FIVE INSIGHT BRIEFS

NOVEMBER 2024

Transforming PET Packaging and Textiles in the United States

Systems Change Scenarios and Recommendations to Cut Waste, Create Jobs and Mitigate Climate Change

Author SYSTEMIQ

Funder EASTMAN

INSIGHT BRIEF
Building a Circular Economy in the U.S.

2040 Ambitious Circularity Scenario: Scaling up proven circular approaches could deliver substantial benefits to cut waste, create jobs and mitigate climate change. To maximize benefits, reduction, reuse, and recycling of PET through both mechanical and depolymerization recycling will be needed in parallel.

Key Findings:

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Virgin PET/polyester consumed **reduces by half** (by 5.9 Mt/year by 2040) [a]

↓ ½
PET/polyester waste to landfill and incineration **reduces by half** (by 5.5 Mt/year by 2040) [a]

70%
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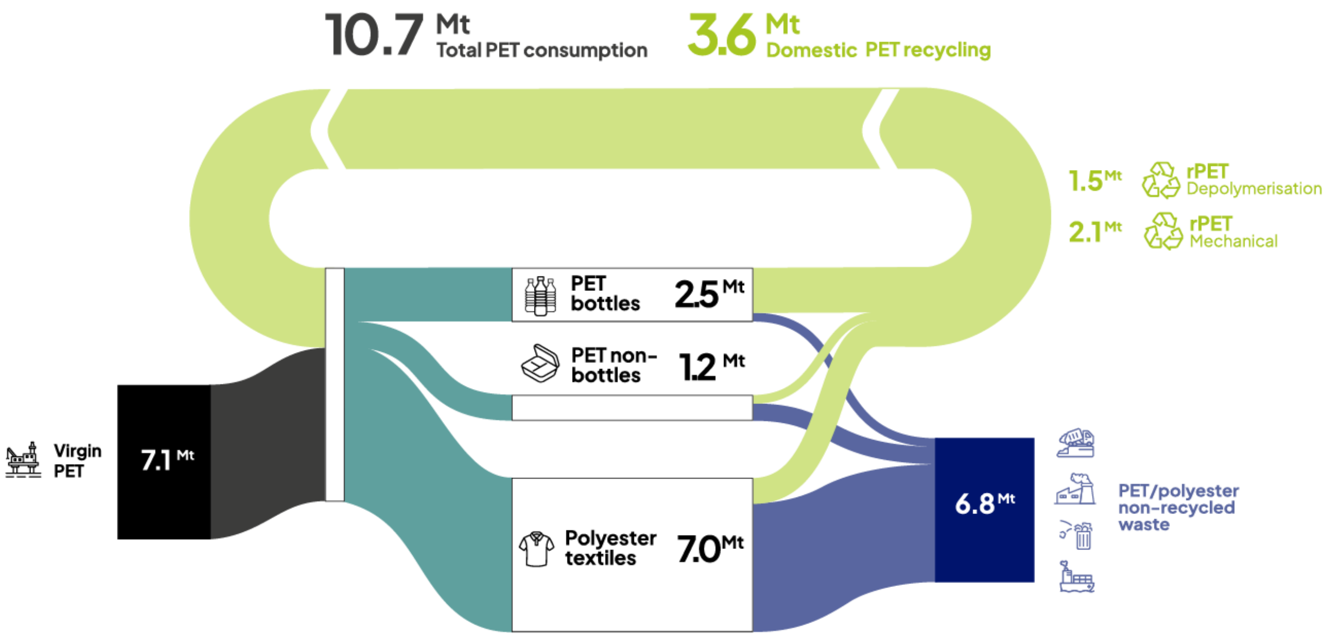
GHG emissions for PET/ polyester consumed in the U.S. reduces by **58% for PET packaging** and by **16% for polyester textiles** [a]

↑46k
Generates **46k net additional direct jobs** in the U.S. [b]

$4.9bn
Generates **$4.9 billion** in revenues for U.S. recycling industries, **a 4.5x increase** [b]

Note **a.** Relative to a continuation of current trends by 2040; **b.** Relative to 2022.

U.S. PET Packaging and Polyester Textiles Flows, Ambitious Circularity Scenario 2040



About the study
Transforming PET Packaging and Textiles in the United States"* assesses the circularity of PET/polyester (a type of plastic used extensively in packaging and textiles) in the U.S., uses detailed system modelling to quantify the impact of applying proven circular approaches (reduce, reuse, recycling) under different scenarios, and outlines recommendations for government and the private sector to achieve the benefits of an ambitious scenario.

*"Transforming PET Packaging and Textiles in the United States" is published by Systemiq with support from Closed-Loop Partners, Eunomia, and The Recycling Partnership and with the support of an independent Steering Group of 15+ industry, civil society and academia members. The report was funded by Eastman.

INSIGHT BRIEF
Policy Recommendations to Transform PET Packaging and Textiles in the U.S.

High-level results of the study

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Well-designed Extended Producer Responsibility (EPR) is a particularly important policy instrument for both packaging and textiles to overcome economic barriers to circularity and account for the full product life cycle.

Recommendations at the state and federal levels

1. Adopt best practice policies and implementation approaches to **reduce unnecessary consumption** of textiles and single-use packaging
2. Introduce **well-designed EPR** legislation for both packaging and textiles (detailed further in the report)
3. Enact policies to increase demand for post-consumer **recycled content**
4. Set **recycling targets** by product types for both packaging and textiles and expand coverage of curbside **recycling collection** for all packaging types and high-proximity drop-off points for textiles
5. Increase the price of sending waste to disposal through higher **landfill and incineration fees**
6. "De-risk" private sector investments by increasing **public investment** into circularity infrastructure, technology and research

Recommendations for well-designed EPR to enable the delivery of the Ambitious Circularity Scenario for PET/polyester

- Incentivizes **product design** for circularity
- Incentivizes **US recycling** over imports
- Considers **high-yield material-to-material recycling technologies** as responsible end-markets
- **Differentiates** EPR approaches for **packaging and textiles**
- Clear on **scope, KPIs** and value chain **responsibilities**
- Accounts for **full coverage** of net costs
- Supports a **broad range of efforts, including end-market development and R&D funding**
- Allows for **innovation**
- Incentivizes flows of recycled materials into **high-value end products** with the potential for **multiple recycling loops**
- Evaluates the benefits of integrating **DRS**

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INSIGHT BRIEF
Role of Depolymerization Recycling in PET/polyester Circularity

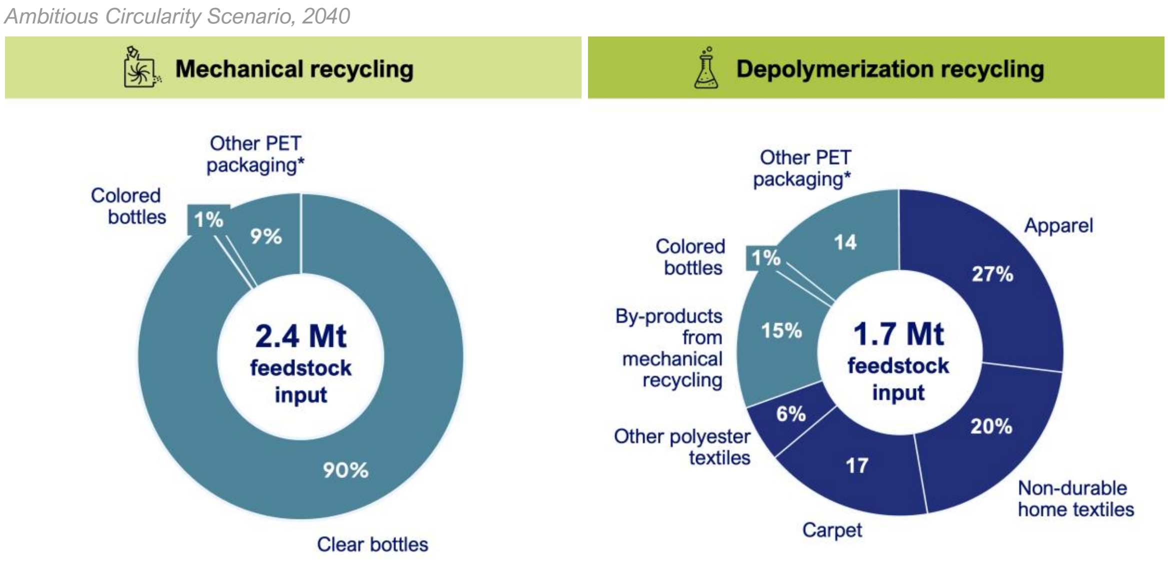
Role of depolymerization

To achieve the results of the Ambitious Circularity Scenario, mechanical and depolymerization recycling are both needed.

Key Findings:

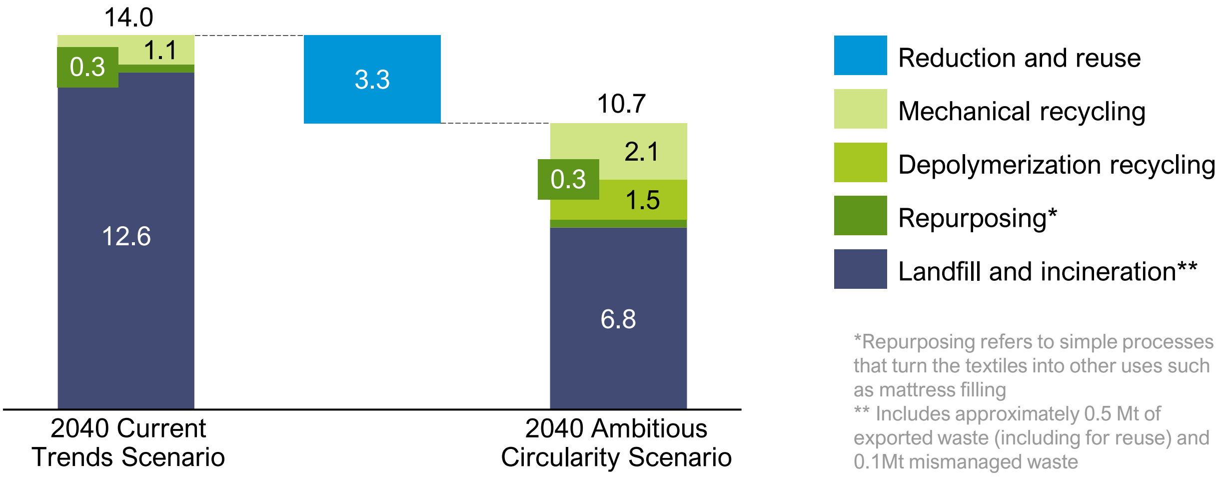
- Depolymerization recycling, a material-to-material technology, converts PET/polyester back into monomers (the building blocks of new plastics) and then combines them again to make virgin-quality recycled PET/polyester.
- Mechanical recycling and depolymerization recycling are complementary technologies, enabling higher overall recycling rates when deployed together.
- Depolymerization provides a solution for recycling harder-to-recycle packaging formats and textiles into virgin-equivalent rPET that meets market demands for performance, food safety and color.
- Mechanical recycling alone will not achieve the results of the Ambitious Circularity Scenario.
    - If depolymerization is not included in the Ambitious Circularity Scenario, 40% less packaging and textiles will be recycled, and 40% less rPET will be generated.
    - Textiles and some packaging categories (e.g., some colored bottles, thermoforms and by-products from mechanical recycling) would not be recycled without the deployment of depolymerization recycling.
    - Depolymerization future-proofs the system by creating virgin-quality rPET output, overcoming degradation challenges resulting from multiple mechanical recycling loops.

Distribution of Feedstock Processed by Mechanical and Depolymerization Recycling



*Other PET packaging includes thermoforms as well as other non-bottle PET packaging (e.g., strapping).

Fate of PET Packaging and Polyester Textiles in the Ambitious Circularity Scenario



*Repurposing refers to simple processes that turn the textiles into other uses such as mattress filling
** Includes approximately 0.5 Mt of exported waste (including for reuse) and 0.1Mt mismanaged waste

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INSIGHT BRIEF
What is Depolymerization Recycling?

Key Findings:

- Depolymerization recycling, a material-to-material technology, converts PET/polyester back into monomers (the building blocks of new plastics) and then combines them again to make virgin-quality recycled PET/polyester.
- Mechanical recycling and depolymerization recycling are complementary technologies, enabling higher overall recycling rates when deployed together. Depolymerization provides a solution for recycling harder-to-recycle packaging formats and textiles into virgin-equivalent rPET that meets market demands for performance, food safety and color.
- Depolymerization consistently produces an rPET quality equivalent to virgin plastic from a broader range of feedstock. Depolymerization has, on average, higher GHG emissions than mechanical recycling and lower than fossil-fuel derived virgin PET.
- PET/polyester are target materials for depolymerization recycling. Polypropylene and polyethylene are not suitable for depolymerization recycling.
- Depolymerization recycling is now entering the U.S. market on a commercial scale with support from apparel and packaged goods companies and the federal government.

Mechanical recycling and depolymerization are suitable for PET and polyester recycling and have lower energy requirements than pyrolysis-based recycling

	Mechanical Recycling	Depolymerization Recycling	Pyrolysis-Based Recycling
Description	Remolds PET/polyester at lower temperature into new applications without changing their chemical composition	Breaks bonds in polymers down into smaller molecules, called monomers, that are the building blocks for new plastics	Breaks down the polymer chain into pyrolysis oil by heating at high temperature within inert atmosphere. Pyrolysis oil can be used to make a range of hydrocarbon products
Feedstock	Rigid PET packaging, mostly clear PET bottles today	PET packaging that is more difficult to mechanically recycle and polyester textiles	PE / PP and mixed polyolefins *Not suitable for PET/polyester recycling. PET is considered a contaminant to the pyrolysis process*
Output	Flakes into pellets	Monomers into pellets	Pyrolysis oil into fuel, chemicals, or materials (into pellets)
Output Quality (when converted back into plastic)	Varying grades (from food-grade to non-food grade) possible depending on input quality, processing technology and target end-market	Equivalent to virgin plastic	Equivalent to virgin plastic
Energy Requirements	On average lower than depolymerization per ton of plastic processed	On average lower than pyrolysis per ton of plastic processed	On average higher than depolymerization per ton of plastic processed
GHG emissions of recycled PET vs. virgin PET	Lower GHG emissions than virgin PET	Most types of depolymerization generate lower GHG emissions than virgin PET*	Not applicable to PET

*GHG emissions comparison is not relevant for product applications where mechanical recycling is not possible

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INSIGHT BRIEF
Recycled PET imports compromise domestic recycling infrastructure development

Key Findings:

- rPET imports have grown to supply 20% of rPET demand, challenging domestic sorting and recycling infrastructure investment.
- If investment in new U.S. sorting and recycling infrastructure were to stop between now and 2040, due to high rPET imports, the overall PET packaging recycling rate could fall from 70% in the Ambitious Circularity Scenario to 24%, and polyester textiles would not be recycled. A low PET recycling rate means that U.S. PET waste will end up in landfills.
- To overcome this challenge, we suggest three recommendations:
    - For policymakers:
        - Incentivize US domestic infrastructure as part of well-designed EPR
        - Push incentives and public procurement rules promoting the use of recycled materials from U.S. recyclers
    - For industry:
        - Increase procurement of domestically generated post-consumer recycled content from both packaging and textiles through long-term contracts

Impact of rPET Imports Undermining Domestic Recycling in the Ambitious Circularity Scenario

	Recycling rate (%)		**rPET Revenue** (US$ bn)	**Domestic rPET generated** (Mt)
	Packaging	Textiles		
Ambitious Circularity Scenario *As described previously*	70%	19%	4.9	3.6
Ambitious Circularity Scenario with rPET imports undermining domestic recycling investment	24%	0%	1.1	.07* (+ rPET imports)

*Assuming constant volume of domestic rPET generation

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