

## A Strategic Sustainability Analysis of Electric Vehicles in EU Today and Towards 2050

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**Abstract :** Ambitions within the EU for moving towards sustainable transport include major emission reductions for fossil fuel road vehicles, especially for buses, trucks, and cars. The electric driveline seems to be an attractive solution for such development. This study first applied the Framework for Strategic Sustainable Development to compare sustainability effects of today's fossil fuel vehicles with electric vehicles that have batteries or hydrogen fuel cells. The study then addressed a scenario where electric vehicles might be in majority in Europe by 2050. The methodology called Strategic Lifecycle Assessment was first used, where each life cycle phase was assessed for violations against sustainability principles. This indicates where further analysis could be done in order to quantify the magnitude of each violation, and later to create alternative strategies and actions that lead towards sustainability. A Life Cycle Assessment of combustion engine cars, plug-in hybrid cars, battery electric cars and hydrogen fuel cell cars was then conducted to compare and quantify environmental impacts. The authors found major violations of sustainability principles like use of fossil fuels, which contribute to the increase of emission related impacts such as climate change, acidification, eutrophication, ozone depletion, and particulate matters. Other violations were found, such as use of scarce materials for batteries and fuel cells, and also for most life cycle phases for all vehicles when using fossil fuel vehicles for mining, production and transport. Still, the studied current battery and hydrogen fuel cell cars have less severe violations than fossil fuel cars. The life cycle assessment revealed that fossil fuel cars have overall considerably higher environmental impacts compared to electric cars as long as the latter are powered by renewable electricity. By 2050, there will likely be even more sustainable alternatives than the studied electric vehicles when the EU electricity mix mainly should stem from renewable sources, batteries should be recycled, fuel cells should be a mature technology for use in vehicles (containing no scarce materials), and electric drivelines should have replaced combustion engines in other sectors. An uncertainty for fuel cells in 2050 is whether the production of hydrogen will have had time to switch to renewable resources. If so, that would contribute even more to a sustainable development. Except for being adopted in the GreenCharge roadmap, the authors suggest that the results can contribute to planning in the upcoming decades for a sustainable increase of EVs in Europe, and potentially serve as an inspiration for other smaller or larger regions. Further studies could map the environmental effects in LCA further, and include other road vehicles to get a more precise perception of how much they could affect sustainable development.

**Keywords :** strategic, electric vehicles, sustainability, LCA

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