Techno-economic assessment of a biorefinery concept consisting of AD und HTL

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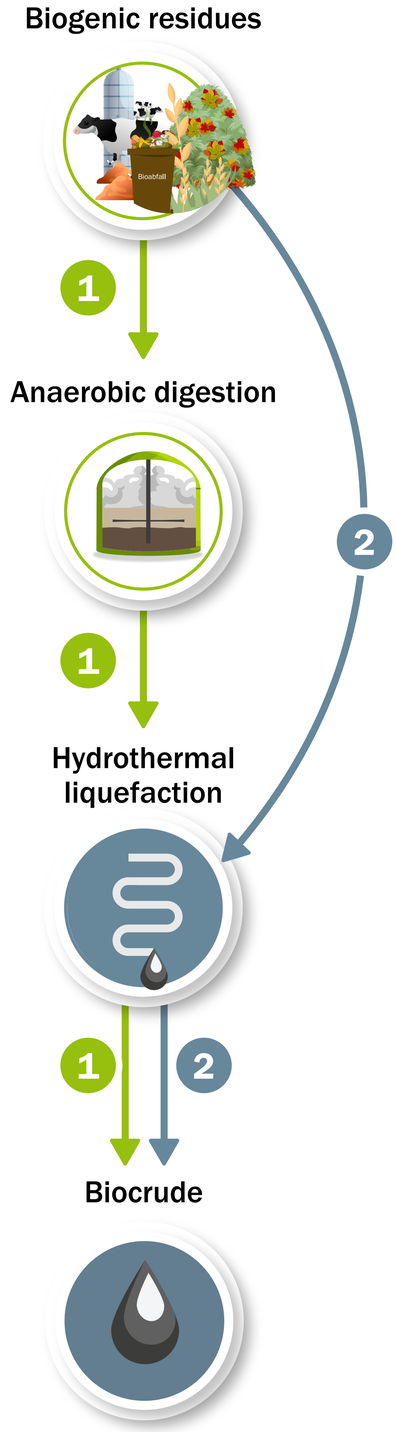
Intro

The management of digestate from anaerobic digestion poses an economic and environmental problem, especially for concentrated operations. In the present work, hydrothermal liquefaction is investigated as a potential treatment technology for digestate and compared with hydrothermal liquefaction of the undigested material prior to fermentation. A process simulation in Aspen Plus is set up based on experimental results for the design of equipment and a preliminary cost estimate in order to evaluate the process techno-economically. The equipment prices are then used to analyse the production costs via factorial methods.



1 Anaerobic digestion + hydrothermal liquefaction

Method:

- Biogas yield from operator data.
- Cost estimation using KTBL calculator.

Production cost:

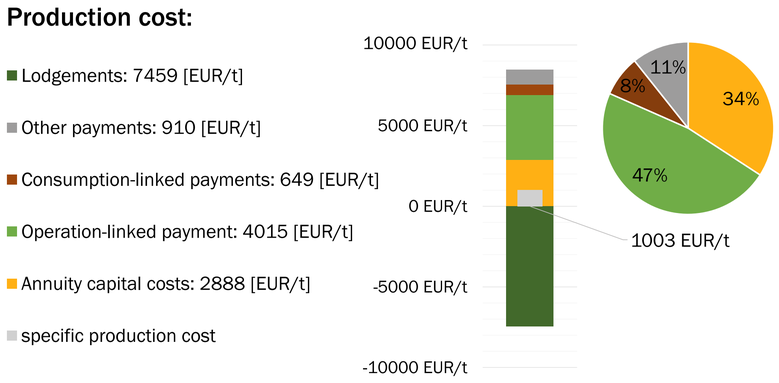


Fig. 1: Breakdown of production cost for AD + HTL

Analysis of production cost:

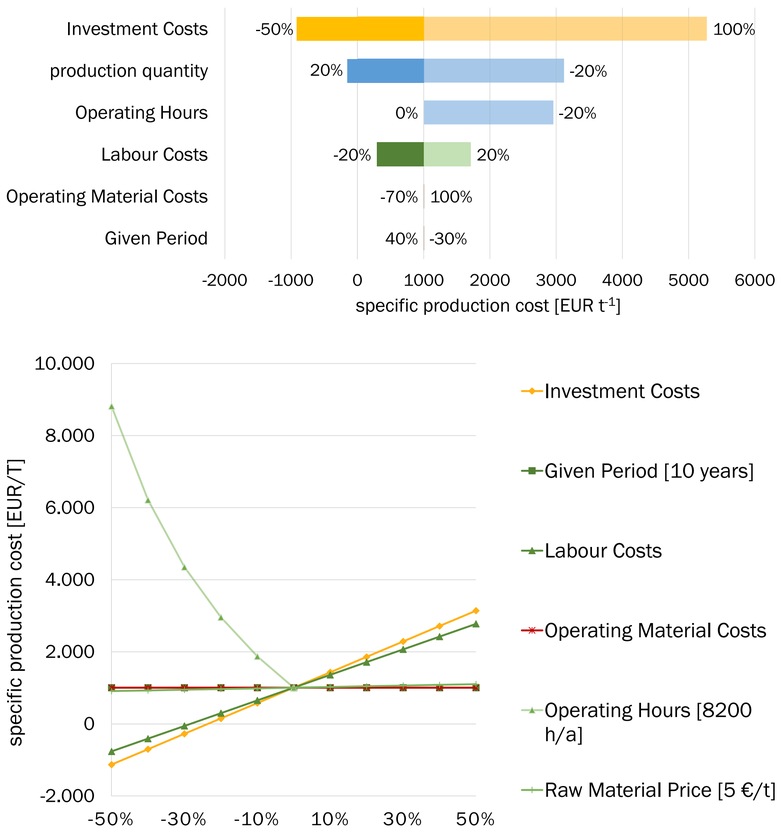


Fig. 2: Sensitivity analysis for AD + HTL

Conclusion & outlook

- Fuel precursor can be produced for < 4 €/L
- Combination AD + HTL facilitates lower production cost and higher energy yield
- Sensitivity analysis highlights investment cost, labour cost and production quantity as price drivers
- To come: comparaitive price calculation (DACE, Peters) and scale up

Mass and energy balance

Comparative balancing of routes 1) AD + HTL and 2) HTL shows the production costs of biocrude oil according to Aspen Plus of the different paths for the residual material straw/manure.

Tab. 1: Mass and energy balance

Feedstock	Prozess	T[°C]	Y_{Biogas}	$Y_{Biocrude}$	ER_{total}	Biocrude sale [€/L]
Stroh/Gülle	AD + HTL	300	10,09 %	20,50 %	48,50 %	2,69
		325		19,68 %	49,11 %	2,94
		350		19,08 %	50,01 %	3,16
	HTL	300	-	21,07 %	32,35 %	4,03
		325		23,53 %	37,15 %	3,68
		350		22,59 %	36,40 %	3,90

2 Hydrothermal liquefaction

Method:

- Experiments in lab scale
- Process simulation with Aspen Plus, cost estimation using factorial methods

Production cost:

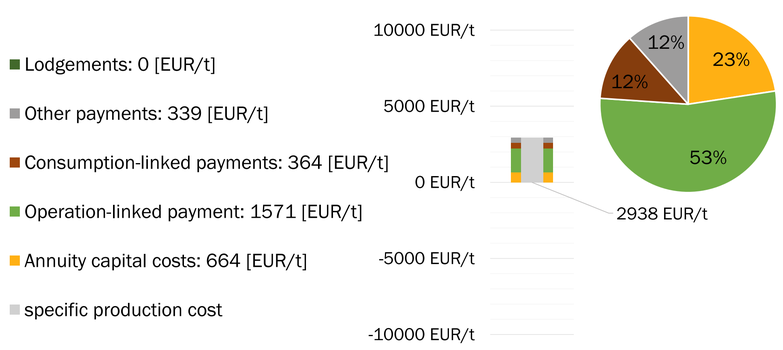


Fig. 3: Breakdown of production cost for HTL

Analysis of production cost:

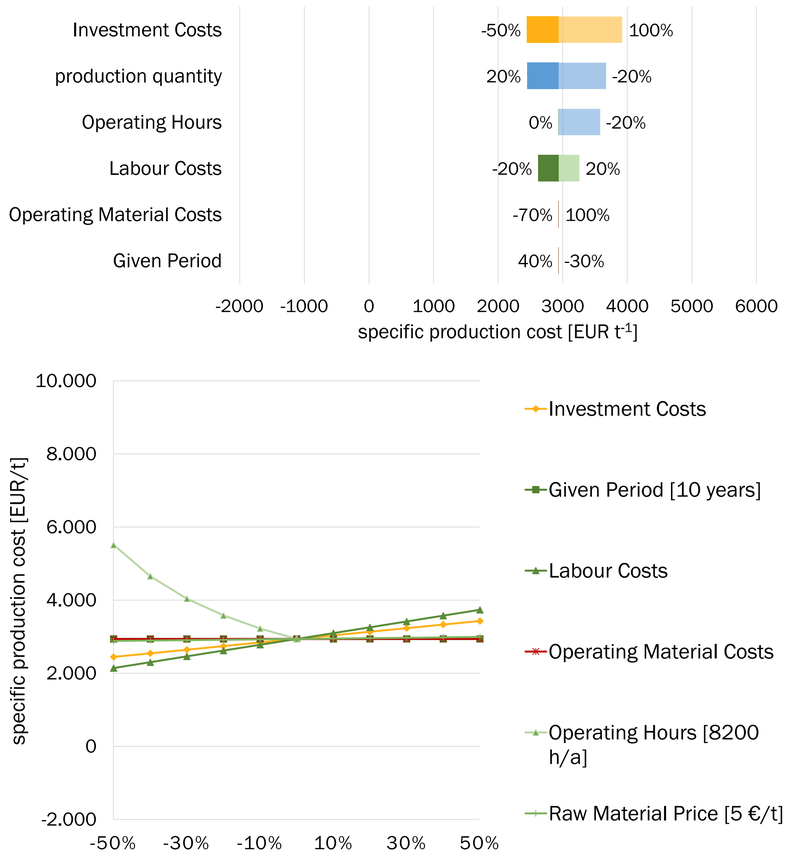


Fig. 4: Sensitivity analysis for HTL

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For more background information on the Pilot-SBG project and the pilot plant for renewable methane, please scan the following QR code:

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