Integration of the LCA analysis on the simulation platform with user guide and method descriptions

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Publishable summary

To allow a more complete evaluation of the impact of different vehicle propulsion technologies and fuels the methods of Life Cycle Analysis (LCA) offer standardized methods. Beside tailpipe emissions, the LCA also takes emissions in fuel production, vehicle production and disposal into account and calculates the total greenhouse gas (GHG) emissions related to the vehicle life.

To ensure comparable results in the evaluation of the different use cases and technologies in LONGRUN, a common LCA-tool was elaborated. The tool is integrated into the LONGRUN simulation platform for a user-friendly operation. The LCA is differentiated into the Well to Tank (WtT), the Tank to Wheel (TtW), i.e., tailpipe vehicle emissions, and vehicle manufacturing and disposal related GHG emissions (CO_2, CH_4, N_2O).

The TtW emissions of CO_2 are provided by the VECTO tool as standard output and/or other vehicle emission models integrated in the LONGRUN platform. The WtT data considers all emissions from the production of the feedstock up to the delivery of the fuel into the vehicle tank. Results of the WtT process are the energy consumption and emissions in g/kWh fuel. The necessary data was gained from a literature review of most recent European publications. The emissions per kg of vehicle components resulting from the vehicle manufacturing and disposal processes are considered for the most relevant vehicle components separately. These include batteries, combustion engine, electric machines and fuel tanks. The difference of the weight of the single components to the total weight of the vehicle is treated as “rest of the vehicle for which a generic emission value for manufacturing and disposal is used since the corresponding components are independent of the propulsion technology considered.

For all LCA steps, emission data for different raw materials, production processes and energy sources have been elaborated. The results for these different pathways are integrated into the data base of the LCA tool to allow the user the selection of the according system and/or the comparison of different options. A user guide explains the application of the tool and is included in this deliverable.

The combination of VECTO with the LCA tool was finally used to simulate the LCE GHG emissions for an articulated truck in the long-haul mission mix with different propulsion systems and energy sources to demonstrate the capabilities of the simulation system. As expected, the LCA results differ from the tailpipe results. With the expected 2030 energy mix, the battery electric propulsion has higher emissions from vehicle production due to the battery production but overall is almost 50% lower LCA-GHG emissions while Hydrogen, mainly from natural gas, results in higher GHG emissions than the diesel for fuel cell and for combustion engine operation. With green energy as basis, all propulsion systems have at least 75% lower GHG emissions than the fossil diesel vehicle. Thus, the main influencing parameter is the energy source. However, the optimised vehicle technology helps to reduce the demand of green energy in future.

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Project partners:

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