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Launch of EU-funded Project CIRCULAIR

Sustainable Aviation Fuels from Manure and Straw

The EU-funded research project CIRCULAIR was launched on 1 January 2023. Leading European partner institutions from academia and industry will develop innovative conversion technologies to produce sustainable fuels from abundant agricultural residues through hydrothermal liquefaction.

What CIRCULAIR is about

Making Europe a more circular and climate-neutral society requires responsible utilisation of residues and wastes, as well as large volumes of sustainable fuels for transport sectors like aviation and shipping, where direct electrification is not viable.

The CIRCULAIR project addresses these challenges by developing an advanced biomass conversion pathway for cost-effective fuel production from abundant agricultural residues through hydrothermal liquefaction (HTL). HTL can convert a wide range of organic feedstocks into fuels and is in particular suitable for wet feedstock. The CIRCULAIR process scheme can reduce greenhouse gas emissions as well as air and water pollution issues that result from current manure handling practices. "CIRCULAIR will pave the road for jet fuel production from abundant agricultural residues", says project coordinator Valentin Batteiger of Bauhaus Luftfahrt, "the innovative integration of the HTL process with green hydrogen generation enables almost complete feedstock utilisation and yields methanol as a main by-product." Methanol can be used as marine fuel or as a renewable commodity chemical.

CIRCULAIR consortium

The CIRCULAIR consortium consists of ten partners from six European countries. The implementation activities have a strong regional focus in Denmark. The partners Aarhus University and Circlia Nordic develop the HTL conversion at pilot scale. Aalborg University and Topsoe concentrate on refining intermediate biocrudes from HTL with a high share of jet fuel in the final product. RISE (Sweden) investigates an alternative upgrading process for HTL biocrude using slurry hydro-treatment.

The analysis of the jet fuel produced is ensured by the skills and capabilities of R&D laboratories of Eni (Italy). Universidad Complutense de Madrid (Spain) will recover volatile fatty acids and ammonium from aqueous side streams and separate CO₂ of sufficient purity for methanol synthesis. Universität Hohenheim (Germany) investigates the utilisation of HTL biochars for soil amendment in agriculture. Bauhaus Luftfahrt (Germany) analyses the future performance of the fuel pathway in terms of economic, social and environmental parameters and acts as project coordinator of CIRCULAIR. L-up (France) supports project coordination and leads communication and dissemination activities.

Key innovations

CIRCULAIR's key innovations cover the entire process chain from feedstock to final fuels and by-products. Manures and straw were chosen as feedstocks, due to their abundance in agriculture and potential synergy effects in the co-liquefaction of these feedstocks. CIRCULAIR investigates the co-liquefaction phenomenon and aims at solving the process water challenge of HTL by closely integrating HTL conversion with wet oxidation of HTL process waters.

In addition, CIRCULAIR will develop innovative approaches to upgrade HTL biocrudes to on-specification jet fuel and thereby prepare the approval process of HTL jet fuel for civil aviation. Biomass resource utilisation will be maximised by developing suitable valorisation schemes for all relevant side streams. In particular, volatile fatty acids will be extracted from HTL process waters and methanol will be synthesised using CO₂ from effluent gas streams and renewable hydrogen. CIRCULAIR will fill a knowledge gap regarding the use of HTL chars for soil application, thereby creating a negative contribution to the carbon footprint. CIRCULAIR builds on the results of its precursor [HyFlexFuel](#), an EU Horizon 2020 project, which delivered ground-breaking research and innovations in HTL fuel production.

Project information

CIRCULAIR is a four-year research project funded by the European Commission under the Horizon Europe Programme with a total budget of 5 million Euros. The Research and Innovation Action (RIA) will advance the technical maturity of core conversion steps along the HTL fuel production chain to a technological readiness level of TRL 4-5 on a scale from TRL 1 to 9 (TRL 4: Technology validated in a lab, TRL5: Technology validated in an industrially relevant environment). Official start date: 1 January 2023.

Contact

Coordinator: Dr. Valentin Batteiger | Bauhaus Luftfahrt e.V., Taufkirchen, Germany

Tel: +49 89 307484961

Mail: contact@project-circulair.eu

Website: www.project-circulair.eu

LinkedIn: <https://www.linkedin.com/company/92941206/>