



Bio-based in Soil applications with Optimal biodegradation in their Ultimate Life

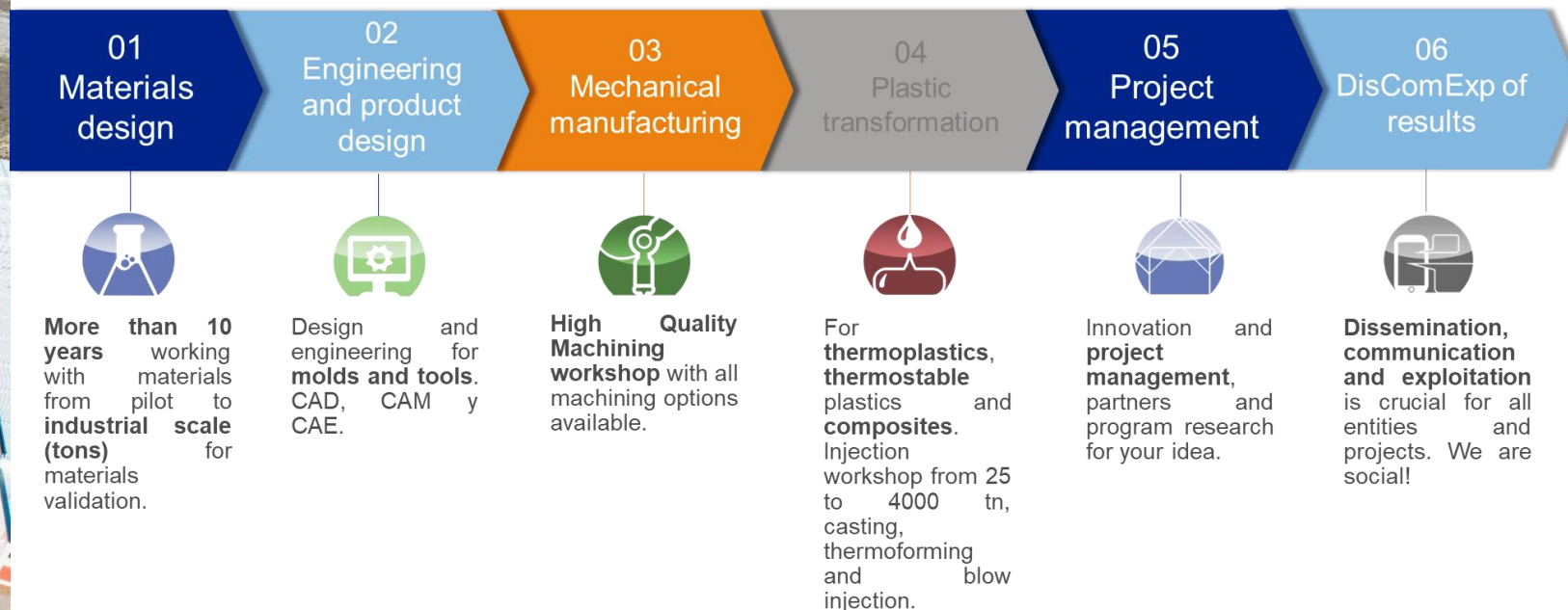
SOUL project



Co-funded by
the European Union



This project is supported by the Circular Bio-based Europe Joint Undertaking and its members, and co-funded by the European Union under the GA n°101214822. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CBE JU. Neither the European Union nor the CBE JU can be held responsible for them.



17,000 m²

Innovative pilot lines for circular processes and sustainable products



15 M turnover

2 M€ yearly investment for key enabling technologies to the European Industry



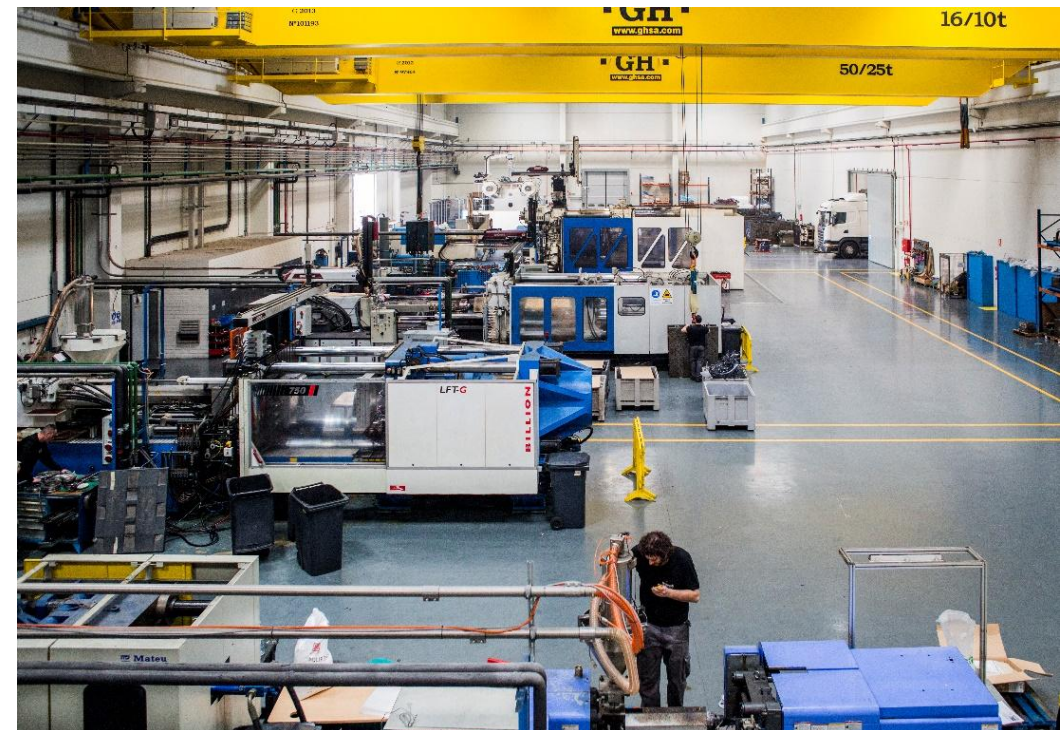
120

Multidisciplinary staff



4 spin offs

Sustainable solutions, advanced materials, 3D printing & IT solutions





From the Earth, for the Earth

SOUL is a co-funded **Horizon Europe project** under the Circular Bio-based Europe Joint Undertaking (CBE JU).

The project is funded under GA 101214822.

- Topic: HORIZON-JU-CBE-2024-IA-01 - Bio-based materials and products for biodegradable in-soil applications
- Type of Action: HORIZON JU Innovation Actions
- Full title: Bio-based in Soil applications with Optimal biodegradation in their Ultimate Life
- Duration: 48 months
- Start Date: 01st September 2025
- Estimated Project Cost: 10.014.752,00€
- CBE JU contribution: 7.267.599,50 €



Problem and background information



In **agriculture, farming & gardening**, plastics represent 3.1% of the end-use market, with crop production and livestock sectors as the largest users, accounting for **10 Mt annually**.

The agricultural plastic industry forecasts the **global demand** for greenhouse, mulching and silage films to **increase by 50 %** from 6.1 million tonnes in 2018 to **9.5 million tonnes in 2030**.

Around **63%** of **agriplastic** non-packaging **waste generated** in the EU was reported as collected in 2019 by **APE Europe**. The fate of the remaining **37% of agriplastics is not known** – as by definition this is not recorded – but the agriplastics may be stored, burnt, buried, or collected with another waste stream.

Environmental Impact

- **Soil & Crop Impact:** Accumulation of mulching film residues in soils reduces agricultural productivity.
- **Health & Wildlife Risks:** Plastics and their toxic additives harm wildlife and pose potential risks to human health through food chain transfer.
- **Pollution & Contamination:** Microplastics spread pathogens and chemicals; burning or dumping releases persistent toxic pollutants.
- **Climate Contribution:** Fossil-based plastic production and degradation add to global greenhouse gas.

Problem and background information

In this context, **SOUL** will develop novel biomaterials with **high renewable material content** and biodegradable in soil to find solutions that complies with regulations (microplastics) and that do not hamper soil fertility.

RENEWABILITY BPSs will be based on high renewable content biomaterials (**>95% RRM**) by valorising industrial biobased building blocks (1,4 bio-BDO, C18-DCA, Azelaic acid)

VALIDATION The industrial **manufacturers** will ensure full validation of technical requirements at high TRL, and **end users** will ensure **in-field** validation in **5 demo** sites (Spain, Italy, Portugal, Poland and Ireland).

REPLICABILITY products with direct exposure to soil or at high **risk of dispersion in the open environment** even in other sectors than those studied at the project, ensuring **cross-fertilization**

FLEXIBLE PRODUCTION **Innovative platform** ensuring the BPS to meet the different application needs in terms of mechanical properties, time of use and EOL options.

SAFETY Design of novel biomaterials following EU methodological approach to **SSbD** and combining the **biodegradability-in-soil** with **different end-of-life** options



Project Scope and Objectives

SOUL's main objective is to **develop and bring to market novel biobased and biodegradable-in-soil product solutions** that can replace fossil-based plastics in agriculture, improving waste management, reducing carbon footprint, and preventing soil degradation, while ensuring compliance with regulations (e.g. microplastics) supporting the transition to a circular, sustainable plastics economy in Europe

SO1: To scale up at **TRL8** the production of novel high renewable content biomaterials tuned for biodegradable-in-soil product solutions.

SO2: To develop **novel biomaterials with enzymes for *ad hoc* degradation** in open environments.

SO3: To develop biobased, high-performing **biodegradable-in-soil product solutions** by means of **industrial technologies**.

SO4: To demonstrate the performance of biodegradable in soil product solutions in real **demonstration sites**.

SO5: To **test and model the biodegradation** pathways for the biopolymers developed and assure soil quality.

SO6: To **amplify the EOL** of relevant biodegradable in soil product solutions.

SO7: To comply with the **Safe and Sustainable by Design** initiative and provide recommendations.

SO8: To define a **sound business case** for the commercial exploitation and replication of SOUL innovations.

SO9: To **engage end users** to achieve a high societal impact **creating synergies** with **similar initiatives**.



Project concept

Raw material



BIOMATERIALS PRODUCTION BY USING 3 BIO-BASED BUILDING BLOCKS (1,4 BIO-BDO, C18-DCA, AZELAIC ACID) FROM EU SUSTAINABLE FEEDSTOCK

Functionality



LARGE SCALE PROCESSING OF 11 NEW BIOMATERIALS (95% EU RRM) VALIDATED FOR 8 KEY TECHNOLOGIES



11 BPS BIODEGRADABLE IN SOIL FOR 8 APPLICATIONS DEVELOPED FOR 3 SECTORS: AGRICULTURE, GARDENING/LANDSCAPING AND SPORTS/LEISURE

Production process & Validation



PERFORMANCE, SOIL QUALITY AND BIODEGRADABILITY IN SOIL ANALYSIS IN 5 EUROPEAN REGIONS TESTED.
18 PARTNERS FROM 7 EU COUNTRIES + 1 AC AND 25 STAKEHOLDERS ENGAGED IN THE PROJECT

End-of-Life



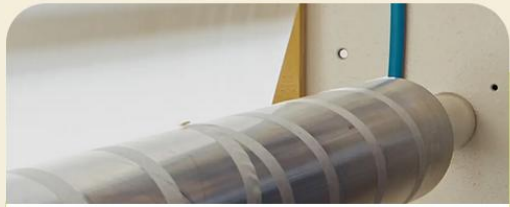
- 5 DIFFERENT END OF LIFE OPTIONS TESTED
- CIRCULARITY INDEX >0.55
- MPEP < 13.
- BIODEGRADABILITY PREDICTION MODEL

Safe and Sustainable by Design Tool

Our consortium

SOUL brings together **17 organisations** from across Europe + **1 associated partner**, combining research excellence, industrial expertise, and stakeholder engagement, under the **coordination of Fundación AITIIP (Spain).**





BPS 1 - agriculture

Monolayer ultrathin mulch film



BPSs 2-3 - agriculture

Multilayer black & white mulch film



BPS 4 - agriculture

**Controlled Release Fertilizers (CRF)
- Spray coating**



BPS 5 - agriculture

Clips



BPS 6 - agriculture

Twines



BPSs 7-8 - agriculture

Pheromone dispenser



BPS 9 - gardening/landscaping

Turf nets



BPS 10 - gardening/landscaping

Tree shelter



BPS 11 - leisure/sports

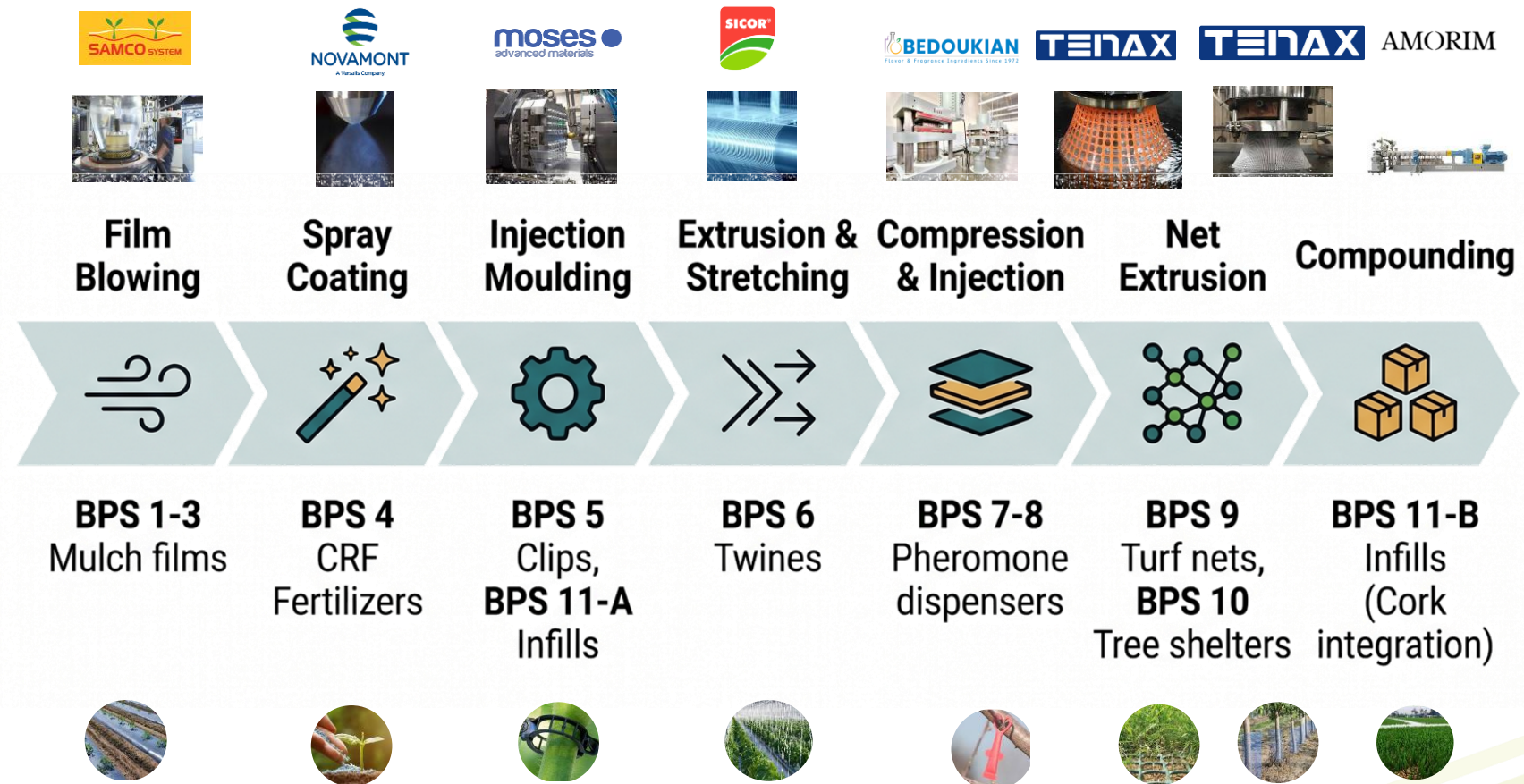
Infill

Our 11 product solutions

are designed to:

- work with **existing** plastic manufacturing technologies
- **perform** well during use
- fully **biodegrade** in soil





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Our demo sites

SOUL BPSs will be **tested in real-world conditions** and brought close to market readiness.

SOUL demo sites are based in **5 EU countries:**

- Portugal
- Spain
- Ireland
- Italy
- Poland



EOL CIRCULAR STRATEGIES MATRIX

BPS Solution	Reuse	Recycling	Industrial Compost	Anaerobic Digestion	In Soil Biodegradability
BPS 1-3: Mulch Films	--	--	--	--	✓
BPS 4: CRF Fertilizer	--	--	--	--	✓
BPS 5-9: Clips & Tree Shelters	✓	✓	✓	✓	✓
BPS 7-8: Twines & Pheromone Disp.	--	✓	✓	✓	✓
BPS 9-10: Turf Nets & Infills	--	--	--	--	✓





SSBD PRINCIPLES, CIRCULARITY AND MICROPLASTIC EVALUATION



BIOMATERIALS PRODUCTION

Upscaled
Biopolymers
grades



Masterbatches

Upscaled
Enzymes



PRODUCT MANUFACTURING

Mulch film
Pherom.
dispenser
Twines
Tree shelters



CRFs
Clips



Infills



Turf nets



VALIDATION IN-FIELD DEMOS SITES. SOIL AND PLANT QUALITY

Spain Demo



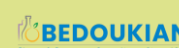
Portugal Demo



Ireland Demo



Italy Demo



Poland Demo



Soil and
plant quality



BIODEGRADATION TEST AND MODELLING. EOL STRATEGIES

Biodegradation
in soil



Modelling



Reusability and
recycling



REPLICATION / POLICY-REGULATION / LABELLING / STANDARIZATION



MARKET, EXPLOITATION / DISSEM-COMM, ENGAGEMENT & TRAINING



PROJECT MANAGEMENT



Current Tasks Progress

Biomaterial Preparation

Designed formulations for all BPSs with **>95% renewable content**. Evaluated upscale strategies for pilot production.

Key Result: Prepared >200 kg of large scale samples of biomaterial for infill (BPS11-B) and provided to Amorim.



SOUL BIOMATERIAL



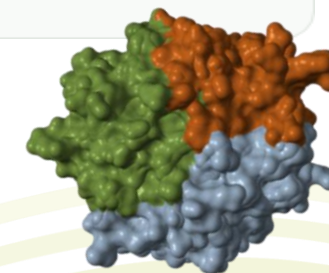
CORK COMPOUNDING

Enzyme Hydrolysis

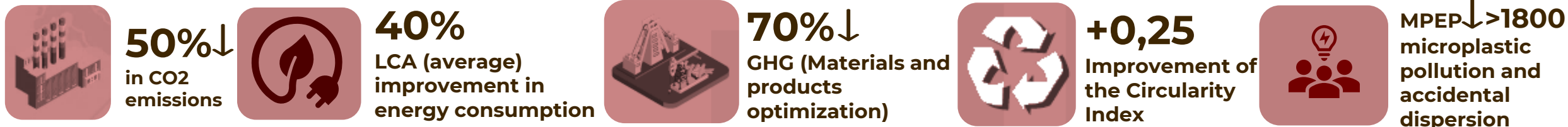
Planned tests for enzymatic hydrolysis of biopolyesters in collaboration between NVMT and EVOENZYME.

Status: Evaluation of intermediate building blocks and masterbatch matrix selection currently ongoing.

High degradation activity and low thermostability



Soul outcomes & impacts



IMPACTS

Expected to create up to **1,000 new jobs** in the early years, boost the European bioplastics industry, and generate **€7 million** in returns **within four years** after project completion.

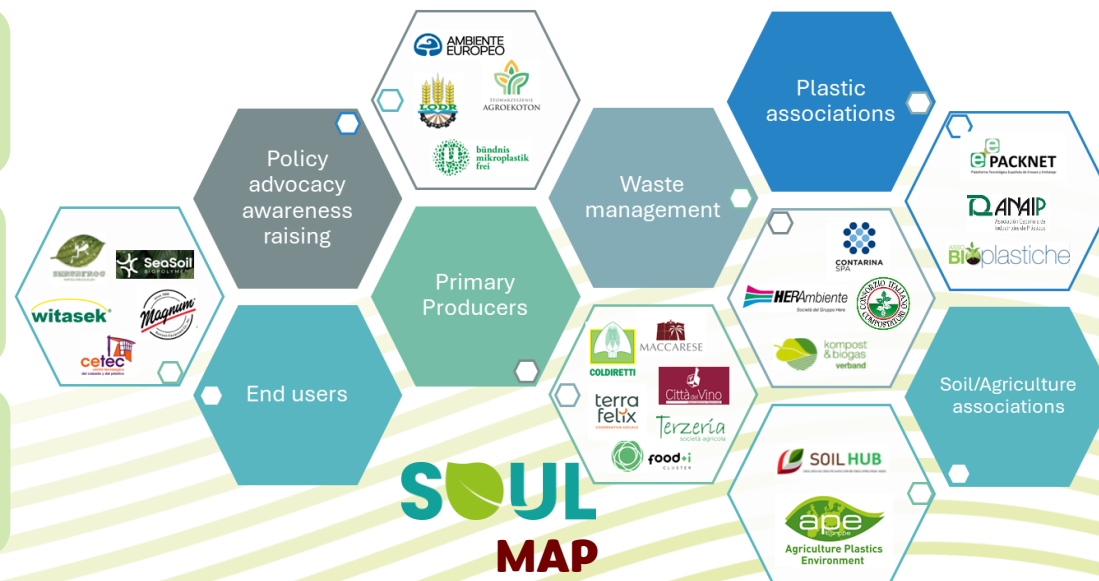
SOUL directly supports the **European Green Deal**, the **Biodiversity and the Farm to Fork Strategies** and contributes to the **EU's Zero Pollution Action Plan** and **Circular Economy Action Plan**.

Multi-actor Advisory Panel (MAP): stakeholders from the entire value chain will help define a **replication roadmap** and **deployment strategy** for sustainable solutions, ensuring the exchange of knowledge and benefits.

Standardisation actions led by OWS, a **Belgium delegate** in some **CEN and ISO committees** focused on biodegradation and ecotoxicity, in collaboration with all technical partners and the stakeholders engaged in the MAA.

Replicability -> Impact on other industries:

- Growth and jobs
- Technological spillover and new applications



SOUL joining forces

Contact us to be part of:

- **Multiactor Advisory Panel** 

- **Cluster “Biobased materials and products for biodegradable in-soil applications” with our Twin project** 

- **Thematic Network BBioNets**



We are open
to collaborate
with
stakeholders
interested in
our activities!

SOUL

Thank you for your attention

www.soul-biobased.eu



SOUL biobased

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