

Charging Ahead: The Commodities Market in a World of Electric Vehicles



Key Statistics



~37mn

Forecast of Global Electric Car Sales in 2030

~6x Rise from 6.5mn in 2021

Source: International Energy Agency



6x

Minerals Used in EVs Compared to Conventional Cars

Source: International Energy Agency



42x

Lithium Demand Growth Ratio (2020-2040)

Followed by Graphite 25x, Cobalt 21x & Nickel 19x

Source: International Energy Agency



27%

CAGR Growth of Lithium Price Index (2016-2022)

vs Growth in Nickel Prices of 18%, Manganese & Cobalt of 17%

Source: International Monetary Fund

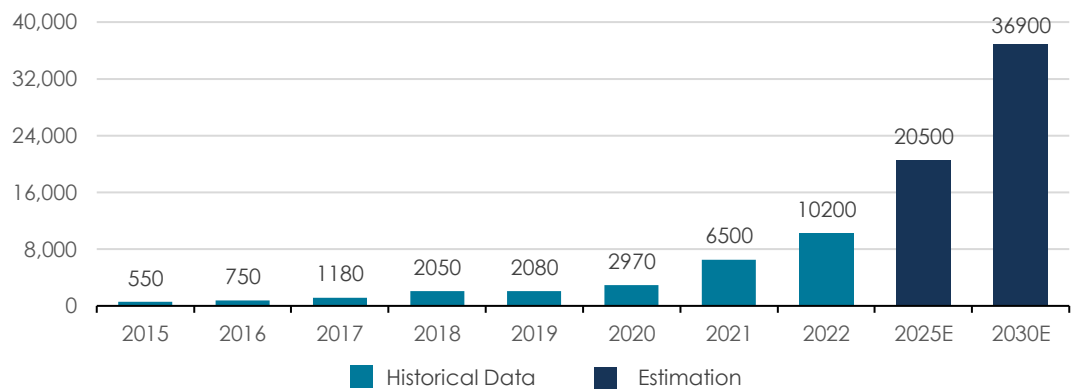
Key Highlights

- The surge in demand for Electric vehicles (EVs) means demand for the key commodities that go into batteries and EVs is also expected to rise
- An electric car requires six times more minerals than a conventional car, leading to increased demand for critical battery minerals like lithium, nickel, graphite, and cobalt
- The unprecedented EV demand and supply chain disruptions due to Russia-Ukraine war resulted in huge increase in prices of critical minerals during the first half of 2022. However, prices declined in the subsequent quarters on account of uncertain economic prospects
- One pressing concern for EV adoption is the question of supply of critical minerals matching the future demand as there is geographical concentration of supply, long lead times in mining production, and environmental/social vulnerabilities in the procurement
- The widespread EV adoption is predicated on stakeholders' taking necessary steps, making substantial investments in securing adequate supply of critical minerals and ensuring their price stability

Boom in EVs to have Implications on Demand for Key Commodities

The Paris Agreement sets a long-term goal of reducing the global temperature rise to well below 2 degrees Celsius and achieving climate neutrality by reducing greenhouse gas (GHG) emissions. This goal is set in motion by decarbonizing mobility and shifting to clean energy transitions. As the transportation sector contributes around one-fifth of GHG emissions, with road transportation accounting for about 75% of this share, various countries have instituted ambitious policy initiatives and incentives to electrify the road ahead. This shift to cleaner energy is set to drive a huge increase in the requirement for the 'commodities of the future' - minerals used to manufacture EVs, batteries, and renewable infrastructure.

Global EV Car Sales (In thousands)



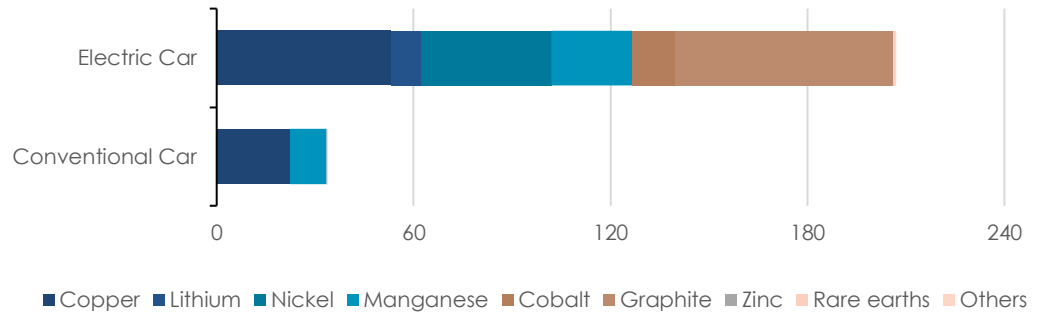
Source: International Energy Agency (IEA)

Notes: EVs refers to all electric vehicles (BEVs + PHEVs). BEVs are battery electric vehicles. PHEVs are plug-in hybrid electric vehicles. The estimated share for 2025 and 2030 is based on the Stated Policies Scenario (STEPS).

EV sales have been surging in recent years driven by concerns over climate change and strong policy impetus to decarbonize the mobility sector. According to the International Energy Agency (IEA), the global EV car sales jumped from about 120,000 units in 2012 to a milestone of 10 million units in 2022 and are estimated to reach ~37 million units in 2030. An EV calls for the use of the commodities comprising a slew of critical minerals such as lithium, nickel, copper, manganese, etc. The acceleration toward EVs will lead to humongous increase in demand, necessitating adequate supply of these key commodities.

Higher Usage of Critical Minerals in EV Cars

Minerals Used in Electric Cars Compared to Conventional Cars



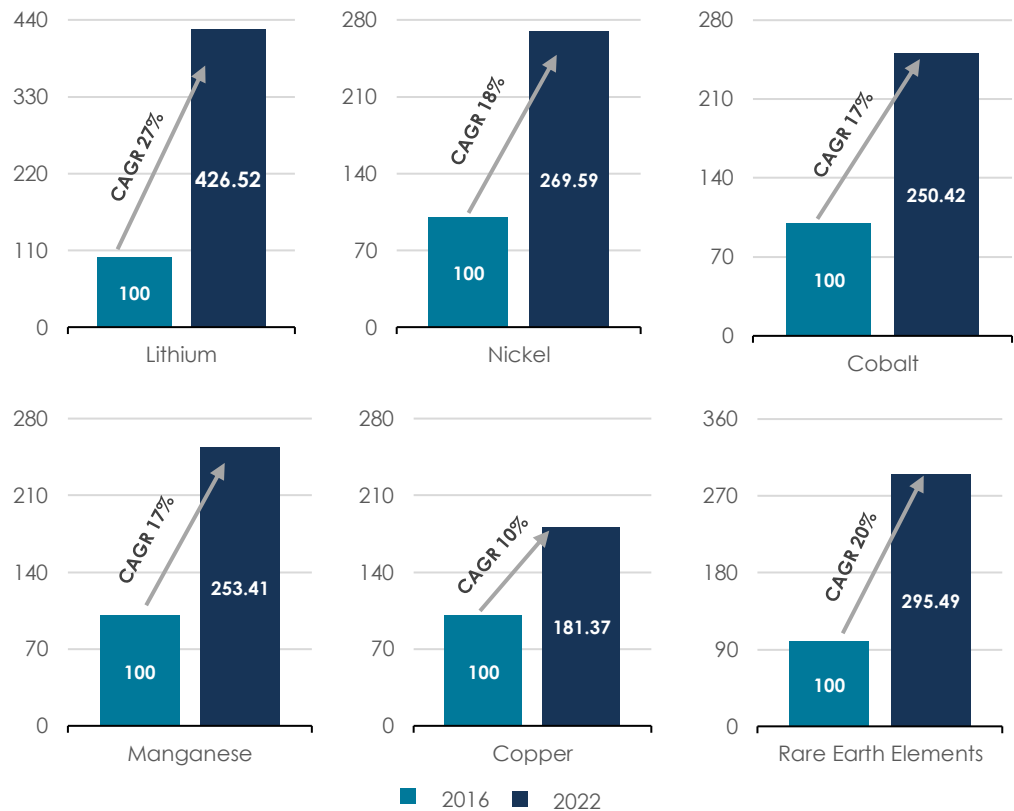
Source: International Energy Agency (IEA)

Notes: Units are measured in Kg.

According to IEA, a typical electric car uses six times more minerals than a conventional car. Conventional cars mainly use copper and manganese, while electric cars rely on critical minerals such as lithium, nickel, cobalt, graphite, copper, and manganese for their performance, longevity, and energy density. Rare earth elements are crucial for the permanent magnets that are essential for EV motors. Estimates from IEA show that EVs and battery storage have already ousted consumer electronics to become the largest consumer of lithium. They are also poised to overtake from stainless steel as the largest end-users of nickel by 2040.

Dramatic Rise in Prices of Key Battery Metals Pose a Significant Challenge

Metals Price Indices CAGR Growth (2016-2022)



Source: Primary Commodity Price System, International Monetary Fund (IMF)

Notes: Indices reflect changes in prices of respective commodities over the period. The prices are in terms of \$ per metric ton. Benchmark prices are representative of the global market, determined by the largest import markets of a given commodity.

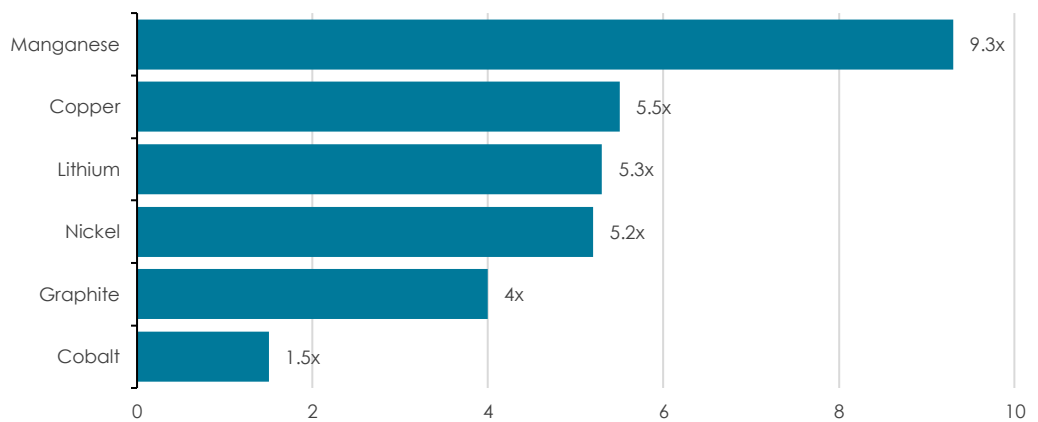
“Investing in these raw materials provides a way for automakers to control margins along the supply chain and ensure they remain competitive. Raw materials are now the largest cost driver for a battery.”

Andrew Miller,
COO of Benchmark Mineral Intelligence

The prices of metals surged in early 2022 due to the unprecedented rise in EV sales and concerns over supply chain disruptions amid Russia-Ukraine war. For instance, in March 2022, nickel prices surged to a record high of more than \$100,000 per tonne causing the reputed London Metal Exchange (LME) to halt trading nickel. This was reflective of market's concern that Russia is the world's largest supplier of Class 1 battery grade nickel. As of early 2023, lithium prices were six times higher than their average over the 2015-2020 period. According to the International Monetary Fund's commodity prices index, the lithium price index has grown at the highest pace registering CAGR of 27% from 2016 to 2022, followed by annualized price growth of 18% for nickel and 17% for both cobalt and manganese. The IEA warns of the potential implications of the rise in raw material costs in the long-term. For instance, a doubling of lithium or nickel prices would lead to a 6% rise in battery costs, offsetting much of the anticipated unit cost reductions associated with significant scale up of battery production capacity. However, the prices of critical minerals are expected to see a huge rise going ahead considering the anticipated future demand for EVs and batteries.

Surge in Demand of Critical Minerals in EVs to Rise Multifold

Demand Growth of Critical Minerals by 2030 (in times compared to 2021)



Source: Bloomberg NEF

EV makers will consume a rising share of the world's lithium, nickel, manganese, and other minerals needed to make batteries as EV sales are expected to surge. In 2022, EV batteries accounted for about 60% of lithium demand, 30% of cobalt, and 10% of nickel (per IEA). Bloomberg NEF forecasts the demand for manganese will increase over ninefold between 2021 and 2030, while demand for copper, lithium, and nickel demand will increase fivefold over the same period. The trend of battery chemistries towards lower cobalt usage is curbing the demand for cobalt while the demand for nickel is growing. These demand fluctuations rely on the uncertainty around the stringency of climate policies. According to IEA, the demand for minerals used in EVs and battery storage grows about ten times in the Stated Policies Scenario (STEPS) and nearly 30 times in the Sustainable Development Scenario (SDS) by 2040. As an essential component of battery chemistries, lithium is expected to record the fastest growth, with demand increasing over 40 times in the SDS by 2040, followed by graphite, cobalt and nickel growing around 20 times. In terms of weight, copper and graphite dominate mineral demand, followed by nickel.

Rising EV Sales Challenge Adequate Supply of Critical Minerals

The pressure on the supply of critical minerals will continue to increase as electrification of mobility expands to meet net zero ambitions. The rapid rise in demand for the critical minerals used in batteries and other EV infrastructure raises huge questions about the availability and reliability of supply. There is high geographical concentration of production, where more than half of the supply of lithium, nickel, and cobalt comes from the top three producing nations. For instance, China produces three-quarters of all lithium-ion batteries and is home to the majority of production capacities of cathodes and anodes, accounting for 70% and 85%, respectively. According to an IEA estimate, mining projects take more than 16 years to deliver their first production, highlighting the need for sufficient investments in mining to ensure adequate availability of critical materials in the medium- to long-term to meet the surging demand for EVs and to avoid prolonged period of market tightness and price volatility.

“Today, the data shows a looming mismatch between the world’s strengthened climate ambitions and the availability of critical minerals that are essential to realising those ambitions. Left unaddressed, these potential vulnerabilities could make global progress towards a clean energy future slower and more costly and therefore hamper international efforts to tackle climate change.”

Fatih Birol,
Executive Director of the
International Energy Agency
(IEA)

“Over the long term, there could be new technologies disrupting the market if they are proven to be more energy and cost effective and more sustainable in supply.”

*Stephen Chan,
Associate Director,
S&P Global Ratings*

Evolving Battery Chemistries to Determine the Demand Mix of Critical Minerals

The evolution of battery chemistries will determine the demand trajectories for critical minerals given their long lead times. Currently, lithium-ion batteries for EVs are categorised into two types: nickel-based (such as nickel manganese cobalt oxide [NMC] and nickel cobalt aluminium oxide [NCA]) and lithium iron phosphate (LFP) batteries. In 2022, NMC remained the dominant battery chemistry with a market share of 60%, followed by LFP and NCA with a share of nearly 30% and 8%, respectively. Due to the lower cost, there has been a major uptake of LFP battery chemistry over the last few years especially in China. The future of battery chemistries is not predetermined, but sustained higher prices of commodities could lead to a development of new chemistries that rely on less critical minerals such as the manganese-rich cathode chemistry (lithium nickel manganese oxide [LNMO]) and even alternative lithium-free battery chemistries, such as sodium-ion batteries.

Outlook

While policy measures by various governments¹ and the overall rise in EV adoption thus far is laudable, the lack of sufficient availability of critical minerals may become a big impediment to a greener future. According to current projections of supply, some critical minerals are expected to reach deficits by 2030. Besides, price volatility of critical minerals could severely thwart the outlook for EV adoption as it is partly predicated on anticipated reduction in battery costs in the future.

Some countries with biggest EV sales currently, such as the Germany and the United States, are also the countries with most vulnerable supply chains owing to their heavy reliance on imports for EV batteries and critical minerals. To keep up with the growing demand of critical minerals, it is imperative for EV stakeholders to make adequate investments in the mining of key materials. It is only with the right prioritisations on securing key raw materials availability and price stability that the world can accelerate into an EV future.

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