PETCORE EUROPE

ADVANCING POLYESTER TEXTILE CIRCULARITY

11 December

Pioneering PET circularity since 1993

PETCORE EUROPE

END WASTE RECYCLE THE 1

www.petcore-europe.org

Agenda

13:30-14:10 Circularity in Textiles and Sustainability Challenges

13:30-13:35 Welcome by Antonello Ciotti - PETCORE EUROPE

13:35-13:40 Introduction by Christian Crépet - PETCORE EUROPE and Bruno Langlois - Carbios

13 :40-14:00 Overview of Current Circularity Challenges in the Polyester Textile Industry and the Role of Circularity in Driving Sustainable Development:

Key statistics and figures. Textile imports & production, EU Collection & sorting for PET by Loic Mace - Axens & Frederic Favre & GAUTHIER Thierry - IFPEN

The complexity of materials: Polyester, Polycotton, Polyester/Elastane, and PO/PA by Bruno LANGLOIS - CARBIOS

14:00-14:15 EU Developing EU-wide End-of-Waste criteria for textile waste by Lukas Egle - European Commission

14:15-14:30 Q&A session with Lukas Egle - European Commission

14:30-15:50 Technologies and Innovation Deployment moderated by Raphael Jaumotte - PETCORE EUROPE:
A. Overview of PET Recycling Technologies supporting polyester textile circularity.

14:30-14:40 Recognition and automatic sorting by Jo Eikeland Roald - TOMRA & Eric Westerhoff - Pellenc ST

14:40-14:50 Depolymerization recycling, multiple technologies, including glycolysis, hydrolysis, enzymatic, solvolysis and methanolysis by Maurizio Crippa - Gr3n Recycling

14:50-15:00 Mechanical recycling: updates from Starlinger, Erema and Coperion by Wolfgang Herman – Erema

15:00-15:10 Return of experience on Mechanical and Depolymerisation Recycling – Anca Pora (GreenGroup)

15:10-15:20 Q&A

B. 15:20-15:30 Geographical Presence and Development - Philip Boydell
•Mapping and Panorama: Present and Future Outlook
•Pilot units and Technology Readiness Levels (TRL)
•Ongoing and finalized industrial projects (Capacities)

C. 15:30-15:40 Indicative Value Chain Costs by Bruno Langlois - Carbios
•Breakdown of costs across the value chain: Collection, sorting, preparation for recycling, mechanical recycling, depolymerization, repolymerization
•Learnings from existing studies (Mc Kinsey, …)

15:40-15:50 Q&A Session

15:50-16:00 Coffee break

16:00-16:20 Essential Tools for Recycling and Mandatory Design Standards for Circularity by Josse Kunst - CuRe TECHNOLOGY
•Guidelines for Circularity in Polyester-Based Textiles
- Collection & Sorting
- Preparation for depolymerization & mechanical recycling
- Design for Recycling for clothing

•Update on T-Rex

Agenda

16:20-16:25 Q&A Session

16:25- 16:50 Current State and Global Collaboration for EU Alignment on SIMULTANEOUS SCALABLE SOLUTIONS by Christian Crépet - PETCORE EUROPE

•Alignment Across the EU to organize the circular value chain:
EPR, collection, sorting and preparation deployment updates

•Collection schemes deployment
Reverse logistics strategies, asset recovery, take-back programs, voluntary return, kerbside, charity led
Consumer education and incentivizing

•Regulatory Framework to support deployment of a circular value chain

Recycled content, End-of-Waste, Waste shipment, Textiles labelling, industry standards, Enforcement and Monitoring

16:45-16:50 Q&A on how can the textile industry be ready to harmonize simultaneously scaling for an EU sustainable success?

16:50-17:05 The key challenge lies in driving global expansion of textile circularity while simultaneously aligning all recycling steps across the EU moderated by Bruno Langlois – Carbios

Stakeholder Perspectives on a harmonized & synchronized collective effort for an EU PET circular economy

•17:05-17:15 Insights from EPRs & Refashion by Christian Crépet - PETCORE EUROPE

•17:15-17:30 European Commission - DG Grow - António de Sousa Maia

•17:30-17:45 Associations by Karla Magruder - accelerating Circularity

17:45-18:00 Q&A Session

•Could a global forum on synthetic fibers, similar to the Circular Plastics Alliance led by DG GROW for plastic packaging, promote global collaboration, synchronized growth through a transparency attitude to evaluate progress across the value chain and be helping for regulatory adjustments?

•Ensuring compliance through continuous monitoring.

•18:00-18:10 Wrap-up and Conclusions by Christian Crépet - PETCORE EUROPE

ANTITRUST

For a competition safe environment

MEETINGS MANAGEMENT

- PETCORE EUROPE staff and Chairperson of the meetings will issue in advance an agenda that must not cover subjects likely to infringe the competition laws;
- Agenda and registration forms shall carry the following words: "PETCORE EUROPE is committed to complying with EU Competition Law. The participants to this meeting agree to adhere to the PETCORE EUROPE manual on competition law compliance";
- A lawyer expert in EU competition matters or a PETCORE EUROPE executive from the staff, should be present in the meetings. Discussions which occur during the meeting will be recorded in the minutes;
- If any prohibited subject is raised, Chairperson and/or PETCORE EUROPE staff should request to stop the conversation. If the discussion is continued the meeting will be closed and the foregoing recorded in the minutes;
- If necessary, PETCORE EUROPE will provide its staff and members with training and up-to-date to ensure that no activity deemed to be anti-competitive is undertaken.

MEMBERSHIP CONDITIONS

Membership rules should be transparent and non-discriminatory. In particular ,they should not place any member at a competitive disadvantage.

TECHNICAL STANDARDS

Voluntary technical industry standards set up by PETCORE EUROPE members should be objective and accessible to everyone.

PROHIBITED DISCUSSION TOPICS

Never discuss with undertakings in fact or appearance in formal or social meetings about:

PRICES

Agreements or coordinated practice on individual prices, costs, discounts, allowances, price changes. Exchange information on price decisions, profit margins, terms of sales.

PRODUCTION

Information on production capacity, suppliers or distribution. Fixing of production quotas.

MARKET SHARES

Agreements on market shares, boycott suppliers, divide up the market, allocation of sales territories, distribution or marketing.

CUSTOMERS

Blacklist customers, agree to classify or select potential customers.

INVESTMENTS AND TRENDS:

Do not share credit terms, future plans concerning technology. Do not apply dissimilar conditions to equivalent transactions with other trading parties.

Please refer to the full PETCORE EUROPE competition law policy as distributed and available from the secretariat

Textile SIG Members

Axens
IFP Energies nouvelles
CARBIOS
Enzymes powering the Circular Economy
CuRe Polyester Rejuvenation
ChemPET
DePoly
DOW
EASTMAN
Equipolymers
EASTMAN
EREMA
GR3N
INDORAMA
INEOS
ioniqa
Herbold
loop INDUSTRIES
Mylar
PELLENC ST
PET EUROPE
POLYMETRIX
POSEIDON PLASTICS
RITTEC
Starlinger
SK chemicals
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Green Tech
ACCELERATING CIRCULARITY

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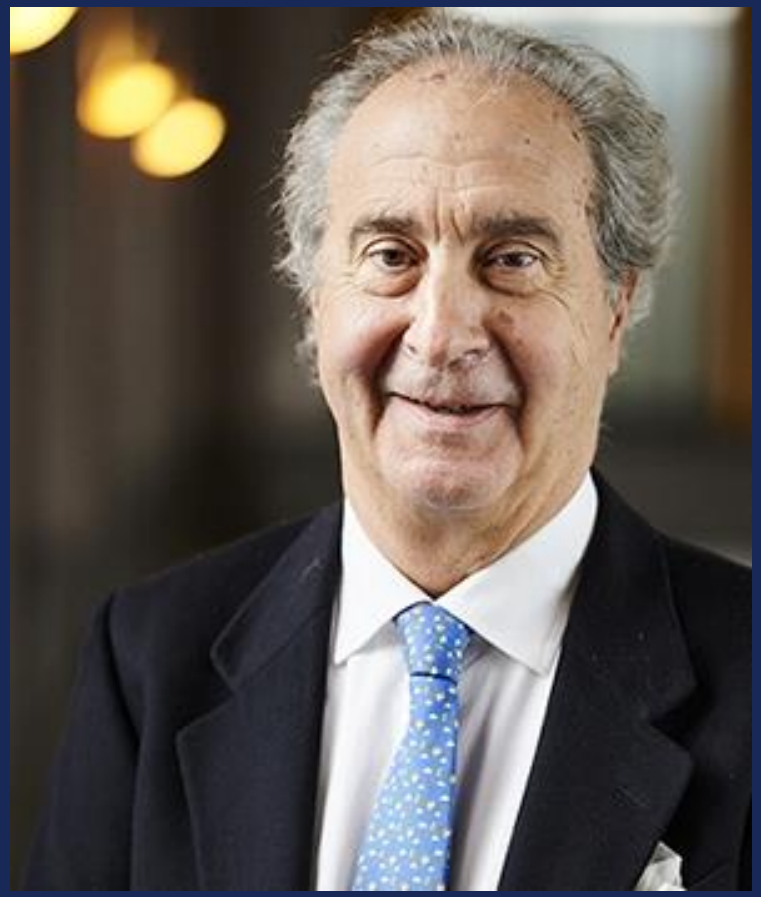
END WASTE RECYCLE THE

13:30-13:35
Welcome by Antonello Ciotti – PETCORE EUROPE



ANTONELLO CIOTTI
Chairman at PETCORE EUROPE

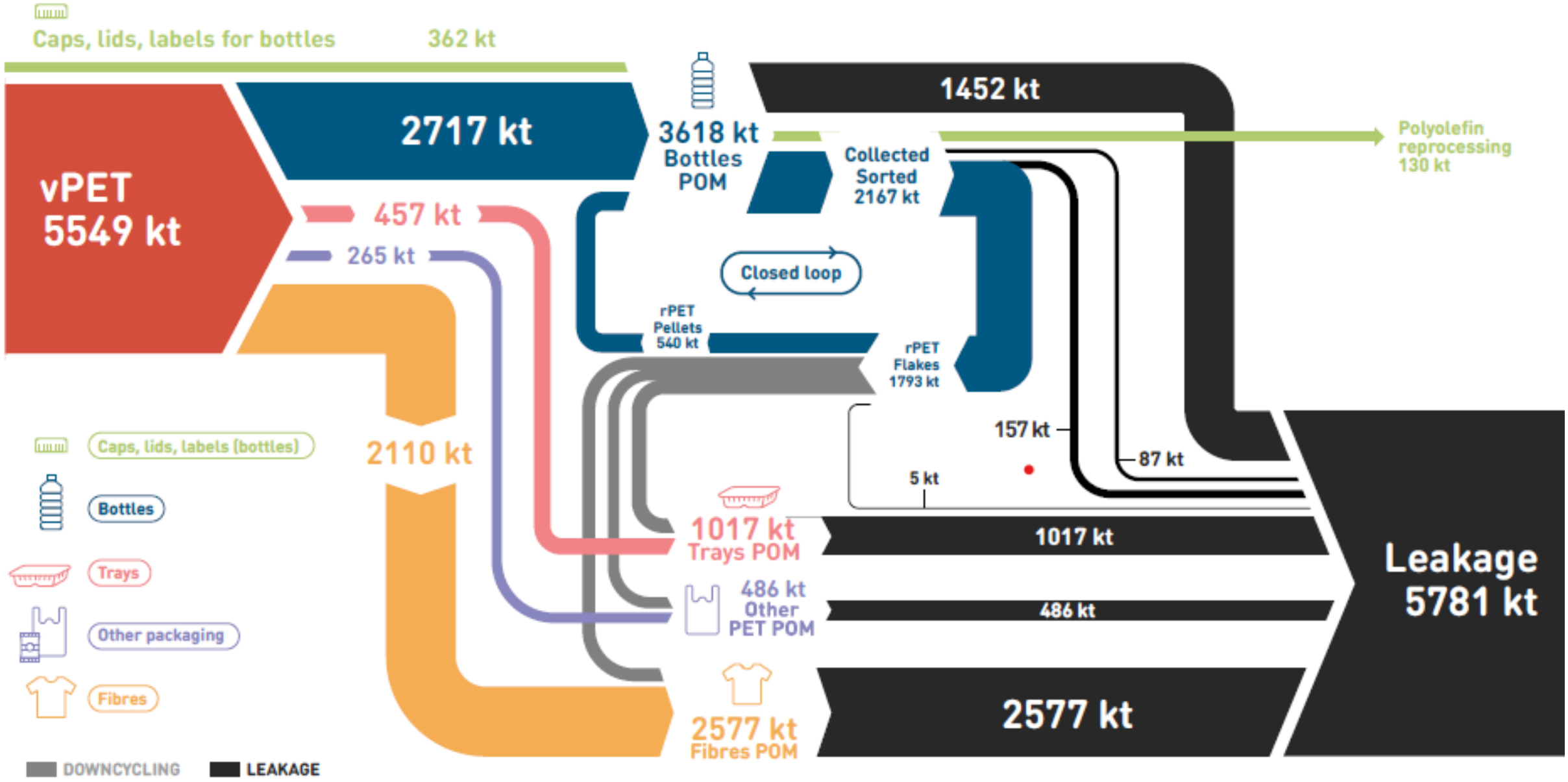
Antonello Ciotti is the PETCORE EUROPE chairman. Antonello has a long-term story as Dow Plastic employee in different roles mainly in the PET business as Equipolymers Global Commercial Director and in plastic recycling as Sr. Business Development Director EMEAI in Dow Plastics & Specialty Plastic. Antonello is Past President and at present Board Member in Corepla, the Italian EPR scheme for plastic packaging recycling.

HOW CIRCULAR IS PET?

A report on the circularity of PET bottles, using Europe as a case study

February 2022

Figure 2.7: PET Mass Flows - current state



13:35-13:40

Introduction by Christian Crépet - PETCORE EUROPE and Bruno Langlois - Carbios

Bruno Langlois, PhD, Carbios

Graduated from Clarkson University, NY, USA. Over 25 years of experience in the chemical industry to develop business with innovative chemistries and establish long term partnerships. Bruno is passionate about innovations. Carbios, with its unique technical solution, business model, and ability to make PET circular is a perfect fit to passionately address the major issues to transition to a more sustainable economy by reducing our plastic and textile waste.

Christian-Yves Crépet, Ambassador and honorary member of the Board at PETCORE EUROPE

With a commercial and executive business management background, Christian-Yves Crépet started his career with Dow Chemical and went on with Eni Chem both in France and other European countries. Before running PETCORE EUROPE, he has been the Managing Director of the French 50 kt/pa PET&HDPE recycling company Corepla Industrie for the last 21 years. A former Vice-President, co-founder of Recyclass, Co-chair of the PET WG and Chair of the HDPE/PP WG of PRE until 2016.

13:40-13:40

Overview of Current Circularity Challenges in the Polyester Textile Industry and the Role of Circularity in Driving Sustainable Development

GAUTHIER Thierry - IFPEN

Currently Advisor for Circular Industry in the BU Chemistry for Industry at IFPEN. More than 30 years experience in process and technology development at IFPEN.

Frederic FAVRE - IFPEN

Joined IFPEN's Development department in 2000, and participated in the development of several processes He is currently project manager at IFPEN-Lyon for the Chemistry for Industry Results Center, and coordinates IFPEN's PET recycling demonstration project.

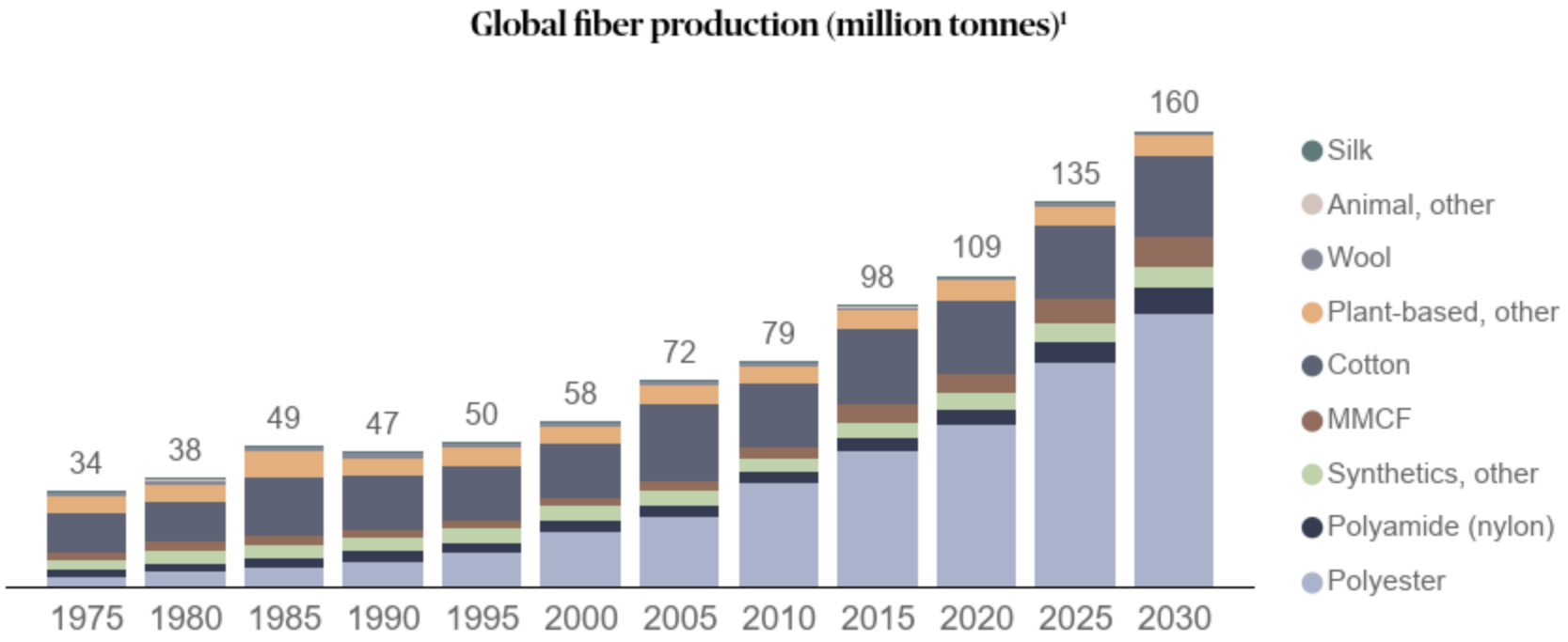
Loïc MACE -Project Development Manager, Plastic Circular Economy Department

Loïc Macé is Project Development Manager in Axens Plastic Circular Economy Department. He holds a Chemical Engineering Degree and has more than 15 years of experience in Oil and Gas industry. Loïc started his career as Production Support Engineer in Port-Jérome ExxoMobil Refinery in France. He joined Axens in 2008 and has covered various positions in Technical and Commercial departments. He was appointed to his current position in 2022

Advancing Polyester Textile Circularity
Key Statistics and Figures

December, 11th 2024

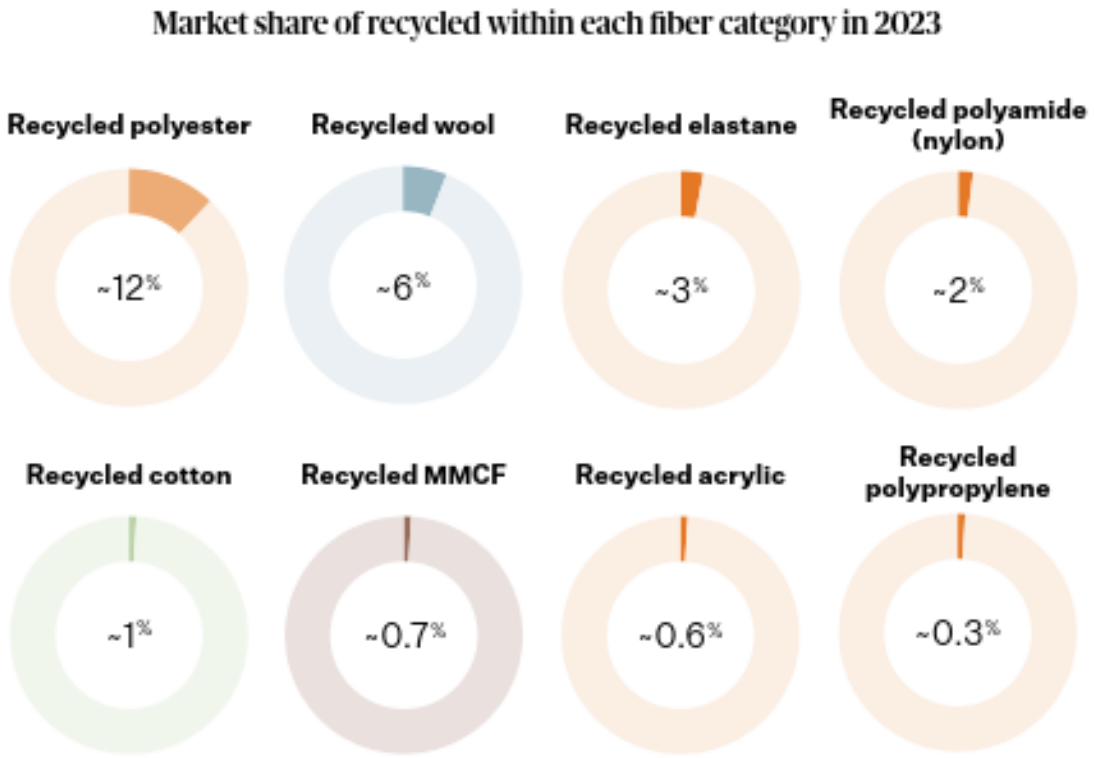
Textile: a growing market



Source: Textile Exchange – Materials Market Report 2024

- Polyester represents currently 57 % of the worldwide fiber production
- Main part of the fiber production growth will come from polyester

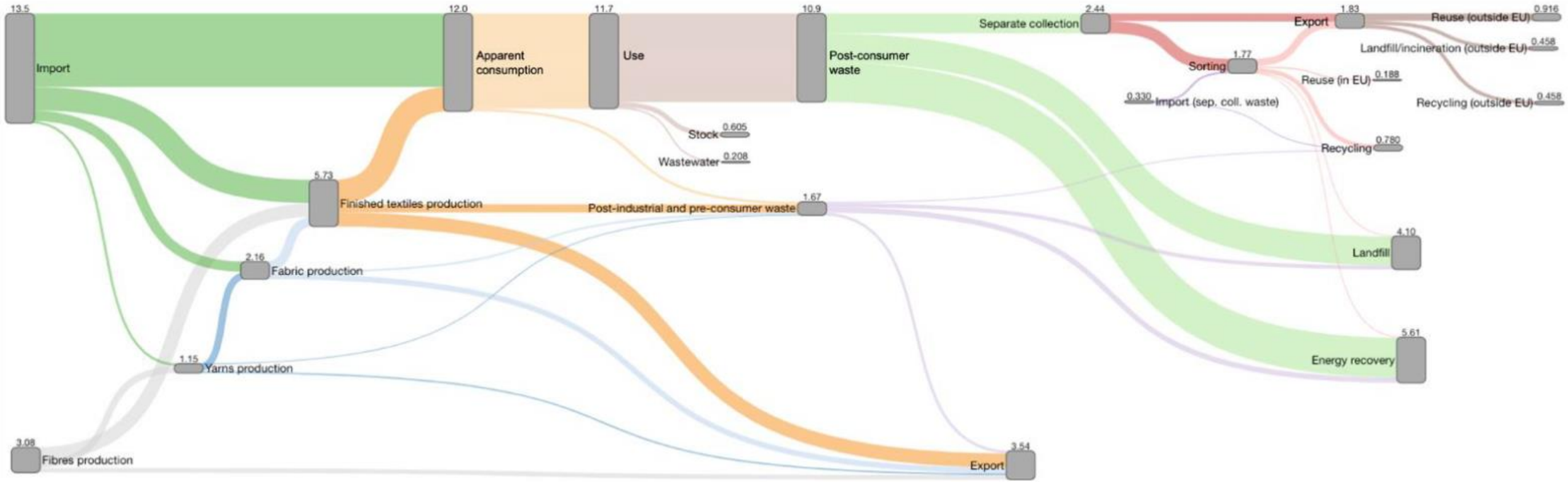
Textile: global reycled material share



Source: Textile Exchange – Materials Market Report 2024

- Polyester is the fiber with the highest average recycled material content
- Recycled polyester is mostly coming from bottle to fiber recycling (down-cycling)

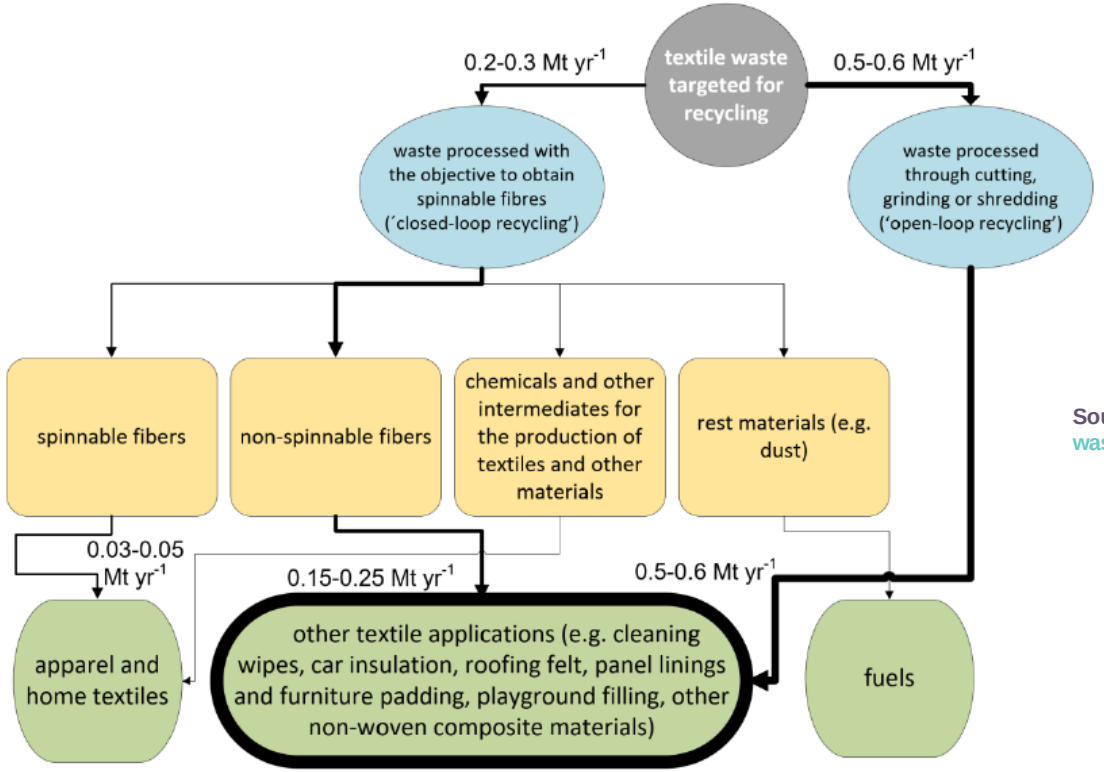
Mass Flow Analysis of Textile in Europe (Mt)



- Circa 20% of textile waste are collected separately
- Less than 7% are recycled
- Most of the textile waste are incinerated or landfilled

Source: Techno-scientific assessment of the management options for used and waste textiles in the European Union JRC, 2023

Mass Flow Analysis of Textile in Europe: Recycling



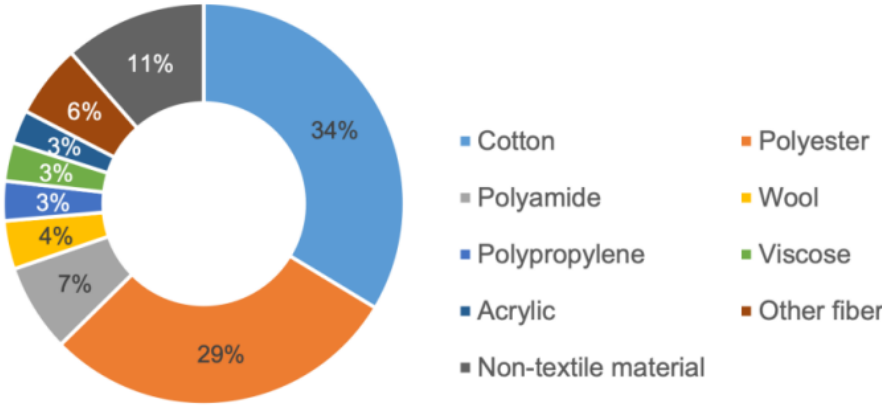
Source: own work.

Source: Techno-scientific assessment of the management options for used and waste textiles in the European Union JRC, 2023

- Most of textile recycling is “down-cycling”
- Less than 0.5 % of textile waste are recycled back to spinnable fibers

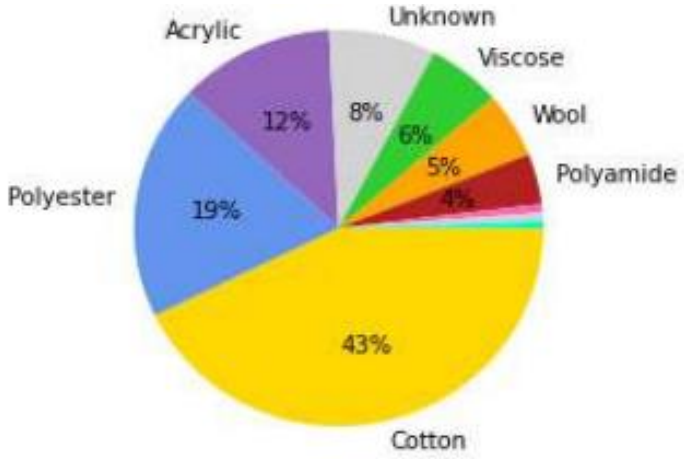
Post consumer Textile waste Fraction composition

European textile waste composition



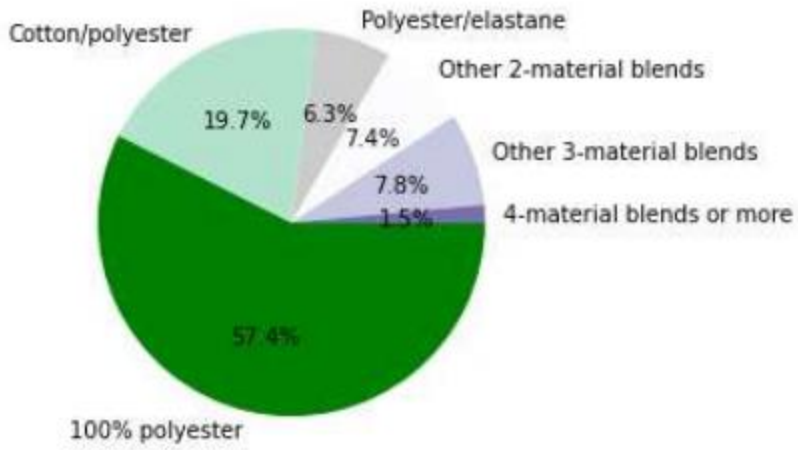
Source: Techno-scientific assessment of the management options for used and waste textiles in the European Union JRC, 2023

French textile waste composition



Source: Re_fashion Study, 2023

French polyester waste type



Source: Re_fashion Study, 2023

- Polyester is the second main fiber after cotton in textile waste
- Estimated European Post-consumer textile polyester waste: 3.2 Mtons/year
- Circa 43% of the polyester waste are mixed with other fibers

13:40-13:40
Overview of Current Circularity Challenges in the Polyester Textile Industry and the Role of Circularity in Driving Sustainable Development

Bruno Langlois, PhD, Carbios

Graduated from Clarkson University, NY, USA. Over 25 years of experience in the chemical industry to develop business with innovative chemistries and establish long term partnerships. Bruno is passionate about innovations. Carbios, with its unique technical solution, business model, and ability to make PET circular is a perfect fit to passionately address the major issues to transition to a more sustainable economy by reducing our plastic and textile waste.

Recycling textile : The technical challenges

The complexity of materials: Polyester, Polycotton, Polyester/Elastane, and PO/PA

The complexity of the value chain, the complexity of the production and blend of materials

- Apparels (clothing, shoes, accessories…) are designed to meet several functions:
  - Protection and cover (UV, stains, flames, static electricity…)
  - Comfort (Keep us warm and/or dry, sunburn, pre-shrink, stretchable…)
  - Ease of maintenance (cleaning, drying, ironing …), durability

  But also, be fashionable, stylish or desirable (emotional design).

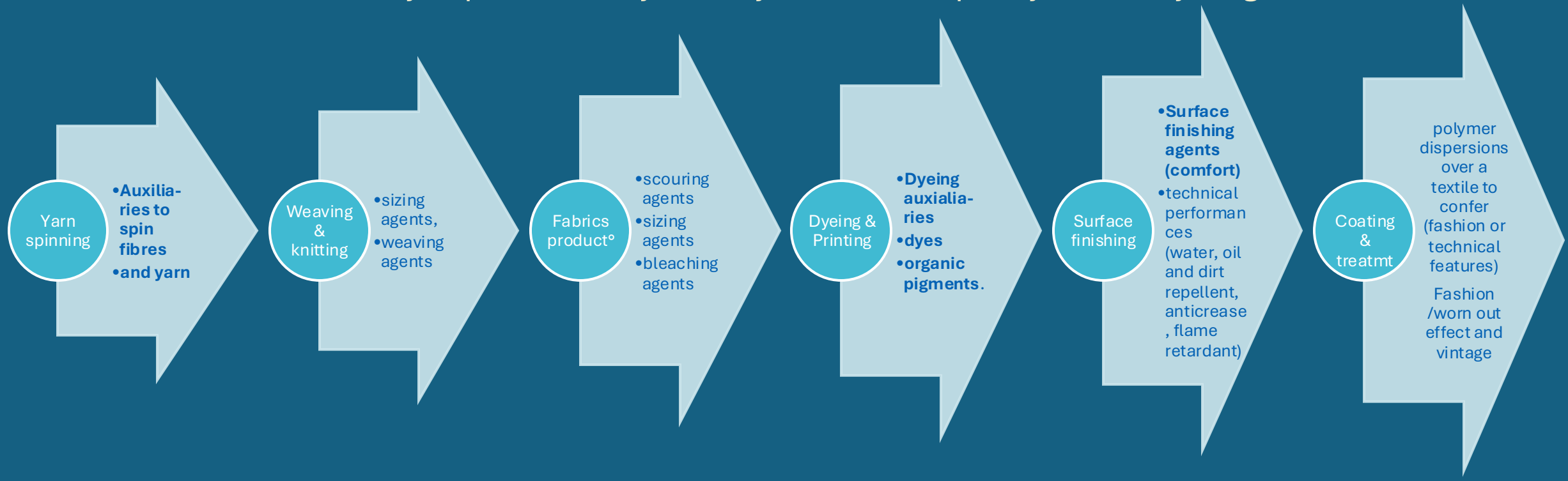
  TO MEET ALL THESE FEATURES, Textile is made of different fibers, and goes under several processes to make fabrics, and finishes: surface treatment, layers, dyeing, coatings, printings…

Textile value chain and use of chemicals:

Different processing to prepare textile is introducing a significant amount of chemicals (estimated to be more than 8000)

Knowing the adverse effect of these on short- and long-term exposure will be critical for the recyclers to develop robust processes to control level and eliminate the hazardous chemicals

Some chemicals may impact the recyclability or material quality after recycling



The impact of chemicals for recyclers

- Substances of concern can be present in the textile to recycle
  - Some are hazardous, according to KEMI 2014: 750 to 2450 are hazardous
  - Functional and process chemicals can undergo degradation products (aryl amine, PAH's, formaldehydes, VOC's during recycling.
- For recycler: Legacy Chemicals,
  - could remain in the textile and reintroduced when recycling and reuse clothes: purification steps to remain virgin like quality material
- Complication: most of textile are manufactured outside the EU; where supply chain is unknown, and regulation is different
  - Ensure there is no SVCH, no restricted chemials (BPR, POP'S…)

Technical challenges for recycling textile

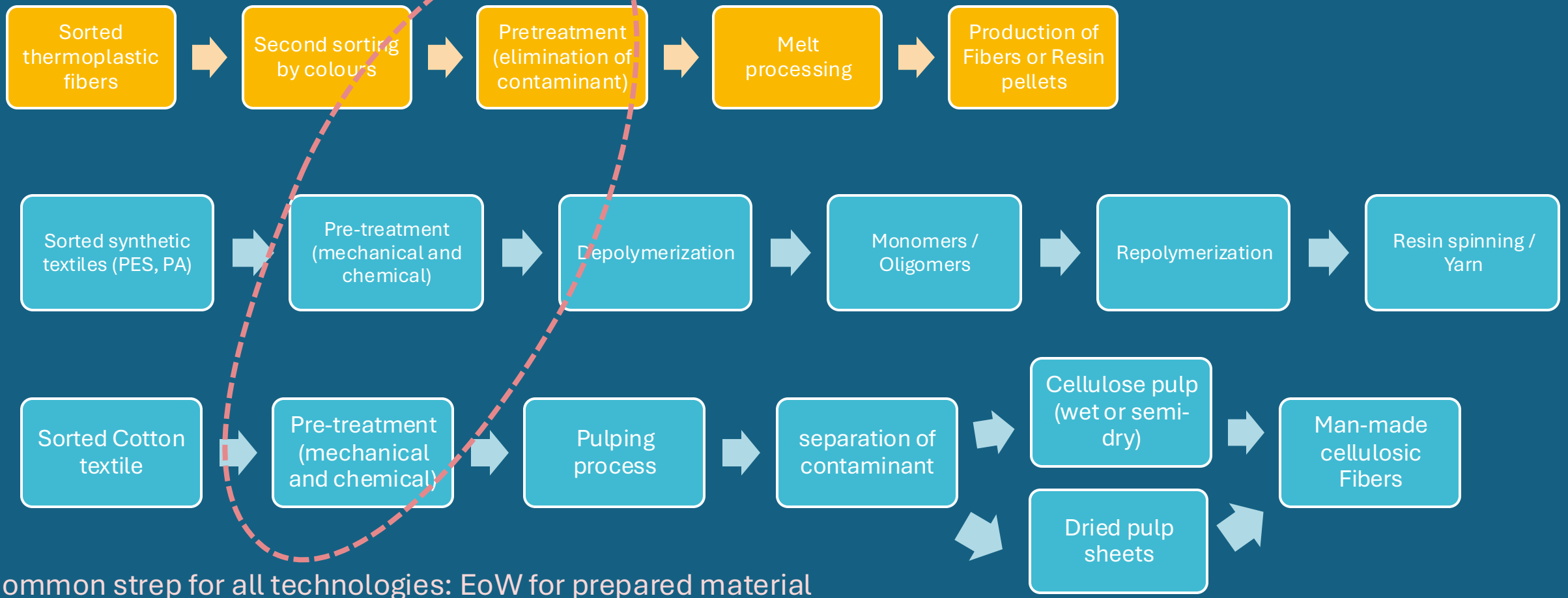
- All these materials and treatment are producing apparels that are difficult to recycle (in comparison with packaging)
- To recycle textile, we need to build and develop an EU framework to support
  - Technologies that can accommodate a maximum of contaminant (other material, process additives and chemicals, dyes, coatings)
  - Having robust process to eliminate the restricted substances
  - The ability to use several technologies targeting different materials to recover a maximum of content and **increase circularity**
  - Existing and developing technologies that have the best yields and best LCA*
  - Existing and developing technologies which have good LCC*
  - And organize collection & sorting AND textile preparation for recycling

* LCA Life-Cycle Analysis, LCC Life-Cycle Costing

Using learnings from recycling plastic to be successful and accelerate the circularity of textile

- One technology does not fit all : Technologies are complementary,
  - Mechanical and Chemical, the latter being more adapted to the complexity of the feedstock
  - Recycling targeting different material: Polyester, Cotton, Elastane, Polyamide…
  - Facilitate interoperability of technology and recyclers (EoW criteria, r-content)
- Setting targets to promote the development of European champions
  - A minimum of recycled content coming from textile, coming from post-consumer waste.
  - Eco-design, information on dangerous chemical for recyclers (EU label)
  - Economics incentive to promote circular material vs. virgin ones
- Innovation and investments required to develop at scale efficient sorting, preparation and recycling technologies

Market of blends: recycling Polyester, and Cotton is key in creating a textile circular market, 70% of waste volume could be recycled with developing technologes.



Common strep for all technologies: EoW for prepared material

Desing guideline for recycling POLYESTER

1/ Mechanical PES recycling

Two mechanical textile technology global leaders and members of PETCORE EUROPE specify:

1. Less than 1% of Cotton and Cellulose (maybe Rayon also.)
2. Less than 5% of PU/PP/PE.

2/ Mix Synthetic Fibres Depolymerization

10 EU PES CHEMICAL RECYCLERS and members of PETCORE EUROPE are technically efficient for recycling within lower and higher limits of contaminants starting from **5% to 30% of:**

1. PES+PU (elastane)
2. PES+PA
3. PES+PE or PP

NB: ACRYLICS remains an issue to be solved by most recyclers. The same would apply for PVC coating.

3/Depolymerization of Polycotton

Technically most chemical recyclers have no limits but can be economically viable within only the following ranges:

1. From 5% Cotton to a maximum of 40% Cotton.

non-economically viable percentages from 40 to 95% cotton could be acceptable for the cotton industry. Therefore, it remains necessary to coordinate an approach with the cotton recyclers.

14:00-14:15
Developing EU-wide End-of-Waste criteria for textile waste by Lukas Egle - European Commission

Lukas Egle

Currently Contracted staff at European Commission - Joint Research Center (JRC) Circular Economy and Industrial Leadership.

Previously Head of the Working Group "Sewage Sludge Recycling Products".

Member of the "Sewage Sludge/Biosolid Platform.

Strategic Controlling & Assistance Waste Management and Material Flow Management.

14:30-15:50

Technologies and Innovation Deployment moderated by Raphael Jaumotte - PETCORE EUROPE

A. Overview of PET Recycling Technologies supporting polyester textile circularity.

RAPHAEL JAUMOTTE - Technical Manager at PETCORE EUROPE

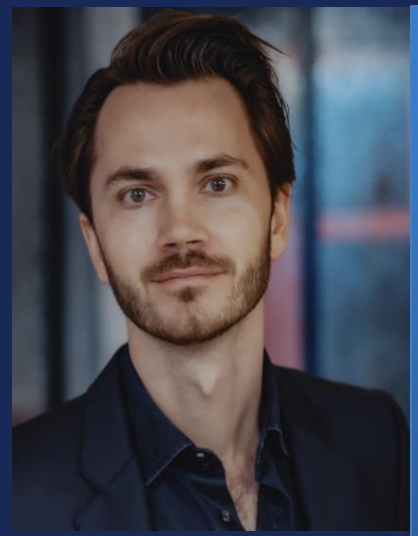
He has been for more than 20 years in the business of PET recycling. Held various positions related to quality, environment, operations, purchasing and projects.

His last position prior to joining PETCORE EUROPE, was Director of Projects and Quality for the Plastipak Beaune (FR) operation producing more than 45.000T/y of food grade rPET for Plastipak's preform injection operations with the main focus on continuously improving quality and output.

He was formerly a board member and a treasurer of PETCORE EUROPE and a board member of the French Elipso association.

14:30-14:40

Recognition and automatic sorting by Jo Eikeland Roald - TOMRA & Eric Westerhoff - Pellenc ST



Jo Eikeland Roald

Jo Eikeland Roald is the Head of External Relations for TOMRA Textiles, a dedicated effort within TOMRA to explore new business models, technology applications and partnerships to close the gap in circular textiles. Prior to joining TOMRA, Jo served in senior policy, public affairs and strategic communications positions in the tech and telecoms industry, both in Norway/Europe and in several Asian markets. He holds an MSc in Industrial Design Engineering and an MBA, and splits his time between Oslo and Brussels

Eric Westerhoff

Eric is a Sales Director for Advanced Recycling at Pellenc ST, a Sensor based sorting solution provider for the Waste & Recycling industry. With 20 years of Marketing & Sales experience in the Greentech Industry, Eric joined Pellenc ST in 2019 to address the challenge of plastic waste by exploring new solutions contributing to material circularity. After heading the Marketing Department, he now supports Chemical Recyclers as well as the HolyGrail 2.0 initiative with his expertise and industrial know-how.

Closing the gap in textile circularity

The role of automated sorting

Eric Westerhoff
Sales Director Advanced Recycling
Pellenc ST

Jo Eikeland Roald
Head of External Relations
TOMRA Textiles

Automated Sorting for Circularity at Scale

Near-infrared (NIR) & visual (VIS) spectrometry combined to sort textile

Textile type & size

- Whole garments/ fabrics
- Clippings > 10cm

Extract mono-materials (NIR)

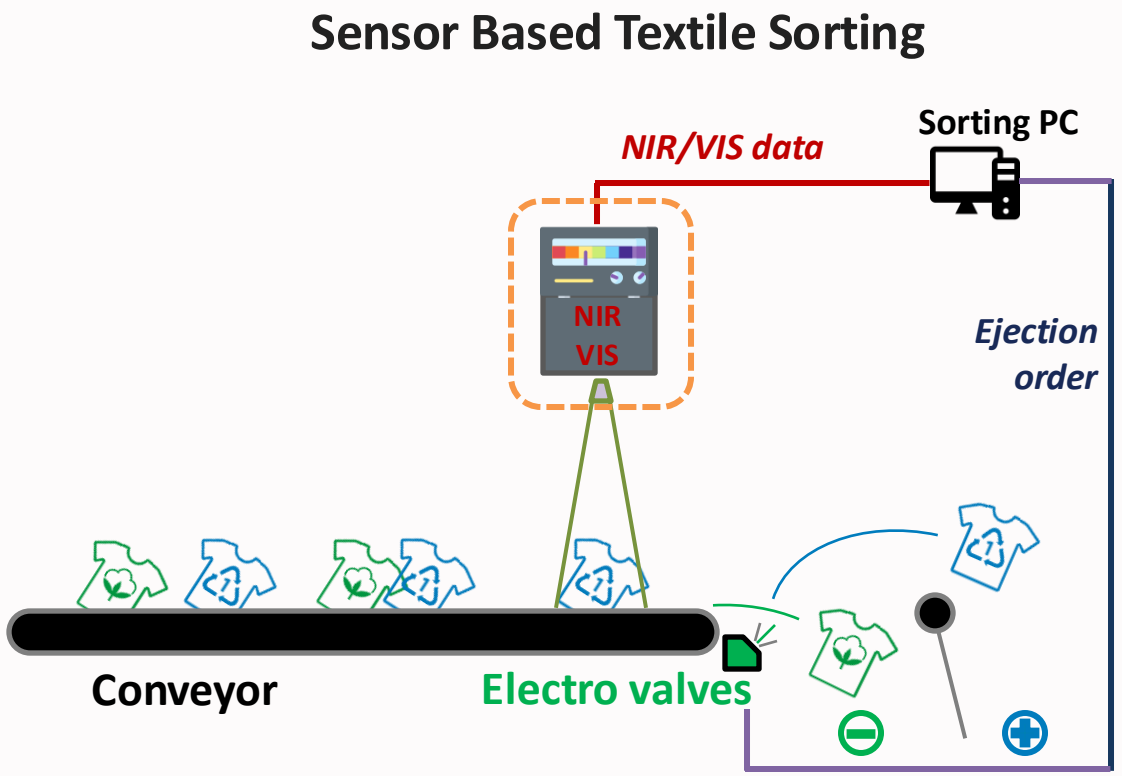
Cotton, PES, PA, Viscose, Wool, Silk, Acrylic

Multi-material classes (NIR)

- Polycotton classes: 80/20- 60/40- 40/60- 20/80
- Wool-acrylic

Color classes (VIS)

Yellow, red, blue, “jeans”, black, white… & color shades



INS3RTEGA

RECICLAR REDUCIR REUTILIZAR

Automated textile sorting plant

La Coruna, Spain

10 kta capacity
Operational since 2023

Full clothes sorting:

- 100% Cotton > 98% purity
- Polycotton (60 - 40) > 95% purity
- 100% Polyester > 95% purity

Automated sorting

becomes a standard for

Textile Circularity

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Nouvelles Fibres Textiles

First industrial textile fiber preparation plant for recycling

Amplepluis, France

3 kta pilot line
Operational since 2023

A unique ecosystem

SYNERGIESTLC — **PC Textile provider**

ANDRITZ — **Turn-key textile solutions**

PELLENC ST WE CAN SORT IT — **Sensor based sorting**

Textile preparation for recyclers…

LTC — CARBIOS

Next step:
25kta sorting center planned for 2026 in France

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END WASTE RECYCLE THE

Nouvelles Fibres Textiles

Automated sorting full clothes

Cutting (clips)

Automated sorting clippings

Hard point removal

Textile tearing

- Fiber for spinning
- Fiber for nonwoven
- Fiber for chemical recycling

A unique process for PC textile sorting & fiber preparation process

pioneering PET circularity since 1993
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TOMRA: Approaching a decade of textile sorting R&D

2016

Swedish R&D project applying sensor-based sorting on polyester/ cotton mixes

Textilier och klimatet.

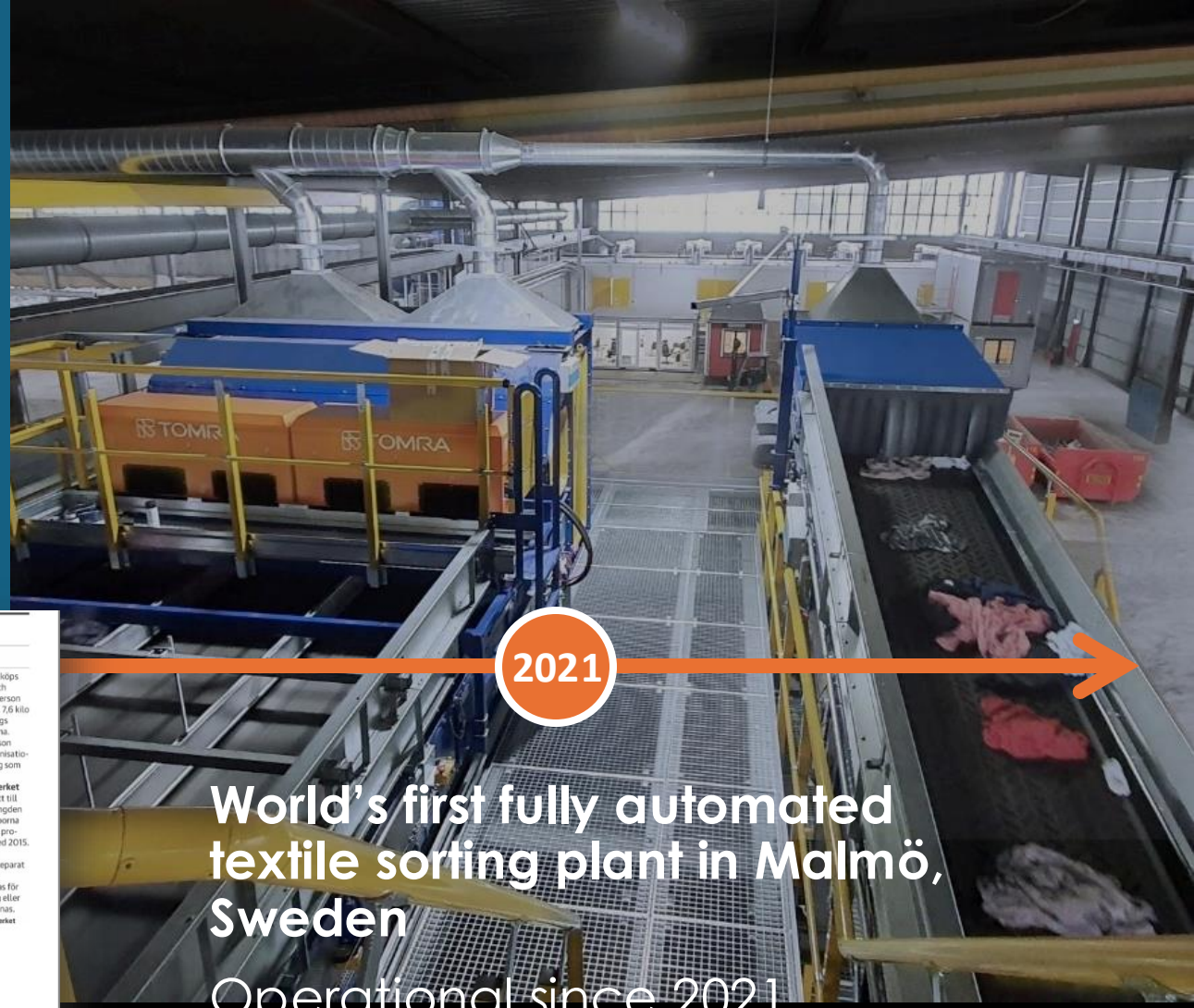
Fakta.

- I genomsnitt köps 13 kilo kläder och hemtextil per person och år i Sverige. 7,6 kilo per person slängs i hushållssoporna. 2,4 kilo per person lämnas till organisationer eller företag som samlar in.
- Naturvårdsverket har föreslagit att till år 2025 ska mängden textilavfall i soporna minska med 60 procent jämfört med 2015.
- År 2025 ska 90 procent av separat insamlat textilavfall förberedas för återanvändning eller materialåtervinnas.

Källa: Naturvårdsverket

Maskinen som provkörs i Avesta skiljer ut textilier med hjälp av infraröda strålar. Sensorer läser av hur ljuset reflekteras när det träffar olika material. "Vissa program fungerar jättebra, jag är förvånad över resultaten", säger maskinskötaren Jan Eriksson.

Unik klädsorterare öppnar för lönsammare återvinning



2021

World's first fully automated textile sorting plant in Malmö, Sweden

Operational since 2021

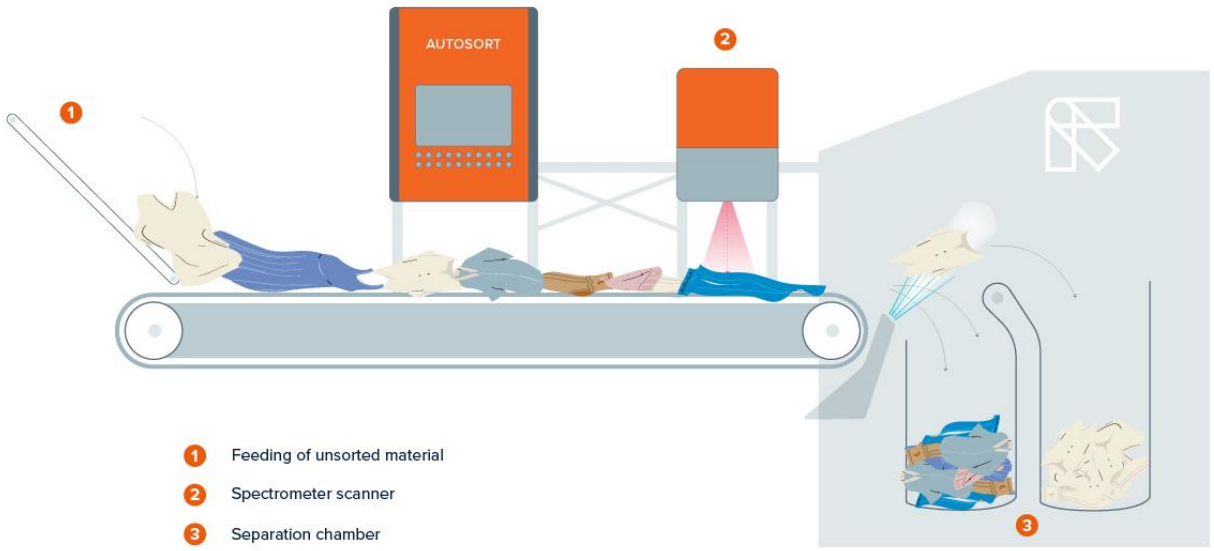
24 kt/a capacity, 16 fractions

TOMRA AUTOSORT Technology

Dedicated textiles circularity efforts

2022

2025



Building a dedicated Textile Technology Centre in Europe

Integrated Value Chain beyond sorting, incl. advanced processing

Approx. 2,700 m2

Opening in 2025

Circular Textiles can become a new, green European Industry through targeted policies

1. Make **recycled content a mandatory performance requirement** for cotton and polyester textiles

2. Ban **export of unsorted textiles** from Europe

3. Implement a **harmonized textiles EPR** and stimulate swift national implementation

Create the market

Trace, monitor, control and enforce

Sufficient financial support for infra

Closing the gap in textile circularity

The role of automated sorting

Eric Westerhoff
Sales Director Advanced Recycling
Pellenc ST

Jo Eikeland Roald
Head of External Relations
TOMRA Textiles

14:40-14:50

Depolymerization recycling, multiple technologies, including glycolysis, hydrolysis, enzymatic, solvolysis and methanolysis by Maurizio Crippa - Gr3n Recycling

Maurizio Crippa, PhD in Materials Science, CEO.

After many years in academia dedicated investigating in organic and inorganic chemistry he co-founded GR3N. After years spent creating new materials, he switched his interests on providing technological solutions to solve environmental issues especially focusing on chemical recycling of polymers.

As GR3N SA he is one of the founder of Chemical Recycling Europe and served as vice president of the association from 2020 to 2024. He is also active member of textile working group at PETCORE.

PETCORE EUROPE

Pioneering PET circularity since 1993

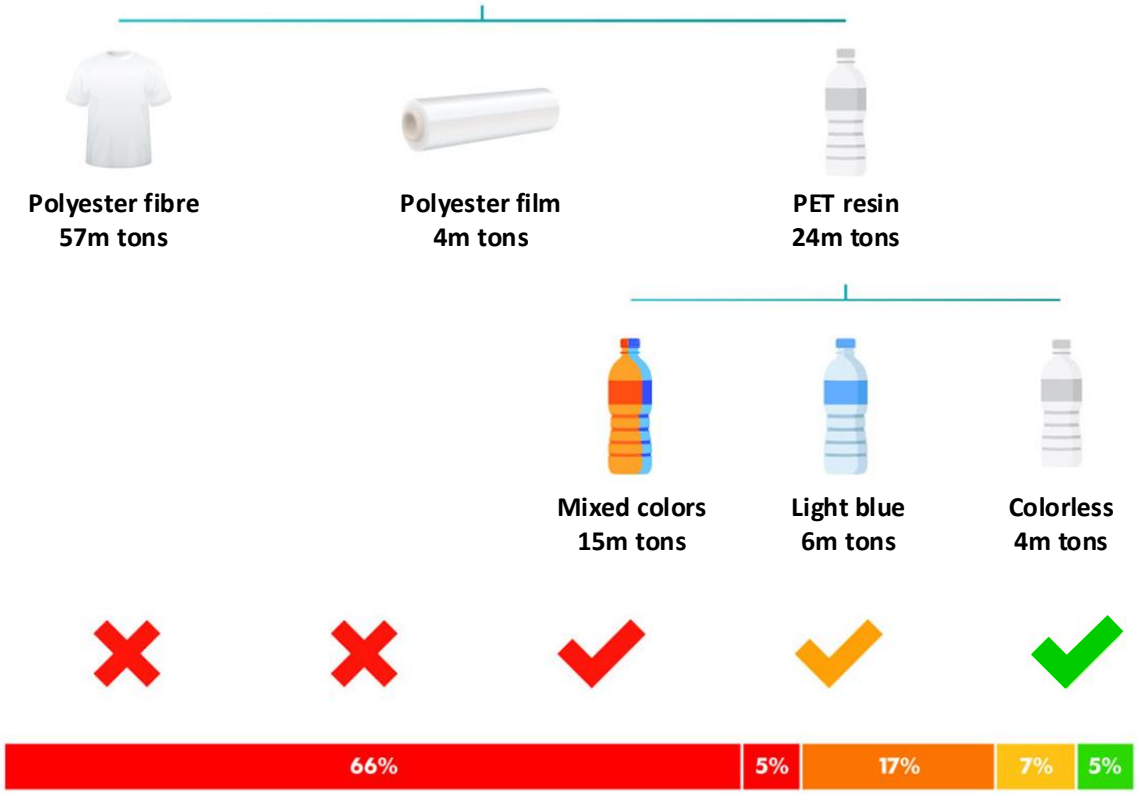
PETCORE EUROPE

END WASTE RECYCLE THE 1

www.petcore-europe.org

Today's PET lifecycle is not a closed loop

PET = 90m tons *(2nd most used plastic after PE)*



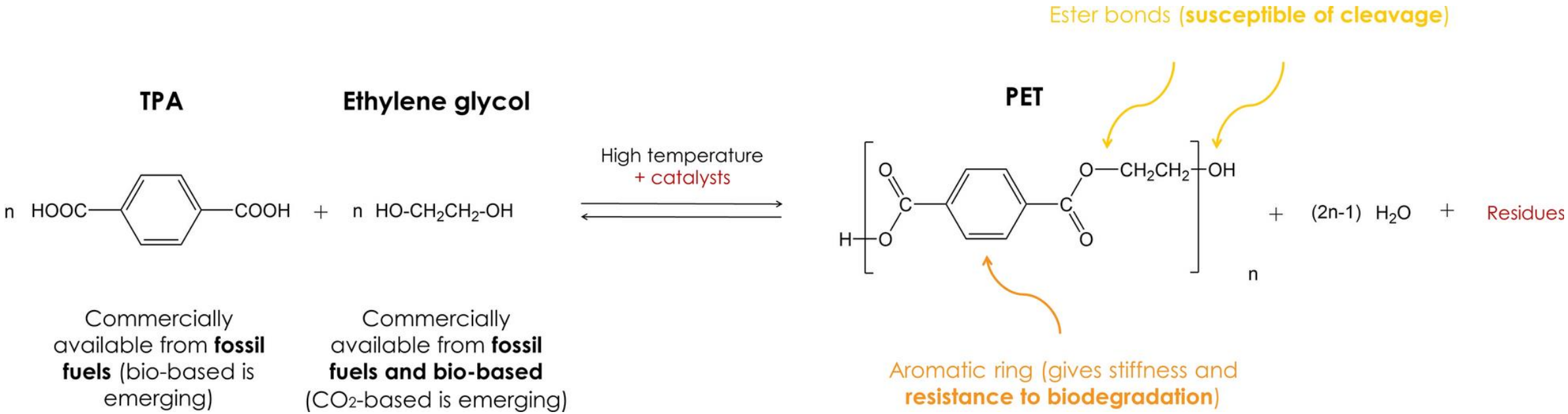
Source: ICIS data and Petcore

Mechanical recycling is suitable for treating only a **small percentage** of items (~15-20% of total production)

All the remaining items are **incinerated, landfilled or dispersed into the environment** after use

More than **70% of recycled PET** produced (about 10m tons per year) is **down-cycled or cascaded** to produce fibre, which in their turn could not be recycled anymore via mechanical processing

PET | Synthesis



Commercially available from **fossil fuels** (bio-based is emerging)

Commercially available from **fossil fuels and bio-based** (CO_2-based is emerging)

C. Palacio-Mateo et. Al, *Environmental Sciences Europe*, 2021, ***33***

After the to the polymer is compounded with other material to acquire the desired functionality according to its application. The other material are the contaminants that creates the issue at the end-of-life of the polymer.

Feedstock composition | Packaging vs Textile

PACKAGING

MATERIAL	Amount (% wt/wt)
PET	70-100
Other polymers	< 30
Colorants	< 1
Dyes	< 1
Antioxidants	< 1
UV Scavengers	< 1

TEXTILE

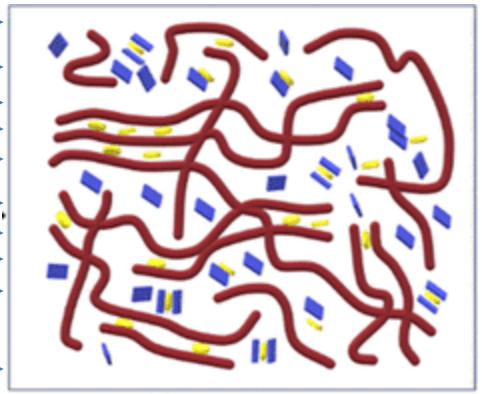
MATERIAL	Amount (% wt/wt)
PET	30-100
Other polymers	<70
Colorants	1-3
Dyes	0.3-2
Metals (brass, zinc alloy, aluminum, steinless steel	variable
Glass beads	variable
Waterbased/polyurethane prints	variable
Dispersed ink transfer prints	variable
Rubber prints	variable
PVC prints	variable
Pigment prints	variable
DWR finishes	variable
Wicking/Hydrophylic finishes	variable
Non-Metal based antimicrobial	variable
Metal based antimicrobial	variable
Fire retardants finishes	variable

Where the contaminants are |Polymeric trapping

Surface contamination

- Other polymers
- Colorants
- Dyes
- Metals (brass, zinc alloy, aluminum, steinless steel
- Glass beads
- Waterbased/polyurethane prints
- Dispersed ink transfer prints
- Rubber prints
- PVC prints
- Pigment prints
- DWR finishes
- Wicking/Hydrophylic finishes
- Non-Metal based antimicrobial
- Metal based antimicrobial
- Fire retardants finishes

Molecular contamination



Mechanical processing removes contaminants from the surface of the fibers but cannot removes what is trapped/blended in/with the polymer chains. The removal of these materials requires a molecular processing

Chemical recycling | A general process

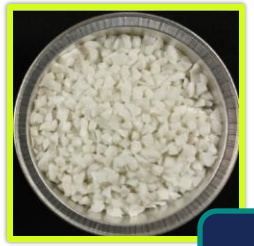
INPUT: POST/PRE CONSUMER WASTE

PRE-TREATMENT

DEPOLYMERIZATION

PURIFICATION

RE-POLYMERIZATION

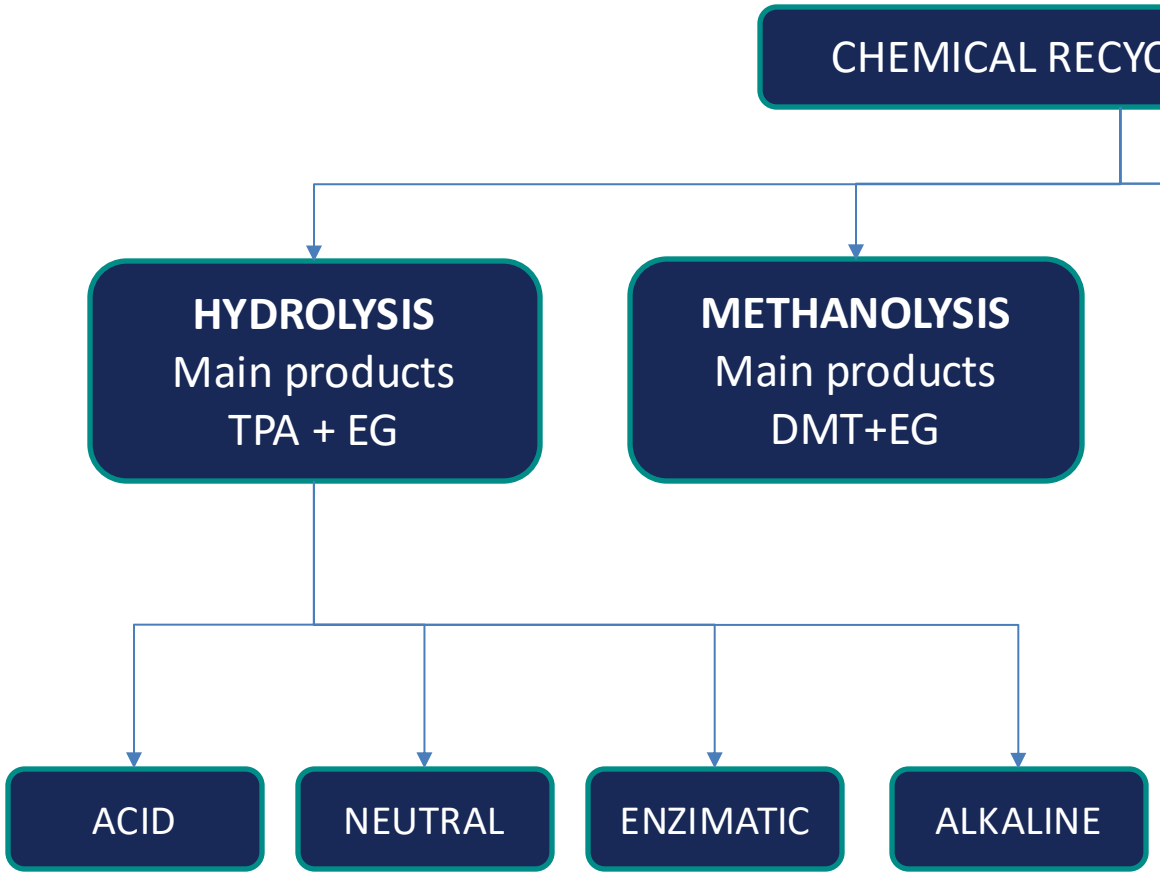


RE-CONVERSION

OUTPUT: NEW VIRGIN PRODUCTS

CONTAMINANTS

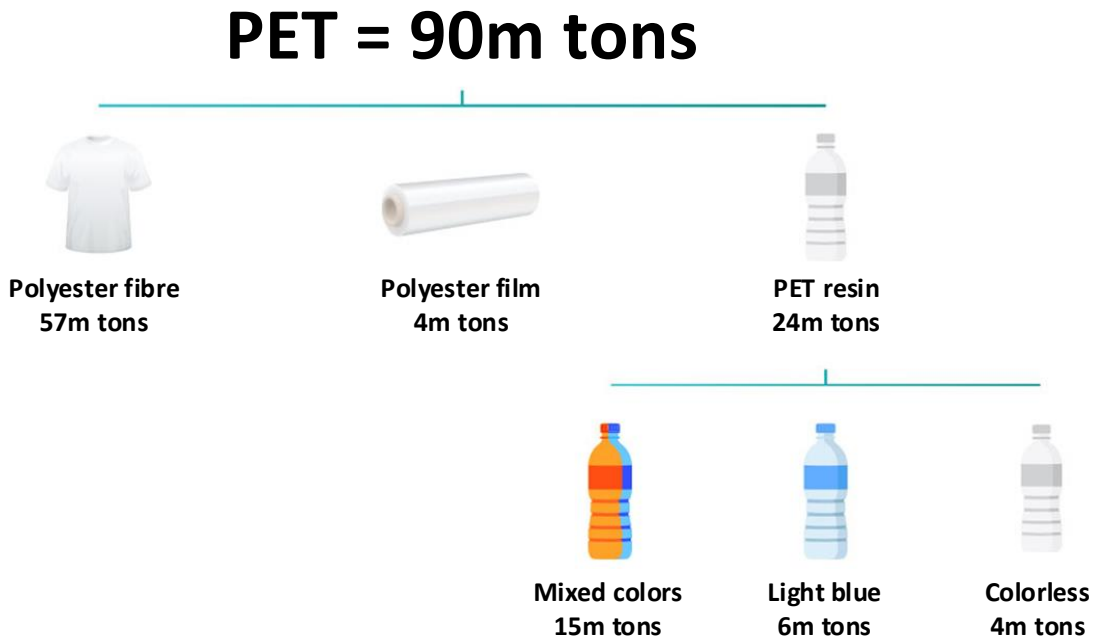
Chemical recycling | An overview

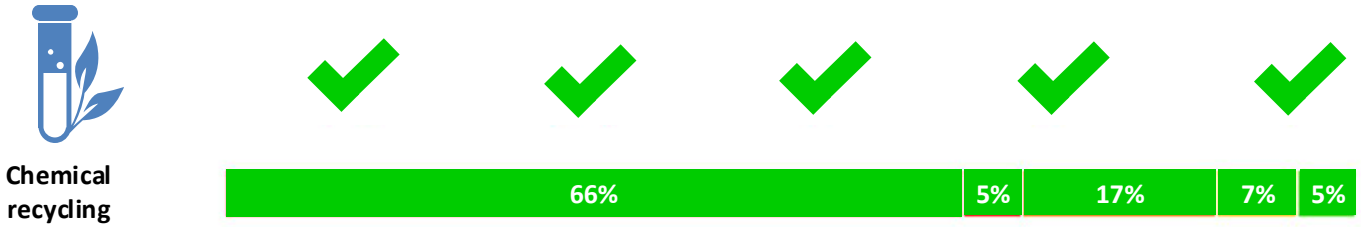


Axens · CARBIOS · ChemPET · CURE Polyester Rejuvenation · loop INDUSTRIES · POSEIDON PLASTICS
EASTMAN · Starlinger RECYCLING TECHNOLOGY · EREMA PLASTIC RECYCLING SYSTEMS · GR3N · HERBOLD MECKESHEIM
IFP Énergies nouvelles · INEOS Aromatics · ioniqa · SK chemicals · RITTEC · PET EUROPE
PELLENC ST WE CAN SORT IT · DePoly · TOMRA · POLYMETRIX · DOW
Mylar Specialty Films

pioneering PET circularity since 1994 PETCORE EUROPE
END WASTE RECYCLE THE

Chemical recycling | Why





Virtually **all treatable PET as feedstock**: ODR packaging, polyester fibres, coupled plastics, film, …

Virgin grade monomers obtained; thus, **new virgin grade plastic** could be produced **endlessly** out of waste without recurring to depletable fossil fuels

14:50-15:00
Mechanical recycling: updates from Starlinger, Erema and Coperion by Wolfgang Herman - Erema

Wolfgang HERMANN PhD Chemist - Erema

R&D Chemist in Polymer Industry since 1989 in companies CIBA, Borealis, dealing with Fiber Reinforced Products for Windenergy, Sports Goods

Business and Product Development for Individual Marking Solutions (Trodat Group)

Technology and Product Development for Basaltic Fibers, Thermoplastic Fibers

Managing Director in IFG (International Fibers Group), Company Asota Thermoplastic Fibers

Business Development Manager for Fibers & Textiles in Erema Group

Advancing Polyester Textile Circularity

joint view from mechanical recycling solution providers

Downcycling of Polyester/PET

images courtesy of Ikea, Amazon, rowlandsupholstery.co.uk

Upcycling of Polyester/PET

images courtesy of
Freudenberg, Ford and Unifi

UNDERBODY SYSTEMS

LOAD FLOOR / SEATING

PRIMARY BACKING TUFTED

FLOOR MATS

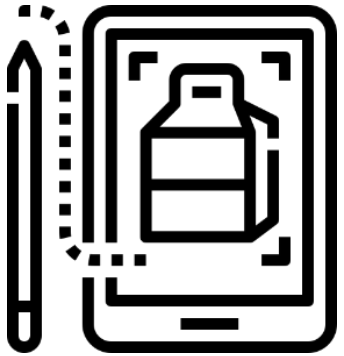
Challenges for Recycling of Textiles

- Feedstock Post Consumer Textiles as (wild) mix of fibers → Mission impossible ?
- Cooperation along the Value Chain absolutely required (see Key Success Factors nxt slide)
- Complementary Technologies as Separation / Exploiting Technologies required

  → separation by mechanic / hydrolysis / or (bio)chemical / enzymatic technologies to process fractions

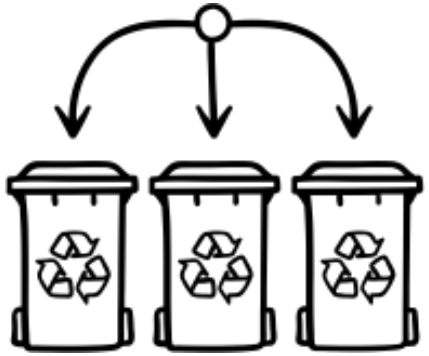
  Focus on IDENTIFICATION / SORTING / SEPARATION PROCESSES (incl. Sensors, AI,…)
- partially existing → need for scale up / industrialisation / economic prove of new technologies

Key Success Factors for Textiles Recycling



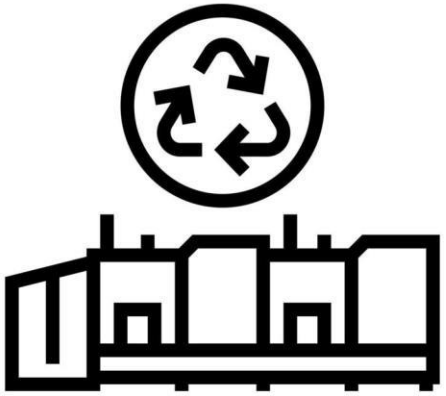
PRODUCT DESIGN

Monomaterials (instead of or multilayers separation technology) for Recycling



COLLECTION / SORTING

- digital marking / chemical tracers for efficient Identification
- NIR (and other optical scanning - computer vision technologies) sorting systems
- Artificial Intelligence machine learning / Advanced Robotics systems to support sorting



PROCESSING

- Complementary Application of all existing and new Recycling Technologies:
- MECHANICAL RECYCLING
- **(ADVANCED) THERMOMECHANICAL RECYCLING**
- CHEMICAL RECYLING

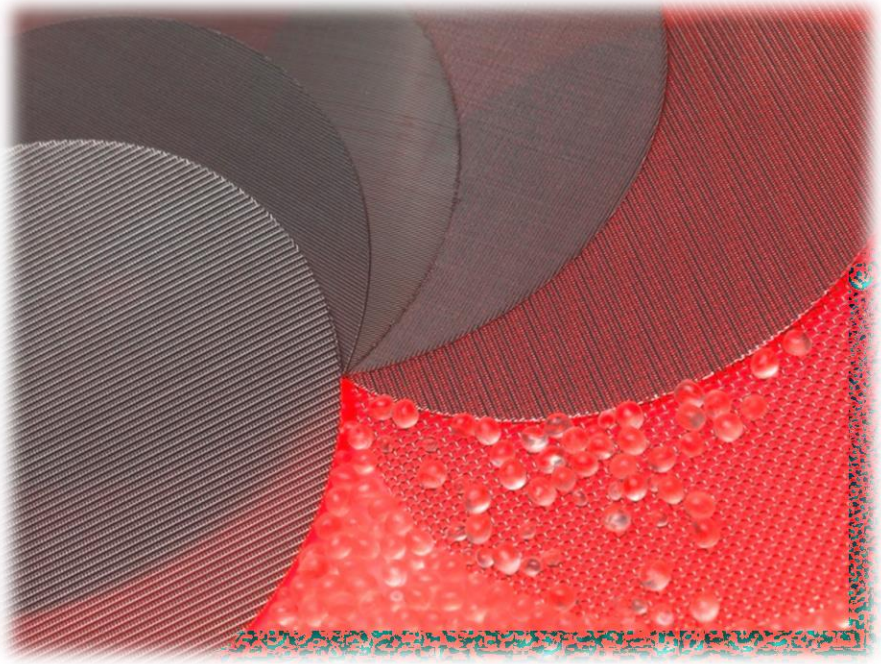
Mechanical Recycling
Cost-effective and proven technology

- Extrusion in single screw or twin screw extruders
- Melt filtration typically in 2 steps
- IV increase in melt phase or solid phase (pellets)
- Low(est) Energy Input for fibrous Plastics Recycling

Requirements for re-use in filaments (upcycling)

melt filtration

1



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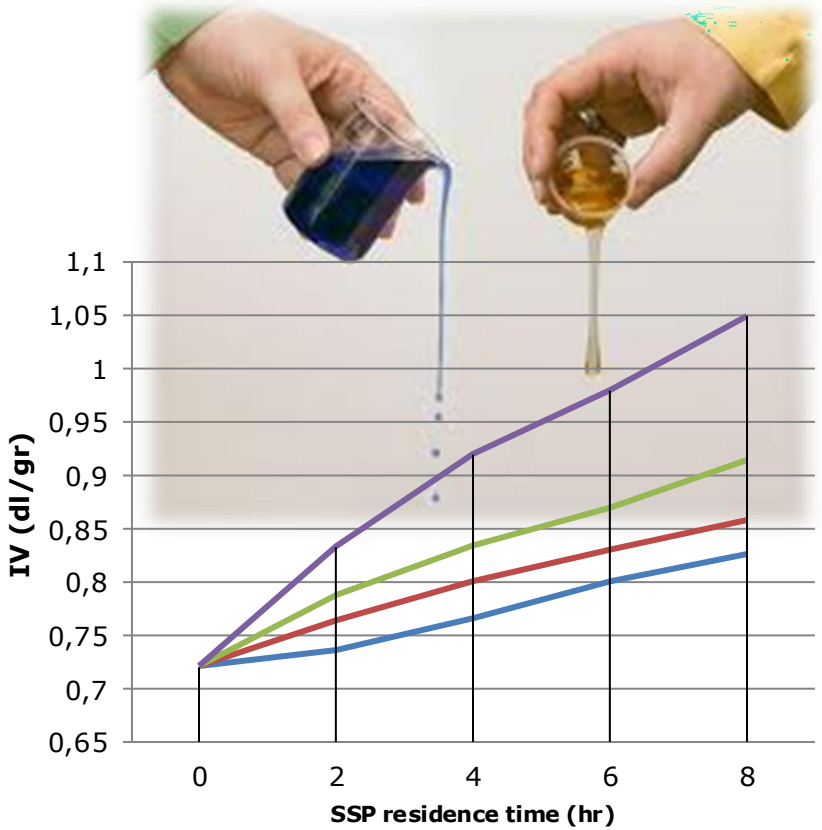


viscosity/IV

image courtesy of ingenieur.de

Advanced Thermomechanical Recycling

- ADVANCED THERMOMECHANICAL RECYCLING by Inline REPOLYMERISATION

  → <u>Utilisation for FIBRE to FIBRE RECYCLING „100%“</u>

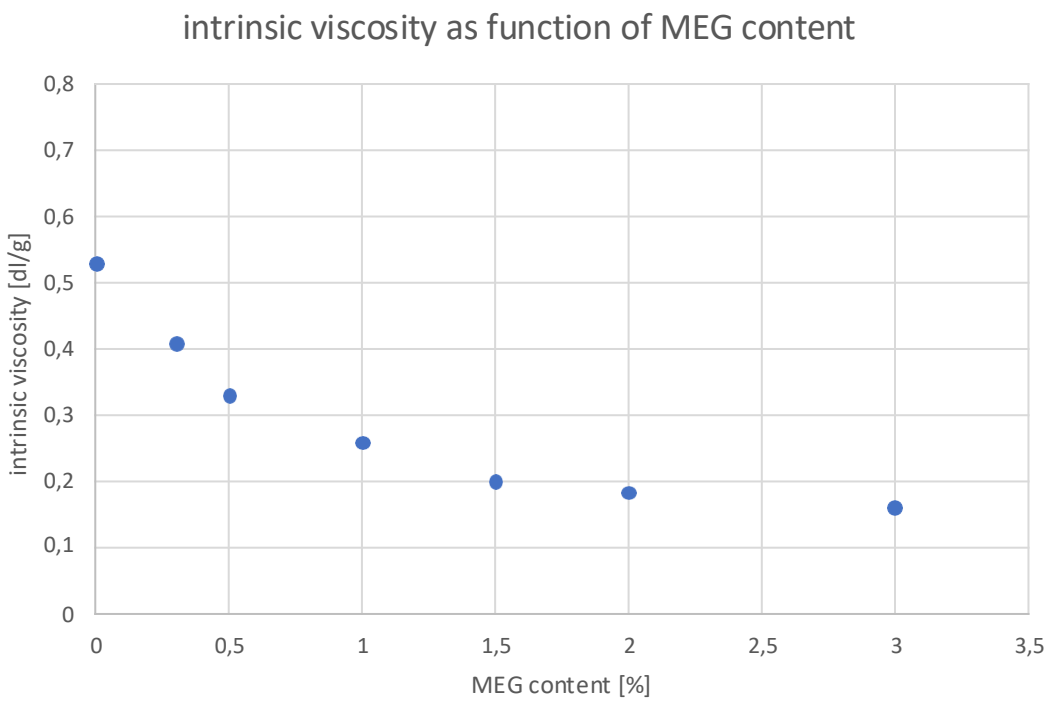
  i.e. All Output Material direct convertible back to Melt Spun Fibres, no blending required

  ….meaning Output Material to 100% useable for Fibre Spinning without Blending !

- Inline Feeding into Fibre Spinning Process feasible by fast inline Repolymerisation Process
- Keeps „very nice“ White Grades (low B Values) by high Vacuum
- Dying possible into darker shades (no removal of Input feedstock colouz)
- Needs high Purity Levels (< 5 % Contamination) depending on nature of (polymer) Impurities
- Industrial Scale fully evaluated Technology

Feedstock preparation → chemical recycling

- Twin Screw Extruder as prepartion and feeder for downstream reactor
- Partial Glycolysis during extrusion



Post consumer Polyester textile

Polyester textile and fibers

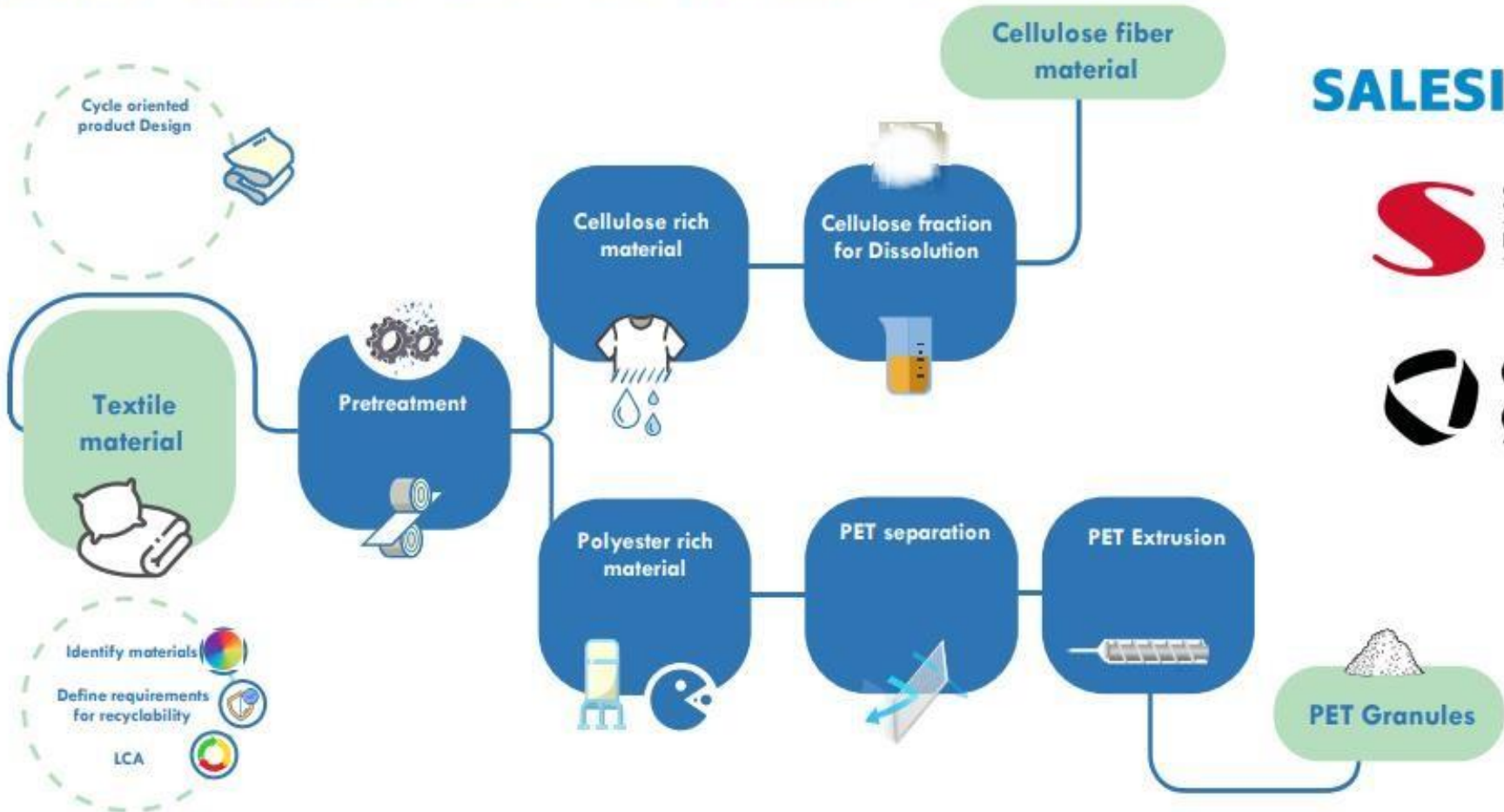
Multilayer PET bottles and packages

Economic potential of textile recycling and hydrogen production from textile waste in Bavaria - Research project: Bifa

Recovery Strategies for Textiles

FH WIENER NEUSTADT
BIOTECH CAMPUS TULLN
– Biotechnology & Digital Future –

A research project to separate cotton and polyester textile material



SALESIANER

Starlinger RECYCLING TECHNOLOGY

erema group

Summary „Thermomechanical“

- Proven technology over decades for PET Recycling
- Short Loop with lowest Energy Input for Plastics Recycling
- Recent Developments into Inline Repolymerisation proven

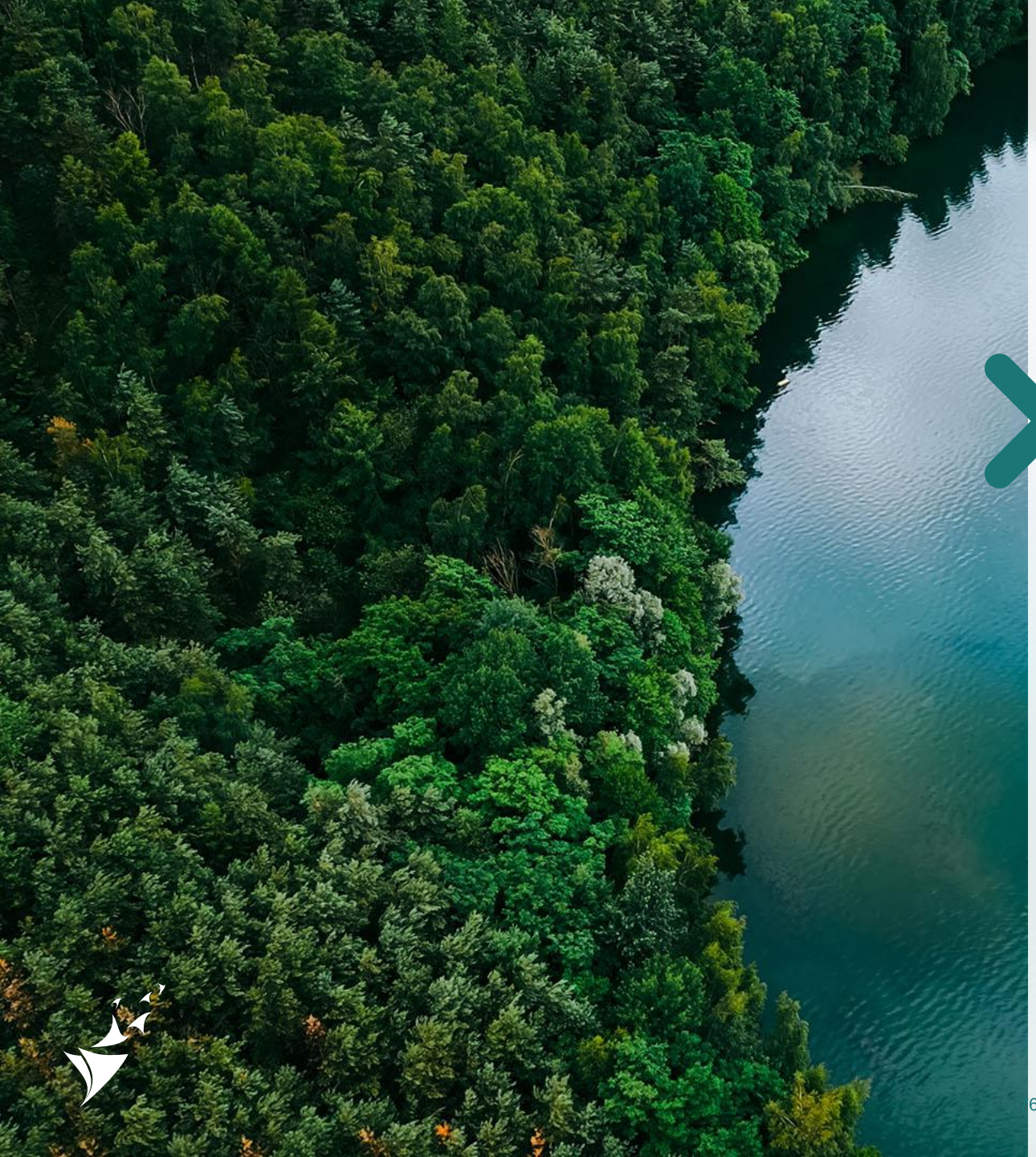
→ Capabilities for PET Fibre to Fibre Recycling for Textiles

15:00-15:10
Return of experience on Mechanical and Depolymerisation Recycling – Anca Pora (GreenGroup)

Anca Pora - GreenGroup

As the Commercial Director at GreenTech, the plastic recycling division of GreenGroup - the largest PET recycler in Central and Eastern Europe and a leading producer of recycled polyester staple fibers: Anca leads a dedicated team with 14 years of expertise in producing and selling sustainable products, including polyester staple fiber, rPET, and PET straps.

GreenTech offers key industry players innovative solutions for sustainability, CO2 emission reductions, and 100% recycled products. We are passionate about our work, committed to environmental responsibility, and deeply care about both our partners and employees. We take pride in being flexible, dynamic, and supportive, always open to new challenges and dedicated to delivering just-in-time solutions.



Return on experience in depolymerization & mechanical recycling

ANCA PORA

Marketing & Business Development Director
GreenTech a GreenGroup company

December 2024

GreenTech is a GreenGroup Company

~ 100 Mil Euro Revenues

Continuous growth
and investment

1000+ employees

A healthy environment for
future generation

150.000 tones/year

Total input of waste capacity

European Footprint

Romania,
Slovakia,
Lithuania

Output Products

PET Flakes ~ 17.000 t/year
r-PET Granules ~ 15.000 t/year
Polyester Staple Fibers
~ 45.000 t/year
PET Strap ~ 7.500 t/year
By-Products

Market Context

Evolving Context: Europe faces increasing pressure to address the environmental impact of the textile and fashion industries, pushing for more sustainable practices in production, consumption and disposal.

GreenTech's Leadership: As the largest recycler in Europe, GreenTech recognizes the need to adapt to market dynamics and changing legislation to stay competitive.

Sustainability Focus: We are committed to continuous improvement and sustainability, exploring alternative solutions for sourcing PET bottles used in polyester fiber production.

Diversifying Feedstock: In response to rising production costs and industry shifts, we are seeking new input materials such as soft and hard waste to replace traditional PET bottles.

Ensuring Efficiency: By diversifying feedstock, we aim to maintain operational efficiency, profitability and uphold our environmental commitments.

Circular Economy: This strategy supports our competitive edge while advancing our efforts to reduce waste and promote a circular economy.

Mechanical and Chemical Recycling

Complementary Recycling Methods: Chemical and mechanical recycling must work together. Waste that cannot be processed through mechanical recycling should be directed to chemical recycling, which can break down and reuse materials like cotton, polyester and wool.

GreenTech's Approach: GreenTech, along with other companies, is focused on developing processes that allow textiles to be recycled into new products, helping close the loop on textile waste.

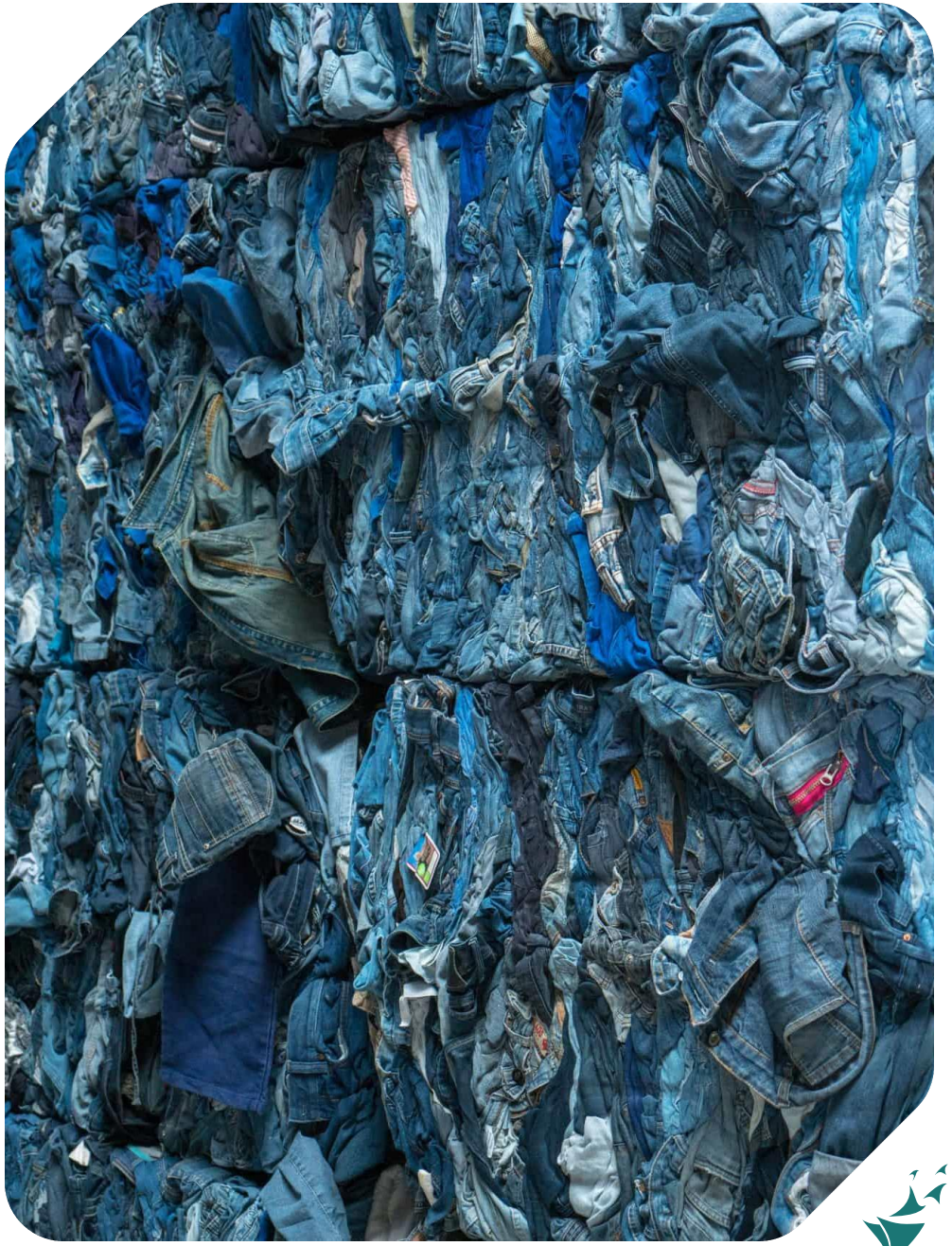
Addressing Limitations: Both mechanical and chemical textile recycling have limitations that can be overcome through clear legislation, recycling innovation and scaling up infrastructure across Europe.

Key Challenges:

- Complexity of recycling mixed-fabric textiles.
- Contamination from non-recyclable materials.
- Lack of clear collection streams on 100% PET or max 5% contamination with other materials.
- Lack of a uniform recycling system across countries.

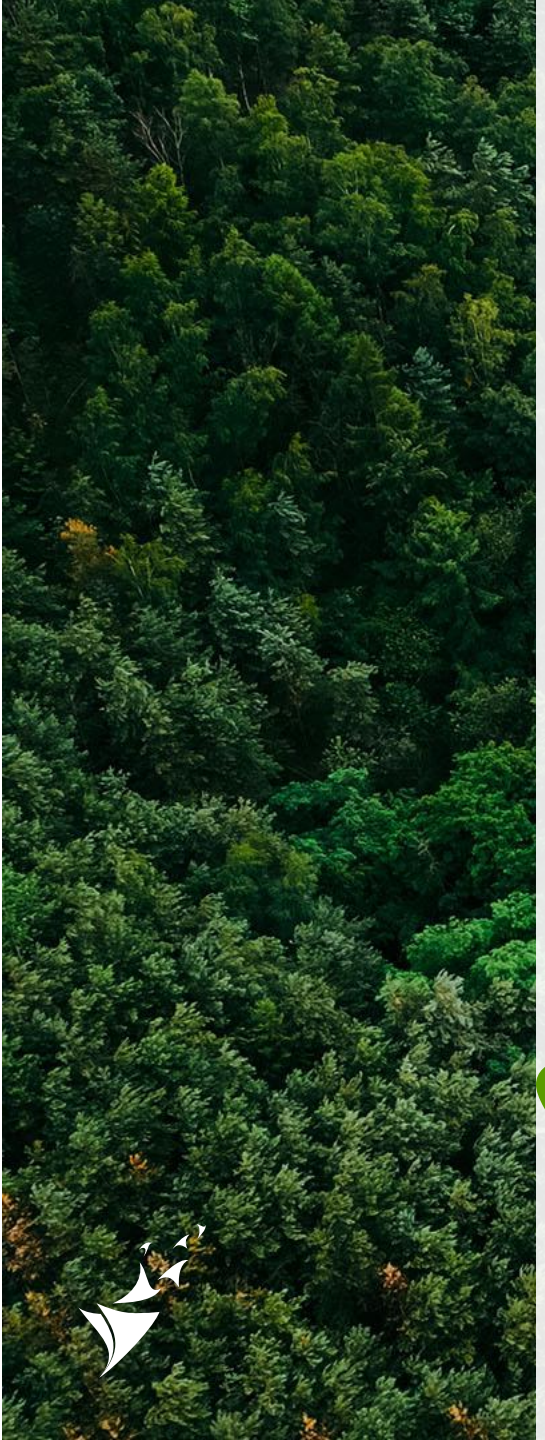
Opportunities for Growth:

- Scaling up textile recycling infrastructure to increase processing efficiency and capacity.
- Raising consumer awareness and promoting responsible purchasing habits to drive demand for recycled products.
- Collaborating with brands to design textiles using single-material fabrics and eco-friendly processes to enhance recyclability and support a circular economy.



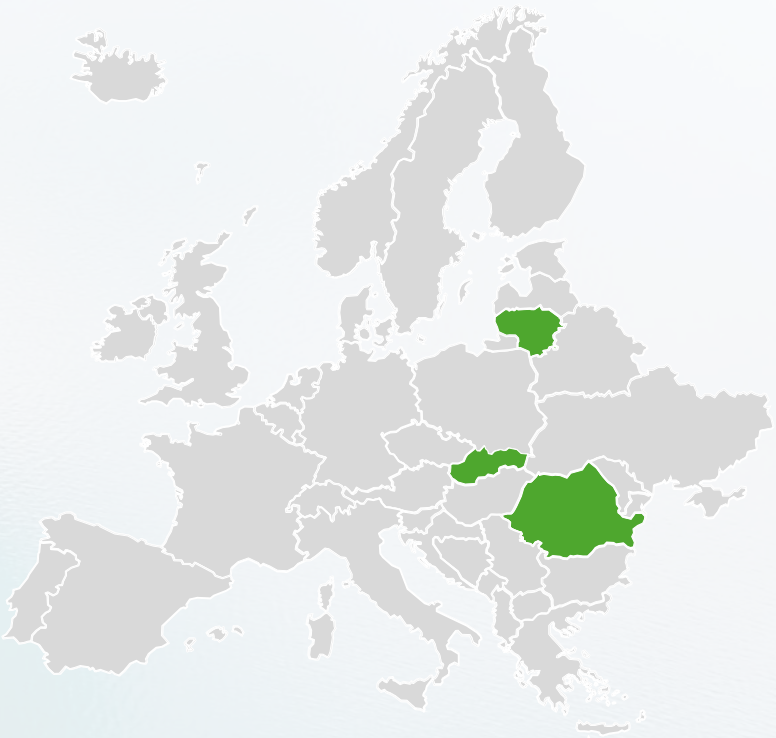
Short and Mid-Term perspective

- **GreenTech** is committed to adaptability and flexibility in response to current industry challenges.
- As one of the largest recyclers in Europe, we continuously evolve to meet changing market demands and shifting regulations.
- With new legislation we are moving away from using PET bottles as feedstock for polyester fibers and we have taken significant steps to identify and implement alternative sources (e.g. textile).
- **Mechanical recycling** can only handle a limited input of textiles depending on the composition, targeted 100% PET
- **Mechanical recycling** can handle part of the textile waste depending on how collecting streams are organized - %PET content
- **Mechanical recycling vs Chemical recycling** advantages: processing cost & CO2 emissions
- **Chemical recycling** should be a complementary process that should handle more sophisticated compositions of textiles that cannot be handled by mechanical.



Green | Tech
A GREENGROUP COMPANY

WE DRIVE
RECYLCING FORWARD



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Web: www.greentech.ro/sk

15:10-15:20 Q and A session

Feel free to use our dedicated channel for the Q and A so that we can be sure to answer as many questions as we can.

15:20-15:30
Geographical Presence and Development - Philip Boydell

Philip Boydell - Depoly

Philip Boydell worked 35 years for DuPont in a variety of roles including technical and business developments in recycling.

In the last 3 years, Philip has acted as a consultant to DePoly, a swiss company commercialising alkaline hydrolysis.

Geographical Presence and Development

Philip Boydell

Panorama

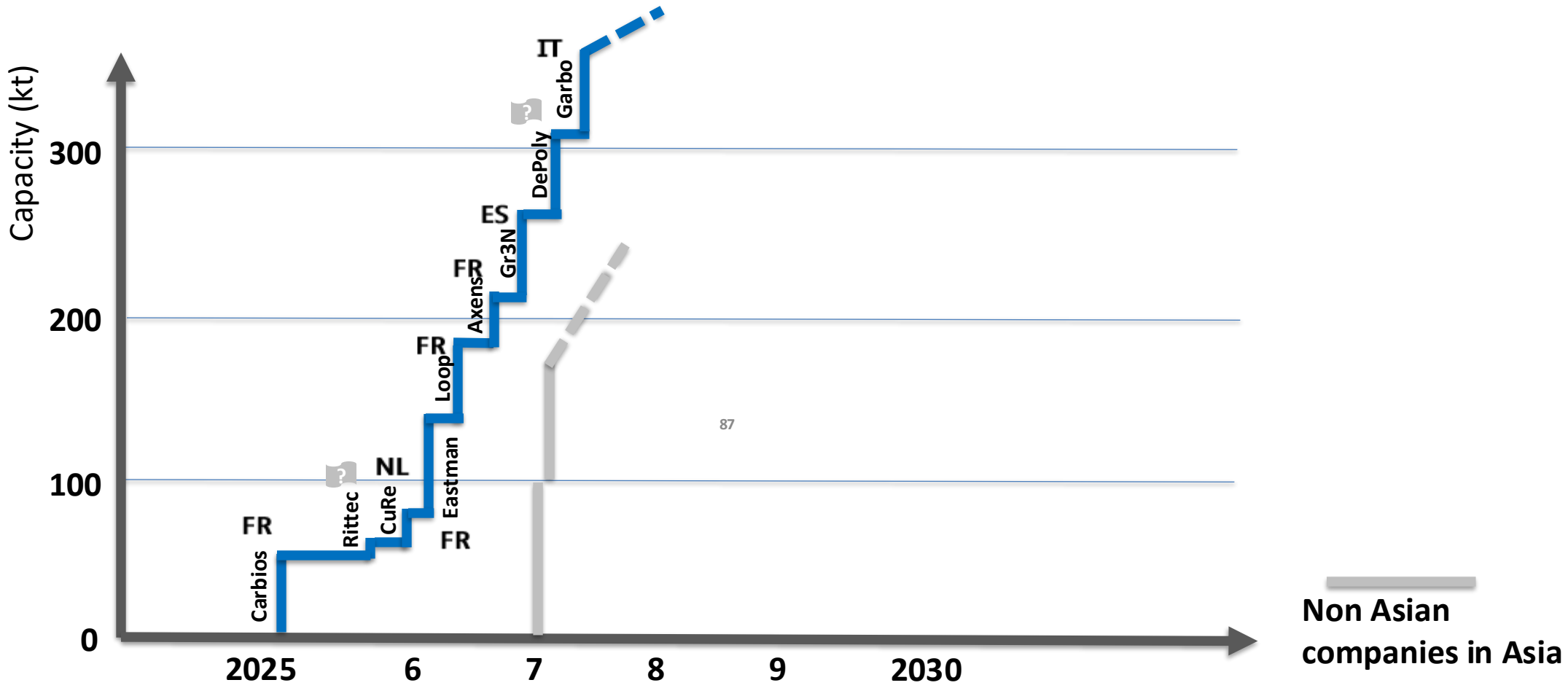
- Global Issue
- Technology being developed in Europe, N. America and Asia

Readiness to Depolymerize in Europe*

* 27+nochuk

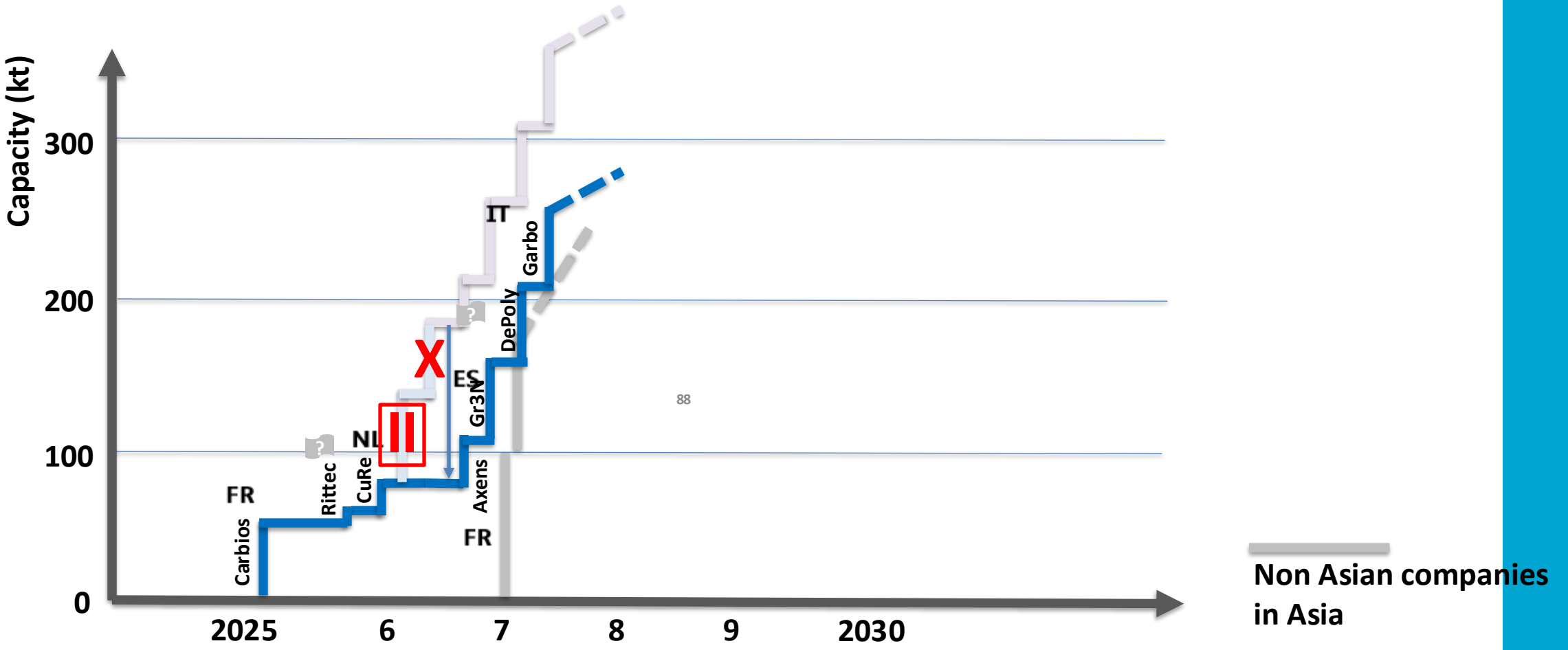
Status of Depolymerization in Europe

Industrial Scale Projects (2Q24)



Status of Depolymerization in Europe

Industrial Scale Projects (4Q24)



Barriers to Industrialization

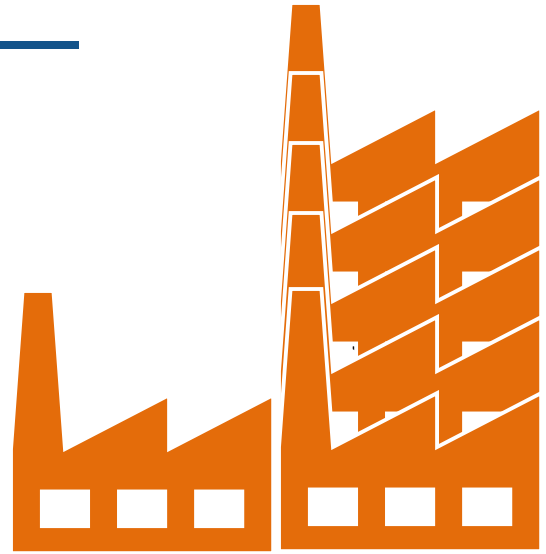
- Chinese dumping of cheap polyester-based clothing, ultra-fast fashion.
- Price sensitivity of brands and consumers for using recycled fibres.
- ‘End of Waste’ status too far downstream.
- Lack of ecosystem: collection, sorting, preparation into standardized textile feedstock streams.
- Lack of regulation and economic incentives to use European waste v import.
- Securing investment for industrial scale depolymerisation.
- Cost of energy v other regions

Measures Needed

- Clear legislation
  - mandating fibre production from European fibre waste allowing mass balance.
  - ‘End of waste’ status at monomer level
  - facilitation the trade of semi-recycled feedstock*
- Collection of EoL apparel etc., sorting and preparation into standardized textile feedstock streams.
- Quality standards through the supply chain.
- Financial incentives to build industrial scale plants.
- Globally competitive energy cost.

*(*e.g. cotton fraction of depolymerized ‘polycotton’ able to be traded without hindrance amongst certified recyclers in the EU in order to be able to process blends*

What Success Looks Like



Right Framework for Depolymerization

→ polyester fibre waste moves from environmental burden to import-replacing feedstock

Disclaimer

The information provided in this presentation reflects the author's best effort to reflect information provided by the parties concerned. The author takes no responsibility for the accuracy of the information presented and accepts no liability for inaccuracies.
Actual future events may differ from those outlined in the presentation.
The information provided in this presentation is under no circumstances to be used as a basis for financial or investment decisions.

15:30-15:50
Indicative Value Chain Costs by Bruno Langlois - Carbios

Bruno Langlois, PhD, Carbios

Graduated from Clarkson University, NY, USA. Over 25 years of experience in the chemical industry to develop business with innovative chemistries and establish long term partnerships. Bruno is passionate about innovations. Carbios, with its unique technical solution, business model, and ability to make PET circular is a perfect fit to passionately address the major issues to transition to a more sustainable economy by reducing our plastic and textile waste.

Indicative Value Chain Costs

A shift from Linear to circular requires new value chain steps

Cost structure to recycle textile (Fiber to Fiber)

Polyester : Collection – Sorting – Depolymerization – Repolymerization

Collection & Sorting	Feedstock preparation and pre-processing	Depolymerization and purification	Repolymerization and spinning
Logistic collection Sorting NIR/ Camera	Hard point removal (button, zipper, trims)	Solvolysis	Polymerization of monomers /oligomers
Output: feedstock polyester blends	Output: shredded agglomerated polyester blends	Output: pure monomers/ oligomer	Output: virgin quality resin, spinning to fiber
Cost: 500€/T	Cost 700€/T	Cost 1050€/T	Cost 350€/T

Cost estimate based on pilot units, and McKinsey Apparel, Fashion & Luxury Group July 2022 notes with adjustment based on inflation in EU between 2021-2024, total cost : 2600€/T at large scale, could be higher at start.

Polyester recycling : LCC

- The challenge to turn circular cannot be solved by a single player
  - All need to be developed at the same pace
- There is a huge gap between a mature production of virgin polyester, and an embryonic recycling polyester market (<1% T-to-T)
  - BUILD CAPACITY : 25-100kT units
- There exist capability to produce virgin quality PES from textile waste:
  - Give Value r-PES textile to textile, post consumer textile, close loop applications
  - Give value to lower CO2 emission and avoidance of feedstock destruction
  - Ban material not meeting a minimum environmental requirement
  - Built policies to promote collection & sorting of waste, ban export of unsorted material around the world.

Polyester LCC:

- The solution has no impact on the production of textile
  - Yarn spinning, fabric production garments, product manufacturing, consumer usage (durability, maintenance, aesthetic)
- The impact of cost is minimal on the final price of a textile garment:
  - In most of garments, the cost of material is low (high transformation value chain), and the additional cost will be below 1€ per piece.

Fleece jacket (100% polyester)

Selling price **	192€
PET weight	775gr

ADD + 0,91€ / Unit

* Assumptions on April 2023: Virgin PET price index (€/metric ton) 100; Mechanical r-PET 200; Advanced r-PET 300
** Unit price excluding VAT

Moderation

The key challenge lies in driving global expansion of textile circularity while simultaneously aligning all recycling steps across the EU moderated

15:40-15:50
Q and A session

Feel free to use our dedicated channel for the Q and A so that we can be sure to answer as many questions as we can.

We will be back after a short coffee break

15:50-16:00

16:00-16:20
Essential Tools for Recycling and Mandatory Design Standards for Circularity by Josse Kunst - CuRe TECHNOLOGY

Josse Kunst - CuRe TECHNOLOGY

Circular economy entrepreneur. He has lived and worked around the world and has 30 years business experience. After leading Royal DSM's circular economy initiative Niaga® he has founded his own company Kiduara focussing on molecular recycling, designing with advanced bio-based materials and impact investing in early-stage circular start-ups.

He acts as Holland Circular Hotspot Special Envoy, representing the thriving Dutch circular economy industry around the world and is member of the committee to select the winners of the Dutch NWO Spinoza Prize and NWO Stevin Prize, the highest honorary awards for top researchers in the Netherlands.

He is co-founder and/or co-owner of circular start-ups CL2B (Vietnam), Arapaha and Textile4Ever (NL) and is shareholder and Chief Commercial Officer of CuRe Technology (NL).

Essential Tools for Recycling and Mandatory Design Standards for Circularity

Josse Kunst, CCO CuRe Technology

11 December 2024

T-REX PROJECT Introduction

T-Rex

T-REX Project brings together 13 major players from across the entire value chain to create a harmonised EU blueprint and business opportunities for closed loop sorting, and recycling of household textile waste. Transforming end-of-use textiles, from waste, into a desired feedstock, and a commodity for new business models that can be adopted at scale.

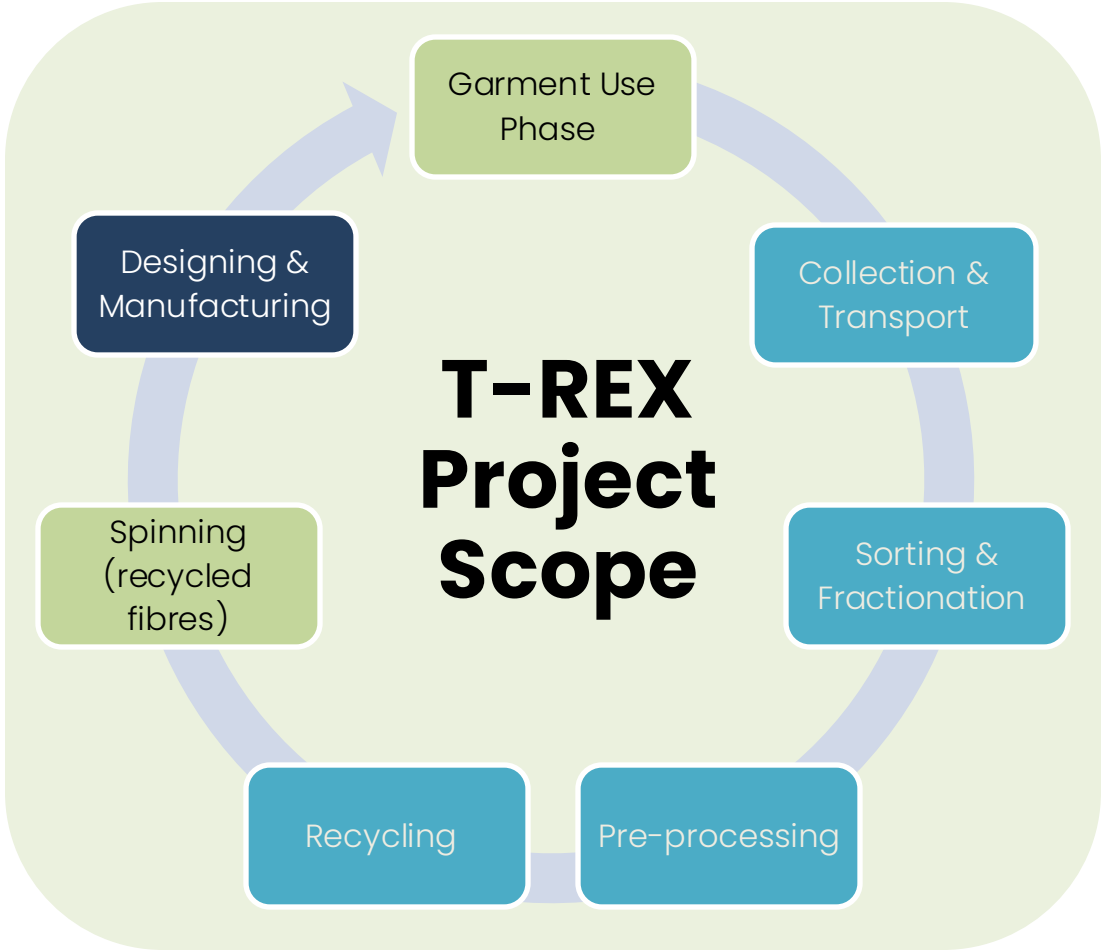
The Challenge

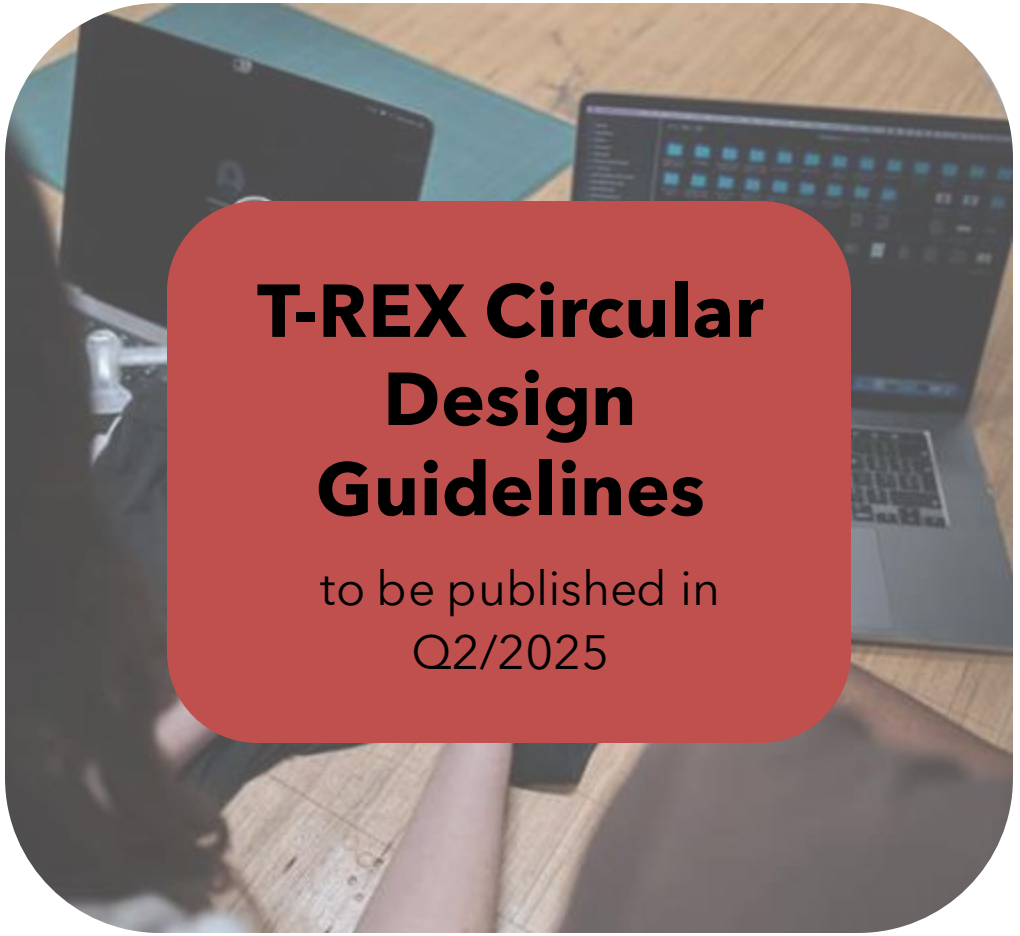
Today, 2% of post–consumer textiles (in Europe) are diverted to fibre-to-fibre recycling. Creating a circular system for post-consumer textile waste currently faces many challenges, including a lack of standards for collecting and sorting textile waste across countries, inaccurate composition claims, uneven quality of materials, and a lack of reliable data across value chain stakeholders.

T-Rex Project Partners

- Aalto University School of Arts, Design and Architecture — University
- adidas — Brand
- ARAPAHA — Innovator
- BASF We create chemistry — Polyamide Producer and Recycler
- CURE Polyester Rejuvenation — Polyester Recycler
- FASHION FOR GOOD — Innovation Consultancy
- FAU Friedrich-Alexander-Universität Erlangen-Nürnberg — University
- FULGAR — Fibre Spinner
- INDORAMA VENTURES — Fibre Spinner
- INFINITED FIBER — Cellulosics Recycler
- LinzTextil — Fibre Spinner
- Quantis — Consultancy
- VEOLIA — Waste Management Company

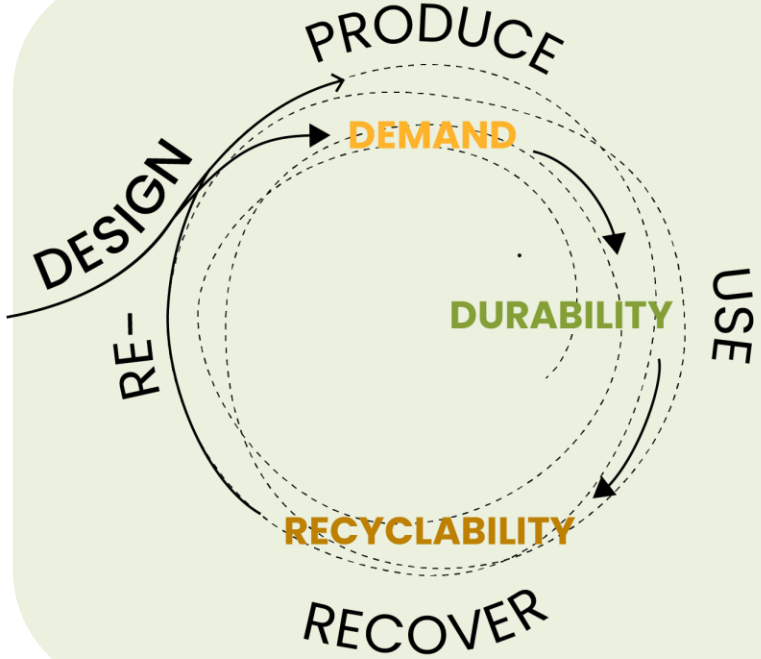
T-REX PROJECT Circular Design Guidelines





DESIGNING FOR RECYCLABILITY

The **PERFECT CIRCULAR GARMENT** considers all three design approaches:



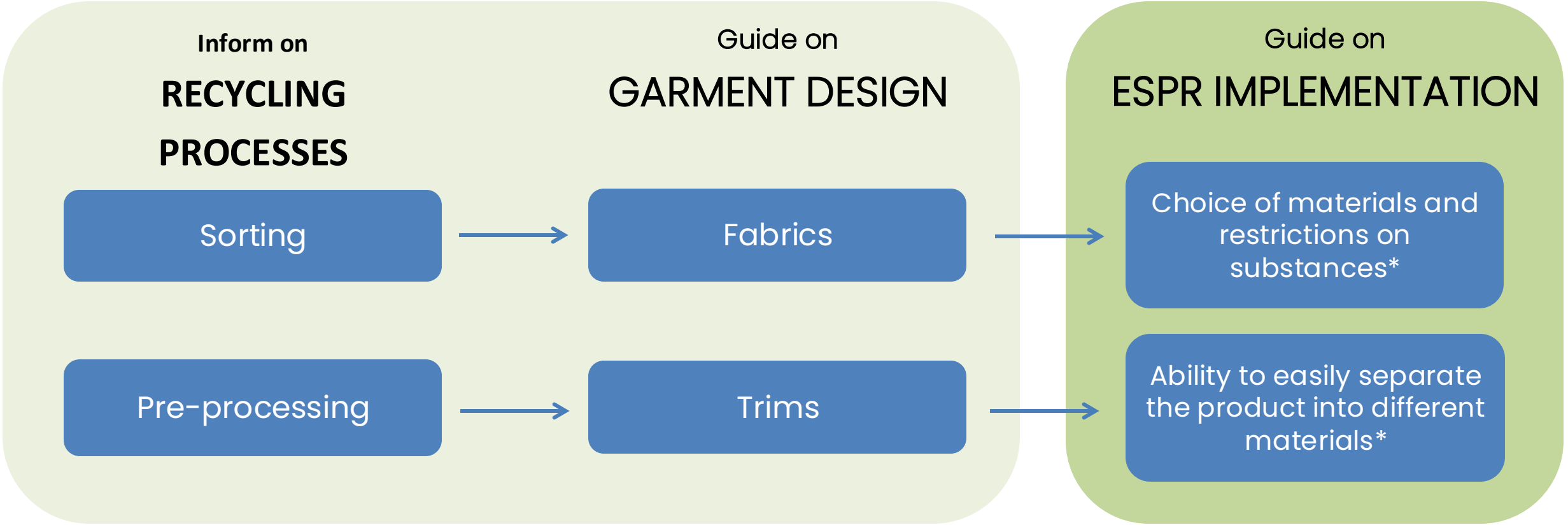
DEMAND
lowering the impact of the materials and processes used during production and minimizing over-production

DURABILITY
increase the lifespan of a garment

RECYCLABILITY
Ensuring the highest quality and quantity of material recovery due to the use of recyclable fabrics and garment elements

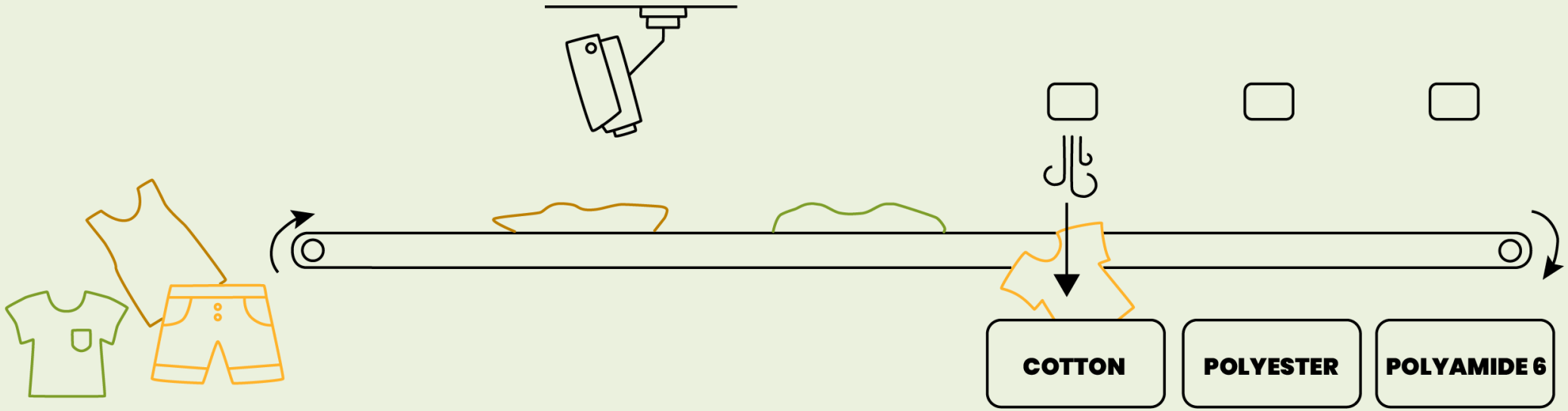
But it's not simple: the garment **INCLUDES TRADE-OFFS** between recyclability, demand & durability

Relation between RECYCLING, DESIGN & REGULATIONS



*Source: JRC science for policy report: Ecodesign for Sustainable Products Regulation preliminary study on new product priorities - 2023

FABRIC DESIGN in the context of SORTING



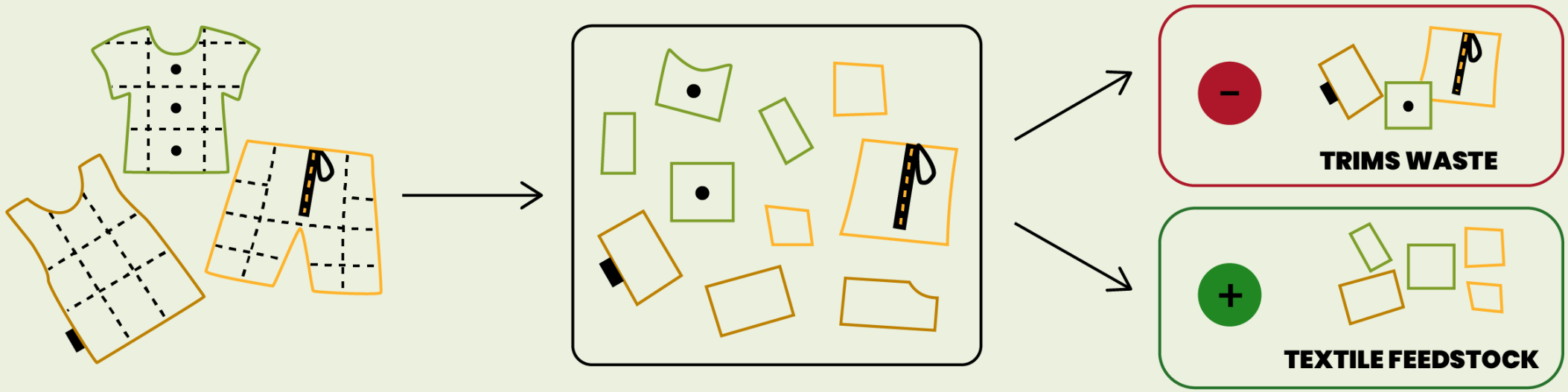
SORTING SPECIFICATIONS & LIMITATIONS
Only the main fabric is scanned to determine if the whole garment is valuable for recycling
Scans can become less accurate when there're multiple materials blended in one fabric
Scans can become less accurate when fabrics with different compositions are used in one garment
The finishes & coatings on garments cannot be detected by scanning techniques

RECOMMENDATIONS FOR ESPR

Choice of Materials and Restrictions on Substances

- **Primarily focus measures on the composition of the main fabric** as this is the part of the garment that will actually be recycled
- **Measures should allow the usage of blends within a specific range** if this is complementary to demand and durability design considerations
- **Measures should create incentives to use fabrics with the same compositions in a garment** to improve the reliability of sorting

TRIMS USAGE in the context of PRE-PROCESSING



DE-TRIMMING SPECIFICATIONS & LIMITATIONS

Hard trims can be removed relatively easily based on weight difference, but soft trims can't due to their similar weight as the fabric
Soft trims will most likely end up in the recycling feedstock
On an industrial scale there's no time to check individual trims or implement complex garment separation designs of individual garments
De-trimming can result in material wastage as some fabric will be attached to the removed trims

RECOMMENDATIONS FOR ESPR

Ability to easily separate the product into different materials

- **Focus on disassembly measures that are viable on an industrial scale** as complex disassembly designs of individual garments won't have much impact
- **Primarily focus measures on the materials used in soft trims** as they are significantly more difficult to remove than hard trims
- **Measures should stimulate to reduce trims usage** while still considering that trims may need to be used from a demand, durability & safety perspective

ASSESSING RECYCLABILITY T-REX BBLUEPRINT

The T-REX Circular Design Guidelines will contain product-level **Material Guidance** based on the feedstock requirements of the three recyclers participating in the project

Garment-level Design Specifications

Bale-level Recyclers Feedstock Requirements

LIST OF MATERIALS	RECYCLABILITY KEY	MAX % of weight accepted
List of common materials in **fabrics**	Fully compatible material/ Contaminant/ Disrupter	…% per material
List of common materials in **trims**		…% per material

Details public in Circular Design Guidelines in Q2/2025

ASSESSING RECYCLABILITY Methodology on Industry Level

RECYCLABILITY TESTING STANDARDS & CERTIFICATION should be established, considering the complexity of the processes involved:

- As many chemical recyclers in Europe are at pilot scale, the **processes and feedstock requirements** are still under development
- Depending on the type of material and technology, recyclers can have **significantly different feedstock requirements**
- How many material contaminants can be handled is not only a **technical but also an economical and environmental question**

There is a need for us to take action: bringing structure to this complexity by introducing standardization and certification to **ACCELERATE CIRCULARITY IN THE APPAREL INDUSTRY**

t-rex

THANK YOU FOR YOUR ATTENTION

pioneering PET circularity since 1993
PETCORE EUROPE
END WASTE RECYCLE THE

16:20-16:25 Q and A session

Feel free to use our dedicated channel for the Q and A so that we can be sure to answer as many questions as we can.

16:25- 16:50

Current State and Global Collaboration for EU Alignment on SIMULTANEOUS SCALABLE SOLUTIONS by Christian Crépet - PETCORE EUROPE

Ambassador and honorary member of the Board at PETCORE EUROPE

With a commercial and executive business management background, Christian-Yves Crépet started his career with Dow Chemical and went on with Eni Chem both in France and other European countries. Before running PETCORE EUROPE, he has been the Managing Director of the French 50 kt/pa PET&HDPE recycling company Corepla Industrie for the last 21 years. A former Vice-President, co-founder of Recyclass, Co-chair of the PET WG and Chair of the HDPE/PP WG of PRE until 2016.

PETCORE EUROPE

Pioneering PET circularity since 1993

PETCORE EUROPE

END WASTE RECYCLE THE 1

www.petcore-europe.org

THE IDEA

Addressing current challenges to enhance and refocus collection and sorting of post consumer garnments efforts through « Global Collaboration EU Alignment » for scalable and coordinated solutions.

Textiles Circularity Challenges in the EU: is the EPRs Concept Enough to Drive Polyester Circularity Across Member States?

1. Producers' Responsibility:

- This concept has gained traction by EU regulation for packaging but remains due to the complexity of the textile sector somewhat ambiguous for post-consumer textiles garments and particularly polyester recycling.
- The EPR concept is however essential! Countries like Italy, Belgium, Spain, and Germany are making progress in addressing it. With **France** taking a significant step forward **since 2008, It is an interesting model which is however confirming certain concerns about polyester feedstock in Europe.**

- **France - 2024 Update:**

- **188 kt** out of 870 KT/PA of textiles materials collected, with **60% reused amongst which** 10% remain in France and 90% going abroad.
- **32%** directed to recycling, including **19% (of 32%) polyester** .

- **As a result only 12 kt annually** of polyester are left for recycling. **Related with polyester imports 12 kt is terribly low! It bodes a dark futur if nothing is done quickly.**

2. Collection and Sorting Challenges

- **Mixed Textile Streams issues are mostly solved** :
  - **Automatic sorting enables scaling up** processes for subsequent preparation, making them suitable for recycling, including mechanical methods and depolymerization. However, these efforts are **not currently well funded for recycling**.
  - **Also, Polyester garments are often blended** with other fibers, but this is no longer the primary challenge - hence - facilitating the sorting.
- **Infrastructure Gaps remain major concerns**: Despite increasing volumes of polyester textiles, existing systems for collection and sorting they remain underdeveloped or overwhelmed.
  - **Curbside Collection programs are** limited. Resulting low recovery rates for polyester post consumer garments.
  - **Charity Systems**: Charitable organizations manage substantial textile volumes, but their capacity to process non-reusable or low-value items is strained.
  - As it may be difficult to change the collection systems adequatly, we then must **concentrate on investing & harmonizing sorting guidelines.**

3. Export Dominance is Leading to Supply Shortages and to environmental consequences.

- **High Export Rates**: 60–80% of collected garments are sent to low- and middle-income « global south countries ».
- **Overwhelmed Recipients**: Global South Countries face challenges with handling polyester low-quality & non-reusable garments.
- **Waste Accumulation** & Non-reusable textiles often end up in landfills or are incinerated, contributing to pollution and greenhouse gas emissions.
- **Economic Burden**: These countries lack the infrastructure for large-scale recycling or waste management, **leading to environmental degradation**.

4- Leading to a first conclusion

1. **No or Limited Recycling Capacity**:
   - Only a small fraction of polyester garments is sorted and, even less recycled.
2. **Barriers to Material Availability**:
   - Insufficient availability to almost no feedstock of polyester textiles for recycling due to significant quantities being shipped outside Europe without proper sorting.
3. **Amongst local EU member state policies and EPR's disparities, there is an urgent need for EU harmonization & coordination to ensure efficient collection and sorting.**
   - Effective recycling efforts hinge on the EU harmonization of collection and sorting systems across regions. It is essential not to follow to the letter the packaking model which often ended up by DRS but to adapt a special textile one…

- **Clear and well-adjusted EU regulations & organisation are essential to addressing these challenges, improving recycling rates, and establishing a sustainable framework for polyester recycling.**

The challenge of this complex polyester textile ecosystem lies in scaling-up EU-wide harmonization and coordinated infrastructure for collection and sorting. It is aimed at facilitating efficient preparation for recycling and enhance the entire value chain.

While considering that the polyester textile circularity value chain is five to ten times more capital-intensive than the packaging sector, a critical question arises: how can polyester feedstock availability be scaled up to drive industrialisation and avert major economic setbacks for start-ups burdened by substantial R&D investments?

The EU Institutions hold the key of the solutions of its systemic challenge

As opposed to packaging, the primary challenge will be to achieve simultaneous alignment across the EU to **coordinate** regulation while implementing of the Textile strategy.

1. **Development for an EU harmonized collection & automated sorting technologies scheme.**
2. **Strengthen preparation for recycling domestic & trans-national polyester recycling capacities with chemical recycling facilities to transform post-consumer polyester into high-quality raw materials.**
3. **ECODESIGN regulation.**
4. **Reduce « Over-Reliance » on Exports: regulate on EU domestic solutions for textile waste management recycling.**
5. **Revision of EoW definition.**
6. **Enforce Extended Producer Responsibility (EPR) schemes to ensure brands to contribute from collection to recycling costs.**
7. **Ambitious recycled content program.**
8. **Standards with chain of custudy treacability.**
9. **Certification**
10. **Robust Monoring**
11. **...**

To improve effectiveness, the following considerations could be suggested:

1. Collection Targets with Incentives

- Ambitious goals, such as the EU's existing target for implementing separate waste collection will be too challenging **without** mandatory incentives to boost participation.

- **MOST IMPORTANTLY : incentives (ex: reward clothing return, discounts on new purchase…) will address the unsolved data issue of reuse and UNDOCUMENT materials leaving Europe for « Global South ».**

2. Set ambitious recycled content targets

- Aiming for a **mandatory objectives** from 10% to 20% from post consumer garments **willl** drive innovation and investment in niche markets like mechanical recycling and most importantly for polyester depolymerization recycling.
- **But still it is essential to encourage manufacturers** to reclaim and recycle production waste, such as off-cuts and trims…
- **Provide incentives such as tax benefits**, **subsidies**, or preferential trade agreements to manufacturers that incorporate recycled polyester into their production processes.

3. Waste Shipment Rules

- **Transparent and SIMPLE Documentation Systems**:

  Use blockchain or other digital platforms to create simple, tamper-resistant tracking systems for textile shipments.

4. Clear Labeling… DPP (Digital Product Passport)…

– **Simplified Labeling Requirements**:

- Mandate easy-to-understand labels that indicate fiber composition, recyclability, and care instructions.
- Include QR codes or mobile-friendly links for detailed information, catering to regions with literacy or language barriers.

– **Integration with Informal Markets**:

- Educate secondhand sellers and buyers about the significance of labels through campaigns, ensuring the information is used effectively.

5. Robust Monitoring and Enforcement Mechanism to manage an Undocumented Market: a most Critical Challenge for Polyester Recycling.

- **Digital Solutions for Transparency:**
  Leverage mobile apps for real-time data collection and reporting, enabling even informal participants to contribute to tracking and monitoring efforts.
- **Community-Based Monitoring:**
  Involve local organizations, cooperatives, or trade associations as intermediaries to oversee and ensure proper monitoring within the community.
- **Crowdsourced Data Collection:**
  Empower consumers, waste collectors, and retailers to report textile flows via user-friendly platforms, facilitating comprehensive and accessible data collection.

6.Third-Party Verification & Certification

Collaborate with global certification bodies to introduce affordable audit systems, ensuring compliance without burdening small-scale players.

7. ECO DESIGN (DG GROW Polycy officer) A. De Sousa presentation coming next)

8. EoW definition has been addressed by L.Egle (JRC) Circular Economy and Industrial Leadership.

TO BE READY BY 2027-2030

- **A comprehensive strategy is essential to address a far more intricate & capital intensive challenge than packaging, requiring extensive collaboration & coordination** across the entire value chain, member states, textiles associations, most polyester stakeholders and the EU Commission.

- The current approach, largely relying on local Extended Producer Responsibility (EPR) schemes and EU regulatory decisions, is unlikely to effectively tackle many of the challenges facing the textile and polyester industries on its own, particularly in terms of recycling, without the involvement of the Brussels Value Chains and all specialized stakeholders.

- Ongoing amendments and adjustments will be necessary.

Last but not least

- **How can we harmonize and coordinate the polyester textile circularity value chain in Brussels, in collaboration with EPR stakeholders?**

- **One proposed solution is to establish a Polyester Textile, « ad hoc » ,Platform in Brussels**, modeled after the Circular Plastics Alliance (CPA) and **moderated** by the EU Commission. This platform would:
- **Educate stakeholders** who frequently express concerns about the complexity of navigating the polyester value chain.
- **Unite key players**, including brands, associations, member states, EPR schemes, producers, converters, collectors, recyclers, weavers, and other critical stakeholders.
- **Support the EU Commission** in addressing complex challenges more efficiently.
- **Provide a practical framework** for faster and more effective coordination on pressing issues.

- **& most importantly Enhance the industry's and investors' capacity** to shape a more sustainable and future-ready polyester textile sector.

Thank you

16:45-16:50

Q&A on how can the textile industry be ready to harmonize simultaneously scaling for an EU sustainable success?

Feel free to use our dedicated channel for the Q and A so that we can be sure to answer as many questions as we can.

16:50-17:05

The key challenge lies in driving global expansion of textile circularity while simultaneously aligning all recycling steps across the EU moderated by Bruno Langlois - Carbios

Bruno Langlois, PhD, Carbios

Graduated from Clarkson University, NY, USA. Over 25 years of experience in the chemical industry to develop business with innovative chemistries and establish long term partnerships. Bruno is passionate about innovations. Carbios, with its unique technical solution, business model, and ability to make PET circular is a perfect fit to passionately address the major issues to transition to a more sustainable economy by reducing our plastic and textile waste.

17:05-17:15
Insights from EPRs & Refashion by Christian Crépet - PETCORE EUROPE

Ambassador and honorary member of the Board at PETCORE EUROPE

With a commercial and executive business management background, Christian-Yves Crépet started his career with Dow Chemical and went on with Eni Chem both in France and other European countries. Before running PETCORE EUROPE, he has been the Managing Director of the French 50 kt/pa PET&HDPE recycling company Corepla Industrie for the last 21 years. A former Vice-President, co-founder of Recyclass, Co-chair of the PET WG and Chair of the HDPE/PP WG of PRE until 2016.

Re_fashion

Accélérer la transition vers une mode 100% circulaire

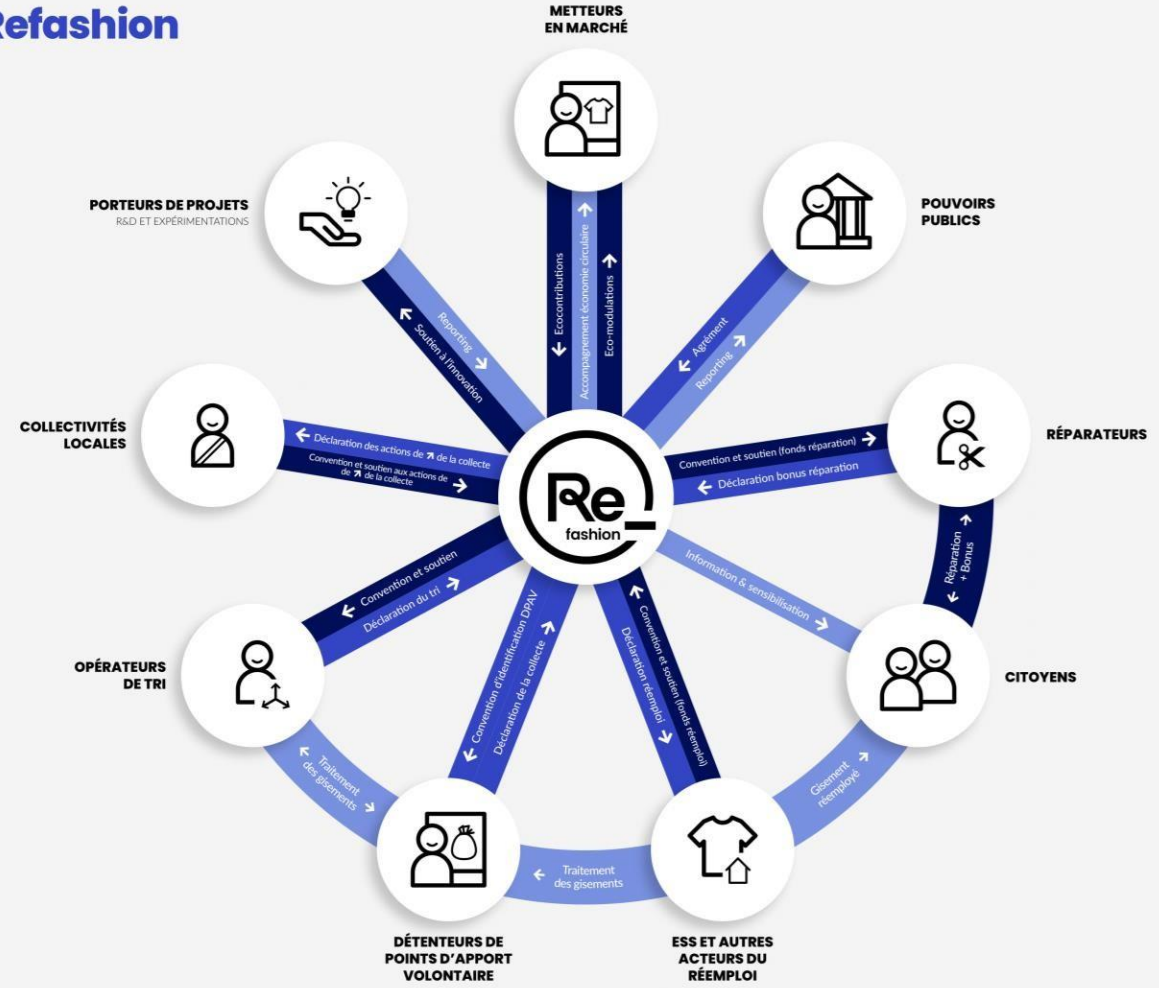
6 ans pour transformer - 2023- 2028

Refashion :
Le business model,
écosystème et parties prenantes

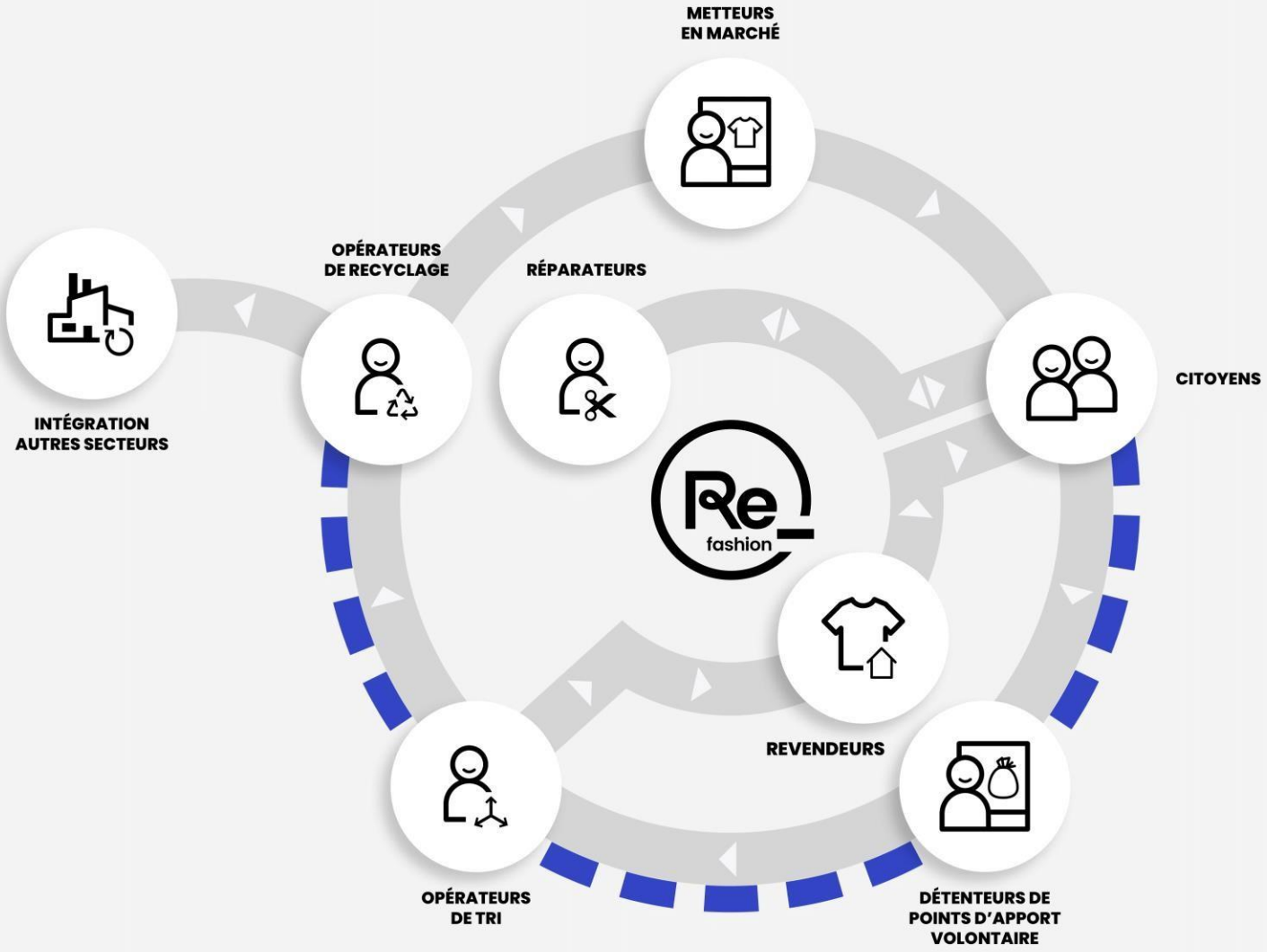
Pour rappel

- ✓ *Refashion est l'éco-organisme de la filière Textile (textiles d'habillement, linge de maison et chaussures).*
- ✓ *Il assure, pour le compte des entreprises qui mettent ces produits sur le marché, la prévention et la gestion de la fin de vie de ces articles : **R**esponsabilité **E**largie du **P**roducteur.*
- ✓ *Au cœur de l'écosystème de la filière, Refashion accompagne la transformation vers l'économie circulaire avec les différentes parties prenantes : metteurs en marché, opérateurs de collecte et de tri, collectivités locales et pouvoirs publics, porteurs de projets, citoyens.*

L'écosystème Refashion



Les étapes du cycle de vie des textiles et chaussures



Collectivités locales : facilitateurs de la circularité dans les territoires

Notre but :
accompagner
l'ensemble de ces
acteurs pour
construire *une filière*
responsable
et engagée à
réduire son impact
environnemental
au bénéfice de tous.

2023- 2028 :
le début d'une nouvelle ère et un dispositif augmenté

Création de la société Eco TLC
Eco-organisme de la Filière Textile agréé par le ministère de la Transition Écologique et le ministère de l' Économie.

2ème agrément : accélération de l'efficacité
Bilan des 10 premières années : l'éco-organisme a consacré 150 millions d'euros pour financer majoritairement le tri permettant la réutilisation des produits.

4ème agrément : un dispositif augmenté
Pour transformer la Filière Textile et réduire son impact environnemental sur les 3 phases du cycle de vie : **Production / Consommation / Régénération /**

2008 → 2009 2013 → 2014 2019 → 2020 2022 → **2023 2028**

1er agrément : mise en place du dispositif
Premiers résultats encourageants : 27 %des textiles usagés sont collectés, et les tonnages triés sont multipliés par 2.

3ème agrément : transition
Pour préparer les évolutions majeures de la Filière Textile : éco-conception et développement de solutions industrielles de recyclage des produits usagés en France et Europe.

Au service d'un plan de progrès avec des objectifs sur les 3 phases du cycle de vie du produit

Régénération

Collecte

60 %

De la mise en marché moyenne 2025-2028 collectée en **2028**

Tri

99,5%

De valorisation, soit **0,5%** de stockage ou élimination sans valorisation

Recyclage

80 %

Des TLC non-réutilisables recyclés en **2027**

90 %

De recyclage des TLC intégrant de la matière synthétique plastique en **2027**

Réemploi Réutilisation

120kT

Réemployées /réutilisées en **2024**

15%

Réemployées /réutilisées à moins de 1500km du lieu de collecte en **2027**

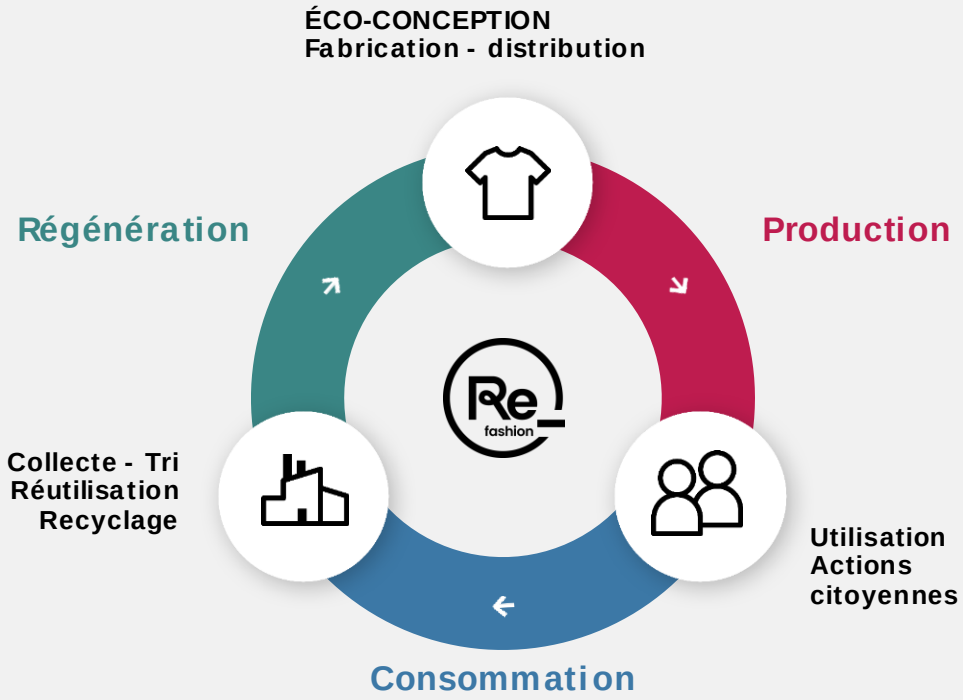
22M€ + 5%

Du budget Refashion dédiés au financement du réemploi en 2028, soit **135 M€** sur la période

R&D

5%

Des contributions alloués à la R&D, soient **58 M€** sur la période



Production

Eco-modulation

3 primes

Durabilité, labels environnementaux, incorporation de matière recyclée

62M€

D'éco-modulations en 2028 selon les nouveaux barèmes, soit **237 M€** sur la période d'agrément

Consommation

Réparation

+35%

D'actes de réparation

44M€

De soutiens à la réparation en 2028, soit **154 M€** sur la période

Communication

2% des contributions

Au minimum alloués à l'information et la sensibilisation

Régénération

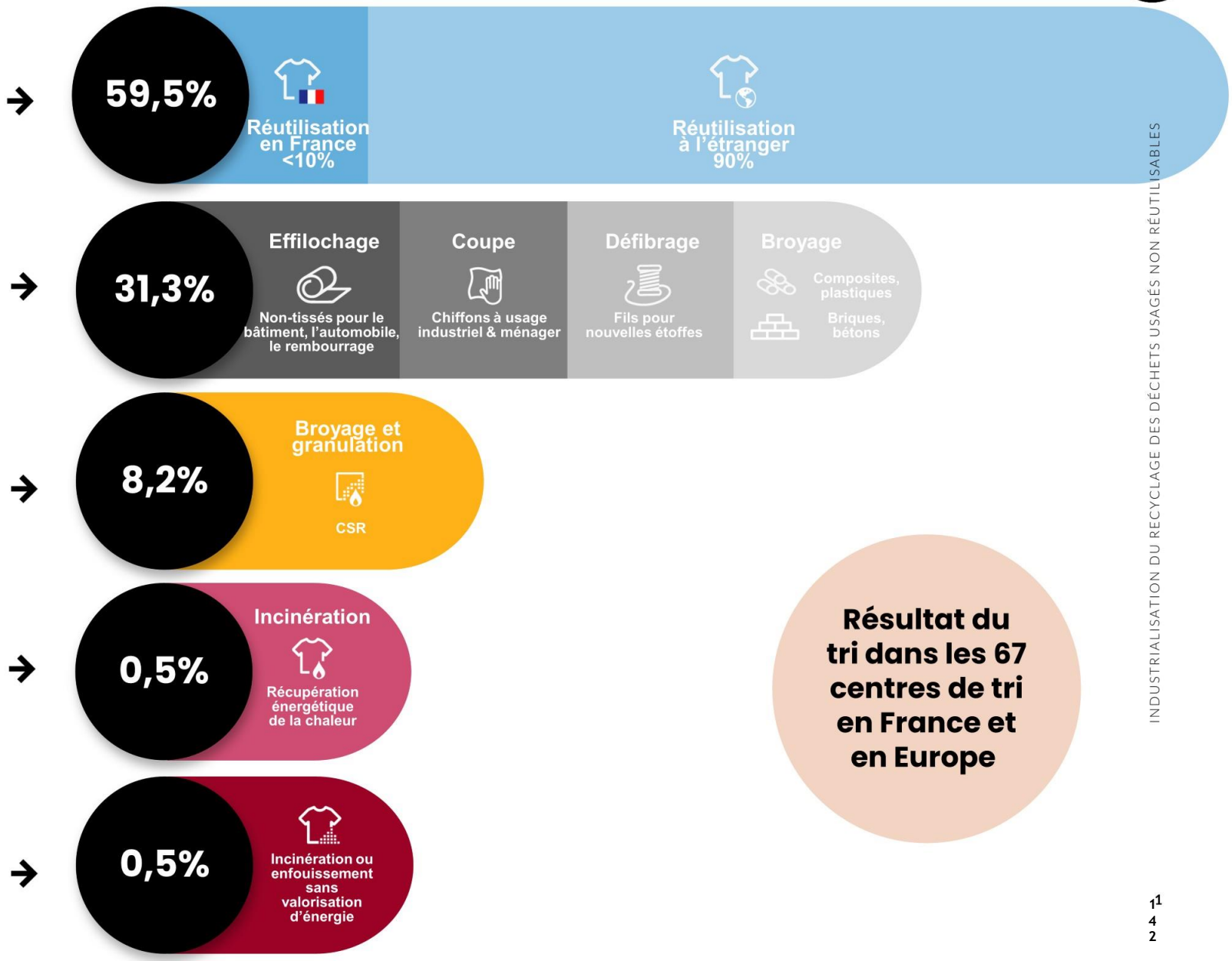
1. Débouchés post tri

Tri et régénération
par des opérateurs conventionnés

188 KT
Soit un ratio tri/ mise en marché de 23%

84 % Triées en France

16 % Triées hors France



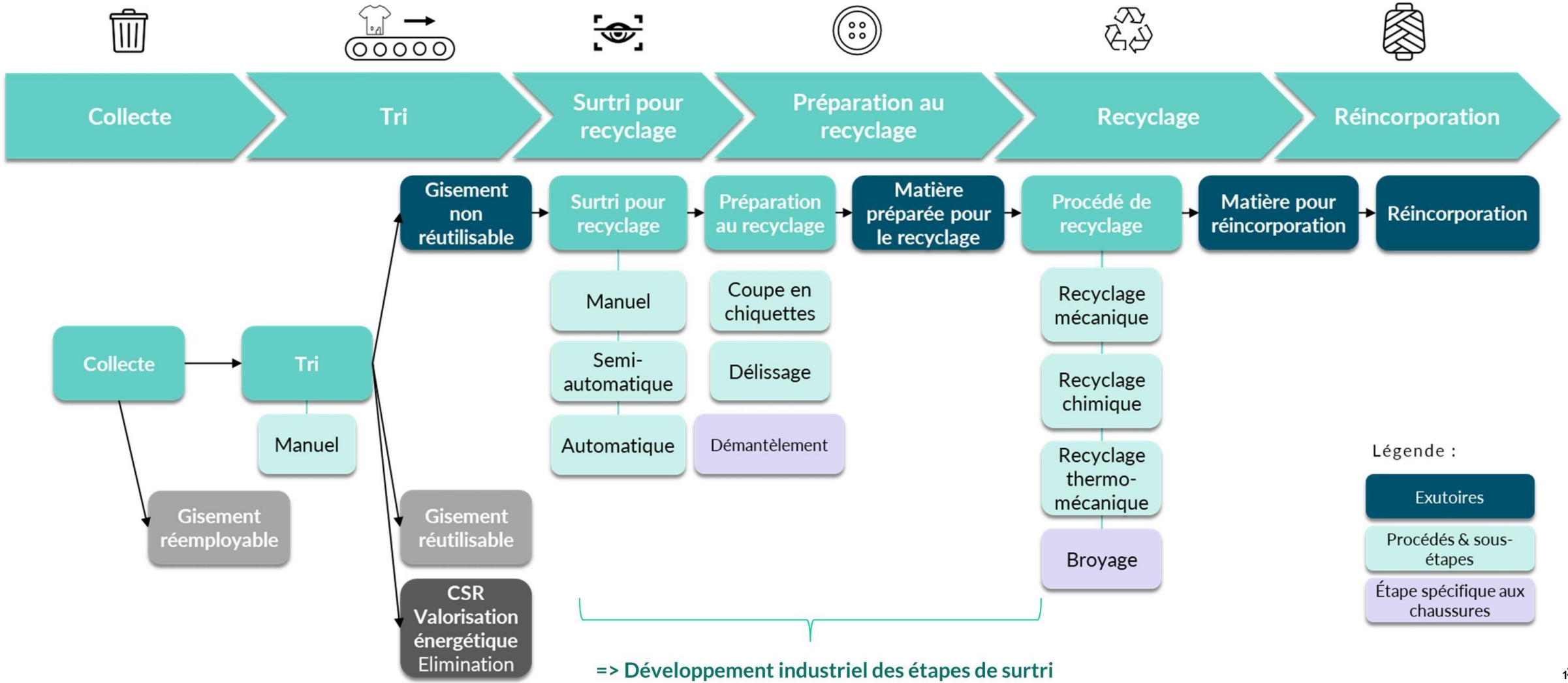
Les flux dans la Filière Textile française*

Résultat du tri dans les 67 centres de tri en France et en Europe

*source : RA 2022

Rappel

Principales étapes de la chaîne de valeur de la fin de vie des TLC



=> Développement industriel des étapes de surtri et de préparation matières

Dispositifs de financement et d'accompagnement

Collecte Tri | Surtri & Préparation au Recyclage | Recyclage | Réincorporation

Soutien au Tri
de la collecte à la valorisation
125 €/t en 2024

Soutien au Surtri
de nouveaux débouchés non cumulables avec dispositifs R
150 €/t en 2024

Appels d'offres Collecte, Massification, Traitement

Expérimentations
Préparation Matière & Recyclage
€ : 100%

New
Expérimentations
Incorporation de Matière Recyclée
€ : 100%

Challenge Innovation
€ : 50%

Partenariats R&D

Challenge Industriel
€ : 50%

New
Appels d'offres Recyclage

New
ReHubs

Légende :

- xx — Dispositif financier (€/T)
- xx — Dispositif financier R&D (€/projet)
- xx — Dispositif opérationnel

17:15-17:30
European Commission - DG Grow - António de Sousa Maia

António de Sousa Maia - European Commission - DG Grow

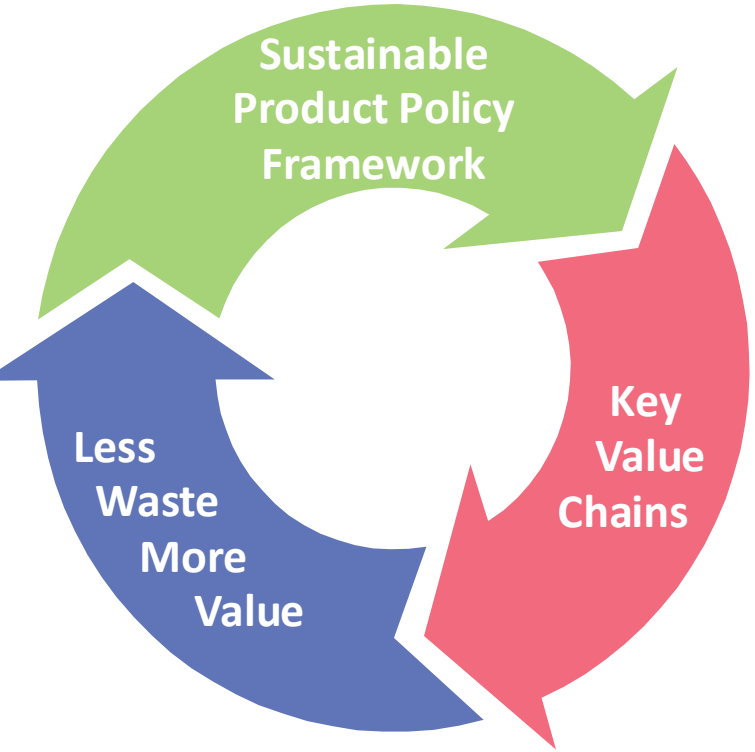
A legal and policy officer involved in internal market legislation since 2009, Antonio de Sousa Maia has been active in implementing the EU Strategy for Sustainable and Circular Textiles, from a regulatory perspective since 2022.

Online webinar

ADVANCING POLYESTER TEXTILE CIRCULARITY

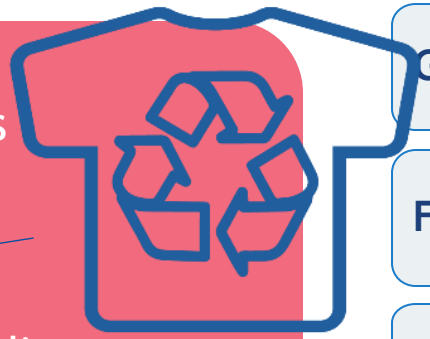
Antonio de Sousa Maia, DG GROW

Textiles within the Circular Economy Action Plan



Make sustainable products the norm in the EU
Empower consumers and public buyers
Sustainable production processes

Electronics and ICT
Batteries and vehicles
Packaging
Plastics
Textiles
Construction and buildings
Food, water and nutrients



Reduce Waste
Reduce Waste Exports
Boost market for high quality and safe secondary raw materials

35 actions

Making circular economy work for people, regions and cities

Circular economy as a requisite for climate neutrality

Getting the Economics Right

Financial Markets

Investments and R&I

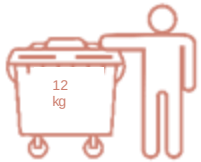
Global Level Playing Field

Monitoring

European Commission

Need for action - textiles

Impacts:



About **5 million tonnes** of clothing and footwear are discarded every year, equivalent to about 12kg per person (EU)

European consumption of textiles is one of the top 3 pressures on **water and land use**

Source: unsplash.com

European consumption of textiles is one of the top 5 pressures in terms of **raw material use** and **greenhouse gas emissions**

Opportunities:

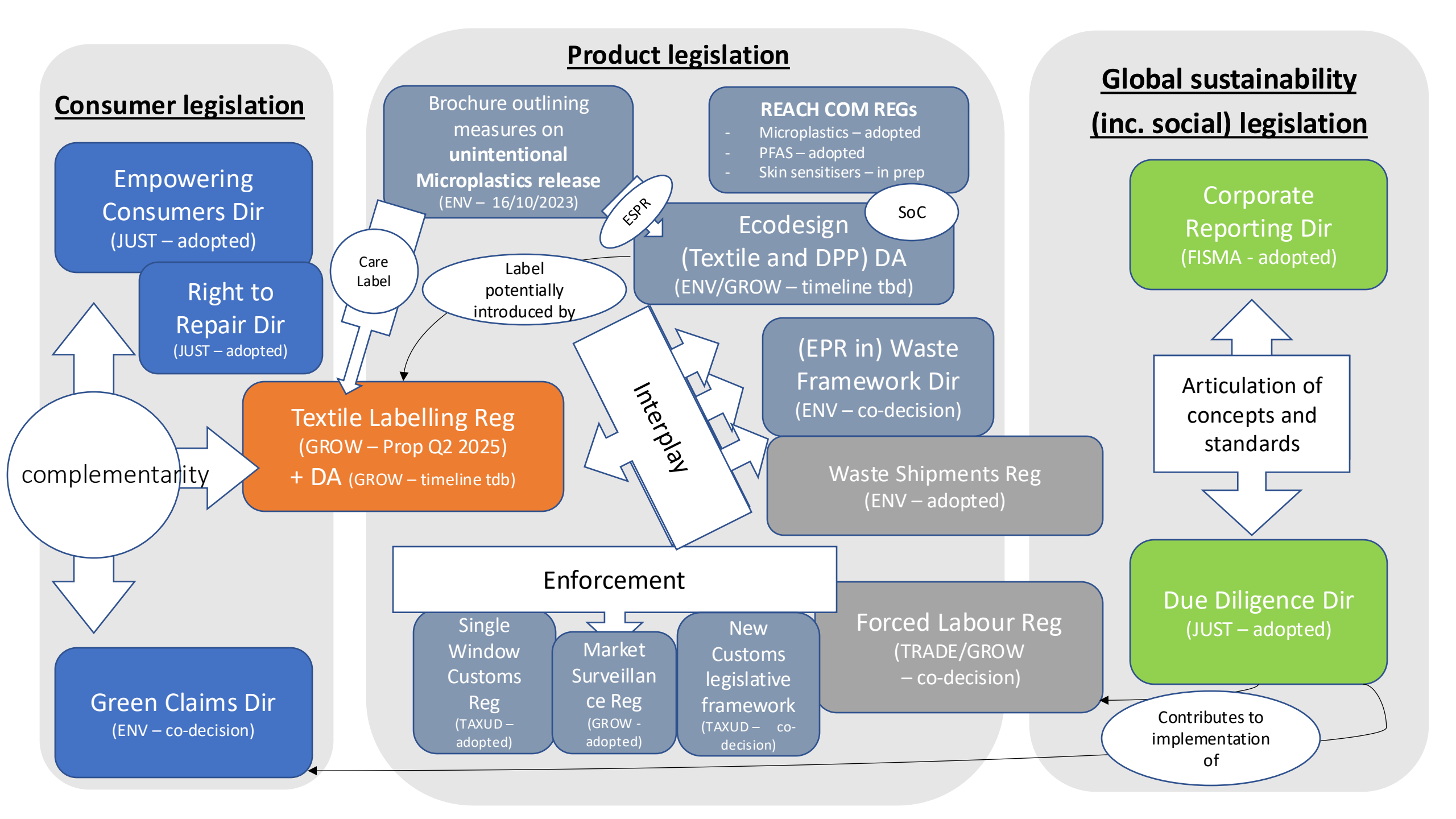
- Increase the EU textiles ecosystem's **resilience**
- Boost its attractiveness, creative and innovative potential
- Tap into new markets for **sustainable textiles**
- An average of 20 to 35 jobs are created for every 1.000 tonnes of textiles collected for re-use, such as selling them second-hand

European Commission

ESPR and the vision of the EU Textile Strategy

- By 2030, all textile products placed on the EU market are:
  - **durable, repairable and recyclable**
  - to a great extent **made of recycled fibres**
  - free of hazardous substances
  - produced respecting social rights **and the environment**
- ”**Fast fashion is out of fashion**” - consumers benefit longer from high quality textiles
- Profitable **re-use and repair services** are widely available
- In a competitive, resilient and innovative textile sector producers take responsibility for their products along the value chain
- **Circular** rather than throw-away clothes have become the norm, with sufficient capacities for recycling and minimal incineration and landfilling

European Commission


Consumer legislation
Empowering Consumers Dir
(JUST – adopted)
Right to Repair Dir
(JUST – adopted)
Green Claims Dir
(ENV – co-decision)
complementarity
Product legislation
Brochure outlining measures on unintentional Microplastics release
(ENV – 16/10/2023)
REACH COM REGs
- Microplastics – adopted
- PFAS – adopted
- Skin sensitisers – in prep
ESPR
SoC
Ecodesign (Textile and DPP) DA
(ENV/GROW – timeline tbd)
Care Label
Label potentially introduced by
Textile Labelling Reg
(GROW – Prop Q2 2025)
+ DA (GROW – timeline tdb)
Interplay
(EPR in) Waste Framework Dir
(ENV – co-decision)
Waste Shipments Reg
(ENV – adopted)
Enforcement
Single Window Customs Reg
(TAXUD – adopted)
Market Surveillance Reg
(GROW - adopted)
New Customs legislative framework
(TAXUD – co-decision)
Forced Labour Reg
(TRADE/GROW – co-decision)
Global sustainability (inc. social) legislation
Corporate Reporting Dir
(FISMA - adopted)
Articulation of concepts and standards
Due Diligence Dir
(JUST – adopted)
Contributes to implementation of

ESPR’ s new tools

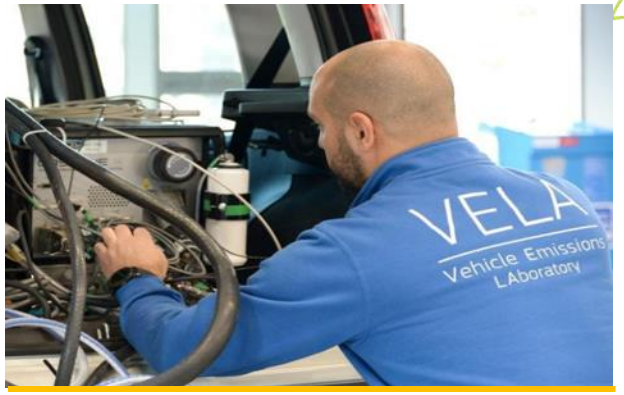
Mandatory Green Public Procurement

Mandatory GPP criteria to be set for contracting authorities or contracting entities

Prevention of destruction of unsold consumer goods

Transparency requirements for those discarding unsold goods

Ban on destruction of unsold **apparel** and **footwear** after 2 years



Market surveillance and customs controls

Strong focus on controls of regulated products, incl. planned market surveillance activities

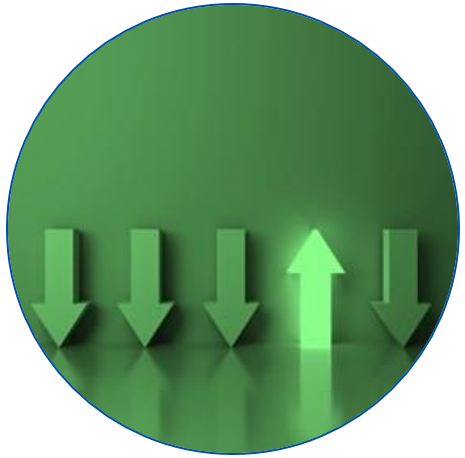
Support to common projects and investments

European Commission

ESPR sets a new sustainability & ecodesign approach

Broad scope

Moving beyond energy-related products to a **wide product scope**



New sustainability & ecodesign aspects

e.g. **performance requirements** - durability, CO_2 footprint, recycled content

Horizontal measures

Common ecodesign requirements for products with similarities

Strong focus on product information

Digital Product Passport, labels & **information requirements**

European Commission

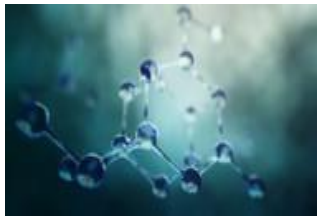
Key Ecodesign aspects under ESPR

European Commission

Products highlighted for *possible* prioritization in ESPR working plan

INTERMEDIATES

- **Iron & Steel**
- (Prep Study started)



- **Chemicals**

- **Aluminum**

FINAL PRODUCTS

- **Textiles, notably garments and Footwear**

- **Furniture & Mattresses**

- **Energy related products,** including reviews

- **Paints**

- **Information and communication technologies**

- **Detergents**

- **Tyres**

- **Lubricants**

European Commission

ESPR - **tentative timeline & milestones**

July 2024

Publication of ESPR in the OJ

18 July 2024

ESPR **entry into force**

End 2024

Establishment of Ecodesign Forum; calls for membership

Early 2025

First meeting of the **Ecodesign Forum (EDF)**

Consult the **Ecodesign Forum** incl. MS group **on WP**

March/April 2025

Adoption of the 1st ESPR **Working Plan** (9m after entry into force)

July 2025

Acts on **unsold goods** destruction derogations and disclosure format

Mid 2026

Acts on DPP registry, service providers, data carriers, digital credentials

European Commission

ESPR DA for textiles - next steps and process

Start working on textile product group in 2023

Preparatory Study & Impact Assessment

Estimated

2023-2026

Consultation of Ecodesign Forum

Adoption of Measure *Estimated*

2026

18 months

Measure applies

Estimated

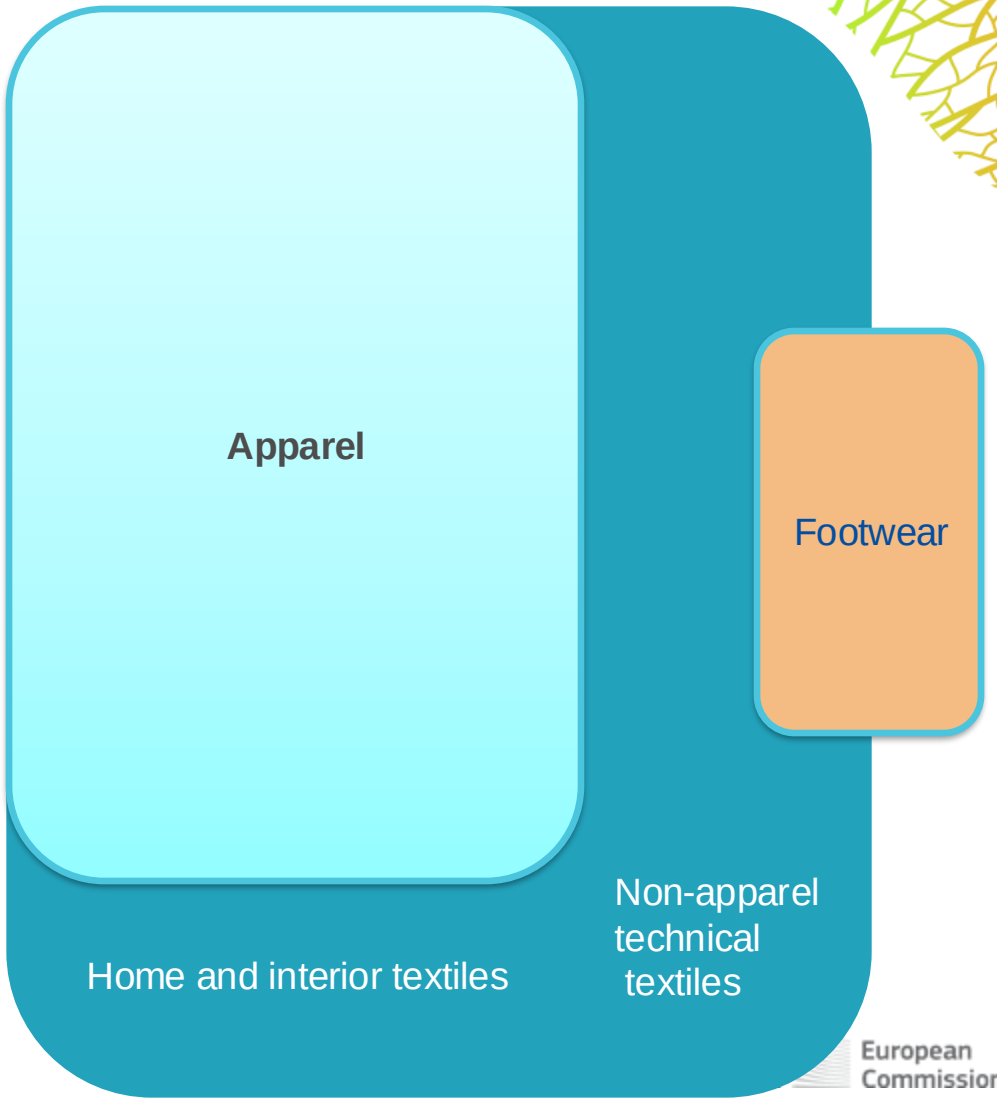
early to mid 2028

Stakeholder input collected throughout

European Commission

Textiles (and footwear) under ESPR

- Textile products to be covered by ecodesign requirements will be determined by the **ESPR working plan**
- A preparatory study has already been launched in anticipation of the working plan and based on commitments in the textile strategy.
- The preparatory study focuses on **apparel (garments + clothing accessories)**
- **Other textile and footwear products** will still be considered for inclusion in the ESPR working plan.



Possible ecodesign requirements for textiles

How to operationalize? – Standardization needs?

- Durability → Color fastness? Fabric resistance to pilling and abrasion? Dimensional change due to washing?
- Recyclability → Fibre blending, recycling disruptors?
- Recycled content → fiber to fiber? Chain of custody systems
- Environmental impacts → Based on LCA - PEFCR?
- Etc

→ Performance and/or information requirements

Trade-offs

- *Durability vs recyclability, recycled content vs comfort, etc*

Scope

- ***Textile apparel*** *(garments and clothing accessories) as likely focus of first DA (thus not* ***non-textile apparel****,* ***non-apparel textiles*** *or* ***footwear****)*

All to be determined through preparatory study and impact assessment

Art. 4 – Empowerment

Digital Product Passport

Delegated acts

Ecodesign requirements

Information requirements

Performance requirements

European Commission

Thank you

European Commission

17:00-17:15
Associations by Karla Magruder - accelerating Circularity

Karla Magruder - Accelerating Circularity

Founder at Accelerating Circularity. Textile professional with global experience in collaborating with the textile value change to transition to circular and more sustainable materials and processes.

Experience in fabric development and launching new technical textile technologies. Practiced in team building and cross cultural business. Skillful in creating and implementing strategies. Adept at product education with excellent presentation skills. Extensive industry contacts. Proven track record of building relationships internally and externally for truly profitable partnerships.

Circular System Requirements

Textile-to-Textile Recycling

December 11, 2024

ACCELERATING CIRCULARITY

ACCELERATING CIRCULARITY

WE ARE

an action-oriented nonprofit focused on textile-to-textile recycling at commercial scale through a collaborative, stakeholder-led approach.

WITH A MISSION

to build circular systems that turn used textiles into new raw materials.

AND A VISION

of a world in which textiles are no longer wasted.

The move to sustainable practices is the only way forward. The textile industry must become circular to eliminate discarded materials and reduce the need for virgin raw materials. *Because textiles are too good to waste™*.

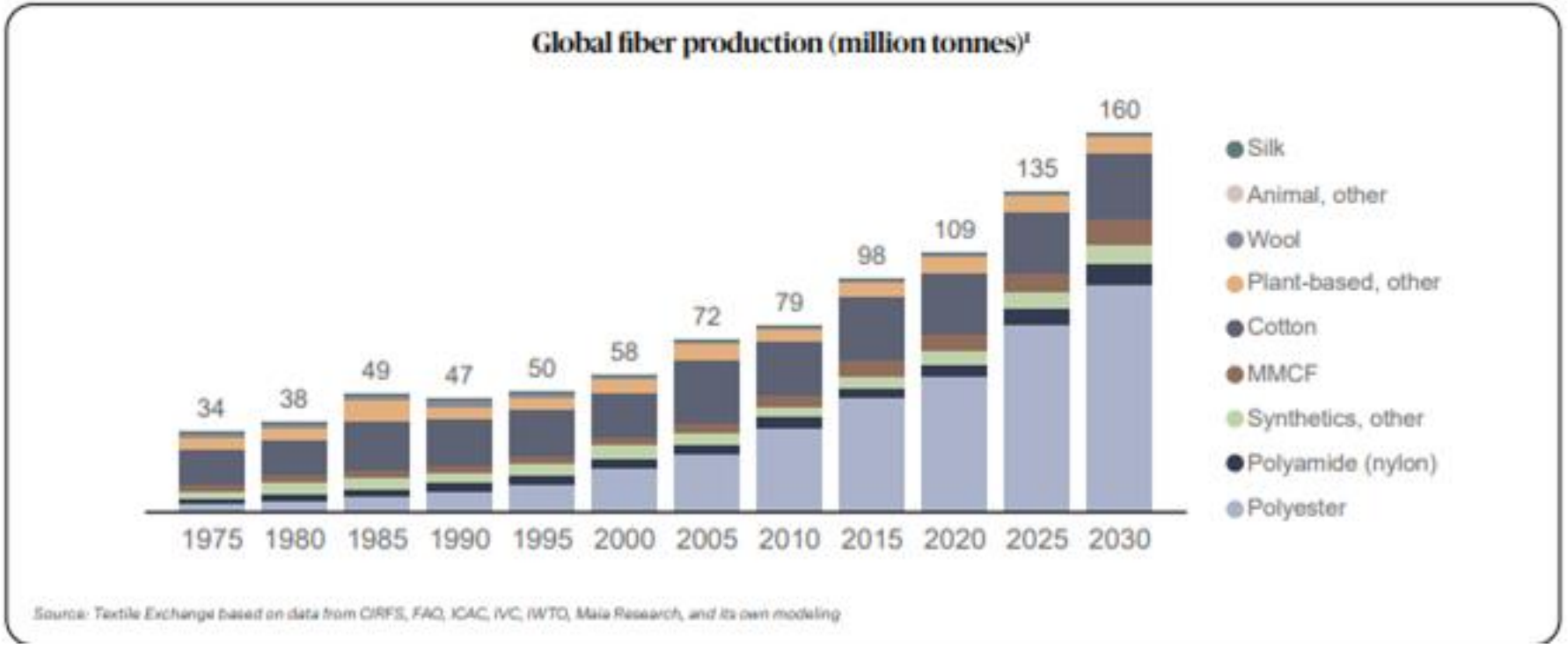
Accelerating Circularity's vision is a world in which textiles are no longer wasted. It will require large-scale industry action and commitment to transparency and traceability. It will require the adoption of virgin materials based on strategic limits with recycled inputs lowering GHG emissions. It's logical, scalable, and achievable.

And, you're going to want to be a part of it.

Agenda

- Textile Landscape
- Textile Hierarchy
- Circular Textile-to-Textile Systems

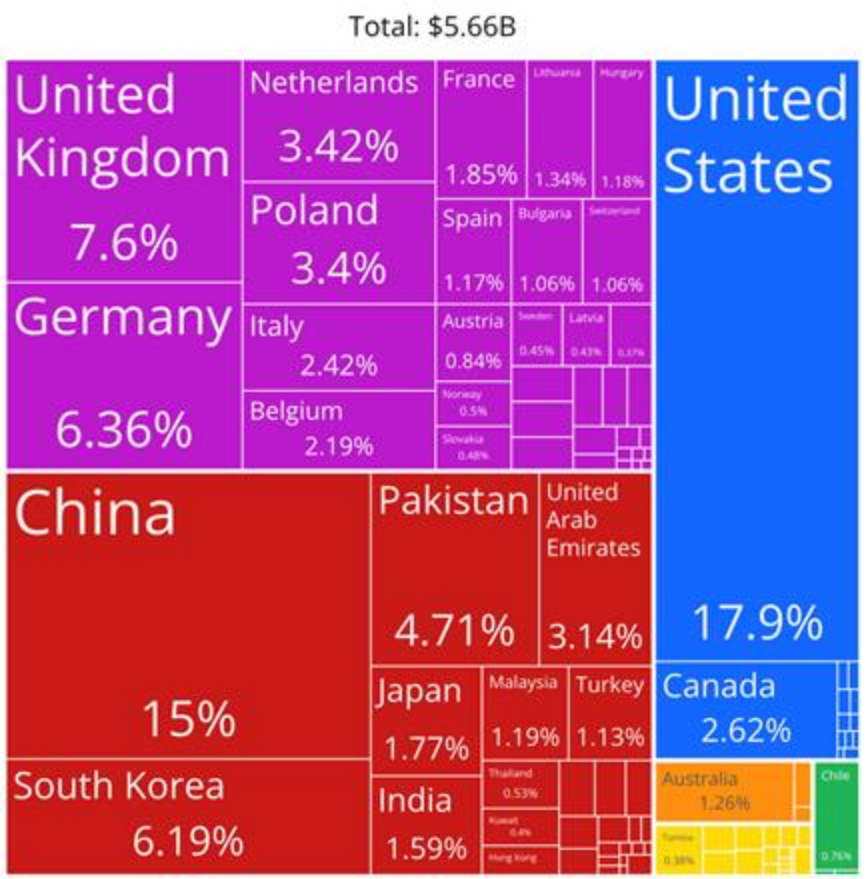
Textile Landscape



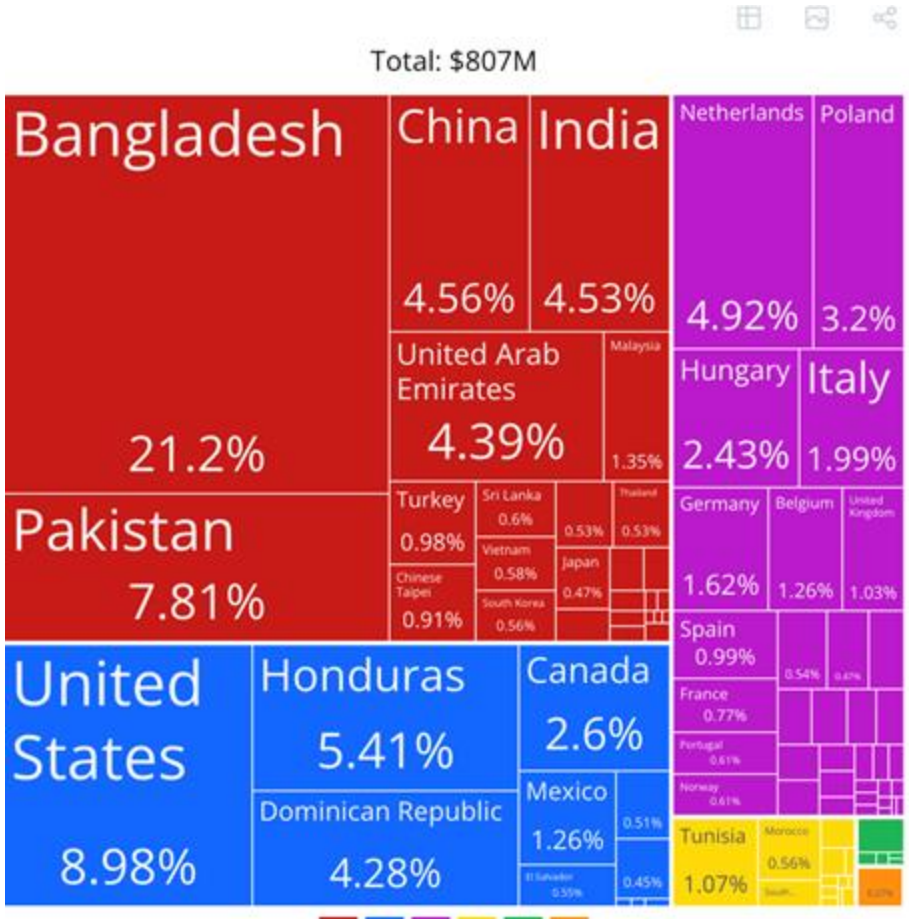

92
MILLION
Tons of textiles go to landfill annually.
The textile industry accounts
for 10% of all GHGs.[1]
1 businesswaste.co.uk/your-waste/textile-recycling/fashion-waste-facts-and-statistics

Textile Landscape 2022

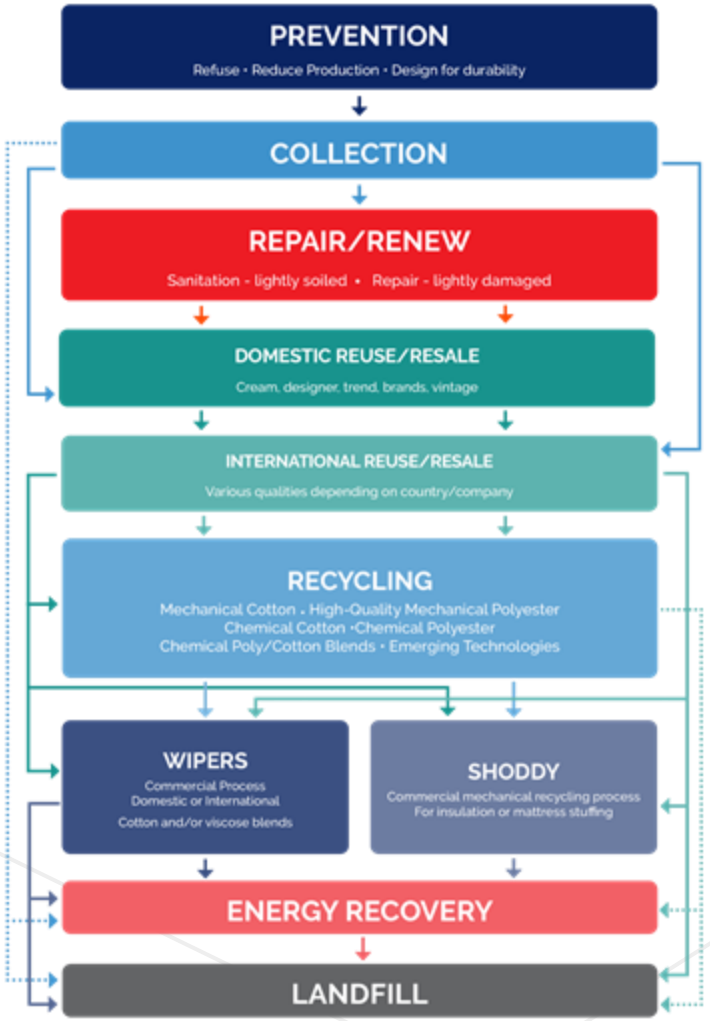
Exports Used Clothing



Exports Textile Scraps



Hierarchy



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T2T System

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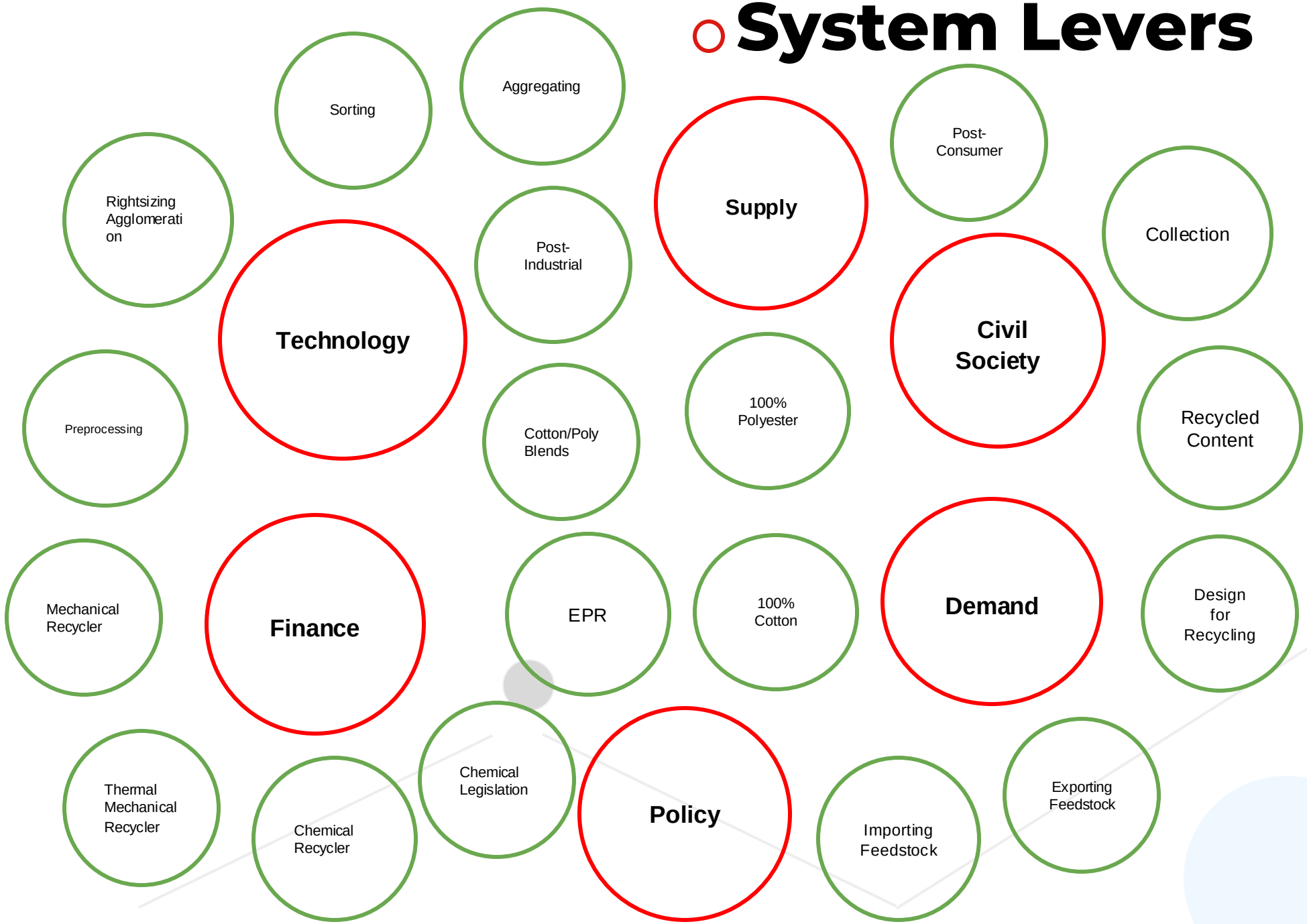
System Levers



Thank you!

ACCELERATING®
CIRCULARITY

17:45-18:00 Q and A session

Feel free to use our dedicated channel for the Q and A so that we can be sure to answer as many questions as we can.

18:00-18:10
Wrap-up and Conclusions by Christian Crépet - PETCORE EUROPE

Bruno Langlois, PhD, Carbios

Graduated from Clarkson University, NY, USA. Over 25 years of experience in the chemical industry to develop business with innovative chemistries and establish long term partnerships. Bruno is passionate about innovations. Carbios, with its unique technical solution, business model, and ability to make PET circular is a perfect fit to passionately address the major issues to transition to a more sustainable economy by reducing our plastic and textile waste.

Christian-Yves Crépet, Ambassador and honorary member of the Board at PETCORE EUROPE

With a commercial and executive business management background, Christian-Yves Crépet started his career with Dow Chemical and went on with Eni Chem both in France and other European countries. Before running PETCORE EUROPE, he has been the Managing Director of the French 50 kt/pa PET&HDPE recycling company Corepla Industrie for the last 21 years. A former Vice-President, co-founder of Recyclass, Co-chair of the PET WG and Chair of the HDPE/PP WG of PRE until 2016.

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Follow us on social media to stay updated:

Annual Conference 2024
www.petcoreeuropeanannualconference.eu

Communications Campaign
www.recycletheone.com

Recording and other materials will be sent by 18th of December 2024