Zero-emission commercial vehicles
A closer look on economic and ecological aspects

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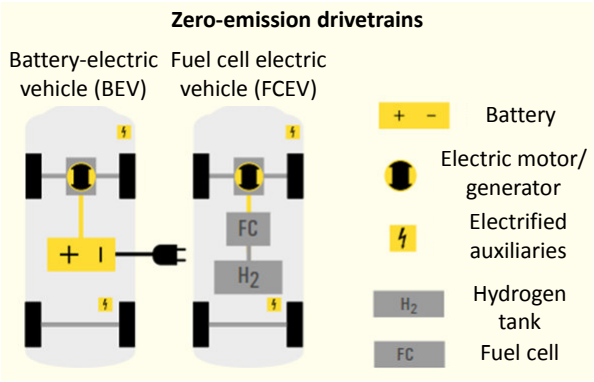
Introduction

Political efforts to electrify the vehicle fleet mostly focus on cars, busses and light delivery vans. However, since European air quality standards related to particles and NO_x are still exceeded in many cities, exhaust emissions of other commercial vehicles (CVs) as well as non-road mobile machinery (NRMM) like construction machines and agricultural vehicles have to be considered as well to improve urban air quality accordingly. Only in Baden-Württemberg these segments total up to over 400,000 units which are almost 100 % diesel-powered and thus contribute significantly to local emissions. In 2010, NRMM had about the same particle emissions as the entire road traffic and about one quarter of its NO_x emissions [1]. Thus, in this study the potential application of zero-emission drivetrains in the whole CV sector including NRMM should be evaluated. First, the regulatory framework as well as the economic and ecological relevance of the different CV segments were depicted. For five selected CVs, the total cost of ownership (TCO) and the life-cycle greenhouse gas (GHG) emissions of zero-emission drivetrains were then analysed in comparison to conventional diesel engines. Based on these results, the potentials, barriers and market readiness of zero-emission CVs were assessed.

[1] ifeu: Schadstoffemissionen und Belastungsbeitrag mobiler Maschinen in Baden-Württemberg; Heidelberg, 2014

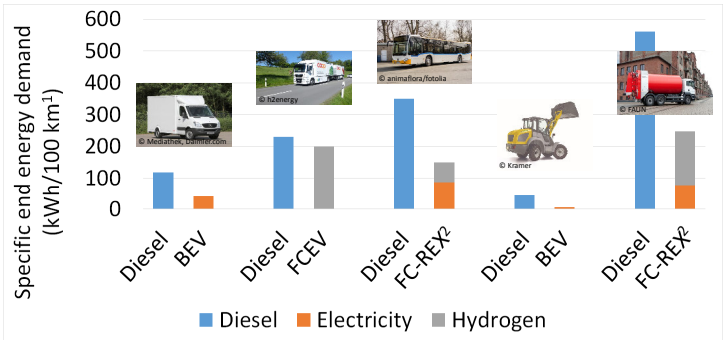
Results

Zero-emission drivetrains



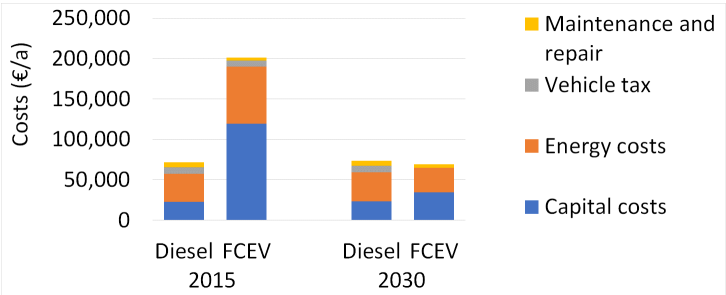
Adaptiert nach [e-mobil BW, Fraunhofer IAO: Strukturstudie BW^e mobil 2015, Stuttgart 2015]

Specific end energy demand of selected CV, zero-emission vs. diesel drive

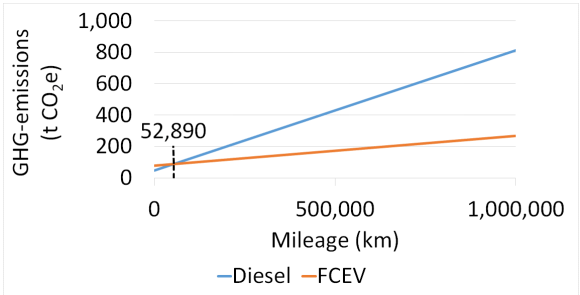


[1] Wheel loader: kWh/h [2] FC-REX: Fuel cell range-extender

TCO for heavy truck, FCEV vs diesel



GHG emissions by mileage for heavy truck, FCEV vs diesel



Conclusions

- For all considered segments, zero-emission drivetrains have a considerably lower specific end energy demand than diesel drives, especially when operating conditions require frequent load changes.
- By applying a LCA approach, zero-emission CV offer significant ecological advantages considering their lifetime GHG emissions, despite their higher production related initial impact. They thus offer an appropriate measure to reduce GHG emissions in the CV sector.
- It is expected that costs for zero-emission CVs decrease significantly in upcoming years so that they may reach TCO equality with diesel vehicles until 2030. Therefore, zero-emission alternatives could gain a relevant share in the CV stock by then, at least in some segments.
- While in some CV segments a demand for zero-emission alternatives exists already today, the availability of appropriate vehicles is considered very limited by users. Apparently, there is a considerable mismatch between user requirements and the portfolio of the established manufacturers, opening an opportunity for small and medium sized enterprises that can react far more flexible to address specific customer needs.
- Political actions are necessary to foster the introduction of zero-emission CVs. While they may be beneficial by allowing services like night delivery, they currently do not get sufficient privileges compared to hybrids or EURO 6-diesel to compensate their higher costs. Regulatory advantages, subsidies or exemptions from taxes or road charges are thus key instruments to accelerate their market penetration.

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