# Beyond Well-to-Wheels analysis: assessing the full supply chain impact of Fuel Cell Electric Vehicles (FCEV) in future automotive scenarios

Topic: Life-cycle analysis
Author: Matteo Vincenzo Rocco

According to projections of International Energy Agency, to comply with the European GHGs emission target, the provisioned penetration of Fuel Cell Electric Vehicles (FCEV) is estimated as the 30% of the total passenger light-duty vehicles in 2050, implying a massive production of Proton Exchange Membrane Fuel Cell (PEMFC) for the next decades, as well as an extensive penetration of hydrogen production facilities and distribution infrastructures. Traditional Well-to-Wheels (WtW) models are capable to assess the primary energy requirements and the emissions of the prospected transition focusing on the fuel pathways, but, compared to Life Cycle Assessment (LCA) models, they neglects the physical infrastructures required to support such new technologies, namely the fabrication of the vehicles and the fuel distribution infrastructures, and also neglecting the indirect effects due to the prospected changes in the national energy sector.
The objective of this research is to evaluate the economic and environmental impact of the penetration of FCEVs in the German transport sector in 2050, focusing on CO2 emissions and primary non-renewable energy consumption. The LCA analysis is based on an Integrated Hybrid Input-Output model: the background system (supply chains) has been modeled trough the EXIOBASE database, while the foreground processes have been characterized based on the Authorsâ€™ experience in Fuel Cells technology, an in-depth literature surveys and the support of the EcoinventÂ® database. The main exogenous scenario parameters are related to the prospected shares of FCEV in the automotive technology mix, different hydrogen production and distribution processes, and different electricity production technologies. In addition to the hydrogen production and use phases, the developed LCA model also includes the production of vehicles and infrastructures for hydrogen production and distribution, and the prospected change in the national electricity production mix.
Significant discrepancies have been found by comparing results of WtW models and the developed LCA model: in particular, it is found that the impact caused by infrastructures and vehicles production could significantly offset the expected reduction in CO2 emissions by about 30% and primary energy consumption by about 10%.