HIGFLY: HIGEE TO FURANIC-BASED JET-FUEL TECHNOLOGY

Low-TRL Renewable Technologies Workshop

Sustainable Places 2022

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Consortium

9 partners, 4 countries,

entire value chain (5 RTO/HES & 4 SME/IND)

SUSTAINABLE PLACES 2022

Sep. 6 - Sep. 9, 2022 | Nice, France

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°101006618

HIGEE TO FURANIC-BASED JET-FUEL TECHNOLOGY

HIGFLY

RIA in H2020 WP «Secure, Clean and Energy Efficiency»

Developing the next generation of renewable energy technologies

Jan 2021 ← 4 years = 48 months → Dec 2024

~today

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HIGFLY Overall Aim

HIGFLY aims to develop the next generation of technologies for the production of advanced renewable jet fuels from abundant and sustainable biomass feedstocks.

HIGFLY vs. alternative bio jet fuel technologies

	Conventional bio jet fuels	Advanced bio jet fuels	
	HEFA	Gas-to-Jet & Alcohol-to-Jet	HIGFLY
Feedstock	Used cooking oil, fats, vegetable oils	Forestry residues, agri-residues, biogenic wastes, etc.	
	Scarce and costly feedstock	**Abundant and low cost feedstock**	
Carbon efficiency of key conversion step	50-65%	20-65%	70-90%
	• High resource efficiency • High operation costs • Regulatory restricted to 1.7% of total jet fuel	• Low resource efficiency • High capital costs	• **High resource efficiency** • **Synergy with other biorefinerie** • **Reduced costs**

Project Concept

2G Biomass

Biorefinery technologies

Steam explosion	Organosolv fractionation
Hydrolysis	Hot water
Other concepts	

Synergy with other bio-refineries

Target products: Cellulose sugars

Under-utilised: Other sugars
Pentoses, acetic acid, furfural, phenolics, others

Under-utilised: Lignin
Material & energy applications

ATJ technologies + HIGFLY process

Sustainable aviation fuel

In a nutshell...

C5 biorefinery streams

HIGFLY Technology

Drop-in grade jet fuel

C5 biorefinery streams

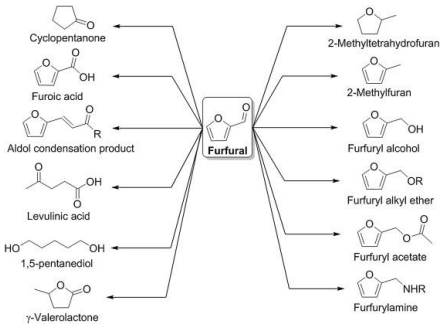
5 Feedstock analysis, Jet fuel analysis; Technology evaluation, Stakeholder analysis; Social assessment, Environmental impact

1 Synthesis of jet fuel precursors

2 Membrane Purification

3 Synthesis of jet fuels

Sustainable Jet-fuel (~C8-C15 HC)



Light oxygenates

To process H_2 /Hydrocarbons

4 Catalytic valorization of light oxygenates

Target sustainable feeds

Maximise resource efficiency

Minimize energy demands

Increase process scalability

Minimize environmental impact

Decrease cost & accelerate uptake

HIGFLY Objectives

Main aim: develop the next generation of technologies for the production of advanced renewable jet fuels from abundant and sustainable biomass feedstocks.

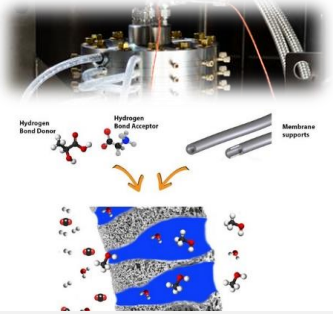
Feed

To utilise abundant and sustainable feedstocks, e.g. 2G biomass, biogenic wastes, and sustainably cultivated biomass.

Technology

To develop and demonstrate at TRL3-4 innovative technologies to produce advanced bio jet fuels resource, energy and cost-effectively.

Robust catalytic materials and sustainable solvents



Innovative, highly-efficient reactor and separation technologies

Value-chain & jet-fuel

To advance the knowledge of its innovative technologies through evaluation of the entire value chain, from feedstock(s) to bio jet fuel in order to:

- Demonstrate the advantages of the environmental, social and techno-economic performance of HIGFLY technologies
- Accelerate prospect of regulatory compliance of HIGFLY's bio jet fuel.

Achievements & challenges

Feed

To utilise abundant and sustainable feedstocks.

1. Evaluation & selection of suitable feeds

2. TRL3-4 demonstration (in the lab) of HIGFLY technology, step-wise, using a real biorefinery streams to bio jet fuel

To reach this goal, HIGFLY has already…

- Assessed availability & suitability of sustainable feedstocks, and identified potential synergies of HIGFLY technologies with existing/emerging biorefineries in EU
- Selected potential bio-refinery streams = combination of feed & bio-refinery technology.
- Engaged in activities for sample exchange with other EU projects for lab-tests. One sample is being tested in first steps of HIGFLY – want to connect with HIGFLY? M.f.neira.dangelo@tue.nl

Achievements & challenges

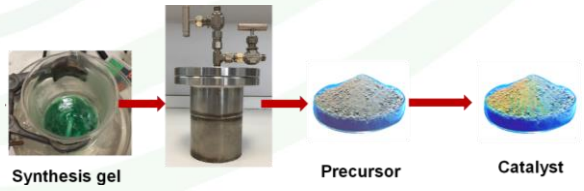
Technology

To develop and demonstrate at TRL3-4 innovative technologies to produce advanced bio jet fuels resource, energy and cost-effectively.

1 Continuous synthesis of jet-fuel precursors (furanics) with high yields - targets ~90% (benchmark ~50-60%)

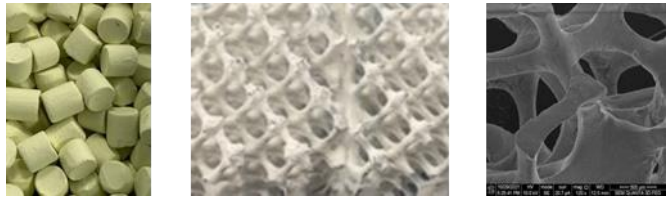
New catalyst materials

Synthesized, characterized & tested > 35 solid catalysts
Identified 2 highly attractive – stable & selective
Generated basis for IP



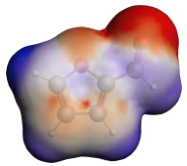
Catalyst structuring

Scalability & high efficiency



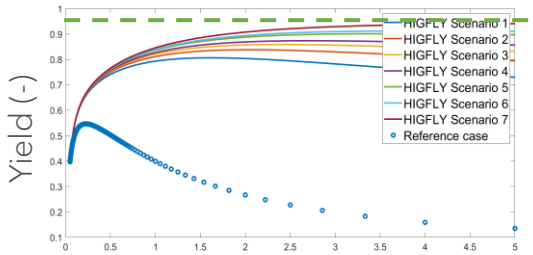
New solvents - Deep-Eutectic Solvents from natural compounds

Discovery of new solvents using AI-based modelling using quantum mechanical data
5-10 times greater performance than conventional solvents
Basis for IP



New reactors based on HiGee technology

Design, building & modelling



targets ~90% can be achieved!

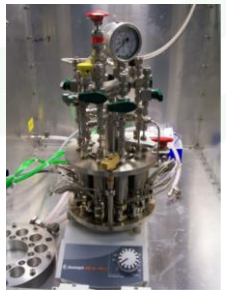
Achievements & challenges

Technology

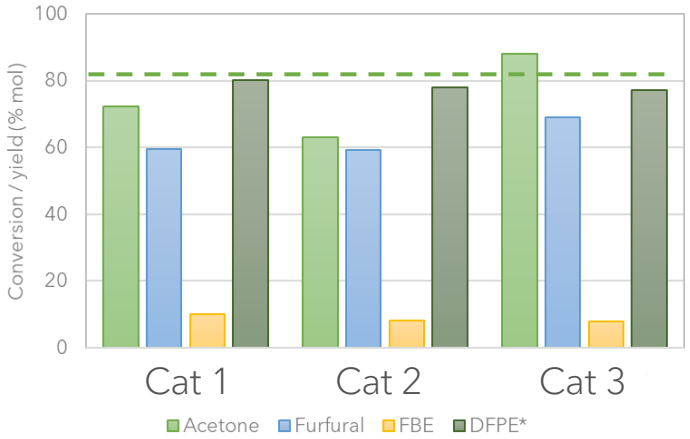
To develop and demonstrate at TRL3-4 innovative technologies to produce advanced bio jet fuels resource, energy and cost-effectively.

1. Continuous synthesis of jet-fuel precursors (furanics) with high yields - targets ~90% (benchmark ~50-60%)
2. Continuous synthesis of jet-fuel from furanic precursors with high yields - targets ~80%

Synthesized, characterized & tested > 35 solid catalysts



Identified 3 highly attractive 80% target achieved



Catalyst forming for scalable processes

Batch to continuous

Gas vs. liquid phase process

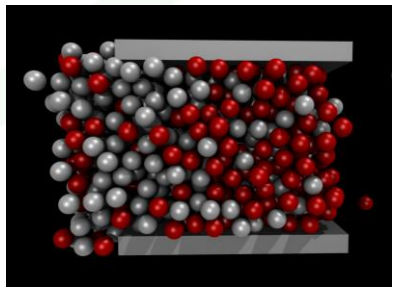
Interested?
Presentation by Karla Dussan - Session: Renewable Energy Technologies, 9 September

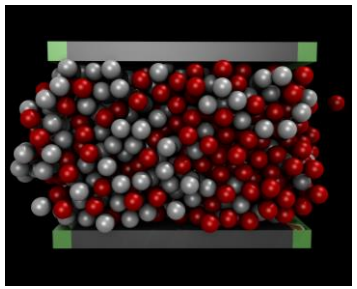
Achievements & challenges

Technology

To develop and demonstrate at TRL3-4 innovative technologies to produce advanced bio jet fuels resource, energy and cost-effectively.

1. Continuous synthesis of jet-fuel precursors (furanics) with high yields - targets ~90% (benchmark ~50-60%)
2. Continuous synthesis of jet-fuel from furanic precursors with high yields - targets ~80%
3. Purification of key bio-oxygenates via membranes & affinity separation





To be continued…

Challenges:

- Timing/scales in technology integration – useful: integration sessions
- Complexity in real vs. model feeds
- Analytics of real feeds

Achievements & challenges

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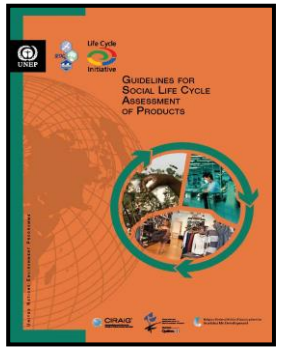
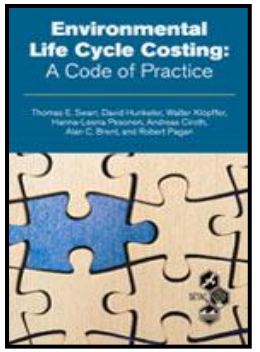
Preliminary phases…

TEE: Overall process performance

Scenario code	Carbon Efficiency [%]	Energy efficiency [%]
T1	80%	74%
T2	78%	73%
S1	78%	70%
S2	89%	80%
S3	85%	77%
S4	78%	73%
D1	84%	77%
D2	78%	73%

Social & Environmental Life Cycle Assessment (sLCA & eLCC)



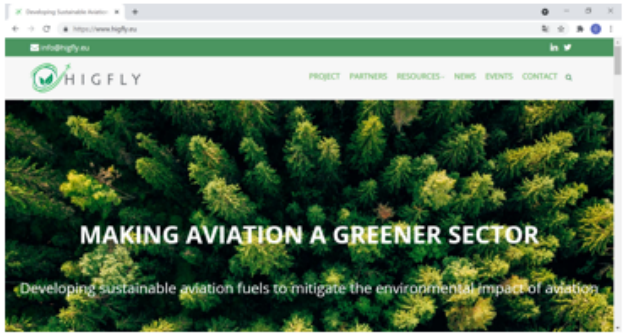


Evaluation HIGFLY jet fuel properties (vs. ASTM standard D7566)

- Impact and target blending ratios
- Barriers to certification
- Feedback to technology development

Challenge: Acquiring good quality data on time..

Dissemination and Communication activities



www.higfly.eu

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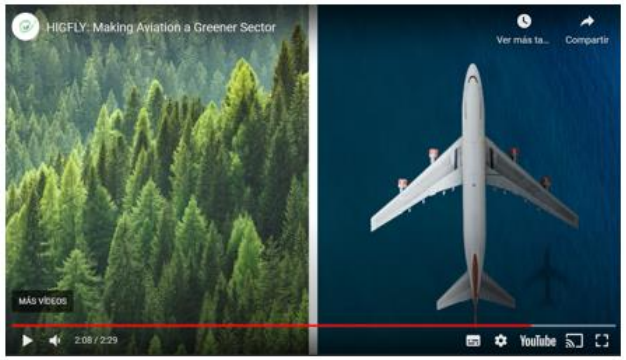

YouTube HIGFLY

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HIGFLY

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