NexantECA

Technology and Costs

# TECH 2023S11: Recycling Options for Polyolefins

**Recycling Options for Polyolefins is one in a series of reports published as part of NexantECA's 2023 Technoeconomics – Energy & Chemicals (TECH) program.**

## Overview

Global plastic demand continues to grow over 3 percent annually, underscoring the imperative of expanding recycling infrastructure to manage the ever-growing waste volumes, which are expected to exceed 500 million tons by 2030 if current trends persist. With polyolefins representing half of global volumes, leveraging mechanical and advanced chemical technologies to recapture their value is vital within broader circular economy efforts targeting these ubiquitous and versatile materials. Progress rests on the dual pillars of improving economics through technical and market innovation as well as policy action that can build sustainable, economically viable solutions to the market.

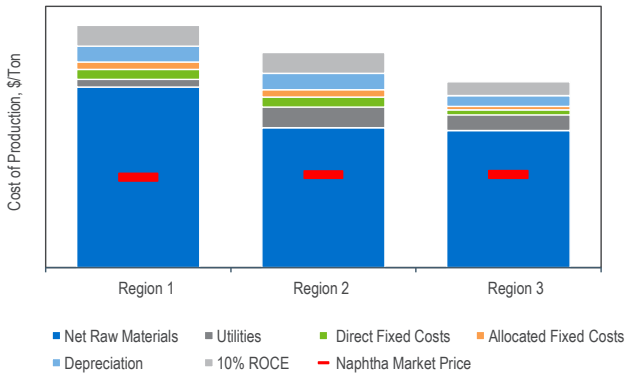
## Commercial Technologies

Installed recycling capacity varies significantly across regions. The United States has around 330 mechanical recycling plants with a total capacity of 9.2 million tons per year. Chemical recycling in the U.S. encompasses 20 plants contributing 600 000 annual tons. Europe possesses approximately 800 mechanical facilities providing 12 million tons of capacity and 40 chemical plants constituting 150 000 tons. China estimates 12 million tons per year for mechanical recycling spread over 600 sites while advanced chemical recycling contribute 1-2 million tons presently. Although mechanical processes lead volumes currently, chemical methods are gaining increasing interest given their ability to reclaim value from difficult plastic waste streams. Pyrolysis leads chemical recycling developments with around 60% of current European capacity targeting mixed plastic feeds, intensifying competition with mechanical recycling over this key feedstock, especially as new European sorting capabilities come online. While mechanical recycling dominates present volumes, chemical methods are gaining prominence through announced projects not yet operational, promising over 2.5 million tons added annual capacity in the U.S. and Europe by 2030 based on pre-FID declarations.

## Process Economics

Production costs for recycling vary substantially based on region, with locations proximate to plastic feedstock supply chains and industrial centers benefiting from economics of scale. While mechanical recycling currently leads in cost-efficiency, the rapid technological advancements in advanced chemical recycling hint at a future where it could potentially offer more versatile recycling solutions.

**Summary of Pyrolysis-based Naptha Production Costs**
*(Third Quarter 2023)*




## Carbon Intensity

The report explores the carbon intensity of mechanical recycling, solvent-based purification, pyrolysis, and hydrothermal treatment of polyolefin waste in the United States, Western Europe, and China, highlighting the carbon intensity in tons of $CO_2$ equivalent per ton of produced material.

## Outlook

Polyolefin recycling presents strong growth potential as environmental concerns, corporate sustainability commitments, and favorable regulatory policies drive demand. However the industry faces challenges related to collection infrastructure, sorting capabilities, feedstock availability, and process economics that must be addressed to realize the full potential. Achieving cost competitiveness with virgin resin production through continued technological innovation and scale is pivotal for the widespread adoption of mechanically or chemically recycled polyolefins across major end-use sectors.

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**Technology and Costs** comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

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