BIOMAC: European Sustainable Biobased Nano Materials Community

allowing the uptake of nano bio-based materials (NBMs)

Prof. Dimitrios Bikiaris

Aristotle University of Thessaloniki

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BIOMAC in a nutshell

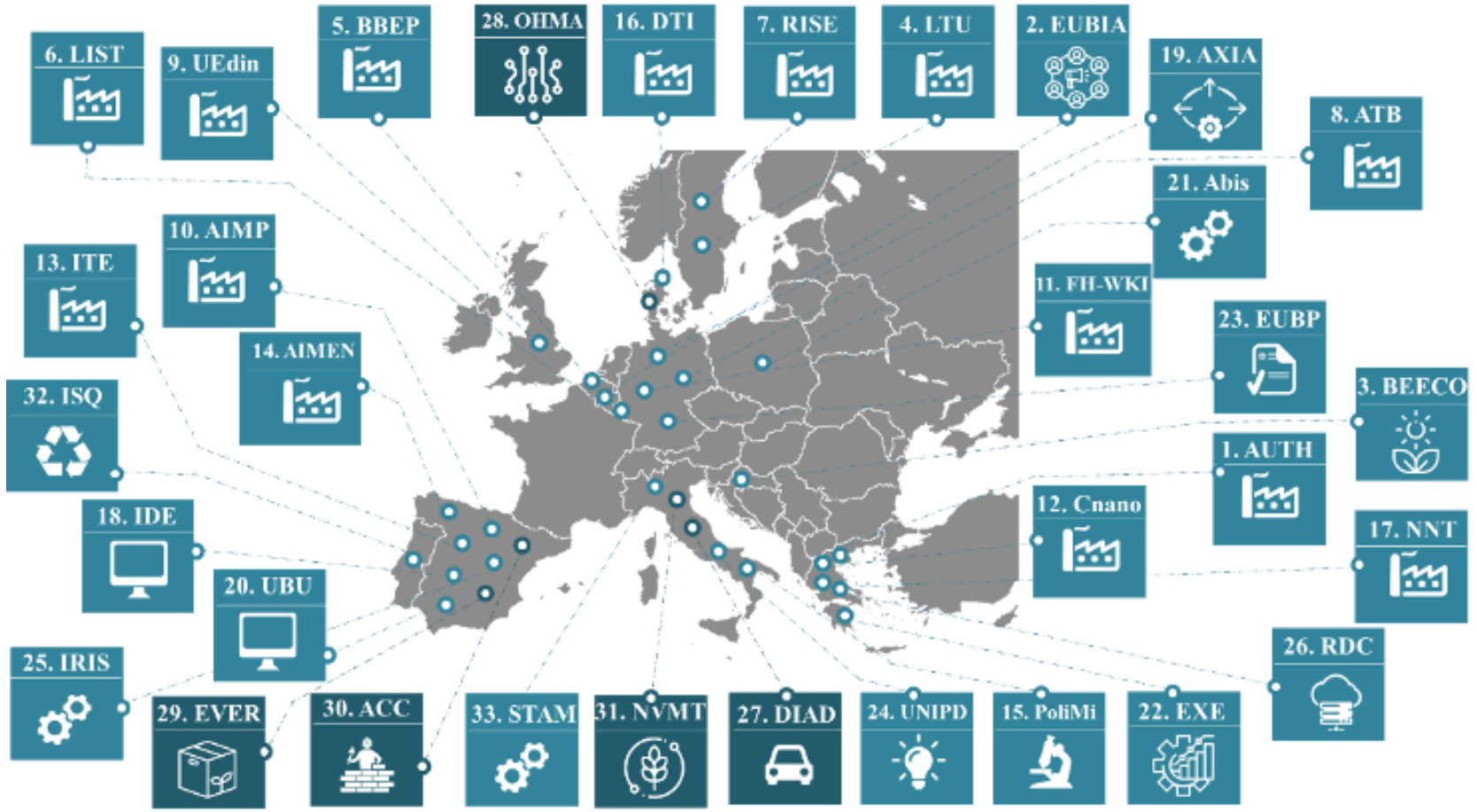
BIOMAC is a Horizon 2020 project that will establish an **Open Innovation Test Bed (OITB).**

It is a collaborative **ecosystem** where technologies and solutions utilizing **nano-enabled bio-based materials (NBMs)** will be **upscaled** and **prepared for market applications**.

The BIOMAC Ecosystem will provide **open access** to its facilities **(17 Pilot Lines)** and **complementary services** required for the development, testing and upscaling of materials and products in the field of nano-enabled bio-based products and materials.

The Pilots Lines of BIOMAC cover the whole value chain, from biomass fractionation and intermediate chemicals to final NBMs.

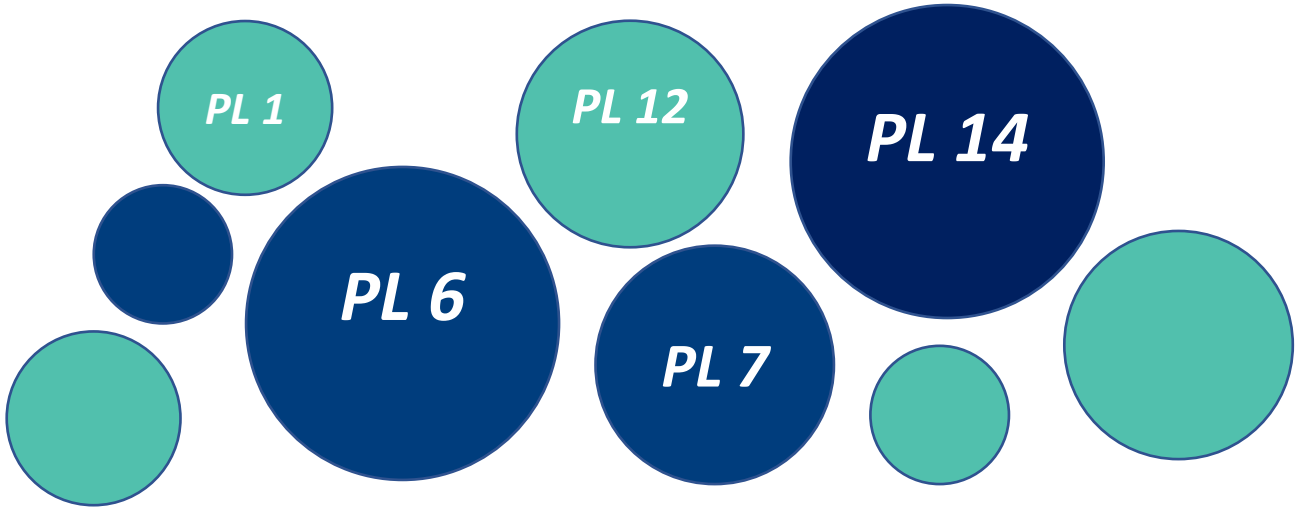
34 European Partners



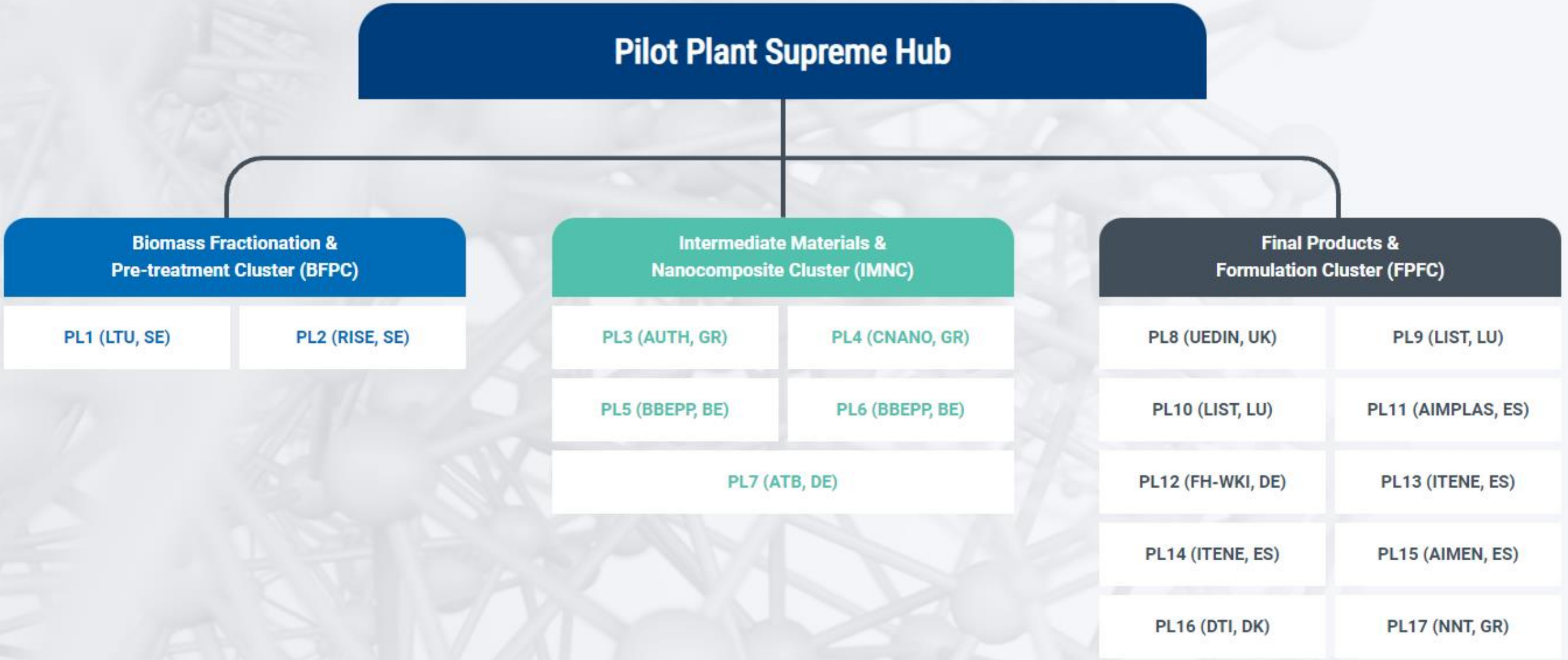
- PILOTS
- CHARACTERIZATION
- MODELLING
- MONITORING
- INNOVATION
- IT PLATFORM
- LCA, LCC
- DECISION SUPPORT TOOL
- DISSEMINATION & CLUSTERING
- BIOMASS PROVIDER
- BUSINESS DEVELOPMENT
- STANDARDIZATION
- TC1. AUTOMOTIVE
- TC2. AGRICULTURAL APPLICATIONS
- TC3. FOOD PACKAGING
- TC4. CONSTRUCTION
- TC5. PRINTED ELECTRONICS

Pilot Lines: the core of BIOMAC

The BIOMAC ecosystem will function as a cluster of parallel activities taking the form of **17 Pilot Lines (PL)** covering the whole value chain, from **biomass fractionation** and **intermediate chemicals** to **final-enabled biopolymers**.



Pilot Lines: the core of BIOMAC



Pilot Lines summary

- PL1: Semi-continuous organosolv-steam explosion
- PL2: Hydrolysis of fibre sludge and Bacterial nanocellulose production
- PL3: Sugar derived polyols and diols by catalytic hydrogenation/hydrogenolysis
- PL4: US assisted PL reactor for the production of NL
- PL5: Hydrothermal pre-treatment of biomass
- PL6: Recovery / Separation of the different liquid fractions from different pilot lines
- PL7: Enzymatic Hydrolysis & Microbial Fermentation
- PL8: Pyrolysis and carbonization of biomass up to 850°C
- PL9: Continuous Reactive Extrusion
- PL10: Mechanical milling and Production
- PL11: Reactive extrusion
- PL12: Resins Pilot Line for biobased polyesters and PU (UV curing applications)
- PL13: Mechanical treatment to produce NFC and/or CNC
- PL14 Nano based coatings and inks
- PL15: Additive manufacturing (AM)
- PL16: Printed electronics
- PL17: R2R Nanopatterning and thermoforming

Pilot Lines summary

PL1

Semi-continuous organosolv-steam explosion pre-treatment (LTU, SE)

DESCRIPTION | UPGRADE & MODIFICATION PLAN | GALLERY

DESCRIPTION

The semi-continuous organosolv-steam explosion pre-treatment PL is capable of fractionating lignocellulosic biomass (e.g. agricultural and forest residues) to its three main polymer components, i.e. cellulose, hemicellulose and lignin. It offers unique advantages by combining the effects of steam explosion with that of hemicellulose and lignin solubilization (organosolv) in ethanol/water mixtures under pressure and temperatures up to 200oC. The Semi-continuous PL of LTU provides the additional benefit of solid/liquid separation that can take place during operation at high temperature and pressure, simulating the continuous organosolv operation mode.

Pilot Lines summary

Hydrothermal pre-treatment of biomass

DESCRIPTION UPGRADE & MODIFICATION PLAN

DESCRIPTION

Pre-treatment of biomass to obtain Fractions of Lignin, Hemicellulose, Cellulose parameter optimization to achieve the desired monomeric characteristics while limiting the formation of unwanted by-products (inhibitors).

Pilot Lines summary

PL12

Resins Pilot Line (FH-WKI, DE)

DESCRIPTION | UPGRADE & MODIFICATION PLAN | GALLERY

DESCRIPTION

In PL12, monomers from PL3, such as succinic acid, glycerol, EG, 1,2-PDO and sugar alcohols will be used as starting materials for bio-based polyester and polyurethane resins. For UV-curing applications, bio-based itaconic acid or acrylic acid will also be incorporated into the polymers. The resins will be synthesized by azeotropic polycondensation or polyaddition reactions. These polymer resins will be used as starting materials for UV-curing materials in additive manufacturing (PL15) and printing ink application (PL16). In addition, the resins can be formulated for coatings and additive manufacturing purposes and applied on different substrates. UV-curing of samples, as well as DLP and SLA-machine for additive manufacturing is available. The materials will be synthesized in reactors on lab-scale (up to 2 kg) and small pilot scale (up to 4 kg) in a double-walled steel reactor.

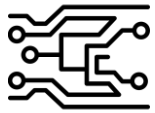
Test Cases (TeCs)

TeC1 – Automotive

TeC2 – Agriculture

TeC3 – Food packaging

TeC4 – Construction



TeC5 – Printed electronics

The Open Call

After the **TeCs validation phase**, SMEs and Research Centers will be granted access to the services and facilities of the BIOMAC ecosystem.

An **Open Call** targeted to end users will be launched **here** in **December 2022**, with the aim of selecting **5 additional TeCs** utilizing biobased nanomaterials. The Open Call will last for **6 months** until **May 2023**.

BIOMAC OPEN CALL

The Open Call

Applicants will liaise with BIOMAC's single entry point (SEP) constituted by **European BioPlastics (EUBP) and Industrielle Biotechnologie Bayern Netzwerk GmbH (BBI)**. A call for Innovation Concepts will be designed based on questionnaires filled in by the applicants. All the members of the OITB will participate to cover all aspects of innovation.

The main selection parameters will be the **proof of TRL 4-5** of the applicants' cases, the **feasibility study** and the **complexity** of the test cases. Another aspect is that **all 17 PLs** must be **utilized** during the implementation of the open call test cases.

Structure of the OITB

a) *Biomass Fractionation and Nanocomposite Production Cluster*

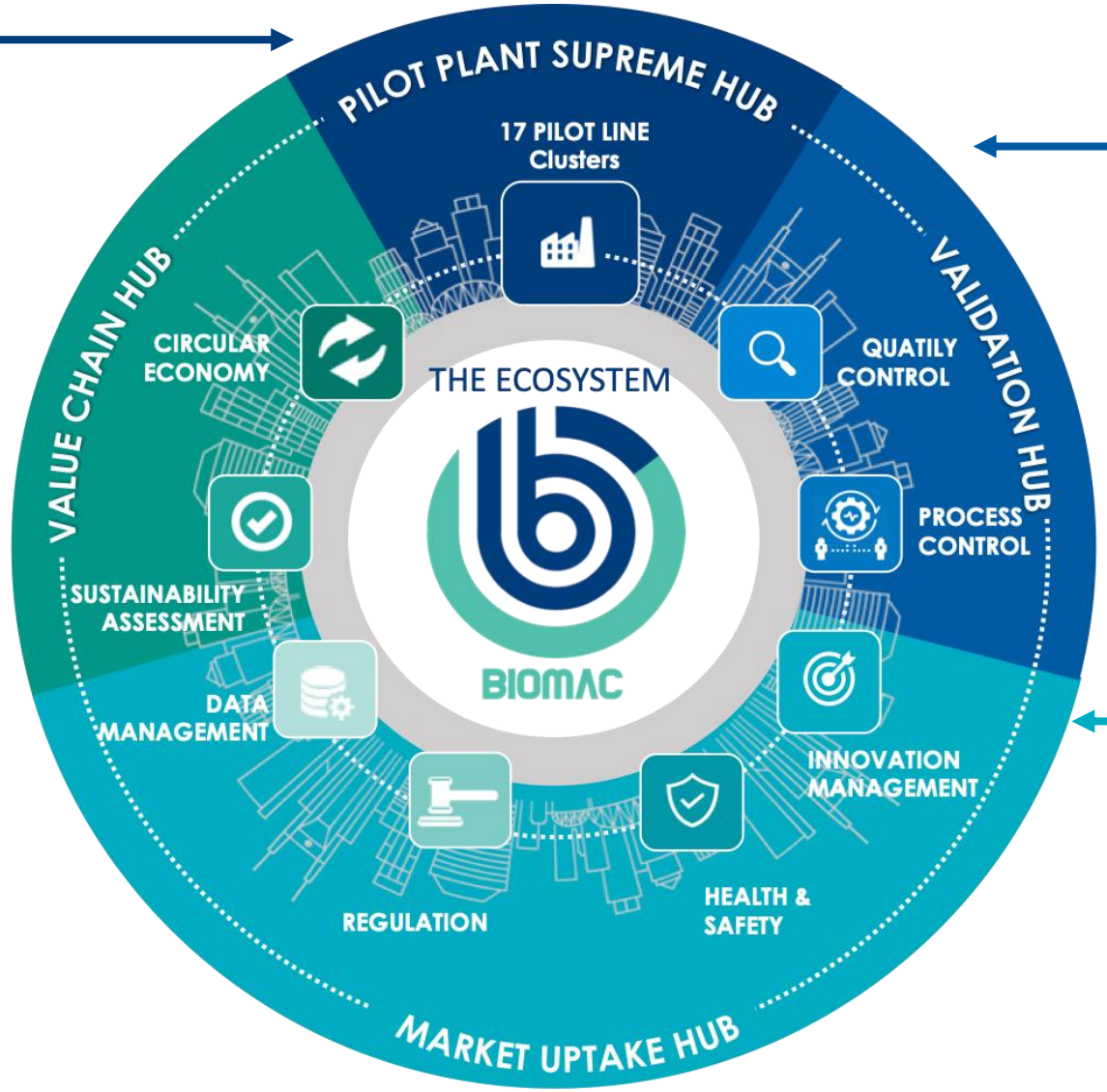
b) *Intermediate Materials and Nanocomposite Production Cluster*

c) *Final Products Production and Formulation Hub*

a) *Quality control, characterization*

b) *Standardization*

c) *Process validation: modelling*



a) *Sustainability assessment*

b) *Supply management*

c) *Circular economy*

a) *Innovation management*

b) *Health and safety*

c) *Regulation*

d) *Data management*

Pilot Plant Supreme Hub

The **Pilot Plant Supreme Hub (PPSH)** includes three clusters of PLs for the upscaling of multifunctional nanostructured materials that will be available for open access by the clients of the ecosystem. The three clusters are:

- Biomass Fractionation and Pre-treatment Cluster (BFPC)
- Intermediate Material and Nanocomposite Cluster (IMNC)
- Final Products and Formulation Cluster (FPFC)

The PPSH offers multiple advantages to potential clients, such as **shorter processing time**, **better selectivity**, **lower energy and footprint**, **fewer production steps** and **reduction of by-products**.

Pilot Plant Supreme Hub

The main objective is primarily to showcase, in collaboration with the other transversal services, the ecosystem's capability in providing a **holistic solution for potential clients**. A secondary target is the **performance evaluation** of the pilot lines, the **identification of bottlenecks** in the process and of the **weak spots** in the pilot systems so as to optimize the pilot plant operation alone and in conjunction with all the other ecosystem services.

Validation Services Hub

The **Validation Services Hub (VSH)** will provide in-detail characterization, performed under international standard procedure guidelines, of starting materials, raw materials and final products in terms of their physical, structure and morphological properties thanks to a wide range of analytical devices and setups. This group of services examines the feedstock, the technologies and the products from chemical, environmental, and economical perspective.

Validation Services Hub: the services

Quality control and characterization -> the validation of novel materials will use advanced techniques evaluating their functional properties; the aim is to promote the bridging of materials developments with end users and real market applications

Validation Services Hub: the services

Standardization -> compliance with standards of all results and definition of the specific actions to direct the development activities toward existing standards and regulatory frameworks for the adoption of new technologies by the industry

Validation Services Hub: the services

Process validation - modelling -> provide a model of the production lines built from the combination of the different pilots with the main purpose to produce a simulation tool which provides data for the techno-economic and environmental assessment at the desired scale

Market Uptake Hub

The **Market Uptake Hub (MUH)** will develop business plans for the potential clients of the OITB, including feasibility study, market search and financial projections, and will provide the technology landscape in terms of submitted patents across the world, ensuring the compliance with standards and regulatory framework.

The second group of services is structured to support business, legalization and data handling issues.

Market Uptake Hub: the services

Innovation management (IM) -> the activities related to IM will ensure the effective deployment of the exploitation plan provided by the clients of the ecosystem and will indicate the customer segments and which value propositions they require/need

Market Uptake Hub: the services

Health and safety -> a safe-by-design approach will be applied across the value chains to reduce potential health, safety and environmental risks at an early phase in the innovation process

Market Uptake Hub: the services

Regulation -> An assessment of regulation will be conducted to ensure partnering in the commercialization phase of a technologies, securing compatibility and reducing market uncertainties

Value Chain Hub

The **Value Chain Hub (VCH)** will assess the sustainability of the revalorization routes proposed through the PLs and develop new high-value markets, considering ecological, financial and social aspects. End users will collaborate with the VCH to specify workflows of activities to be run, as well as provide requirements and define the Life Cycle Assessment and Cost. This group of services examines the feedstock, the technologies and the products from chemical, environmental, and economical perspective.

Value Chain Hub: the services

Sustainability assessment -> To demonstrate the final processes and products' environmental and economic sustainability, S-LCA, LCA and LCC will be performed, especially to highlight the environmental impact versus petroleum-based benchmarks

Value Chain Hub: the services

Supply management -> A Decision Support Tool (DST) will be developed to simultaneously assess the products against environmental and economic criteria; the DST will be then developed into an online user-friendly platform to secure general use

Value Chain Hub: the services

Circular economy -> a circular overview of the value chain will be undertaken, allowing the development of efficient networks, identifying opportunities to foster the transition from linear to circular model, and evaluating the sustainability and economic feasibility

Thank you!

www.biomac-oitb.eu

biomac@chem.auth.gr