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New Energy Vehicle Power Battery Raw Material Industry Analysis

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Abstract: With the rapid development of China's new energy vehicle industry, the scale of the power battery industry has gradually expanded, directly driving the demand for raw materials for power batteries. Raw material supply, cost and power battery recycling will directly or indirectly affect the healthy and sustainable development of China's new energy vehicle industry. This paper analyzes China's new energy vehicle power battery raw material market, explains the current situation of the power battery raw material market from the perspectives of market pattern, price changes and technology trends, and proposes the market demand and prospects of power battery recycled materials.

1. Introduction

In recent years, China's new energy vehicle industry has expanded rapidly under the drive of policy and market. As of the first half of this year, the cumulative production of new energy vehicles in China exceeded 6.7 million units, and the process of electrification of vehicles is unstoppable. The demand for downstream new energy vehicles has directly driven up the demand for midstream power batteries, which has been transmitted to the upstream power battery raw material.

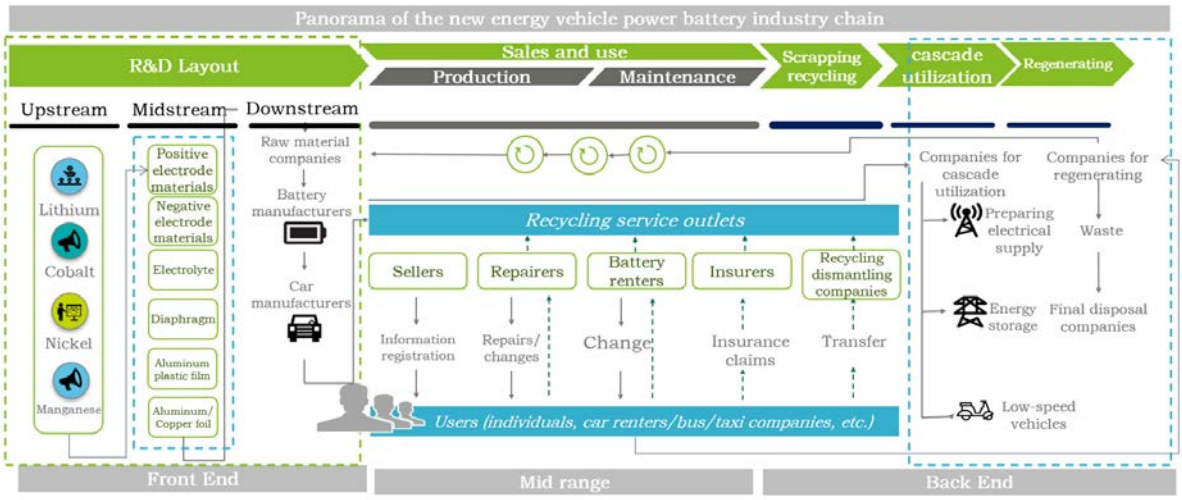

Figure 1: Panorama of the power battery industry chain for new energy vehicles

2. Raw materials are the core link to achieve cost reduction in power batteries

In order to occupy a greater advantage in the fierce market competition, new energy vehicles and power battery manufacturers reducing the cost of power batteries to make efforts further. The way of reducing cost of power battery includes raw material cost reduction, capacity expansion to achieve the scale effect and technological innovation, of which the use of raw material cost reduction is the core link to achieve power battery cost reduction.

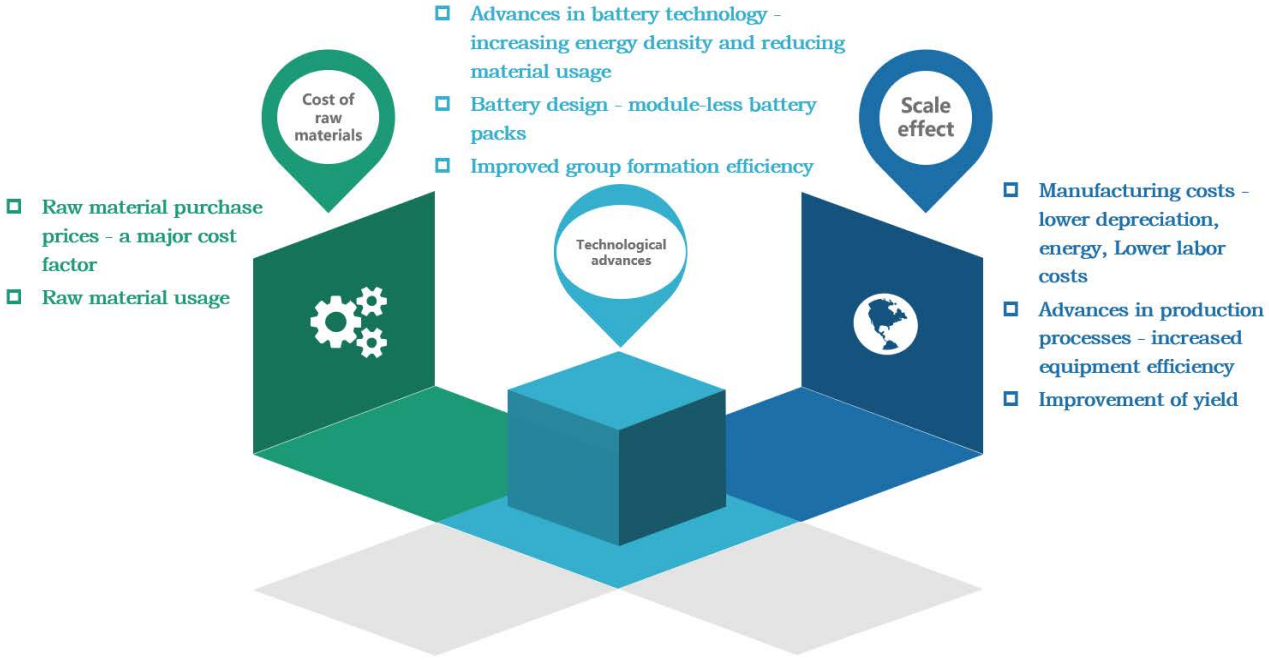

Figure 2: Power battery cost reduction path

The cost of power batteries is divided into cathode materials, cathode materials, diaphragm, electrolyte, conductive agent, binder and so on. Among the four major materials for power batteries, the market size of cathode materials is relatively the largest, but the gross margin is low; the market size of cathode materials is relatively small and the profitability is stable; the diaphragm has high technology content and the smallest market size, and the gross margin is high; the market size of electrolyte ranks third, and in the future, as the trend of high nickel ternary technology gradually becomes clear, the requirements for electrolyte in terms of high voltage and high safety are increasingly high.

Take a certain NCM811 square power battery as an example, the cost of cathode material is the highest, accounting for about 58% of the total cost. Next, the cost of cathode material and battery case account for about 12% and 10%. Therefore, it can be said that the cost of cathode material directly determines the cost of the battery. At the same time, the use of cathode materials also directly affects the performance of lithium-ion batteries in terms of energy density, cycling, high and low temperature. Therefore, cathode materials are of great significance to the development of the power battery industry, from both the perspective of cost reduction and the perspective of battery performance enhancement.

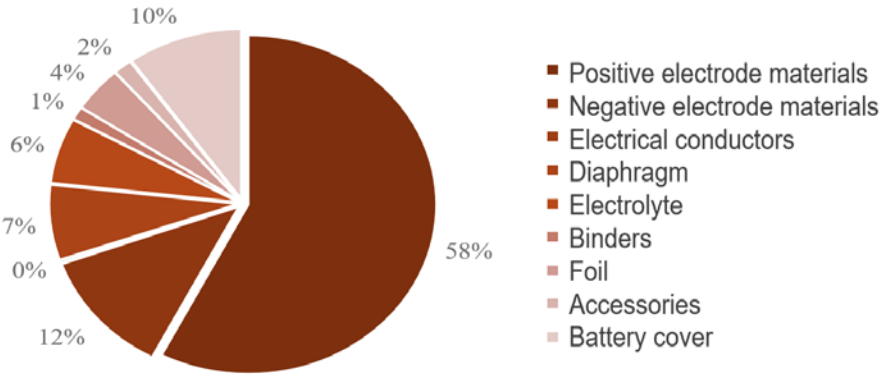

Figure 3: Raw material cost share of a particular NCM811 square power cell

3. The rapid expansion of the cathode material industry, leading to increased demand for metal resources

According to statistics, the shipment of cathode materials for batteries in China maintained steady growth in 2020, reaching 510,000 tons, an increase of 26% year-on-year. Among them, the shipment of ternary cathode materials is 235,000 tons, an increase of 22% year-on-year; the shipment of lithium iron phosphate materials is 127,000 tons, an increase of 44% year-on-year; the shipment of lithium cobalt-acid materials is 82,000 tons, an increase of 24% year-on-year. The lithium iron phosphate cathode material market share has increased, influenced by the power battery, energy storage and other aspects of the market. For example, blade battery of BYD, CTP battery technology development of CATL, as well as BYD Han, lithium iron version of model 3, Hong Guan mini-EV and other models' hot sales, driving the lithium iron phosphate market rebound.

The expansion of the cathode material industry will lead to an increase in demand for battery metal resources and increase China's external dependence on resources. It is estimated that in 2020, power battery production will consume approximately 0.62 million tons of lithium, 0.72 million tons of cobalt, 17,900 tons of nickel and 10,500 tons of manganese; it will cumulatively consume approximately 27,000 tons of lithium, 28,000 tons of cobalt, 70,000 tons of nickel and 48,000 tons of manganese. China's metal resources are relatively scarce, with lithium, cobalt, nickel and manganese resources all relying heavily on imports and high dependence of entrance. In 2020, China's external dependence on lithium resources will be nearly 80%, while the external dependence on cobalt, nickel and manganese metal resources will be over 90%, with the external dependence on cobalt resources reaching 97%.

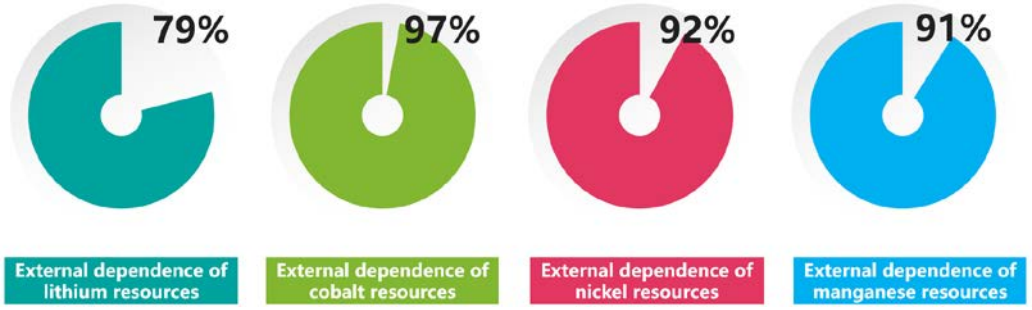

Figure 4: China's external dependence on lithium, cobalt, nickel and manganese resources

Further increase in demand for power batteries in the future will drive demand for lithium, nickel, cobalt and other metal resources to maintain high levels. Combined with the projected installed

capacity of new energy vehicle power batteries, the annual demand for lithium resources in China's new energy vehicle industry will reach 24,600 tons, cobalt resources 28,500 tons, nickel resources 71,000 tons and manganese resources 41,400 tons in 2025. Otal lithium-cobalt-nickel-manganese metal demand is expected to quadruple in 2025 compared to 2020.

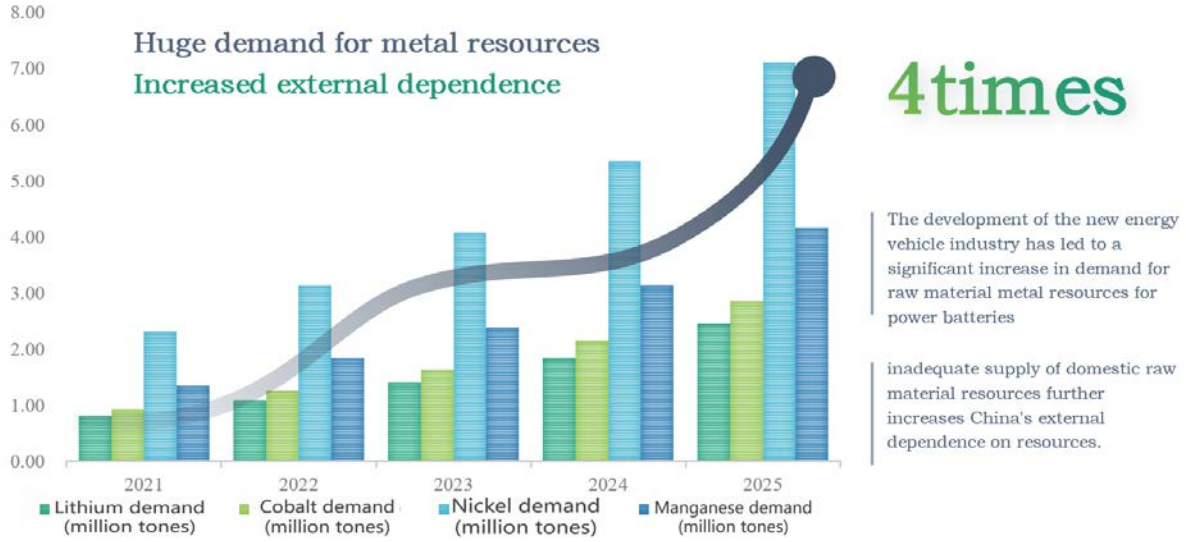

Figure 5: China's demand forecast for lithium, cobalt, nickel and manganese from 2021-2025

4. Fierce competition in the cathode materials market, companies accelerate layout to capture key resources

From the perspective of China's ternary cathode material market competition pattern, the market share of the top ten enterprises does not vary greatly, occupying the top three enterprises are Rong Bai Technology, Tianjin Bamo and Long Term LiCo.

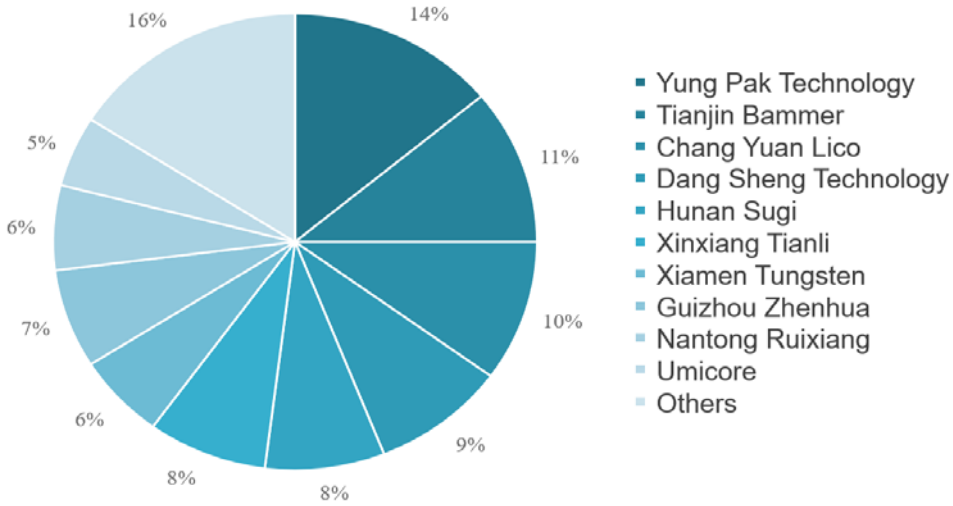

Figure 6: Competitive landscape of China's ternary cathode materials market

The cathode material market is highly competitive, and in order to expand the advantages of enterprises, relevant enterprises have accelerated the layout. On the one hand, the leading lithium-cobalt-nickel and other mineral enterprises have accelerated the expansion of their resources; on the other hand, power battery manufacturers have vertically extended their industrial chains to ensure the

stability of cathode material supply while reducing raw material costs. At present, leading lithium-cobalt-nickel mineral enterprises such as Gan Feng Lithium and Hua You Cobalt, and battery producers such as CATL, BYD and Guo Xuan Hi-Tech have deepened their control of upstream raw materials through self-built, holding, mergers and acquisitions, and locking in long orders to lay out the world and seize key resources.

5. Prices of anode materials have steadily increased, driven by the impact of metal prices

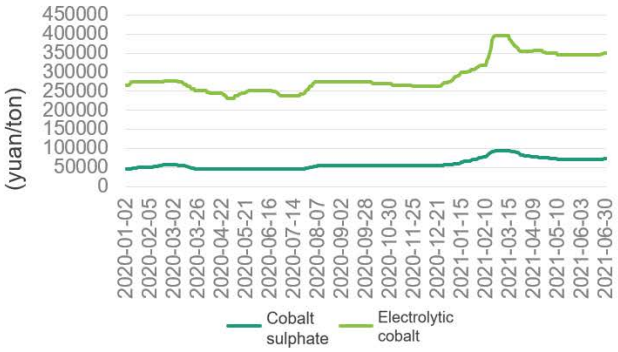

Figure 7:Cobalt sulphate and electrolytic cobalt price trends
(1st January 2020 - 30th June 2021)

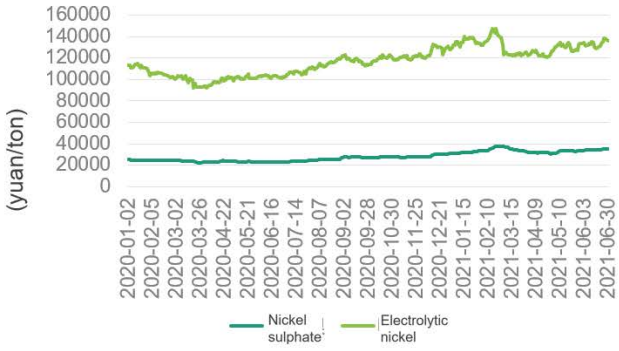

Figure 8:Nickel sulphate and electrolytic nickel price trends
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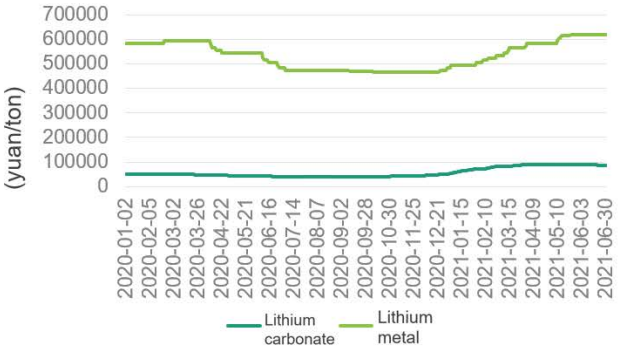

Figure 9:Lithium carbonate and lithium metal price trends
(1st January 2020 - 30th June 2021)

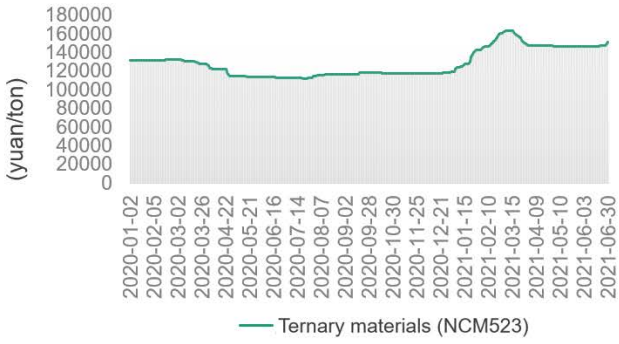

Figure 10:Ternary material (NCM523) price trend
(1st January 2020 - 30th June 2021)

Figure 7: Cobalt sulphate and electrolytic cobalt price trends

As the pricing model for cathode materials is a cost-plus model, attention needs to be paid to the volatility of metal resource prices. The cost-plus model means that companies add processing fees to the point-in-time prices of major metal resources, which are usually negotiated at the end of the year or at the beginning of the year. Therefore, under this pricing model, the profitability of cathode material companies depends mainly on the market price trend of upstream metal resources.

This year, due to the oversupply of the upstream raw material- lithium carbonate, the price of lithium iron phosphate material has gone up, from 40,000/ton in June 2020 to 87,000/ ton in June 2021. In addition, iron phosphate relative to lithium iron phosphate, because of lower production capacity and longer expansion cycle than lithium iron phosphate and other factors that contribute to the rising cost of lithium iron phosphate. Meanwhile, this year, cobalt and nickel prices have seen a round of sustained and significant increases. Cobalt sulphate reached $74,000 per ton in June 2021, an increase of 60.9% compared to $46,000 per ton in June 2020; nickel sulphate prices rose from $23,000 per ton in June 2020 to $35,000 per ton in June 2021, an increase of 34.3%. Influenced by the domestic cobalt sulphate and nickel sulphate prices, the price of nickel-cobalt-manganese ternary

materials has also risen, with the price of 523-type ternary cathode materials rising from 113,000 yuan/tonne in June 2020 to 152,000 yuan/tonne in June 2021.

From a long-term perspective, new energy vehicle production growth certainty, will drive upstream cathode material demand, its short-term expansion capacity will be difficult to effectively release, supply and demand is still tight, prices will be expected to continue to go up.

6. High energy density materials will be a future technology trend

With the change of industry subsidy policy and the improvement of subsidy technology standard, the power battery develops in the direction of long range and high energy density. Compared with traditional ternary cathode materials, high nickel ternary cathode materials have more advantages in terms of energy density, prompting more mainstream power battery enterprises to choose the technical direction of high nickel, thus forming a continuous demand for high nickel ternary cathode materials. In addition, the acceleration of the application of high nickel ternary materials in the field of power batteries also comes from the scarcity of global cobalt resources, the continued high price of cobalt and the enormous pressure to improve quality and reduce costs. Compared to NCM523, the cobalt content of NCM811 is reduced from 12.21% to 6.06%, which translates into a reduction of 0.22kg of cobalt per kWh of power cell to 0.011kg[1].

7. Recycled materials gradually become the focus of the industry

The introduction of China's "carbon neutrality" target and the new European "Battery Law" and other policies will force companies to accelerate the use of recycled power battery materials.

China's waste power battery recycling industry has a certain industrial scale, as of the end of 2020, China has the capacity of recycling enterprises have more than 20, has built capacity of about 690,000 tons / year, the scale of the industry is still expanding, known enterprises planning capacity of more than 400,000 tons / year. Due to restrictions such as environmental protection and industrial planning in some areas, these enterprises are mainly concentrated in small and medium-sized cities in Hunan, Zhejiang, Guangdong, Hubei and Jiangxi that have a corresponding industrial base. The enterprises involved in the recycling of waste batteries are mainly developed by waste electrical and electronic products processing enterprises and non-ferrous metal smelting enterprises, and there are more kinds of enterprises under construction or to enter the recycling industry of waste power batteries, both in the layout of new energy vehicles and battery manufacturers, and also the inflow of social capital.

In recent years, there have been many capital and enterprises including Tianqi, Fujian Evergreen New Energy, Dishengli and others entering the recycling sector. At present, 13 backbone enterprises such as Jingmen Greenmei, Hunan Bangpu and Quzhou Huayou have entered the list of enterprises announced by the Ministry of Industry and Information Technology as "*New Energy Vehicle Waste Power Battery Comprehensive Utilization Industry Specification Conditions*", with a combined capacity of over 470,000 tons/year, accounting for about 68% of the total capacity. At present, China's used power batteries can be mainly divided into two categories: ternary material batteries and lithium iron phosphate batteries. From a technical point of view, the technical route based on wet metallurgy process can safely, environmentally friendly and effectively recycle these two types of used power batteries, with mature technology, high element recovery rate and mature industrialization experience. Taking the wet metallurgy process as an example, a unified mathematical model of the revenue from the recycling of used power batteries was established in accordance with the cost analysis method and appropriate simplifications, and an in-depth analysis of the economics of the wet recycling process was carried out, taking into account the current sales prices of various metals in the market and industry research. The study found that recycling earnings fluctuate with the price of rare metals and that the price of recycling used batteries, transportation costs and the availability of input tax

invoice credits all have a significant impact on corporate profitability. For a single recycling enterprise, whether dealing with ternary batteries or lithium iron phosphate batteries, the break-even point of the enterprise depends on the capacity utilization rate, only to meet certain conditions of capacity utilization rate to ensure that the enterprise break-even.

At present, China's recycling process is mainly based on wet metallurgy, mainly extracting cobalt, nickel, lithium, manganese and other rare metals and has been able to achieve a high recovery rate of resources, led by enterprises such as Greenmax and HuaYou, the comprehensive recovery rate of nickel, cobalt and manganese elements have reached more than 98%, and the recovery rate of lithium elements is not less than 85%. According to their own development strategies, the companies reproduce products into metal powders, metal salts, battery precursor materials and battery cathode materials. In addition， the main products using the material reconditioning process route are cathode powder, aluminums powder, copper powder, cathode powder, electrolyte, diaphragm and other products.

Research has shown that the precious metal resources in used power batteries, after recycling, can be incorporated into the power battery production process as recycled materials, which will significantly reduce carbon emissions, with a carbon reduction effect of approximately 0.19 tonnes per kWh. At the same time, metal resources such as lithium, cobalt, nickel and manganese have limited reserves to develop, and the use of recycled materials can effectively reduce the rate of their consumption and ease our external dependence on metal resources. In addition, in terms of cost benefits, in the case of ternary batteries, for example, the cost of obtaining recycled materials through resource recovery is lower than the cost of producing raw materials directly from mineral extraction. According to research, through the production of recycled material ternary precursors profit margin of about 22%, while the use of raw ore development and production of raw materials produced ternary precursors profit margin of about 15%. Therefore, recycled material has gradually become the focus of the industry, and all the enterprises concerned have laid out to seize the market.

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