BioTheRoS

Collaborative actions to bring novel **BIO**fuels **THE**rmochemical **RO**utes into industrial **S**cale

WORKSHOP: "BIOFUELS FOR TRANSPORT: BIOTHEROS PROJECT INSIGHTS INTO TECHNOLOGY, MARKETS, AND SUSTAINABILITY"

From pilot to industrial scale: the BioTheRoS project driving Europe's thermochemical biofuel revolution

Dr. Dimitris Kourkoumpas (CERTH)

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BioTheRoS Overview

Project Details

BioTheRoS is an EU Horizon Programme under Grant Agreement No 101122212 running from 2023

Consortium Members

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

circe

MOTOR OIL

btg biomass technology group

BEST Bioenergy and Sustainable Technologies

WIP RENEWABLE ENERGIES

Demonstration Cases

Application in pyrolysis and upgrading units in Netherlands & gasification unit in Austria

BioTheRoS Objectives

BioTheRoS develops **innovative** & cost-competitive **Fast Pyrolysis-to-biofuels** and **Gasification-FT-Synthesis value chains**, combining **Carbon Capture Utilization (CCU)** and **fuel upgrading** for accelerating the scale-up of sustainable biofuels.

BioTheRoS Goal: Transfer biomass into an opportunity

1. Development of cost-effective & sustainable technologies for thermochemical conversion of biomass to produce biofuels to TRL5

2. Selection and assessment of several biomass feedstocks suitable for scaled-up sustainable pyrolysis & gasification biofuel value chains employing predictive biomass demand AI models

3. Development of scale-up rules of biofuels production based on advanced modelling techniques and lab/pilot-scale trials.

4. Development of an LCSA framework, integrating technical, environmental, economic & social parameters via multi-criteria decision analysis techniques

5. Identification of concrete measures to improve the sustainability of thermochemical conversion of biomass to biofuels via pyrolysis and gasification

6. Provide clarity into the market dynamics of scaled-up pyrolysis and gasification biofuel value chains

Demo sites & related technologies

The Netherlands – Pyrolysis and Upgrading units

Pyrolysis Units:

- Bench-scale unit: 2–5 kg/h
- Pilot plant: 80–200 kg/h

Upgrading Unit (for pyrolysis oil to fuels):

- Continuous operation
- Capacity: 0.8–1.5 kg/day

Austria – Gasification Unit

Gasification Units:

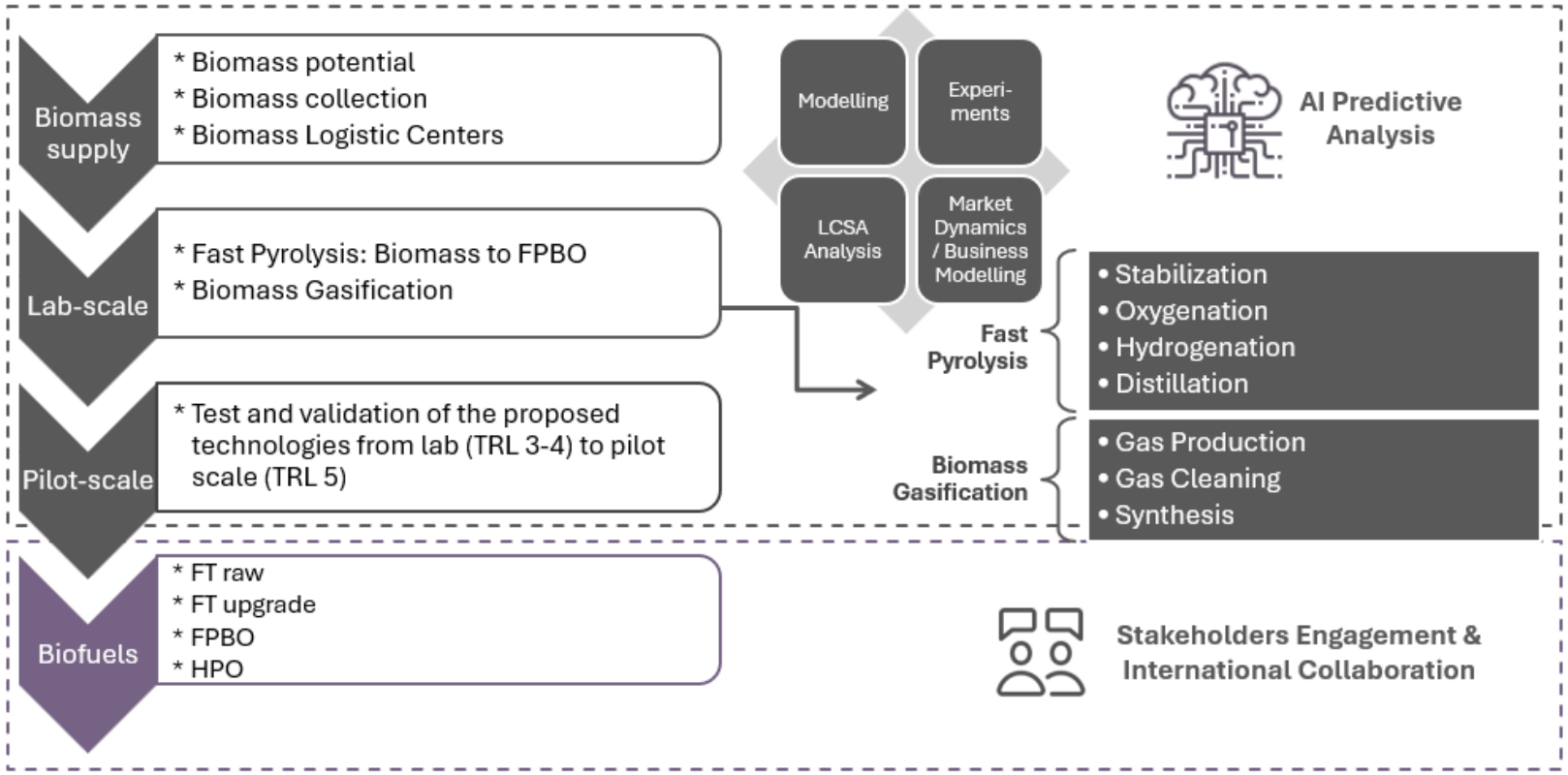
- 1 MW DFB reactor: ~200 kg/h feed rate
- 250 kW Fischer–Tropsch pilot unit: produces 15-20 L of FT raw product

Upgrading Unit (for FT waxes to fuels):

- Hydrocracking pilot plant located in Greece

BioTheRoS Methodology

Core Focus: Pyrolysis & gasification-based advanced biofuel value chains



Multidisciplinary, stepwise methodology

- Feedstock selection
- Pilot-scale validation
- Scale-up simulation & modelling
- Environmental, techno-economic & social assessments

BioTheRoS Reached Outcomes

1. Biomass-to-Biofuel Optimization Process

- Quantified and categorized agricultural and forestry biomass to optimize value chains and prioritize biofuel feedstocks.
- Successfully developed an initial AI-driven optimization model for processing plant siting.

2. Validation of TEC value Chains

- Pyrolysis Value Chain**:** Achieved targeted FPBO production: 22.3 L from forestry residues and 23.5 L from barley straw. About 5 litter of barley straw derived HPO is available.
- Gasification Value Chain: Syngas from both forestry residues and softwood met Fischer-Tropsch specifications, with effective nitrogen removal from forestry residues.

3. Holistic Sustainability Framework

- Established a novel MCDA approach that merges efficiency assessment with multi-criteria ranking to identify optimal production routes for advanced biofuels.
- Developed an integrated Life Cycle Sustainability Assessment (LCSA) framework combining LCA, LCC, and sLCA to enable comprehensive evaluation of biofuel scale-up pathways.

4. Market Insights

- Advanced biofuel demand quantified, providing a robust analytical basis for future production targets.
- Completed assessment of RED III Annex IX-A feedstocks currently utilized in advanced biofuel production, supporting informed policy and investment decisions.

5. Building knowledge for upscaling

- Developed BioTheRoS Knowledge Hub and Tech State Navigator, connecting 50+ research groups & stakeholders

Potential Synergies

Government & Regulatory Bodies	BioTheRoS shares lessons learned and regulatory insights at EU and regional levels
Fuel Producers and Suppliers	BioTheRoS highlights the environmental and economic benefits of biofuel production & use
Biomass Providers	BioTheRoS provides economic benefits for engaging in the biofuel supply chain
Research Stakeholders	BioTheRoS shares technical results, innovations, progress, and project challenges
Airlines & Shipping Companies	BioTheRoS raises awareness of the potential for biofuel use
General Public / Citizens	BioTheRoS shares insights on EU competitiveness, external dependency, environmental and societal impacts.

Take-Home Messages

Feedstock Supply & Cost Competitiveness:

Ensuring a **sustainable, cost-effective feedstock supply** is essential for the growth of future biorefineries. Investment incentives are needed to offset biomass's price disadvantage relative to fossil fuels.

Supply Chain Risk Management:

Effective biomass supply chain management is critical to securing long-term sustainability and consistent fuel availability.

Circular Economy Integration:

Holistic, circular economy-driven guidelines are required across the entire advanced biofuel supply chain to stimulate aviation and maritime fuel markets.

Technology Pathways & Scale-Up:

Constraints and opportunities for scaling up pyrolysis and gasification pathways must be clearly identified.

Sustainability & LCA Focus:

Growing attention to GHG impacts in aviation and maritime sectors underscores the need for **LCSA** and integration of **economic, environmental, and social dimensions** for a balanced sustainability approach.

Thank you!

Dr. Dimitrios Kourkoumpas

Senior Collaborating Researcher (CERTH)

kourkoumpas@certh.gr

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