# NOvel REcyclable GREen polyesTers NO-REGRET

**Publieke samenvatting / Public summary**

## Aanleiding

The European chemical industry aims for climate neutrality by 2050. For polymers, widely used in products like plastics, this can be achieved with a biobased circular economy—maximizing recycling and replacing losses with biomass. There are two approaches to using biomass as a sustainable carbon source for polymers: drop-ins and novels. Drop-ins, bio-based versions of existing fossil-based polymers, directly replace them without altering production processes or products. However, converting biomass to drop-ins is inefficient and resource-intensive as abundantly present oxygen in the biomass must be removed. With novels, the oxygen present is embraced to create new polymers, such as biodegradable plastic PLA. Thus, novels have the potential for more efficient production and improved performance. Polyesters, known for their good recyclability and/or biodegradability, are ideal novel candidates but require development to match the properties of fossil polymers. In transitioning to a bio-based circular economy, challenges must be overcome: bridging the performance gap, achieving cost competitiveness and accelerating development to catch up with today's fossil polymers.

## Doelstelling

Goal is to accelerate the development of new generations of cost-competitive polyesters with improved performance and circularity compared to today's fossil polymers, by employing machine learning (ML). Within NO-REGRET, the existing ML-model “polySCOUT” will be improved by its involvement in the development, scale-up and

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prototyping of novel polyesters based on both commercially available and novel carbohydrate-derived monomers. Hereby, NO-REGRET contributes to MOOI-missie Industrie “Biobased Circular (BBC)”, that focusses on the development and advancement of sustainable value chains for production of building blocks and applications for carbohydrate-derived polyesters. Focussing on BBC subthemes “New generation building blocks and biobased polymers” and “Circular product design”, NO-REGRET targets 1) efficient use of resources by retaining as much carbohydrate functionality as possible, creating an efficient production chain compared to drop-in bio?polyesters (e.g. bio-PET), 2) improved material performance, as such overcoming the functionality gap, and 3) circular design: balancing between performance and circularity.

**Korte omschrijving**

The following activities are planned by the NO-REGRET consortium: - Development and validation of machine-learning based model that connects properties of building blocks (monomers) with product specifications in textile & packaging for design of novel polyesters (TNO with all partners); - Development of technologies for conversion of carbohydrates into novel building blocks (monomers) (TNO, UvA: University of Amsterdam, AVT: Avantium); - Development of polyesters and corresponding polymerization technologies (SPI: Senbis Polymer Innovations, SSP: Senbis Sustainable Products, UvA, TNO, AVT); - Experimental validation of recyclability and/or biodegradability of the generated polyesters (CuRe: Cure Technology, SPI, SSP, UvA); - Formulation of polyesters and application development for textile & packaging (SPI, SSP, UvA, AVT); - Assessment of economic viability and sustainability of the products and their technologies (Ecoras and TNO with all partners); - Dissemination of project goals and outcomes and engagement of stakeholders via an Advisory Board (TNO with all partners).

**Resultaat**

NO-REGRET brings biobased polyester innovations

to the market in three consecutive waves. A first wave targets novel polyesters for industrially relevant use cases, produced from commercial bio?based building blocks, allowing first applications relatively quick. By also considering the next generation of biobased building blocks, the project allows for a second wave of novel polyesters that can be scaled-up once the production processes for these new building blocks are being scaled-up as well. To accommodate post-project scale-up and first applications within 10 years, NO-REGRET aims to deliver prototypes and their production processes at TRL5. Finally, NO-REGRET's partners will jointly improve an existing machine learning model for accelerated design of novel bio-based polyesters. Broader use of this “polySCOUT” model to design novel polymers for applications beyond textile and packaging will lead to a third wave of novel bio-based polyesters. This model will also accelerate the first two waves during the project. The model will focus on performance, recyclability, biodegradability and, to ensure commercial success, also production energy requirement and feedstock.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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