

# **Assessing the environmental impacts of biofuels in the Swiss transport sector**

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## Abstract

This thesis analyzes the environmental impacts of different biofuels' production pathways and their subsequent usage for powering different mid-sized cars in the Swiss territory. Starting from the available biomasses present in Switzerland which are mainly wood biomass (from the forests, landscape maintenance and industrial residues), and animal waste. Algae biomass is also considered even though it is not currently possible to cultivate it in Switzerland with high yield, due to the non-optimal weather and latitude conditions, but the production abroad (e.g. in Italy) and the following importation of the finished fuels has been analyzed. Different processes have been investigated and the pathways examined are: *electricity* from a combined heat and power plant (CHP) or from an ORC (Organic Rankine Cycle) plant, *hydrogen* from wood gasification, *gasoline and biodiesel* from fast-pyrolysis of wood biomass, or from algae oil esterification or hydrothermal liquefaction processes, and the upgrade of *biogas and SNG* (Synthetic Natural Gas) into *methane* from wood biomass gasification, manure anaerobic digestion, and wood and manure biomass hydrothermal gasification (HTG). For reaching the goal of this study the functional unit for the biofuels production has been set equal to 1 MJ.

The different biofuels analyzed have been then considered in powering different mid-sized cars, whose data come from the THELMA project. In this way, a comparison among the different biofuels produced and the conventional fossil fuels or the different electricity mix have been used as references, in order to understand which are the most promising pathways for powering a vehicle. For this part of the thesis the functional unit has been set equal to one vehicle kilometer (vkm), to allow the comparison of the different vehicles in covering one kilometer.

These processes are modeled using the SimaPro v8.04 software using information from available literature, personal interviews with experts and scientists, and the existing datasets in the ecoinvent database.

The results obtained suggest the best environmental way to exploit the different biomass resources for light duty vehicles in the Swiss transportation sector.