

Transition metals: despite favourable long-term demand forecasts, the nickel, lithium, and cobalt markets are experiencing overcapacity

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Confidential

Summary

The lithium, nickel and cobalt markets are in a paradoxical situation: after experiencing a surge in prices in 2021-2022, fuelled by expectations of exponential demand linked to electric vehicles and energy storage, the trend has reversed. Massive investments in mining, refining and battery materials have created significant overcapacity. Supply has therefore grown faster than consumption, causing prices to fall. This reversal reflects a gap between anticipated long-term demand and short-term market reality. What's more, the inertia of these markets is contributing to the persistence of this overcapacity. Supply remains difficult to adjust due to investment lead times, energy costs and geological constraints.

The constraints specific to each metal accentuate these imbalances. Nickel, mainly produced in Indonesia, faces an oversupply that is weighing heavily on the market. In addition, this increase in capacity is leading to an increase in cobalt production. As a co-product of copper and nickel, cobalt cannot adapt its supply independently of the cycle of the main minerals. In this context, Indonesia could even overtake the DRC by 2040 as the world's leading cobalt producer. Finally, lithium, produced from primary deposits, is also seeing its margins squeezed by the rise of Chinese refining and low prices.

Added to these constraints is a technological shift. The rise of nickel- and cobalt-free batteries is reshaping demand for ore: between 2022 and 2024, their global market share rose from 28% to over 50%. This shift, driven by China, is reducing the role of cobalt and, to a lesser extent, nickel in the battery sector, to the benefit of lithium.

Governments are responding to these changes with proactive policies. On the producer side, the DRC is favouring the introduction of export quotas on cobalt, Indonesia is seeking to limit its nickel production, and Chile is strengthening public sector control over the lithium industry. On the consumer side, China is taking advantage of falling global prices to build up strategic stocks and consolidate its industrial dominance. The United States is focusing on relocation and domestic investment, while the European Union is banking on partnerships and regulatory oversight.

All in all, cobalt currently appears to be the most vulnerable metal, caught between sluggish supply (due to its status as a co-product) and less favourable demand prospects because of technological substitution in the battery manufacturing process. Nickel is also likely to suffer but still has outlets in high-energy-density batteries and industrial alloys. Finally, lithium stands out as the winning metal in this technological transition, with demand expected to remain very robust.

1. The paradox of transition minerals markets: forecasts of sustained demand but falling prices

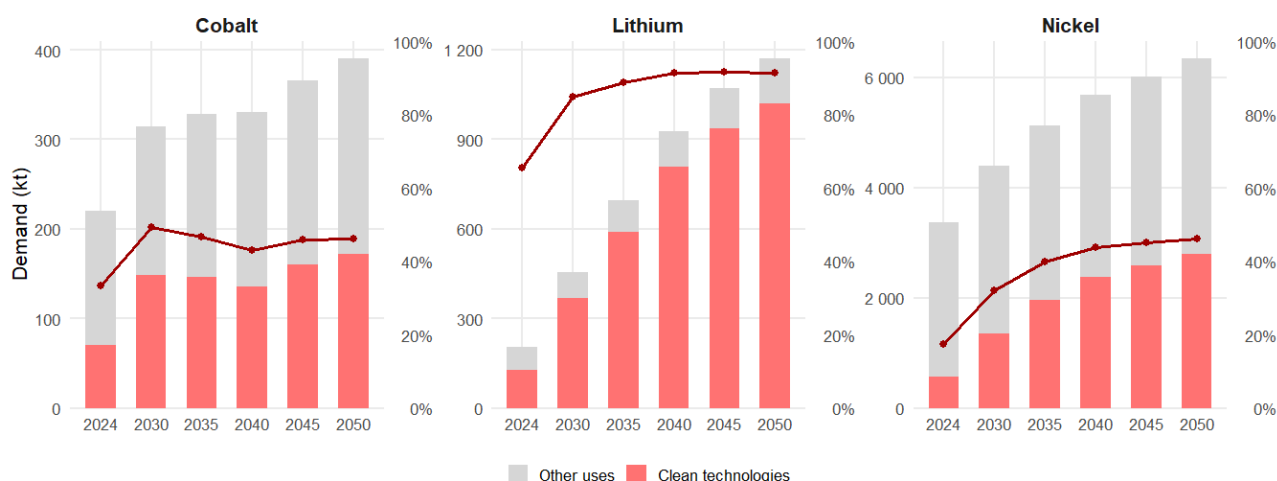
1.1. Demand driven by low-carbon and digital technologies...

Lithium, nickel and cobalt have long been used in industry: nickel is used in the manufacture of stainless-steel alloys, cobalt is essential for magnets and portable electronics, and lithium is used in metallurgy, glass and ceramics. **But in recent years, these minerals have taken on a new dimension: they are at the heart of the energy transition and global digitalisation.**

These three minerals are widely used in transition technologies, particularly in electric vehicle batteries and energy storage. **As such, they are included on the lists of critical minerals published by the United States (USGS)¹, the European Union² and India³, as well as by many other economies that consume or produce these resources.**

The International Energy Agency (IEA) also classifies these metals as **critical raw materials for which demand is expected to grow most rapidly between now and 2050**, driven by the electrification of transport and the digitalisation of energy systems. According to the Global Critical Minerals Outlook 2025⁴, global consumption of lithium, nickel and cobalt could **at least double by 2040 compared to demand in 2020**, depending on the scenario studied (STEPS, APS or NZE).

Figure 1 – Evolution of mineral demand for the STEP scenario, in kt (left scale) and share of low-carbon technologies, in % (right scale)



Source: IEA

Lithium has seen **the most spectacular growth**. Demand for lithium is expected to grow by 30% in 2024, equivalent to the total demand for the whole of 2018. 95% of this growth is driven by batteries for electric vehicles (90%) and energy storage (5%). According to the IEA⁵, under the Stated Policies (STEP) scenario⁶, low-carbon technologies are expected to account for **more than 80% of total lithium demand by 2030 (90% by 2050)**. In 2024, three-quarters of demand will come from **China**. Demand from **South Korea** and **Japan** is also on the rise. And, in the long term, a possible expansion of consumption areas to North America and Europe is expected because of the "IRA" and "Net Zero Industry Act" industrial plans.

¹ About the 2025 Draft List of Critical Minerals | U.S. Geological Survey, USGS, 25/08/2025

² Critical Raw Materials Legislation - Consilium, Consilium, 21/03/2025

³ Critical Minerals for India, mines.gov.in, 06/2023

⁴ Global Critical Minerals Outlook 2025, iea.blob.core.windows.net, 3374

⁵ Global Critical Minerals Outlook 2025, iea.blob.core.windows.net, 3374

⁶ The IEA's Stated Policies Scenario (STEPS) only takes into account policies and commitments already announced or being implemented by governments, without assuming any new future measures.

Demand for nickel rose by **6% in 2024**, with **17% coming from low-carbon energy technologies**. According to the IEA, **around 75% of demand is linked to stainless steel production**. However, green energy is expected to grow significantly, accounting for **44% of demand in 2050** and bringing total demand to over 6 million tonnes (Mt) – again according to the STEP scenario.

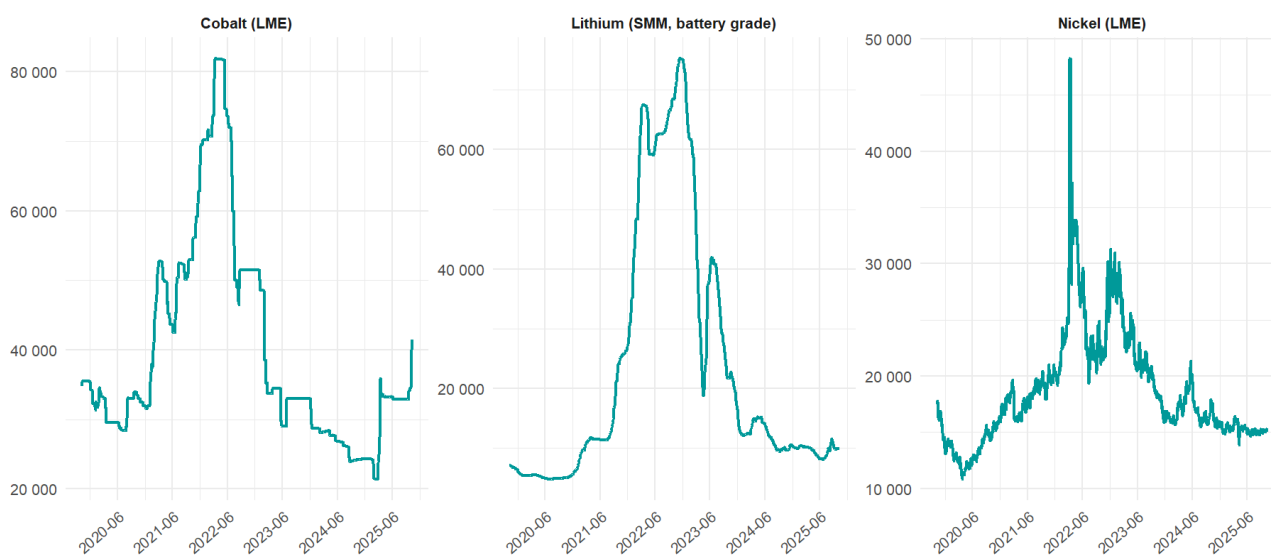
In terms of consumer countries, **China captured 60% of the global market on average between 2020 and 2024**, mainly for stainless steel production. **Indonesia** (5% of demand in 2024) is expected to grow in the coming years due to an increase in its refining capacity, while the rest of the world is expected to maintain a stable share of global consumption.

Finally, global demand for cobalt has increased by **10% over the last two years**, exceeding **200 kt** for the first time. In 2024, 76% of demand will be linked to the manufacture of batteries⁷, electric vehicles and, above all, mobile phones. **However, the market share of cobalt-containing batteries in the total electric battery market is declining, from 64% in 2022 to 49% in 2024⁸**; the IEA has lowered its 2040 forecast for cobalt consumption in this sector by 25%, signalling a structural trend towards the production of less cobalt-intensive batteries (see 2.3). Unsurprisingly, **China** is by far the largest consumer (70% in 2024).

In summary, **global demand is strong but still highly dependent on the Chinese economy**. The extent of growth varies from one metal to another. Lithium has the strongest momentum, while nickel growth is driven by energy-related outlets but is held back by weaker stainless-steel outlets. Cobalt, meanwhile, is being impacted by the diversification of battery chemistries. **However, these differences do not call into question the upward trend in demand, which remains robust for all three minerals.**

1.2. ...against a backdrop of prices that have remained low since 2022

Figure 2 – Lithium, cobalt and nickel prices since June 2020, USD/metric tonnes



Source: LME, SMM, via LSEG

1.2.1 2022: a year of speculative surges amid industrial and geopolitical shocks

In 2022, the markets for critical minerals experienced spectacular surges (figure 2). Battery-grade lithium carbonate (99% purity), traded on the *Shanghai Futures Exchange*, peaked at over **USD 70,000/tonne** at the end of 2022, a tenfold increase in less than two years. Nickel briefly exceeded **100,000 USD/tonne** in March

⁷ Cobalt-Market-Report-2024.pdf, www.cobaltinstitute.org, 05/2025

⁸ Cobalt Market report 2024, www.cobaltinstitute.org, 05/2025

2022⁹. Cobalt, meanwhile, almost matched its record high of 2018 with an average price in 2022 of **64,000 USD/tonne**¹⁰.

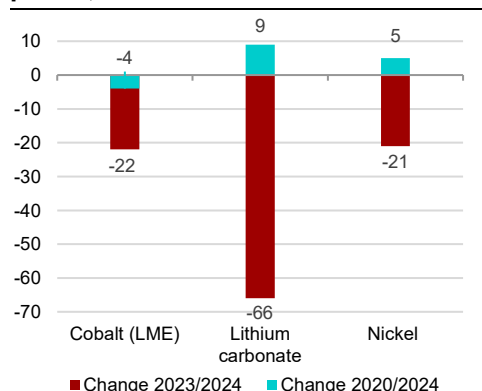
There were several reasons for these record highs:

- (1) **The post-Covid-19 industrial recovery** coupled with the rapid rise of electric vehicles in the face of supply tensions linked to the slowdown in investment and production during the health crisis.
- (2) **Geopolitical and logistical shocks** affecting two key producers: Russia¹¹ (6% of global refined nickel, 5% of cobalt), because of the invasion of Ukraine in February 2022, and the Democratic Republic of Congo (70% of global cobalt), which is facing political uncertainty.
- (3) **Price overreactions linked to the energy transition and financialisation**, particularly illustrated by the proliferation of specialised index funds and futures contracts.

In summary, **it was a triple shock – industrial, geopolitical and speculative** – that led to these price levels, which were disconnected from physical fundamentals.

1.2.2 2023–2025: a correction driven by a catch-up in supply and a slowdown in Chinese demand

Figure 3 – Four-year and year-on-year changes in lithium, cobalt and nickel prices, in %



Source: USGS MCS 2025

From the second half of 2022 onwards, global prices underwent a sharp correction. Between July 2022 and July 2025, lithium lost nearly 90% of its value¹². In 2023, the average annual price of nickel fell by around 16% compared to 2022¹³. And the price of cobalt collapsed by nearly 50% between April and December 2022. In 2025, the price of cobalt remains around 60% below its spring 2022 level¹⁴.

This decline, which continued in 2024, can be explained in part by two structural factors:

- (1) **The euphoria of 2022 triggered a wave of massive investment in mining and refining.** The International Energy Agency points out that the proliferation of exploration and processing projects has led to a significant increase in global production capacity¹⁵ (see section 1.3).

- (2) **After a sharp acceleration in battery production in 2022-2023, the Chinese industry faced a slowdown** in battery demand in a more challenging macroeconomic environment, both domestically and in terms of exports¹⁶. Chinese battery exports fell by 6% in value year-on-year in 2024¹⁷.

1.2.3 Price dynamics are putting pressure on the entire production chain

This prolonged decline in lithium, nickel and cobalt prices is testing the **economic viability** of producers, against a backdrop of global overcapacity, rising costs and tougher ESG requirements.

Indeed, **some producers have reported losses (Ganfeng, Tianqi)**¹⁸. This pressure on margins is encouraging consolidation strategies, particularly in concentrated value chains such as those in China and

⁹ The story of the man who caused nickel prices to skyrocket - La Voix du Caillou, La Voix du Caillou, 04/07/2023

¹⁰ Facts about cobalt - Natural Resources Canada, naturalresources.canada.ca, 13/03/2025

¹¹ War in Ukraine: oil, wheat, rapeseed, aluminium, nickel... prices of certain raw materials are skyrocketing, Le Monde.fr, 25/02/2022

¹² Lithium Oversupply 2025: Key Takeaways from Conference - Fastmarkets, Fastmarkets, 01/07/2025

¹³ Nickel market – Commodity markets – Strategic report – Nor Nickel 2023 Annual Report, ar2023.nornickel.com, January 2024

¹⁴ Cobalt's Supply Risks and Demand Drivers - CME Group, www.cmegroup.com, 17/04/2025

¹⁵ Executive summary – Global Critical Minerals Outlook 2025 – Analysis - IEA, IEA, 11/09/2025

¹⁶ China slowdown dampens 2023 EV battery demand outlook | Benchmark Source, Benchmark Source, 1 October 2025

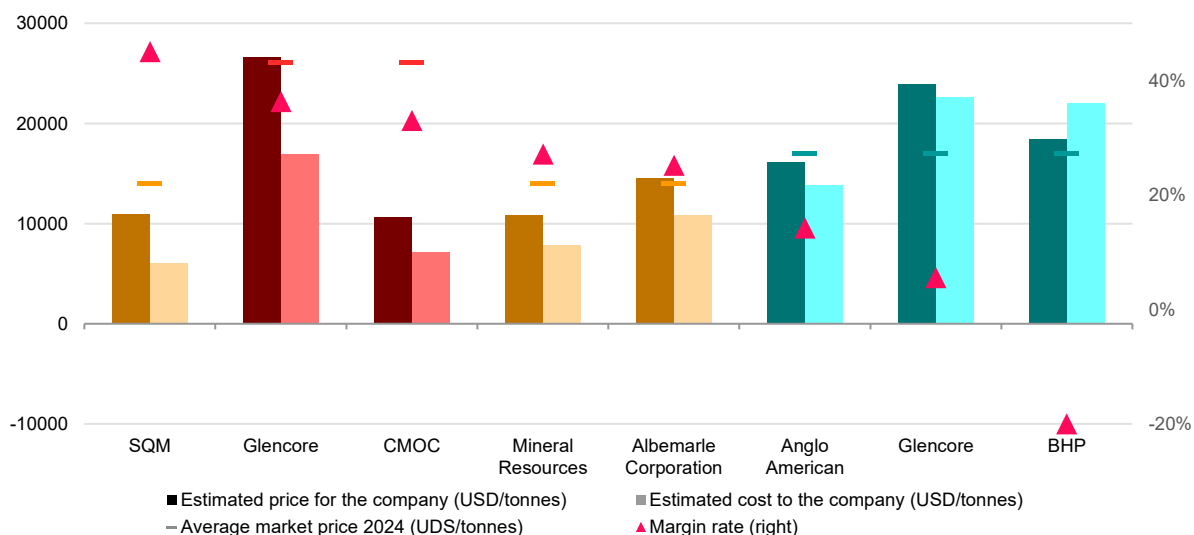
¹⁷ Chinese Li-ion Battery Market: Ways to Survive under fierce competition - Shanghai Metal Market, www.metal.com, 18/04/2025

¹⁸ Lithium woes hold top China producers to year-to-date losses - MINING.COM, MINING.COM, 30/10/2024

Indonesia¹⁹. Each mineral faces its own challenges and technical characteristics that impact its production costs and the margins achieved by the sector.

Today, **30%** of producers do not cover all their costs and are operating at a loss²⁰. Others, such as **Mineral Resources** and **Albemarle Corporation** (figure 4), both operating in Australia, are managing to maintain a margin of around 25%. **SQM, the Chilean national company, whose country is the world's second largest lithium producer, manages to maintain a margin rate of over 40%**. The different levels of pressure on companies can be explained by the technical characteristics of lithium extraction and refining. There are two types of lithium reserves: **lithium brine** (as in Latin America) and **hard rock lithium** (as in Australia). The former is more expensive to extract due to the chemical reagents used to produce lithium carbonate. However, and this is where the advantage lies for SQM, hard rock deposits mainly produce spodumene concentrate, a raw material used for lithium carbonate. **Brine, on the other hand, can be used to produce lithium carbonate directly. Selling prices can therefore be higher for these deposits and margins greater²¹.**

Figure 4 – Costs and prices of the main lithium (yellow), nickel (blue) and cobalt (red) producers, 2024
(see methodology in [Appendix 1](#))



Source: 2024 annual reports of each company, INSEE, GSA calculations

Note: These figures are approximations based on available data provided by the companies concerned.

Margins in the nickel market contracted in 2025, due to both low selling prices and rising energy costs. **25% of global production is estimated to be operating at or below cost²²**. Here again, costs vary depending on the extraction techniques used and the end products obtained. **The average break-even point is estimated at between USD 13k/t and USD 20k/t**. Thus, the deposits mined using the HPAL process²³ in Indonesia are the most expensive, but the level of integration of the production system helps to limit the risks. Similarly, the cobalt co-produced in some of these mines makes it easier to amortise costs by increasing credit through this co-production²⁴.

Cobalt is in a unique position in that it is a by-product of copper or nickel. It accounts for between **8% and 15% of nickel mining revenues²⁵** and depends on the more positive dynamics observed in the copper

¹⁹ [Lithium Industry Consolidation: Drivers and Future Outlook, Discovery Alert, 07/05/2025](#)

²⁰ Nearly 30 per cent of lithium producers are losing money, shutdowns likely if prices don't improve, [Market Index, 29/08/2024](#)

²¹ [Lithium Sector: Production Costs Outlook | S&P Global Market Intelligence, pages.marketintelligence.spglobal.com, 10 May 2019](#)

²² [Nickel Prices: Navigating Supply Surplus Challenges, Discovery Alert, 20/06/2025](#)

²³ The HPAL (High Pressure Acid Leach) process involves extracting nickel and cobalt from laterites by dissolving them in sulphuric acid at high temperature (around 250°C) and high pressure. This chemical treatment separates the precious metals from the ore, which are then purified and transformed into intermediate or finished products.

²⁴ According to Benchmark Mineral Intelligence

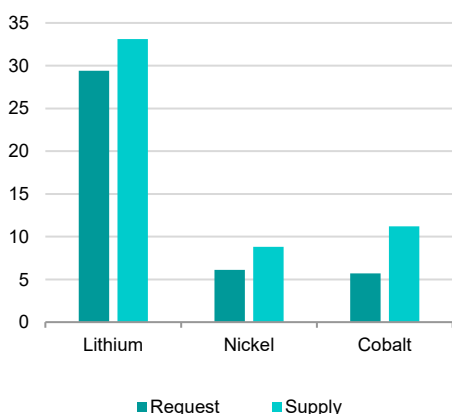
²⁵ [Nickel Prices: Navigating Supply Surplus Challenges, Discovery Alert, 20/06/2025](#)

market (see section 2.2). Cobalt-producing companies are therefore dependent on revenues from their main production.

1.3. Overcapacity resulting from overly optimistic demand forecasts

The downturn in the lithium, nickel and cobalt markets is primarily due to a gap between short-term investment dynamics and consumption (figure 6). This has created a situation of global overcapacity and downward pressure on prices. The International Energy Agency (IEA) notes that, **since 2020, the growth in the supply of battery metals has been twice as fast as that observed at the end of the 2010s**²⁶.

Figure 6 – Growth in supply and demand between 2021 and 2024, in %



Source: IEA

For lithium, Australia, Chile and China continue to dominate and increase mining production and refining.

For nickel, Indonesia stands out with an acceleration in HPAL (High Pressure Acid Leach) processing capacity²⁷. The country increased its production by around 400 kt between 2023 and 2024, representing 2% growth over one year²⁸.

For cobalt, in the DRC, the major Kamoakakula and Tenke Fungurume projects continue to ramp up production. For example, Tenke Fungurume produced more than 18 kt of cobalt in 2021 and was already planning expansions to double this capacity²⁹. Between January and September 2024, CMOG produced 84,722 tonnes of cobalt in the DRC, exceeding its annual production forecast of 60,000 to 70,000 tonnes and recording a 127.4% increase compared to the previous year³⁰.

The consensus is that surpluses will persist in the short term. The IEA forecasts that supply and demand will only return to equilibrium between 2027 and 2032, depending on the mineral.

For nickel, S&P Global anticipates a surplus of 198 kt in 2025 and a persistent surplus (fourth consecutive year), potentially until 2031³¹. Regarding primary nickel, comments from Shanghai Metals Market (SMM) highlight a tense balance in the short term (policy effects, transport disruptions), but a surplus in the medium/long term³².

For cobalt, the surplus is expected to decline but persist in 2025 – falling from 53 kt in 2024 to 28 kt, driven by the DRC and the rise in volumes associated with HPAL nickel projects in Indonesia³³. Project Blue nevertheless forecasts a slight supply deficit from 2026 onwards under pressure from export quotas imposed by the DRC³⁴ (see part 3). The government could grant quotas representing half of 2024 exports for 2026 and 2027. However, the accumulation and management of intermediate stocks remain key issues for market balance, as quotas cannot be applied to production (see 2.2). Beyond reducing the surplus, this policy is likely to significantly increase price volatility³⁵.

²⁶ Executive summary – Global Critical Minerals Outlook 2025 – Analysis – IEA, IEA, 14/10/2025

²⁷ The rise and rise of Indonesian HPAL – can it continue? | Wood Mackenzie, www.woodmac.com, 04/04/2023

²⁸ Indonesia - Mining by the numbers, 2024 | S&P Global, S&P Global Market Intelligence, 18/09/2024

²⁹ Based on USGS data

³⁰ COMMODITIES 2025: Cobalt market oversupply to ease in 2025 | S&P Global, S&P Global Commodity Insights, 19/12/2024

³¹ TRADE REVIEW: Slow stainless steel, battery demand to weigh on nickel prices in Q3 | S&P Global, S&P Global Commodity Insights, 14/07/2025

³² SMM: Nickel ore prices could remain high throughout 2025, with the nickel market expected to maintain a tight balance in the short term [Mining Conference in Indonesia] - Shanghai Metal Market, www.metal.com, 30/06/2025

³³ COMMODITIES 2025: Cobalt market oversupply to ease in 2025 | S&P Global, S&P Global Commodity Insights, 19/12/2024

³⁴ Cobalt under lockdown: How will the DRC's new export quota system reshape the cobalt market? | LinkedIn, www.linkedin.com, 22/09/2025

³⁵ DRC cobalt export quotas to support cobalt prices, though challenges loom | S&P Global, S&P Global Market Intelligence, 16/10/2025

Lithium will also end 2025 with a surplus once again. Forecasts predict a market surplus until at least 2028³⁶. The abundance of supply from Australian hard rock deposits and the rapid expansion of Chinese refining capacity have led to significant stock levels that cannot be absorbed by the market in the short term³⁷.

2. Obstacles to restoring the balance between supply and demand

Markets characterised by short-term price inelasticity

2.1. Markets marked by short-term supply price inelasticity

This difference between short-term price dynamics and long-term demand dynamics driven by anticipated energy transition needs seems contradictory at first glance.

To better understand this paradox, **we need to distinguish between the forces at work in determining prices over different time horizons:**

- **In the short term, prices are particularly sensitive to economic or geopolitical shocks**, such as trade tensions, announcements of customs duties, export restrictions or other national decisions with a global impact on the market. **These factors also explain the slight recovery in prices in early 2025**, marked by the new US trade policy and increasingly assertive strategies in favour of mining nationalism (such as cobalt export quotas in the DRC, see section 3)³⁸.
- **In the medium term, production capacity plays a more important role in determining prices** by adjusting to long-term demand expectations. The surge in 2022 led to significant investment in the mining sector thanks to particularly attractive returns. **The effects of this overinvestment are now being felt, and oversupply is making it difficult to regulate the market in the medium term.**
- Finally, **in the long term, mineral markets are driven more by structural forces of demand**³⁹.

Recent empirical studies confirm that, for transition metals, geopolitical shocks account for a large part of short-term price movements, noting that in the long term, demand plays a central role while supply plays a secondary role.

The OECD shows that variations in aluminium and copper prices are mainly explained by aggregate demand shocks, while **nickel reacts to all shocks and is characterised by high price sensitivity to announcements of trade restrictions**⁴⁰.

Other studies confirm that anticipated changes in long-term demand have significant effects on supply. The IMF (Boer et al., 2021)⁴¹ estimates, based on a structural model and a long historical record (since the early 20th century), **that a specific demand shock for a mineral leading to a +10% increase in prices increases production in the same year by +7.1% for nickel, +3.2% for cobalt and +16.9% for lithium.** Over a 20-year horizon, the responses increase to +13.0%, +8.6% and +25.5% respectively.

The analysis conducted here for the period 1990-2024 confirms the low elasticity of supply in the short term (Table and Figure 5, methodology in [Appendix 2](#)). **The estimated coefficients show that prices have little influence on production volumes, with elasticities ranging from 0.04 to 0.11.**

³⁶ [Lithium Industry Consolidation: Drivers and Future Outlook, Discovery Alert, 7 May 2025](#)

³⁷ [China's lithium export controls shake market: LME Week 2025, Fastmarkets, 14/10/2025](#)

³⁸ [DRC suspends exports of cobalt, a mineral essential for the manufacture of electric batteries, Le Monde.fr, 10/03/2025](#)

³⁹ [The Markets of Metals: Determinants, Predictors, and Interrelations, opus.bibliothek.uni-augsburg.de, April 2023](#)

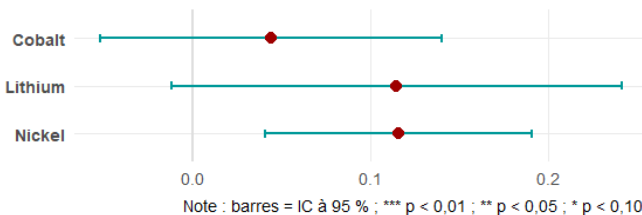
⁴⁰ [The changing dynamics in global metal markets \(EN\), www.oecd.org, 04/2025](#)

⁴¹ [Energy Transition Metals, WP/21/243, 10/2021](#)

Table and figure 5 – Price elasticities based on a log model for cobalt, lithium and nickel
(see methodology in [Appendix 2](#))

Metal	β (elasticity)	R ²
Cobalt	0.044	0.020
Lithium	0.115*	0.069
Nickel	0.116***	0.130

Note: Robust HC1 standard errors. *** p < 0.01; ** p < 0.05; * p < 0.10



Source: GSA, USGS data, World Bank and LME

Note: estimate based on data from 1990 to 2024. The estimated elasticity should be interpreted here as an observed reaction elasticity rather than a structural capacity elasticity.

The period studied includes major structural changes in the transition metals sector that must be considered when interpreting these coefficients: Indonesia's rise in nickel production, diversification of lithium sources, development of recycling, and the effects of the pandemic and geopolitical tensions on supply chains.

The estimated elasticities for **lithium (0.115)** and **nickel (0.116)** are **broadly similar**: a 10% increase (decrease) in prices is associated with a 1.1% increase (decrease) in supply in both cases. **This result suggests that supply is relatively independent of short-term price dynamics for both metals.**

Cobalt, with an estimated elasticity of **0.044**, remains logically the least sensitive to price variations. Produced almost exclusively as a **by-product of copper and nickel**, its extraction level depends primarily on decisions relating to these main metals rather than its own price. **This specificity explains the statistical insignificance of the estimated coefficient and confirms that the price of cobalt is only an indirect determinant of its supply.**

Regarding demand, the estimates are insignificant and difficult to interpret in this type of aggregate model. In the literature, Shojaeddini's estimates⁴² find **price elasticities of demand close to zero in absolute terms for several metals, in the order of -0.11 for lithium, -0.09 for nickel and -0.45 for cobalt** (period 2000-2021). This short-term inelasticity of demand can be explained by industrial needs. **The volumes of s consumed depend mainly on incompressible industrial uses** (batteries, alloys, catalysts), which do not adjust instantly to price signals. The properties of these minerals make them difficult to substitute, especially in a context of expanding demand linked to the energy transition.

2.2. Geological constraints slow down supply adjustments, particularly for cobalt

Nickel and lithium are mainly produced from primary deposits, allowing for more independent management of extracted volumes. However, **the characteristics of cobalt deposits – a co-product of copper and nickel – largely explain the low flexibility of its production and the difficulty in restoring a short-term supply-demand balance.** Its status as a co-product directly links production cycles to the main ore extracted from a mining infrastructure.

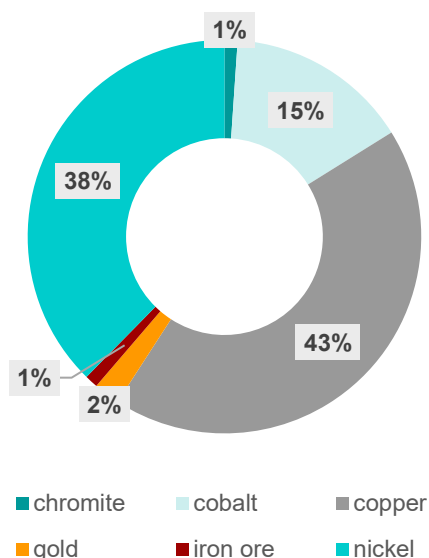
This configuration results in a constrained supply of cobalt: when producers adjust their copper or nickel production in response to the prices of these metals, cobalt automatically follows the same trajectory, regardless of its own market. A study by Nature Communications (2025)⁴³ shows that the production of non-primary minerals is more sensitive to the price of the main mineral than to its own price, confirming the **"geological inelasticity"** of cobalt.

⁴² Estimating price elasticity of demand for mineral commodities used in Lithium-ion batteries in the face of surging demand - ScienceDirect, www.sciencedirect.com, 01/08/2024

⁴³ Modelling interconnected minerals markets with multicommodity supply curves: examining the copper-cobalt-nickel system | Nature Communications, Nature, 07/08/2025

In 2024, **78% of cobalt extracted came from copper mines, 22% from nickel mines, and only 0.5% from the Bou Azzer mine** (Morocco), one of the few primary cobalt mines outside of artisanal operations in the DRC⁴⁴. In terms of the number of mines alone, and without even considering the volume extracted, "primary" cobalt accounts for only about 15% (figure 7).

Figure 7 – Main raw material extracted from cobalt-producing mines, by number of mines, 2025



Source: ICMM

Note: the database used includes more than 8,000 facilities, all minerals combined. This does not include the entire global capacity but provides a representative picture of the sector. It should be noted that few Indonesian facilities are represented.

Furthermore, cobalt accounts for only a small proportion of the revenue generated by the main mineral operations: between 8% and 15% for nickel operations⁴⁵ and less than 2% for copper operations⁴⁶. It should be noted that the latter figure is higher for copper-cobalt production in Africa, where cobalt accounts for more than 25% of copper mine revenue⁴⁷. The cobalt market therefore has relatively little influence on production decisions for a given deposit. Its production acts as an economic credit, reducing the costs of extracting copper or nickel. When prices are high, cobalt improves the cost competitiveness of the mines concerned; when prices fall, operators continue to produce as long as copper or nickel remain profitable⁴⁸.

From a technical point of view, cobalt produced through copper mines yields copper and cobalt oxide, which are then separated to produce cobalt hydroxide. The latter is then shipped to China to be converted into cobalt sulphate for use in batteries. Cobalt from nickel mines can be produced using the HPAL process, which produces a mixed hydroxide precipitate (MHP) containing nickel, cobalt and manganese hydroxides. This is then converted into sulphates, again mainly in China (see [appendix 3](#) for the cobalt production chain).

This point is important for understanding the ongoing geographical restructuring of cobalt production. Indeed, the share of copper-cobalt is declining relative to the rise of nickel-cobalt. According to Benchmark's Cobalt Forecast⁴⁹, nickel-cobalt could increase from 22% in 2024 to 40% of global cobalt production in 2030, mainly due to the increase in Indonesian HPAL capacity. Indonesia could thus overtake the DRC by 2040 if all the integrated nickel-cobalt projects currently under development are completed. Indonesia's share of global cobalt production has already grown significantly, from 1% in 2020 to 12% in 2024 and projected to reach 22% in 2030⁵⁰, solely thanks to the industrial policy of nickel valorisation and the national vertical integration strategy that justify the installation of HPAL refining capacity.

Conversely, lithium, a primary metal, is a more flexible market. It is extracted directly from primary deposits, either from saline brines (Chile, Argentina, Bolivia) or from hard rock (Australia, China). This primary nature makes its supply more responsive to price signals, even though it takes 5 to 7 years to bring a new project into production. The lithium market therefore reacts more directly to price variations

⁴⁴ Cobalt - L'Élémentarium, L'Élémentarium, 02/06/2025

⁴⁵ Nickel Prices: Navigating Supply Surplus Challenges, Discovery Alert, 20/06/2025

⁴⁶ Cobalt - L'Élémentarium, L'Élémentarium, 2 June 2025

⁴⁷ The Cobalt Expansion Drive Is A Copper Story | S&P Global, S&P Global Market Intelligence, 2 March 2023

⁴⁸ Ibid.

⁴⁹ Two-fifths of cobalt could come from nickel mines by 2030 | Benchmark Source, Benchmark Source, 15/10/2025

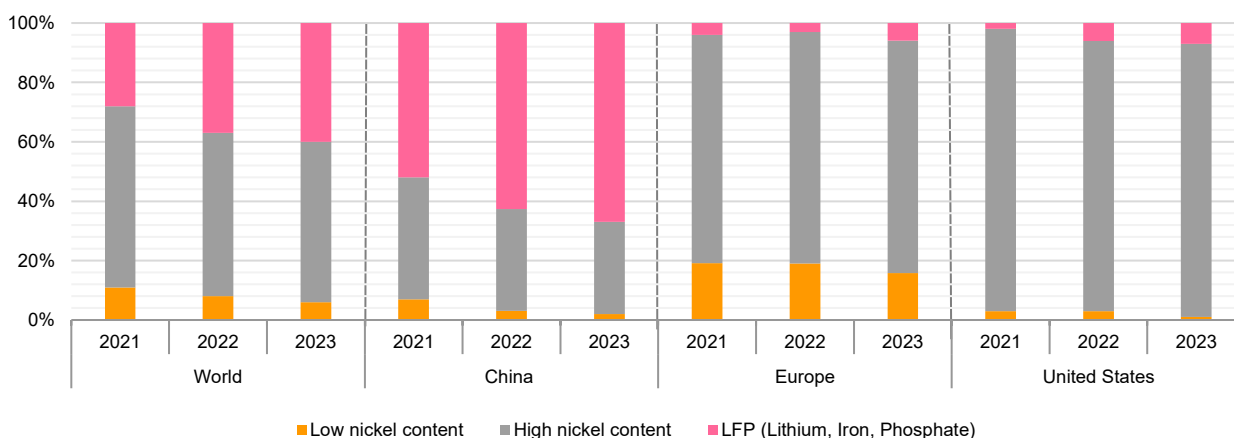
⁵⁰ Cobalt: Indonesia to overtake the DRC by the 2040s (IEA), Agence Ecofin, 22/05/2025

than the cobalt market, but is subject to other constraints: water availability, energy costs and increasing environmental requirements in producing regions.

2.3. The rise of lithium iron phosphate batteries is coming at the expense of nickel and cobalt

Technological developments in battery chemistry are a third obstacle to a rapid return to supply-demand equilibrium in these markets. While global demand for batteries continues to grow, the mix of technologies is changing rapidly in favour of lithium iron phosphate (LFP) batteries, which are less expensive and do not contain cobalt or nickel.

Figure 8 – Market share of different battery technologies in electric vehicle sales each year



Source: IEA – "Low-nickel compounds include lithium-nickel-manganese-cobalt oxide (NMC) 333, NMC442 and NMC532. High-nickel compounds include NMC622, NMC721, NMC811, lithium nickel cobalt aluminium oxide (NCA) and lithium nickel manganese cobalt aluminium oxide (NMCA). LFP also includes lithium iron manganese phosphate (LFMP).

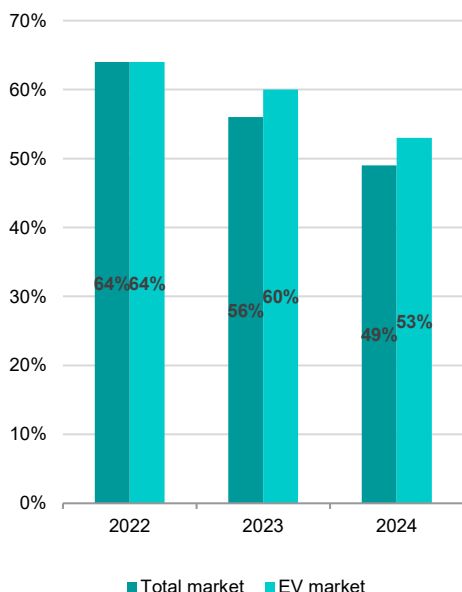
According to the IEA, demand for energy storage batteries is expected to exceed the historic milestone of **1 TWh in 2024**. In that same year, demand in a single week exceeded the total annual demand of a decade ago. Electric vehicles are the main driver of this demand, accounting for more than **85% of the market, with demand increasing by 25% compared to 2023**⁵¹.

However, **the share of LFP (lithium iron phosphate) batteries has risen from 28% to 40% in just two years**. This transformation is taking place at the expense of nickel-cobalt-manganese (NCM) and nickel-cobalt-aluminium (NCA) batteries, although these still account for the majority of the global market, particularly in Europe and the United States (figure 8).

Cobalt is particularly affected by this technological transformation, as its market remains closely dependent on the battery sector, which will account for **76% of its total consumption in 2024**. In that year, demand for nickel- and cobalt-based chemistries (NMC and NCA) grew by 10%, contributing to 19% of the total growth of the battery market. However, **this growth remains modest compared to the spectacular breakthrough of lithium iron phosphate (LFP) batteries, which alone accounted for 79% of the sector's demand growth in 2024**.

Figures from the Cobalt Institute confirm the structural decline of cobalt-containing chemistries in the global mix: **their share fell from 64% in 2022 to 49% in 2024 for the total battery market, and from 64% to 53% for the electric vehicle segment alone** (figure 9).

⁵¹ [Electric vehicle batteries – Global EV Outlook 2025 – Analysis - IEA](#), IEA, 14/10/2025

Figure 9 – Share of demand for cobalt-containing batteries

Source: Cobalt Market Institute

These LFP batteries saw their market share climb to 51% in 2024, driven by China, which accounts for 77% of global demand and almost all of production. China's dominance can be explained by an industrial strategy focused on reducing costs and securing supply chains. Conversely, in Europe and North America, car manufacturers continue to favour high- or medium-nickel chemistries (NCM/NCA), which are more suited to high-end vehicles with long ranges. **Ultimately, this shift significantly reduces the global cobalt market's exposure to growth in the Chinese automotive sector.**

Nickel is undergoing a similar, albeit less pronounced, trend: NCM811 batteries, which are very rich in nickel, continue to be developed for high-end vehicles, but their relative share in the overall mix is declining. **Thus, although the battery sector contributed approximately 11.5% of primary nickel consumption in 2024⁵²,** the estimate for nickel demand for batteries in 2030 has been revised to 967,000 tonnes, down from 1.5 million tonnes in industry estimates two years earlier⁵³. However, as its market is more dependent on steel production than batteries, the consequences are less significant than for cobalt.

Lithium, on the other hand, is the big winner in this technological shake-up. All battery chemistries – LFP, NCM, NCA and LMFP (lithium-manganese-iron-phosphate) – rely on this component, which has become indispensable.

With this technological renewal, cobalt is becoming more easily replaceable for manufacturers in the battery sector. As a result, attempts by the DRC to regulate international prices through export quotas are likely to lead more manufacturers to move away from cobalt components⁵⁴.

Thus, **while nickel and lithium are temporarily affected by industrial overcapacity, cobalt faces a double shock – geological and technological – that poses a more lasting threat to its long-term prospects.**

3. Mining geopolitics and state adaptation strategies in the face of market imbalances

Faced with falling prices for lithium, nickel and cobalt since 2023, the challenge for producing countries is to maintain export revenues. For consuming countries, the objective is to ensure continuity of supply while preparing for an industrial restructuring that is less dependent on imports.

3.1. Producers on the front line, between export rationalisation and public support

In this context, **producing countries whose economies are particularly dependent on mineral resources are implementing strategies to limit the impact of low prices.**

The **Democratic Republic of Congo** is particularly dependent on minerals for its exports (93% in 2024 – including cobalt, which accounted for around 10% that same year⁵⁵). **The fall in cobalt prices is therefore particularly damaging to the Congolese economy.** To stem the erosion of mining revenues, Kinshasa

⁵² [TRADE REVIEW: Asian nickel market faces supply surplus, Q2 demand recovery uncertain | S&P Global](#), *S&P Global Commodity Insights*, 14/04/2025

⁵³ [Nickel oversupply to persist on expansion, slower demand growth, industry experts say | Reuters](#), *Reuters*, 5 June 2025

⁵⁴ [Cobalt Rally Risks Pushing Away Battery Makers, Top Miner Says - Bloomberg](#), *Bloomberg.com*, 14/10/2025

⁵⁵ According to TradeMap data

decided to introduce **a ban on cobalt exports in February 2025**. In October, **this ban was transformed into quotas** granted to 21 exporting companies in the country⁵⁶.

However, **the consequences of this policy are mixed**. As a **by-product of copper** in the DRC, cobalt is subject to the opposite dynamic observed in the main ore market (see above)⁵⁷. **This status limits the ability to regulate production, as it would go hand in hand with that of copper. Export bans or quotas encourage an increase in domestic stocks in the short term, which is likely to prolong the period of overcapacity on the global market.** What is more, these restrictions weigh on export revenues in the short term. These constraints are compounded by those already mentioned above (geological, technological, the importance of Chinese players in local production, etc.).

In **Indonesia**, after pursuing an industrial policy of increasing processing capacity, the new President, Prabowo Subianto, who took office in October 2024, wanted **to introduce quotas on processing capacity to reduce overcapacity**. **The government has announced a drastic reduction in production quotas for 2025, from 272 million tonnes produced in 2024 to 150 million in 2025**. In total, this reduction would correspond to **a decrease of nearly 35% in global production**⁵⁸. In addition to the quantity, the duration of the quotas will be shortened **from 3 to 1 year** from 2026, forcing companies to renew them at the end of each year⁵⁹. However, political pressure and pressure from Chinese manufacturers have prevented this reduction in quotas, **which will remain at over 315 Mt in 2025**⁶⁰.

Here again, **the results are mixed**. Refining capacity depends on nickel production for its operation. With quotas in place, **the premiums payable for Indonesian nickel are increasing and the country is becoming an importer of nickel ore from the Philippines** to keep its refineries running. Faced with this situation, **local producers such as Eramet are reducing their sales forecasts** after the government refused to increase their quotas⁶¹. However, according to Project Blue, **the number of quotas granted exceeds national production each year**⁶², rendering this policy ineffective in the long term, while allowing the government to maintain control over its industrial fabric and facilitate the establishment of certain groups over others.

In Latin America, **producing countries have reaffirmed their desire to regain control over the governance of strategic resources**, mainly lithium and copper, **by combining mining nationalism with controlled openness to foreign capital**. In Chile, for example, the government formalised a **national lithium strategy** in 2023 that places public companies at the heart of the sector's development. According to the Chilean Ministry of Mines, any new project on salt flats considered strategic will now **require majority state participation** through the two national companies (Codelco and Enami)⁶³. The objective is twofold: to increase mining revenues and to ensure stricter environmental control over the exploitation of the Atacama and Maricunga salt flats.

More broadly, the Latin American region – in particular **the "lithium triangle"** – is pursuing strategies aimed at consolidating its market power over lithium, but also at controlling the balance of power to secure the resulting state revenues. **Chile** is focusing on national exploitation of the resource, **Argentina** is favouring international integration through bilateral agreements, while **Bolivia** is pursuing a model of comprehensive state sovereignty, with the public company YLB (Yacimientos de Litio Bolivianos), although its industrial capacity remains limited at this stage.

⁵⁶ DRC: cobalt exports resume after five-month hiatus, *RFI*, 17/10/2025

⁵⁷ Chinese Copper Smelters Boost Exports as LME Prices Near Record Highs - *Bloomberg*, *Bloomberg.com*, 15/10/2025

⁵⁸ Indonesia Nickel Move May Cut Global Supply 35%, Macquarie Says, *Bloomberg*, 9 January 2025

⁵⁹ Indonesia shortens validity of mining quotas to one year | *Reuters*, *Reuters*, 7 October 2025

⁶⁰ New Indonesian RKAB 2026 regulations published! - *Shanghai Metal Market*, *www.metal.com*, 7 October 2025

⁶¹ Indonesia Controls Nickel Ore Supply to Balance Weak Demand - *Bloomberg*, *Bloomberg.com*, 18/10/2024

⁶² Indonesia's shifting RKAB policy, *www.linkedin.com*, 21/10/2025

⁶³ Chile plans to nationalise its vast lithium industry | *Reuters*, *Reuters*, 21/04/2023

3.2. Consumer countries: diversification of supplies, storage and proactive industrial policy are the preferred strategies

Consumer countries must also adapt to ensure a reliable and consistent supply in the long term.

One of the preferred levers is the creation of national strategic stocks. This is particularly the case in China, which has taken advantage of the decline in world prices to strengthen its reserves of critical metals. Faced with growing uncertainty linked to the trade war with the United States and market volatility, **between December 2024 and June 2025, the National Food and Strategic Reserves Administration (NFSRA) purchased around 100,000 tonnes of grade 1 nickel** on the London Metal Exchange (LME). China's strategic nickel stocks, previously estimated at between 60,000 and 100,000 tonnes, **are said to have doubled** in the space of a few months, reaching a level not seen since the system was created⁶⁴.

This massive stockpiling strategy has two objectives: **to secure national supply and stabilise domestic prices**. The choice of nickel is not insignificant: China does not hold a dominant position in global nickel refining, a sector largely controlled by Indonesia. **Beijing is therefore seeking to offset this relative dependence with physical stockpiles**, enabling it to influence the physical market and anticipate possible export restrictions. **This strategy also applies to lithium, cobalt and copper**, for which the NFSRA announced its intention to purchase in a statement in March 2025⁶⁵.

At the same time, thanks to its dominant position, **China is combining this storage strategy with a policy of export controls**. In October 2025, Beijing introduced new restrictions on exports of battery materials, including certain refined lithium and cobalt products⁶⁶. **These measures reflect a logic of "industrial nationalism"**: priority is given to the domestic market and to supporting national champions in the battery sector. With China enjoying a virtual monopoly in the refining and production of battery anodes and cathodes, **it is seeking to assert its control over these sectors in a context of trade tensions**.

The United States is taking a different approach, focused on bringing back domestic industrial capacity and diversifying sources of supply outside China. However, **the Trump administration has not been immune to the temptation to build up strategic stocks**. In mid-August 2025, the *Defence Logistics Agency* requested bids for the purchase of **7,500 tonnes of cobalt over five years for a maximum amount of USD 500 million**. This initiative was the first of its kind since 1990, but **the call for tenders was abandoned in October 2025** due to problems with the specifications, despite the extension of the deadline for submitting bids⁶⁷.

Washington ultimately preferred to take more direct action on productive investment. At the end of September 2025, the US Department of Energy (DOE) announced **that the federal government would take a stake in Lithium Americas Corp.**, a Canadian company, to support the development of **the Thacker Pass Project in Nevada**, the largest lithium deposit in the United States⁶⁸. The agreement includes a 5% stake in the company's capital and a 5% stake directly in the project, in addition to a loan finalised under the Biden administration of USD 2.2 million to build a refinery adjacent to the deposit. **In total, this project could produce up to 40,000 tonnes of lithium carbonate per year, according to the DOE**.

These policies are in line with the Inflation Reduction Act (IRA), which aims to consolidate the mining-to-battery industry on American soil, **but they also reveal the internal paradoxes of American industrial policy under the Trump administration**. The latter seeks to limit investment in low-carbon energies **while supporting the national industrial sector**. The goal of battery recycling has therefore been set aside in favour of acquiring stakes in the development of domestic projects. In October 2025, **Ascend Elements**, which

⁶⁴ China boosts nickel reserves as tensions with US simmer, www.ft.com, 07/07/2025

⁶⁵ *Ibid.*

⁶⁶ Chinese battery shares slide after Beijing imposes export controls over supply chain | Reuters, [Reuters](https://www.reuters.com), 10/10/2025

⁶⁷ US Cancels \$500 Million Cobalt Tender in Critical Minerals Blow - Bloomberg, [Bloomberg.com](https://www.bloomberg.com), 16/10/2025

⁶⁸ US to Take Stake in Lithium Americas to Boost Nevada Project - Bloomberg, [Bloomberg.com](https://www.bloomberg.com), 30/09/2025

had seen its valuation rise rapidly thanks to public subsidies, **lost more than 80% of its value after the cancellation of \$480 million in federal funding**⁶⁹.

For its part, **the European Union, which depends on imports for more than 90% of its critical metals, favours a contractual and diplomatic approach**. The *Critical Raw Materials Act* (CRMA) adopted in 2024 sets a target of 10% domestic extraction and 40% local processing by 2030, accompanied by strategic partnerships with **Canada, Australia** and several African countries (**DRC and Zambia**)⁷⁰. **France has played a leading role by signing bilateral agreements, notably with Argentina**⁷¹, aimed at guaranteeing stable supplies and pooling price risks.

Within the framework of the CRMA, **the EU has selected 47 intra-EU projects considered strategic for securing the European supply chain** (investments also concern 13 extra-EU projects)⁷². Thus, beyond the bilateral agreements signed, **the EU is seeking to revive the sector on its own soil**. These projects include extraction, processing, recycling and substitution for battery minerals (lithium, nickel, cobalt, manganese and graphite). In addition, to meet the requirements of Fit For 55, **these projects must comply with relatively strict environmental criteria and ESG standards**.

Ultimately, the fall in prices has accelerated a shift **that was already underway: the return of states to global mining governance**. **Traditional producing countries are seeking to capture a greater share of the added value, while consuming countries are seeking to secure their supplies**. But this dual logic of state intervention is paradoxically contributing to **further fragmentation of global value chains for critical metals**.

4. Appendices

Appendix 1 – Methodology for Figure 4: calculation of realised prices and production costs

The data used is public data presented in the 2024 annual reports of each entity observed.

The estimated realised selling price is calculated using the following ratio:

$$\text{Estimated price} = \frac{\text{Revenue from ore sales (M USD)}}{\text{Production (Mt)}}$$

The estimated production cost is calculated using the following ratio:

$$\text{Estimated cost} = \frac{\text{Revenue from ore sales} - \text{EBITDA (M USD)}}{\text{Production (Mt)}}$$

Appendix 2 – Table 5 methodology: calculation of price elasticities for each mineral

The estimate is based on a **differentiated log-log** model designed to measure the sensitivity of mining production (supply) to short-term price variations for cobalt, lithium and nickel. The model is based on annual data from **1990 to 2024**, sourced mainly from **the USGS**, the **World Bank** and the **LME** (via LSEG). These series cover the recent period of strong expansion in critical metals, marked by geopolitical tensions and rising demand linked to the energy transition.

The estimated model is of the form:

$$\Delta \ln(Q_{i,t}) = \beta \Delta \ln(P_{i,t}) + \varepsilon_{i,t}$$

⁶⁹ Lithium CEO Pledges to Forge Ahead on Project Without US Grant, *Bloomberg*, 16/10/2025

⁷⁰ Critical Raw Materials Act - Internal Market, Industry, Entrepreneurship and SMEs, *Internal Market, Industry, Entrepreneurship and SMEs*

⁷¹ Lithium, copper, cobalt... France signs key agreement with Milei's Argentina | *Les Echos*, *Les Echos*, 30/06/2025

⁷² Selected strategic projects under CRMA, *Internal Market, Industry, Entrepreneurship and SMEs*, 25/03/2025

where:

- $Q_{i,t}$ represents the **production** of metal i at date t ,
- $P_{i,t}$ the corresponding **price**, expressed in constant dollars,
- β the **price elasticity of supply** (response of production to a 1% change in price),
- $\varepsilon_{i,t}$ the error term capturing unobserved shocks.

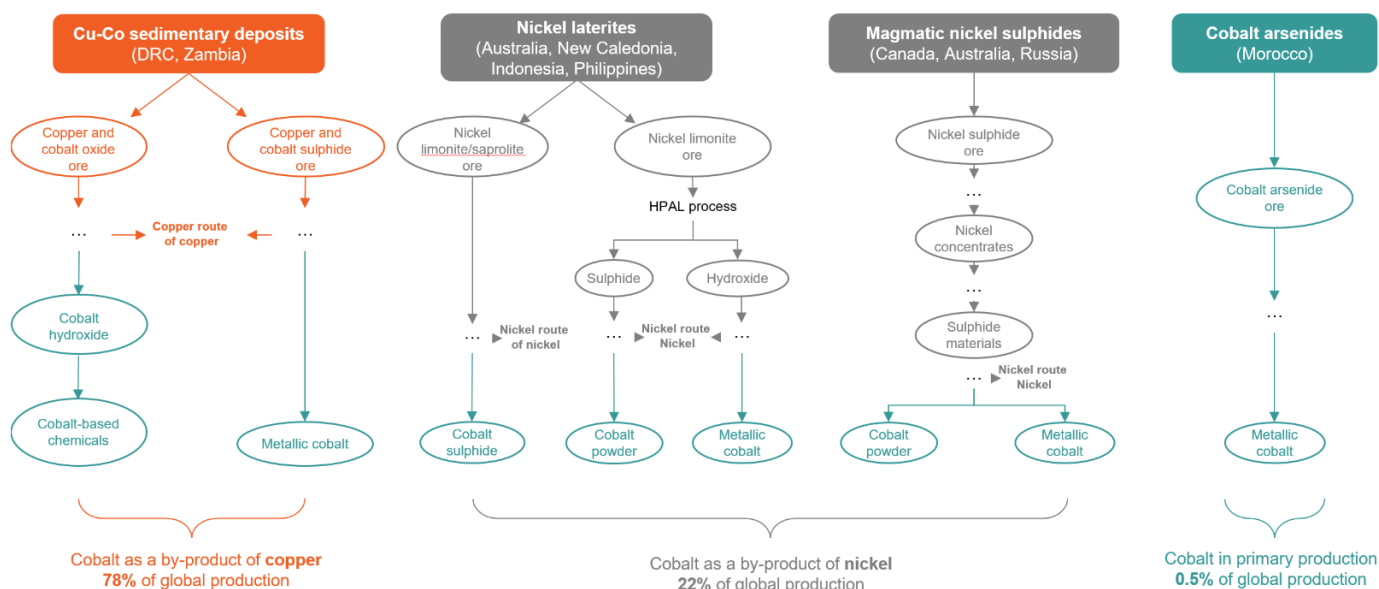
The model is estimated in **logarithmic differences** to eliminate common trends and focus on **short-term variations**. The coefficients are therefore interpreted as **instantaneous elasticities**, rather than long-term structural elasticities.

The estimation is performed using **ordinary least squares (OLS)** with **robust errors** to account for possible **heteroscedasticity** of the residuals. Stationarity tests showed that the series were non-stationary in terms of levels, justifying the use of first differences.

The estimated elasticity (β) reflects the relative change in output in response to a relative change in price. For example, an elasticity of 0.10 means that a 10% increase in price is accompanied, in the short term, by an average 1% increase in production.

The coefficients presented in **table and figure 5** should therefore be interpreted as **observed reaction elasticities**, limited by the capacity and investment constraints specific to each mining sector.

Appendix 3 – Cobalt production chain



Source: GSA, (PDF) *Geometallurgy of cobalt ores: A review*, ResearchGate, 01/01/2021

Note: the "... " represent the industrial stages between two states of the material.