Well-to-tank data for advanced tailor-made biofuel alternatives

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Background

The present work is part of a cross-disciplinary national Swedish research project on advanced tailor-made biofuels that aims at identifying drop-in biofuel options for the transport sector that combine excellent combustion properties with sustainable production pathways. A key aspect of the research collaboration is a close dialogue between the experimental engine research teams investigating engine performance and biofuel handling and combustion in the engine systems, and the energy systems research groups analyzing the biomass potential, production aspects for the respective biofuels, and performance of the entire value chain from well-to-wheel (WTW). The present paper addresses the methodology and primary results of the biofuel production pathway assessment for the Diesel fuel alternatives identified for assessment within the project.

Research challenge

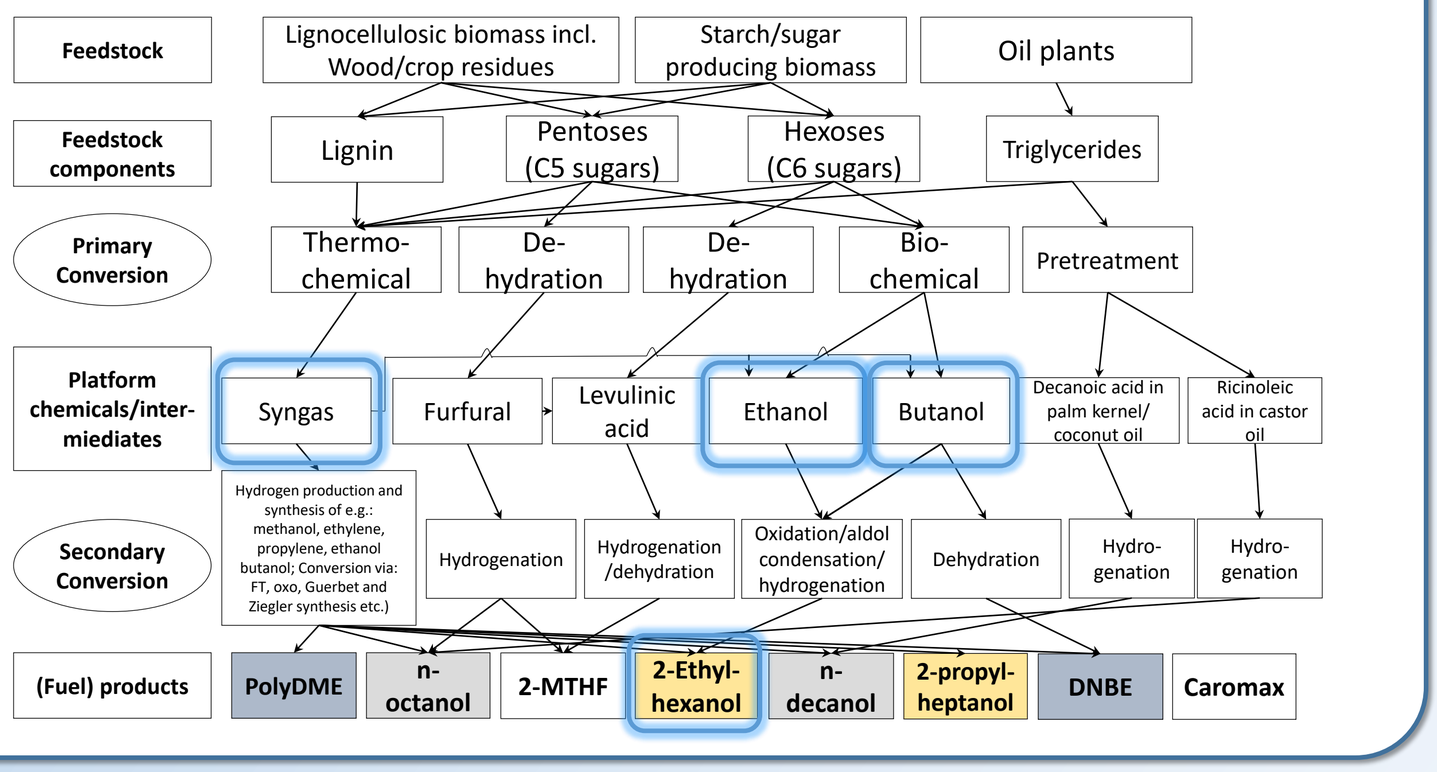
- Multitude of potential fuels in combination with numerous production pathways available

Methodology

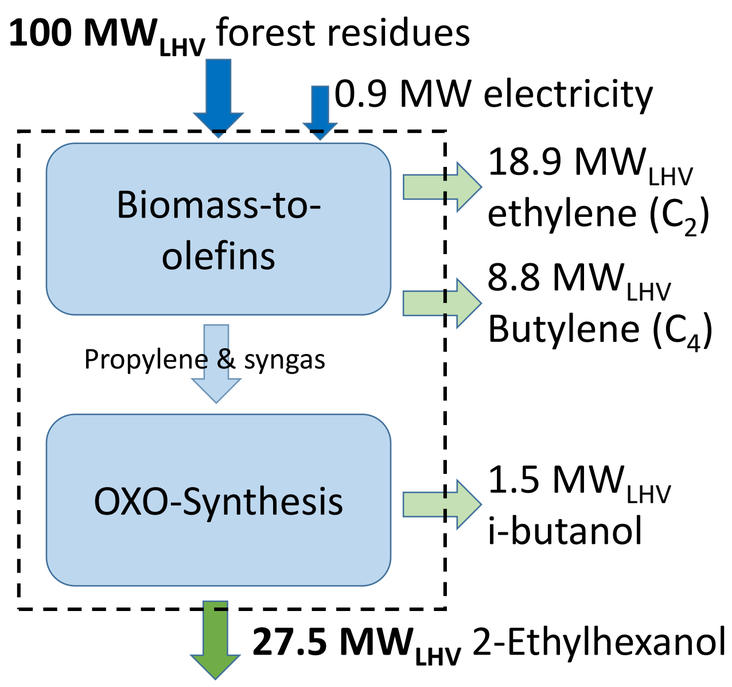
- Screening of promising fuels
- Production pathway analysis
- Choice of industrially relevant pathways
- Process synthesis and analysis of process integration opportunities
- Identification of critical factors for sustainability performance

- The methodology is illustrated for **2-Ethylhexanol (2-EH)**

Eight diesel fuel alternatives – production pathways

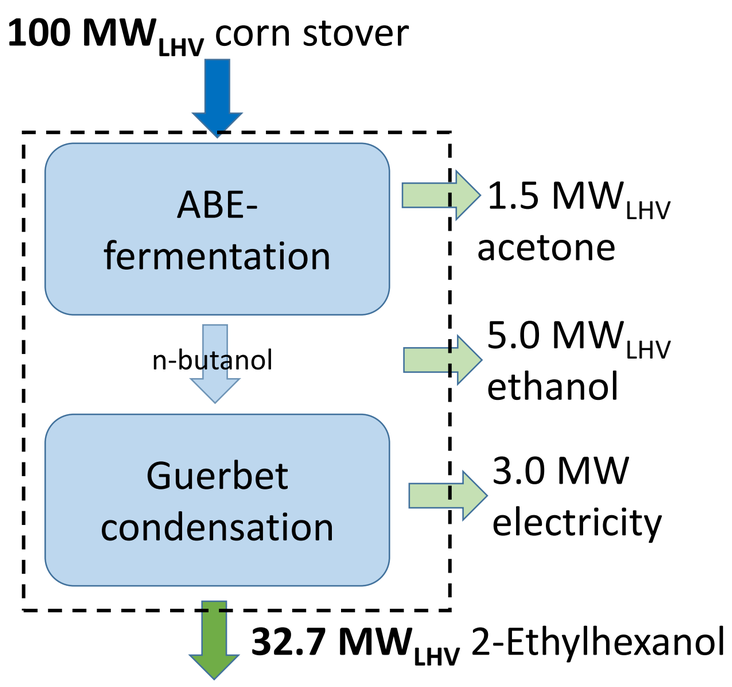


Gasfication-based



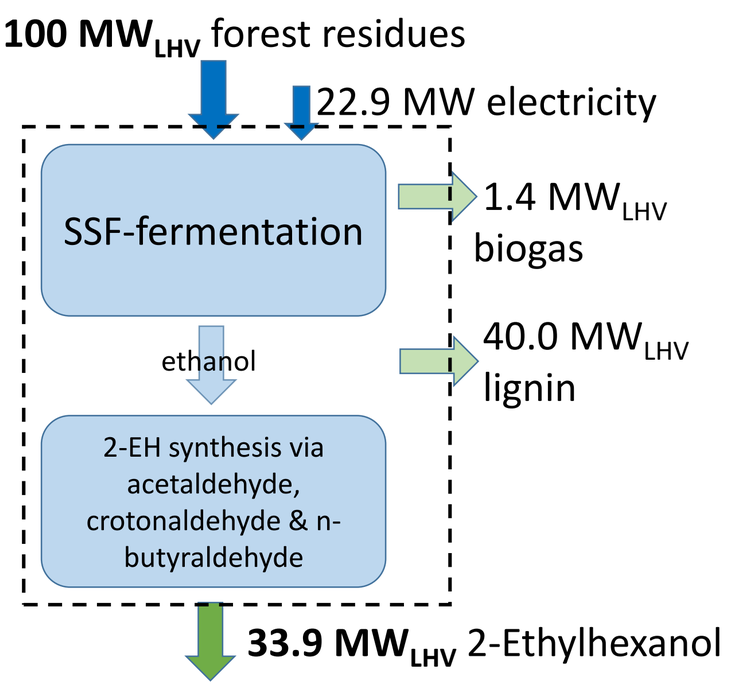
$\eta_{bio\text{-}to\text{-}2\text{-}EH}$ = 27.5% η_{tot} = 56.1%

Butanol-based



$\eta_{bio\text{-}to\text{-}2\text{-}EH}$ = 32.7% η_{tot} = 42.2%

Ethanol-based



$\eta_{bio\text{-}to\text{-}2\text{-}EH}$ = 33.9% η_{tot} = 61.2%

Preliminary results

- Highest biomass to 2-Ethylhexanol conversion via ethanol
- Varying spectrum of by-products
- 2-Ethylhexanol production performs worse from an energy efficiency perspective than ”conventional” biofuels (due to additional conversion steps)
- Use phase benefits such as higher blend-in ratios, existing distribution infrastructure and reduced NO_x or particle emissions may change the WTW picture

Outlook

- Evaluation of process concepts using attributional Life Cycle Assessment accounting for by-products by system expansion with product substition (to be presented at TMFB conference 20-22 June 2017)
- Guidance towards promising pathways (*platform chemicals*) based on critical parameters for 2-Ethylhexanol production
- Combination of WTT data with engine combustion experiments to evaluate the whole WTW performance
- Multi-criteria analysis to illustrate potential for advanced biofuels from different perspectives

Project partners / Supported by:

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