

# UNRAVEL

Unique Refinery Approach to Valorise European Lignocellulosics

## Summary

The UNRAVEL project aims to develop advanced pre-treatment, separation and conversion technologies for complex lignocellulosic biomass. The technology relies on pre-extraction, fractionation using low-temperature acetone and subsequent downstream processing to isolate and convert the lignocellulosic constituents into high-value applications. This will produce usable lignin fragments and monomeric sugars from the cellulose along with a hemicellulose fraction suitable for biochemical conversions.

It will bring together specialists with expertise of the entire value chain from feedstock composition, chemical pulping and pre-treatment, enzymes production, polymer chemistry, separation and reactor engineering, techno-economic and sustainability assessments and knowledge dissemination, exploitation and communication.



<http://unravel-bbi.eu/>

**Type of Action:**  
Research & Innovation Action

**Value Chain:** VC1 –  
lignocellulose

**Start date:** 01 June 2018

**End date:** 31 May 2022

**BBI JU contribution:**  
€3,603,545

## Objectives

The UNRAVEL Project aims to develop an innovative lignocellulosic value chain and has the following specific objectives:

- Develop a pre-extraction process optimised for mixed lignocellulosic biomass streams;
- Achieve at least 80 percent delignification, 90 percent glucan recovery, 80 percent yield of monomeric hemicellulose sugars and less than 1 percent solvent loss;
- Achieve at least 95 percent lignin recovery and 99 percent (non-condensed) solvent recovery from the liquor;
- Develop an economically viable process for purifying the hemicellulose hydrolysate to ferment the hemicellulose sugars effectively into chemical building blocks;
- Achieve over 90 percent sugar conversion, over 20 percent reduction of hydrolysis time and 20 percent reduction of enzyme dosage compared to cellulose alone;
- Demonstrate the low inhibitory effect of the C5 and C6 hydrolysate in fermentation;
- Activate and depolymerise lignin from the FABIOLATM process
- Establish a series of high-value lignin

## Expected impacts

As well as its contribution to the overall BBI-JU goals and Key Performance Indicators, the UNRAVEL project aims to have the following impacts:

- Creating a new cross-sector interconnection between the forestry, pulp and paper industries, the biotechnology industry and the building and construction material industry;
- Establishing a new value chain using a mixture of hardwood wood chips, forest residues and bark, as well as straw and nut shells, to produce extractives, lignin-based polyols and chemical building blocks for the sugar fractions;
- Reducing operational expenditure by at least 30 percent through a series of process improvements, principally by reducing operating temperatures. This reduction will also reduce the carbon footprint of the operation;
- Lowering the overall environmental impact of biorefineries by reducing emissions and increasing the efficiency resource and chemical use;

Applications;

- Show a 30 percent reduction in operating expenses through lower overall energy consumption and costs as compared with a benchmark pre-treatment process;
- Demonstrate an overall reduction of at least 15 percent in the carbon footprint compared with the state-of-the-art bio-based operation.

- Stimulate innovation through international and cross-sector collaboration.

## Project coordination

- Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V. (Germany)
- Celignis Ltd (Ireland)
- Metgen OY (Finland)
- Soprema (France)
- Stichting Energieonderzoek Centrum Nederland (The Netherlands)
- Institut für Energie und Umweltforschung Heidelberg - GMBH (Germany)
- Rita Clancy (EURIDA) (Germany)
- Centre National de la Recherche Scientifique - CNRS (France)
- Sappi Lanaken (Belgium)
- Max-Planck-Gesellschaft zur Förderung der Wissenschaften eV (Germany)

**Organisation name:** Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V. (Germany)