Vehicle Battery Market under Metal Resource Constraints

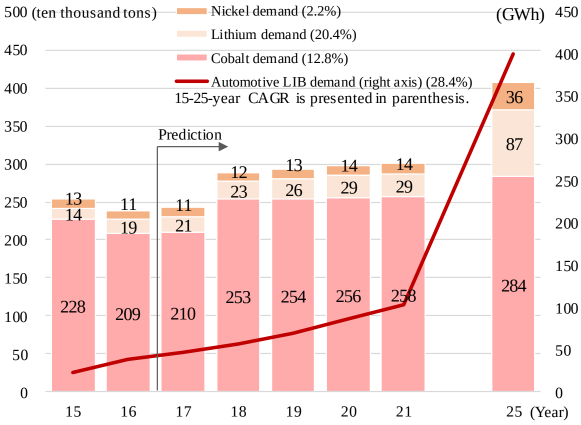
Associate Senior Researcher, Industry Research Group, 3rd Research Department
Hayato Kawakami

From 2020, mobile manufacturers will accelerate the widespread of electric vehicles (EVs) in response to environmental measures taken by countries worldwide.

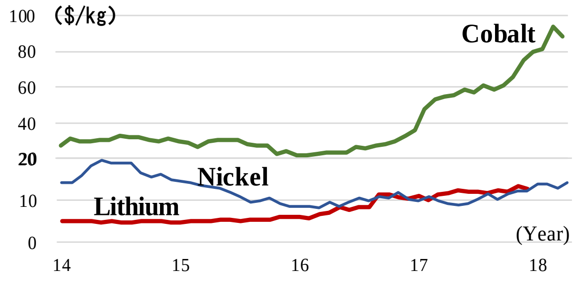
On the other hand, there is a concern that batteries, which are the power source of EVs, may become a bottleneck for the spread of EVs due to a shortage in the supply of rare metals which are the major raw materials thereof. This paper describes the current state of constraints of rare metal resources and efforts made by battery manufacturers in the automotive battery market to cope with the challenge.

1. Resource constraints facing the EV and automotive battery markets

According to the target unit sales of EVs set by the world's major automobile manufacturers, the demand for lithium-ion batteries (LIB), the power source of EVs, is likely to increase by three or four times from the current level by 2025 (Figure 1). Due to a concern over tight supply, the market price of cobalt, a key material for LIB, and other rare metals has already soared (Figure 2). In particular, the production of cobalt, a by-product of copper and other metals, is affected not only by the market conditions for its main product copper, but also by the fact that approximately 60% of its production and reserves are concentrated in the Democratic Republic of the Congo, which faces serious geopolitical risks such as conflicts, thus posing an extremely large supply chain risk. In addition, the minable reserves that have been confirmed at the moment are less than demand, which accelerates a concern over a possible shortage of supply in the future[1].



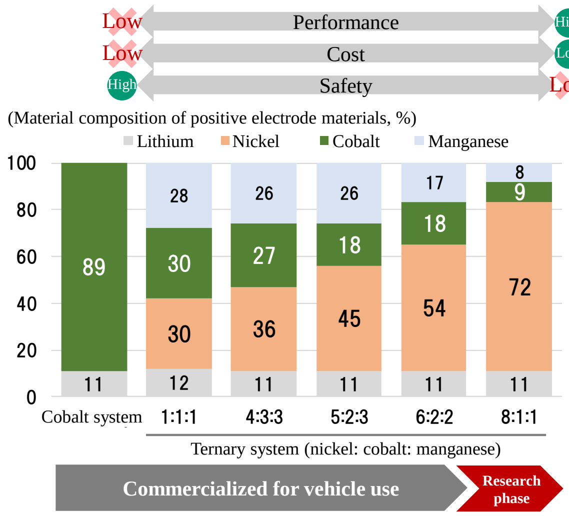
Note: Estimated EV sales for 2025 as 7 million units
Source: Prepared by Hitachi Research Institute based on the materials of Fuji Keizai, etc.
Figure 1: Demand outlook for rare metals for battery materials



Source: Prepared by Hitachi Research Institute based on LME and other materials
Figure 2: Prices of rare metals for battery materials

2. Increasing importance of development of resource-saving batteries

Automobile manufacturers plan to lower EV prices by reducing the cost of LIB, but the rising price of rare metals is an obstacle. To solve this problem, automobile manufacturers and battery manufacturers are developing batteries that provide higher performance and constant safety while reducing costs, by reducing the use of cobalt by partially replacing it with relatively cheaper nickel, manganese, and the like (Figure 3). Research and development of next-generation batteries, such as metal-air batteries that are rare metal-free and have higher performance compared to LIBs, is also under way in parallel, but practical application is expected after 2030 at the earliest.



Price (ten thousand yen)	24.1	11.0	10.2	8.5	8.6	6.9

Note: Spot price for 2017 is used. Estimated based on a capacity of 40 kWh
Source: Prepared by Hitachi Research Institute based on the materials of Fuji Keizai, etc.
Figure 3: Example of composition of an LIB active cathode material

[1] Estimation based on the demand in line with the aforementioned targets set by automobile manufacturers and the current minable reserves shows that these metals will be exhausted in 2037. However, minable reserves only indicate the amount of reserves that can be extracted technically and economically out of the currently-identified reserves, and they may increase later.

3. Remanufacturing of spent batteries

In response to rising prices of rare metal materials, the importance of reusing spent LIBs will also increase. There are three main ways of reusing LIBs (Figure 4).

1. Reusing: Reuse a battery pack[2] as is
2. Remanufacturing: Select cells or modules in a battery pack that have a certain residual performance and are recyclable, and repackage them
3. Recycling: Disassemble cells and recycle rare metals and other materials

In particular, there are expectations for the use of remanufactured LIBs in that they meet the performance standards required for EVs and can be provided at low cost. Nissan Motor Co., Ltd. has already started to supply remanufactured LIBs for its own LEAF EVs in Japan since 2018. The LIBs are offered at less than half the price with the condition of 78% capacity guarantee of a new LIB.

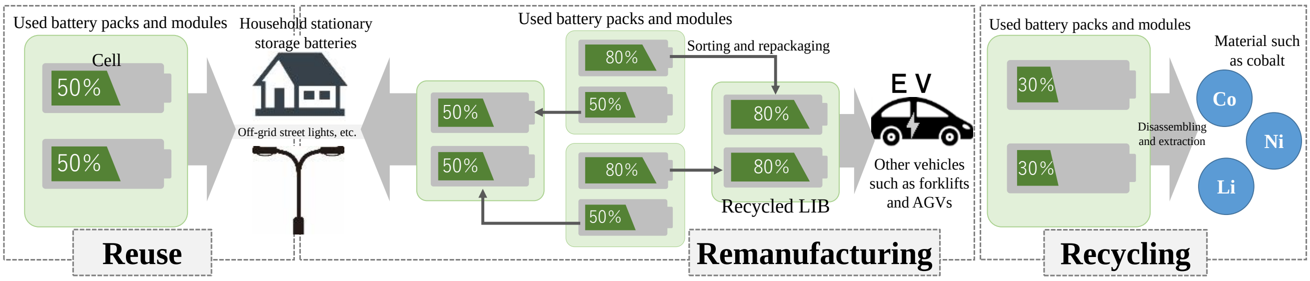
In order to remanufacture spent LIBs, it is essential to evaluate the residual performance (capacity, charge-discharge efficiency, etc.) in advance. 4R Energy Corporation, a joint venture of Nissan Motor Co., Ltd. and Sumitomo Corporation, has technically established an EV-purpose LIB remanufacturing business by, since 2010, accumulating the know-how of residual performance evaluation using spent LIBs that were collected.

4. Future outlook

It is possible to shorten the processing time and improve the accuracy of residual performance evaluation of LIBs by monitoring the operation status of LIBs in use as well as after use, and utilizing the accumulated data. For example, Battery Management System (BMS) installed on EVs collects and monitors data associated with the operation status of LIBs (temperature, humidity, voltage and current, etc.), based on which, together with vehicle information, etc. obtained from on-board diagnosis (OBD) on vehicles, residual performance of LIBs in use can be predicted real-time. Such cases may need a company acting as a monitoring center that receives BMS and OBD data via telematics in cooperation with automobile manufacturers and others, manages the data in real time to predict remaining performance (Figure 5).

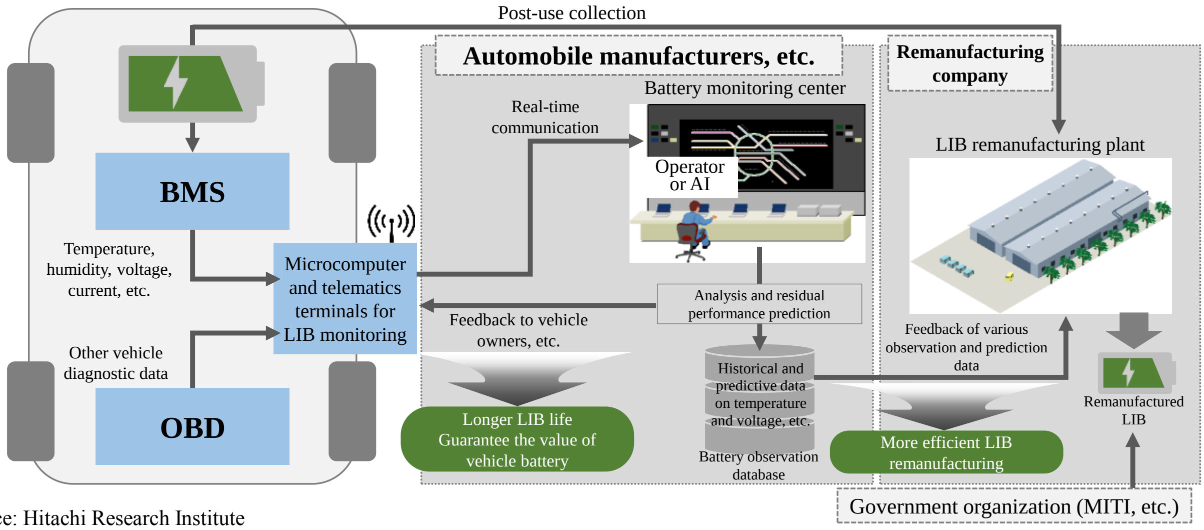
Certain companies may take an approach to overcoming resource constraints through extending the battery life and reusing spent batteries, while seeking an innovative battery technology for resource saving. This will accelerate the development of ancillary services using vehicle and battery operation data and other innovations, as well as the cooperation beyond the existing framework of industries.

Hitachi Research Institute will continue to monitor these trends and forecast the future of automotive batteries, EVs and related industries.



Source: Hitachi Research Institute

Figure 4: Image of reusing LIBs (reuse, remanufacturing, and recycling)



Source: Hitachi Research Institute

Figure 5: Image of monitoring and residual performance projection for improving the recycling efficiency of LIBs

[2] A battery pack is a package of multiple modules composed of multiple cells that are connected together with a sensor and a controller.