

Feasibility Study on Policies of Comprehensive Solutions for Recycling of Overseas Retired Batteries

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Abstract: Climate change is one of the grimmest challenges for the world. As the growth of Chinese new energy vehicle-marking industry, the exporting volume of Chinese NEV increasing correspondently. Accompanying with the exporting volume, the amount of retired NEV has been growing as well. As tightened global environmental protection policies, issues of battery recycling has attracted the attention from many countries especially from our exporting destination. For Chinese export enterprises, how to recycle and dispose of the batteries exported overseas, whether to recycle in local or return to China, the first step requires us to carry out policy research.

Keywords: NEV, Export, Battery recycling policies, Waste batteries, Transportation of overseas power batteries, Overseas disposal.

1. Introduction

Climate change is one of the grimmest challenges for the world (Y. Feng, 2022). Due to its wide-range of industrial chain and high carbon emissions, auto industry has become one of key industries under global carbon emission management. As an important means to cope with global climate change, new energy vehicles(NEV) have been widely concerned and vigorously promoted by countries around the world. As the world's largest producer of NEVs, China has seen its exports of NEVs are growing. In September 2022, China exported 50,000 NEVs. This year, the cumulative exported NEVs reached 389,000, with a year-on-year growth of more than twice. China's NEV export is entering the golden window period.

As increasingly many domestic NEV enterprises began to sell their NEVs abroad, the problem of how to recycle retired power batteries has also attracted the attention of many enterprises. This paper will focus on the export status of China's NEV enterprises and relevant overseas laws and regulations, analyze the difficulties of recycling overseas retired batteries at present, and propose research and judgment on the future development trend.

2. Current Condition of Export of New Energy Vehicles from China

Thanks to China's advantages in the R&D as well as the technology of NEVs and power batteries, a large number of new energy vehicles made in China have flooded into the world, showing a strong growth momentum, against the background of the increasing demand for NEVs worldwide and the acceleration of electrification.

Previously, Asia was the largest overseas market for China's NEVs. At present, due to the increasing environmental awareness of the people and the improvement of infrastructure such as charging piles in European countries, they have become a major growth market for NEVs and a region with the highest penetration rate of NEVs in the world. In view of this, China's NEV enterprises have rapidly made their way into the European market. Consequently, the European market rapidly surpassed the Asian market, occupying about 50% of China's NEV export share. The figure below is the regional map of China's NEV export from 2018 to 2021. From the perspective of export volume, the European market and Asian market are currently performing well, followed by the Americas.

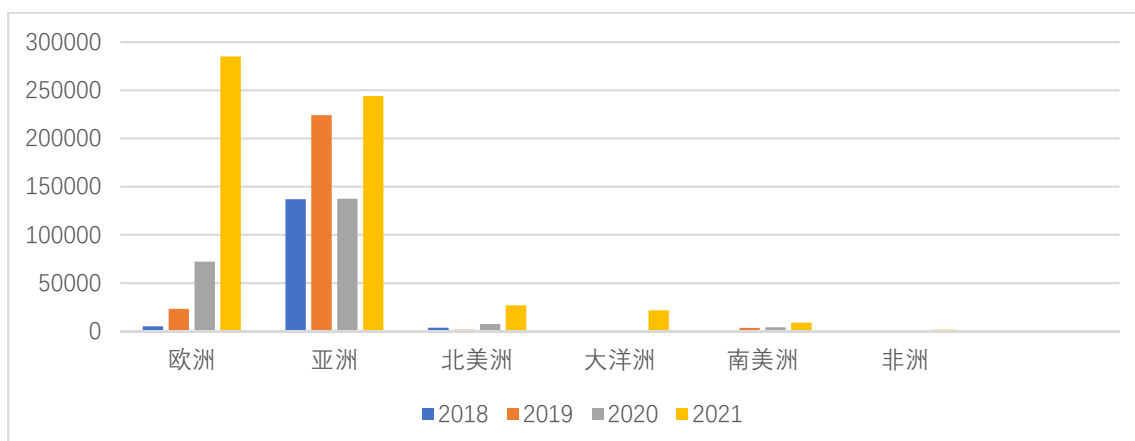


Fig. 1 Export of NEVs in China from 2018 to 2021

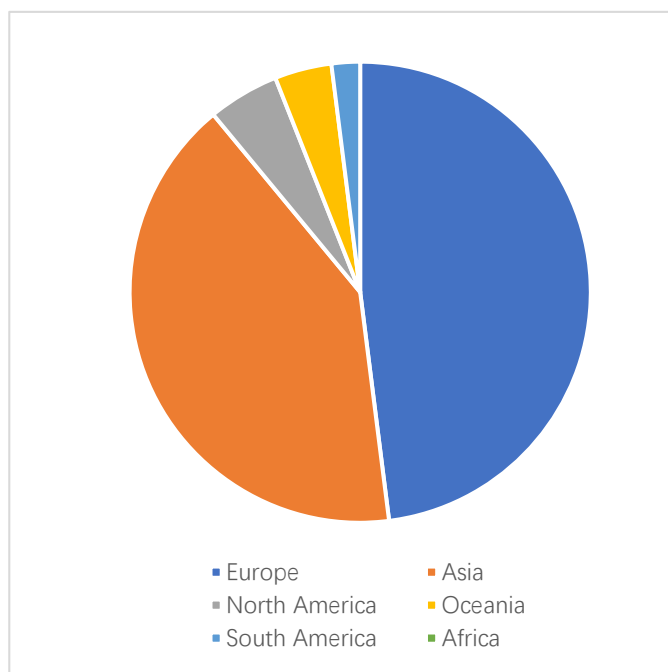


Figure 2. Export Proportion of NEVs in China in 2021
Data sources: China Automobile Dealers Association(CADA)

The export of new energy passenger vehicles can date back to December 2018 when BYD, a complete vehicle manufacturer that exports NEVs to overseas markets at an early time, exported 10pcs of Yuan EVs to Mexico. The landmark event of mass export is the debut of TangEV in Norway on May 7, 2020. As a country with the highest penetration rate of NEVs, which is over 70%, Norway has a mature market.

In addition, as a traditional automobile giant in China, SAIC's performance is also very impressive. On September 13, the largest batch of pure electric vehicles in China was

shipped in Shanghai and exported to the European market. There were 10,000 pure electric vehicles exported by SAIC to the global market, which is also the first "Chinese car" listed in more than 80 countries in the world.

In terms of the export of new domestic car-making enterprises, Xpeng Inc. delivered 100 G3 electric vehicles in Norway in December 2020, and entered the Swedish, Danish and Dutch markets this year. In September 2021, NIO officially launched the new model of ES8 to the Norwegian market, and planned to export to at least five European countries this year.

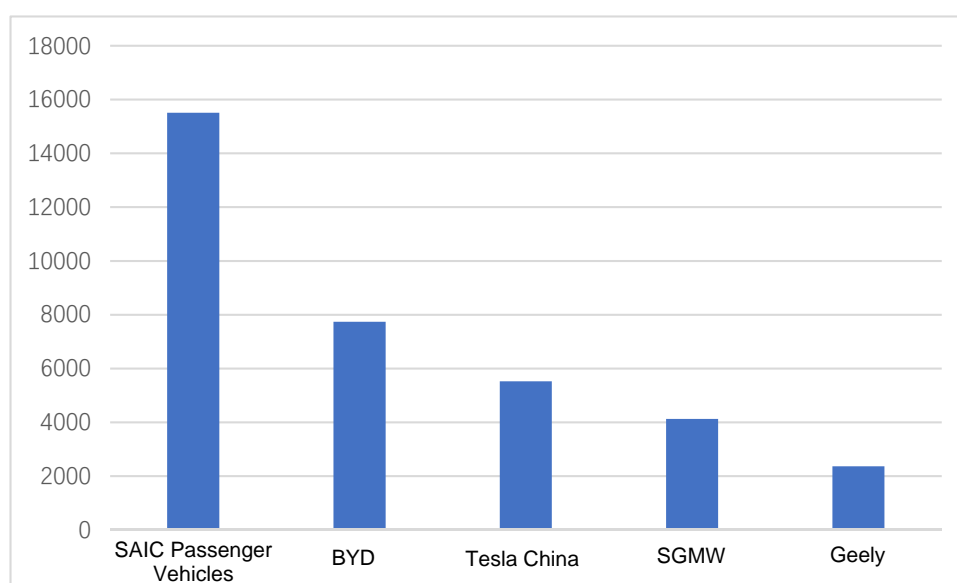


Figure 3. Top 5 New Energy Passenger Vehicles Exports in September 2022

Source: CPCA

For overseas markets, in addition to direct sales to individual users, BYD and NIO are also gradually working on

the rental market. Among them, BYD signed a cooperation agreement with the car rental company SIXT, which will

purchase at least 100,000 NEVs from BYD in the next six years. The first batch of thousands of BYD pure electric vehicles will be delivered in the fourth quarter of this year. In the first phase, the cooperative market includes Germany, Britain, France and the Netherlands.

At the NIO Berlin held on October 8, NIO announced that its products, whole system services and innovative business models will be launched in the German, Dutch, Swedish and Danish markets. In addition, NIO has signed a contract with LeasePlan, the largest car rental platform in Europe, to launch a subscription rental business.

3. Overseas Policies Analysis

3.1. Overseas power battery recycling policies

With the continuous development of NEVs, the number of retired power batteries is also increasing. The power batteries of the first batch of NEVs put into the market have been used for more than 10 years and are going to retire. It is estimated that after 2025, the number of retired batteries will exceed one million GWh. It is urgent to solve the problem of recycling retired power batteries from the perspective of environmental protection and the supply of front-end resources. After the power batteries of exported NEVs reach their service life, how to recycle them depends on many factors, including local recycling policies, modes and costs. It is necessary to study the relevant recycling policies of the main export regions of China's NEVs.

As an important region for China's NEV export, developed

countries such as the EU, Japan and the United States have conducted in-depth research and practice on the environmental hazards, recycling strategies, recycling processes and other aspects of waste batteries, and have formulated relevant laws and regulations to promote the collection and recycling of waste batteries. The following will focus on the analysis of recycling policies in these three regions.

3.1.1. European Union

In December 2020, the European Commission issued EC Proposal for a Regulation on batteries and waste batteries (the "New Battery Regulation"), which aims to replace the policy on waste battery treatment and recycling (2006/66/EC) issued in 2006, and regulate battery production, sales and recycling. The EU New Battery Regulation is the first policy system in the world to comprehensively regulate all aspects of the battery life cycle and make it laws.

The EU New Battery Regulation stipulates the whole process of power batteries from raw material acquisition, manufacturing, and use to recycling. For the recycling process of scrap batteries, the New Battery Regulation stipulates that battery manufacturers or importers, as the main body of the extension of producer responsibility, should organize the collection, transportation, recycling and disposal of waste batteries at their own expense. At the same time, the regulation also stipulates the minimum recycling target (as shown in Tables 2 and 3), and proposes that the EU will gradually improve the minimum recycling target with the progress of recycling technology.

Table 1. The Battery Recycling Target Specified in the EU New Battery

Timeline (After the implementation of the Regulation)	Minimum recovery ratio (by average weight)			
	Lead acid battery	Lithium battery	Nickel cadmium battery	Other waste batteries
3 years	75%	65%	85%	50%
8 years	80%	70%	Over 85%	70%

Table 2. The Material Recycling Target Specified in the EU New Battery Regulation

Timeline (After the implementation of the Regulation)	Minimum recycling ratio				
	Cobalt	Copper	Lead	Lithium	Nickel
4 years	90%	90%	90%	70%	90%
8 years	95%	95%	95%	90%	95%

Compared with the original Battery Directive of the EU, the New Battery Regulation specifies more battery types and imposes mandatory requirements on battery recycling, trying to drive the green and low-carbon transformation of the battery industry with stricter requirements.

3.1.2. Japan

Japan recycled waste batteries at an early time, and the relevant laws and regulations are relatively complete. Japan has not formulated special battery legislation, but in the field of environmental protection law, it has established a circular

economy legislation system of "basic law, comprehensive law and special law". Basic law, namely, the Basic Act on Establishing a Sound Material-Cycle Society; Comprehensive laws, including the Act on the Promotion of Effective Utilization of Resources and the Act on Waste Treatment and Public Cleanliness; Special laws, including Automobile Recycling Act, High Pressure Gas Safety Act, etc. Among them, comprehensive laws make relevant provisions on the recycling of waste batteries, which can be regarded as a special law of Japan.

Table 3. Japan's Macro Policies for Battery Recycling

Policies and regulations	Year	Description
The Basic Act on Establishing a Sound Material-Cycle Society	2000	It focuses on waste and strives to ensure the social material cycle, while curbing the consumption of natural resources and reducing the environmental load.
The Act on the Promotion of Effective Utilization of Resources	2001	The Act on Promoting the Effective Use of Renewable Resources was promulgated in 1991 and renamed in 2001. Mandatory recycling is adopted for small secondary batteries used by battery manufacturers and sales companies for resource recycling. It mainly collects rare metals (nickel, cobalt, lead, etc.).
The Act on Waste Treatment and Public Cleanliness	1971	It identifies waste classification, customs declaration, collection and disposal methods, and strengthens public awareness.
Automobile Recycling Act	2008	Among the items collected and recycled by the dismantling enterprises of electric vehicles and hybrid electric vehicles, the recycling of lithium batteries and nickel metal hydride batteries, as well as the recycling methods and storage methods are added. Enterprises that recycle and dismantle scrap vehicles have the obligation to dismantle batteries.
High Pressure Gas Safety Act	2019	In response to the popularity of hydrogen fuel cell electric vehicles and the progress of clean energy technology, the technical standards of compression hydrogen refueling stations are reviewed in the project of identifying safety problems of reviewing relevant regulations of fuel cell electric vehicles.
Battery Industry Strategy	2022	It is proposed to establish a domestic manufacturing base of 150 GWh/a by 2030, with a global production capacity of 600 GWh/a.

For Japan's recycling mode, Japan established a complete reverse logistics battery recycling system of "battery production - sales - recycling - regeneration" in 1994. Battery manufacturers independently formulate the recycling plan of power batteries, and vehicle manufacturers play an important role in the recycling of waste batteries. Retailers, auto dealers and gas stations can recycle waste batteries from consumers for free, and decompose them through professional recycling companies.

government mainly manages the batteries by formulating environmental protection laws and regulations, which are implemented through market supervision and management. Specifically, a complete set of battery recycling management legal system has been formed mainly from three levels of federal, state and local legislation. Its legislation is mainly aimed at nickel cadmium batteries, small sealed lead-acid batteries, mercury containing batteries and all other types of batteries.

3.1.3. The United States

For the recycling of waste batteries, the United States

Table 4. Macro Policies for Battery Recycling in the United States

Policies and regulations	Year	Description
Resource Conservation and Recovery Act	1976	Scrap nickel cadmium, lead acid, silver oxide and mercury containing batteries are hazardous wastes, while lithium-ion batteries are potentially hazardous wastes. Lead acid battery and other hazardous wastes shall be tracked in the whole life cycle from cradle to grave, and the whole process should be recorded in the form of documents. An enterprise must apply for a license to recycle, store, transport and treat hazardous wastes. The government controls the operation process of relevant enterprises through licenses, and requires them to gradually remove the previous pollution.
US Public Law 104-142	1996	It mainly regulates the production, collection, transportation and storage of waste nickel cadmium batteries, waste sealed lead acid batteries and other waste rechargeable batteries. Batteries sold in the United States have a unified logo to remind consumers to assist in battery recycling.
Clean Air Act	2013	Lead is listed as one of the six standard pollutants for evaluating air pollution, and a series of standards are provided to control and manage lead emissions.
General Waste Management Measures Management Law on the Marking and Transportation of Waste Nickel Cadmium Batteries		It is proposed to establish a unified battery identification standard and regulatory signs to promote the later recycling work.
New York Recycling Act California Rechargeable Battery Recycling and Reuse Act		It is mandatory that retailers of rechargeable batteries should recycle waste rechargeable batteries generated by consumers free of charge.
National Blueprint of Lithium Battery	2021	Five key objectives and key actions are listed to guide the cooperation of federal agencies to ensure the long-term economic competitiveness of the United States.

For the recycling model in the United States, based on the extension of producer responsibility and the deposit system,

the government has promoted the establishment of a battery recycling network, adopted the method of additional

environmental fees, collected a certain amount of handling fees when consumers purchase batteries and a part of the recycling fees from battery manufacturers as financial support to promote the recycling, utilization and disassembly of waste batteries, meanwhile, waste battery recycling enterprises can sell purified renewable raw materials to battery manufacturers at an agreed price, completing the closed-loop of the recycling industry.

Through reviewing the relevant policy systems of battery recycling in the EU, Japan and the United States and introducing the recycling mode, Chinese new energy automobile enterprises face strict policy and institutional requirements for recycling waste battery overseas. How to respond to the policy provisions at all levels and implement the extended producer responsibility system are important issues that enterprises need to pay attention to.

3.2. Cross-border transportation of overseas power batteries Policies

In addition to the direct recycling of retired batteries in overseas markets, new energy automobile enterprises can also choose to import retired batteries to China for further recycling. The policy of cross-border transportation of waste batteries has become one of the criteria for the feasibility of this scheme.

3.2.1. European Union

On November 17, 2017, the European Commission adopted a proposal on new regulations on waste transport to promote innovative and sustainable waste management in line with the European Green Deal. According to the requirements of the New European Waste Transport Regulation Proposal and the New Battery Regulation, waste batteries can be transported to countries outside the EU member states for recycling, provided that the transportation is allowed in receiving countries, the subsequent non-toxic treatment of the imported waste batteries can be proved, and the transportation meets the relevant safety requirements.

3.2.2. Japan

The OECD (Organization for Economic Co-operation and Development, OECD) issued the Council Decision C (2001) 107/FINAL on Control the Cross-border Transportation of Wastes, which regulates and restricts the conditions for waste cross-border transportation between member countries and non-member countries on the basis of the Basel Convention. As a member of OECD and a party to the Basel Convention, Japan is not allowed to export wastes (including waste batteries) to countries (especially developing countries) that fail to handle wastes.

3.2.3. The United States

As a member of OECD, the United States needs to comply with the requirements of the Control of Cross-border Transportation of Wastes. In principle, the cross-border transportation of hazardous wastes including waste batteries is not allowed. However, if it can be proved that the purpose of exporting wastes is to recycle them locally in the importing country, and the written approval of the environmental authorities of the importing country is obtained, the export of wastes in the United States is allowed.

It can be seen that the EU, Japan and the United States have not completely closed the door to cross-border transportation of retired batteries, which also gives the green light for the first journey of retired batteries back home.

4. Difficulties and Current Rules in Power Battery Recycling

First of all, the management systems and standards for the full life cycle of power batteries are weak in foreign countries. For China, since 2016, policies related to the recycling of power batteries have been intensively introduced, forming a management system framework covering the whole process including battery manufacturers, automobile manufacturers, recycling and dismantling enterprises, echelon utilization enterprises as well as regenerating and use enterprises. For overseas countries, although they have formulated a policy system on battery recycling requirements, the division of responsibilities and industry standards for affiliated enterprises are unclear, which does not provide sufficient guidance for Chinese vehicle enterprises that have just set foot in the overseas recycling industry, and the development prospects are obscure.

In addition, the main limitation for new energy vehicle enterprises engaging in battery recycling is the high cost of overseas disposal. For exporting vehicle enterprises, retired batteries mainly come from the scrapped amount of their own power batteries. Chinese vehicle enterprises whose NEV exports are on the rise, they will see higher recovery and disposal costs due to the unformed scale benefit.

China's import policy is the main limitation for the plan of returning the retired batteries to China. Since the country has adopted increasingly strict control on waste management, the import of waste power batteries is prohibited. Especially in July 2017, after the State Council issued the 2018-2020 Action Plan for Implementation of the Reform Plan to Ban Waste Imports, China has basically eliminated the import of waste materials by the end of 2020. In addition, the Notice on Adjusting the Catalogue of Imported Wastes Management and the Opinions on Strengthening Eco-environmental Protection and Pollution Prevention and Control issued in 2018 have hindered the import of retired power batteries.

However, the Ministry of Industry and Information Technology implemented the standard document of Crude Nickel Cobalt Hydroxide (YS-T 1460-2021) on April 1, 2022, which put forward the crude nickel cobalt oxide products obtained from the lithium-ion battery waste containing nickel and cobalt elements through wet enrichment processes such as pretreatment, leaching, impurity removal and precipitation can be legally imported from overseas in order to alleviate the tension among China's economic development, resource constraints and environmental protection, regulate the production of the waste battery recycling industry and promote high-quality economic development, while cracking down on the import of solid wastes and exploring the source of strategic resource imports. The standard has opened up a path for the import of valuable resources from retired power batteries.

5. Summary

Based on the feasible exports of waste batteries from Europe, Japan and the United States, it is currently a more feasible scheme to select countries that can accept the import of retired batteries as intermediate countries, and to dispose of the retired batteries to crude nickel cobalt oxide that meets the standards, and then import them into China. Take South Korea for example, South Korea allows qualified retired batteries to be imported into the country for recycling and

processing. According to data, most of Japan's waste batteries and waste raw materials are exported to South Korea for recycling. Therefore, South Korea or countries in Southeast Asia with low recycling and disposal costs can be considered as intermediate countries to facilitate the return of overseas retired batteries.

In addition to the return of retired batteries with different steps, the direct return path can also be studied in the future. Consistent with the traceability management of domestic NEVs, it is important to reduce the cost of recycling and disposing of overseas retired batteries to carry out mandatory traceability management on export vehicles, evaluate them after they reach the end-of-life, formulate relevant import standards, and allow qualified retired batteries to return to China for recycling.

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References

- [1] China Automobile Dealers Association(CADA), Export of NEVs in China from 2018 to 2021.
- [2] China Automobile Dealers Association(CADA), Export Proportion of NEVs in China in 2021 .
- [3] FENG Yi, ZHANG Peng, et al. Low-carbon development strategy and transformation path for carbon neutral automobile industry, 2022, 1(1): 1-13.
- [4] LIN Xiao, DENG Yi, et al. Blue Book on the Recycling of Spent Power Lithium-ion Batteries, 2022, 5: 145-171.
- [5] People's Republic of China Non-Ferrous Metal Industry Standard: Crude Nickel Cobalt Hydroxide (YS-T 1460-2021) , 2022, 1-15.