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Batteries – 2nd Life: Beyond mobility

Solar Power Africa 2022

24 February 2022

https://www.rubiconsa.com

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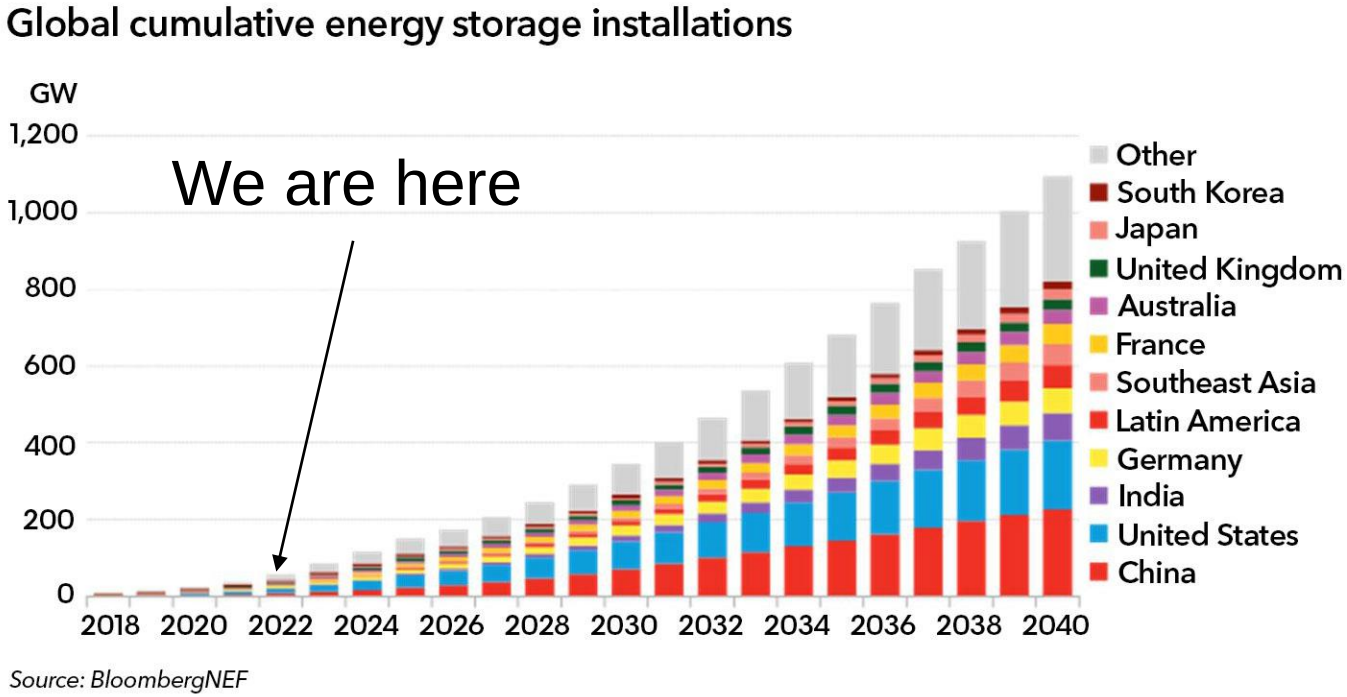
Li-ion production - where are all the cells going?

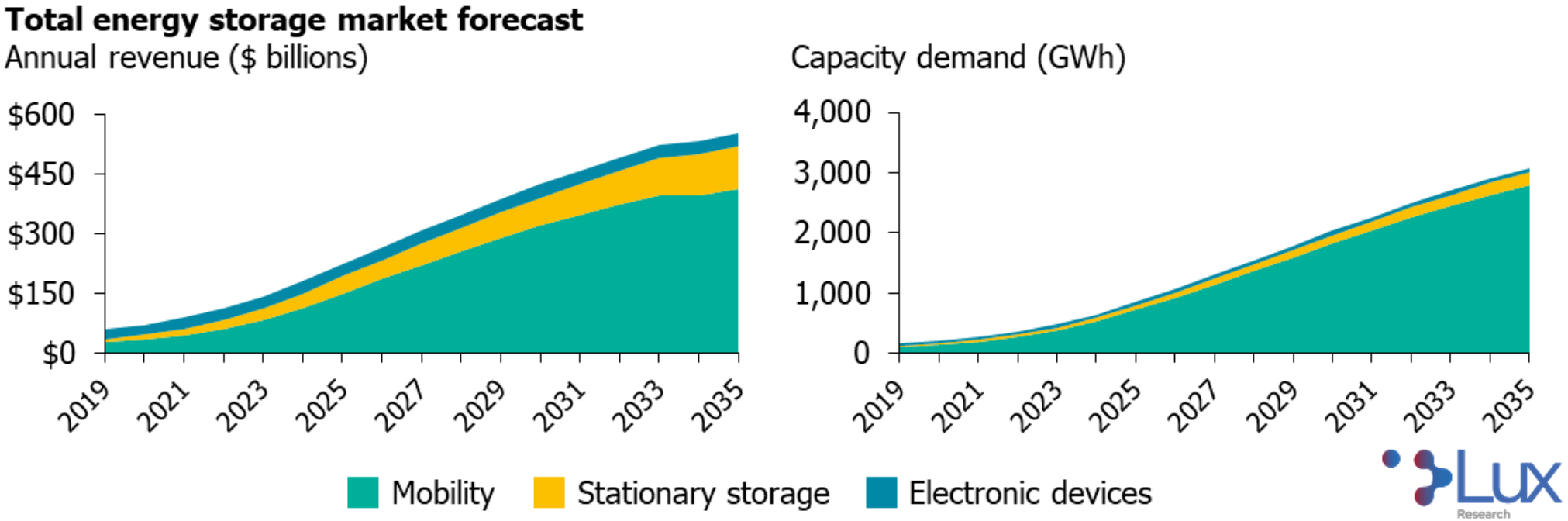
- Globally, the demand for Li-ion cells, and the subsequent batteries made from them is at an all time high
- Between 2010 and 2020 there was an 89% decrease in cost of li-ion battery packs. Prices are now market competitive and material and labour costs will stabilise the cost decline
- Chemicals company Wood Mackenzie anticipates a **31% compound annual growth** in global energy storage by 2030
- BloombergNEF expects global storage installations to surpass 1TW by 2040



Source: BloombergNEF

Li-ion production - where are all the cells going?

- The global demand is being driven by the exponential increase in demand for Electric Vehicles (EVs)
- 95% of lithium ion storage production goes towards e-mobility – driving the global R&D
  - Expected to stay at 90% by 2040



Lux Research

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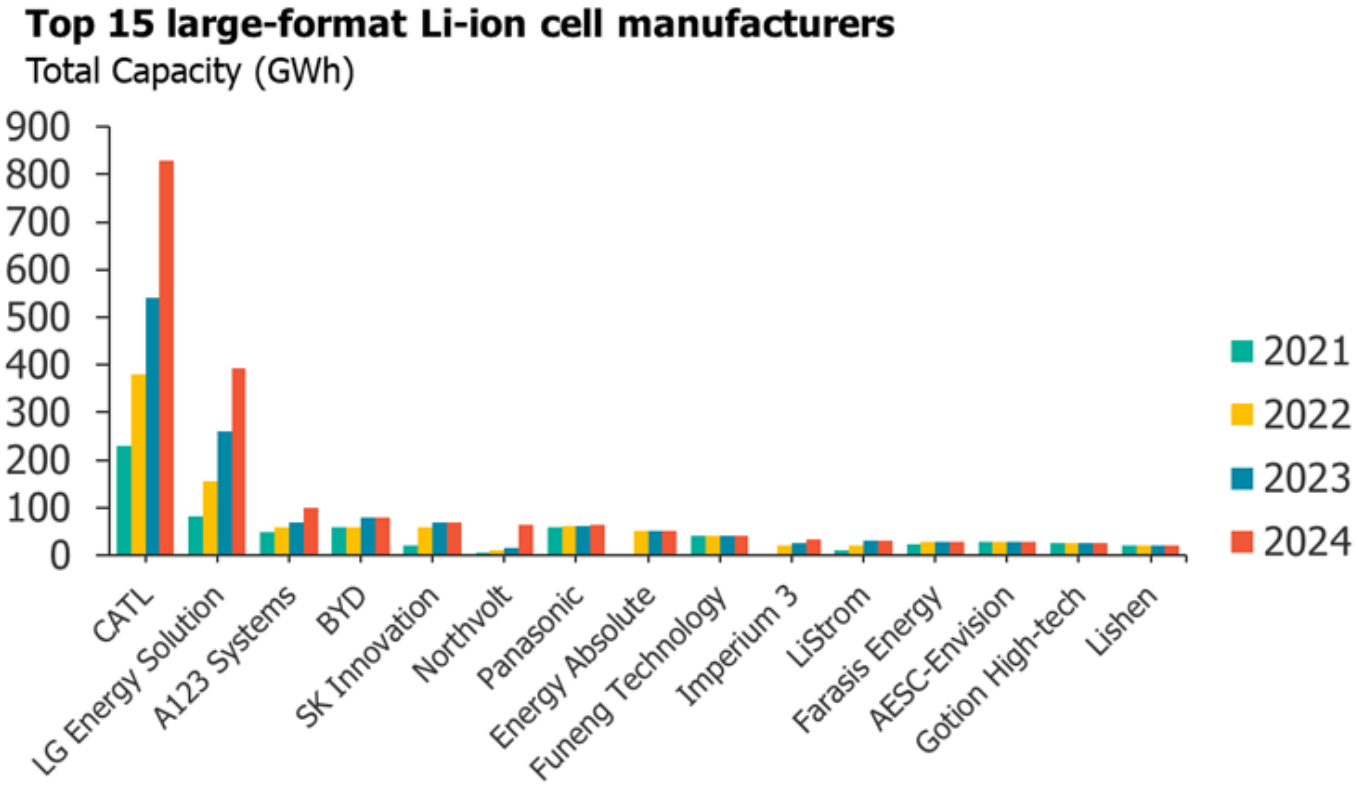
Li-ion production - where are all the cells going?

- New production companies are coming into the market, most with off-taker agreements already in place with EV manufacturers
- China dominates the global supply, currently with around 75% of the market share. This is predicted to decrease to 62% by 2024
- Chinese companies are expanding fast, and they are making their mark by announcing various production facilities in Europe and Asia.
- Automakers will enter the cell manufacturing space. Volkswagen and Tesla recently announced their plans to develop their cells, others like Ford are looking into it as well



Source: https://www.luxresearchinc.com

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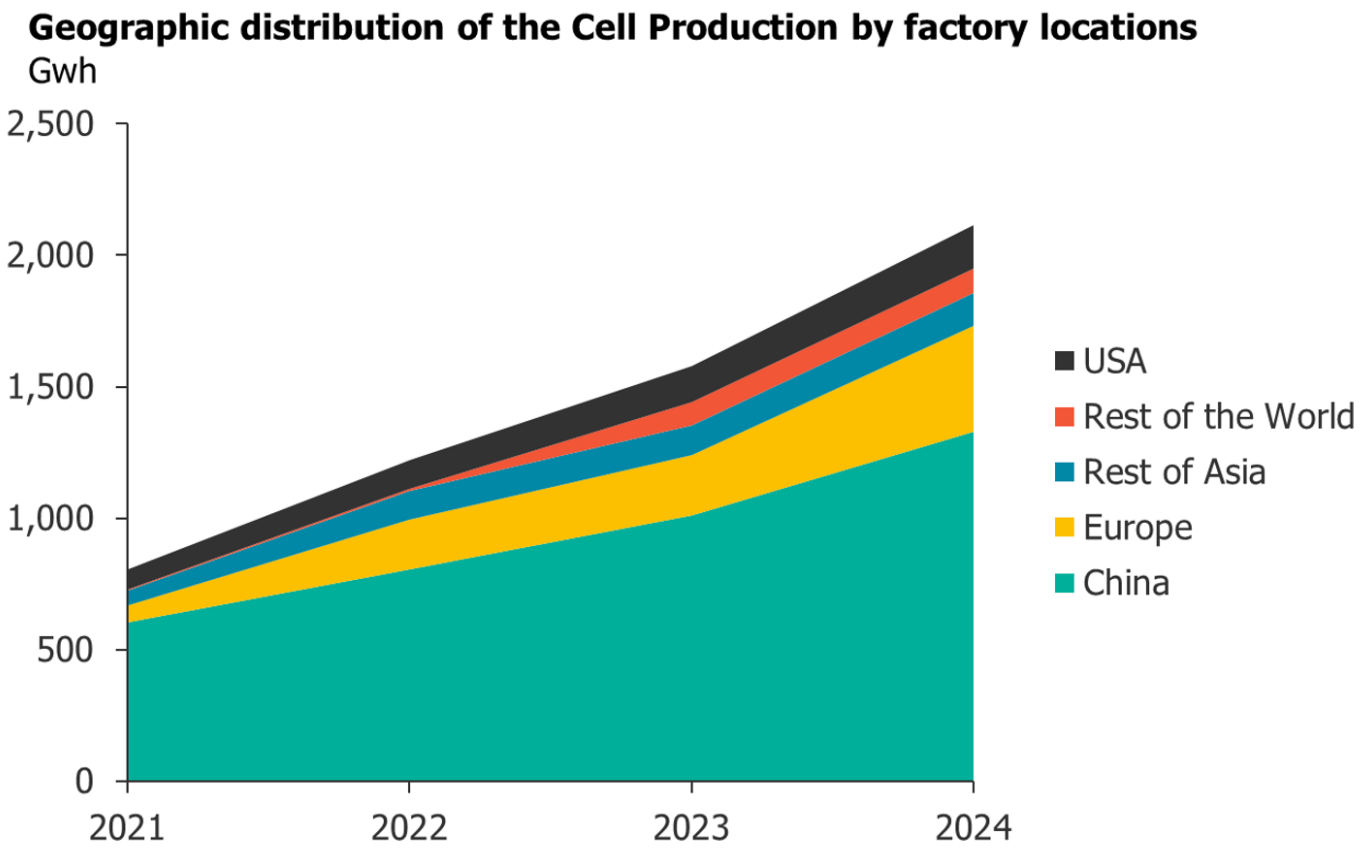

Source: https://www.luxresearchinc.com

The typical EV battery

- EV batteries range between 40 – 100kwh
- Typically NMC (highest energy density)
  - Chinese EVs have been using LFP chemistry, especially in bus fleets
- Tesla batteries – considered the highest quality on the market, are degrading down to 90% over 250’000km
  - We can assume that other suppliers will be reaching these numbers in the future.

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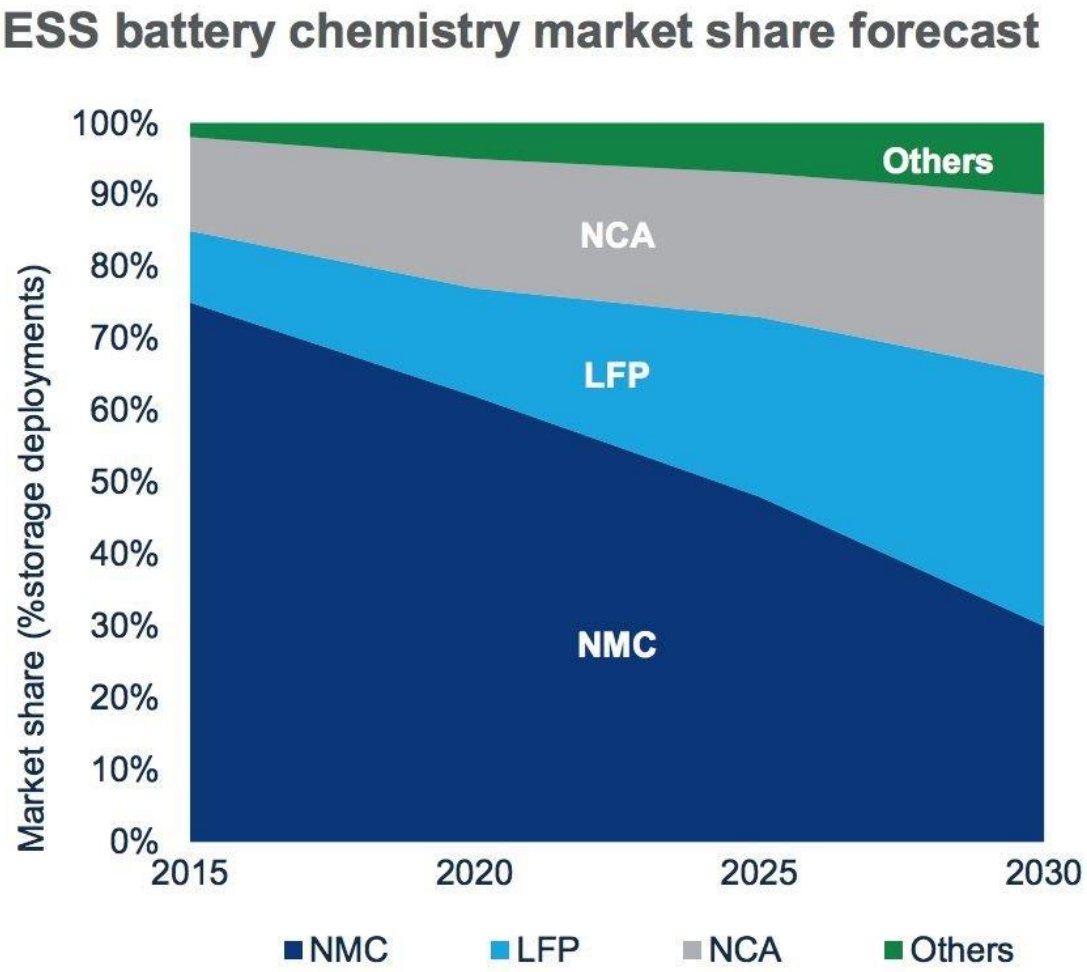

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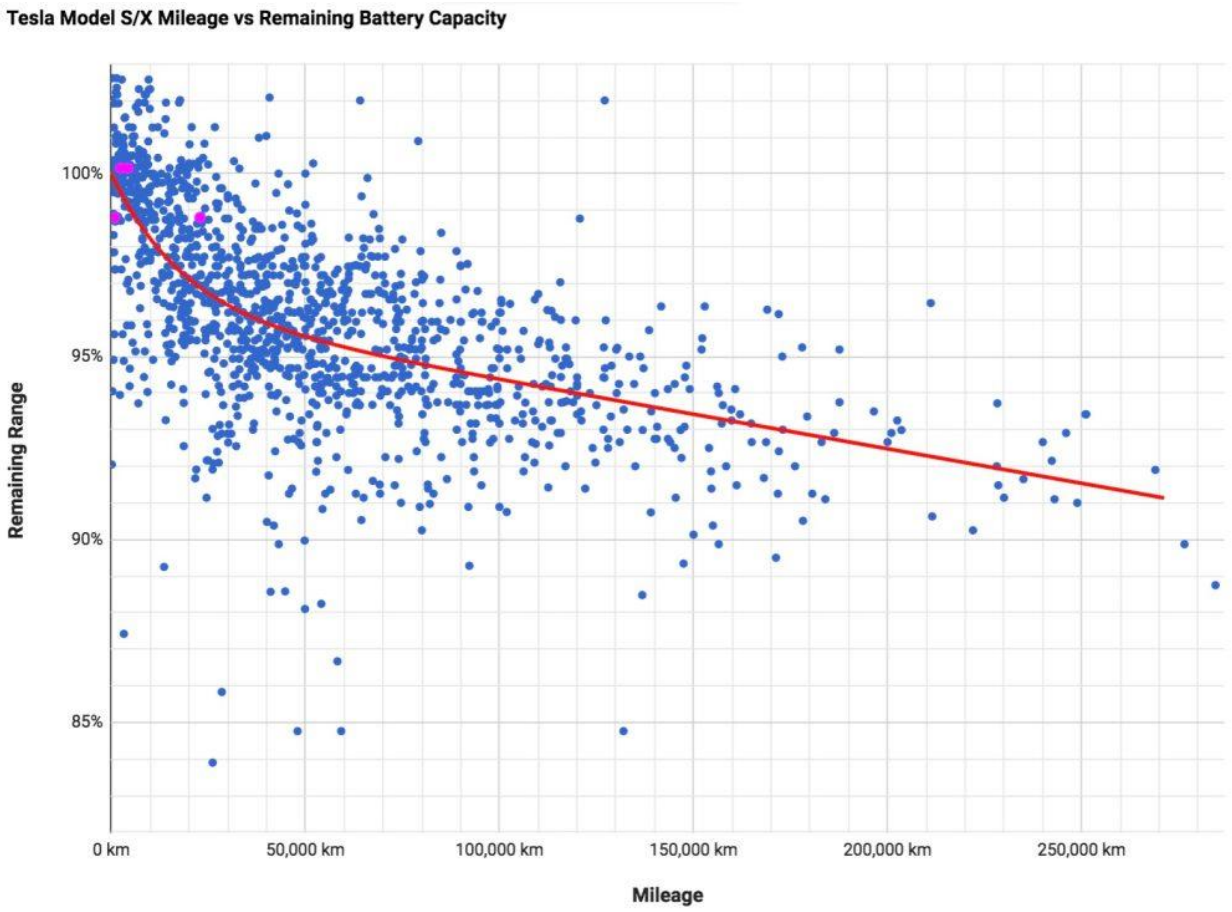
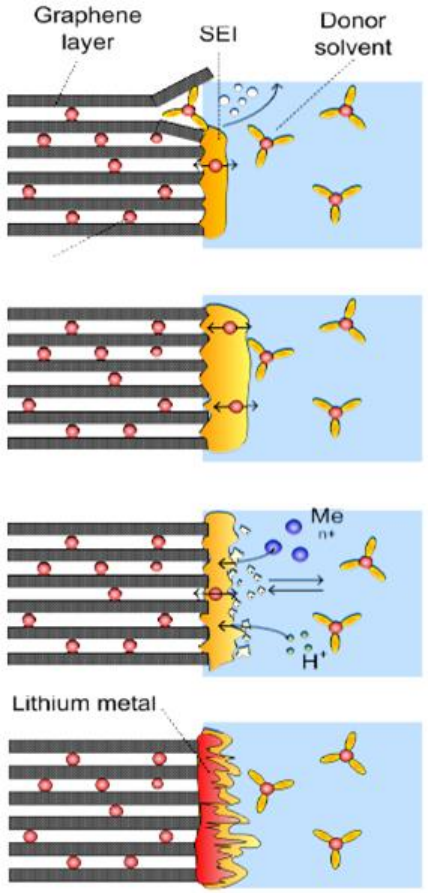


What is end-of-life for an EV battery?



Batteries2020 project; after: Vetter, JPS, 147, 269 (2005)

Anode ageing

- Intercalation of solvent/ peeling of graphite/cracking
- Dissolution of electrolyte (cathodic oxidation / anodic reduction) / dissolution of binder
- Growth of SEI/ Change of surface porosity
- Decrease of active surface (continuous growth of SEI)
- Deposition of metallic lithium/ formation of SEI
- Loss of contact active mass particles because of volume change
- Corrosion of conductor

Cathode ageing

- Structural disordering
- Migration of soluble species
- Electrolyte decomposition
- Corrosion of conductor

Electrolyte ageing

-Decomposition

- Ageing factors (and/or)

-high/low SOC, high current, high/low temperature

KPIs impacted (and/or)

-Capacity, power, efficiency

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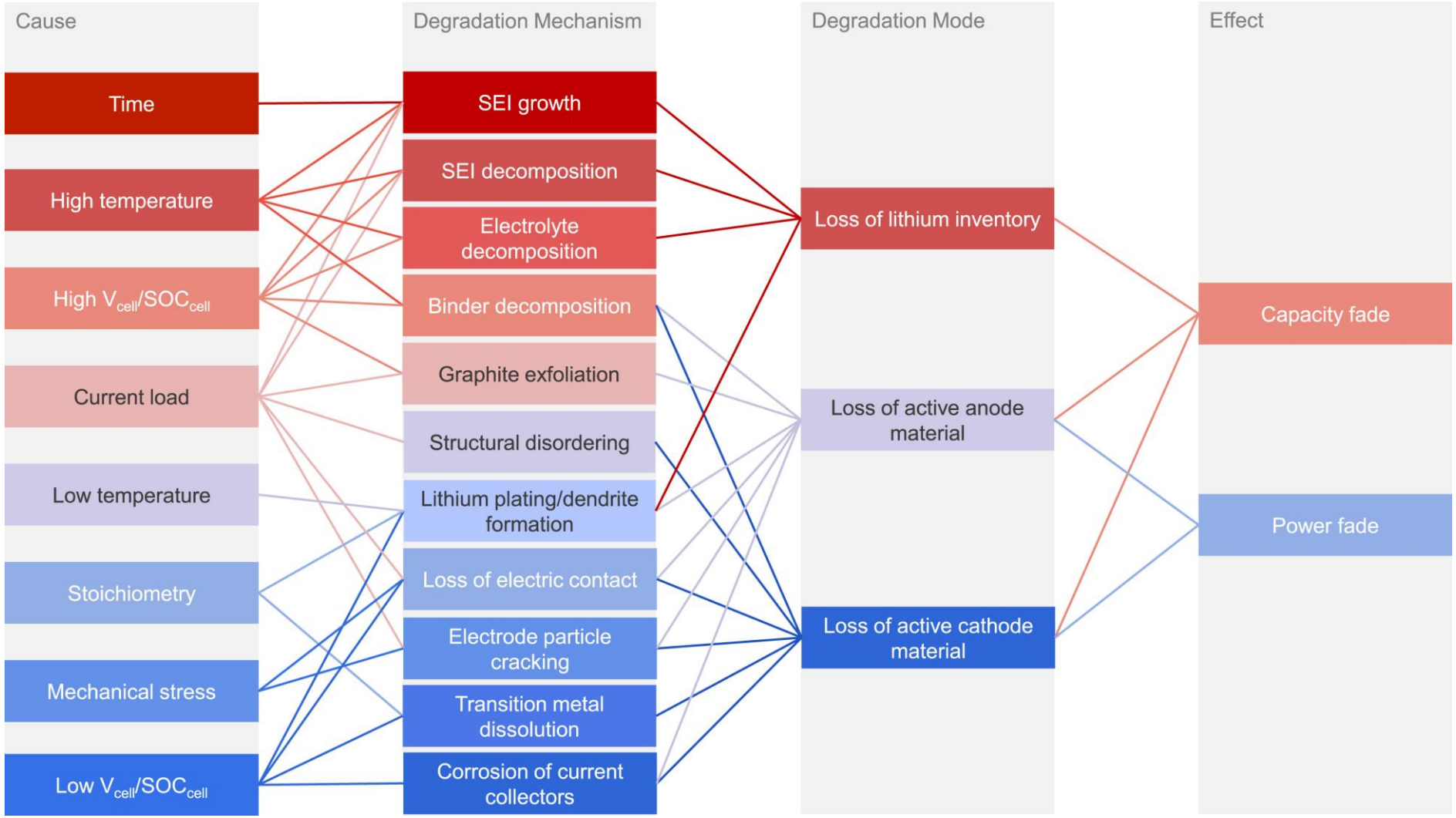
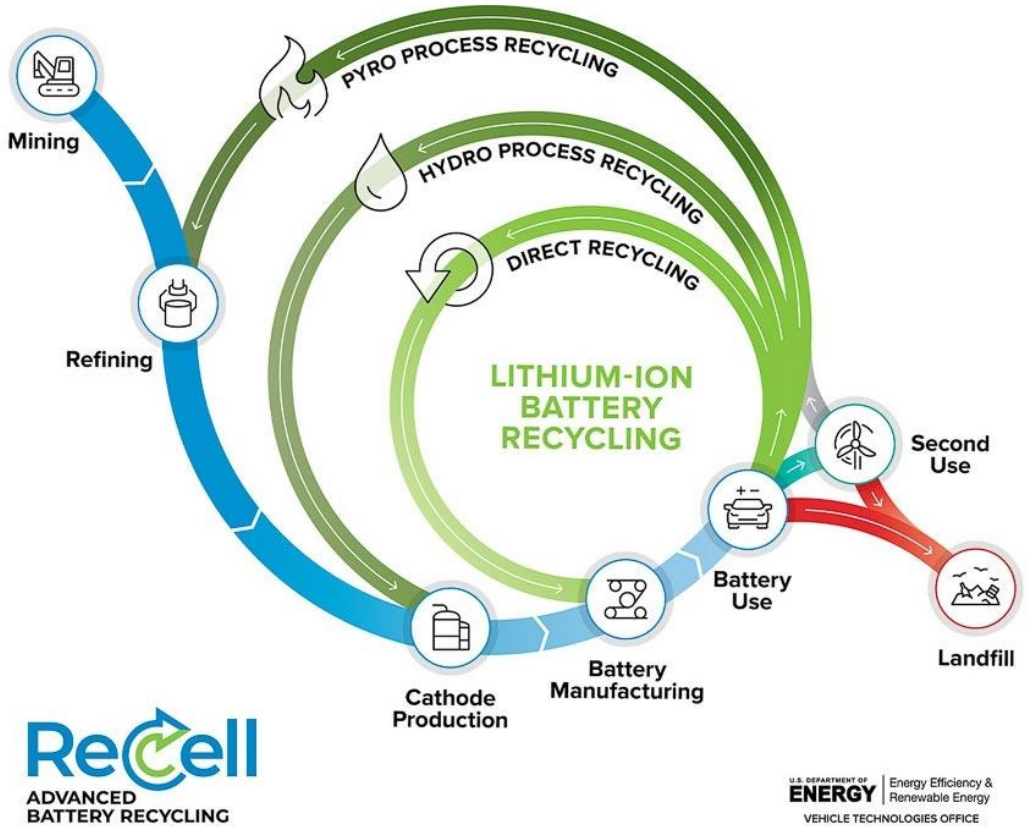


Source: (https://www.sciencedirect.com/science/article/pii/S0378775316316998)

What is end-of-life for an EV battery?

- EVs rely on the active capacity of the battery for its range – thus, battery degradation beyond 80% will signify the end-of-life of the battery
- These batteries can still deliver high power and still has sufficient life to be used for stationary storage applications
- Different Li-ion chemistries (NMC, NCA & LFP) have varying economic feasibilities for recycling, due to content of high-value metals.
  - ~$9/kWh for LFP vs $25/kWh for NMC
  - This makes LFP batteries even more suited for 2nd life BESS as stationary storage
- After 2nd life recycling is more likely to be economically viable



How can EV batteries be used in their 2nd life?

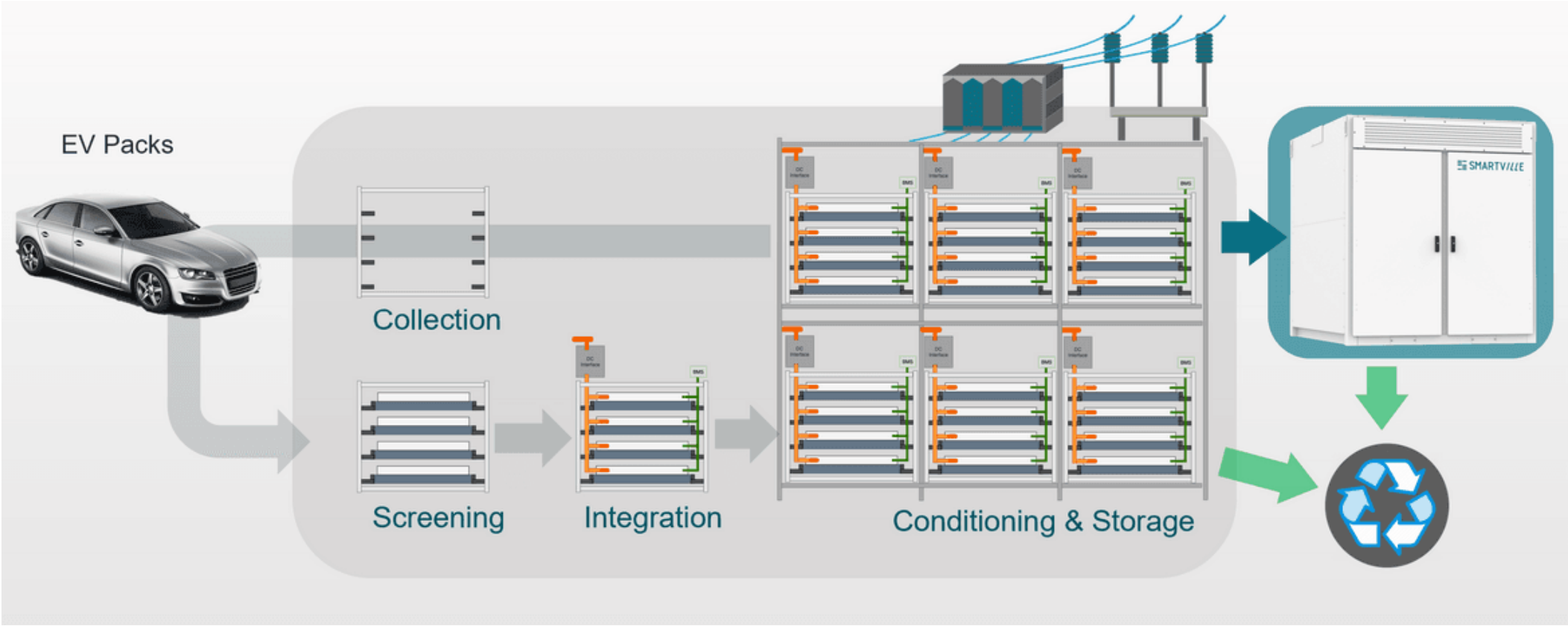
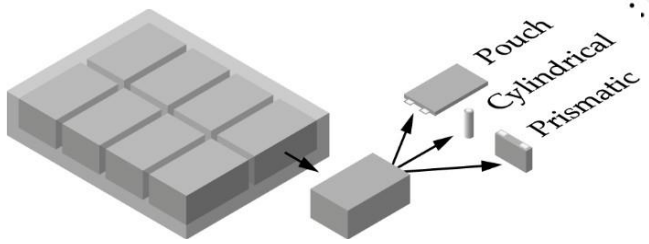
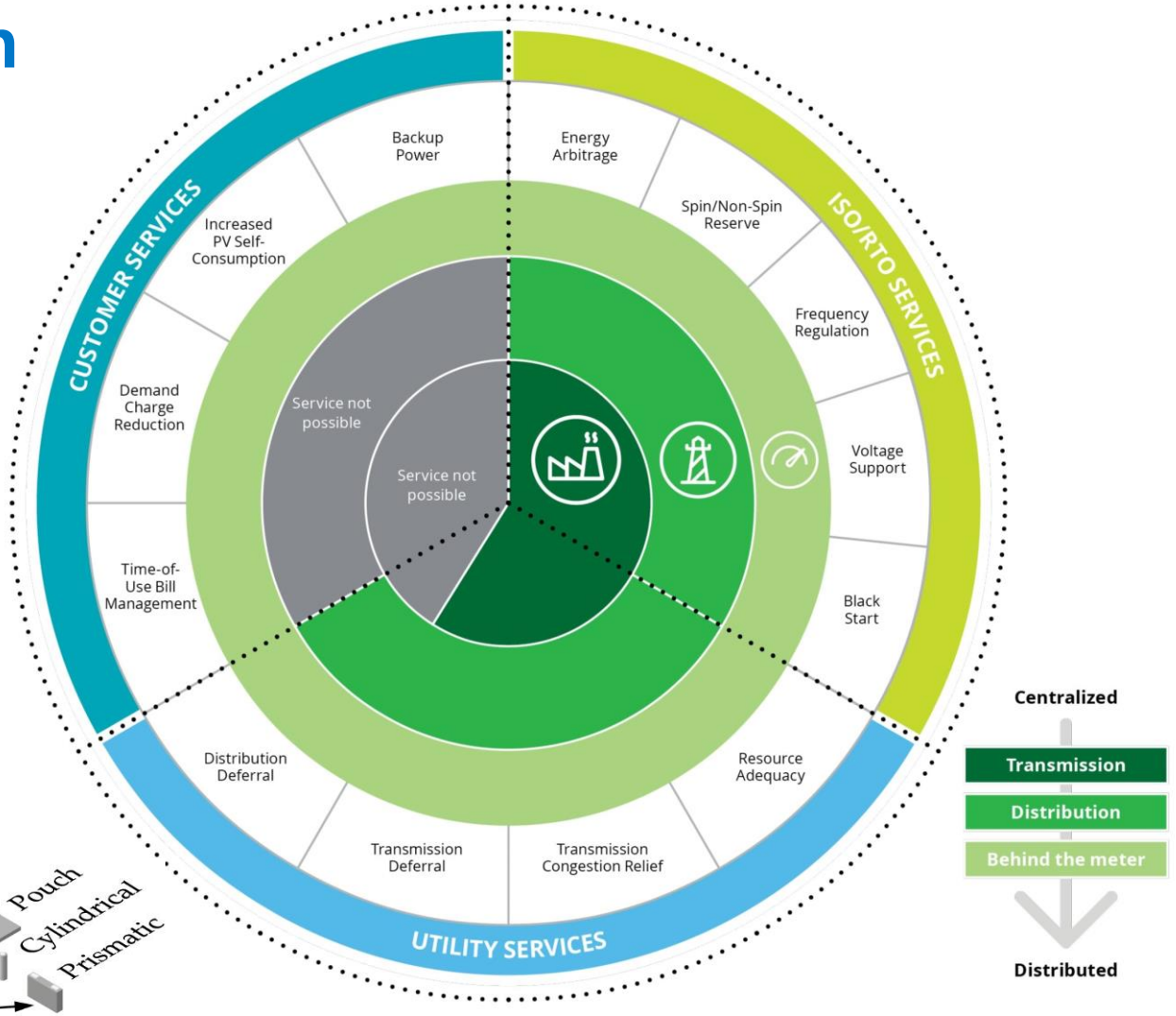


Image credit: Smartville

How can EV batteries be used in their 2nd life?

- 2nd life means repurposing a product or some components used for a different purpose, application, function, or context.
- 2nd life also means that the legal liability lies with the new producer.
- Applications of 2nd life BESS will mostly be:
  - Backup power
  - Increased RE self-consumption
  - Demand charge reduction
  - TOU- arbitrage
  - Spinning reserve





The possibilities for Africa

- Africa's barrier to entry has so far been cost
  - 2nd life batteries are expected to be between 50% and 70% the cost of new batteries
- Direct opportunities for using 2nd life BESS will be to make use of the low costs of storage. Such applications will be:
  - Electrifying rural areas with mini-grids
  - Providing back-up power for grid interruptions
  - Load shifting renewable power
- Other opportunities will be the recycling stations that will inevitably be necessary once the BESS are retired after 2nd life.
- Recycling provides a crucial solution to raw material supply insecurity and price fluctuations.

Summary

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Thank you for your time

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