European Commission

BIOFUELS AND BIOREFINERIES

INNOVATION FUND

Deployment of net-zero and innovative technologies

SOL: Sugar Oil as sustainable marine fueLs

The Innovation Fund is 100% funded by the EU Emissions Trading System

| Project Factsheet

This project considers crude sugar oil (CSO™) as a fuel for internal combustion engines, specifically those that propel sea going vessels. CSO™ is produced from cellulose and a stable blend with fossil marine fuel is created through emulsification. The SOL project aims to validate the technical and economic viability of this fuel source whilst also achieving a greater than 80% relative greenhouse gas (GHG) emission avoidance during the first ten years of operation compared to the reference scenario.

Globally, sugars are produced by photosynthesis at a scale of roughly 100 billion tonnes per annum, mostly in the form of cellulose (a polymer of glucose units). By contrast, a "mere" 5 billion tonnes per annum of fossil-based oil is pumped out of the ground. While sugars are abundant fuels in nature, SOL is the first project in the world to optimize and scale-up their use as transport fuels.

COORDINATOR
VERTORO BV

LOCATION
Netherlands

CATEGORY
Energy intensive industries (EII)

SECTOR
Biofuels and bio-refineries

AMOUNT OF INNOVATION FUND GRANT
EUR 4,000,000

EXPECTED GHG EMISSIONS AVOIDANCE
44,736 tonnes CO2 equivalent

STARTING DATE
01 June, 2023

ENTRY INTO OPERATION DATE
31 May, 2025

FINANCIAL CLOSE DATE
31 December, 2024

Updated on 02 December 2024

This requires two process steps: I) the conversion of cellulose to crude sugar oil (CSO™) by means of dilute acid hydrolysis and II) the emulsification of CSO™ with heavy fuel oil (HFO).

The use of dilute acid hydrolysis to convert cellulose to sugar dates back to the late 19th century. Historically, hydrolysis conditions were optimised to achieve a maximum sugar yield, since in nearly all commercial settings, the target product was ethanol. In SOL, the objective is to maximise the yield of CSO™, which also contains some sugar derivatives, notably levulinic- and formic acid, which would act as inhibitors to the fermentation of sugar to ethanol. CSO™, being a blend of sugar (derivatives) in water, does not readily blend with HFO so requires emulsification. Stable sugar-water-HFO blends are prepared with the aid of surfactants that allow for the polar sugar molecules to form a stable emulsion with apolar HFO.

Currently cellulosic ethanol is the go-to transport fuel that is produced from cellulose. However, unlike cellulosic acid, sugars can be used directly in engines, without the need for downstream fermentation and distillation operations, which are both expensive and energy intensive. Bypassing the need for these processes results in greater GHG emissions avoidance. Moreover, the CSO™ process also offers superior atom economy, with more than 90% of the carbon in the cellulose feedstock ending up in the transport fuel compared to 50% in the case of cellulosic ethanol. As a result, this process delivers more fuel calories per unit of biomass in the combustion process than competing ethanol technologies and therefore supports the decarbonisation targets for the maritime sector, as outlined in the 'Fit for 55' Section of the EU Renewable Energy Directive.

The SOL project will increase the technical maturity and scale of this production technique from a 1 kiloton per annum (ktpa) demonstration plant to a 5 ktpa commercial plant in the Port of Rotterdam. When the project is complete the aim is to develop a full scale 250 ktpa plant in the same location.

| Participants

VERTORO BV	Netherlands
VERTORO WEST	Netherlands