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LIFE BIOMASS C+

Low-cost, carbon positive bioethanol production with innovative Green Floating Filters in multiple water bodies

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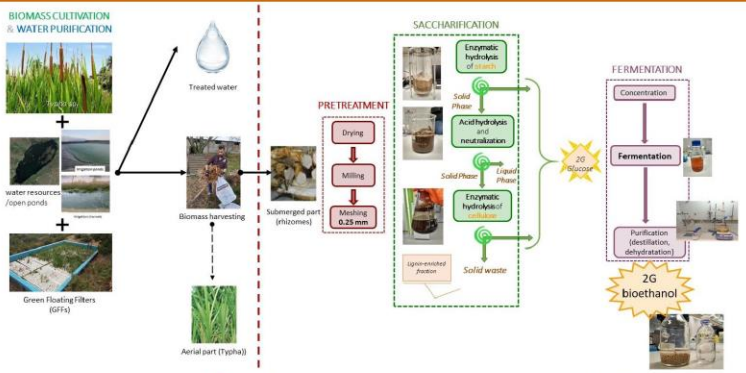
"CARBON-NEGATIVE PRODUCTION PROCESS OF SECOND-GENERATION BIOETHANOL FROM TYPHA BIOMASS: AN INNOVATIVE PILOT-SCALE INTEGRATED SOLUTION FOR WASTE WATER TREATMENT AND 2G BIOREFINERIES"

THE BIOMASS C+ CONCEPT: A BIOMASS BIOREFINERY & WASTEWATER BIOFILTER SYSTEM

What is Biomass C+?

LIFE Biomass C+ aims to demonstrate improvements in climate mitigation strategies through the production of **sustainable 2G biofuel,** utilising existing and underused infrastructure and water resources (i.e. irrigation channels, ponds, lakes, river arms) or even **waste water purification systems** installed in agro-food industries to produce carbon-negative biomass, with a high starch/cellulose content that will be converted into **bioethanol** and, **eventually, blended with commercial fuel**.

CARTIF's role in the project is to develop the up-scaling of a sustainable and cost-competitive bioprocess to obtain 2G bioethanol from high starch/lignocellulosic bio-feedstock such as *thypha,* produced by aquatic green filter systems for waste water purification.



Goals of the Project

#1: Development of an innovative technology based on **Green Floating Filters** (GFFs), where aquatic macrophyte plants (*Typha*) to treat industrial/farming waste water in efficient & cost-competitive way.

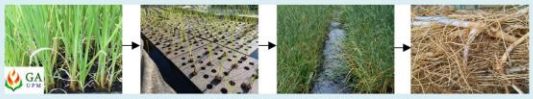
#2: Development of an **integrated biorefinery process**, from the laboratory to the pilot plant scale, to convert lignocellulosic biomass with high starch/cellulose content (e.g. *Typha*) into high purity bioethanol demonstrating a negative carbon footprint.

#3: Final testing of the produced **2G bioethanol for fuels blending**.

BIOMASS PRODUCTION (& WASTEWATER TREATMENT SYSTEM)

Innovative green technology of **Green Floating Filters (GFF)**, where aquatic macrophyte plants will be grown in multiple water bodies. Under-water biomass (rhizomes) will be harvested.

Demonstration of the LIFE Biomass C + concept applicable to any type of large water body with organic matter load using *Typha* as a green filter system to improve water quality.

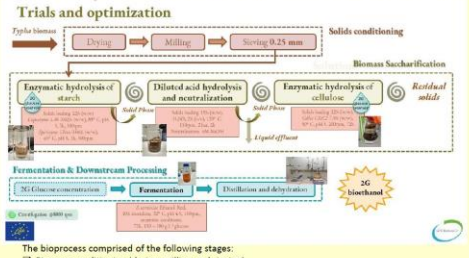


***Scheme of* Green Floating Filters (GFF) and thypha biomass production**

Typha biomass samples were produced and harvested from GFFs demos and further characterized to determine its composition as a biofeedstock (25.3 wt % starch, 21.6 wt % cellulose, 17.5 wt % hemicellulose, 20.3 wt % lignin).

BIOPROCESSING & BIOREFINERY CONCEPT

CARTIF's role in LIFE BIOMASS C+ project is focused on the bioprocess development and up-scaling. to maximize the production of 2G fermentable monosaccharides into bioethanol.



The bioprocess comprised of the following stages:

- ❑ Biomass conditioning (drying, milling and sieving)
- ❑ Biomass liquefaction/saccharification based on three-stage cascade process: enzymatic hydrolysis of starch, diluted acid hydrolysis and neutralization and enzymatic hydrolysis of cellulose.
- ❑ Fermentation & downstream processing.

BIOFUELS APPLICATIONS

Key performance parameters such as yield and productivity were optimized to demonstrate the scalability of the biomass-to-liquid process for future pilot/demo scale scenarios into integrated biorefinery and full circular bioeconomy concept.

Scheme of Biomass-to-2G bioethanol processing at lab scale

Finally, the process was scaled-up through the design and construction of a 200L multi-purpose bioreactor to perform a unique one-pot process which includes both the hydrolysis/saccharification and the fermentation processes.

CO-BENEFITS / CONCLUSIONS & OUTLOOK

Biomass-to-2G Bioethanol process results:

- Development of the bioprocess to obtain high purity 2G bioethanol from lignocellulosic biomass with high starch content (e.g. *Typha) both* at laboratory and pilot plant scale.
- Optimal process parameters were determined (e.g. biomass solid concentration, enzyme / substrate ratio, temperature, pH, agitation speed, time, glucose concentration, etc.) to obtain a final glucose titer *ca.*40-45 g/L and a biomass-to-glucose yield of 65-70 wt %.
- Also, *S. cerevisiae* Ethanol Red® yeast strain was selected to improve the fermentation to reach a final ethanol concentration up to 18 % (v/v), followed-up with a final distillation to obtain 97-99 wt %. pure bioethanol.

Other expected results

- ✓ Achieve a reduction of GHG emissions of 250 tons of CO_2
- ✓ Set up replication of results and market uptake.
- ✓ Develop an effective business plan.

Project LIFE BIOMASS C+: Low-cost, carbon positive bioethanol production with innovative Green Floating Filters in multiple water bodies.
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