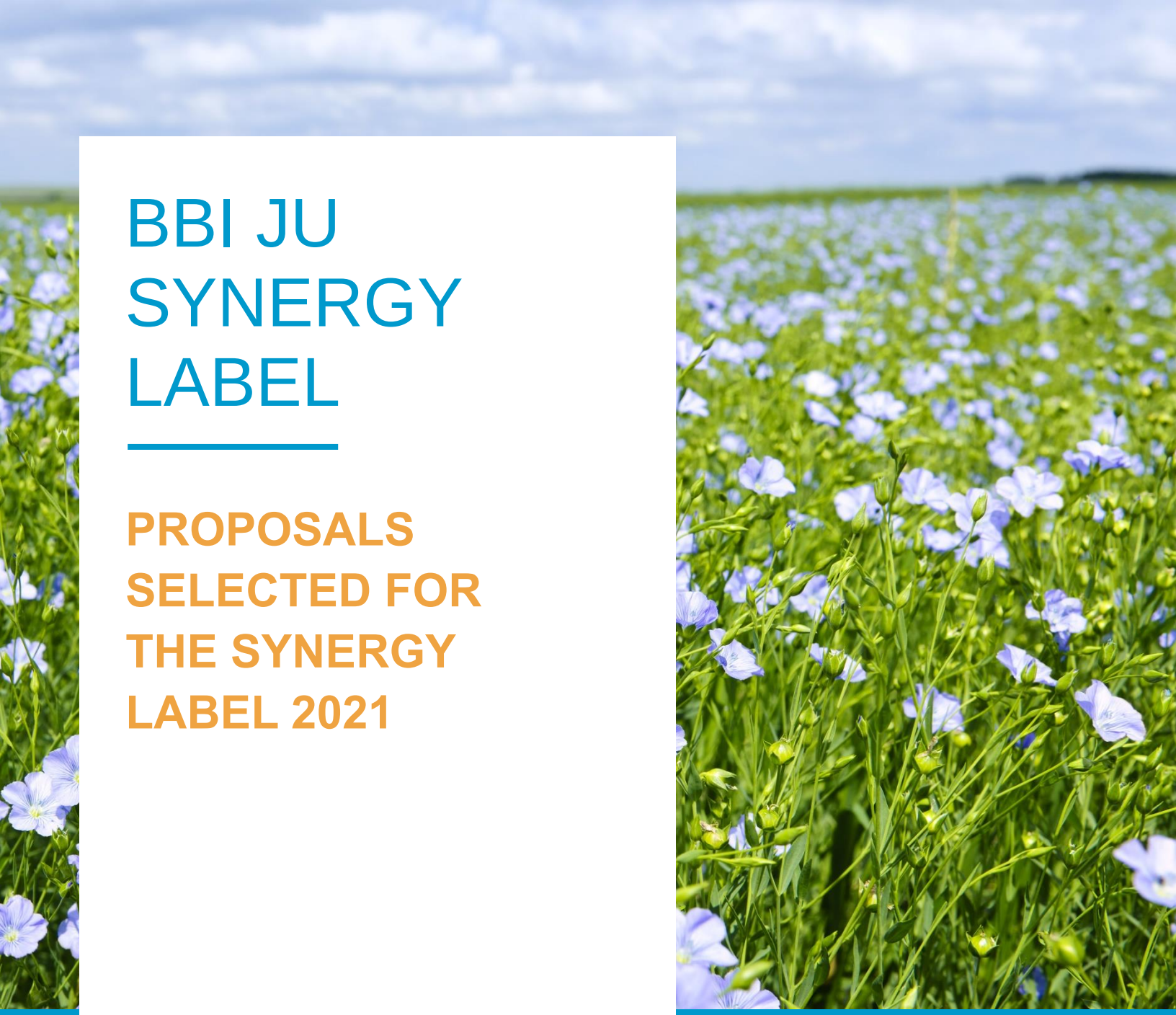

BBI JU SYNERGY LABEL

PROPOSALS SELECTED FOR THE SYNERGY LABEL 2021

September 2021

AddDegPack

Demonstration of new Packaging solutions with Additional functionalities and Ad-justable bioDegradability

The AddDegPack project addresses bio-based packaging from food, cosmetic and agriculture industries and provides them superior functionalities. With six use cases (cucumber foil, tofu bowl, sachets for cosmetics - also refill - and supplements and flowerpot) large areas of the packaging industry are covered.

The packaging innovations are built up from a base material (biopolymer- or paper-based) (WP1), which basically can work stand-alone. However, extremely important and unique features are added by coatings, particles and capsules. In the subsequent WP2 gas barrier, emptying capability and traceability will be developed.

Nevertheless, AddDegPack focusses on adjustable biodegradability, which is affected by protective layers or accelerated by encapsulated triggers. Different environments, which are relevant for the respective application, will be considered in the material development. In order to enable quick feedback on the material (WP1 and WP2) and process development (WP3), AddDegPack will use accelerated tests (WP5).

In automated facilities, the biodegradability can be determined simultaneously and under different conditions. The evaluation follows established test protocols. Besides the influence of the residues on the plant growth are examined to ensure that AddDegPack materials don´t have a negative impact on the environment. WP3 bundles all processes, e.g. innovative paper thermoforming, which are necessary for the packaging production, and prepares their upscaling in WP4. Existing pilot plants are used, others will be upgraded.

At the end, the six demonstrators will be produced at TRL7, which will be finally evaluated with regard to their biodegradability and environmental compatibility (WP5) and LCA, LCCA and S-LCA (WP7). All relevant test for a later certification is covered. The involved end users evaluate the marketability of the products and their properties in application.

BIOFREEZE

Bio-based and compostable packaging solutions for frozen food products

BIOFREEZE aims to develop bio-based compostable packaging solutions for frozen food products, with superior performance (in terms of barrier properties, improved food safety, longer shelf life, compostability, etc.) along its entire value chain and life cycle, from production to disposal. A circular value chain will be validated for the bio-based compostable packaging, considering industrial composting as the most suitable end-of-life options, to demonstrate a minimal environmental damage.

BIOFREEZE will follow different material development approaches:

1. development of novel biopolyester grades derived from bio-based building blocks, and
2. novel blends of current biopolyesters with improved superior properties

BIOFREEZE considers industrial composting as the primary and most suitable route for managing BIOFREEZE bio-based and compostable packaging solutions after its end-of-life.

Additionally, BIOFREEZE considers the enzymatic recovery of monomers from the bio-based compostable material developments as an alternative route for valorisation with a circular economy approach. Lastly, BIOFREEZE will assess the biodegradation of the developed packaging materials in marine and in-soil environments in order to determine the consequences of an unintended disposal of BIOFREEZE packaging solutions into nature.

BIOFREEZE will approach the circular economy by the validation of a holistic circular value chain from material production to packaging end-of-life, by:

1. developing packaging materials with longer shelf life
2. develop plastic materials from biobased renewable resources
3. valorising first generation sugars from by-product streams into novel bio-based building blocks
4. valorise plastic waste for the recovery of monomers that will be used for the production of new biopolymers; and
5. valorising plastic packaging as compost as soil enhancer in the production of raw material for food production

BIOGENIC1

Bio-based products from biogenic gases in zero-waste bioindustries

Bio-based industries (i.e. food & beverage, waste and wastewater treatment, bioethanol, biogas or syngas production) emit large amounts of biogenic CO2, CH4 and CO (~ 600 Mt/y). These C1 emissions are underused or discharged to the atmosphere, which represents an environment burden and a waste of valuable resources. In this context, a cost-competitive valorization of these emissions would foster an unexploited and profitable business opportunity, while drastically decreasing the greenhouse gas (GHG) emissions of bio-based industries.

The aim of the BiogeniC1 project is to validate at demo scale the technoeconomic and environmental feasibility of an integral and sustainable multi-platform (devoted to the bioconversion of CO2, CH4 and CO) capturing at least 20% of the GHG emissions of MAHOU brewery.

For this purpose, a new generation of compact high mass-transfer gas-phase bioreactors (taylor flow, pressurized gas-lift and forced-circulation loop) and their corresponding gas-conditioning and downstream processes will be upscaled to cost-effectively biotransform fermentative CO2, biogas and syngas into:

1. (bio) chemicals such as caproic acid, hydroxyectoine and polyhydroxyalkanoates
2. advanced chlorine-based disinfectant agents, and
3. high-quality SCP-based pet-food

Demo operation of this novel GHG biorefinery will generate enough quantities of three new business to business products and two new business to consumer products for further validation in terms of safety, efficacy, stability and/or acceptance by end-users. Thus, four new cross-sector interconnections will be created between bio-based industries and the cosmetic, chemical (hygiene), pet-food and packaging sectors, through the five new bio-based value chains.

BiogeniC1 will position MAHOU at the world forefront of ‘zero-waste’ and ‘carbon-neutral’ breweries while significantly boosting its economic profitability. The CO2, CH4 and CO platforms validated in BiogeniC1 could be implemented in most bio-based industries.

ByeOpack

Biopolymers for enhanced home compostable packaging

The ByeOpack project is designed to develop a low environmental-impact packaging solution. A lignin-based coating will be engineered to replace fossil-based plastic liner within paper-based containers.

This coating will be biodegradable, resistant to temperature higher than 100°C and waterproof to replace plastic ones usually used in coffee cups. The implementation of the coating will be demonstrated on coffee cups application. One major advantage compared to existing solutions will be the home-compostable capability of the developed materials. Results of biodegradation studies will provide the necessary data to evaluate end of life characteristics.

Additionally, an environmental analysis will be performed to access the environmental impacts of the developed packaging from the raw material to its end-of-life management. Data collected during the project will be compared to fossil-based packaging data in agreement with the Life Cycle Assessment methodology. To complete the evaluation, a Social Life Cycle Analysis and a Life Cycle Costing will be conducted to identify the main drivers for the implementation of such new bio-based solution.

The main driver of this project is the development of technologies and value chains that support the achievement of challenging European environmental targets. The project will have sizable impact on Green House Gases (GHG) emission reduction and will help protect environment from plastic via exploring recyclability and biodegradability of the end product.

ByProducts4Bioeconomy

ByProducts4Bioeconomy

ByProducts4Bioeconomy brings together a multi-disciplinary, world-leading team of companies and scientists with expertise in food science and product development, seaweed biochemistry, animal science, animal feed development, microbiology and metabolomics, life cycle analysis (LCA), cosmetic product development, physics and electrode sensor development as well as aquaculture & marine science and fish nutrition. It includes ten companies (large industry and SMEs), five universities, six research organisations and two state agencies.

ByProducts4Bioeconomy includes key industry members with experience in by-product recovery and valorisation (Innosun Ltd.), feed and aquaculture development (Sparos Ltd., Fermentation experts, NuSciences), cosmetic product development (SagaNatura), and electrode development (Tyndall).

Specifically within ByProducts4Bioeconomy we will investigate the potential to recover residual biomass at demonstration-scale (TRL 7): marine (pelagic processing blood-waters, undersized and broken mussels, microalgae and seaweed polymer residues) and agricultural (rapeseed cake) by-products. This will be achieved by

1. careful logistical planning concerning collection, transport and storage of residual biomass
2. educating processors concerning the potential value of correctly stored residual by-products through state agency extension services in consortium member countries and
3. by implementing novel process technologies for stabilisation and volume reduction of biomass using methods including electro-flocculation, bioremediation and membrane filtration, and further processing and conversion of by-products to value-add products (antimicrobials, anti-inflammatory ingredients, electrodes, cosmetics)

Novel technologies include laser induced graphene (LIG) technology to convert mussel shell by-product into electrodes for use in novel packaging applications to replace coal and petroleum derived electrodes. In addition, feed and cosmetics will be used.

CONQUER

Flagship demonstration of industrial scale production of hydrolysed peptides for human consumption from sidestreams of salmon processing industries

The CONQUER project aims at sustainably exploiting the sidestreams of the salmon processing industry for producing salmon peptides and oil, to be used as ingredients for human nutrition at large scale. A sustainable first-of-its-kind biorefinery will be developed in Hirtshals (Denmark) based on know-how developed by BG, the Coordinator, in its DEMO plant in Norway, bringing the process from TRL 6 to TRL 8.

The biorefinery process will be based on a proprietary hydrolysis reactor concept and will allow the treatment of human grade fresh offcuts from the salmon industry to obtain peptides, oil, and bones. Such primary products will be further processed through secondary refining to obtain ingredients for human consumption according to market demands.

The resulting products will have a huge potential since they will find different applications thanks to the therapeutic effects that they can exert. The residual product obtained from the enzymatic hydrolysis as side-product will be valorised as ingredients for on the premium pet food market, as already done in the Norwegian plant (Branded as Salmigo Active).

To demonstrate the project replicability, the CONQUER concept and technology will be applied to another raw material, i.e., sidestreams from whitefish and pelagic species, demonstrating the applicability to different value chains and not only salmon-based processing. Moreover, after the project end the biorefinery concept will be replicated in others European sites, showing the replication potential of the project.

The CONQUER concept will give an answer to the growing demand for new sources of food proteins, which will significantly increase due to the population growth. Moreover, the developed biorefinery process will not only valorise marine sources and aquatic based products, but it will also give a great contribution to the European bioeconomy by offering a solution for the management of fish processing industry sidestreams.

DIFFERENTIATOR

Demonstration and optimization of a CO2 based methanol fermentation platform

Biogenic CO2 is produced as a sidestream of bio-industry and accounts for approximately 101 Mio tons in Europe of which about 33 Mio tons originate from biogas plants. Most of this CO2 is emitted in the air, as there are currently no incentives for valorization. DIFFERENTIATOR gives value to CO2 from biogas as feedstock for a biogenic CO2-based methanol fermentation platform that produces a variety of products.

It is DIFFERENTIATOR's ambition to demonstrate a first-of-kind circular biorefinery that exemplifies the BIC vision paper on the circular bio-society in 2050. In this zero-waste plant, also the CO2 originating from the methanol fermentation is re-used as feedstock. Full resource efficiency is obtained through nutrient recovery and reuse, advanced process control and process integration.

Eleven new value chains are established in growing markets by producing four new biogenic CO2-based products, namely microbial protein and L-lysine for premium feed applications and polyhydroxybutyrate and 1,5 pentanediamine for biopolymer applications.

The bioindustry, feed- and polymer industry, but also regulators and consumers are involved in product development to secure market success for these new products. DIFFERENTIATOR prepares for building a flagship production plant of 40kt/y microbial protein with an expected investment of 55Mio, job creation to 45 FTE, and a payback time of ≤ 8 years.

HOMCOMPACK

Demonstration of bio-based and HOMe-COMpostable materials for food PACKaging applications through the optimisation of PLA end-of-life and performance

HOMCOMPACK proposes an innovative solution to tackle the challenges in the use of plastics for food packaging applications related to sustainability, footprint end of life. The use and negative impact of plastics in packaging applications has increased the awareness of the consumers and EU society generating a necessity to find a global solution to which HOMCOMPACK will contribute.

The project will implement and validate all-inclusive processes for the production of two high performance bio-based packaging materials, home compostable by design and integrable into existing European waste management infrastructures: hence rendering polylactic acid market even more attractive for investment towards a sustainable future.

HOMCOMPACK will engage European relevant industrial actors covering the whole value chain of food packaging products (biomass, materials providers, plastic converters, retailers, end users, waste managers and consumers). HOMCOMPACK will develop and demonstrate on rigid and flexible packaging solutions at pre-industrial scale on two types of food products, namely fresh mushrooms and salad. Food safety and quality will be maintained, and shelf-life will be enhanced notably through O2 barrier improvement.

HOMCOMPACK project will directly contribute to achieve SIRA's objectives in KPI1, KPI2, KPI5 and KPI6 and to demonstrate the solution decreasing the fossil dependency of the food packaging sector. HOMCOMPACK consortium involves fifteen partners (industrially driven): four RTD (PACKLAB, ULS, IRTA and ESCI), five SMEs (TECNO, CAR, GCM, OWS and EQY), four large companies (GG, BARBIER, BASF, RBR), and two other (EUFIC and ANIA).

The proposed 55-months will comprise a total estimated budget of €9,244,807; being the 31.5 % covered by consortium own contribution (in-kinds) and adding more than €4,000,000 in additional investments during the project implementation and envisaged to upgrade TRL after the end of the project.

Hortitex

Complete Supply Chain to Turn Horticulture Waste to Sustainable Textiles, Paper, Bio-Fertilisers and Growth Stimulants

Hortitex addresses the dual challenges of feeding a rising global population whilst meeting demand for non-food products in a sustainable way (minimising resources consumption, GHG emissions and toxic chemicals use).

Horticulture has traditionally created great value in rural areas and is becoming important in EU urban areas too thanks to its economic contribution (18% in EU - worth over €50 billion) for only 3% use of the land. Undoubtedly, the horticulture sector will play a key role in the EU's ambitions to combat climate change, preserve natural landscapes and biodiversity whilst delivering healthy food.

However, there is limited circularity in this sector. Tomatoes are dominant in horticulture. With the rise in greenhouse production, there has also been a formidable increase in tomato plant residue. This is a major issue for farmers, with no options to extract value from these residual streams, most residues ending up in landfills, as compost or in energy recovery, costing farmers between €1,500-2,500.

Hortitex's main goal is to demonstrate a viable supply chain using tomato plant residues as a feedstock to extract high value functional molecules to be turned into bio-fertilisers, bio-stimulants and cellulose for textiles and paper making. Despite cellulose being abundantly available within this waste stream (630 million kgs. annual potential in EU alone), there is no commercially successful supply chain to reach effective valorisation.

Hortitex will introduce new sustainable bio-based textiles and clothing substituting petroleum-based fibres (such as polyester) and virgin wood. It will reduce CO2 emissions in the supply chain by >20.6%, increase the value of tomato plant residue final use by >700% and offer sustainable textile and paper products to consumers and bio-stimulants and bio-fertilizers to growers. Additionally, Hortitex will contribute significantly to the EU economy through value (>€186 million) and job creation (potential >3,000 jobs in 5 years).

PEFpower

Production of eco-friendly PEF bottles originating from wood residues

PEFpower rethinks resource use and waste in the plastic value chain and decouples plastics from fossil feedstocks. Biobased polyethylene furanoate (PEF) is a polymer synthesized by co-polymerization of 2,5-furandicarboxylic acid (FDCA) and monoethylene glycol (MEG) with superior technical and environmental performance over its fossil-based alternative, polyethylene terephthalate (PET). The production of bio-based MEG is already being developed today. FDCA is not produced at a commercial level in the EU, hampering further development of PEF.

PEFpower will demonstrate the production of 5 tonnes FDCA, as a PEF monomer and important bio-based platform molecule, using an efficient biotransformation process from HMF (hydroxymethylfurfural). Unlike the chemical route, the microbe-assisted route takes place at mild process conditions with high selectivity and yields, while accepting relatively impure grades of HMF and producing highly pure polymer-grade FDCA.

By demonstrating a fully bio-based, more effective and affordable alternative to the chemical FDCA process, the consortium aims to substantially limit environmental and occupational hazards and improve sustainability of the target industries.

The FDCA production step will be implemented in a new value chain, producing over 100,000 PEF bottles from forest residues. To achieve this goal, a first step includes wood biorefining to generate glucose and Bio-MEG. Glucose will be converted to HMF, biotransformed at its turn into FDCA. FDCA and Bio-MEG will be co-polymerized to form PEF polymer.

After PEF bottle production and filling with sustainably sourced juice, the product will reach the final consumer in different markets. Post-consumer collection of the PEF packaging using established or fast-evolving systems and a chemical and mechanical recycling process will be integrated. This enables to compare different end-of-life scenarios and to fit in the EU's Circular Economy Action Plan.

RevoLignin

Revolutionizing the valorisation of lignin into high quality applications and end products with global market potential

The main objective of the RevoLignin project is to build a first-of-its-kind lignin-centric biorefinery (4000 ton/year), which can cost-efficiently convert multiple crude lignin feedstocks into various intermediate building blocks having tailored end-user characteristics.

The efficiency of the flagship plant will be further improved by integrating an innovative AI module to allow reverse engineering of end-product chemistries into optimized process parameters. Sustainable materials of the future will be tailored for customer-specific needs by combining the power of biotechnology and AI. Comprehensive lignin analytics will also be integrated into the operation of the flagship plant to ensure the production of optimally functioning lignin intermediates for high-value applications.

The converted lignin fractions will be demonstrated in high-end applications in a variety of markets:

1. lignin as a more sustainable pre-cursor for carbon fibres in automotive parts
2. biodegradable plastics for agricultural products
3. bio-based and biodegradable or recyclable toys and
4. bio-based sizing coating for packaging board

The lignin fractionation process has been validated in relevant environment (TRL 7), aiming to reach TRL 9 by the end of the RevoLignin project. All four lignin value chains are based on technologies verified at TRL 6 and achieving TRL8 in the end of the project. RevoLignin will enable an environmentally friendly and industrial-scale method for refining lignin without the use of toxic chemicals, solvents, or metal catalysts. The RevoLignin flagship is in practice a zero-waste process, in which all wastewater is fully recycled.

The overall sustainability of all the flagship processes and the end use applications will be fully assessed by performing comprehensive LCA, LCC and S-LCA evaluations, and additionally the technical and economic viabilities of all the processes of RevoLignin will be evaluated by performing a techno-economic assessment (TEA).

UPSIDE

UPScale the production of biobased platform molEcules for large higher value markets

Market demand for bio-based platform molecules (including organic acids) is increasing and market actors are demanding larger quantities to sufficiently high levels of quality to develop new formulations for specific applications, including food, feed and consumer goods.

To foster the market penetration of these bio-based platform molecules, the bio-based industry, in their pursuit of becoming more economically viable, must find ways to create processes capable of fully treating (zero-waste approach) different sources of biomass feedstocks, achieve a sustainable production quantity and quality that promote the attractiveness of converting biomass waste into added value chemicals as a viable alternative to producing heat and power through biogas production.

THE UPSIDE approach therefore fully encompasses the following:

1. feedstock agnostic - fermentation processes described can be modified to be able to treat different biomass feedstocks dependent upon local/regional availability
2. zero-waste - treating all of the biomass waste initially converting to platform chemicals with residuals being added to an anaerobic digester for biogas production (heat and power)

The UPSIDE consortium has already established supply of biomass waste feedstock - agricultural residues, fish waste and organic fraction municipal solid waste (OFMSW) - in several European countries. UPSIDE will demonstrate conversion of these waste streams using existing/new pilot plants into Volatile Fatty Acids (VFAs) for later use in in downstream conversion processes.