Strategic Overview of the Cobalt Market

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Executive Summary

- In 2015, between 110,000 and 120,000 tonnes of cobalt was mined globally with over 65% originating in the Democratic Republic of the Congo (DRC). This grew in 2015 due to artisanal mining in the DRC, supply is expected to shrink in 2016 and 2017 due to mine economics.
- Refined cobalt production totaled slightly less than 93,000 t. This is forecast to shrink in 2016 and 2017.
- The refined metal form of cobalt is best suited for the superalloy and magnet industries (about 26% of 2015 demand) while the chemical form is best suited for the rechargeable battery sector (about 49% of 2015 demand).
- Further supply growth is dependent on the prices of copper and nickel. Cobalt is almost exclusively a byproduct, with two thirds of supply coming from nickel production and one third of supply coming from copper production with roughly 2% coming from primary cobalt operations.
- The harsh environment for mining companies in recent years has forced major cobalt producers such as Glencore (GLEN:LON) and Freeport McMoran (FCX:NYSE) to make strategic decisions to strengthen their balance sheets and rethink the “growth at all costs” mantra of the 2000s. As GLEN and FCX are historically two of the largest integrated cobalt mining companies, the decisions they make will materially affect cobalt supply.
- GLEN’s 18 month closure of its Katanga mining operation in 2015 and FCX’s intention to sell its African copper interests and cobalt refinery operations to an undetermined buyer (possibly China Molybdenum (3993:HKG)) are two examples.
- Cobalt demand has grown by roughly 6% per annum in recent years, led by the rechargeable battery business with demand growing by over 10% per annum. The rechargeable battery business was responsible for approximately 45,000 t (49%) of cobalt demand in chemical form in 2015 (primarily in cobalt sulfate and hydroxide forms). This growth has compensated for slower growth in other sectors more in line with GDP growth.
- Avicenne Energy, a respected technology consultancy, states that 115,000 t of cathode materials were consumed in 2015 and this is forecast to grow to 400,000 t by 2025 with “cobalt-heavy” chemistries accounting for two thirds of this total.
- Vehicle electrification is a main driver of growth. According to the IEA, in 2009 there were 6,000 EVs on the road globally. In 2015, there were 1.2 million. A 25% CAGR going forward would put this total at 10 million in 2025.
- Perhaps the largest threat to this growth thesis concerns technology. As cobalt is an expensive cathode component, a great deal of work is going towards minimizing its uses in batteries.
- The cobalt price has performed well year-to-date, up 20% with the LME price currently at \$12.95/lb. It is important to remember that there are multiple prices for cobalt as there are

multiple forms. That said, the LME or Metal Bulletin prices (for low grade feedstock at 99.3%) serve as a key benchmark.

- With cobalt demand forecast to increase by 6% per year to 2020 and supply forecast to grow at 2% per year to 2020, the benchmark LME cobalt price should grind higher to $17 to $18 per lb by 2018.

In writing the report, I spoke with and interviewed roughly 20 market participants along the cobalt supply chain including mining companies, trading companies, battery chemists, and investors. The purpose of this report is to offer both a quantitative and qualitative overview of the cobalt market. In offering a detailed overview of the sector, the goal is to offer strategic recommendations around how to approach this sector and participate in its growth.

Abbreviations

AAPL – Apple Inc.
CDM – Congo Dongfang Mining
Co – Cobalt
Cu – Copper
DRC – Democratic Republic of the Congo
EV – Electric Vehicle
FCX – Freeport McMoRan
GLEN – Glencore
GWh – Gigawatt-hours
KWh – Kilowatt-hours
LCO – $LiCoO_2$ - Lithium Cobalt Oxide
LFP – $LiFePO_4$ - Lithium Iron Phosphate
LME – London Metals Exchange
LMO – $LiMn_2O_4$ - Lithium Manganese Oxide
LTO – Li_2TiO_3 - Lithium Titanate
MWh – Megawatt-hours
NCA – $LiNi_{0.8}Co_{.15}Al_{0.05}O_2$ - Nickel Cobalt Aluminum
Ni – Nickel
NMC – $LiNiMnCoO_2$ - Nickel Manganese Cobalt
PHEV – Plug-in Hybrid Electric Vehicle
TSLA – Tesla Motors
SOE – State Owned Enterprise
SNY – Sony Corp.
Wh/kg – Watt-hours per kilogram

INTRODUCTION

Aside from lithium, perhaps no other battery raw material has generated as much interest as cobalt. Atomic number 27 on the periodic table, cobalt has been a truly critical material in the adoption and proliferation of lithium ion battery chemistries – primarily as nickel cobalt aluminum (NCA) and nickel manganese cobalt (NMC) have increased - due to lithium ion battery uptake. In the year 2000, roughly 1% of cobalt was used in the rechargeable battery market. This has grown to roughly 45% today and at present growth rates of 6% per annum, will consume 100% of all cobalt production in 2025. The lithium ion battery is not new, having been “discovered” in 1976, but as energy density and power density continue to improve across a range of chemistries, the raw materials critical for its use are likely to see continued strong demand.

In 2015, between 110,000 and 120,000 tonnes of cobalt was mined globally with over 65% originating in the Democratic Republic of the Congo (DRC). Refined cobalt production totaled slightly under 93,000 t. Refined cobalt can be separated into two forms: metal and chemical. Metal cobalt is found in several forms including cathodes, powders, briquettes, and ingots. Cobalt in its chemical form can be found in oxide, sulfate, nitrate, hydroxide form to name a few. Each form has its own supply and demand dynamic and price. The refined metal form of cobalt is best suited for the superalloy and magnet industries (about 26% of 2015 demand) while the chemical form is best suited for the rechargeable battery sector (about 49% of 2015 demand).

Both supply and demand have been on the increase in recent years with…..

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