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THE COMING ENERGY TRANSITION: INDUSTRY'S OPPORTUNITIES ARE NOT JUST IN CANADA

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SUMMARY

Global policy rhetoric suggests that a great energy transition will soon be underway, driven in large part by electric vehicle (EV) and fuel-efficiency mandates. Shifting away from carbon-emitting fossil fuels toward cleaner, renewable sources of electric energy will require no less than an order of magnitude more mined minerals and rare earth elements, and Canada has a limited share of these transition minerals. Most of North America's critical transition minerals will have to come from reserves in South America, Africa, and the Caribbean as well as Australia and China, which will see economic growth from mining jobs and capital investments. The authors conclude that Canada's participation in the energy transition mining market may hinge on the shape of its regulatory and taxation framework for mining companies.

Top Mining Countries Ranked by Reserves as of 2020 – Minerals Critical to the Energy Transition (in thousands of metric tons).

Bauxite			Cobalt			Copper			Graphite		
Country	Reserve Share	Production Share	Country	Reserve Share	Production Share	Country	Reserve Share	Production Share	Country	Reserve Share	Production Share
Guinea	23.1%	22.0%	Congo	46.1%	69.0%	Chile	22.7%	27.8%	Turkey	28.1%	0.3%
Vietnam	18.1%	0.9%	Australia	18.4%	4.0%	Australia	10.6%	4.3%	China	22.8%	78.9%
Australia	16.6%	26.6%	Indonesia	7.9%	0.8%	Peru	8.8%	10.4%	Brazil	21.9%	6.6%
Brazil	8.4%	7.9%	Cuba	6.6%	2.7%	Russia	7.0%	3.9%	Madagascar	8.1%	2.2%
Jamaica	6.3%	1.9%	Philippines	3.4%	3.2%	Mexico	6.0%	3.6%	Mozambique	7.8%	2.9%
Canada	NR	NR	Canada (7)	2.9%	2.6%	Canada (13)	1.1%	2.8%	Canada	NR	0.8%
World	32,000,000	391,000	World	7,600	142	World	880,000	20,600	World	320,000	966

Lithium			Manganese			Nickel			Zinc		
Country	Reserve Share	Production Share	Country	Reserve Share	Production Share	Country	Reserve Share	Production Share	Country	Reserve Share	Production Share
Bolivia	24.4%	NR	South Africa	42.7%	34.4%	Indonesia	22.1%	30.7%	Australia	27.6%	16.8%
Argentina	22.1%	0.6%	Australia	18.0%	17.6%	Australia	22.1%	6.7%	China	17.6%	10.9%
Chile	11.4%	2.2%	Brazil	18.0%	2.6%	Brazil	16.8%	3.1%	Russia	8.8%	33.8%
United States	10.6%	NR	Ukraine	9.3%	3.1%	Russia	7.9%	11.3%	Peru	7.6%	2.3%
Australia	8.5%	4.0%	Gabon	4.1%	17.5%	Philippines	5.1%	13.3%	Mexico	7.6%	11.1%
Canada	NR	NR	Canada	NR	NR	Canada (7)	2.1%	6.7%	Canada (9)	2.2%	6.0%
World	86,000	983	World	1,500,000	18,900	World	95,000	2,510	World	250,000	12,000

Source: USGS Commodity Summaries 2021

Notes:

1. Reserves are resources that can be economically extracted at time of determination. With respect to lithium, we also include marginally economic and sub-economic components of reserves.
2. Canada's rank is in parentheses. (NR means no reserves).

Contemporary policy rhetoric on the global stage suggests that we are on the precipice of a great energy transition, away from heavier carbon-emitting fossil fuels toward an age of cleaner and renewable sources of electric energy. Electric vehicle (EV) mandates such as those seen in China, California and British Columbia, along with fuel-efficiency regulations, are expected to lead to wide adoption of electric cars in the coming decade.

A substantial global energy transition toward an electric future will require no less than an order of magnitude more mined minerals and rare earth elements. A recent report by the International Energy Agency (IEA), "The Role of Critical Minerals in Clean Energy Transitions," highlights the minerals that will be most needed for the transition: lithium, nickel, cobalt, manganese and graphite are "crucial to battery performance, longevity and energy density" and, along with copper and aluminium, represent the 'cornerstone' of electrical systems and technology. For instance, lithium production levels more than thirteen times today's will be required by 2040 to satisfy the current policy goals. Going further toward a fully sustainable development scenario, that number balloons to more than forty-two times current production. For graphite we see an eight-times multiple needed to meet stated policy and twenty-five times for sustainable development, with cobalt requiring six times and twenty-one times respectively, with similar numbers for the other minerals required.

This raises a number of questions about the future of mineral development. Where are critical energy transition minerals located, and who owns demonstrated reserves? What about potential future risks regarding consolidation and strategic control of critical minerals? From a Canadian perspective, does this country have the potential to be a significant producer, as with oil and gas?

To give context to these questions about the future of energy and the mineral production that will be required, we have assembled a survey of national reserve and production data for the primary group of critical transition minerals.

Looking at the data from a North American energy security perspective, it becomes clear that most critical transition minerals will have to come from abroad. By extension, the energy transition will see economic growth associated with capital investment and high-value-added mining jobs in South America, Africa and Australia. Already, Chinese investments in mining for the period 2005-22 totalled US\$165 billion, of which investments 44 percent are in Africa, the Caribbean and Latin America (data based on <https://www.aei.org/china-global-investment-tracker/>).

Relatively high concentration of a given mineral among few nations is also the norm. For a given mineral it is common for the top three nations—by reserve—to possess roughly one half or more of available reserves; for instance: 58 percent of bauxite is located in Guinea, Vietnam and Australia), 72 percent of cobalt is located in Congo, Australia and Indonesia, 73 percent of graphite is located in Turkey, China, Brazil and 78 percent of manganese is located in South Africa, Australia, Brazil. In the case of lithium, 58 percent of known reserves are located in the Lithium Triangle (Bolivia, Argentina and Chile). In contrast, currently Canada holds less than 5 percent of the economic mining reserves of any metal needed for the energy transition.

Although Canada does not possess large quantities of critical minerals relative to global totals, Canadian reserves of cobalt, copper, nickel and zinc represent the best opportunities for growth. However, with the majority of these critical mineral reserves abroad, we wonder if Canada's industry is positioned to compete for the international mining investment required for the energy transition. While that question is beyond the scope of this brief analysis, we will be taking a deep dive look at this issue in a forthcoming companion piece on comparative international mining tax policy.

Given Canada's limited share of global energy transition minerals, securing Canadian participation in the energy transition mining market may indeed hinge on the shape of its regulatory and taxation framework for mining companies.



ABOUT THE AUTHORS

Philip Bazel is a Research Associate at The School of Public Policy at the University of Calgary. In addition to publishing through The School of Public Policy, Philip has also played a role in projects consulting for governments and private organisations in the area of taxation and public finance.

Dr. Jack M. Mintz is the President's Fellow of the School of Public Policy at the University of Calgary after serving as the Palmer Chair and founding Director from January 1, 2008 to June 30, 2015. He also serves on the board of Imperial Oil Limited and is the National Policy Advisor for Ernst & Young. He is also a regular contributor to the Financial Post and is a member of the editorial board of International Tax and Public Finance. He currently serves as Chair of the Alberta Premier's Economic Recovery Council. Dr. Mintz became a member of the Order of Canada in 2015 as well as receiving the Queen Elizabeth Diamond Jubilee Medal in 2012 for service to the Canadian tax policy community.

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