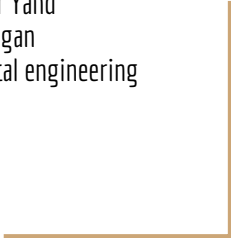


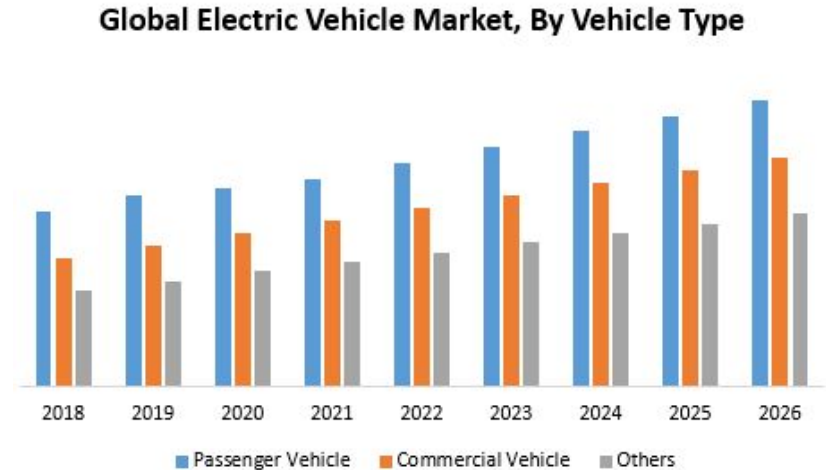
Hydrometallurgy Recycling of Lithium Batteries

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Growth of Electric Vehicles & Lithium Batteries

- The number of electric vehicles used worldwide in 2020 is over 10 million.
- Lithium-ion batteries (LIBs) are the foundation technology of EVs
- Lithium-ion batteries have a lifetime expectation of 15-20 years

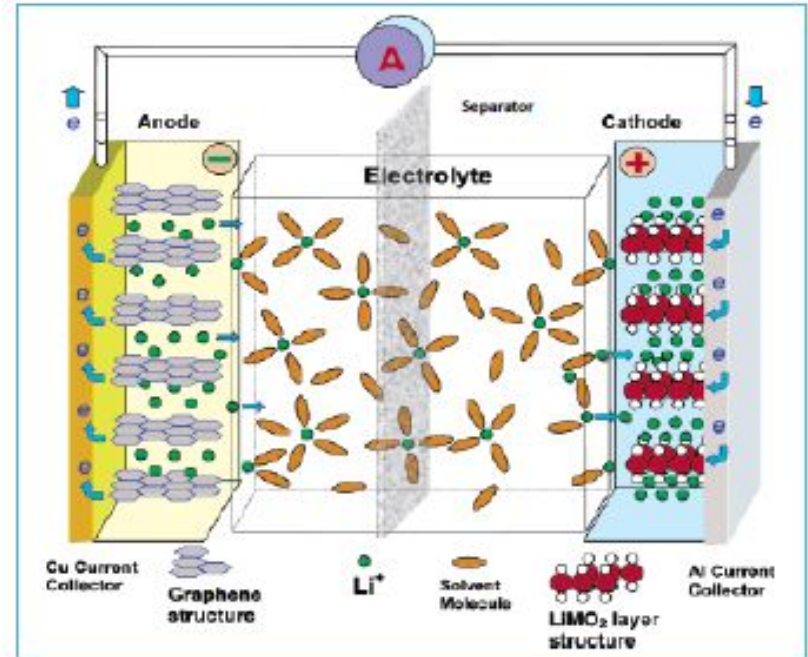


Lithium-ion Batteries

- A lithium-ion battery is a type of rechargeable battery.
- Lithium-ion batteries have a positive and negative electrodes and electrolyte

The 2 main Li types are LFP & LNCM

- LFP: Lithium Iron Phosphate
- LNCM: Lithium Nickel Cobalt Manganese



Lithium-ion Battery Waste

lithium-ion battery can produce 250,000 tones and half a million cubic meters of waste

Effect of not recycling lithium-ion battery:

- Air contamination
- Water contamination
- Soil contamination



Different Electric Vehicle types, includes Hybrids!



BEV

BATTERY ELECTRIC
VEHICLE



EREV

EXTENDED RANGE
ELECTRIC VEHICLE



PHEV

PLUG-IN HYBRID
ELECTRIC VEHICLE

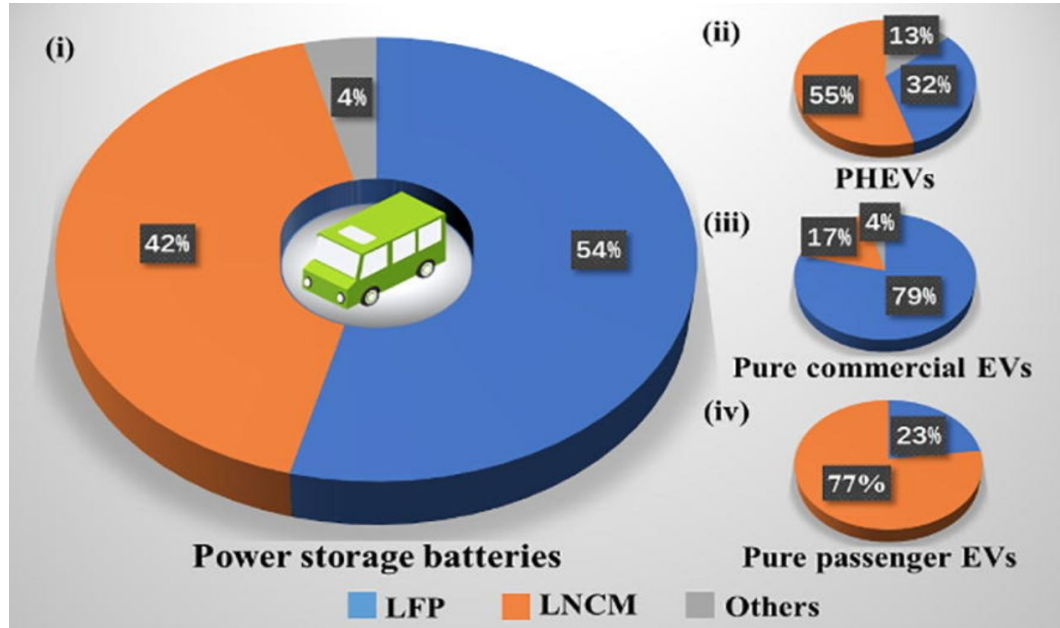


HEV

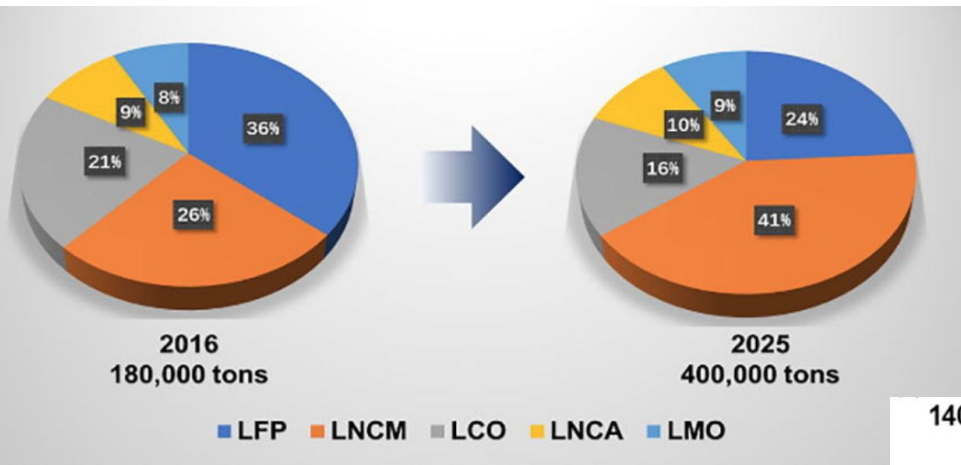
HYBRID ELECTRIC
VEHICLE

- Usually people think of Tesla, Chevy Volt, Nissan Leaf, etc. when thinking of EV's, but there are many other types of vehicles using some type of lithium battery, including hybrid models
- Different models of Trucks, Golf carts, ATVs, and even Go-karts

Why we decided to focus on LNCM type battery?

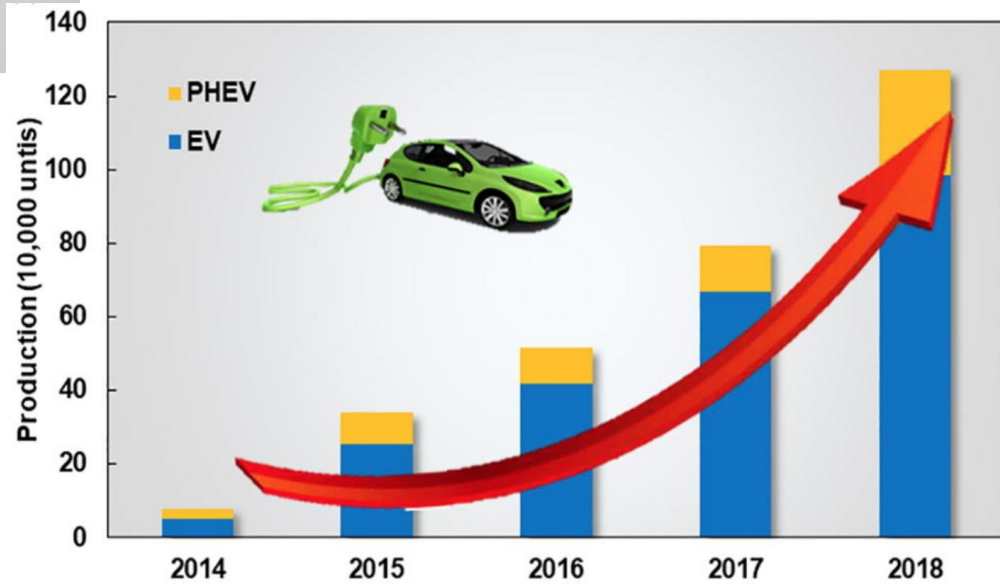


- Despite LFP being 54% of current market, the batteries are less efficient & older design
- Majority of passenger vehicles will be LNCM
- As the number of EV sales continue to increase, the LNCM demand also increases



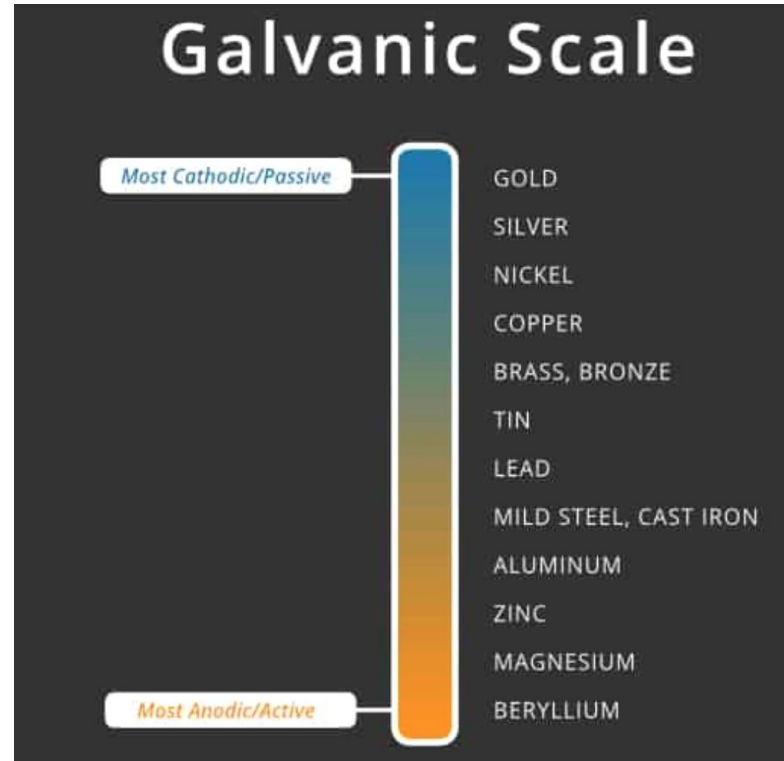
- More energy storage potential
- Most common in EV
- Longer battery life

- Future growth of market is "LNCM", (also called: "LCMN/LNMC")
- LFP are cheaper, but there are more benefits to using LNCM



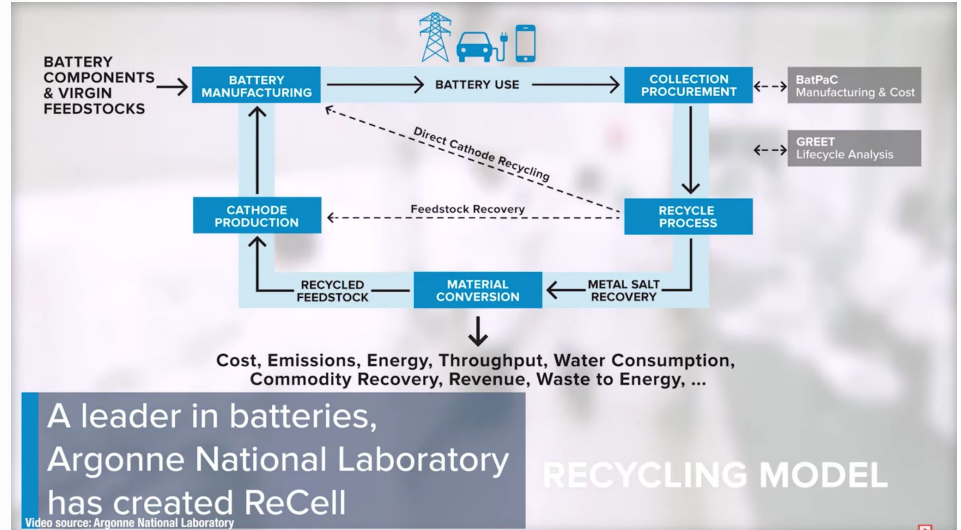
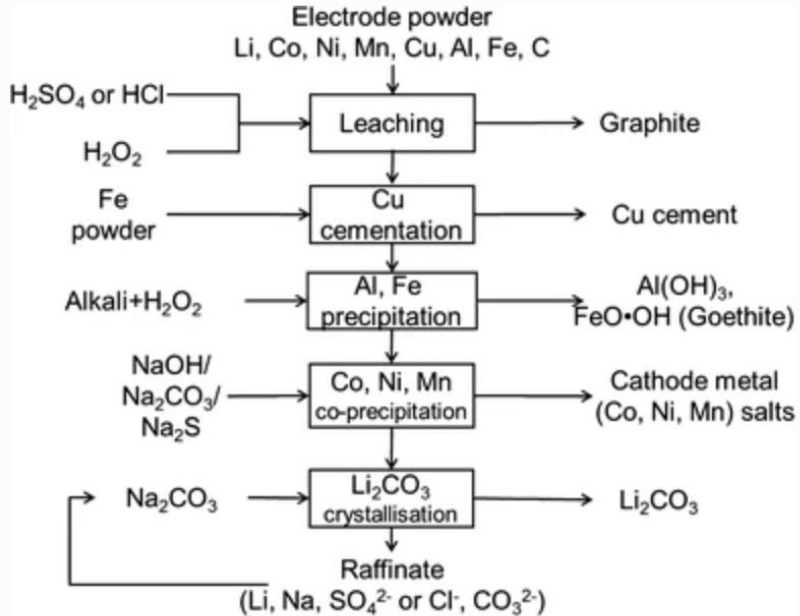
Advanced Recycling Process - Hydrometallurgy

- Specifically tailored to LNCM Batteries, from variety of sizes
- 90-95% efficiency of battery recycling
- Chemical Plant type can be built in a variety of locations
- Creates Jobs and Revenue



Our recycle process and overall recycling relationship

Fig. 1



Hydrometallurgy Recycling of Lithium Batteries



Oregon State
University

COLLEGE OF ENGINEERING

ENGINEERING
VIRTUAL

EXP

