

Polyurethane (PUR) is a versatile high-performance polymer used in products ranging from mattresses, shoes and refrigerator insulation to automotive components. PUR accounts for approximately 8% of total plastic production, yet 95% of all PUR waste is incinerated or landfilled. Existing recycling methods for PUR, yield secondary materials with compromised properties. A truly circular solution requires the recovery of PUR's original chemical building blocks: polyols and isocyanates.

This presentation reports on two consecutive Danish innovation projects — **RePURpose** (2019–2021) and **PURfection** (2023–2026) — that have developed and are now scaling a novel chemical recycling technology for PUR. In RePURpose, we demonstrated, for the first time, that commercial and end-of-life PUR can be deconstructed into their monomeric building blocks using a catalyst in combination with a green solvent and dihydrogen. Building on these findings, PURfection now pursues two complementary strategies to achieve full circularity: (1) closed-loop recycling of traceable production spill directly back into manufacturing, and (2) chemical deconstruction of complex, mixed post-consumer PUR waste streams — such as discarded mattresses and refrigerators — into monomers that can serve as drop-in feedstock for virgin-quality PUR production.

The technology holds the potential to eliminate a major fossil-dependent waste stream, reduce CO₂ emissions from PUR production, and establish a scalable, economically attractive circular value chain for polyurethane.