

# European Sustainable Biobased Nano Materials Community

An open innovation test bed for the upscaling, the market-readiness and the production of Nano structured bio-based materials (NBM)

> Open Innovation Test Bed Handbook





# Table of contents

What is an Open Innovation Test Bed?	3
The BIOMAC OITB in a nutshell	4
Why choose the BIOMAC OITB for your bio-based material development needs?	6
Who can access the services of BIOMAC and how?	7
Services offered by the OITB	9
OITB Partners	12
AIMPLAS	13
CNANO	15
European Bioplastics (EUBP)	16
EXELISIS	17
IBB	20
ISQ	22
ITENE	25
NANOTYPOS	27
RISE	29
OITB associated partners	30
AIMEN	30
АТВ	32
AUTH	34
BBEPP	36
FRAUNHOFER	38
LIST	41
LTU	42
POLIMI	44
UBU	46
UNIPD	47





# INTRODUCTION

In this section you will understand what an Open Innovation Test Bed is (OITB) and how BIOMAC has developed this concept.





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### What is an Open Innovation Test Bed?

Open Innovation Test Beds (OITBs) are entities, established in at least three Member States or Associated Countries, offering access to physical facilities, capabilities and services required for the development, testing and upscaling of nanotechnology and advanced materials in industrial environments. The objective of the Open Innovation Test Beds is to bring nanotechnologies and advanced materials within the reach of companies and users in order to advance from validation in a laboratory (TRL 4) to prototypes in industrial environments (TRL 7).

Open Innovation Test Beds help upgrade existing or support the setting of new public and private test beds, pilot lines, and demonstrators. The aim is to develop, test and upscale nanotechnologies and advanced materials for new innovative products and services in some specific domains.

The Horizon 2020 programme has funded the BIOMAC project to develop a brand new OITB, which will continue its activities after the project's completion in 2025. The OITB is managed by former project partners, and this handbook is a guide for exploring its services and opportunities .

#### What is so special about OITBs?

- 1. They offer complete, holistic services via a single contractor the Single-Entry Point (SEP)
- 2. They are comprised of a multitude of expert scientists from all over Europe, offering their expertise and infrastructure at competitive prices
- 3. They have integrated business and marketing services, which can help with access to financing opportunities and reaching out to new markets
- 4. They allow substantially reduced time and cost to progress from an idea to a successful product.





# The BIOMAC OITB in a nutshell

BIOMAC (European Sustainable BIO-based nanoMAterials Community) was a Horizon 2020 project that ran from 2021 to 2025, and led to the establishment of an Open Innovation Test Bed (OITB), a true collaborative ecosystem where technologies and solutions utilising nanoenabled bio-based materials (NBMs) can be upscaled and prepared for market applications. After the project's conclusion, partners have continued post-project activities within the OITB, offering a variety of fee-based services.

BIOMAC offers a wide range of services, distributed in 4 hubs, including access to its Pilot Lines that cover the whole value chain (see page 9), starting from biomass pre-treatment and ending in the final plastic-based products. Everything is supported by complementary services such as quality control, characterization, standardization, modelling, innovation management, health and safety, regulation, data management, sustainability assessment, supply management and circularity checks.

The BIOMAC Ecosystem's service providers are all highly skilled experts in the field, and they are geographically distributed across Europe.



The BIOMAC ecosystem services





The pilot lines and complementary services of BIOMAC have been validated in the development of the eleven (11) original <u>Test Cases</u> (TeCs), actual realization of products and components, using bio-based materials. Six (6) of these were proposed by external entities that applied to the (free of charge) Open Call organized by BIOMAC.

Explore Biomac's success stories: https://www.biomac-oitb.eu/en/static/dissemination\_material



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# Why choose the BIOMAC OITB for your bio-based material development needs?

#### Complementarity of services:

- 1. BIOMAC offers technological services covering the complete value chain, including
  - pre-treatment and conversion of biomass
  - bio-based polymer and composites production pilot lines
  - process monitoring and
  - scale up industrialization services.
- 2. BIOMAC offers ecosystem services with strong cooperation between research and industry and good connections between users and suppliers of innovations across the bio-based value chain.
- 3. BIOMAC offers business-oriented services, including access to financing and investors, to support clients in commercially applying their innovations and transforming their businesses

#### Open and fair access:

- 1. BIOMAC is an open innovation ecosystem that will reach out to new users/"clients" across different regions of the EU, sharing best practices and experiences.
- 2. BIOMAC creates only a minimal administrative burden for the customers as they will only be in contact with the Single-Entry Point (SEP).

#### Expertise:

BIOMAC consists of a network of experts with year-long knowledge in the fields of biomass pre-treatment, value platform chemicals extraction, processing and manufacturing, monitoring, testing, characterization, modelling, environmental assessment, standardization, nano-safety, innovation management, and training.





# Who can access the services of BIOMAC and how?

#### Who?

- SMEs, Industry, Start-ups, Universities, Research Institutes, and other stakeholders from Europe and beyond have non-discriminative, open access to the OITB's facilities, capabilities, and services, under fair conditions and prices, and with transparent and mutual obligation regarding, for instance, the security and safety of IPRs.
- Any client operating in the field of nano-structured bio-based materials (NBM), aiming to upgrade existing or develop new concepts within the lignocellulosic value chains of nanomaterials and polymers, starting from Technical Readiness Level (TRL) 4-5.

#### How?

BIOMAC is a one-stop shop, accessible at fair conditions and costs through a Single Entry Point (SEP), managed by the IBB Netzwerk GmbH in Munich, Germany. You can apply for the services of BIOMAC using the online platform at <u>www.biomac-oitb.eu</u>. After submitting your application, IBB will find the appropriate partners and provide you with a quotation.



Single-Entry-Point operation and access





# THE OITB SERVICES

In this section we present in detail all the services offered by the BIOMAC OITB.



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8



# Services offered by the OITB

#### Overview of BIOMAC Services and Partner Capabilities.

Cells highlighted in petrol indicate Pilot Line hubs as structured in the original BIOMAC Handbook. Grey-highlighted rows refer to services offered exclusively by associated partners (available through subcontracting).

		Partner(s)	Pilot line	Page
Biomass	Cellulose	ITENE, LIST (associate), AUTH (associate)	-	25, 41, 34
	Lignin	CNANO, AUTH (associate)	-	15, 34
	Lignocellulose	ITENE, LIST (associate), AUTH (associate), RISE	-	25, 34, 41, 29
Intermediate chemicals/ monomers	Lactic acid	ATB (associate)	PL7	30
	Sugar alcohols (e.g., sorbitol, xylitol)	AUTH (associate)	PL3	34
	Glycols/diols (e.g., glycerol, ethylene glycol)	AUTH (associate)	PL3	34
Polymer	Polylactic acid and other thermoplastic polyesters	AIMPLAS, POLIMI (associate)	-	13, 42
	UV-curable Resins/Materials	AIMEN (associate), FRAUNHOFER (associate)	PL12	12, 38
Nanomaterial	Nanofibrillated cellulose	ITENE, LIST (associate)	PL10	25, 41
	Cellulose nanocrystals	ITENE	PL13	25
	Nanolignin	CNANO	PL4	15
	Bacterial nanocellulose	ITENE, BBEPP (associate)	PL2	25, 36





Biomass fractionation & pretreatment	Organosolv-steam explosion of biomass	LTU (associate)	PL1	42
	Fiber sludge hydrolysis	RISE	PL2	29
Intermediate materials & nanocomposites	Bacterial nanocellulose production via fermentation	ITENE, RISE	PL2	25, 29
	Catalytic hydrogenation/ hydrogenolysis towards sugar derived polyols and diols	AUTH (associate)	PL3	34
	Ultrasonic assisted nanolignin production	CNANO	PL4	15
	Enzymatic Hydrolysis & Microbial Fermentation for succinic acid and lactic acid	ATB (associate)	PL7	30
	Mechanical milling of cellulose to nanocellulose	ITENE, LIST (associate)	PL10	25, 41
Final Products & Formulation	Reactive extrusion	AIMPLAS, POLIMI (associate)	PL9	13, 42
	Coating formulation	ITENE, FRAUNHOFER (associate)	PL14	25, 38
	Additive manufacturing I: Thermoplastic	AIMEN (associate)	PL15	12
	Additive manufacturing II: Photopolymerization	AIMEN (associate), FRAUNHOFER (associate)	PL15	12, 38
	R2R Nanoimprint lithography	NANOTYPOS	PL17	27





Validation service hub	Quality control, Characterization	ITENE, ISQ	-	22, 25
	Standardization	EUBP	-	16
	Process Validation, Modelling	ISQ	-	22
Market uptake hub	Innovation Management	EXELISIS, UNIPD (associate)	-	17, 47
	Health and safety	ISQ	-	22
	Regulation	EUBP	-	16
	Data Management	ISQ	-	22
Value chain assessment hub	Sustainability Assessment	ISQ	-	22
	Value Chain Assessment	EXELISIS	-	17
	Circular Economy	ISQ	-	22





# **OITB Partners**

This section provides an overview of the partners of the Open Innovation Test Bed and in particular of their services provided within BIOMAC.





# AIMPLAS

#### Description of the organization

AIMPLAS, Plastic Technology Center located in Valencia, is a private, non-profit Association with more than 30 years' experience and its mission is to respond to social challenges through R&D and to increase the added value of companies throughout the plastics value chain so that they can generate wealth and create employment. The calculated social return on investment (SROI) of AIMPLAS showed a social impact of €665 million. Its impact on the SDGs was 294,6M€ (44% of the total SROI) and 431,6M€ (65%) in the circular economy.

AIMPLAS provides solutions to companies, throughout the value chain, from raw material manufacturers to transformers and end users in different areas; Sustainable mobility, Industry 4.0, Sustainable energy, Aquaculture and aquatic environment, Decarbonization, Circular economy, Smart construction, Packaging, Health and wellbeing.

AIMPLAS services include technological support for the development of R&D projects, technical assistance, product design, prototype testing, material improvement, legislation and certification support.

AIMPLAS has over 35 pilot plants for plastic processing, aimed at research, formulating new materials and improving existing processes, that include the following technologies: Biotechnology, Synthesis, Mechanochemistry, Catalyst, Compounding, Reactive extrusion, Extrusion, Injection moulding, 3D printing, Plastronics, Printing, Coatings, Composites, Recycling.

AIMPLAS has the highest number of tests accredited by ENAC for plastics according to the UNE-EN ISO/IEC 17025 standard in Spain. Annually, we provide over 5,000 services where we add value to our clients through personalized attention, guidance in result interpretation, and the preparation of clear and understandable reports.

In addition, AIMPLAS imparts over 170 training activities a year, we offer the most comprehensive and innovative range of programmes for the plastics industry. Every year, more than 2700 professionals receive training at AIMPLAS and express a high satisfaction rate.

#### Description of the services offered

AIMPLAS offers comprehensive support in product and material development through its Reactive extrusion (REX) & Compounding pilot plant, which was updated and optimised within BIOMAC project (PL11) to produce PLA and PLA copolymer-based nanocomposites and blends.





The REX pilot line was updated with an in-line monitoring device based on NIR spectroscopy to monitor unreacted lactide (monomer) content to control the conversion in the extruder during the polymerization of PLA by reactive extrusion. This device allows the optimisation of the REX process to achieve the maximum conversion in-situ.

AIMPLAS also gives support in the synthesis of nanocomposites either by in-situ polymerization of PLA by REX, or by the compounding process through the formulation of PLA or other polymers with nanosized functional particles like nanolignin (NL), nanocellulose (NC), bacterial nanocellulose (BNC) and biochar among others.

The REX and compounding pilot line capacities range from 4 to 10 kg/h for the REX process to 20 - 40 kg/h for the compounding process. Production lots can range between 5 to 50 kg for pilot plant tests and up to hundred kilograms for scale-up activities.

Auxiliary equipment that completes the pilot line include dryers, vacuum ovens, gravimetric feeders for solids and liquids (pumps), vacuum pumps, melt pumps, water baths, belt conveyors, strand pelletizers, underwater pelletizer.

After the production of polymer or nanocomposite pellets, AIMPLAS offers different extrusion (cast film, blown film, pipe, profile), and injection moulding pilot plants to study the processability of the materials and production of test specimens for material characterization, as well as accredited laboratories for complete characterization of the obtained materials and products.

To support the R&D activities and assess the scalability of the reactive process, AIMPLAS offers laboratory equipment such as HAAKE<sup>™</sup> MiniLab extruder and Brabender<sup>™</sup> torque rheometer that allow to carry out the REX and compounding processes to obtain small batches of polymers and nanocomposites (5 to 50 g respectively). At this scale, the reactivity, kinetics and/or residence time required to maximum conversion can be studied and optimized from the formulation and processing point of view before scaling-up to continuous process at pilot plant scale.

In addition, AIMPLAS gives support in the production of L-Lactide (monomer of PLA) from Llactic acid (LA) obtained from different feedstocks. The synthesis of L-lactide is carried out in a three-step process; oligomerization of LA, depolymerization / lactide distillation into crude lactide, and purification. The capacities for lactide production ranges from 50 g to 10 kg/lot, with an expected near future increase of scale up capabilities to 20 - 40 kg/lot.

This methodology was validated and optimised within BIOMAC project to obtain PLA, PLA copolymers, nanocomposites and blends of high molecular weight suitable for injection moulding, cast film and blown extrusion for agriculture and packaging applications.





# **CNANO**

#### Description of the organization

Creative Nano PC is a research-intensive and commercialization-focused SME located in Athens, Greece, providing technological solutions in the field of materials, nanoscience and nanotechnology. The company's main mission is to conduct basic, applied, and technological research, with a strong focus on commercialization. By evaluating new ideas, Cnano identifies the most effective pathways to ensure successful knowledge transfer from the laboratory to industry. Cnano has developed significant expertise in electroplating, advanced materials, and nanotechnology, and is actively involved in several H2020 and Horizon Europe projects. In addition, Cnano provides services, scientific advising, and technical support to major clients. The company has strong expertise in surface treatment, the development and validation of advanced materials and nanomaterials, including bio-based nanomaterials.

#### Description of the services offered

Through Pilot Line 4 (PL4), Cnano can produce stable aqueous colloidal dispersions of lignin nanoparticles (LNPs) with controlled particle sizes, derived from various types of lignin sources (e.g., kraft, soda, organosolv). PL4 is a semi-flow system that utilizes ultrasonication (US) – an environmentally friendly, physical method – to convert raw lignin into LNPs. Supplementary pre-treatment processes, such as ball milling, are also employed alongside ultrasonication to achieve the desired particle size distribution. Ultrasonication significantly enhances lignin's potential as a nanoscale functional filler, improving mechanical properties as well as imparting antibacterial and antioxidant characteristics when incorporated into biobased polymer matrices and compounds.

PL4 is engineered to operate in semi-flow mode, enabling precise control over particle size by adjusting ultrasonication parameters. The resulting aqueous dispersions can be further processed via lyophilization (freeze-drying) to obtain solid-state LNPs in dry powder form, ready for downstream applications. Cnano currently has the capacity to produce up to 500 g of LNPs per week.





# **European Bioplastics (EUBP)**

#### Description of the organization

European Bioplastics is a European association. Our mission is to advance the economic and regulatory framework in Europe so that the bioplastics market can grow and flourish. Therefore, we aim to bring together all relevant partners and stakeholders and serve as both a knowledge platform for all audiences and a business platform to support sustainable technological development along the entire value chain and a full-scale market introduction of bioplastics.

Our primary tasks are:

- To raise awareness and inform businesses, brands, consumers, policy makers, media, and the interested public about the properties, benefits, and potential of bioplastics for a sustainable society.
- To closely monitor, evaluate, and contribute to relevant developments in European legislation and standardization concerning the European bioplastics industry.

#### Description of the services offered

- Support in understanding the standardisation process, by checking the compliance of R&D activities and potential products with existing standards (at CEN level) and the European legislative framework
- Legislative framework: By providing an assessment of the existing and potentially applicable legislative framework that might impact the commercialisation of goods in the European market.





# **EXELISIS**

#### Description of the organization

EXELISIS is an engineering-based consulting company located in Athens, Greece. EXELISIS was created by a group of engineers and entrepreneurs with extensive experience in business development and innovation especially emphasizing in the materials and energy field.

EXELISIS is committed to delivering practical advice that empowers businesses of all sizes, from small start-ups to medium-sized enterprises and large corporations. With our team having over 15 years of experience in International Business, Company Formation, Opt-Out, and Exit Strategy, we bring a wealth of expertise to the table. The main core of our services is providing professional assistance and services to our clients that helps them to improve their business perception. EXELISIS equips clients with customized strategies, tools, and solutions to meet their unique needs, ultimately fostering growth and success.

#### Description of the services offered

The innovation management services described below, will be offered primarily by EXELISIS:

#### **Exploitation risk assessment:**

All potential exploitation risks associated with the clients' projects will be analysed, including significant barriers, evaluating risk probability of occurrence and potential impact as per different risk types, as well as establishing a risk management plan that includes predefined monitoring and re-assessment plans, mitigation actions foreseen and other previsions.

#### Investment need assessment:

Evaluating the financial sustainability of the clients, conducting a financial valuation and forecasting scenarios to assess the client's investment need, conducting identification and offering consultancy for the appropriate funding instruments to cover those investment needs, optionally also offering assistance in the engagement of various funding sources (instruments).





#### EXELISIS can offer additional services, as a secondary service provider:

#### **Business planning:**

Consultancy will be provided for the development or refinement of business plans, tailored to the client's innovation strategy and commercialization goals. This includes strategic positioning, analysis of the market and the competition, business model validation, go-to-market planning, and financial projections, ensuring the client has a clear roadmap to move from R&D to market uptake and sustainable growth.

#### Intellectual Property Rights management and patent landscape mapping:

Clients will receive guidance on the identification, protection, and strategic use of their intellectual property, as well as an overview of the competitive patent landscape in their technological domain. This will be including fully customizable assessments of targeted patent mapping analyses, using powerful, state-of-the-art commercial IP and R&D intelligence tools. This service includes IP risk identification, alignment of IP strategy with the overall exploitation plan, and fully scalable assessments to support the client's freedom-to-operate.

#### **Proposal writing coordination:**

EXELISIS can support clients in the preparation and coordination of competitive funding proposals, offering guidance throughout the process—from shaping the initial idea into a well-structured concept, to aligning it with appropriate funding calls. This service includes drafting key sections, managing administrative and technical compliance, and building a strong consortium through targeted partner identification and technology transfer facilitation. The service is designed to maximize proposal quality and improve funding success rates.

#### **Communication & Design:**

EXELISIS offers comprehensive communication and design services, including the development of strategic communication plans, branding, and both digital and printed dissemination materials. Our team develops and manages websites, social media content, and marketing campaigns, and creates professional videos to effectively communicate business messages. A key component of our offering includes the organization of high-impact events and large-scale conferences, designed to maximize outreach and stakeholder engagement. We focus on building strategic alliances and delivering tailored solutions to ensure maximum visibility and impact.





#### The value chain assessment services described below, will be offered primarily by EXELISIS:

#### **Decision Support Tool for Value Chain Analysis and Assessment:**

EXELISIS offers tailored consultancy through the development and use of a Decision Support Tool (DST) designed to support holistic value chain analysis in bio-based production routes. This optimization model integrates diverse value chain elements—biomass inputs, intermediates, and final products—assessing multiple factors such as cost, resource efficiency, and environmental impact. The DST supports scenario analysis and pathway optimization, providing clients with strategic insights into the most sustainable and costeffective value chain configurations. Custom assessments can also incorporate clientspecific processes and parameters to enhance relevance and impact.

#### EXELISIS can offer additional services, as a secondary service provider:

#### Life Cycle assessment & Life Cycle Costing (LCA & LCC):

EXELISIS offers analytical Life Cycle Assessment and Life Cycle Costing (ISO 14040 & 14044) for new products and processes, aiming to support the client to optimize environmentally and economically the new procedures. The service includes communication with the client throughout the procedure to clearly describe the examined system and provide any available data. EXELISIS will also support the client to: 1) Identify the hot spots (high energy consuming, high environmental impact) and propose alternative pathways towards the optimization of the procedures; 2) Compare with conventional processes and materials; 3) Support sustainability claims of new products; and 4) Evaluate environmental and cost performance of alternative design options.





### IBB

IBB Netzwerk GmbH is a Munich-based company specializing in the management of innovation networks and the development of collaborative R&D projects, particularly in the fields of biotechnology, bioeconomy, and sustainable materials. IBB serves as the coordination office of the Cluster Industrial Biotechnology in Bavaria, managing a strong network of over 200 companies and research institutions active in these fields. As an experienced project partner, IBB supports the transformation of scientific results into market-ready applications by facilitating cooperation between industry, academia, and public institutions. Within the BIOMAC OITB, IBB acts as the Single Entry Point (SEP), serving as the main contact point for clients and coordinating their access to the test bed's services. In this role, IBB ensures smooth communication, tailored service packages, and efficient navigation through the OITB service landscape, contributing its expertise in network coordination, innovation strategy, and exploitation of biobased solutions.

#### Description of the services offered

As the Single-Entry Point (SEP) of the BIOMAC Open Innovation Test Bed (OITB), IBB Netzwerk GmbH acts as the central coordination and contact node for industrial clients, supporting their journey from initial contact to project delivery. Its role spans several key service areas:

#### **Client Acquisition & OITB Visibility:**

IBB leverages its strong industrial and scientific network, established communication platforms, and sector visibility to attract new clients, promote BIOMAC at stakeholder events, and disseminate the OITB's capabilities through targeted outreach.

#### **Client Liaison & Coordination:**

IBB acts as the primary contact point for clients, managing all communication between clients and BIOMAC partners throughout the entire collaboration period. This ensures smooth coordination, clear expectations, and timely feedback across all service providers.





#### Administrative & Contract Management:

On behalf of the OITB, IBB handles administrative documentation and contractual matters, including drafting and managing Framework Agreements, End User Agreements, and NDAs. It also supports the implementation of the OITB's governance structure and internal operating procedures.

#### Workflow Development & Translation of Industrial Needs:

IBB plays a pivotal role in translating industrial requests into tailored project workflows. Together with the technical hubs, it contributes to the development of methodologies that organize client needs—whether legal, regulatory, or technical—into structured service sequences. This hierarchical approach, starting from upscaling units and extending to modeling, monitoring, and characterization, ensures efficient, cost-effective, and fit-for-purpose project design.

#### **Risk Assessment & Project Monitoring**

IBB supports the continuous monitoring of ongoing projects, ensuring adherence to quality standards, timelines, and deliverables. It identifies and assesses risks related to intermediates, suppliers, and cross-partner coordination, implementing mitigation strategies and conducting regular re-evaluations to ensure project stability and success.

#### Strategic Contribution to OITB Ecosystem Development

IBB contributes to the legal and operational integration of the BIOMAC ecosystem. This includes the development and monitor of internal communication protocols, data and sample transfer channels, and the alignment of operational workflows between the SEP and the service hubs.





# ISQ

#### Description of the organization

ISQ, or Instituto de Soldadura e Qualidade, is a private, independent, and accredited entity based in Portugal. Established in 1965, ISQ has grown to become the largest Technological Interface Center in Portugal, offering a wide range of services in engineering, consulting, inspection, testing, research and development (R&D), and innovation. ISQ provides high-quality solutions across various sectors, including energy, process industries, transportation and infrastructure, automotive, health, pharma. ISQ services are designed to enhance the quality of products, services, installations, and processes, thereby promoting accreditation, competitiveness, and innovation. With over 60 years of experience, ISQ operates internationally, with a presence in 12 countries, and offering over 250 specialized services. ISQ is also involved in several international R&D projects and has received over 50 international awards and recognitions. ISQ's mission is to provide scientific and technological support to industries and services, focusing on continuous improvement, innovation, and the safety of people and assets, and to be recognized as an autonomous technological organization with a global reach, constantly expanding and contributing to the evolution of the global market.

#### Description of the services offered

ISQ provides specialized services to support the development of biobased materials or products. These services include evaluating sustainability and potential environmental life cycle impacts, assessing operational health and safety risks and potential exposure scenarios, and offering predictive modeling services as detailed below.

#### a) Sustainability Assessment studies

**Life Cycle Assessment (LCA)** service enables the estimation of environmental impacts associated with a product, process, or service throughout its life cycle. Whether applied from cradle-to-grave or cradle-to-gate, LCA supports informed decision-making and stakeholder communication by identifying environmental hotspots and comparing alternative solutions. It is conducted in accordance with ISO 14040 and ISO 14044 standards and considers multiple impact categories such as global warming potential, water scarcity, acidification, and eutrophication. LCA also serves as the foundation for developing Environmental Product Declarations (EPDs) and aligning with the EU-recommended Product Environmental Footprint (PEF) methodology. These tools enhance transparency and credibility in environmental performance reporting. In addition to LCA, ISQ can provide:





**EPD Development Support**: Assistance in compiling and developing EPDs to communicate product sustainability in a standardized and credible manner.

**Ecodesign Support**: Integration of environmental criteria into product design and development to foster innovation and reduce lifecycle impacts.

Life Cycle Costing (LCC) or environmental LCC support: Economic analysis of products or systems over their life span, enabling cost-effective and sustainable decision-making, including externalities to be internalized.

**Social Life Cycle Assessment (S-LCA)**: Evaluation of social and socio-economic impacts across the value chain, addressing stakeholder well-being and ethical considerations.

These services are tailored to support the development of bio-based materials and contribute to the transition toward a low-carbon, circular economy. Whether through streamlined or comprehensive studies, ISQ adapts the approach to meet client-specific needs. Primary data from client or partner operations is essential for accurate inventory modeling, and comparative assessments can be performed when benchmark data is available.

#### b) Health and Safety (H&S) risk assessment during manufacturing of new nanomaterials and nano-enabled products

ISQ's H&S risk assessment service for nanotechnology includes the following:

**Risk and potential exposure scenarios identification:** ISQ identifies emerging new or modified risks, and potential exposure scenarios to inhalable nanoparticles during manipulation activities of nanomaterials and nano-enabled products, using nano-specific risk assessment tools.

**Exposure Assessment:** ISQ can perform exposure assessments to determine the release and transfer of engineered nanomaterials to receptors. This includes monitoring activities with direct reading instruments across various industrial scenarios, focusing on particle concentration, surface area and size distribution.

**Control Measures and Compliance:** Based on the risk assessment, ISQ can propose control measures to reduce risks, raise awareness of potential hazards, and promote safer practices. Our recommendations adhere to regulations and standards, such as the European Regulation on classification, labelling, and packaging of substances and mixtures (CLP) and REACH.





Some of the benefits of ISQ Service are: 1. Support regulatory compliance with relevant H&S and nanosafety regulations, recommendations and guidelines, minimizing legal and operational risks; 2. Support faster Market Implementation; 3. Target Safety Practices involving nanosafety.

#### c) Machine Learning (ML) and Predictive Modelling services, sensoring

ISQ offers advanced solutions for optimizing industrial processes and identifying critical data points or processes. These services utilize sophisticated algorithms and statistical models to predict future trends, identify patterns, and make informed decisions to enhance operational efficiency. By integrating sensoring and motorization, ISQ can provide real-time monitoring and control of industrial lines, ensuring that machinery operates at optimal performance levels. This holistic approach allows for the continuous collection and analysis of data, leading to improved decision-making and process optimization. The application of ML and Predictive Modeling spans various stages of the industrial process, from initial design and development to ongoing operation and maintenance. These technologies can identify potential failures before they occur, optimize resource allocation, and improve product quality.

ML and Predictive Modeling services can be used to estimate the performance of different process alternatives under development or optimize existing processes. By leveraging real-time data from sensors and motors, ISQ can provide detailed insights into operational performance and recommend adjustments to enhance efficiency.

Primary data from clients or partners' processes is essential for building accurate predictive models and conducting thorough analyses. ISQ's expertise in data analytics ensures that the insights derived are actionable and relevant to the client's specific needs.





# ITENE

#### Description of the organization

With 30 years of experience, ITENE is the Technological Centre specialised in R&D that provides companies with cutting-edge knowledge and technology to build a safer and more sustainable future in four main areas: sustainable materials and technologies for the circular economy; design, safety, and functionality in packaging; safety and environmental monitoring technologies; and transport, logistics, and digital transformation.

Thanks to the high level of specialisation of its team — made up of more than 200 professionals, over 66% of whom hold a PhD or Master's degree in their field — ITENE carries out intensive research activity through R&D projects (238 conducted in 2024 alone, including 36 European projects). Since 2020, it has participated in a total of 50 European projects, 15 of which it has coordinated. In addition to its research activity, ITENE offers consultancy and innovation services (more than 400 carried out in 2024), testing services (726 performed during the same year), and training. This includes a specialised Master's Degree in Packaging, co-organised with IATA-CSIC, currently in its 18th edition, and events attended by 5,178 professionals in 2024.

ITENE is based in Valencia (Spain), at the Paterna Technology Park. Its 12,000 m<sup>2</sup> of facilities – comprising the main building and the new ScaleUp facility for industrial pre-scaling – host state-of-the-art laboratories and pilot plants for demonstrating and validating technologies in industrial environments.

#### Description of the services offered

ITENE provides expertise and new facilities to support the study and development of new materials, including the design, synthesis and application of additives and materials in relevant industrial sectors. This group has relevant experience in the valorization of different lignocellulosic biomass for the extraction of cellulose and cellulose nanofibers (CNF) and in the development of high barrier coating, including synthesis and characterization of bio-based materials, formulation and production of new bio-plastics solutions with advanced properties for high performance and cost-efficient bio-based plastics.

#### Mechanical treatment to produce NFC and / or CNC -PL13 (ITE, ES)

- Production of NFC by a mechanical disintegration process with a production capacity of 50kg/day (2% solid content).
- Extraction of cellulose from different lignocellulosic raw materials by cooking and bleaching processes in a 20L digestor.
- Synthesis of CNC by acid hydrolysis in a 20L reactor.





#### Coating Formulation -PL14 (ITE, ES)

- Preparation and dispersion of coating and ink formulations up to 20L of volume.
- Coating application by flexographic or huecogravure techniques at lab and pilot scale with a roll to roll pilot machine.

ITENE will be leading the deployment and demonstration of its own pilot lines (PL13 &PL14) to produce NFC and/or CNC, which would be functionalized according to the needs of its final use, and to formulate nano-based coatings and inks. ITENE will be also supporting the Test Cases on Agriculture mulch film (TC2), Food packaging (TC3), and Printed electronics (TC5) under Tasks 3.3, 3.4, and 3.5 accordingly. In WP2 ITENE will be involved in the process monitoring and optimization of Pilot Lines. Additionally, in WP4 ITENE is leading the characterization task of materials and products. Finally, ITENE will participate in general tasks regarding communication, dissemination, and exploitation issues.





# NANOTYPOS

#### Description of the organization

Nanotypos (<u>www.nanotypos.com</u>) is a nanomanufacturing company who specializes in providing advanced nanopatterning solutions across multidisciplinary industries. Nanotypos provides solutions along the whole manufacturing value chain starting from conceptual design, material development, mastering, tooling, up to pilot scale manufacturing and characterization. With our 22-year experience in nanofabrication we commit to deliver ICT standard solutions and products to our customers. Since 2012 Nanotypos has been involved in several national (Greek) and European research project casing solutions in the fields of photonics, optics, biotechnology, packaging industry, automotive, transport, construction and energy.

#### Description of the services offered

Nanotypos has state of the art inhouse manufacturing facilities and collaborates with world leading entities to deliver demanding projects and services from a laboratory scale to pilot scale production. In particular we offer:

#### Materials development:

We provide photo sensitive resists suitable for lithography-based processing with tailored physical and chemical properties. Our portfolio includes acrylate-based resists with low and high refractive index properties and tailored surface energy properties. Our interest is to provide sustainable materials for imprint-based processes addressing high throughput and low cost manufacturing.

#### Mastering solutions:

Nanotypos has inhouse laser-based lithography facilities to design and generate master moulds for both injection moulding and embossing processes. In particular we can deliver micro lithography solutions for critical dimension as small as 2µm lateral dimensions over 10's of cm2 areas. Our unique offer concern mastering of flat and 3D surfaces materials suitable for processing batch to batch or continuous mode production schemes.





#### Micro/nano replication solutions:

We have state of the art mass replication facilities which include injection moulding, thermal and ultraviolet light assisted nanoimprint lithography processes including batch to batch and continuous (roll to roll) processing. Moreover as part of the advance nanomanufacturing capacity Nanotypos provides post processing technologies, example spray coating and thermoforming, to create functional products, devices, components and surfaces.





# RISE

#### Description of the organization

RISE Processum is a unit in RISE, the biggest research Institute in Sweden. The Unit operates a newly built (2024) cutting edge Pilot Scale facility including Biotech, Chemistry and DSP equipment and a large range of R&D possibilities. The Biotechnology Group has developed a **Strain-to-Scale Biotechnology Platform** in order to offer complete R&D solutions to startups, industry leaders, and research partners to realize and industrialize novel biotechnologies. Application areas include **food, materials and polymers, chemicals, pharmaceuticals, and biofuels**—and extend to a wide range of emerging bio-based products.

#### Description of the services offered

The **Strain-to-Scale Biotechnology Platform** is a comprehensive R&D and scale-up infrastructure designed to accelerate the development and commercialization of biotechnological processes. Spanning the full innovation chain—from strain engineering and high-throughput screening to pilot- and production-scale bioprocessing—our platform supports partners in transforming biotech concepts into scalable, real-world solutions.

Equipped with advanced capabilities including:

- High-throughput strain development (screening, evolution, genetic engineering)
- Pretreatment of various lignocellulosic feedstocks (40L scale)
- Enzymatic hydrolysis for processing complex biomass feedstocks (0,1-500L scale)
- Flexible bioreactor systems (ranging from 1 mL to 10 m<sup>3</sup>)
- Integrated process development and scale-up, including downstream processing at PILOT scale (Homogenisation, Centrifugation, Drying, Chromatography, Filtration & Ultrafiltration, etc)
- Data-driven optimization and process analytics





# **OITB associated partners**

# AIMEN

#### Description of the organization

We are an Innovation and Technology Centre highly specialized in materials and in advanced manufacturing technologies, especially joining technologies and laser technologies. Our vision is to become an strategic technology partner for all of our associates and customers, contributing to improve their technological capabilities. Our activity involves identification and development of business opportunities through applied research, technology development and innovation, and problem solving through the provision of high value-added services.

#### Description of the services offered

The robotic 3D printing cell, also known as LFAM (Large Format Additive Manufacturing), located at the Laser Applications Center (CAL), is an automated facility designed for the additive manufacturing of large-format thermoplastic materials.

The printing booth, measuring 5 m long, 4 m wide, and 3 m high, is equipped with:

- Gas extraction system,
- Compressed air supply,
- Inert gas inlets (Ar and N<sub>2</sub>),
- Optical and thermal monitoring systems,
- Assisted external heating for thermal control of the environment.

The cell integrates a 6-axis FANUC R-2000iC/125L industrial robot, with a wrist load capacity of up to 125 kg, mounted on a GÜDEL TMF-3 linear system that allows a travel of approximately 4.7 m. This robot can be equipped with extrusion heads and various peripherals for control, monitoring, and process support.





Currently, there are two main extrusion heads compatible with non-planar printing:

1. CEAD Robot Extruder E25 System 4.13 pellet head:

- VISMEC DryPlus 50 hopper, dryer, and feeder.
- Four heating zones and a single screw.
- Extrusion temperature up to 500°C.
- Flow rate up to 10 kg/h.
- Nozzles available with diameters between 4 mm and 20 mm.

2. TYPHOON filament head by DYZE DESIGN:

- Includes dedicated liquid cooling from the same brand.
- Compatible with 2.85 mm diameter filament.
- Extrusion temperature up to 450°C.
- Flow rate up to 0.9 kg/h.

Both printheads feature auxiliary systems that allow for:

- Active heating of the material during printing, improving adhesion between layers.
- External thermal control using infrared radiative heating modules.

The cell has two printing surfaces:

1. CEAD Print Bed AA heated bed, with a heating capacity of up to  $150^{\circ}$ C and a usable surface area of 3 x 1.5 m.

2. FANUC 2-axis rotary positioning table (A05B-1220-J201), with a load capacity of up to 500 kg.

The entire system is interconnected via ProfiNet, enabling both process control and real-time data acquisition and management.

As well, infrastructure for photopolymerization processes is based on two different processes. The use of isolated pulsed lasers from picosecond to femtosecond pulses-width, with wavelengths in the UV-Vis, including the optics to focus the laser beam can be utilized for testing 3D fabrication with resolutions below the micron range, while the use of commercial 3D printers can be used for the 3D fabrication with resolutions in the range of tens of microns. These two processes are available at AIMEN premises for the realization of viability studies on the formulation of photocurable resins. In this way, photocurable resists can be tested in terms of printability and resolution, being possible as well the fabrication of samples for tribological/mechanical tests.





# ATB

#### Description of the organization

The Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) is an internationally active research center operating at the interface of biological and technical systems. Our work focuses on analysing, modelling, and evaluating bio-economic production systems, while also developing and integrating innovative technologies and management strategies.

ATB's research supports the sustainable intensification of agriculture and contributes to a knowledge-based, site-specific production of biomass. This biomass is then utilized for food, raw materials, and renewable fuels. Our research fosters food security, animal welfare, climate and environmental protection, and the holistic use of biomass. Our expertise spans the full spectrum—from fundamental research to applied science.

We envision a circular, diverse, innovative, and sustainable bioeconomy that produces healthy food for all, operates based on renewable raw materials, advances the one health concept, promoting the well-being of humans, animals, and the environment. ATB is a pioneer and catalyst in bioeconomy research. We provide the scientific foundation necessary to transform agricultural, food, industrial, and energy systems into an integrated, bio-based circular economy. We develop and integrate technologies, processes, and management strategies, create intelligent, adaptive, and largely automated systems that effectively fermentatioconnect diverse bio-economic production models, work at the convergence of disciplines and technologies to maximize efficiency and sustainability. Our research is knowledge-driven and application-oriented, and we engage in continuous dialogue with society to ensure our innovations address real-world needs and challenges.

#### Description of the services offered

The lactic acid (LA) fermentation group at ATB has extensive experience in lactic acid production, covering the entire value chain—from feedstock selection to the utilization of bacterial strains sourced from both ATB's proprietary collection and the DSMZ strain catalog.





The facility dedicated to LA production represents a strategic balance between fundamental and applied research, with the goal of transferring biotechnological innovations into practical, scalable processes. Since 2006, ATB has operated a state-of-the-art pilot plant focused on the development and optimization of biotechnological processes for the material utilization of renewable raw materials and industrial residues.

This integrated pilot facility includes all necessary technical components for substrate processing, enzymatic and microbial conversion, as well as the downstream separation and purification of fermentation products. The system is designed for scalability, ranging from laboratory-scale to small- and pilot-scale volumes (0.5 to 1000 liters), and supports both traditional batch operations and continuous high-performance processes.

Our research aims to develop robust, economically viable bioprocesses capable of utilizing a wide spectrum of feedstock. In addition to lactic acid, ATB is expanding its focus to include the production of other bio-based monomers such as succinic acid. Depending on client needs, the facility and processes can be adapted for the development of additional monomers.





# AUTH

#### Description of the organization

Aristotle University of Thessaloniki (AUTH) is an academic Institution which is composed of 11 faculties consisting of 36 Schools and involves a critical mass of Faculty approximately equal to 40000 active students (31,000 undergraduate and 9,000 postgraduates of which 3,952 at doctorate level) and 2,366 faculty members. AUTH is the largest University in Greece and in the Balkans and in terms of promoting innovation. Based on recent data from international ranking lists, AUTH has the 303<sup>th</sup> place among of 14,131 universities in the world, the 113<sup>th</sup> of 2,785 in Europe and the 2<sup>nd</sup> of 36 in Greece for 2025. AUTH has a total funding of €354 million (2019-2023) and a 2023 annual turnover of €91.7 million. It is also worth to mention that AUTH has over 5,000 active research programs. This number was reported in 2023, along with information about 7,590 external researchers and 1,224 international partners. The School of Chemistry (Faculty of Sciences) established at the AUTh in 1927. From the School of chemistry, an undergraduate programme can lead to different specializations including inorganic and theoretical chemistry, analytical and environmental chemistry, organic chemistry and biochemistry, chemical technology and industrial chemistry, including polymer and food chemistry and technology. In the framework of BIOMAC project, two Laboratories are involved, the Laboratory of Chemical and Environmental Technology (LCET) and the Laboratory of Polymer and Colors Chemistry and Technology (LPCCT). LCET has expertise and infrastructure on thermochemical and (bio)catalytic processes for biomass valorisation to fuels, chemicals, and polymers and various materials synthesis and characterization. LPCT focuses on (bio)polymer and (bio)composites synthesis and characterization, as well as applications of (bio)polymers in several areas including pipes, films, bottles, fibers, etc.





#### Description of the services offered

The Laboratory of Chemical and Environmental Technology, has developed an "Integrated Biorefinery" approach for whole-biomass valorization towards chemicals, fuels and polymers. The biomass can be fractionated to it's components(cellulose, hemicellulose and lignin) which can be further processed in lab-scale to semi-pilot scale units. Within the frame of BIOMAC and the established OITB, the Laboratory of Chemical and Environmental Technology (LCET) has mobilized a pilot line that can be utilized in the:

- Conversion of biomass derived sugars to the respective sugar alcohols, glycols and diols, via catalytic hydrogenation/hydrogenolysis processes.
- Production/isolation of (nano)lignin for various uses in polymers, cosmetics or other applications.
- Conversion of lignin to phenolic biooils via catalytic hydrogenolysis
- Catalytic hydrodeoxygenation of phenolic biooils to cyclo-aromatic/alkane hydrocarbons with potential use a road or aviation fuels.

The LCET lab, has also the expertise to:

- Produce in-house supported metal and metal-acidic bifunctional catalysts for the above processes.
- Conduct detailed analysis and characterization of feed, products and catalysts.





### **BBEPP**

#### Description of the organization

Bio Base Europe Pilot Plant is an independent, open access state-of-the-art pilot facility that operates from a laboratory level to a multi-ton scale (TRL3 – TRL 9) for process development, scale-up and custom manufacturing of innovative biobased products and processes. BBEPP accelerates the translation from a biobased lab protocol into a viable industrial process, by enabling the conversion of renewable feedstocks into biochemicals, biomaterials, biofuels and other bioproducts by using technologies such as biomass pretreatment, biocatalysis, (gas)fermentation, green chemistry and product recovery and purification with a wide and flexible spectrum of modular unit operations (technology infrastructure) combined with the experience of highly competent engineers and technicians. Since its establishment in 2008 in Ghent, Belgium as a non-for-profit SME, BBEPP has grown into a mature organisation employing 170+ dynamic and engaged staff members. As an open access multipurpose pilot/demo facility performing scale-up work for start-ups, SMEs and large enterprises for over 15 years in the bioeconomy and life science sector (>450 scale-up innovations up to TRL9 with over 280 different small, medium and large sized companies) we have a first hands-on experience and a good idea of the barriers and bottlenecks start-ups and young entrepreneurs encounter on their path to the market considering the benefit of society, the environment and the economy. Along with private, bilateral projects, BBEPP is currently involved in 35 consortium-based projects on regional, national and European level.

#### Description of the services offered

**Bench-scale up to 75 m3 scale bioreactors:** Process reactors for aqueous reactions. Scale-up and demonstration of biocatalytic processes (i.e., plastic depolymerization), using purified enzyme and whole-cell biocatalysts

**150 L stainless steel fermenters:** Scale-up and demonstration of the fermentation processes





**1 L, 2 L, 3.6 L, 7 L and 10 L glass fermenters**: Allow technology transfer from partners to BBEPP to check the robustness of the process with the given parameters before scale-up. The aim of the technology transfer is to be able to replicate and reproduce the results achieved by the partners at lab scale.

**Extensive DSP equipment for all scales**: Centrifuges, filtration units, IEX, decanters; Variety of modular unit operations to perform biomass separation, purification and product recovery processes.

**Analytical equipment**: Process follow-up for the quantification of sugars and compounds of interest: HPLC, GC, GCMS, fast biochemistry analyzer (YSI), (mass spec) off-gas analysis and data logging.





# FRAUNHOFER

#### Description of the organization

Sustainability has been the central theme at the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI since its foundation in 1946. Today, the Fraunhofer WKI utilizes the entire spectrum of renewable raw resources in order to develop sustainable materials, components and chemical products. A particular focus is on the use of plant residues and waste materials. The institute, with locations in Braunschweig, Hanover and Wolfsburg, specializes in process engineering, molding and component production with biomaterials, biobased binders and coatings, functionalization, fire protection, material and product testing, recycling processes and the utilization of renewable raw materials in buildings and vehicles. A particular focus is on sustainable lightweight construction solutions. Furthermore, the Fraunhofer WKI is one of the leading research institutions in the field of indoor air guality. Virtually all the processes and products resulting from the institute's research activities are used in industry. The Fraunhofer WKI's customers include companies from the wood and agricultural industries, the chemical industry, the construction and furniture industry, the automotive industry and the packaging industry. Through its research and development activities, the Fraunhofer WKI provides an important contribution towards the development of a bio-based circular economy (circular bioeconomy).

#### Description of the services offered

The department of binder and coatings develops coatings, paints and adhesives on the basis of bio-based building blocks, such as vegetable oils, sugars, lignin and waste materials. The department carries out research for customers on the entire value chain of wood coatings and adhesion, including the synthesis of polymeric binder resins, formulation and application of coatings. Method development of weather-related aging processes, standard tests and damage analysis complete our profile. The department of binder and coatings examines the products in their entirety and are therefore your competent research partner at every stage of the development.





In more detail, the following research services are offered by the department of binders and coatings:

#### Synthesis and development

#### Synthesis of monomers and polymers

- Customized modification of renewable raw materials such as sugars, fatty acids and lignins
- Polyesters, polyurethanes, alkyds, poly(meth)acrylates, sugar acrylates, polyitaconates, polyvinyl acetates, UV-crosslinking polymers
- Dispersions
- Functionalized and switchable polymers

#### **Development of coatings**

- Coatings on the basis of renewable raw materials
- Aqueous and solvent-containing coatings in accordance with Decopaint and VOC guidelines
- Interior coatings, exterior coatings
- Functional coatings (antimicrobial, hydrophobic, flame-retardant, adhesion to PE, PP)

#### Development of printing inks and 3D-printing materials

- UV-curable printing inks, thermoplastic screen-printing inks
- UV-curable 3D-printing materials for SLA, DLP and MJM
- Bio-based materials for FFM





#### **Development of adhesives**

- Dispersion adhesives
- Hotmelts / reactive hotmelts
- 1 and 2-component PUR adhesives
- UV-curable adhesives
- Formaldehyde-free amino resins

#### **Application and testing methods**

#### **Coatings**

- Coating laboratory with handling robot, equipped with modern application technology
- Roller coating
- Automatic film applicator
- UV/IR convection dryer

#### 3D printing

• UV-curing DLP printing (13 x 13 x 18 cm, 405 nm)

#### Analytics

- Determination of viscosities
- Determination of particle size and zeta potential
- Determination of molar mass and molar mass distribution
- Determination of minimum film-forming temperature
- Measurement of NMR and IR spectra

#### Test procedure

- Natural weathering (45° and 90°) and artificial weathering (QUV, XENON)
- Mechanical, chemical and physical measuring methods, including temperaturedependent stress-strain diagrams, DMA, FTIR microscopy, paint analysis, MFT, pendulum hardness
- Product testing and monitoring
- Development of new methods for the determination of paint aging

#### Damage analysis

- Analysis of defects in coatings, bondings, wood-based materials and solid wood
- Application of microscopic, spectroscopic, mechanical and forensic methods
- Clarification of claims for companies, courts and assessors





# LIST

#### Description of the organization

LIST is a Luxembourgish research and technology organization formed from the merger of CRP-Henri Tudor and CRP-Gabriel Lippmann in 2015. It consists of ~630 employees and has been involved in many projects (>250) at national and European level. The scientific outcome of the Institute is represented by ~350 referenced scientific publications and a portfolio of ~60 patents. Its efforts are devoted to impactful, application-driven research and the development of product/service prototypes for both public and private stakeholders, with developments covering fundamental, applied research, incubation, and transfer of technologies.

#### Description of the services offered

LIST offers access to a state of the art mechanical milling system based on a Masuko Sangyo MKZA10-20J Supermasscolloider that has been modified for continuous processing using a pump-controlled circulating system, an in-line viscosimeter, and power consumption meters (shown below). This system is capable of the continuous wet milling of suspension volumes of up to 25 L, and enables the production of nanofibrillated cellulose (NFC) from aqueous suspensions of cellulosic materials with solids contents of up to ~2 wt%, as well as the generation of nanobiomaterials more broadly from all manner of feedstocks. In this context, the services offered here include the generation of aqueous suspensions of bio-based feedstocks, as well as optimization of the wet milling process with energy consumption, throughput and materials performance in mind. Depending on the exact nature of the need, additional post-processing (e.g. freeze drying, spray drying, surface treatment, masterbatch formation, etc.)



and characterization (e.g. analytical centrifugation to assess equivalent particle dispersion diameter and stability, microscopy, x-ray diffraction, thermal and elemental analysis, etc.) may also be possible; see for instance Nguyen et al, "Evaluating Ultra-Fine Friction Grinding for the Continuous Production of Nanofibrillated Cellulose," Carbohydrate Polymer Technologies and Applications 2025, 10, 100838.





# LTU

#### Description of the organization

Luleå University of Technology (LTU) is a research-intensive university in northern Sweden, well known for its strong industrial collaborations and its strategic focus on sustainability and innovation. LTU has approximately 19,000 students and 1,800 employees, and plays a central role in the development of Sweden's green and circular economy. The Biochemical Process Engineering (BPE) group specializes in cutting-edge biomass biorefinery technologies, with a core expertise in biomass fractionation via the organosolv process. This advanced method allows us to effectively separate various biomass types into their core components: cellulose, hemicellulose, and lignin streams. A key strength is our ability to precisely tune organosolv process parameters to recover fractions optimized for specific downstream applications.

#### Description of the services offered

Within the framework of the BIOMAC project and the established Open Innovation Test Bed (OITB), the BPE group operates a versatile pilot line capable of:

- Fractionating diverse biomass feedstocks into high-purity cellulose, hemicellulose, and lignin streams.
- Implementing aqueous-based pre-extraction steps for targeted recovery of biomass extractives, such as tannins.
- Testing a wide range of operating parameters, including solvent composition, treatment duration, and the application of low-concentration acid or base catalysts.
- Analyzing the produced fractions for their purity, structural characteristics, and suitability for various applications.

Beyond fractionation, the BPE group possesses extensive expertise in:

- Evaluating the enzymatic saccharification potential of cellulose fractions to produce glucose hydrolysates for subsequent conversion.
- Conducting in-depth structural analysis of lignin.
- Assessing the suitability of cellulose and hemicellulose hydrolysates as feedstocks for microbial cultivations.





The Department of Civil, Environmental and Natural Resources Engineering is one of LTU's largest and most research-active departments, hosting a broad spectrum of disciplines connected to sustainable use of natural resources, industrial transformation, and climate-neutral processes. Within this department, the Biochemical Process Engineering group conducts cutting-edge research in biorefinery technologies, focusing on the fractionation and conversion of biomass and residual streams into fuels, chemicals, and materials using environmentally friendly, enzyme- and microbe-based processes. The research is highly interdisciplinary and addresses challenges linked to industrial side streams. Advanced laboratory and pilot-scale infrastructure supports process development from lab to pilot scale.





# POLIMI

#### Description of the organization

Politecnico di Milano (Italy) is the largest and highest-ranking university in Italy and among the top 21 universities in the world for Engineering, Design and Architecture (QS Ranking, 2025). POLIMI has seven campuses located in Milano and in other nearby Italian cities. It is organised in 12 Departments, devoted to research, and in 4 Schools, devoted to education. POLIMI is member of IDEA League, a strategic alliance among five leading European universities of technology that aims to educate a new generation of Engineers with extra-curricular activities for selected, highly talented students.

The activities are undertaken within the Department of Chemistry, Materials and Chemical Engineering "Giulio Natta" (DCMC), which is equipped with a vast array of synthesis, characterization and validation facilities for (bio -based) polymeric (nano)materials.

#### Description of the services offered

DCMC is active in the design, development, characterization and validation of polymer-based materials (also from renewable sources) for a broad spectrum of applications (coatings, composites, adhesives, reversible materials, thermoplastics and thermosets). The department carries out research and supports technological development in collaboration with public and private bodies on different topics related to polymers, composites, nanomaterials, within the areas of the circular economy of polymeric materials and of sustainable, advanced manufacturing.





#### In more detail, the following services are offered.

#### Synthesis and characterization of (biobased) polymeric (nano)materials

DCMC is equipped with a vast array of synthesis, characterization and validation facilities. In addition to versatile lab-scale polymer synthesis and functionalization equipment, the available characterization techniques include: chemical (1H-, 13C-, 31P-NMR, FTIR, TGA-FTIR, GPC), thermal (DSC, photo-DSC, TGA), mechanical and rheological (rotational rheology, dynamic mechanical analysis, adhesion), morphological (optical, fluorescence, TEM, SEM, AFM), surface (optical contact angle, XPS) characterization. In addition, dedicated processing technologies for coating application are available (e.g., dip coating, spin coating, blade coating, spray coating), as well as surface modification (UV grafting, plasma treatment), compounding (twin screw extrusion), molding (injection molding, compression molding, cast-film extrusion) and recycling facilities (chemical recycling/solvolysis, microwave-assisted pyrolysis).

#### Circular economy, recycling and end-of-life management

DCMC can assist in the definition of appropriate end-of-life management strategies for (biobased)polymeric materials and polymer-based products, analyzing the entire value chain from raw materials to end-of-life fate. The methodological approach is based on the Material Circularity Indicator (MCI) and other circular economy practices as tools to measure the circularity of a material or a product (https://www.ellenmacarthurfoundation.org/). Through the analysis of current end-of-life schemes, available material feedstock and expected/current material flows, this activity can lead to the definition of technical and management guidelines for the extension of the life-cycle of products. Aspects considered include the technical characteristics of the product, their quality requirements downstream the value chain, as well as possible end-of-life management options (e.g., reuse and/or recycling).





# UBU

Description of the organization

[Max half page]

Description of the services offered [Max two pages]





# UNIPD

#### Description of the organization

The University of Padua is one of Europe's oldest and most prestigious seats of learning; it is a multi-disciplinary university that aims to provide its students with both professional training and a solid cultural background. A qualification from the University of Padua is a symbol of having achieved an ambitious objective, one that is recognised and coveted by both students and employers alike.

The Department of Economics and Management Marco Fanno (DSEA) was founded in 1989 and it soon became a leading centre in delivering high-quality research and teaching within the higher education Institutions in both fields of economics and business. Currently, the DSEA counts more than 80 faculty members, 25 admin staff and approximately 2500 students. According to the Italian regulations, the working language of the Department is Italian, whereas the teaching offer is provided mainly in English.

The Department of Economics and Management has been awarded the "Departments of Excellence" seal and is confirmed as one of the 18 Italian departments of economics and statistics to receive funding for the five-year period 2023 – 2027. Since 2012 the Department of Economics and Management has ranked among the best Bachelor's degree in Economics and Management degree in Italy by the famous Italian Research Institute – Censis. The Department is also among the 200 best departments in the world in Economics and Econometrics according to the QS World University Rankings.

dSEA is proud to be the first Department of an Italian public university to achieve the prestigious EQUIS – EFMD Quality Improvement System – accreditation.





#### Description of the services offered

#### **Business plan and market analysis**

The main goal of this service is the development of a business plan and market analysis to assess the innovation potential in terms of markets and commercial opportunities of the technological requests for companies interested in the OITB services.

This service will allow the company to better develop and position its product in the bioplastic and specific industry market, understanding potential opportunities, and to define a clear value proposition and business plan for the implementation of the product. The services include a range of analyses and assessments to choose from based on each particular case: Focused market analysis, competition analysis, business model canvas, value proposition analysis, SWOT and PESTLE analysis.

#### Intellectual Property Rights management and patent mapping analysis.

Concerning Intellectual Property, UNIPD (with the support of UNISMART) is able to provide descriptive analytics of patents, focusing on different technological classes and assignees, in different years and countries and with multiple combinations of keywords. The service can identify the Freedom-to-Operate scenario concerning the technological development and outcomes of the companies interested in the OITB services.

Through such service the outcome can be a market discovery analysis, identifying also key players and potential collaboration directions. The service can also include landscape mapping based on knowledge channeling between assignees and potential areas of collaboration in terms of shared technologies.











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