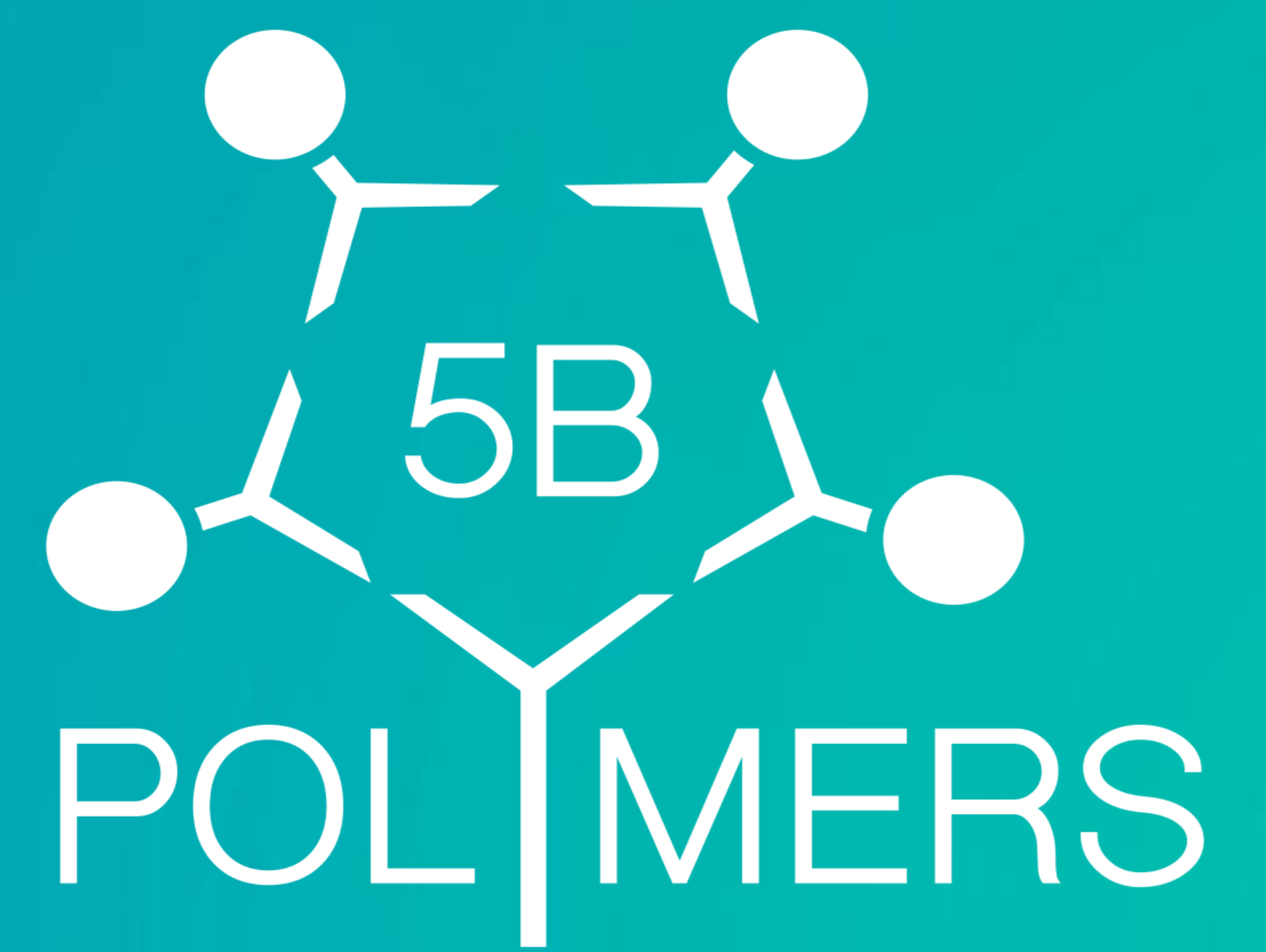


Safe and Sustainable Biobased Eco-design and Circularity methodology. The POLYMERS-5B approach

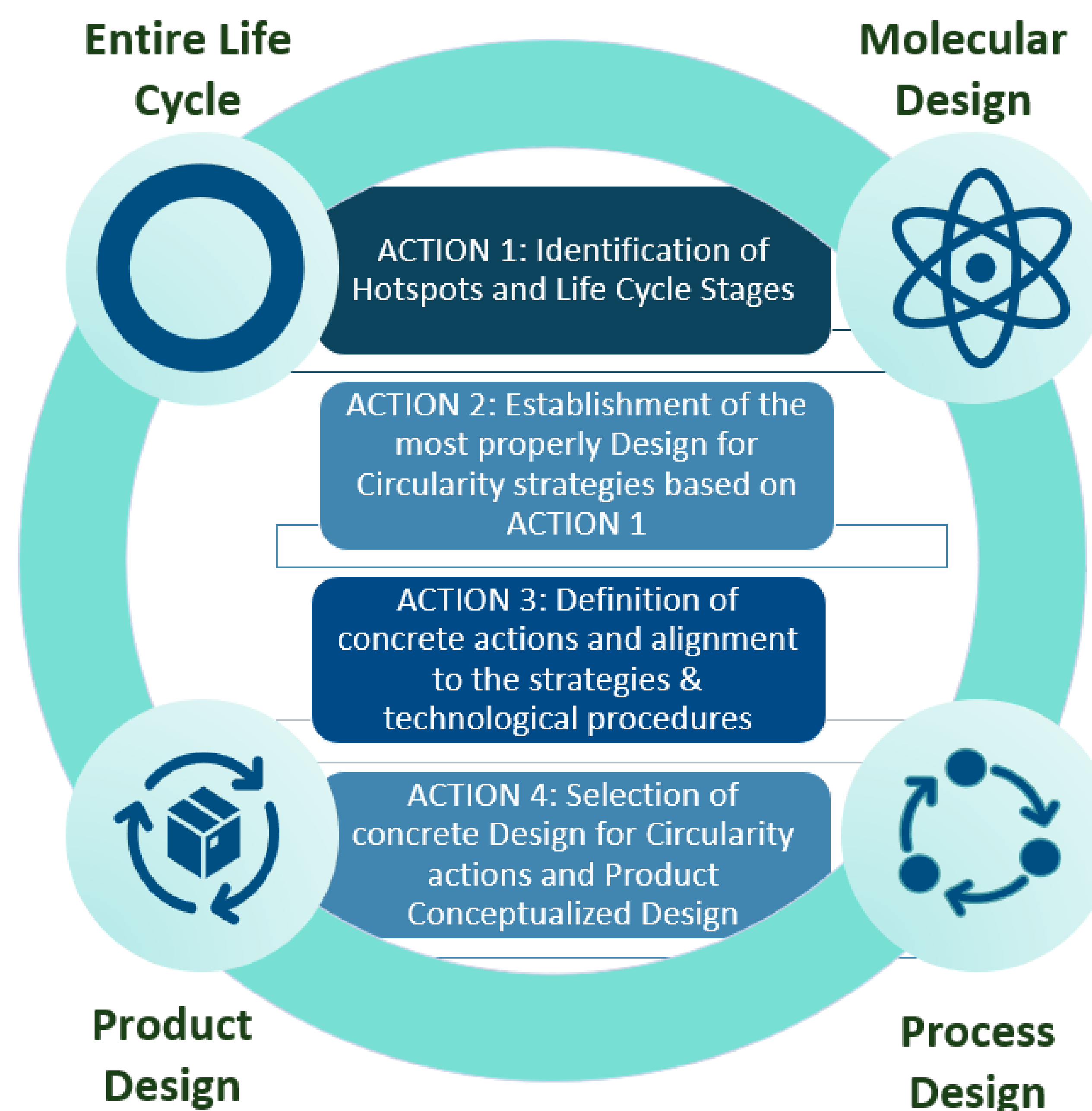
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Turning agri-food waste & biomass into sustainable polymers

INTRODUCTION

Bio-based materials, derived from biological sources, offer enhanced functionalities while supporting renewable resources, reducing fossil fuel dependence, and lowering environmental impacts. Such material standards promote transparency and validate claims related to biodegradability, sustainability, and recyclability, in line with the EU's Bioeconomy strategy. The Joint Research Centre (JRC) launched the SSbD (Safe and Sustainable by Design) framework to address challenges like raw material instability, production costs, and regulatory complexity.



THE CHALLENGE

The development of bio-based products requires a multidisciplinary approach that integrates all stakeholders across the value chain. In the POLYMERS-5B project, EURECAT introduces a flexible eco-design methodology that combines SSbD principles with circular design strategies, ensuring the active participation of stakeholders from the agri-food and wood biowaste sectors. This framework adopts a holistic and iterative approach that prioritizes both sustainability and functionality. Each phase of the cycle is applied repeatedly throughout the SSbD analysis to optimize the product life cycle, integrate safety and environmental considerations, ensure economic viability and promote social acceptance.

CONCLUSIONS

This holistic eco-design methodology, aligned with the SSbD framework, ensures that bio-based polymers developed in the POLYMERS-5B project are safe and sustainable throughout their life cycle. Its iterative approach drives continuous improvement, helping developers reduce resource use, avoid hazardous substances, enhance environmental performance, and enable depolymerization and renewability—without compromising technical functionality.

DESIGN TYPE	DESCRIPTION	SSBD ECO-BIODESIGN STRATEGIES
MOLECULAR DESIGN	Design of new bio-based and renewable monomers at the atomic level to create monomers and polymers safer and more sustainable	SSbD1: Bio-Based Material Optimization
		SSbD2: Minimize the use of hazardous chemicals/materials
		SSbD4: Sustainable Biomass Sourcing
		SSbD5: Emission Prevention in Bio-Production
PROCESS DESIGN	Design of new or improved processes for producing bio-based polymers, focusing on safety and sustainability	SSbD1: Bio-Based Material Optimization
		SSbD3: Energy Efficiency in Bioprocessing
		SSbD4: Sustainable Biomass Sourcing
		SSbD5: Emission Prevention in Bio-Production
PRODUCT DESIGN	Design of biobased polymers using bio renewable monomers for the application in the Textile, Furniture, Automotive, and Polymeric Resins industries in the EU	SSbD6: Non-Toxic Bio-Based Design
		SSbD7: End-of-Life Biocompatibility
		SSbD8: Full Life Cycle Sustainability for Bio-Based Products

Table 1.- Summary of the 8 Eco-Design Principles in the SSbD Framework by the JRC and adapted to bio-based monomers and polymers production.



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