Techno-economically-driven identification of ideal plant configurations for a new biomass-to-liquid process – A case study for Central-Europe

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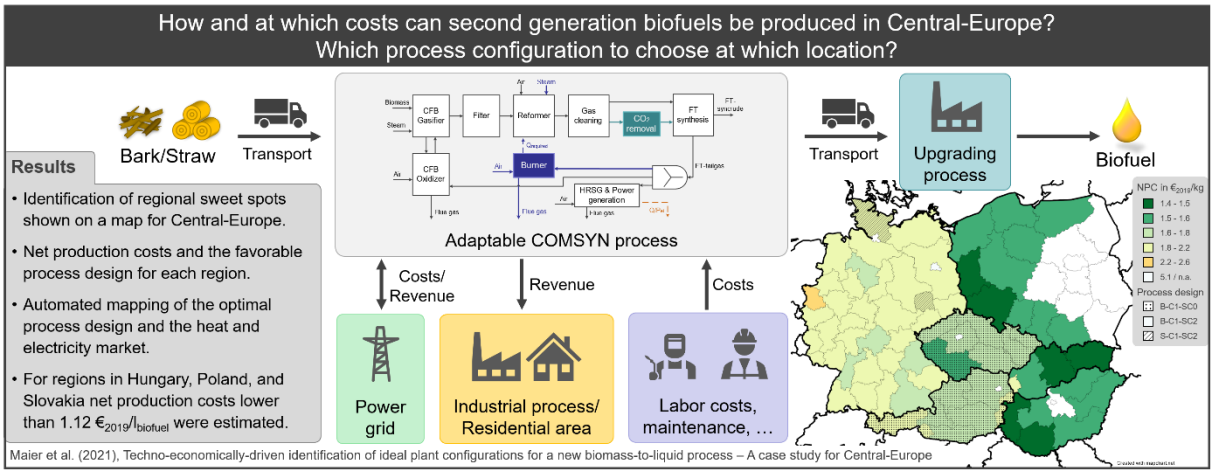
Abstract

The conversion of agricultural waste materials such as bark or straw into 2nd generation biofuels constitutes an auspicious way to meet part of the future fuel demand in a sustainable way. The number of possible production routes is diverse, and the techno-economic analyses of these routes have been conducted in very different ways. The route involving gasification, gas purification, and a subsequent Fischer-Tropsch synthesis enables the production of hydrocarbons that achieve current fuel standards after upgrading in the existing refinery infrastructure. To evaluate a promising biomass-to-liquid process, a methodology is presented that incorporates economic constraints into the process design, allowing identification of a regionally optimal process design. The production costs of the new concepts are estimated by setting up a detailed flowsheet simulation in AspenPlus® based on experimental data from the successful demonstration runs of the EU-Project COMSYN. In addition, an existing techno-economic evaluation methodology incorporated into the in-house software tool TEPET (Techno-Economic Process Evaluation Tool) has been extended to evaluate the processes' performance in different European regions and to include transportation and refining costs. The approach enables the identification of regional sweet spots shown on a map for Central-Europe, indicating production costs and favorable process design for each region. Furthermore, the results of an automated mapping for the optimal process design depending on the heat and electricity market are presented. The performed analyses show that the techno-economic evaluation tends to expand the technology in regions with low feedstock costs, while the optimal process design is defined by the regional heat and electricity market. In this work, net production costs of less than 1.12 $€_{2019}/l_{biofuel}$ were determined for regions in Hungary, Poland and Slovakia.

Graphical Abstract



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