



COBALT IN THE DEMOCRATIC REPUBLIC OF CONGO

Market Analysis

World Bank

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Introduction

The Democratic Republic of Congo (DRC) ranks among the world's largest producing countries of minerals needed for the energy transition. DRC is the fifth largest copper producer globally and is in the fortunate position of having most of the world's mine production and reserves of cobalt, currently one of the most demanded minerals in the world. While cobalt has traditionally been used in superalloys, magnets, ceramics, paints and consumer electronics, there has been a recent surge in demand for batteries for stationary energy storages and, mostly, for electric vehicles (EV), which are expected to lead most of the future growth in consumption.

This report provides an overview of the global cobalt market, and the opportunities and risks for DRC in supplying the mineral. On the production side, although it deals primarily with artisanal mining, it also examines the complex relations and interactions between the supply circuits of artisans and large-scale industrial mines.

The key finding of the report is that, despite DRC's global comparative advantage in producing cobalt, there is a risk that human rights abuses in artisanal mining might sterilize or, at the very least, devalue the country's entire cobalt resources, either by making DRC a supplier of last resort or incentivizing technological shifts and substitution away from cobalt. Despite Government's recent efforts (namely through the recent creation of EGC and ARECOMS), if DRC wants to get the maximum benefit from the global interest in cobalt, significant immediate improvements are needed on sector governance, including:

- Traceability / due diligence - to provide the confidence to end-users that cobalt is free from child-labor, demonstrate human rights compliant production, and is free from corruption and risk of fueling armed conflict;
- Formalization - to shift production from informal/illegal, to formal and legal which in turn will improve health and environmental & human safety thereby "clean up" the DRC side of the global supply chain.

This report is primarily aimed at DRC Government decision makers but can hopefully stimulate dialog within the community of key stakeholders involved in the supply chain of cobalt and other minerals critically needed for the energy transition. The World Bank stands ready to collaborate with the DRC, combining technical and financial support to strengthen the rule of law, mitigate conflict risks and stop human rights abuses around the mining areas.

The report has been prepared by a team composed of Remi Pelon and Kirsten Hund (TTLs), Thao Fabregas, Paulo De Sa and Gary McMahon (consultants). Unless otherwise noted, the cobalt figures and findings referenced in this paper have been developed by Benchmark Mineral Intelligence (BMI), and will be cited as "BMI, 2020".

1. Executive Summary

Cobalt will play a key role in the low-carbon transition as it is a key ingredient for lithium-ion batteries, which are critical to decarbonize both the power and transport sectors. The cathodes used in lithium-ion batteries account for 55 percent of cobalt demand among all products in which it is used, with its second largest use going toward the construction of super alloys, at 17 percent, used in aircrafts and other high-impact machinery.

To meet the Paris Agreement of achieving a 2°C or below future, global consumption of refined cobalt may increase to 200,500 tons in 2025 to 344,000 tons in 2030, growing by 9.6 percent annually between 2017 and 2030. The automotive sector is expected to account for the majority of this demand due to the massive deployment of electric vehicles to meet many countries' ambitious climate targets of decarbonizing their transport sector. Lithium-ion batteries are expected to account for 85 percent of cobalt demand by 2030.

As the Democratic Republic of Congo (DRC) supplies more than 70 percent of 'mined' cobalt to date, the country has a significant opportunity to contribute to the low-carbon transition and leverage its comparative advantage in cobalt to meet its development objectives, reduce poverty and boost shared prosperity. Cobalt's contribution to DRC's economy is palpable, with copper and cobalt representing 50 and 35 percent of total mining exports, respectively, in 2018. More specifically, cobalt accounted for about 9 percent of GDP on average from 2013-18, with 10 percent in 2018, and is also estimated to have contributed 9 percent of Foreign Direct Investment from 2008 to 2018.

China dominates the refined cobalt sector, with a market share of 67 percent as of 2019. Refined cobalt refers to cobalt metal, chemicals and other products that are used specifically by industrial end users, including battery manufacturers and automakers. In addition to China's dominant position in refined cobalt, eight of the 14 largest cobalt miners in DRC are now Chinese-owned, accounting for almost half of the DRC's output of mined cobalt. This gives China a significant role over the global cobalt supply and some influence over DRC's mined cobalt output and, to some extent, its development objectives.

While global cobalt demand is expected to recover in the short-term and remain strong, the general concerns that downstream players have with sourcing cobalt from DRC should be taken seriously. On one hand, while the DRC is expected to dominate the cobalt market until 2025, there are massive efforts underway today to source cobalt from different countries as well as develop new battery technologies that would significantly reduce and remove cobalt altogether. In the long-term and from a macroeconomic standpoint, this could have adverse implications on the DRC economy, which is already vulnerable to external commodity shocks given the important role the mining sector plays in the economy.

DRC's cobalt Artisanal and Small-scale Mining (ASM) represents a significant share of the country's cobalt production, contributing to 10-20 percent of total supply depending on the estimates. Output surged rapidly in 2017/2018 in response to higher prices, a period when ASM played an important role in stabilizing the global market. But when prices fell in 2018, ASM share of DRC's cobalt production fell to about 5 percent of total supply and remained subdued ever since. Although history suggests ASM supply is highly price-elastic, given geological and human constraints, ASM output is not expected to expand beyond prior peaks over the foreseeable future.

The perceived reputational risks associated with sourcing artisanal cobalt from the DRC could negatively impact the country’s comparative advantage in supplying cobalt from 2025 onwards. In 2019, a lawsuit was filed in US courts against many major automotive and technology companies accusing them of aiding and abetting the exploitation of child miners in the DRC to source cobalt. Anecdotal evidence and off-the-record interviews suggest that the recent lawsuits have caused a chill across these different industries, with many of them aiming towards producing cobalt-free batteries as soon as possible, or sourcing ‘DRC-free’ cobalt.

There is increasing pressure on large-scale mining (LSM) companies, traders and processors in DRC to provide “ASM-free” cobalt – material not mined by artisanal and small-scale miners (ASM) - to avoid the risk of child labor being involved in their supply chains. This phenomenon, however, has put pressure on LSM companies to disengage from ASM products entirely, estimated to account for about 200,000 miners in the Katanga- Lualaba region, instead of meaningfully engaging with ASM communities to make their working conditions safer and environmentally more responsible. As most ASM producers rely on cobalt extraction for their livelihoods, complete disengagement from ASM is likely to be counterproductive towards DRC’s development objectives and could lead to more poverty, conflict and political instability. A few cases exist, however, where a large company has facilitated the formalization of artisanal miners in cooperatives, in exchange for the right to purchase their output.

DRC’s current dominant position in the upstream cobalt market can be challenged by material substitution and new sources of primary and secondary supply. In light of the cobalt supply chain issues within DRC, there are massive efforts underway, supported by companies and governments alike, to develop new battery technologies and explore other forms of low-carbon technologies to reduce and eliminate their dependence on DRC cobalt. As the DRC economy is highly dependent on cobalt exports, the mineral’s contribution to the country’s economy and development could be put in jeopardy in the long-term if downstream companies continue to see DRC cobalt as a risk. Downstream companies cannot claim to be “socially responsible and climate-oriented” while the minerals they source are linked to human right abuses and environmental degradation. This risk increases even more for DRC post-2025, as other countries such as Indonesia and the Philippines are also expected to become significant producers of mined cobalt and located closer to ‘fine refiners’ and end-markets for EVs.

Without major changes to improve the traceability of cobalt supply chain, the DRC may lose in the long-term its strategic position in mined cobalt at the global level. DRC passed two decrees in December 2019 meant to change the way artisanal cobalt production is managed. The first created Entreprise Générale de Cobalt (EGC), a state-owned company with exclusive purchasing rights on all production of the country’s strategic minerals extracted by artisanal methods. The second established ARECOMS, a new regulatory agency charged with setting the price of cobalt purchased from ASM, performing audits and issuing certificates of compliance of ASM operations with applicable standards and legislation, including on child labor, and closing illegal mining sites.

EGC was officially launched on March 31, 2021 following the signing of an offtake agreement with trading house Trafigura. The agreement includes a credit line prefinancing the purchases of artisanal cobalt and funding to EGC and its partners for the development of controls and traceability in three selected ASM cobalt sites. The selection of EGC’s commercial and financial partners should be transparent and competitive, as they must commit to high levels of due diligence and transparency to ensure the ore was produced according to acceptable standards and sold at a fair price. Likewise, the identification of the

mining cooperatives that will work with EGC must be done with integrity. Notwithstanding, it will take several years for making all artisanal cobalt miners in DRC compliant with internationally accepted standards like OECD guidance and building trust with consumers regarding the accuracy of the compliance audits.

DRC needs a specific policy for artisanal cobalt mining to increase transparency and reduce reputational risks for consumers linked to the use of Congolese cobalt in their supply chains, while offering a path out of poverty for artisanal miners and communities in Lualaba and Haut-Katanga. Such a policy should attempt to take advantage of a predictable window of opportunity in the world market, but it must be formulated with care so as not to increase consumers' concerns and accelerate substitution. The main objective of the policy should be to promote economic opportunities for artisanal miners; to provide legal security for their work and facilitate access to legitimate supply chains; to improve working conditions in mining sites; to ensure the protection of human rights; and to avoid child labor and corruption.

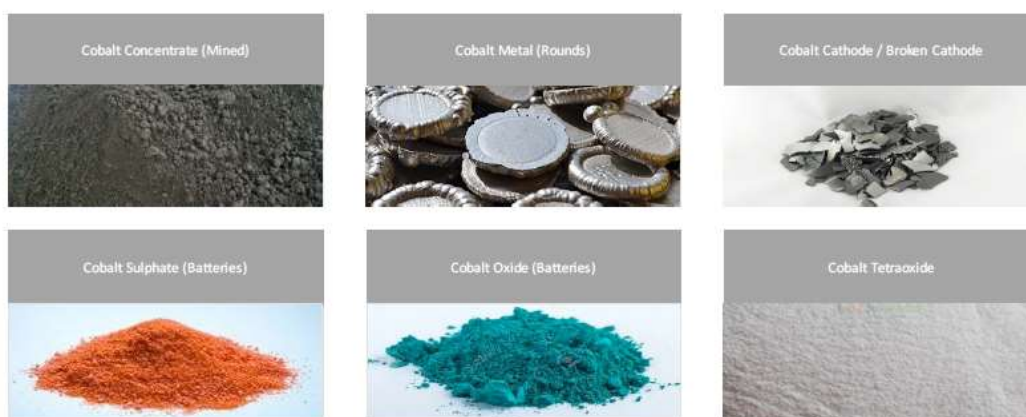
The economic recovery post covid-19 provides an opportunity to organize the artisanal cobalt supply chain. Government should initiate a dialogue with representatives from artisanal miners to address the problems in the supply chain and prepare developing plans with them to support the creation of authorized and economically viable mining zones where artisanal mining can be conducted legally, safely, and with respect for the human rights of workers and surrounding communities.

Many stakeholders are willing to collaborate with DRC to optimize its cobalt comparative advantage. Large consumers, United Nations agencies, multilateral organizations, donor countries and civil society organizations are willing to combine technical and financial support to increase the country's benefits accruing from its comparative advantage in cobalt. Investing in good governance to strengthen the rule of law, mitigate conflict risks and stop human rights abuses in mining areas will contribute to improve the living conditions in areas of extreme poverty and the sustainability and reliability of the supply chain. Several initiatives and standards for the responsible sourcing of cobalt have been launched and implemented in the last few years, but they are different in scope and applied at different stages in the supply chain (mining, smelting/refining, manufacturing, etc.). The World Bank could assist DRC in planning and coordinating the efforts needed to make DRC cobalt compliant with good environmental, social and governance practices that will allow it to integrate favorably in global supply chains.

2. Global Cobalt Market Overview

Cobalt has become more publicized today given its central role in battery technologies, particularly for electric vehicles (EV), followed by stationary and decentralized energy storage applications. The mineral, however, has been in use for a long time across many industries and products, such as superalloys, magnets, hard metals, ceramics, paints, and, in more recent years, in consumer electronics such as smartphones. The cathodes used in lithium-ion (li-ion) batteries account for 55 percent of cobalt demand, while 17 percent go for super alloys, typically used in aircrafts and other high-impact machinery (e.g., gas turbine generators), its second largest use. Cobalt comes in various forms and is usually transformed into a chemical as a final product—cobalt sulphate or oxide—for the production of batteries; 70 percent of cobalt is refined into chemicals while 30 percent of it is made available in its metallic form.¹

Figure 1: Cobalt in its various forms, from mined product to its transformation into other products



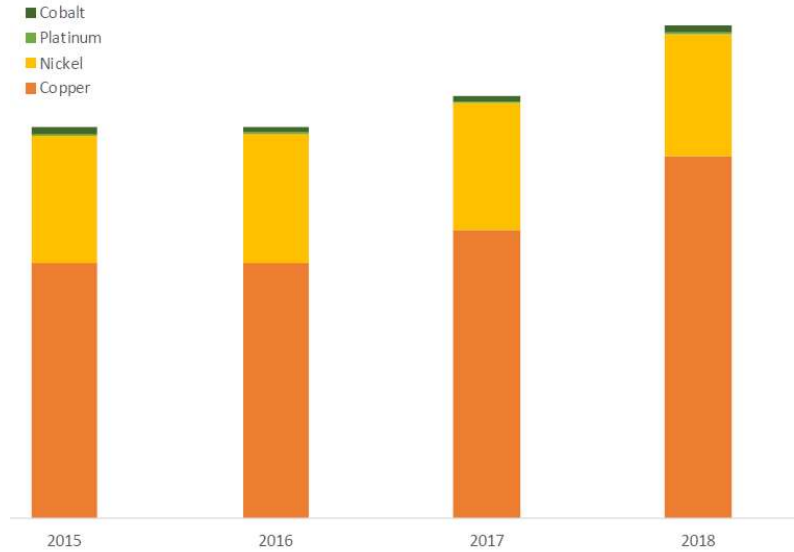
Unlike base metals, cobalt is mined as a by-product of copper and nickel, on which its economics largely depend, and therefore considered to be a “minor” metal. In recent years, copper mines have accounted for about 73 percent of mined cobalt production, while nickel mines accounted for 25 percent and primary cobalt only represented a mere 1-2 percent of mined cobalt supply, coming only from Morocco (BMI, 2020). Glencore is the largest cobalt miner in the world yet only a small percentage of its mining revenue comes from cobalt production.² In 2019, about 70 percent of total global raw cobalt (mined) supply came from the Democratic Republic of Congo (DRC), with the remaining amount of cobalt coming from other countries, notably from Russia, the Philippines and Cuba.³

¹ Many of the cobalt figures and findings referenced in this paper have been developed by Benchmark Mineral Intelligence (BMI), and will be cited as “BMI, 2020”.

² This may not always be true at the mine site level, depending on the price of cobalt. For example, at Glencore’s Mutanda mine in DRC, cobalt revenues surpassed copper revenues when cobalt prices were elevated in 2018. In this case, the Mutanda mine was considered more of a “cobalt mine”.

³ [Cobalt \(usgs.gov\)](https://www.usgs.gov/energy/minerals/cobalt).

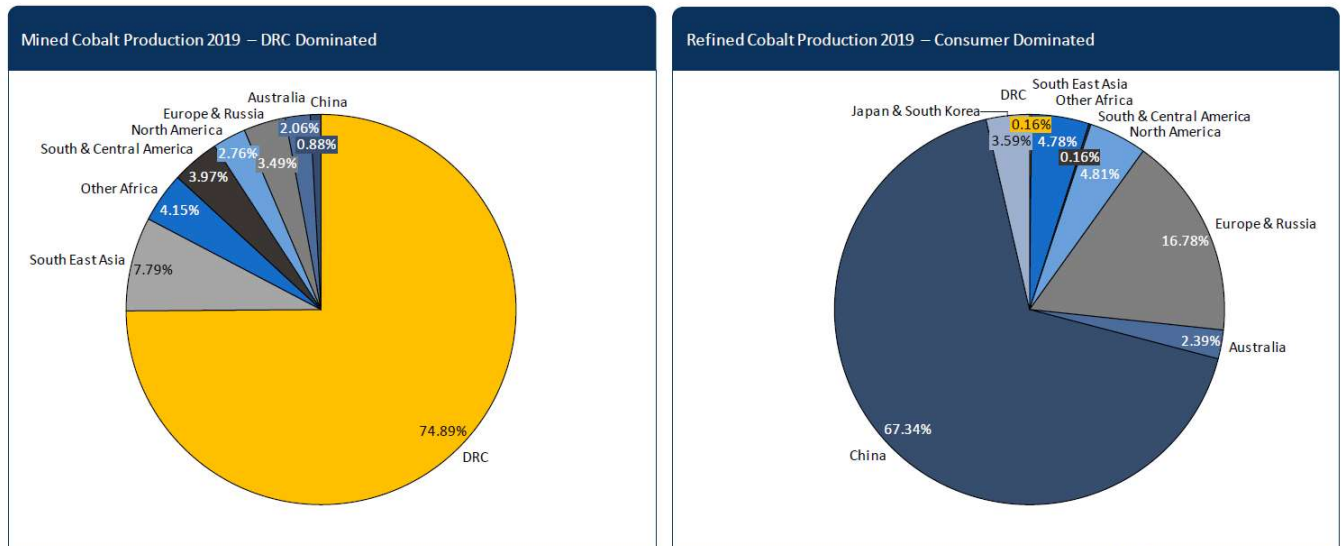
Figure 2: Mined cobalt supply by primary minerals, 2015 - 2018



Source: BMI, 2020

While the cobalt supply chain focus has been heavily centered on the DRC given the recent negative media attention regarding the use of child labor and other concerns, as well as its large cobalt reserves, the picture is starkly different for refined cobalt, which is the ultimate final cobalt product needed to build batteries. In 2019, China refined 67 percent of global cobalt, up from 53 percent in 2015. Most of the refined cobalt that is supplied by China is for cobalt chemical products specifically (OECD, 2019). Outside of China, Finland and Norway are the second and third largest refiners in the world.

Figure 3: Mined cobalt versus refined cobalt broken down by country, 2019



Source: BMI, 2020.

2a. Cobalt and the Clean Energy Transition

Li-ion batteries for mobile, stationary and decentralized applications are expected to play a significant role

in helping the world transition to a low-carbon future. Without this battery technology, it will be difficult for the automotive sector to move away from internal combustion engines (ICE) vehicles, and for countries to integrate variable renewable energy, such as solar PV and wind, into their national grids as these technologies are expected to take a larger share of global electricity production in the medium- to long-term.⁴ Given the global concerns linked to current cobalt production in the DRC from stakeholders that are heavily interested in accelerating a low-carbon future, including financing stakeholders and the banking community, downstream companies (e.g., automotive, energy and technology companies) that do not address the environmental and social challenges associated with upstream activities (e.g., extraction and processing) will likely face strong consumer backlash and find it increasingly difficult to position themselves as being ‘socially responsible and green’ companies.

Sourcing ‘Clean Cobalt’

In December 2019, the heat rose dramatically when a lawsuit was filed in US courts against many major technology companies accusing them of using child miners in the DRC, many of whom have suffered very serious injuries or been killed on the job. “The lawsuit name[d] Apple, Alphabet (Google), Dell, Microsoft, and Tesla as Defendants. Plaintiffs have evidence that these companies in particular aided and abetted the mines that abused and profited from forcing Plaintiffs and other children to mine cobalt under conditions that led to their deaths or serious, crippling injuries. Plaintiffs’ research team is continuing to investigate other tech and car companies and expects to add additional companies to the lawsuit.”⁵ Anecdotal evidence and off-the record interviews suggest that these recent lawsuits have caused a chill across the automotive and technology industries and that many of them are aiming to produce cobalt-free batteries as soon as possible, or sourcing ‘DRC-free’ cobalt.

Given the supply risk associated with cobalt production in DRC, many downstream companies have also been exploring the possibility of investing directly in upstream and refining segments of the cobalt supply chain to secure supply, as well as reduce the reputational and environmental risks from sourcing cobalt from third-party sources, namely from refineries in China (OECD, 2019). Therefore, it is likely that vertical partnerships will become more commonplace as downstream companies scramble to secure the supply of mineral needed for their products, all while managing the reputational, social and environmental risks associated with cobalt production.

For example, on July 2020, German carmaker BMW has signed a five-year cobalt supply agreement with Moroccan producer Managem, the world’s only primary cobalt mine, that will cover 20 percent of BMW’s cobalt requirements for the 2020-2025 period. BMW will source the other 80 percent from Australia, avoiding further involvement in DRC. Likewise, Mercedes-Benz will in the future only source battery cells with cobalt and lithium from mining sites without human rights violations certified by the “Standard for Responsible Mining” of the “Initiative for Responsible Mining Assurance”. In the coming generations of battery cells, Mercedes-Benz is already reducing the cobalt content to less than ten percent and intends to replace it entirely through post-lithium-ion technologies with new material compositions. In addition, media sources reported in

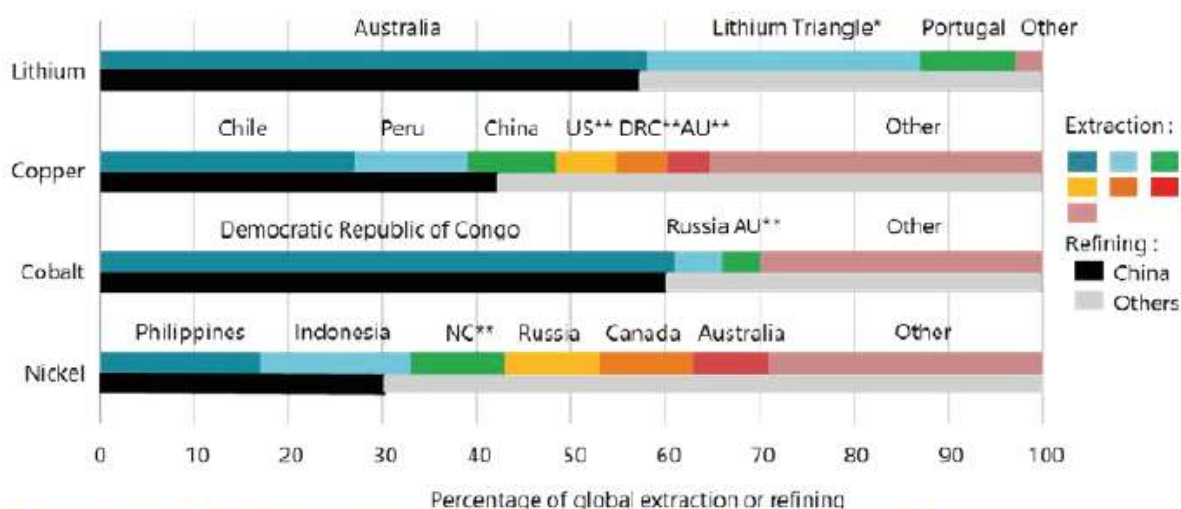
⁴ Variable renewable energy (VRE) refers to a renewable energy source that is non-dispatchable due to its fluctuating nature, such as a solar and wind energy, unlike hydropower.

⁵ Dempsey, Harry. *Tech Giants Sued over Child Deaths in DRC Cobalt Mining*, The Financial Times, 16 Dec. 2019, www.ft.com/content/3ab6b934-202e-11ea-92da-f0c92e957a96.

September 2020 that Tesla is currently in discussions with a mining company in New Caledonia to develop a large mine that would give the company access to “low carbon nickel” as well as cobalt.

There is also increasing pressure on LSM companies and processors, from these same downstream companies, to provide “ASM-free” materials to avoid the risk of child labor being involved in their supply chains, particularly for cobalt. This phenomenon, however, has put pressure on LSM companies to disengage from ASM producers entirely instead of meaningfully engaging with ASM communities to make their working conditions safer and environmentally more responsible (OECD, 2020). For example, Tesla recently signed an agreement with Glencore to secure cobalt supply for a number of years, potentially to be able to claim that it is procuring “ASM-free” cobalt products and therefore not participating in child, labor and/or environmental issues; Glencore is one of the few mining companies that is considered to be Tier 1, a reliable supplier of the mineral.⁶

Figure 4: Main extraction and refining locations of key materials for EV batteries



Source: International Energy Agency (2019) Global EV Outlook. All rights reserved.

There are several global or regional initiatives that focus on overcoming this cobalt sourcing challenge with efforts to diversify the battery supply chain, but many experts point out that Europe and North America are largely behind Asia when it comes to scaling up battery manufacturing capacity. Anecdotal sources also suggest that other regions may not be able to catch up anytime soon, especially since China refines all major EV battery minerals. As highlighted in Figure 4, the majority of lithium and cobalt is refined in China, while 42 percent and 30 percent of copper and nickel, respectively, are also refined there. On top of that, China accounted for 73 percent of global li-ion battery manufacturing capacity in 2019.⁷

The European Union (EU) Conflict Minerals Regulation, which came into force on January 2021, requires EU operators importing tin, tantalum, tungsten and gold (or 3TG) from high-risk and conflict-affected areas to carry out due diligence on their supply chains, in accordance with the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD

⁶ Sanderson, Henry. *Tesla to Buy Cobalt from Glencore for New Car Plants*, The Financial Times, 16 June 2020, www.ft.com/content/aa09dbcb-37ed-4010-a0ee-ab6cfab4d4b5.

⁷ Rapiet, Robert. *Why China Is Dominating Lithium-Ion Battery Production*, Forbes, 19 Aug. 2019, www.forbes.com/sites/rrapiet/2019/08/04/why-china-is-dominating-lithium-ion-battery-production/#72d7f6f23786.

Guidance). The regulation applies to all 'conflict-affected and high-risk areas' (CAHRAs) - i.e., regions in a state of armed conflict or fragile post-conflict, as well as areas witnessing weak governance and security and widespread and systematic violations of international law, including human rights abuses - and could be expanded to include cobalt. Moreover, the European Commission is finishing consultations on an EU Battery Regulation that would require all businesses in the battery industry to report on the social and environmental impact of their operations. This would ensure that batteries entering the EU market are responsibly sourced, and the minerals in their batteries are free of corruption and do not indirectly finance armed groups or child labor.

North America also indicated an ambition to have increased critical raw material security, with the US having recently launched a program to supply battery minerals in Canada and build an EV supply chain between the two countries.⁸

Substituting Cobalt

Concerns regarding the integrity of the supply chain have led many companies to believe that cobalt can be a limiting factor in the deployment of lithium-ion batteries. These concerns have created shifts in the chemistries of rechargeable batteries, leading to a decrease in the consumption of cobalt while favoring the use of substitutes. Cell development for the EV industry is now focused on reducing cobalt use in cathode technology to reduce dependence/cost and increase energy density. For example, Nickel Cobalt Manganese 811 battery chemistries (nickel = 80 percent; cobalt = 10 percent; manganese = 10 percent) are becoming the preferred battery composition in the EV industry to reduce the battery's sector dependence on cobalt. A strong move to NCM 811 battery composition would lead to a reduction of cobalt in the minerals mix to only 10 percent, versus the commonly used 40 percent of cobalt in other battery compositions. There is also an economic incentive for that since nickel is cheaper than cobalt. Because cobalt is mostly mined as a by-product of (copper and) nickel, this price premium is expected to continue over the long-term.

Likewise, alternative technologies that achieve comparable functionality using different materials can accelerate the replacement of cobalt for a substitute. For example, to produce its Model 3 electric car in China, Tesla has chosen to buy prismatic lithium-iron phosphate batteries (LFP) from China's CATL that do not contain cobalt. Despite lower energy density, and thus shorter autonomy range, LFP batteries currently have a significant cost advantage. A full overview of the different li-ion battery compositions and impact on cobalt demand is further addressed in the **2b. Global Cobalt Demand section**.

There is also a large number of financial resources, both public and private, mobilized to speed up research, development and deployment (RD&D) of solid-state batteries, fuels cells (hydrogen) and other forms of batteries and/or other new technologies to accelerate the transition toward a lower-carbon future and reduce the dependence on cobalt. Fuel cells have a significant advantage over batteries as they can be replenished quickly, similar to filling up a gas tank. Automobile manufacturers, especially for heavy and long-haul trucks, are currently investing heavily in the use of fuel cells; there are also ongoing discussions on decarbonizing the shipping industry via hydrogen technology. Currently, the main stumbling block for green hydrogen⁹ is to get the price of the fuel down to a competitive level. On the

⁸ See [Exclusive: U.S. looks to Canada for minerals to build electric vehicles - documents | Reuters](#).

⁹ Green hydrogen is a gas that is created using renewable energy through the electrolysis of water.

battery spectrum, solid-state batteries use no cobalt and according to some analysts, it seems likely that some EVs will be using solid-state batteries by 2025.

Still, to date, there is no real cobalt substitute in the battery supply chain, but if risks continue to exist with sourcing cobalt from DRC, from a social and environmental perspective, policymakers and the private sector will continue to invest in other forms of technology and battery subtechnologies¹⁰ to reduce their exposure to cobalt in the long-term. Changes in technology and subtechnology deployments for battery storage and other emerging technologies could also have impact on overall cobalt demand, and therefore its future price.

2b. Global Cobalt Demand

Electric Vehicles' Role in Driving Cobalt Demand

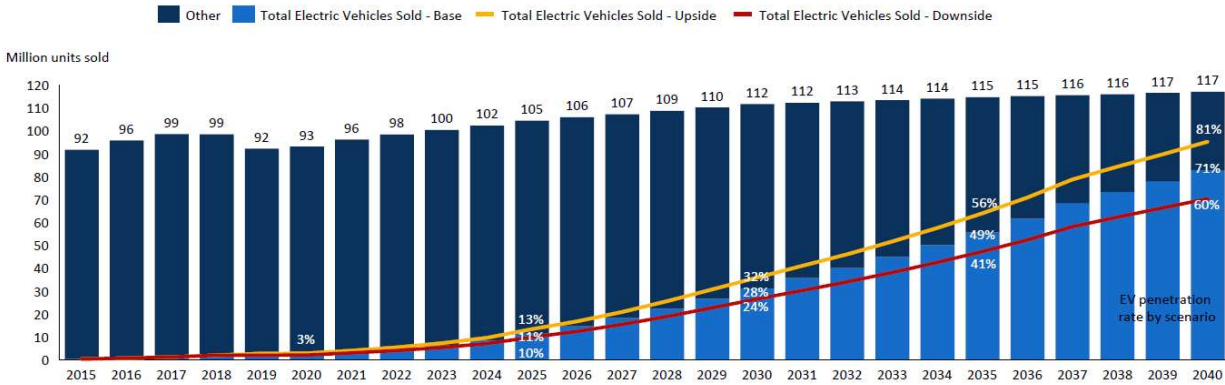
The majority of cobalt demand is coming primarily the battery sector, led by companies such as CATL, LG Chem, Tesla, BYD, Panasonic and Samsung. More specifically, most of this demand for batteries is coming almost exclusively from two industries: the power and the automotive sector, which is trying to shift from ICE vehicles into EVs to conform with new policies and climate targets across different countries to decarbonize the transportation sector, as well as respond to consumers' preference to shift to cleaner cars. While there are a wide variety of battery chemistries available for the EV sector, with some batteries using zero to larger amounts of cobalt in their cathodes, it is widely believed that li-ion batteries, will continue to dominate the battery sector in the medium-term due to continued falling costs, higher energy intensity and better performance, compared to other emerging technologies. The other key markets for li-ion batteries are portable devices and stationary/grid energy storage, both having a strong growth profile over the coming years.

Some sources suggest that EVs will make up nearly half of new vehicles sold in the world starting 2035, with total vehicles sold hovering between 100 and 128 million units sold annually (BMI, 2020). There are a number of factors underpinning this market growth, with several governments supporting the adoption of EVs over the coming two decades through proposals for the banning of internal combustion engine vehicles, or targets for zero-emission vehicle market share matched with subsidies and other incentives. It is unclear whether these projections consider the new grid infrastructure that will be required to charge all these new EVs starting 2030 but is regardless a trend that should be followed closely to understand how cobalt demand could be impacted in the medium- to long-term as policy support will be needed to support this new grid infrastructure.

*Figure 5: EV sales as share of total cars, 2015 – 2040*¹¹

¹⁰ Battery subtechnologies refers to other form of battery compositions, such as solid-state batteries or other li-ion batteries that do not use cobalt.

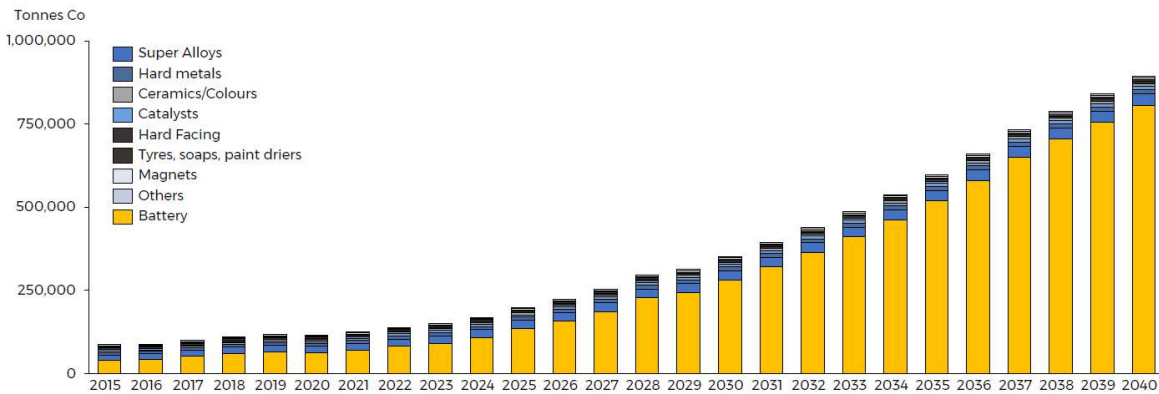
¹¹ Quoted by BMI, 2020.



Source: rhc motion

In 2016, li-ion batteries accounted for 51 percent of cobalt demand; by 2030, they are expected to account for about 85 percent of cobalt demand (OECD, 2019). As more EVs are increasingly put on the road, especially those that use li-ion batteries, cobalt demand is expected to grow from 102,783 tons in 2020 to 663,438 tons in 2035. Moreover, to meet the Paris Agreement¹² of achieving a 2-degree or below future, global consumption of refined cobalt may amount to 200,500 tons in 2025 to 344,000 tons in 2030, increasing by 9.6 percent annually between 2017 and 2030.

Figure 6: Global refined cobalt demand, 2015- 2040



Source: BMI, 2020.

Cobalt demand from Nickel, Cobalt and Manganese (NCM) batteries, a relatively common li-ion battery chemistry, will increase from around 20,236 tons in 2020, to about 253,392 tons by 2030. Within NCM, there are four primary battery chemistries: NCM 111, NCM 525, NCM 622 and NCM 811.¹³ All NCM battery chemistries are expected to move from a market share of around 5 percent in 2019, to 60 percent by 2030, outpacing battery compositions such as Lithium Cobalt Oxide (LCO).

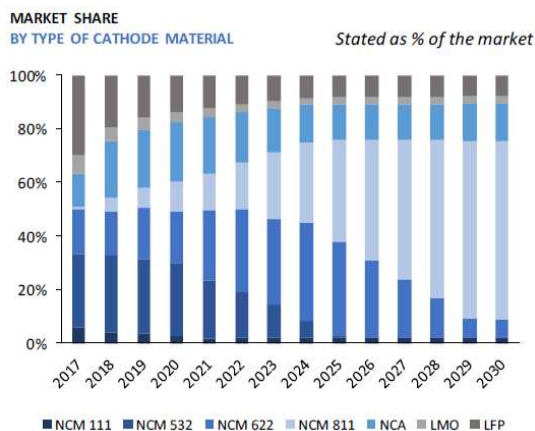
Within NCM batteries, the new 811 chemistry is expected to take a larger share of the market in the long-term, which is the battery chemistry with the lowest amount of cobalt needed, due to tight cobalt

¹² The Paris Agreement sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C (European Commission).

¹³ Each of those numbers represent the ratio of the mineral content in each battery, with the NCM 811 having the lowest amount of cobalt in its composition (e.g., Nickel = 80 percent; Cobalt = 10 percent, and; Manganese = 10 percent).

availability and battery manufacturer’s focus on reducing their dependence on the mineral. Despite the automotive sector’s shift toward NCM 811 and 622 batteries to limit their dependence on cobalt, some sources suggest that the overall cobalt market is still expected to grow strongly, with cobalt demand expected to outstrip cobalt supply in the medium- to long-term.

Figure 7: Expected market share of li-ion batteries, 2017-2030



Source: Trafigura Research. *Cobalt Market Overview*. Trafigura, June 2020.

Prior to the COVID-19 crisis, it was predicted that demand growth for cobalt would outpace the ability for supply to keep up with demand by 2025. Demand is still expected to remain strong through 2025, even though supply chain disruptions as a result of the global health crisis had short-term implications on cobalt demand as consumers reconsidered their spending strategies, particularly in EV purchases. Government policies, such as fiscal packages with a focus on a green economic recovery, are seen to be crucial in helping the EV sector regain ground in the automotive sector after the COVID-19 crisis. As substantial new investment and increased economic stimulus funding continues to be announced by governments around the world, speeding up the roll out of fully electric li-ion powered vehicles, COVID-19 is expected to have minimum impact on cobalt demand in the medium- to long-term.

However, there is a high level of uncertainty with the type of energy storage technology that will be deployed within the next decade. The IEA provides the highest level of uncertainty post-2030, as it is unclear whether other technologies, such as fuel cells and other types of cobalt-free batteries, like solid-state and redox batteries, could end up becoming more competitive in the medium- to long-term. Other technological revolutions and policy shifts, such as the ramping up of mineral recycling from li-ion batteries and other forms of material substitution to reduce costs and dependence on primary materials could have an impact on cobalt demand in the long-term. The volatile price of cobalt, as well as downstream companies’ perceived reputational risks associated with sourcing cobalt from DRC, are also contributing to their scramble to shift to other forms of minerals and/or develop alternative technologies to decarbonize both the transport and energy sectors.

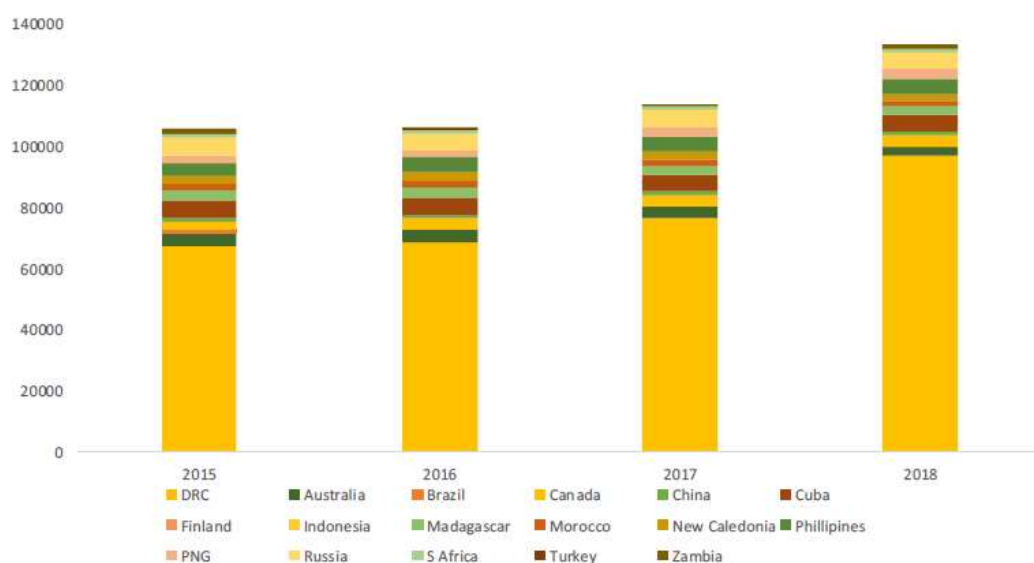
2c. Global Cobalt Supply

Mined Cobalt

Mined cobalt is currently produced via two types of producers: 1) **industrial** or **large-scale mining (LSM)**, which are usually large-scale operations that are regulated in the countries in which they operate, and; 2) **artisanal** and **small-scale miners (ASM)**, who usually operate in an informal matter “with limited available information on production, revenues, operations and even location of activities”¹⁴.

As highlighted earlier, mined cobalt supply is dominated by the DRC, supplying more than 70 percent of global production of mined cobalt in 2019. The remainder of the market is supplied by large industrial mining operations in other countries, such as Russia, Philippines and Cuba, most commonly as a by-product of copper and nickel mining, making the economics of cobalt mining very dependent on those two commodities (BMI, 2020). From 2015 to 2018, DRC produced 67,300 tons to 96,747 tons of cobalt, with industrial producers accounting for 27,547 tons of this increase, by ramping up production, predominantly as a result of copper mine expansion.

Figure 8: Global mined supply, 2015-2018



Source: BMI, 2020.

Glencore (DRC) accounted for 32 percent of global mined cobalt market in 2018. China Moly (DRC) was the second largest global producer with 14 percent, while ASM in DRC was the third largest producer in the world, if aggregated together (BMI, 2020). Other major producers include Chemaf (DRC), Jinchaun (DRC), Norilsk (Russia), Huayou Cobalt (DRC), Sumitomo (Philippines and Madagascar) and Vale (Canada and Brazil).

The COVID-19 crisis led to the temporary shutdown of several exploitations in the DRC, including Eurasian Resources Group (ERG), which suspended its activities, affecting 1,400 jobs. Additionally, some processing plants also shut down. In general, several major mining and trading companies reported production disruptions, including Trifigura, Ivanhoe and China Molybdenum (NRGI, 2020). Cobalt capacity expansions were therefore delayed by more than 12 months, leading to a tightening of the cobalt market in early 2021, once the Chinese economy started to recover from the COVID-19 crisis. As DRC’s economy is highly dependent on the extractive sector, accounting for 30 percent of its GDP, or about 20 percent from

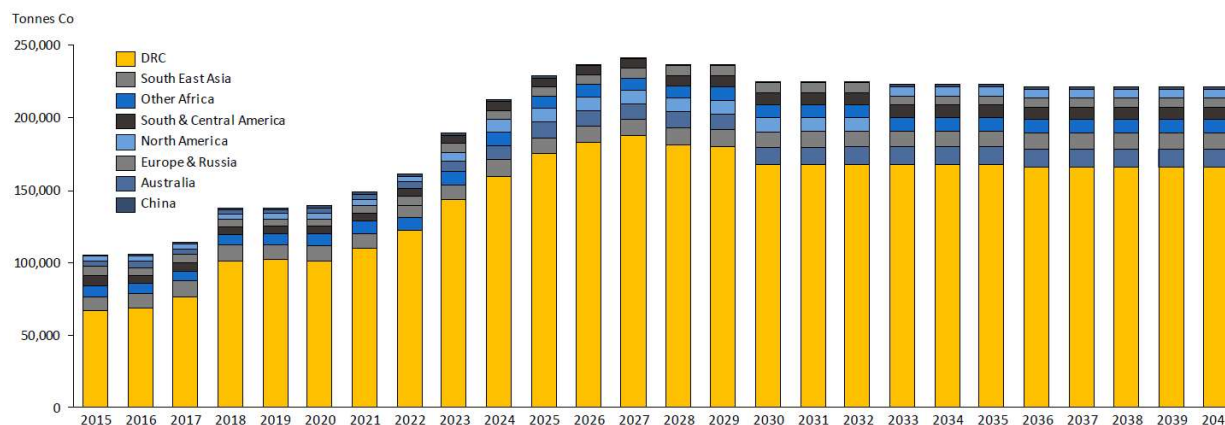
¹⁴ Extractive Industries Transparency Initiative (EITI), 2020.

mineral exports specifically, the COVID-19 crisis had significant social and economic impacts on the DRC, both at the national and local levels (NRGI, 2020).

In addition to falling production and demand, another key challenge with COVID-19 has been linked to the transportation of mined cobalt being disrupted, such as the lockdown in South Africa, where DRC minerals are usually shipped from to reach their final destination in Asia. The logistical bottlenecks with exporting cobalt from DRC to South African ports have added another layer of risk associated with sourcing cobalt from DRC, particularly from the perspective of automotive manufacturers. This temporary gap in supply from the COVID-19 crisis has influenced China’s decision to build a 2,000-ton cobalt stockpile, with other countries also deciding to declare cobalt a ‘strategic mineral’.¹⁵

In the medium-term, McKinsey & Co (2018) estimates that DRC will keep its dominant position and could be responsible for 75 percent of global primary cobalt production up until 2025. After 2025, BMI estimates that the growth curve for global cobalt supply is likely to flatten as the cobalt mines that will need to come online during this period will either be still undiscovered and/or early stages of exploration. Overall, the longer supply-demand balance is largely due to an expansion of production by industrial mines and the flexibility of artisanal miners, both in DRC, which is now often viewed as the force that will in the short-term at least, keep the cobalt market in balance.

Figure 9: Global mined supply outlook by region and key producing countries, 2015-2040



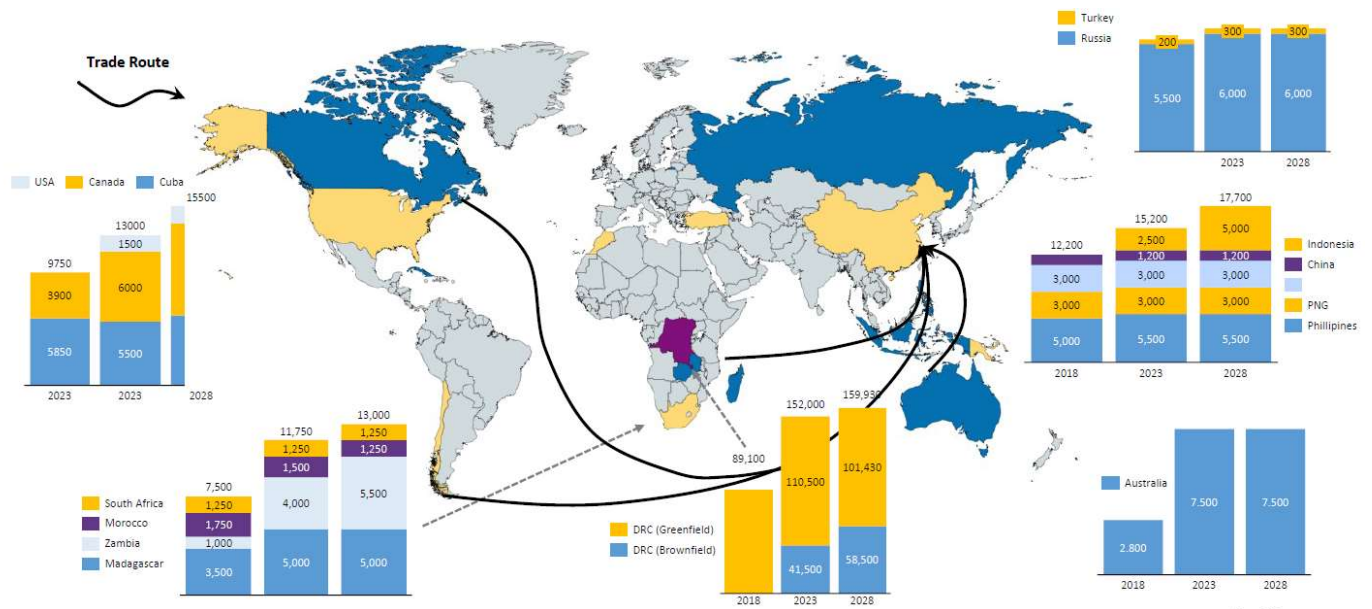
Source: BMI, 2020.

While the DRC supplies the majority of global mined cobalt today, Indonesia is forecasted to become a significant producer due to its large nickel-copper mines expected to come online in the next decade, followed by the Philippines. The outlook is that the expansion of mined cobalt will be seen elsewhere in the world and the majority of nations who produce mined cobalt today will hold their market share.

China dominates the refined cobalt sector, with a market share of 67 percent as of 2019. Refined cobalt refers to cobalt metal/chemicals and or other cobalt products that are used specifically by industrial end users, including battery manufacturers and automakers. As mentioned earlier, outside of China, Finland and Norway are the second and third largest refiners, or “fine refiners”, in the world.

Figure 10: Global cobalt supply and trade visualization

¹⁵ States or regional bodies that have declared cobalt a strategic mineral include: China, US, European Union, Japan and the UK.



Source: BMI, 2020.

Refined Cobalt

Refined cobalt is produced in distinct refineries, often not located near the source of production and sourcing material from one or more mined cobalt producers (BMI, 2020). Due to increased competition from China, some refineries had to close and the rest of world's refined cobalt declined due to these closures. While the DRC is known to process some of its cobalt, by choosing to only do the first step of the process in-country, its products are not at a level that would be considered high grade in the international market. Almost all refined cobalt coming from the DRC is further refined and processed in China or elsewhere to reach the desired level of high grade and to be closer to the consumer market.

The largest refining companies typically have equity investments or outright ownership in mined cobalt assets. China's Huayou Cobalt and Jinchuan, for example, are some of the world's largest cobalt miners, in addition to being significant refiners of the metal. Currently, there are few plans to build refineries outside of China despite some concerns over China's dominance on the cobalt supply chain, particularly with its refining capacity as well as some of its mine ownerships in DRC. However, that may change as governments and industries are attempting to develop battery supply chains outside of China and become competitive. Some sources suggest that the outlook on China's dominance over refined cobalt could change as refineries on average, take only about 18-36 months to build (BMI, 2020).

In general, the relationship between battery producers and cobalt suppliers usually take form as a long-term offtake agreement or as an equity investment. As seen in Table 1, some off-take agreements for refined cobalt can range anywhere between three and five years, with some buyers being cathode manufacturers while others are full battery producers. As mentioned earlier, since downstream users are scrambling to secure cobalt and nickel supplies over the long term, it is likely that vertical partnerships will become more commonplace to reduce supply chain risks, as highlighted by the latest announcements by Tesla.

Some sources suggest that China is also known to purchase the majority of the artisanal material from DRC to eventually refine, although its exact source is hard to trace at the company level. Refineries in

China produce almost all types of cobalt products and are accustomed to producing the material for the battery sector, as China is the largest battery producer, but also the largest market for EV, accounting for 47 percent of total EVs in use in the world.¹⁶

Table 1: Examples of cobalt supply agreements

Year	Buyer	Buyer Type	Country	Material Source	Source Type	Country	Notes
2017	Easpring Material Company	Cathode Manufacturer	China	Clean Teq	Project	Australia	Five year offtake for nickel and cobalt sulphate from the mine in Australia. 20% of CleanTeq production
2018	POSCO	Cathode Manufacturer	Korea	Huayou Cobalt	Producer	DRC / China	Two JVs set up between POSCO and Huayou. JVs will produce 4.6ktpa of precursor and cathode from 2020
2018	GEM	Battery Recycler	China	Glencore	Producer	DRC / China	Glencore agrees to sell around 30% of its cobalt production to GEM over the next three years. Total 52,800tonnes of cobalt hydroxide
2018	LG Chem	Battery Producer	Korea	Huayou Cobalt	Producer	DRC / China	Two JVs set up to produce cathode and precursor in China. LG to contribute US\$225M by 2020
2018	SK Innovation	Battery Producer	Korea	Australian Producers	Project	Australia	Various agreements in place
2018	LG Chem	Battery Producer	Korea	Cobalt Blue	Project	Australia	LG invested US\$6M in Cobalt Blue
2018	Easpring Material Company	Cathode Manufacturer	China	Pacific Rim Cobalt	Project	Indonesia	5 year offtake agreement for nickel and cobalt sulphate from the Cyclops project

Secondary Cobalt (Recycled)

Recycling rates for cobalt are currently low. For example, recovery rates for cobalt in Waste Electric and Electronic Equipment (WEEE) are only 30 percent, the rest being lost in processing. Less than 5 percent of lithium-ion batteries are recycled today at the end of their life. Current barriers to cobalt recycling include product design without consideration of second life uses, inefficient collection infrastructure, and transparency issues regarding secondary processes. Therefore, the stockpiles of end-of life products containing cobalt are not large or homogenous enough to mandate investments in more efficient collection infrastructure and recycling technologies but that could change with the effective collection of EV batteries (IISD 2019).

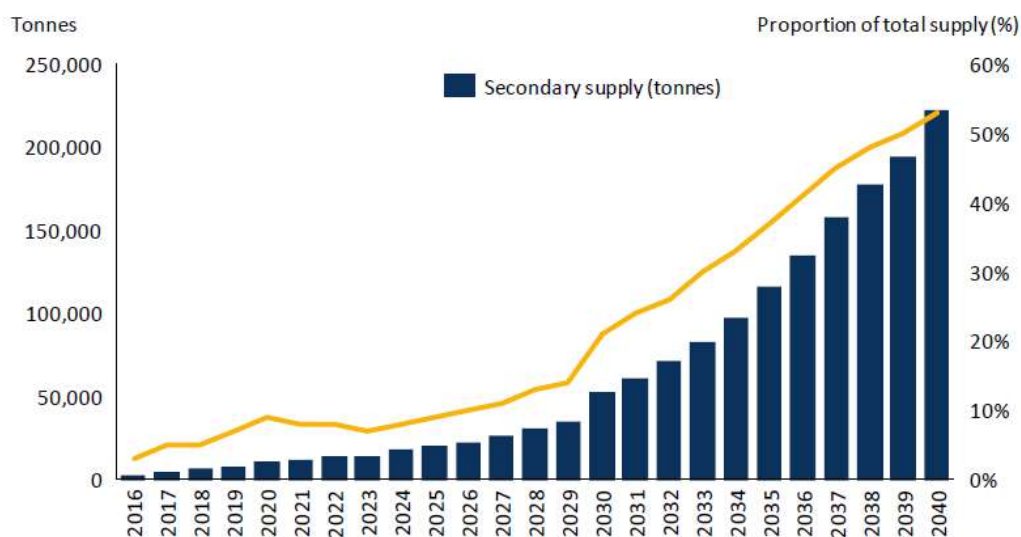
However, recycled and re-used cobalt is expected to play an increasingly important role in the market, with secondary cobalt expected to supply nearly 50 percent of all cobalt by 2040, compared to less than 10 percent today (Figure 11). That said, the current economics of recycling li-ion batteries outside of China is marginal due to the complex hand sorting operations required, coupled with the high cost of the technology required to do this in an environmentally acceptable way. From a re-use perspective, the bulk of li-ion batteries from the EV sector are today repurposed for stationary applications for the grid or used in low-load applications, such as forklifts and other warehouse production and equipment. Still, some

¹⁶ International Energy Agency (IEA), 2020.

sources estimate that supply-demand imbalance will remain for cobalt as demand is expected to outstrip all supply, including primary and secondary cobalt.

While there has been some high-level announcements, notably from governments in Europe, to increase li-ion battery recycling rates, the EU’s recycling sector lags behind China’s battery recycling capacity, although companies like Umicore are highly advanced in recycling of metals and have been doing this within Europe for quite some time¹⁷. It is estimated that if 90 percent of all batteries deployed in the EV sector would be collected and subsequently recycled at end of life, in 2030 about 38,000 tons of cobalt could come from the recycling of EV batteries in the EU, providing for around 10 percent of the European cobalt consumption in the EVs sector (Alves Dias et al. 2018).

Figure 11: Secondary cobalt supply forecast from recycled products, 2016 – 2040



Source: BMI, 2020.

China increased its pool of future end of life (EOL) batteries by developing a vibrant battery refurbishment/re-use sector. EOL batteries refer to battery products that have reached their end life and are ready to be disposed or repurposed/recycled for other applications. Some sources suggest that China has been importing ‘waste’ batteries from developed markets to increase its EOL batteries supply pool. In addition to low labor costs relative to other countries, China’s battery recycling and re-use sector has benefited from economies of scale and expertise, leading to more efficient collection and processing chains. It remains to be seen whether other countries will be able to catch up to China in the battery recycling space to increase the overall supply of secondary cobalt in the medium- to long-term.

2d. Cobalt Prices

Cobalt supply is rigid and subject to severe price volatility mostly because cobalt has always been mined as a by-product of other products. The economics of any new large-scale cobalt capacity is mostly driven by nickel and copper prices, as investment will not be made directly into cobalt, but into other metals.

¹⁷ See [Our recycling process | Cobalt & Specialty Materials \(umicore.com\)](https://www.umi.com/en/our-recycling-process/cobalt-specialty-materials).

As shown in Figure 12, in 2008 and 2018, cobalt experienced significant price spikes, reaching \$90,000 to \$105,000 per ton in 2018 and 2008, respectively, due to a stock built at a time of tight supply as a result of prolonged low prices preceding those years (BMI 2020). In 2008, the supply shortfall stemmed from constrained supply, due to low prices and lower cobalt output. In 2018, a decade later, the same phenomenon happened again and then cooled down a few months later due to stronger levels of supply and a positive outlook from buyers regarding cobalt supply; prices stabilized to about \$26,000/tons in June 2018, from its peak at \$90,000/tons in January 2018.¹⁸

Figure 12: Cobalt price from 2006 to 2020 (US\$/tons)



Source: Infomine.

Demand for cobalt surged in 2015 but notwithstanding supply kept up with the rise in demand. DRC’s cobalt production increased from 67,300 tons in 2017 to 96,747 tons in 2018 with an additional 27,547 tons coming from large scale mechanized copper/cobalt mines which accounted for more than 90 percent of the production expansion during the period. Still, DRC’s ASM was a key factor contributing to the reestablishment of the balance between supply and demand. Following a ‘cobalt rush’ that brought the number of cobalt artisanal miners to an estimated 200,000 in Katanga and Lualaba, artisanal production increased by about 1,900 tons, from 7,100 tons to 9,000 tons (BMI 2020). By expanding output in response to high prices, it reduced market tightness and prevented prices from spiking further, playing the role of “swing producer”¹⁹. ASM is cobalt’s supply source with the greatest elasticity, partly due to the availability of temporary labor and partly because cobalt is the main material mined. However, when cobalt prices fall, artisanal miners being high cost producers tend to curtail production, turning to copper given its greater price stability.

From a pricing standpoint, cobalt prices were already at 2012 to 2015 levels since June 2018, irrespective of the pandemic, at around US\$26,000-\$30,000/ton. Since then, following favorable EV policies put in place by governments globally as part of the post COVID-19 recovery, the industry has seen rapidly increasing demand for cobalt under a backdrop of surging EV sales. Prices began their recovery in late 2020 and gained some 65 percent in the first two months of 2021, hitting two-year highs of around

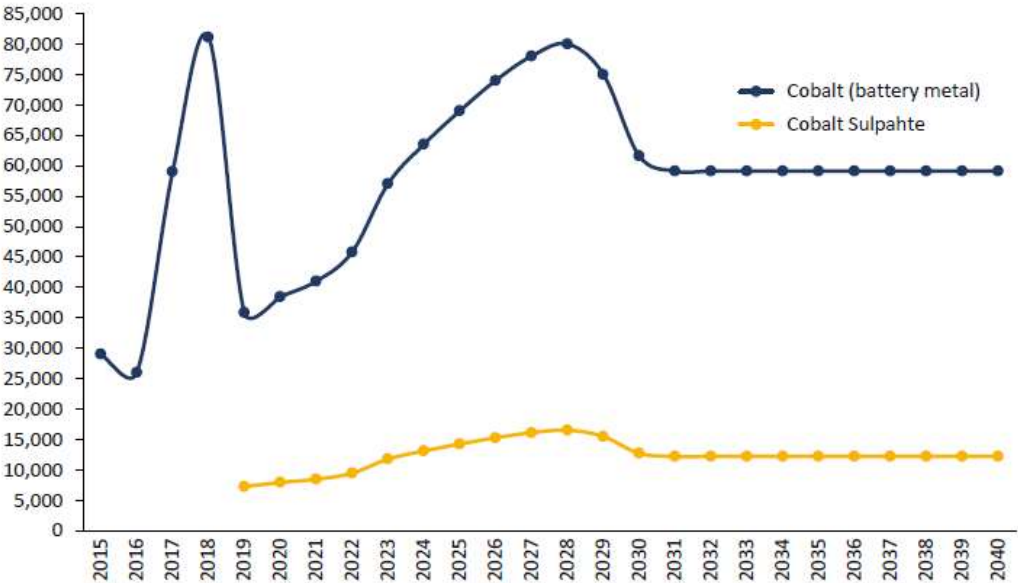
¹⁸ Mining.com. “15 Years Cobalt Price.” Markets Single, 1 Sept. 2020, www.mining.com/markets/commodity/cobalt/all/.

¹⁹ A swing producer typically has a large amount of spare capacity and is willing to use it to influence market prices by adjusting its output to balance or artificially regulate the market and keep prices stable.

US\$55,000/tons. There was a small correction in March, with cobalt prices falling below \$50,000/tons and remaining at that level until the end of the first semester of 2021.

Despite previous price spikes, some analysts predict that prices will rise again once demand outstrips supply, thanks to the automotive sector, with cobalt prices expected to remain elevated, at \$30,000 per ton or more, moving forward (see Figure 13).

Figure 13: Cobalt price forecast to 2030 (US\$/tons)



Source: BMI, 2020.

If prices spike again due to limited supply, this *could* incentivize downstream companies, particularly battery manufacturers and automotive companies, to speed up the development of alternative battery technologies or hydrogen fuel cells to reduce their dependence on cobalt. As raw materials account for about 60 percent of a battery cost, with the cathode (cobalt) accounting for nearly 34 percent of the total cell cost (BMI 2020), the cost of raw materials needed to build them will most likely incentivize the EV industry to move faster with material substitution, if and when, that becomes technologically and economically possible to reduce manufacturing costs.

3. Cobalt’s Role in DRC

3a. A Comparative Advantage That Fuels the Economy

The DRC has a strategic position in supplying mined cobalt given its large reserves in both copper and cobalt, as well as the advantageous geological features that make it highly economic to mine it. About 55 percent of the world’s cobalt resources are located in DRC, amounting to almost 10 million tons of mineral (Alves Dias et al. 2018). In addition, the country is endowed with particularly enriched oxidized minerals with natural concentrations of cobalt in ores of 0.4 percent to 0.8 percent, up to five times higher than

those of lateritic nickel ores found in other cobalt producing countries. These relatively soft and highly concentrated rocks can be mined by artisanal methods, while sulfide ores tend to be more difficult to extract. This gives the DRC a *significant* comparative advantage in cobalt production globally.

DRC did not always supply the majority of the world’s cobalt. In 2000, for example, before the approval of a modern mining code, DRC only contributed to 9.7 percent of total global cobalt supply. Starting 2010, DRC’s role in the cobalt market grew rapidly, with the country providing more than 50 percent of cobalt from that year and beyond. In 2019 alone, DRC provided about 70 percent of global cobalt output, producing about 100,000 tons of cobalt compared to approximately 140,000 tons for the rest of the world (USGS, 2021).

The mining sector plays a central role in the DRC’s economy and is a key driver to the country’s economic growth. In 2018, copper and cobalt represented 50 and 35 percent of total mining exports, respectively, together accounting for 85 percent of mineral sales. According to the International Monetary Fund, natural-resource extraction typically provides about a third of DRC’s government revenue and more than 90 percent of its export earnings, again, mostly from copper and cobalt production. The DRC’s economy dependence on the mining sector and low foreign exchange reserves makes the country highly vulnerable to external shocks, such as volatile commodity prices (IMF, 2019).

Table 2: Cobalt mined in DRC versus rest of the world (thousand tons)

Year	DRC Production	Global Production	Percentage of global production from DRC
2000	7	36.9	9.7%
2005	22	57.5	42.7%
2010	47.4	89.5	53.0%
2011	60	109	55.1%
2012	60	110	54.5%
2013	54	110	49.1%
2014	63	123	51.2%
2015	63	126	50.0%
2016	64	110	58.2%
2017	90	140	57.1%
2018	73	120	71.4%
2019	100	144	69.4%
2020e	95	140	67.9%

Source: Various issues of United States Geological Survey (USGS) annual minerals reports on cobalt.

Table 3: Mining sector’s role in DRC economy, 2014-2018

Democratic Republic of the Congo: Mining Sector, 2014-18

	2014	2015	2016	2017	2018
	Actual				Prel.
Mining GDP growth	19.3	4.8	-0.7	7.8	16.9
Mining share in GDP (percent of GDP)	26.3	25.8	25.0	26.0	28.7
Mining export as share of total exports	94.8	97.2	73.0	99.0	98.8
Mining revenue as share of total revenue	n.a	n.a	n.a	10.6	20.3

Sources: Congolese authorities; and IMF staff estimates and projections.

Cobalt provided an estimated 6.3 percent of the country’s fiscal revenues in 2016. It accounted for about 9 percent of GDP on average from 2013-18, with 10 percent in 2018, and is also estimated to have contributed 9 percent of Foreign Direct Investment (FDI) from 2008 to 2018. It is anticipated that cobalt will continue to play an important role in fueling the DRC economy in the medium- to long-term.

Opportunities and Risks

As highlighted in the **Mined Cobalt section**, DRC is expected to dominate the ‘mined cobalt’ market for some time, with the country forecasted to continue to provide about 70 percent of the mineral at least until 2025. DRC’s comparative advantage in cobalt reserves and production, associated to the current demand trends are expected to give the DRC government considerable influence on how to decide to supply mined cobalt to the market.

Notwithstanding, DRC’s comparative advantage is only in the upstream segment of the value chain and is heavily dependent on a Chinese-dominated value chain. China controls almost 50 percent of DRC’s cobalt production, as 8 of the 14 largest cobalt miners in Congo are now Chinese owned²⁰. While most of the mines are joint ventures with Gécamines, they are managed by the Chinese firms. In addition, a big portion of DRC’s artisanal cobalt is sold in trading warehouses called “dépôts” or “comptoirs”, currently almost exclusively controlled by Chinese nationals, who then sell to “crude” refiners who mix materials coming from different sources. The output is roughly refined in DRC before being shipped to China where most of the world’s capacity of “fine” refined cobalt resides. China is the largest producer of batteries, with 73 percent of the global li-ion battery manufacturing capacity in 2019, and also the largest market for electric vehicles.²¹ With demand for electric vehicles set to grow exponentially, China is leading the race for the construction of electric vehicles and aiming to control an increasing share of the cobalt market to secure the stable supply of critical raw materials. The dominant positions of the DRC and China, respectively in the extraction and refining of cobalt, are seen as big risks by the rest of the market.

Moreover, political instability in the DRC and the 2018 revision of the mining code resulted in major mining companies considering investments in the DRC more cautiously and assigning a higher risk premium to such investments. Their investment decisions are not solely based on price projections but is also affected by weak governance, changing fiscal terms, reputational and project risks.

²⁰ They include China Molybdenum (CMOC), the largest stakeholder in Tenke Fungurume Cu/Co mine (TFM), Jinchaun, Huayou Cobalt, Congo Dongfang Mining, Comika Mining/Wanabao Mining, and Hunrui Cobalt.

²¹ <https://www.forbes.com/sites/rrapier/2019/08/04/why-china-is-dominating-lithium-ion-battery-production/#72d7f6f23786>

Despite DRC's comparative advantage, the perceived reputational risks associated with sourcing cobalt from the DRC due to child labor and environmental degradation associated with ASM production but also wider governance issues in the sector could negatively impact the country's strategic position in supplying cobalt from 2025 onwards (see **Sourcing 'Clean Cobalt'** section).

The impacts of these concerns can be felt in the global market today. Various companies have highlighted supply chain risks related to raw materials in batteries, identifying cobalt as the material presenting the highest risk, especially concerning human rights abuses, child labor and poor working conditions in the DRC. Several initiatives and standards for the responsible sourcing of cobalt have been launched and implemented in the last few years with diverse scopes that can be applied at different stages in the supply chain (see **Global Initiatives and Perspectives to Improve the Cobalt Supply Chain** section). Still, the lack of transparency and traceability in the DRC cobalt supply chain is leading many downstream companies to put in place measures to prevent any artisanal cobalt from the DRC entering the supply chain, claiming to source 'ASM-free' cobalt. Material must come from a compliant source and must be independently audited and verified to protect stakeholders from potential legal action.

This means that while DRC will continue to benefit from mined cobalt production at the macroeconomic level, this advantage could be short-lived, leading to declines in job creation, local economic development, as well as poverty reduction within the Katanga-Lualaba regions if current trends from downstream companies to attempt to source 'ASM-free' cobalt persist.

Battery suppliers and automakers are already looking to diversify their cobalt sources, as well as investing in RD&D to develop new battery and/or energy technologies that will limit their dependence on cobalt or eliminate the need for cobalt altogether in the long-term. While it may take five or more years for these new technologies to be developed, or for new sources of mined cobalt to be identified in other parts of the world, material effects might start to affect the global market as soon as 2025. This would in turn negatively impact the country's national economy given that cobalt accounts for roughly 10 percent of the nation's GDP.

In short, DRC's comparative advantage in mined cobalt production will likely remain intact up until 2025, but its dominance at the international level may not last beyond that timeframe, if the cobalt supply chain issues are not adequately addressed in the short-term. This is a significant risk for the country at both the macro- and microeconomic levels, which could severely impact its future economic prospects, development and social progress, and poverty reduction objectives.

The response of the DRC Government

In December 2019, DRC passed two decrees meant to change the way strategic minerals extracted with artisanal methods are managed. The two decrees can be summarized as follows:

- Decree No. 19/15 created Entreprise Générale de Cobalt (EGC) as a state-owned company with exclusive purchasing rights on all production of the country's strategic minerals²² not extracted by industrial operators, including the purchase and resell of cobalt mined by artisanal methods. EGC will be managed by state-owned mining company Gécamines. The decree authorizes the

²² Strategic minerals are determined by Government and are subject to a 10% royalty rate. The Prime Minister has issued Decree No. 18/0442 of November 24, 2018 declaring cobalt, germanium and columbo-tantalite ("coltan") as strategic minerals.

State monopoly to exercise its rights directly, through partnerships, or by delegating all or part of its activity to one or more other companies.

- Decree No. 19/16 established the Agency for Regulation and Control of the Strategic Mineral Substance Markets (“Autorité de Régulation et de Contrôle des Marchés des Substances Minérales Stratégiques” - ARECOMS) as a new regulatory agency for strategic minerals. ARECOMS will be charged with setting the price of locally purchased cobalt from ASM, issuing certificates of compliance of ASM operations with applicable standards and legislation, closing of illegal mining sites, performing audits and controls of artisanal miners, ensuring that no children are active on mining sites, and providing education programs.

Mining in the DRC is governed by Law No. 007/2002 of July 11, 2002 on the Mining Code as amended and supplemented by Law No. 18/001 of March 09, 2018. The measures for implementing this law are contained in Decree No. 038/2003 of March 26, 2003 establishing the Mining Regulations as amended and supplemented by Decree No. 18/024 of June 08, 2018. The two decrees refer to the Mining Code, and their stated objectives include:

- To regulate cobalt’s world market price, given the strategic position occupied by the Democratic Republic of Congo (DRC) in its supply;
- To control the entire value chain of artisanal production and increase state revenues through the control of the prices of strategic substances;
- To reduce production stoppages at industrial mines caused by conflicts with artisanal producers;
- To control artisanal production areas of strategic minerals and ensure the traceability of extracted products and the respect of working conditions;
- To promote the integration of artisanal miners of strategic substances into the formal economy;
- To increase tax revenues;
- To improve the business climate and make effective the fight against poverty;
- To create a technical body responsible for regulating the market for strategic minerals in order to strengthen compliance with applicable legislation, and the recommendations of international organizations regarding respect for human rights in this area.

Enforcement of the new regulation is a major concern as its implementation is already lagging behind, partially because of COVID-19 but also because the decrees are ambitious in scope. For example, they gave artisanal mining cooperatives a 60-day deadline to obtain certificates from the ARECOMS and comply with EGC’s monopoly, deadlines that have expired a longtime ago. While EGC was launched on March 31, 2020, ARECOMS is still struggling to become operational.

On October 27th, 2020 trading house Trafigura entered into an offtake agreement that includes a loan facility up to US\$ 15 million of support to EGC and its partners for the development of controls and traceability associated with ASM cobalt production. EGC established a Technical Committee through which Trafigura and the NGO Pact, among others, will supervise the production process and promote responsible sourcing diligence, respectively. Only three purchase stations will be created initially, but the agreement could be scaled up later. Gécamines will be responsible for selecting the three pilots. Trafigura will act as marketing agent for EGC, assuming the marketing risks (freight and insurance), while EGC will sustain all commercial risks as well as the costs related to mine management (e.g., conducting geological research, carrying out overburden removal and distributing protective equipment to artisanal miners). A renewable prepayment facility up to US\$ 65 million will prefinance the costs of bringing the cobalt exclusively from strictly controlled artisanal producing areas complying with the Congolese law to an export point.

EGC was officially launched on Wednesday March 31, 2021, while its activities are expected to begin later this year. The same day, EGC also released the EGC Responsible Sourcing Standard²³, developed in collaboration with Trafigura and Pact, that will support the establishment of EGC's artisanal cobalt mining zones. Implementation of the EGC Standard will be supported by Pact through capacity-building and training of local stakeholders, including EGC and the mining cooperatives. Pact will also conduct ongoing monitoring and provide guidance for the assessment and mitigation of identified risks.

ARECOMS will set the local purchase price of cobalt, ensure compliance with international standards and focus on solutions for child labor. The regulator will also aim to enforce the national standard for certified commercial chains (CTC), a system of standards and certification developed by the BGR in 2007-2010 and adapted and implemented in the DRC since 2011. Previously used only for artisanal mining of 3TG, a ministerial decree in April 2020²⁴ approved its application to cobalt. Achieving responsible sourcing will depend on the regulator's ability to adopt the strict certification requirements (comprehensive due diligence and traceability) required by most consumers today.

ARECOMS' structure and funding are yet to be defined. Decree No. 19/16 provides no details on how the regulator's mission will be funded, although it is planned that the agency will be financed by certificates of conformity and cooperatives. Because the regulatory agency is not operational yet, cooperatives have no way to comply with the new framework.

3b. Mapping the DRC Cobalt Supply Chain

Overview

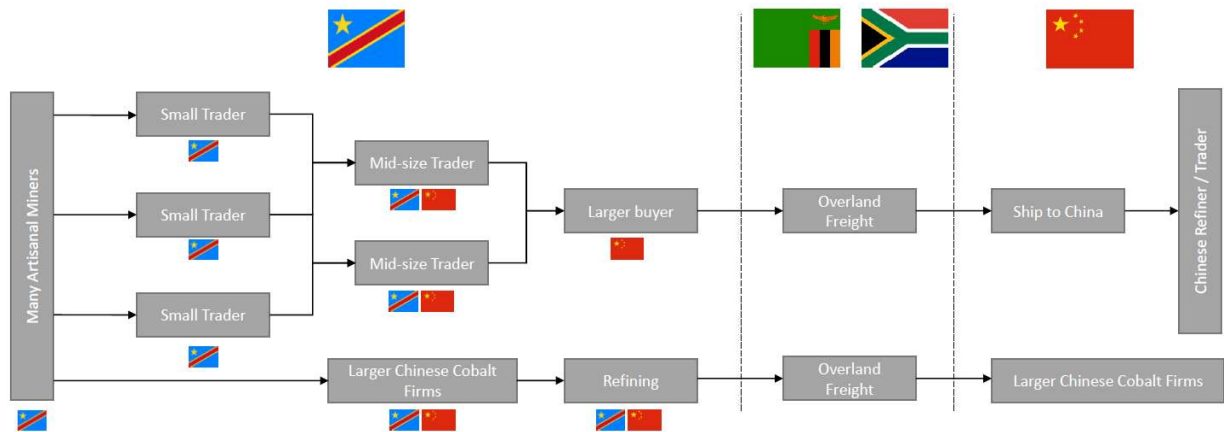
The cobalt supply chain within DRC is extremely complex and difficult to trace, from extraction—where it is often presented as two distinct types: artisanal and small-scale mining (ASM) and large-scale mining (LSM)—to in-country processing and/or shipment to refineries overseas. An analysis by Le Petit highlights that the “traceability on where cobalt is extracted and transparent information on mining site conditions on the ground remain the weakest spots of most (certification) schemes.”²⁵ In other words, traceability is one of the key challenges from the DRC cobalt supply chain, as it remains difficult to track the different cobalt sources all the way down to the exact extraction location. This results in ASM products often ending up in LSM supply chains, despite company assurances to the contrary.

Figure 14: Typical flowchart for artisanal cobalt from the DRC sold to China

²³ <https://www.egcobalt-rdc.com/app/uploads/2021/03/20210326-EGC-Responsible-Sourcing-Standards-English.pdf>.

²⁴ Ministerial Decree N ° 00139 / CAB.MIN / MINES / 01/2020 of April 20, 2020 on the CTC Certification Manual “Certified Trading Chain” of ores from the gold, Cupro-cobaltiferous, stanniferous and colored stones sectors in DRC.

²⁵ Le Petit, 2019.



Source: BMI, 2020.

As a result, there has been increased focus from several players along the cobalt supply chain to work with ‘formalized’ ASM producers to better source cobalt. However, some sources suggest that de facto they are not so “clean”, as they often also buy the output of informal ASM producers. Most informal output is allegedly sold to markets called *dépôts* (buying centers; see Table 4 below), many of which are controlled by Chinese nationals, who then sell to “crude” refiners that also supply LSM companies, who then mix this material with their own production (OECD, 2019). The ‘crude’ refiners’ ability to process feed material mined from different sources and different extraction methods rendered supply chains complex and interconnected, as transactions prior to sale to the local trader are undocumented.

To better understand the cobalt supply chain within DRC, it is crucial to identify the different stakeholders that exist along the cobalt supply chain, from the miners, traders, regulatory authorities to the security forces (private or public). In the case of DRC, key stakeholders will be defined as actors who are involved in the cobalt supply chain from extraction to ‘crude’ processing, where the product is partially processed in-country before being exported abroad to reach a ‘fine refiner,’ usually in China.

A table below has been provided to illustrate the role of each of the key stakeholders and their role within the DRC cobalt supply chain.

Table 4: Description of key stakeholders in DRC cobalt supply chain

ROLE	STAKEHOLDER	DESCRIPTION
MINERS	Formal ASM	Formal artisanal miners usually work in groups of 5-8 people for each pit, producing about 1-3 tons of ore (copper or cobalt) per day. The equipment involved to mine these minerals are sometimes financed by the miners themselves, which will enable them to retain 60% of price of the mined minerals once they are sold at the buying stations (<i>dépôts</i>). Formal artisanal miners usually work through cooperatives and are sometimes paid less than informal miners due to the concessionaire’s higher cost of a running a formal ASM site, which is then passed on to artisanal miners. This can often result in formalized ASM sites being less competitive than informal ASM sites.
MINERS	Informal ASM	Unlike formal artisanal miners, informal ASM miners do not work as part of a cooperative nor have a formal legal status for their production. Informal ASM operations are known to take place in privately-owned mining concessions, whether active or inactive, leading to continued conflicts between LSM-ASM producers. These informal ASM activities can also take place in residential

		<p>areas. According to the OECD, informal ASM accounts for about 20 percent of production, which represents about 13 percent of the world’s production of cobalt.</p>
<i>MINERS</i>	Cooperatives	<p>Permit holders and operators (LSM) can only source ASM cobalt from registered cooperatives. Under the Mining Code, cooperatives are the only entities allowed to market ASM cobalt material, but now EGC has monopoly rights to market all ASM material. Some cooperatives are known to demand or extort unofficial payments from artisanal miners, accounting sometimes for up to 20% of extraction. The lack of transparency over cooperatives’ registration and allocation of sites is a serious concern in the ASM industry; sometime the heads of the cooperatives are political exposed persons (PEPs). Knowing the beneficial ownership of cooperatives is an important due diligence step to take to root out potential corruption in ASM cobalt production.</p>
<i>MINERS</i>	LSM (large-scale mining)	<p>LSM producers, permit holders and/or operators, represent some of the largest foreign-owned mining companies in DRC, producing about 70-80% of global cobalt. They typically operate in the country via joint ventures with SOE Gécamines, and can be structured in various ways between extraction, processing and refining activities. Some LSM are vertically integrated, retaining custody of the mineral from production to export, while others specialize in certain aspects of the cobalt supply chain.</p>
<i>BUYERS OR TRADERS</i>	Négociant or pit sponsors	<p>Négociants are described as middlemen who source and supply cobalt to trading houses;²⁶ they are the connecting stakeholder between ASM miners and dépôts (buying centers). They can choose to pre-finance materials needed to extract the ore and have been reported to work in the mines themselves when cobalt prices have been low. Some sources suggest that négociants can buy minerals from any mining location without problem, making it harder to trace cobalt from the extraction stage once it reaches a dépôt.</p>
<i>BUYERS, TRADERS</i>	Dépôts (buying center)	<p>Dépôt is a buying center for mined cobalt that can be located directly on a mine site or outside of active concessions, villages and towns. According to the Mining Code, only Congolese nationals can own a dépôt. Still, a foreign partner may finance a dépôts’ operations. In the case of cobalt, the majority of foreign partners tend to be Chinese, followed by Lebanese and Indian citizens. Cooperatives rely heavily on dépôts to sell the ore they have extracted from artisanal miners. On-site dépôts can exist but need to have an agreement with a cooperative to be able to operate in their territory. Still, the power balance between dépôts and cooperatives depends heavily on local political or elite support. The minerals are usually brought to dépôts by miners or négociants and then are sampled, weighted and purchased; however, fraud is prevalent at dépôts due to the frequent use of manipulated weighted instruments to obtain a lower price on minerals purchased.</p>
<i>BUYERS, TRADERS</i>	Commodity trader	<p>Non-integrated refining companies usually rely on international commodity traders to get cobalt concentrates from DRC to “fine refiners” outside the country. In terms of volume, the majority of cobalt exports are usually handled by a few commodity traders, which tend to be based in Europe. Some “fine refiners” can bypass commodity traders through offtake agreements with cobalt exporters in DRC, such as those that extract and refine cobalt specifically.</p>
<i>PROCESSOR</i>	Processing facilities	<p>Processors are companies that will buy the cobalt ore from dépôts. A processing plant could buy all the ore from the production of 1 dépôt, or alternatively, a dépôt could be selling its ore to multiple processing parties. Many dépôts are usually part of a vertically integrated supply chain, where Chinese refiners either own or have exclusive buying relationships with processors.</p>

²⁶ Global Witness, 2010.

<i>REGULATORY AUTHORITY</i>	SAEMAPE	Service d'Assistance et d'Encadrement des Mines Artisanales et de Petit Echelle (SAEMAPE) is a state service tasked with supervising ASM production, providing technical assistance to miners and ensuring the safety of ASM mines by performing regular checks on pits.
<i>SECURITY (PUBLIC)</i>	Republican Guard (RG)	The RG is an elite armed force that is tasked with protecting the President of DRC and his or her distinguished guests. RG has reportedly been involved in securing and controlling ASM mine sites and dépôts for PEPs, policing activities and demanding payments from artisanal miners to access sites. Since 2018, RG personnel have reportedly left some of these mining sites they had once controlled, potentially due to RG's strong political ties with the former president, who left his position that same year.
<i>SECURITY (PUBLIC)</i>	Armed Forces of the DRC (FARDC)	FARDC is the country's military. They are reported to have raided and destroyed dépôts in Mulungwishi and Kisanfu regions, after the RG left those regions in 2018. FARDC seems to also have been involved in the clearing of ASM miners on active concessional mines, but this is not considered to be a viable long-term solution.
<i>SECURITY (PRIVATE)</i>	Private security personnel	LSM will usually hire private security personnel to protect their mining concession, particularly in LSM-ASM conflicted sites. However, in practice, it has been reported that private forces will usually allow ASM miners to access sites at night to extract cobalt since the salary they make on a nightly basis from artisanal miners is higher than what they earn on a monthly basis from a LSM company. Both public and private forces have been alleged to be implicated in human right abuse in cobalt production.

Source: based on OECD, 2019.

Key Players

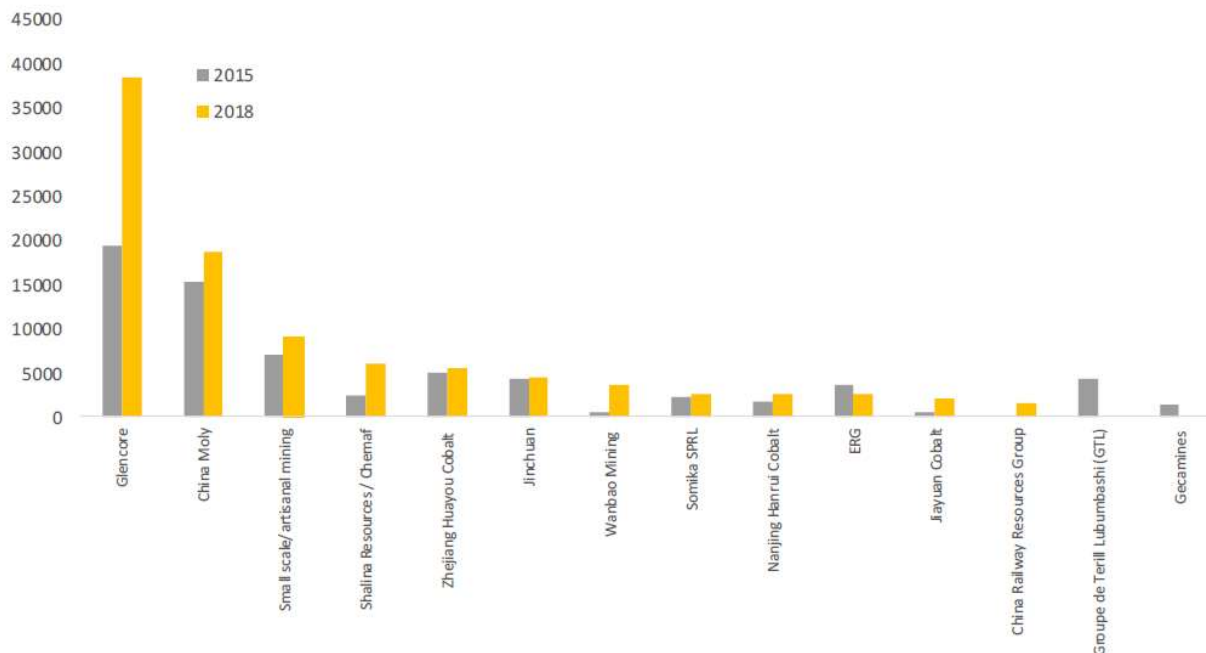
Large-scale miners

Eight of the 14 largest cobalt miners in DRC are now Chinese-owned, accounting for almost half of the country's output of mined cobalt. While many of the mines are joint ventures with Gécamines, they are usually managed by the Chinese firms. DRC's potential control of the global cobalt market has been preempted by the Chinese, who also own most of the 'crude' refineries in the country. As a result, China controls about 85 percent of global cobalt supply and could influence future developments in DRC's cobalt output and prices.

In 2015 and 2018, industrial producers accounted for 60,200 and 87,747 tons of production, respectively.²⁷ Glencore is the major producer in DRC today, but its dominance is expected to wane. Most of largescale producers extract cobalt as a by-product of copper, with assets doubling in production since 2015 in the Katanga and Mutanda regions. China Moly will continue its expansion, along with ERG, and is expected to take a bigger portion of the market by 2030. Jinchuan Group also operates one copper and cobalt mine, and another copper mine; it also owns the world's second and 14th largest copper refineries in China and was the world's second largest refined cobalt producer in 2017 (OCDE 2019).

Figure 15: DRC mined cobalt supply by producer, 2015 and 2018 (tons)

²⁷ The actual cobalt production figures may vary depending on the source of that information. In this case, the figures come from BMI.



BMI, 2020.

The largest cobalt project is the Glencore Mutanda mine, followed by Tenke Fungurume, Luiswishi and Lubumbashi mines. In 2016, these four operations were responsible for 43 percent of the world’s cobalt production.

Mutanda mine closure: Glencore closed the Mutanda mine in November 2019, citing weak cobalt prices, rising production costs and increased royalty payments. The mine, which has a capacity of 30,000 is particularly sensitive to cobalt prices as the mineral accounts for up to 50 percent of its revenues, unlike other mines in the country, where cobalt is produced primarily as a byproduct. The company announced that it would be reopening the mine on the second half of 2021, on a limited capacity basis, because of improved copper and cobalt prices.

One of the most important features of the LSM sector is the partnership with Gécamines, DRC’s state-owned mining enterprise (SOE). The 2002 Mining Code tried to make a transparent and level playing field in the copper and cobalt industries. However, Gécamines became the private gatekeeper to exploitation rights to the copper and cobalt mines, exploiting a clause in the mining code that allowed SOE companies to retain their mining permits and sell them to other companies. Most known cobalt deposits

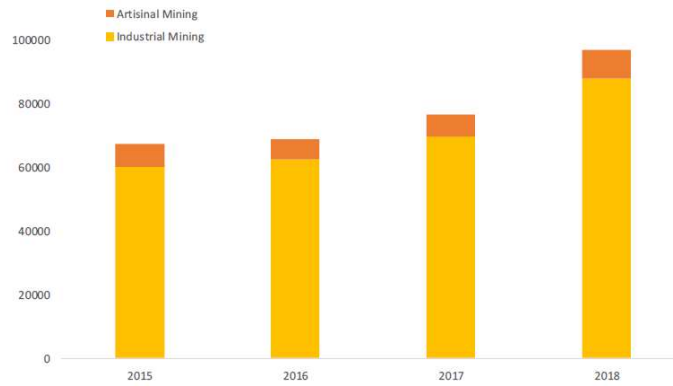
in the DRC were initially owned by Gécamines and are already covered almost entirely by industrial mining which, resulting in continued conflict between ASM and LSM operations. Gécamines is now largely a junior partner in over 20 joint ventures with foreign companies, with some sources suggesting that this has led to opaque deals that reportedly never found its way to the government treasury. For example, a recent EITI report showed a minor divergence between tax revenues paid by mining companies and received by the government, with some gaps in coverage from SOEs and significant mining deals not being published (IMF, 2019).

Artisanal and small-scale miners

ASM producers accounted for 9,000 tons of mined cobalt in 2018 but output reportedly fell to about 5,000 tons in 2019 (BMI 2020). Yet, if aggregated together, they still are the third largest producer of mined cobalt, with output expected to remain static until 2025-2030, at about 10,000 to 11,000 tons of cobalt

per year. The recent expansion of cobalt mining experienced between 2015 and 2018 is not expected to be sustainable moving forward due to labor and resource constraints.

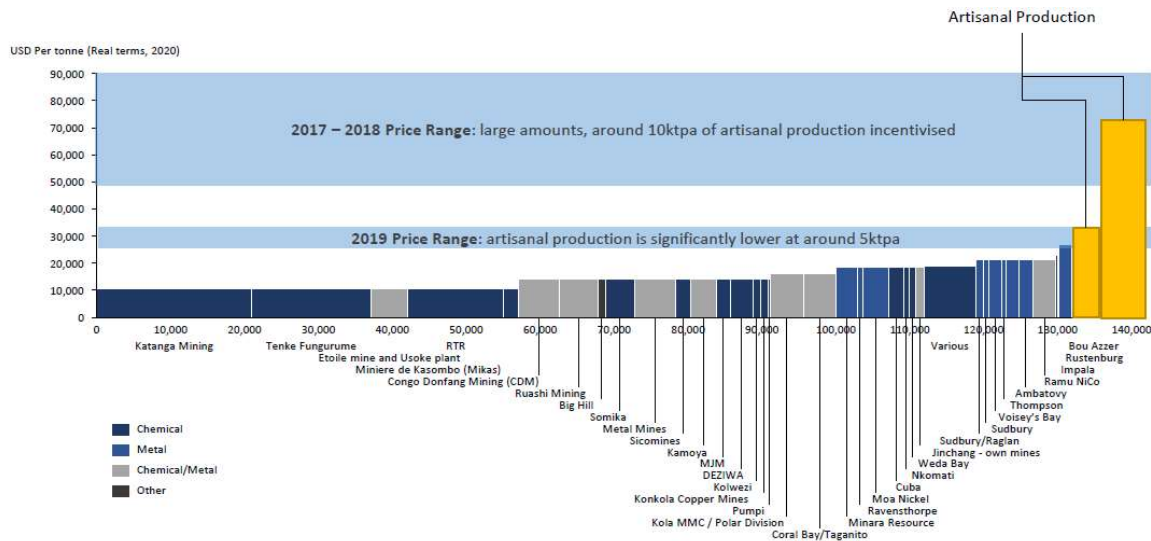
Figure 16: DRC mined cobalt supply from ASM versus LSM, 2015 - 2018 (tons)



Source: BMI, 2020.

ASM producers in the DRC have also been seen as “swing producers” in the cobalt market. They tend to bridge the gap between cobalt supply and demand, and their production levels fall as prices decline. Some sources suggest the majority of ASM producers require at least a price of over US\$30,000 per ton of cobalt to operate at higher capacity. When cobalt prices fall, ASM workers tend to switch to copper extraction given the greater stability in copper prices; this is what happened in 2018-19, when cobalt prices plummeted from US\$90,000 to under US\$30,000 per ton. DRC accounts for 6 percent of global copper production and is the largest copper producer in Africa.

Figure 17: Cobalt Intermediate Cost Curve 2020 (US\$/tons)



Source: BMI, 2020.

One reason why ASM is persistent in DRC is because oxidized materials, which are typically closer to the surface, are characterized by relatively soft and concentrated rocks, while sulfide ores tend to be more difficult to mine through artisanal methods due to depth and hardness. However, the reduction in accessible oxidized mineral resources is expected to affect it over time. Therefore, DRC's ASM production is expected to peak around 10,000 tons per annum, as it will be difficult to continue the recent expansion into the future.

Most of the oxide reserves have been mined and companies will need to gradually tap into the hybrid and the sulfide reserves to continue cobalt production. As oxide deposits progressively deplete in the next 10 to 15 years, the industry will probably have to make major investments in pyrometallurgy to treat sulfide ores and be able to sustain or increase output capacity. Alternatively, flotation on site and export of concentrates could make economic sense if there was an efficient rail connection to a port.

ASM is labor intensive, produces a lot of employment, generates higher revenues for individuals and communities than alternative sources of livelihood, and creates benefits to the local economy. Still, as reported by Amnesty International²⁸, DRC's artisanal mining can entail high risks to human rights because of local authorities' very limited ability to enforce laws against dangerous working conditions, lack of safety equipment and protective gear, debt bondage, extortion, child labor, and sexual assault. Another serious concern is the involvement of rogue elements of public security forces in the operations. In addition, mining frequently results in severe environmental impacts and community dislocation.

In 2011, the DRC government developed a national action plan to eliminating the worst forms of child labor by 2020 which has never been implemented. Government also committed to prepare a national strategy to remove children from all artisanal mines by 2025, but the strategy has not been finalized yet. DRC launched new monitoring and tracing mechanisms in 2018 to tackle child labor in mineral production, applying both to artisanal and largescale mines. However, according to the OECD, one in four ASM sites in DRC are believed to use some form of child labor. Moreover, a 2019 report by the National Institute of Statistics found that about 15 percent of children aged 5 to 17 across Congo are engaged in child labor, with most doing dangerous work.

Government's past efforts to incorporate artisanal miners in the formal economy have also been inadequate. The 2002 Mining Code and its 2018 revision provide artisanal miners of Congolese nationality grouped into legally constituted mining cooperatives access to areas where they are authorized to mine legally and market their production locally ("Zones d'exploitation artisanale", ZEAs). This policy has not

How cobalt contributes to ASM producers' livelihoods

In the DRC, there are about 200,000 artisanal miners of copper and cobalt, the majority located in the Katanga region.¹ A small number of artisanal miners are formalized, but the vast majority work as informal miners and are not subject to the same regulations and inspections as LSM due to their informal status.

One in four ASM sites in DRC are believed to use some form of child labor. This is primarily due to the fact that a large majority of households in the Copperbelt area are highly dependent on ASM mining for their livelihoods.¹ While NGOs and other observers have frequently reported seeing children at work at cobalt sites,¹ "forced labor" has not been widely observed in ASM or LSM mine sites.

The high number of children working in ASM is therefore primarily due to economic reasons. ASM workers' income tend to fluctuate based on international copper and cobalt prices, similar to how DRC's GDP output can be negatively impacted by the drop in external commodity prices. For example, when cobalt prices collapsed in the spring of 2018, earnings for ASM cobalt producers dropped by nearly 80 percent between March 2018 and August 2019, severely impacting households in the Copperbelt region who depend on cobalt extraction to make a living.

²⁸ Amnesty International and African Resources Watch (Afrewatch) (2016).

been adequately implemented, often resulting in a scarcity of permits awarded, high costs and extremely lengthy and bureaucratic processes for miners to legalize their operations. As a result, very few ZEAs have been created, and many of those that have been formed are not viable (SARW 2020) because of the unavailability of geological information, the need for overburden removal and stripping to safely access the deposit, as well as the lack of basic infrastructure (roads, energy, water, markets, health centers).

In principle, formalizing ASM operations through cooperatives should provide artisanal miners with safer working conditions than in informal ASM operations. In practice, however, cooperatives vary significantly from each other and the allocation of ZEAs is fraught with political interference. Several reports indicate that some cooperatives are created or sponsored by local authorities (OECD, 2018 and LICOCO, 2017) and that ZEAs are often allocated to cooperatives created or sponsored by political leaders (SARW, 2020). Therefore, the allocation of ZEAs to cooperatives tends to be discretionary, violating the transparency principle advocated by the Mining Code. The lack of ZEAs has favored the invasion of private concessions to extract high-grade ore with the complicity of the State services and company security. Therefore, more than 90 percent of cobalt ASM activities take place either on LSM concessions, with or without the owner's permission, or in urban areas sitting atop economically viable deposits. (Mancini et al., 2020).

As described in Table 4, tracing cobalt at the extraction stage within DRC is not straightforward given the interlinkages between different stakeholders along the supply chain, including ASM and LSM producers themselves, as well as traders. Additionally, the lack of a clear regulatory framework between ASM and LSM cooperation leads to the inaccurate declaration of the origin of minerals by upstream operators. Some sources also suggest that a significant number of top LSM companies are known to indirectly source ASM cobalt due to the technical and commercial requirements of the mineral, such as higher ore grades (OCDE 2019).

Although the LSM-ASM interface is generally characterized by confrontation and ambiguity, a few initiatives to facilitate ASM on large concessions have shown promising results. An example is the 2018 three-year agreement signed between trading house Trafigura to buy all the cobalt produced from CHEMAF, that helped formalize previously illicit ASM production on the Mutoshi concession. The venture was a partnership with SAEMAPE, the NGO Pact and cooperative COMIAKOL, that carried out the extraction work. Another example is the Kasulo ZEA, owned by the Provincial Government of Lualaba, which has granted Congo Dongfang International Mining (CDM), the Congolese subsidiary of Huayou Cobalt Co., an exclusive right to buy all the production of the cooperative present on site, Coopérative Minière Kupanga (Comiku). Implemented by the consulting and audit group RCS Global Group, the Better Mining initiative is a site-monitoring solution that generates monthly reports and corrective action plans for planning and implementation by CDM and the state agency SAEMAPE.

From a downstream perspective, most end-users of cobalt are ultimately buying the final form of cobalt (chemical or metal) from China, where many of these smelters do not have a single source of mined and/or raw processed cobalt supply. Therefore, it is highly likely that almost all end use cobalt products contain some level of artisanal material, despite the many claims by upstream and downstream companies to only source cobalt from LSM producers in DRC.

An OECD report found that cobalt refiners had very low levels of disclosure when it came to managing child labor risk; none of the 42 cobalt refining companies had taken the steps to manage risks associated with child labor (OCDE 2019). The OECD cautions that "claims that supply chains are 'clean', sustainable, or responsible simply because they do not source ASM material, without providing evidence of

comprehensive due diligence on risks of corruption, are misleading and should be viewed with skepticism by customers, business counterparts and stakeholders.”

Beyond cobalt extraction, the DRC government has tried to go the next step to have more influence over the entire cobalt supply chain by encouraging fine refining in-country and eventually moving into the production of batteries in DRC. However, multiple sources suggest that the country is unlikely to achieve this objective in the medium-term due to technical, economic and energy requirement barriers.

3c. Global Initiatives and Perspectives to Improve the Cobalt Supply Chain

On the international level, there are a wide range of initiatives supported by well-known companies and organizations to source cobalt responsibly from the DRC, most of them having been developed in response to the OECD Guidance. It is widely accepted among stakeholders that artisanal miners rely on cobalt production for their livelihoods; ignoring the ASM challenge in the DRC would most likely be counterproductive and lead to more poverty, conflict and political instability in the DRC.

Despite the widespread recognition that cobalt plays an important role for DRC’s development, many of these initiatives still see anti-corruption, human rights and sustainability efforts as being essential steps to take within the country to enable artisanal material to be accepted within the global cobalt supply chain. Until these issues are effectively addressed, particularly for ASM production, downstream companies will continue to focus on limiting their exposure to cobalt from DRC, even though the mineral could play a pivotal role in reducing poverty and boosting shared prosperity in the country.

Table 5: Overview of international responsible sourcing initiatives

	Type	Key Sponsors	Overview
OECD	International organization	OECD Regulations	The guidelines deal with all aspects from human rights to bribery and tax
Responsible Minerals Initiative	NGO/Trade Organization	Membership	Mostly concerned with child labor in the supply chain but also other areas
Cobalt Refiner Due Diligence Standard	NGO/Trade Organization	<ul style="list-style-type: none"> China Chamber of Commerce of Metals Minerals & Chemicals Importers & Exporters The Responsible Cobalt Initiative (RCI) Responsible Minerals Initiative (RMI) 	General human rights, environmental and sustainability
Responsible Cobalt Initiative	NGO/Trade Organization	<ul style="list-style-type: none"> China Chamber of Commerce of Metals OECD 	Priority to ensure child labor is not used in the supply chain, but also corruption and other areas
LME	Trade Organization	<ul style="list-style-type: none"> LME Members 	Ensure members meet OECD guidelines or better for all cobalt on the LME
Cobalt Institute	Trade Organization	<ul style="list-style-type: none"> Cobalt producers 	Human rights, responsible sourcing and sustainable practices
Global Battery Alliance, World Economic Forum	International organization	<ul style="list-style-type: none"> Miners NGOs Auto manufacturers 	Concerned with the entire supply chain, its environmental and social impact

- Battery manufacturers

Based on interviews conducted with different players along the cobalt supply chain, some of the key hurdles that make it difficult for stakeholders to accept artisanal cobalt from DRC include social, environmental, legal and corruption risks. From an environmental and social standpoint, artisanal cobalt will not be deemed acceptable until it is produced sustainably and responsibly, with the material being independently audited and verified at the extraction and processing stages to protect stakeholders from legal action (see **Sourcing ‘Clean Cobalt’ section**). This is further pressuring companies to adopt a risk management strategy that aims to remove DRC cobalt as much as possible, or altogether, from their supply chains.

From a monitoring and compliance perspective, many participants welcomed the Responsible Minerals Initiative as a first step in the right direction. However, they also expressed the need for further action to bring transparency into DRC’s cobalt production, with a recommendation to use third party firms to track each step within the cobalt supply chain and ensure compliance. Most stakeholders found it critical for independent auditing to be part of this process, particularly if the DRC government had some sort of oversight role over the cobalt supply chain, particularly regarding ASM production.

Lastly, participants also found it important for NGOs to be more involved in ASM activities, not only to monitor each step along the cobalt supply chain within the country, but also to work in tandem with the DRC government to progressively and eventually formalize some ASM activities while promoting safer working conditions to support local economic development. Most stakeholders agreed that this proposed approach, which would include all key stakeholders along the supply chain and independent auditors, would likely take years to fully implement and require full cooperation from the DRC government, LSM and ASM producers, as well as NGOs and international organizations.

4. Conclusion

Despite DRC’s strategic position in cobalt, the country will likely have a limited ability to influence the cobalt global market over the long-term because of insufficient control over supply, as well as the uncertainty over technology deployments to meet the low-carbon transition. China’s dominant position in the sector as a producer and refiner of cobalt, the emergence of other sources of mined cobalt supply—leading to the country’s declining global market share—as well as an increase in cobalt recycling and material demand substitution for existing and new technologies will likely reduce the benefits the DRC receives from its cobalt resources in the future. The combination of these factors is already being felt in the cobalt market today and is only likely to speed up in their full materialization, especially if the cobalt supply chain challenges continue to persist in DRC.

Based on the current state of the market, the role cobalt will have in clean energy transition and its important contribution to the DRC economy, there are a number of opportunities and risks the DRC government should consider in its approach to manage its strategic and comparative advantage in ‘mined’ cobalt production as means to achieve its development objectives:

- Despite the COVID-19 crisis, global demand for cobalt will likely remain strong from the battery, EV, energy and technology sectors. This means that over the medium term DRC will likely continue to dominate the ‘mined’ cobalt supply chain. Overall, this is good news for the government at the national level, as cobalt accounts for roughly 10 percent of the country’s GDP.
- While the general perception is that DRC heavily controls the cobalt supply chain, China potentially has a more important role in influencing global cobalt supply as both a producer and “fine refiner” of cobalt. It also happens that most of the demand for cobalt chemicals is coming, and will continue to come from, China itself. This is due to China’s high battery manufacturing capacity and ambitious EV deployment targets to achieve net-zero emissions by 2060.
- The perceived risk with buying cobalt from DRC is forcing downstream companies to reconsider their raw material sourcing strategy. Today, there are massive efforts underway, supported by governments and companies alike, to develop new battery technologies and explore other forms of low-carbon technologies (e.g., hydrogen) to reduce their exposure to DRC cobalt. This is because downstream users cannot claim to be “socially responsible and climate-oriented” while the minerals they source are linked to human rights abuses and environmental degradation. Governments with ambitious climate goals and clean energy targets will also find it increasingly difficult to deploy new low-carbon technologies that use minerals that have not been produced in a responsible and sustainable fashion.
- From a regional development perspective, the insistence from downstream companies to source “ASM free” cobalt will only make it harder for Copperbelt residents to benefit economically from all this new cobalt demand. As many ASM producers rely on cobalt and copper production for their livelihoods, further stigmatization on their role in the DRC supply chain will only exacerbate the poverty challenges faced by many civilians in the Katanga-Lualaba region. To tackle the cobalt supply chain issues (e.g., human rights, corruption, child labor, lack of social and environmental safeguards), it will be imperative for ASM production issues to be addressed by the DRC government in collaboration with all stakeholders along the supply chain, including independent auditors. As highlighted by off-the-record interviews, most participants agree that it will likely take years for the different global initiatives to improve the overall cobalt supply chain and enable artisanal material to become acceptable to climate-conscious consumers.
- The latest signals from the global cobalt market highlight the importance in addressing the cobalt supply chain in DRC as soon as possible for the country to remain competitive at the international level. Without changes to the current cobalt supply chain, the DRC government risks losing its comparative advantage post-2025. Technology deployment uncertainty and increased competition from other mined cobalt producers around the world could offset the country’s advantage in its cobalt-resource abundance. As DRC is very dependent on cobalt exports as part of its fiscal revenues, this could have negative long-term implications for the country’s economy.
- To mitigate some of these potential risks, there are a few issues that could be addressed to improve the traceability and accelerate the formalization of cobalt production within DRC:
 - ASM: DRC needs a specific policy for artisanal mining to increase transparency and reduce reputational risks for consumers linked to the use of Congolese cobalt in their supply chains. Additional efforts should be made to improve the level of transparency around the establishment of cooperatives and allocation of ZEAs to incentivize informal miners to eventually take the formal route. The ASM policy must respect human rights and offer a path out of poverty for artisanal miners and communities in Lualaba and Haut-Katanga.

- LSM: Large mining companies should commit to rigorous due diligence processes to ensure the traceability of minerals. Successful cases where large companies have facilitated the formalization of artisanal miners should be analyzed and replicated.
- Consumers: Given the interactions between ASM and LSM production circuits, de-risking strategies based on sourcing cobalt exclusively from large mining operators are likely to exacerbate ASM poor working conditions and therefore be difficult to implement.
- EGC: The selection of EGC's commercial and financial partners should be transparent and competitive while the identification of the cooperatives with whom EGC will work must be done with integrity. Companies selected to finance cobalt purchases must commit to high levels of due diligence and transparency to ensure the ore was produced according to acceptable standards and sold at a fair price.
- Fiscal revenues: As cobalt extraction contributes heavily to DRC's fiscal revenues, the goal should be to make sure that they contribute to the government's development efforts within the country, particularly at the local level, to reduce poverty and contribute to social progress.
- Regional development: The additional revenues generated from the cobalt sector at the national level should be leveraged to diversify the local economy, especially in the Copperbelt region so that its residents are not only dependent on the mining sector as their sole source of income. Government should take advantage of DRC's current strategic position in mined cobalt production to prepare regional development plans that identify new economic opportunities for the residents of mining areas so they may obtain new skills and move into new sectors.

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