Environmental Risk Assessment of Lithium Battery Electric Cars

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ABSTRACT

Overview. Over the last decade, the electrification of mobility is discussed as one of the key strategies for heading towards a more sustainable transport system. Electric vehicles (EVs) are considered as an important means to reduce local air pollution, noise pollution, global greenhouse gas emissions from the transport. Moreover, electric vehicles are seen as an important contributor to higher energy supply security through the reduction of oil import dependency. Due to this, many governments have set goals to increase number of electric vehicles offering a broad portfolio of supporting policy measures. Furthermore, according to the Paris Declaration global electric vehicles stock should be over 100 million by 2030. Different types of electric vehicles are already available on the market especially in China, Europe and the USA, see Fig 1. Until now, market penetration of electric vehicles was very slow mostly due to their high capital costs and limited driving range in comparison to conventional internal combustion vehicles. However, battery performances has been considerably improved, and price has been significantly reduced over the last years, so that market penetration in the next years could be much faster.

The core objective of this paper is to investigate the environmental risks associated with the increasing use of lithium battery electric vehicles**.**

Method. Our method of approach is based on a life-cycle approach of electric vehicles in comparison to conventional cars to assess possible environmental benefits and risks. We have considered the whole energy supply chain including different primary energy sources used for electricity generation, see Fig. 2. For the analysis of future market prospects we conducted dynamic economic assessments and scenario developments based on policies implemented and price development, based on technological learning regarding investment costs of batteries.

Of special interest is assessment of lithium demand as well as associated environmental impacts of lithium mining. Moreover, battery recycling will be discussed from an economic and environmental point of view.

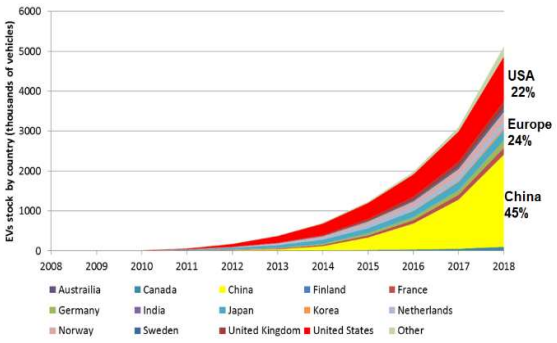

Fig. 1. Development of the global stock of rechargeable EVs

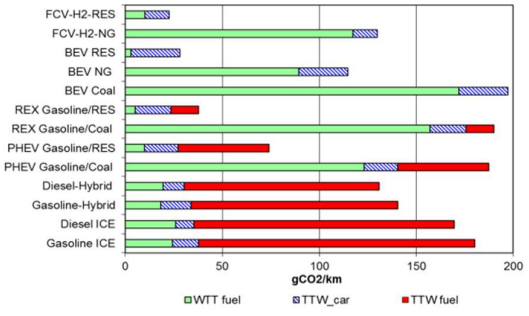

Fig. 2. CO_2 emissions per km driven for various types of electric vehicles in comparison to conventional cars

Results. Battery electric vehicles are seen as an environmentally friendly alternative to conventional passenger cars especially in the case that electricity are produced from renewable energy sources, see Fig. 2.

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However, total environmental benefits of electric vehicles are also dependent on the sustainability of the resources used in battery production. With the decreasing price of battery demand for scarce raw materials will be rapidly increasing. For example, demand for lithium is already increasing exponentially. The lithium-ion industry is expected to grow from 100 GWh of annual production in 2017 to more than 800 GWh in 2030.

Conclusions. Electric vehicles have potential to reduce some of the problems in the transport sector such as noise- and air pollution in the well-developed regions e.g. the USA, the EU and China, which are able to invest in electric vehicles. Reduction of the global GHG emissions is very dependent on the electricity mix used in EV, and currently only few countries (e.g. Norway, Sweden) can contribute to GHG emissions reduction. At the same time, the number of the countries which are suffering from this development (e.g. Argentina, Bolivia, Chile) is increasing.

Moreover, the dependency on imported oil from Middle East countries could be replaced by dependency on lithium imports from South America, see Fig. 3 and 4.

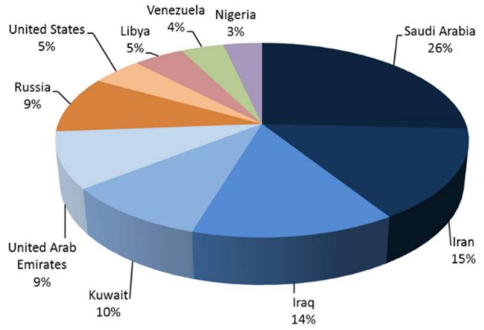

Fig. 3. Countries with largest conventional oil reserves

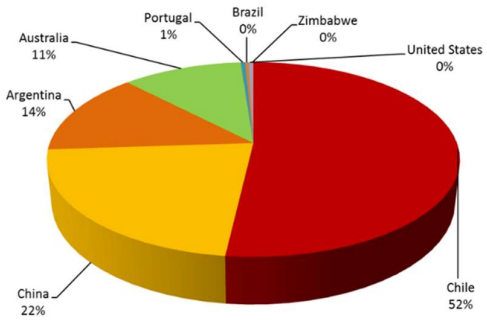

Fig. 4. World lithium reserves by country

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