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TRAFIGURA

Accelerating transition:

The case for formalising artisanal and small-scale mined cobalt in the DRC

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Executive summary

As one of the world's leading independent commodity companies, Trafigura responsibly connects the world with the vital resources it needs.

We deploy infrastructure, skills and our global network to move physical commodities from the places they are plentiful to where they are needed most, forming strong relationships that make supply chains more efficient, secure and sustainable.

In this briefing paper, Trafigura presents proposals for managing the supply chain challenge posed by the rapid increase in demand for the raw materials for lithium-ion batteries, with particular regard to the cobalt supply chain.

Electric vehicles are key to the energy transition

The 2015 Paris Accord identified moving from fossil fuels to electrified transportation as a core strategy in the global effort to combat climate change. The transition to electric vehicles (EVs) is well underway. A growing number of governments around the world have announced plans to limit or ban sales of petrol and diesel vehicles. In the private sector, car manufacturers have announced multi-billion-dollar EV-related investment programmes. Trafigura projects that the global EV fleet could exceed 200 million vehicles by 2030.

The high energy density battery is a critical component for EV mobility. Currently, only lithium-ion chemistries deliver the required power and performance. This is driving demand for key raw materials, including lithium, graphite, nickel, copper and cobalt.

Of these, the cobalt market arguably has the most challenging supply chain. Advances in technology may reduce the need for cobalt in the long term but, for now at least, there are few realistic alternatives. Meeting that demand responsibly requires that social and environmental challenges, particularly those centred around artisanal and small-scale mining (ASM), are urgently addressed.

EV demand outstrips expectations

Under existing technology, each new EV requires 5–10kg of cobalt. Approximately 170,000 tonnes of cobalt were consumed globally in 2021 and EVs made up around 25 percent of that figure, approximately 45,000 tonnes. That proportion is growing fast: Trafigura's most conservative estimate projects that by 2030 EV-related demand will account for 45 percent of the market. In absolute terms, demand will likely at least treble, to over 150,000 tonnes annually. The rate at which EV uptake is currently accelerating, consistently outstripping market expectations, suggests that even that may turn out to be an under-estimate.

Cobalt supply is critical but vulnerable

Cobalt production remains critical for EV mobility and ensuring its supply is strategically vital, but the rapid growth in cobalt demand is piling pressure on an already vulnerable supply chain – a chain that, knowingly or unknowingly, relies heavily on ASM.

The current situation is not sustainable. Artisanal cobalt miners, their families and wider communities are being left behind in the energy transition. Their plight, once a subject of significant media and civil society focus, appears to have slipped from the public consciousness.

Meanwhile, human rights violations perpetrated at and around ASM cobalt mine sites in the DRC continue to promote unsafe working conditions, permit child labour and result in considerable loss of life. Regrettably, almost without exception, international and domestic efforts to mitigate the negative, often egregious, human rights impacts associated with ASM in the Democratic Republic of the Congo (DRC) have so far failed to gain traction.

The DRC and China dominate global cobalt supply

More than two-thirds of global mined cobalt production comes from the Democratic Republic of the Congo (DRC). There are deposits elsewhere, notably in Australia, Indonesia and Cuba, but these are considerably smaller and relatively uneconomic to exploit.

Most of the DRC's industrialised extraction is controlled by a handful of companies; 80 percent of its exports are committed to supplying Chinese refiners.

Current large-scale mining (LSM) cobalt production falls well short of expected future needs. There is limited capacity to bring additional LSM production on stream within the timeframe needed to meet expected future shortfalls.

The world needs responsibly sourced ASM material

The DRC also has a large artisanal and small-scale mining (ASM) sector, which currently contributes at least 20 percent, perhaps as much as 40 percent, of the country's total cobalt production. This is labour-intensive, largely unregulated and often highly dangerous work. Exact numbers are hard to come by, but ASM is thought to employ more than 200,000 copper-cobalt miners in the country.[1]

Globally, a tight market for cobalt underpinned upward price momentum during 2020 and 2021. These price rises incentivised the ASM sector to scale up production. ASM-derived materials now account for more than 10 percent of global supply. Without these additional cobalt units, battery production would have been severely curtailed over the past two years, radically slowing the shift to EV mobility.

Trafigura is forecasting surplus supply at least until 2024, but, again, this assumes continuing ASM production. As shown in the chart below, with ASM out of the picture the market would already be in deficit, and by 2026, we are forecasting a shortfall compared to global demand, even including ASM material.

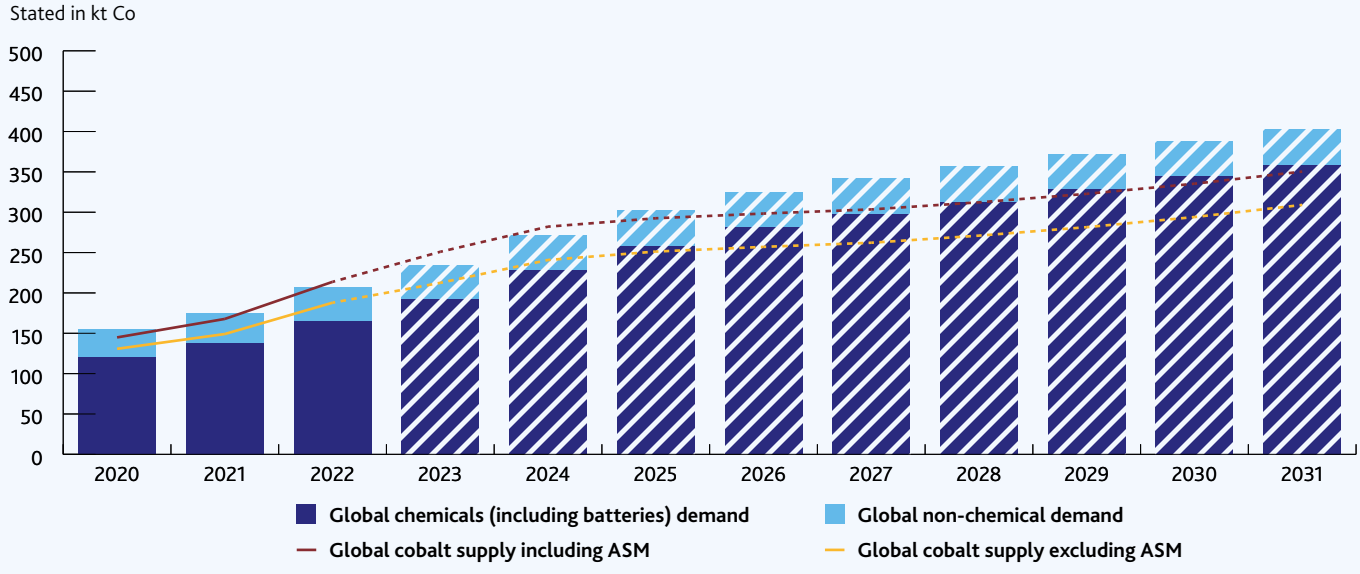
An urgent need for standards

Governments are increasingly sensitive to security of supply. Many have been late to the table in attracting supply agreements for critical minerals but, nonetheless, are now seeking to rectify the situation. Engaging actively in righting the wrongs of the artisanal cobalt supply chain and, in turn, procuring responsibly sourced material should be an important consideration.

It is imperative that regulatory bodies come together, in support of those efforts already made by the DRC Government, to adopt a common set of standards, implementation processes, performance metrics and assurance protocols so as to ensure that only cobalt from safe and responsibly managed artisanal mine sites can reach the legitimate market.

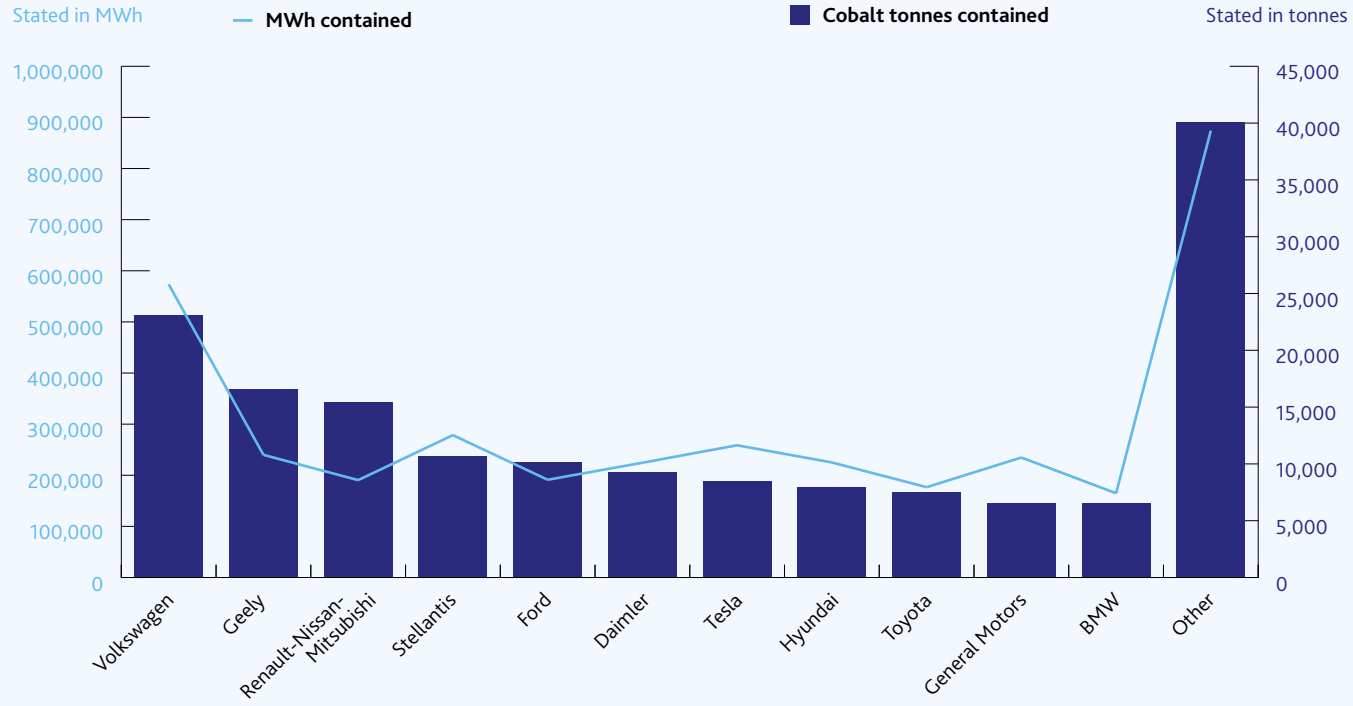
1 Reuters. 22 February 2018. Available at *https://uk.reuters.com/article/uk-artisanal-mining-ahome/commentary-forcobalt-buyers-is-artisanal-mining-the-problem-or-the- solution-idUKKCN1G627E*

1 The cobalt market needs artisanal ASM material to meet electric vehicle demand



Source: Trafigura Research

2 EV manufacturer production plans in 2030



Source: IHS, Trafigura Research

Managing the human rights consequences

The hazardous nature of ASM mining and its lack of regulation make it highly problematic as a production source for DRC cobalt. Amnesty International's landmark 2016 report, 'This is what we die for'[2] documented the dangerous conditions in which artisanal miners, including thousands of children, mine and process cobalt in the DRC.

Since then, international organisations have tried to find ways to address the serious human rights concerns surrounding ASM in the DRC. Some downstream brands have pledged to secure their cobalt from other countries or through mechanised miners that commit to child-labour-free and/or ASM-free production. Such 'de-risking' strategies, which have been openly criticised by international bodies such as the OECD, will likely perpetuate rather than resolve issues on the ground. Various industry bodies have sought to develop standards for the responsible sourcing of cobalt from ASM, albeit rarely with the involvement of stakeholders within the DRC, nor with a clear plan to distinguish responsibly sourced material in the formal supply chain.

The complex interactions between ASM, LSM and refiners make it very difficult to provide absolute assurance of ASM-free status. Declarations along such lines should be treated with a degree of scepticism. A lack of transparency in the ASM sector, its quasi-legal status and the inability of the DRC State to secure vital taxes and royalties have hampered domestic and international attempts to raise standards.

Lives are still being lost and human rights violations continue to be perpetrated at and around artisanal mine sites in the DRC. This reality can and must be addressed.

The fundamental problem remains unchanged. Ultimately, rapid growth in global cobalt demand is a prerequisite for transition and that cannot be met without ASM. Engaging with that reality must be a priority for governments, producers, traders, refiners and the downstream market amongst others as they seek to meet evolving market needs.

2 Amnesty International, 2016. *This is what we die for: Human rights abuses in the Democratic Republic of the Congo power the global trade in cobalt.* Available at https://www.amnesty.org/download/Documents/AFR6231832016ENGLISH.pdf

The case for formalising ASM

Attempts by market actors to exclude ASM-produced materials from supply chains have proven counterproductive. By constraining the supply of cobalt they push prices up faster, which encourages more, not less, unregulated ASM activity.

What is more, such measures are fundamentally at odds with the need for society to pursue a transition that leaves no one behind. The transition to electric vehicles should not come at the expense of the human rights and employment prospects of the many marginalised communities that currently rely on ASM for their livelihoods.

At Trafigura, we want to see a sustainable, regulated ASM sector. The following pages set out the rationale for, and broad parameters of, a new mining model we have been developing with the DRC Government and wider partners to formalise and professionalise ASM activity in the DRC. Such efforts are applicable not just to cobalt but also to the closely related copper sector, which has similar market dynamics. With industry and regulatory backing these procedures and processes, replicated globally, can potentially transform the working lives of more than 44 million people worldwide[3] directly engaged in the artisanal production of metals and minerals.

Trafigura calls for the adoption of a domestically owned, internationally recognised standard in support of the DRC's ASM cobalt production. The DRC Government established Entreprise Générale du Cobalt (EGC) in 2019 to responsibly purchase, process and sell all cobalt produced by artisanal miners or companies involved in ASM in the country. Despite this intervention, international buyers have continued to finance and purchase ASM cobalt at point of source and/or buy from a growing number of independent cobalt refiners that purchase ASM material often with limited regard for the social and environmental cost.

The EGC's Responsible Sourcing Standard (see page 33), launched in 2021, supports the creation and maintenance of safe and strictly controlled artisanal cobalt mining zones in the DRC. The Standard, which provides the basis for due diligence, will apply to all sites overseen by EGC and has been designed to complement and align with DRC law and DRC mining regulations as well as the OECD Due Diligence Guidance for Responsible Supply Chains.

A formalised, regulated ASM sector safeguards human rights, supports the livelihoods of thousands of people, sustains a just transition and helps meet the growing need to support energy security objectives. But this vision cannot be realised without a unified commitment to a practical and defence-able standard, action on the ground and transparent, effective regulation.

3 Delve, *State of the Artisanal and Small-Scale Mining Sector report,* https://delvedatabase.org

Market dynamics

Climate change and energy policy

At the historic 2015 Paris Agreement, 195 members of the United Nations Framework Convention on Climate Change (UNFCCC) signed up to a shared, long-term goal of keeping the increase in global average temperatures to well below 2°C above pre-industrial levels, and to aim to limit that increase to 1.5°C or less. They also agreed that, to meet these ambitious climate mitigation targets, emissions would need to peak before 2020 and decline steeply after that.

Global energy-related carbon emissions peaked in 2019 and then fell in 2020, but this was attributable to the COVID-19 pandemic. In 2021, they rebounded to their highest ever level.

At COP26 in Glasgow, stakeholders came together to find ways to accelerate transition. Governments signed up to net-zero commitments. Leading OEMs, governments and cities pledged to achieve 100 percent zero-emission car sales by 2040 globally and by 2035 in leading markets.

The quickest route to net zero combines low-emission transportation with progressive decarbonisation of the global power grid. In ratifying the Paris Accord, UNFCCC signatories agreed that, to keep global warming below 1.5°C, at least 100 million electric vehicles would be needed globally by 2030. Seven years on, as the challenge has become more urgent, it is clear that was a significant underestimate.

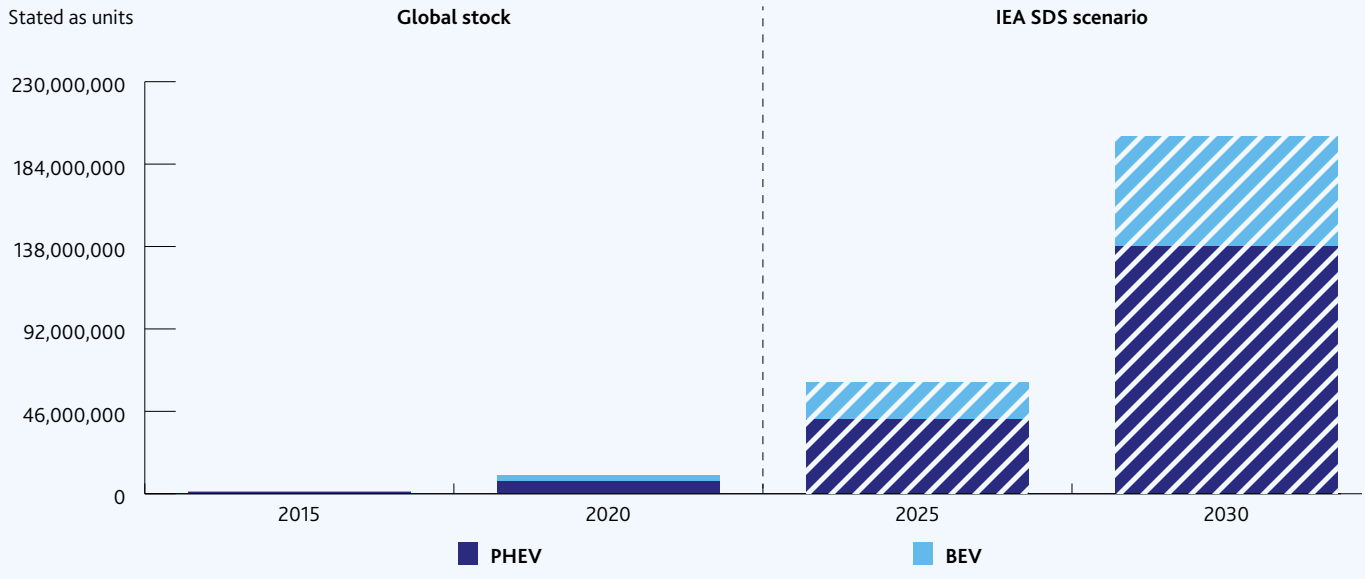
Annual global sales of battery-powered and plug-in hybrid electric vehicles (BEV+PHEV) reached 6.6 million units in 2021, up from 2.5 million in 2019. Global sales are forecast to top 22 million by 2025 (IHS Markit April 2022). EV sales and existing automotive manufacturer production announcements are ahead of the IEA's revised SDS 2030 target, which was raised to 230 million units in 2021. Figure 3 illustrates the rapid rate at which momentum is growing. This is good news for the energy transition, but it raises the stakes for battery suppliers.

Various factors are combining to accelerate EV uptake. They include better battery technology and lower costs, swifter roll-outs of charging infrastructure, more regulatory support and government incentives, and more vehicle models being made available to customers, with longer range and faster charging speed on the latest vehicles.

By 2025, global annual EV battery demand is projected to reach 1.1TWh.[4] By 2040, the IEA's SDS projections require a fiftyfold increase in energy storage; batteries storing solar power for businesses and households will be expected to account for 57 percent of the world's energy storage capacity. Meanwhile, as EV battery technologies develop, other mobile applications using lithium-ion batteries are coming into view, including drones and robots.

4 The International Energy Agency, 2021. *Annual EV battery demand projections by region and scenario, 2020-2030*, IEA, Paris, https://www.iea.org/data-and-statistics/charts/annual-ev-battery-demand-projections-by-region-and-scenario-2020-2030

3 Global stock of electric cars and IEA SDS deployment scenarios to 2030



Source: IEA (2021), *Global EV Data Explorer*, IEA, Paris https://www.iea.org/articles/global-ev-data-explorer

The rapid increase in EV demand

The rapid growth in EV adoption has more than kept pace with the ambitious objectives set out in Paris. EV batteries are now forecast to make up at least 70 percent of lithium-ion battery capacity by 2025.

Clean Energy Ministerial, a global forum for ministers with responsibility for clean energy technologies in the world's major economies, has established the Electric Vehicles Initiative (EVI). Participating countries commit to accelerate EV take-up in their economies. EVI members crystallised this collective aspiration with the launch of the EV30@30 campaign in 2017, targeting a 30 percent market share for EVs by 2030. To achieve its goal, EV30@30 requires a global stock of 230 million EVs by 2030. In 2017, when this target was originally set, it was highly ambitious, over 100 million vehicles more than existing projections for 2030. By 2021, projected 2030 EV stock levels had more than doubled and were in line with the EV30@30 target.

Vehicle manufacturers have been announcing increasingly ambitious electrification plans. Out of the world's top 20 vehicle manufacturers, which represented around 90 percent of new car registrations in 2020, 18 have plans to widen their portfolio of models and rapidly scale up the production of light-duty electric vehicles. The availability of electric heavy-duty vehicles is also broadening, with four major truck manufacturers indicating an all-electric future.

In the private sector, car manufacturers are committing to a half-trillion dollar spend on EVs and batteries through 2030, according to Reuters analysis. Tesla spent USD1.8 billion in 4Q2021, up from USD1.2 billion in 4Q2020. The total Tesla spend for FY2021 was USD8 billion. GM has pledged USD35 billion in EV spending by 2025 as it seeks to unseat Tesla as the US market leader.

Competition in all segments is intensifying. At end-2021, Volkswagen announced plans to spend USD100 billion on electric cars and batteries over the next five years. It expects 25 percent of its vehicle sales will be fully electric by end-2026, compared with 5-6 percent in 2021. The company will have electric options for all of its models by 2030. BMW is investing USD24 billion in batteries and plans to produce 12 all-electric models by 2025. Mercedes has announced plans to produce only electric cars by 2030. Jaguar cars will be all-electric by 2025.

Advances in battery and charging technology are making longer range, high-performance EVs and electric SUVs more usable. Van and truck manufacturers are also joining the market.

EV transition is accelerating on all fronts. Forecasts are continually revised upwards. This unprecedented growth in scale is testing the entire electric vehicle supply chain and its ability to scale up.

Promoting sustainable development

Battery-powered transportation is key to a greener future, but, paradoxically, realising this goal could inflict unintended harm on both humans and the environment. Electric vehicles may be cleaner in operation, but without careful management, sourcing the raw materials for the batteries they require can impose significant social and environmental costs. The question for regulators, manufacturers and raw material producers is how best to stimulate and manage the exponential growth in transition raw materials while meeting environmental objectives and human rights obligations.

Advances in technology are reducing battery production costs and enhancing performance, but battery production remains very energy intensive. Currently, building an electric vehicle can cost twice as much in energy terms as the equivalent internal combustion engine (ICE) and the main cost component is battery production. Raw materials have to be sourced, refined and transported; the manufacturing process also uses a lot of electricity.

These relative costs are improving as economies of scale take hold, but it underlines the importance of delivering the full green potential of EV mobility. EVs can deliver big savings in operation, but their overall contribution to emissions reduction depends on the electricity source. The more renewables there are in the national energy mix, the greater the achievable emissions reductions. Governments play an important role.

If batteries are to help rather than hinder global sustainable development, the entire value chain needs to be addressed. Developing a more circular economy is therefore an allied objective. This will require international coordination and close cooperation between public and private sector organisations.

In 2017, the World Economic Forum (WEF) launched the Global Battery Alliance (GBA) to meet these challenges. It brings together leading businesses from the entire battery value chain, along with governments, international organisations and NGOs. The Global Battery Alliance seeks to connect and scale up efforts towards a battery value chain that is innovative, socially responsible and environmentally sustainable. A number of other organisations with similar objectives have since been established.

Developing the circular economy

The negative environmental effect of producing batteries becomes less material the longer EVs stay in use. Although lithium-ion batteries are durable, they have a limited lifespan. Typically, after a decade, their charging capacity will drop to 70-80 percent. At this point, they are no longer viable.

However, they can be repurposed. Some companies are looking at secondary uses for used EV batteries in grid storage and other applications. This could potentially double the life of EV batteries.

Recycling raw materials is another priority. Volumes are currently limited as relatively few spent batteries are yet available, but by 2030, it is expected that up to 11 million tonnes of spent lithium-ion batteries will have to be discarded. As yet, there are few effective recycling systems in place, but this will become more significant as the market matures.

Cobalt is the material of most interest to lithium-ion battery recyclers. The high cost of cobalt extraction from ores makes cobalt recovery relatively attractive economically. The EU's CROCODILE project is setting up public-private sector partnerships to develop advanced metallurgical systems that could recycle up to 10,000 tonnes of cobalt annually by the end of the decade.

While this can have a meaningful impact on supply levels – it is equivalent to 50 percent of the EU's projected cobalt demand from the EV sector in 2025 – demand for cobalt is growing fast. The EU estimates[5] it will use up to 18 times more lithium and five times more cobalt by 2030 than in 2021, and almost 60 times more lithium and 15 times more cobalt in 2050.

In addition, as battery technology advances and the proportion of cobalt in lithium-ion batteries declines, recycling cobalt may become economically less attractive. This could limit recycling programmes in future.

In any case, large-scale recycling of EV batteries is not expected to become a meaningful supply source before 2025. At least until then, demand for extracted cobalt will continue to accelerate.

5 European Commission, 2021. *https://www.europarl.europa.eu/news/en/press-room/20211118IPR17620/critical-raw-materials-the-eu-should-secure-its-own-supply*


UNION

The criticality of cobalt in the EV supply chain

Battery technologies are evolving but cobalt remains critical

With its capacity for high energy density storage, the lithium-ion family is the key enabling battery technology. Different chemistries employ various combinations of anode and cathode materials. Each has advantages and disadvantages in terms of safety, performance, cost, lifespan and other parameters. The most prominent cathode chemistries for automotive batteries are lithium-nickel-cobalt-aluminium (NCA), lithium-nickel-manganese-cobalt (NMC), lithium cobaltite (LCO) and lithium-iron phosphate (LFP).

Currently, the main commercially feasible technologies with the right gravimetric and volumetric energy density properties for EVs are nickel-cobalt-manganese/aluminium based – the so-called ternary batteries. Although some cobalt-free innovations show promise, most are more applicable to the electronics industry and unlikely to provide sufficient power-weight capabilities for EV transportation, especially for heavy-duty, long-range uses.

The high cost of cobalt has spurred a revival of interest, especially in China, in LFP technology. Tesla has introduced cobalt-free batteries for its lower-end models. However, it has also acknowledged that cobalt will continue to be an important raw material for it in the medium term.

LFP batteries are currently cheaper to produce than ternary batteries and that cost advantage improves as cobalt and nickel prices rise. Against that, their lower energy density results in shorter EV driving ranges. This suggests that although LFP is likely to play a continuing role in EV development, this will be mainly for light and short-range vehicles. The higher energy density and better driving range afforded by ternary batteries makes them more suitable for longer-range, larger and higher-performance vehicles.

4 Relative benefits of principal battery cathodes

	Uses	Li%	Ni%	Co%	Energy	Power	Safety	Life	Cost
LCO Lithium Cobaltite	Mobile electronics	7%	0%	60%	+++	+++	-	++	+
LMO Lithium Manganese Oxide	Nissan Leaf (old)	8%	0%	0%	-	+++	++	-	++
NMC Nickel Manganese Cobalt	Most new EVs	8%	20-52%	4-20%	+++	++	++	+++	+++
NCA Nickel Cobalt Aluminium	Tesla, Panasonic	7%	45-55%	4-8%	++	+++	++	+++	+
LFP Lithium Iron Phosphate	Small lower range EVs	5.5%	0%	0%	+	+++	+++	++	++

Source: SMM, Trafigura Research

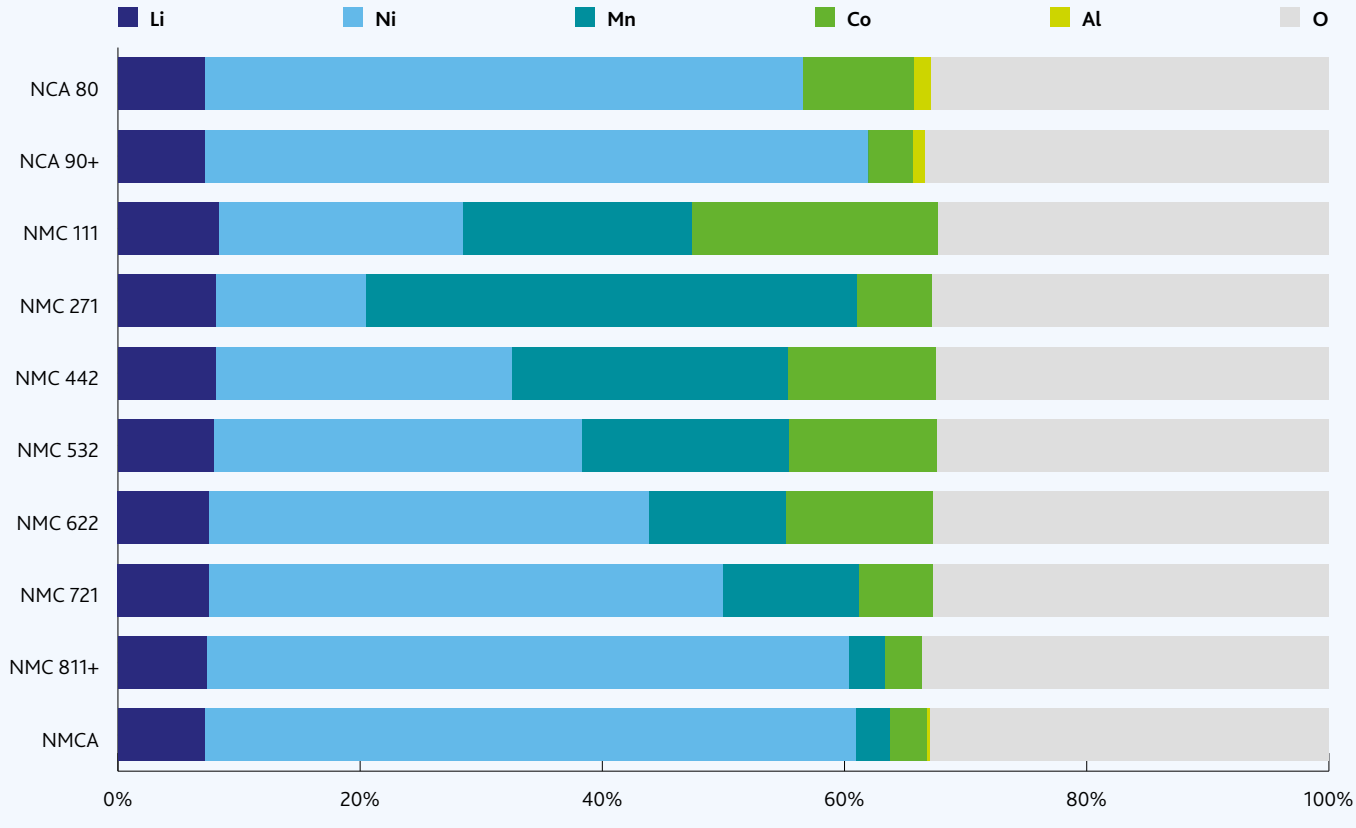
Technological innovation in ternary batteries is bringing down the cost of delivering energy for automotive applications. High-nickel layered oxides that offer higher energy density than their low-nickel counterparts are gaining major traction in automotive lithium-ion batteries for electric vehicles, particularly in Europe.

Improvements in NMC technology in recent years have steadily increased the nickel ratio of metal content in NMC batteries – from a third in NMC 111, to 50 percent in NMC 532, to two-thirds in NMC 622 cathodes.

Many OEMs, especially in China, are focusing on developing the next generation of nickel-rich battery. Of these, NMC 811, with up to 10 percent cobalt content in the cathode, is the most widely pursued. NMC 811 may eventually supplant NMC 622 as a battery of choice for EV, but cost and safety concerns are currently delaying its deployment. NCA is another prime candidate. NCA cathodes are already in widespread use, notably by Panasonic and Tesla. These combine nickel and cobalt with aluminium instead of manganese. Their cathodes typically contain 50 percent nickel and five percent cobalt.

The technological direction of travel is towards more nickel-dense chemistries that retain a cobalt component to preserve thermal stability. Although less cobalt per battery unit will be required in future, this reduction is more than offset by the rapid growth in EV adoption. And this growth continues to accelerate – in 2021, the European Commission projected a fivefold increase, driven by EV adoption, in Europe's annual cobalt demand by 2030. Since then, it has published successive upward revisions. The demand for cobalt will continue to grow until at least the end of the decade. Satisfying that demand remains critical if the world is to meet its energy transition ambitions.

5 Content of cathode active material



Source: Various, Trafigura

Sourcing raw materials for battery production

EVs overtook electronics as the most significant demand source for cobalt for the first time in 2021 and this trend will continue.

The growth in the market for rechargeable batteries will stimulate a large increase in demand for lithium, cobalt and nickel. These key raw materials are concentrated in very few countries. Securing long-term access to them poses serious social and environmental challenges.[6]

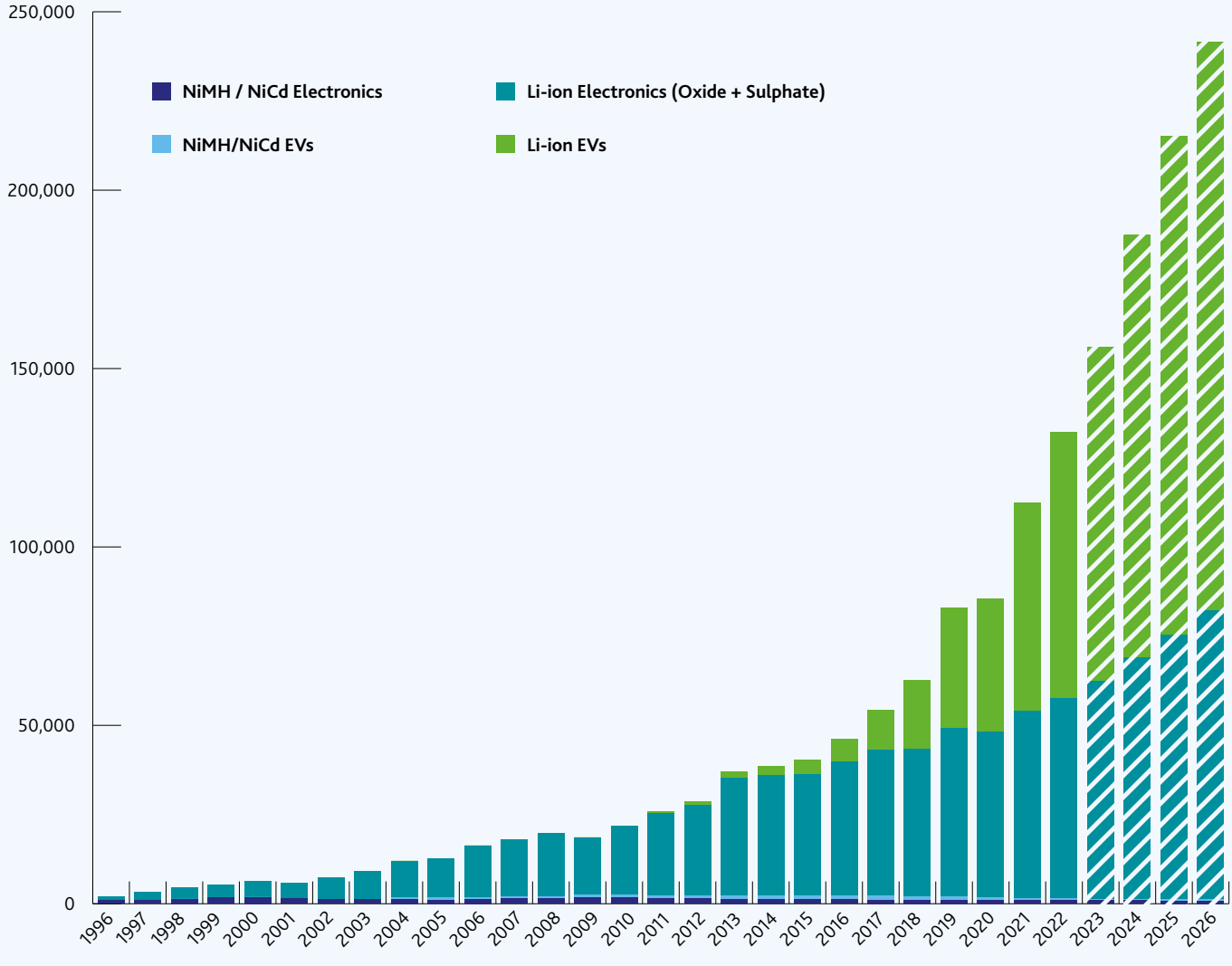
Lithium and cobalt are both expected to be supply-constrained in the very near future. According to the latest IEA projections, global demand for both lithium and cobalt will outgrow current production capacity before 2025.

Lithium benefits from diverse extraction technologies so it is possible that, with more research, there will be sufficient supply to meet current demand estimates. What is more, since lithium resource exploration is still relatively immature, additional resources are constantly being discovered.

6 Olivetti, E.A., Ceder, G., Gaustad, G.G., Fu, X. *Lithium-Ion Battery Supply Chain Considerations: Analysis of Potential Bottlenecks in Critical Metals Joule Volume 1, Issue* 2, 11 October 2017 https://www.sciencedirect.com/science/article/pii/S2542435117300442

6 Cobalt demand from batteries

Stated in tonnes cobalt contained



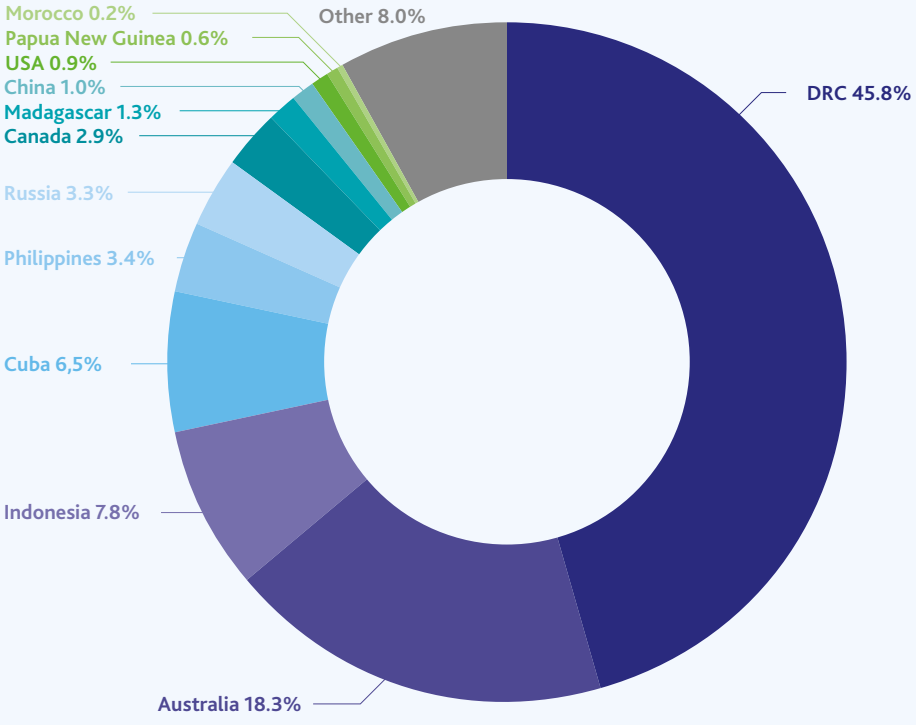
Source: CRU

Including recycling, global refined cobalt production in 2021 was just 170,000 tonnes. Of all the raw materials, cobalt is the most likely to suffer a supply shortfall. It is produced mainly as a by-product to other minerals. Production is heavily concentrated in the Democratic Republic of the Congo (DRC). That makes its supply chain particularly vulnerable.

Major manufacturers are now locked in a race to secure long-term supplies. Their growing requirements mean that lithium, cobalt, battery components and assembly plants all need to be ramped up significantly to meet demand.

To protect their supply chains, car manufacturers and other end-users are pursuing long-term agreements to source materials direct form miners. The resulting scarcity is creating sellers' markets in the key raw materials.

7 Global cobalt reserves

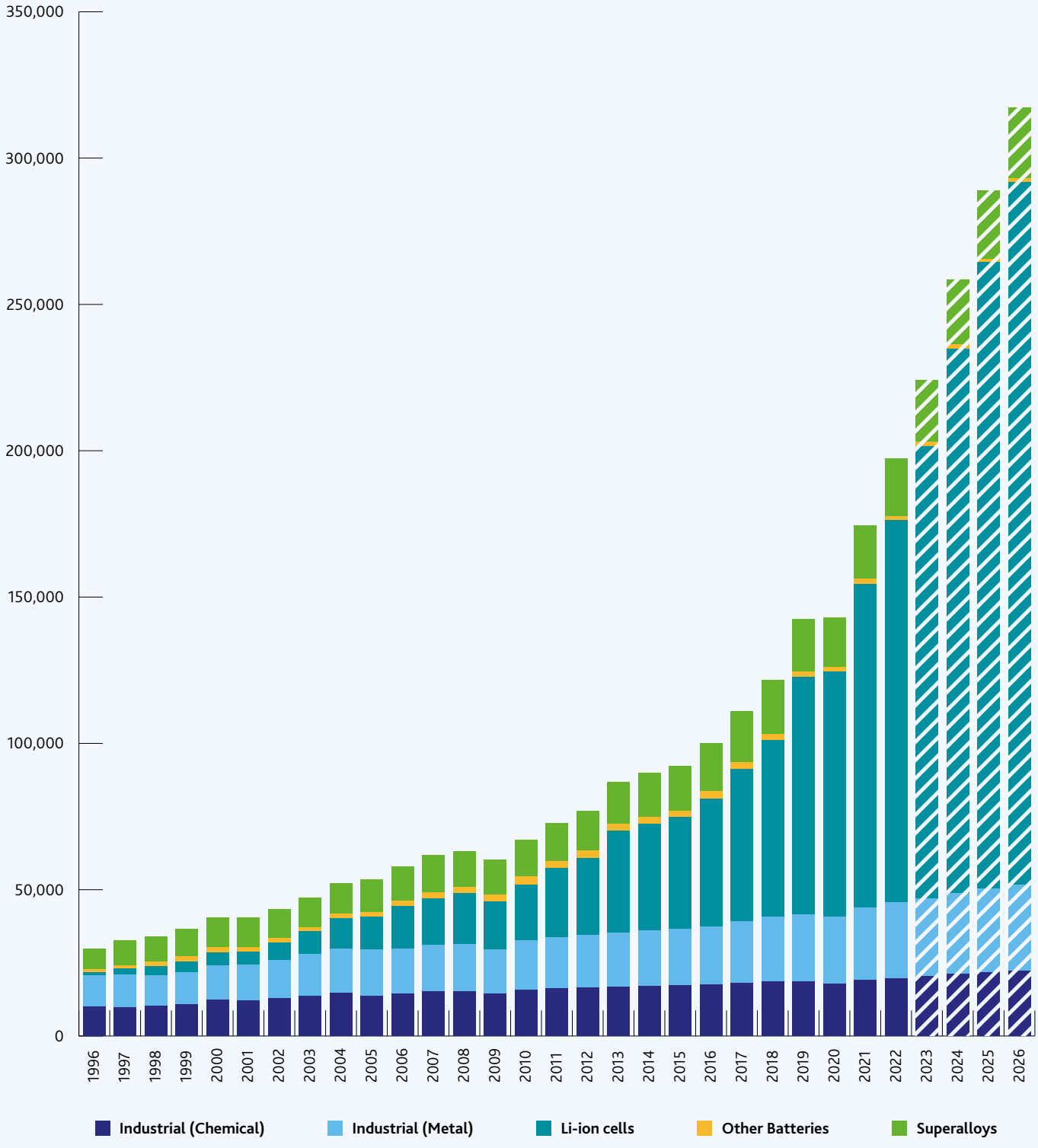


Stated reserves (thousand tonnes)	
DRC	3,500
Australia	1,400
Indonesia	600
Cuba	500
Philippines	260
Russia	250
Canada	220
Madagascar	100
China	80
USA	69
Papua New Guinea	47
Morocco	13
Other countries	610

Source: USGS, CRU

8 Cobalt demand by end use

Stated in tonnes cobalt contained



Source: CRU

The race for cobalt

Trafigura estimates that cobalt demand for EVs alone will reach over 150,000 tonnes by 2030. The IEA is forecasting continued strong uptake of EVs. It projects sevenfold growth in clean energy technologies demand for cobalt by 2040 (versus 2020) under its conservative, STEPS scenario and over twentyfold growth in the sustainable development scenario (SDS). The IEA expects clean energy technologies will account for between 40 percent (STEPS) and 70 percent (SDS) of total cobalt demand by 2040, compared with 15 percent in 2020.

Cobalt is typically mined as a by-product of nickel (21 percent) and copper (78 percent) mines. Little over one percent of cobalt production is attributable to cobalt mining operations.

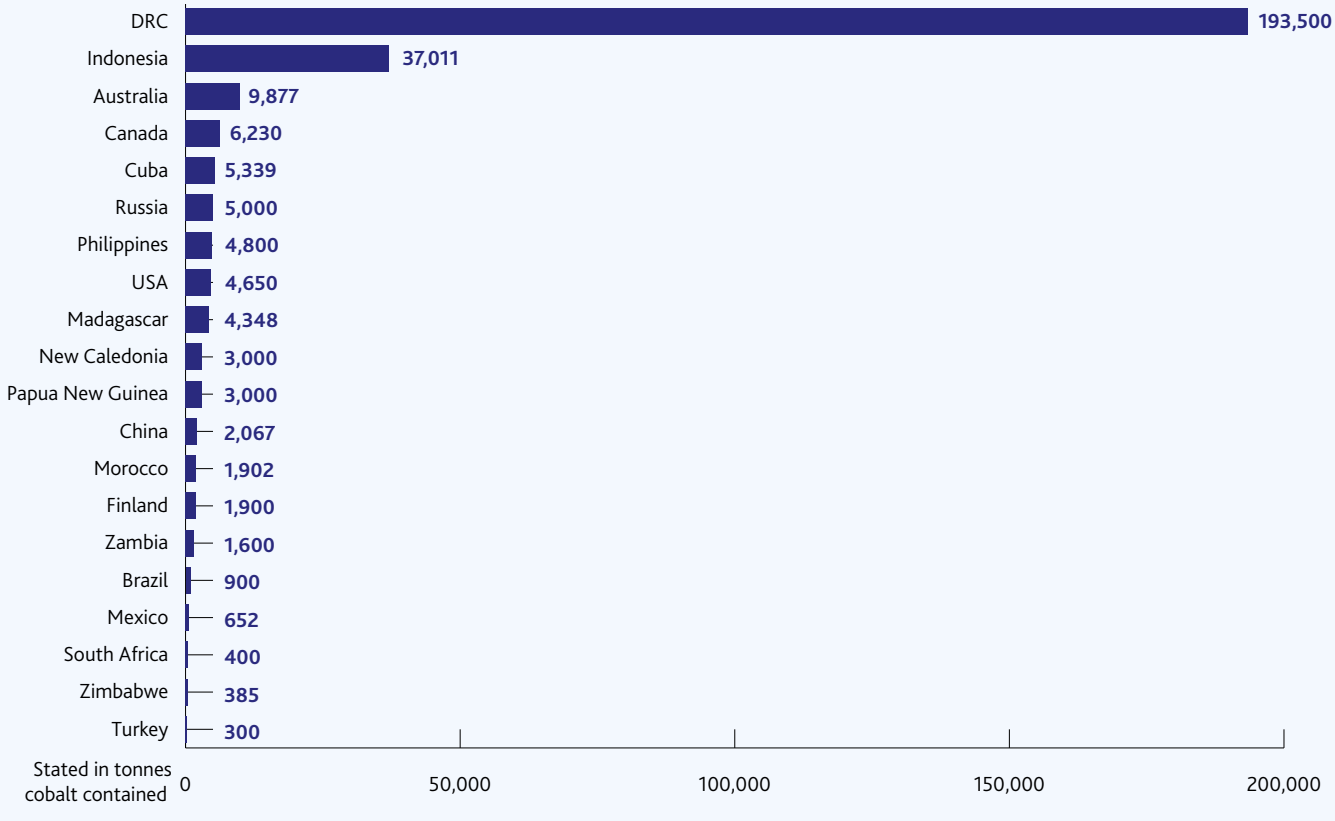
Copper-cobalt ore deposits are found primarily in the Lualaba province of the DRC. These usually contain at least 0.5 percent cobalt and four percent copper. Most of those ore bodies are found close to the surface, making open-pit extraction, the most cost-effective mining process, feasible. In other parts of the world, cobalt is found underground in nickel-cobalt deposits at much lower concentrations. That makes Lualaba's cobalt significantly cheaper to extract.

Over 70 percent of global cobalt production takes place in the DRC as a by-product of its copper mines. New projects in the Lualaba province will increase the DRC's share to close to 75 percent by 2023. Around three-quarters of DRC production comes from large-scale mining operations, while the rest (20-40 percent) is from ASM.

China, the world's biggest cobalt consumer, is responsible for over 50 percent of global cobalt demand. China produces just one percent of its cobalt domestically. It is therefore heavily reliant on raw material imports, particularly from the DRC, from where it offtakes around 80 percent of cobalt production. China also controls 80 percent of global cobalt refining. Much of the other 20 percent is processed in Finland. The cobalt raw materials feeding the Finnish refiners also originate from the DRC.

In 2022, the war in Europe intensified energy security concerns. Sourcing additional cobalt to develop electrification and meet the challenge of rapid EV growth has become an even more pressing consideration for the international community.

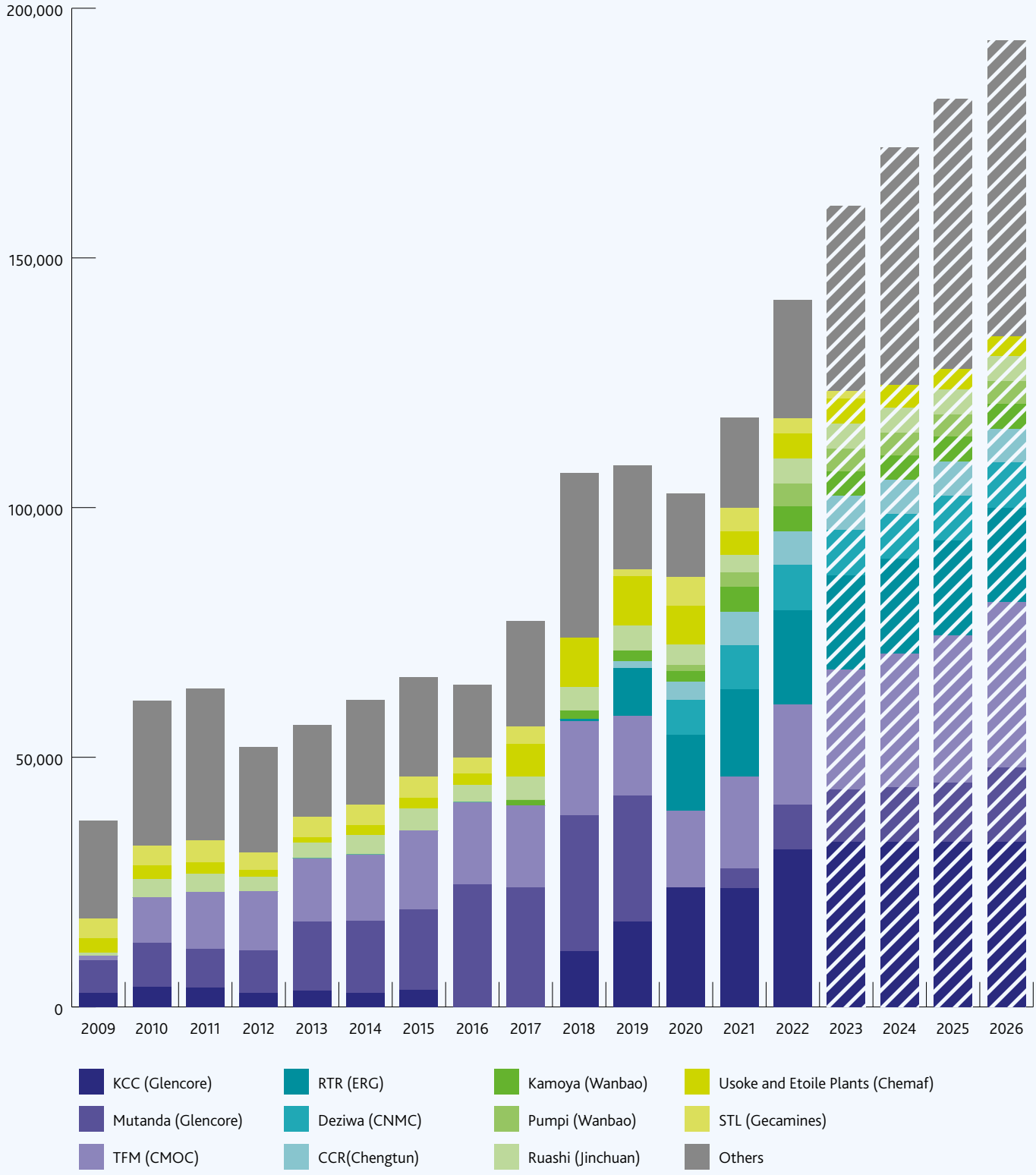
9 Projected mined cobalt production by country in 2026



Source: CRU

10 DRC cobalt production by producer

Stated in tonnes cobalt contained



Source: CRU

The role of ASM in the supply of raw materials

While their methods are simple, the operational impact of artisanal and small-scale mining (ASM) on a global basis can be significant, accounting for somewhere between 10 and 20 percent of the world's supply of all metals and minerals, according to the International Institute for Environment and Development (IIED). ASM is labour intensive and is conducted by individuals, small groups and larger cooperatives, often supplying middlemen and aggregators who have access to international markets.

Cobalt is mined through a variety of means – at mechanised and semi-mechanised operations, as well as through ASM. Mechanised mining is typically undertaken by major international mining conglomerates.

Artisanal cobalt production in DRC accounts for at least 20 percent and potentially up to 40 percent of the country's production. That makes ASM a key swing factor in commodity markets. While the development of mechanised mines is both highly capital and resource intensive, ASM production scales quickly. This can cause problems for ASM workers, who bear the brunt of price uncertainty. This was evident in 2019 when reduced Chinese demand led to lower cobalt prices and a number of ASM-related projects were forced to close or scale down their activities.

The cobalt market has strengthened since 2020. Rising international mineral prices and limited viable alternatives for income generation at a local level have contributed to the growth of the sector. The '2020 State of the Artisanal and Small-Scale Mining Sector'[7] report estimated that over 44 million people were directly engaged in ASM worldwide, up from 30 million in 2014. And many more are affected: the World Bank reported in 2013 that around 100 million people worldwide – workers and their families – were reliant on artisanal mining; compared with the 7 million people who depended on industrial mining for their livelihoods that same year.

Where DRC cobalt production is concerned, the relative ease with which the material can be recovered and the fact that it represents a source of such concentrated and growing wealth, has led to a significant rise in ASM activity. Although an exact number is difficult to pinpoint, it is estimated that there are between 80,000-90,000 people in the DRC who permanently dig for cobalt. The number of diggers is highly elastic as individuals respond to a diverse range of factors including, price, ease of access to ore bodies, markets and climatic conditions (e.g. wet and dry season). Numbers, which can rise and fall by as much as 20,000 people per site, have been estimated to be as high as 200,000 in the country.

ASM production is estimated to contribute between 10,000 and 25,000 tonnes per annum to the supply chain. That number looks set to grow as the energy transition steps up.

There has been a marked increase in the construction of independent cobalt refining units in the DRC over recent years. These refiners, which are not tied to any particular mine, have the capacity to purchase and process up to 36,000 tonnes of cobalt in ore per annum. Many do so with few, if any, checks on the provenance of the material that they purchase. The material is consequently processed into cobalt in hydroxide before being exported internationally.

Given the unique abundance and distribution of cobalt, the productivity of ASM miners, as well as the considerable refining capacity in-country, the importance of DRC-origin, ASM-mined cobalt to the market cannot be underestimated.

7 Delve, 2020 *State of the Artisanal and Small-Scale Mining Sector report, https://delvedatabase.org/resources/2020-state-of-the-artisanal-and-small-scale-mining-sector*

Responsible sourcing

Responsible sourcing: a practical perspective

As one of the world's leading commodity companies, Trafigura is alert to the risk of adverse social or environmental impacts associated with the extraction, processing and sale of metals and minerals – whether originating from mechanised or ASM sources.

The company's Responsible Sourcing programme, which directly reflects the OECD's Due Diligence Guidance for Responsible Supply Chains (OECD Guidance), is aligned with relevant regulatory requirements, including Section 1502 of the US Dodd-Frank Act, the EU's Conflict Minerals Regulation and London Metals Exchange regulations. Importantly, the programme extends to the purchase of all metals and minerals for geographies and activities that Trafigura deems to be of greater risk.

Trafigura is a co-founding member of the Global Battery Alliance (GBA). In 2021, it joined the Executive Board. Trafigura's participation in the GBA focuses mainly on the Cobalt Action Partnership (CAP), which aims to end child labour in the cobalt supply chain and contribute to the sustainable development of mining communities. Trafigura is the only member of the GBA that has developed 'proof of concept' in the formalisation of ASM cobalt mining.

Trafigura has a growing interest in the procurement and onward trade of cobalt. In 2018, the company signed a long-term supply agreement with Chemaf, a leading mineral exploration, mining and processing company in the DRC. As part of that, Trafigura agreed to provide continuing support to assist Chemaf in managing social and environmental impacts across its operations – particular focus has been given to Chemaf's exposure to ASM at its Mutoshi concession in Kolwezi.

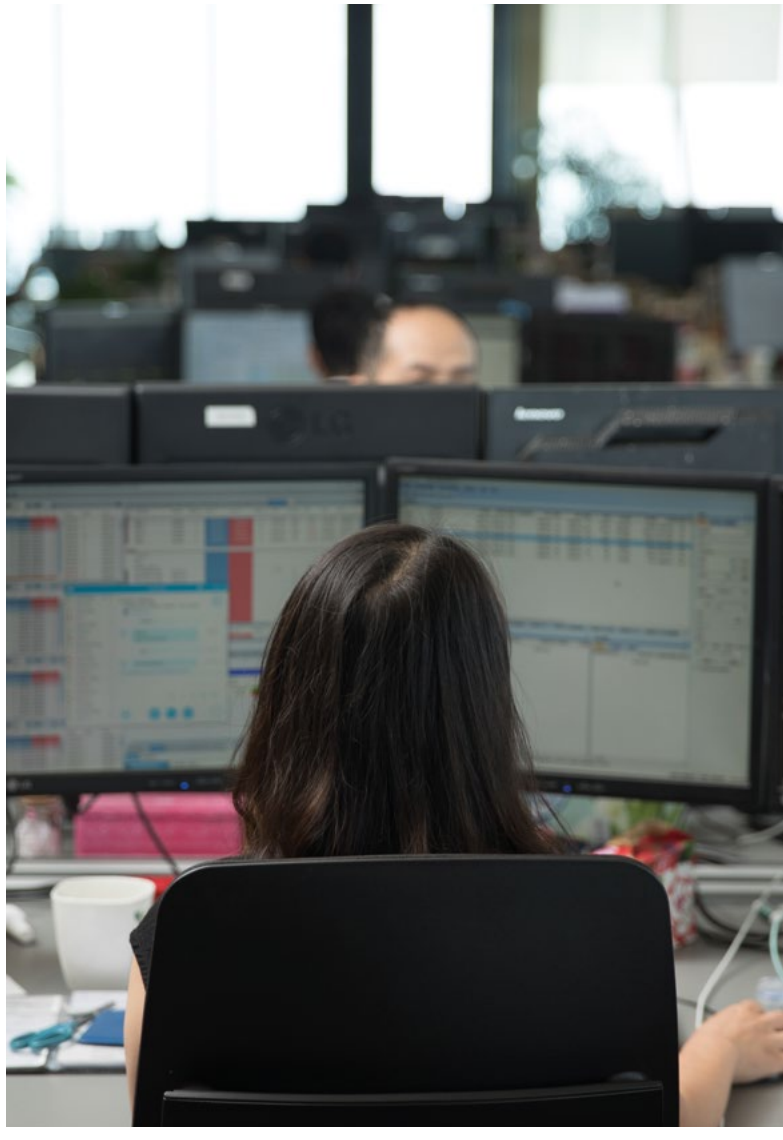
Buyers in international markets are increasingly mindful that they need to ensure they are receiving responsibly sourced materials. Trafigura has experience of this in a highly complex operating environment. It has seen a rise in commercial partners that seek its help to enhance and sustain similar programmes of work elsewhere.

The need for effective due diligence

The China Chamber of Commerce of Metals, Minerals & Chemicals Importers & Exporters (CCCMC), the Responsible Cobalt Initiative and the Responsible Minerals Initiative have sought to establish expectations for refiners to conduct due diligence on cobalt supply chains through their Cobalt Refiner Supply Chain Due Diligence Standard.

Refiners and upstream companies, whether reliant on mechanised production or ASM flows, need to be able to track their purchases, analyse and support the mitigation of social and environmental risks before they can source responsibly. That promotes full product traceability from mine to end-user.

Blockchain-based technologies offer a way forward in support of diligence efforts. Incorporating product tagging protocols into ASM mining would help to accelerate international adoption of a universal blockchain-based supply chain.



Understanding and responding to ASM in the cobalt supply chain

The economic impact of artisanal mining is immense: The Washington Post reported in 2016 that artisanal miners contributed up to 25 percent of the world's cobalt, with some 15,000 to 35,000 tonnes annually coming from the ASM sector.[8]

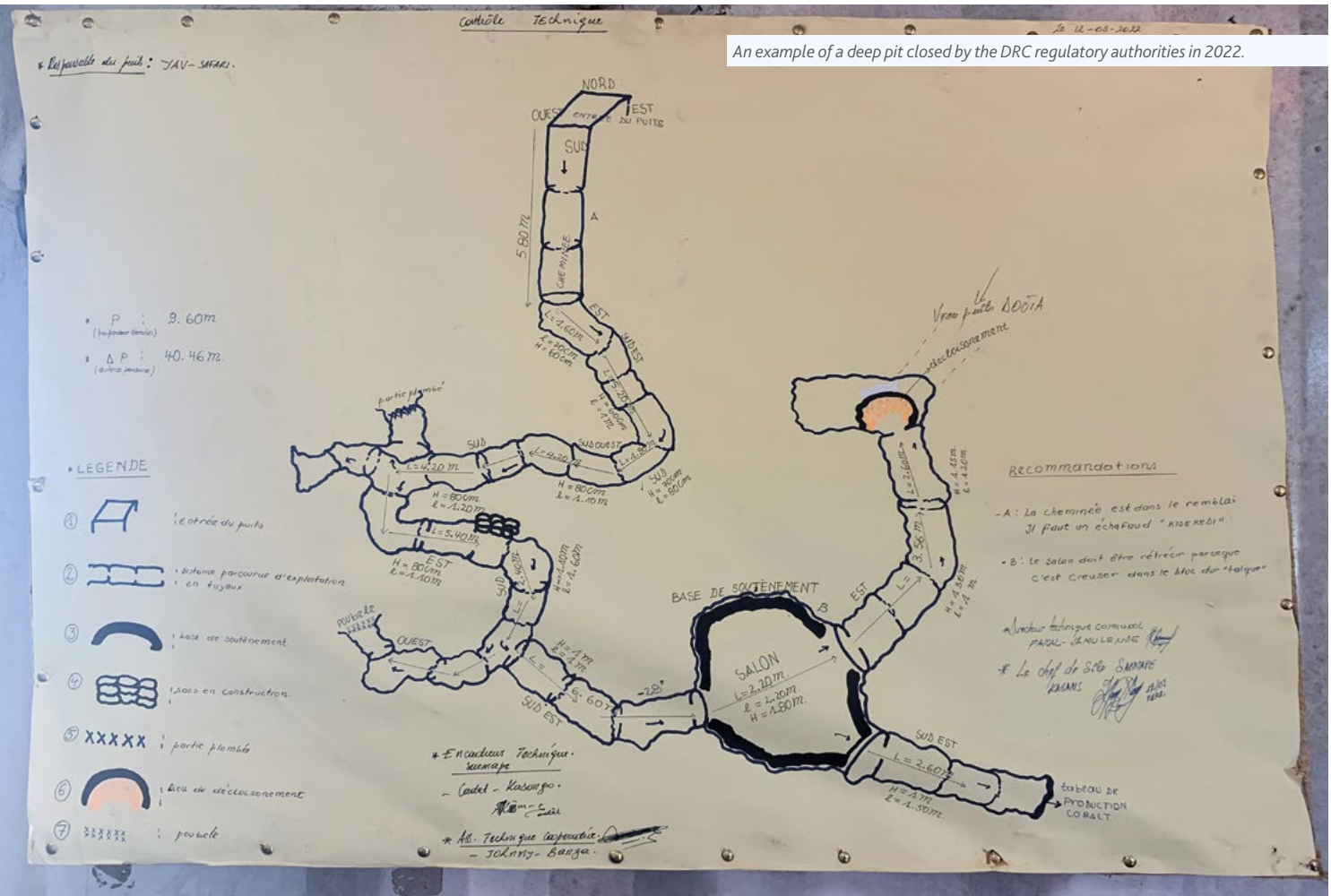
The informal nature of the ASM sector in DRC leaves scope for irresponsible practice and exploitation at multiple levels. Over 200,000 people in the DRC are reliant on artisanal mining for their income. They are serving global needs in hazardous conditions and with very little reward.

While child labour is frequently cited as a human rights abuse of acute concern, other negative impacts – typically exacerbated by subterranean work carried out in deep, complex, unsupported tunnel systems – include:

- Exposure to elevated safety risk resulting from rock falls, pit/tunnel collapses and work in confined spaces.
- Excessive and/or prolonged manual handling.
- Exposure to heat stress and dehydration.
- Exposure to excessive noise, dust, vibration and radioactivity.
- Exposure to eye injuries (e.g. during rock breaking, excavation).
- Exposure to disease through poor hygiene and sanitation.
- Inadequate management of hazardous waste.
- Forced or compulsory labour.

Amnesty International's 2016 report – "This is what we die for", 'Human rights abuses in the Democratic Republic of the Congo power the global trade in cobalt' – highlighted the scale of the problem. It detailed dire conditions in artisanal cobalt mining, called for better due diligence, and a corporate international human rights standard, and bemoaned the lack of product traceability. The report also accused some major companies that were reliant on ASM production of taking little or no action to prevent child labour and other human rights abuses occurring in their cobalt supply chains.

8 Washington Post, 2016. *The Cobalt Pipeline*, https://www.washingtonpost.com/graphics/business/batteries/congo-cobalt-mining-for-lithium-ion-battery



An example of a deep pit closed by the DRC regulatory authorities in 2022.

In response to the multiple ASM risks identified (see prior page), global automotive and electronics companies looked into their own supply chains to gain assurance that the right steps were being taken to mitigate these risks. The ensuing international efforts to de-risk and/or address negative social and environmental impacts coalesced around a series of key activities and initiatives.

- Various downstream brands sought to secure cobalt supply from countries other than the DRC and/or from mechanised production sources only.
- Certain government, industry and civil society organisations formed the multi-stakeholder initiative, Global Battery Alliance, to consider how negative impacts could be best addressed.
- Existing industry alliances, such as the Responsible Minerals Initiative (RMI), elevated their focus on the cobalt value chain.
- New industry alliances developed, such as the Responsible Cobalt Initiative, Fair Cobalt Alliance and Cobalt for Development.
- Mechanised miners began marketing, child-labour-free, and/or 'ASM-free' cobalt production.
- Some vehicle manufacturers announced plans to engineer cobalt out of their batteries.
- Programmes, such as the Mutoshi Pilot Project[9], were established to formalise safe and responsible ASM cobalt production.
- There was increased support for philanthropic programmes in pursuit of, for example, 'alternate livelihoods', and/or children's education.
- Responsible ASM sourcing standards were developed and proposed.

The DRC Government's response to these challenges included the establishment in 2019 of Entreprise Générale du Cobalt (EGC) as the sole purchasing authority for all domestically produced ASM cobalt, with standards in place to promote responsible sourcing.

While the role and mandate of EGC remains open to some discussion, it is regrettable that in the meantime, international and domestic efforts to meaningfully mitigate negative human rights impacts in the DRC's value chain have largely failed to take shape at any recognisable scale.

9 Trafigura. *Mutoshi Pilot Project*, https://www.trafigura.com/sustainability/responsible-sourcing/mutoshi-pilot-project/

Constructive engagement

Eliminating the risk of child labour and dangerous working conditions in the supply chain is a clear moral imperative, but an outright ban on ASM would be impractical, unethical and counterproductive.

Artisanal mining is deeply entrenched in DRC society. It is a vital source of revenue for hundreds of thousands of people. Criminalising what is currently a legal activity would be widely opposed. What is more, it risks marginalising ASM communities still further, which can only exacerbate the risk of human rights abuses.

Some producers avoid ASM by limiting their production to mechanised operations where they can exert direct control. For OEMs, entering into long-term contracts that exclude ASM-generated materials from their supply chains is a popular solution.

Although it is true that, as currently constituted, unscrupulous practices are hard to identify (let alone control) in DRC's ASM sector, these exclusionary approaches have negative consequences for ASM workers.

Ultimately, the stark calculus for artisanal miners is food on the table. So long as there are willing buyers there will be those willing to risk their own, and their children's, lives in perilous conditions. Banning or curtailing ASM activity doesn't serve their interests. By constraining supply, it simply pushes up cobalt prices and increases risks for ASM miners. Some people will lose their livelihoods others will gravitate towards (the now more profitable) illegal or unofficial ASM, with all its attendant risks.

ASM in the DRC does not exist in isolation – it is often congruent with, or integrated into, major mining operations. Trafigura's due-diligence activities in the region have revealed multiple forms of interaction between the formal and informal mining sectors, including:

- Long-term, as well as transient, establishment of unregistered ASM digging communities on formal mine sites – often leading to protracted friction between parties.
- Persistent and unauthorised incursions of ASM diggers onto formal mechanised mine sites.
- The appointment of ASM cooperatives by mining houses to work on mining concessions, either prior to or alongside mechanised production.
- Direct or tacit support for ASM by local authorities either aligned or in contravention with legislation, including formal and unofficial taxation of ASM.
- Open-market purchases of ASM material by mining houses, often anonymous or covert, with the intention of 'topping-up' production for onward sale.
- The direct purchase of ASM material by small buying stations for onward large-scale aggregation and smelting.

There are many shortcomings in the ASM sector, with human rights impacts shared to varying degrees between those directly involved with, or impacted by, formal and informal large-scale and small-scale cobalt mining.

In Trafigura's view, these are best tackled through a programme of constructive engagement. Collaboration between the formal mechanised mining sector and the ASM mining sector offers the best prospect of saving lives, promoting livelihoods and integrating ASM-originated commodities into global markets.

The power of partnership

A more inclusive, collaborative approach begins with interventions that formalise the ASM sector and deliver sustainable improvements. An intensive, sustained work programme is needed. It will take patience, realism, tenacity and above all close collaboration with key stakeholders on the ground.

Trafigura has committed to working with commercial partners, NGOs, academics, regulators and governments to isolate and address the many challenges that ASM sourcing presents. Our aim is to support ASM miners. In doing this, we are also building mutually beneficial, long-term commercial relationships with counterparts up and down the chain.

With our partners, we have developed a template for collaborative working that can meet human rights expectations by raising standards in the ASM sector. We believe there are important lessons for opinion formers and policy makers seeking to satisfy the growing demand for cobalt, while supporting and promoting fundamental human rights.

We have developed ASM governance processes that are structured to promote artisanal and small-scale cobalt miners' interests in a way that is respectful, safe and legally robust. One such scheme in the DRC was the Mutoshi Pilot Project. This was a proof-of-concept partnership with mid-tier miner, Chemaf. It maintained high levels of local employment and improved mining standards and efficiency.

The practical experience gained from this project was invaluable. The lessons from Mutoshi are applicable across the sector. We have since been engaging with governments, NGOs such as Pact, academics from the Center for Business and Human Rights at Geneva University's School of Economics and Management and New York University Stern Center for Business and Human Rights, along with other commercial and financial partners to learn from prior experience and scale up this project across the ASM sector in the DRC.

'The Mutoshi Pilot Project: Local economic impact of a project aimed at formalizing artisanal and small-scale mining', Johansson de Silva, Strauss and Morisho.

www.trafigura.com/brochure/the-mutoshi-pilot-project

'Making Mining Safe and Fair: Artisanal cobalt extraction in the Democratic Republic of the Congo', World Economic Forum in collaboration with Geneva Center for Business and Human Rights at Geneva University's School of Economics and Management, and New York University Stern Center for Business and Human Rights.

www.trafigura.com/brochure/wef-making-mining-safe-2020

A mechanism for formalisation

In October 2020, Trafigura entered into a non-exclusive cobalt marketing agreement with Entreprise Générale du Cobalt (EGC). As part of the agreement, Trafigura committed to work with EGC, the NGO Pact and other partners to develop controls and traceability for ASM-based cobalt production.

Pact is an international NGO with a long history of operating in the DRC. It specialises in health and safety in mining, human rights, traceability, economic empowerment among miners, child labour reduction, and responsible sourcing. Trafigura and Pact had already worked together closely on the Mutoshi Pilot Project.

EGC, Pact and Trafigura are aligned in the belief that supporting the DRC State in formalising the ASM cobalt sector offers a game-changing opportunity for the country and for the wider cobalt industry.

Trafigura, Pact and the EGC have been working on a common programme that formalises ASM cobalt production. In outline, the overall approach is as follows:

- Artisanal zones are officially nominated by governmental authorities. These will be in areas in which cobalt can be readily accessed with limited immediate need for the mechanised removal of waste/overburden.
- Cooperatives are granted rights to mine these zones. Their production standards are set out in a charter (the EGC Responsible Sourcing Standard), which includes commitments on human rights, safe working conditions and a ban on child labour. The members of these cooperatives, mainly artisanal miners, agree to these standards.
- ASM mining activities are overseen by EGC and by the NGO Pact. Risks are identified and jointly mitigated with relevant stakeholders, in line with due-diligence expectations.
- Waste/overburden is systematically removed by mechanised means in order to avoid the need for diggers to dig deep pits and dangerous tunnels.
- All cobalt ore produced by the cooperative is weighed, assessed for cobalt content, bagged and then QR-tagged. ASM miners are then paid at a government-regulated price before material is transported to a central buying station.
- The tagged bags are then aggregated into one tonne big bags, re-tagged and sent on to approved local refiners. The ore is converted into cobalt in hydroxide and is then made available for export.

Removing structural impediments

The processes described can have benefits for all stakeholders, but getting the necessary cooperation between ASM producers and wider market participants has proved challenging. A common approach is needed and, for that to happen, responsible sourcing standards must be enforced by government authorities and respected by operators and buyers alike.

The binary nature of due-diligence policies, whereby cobalt originating from the DRC and/or ASM sources can be rejected outright with little or no meaningful diligence, is of significant concern. Very few ultimately seek to identify and mitigate their ASM risks directly.

The risk mitigation measures and due-diligence costs linked to formalised sites will inevitably result in slightly higher prices for buyers, when compared with purchases from informal sites, but this will be balanced by safer, more stable working conditions at site level.

Not only would ASM diggers operating at formalised sites benefit from a safe working environment, they would also benefit from elevated productivity (given the deployment of machinery to remove waste rock), they would avoid financial risks (such as not being required to make ad hoc payments to malign actors on the ground) and ultimately they would avoid falling foul of unscrupulous buyers who, presently, are known to deploy faulty weighing and assaying equipment to the detriment of the seller realising a 'fair' price.

A regulator-backed pricing system for material from formalised ASM improves transparency and protects ASM miners from predatory pricing tactics. The basis on which this is agreed is critical. ASM miners need to be able to influence pricing decisions and get access to accurate information.

More regulated pricing can improve stability, but ultimately cobalt pricing will reflect international market conditions. In 2019 and 2020, falling cobalt prices choked off ASM supply. Formalised ASM, which also had additional, COVID-19-related costs, became economically unviable.

Price volatility in international cobalt markets poses a continuing threat to formalised ASM. There is a need for research and contingency plans that help workers cushion the impact on their livelihoods when prices fall. If ASM miners cannot support their families they will look for other opportunities. Unless this is managed, there is a continuing prospect that ASM miners will revert to informal ASM when times get tough. Better mine planning, more transparency and improved communication with ASM workers can all help to mitigate this risk.

Case study: Facing the challenge at Mutoshi

Considering Chemaf's intention to develop its Mutoshi concession, initially through the appointment of ASM contractors. Trafigura engaged internationally respected NGO Pact in January 2018 to support Chemaf's programme to source ASM-mined cobalt responsibly. Pact has extensive experience working with artisanal miners in challenging environments and is a sector leader in the practical implementation of responsible ASM sourcing.

The Pact-piloted intervention at the Mutoshi concession, implemented along with DRC Government representatives, Chemaf and Trafigura ended in 2020. It yielded important benefits, many of which are directly replicable elsewhere. These benefits, captured within a formal socio-economic assessment by de Silva, Strauss and Morisho included:

- Significantly improved working conditions.
- Freely accessible health care services for participants.
- A marked (positive) impact on the local economy, including through the creation of new businesses in response to higher demand for goods and services. For every 1,000 miners at the site, the local economic impact was approx. USD1 million per year.
- Female miners participating in the project earnt about two and a half times more than their counterparts working in mines outside the project site.
- The ban on child labour was strictly enforced. The pilot programme backed this up with local educational facilities for young people.

Perhaps the most notable output of this collaboration has been the development of responsible sourcing standards for the ASM cobalt sector. Trafigura and Pact have built on the lessons learnt at Mutoshi to support their programme of work with EGC.

The need for robust standards

To align with current international norms and standards, all companies that purchase cobalt or components that contain it must conduct supply chain due diligence.

The UN Guiding Principles on Business and Human Rights (UNGPs) require companies to take proactive steps to ensure they do not cause or contribute to human rights abuses within their global operations and respond to any human rights abuses when they occur.

The OECD five-step framework

The OECD Due Diligence Guidance is a set of guidelines, endorsed by governments, for the responsible management of global mineral supply chains. It provides management recommendations that respect human rights and avoid contributing to conflict through mineral or metal purchasing decisions and practices. The guidelines cultivate transparent, conflict-free supply chains and sustainable corporate engagement in the minerals sector.

The OECD Guidance may be used by any company potentially sourcing metals or minerals from conflict-affected and high-risk areas. EU importers and US-listed companies are required by law to follow the framework when sourcing tin, tantalum, tungsten and gold (also known as 3TG conflict minerals).

The OECD Guidance recognises that companies at different stages of the supply chain have differing responsibilities. Upstream companies, which include smelters and traders, are expected to map the circumstances of the extraction, trade, handling and export of their minerals. Their due diligence should include expert on-the-ground assessment. They are also encouraged to provide any information they gather to their downstream customers. Additionally, they are expected to take steps to identify, assess and manage any human rights abuses in their supply chain. They should, for example, act to minimise the risk of exposure of artisanal miners to abusive practices and support the progressive professionalisation and formalisation of the sector.

The EGC Responsible Sourcing Standard

In March 2021, EGC released the EGC Responsible Sourcing Standard to support the establishment and maintenance of safe and strictly controlled artisanal cobalt mining zones in the DRC. The EGC Standard aligns with State law and DRC mining regulations, as well as with the OECD Guidance.

The EGC Standard was developed following extensive collaboration with Trafigura and Pact, amongst others, as well as through practical experience garnered at the Mutoshi Pilot project. The EGC Standard will be updated systematically to reflect evolving risks and stakeholder perspectives. EGC has publicly committed to working with stakeholders in improving and refining the standard through a credible multi-stakeholder engagement process. As noted by Trafigura on its website, 'The EGC Standard is a 'living document' and will be updated on an ongoing basis. The intention is that the update process will be dynamic. It will respond to challenges faced by those involved in the daily execution of the project, but also to the evolving views and aspirations of stakeholders.'[10]

The implementation of the EGC Standard at EGC-controlled sites will be supported by Pact through the training of local stakeholders, including EGC itself and mining cooperatives amongst others. Pact will also conduct ongoing monitoring while supporting and providing guidance to local stakeholders for the assessment and mitigation of identified risks.

The EGC Standard has been designed to complement, and indeed go beyond, regulatory compliance determined by the Agency for Regulation and Control of the Strategic Mineral Substance Markets (ARECOMS) which has regulatory oversight over EGC.

External standards benchmarked as part of the development process for the EGC Standard included Certified Trading Chains (CTC), the Craft Code, Amnesty International's Principles and the Responsible Minerals Initiative's Risk Readiness Assessment.

Following their appointment by EGC's Technical Committee, international due diligence experts Kumi will conduct quarterly assurance reviews against the EGC Standard at every EGC site.

10 Entreprise Générale du Cobalt, *EGC Responsible Sourcing Standard,* https://www.trafigura.com/brochure/egc-responsible-sourcing-standards

Conclusion

The global market for EVs is gaining momentum. Governments are regulating in support of electrified transportation, infrastructure is being rolled out, manufacturers are investing, battery technologies are improving and consumers are increasingly buying into the benefits.

The speed and scale of this transition is testament to government policy and industry's ability to innovate and rapidly expand productive capacity to meet a major global challenge. This commercially driven success has shifted the focus of attention to the provision of raw materials.

For upstream companies, the challenge now is to match that innovation by radically scaling up the supply of physical commodities to meet fast-growing market needs.

When demand outstrips supply, large-scale, mechanised mining can normally deliver additional capacity. However, there will always be significant lead time, involving the expansion of existing mines or the development of new projects. Typically this process can take years – if not decades – to accomplish.

In the cobalt supply chain, the situation is more complicated because the element is usually extracted as a by-product of copper or nickel mining. Any investment decisions in new capacity have historically been informed by the market dynamics for these metals.

The ASM sector operates on a much smaller scale. That radically reduces lead times. This increased scalability can make a decisive contribution in markets with rapidly growing demand. Upstream companies benefit by sourcing ASM materials, but they must also use their leverage to ensure fundamental respect for the dignity, human rights and employment prospects of artisanal miners. The informal nature of the ASM sector and its lack of transparency present severe barriers but these can be overcome.

The rapid growth in EV-led demand for cobalt increases the risk that it becomes a bottleneck in the EV supply chain. By engaging with the ASM challenge, rather than looking the other way, Trafigura aims to help alleviate that risk. The partnership-based responsible sourcing model developed by Trafigura, Pact and EGC comprises mechanisms and processes that can help formalise the ASM sector and promote transparency. We are working closely with regulators, NGOs, academics and commercial counterparts to make ASM cobalt, sourced in line with standards that are owned domestically and respected internationally, an integral part of the DRC's cobalt value chain. We invite others to help make this imperative a reality.

References

Amnesty International, 2016. *This is what we die for: Human rights abuses in the Democratic Republic of the Congo power the global trade in cobalt.*
Available at *https://www.amnesty.org/download/Documents/AFR6231832016ENGLISH.pdf*

Artisanal and Small-Scale Mining.
Available at *http://www.worldbank.org/en/topic/extractiveindustries/brief/artisanal-and-small-scale-mining*

Artisanal and Small-Scale Mining Inventory.
Available at *http://www.artisanalmining.org/Inventory/*

Bloomberg, March 2018. *VW Just Gave Tesla a $25 Billion Battery Shock.*
Available at *https://www.bloomberg.com/news/articles/2018-03-13/vw-secures-25-billion-battery-supplies-in-electric-car-surge*

Buxton, A. 2013. *Responding to the challenge of artisanal and small-scale mining. How can knowledge networks help?* IIED. February.
Available at: *http://pubs.iied.org/16532IIED/*

Carstens, J., 2017. *The artisanal and small-scale mining (ASM) sector and its importance for EU cooperation with resource-rich developing and emerging countries.*
STRADE European Policy Brief.
Available at *http://stradeproject.eu/fileadmin/user_upload/pdf/STRADE_PB09-2017_ASM_and_EU-cooperation.pdf*

Crocodile Project.
Available at *https://www.cordis.europa.eu/project/rcn/214467_en.html*
Available at *http://ecorecycling.eu/en/projects*

Darton Commodities Limited, 2018. *Cobalt Market Review 2017-2018.* 01 February.
Available at *http://www.dartoncommodities.co.uk/market-research/*

Delve, 2020. *State of the Artisanal and Small-Scale Mining Sector Report.*
Available at *https://delvedatabase.org*

Electric Vehicles Initiative.
Available at *https://www.iea.org/topics/transport/evi/*

Entreprise Générale du Cobalt, March 2021.
EGC Responsible Sourcing Standard.
Available at *https://www.trafigura.com/brochure/egc-responsible-sourcing-standards*

European Commission, 2021.
Available at *https://www.europarl.europa.eu/news/en/press-room/20211118IPR17620/critical-raw-materials-the-eu-should-secure-its-own-supply*

European Commission, 2018. *Report on Raw Materials for Battery Applications.* Commission Staff Working Document, 17 April.
Available at *https://ec.europa.eu/transport/sites/transport/files/3rdmobility-pack/swd20180245.pdf*

EV30@30 Campaign.
Availaible at *https://iea.blob.core.windows.net/assets/0f695db4-14b0-4360-9c16-adccfde98536/CampaignDocumentupdate_2021.pdf*

Frankel, T.C., 2016. *The Cobalt Pipeline.*
The Washington Post, 30 Sept.
Available at *https://www.washingtonpost.com/graphics/business/batteries/congo-cobalt-mining-for-lithium-ion-battery/??noredirect=on&noredirect=on*

Home, A. 2018. *For cobalt buyers, is artisanal mining the problem or the solution?* Reuters 22 February.
Avalaible at: *https://uk.reuters.com/article/uk-artisanal-mining-ahome/commentary-for-cobalt-buyers-is-artisanal-mining-the-problem-or-thesolution-idUKKCN1G627E*

Intergovernmental Forum on Mining, Minerals and Sustainable Development (IGF), 2017. *Global Trends in Artisanal and Small-Scale Mining (ASM): A review of key numbers and issues.* 01 January.
Available at *https://www.iisd.org/sites/default/files/publications/igf-asm-global-trends.pdf*

Lambert, F., 2017. *VW announces massive $84 billion investment in electric cars and batteries.* 11 September.
Available at *https://electrek.co/2017/09/11/vw-massive-billion-investment-in-electric-cars-and-batteries/*

McKinsey, 2017. *The future of nickel: A class act* 02 November.
Available at *https://www.mckinsey.com/industries/metals-and-mining/our-insights/the-future-of-nickel-a-class-act*

McKinsey, 2018. *Metal mining constraints on the electric mobility horizon.* 02 April.
Available at *https://www.mckinseyenergyinsights.com/insights/metal-mining-constraints-on-the-electric-mobility-horizon*

Olivetti, E.A., Ceder, G., Gaustad, G.G., Fu, X., 2017. *Lithium-Ion Battery Supply Chain Considerations: Analysis of Potential Bottlenecks in Critical Metals Joule Volume 1, Issue 2*, 11 October.
Available at *https://www.sciencedirect.com/science/article/pii/S2542435117300442*

Reuters. 22 February 2018.
Available at *https://uk.reuters.com/article/uk-artisanal-mining-ahome/commentary-forcobalt-buyers-is-artisanal-mining-the-problem-or-the- solution-idUKKCN1G627E*

Schroders, 2017. *Electricity supply: Forging the EV supply chain.* 15 October.
Available at *http://www.schroders.com/en/insights/economics/electricity-supply-forging-the-ev-supply-chain/*

The Economist, 2018. *What if China corners the cobalt market?* 24 March.
Available at *https://www.economist.com/finance-and-economics/2018/03/24/what-if-china-corners-the-cobalt-market*

The International Energy Agency, 2018. *Global EV Outlook 2018. Towards cross-modal electrification.*
Available at *https://iea.blob.core.windows.net/assets/387e4191-acab-4665-9742-073499e3fa9d/Global_EV_Outlook_2018.pdf*

The International Energy Agency, 2021. *Annual EV battery demand projections by region and scenario, 2020-2030.*
Available at *https://www.iea.org/data-and-statistics/charts/annual-ev-battery-demand-projections-by-region-and-scenario-2020-2030*

Trafigura, 2019. *Mutoshi Pilot Project*.
Available at *https://www.trafigura.com/sustainability/responsible-sourcing/mutoshi-pilot-project/*

Ward, J., 2017. *EV supply chains: Shifting currents. Automotive Logistics.* 28 April.
Available at *https://automotivelogistics.media/intelligence/shifting-currents*

World Economic Forum, 2020. *Making Mining Safe and Fair: Artisanal cobalt extraction in the Democratic Republic of the Congo white paper. September 2020.*
Available at *https://www.trafigura.com/brochure/wef-making-mining-safe-2020*

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