

BeBOP

Biomass to bio/E-methanol by Breakthrough SOEC-based Process: the BeBOP innovation



PROJECT AND GENERAL OBJECTIVES

The Horizon Europe **BeBOP** project aims to industrially deploy a disruptive, **digital process-intensified, ultra-high resource efficient and flexible biomass power-to-methanol plant**, that can transform the chemical sector, while showcasing a **first-of-its-kind complete TRL6 pilot plant**, ready to be scaled-up and replicated by the European biomass-based industry.

CURRENT CHALLENGES

- Climate change is calling for **cleaner energy sources** in the electric, industrial and mobility sectors and **higher efficiency in the use of resources**
- Synthetic methanol** produced from biomass (biomethanol) and/or electricity (e-methanol) can play an important role in **decarbonising the chemical industry** as well as hard-to-electrify mobility

Current methanol production (from fossil fuels): 98 Mt/y

- Associated CO₂ emissions: 300MrCO₂/y
- Production costs: 100-250 USD/t

Current Renewable methanol production: 0.2 Mt/y

- Production costs of Biomethanol: 320-770 USD/t
- Production costs of E-methanol: 800-2400 USD/t

Production by 2050 perspective: 500 Mt/y

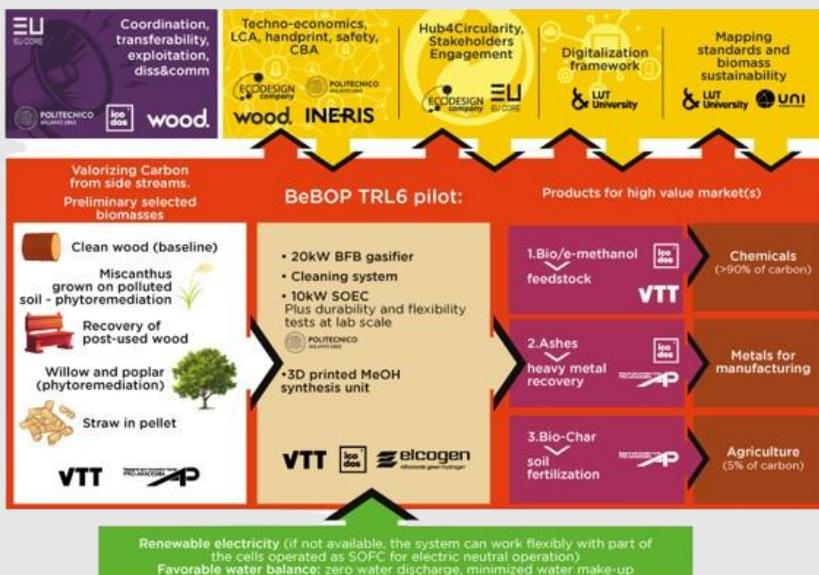
- Potential emissions 1.5 GtCO₂/y

Project ID	101178117
Call topic	HORIZON-CL4-2024-TWIN-TRANSITION-01-41: Breakthroughs to improve process industry resource efficiency (Processes4Planet partnership)
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Beneficiaries	WOOD, RIC, UNI, ELCOY
Website	www.bebop-project.eu

THE BeBOP SOLUTION

BeBOP: a disruptive Power Biomass to X (PBtX) system.

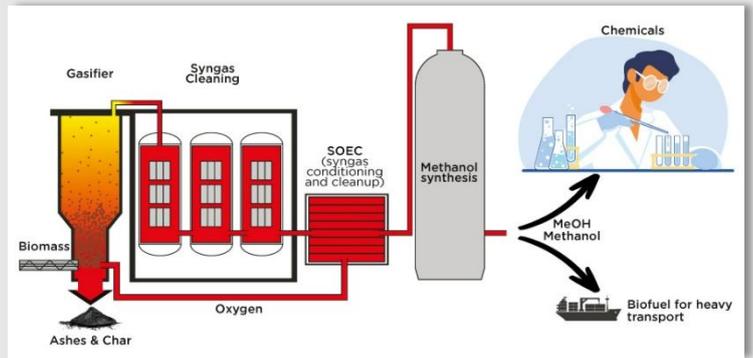
- Integrated SOEC for syngas upgrading** – Electrochemical separation of excess oxygen to enhance bio/e-methanol production
- 100% biogenic carbon usage** – Reduction of environmental impact & carbon footprint
- TRL6 pilot demonstration** – 20 kW biomass-to-methanol system at VTT (Finland)
- Biomass flexibility** – Adapts to various feedstocks
- Self-sustaining energy** – SOEC reversibility enables in-situ electricity production



THE BeBOP CIRCULARITY

BeBOP: full waste-stream valorization

- **Zero-water discharge** – Sustainable process design
- **Biochar & heavy metals recovery** – Extracted from biomass gasifier ash
- **Oxygen co-production** – used for gasification or exported



THE BeBOP TECHNICAL POTENTIAL

- **Double** the methanol productivity
- Achieve over **95%** of carbon efficiency using polluted wood and phytoremediation biomasses mapped along Europe
- **Recover** high-value components from biomass residues

THE BeBOP FINANCIAL POTENTIAL

- **Lower** methanol production **costs**: below €250 per tonne
- Prevent over **30 million tonnes of CO₂ emission annually**
- Create **new market opportunities**

THE BeBOP PATHWAY TO TRL9

MAIN GOALS



First small-scale pre-commercial TRL8 (e.g. 5MW SOEC and 10MW biomass) demonstrator



Large-scale (e.g. 50 MW SOEC and 100 MW biomass) FOAK/marble demonstrator



10% of the European e-Methanol production shifted to BeBOP technology



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