THE IMPACT OF ENERGY CROP CULTIVATION IN LCA OF TRANSPORTATION BIOFUELS – FINDINGS OF THE BIOENERGY NETWORK OF EXCELLENCE (NOE

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ABSTRACT: The increase usage of biofuels in transportation sector is the driving factor for the development of advanced processes to produce biofuels to reduce greenhouse gas emissions and fossil energy use in the transportation sector. The energy crops for these transportation biofuels are cultivated in agriculture applying conventional agricultural production methods, which are associated with environmental effects, e.g. N_2O-emisisons, fossil energy use. So the agricultural cultivation of energy crops significantly determines the overall environmental effects of transportation biofuels. The purpose of this work is to identify the key impacts of energy crop cultivation on the Life Cycle Analyses (LCA) of transportation biofuels. The approach is based on a review of the applied methodologies (e.g. allocation, system boundary) and the specific data used to identify the key aspects on the energy crop cultivation for the environmental performance of biofuels.
Keywords: biofuels, sustainability, life cycle assessment, energy crops

1 PURPOSE OF THE WORK

The increase usage of biofuels in transportation sector is the driving factor for the development of advanced processes to produce biofuels to reduce greenhouse gas emissions and fossil energy use in the transportation sector. Currently biodiesel made from oils and fats and bioethanol made from sugars and starch play already a significant role in the transportation sector in some European countries e.g. France, Austria, and Germany. The energy crops for these transportation biofuels are cultivated in agriculture applying conventional agricultural production methods, which are associated with environmental effects, e.g. N2O-emisisons, fossil energy use. So the agricultural cultivation of energy crops significantly determines the overall environmental effects of transportation biofuels. The purpose of this work is to identify the key impacts of energy crop cultivation on the Life Cycle Analyses (LCA) of transportation biofuels.

Based on existing LCA studies the influence of the energy crop cultivation on the overall environmental effects is analyzed. These studies show quite significant differences, e.g. GHG emissions varying by a factor of 3 across the studies. The approach is based on a review of the applied methodologies (e.g. allocation, system boundary) and the specific data used to identify the key aspects on the energy crop cultivation for the environmental performance of biofuels.

2 RESULTS AND CONCLUSIONS

The following key findings are concluded

- First the considered transportation biofuel system must be specify by (Figure 1, Figure 2)
  1) type of agricultural energy crop,
  2) type of transportation biofuel and
  3) country/region of the agricultural energy crop cultivation
- The agricultural energy crop cultivation has significant impact in LCA of transportation biofuel (Figure 3)
- Key influences: regional characteristics with yields, fertilization, plant protective agent and irrigation
- Impact allocation to transportation biofuels and by-products gives different results: energy allocation and substitution method
- Direct N_2O-emission of agricultural soils by N-input are a major impact on greenhouse gas emissions (30 – 60%) but difficult to quantify exactly (Figure 4)
- But: agricultural cultivation for food, feed, fibre&fuel is done similar

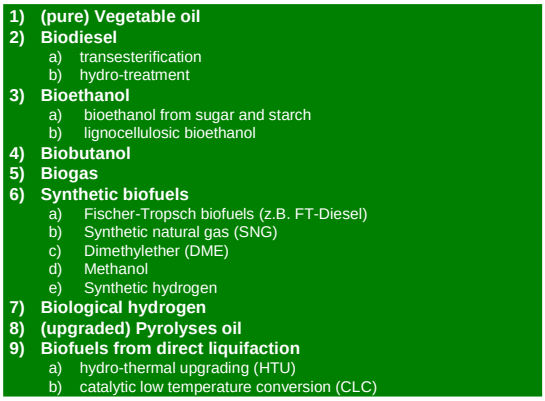

Figure 1: Overview of transportation biofuels

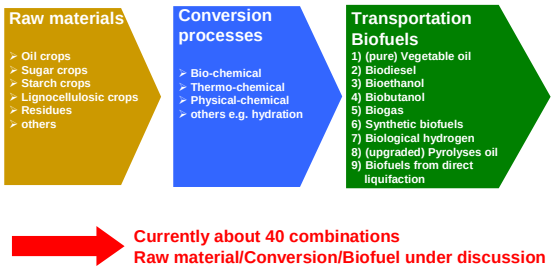

Figure 2: Possible combinations from biomass resource to transportation biofuels

- Kind of crop
- Water content of crop [%]
- Heating value of crop [MJ/t_{dm}]
- Yield [t_{dm}/(ha*a)]
- Kind and amount of plant protective agent [kg/(ha*a)]
- Kind and amount of fertilizer [kg/(ha*a)]
- Irrgiation [kWh_{el}/(ha*a)]
- Kind and usage of machine [l_{fuel}/(ha*a)]

Figure 3: LCA data for energy crop cultivation

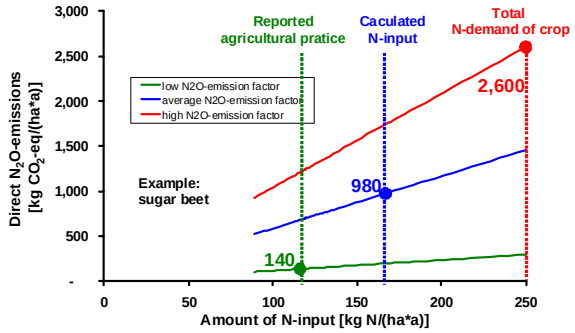

Figure 4: Range of direct N2O-emissions from agricultural soils

3 REFERENCES

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