LCA of biomass-based energy systems - DTU Orbit (19/03/2019)

LCA of biomass-based energy systems: a case study for Denmark
Decrease of fossil fuel consumption in the energy sector is an important step towards more sustainable energy production.

Environmental impacts related to potential future energy systems in Denmark with high shares of wind and biomass energy were evaluated using life-cycle assessment (LCA). Based on the reference year 2008, energy scenarios for 2030 and 2050 were assessed. For 2050 three alternatives for supply of transport fuels were considered: (1) fossil fuels, (2) rapeseed based biodiesel, and (3) Fischer–Tropsch based biodiesel. Overall, the results showed that greenhouse gas emissions per PJ energy supplied could be significantly reduced (from 68 to 17 Gg CO2-eq/PJ) by increased use of wind and residual biomass resources as well as by electrifying the transport sector. Energy crops for production of biofuels and the use of these biofuels for heavy terrestrial transportation were responsible for most environmental impacts in the 2050 scenarios, in particular upstream impacts from land use changes (LUCs), fertilizer use and NOx emissions from the transport sector were critical. Land occupation (including LUC effects) caused by energy crop production increased to a range of 600–2100 × 106 m2/PJ depending on the amounts and types of energy crops introduced. Use of fossil diesel in the transport sector appeared to be environmentally preferable over biodiesel for acidification, aquatic eutrophication and land occupation. For global warming, biodiesel production via Fischer–Tropsch was comparable with fossil diesel.

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