

Green-Loop: Bio-Based and Circular Made in Europe

Easy-to-Recycle Bio-Based Materials That Can Replace Plastic in Various Sectors: The First Achievements of the Horizon Europe Green-Loop Project

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Replacing plastic with bio-based materials. Transforming agricultural processing waste into new materials. These are the challenges that the **Horizon Europe Green-Loop project** has been tackling for the past two years. Now almost halfway through the journey, the fourth general assembly of the project consortium, held in Italy a few weeks ago, showcased the **first significant advancements** in both production technologies and new bio-based materials. Additionally, opportunities are emerging to **replicate the supply chain** in other manufacturing sectors, from packaging to furniture and design, aiming to significantly reduce the ecological footprint of waste streams.

Research areas and initial results

The search for innovative and bio-based materials within production processes to make them more cost-effective is at the heart of the Green-Loop project. This is a scientific field that integrates several disciplines—combining engineering, physics, chemistry, biology, and materials science—which enable the **creation of bio-based materials that are easy to recycle**. These materials have the potential to substantially reduce the ecological footprint of waste streams.

The research has focused on three innovative bio-based materials and components within production processes: **bio-rubber**, exploring its use in the development of multifunctional fireproof and anti-vibration panels; **bioplastics**, testing it in the creation of bottle caps for the beverage industry; and **lignin-based composites** to produce sliding bearings for industrial tools.

The work has centred on finding solutions to optimise and improve *smart manufacturing* processes, including injection moulding and extrusion. There is a need to fully **exploit the potential of bio-based materials**, such as biopolymers and other fibrous materials, including those with a positive carbon footprint, like wood, rubber, and composites, across different products, to achieve high technical properties while **simultaneously reducing the environmental footprint throughout the entire production and/or product lifecycle**.

Following demonstrations and use cases of green production technologies incorporating bio-based materials, efforts must now address the standardisation

activities of these new materials, adapting quality control and characterisation methods to suit them in their various formats and applications.

The fourth general assembly

Two years into the research and development activities, the fourth general assembly of the Green-Loop project partners was held in Italy a few weeks ago. Organised by NSBproject, acting as an Innovation Broker for the European Commission, the event took place in Breganze at the premises of Mixcycling, a Vicenza-based startup that owns a patented technology capable of **upcycling organic waste and blending it with plastics** derived from both organic and plant-based sources, as well as giving a second life to fossil-based materials, creating new raw material. The Green-Loop consortium presented the progress made in its research activities on production technologies and new bio-based materials.

Research initiated to provide sustainable food packaging and materials for the creation of bottle caps has yielded highly positive results, opening up the possibility of **replacing plastic** in other areas where no other material has yet matched the same performance in terms of durability, hygiene, and versatility in shape. Study visits to the Guala Closures and Mixcycling facilities provided all partners with insights into the state-of-the-art research and development of bottle closures for the beverage packaging sector. The focus was particularly on solutions for limoncello and olive oil, products of Green-Loop partner Le Terre di Zoè, an organic farm.

These bottle closures will use **materials that are up to 100% biodegradable**, with bio-based raw materials being natural fibres supporting biodegradable thermoplastics. The new materials will first be validated in the laboratory, testing various natural fibres sourced from the agri-food chain. Once the most suitable biocomposite material is selected, representative samples will be produced to be integrated into real-world trials at a bottling plant.

The innovation in production concerns the energy efficiency of the injection moulding process, which involves reaching high temperatures and is based on microwave technology, potentially **reducing current energy consumption by up to 30%**. In the coming months, activities will focus on characterisation and standardisation, and the entire supply chain will be monitored using environmental impact and circularity indicators to ensure full sustainability.

Bio-based solutions Made in Europe: Upcoming events

These technologies offer a viable alternative to conventional materials, with a substantially lower environmental impact and a wide range of applications. As demonstrated by the business cases presented, **this supply chain could be replicated in other sectors** such as cosmetic packaging, household goods, furniture, and interior design. There are also those considering their use in aircraft interior coverings.

GREEN-LOOP

This is a significant step towards the implementation of the **Made in Europe Partnership**, which is part of the *Research and Innovation Action* and a key contribution to the *Circular Economy Action Plan 2020*, aimed at making products in the European Union increasingly sustainable.

Green-Loop has also confirmed its collaboration with other relevant European projects, particularly through synergies with members of the BIO-MATTERS Cluster. Together, they will present their latest results at one of the most important European events in the field, the European Biomass Conference & Exhibition (**EUBCE**), to be held from 24 to 27 June 2024 in Marseille.

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