



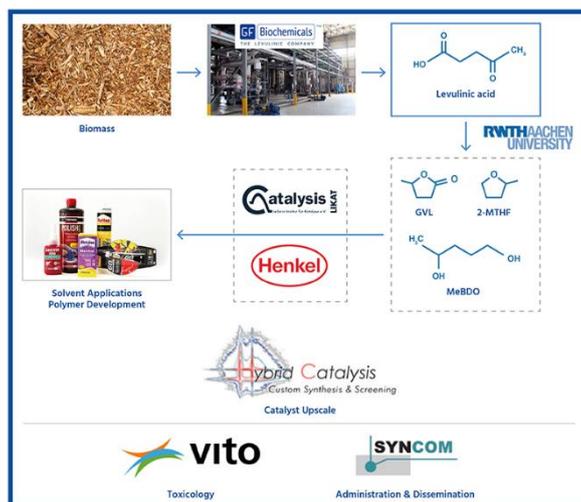
## Green solvents and resins from lignocellulosic biomass

### New European innovation project GreenSolRes will convert lignocellulosic feedstock into chemical building blocks and high added value products

The need to establish economic and sustainable large-scale operations for the conversion of renewable resources to chemical building blocks is becoming increasingly urgent in the context of climate change and depleting fossil fuel reservoirs. Pathways for manufacturing of bio-based fuels and chemicals have been developed but most of them rely on sugar and starch crops for feedstock. Alternative technologies that alleviate competition with food production are highly sought after.

Within the project GreenSolRes, a sustainable and competitive industrial production of levulinic acid (LVA) from lignocellulosic wastes and residues originating from forestry and agricultural sector will be established. The conversion of LVA into industry relevant building blocks and products takes place by new catalytic methods. Finally, these chemicals will be upgraded to solvents and resin monomers for the production of high added value adhesives and consumer products.

Levulinic acid is a versatile platform chemical, which is considered key for moving Europe towards petrochemicals-free green manufacturing. Successful completion of GreenSolRes will lead to sustainable commercial production of LVA and its derivatives, stimulating a rapid gain in the production volume of bio-based consumer products. The bio-based building blocks have a high greenhouse gas (GHG) avoidance of at least 70% comparing to their fossil-based counterparts.



A brief outline of GreenSolRes with role of beneficiaries

The project consortium is led by GFBiochemicals Italy, which owns a demonstration scale biomass based LVA plant operated in Caserta in Southern Italy. Its proprietary technology portfolio and experience make GFBiochemicals a leader in the field of bio-based LVA production. Senior Scientist Dr. Bart Engendahl says, “GFBiochemicals is proud to be part of this project, bringing our expertise in the production of levulinic acid from lignocellulosic biomass. We view this as a great opportunity to collaborate with key leaders in the industry to reveal the power of new performance biobased technologies at economic scale.”

Further partners from industry and research are placed in Belgium, Germany and Netherlands. This demonstration project is funded under Bio-based Industries Innovation action within Horizon 2020 for a duration of 48 months starting in September 2016.

The overall objective of GreenSolRes is to demonstrate the competitiveness of the LVA value chain in terms of costs, environmental impact and technical performance. The final project target is to have the optimized process design of all process components in full scale ready stage, enabling commercial exploitation after successful completion of the project.

GreenSolRes consists of three process steps, the first step is the conversion of lignocellulosic biomass to LVA via a robust and low-impact thermochemical process. To achieve this, the feedstock in GFBiochemicals existing demo plant in Caserta will be shifted to lignocellulosic residues by implementation of a char separation unit and char valorization to cover the process energy demand. The second step is subsequent hydrogenation of LVA to 2-methyltetrahydrofuran (2-MTHF), gamma-valerolactone (GVL) and 1-methyl-1,4-butanediol (MeBDO), a highly efficient technology that originated in the Cluster of Excellence "Tailor-Made Fuels from Biomass (TMFB)" at RWTH Aachen University.

The third step is to formulate and validate the application of these products in adhesives and in the pharma sector with an aim to substitute fossil-based C4-analogues. It is anticipated that the products will have superior ecotoxicity properties compared to the established fossil-based solvents e.g. tetrahydrofuran, gamma-butyrolactone and 1,4-butanediol. "Henkel is proud to be part of this exciting project. It greatly matches our own research strategy with the aim to develop new bio-based technologies with advanced performance profiles. In close collaboration with LIKAT who has specific know-how on the catalysis of chemical building blocks, Henkel aims to achieve the conversion of bio-based intermediates into new, high performing and sustainable adhesives, explains Horst Beck, Head of the R&D platform for Bio-Renewables at Henkel."

Products from biomass waste are sustainable alternatives for petro products, provided they are safe for ecosystem. Life cycle analyses (LCA) and Environmental impact analyses (EIA) will be performed to evaluate biomass based derivatives and to document safety performance of the sustainable alternatives.

## Consortium Partners

**1 GFBiochemicals Italy SPA, Italy**, is the only company to produce levulinic acid at commercial scale directly from biomass. In 2008, a group of biobased chemical experts saw the significant potential of levulinic acid to replace petroleum-based products across a range of market sectors and founded the company to develop the production technology needed for this revolution.

**2 Henkel AG & Co. KGaA , Germany**, founded in 1876, holds globally leading market positions in consumer (Laundry & Home + Beauty Care) and industrial businesses (Adhesive Technologies) with well-known brands like Persil, Schwarzkopf and Loctite. The Dax-30 company (headquarters in Düsseldorf, Germany) is proud of its 49,000 employees from more than 120 nations worldwide, located at 164 manufacturing and 17 major R&D sites around the world.

**3 Rheinisch-Westfaelische Technische Hochschule (RWTH) Aachen, Germany**, is among the leading European educational and research institutions with its 260 institutes in nine faculties. The work of the research centers of RWTH Aachen is closely oriented towards the current needs of business and industry. This leads to numerous developments and inventions that are patented and exploited. The University's innovative capacity is further reflected in the high number of business startups, currently more than 1,400. As a result, around 32,000 jobs have been created in the region in the last 25 years

**4 The Leibniz Institut für Katalyse in Rostock, Germany**, is one of the largest publicly-funded research institutes in Europe in the area of applied catalysis, combining both homogeneous and heterogeneous catalysis. The institute currently employs ca. 300 people. It is housed in modern laboratories and has an excellent infrastructure, including state-of-the art analytical facilities. The research for GreenSolRes will take place in the Department of Catalysis with Renewables, headed by Prof. Dr. Johannes G. de Vries.

**5 SYNCOM Forschungs-und Entwicklungsberatung GmbH, Germany**, is a consulting firm founded in 1997 with the focus on innovation management. Physicists, Chemists, Engineers and Business managers apply management expertise and scientific know-how to support their clients in realizing innovations. Key business sectors are bio-refineries, materials and mechanical/electrical engineering.

**6. Hybrid Catalysis B.V., The Netherlands**, has served the chemical industry with respect to contract R&D in advanced nanostructured catalyst development and automated screening since its launch in 2005. It has own IP on nanocatalysts that are in cases being subjected to plant trials. Currently, Hybrid has about 15 multinational customers. Hybrid was participant in FP7 granted programs NanoHost, HiCat, INCAS, DEMCAMER and REFORCELL as well as in CatchBio, a 29 M€ Dutch research effort related to catalytic utilization of renewable feedstocks.

**7 Vlaamse Instelling voor Technologisch Onderzoek N.V. (VITO), Belgium**, is an independent research and technology organisation in the areas of cleantech and sustainable development, elaborating solutions for the large societal challenges of today. VITO provides innovative and high-quality solutions, whereby large and small companies can gain a competitive advantage. The organisation advises industry and governments on determining their policy for the future. VITO has 750 highly qualified employees who work on international projects all around the world. The environmental impact assessment in GreenSolRes will be performed by experts of the Environmental Risk and Health Unit of VITO.

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