COMPARATIVE EVALUATION OF THE ECOLOGICAL AND ECONOMIC PERFORMANCE OF NEW RENEWABLE FUELS AND E-MOBILITY

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The aim of this study is a comparative assessment of new renewable fuels (mainly so-called second-generation fuels) and e-mobility refering to the service capacity in terms of ecological and economic performance. From the objective, a number of questions can be derived:

- What are the reductions of greenhouse gas emissions which can be achieved with advanced biofuel technologies and e-mobility compared to fossil based reference systems?
- What is the impact of the application of these new technologies to other enviornmental media?
- Which second generation biofuel supply pathways have the highest efficiencies (respectively primary energy use etc.)?
- Which of the investigated process chains allow the most efficient renewable fuel deployment across the entire life cycle?
- What process chains turn out to benchmark with other technologies as particularly economically attractive?
- What are the raw materials and quantities available in Europe at an sustainable extraction?

The evaulated reference systems are based on the following technologies:

- Bioethanol from wheat (‘first generation’ with natural gas as process fuel)
- Bioethanol from wheat straw (‘second generation’ with enzymatic saccharification)
- Biomass to Liquid (BtL) from woody residues
- Biomethane production from lignocellulosic raw materials after pretreatment with steam explosion
- Biomethane production from organic wastes
- Synthetic Natural Gas (SNG) from wood biomass
- Electric-driven car with electricity from renewables (Photovoltaic and Wind)
- Electric-driven car with electricity from UCTE-Mix
- Fossil diesel and gasoline according to DIN EN 228 and DIN EN 590

As an essential reference point the results are assessed using the sustainabilty criteria for biofuels, defined under the climate package of the European Union. These were also involved when defining the system boundaries and impact indicators. The economic analysis (life cycle cost analysis) focuses on the investigation of investment and running costs of production facilities to generate specific full-costs per service unit.

The comparative technology evaluation within the Life Cycle Assessment showed significant differences in the environmental impacts of biomass related technologies. An important impact for the “environmental performance” of a biobased energy provision comes from the used supportive energy source in the biomass conversion stage as well as the conversion efficiency and by-product handling.

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Additionally the effects of land use change showed high impacts when the potential for reduction of Green House Gases (GHG) of bioenergy pathways versus fossil energy sources is quantified. The different technologies showed different positive and negative attitudes in the applied impact categories therefore cumulating the environmental effects into single indicators causes a high loss of information. Regional aspects play a significant role for the feedstock availability and subsequently for the environmental effects caused by biomass transportation, land use change and change in nutrition balance of arable land. The ecological performance of the e-mobility systems very strongly depends on the choosen electricty source.

The economic performance of the biobased technology showed a significant economy of scale and dependency on feedstock input prices. The cost factor of e-mobility is found in the utilisation phase due to high investments in electricity storage in the current pricing.

The results of the investigation process is adressed to developers and potential technology users in order to get an objective picture of the performance and to stimulate system changes positively. The applied combination of Life Cycle Assessment and Life Cycle Costing methods can support a more holistic picture of the compared technology initiatives.