circula·tex

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REPORT ON THE CLASSIFICATION AND TAXONOMY FOR THE EOW

Deliverable 4.1

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Responsible Partner	RETEX.Green
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Author(s)	Pasquale Campanile, Massimiliano Marin, Riccardo Stronati
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TABLE OF ABBREVIATIONS

Abbreviation	Definition
SRM	Secondary Raw Material
EoW	End of Waste
DPP	Digital Product Passport
DMP	Digital Material Passport
ESPR	Ecodesign for Sustainable Products Regulation
EPR	Extended Producer Responsibility
WFD	Waste Framework Directive
PRO	Producer Responsibility Organisation
B2B	Business to Business
B2C	Business to Consumer

EXECUTIVE SUMMARY

This report synthesises the findings of the activities performed in the Tasks 2.2 and 4.1.

Task 2.2 is aimed at defining a recycled-oriented taxonomy to classify the EoW and the SRM.

Task 4.1 is aimed at investigating the information requirements for developing a labelling system that could support specialized sorting and facilitate purchasing by recyclers.

This report presents a gap analysis of the needs of the different operators of the value chain in scope for the project, followed by a review of existing taxonomies, both private and public, that are applied to classify the materials in scope for the EPR, namely the textile waste separately collected that originates mostly from urban collection and household.

Based on the gap analysis, a set of six taxonomies has been elaborated with a special focus on recycling. The proposed taxonomies have been reviewed and consolidated through confrontation with stakeholders including both sorters and recyclers.

The proposed taxonomies represent a model to define the information package to attribute to the different streams of materials in terms of quality, granularity and accuracy. They are instrumental to the development of a labelling system that could support traceability and monitoring. This labelling system will be integrated with the Digital Product Passport paying attention to the fact that the materials in scope to be tracked are not single items but they are aggregated in groups of (relatively) homogeneous items.

This report is public, available to all actors interested in supporting the co-creation of a circular ecosystem for textiles in Europe, a business scenario that is expected to evolve dynamically in the coming years.

The Circula-Tex partners welcome the opportunity to continue interacting with interested stakeholders and similar projects to extend and refine the taxonomies also in view of issuing an updated version of this report by the end of the project in December 2028.

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1. OBJECTIVES AND METHODOLOGY

Task 2.2 analysed the gaps related to the categorization of EoW and SRM that is a key element towards the establishment of a sustainable circular market. The activity started from reviewing the criteria and procedures currently used to categorize the EoW for reuse and recycling and ended up with the proposal of a recycled-oriented taxonomy to classify the EoW, aimed at facilitating B2B interaction between sorters and recyclers. The final goal is to support the definition of future standards and promote scalability of this market.

Task 4.1 focused on investigating the information requirements for the development of a labelling system that could support specialized selection by sorters and facilitate purchasing of SRM by recyclers, ultimately contributing to the scalability of the SRM market. Specific topics investigated include:

i) Identifying information on EoW generated by the sorters, including characteristics and origin (pre/post-consumer), and determining how to integrate this data into labelling;

ii) Examining how labelling should adapt when a waste undergoes sorting for reuse, considering the essential information that must still be included;

iii) Analysing necessary modifications to labelling when a waste is disassembled for recycling, specifying the information that should persist in the new product;

iv) Integrating a recycled-oriented taxonomy for classifying SRM materials, contributing to an environmentally conscious labelling system;

v) Developing strategies for managing information recovery during sorting, particularly in cases where the physical label is absent on the waste (> 50% of cases) resulting in a loss of linkage with the digital label.

This comprehensive approach aims to contribute to developing a robust integrated digital labelling system that proves effective in the processes of sorting, reuse, and recycling.

The methodology followed in this activity included an initial workshop among the Circula-Tex partners to preliminary review the gaps and needs to be faced.

A detailed inventory and analysis of existing taxonomies was made to recover any best practice applied by market operators that could be instrumental to this Task. Based on this inventory a set of concept taxonomies was elaborated to cover the main gaps identified.

The concept taxonomies were discussed with the Circula-Tex partners, especially sorters and PRO, that are more experienced and possibly involved in the practical utilization, and subsequently discussed with external stakeholders to collect further feedbacks and suggestions for improvement.

2. THE REFERENCE VALUE CHAIN

The taxonomy to be developed in Circula-tex is instrumental to facilitating the exchange of information and trading of SRM across the value chain to support the implementation of EPR schemes.

To focus this development a reference value chain was defined to specify the operations in scope.

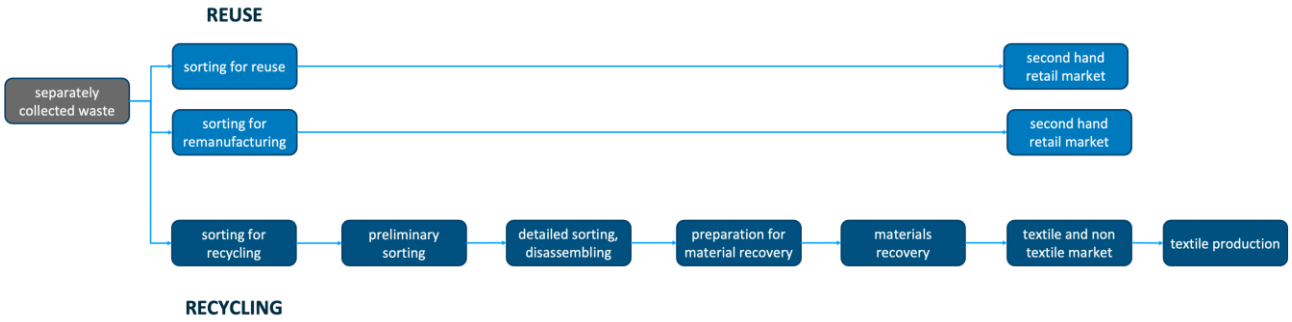


Fig.1 – reference value chain for processing the SRM in scope for the EPR

The value chain considered refers primarily to processing the SRM in scope for the EPR, namely textile waste separately collected that originates mostly from urban collection and household. However, a similar value chain could be applied also to other sources of waste such as post-industrial and pre-consumer.

2.1 DESCRIPTION OF THE VALUE CHAIN

The separately collected textile waste undergoes a sequence of sorting operations that follow the hierarchy of the Waste Directive.

The original undifferentiated waste is sorted into two main streams of materials, the first includes the items **suitable to reuse**, the second the items **not suitable to reuse** and then eligible for recycling or recovery of the constituent materials.

The stream **suitable to reuse** can be further divided into **sorted for reuse** (that can be sold as second hand as is) and **sorted for remanufacturing** (that could be sold as second hand after some repair/refurbishment).

The stream **not suitable to reuse** undergoes a sequence of operations to prepare it for the recovery of the constituent materials.

These operations include incremental levels of sorting, disassembling of multi-material items into the main components and preparation for material recovery as detailed in the following table.

	description of the operations	output
preliminary sorting	aggregate the items not suitable to reuse into groups to some extent homogeneous in terms of colour, monolayer/multilayer, apparent material composition, etc.	relatively homogenous groups of textile items
detailed sorting, disassembling	• sort the recoverable textile components by colour and material composition • disassemble multilayer / complex items into more homogeneous textile and non textile components either suitable to materials recovery or not	• homogeneous groups of recoverable textile components (fabrics, paddings) • recoverable and non-recoverable non textile components (zippers, buttons)
preparation for material recovery	cut the recoverable textile components into pieces of quite homogeneous size (indicatively 50 mm) to make them more regular and facilitate material recovery	homogeneous groups of clippings

Fig.2 – Preparation for materials recovery, description of the main operations

The sequence of operations indicated in Fig.2 is exemplary, does not represent a standard procedure. For example, the detailed sorting of monolayer items is typically made before the disassembly while for multilayer items the opposite sequence is applied.

The function of the overall sequence is to sort and prepare heterogeneous and multi-material waste items to end up into groups of homogeneous textile clippings or components that could be channelled to different specific recovery operations (e.g. textile clippings can undergo recovery of the component fibres while zippers can undergo recovery of the component metal or plastic).

The higher the accuracy and detail of these preparatory operations the higher the overall yield of material recovered from the non reusable fraction. However, industrial scaling of material recovery requires this sorting not to be too granular to facilitate aggregation in higher volumes.

Therefore, sorting for material recovery must **trade-off must between granularity** (to facilitate specialised materials recovery) **and aggregation** (to facilitate scaling of volumes).

2.2 GAP ANALYSIS

The main gaps in the categorisation of the SRM are related to the non-reusable materials that are directed to material recovery, while for the reusable items different categorisations are commercially applied even if they are not really standardised.

The gaps originate from the **extreme heterogeneity of the input** (undifferentiated non-reusable waste) that is processed by the sorters and from the **misalignment between the demand** (needs and expectations of the operators of material recovery) **and the potential offer** (sorting ability of the sorters).

Regarding the **demand**, the operators of material recovery in general are different subjects than the sorters and in most cases do not yet operate fibre-to-fibre recovery at scale. Therefore, their specifications for the feedstock are not yet consolidated and have significantly evolved over time (e.g. regarding the tolerance for mixed compositions or the presence of disruptors such as the elastane).

Regarding the **offer**, the ability of NIR-based technologies to recognise the material composition of textiles has greatly improved in recent years making it possible to accurately measure even mixed compositions and to recognise the presence of disruptors even in minimal quantities.

In summary, the main gaps commonly reported by sorters and recyclers could be classified as follows:

- lack of common definitions for the SRM across the value chain
- lack of recognised quality parameters for the SRM to characterise the properties of interest
- lack of clear technical specifications and related tolerances.

In this scenario, in Circula-Tex we started from an inventory and review of existing taxonomies from different sources with the rationale to:

- identify definitions that could be relevant for the project and commercially accepted
- build upon existing practices
- avoid unnecessary duplications of efforts, especially in consideration of the final objective of this activity that is to create a set of publicly available definitions to support the exchange of information and trading of SRM across the value chain.

In the following section 3 a review of existing taxonomies is presented along with an analysis of their suitability for the objectives of this project.

2.3 STATUS AND CONDITIONS OF THE MATERIAL IN SCOPE

The material in scope for this project is textile waste separately collected that undergoes sorting to become EoW and then be channelled towards reuse or recycling depending on its conditions.

Since this material was disposed of in containers (having lost its functional or perceived value for the owner) from a legal standpoint in several Member States it ceased to be considered a product and became waste.

There is no generally applicable definition of 'textile waste' laid down in EU legislation. This means that the stage at which used textiles are considered textile waste differs between Member States.

According to the definition of waste in the Waste Framework Directive (Art. 3 paragraph 1), textiles become waste when the holder in fact discards, intends to discard, or is required to discard the textile product. However, when or at what stage textiles become waste can differ due to a different interpretation or implementation of this definition into national legislation. In line with this, the Commission and its Joint Research Centre (JRC) are currently working on the development of end-of-waste criteria for textiles[1].

For example, a brand X jacket or blouse disposed of in a container becomes textile waste regardless of its condition or the presence of a brand label. If, however, the owner resold that item through an online platform it would retain its original legal status as a product and corresponding category.

Therefore, the product category of the original item is no more applicable since it became a waste and a **new categorisation needs to be developed** to denominate and track the material along the operations of sorting and preparation for reuse or recycling that occur from then on.

This categorisation needs to **accomplish for the changes in legal status and physical conditions (repair, disassembling, fragmentation)** that this material undergoes as it passes from waste to EoW until it ends up in new products depending on the reuse or recycling path followed.

For example, an item sorted for reuse can be resold as is or need some repair. In most cases it undergoes sanitation before being sold to second-hand resellers. These operations are relevant to the implementation of EPR and need to be denominated, attributed to the item, tracked and monitored.

The situation with non reusable items is much more complex, because to recover the material components the original item undergoes **fragmentation** (disassembling of multi-layer into homogeneous parts, removal of disruptors, cutting in smaller pieces, etc.) and **transformation** (to recover the component materials through mechanical or chemical processes).

Fragmentation produces more sub-components from a single item depending on its characteristics (multi-layer, presence of zippers or buttons, etc.), therefore all sub-components need to be denominated, tracked and monitored.

Transformation modifies the physical form of the feedstock to recover the component materials in ways that depend on the specific recovery process (fibres, granulates, sludges, etc.), therefore different types of outputs need to be denominated, tracked and monitored.

The Circula-Tex project is following closely the ongoing definition of EU policies relevant for the EPR scheme, including the Revised WFD, the EoW criteria for textiles, the Delegated Act for the ESPR, the Textile Labelling Regulation and the forthcoming Circular Economy Act. Based on this evolving policy scenario, updates of the taxonomy could be considered.

[1] Deckers J., Duhoux T. , Due S. 'Textile waste management in Europe's circular economy', ETC CE Report 2024/5

2.4 NEEDS FOR TAXONOMY AND LABELLING

The taxonomy and the labelling in Circula-Tex must be conceived and developed to address the above-mentioned complexity to support the day-by-day activities in the implementation of the EPR scheme.

The general functions of the envisaged taxonomy could be summarised as follows:

1. to **denominate** the different streams of materials that originate from the operations of sorting and preparation for reuse or recycling that the undifferentiated input waste undergoes in real life
2. to **define a set of information** to qualify the characteristics of the different streams of materials and be associated to them to enable tracking and facilitate trading among value chain operators
3. to **define qualitative/quantitative descriptors** for the information that can support trading, tracking, monitoring and reporting.

More in detail:

Denomination

The undifferentiated textile waste that represents the input for sorting has a standardised classification with CER codes that is detailed in section 3.1.

However, when the feedstock undergoes sorting the outputs do not have standard denominations and are classified in sorter-specific categories. This condition applies to all outputs, both reusable and non-reusable.

Even if the market of the reusable outputs is well developed, the denominations vary among the sorters and this does not facilitate scaling of volumes and monitoring.

The situation with the fraction not suitable to reuse is more complex because the market is underdeveloped and the materials in scope are very diversified (fabrics, clippings, accessories, etc.).

Information

Every stream of output material needs to be qualified by characteristics that facilitate trading and enable tracking and monitoring. The reusable fraction needs descriptions that are clear and valuable for the resellers of second hand garments. The example of taxonomy described in section 3.5 include type of garment, gender and quality (classified in different grades). The non-reusable fraction needs descriptions that are clear and valuable for material recovery operators. These include the exemplary list detailed in section 3.6 and other relevant information such as the origin of the SRM.

Moreover, for every stream of output material it is relevant to define the granularity of this information, i.e. to which level of aggregation of SRM it must be applied (labelling single outputs is not logical nor useful).

Descriptors

The list of characteristics that constitute the information on the SRM must be specified in terms of format and accuracy. For example, the material composition of a batch of clippings obtained from non-reusable items must be defined by quantitative data that correspond to the needs of material recovery operators. This could include the percentage in weight of the constituent materials (over a threshold of share), possibly organised into ranges (to avoid excessive granularity and promote aggregation) as shown in the example in section 3.6

2.5 ORIGINAL LABEL AND DPP

The labels of original products that later become waste contain information (e.g. material composition) that can be instrumental for value chain operations.

The introduction of the Digital Product Passport under the Ecodesign for Sustainable Products Regulation significantly changes this context. The DPP establishes a digital, standardised and regulated information layer, accessible via a data carrier (e.g. QR code or RFID), covering product materials, chemical content, carbon footprint, repairability and recyclability. The exact level of detail will be defined in upcoming delegated acts, but it is expected to fully support the needs of the textile value chain.

Conclusions drawn from pre-DPP studies on missing or damaged physical labels (e.g. up to 57% missing labels reported by Re_Fashion), including statements that when waste undergoes sorting the availability of the information carried in the DPP cannot be guaranteed due to the label being removed or damaged, should be interpreted with caution. These observations reflect a pre-DPP regulatory environment where label durability, persistence and data accessibility were not governed by harmonized requirements.

Under the DPP framework, significantly higher requirements will be imposed on data carriers and their lifecycle performance, including durability, persistence, and accessibility of information throughout the product lifecycle, including end-of-life stages. At the same time, it must be acknowledged that damaged or missing data carriers will not be fully eliminated in practice and such cases will never reach zero. Therefore, the labelling system must also provide complementary mechanisms to ensure continued access to product information even when the physical carrier is partially or fully unavailable.

The appropriate response is to improve DPP data, taxonomies and data carrier solutions and their integration into products, ensuring they remain accessible and functional even under demanding lifecycle conditions such as washing and wear so that they could remain usable in the value chain operations that implement recycling, reuse and repair.

Therefore, the taxonomy and labelling system in Circula-Tex is coherent with the DPP framework, focusing on ensuring that the required information is captured, structured, and made accessible within the DPP system itself. Also the need for reconstructable information in the absence of a physical label will be addressed in terms of DPP-compliant mechanisms.

In summary, to ensure traceability of the outputs of the value chain operations in scope for this project it is necessary to define a taxonomy and a labelling system based on information that is (1) representative for the interests and needs of the operators and (2) reconstructable by the best available sorting technologies also in cases when there is no access to the physical label or DPP.

3. REVIEW OF EXISTING TAXONOMIES

3.1 TEXTILE WASTE – CER CODES

The CER (European Waste Catalogue) codes for textile waste are 6-digit numerical sequences that classify waste fibres, clothing and textile materials based on their origin (industrial or urban) and composition, identifying their hazardousness for correct disposal or recovery. The textile CER codes are listed below:

Urban waste
20 01 10: Clothing (non harmful)
20 01 11: Textile products (non harmful)
Special waste (textile industry)
04 02 09: Waste from composite materials (es. impregnated fibres)
04 02 14: Waste from finishing operations containing organic solvents (harmful)
04 02 15: Waste from finishing operations, different from above (non harmful)
04 02 21: Waste from raw textile fibres (non harmful)
04 02 22: Waste from processed textile fibres (non harmful)
Additional codes for contaminated textiles
15 02 02: Absorbents, filtering materials, rags, protective clothing contaminated by harmful substances (if applicable)
15 02 03: same as in code 15 02 02, classified as non-hazardous.

Analysis

The codes relevant for Circula-Tex are the first two 20 01 10 and 20 01 11 that apply to post-consumer waste and as such are in scope for the EPR.

The other codes refer to waste that are not in scope for the EPR and will not be considered in this project.

3.2 RE_FASHION TAXONOMY

Re_Fashion, the PRO consortium that manages the EPR scheme in France, adopts a taxonomy (synthesised below) to classify the textile products in scope for the EPR that is used also for the implementation of the eco-modulation system (source: EN_Nomenclature_Refashion_2025)

CLOTHING	TOP	T-shirt, Shirts, Pull-overs/jumpers
	BOTTOM	Skirts, Dresses, Denim trousers, Everyday trousers, Sport trousers and sportswear, Shorts, Bermuda shorts, Overalls, overalls with straps
	INTIMATE	Underwear, Lingerie and lingerie accessories, Pyjamas and other homewear/loungewear, Pyjama sets and other homewear/loungewear sets, Swimwear
	CLOTHING	Jackets and light jackets, Waterproof clothing, Coats, Padded clothing – multilayer
	OTHERS	Clothing fabric sold by meter for dress-making and accessories, High visibility safety vests, Dressing-up sets and fancy dress, Light work clothes, Other work clothing, Small accessories, Hats and other headgear, Gloves, hand muffs, mittens, Medium-sized accessories, Suits - 2-3 piece, 2-3 piece sports sets
	BABY	Baby (0-36 months) footwear and underwear and small accessories, Baby (0-36 months) clothes Small items, Other Baby clothes
HOUSEHOLD LINEN	BATH LINEN	Bath linen and mats (humid areas), Towels, Bath linen for babies
	BED LINEN	Pillow/bolster cases & protector cases, Sheets, Continental quilt cover, Bed linen set, Protective covers, Blankets, Bedlinen for Baby
	TABLE LINEN	Cleaning items and various linens, Tablecloths, Table linen,
	OTHERS	Fabric by the meter for making bed linen, bath linen, table linen , Gloves
FOOTWEAR	OPEN-TOED SHOES	Summer footwear
	CLOSED SHOES	Flat footwear, Footwear such as “booties”, Footwear such as “boots”,
	SNEAKERS / TRAINERS	Footwear such as “trainers”
	OTHERS	Indoor footwear, Baby (0-36 months) footwear

Analysis

The Re_Fashion taxonomy refers to textile products while the taxonomy to be developed in Circula-Tex must refer to material streams that start as waste and become new products through several operations and aims at classifying these materials in such a way as to promote reuse and/or material recovery.

3.3 PRODCOM

PRODCOM (PRODuction COMmunautaire) is an annual EU survey providing detailed, comparable statistics on the value and volume of manufactured goods produced by industrial enterprises.

Based on 8-digit product code list linked to NACE Rev.2 and the Combined Nomenclature, it covers mining, quarrying, and manufacturing sectors.

PRODCOM list includes broad textile categories like 'Manufacture of textiles' (NACE 13) and 'Manufacture of wearing apparel' (NACE 14), with detailed 8-digit codes for items such as specific apparel (shirts, trousers), carpets, technical textiles, non-wovens, ropes, and made-up articles, helping align production and trade data across the EU.

Examples of Specific PRODCOM Codes & Products

13.93: Manufacture of carpets and rugs.

13.94: Manufacture of cordage, rope, twine, and netting.

13.95: Manufacture of non-wovens and articles made from non-wovens (except apparel).

14.14: Manufacture of shirts, under-shirts (knitted/crocheted).

13.96: Manufacture of other technical and industrial textiles.

How it Works

Standardized list: PRODCOM is a common, updated list of circa 4,000 products for EU industrial surveys, ensuring comparable statistics.

Hierarchical codes: products have 8-digit codes linking to NACE (activity) and CPA (product) classifications.

Data collection: businesses report sales value and volume for these specific products.

Analysis

As for the Re_Fashion taxonomy, the PRODCOM list is not applicable to Circula-Tex as it refers to textile products while the taxonomy to be developed must refer to material streams that start as waste and become new products through several operations and aims at classifying these materials in such a way as to promote reuse and/or material recovery.

3.4 E-BIZ TAXONOMY

eBIZ is a European initiative, supported by EURATEX, CEC and ENEA that defines a standard language and reference architecture for digital B2B data exchange in the textile, clothing, and footwear sectors. It enables seamless, interoperable communication between companies—from raw materials to retail—using XML and other IT tools to streamline supply chain processes. In the following the eBiz taxonomy is reviewed in detail to assess its potential suitability for the project.

E-BIZ Taxonomy categories:

1. Waste treatment
2. Sub-categories PEFCR / reference products
3. Textile objects
4. Industrial operations

3.4.1 WASTE TREATMENT

Table	NT316		
Description	waste final treatment type		
Code List URI	http://www.ebiz.enea.it/moda-ml/repository/codelist/Draft/gc_NT316.xml		
Table values	**Code**	**Table values**	**Suitability for Circula-Tex**
	CHR	Chemical recycling	Yes
	COM	Composting process	No
	IER	Incineration with energy recovery	Yes
	IWE	Incineration without energy recovery	No
	LND	Landfill	No
	MCR	Mechanical recycling	Yes
	REC	Recovery (of parts)	Yes
	REU	Reuse	Yes
	TMR	Thermo-mechanical recycling	Yes
	OTH	Other	No

Analysis

The categories related to reuse and recycling are applicable to this project.

3.4.2 SUB-CATEGORIES PEFCR / REFERENCE PRODUCTS

Table	NT321		
Description	PEFCR Sub-category / representative product		
Generalities	Extracted from draft of APPAREL-FOOTWEAR PEFCR, version 1.2, 7/7/2021		
Code List URI	http://www.ebiz.enea.it/moda-ml/repository/codelist/Draft/gc_NT321.xml		
Table values	**Code**	**Table values**	**Suitability for Circula-Tex**
	1	T-shirts	No
	10	Apparel accessories	No
	11	Open-toed shoes	No
	12	Closed-toed shoes	No
	13	Boots	No
	2	Shirts and blouses	No
	3	Sweaters and midlayers	No
	4	Jackets and coats	No

	5	Pants and shorts	No
	6	Dresses, skirts and jumpsuits	No
	7	Leggings, stockings, tights and socks	No
	8	Underwear	No
	9	Swimsuits	No
	101	Costumes	No
	102	Wedding dresses	No
	103	Protective wear	No
	104	Gloves	No
	105	Hats	No

Analysis

The PEFCR sub-categories are not applicable to this project for the same reasons as the PRODCOM.

3.4.3 TEXTILE OBJECTS

Table	T302		
Description	type of object		
Generalities	indicates the type of object (the nature of a traceable object, e.g. the content of a truck load)		
Code List URI	http://www.ebiz.enea.it/moda-ml/repository/codelist/Draft/gc_T302.xml		
Table values	**Code**	**Table values**	**Suitability for Circula-Tex**
	ACCE	accessory	No
	RAFA	fabric (non knitted)(raw)	No
	CFBR	fiber (combed)	No
	PFBR	fiber (processed)	Maybe (too generic)
	RAFI	fiber (raw)	No
	GARM	garment (finished)	No
	RAGA	garment (unfinished)	No
	GRCO	garment component	No
	RAYA	yarn (unfinished)	No
	YARN	yarn (finished)	No
	POLY	polymers	Maybe (too generic)
	TRIM	trimming	No
	FIL	filament	No
	WFYP	waste fibre from yarn production	No (post-industrial)
	WYYP	waste yarn from yarn production	No (post-industrial)
	WYFP	waste yarn from fabric production	No (post-industrial)
	WFFP	waste fabric from fabric production	No (post-industrial)
	WFGP	waste fabric from garment production	No (post-industrial)
	WGGP	waste garment from garment production	No (post-industrial)
	WTRM	waste trimming	No (post-industrial)
	WACC	waste accessories	No (post-industrial)
	WPGR	waste garment (Post-Consumer)	Yes
	WPFB	waste fabric (Post-Consumer)	Yes
	WPTR	waste trimming (Post-Consumer)	Yes
	WPAC	waste accessories (Post-Consumer)	Yes
	FABR	fabric (finished) (non knitted)	No
	LFIB	loose fibers	No

	KNFA	knitted fabric (finished)	No
	RAKF	knitted fabric (unfinished)	No
	PPFB	fiber (preprocessed)	No

Analysis

The eBiz categories are mostly suitable to classify post-industrial waste that is not in scope for EPR.

3.4.4 INDUSTRIAL OPERATIONS

Identifier	Manufacturing Operation Name	Suitability for Circula-Tex
0	Fibers production	No
0.1	Animal fibers production	No
0.2	Plant fibers production	No
0.3	Production of man-made filaments and fibers	No
0.3.1	Raw materials for man-made filaments and fibers	No
0.3.2	Extruders	No
1	Yarn manufacture	No
1.1	Spinning Preparation for cotton fibers	No
1.1.1	Opening for cotton	No
1.1.2	Cards	No
1.1.3	Drawing machines for cotton	No
1.1.4	Lap winders	No
1.1.5	Combing machines for cotton	No
1.1.6	Roving frames	No
1.2	Spinning Preparation for wool fibers	No
1.2.1	Opening lines for raw wool	No
1.2.2	Raw wool scouring lines	No
1.2.3	Carbonising lines	No
1.2.4	Opening for wool	No
1.2.5	Worsted cards	No
1.2.6	Semi-worsted cards	No
1.2.7	Woollen cards	No
1.2.8	Drawing machines for wool	No
1.2.9	Combing machines for wool	No
1.2.10	Back washing machine	No
1.2.11	Finishers	No
1.2.12	Roving frames for worsted yarn	No
1.3	Spinning preparation for blended fibers	No
1.3.1	Blending	No
1.4	Spinning	No
1.4.1	Mechanical Spinning	No
1.4.1.1	Ring-spinning	No
1.4.1.2	Compact spinning	No
1.4.1.3	Rotor spinning	No
1.4.1.4	Air-jet spinning	No

1.4.1.99	Other Spinning machines	No
1.4.2	Thermo-mechanical Filament spinning	No
1.4.2.1	Melt spinning	No

1.4.3	Chemical -Cotton Filament Spinning	No
1.4.3.1	Blending with wood pulp	No
1.4.3.2	Drying of pulp sheets	No
1.4.3.3	(Dry-jet) wet spinning	No
1.5	Winding, reeling and covering	No
1.5.1	Winding machines	No
1.5.2	Reeling machines	No
1.5.3	Covering machines	No
1.6	Yarn finishing	No
1.6.1	Yarn steaming, setting, moistening, coating	No
1.6.1.1	Autoclaves for steaming	No
1.6.1.2	Heat-setting machines	No
1.6.1.3	Moistening machines	No
1.6.2	Yarn coating machines	No
1.6.2.1	Plasma treatment	No
1.6.3	Yarn Mercerising	No
1.6.4	Yarn washing	No
1.6.5	Yarn continuous dyeing	No
1.6.6	Hank	No
1.6.7	Yarn Dryers	No
1.7	Texturing, bulking and crimping	No
1.7.1	Texturing machines	No
1.7.2	Bulking and crimping machines	No
1.8	Doubling and twisting	No
1.8.1	Doubling machines	No
1.8.2	Twisting machines	No
2	Fabric manufacture	No
2.1	Weaving preparation	No
2.1.1	Sectional warping	No
2.1.2	Beam warping	No
2.1.3	Draw-warping	No
2.1.4	Beaming machines	No
2.1.5	Sizing/slashing	No
2.1.6	Indigo warp dyeing lines	No
2.1.7	Degumming (of silk)	No
2.2	Weaving	No
2.2.1	Rapier weaving	No
2.2.1.1	Rapier weaving with Jacquard	No
2.2.1.2	Rapier weaving with dobby	No
2.2.2	Projectile weaving	No
2.2.3	Air jet weaving	No

2.2.4	Water jet weaving	No
2.2.5	Shuttle looms	No

2.2.6	Circular weaving	No
2.2.7	Narrow fabrics weaving	No
2.3	Preparation for knitting	No
2.3.1	Beam warping	No
2.3.2	Sectional warping	No
2.4	Knitting (knitted fabric)	No
2.4.1	Circular knitting machines	No
2.4.2	Flat knitting machines	No
2.4.3	Warp knitting machines	No
2.4.4	Knitting machines for special purposes	No
2.99	Other fabric production technologies	No
3	Finishing and Dyeing	No
3.1	Pretreatment	No
3.1.1	Carbonising	No
3.1.2	Singeing	No
3.1.3	Crabbing	No
3.1.4	Desizing	No
3.1.5	Bleaching batch	No
3.1.6	Continuous Bleaching	No
3.1.7	Rope washing	No
3.1.8	Open-width washing	No
3.1.9	Solvent washing	No
3.1.10	Milling/fulling	No
3.1.11	Fabric Mercerising	No
3.2	Dyeing	No
3.2.1	Fiber Dyeing	No
3.2.1.1	Cellulose fiber dyeing	No
3.2.1.2	Protein fibers dyeing	No
3.2.1.3	Synthetic fibers dyeing	No
3.2.2	Fabric continuous dyeing	No
3.2.3	Autoclaves	No
3.2.4	Jet	No
3.2.5	Overflows	No
3.2.6	Winch becks	No
3.2.7	Jiggers	No
3.2.99	Other dyeing machines	No
3.3	Water extraction and drying	No
3.3.1	Centrifugal hydro-extractors	No
3.3.2	Stenter	No
3.3.3	Fabric Dryers	No
3.3.4	Other Dryers	No
3.3.5	Tumblers	No

3.4	Finishing machines	No

3.4.1	Mechanical finishing	No
3.4.2	Decatising	No
3.4.3	Calenders	No
3.4.4	Singeing machines	No
3.4.5	Knitwear ironing presses	No
3.4.6	Tumblers	No
3.4.7	Sanfor	No
3.4.8	Moth-proof finishing	No
3.4.9	Shrink-proof finishing	No
3.4.10	Water-proof finishing	No
3.4.11	Crease-proof finishing	No
3.4.12	Stain-proof finishing	No
3.4.13	Flame-resistance finishing	No
3.4.14	UV-protection finishing	No
3.4.99	Other finishing machines	No
3.5	Printing	No
3.5.1	Top and yarn printing	No
3.5.2	Flat screen printing	No
3.5.3	Rotary screen printing	No
3.5.4	Inkjet printing	No
3.5.99	Other printing machines	No
4	Clothing and accessories manufacture	No
4.1	Cutting	No
4.2	Sewing	No
4.3	Ironing	No
4.4	Washing (clothing)	No
4.5	Dyeing (clothing)	No
4.6	Knitting (hoisiery)	No
4.7	Packing	No
4.99	Other clothing and accessories production	No
5	Distribution	No
6	Usage	No

Analysis

The eBiz categories refer to industrial operations of textile production, while the taxonomy to be developed in Circula-Tex must refer to the operations indicated in the value chain described in section 2.

3.5 EXAMPLE OF SORTER'S PRACTICES

Sorters adopt consolidated taxonomies to categorise their outputs. These definitions are not standardised, even if quite similar from one another, and mostly tailored to the destination markets they serve. A typical example is shown below.

Analysis

The above categories are exemplary, however they can represent a typical structure for the taxonomy model to be developed in Circula-Tex. The categories of the non reusable fraction can be more detailed to include for example categories related to product / mesh type (denim, knitted, etc.).

3.6 COMMERCIAL PRACTICES FOR SRM

Fraying companies purchase textile clippings to produce recycled fibres through mechanical recovery. These commercial transactions make reference to quite consolidated categories such as the following:

Colour categories	• greige • black • beige (red flame and yellow flame) • heather grey • brown (red flame and yellow flame) • yellow • orange (light and dark) • red (light and dark) • burgundy (purple flame and red flame) • green (bottle green and rotten green) • blue (midnight blue and red flame blue) • light blue (sugar paper, turquoise)
Mono-compositions	when the main component is at least 95%
Mixed compositions	typical ranges when two-material compostion applies (e.g. Cotton-polyester, Wool-polyammide, Wool-acrylic, etc.) • 80-20 • 70-30 • 50-50

Analysis

These categories are exemplary, however they can represent a typical structure for the taxonomy model to be developed in Circula-Tex.

The classification of the colours in twelve categories is a proposal for the taxonomy model, the granularity in mapping the different colours is considered adequate by fraying companies and spinners. However, the taxonomy could include other / different colour categories.

The classification of the mixed compositions in three classes is a proposal for the taxonomy model, the granularity of the classes is coherent with the requests from the mechanical and chemical recyclers that have been interviewed. However, the taxonomy could include other ranges of mixed compositions.

3.7 TAXONOMIES IN THE PRATO DISTRICT

Situation

In the Prato district there is a consolidated industrial eco-system that transforms textile waste into new textile products through material recovery.

The Chamber of Commerce, Industry and Agriculture in Prato and Pistoia applies a consolidated official taxonomy to monitor the wholesale prices of secondary materials originating from different sources.

This taxonomy covers the following sources and related items:

Post-consumer	Materials from used clothing collection and destined to reuse
	Rags
Post-industrial	Textile by-products
	Clippings/cuttings
	Waste
	Threads.

For every item (e.g. clippings/cuttings) the taxonomy foresees several sub-categories that are described by a standard description sheet. The standard description sheets are used by the value chain operators to report to the Chamber of Commerce the quantities they traded. Based on these data, the Chamber of Commerce monitors the market and periodically publishes the volumes traded and the wholesale price ranges.

Analysis

The experience in Prato demonstrates the importance and impact of establishing a taxonomy for SRM to enable industrial scalability and support monitoring of the traded items.

3.8 FRAMEWORK FOR CIRCULAR TEXTILES

Information taken from "Framework for circular textiles"[2]

The aim of the project Framework for circular textiles has been to work with conditions for large scale use of recycled raw materials and developing frameworks regarding classification of textiles for material recycling and for assessment of materials and products' recyclability and circularity.

The project had a special focus on the establishment of a framework where textiles for recycling were classified based on parameters developed in close collaboration with technology developers and users, to set a system of classification codes. To limit the complexity of the framework, it is focused on the most common fiber types in post-consumer textile (PCT) waste: cotton, polyester and polycotton blends.

For each recycling method; chemical or mechanical recycling, and each material; cotton, polycotton and polyester, 3–5 qualities were defined. For mechanical recycling, the intended use i.e. nonwoven and yarn, was also considered and separate material classes for this was developed.

As a result of developing the classification system, a classification tool was built as an excel. The input of data describes the characteristics of the textile waste. Drop-down lists allow users of the tool to go through each category and select the data points for a specific textile item (e.g. composition, recycled content, finishing). As a result of the user providing this input data, the output is the material's classification, for example ChemPolyCot2. "Chem" refers to suitability for chemical recycling, "PolyCot" to a mixture of polyester and cotton, and "2" refers to the material class. In cases where both chemical and mechanical recycling is possible, mechanical recycling has priority in accordance with the waste hierarchy, in favour of reusing materials through mechanical recycling rather than recycling options that require more resources.

The classification is made up of 31 classes from textile waste (Table 1). They are material specific (polyester, cotton, polycotton), recycling specific (chemical and mechanical recycling) and intended use specific (for mechanical recycling classes for use in nonwovens and yarns).

Table 3. List of classification for chemical or mechanical reyccling, intended use for yarn spinning (Y) and nonwovens (N)

PRIO	Method	Description
2	ChemCotton1	100% cotton. White or non-colored. No anti-wrinkle treatment.
2	ChemCotton2	>98% cotton. Light colors. Pure materials (zippers and buttons OK but no additional non-textile items such as plastic prints, sequins, glitter etc). No anti-wrinkle treatment.
2	ChemCotton3	>98% cotton. All colors. Pure materials. No anti-wrinkle treatment.
2	ChemCotton4	>95% cotton. All colors. Pure materials. No anti-wrinkle treatment.
2	ChemCotton5	>90% cotton. All colors. Less purity is accepted. No anti-wrinkle treatment.
2	ChemPES1	100% polyester. White or non-colored. Pure materials (zippers and buttons OK but no additional non-textile items such as plastic prints, sequins, glitter etc).
2	ChemPES2	100% polyester. All colors. Pure material.
2	ChemPES3	>95% polyester. All colors. Pure material.
2	ChemPES4	>70% polyester. All colors.
2	ChemPolycot1	>70% cotton. Rest is polyester, no other heterofibers. White. Pure materials ((zippers and buttons OK but no additional non-textile items such as plastic prints, sequins, glitter etc).
2	ChemPolycot2	>70% cotton. Rest is polyester, no other heterofibers. All colors. Pure materials.
2	ChemPolycot3	>70% cotton. Rest is polyester or other fibers. White.

[2] https://www.ri.se/en/materials-and-durability/textiles/project/framework-for-circular-textiles

2	ChemPolycot4	>70% cotton. Rest is polyeste or other fibers. All colors.
1	MechCotton Y1	100% cotton. >Long fiber length or longer (>29 mm). Color sorted. Medium to very dense weft knitted fabrics.
1	MechCotton Y2	>98% cotton. Medium fiber length or longer (>24 mm). Color sorted. Medium to very dense weft knitted fabrics.
1	MechCotton Y3	>95% cotton. Medium fiber length or longer (>24 mm). Color sorted. Thin to very dense woven and weft knitted fabrics. Tolerance of PVC prints in the batch (<10%).
1	MechCotton N1	100% cotton. All fiber lengths. Sorted white and grey. Medium to very dense woven, weft knit and non-woven constructions.
1	MechCotton N2	>98% cotton. All fiber lengths. Color sorted. Medium to very dense woven, weft knit and non-woven constructions. Tolerance of PVC prints in the batch (<10%).
1	MechCotton N3	>95% cotton. Color sorted. All fiber lengths. Color sorted. Thin to very dense woven, weft knit, warp knit, braided and non-woven constructions. Tolerance of PVC prints in the batch (<10%).
1	MechPES Y1	100% polyester. Extra-long polyester staple fibers and continuous filaments. Color sorted. Medium to very dense weft knitted fabrics.
1	MechPES Y2	>98% polyester. Extra-long polyester fibers and continuous filaments. Color sorted. Medium to very dense weft knitted fabrics. Tolerance of PVC prints in the batch (<10%).
1	MechPES Y3	>95% polyester. Extra-long polyester fibers and continuous filaments. Color sorted. Thin to very dense woven and weft knitted fabrics. Tolerance of PVC prints in the batch (<10%).
1	MechPES N1	100% polyester. All fiber lengths. Sorted white and grey. Medium to very dense woven, weft knit and non-woven constructions.
1	MechPES N2	>98% polyester. All fiber lengths. Color sorted. Medium to very dense woven, weft knit and non-woven constructions. Tolerance of PVC prints in the batch (<10%).
1	MechPES N3	>95% polyester. All fiber lengths. Color sorted. Very thin to very dense woven, weft knit, warp knit, braided and non-woven constructions. Tolerance of PVC prints in the batch (<10%).
1	MechPolycot Y1	Sorted and classified according to the fiber content (ex. poly20/cot80). No elastane. > Long fiber length or longer (>29 mm). Color sorted. Medium to very dense weft knitted fabrics.
1	MechPolycot Y2	Sorted and classified according to the fiber content (ex. poly20/cot80). Max. 2% elastane. Medium fiber length or longer (>24 mm). Color sorted. Medium to very dense weft knitted fabrics.
1	MechPolycot Y3	Sorted and classified according to the fiber content (ex. poly20/cot80). Max. 5% elastane. Medium fiber length or longer (>24 mm). Color sorted. Thin to very dense woven and weft knitted fabrics. Tolerance of PVC prints in the batch (<10%).
1	MechPolycot N1	Sorted and classified according to the fiber content (ex. poly20/cot80). No elastane. All fiber lengths. Sorted white and grey. Medium to very dense woven, weft knit and non-woven constructions.
1	MechPolycot N2	Sorted and classified according to the fiber content (ex. poly20/cot80). Max. 2% elastane. All fiber lengths. Color sorted. Medium to very dense woven, weft knit and non-woven constructions. Tolerance of PVC prints in the batch (<10%).
1	MechPolycot N3	Sorted and classified according to the fiber content (ex. poly20/cot80). Max. 5% elastane. Color sorted. All fiber lengths. Color sorted. Very thin to very dense woven, weft knit, warp knit, braided and non-woven constructions. Tolerance of PVC prints in the batch (<10%).

Analysis

The objectives of this project are very synergic with Circula-Tex and the taxonomy proposed is accurate and valuable. However in Circula-Tex the objective is to elaborate a taxonomy less structured towards a specific recycling process, instead a more general classification framework that could help the value chain players to know in adequate detail the nature of the SRMs that have been sorted.

Valuable methodological elements for Circula-Tex come out of this study including the grouping of material compositions in quite coarse classes, the indication of disruptors such as the elastane and PVC prints, and the indication of the mesh type. Other qualities such as the length of the fibers will not be considered in Circula-Tex because there are no standardized methods to measure them at scale.

3.9 OTHER AVAILABLE SOURCES

PESCO-UP project

Source: Digital Product Passports: the golden thread through textile recycling? – Policy Brief

PESCO-UP, is an EU-funded project that is developing new solutions for the recycling of polyester–cotton (PES/CO) blends. These make up a large share of textile waste but are difficult to sort and recycle because they combine synthetic and natural fibres. The goal of the project is to create sustainable and economically viable upcycling processes for textile blends, supporting the textile sector's transition towards circularity.

The consortium includes various stakeholders involved in textile recycling, ranging from raw material providers to tech companies working on fibre sorting, purification, separation and recycling, as well as research institutes and universities.

A key project output is the development of a digital infrastructure, including a DMP structure and an accompanying digital marketplace for textile waste and recycled fibres.

While not enshrined in EU law, the Digital Material Passport (DMP) is also relevant for textile circularity. Compared to the DPP, the DMP focuses specifically on materials rather than entire products, and only targets value chain actors rather than including consumers. This is particularly important for textile recycling, where traceability tools must address data needs such as fabric construction, fibre composition and the presence of contaminants alongside chain of custody data.

While part of the broader DPP ecosystem, DMPs specifically target material-level data to support sorting, feedstock preparation and waste recycling. The DMP concept is not new, as it has already been applied in sectors such as steel and the built environment, though often labelled as DPP for simplification purposes. When transitioning to a circular economy, integration between DMPs and DPPs will become increasingly important to ensure smooth data flows along the entire product lifecycle.

Project partners VTT, Reverse Resources and TEXroad are leading the design of these digital tools. The PESCO-UP DMP is gathering detailed material information relevant to the different stakeholders and processes involved in textile recycling. For example, sorters of post-consumer textiles need to know about recyclers' feedstock needs to adjust their sorting lines accordingly. Textile recyclers require information on composition and the chemicals used during manufacturing, as some types of dyes and contaminants such as flame retardants can hamper pretreatment processes. Yarn spinners need to know fibres' length and strength when purchasing recycled materials. Each piece of information constitutes a potential data point in the DMP. The more data is collected and shared, the more streamlined textile recycling can be.

All this information is shared in a digital commodity marketplace that establishes a direct trading connection between recyclers and sorters or pretreatment actors. Within the marketplace, recyclers can communicate their feedstock specifications to sorters, while sorters can make their demand visible to recyclers. This facilitates bilateral trade where both parties can post offers, request materials or negotiate terms. In this way, data sharing tools are used to address the issue of unmatching supply and demand for textile waste feedstock.

In the deliverable report D2.1 "Requirements for imaging and data technologies" a set of Minimum Data Requirements is presented as follows.

The data models co-developed by PESCO-UP partners within and outside of the project are designed to support every step of the recycling value chain and generate crucial information for high priority use cases in the circular textile sector. Data needed for the PESCO-UP use cases is divided into four groups (1) Entity and facility data, (2) Batch data, (3) Input and output specification data, (4) Interpreted sensor data.

An overview of minimum data requirements and uses for each data group are included in the table below. These will be updated during the PESCO-UP project to take into account stakeholder feedback and industry and policy developments.

Data group	Data Requirements	Uses
Entity and facility data	• Entity + facility names • Geographic locations • Business registry + number • Activities carried out by location	• Confirm lawful registration of the entity • Define the entity or facility's place in the value chain and geographic location of activities • Assign data ownership • Basis for chain of custody
Batch data	• Unique batch ID number • Batch weight • Batch production date • Activities carried out in processing • Packaging for shipment • Chain of custody validation	• Enable traceability of materials flows through value chain • Quantify materials being processed or shipped • Document activities that were carried out on the batch (high level) • Define how batches are packaged for shipment • Provide link for approved parties to access Chain of Custody validation documents
Input and output specification	• Grade name • Accuracy of specification • Format of the materials • Colour • Fibre composition • Contaminants • Physical properties	• Define acceptance criteria for materials buyers • Define precise characteristics of materials offered for sale • Incorporate sensor data when available • Call attention to showstopper contaminants or hazardous substances that may special attention
Interpreted sensor data	• Sensor manufacturer and type • Accuracy of the sensor • Colour • Fibre composition • Contaminants • Physical properties	• Identify which manufacturer and model of equipment was used to generate sensor data • Define precise characteristics of materials as detected by sensors • Populate output specification data for some use cases • Data available from sensors varies

Table 1. Description of data groups, requirements and uses

Example of batch and output specification data

Recycling feedstocks made from post-consumer textiles. The table below includes data groups, PESCO-UP ID numbers, Data field names and an example of one of the possible values that would appear in the data field. The PESCO-UP ID number is provided to facilitate feedback and updates to the proposed minimum data requirements and make it easier to map to other data models to increase interoperability between digital and data sharing tools.

Data Group	PESCO-UP ID	PESCO-UP Data Field Name	Data Value
Batch Data	900,00	**Batch Number**	*PESCO123*
Batch Data	900,10	**Batch Weight**	*1500*
Batch Data	900,20	**Batch Weight Unit**	*kg*
Batch Data	900,40	**Batch Production Date**	*28/08/2024*
Batch Data	900,50	**Batch Expiration Date**	*28/08/2026*
Batch Data	901,00	**Activity 1**	*Automated fiber detection, [tech name]*
Batch Data	902,00	**Activity 2**	*Mechanical pretreatment: Dry processing*
Batch Data	942,00	**Packaging**	*Bales, 100 kg*
Batch Data	970,00	**End Point 1**	*Next step, Fine sort*
Batch Data	980,00	**Shipment Validation 1 Type**	*Invoice*
Batch Data	981,00	**Shipment Validation 1 Doc**	*Link to documentation*
Output Spec	710,00	**Grade Name**	*PESCO 50/50 Mixed Color*
Output Spec	720,00	**Accuracy**	*95%*
Output Spec	721,00	**Accuracy Method**	*Fiber composition from representative sample size of sorted textile batches was lab tested using a dissolution method*
Output Spec	730,00	**Format**	*Recycling feedstock, post-consumer*
Output Spec	731,00	**Color Generic**	*Multicolored*
Output Spec	732,00	**Content 1 Name**	*Cotton*
Output Spec	732,10	**Content 1 Value**	50%
Output Spec	733,00	**Content 2 Name**	*Polyester*
Output Spec	733,10	**Content 2 Value**	*50%*
Output Spec	751,00	**Contaminant 1 Name**	*Elastane*
Output Spec	751,10	**Contaminant 1 Amount**	*5*
Output Spec	751,20	**Contaminant 1 Amount Unit**	*% of total weight*
Output Spec	751,40	**Contaminant 1 Hazardous Substance**	*No*
Output Spec	751,50	**Hazardous Substance 1 Details**	File attachment or link
Output Spec	780,00	**Physical Property 1 Name**	*Piece size*
Output Spec	780,10	**Physical Property 1 Measure**	*5*
Output Spec	780,20	**Physical Property 1 Unit**	*mm*
Output Spec	780,30	**Physical Property Verification Method**	*Microscopic evalution*
Output Spec	770,00	**Contaminant Showstopper Check**	*Yes*

Table 3. Example data for recycling feedstocks

Analysis

The developments undertaken in PESCO-UP, particularly those related to the DMP, present several potential synergies with Circula-Tex's developments. For this reason, structured contacts have been established to evaluate potential collaborations.

4. PROPOSAL FOR THE TAXONOMIES

A set of taxonomy concepts is presented to support specific operations of the value chain in scope.

For every concept taxonomy the description includes the SRM in scope, its granularity, the type of information with description examples and a preliminary assessment of the feasibility in consideration of the current practices and enabling technologies. The detailed description is presented in Annex 2.

4.1 MATERIALS RECOVERY – TAXONOMY CONCEPT #1

Reference operation in the value chain

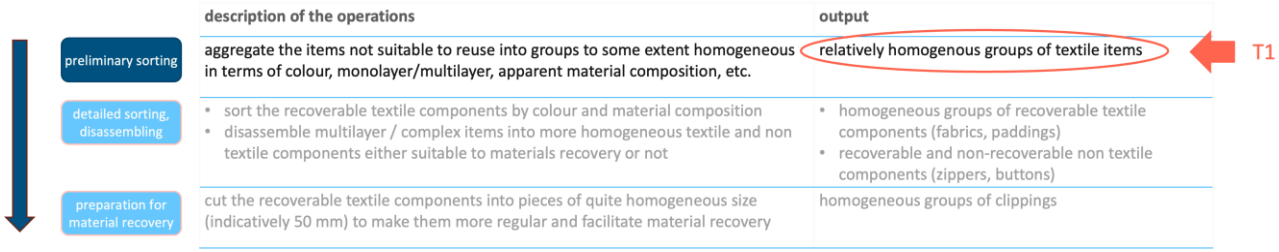


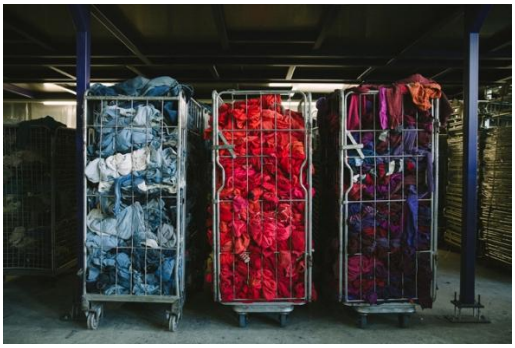
Fig.3 – Taxonomy 1 / preliminary sorting

Description of the SRM in scope

Sorted non-reusable textile items aggregated in relatively homogenous groups based on colour, monolayer / multilayer structure, apparent material composition, etc.

Granularity

Group of textile items.



Concept structure and feasibility of the taxonomy T1

Feasibility is intended as the absence of significant barriers for implementation

information	description examples	feasibility
origin	post-consumer, pre-consumer, post-industrial	OK, part of EPR obligations
lot IDs	point(s) and date(s) of collection of the input waste	OK, part of EPR obligations
item type	• multi-layer • mixed rags • knitted • jeans • polyester • white rags • other	OK, common practice in the market
sorting site	where preliminary sorting for material recovery was made	OK, part of EPR obligations

4.2 MATERIALS RECOVERY – TAXONOMY CONCEPT #2

Reference operation in the value chain

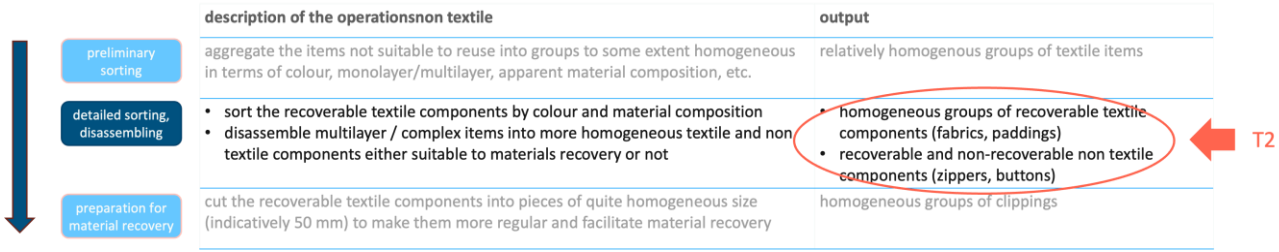


Fig.4 – Taxonomy 2 / detailed sorting, disassembly

Disassembly and detailed sorting of multi-material or multi-layered items into homogeneous textile and non textile components is a key operation for implementing an effective recovery of the constituent materials.

The components resulting from disassembly are grouped by type and material composition to be channelled towards specific materials recovery paths or energy recovery.

Towards tracking the flows of materials, disassembly operations have the distinctive feature of generating multiple outputs from a single input item. Therefore, the taxonomy has to take account of this fragmentation: some properties of the input can be passed to all the multiple outputs, while others have to be defined for every type of output (e.g. the description of the material).

Description of the SRM in scope

Textile and non-textile components originated by the disassembly of multi-material or multi-layered items.

Examples of textile components include fabrics, linings, paddings, labels, etc..

Examples of non-textile components include trims such as zippers, buttons, buckles, etc.

Granularity

Group of homogeneous components.

Concept structure and feasibility of the taxonomy T2

information	description examples	feasibility
origin	post-consumer, pre-consumer, post-industrial	OK, part of EPR obligations
lot IDs	point(s) and date(s) of collection of the input waste	OK, part of EPR obligations
component type	• fabric • lining • padding • button • zipper • buckle • other	categories easy to define and manage
material type	• textile • metals • plastic • other	categories easy to define and manage
disassembly site	site where disassembly was made	OK, part of EPR obligations

4.3 MATERIALS RECOVERY – TAXONOMY CONCEPT #3

Reference operation in the value chain

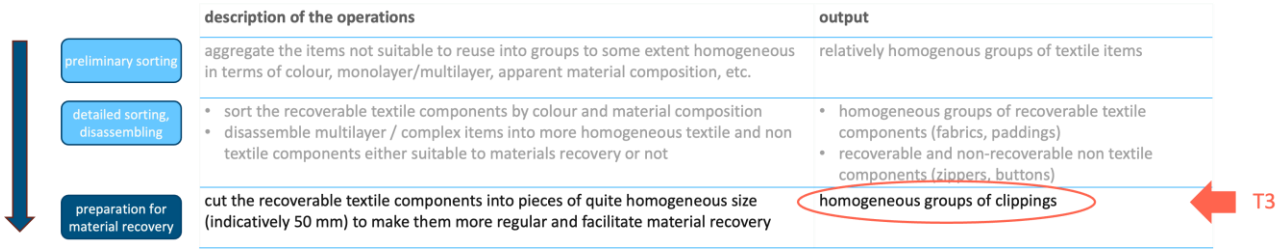


Fig.5 – Taxonomy 3 / preparation for material recovery

Description of the SRM in scope

Clippings of textile fabrics (knitted, woven, nonwoven) aggregated in groups of relatively homogeneous colour, material composition and size.

Granularity

Group of homogeneous clippings.

Concept structure and feasibility of the taxonomy T3

information	description examples	feasibility
origin	post-consumer, pre-consumer, post-industrial	OK, part of EPR obligations
lot IDs	point(s) and date(s) of collection of the input waste	OK, part of EPR obligations
colour	• **single-colour** among black, beige (red flame and yellow flame), heather grey, brown (red flame and yellow flame), yellow, orange (light and dark), red (light and dark) burgundy (purple flame and red flame), green (bottle green and rotten green), blue (midnight blue and red flame blue), light blue (sugar paper, turquoise) • **multi-colour** (fantasy, printed, logged, etc.)	common in the market and measurable automatically
composition	• **single-material** (> 95%) among CO, PES, WO, PA, VI, PC, MA, SE, etc. • **two-materials**: material types and rates: M1%-M2% where M1, M2 among CO, PES, WO, PA, PC, MA, etc. and % among 80-20, 70-30, 50-50	common in the market and measurable automatically
mesh type	woven, knitted, non-woven	common in the market and measurable automatically
other	• presence / quantity of elastane (EL) • upper limits for other materials may be required by chemical recyclers • sanitisation YES / NO	measurable automatically down to 2% share in the blend information available
sorting site (s)	site(s) where sorting for materials recovery was made, maybe more than one	OK, part of EPR obligations

4.4 MATERIALS RECOVERY – TAXONOMY CONCEPT #4

Material in scope

Outputs of material recovery operations that can be obtained through various process technologies including mechanical, chemical, thermo-mechanical.

Granularity

Batch of homogeneous outputs and of residues of material recovery.

Objective of the T4 taxonomy

To classify the output material into categories that are recognised by textile industries including spinners and producers of non-woven to support industrial scalability and facilitate trading.

process	outputs		descriptors
Mechanical	• slivers of coloured fibers • residues / leftovers (short fibers, powder)		**main output:** colour, material composition, origin, lot IDs, sorting site, recovery site. Other technical features (fiber length and strength) are not measurable at scale nor standardised **residues/leftovers:** recovery site
Chemical	• chemical commodities (either monomers or polymers) • granulates, chips of polymers • residues (elastane, fibers when input is multi-material, sludges, etc.)		**main output:** monomer/ polymer type, origin, lot IDs, sorting site, recovery site. **residues:** type, recovery site.
Thermo-mechanical	• granulates, chips of polymers • residues		**main output:** polymer type, colour, origin, lot IDs, sorting site, recovery site. **residues:** tbd

Feasibility

The descriptors indicated for the mechanical recovery process are derived from information made available by the upstream operations (e.g. material composition, sorting site). The colour of the output slivers can be described by the same categories as in Taxonomy T3.

The descriptors indicated for the chemical recovery process are derived from those made available by the upstream operations or can make reference to consolidated commercial taxonomies to describe polymer or monomer type and detailed compositions.

4.5 REUSE – TAXONOMY CONCEPT #5

Material in scope

Sorted reusable textiles.

Granularity

Group of commercially homogeneous reusable textile items.

Objective of the T5 taxonomy

To classify the textile items into categories that are recognised by market operators including traders and second-hand resellers.

Given that the second-hand market is well developed, especially in terms of export, the objective in Circula-Tex is to propose a general classification model that can facilitate the scalability of the second-hand market in Europe and the monitoring of material flows for the purposes of managing the EPR scheme.

Taxonomy concept T5

The exemplary taxonomy shown in section 3.5 represents a good proxy for the taxonomy T5. Categories and definitions can be adjusted or integrated to cover a wider range of commercial practices. These categories do not correspond to the denominations of the products that will be sold in the second hand shops or online because these denominations are defined by the retailers.

FOR REUSE

MAIN CATEGORIES	
Cream	Shoes
Prime	Winter
Grade A	Bags
Grade B	Tropical Mix
Grade C	Plaids
	Linen

SUB-CATEGORIES

Prime
- Extra
- Man Summer
- Woman Summer
- Baby Summer
- Man Winter
- Woman Winter
- Baby Winter
- Upholstery
- Underwear

Grade A

Anorak	Man Cotton Jacket
Baby Light Summer	Man Jeans Pant 100 pcs
Baby Summer 0-6	Man Polo
Baby Summer 6-12	Man Shirt
Blanket	Man Shorts
Bathrobe	Man Suit
Blouse	Mix Dress
Collant	Mix Skirt
Cotton Caps	Night
Cotton Man Pant 100 pcs	Short 3/4
Ties	Socks
Foulard	Soft Toys
Handkerchief	Swim
Heavy Curtains	Sport
Jeans Jacket	Velvet Pants
Jeans Skirt	Underwear Mix
Lace Curtains	Wedding
Ladies Polo	Wool Caps
Ladies Slim Pants	Work

Grade B
- Shorty Man
- Baby
- Blouse Woman
- Dress Grade B
- Ladies Polo
- Man Pants Cotton
- Man Jeans Pant
- Man Polo
- Man Shirt
- Mix Training

Grade C
- Jackets
- Underwear
- Upholstery
- Suits
- Baby Mix

Shoes
- Cream Summer
- Cream Winter
- Extra
- Woman Summer
- Winter
- Africa
- Bags

Winter
- Coats Man
- Coats Woman
- Furs
- Sheepskin Jackets
- Leather
- Jackets Velvet
- Jackets Wool
- Pants Wool
- Pants Velvet

4.6 REMANUFACTURING – TAXONOMY CONCEPT #6

Material in scope

Sorted reusable textiles that need repair or remanufacturing to become sellable.

Granularity

Group of homogeneous (e.g. based on need for repair) textile items needing repair or remanufacturing.

Objective of the T6 taxonomy

To classify the textile items into categories of interest for repairers and remanufacturers.

Given that the items in scope were recognised to need some repair, it is important that the taxonomy qualifies that need for repair in categories that could facilitate channelling towards the most appropriate operator.

In the future, sorting could be supported by AI-based solutions in the evaluation of the economic viability of repair or remanufacturing, offering insights into the most cost-effective and sustainable methods based on resource efficiency and resale value.

Taxonomy concept T6

information	description examples	feasibility
origin	post-consumer, pre-consumer, post-industrial	OK, part of EPR obligations
lot IDs	point(s) and date(s) of collection of the input waste	OK, part of EPR obligations
type of failure	• fabric breakdown • tear • seam failure • stain • missing/damaged components (e.g. buttons) • other	not difficult to detect
sorting site	site where sorting was made	OK, part of EPR obligations

4.7 IMPLEMENTATION AND LABELLING

The proposed taxonomies T1, T2, T3 and T4 represent a solution to categorise the SRMs that result from the operations of sorting, disassembly, preparation for materials recovery and materials recovery respectively.

T3 and T4 refer to the areas where currently there is more lack of definition and potential to scale up.

Taxonomies T5 and T6 are proposed to support sorting for reuse and remanufacturing.

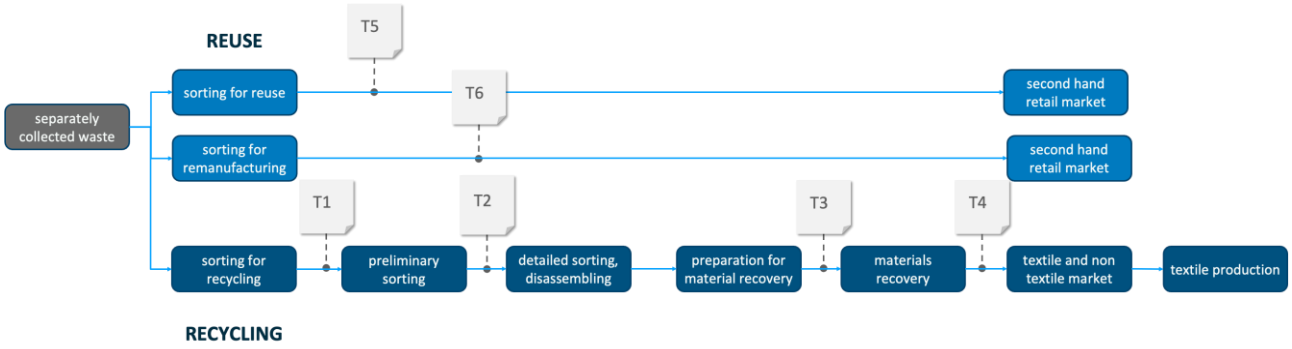


Fig.6 – proposed taxonomies in the reference value chain

Taxonomy #	Granularity	Label application
1	Groups of non reusable SRM	bags or any suitable container
2	Groups of homogeneous components	different bags for different components
3	Batches of homogeneous clippings	bags or any suitable container
4	Batches of homogeneous outputs or residues	bags or any suitable container
5	Groups of reusable items	bags or any suitable container
6	Groups of reusable items to be repaired	bags or any suitable container

The taxonomies T1, 5 and 6 qualify the three main streams of materials produced by sorting operations. Their granularity refer not to single items, but to groups of items to be directed towards material recovery, reuse and remanufacturing respectively. Therefore, the labels carrying the information of the three taxonomies are applied to bags or any other container used to transport that group of outputs. The physical carrier can be a QR code.

The taxonomy T2 qualifies the different groups of components that originate from disassembling single items. Each group of components has to be qualified by a specific label that can be applied to the type of container is used for their transport.

The taxonomy T3 qualifies the textile clippings originated by the preparation of the textile components obtained from disassembly. The label carrying the information foreseen in the taxonomy can be applied to the container used for their transport.

The taxonomy T4 qualifies the main outputs and residues of material recovery, whose physical aspect varies from one process to another. Both the main outputs and the residues need a label that carries the information defined in the taxonomy that can be applied to any type of container is used for their transport.

5. LABELLING ADAPTATION AND FUTURE STRATEGY

The textile waste management hierarchy, commonly referred as the 5Rs (Reduce, Reuse, Repair, Repurpose, Recycle), represents the conceptual framework underpinning the Circula-TEX approach to circularity.

The analysis of the value chain needed to operationalise this hierarchy, including the identification of the key phases and actors involved, is addressed in depth in Task 3.3.

In this broader framework, the present deliverable focuses on **reuse** and **recycling** as the two pathways with the highest relevance for the development of the labelling system. This choice is justified by practical and strategic reasons.

From a volume perspective, reuse and recycling together account for the main share of separately collected textile waste that undergoes further processing. Around 60% of sorted post-consumer textiles qualifies for resale and reuse, while approximately 15% undergoes mechanical recycling and a further 15% is directed to downcycling processes. (source: Circle Economy Knowledge Hub / TEXAID). EUROTEX, operates a two-stage grading and sorting process generating nearly 300 distinct second-hand article categories (source: eurotexglobal.com).

These figures confirm that reuse and recycling together represent by far the most important material flows in terms of volumes and economic value generated from separately collected post-consumer textiles.

The labelling system to be developed in Circula-TEX must therefore serve two distinct but complementary functions:

- supporting the identification and classification of the items **suitable for reuse**
- enabling the traceability and quality characterisation of **materials directed to recycling**.

These two pathways call for different information architectures and different labelling strategies, as detailed in the following sub-sections.

Looking ahead, the most significant regulatory driver in labelling requirements will be the **DPP** that is foreseen in the ESPR regulation. The DPP will radically change the information landscape for textiles by introducing structured digital records linked to each product from the point of manufacture.

However, it is important to underline that the DPP of a product resold after being sorted will have substantially different characteristics from that of a new garment put on the market.

In fact, the DPP of the ‘resold after sorting’ item will need to capture the history of use, sorting and conditioning operations in addition to the original product data. As of the time of writing of this deliverable, the delegated act specifying the detailed requirements for the textile DPP has not yet been published. The Circula-TEX project will monitor the evolution of this regulatory framework and will update its labelling specifications accordingly.

5.1 REUSE

Sorting for reuse represents the highest-value pathway in the post-consumer textile waste hierarchy. Through the manual or semi-automated assessment of garment conditions, quality, and marketability, it generates significant economic and environmental value by extending the useful life of textile products without transformation. The reuse pathway avoids the energy-intensive processes associated with recycling and preserves the full material complexity of the garment, which would otherwise be lost through shredding or chemical processing.

From a labelling perspective, the key challenge in the reuse pathway lies in **re-establishing traceability continuity** from the moment when a product is re-classified as suitable for reuse and re-enters the market as

second-hand good. The original product label, if physically present and readable, carries information relevant to the item's composition and origin but does not capture the history of use, condition at the point of sorting, or the sorting operator's classification. A labelling strategy for reuse must therefore address the **redundancy and update** of the existing label (if still present): either by supplementing it with new information or by replacing it with a new digital record that incorporates both the upstream product data and the downstream sorting classification.

This re-labelling approach is particularly relevant in the context of the emerging DPP framework, where the traceability record of a second-hand item will need to branch from the original product record to reflect the new life cycle stage. The development of protocols for this re-labelling operation is one of the key contributions expected from the labelling system designed in WP4.

5.2 RECYCLING

Sorting for recycling addresses a broader and more heterogeneous range of textile products than sorting for reuse. It encompasses not only post-consumer clothing but also household textiles, footwear components, and technical textiles; material streams with significantly different compositions, structures, and processing requirements. This heterogeneity makes the development of a shared, standardised labelling framework both more complex.

The labelling requirements for recycling differ substantially depending on the specific recycling pathway.

- Mechanical recycling requires information on colour and composition (especially the presence and quantity of disruptors such as elastane) to ensure the quality of the recovered fibre.
- Chemical recycling requires higher compositional purity and more precise molecular-level characterisation.
- Thermo-mechanical recycling focuses primarily on polymer type and colour.

In all cases, the labelling system must convey information that is actionable by the receiving recycler and compatible with the technology employed.

A critical challenge specific to the recycling pathway is the frequent **absence of the physical label** on the waste item at the point of sorting, a condition that affects over 50% of collected textiles. In these cases, the link between the physical item and its digital record is broken, making it impossible to retrieve upstream product information without additional identification steps.

The Circula-TEX labelling system will investigate the feasibility and conditions of such embedded identification solutions in the recycling context.

Different garment types follow inherently different recycling paths. Mono-material knitted garments, woven fabrics, multilayer outerwear, and accessories each present distinct challenges in terms of disassembly, fibre recovery, and contamination risk.

The taxonomy concepts developed in Section 4 of this deliverable provide the classification foundation to differentiate these pathways and to define the corresponding labelling information requirements.

6. CONCLUSIONS AND NEXT STEPS

This deliverable presents the outcomes of the Tasks 2.2 and 4.1 of Circula-TEX, covering the first phase of the activities implemented in WP4.

The work carried out has produced two main sets of results.

First, a structured review and critical analysis of existing taxonomies (including CER codes, Re_Fashion, PRODCOM, eBIZ, and commercial practices from sorters and the Prato district) made it possible to identify the gaps in current classification systems with respect to the needs of the EPR value chain, and to identify good market practices to build upon instead of proposing totally new frameworks.

Second, based on this analysis and the inputs gathered through the consortium workshop held in December 2025, a set of six taxonomy concepts has been elaborated to cover the main classification needs across the post-consumer textile value chain:

- sorted non-reusable items ready for material recovery (T1)
- sub-components of textile items after disassembly (T2)
- textile clippings characterised by colour and composition (T3)
- outputs of material recovery processes - mechanical, chemical and thermo-mechanical (T4)
- sorted reusable items for the second-hand market (T5)
- sorted reusable items needing repair to be resold (T6).

In parallel, the analysis of the reuse and recycling pathways carried out in Section 5 has identified the key information requirements and challenges that the labelling system will need to address, including the re-labelling logic for reuse, the management of unlabelled textiles in the recycling pathway, and the anticipated evolution introduced by the Digital Product Passport.

These results are not standalone but represent the foundation upon which the subsequent deliverables of WP4 will be built.

Specifically, the taxonomy concepts and the labelling information requirements defined in this report will feed directly into Task 4.2 (System architecture definition and knowledge database development, led by NTT and TEM, D4.2 due at month 27), which will translate them into the technical specifications and information architecture of the Circula-TEX labelling system. They will further inform Task 4.3 (Label logic layer and interface, led by TEM, D4.3 due at month 32), where the classification logic and traceability protocols developed here will be implemented in the digital platform. The physical label selection process (Task 4.4, D4.4 due at month 32) will also draw on the operational constraints and technology requirements identified in this report, particularly regarding label durability across the collection, sorting, reuse and recycling phases.

The taxonomies proposed in this deliverable are conceived as living frameworks: they reflect the current state of market practices and stakeholder needs, but are expected to evolve as fibre-to-fibre recycling technologies mature, regulatory frameworks enter into force (including the ESPR delegated acts for the textile DPP), and feedback from the validation activities in WP5 is incorporated.

7. ANNEX 1 - WORKSHOP

On December 16th 2025 a workshop was organised within the context of the Circula-Tex General Assembly to collect the vision of the partners towards the definition of a taxonomy and related labelling system.

The workshop was held in Florence and was coordinated by RETEX.Green and Temera.

An interactive, participatory workshop was organised using a World Café / table-based brainstorming approach. All participants were divided into four working tables. Each table discussed guided questions related to the core themes of the project. The objective was to stimulate collective reflection, compare perspectives, and identify shared definitions and practical approaches. Moderators facilitated the discussion and collected inputs from each table. In the following the results of the analysis in the different groups are presented.

7.1 TOPIC 1: DEFINITION OF "WASTE" FOR THE PROJECT

The discussions highlighted that waste is not an intrinsic property of a textile product, but rather a status linked to value, function, ownership, and professional classification.

Key Elements identified across the tables:

- Loss of value or usability for the owner (Tables 1 and 3)
- Inability to fulfil original or alternative functions (Table 3)
- Decision by the owner or customer to dispose of the item (Table 4)
- Formal classification as waste by a professional organisation during first sorting (Table 4)
- Change of value or function through physical movement or transfer (Table 2)

Shared Working Definition:

For the purposes of the project, textile waste can be defined as a textile product or material that has lost its perceived value or functional purpose for its owner and is formally designated as waste through disposal.

7.2 TOPIC 2: REVISED SYNTHESIS OF WORKSHOP RESULTS – SORTING FOR REUSE

The discussion on sorting for reuse followed a shared pattern of questions across the tables. Not all tables provided answers to all questions, however the outputs allow highlighting common challenges, partial solutions, and emerging needs.

Pain Points

Across all tables, sorting for reuse was identified as a labour-intensive and skill-dependent process. Common challenges include:

- Heavy reliance on manual operations (Tables 1, 2, 3, 4)
- Lack of experience and specialised skills among sorters (Tables 1, 2, 3)
- Strong prevalence of B2B-oriented classification systems, with limited adaptation to B2C reuse pathways (Tables 1, 2)
- Absence of shared standards for reuse assessment (Tables 1, 2)
- Subjectivity in decision-making: reuse eligibility often depends on the sorter's judgement, market demand, or emotional consumer perception (Table 4)
- Variability linked to quantities handled and sensitivity to product condition (Table 3)

- Overall, reuse decisions are currently influenced by human interpretation rather than harmonised criteria.

Taxonomy / Definitions / Hierarchy

Taxonomy emerged as a critical but fragmented area. Key observations:

- Existing taxonomies are mostly company-specific and B2B-oriented (Tables 1, 2)
- Some organisations apply structured taxonomies based on gender, thickness, quality, and brand, with possible overlaps (Table 4)
- Additional classification criteria include contamination level, product state, and gender (Table 3)
- Taxonomies are not static: sorting criteria are regularly updated based on operational needs and market demand (Table 4)

Synthesis: There is no common hierarchy for sorting for reuse. Instead, multiple parallel taxonomies coexist, limiting comparability and scalability across organisations.

Tracked Data

Data tracking practices vary significantly among operators. Types of data mentioned:

- Material flows and streams by category, buyer, first-tier operator, and export country (Tables 1, 2)
- Product-level data such as composition, brand, place of production, intended application, and product type (Table 3)
- Comprehensive system-based tracking, including sorter performance and decision-making (Table 4)

Synthesis: While advanced tracking systems exist in some organisations, data collection is not harmonised, and reuse-relevant data are not consistently captured across the sector.

Tools Used

Sorting for reuse relies on a mix of low-tech and high-tech solutions. Identified tools include:

- Bar codes for identification and tracking (Tables 1, 2)
- Manual and visual inspection as a primary assessment method (Table 3)
- Combination of hands-on sorting with automated sorting technologies and supporting documentation (Table 4)

Synthesis: Manual sorting remains central, with automation acting as a support rather than a replacement. Documentation and digital tools can improve consistency but are not universally applied.

Standardisation: Required or Welcome?

Although not explicitly answered by all tables, standardisation was generally perceived as necessary and beneficial. Referenced or implied needs include:

- Common reuse criteria to reduce subjectivity
- Integration of Life Cycle Assessment (LCA) approaches (Table 3)
- Adoption of Digital Product Passports (DPP) for traceability (Tables 1, 3)
- Harmonised monitoring systems, particularly for export flows and B2C markets (Tables 1, 2)
- Supporting processes such as sanitisation to enable safe reuse (Table 3)

Overall Conclusion

Participants agreed that sorting for reuse would strongly benefit from clearer standards, shared taxonomies, and interoperable data systems, while still recognising the need for flexibility to address market-specific and organisational constraints.

7.3 TOPIC 3: REVISED SYNTHESIS OF WORKSHOP RESULTS – SORTING FOR RECYCLING

The discussion on sorting for recycling followed the same structured pattern applied for reuse. Although inputs differed significantly across tables, the collected contributions allow for a consolidated overview of technological, regulatory, and organisational challenges specific to recycling pathways.

Pain Points

Sorting for recycling was primarily described as a technology-driven but highly constrained process, strongly influenced by material composition and regulatory status. Key challenges identified include:

- Complex material composition of garments, especially blends, limiting recyclability (Tables 2, 3, 4)
- Contamination (involuntary, domestic, or voluntary), affecting material quality and processing options (Table 2)
- Dependence on sorting technologies and their limits in identifying mixed materials (Tables 3, 4)
- Continued presence of manual operations, despite increasing automation (Table 2)
- Uncertainty linked to economic value of recycled outputs (Table 2)
- Regulatory constraints and changes, particularly related to REACH and waste status transitions (CER → End-of-Waste) (Tables 2, 3, 4)

Synthesis: sorting for recycling is constrained by both technical feasibility and regulatory compliance, with limited flexibility once textiles are classified as waste.

Taxonomy / Definitions / Hierarchy

With respect to reuse, taxonomies for recycling are more tied to material characteristics and processing requirements. Key observations:

- Classification is primarily based on composition, colour, and material structure (Tables 2, 3, 4)
- Taxonomies are implicitly linked to the recycling technology used (Table 2)
- Internal use and regulatory classification (e.g. CER codes and End-of-Waste criteria) strongly influence sorting decisions (Tables 3, 4)

Synthesis: While recycling taxonomies are more technical than those for reuse, they remain fragmented and technology-dependent, limiting cross-operator alignment.

Tracked Data

Data tracking for recycling focuses on traceability and compatibility with industrial processes. Types of data mentioned:

- Material composition and colour, depending on recycling technology requirements (Table 2)
- Production batch labels to ensure process consistency and traceability (Tables 3, 4)

Synthesis: Tracked data are narrowly focused on recycling feasibility. Broader harmonisation of data standards across operators is currently lacking.

Tools Used

Compared to reuse, sorting for recycling relies more heavily on advanced technologies. Identified tools include:

- Digital Product Passports (DPP) to access material-related information (Table 2)
- Near-Infrared (NIR) sensors, cameras, robotics, and automated detection systems (Tables 3, 4)
- Hybrid systems combining automation with residual manual intervention (Table 2).

Synthesis: automation is key for sorting for recycling, its effectiveness depends on data quality, material homogeneity, and investment capacity.

Standardisation: Required or Welcome?

Standardisation was explicitly identified as a critical need for recycling pathways. Key needs highlighted:

- Standardisation of sorting criteria after initial sorting stages (Tables 3, 4)
- Alignment between shredding and subsequent processing phases (Tables 3, 4)
- Clearer regulatory frameworks supporting End-of-Waste transitions
- Interoperable data standards to support automated sorting

Overall Conclusions

Participants agreed that effective sorting for recycling requires stronger standardisation, clearer regulatory alignment, and interoperable data systems to fully leverage existing and emerging technologies.

8. ANNEX 2 – TAXONOMIES AND LABELLING MODELS

8.1 TAXONOMY PROPOSAL T1

SRM in scope: non-reusable textile items aggregated in relatively homogenous groups based on colour, monolayer / multilayer structure, apparent material composition, etc.

Granularity of the SRM in scope: groups of textile items.

First level sorting – model label for the output

The information in the label T1 qualifies the preliminary categorisation that is introduced to sort and channel the non-reusable items towards material recovery. Moreover, the label T1 recovers the information on the input waste from the labels / descriptors provided by the collector or transporter.

information	description		instructions
1.1 item type	multi-layer		*mark if applicable*
	mixed rags		*mark if applicable*
	knitted		*mark if applicable*
	jeans		*mark if applicable*
	polyester		*mark if applicable*
	white rags		*mark if applicable*
	other		*mark if applicable*
1.2 sorting identification	sorter name		*indicate name*
	date(s) of sorting operation		*indicate date*
1.3 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
1.4 waste identification	collector name		*indicate name*
	collector's identifier of the batch		*indicate date*

8.2 TAXONOMY PROPOSAL T2

SRM in scope: Textile and non-textile components originated by the disassembly of multi-material or multi-layered items. Examples of textile components include fabrics, linings, paddings, labels, etc. Examples of non-textile components include trims such as zippers, buttons, buckles, etc.

Granularity of the SRM in scope: groups of homogeneous components.

Preliminary sorting - model label

The information in the label T2 qualifies the preliminary categorisation that is applied to the components that result from disassembly and detailed sorting to channel the non-reusable items towards the most appropriate material recovery. Moreover, the label T2 recovers the information on the input waste and on the upstream operations from the label T1.

information	description		instructions
2.1 component type	fabric		*mark if applicable*
	lining		*mark if applicable*
	padding		*mark if applicable*
	button		*mark if applicable*
	zipper		*mark if applicable*
	buckle		*mark if applicable*
	other		*mark if applicable*
2.2 material type	textile		*mark if applicable*
	metal		*mark if applicable*
	plastic		*mark if applicable*
	other		*mark if applicable*
2.3 disassembling identific.	disassembler name		*indicate name*
	date(s) of disassembly operation		*indicate date*
2.4 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
2.5 waste identification	collector name		*indicate name*
	collector's identifier of the lot		*indicate date*
2.6 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*

8.3 TAXONOMY PROPOSAL T3

SRM in scope: clippings of textile fabrics (knitted, woven, nonwoven) aggregated in groups of relatively homogeneous colour, material composition and size.

Granularity of the SRM in scope: batches of homogeneous clippings.

Preparation for material recovery - model label

The information in the label T3 qualifies the categorisation applied to the clippings that result from cutting the textile components obtained from disassembly and detailed sorting to channel them towards the most appropriate material recovery process. Moreover, the label T3 recovers the information on the input waste and on the upstream operations from the label T2.

information	description		instructions
3.1 single-material	(>95%)		*indicate fibre type*
3.2 two-materials 80-20	80% fibre type		*indicate fibre type*
	20% fibre type		*indicate fibre type*
3.3 two-materials 70-30	70% fibre type		*indicate fibre type*
	30% fibre type		*indicate fibre type*
3.4 two-materials 50-50	50% fibre type		*indicate fibre type*
	50% fibre type		*indicate fibre type*
3.5 3+ materials			*mark if applicable*
3.6 mesh type	woven		*mark if applicable*
	knitted		*mark if applicable*
	non-woven		*mark if applicable*
3.7 colour / single	black		*mark if applicable*
	beige (red flame and yellow flame)		*mark if applicable*
	heather grey		*mark if applicable*
	brown (red flame and yellow flame)		*mark if applicable*
	yellow		*mark if applicable*
	orange (light and dark)		*mark if applicable*
	red (light and dark)		*mark if applicable*
	burgundy (purple flame and red flame)		*mark if applicable*
	green (bottle green and rotten green)		*mark if applicable*
	blue (midnight blue and red flame blue)		*mark if applicable*
	light blue (sugar paper, turquoise)		*mark if applicable*
3.8 colour / multiple	fantasy, printed, logged, etc.		*mark if applicable*
3.9 elastane			*indicate percentage share*
3.10 other disrupting fibres	material type		*indicate fibre type*
			indicate percentage share
3.11 sanitisation			*YES / NO*
3.12 preparing identif.	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*
3.13 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*

3.14 waste identification	collector name		*indicate name*
	collector's identifier of the lot		*indicate date*
3.15 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*

8.4 TAXONOMY PROPOSAL T4

SRM in scope: outputs of material recovery operations carried out using various process technologies including mechanical, chemical, thermo-mechanical.

Granularity of the SRM in scope: batches of homogeneous outputs and of residues of material recovery.

In the following the taxonomy and model labels are presented for the different recovery processes.

Mechanical recovery – model label for the main output

In mechanical recovery the input is not modified by the process, changes are related only to the physical form (from fabric to fibres) and the possible blending of different input batches in the same process. Therefore, the structure of label T4 for the main output of the process corresponds to that of T3 with few exceptions, including origin of the input, waste identification and the presence of elastane. Moreover, the label T4 recovers the information on the input waste and on the upstream operations from the label T3.

information	description		instructions
4.1 single-material	(>95%)		*indicate fibre type*
4.2 two-materials 80-20	80% fibre type		*indicate fibre type*
	20% fibre type		*indicate fibre type*
4.3 two-materials 70-30	70% fibre type		*indicate fibre type*
	30% fibre type		*indicate fibre type*
4.4 two-materials 50-50	50% fibre type		*indicate fibre type*
	50% fibre type		*indicate fibre type*
4.5 3+ materials			*mark if applicable*
4.6 mesh type	woven		*mark if applicable*
	knitted		*mark if applicable*
	non-woven		*mark if applicable*
4.7 colour / single	black		*mark if applicable*
	beige (red flame and yellow flame)		*mark if applicable*
	heather grey		*mark if applicable*
	brown (red flame and yellow flame)		*mark if applicable*
	yellow		*mark if applicable*
	orange (light and dark)		*mark if applicable*
	red (light and dark)		*mark if applicable*
	burgundy (purple flame and red flame)		*mark if applicable*
	green (bottle green and rotten green)		*mark if applicable*
	blue (midnight blue and red flame blue)		*mark if applicable*
	light blue (sugar paper, turquoise)		*mark if applicable*
4.8 colour / multiple			*mark if applicable*
4.9 elastane			*indicate percentage share*
4.10 sanitisation			*YES / NO*
4.11 recover identification	recoverer name		*indicate name*
	date of recovery operation		*indicate date*
4.12 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*

	post-industrial		*mark if applicable*
4.13 waste identification	collector #1 name		*indicate name*
	collector #1 identifier of the lot		*indicate date*
	collector #2 name		*indicate name*
	collector #2 identifier of the lot		*indicate date*
4.14 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*
	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*

Mechanical recovery – model label for residues / leftovers

The residues of mechanical recovery are short fibres and powder that go to downcycling, chemical recovery (if feasible) or energy recovery. Therefore, the structure of label T4 for the residues is much simpler than that for the main output as it contains only information relevant for these operations. Moreover, the label T4 recovers the information on the input waste and on the upstream operations from the label T3.

information	**description**		**instructions**
4.1 single-material	(>95%)		*indicate fibre type*
4.2 elastane			*indicate percentage share*
4.3 sanitisation			*YES / NO*
4.4 recover identification	recoverer name		*indicate name*
	date of recovery operation		*indicate date*
4.5 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
4.6 waste identification	collector #1 name		*indicate name*
	collector #1 identifier of the lot		*indicate date*
	collector #2 name		*indicate name*
	collector #2 identifier of the lot		*indicate date*
4.7 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*
	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*

Chemical recovery – model label for the main output

In chemical recovery the input SRM is deeply modified by the process in many aspects including physical and chemical form and colour. Depending on the process, the type of main output and residues can be very different. The information in the label T4 qualifies the main outputs and residues that result from chemical recovery. Moreover, the label T4 recovers the information on the input waste and the upstream operations from the label T3.

information	description		instructions
4.1 output #1	polymer type		*chemical description*
	monomer type		*chemical description*
	physical form		*description*
4.2 output #2	polymer type		*chemical description*
	monomer type		*chemical description*
	physical form		*description*
4.3 recover identification	recoverer name		*indicate name*
	date of recovery operation		*indicate date*
4.4 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
4.5 waste identification	collector #1 name		*indicate name*
	collector #1 identifier of the lot		*indicate date*
	collector #2 name		*indicate name*
	collector #2 identifier of the lot		*indicate date*
4.6 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*
	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*

Chemical recovery – model label for residues / leftovers

The residues of chemical recovery are sludges or fibres that can go to further material recovery (if possible) or incineration. Therefore, the structure of label T4 for the residues contains only information relevant for these recovery or energy operations. Moreover, the label T4 recovers the information on the input waste and on the upstream operations from the label T3.

information	description		instructions
4.1 residue #1	physical form		*description*
	precise / approximate material composition		*chemical description*
4.2 residue #2	physical form		*description*
	precise / approximate material composition		*chemical description*
4.3 recover identification	recoverer name		*indicate name*
	date of recovery operation		*indicate date*
4.4 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
4.5 waste identification	collector #1 name		*indicate name*

	collector #1 identifier of the lot		*indicate date*
	collector #2 name		*indicate name*
	collector #2 identifier of the lot		*indicate date*
4.6 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*
	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*

Thermo-mechanical recovery – model label for the main output

The input SRM is modified by the recovery process in the physical form and colour. The information in the label T4 qualifies the main outputs and residues that result from chemical recovery. Moreover, the label T4 recovers the information on the input waste and on the upstream operations from the label T3.

information	**description**		**instructions**
4.1 output	polymer type		*chemical description*
	physical form		*description*
	colour		*description*
4.2 recover identification	recoverer name		*indicate name*
	date of recovery operation		*indicate date*
4.3 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
4.4 waste identification	collector #1 name		*indicate name*
	collector #1 identifier of the lot		*indicate date*
	collector #2 name		*indicate name*
	collector #2 identifier of the lot		*indicate date*
4.5 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*
	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*

Thermo-mechanical recovery – model label for residues / leftovers

The residues of the thermo-mechanical recovery are minimal, they depend on the material processed and on the technology and can go to incineration. Therefore, the structure of label T4 for the residues contains only information relevant for incineration. Moreover, the label T4 recovers the information on the input waste and on the upstream operations from the label T3.

information	**description**		**instructions**
4.1 residue	physical form		*description*
	precise / approximate material composition		*chemical description*
4.2 recover identification	recoverer name		*indicate name*
	date of recovery operation		*indicate date*
4.3 origin of the input	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*

	post-industrial		*mark if applicable*
4.4 waste identification	collector #1 name		*indicate name*
	collector #1 identifier of the lot		*indicate date*
	collector #2 name		*indicate name*
	collector #2 identifier of the lot		*indicate date*
4.5 upstream operations	sorter(s) name(s)		*indicate name*
	sorting date(s)		*indicate date*
	preparing operator name		*indicate name*
	date(s) of preparing operation		*indicate date*

8.5 TAXONOMY PROPOSAL T5

SRM in scope: Sorted reusable textiles.

Granularity of the SRM in scope: Group of commercially homogeneous reusable textile items.

Sorting for reuse - Model label for the outputs

The information in the label T5 qualifies the detailed categorisation that is applied to the items that result as reusable in the sorting operation. Moreover, the label T5 recovers the information on the input waste from the label T1.

information	description		instructions
5.1 cream			*mark if applicable*
5.2 prime	extra – man summer		*mark if applicable*
	extra – woman summer		*mark if applicable*
	extra – baby summer		*mark if applicable*
	extra – man winter		*mark if applicable*
	extra – woman winter		*mark if applicable*
	extra – baby winter		*mark if applicable*
	upholstery		*mark if applicable*
	underwear		*mark if applicable*
	other		*specify*
5.3 grade A	anorak		
	baby light summer		*mark if applicable*
	baby summer 0-6		*mark if applicable*
	baby summer 6-12		*mark if applicable*
	blanket		*mark if applicable*
	bathrobe		*mark if applicable*
	blouse		*mark if applicable*
	collant		*mark if applicable*
	cotton caps		*mark if applicable*
	cotton man pant 100 pcs		*mark if applicable*
	ties		*mark if applicable*
	foulard		*mark if applicable*
	handkerchief		*mark if applicable*
	heavy curtains		*mark if applicable*
	jeans jackets		*mark if applicable*
	jeans skirts		*mark if applicable*
	lace curtains		*mark if applicable*
	ladies polo		*mark if applicable*
	ladies slim pants		*mark if applicable*
	man cotton jacket		*mark if applicable*
	man jeans pant 100 pcs		*mark if applicable*
	man polo		*mark if applicable*

	man shirt		*mark if applicable*
	man short		*mark if applicable*
	man suit		*mark if applicable*
	mix dress		*mark if applicable*
	mix skirt		*mark if applicable*
	night		*mark if applicable*
	short ¾		*mark if applicable*
	socks		*mark if applicable*
	soft toys		*mark if applicable*
	swim		*mark if applicable*
	sport		*mark if applicable*
	velvet pants		*mark if applicable*
	underwear mix		*mark if applicable*
	wedding		*mark if applicable*
	wool caps		*mark if applicable*
	work		*mark if applicable*
5.4 grade B	shorty man		*mark if applicable*
	baby		*mark if applicable*
	blouse woman		*mark if applicable*
	dress grade B		*mark if applicable*
	ladies polo		*mark if applicable*
	man pants cotton		*mark if applicable*
	man jeans pant		*mark if applicable*
	man polo		*mark if applicable*
	man shirt		*mark if applicable*
	mix training		*mark if applicable*
5.5 grade C	jackets		*mark if applicable*
	underwear		*mark if applicable*
	upholstery		*mark if applicable*
	suits		*mark if applicable*
	baby mix		*mark if applicable*
5.6 shoes	cream summer		*mark if applicable*
	cream winnter		*mark if applicable*
	extra		*mark if applicable*
	woman summer		*mark if applicable*
	winter		*mark if applicable*
	Africa		*mark if applicable*
	bags		*mark if applicable*
5.7 winter	coats man		*mark if applicable*
	coats woman		*mark if applicable*
	furs		*mark if applicable*
	sheepskin jackets		*mark if applicable*

	leather		*mark if applicable*
	jackets velvet		*mark if applicable*
	jackets wool		*mark if applicable*
	pants wool		*mark if applicable*
	pants velvet		*mark if applicable*
5.8 sanitisation			*YES / NO*
5.9 sorting identification	sorter name		*indicate name*
	date(s) of sorting operation		*indicate date*
5.10 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
5.11 waste identification	collector name		*indicate name*
	collector's identifier of the lot		*indicate date*

8.6 TAXONOMY PROPOSAL T6

SRM in scope: Sorted reusable textiles that need repair or remanufacturing to become sellable.

Granularity of the SRM in scope: Group of homogeneous (e.g. based on need for repair) textile items needing repair or remanufacturing.

Sorting for remanufacturing - Model label for the outputs

The information in the label T6 qualifies the categorisation that is applied to the items that result as reusable in the sorting operation provided that some repair or remanufacturing is introduced. The information must qualify the need for repair in categories that could facilitate channelling towards the most appropriate operator Moreover, the label T6 recovers the information on the input waste from the label T1.

information	**description**		**instructions**
5.1 type of failure	fabric breakdown		*mark if applicable*
	tear		*mark if applicable*
	seam failure		*mark if applicable*
	stain		*mark if applicable*
	missing/damaged components (e.g. buttons)		*mark if applicable*
	other		*mark if applicable*
5.2 sanitisation			*YES / NO*
5.3 sorting identification	sorter name		*indicate name*
	date(s) of sorting operation		*indicate date*
5.4 origin of waste	post-consumer		*mark if applicable*
	pre-consumer		*mark if applicable*
	post-industrial		*mark if applicable*
5.5 waste identification	collector name		*indicate name*
	collector's identifier of the lot		*indicate date*