COBALT INSTITUTE
enabling technology, advancing society

Cobalt Market Report 2024

May 2025

TABLE OF CONTENTS

BENCHMARK | rho motion

Benchmark Mineral Intelligence was commissioned by The Cobalt Institute to prepare the 2024 Cobalt Market Report ahead of the Cobalt Congress in Singapore in May 2025. The report summarises the key trends in the cobalt market across demand, supply, prices, sustainability and policy.

The report was prepared using Benchmark's actionable, proprietary data and analysis on the lithium-ion battery supply chain and broader new energy markets. In 2024, Benchmark acquired Rho Motion, a leader in downstream energy transition intelligence specialising in demand sectors such as EVs, powertrain technology, energy storage systems (ESS), EV charging ecosystems, semiconductors, and renewable energy. Benchmark now offers unparalleled market visibility, from mine to grid. This report's coverage of cobalt is sourced from Benchmark's Cobalt Forecast and Price Assessment, as well as Recycling, Sustainability and Policy analysis.

1. FOREWORD

COBALT HAS BEEN MAKING HEADLINES

As countries rush to secure access to critical materials and as coalitions form after 2024 elections in key cobalt market geographies – the US, the EU, DRC and Indonesia – essential minerals are, more than ever, at the top of the world's agenda.

Political winds shift, and so do the narratives. In 2024, we talked about climate emergency, reaching net-zero and the transition to a low-carbon economy.

While these priorities remain unchanged in 2025, the goals of national security, industrial growth, and economic prosperity are now also top of mind.

Cobalt is essential to industrial growth, national security and a low carbon economy. It is at the heart of many technologies that power and sustain modern life: electronics, automotive, aerospace, and healthcare. It is crucial to the production of lithium-ion batteries, which power everything from smartphones to electric vehicles, making it indispensable for the ongoing transition to more sustainable technologies. Cobalt is also vital for national security, as it is a key component in military technologies and advanced defence systems.

It is essential to build reliable and responsible cobalt value chains and to secure cobalt supply. We must act urgently to ensure that cobalt achieves its potential. Economic growth, industrial processes, and the energy transition all depend on it.

Cobalt Institute and its members remain committed to this goal.

Dinah McLeod,
Director General,
Cobalt Institute

2. EXECUTIVE SUMMARY

OUTLOOK REMAINS POSITIVE DESPITE SUSTAINED MARKET WEAKNESS

Cobalt demand exceeded 200kt for the first time in 2024, with battery applications accounting for 76% of absolute demand and 94% of annual demand growth. Electric vehicles (EVs) were the key battery demand sector and represented 43% of total demand, with EV unit sales delivering robust growth of +26% year-on-year (y-o-y) despite market headwinds.

The portable electronics sector – the second-largest demand segment – also recovered in 2024, following years of turbulence, and posted cobalt demand growth of +12% y-o-y. The growing use of artificial intelligence (AI) has also led to increased battery sizes owing to its requirement for higher computational demand. AI growth has also contributed to cobalt consumption in data centres.

Superalloy and military demand for cobalt rose on an uptick in defence spending. This included non-battery applications like cobalt-containing magnets for control systems and superalloys in jet turbines, as well as battery uses – such as portable communication and optics devices, unmanned drones, electric micromobility and electrified tactical and non-tactical vehicles. Superalloys – the largest industrial application for cobalt – saw robust growth in cobalt demand on the back of both defence sector support and the larger commercial aircraft segment.

However, for the third consecutive year, demand growth was outpaced by supply additions. CMOC, the largest cobalt miner, produced 114kt from its two DRC sites, TFM and KFM – 31% above stated capacity. The company ramped up KFM to particularly high levels – surprising the market and increasing the company's global market share to 31% in 2024 (+7% y-o-y). CMOC's total output further cemented the market in structural oversupply – of +36kt, up from +25kt in 2023, weighing on prices.

Cobalt hydroxide (CIF Asia) and metal (EXW Europe) prices fell by 15% and 22%, respectively, throughout the year. Prices stabilised somewhat mid-year as rumours built around a large upcoming purchase from China's state reserve – the NDRC – but failed to materially rebound as the market remained in a structural surplus. **By the end of 2024, cobalt prices were at historic lows.**

The low-price environment led some smaller producers in the DRC to cut output, or in some cases, to stop cobalt production entirely. Conversely, producers in Indonesia – the second-largest cobalt-producing country – ramped up cobalt output as high-pressure acid leach (HPAL) operations continued to expand nickel production, and with it adding by-product cobalt. **Indonesia accounted for 12% of mined cobalt supply in 2024, up from 8% in 2023.**

The year also saw a record number of producers engaging with third-party sustainability assessments. In particular, 82% of refined cobalt was assessed under the Responsible Minerals Initiative (RMI). From this, Benchmark has estimated that 77% of total mine supply now meets RMI criteria at least at one stage of downstream processing. And April 2025 saw Glencore's KCC

and Mutanda assets receive the Copper Mark, joining CMOC's TFM, which received it in 2024.

Sustainability accreditation is increasingly important for raw material procurement decision-making, with European OEMs increasingly introducing it into purchasing agreements.

While the market ended 2024 in structural oversupply and recording historic low prices, the DRC government announced a four-month cobalt export ban in February 2025 to address market oversupply and lift prices. **This was the first major policy intervention by the DRC government in the cobalt market and it resulted in immediate price support.** As of April 2025, the DRC government has not communicated specific next steps, though it has signalled options. As a result, particularly combined with geopolitical uncertainty in the US and elsewhere, the cobalt market is likely to face continued uncertainty and volatility in 2025.

3. DEMAND EXCEEDS 200KT FOR THE FIRST TIME

3.1 COBALT DEMAND

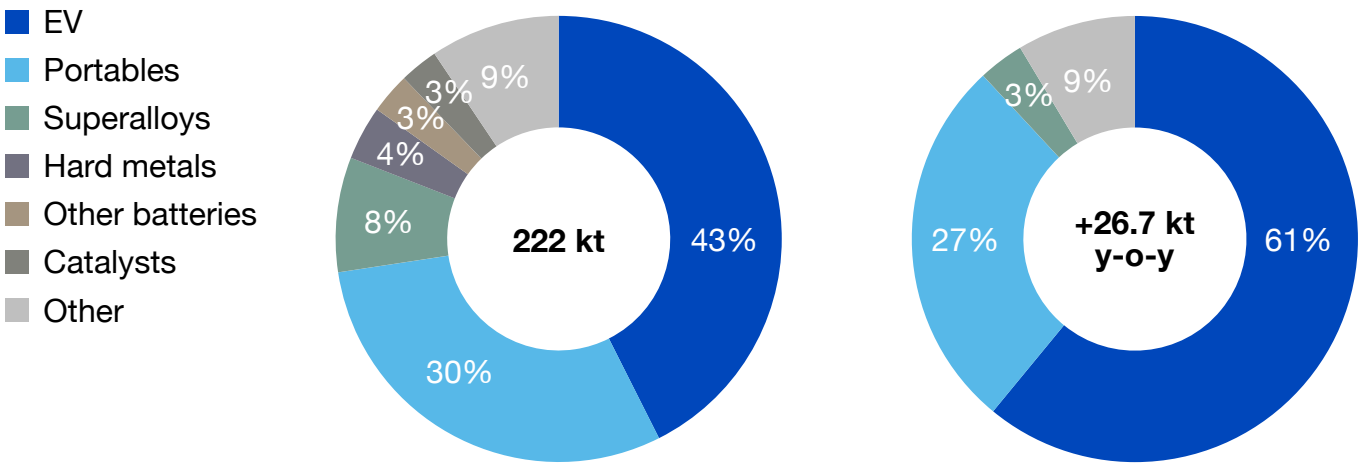
Cobalt demand exceeded 200kt for the first time in 2024, growing by 14% y-o-y and marking the strongest annual growth since 2021. Demand rose by 27kt annually, more than double the 12kt of annual growth in 2023.

The largest end use market, electric vehicle (EV) batteries, gained further demand share in 2024 – reaching 43% of cobalt demand (+3% y-o-y) – and accounted for 61% of total annual demand growth. Cobalt demand from EVs totalled close to 95kt, up by 21% y-o-y.

After several years of turbulence, the portable electronics sector saw a recovery in 2024, with cobalt demand from those batteries growing by 12% y-o-y and reaching 67kt. The sector maintained a 30% market share and contributed 27% of total annual growth. Including other minor applications (3%), Li-ion batteries now account for 76% of cobalt demand, up from 73% in 2023. Batteries combined drove 94% of cobalt demand growth in 2024.

Superalloys remain the largest of the non-battery applications by some margin and once again supported ~8% of total demand (discussed further in Section 3.7). Annual demand growth was marginally stronger than previous years at 5% – cobalt demand rose by 0.9kt. Other applications, across a variety of industrial and often niche end uses, made up the remaining 16% of demand in 2024, growing by 6% y-o-y. There has also been small but growing use in artificial intelligence (AI) applications, eBikes, as well as defence applications, which include superalloys, magnets, and batteries in non-road vehicles.

Figure 1: Cobalt demand (LHS) & annual growth (RHS) in 2024 by major end use, kt cobalt



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Note: Other minor applications include ceramics, colours, hard facing uses, tyres, soaps, paints and magnets.

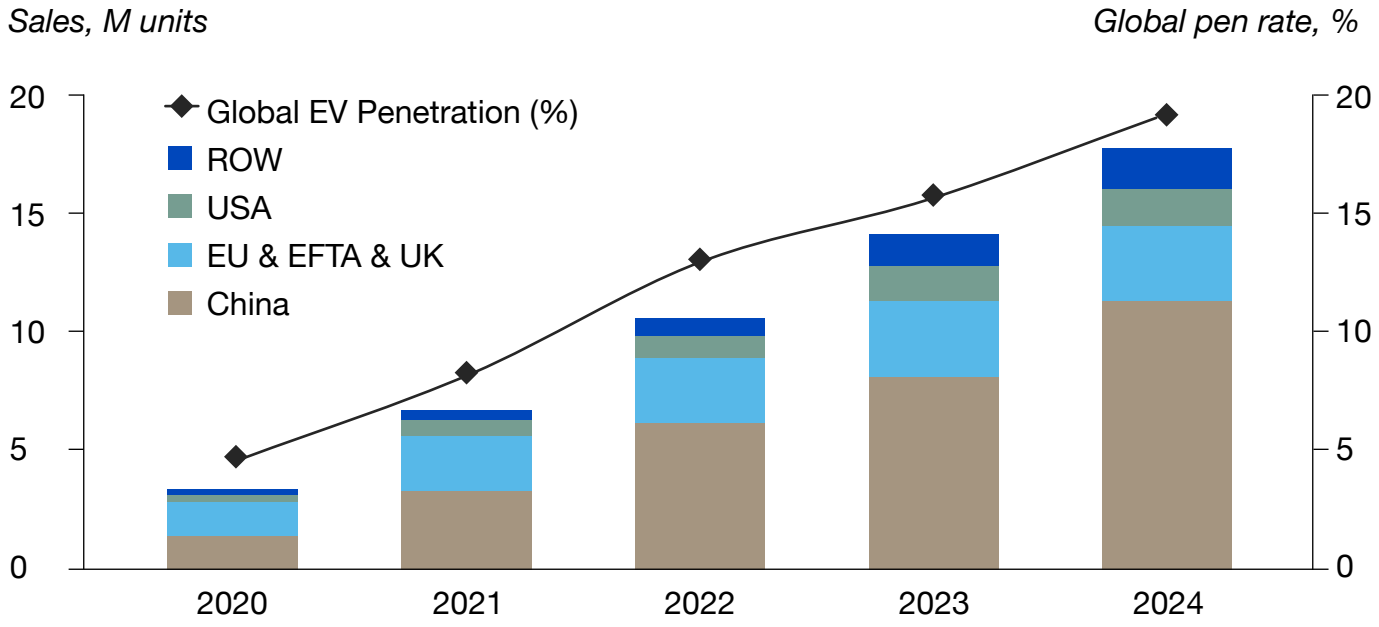
3.2 ELECTRIC VEHICLE (EV) MARKET GAINS DESPITE HEADWINDS

EV MARKET – DEMAND GROWTH SLOWER BUT STILL STRONG

The EV market underperformed compared to initial market expectations but still delivered robust year-on-year (y-o-y) growth in 2024. Combined EV sales – battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) – reached 17.5 million units across all vehicle classes, a y-o-y increase of 26%, down marginally from 33% y-o-y growth in 2023. Global EV penetration reached 20%, up from 16% in 2023.

The slowdown in EV sales growth was to be expected, as previous annual growth rates from 2020-22 of 49%, 98%, and 58% were not sustainable and were also from a significantly lower base. Global EV sales in 2024 were more than five times higher than in 2020.

Figure 2: Global EV sales by major region, million units (LHS) & penetration (RHS)



Data: Rho Motion – EV & Battery Outlook.
Note: all vehicle classes.

2024 was marked by diverging trends in major regions. China continued to drive the global market with 88% of total EV sales growth. Sales in China recorded a growth rate of +39% to 11.2 million units, growing faster than in 2023 (+31%). Strong growth was supported by a trade-in subsidy as well as a wide EV offering with numerous new models being released.

China's trade-in subsidy aims to promote the adoption of vehicles with higher emission standards. Specifically, it includes a subsidy for scrapping lower emission standard vehicles as well as for purchasing EVs or vehicles with higher emission standards. It was first introduced in April 2024 and doubled in August 2024, resulting in an available subsidy higher than that of 2021 or 2022, and close to 2020 levels.

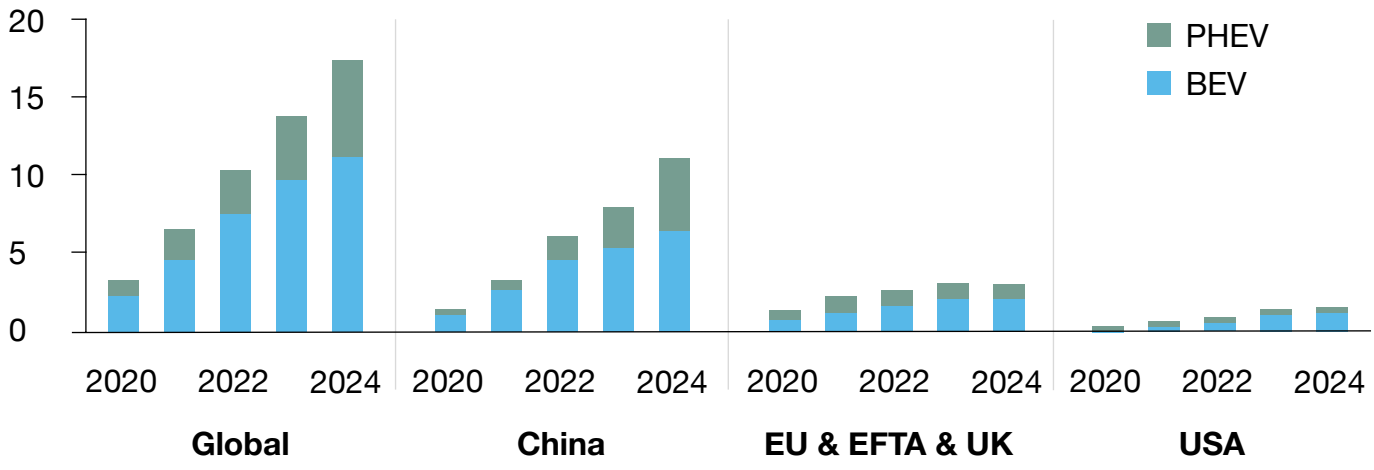
Following two years of robust growth (+16% in 2022 and +18% in 2023), European sales declined by -2% in the face of weak macroeconomic conditions and subsidy removals and reductions – all adding to the ongoing challenge of price disparity between internal combustion engines (ICEs) and EVs. Hybrids (HEVs) performed well as a result. This was particularly the case for Germany and France, both major automotive markets, with Germany at the end of 2023 unexpectedly removing subsidies which were previously planned to continue into 2024. Excluding Germany, EV sales in the EU grew by 21% y-o-y in 2024. Additionally, changing emissions standards in 2025 incentivised the delay of some models and demand from late 2024 into 2025 to aid meeting targets. The UK was a brighter spot: pushed by a zero-emission vehicle (ZEV) mandate, it posted 19% y-o-y growth despite consumer subsidies being removed in 2022. The UK overtook Germany as the largest European BEV market late in 2024.

The US also saw challenging market conditions with annual growth at just 6%, down from 56% y-o-y in 2023. Tesla sales weakened whereas sales from other OEMs were stronger due to improved EV offerings. Tesla's sales in North America contracted by -7% in 2024, compared to +29% growth in 2023. Sales from Hyundai-Kia, Ford and General Motors (the next three largest EV providers in North America) grew by 28%, 32% and 53%, respectively.

Sales in the US did improve late in 2024, particularly following the presidential election, due to expectations of the Trump administration removing Clean Vehicle Tax Credits in 2025. Environmental Protection Agency (EPA) Emissions Standards are also expected to be weakened, which will likely weigh on the US EV sales outlook.

Western OEMs have been slow to expand their EV offering to compete with traditional ICE vehicles across all market segments. Western OEMs are executing on a programme to reduce the cost of making EVs by realising efficiencies in both vehicle and lithium-ion battery (LiB) production. They are also increasing the number of BEV models on offer across the full range of Passenger Car (PC) and Light-Duty Vehicle (LDV) markets, from entry-level to premium vehicle segments.

Figure 3: Regional EV sales by type, million units



Data: Rho Motion – EV & Battery Outlook.
Note: all vehicle classes.

PLUG-IN HYBRID ELECTRIC VEHICLES (PHEVS) GAINED SHARE IN 2024, PARTICULARLY IN CHINA

PHEVs experienced a resurgence in 2024, accounting for close to 60% of global EV sales growth and rising to a 36% share of overall EV sales. This was primarily driven by China, where PHEV sales grew by 78% y-o-y compared to +20% growth for BEVs. PHEVs accounted for 42% of 2024 sales in China, up from 25% and 33% in 2022 and 2023, respectively.

The rise in Chinese PHEV sales has come on the back of the launch of low-priced, long-range models. These have been particularly attractive for drivers in Tier-2, -3 and -4 Chinese cities that currently lack the charging infrastructure available in Tier-1 cities, and from consumers who are more sensitive to upfront costs. In contrast to Western jurisdictions, Chinese policy is currently equally favourable to PHEVs and BEVs.

Range-extended EVs (REEVs) particularly gained share in 2024. REEVs provide ranges over 1,000 km, which gives consumers confidence and flexibility relative to BEVs. REEV sales in China have significantly increased since the start of 2023, with REEVs increasing from 5% of China's total EV sales in Q1 2023 to 10% in 2024. However, more than 96% of REEV sales are from four Chinese brands meaning that further build out of the REEV market share remains uncertain. Outside China, Ford, Volkswagen, Stellantis and Hyundai-Kia have all announced plans for REEV models.

While PHEVs (and REEVs) represent a transitional step in the move from ICEs to full BEVs, there will be regional differences in penetration rates. PHEV sales could be stronger in the outlook for the US given the expectation of less stringent emissions standards.

3.3 CATHODE CHEMISTRY DEVELOPMENTS FOR EVS REMAIN AT CENTRE OF COBALT DEMAND STORY

With 76% of demand for cobalt coming from the battery market in 2024, the continued development of cathode chemistries and battery technologies remains at the centre of cobalt's role in the energy transition.

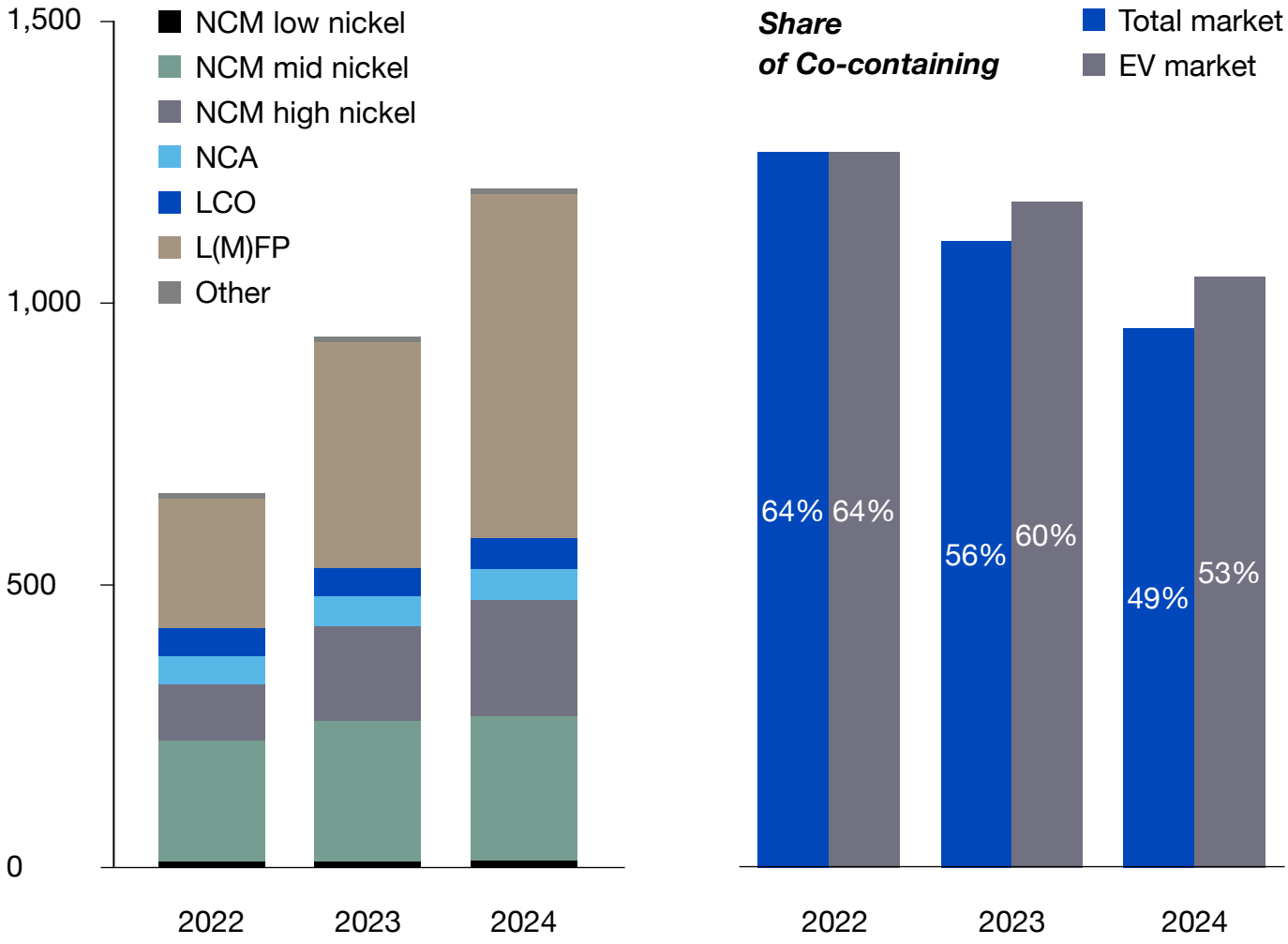
Demand for Ni-Co chemistries (variants of NCM and NCA) rose by 10% y-o-y and accounted for 19% of total battery demand growth. As a result, cobalt-containing battery chemistries in 2024 accounted for 49% of the total market, down from 56% in 2023. But the picture for cobalt in the total battery market is skewed somewhat by the battery energy storage systems (BESS) sector, which primarily uses LFP.

Looking at the EV market – which in 2024 accounted for 43% of cobalt demand – cobalt-containing chemistries have a stronger position. Cobalt-containing chemistries accounted for 53% of EV market demand in 2024, albeit down from 60% in 2023.

The dominant theme of 2024 was the growth in demand for lithium iron phosphate (LFP) batteries, particularly in China. LFP's global share rose to 51% as annual demand grew by more than

50% y-o-y. LFP alone accounted for 79% of total battery demand growth in 2024. It is worth noting that as LFP contains no cobalt, the chemistry's dominance in the Chinese market reduces the impact of the country's market dynamics on the overall cobalt demand picture.

Figure 4: Global battery demand by cathode chemistry, MWh



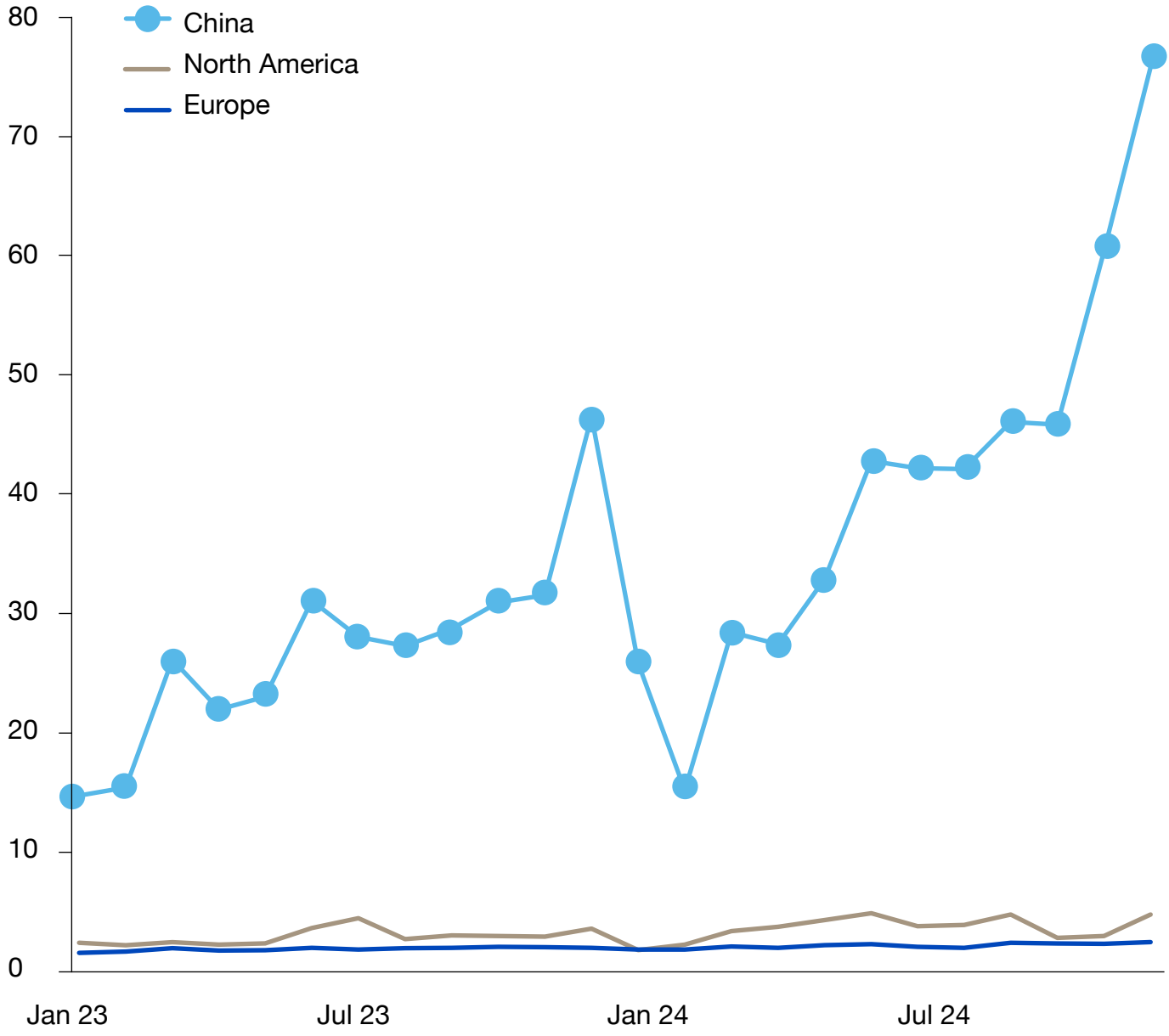
Data: Benchmark Mineral Intelligence & Rho Motion.

LFP GAINS FURTHER GROUND IN 2024, PARTICULARLY IN CHINA

Global LFP demand rose by 50% in 2024, with 66% of growth from EVs and 34% from BESS. The LFP market – both in terms of production and demand – remains dominated by China, where demand rose by ~50% y-o-y in 2024, building on the strong trend seen in 2023. Other regions have comparatively lower LFP uptake, supporting cobalt-containing battery demand outside China.

Demand growth was also seen in the other major regions but from a significantly lower base. By the end of 2024, China's monthly LFP demand was more than eight times higher than North America and Europe combined. China accounted for 77% of global LFP demand growth in 2024.

Figure 5: Monthly LFP demand by region – all markets, GWh



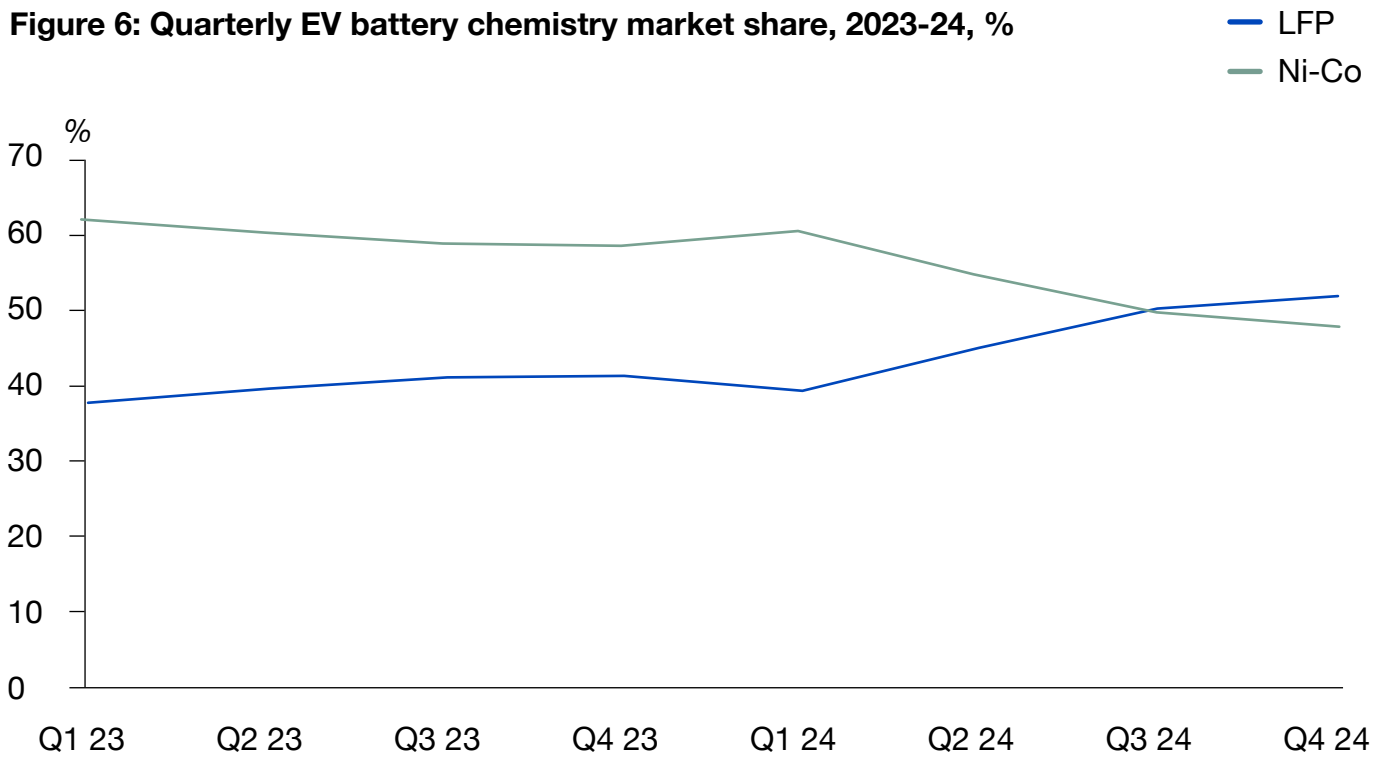
Data: Benchmark Mineral Intelligence & Rho Motion.

Note: Decline in early 2024 in China reflects seasonal factors and Chinese New Year.

In the EV market, quarterly demand by chemistry also demonstrates LFP's rising position through 2024. Ni-Co chemistries held steady at around 60% through 2023 but progressively lost ground in 2024. This shift was driven by China's dominant role in the EV market, particularly in 2024, with 75% of BEV sales growth solely from China, alongside weakness in the non-LFP-dominant European and North American markets.

China's LFP share in the EV market rose to 70% in 2024, up by 7% y-o-y from 63% in 2023 and from as low as 36% in 2020. China has a large market for low-cost entry-level BEVs utilising small battery packs, whereas the LFP share was just 9% in both Europe and North America in 2024, with the latter's share falling y-o-y.

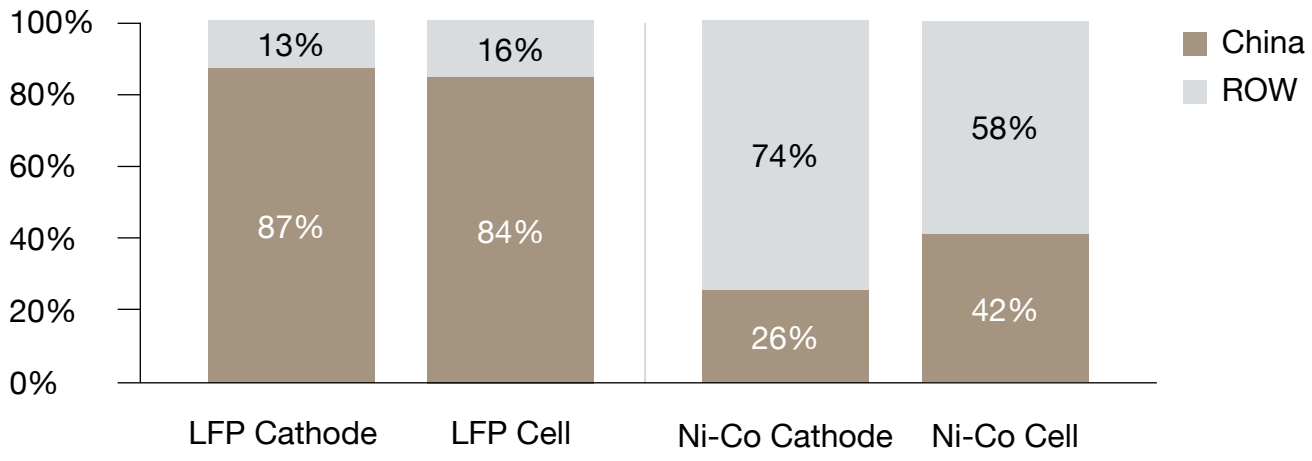
Figure 6: Quarterly EV battery chemistry market share, 2023-24, %



Data: Benchmark Mineral Intelligence & Rho Motion.

Whilst further growth in the LFP market share is forecast in the rest of the world, China's dominance over the LFP supply chain will continue to restrict growth in the near to medium term, without significant further investment. China accounted for 99% of LFP cathode and cell production globally in 2024. When considering the full project pipeline for both cathode and cell capacity, LFP growth to the end of the decade is also dominated by China, at 87% and 84% of potential expansions, respectively.

Figure 7: Share of 2024-30 cathode and cell growth by region, %



Data: Benchmark Mineral Intelligence – Li-ion Battery & Cathode Forecasts.
Note: share of total potential growth and not weighted for development stage.

COBALT-CONTAINING CHEMISTRIES DOMINATE EV MARKET IN NORTH AMERICA AND EUROPE

The rest of the world – primarily South Korea, Japan, Europe and North America – plays a much larger role in the build-out of cobalt-focused mid- and downstream production capacity. Combined, the rest of the world (ROW) will contribute 74% of potential growth in Ni-Co cathode production between 2024 and 2030, and 58% for Ni-Co cells in that time period. This reflects both China's dominance of the LFP supply chain – slowing the buildout elsewhere – but more importantly the focus of the downstream on cathode chemistries for the next generation of EVs. The share of Ni-Co chemistries in EVs was 90% in both Europe and North America in 2024.

All the top 10 BEV models in the US and Europe relied on cobalt-containing chemistries. The US market was dominated by high-nickel chemistries, targeting higher energy density batteries for larger vehicles (and so with larger pack sizes) and higher driving range – 69% of EV demand was for high-nickel chemistries (20% for mid-nickel). Mid-nickel variants of NCM were more popular in Europe, reflecting smaller average vehicle sizes – accounting for 59% of demand (30% for high-nickel).

Figure 8: Top 10 BEV sales in 2024 by model and chemistry

Top 10 BEV models sold in the US in 2024

Top 10 BEV models sold in the EU in 2024

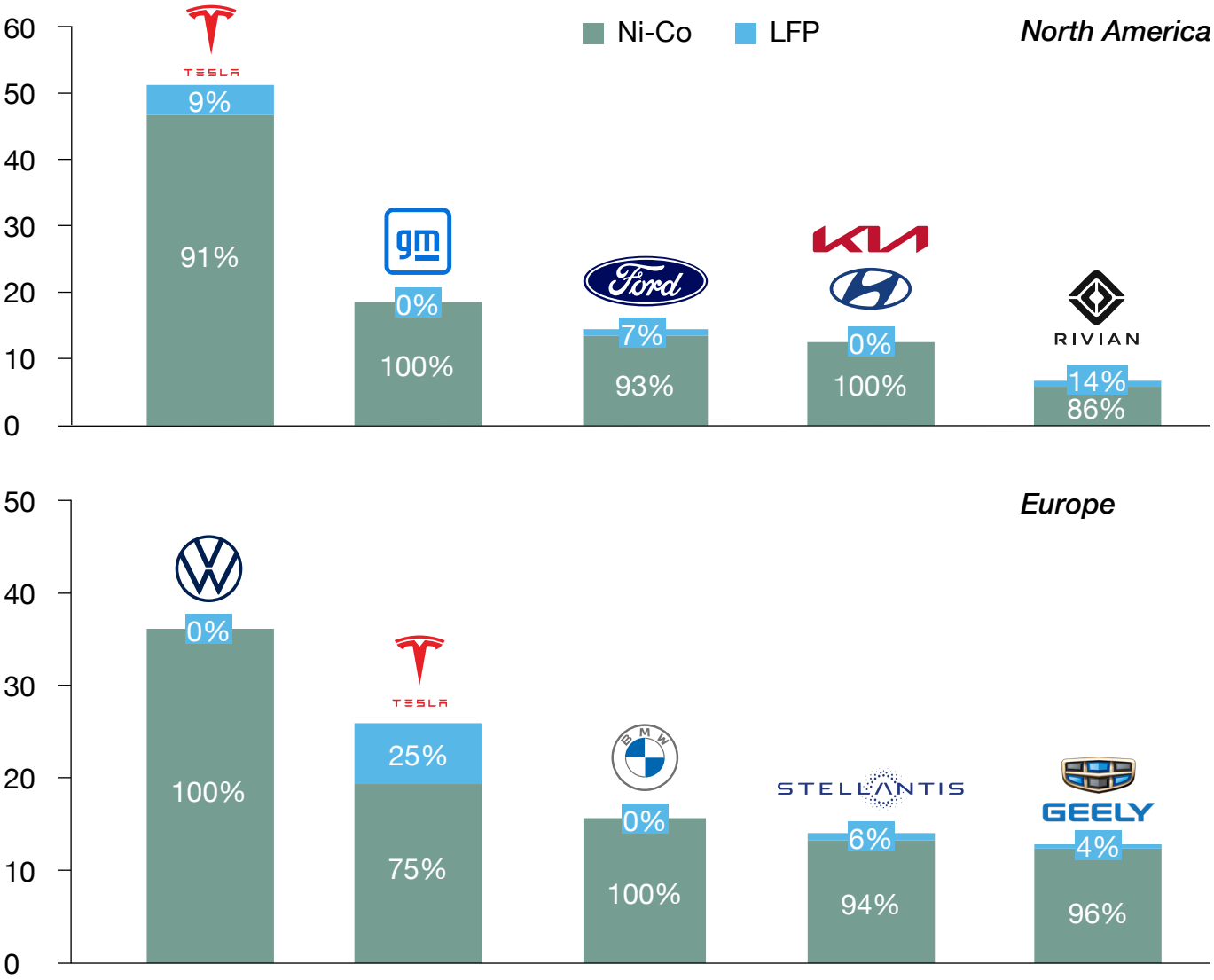
Rank	Model	Chemistry	Rank	Model	Chemistry
1	Tesla Model Y	High-nickel & LFP	1	Tesla Model Y	High-nickel & LFP
2	Tesla Model 3	High-nickel & LFP	2	Tesla Model 3	High-nickel & LFP
3	Ford Mustang Mach-E	High-nickel & LFP	3	Skoda Enyaq iV	Mid-nickel
4	Hyundai Ioniq 5	High-nickel	4	Volvo EX30	Mid-nickel & LFP
5	Ford F-150	High-nickel	5	Audo Q4 e-tron	Mid-nickel
6	Chevrolet Equinox	High-nickel	6	VW ID.4	Mid-nickel
7	Tesla Cybertruck	High-nickel	7	MG-4	High-nickel & LFP
8	Honda Prologue	High-nickel	8	VW ID.3	Mid-nickel
9	Rivian R1S	High-nickel & LFP	9	BMW iX1	Mid-nickel
10	Cadillac Lyriq	High-nickel	10	BMW i4	Mid-nickel

Data: Rho Motion – EV & Battery Outlook.

Note: Mid- and high-nickel chemistries contain cobalt – primarily NCM and NC(M)A.

LFP was used by some models, for example Chinese-made Teslas and some standard range vehicles – NCM is typically employed for longer range applications. EV demand data for the top five OEMs in North America and Europe shows the continued dominance of Ni-Co chemistries, with LFP only making up a very small percentage of demand.

Figure 9: EV cell chemistry demand by OEM in 2024 – top 5 OEMs in North America and Europe, GWh

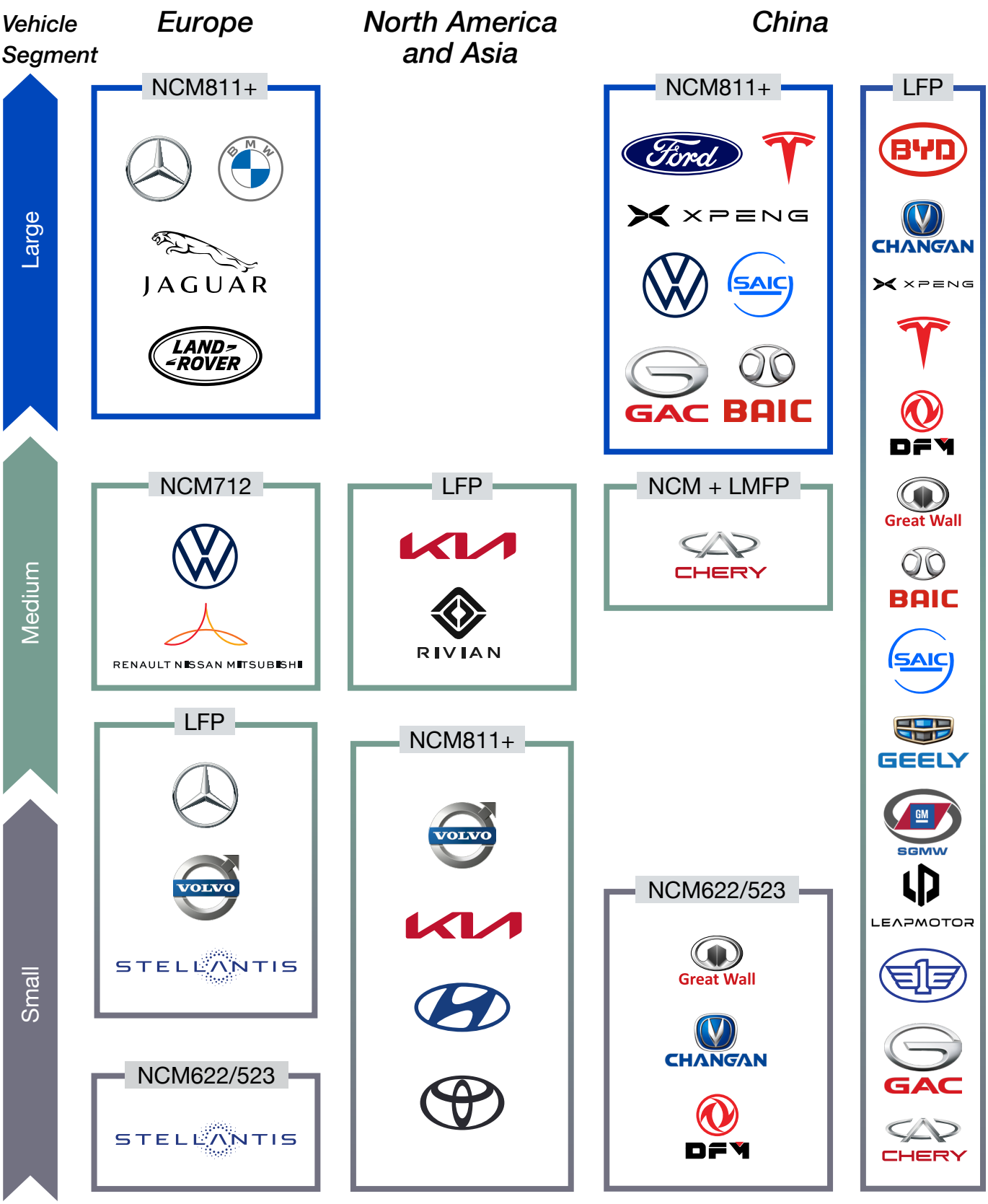


Data: Rho Motion – EV & Batttery Outlook.

The roadmap for new models in the major regions also reinforces this dynamic with European OEMs favouring mid-nickel NCM, North America and Asia favouring high-nickel NCM, and China remaining dominated by EVs using LFP, whilst also utilising Ni-Co chemistries for larger vehicles.

Recently heightened tariffs from the Trump administration on Chinese imports, and China proposing restrictions on battery technology exports including LFP intellectual property, will present further barriers to faster LFP adoption in the US and Europe in the near term.

Figure 10: OEM chemistry roadmap – upcoming releases by region



Data: Rho Motion.

A SHIFT TO HIGH VOLTAGE MID-NICKEL CHEMISTRIES PROVIDES POTENTIAL FURTHER DEMAND SUPPORT FOR COBALT

In recent years, cathode technology developments have seen a move towards lower cobalt intensity within NCM chemistries – by moving from mid-nickel to high-nickel NCM. This was primarily to reduce cost, increase energy density and considering responsible sourcing and sustainability concerns. While it seemed that this trend of cobalt thrifting would continue, the recent developments in high-voltage mid-nickel chemistries may shift the outlook.

Since early 2024, high-voltage (HV) mid-nickel cathode materials have been in development to combat stability and safety issues possible with high-nickel NCM, as cobalt content is reduced. The Ni content of HV mid-nickel cathode active materials (CAM) is usually between 50-70% (compared to >80% for NCM811) – the lower Ni content is offset by operating at a higher voltage, resulting in significant improvements in energy density. Processing is similar to high-nickel NCM but with differing calcination conditions and higher operating voltages are possible with minimal modifications to the composition. Various methods are employed to enable higher voltages. The most common strategy is the use of single crystals to reduce the risk of microcracking which can occur in Ni-rich CAM – leading to degradation and possible heat generation. Electrolyte and surface modifications and doping are also used.

Developments in high-voltage mid-nickel chemistries gathered pace throughout 2024 and are now expected to slow down the growth of high-nickel chemistries, initially in China before having an impact elsewhere. Low cobalt and nickel prices in 2024, paired with the energy density gains from operating at high voltage, are fast making the chemistry popular amongst cell manufacturers and OEMs, with reports of increasing cathode orders from Tier 1 cell producers.

Chinese and South Korean producers have led the development of HV materials, including Reshine, XTC and ZEC, amongst others. Bamo, a subsidiary of Huayou Cobalt, and Brunp, a CATL subsidiary, are also producing HV mid-nickel materials. Battery producers including CATL, EVE, Sunwoda and CALB are already using HV mid-nickel CAM, with LGES also expected to start operations in 2025. Many of CATL's EV customers have reportedly already switched from high-nickel to HV mid-nickel. As major players continue to innovate and scale production, these materials will play a pivotal role in shaping the future of efficient, high-performance EV batteries.

Due to the rapid advancements in HV mid-nickel technology and rising adoption by major downstream players, the expected future market share of high-nickel NCM has fallen, with HV-mid nickel gaining.

The average cobalt intensity of mid-nickel NCM is more than double that of high-nickel, so the **shift to mid-nickel chemistries provides potential further demand support for cobalt.**

Figure 11: Benefits of high voltage (HV) mid-nickel over high-nickel

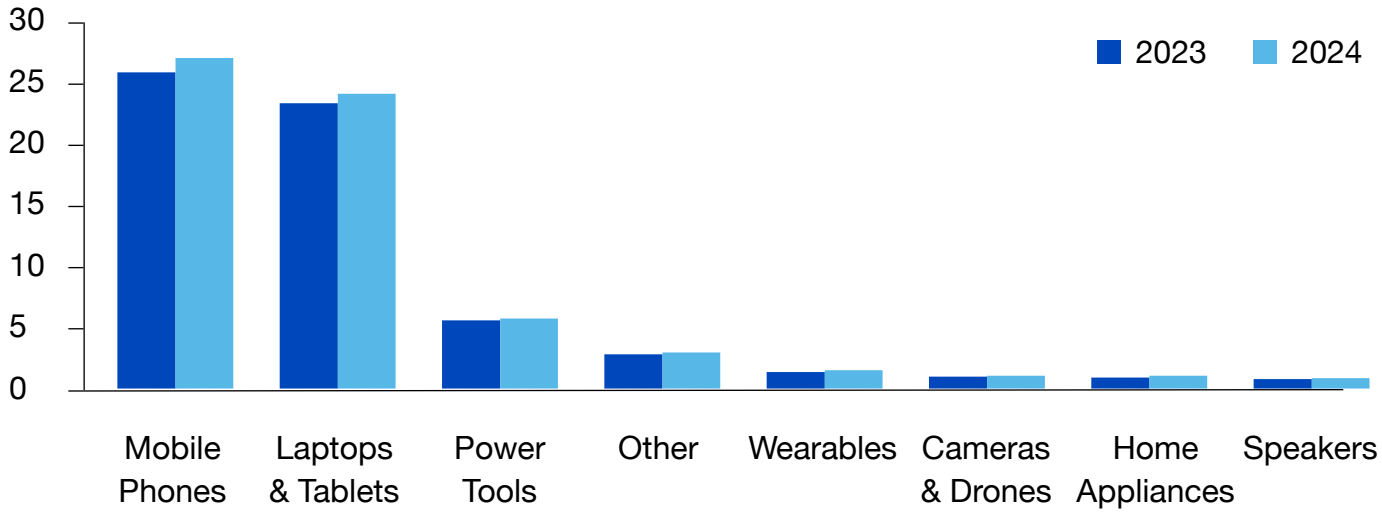
3.4 COBALT REMAINS FIRM IN THE PORTABLE ELECTRONICS MARKET

2024 was the strongest year ever in the portables markets after several years of turbulence post-pandemic and macroeconomic headwinds. Battery demand from portables rose to 72 GWh, up by 7% y-o-y, and 5% higher than the previous peak in 2021.

Cobalt benefitted from this recovery due to the reliance on cobalt in many portable electronics batteries. Cobalt demand rose by 12% y-o-y, the strongest growth seen in this sector since 2019. Demand increased to 67kt, surpassing the previous high of 62kt in 2021. Portable electronics accounted for 30% of cobalt demand in 2024, a similar share compared to 2023.

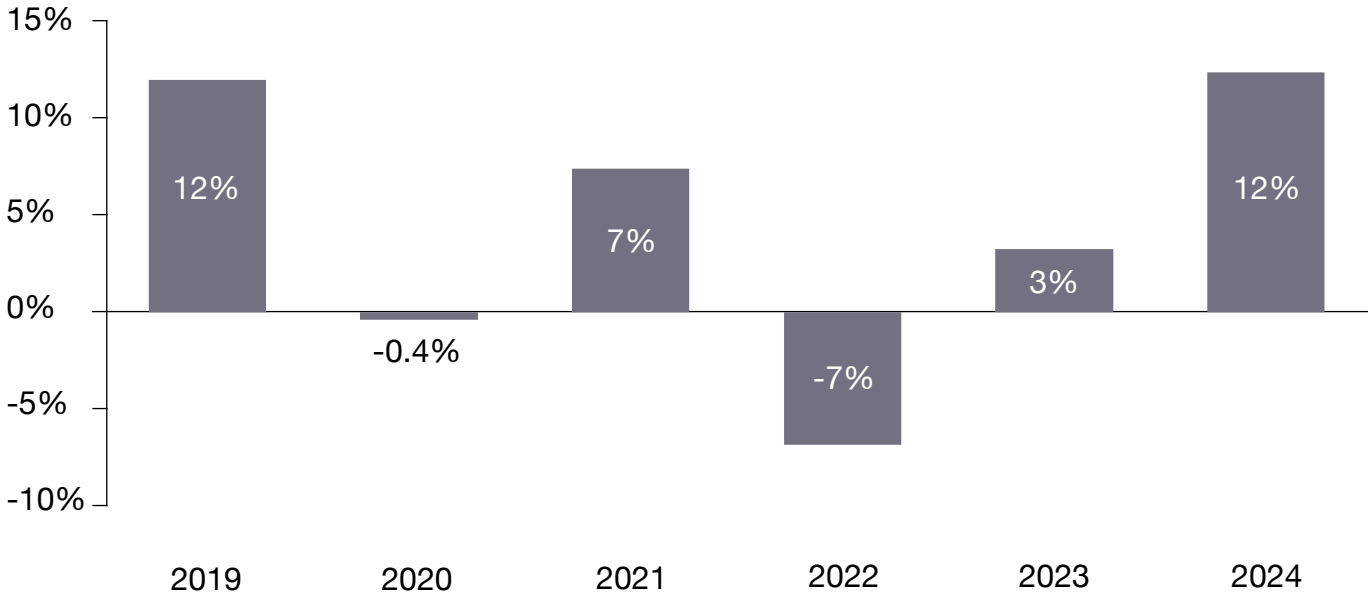
Lithium cobalt oxide (LCO) chemistries account for ~96% of cobalt demand from portables. LCO chemistries (predominantly in pouch cells) continue to dominate consumer electronics applications – mobile phones, laptops, wearables and cameras. LCO is the chemistry of choice owing to its inherent safety and stability compared with other battery types, which is essential for consumer applications. Larger portables, including power tools and home appliances, are using a larger variety of cell chemistries although LCO still has the largest share of this sector. Mobile phones, laptops, tablets and power tools remain the largest sectors for cobalt consumption.

Figure 12: Cobalt demand by portables sector, kt Co



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

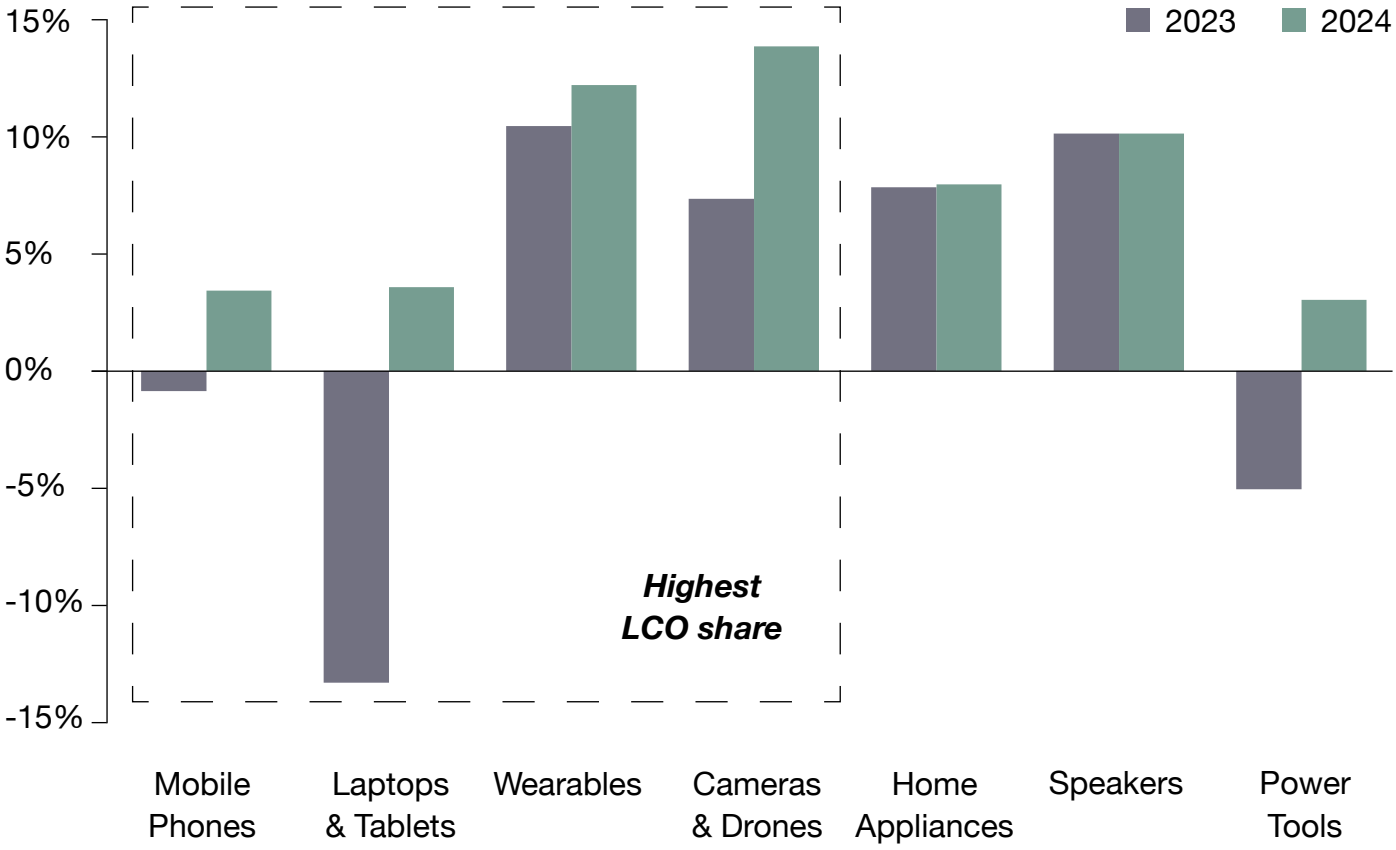
Figure 13: Growth in cobalt demand from portables, % y-o-y



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

A widespread recovery in sales was seen across all portables sectors in 2024, particularly for mobile phones, laptops, tablets and power tools, sales of which had declined in 2023. Improvements in economic conditions supported smartphone and laptop sales in 2024.

Figure 14: Annual growth in portables sales (units) by sector, %



Data: Benchmark Mineral Intelligence & Rho Motion.

MOBILE PHONES

In 2023, the mobile phones sector accounted for the largest share of portable battery demand at 34% due to the dramatic decrease in the laptop and tablet market – this share was maintained in 2024. The Chinese smartphone market reported a fourth consecutive quarter of expansion in Q3 2024 driven by a wave of device upgrades. Smartphone demand in Europe and North America recovered more quickly than expected in 2024 following economic stabilisation and top-tier vendors introducing innovative models in their portfolio, including new AI technologies (discussed further below).

Future demand for smartphones is expected to be fuelled by emerging economies with more limited growth in mature markets such as North America, Europe and China. Currently only 20-25% of the global population have subscribed to 5G services – further adoption will drive smartphone replacement demand in future.

LAPTOPS AND TABLETS

In 2022, as economies began to reopen following Covid-19, there was a downward adjustment in laptop and tablet sales after the pandemic peak. Subsequent inflation and cost of living pressure then put further pressure on sales. In 2023, sales dropped sharply by 13% y-o-y. However, the market saw the beginning of a recovery in early 2024 with sales ramping up again – laptop and tablets sales rose by 4% y-o-y.

Demand for laptops and tablets is expected to be driven by the service sector expansion and increasing digitalisation in businesses globally, with tablet use rising in education and healthcare sectors.

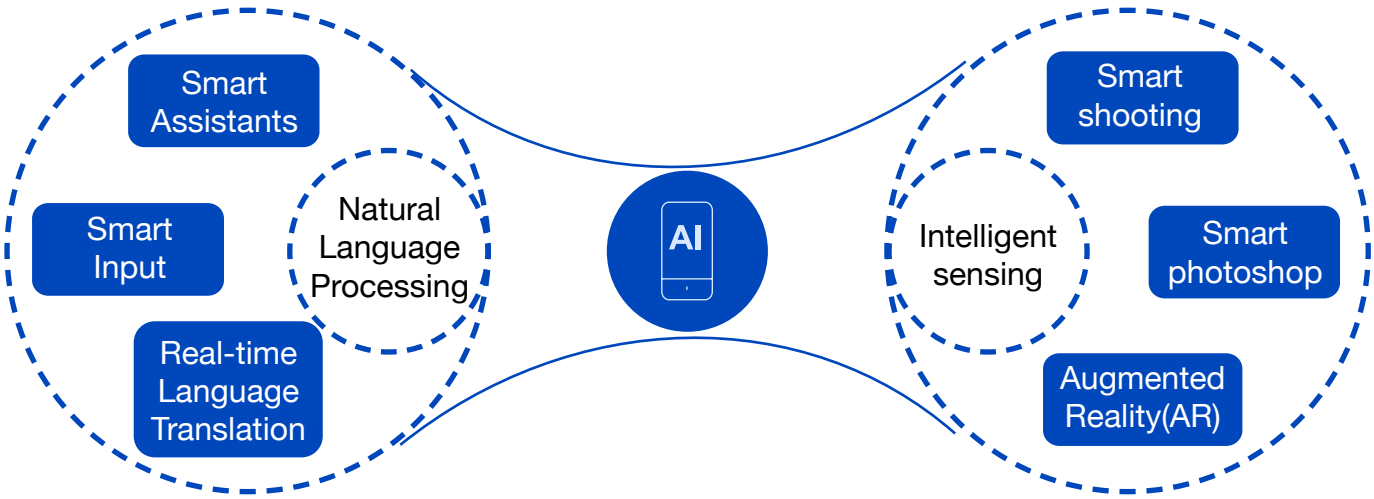
ARTIFICIAL INTELLIGENCE (AI) TECHNOLOGIES TO BOOST PORTABLES DEMAND

AI is increasingly being applied to smartphone improvements, covering numerous applications including smart assistant, real-time language translation, smart photography, photo edits and augmented reality. Alongside improving sentiment and overall market demand, this is expected to require larger battery sizes due to higher computational demands, background processes and data volumes. Phone battery capacities have not markedly increased in recent years, reinforcing the need for enhancements.

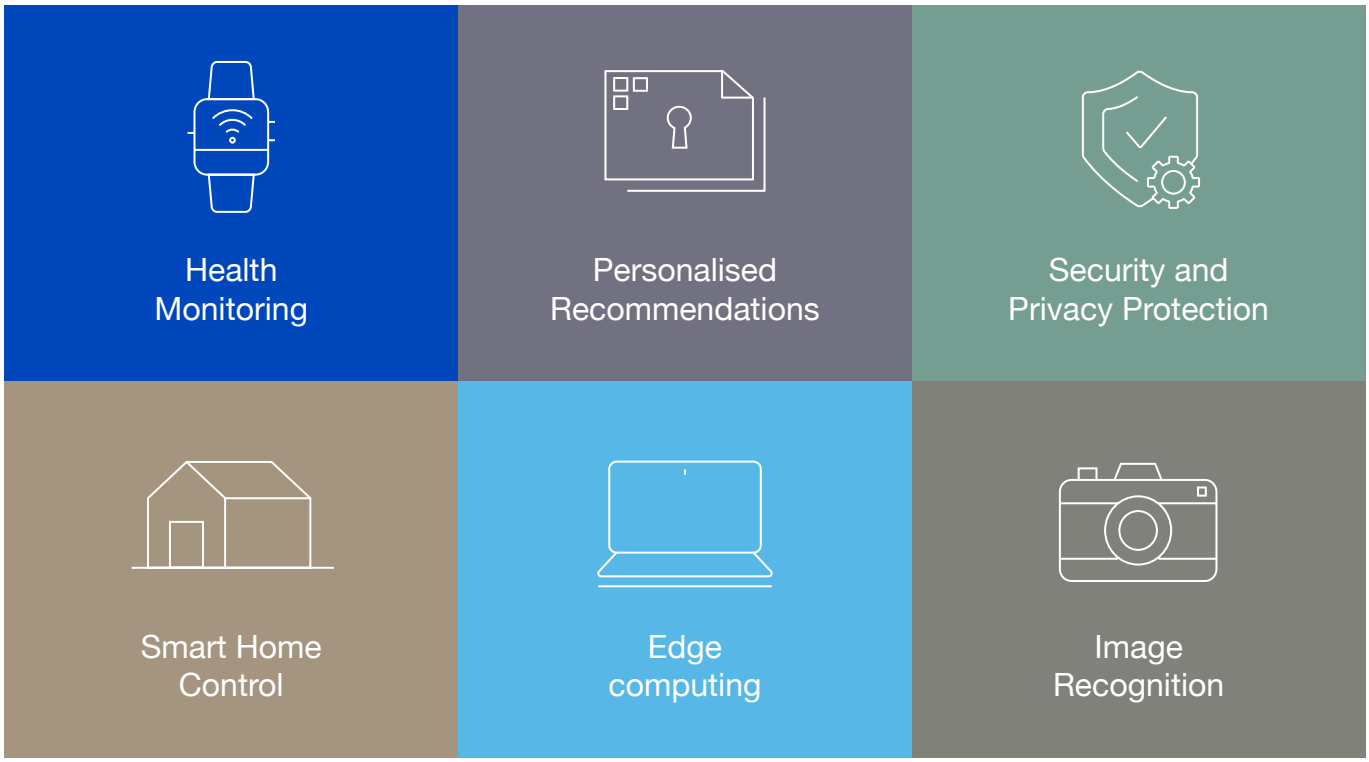
AI-capable PCs are capturing a growing share of total sales with further penetration driven by refresh cycles and processor roadmaps. The wearables market is also benefitting from new AI features, further supporting demand following accelerated interest in health-focused wearables after the pandemic.

Europe is witnessing a growing trend of investment in AI, especially in generative AI which is expected to drive smartphone demand in the region in the medium term.

Figure 15: Overview of AI technologies in portable electronics



Other AI functions:



Data: Rho Motion.

3.5 BATTERY ENERGY STORAGE SYSTEMS (BESS) SEE STRONG GROWTH ALTHOUGH COBALT INTENSITY REMAINS LOW

Battery demand from the energy storage sector continues to grow at pace with global demand up by 56% y-o-y in 2024, outpacing percentage growth from EVs and reaching 193 GWh. The BESS share of total battery demand now sits at 16%, up from 5% in 2021.

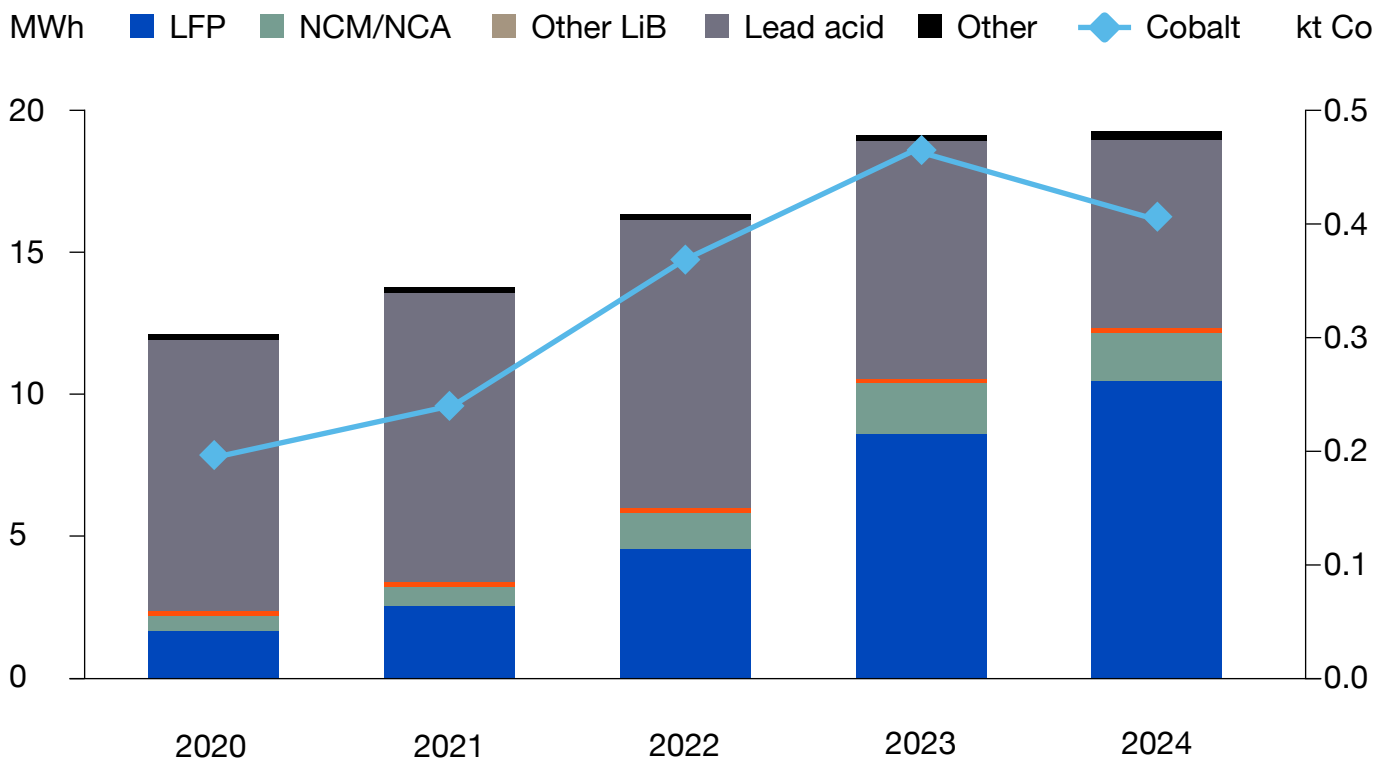
For cobalt, BESS is currently a small sector – at just 2% of total demand – totalling 3.7kt of demand in 2024 (+19% y-o-y). This sector primarily uses LFP and other cobalt-free chemistries, however BESS applications will still support cobalt demand growth in the short term and overtake some of the smaller non-battery applications.

In addition to its influence on demand growth for portables, AI is also a driver of one BESS subsegment. Uninterruptible Power Supplies (UPS) are used for applications including telecoms and data centres. These applications have historically been heavily dominated by lead-acid batteries or diesel generators, but these are increasingly being replaced by lithium-ion batteries. Globally there are over 9,000 data centres – these require UPS to eliminate down time and battery UPS systems are the most common type. The batteries used in UPS systems are extremely durable

high thermal stability. Energy density is not the key consideration here, thus LFP batteries are likely to be most relevant, however high power will also be required. Each data centre on average has 5,000 servers and each server requires a 13kWh battery UPS system.

Although this segment has seen growth, its makeup has shifted from lead-acid dominant to LFP-dominant, with comparatively little room for NCM chemistries. As a result, cobalt demand from this segment is very small, at much less than 1ktpa.

Figure 16: UPS installations (LHS) and cobalt demand (RHS), MWh and kt Co



Data: Rho Motion & Benchmark Mineral Intelligence.

3.6 COMMERCIAL AVIATION THE BEST PERFORMER OF THE NON-BATTERY APPLICATIONS

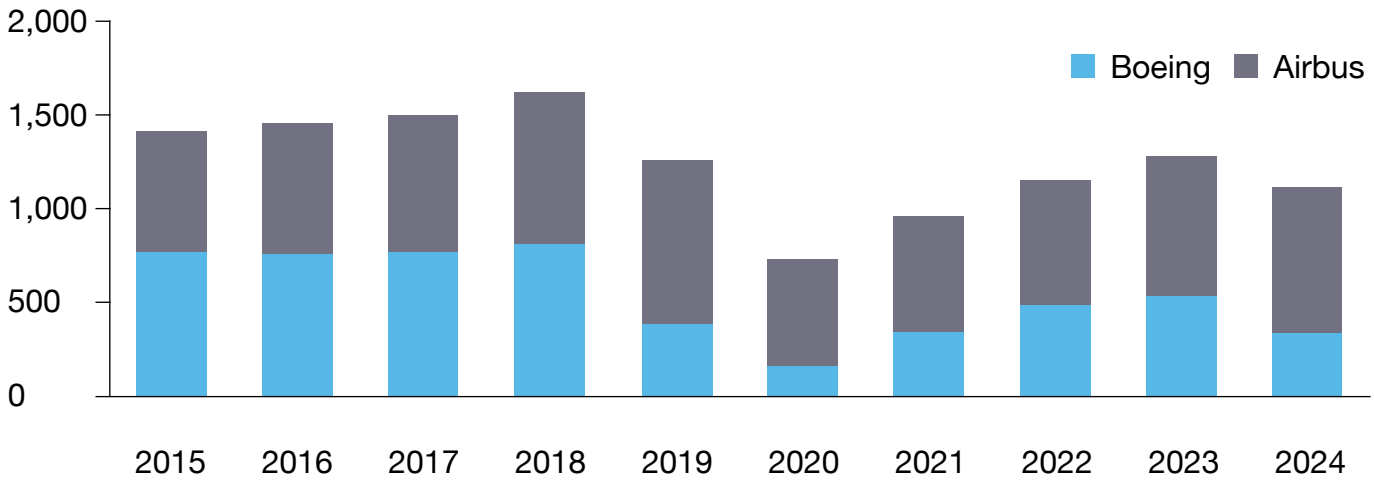
The largest non-battery cobalt application is superalloys, which are primarily used in commercial and defence aerospace applications. While defence uses are strategic, a larger share of superalloy – and therefore cobalt – demand comes from commercial aviation, a segment that is set to see steady projected growth.

Both Boeing and Airbus in their respective 2024 outlooks anticipated global commercial deliveries of over 40,000 aircraft from 2024-2043. Commercial aircraft deliveries from Boeing and Airbus were just under 1,100 units in 2024, down by 13% from the almost 1,300 delivered the

the previous year. But the decline was entirely because of Boeing, which delivered 495 fewer aircraft y-o-y. In comparison, Airbus' deliveries of 766 units were up by 4% compared with 2023. Although total deliveries were down, the disconnect between jet engine production and aircraft deliveries, as well as a boost from defence spending (see Section 3.7), meant overall, superalloy demand for cobalt grew by 5% y-o-y to reach 18.5kt in 2024.

And Boeing deliveries have picked up in the first two months of 2025, outpacing Airbus in both narrowbody and widebody deliveries, although US tariffs on steel and aluminium present a risk to production.

Figure 17: Boeing and Airbus commercial deliveries, units



Source: Boeing, Airbus.

3.7 MILITARY DEMAND FOR COBALT GROWS ON DEFENCE UPTICK

Cobalt demand for defence applications continues to grow strongly. This demand can be broadly split into metal (superalloys), battery and magnet applications.

Superalloys can operate at high fractions of their melting points, and as a result are of common use in high-temperature applications such as jet engines. Several types of superalloys are in use, including nickel-based superalloys – which although nickel-rich do contain varying amounts of cobalt – and cobalt-based superalloys, which are much more cobalt-rich.

Superalloys are used in both commercial and military aircraft applications. In addition to their use in aircraft, nickel- and cobalt-based superalloys are also found in integrated full electric propulsion systems (IEPs) for aircraft carriers. These propulsion systems use a combination of diesel generators and/or gas turbines to generate an AC current which then runs through a frequency convertor before being used to power electric motors, which turn either impellors or propellers. The gas turbines operate at high temperatures and therefore require superalloys.

Battery applications for defence include a number of portable uses, including:

- **Portable communications devices**, such as tactical radios and tablets.
- **Wearable electronics,** such as night-vision goggles, helmet-mounted displays and body-worn sensors.
- **Unmanned systems** such as drones, robotics and ground systems.
- **Optics,** including smart optics and scopes and directed energy weapons.

The increased use of portables for military applications has been driven by soldier modernisation programmes – such as US and Canadian investments in future soldier systems, as well as battery technology improvements with higher energy density and durability. And the integration of AI and machine learning in unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs) and smart optics marks a push towards AI and autonomous applications.

There are also several military applications across the EV space, particularly in non-road mobile machinery (NRMM) and eMicromobility (eMM) applications. For NRMM, key applications include tactical and non-tactical vehicles.

Like general ICE vehicles, tactical vehicles are fit with a 12V or 24V battery – these have historically been lead-acid. Tactical vehicles are typically fit with two or more such batteries, with each battery serving a different function. The primary function is to store energy to ensure that that the engine starts and remains running, while also providing power to the vehicle's electrical system to ensure key functions such as lighting work before the engine is turned on.

The second function, which is served by any additional batteries, provides power to the vehicle's electrical system when it is performing a "silent watch" operation. This allows the vehicle to sit in silence to gather enemy intelligence without reliance on the engine. These additional batteries typically mirror the format and chemistry of the primary 12V or 24V battery.

TSeveral companies are developing lithium-ion battery packs for military applications. Epsilor, a subsidiary of American defence company Arotech Corp., provides vehicle batteries with either NCA or LFP chemistries. In August 2023, Epsilor was awarded a contract to supply the Australian Government with its lithium-ion vehicle battery for self-propelled artillery systems.

TMilitaries are already electrifying their fleets of non-tactical vehicles. These are the vehicles not designed to military specifications and are registered for use on the road. The US Army is aiming to operate an all-electric non-tactical light-duty vehicle (LDV) fleet by 2027, with a full all-electric non-tactical fleet by 2035, although this faces potential rollbacks from the Trump administration.

The electrification of non-tactical vehicles is easier than the electrification of tactical vehicles for two primary reasons:

1. There is no technological development required for the vehicles. Non-tactical vehicles can be purchased on the civilian vehicle market.
2. Charging is less of a concern. They are not used in remote locations and so charging infra structure can be installed on military bases to charge the vehicles. Equally the vehicles can rely on public charging infrastructure when they are out on the road.

Bikes are set to be the main driver for military eMM applications. Militaries have long had an interest in high speed micromobility. Their low weight allows them to be airdropped into conflict areas on land at short notice.

Beyond superalloys and battery applications, other key military applications of cobalt include samarium-cobalt (SmCo) magnets used in sensors, avionics, and actuators, as well as in some electric motor applications.

Table 1: Cobalt use in defence applications

Application	Component	Segment	Material
Aircraft/Helicopter	Combustor	Superalloys	Ni/Co superalloy
	Sensors/Avionics	Magnets	SmCo
Missiles	Propulsion system	Magnets	SmCo
	Control actuator	Magnets	SmCo
Aircraft Carriers	Integrated full electric propulsion	Superalloys	Ni/Co superalloy
	Propulsion with outboard electric motors	Magnets	SmCo
Corvettes/Frigates /Submarines	Electric motors	Magnets	SmCo
Drones	Batteries	Batteries	LCO

Source: The Hague Centre for Strategic Studies, Benchmark Mineral Intelligence.

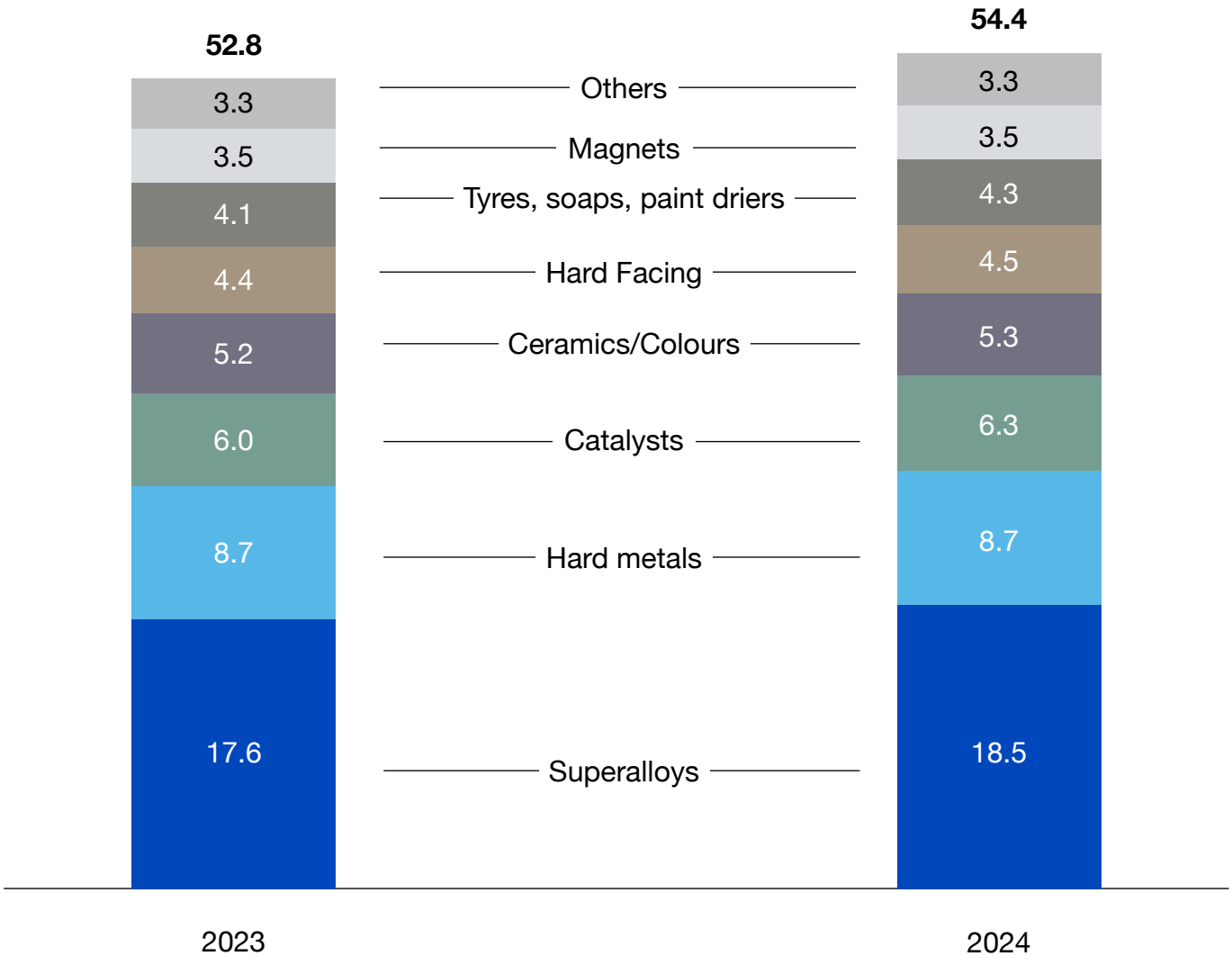
Overall, the use of cobalt in defence applications – particularly in the form of superalloys and magnets – is of increasingly visible importance. In 2024, NATO endorsed a supply-chain security roadmap listing cobalt as being of high supply risk for military applications.

The Trump administration's critical minerals policies, as well as tensions with other regions such as Europe, mean strategic and defence applications of critical minerals are likely to become more important to those markets.

3.8 OVERVIEW OF INDUSTRIAL APPLICATIONS

Total industrial demand for cobalt grew from 52.8kt in 2023 to 54.4kt in 2024 – an increase of 3%. Higher growth from the superalloys sector was offset by more conservative gains elsewhere. Catalysts saw solid growth of +3.1% y-o-y in 2024, while ceramics, colours, tyres, soaps and paint driers all saw growth of +2.5%. Magnets and hard-metal applications saw weaker growth.

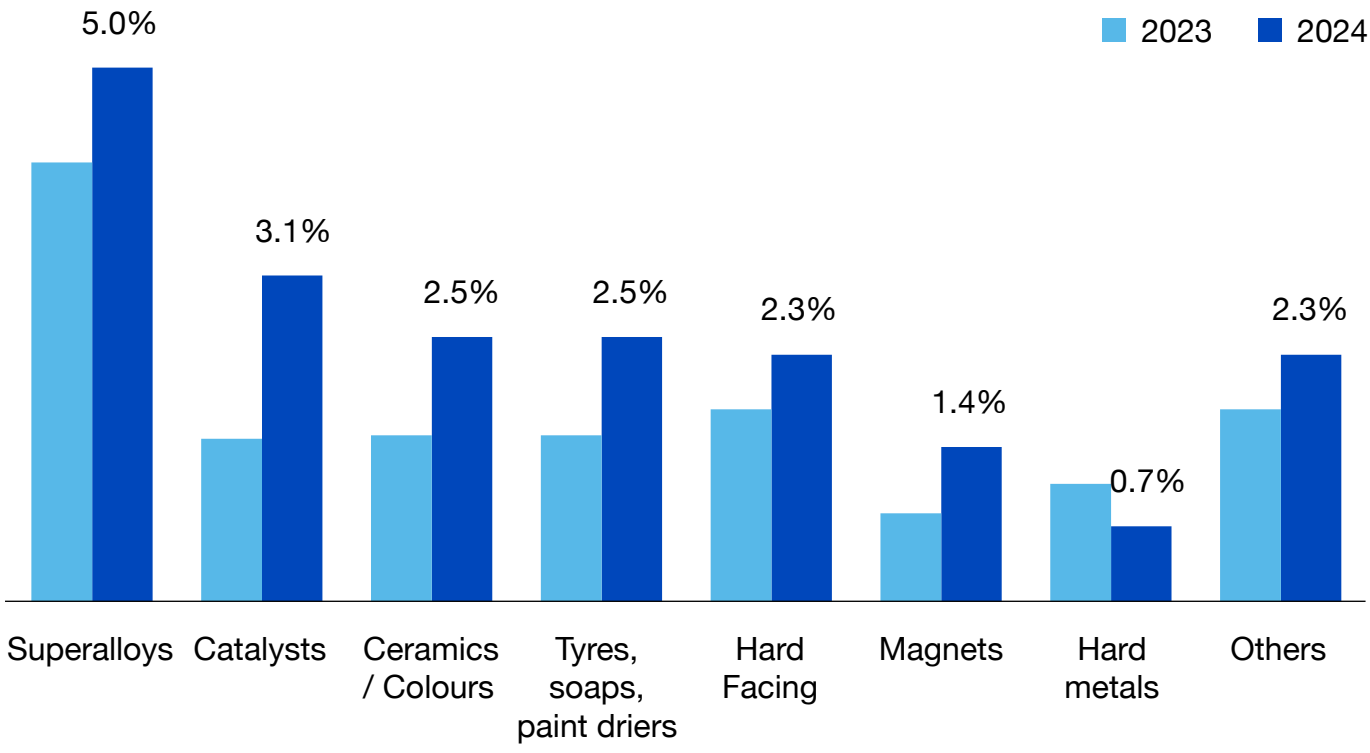
Figure 18: Demand from non-battery cobalt end uses in 2023 and 2024, kt cobalt



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Although industrial applications of cobalt command a lower market share of total demand than battery uses – and offer less dramatic opportunities for growth – they remain an important, and in many cases, strategic demand segment, and their steady growth can offer secure demand support for certain refined product types (e.g. rounds for superalloy applications). As broader battery demand, while growing at higher rates, can face volatility in some instances (e.g. in the face of policy shifts), many industrial applications, albeit smaller, may be on more solid ground.

Figure 19: 2024 annual cobalt demand growth by non-battery sector, % y-o-y



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

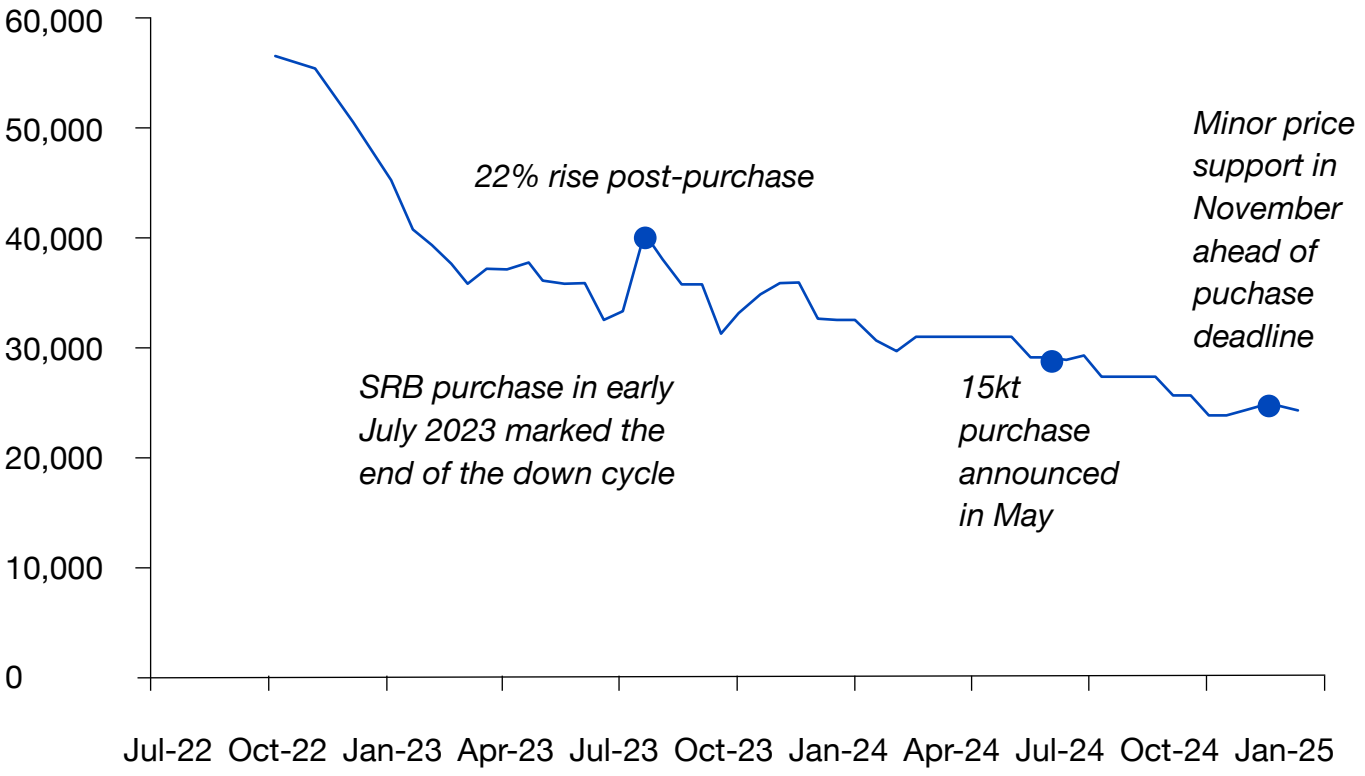
3.9 CHINA'S NDRC PURCHASING AT RECORD LEVELS WHILST PRICES AT RECORD LOWS

China's National Development and Reform Commission (NDRC) – formerly the State Reserve Bureau (SRB) – received approximately 16.6kt of cobalt in 2024, up from an estimated 7.2kt in 2023. An unprecedented ~15kt was purchased in H2 2024, in addition to ~1.6kt remaining from 2023 purchasing – equivalent to 7% of total demand in 2024. With the market in oversupply, the purchase also helped to reduce potential oversupply from >50kt to around 36kt.

News of a purchase for China's strategic stockpiles typically marks the floor for cobalt prices, as the intention to buy a large tonnage helps alleviate some of the oversupply. Additionally, it shows a belief by the Chinese government that prices are at their lowest point. This was the case in 2023 when the purchase marked the end of a prolonged down cycle.

However, in 2024, prices were already at historic lows and the market remained in structural oversupply. Prices stabilised somewhat in the mid-year as rumours built around a large upcoming purchase, but failed to materially rebound. Metal prices also experienced some brief support in November as metal availability tightened whilst Chinese refiners aimed to reach the end-November deadline, and European imports from China slowed. Some refiners were also reportedly forced to purchase volumes from the Wuxi Exchange to supplement lower production volumes following quality issues.

Figure 20: Cobalt metal prices – EXW Europe, $/tonne



Data: Benchmark Mineral Intelligence – Cobalt Price Assessment.

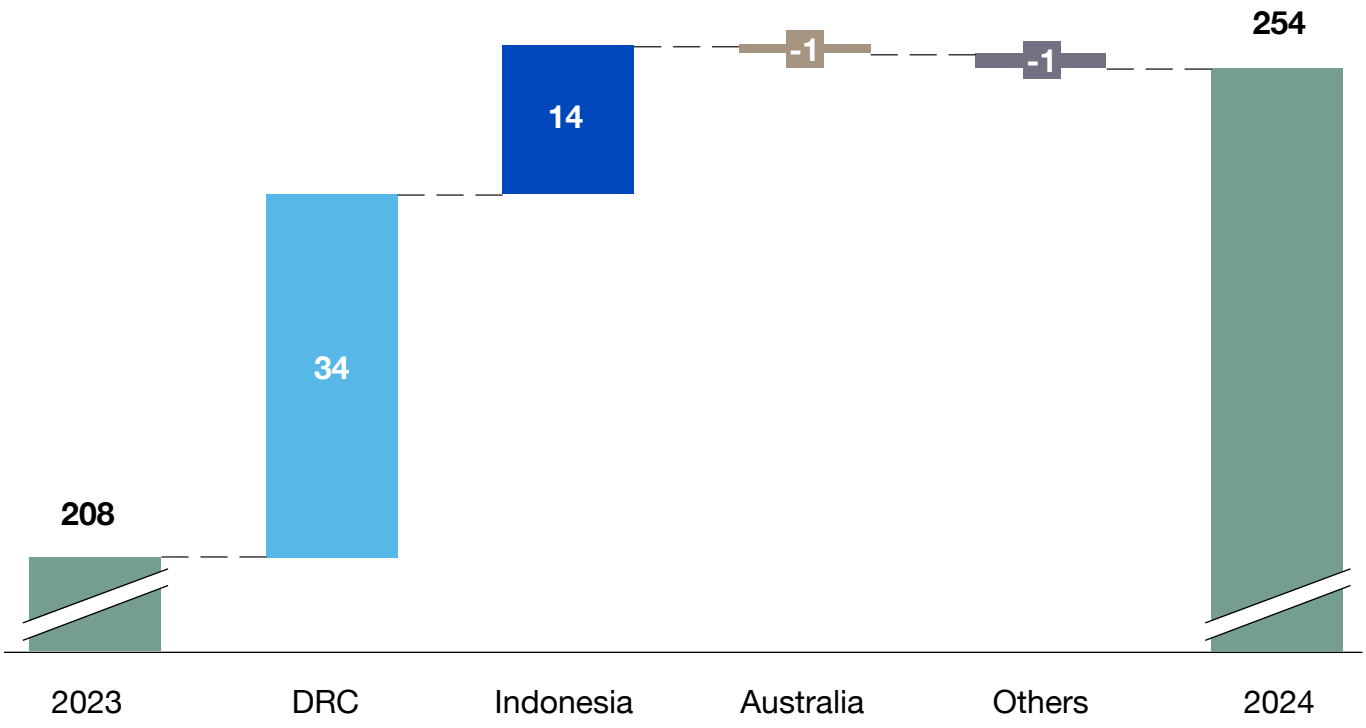
4. SUPPLY REACHES NEW HIGHS AS CMOC RAMPS UP KFM OUTPUT

4.1 OVERVIEW OF MINED SUPPLY

Cobalt is mined primarily as a by-product of copper and nickel, with some small volumes as primary cobalt or as a by-product of platinum-group metals (PGM) production.

Cobalt mined supply exceeded 250kt in 2024, with total output up +22% y-o-y to 254kt (equivalent to +46kt). The Democratic Republic of the Congo (DRC) was the biggest producer, accounting for 76% of mined output, with its contribution growing by +34kt compared with 2023. The increase in DRC output was primarily owing to the ramp up of CMOC's assets, especially its Kisanfu (KFM) site. In total, CMOC produced 26 kt more than its stated DRC capacity.

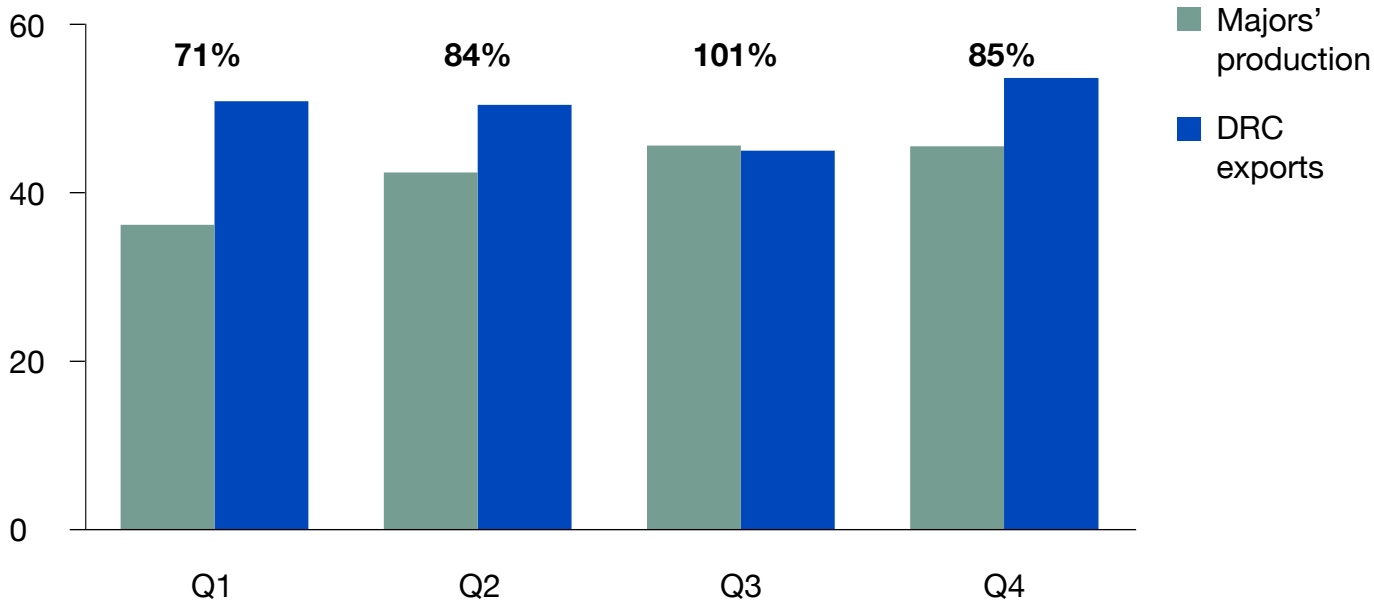
Figure 21: Mined cobalt supply, 2024 vs 2023, kt Co



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

CMOC, Glencore and ERG, as the three largest, "major" producers, provided an outsized contribution to the DRC's cobalt industry even before the KFM ramp up. But with it, their share of DRC production – and particularly of exports – has become even greater. In 2024, supply from these three majors was equivalent to 85% of DRC exports, with low supply from non-majors set to continue throughout 2025.

Figure 22: DRC majors' production vs DRC exports in 2024, kt Co

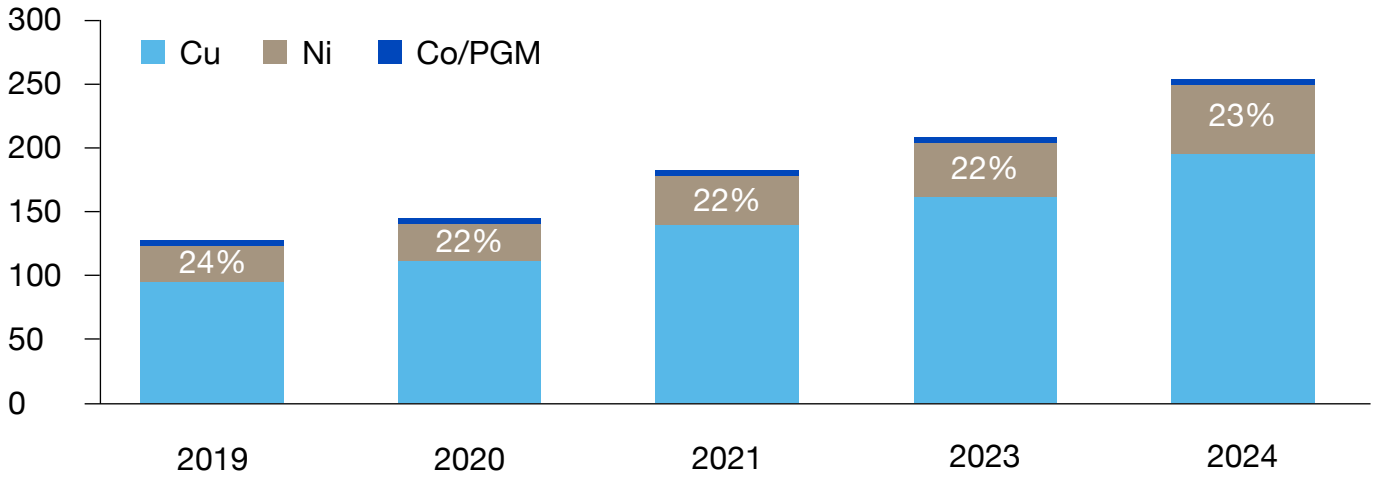


Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Indonesia was the second-largest producer, accounting for 30kt (+82% y-o-y), with growth in the country driven by several HPAL operations. Other countries supplied comparatively small amounts. **Despite the strong growth from Indonesia – where all cobalt is mined as a by-product of nickel – the share of nickel vs copper as the primary mineral has remained fairly stable, with the explosion of Indonesian HPALs keeping step with CMOC's copper-cobalt build-out.**

PGM-by-product cobalt and primary cobalt remain extremely small contributors to total supply.

Figure 23: Mined cobalt supply by primary mineral, kt Co



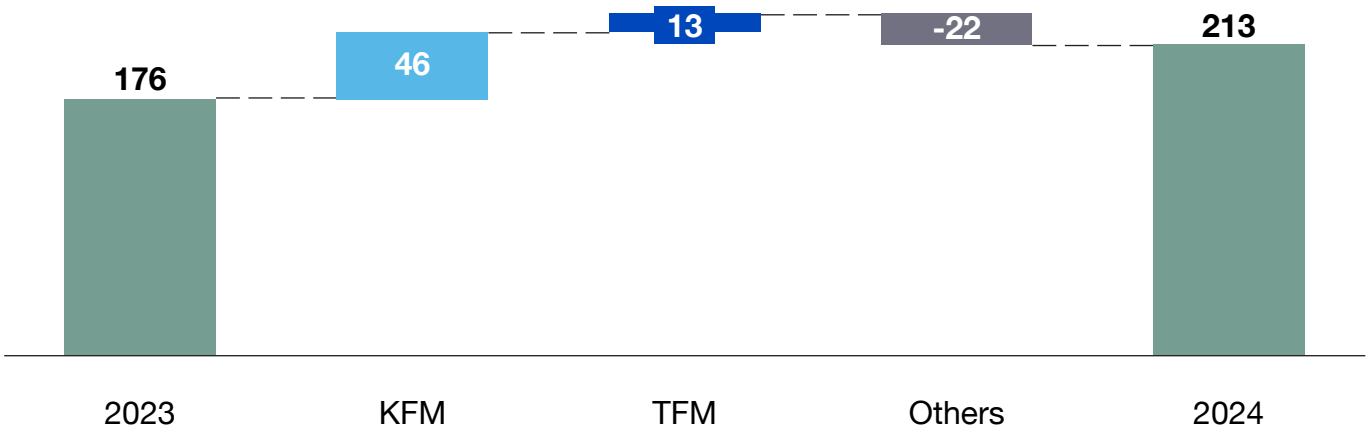
Data: Benchmark Mineral Intelligence – Cobalt Forecast.

4.2 DRC DEVELOPMENTS

CMOC BEATS EXPECTATIONS

The story of 2024 cobalt mine supply begins and ends with CMOC. The company operates two copper-cobalt (Cu-Co) assets in the DRC – Tenke Fungurume (TFM) and Kisanfu (KFM), the two largest operations globally. Both beat guidance and expectations for cobalt and copper output in 2024.

Figure 24: DRC cobalt supply additions in 2024*, kt Co



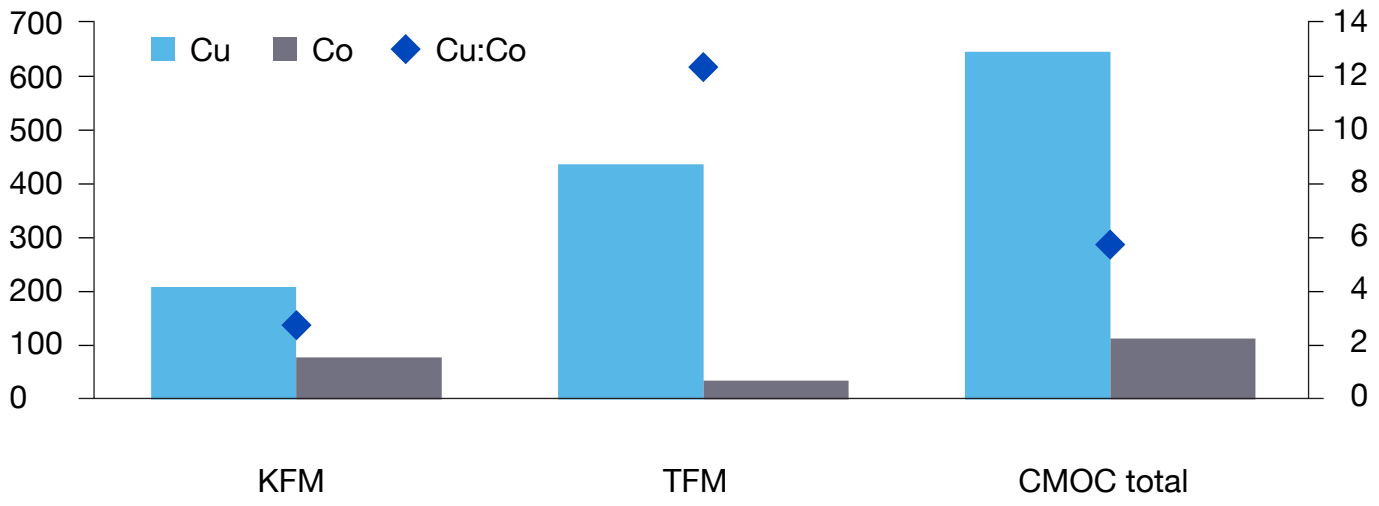
Data: Benchmark Mineral Intelligence – Cobalt Forecast.
Note: *Unadjusted for downstream yield losses.

CMOC's stated cobalt capacity at TFM is 37kt and at KFM it is 50kt, totalling 87kt. But the company produced 114kt in 2024, 31% above stated capacity. The flood of material increased the company's global market share from 24% in 2023 to 41% in 2024 – over half of DRC production. CMOC's ramp up of these assets has contributed to structural oversupply in the global market, weighing on prices.

Comparing output from KFM with other company data, it is clear that the mill feed volume was higher in 2024 than previously reported, meaning more ore was processed into copper and cobalt. It is also apparent that the asset was high-grading – that is, targeting volumes of ore that had higher cobalt (and copper) content than the life-of-mine average. Both these factors contributed to cobalt output being higher than otherwise expected in 2024.

While both KFM and TFM operated above capacity, output was particularly notable at KFM, which had only started production the previous year. The rationale behind CMOC's rapid ramp up has been brought into question, but Benchmark believes it is first and foremost a copper play. China views copper as a key strategic commodity for the energy transition – CMOC's rapid ramp up has targeted new copper units as part of this, and has also capitalised on higher copper prices.

Figure 25: CMOC 2024 copper and cobalt production (LHS) and Cu:Co ratio (RHS) for DRC operations, kt



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Copper prices soared to a record high at close to $11,000/t in early 2024, before tailing off in the latter half of the year on growing macroeconomic uncertainty – stemming primarily from China's uneven economic performance. As concentrate supply tightened, hedge funds flooded the copper market between March and June, driving prices to all-time highs. This rally was fuelled by bullish sentiment around a perceived copper undersupply. However, there was a subsequent realisation that the pronounced concentrate deficit was mainly underpinned by new smelter overcapacity in China, rather than weak mine supply.

The US Federal Reserve's decision to initiate a rate-cutting cycle in September (50 basis points, bps) provided a tailwind for copper prices. This announcement was followed by cuts in October (25bps) and December (25bps) – taking the Fed's rate from an upper range of 5.5% to 4.5% by year-end.

Copper prices were buoyed in the immediate aftermath, reversing a downward trend visible since late May. Lower interest rates typically weaken the US dollar, benefiting dollar-denominated commodities like copper. A softer dollar can make copper more affordable for buyers, increasing demand and supporting higher prices.

Because of its more holistic demand picture and broader use in the energy transition, copper is seen as more strategic, particularly for China. KFM is notable for its low Cu:Co ratio which means that for every tonne of copper mined, it yields more cobalt than is typical. In the DRC, the average Cu:Co ratio is 10:1 on a reserves and resources (R&R) basis, whereas data from CMOC showed that KFM's Cu:Co ratio at the end of 2023 was 2.2:1 (R&R basis). This means that as CMOC has ramped up ore throughput rates to pump copper out, it has also been forced to produce cobalt. The key choice facing the company – and all Cu-Co DRC producers – was whether to process the cobalt into hydroxide or dump it in tailings. And for CMOC, the decision was to produce. Every quarter of 2024 saw CMOC exceed production expectations.

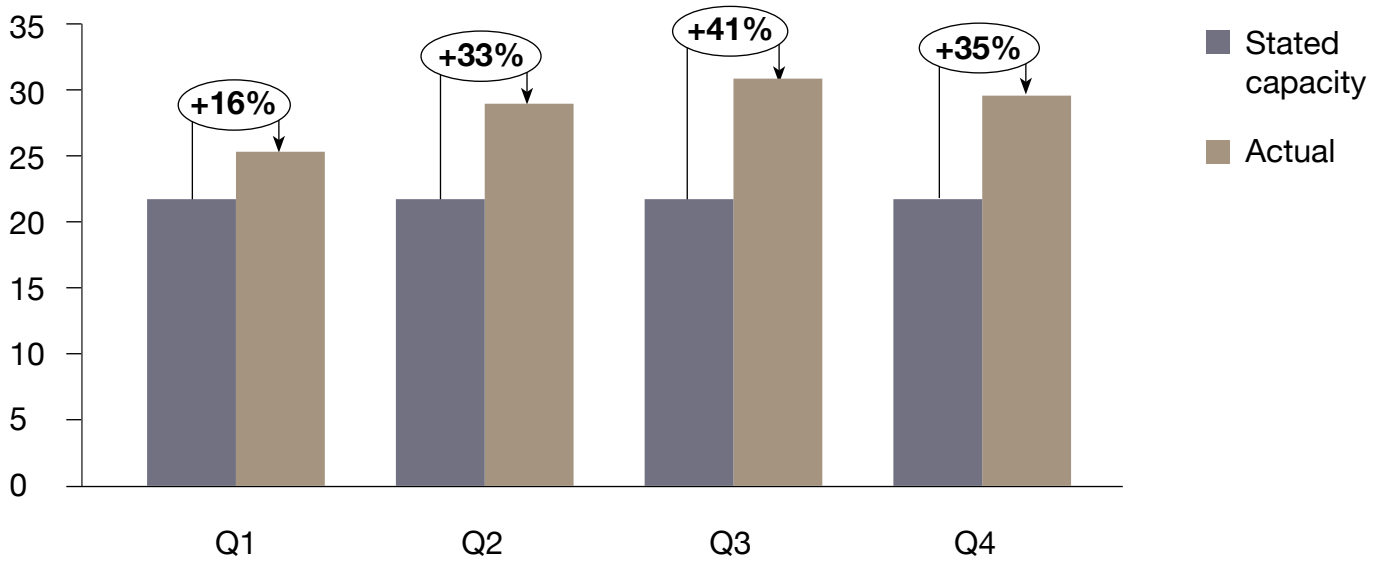
Copper prices soared to a record high at close to $11,000/t in early 2024, before tailing off in the latter half of the year on growing macroeconomic uncertainty – stemming primarily from China's uneven economic performance. As concentrate supply tightened, hedge funds flooded the copper market between March and June, driving prices to all-time highs. This rally was fuelled by bullish sentiment around a perceived copper undersupply. However, there was a subsequent realisation that the pronounced concentrate deficit was mainly underpinned by new smelter overcapacity in China, rather than weak mine supply.

The US Federal Reserve's decision to initiate a rate-cutting cycle in September (50 basis points, bps) provided a tailwind for copper prices. This announcement was followed by cuts in October (25bps) and December (25bps) – taking the Fed's rate from an upper range of 5.5% to 4.5% by year-end.

Copper prices were buoyed in the immediate aftermath, reversing a downward trend visible since late May. Lower interest rates typically weaken the US dollar, benefiting dollar-denominated commodities like copper. A softer dollar can make copper more affordable for buyers, increasing demand and supporting higher prices.

Because of its more holistic demand picture and broader use in the energy transition, copper is seen as more strategic, particularly for China. KFM is notable for its low Cu:Co ratio which means that for every tonne of copper mined, it yields more cobalt than is typical. In the DRC, the average Cu:Co ratio is 10:1 on a reserves and resources (R&R) basis, whereas data from CMOC showed that KFM's Cu:Co ratio at the end of 2023 was 2.2:1 (R&R basis). This means that as CMOC has ramped up ore throughput rates to pump copper out, it has also been forced to produce cobalt. The key choice facing the company – and all Cu-Co DRC producers – was whether to process the cobalt into hydroxide or dump it in tailings. And for CMOC, the decision was to produce. Every quarter of 2024 saw CMOC exceed production expectations.

Figure 26: CMOC DRC 2024 cobalt production vs stated capacity, kt Co



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

The DRC export ban (discussed further in Section 7.2) casts uncertainty on both the response in 2025 from CMOC, and that of other producers. It remains to be seen whether those assets that shut down production in 2024 will attempt to reopen to reap the price gains when or if the borders reopen, and some players that persisted through 2024 could face cash-flow issues from their inability to export, and could in fact shut down in the short-term.

OTHER DRC PRODUCERS CUT OUTPUT

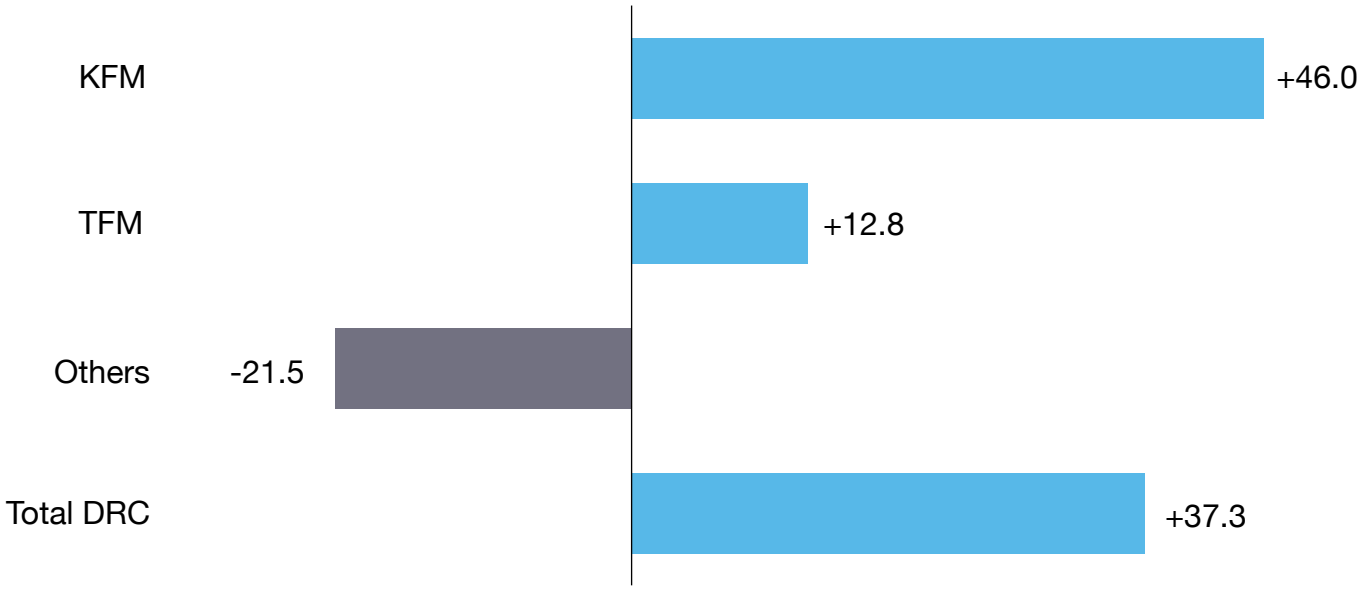
CMOC's increase in output came as several other operations curtailed cobalt production in the DRC.

Glencore, the second-largest cobalt miner, reported global cobalt production of 38kt, down by 8% from 41kt in 2023. This included 27kt at its KCC site and 8kt at Mutanda – both DRC operations. The company also updated guidance for 2025 to 40-45kt and 2026 to 45kt, both lower than previous guidance. Benchmark estimates the third largest miner, ERG, produced 19.5kt at its Metalkol RTR operation in 2024, compared with 20kt in 2023.

Other, smaller producers in the DRC reacted differently to the increasing pressure from the low-price environment. China Railway Resources Group's' MKM asset shut its cobalt line completely and did not produce at all during the year – although it continued to produce copper. Big Hill, owned by Société du Terril Lubumbashi (STL), also shut cobalt production during the year as the company focused on germanium recovery. And although it only ramped up in 2024, MMG's Kinsevere site shuttered cobalt production in early 2025 following pressure from low prices.

Without CMOC, cobalt output from the DRC declined by more than 20kt y-o-y in 2024.

Figure 27: Change in DRC mine production*, 2024 vs 2023, kt Co



*Note: mine production shown not including downstream yield losses.

Data: Benchmark Mineral Intelligence – Cobalt Forecast.

ARTISANAL MINING DROPPED TO A HISTORIC LOW

As a result of the prolonged low-price environment, coupled with increasing attempts at formalisation, artisanal and small-scale cobalt mining (ASM) – a very price-sensitive segment – in the DRC has dropped to a historic low, both in absolute and relative terms.

Owing to the intrinsic lack of reporting associated with artisanal production, it is difficult to exactly quantify volumes from the sector, but small-scale production (including artisanal and some small non-artisanal mining) volumes have declined in recent years.

In 2018 – when cobalt metal prices peaked at over $40/lb – the share of small-scale miners was ~10% of DRC output. **By 2024, with the significant rise in DRC (and global) supply, Benchmark estimates the ASM share dipped to less than 2% of DRC production or approximately 1% of global.**

Artisanal production will remain highly price elastic – volumes will rise in line with price volatility and ASM supply is likely to increase in early 2025 as cobalt prices have risen following the export ban. **Due to the now much larger volumes of industrial mining in the DRC than in the past, even with potential rising prices in future, the ASM share will still not recover to its previous market share.**

Recent measures introduced by the DRC government, and announced by the Authority for the Regulation and Control of Strategic Mineral Substances' Markets, known as ARECOMS, are set to significantly influence the mining and processing of artisanal cobalt ore. These include reiterating exclusive rights held by the Entreprise Générale du Cobalt (EGC) to purchase and export hand-dug cobalt, adopting EGC's responsible sourcing standard as national policy, and granting EGC special rights to operate ASM concessions under lease, alongside a strict prohibition on industrial mining companies mixing their minerals with cobalt from non-certified artisanal sources. The EGC is the DRC government's effort to offer a consistent channel for "clean" cobalt, particularly during periods of strong market demand, while working to address longstanding social and safety issues tied to ASM operations.

US LOOKS TO CURB CHINESE DOMINANCE OF THE DRC MINING SECTOR

2024 saw the US manoeuvre to weaken China's grip on the DRC's critical minerals sector, as US officials sought to block DRC copper-cobalt assets falling into the hands of Chinese companies.

Reports emerged that US officials had opposed the sale of Chemaf Resources to Norin Mining – a Chinese state-owned company within a group that supplies arms to the Chinese military. The DRC state mining company, Gécamines, later blocked the sale. It was also reported that the US had sought to facilitate Swiss trading house Mercuria's acquisition of copper-cobalt mines from Eurasian Resources Group (ERG), contingent on lifting its sanctions against Israeli billionaire, Dan Gertler.

US companies had largely ceded their interests in the DRC's mining sector to China over the last decade, best evidenced by the sale of the TFM and KFM assets by Freeport-McMoran to CMOC

in 2016 and 2020, respectively. The US is attempting to increase its influence in the Central African Copperbelt through the Lobito Corridor Railway; while China continues to invest in TAZARA – see Section 6.5 for more details.

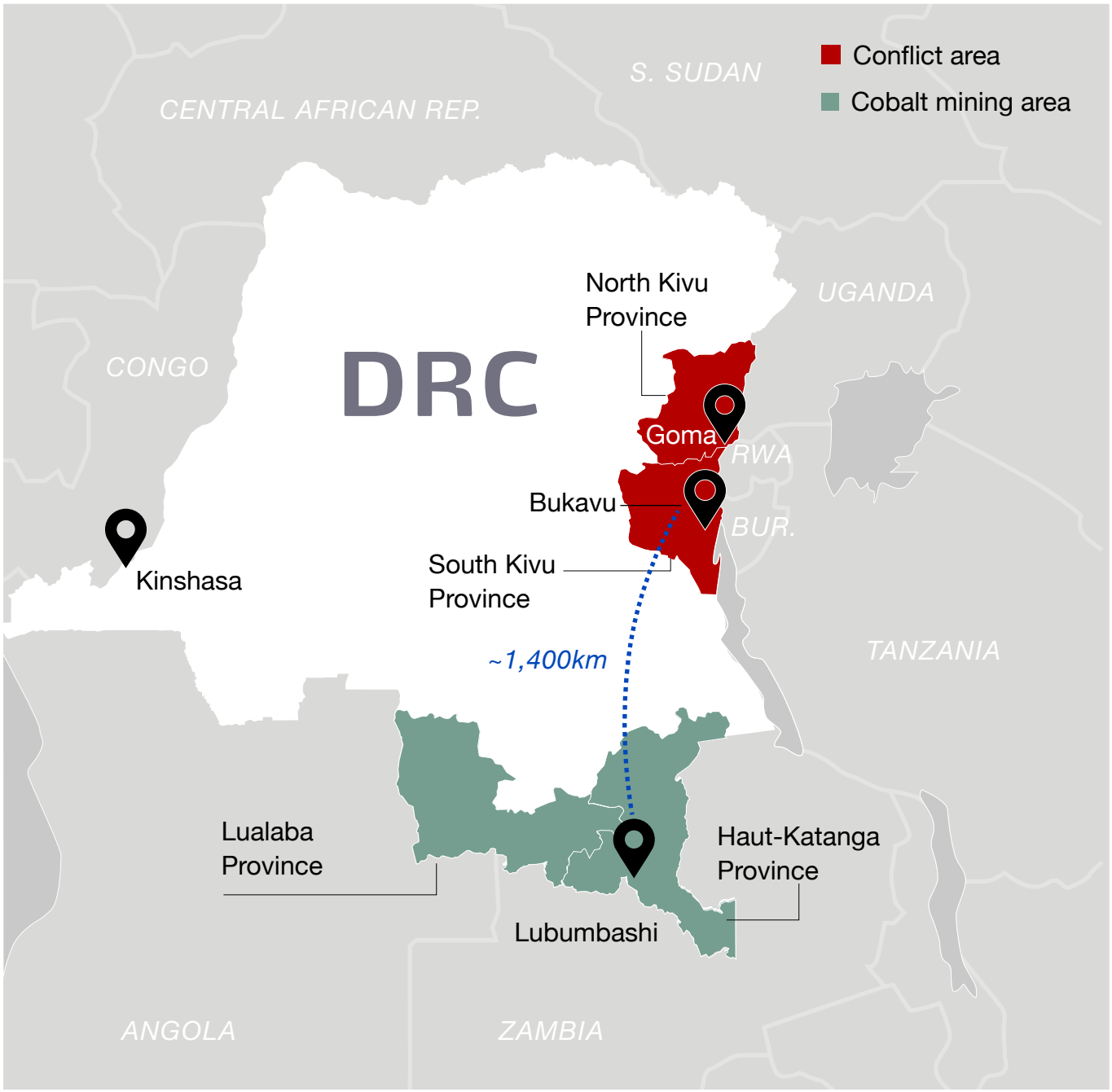
CONFLICT IN EASTERN DRC IS FAR FROM CU-CO ASSETS, BUT RISKS REMAIN

The eastern DRC saw a resurgence in conflict in late 2024, with the Rwanda-backed rebel M23 group capturing a number of key cities and towns, including capital of North Kivu, Goma, and swathes of North and South Kivu provinces in early 2025. Although the conflict is localised in the eastern DRC, it has been a source of political disruption and minor unrest throughout the rest of the country.

While North Kivu and South Kivu are mineral-rich, they are not a major source of cobalt. Cobalt is concentrated in the Copperbelt of the southern DRC. The Kivus, bordering Rwanda, are a key source of other minerals – particularly those sometimes called "conflict minerals": tin, tungsten, tantalum and gold (3TG). Because of their similar names, coltan – the key ore that yields tantalum – is sometimes confused with cobalt, but the two are distinct in usage, geology, geographical distribution, and levels of artisanal mining.

In the DRC, coltan is mined, with relatively high levels of artisanal mining, in the eastern provinces of North and South Kivu – near the border with Rwanda. It is also produced in the north-eastern parts of former Katanga province, again primarily from artisanal mining, though these areas are not the focus of conflict. The tantalum it contains finds key applications in capacitors for electronic devices. Cobalt, conversely, is mined in the southern DRC (the Copperbelt) as a by-product of copper, has comparatively lower volumes of artisanal mining and is used primarily in lithium-ion batteries (see Section 3).

Figure 28: Conflict region in eastern DRC relative to cobalt mining region in southern DRC



Cobalt mining is far from the region to which the conflict has so far been confined. The distance from Goma to Lubumbashi is ~1,400km, and in addition to the absolute distance, travel times are long, and roads are generally poor (if existent at all). As a result, there has been little impact on cobalt mining.

4.3 INDONESIA DEVELOPMENTS

INDONESIA'S NICKEL BOOM FLOWS THROUGH TO COBALT

Indonesia evolved from producing just 5% of global nickel supply in 2015 to close to 60% in 2024. Production in the country was previously focused on the stainless steel and metal markets, the dominant share of nickel demand. Stainless steel remains the major end use market (66% in 2024), however, development in recent years has turned to the building wave of demand from the battery supply chain.

Nickel resources in Indonesia are within laterite deposits, typically formed from prolonged weathering of rocks in tropical or sub-tropical environments with appropriate geological characteristics. Up until recently, the saprolite portion of these laterite deposits was exclusively targeted by Indonesian nickel miners and refiners to produce ferronickel (FeNi) and nickel pig iron (NPI). The limonite portion, sitting above the saprolite, was removed, effectively as overburden, and stockpiled or even treated as waste.

In 2020, the Indonesian government banned all nickel ore exports, forcing producers to add value to their resources and to encourage further downstream development in the country. The value of the limonite ore was not fully realised until high pressure acid leaching (HPAL) facilities were planned and built. The technology had been used in the past in other parts of the world, but with varying success and with a number of projects going significantly over budget.

Despite initial scepticism, the operations which have started to date in Indonesia have ramped up successfully and committed to further expansions, with many more new development projects announced since. Much of this success has been down to Chinese JV partners bringing extensive technical expertise and key equipment from China. The current producers include PT Lygend, Huayue, PT QMB, Huafei – all starting prior to 2024 – as well as PT Meiming and PT ESG, which started operations in 2024.

Within the Indonesian nickel industry, these HPAL operations are of most relevance to cobalt, produced as a by-product in MHP, because the other key processing route, RKEF-to-stainless-steel (through NPI), recovers effectively no cobalt. HPAL operations produce mixed hydroxide precipitate (MHP) – an intermediate product containing both nickel and cobalt, typically at a ratio of between 8:1 and 10:1. Similarly to by-product cobalt from copper-cobalt operations in the DRC, cobalt is a by-product of the nickel production process in Indonesia – albeit predominantly as a mixed (MHP) product.

The development of planned HPAL capacity in Indonesia has been rapid – in early 2021, just 10 nickel-cobalt projects were being tracked in Indonesia. As of early 2025, that number has risen close to 70 with two-thirds from HPAL projects. The remainder comes from cobalt in matte driven by developments in the matte process route for nickel. This route is also seeing further project development but to a lesser extent than HPAL.

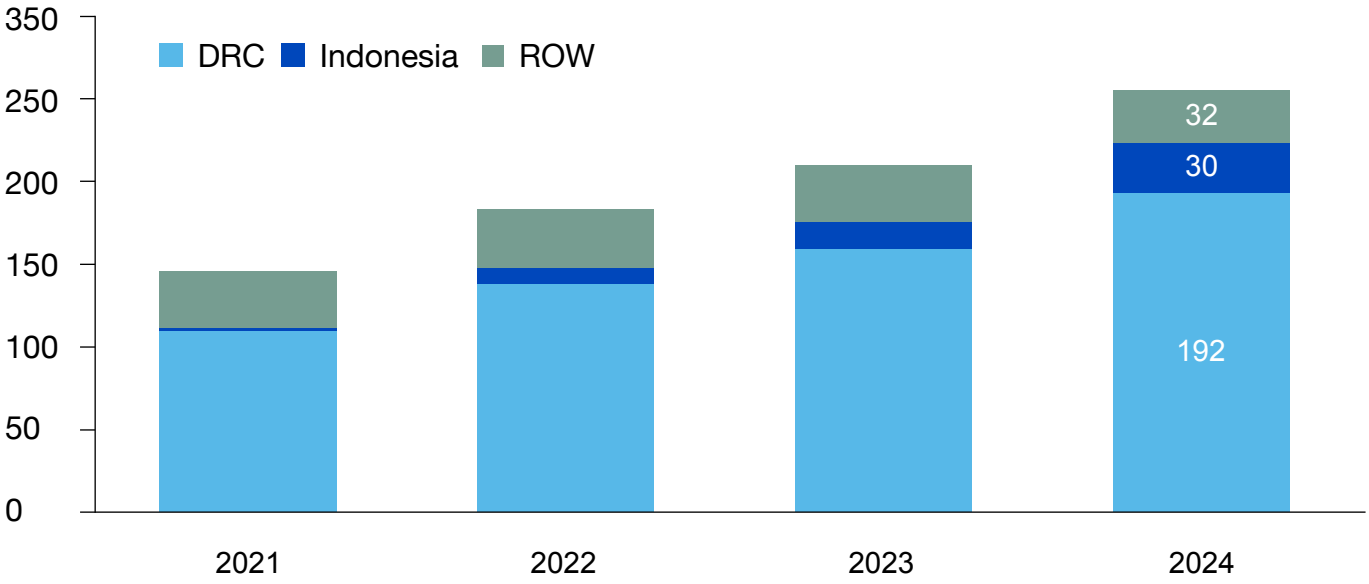
INDONESIA NOW THE STANDALONE SECOND LARGEST COBALT PRODUCER

HPAL operations accounted for 43% of Indonesia's nickel supply growth in 2024. As a result, cobalt output has also continued to climb – exceeding 30kt and rising 82% y-o-y. The country now stands as the second largest cobalt producer, producing almost seven times the volumes from Russia, the third-largest producer.

Aside from the DRC, Indonesia's output is now equivalent to all other producers combined, with ROW supply contracting for the last two years to 32kt in 2024.

The growth of nickel, and by-product cobalt, supply has lifted Indonesia from producing just 2% of global cobalt in 2021 to 12% in 2024. Over that period, cobalt output grew 12-fold. In 2024, Indonesia contributed 30% of global cobalt supply growth, up from 23% in 2023.

Figure 29: Mined cobalt supply by major country, kt cobalt



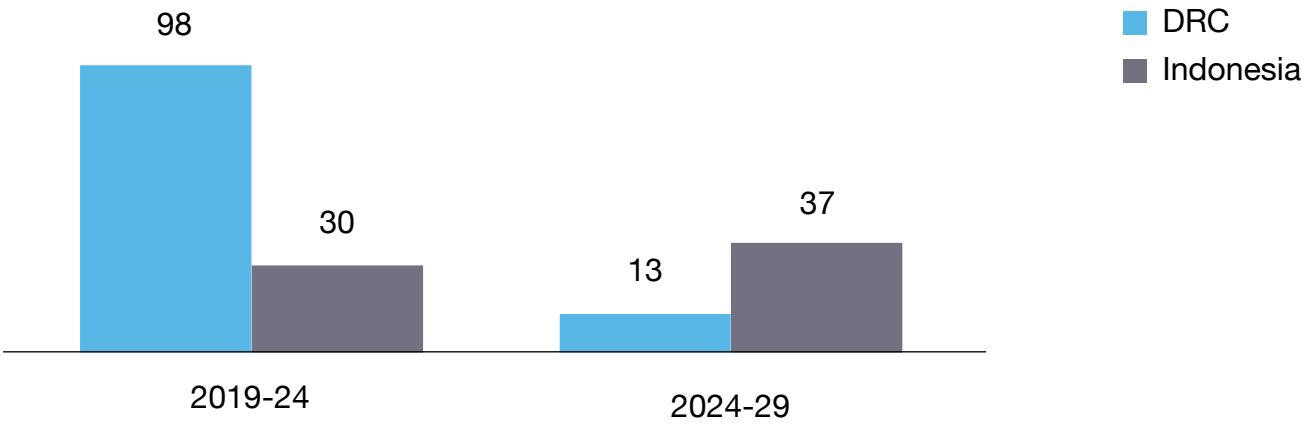
Data: Benchmark Mineral Intelligence – Cobalt Forecast.
Note: ROW includes Russia (1.8% of mined supply in 2024), Cuba (1.5%), Australia (1.4%), Philippines (1.3%), Turkey (1.1%), Canada (1.0%), Madagascar (1.0%); and Papua New Guinea, Finland, New Caledonia, China, Morocco, South Africa, Mexico, US, Zambia, and Brazil (all <1%).

In the last five years, the DRC far outpaced volume growth from Indonesia, however that dynamic will switch in the short term as supply growth slows in the DRC and Indonesia's output continues to climb on the back of the nickel industry.

Despite volumes being significantly lower than from the DRC, the rising role of Indonesia in the cobalt market may be welcomed by actors seeking supply diversification and security of supply. This has become even more relevant since the DRC export ban in early 2025 (discussed further in Section 7.2) to provide alternative sources of supply and reduce risks of a single country

supporting the global market. Chinese sulphate producers have reported that Indonesia's MHP supply will be sufficient to support domestic EV demand for cobalt in the short term (although volumes will likely not be sufficient beyond that), reducing the requirement to import hydroxide volumes from the DRC whilst the ban is in place.

Figure 30: Cobalt supply growth from the DRC and Indonesia, kt cobalt

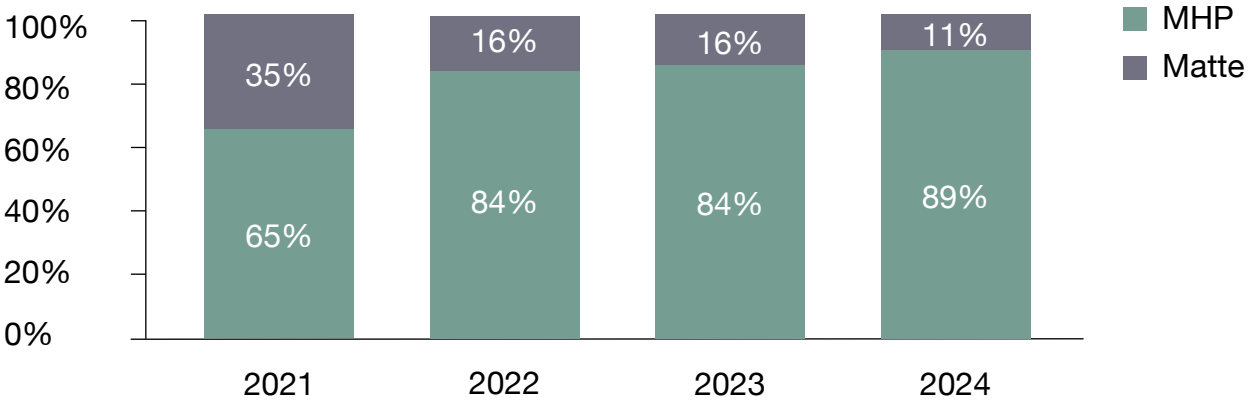


Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Prior to the start of MHP production in Indonesia in 2021, small volumes of cobalt were produced exclusively from matte. However, since then, with a number of HPAL operations now fully ramped up and further new projects and expansions underway, matte is quickly losing share to MHP. In 2024, 89% of Indonesia's output was from MHP, and just 11% from matte.

Over time, with much smaller volumes of matte production growth, the product is expected to lose further share to the booming MHP industry in Indonesia. Cobalt from MHP has the potential to rise five-fold by the end of the decade, equivalent to exceeding the DRC's total output in 2022. More than 95% of Indonesia's cobalt supply growth to 2030 is expected to come from MHP.

Figure 31: Cobalt supply by intermediate product in Indonesia, kt cobalt



Data: Benchmark Mineral Intelligence – Cobalt & Nickel Forecasts.

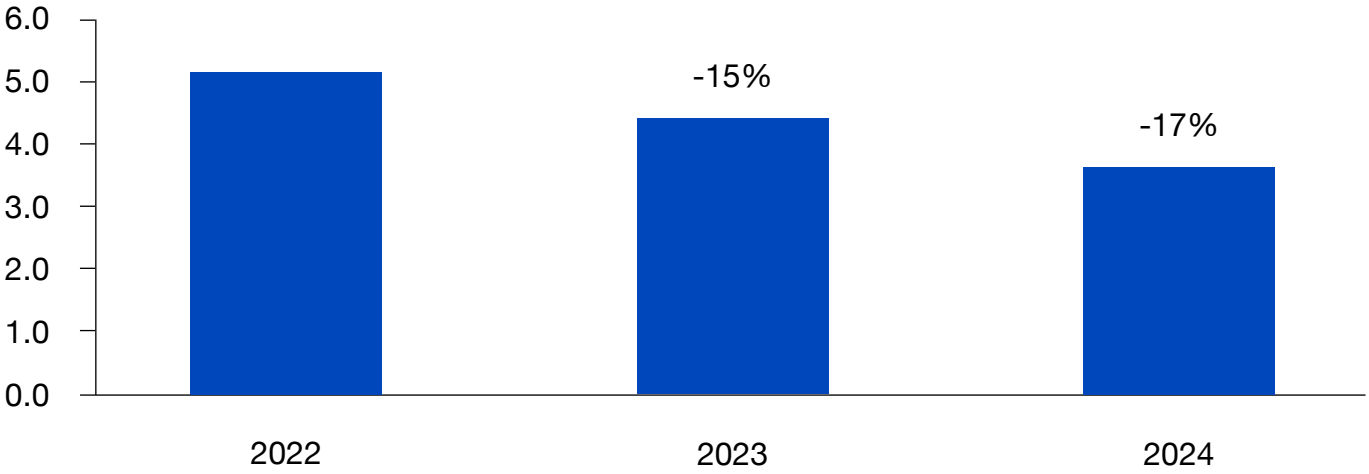
4.4 AUSTRALIAN MINED SUPPLY DECLINES FURTHER AS NICKEL MARKET STRUGGLES

Weak nickel prices have led to several Australian nickel projects closing or partly suspending operations. A number of these produce cobalt as a by-product – Panoramic Resources' Savannah mine was put into Care and Maintenance (C&M) in 2023; in 2024, BHP's Nickel West, Mallee Resources' Avebury operations and First Quantum Minerals' Ravensthorpe followed the same path.

This has resulted in a -31% decline in Australian nickel production since 2022 and -29% in cobalt output. As of 2024, Australia's share of global cobalt production declined to just 1% – the country is now the fifth largest producer, down from third place in 2023.

With nickel prices expected to remain under pressure in the short to medium term, these assets are unlikely to return to the market until prices improve. For example, BHP has said that the suspension of Nickel West will be reviewed by early 2027.

Figure 32: Mined cobalt supply from Australia, kt cobalt (% y-o-y)



Data: Benchmark Mineral Intelligence – Cobalt & Nickel Forecasts.

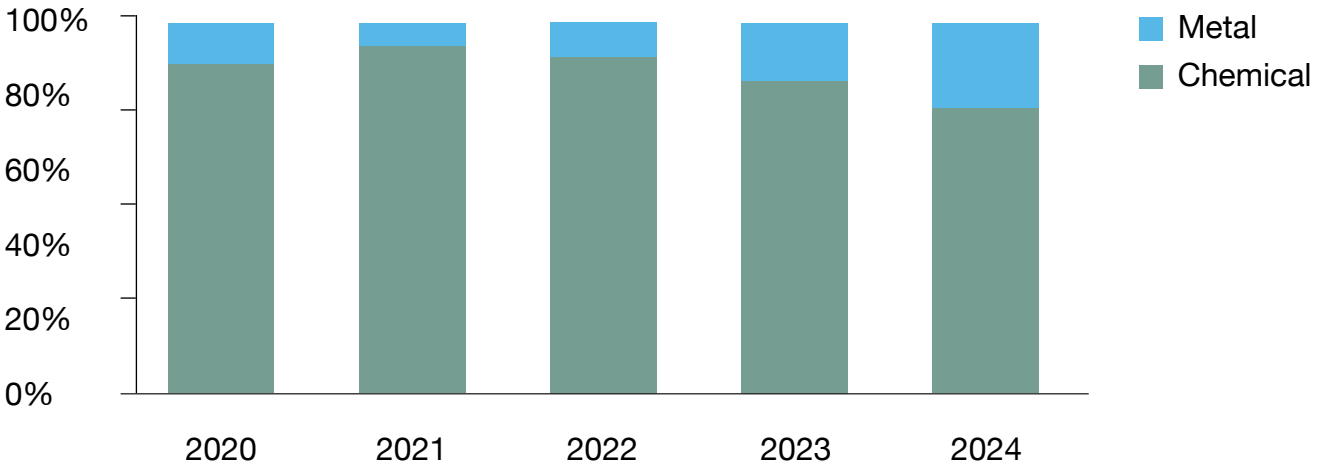
4.5 REFINED SUPPLY UP ON CHINESE CAPACITY ADDITIONS

Global refined cobalt production hit 222kt in 2024, up by 17% over 2023 levels. Refined supply grew primarily on the back of Chinese output – which increased by 8% y-o-y to 131kt. China is the key producer of refined cobalt, accounting for 79% of the market. Japanese output grew by 22% and Canadian supply by 11% – but from a much lower base than China. But Finland, the second-largest producer, saw stable growth at +1% y-o-y. The key trend within the refined market was one of additional Chinese capacity, albeit not necessarily resulting in commensurate growth in production.

CHINESE REFINERS ADD CAPACITY

2024 saw a dramatic increase in metal capacity added by several producers, including GEM (which increased its cobalt cathode capacity to 13 ktpa) and CNGR (which added a 2ktpa metal line in 2024). This additional capacity means that more Chinese refiners have been able to pivot between chemical and metal production to take advantage of arbitrage opportunities. This also gives these assets a degree of future-proofing as it will allow them to increase production for both or either product types as demand grows (Chinese refineries typically operate well below capacity).

Figure 33: Chinese refined supply by product type, Co contained basis (%)



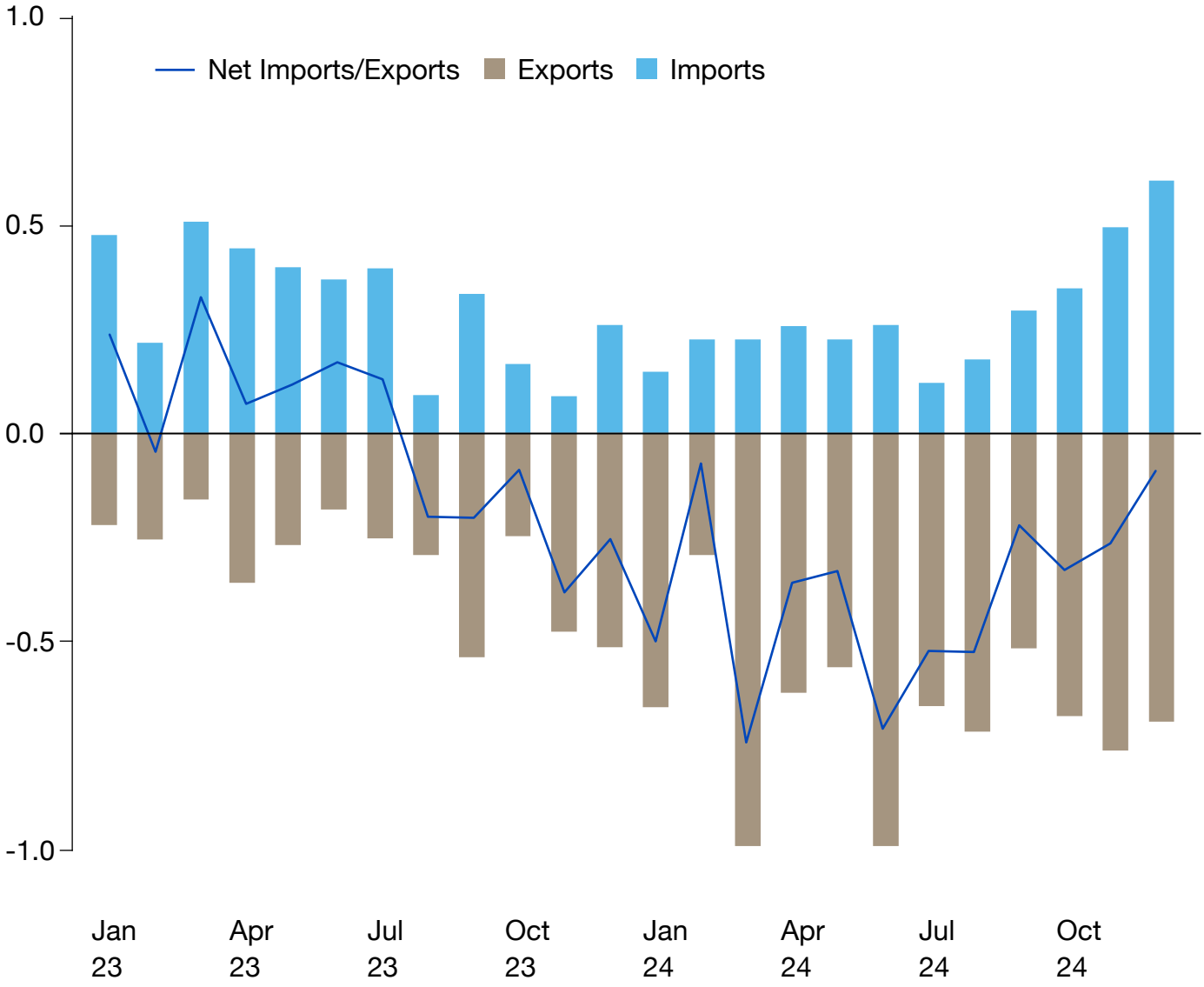
Data: Benchmark Mineral Intelligence – Cobalt Forecast.

While these new lines were not run at full capacity, it is clear that the Chinese market faced a significant shift in metal production, driven by the price differential between sulphate and metal, and also to an extent by lower conversion costs for some producers (the cost of producing either finished product from intermediate feedstock material).

Some Chinese refiners were able to process hydroxide to metal at rates as low as RMB 30,000-40,000/t cobalt contained (~$2-3/lb) – notably lower than the $5/lb considered generally representative of the market in the past. In comparison, conversion costs from hydroxide to sulphate and from MHP to sulphate were generally about RMB 40,000/t (~$6,000/t), providing further margin for producers targeting metal over sulphate.

Trade statistics reflect the ramp up in Chinese metal output, with data from Global Trade Tracker showing that China has been a net exporter of cobalt metal since August 2023 (although in 2025 it pivoted back to being a net importer for the month of February). After a widening net export position in early 2024, later months saw a reduction as exports declined and imports grew. This may have also been linked to the end of the Chinese National Development and Reform Commission (NDRC) – formerly the State Reserve Bureau (SRB) – delivery deadline for Chinese government stockpiling of metal in late November (see Section 3.9).

Figure 34: China monthly cobalt metal imports and exports, kt Co



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Following PT Lygend starting cobalt sulphate production in 2023, refined cobalt output in Indonesia expanded further in 2024.

PT QMB began installation of integrated cobalt (and nickel) sulphate capacity at Indonesia Morowali Industrial Park (IMIP) and PT Lygend rapidly added new metal capacity to its existing sulphate capacity at Obi Island (also converting from MHP), to target higher margins available from metal production. PT Lygend's metal expansion was also aimed at targeting arbitrage opportunities, in a similar fashion to the refiners in China discussed above.

Indonesian refined cobalt output increased by more than double y-o-y, to 3.8kt. The country's global refined share rose to 1.7%, with only minor changes from other producers compared to 2023.

Table 2: Share of global refined production by country, %

Country	Share of global refined production		
	2023	2024	y-o-y
China	78.6%	78.6%	-
Finland	8.3%	7.2%	-1.1%
Canada	2.9%	2.7%	-0.2%
Japan	1.8%	1.9%	+0.1%
Madagascar	1.6%	1.8%	+0.2%
Indonesia	0.8%	1.7%	+0.9%
Norway	1.6%	1.4%	-0.2%
Australia	1.6%	1.4%	-0.2%
ROW	2.7%	3.2%	+0.5%

Data: Benchmark Mineral Intelligence – Cobalt Forecast.

4.6 SUSTAINABILITY AND ITS IMPACT ON PURCHASING DECISIONS

Sustainability is a factor increasingly feeding into raw material procurement decision-making. For consumers, specifically automakers, understanding where material has come from, at what carbon footprint, and how due diligence has been undertaken along the value chain are some of the questions being asked as part of these discussions.

Amongst European OEMs, sustainability requirements are increasingly being introduced into purchasing agreements. A key priority, due to regulatory requirements (particularly the EU Batteries Regulation and its upcoming due diligence mandates) and reputational risk, is the need to demonstrate rigorous supply chain due diligence. This has led to increasing calls for the raw materials feeding into their batteries and EVs to be mined and refined at third-party assessed sites. Responsible sourcing commitments from downstream consumers have led to continued momentum on enhancing sustainability practices over the last year. This includes heightened due diligence on value chains, requests for third-party assessed material at mine site level, and tar-

gets for recycled content in their batteries.

Their requirements, in tandem with the evolving sustainability and due-diligence regulatory landscape, are further shaping how cobalt producers are approaching the management of environmental, social and governance practices at their operations.

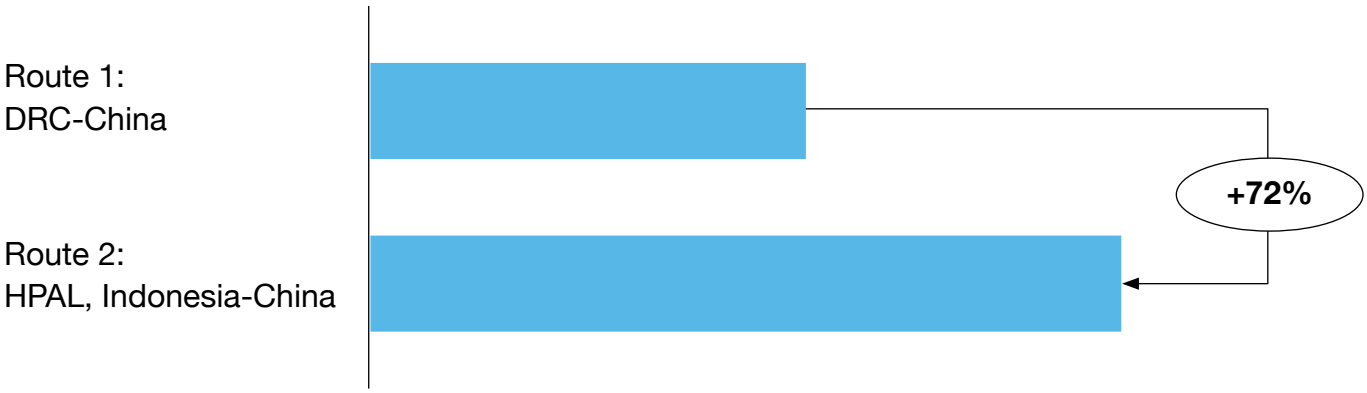
Key areas of social- and governance-related risk relate to human rights, community development, transparency and artisanal mining. From an environmental perspective specifically, biodiversity and water are prominent areas of risk[1].

Benchmark's Global Cobalt Life Cycle Assessment (LCA) assesses the environmental impact of dominant cobalt production routes:

- Material mined and pre-refined to crude cobalt hydroxide in the DRC and refined to cobalt sulphate in China;
- Cobalt mined in Indonesia and processed in China, via the High Pressure Acid Leach (HPAL) process.

From an environmental impact perspective specifically, Benchmark's latest Global Cobalt LCAs indicate the global warming impact (in kg CO2 equivalent) of cobalt produced (via HPAL) in Indonesia is significantly higher (>70%) than that of material mined in the DRC and refined in China. This is predominantly explained by the lower cobalt content in nickel-cobalt ore in Indonesia, leading to higher energy and consumable requirements to produce the same amount of cobalt. For the Indonesian (HPAL) route, direct emissions arising from the acidic slurry neutralisation process using limestone during MHP production are responsible for almost one-third of its overall global warming potential.

Figure 35: Difference in global warming potential impact by dominant cobalt production routes, %



Data: Benchmark Mineral Intelligence – Global Cobalt LCAs.

[1] Benchmark Mineral Intelligence – Cobalt Materiality Assessment, Nickel and Cobalt Sustainability Report.
[2] Benchmark Mineral Intelligence – Global Cobalt LCAs.

SUSTAINABILITY POLICY AND REQUIREMENTS LANDSCAPE

With sustainability a key focus of the European Union (EU) Batteries Regulation, automakers are sharpening their focus on preparing for the staggered implementation of its requirements. For example, Volvo launched the first EV battery passport in June 2024 for its EX90 SUV, including data on raw material origin, recycled content and carbon footprint.

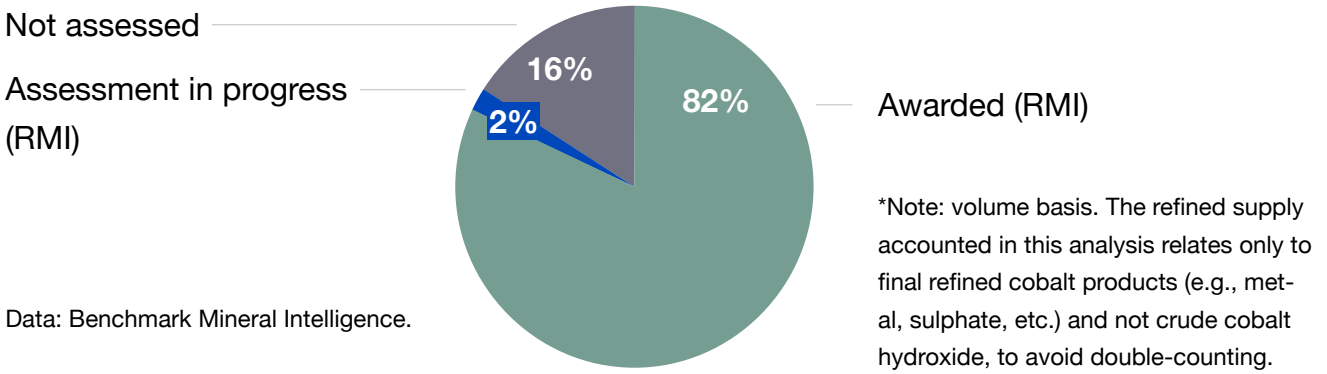
Though EU-specific, the impact of this regulation is far-reaching. Coupled with broader moves towards transparency and traceability, sustainability and reporting on such topics is climbing the agendas of actors across the supply chain.

Benchmark's sustainability analysis noted a trend over the course of 2024 of improved reporting amongst Chinese producers[3]. Though sustainability reporting is not broadly mandatory in China, there have been developments over the last 12 months: in May 2024, the Ministry of Finance of China published an Exposure Draft of the Chinese Sustainability Disclosure Standards for Businesses for public consultation. China is also looking to establish a mandatory sustainability reporting system which would align with the International Sustainability Standards Board (ISSB) by 2030, following the EU's lead. This comes as Chinese-owned companies increasingly seek to demonstrate their commitment to sustainability, with CMOC Group, the largest cobalt producer, having its TFM asset certified by the Copper Mark in June 2024, making it the first Chinese-owned company and African asset to receive the accreditation.

THIRD-PARTY ASSESSMENTS IN THE COBALT MINING AND REFINING INDUSTRY

Engagement with third party assessments is commonplace in the cobalt mining industry. Benchmark notes that there is higher engagement with certain assessments: predominantly the Responsible Minerals Initiative (RMI). This is largely due to its focus on responsible sourcing from high-risk areas. In 2024, 82% of global refined cobalt supply was certified against RMI.

Figure 36: Share of 2024 refined cobalt supply by engagement with RMI's assessment*, %



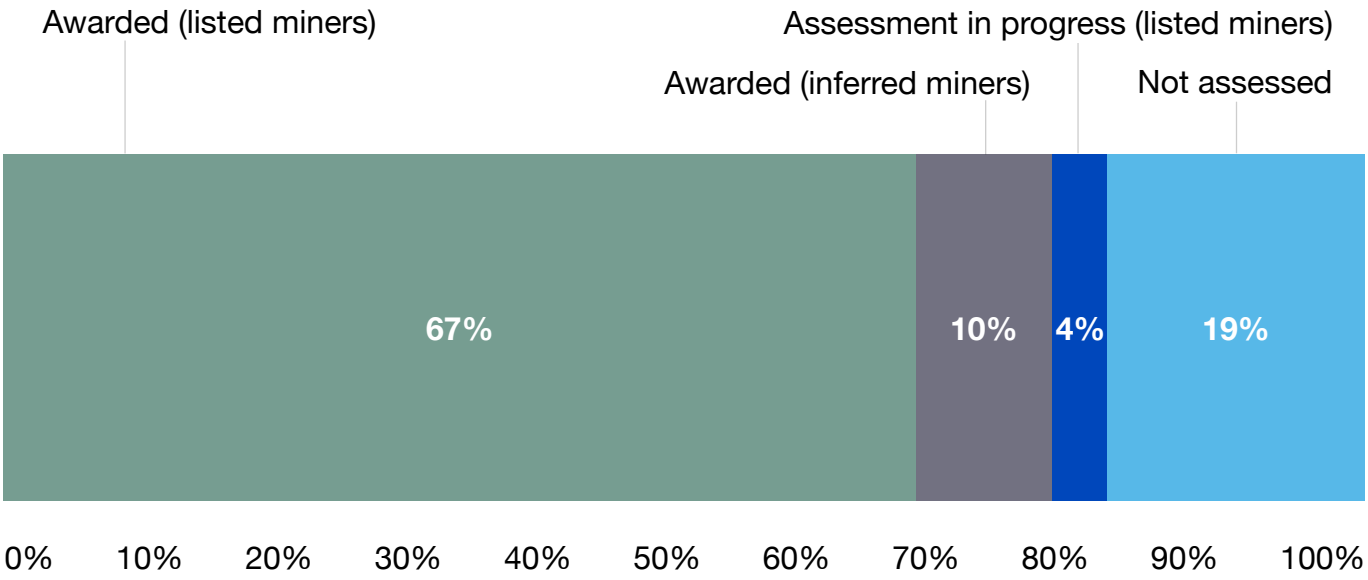
*Note: volume basis. The refined supply accounted in this analysis relates only to final refined cobalt products (e.g., metal, sulphate, etc.) and not crude cobalt hydroxide, to avoid double-counting.

Data: Benchmark Mineral Intelligence.

[3] Benchmark Mineral Intelligence – Cobalt Sustainability Report.

Although the RMI assessment applies to refiners, all the cobalt sourced, including mined material, is subject to due diligence by these refiners which is verified in the scope of the RMI evaluation. Through detailed understanding of the supply chain, Benchmark has been able to quantify the amount of mined cobalt that falls within the scope of the assessment. In 2024, 77% of global cobalt mined supply was subject to 'RMI conformant' due diligence practices, with 83% of this assessed material originating from assets located in the DRC.

Figure 37: Share of 2024 mined cobalt supply by engagement with RMI's assessment [4], %

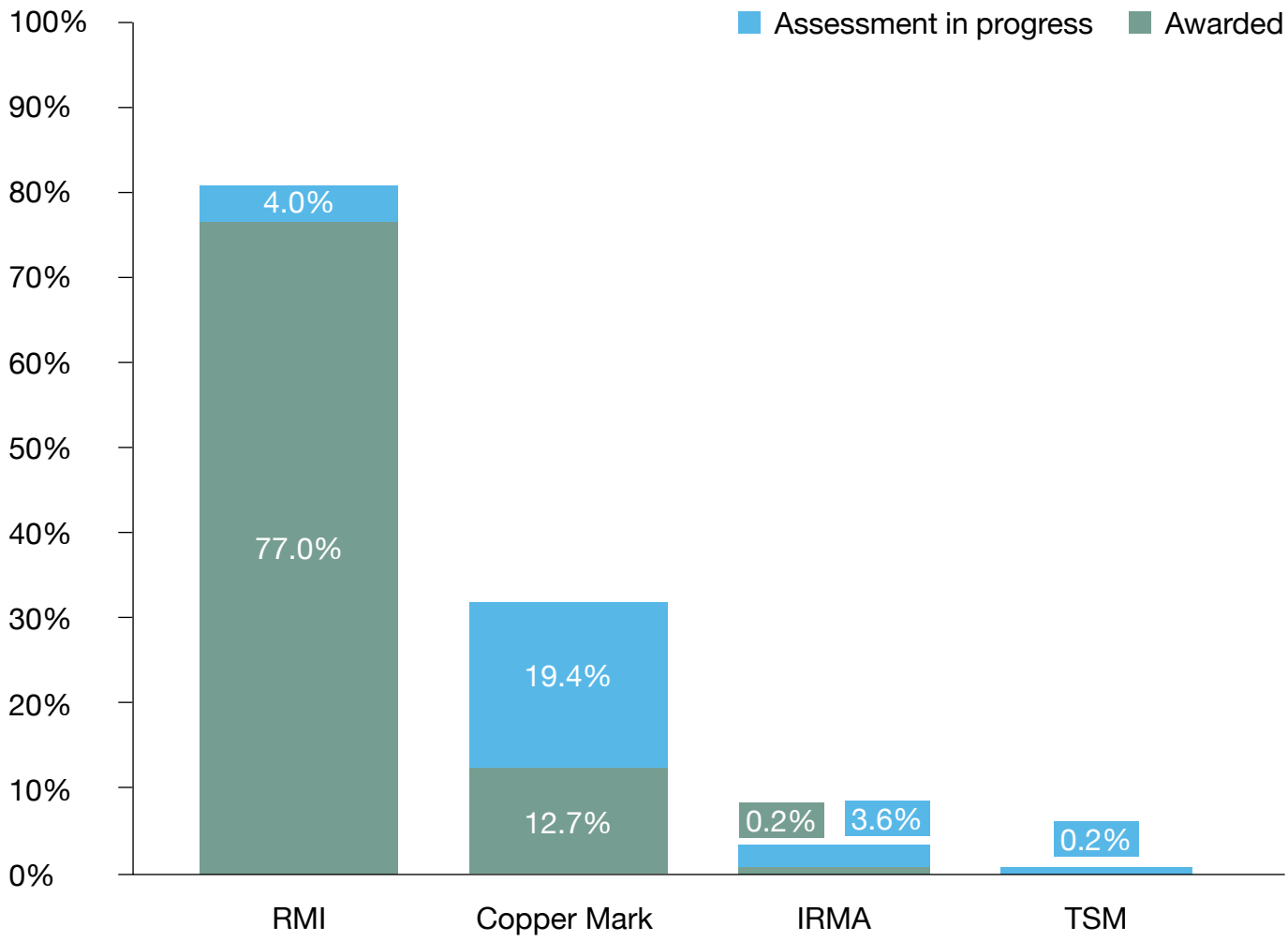


Data: Benchmark Mineral Intelligence.

The Copper Mark Assurance Process covers the second largest share of cobalt supply due to cobalt primarily being a by-product of copper. This is explained by both the number of assets undergoing these assessments, and critically, the volume of cobalt mined by these assets that have been awarded the relevant accreditation. Other third-party assessments are applied in the cobalt market, though are not as ubiquitous in their adoption. These include the Initiative for Responsible Mining Assurance (IRMA) and Towards Sustainable Mining (TSM).

[4] Listed miners refer to "crude cobalt refiners" as described by RMI. In some cases, Benchmark has inferred RMI-assessed mines from RMI-assessed refineries and includes these in its analysis of RMI assessments, even if those mines are not explicitly listed as RMI-assessed.

Figure 38: 2024 mined cobalt supply by third party assessment status %



Data: Benchmark Mineral Intelligence.

Note: Glencore's Copper Mark certified assets are included in the 2024 "Assessment in process" category as they were awarded the certification in 2025.

Some large-scale mining operations in the DRC have gone through multiple assurance processes, typically undergoing assessments against both RMI and the Copper Mark, such as CMOC's TFM mine and Glencore's assets, KCC and Mutanda, which went through the Copper Mark accreditation process in 2024 and received it in April 2025. These assets in addition to other sustainability-certified mines account for the majority of mined cobalt produced in the DRC, reflecting industrial miners' commitment to transparency.

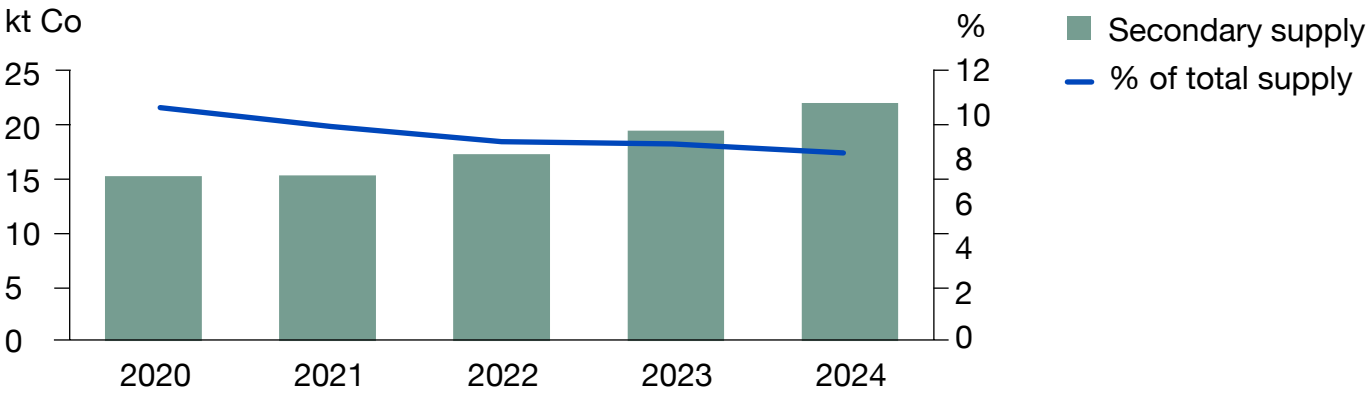
Smaller producers in other regions have also recently committed to these certification processes. This trend is expected to continue as the cobalt market responds to downstream end users, battery consumer demands and regulatory sustainability requirements.

Whilst the move towards increased engagement with third party audits is set to continue, there are simultaneous industry initiatives to streamline sustainability certifications and assessments such as the Consolidated Mining Standard Initiative (CMSI) developed collaboratively by the International Council on Mining and Metals (ICMM) and several industry associations and standard setters.

4.7 SECONDARY SUPPLY OF COBALT RISES EVEN AS MARKET SHARE DECLINES

Secondary cobalt production – from the recycling of lithium-ion batteries – represents a sizeable segment of supply. In 2024, secondary cobalt supply amounted to 22kt, or 8% of total supply, up by 13% y-o-y from 19kt in 2023. Despite this growth in absolute terms, overall, recycled volumes have fallen as a percentage of total supply, mainly owing to the stronger primary supply growth from assets such as CMOC's KFM (discussed further in Section 4.2).

Figure 39: Secondary cobalt supply from batteries in volume terms (LHS) and as a percentage of total supply (RHS)



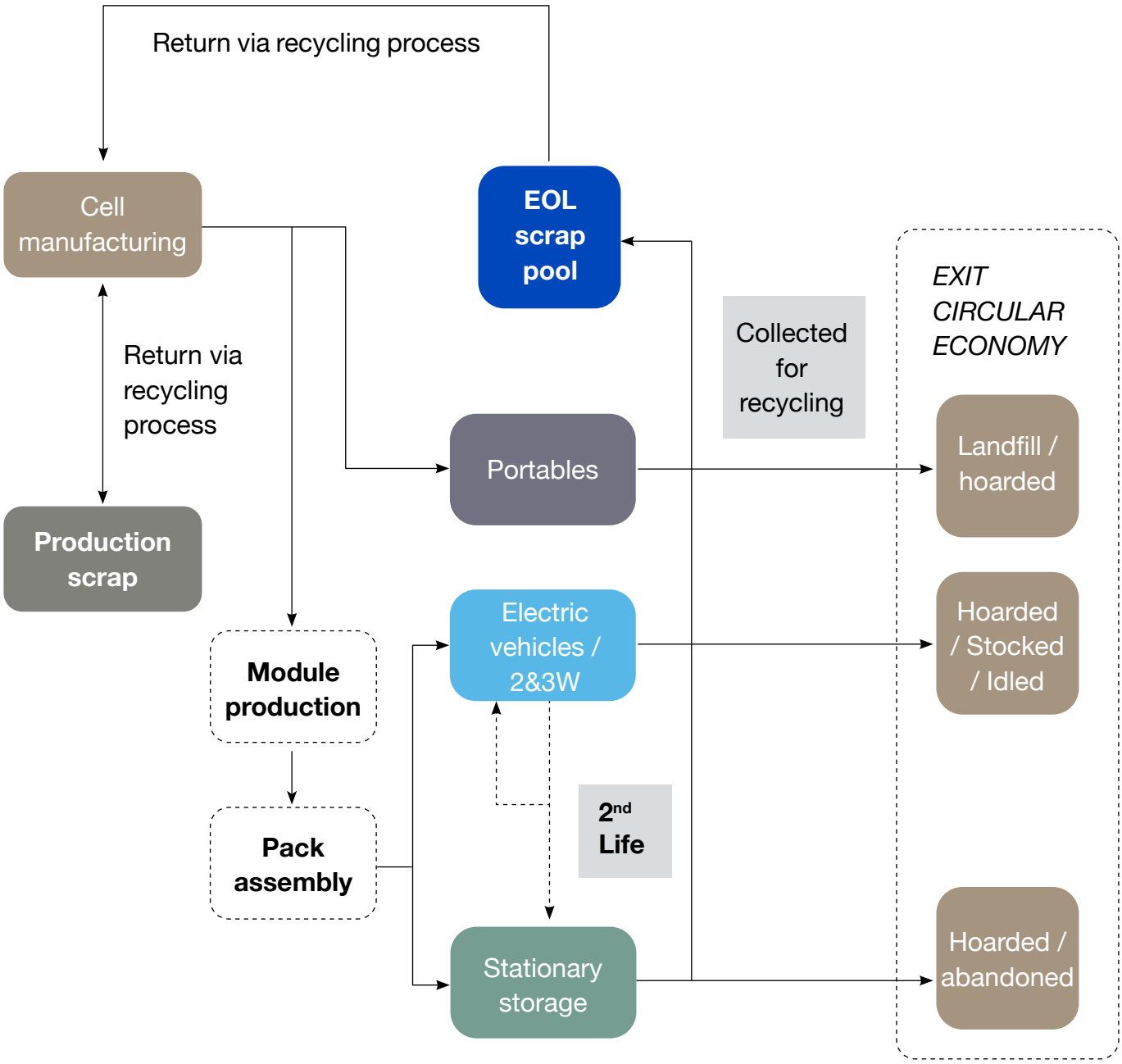
Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Data on secondary supply from recycled Li-ion batteries is often lacking and traceability has historically been challenging to track[5], particularly with respect to prior inconsistencies in black mass classification. Benchmark uses a bottom-up approach in its battery recycling methodology and estimates and forecasts cobalt contained by considering refining technologies and cobalt recoveries across hydrometallurgical, pyrometallurgical and direct recycling routes. This metal recovery rate by technology, alongside the metal intensity of cobalt in each cathode chemistry reported in the scrap pool, is used to determine the recycled metal for a given year in each application for each region.

Secondary supply comes from two key sources: process scrap and end-of-life (EOL) scrap. The majority of recycled cobalt circulating the global market comes from EOL portables and production scrap – which is reflected in the global scrap distribution of the cobalt market. Considering this on a regional basis, the vast majority in EU & EFTA & UK is contained within the available portables scrap, and in China from production. Within Europe, this is due to the lacking production and reasonable collection rate targets for portables, and in China this is due to the cell manufacturing dominance and the low portable collection rates for portables reported in China.

[5] https://www.cobaltinstitute.org/sustainability/responsible-secondary-cobalt/

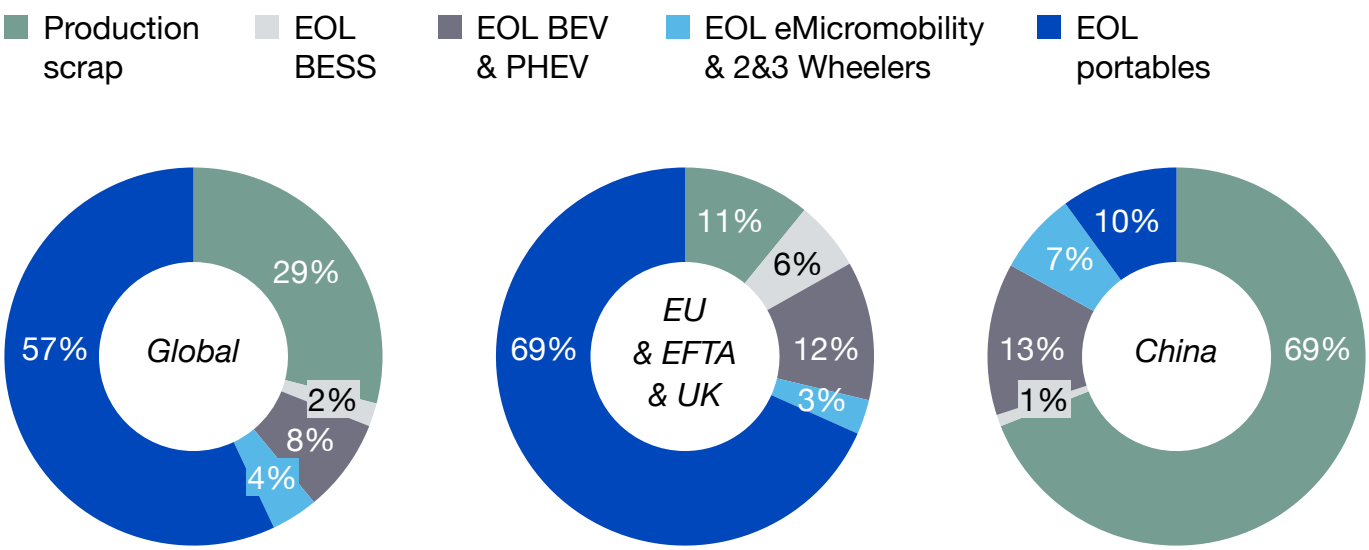
Figure 40: Battery recycling flowsheet



Source: Benchmark Mineral Intelligence – Battery Recycling Forecast.

Of the scrap available within Europe, the majority comes from EOL EV scrap, which is primarily made up of mid-nickel NCM chemistries. LCO-based material from portables also provides a source of cobalt from recycling, and this constitutes just under 20% of the cathode chemistry mix within the region. With increased collection rate targets, and business and consumer incentivisation to recover portable batteries, this could increase the available recycled cobalt within the region. As part of the EU Batteries Regulation, there has already been legislation implemented that outlines the requirement for easy-to-remove portable batteries in devices – which is beneficial to the recycling industry within Europe.

Figure 41: Breakdown of battery scrap pool by region and segment in 2024, kt Co contained basis (%)



Data: Benchmark Mineral Intelligence – Battery Recycling Forecast.

BATTERY RECYCLING – BLACK MASS AND MATERIAL FLOW TRENDS

China's dominance of global lithium-ion battery value chains means that companies in Western regions are catching up to build capacity and expertise for recycling – this is a key underlying reason for today's recycling market dynamics.

Western recycling infrastructure is predominantly set up for black mass production – i.e., shredding batteries and battery scrap into black mass from which battery metals are extracted. The recycling market experienced challenges in 2024, with investment delays, insufficient scrap and weak material prices, which further pressured recyclers' financial performance, leading recyclers to restructure and downsize to reduce costs and strengthen financial competitiveness, with Western recyclers delaying plans to bring hydrometallurgical capacity online.

Historically, importing black mass to China was prohibited because the material was classified as a hazardous waste. As a result, the key trade flow was black mass exported from the West into other Asian markets, where it could be refined to intermediates and then shipped to China under new waste codes. However, in 2025, it is expected that black mass import restrictions will be loosened to ensure a higher material flow into the country, as currently there is an overcapacity for recycling in China and the rest of Asia.

Despite this, legislation and incentives have been implemented to limit black mass exports, particularly in Europe. The EU Commission updated the European Waste Catalogue (EWC) at the beginning of 2025 to classify black mass and other battery waste intermediates as hazardous

waste in an attempt to limit material leakage from Europe – a measure to both support domestic supply chains and bolster environmental policy. But it is likely that materials leakage will still be observed within the region, because waste can still be exported to OECD countries. Alongside the lacking refining capacity and high Asian purchasing power, the updated EWC is therefore unlikely to disrupt the current flow of black mass to China until further measures are taken, as black mass could potentially be routed through OECD countries such as South Korea and Japan. **This means that in order to meet the EUBR minimum recycled content requirements, imports of recycled cobalt will still be necessary.**

EU LEGISLATION TO DRIVE HIGHER COBALT RECOVERY

The European Union has implemented legislation to boost both recycled content in new batteries and to increase material recovery. For cobalt, the Batteries Regulation (EU) 2023/1542 that entered into force in August 2023, outlined material recovery requirements of 95% for cobalt, and minimum levels of recycled content in new industrial, SLI and EV batteries of 16% by 2031. Though there have been few announcements on the recovery yields from the handful of operating European recycling projects, Belgian-French materials company Umicore has outlined that using its pyrometallurgical-hydrometallurgical method, recovery yields of over 95% for cobalt are already being met – highlighting the feasibility for this target to be met and supporting higher cobalt yields in secondary supply moving forwards.

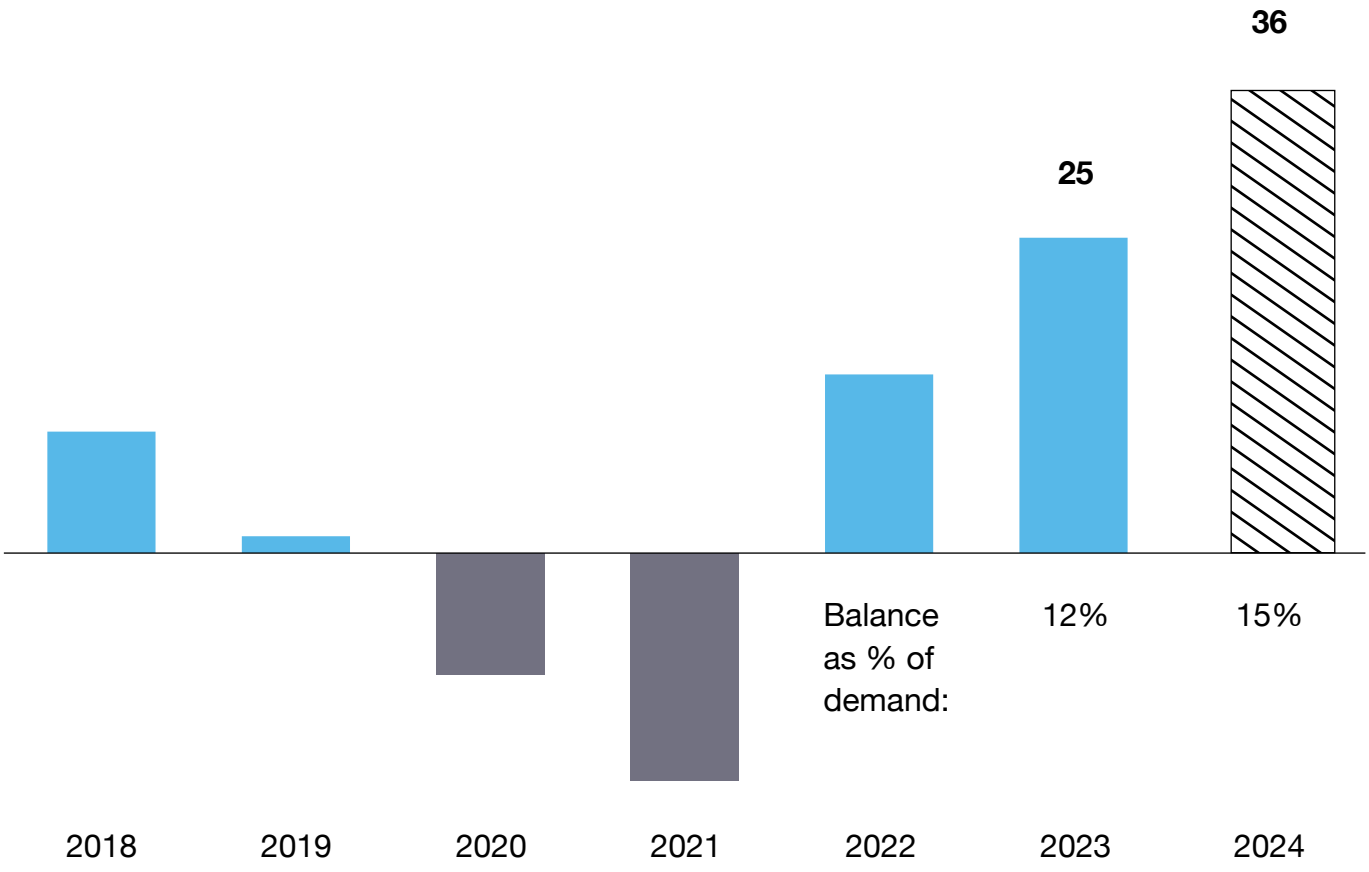
5. STRUCTURAL OVERSUPPLY WEIGHED FURTHER ON PRICES IN 2024

5.1 MARKET BALANCE

In 2024, the cobalt market was in a significant surplus of +36kt – equivalent to 15% of demand. The surplus was up from +25kt in 2023 (12% of demand in that year).

The market remains in supply-driven structural oversupply – primarily from the rapid ramp-up of CMOC's KFM asset – as total supply growth has outpaced demand.

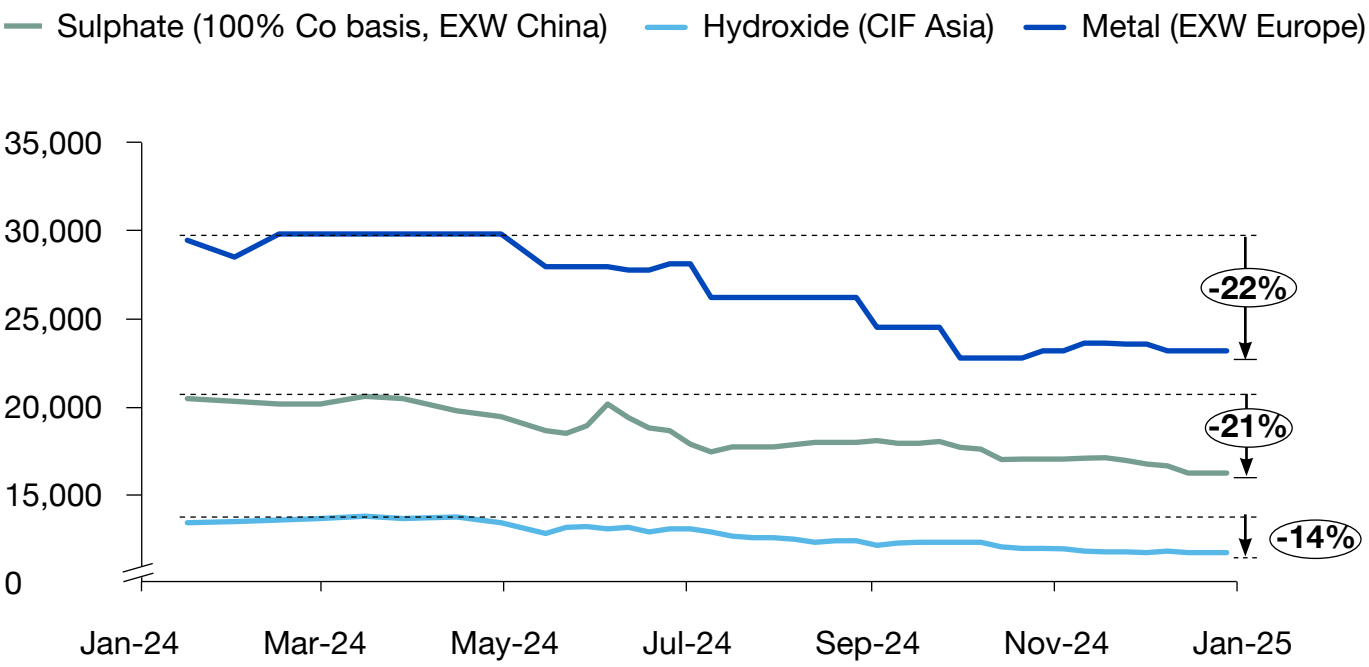
Figure 42: Cobalt market balance, kt Co



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Cobalt stocks have continued to build following three consecutive years of market surpluses. In addition to working stocks equivalent to typically two months of demand, the ramp up of CMOC's KFM led to large stockpiles beyond this. CMOC alone sat on a reported 42kt of stocks by the end of the year. Ongoing oversupply and growing stock levels led to the continued decline in prices throughout 2024, and the historic lows that were reached in the tail end of the year.

Figure 43: Cobalt prices, 2024, $/t cobalt contained



Data: Benchmark Mineral Intelligence – Cobalt Price Assessment.

5.2 COBALT HYDROXIDE

Cobalt hydroxide prices were consistently under pressure throughout 2024, largely due to a significant supply glut caused by increased production in the DRC, led by CMOC.

Cobalt hydroxide prices saw a mild recovery in Q 1 2024, after falling below $7.00/lb at the end of 2023. This price increase was a result of midstream restocking efforts, as well as relatively strong demand for mid-series NCM chemistries. On the supply side, price discipline efforts by producers began to bear fruit, allowing prices to return above $7.00/lb for much of the quarter.

In Q2, weakening relative demand resulted in prices falling due to the considerable oversupply. This decline was halted slightly by rumours of a large stockpile purchase of cobalt metal in China by the SRB (now NDRC) – discussed further in Section 3.9 – however, the news was not able to raise prices meaningfully, instead adding a stabilising force to prices.

Q3 saw further price depreciation, as a strong copper market incentivised DRC miners to maximise output, further fuelling the supply glut. With prices falling below the perceived $6.00/lb floor in Q4, market attitude remained bearish, with prices falling to their lowest point in December, down 14.5% from the beginning of the year.

Market expectations throughout 2024 remained bearish due to the significant oversupply of cobalt, fuelled particularly by the ramp up of CMOC's KFM operation, which continuously exceeded its output guidance.

5.3 COBALT METAL

Cobalt metal prices (EXW Europe) declined by 21.5% throughout 2024, largely driven by a significant oversupply of cobalt hydroxide. Additionally, Chinese cut cathode permeated the European market as alternative forms had much smaller volumes available and tariffs imposed on Chinese material in the US made it uncompetitive in that region, as well as a more favourable price environment for Chinese producers. This led to an overabundance of Chinese metal priced at a significant discount, meaning European metal was priced lower. As with the wider cobalt market, metal prices saw some minimal increases through Q1.

Furthermore, strong superalloy demand in Q1 helped bolster buyer interest in cobalt metal, particularly in the US. Prices in Q2 saw a notable downturn, due to weak demand expectations and bearish sentiment from the uncertainty surrounding a large purchase by the SRB. Market activity saw a significant seasonal downturn in the latter half of the quarter, hiding much of the price decrease, and as liquidity resumed, prices fell in line with the rest of the cobalt market.

Q4 presented some small relief for metal prices, as contract obligations left less Chinese metal available for the spot market. Increased demand, along with supply issues from Western producers, helped motivate a mild price recovery for much of the cobalt metal market, however, a reduction in superalloy demand tightened the premium on some cobalt metal forms.

Overall, metal prices in 2024 were largely driven by Chinese supply into Europe, with some traditional sulphate producers expanding their metal capacity to target higher profitability. Although much of this material was sheltered from the US market, as significant tariffs on Chinese imports have made these products less economical for buyers. However, some Chinese producers operating in other countries, such as Indonesia, begun to fill this niche in the US, offering similar and cheaper cobalt metal without the additional tariffs associated with Chinese imports; although this remains a small subset of the metals market.

5.4 COBALT SULPHATE

Throughout 2024, cobalt sulphate prices decreased by 20.2%, amid weak NCM demand growth and a persistent supply glut. Although market expectations around Q1 were optimistic due to restocking from NCM producers, this did not translate into a meaningful increase in prices until the end of the quarter, as strong expectations for EV sales led to a further increase in demand for NCM battery chemicals.

Moving into Q2, prices fell rapidly as restocking dried up and the hydroxide oversupply begun to weigh on prices. However, prices rallied somewhat at the tail end of May following rumours of the SRB purchase bolstering sentiment.

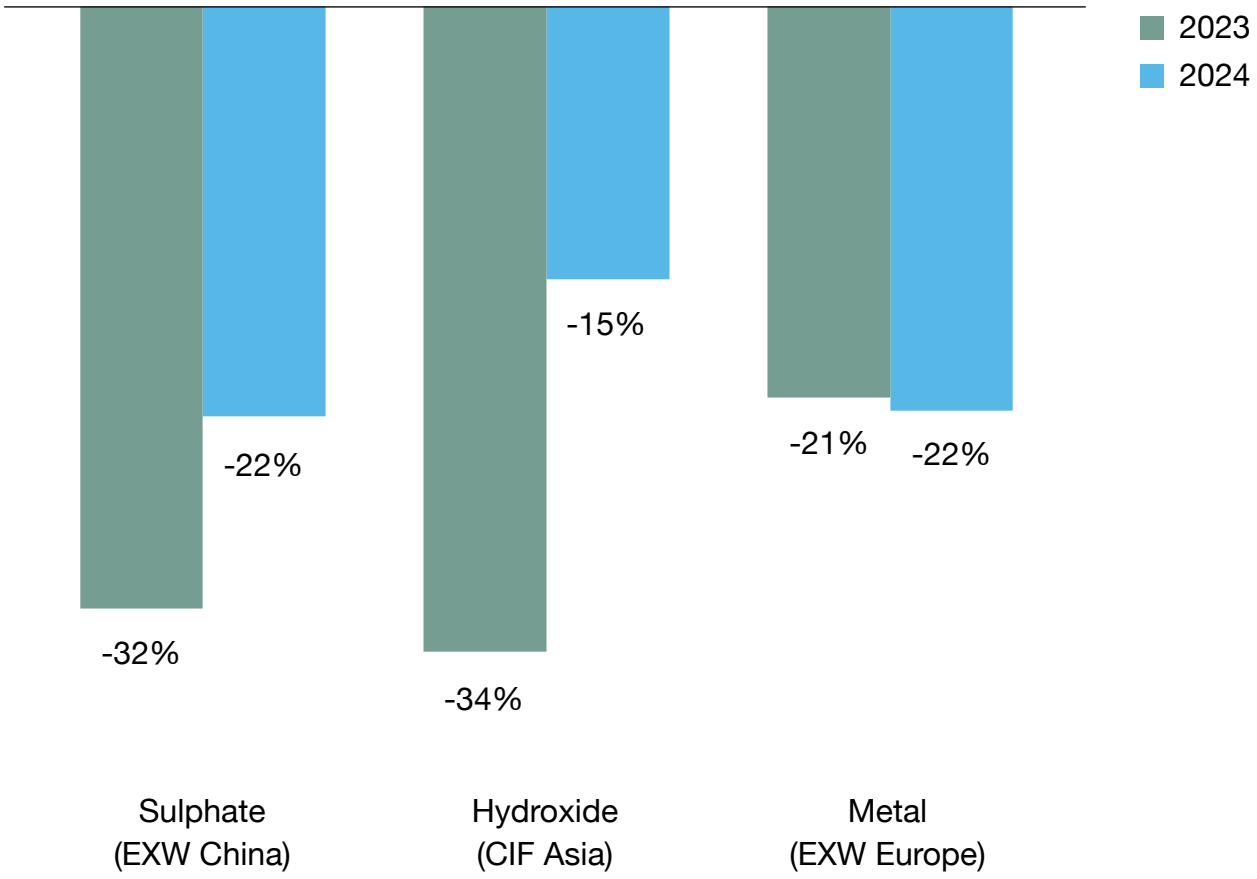
Weak NCM demand in Q3 incentivised sulphate producers to look at other potential end markets to try and counter some of the oversupply, however, this was largely unsuccessful due to the scale of the cobalt battery supply chain compared to alternative demand sectors.

As prices for cobalt sulphate continued to decline, some refiners found tight margins presenting

significant challenges, with worries that an extended period of low pricing would lead to some producers being forced to shutter production. There was also a noticeable shift towards the production of other cobalt products by some producers, with cobalt metal and cobalt oxide presenting more profitability than sulphate. Q4 2024 was characterised by persistent offers above the trading range by sulphate refiners hoping to feel out any potential buyer interest above the market range, though this was often unsuccessful.

While the decline in sulphate prices was less significant than the previous two years, there were considerable concerns from producers that the price level at the end of 2024 would not be sustainable long term. However, consistent downwards pressure from weak NCM demand growth, as well as a vastly oversupplied cobalt market limited opportunities for sulphate prices to recover.

Figure 44: Cobalt price changes y-o-y in 2023 and 2024, %



Data: Benchmark Mineral Intelligence – Cobalt Price Assessment.

6. GEOPOLITICS AND POLICY ARE RISING IN IMPORTANCE

6.1 THE GLOBAL RACE FOR CRITICAL MINERALS REMAINS HIGH ON THE GEOPOLITICAL AGENDA AMID A MORE FRAGMENTED GEO-ECONOMIC WORLD

Access to critical minerals, including cobalt, is essential for the energy transition, industrial growth and national defence needs. It remains high on the geopolitical agenda as countries strive for industrial competitiveness and supply security. Considering China's dominance across the cobalt supply chain and key parts of the battery value chain, supply diversification and de-risking from China are among the central geopolitical drivers. Particularly in the US, derisking supply chains from China is a national security concern and has bipartisan support as geo-economic competition between the two superpowers intensifies over strategic sectors.

In the last year, several geopolitical developments have impacted the cobalt, battery and other related clean energy supply chains:

- The transition to Trump 2.0 and the upheaval of the traditional international trade order, leading to geo-economic uncertainty and fragmentation
- The escalating tit-for-tat trade war between China and the US, with China leveraging its control over clean energy supply chains through export restrictions on critical minerals
- The start of the new European Commission after the EU elections in June 2024, with a policy agenda centred on defence and green industrial competitiveness
- Rising geopolitical competition over access to minerals, including cobalt, in the African Copperbelt
- The start of the President Prabowo era in Indonesia, which is at a crossroads in translating its nickel dominance into a domestic EV battery ecosystem.

Against this background, this section examines these geopolitical developments in more detail, and their relevance to the cobalt market.

6.2 INCREASING CRITICAL MINERAL SUPPLY SECURITY REMAINS A CENTRAL US POLICY PRIORITY UNDER TRUMP 2.0

Donald Trump was sworn in as the 47th US President on January 20, 2025. The Republican Party secured a congressional majority in both the US House of Representatives and the US Senate, allowing room for legislative changes, albeit with a tight majority. The second Trump administration's "America First" tariff policy, aimed at boosting domestic manufacturing – including critical mineral production – and addressing global US trade imbalances, has led to macroeconomic uncertainty in the short term. Macroeconomic uncertainty, combined with tit-for-tat trade tensions, especially with China, will likely hamper business confidence and could lead to supply chain disruptions and inflation, negatively impacting overall economic growth and demand.

With a strong national security imperative, the Trump administration seeks to bolster domestic up- and midstream – i.e., mining and processing – critical mineral production and catalyse private investment through federal funding, government-backed offtakes and faster permitting. Especially for cobalt, the US depends on foreign sources and requires significantly more investment to meet a greater proportion of its domestic needs. Benchmark analysis shows that US cobalt supply was equivalent to only 1% of domestic demand from lithium-ion batteries in 2024. In addition to the deployment of existing funding mechanisms (such as the Defense Production Act (DPA) investment authorities, the US Export-Import (EXIM) Bank and the US International Development Finance Corporation (DFC)), the Trump administration plans to establish a critical minerals production fund, administered by DFC, to fund primarily domestic upstream projects. Since the US has one of the longest mining permitting timelines in the world, addressing this key bottleneck could lead to increased supply. However, regulatory hurdles are likely to remain, given the environmental and social concerns associated with Trump's proposed changes relating to permitting, as well as the litigation-prone nature of the mining industry.

Furthermore, the Trump administration has expressed its intention to dismantle some of Biden's climate policies – the US Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL) - and scrap the so-called "EV mandate", i.e., weakening the EPA emission standards for passenger cars and light trucks for 2027-2032 and removing the IRA 30D clean vehicle tax credits. Both the IRA and the BIL have been instrumental in developing the battery supply chain, resulting in increased demand for critical minerals, driven by stringent sourcing and local content requirements, as well as tax incentives, grants, and loans. Weakened emission standards and reduced support for downstream projects put various investments at risk, including those in Republican states, which in turn will likely affect US battery and, consequently, critical mineral demand growth. However, rewriting the EPA emission standards for passenger cars and light trucks is typically a multi-year process, and removing parts of the IRA and the BIL requires congressional approval, which could face opposition from some Republicans, given the cleantech investments in red states.

Even though the US faces cobalt supply deficits and requires foreign supply to meet domestic demand, less global critical mineral cooperation and a more bilateral and transactional resource diplomacy under the Trump administration look likely. However, the US remains part

of multilateral initiatives, such as the Mineral Security Partnership (MSP) and the Minerals Investment Network for Vital Energy Security and Transition (MINVEST), which aim to spur investments and develop global mineral projects in line with ESG principles through public-private dialogue in view of supply security. Additionally, the Trump administration reportedly remains committed to implementing the Lobito Corridor upgrade in the African Copperbelt, Biden's signature infrastructure project in Africa, to improve US access to minerals and counter China's control over the cobalt and copper supply in the region (discussed further below).

Finally, while global discussions on deep-sea extraction continued at the International Seabed Authority (ISA), the 170 ISA members – the US is not a member – failed to agree on an international code for commercial extraction, which would allow the extraction of cobalt and other minerals from the international seabed. Deep-sea extraction remains controversial, with environmental groups and more than 30 countries favouring a moratorium or a precautionary pause due to a lack of knowledge about the overall environmental impact of deep-sea extraction. On the other hand, the Trump Administration issued an Executive Order in April 2025 to allow and speed up the permitting of deep-sea exploration and extraction projects both in US and in international waters, challenging the ISA's legal authority in a bid to reduce China's grip on critical mineral supply chains. This could benefit deep-sea extraction companies, such as The Metals Company (TMC), which plans to apply for exploration and commercial recovery permits under US legislation. This comes in addition to TMC's ambition to submit its application to the ISA for an international exploitation permit on June 27, 2025.

6.3 CHINA DOUBLES DOWN ON THE DEVELOPMENT OF BATTERIES AND EVS TO REMAIN THE GLOBAL CLEANTECH LEADER, WHILE IT NEEDS TO NAVIGATE A SLOWING ECONOMY AND A MORE HOSTILE INTERNATIONAL TRADE SYSTEM

China's 5% GDP growth target for last year was achieved, but primarily due to rising production and exports, whereas domestic demand remained weak and a drag on further economic growth. This has contributed to excess production and exports of various EV battery supply chain segments, with governments and other key stakeholders expressing frustrations about oversupply. To boost domestic consumer demand, China implemented a trade-in subsidy scheme, under which consumers can trade in an old petrol car and receive subsidies to upgrade to an EV, contributing to the growth of EV sales. However, some argue that additional government support is necessary to stimulate household consumption and drive demand, ultimately promoting overall economic growth.

With 2025 being the last year of its 14th Five-Year Plan (FYP), Chinese officials are laying the groundwork for the draft 15th FYP, which aims to outline the economic and industrial goals for the period 2026-2030. In addition to boosting domestic demand, the FYP will likely focus on expanding China's advantage in current and future clean energy technologies, including batteries and EVs, to achieve technological self-reliance.

Besides focusing on boosting slowing economic growth and deepening its position as a global clean energy leader – which requires increasing access to cobalt supply, amongst other critical minerals – China must also navigate growing international trade tensions, especially with the US. An illustration of this is the multiple rounds of US tariff increases introduced since Trump's inauguration throughout 2025 on Chinese imports, including the so-called "April 2 Liberation Day" reciprocal tariffs. Cobalt ore, concentrates and sulphate have been exempted so far from the US reciprocal tariffs. At the same time, the Trump administration has launched a Section 232 investigation into US imports of processed minerals, which could result in additional tariffs.

In response to trade tensions with the US, China imposed tariffs on US imports and announced export controls on some medium and heavy rare earth elements (REEs), thereby demonstrating its control over critical mineral supply chains and heightening Western concerns about their dependence on China. Although China could offset the negative economic impact of tariffs through currency depreciation, making China's exports more attractive, the increasing trade tensions make reaching the 5% GDP growth rate more challenging.

6.4 THE EU AIMS TO BOLSTER ITS DEFENCE CAPABILITIES AND CLOSE THE GREEN INDUSTRIAL COMPETITIVENESS GAP WITH THE US AND CHINA

The European Parliament elections in June 2024 brought about political change and led to losses for green and centrist political blocs, with climate policy and the EU Green Deal no longer taking centre stage. This accelerated a shift in policy priorities and prompted the new European Commission – the EU's executive arm – under Commission President Ursula von der Leyen to focus its five-year policy agenda on competitiveness and defence. The EU still views critical raw materials (CRMs), including cobalt, as essential for bolstering its green industrial competitiveness and defence capabilities, while aiming to reduce its reliance on imports from third countries, such as China, through supply localisation, diversification, and circularity. Cobalt is also recognised as a strategic raw material (SRM) by the EU Critical Raw Materials Act (CRMA), identifying the metal as having strategic importance for both the digital and green transition.

In response to the war in Ukraine and Donald Trump's "America First" and transactional foreign policy, the EU unveiled the ReArm Europe Plan/Readiness 2030, an ambitious defence plan and spending package. This plan aims to strengthen Europe's defence industrial capabilities and increase European strategic autonomy. With increasing future investments in Europe's defence capabilities, cobalt demand from defence-related end-use sectors, such as superalloys, magnets and drones, is expected to rise (see Section 3.7).

To boost European green industrial competitiveness and close the competitiveness gap with the US and China, as well as boosting supply chain resilience, the EU has tabled several initiatives, including the Clean Industrial Deal (CID) and the EU Industrial Action Plan for the Automotive Industry with the following policy aims relevant to cobalt and CRMs more generally:

- The creation of a CRM Centre to jointly purchase raw materials on behalf of interested com panies and to coordinate strategic stockpiles
- The establishment of a Battery Raw Materials Access Entity to help downstream players get access to the CRM supply
- New Clean Trade and Investment Partnerships (CTIPs) alongside the existing strategic partnerships on CRMs, in view of friendshoring and supply diversification
- The classification of black mass as hazardous waste to address black mass leakage to Asia, particularly South Korea and China, and to maintain the recycling feedstock within the EU. Furthermore, the adoption of a Circular Economy Act to create a Single Waste Market and bolster resource security
- The inclusion of sustainability, resilience and "made-in-Europe criteria" in procurement schemes to incentivise local and green manufacturing – and, in turn, sustainable CRM sourcing – along with local content requirements for battery production.

Moreover, to meet the non-binding 2030 domestic production and supply diversification benchmarks outlined in the CRMA, the EU unveiled its list of 47 strategic projects in March 2025, comprising 25 extraction activities, 24 processing projects, and 10 recycling projects, all within the EU area. These included three with cobalt extraction activities: Rio Narcea's Aguablanca project in Spain, Terrafame's Kolmisoppi in Finland, and Anglo American's Sakatti project, which provides for integrated processing, also in Finland. A number of cobalt (and other battery metal) recyclers were included, as well as Jervois' processing plant expansion in Finland and Sibanye-Stillwater's GalliCam pCAM facility in France.

The CRMA aims to ensure European extraction, processing and recycling of SRMs, including cobalt, meet at least 10%, 40% and 25% of the EU's annual consumption by 2030, respectively. Additionally, no more than 65% of the EU's annual consumption of each SRM should come from a single third country. The strategic projects will benefit from coordinated support by the EU Commission, member states, and financial institutions to become operational, facilitated by easier access to finance and off-takers, as well as streamlined permitting provisions aligned with ESG principles. In line with the CRMA, the permitting process for extraction projects is limited to 27 months, and for processing and recycling projects, it is limited to 15 months.

However, Benchmark analysis reveals that cobalt is expected to fall short of the 10% mining, 40% processing, and 25% recycling targets to meet EU battery demand by 2030. As a result, the EU will remain largely dependent on cobalt supply from third countries such as the DRC, Indonesia, Australia and Canada. Additionally, derisking European supply chains from China will remain challenging, given Chinese deep corporate involvement in the DRC mining industry.

This highlights the importance of supply diversification through strategic projects outside the EU, which are still to be unveiled as of late April 2025, and the implementation of strategic partnerships concluded with cobalt-producing countries, including the DRC, Zambia, Canada, and Australia. These partnerships aim to de-risk joint investments, foster public-private cooperation, and incentivise local value-addition in CRM-producing countries, while meeting rigorous ESG criteria.

Furthermore, the strategic partnerships align with the Global Gateway strategy, the EU's global infrastructure development and investment scheme, which supports the development of strategic mineral corridors, such as the Lobito Corridor. Regarding the implementation of the EU-DRC strategic partnership, little progress has been made in terms of investments and value-added activities despite the roadmap launch in December 2024.

6.5 THE AFRICAN COPPERBELT AND THE DRC REMAIN A GEOPOLITICAL FOCAL POINT, CENTRED ON SECURING AFRICAN MINERALS

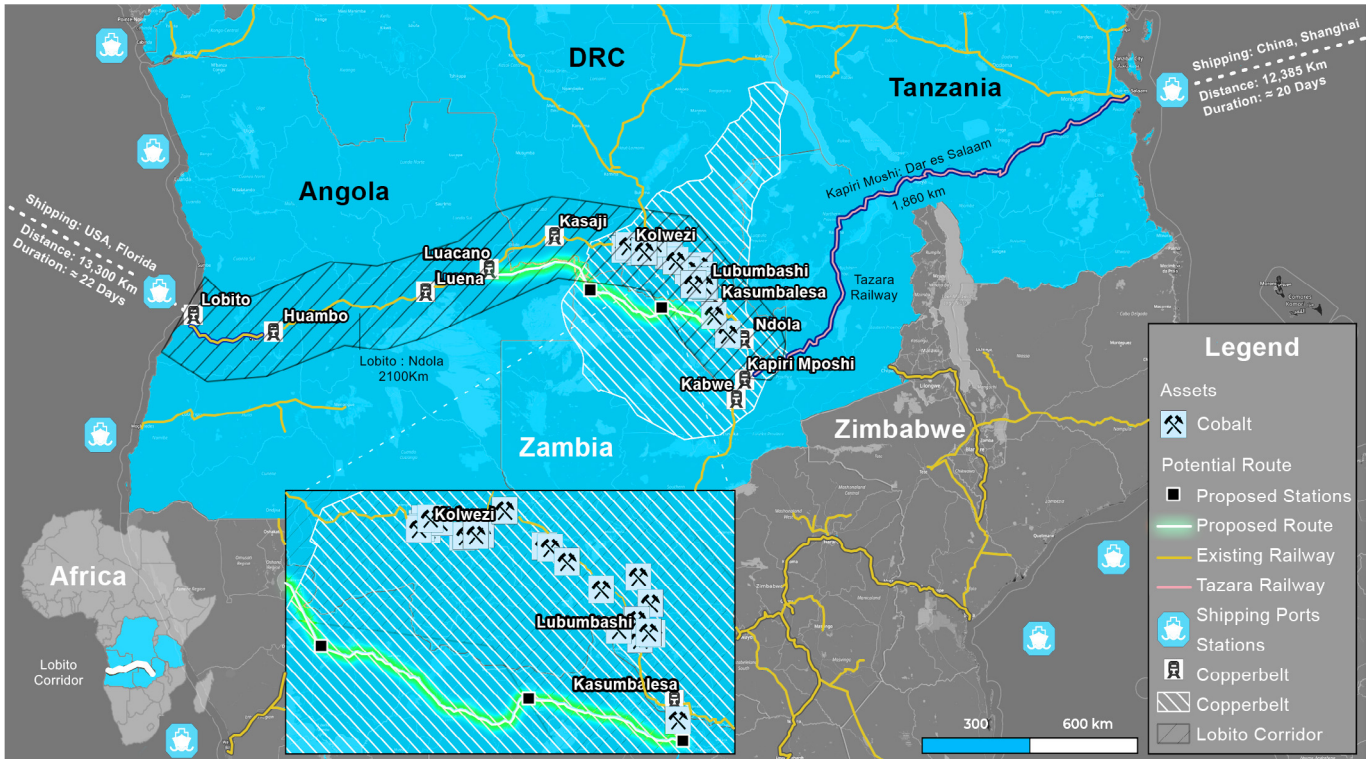
The African Copperbelt remains pivotal to the global energy transition and a key geopolitical focal point, primarily between the US and China, as the US seeks to counter China's geoeconomic involvement in the region. The Copperbelt is central to a major infrastructure project, the Lobito Corridor upgrade, which is backed by the US through the US Partnership for Global Infrastructure and Investment (PGI) and several other actors, such as the EU, Angola, Zambia, the DRC, and financial institutions.

The Lobito Corridor upgrade involves upgrading the existing rail, port, and other related infrastructure between the Atlantic Port of Lobito in Angola and Kolwezi in the DRC, with a planned expansion to Zambia. The project looks to address logistical bottlenecks, cut transport times, support local value addition across the cobalt-copper supply chain, and reduce emissions, as exports rely on costly and inefficient trucking routes to southern African ports. The upgrade could allow for more volumes to be shipped to the US or European markets, rather than China. The Lobito Corridor's impact extends beyond cobalt and copper in the DRC and Zambia, and is likely to impact other early-stage critical mineral projects, such as REE mining and processing projects in Angola.

Given China's dominance across the copper and cobalt supply chains, the US also expressed interest in expanding the Lobito Corridor to the Indian Ocean, aiming to create a Trans-African Corridor and bring new critical mineral projects online in Tanzania and Mozambique. This would put the US into direct competition with China, which intends to revitalise the Tanzania-Zambia Railway Authority (TAZARA) corridor in East Africa.

China's revitalisation of the TAZARA line aims to strengthen its long-standing presence and influence in the region by pledging to invest around $2bn to modernise the line that links Zambia to the Tanzanian port of Dar es Salaam on the Indian Ocean. A Chinese consortium, the China Civil Engineering Construction Corporation (CCECC), reportedly plans to invest in transforming the TAZARA railway into a more efficient and reliable transport corridor and intends to operate the corridor through a 30-year concession.

Figure 45: Overview of Lobito Corridor and TAZARA Railway in relation to cobalt assets



Data: U.S. Geological Surveys.

Note: © OpenStreetMap contributors, CC-BY-SA Contains Modified Copernicus Sentinel Data.

Even though the Trump administration's critical mineral supply security policy remains primarily domestically focused, it appears to further support the Lobito Corridor upgrade and favour continued US geoeconomic engagement in the Copperbelt region. Moreover, DRC President Tshisekedi offered the Trump administration a minerals deal, which is reportedly still under discussion as of late April 2025. This deal would provide the US private sector access to mining assets in exchange for US security support. This is of interest to the DRC government as a result of ongoing conflict with the M23 armed group. M23 is subject to US and UN sanctions, and UN reports state it is backed by Rwanda (see Section 4.2). The US (alongside Qatar) has supported talks between the DRC, M23 and Rwanda, which have most recently resulted in an agreement at the end of April 2025 to work towards a truce.

6.6 WITH THE START OF THE PRABOWO ERA, INDONESIA IS AT A CROSSROADS TO TRANSLATE ITS NICKEL DOMINANCE INTO A FULLY-FLEDGED EV BATTERY ECOSYSTEM

Prabowo Subianto was sworn in as President of Indonesia in October 2024, having won the election on a "continuity" platform, claiming to continue implementing former Indonesian president Joko Widodo's so-called "downstreaming" policy. Through this policy, underpinned by the 2020 nickel export ban, which led to an influx of mainly Chinese investments in the processing industry, Indonesia has emerged as a key player in the EV battery supply chain.

With the start of the Prabowo era, Indonesia finds itself at a crucial moment to translate its nickel dominance into the development of downstream stages of the battery value chain, establishing a fully-fledged EV ecosystem. Despite some progress, reaching the Indonesian government's 2030 target of 140 GWh will be challenging, with Indonesia's battery cell capacity expected to reach only 20 GWh by the end of the decade.

Furthermore, Indonesia aims to attract Western investment to diversify its economy away from reliance on China. However, this is proving challenging due to the troubling environmental, human rights, and safety records of its nickel sector, as well as China's deep corporate involvement in the Indonesian nickel sector. Even if the Indonesian government seeks to diversify investments and move up the value chain, China will almost certainly remain a key partner, both in terms of capital and technological expertise.

7. KEY CONSIDERATIONS

7.1 KEY TAKEAWAYS FROM 2024

Exceptionally strong output from CMOC's DRC operations (particularly KFM) was the major supply story, with supply cuts from many other smaller players in the face of sustained weak prices. Indonesia's output continued to rise, reaching 12% of global supply.

Cobalt demand exceeded 200kt for the first time, rising 14% y-o-y – the strongest annual growth since 2021. Battery applications accounted for 76% of demand, with EVs alone supporting 61% of total market growth.

Market oversupply expanded to +36kt, weighing on cobalt metal prices which fell 22% through the year (EXW Europe).

Industrial applications saw robust growth, with superalloys accounting for ~8% of total cobalt demand. The strategic importance of superalloy use in both defence and commercial aviation continues to provide support for non-battery cobalt applications.

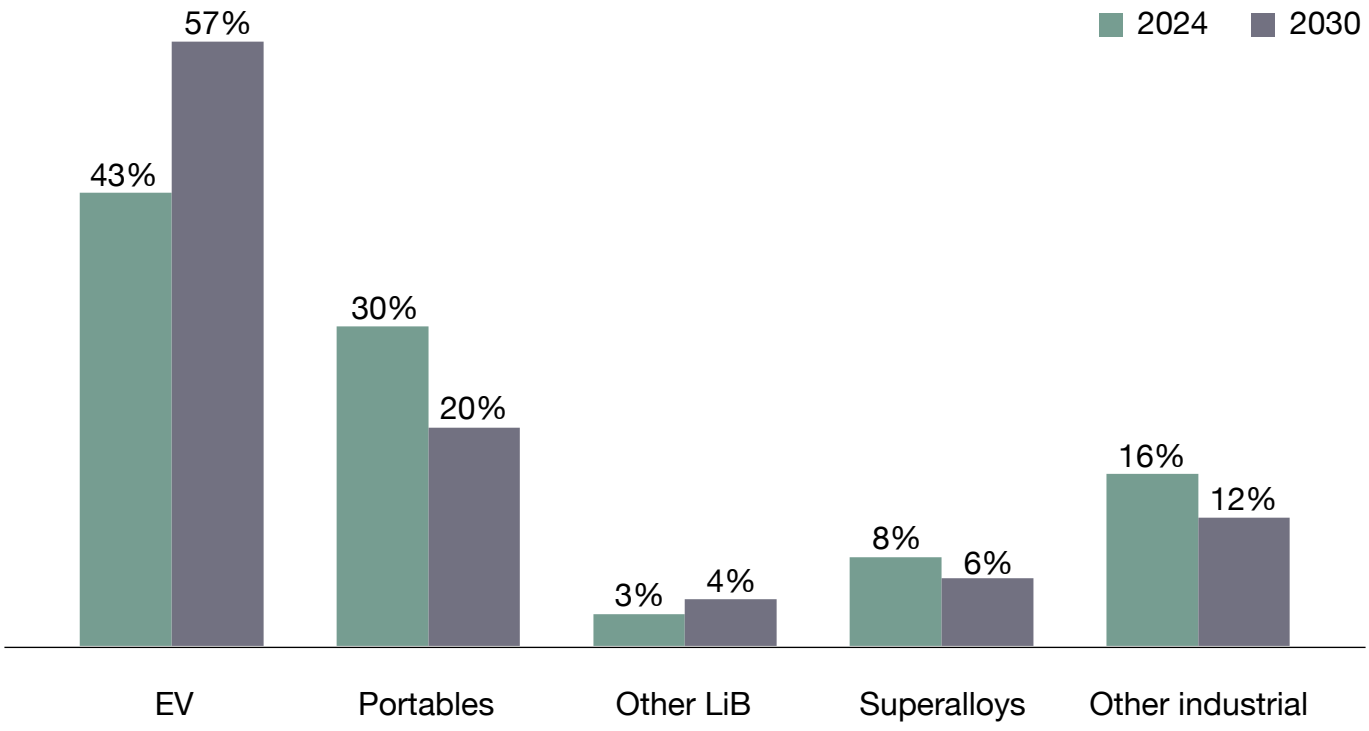
As 2024 came to a close, the cobalt market faced historically low prices, structural oversupply, and rising geopolitical uncertainty. However, cobalt's key role in both battery and non-battery applications continues to offer strong growth opportunities.

7.2 COBALT MARKET SET TO GROW FURTHER IN 2025 AND BEYOND

Cobalt demand (excluding government stockpiling) is expected to continue to grow in 2025, albeit with somewhat slower growth of +9% y-o-y vs +14% in 2024. Demand will primarily be driven by the EV market, for which cobalt demand will grow by 16% y-o-y.

To 2030, Benchmark forecasts total cobalt demand growth of 7% CAGR, with the market hitting 400kt by the early 2030s. The relative market share of EVs will increase from 43% of demand in 2024 to 57% in 2030, with most other segments – including that of portables, superalloys, and other industrial, seeing their market shares fall as EV demand growth outpaces increases from other segments. One exception will be other lithium-ion battery applications, where growing BESS demand will increase its market share slightly, albeit from a low base.

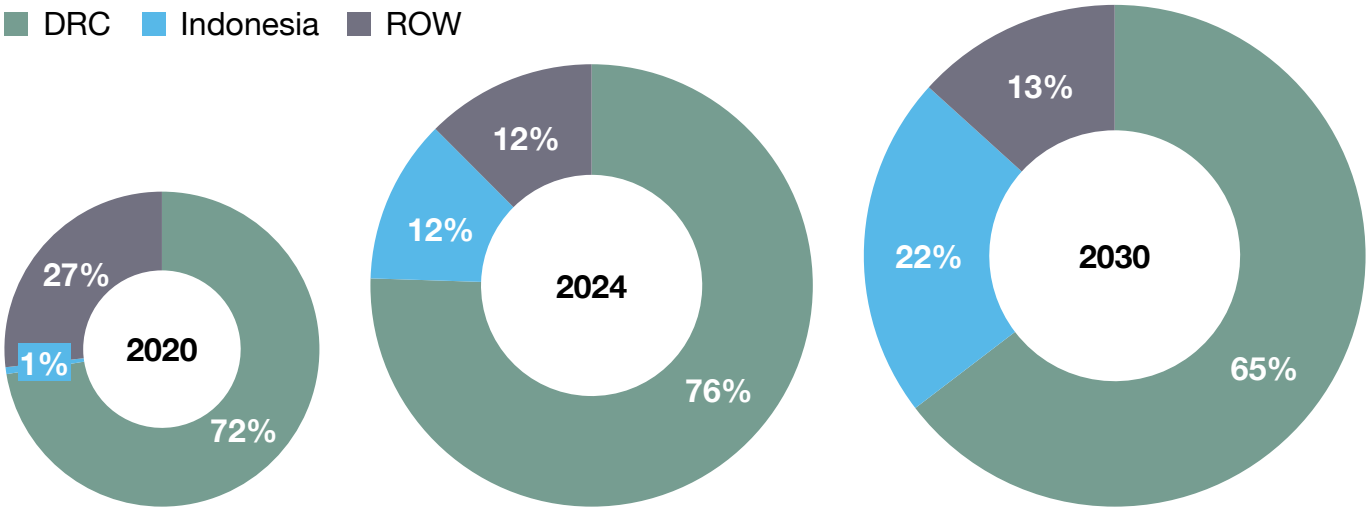
Figure 46: Cobalt demand share by sector, 2024 and 2030, %



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

At the same time, cobalt supply will also increase (notwithstanding some uncertainty regarding the DRC export ban – see below). Total cobalt supply will grow at a CAGR of 5% – lower than that of demand. The DRC – which accounted for 76% of primary cobalt supply in 2024 – is expected to see a lower market share moving forward as Indonesia ramps up output more quickly. By 2030, the DRC is expected to command a market share of 65%. In contrast, Indonesia's share will grow from 12% in 2024 to 22% by 2030.

Figure 47: Primary cobalt supply in 2024 and 2030, Co contained basis (%)



Data: Benchmark Mineral Intelligence – Cobalt Forecast.

Although demand will grow at a faster rate than supply, the surplus seen in 2024 will shrink, but not shift to a deficit until the early 2030s. Prices saw a step-change in early 2025 following the DRC export ban – and smaller surpluses mean fundamentals are supportive of higher prices moving forwards than in 2024.t A shift to a market deficit in the 2030s will trigger a call for material – considering the potentially long lead times required to bring new mines online, this means more investment is needed in the short-term to meet long-term demand trends.

DRC EXPORT BAN LOOKS TO SHAKE UP THE MARKET

Following a prolonged period of oversupply and falling prices – which weighed on DRC government revenues – early 2025 has seen an earthquake in the cobalt market, with the DRC government intervening in market dynamics for the first time. In late February, the DRC government announced a ban on all cobalt exports for at least four months. The ban will be reviewed from late May, three months after the ban's implementation.

Mining companies operating in the DRC will likely continue to produce throughout the ban period, albeit some at a reduced rate – and so supply will continue to rise, even if it cannot be exported. There is a risk that some assets will shut down – in 2024, the low-price environment led Cu-Co assets such as China Railway Resources Group's MKM and STL's Big Hill to close their cobalt lines. Cash-flow issues caused by the cobalt export ban may encourage these sites to retain closed cobalt lines and also lead other sites to reduce or stop cobalt production entirely.

The DRC government has indicated that further export controls, including a ban extension, or quotas, will follow. But it has not provided specifics on how quotas will operate, or timeframes for any further export controls.

Global stock levels were sufficient at the beginning of 2025 to meet demand for the four-month period, but not enough for a significantly longer ban. However, there remains uncertainty as to how much material is in the DRC compared to what is stocked outside the country. Cobalt supply chains are notoriously slow – even though material may be outside the DRC, it will take time for stocks to move to port and then to market. All of this contributes to price volatility.

Following the export ban announcement, prices increased rapidly in Q1 2025. Benchmark assessed metal (EXW Europe) prices rose +41% from 19 February to 19 March on the news, and sulphate (EXW China) rose +92% from 19 February to 26 March. Prices then began to moderate – a trend that is expected to continue. The rise in prices was likely driven partly by speculation, but also because some traders holding short positions were caught out by the ban, leading them to offer high bids to secure material for delivery. Once these positions were settled and sentiment moderated, the price softened slightly to a level supported by the fundamentals. This is the first time that DRC policy has materially impacted supply and so the price response is unlikely to closely match previous cycles.

To address the uncertainty in the outlook, Benchmark has modelled four potential scenarios. The potential impact of each scenario on the forecast market balance is shown in the following table.

Table 3: DRC export ban scenarios

Scenario	Four-month export ban followed by:	Potential impact
Base Case	Some short-term supply-side disruption.	• Cobalt market remains structurally oversupplied until early 2030s, albeit with surpluses at a lower level than in 2024. • Prices spiked in Q1 2025 as some sellers were caught short but prices quickly equilibrated into Q2 whilst the market awaits further updates.
Production quota at 2023 levels	Quota would equate to weighted DRC supply of 158 ktpa moving forward, including downstream yield losses.	• Cobalt market rebalances in 2025 and remains close to balance in 2026, but structural deficits emerge from 2027 onwards as supply ex-DRC is unlikely to ramp up quickly enough to meet growing battery demand. • Overall demand destruction is likely. Substitution risk emerges from the late 2020s with a possibility of quicker and more definite adoption of cobalt-free chemistries, even in Western markets.

Scenario	Four-month export ban followed by:	Potential impact
Export quota at 2023 levels	Hydroxide exports are capped at reported 2023 levels. In the absence of significant domestic refining, this effectively limits DRC supply. According to the Ministry of Mines, this wouldbe 140kt, excluding yield losses.	• Similar to the production quota scenario but more extreme. • The market would immediately move into structural deficits, likely resulting in strong upwards price support followed by demand destruction and a swift move from battery makers towards cobalt-free chemistries.
Output limited to capacity	Quota to limit cobalt output at DRC operations to stated capacity.	• A scenario that would particularly impact CMOC. • The market rebalances and remains broadly balanced until the early 2030s, when the market enters structural deficits, similar to the Base Case. • These fundamentals would suggest a tighter balance but one that is sustainable for several years without leading to demand destruction. • The deficits that emerge are similar to those in the Base Case and would still allow time for investment in new supply sources.

Data: Benchmark Mineral Intelligence – Cobalt Forecast.

7.3 OVERVIEW OF KEY TRENDS IN THE COBALT OUTLOOK

Beyond the near-term uncertainty associated with the DRC export ban there are several key trends that will shape the future of the cobalt market:

- **Shrinking surpluses:**
  Even if no further production quotas are put in place by the DRC, the cobalt market surplus is expected to decline from 2024 levels, both in absolute terms and as a share of demand, as demand growth outpaces supply. A more balanced market will support prices over time. From at least the early 2030s, demand will outstrip supply increases, triggering a call for material beyond what the current pipeline can provide – demand growth will drive price support, encouraging investment in new capacity.

- **Demand tailwinds (and some headwinds):**
  As more countries implement ICE bans, EV adoption will continue to rise dramatically. In Western markets in particular, this growth will in turn drive cobalt demand to increase. But the market is not without headwinds: in the US, the Trump administration's policies towards EVs means a more bearish outlook than previously, in what is a cobalt-dominant EV market.

- **LFP technology export ban:**
  In January 2025, China's Ministry of Commerce proposed restrictions on the export of technologies related to lithium-ion batteries, including intellectual property (IP) related to LFP battery production. This restriction could see the review of construction or project development for ex-China LFP cell producers. As the key LFP alternative, such a ban could be supportive of NCM chemistries that are already favoured in Western markets – and therefore of cobalt demand.

- **Geopolitical and military tensions:**
  As global economies pivot away from free trade and globalisation, critical mineral supply chains become more important than ever. Many countries will have to strike a balance between security of supply (e.g. through onshoring or friend-shoring) and access to material – and to key markets. As historical geopolitical alliances evolve, there will be risk as well as opportunity for critical minerals markets. For example, growing military spending offers a demand growth opportunity for both battery and non-battery applications, while growing uncertainty can be unpalatable for debt markets that are needed to build out Western supply chains. All this, alongside continued uncertainty in US trade policy which impacts global economic and financial sentiment, means the outlook for cobalt is likely to remain volatile and uncertain moving forwards.

LIST OF FIGURES

ABBREVIATIONS & DEFINITIONS

GENERAL

$: US dollar.

3TG: tin, tungsten, tantalum, and gold; the so-called “conflict minerals”.

AC: alternating current.

AI: artificial intelligence.

ARECOMS: l’Autorité de Régulation et de Contrôle des Marchés de Substances Minérales Stratégiques. A DRC strategic minerals watchdog.

ASM: artisanal and small-scale mining.

BESS: battery energy stationary storage.

BHP: BHP Group Ltd., the world’s largest mining company (also known as Broken Hill Proprietary Co.).

Black mass: a mixture of crushed metals produced from shredding battery scrap.

bps: basis points, 1/100th of 1%.

CAGR: compound annual growth rate, %.

CCECC: China Civil Engineering Construction Corporation.

CIF: cost, insurance and freight, a shipping arrangement under which the seller is responsible for delivery of goods onto the ship and insuring the shipment until it reaches destination.

CMOC: CMOC Group Ltd., the largest cobalt producer, formerly known as China Molybdenum Co., Ltd.

Co: chemical symbol for cobalt.

CO2: carbon dioxide.

Cobalt chemical: refined chemicals containing cobalt, in the form of cobalt sulphate for batteries, and other specialty products.

Cobalt metal: refined metal products in the form of briquettes, cathodes, broken cathodes and rounds.

Cu: the chemical symbol for copper.

bn: billion.

DFC: U.S. International Development Finance Corporation.

DRC: Democratic Republic of the Congo.

EFTA: European Free Trade Association, includes Iceland, Liechtenstein, Norway, and Switzerland.

EGC: Entreprise Générale du Cobalt.

EOL: end of life material for recycling.

EPA: U.S. Environmental Protection Agency.

ERG: Eurasian Resources Group.

ESG: Environmental, social and governance.

EU: European Union.

EXIM: Export-Import Bank of the United States.

EXW: Ex-works, a shipping arrangement under which the seller is only responsible for making goods available at a location, with the buyer responsible for transport and insurance costs.

Fed: the US Federal Reserve.

FeNi: ferronickel, a crude nickel intermediate commonly used to make stainless steel.

GDP: gross domestic product.

Gécamines: la Générale des Carrières et des Mines. DRC state-controlled mining corporation.

GWh: gigawatt-hour, one billion watt-hours.

HPAL: high pressure acid leaching process for cobalt and nickel refining.

HV: high-voltage.

IEP: integrated electric propulsion.

IMIP: Indonesia Morowali Industrial Park.

IP: intellectual property.

ISA: International Seabed Authority.

JV: joint venture.

KCC: Kamoto Copper Company, a Glencore-owned copper-cobalt producer in the DRC.

KFM: Kisanfu, the largest cobalt mine in the world, owned by CMOC.

km: kilometer.

kt: kilotonnes, equivalent to 1,000 metric tonnes.

kWh: kilowatt-hours, equivalent to 1,000 watt-hours.

lb: pound mass; one metric tonne is approximately 2,204.62lb.

LCA: life-cycle assessment, a methodology for assessing environmental impact.

LDV: light-duty vehicle.

LHS: left hand side, typically for a chart axis.

Li: chemical symbol for lithium.

Li-ion or LiB: lithium-ion battery, the current dominant battery technology.

M: million.

MWh: megawatt-hour, one million watt-hours.

M23: March 23 Movement, a Rwanda-backed rebel group in the DRC.

Matte: a crude intermediate product of ore refining, typically of nickel, copper or lead.

MHP: mixed hydroxide precipitate containing cobalt and nickel.

MKM: Minière de Kalumbwe Myunga, a copper-cobalt mine in the DRC owned by China Railway Resources Group Co., Ltd.

m-o-m: month on month change.

NATO: North Atlantic Treaty Alliance.

NDRC: National Development and Reform Commission, a Chinese government department that is responsible, among other things, for strategic mineral stockpiling. Formerly this was done by the State Reserve Bureau (SRB).

Ni: chemical symbol for nickel.

NPI: nickel pig iron, an intermediate nickel product from laterite mining which is typically used to make stainless steel.

NRMM: Non-road mobile machinery.

OECD: the Organisation for Economic Co-operation and Development.

OEM: original equipment manufacturer, e.g. automotive company.

PC: passenger car, or in the context of portable electronics, personal computer.

PGM: platinum-group metals.

R&R: ore reserves and resources. Resources include concentrations of minerals of economic interest whereas reserves are those that can be economically recovered.

REE: rare earth element.

RHS: right hand side, typically for a chart axis.

RMB: renminbi, the Chinese yuan.

RMI: Responsible Minerals Initiative.

ROW: rest of the world.

SLI: starting, light, ignition batteries, used to start internal combustion engines.

SmCo: samarium-cobalt, a type of permanent magnet.

STL: Société pour le traitement du terril du Lubumbashi, a subsidiary of Gécamines which operates a tailings recovery site at Big Hill in the DRC.

SUV: sports utility vehicle.

t: metric tonne.

TAZARA: Tanzania-Zambia Railway Authority.

TFM: Tenke Fungurume, a copper-cobalt mine owned by CMOC.

TMC: TMC the metals company Inc., a deep-sea mining company.

TSM: Towards Sustainable Mining.

UAV: unmanned aerial vehicle.

UGV: unmanned ground vehicle.

UK: United Kingdom.

UN: United Nations.

US: United States of America.

V: volt, a unit of electric potential difference.

y-o-y: year on year change.

CATHODE CHEMISTRIES:

CAM: cathode active material.

LCO: lithium cobalt oxide.

LFP: lithium iron phosphate (no cobalt).

LMFP: lithium manganese iron phosphate (no cobalt).

NCA: lithium nickel cobalt aluminium oxide.

NCM: lithium nickel cobalt manganese oxide. Typically referred to with the ratio of each metal e.g. 622 contains a 6:2:2 ratio of nickel to cobalt to manganese.

ELECTRIC VEHICLES:

BEV: battery electric vehicle.

eBike: electric bike.

eMM: electric micromobility (e.g., bikes, scooters etc.).

EV: electric vehicle.

HEV: hybrid electric vehicle, with both an internal combustion engine and an electric motor.

ICE: internal combustion engine, typically powered by either petrol or diesel.

PHEV: plug-in hybrid electric vehicle.

REEV: range extended electric vehicle – powered by a battery, with a small internal combustion engine to recharge the battery.

ZEV: zero emission vehicle.

GEOPOLITICS:

BIL: Bipartisan Infrastructure Law, a US federal statute.

CID: EU Clean Industrial Deal.

CRM: Critical Raw Material.

CRMA: EU Critical Raw Materials Act.

CTIP: EU Clean Trade and Investment Partnership.

DPA: US Defense Production Act.

EWC: European Waste Catalogue.

FYP: Five-year plan, Chinese social and economic development initiatives.

ISSB: International Sustainability Standards Board.

MINVEST: Minerals Investment Network for Vital Energy Security and Transition.

MSP: Minerals Security Partnership.

PGI: Partnership for Global Infrastructure and Investment.

SRM: Strategic Raw Material.

Contact us if you have any questions

COBALT INSTITUTE
enabling technology, advancing society

+44 1483 578877
ci@cobaltinstitute.org

3rd Floor, 45 Albemarle Street, Mayfair,
London W1S4JL UK

www.cobaltinstitute.org
LinkedIn: Cobalt Institute

BENCHMARK | rho motion

Harry Fisher
Product Director - Cobalt and Nickel
hfisher@benchmarkminerals.com

William Talbot
Research Manager
wtalbot@benchmarkminerals.com

www.benchmarkminerals.com