Waste2BioComp

Converting organic waste into sustainable bio-based components

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26 June 2024, Circular Value Chains for Bio-Based Products: the BIO-MATTERS Cluster

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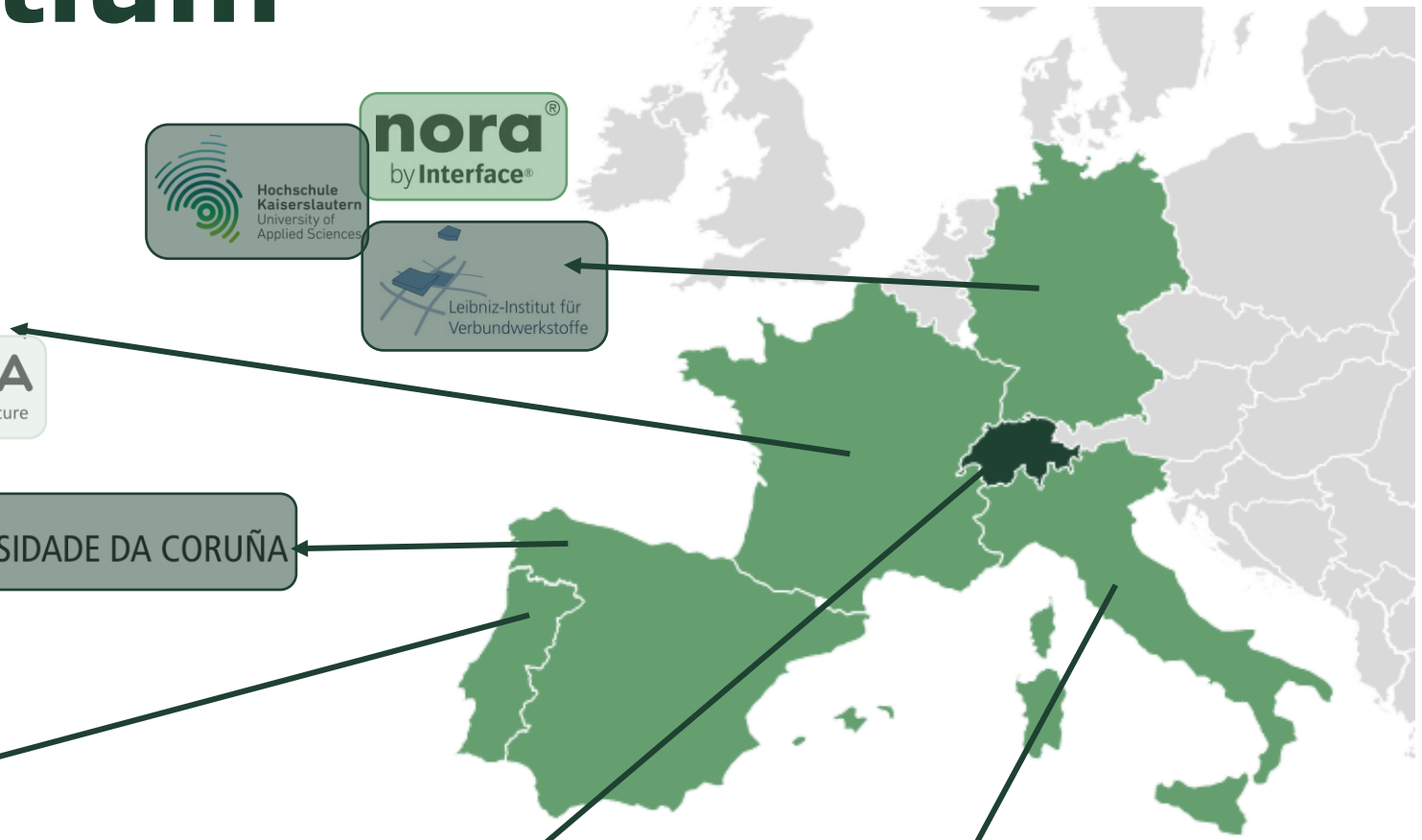
01. Consortium

- 13 European partners

5 SMEs

3 large industries

5 research entities



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propa group

02. Main goal

- **Relevant scale production of bio-based products and materials** (from TRL 3-4 to TRL 6)
  - alternatives to **traditional materials**
  - **innovative manufacturing technologies**
  - **closed loop**

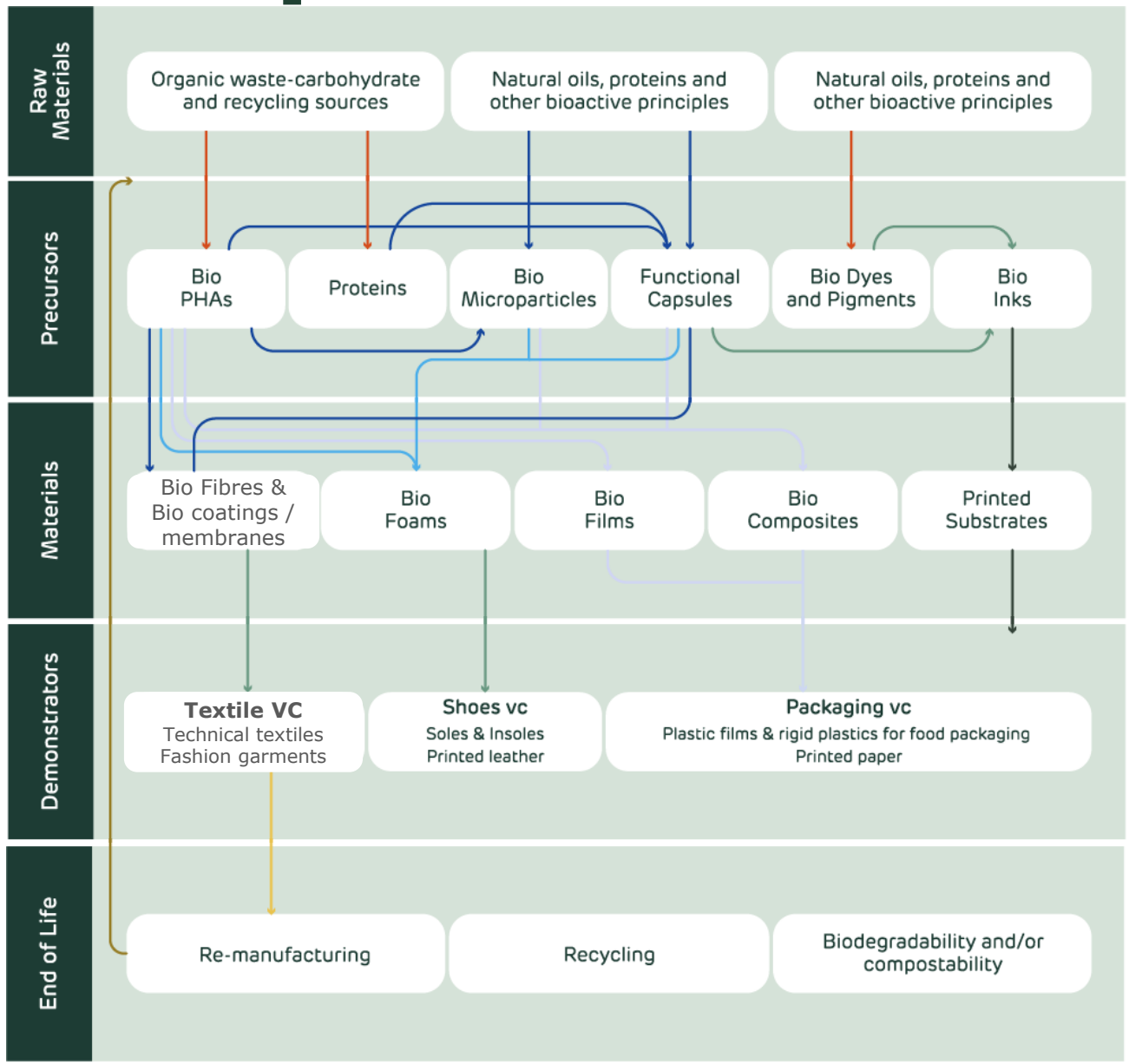
Starting date
1 June 2022

Duration
36 months

Funding
5.8 M€

03. Value-chains covered

04. Concept


Raw Materials
Organic waste-carbohydrate and recycling sources
Natural oils, proteins and other bioactive principles
Natural oils, proteins and other bioactive principles
Precursors
Bio PHAs
Proteins
Bio Microparticles
Functional Capsules
Bio Dyes and Pigments
Bio Inks
Materials
Bio Fibres & Bio coatings / membranes
Bio Foams
Bio Films
Bio Composites
Printed Substrates
Demonstrators
Textile VC
Technical textiles
Fashion garments
Shoes vc
Soles & Insoles
Printed leather
Packaging vc
Plastic films & rigid plastics for food packaging
Printed paper
End of Life
Re-manufacturing
Recycling
Biodegradability and/or compostability


Toxicity & Sustainability assessments
Training, Standardization and regulations

05. Use cases

Shoe soles and insoles

shoe soles with different hardness

three-layered **shoe insole**

Compounding

Plastic films and packages

flexible plastic film

rigid plastic package

(Blown) extrusion, Injection moulding

Bio-based textiles

technical textiles for sportswear & shoes

Spray & Lamination

Printed substrates

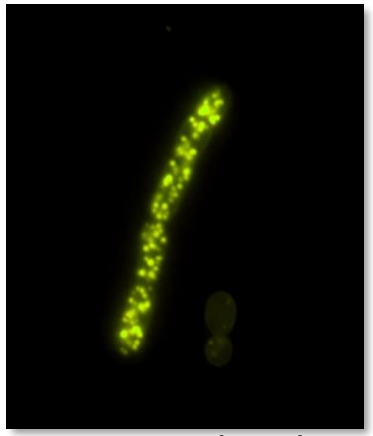
textiles, shoes, insole & film printed with the bio-based inks

Inkjet printing

Demonstrators validated in relevant environments, with no toxicity, and comparable with fossil-based benchmarks.

06. Challenges & achievements: Bio-based precursors

- Production of several PHAs, with different levels of crystallinities, by biogenesis and chemical routes



Bacteria stained with NileRed, showing the PHA produced

Different PHAs produced by chemical routes

Challenges (overcome):

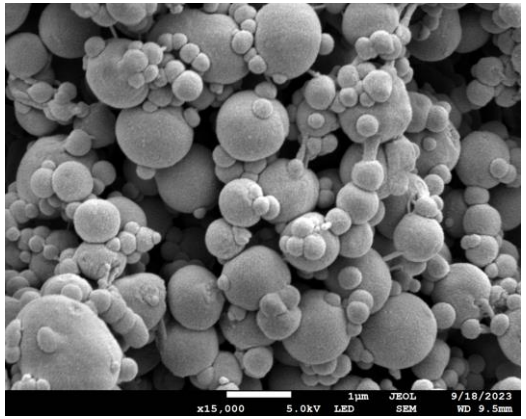
Identify PHB production by the bacteria

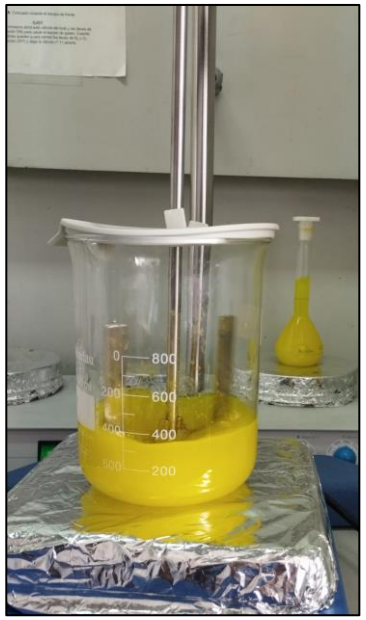
Obtain PHAs with wide range of crystallinities

- ✓ Chemical synthesis of different PHAs:
  - ✓ by different techniques
  - ✓ with different molecular weights
  - ✓ successful up-scale trials up to 5 kg

06. Challenges & achievements: Bio-based precursors

- PHB microparticles (lab-scale)





Good thermal resistance during processing

Challenge: scale-up | solvent recovery

- Core-shell nanocapsules with EO (5 kg scale)

Zein + modifications

PHB

PHBV

Some with good antimicrobial activity against *E. Coli*

Challenge (overcome):obtain stable capsule emulsions

06. Challenges & achievements: Bio-based precursors

- Pigments (g to kg scale)

Trichromy of pigments produced

- Inks (lab-scale)

Fermentation and chemicals joint approaches

Challenge: scale-up of pigments

Ink for textile cotton and PES substrates

Challenge: dispersion of the pigment in the ink

06. Challenges & achievements: Bio-based materials

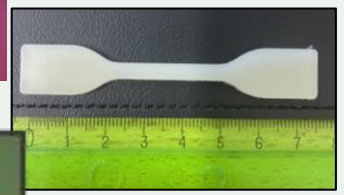
Foam with bio-polyol

Foam with PHA

Crosslinking & foaming

Blown extrusion

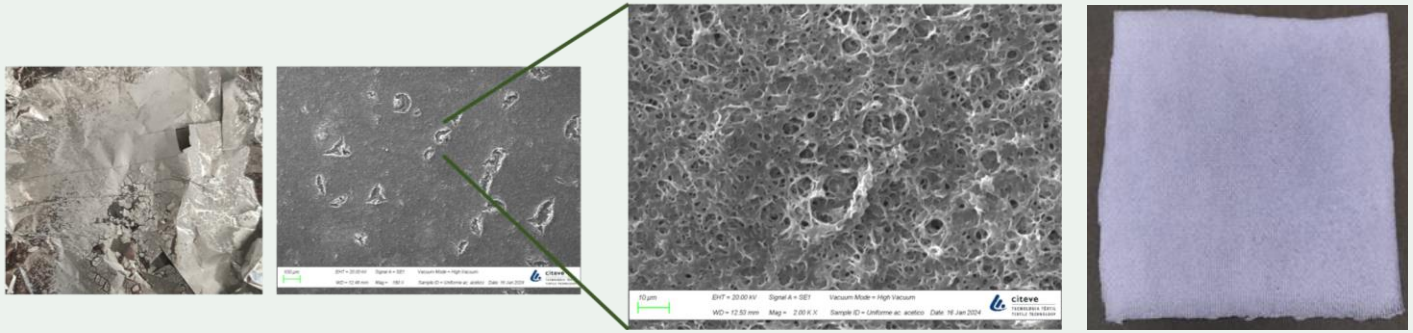
Plastics with PHA



Extrusion, Injection Moulding

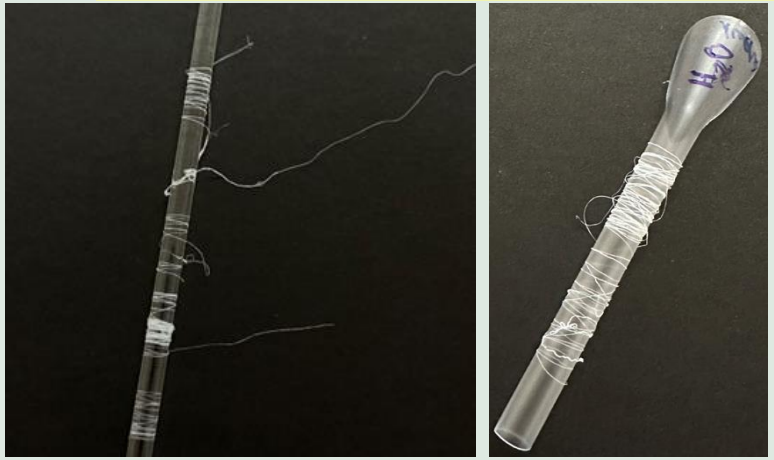
Challenge: limited amount of PHA

06. Challenges & achievements: Bio-based materials



Spray coatings

Challenge: produce fibres or coatings



Spinning fibres

Challenge: avoid spread of ink drop & improve fastness

Inkjet printed textiles

06. Challenges & achievements: Inkjet system

2D printer

3D printer

Goal with 3D printing

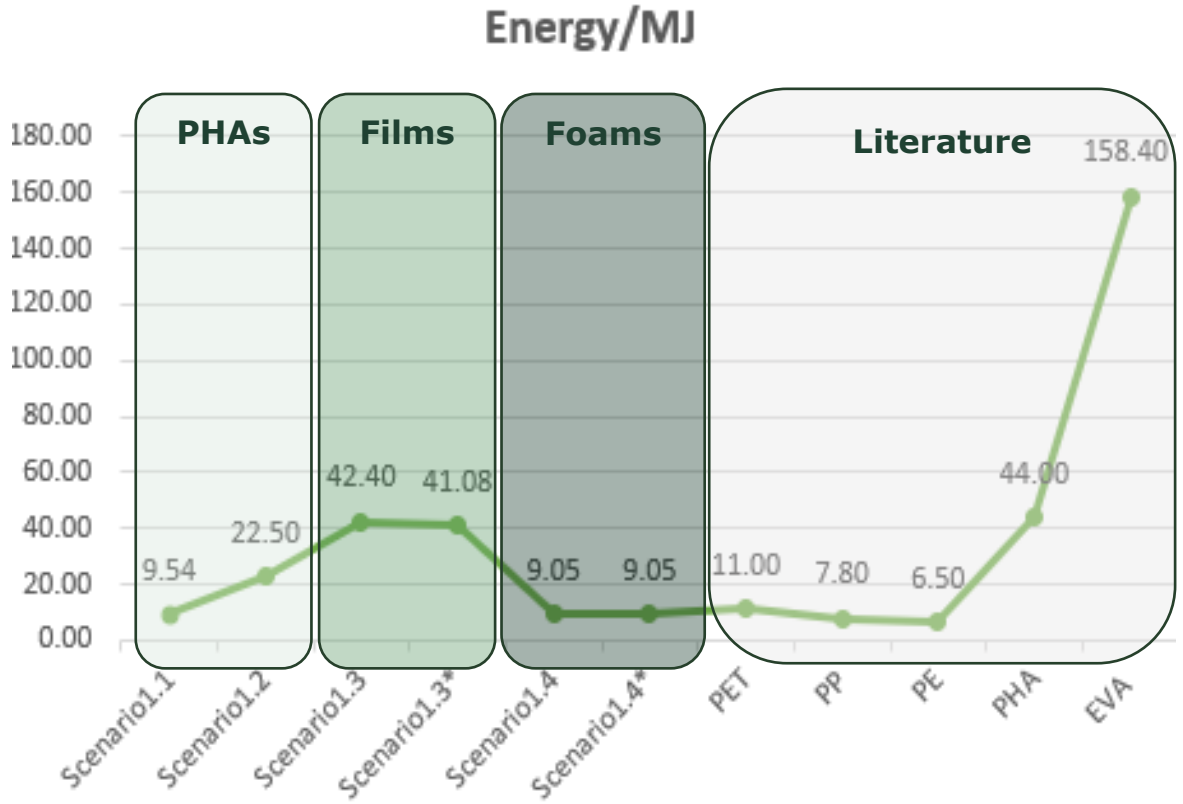
Challenge: communication between all systems of the equipment

06. Challenges & achievements: Sustainability assessment

- ✓ **Chemical recycling** of pure PHA into starting molecules (lab-scale)
- ✓ **Microwave-assisted chemical recycling** of PHA-waste and use of recyclates in PU-foams (lab-scale)
- ✓ **Recycling** in bio-based solvents for **whole insole** (foam + textile) (lab-scale)
- ✓ PHAs, microparticles and processed PHA with **no cytotoxic potential**
- ❖ **Colour removal** from printed textiles still **a challenge**

06. Challenges & achievements: Sustainability assessment

- Promissing LCA results (still under development…)



07. Next steps

- Demonstrators production & testing
- Sustainability assessment of demonstrators (LCSA, toxicity, degradability)
- Assemble full inkjet system, and test with bio-based ink
- Continue trainings sessions for a skilled workforce in bio-based materials
- Publication / patenting of project results

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Thanks for your attention!

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