

The Size of the Prize: Building a Domestic Battery Metals Supply Chain

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Prepared for



Mining & Metallurgical
Society of America



House Mountain Partners

Who Am I?

I have been active in financial markets for 20 years and since 2010 I have been an analyst and advisor focused on Energy Metals supply chains since 2010 - those metals or minerals used in the generation or storage of energy

I advise hedge funds, mining companies, global corporates, and academia across six continents to better understand opportunities and threats along the energy metals supply chain

In 2020 I authored a chapter for a forthcoming textbook on energy storage. Chapter title is “*Taming the Hydra: Funding the Lithium-Ion Supply Chain in an Era of Unprecedented Volatility*”

I have served on two company boards as an independent director and work closely with a lithium-ion battery recycler



Agenda

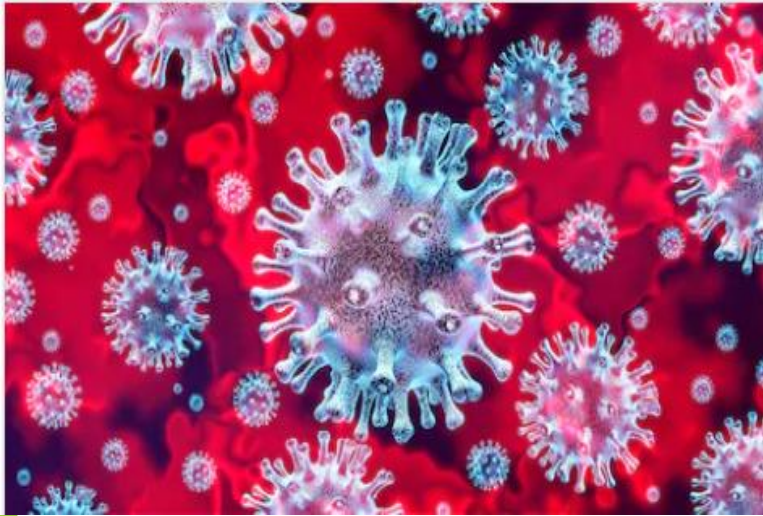
- ▶ What is the current state of play?
- ▶ What is the competitive landscape?
- ▶ What are raw material requirements and the global impact?



I. The State of Play



How did we get here? Public health and geopolitics exposed supply chain weaknesses



The Implications of Tesla's Battery Day



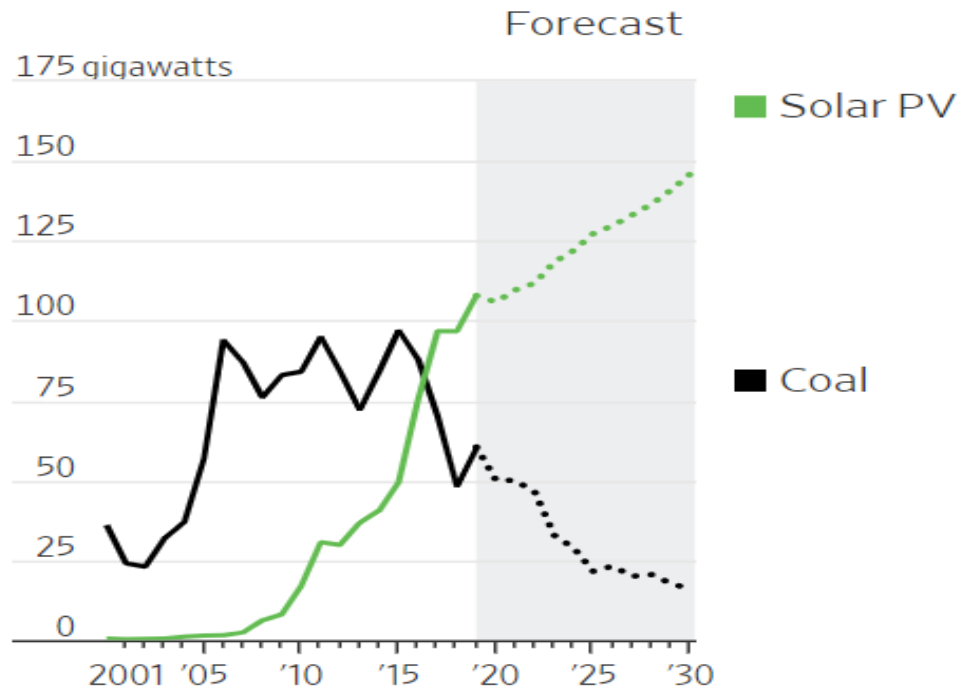
“Tera is the new Giga”

- ▶ Tech-driven cost deflation in batteries is set to continue
- ▶ We are going to need more raw materials. How much? 4X lithium, 2X cobalt, 3x copper, 3x nickel by mid-decade to meet anticipated EV battery demand
- ▶ ESG is a driver of capital investment
- ▶ Security of Supply demands a regionalized supply chain



Cost Deflation Tells a Powerful Story

Average annual solar PV and coal electricity generating capacity additions world-wide



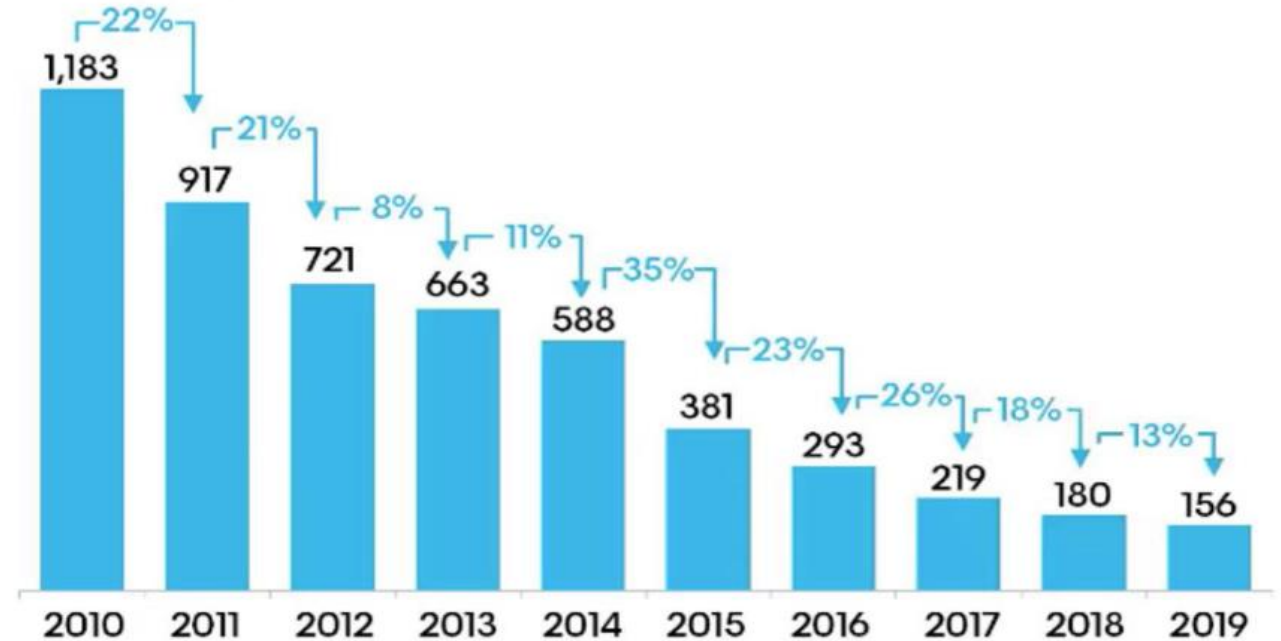
Source: International Energy Agency



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Lithium-ion battery price survey results: Volume-weighted average

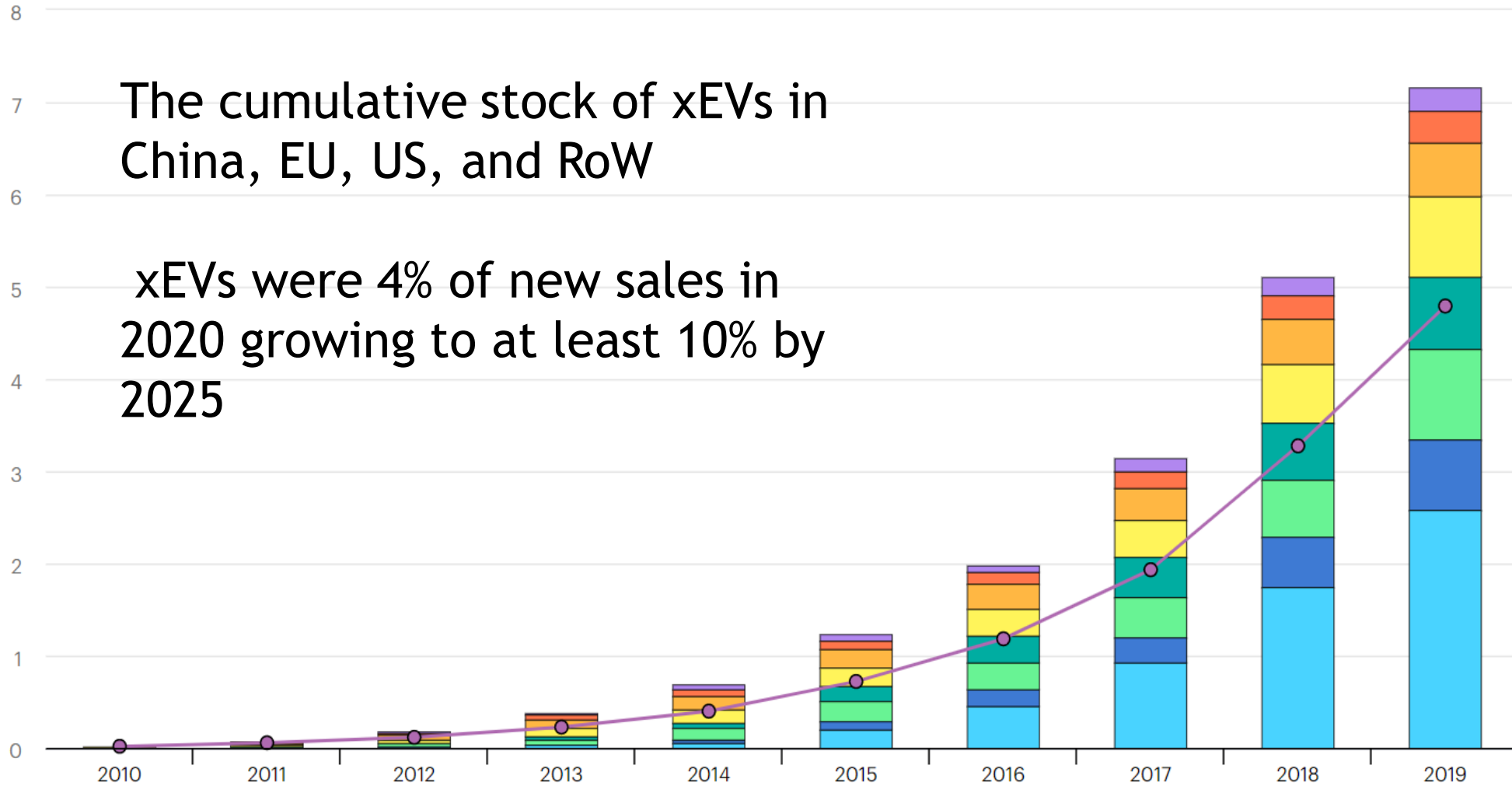
Battery pack price (real 2019 \$/kWh)



Source: BloombergNEF

Lithium ion battery prices have fallen nearly 90% over the past decade, according to BloombergNEF's ... [+] BNEF

million





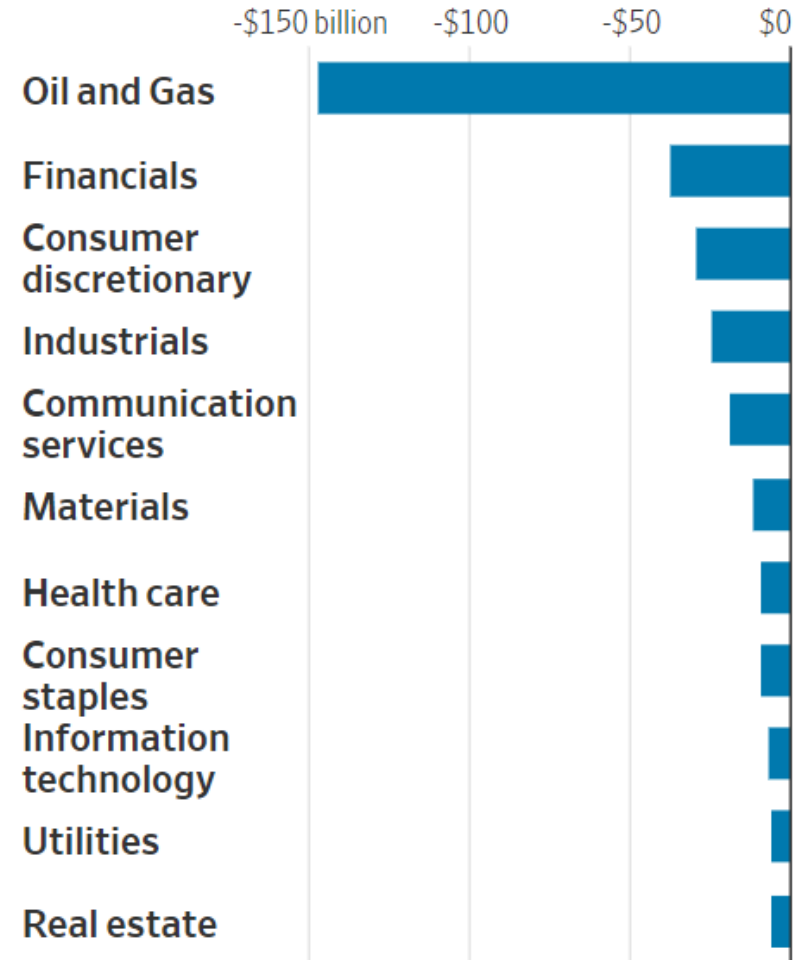
Note the divergence between oil and gas and battery materials.

This could be a liquidity fueled bubble or evidence of a secular shift.



If the shift is structural, how will the Oil and Gas business generate returns?

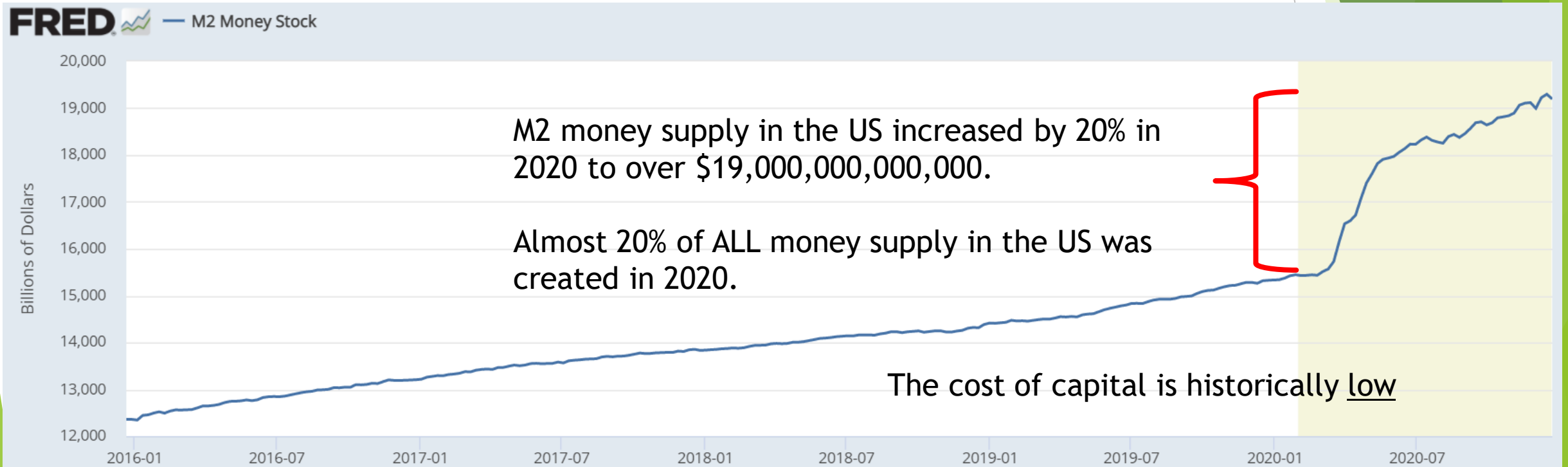
Write-downs by industry, Q1-Q3 2020



Source: WSJ



The Federal Reserve has “flooded the zone” in response to COVID



II. Competitive Landscape



The Government Leviathan has awoken

Japan sets aside ¥243.5 billion to help firms shift production out of China

India's Coronavirus Crisis Spurs a New Look at Self-Reliance

Aus, India Both Stand To Gain From Expanding Trade In Lithium Resources: Australian High Commissioner

UPDATE 1-France urges business to rethink supply chains as coronavirus hits Asia

EIB confirms €1bn to consolidate European battery industry

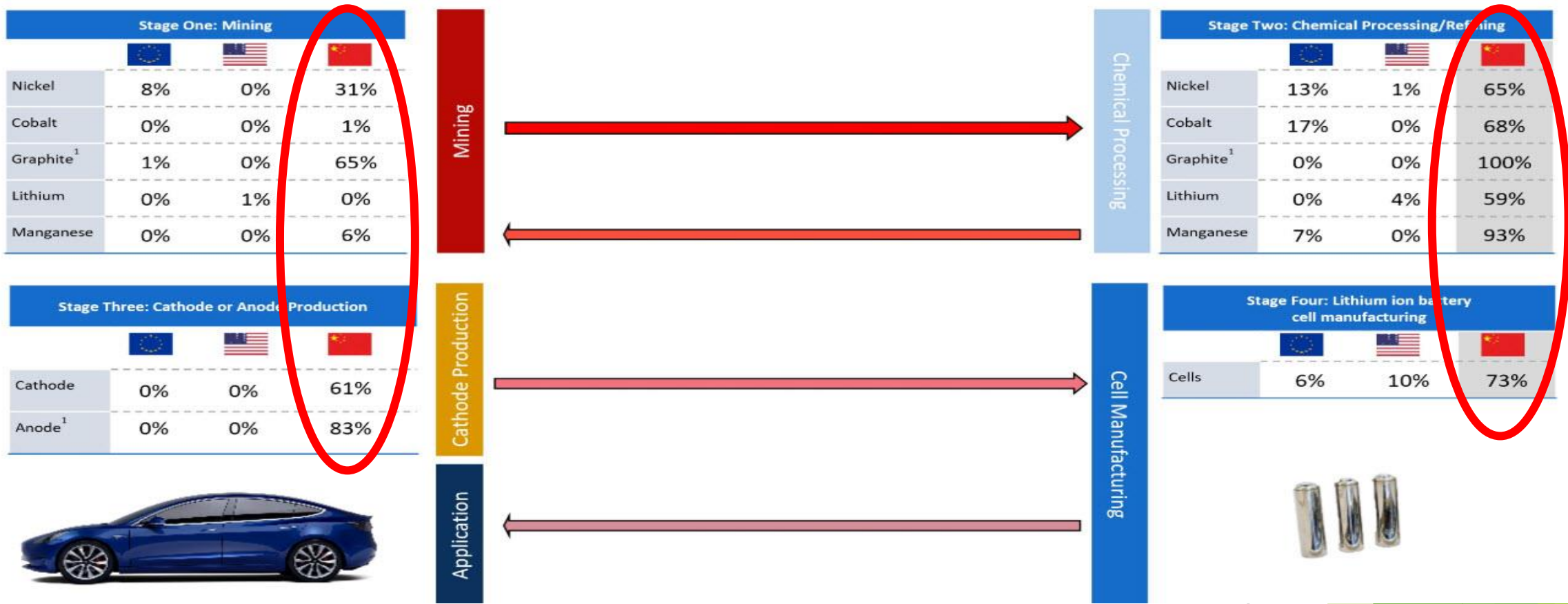


The US is moving forward to address supply chain dependency

- ▶ National Defense Authorization Act (NDAA); DPA Title III
- ▶ Senator Cruz (R-TX) - ORE Act
- ▶ Senator Murkowski (R-AK) - American Mineral Security Act, American Energy Innovation Act
- ▶ Senator Rubio (R-FL) - RE Co-op 21st Century Manufacturing Act
- ▶ President Trump Executive Order- 13817 - A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals - National Emergency on 9/30/20
- ▶ The US is 100% dependent on imports of 18 minerals/metals and at least 75% dependent on imports of 32



China is and will remain a dominant player here



Source: Benchmark Mineral Intelligence



III. Raw Material Tremors and The Global Impact



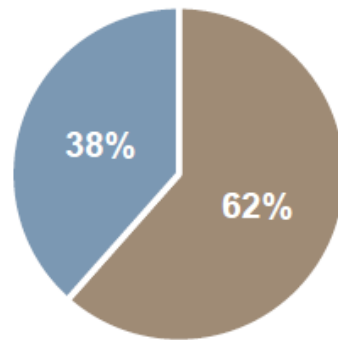
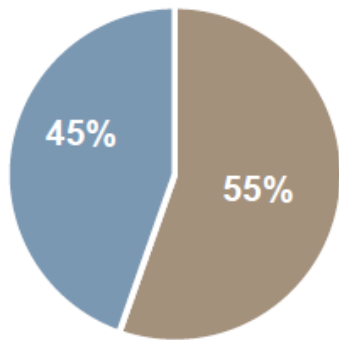
Lithium Market Breakdown

BY RESOURCE ORIGIN

KT LCE	2019E	2025F
Total Brine	145	400
Total Rock ^{1,2}	180	640
Total Supply	325	1,040

2019

2025

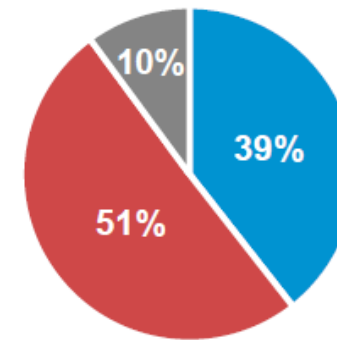
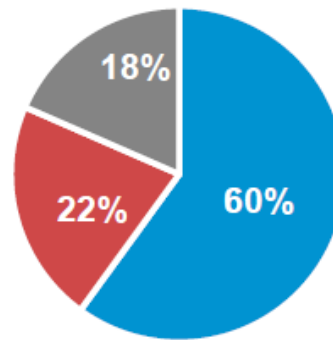


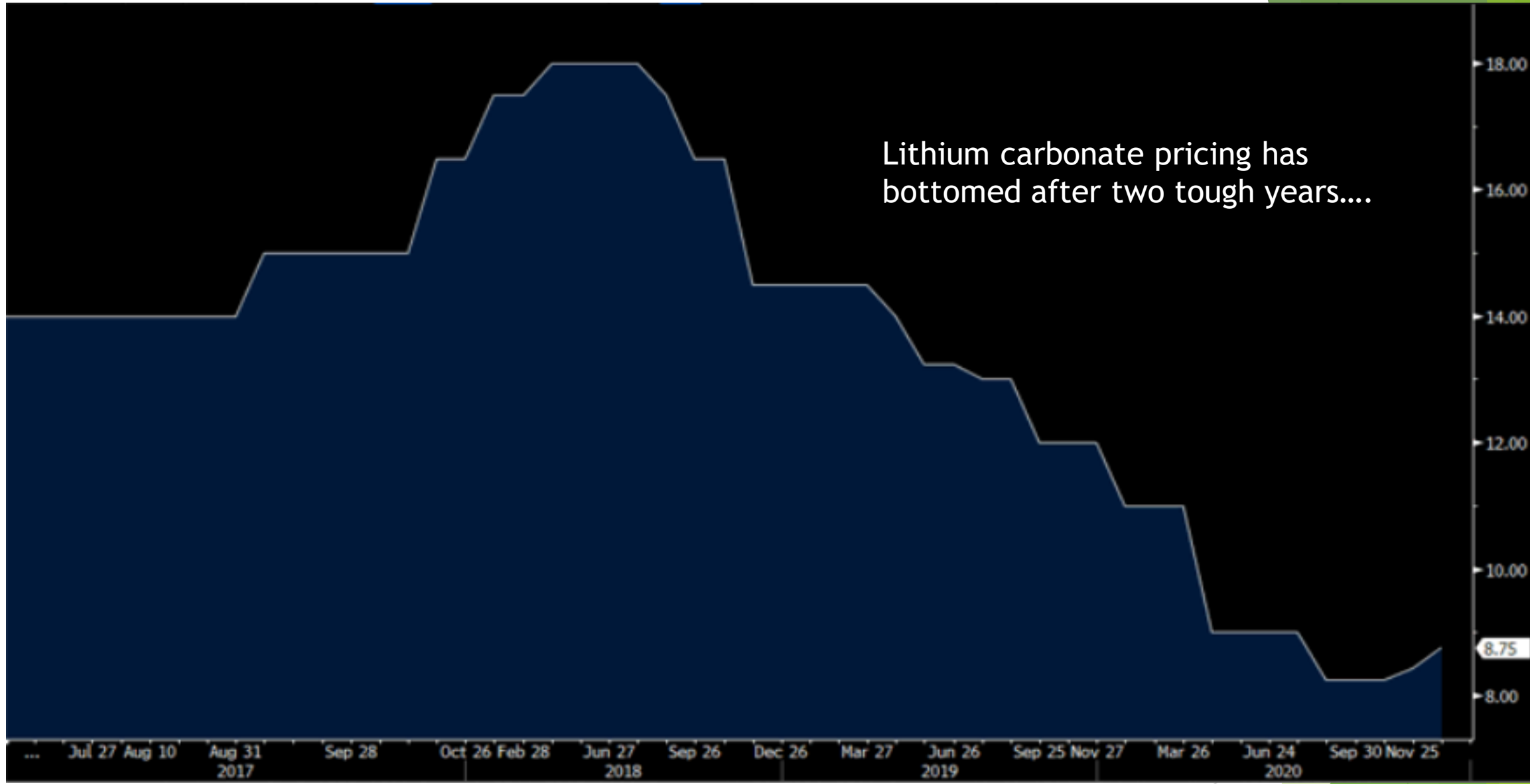
BY PRODUCT

KT LCE	2019E	2025F
Carbonate	195	410
Hydroxide	70	525
Specialties ²	60	105
Total Supply	325	1,040

2019

2025





What Will a 10% EV penetration rate require?

- ▶ Assume a 100M unit automotive market and battery size of 50kWh and NMC 523 chemistry
- ▶ Lithium - .8 kg/kWh
- ▶ Cobalt - .2 kg/kWh
- ▶ Nickel - .6 kg/kWh
- ▶ Copper - .8 kg/kWh
- ▶ Graphite - 1.25kg/kWh
- ▶ 400,000 t lithium, 100,000 t cobalt, 300,000 t nickel, 400,000 t copper, 625,000 t natural graphite



Takeaways

- ▶ Decarbonization, decoupling, cost deflation, and demand
- ▶ The lithium market will triple in size and then double again
- ▶ Project funding of \$10B+ needed to meet mid-decade lithium demand alone. Capital is cheap but what is the source?
- ▶ The United States in competing for capital with China AND the EU - We have the capital markets, domestic resources, and political will



Thank you for your time today

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