



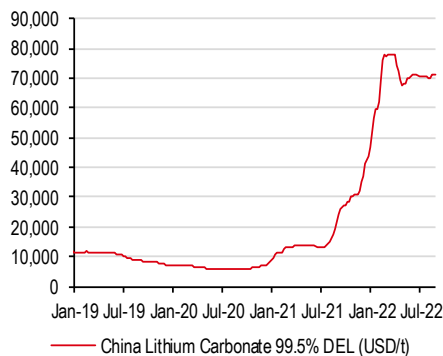
Lithium 101

The irreplaceable "White Oil"

- ◆ Lithium is a lightweight metal with the capacity to store large amounts of energy
- ◆ This makes it an ideal material in the manufacturing of batteries, making lithium the most crucial resource in energy transition
- ◆ The race to build precious new supply is accelerating but can recycling help bridge the gap between supply and demand?

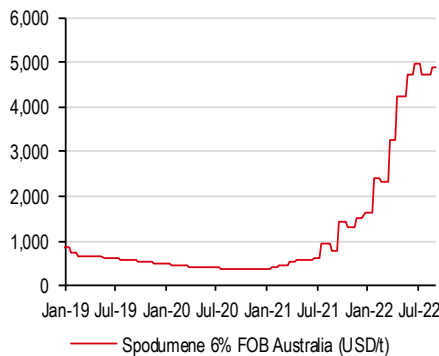
Lithium (Li), the lightweight metal with the capacity to store large amounts of energy, is now known as "White Oil." With good reason. Prices have risen more than 8x since 2021 due to a supply shortage and soaring growth in demand from surging EV sales. The reality is that lithium is simply irreplaceable when it comes to making EV batteries. This report is based on a larger note titled "China Lithium: The search for irreplaceable 'White Oil'" looking at the importance of new supply projects, the limited supply and huge demand in China, the prospects for battery recycling, and why demand for lithium is so much greater than for other battery materials.

1: Lithium spot price



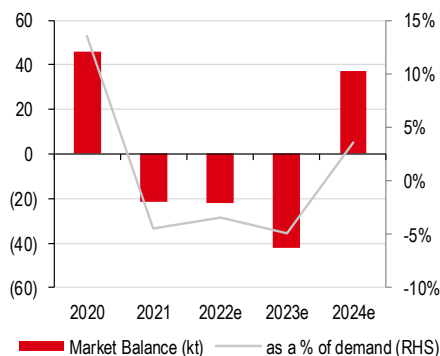
Source: Bloomberg, HSBC

2: Spodumene spot price



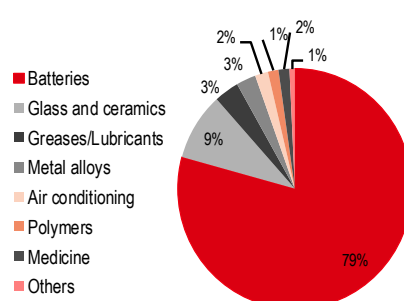
Source: Bloomberg, HSBC

3: Lithium market balance



Source: LME.com, HSBC estimates

4: Lithium demand by industry (2022e)



Source: Wood Mackenzie, HSBC estimates

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This is a Free to View version of a report titled "China Lithium: The search for irreplaceable 'White Oil'" published on 10-Oct-22. Please contact your HSBC representative or email AskResearch@hsbc.com for more information.

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This report must be read with the disclosures and the analyst certifications in the Disclosure appendix, and with the Disclaimer, which forms part of it.

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Lithium 101

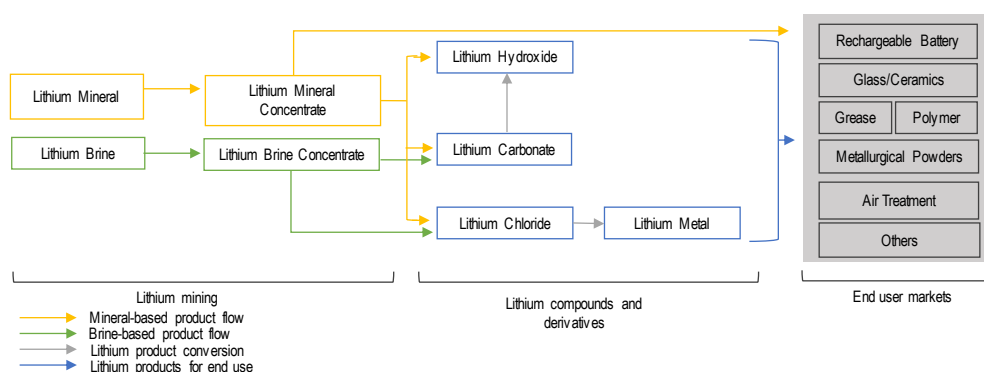
What is lithium?

As the third element and first metal on the periodic table, lithium is the lightest metal with good electric conductivity. The unique properties of lithium make it an ideal material in the manufacturing of batteries as it increases the batteries' energy density efficiently (Wh/kg, the energy stored per mass), making lithium the most crucial resource in energy transition. According to the United States Geological Survey (USGS), lithium-ion batteries (LIB) contributed to over 70% of global demand for lithium, followed by c14% from ceramics and glass. LIBs are mainly used in power batteries, energy storage systems (ESS), and consumer electronics. The growing demand for EVs are the main demand drivers of LIB and lithium.

Lithium industry value chain

Lithium is primarily found in hard rock (including spodumene, lepidolite, petalite, and amblygonite) and can also be extracted from brine in water. Following the extraction of lithium from minerals or brine, refineries further convert the lithium concentrate into lithium chemicals, like lithium carbonate, lithium hydroxide, lithium chloride, and lithium metal. The refined lithium chemicals are used as raw materials of the precursor of cathode, lithium hexafluorophosphate, the raw material of electrolyte solution in rechargeable batteries, and other non-battery uses.

5: Simple lithium industry value chain

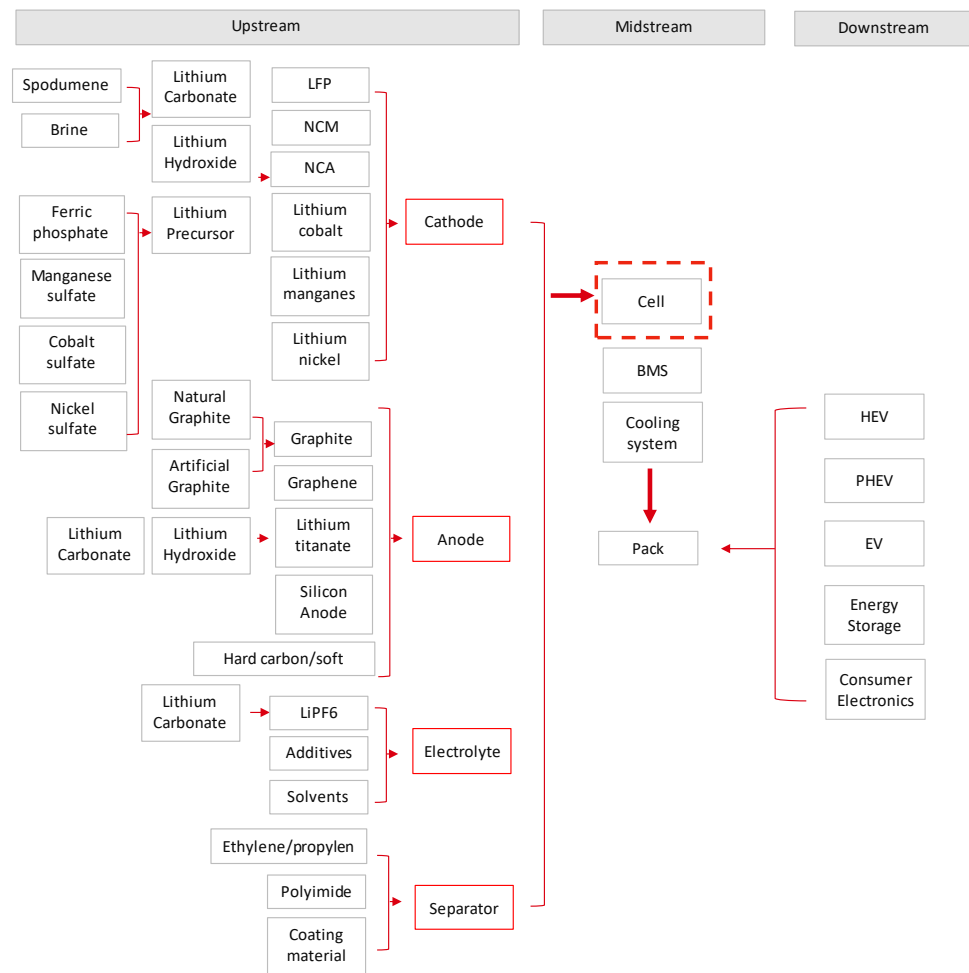


Source: Wood Mackenzie, HSBC

The Li-ion battery value chain

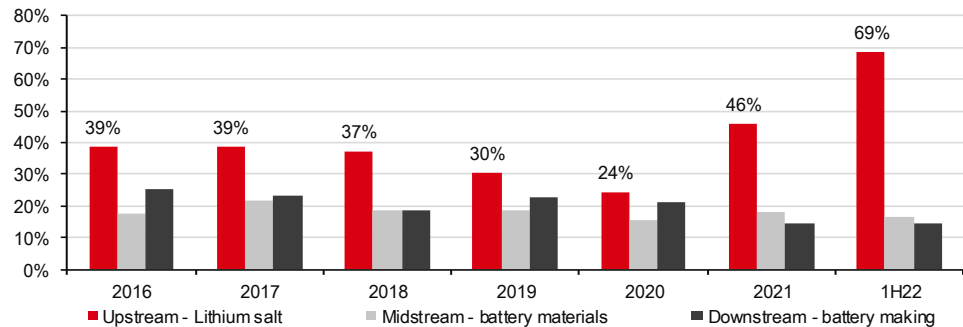
A lithium-ion battery cell is made of four key components: cathode, anode, electrolyte and separator. Lithium compound is primarily used as the raw material of cathode precursor, electrolyte and lithium metal anode. Cathode is the source of lithium-ion in a battery, and plays an important role in determining the energy density and voltage of a battery. Lithium-ion is stored and released as a form of lithium oxide in anode because lithium is unstable in its element form. Graphite is the mainstream anode material. Electrolyte works as the medium that allows lithium-ion to move freely between cathode and anode. The separator separates cathode and anode. The battery cell is also packed with other components, like battery management systems and cooling systems, to become a battery pack, which could be used for EVs, ESS and consumer electronics production. The chart below illustrates the details of each stage.

6: Battery industry value chain



Source: HSBC

7: Gross profit margin of companies along the battery industry value chain



Source: Wind, HSBC

Lithium compound

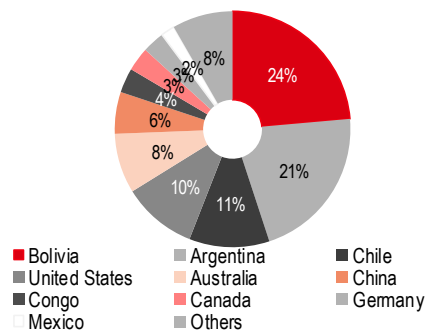
Many technologies for rechargeable battery cells have been developed, such as nickel manganese cobalt (NMC), lithium iron phosphate (LFP), nickel-cobalt-aluminium (NCA), and lithium manganese oxide. NMC battery and LFP have become the mainstream technology route of rechargeable battery due to their high energy density, longer life-time recycle and high safety. Lithium carbonate and lithium hydroxide are the major refined lithium compound that will participate in rechargeable battery production. Lithium carbonate is usually used as cathode precursor for LFP batteries, while lithium hydroxide is primarily used to process cathode precursor of nickel-rich NMC batteries.

Lithium resource distribution and production

Lithium makes up 0.002% of the earth's crust, making it the 32nd most abundant element. According to United States Geological Survey (USGS) data, global identified lithium resources total about 89mt in 2022. More than 70% of identified lithium resource deposits are in five countries – Bolivia (24%), Argentina (21%), Chile (11%), the US (10%), and Australia (8%).

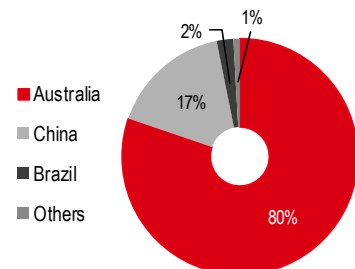
Lithium cannot exist as pure element due to its high reactivity, so it is usually found as compound in hard rock and brine. Lithium mineral, produced predominately in Australia, accounts for c80% of global mineral lithium production in 2021. China and Canada contribute 17% and 2% of global mineral lithium production, respectively. Lithium brine is primarily exploited in Chile and Argentina. Among current lithium projects, brine contributes the most to lithium resources, accounting for 46% of global total projects, while mineral and clay projects contribute 45% and 9%, respectively, according to Wood Mackenzie.

8: Identified lithium resource by country (2021)



Source: USGS, HSBC

9: Lithium mineral resource production by country (2021)



Source: Wood Mackenzie, HSBC

Disclosure appendix

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