



# GLAMOUR



GLycerol to Aviation and Marine prOducts  
with sUstainable Recycling

## UPDATES ON THE FIRST YEAR OF ACTIVITIES

GLAMOUR celebrates its first year of implementation! The second project newsletter deals with the interesting findings related to each Work Package made by the consortium.

A focus on the technical achievements related to the purification of glycerol, the syngas generation, the development of a customized structured (3D printed) Fischer-Tropsch (FT) catalyst and the lab retrofitting and prototype development is given, as well as insights on the Market and Stakeholder Analysis. Details on the Dissemination materials and tools developed to maximize the visibility of the GLAMOUR project are also provided.

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

## INDUSTRIAL APPLICATIONS

Argent Energy achieved significant progress in the purification of glycerol. Testing of different glycerol feedstocks have been conducted at the University of Manchester and progress has been made in improving the quality with a simple purification step. Soon the analysis of the samples will yield preliminary results which can be used as a foundation for further purification steps.

From the glycerol market report, it has concluded that the drive for more sustainable fuel sources will lead to an increase in crude glycerol production, which will increase the overall supply to the market. Furthermore, high edible oil prices will push Biodiesel producers to more low-grade waste-based feedstocks which will increase the feedstock availability for projects such as GLAMOUR.

Furthermore, Siirtec Nigi carried out the review of the current technologies for producing liquid synthetic fuels, on industrial scale. At the time being only Gas to Liquid Fischer-Tropsch (GTL-FT) processes have been deployed on industrial scale and can be used as a commercial benchmark. For GTL, Siirtec Nigi spotlighted a specific case study upon which a dashboard of technical and economic key performance indicators has been worked out for comparison purposes.

The preliminary design of 250 tonne/day of glycerol-fueled GTL plant has been simulated for the production of kerosene and gasoline. The initial plant underwent preliminary techno-economic assessment showing the feasibility of such a plant.

## SYNGAS GENERATION

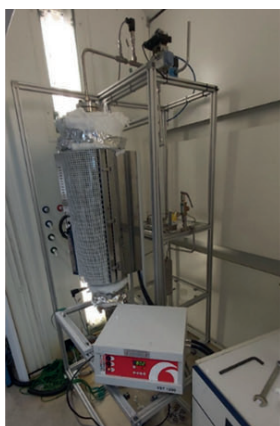
Along this year of activities, the basic mass and energy balances for the syngas generation step have been solved, and this served to define materials requirements as well as to define preliminary strategies for operation.

For a reliable working process, the feedstock must be pre-treated, and all inorganic material must be removed in order to avoid poisoning of the catalyst. Hence, a summary of existing and novel purification routes for crude glycerol from biodiesel manufacture has been made by Argent Energy. Currently, the majority of purification routes rely on a combination of physico-chemical pre-treatments such as saponification, acidification, neutralization and possible extraction with polar and non-polar solvents followed by refining technologies such as ion-exchange, vacuum distillation, activated carbon adsorption and membrane technology. Other innovative processes come from the desalination area such as electrodialysis. Very high glycerol purities are achieved with the combination of these processes. Initial techno-economic analysis, life-cycle assessments and sustainability factors have been explored as well.

During this period there has been also an intense work on the development of functional materials for the process by the partners involved within this task. C&CS is developing Ni-based reforming catalysts with tailored compositions and surface

properties under the target application conditions. A first sample has been sent for catalytic activity testing at CSIC, showing promising results within the initial glycerol reforming tests. CSIC has also produced bi-metallic materials Ni-Fe those have been also evaluated as oxygen carriers and glycerol reforming catalyst. In parallel, CaO-MgO based CO<sub>2</sub> sorbents, have been identified as candidates for the sorption assisted chemical reforming of glycerol.

University of Manchester began testing 500 grams of commercial Ni-based oxygen carrier materials for chemical looping reforming of methane in the large-scale reactor from 1-5 bar and 400°C to 1000°C. The testing has run for 500 hours. Glycerol feeding system and steam generator are being designed and built to have the set-up ready for the proof-of-concept of GLAMOUR at TRL4 along the coming year.



Reactor used for chemical looping reforming of methane



Gas feeding system



Gas-solid reaction lab at the University of Manchester

## FUEL SYNTHESIS

TNO as WP4 lead, together with the WP4 partners (TU/e, VITO, INERATEC, C&CS) has focused on the development of a customized structured (3D printed) Fischer-Tropsch (FT) catalyst in the first year of the project. The work started with reporting the state-of-the art FT processes and catalysts. It has been shown that the industrially preferred route is co-production of chemicals and liquid fuels of which predominantly diesel (max 58% selectivity). In novel studies, it has been reported that jet fuel can be obtained in up to 75% selectivity directly using bifunctional catalysts, with no wax formation or the additional hydrogen consumption in hydrotreatment. Following the study, 8 cobalt based catalysts were selected, and samples were prepared on gram scale. The samples were analyzed using various techniques like SEM, N<sub>2</sub> physisorption, ICP-OES, NH<sub>3</sub>-TPD (TNO) and XRD (VITO) to determine crucial properties such as acidity (crucial for selective cracking) and cobalt dispersion. INERATEC has focused on the benchmark testing of a commercial catalyst to compare to the upcoming results from the screening tests at TNO. TU/e has started with modelling and has created a first 2D model demonstrating the axial and radial

heat distribution under different FT conditions based on reference monolith geometries supplied by VITO. The developed model is a starting point for investigating a variety of geometries and optimizing heat management within the structure.

In parallel, VITO has started with the first 3D prints using commercial catalyst powder and using bifunctional catalysts prepared by TNO.



First 3D printed GLAMOUR catalysts produced by VITO

## DEMONSTRATION

The current WP 5 activities are focusing on lab retrofitting and prototype development at Eindhoven University of Technology premises.

The piping & instrumentation diagram (P&ID) consisting of chemical looping reforming followed by Fisher-Tropsch reactors has been finalized. A safety report including a thorough description of the P&ID, normal operation and leak testing procedures, identification and evaluation of risks to personnel or equipment, related safety barriers and procedures in case of emergency shut-down has been drafted and is currently under internal review at TU/e.



## LIFE CYCLE SUSTAINABILITY ASSESSMENT

University of Manchester has begun gathering preliminary data from the partners. An extensive literature review is being conducted in order to supplement the available experimental data, allowing to perform simplified Life Cycle Assessments. Current LCA work is focusing on the production of the Ni-based oxygen carrier and on the reforming of glycerol.

## EXPLOITATION & DISSEMINATION

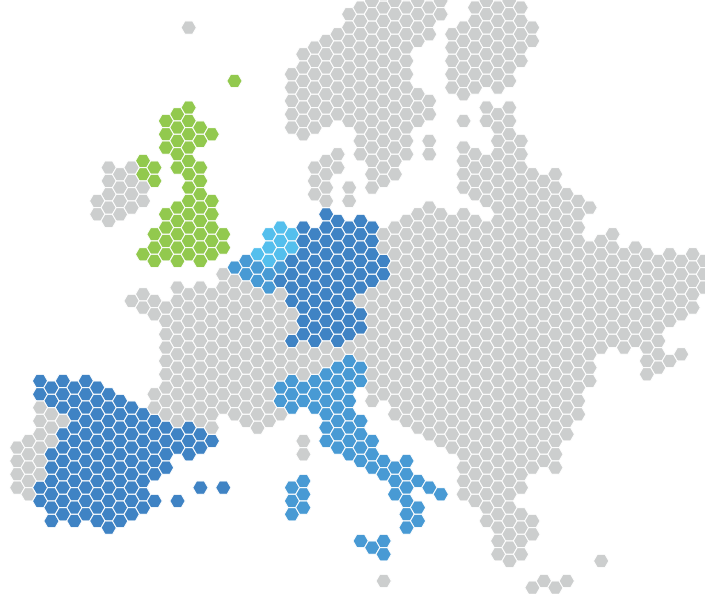
CiaoTech developed many Dissemination materials and tools to maximize the visibility of the GLAMOUR project. At the beginning of the activities, the [project website](#) has been launched, as well as the [LinkedIn](#) and [Twitter](#) accounts, which are monthly updated with interesting news and events related to the initiative's scope. Follow us to remain always update about the latest project news!

The D&C materials were published and are used to disseminate the GLAMOUR aims in events and other communications activities. The [brochure](#) and [poster](#) are available for free download in the [Documents](#) page of the project website, have a look of them! CiaoTech also presented the project in the online poster session of [IFIB 2020](#), the International Forum on Industrial Biotechnology and Bioeconomy, of which it was sponsor.

As part of the Exploitation, CiaoTech has led the first of a series of exploitation workshops that will be carried out during the lifetime of the project. This first event, the IPR workshop, consisted in an introduction to the partners of the main concept, recommendations, issues on the IPR management followed by an interactive session where partners had a first discussion on possible IPR measures to be implemented for each GLAMOUR result.

Finally, CiaoTech is now starting the market and stakeholder analysis activities that will be carried out using an its own innovation intelligence methodology. These activities will be crucial to identify the market and technology trends and the most important stakeholders related to the GLAMOUR project, stay tuned to be updated about the results!

## CONSORTIUM



University of Manchester  
UNITED KINGDOM  
[www.manchester.ac.uk/](http://www.manchester.ac.uk/)



Eindhoven University of Technology  
NETHERLANDS  
[www.tue.nl/spe](http://www.tue.nl/spe)



Nederlandse Organisatie  
voor Toegepast  
Natuurwetenschappelijk  
Onderzoek  
NETHERLANDS  
[www.tno.nl/en/](http://www.tno.nl/en/)



Instituto de Carboquímica-Spanish  
National Research Council  
SPAIN  
[www.csic.es/en/home](http://www.csic.es/en/home)



Vlaamse Instelling voor  
Technologisch Onderzoek NV  
BELGIUM  
[www.vito.be](http://www.vito.be)



CiaoTech  
Italy  
[www.pnoconsultants.com/it](http://www.pnoconsultants.com/it)



Siirtec Nigi S.p.A  
ITALY  
[www.siirtecnigi.com](http://www.siirtecnigi.com)



Argent Energy  
UNITED KINGDOM  
[www.argentenergy.com](http://www.argentenergy.com)



INERATEC GMBH  
GERMANY  
[www.ineratec.de/en/home](http://www.ineratec.de/en/home)



Catalysts and Chemical  
Specialties GmbH  
GERMANY  
[www.candcs.eu](http://www.candcs.eu)

## CONTACT US PROJECT COORDINATOR

 Vincenzo Spallina,

- Lecturer in Chemical Engineering Department of Chemical Engineering and Analytical Science
- School of Engineering
- The University of Manchester

 [vincenzo.spallina@manchester.ac.uk](mailto:vincenzo.spallina@manchester.ac.uk)



[linkedin.com/company/glamour-horizon-2020](https://www.linkedin.com/company/glamour-horizon-2020)



[twitter.com/GlamourH2020](https://twitter.com/GlamourH2020)



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