



GLAMOUR



GLycerol to Aviation and Marine prOducts
with sUstainable Recycling

UPDATES ON GLAMOUR PROGRESSES

GLAMOUR celebrates its second year of implementation!

Take a look at the fourth project newsletter to discover the interesting findings related to each Work Package made by the consortium and to learn more about latest achievements obtained towards the conversion of bio-waste feedstock such as glycerol into jetfuel and marine diesel oil!

Remember to subscribe to the [GLAMOUR newsletter](#) and follow the main updates visiting the [project website](#) and [LinkedIn](#) and [Twitter](#) accounts!



University of Manchester

The **University of Manchester** has started the testing of the glycerol chemical looping reforming at TRL4 using a benchmark oxygen carrier material previously tested for

other process. A small batch of the new material developed in C&CS has been tested as well. On the same topic, the gas-solid reactor modelling for the chemical looping reactor has been verified and the model is ready for validation after the experimental campaign will be completed. Together with Argent Energy, the glycerol purification via physio-chemical treatment has been completed. Finally, from a process design and conceptual integration, main activities involve the overall techno-economic assessment of the process at industrial scale and the LCA of the different parts of the plant to determine the main sources and more impacting steps for manufacturing new and conventional components and operating the overall process in terms of environmental performance.



Eindhoven University of Technology

To achieve project objective, a full design of the GLAMOUR process prototype at a TRL5 scale has been completed in WP5 at **TU/e**. Investigation and definition of the operating condition of setups such as temperature, pressure, gas composition for each step/cycle, and equipment were performed to gain

the best results. The energy balance of the process has been conducted using the characterization of oxygen carriers provided by our WP partner to evaluate the temperature variation during oxidation and reduction reactions in the reactors. Furthermore, a list of all equipment and instruments required to scale up the GLAMOUR set-up were prepared. More than 120 items have been considered according to the P&ID and are under the procurement phase. The dimensioning and design of equipment have been performed successfully. Aspen Plus simulator was also applied to have a better understanding of process performance, product gas composition as well as mass balance and energy balance analysis. TUE's contribution to WP3 is to assess the oxidation-reduction behavior of the oxygen carriers developed by other WP partners under reaction conditions of interest at large-scale operations. In this regard, a high pressure and temperature thermogravimetric analyzer (TGA) setup has been constructed at TUE which can be operated for temperatures up to 1100 °C and pressures up to 30 bar. TGA experiments using developed materials are currently conducted at TUE to study the performance of the material at high temperatures and pressures.

TNO

The **TNO** work started with reporting the state-of-the art FT processes and catalysts. Following the study, 8 cobalt based catalysts were selected, and samples were prepared

on gram scale. The catalysts, in total 8, of which 6 bifunctional, were tested under FTS conditions. The reference catalyst Co+Ru/Al₂O₃ and Co/SiO₂ performed within the expected range, with C₅+ selectivities (SC₅+) of, respectively, 77% and 78%, with 11% and 12% CH₄ formation. For the ZSM-5-based catalysts, the activities were reduced compared to Co/SiO₂, and Co/H-ZSM-5 showed a remarkably high CH₄ formation at 50.7%, resulting in a low liquid selectivity (SC₅+) of only 30.9%. For the mesoporous Co/mesoZSM-5, the selectivity improved significantly to 70.6% with only 16.8% CH₄. Following these screening results, pilot FT experiments are being conducted using 3D printed structures made by VITO.



CSIC

CSIC has been dedicated to assessing the performance of C&CS catalysts as function of main operation process variables, including the effect of redox cycles in catalyst activity and the capability of acting as oxygen carriers to sustain the energy balance in the CLR process. Suitable

catalysts have been identified capable of producing the H₂/CO ratio targeted at relevant spatial velocities for the process, the efforts in the present months are dedicated to improving their redox properties.

Also, CSIC has been developing NiFe based catalysts applicable for CLR of glycerol. The effect of Ni and Fe load on catalyst performance has been assessed, and the efforts are oriented to optimize active phase content to optimize both catalyst activity and their performance as oxygen carriers.



VITO

In the last couple of months, **VITO** has been evaluating the impact of the impregnation method on the physico-chemical and catalytic properties of the 3D-structured

catalyst. The impregnation of Co and Ru-based salts onto the 3D-printed alumina supports post printing showed the greatest potential in terms of CO conversion, selectivity and scalability. This approach was therefore selected for scale-up for a fixed bed reactor at TNO. Multiple (>30) 3D-printed catalysts have been developed successfully and thoroughly screened at TNO's facilities to enable us to verify that the reactor conditions are on course to reach TRL-5 at the next stage in the coming months.



CIAOTECH

With the final goal to establish a sound exploitation of the GLAMOUR results, **CiaoTech** has finalised the market and stakeholders' analysis, gathering strategic information on the technology and market trends relevant for the project as well as

mapping the most important organisations within and around the GLAMOUR value chain to set up engagement strategies.

Regarding the Dissemination and Communication task, CiaoTech attended national and international events with the aim of presenting GLAMOUR and its aims to stakeholders and general public. In particular, the project was showcased at **IFIB**: the International Forum on Industrial Biotechnology and Bioeconomy, held in Trento (Italy) from September 30th to October 1st, 2021, and displayed in **ECOMONDO** - the benchmark event in Europe for technological and industrial innovation in the field of green and circular economy, which will take place in Rimini (Italy) from 26th to 29th October 2021. In addition, CiaoTech also attended the **5th H2020 Biofuels Workshop**, organized by CINEA and held on 14-15 October 2021, together with the University of Manchester.



Argent Energy

ARGENTENERGY

Argent Energy has developed a process for the purification of one type of crude glycerol. This process yields a glycerol purity of 84 wt.% and a glycerol yield of approximately 40 wt.%. In the next step an

academic paper is prepared which will be submitted in a peer-review journal. A review paper was already submitted and is currently being checked.

As this purification route is not suitable for other purification routes due to the different composition of the feedstock, a different approach is currently tried out to find a general step which increases the purity of crude glycerol constantly to a certain degree. Therefore, tests with an electro dialysis rig will start soon. The report on WP task 3.2 is currently in preparation.



INERATEC GMBH

INERATEC performed catalysts screening to better understand the influence of the FT (Fischer-Tropsch) reaction parameters and composition of the feed gas on the FT-products composition. A goal was to

define optimum ranges for the jet Fuel production, one of the targeted products in the GLAMOUR project. The screening resulted in a benchmark of two conventional industrial catalysts and one reference catalyst. This benchmark helped the partners to compare the performance of the industrial catalysts to the reference provided by TNO. This benchmark was used to compare the reference catalyst with the other benchmarked catalysts. Data from the experimental campaigns were also used in the Life Cycle Assessment for the FT small-scale reaction and will be incorporated in the modelling of catalyst and FT-reactor performance. Concerning the Marine fuels and in regards of the exploitation of GLAMOUR results (WP7), INERATEC was actively networking with possible stakeholders and partners and continues its work on understanding the value chain of the FT Products and their market, sharing relevant details with the GLAMOUR consortium.

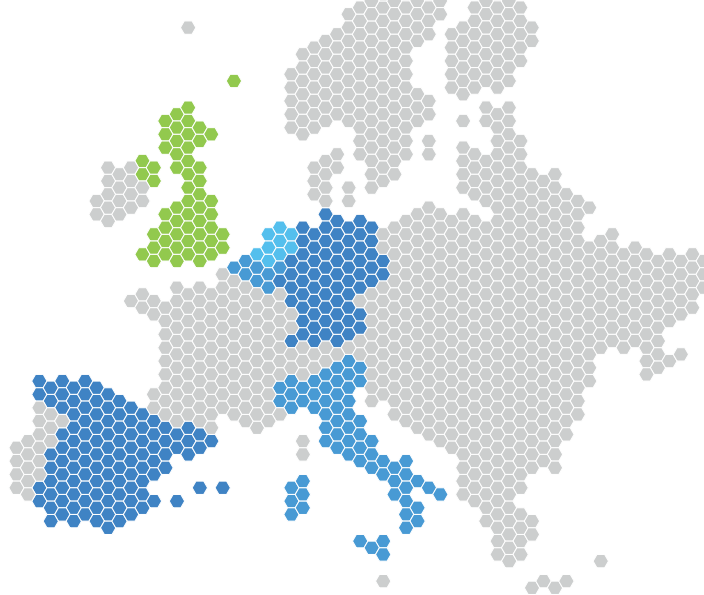


C&CS

At **C&CS**, in a catalyst screening campaign, different catalyst systems were developed in tablet form and examined on their surface, structural and mechanical properties as well as on their catalytic performance by the

partner CSIC. The most suitable support material system was then used to produce > 1000 tablets of approx. 4 x 4 mm size by means of a tablet pressing machine for the preparation of the appropriate catalyst in a higher amount. Results of measured surface properties and side crush strengths as well as examination results on the catalytic performance are very promising with respect to the target application. Therefore, this catalyst system was selected to be further examined by the partner University of Manchester in chemical looping reforming (CLR) experiments. First CLR results have already shown its suitability under the alternating reaction conditions in chemical looping reforming of glycerol. Further tests are planned to be performed on an optimized catalyst system.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 884197