19.11.2019

H2020 HyFlexFuel

Hydrothermal Liquefaction: Enhanced performance and feedstock flexibility for efficient biofuel production

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 764734

H2020 HyFlexFuel: Main objectives

Develop process chain to sustainable liquid fuels via *hydrothermal liquefaction* of *various biomass feedstock*

- ***Feedstock potential assessment***
- ***Hydrothermal liquefaction***
- ***Catalytic upgrading***
- ***Co-refining of biocrudes***
- ***Valorization of HTL aqueous phase***
  - **Catalytic hydrothermal gasification/anaerobic digestion**
- ***Recovery of inorganic nutrients***
- ***System analyses***

Feedstock potentials for HTL

- ***Spatial analysis of feedstock availability for HTL in Europe***
- ***High spatial resolution 1 km²***
- ***Feedstock density maps available for:***
  - **Animal excretions (cattle, pigs, poultry)**
  - **Agricultural by-products**
  - **Sewage sludge**
  - **Biowaste**
- ***Conversion to biofuels potentials based on yield model (HTL and upgrading)***

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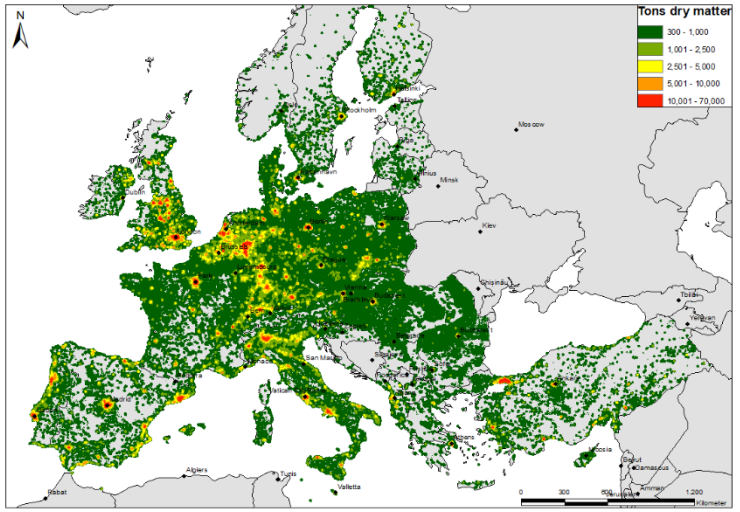
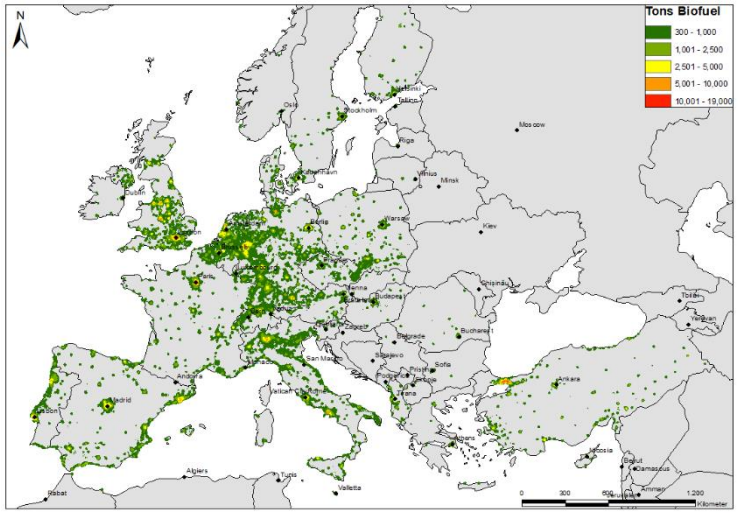
Sewage sludge: Theoretical feedstock potential

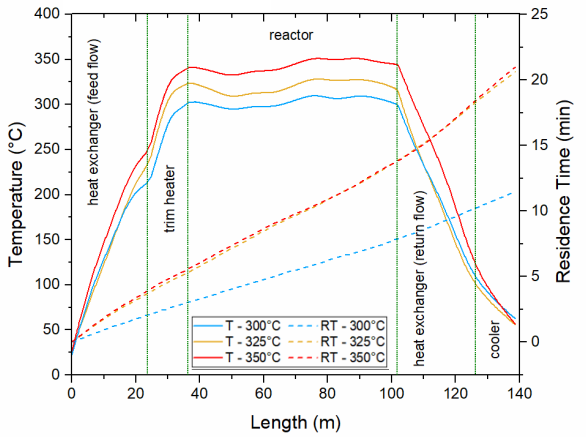


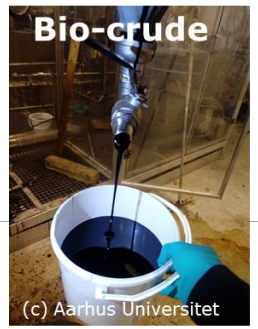


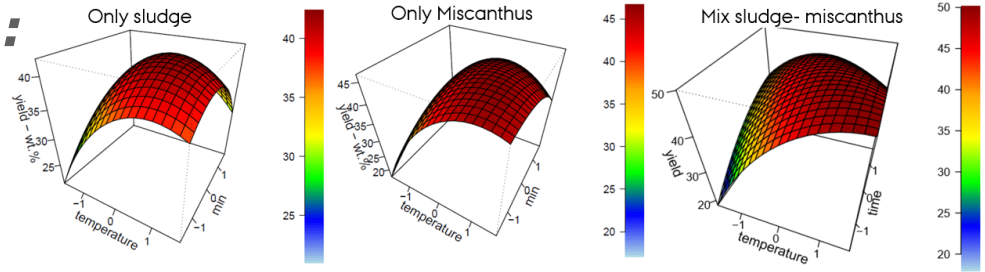
Sewage sludge: Biofuel potential

Pilot-scale HTL campaigns

- ***Typical conditions: 160-220 bar, 300-350ºC, 10-20 min, 60 L/h***
- ***Heat recovery 75-85% (EROI* 3-7)***
- ***In-line filtration to separate solids***
- ***Miscanthus, Spirulina, Sewage sludge***
  manure, corn stover, pine, digestate, willow
- ***Performance enhanced by:***
  - *Water phase recycling*
  - *High DM slurries (up to 23% DM content)*
  - *Feedstock mixes*
- ***Total biocrude production: > 300 kg***







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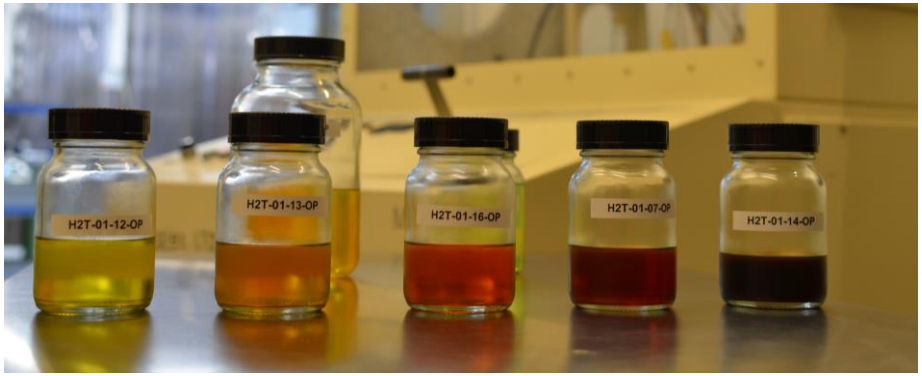
***EROI reactor**: heating value of the bio-crude/ energy input in the system (heating, pumps).

Continuous biocrude upgrading to drop-in fuels

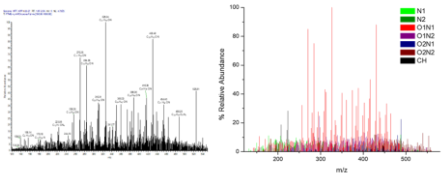
Catalytic hydrotreating

- Flow rate: ~ 30 mL/h
- T=350-400 °C, P ~ 100 bar
- NiMo catalysts by HALDOR TOPSØE



Successful production of drop-in fuels!

Petroleomic Characterization of Bio-Crudes



Co-Distillation - Refining Tests are in progress

Ratio between Biocrude:Fossil Feed determined according to BioCrude quality

Valorisation of residual streams

- ***Energetic valorization of aqueous phase***
  - **Catalytic hydrothermal gasification (HTG)**
  - **Anaerobic digestion**

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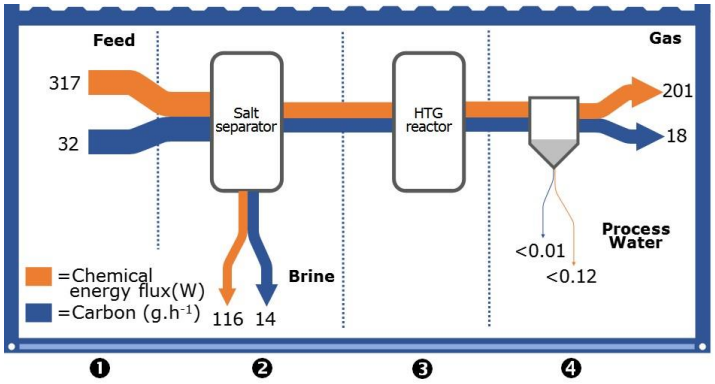
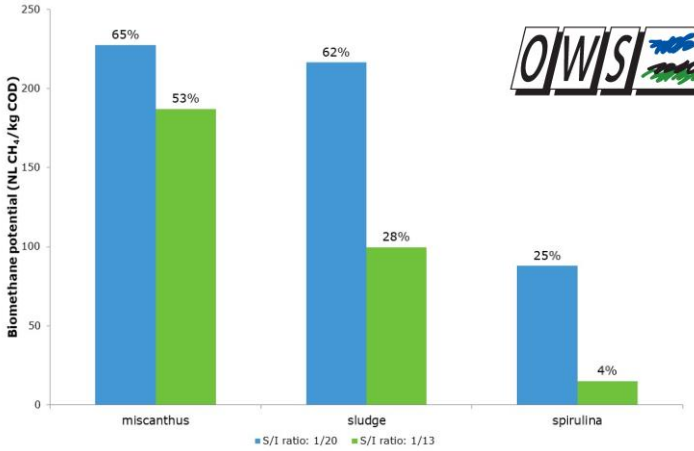
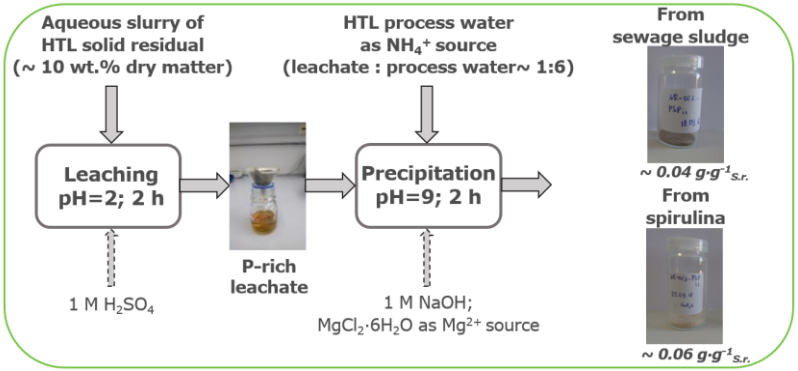




- ***Nutrient recovery***
  - **Precipitation of struvite from solid residuals, HTG brine and HTL process water**



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Conclusions

- ***HyFlexFuel addresses all relevant process steps along the HTL pathway***
- ***Full HTL chain demonstrated:***
  - **Feedstock ⟶ biocrude ⟶ hydrotreated fuel product**
  - **Continuous processing both for HTL and upgrading**
  - **First fuel samples sent for analysis to JETSCREEN project**
- ***Novel high-resolution analytical methods developed for investigation of oil, aqueous phase, and solid residue composition***

Thank you!

Valentin Batteiger

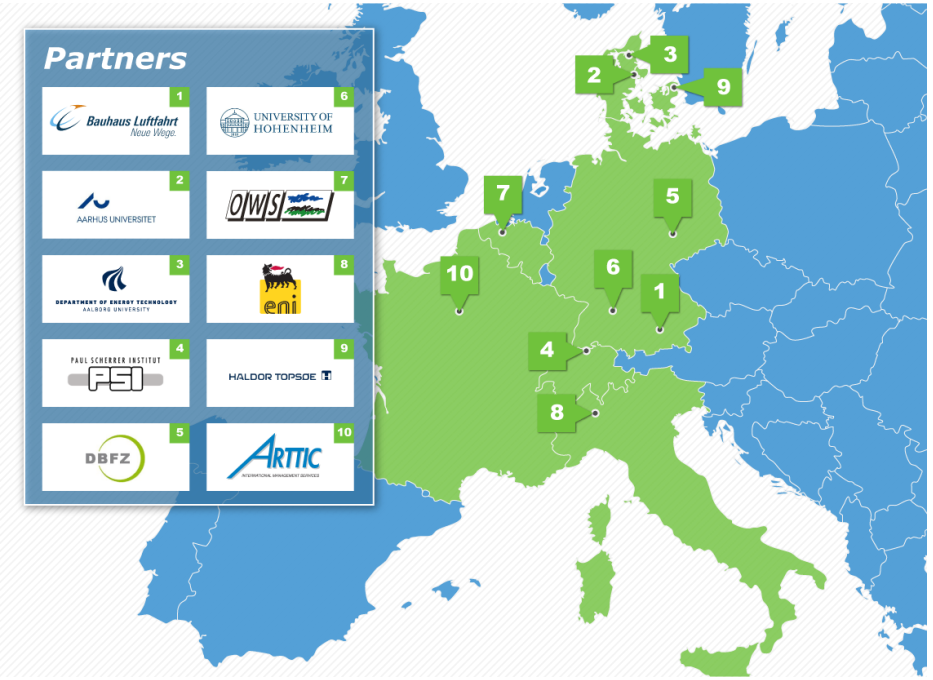
Bauhaus Luftfahrt e. V.

Willy-Messerschmitt-Str. 1

82024 Taufkirchen, GERMANY

+49 (0)89 307 4849-61

Valentin.batteiger@bauhaus-luftfahrt.net



www.hyflexfuel.eu

hyflexfuel-arttic@eurtd.com

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