

AI-STRAP: Accelerating Circular Plastics with Solvent Recycling Intelligence

Publieke samenvatting / Public summary

Aanleiding

Current recycling methods cannot recover high-value polymers from complex waste streams such as multilayer packaging and mixed plastic waste (including e-waste), leading to large volumes being incinerated or landfilled. Mechanical recycling is limited by polymer incompatibility, while existing solvent-based methods lack adaptability, generate excessive solvent waste, and remain economically unviable at scale. STRAP (Solvent-Targeted Recovery and Precipitation) technology offers a promising route to produce high-quality recyclates, but current implementations rely on static process design and control that don't account for feedstock variability, inefficient solvent use, and high energy demand—hindering scale-up. There is an urgent need for an AI-assisted, modular recycling system that dynamically adapts to real-world feedstock variability, improves solvent efficiency, reduces energy use, and delivers market-grade recyclates. This project aims to close that gap, enabling scalable, low-impact recovery of polymers currently unrecyclable through conventional routes.

Doelstelling

This project will develop and validate an AI-enhanced solvent-based recycling process for complex plastic waste streams such as multilayer packaging and e-waste, which are currently landfilled or incinerated due to incompatibility with mechanical recycling. The goal is to achieve selective recovery in high yield (>95%) of high-value polymers (e.g., PET, PS, PC, ABS) at high

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Algemene informatie / General information

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Exergy Software Solutions

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purity (>99%), while minimizing solvent consumption and energy demand. The process will integrate Exergy's proprietary process learning engine to predict outcomes and dynamically reconfigure operating conditions in real time, enabling adaptability to variable feedstock composition. Environmental and economic performance will be quantified through GHG reduction, circularity metrics, and cost-benefit analysis. By delivering a scalable, with a reduced environmental footprint technology for plastics currently unrecyclable via conventional routes, the project directly supports EKOOP objectives of advancing circular feedstocks, reducing environmental impact, and accelerating market-ready innovation in the Netherlands.

Korte omschrijving

The project combines experimental, simulation, and analytical activities to develop an adaptive solvent-based recycling process for complex plastic waste. TU/e will lead the characterization of multilayer and e-waste plastic streams and conduct lab-scale testing of solvent systems for selective polymer dissolution and precipitation. Exergy will focus on simulating adaptive process configurations, developing a digital twin, and integrating machine learning tools for optimal solvent selection under varying feedstock conditions. Joint activities will include system optimization, mass and energy balance calculations, solvent recovery efficiency improvements, and modular process design for scalability. An environmental Life Cycle Assessment (LCA) and techno-economic analysis will compare the proposed system's performance against conventional recycling routes. Results will be disseminated through an industry workshop, stakeholder roadmap, and a publicly available report to foster adoption and inform policy and market stakeholders.

Resultaat

The project will deliver a trained AI agent capable of predicting optimal solvent systems and process configurations for recycling multilayer and mixed plastic waste. Targeted experiments will provide

high-quality data to validate the AI predictions and demonstrate high-purity (>99%) and high-yield (>95%) polymer recovery. Using these inputs, a modular adaptive plant concept will be designed and simulated, including a digital twin for real-time process reconfiguration. The system will be validated with real waste streams, generating operational data to refine the models and confirm robustness. A complete techno-economic analysis tool will be developed, covering mass and energy balances, solvent recovery efficiency, CAPEX, OPEX, minimum selling price, and process flow diagrams. Together, these outputs form a scalable and adaptive solvent-based recycling platform, providing a blueprint for pilot-scale deployment and future industrial roll-out. The result is a de-risked pathway toward market-ready solvent recycling technology that enables recovery of complex plastics currently unrecyclable by conventional methods.

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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