Cars, EVs and battery recycling forecasts and economic models

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Abstract

Automobiles have overtaken consumer electronics as the biggest users of lithium-ion batteries and thus, innovative recycling methods desperately need to be developed and industrialised in order to recover lithium and cobalt affordably and efficiently (Cusenza et al., 2019). While progress in the immediate term can be achieved (Hill et al., 2019) with agreed upon chemistry standards, successful recovery in long term will hinge on accurately forecasting the use and disposal of EVs. This presentation describes different forecasting models to predict the scrappage and recycling rates for Internal Combustion Engine (ICE) Cars and Electric Vehicles (EV) and their battery systems.

Usually cars become available for recycling through one of three basic routes. First, the car is damaged (collision or other) and must be scrapped because it is beyond safe and / or economic repair. Second, the car's age and condition is such that that the cost of keeping the vehicle outweighs its value. Third, the car may be (illegally) abandoned resulting in collection by a Local Authority. In the EU, 6 to 7 million cars are scrapped annually, with an additional 3 to 4 million classified as 'Vehicles of unknown whereabouts'.

Regarding EV uptake, we quantify three uptake scenarios considering "BAU" is "Business As Usual" and is an extrapolation of current EV purchasing habits through to 2050; "Targeted" is an increase of current EV buying up to the level necessary for 100% of all vehicles purchased in 2040 to be EVs and "Accelerated" is similar to "Targeted" but with an even faster increase in EV purchase. We present the swelling stockpile of batteries that might be available for recycling over the next 10-20 years all the way to 2050.

Even though EV scrappage rates are calculated these do not necessarily mean that Battery scrappage rates are the same. There are several considerations to be taken into account, based on the data collected. For example, if 'high-usage' business models such as MaaS or battery swapping catch on (Skeete, 2017), then the industry may consume batteries at a higher rate than individual BEVs are scrapped, thus offsetting the 1:1, battery/car, scrappage ratio.

Another consideration is that with regards to EVs, there are several applications for automotive battery packs beyond their use in vehicles . These so-called 'second life' applications are mostly in stationary storage as emergency electricity supplies. Therefore in a case where second-life solutions

become viable at scale, then the inverse may occur where vehicles are scrapped, while their original batteries continue to function in the second-life markets 5-10 years post-vehicle scrappage.

Innovation and economics also present other important variables (Steinhilber et al., 2013): If more efficient (cheaper and/or better) methods of recycling emerge, then recycling may become a source of raw minerals fit for reuse. However if recycling methods remain unprofitable and/or inefficient (lithium still not recoverable in the process), then waste disposal and the status-quo is likely to continue. Battery innovation will very likely affect these outcomes either in the form of new technology/chemistry, or in the form of industry standardisation of chemistry. The presentation concludes by discussing some limitations and future outlooks

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