THE TEXTILE RECYCLING BREAKTHROUGH

Why policy must lead the scale -up of polyester recycling in Europe

TECHNICAL APPENDIX

Table of Contents

List of Tables

1. Objective of this document

This Technical Appendix aims to provide detail on the scope, methodology, assumptions, metrics and data used for the analyses underpinning the Systemiq report: "*The Textile Recycling Breakthrough: Why policy must lead the scale-up of polyester recycling in Europe*" (2025).

2. Disclaimer

Responsibility for the information and views set out in this publication lies with the authors. Members of the Steering Group or sponsors endorse the overall project approach and findings, although not all statements in this publication necessarily represent their views and they cannot be held responsible for any use which may be made of the information contained or expressed therein. Nothing in the report should be construed as implying new legal obligations or intended to explore individual approaches to, or involvement in, specific impacts; and nothing in the report should be deemed or construed as statements made individually by any member of the Steering Group or sponsors.

The economic modelling is based on publicly available sources as well as stakeholder input across the value chain, which has been averaged, triangulated and vetted to produce credible yet non-attributable results. As such, the absolute figures need to be considered directional and will differ across different markets within the EU.

3. Introduction

The objective of the report is to assess how textile-to-textile depolymerisation can reach a tipping point in Europe – a point at which it becomes the preferred alternative to virgin polyester from fossil fuels and begins to reach mass adoption. The material scope of this study is textiles, defined as all apparel (clothing and footwear) and home textiles, in line with the EU's proposed Extended Producer Responsibility (EPR) framework. The analysis thereby focuses specifically on post-consumer waste originating from private households.

This work applies Systemiq's tipping point methodology, developed in collaboration with the University of Exeter. The approach builds on the insight that the adoption of clean technologies often follows an S-curve: once a tipping point is reached – when the clean solution becomes more Affordable, Attractive, and Accessible than the incumbent – uptake accelerates rapidly. Enabling such tipping points can unlock significant environmental, economic, and energy security benefits for companies and regions.

Through a structured framework, the methodology identifies the conditions required for exponential scale-up, assesses gaps that currently prevent tipping, and highlights targeted policy and investment interventions to unlock progress. This framework has been successfully applied across sectors including energy, food, and materials.

Within this context, the Technical Appendix outlines the modelling approach, data sources, and assumptions that underpin the analysis. It comprises two core components:

1. A volume flow model, which tracks post-consumer polyester textile waste through collection, sorting, and recycling;
2. A cost model, which estimates the levelised cost of producing recycled polyester via depolymerisation under varying system conditions.

Together, these models help quantify what it would take – in terms of infrastructure, policy, and economics – to reach a tipping point for textile-to-textile recycling in Europe.

4. A note on data, approach, and uncertainty

The model was developed using a combination of publicly available sources, industry reports, confidential financial data provided by value chain actors, and interviews with experts across the textile and recycling industries. All confidential data inputs were triangulated, averaged, and vetted to ensure results are robust, non-attributable, and suitable for system-level analysis. While the analysis draws on the best available information, the outputs should be interpreted as directional, and absolute figures may differ across EU Member States, depending on local market structures, existing infrastructure, cost conditions, and regulatory contexts.

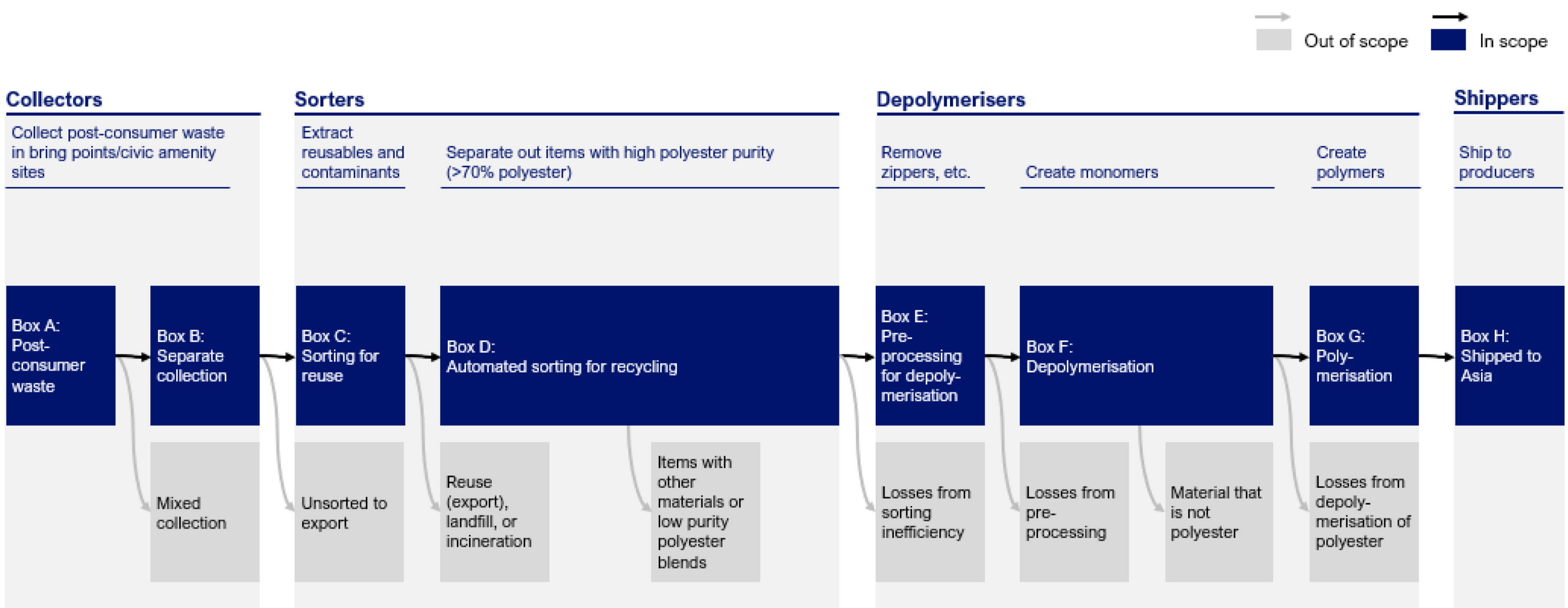
The model does not capture feedback effects, behavioural change, or market shocks (e.g. oil price fluctuations). Likewise, its EU-wide scope limits the granularity of country-specific insights. Especially cost estimates and EPR fees are assuming a specific process in a scaled system scenario and might therefore not be fully representative of the ramp-up period, or if the modelled levers do not materialise as assumed. Despite these limitations, the model offers important directional insights into the scale of change required to unlock textile-to-textile recycling in Europe.

5. Geographical region taxonomy

The analysis focuses on the EU-27 as a whole. No country-specific differences are modelled. All volumetric flows, cost, and lever impact assumptions are applied uniformly across the EU.
To assess economic competitiveness, costs of EU-based depolymerisation are compared with the cost of virgin polyester production in Asia. This reflects the general structure of the global textile industry, in which polyester polymerisation, fibre production, and yarn spinning are predominantly concentrated in Asia. As noted in the main report, this comparison provides a more realistic benchmark for assessing the tipping point at which European recycled polyester could displace virgin inputs in global supply chains.

6. Model architecture: System map

The model architecture is based on a mass flow system map. It features "boxes" representing points of material aggregation and "arrows" indicating directional flows along the textile recycling chain. Grey-shaded boxes denote flows that exit the system boundary (e.g., losses or exports). The principal focus lies in **tracing material from post-consumer textile waste (Box A) through to the production of recycled polyester**.



Total volumes of textile waste entering the system are first established at Box A, representing post-consumer textile waste generated in the EU. From there, flow percentages determine the mass passed along each subsequent step, ultimately identifying the quantity available for depolymerisation.

Four categories of actors are defined:

1. **Collectors** – Responsible for capturing post-consumer textiles through bring-points or civic amenity sites and transporting them to sorting centres for reuse.
2. **Sorters** – Split between two tasks:
   - **Sorting for reuse**: Assumed to be predominantly manual, including removal of large contaminants, e.g. footwear.

- Sorting for recycling: Conducted via automated near-infra-red (NIR) technology, extracting polyester blends with 70% purity or more.

3. **Depolymerisers** – Conduct transport from sorting, pre-processing (including de-trimming and shredding), and convert polyester-rich feedstock into virgin-equivalent polyester. Our analysis stays technology agnostic, i.e. covering different technological routes (e.g. hydrolysis, methanolysis, glycolysis).
4. **Shippers** – Responsible for transporting recycled content to textile manufacturers, primarily in Asia, where global textile production is concentrated.

This system represents one of several possible configurations. In practice, responsibilities such as pre-processing or transport may be distributed differently across stakeholders.

Note: For EPR fee calculations (see Section 9), textiles placed on the market are considered in addition to material waste flows.

7. Textile waste scope and taxonomy

The model examines the flow of post-consumer polyester textile waste destined for depolymerisation. The scope begins broadly and is narrowed progressively through successive stages of the recycling chain:

- **Box 0 – Textiles consumption**: Includes all apparel (clothing and footwear) and home textiles placed on the EU market. Subject to EPR fees.
- **Box A – Post-consumer textile waste and Box B – Separate collection**: Encompasses the same categories as Box 0.
- **Box C – Sorting for reuse**: Filters out resellable items and non-recyclable contaminants (e.g., footwear).
- **Box D – Automated sorting for recycling:** Narrows the scope down to items with ≥70% polyester content, which are suitable for depolymerisation.
  Note: items with e.g. 100% cotton purity – no longer in-scope of this analysis beyond sorting – may still qualify for other recycling options.
- **Box E – Pre-processing for depolymerisation**: Involves removal of non-textile elements (e.g., zippers, buttons) and shredding into uniform input sizes.
- **Box F – Depolymerisation**: Removes residual non-polyester materials and produces 100% polyester pellets.

8. Qualitative baseline of 2025 textile-to-textile depolymerisation

As previously mentioned, a “tipping points” assessment underlies the reports analysis. The summary of the evaluation of the three criteria of affordability, accessibility, and attractiveness is shown in the table below. The table thus presents the 2025 baseline assessment of the main drivers that support or constrain tipping point dynamics. The comparison focuses on the performance of depolymerised polyester relative to virgin polyester sourced from Asia.

Green: Advantage vs virgin; Yellow: Same vs virgin; Red: Disadvantage vs virgin

Table 1: 2025 baseline assessment of key drivers that enable or hinder tipping point dynamics for textile-to-textile depolymerisation

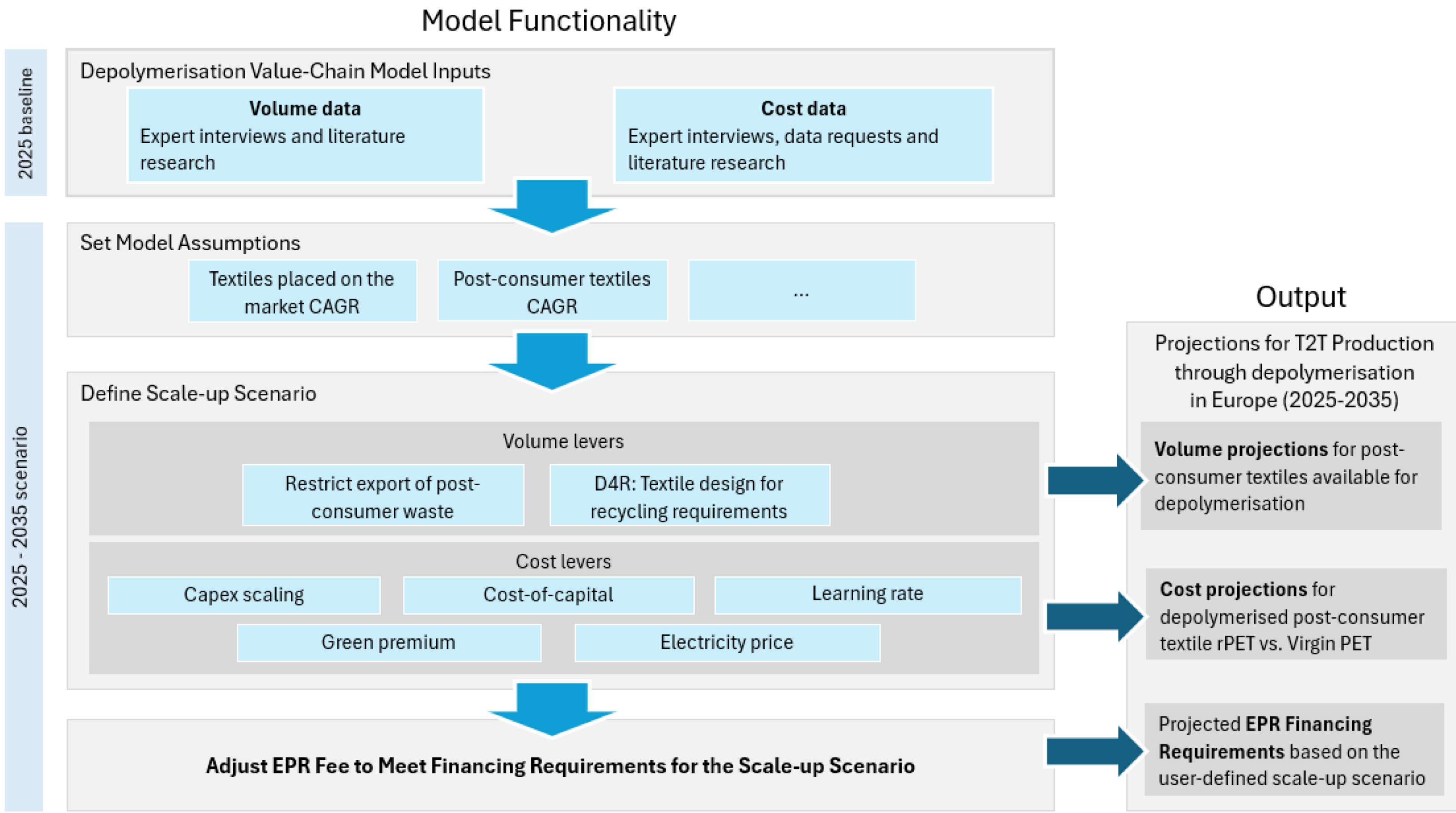
Dimension	Driver Category	Driver	Explanation
Accessibility	Access to off-takers	Import/export barriers	Regulatory uncertainty around the definition of "end of waste" in the EU and restrictions in key markets (e.g. China) constrain global movement of recycled pellets.
		Process integration: yarn producers	Yarn producers are hesitant to switch inputs due to technical changeover requirements, machine downtime, testing costs and lack of financial incentives.
		Process integration: brands	Most brand sourcing teams operate transactionally and lack long-term offtake commitments aligned with sustainability strategies.
	Production capabilities	Technological maturity	Depolymerisation remains at limited commercial scale, with most projects in pilot or early demonstration phases.
		Land permitting	Complex and slow permitting processes delay facility construction.
	Access to feedstock	Quantity	Separate collection systems are underdeveloped; only ~35% of waste is captured and much less is available for depolymerisation.
		Quality	Feedstock is highly contaminated and composed of mixed fibres, reducing suitability for chemical recycling.
		Lack of standardisation	Variability in collection, sorting and quality specifications hinders efficient sourcing and process design.
Affordability	OPEX per kg	Labour costs	High labour costs in Europe vs. virgin polyester-producing regions, where automation and scale are more advanced.
		Feedstock costs	Cost of acquiring and preparing suitable feedstock is high due to low supply, manual processing and lack of economies of scale.
		Energy costs	While depolymerisation can be energy-efficient, high EU energy prices reduce competitiveness versus production in Asia.

		Fees (e.g. carbon tax)	Carbon pricing could help but is not yet sufficiently implemented across the EU to materially shift the cost balance.
		Shipping costs	Recycled polyester must often be shipped back to Asia for downstream textile production, adding logistics costs and emissions.
	CAPEX per kg	Upfront investment	Initial investments are high given the capital-intensive nature of installing large-scale chemical facilities.
		Cost of capital	Financing is constrained by limited track record and offtake risk, driving up cost of capital.
Attractiveness	Quality	Technical performance	Depolymerised polyester performs comparably to virgin across key technical specifications.
		Look and feel	Slight off-colouring may occur but is usually correctable; generally meets market expectations.
	Health & Safety	Air pollution	Lower emissions from depolymerisation versus fossil-based production pathways.
		Microplastic discharge	Most microfibre leakage occurs during the textile production and consumer use phases, therefore we do not expect material differences in microplastic discharge.
	Environmental impact	GHG emissions	Depolymerised polyester offers significantly lower GHG emissions than virgin polyester (see section 12).
		Water use	Water intensity is similar between pathways; major impacts occur downstream in dyeing and finishing, and in the consumer use phase.
		Macro-plastic leakage	Depolymerisation helps avoid mismanaged waste, reducing macroplastics loss into the environment.

In summary, substantial barriers remain across affordability and accessibility in 2025. In contrast, attractiveness is not considered a limiting factor—recycled polyester already performs comparably or better than virgin alternatives in environmental and quality-related terms.

9. Overarching functionality of the quantitative cost and volume model

To quantitatively assess the current accessibility and affordability constraints of the above driver tree, and understand how they can be resolved, the following model architecture was developed:



The next two sections will first explain the 2025 baseline, and subsequently the 2025-2035 scenario shown above.

10. Quantitative baseline of 2025 textile-to-textile depolymerisation

The baseline assessment was carried out by establishing volume flows and corresponding cost structures for the year 2025, based on the system map described earlier. This involved two interlinked components: a volume flow model and a cost model.

Volume flow model

Key assumptions related to each step of the value chain were informed by a combination of secondary sources and expert interviews. These assumptions determine how textile materials placed on the EU market flow through collection, sorting, and depolymerisation, and ultimately how much depolymerised material is available.

The model accounts for inputs such as the total volume of textiles placed on the market, the share that becomes post-consumer waste, the share that is separately collected, and the proportions that are subsequently sorted for reuse or recycling. Assumptions around sorting efficiency, polyester content, and processing yields are applied to calculate the final volume of polyester material reaching and passing through depolymerisation in 2025.

Table 2: Volume stock and flow model baseline assumptions

Value chain step	Parameter	ID	Unit	2025 value	Source	Comments / assumptions	Relevant URLs
Material placed on market	Textiles placed on market	Box 0	tonnes	7,367,613	ERPS (extrapolated)	Based on 2020 consumption of clothing and footwear. Household textiles estimated through share of spend (70% clothing, 10% footwear, 20% household textiles). CAGR of ~2% to 2025; assumed same as growth rate of post-consumer waste.	https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/729405/EPRS_BRI(2022)729405_EN.pdf#:~:text=It%20has%20been%20estimated%20that%2C%20in%202020%2C%20EU,of%20household%20textiles%20and%202.7%20kg%20of%20footwear%29.
Collection	Post-consumer waste	Box A	tonnes	6,162,163	JRC (extrapolated)	JRC 2021 report. All post-consumer textile waste considered except technical textiles. CAGR of ~2% to 2025; assumption that growth rate for post-consumer textile waste with and without technical textiles is the same.	https://publications.jrc.ec.europa.eu/repository/handle/JRC125110

Collection	Share separately collected (in bring points and civic amenity sites)	Arrow A1	%	35%	Fashion for Good report and interviews	Collection rate of all household waste excluding shoes. Assumption that this rate is equivalent for non-household textiles that are non-technical (e.g. hotel uniforms). Assumption of constant collection rate across past years.	https://reports.fashionforgood.com/report/sorting-for-circularity-europe/
Sorting	Share sent for sorting for reuse	Arrow B1	%	59%	JRC (extrapolated)	JRC 2024 report. Study includes all post-consumer waste incl. technical textiles. However, beyond separate collection feedstock assumed to not include noteworthy quantities of technical waste.	https://publications.jrc.ec.europa.eu/repository/handle/JRC135003
Sorting	Share sent to sorting for recycling	Arrow C1	%	22%	Interviews and Fashion for Good	N.A.	https://reports.fashionforgood.com/report/sorting-for-circularity-europe/
Sorting	Share of inflow items with recyclable polyester composition	Arrow D1	%	15%	Fashion for Good and assumption	Fashion for Good - 12% of textile waste items are pure polyester, 21% of all material is polyester. Conservative assumption that 15% of items have polyester purity of 70% or above.	https://reports.fashionforgood.com/report/sorting-for-circularity-europe/
Sorting	Efficiency of automated sorting for recycling	Arrow D1.1	%	95%	Interviews	Based on SG sorter approximation	N.A.
Depoly-merization	Yield of pre-processing for depoly-merization	Arrow E1	%	96%	Interviews	Based on SG recycler approximation	N.A.
Depolymerization	Share of inflow material that are polyester	Arrow F1	%	85%	Interviews	Based on SG recycler approximation	N.A.
Depolymerization	Efficiency of depoly-merization	Arrow F1.1	%	97%	Interviews	Based on SG recycler approximation	N.A.

Cost model

The cost estimates used in the model reflect commercial-scale operations rather than pilot or demonstration facilities. This includes operational and annualised capital expenditures (CAPEX and OPEX) for automated sorting and depolymerisation facilities, assuming realistic future-state infrastructure configurations based on the best available data. Certification costs are excluded, as these are typically considered optional from a brand perspective.

Due to the confidential nature of the data inputs provided by stakeholders in the steering group, figures were anonymised and averaged across contributors. As a result, no company-specific data is disclosed in the model or this technical appendix.

The model includes assumptions for key cost categories such as electricity consumption, labour, overhead, waste management, transport, and chemical inputs. These costs are combined with assumptions on plant capacity and utilisation rates to estimate the levelised cost of recycled polyester output in 2025.

Table 3: Averaged cost model baseline assumptions from steering group

Please note these figures have been averaged and are thus non-attributable and not company-specific.

Value chain step	Parameter category	Parameter	Unit	Value
Collection	Total cost	Total costs per unit	EUR/tonne	400
Sorting for reuse	Total cost	Total costs per unit	EUR/tonne	350
Sorting for recycling	Scaling	Plant capacity (industrial scale)	tonnes/year	36,500
Sorting for recycling	Scaling	Utilisation	%	73%
Sorting for recycling	Opex	Electricity price	EUR/kWh	0.25
Sorting for recycling	Opex	Electricity consumption	kWh/year	2,813,542
Sorting for recycling	Opex	Maintenance & waste management	EUR/year	358,178
Sorting for recycling	Opex	Labour	EUR/year	946,026
Sorting for recycling	Opex	Overhead	EUR/year	323,002
Sorting for recycling	Capex	Lifetime buildings, infrastructure	years	20
Sorting for recycling	Capex	Construction costs (buildings and infrastructure)	EUR	5,208,000
Sorting for recycling	Capex	Lifetime machinery	years	20
Sorting for recycling	Capex	Machinery and installation	EUR	14,075,000
Recycling	Scaling	Plant capacity (commercial scale)	tonnes/year	33,607
Recycling	Scaling	Utilisation	%	91%
Recycling	Opex	Electricity costs	EUR/year	9,625,000
Recycling	Opex	Utilities - Chemical agents	EUR/year	1,380,000
Recycling	Opex	Utilities - Water	EUR/year	105,000
Recycling	Opex	Utilities - Fuel(s)	EUR/year	6,000,000
Recycling	Opex	Transport	EUR/year	1,050,000
Recycling	Opex	Maintenance	EUR/year	2,450,000
Recycling	Opex	Waste management	EUR/year	1,750,000
Recycling	Opex	Labour	EUR/year	3,350,000

Recycling	Opex	Overhead	EUR/year	3,000,000
Recycling	Capex	Lifetime buildings and infrastructure	years	20
Recycling	Capex	Construction costs (buildings and infrastructure)	EUR	10,000,000
Recycling	Capex	Machinery and installation	EUR	134,500,000
Recycling	Capex	Lifetime machinery	years	20
Shipping	Total cost	Full container load (FCL)	EUR/tonne	50
Virgin polyester pellet	Total cost	Crude Oil Extraction and Refining	EUR/tonne	41
Virgin polyester pellet	Total cost	Production of PET Raw materials	EUR/tonne	577
Virgin polyester pellet	Total cost	PET polymer production and pellitisation	EUR/tonne	332

Table 4: Additional cost assumptions

Value chain step	Parameter category	Parameter	Unit	Value	Sources
Shipping	Total cost	Full container load (FCL)	EUR/tonne	50	Range based on quotes of different providers e.g. Freightos and container-xchange.
Virgin polyester pellet	Total cost	Crude Oil Extraction and Refining	EUR/tonne	41	Based on ~$43.72/t crude oil, converted to EUR and adjusted for margin.
Virgin polyester pellet	Total cost	Production of PET Raw materials	EUR/tonne	577	Assumed as 65% of final PET cost, net of crude oil input.
Virgin polyester pellet	Total cost	PET polymer production and pellitisation	EUR/tonne	332	Residual to reach an assumed €950/tonne total virgin PET cost.
Recycled polyester pellet	Total cost	Recycled polyester pellet from PET bottles	EUR/tonne	1,140	Based on SG and expert input, assuming 20% price-premium for recycled PET versus virgin.

11. The 2035 scale-up scenario

This section presents a forward-looking scenario that builds on the 2025 baseline, outlining a plausible pathway for scaling textile-to-textile depolymerisation across Europe by 2035. The analysis explores how accessibility and affordability constraints can be addressed through feedstock improvements, production optimisation, scale-up of offtake, and financing mechanisms.

The 2035 scenario is defined by three core elements:

A. Set model assumptions, such as growth in textile consumption and post-consumer waste generation.

B. Volume and cost levers, which define how material flows and cost structures evolve over time.

C. Financing mechanisms, including Extended Producer Responsibility (EPR) fees and green premiums, used to close the cost gap between recycled and virgin polyester.

A. Set model assumptions

The model assumes that both textile consumption and post-consumer textile waste grow at a compound annual rate of 3% between 2025 and 2035. This is slightly higher than historical trends, reflecting the increasing influence of ultra-fast fashion. These growth rates form the volumetric foundation for the 2035 scenario and are applied consistently across the model timeline.

Table 5: Volume stock and flow model baseline assumptions

Parameter	Unit	2025-2035 value	Comments / assumptions
CAGR of textiles placed on market	%	3%	Assumed as proportional to CAGR of post-consumer waste.
CAGR of post-consumer waste	%	3%	JRC report assumed a ~2% CAGR between 2019-2025. Model assumed higher ~3% in light of emerging ultra-fast fashion trend.

B. Defined volume and cost lever impacts of the scale-up scenario

To define the scale-up pathway, impact values for 2035 were developed in collaboration with the project steering group. These reflect what the system could realistically look like if targeted interventions are implemented.

Volume levers include increased rates of separate collection, reduced waste exports, and higher shares of textiles designed with recyclable polyester content. Cost levers include larger plant capacities, improved labour productivity through learning effects, reductions in electricity prices, and a lower cost of capital for investments in recycling infrastructure.

All values between 2025 and 2035 are linearly interpolated to reflect gradual system transformation.

Table 6: Volume lever impact assumptions

Volume levers	Impact variable	Unit	2025 value (baseline)	Impact value (2035)	Impact value explanation
Establish widespread separate collection	Share of separate collection (vs mixed collection)	%	35%	50%	Based on EEA separate capture rate for Belgium and Luxemburg, and based on Germany's figures today (industry input).
Establish clarity on trade	Share sent to sorting for reuse after export restrictions	%	59%	95%	Assuming that waste framework directive will stop unsorted exports almost entirely, but likely to remain >0%).
	Share to sorting for recycling after export restrictions	%	22%	50%	Assuming 50% of items go to sorting for recycling after reuse/export and disposal of waste, based on expert input and Fashion for Good report.
Implement design for recycling	Share of inflow items with >70% polyester content	%	15%	20%	Assuming an increase to 20% of items with higher polyester content due to design for recycling, based on expert input.

Please note: The above impact values are further enabled by the levers to strengthen off-take demand: the levers "Create demand-side policy incentives" and "Ensure brand & supply chain commitments" are assumed as essential levers to incentivise the scale-up associated with the above three supply-side levers.

The lever "Set standards for sorting for recycling" has not been quantitively assessed.

Table 7: Cost impact assumptions of volume ramp-up

Cost levers	Impact variable	Unit	2025 value (baseline)	Starting year	Starting value (on starting year)	Impact value (2035)	Impact value explanation
Economies of scale (fixed cost digression)	Avg. Plant capacity of automated sorting for recycling	tonnes	36,500	2028	36,500	70,000	Based on interviews with sorters on expected industrial-scale capacity by 2035
	Avg. Plant capacity of depolymerization	tonnes	33,607	2028	33,607	70,000	Based on interviews with depolymerisers on expected industrial-scale capacity by 2035
	Cost-capacity exponent for buildings, infrastructure, and machinery	-	0	2028	0.49	0.49	Corresponds to a 40% increase in fixed costs (especially CAPEX) for every doubling of plant capacity
Learning effects	Learning rate of automated sorting for recycling and depolymerisation	%	0%	2028	15%	15%	Means a 15% reduction in labour cost for every doubling of cumulative capacity

Table 8: Cost lever impact assumptions

Cost levers	Impact variable	Unit	2025 value (baseline)	Starting year	Starting value (on starting year)	Impact value (2035)	Impact value explanation
Reducing (industrial) electricity prices	Average EU price of industrial electricity	€/kWh	0.25	2025	0.25	0.20	Assuming a 20% electricity price reduction via tax reductions and/or lower grid fees
Derisk investments	Weighted Average Cost of Capital (WACC) for automated sorting for recycling and depolymerisation	%	17.5%	2025	17.5%	12%	Assuming a reduction to 12% based on expert input and SG interviews, in light of offtake agreements and private-public partnerships (and EPR fees)

C. EPR financing and green premiums to meet financing requirements of the scale-up scenario

Despite improvements in scale and efficiency and their impact on the volume and cost metrics, we expect that a significant cost gap remains between recycled and virgin polyester by 2035. To bridge this gap, two complementary financing mechanisms are introduced in the model:

- **EPR fee**: Designed to fully cover the net system costs of collection, sorting, and recycling. The fee is calibrated to match total infrastructure costs under the modelled assumptions in any given year. If any cost-reduction levers are not implemented as planned, the required EPR fee would need to be proportionally higher. The fee goes up over time as volumes of waste and handling go up.
- **Green premium**: A smaller residual cost – related to shipping recycled polyester to Asia – is not covered by EPR fees. This is assumed to be absorbed by voluntary brand premiums paid on top of market prices.

EPR fee design and limitations

The suggested EPR fee is based on the following assumptions:

- Full coverage of annualised capital and operational expenditures, including cost of capital.
- Net cost coverage only, assuming that revenues from the sale of reusable items fully offset the costs of sorting for reuse, and that depolymerisation is financed only to the extent it is cost-competitive with virgin polyester.
- A 25% allocation of collected funds for administrative costs and awareness-raising measures.

This EPR fee should be seen as a directional average for polyester. The actual amount will vary by Member State depending on the state of existing infrastructure and should be differentiated by material type. However, current proposals – such as those in The Netherlands, at ~€120–220/tonne are insufficient to make textile-to-textile recycling economically viable. Crucially, strong enforcement will be needed to ensure sufficient funding and a level playing field. Packaging EPR schemes highlight risks of non-compliance, especially in online retail – which may be even more pronounced for textiles.

EPR fee impact calculation methodology

EPR impact is calculated via the following steps. For a given year between 2025 and 2035:

1. EPR funds available are calculated
    a) Tonnes of textiles placed on the market are calculated based on the assumed 2025 value and CAGR.
    b) This is multiplied by the EPR fee of that year (which is 0 prior to the starting year, and interpolated between the starting year value and 2035 value after the starting year). As a result, the total funds available to PROs are determined.
    c) 20% administration expenses and 5% for non-infrastructure related initiatives (e.g. awareness campaign financing) are deducted, leaving 75% for infrastructure financing.

2. EPR funds to infrastructure allocation is determined

d) The costs for collection, sorting, and recycling are sourced – after these have been impacted by the other levers (e.g. the electricity price reduction lever). Note that mechanical recycling costs – assumed as equal to those of chemical recycling due to a lack of better data – are also considered, since this will receive EPR financing as well. Costs include both opex as well as annualized capex incl. the capital costs.

e) Revenues of each step from outside the system boundaries are assumed as follows:

  - At least 350 €/tonne received by sorters for reuse from the sale of resellable textiles. This is based on the assumption that sorters for reuse can fully offset their sorting costs and has been triangulated against market prices for reusable textiles. We therefore assume that their business model is independently viable as it was in the past – with the key difference that they would no longer pay for collection.
  - 950 €/tonne received by recyclers for the final sale of their recycled pellets to yarn producers. This is assumed as equal to the cost of virgin pellet production – a price point necessary to unlock a tipping point (see section 7).

f) Based on the costs and revenues, the net costs per tonne material at each value chain step are determined.

g) The financing need per value chain step is determined by multiplying the volume of textile waste entering each value chain step (sourced from the stock-and-flow volume model) by the previously determined net costs.

h) The % funding allocation to each value chain step is determined by calculating the relative weight of the financing need established.

i) The % funding allocation is multiplied by the total available funds from step 1 to determine the total amount of investment into each value chain step.

3. Calculate the amount of infrastructure financed by EPR funding for collection, sorting, and depolymerisation. For each of these, the following calculation is conducted:

j) Divide the amount of investment available for the value chain step (calculated in step 2) by the net cost per tonne. This establishes how many tonnes of infrastructure are able to be financed.

k) Source the volume of infrastructure expected of the 2035 scale-up scenario.

l) Determine the share of available infrastructure financed by EPR as the share of step k) vs step j). The EPR fee input in the model dashboard is modulated, such that this share is ~100% across the years, i.e. such that the EPR is just about sufficient to cover all net cost expenses.

m) Multiply the share of available infrastructure financed by the net costs of the value chain step to determine the available per tonne subsidy.

The above methodology enables inputting various EPR fees and seeing at what scale they would suffice to cover all net costs across the value chain. The numbers below are the result of this exercise.

Please note: the below EPR figures are assuming a specific process in a scaled system scenario and might therefore not be fully representative of the ramp-up period; for example, a given process step such as automated sorting may prove a system bottle neck and require much higher upfront investment to scale beyond pilot plants. As a result, the below figures are of directional guidance only, with continuous and country-specific analyses required for the required EPR fees.

EPR fee and green premium magnitude

Table 9: EPR fee and green premium lever assumptions

Cost levers	Impact variable	Unit	2025 value (baseline)	Starting year	Starting value (on starting year)	Impact value (2035)	Explanation
Fully cover net costs with EPR	EPR fee	€/tonne	0	2028	250	330	Required magnitude to cover the net costs resulting after the scale-up scenario defined via model assumptions and volume and cost levers described above.
Internalise shipping costs	Green premium	€/tonne	0	2025	55	55	Required to cover costs of shipping to Asia (these are not covered by EPR fees)

The combined magnitude of these levers would make an average jumper of 400g (assuming 100% polyester composition) only 15 eurocents more expensive:

- Total added cost per tonne = 330 + 55 = 385 €/tonne
- Added cost for 400 gramme jumper = (385 / 1,000,000) *200 = 0.15 €

12. Carbon footprint data in the report

The emissions data referenced in the main report is derived from the modelling set out in the *Transforming PET Packaging and Textiles in the United States* (Systemiq, 2024) report.

Emissions factor for PET/polyester depolymerisation
The greenhouse gas (GHG) emission factor for depolymerisation is based on an average of the four main technologies with the greatest commercial expansion potential: **methanolysis**, **glycolysis**, **alkaline hydrolysis**, and **enzymatic hydrolysis**. Enzymatic hydrolysis is considered separately from conventional hydrolysis due to its biologically distinct process and significantly different emissions profile. Multiple studies evaluating the environmental impacts of PET depolymerisation were identified. However, the **2023 JRC report** *Environmental and Economic Assessment of Plastic Waste Recycling* was prioritised, as it evaluates three of the four technologies under consistent, EU-aligned conditions.

These data were adapted for use in this study's material flow model due to the following considerations:

1. The JRC estimates are based on input waste streams containing **84% PET by weight**. Emissions were scaled to represent **100% rPET output**.
2. For methanolysis-hydrolysis and alkaline hydrolysis, the JRC boundaries stop at the production of PET precursors (TPA and EG). Emissions associated with **repolymerisation to rPET pellets** were added to ensure alignment across technologies.

For enzymatic hydrolysis, two academic studies from the United States were used. Their emission factors were adjusted to reflect the **lower carbon intensity of the EU electricity grid**, assuming that 60% of the GHG footprint is energy-related and that the EU grid yields a ~33% lower emission intensity than the US equivalent. The final enzymatic figure reflects the average of both studies.

The resulting GHG factors and adjustments are summarised below:

Table 10: Depolymerisation emissions factors

Technology	Source	Emission factor - published	Explanation	Adjustments
Methanolysis-Hydrolysis	JRC, 2023	1.0 (tCO2/Input)	Emission factor per tonne of waste containing 84% PET (input)	1.6 (tCO2/tOutput), add 0.2 kgCO2/kg PE
Glycolysis	JRC, 2023	0.4 (tCO2/tInput)	Includes up to PET granulate production	0.6 (tCO2/tOutput)
Alkalyne Hydrolysis	JRC, 2023	1.2 (tCO2/tInput)	Includes up to TPA+EG production	1.9 (tCO2/tOutput), add 0.2 kgCO2/kg PE
Enzymatic Hydrolysis	Taylor U. et al. (2023); Gracida-Alvarez U et al. (2023)	4.0 / 3.0 (tCO2/tOutput)	US-based, adjusted to EU grid	2.8 (tCO2/tOutput)
Average depolymerization				1.7 (tCO2/tOutput)

To calculate the value used in the main report (~1.8 tCO_2/t output), the emissions factor for depolymerisation (1.7 tCO_2/t output) was combined with collection and sorting emissions:

- **Collection**: 0.0 tCO_2 / t output
- **Sorting**: 0.1 tCO_2 / t output
  Source: Deloitte for Plastic Recyclers Europe, Germany (*Blueprint for Plastics Packaging Waste: Quality Sorting & Recycling*, 2015)

Virgin PET benchmark
The comparator value of **~3.9 tCO_2e per tonne** of virgin PET is based on updated data from the **Ecoinvent database**. It reflects the **global average emissions intensity** of virgin PET production, including upstream fossil extraction, monomer synthesis, and polymerisation. This benchmark is not region-specific and represents average global production conditions.

Avoided emissions from incineration
An additional **~1.4 tCO_2e per tonne of material** may be avoided when depolymerisation is used instead of **incineration with energy recovery**, which remains a prevalent end-of-life treatment for polyester in Europe.
The emissions factor for incineration includes combustion of PET/polyester waste and applies a credit for energy recovered (i.e. heat or electricity substitution). Since the use-phase of this energy occurs outside the PET system boundaries, credits are embedded in the emission factor itself.
The 2023 JRC report was used as the primary source due to its adherence to EU protocols. Adjustments were made to align published values to 100% PET output. Supporting data from Gracida-Alvarez and Bassi et al. were also considered.

Table 11: Incineration emissions factors

Emission factor	Explanation	Source
2.1 (tCO2/tinput)	GHG emissions from incineration of PET waste (84% PET)	JRC, 2023
2.3 (tCO2/tinput)	Mathematical estimation of GHG emissions	Gracida-Alvarez et al. (2023)
2.6 (tCO2/tinput)	GHG from incineration of PET bottles waste	Bassi et al. (2023)
-0.9 (tCO2/tinput)	Energy and material savings from incineration (84% PET waste)	JRC, 2023