

## Abstract

Due to rising concerns of energy security and the environmental implications of using fossil fuels, there is a need to explore other fuel options. The objective of this thesis is to compare different biofuel production methods from an environmental and economic perspective and to evaluate potential implications for Iceland. The environmental implications are assessed using a “well-to-tank” (WTT) perspective, meaning in general terms the boundaries extend from the cultivation and harvest, feedstock transport, biofuel production, and finally biofuel transport. Economic implications are assessed using conventional break-even point analysis.

Results indicate that when bioethanol is produced from timber employing a bio-chemical conversion method, this yields the least impact (7.26 CO<sub>2</sub> eq. g/MJ) to environmental categories such as global warming potential (GWP), however if using the thermal-chemical platform, the utilization of timber to produce Fisher-Tropsch biodiesel (FTD) has the least impact to acidification potential (AP) (0.1 to 0.14 SO<sub>2</sub> eq. g/MJ). At the same time, FTD had the highest and lowest impact to POCP, depending on the feedstock (0.01 to 0.09 C<sub>2</sub>H<sub>4</sub> eq. g/MJ). Both types of technology reported the same in regard to eutrophication potential (EP) and that the application of fertilizer from cultivation had the largest impact. In contrast, when the organic fraction of municipal solid waste is used to make bioethanol and biodiesel from rapeseed this yielded the largest impact to GWP (86 to 80 CO<sub>2</sub> eq. g/MJ) explained by the high moisture content, transportation and low lignin content. However, more research is needed to estimate the environmental impact in the production of biofuels in Iceland, based on Icelandic circumstances.

In conclusion based on quantity estimates of the selected Icelandic feedstocks and assuming that equal hectares of land as already cultivated land, is transformed to producing energy crops and increasing forest cover by 300%, beyond what is already planned, the potential quantity of displaced petroleum products in Iceland ranges from <0.1 % (FTD-recycled newspaper) to 68% (second generation bioethanol from wheat).