Lithium-ion Battery Recycling Market & Technology Trends 2020

Market and Technology Report 2020
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COMPANIES CITED IN THIS REPORT


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• Provide the market value (in $million) of raw materials and market size (in tons/year) for rechargeable lithium-ion (Li-ion) batteries recycling use for consumer goods, e-mobility, stationary storage, and other applications.

• Demonstrate the strong, consistently-growing business potential for Li-ion battery recyclers and players involved in Li-ion batteries’ second-life applications.

• Provide the Li-ion battery recycling supply chain landscape, including the key players for battery cells, battery packs, Li-ion battery recycling, and associated business models.

• Discuss market opportunities for players that can pack and transport the end-of-life batteries.

• Provide insight into different Li-ion cell technologies, related technology trends and their impact on battery recycling market.

• Analyze different Li-ion battery recycling technologies.
• Li-ion batteries find many applications in
  • Smart consumer electronics (mobile phones, smart watch, tablets, laptops…)
  • Clean and local energy generation (PV, wind) and their integration with the electricity grid,
  • Electricity grid stabilization and energy back-up for industrial and home applications,
  • Electric mobility (electric and hybrid electric vehicles, electric trucks and buses) as well as in related charging infrastructure.
  • New applications like cordless power tools, drones…

• Li-ion batteries in electric vehicles become an integral part of “Internet of Energy” concept with optimized generation/distribution/storage and consumption of electricity.

Application trends of Li-ion batteries applications
Source: Yole Développement
Rise of Li-ion batteries could leave us with a big battery waste problem.
LI-ION BATTERY MARKET VOLUME IS GROWING
…and the demand for recycling too!

Growing EV/HEV market will result in a huge volume of batteries to be recycled.

High manufacturing volumes (units) and growing share of Li-ion batteries + Growing battery energy capacity per end application = Growing volume of batteries to be recycled.
As EV market is new, most of the EV batteries are still enjoying their first life. Therefore, there is a time delay of a few years before battery demand and demand for battery recycling. Better opportunities for battery recycling companies are coming due to EV batteries. 

Volume of produced batteries

Historical market for LIB for consumer applications, production scrap, etc.

Volume of batteries to be recycled

Timeline

5-8 years

We are here: huge battery market (consumer, EV…) but still relatively low demand for recycling
SUPPLY CHAIN ANALYSIS

LI-ION BATTERY RECYCLING COMPANIES – GEOGRAPHIC OVERVIEW

RECYCLING COMPANIES AND THEIR LI-ION BATTERIES' RECYCLING CAPACITY

BATTERY RECYCLING SUPPLY CHAIN MOVEMENT

SECOND-LIFE BATTERY PROJECTS
LI-ION BATTERY - GENERAL RECYCLING PROCESS

All process steps shown are rarely realized by just one company

Collection and transportation of end-of-life batteries and battery waste

Primary sorting of batteries (i.e. alkaline battery, NiCd, NiMH, Li-ion)

Large battery-pack neutralization and dismantling

Removing the combustible material (plastics and insulation) with a gas-fired thermal oxidizer, leaving clean cell

Crushing, solvent removal, and mechanical separation

Chemical separation & refining

Here is the strongest know-how related to battery recycling

Raw materials

→ Sold to battery cell makers

→ Used internally for electrode manufacturing (integrated company)

Good cells and materials (cable, connectors, casing, cooling plates and liquids, etc.) can be re-used in second-life batteries

Some substances are burned off, leaving a black mass on top that a slag arm removes

- Manual process realized by trained operators

Same for recycling and second-life batteries

Simplified schematic of the Li-ion battery recycling process, also showing synergies with second-life batteries

source: Yole Développement

The actual process may vary depending on cell chemistry and the chemical separation process used

source: Yole Développement

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TECHNOLOGY TRENDS

RECYCLING OF ELECTRIC VEHICLE’S BATTERIES - CHALLENGES

- Recycling the inactive battery from an EV (electric vehicle) is a challenging task.
- Transportation of EV batteries:
  - from EVs to recycling plants
  - from recycling plants to secondary users
- Lithium-ion battery recycling: a complex and expensive process.

Disassembly

- Electric vehicle battery packs are assembled into different cells, thus making it difficult to develop standard recycling methods.
- Different battery packs possess very different physical configurations, requiring different approaches for disassembly.
- The purpose of disassembly is to develop automated disassembly processes.

Recycling process

- Lithium-ion batteries are a source of potential energy, making it difficult to recycle them.
- Recyclers must develop standard recycling methods.

WHICH CHEMICAL PROCESS IS THE BEST FOR RECYCLING?

Pyrometallurgical process or hydrometallurgical process?

- Pyrometallurgical process is not sufficient to get pure metals from the mixture of end-of-life batteries.
- Both the processes have their advantages and disadvantages.

A combined pyro-hydrometallurgical process may be preferable due to two reasons:
- Pyro treatment avoids the disadvantages of scaling issues linked to the different scales of pyrometallurgical processes and their lower output.
- Pyro treatment can be used for the separation and the treatment of the different materials present in the slag received after pyro treatment to get pure metals.

LI-ION BATTERIES RECYCLING - TRANSPORTATION OF BATTERIES

- Transportation of the end-of-life batteries from their last user to the collection site.
- Transportation of the collection site batteries from the collection sites to the battery recycling plants.
- Transportation of recovered materials from the battery recycling plants to the material users (phosphate plants/battery manufacturers).

- Transportation mode for each of the transportation segment (depends on the weight, distance...):
  - medium-duty truck, heavy-duty truck, ship...

BATTERY PACK DISASSEMBLY/ DISMANTLING METHODS - TECHNICAL TREND

- Battery packs assembly is an optimized and efficient process. However, these battery packs are not easy to disassemble.
- Battery packs are not designed for easy dismantling. There are strict standards for design and production methods.
- Automated dismantling methods can have many benefits. However, the battery manufacturers should be identified to battery pack design and easy to form equipment.
- Dismantling of battery packs is done primarily today.
- There is a need for the help of dismantling robots and robotic systems (semi-automated). Fully automated dismantling is not yet possible in the current years.

SECOND-LIFE APPLICATIONS - TREND

- Second-life batteries represent an additional added value for end-of-life EV/HEV batteries.
- As the number of EVs increases, the second-life applications are becoming more and more. More and more EVs should go for second-life applications instead of being recycled.
- However, currently, the number of EVs is marginal, and most of them are not reached end-of-life. Therefore, the question about the real trend of second-life applications is still pending and will only unfold when their producers through the actual practice of recycling and second-life applications of EV batteries.
YOLE GROUP RELATED REPORTS

Yole Développement

Status of Rechargeable Li-ion Battery Industry 2019

Power Electronics for Electric & Hybrid Electric Vehicles 2020

Li-ion Battery Packs for Automotive and Stationary Storage Applications 2020
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