

# Toward the Creation of the Asian xEV Battery Recycling Zone

So Sasaki<sup>1\*</sup>, Yoshiaki Ishimoto<sup>2</sup>, Hiromitsu Takagi<sup>3</sup>

1: Chuo University, 742-1 Higashinakano, Hachioji-shi, Tokyo 192-0393, Japan

2: Toyota Daihatsu Engineering & Manufacturing Co., Ltd., 99 Moo 5, Ban-Ragad, Bang-Bo, Samutprakan 10560, Thailand.

3: Waste Management Siam Ltd., 25th Floor, Central City Tower 1 Building, 589/142 Debaratana Road, Kwang North Bangna, Khet Bangna, Bangkok 10260, Thailand

\*corresponding author: so-s@tamacc.chuo-u.ac.jp

**Keywords:** hybrid electric vehicle, Nickel-Metal Hydride batteries, and Lithium-Ion Battery, and used vehicles

## INTRODUCTION

Even prior to Covid-19, the automobile industry with advancements such as connected, autonomous, shared & services, electric (CASE) and Mobility as a Service (Maas) was believed to be responsible for ushering in “an era of revolution” that only occurred once in 100 years. This trend is further enhanced by revised automobile industry policies that focus on a green recovery post-pandemic. Under the green recovery program, it has been announced that new vehicles with an internal combustion engine (ICE) will be banned from sales in addition to other measures to promote the electric motor vehicle in many countries. The electric motor vehicle is commonly referred to as a hybrid electric vehicle (HEV), a plug-in hybrid electric vehicle (PHEV), an electric vehicle (EV), and a fuel cell electric vehicle (FCEV). In this presentation, it is referred to as xEV.

The core technologies of xEV are “batteries,” especially Nickel-Metal Hydride (NiMH) batteries and Lithium-Ion Battery (LIB). In the European Union (EU), which is leading the green recovery efforts, a strategic supply chain is being built in collaboration with the circular economy (CE). The European Battery Alliance (EBA) aims to strengthen the competitiveness of local industries. At the end of 2020, the European Commission (EC) announced a draft that would be a major revision of battery regulations, as a measure to strengthen existing collection obligations for EV and automobile storage batteries, however, the collection will be free and without an obligation on the end-user to buy a new battery (EC, 2020).

A few similar strategies also exist in Asian countries. In this presentation, we will summarize the current situation of the reuse and recycling of NiMH batteries and LIB, focusing on advanced cases in Thailand.

## Flow analysis of Used xEV exports

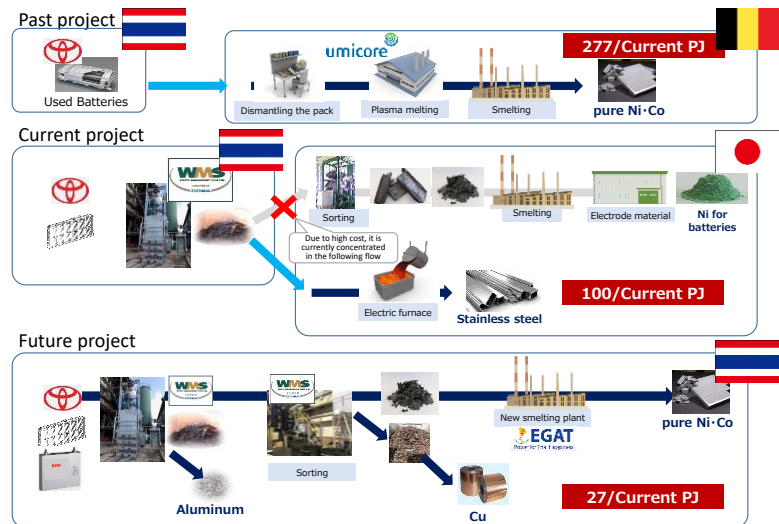
The global demand for LIB recycling market was valued at USD 1,928.6 million in 2019 with the Asia-Pacific region having the highest geographic share (% Revenue Basis) of 38.1% (Value Market Research, 2020). There is little reference to used xEV exports in these forecasts.

The United Nations Environment Programme (UNEP) reported that 146 countries imported used vehicles, and called for action to regulate trade through the adoption of a set of harmonized minimum quality standards (UNEP, 2020). The total number of used HEVs worldwide in 2018 was about 170,000, with > 90% of them being exported from Japan. Mongolia is the largest importer of Japanese used HEVs. Therefore, there will be a huge amount of End-of-Life HEV as well as NiMH batteries generated in Mongolia from now on, even more than in Japan, which is the largest HEV market (Wang, S. and Yu, J. et al., 2019). In contrast, in 2019, the countries in EU exported 8,470 used HEV, of which 6,935 (81.9%) were within the EU and 1,535 (18.1%)

were outside the EU. Hence, it can be said majority of used HEVs circulate within the EU. Therefore, although Asia is the largest in terms of production and generation forecasts, it is expected that battery collection associated with used xEV exports will become an issue in resource recycling in Asian countries.

### Advanced case study of xEV battery recycling in Thailand

Under these circumstances, Toyota Motor



**Figure 1 xEV battery recycling in Thailand**

Thailand and Waste Management Siam under DOWA ECO-SYSTEM have been primarily processing NiMH batteries in Thailand since 2019, and then exporting to Japan for smelting and using as recycled materials for new batteries (Figure 1).

When this amount of CO<sub>2</sub> emissions generated in current project is counted as 100, the past project which collected NiMH batteries in Thailand and shipped to Belgium for recycling generated about 277 more CO<sub>2</sub> emissions. It is estimated that CO<sub>2</sub> emissions can be suppressed up to 27, if collected from neighboring countries making integrated recycling including the process of smelting in Thailand a possibility in the future.

### CONCLUSION

In Asian countries where there is no strategic resource circulation between nations, battery resource circulation would be the main issue in the promotion of xEVs in the near future. Establishment of an Asian Battery Alliance similar to EBA, measures to mitigate cross-border movement of battery recycling resources, and manufacturer-led cross-border extended producer responsibility (EPR) to collect batteries from exported used xEV, will be crucial steps in achieving xEVs targets. On the academic front, statistics on scrapped cars have not yet been developed in many Asian countries, and it is necessary to estimate the material flow analysis with used car trade.

### ACKNOWLEDGEMENT

This presentation is part of a Grant-in-Aid for Scientific Research(B) 19H01385 and the Grant-in-Aid for Young Researchers (A)17H04722 funded by the Japan Society for the Promotion of Science (JSPS).

### NOTICE

The views and opinions expressed herein are those of the author and do not necessarily reflect the views of their institution.

### REFERENCES

- European Commission (EC), Proposal for a Regulation of the European Parliament and of the Council concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020, 2020.
- Wang, S., Yu, J., and Okubo, K., Scenario Analysis on the Generation of End-of-Life Hybrid Vehicle in Developing Countries—Focusing on the Exported Secondhand Hybrid Vehicle from Japan to Mongolia, Recycling, 4(4), 41, 2019.
- United Nations Environment Programme (UNEP), Global Trade in Used Vehicles Report, 2020.
- Value Market Research, Lithium-Ion Battery Recycling - Global Market Research Report (2019–2026), 2020.