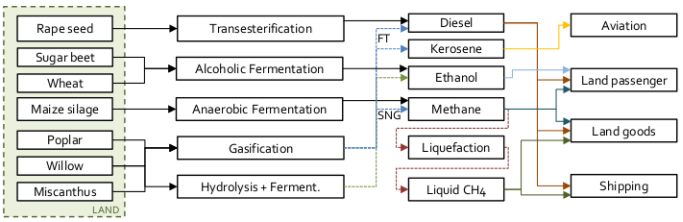
Optimal biofuel futures: the role of functional units and fuel suitability

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Abstract

Statement of the Problem: Biofuels are a renewable alternative for reducing the climate impact of transport. Policy uses different functional units for introducing biofuels, with resulting differing optimal biofuel pathways. **Methodology & Theoretical Orientation:** Several models are developed in order to assess the competitiveness of various crop based biofuel options, using different economic and environmental functional units, in Germany until 2050. **Findings:** Different functional units, as well as fuels and markets included result in different merit orders for the biofuel options. Currently most common conventional biofuels were found not to be competitive, and advanced liquid fuels were only competitive at extreme assumptions, contrary to common expectations. Instead, sugar beet based ethanol dominated for most of the time span when comparing energetic cost, whereas Synthetic Natural Gas (SNG) was competitive on a greenhouse gas abatement (GHG) cost basis, especially at a rapid decarbonisation of the power mix. Switching from current practise to higher yielding biofuel options can potentially increase GHG abatement per land unit by a factor of five. With such a functional unit, silage maize based biomethane was the best, with SNG converging only at very high renewables shares of the background systems; and the land passenger transport becomes the highest priority due to the suitability of higher yielding biofuel options, followed by land goods transport, shipping and finally aviation. If gaseous fuels are not possible to introduce on a large scale, goods transport and shipping become priority. Biofuel admixture quotas to sub-sectors of land transport renders a significantly lower climate benefit compared to an overall optimal usage. **Conclusion & Significance:** The direct importance of land use has thus far not received enough attention in terms of the economics of biofuels from dedicated crops, as well as for the greenhouse gas emissions policy.

Image



Recent Publications (minimum 5)

1. Millinger, M., Thrän, D. (2018): Biomass price developments inhibit biofuel investments and research in Germany: The crucial future role of high yields. Journal of Cleaner Production. 172, 1654-1663.
2. Millinger, M., Meisel, K., Budzinski, M., Thrän, D. (2017): Relative Greenhouse Gas Abatement Cost Competitiveness of Biofuels in Germany. Preprints. doi:10.20944/preprints201712.0122.v1
3. Millinger, M., Ponitka, J., Arendt, O., Thrän, D. (2017): Competitiveness of advanced and conventional biofuels: Results from least-cost modelling of biofuel competition in Germany. Energy Policy. 107, 394-402.
4. Thrän, D., Arendt, O., Banse, M., Braun, J., Fritsche, U., Gärtner, S., Hennenberg, K. J., Hünneke, K., Millinger, M., Ponitka, J., Rettenmaier, N., Schaldach, R., Schüngel, J., Wern, B., Wolf, V., (2017): Strategy elements for a sustainable bioenergy policy based on scenarios and systems modeling demonstrated on the example of Germany. Chem. Eng. Technol. 40 (2), 211-226.

Thrän, D., Schaldach, R., Millinger, M., Wolf, V., Arendt, O., Ponitka, J., Gärtner, S., Rettenmaier, N., Hennenberg, K., Schüngel, J., (2016): The MILESTONES modeling framework: An integrated analysis of national bioenergy strategies and their global environmental impacts. Environ. Modell. Softw. 86, 14 – 29.



Biography

Markus Millinger conducts research on bioenergy futures through systems modelling. He has developed several models for assessing biofuel future scenarios from different perspectives. Millinger has a background in mechanical engineering and industrial ecology from Chalmers University of Technology, Gothenburg, Sweden.

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Prof. Daniela Thrän works in system analysis of renewable resources for energy and materials. She holds the chair of bioenergy systems at Leipzig University.

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