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D1.3 - Mapping and gap analysis of value chains for sustainable and circular textiles

Interregional Innovation Investments Instrument (I3)

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EXECUTIVE SUMMARY

In work package 1 (WP1), D1.3 focuses on **mapping and gap analysis of value chains for sustainable and circular textiles**.

While linear value chains are fairly straightforward, the move towards circularity opens up a wide range of new options for building value chains, for example by considering reuse, upcycling or all recycling options. This adds complexity and creates new types of obstacles. In addition, the introduction of innovation components, which by their very nature can be ahead of the game, also presents specific challenges.

Proceeding to a precise mapping and a thorough gap analysis becomes a key element in the preparation and development of value chains to:

- **visualise** the proposed set-up and show the inter-connections
- to **identify** and **prioritise** the gaps
- to **define action plans** to address the gaps

Before analysing actual value chains involving RegioGreenTex partners, a series of elements were collected and analysed through the following activities:

- **data collection** on circular value chains
- **survey on gaps** directed to RegioGreenTex partners and STEP 2030 supporters
  The main objective of this survey was to understand what different stakeholders involved in various existing value chains see as the main gaps.
- **1 quadruple helix workshop on gap analysis** organised in the frame of the ECOSYSTEX Conference, in Barcelona, in October 2023
  During this workshop, the participants, divided in 3 randomly formed groups, were asked to highlight the main gaps they face in real life, to discuss them and to prioritise them.
- **1 workshop on mapping of value chains** organised during the RegioGreenTex Consortium Meeting, in CITEVE (Vila Nova de Famalicão, Portugal) in March 2024
  During this workshop, only involving RegioGreenTex partners, the participants were asked to develop 3 different value chains

This preparatory and analytical work was crucial in designing a flexible **Mapping and Gap Analysis Tool** that would not only facilitate data collection, but also guide reflection on the gap analysis, help prioritise and initiate action plans.

For instance, 3 main categories of gaps emerged:

- gaps related to the **core functions** of the value chain (key activities in the value chain)
- gaps linked to **support functions** (e.g. testing laboratories, machinery providers)
- gaps associated to **policy instruments** (e.g. standards and norms, customs administration)

For the mapping, it was obvious that the main input and output for each process step had to be described.

All these elements were used to start analysing existing or potential value chains within the RegioGreenTex context, with a focus on **3 value chains**:

- **Chemical recycling of cotton** – developed during workshop (Consortium Meeting)

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- **Mechanical recycling of wool and long fibres** – developed during workshop (Consortium Meeting) and through the Mapping and Gap Analysis Tool
- **Recycling of synthetic fibres used for technical applications** - developed during workshop (Consortium Meeting)

The Mapping and Gap Analysis Tool was first used by the **NTT (NEXT TECHNOLOGY TECNOTESSILE) Team**, with a focus on the regional mechanical recycling of the wool. The **3 main objectives of the tool were met**. It guided the **reflection work** of the team, it helped **visualising the value chain** with its strengths and weaknesses, and it supported a **thorough gap analysis**.
After completing this analysis, the NTT Team considered the broader picture, at regional level, for the entire wool recycling business. This reflection enabled to highlight several areas of concern, and to suggest finetuned categories of gaps, such as:

- **System oganisation gaps**, that impact the entire value chain organisation
- **Cultural/skills gaps in circular practices and products**, linked to a lack of knowledge
- **Skills gaps in digital solutions**, leading for example to difficulties in data sharing/analysis

These possible (sub-)categories will be taken into consideration to improve the tool.

As specific value chains face specific challenges, the list of possible gaps is extensive. But we see some trends in the nature of the gaps that prevent smooth operation or development of circular textile value chains. Here are some of the main ones:

- **Core functions gaps**: lack of large scale precise sorting process, no efficient industrial process for the removal of hard parts, difficulty to identify partners at local level, scarcity of raw materials, lack of skilled workers
- **Support functions gaps**: difficulties to share data related to material and production, lack of knowledge about eco-design and circular business models
- **Policy instruments**: no standards for recycled products, lack of certification schemes, policies applied consistently across the EU (e.g. waste management)

In total, in WP1 T1.3 'Value Chain Mapping', More than 100 experts from a wide range of technical and non-technical backgrounds, as well as business owners, whether RegioGreenTex partners or not, contributed to numerous open discussions and workshops that helped to better understand how circular textile value chains work or can be developed, to identify the main gaps and to start the search for solutions.

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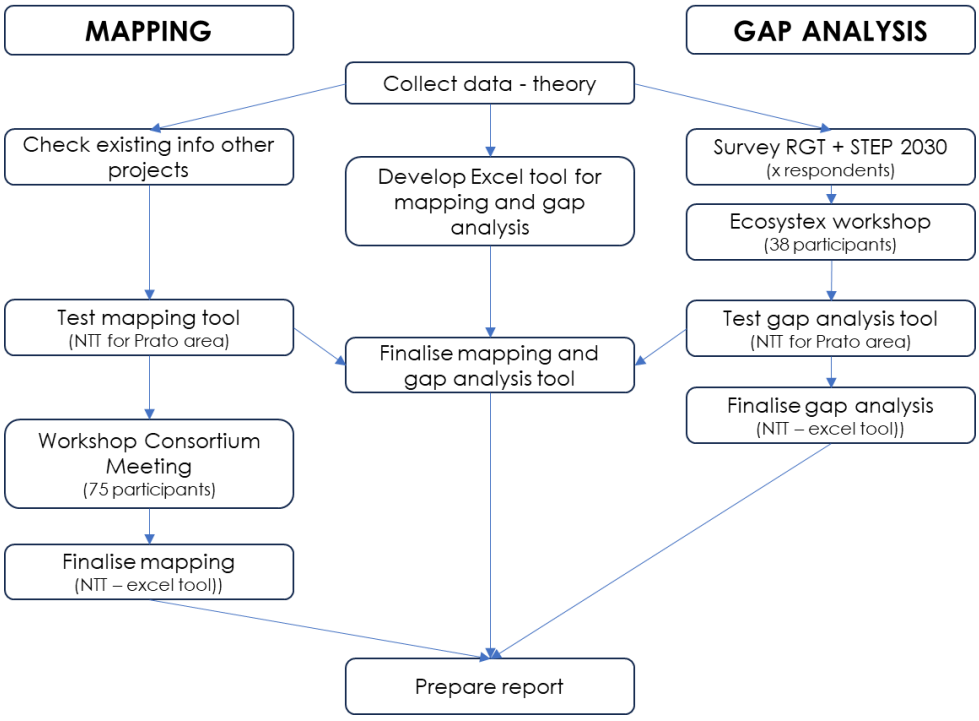
1 INTRODUCTION

1.1 Deliverable D1.3: Value chain map and gap analysis

This deliverable is part of WP1 - Value chain mapping and gaps analysis.
According to the Annex 1 (Description of the Action) of the Grant Agreement, the main objective is to prepare a value chain mapping and gap analysis to better address the progress of innovation and investments during the project implementation. As the landscape is evolving fast in relation to the implementation of the EU textile strategy, the intention is to update the gap analysis each year (to be continued possibly after the end of the project), to provide a context for investment decisions inside and outside/beyond this project. For this work, we need to consider circular textile value chains in generic terms, and to analyse the situation in the RegioGreenTex context.
To shift the value chain from a linear to a circular model, a proper analysis of the gaps and bottlenecks needs to be carried out.
The main objective of D1.3 was to provide a value chain map for circular textiles & clothing and gap analysis, with a focus on (inter) regional aspects, including a global analysis to make EU circular textile value chains more competitive towards international competitors.
This report covers the different steps and activities considered to complete this deliverable.

1.2 Main steps and activities

The main activities that contributed to collect data, to listen to RegioGreenTex partners or other organisations about gaps, and to analyse value chains, are shown in the diagram below. The development and testing of the mapping and gap analysis tool are other key activities.
These activities are all described later in this report.



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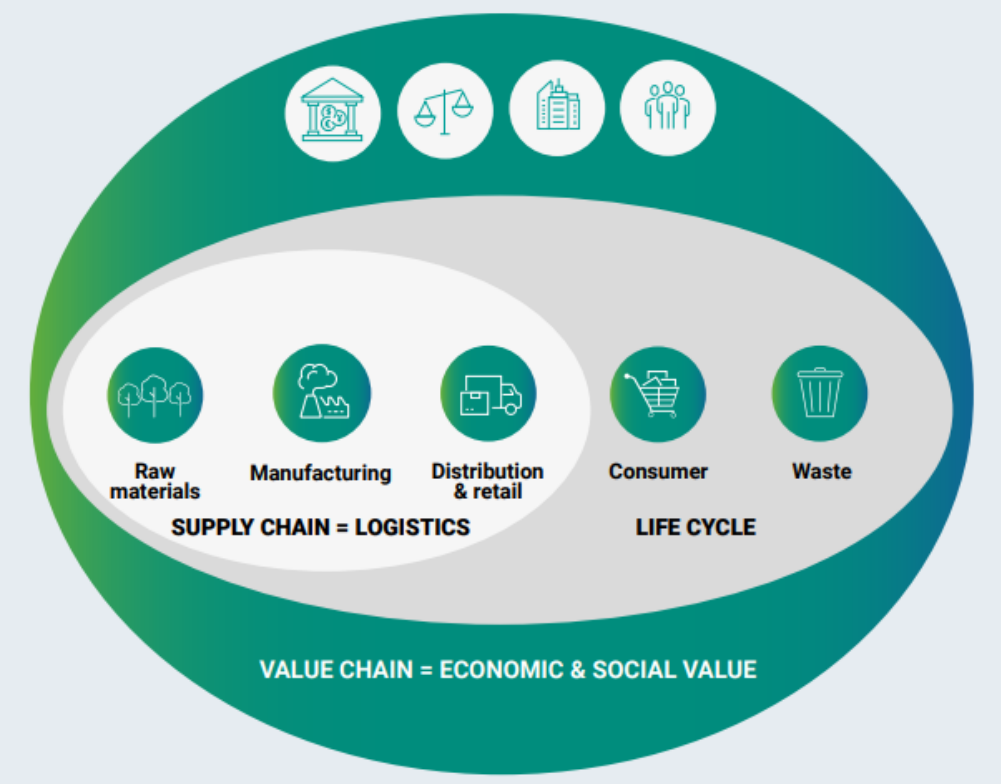
2 TEXTILE VALUE CHAIN

2.1 Definition

UNEP (United Nations Environment Programme) proposes a clear definition of a Value Chain (ref: Sustainability and Circularity in the Textile Value Chain - A Global Roadmap): the textile value chain comprises all activities and stakeholders that provide or receive value from designing, developing, making, distributing, retailing, and consuming a textile product (or providing the service that a textile product renders), including the extraction and supply of raw materials, as well as activities involving the textile after its useful service life has ended. The value chain covers all stages in a textile product's life, from supply of raw materials through to disposal after use, and includes the activities linked to value creation such as business models, consumption patterns, investments, and regulation.

The value chain also comprises the actors undertaking the activities, and the stakeholders that can influence those activities.

The textile value chain is thus considered as a whole system that goes beyond the supply chain and the life cycle of products.



In the context of circular economy, the different activities will be designed and organised to minimise waste and maximise the efficient use of resources throughout the lifecycle of textile products. Unlike a linear model, where products are made, used, and disposed of, often leading to significant environmental impact and resource depletion, a circular textile value chain aims to create a closed-loop system where materials are reused, recycled, or regenerated, thus reducing the need for new resource extraction, and minimising the negative environmental impact.

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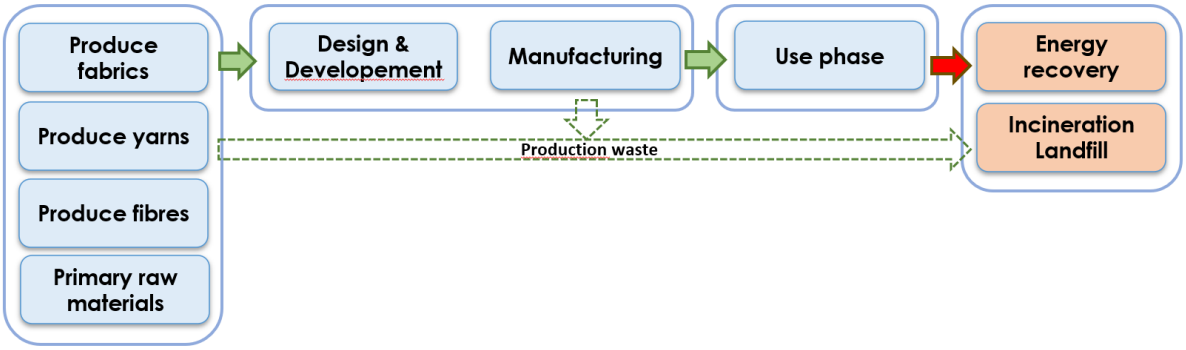
As a result, circular value chains tend to be more complex than linear ones because they allow for more options and activities. For example, the development of R-strategies (see 2.3.1) significantly increases the number of processes and actors to be considered in the value chain.

2.2 Linear Textile Value Chain

A **linear value chain** operates according to the "take-make-waste" principle. In a nutshell, this one-direction type of organisation is based on the sole use of virgin resources produced by the agriculture or the industry to make intermediary and final products that will be disposed of and destroyed after use. It involves various stakeholders such as suppliers, manufacturers, distributors, and consumers, each playing a role in the extraction, manufacturing, distribution, and disposal of textiles within the supply chain.

Beside the relatively straightforward structure of the supply chain for one product – a retailer can produce thousands of different styles every year with a network of hundreds of suppliers -, this way to operate has enabled to optimise processes, ensure very short lead-times, and maximise profit.

The following diagram illustrates a basic linear value chain.



It is worth mentioning that some companies have developed intermediary solutions to reduce the negative impact of such a model long before the circular economy came to the fore. For example, by optimising the consumption of energy, by developing limited recycling solutions for their waste, they were able to reduce their costs and improve the sustainability of their products. Some of these evolutions were also imposed by regional regulations related to waste management, etc.

2.3 Circular Textile Value Chain

The transition from a linear to a circular textile value chain for the production of textile products requires significant adaptations. While the linear value chain is relatively straightforward and well-known, the many additional options that can make up a circular value chain add significantly to the complexity.

In a circular model, every step in the value chain can be developed to reduce the use of fresh/virgin resources, to optimise the use and life duration of products, and eventually to recycle the waste and enter a new circle**.** Additionally, new business models will also require adaptations of the value chain.

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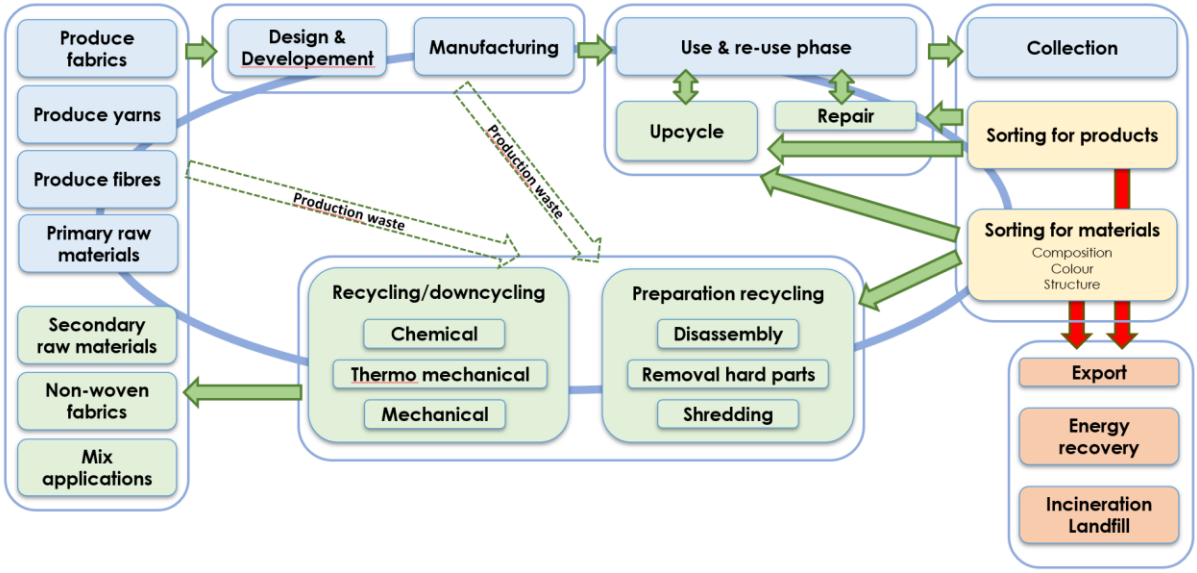
Said differently, circular textile value chains will involve new types of markets, innovation in technology or business models, new types of materials, new skills, new types of collaborations, etc., and a different mindset.

Therefore, the types of and the number of gaps to analyse will also increase considerably. In WP1 "mapping and gap analysis", to integrate this complexity, there is a need to be very specific in terms of processes and process steps.

When digging into actual or potential value chains within the RegioGreenTex context, we will face the constraints of reality, a situation that will make the gap analysis even more important.

From this definition, we can draw an overall circular textile value chain picture.



2.3.1 R-Strategies

Improving the circularity can be achieved by applying or enabling one or more of the following 9 circular economy 'R' strategies or principles described in the following table.

R#	Strategy	Description
R1	Refuse	Make product redundant by abandoning its function or by offering the same function by a radically different (e.g. digital) product or service
R2	Rethink	Make product use more intensive (e.g. through product-as-a-service, reuse and sharing models or by putting multi-functional products on the market)
R3	Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
R4	Re-use	Re-use of a product which is still in good condition and fulfils its original function (and is not waste) for the same purpose for which it was conceived
R5	Repair	Repair and maintenance of defective product so it can be used with its original function

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R6	Refurbish	Restore an old product and bring it up to date (to specified quality level)
R7	Remanufacture	Use parts of a discarded product in a new product with the same function (and as-new-condition)
R8	Repurpose	Use a redundant product or its parts in a new product with different function
R9	Recycle	Recover materials from waste to be reprocessed into new products, materials, or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations

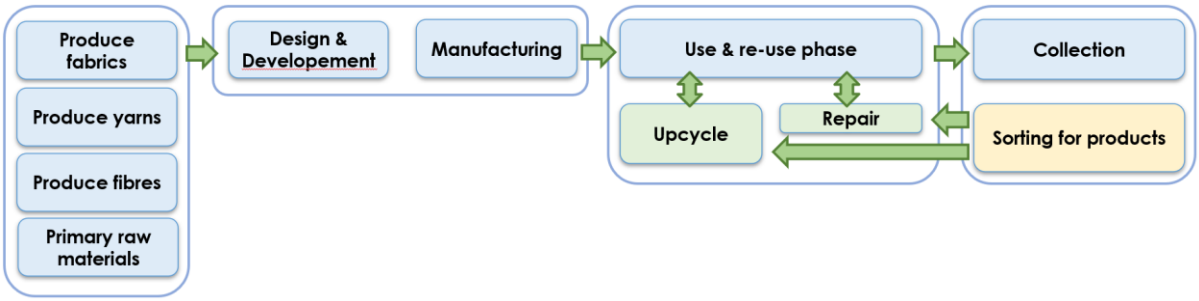
Ref: https://circulareconomy.europa.eu/platform/sites/default/files/categorisation_system_for_the_ce.pdf

When developing a circular textile value chain, All R-strategies will be at the centre of the reflection. There will potentially be many more actors involved to develop all the possible processes and solutions. Some companies could be for example interested in using the waste out of one process as a new raw material whereas it would have ended up in incineration in the linear process. This is a major evolution. This means also that some tiny companies will end up cooperating with major industrial partners.

Very different scenarios will emerge from the development of circular textiles processes. For example, a well-established large company that adapts its processes to one or more R-strategies will face different obstacles than a start-up that would start from scratch to develop similar options.

2.3.2 Products sorting

By sorting end-of-life textile products, it is possible to maximise their value, minimise waste, and contribute to a more sustainable and circular textile economy. The sorting should target in the first place the extension of the product life/use. The 3 strategies to prioritise are the R4 (re-use), R5 (repair) and R6 (refurbish/upcycle).



Consumers may be inclined to engage with these options because they can manage them themselves, possibly through third-party applications. Some brands also encourage practices such as reuse, for example by accepting used garments from consumers to sell as second-hand. Social enterprises are also active in this area.

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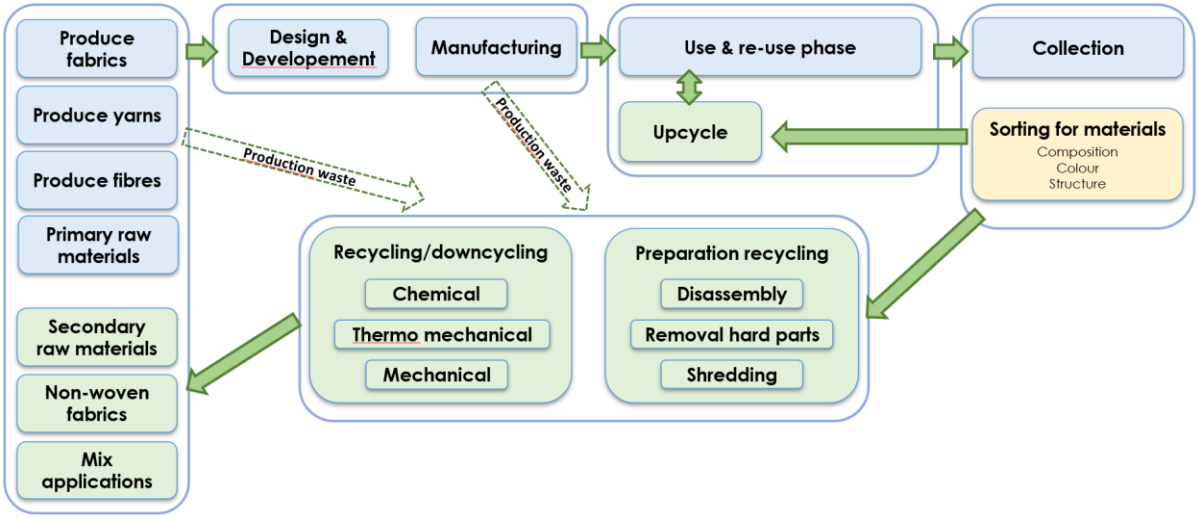
2.3.3 Material sorting

Where options at the product level are not possible, the focus is on the material contained in the collected waste, whether from industry or from consumers. The aim is to exploit as much material as possible, mainly through recycling activities.



When it comes to sorting, the post-consumer products pose several problems. The very wide variety of materials and fibre mixes, the complexity of the garments (e.g. multi-layer, prints, embellishments, coating), and the absence of highly efficient industrial solutions, make an accurate sorting (e.g. based on fibre content and colour range) a tedious, time-consuming, and costly process. Another challenge can be to reach the minimum quantities of accurately sorted material to reliantly feed industrial scale processes.

This explains why large quantities are processed in low labour cost countries, meaning large quantities will have to be moved around the world before reaching the recycler. Some social organisations are able to propose viable solutions, at a bearable cost.

It also explains why companies transforming fabrics into fibres generally prefer production waste that comes free of any hard parts such as buttons, labels, etc. This is also due to the absence of automatic removal options, or their lack of efficiency.

When recycling is considered, a series of processes are based on new technologies. Therefore, some situations that work on paper will be extremely difficult to translate into efficient processes. In some cases, the economic reality, meaning an excessive cost, will prevent from bringing some options to life.

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3 MAPPING OF A VALUE CHAIN

Mapping textile value chains involves a comprehensive analysis and visualisation of the different stages, processes and actors involved in production, distribution, consumption/use, and end-of-life management. It aims to provide a clear understanding of the interconnected relationships and flows, from the sourcing of raw materials to the consumption and disposal of the end product.
Depending on the objectives of a study, of a project, the depth of the analysis and the list of the parameters that will be investigated and reported can vary considerably.
Here are the key elements that are taken into consideration.

- **Identification of Stakeholders**

One of the first elements is the identification and categorisation of the key stakeholders involved in the considered textile value chain. This includes for example raw material suppliers, recyclers, manufacturers, distributors, retailers, consumers, waste management companies, etc.
For the work in WP1, the focus was set on actors involved in the production process (e.g. from waste collection to production of slivers for the spinning).

- **Mapping of Supply Chain Stages**

The value chain is broken down into different stages such as raw material sourcing, fibre production, textile manufacturing, garment production, distribution, retailing and end-of-life management. If necessary, the analysis can go down to the level of process steps. For example, some facilities that convert pieces of fabric into fibres may end their process with the baling of fibres, while others may go as far as preparing slivers for spinning.
Each stage is analysed to understand the activities, processes and interactions involved.

- **Mapping of Flows and Interactions**

As much as possible, the mapping process visualises the flow of materials throughout the value chain. This includes tracing the movement of raw materials from source to production facilities, intermediate products between different stages, finished goods to consumers, etc.
The way the materials, the products components, etc, move from one step to the next, from one company to the other, can have a significant influence on the environmental impact of the whole value chain, on the cost related to transportation, and by extension, on the viability of the value chain.

- **Clarification of Inputs and Outputs**

For each stage of the value chain, inputs (e.g., raw materials) and outputs (e.g., components, products) are identified and possibly quantified. This helps to evaluate resource gaps and opportunities on an offer/demand mode.
For the work in WP1, the focus was set on the material inputs and outputs. Other elements such as water, energy, chemicals, etc., are out of scope.

- **Identification of Critical Obstacles and Bottlenecks**

The mapping process helps to highlight critical obstacles and bottlenecks within the value chain, firstly for elements related to the actual production processes (e.g. missing local partner for a specific operation).
These elements will be scrutinised in the Gap Analysis phase.

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- **Visualisation and communication**:

Presenting a value chain, ideally in the form of a diagram or map, enables to get a good indication of the interactions and dynamics immediately.

With the information collected and highlighted in the mapping for a specific value chain, all stakeholders will be able to identify opportunities for optimisation and innovation, the bottlenecks, and the gaps.

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4 GAPS ANALYSIS

In the context of circular textile value chains, a 'gap' refers to anything that hinders the achievement of a fully circular and viable model. These gaps can be highlighted at different stages of the value chain; they can be technical, material, economic, regulatory, or behavioural. Several examples are described in section 4.1.

Identifying and addressing these gaps is essential to advance the transition to more circular and sustainable textile value chains. This requires collaboration between stakeholders across the industry, including policy makers, businesses, consumers, and research institutions, as is the case in the frame of RegioGreenTex. Beyond the direct negative impact, there are situations where finding and implementing solutions may represent an opportunity to develop a new business option.

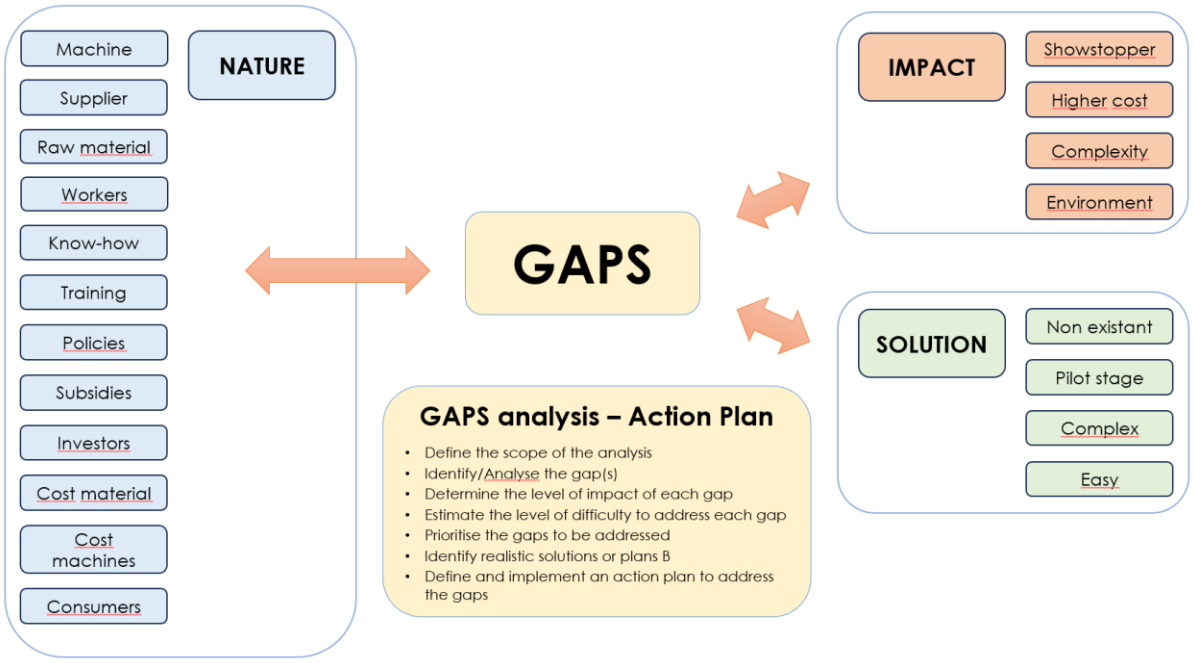
4.1 Main Types of Gaps

When analysing a value chain, many types of gaps should be considered.

In addition to material gaps specific to a process or plant (e.g. lack of properly conditioned feedstock), other gaps may be more widespread and affect an entire value chain (e.g. lack of skilled labour, lack of training) or an entire type of business (e.g. waste management regulations).

Because each gap has its own characteristics, each gap can have a different impact on the activities of a value chain. And there will be a different level of difficulty in finding the solutions or improvements to close it.

The following diagram provides key elements for a basic gap analysis by listing different options for the nature of a gap, its impact level, and the level of difficulty to fix it.



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The following table provides further information on common categories and types of gaps; it is by no means exhaustive.

GAPS CATEGORY	GAPS DESCRIPTION
Material Supply Chain Gaps	. Poor availability of recycled or sustainable raw materials . Poor consistency and reliability of recycled material supply . Low/no traceability and transparency in the material sourcing process
Production Process Gaps	. Lack of integration between different stages of production . Inefficient or outdated machinery and technology . Energy and resource inefficiencies during manufacturing
Quality and Standards Gaps	. High variability in the quality of recycled materials . Non-compliance with industry standards and regulation . Poor quality control measures throughout the production process
Market and Demand Gaps	. Limited consumer awareness and demand for sustainable products . Market access barriers for circular products . Pricing differentials between circular and non-circular products
Technological Gaps	. Insufficient innovation in recycling and upcycling technologies . Lack of scalable and cost-effective circular solutions . Low integration of digital technologies for tracing materials
Policy and Regulatory Gaps	. Inadequate policies supporting circular economy initiatives . Lack of enforcement mechanisms for sustainable practices . Regulatory barriers to recycling and reuse
Collaboration and Partnership Gaps	. Limited collaboration across different stakeholders in the value chain . Lack of communication and knowledge sharing between companies . Challenges in establishing partnerships for closed loop systems
Consumer Engagement Gaps	. Limited consumer education on the benefits of circular products . Behaviour changes challenges in adopting sustainable consumption patterns . Poor accessibility and availability of circular products to consumers
Waste Management and End-of-Life Gaps	. Infrastructure gaps in waste collection and recycling facilities . Challenges in reverse logistics and product take-back schemes . Lack of incentives for proper disposal and recycling of textile waste
Financial and Investment Gaps	. Limited funding opportunities for circular economy projects . Return on investment uncertainties for circular initiatives . Financial barriers to scaling up circular business models

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4.2 Analysis of Gaps

Obviously, not all gaps have an impact on all value chain activities. Furthermore, there are different levels of impact, ranging from areas for improvement to showstoppers, which means that the search for a solution will vary considerably.

For a thorough analysis, it is recommended to use a systematic and consistent approach that will enable to prioritise the actions to be taken, as suggested in the list here-under. The level of impact of each gap and the estimated level of difficulty to address them should be evaluated; these 2 elements will be used as drivers for the prioritisation of the action plans.

- **Definition of the scope of the analysis**

Clearly define the boundaries of the analysis, by describing the value chain that needs to be analysed.

- **Identification of the gaps**

Identify all potential or actual gaps across all process stages of the selected value chain. All gaps' categories (e.g. inputs, outputs, technologies, human resources, policies) should be considered. At this stage, it is fine to only list the gaps, possibly through a brainstorm session. The relevance of the selection will be considered in the following steps of the analysis work.

- **Determination of the level of impact of each gap**

This is a key step in the analysis' process. It is essential to consider different types of impacts.

- **Estimation of the level of difficulty to address each gap**

Estimating the level of difficulty of closing a gap can be a tricky exercise, as the data needed to make an accurate assessment is not always available.

The experience, discussions with different stakeholders (e.g. for topics related to policies), existing data (e.g. planning for the transition from a pilot to an industrial scale stage) are valid elements to take into consideration.

- **Prioritisation of the gaps to be addressed**

Based on the level of impact of the identified gaps and on the difficulty to address them, priorities can be defined.

As different stakeholders will be working on very different topics, it is possible to consider several lists for different gaps categories, for instance:

- gaps related to core production functions of the value chain
- gaps related to support functions
- gaps related to policy instruments

- **Identification of realistic solutions or plans B**

The main objective of gap analysis is to drive improvements in the overall performance of the entire value chain by eliminating the gaps or reducing their negative impact.

This may involve redesigning processes, investing in new technologies, optimising resource allocation, improving skills and capabilities, or other initiatives.

Plan B should be understood as a possibility, most likely temporary, to fill a gap and enable an activity to start or continue. In recycling value chains, a typical Plan B at the preparation stage may be to outsource the sorting and removal of hard parts to a distant location, for example in Asia.

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- **Definition and implementation of an action plan to address the gaps**

An action plan to address the gaps should be defined, in line with the priorities' lists. Depending on the complexity, an in-depth analysis of the root causes, a specific data collection might be required (e.g. use of problem-solving techniques).

Note: a tool was developed in EXCEL to support and guide this approach (cf. section 5).

4.3 Gaps Survey

It is important to compare theory with practice in the field.

In the frame of WP1 activities, the ECOSYSTEX Conference in Barcelona (18-20/10/2023) came out as a perfect occasion, given the timing and the mix of participants, to organize a Quadruple Helix Workshop focusing on gap analysis. Centexbel and EURATEX co-organised it.

To make this workshop even more meaningful, a survey was organized before the event to collect info on actual gaps (as perceived or faced by responders) in existing value chains. To broaden the scope, the survey was sent to all RegioGreenTex partners and the STEP 2030 supporters.

The response rate was positive (28), and all results have been sorted and consolidated in an excel document.

For this survey, we asked to receive feedback related to gaps encountered at each step of a generic circular textile value chain. The diversity in the companies and organisations that responded ensured that all value chain activities were covered.

These 28 respondents represented a very diverse group of companies involved at different stages of circular textiles value chains, with different recycling technologies owners/users, etc. There were also several organisations/universities involved in research, policies, or in cluster management.

The following list summarises the results of the survey. Note that as long as it is, it is by no means exhaustive.

GAPS CATEGORY	GAPS DESCRIPTION
Feedstock sourcing + raw material preparation	. Lack of suppliers (EU), too low volumes, not all fibre types available . Lack of capacity for sorting based on fibre content . Lack of partners with consistent quality . Traceability of material not always clear
Product design	. Customers still focus on price . Highly time-consuming . Limitations due to potentially lower quality
Product development + prototyping	. Lack of in-house testing capability . Cost of material . High cost of prototyping, of material and lack of trained workers . Lack of hardware/software for 3D prototyping and of competencies . Low demand from global players
Fibre preparation	. Technical limitations of machinery and compatibility of existing machines with recycled fibres . Lack of long enough fibres for the mechanical recycling

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	. Lack of knowledge about properties of recycled fibres . Presence of (forbidden) chemicals in recycled materials . Lack of know-how and of trained workers . Lack of partners for removal of hard parts
Spinning	. Ready to spin raw material scarcity . Lack of research for new material with a low environmental impact . Lack of investment in innovation . High energy cost . Lack of qualitative (purity/length) cotton/wool fibres for mechanical recycling . Lack of spinning capacity for chemically recycled fibres (large scale) . Consistency of quality of the recycled fibres (length, strength,...) . Lack of trained workers
Weaving + knitting + non-wovens	. Lack of trained workforce . Minimum quantities per order too high . Strength of yarns with recycled fibres on the low side . Higher costs than competition (energy) . Regulations in EU tougher than outside EU . Important financial investment required . Long lead-times . Lack of innovation with mechanically recycled materials (non-woven)
Bleaching + dyeing + finishing	. Lack of collaboration between companies . Lack of a strong commercial network . Minimum quantities per order too high . Presence of alien fibres = defects . High cost of energy and logistics
Manufacturing + assembly	. Lack of trained workforce and of equipment . Cost of energy and recycled materials . Lack of data to compare circular approach to 'old' way
Distribution	. Lack of cooperation to drive cost down . High competition . Costly administration
Retail + Sale	. Limited clients/customers base . Low visibility for new sales pipelines . Higher prices for products with recycled content . Lack of space to display products . Higher price for higher sustainability/quality not understood
Repair of textile goods	. Lack of trained staff . Cost of repairs . Poor repairability of the products . Lack of promotion of the sector

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Collection of pre-consumer products	. Collected quantities too low, no massification . Too few companies interested . No mapping of regional production waste . Lack of storage space
Sorting of pre-consumer products	. Lack of sorting based on composition and/or colour . Volumes too low . High cost of equipment . Mixed waste, lack of training for sorting methods
Collection of post-consumer EoL products	. Number of interested/relevant companies too low (technical textiles) . Lack of space to store items . Volumes collected too low (workwear) . Consumers not properly informed of how to manage their EoL products . Not enough investment in communication . Need legislative support to speed up the compulsory recycling for EoL garments . Low quality products (fast fashion) = less possibilities for life/use prolongation
Sorting post-consumer EoL products	. Low capacity in fibre content based sorting . Lack of partners for the removal of hard parts . Missing capacity for automated sorting based on color & composition . Consumers not properly informed of how to manage their EoL products . Cost of NIR equipment . Cost of auto-sorting lines
Upcycling	. Several issues directly linked to gaps in collecting/sorting stages . No efficient production scrap management to produce high added value goods . Limited market for upcycled products
Recycling (closed loop - fibre to fibre)	. lack of data - no test reports for quality of feedstock . Lack of communication due to small structures involved . Lack of properly sorted feedstock . Difficulty to move to industrial scale (chemical recycling)
Recycling (open loop)	. lack of data - no test reports for quality of feedstock . Lack of partners in very specific recycling channels . Difficulty to form a complete value chain . Lack of composition-based sorting capacity
Down-cycling	. Lack of investment . Low volumes and low profitability
Research	. Lack of funding for research . Limited capacity of internal researchers . Low interest for biobased/fossil-free textiles as long as fossil based materials are subsidised

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Policies	. Lack of long-term strategy: too high targets on too short term > should be decades (2040) . Lack of common language (taxonomy gap), different interpretations between member states and regions . Lack of understanding of waste policy (waste framework directive elements of end of waste criteria, transboundary transport of waste) by industry
Training	. Relation between agricultural activities and textiles not enough recognised . Lack of properly trained operators for manual sorting
Support to industry	. Lack of incentives for research, development and scaling up . Lack of financing for early higher risk activities
Administrative tasks	. Enormous administrative procedures to achieve . No proper EU regulations (national/regional) . Oeko-tex difficult to achieve with recycled material
Match-making	. Lack of digital tools for offer/demand matchmaking
Circularity	. Lack of broad life-cycle approach, including eco-design phase . Lack of info on circular business models
Knowledge/data	. Lack of knowledge on hazardous substances and substances of concern in sourcing-recycling: issues of transparency, traceability, labelling . Lack of data collection at European level (waste flows from producer to recycling plant)
Waste management	. Lack of waste management and recycling capacity in EU . Lack of production of recycled yarn from textile quantities under 5 tons
Communication (customers + consumers)	. Higher price for higher sustainability/quality not understood

The long list of activities, 29 in total, shows the complexity of circular textile value chains and somehow the level of risk involved to develop new types of businesses.

Some gaps are very specific, some cover entire value chains. It shows how important it is to map value chains, highlight gaps and analyse them thoroughly to be able to prioritise actions and activate them. Very different fields of expertise will be involved in this work (e.g. recycling processes, waste management regulations, chemicals, traceability).

In this survey, all categories of gaps are covered. This shows the extent of the progress that is needed/expected to be able to build viable value chains.

A key learning is that the material side of a value chain (e.g. from waste collection to the spinning of recycled fibres) is key but it requires lots of other elements that support the creation and management of a business. What if competition is out of EU, are policies adapted to new circular options, is there enough support for innovation, can collaboration overcome the barrier of competition, etc.

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4.4 ECOSYSTEX Conference Workshop

CENTEXBEL organized a quadruple-helix workshop, in collaboration with EURATEX (STEP 2030) during the ECOSYSTEX Conference held in Barcelona, in October 2023.
38 participants contributed to the discussions. They represented a very diverse group, in terms of activities, knowledge, country, organisation, etc. This made it possible to get a highly valuable input, both through the discussions and in terms of results.
The approach for this workshop was to ask the participants to highlight possible gaps, to prioritise them, and to start thinking about possible solutions.
The complete report is available in annex….
For the first discussion, the 3 randomly composed groups came up with the following top 3 gap types:

A	B	C
Data	Policies	Sorting
Policies	Collecting Sorting	Consumers' behaviour
Sorting	Design	Design

We end up with gaps of different natures: technical (production), policies, eco-design.
All three groups highlighted the difficulties related to the sorting for recycling. This is no surprise, as we know there are numerous projects and activities working on this usual bottleneck.
The "policies" category covers different aspects related to rules, or absence of, harmonization of standards, etc.
The design was also a priority for 2 groups. Planning to improve the circularity at development stage is seen as a best practice.
While data was seen as a priority by only one of the groups, it is worth mentioning this is an ongoing issue. The lack of data, or the lack of accuracy, of traceability, can make it very difficult and tricky to define strategies, to anticipate volumes, etc.

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5 MAPPING AND GAPS ANALYSIS TOOL

A tool was developed in Excel to facilitate the actual mapping and gap analysis within the RegioGreenTex context. This tool consists mainly of 2 sheets, one to highlight the different components of the value chain under review, the other to record the different gaps, obstacles, or disruptive factors.

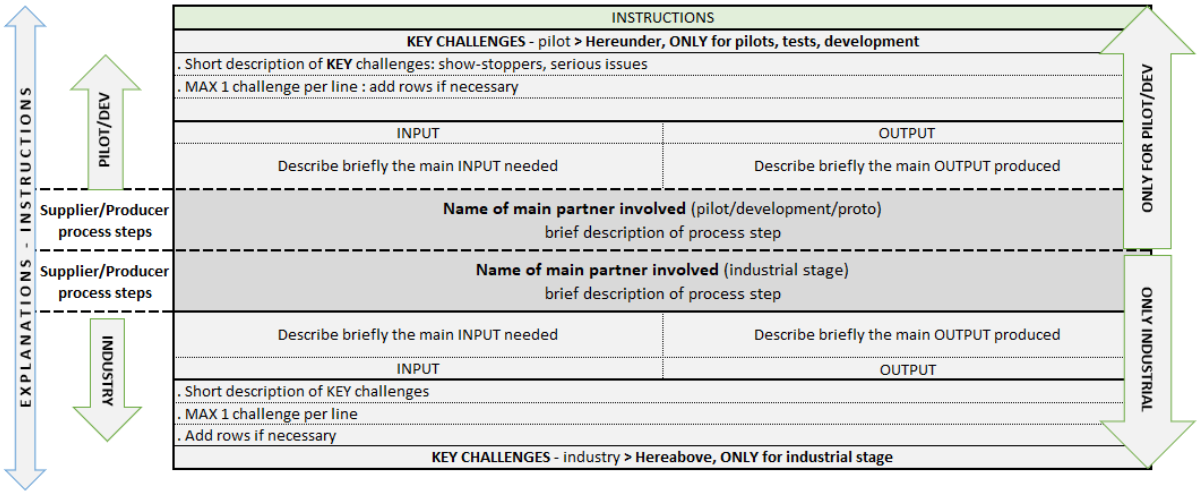
It should be stressed that the intention was to develop a tool that supports the visualisation of a value chain and the description of the gaps, but more importantly that stimulates the reflection on these elements to initiate action plans where appropriate. The key functions of this tool are briefly described in the following sections.

In practice, the tool was used - and tested - to help carrying out a mapping and gap analysis for an existing value chain. The partial data shown in the visuals, in the following sections, is taken out of that exercise. The focus was on a value chain covering the mechanical recycling of wool in the Prato region.

Note: the figures in section 5 are partial elements taken from large excel sheets. For a proper review, refer to ANNEXES 4, 5, and 6 and zoom in.

5.1 Value Chain Mapping Tool

In a first attempt, the idea was to fill in data in blocks that would represent each a company and a process step. In that version, the pilot and industrial stages were always represented. With the RegioGreenTex SMEs activities being at pilot stage, this distinction can be relevant as a different scale can call for different partners.



Eventually, this visual approach proved too complex in practice and was abandoned. The key elements were retained in either the Gaps Analysis sheet or in a workable version of the mapping that focuses on the situation at the time of the mapping (pilot, industrial, or intermediary stage).

In the final version of the mapping tool, the focus is set on the partners involved in each key process step of a specific value chain. The input required for the process step and the output it delivers are also mentioned. The top gaps should also be listed, for quick reference.

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One of the interests of this representation is to quickly see the strengths and weaknesses within the value chain.

In the example shown hereunder (limited section of the value chain, incomplete data), there are 2 different sources for textile waste, and one operation cannot be completed within the regional set-up of the chain.

MAPPING VALUE CHAIN - KEY DATA

Detailed challenges and GAPS in separate form

Process Step	Textile waste collection (Production and post-consumer)	Pre-sorting	Sorting
Supplier/Producer	Company 7	Operation outside Italy	Company 5
	INPUT: Various production waste OUTPUT: Waste packed in bales	INPUT: Mixed products packed in bales OUTPUT: Material sorted by category + packed In bales	INPUT: Bales of products sorted by colour OUTPUT: Bales of products better sorted by colour and composition
	TOP 3 CHALLENGES	TOP 3 CHALLENGES	TOP 3 CHALLENGES
		Find a company based in Italy	No large scale activity
			Data sharing between companies
			Categorisation of companies by authorities
	Company 8		
	INPUT: Mixed post-consumer waste (clothing) OUTPUT: Mixed products packed in bales		
	TOP 3 CHALLENGES		

Instructions on how to fill in the document are provided in the excel sheet.

5.2 Gaps Analysis Tool

While the mapping tool is designed to provide basic information at a glance, the gap analysis tool is intended to provide more detailed information about the gaps that may be holding back the potential of a particular value chain.

The construction of the sheet is based on the main findings of the theory, the results of the survey, and the results of the ECOSYSTEX workshop.

The information is organised in different blocks, as briefly explained hereunder.

5.2.1 Activities within the value chain

The process steps and all companies involved in the value chain are listed, as shown in the table here-under (table incomplete). RegioGreenTex partners are identified.

Each identified partner is listed and a ‘X’ shows what operations they can complete.

This enables to quickly get an idea of how the operations are spread, how many companies, meaning options, are available for each process step.

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ACTIVITIES - PROCESS STEPS	Contributors to the VC + activities Add identified partners (insert column)	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing
	RGT partner	x	x										
	VC starts... Process steps												
	Collecting pre-consumer waste							x					
	Collecting post-consumer waste								x		x		
	Pre-Sorting											x	
	Sorting					x					x		
	Carbonization					x							
	Removal of hard parts and non-textile elements					x							
	Fibre preparation (shredding)					x							
	Product design of semi-finished products	x		x	x	x	x						
	Product development and prototyping	x		x	x	x	x						
	Fibre preparation			x									

The process steps are listed in logical order, from the start to the end of the value chain. For each process step, a description of the input and the output are also given. Comments can be added.

CORE FUNCTIONS - Input - Output - Gaps															
ACTIVITIES - PROCESS STEPS	Contributors to the VC + activities Add identified partners (insert column)	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	Input	Output	Comments
	RGT partner	x	x											Describe input/feedstock for each process step	Describe output for each process step	
	VC starts... Process steps															
	Collecting pre-consumer waste							x						Yarns, Wool Fortresses, Combing waste (short and small fiber)	Collection of the material in bales	
	Collecting post-consumer waste								x		x			Clothing (T-shirt, pants, socks, ...)	Collection of the material in bales with mix of clothing	
	Pre-Sorting											x		Bales of mixed clothing (T-shirt, pants, socks, ...)	Division of material in bales by category: fiber, colors,	Often this phase is implemented outside of Italy
	Sorting					x					x			Bales of waste textile sorted by color	Bales of textile waste with a greater refinement of color and fiber	The sorting phase involves separating and categorizing textile waste based on various criteria such as material type, color, condition, and potential for reuse or recycling. This phase is crucial for efficient waste management
	Carbonization					x								Bales of waste wool	Wool without impurity of grass, wood, cotton or similar remains	Carbonization is used to remove impurity from wool waste.
	Removal of hard parts and non-textile elements					x								Products with hard part as buttons, zippers and labels	Products free from non-textile elements	Although much of this phase is carried out manually, there are instances where an automatic machine is employed to assist and enhance the recycling process
	Fibre preparation (shredding)					x								Bales of waste textile without hard parts	Textile shredded	This process is used to pulled back the fabric into small fibers
	Product design of semi-finished products	x		x	x	x	x							Information about starting fibers of textile waste already shredded + idea/objectives about the outputs and the market destination	Design, specs of the new circular product	Usually this phase is implemented by companies that produce semi-finished products/finished products
	Product development and prototyping	x		x	x	x	x							Project about textile waste-based products or semi-finished products	Prototype of product/semifinished product/finieshed product	

5.2.2 Gaps description and analysis

Based on the gaps highlighted during the different workshops and the survey, a separation in 3 different groups enables an easier reading of the data:

- Gaps related to **CORE FUNCTIONS** – mainly the process steps
- Gaps related to **SUPPORT FUNCTIONS** – e.g. laboratories, machine manufacturers
- Gaps related to **POLICY INSTRUMENTS** – e.g. policy makers, regional institutions

If needed, more gaps categories could easily be added.

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GAPS - Core Functions	GAP = an element missing (company, material, money, ...), or only available in limited quantities, lack of or problematic regulations, etc.	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	GAP description For GAPS that require a different response (e.g. pilot stage vs. industrial state), use 2 or more different rows!
	Large scale-sorting process										x			There is not a company/organisation that offers a large-scale service for the sorting phase of waste material. At the moment only humanitarian associations as Caritas and Humana. They keep only the good clothes for second-hand. The rest of the material is sent in Africa or China or burned to make energy.
	Hard-to-remove components from textiles					x								Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.
	Hard-to-remove components from textiles					x								Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.
	Mapping of the all recycling value chains: mapping of the different companies that could contribute in the long recycling process	x	x	x	x	x	x	x	x	x	x			Companies of Prato district have the capability to cover the entire value chain for recycling wool. However, it is still a disconnected system, that lacks of awareness regarding the processes that the companies are capable of undertaking.
	Lacking of competencies and effort spent for the products circular design phase	x	x	x	x	x	x	x	x	x				Circular design methodologies and techniques are not clear for most of the SMEs

As said before, a key function for the tool is to stimulate the reflection about the gaps. Listing them is simply not enough to move towards a solution, or to prioritise necessary actions.
For each gap, the following parameters must be estimated:

- Impact at pilot and/or industrial stage
- Timing: is it already impacting the process?
- Impact level: scale of 1 (low) to 5 (showstopper)
- Fixing difficulty: estimate of how difficult it will be to fix the gap

Pilot	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)
	x	0	4	5
x		0	3	5
	x	0	4	3

Finally, it is requested to add information about what could be seen as elements of solutions, and if possible, to provide indications about an action plan. In case these elements would not be available because further analysis is required, it is advisable to provide indications on what those involved in the first place think will be helpful when moving towards a prioritisation and a more detailed action plan.

5.2.3 User's guide

A series of instructions are provided on the excel sheet to ensure consistency between groups working on different value chains.
The following table, for example, provides indications on the different categories of gaps, and some values that need to be reported.

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Criteria - Data description		
ıre functions = ngible actions to make process deliver	**Support functions** = validation of the process, of the output, certification services, etc	**Regulations** = external players with an influencial role on the entire business
Raw material providers	Testing laboratories	Financial institutions
Fibres producers	3rd party certification bodies	NGOs
Yarn producers	Auditors/Inspectors	Consumer associations
Fabric weaving/knitting/NW	Sourcing agents	Customs administrations
Accessories and trims supplier	Freight and shipping	National government bodies
Assembly	Chemical suppliers	Independent experts
Retailers and brands	Technology providers	
Consumers/market?	Machinery providers	

Category	Possible values
Pilot	X if the case, empty otherwise
Industrial	X if the case, empty otherwise
Timing	0 = now already
Impact level	1 = low, to 4 = high - 5 = SHOW-STOPPER
Fixing difficulty level	1 = easy, to 5 = very difficult

5.2.4 Evaluation of the tool

Both the mapping and gaps analysis parts of the tool were tested based on an actual value chain data (wool fibres – Prato area). The final evaluation took place during an on-line discussion with the NTT Team and CENTEXBEL, on March 29, 2024.

The overall feeling was that the tool is useful and enables a thorough analysis of the value chain.

The following modifications and improvements were requested to improve the efficiency:

- Remove the pilot stage from the mapping: the pilot and industrial stages were first separated ➔ the layout was modified accordingly
- For the gaps analysis tool, merge the boxes for the possible solutions and action plans, and remove the cells related to the timing for the impact of the gaps ➔ modifications completed

The data collected by the NTT Team is described in section 6.2 of this report.

We anticipate that further fine-tuning will be required to ensure that the tool remains practical, based on further feedback at a later stage.

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6 MAPPING AND GAPS ANALYSIS IN REGIOGREENTEX VALUE CHAINS

For the mapping within the RegioGreenTex project, it was decided to first focus on 3 value chains.

- **Recycling of synthetic fibres used for technical applications (e.g. aramids)**

In this value chain, the original idea was to consider primarily the aramids, a high value type of fibres that was already handled by SMEs such a Peignage Dumortier or Textiles de la Thiérache, both in Hauts-de-France Region, or Hilaturas Arnau in Catalonia. It was extended to synthetic fibres used for technical applications.
Recyc'Elit, based in the Auvergne-Rhône-Alpes Region, has developed a process for the chemical recycling of textiles containing polyester.

- **Mechanical recycling of wool and long fibres**

Tuscany and Piedmont regions are specialised in the mechanical recycling of wool (Prato area) and other types of long fibres. A whole textile ecosystem is organised around that focus.

- **Chemical recycling of cotton**

SaXcell, located in Eastern Netherlands, is a SME that developed a process for the chemical recycling of cotton. Two key elements for this value chain are the availability of cotton products (no mix) and the sorting of textile waste to ensure a qualitative feedstock, in necessary quantities.

Two different approaches were used to conduct the analysis:

- **Workshop on value chains mapping** during the RegioGreenTex Consortium Meeting in Citeve (March 2024) – for the 3 described value chains
- **Mapping and Gap Analysis Excel tool** – for the recycling of wool in the Prato area

In addition, various discussions took place in several meetings, allowing information to be added.

6.1 Value Chain Workshop – RegioGreenTex Consortium Meeting – 12/03/2024

The Consortium meeting hosted by Citeve in Vila Nova de Famalicão, near Porto, was a great opportunity to meet with all partners and SMEs involved in the project.
CENTEXBEL and Oost NL organised a workshop that was meant to explore and promote business opportunities and hubs creation in concrete terms, based on RegioGreenTex SMEs. The presence of all stakeholders and partners under one roof made it possible to take an in-depth look at the 3 selected value chains. It was decided to run 3 concurrent workshops, after a plenary introduction and before a joint wrap-up.
While bringing a circular value chain to life by linking activities to each other is somehow easy on paper, the numerous gaps that were listed through different RegioGreenTex activities suggest that moving to reality faces several hurdles. It was therefore particularly interesting to evaluate the possibilities within the RegioGreenTex context. All participants were open to think about different channels and be transparent about their situation, initiatives, perspectives, solutions, etc.
Even though the focus was on value chains' development, some important gaps were highlighted.

6.1.1 Workshop objectives and methodology

The main objectives of the workshop were to:

- describe and visualise the different elements considered for each value chain
- organise the highlighted partners in a (interregional) recycling hub

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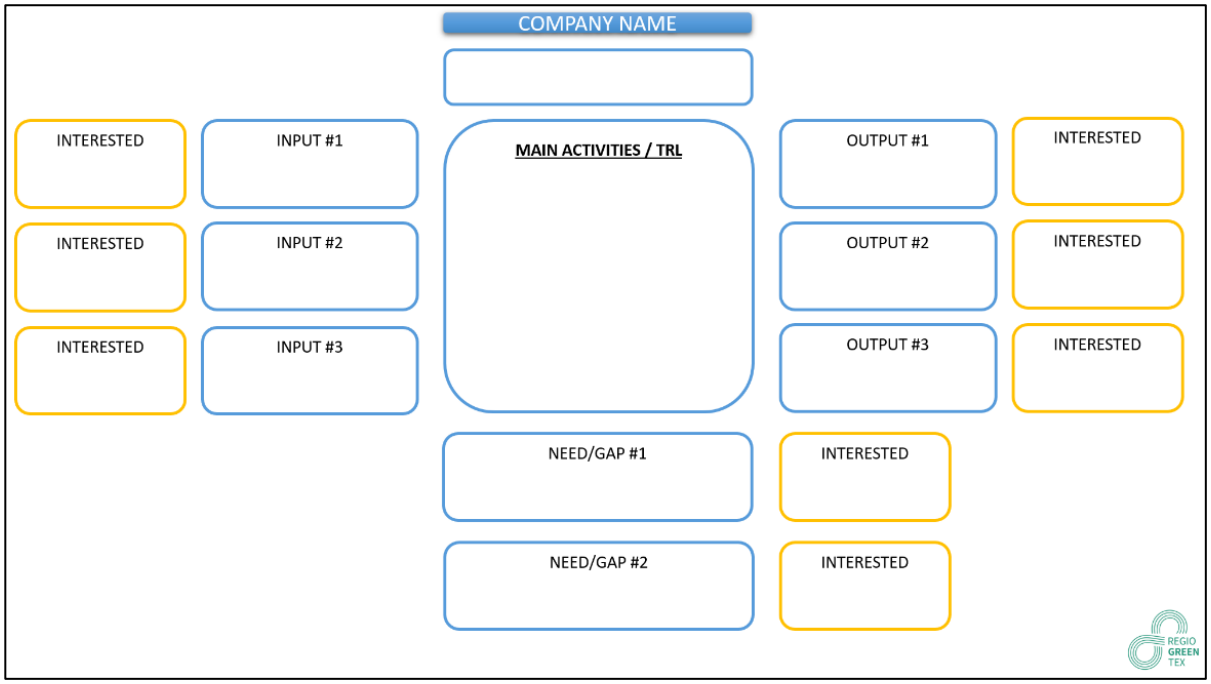
- highlight key processes and optional services/functions
- identify bottlenecks and highlight possible solutions and investments needs
- provide useful data for the completion of RegioGreenTex project's objectives
- fuel an open discussion between potential partners

In terms of methodology, the available time was divided into 3 phases:

- fill in individual forms to be shared with the group (10')
- build a value chain through an open discussion (60')
- conclusion (10')

6.1.2 1st step: company forms

Each participant was requested to fill in a form for their company/organisation. This warm-up exercise was meant to stimulate the self-reflection on the possible contribution and expectations or needs from every company/organisation to the value chain. It was also possible to use the filled in form to express an interest for a contact.



The participants from SMEs were asked to describe or highlight the following elements:

- **INPUT 1-3**: a description of the main input type(s) to feed their main process, if possible with an indication of quality and quantity.
- **OUTPUT 1-3**: a description of the main output type(s) coming out of their main process, if possible with an indication of quality and quantity.
- **NEED/GAP 1-2**: a description of the most important gaps slowing down their activities.
- **INTERESTED**: the descriptions of inputs, outputs and gaps were visible to all participants, who could indicate their interest (to learn, to support, to provide solutions) and initiate a contact and discussion.

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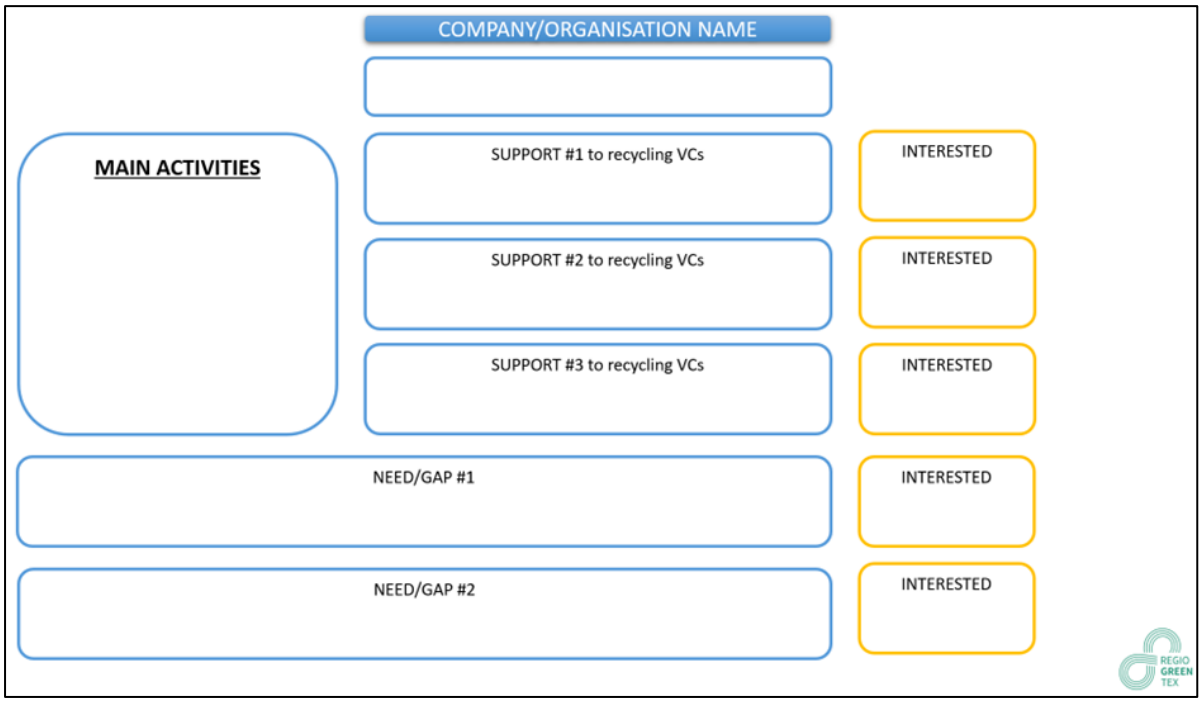
A specific form was also available for the organisations that could provide support for the development of these value chains.



The participants from the supporting organisations were requested to describe or highlight the following elements:

- **MAIN ACTIVITIES**: description of their main activities or field(s) of expertise.
- **SUPPORT TO RECYCLING VALUE CHAINS 1-3**: a description of the different types of support they can propose to the SMEs involved in the selected value chains.
- **NEED/GAP 1-2**: a description of the main gaps they identified
- **INTERESTED**: the descriptions of activities, possible support and gaps were visible to all participants who could indicate their interest (to learn, to support, to provide solutions) to initiate a contact and a discussion..

In total, for the 2 categories, 42 documents were completed, the content of which was summarised in an Excel file (not available in this report for confidentiality reasons).

6.1.3 2nd step: "creating" the value chains

The biggest part of the workshop was dedicated to a group's exercise for the creation of a recycling hub, of a value chain. For this part, an overall value chain poster was used as a basis to be completed with post-it's. A series of comments were also reported on a flipchart.

The representatives of the SMEs attended the workshop session for the value chain closest to their activity. Some could have been active in other value chains too, or not fit exactly in any. As a result, some of the highlighted scenarios were not necessarily realistic (e.g. geographical spread of activities), but were pertinent to fuel the process, the discussions, and to generate the learning.

The organisations, research centres, etc. were spread across the 3 sessions and explained how they could best support and contribute to the creation of each value chain. Obviously, most of the

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'supporting' organisations are in a position to contribute to any of the 3 value chains, even if this is not reflected in the visuals extracted from the workshop.

In the following visuals, the yellow stickers correspond to SMEs, and the green ones to supporting organisations.

At this stage, it is interesting to clarify what the main activities of each SME are.

Region	SME	Expertise and area of intervention
East-NL	Saxcell	chemical recycling of cotton into cellulose fibres
	RTT (NGO)	collection & sorting of textiles, validation of taxonomy that will be made (in WP1)
Flanders	Ariadne	digital platform for a community/ecosystem of circular textiles actors and wider stakeholders (incl. policy level)
	Quest Studio	design of circular value chains for clothing
	Ecoso (NGO)	group of charity working on collection & sorting
Hauts-de-France	Thierache	demo & scaling up of a recycled yarn portfolio for apparel (mainly cotton & polycotton)
	Dumortier	Fraying and carding process of recycled/rejuvenated fibres for the production of slivers (for subsequent yarn making)
Norte	Tintex	development of sustainable knitted fabrics and their dyeing & finishing using recycled content
	Sasia	mechanical recycling of textiles towards recycled content for spinning high quality yarns
Tuscany	Marini	Plasma treatment for zero waste & enabling recycled fibres use
	Trafi	creation of elaborate products based on a non-woven modified technology using only textile waste and scraps
Valencia	Technocolor	developing natural dye processes for recycled natural fibres
	Synthelast	chemical recycling of PU/PET coated fabrics
	H. Mar+ Ubitech	dref spinning of hybrid yarns (recycled carbon fibre) + embroidery for preforms
North-East Romania	Maibine (NGO)	zero waste design for clothing patterns, collection of End-of-Life clothing
	Kattv Fashion	digital design services for zero pre-consumer waste production, thus minimising waste
Catalonia	H. Arnau	demo and scaling-up of a novel portfolio of recycled yarns for technical applications
	Polisilk	chemical recycling of polypropylene towards a new compound for yarn extrusion
Piemonte	DBT	worsted yarn & long fibre recycling
	Casalegno	sheer curtain fabrics from recycled polyester fibres for the 'northern market'
	OFFICINA	development of a paste for textile colouring using recycled fibres, building further on an already patented process
Rhone-Alpes	ROVITEX	ultrasonic fusion technology applied to the assembly of multilayer fabrics to enable recycling (by preventing glue)
	RECYCEUT	chemical recycling of polyester back to fibre grade
Vastra Gotaland	Vividve	deinking/decoating of textiles
	FOV	sustainable high tech woven fabrics: use of scrap parts & sustainable coloration/decolouration

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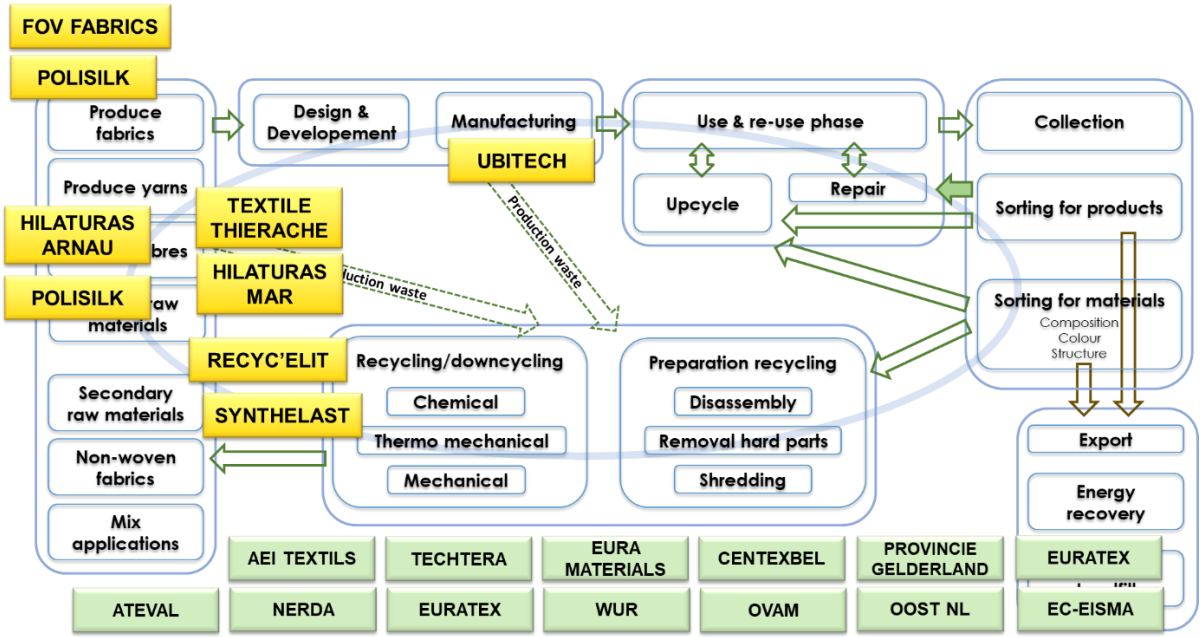
6.1.4 VC#1: Recycling of synthetic fibres used for technical applications

Facilitators: OOST-NL, TEXTILE DE LA THIERACHE, AEI TEXTILS

The focus for this value chain is the recycling of synthetic fibres used in technical applications. This includes for example the aramids used in protective equipment.

With the SMEs present in the room, we see an obvious concentration of activities in the recycling and the spinning of fibres from different composition (e.g. aramids, polypropylene). Others were active in the production of fabrics or worked with composites materials.

The following diagram shows where these activities are taking place in an overall circular textile value chain.

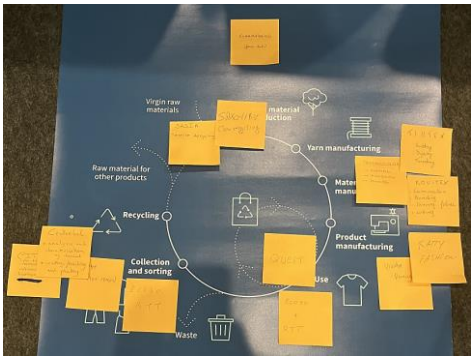


6.1.5 VC#2: Chemical recycling of cotton

Facilitators: OOST-NL, SAXCELL, CITEVE

The starting point for the creation of this value chain is the chemical recycling process developed by SaXcell. Eventually, different possibilities related to different R-strategies for cotton products were taken into consideration.

For the recycling, SASIA, a SME active in the mechanical recycling of cotton (and other types of fibres), was added as a second option for recycling. For the feedstock supply,



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a sensitive element given the demanding criteria to ensure a good recyclability (e.g. composition, colour, absence of hard parts), RTT and ECOSO, both active in the sorting, could play a role.

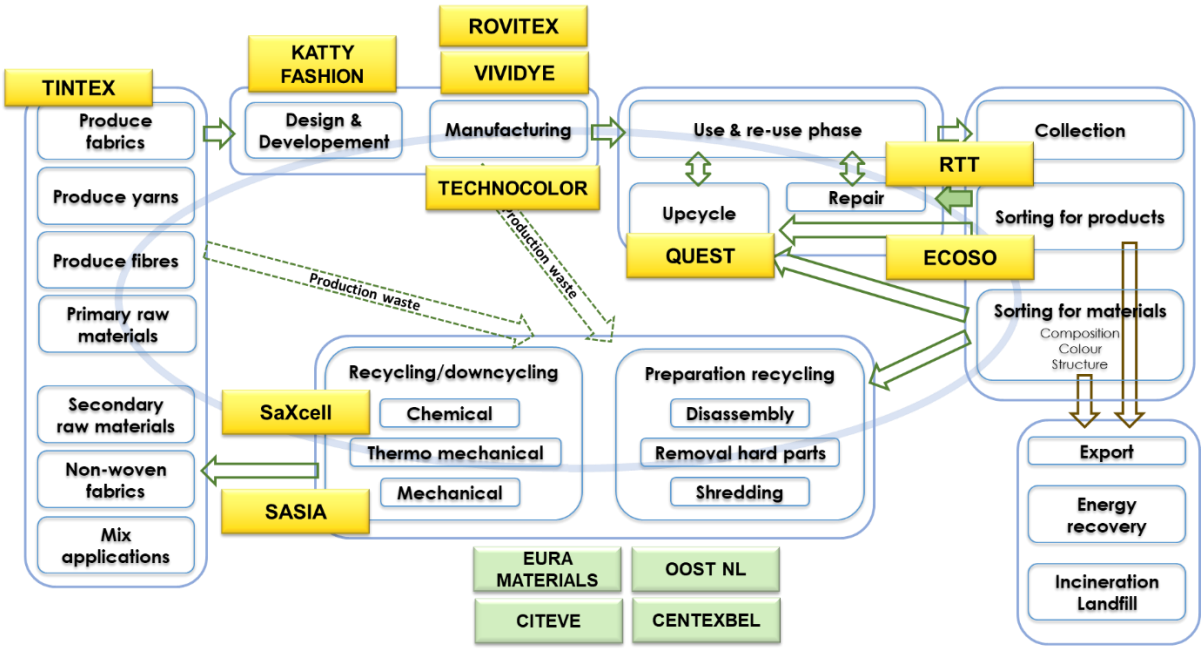
If considering re-use or up-cycling starting from post-consumer goods, sorted at ECOSO or RTT, QUEST and ECOSO would be the SMEs available with different proposals.

Several SMEs can also offer a series of treatments or support for the knitting, dyeing, printing, zero-waste prototyping, etc.

It is worth mentioning that, even if it is not a surprise, that value chain is missing 2 important steps:

- the cellulosic pulp generated by the chemical recycling must be processed to be transformed into filaments/fibres, with usual partners from SaXcell
- there is no spinning capability, a necessary step between the recycling and the weaving/knitting steps

The following diagram shows where these activities are taking place in an overall circular textile value chain.



6.1.6 VC#3: Mechanical recycling of wool and long fibres

Facilitators: CENTEXBEL, PEIGNAGE DUMORTIER, NTT, PO.IN.TEX

The regions of Tuscany (Prato) and Piedmont have a strong position in the recycling of wool and other types of long fibres. During this workshop, we considered the activities in these regions and added other RegioGreenTex SMEs in the picture, such as Peignage Dumortier (production of combed slivers), DBT Fibres (production of carded slivers), etc.

Based on the partners involved in the discussion, we developed different scenarios, all somehow incomplete.

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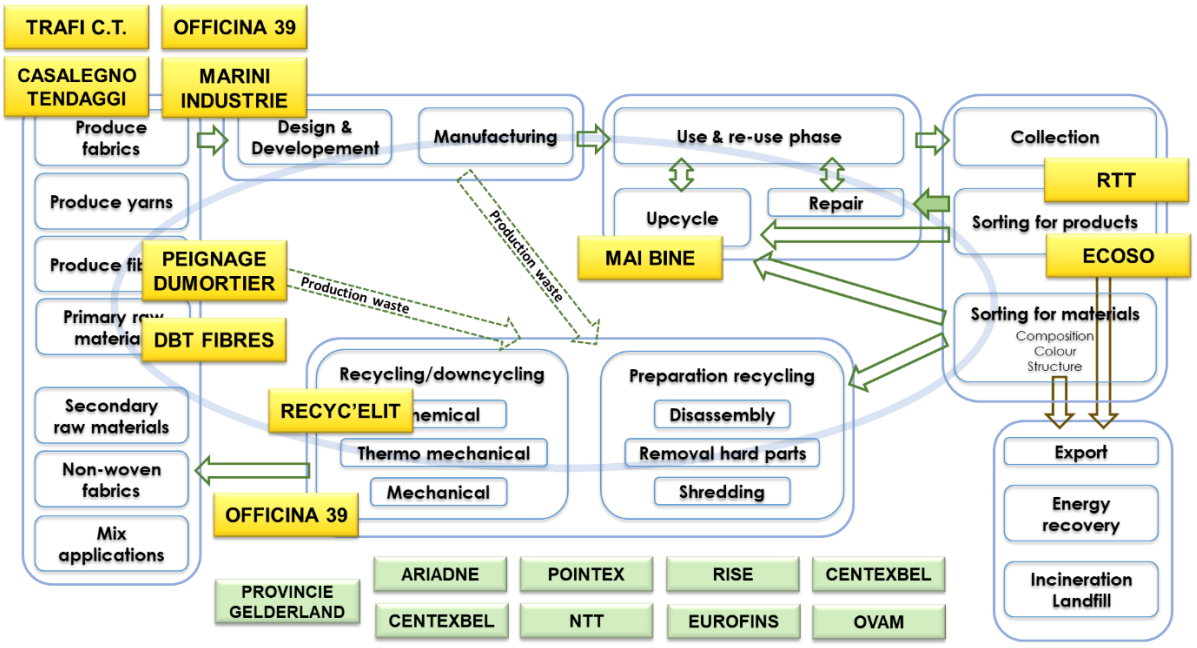
All recycling activities start with a proper sorting to deliver the necessary feedstock. This is the type of activities RTT and ECOSO can manage. Based on that sorting, MAI BINE and ECOSO could work on some upcycling activities.

But the sorted products require further preparation to be integrated into the recycling stage, for instance, the removal of hard parts and the shredding. There were no SMEs to cover these operations. RECYC'ELIT manages the chemical recycling of polyester-based products. Peignage Dumortier can produce combed/carded slivers in a wide variety of fibres (e.g. wool or aramids). DBT Fibres is producing carded slivers in different long/short fibre types.

There was no SME to cover the spinning. TRAFI could use slivers in some products made with the punching needle technique or produce some wool "fur" for carpets.

For the production of fabrics (different techniques), 3 SMEs would be involved.

OFFICINA 39 can be considered at different stages of the value chain. They develop dyestuff out of cotton waste, meaning they recycle. Their dyestuff can then be used for the dyeing (or to get special effects) of fabrics or garments.



As a complement to the mapping exercise, the group discussed about the existing gaps and about investments that could drive a positive evolution.

- **Gaps**

. Difficulty to get permits for production
. LCA for wool not favourable in comparison with synthetic fibres
. Lack of innovation in recycling value chains (no breakthrough or important evolution for too long)
. Separation of fibres requires improvement to improve the quality
. Need for uniform legislation
. Clarification of specs (Input/Output) needed
. Local > cost of transport + impact LCA

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- **Investments**

. Support for sorting in finer categories
. Develop/optimise reverse logistics options
. Develop/optimise traceability (before/after)
. Develop consumer education (sorting options)
. Develop technology for chemicals' detection

6.1.7 Workshop conclusion

One of the objectives for these 3 concurrent workshops was to collect data that could be used for the Mapping and Gap Analysis work. Objective met!
We knew beforehand that it would not be possible to create three complete value chains in this exercise, but it was important to have an open discussion about how the different SMEs can link their activities and possibly think of new options.
It also gave us the opportunity to better understand what kind of support is needed to make the value chain activities possible.

6.2 Value Chain: Mechanical Recycling of Wool – Tuscany Region - NTT

NTT worked on a thorough mapping and gap analysis for a major value chain in the Tuscany Region: mechanical recycling of wool fibres.
The 2 main objectives of their work were the following:

- Analyse that value chain to highlight the main gaps that hinder the development of a scalable recycling system in the region
- Use and test the Mapping and Gap Analysis Tool

The work was organised in 2 phases. In the first one, the tool was used to analyse the value chain and systematically describe the functions and the gaps within the value chain. In a second phase, a reflection work took place to think about the bigger picture and highlight gaps at a higher and broader level.

6.2.1 Using the Mapping and Gap analysis Tool

The excel tool developed for the mapping and gap analysis is described in the section 5 of this report. NTT trialled the tool in an actual scenario related to the mechanical recycling of wool-based products. One of the main functions of the tool is to guide the reflection around the mapping and the gap analysis, and to ensure a good consistency in the way to analyse and report these elements between the value chains that will be analysed.
It has lived up to expectations.
For this work, NTT considered 2 SMEs from RegioGreenTex, named 'RGT Company 1' and 'RGT Company 2' in this report. Other companies, referred to as Company 3 to 8, and Consortium/Association 1 and 2 were added to form a complete value chain.
The analysis shared in the following paragraphs is a summary of the findings. All necessary details to push the analysis further and orientate action plans is available in the excel file.
Important note: the exercise was not meant to define and activate solutions to gaps or issues that would be highlighted. The focus was on the identification and analysis of the gaps.

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6.2.2 Mapping

As said in the description of the tool, the first version of the tool was too complex. It took both the pilot and industrial stages into consideration, an approach that made the tool too cumbersome to use. A simplified version was reworked, and the mapping will be done on that basis.

Hereunder an extract of the Mapping Excel sheet.

MAPPING VALUE CHAIN - KEY DATA

Detailed challenges and GAPS in separate form

Process Step	Textile waste production (Production and post-consumer)	Textile waste collection (Production and post-consumer)	Pre-sorting	Sorting
Supplier/Producer	Consumers	Company 8, Consortium/Association 2	Outside of Italy	Company 5, Consortium/Association 2
INPUT	Mix of garments from market	Textile gaments (T-shirt, pants, socks, ...)	Bales of mixed clothing (T-shirt, pants, socks, ...)	Bales of waste textile sorted by color
OUTPUT	EoL product for collection = post-consumer textiles	Collection of the material in bales with mix of clothing	Rough division of material in bales by category: fiber, colors, ...	Bales of textile waste with a greater refinement of color and fiber
TOP 3 CHALLENGES	Consumer awareness about textiles - based waste management	Definition of Regulations and laws governing the post-consumer collection phase	Integrate this phase of the value chain in Italy (or at regional level)	Improve the technologies for the sorting phase
		Definition of a point of reference for the textile waste collection (company or similar organization)	Improve the technologies for the sorting phase to remove the pre-sorting one that is implemented manually at now	Industrialise the technologies for the sorting phase
Supplier/Producer	Pre-consumers	Company 7		
INPUT	Mix of yarns, wool fortresses, combing waste, ..	Mix of yarns, wool fortresses, combing waste, ...		
OUTPUT	EoL product for collection = pre-consumer textiles	Collection of the material in bales		
TOP 3 CHALLENGES	Perform an initial sorting to separate the different types of textiles at the level of the company that produces the textile waste	Definition of Regulations and laws governing the post-consumer collection phase		
		Definition of a point of reference for the textile waste collection (company or similar		

The data shows a clear path through the value chain, using the output of one process step as an input for the following stage. As previously said, outside companies were added and a complete VC was formed, starting with the collection of textile waste, both out of production and from post-consumer sources. The value chain ends with the sale, on a B2B mode, of the dyed/finished fabrics and non-woven's made with the recycled materials. This set-up shows a good level of flexibility in terms of what waste categories can be used, and in the final product range. The main gaps are also listed without details under each company/process step.

The diagram below is not part of the tool. It provides a good indication of the level of complexity that can arise when working on all operations to develop a circular value chain.

This value chain comprises 12 distinct stages on top of the activities related to the product design and development, and the prototyping. The numbers correspond to how many companies are involved at each process step. Several of them are covered by one company only.

A specific aspect of this value chain lies in the fact that 5 companies work on the design/development and the sale of products that are mostly manufactured by other companies of the value chain.

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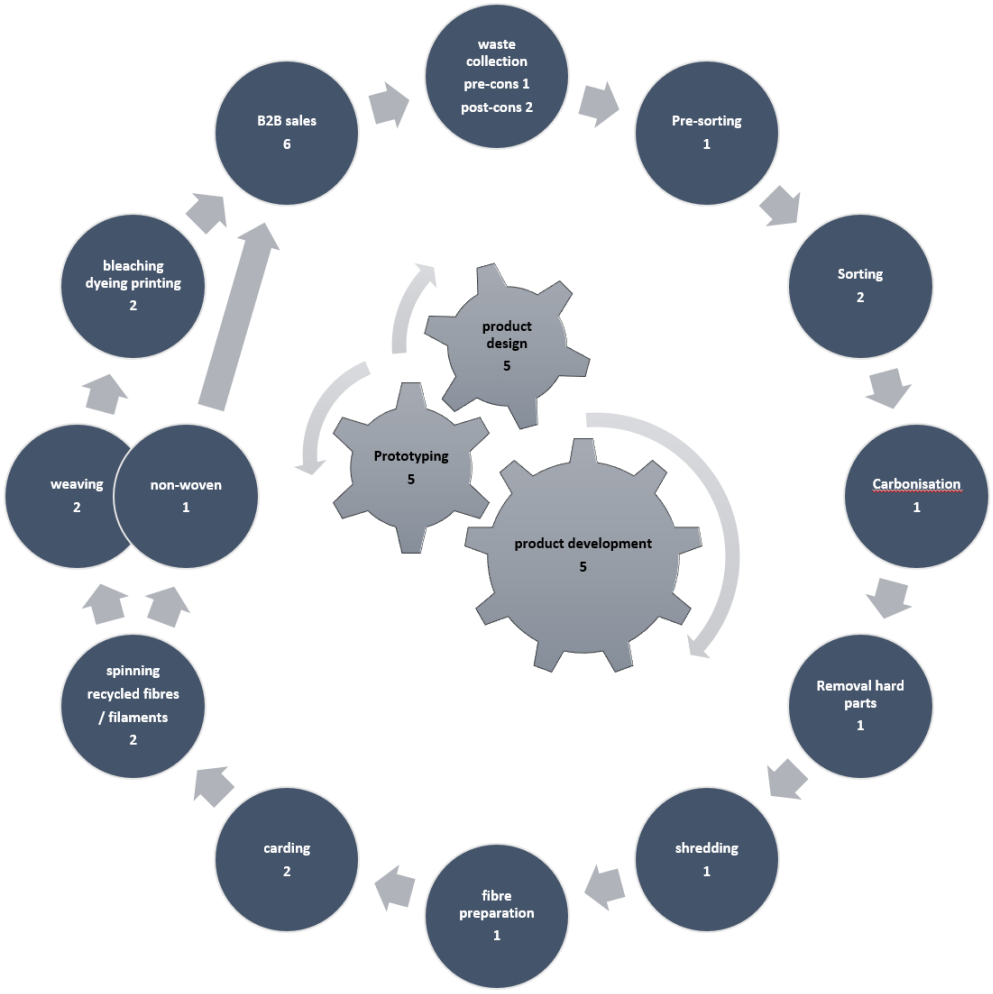

6.2.3 Gap analysis

The NTT Team realised the most advanced mapping and gap analysis, based on actual data. They used the draft Mapping and Gap Analysis Tool (Excel file). The latter was slightly modified based on their initial feedback.

The gap analysis covers the following elements:

- all process steps from the value chain
- all stakeholders
- the main categories of gaps (core functions, support functions, policy instruments)
- the impact level for each highlighted gap
- an estimate of the difficulty to address each gap
- an indication of the possible actions to initiate in order to close the gaps

Note: the data presented below is best reviewed in the Excel file. The screenshots are only partial and for indication.

The first step after the mapping consists in listing the companies involved at each process step. The input and output are described for each operation. In the present case, the set-up is straightforward, and the Input/Output types are standard.

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CORE FUNCTIONS - Input - Output - Gaps

ACTIVITIES - PROCESS STEPS

Contributors to the VC + activities Add identified partners (insert column)	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	Input	Output
RGT partner	x	x											Describe input/feedstock for each process step	Describe output for each process step
VC starts... Process steps														
Collecting pre-consumer waste							x						Yarns, Wool Fortresses, Combing waste (short and small fiber)	Collection of the material in bales
Collecting post-consumer waste								x		x			Clothing (T-shirt, pants, socks, ...)	Collection of the material in bales with mix of clothing
Pre-Sorting											x		Bales of mixed clothing (T-shirt, pants, socks, ...)	Division of material in bales by category: fiber, colors,
Sorting					x					x			Bales of waste textile sorted by color	Bales of textile waste with a greater refinement of color and fiber
Carbonization					x								Bales of waste wool	Wool without impurity of grass, wood, cotton or similar remains
Removal of hard parts and non-textile elements					x								Products with hard part as buttons, zippers and labels	Products free from non-textile elements
Fibre preparation (shredding)					x								Bales of waste textile without hard parts	Textile shredded
Product design of semi-finished products	x		x	x	x	x							Information about starting fibers of textile waste already shredded + idea/objectives about the outputs and the market destination	Design, specs of the new circular product
Product development and prototyping	x		x	x	x	x							Project about textile waste-based products or semi-finished products	Prototype of product/semifinished product/finieshed product
Fibre preparation			x										Bales of shredded fiber sorted by color	New fiber
Carding		x	x										Shredded fiber	Spun
Spinning (recycled fibres/filaments)		x	x										Spun	Yarn
Weaving			x			x							Yarn	Fabric
Bleaching/dyeing/printing/finishing	x		x				[2]						Yarn or Fabric	Yarn or Fabric treated by finishing processes
Non woven production				x									Shredded fiber, too short for carding	Fiber panels (and other semi-finished products for different market segments)
Selling B2B	x	x	x	x	x	x							semi-finished products	finished products
Recycling (closed loop - fibre to fibre)				x		x								
VC ends...														

It is possible to add comments for clarification to each process step. For this value chain, the following are worth mentioning.

Sorting: the sorting phase involves separating and categorising textile waste based on various criteria such as material type, color, condition, and potential for reuse or recycling. This phase is crucial for efficient waste management

Removal of hard parts: although much of this phase is carried out manually, there are instances where an automatic machine is employed to assist and enhance the recycling process

Non-woven production: the nonwoven applications are cross-sectorial, and go beyond the Fashion sector

The gaps are listed and described for each category (core and support functions, policy instruments), with the necessary details on the impact level and the expected level of difficulty to address the gap.

GAPS - Core Functions

GAP = an element missing (company, material, money, ...), or only available in limited quantities, lack of or problematic regulations, etc.	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	GAP description For GAPS that require a different response (e.g. pilot stage vs. industrial state), use 2 or more different rows!	Pilot	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)
Large scale-sorting process										x			There is not a company/organisation that offers a large-scale service for the sorting phase of waste material. At the moment only humanitarian associations as Caritas and Humana. They keep only the good clothes for second-hand. The rest of the material is sent in Africa or China or burned to make energy.		x	0	4	5
Hard-to-remove components from textiles					x								Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.	x		0	3	5
Hard-to-remove components from textiles					x								Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.		x	0	4	3
Mapping of the all recycling value chains: mapping of the different companies that could contribute in the long recycling process	x	x	x	x	x	x	x	x	x	x			Companies of Prato district have the capability to cover the entire value chain for recycling wool. However, it is still a disconnected system, that lacks of awareness regarding the processes that the companies are capable of undertaking.	x		0	4	4
Lacking of competencies and effort spent for the products circular design phase	x	x	x	x	x	x	x	x	x				Circular design methodologies and techniques are not clear for most of the SMEs		x	0	4	3

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There is also an indicative action plan described for each gap. In future versions of the tool, the elements of solution and the proposed action plans will be merged.

GAP description For GAPS that require a different response (e.g. pilot stage vs. industrial state), use 2 or more different rows!	**Pilot**	**Industrial stage**	**Timing** (# months)	**Impact level** (1 to 5)	**Fixing difficulty** (1 to 5)	**Elements of solution(s)**	**Action(s)** What - Who - When
There is not a company/organisation that offers a large-scale service for the sorting phase of waste material. At the moment only humanitarian associations as Caritas and Humana. They keep only the good clothes for second-hand. The rest of the material is sent in Africa or China or burned to make energy.		x	0	4	5	In Italy, sorting is frequently implemented manually to ensure optimal results, although certain companies opt for new automated sorting processes. The integration of automated sorting technology could significantly enhance the separation of textile materials. Consequently, there is a growing demand for new investments in sorting technologies	Research centers could collaborate with technology producers inolved in the development of sorting machine technologies
Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.	x		0	3	5	Design clothing with hard parts easy to remove.	Designer must improve skills to make fashion products easy to recycle
Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.		x	0	4	3	Encourage and spread the use of automated processes already available in the Tuscan district	Create and implement diffusion and exploitation processes for spreading the technology opportunites
Companies of Prato district have the capability to cover the entire value chain for recycling wool. However, it is still a disconnected system, that lacks of awareness regarding the processes that the companies are capable of undertaking.	x		0	4	4	Some territorial organisations are developing the map to contribute to the Hub project implementation	
Circular design methodologies and techniques are not clear for most of the SMEs		x	0	4	3	Organize design and creative workshops to explain circular design. Create new vertical figures specialised in eco-design	Organize new public and private courses dedicated to the new needs of the entire recycling wool value chain

This data is of key importance as it highlights the elements that make the functioning of the value chain more difficult or more complex. As such, they also highlight opportunities for improvement at various levels.

6.2.4 Gaps related to Core Functions

5 gaps were highlighted, all very relevant.

4 have an impact level (IL) of 4, 1 is at level 3. The 'fixing difficulty' (FD) ranges from 3 to 5.

The tables from the tool highlight an interesting additional element. If 3 gaps have mainly an impact on 1 company, the other 2 impact 9 or 10 companies. This could also influence the decision to tackle some gaps first.

Let's analyse 3 of them.

- **Large scale-sorting process** – IL4, FD5

Currently, there is no large-scale sorting activities for the recycling. The work is mostly done by hand to obtain optimal results and would benefit from the introduction of automated processes.

- **Removal of hard parts** – IL3, FD5

No exception for this region, this activity is challenging and can be a bottleneck. The use of new machinery and a thorough work of eco-design could help improve the situation.

- **Mapping of regional companies** – IL4, FD4

Companies of Prato district have the capability to cover the entire value chain for recycling wool. However, it is still a disconnected system, that lacks awareness regarding the processes that the companies are capable of undertaking.

This issue potentially affects the whole regional textile ecosystem.

6.2.5 Gaps related to Support Functions

2 gaps were highlighted, both impacting 9 or 10 companies. Both have an impact level of 4.

- **Difficulties to share data related to production/manufacturing** – IL4, FD5

Companies struggle with the sharing of info and evolve at different digitalisation levels. An interesting element is that the solutions would be both technical and cultural.

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- **Lack of knowledge about eco-design, circular business models** – IL4, FD 3

This type of gap slows down the progress that can be done in terms of transition towards circular economy. The positive is that it is possible to address it relatively easily, for example by organising webinars or training sessions.

6.2.6 Gaps related to Policy Instruments

4 gaps were highlighted, with impact levels 3 or 4; the fixing difficulty is either 4 or 5.
The difficulties can be linked to the application of existing regulations (e.g. at local level) or the absence of relevant standards or directives, mostly at EU level.

- **Standards and certification** - IL4, FD5

2 gaps relate to either the lack of standards for sustainable products or the absence of a reliable certification process for products containing recycled (waste) material.

6.2.7 Reflection on the gap analysis

After completing the analysis with the Excel tool, NTT went through a broader reflection on the gaps categories that can possibly impact the entire wool recycling business of the region, and not just a specific value chain.
They consolidated the gaps into 5 different categories:

- **Technical/Technological gaps**

The value chain misses industrial scale solutions to process the wool in larger quantities, at the right quality and standard level. Some companies develop their own innovative solutions that can be worth scaling up. It would be useful to have a system that promotes such innovations, and that also enables newcomers in the recycled wool business to have directly access to the right technology.

- **System/Organisation gaps**

Such gaps are linked to the lack of a unique control “room” that can be a point of reference for the whole value chain. For example, it would be useful to have an organization that maps and knows all the companies that have technological solutions/phases for the wool recycling.
In addition, at system level, transparency and traceability in the recycled wool supply chain is lacking. Without clear information about the origin and processing of recycled wool products, it is difficult for businesses to make informed decisions about their re-worked.
On the consumer side, supply chain transparency gaps can undermine trust and confidence in recycled wool - based products.

- **Cultural/skills gaps in circular practices and products**

There is a cultural gap that makes it difficult to shift mindsets away from traditional linear models of production and consumption towards circular thinking, adopting new economy concepts and sustainable practices.
The skills Gap involves the absence of specialized skills and expertise required to design, produce, and manage circular products and processes. While companies often invest in high-level plant and machinery, these efforts necessitate support through collaborations between companies, as well as the enhancement of workers' knowledge through workshops and training activities.

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The enhancement of the value chain and the resolution of its gaps require greater synergy among industrial actors.

- **Skills gaps in digital solutions (and in general in Industry 4.0 framework)**

In order to create a robust recycling system, data is crucial. Data is the most important element of the Industry 4.0 framework, and in the textile sector, its collection is still a serious deficiency due to a lack of skills in integrating digital solutions into existing processes and in data analysis, both at company and value chain level.

- **Regulatory gaps**

Regulatory challenges, including environmental regulations, trade policies and waste management laws, create barriers to the efficient operation of the recycled wool value chain. Inconsistent or burdensome regulations increase the administrative costs of properly implementing recycling processes that prove uncompetitive with non-recycled alternatives.

There is a high level of complexity in certification schemes as there is no single reference at European/international level to demonstrate commitment to sustainability and quality standards.

This input will be considered for possible adaptations in the structure of the Mapping and Gap analysis Tool, especially in the way gaps are split into categories.

6.3 Value Chain: Mechanical Recycling of Long Fibres - Piedmont Region PO.IN.TEX

At the time of writing, po.in.tex is working on the mapping and gap analysis using the Excel tool.

Initial indications are that their overall findings are quite similar to those highlighted by NTT. The full report should be available shortly.

This data will be used in the next phases of the project.

6.4 Conclusion

The mapping and gap analysis should be seen as a necessary step to provide key information about the situation for specific value chains. It is an eye-opener and a basis for action. The use of the Mapping and Gap Analysis Tool proves useful to guide the reflection, collect the data and enable a shared view on value chains, in a consistent way.

The quality of the analysis, in terms of relevance, transparency, and openness is crucial! If carried out by the right panel of people and organisations, as was the case for the work led by NTT, it can deliver an objective perspective on the existing gaps, help prioritise the issues to be addressed, and provide hints on what solutions could be developed, activated, and implemented.

This data should therefore be used as one of the key elements to drive further improvements and investments to reduce the negative impact of the most important gaps.

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7 OVERALL CONCLUSION

The different elements collected since the beginning of the RegioGreenTex project, through the specific activities of WP1 and several other opportunities, have shown how difficult it is to establish efficient and viable circular textile value chains.

WP1 T1.3 focuses on the Mapping and Gap Analysis. Several steps enabled to drive a proper mapping and gap analysis in 3 value chains, for example:

- Survey on gaps (RegioGreenTex and STEP 2030)
- Ecosystex workshop on value chains gaps
- Value Chain Workshop during the Consortium meeting in Porto

The preparation of the Mapping and Gap Analysis Tool enabled to finetune the gap analysis. Major gaps' categories (core functions, support functions and policy instruments) were defined, the evaluation of the impact level and the degree of difficulty to fix each gap were taken into consideration to enable a prioritisation and highlight elements of solutions.

The use of the tool by the NTT Team for the value chain "Mechanical recycling of wool in Tuscany Region" demonstrated the interest of structuring the mapping and the gap analysis: a thorough analysis, led by the right mix of experts, can serve as a robust basis to define action plans, and to raise awareness among all stakeholders, based on facts, based on the actual situation. They extended their analysis to a broader level and identified structural gaps or issues that are slowing down the development of wool recycling activity.

If specific value chains are facing specific challenges, we see some trends in the nature of the gaps that prevent smooth operation or development of circular textile value chains. Here are some of the main ones:

- Core functions gaps: lack of large scale precise sorting process, no efficient industrial process for the removal of hard parts, difficulty to identify partners at local level, scarcity of raw materials, lack of skilled workers
- Support functions gaps: difficulties to share data related to material and production, lack of knowledge about eco-design and circular business models
- Policy instruments: no standards for recycled products, lack of certification schemes, policies applied consistently across the EU (e.g. waste management)

This analysis will also be used to further improve the tool.

All this opens up interesting perspectives for analysing more value chains in the context of RegioGreenTex and hopefully identifying opportunities to eliminate or reduce gaps.
It would therefore be advisable to build on this work and experience, and continue the mapping and gap analysis of other value chains, using the mapping and gap analysis tool and the data collected and analysed so far.

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8 LIST OF ANNEXES

- **ANNEX 1:**
  Extracts from the Grant Agreement (WP1 and D1.3)
- **ANNEX 2:**
  Survey on gaps in circular textile value chains (preparation ECOSYSTEX workshop)
- **ANNEX 3:**
  Report Quadruple Helix ECOSYSTEX workshop
- **ANNEX 4:**
  Mapping tool – Tuscany (Prato) Region
- **ANNEX5:**
  Gap Analysis Tool - empty
- **ANNEX 6:**
  Gap Analysis Tool – Tuscany (Prato) Region

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LIST OF WORK PACKAGES

Work packages

Grant Preparation (Work Packages screen) — Enter the info.

Work Package No	Work Package name	Lead Beneficiary	Effort (Person-Months)	Start Month	End Month	Deliverables
WP1	Gap analysis and value chain mapping	8 - CTB	82.32	1	36	D1.1 – Taxonomy D1.2 – Waste stream analysis and recycled textile classification D1.3 – Value chain map and gap analysis
WP2	Building ecosystem for transition to a green textile sector	4 - NE RDA	122.06	1	36	D2.1 – Ellie Connect upscaled with new functions to be a fully functional digital ecosystem D2.2 – Digital Self-Assessment Tool D2.3 – REGIOGREEN- TEX Course Curricula D2.4 – Ecosystem activities report
WP3	Implementation portfolio of investment projects	3 - CITEVE	850.44	1	36	D3.1 – Pilot Report D3.2 – Products/Services Demonstrators
WP4	“Advisory” - Services and support to the portfolio of the SME projects	14 - NTT	196.35	1	36	D4.1 – Coaching strategy D4.2 – Report on the result achieved through the delivery of coaching actions and green advisory services provided D4.3 – Repository of business plans developed D4.4 – Exploitation Plan
WP5	Regional Hubs	15 - OOST NV	311.06	1	36	D5.1 – Hub Inception Plan D5.2 – Pilot Actions D5.3 – Hub Investment plan D5.4 – Business and Investment Plans

Associated with document Ref. Ares(2022)8552165 - 09/12/2022

Work package WP1 – Gap analysis and value chain mapping

Work Package Number	WP1	**Lead Beneficiary**	8. CTB
Work Package Name	Gap analysis and value chain mapping		
Start Month	1	**End Month**	36

Objectives
Define a Taxonomy & Nomenclature: to establish a common language for the novel building blocks of the textile recycling value chain from collection to reprocessing Setup a waste channelling structure: decision tree on how to sort, separate and aggregate the various EoL waste streams into streams that enable recycled materials to use, e.g. in streams for dedicated re-use, disassembly or recycling technologies Gap analysis and value chain mapping to better address the progress of innovation and investments during the project implementation. As the landscape is evolving fast in relation to the implementation of the EU textile strategy, the progress towards the 2025 deadline and the introduction of EPR schemes, the gap analysis is updated each year (to be continued possibly after the end of the project), to provide a context for investment decisions inside and outside/beyond this project

Description
REGIOGREENTEX has targeted 6 main steps along the main streams of the value chain, identified in the scheme above (figure 1), referring to both material strategies (sorting, shredding, disassembly and separation, channelling waste streams, using recycled contents) and product strategies (design and manufacturing). To shift the value chain from a linear to a circular model, we will further investigate gaps and bottlenecks of those steps (WP1),

Work package WP2 – Building ecosystem for transition to a green textile sector

Work Package Number	WP2	**Lead Beneficiary**	4. NE RDA
Work Package Name	Building ecosystem for transition to a green textile sector		
Start Month	1	**End Month**	36

Objectives
The main objective of this WP is to build a dynamic recycling textile ecosystem at the European level. The ecosystem set up and nurturing will be achieved thanks to the support of a digital platform already in place called Ellie Connect, which will be scaled up and finetuned to host and support multiple tools, contents, functions and training material functional to match SMEs at EU level and to disclose new path for the sustainability and resilience of textile production and market. The specific objectives of the WP are: Build up a European recycling textile ecosystem on a digital platform To assess and profile each SME joining the ecosystem (Self-assessment tool) to provide specific coaching/training as well as effective matchmaking Raise awareness and upskill SMEs on textile recycling and circular design Encourage the interregional debate on the future of the sector, its sustainability and green transition (policy dimension of the ecosystem)

Description
. A digital platform will be built under the RegioGreenTex project, where SMEs and other relevant actors come together and cooperate along the value chain to optimize the eco-effectiveness of the entire ecosystem and create shared value. The SMEs will undergo a self-assessment exercise to evaluate their recycling potential regarding processes and products. Based on the results, the companies will receive feedback on how to achieve the following steps on textile circularity and offered coaching or training to improve their business models, as well as other inputs regarding eco-design, waste management and recycling. The SMEs present in the ecosystem will be offered the opportunity to match with other companies in the platform and through EEN. These actors will also be able to connect and seize upon market

LIST OF DELIVERABLES

Deliverables

Grant Preparation (Deliverables screen) — Enter the info.

The labels used mean:

Public — fully open (⚠ automatically posted online)
Sensitive — limited under the conditions of the Grant Agreement
EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D1.1	Taxonomy	WP1	8 - CTB	R — Document, report	PU - Public	6
D1.2	Waste stream analysis and recycled textile classification	WP1	12 - RISE	R — Document, report	PU - Public	15
D1.3	Value chain map and gap analysis	WP1	8 - CTB	R — Document, report	PU - Public	33
D2.1	Ellie Connect upscaled with new functions to be a fully functional digital ecosystem	WP2	18 - Ariadne	DEC —Websites, patent filings, videos, etc	PU - Public	12
D2.2	Digital Self-Assessment Tool	WP2	2 - EURAMATERIALS	DEC —Websites, patent filings, videos, etc	PU - Public	18
D2.3	REGIOGREEN- TEX Course Curricula	WP2	13 - WR	DEC —Websites, patent filings, videos, etc	PU - Public	24
D2.4	Ecosystem activities report	WP2	1 - EURATEX	R — Document, report	SEN - Sensitive	36
D3.1	Pilot Report	WP3	3 - CITEVE	R — Document, report	SEN - Sensitive	12
D3.2	Products/Services Demonstrators	WP3	5 - ATEVAL	R — Document, report	PU - Public	36
D4.1	Coaching strategy	WP4	14 - NTT	R — Document, report	PU - Public	18
D4.2	Report on the result achieved through the delivery of coaching actions and green advisory services provided	WP4	12 - RISE	R — Document, report	PU - Public	36

Deliverable D1.1 – Taxonomy

Deliverable Number	D1.1	Lead Beneficiary	8. CTB
Deliverable Name	Taxonomy		
Type	R — Document, report	Dissemination Level	PU - Public
Due Date (month)	6	Work Package No	WP1

Description
Taxonomy for recycled materials usable in the textile sector, focus on circularising materials streams

Deliverable D1.2 – Waste stream analysis and recycled textile classification

Deliverable Number	D1.2	Lead Beneficiary	12. RISE
Deliverable Name	Waste stream analysis and recycled textile classification		
Type	R — Document, report	Dissemination Level	PU - Public
Due Date (month)	15	Work Package No	WP1

Description
Mapping and analysis of textile waste streams with large scale focus, draft framework for classification of textile for recycling based on waste channelling decision tree.

Deliverable D1.3 – Value chain map and gap analysis

Deliverable Number	D1.3	Lead Beneficiary	8. CTB
Deliverable Name	Value chain map and gap analysis		
Type	R — Document, report	Dissemination Level	PU - Public
Due Date (month)	33	Work Package No	WP1

Description
Value chain map for circular textiles & clothing and gap analysis, focus on (inter) regional aspects, including a global analysis to make EU circular textile value chains more competitive towards international competitors. Updated twice.

Deliverable D2.1 – Ellie Connect upscaled with new functions to be a fully functional digital ecosystem

Deliverable Number	D2.1	Lead Beneficiary	18. Ariadne
Deliverable Name	Ellie Connect upscaled with new functions to be a fully functional digital ecosystem		
Type	DEC —Websites, patent filings, videos, etc	Dissemination Level	PU - Public
Due Date (month)	12	Work Package No	WP2

Description
A fully functional digital environment with all the embedded functions to host SMEs and enable matchmaking, as well as

REGIOGREENTEX

WP1/Flanders – **Quadruple Helix Workshop**

Workable mapping and gap analysis of value chains for sustainable and circular textiles

Report

CENTEXBEL – 15 November 2023

Content

Contents

1. Introduction

The ECOSYSTEX Conference in Barcelona (18-20/10/2023) came out as a perfect occasion, given the timing and the mix of participants, to organize the Quadruple Helix Workshop for the Region Flanders, in the frame of the WP1 (Mapping and gap analysis).

It represented an opportunity to learn from the broad experience and knowledge of all participants in terms of value chains mapping and more specifically about the gaps analysis.

2. Workshop organiser

CENTEXBEL organized this workshop, in collaboration with EURATEX (STEP 2030).

Given the number of participants (38), 3 break-out discussions were organized.

CENTEXBEL and EURATEX (STEP 2030) prepared the structure of the workshop and facilitated the 3 sessions.

3. Workshop location, date and context

The workshop took place in the frame of the **ECOSYSTEX Conference:**

From EU Research to Sustainable Textile Business

Location: Barcelona, Spain

Date: 19 October 2023

4. Structure, Speakers and Participants

The workshop was structured as follows:

• Introduction + background (update WP1 activities)	CENTEXBEL
• Introduction to STEP2030	EURATEX (STEP 2030)
• Instructions for the discussions	CANTEXBEL
• Facilitation break-out discussions (part 1 - 25 min)	EURATEX, CENTEXBEL
• Instructions for second discussion	CENTEXBEL
• Facilitation break-out discussions (part 2 – 25 min)	EURATEX, CENTEXBEL
• Feedback discussions	1 participant/group
• Conclusion	CENTEXBEL

38 participants contributed to the discussions.

They represented a very diverse group of participants, in terms of activities, knowledge, country, organisation, etc. This made it possible to get a highly valuable input, both through the discussions and in terms of results.

5. Objectives of the workshop

The WP1 is about mapping and gap analysis. The work will move from a more theoretical approach to the analysis of actual value chains, or value chains to be created in 3 different RGT Regions.

The main objectives of this workshop were:

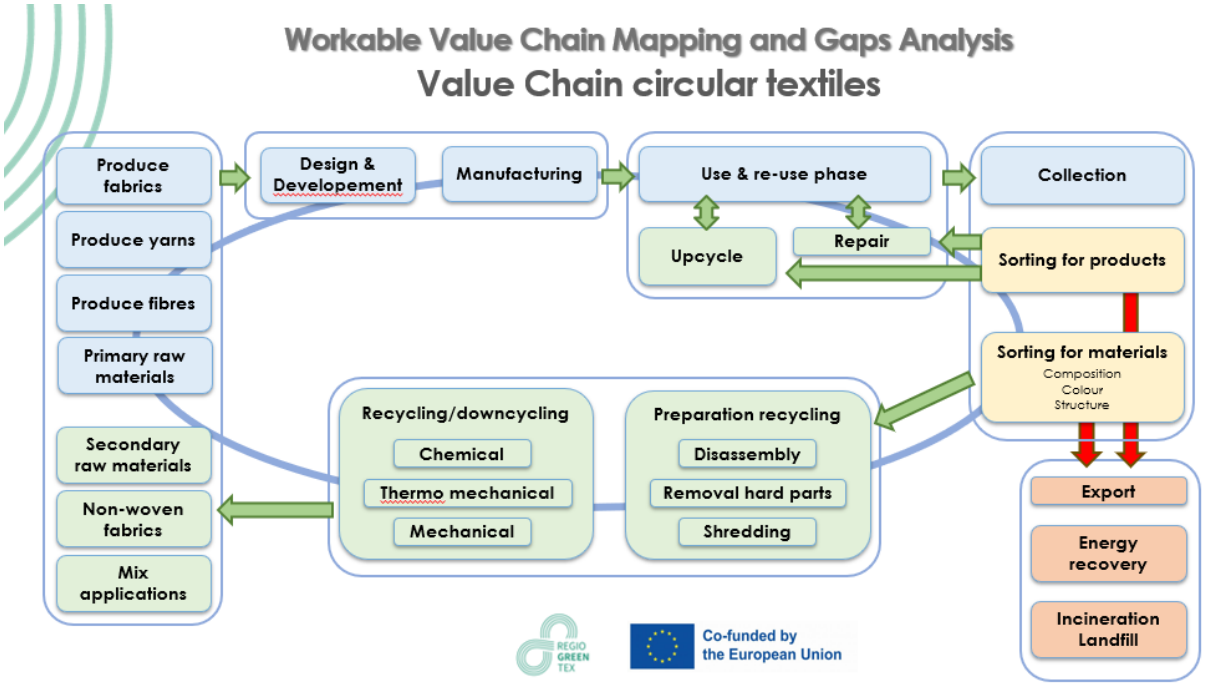
- to understand from a very diverse group of experts what their experience was in terms of gaps in circular textile value chains
- to highlight top gaps' types (top 3 per group)
- to collect ideas about possible solutions for the most important gaps

A key element was to be able to pull out key info from the animated discussions so these data could be integrated into the WP1 work.

The leading directions were the following:

- **What is your experience with GAPS?**
- **What is on your way to integrate circular textile value chains?**
- **Do you see possible solutions?**

The following diagram was used to set the scene and help the participants to place themselves in a complete value chain.



6. Preparation activities

To make this workshop even more meaningful, a survey was organized before the event so we could collect info on actual gaps (as perceived or faced by responders) the RGT partners and SMEs are facing.

To broaden the scope, the same survey was sent to all STEP 2030 supporters.

The response rate has been positive (28), and all results have been sorted and consolidated in an excel document.

The initial analysis was used as a background information for the workshop. An in-depth review will be completed to feed the work in WP1. Some interviews might be necessary to collect more details.

For this survey, we asked to receive feedback related to gaps encountered at each step of a generic circular textile value chain. The diversity in the companies and organisations that responded ensured that all value chain activities were covered. This will represent a key input for the next steps in the WP1 work.

Here is a list of the companies/organisations that sent their feedback:

ATEVAL	Home textiles and technical textiles
HILATURAS ARNAU SL	CARDING SPINNING MILL -INDUSTRIAL APPLICATIONS
CILAB	Fashion
Coisne & Lambert	Workwear and PPE
DBT FIBRE SPA	Fashion
Dickson-Constant	Outdoor
Edel Carpets BV	consumer products
Gomate	Industrial/Textil/Fashion
ROVITEX	building - protective workwear - clothing - lingerie -
SaXcell BV	Recycling of cotton - cellulose pulp production
Associated Weavers Europe NV	Floor covering - Tufted broadloom carpets & carpet
Copaco Screenweavers	construction - sun protective fabrics
Dollfus-Muller	Technical textiles -Net Dryer belts and endless felts
ERION TEXTILES	Extended Producer Resposability Organization
EZIO GHIRINGHELLI SPA	Fashion
Maes Mattress Ticking	Weaving/knitting mattress ticking
Mai Bine NGO	Fashion clothes and accessories
MARCHI & FILDI SPA	Yarn production
Mitwill Textiles Europe	Textile fabrics and garments
Rubelli S.p.a.	Textile fabrics for furniture
STAM	Engineering and technology consulting
Utexbel	Spinning - Weaving -Dyeing - Finishing : fashion,
TECHTERA	All textiles
Textil Olius SA	Technical textiles for a wide range of applications in industry and consumer goods
Tintex	Fashion - fabric finishing
Ubitech	Mold and Machine manufacturing. Composites
OVAM	Waste management - Flanders (Belgium)
WUR	Research

A proper report will be issued later, after a thorough analysis has been completed. Additional contacts will be made in case a clarification is required or some ideas are worth developing further.

Hereunder an extract of the consolidated data, with the first highlights.

Your name					
Your company/organisation	CONSOLIDATION - list respondants at the bottom				
Main activity sector			E.g. fashion, workwear, medical, outdoor, industrial applications, agriculture, construction, etc.		
Main product category (if production)			E.g. Fabric, dyestuff, non-woven fabric, fibres, etc.		
			Gap = an element missing, an element preventing you from completing or integrating a value chain, something slowing consid Examples (list not exhaustive): company/sub-contractor to complete your process, material, machines, money, know-how, human resources, your input = lo		
What are your main activities ?	X (one or more)	More precisely	Most impactful GAP description	GAP (some clarifications required)	GAP description #2
Material sourcing	HILATURAS ARNAU SL	We have good partners of fibers	lack of suppliers too low and limited	Lack of suppliers	Limited partners with regu
Material sourcing	ROVITEX	we supply all kind of fabric , foam membrane etc..	nothing to say excepted price sometime	High price	
Material sourcing	Associated Weavers Europe NV	Sourcing of yarns, primay/secundary backing and aditives	Eco-friendly materials still significantly higher priced compared to current fossil-based products	High pric	at orig ycling
Material sourcing	Copaco Screenweavers	mainly buying glass fiber, PVC, plasticizer & additives	dependant on raw materials available, limited amount of materials are useable for our application to achieve high level products	Limited	m rec
Material sourcing	Mitwill Textiles Europe	buying yarns for knitting at partners	costly logistics	Costly l	e avai
Material sourcing	STAM	Nature based materials	Development of new materials from vegetable scraps to increase performance of textile product	Develop scraps	
Material sourcing	WUR (PH)	overview of carbon sources for materials			
Material sourcing	EZIO GHIRINGHELLI SPA		Recycled raw material is available only in polyester	Only recyc	oducers fibers
Material sourcing	Modint		Availability of fabrics with recycled fiber content	Lack of fabrics with recycled content	lack of ability and capacity fibres
Raw material production	DBT FIBRE SPA	recycled fibres (mechanical)	sorting before processing	Lack of sorting based on composition	higher price for a higher qu understood
Raw material production	STAM	Bio-based renewable fiber	Developing bio-coatings and bio-chemistries that enhance the performance, such as hydrophobic properties, of bio-based fibers.	Lack of bio-based coatings and finishes to enhance properties of bio-based fibres	Also the scaling up the pro essential for effective app and chemistries

Material sourcing

. Lack of suppliers
. Too low volumes
. Costly logistics
. Recycled material not available for all fibre types
. Reduced offer for fabrics with recycled fibres
. Lack of partners with consistent quality
. Traceability of material not always clear
. Lack of capacity for spinning of recycled fibres
. Lack of modern producers for artificial fibres
+
. Lead-times to get some materials

7. Workshop results

The approach for this workshop was to ask the participants to start thinking about possible solutions for the gaps they would highlight and prioritise.

For the first discussion, the 3 randomly composed groups came up with the following top 3 gap types:

A	B	C
Data	Policies	Sorting
Policies	Collecting Sorting	Consumers' behaviour
Sorting	Design	Design

Interesting! We end up with gaps from various natures: technical (production), policies, eco-design.

All three groups highlighted the difficulties related to the sorting for recycling. This is no surprise, as we know there are numerous projects and activities working on this usual bottleneck.

The "policies" category covers different aspects related to different rules, or absence of, harmonization of standards, etc.

The design was also a priority for 2 groups. Planning to improve the circularity at development stage is seen as a best practice.

The proposed solutions are listed hereunder. They will be considered in the WP1 gap analysis.

Group A – Gaps and Solutions

#1 - Data

- Need for data about materials, waste streams, etc.
- Data necessary to measure progress, to make decisions.

⇨ **Solutions?**

- Structured, transparent and safe sharing of data and best practices between stakeholders. e.g. platform for academia, companies, etc. to upload their data and collect the data they need.
- Possible extensions with matchmaking tool between service providers/seekers, materials produced/used.

#2 - Policies/consumers engagement

- Need for a major move at consumers' level.

⇨ **Solutions?**

- Economic incentives to become more circular: the consumer's behaviour is oriented towards overconsumption, this cannot change without a shift, and economic incentives, towards circularity.

#2 - Sorting for materials

- Need to progress to provide abundant specific feedstock to recycle.

Group B – Gaps and Solutions

#1 – Regulatory framework

- Clarity of rules, global level playing field, standardization, funding, prioritized and SME friendly implementation, realistic approach.

⇨ **Solutions?**

- Improve on these areas.

#2 – Collecting/Sorting Infrastructure and technologies

- Limited capacity to deliver specific feedstock

⇨ **Solutions?**

- Widespread digitalization, consistent dataflow to match material flow (Traceability, statistics), funding, etc.

#3 – Design

- Need to move towards more eco-design

⇨ **Solutions?**

- Virtual sampling, material knowledge, Open Source Material Database

Group C – Gaps and Solutions

#1 – Sorting

- Unavoidable priority, difficulties to reach high quantities of 'pure' feedstock.

⇨ **Solutions?**

- Many projects working on this!

#2 – Consumers' willingness to buy more sustainable

- Consumers/buyers focus on price more than on circularity priority.

⇨ **Solutions?**

- Create a circularity/sustainability score for all products to guide consumers
- Provide 'green' incentives to boost interest
- Bring transparency on cost structure, on manufacturing process
- Provide 'good' (understandable, objective) info on properties of the products

#3 – Design for circularity, sustainability, etc.

- Integrate circular characteristics right from conception stage.

⇨ **Solutions?**

- Educate designers on requirements
- Design for circularity, sustainability, etc
- Develop AI to support designers
- Develop strategy for different types of textiles (non-wovens, technical, floor…)
- Adapt some requirement to reality of recycling (e.g. shade inconsistency)

8. Follow-up actions

As mentioned above, the intention with this workshop was to lead the discussions so that the input of this large group could be used in the frame of the project (WP1).
These data will be used in the Gap Analysis phase.

RegioGreenTex - GAP ANALYSIS - indicative survey - Please return by 11 October 2023

Your name		
Your company/organisation	**CONSOLIDATION -** list respondants at the bottom	
Main activity sector		E.g. fashion, workwear, medical, outdoor, industrial applications, agriculture, construction, etc.
Main product category (if production)		E.g. Fabric, dyestuff, non-woven fabric, fibres, etc.

Gap = an element missing, an element preventing you from completing or integrating a value chain, something slowing considerably down your operations.
Examples (list not exhaustive): company/sub-contractor to complete your process, material, machines, money, know-how, human resources, your input = low offer or not available, your output = low or no interest, ...

What are your main activities ?	**X (one or more)** **For each activity, 1 row = 1 respondent**	**More precisely**	**Most impactful GAP description**	**GAP** (some clarifications required)	**GAP description #2**	**GAP** (some clarifications required)	**GAP description #3**	**GAP** (some clarifications required)
Material sourcing		We have good partners of fibers	lack of suppliers too low and limited	Lack of suppliers	Limited partners with regular quality	Lack of partners with regular quality		
Material sourcing		we supply all kind of fabric , foam membrane etc..	nothing to say excepted price sometime	High price				
Material sourcing		Sourcing of yarns, primay/secundary backing and aditives	Eco-friendly materials still significantly higher priced compared to current fossil-based products	High price vs. non-recycled	Not always clear what origin/source is of input materials for the recycling proces	Traceability of input materials for recycling	No clarity on definition of what is "recycled" (difference between ISO definition and European vision)	Definition of "recycled" (ISO vs. EU)
Material sourcing		mainly buying glass fiber, PVC, plasticizer & additives	dependant on raw materials available, limited amount of materials are useable for our application to achieve high level products	Limited amount for high level products	no raw materials from recycled origin	No recycled raw material	Limited amount of bio-based origin	Too low mount of material of bio-based origin
Material sourcing		buying yarns for knitting at partners	costly logistics	Costly logistics	lead time/immediate availability of certain yarns	Lead-times to get certain yarns		
Material sourcing		Nature based materials	Development of new materials from vegetable scraps to increase performance of textile product	Development of new materials from vegetable scraps				
Material sourcing		overview of carbon sources for materials						
Material sourcing			Recycled raw material is available only in polyester	Only recycled polyester availble	Lack of modern producers of artificial filament fibers	Lack of modern producers of artificial filament fibres		
Material sourcing			Availability of fabrics with recycled fiber content	Lack of fabrics with recycled content	lack of ability and capacity of spinning recovered fibres	Lack of ability and capacity of spinning for recycled fibres		
Raw material production		recycled fibres (mechanical)	sorting before processing	Lack of sorting based on composition	higher price for a higher quality not always understood	higher price for a higher quality not always understood		
Raw material production		Bio-based renewable fiber	Developing bio-coatings and bio-chemistries that enhance the performance, such as hydrophobic properties, of bio-based fibers.	Lack of bio-based coatings and finishes to enhance properties of bio-based fibres	Also the scaling up the production processes is essential for effective application of coatings and chemistries	Scaling up of processes for application of coatings and chemistries		
Raw material production		raw materials from agricultural (waste) streams	food vs material discussion. No dedicated crops for textiles 'allowed', so only waste streams are available	Competition food/textiles means only waste available for textile	low availability	Low availability	Low quality	Low quality
Raw material production			Missing companies in Europe	Missing companies in Europe	Search for long-distance suppliers	Search for long-distance suppliers	Unsustainable process for the planet	Unsustainable process for the planet
Product design		Development of new look & feel according to markettrends/customer demands	Our customers (residential market) are still more focussing on price then on sustainability	Customers focus on price rather than on sustainability				
Product design		We design products specifically for small sizes of fabrics that we collect from factories and fabric stores	Lack of time to focus on design, do market research etc. Small team, lots of projects.	Lack of human resources for design, market research, etc.				
Product design		Trend research, moodboards, print designs, collections	time intense	Highly time consuming				
Product design		Development of fabrics according to the intended garment where they will be applied. Ideation of composition, structure, weights, etc.						
Product design		Defining product composition and technical specifications to meet a certain requirement	Obtaining meaningful amounts of 100% wool recycled fibers	Availability of meaningful amounts of 100% wool recycled fibres				
Product design			design for recycling guidelines	Recycling guidelines	Common understanding on recyclability	Common understanding on recyclability		
Product design		Consumer- and hospitality market	no European standard which facilitates recyclability	No EU standard for recyclability				
Product development and prototyping		We develop new qualities and uses of yarns (pbo, antiestathic...)	Internal quimic and mechanical analysis (Test reports)	Internal chemical and mechanical analysis (Test reports)	Cost of equipment for analysis	Cost of equipment for analysis	trained workers	Trained workers
Product development and prototyping		we laminate all the material we have supply	cost of material	cost of material	cost of material - change of mentaly by using other kind of material	Change of mentality by using other kind of material	company that dont want to purchase at higher cost and prefer material low cost from asia	Prices in comparison with Asia
Product development and prototyping		R&D on new (eg. better recyclable) carpets	Our customers (residential market) are still more focussing on price then on sustainability	Customers (residential market) focus on price rather than on sustainability				
Product development and prototyping		I will just copy paste what I wrote for Product design. We are a very small team that handle both activities: We design products specifically for small sizes of fabrics that we collect from factories and fabric stores	Lack of time to focus on prototyping, do product research etc. Small team, lots of projects.	Lack of human resources for design, market research, etc.	lack of 3D competences for 3D prototyping, digital twins etc.	lack of 3D competences for 3D prototyping, digital twins etc.	lack of hardware and software for 3D prototyping etc.	Lack of hardware and software for 3D prototyping etc.
Product development and prototyping		Production of small series of fabric aiming to assess market approval. Optimization of dyeing and finishing parameters. Study of different types of finishing methods.	High costs of prototyping	High costs of prototyping	Lack of knowledge of the costumers regarding the impact of the used processses	Lack of knowledge of the costumers regarding the impact of the used processses		
Product development and prototyping								
Product development and prototyping			Too many prototypes for a single final product	Too many prototypes for a single final product	Demand from the main global players	Demand from the main global players	Unsustainable process for the planet	Unsustainable process for the planet
Fibre preparation (fraying, carding, etc)		We sort different technical fibers	technical limitation due to machinery.	Technical limitations of machinery	Desired machinery to produce recycled non wovens	Suitable machinery to produce recycled non wovens	trained workers	Trained workers
Fibre preparation (fraying, carding, etc)		carding	know how	Know-how				
Fibre preparation (fraying, carding, etc)		Fraying of cotton and wool. Preparation of cotton, poliester, acrilic, nylon, wool and blend of these fibres	Cotton Post-consumer not available in the market	Lack of post-consumer cotton products	Presence of chemicals forbidden in the recycled materials	Presence of chemicals forbidden in the recycled materials		
Fibre preparation (fraying, carding, etc)		Natural fibers	Scale up of process to transform different type of natural fibers (not only traditional, e.g. cotton, canapa) into fabrics.	Scale up of process to transform different type of natural fibers (not only traditional, e.g. cotton, canapa) into fabrics.				
Fibre preparation (fraying, carding, etc)			Knowledge about properties of recycled fibers. It can prevent some industriels from using recycled fiber	Knowledge about properties of recycled fibers	Are the current machines compatible with recycled fibers ?	Compatibility of available machinery with recycled fibres		
Fibre preparation (fraying, carding, etc)		Opening and blending of fibers, carding of such fibers to obtain a non-woven web	Lack of qualitative (long enough) fibres	Lack of qualitative (long enough) fibres				
Fibre preparation (fraying, carding, etc)		preparing spinnable recoverd fibres by sophisticated unravelling						
Spinning (virgin fibres/filaments)		Circular economy and greener less consuming process, obsolete equipment, lack of performance on the processes	raw material scarcity	Raw material scarcity	lack of investment in innovation			
Spinning (virgin fibres/filaments)		Open End yarn cotton, poliester, acrilic, nylon, wool and blend of these fibres						
Spinning (virgin fibres/filaments)			Lack of research for new materials with a low environmental impact	Lack of research for new materials with a low environmental impact				
Spinning (virgin fibres/filaments)		Extrusion PA + PES						
Spinning (recycled fibres/filaments)			The high energy costs have direct consequences on raw material costs and the final textile product final	High energy cost	raw material scarcity	raw material scarcity		
Spinning (recycled fibres/filaments)		Crushed fibres (recycled aramids) of mechanical recycling	Lack of qualitative (pure enough) fibres	Lack of qualitative (pure enough) fibres	Chemical process to remove the non pure flamable ibers	Chemical process to remove the non pure flamable fibres		
Spinning (recycled fibres/filaments)		Short fibres (cotton type) out of mechanical recycling	Lack of qualitative (long enough) fibres	Lack of qualitative (long enough) fibres	No partner for removal of hard parts (clothing)	No partner for removal of hard parts (clothing)	Trained workers	Trained workers
Spinning (recycled fibres/filaments)		Open End yarn cotton, poliester, acrilic, nylon, wool and blend of these fibres	Pure Cotton (recycled) and pure Wool (recycled) available in the market	Lack of pure Cotton (recycled) and pure Wool (recycled)	quality of the recycled fibers is very varied (length, strength, etc.)	Consistency of quality of the recycled fibers (length, strength, etc.)	lack of quality assessment producers at massive level, not lab tests	Lack of quality assessment (lab testing)

Material sourcing
. Lack of suppliers
. Too low volumes
. Costly logistics
. Recycled material not available for all fibre types
. Reduced offer for fabrics with recycled fibres
. Lack of partners with consistent quality
. Traceability of material not always clear
. Lack of capacity for spinning of recycled fibres
. Lack of modern producers for artificial fibres
+
. Lead-times to get some materials

Raw material production
. Lack of sorting based on composition
. Competition food/textiles > only waste available for textile
. Higher price for higher sustainability/quality not understood
. Lack of scaling-up of production processes
. Missing companies in EU
. Low availability

Product design
. Customers still focus a lot on price
. Lack of human resources for design, market research, etc
. Highly time-consuming
. Limitations due to lack of some fibres
. Limitations due to possible lower quaity
. No existing design for recycling guidelines

Product development and prototyping
. Lack of in-house testing capability
. Cost of material
. Customers still focus a lot on price
. High cost of prototyping
. Too many prototypes for a single product
. Resistance to change by using other kind of material
. Lack of 3D/digital competences
. Lack of hardware/software for 3D prototyping
. Low demand from global players

Fibre preparation
. Technical limitations of machinery
. Lack of post-consumer cotton products
. Lack of long enough fibres
. Knowledge about properties of recycled fibres
. Presence of (forbidden) chemicals in recycled materials
. Compatibility of existing machines with recycled fibres
. Know-how
. Trained workers

Spinning (virgin fibres/filaments)
. Raw material scarcity
. Lack of research for new material with a low environmental impact
. Lack of investment in innovation

Spinning (recycled fibres/filaments)
. High energy cost
. Lack of qualitative (purity) fibres - cotton, wool
. Lack of qualitative (length) fibres - cotton, wool
. Lack of spinning for chemically recycled fibres (large scale)
. Recycled raw material mainly polyester
. Lack of partners for removal of hard parts

Spinning (recycled fibres/filaments)	. Lack of partners for removal of hard parts . Consistency of quality of the recycled fibres (length, strength,...) . Lack of modern producers of artificial filaments . Lack of trained workers		Lack of partners able to spin synthetic (chemically) recycled synthetic fibers at large scale. (Recyc'Elit)	Lack of partners able to spin chemically recycled synthetic fibres at large scale. (Recyc'Elit)				
Spinning (recycled fibres/filaments)			Recycled raw material is available only in polyester	Recycled raw material is available only in polyester	Lack of modern producers of artificial filament fibers	Lack of modern producers of artificial filament fibers	Lack of modern producers of artificial filament fibres	
Spinning (recycled fibres/filaments)		Short fibres (cotton type) out of mechanical recycling	Lack of qualitative (long enough) fibres	Lack of qualitative (long enough) fibres				
Weaving			Lack innovation and lack of cooperation in textile manufacturing	Lack innovation and lack of cooperation in textile manufacturing	lack of performance on the processes such as automatization, traceability, optimization, and monitoring	lack of performance on the processes such as automatization, traceability, optimization, and monitoring	lack of qualified staff and recruitment textile personnel issues	Lack of qualified staff and recruitment textile personnel issues
Weaving		Done on manufacture by third partner companies	Done by our own	Managed externally	increase the company structure	Modification company structure	Financial investment	Investment
Weaving		jacquard weaving mattress ticking	skilled labor forces with textile knowledge	Skilled labor forces with textile knowledge	higher costs then competitors (people and energy)	higher costs then competitors (people and energy)	unequal competition because of unequal regulations from outside Europe (Eg. Turkey)	Regulations EU vs. world
Weaving		buying from suppliers	minimum production quantity high	Minimum production quantity high	costly logistics	costly logistics	lead time	Long lead-times
Weaving		Production of fabrics for furniture (curtains, wall covering, upholstered furniture)	Lack of hubs with the capability to collect and recycle fabrics waste	Lack of sorting/recycling hubs	Difficulty to separate different types of fibers, especially in fabrics with a mix content.	Difficulty to separate different types of fibres, especially in fabrics with a mix content.	Lack of knowledge in recycling practices	Lack of knowledge in recycling practices
Weaving			sufficient strong yarns with recycled content	Strength of yarns with recycled fibres				
Weaving	**Weaving + knitting + non-wovens** . Lack of trained workforce . Min quantities per order . Strength of yarns with recycled fibres . Higher costs than competition (energy) . Regulations in EU tougher than outside eu . Financial investment . Long lead-times . Lack of innovation with recycled materials (N-W)	Mainly Solution Died Acrylic	we need a recycling channel to manage our textile wastes	Lack of sorting/recycling hubs	We are implementing a closed loop process to get recycled yarns from our wastes, but also need an open loop channel as a complement			
Knitting		Done on manufacture by third partner companies	Done by our own	Managed externally	increase the company structure	Modification company structure	Financial investment	Investment
Knitting		jacquard circular kniting mattress ticking	skilled labor forces with textile knowledge	Skilled labor forces with textile knowledge	higher costs then competitors (people and energy)	Higher costs than competitors (people and energy)	unequal competition because of unequal regulations from outside Europe (Eg. Turkey)	Regulations EU vs. world
Knitting		buying from suppliers OR make with partners	minimum production quantity may be high	Minimum production quantity high	costly logistics	costly logistics	lead time	Lead-times
Non-woven		Done on manufacture by third partner companies	Done by our own	Managed externally	increase the company structure	Modification company structure	Financial investment	Investment
Non-woven		New types of non woven	Developement of new non-woven with recycled fibres using textile technics	Developement of new non-woven with recycled fibres using textile technics				
Non-woven		Felting and fulling of wool felts (for which wool with good felting ability is required)	Degraded nature of recycled wool fibers	Low quality of recycled wool fibres				
Tufting		Tufting of broadloom carpets						
Bleaching/dyeing/printing/finishing			the lack of collaboration between companies and as well difficulties to find a solid commercial network	Lack of collaboration between companies and as well difficulties to find a solid commercial network because	The common risk cost is identified for the energy and raw materials as well high costs for renewing the	High cost of energy and raw materials	lack of qualified staff and insufficient adaptation of the education/training with the needs of textile	Lack of qualified staff Lack of adequate training/education
Bleaching/dyeing/printing/finishing	**Bleaching/dyeing...** . Lack of collaboration between companies . Lack of a strong commercial network . Min quantities per order . Presence of alien fibres = defects . Lack of scale-up . Cost of energy	Ecological dyeing	Lack of skills and infrastructure	Lack of skills and infrastructure	Overprint capabalities	Overprint capabalities		
Bleaching/dyeing/printing/finishing		Backing, printing & dyeing of carpets	Lack of technologies using renewable energy for drying wide products (up to 5m width)	Lack of technologies using renewable energy for drying wide products (up to 5m width)				
Bleaching/dyeing/printing/finishing		digital/conventional printing and finishing	production errors (file, print, inspection, fabric...)	?	color management/communication	?	costly logistics	Costly logistics
Bleaching/dyeing/printing/finishing		Natural and bio-based dyes	Scaling up processes	Scaling up processes				
Bleaching/dyeing/printing/finishing			Lack of knowledge about the behaviour of recycled fibers to be dyed.	Lack of knowledge about the behaviour of recycled fibres to be dyed.				
Bleaching/dyeing/printing/finishing		Dyeing, finished and coating of, mostly, knitted fabrics.						
Bleaching/dyeing/printing/finishing		Dyeing and finishing of felts	Presence of alien fibers (e.g. non-wool) causing colour defects in final product	Presence of alien fibers (e.g. non-wool) causing colour defects in final product				
Bleaching/dyeing/printing/finishing			New dyeing equipment with lower water consumption	New dyeing equipment with lower water consumption				
Bleaching/dyeing/printing/finishing		Mainly Solution Dyed Acrylic	we need a recycling channel to manage our textile wastes	Recycling hub for production waste (acrylic?)	We are implementing a closed loop process to get recycled yarns from our wastes, but also need an open loop channel as a complement	Open loop recycling process for production waste (acrylic?)		
Manufacturing/assembly			high energy costs, raw material costs	High energy and raw material cost	lack of investment for the innovation industry and lack of investments in the branding	Lack of investment for the innovation industry and lack of investments in the branding	lack of qualified staff specially for textile industry and lack of adaptation of the education/training with the needs of industry for the personnel	Lack of qualified staff Lack of adequate training/education
Manufacturing/assembly	**Manufacturing/Assembly** . Lack of trained workforce . Cost of energy . Cost of materials . Lack of data to compare circular and old way . Lack of equipment	ultrasonic welding	update our process to have more possibility	Process upgrade to develop new possibilities	cost of the material	Cost of raw material	time and cost for training	Time and cost for training
Manufacturing/assembly		Manufacturing of net dryer belt and enless felts	Lack of bio-based fibres	Lack of bio-based fibres	No possibility yet of recycling anything	Lack of recycling possibilities	Lack of trained workers	Lack of trained workers
Manufacturing/assembly		As mentioned above, we are a small workshop and we do all the manufacturing of our products	Small team = higher production times = higher prices	Lack of human resources	lack of specific equipment for better finnishes	Lack of equipment		
Manufacturing/assembly		CMT with partners	delays/errors in prototyping	Delays/errors in prototyping done by a partner	miscommunication			
Manufacturing/assembly		Lamination by ultra-sound (Rovitex)	Find other business markets.	Lack of new markets	Get data to prove how better it is compared with traditionnal method.	Lack of elements proving benefits of new coating method		
Manufacturing/assembly		Heatset , Carpet cabling, tufting	recycling capacity EOL PES carpet	Lack of recycling capacity EOL PES carpet	recycling capacity woolen carpet	Lack of recycling capacity woolen carpet		
Distribution			high competition (highly exploited market) but also lack of cooperation and price competition	Lack of cooperation + tough competition	a lack of adopting green technologies in polluting operations	a lack of adopting green technologies in polluting operations	high energy costs moreover, fluctuation of energy costs for the unstable political situation	High energy cost + fluctuation (political situation)
Distribution	**Distribution** . Lack of trained workforce . Lack of cooperation to drive cost down . High competition . Costly administration	Distribution of finished products to wholesellers, shops, retail						
Distribution		B2B						
Distribution		sales and distribution of goods	new sales pipelines (weak visibility)	Lack of new sales pipelines (visibility)	costly administration	Costly administration		
Retail/sale (stores/online)	**Retail/Sale** . Limited clients/customers base . Low visibility for new sales pipelines . Higher prices for products with recycled content . Lack of space to display products	A phisycal store, located in our second social enterprise, Cuib, where we sell our products and other self-care and house-care products which support a Zero-Waste lifestyle.	relatively small number of clients, most of the times they are the same, we call it a sustainability bubble.	Small client base	lack of space to showcase more products.	Lack of retail space		
Retail/sale (stores/online)		on-demand webshob printed fabrics (upload design)	new sales pipelines (weak visibility)	Lack of new sales pipelines (weak visibility)				
Retail/sale (stores/online)		uncertain consumer response	higher prices for textiles with recycled content	Higher prices for textiles with recycled content				
Repair of textile goods		Repair Business2Business	Skilled workforce	Skilled workforce				
Repair of textile goods	**Repair of textile goods** . Lack of trained staff . Cost of repairs . Poor repairability . Lack of promotion	At our workshop we offer repairing services for the clothes & accessories that we make & sell, but not limiting to.	lack of personell dedicated to this specific action. Same team that does the manufacturing deals with the repairs.	Skilled dedicated workforce	not enough promotion, online and offline.	lack of promotion, online and offline.		
Repair of textile goods		End life and rejected goods	Processes to manage the rejected / returned textile goods and / or goods at the end of life in a circular perspective	Processes to manage the rejected / returned textile goods and / or goods at the end of life in a circular perspective				
Repair of textile goods			repairability and costs	Lack of repairability		Cost of repairs		
Collecting pre-consumerEoL products		Production waste from regional foreign companies	number of interested companies too low	Number of interested companies too low	investing in communication of this possibility	Lack of investment in communication		
Collecting pre-consumerEoL products	**Collecting pre-consumer products** . Collected quantities too low . Too few companies interested . No mapping of regional production waste . Mixed waste . Lack of storage space . No massification	Production waste from regional companies	Collected quantities too low	Collected quantities too low				
Collecting pre-consumerEoL products		We have a few number of factories from our region where we collect post-industrial waste(cut-offs) that we use for creating up-cycled products.	Not enough human and space capacity to collect more fabrics.	Lack of workforce Lack of storage space	Not enough time to come up with specific designs for specific types of fabrics. Too much waste from the factories.	Not enough time to come up with specific designs for specific types of fabrics		
Collecting pre-consumerEoL products			Mapping of the Production waste from regional companies	Mapping of the Production waste from regional companies	No massification	No massification	Industrials are not trained to know how to sort their production scraps to make them recyclable more	Lack of training on sorting of production scraps (to enable recycling)

Collecting pre-consumerEoL products		higher seperate collecting rate	Too much mix in waste	and quality: less polluted with other household waste	Too much mix in waste		
Collecting pre-consumerEoL products		waste collection and treatment services to Consortium Members	lack of information	Lack of information				
Sorting pre-consumer EoL products		sorting based on solid solours	composition based sorting	Lack of sorting based on composition	colour composition sorting	Lack of sorting based on colour	Cost of equipment	Cost of equipment
Sorting pre-consumer EoL products	**Sorting pre-consumer products** . Lack of sorting based on composition . Lack of sorting based on colour . Lack of volumes . High cost of equipment . Too low volumes		Sorting based on colour	Lack of sorting bsed on colour	Missing sorting based on composition	Lack of sorting based on composition	Cost of equipment for NIR	Cost of equipment for NIR
Sorting pre-consumer EoL products			Missing sorting based on composition	Missing sorting based on composition	High cost of equipment (ex : NIR)	High cost of equipment (ex : NIR)		
Sorting pre-consumer EoL products			sorting of feedstock for recycling	Lack of sorting for feedstock for recycling				
Sorting pre-consumer EoL products		waste collection and treatment services to Consortium Members	lack of volumes	Lack of volumes	low technologies for sorting	Lack of technologies for sorting		
Collecting post-consumerEoL products		Production waste from regional foreign companies	number of interested companies too low	number of interested companies too low	investing in communication of this possibility	Lack of investment in communication		
Collecting post-consumerEoL products	**Collecting post-consumer products** . Number of interested/relevant companies too low (technical textiles) . Lack of space to store items . Not enough processes to manage a sustainable EoL for all textile products . Volumes collected too low (workwear) . Consumers not properly informed of how to manage their EoL products . Not enough investment in communication . Need a legislative support to speed up the compulsory recycling for EoL garments . Low quality products (fast fashion) = little possibilites for life prolongation	We collect specific items from the community by making calls on social media. At the moment we collect mainly used Men's shirts and up-cycle them in bags.	Lack of space to store more items.	Lack of storage space	Lack of place to collect more items.	Lack of storage space	Low quality products (fast fashion) = little possibilites for life prolongation	
Collecting post-consumerEoL products		End of life management	Processes to manage the end of life of textile or wearable products ensuring environmental sustainability, safety and logistic efficiency	Lack of processes for sustainable management of EoL textiles				
Collecting post-consumerEoL products		EoL workwear garments	Collected quantities too low	Collected quantities too low	Need a legislative support to speed up the compulsory recycling for EoL garment	Need a legislative support to speed up the compulsory recycling for EoL garment		
Collecting post-consumerEoL products								
Collecting post-consumerEoL products		textile waste collection and sorting b2c	lack of information by citizens	Lack of information to citizens	lack of volumes	Lack of volumes		
Sorting post-consumer EoL products		sorting based on mixed colours	composition based sorting and remove non textile elements	Lack of sorting based on composition Lack of process for removal of non textile elements	colour composition sorting	Lack of sorting based on composition and colour	Cost of equipment	Cost of equipment
Sorting post-consumer EoL products	**Sorting post-consumer products** . Low capacity in fibre content based sorting . Lack of partners for the removal of hard parts . Missing capacity for automated sorting based on color & composition . Consumers not properly informed of how to manage their EoL products . Cost of NIR equipment . Cost of auto-sorting lines	Sorting based on colour and woven/knit	No partner for removal of hard parts (clothing)	No partner for removal of hard parts (clothing)	Missing sorting based on composition	Lack of sorting based on composition	Cost of equipment for NIR	Cost of equipment for NIR
Sorting post-consumer EoL products		New materials from recycling of waste/urban biowaste	Integration of advanced robotic sorting technologies for material selection.	Lack of advanced robotic sorting technologies for material selection.	Upcycling technology for new raw materials	Upcycling technology for new raw materials		
Sorting post-consumer EoL products			Sorting precisely by composition can be difficult. Sourcing for Recyc'Elit	Lack of efficient sorting based on composition	Lack of partners to prepare the material before recycling : removal of hard parts (clothing), shredding	Lack of partners for shredding and removal of hard parts	Cost of equipment for NIR	Cost of equipment for NIR
Sorting post-consumer EoL products		experience with single use plastics						
Sorting post-consumer EoL products		Sorting based on colors and composition + empty pockets + cleaned garments	Missing capacity for automated sorting based on color & composition	Lack of sorting based on composition and colour	Need to educate the market to send EoL garments with empty pockets and clean	Lack of education for consumers to only send EoL garments clean and with empty pockets		
Sorting post-consumer EoL products								
Sorting post-consumer EoL products		textile waste collection and sorting b2c	lack of volumes	Too low volumes	low technologies for sorting	Lack of efficient technologies for sorting		
Upcycling	**Upcycling** . Several issues directly linked to gaps in collectiong/sorting stages . No efficient production scrap management to produce high added-value goods . Limited market for upcycled products	This is our main activity, up-cycling. Out of pre-consumer, post- industrial waste (cut-offs and deadstock	All of the above mentioned		All of the above mentioned			
Upcycling		waste management	Production scrap management to produce high added-value goods	Production scrap management to produce high added-value goods				
Upcycling			limited market volume of upcycled products	limited market volume of upcycled products				
Recycling (closed loop - fibre to fibre)		We offer the service to make new product with tech waste same customer	mechanical analysis (Test reports)	Test reports	limited company structure to communicate this possibility	Broder communication, for the business	trained workers	Trained workers
Recycling (closed loop - fibre to fibre)	**Closed loop recycling** . Test reports for quality of feedstock . Lack of communication due to small structures involved . Lack of feedstock	PET chemical recycling (Recyc'Elit)	Have a demonstrator at (pre) industrial scale to assess the performances of the process at large scale.	Demonstrator at pre-industrial scale	Find an industrial able to go from the DMT to PET (fiber grade) = PET manufacturer. Understand their needs.	Lack of partner (very specific)		
Recycling (closed loop - fibre to fibre)		spinnable fibres						
Recycling (closed loop - fibre to fibre)			Difficult when using mixed fibers	Lack of properly sorted material				
Recycling (open loop)		We offer the service to make new product with tech waste	mechanical analysis (Test reports)	Lack of data (tests reports)	limited company structure to communicate this possibility	Broder communication, for the business	trained workers	Trained workers
Recycling (open loop)	**Open loop recycling** . Test reports for quality of feedstock . Lack of partners in very specific recycling channels . Difficulty to form a complete value chain	in collaboration with partners	difficult to recycle glass fiber with PVC	Recycling technology for fibre-glass with PVC	depending on other companies for reuse of our glass/PVC waste	Lack of partners (very specific)		
Recycling (open loop)		does not replace virgin fibre consumption						
Recycling (open loop)		Waste - cotton mixed with polyamide and elastane	Recycling operator missing	Lack of sorting based on composition	Unknown or expensive process	Unknown or expensive process		
Downcycling		mechanical recycling of left-overs	Low cost infrastructure mechanical recycling	Lack of investment in mechanical recycling	Procedures for manual recycling	Procedures for manual recycling		
Downcycling	**Downcycling** . Lack of investment . Low volumes and low profitability	in collaboration with partners	previously done in small scale projects - low volumes, not very profitable	Lack of volumes				
Downcycling		waste management	Production scrap management to produce ancullary items for production or packaging	Production process (very specific)				
Downcycling			market demand/volume irt textile waste volume	?				
Research	**Research** . Lack of funding for research . Limited capacity of internal researchers . Low interest for biobased/fossil-free textiles as long as fossilbased materials are	As part of the Horizon 2020 projects that we are partners in we have done research on developing lifecycle extension	lack of funding for further research	Lack of funding for further research				
Research		private, industrial partners, institutes, universities	limited capacity of internal researchers	Limited capacity of internal researchers				
Research		Work developed on the research of novel dyeing methods - natural dyeing for example. Development of novel coatings using biopolymers and incorporating waste from other industries. Collaboration with research centers and universities aiming to innovate in all areas of business.						
Research	**Policies** . Lack of long term strategy: too high targets on too short term > shoud be decades (2040) . Lack of common language (taxonomy gap), different interpretations between member states and regions . Lack of understanding of waste policy (waste framework directive elements of end of waste criteria, transboundary transport of waste) by industry	applied research biobased materials in general	interest for biobased/fossil free textiles is limited as long as fossilbased materials are subsidised.	Low interest for biobased/fossil free textiles as long as fossilbased materials are subsidised.				
Research		innovative f2f recycling technologies						
Research		participation in EU projects						
Training		students and professionals	Relation between agricultural activities and textiles is often not recognised	?				
Policies			longer term transition strategy	Long term strategy	too high targets on too short term	Too high targets on too short term	circular transition is a matter of decades (2040?)	Circular transition to last for decades (2040?)
Support to industry	**Miscellaneous** **Training** . Relation between agricultural activities and textiles not enough recorgnised . Lack of properly trained operators for manual sorting **Support to industry** . Lack of incentives for research, development and scaling up . Lack of financing for early higher risk actvities **Administrative burden**	in the form of contract research						
Support to industry		ibidem	research, development and scaling incentives	Incentives for research, development and scaling	early & high risk financing support	Financing support for early and high risk activities		
Administrative burden		Enormous administrative procedures to achieve	Blocks every circular development	Administrative burden	Administration has to be simplified and levelled at European level	Harmonisation and simplification of administration at EU level		
Certifications		Oekotex certification for post consumer products	Difficult to achieve	Oeko-tex standards difficult to achieve with post-consumer products				

Definitions and elements of EU/national/regional policy	**Administrative burden** . Enormous administrative procedures to achieve . No proper EU regulations (national/regional) . Oeko-tex difficult to achieve with recycled material **Matchmaking** . Lack of digital tools for offer/demand matchmaking **Circularity** . Lack of broad life-cycle approach, including ecodesign phase . Lack of info on circular business models **Knowledge/data** . Lack of knowledge on hazardous substances and substances of concern in sourcing-recycling: issues of transparency, traceability, labelling . Lack of data collection at European level (waste flows from producer to recycling plant) **Waste management** . Lack of waste management and recycling capacity in EU . Lack of production of recycled yarn from textile quantities under 5 tons **Communication + Customers/Consumers** . Higher price for higher sustainability/quality not understood		Lack of common language (taxonomy gap), different interpretations between member states and regions	Lack of common language (taxonomy gap) between member states and regions	Lack of understanding of waste policy (waste framework directive elements of end of waste criteria, transboundary transport of waste) by industry	Lack of understanding of waste policy (waste framework directive elements of end of waste criteria, transboundary transport of waste) by industry		
Matchmaking			Lack of digital tool to match supply and demand	Lack of digital tool to match supply and demand				
Training			Need for trained workers for manual sorting	Lack of trained workers for manual sorting				
Circularity			Need for broad life cycle approach, including ecodesign phase	Lack of broad life cycle approach, including ecodesign phase	Need for circular business models (e.g. cost of repair vs. cost of new textile)	Lack of circular business models (e.g. cost of repair vs. cost of new textile)	Sourcing barriers due to small scale: for designers who want to work in a circular way - Need to join forces	Sourcing barriers due to small scale: need to group actors
Circularity			circular business models	Lack of info on circular business models	revenu model for circular products	Lack of proper revenue model for circular products		
Knowledge			Lack of knowledge on composition of textile feedstock for recycling - Need for (better) identification of feedstock specifications	Lack of sorting based on composition	Lack of knowledge on hazardous substances and substances of concern in sourcing-recycling: issues of transparency, traceability, labelling	Lack of knowledge on hazardous substances and substances of concern in sourcing-recycling: issues of transparency, traceability, labelling	Lack of data collection at European level (waste flows from producer to recycling plant)	Lack of data collection at European level (waste flows from producer to recycling plant)
Waste management			Need for technological developments in sorting-recycling	Lack of technology for sorting/recycling	Lack of waste management and recycling capacity in EU	Lack of waste management and recycling capacity in EU	Lack of production of recycled yarn from textile quantities under 5 tons	Lack of production of recycled yarn from textile quantities under 5 tons
Company/Organisation	**ATEVAL**	Home textiles and technical textiles						
Company/Organisation	**HILATURAS ARNAU SL**	CARDING SPINNING MILL -INDUSTRIAL APPLICATIONS						
Company/Organisation	**CILAB**	Fashion						
Company/Organisation	**Coisne & Lambert**	Workwear and PPE						
Company/Organisation	**DBT FIBRE SPA**	Fashion						
Company/Organisation	**Dickson-Constant**	Outdoor						
Company/Organisation	**Edel Carpets BV**	consumer products						
Company/Organisation	**Gomate**	Industrial/Textil/Fashion						
Company/Organisation	**ROVITEX**	building - protective workwear - clothing - lingerie -						
Company/Organisation	**SaXcell BV**	Recycling of cotton - cellulose pulp production						
Company/Organisation	**Associated Weavers Europe NV**	Floor covering - Tufted broadloom carpets & carpet tiles						
Company/Organisation	**Copaco Screenweavers**	construction - sun protective fabrics						
Company/Organisation	**Dolfus-Muller**	Technical textiles -Net Dryer belts and endless felts						
Company/Organisation	**ERION TEXTILES**	Extended Producer Resposability Organization						
Company/Organisation	**EZIO GHIRINGHELLI SPA**	Fashion						
Company/Organisation	**Maes Mattress Ticking**	Weaving/knitting mattress ticking						
Company/Organisation	**Mai Bine NGO**	Fashion clothes and accessories	Lack of productio					
Company/Organisation	**MARCHI & FILDI SPA**	Yarn production						
Company/Organisation	**Mitwill Textiles Europe**	Textile fabrics and garments						
Company/Organisation	**Rubelli S.p.a.**	Textile fabrics for furniture						
Company/Organisation	**STAM**	Engineering and technology consulting						
Company/Organisation	**Utexbel**	Spinning - Weaving -Dyeing - Finishing : fashion, workwear						
Company/Organisation	**TECHTERA**	All textiles						
Company/Organisation	**Textil Olius SA**	Technical textiles for a wide range of applications in industry and consumer goods						
Company/Organisation	**Tintex**	Fashion - fabric finishing						
Company/Organisation	**Ubitech**	Mold and Machine manufacturing. Composites Production.	No indication on gaps, only on activities					
Company/Organisation	**OVAM**	Waste management - Flanders (Belgium)						
Company/Organisation	**WUR**	Research						

28 respondents
. Entire value chain represented
. Different recycling technologies owners/users
. Mix of RGT and outsiders
. Organisations/universities involved in research, policies, etc
. Organisations involved in cluster management

MAPPING VALUE CHAIN - KEY DATA

Detailed challenges and GAPS in separate form

Process Step	Textile waste production (Production and post-consumer)	Textile waste collection (Production and post-consumer)	Pre-sorting	Sorting	Carbonization	Removal of hard parts and non-textile elements	Fibre preparation (Shredding)	Product design of semi-finished products	Product development and prototyping	Fibre preparation	Carding	Spinning (recycled fibres/filaments)	Weaving	Bleaching/dyeing/printing/finishing	Selling B2B	Recycling (closed loop - fibre to fibre)
Supplier/Producer	Consumers	Company 8, Consortium/Association 2	Outside of Italy	Company 5, Consortium/Association 2	Company 5	Company 5	Company 5	RGT Company 1	RGT Company 1	Company 3	RGT Company 2	RGT Company 2	Company 3, 6	RGT Company 1	RGT Company 1, 2	Company 4, 6
	INPUT: Mix of garments from market OUTPUT: Eol. product for collection – post-consumer textiles	INPUT: Textile garments (T-shirt, pants, socks, ...) OUTPUT: Collection of the material in bales with mix of clothing	INPUT: Bales of mixed clothing (T-shirt, pants, socks, ...) OUTPUT: Rough division of material in bales by category: fiber, colors, ...	INPUT: Bales of waste textile sorted by color OUTPUT: Bales of textile waste with a greater refinement of color and fiber	INPUT: Bales of wool waste OUTPUT: Wool without impurity of grass, wood, cotton or similar remains	INPUT: Products with hard part as buttons, zippers and labels OUTPUT: Products free from non-textile elements	INPUT: Bales of waste textile without hard parts OUTPUT: shredded textile	INPUT: Information about starting fibers of textile waste already shredded + ideas/objectives about the outputs and the market destination OUTPUT: Design, specs of the new circular product	INPUT: Project about textile waste-based products or semi-finished products OUTPUT: Prototype of product/Semifinished product/finished product	INPUT: Bales of shredded fiber sorted by color OUTPUT: New fiber	INPUT: Shredded fiber OUTPUT: Spun	INPUT: Spun OUTPUT: Yarn	INPUT: Yarn OUTPUT: Fabric	INPUT: Spun OUTPUT: Yarn or Fabric treated by finishing processes	INPUT: Semi-finished products OUTPUT: Finished products	INPUT: OUTPUT:
	TOP 3 CHALLENGES: Consumer awareness about textiles - based waste management	TOP 3 CHALLENGES: Definition of Regulations and laws governing the post-consumer collection phase Definition of a point of reference for the textile waste collection (company or similar organization)	TOP 3 CHALLENGES: Integrate this phase of the value chain in Italy (or at regional level) Improve the technologies for the sorting phase to remove the pre-sorting one that is implemented manually at now	TOP 3 CHALLENGES: Improve the technologies for the sorting phase Industrialise the technologies for the sorting phase	TOP 3 CHALLENGES: New solutions to manage the environmental impact of the carbonization phase Optimizing the energy efficiency of the carbonization process The technology used for wool carbonization must be scalable to handle increasing volumes of material to be recycled efficiently and cost-effectively.	TOP 3 CHALLENGES: Improvement and spreaing of the innovative technologies available at industrial stage for the phase Design clothing items with hard parts easy to remove	TOP 3 CHALLENGES: Development of innovative tacnologies to maintain fibers for as long as possible (preventing the degradation of fiber quality and performances), enabling the upcycling of waste	TOP 3 CHALLENGES: Adoption of eco-design strategies Creation of new collaborations businesses/design - fashion scools to generate new products and innovation	TOP 3 CHALLENGES	TOP 3 CHALLENGES	TOP 3 CHALLENGES	TOP 3 CHALLENGES	TOP 3 CHALLENGES	TOP 3 CHALLENGES	TOP 3 CHALLENGES: Individuate/Creating new markets and applications Definition of unique standards for the certification and/or labelling of new circular products	TOP 3 CHALLENGES
	Pre-consumers	Company 7						Companies 3, 4, 5, 6	Companies 3, 4, 5, 6		Company 3	Company 3		Company 3	Company 3, 4, 5, 6	
	INPUT: Mix of yarns, wool fortresses, combing waste, ... OUTPUT: Eol. product for collection – pre-consumer textiles	INPUT: Mix of yarns, wool fortresses, combing waste, ... OUTPUT: Collection of the material in bales						INPUT: Information about starting fibers of textile waste already shredded + ideas/objectives about the OUTPUT: Design, specs of the new circular product	INPUT: Project about textile waste-based products or semi-finished products OUTPUT: Prototype of product/Semifinished product/finished product		INPUT: Shredded fiber OUTPUT: Spun	INPUT: Spun OUTPUT: Yarn		INPUT: Spun OUTPUT: Yarn or Fabric treated by finishing processes	INPUT: Semi-finished products OUTPUT: Finished products	
	TOP 3 CHALLENGES: Perform an initial sorting to separate the different types of textiles at the level of the company that produces the textile waste	TOP 3 CHALLENGES: Definition of Regulations and laws governing the post-consumer collection phase Definition of a point of reference for the textile waste collection (company or similar organization)						TOP 3 CHALLENGES: Adoption of eco-design strategies Creation of new collaboration businesses/design - fashion scools to generate new products and	TOP 3 CHALLENGES		TOP 3 CHALLENGES	TOP 3 CHALLENGES		TOP 3 CHALLENGES: Reduce the using of chemicals	TOP 3 CHALLENGES: Individuate/Creating new market and applications Definition of unique standards for the certification and/or labelling of new circular	

What are your main activities ?
Material sourcing
Raw material production
Product design
Product development and prototyping
Fibre preparation (fraying, carding, etc)
Spinning (virgin fibres/filaments)
Spinning (recycled fibres/filaments)
Weaving
Knitting
Non-woven
Bleaching/dyeing/printing/finishing
Manufacturing/assembly
Distribution
Retail/sale (stores/online)
Repair of textile goods
Collecting pre-consumerEol. products
Sorting pre-consumer Eol. products
Collecting post-consumerEol. products
Sorting post-consumer Eol. products
Upcycling
Recycling (closed loop - fibre to fibre)
Recycling (open loop)
Downcycling
Research
Training
Policies
Support to industry

Non woven production

Company 4

INPUT	OUTPUT
Shredded fiber, too short for carding	Fiber panels (and other semi-finished products for different market segments)

TOP 3 CHALLENGES

Ensure the material delivers significant performance, even when produced with substantial quantities of recycled fiber.

RegioGreenTex - VALUE CHAIN MAPPING & GAP ANALYSIS TOOL

Companies/organisations (RGT)		Date:
Description Value Chain		Completed by (name/company):

CORE FUNCTIONS - Input - Output - Gaps

ACTIVITIES - PROCESS STEPS

Contributors to the VC + activities Add identified partners (insert column)						Missing	Input	Output	Comments
RGT partner						?	Describe input/feedstock for each process step	Describe output for each process step	
VC starts... Process steps									
VC ends...									

Notes
. Check GAPS highlighted in survey
. Finetune description of different types of functions

Instructions
. MAX one GAP per row
If same GAP for pilot and industry stages, repeat in different rows as characteristics are different
. Brief descriptions
. Insert row for more process steps or gaps:
left click on row number under which you want to insert a new row,
right click and select 'insert'
. Insert column for more companies and partners:
left click on the letter of the column before which you want to add a new column
right click and select insert

GAPS - Core Functions

GAP = an element missing (company, material, money, ...), or only available in limited quantities, lack of or problematic regulations, etc.						Missing	**GAP description** For GAPS that require a different response (e.g. pilot stage vs. industrial state), use 2 or more different rows!	Pilot	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)	Elements of solution(s)	Action(s) What - Who - When	Comments

SUPPORT FUNCTIONS - Gaps

GAPS - Support Functions

Contributors to the VC + activities								Pilot	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)			
RGT partner							GAP description						Elements of solution	Action(s) What - Who - When	Comments

POLICY INSTRUMENTS - Gaps

GAPS - Regulations

Contributors to the VC + activities								Pilotc stage	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)			
RGT partner							GAP description						Elements of solution	Action(s) What - Who - When	Comments

What are your main activities ?
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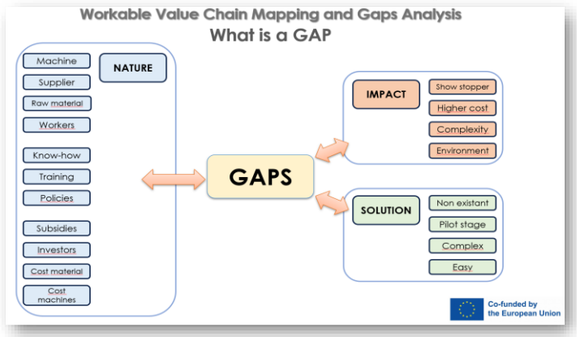
Sorting pre-consumer EoL products
Collecting post-consumerEoL products
Sorting post-consumer EoL products
Removal of hard parts and non-textile elements
Upcycling
Recycling (closed loop - fibre to fibre)
Recycling (open loop)
Downcycling
Research
Training
Policies
Support to industry
Other (please add as many lines as needed)



Criteria - Data description

Core functions = tangible actions to make process deliver	**Support functions** = validation of the process, of the output, certification services, etc	**Regulations** = external players with an influencial role on the entire business
Raw material providers	Testing laboratories	Financial institutions
Fibres producers	3rd party certification bodies	NGOs
Yarn producers	Auditors/Inspectors	Consumer associations
Fabric weaving/knitting/NW	Sourcing agents	Customs administrations
Accessories and trims supplier	Freight and shipping	National government bodies
Assembly	Chemical suppliers	Independent experts
Retailers and brands	Technology providers	
Consumers/market?	Machinery providers	

Category	Possible values
Pilot	X if the case, empty otherwise
Industrial	X if the case, empty otherwise
Timing	Effects of the gap felt as of X months from now 0 = now already
Impact level	1 = low, to 4 = high - 5 = SHOW-STOPPER
Fixing difficulty level	1 = easy, to 5 = very difficult

RegioGreenTex - VALUE CHAIN MAPPING & GAP ANALYSIS TOOL

Companies/organisations (RGT)	**Next Technology Tecnotessile**	**Date:** 22/03/2024
Description Value Chain	Value Chain for the recycling of wool-based waste textile (>=80% of wool): from textile waste collection to alternative outputs of recycled material in closed or open loop	**Completed by (name/company):** Next Technology Tecnotessile

CORE FUNCTIONS - Input - Output - Gaps

ACTIVITIES - PROCESS STEPS

Contributors to the VC + activities Add identified partners (insert column)	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	Input	Output	Comments	Questions
RGT partner	x	x											Describe input/feedstock for each process step	Describe output for each process step		
VC starts... Process steps																
Collecting pre-consumer waste							x						Yarns, Wool Fortresses, Combing waste (short and small fiber)	Collection of the material in bales		
Collecting post-consumer waste								x		x			Clothing (T-shirt, pants, socks, ...)	Collection of the material in bales with mix of clothing		
Pre-Sorting											x		Bales of mixed clothing (T-shirt, pants, socks, ...)	Division of material in bales by category: fiber, colors, ...	Often this phase is implemented outside of Italy	
Sorting					x					x			Bales of waste textile sorted by color	Bales of textile waste with a greater refinement of color and fiber	The sorting phase involves separating and categorizing textile waste based on various criteria such as material type, color, condition, and potential for reuse or recycling. This phase is crucial for efficient waste management	
Carbonization					x								Bales of waste wool	Wool without impurity of grass, wood, cotton or similar remains	Carbonization is used to remove impurity from wool waste.	
Removal of hard parts and non-textile elements					x								Products with hard part as buttons, zippers and labels	Products free from non-textile elements	Although much of this phase is carried out manually, there are instances where an automatic machine is employed to assist and enhance the recycling process	
Fibre preparation (shredding)					x								Bales of waste textile without hard parts	Textile shredded	This process is used to pulled back the fabric into small fibers	
Product design of semi-finished products	x		x	x	x	x							Information about starting fibers of textile waste already shredded + idea/objectives about the outputs and the market destination	Design, specs of the new circular product	Usually this phase is implemented by companies that produce semi-finished products/finished products	
Product development and prototyping	x		x	x	x	x							Project about textile waste-based products or semi-finished products	Prototype of product/semifinished product/finieshed product		
Fibre preparation			x										Bales of shredded fiber sorted by color	New fiber	The phase of fiber preparation involves several key steps to process raw wool or used wool products into fibers suitable for further manufacturing or reuse	
Carding		x	x										Shredded fiber	Spun		
Spinning (recycled fibres/filaments)		x	x										Spun	Yarn		
Weaving			x			x							Yarn	Fabric		
Bleaching/dyeing/printing/finishing	x		x				?						Yarn or Fabric	Yarn or Fabric treated by finishing processes	Different colors and patterns	
Non woven production				x									Shredded fiber, too short for carding	Fiber panels (and other semi-finished products for different market segments)	The nonwoven applications are cross-sectorials, and go beyond the Fashion sector	
Selling B2B	x	x	x	x	x	x							semi-finished products	finished products		
Recycling (closed loop - fibre to fibre)				x		x										
VC ends...																

GAPS - Core Functions

GAP = an element missing (company, material, money, ..), or only available in limited quantities, lack of or problematic regulations, etc.	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	GAP description For GAPS that require a different response (e.g. pilot stage vs. industrial state), use 2 or more different rows!	Pilot	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)	Elements of solution(s)	Action(s) What - Who - When	Comments	Questions
Large scale-sorting process										x			There is not a company/organisation that offers a large-scale service for the sorting phase of waste material. At the moment only humanitarian associations as Caritas and Humana. They keep only the good clothes for second-hand. The rest of the material is sent in Africa or China or burned to make energy.		x	0	4	5	In Italy, sorting is frequently implemented manually to ensure optimal results, although certain companies opt for new automated sorting processes. The integration of automated sorting technology could significantly enhance the separation of textile materials. Consequently, there is a growing demand for new investments in sorting technologies	Research centers could collaborate with technology producers inolved in the development of sorting machine technologies		
Hard-to-remove components from textiles					x								Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.	x		0	3	5	Design clothing with hard parts easy to remove.	Designer must improve skills to make fashion products easy to recycle	There is no a practical solution, but a change of mind	
Hard-to-remove components from textiles					x								Removing hard parts from textiles isn't always straightforward. This phase has the potential to slow down the entire value chain and/or results in generate new textile waste.		x	0	4	3	Encourage and spread the use of automated processes already available in the Tuscan district	Create and implement diffusion and exploitation processes for spreading the technology opportunites		
Mapping of the all recycling value chains: mapping of the different companies that could contribute in the long recycling process	x	x	x	x	x	x	x	x	x	x			Companies of Prato district have the capability to cover the entire value chain for recycling wool. However, it is still a disconnected system, that lacks of awareness regarding the processes that the companies are capable of undertaking.	x		0	4	4	Some territorial organisations are developing the map to contribute to the Hub project implementation			
Lacking of competencies and effort spent for the products circular design phase	x	x	x	x	x	x	x	x					Circular design methodologies and techniques are not clear for most of the SMEs		x	0	4	3	Organize design and creative workshops to explain circular design. Create new vertical figures specialised in eco-design	Organize new public and private courses dedicated to the new needs of the entire recycling wool value chain		

GAPS - Support functions

SUPPORT FUNCTIONS - Gaps

Contributors to the VC + activities	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Association 1	Consortium/Association 2	Outside of Italy	Missing	GAP description	Pilot	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)	Elements of solution	Action(s) What - Who - When	Comments
RGT partner													**GAP description**						**Elements of solution**	**Action(s)** What - Who - When	**Comments**
Difficulties to share production/manufacturing data among companies	x	x	x	x	x	x	x	x	x				The companies in the district struggle significantly with sharing data and information across the entire supply chain. In addition, there are lots of differences in the levels of digitalisation of the interested companies		x	0	4	5	Encouraging the digitalization of companies of district. There are new available digital solutions for the horizontal integration.	Training: technical training and/or for cultural shift	
Necessity of training for producers and awareness for consumers with reference to the circular practices and products	x	x	x	x	x	x	x	x	x	x			Lack of knowledge about circular design, opportunities for recycling and new circular business models		x	0	4	3	Webinars, workshops, case studies of success, Companies with a profitable model in circular economy	Organize new public and private courses dedicated to the new needs of the entire recycling wool value chain	

GAPS - Regulations

POLICY INSTRUMENTS - Gaps

Contributors to the VC + activities	RGT Company 1	RGT Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Consortium/Asso ciation 1	Consortium/Asso ciation 2	Outside of Italy	Missing	GAP description	Pilot: stage	Industrial stage	Timing (# months)	Impact level (1 to 5)	Fixing difficulty (1 to 5)	Elements of solution	Action(s) What - Who - When	Comments
RGT partner													**GAP description**						**Elements of solution**	**Action(s)** What - Who - When	**Comments**
Unclear legal and economic position of collecting and/or sorting factory					x								Italian legislation lacks a clear definition of the economic classification of enterprises/associations that are responsible of the phase of textile collecting and sorting. While some fall under the category of craftsmanship, others are considered industrial entities. This ambiguity leads to confusion and inconsistent actions.		x	0	3	5	Discussions going on at EU level	Follow up on progress discussions with textile federations and different stakeholders	
Italian organizations for waste textile collection							x	x		x			Italy applied in advance the "Waste framework directive" for the textile collecting by D.Lgs. n° 116/2020. The results are not concrete after two years.There are strong differences in the level of advancement among different regions or districts regarding this matter		x	0	4	4	Promote projects and private actions to generate Hub for recycling. Coordinate project and initiatives involving districts and enterprises for the construction of Hub.	Follow up the progress of projects and initiatives that are already started.	
Lacking of an homogeneus standards for sustainability measure of products	x	x	x	x	x	x	x	x	x				Lacking of an homogeneus standards for sustainability measure of products.		x	0	4	5	Discussions going on at EU level	Follow up on progress discussions with textile federations and different stakeholders	
Certification, Labeling for new circular products. There is a lack of unique standard for identify the waste textile in input and circular products in output	x	x	x	x	x	x	x	x	x				Certifying and labeling semi-finished/finished products containing waste textiles proves challenging due to regulatory gaps. Existing laws lack clarity regarding the classification of new products derived from waste textiles, limiting their market viability.		x	0	4	5	Discussions going on at EU level	Follow up on progress discussions with textile federations and different stakeholders	

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Bleaching/dyeing/printing/finishing
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Sorting pre-consumer EoL products
Collecting post-consumerEoL products
Sorting post-consumer EoL products
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Recycling (open loop)
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Training
Policies
Support to industry
Other (please add as many lines as needed)

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Yarn producers	Auditors/Inspectors	Consumer associations
Fabric weaving/knitting/NW	Sourcing agents	Customs administrations
Accessories and trims supplier	Freight and shipping	National government bodies
Assembly	Chemical suppliers	Independent experts
Retailers and brands	Technology providers	
Consumers/market?	Machinery providers	

Category	Possible values
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