic autonomy, in energy, food, critical minerals, in finance and supply chains."[3]

For Canada, securing defence-critical minerals requires more than having the right geology. These resources must first be identified, developed, and brought into production before they can contribute to defence supply chains. Canada's central challenge is therefore its ability to translate its vast geological potential into reliable, defence-ready supply on the timelines required by Canada and its allies. Looking ahead, Canada needs to develop strategic optionality where the right materials, in the right processed form and specification, can reach a defence manufacturer in the time and at the scale needed.

This threat assessment examines how government and industry can cooperate to secure the critical mineral supply chains that underpin the expanding defence requirements of Canada and its allies. It begins with an overview of the international context. It then argues that three market failures constrain Canada's ability to deliver on the timelines required by Canada: information failures, which leave valuable by-product minerals unidentified or unreported; investment-horizon mismatches, which limit patient capital for exploration and development despite long-term strategic needs; and coordination failures, which prevent explorers, processors, and defence end users from aligning supply, investment, and demand. The assessment ends by proposing four targeted government interventions to address these failures.

Adversarial Control of Defence-Relevant Minerals

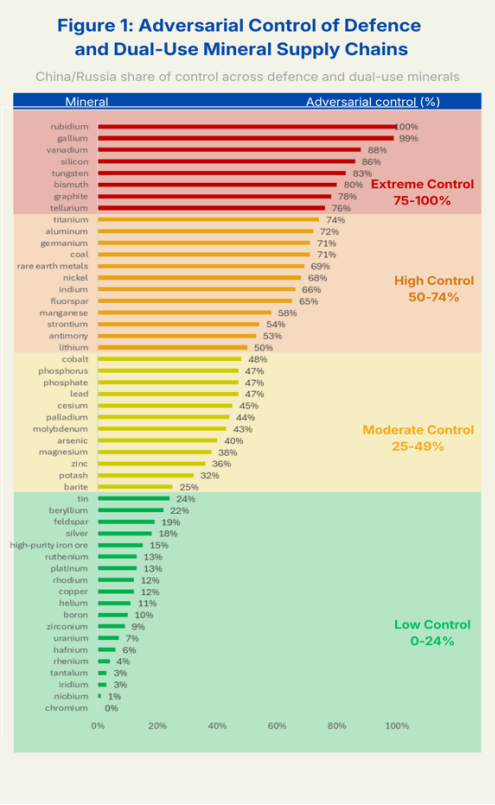
Canada is vulnerable to a highly concentrated global supply chain where alternative supply takes a long time to create. The International Energy Agency (IEA) finds that it takes on

average more than 16 years to develop a new major mine.[4] Given this long time for new mine supply, even a temporary disruption creates a mismatch between the speed of geopolitical action and that of market adjustment. Therefore, Canada and its allies need to develop the strategic optionality to replace mineral supply before the disruption begins to constrain defence production in a time of conflict.

Countries like China and Russia are increasingly willing, and able, to intervene in mineral supply chains not only to pursue commercial objectives, but also to advance industrial policy, respond to geopolitical events, and in some cases, impose costs on other states. The security challenge for Canada therefore extends beyond dependence on any single country. It is the growing possibility that access to strategically important materials will be determined by political decisions rather than market conditions alone.

China represents the most significant concentration of this risk. The IEA finds that China is the largest refiner for 19 of the 20 strategic minerals it tracks, with an average market share of 70 percent.[5] Concentration alone, however, does not necessarily constitute a threat. The strategic vulnerability emerges when a dominant supplier is willing and able to restrict access. China has demonstrated that capability repeatedly. Chinese export controls introduced on gallium and germanium in 2023[6] were followed by restrictions on graphite[7] and subsequently expanded to additional strategic materials, including tungsten[8] and rare earth elements (REEs).[9] By 2026, more than half of the 20 strategic materials monitored by the IEA were subject to some form of Chinese export control.[10] China is not the only country that leverages its control of a concentrated supply chain. In November 2024, Russia temporarily restricted exports of enriched uranium to the United States.[11] Moscow explicitly presented the measure as a response to US policy.[12]

Figure 1 below highlights the extent of adversarial control of mineral access. Out of the 51 minerals identified by Canada, the US, and the EU as critical minerals, 8 minerals are under extreme control meaning that China and Russia account for 75-100% of the mineral production. 12 minerals are under high control at 50-74%. Overall, the median control share across the 51 minerals is 44% with a mean of 42%, illustrating the high concentration (see Figure 1).[13]



When looking at the 12 minerals that NATO has identified as defence critical, the concentration risk is even higher. 9 out of the 12 NATO minerals rely on 50% or more of their supply from China or Russia. Overall, the median control share across the 12 NATO minerals is 70% with a mean of 61%.

This intense reliance on mineral supply chain is a strategic vulnerability. Importantly, a dominant producer does not need to permanently withhold a mineral supply to exercise leverage. It needs only to control a sufficiently important bottleneck that alternative suppliers cannot replace, thereby disrupting the affected materials within the timeframe required by downstream industry. For example, in April 2025, China imposed export controls on heavy rare-earth elements and related compounds, metals, and magnets. This was not a permanent embargo as exports became subject to licensing, and volumes subsequently recovered as licences were granted.[14] However, in the temporary time that China imposed export control, automakers in Europe and the US reported shutting down production.[15]

Why Markets Alone Cannot Correct the Threat

In a conventional commodity market, price signals control supply. Scarcity should lead to higher prices, higher prices should attract investment, and new supply should eventually enter the market. This mechanism remains important in mineral development. For many defence critical minerals, however, the market operates too slowly or incompletely to provide security against a sudden disruption. Canada's mineral exploration ecosystem is particularly vulnerable to three market failures and structural frictions: information failure, a mismatch between investment and strategic timelines, and coordination failures across the supply chain.

Information Failure

Mineral exploration is shaped by the information available to companies and investors. Capital tends to favour commodities with established markets, transparent pricing, and well-understood development pathways. This creates a natural bias toward familiar commodities that miners already develop, such as gold, copper, nickel, and zinc.[16]

The problem is that many defence relevant minerals occur within the same geological systems but may not be the primary target of exploration. Where a mineral has historically had limited commercial value, companies may have had little reason to assay it systematically, characterize its distribution or incorporate it into early project planning.[17]

This information gap affects mining companies, investors, and governments alike. Strategically important minerals may already exist within known Canadian deposits or exploration projects but remain unidentified or poorly understood. The market cannot value a resource that has not been detected, and governments cannot incorporate it into defence or industrial planning if they do not know it exists.

For Canada, the consequence is a lost opportunity. The country may possess more defence-mineral optionality than current production and resource statistics suggest, while existing exploration practices may systematically understate that potential. Improving geological information and expanding assaying for strategically relevant minerals can therefore have a national security value that is not fully captured by the immediate commercial return to an individual exploration company. Importantly though, the later this work is left in the planning and feasibility of a project, the more expensive it becomes to shift project design to incorporate previously overlooked minerals into the project.

Time-Horizon Mismatch

Mineral exploration and defence planning also operate on fundamentally different timelines. Defence planners must consider materials that may be required to sustain military capabilities many years into the future. Mineral exploration finance, by contrast, is highly sensitive to current commodity prices, investor sentiment, and short financing cycles.[18] Capital can move quickly between commodities and projects as market conditions change, while the development of a new source of mineral supply can take 16-23 years.[19] Ultimately, mineral explorers and miners are highly sensitive to short-term markets, which may not align well with the long-term strategic needs of the defence industry.

This creates a fundamental mismatch between when investment is strategically valuable and when markets have the strongest incentive to provide it. A mineral may not appear scarce today. Its price may therefore provide little incentive for new exploration or project development. Yet if geopolitical conditions change, such as the 2026 demand surge for tungsten caused by the war with Iran,[20] new defence requirements emerge, or a major supplier restricts exports, demand can shift much faster than new supply can be created. By the time scarcity produces a strong enough price signal to attract capital, the opportunity to build an alternative supply chain in advance of the disruption may already have been lost.

The market can therefore respond rationally to present conditions while still producing too little strategic capacity for the future. For defence minerals, waiting for scarcity to reveal itself through prices is particularly risky because the development timeline for alternative supply is far longer than the timeframe in which a geopolitical disruption can occur.

Coordination Failure

A third vulnerability arises because defence-mineral supply chains depend on decisions made by multiple actors that do not necessarily share the same incentives or information. It is unlikely that a single actor has sufficient incentive or visibility to optimize the whole supply chain.

The current mineral supply chain is populated by various actors in different segments, many with different investor demands and market decisions that do not align with each other. This problem is

particularly acute for strategic minerals produced as co-products or by-products. An exploration company may have little incentive to characterize a minor mineral if no clear buyer or processing pathway exists. To ensure that exploration is connected to downstream demand, exploration projects need to connect to processors, refiners, manufacturers, defence suppliers, allied governments, stockpiles, and offtake partners.

However, for many explorers, this downstream world can be distant and difficult to navigate. Explorers may understand geology but not necessarily industrial demand from aerospace, electronics, and advanced manufacturing. At the same time, downstream defence and industrial actors may not always understand how early-stage exploration pathways are generated.

The result is a coordination problem across exploration, processing, financing, and demand. Canada may possess the geological resource, technical expertise, and downstream requirement necessary to build a defence-mineral supply chain yet still fail to connect those elements in time.[21]

The three market failures listed above reinforce one another. Canada may fail to identify strategically important minerals within existing geological systems. Short-term capital markets may then underinvest in projects whose value lies years in the future. Even where resources are identified, fragmented incentives across the supply chain may prevent them from reaching the defence market. The result is that the market can function efficiently under normal commercial conditions while still leaving Canada exposed when geopolitical conditions change faster than alternative supply can be developed.

How Canada Can Build its Strategic Optionality

To address these market failures, Canada should pursue four complementary interventions: Define, Discover, De-risk, and Connect. Together, these measures would improve the information available to markets, reduce the mismatch between commercial and strategic timelines, and strengthen coordination between exploration and downstream defence demand.

1. Define: Make Strategic Value Visible

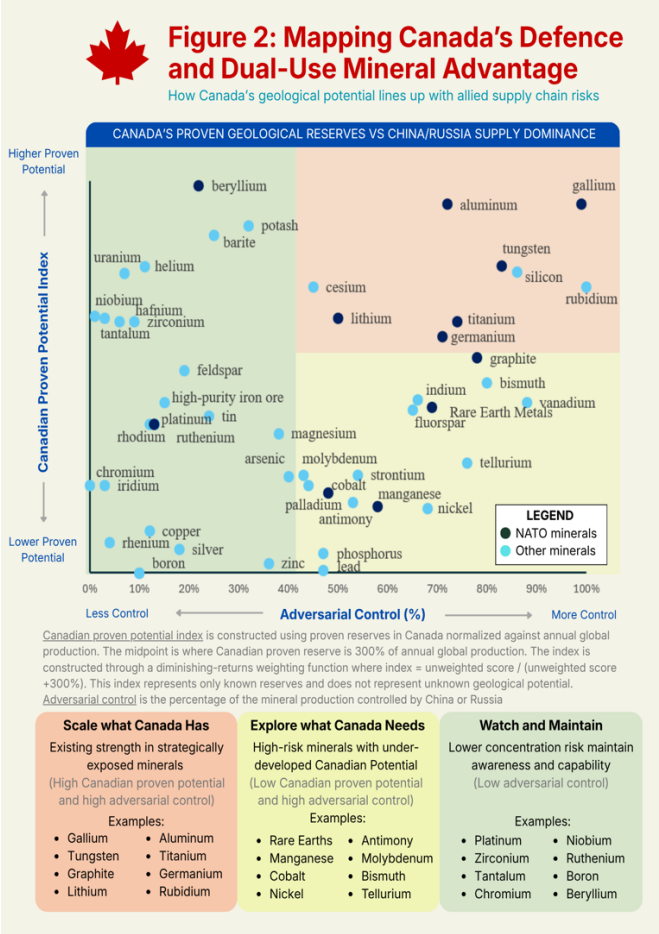
The first priority is to provide clear signals to explorers, investors, and governments about which minerals and mineral systems matter for national security, through a dual-use designation.

This distinction matters because unless demand is clearly identified, markets may not respond effectively to strategic demand signals. Canada should establish a clear dual-use designation framework identifying priority minerals, relevant mineral systems, and major byproduct pathways. Such a framework would give explorers a credible basis for assessing whether a project may have defence relevance and would give governments a more disciplined way to direct incentives and support.

As a starting point, this assessment considers Canada's opportunities by plotting advers-

arial control of a mineral supply chain to Canada's proven potential of that mineral, represented by a calculated ratio of Canada's known reserves of a mineral to current world production. The index in Figure 2 shows this graph, which identifies the minerals that Canada has the most known potential to develop and replace existing world supplies.

The red area identifies the minerals that have high adversarial control and where Canada has significant geological potential to develop. On the other hand, the yellow area points to minerals with high adversarial control but low Canadian known reserves. This low Canadian potential can change, however, as new extraction technology and better geological surveys reveal more Canadian reserves. Lastly, the green side shows minerals with low adversarial control, where Canada should maintain capabilities, but where it has more supply options in the case of supply chain disruption.



2. Discover: Treat Geological Knowledge as Strategic Capacity

Once Canada defines which minerals are strategically important for its defence and industrial needs, the next step is to ensure that these minerals are actually being discovered. Rather than creating a separate exploration system for defence minerals, Canada should leverage its existing strengths in gold, copper, nickel, and other established commodities to expand potential supply opportunities. Many strategically important minerals occur as co-products or by-products of these familiar commodities and may not be commercially viable as standalone exploration targets.

While government procurement and offtake agreements can strengthen demand, they may not be sufficient to incentivize companies to identify minerals that are not routinely assessed in existing exploration programs. Targeted government support for expanded geological mapping, systematic assaying for designated strategic minerals, and better characterization of existing deposits would help close the gap.

This expansion of scope helps to lower the cost of producing information that has strategic value but may have low immediate commercial value to an individual company. Public geoscience is particularly appropriate because the information generated becomes available across the market, allowing multiple companies and investors to make better decisions.[22] Canadian geologists are well equipped and widely considered to be experts in finding and developing copper and gold projects, while the knowledge for doing so on defence metals may not always be at the same level. Investments in geoscience and exploration for defence metals would be a long-term investment in Canada's future security.

Canada has strong institutions at both the federal and provincial levels that manage geological data, but they are largely underfunded. Investments in these institutions on projects with a defence focus are an investment in future security. It is difficult to predict today which mineral will become the critical bottleneck of the 2030s. A discovery-centric approach can ensure that future governments know where potential sources are located and which projects could be advanced if circumstances change.

3. De-risk: Bridge the Gap Between Strategic Value and Commercial Investment

A third pillar is to accelerate the timeline between discovery and development. Mineral projects can require 16 years or more to move from exploration toward a shovel-ready development opportunity.[23] Throughout that period, companies face geological uncertainty, technical studies, permitting, financing requirements, and consultation. Markets therefore heavily discount discoveries whose economic value may lie many years in the future, even where the potential strategic value to Canada is significant.

This is the point at which the mismatch between commercial and national-security timelines can stall projects. Government may value optional future supply well before the market is prepared to finance it. The appropriate response is not to guarantee project success through direct government subsidies, but to bridge the uncertainty that prevents potentially strategic projects from reaching an investable stage. An often-discussed bottleneck is the permitting and environmental assessment process, which has become long and arduous. Additionally, restrictions on land access can limit exploration activities.

Canada should therefore create more predictable support for early feasibility and project-advancement work, particularly where a project contains defence-relevant co-products or by-products whose recovery economics require additional study. One option is to modernize the current exploration finance policy. This includes an expansion of the CEE eligibility to targeted feasibility-stage activities.[24] This would allow companies to determine recovery potential earlier, before project designs are fixed and strategically important minerals are excluded from future production pathways.

De-risking should also include the enabling conditions surrounding projects. Gov-

ernments can establish clearer service standards for exploration and early-development permits, support Indigenous partnership capacity at earlier project stages, and ensure that strategically relevant projects do not lose momentum because of avoidable regulatory uncertainty.

4. Connect: Make Future Demand Visible to Exploration Markets

Explorers operate at the beginning of the mineral supply chain, often many years before a mine begins production. Defence manufacturers, processors, refiners, procurement agencies, and allied gov-ernments operate much further downstream. The two sides therefore receive very different information signals and often work on very different timelines. Explorers may have limited visibility into future defence specifications and procurement needs, while defence and industrial actors may have little understanding of how early future supply must be identified and financed.

Government has an important role in connecting these markets. Canada should continue to create clearer demand signals through procurement strategies, stockpiling, offtake arrangements, allied partnerships, and defence industrial planning. Exploration capital responds to expectations about future markets. If governments want more private investment in defence-relevant mineral supply, they must make credible future demand more visible upstream.

This also requires deliberate convening. Explorers, processors, manufacturers, defence suppliers, investors, Indigenous partners, and governments need mechanisms through which information about future demand, technical requirements, and emerging projects can be exchanged. Canada could complement national coordination with regional defence and dual-use mineral hubs that connect geological resources with existing processing capabilities, infrastructure, research expertise, and industrial demand.[25]

Such interventions should remain targeted. Government does not need to guarantee a buyer for every project or determine the commercial structure of every supply chain. But where strategically important minerals face weak or uncertain commercial demand, public procurement, stockpiling or supported offtake agreements can provide enough market visibility to unlock private financing.

Conclusion

In an increasingly uncertain world, Canada is already a safe and responsible supplier of the minerals that like-minded countries need. As control of mineral supply become increasingly deployed as an instrument of geopolitical competition by countries such as China and Russia, Canada needs to ensure it maintains strategic optionality in its mineral supply chain to counter the risks of coercion, control, and disruption from adversarial powers.

However, the current exploration markets are not designed to produce this outcome on their own. Capital markets often reward familiar commodities and near-term catalysts.

Associated minerals may be under-assayed, underreported, or left out of project planning. Strategic minerals may need to be identified years before demand becomes visible. Byproduct recovery may require co-ordination across exploration, mining, processing, refining, procurement, and downstream manufacturing. These failures reveal structural deficiencies in the current market that Canada needs to address in order to achieve its strategic ambitions.

To address this gap, Canada needs to target these specific market failures through four complementary actions: define, discover, de-risk, and connect. With targeted leadership, Canada can enable responsible exploration, and turn geological potential into long-term security, prosperity, and allied advantage.

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