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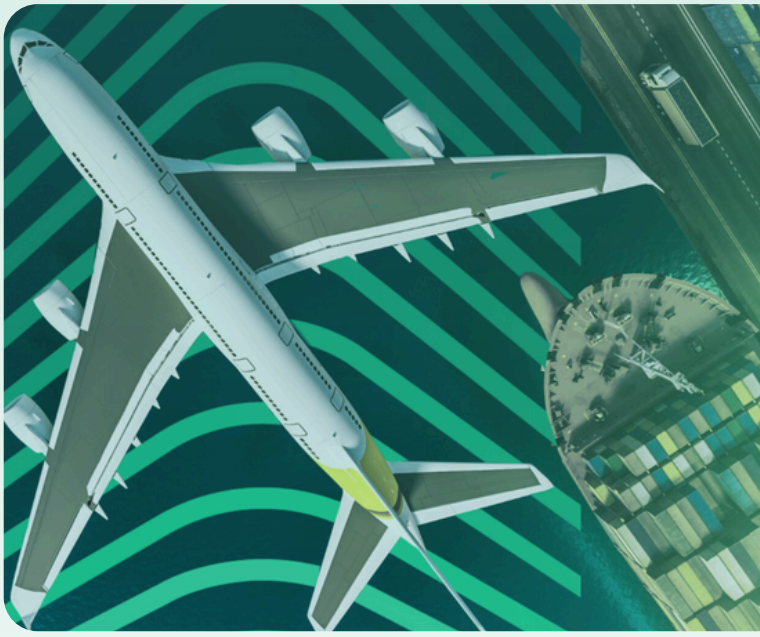
PROJECT NEWSLETTER

Fuel-Up

Powering a Greener Future for Aviation and Marine Transport



We are pleased to share the first issue of FUEL-UP newsletter, keeping you up to date with all the latest news and developments from the project. FUEL-UP – *Production of advanced biofuels via pyrolysis and upgrading of 100% biogenic residues for aviation and marine sector, including full valorisation of side streams* – is a Horizon Europe Innovation Action aimed at transforming biogenic waste into advanced biofuels to enable the green transition and the decarbonisation of the aviation and the marine transport sectors.

CONTENT

1. Introduction and Objectives

FUEL-UP is a Horizon Europe Innovation Action aimed at transforming biogenic waste into advanced biofuels to enable the green transition and the decarbonisation of the aviation and the marine transport sectors.

FUEL-UP will provide solutions to make a paradigm shift towards the production of renewable sustainable aviation fuels (SAF) and marine fuels by producing stabilized deoxygenated pyrolysis oils (SDPO) from pyrolysis oils (PO) derived from 100% biogenic feedstock that can be subsequently processed towards a fully hydrotreated oil in a refinery.

The project will, therefore, validate, at demo scale, a route to produce sustainable liquid biofuels from lignocellulosic streams with more than 45% aviation fuel, about 35% in the marine diesel and 20% heavy naphtha at technology readiness level-7 (TRL-7).

FUEL-UP will expand Europe's technology portfolio for biogenic feedstocks to second generation transportation fuels by 2030, to demonstrate superior performance in product quality, price and yields, compared to alternatives being developed.

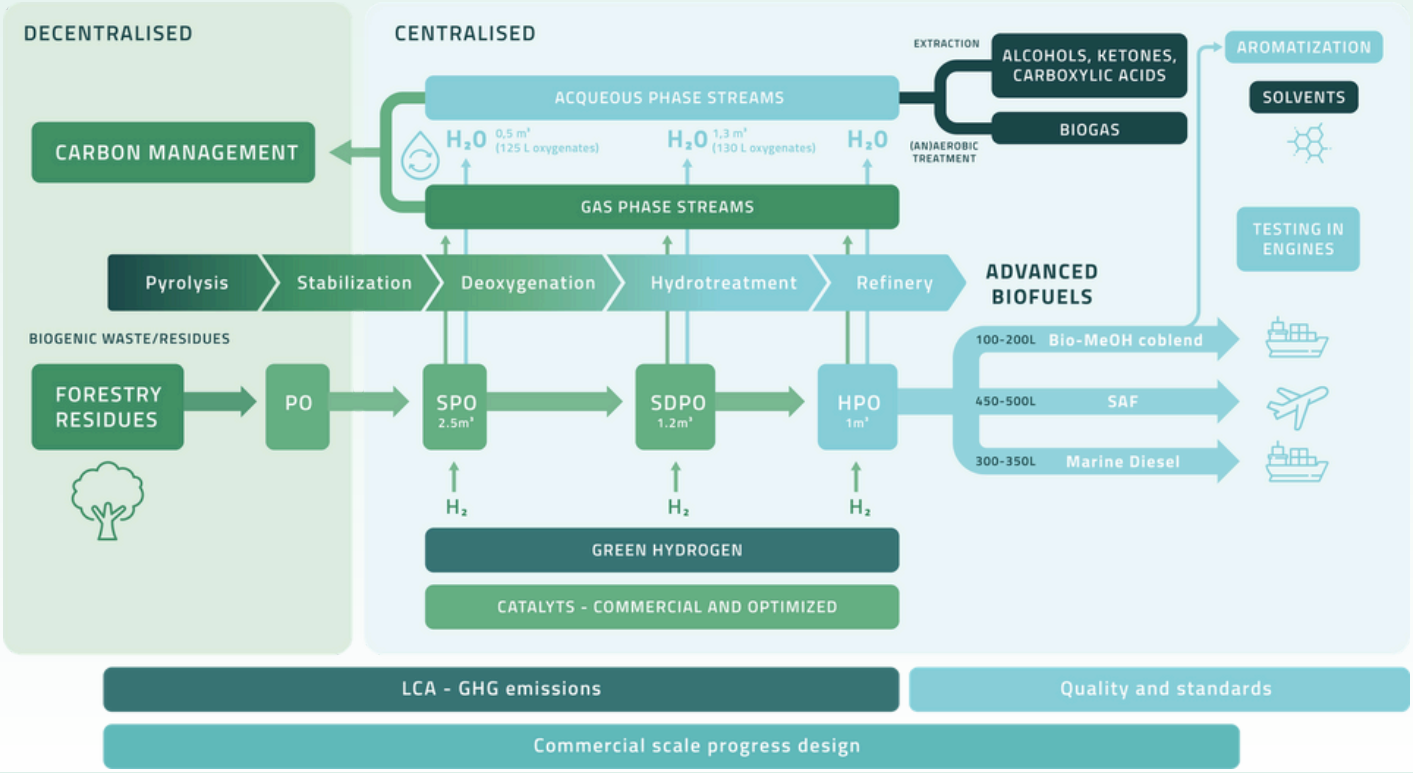


Figure 1. FUEL-UP Overall Project Concept. Source: FUEL-UP Website

Key objectives of the project include:

- **Demonstrating the full value chain of production of advanced biofuels**: FUEL-UP will showcase a viable pathway for creating advanced biofuels from readily available resources such as lignocellulosic feedstock and biogenic waste, thus offering a practical solution for de-fossilizing key industries.

- **Accelerating the cost-effective conversion of biomass into SAF and marine biofuels**: By demonstrating efficient methods like pyrolysis, oil upgrading, refining and utilization of by-products, the project aims at ensuring biofuel price parity and at responding to market demand in biofuels.

- **Boosting economic productivity and competitiveness**: FUEL-UP is expected to contribute to achieving higher levels of economic productivity through innovation, diversification and technological upgrading.

- **Mitigating climate change**: FUEL-UP aims at achieving up to 80% reduction in GHG emissions compared to fossil fuels and >40% compared to the state-of-the-art advanced biofuels and at providing scenarios for green hydrogen production.

- **Paving the way to marine and aviation fuel certification** of products and processes to ensure that production is compatible with specifications, practical usage, and it is socially accepted.

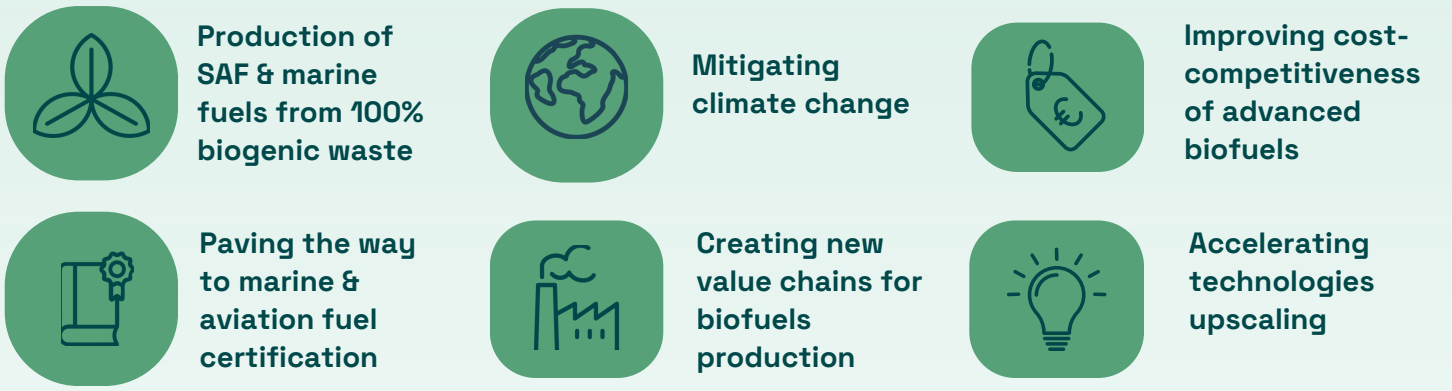


Figure 2: FUEL-UP Project Key Objectives. Source: FUEL-UP Website

2. Advanced Biofuels Perspectives for the Aviation and the Maritime Sectors

Advanced biofuels are an essential solution to achieve the European objectives for tackling climate change. According to the IEA's "**Net Zero by 2050**" report, advanced biofuels can provide **14% of global transport fuel, 45% of global aviation fuel by 2050**, achieving reductions of around 2.1 Gt of CO_2 emissions per year when produced sustainably.

ReFuelEU Aviation promotes the increased use of **sustainable aviation fuels (SAF)** as the single most powerful tool to decrease aviation CO_2 emissions. The measure is part of the **Fit for 55 package** to meet the **emissions reduction target of 55% by 2030**. It sets requirements for aviation fuel suppliers to gradually increase the share of SAF blended into the conventional aviation fuel supplied at EU airports.

For the marine sector, the **FuelEU Maritime Regulation**, entering into force from 1 January 2025, promotes the use of **renewable, low-carbon fuels** and **clean energy technologies** for ships, essential to support decarbonisation in the sector. Fuel EU Maritime sets maximum limits for the yearly average greenhouse gas (GHG) intensity of the energy used by ships above 5,000 gross tonnage calling at European ports, regardless of their flag. Targets will ensure that the greenhouse gas intensity of fuels used in the sector will gradually decrease over time, starting with a **2% decrease by 2025** and reaching up to an **80% reduction by 2050**.

However, there are some challenges that need to be addressed in order to scale up the production of advanced biofuels:

- **Increased production capacity of advanced biofuels** from sustainable biogenic residues and wastes to replace fossil fuels.
- At present, **hydrotreating of pyrolysis oils has not yet been demonstrated at commercial scale**.
- **Improved efficiency and technological innovation** of the conversion processes while reducing energy consumption and increasing yields. There is a definite need to convert biomass especially into fuels in the aviation and marine diesel range.
- **A clear certification roadmap** to enable the deployment of fuel specifications for pyrolysis-based aviation/marine fuels and to ensure the quality, safety and sustainability of their use.
- **Cost-effective solutions** to improve the competitiveness of advanced biofuels in the marketplace.

- **New markets to be developed** to promote the uptake of advanced biofuels.

3. Project Activities

Coordinated by **SINTEF**, FUEL-UP has a consortium of **12 partners from 8 different EU countries**, gathering major industrial actors, leading research institutes and small and medium-sized enterprises, covering the entire value chain for the development of next generation of biofuel production technologies for the aviation and the marine sectors and their implementation in existing refineries.

The activities carried out by FUEL-UP project in the first year can be summarized in **7 main working areas**:

- **Project Management**
- **Production of Stabilized Intermediates**
- **Optimization Reaction Conditions for HPO and Biofuel Production**
- **Fuel Pre-Screening**
- **Carbon Management and Process Side-Stream Valorization Evaluation**
- **Preliminary Process Design, Feasibility Study, Techno-Economic Assessment**
- **Communication and Dissemination Activities**

As the project coordinator, **SINTEF** is responsible for overseeing the project's implementation, ensuring adherence to the work plan, and achieving the project objectives.

The partners involved in the **production of stabilized intermediates** are **BTG (Biomass Technology Group), Ranido, Avecom** and **SINTEF**.

The specific objectives are as follows:

- **To understand the relation** between operating conditions for stabilized pyrolysis oil (SPO) production and subsequent processing to stabilized deoxygenated pyrolysis oils (SDPO) and finally hydrotreated pyrolysis oil (HPO).

- **To produce sufficient amounts of oils** (SPO and SDPO) for further processing to HPO.

- **To develop scaled up stabilization catalysts** as well as options for recycling hydrotreating catalysts.

- **To determine the physico-chemical characteristics** and biodegradation potential of the aqueous streams.

- **To establish an integrated automated Aqueous Phase Treatment Pilot (APTP)** as well as to develop environmentally friendly, cost-efficient aqueous phase treatment techniques.

The activities concerning the **optimization reaction conditions for HPO and biofuel production** are aimed at:

- **Understanding SDPO hydrodeoxygenation** reaction and revealing optimal process conditions.

- **Understanding deep hydrotreatment/hydro isomerisation of HPO fractions** and revealing optimal process conditions.

- **Developing the most compatible HPO conversion route for biofuel production scaling-up**.

- **Producing kerosene fraction** by distillation/hydrotreating/hydroisomerisation at TRL6-7.

- **Producing marine fuel** by distillation/ hydrotreating at TRL6-7.

Tupras is the leader partner for these related activities, supported by **BTG**, **Ketjen** and **DLR**.

Fuel pre-screening activities, managed by **DLR**, supported by **Tupras** and **BTG**, are aimed at exploring the **fuel design space**, providing context for **process development** and **aviation fuel approval.** The resulting fuel design space, evaluated by model-based jet fuel prescreening, serves as a tool for identifying feasible products in terms of their properties and performance.

The objectives of the activities focused on the **Carbon Management and Process Side-Stream Valorization Evaluation** are to design side streams valorization processes to maximize biomass carbon content utilization as well as to determine the most environmentally friendly and economically viable side-streams valorization process. Different process alternatives for the valorization of the side-streams are designed by **AristEng** and assessed to maximise the carbon content reclaim and minimize the GHG emissions of the whole biofuel production chain. The different process alternatives will also be assessed from the business perspective of **BTG-Next**. Other partners involved in these activities are **Sintef, BTG, Tupras, Sintef Ocean, Avecom, DLR** and **LIST**.

The working area related to the **preliminary process design, feasibility study, techno-economic assessment** is aimed at **delivering a design of a commercial plant** including cost estimate as well as of a **preliminary techno-economic assessment of the production of SAF and marine fuels** via pyrolysis and at implementing a screening study concerning **suitable biogenic feedstocks**, product applications and fuel market. A start document is prepared by **BTG-Next** defining the boundaries and constraints of a full-scale plant. A screening study is also carried out by BTG-Next for the complete value chain from biomass sourcing until the distribution of the advanced biofuels.

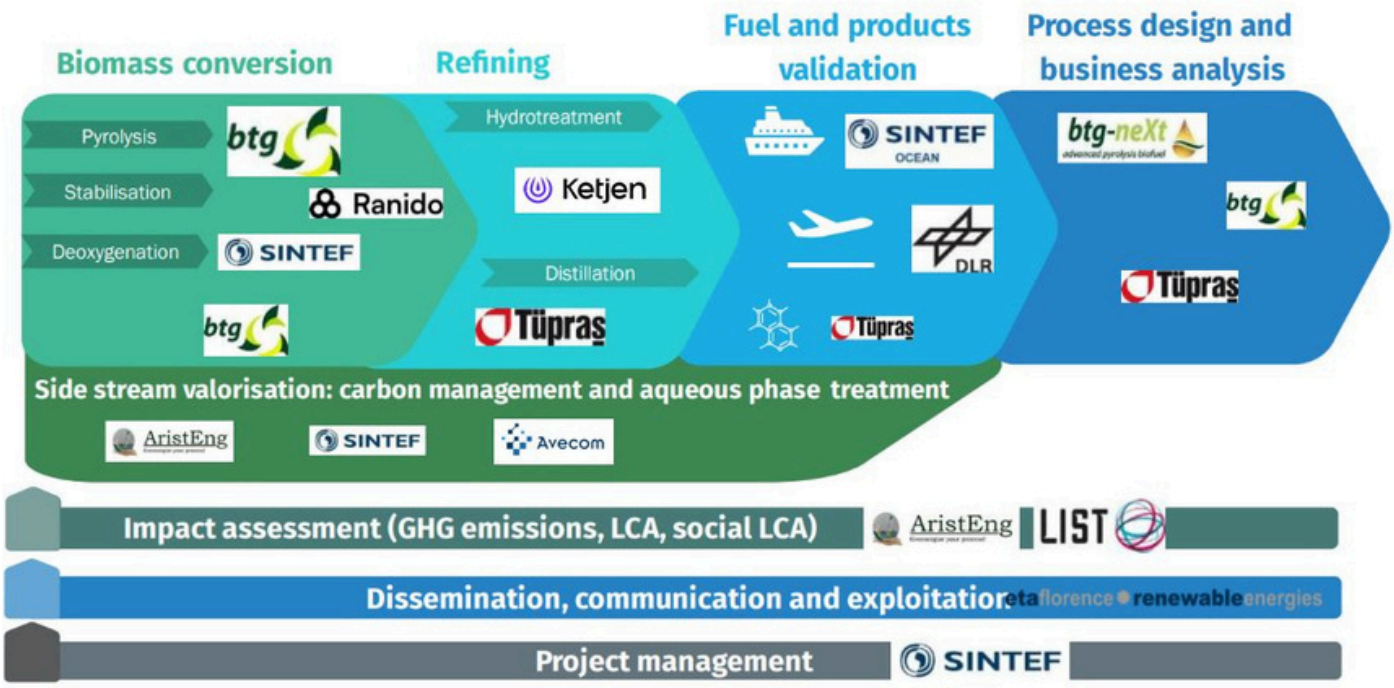


Figure 3: Value Chain of FUEL-UP Project. Source: FUEL-UP Project

The output from these activities is to be used to prepare a preliminary techno-economic assessment.

Communication and dissemination activities, managed by **ETA-Florence**, are focused on 3 main objectives:

- **Disseminating the knowledge** generated by the project by transferring the project's results to key stakeholders and engaging with them.
- **Communicating to a wider audience** the benefits of the project and its contribution to both solve societal challenges and to reach the goals of the Green Deal.
- Creating the conditions for the **uptake of the project's key exploitable results** both by partners and third parties.

4. Dissemination and Communication Activities

In order to have a major impact and streamline the interactions with stakeholders all along the value chain, **clear communication** throughout the project's life time will be crucial. Targeted dissemination and communication activities will be key. As this goal extends beyond the FUEL-UP consortium, dedicated communication and dissemination actions have been settled to discuss the technological advancements within large platforms, initiatives or conferences. These actions can act as a funnel for the deployment of the technology in Europe and beyond.

Figure 4: Robbie Venderbosch at tcb biomass. Source: BTG Biomass

The project started its dissemination activities with the first oral presentation in September 2024 at **tcb biomass** in Itasca, IL, USA. Robbie Venderbosch, Senior Engineer at BTG Biomass Technology Group, during his presentation "Stabilised pyrolysis oil by mild hydrogenation: status and developments" introduced FUEL-UP project and presented data from previous and other projects such as REFOLUTION Project.

FUEL-UP was also presented at **CINEA Cluster Event** in October 2024 on Aviation/Marine Fuels and Biomethane with a poster presentation by Duncan Akporiaye, project coordinator and research director at SINTEF. FUEL-UP participated in the event together with other 32 renewable fuels/biofuels & biomethane projects to provide information about relevant policy

Figure 5: CINEA Cluster Event, October 2024. Source: CINEA

frameworks for the technologies and the final fuels, and to foster exchange and collaboration between the projects.
A list of the first D&C materials are available in the public deliverable **D12.2 Dissemination and**

Communication Toolkit. This document gives an overview on the visual identity of FUEL-UP by describing the project's graphic concept and by unveiling the first related graphic tools which will be updated at a later time during the project.

The project's online presence is guaranteed by a **dedicated website** and two social media accounts (**LinkedIn** and **X**).
The website has been updated with **14 news** so far and the social media with 20 posts. In addition, the online presence of the project has been implemented by **6 video-interviews** and one video about the kick-off meeting.

5. Consortium Meetings

FUEL-UP Project partners met for the first time in-person in February 2024 at SINTEF's Brussels Office, for the project kick-off-meeting. All project partners had the chance to delve into the project's goals, activities, and into the road map ahead.

After this meeting, the partners met for the second consortium assembly in September 2024 at SINTEF's premises in Trondheim, Norway.

The partners enthusiastically discussed the project research progress after 9 months of activities, presented their future plans and got the opportunity to visit SINTEF Ocean Maritime Energy Systems Laboratory and SINTEF Industry Tiller Lab.

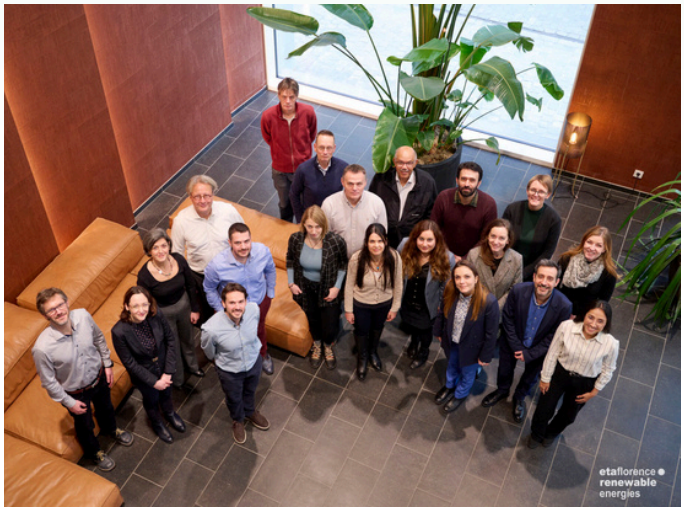


Figure 6: KOM in Brussels, February 2024. Source: ETA-Florence

Consortium Meeting in Trondheim, September 2024. Source: ETA-Flor.

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AristEng · Avecom · btg biomass technology group · btg-neXt advanced pyrolysis biofuel · DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center · etaflorence renewable energies · Ketjen · LIST Luxembourg Institute of Science and Technology · Tüpraş · Ranido

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