

Turning sewage sludge into fuels and hydrogen

Issue 6 / July 2022

The TO-SYN-FUEL consortium is delighted to introduce its sixth newsletter edition

This newsletter reports the latest news and developments of the project that have occurred up to July 2022 including what was presented at the EUBCE 2022.

The H2020 To-Syn-Fuel project is demonstrating a new integrated process combining thermo-catalytic reforming (TCR®), with hydrogen separation through pressure swing adsorption (PSA), and hydrodeoxygenation (HDO), to produce a fully equivalent gasoline and diesel substitute. The technology developed by To-Syn-Fuel will contribute to decarbonizing the transport sector.

Contents

1. Promotional Car Tour
2. Summary of TO-SYN-FUEL Conference
3. To-Syn-Fuel at EUBCE 2022
4. New project deliverables
5. Project Timeline

1. Promotional Car Tour

The European Green Deal is a top priority for climate, energy and mobility. The target is for Europe to become climate-neutral by 2050, protecting humans, animals and ecosystems, but also creating economic growth across all demographics. All these measures are important for the support of biofuels, bioenergy and renewable fuels, under sustainable conditions and with sustainable feedstocks. In addition, the Fit for 55 package was adopted in the second part of 2021 by the European Commission to implement the 2030 Climate target plan with the 55% greenhouse gas emissions reduction.

The To-Syn-Fuel project, that will end in September 2022 after more than 5 successful years, is demonstrating a sustainable process that can transform waste biomass, such as sewage sludge into high-quality renewable liquid fuels and hydrogen.

To-Syn-Fuel integrates three different technologies in a new process to convert a wide range of residual and waste biomass: the pyrolysis-based Thermo-Catalytic Reforming, TCR®, hydrodeoxygenation (HDO), and pressure swing adsorption (PSA) will successfully achieve the project's three key objectives: 1) the optimisation of the technologies involved, 2) their



Promotional Car Tour planned this September 2022: a car, fuelled with To-Syn-Fuel diesel. Credits: WRG Europe

integration into a pilot plant and 3) the end use demonstration of diesel-equivalent fuel for transport. The To-Syn-Fuel pilot plant built in Markt Hohenburg, district of Amberg-Sulzbach (Germany) can treat up to 500 kg/h of dried sewage sludge, which yields up to 50 litres/hour of biofuel.

By demonstrating all the essential process steps in an industrial operational environment, the project will advance the technology's technical readiness to level 7 (demonstration in an operational environment) while achieving the main aim of the project, which is the long-term operation of a pre-commercial demonstrator. This is the final step of development before the technology reaches full commercial scale.

The first testing campaigns with TCR® have shown very satisfying performance, with the biocrude

oil quality being in line with expectations. Also, the business plan and the socio-environmental sustainability analysis for the process provide very positive outcomes.

The consortium is working hard on communication at both national and international levels. One of the most significant is a promotional Car Tour planned this September 2022. A car, fuelled with To-Syn-Fuel diesel, will stop at key locations around Europe, including a premium showcase presentation at this year's European Sustainable Energy Week 2022. This is taking place on 26-30 September to promote the technology and the importance of biofuels in the clean energy solutions mix for greener transport now and for decades to come.

2. Summary of To-Syn-Fuel Conference

The To-Syn-Fuel Final Conference titled "To-Syn-Fuel plant to produce renewable fuels" took place virtually in the framework of the 30th EUBCE, on the 11 May 2022. It was listed among the EUBCE Parallel Events with a dedicated webpage containing basic information, a description, and a detailed agenda of the event. Virtual participation was open to anyone registered at the EUBCE with a free Visitor pass.

The event has been widely promoted through social media, and by exploiting the broad communication channels of the EUBCE.

The event was followed by more than 60 attendees who interacted enthusiastically with the panellists. The video recording of the full event is accessible on the EUBCE Virtual platform (until May 2023, for those visitors registered to EUBCE 2022), but it is also available on the To-Syn-Fuel YouTube channel:

To-Syn-Fuel plant to produce renewable fuels | EUBCE 2022 workshop
(also retrievable from the project website Video section).

 [Watch it](#)

The conference was dedicated to the To-Syn-Fuel project entering its last phase. The current state of the project was illustrated, focusing on the demonstration activities that are underway. To this end, the workshop included a live streaming from the project's demonstrator plant in Hohenburg, conceived as a virtual tour.

The plant tour experience was framed by a series of presentation during the workshop, concerning the following aspects: characterisation of processed feedstock (sewage sludge) and main products from the process (H₂-rich syngas, biochar and bio-oil), core component of the integrated technology, first results of the study on stakeholders' perceptions towards the project technologies, and promotional initiatives proposed to engage industry.

The full agenda with panellists and covered topics is available [here](#).

*A moment in the virtual plant tour conducted by Stefan Eder.
Credits: To-Syn-Fuel project*

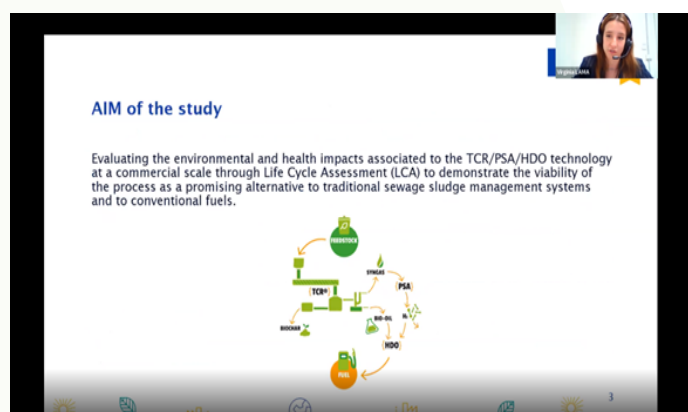


3. To-Syn-Fuel at EUBCE 2022

As a selected EU project, the To-Syn-Fuel project joined the European Biomass Conference and Exhibition (EUBCE) in May 2022. Besides the project Final Conference (see details above), To-Syn-Fuel's results and activities were illustrated in several sessions.

Robert Daschner, Fraunhofer UMSICHT, presented the project within a speech during the 30th EUBCE virtual edition, held online in May 2022. The presentation was titled "To-Syn-Fuel Project and the Sustainable Process for Waste Biomass Conversion" (code: 5CO.13.4). The related presentation paper is included in the full open access conference proceedings database.

During this event, Virginia Lama, University of Bologna, presented project activities with a speech titled "Evaluating the Environmental Sustainability of a Commercial TCR®/PSA/HDO Integrated System for the Conversion of Municipal Sewage Sludge into Value-Added Products in the Bioenergy Sector" (code: 2DO.5.4).



Virginia Lama presentation.
Credit: EUBCE 2022.

Irene Rapone, Eni spa Renewable, New Energies and Material Science Research Center presented a poster titled "To-Syn-Fuel Project: Chemical and Physical Characterization of TCR Oil and HDO Oil, Analysis of Synthetic Fuel Fractions" (code: 1CV.2.11) on Monday 9 May.

The Scientific Programme of the EUBCE includes several other presentations and sessions dedicated to conversion processes and technologies for advanced biofuels production.

Moreover, the To-Syn-Fuel project hosted a virtual stand in the EU project area.

The workshop included a live streaming from the project's demonstrator plant in Hohenburg, conceived as a virtual tour.

4. New project deliverables

Twelve public reports have been produced so far in the project framework. The full list of To-Syn-Fuel deliverables can be retrieved in the [Docs](#) section of the project website, as well as on [CORDIS](#) Results section.

The latest releases:

[D4.8 Full ash characterization in terms of heavy metals](#)

This deliverable deals with characterisation of the biochar that is formed as a co-product while thermo-catalytic reforming. The biochar collected from the char storage of the To-Syn-Fuel demonstrator as well as the ashes from char gasification is analysed in terms of heavy metals by RFA analysis. Evidence shows that the concentration of heavy metals is increasing from sewage sludge to char to ash due to its higher conversion rate.

Further ash analysis will follow within the upcoming deliverable D4.6 "Performance results of char for generation of energy through gasification".

[D7.3 Business Potential Analysis Report](#)

The objective of the business potential analysis is the economical evaluation of the To-Syn-Fuel approach for decentralized production of advanced biofuels derived from sewage sludge and further residues. A business potential analysis was carried out for future commercial implementation of a technical concept previously tested on a demonstration scale. For this purpose, the potential of suitable feedstocks was determined, and a business case was calculated for each of them (sewage sludge, digestate, manure, green and park waste, etc.).

A variety of technology approaches for the production of liquid biofuels was developed in recent years. These are on different levels of development. Already commercialized technologies apply mostly to energy crops for fuel production and not residues or waste.

5. Project Timeline

The Renewable Energy Directive for the post 2020 period proposal was released by the European Commission in December 2016. "RED II" sets a gradual phase-out of conventional biofuels while introducing minimum targets related to an increased production of advanced biofuels, i.e. being produced from non-food-competing sources, to be used in the

transportation sector.

To-Syn-Fuel is designed to set the benchmark for future sustainable development within Europe, by providing a valuable example of renewable fuels and green hydrogen production from organic waste to the rest of the world, while successfully addressing energy, environmental, economic and social needs.

2016

The European Commission released its proposal for the RED II, the Renewable Energy Directive for the post 2020 period, in December.



2018

Fraunhofer UMSICHT presented the project during the 26th European Biomass Conference & Exhibition (EUBCE), in Copenhagen in May.



Project partners visited a sewage sludge treatment plant at a site in Hohenburg, Germany, in June. This plant locally dries and produces sewage sludge feedstock.



2020

At the beginning of the year, the pilot plant hall for the To-Syn-Fuel demonstrator was completed and the first components were on site.



2022

To-Syn-Fuel project conference and plant Demo Day were held virtually by EUBCE 2022 in May.



2017

Fraunhofer UMSICHT, To-Syn-Fuel project coordinator, hosted the kick-off meeting in Sulzbach-Rosenberg, Germany, in May.



The first TCR® research & development plant processed dried sewage sludge and achieved an important milestone with a successful > 50 hours test run in May.



The starting signal for the construction of the To-Syn-Fuel plant, a pre-commercial demonstrator for the production of advanced biofuels from sewage sludge, was given during the ground-breaking ceremony in Markt Hohenburg Industrial Park in November.



2021

The demonstrator plant was in operation in the second part of the year to produce biocrude oil. TCR® is combined with pressure swing adsorption (PSA) and hydrodeoxygenation (HDO) technologies in an integrated plant.



A car, fuelled with To-Syn-Fuel diesel, will stop at key locations around Europe in September to promote the technology and the importance of biofuels in the clean energy solutions mix for greener transport.



Upon successful demonstration of the first integrated TCR®/PSA/HDO plant, there are plans in place for the future role of the technology.



Pilot plant for the To-Syn-Fuel project in Markt Hohenburg, district of Amberg-Weiz, district of Amberg-Weiz.
Credit: Fraunhofer UMSICHT

About the project

The consortium with 11 partner organisations has brought together some of the leading researchers, industrial technology providers and renewable energy experts from across Europe, in a collaborative, committed and dedicated research effort to deliver the overarching ambition. Partners include: Engie Services Netherlands NV, HyGear Technology and Services BV (The Netherlands), Fraunhofer UMSICHT, Verfahrenstechnik Schwedt GmbH, Martech GmbH (Germany), Alma Mater Studiorum – University of Bologna, Eni SpA, ETA-Florence Renewable Energies (Italy), University of Birmingham, WRG Europe Ltd (UK) and LEITAT (Spain). The project has a total duration of 65 months from May 2017 to September 2022 and is funded by the European Union under the Horizon 2020 programme.



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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 745749.