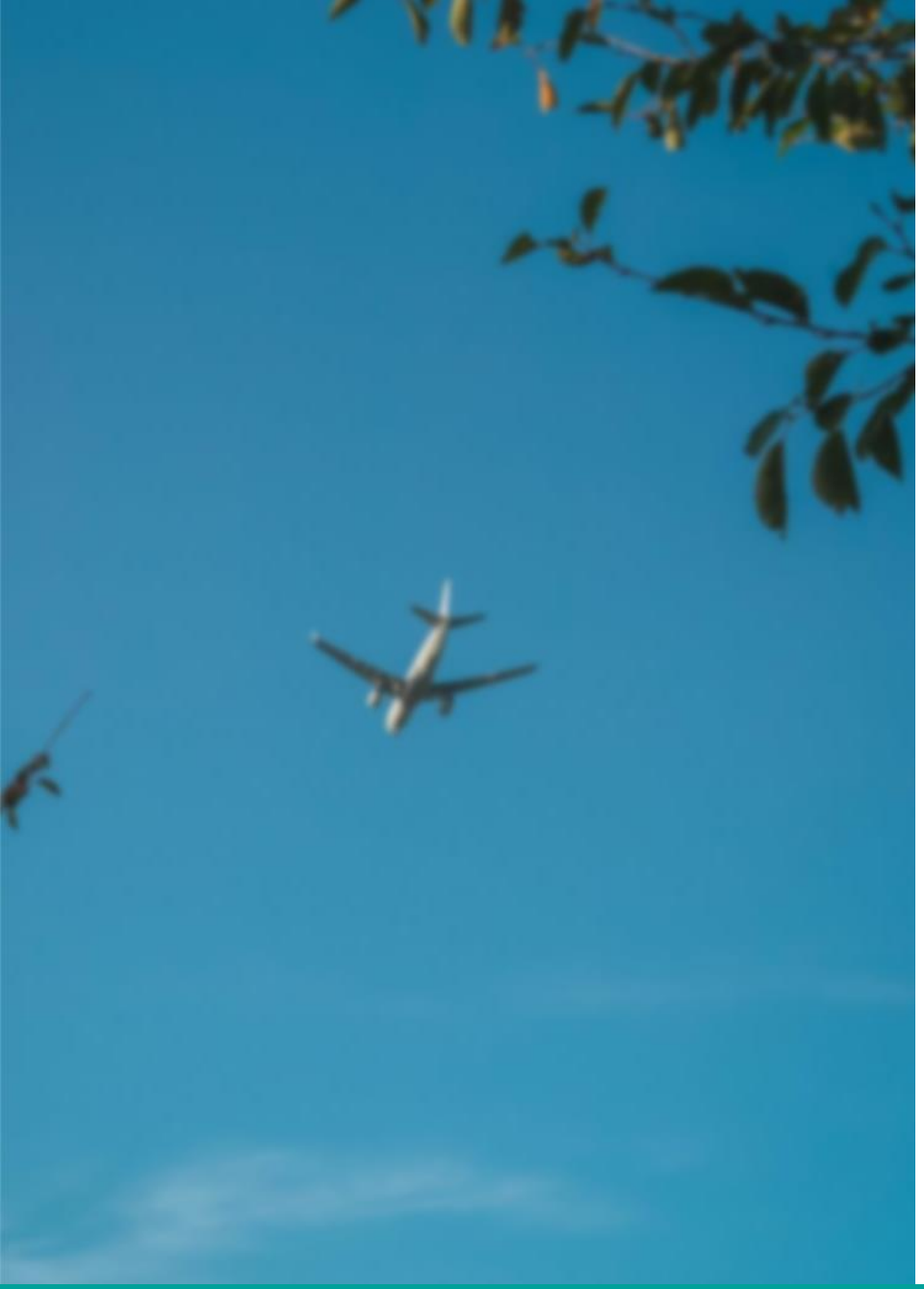
INTERNATIONAL COOPERATION FOR SUSTAINABLE AVIATION BIOFUELS

International Cooperation on Sustainable Aviation Biofuels

Myrsini Christou

ΚΑΠΕ CRES

Head of Biomass Department / CRES



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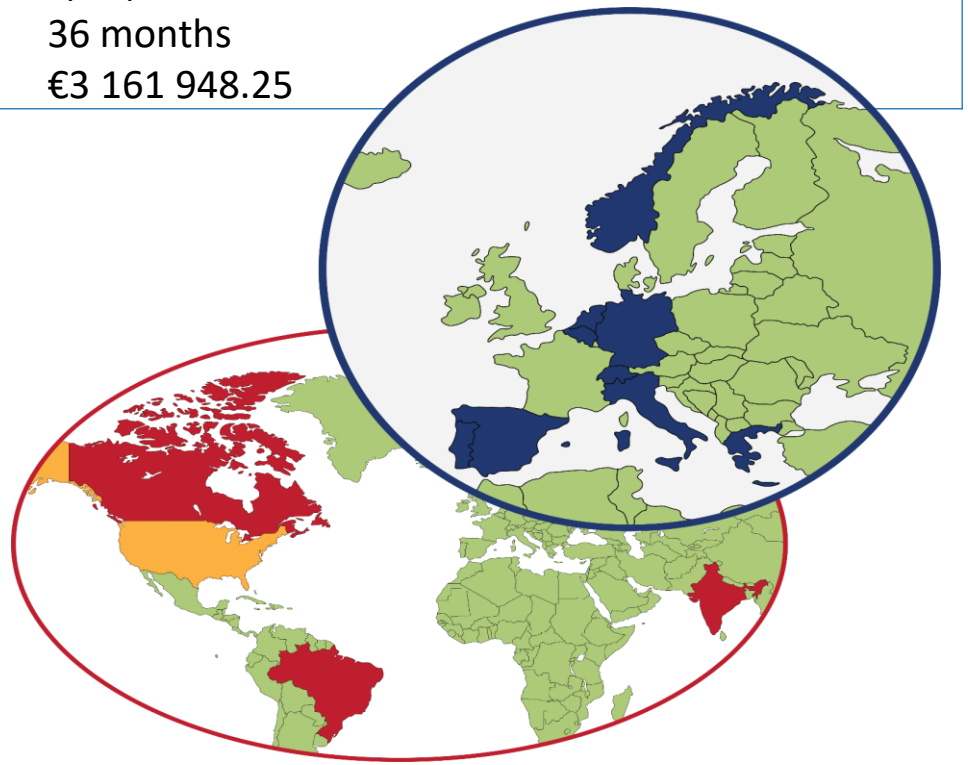
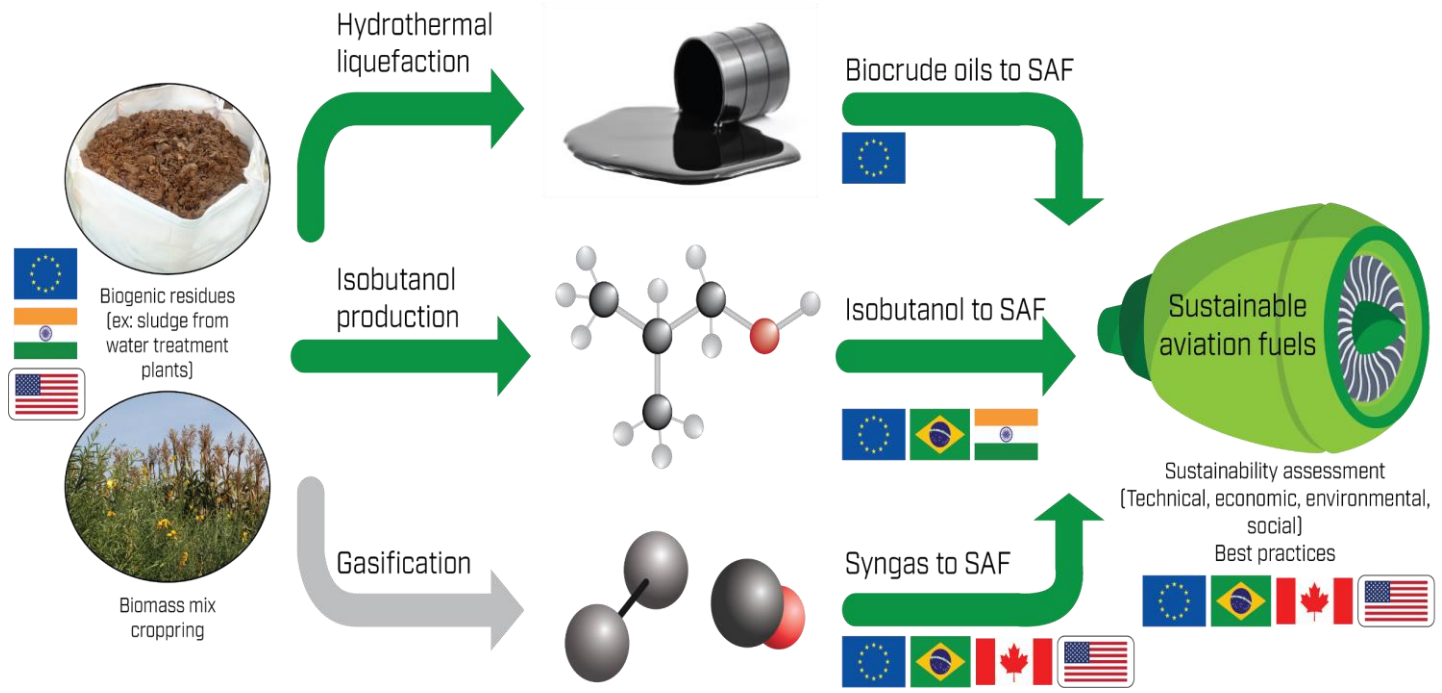
Project Details	
Project:	101122303—ICARUS—HORIZON-CL5-2022-D3-03 Best international practice for scaling up sustainable biofuels
Service:	CINEA/C/02
Starting date:	1/10/2023
Duration:	36 months
Budget:	€3 161 948.25



	Participants	Status	Country
1	CRES	RTO	Greece
2	LNEG	RTO	Portugal
3	TNO	RTO	Netherlands
4	NTNU	University	Norway
5	SINTEF	RTO	Norway
6	WIP	SME	Germany
7	DBFZ	RTO	Germany
8	UNIBO	University	Italy
9	BIOREF	RTO	Portugal
10	PETROGAL	IND	Portugal
11	EHU	University	Spain
12	NovelYeast	SME	Belgium
13	NEVIS	SME	Greece
14	KM-IIC	Consultant	Belgium
15 (AP)	RSB	NGO	Switzerland
16 (AP)	UDS	RTO	Canada
17 (AP)	To be confirmed		India
18 (AP)	AVIONIC	SME	India
19 (AP)	SENAI RN - ISI-ER	RTO	Brazil
20 (AP)	SENAI CIMATEC	RTO	Brazil

Objectives

The ultimate objective is to develop **best practices** (based on improved innovative technologies) **and concepts** (founded on market access knowledge) along three entire value chains for accelerating the scale-up of sustainable aviation biofuels production worldwide.



Specific objectives

- ✓ To evaluate the framework conditions for SAF development in Europe and Mission Innovation countries, along the three major value chains
- ✓ To improve scaling up of selected promising technologies in Europe and MI countries, specifically on topics/technological challenges which hinder the market deployment.
- ✓ To enhance overall cost-effectiveness and sustainability of large scale production of sustainable biofuels based on Life Cycle Analysis addressing social, economic and environmental aspects for selected value chains.
- ✓ To develop future best practices and concepts along the entire values chains, based on experiences and lessons learnt built on European and MIC. To set guidelines for scaling-up and synergies between the private industry and the scientific community at European and global level.
- ✓ To effectively disseminate and exploit ICARUS activities and results among important international stakeholders and end users as well as the general public

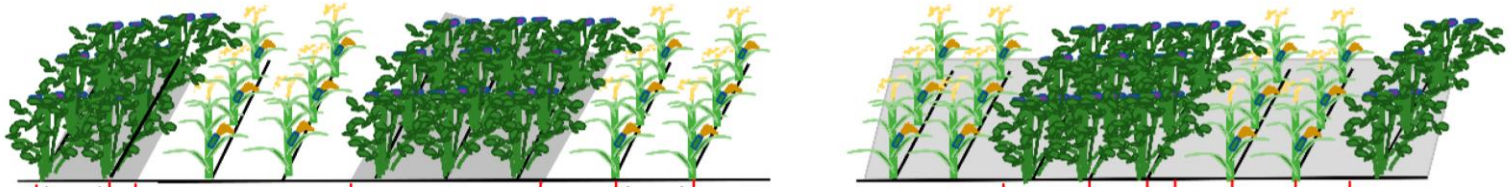
Innovations (1/5)

INNOVATION PILLAR 1: Feedstock

SPECIFIC NEED: To assure sustainable, affordable and diversified biomass feedstock

OUTCOME: New knowledge on mix cropping systems

Technical novelty beyond the state of the art:



- Biomass sorghum mix cropped with legumes and cover crops
- Managing the species combination ratios in the mixed cropping system, the lignocellulosic, oil and mineral composition of blended feedstocks can be somehow regulated.
- Mix cropping systems, integrated within a conventional food crop rotations will increase biomass availability by 3 to 4 times, contribute to a more efficient use of land resources and reduce GHG emissions.

R&I maturity - TRL evolution: Tests at 2 TRL levels: i) under controlled environmental conditions (TRL3-4 by UNIBO), and ii) in field trials during the last two years of the project (TRL 4-5 by UNIBO, CRES, and ICRISAT), for the best performing mixtures.

Innovations (2/5)

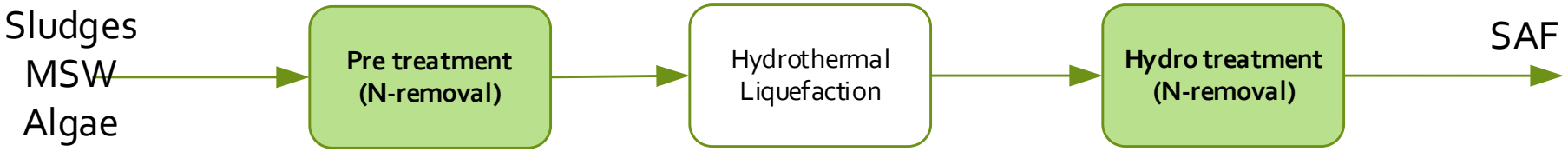
INNOVATION PILLAR 2: Biocrude oils to SAF value chain

SPECIFIC NEED: To demonstrate optimal catalyst ensemble for the bio-oil hydrotreatment

OUTCOME: N removal technology for improving biocrude oils quality

Technical novelty beyond the state of the art:

- Improvement of feedstock pretreatment and HTL processing to reduce the nitrogen in the biocrude prior hydrotreating.
- Creation of an innovative catalyst bed with blends of strategical catalysts to simplify the hydrotreatment process by decreasing the steps, energy/H2 consumption and materials applied.



The biocrude oils to SAF value chain can be depicted in several main steps. For each of these steps, an effort will be made to reduce the nitrogen content within Icarus. Additionally, we will also develop an innovative single step biocrude oil upgrading to maximize process yield and to minimize the nitrogen content in the product fuel, which is detrimental to the quality of the SAF.

R&I maturity - TRL evolution: TRL 3/4 to TRL 5.

Innovations (3/5)

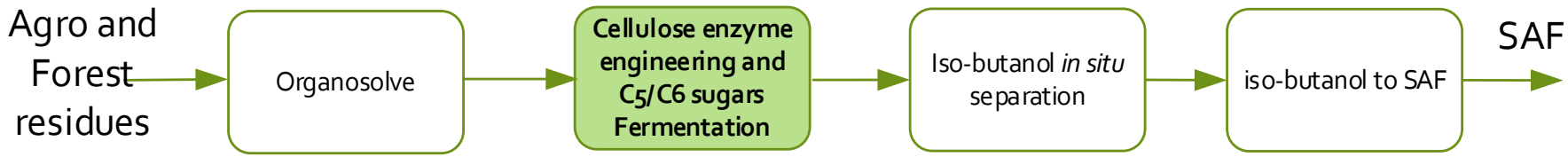
INNOVATION PILLAR 3: Isobutanol to SAF value chain

SPECIFIC NEED: to engineer secretion of cellulolytic enzymes in 2G isobutanol yeast to lower enzyme cost in biomass saccharification.

OUTCOME: Optimized yeast for the direct conversion of cellulose and C5 and C6 sugars into isobutanol

Technical novelty beyond the state of the art:

- Reducing OPEX related to enzyme requirement in the conversion of 2G biomass to alcohol by developing a modified yeast strain allowing improved economic viability of this pathway.



The Isobutanol to SAF value chain can be depicted in several main steps. Within Icarus the main focus is on the direct cellulose hydrolysis and C_5/C_6 sugars fermentation with the aim to minimize the need for an expensive cocktail of enzymes.

R&I maturity - TRL evolution: Starting at lab scale TRL3 the developed strain will be successfully tested in a 100- to 1,000-Litres scale coupled to a pervaporation membrane in a closed loop, where both technologies will reach TRL 5.

Innovations (4/5)

INNOVATION PILLAR 4: Syngas to SAF value chain
SPECIFIC NEED: Design and testing of a new FT catalyst, which will only produce liquid products **OUTCOME:** Design and testing of the new FT catalyst which allow smaller sized plants fitting much better with the local availability of biogenic residues.
Technical novelty beyond the state of the art: ➲ Demonstrate a new FT synthesis that will significantly reduce the CAPEX and hence improve the economic viability of this pathway.    For each of these steps innovation is possible but within Icarus the main focus is on the Fischer Tropsch synthesis with the aim demonstrate a pathway directly to liquids, reducing the CAPEX of the overall value chain.
R&I maturity - TRL evolution: FT catalyst will be brought to TRL 4/5

Innovations (5/5)

INNOVATION PILLAR 5: Sustainability analysis
SPECIFIC NEED: To secure a sustainable transition to a large-scale use of SAFs **OUTCOME:** Methods and approaches for sustainability assessments
Technical novelty beyond the state of the art: ➲ To establish a novel framework for the sustainability analysis from a value chain perspective of SAFs that are at a precommercial stage, to facilitate their sustainable development and realize sustainability-driven innovation. ➲ The environmental analysis will take a future-oriented (prospective) approach to embed forthcoming technological and socio-economic changes ➲ New approaches will be used to estimate effects of scaling-up the technology to a commercial scale ➲ The process model-based approach will provide a basis to systematically connect processing stages also to reverse-engineer decision making suggesting means to debottleneck conversion and downstream inefficiencies.

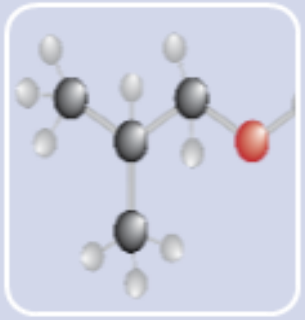
The consortium and its involvement

FEEDSTOCK

CRES, UNIBO, BIOREF, LNEG, NEVIS ICRISAT, NDSU*

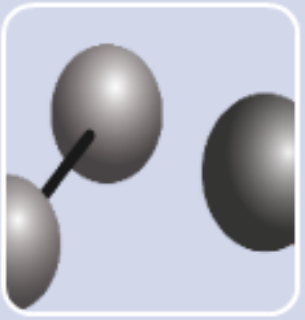
BIOCRUDE OILS - SAF

BIOREF, DBFZ, LNEG, SINTEF,



ISOBUTA-NOL - SAF

EHU, LNEG, BIOREF, TNO, NY, AVIONIC, SENAI-CIMATEC



SYNGAS - SAF

TNO, EHU, PETROGAL, UDS, NREL* SENAI R/N,

ASSESSMENTS

NTNU, LNEG, DBFZ, CRES, NEVIS, KM, RSB, UDS, SENAIR/N NREL*

BEST PRACTI-CES

SINTEF, ALL

External Executive Advisory Board

Members of the External Executive Advisory Board Key expertise	Contribution in the project
Dr Robert Baldwin, NREL Extensive experience in catalysis, reaction engineering, biomass gasification, biomass liquefaction, upgrading of bio-oil, and advanced biofuels.	Innovation in Syngas-SAF Value Chains (WP2)
Dr Marisol Berti, NDSU Expert in forage, cover crops, and bioenergy crops production research. Sustainability and resilience and environmental impact of cropping systems.	Innovation in feedstock (WP2)
Prof. Glaucia Souza, FAPESP Bioenergy Research Program Coordinator University of São Paulo Full Professor, IEA Bioenergy TCP Task 39 Co-Leader on Biofuels to Decarbonize Transport	Capacity building globally (WP5)
Tomas Ekbom, Program Director, BioDriv, Svebio – Swedish Bioenergy Association IEA Bioenergy TCP Task 39 Co-Leader on Biofuels to Decarbonize Transport	
Marco Buffi, JRC Expert in GHG emissions calculations of SAF for both REDIII and ICAO CORSIA' initiative	Sustainability assessments (WP3)
Themistoklis Neokosmidis, Concawe Low Carbon Pathways Science Associate	Coordination with the Oil Sector (WP4)

Thank you for your attention

Stay tuned….

Myrsini Christou
mchrist@cres.gr

Partners

Associated Partners

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