ENVIRONMENTAL IMPACT AND FLOWS OF WASTE BATTERIES IN CHINA

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Introduction

- China is the world's largest producer and consumer of dry cell batteries: about 7 to 8 billion batteries per year.
- Battery recycling rate is less than 2%.
- Most of China's waste batteries are not managed as hazardous waste

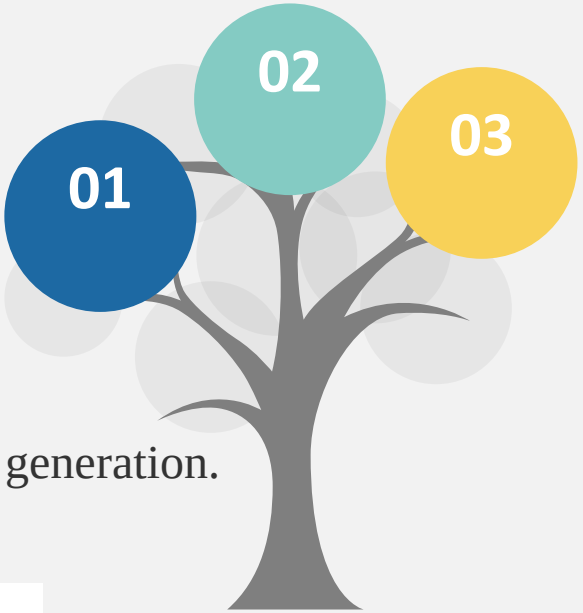
The **purpose** of this study is to analyse environmental impact of waste batteries and evaluate their generation and flows in China in order to cope with the environmental challenges brought by waste batteries and promote the sustainable use of resources.

Materials and Methods

1. Assessment of batteries quantity placed on the market

$$POM(t) = P(t) + I(t) - E(t)$$

2. Estimation of the average lifespan of batteries



3. Calculation of waste batteries generation. A Weibull lifetime distribution

$$\left(\frac{T_{average}}{T_{max}}\right)^{\beta} = \frac{\beta - 1}{-\beta \cdot ln 0.01} \cdots$$

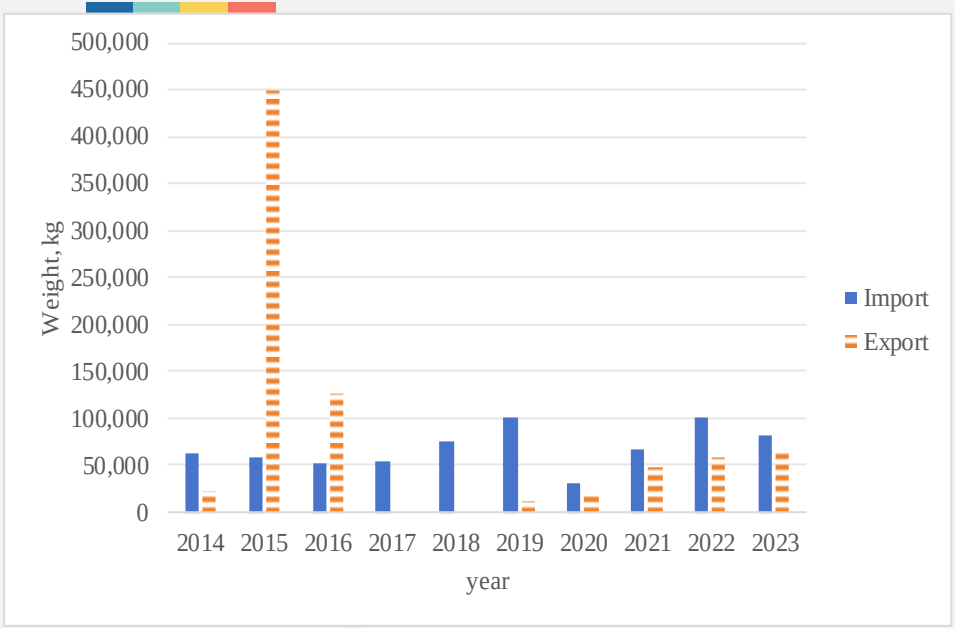
Results and Discussion

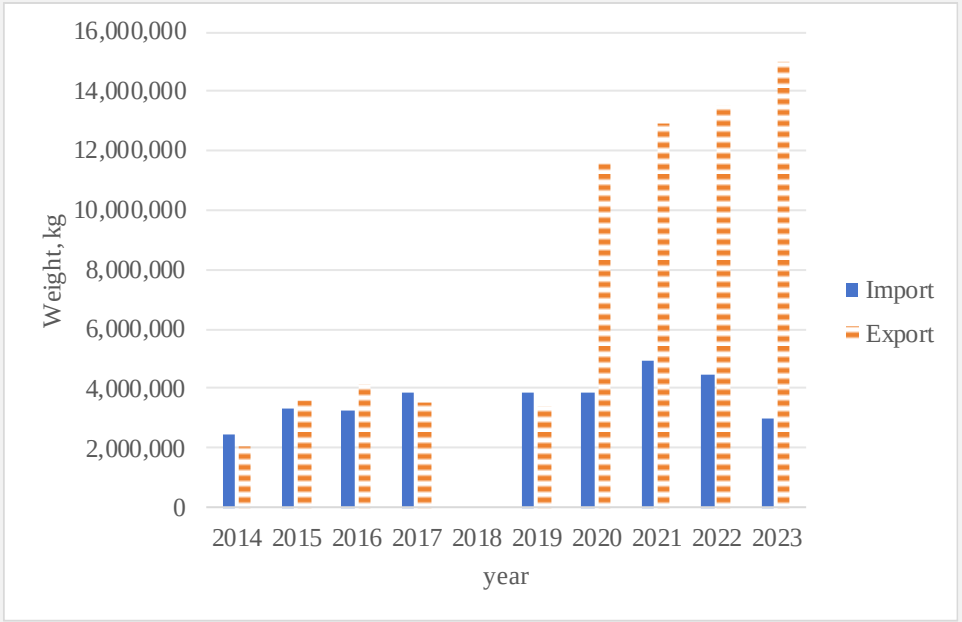
Environmental impact of waste batteries

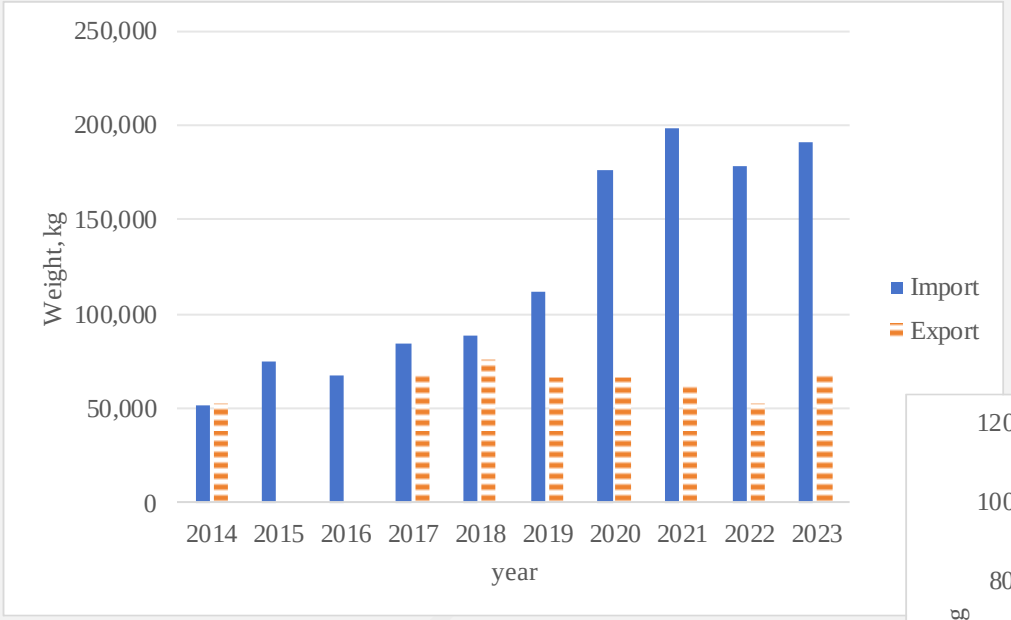
Heavy metals:

- Cadmium
- Lead
- Arsenic
- Nickel

Assessment of batteries quantity placed on the market



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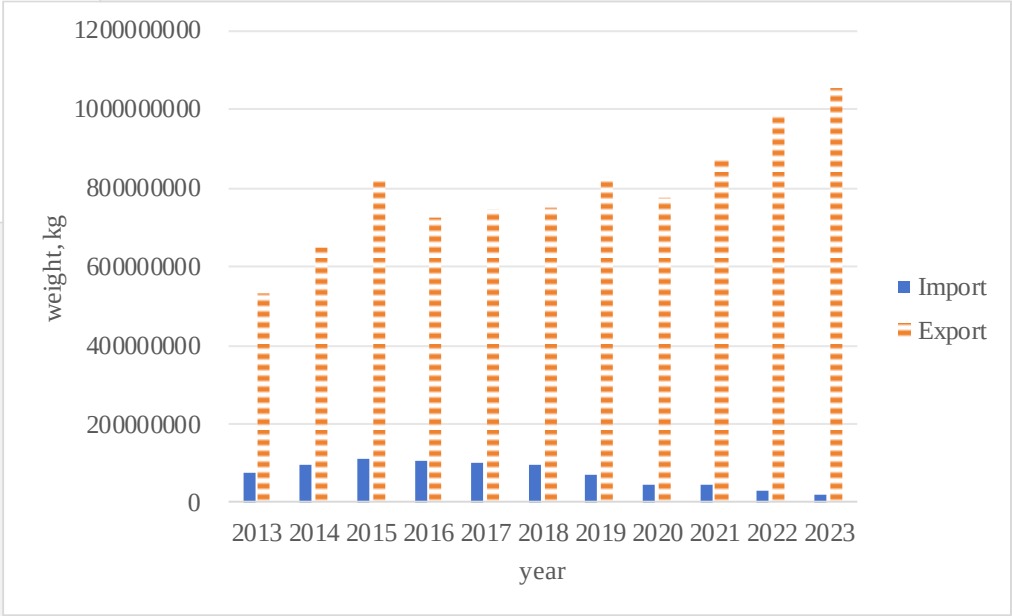
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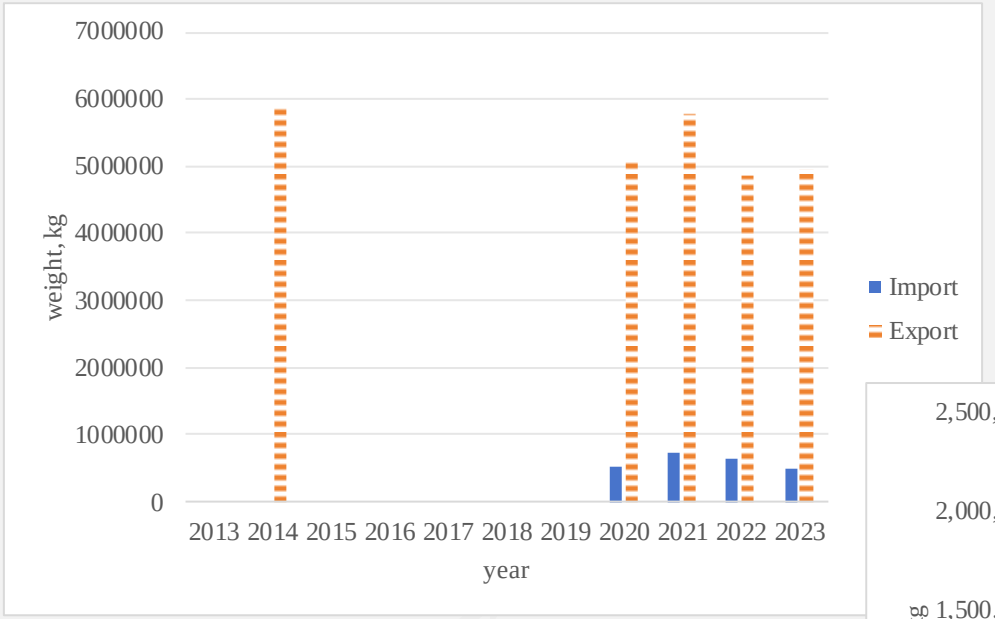
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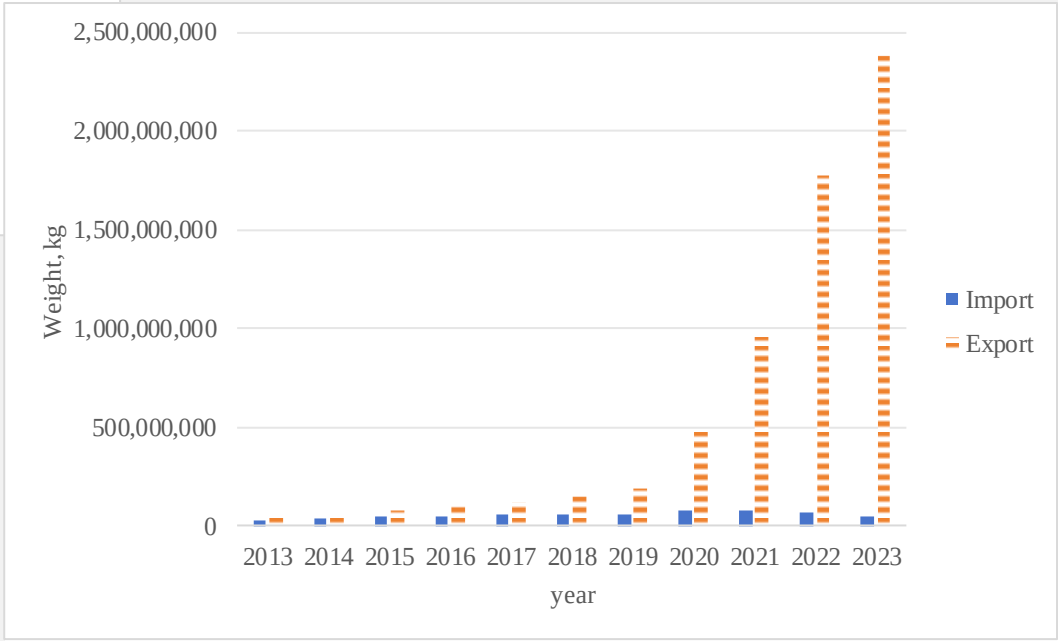
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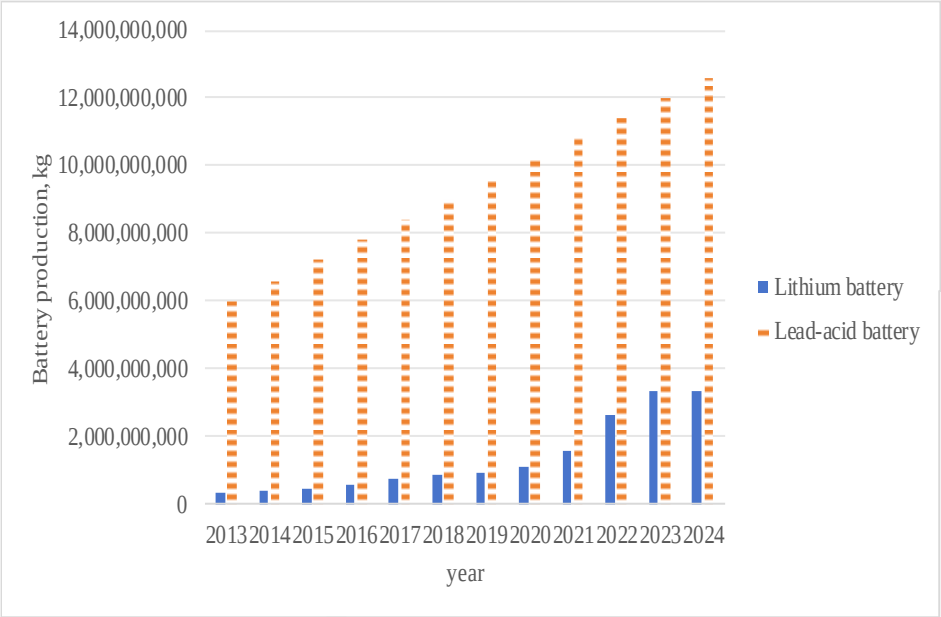
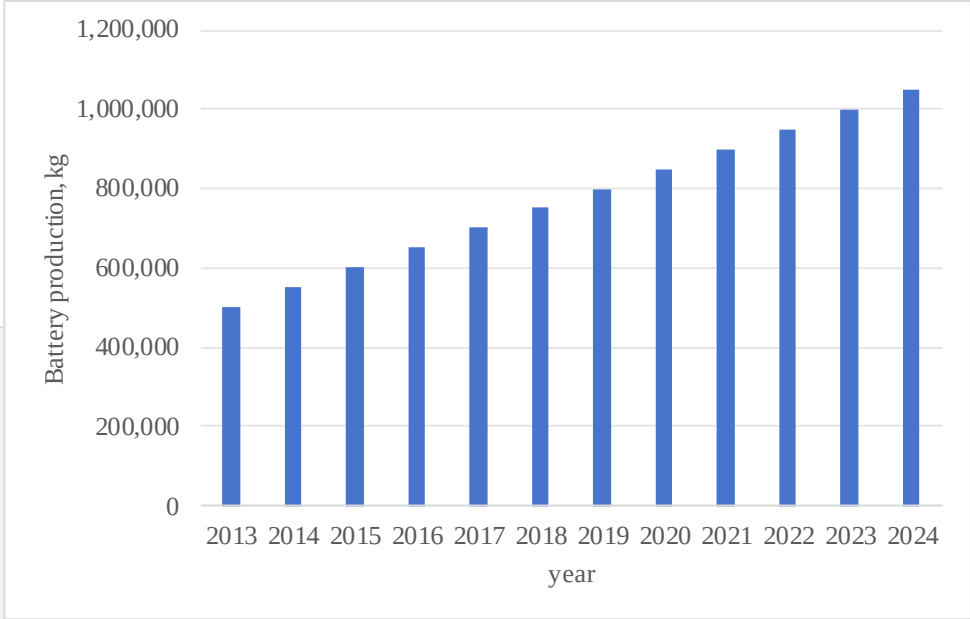
Production of batteries in China





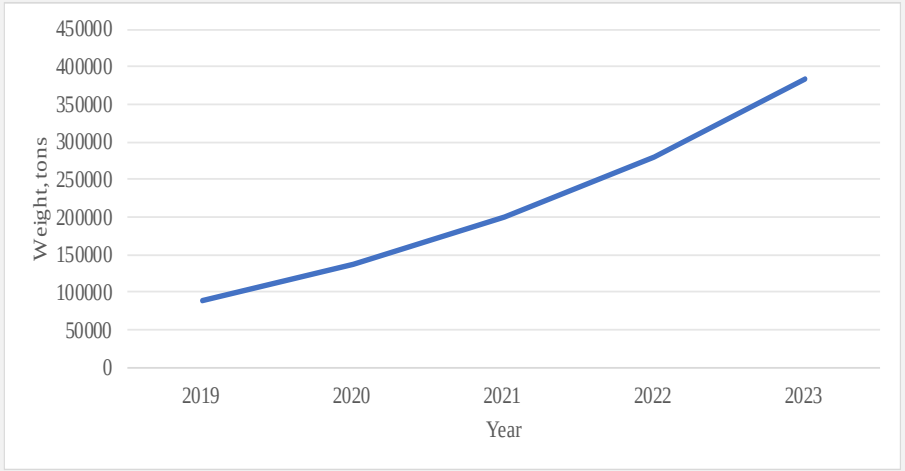
Batteries placed on the market in China

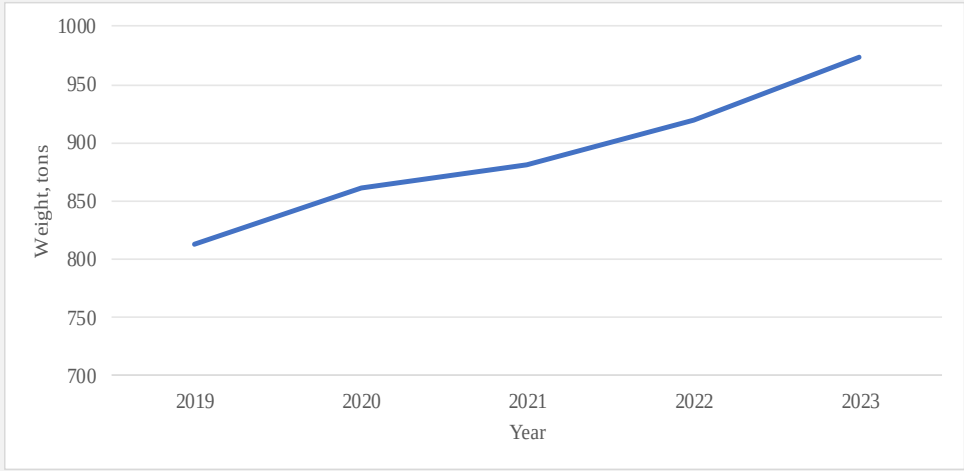
The life of lead-acid batteries is relatively short, with a typical charge and discharge cycle of 300–500 times and a service life of about 2 years. The self-discharge rate of silver oxide batteries is relatively low, about 5–10% per year. The lifetime of such battery is usually 1.5–2 years. In this study, we use 2 years lifespan for lead-acid batteries.

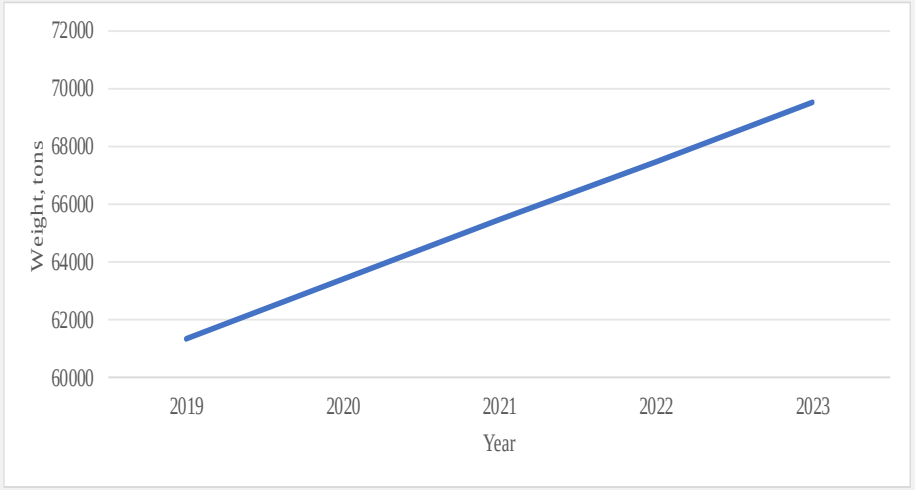
Silver oxide battery has an average lifespan around 2–3 years (Karpinski et al., 2000). In this study, we use 2 years lifespan for lithium batteries.

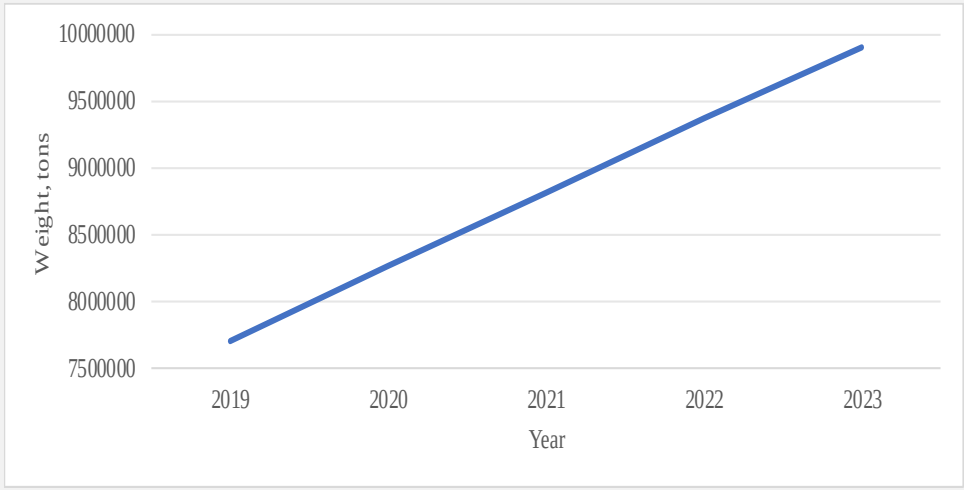
Zinc-air battery has very short lifetime – up to 1 year (Sherman, 2019). In this study, we use 1 year lifespan for zinc-air batteries.

Calculation of waste batteries generation









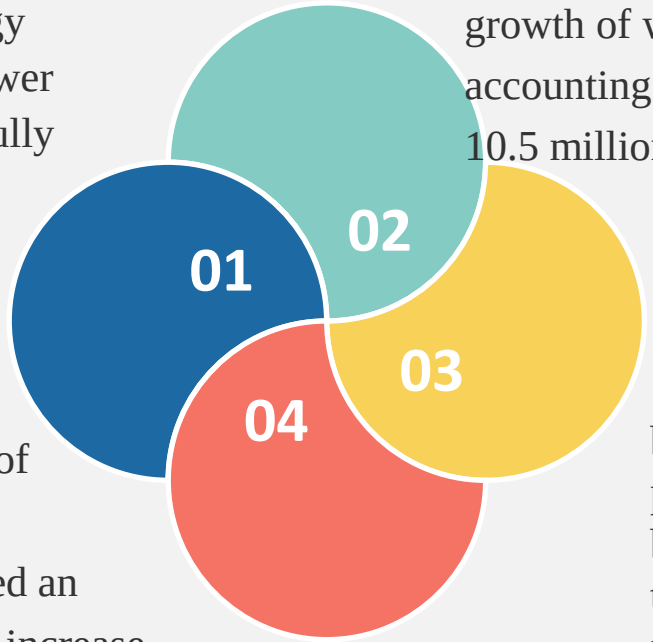
Conclusions

Trends in China's battery production

The development focus of China's battery industry is on new high-energy batteries such as nickel-hydrogen power batteries, lithium-ion batteries, and fully sealed maintenance-free lead-acid batteries.

Battery circulation analysis

From 2014 to 2023, China's imports of primary batteries generally showed a downward trend, while exports showed an upward trend, especially a significant increase in net export weight.



Waste lithium batteries and lead-acid batteries are the main contributors to the growth of waste battery production, accounting for 99% of China's approximately 10.5 million tons of waste battery production

With the advancement of battery technology and the promotion of policies, China's battery industry is moving towards mercury-free, cadmium-free and high-efficiency development.

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