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# PDAC Sustainability Forum: Minerals and Metals in a Low-Carbon Economy

March 3, 2018, 1:00–5:00 pm  
Room 202, Metro Toronto Convention Centre  
255 Front Street West, Toronto



Prepared by



**IGF**

INTERGOVERNMENTAL FORUM  
on Mining, Minerals, Metals and  
Sustainable Development

## Meeting Summary

The Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF), the World Bank, World Economic Forum (WEF) and the Prospectors and Developers Association of Canada (PDAC) co-hosted a Sustainability Forum on the sidelines of the 2018 PDAC Convention on Saturday, March 3, from 1:00 p.m. to 5:00 p.m. in Toronto, Canada. Over 120 participants registered for the meeting, which addressed the important role of minerals and metals in the shift to a low-carbon economy. Panelists and participants discussed the increasing demand for minerals and metals, subsequent implications and opportunities, as well as the role of technology, innovation, and responsible sourcing in the sector. Participants continued discussing the day's themes during an evening networking reception. The following is a summary of the key topics discussed:

- Achieving the Sustainable Development Goals (SDGs) will only be possible through the use of metals and minerals, as well as new and innovative low-carbon technologies. Governments must play a role in ensuring that mines are planned and developed with long-term strategies in mind to mitigate and adapt to climate change. Participants identified a need for increased coordination across existing international and national sustainability initiatives.
- Investing in exploration now is essential to a fluid and rapid transition to a low-carbon future, due to the length of time between exploration and processing. While lithium and cobalt are important to meet the demands of low-carbon technologies, so too are base metals and minerals like copper and iron ores.
- Growing demand for renewable energy and low-carbon technologies will see a corresponding increase in demand for metals and minerals and thus an increase in the mineral sector's carbon footprint. Those companies which maintain a low-carbon footprint and monitor the social implications of their mines will gain a strategic advantage over those who do not.
- Lack of geological data is a challenge, especially for up-and-coming smaller, niche metals, like lithium and rare earths. Most participants stressed the need for improved national-level support for geological data, as well as more opportunities for dialogue between stakeholders. There is also a financing challenge for smaller players in the lithium and rare earths fields, as investment needs are great in comparison to the relatively small, but necessary, resulting outputs.
- The speed with which technology (e.g., renewable energy) has changed and continues to change poses challenges of planning for the long term. The mineral sector needs to "future-proof" its investments by adopting flexible approaches and integrating technology. Companies will need to consider new technologies when initiating the permitting process, integrate flexibility into their strategies and consider future land needs so that they are able to incorporate future technologies at later stages.
- There is a growing demand for responsible sourcing frameworks from stakeholders, both internal and external. There is a need to look at the entire life cycle of responsible sourcing and not just at the extraction level. Mineral industry stakeholders must work together to increase exploration while remaining cautious of market fluctuations. The increasing demand for metals and minerals must be met with responsible sourcing practices.

- Participants agreed that recycling has the potential to play an increasing role in the mineral sector and offers an opportunity to more immediately satisfy the demand for raw materials. However, participants also stressed that there is a need for greater traceability in this business (e.g., child labour is still employed in some electronics recycling), and that recycling needs to be considered early from the design stage of mining. In addition, groups also highlighted the need for government and stakeholder collaboration to incentivize recycling practices across the industry. The potential to recycle and reuse the valuable minerals contained in these products is significant, and cheaper than conventional mining, but currently represents a missed opportunity and source of considerable waste.

## Opening Remarks

Greg Radford, Director of the IGF, welcomed participants and panelists to the Forum and noted that achieving the Sustainable Development Goals (SDGs) would only be possible through the use of metals and minerals, as well as new and innovative low-carbon technologies. Radford stressed that the material needs for a low-carbon economy are significant, and that the ramifications for this demand are global in scale. The renewable energy sector, cited Radford, is witnessing exponential growth, accounting for an estimated 26 per cent of global electricity generation by 2020 according to the International Energy Agency. China is driving a significant portion of this growth and demand, especially in the solar industry. Radford highlighted that Deutsche Bank predicted solar grid parity in 80 per cent of the global market by 2018.

With rapidly growing demand for renewable energy and low-carbon technologies, Radford emphasized a corresponding increase in demand for metals and minerals and the potential implications of this shift on the mineral sector's carbon footprint. For example, the energy demand for copper production—a vital mineral in the construction of wind turbines, solar thermal technologies, and energy management systems—is expected to grow significantly. Countries looking to grow their mineral sector, Radford continued, are therefore looking at how the low-carbon economy will change global supply chains and generate employment. Radford concluded by stating that while increased demand carries potential risks and impacts for governments and the mineral sector, it also represents a significant economic opportunity for both.

## Panel Discussion

### Matching Increasing Demand With Enhanced Responsibility: Implications and opportunities

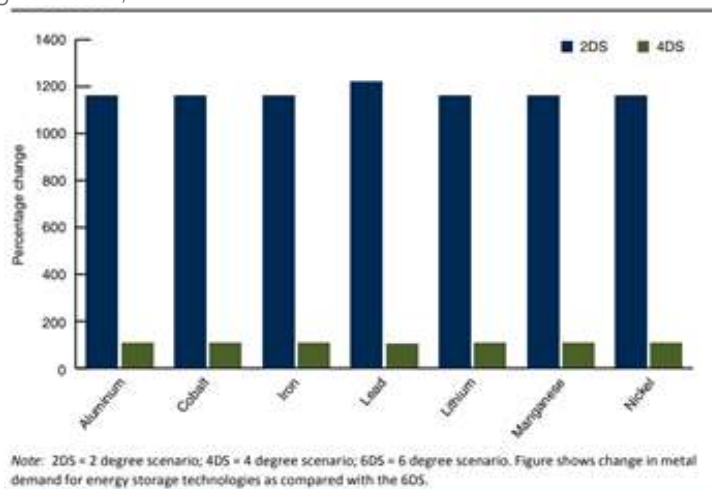
Morgan Bazilian, Executive Director of the Payne Institute for Earth Resources at the Colorado School of Mines, facilitated the panel discussion on matching the increasing demand for low-carbon energy technologies with enhanced responsibility. He prompted panelists to identify which minerals and metals would be required for a low-carbon future, highlight what this shift would mean for the mineral industry, discuss opportunities and challenges for resource-rich countries, answer how metal and mineral value chains have changed and predict any future trends in the mineral sector.

Panelists Kirsten Hund and Daniele La Porta, Senior Mining Specialists at the World Bank, delivered a joint presentation on the findings of the June 2017 World Bank report: "The Growing Role of Minerals and

Metals for a Low Carbon Future.” La Porta began by highlighting the motivations for the report, stating that the World Bank sought to analyze what a shift to low-carbon technologies would mean for mineral-rich developing countries. In the preliminary stages of the report, the team at the World Bank found that while there was considerable analysis on specific minerals like lithium, comprehensive quantitative analysis on how much and which minerals would be required for different clean energy technologies was absent from the field of literature.

While clean energy is a topic of major discussion worldwide, La Porta pointed to the fact that for many, the link between clean energy and the mineral sector is often overlooked. In order to meet low-emission commitments, there are significant material considerations, especially in the mineral sector. Hybrid cars for example, require twice as much copper as regular cars, cited La Porta.

The report used the International Energy Agency’s projections regarding the renewable technology implications of meeting the global temperature warming scenarios of 2°C, 4 °C, and 6 °C. La Porta highlighted the range of renewable energy technologies available today, including but not limited to wind, solar, and energy storage. Using the 6°C worst-case scenario as the baseline (i.e., the smallest adoption of low-carbon technologies) and getting progressively more ambitious, La Porta demonstrated that, according to these scenarios there will be a change in total metal demand, with mineral demands growing exponentially as the global economy comes closer to maintaining the global temperature increase to 2°C.



**FIGURE 1. Median Metals Demand Scenario for Supplying Energy Storage Technologies Through 2050**

*Courtesy of the World Bank report The Growing Role of Minerals and Metals for a Low Carbon Future*

La Porta also noted that while lithium and cobalt are important to meet the demands of low-carbon technologies, so too are base metals and minerals like copper and iron ores. She also stressed that the choice of technology matters in this conversation (e.g., onshore vs. offshore wind turbines).

Finally, La Porta noted the limits in the scope of the report, stating, for example, that recycling minerals and metals was not factored. In addition, La Porta pointed to some of the data gaps in mapping where global mineral supplies and reserves are located. She concluded that these gaps present both opportunities and challenges to better understanding the mineral potential in developing countries, especially those in Africa, and their role in a low-carbon future.

Hund continued the presentation, emphasizing the need for “climate-smart” mining. Given the significant role of the mineral sector in the low-carbon future, Hund stressed that it is the sector that will have to drive the demand for technologies in climate mitigation, like carbon capture. She continued

that mineral-producing countries will be crucial for a low-carbon future, and reducing emissions throughout all steps of the supply chain—production, transportation and recycling—requires cross-sectoral coordination. In addition, Hund highlighted that where countries plan their future mines and associated infrastructure is crucial to the climate change conversation as well. About 20 per cent of greenhouse gas emissions worldwide derive from deforestation and land-use changes, and the induced impacts of mineral development on deforestation are notable in, for example, the Amazon and Indonesia. Governments, said Hund, must play a role in ensuring that mines are planned and developed with long-term strategies in mind to mitigate and adapt to climate change.

Hund concluded the World Bank presentation by stating that the need for more minerals presents an exciting opportunity for the sector, but that this increased demand also presents challenges and responsibilities that must be addressed. Hund states that the transition to a low-carbon future in the mineral sector will require long-term data collection and strategies, and that all parties—the private sector, civil society, the climate change community and investors—must be involved.

Bazilian then introduced the third panelist, Ricardo Labó, the Vice Minister of Mines for Peru. Labó identified the need for exploration in Peru and beyond, to better understand global supplies and reserves of metals and minerals. Labó stated that Peru represents 7 per cent of the global budget for exploration and hopes that by 2021 this will grow to 8 per cent. Investing in exploration now, underlined Labó, is essential to a fluid and rapid transition to a low-carbon future, due to the length of time between exploration and processing. There are some deposits in Peru that were explored and identified more than 25 years ago that are only just now being processed, he said. Labó concluded by stating that exploration and data collection are critical to understanding the global supply of the minerals crucial for a low-carbon future and providing reliable data to the international community of investors.



Guy Ethier, Umicore, Ricardo Labó, Peru, and Daniele La Porta, World Bank.

Guy Ethier, Senior Vice President of Supply Chain Sustainability at Umicore, continued the panel discussion by speaking to the enormous responsibility of the mineral and technology sectors in meeting the demands of the low-carbon future. Ethier compared the demands of electric vehicle (EV) batteries to other technologies, stating that batteries for EVs would require 7,500 more units of some minerals than are required for mobile phones. This increasing demand will require collective responsibility from the sector to ensure minerals are being used and extracted in a way that is both efficient, responsible and clean.

Ethier also discussed the necessity to address all stages of the global supply chain, including the “end of life” for many products with significant mineral inputs. Ethier cited that 1.5 billion units of electronic equipment are sold every year (excluding personal computers), and that 1.3 billion of these units are not recovered; the potential to recycle and reuse the valuable minerals contained in these products is significant, and cheaper than conventional mining, but currently represents a missed opportunity and source of considerable waste. It is therefore vital to integrate end-of-life scenarios into the discussion to address recovery challenges and close loops in the production cycle.

Mark Wiseman, Vice President of Sustainability at Avalon Advanced Materials Inc., discussed the challenges to smaller players in the mineral sector that mine some of these strategic minerals. While the demand for metals and minerals like lithium and rare earths will increase in the low-carbon future, Wiseman stated that this demand still pales in comparison to many base metals. Lithium production for all of 2017, for example, was equivalent to only 15 minutes of global iron ore production in that same year. Wiseman highlighted that this presents a challenge for smaller players in the lithium and rare earths fields, as investment needs are great in comparison to the relatively small, but necessary, resulting outputs.



However, Wiseman pointed to a key opportunity for the smaller players in the mining market that utilize clean energy technologies. As companies and consumers increasingly demand clean energy supplies, smaller companies may benefit, as they have proven to be more nimble and responsive to calls for responsible sourcing. Wiseman concluded that those companies that maintain a low-carbon footprint and monitor the social implications of their mines will gain a strategic advantage over those who do not.

During the question-and-answer period that followed, a participant asked how governments will ensure that environmental protections and the livelihoods of Indigenous people are considered in the mineral sector in a future of increased mining for low-carbon inputs. Ricardo Labó responded that, for Peru, environmental assessments are a crucial part of this process, as is independent monitoring and evaluation of their implementation. Mark Wiseman further answered that international and national regulations will be necessary to ensure mines are sustainable in all respects (e.g., health, community and energy, etc.). Daniele La Porta added that the World Bank works with countries to build their capacity to enforce this type of legislation and monitoring capacity.

A second question related to the potential for an international rating system regarding environmental stewardships of mining processes. Wiseman replied that the cobalt industry has developed a framework to this end that could provide a model for other minerals.

Kirsten Hund concluded the panel by summarizing that the mineral industry is currently experiencing some fundamental changes—in the form of recycling challenges, urban mining, new players to market and new approaches to the industry—each of which will need to be considered to both benefit from the increasing demand while reducing the global carbon footprint and material footprint in the mineral sector and beyond.

## Round Table Discussions

Participants broke into groups to discuss different aspects of the shift to a low-carbon economy and the implications of this shift for the mineral sector. Table moderators guided the discussions in English, French, or Spanish, by posing questions regarding the topics presented by the panel speakers.

### 1. What are the implications for mineral-rich developing countries: Key opportunities and challenges?

Groups noted that the increased demand for metals and minerals was a key opportunity for the mineral sector, with the potential to both promote economic development in mineral-rich countries and contribute to reducing the impacts of climate change. Some of these positive changes are already underway, in countries like Botswana, Peru and Chile.



However, just as increased demand creates opportunities, so too does it pose challenges. In the Democratic Republic of Congo, demand for cobalt—used in energy storage—has exacerbated conflicts, perpetuating the idea of a “resource curse.” In Central and South America, as well, participants noted increased levels of conflict and marginalization of Indigenous groups directly or indirectly caused by heightened demand for minerals. Many participants, while praising recent advances in frameworks and guidance for responsible mineral supply chains, noted that increased demand could either destabilize or accelerate the progress that has been made, depending on how it is governed.

### 2. Are there other important metals and minerals that have not been identified in the panel that will support a low-carbon future?

Participants pointed to a number of metals and minerals not typically lauded as key to the green energy movement. These included niobium, scandium, and vanadium, but also base metals like copper, gold, nickel and manganese. Groups discussed that this variance of metals and minerals is dependent on the chosen technologies and is subject to change as technological innovations occur. Therefore, consistent data is needed from both developed and developing countries to adapt to the changing demands.

### 3. How can the lack of geological data for “strategic minerals” be addressed in a timely manner?

Groups repeatedly emphasized the lack of geological data as a challenge, especially for up-and-coming smaller, niche metals like lithium and rare earths. Most participants stressed the need for improved national-level support for geological data, as well as more opportunities for dialogue between stakeholders. Participants also identified a need for increased coordination across existing international and national sustainable initiatives.

#### 4. How can different stakeholders work together to address the challenges and make the most of the opportunities the low-carbon future offers to both the mineral sector and mineral-rich countries?

Participants noted that up until now, the mineral sector has typically been a marginal player in the climate change conversation. However, to meet demands for a low-carbon future, stakeholders from both the mineral and environmental sectors will have to come together to share capacities, knowledge and strategies for the future. Participants highlighted a need for increased transparency and coordination between the two sectors, as well as increased convening opportunities and spaces for sharing dialogue.

### Panel Discussion: Technology, innovation and responsible sourcing

Michael Stanley, Sector Lead of Extractives for the World Bank, led the second panel discussion on technology, innovation and responsible sourcing in the mineral sector. He began by asking the panelists how relevant minerals could be supplied in a responsible way. In particular, he prompted the speakers to address the role of technology and innovation in promoting responsible sourcing, the challenges of adopting responsible mining practices, how to sustainably secure supplies of key commodities, and expectations for metals and minerals mining going forward.



*Andrea Vaccari, International Copper Association*

Robert Lydan, CEO and Managing Director of Phovontus, responded by discussing the potential for electrification in the sector. The move to electrification is part of an effort to reduce greenhouse gas emissions and is the byproduct of both market forces and government actions. The reduction of diesel use in the platinum and asbestos industries, for example, has had dramatic impacts on the mineral industry as a whole. Lydan posited that this shift to green energy and electrification will mirror the scale of both the Industrial and Information Revolutions.

Further, Lydan stated that while most people are not opposed to the shift in green energy, many are still stunned at the speed with which the technology has changed and continues to change. Given this rate of change, Lydan spoke to the challenges of planning for the long term, especially when considering short financial horizons (i.e., by the quarter). In addition, Lydan spoke of the need to look at the entire life cycle of responsible sourcing, not just at the extraction level. He further prompted the participants to consider what happens after projects cease to produce ore, and urged all to identify mechanisms to assign risks after mine closures.

Andrea Vaccari, Director of Health, Environment and Sustainable Development at the International Copper Association (ICA), began first by alluding to the growing demand for responsible sourcing frameworks from stakeholders, both internal and external. She stated that ICA currently is working on a dialogue to this regard and will announce further updates later in the spring. In addition, Vaccari noted the significance of reliable data to achieve these frameworks and referred to the World Bank's recent work on data collection in extractive industries.



Vaccari next highlighted the importance of life cycle assessments to ensure responsible sourcing. Copper, she stated, is used in electric vehicles as well as many other key areas in the transformation to a low-carbon economy. However, she also noted that on average only 70 per cent of copper is recovered at the end of life, and that a shift to a low-carbon economy will require that upwards of 90 per cent of copper is recovered. Vaccari identified that smelting and refining copper has significant impacts on the energy grid, and that improvements at this stage could have significant impacts on the copper industry as a whole.

Suzanne Greene, Sustainable Supply Chains Manager at MIT's Center for Transportation and Logistics, concluded the presentations of the panel by outlining some of MIT's recent technological innovations in the mineral sector. Greene introduced the Metals and Minerals for the Environment Program, which aims to contribute on a foundational level toward sustainable mining practices. Greene stated that the program revisits and challenges many of the processes in mining that have existed for hundreds of years. She highlighted the fact that the carbon footprint of the transport of minerals must be better accounted for especially since its dwarfs the footprint of the mining itself.

Some of the new technologies put forth by the program involve innovations in copper smelting and making steel that uses less carbon. Greene also discussed innovations in decentralizing fertilizer production, as well as a project that produces bricks out of sugar cane waste. Greene then spoke to innovations in carbon capture, as well as efforts to trace commodity supply chains, including that of palm oil and conflict minerals.

Following the panelists' presentation, Michael Stanley underlined the importance of the rate of change in the mining and clean energy industries. Robert Lydan agreed, comparing the rate of change in the clean energy sector to that of Silicon Valley. Lydan continued that the mineral sector needs to "future-proof" its investments, by adopting flexible approaches and integrating technology. Andrea Vaccari added that engaging in dialogue with stakeholders at early stages will be vital to adapting to this rate of change. Suzanne Greene distinguished between the types of green energy technologies involved in this production process: those that can be easily adapted to existing processes (e.g., retrofitting), and those that require significant investment and infrastructure. Green underscored that funding research for both will be required to bring these technologies to the market.



*Andrea Vaccari, International Copper Association, Robert Lydan, Phoventus, Suzanne Greene, MIT Center for Transportation and Logistics, Michael Stanley, World Bank, engage in discussions on technology, innovation, and responsible sourcing.*

Panelists were asked about permitting timelines for new mines and technologies as well as how the mineral sector can compete with the circular economy. Lydan suggested that companies consider new technologies when initiating the permitting process, integrate flexibility into their strategies and consider future land needs so they are able to incorporate future technologies at later stages. Vaccari highlighted the importance of consulting with institutions that work with stocks and flows to address the circular economy.

## Round Table Discussions

A second session of round table discussions focused on clean technology, innovation, carbon footprints, and responsible supply chains.

### 1. How can responsible supply chains be structured to support a low-carbon future?

Throughout discussions, participants reiterated that all stages of the mineral supply chain—exploration, extraction, processing, transportation and recycling—must be considered to fully contribute to a low-carbon future. For this reason, participants stressed the need for comprehensive life-cycle assessments and reliable data. In addition, participants discussed societal pressures toward green energy and recycling, and how this pressure presents visibility and opportunities for investment and research in low-carbon initiatives throughout the mineral sector’s supply chains.

### 2. How can the extraction and processing of these minerals and metals be aligned with seeking to decrease the overall greenhouse gas emissions and material footprint of the sector?

Groups emphasized the role of conducting life-cycle assessments as well as making permitting requirements more flexible within the sector to align the extraction of minerals and metals with reducing overall greenhouse gas emissions. Participants underlined the need for effective public policies, like carbon pricing and offsetting, as well as well-coordinated internal company policies that are responsive to societal needs. In addition, some groups highlighted the role of artisanal small-scale mining, and the opportunities therein, for cultural shifts and improved safety.

### 3. What will be the role of new technologies and innovation to address the overall sustainability of the mineral sector?

Participants discussed the potential for new technologies to address the overall sustainability of the mineral sector, particularly in reference to innovations in recycling and recovering. Recovering from waste and tailings, conserving water use, and recycling previously used products, for example, present challenges to traditional mining practices, but also opportunities for new businesses to meet the demands of a low-carbon economy. Groups highlighted as well as the potential energy savings of deploying green energy technologies in the milling, smelting and processing steps of the supply chain.

### 4. What is the role of recycling in meeting increased demand for minerals and metals?

Groups agreed that recycling has the potential to play an increasing role in the mineral sector and offers an opportunity to more immediately satisfy the demand for raw materials. However, participants also stressed that there is a need for greater traceability in this business (e.g., child labour is still employed in some electronics recycling), and that recycling needs to be considered early from the design stage of mining. In addition, groups also highlighted the need for government and stakeholder collaboration to incentivize recycling practices across the industry.

## Closing Remarks

At the conclusion of the day's sessions, Lisa McDonald, Executive Director (interim) of PDAC, delivered closing remarks by reiterating the critical role of metals and minerals in enabling the transition to a low-carbon economy. McDonald expressed her hope that all participants would leave the session with fresh ideas on how the mineral sector can work together to address the aforementioned challenges and opportunities.

She underlined that while key minerals like aluminum, copper and lithium are predicted to increase in demand, mineral industry stakeholders must work together to increase exploration while remaining cautious about market fluctuations. Further, she stated that the considerable excitement regarding the increasing demand for metals and minerals must be met with responsible sourcing practices. She concluded the day by thanking the IGF, the World Bank, and WEF and encouraged all participants to continue to engage in these dialogues moving forward.



*Lisa McDonald, Executive Director (interim), PDAC*



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