A Supply Chain Risk Analysis of Cobalt Used in Electric Vehicle Batteries in the US

UCLA Grand Challenges | Sustainable LA

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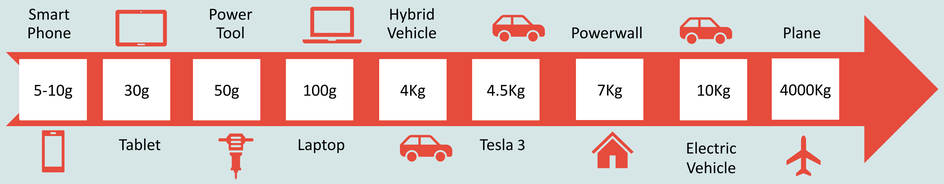
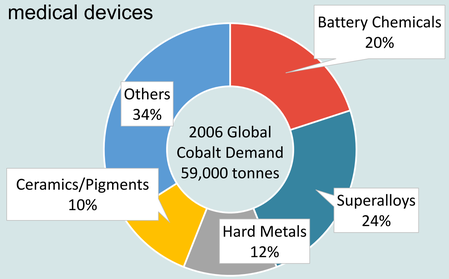
27 Cobalt 58.993

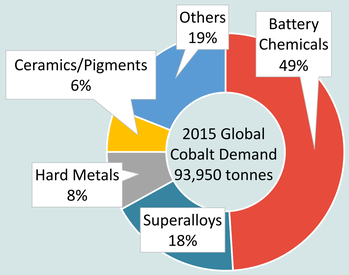
Background

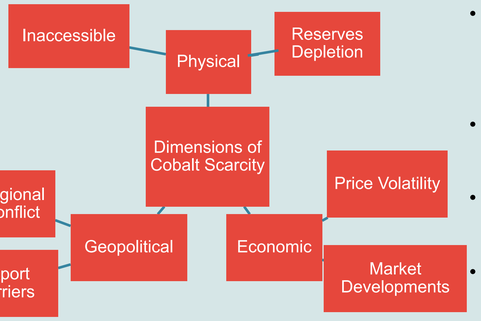
- **Electric vehicles (EVs)** can potentially **lower carbon emissions** and mitigate the effects of **climate change**
- Cobalt is used in the cathodes of batteries in EVs because it improves the **energy density of batteries**, increasing driving range



- Cobalt is also used extensively in other industries, mainly as a **super metal alloy**, including defense and medical devices







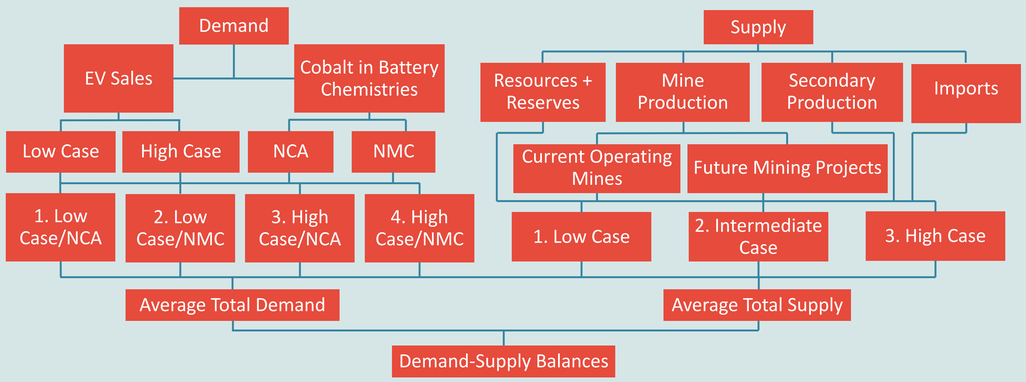
- Supply chain of cobalt is risky due to the metal's **price instability**, **limited** and **concentrated supply,** and its **unethical** mine sourcing
- Over **50%** of cobalt is mined in the **politically unstable Congo** and **46%** is refined in **China**
- Price jumped by 275% from **$34,000/tonne** in 2010 to an all-time high of **$93,538/tonne** in March 2018
- Expected supply shortages can disrupt the growth of EVs market by increasing battery prices

Objectives

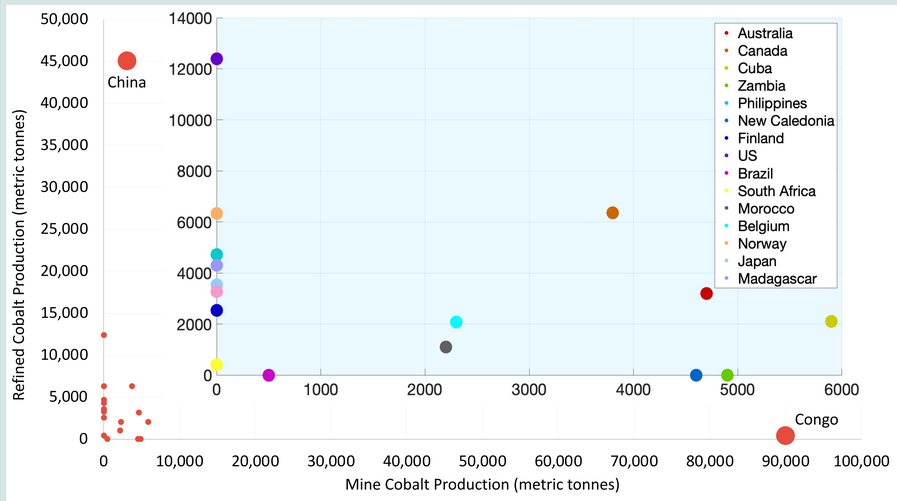
- Conduct a supply chain risk analysis of cobalt since it poses the greatest threat to EVs market growth in US
- Investigate domestic cobalt demand and supply till 2050 to determine cobalt demand-supply balances
- Assess how EVs market in the US will evolve in response to cobalt demand-supply balances

Approach and Layout of the Study

- Data has been collected from online reports, media, and conferences

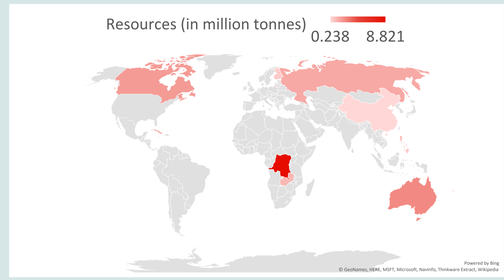


Results: Global Distribution of Resources and Production

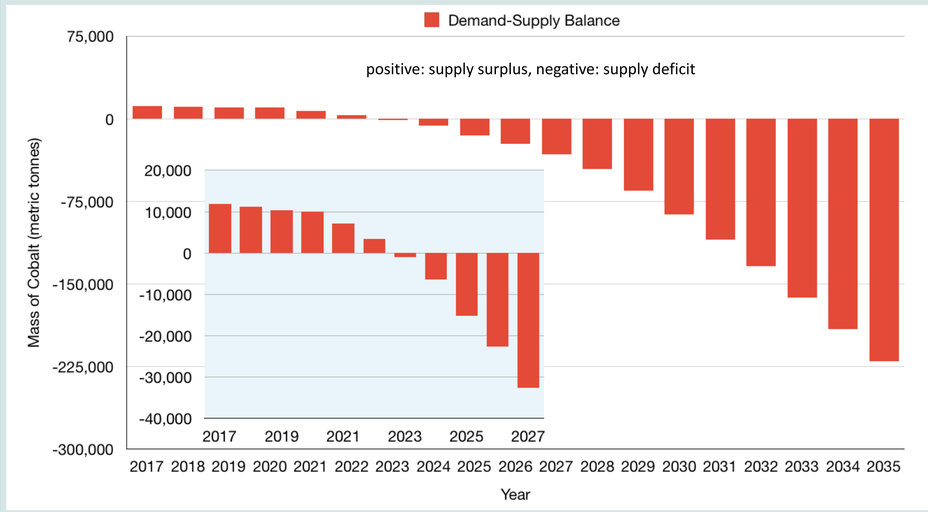


Global distribution of cobalt resources and mine and refined cobalt production in 2018.

- **Congo** dominates the mine cobalt production market at **90,000 tonnes** annual production rate
- **China** dominates the refined cobalt production market at **45,046 tonnes** annual production rate

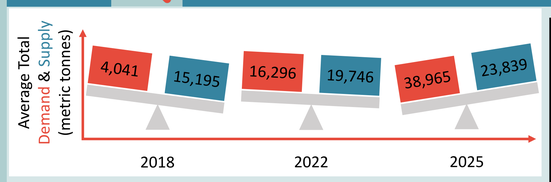


Results: demand-supply balances

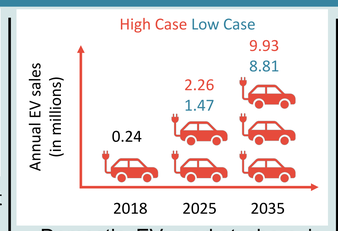


- Forecasted average cobalt demand-supply balances in US till 2035.
- Surplus of supply up to **2022** where supply and demand balance out at around **20,000 tonnes**
- Supply deficit grows exponentially to **15,126 tonnes** by **2025** and **86,717 tonnes** by **2030**
- Best case scenario: first shortage in **2026** if demand for cobalt follows low case for EV sales, all EVs use NCA battery chemistry, and supply follows high case
- Worst case scenario: first shortage in **2021** if demand for cobalt follows high case for EV sales, all EVs use NMC battery chemistry, and supply follows low case

Conclusion



- By end of **2022**, demand and supply balance out at **20,000 tonnes**
- Future supply deficits can cause increase in battery prices and slow down EV market growth
- Without substantial EV domination, transportation sector will remain a large contributor to CO2 emissions



- Domestic EV market share is **1.4%** of LDVs in **2018**
- By **2030**, EV market share rises to **24.9%** under low case and **27.1%** under high case

Suggestions

- Increase **R&D funding** to speed up development of **NMC 811 chemistries** and **solid state batteries**
- **Fuel cell cars** are more efficient than EVs and require no cobalt, but not yet affordable and eco-friendly
- Potential **substitutes** for cobalt superalloy in aerospace industry include metal & ceramic matrix composites
- Provide **subsidies** to increase cobalt **recycling** rates
- Encourage **investments** in feasibility and development projects to mine for cobalt in **oceans**

Acknowledgments

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