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Building Supply Chain Resiliency of Critical Minerals

by Brendan Marshall

November 2021

POLICY PERSPECTIVE

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Prepared for the Canadian Global Affairs Institute
1800, 150 – 9th Avenue S.W., Calgary, AB T2P 3H9
www.cgai.ca

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ISBN: 978-1-77397-217-6

Building Supply Chain Resiliency of Critical Minerals

Increasing geopolitical uncertainty has magnified the precariousness of existing sources of critical minerals. These minerals are vital in aerospace, defence, health care, telecommunications, computing and in clean technologies such as solar panels, nuclear energy and electric vehicle (EV) batteries and motors. Governments globally have started assessing the vulnerability of their economies to supply shocks for critical minerals that they cannot sufficiently source (or at all) inside their own borders, but on which the proper functioning of their economies (and sovereign responsibilities) depends.

China's publicly stated intention that Taiwan "must and will be" reunited with China increases the potential for both regional and global instability. From a supply chain perspective, the potential destabilization of Taiwan, host to 55 per cent of global chip manufacturing capacity, would further deepen the West's reliance on China for key inputs essential for manufacturing advanced technologies.

According to the recently released G7 Panel on Economic Resilience report, China alone accounts for 80 per cent of the U.S.'s rare earth elements (REE) imports and 98 per cent of the EU's. Without these imports, wind energy, EV motors, enhanced defence systems and a host of other technologies would be impossible to manufacture. Reinforcing this acute vulnerability is the ongoing global chip and semiconductor shortage, and the demand implications for autos and other advanced manufacturing technologies this presents.

China has dominated the market for these key materials, controlling a majority of their production and distribution, and resulting in an over-reliance by the rest of the world on one country for procurement. These circumstances are amplified by projections for future mineral demand. The World Bank forecasts up to 500 per cent increases in the production of multiple mineral and metal inputs required to produce the clean technology essential to limiting global temperature rise to two degrees Celsius. Similarly, the International Energy Agency projects that EVs and battery storage will account for roughly half of the mineral demand growth from clean energy technologies over the next two decades (to 2040), spurred by surging demand for battery materials.

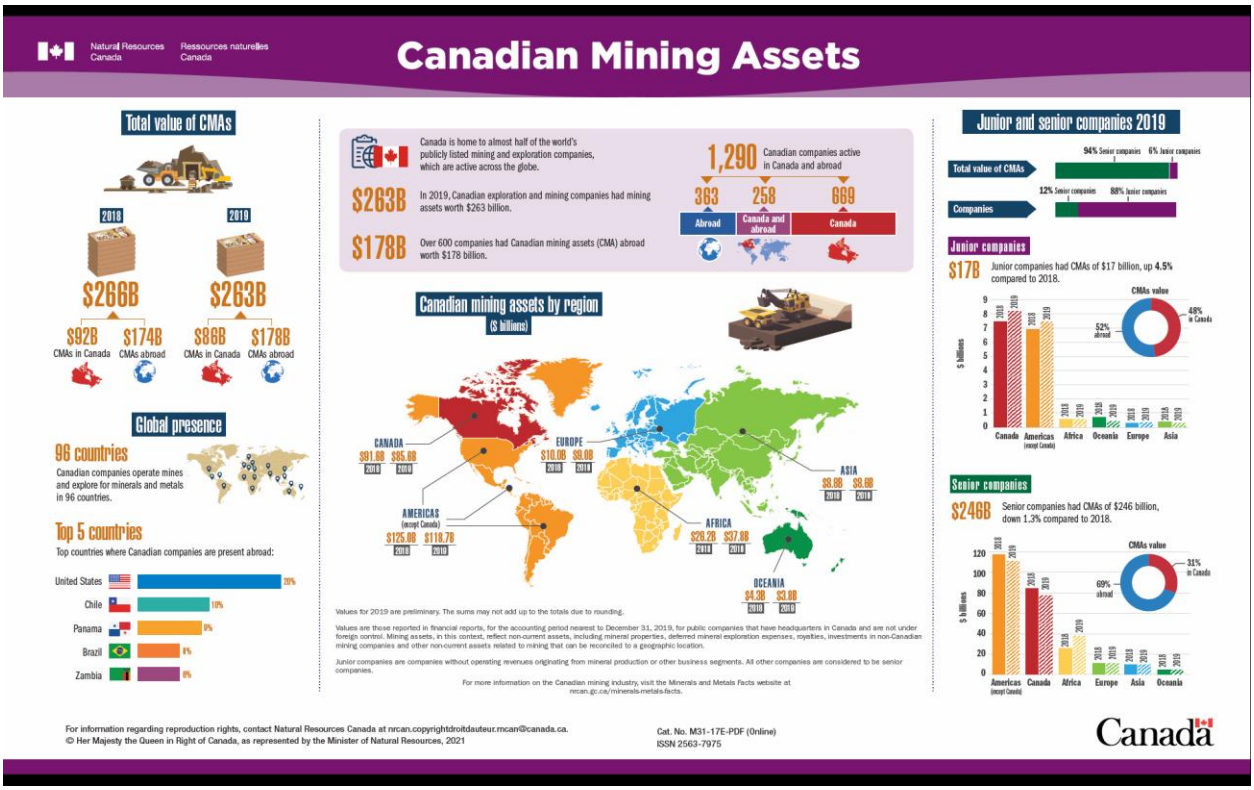
In response, policies and partnerships are being developed and deepened across like-minded countries to secure new access to the critical minerals required to bolster economic security, national defence and low carbon energy transition. Canada has entered critical minerals dialogues with the United States and the European Union, among other partners, to assess how deepened partnerships can increase supply chain resiliency. In each case, governments are looking to Canada as a preferential source for increased volumes of critical minerals and as a destination of choice to reliably diversify existing supply reliance.

The dual pillars of newly sought critical minerals supply – and key considerations driving policy development around it internationally – can be rationalized as follows:

1. Supply source proximity from trusted partners increases reliability of access while reducing scope for supply chain disruption and associated risks; and,

2. Supply sources with higher environment, social and governance (ESG) ratings are preferred as demonstrable sustainability performance is consistent with the impetus driving demand in the first place. Low GHG production intensity is a key metric, given that low carbon transition accounts for the majority of projected critical mineral demand increases over the long term.

On this backdrop, Canada is well positioned to increase the domestic production of critical minerals and metals to reduce its import reliance while simultaneously supporting broader international supply chain security and climate policy objectives.



Canadian Critical Minerals – State of Play

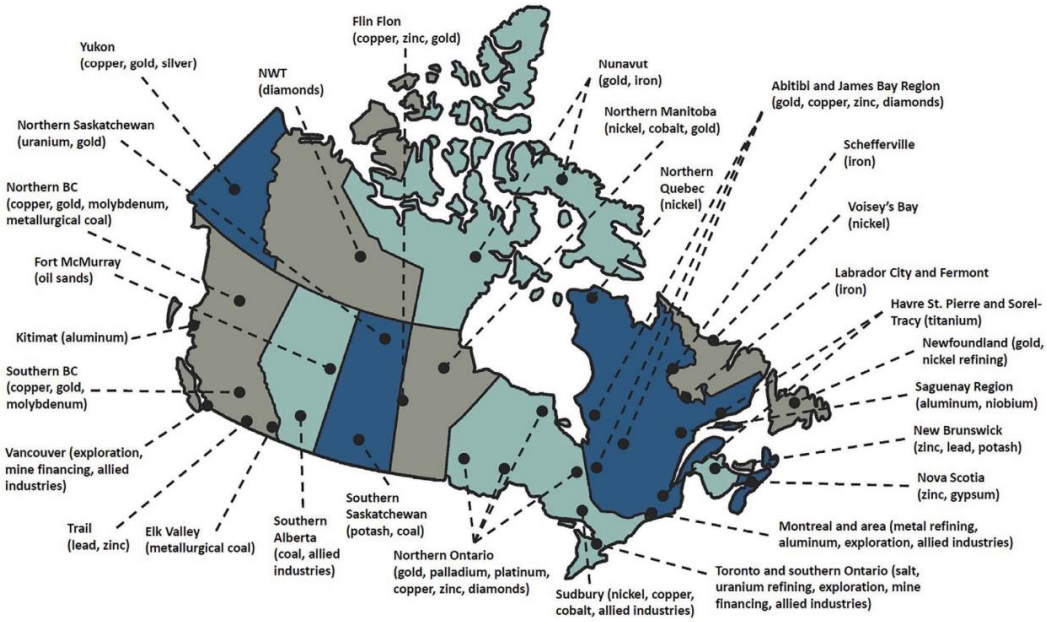
Governments are creating lists of minerals and metals on which their economies and national interests rely but to which they have insufficient or precarious access. While the materials on national critical minerals lists vary across jurisdictions, economic security, national defence and sustainability are common themes through which critical material identification has been justified. To help frame the issue while identifying the opportunity for Canada, this policy brief

focuses on two general categories of critical minerals at the heart of the supply chain security-sustainability nexus: battery minerals and REEs. Materials from both categories are listed on Canada's critical minerals list – published in March 2021 – but the policy actions required for increased domestic production and manufacturing differ for each set.

Battery Materials

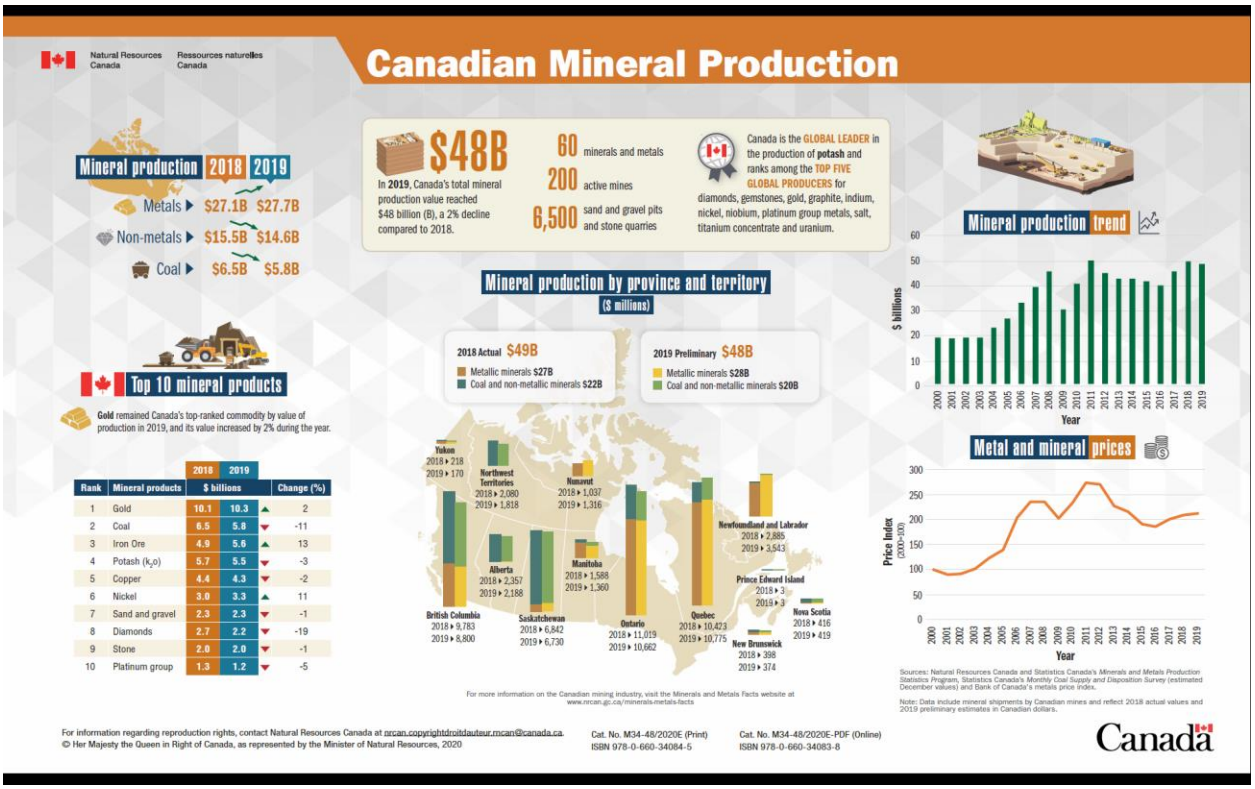
Nickel, cobalt, manganese, lithium and graphite are the predominant battery minerals. Evolution of battery chemistries may displace reliance on some of these materials for others, in whole or in part, but current EV production overwhelmingly uses batteries formulated on a mix of these materials and this reliance is likely to continue for the foreseeable future.

Fortunately, Canada possesses all of these materials, some at world-leading production scales and others being developed.[1] Canada hosts an established upstream and downstream nickel extraction, smelting and refining supply chain with the second lowest carbon intensity nickel production in the world. Relatively significant volumes of low carbon cobalt are also produced in Canada, largely as a byproduct from the nickel mining and manufacturing process. Graphite and manganese are produced at a smaller volume, while graphite, manganese and lithium projects are at various stages of development.



Source: Mining Association of Canada

[1] For a detailed overview of Canada's current production of these and other critical minerals, see Annex 4 of Facts and Figures 2020, produced with data from Natural Resources Canada, https://mining.ca/wp-content/uploads/2021/02/FF-2020-EN-Web-1.pdf.



Possessing battery minerals and metals, however, does not equate to having value-added battery-grade materials. To create battery-grade materials, a specified value-added manufacturing stage and process are required for nickel, cobalt, manganese, graphite and lithium. For example, nickel needs to be transformed into nickel sulfate; cobalt into cobalt sulfate; manganese into manganese sulfate; graphite into ultra-high-purity spherical graphite and lithium into lithium carbonate and lithium hydroxide. While Canada has a strong foundation of battery minerals and metals, and downstream smelting and refining capacity for nickel and cobalt, it does not produce battery-grade nickel, cobalt, manganese, graphite or lithium.

Building from its mining and metal manufacturing presence, Canada needs to establish and expand battery-grade material manufacturing capacity for each of the above materials and increase current volumes of mineral extraction to meet growing global demand. Roughly 70 per cent of global battery-grade material manufacturing capacity lies in China, making Canada (and much of the rest of the world) reliant on that country for these materials. To reduce this supply chain risk requires diversifying the supply source. In Canada's case, this is best achieved by establishing domestic manufacturing capacity for both consumption and export. Doing so would maximize economic benefits through clean industrial expansion while increasing supply chain resiliency for both Canada and our partners.

Recycling and other circular economy measures should and will increase as the broader EV battery supply chain expands. While essential, however, these can contribute only modestly to fulfil projected demand. Long product lives and steep demand growth curves mean the supply of

secondary material will remain a fraction of total demand for the foreseeable future, so policy must recognize that new mining establishments are essential to meeting projected demand for EV batteries.

Canada's expansion into battery materials manufacturing is contingent on developing policy that reflects the state of the industry, leverages existing strengths and bolsters areas where competitiveness lags. The inclusion of critical minerals and their supply chains in updated national security review guidelines under the *Investment Canada Act*, and the commitment to establish a critical battery minerals centre of excellence are positive first steps. The introduction of the "mines to mobility" approach to developing Canada's battery supply chain and subsequent inclusion of a domestic EV battery supply chain as a pillar under the Strategic Innovation Fund's Net Zero Accelerator are encouraging. The consistency with which the deployment of these tools is aligned with the pillars of critical minerals policy, and the speed at which new projects can develop, are key determinants of success.

Rare Earth Elements

No set of materials characterizes the security of supply dilemma more than REEs, used in a wide range of essential battery, medical, energy, computing, defence and advanced manufacturing applications, including the magnet-driven motors in EVs. China has dominated the market for these materials, controlling a majority of production and distribution, thus creating a global over-reliance on one country for procurement.

Unlike battery minerals, Canada does not have a pre-existing supply chain for REEs, from extraction through separation and refining. Canada has deposits of REEs with companies involved in a number of advanced-stage exploration projects as well as nascent processing and separation capacity.

Canada has fewer established strengths in the REE space compared to battery minerals. That said, much of the rest of the world is similarly import reliant on China, and without a world-leading mining industry from which to build. While more work needs to be done to establish a REE supply chain than a battery supply chain, Canada should not be deterred from leveraging its competitive advantages to create a greater supply of REEs for domestic use and export, including identified opportunities to extract REEs through recycling and mining value from waste streams.

In addition to the above noted critical minerals centre of excellence, the federal government has committed to providing some targeted R&D funding to advance refining and processing expertise. REEs and their supply chains will also be included in national security review guidance under the *Investment Canada Act*. These are positive but modest first steps. Positioning Canada for success in the REE space is contingent on right-sizing ambition relative to the opportunity at hand and deploying policies that reflect an unequivocal intention to capture greater market share and secure the geopolitical benefits that accompany it.

Policy Rationale

Canada's competitive advantage is that it fulfils the above pillars of critical minerals policy better than most competing mining jurisdictions. On a proximity basis, being land connected neighbours, and having a long-standing free-trading relationship with the U.S., enables Canada to have a supply chain security premium compared to trading partners located further afield. While ocean transit separates Canada from the EU, the voyage is shorter than for many competing jurisdictions, many of which do not have a free trade agreement with the EU as Canada does.

Also important is that Canada has the world's fourth cleanest electricity grid, with 82 per cent of power from renewable or non-emitting sources. As a result, Canadian mineral products are among the lowest carbon intensity in the world, as the ongoing work of SKARN Associates demonstrates. Critical minerals production in Canada yields a lower supply chain carbon-intensity finished product than most alternative raw material sources globally.

The supply chain proximity advantage also produces a climate premium, as it displaces higher indirect scope 3 emissions associated with lengthier supply chain transits. With its clean electricity advantage applied across an upstream and downstream supply chain, Canada has the potential to produce the lowest carbon-intensity EV on a life-cycle basis anywhere in the world. On broader ESG considerations, the award-winning, Canadian-made Towards Sustainable Mining initiative has earned the Canadian mining industry an international reputation as a leader in mining best practices, including in tailings management, climate change and Indigenous community engagement.

Countries diversify their supply chains with improved security and sustainability when they source critical minerals from Canada. Simply put, Canadian resources are a best-in-class solution for international partners seeking to reconcile their security of supply, and their climate change and other ESG priorities.

Canadian Policy Approach

Canada must act prudently and expeditiously to optimize the critical minerals advantages it possesses. Leveraging pre-existing strengths and deploying and refining strategic policies for both battery materials and REEs are key to success.

Battery Materials

In Canada, much of the public discourse has focused on the importance of obtaining a giga factory for final-stage battery production. While desirable, this focus ignores the reality that such a factory would rely overwhelmingly on imports of battery-grade materials from Asia – at higher emissions intensities – and at more vulnerable supply chain distances. This outcome is at odds with the economic security and sustainability objectives that underpin broader critical minerals policy rationale.

Canada should prioritize expanding its battery mineral production and developing new battery-grade material, component and cell production. While a number of positive measures have been taken to support this goal – including targeted investment incentives – both objectives need greater policy cohesion and focus. This is vital for the future of Canada's off-grid mines and for the regulatory processes which will determine whether new major projects in the battery space will be built.

Battery minerals processed in Canada, even if extracted at off-grid mines, are among the lowest carbon intensity in the world on a supply chain basis. Nickel and cobalt are a good proxy for the opportunity and challenge that Canada faces in the global battery race. These two metals commonly make up 60 to 80 per cent of the material input into current EV battery designs. In 2018, 52 per cent and 62 per cent respectively of Canadian nickel and cobalt were mined at diesel-reliant off-grid mines – at higher operational and carbon cost exposure – but processed at clean grid-connected Canadian smelters and refineries, achieving world-leading low carbon production intensity.

Aspects of Canadian climate change policy risk jeopardizing off-grid mines prematurely, thus weakening the root of the very supply chain that is a Canadian strength in the global battery race. Similarly, future discoveries of battery mineral and REE deposits are likely to lie in remote regions, and policy that discourages development or renders it unfeasible is inconsistent with global climate change and domestic economic objectives. Refining emissions abatement policy and regulatory approaches to account for clean technology development objectives is essential to preserving and expanding Canada's world-leading low carbon critical minerals assets. Such action is justified on the basis that the outcome would result in a net global climate benefit.

For Canada to retain its current share of global nickel production in line with World Bank projections, seven new mines, two smelters and one refinery will need to come on line domestically in the next 30 years. For Canada to grow its global market share and establish and scale battery-grade material production – for nickel and other critical minerals – even greater ambition is needed. Many of these projects will require *Impact Assessment Act* (IAA) approvals before they can be built. For context, the last major metal mine to be built in Canada – Voisey's Bay, which also happens to be a nickel mine – took 13 years from discovery to first production. The challenge of meeting global critical mineral demand at the least possible emissions intensity requires improved regulatory timelines and efficiency.

After two years of implementation, there is an urgent need to adjust the IAA process to avoid developing the perception that Canada is an unpredictable and slow destination for mining investment. Once developed, such a reputation is difficult to reverse, will undermine Canada's goal of enhancing critical mineral supply and will detract from the "Mines to Mobility" battery and EV supply chain policy objective.

Rare Earth Elements

The government has publicly committed to establishing a domestic battery supply chain in Canada and has allocated significant support toward achieving this goal. Comparatively less

investment has been made in the REE space, though Budget 2021 made an important first step through commitments to establish a critical minerals centre of excellence along with providing a targeted R&D allocation to support advancements in REE separation and processing.

The most likely path to success for Canada in the REE space is to work with allies on establishing a supply chain sufficiently resilient to independently withstand the Chinese exercise of market power, which has hampered past attempts at market entrance. Given the absence of a pre-existing supply chain domestically, in practice this means targeting policy supports to help launch and sustain individual supply chain segments until sufficient and independent resiliency is attained. To do this well, success needs to be carefully defined and realistic expectations established on Canada's specific REE objectives, and how like-minded international partners complement them.

Prioritizing investments in Canada's critical battery metals and REEs to support domestic and international climate and supply chain resiliency objectives in this way presents lower risk to the taxpayer. The above sequential approach provides meaningful, tangible and expanded economic and environmental benefits consistent with Canadian values and those of our allies. The global climate will benefit from EV and clean technologies produced with lower carbon Canadian critical minerals and manufactured materials. Whether for domestic or international production – and ideally both, at all supply chain stages – one of the greatest climate actions Canada can take in support of Paris Accord objectives is to maximize domestic production of low carbon metals and materials needed to meet projected clean technology demand.

Seizing the Moment

The following policy recommendations support the above approach to securing Canada's policy objectives in the battery and REE spaces:

1. Accelerate battery mineral and REE deposit discovery and development, in support of the next generation of mines and downstream manufacturers, by implementing the proposed doubling of the Mineral Exploration Tax Credit for critical minerals.

2. Ensure the *Impact Assessment Act* is implemented in a manner that creates greater predictability and timelines for permitting the future mines and value-added mineral, metal and battery material manufacturing facilities essential to Canada's critical mineral supply chain objectives.

3. Refine and prioritize the focus of the Strategic Innovation Fund Net Zero Accelerator "Mines to Mobility" pillar to catalyze investments into the production of battery-grade materials, and the expansion of the production, smelting and refining of battery-grade minerals and metals.

4. Create greater coherence between climate and industrial policy objectives by recognizing Canada's regional and supply chain realities, including that off-grid critical mineral mines

are essential to Canada's smelting and refining industry, without which desired expansion into battery-grade material, cell and module manufacturing will be compromised.

5. Expand the initial funding allocated in Budget 2021 to develop state-of-the-art REE identification, extraction and refining processes, including from recycled mine waste streams. Expanded funding should take a two-tier approach to:

    - Commercialize projects across the REE supply chain; and
    - Scale and sustain successful projects until a secure and sustainable supply chain is established.

6. Establish a joint industry-interdepartmental task force to provide regular input in support of Canada as a secure and reliable source of critical battery minerals and REEs. This task force should be mandated to collectively define what policy success realistically looks like in Canada in each of the battery and REE areas, to set targets for measuring progress and inform refining the policy needed to attain them.

About the Author

Brendan Marshall *is the Vice President, Economic and Northern Affairs, at the Mining Association of Canada (MAC). In the economic affairs portfolio, Brendan is the policy and regulatory lead on critical minerals, climate change, energy, tax, trade, infrastructure and transportation. In the Northern Affairs portfolio, he leads the association's work in mining policy and regulation in Canada's North. Brendan is the lead writer and researcher for MAC's annual Facts & Figures publication. Prior to joining MAC, Brendan held several federal government positions in the offices of the Speaker of the Senate of Canada, the Prime Minister of Canada, the Minister of Canadian Heritage and Official Languages. Brendan holds two Masters degrees in Political Philosophy and Energy Management.*

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