Sections from the Environmental Protection Agency USA paper:

The study showed that the batteries that use cathodes with nickel and cobalt, as well as solvent-based electrode processing, have the highest potential for environmental impacts. These impacts include resource depletion, global warming, ecological toxicity, and human health impacts. The largest contributing processes include those associated with the production, processing, and use of cobalt and nickel metal compounds, which may cause adverse respiratory, pulmonary, and neurological effects in those exposed.

As of 2007, batteries accounted for 25% of lithium resource consumption; this amount is projected to increase significantly.

Water is the main material input at 500-5400 kg/kWh (24-67% of total) and second is the lithium brine taken from saline lakes in Chile at 540-750 kg/kWh (9-28% of total). Most of which comes from the materials extraction stage in the life cycle.

Lifetime of the battery is a significant determinant of impact results; halving the lifetime of the battery results effectively doubles the non-use stage impacts, resulting in substantial increases in global warming potential, acidification potential, ozone depletion potential, and photochemical oxidation potential (e.g., smog).

Life-Cycle Stages

Though the use stage of the battery dominates in most impact categories, upstream and production is non-negligible in all categories, and relatively important with regard to eutrophication potential, ozone depletion potential, ecological toxicity potential, and the occupational cancer and non-cancer hazard impact categories. The extraction and processing of metals, specifically aluminium used in the cathode and passive cooling system and steel used in the battery pack housing and battery management system (BMS), are key drivers of impacts.

Recovery of materials in the EOL stage significantly reduces overall life-cycle impacts, as the extraction and processing of virgin materials is a key contributor to impacts across battery chemistries. This is particularly the case for the cathode and battery components using metals (e.g., passive cooling system, BMS, pack housing and casing). Therefore, the analysis underscores the importance of curtailing the extraction of virgin lithium to preserve valuable resources and reduce environmental impacts.

Battery recycling issues

Although metals are recovered from Li-ion batteries, they are currently not fed back into the battery cell manufacturing process. To do so, the recovered battery materials (including lithium) would need to be processed so they are "battery grade" which means they can be used as secondary material in the battery cell manufacturing process. However, there are a few key obstacles to achieving this goal, including:

1. *The battery manufacturers frequently modify their battery chemistries, which makes it difficult to incorporate recovered materials. This is especially a concern for EV batteries, which may be recovered 10 to 15 years after the battery is manufactured. The battery companies continually modify their chemistries to try to obtain market distinction and to improve charge capacity and energy density, which generate benefits in the use stage of the battery.*

2. *The battery manufacturers are hesitant to use secondary materials, as they fear it will not be of high enough quality to meet the battery specifications required by the original equipment manufacturers (OEMs) that purchase the batteries and manufacture the vehicles.*

3. *Batteries may be capable of having a –second life or use as part of another product, such as to provide energy storage for an electricity grid; however, there is limited information on characterizing spent batteries in a secondary application, so the potential second life was not included in this study.*