Summary

Rapid improvements in battery technology have caused the car industry to see electric vehicles as a realistic production option. Besides the application of batteries in passenger vehicles, battery packs are fitted in all sorts of transport equipment like trains, boats, on-site equipment and even plugged-in crane systems. These new (hybrid) electric transport solutions are believed to provide a possibility to lower the transports industry's impact on the environment.

A shift in mentality has arisen when it comes to polluting, due to the growing concern for irreversible environmental damage. Governments have set up a variety of regulations to encourage citizens and industries to lower their emissions. Furthermore, the growing dependence on fossil fuels has stimulated the research into alternative power options. Altogether, these factors, among others, cause the market for (hybrid) electric vehicle to grow rapidly.

Although electric vehicles lower the environmental impact by fuel reduction, the battery might cause a negative effect on the environment by, for instance, the toxicity of its contents. If the electric vehicle is going to be the transport modality of the next generation, it will be imperative to be sure that it causes less harm to the environment than conventional vehicles. In other words, the environmental impact of batteries shouldn't be more negative than the improvements by the reduction of energy consumption.

First, the main tool in the discussed studies, the Life Cycle Assessment, is explained and its validity is discussed. It appears that there are different ways to conduct such a research and that the quality can vary significantly. Four types of uncertainty and variability are discussed, being the goal of the research, the influence of the functional unit, the quality of the data and the method of the impact assessment.

The actual impact of batteries is assessed next. Three battery types (Lead-acid, Nickel-Metal Hydride and Lithium-ion) are discussed as they are most common at present. Various LCA studies are presented, along with their results. The studies are divided up into several vehicle type categories and their results are compared. It appears that it is hard to compare different studies due to variation in methods, although they show similar trends in impact reduction.

The significance of the impact reduction by battery vehicles is calculated. The battery powered vehicles start their use phase with a higher impact than conventional vehicles. However, every kilometer driven results in a smaller difference, and eventually the battery vehicle is cleaner. The results show that, according to the studies assessed, battery vehicles account for 10% less impact at an early stage of the lifetime already.

The upcoming application of battery packs in large plug-in systems like cranes is discussed. The principle of peak-shaving is explained, which shows the potential of the concept to reduce environmental impact. Unfortunately, due to insufficient literature, it is not possible to present any quantitative results.

A final assessment checks which battery types are applied in the different studies. Furthermore, it compares the type of electricity mix or fuel which are used in these studies. It appears that these variables vary a lot, although some trends can be observed.

The comparison of different studies has shown that the battery's negative impact is predominately present in the phases which precede the use of the vehicle. The impact upon to this point will most certainly always be greater for a battery powered vehicle. However, it is shown that the impact in the use phase, which accounts for the larger part of the total impact in the life cycle, is reduced substantially. Finally, the end-of-life phase of the battery has either a positive or a negative impact on the environment, depending on the recycling process.

The choices which are made in the design process, together with the geographical location where the transport product is used, have a great influence on the final environmental impact score. This shows that a number of factors can still be improved, which allows for a further reduction of impact in the future.

Altogether it is can be concluded that the total environmental impact over the whole life cycle caused by (hybrid) battery powered vehicles is most probably always lower than conventional vehicles. Furthermore, the decrease in environmental impact is shown to be significant for all types of vehicles. Therefore, it might be stated that the environmental impact caused by batteries cannot be more negative than the improvements by the reduction of energy consumption.