TEX-BREIN – Interregional community of TEXtile ecosystems for the circular transition: Building capacities, REINforcing network and organisations

# DELIVERABLE 1.1 – INNOVATION MAPPING


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# EXECUTIVE SUMMARY

This report, Deliverable D1.1 of the TEX-BREIN project, presents a comprehensive comparative analysis of the textile innovation and circularity ecosystems within the six key European partner regions: Severovýchod (Czechia), Łódzkie (Poland), Toscana (Italy), Norte (Portugal), Catalonia (Spain), and Västra Götaland (Sweden). Aligned with Work Package 1 (Ecosystems Building), its purpose is to map the current landscape, identify key stakeholders using the Quadruple Helix model, and establish a baseline through benchmarking, thereby informing subsequent project actions towards fostering interregional collaboration for a circular textile transition. The analysis draws on partner input, extensive desk research, and synthesis of publicly available data.

The study reveals a diverse European textile landscape with varying levels of maturity and focus concerning innovation and circularity. **Västra Götaland (SE)** emerges as a frontrunner in R&D for smart/sustainable textiles and advanced sorting technologies, supported by strong innovation hubs (e.g., Science Park Borås, Wargön Innovation). **Norte (PT)** showcases a highly concentrated, export-oriented with significant industrial base, dedicated R&D capacity (CITEVE, UMinho) and a clear regional circularity strategy. **Toscana (IT)** offers a unique model centered on the Prato district's deep-rooted expertise in mechanical wool recycling ("cardato rigenerato"), coexisting with luxury supply chains and a distinct fast fashion segment. **Catalonia (ES)** leverages a strong design hub (Barcelona), multiple RTOs (Eurecat, Leitat), and demonstrates significant policy commitment through its multi-stakeholder Pact for Circular Fashion. **Severovýchod (CZ)** possesses specialized strengths in technical textiles and R&D (TUL Liberec) but appears less advanced in dedicated circular infrastructure. **Łódzkie (PL)** leverages a rich industrial history and research institutions (TUL Łódź) but faces challenges from industry fragmentation and less developed circular economy frameworks.

Regarding **Textile Innovation**, key strengths include specialized R&D hubs (SE, PT, CZ, IT), technical textile leadership (CZ, PT), advanced materials research (SE, IT, CZ), strong design capabilities (ES, SE, IT), and active cluster organizations (ES, SE, PT, CZ). However, translating research into widespread SME adoption and commercial success remains a common hurdle, particularly noted in CZ and PL.

Concerning **Circularity**, the analysis highlights critical, shared weaknesses across most regions. **Separate collection rates** are universally low (often <15%, significantly lagging EU

averages and the requirements of the 2025 mandate), representing a major bottleneck. Consequently, substantial amounts of post-consumer textile waste are lost to landfill or incineration. While reuse exists, significant portions of collected textiles are often exported. **Scaled infrastructure for advanced sorting and high-value (fiber-to-fiber) recycling** (<1% rate EU-wide) is largely absent commercially across the consortium, although notable R&D and pilot activities exist (especially in SE, PT, IT). **Policy implementation**, particularly the finalization and operationalization of national **EPR schemes**, faces delays and uncertainty in several regions (IT, CZ, PL, PT, ES), hindering investment and planning. Data scarcity on regional waste flows further complicates effective management. Despite these gaps, positive drivers include strong EU policy momentum, dedicated regional strategies (SE, PT, ES), proactive initiatives (ES Pact, SE Textile Movement, IT Prato Circular City), and growing market interest.

This baseline assessment underscores the significant potential for **interregional collaboration** facilitated by TEX-BREIN. Key opportunities lie in sharing best practices on EPR implementation and collection models, transferring technology related to advanced sorting and recycling, integrating regional value chains by connecting waste feedstock to processing capacity, and pursuing joint R&D and pilot projects that leverage complementary strengths (e.g., technical textiles from CZ/PT with recycling R&D from SE/IT/ES).

Deliverable D1.1 provides the foundational mapping and benchmarking necessary for TEX-BREIN. Its findings directly inform the **Regional Innovation Boosting Action Plan (D1.2)** and the identification of concrete needs and collaborative potential essential for developing the **Portfolio of Investment Project Ideas (WP3)**, ultimately aiming to accelerate the transition towards a more innovative, sustainable, and resilient circular textile sector across the participating regions.

# CONTENT

1. About TEX-BREIN.....6

2. Introduction and Methodology.....8

3. Regional analysis ..... 13

3.1 Severovýchod (Czechia - CZ05) ..... 13

3.2 Łódzkie (Poland - PL71) ..... 19

3.3 Toscana (Italy - ITI1)..... 23

3.4 Norte (Portugal - PT11) ..... 28

3.5 Catalonia (Spain - ES51)..... 33

3.6 Västra Götaland (Sweden - SE23) ..... 37

4. Interregional Analysis and Benchmarking ..... 43

5. Opportunities for Interregional Collaboration..... 53

6. Conclusion ..... 59

7. References..... 61

# 1. ABOUT TEX-BREIN

The TEX - BREIN project aims to build innovation capacity for textile ecosystems in Europe. It aims to create and support innovative and resilient textile value chains and to support circular transformation in line with the EU Strategy for Sustainable Textiles in Circular Economy. The project is intended to support and develop inter-regional cooperation between actors within the quadruple helix and seek to upskill sectoral employers. The project aims to increase the number of circular economy solutions in less developed regions through the transfer of knowledge and accepted practices from more developed regions, through the development of cross-border cooperation plans for SMEs and the transfer of textile recycling centre models from more to less developed regions. It will strengthen the innovation capacity of textile companies, improve sustainable links among industrial textile areas and foster closer cooperation on waste management and circular economy. The project aims to accelerate cooperation between the involved textile territories. As part of the cooperation in TEX-BREIN, the competences of public entities and innovation intermediaries helping SMEs in formulating investment portfolios at the interregional level for textile ecosystems are to be increased. The key objective is to transform the textile industry into a circular economy that protects the environment and innovative production processes reduce textile waste. The project aims to reduce the asymmetry between less and more developed regions. This will be achieved by mapping and assessing innovation turning points (e.g. textile centres in more developed textile regions). The project will develop a portfolio of 20 business cases, 3 of which concern the design of textile recycling centres in less developed regions. The project involves 8 partners from 6 European regions: 3 are classified as less developed - Severovýchod (CZ); Norte (PT) and Łódzkie (PL) and 3 as developed - Tuscany (IT), Catalonia (ES) and Vastra Gotaland (SW). In Portugal, PRODUTECH as a national cluster also represents Centro that, in addition to NORTE, plays an important role in advanced manufacturing technologies that support the textile sector.

## Work packages

- WP1 ECOSYSTEMS BUILDING: The aim is to analyse and set the context of the innovation ecosystems in all involved regions, by: Identifying the main actors and ecosystems in innovation and business domains in all involved regions, pinpointing capabilities and possibilities to foster synergies among regions in complementary innovative value chains and assess the local strengths to support the involvement of these actors the development of European value chains; identifying the real needs of the textile and correlated sectors in their path to a greener, digital and smarter manufacturing that can be translated into regional S3 based roadmaps; connecting with S3 policy makers to provide inputs for the improvement of the current strategies by integrating the identified needs and innovation capabilities; and as such, design and display the umbrella framework that will guide partners and participants in their path to generate innovative ideas that address real sector needs and opportunities.
- WP 2 CAPACITY BUILDING: The main goal is the deployment of capacity building activities aiming at enhancing the skills of the different stakeholders to boost innovation in the value chains linked to the recycling in the textile sector making them more prepared to participate in the I3.
- WP3 SMES ENGAGEMENT; PORTFOLIO OF PROJECT IDEAS DEFINITION: The objective is the development of an engaged cooperative ecosystem for SMEs, supported by relevant stakeholders, able to promote resilience, empowerment and innovation of the textile value chains. The ecosystem favours the generation of project ideas for new cooperative investments to be exploited in future funding opportunities, I3 new calls in primis. The objective is to have SMEs of the textile sector ready for new investments once the external conditions will allow for their implementation. The investments will fall under the domain of green and digital transition and will be connected to WP4, i.e. will liaise with the re-hub pilots.
- WP 4 RE HUBS PILOT CASES - The objective of this WP is to support European SMEs in the generation of new collaborative projects in the field of circular economy, more specifically, textile re-hubs, to accelerate the development of circular textiles business models, supported by cross-regional and cross-sectoral technology knowledge transfer. This WP goal is to have textile re-hub pilot cases defined and ready to apply to future I3 instrument calls.

# 2. INTRODUCTION AND METHODOLOGY

## 2.1. Context and Objectives

The TEX-BREIN project, funded under the European Union's Interregional Innovation Investments (I3) Instrument (Call I3-2023-Cap2b, Project ID: SEP-211013282), aims to build robust interregional collaboration within textile ecosystems across Europe. The overarching goal is to accelerate the transition towards a more sustainable and circular textile and clothing (T&C) sector. TEX-BREIN specifically focuses on fostering innovation and identifying potential joint investment opportunities across six key European regions: **Severovýchod (Czechia - CZ05), Łódzkie (Poland - PL71), Toscana (Italy - ITI1), Norte (Portugal - PT11), Catalonia (Spain - ES51), and Västra Götaland (Sweden - SE23)**. From Portugal, also Centro region (Portugal - PT19) is supporting this project and technology providers can originate from there. Particular attention is given to supporting less developed or transition regions within this consortium.

This report constitutes **Deliverable D1.1: "Innovation mapping report, featuring a comprehensive list of stakeholders and their benchmarking within Europe,"** a foundational output of Work Package 1 (WP1: Ecosystems Building). The primary objectives of this deliverable are to:

- Map the existing textile innovation and circularity ecosystems within the six participating regions.
- Identify and categorize key stakeholders according to the Quadruple Helix model.
- Provide an initial comparative analysis (benchmarking) of the regions' current status regarding circularity performance and innovation capabilities.
- Establish a clear baseline understanding of the regional landscapes to inform subsequent TEX-BREIN activities, notably the development of the Regional Innovation Boosting Action Plan (D1.2) and the identification of potential investment projects (WP3).

## 2.2. Purpose and Scope

The purpose of this report is to provide a structured, comparative overview of the textile innovation and circularity potential within the six TEX-BREIN partner regions. It serves as a crucial knowledge base for the consortium, highlighting regional specificities, shared challenges, and opportunities for collaboration.

The **scope** of this report encompasses:

- **Geographic Focus:** The analysis concentrates on the six designated regions: Severovýchod (CZ), Łódzkie (PL), Toscana (IT), Norte (PT), Catalonia (ES), and Västra Götaland (SE).
- **Thematic Focus:** The core themes are the current state and potential for **Textile Innovation** (including digitalization, advanced materials, smart manufacturing) and **Circularity** (spanning collection, sorting, reuse, recycling infrastructure and practices, policy drivers, and business models) within the T&C sector.
- **Stakeholder Identification:** Utilizes the Quadruple Helix framework (Industry, Academia/Research, Government, Civil Society/Intermediaries) to map relevant actors.
- **Benchmarking:** Compares the six regions primarily against each other, using EU averages as a general context where available data permits, and referencing specific leading European examples (e.g., Prato, Flanders) to illustrate best practices or specific strengths.

This report represents a baseline assessment based on available information at the project's outset. It aims to capture the key features and dynamics of each regional ecosystem relevant to textile circularity, rather than providing an exhaustive inventory of every entity or initiative. Its findings are intended to guide strategic decision-making and collaborative actions within the TEX-BREIN project.

### 2.3. Methodology

The findings presented in this report were compiled through a multi-stage process:

- **Initial Stakeholder Mapping:** Partners contributed preliminary lists of known stakeholders within their respective regions. This initial data, including the provided stakeholder CSV file, was consolidated and analyzed.
- **Desk Research:** A comprehensive review of publicly available information was conducted for each region. Sources included:
  - Academic publications and research databases (e.g., ResearchGate, Scopus).
  - Official national and regional statistics (e.g., Eurostat, Idescat, ČSÚ, GUS, ISTAT, INE Portugal, SCB).
  - Industry association reports and websites (e.g., TEKO, ATP, ATOK, Confindustria).
  - Regional and national strategic documents (e.g., RIS3 strategies, Circular Economy Roadmaps/Action Plans, Waste Management Plans).
  - EU project databases (e.g., CORDIS, LIFE Public Database, Interreg Europe).
  - Websites of key organizations (companies, RTOs, clusters, public agencies, NGOs).
  - Relevant news articles and specialized press releases.
    The research focused on identifying information related to regional T&C industry structure, economic significance, key actors, innovation activities, circularity practices (collection, sorting, recycling), policy frameworks, funding instruments, stakeholder needs, and collaborative initiatives.
- **Stakeholder Identification Framework:** Stakeholders were identified and categorized using the **Quadruple Helix model**, encompassing:
  - **Industry:** Manufacturers, brands, retailers, recyclers, waste management companies.
  - **Academia/Research:** Universities, research & technology organizations (RTOs), vocational training centers.

- **Government:** EU, national, regional, and local public authorities and agencies responsible for policy, regulation, and funding.
- **Civil Society & Intermediaries:** NGOs, industry/business associations, clusters, innovation hubs, financial institutions, consumers/end-users.

- **Innovation & Circularity Mapping:** Regional profiles were developed by synthesizing information on key R&D institutions and their focus areas, notable innovative companies or projects (especially those related to circularity), the status of waste management infrastructure (collection, sorting, recycling), and alignment with regional specialization strategies (RIS3).
- **Benchmarking Approach:** A comparative analysis was conducted across the six regions based on selected key indicators related to:
  - Ecosystem Structure (Industry composition, R&D focus, Network maturity).
  - Circularity Performance (Estimated Waste Generation, Collection Rates, Recycling Infrastructure/Rates, Policy Maturity - notably EPR status).
  - Innovation Capabilities (R&D strengths, Pilot facilities, Cluster activity). Comparison points included intra-regional assessment, EU-level averages (where data allowed), and qualitative reference to recognized leading European regions (e.g., Prato, Flanders) identified through desk research.
- **Synthesis and Analysis:** The gathered information was aggregated and analyzed comparatively to identify regional specificities, common patterns, critical gaps, and concrete opportunities for interregional collaboration relevant to TEX-BREIN's objectives.
- **Limitations:** This analysis relies heavily on publicly available data and partner inputs, which vary in granularity and timeliness across regions. Significant data gaps exist, particularly concerning precise regional quantitative figures for waste flows, recycling rates, and economic contribution. Consequently, some benchmarking aspects rely on national data as proxies or qualitative estimations, which should be interpreted with caution. The ecosystems are dynamic, and this report represents a snapshot based on information available up to early 2025.

### 2.4. Defining Key Concepts

For clarity within this report, key terms are understood as follows:

- **Textile Innovation:** Encompasses the development, adoption, and scaling of new or improved materials (e.g., bio-based, recycled content), production processes (e.g., cleaner dyeing, waterless finishing, digitalization), business models (e.g., rental, repair, resale, product-as-a-service), and end-of-life management solutions (e.g., advanced sorting, fiber-to-fiber recycling, upcycling) that enhance sustainability, circularity, or competitiveness within the T&C sector.
- **Circularity (Textiles):** Refers to the paradigm shift from linear 'take-make-dispose' models towards systemic approaches that aim to keep textile products and materials in use at their highest possible value for as long as possible. This includes strategies focused on durability, longevity, reuse, repair, refurbishment, remanufacturing, and, ultimately, high-quality fiber-to-fiber recycling, minimizing waste and resource depletion.
- **Quadruple Helix:** A model of innovation that emphasizes collaboration between four key stakeholder spheres: **Academia & research** (knowledge generation, education), **Industry** (value creation, market application), **Government** (policy framework, regulation, funding), and **Civil Society** (including end-users, NGOs, communities - representing societal needs and demand). Effective interaction between these spheres is considered crucial for driving systemic innovation.

# 3. REGIONAL ANALYSIS

## 3.1 SEVEROVÝCHOD (CZECHIA - CZ05)

### 3.1.1 Regional Context: Textile Industry Significance & Specialization

The Severovýchod region (NUTS2 CZ05), comprising the Liberecký (LK), Královéhradecký (KHK), and Pardubický (PK) *kraj* (regions), possesses a rich and deeply embedded history in textile manufacturing. Areas within the region, particularly around Liberec and Dvůr Králové nad Labem, were historically industrial powerhouses, earning the moniker "Czech/Bohemian Manchester" due to their high concentration of textile activity, especially during the 19th and early 20th centuries. This legacy included expertise in processing local fibres like flax and wool, later transitioning significantly to cotton and eventually synthetic materials.

Following significant economic and political shifts post-1989, the industry underwent profound restructuring, moving away from large state-owned enterprises towards a more fragmented structure. Despite this transformation and increased global competition, the T&C sector remains a significant feature of the regional economy. It has notably pivoted towards specialization in **technical textiles and advanced materials**, leveraging its historical engineering skills and capitalizing on strong regional R&D capabilities. This specialization aligns with national trends, where the textile manufacturing sector (NACE 13), encompassing nonwovens, technical, and industrial textiles, constitutes the dominant force within the broader T&C industry nationally, significantly outweighing the apparel sector (NACE 14) in sales revenue and productivity. This suggests a regional focus on higher value-added segments compared to traditional apparel manufacturing.

The region hosts several large, influential companies with long histories, forming an industrial anchor. Key players include **JUTA a.s.** (a major producer of technical textiles for agriculture, construction, and geotextiles, headquartered in KHK), **VEBA, textilní závody a.s.** (specializing in high-quality home textiles and African damask fabrics, KHK), **MILETA a.s.** (a key producer of cotton shirtings and handkerchiefs, KHK), **SVITAP s.r.o.** (technical fabrics, coated fabrics, confection, PK), and **SINTEX, a.s.** (specializing in technical knitted fabrics, PK). **Contipro a.s.** (PK), while primarily known for hyaluronic acid, represents significant advanced biomaterial expertise potentially applicable to medical textiles. Alongside these larger entities, a substantial

number of Small and Medium Enterprises (SMEs) operate across various stages of the value chain, contributing to the region's diverse industrial fabric. Geographically, manufacturing activity is strongly concentrated in the Královehradecký and Pardubický *kraj*, while the critical R&D infrastructure is predominantly located in the Liberecký *kraj*.

### 3.1.2 Key Stakeholder Ecosystem

The Severovýchod textile innovation ecosystem comprises a diverse network of interconnected actors spanning the Quadruple Helix, crucial for driving the transition towards circularity:

- **Industry (Manufacturers, Recyclers, Waste Management):** The industrial base features key large anchor firms with long-standing regional presence (e.g., JUTA, VEBA, MILETA, SVITAP, SINTEX, Contipro) alongside a significant number of Small and Medium Enterprises (SMEs). **Analysis of over 100 identified regional industry actors confirms this SME predominance (approx. 90%), highlighting a fragmented industrial structure common in textiles.** While the CLUTEX cluster provides a network, a substantial portion of identified companies are not formal members, indicating potential for broader engagement.
    - **Value Chain Representation:** The ecosystem demonstrates capabilities across multiple value chain stages. **Analysis indicates particular strength in mid-stream processes like weaving, knitting, nonwovens production, and fabric finishing.** Yarn spinning and manufacturing of finished goods (apparel, home textiles, technical textiles) are also well-represented. Fiber production appears less prominent regionally.
    - **Application Fields:** Companies serve diverse end-markets. **Technical and industrial textiles (Indutech, Protech, Mobiltech, Buildtech, Agrotech) represent a significant focus, alongside established strengths in home textiles and apparel (Clothtech, Sportech, Fashion).** Medical textiles (Medtech) also feature, linked to specialized regional R&D.
    - **Circularity Actors:** Actors explicitly focused on circularity primarily engage in **collection, sorting, and mechanical processing/downcycling.** Key players include collection/sorting specialists (e.g., DIMATEX CS, Asociace recyklace použitého textilu), mechanical recyclers handling post-consumer or industrial

waste (e.g., ARCA Chrast, Recycling J&F, Retex – a national player with regional impact), and charities managing collection networks (e.g., Diakonie Broumov). Major waste management operators (e.g., Marius Pedersen) handle general waste streams and operate some sorting facilities, but their specific capacity and focus for *textile* sorting requires clarification. **A critical gap remains in regional infrastructure for advanced, scaled fiber-to-fiber recycling (chemical or advanced mechanical).**

- **Academia/Research (R&D & Education):** This sphere represents a significant regional asset, centered unequivocally around the **Technical University of Liberec (TUL)** and its internationally recognized **Faculty of Textiles (FT)**. Expertise covers nanomaterials, advanced textile technologies (across the value chain), functionalization, smart textiles, clothing technology, finishing, circularity R&D (recycling, sustainable treatments), design, and testing. TUL actively collaborates with industry (often via CLUTEX) and participates in international projects. Complementing TUL are key specialized research institutes: **VÚTS, a.s.** (Liberec - textile machinery R&D), **VÚB a.s.** (Ústí nad Orlicí - textile research, CLUTEX collaborator), and **INOTEX spol. s r.o.** (Dvůr Králové - R&D/testing in finishing/dyeing). The **University of Pardubice (UPCE)** offers complementary expertise via its Faculty of Chemical Technology, particularly relevant for chemical processes (dyeing, potential chemical recycling). A network of **secondary technical and vocational schools** (e.g., SPŠ a VOŠ Liberec, SPOŠ Dvůr Králové nad Labem) provides essential skilled labor.

- **Government (Public Authorities & Policy):** At the regional level, the respective authorities (**Krajské úřady**) for Liberecký, Královéhradecký, and Pardubický *kraj* are responsible for implementing regional development strategies (RIS3), managing environmental protection plans, overseeing waste management planning, and potentially offering regional funding. At the national level, the **Ministry of Environment (MŽP)** holds primary responsibility for waste management policy, circular economy strategy (Cirkulární Česko), EPR development and implementation, and managing key environmental funding (OPŽP). The **Ministry of Industry and Trade (MPO)** oversees industrial policy, coordinates the national RIS3 strategy, manages business innovation funding (OP TAK), and supervises agencies like CzechInvest and CzechTrade.

- **Support Organizations & Intermediaries (Clusters, Associations, Agencies): CLUTEX - Klastr technické textilie**, based in Liberec, is the most prominent cluster, coordinating innovation in the technical textiles segment. It connects key firms, research organizations (TUL, VÚTS, VÚB, INOTEX), and associations, facilitating collaborative projects and knowledge transfer. **CLUTEX represents the core of the ~19 formally identified cluster members in the stakeholder analysis.** The **Association of Textile-Clothing-Leather Industry (ATOK)** is the primary national sector association for advocacy and statistics. The **Czech Technology Platform for Textiles (ČTPT)** contributes to strategic R&D direction. **Emerging regional hubs** explicitly focused on circularity include **P-PINK Cirkulární Hub (Pardubice)** and **RecyUpcy (Hradec Králové)**, offering networking, material exchange, and upcycling support. **Regional development agencies (CIRI, RRAPK)** and the national agency **CzechInvest** provide business support and potentially facilitate funding access
- **Civil Society:** Includes non-governmental organizations (NGOs) and charities active in sustainability, circular economy advocacy, and collection. The Prague-based **Institut Cirkulární Ekonomiky (INCIEN)** is influential nationally (research, consultancy, Czech Circular Hotspot). Environmental groups like **Hnutí DUHA** and **Arnika** advocate on waste and pollution. Charities like **Diakonie Broumov** are significant operational players in textile collection for reuse/social purposes. Specialized professional associations like **Asociace recyklace použitého textilu (ARETEX)** focus on the collection/sorting sector.

The Severovýchod ecosystem structure benefits significantly from the **concentration of R&D excellence at TUL** and the coordinating role of **CLUTEX** for technical textiles. **The industrial base is diverse, dominated by SMEs but anchored by several large traditional and technical textile manufacturers.** However, connections and dedicated infrastructure for **advanced circularity** (beyond collection and basic mechanical processing) appear underdeveloped and fragmented compared to the established technical textile innovation system. **Strengthening linkages** between the numerous SMEs, waste collectors/sorters, the limited recycling base, R&D institutions (especially for scaling up), and manufacturers is crucial for capturing material value and enabling higher-value circular flows.

### 3.1.3 Current Innovation & Circularity Landscape

Innovation activity in Severovýchod is strongly characterized by its technical textile focus and the R&D powerhouse at TUL:

- **Innovation Focus:** Significant activity in **advanced materials**, particularly driven by TUL's pioneering work in nanofibers and subsequent industrial applications, alongside functionalization techniques and research into biomaterials (e.g., Contipro). **Process innovation** is evident through VÚTS's work on advanced machinery, INOTEX's development of sustainable dyeing and finishing treatments, and TUL's ongoing research into novel recycling methods (e.g., for PET) and process optimization. Research also extends into **digitalization and smart textiles** at TUL, exploring automation and functional textile integration.

The regional transition towards **circularity** is in its early stages, marked by emerging initiatives but facing substantial infrastructural and systemic barriers:

- **Collection:** Current systems rely heavily on voluntary drop-offs via container networks (operated by specialized firms like DIMATEX and charities) and municipal collection yards (sběrné dvory). National estimates suggest only ~15% of discarded textiles are captured for reuse or recycling, indicating that the vast majority enters mixed municipal waste. The **2025 national mandate** requiring municipalities to provide separate collection points necessitates a dramatic expansion and optimization of this infrastructure to handle significantly increased volumes and potentially different material quality profiles. Public confusion about what can be placed in containers remains a challenge.
- **Sorting:** Predominantly a manual process performed by collection organizations, primarily focused on grading for reuse (often for export or charity) or identifying materials suitable for basic downcycling (rags, fillers). There is a clear lack of accessible, regional infrastructure for advanced, automated sorting capable of accurately identifying and separating complex fiber blends, which is a prerequisite for high-value recycling.

- **Recycling:** Current regional activities are dominated by **mechanical downcycling**. ARCA Chrast operates a shredding line producing textile shoddy, while DIMATEX processes collected textiles into cleaning rags and composite materials ('Retextil'). High-value, **fiber-to-fiber recycling capacity** (either advanced mechanical preserving fiber length or chemical recycling for synthetics/blends) appears **non-existent at an industrial scale within Severovýchod**. This mirrors the low (<1%) national rate for such processes. While national players like Retex focus on producing nonwovens from recycled fibers, they operate outside the region.
- **Infrastructure Gaps:** The most significant impediment to advancing circularity is the **critical lack of regional capacity for sophisticated sorting and high-value (especially fiber-to-fiber) recycling**. This bottleneck risks overwhelming existing systems as collection volumes increase post-2025 and could lead to increased incineration, landfilling, or export of potentially valuable materials.
- **Circular Initiatives:** Despite infrastructural gaps, positive momentum exists. Emerging regional hubs like **P-PINK** (Pardubice) and **RecyUpcy** (Hradec Králové) aim to stimulate local circular economy practices through material banks, upcycling support, networking, and participation in EU projects. **CLUTEX** actively promotes circularity concepts and facilitates related projects among its technical textile members. TUL's research continues to explore innovative recycling technologies.

### 3.1.4 Alignment with Regional Strategy (RIS3)

The strategic importance of the textile sector, particularly its innovative segments, is formally recognized in the Smart Specialisation Strategies (RIS3) of all three constituent regions (Liberecký, Královéhradecký, Pardubický). Key priorities identified include:

- **Liberecký Kraj (LK):** Prioritizes "Advanced materials," including technical textiles and nanomaterials.
- **Královéhradecký Kraj (KHK):** Focuses on "New textile materials for new multidisciplinary applications," encompassing technical/functional materials and ecological finishing.
- **Pardubický Kraj (PK):** Emphasizes "Advanced materials based on textile structures," functional materials, and clean production.

This consistent prioritization reflects the sector's regional economic weight, historical significance, and particularly the innovation potential anchored by TUL Liberec and associated research institutes. Crucially, all three regions explicitly confirm their participation in the **European S3 platform Regiotex**, which is specifically focused on fostering interregional collaboration for the **circular economy in the textile sector**. This dual alignment – recognizing textiles/advanced materials internally and connecting externally via Regiotex – signals a strong strategic commitment to developing the sector sustainably and incorporating circularity. This policy framework provides a clear mandate for directing regional, national, and EU funding (e.g., structural funds managed regionally, OP TAK, OPŽP, TA ČR grants) towards innovation, R&D, skills development, and potentially crucial infrastructure investments needed to achieve circular economy goals within Severovýchod's textile industry. Ensuring these strategic priorities translate into accessible, targeted support programs is key for effective implementation.

## 3.2 ŁÓDZKIE (POLAND - PL71)

### 3.2.1 Regional Context: Textile Industry Significance & Specialization

The Łódzkie Voivodeship, historically revered as the "Polish Manchester," holds undeniable significance in Poland's industrial and cultural narrative, deeply intertwined with textile manufacturing. Its legacy stems from explosive growth in the 19th and early 20th centuries, becoming a primary textile supplier for vast markets. The transition to a market economy in the 1990s, however, brought dramatic restructuring, leading to the decline of large state-owned enterprises and the emergence of a **highly fragmented industrial landscape.**

Today, the sector is characterized by **over 1,700 enterprises, the vast majority (estimated >90%) being Small and Medium Enterprises (SMEs)**, many family-owned. This fragmentation presents challenges for coordinated action, though the T&C sector remains a **significant regional employer (estimated ~16% of manufacturing employment)** and maintains a **strong export orientation**, primarily serving EU markets like Germany and France. Łódź continues to be a **major Polish fashion centre**, notably hosting the expansive Ptak Fashion City wholesale complex.

Alongside traditional strengths in apparel, fabrics (cotton, synthetics, velvet), and home textiles, an ongoing modernization leverages the region's historical skills base and strong research institutions. There is an **increasing focus on innovation, higher value-added products, and exploring sustainable materials and technical textiles**, with notable producers emerging in areas like nonwovens and filtration (e.g., TEXTON, FILTER SERVICE).

### 3.2.2 Key Stakeholder Ecosystem

Łódzkie's textile ecosystem features a diverse array of actors reflecting its rich history and ongoing evolution. The interactions between these stakeholders are crucial for navigating the path towards greater innovation and circularity:

- **Industry (Manufacturers, Recyclers, Waste Management):** The industrial fabric consists **predominantly of SMEs** active across the value chain. Key segments include **apparel manufacturers** (e.g., Telimena S.A.), **fabric producers/knitters** (e.g., Bowi-Styl, MIRWAL, Teofilów SA), **yarn spinners** (e.g., Mistral-Elast, EAST WEST SPINNING), **thread manufacturers** (e.g., ARIADNA S.A.), and **specialized processors** (e.g., Farbiarnia Biliński). **Technical textile producers** (e.g., TEXTON S.A., FILTER SERVICE) represent the sector's diversification. **Analysis of identified actors suggests representation across knitting, apparel manufacturing, fabric finishing, and yarn spinning.**
    - **Circularity Infrastructure:** Information regarding dedicated, large-scale facilities for **advanced textile recycling (fiber-to-fiber) operating *within* Łódzkie is limited.** Circularity efforts currently appear focused on basic reuse or mechanical downcycling, potentially relying on national players located elsewhere (e.g., Polfibra in nearby Częstochowa). This signifies a **critical regional gap in high-value recycling capacity.**
    - **Waste Management:** Municipal waste management, including textiles collected via designated points (PSZOKs), involves operators like **MPO Łódź** (primary for the city) and regional contractors (e.g., **EKO-REGION, PGK Opoczno**). The effectiveness of these systems for *diverting textiles to high-value circular pathways* requires further investigation.

- **Academia/Research (R&D & Education):** This sphere is a recognized regional strength. The **Łódź University of Technology (TUL)**, particularly its Faculty of Material Technologies and Textile Design, serves as the principal R&D institution, possessing deep expertise in textile science, engineering, and innovation. The **Strzemiński Academy of Art Łódź** provides crucial capabilities in fashion and textile design. Specialized research capabilities are also offered by institutes within the **Łukasiewicz Research Network (Łódzki Instytut Technologiczny - LIT)** and the **MORATEX Institute of Security Technologies**. Vocational training institutions (e.g., **Zespół Szkół Przemysłu Mody w Łodzi**) are essential for skilled workforce development.
- **Government (Public Authorities & Policy):** The **Marshal's Office of the Łódzkie Voivodeship** sets the regional development strategy (RIS3/LORIS 2030) and manages EU regional funds. **Municipal authorities** (City of Łódź, gminas) are primarily responsible for establishing and managing waste collection systems (including the upcoming 2025 textile mandate). National policies from the **Ministry of Climate and Environment** (waste/EPR) and **Ministry of Economic Development and Technology** (industrial strategy) provide the overarching framework.
- **Support Organizations & Intermediaries (Clusters, Associations, Agencies):** Several organizations facilitate collaboration. Key national industry associations include **PIOT - Federation of Apparel & Textiles Industry Employers**. Regionally, the **Łódzka Izba Przemysłowo-Handlowa (ŁIPH)** represents diverse business interests, including textile firms. The **Łódzka Agencja Rozwoju Regionalnego (ŁARR)** acts as a crucial intermediary, supporting business development and access to finance. **Incubators** (Fundacja Inkubator) and the **Łódź Special Economic Zone (ŁSSE)** provide additional support. **Notably, unlike other TEX-BREIN regions, Łódzkie appears to lack a highly visible, dedicated cluster organization specifically focused on coordinating innovation and circularity within the textile sector.**
- **Civil Society:** Charitable organizations (e.g., **Polish Red Cross**) are involved in textile collection for reuse. Environmental NGOs and sustainable fashion advocacy groups likely operate nationally or regionally, influencing awareness. **Improving consumer awareness regarding proper disposal and the value of circular practices remains an ongoing need.**

The Łódzkie ecosystem benefits from significant historical capital, a strong academic research base (TUL, Academy of Art), and active regional support agencies (ŁARR, ŁIPH). However, the **high fragmentation of the SME-dominated industry** and the **apparent underdevelopment of both advanced recycling infrastructure and dedicated circularity coordination mechanisms (like a focused cluster)** present key challenges for a systemic transition.

### 3.2.3 Current Innovation & Circularity Landscape

Łódzkie's textile sector demonstrates a blend of adapting its traditional industrial base and exploring nascent circularity initiatives:

- **Innovation Focus:** Innovation efforts are strongly linked to regional R&D institutions (TUL, LIT, MORATEX, Academy of Art). Focus areas include modernizing traditional processes, developing **advanced materials (potentially for technical applications)**, and increasing **digitalization**, aligning with the RIS3/LORIS 2030 strategy's emphasis on "modern textiles and the fashion industry". Vocational schools support the necessary technical skills pipeline.
- **Circularity Practices & Infrastructure:**
    - **Reuse:** Activities like clothing repair and online second-hand sales are gaining traction, particularly among younger consumers. Charitable collection for reuse is established.
    - **Collection & Sorting:** The current infrastructure relies mainly on street containers and municipal PSZOKs. **National readiness for the 2025 separate collection mandate is a major concern**, indicating significant gaps in collection capacity and, critically, **sorting infrastructure** needed to handle increased volumes and separate materials effectively. Contamination is a likely challenge.
    - **Recycling:** High-value fiber-to-fiber recycling remains **significantly underdeveloped regionally**. Existing activities likely focus on basic **mechanical downcycling** or preparing materials for export or processing elsewhere. The national textile recycling rate is extremely low (~1%), reflecting systemic challenges.

- **Infrastructure & Policy Gaps:** The lack of accessible, industrial-scale infrastructure for **advanced sorting and high-value recycling** is the most critical bottleneck. Uncertainty around the national **EPR scheme implementation** hinders investment planning. **Data scarcity** on regional waste flows complicates effective strategy development.

The Łódzkie ecosystem leverages its strong historical identity scale and ultimate environmental impact are unclear from available regional data.

### 3.2.4 Alignment with Regional Strategy (RIS3/LORIS 2030)

The Łódzkie Voivodeship's regional innovation strategy (RIS3/LORIS 2030) explicitly designates **"modern textiles and the fashion industry (including design)"** as a key smart specialization area. This provides high-level strategic recognition, aiming to leverage the R&D strengths of TUL and associated institutes to support modernization, advanced material development, and digitalization.

While the strategy implicitly aligns with broader sustainability goals, the degree to which it translates into specific, funded actions or targets explicitly promoting **textile circularity** requires detailed examination of the full strategy document and associated funding programs (e.g., "European Funds for Lodzkie 2021-2027"). The alignment exists at a strategic level, but effective implementation necessitates translating these priorities into tangible support mechanisms and infrastructure development addressing the identified circularity bottlenecks (especially collection, sorting, and advanced recycling).

## 3.3 TOSCANA (ITALY - ITI1)

### 3.3.1 Regional Context & Textile Sector Overview

Tuscany, particularly the **Prato industrial district**, holds a globally unique and historically significant position within the European textile landscape. Its identity is inextricably linked to a centuries-old tradition, not just of textile manufacturing, but distinctively of **mechanical wool recycling**. This practice, known locally as producing "cardato rigenerato", involves the meticulous collection, sorting, and reprocessing of pre- and post-consumer wool and cashmere scraps into new fibers and fabrics. This deep-rooted expertise forms a unique cultural and industrial foundation for circularity.

The Prato district exemplifies a Marshallian industrial district, covering approximately 700 km² across 13 municipalities. It features an exceptionally dense network of **around 7,000 enterprises**, the vast majority being highly specialized **Small and Medium Enterprises (SMEs)**, often family-run businesses collaborating closely within the value chain. This ecosystem directly employs **over 35,000 workers**. While historically centered on regenerated wool, the district's production integrates significantly into the broader Italian and international fashion system, supplying fabrics and components to numerous high-end and luxury brands. Key activities span the full spectrum: spinning, weaving, knitting, dyeing, printing, and finishing.

A notable development since the 1990s is the rise of a parallel **"pronto moda" (fast fashion)** manufacturing segment, often associated with Chinese entrepreneurship. This segment operates with different dynamics, focusing on rapid production cycles and diverse materials (including synthetics), adding complexity to the region's industrial fabric. Tuscany also hosts companies specializing in **technical textiles**.

Nationally, Italy's textile manufacturing and finishing sectors represent substantial economic activity (combined revenue exceeding €33 billion estimated for 2024), with Tuscany, primarily through Prato, being a major contributor. Export performance is crucial, though vulnerable to global demand shifts.

### 3.3.2 Key Stakeholder Ecosystem

The Tuscan textile ecosystem, especially concentrated in Prato, is highly specialized and features strong interconnections across the Quadruple Helix:

- **Industry (Manufacturers, Recyclers, Waste Management):** The ecosystem is defined by its **vast number of specialized SMEs (over 90% of the identified actors are SMEs)**.
    - **Value Chain & Specialization:** Key players include traditional **wool recyclers and processors** renowned for their expertise (e.g., Comistra, Fil Man Made, Manteco, Cormatex, Dell'Orco Villani) forming the historical core of Prato's circular economy. Numerous manufacturers supply fabrics, particularly high-quality ones, to luxury brands (e.g., Pecci Filati, Lanificio Faliero Sarti, Lanificio Bisentino, Milior). **Analysis of identified companies shows strong representation across yarn spinning, weaving, and especially fabric finishing.** Technical textile

specialists (e.g., Menchi Tessuti, LTA Srl) and apparel manufacturers (e.g., Monnalisa, Peuterey) are also significant. The **fast fashion cluster** represents a distinct part of the landscape.

- **Circularity Infrastructure:** The **GIDA S.p.A. industrial aqueduct and centralized wastewater treatment plant** is a unique shared infrastructure enabling water reuse for dyeing/finishing companies. General waste management across Central Tuscany is handled by **Alia Servizi Ambientali**, which is developing an **automated Textile Hub** for sorting post-consumer waste. **Revet** also plays a role in waste management. Collection involves various actors, including specialized firms handling textile scraps (e.g., Nuova F.lli Boretti) and potentially social enterprises (though less prominent in initial mapping compared to other regions). Circular-native brands (e.g., **Rifò**) built on recycled materials are emerging. **The Prato district's strength lies in established mechanical recycling, particularly for wool, while capacity for advanced sorting of mixed materials and chemical recycling appears less developed at scale.**

- **Academia/Research (R&D & Education):** Applied research, testing, and technology transfer are supported by key institutions:
  - **Next Technology Tecnotessile (NTT):** The central public-private research organization in Prato, offering R&D, testing, pilot facilities, and focusing increasingly on circular technologies.
  - **PIN Scrl / ARCO (University of Florence, Prato Campus):** Hosts applied circular economy research and facilitates collaborative projects (e.g., FLOWTEX).
  - **Universities:** Regional universities (**University of Florence, University of Pisa, Sant'Anna School of Advanced Studies, University of Siena**) provide broader research expertise. **INSTM** focuses on materials science.
  - **Testing & Education:** Accredited testing labs (**Centro Qualità Tessile - CQT, Brachi Testing Services**) are based in Prato. The historical **Buzzi Technical Institute** provides textile education (note: commercial lab status requires verification). High-level fashion/design education is offered by **Polimoda** (Florence) and **I.T.S. M.I.T.A.**

- **Government (Public Authorities & Policy):**
  - **Regione Toscana:** Guides regional development (RIS3) and environmental regulations.
  - **Municipality of Prato:** Notably proactive, driving the **Prato Circular City** initiative.
  - **ARPAT:** Regional environmental protection agency.
  - **National Level (MASE):** Responsible for waste policy and the delayed textile EPR implementation.
- **Support Organizations / Intermediaries (Clusters, Associations, Agencies):** The ecosystem benefits from strong, often district-focused, industry representation and support:
  - **Industry Associations: Confindustria Toscana Nord** (larger industries), **Associazione del Tessile Riciclato Italiano (ASTRI)** (recycled textiles), **CNA Toscana Federmoda** (artisans/SMEs).
  - **Chambers of Commerce:** Provide economic data and business support (e.g., Chamber of Commerce of Pistoia-Prato).
  - **Innovation & Creative Hubs: Next Technology Tecnotessile (NTT)** acts as a key innovation hub. **Lottozero** fosters design-led innovation. **PRISMA DIH** supports digitalization.
- **Civil Society:** National environmental NGOs (**Legambiente, WWF**) have regional presence. Sustainable fashion advocacy groups (e.g., **Remake**) engage consumers. Consumer participation in collection is influenced by municipal initiatives.

Tuscany, particularly Prato, showcases an exceptionally specialized ecosystem built on **mechanical wool recycling ("cardato rigenerato")**. Its strengths lie in this deep-rooted expertise, the **high density of its SME network**, unique shared infrastructure (**GIDA**), and strong applied research support (**NTT, ARCO**). A significant number of identified actors are **cluster members** associated with NTT. Key challenges involve adapting traditional models to modern mixed materials, integrating the significant **fast fashion segment** into circularity efforts, and navigating the uncertainties of delayed national **EPR**

**implementation**. Scaling advanced sorting and recycling for diverse materials beyond wool remains a critical need.

### 3.3.3 Current Innovation & Circularity Landscape

Tuscany's circularity landscape presents a fascinating blend of deeply ingrained historical practices and forward-looking innovation efforts:

- **Established Mechanical Recycling:** Prato remains a global benchmark for the mechanical recycling of wool and other natural fibers. This "cardato rigenerato" system processes substantial volumes (>100,000 tonnes annually) of pre- and post-consumer waste, turning them back into high-quality fibers and yarns, representing a long-standing, economically significant circular model.
- **Shared Infrastructure:** Prato boasts unique shared infrastructure: the **GIDA industrial aqueduct and wastewater treatment plant** enables significant water recycling vital for dyeing/finishing. Alia Servizi Ambientali's developing **automated Textile Hub** aims to address the critical bottleneck of sorting large volumes of mixed post-consumer waste. Existing mechanical processing infrastructure in Prato is extensive for its traditional niche (wool).
- **Technological Development:** While mechanical processing is the historical core, R&D addresses limitations. **NTT** researches solutions for recycling complex blends, removing contaminants, and exploring advanced treatments (electron beam, plasma). **ARCO/PIN** and universities investigate digital tools (IoT, AI, blockchain) for traceability and process efficiency (e.g., FLOWTEX, PRISMA projects).
- **Collection Challenges:** Italy mandated separate textile collection from 2022. However, implementation is uneven, and **national collection rates remain low** compared to waste generation. While Prato has channels for its specific feedstock (wool/cashmere scraps), capturing the broader stream of mixed post-consumer textiles across Tuscany is a major challenge.
- **Policy & Initiatives:** The **Prato Circular City** project exemplifies proactive local governance. Industry initiatives (e.g., **Re.Verso**) focus on traceable recycled supply chains. Tuscan actors participate actively in **EU projects** (e.g., RegioGreenTex, LIFE CIRTECHTEX). The primary policy hurdle remains the **delayed finalization and**

**implementation of Italy's textile EPR decrees**, creating significant market uncertainty

### 3.3.4 Alignment with Regional Strategy (RIS3)

Tuscany's Smart Specialisation Strategy (RIS3) for 2021-2027 is explicitly framed around the '**Green Transition**', aiming for environmentally sustainable, circular, and renewable energy-based development models. It emphasizes promoting the **circular economy** and improving resource efficiency in production processes. This overarching strategic direction strongly supports the evolution of Tuscany's textile sector, particularly the circular practices historically embedded in Prato and the newer initiatives focused on broader sustainability. Concrete manifestations of this alignment include the Prato Circular City initiative and the research and technology transfer activities undertaken by NTT and ARCO/PIN, which often leverage regional (ERDF) and national (PNRR) funding streams tied to these green transition goals. While specific, detailed actions or funding allocations dedicated exclusively to *textile circularity* within the publicly accessible RIS3 summary documents might be limited, the overall strategic impetus clearly favours innovation and investment in this area, providing a supportive policy context for TEX-BREIN objectives.

## 3.4 Norte (Portugal - PT11)

### 3.4.1 Regional Context: Textile Industry Significance & Specialization

The Norte region stands as the undisputed heartland and driving force of Portugal's Textile and Clothing (T&C) industry, hosting the vast majority (estimated >80%) of the nation's T&C companies, employment, and economic turnover. This solidifies its role as a major European production centre, geographically concentrated within the NUTS III regions of Cávado, Ave, Oporto Metropolitan Area, and Tâmega e Sousa. Municipalities like Guimarães, Vila Nova de Famalicão, Santo Tirso, Barcelos, Vila do Conde, and Póvoa de Varzim are key manufacturing hubs.

The region's industrial structure is dynamic, comprising large, often vertically integrated companies with significant international reach (e.g., **Riopele, TMG Group, Adalberto, Mundotêxtil, Lasa**) alongside a predominant, highly flexible base of **Small and Medium Enterprises (SMEs)**. This mix fuels the sector's adaptability and responsiveness. Historically recognized for quality and craftsmanship, the industry strategically shifted towards higher

value-added segments post-Multi-Fibre Agreement. While **fashion/apparel** and **home textiles** remain crucial pillars, Norte has also emerged as a European leader in **technical textiles**, producing items for automotive, medical, protective, defense and industrial applications, showcasing significant diversification.

Economically, the T&C sector is vital. Generating an estimated €6.8 billion in regional turnover (2021) out of a national €8.0 billion, it accounts for roughly 19-20% of Portugal's manufacturing employment, with **over 106,000 regional employees** in 2021. Exports are critical, driving the bulk of the €6.0 billion national T&C exports in 2022 (8-10% of total Portuguese merchandise exports), primarily to EU markets (Spain, France, Germany). Despite this economic weight, the sector faces productivity challenges compared to the national manufacturing average, underscoring the importance of innovation and the transition towards higher-value circular models.

### 3.4.2 Key Stakeholder Ecosystem

Norte boasts a dense, well-connected, and highly developed ecosystem supporting its T&C industry, with key actors collaborating across the Quadruple Helix:

- **Industry (Manufacturers, Recyclers, Waste Management):** Encompasses a wide range of manufacturers. Key large firms provide significant scale (e.g., **Riopele, Adalberto, Somelos, Impetus**). However, the ecosystem is **dominated by SMEs**, covering the entire value chain from **spinning** (e.g., Inovafil, Tearfil) and **weaving/knitting** (e.g., A. Sampaio, LMA) to **dyeing/printing/finishing** (e.g., Tintex, Tinamar, Neivacor) and **apparel/product manufacturing** (e.g., Damel, Confetil, Cordeiro Campos, Latino). **Analysis of identified actors indicates strong capabilities across knitting, apparel manufacturing, fabric finishing, and design/product development.** Specific players in **technical textiles** (e.g., ERT Têxtil, Coltec, Foot by Foot) and those utilising **recycled materials** are prominent.
    - **Circularity Actors:** Dedicated textile recyclers focus mainly on **mechanical processes** (e.g., **SASIA, RECUTEX, Valerius 360**). Collection networks for post consumer textiles are operated by charities (**Humana Portugal**) and private firms (e.g. **Ultriplo**, **Wippytex, H Sarah Trading**). Large intermunicipal waste management systems (**LIPOR, Resinorte, Resíduos do Nordeste**) manage primary MSW infrastructure and show increasing engagement with textile

streams, particularly LIPOR. **Advanced fiber-to-fiber recycling at scale within the region appears limited, representing a key infrastructure gap.**

- **Cluster Engagement:** A very high proportion of identified companies (**over 80% based on initial mapping**) are formal members of the Portuguese Textile Cluster, indicating strong network integration.

- **Academia/Research (R&D & Education):** This is a major regional strength and innovation engine.
  - **Key RTO/University Hubs: CITEVE** (Centro Tecnológico das Indústrias Têxtil e do Vestuário de Portugal) in V.N. Famalicão is the cornerstone RTO, providing comprehensive R&D, testing, certification, training, pilot lines, and technology transfer. The **University of Minho (UMinho)** (Braga/Guimarães) is a critical academic partner with world-class research via its Department of Textile Engineering (DET) and **Centre for Textile Science and Technology (2C2T)**. Collaboration between CITEVE and UMinho is deep and established.
  - **Complementary Centers: CeNTI** (nanotechnology/smart materials), **INESC TEC** (ICT/automation), **INEGI** (resources and operations optimization) and **FEUP** (chemical/materials engineering) provide specialized expertise.
  - **Higher Education:** Programs at **UMinho, UPorto, IPCA** (Barcelos), **IPPorto** and **IPVC** (Viana do Castelo) supply skilled graduates.

- **Government (Public Authorities & Policy):**
  - **Regional: CCDR-Norte** guides regional strategy (RIS3) and manages EU funds (NORTE 2030). Municipalities manage local waste planning/collection.
  - **National:** Key agencies include **IAPMEI** (SME/cluster support), **APA** (environment/waste/GPP), **ANI** (innovation funding), **FCT** (research funding), **INPI** (patents), **AICEP** (trade/investment), and **Fundo Ambiental** (environmental projects).

- **Support Organizations / Intermediaries (Clusters, Associations, Agencies):** The ecosystem is well-supported.

- **Clusters: Cluster Têxtil: Tecnologia e Moda (Portuguese Textile Cluster),** Managed by CITEVE, it formally structures R&D-industry-academia collaboration; **PRODUTECH, advanced manufacturing cluster** encompassing entities involved on the development, innovation and certification of new technologies and production equipment used in the textile sector.
- **Industry Associations: ATP** (Associação Têxtil e Vestuário de Portugal) represents the broad sector; **ANIVEC/APIV** (Associação Nacional das Indústrias de Vestuário e Confecção) focuses on apparel; ANIT-LAR (Associação Nacional das Indústrias de Têxteis-Lar) focuses on home textiles; AICR (Associação Nacional dos Industriais de Cordoaria e Redes) focuses on ropes and net industries.
- **Vocational Training: MODATEX** (national center via PPP) has a strong regional presence.
- **General Business Support:** Associations like **AEP** provide networking.
- **Finance: BPF** channels PRR funds; EIB and commercial banks offer green finance; a growing VC/PE ecosystem shows potential.

- **Civil Society:** Includes collection/reuse organizations (**Humana Portugal**), environmental advocacy (**ZERO**), sustainable fashion promotion (**Fashion Revolution Portugal, Sustexmoda**), and corporate sustainability platforms (**BCSD Portugal**).

Norte's ecosystem benefits immensely from the **strong, synergistic relationship between CITEVE, UMinho, ATP, ANIVEC/APIV and the industry**, creating a highly integrated and focused innovation environment, evidenced by high cluster participation. While traditional manufacturing remains strong, there is significant activity in technical textiles and growing adoption of recycled materials, supported by world-class R&D.

### 3.4.3 Current Innovation & Circularity Landscape

Norte is actively engaged in T&C innovation, with a rapidly increasing focus on integrating circularity:

- **Innovation Focus:** Strong emphasis on technological advancement and sustainability. Key areas include **technical textiles, smart materials (CITEVE, CeNTI), sustainable dyeing/finishing (UMinho, CITEVE), digitalization/traceability (INESC TEC, CITEVE,**

**PRODUTECH), industrial equipment and processes (INEGI, INESC TEC, PRODUTECH) and bio-based/recycled materials.** Large collaborative projects (e.g. be@t, Fashion Forward, RegioGreenTex, PRODUTECH R3) funded by PRR/EU are crucial drivers.

- **Circularity Status:** Industry adoption of circular practices (recycled content, durability, reuse/repair exploration) is growing, often catalyzed by CITEVE/EU projects. However, systemic challenges persist:
    - **Collection:** Separate collection of post-consumer textiles is nationally underdeveloped, implying **very low capture rates (<2% est.)** in Norte, far below the 2025 mandate.
    - **Recycling:** Existing regional capacity focuses on **mechanical processing** (e.g., Valerius 360, RECUTEX, SASIA), often resulting in downcycling. **High-value fiber-to-fiber recycling capacity is currently limited to R&D/pilot stages.** Reliance on export for post-consumer textiles remains high.
- **Key Infrastructure:** World-class **R&D, testing, and pilot infrastructure (CITEVE, UMinho)** exists. However, **commercial-scale advanced sorting and high-value recycling facilities are largely absent regionally**, representing a critical gap. Collection infrastructure requires significant scaling and modernization.
- **Collaborative Initiatives:** The formal **Cluster Têxtil** and **cluster PRODUTECH,** as well as numerous project-based consortia (**be@t, Fashion Forward, PRODUTECH R3**), demonstrate effective multi-stakeholder collaboration, facilitated by strong industry-academia links. Digital innovation hubs like **Produtech DIH** and DIGI4FASHION offer cross-sectoral support.

### 3.4.4 Alignment with Regional Strategy (RIS3)

Norte's regional policy landscape demonstrates strong and explicit alignment supporting the textile sector's circular transition:

- The **NORTE RIS3 strategy** identifies **"Culture, Creativity and Fashion"** (explicitly including textiles) as a key priority, emphasizing modernization, design, and new materials.

- The dedicated **PAReg-EC NORTE (Regional Action Plan for Circular Economy)** specifically targets the textile sector, outlining objectives for bio-based/recycled materials, reuse markets, recycling infrastructure, eco-design, waste valorization, and circular business models.
- This dual strategic focus provides a clear mandate for channeling regional funding (e.g., NORTE 2030) and aligning support mechanisms to accelerate the T&C circular transition, directly supporting TEX-BREIN's goals. National policies (PAEC, RGGR, upcoming EPR) further reinforce this.

While strong policy alignment provides a supportive environment, successful transition hinges on translating strategies into scaled infrastructure, widespread industry adoption (especially SMEs), and efficient value chain coordination.

As previously mentioned, PRODUTECH's regions of influence also includes CENTRO. CENTRO regional Smart Specialisation Strategy is aligned with TEX-BREIN namely its contribution to the Innovation Hub 'Development of sustainable industrial solutions', more specifically with action lines "industrial modernisation through circular economy" and "industrial modernisation through digitalisation and the introduction of advanced technologies".

## 3.5 Catalonia (Spain - ES51)

### 3.5.1 Regional Context & Textile Sector Overview

Catalonia possesses a long-standing and significant textile manufacturing tradition, evolving considerably from its historical roots. While the region, particularly Barcelona, is renowned for its **design influence and fashion brands**, a crucial and growing aspect is its strength in **advanced and technical textiles**, supported by a robust network of research centers and specialized industry clusters like **Tèxtils.CAT**.

The textile and clothing sector remains a substantial contributor to the regional economy, generating significant turnover (estimated €14.5 billion circa 2019) and employment (over 64,500 workers circa 2019), accounting for a major share (~30%) of Spain's total T&C exports. The industrial fabric includes key manufacturers across the value chain, many being **SMEs**, but also significant larger players. This manufacturing base benefits from strong **R&D capabilities** and the region's overall industrial dynamism. A key challenge remains the

reliance on global supply chains and the need to adapt to demanding EU sustainability and circularity requirements.

### 3.5.2 Key Stakeholder Ecosystem

Catalonia's ecosystem supporting advanced textile manufacturing and circularity is well-developed, featuring strong capabilities in research, industry support, and collaborative initiatives:

- **Industry (Manufacturers, Technology Providers, Recyclers, Waste Management):** The region hosts numerous manufacturers across different value chain stages, reflecting Catalonia's diverse textile activity. The industrial structure is characterized by a **predominance of SMEs**, although influential companies operate across various segments.
    - **Value Chain & Specialization:** Analysis of identified actors reveals strong capabilities across the value chain. This includes producers of specialized **yarns** (e.g., **Antex, Hilaturas Arnau** - including recycled yarns, **S.A. Hilados Egarfil, Pages Valenti**), **weavers and knitters** producing technical and traditional fabrics (e.g., **FINSA, Marina Textil, E.Cima, MITSA, Texber, Textil Tapias**), and companies specializing in **finishing and coating processes** (e.g., **Bonditex, Laminats Orient, Rosich y Puigdengolas**). The application focus is notably strong in **technical textiles** (Indutech, Protech, Mobiltech, Medtech, etc.), complementing activities in Home Textiles and Clothtech.
    - **Circularity Actors:** Specialized recyclers like **Triturats La Canya** handle the mechanical recycling of fibers. Waste management infrastructure involves authorized conventional operators and social enterprises (**Humana, Roba Amiga network**) managing collection networks under the oversight of the **Agència de Residus de Catalunya (ARC)**. While RTOs like Leitat and Eurecat are involved in developing advanced sorting and recycling solutions, and local providers of sorting technology are emerging, the **capacity for scaled, industrial high-value fiber-to-fiber recycling (chemical or advanced mechanical) for diverse waste streams appears limited within the region itself.**

**Academia/Research (R&D & Education):** This is a core strength. Leading multi-purpose Research and Technology Organizations (RTOs) **Eurecat** and **Leitat** provide extensive capabilities highly relevant to advanced and technical textiles, including materials science, nanotechnology, sustainability assessment (LCA), digitalization (AI, IoT), prototyping, and testing. Both are actively involved in textile-related R&D and circularity projects (e.g., LIFE CIRTECHTEX). University research, particularly from **Universitat Politècnica de Catalunya (UPC)** via the **INTEXTER** institute and **Universitat Autònoma de Barcelona (UAB)** (ICTA-UAB), contributes fundamental and applied knowledge. The **Fab Lab Barcelona (IAAC)** supports experimentation with digital fabrication and novel materials relevant to advanced textiles. Specialized technical and design education is available, supporting the skills base.

- **Government (Public Authorities & Policy):** The **Generalitat de Catalunya** sets the regional strategic direction (RIS3CAT) and coordinates key initiatives like the Pact for Circular Fashion. The **Agència de Residus de Catalunya (ARC)** is central to waste policy, regulation, circular economy promotion, and funding for CE projects. **ACCIÓ** (Agency for Business Competitiveness) is vital for supporting industrial innovation, competitiveness, internationalization, and manages the TECNIO network connecting companies, together with key technology developers like Eurecat and Leitat. Local authorities (i.e. **AMB**) manage collection systems and support local industry.

- **Support Organizations / Intermediaries (Clusters, Associations, Agencies):** Clusters are highly active. **Tèxtils.CAT** is the key cluster dedicated to **advanced textile materials**, playing a crucial role in fostering innovation, international collaboration (managing numerous EU projects like RegioGreenTex, InTransit, xBUILD-EU), and promoting circularity through initiatives like its **Circular Hub**. Other bodies like the **Barcelona Chamber of Commerce** and **BCD Barcelona Design Centre** provide business support relevant to manufacturers and product development.

- **Civil Society:** NGOs and social enterprises (**Humana, Moda re-**) play operational roles in collection and reuse. Advocacy groups (**Asociación Moda Sostenible Barcelona, SETEM Catalunya**) promote sustainability and ethical considerations, influencing the broader industrial context.

The Catalan ecosystem benefits from **strong RTOs (Eurecat, Leitat)**, a highly active and **specialized technical textiles cluster (Tèxtils.CAT)** with strong member engagement, proactive public agencies (**ARC, ACCIÓ**), and significant collaborative momentum via the **Pact for Circular Fashion**. This positions it well for innovation in advanced and circular textiles. However, challenges remain in **scaling collection and high-value recycling infrastructure** to match policy ambitions and managing the transition within its **SME-dominated** industrial fabric.

### 3.5.3 Current Innovation & Circularity Landscape (Snapshot)

Catalonia is actively driving innovation, particularly in advanced materials and technical textiles, with a strong policy push towards circularity. However, practical implementation, especially concerning waste infrastructure, presents significant challenges:

- **Innovation Focus:** R&D (Eurecat, Leitat, universities, Tèxtils.CAT members) focuses on **advanced materials, sustainable manufacturing processes** (reduced water/chemical use), **digitalization** (AI, IoT, smart textiles), and diverse **technical textile applications**. **Cross-sectoral innovation** (e.g., textiles-construction via xBUILD-EU) is explored.
- **Collaborative Platforms & Policy:** The **Pact for Circular Fashion** is a central pillar mobilizing >100 stakeholders. **Tèxtils.CAT's Circular Hub** provides a focused platform for advanced material circularity. **ARC** actively funds CE projects.
- **Collection:** Despite ambitious targets (Pact, 2025 EU mandate), the separate collection rate remains **critically low (est. 11-12%)**, a major weakness hindering resource recovery.
- **Sorting & Recycling:** Current infrastructure primarily supports reuse preparation or export. Advanced automated sorting capacity is developing but not widespread. Industrial-scale **high-value fiber-to-fiber recycling infrastructure is significantly underdeveloped (<1% rate est.)**, leading to high export rates (40-70%) of collected textiles and material value loss. Projects like **LIFE CIRTECHTEX** represent important steps but lack scale.

- **Waste Generation:** Estimated per capita textile waste generation is **higher than the EU average (approx. 21.5 kg/year )**, highlighting consumption levels and the scale of the challenge.
- **Key Challenge:** Bridging the gap between policy ambitions/targets and the reality of low collection rates and lack of scaled domestic infrastructure for advanced sorting/high-value recycling.

### 3.5.4 Alignment with Regional Strategy (RIS3)

Catalonia's Smart Specialisation Strategy (RIS3CAT) identifies "**Industrial systems**" and "**Design-based industries**" as key priority areas, encompassing the textile manufacturing sector and its potential for innovation. The strategy emphasizes sustainability, digitalization, and advanced manufacturing, aligning well with the needs of the technical and advanced textile segments and the push towards circularity. The active roles of **ACCIÓ** in supporting clusters like Tèxtils.CAT and **ARC** in promoting and funding circular economy projects demonstrate the translation of these strategic priorities into tangible support mechanisms. The **Pact for Circular Fashion**, although voluntary, acts as a powerful coordinating mechanism strongly aligned with RIS3CAT's goals of fostering a more competitive, sustainable, and resilient industrial base, specifically targeting the textile value chain from design and manufacturing through to end-of-life management. This strong policy and strategic alignment provides a supportive environment for initiatives focused on advancing circularity within Catalonia's technical and broader textile manufacturing sectors.

## 3.6 VÄSTRA GÖTALAND (SWEDEN - SE23)

### 3.6.1 Regional Context: Textile Industry Significance & Specialization

Västra Götaland, with the city of **Borås ("the textile city")** at its core, represents Sweden's most significant and dynamic hub for textile innovation, design, and commerce. While sharing the historical decline of traditional manufacturing seen across Western Europe, the region successfully pivoted towards **higher education, research, design, e-commerce, technical textiles**, and increasingly, **sustainable and circular solutions**. This rich history provides a unique foundation of knowledge, infrastructure elements (e.g., Textile Museum of Borås), and brand recognition.

The region hosts headquarters or major operations of prominent Swedish **fashion and home textile brands and large e-commerce businesses** (e.g., Lindex, KappAhl, **Ellos , Gina Tricot, Hemtex, Blåkläder**). Alongside these larger players, numerous **SMEs** operate in apparel, design, and specialized manufacturing. A key characteristic is the strong emphasis on **innovation**, particularly in smart textiles, sustainable materials (e.g., cellulose-based fibers), and advanced circular processes, driven by concentrated **R&D infrastructure**. Compared to other Swedish regions, Västra Götaland features a higher concentration of larger corporations and robust overall innovation capacity, making it fertile ground for scaling new textile solutions. The Borås area serves as the primary geographical cluster.

### 3.6.2 Key Stakeholder Ecosystem

Västra Götaland benefits from a well-developed, highly interconnected, and mature ecosystem for textile innovation, with strong players actively engaged in advancing circularity across the Quadruple Helix:

- **Industry (Manufacturers, Brands, Recyclers, Waste Management):** Features leading **brands** (e.g.,**Lindex, KappAhl, Ellos Gina Tricot, Nudie Jeans, Blåkläder**) actively implementing sustainability strategies and circular business models (repair, resale, take-back). Manufacturing includes **home textiles** (e.g., **Ludvig Svensson, Kasthall**) and **technical textiles** (e.g., **FOV Fabrics, Engtex**). Numerous SMEs contribute to design, niche manufacturing, and related services.
    - **Circularity Infrastructure:** Specialized capacity for circular processing *within VGR* is currently focused on **R&D and piloting**: **Wargön Innovation** leads in advanced automated sorting development, while **RISE** operates a mechanical recycling testbed. University of Borås and Science Park Borås offers an innovation environment with a holistic approach on circularity, from business models, to fibers and textile, and to consumer behavior. **Large-scale commercial recycling facilities for textile** (e.g., Circulose (former Re:newcell), Södra are located outside the region, highlighting a **critical gap in local industrial-scale processing**.
    - **Waste Management:** Municipal waste management in key areas (e.g., Gothenburg) is handled by operators like **Renova AB**, primarily focused on waste-to-energy for mixed waste. **Stena Recycling** runs several projects that aim to move textiles up the waste hierarchy. Every year discarded textiles from fashion companies,

furniture manufacturers, textile manufacturers, hotel chains, laundries and hospitals are collected and sorted. Charities (**Myrorna, Red Cross, Björkå Frihet, PMU second hand**) operate established collection systems, mainly for reuse.

- **Academia/Research (R&D & Education):** This is arguably the region's most significant strength.
    - **University of Borås:** A world-leading institution via its **Swedish School of Textiles (SST)** (design, technology, management) and the **Swedish Centre for Resource Recovery (SCRR)** (circularity, waste valorization), both with extensive lab/pilot facilities. The Swedish School of Textiles is a broad and complete academic environment with educational programmes at the Bachelor's, Master's, and doctoral levels and research in technology, design, and textile management. More than 15 research groups have connections to textiles (e.g. Advanced textile structures, Textile Value Chain Management, Textiles and Fashion Design)
    - **RISE (Research Institutes of Sweden):** Major presence with deep expertise in materials science, process development, testing, and mechanical/chemical recycling R&D.
    - **Other Universities: Chalmers University of Technology** (Gothenburg - engineering/science) and **University West** (collaboration on sorting tech) contribute key expertise.
- **Government (Public Authorities & Policy):**
    - **Regional: Västra Götalandsregionen (VGR)** is highly active, setting regional development strategy (RUS), providing significant innovation funding, and platforms like the **Textile Movement**.
    - **Municipal:** Cities like **Borås Stad** and **Gothenburg Municipality** manage local waste collection (including the upcoming separate textile fraction) and support local initiatives.
    - **National:** Key agencies (**Naturvårdsverket** - EPA/EPR, **Tillväxtverket** - economic growth, **Vinnova** - innovation funding, **Formas** - sustainable development research) exert significant influence. Upcoming **mandatory EPR for textiles** is a critical policy driver.

- **Support Organizations / Intermediaries (Clusters, Associations, Agencies):** While lacking a single dominant formal cluster like some regions, a strong network of support organizations exists:
  - **Innovation Hubs/Platforms: Science Park Borås (SP Borås)** is the central orchestrator, part of the University, hosting vital platforms like **Smart Textiles (ESCA Silver certified)**, the national assignment **Textile & Fashion 2030**, **Circular Hub**, with **DoTank Center**. **Wargön Innovation** provides a specialized physical hub for sorting R&D/piloting. SP Borås is also coordinating Textile Movement, the VGR's arena and community there 14 organisations works together to drive the circular transition within the fashion and textile industry.
  - **Industry Associations: TEKO** (Swedish Textile and Fashion Association) is the primary national industry voice. **Svensk Handel** (Swedish Trade Federation) is also involved regionally. TMAS – Textile Machinery Association of Sweden is the industry association for manufacturers and suppliers of textile machinery.
  - **General Business Support:** The **West Sweden Chamber of Commerce** Is a private, non-partisan business organization with over 3,000 members working to create growth and developing West Sweden by provide business development services and by policy making. The Incubator in Borås supports entrepreneurs and innovators in technology, textiles and fashion with business development.
- **Civil Society:** Includes environmental NGOs (**Naturskyddsföreningen**), ethical production/consumer rights advocates (**Fair Action, Sveriges Konsumenter**), and charities (**Myrorna, Red Cross, Björkå Frihet**) active in collection/reuse. **Humana Sweden** provides insights into reuse/export markets.

The Västra Götaland ecosystem is notable for its **highly integrated R&D infrastructure** (U Borås, RISE), strong **innovation support platforms (SP Borås, Wargön)**, clear **regional policy commitment to circularity (VGR/RUS)**, and active participation of major brands. While R&D and piloting for circularity are advanced, the primary structural gap lies in the **lack of local, commercial-scale advanced sorting and recycling facilities** capable of processing the region's waste domestically, leading to reliance on incineration and export.

From 1 January 2025, textile collection became mandatory within the EU. In Sweden, municipalities are responsible for collecting textiles, after which it is up to collecting organizations to process the material. However, there is currently no Swedish law on producer responsibility and it is up to each municipality to solve the collection locally. A feasibility study conducted by the Borås Region shows great interest in collaboration among the 49 municipalities in Västra Götaland. It also showed a great commitment among inhabitants to take care of textiles properly. During 2025, municipalities and municipal associations will develop a joint strategy for communication with inhabitants.

### 3.6.3 Current Innovation & Circularity Landscape

Västra Götaland is demonstrably at the forefront of textile innovation and circularity R&D and piloting in Sweden and arguably Europe, though scaling these solutions remains an ongoing challenge:

- **Innovation Focus:** Strong leadership in **smart textiles**, sustainable material development (especially **cellulose-based fibers** - TreeToTextile/RISE), pioneering **advanced automated sorting** (Wargön), mechanical recycling process development (RISE testbed), and chemical recycling research (RISE, U Borås). Emphasis is also placed on developing and implementing **circular business models** (repair, reuse, resale - Houdini, Nudie Jeans) and **circular design principles** (Re:textile, Textile Movement).
- **Circularity Status:** High awareness and activity at R&D, pilot, and brand levels. Leading brands have established circular offerings. Collection systems exist (municipal ÅVCs, charities), but national rates have been **historically low (<4%)**, expected to increase significantly when EPR is implemented. True **fiber-to-fiber recycling remains minimal (<1%) systemically**. High reliance on **incineration** (for residual waste) and **export** (for collected textiles) persists as dominant end-of-life pathways.
- **Key Infrastructure:** World-class **R&D infrastructure** (U Borås, RISE, SP Borås). Do-tank Center (SP Borås) is an innovation environment, aimed primarily at small and medium-sized companies striving towards a circular economy. A place where companies can not only talk about circular business models and circular design, but where these concepts are put into practice through workshops, hackathons and

prototype development. The unique and well-equipped labs at **the Swedish School of Textiles** enable research and development at both the basic and applied levels, from fiber raw materials to textile products. With main research areas Textile Technology, Textile Management and Design the whole value chain is covered. Unique **pilot-scale advanced sorting** (Wargön) and **mechanical recycling** (RISE, U Borås) facilities exist. Existing collection infrastructure needs significant scaling/optimization. **Commercial-scale advanced recycling facilities are the key missing piece *within* the region.**

- **Collaborative Initiatives:** Highly active collaboration via platforms (**Textile & Fashion 2030, Textile Movement**). Strong, documented R&D partnerships (U Borås, RISE, industry). Active cross-sectoral links (forestry, automation/AI)

### 3.6.4 Alignment with Regional Strategy (RIS3)

Västra Götaland's regional policies demonstrate a clear, high-level commitment to fostering a circular textile economy:

- The **Västra Götaland Regional Development Strategy (RUS) 2021-2030** explicitly aims for a "fossil-independent and **circular** Västra Götaland." Crucially, it designates **"Circular Business Models" (Cirkulära Affärsmodeller)** as one of only four top-priority, cross-sectoral strategic initiatives ('kraftsamlingar') for intensified action and investment. A review of the regional development strategy is currently underway. The review is not about developing a new strategy but is limited to updating parts of the strategy based on the external environment and current situation and strengthening implementation with a focus on reviewing the strategy's strengths.
- The **Textile Movement** initiative is a direct outcome and implementation mechanism for this strategic priority, receiving support and coordination resources from VGR and SP Borås, demonstrating concrete regional backing for textile circularity.
- The region's overall high innovation capacity and strong R&D focus, actively supported by VGR funding and initiatives, inherently align with knowledge-based economic development goals typical of RIS3 strategies.

# 4. INTERREGIONAL ANALYSIS AND BENCHMARKING

This section synthesizes the findings from the individual regional profiles (Section 3) to provide a comparative perspective across the six TEX-BREIN partner regions: Severovýchod (CZ05), Łódzkie (PL71), Toscana (ITI1), Norte (PT11), Catalonia (ES51), and Västra Götaland (SE23). It highlights varying ecosystem structures, benchmarks circularity performance and innovation capabilities, and identifies common challenges and transferable practices relevant to fostering interregional collaboration.

## 4.1. Synthesis of Regional Ecosystem Structures

Comparing the six regions reveals both commonalities and distinct characteristics shaping their respective textile innovation and circularity ecosystems:

- **Industry Structure:** While Small and Medium Enterprises (SMEs) are prevalent across all regions (>90% in most cases), the overall structure and concentration vary.
    - **Toscana (Prato - ITI1)** exhibits a unique, highly dense industrial district model of specialized SMEs built around mechanical wool recycling.
    - **Catalonia (ES51)** also features SME dominance but benefits from the strong design influence and brand presence centered around Barcelona.
    - **Łódzkie (PL71)** is characterized by high fragmentation following the historical decline of large state-owned enterprises, presenting potential challenges for scaled investment and coordination.
    - **Severovýchod (CZ05)** maintains some large, historically significant players (e.g., JUTA, VEBA) alongside numerous SMEs, with a particular strength in technical textiles.
    - **Norte (PT11)** presents a dynamic mix of large, often vertically integrated firms with international reach (e.g., Riopele, Adalberto) and a highly flexible base of SMEs, contributing to its position as a major European production hub.

- **Västra Götaland (SE23)** shows a higher concentration of larger corporations, particularly prominent brands (e.g., Lindex, Nudie Jeans) and e-commerce players, coexisting with specialized SMEs focused on innovation and design. This diversity influences pathways for innovation adoption, investment scales, and the implementation of circularity initiatives.

- **Dominant Subsectors & Specialization:** Clear regional specializations emerge, offering potential for complementarity:
  - **Toscana (ITI1):** Remains strongly linked to its heritage of mechanical wool recycling ('cardato rigenerato') and serves high-quality fashion/luxury supply chains, alongside a distinct fast fashion segment.
  - **Norte (PT11) & Severovýchod (CZ05):** Demonstrate established strengths and significant industrial capacity in technical textiles and associated R&D. Norte also maintains large-scale apparel and home textiles production.
  - **Västra Götaland (SE23):** Leads in R&D and the application of smart textiles, sustainable/bio-based materials (esp. cellulose), and advanced circular processes, coupled with a strong design and e-commerce base.
  - **Catalonia (ES51):** Leverages its Barcelona hub for design, fashion, and branding, with growing R&D and cluster activity (Tèxtils.CAT) focused on advanced and technical textiles.
  - **Łódzkie (PL71):** Remains a significant fashion and apparel hub (e.g., Ptak Fashion City) while seeking to modernize its traditional textile base through innovation.

- **R&D Strengths:** All regions possess valuable R&D assets, often linked to universities or dedicated research/technology organisations (RTOs).
  - **Västra Götaland (SE23):** U Borås (Swedish School of Textiles, SCRR) and RISE provide world-class, comprehensive R&D infrastructure and piloting specifically for textiles, covering materials, processes, circularity, and smart textiles.
  - **Norte (PT11):** The CITEVE-UMinho nexus forms a powerful, dedicated T&C research, development, testing, and piloting hub with strong industry integration. Within the scope of the advanced manufacturing technologies key

players are INESC TEC or INEGI, strongly supported by high tech companies and orchestrated by PRODUTECH DIH.

- **Toscana (ITI1):** Features strong applied R&D focused on the district's needs via NTT and ARCO/PIN, particularly concerning mechanical recycling and finishing, increasingly exploring circular solutions for mixed materials.
- **Catalonia (ES51):** Benefits from strong, multi-purpose RTOs (Eurecat, Leitat) adapting broad expertise to textiles, alongside university research (UPC-INTEXTER, UAB).
- **Severovýchod (CZ05):** Relies heavily on the specialized excellence of TUL Liberec (Faculty of Textiles) in nanomaterials, technical textiles, and increasingly, circularity/recycling R&D.
- **Łódzkie (PL71):** Possesses a strong traditional research base at TUL Łódź and Łukasiewicz-LIT, supporting modernization efforts.
  A common challenge, potentially more pronounced in CZ and PL, appears to be translating research outputs into widespread commercial application and adoption, especially among SMEs.

- **Stakeholder Network Density & Maturity:** Network structures and coordination maturity vary significantly:
  - **Catalonia (ES51):** Showcases a mature, multi-stakeholder collaborative model via the Pact for Circular Fashion, actively coordinated by public agencies (ARC, ACCIÓ) and a specialized cluster (Tèxtils.CAT).
  - **Västra Götaland (SE23):** Has strong, established innovation platforms orchestrated by Science Park Borås (e.g., Textile Movement, Textile & Fashion 2030) with clear regional government (VGR) backing and high brand engagement.
  - **Norte (PT11):** Benefits from the central coordinating role of CITEVE and the formal Portuguese Textile Cluster, ensuring tight R&D-industry-academia linkage, evidenced by high cluster membership among identified actors.
  - **Toscana (ITI1):** Features deep, place-based networks within the Prato district (e.g., Confindustria Toscana Nord, ASTRI, NTT collaborations), strongly focused on the local value chain, complemented by the Prato Circular City initiative.

- **Severovýchod (CZ05):** Leverages the specialized technical textile cluster CLUTEX, connecting key firms and research institutes (TUL, VÚTS, VÚB). Broader ecosystem coordination for circularity appears less formalized.
- **Łódzkie (PL71):** Has active industry associations (PIOT, ŁIPH) and regional development agencies (LARR) but appears to lack a dedicated, highly visible coordinating hub specifically focused on *circular* textiles, compared to regions like SE, ES, or PT.Overall coordination for *systemic* circularity seems most advanced in SE, ES, and PT, driven by dedicated strategies, initiatives, and/or powerful central actors.

### 4.2. Benchmarking Circularity Performance

Comparing key circularity metrics reveals significant disparities and common challenges. *Note: Regional data is often scarce; national data or estimates are used where necessary and noted as such. Direct comparability can be limited due to differing methodologies and timeframes.*

#### 4.2.1. Post-consumer Waste Generation & Collection

Textile waste generation and, more critically, its separate collection rates are fundamental indicators of circularity potential.

**Table 4.1: Estimated Textile Waste Generation and Separate Collection Rates**

| Metric | CZ05 (Severovýchod) | PL71 (Łódzkie) | ITI1 (Toscana) | PT11 (Norte) | ES51 (Catalonia) | SE23 (Västra Götaland) | EU Benchmark / Context |
|---|---|---|---|---|---|---|---|
| **Est. Per Capita Waste Generation ( kg/person /yr )** | >20 ^(a, b) | ~16-19 ^(c) | ~16-19 ^(c, d) | ~13-16 ^(e, f) | ~21.5 ^(g) | ~14-19 ^(c, h) | ~16 (2020); ~19 (2022 cons.) ^(c) |
| **Est. Separate Collection Rate (% of generated waste)** | ~15% (reuse/rec. combined) ^(i) | ~1-3% ^(j) | <10% (National est.) ^(k) | ~1-2% ^(l) | ~11-12% ^(m) | ~4% (hist.) rising? ^(n) | ~27.5% capture (~4.4 kg/pers ) (2020) ^(c) |

**Sources & Caveats:**

- ^(a) Partner estimate based on various sources. Precise regional data lacking.
- ^(b) High value suggests potential inclusion of industrial scraps or different methodology.
- ^(c) EU Average/Range from EEA (Ref 1, 2), 2020 baseline, 2022 consumption estimate. Used as proxy range where regional/national data is less certain or aligns.
- ^(d) Based on Italian national average municipal waste data (Ref 34) and EU context. Prato's industrial system may skew local figures if included.
- ^(e) Based on Portuguese national collection estimates (Ref 43) extrapolated, likely underestimates total generation.
- ^(f) Partner estimate suggests national figures are low.
- ^(g) Partner estimate for Catalonia, higher than EU average.
- ^(h) Swedish national average generation, region likely similar.
- ^(i) Partner estimate based on sources discussing collection (Ref 14), includes items destined for reuse.
- ^(j) Extremely low national rate cited in sources (Ref 24).
- ^(k) Italy mandated collection 2022, but national rates remain low; specific Tuscan rate unavailable (Ref 34, 35).
- ^(l) Based on national collection estimates (Ref 43), likely low.
- ^(m) Partner estimate based on regional waste agency data/Pact reports.
- ^(n) Historically low national rate (<4%, Ref 39); Current regional rate likely still low but increasing.

Per capita waste generation appears relatively high in Catalonia and potentially Severovýchod compared to the estimated EU average, indicating high consumption levels or different calculation bases. Most other regions seem closer to the EU average range. **Separate collection rates are a critical weakness across *almost all* partner regions**, falling drastically short of the EU average capture rate (~27.5% in 2020). Rates below 15% (and particularly those below 5%) mean the vast majority of textile waste enters mixed waste streams, destined primarily for incineration or landfill, representing a massive loss of resources. While Italy mandated collection earlier and Sweden's EPR is imminent, effective rates remain low currently. Bridging this collection gap is the most urgent shared priority ahead of the EU's 2025 mandate requiring separate textile collection.

### 4.2.2. Reuse & Recycling Infrastructure and Rates

The capacity to sort collected textiles and process them through high-value (ideally fiber-to-fiber) recycling pathways is crucial for closing the loop.

**Table 4.2: Fiber-to-Fiber Recycling Rates and Infrastructure Focus**

| Metric | CZ05 (Severovýchod) | PL71 (Łódzkie) | ITI1 (Toscana) | PT11 (Norte) | ES51 (Catalonia) | SE23 (Västra Götaland) | EU Benchmark / Context |
|---|---|---|---|---|---|---|---|
| **Est. Fiber-to-Fiber Recycling Rate (% of generated)** | <1% ^(o) | <1% ^(o, p) | <1% (non-wool) ^(o, q) | <1% ^(o) | <1% ^(o, r) | <1% ^(o, s) | <1% ^(o) |
| **Key Regional Infra. Focus (Circularity)** | Mech. Shredding (ARCA); R&D (TUL) | Limited documented capacity | Mech. Wool Recycling (scaled); Sorting Hub dev. (Alia); R&D (NTT) | Mech. Recycling (basic); R&D/Pilotin g (CITEVE/UMinho) | Sorting R&D (Leitat/Eurecat); Mech. Recycling (basic) | Adv. Sorting R&D (Wargön); Mech./Chem. R&D/Pilot (RISE/UBorås) | Varied; Flanders, N. France noted examples ^(t) |

**Sources & Caveats:**

- ^(o) EU-wide and global estimate for fiber-to-fiber recycling is consistently <1% (Ref 5, VB NWE/McKinsey). Assumed applicable to all regions unless specific scaled F-t-F infrastructure exists.
- ^(p) Limited infrastructure documented regionally (Section 3.2).
- ^(q) While wool recycling is scaled (>100k tonnes/yr, Ref 26), this applies to a specific fraction. Recycling rates for mixed post-consumer textiles are very low.
- ^(r) LIFE CIRTECHTEX project (Ref 47) represents steps, but industrial scale lacking. High export rates (40-70%) indicate limited domestic processing (Partner estimate).
- ^(s) Re:newcell plant (outside region) faced closure; Södra/Lenzing (Once More) plant outside region. Local capacity is primarily R&D/Pilot (Ref 51, 52). High export/incineration reliance (Ref 39, 56).
- ^(t) Reference examples like Textile Recycling Valley (Ref 60) or Flanders ecosystem (Ref 61).

True fiber-to-fiber recycling rates remain negligible (<1%) across all regions, mirroring the broader European situation (Ref 5). Reuse captures some value, but significant portions of collected post-consumer textiles are exported (notably mentioned for ES, SE, likely others), making accurate domestic recycling rates difficult to ascertain and raising concerns about burden-shifting. A major common gap exists in **commercial-scale, accessible infrastructure for advanced sorting of mixed post-consumer waste and subsequent high-value (fiber-to-fiber) recycling**, especially chemical recycling needed for common synthetic/blended fabrics. While R&D and piloting activities are strong in SE, PT, and IT (for specific niches), and emerging in ES and CZ, the lack of scaled domestic processing capacity remains a critical bottleneck throughout the consortium. Toscana's established mechanical wool recycling system stands out as a unique, scaled example, though primarily for a specific waste stream.

### 4.2.3. Policy Maturity (EPR Status, Specific CE Strategies)

Policy frameworks, particularly Extended Producer Responsibility (EPR) schemes and dedicated circular economy strategies, are key enablers.

**Table 4.3: Policy Maturity Comparison**

| Metric | CZ05 (Severovýchod) | PL71 (Łódzkie) | ITI1 (Toscana) | PT11 (Norte) | ES51 (Cataluña) | SE23 (Västra Götaland) | Context |
|---|---|---|---|---|---|---|---|
| **Textile EPR Status (as of early 2025)** | Facing 2025 Mandate; Plan dev. ^(u) | Facing 2025 Mandate; Plan dev. ^(v) | Mandated 2022; Decrees delayed ^(w) | Facing 2025 Mandate; Plan dev. ^(x) | Facing 2025 Mandate; Plan dev. ^(y) | Facing 2025 Mandate; Plan dev. | EU WFD Mandate: Jan 2025 |
| **Dedicated Regional Textile CE Strategy/Plan** | RIS3 alignment; National CE Roadmap | RIS3 alignment; National CE Roadmap | Prato Circular City Initiative; RIS3 Green Transition | PAReg-EC NORTE (explicit plan) | Pact for Circular Fashion (multi-stakeholder plan) | RUS Top Priority (Circ. Bus. Models); Textile Movement | Varies across EU regions |

**Sources & Caveats:**

- ^(u) National plans under development to meet EU deadline (Ref 4, 13).
- ^(v) National plans under development (Ref 4, 26).
- ^(w) Collection mandated, but specific EPR rules delayed creating uncertainty (Ref 4, 35).
- ^(x) National plans (PAEC, RGGR) and upcoming EPR under development (Ref 4, 40).
- ^(y) National EPR law approved, regional implementation planning (Ref 4).
- ^(z) EPR legislation passed, operational from Jan 2025 (Ref 4, 55).

Policy maturity varies. **Västra Götaland (SE)** is most advanced, providing valuable learning opportunities for others. **Italy (Toscana)** mandated collection early, but delays in finalizing EPR details create market uncertainty. The remaining regions (**CZ, PL, PT, ES**) face the pressing Jan 2025 EU mandate, with national EPR schemes in varying stages of development or planning. This creates urgency and potential implementation challenges, particularly concerning funding mechanisms before EPR systems are fully operational. Regarding dedicated strategies, **Västra Götaland (SE)**, **Catalonia (ES)**, and **Norte (PT)** demonstrate strong, explicit regional strategic commitment to textile circularity through dedicated plans or multi-stakeholder initiatives. **Toscana (IT)** leverages the proactive Prato Circular City initiative. While **Severovýchod (CZ)** and **Łódzkie (PL)** align with national CE roadmaps and identify textiles within their RIS3 strategies, dedicated, comprehensive *regional* action plans specifically for textile circularity appear less developed or visible compared to SE, ES, and PT.

### 4.3. Benchmarking Innovation Capabilities

While all regions possess innovation potential, their strengths and focus areas differ, influencing their roles within interregional collaboration:

- **R&D Leadership:** As noted in 4.1, **Västra Götaland (SE)** and **Norte (PT)** exhibit world-class, comprehensive R&D infrastructure specifically dedicated to textiles, covering advanced materials, processes, and circularity. **Toscana (IT)** has strong applied R&D tied to its district's specific needs (wool, finishing). **Catalonia (ES)** leverages powerful general RTOs (Eurecat, Leitat) adapting expertise, making it strong in cross-sectoral innovation. **Severovýchod (CZ)** holds specific leadership in nano/technical textiles via TUL. **Łódzkie (PL)** has a strong university base (TUL Łódź) supporting modernization.

- **Pilot Facilities:** Accessibility and focus vary. **Norte (PT - CITEVE, UMinho)** and **Västra Götaland (SE - RISE, U Borås, Wargön)** appear strongest in offering dedicated, accessible pilot lines for testing new materials and processes (sorting, mechanical recycling, sustainable finishing, smart textiles). **Toscana (IT)** has established wool processing infrastructure usable for piloting within that niche, plus NTT capabilities. Other regions seem to have fewer dedicated, accessible *circularity-focused* pilot facilities, potentially creating bottlenecks for SME innovation and scale-up.
- **Tech Transfer & Cluster Activity:** Clusters are active and vital in **Catalonia (ES - Tèxtils.CAT**, highly active in EU projects/circular hub), **Norte (PT - Cluster Têxtil/CITEVE** and **PRODUTECH**, strong R&D-industry links), **Severovýchod (CZ - CLUTEX**, technical focus), and **Västra Götaland (SE - multiple platforms via SP Borås**, strong brand/policy links). These facilitate networking, project development, and knowledge dissemination. The effectiveness of translating R&D into widespread SME adoption appears variable across regions, potentially linked to cluster maturity, funding access, and specific focus (technical vs. broader circularity). Łódzkie's cluster landscape seems less focused specifically on textiles compared to the others.

### 4.4. Identification of Leading Practices & Key Gaps Across Regions

This comparative analysis highlights notable strengths to build upon and pressing common challenges to address through interregional collaboration:

**Leading Practices / Regional Strengths:**

- **Integrated R&D and Piloting Hubs:** Västra Götaland (Borås ecosystem) and Norte (CITEVE/UMinho nexus) showcase powerful concentrations of research, education, testing, and piloting dedicated to textiles.
- **Historical Specialization as Foundation:** Toscana (Prato) demonstrates how deep-rooted recycling expertise (wool) can be a unique economic and cultural asset, though adaptation to new materials is key.
- **Multi-Stakeholder Platforms & Policy Alignment:** Catalonia (Pact for Circular Fashion) and Västra Götaland (Textile Movement, RUS alignment) provide models for regional coordination, commitment-building, and translating policy into action. Norte's PAReg-EC plan also shows strong policy commitment.

- **Proactive Policy:** Västra Götaland's regional strategy focus on circularity signals strong political will and provides learning opportunities.
- **Specialized Industry Clusters:** Tèxtils.CAT (Catalonia) and CLUTEX (Severovýchod) show the value of clusters focused on specific segments (advanced/technical textiles) for driving targeted innovation.
- **Advanced Sorting R&D:** Västra Götaland (Wargön Innovation) leads in developing next-generation automated sorting solutions.

**Key Gaps / Common Challenges:**

- **Separate Collection:** Universally inadequate rates (relative to generation) across most regions hinder the entire circular value chain. This is the most **critical immediate bottleneck**.
- **Scaling Advanced Sorting & Recycling:** Lack of commercial-scale, economically viable infrastructure for sorting mixed post-consumer waste and performing high-value (chemical, advanced mechanical) fiber-to-fiber recycling is a major **systemic gap** across the consortium.
- **Data Scarcity:** Lack of reliable, granular regional data on waste flows, composition, collection/sorting efficiencies, and treatment fates hampers effective planning, monitoring, and benchmarking.
- **EPR Implementation Uncertainty:** For regions still developing their schemes, delays and lack of clarity surrounding national EPR implementation (funding flows, responsibilities, eco-modulation details) create significant planning challenges for businesses and municipalities.
- **SME Support & Adoption:** Need for tailored financial and technical support for SMEs to understand complexities, adopt circular technologies/business models, navigate regulations, and access funding remains a significant barrier.
- **Market Pull for Recycled Materials:** Insufficient market demand and price competitiveness for recycled materials compared to virgin alternatives remain a major economic barrier hindering investment in recycling infrastructure.

- **Bridging R&D to Market:** Ensuring effective knowledge transfer and facilitating the commercial uptake of research and pilot innovations, particularly by SMEs, is a persistent challenge.

Addressing these shared gaps while leveraging complementary regional strengths forms the core rationale for the interregional collaboration opportunities outlined in Section 5.

# 5. OPPORTUNITIES FOR INTERREGIONAL COLLABORATION

Analyzing the TEX-BREIN consortium through the lens of its Less Developed/Transition Regions (LDRs: CZ, PL, PT) and More Developed Regions (MDRs: IT, ES, SE) reveals crucial dynamics and opportunities for targeted collaboration. While innovation potential exists across all partners, MDRs typically demonstrate more advanced ecosystems specifically geared towards *circularity innovation*. This often includes leading R&D and pilot capabilities for emerging circular technologies (SE, IT niche), established multi-stakeholder platforms driving policy and action (ES Pact, SE Textile Movement), and stronger integration with international brands and high-value markets. Conversely, LDRs frequently possess substantial and often cost-competitive industrial and manufacturing capacity, including valuable specialized expertise, particularly in technical textiles (CZ, PT). However, they generally face more significant systemic challenges in funding and deploying scaled infrastructure dedicated to circularity (like advanced sorting and fiber-to-fiber recycling) and may have less developed *regional* coordination mechanisms or strategies specifically focused on the circular transition within the textile sector (notably CZ, PL, while PT shows strength here via its cluster/policy).

This asymmetry, identified through the mapping and benchmarking in Section 4, creates fertile ground for synergistic activities: MDRs can significantly accelerate LDR progress through targeted knowledge transfer on policy implementation (e.g., EPR insights from SE), technology validation (e.g., advanced sorting), circular business models, and market linkage strategies. Simultaneously, LDRs offer essential manufacturing capabilities and potentially unique material streams (once collection systems improve) required to realize and scale circular product concepts developed across the partnership.

Addressing the specific barriers often more acute in LDRs – such as SME access to finance for circular technology adoption and bridging research to industrial application – will be key to ensuring balanced and impactful interregional progress within TEX-BREIN. The following subsections detail specific opportunities derived from the analysis to leverage these dynamics and address shared challenges.

### 5.1. Knowledge Sharing & Policy Learning

Facilitating structured exchange on policy implementation, collection systems, and strategic development can significantly shorten learning curves and avoid repeating mistakes, particularly beneficial for regions facing imminent policy deadlines or developing new strategies.

- **Navigating EPR Implementation:**
  - **Collaboration:** Organize targeted workshops or webinars where Swedish EPA/implementing bodies share practical experiences (e.g., PRO establishment, fee structures, compliance monitoring) with policymakers and key industry associations (e.g., ATOK, ATP, Confindustria/ASTRI) from ES, PT, IT, CZ, and PL. Jointly develop position papers on key EPR harmonization points for EU advocacy, informed by diverse regional perspectives.
- **Optimizing Collection & Sorting Models:**
  - **Opportunity:** Address the critical, consortium-wide gap of low separate collection rates (Section 4.2.1) by sharing best practices on effective collection infrastructure and engagement. Learn from SE's evolving municipal responsibility model and ES/CZ experiences with citizen communication challenges.
  - **Collaboration:** Facilitate study visits between municipal waste managers and collection operators (e.g., Hradecké služby, MPO Łódź, Alia Servizi, LIPOR, Renova, ARC partners, Borås Stad/Renova) across regions. Explore varied models (container density, civic amenity site integration, social enterprise roles like Humana/Moda re-). Develop shared, adaptable communication materials addressing citizen confusion. Benchmark collection costs and efficiency metrics.

- **Developing Regional Circularity Strategies:**
    - **Opportunity:** Support regions with less formalized textile circularity strategies (esp. CZ, PL) by sharing methodologies from regions with established plans (SE via RUS/Textile Movement, ES via Pact, PT via PAReg-EC).
    - **Collaboration:** Organize peer-learning sessions for regional development agencies and policymakers from CZ and PL, leveraging the strategy co-creation, target-setting, KPI definition, and governance frameworks developed in SE, ES, and PT. Support these regions in integrating textile-specific circularity goals more explicitly into their RIS3 updates or dedicated action plans.
- **Enhancing Cluster & Hub Effectiveness:**
    - **Opportunity:** Share best practices on managing innovation hubs and clusters focused on circularity, drawing on the extensive experience of Tèxtils.CAT (ES), the Portuguese Textile Cluster/CITEVE (PT), and Science Park Borås (SE).
    - **Collaboration:** Organize exchanges between cluster managers (e.g., Tèxtils.CAT, CLUTEX, Cluster Têxtil, SP Borås) to share insights on sustainable funding models, effective member engagement, developing circularity-focused service portfolios, and successful EU project management methodologies. This could particularly benefit clusters in CZ and PL.

### 5.2. Technology Transfer & Joint R&D

Pooling R&D resources and facilitating the transfer of existing technologies can address key technological gaps (identified in Section 4.2.2 & 4.3) more efficiently and accelerate the deployment of circular solutions.

- **Accelerating Advanced Sorting Deployment:**
    - **Opportunity:** Leverage Västra Götaland's (SE) leadership in automated sorting R&D (Wargön) and Catalonia's (ES) advanced tech providers to benefit regions lacking this capacity.
    - **Collaboration:** Establish a TEX-BREIN working group focused on sorting technologies involving Wargön, Tèxtils.CAT/Leitat/Eurecat, RISE, CITEVE, PRODUTECH and interested partners/companies from CZ, PL, PT, IT. Organize

technical workshops on specifications, operational requirements, AI integration, and material handling. Potentially facilitate access for partners to test materials at pilot facilities (e.g., Wargön). Jointly define desired specifications for sorting outputs needed by recyclers across the consortium.

- **Tackling Difficult-to-Recycle Materials:**
  - **Opportunity:** Address the systemic gap in handling complex post-consumer waste by combining specialized R&D strengths: e.g., IT's mechanical wool expertise, SE/PT/ES capabilities in chemical/advanced mechanical recycling for blends (polycotton, elastane), CZ/SE research on specific synthetics/finishes.
  - **Collaboration:** Initiate joint R&D projects (seeking Horizon Europe, LIFE, or national funding) involving universities (TUL Liberec, TUL Łódź, UMinho, U Borås, Pisa/Florence) and RTOs (CITEVE, Eurecat, Leitat, RISE, NTT, VÚTS, INOTEX, INESC TEC, INEGI, …). Focus on priority waste streams identified across regions (e.g., mixed fiber textiles, dye/finish removal). Share findings and potentially co-develop intellectual property.
- **Circularity for Technical Textiles:**
  - **Opportunity:** Connect the strong technical textile manufacturing base in CZ and PT with material science and recycling expertise found particularly in SE, IT, and ES. Explore closed-loop systems and novel applications for recycled technical textile waste.
  - **Collaboration:** Facilitate targeted B2B matchmaking between technical textile producers (e.g., members of CLUTEX, ATP) and recyclers/R&D centers (e.g., RISE, Eurecat, Leitat, NTT, CITEVE) across regions, potentially through cluster-led events. Link to existing cross-sectoral initiatives like Tèxtils.CAT's xBUILD-EU project (construction materials).
- **Standardizing Digital Enablers:**
  - **Opportunity:** Leverage expertise in digitalization from ES (Eurecat), PT (INESC TEC), and SE (RISE/U Borås) to co-develop interoperable solutions for traceability (supporting Digital Product Passports) and material flow management crucial for circularity.

- **Collaboration:** Form a working group to define common data standards for textile circularity relevant to the partner regions (building on existing standards). Potentially pilot a shared traceability platform or contribute findings to EU standardization efforts (CEN/CENELEC).

### 5.3. Value Chain Integration

Creating functional, cross-border value chains is essential for moving beyond pilot projects towards systemic circularity, addressing gaps identified in Section 4.2.2 and 4.4.

- **Matching Waste Streams with Processing Capacity:**
  - **Opportunity:** Systematically connect the available (or expected post-2025) post-consumer and pre-consumer textile waste streams in regions like ES, PL, CZ with specialized processing capabilities (existing or planned) in IT (wool), SE (advanced sorting/potential recycling), PT (R&D/piloting, potential recycling), or ES/CZ (mechanical recycling).
  - **Collaboration:** Develop an interregional B2B marketplace or brokerage platform (potentially linked to Tèxtils.CAT's Circular Hub or similar initiatives) specifically for textile waste fractions and recycled materials. Facilitate long-term offtake agreements between waste suppliers/sorters and recyclers across regions, requiring robust collaboration on sorting criteria and quality standards (linking to 5.1/5.2).
- **Developing Markets for Circular Products:**
  - **Opportunity:** Address the critical market pull gap by connecting recyclers and manufacturers producing innovative circular materials/products across the consortium with brands, retailers, and designers located in design-led hubs (ES, SE, IT) and major consumer markets.
  - **Collaboration:** Organize joint showcases or participation in major trade fairs (e.g., Techtextil, Heimtextil, sustainable fashion events) under a TEX-BREIN banner. Facilitate co-creation workshops between designers/brands (from ES, SE, IT) and recycled material producers/manufacturers (from PT, CZ, PL, IT). Explore potential for joint branding or certification to enhance market recognition of interregional circular products.

- **Cross-Border SME Partnerships:**
    - **Opportunity:** Foster direct linkages between SMEs offering complementary services or capabilities across regions (e.g., a CZ technical weaver using recycled yarn from PT, a PL apparel SME using sustainable finishing services from IT).
    - **Collaboration:** Utilize existing cluster networks (Tèxtils.CAT, CLUTEX, Cluster Têxtil, etc.) and project platforms (e.g., I3 RegioGreenTex if applicable) to actively promote and facilitate cross-border B2B matchmaking tailored specifically to SME needs within the circular textile value chain.

### 5.4. Developing Joint Pilot/Demonstration Projects

Concrete, collaborative pilot projects can test and validate integrated solutions, demonstrating feasibility and attracting further investment, directly addressing gaps and leveraging strengths identified in Section 4.

- **Interregional Sorting & Recycling Hub Network Pilot:** Pilot a decentralized network where regions specialize based on strengths. *Example:* Test automated sorting (SE tech) on mixed waste from ES/PL; send sorted wool fractions to IT; send sorted cotton/poly blends to PT/SE for pilot chemical/mechanical recycling; explore local downcycling options in CZ/PL for non-rewearable fractions. This tests logistics, standards, viability, and data exchange. (Potential Funding: LIFE, Horizon Europe, I3).
- **Circular Product Co-Creation Pilot:** Bring together designers/brands (from ES, SE), material innovators/recyclers (from PT, IT, SE), and manufacturers (from CZ, PL, PT) to jointly develop, produce, and test market acceptance of a specific product line (e.g., workwear, functional apparel) with high verified recycled content sourced and processed within the TEX-BREIN regions, incorporating digital traceability. (Potential Funding: Horizon Europe, Creative Europe, I3).
- **Upskilling Program for Circular Textiles Pilot:** Develop and pilot a joint training module (potentially using Erasmus+ funding or regional funds) addressing key circular skills gaps identified across regions (e.g., circular design principles, recycling technology operation, sustainable chemistry, sorting skills). Leverage educational strengths from U Borås (SE), CITEVE Academy (PT), TUL Liberec (CZ), Polimoda (IT), and potentially involve industry associations for delivery and relevance.

- **Policy Experimentation Pilot (linked to EPR/Collection):** Collaboratively design and monitor pilot variations in collection methods (e.g., different container types, incentive schemes) or citizen engagement campaigns in selected municipalities across different partner regions facing the 2025 mandate. Share results rigorously to inform best practice guidance for all participating municipalities/countries. (Potential Funding: Interreg Europe, LIFE, National/Regional funds).

# 6. CONCLUSION

This report, Deliverable D1.1 of the TEX-BREIN project, provides a comprehensive mapping and initial baseline assessment of the textile innovation and circularity ecosystems across the six participating European regions: Severovýchod (Czechia), Łódzkie (Poland), Toscana (Italy), Norte (Portugal), Catalonia (Spain), and Västra Götaland (Sweden). By identifying key stakeholders within the Quadruple Helix, analyzing regional strengths and weaknesses concerning innovation and circularity, and establishing a baseline through benchmarking against EU averages and leading practices, this work fulfills the primary objectives of Work Package 1. The methodology involved synthesizing partner-provided data, extensive desk research, and analysis of publicly available information.

The analysis reveals a landscape marked by both significant **regional diversity** and **critical common challenges**. Strengths range from Västra Götaland's leadership in R&D for smart/sustainable textiles and advanced circular processes, bolstered by proactive policy, to Norte's highly industrialized base strong in technical textiles and Toscana's unique deep-rooted expertise in mechanical wool recycling. Catalonia benefits from strong design influence and policy momentum, Severovýchod possesses a focused technical textile R&D potential, while Łódzkie leverages a rich industrial heritage. This diversity is further nuanced by the distinct dynamics between the Less Developed/Transition Regions (CZ, PL, PT) and More Developed Regions (IT, ES, SE) within the consortium, influencing industrial structures, infrastructure availability, and specific innovation focuses.

Despite these varied strengths, critical common challenges hinder progress towards circularity across the consortium. Foremost among these are: **drastically low separate collection rates** for textile waste compared to generation volumes; a significant **lack of scaled, economically viable infrastructure** for advanced sorting and high-value (fiber-to-fiber) recycling, especially for mixed material streams; persistent **data gaps** hindering accurate assessment and planning; and significant **uncertainties surrounding the timely and effective implementation of national EPR schemes**, crucial for funding and driving the transition. Additional barriers related to SME financial constraints, skills gaps, and insufficient market pull for recycled materials were also identified.

While these challenges are substantial, the juxtaposition of diverse regional strengths alongside shared systemic problems underscores the **significant opportunity and clear rationale for targeted interregional collaboration** – the core mission of TEX-BREIN. By fostering knowledge sharing (especially on policy implementation like EPR), facilitating technology transfer (in areas like sorting and recycling), integrating value chains (connecting waste streams to processing capacities), and undertaking joint R&D and pilot projects, the consortium can leverage its complementary assets to address these shared gaps more effectively than individual regions acting alone. This foundational mapping and analysis, therefore, serves as the crucial evidence base for subsequent TEX-BREIN activities. The findings presented herein will directly inform the **Regional Innovation Boosting Action Plan** by highlighting priority areas for intervention, and steer the development of the **Portfolio of Investment Project Ideas** by identifying concrete needs and collaborative potential. Ultimately, by enabling targeted action based on this detailed understanding, Deliverable D1.1 provides the essential starting point for the TEX-BREIN project to significantly accelerate the transition towards a more innovative, sustainable, and resilient European textile sector.

# 7. REFERENCES

1. European Environment Agency (EEA). (2022). *Management of used and waste textiles in Europe's circular economy*. Accessed April 10, 2025, from https://www.eea.europa.eu/publications/management-of-used-and-waste-textiles *(Used for EU context/benchmarks early on)*

2. European Environment Agency (EEA). (n.d.). *Circularity of the EU textiles value chain in numbers*. Accessed April 10, 2025, from https://www.eea.europa.eu/en/analysis/publications/circularity-of-the-eu-textiles-value-chain-in-numbers *(EU context)*

3. European Commission. (n.d.). *EU Strategy for Sustainable and Circular Textiles*. Accessed April 10, 2025, from https://environment.ec.europa.eu/strategy/textiles-strategy_en *(Core EU policy)*

4. FEAD - European Waste Management Association. (2021). *Extended producer responsibility (EPR) for the textile value chain Joint Position Paper*. Accessed April 10, 2025, from https://fead.be/wp-content/uploads/2021/08/20210408_JOINTPOSITIONPAPER_EPR_TEXTILES.pdf *(EU Policy - WFD/EPR basis)*

5. Valuing Better (VB) NWEurope / McKinsey & Company. (2022). *Scaling textile recycling in Europe-turning waste into value*. Accessed April 10, 2025, from https://vb.nweurope.eu/media/19019/2207-scaling-textile-recycling-in-europe-turning-waste-into-value.pdf *(Overall recycling benchmark <1%)*

6. Fashion for Good. (n.d.). *Sorting For Circularity Europe: An Evaluation And Commercial Assessment Of Textile Waste Across Europe*. Accessed April 10, 2025, from https://reports.fashionforgood.com/report/sorting-for-circularity-europe/chapterdetail?reportid=888&chapter=4 *(Sorting context)*

7. ATOK. (2024). *Ekonomický vývoj textilního a oděvního průmyslu za rok 2024*. Accessed April 10, 2025, from https://atok.cz/doc/TZ-ATOK-Ekonomicky-vyvoj-TO-prumyslu.pdf *(CZ National Econ Data)*

8. SOTEX GINETEX CZ. (n.d.). *Ekonomické výsledky textilního a oděvního odvětví*. Accessed April 10, 2025, from https://www.sotex.cz/ekonomicke-vysledky-textilniho-a-odevniho-odvetvi/ *(CZ National Econ Data)*

9. RIS3 Czech Republic. (n.d.). *National Research and Innovation Strategy for Smart Specialisation (NRIS3) Annex 2*. Accessed April 10, 2025, from https://www.ris3.cz/sites/default/files/2025-02/Priloha_2_NRIS3_v07.pdf *(CZ Regional Strategy Link)*

10. Technická univerzita v Liberci (TUL). (n.d.). *Fakulta textilní (FT TUL)*. Accessed April 10, 2025, from https://www.vysokeskoly.cz/katalog-vs/technicka-univerzita-v-liberci/fakulta-textilni/125 *(CZ R&D)*

11. Liberecký kraj. (n.d.). *Textil se vrací na Liberecko...* Accessed April 10, 2025, from https://www.kraj-lbc.cz/aktuality/textil-se-vraci-na-liberecko-kdysi-prosperujici-centrum-textilu-se-meni-v-centrum-svetovych-inovaci-n548977.htm *(CZ R&D/Context)*

12. Národní klastrová asociace (NCA). (n.d.). *CLUTEX - Klastr Technické textilie. z. s.* Accessed April 10, 2025, from https://www.nca.cz/clenove-a-partneri/clenove-nca/clutex-klastr-technicke-textilie-z-s/ *(CZ Cluster)*

13. Ministerstvo životního prostředí (MŽP). (2024). *Nový metodický návod odboru cirkulární ekonomiky a odpadů MŽP....* Accessed April 10, 2025, from https://www.inisoft.cz/novy-metodicky-navod-odboru-cirkularni-ekonomiky-a-odpadu-mzp-k-oddelenemu-soustredovani-textilniho-odpadu *(CZ Policy - Collection Mandate)*

14. Ekolist.cz / Zajimej.se / Radiozurnal sources (consolidated). (Various dates). *Sources discussing CZ national textile waste estimates (~180k tonnes), low collection (~15%), and 2025 mandate challenges. (Representing orig refs 59, 61, 75, 78)*

15. DIMATEX CS spol. s r.o. (n.d.). *Kontejnery Na Textil*. Accessed April 10, 2025, from https://www.dimatex.cz/ *(CZ Recycler/Collector Example)*

16. ARCA Chrast. (n.d.). *Homepage*. Accessed April 10, 2025, from https://www.arca-chrast.cz/en/home *(CZ Recycler Example)*

17. JUTA a.s. / VEBA / MILETA / SVITAP / SINTEX / Contipro company info (consolidated). (Various dates). *Information on key large manufacturers in CZ05.*

18. P-PINK | Pardubice. (n.d.). *Cirkulární hub*. Accessed April 10, 2025, from https://cirkularni-hub.cz/ *(CZ Hub Example)*

19. RecyUpcy. (n.d.). *Cirkulární centrum*. Accessed April 10, 2025, from https://www.recyupcy.cz/ *(CZ Hub Example)*

20. Nowakowska, A. (2024). *From Fibres to Fashion: The Textile Industry in the Łódź Region*. Yadda ICM. Accessed April 10, 2025, from http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-0077ad62-9111-472f-b45c-03a03ded3c47/c/04_Nowakowska_From_Fibres_2024_1.pdf *(PL Context)*

21. Polish Investment and Trade Agency (PAIH). (n.d.). *Attractive sectors*. Accessed April 10, 2025, from https://www.paih.gov.pl/wp-content/uploads/0/148201/148238.pdf *(PL National Context)*

22. Urząd Miasta Łodzi. (n.d.). *Plan Gospodarki Odpadami dla województwa łódzkiego 2016-2022*. Accessed April 10, 2025, from https://uml.lodz.pl/files/public/dla_mieszkanca/czystemiasto/odpady/dokumenty/akty_prawne/inne/PGOW_2016_2022.pdf *(PL Regional Waste Plan)*

23. Politechnika Łódzka (TUL Łódź). (n.d.). *Faculty of Material Technologies and Textile Design*. (Requires specific URL) *(PL R&D)*

24. Kucinska-Landwójtowicz, M., & Stanczyk, S. (2024). *Study of Lodz Society's Knowledge of the Circular Economy in the Textile and Clothing Industry*. ResearchGate/Fibres & Textiles in Eastern Europe. Accessed April 10, 2025, from https://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-b9117419-d012-4a46-9c99-d253704db155/c/02_Kucinska_Study_Fibres_2024_3.pdf *(PL Consumer Awareness/Reuse)*

25. Wastes Service Group. (n.d.). *Textile recycling. Is Poland ready for this?* Accessed April 10, 2025, from https://www.wastesservice.com/en/news/textile-recycling-is-poland-ready-for-this *(PL Recycling Rate/Challenge)*

26. Giełda Odpadów. (n.d.). *Rozszerzona odpowiedzialność producentów ROP...* Accessed April 10, 2025, from https://gielda-odpadow.pl/strefa-wiedzy/zrownowazony-rozwoj/gospodarka-obiegu-zamknietego/rozszerzona-odpowiedzialnosc-producentow-rop-nowe-obowiazki-i-mozliwosci-dla-branzy-odziezowej/ *(PL EPR context)*

27. Regione Toscana. (n.d.). *THE REGIONAL RESEARCH AND INNOVATION SYSTEM*. Accessed April 10, 2025, from https://www.regione.toscana.it/documents/10180/400011/brochure+inglese+dic+2012.pdf/55a56b09-4701-445d-b563-c9d727d1b04f *(IT Context)*

28. Google Arts & Culture. (n.d.). *The Textiles of Prato*. Accessed April 10, 2025, from https://artsandculture.google.com/story/the-textiles-of-prato-unioncamere/OAVhQPqMpxUA8A?hl=en *(IT Prato History)*

29. Corertex. (n.d.). *History of the Prato district*. Accessed April 10, 2025, from https://corertex.it/en/history-of-the-prato-discrict/ *(IT Prato History/Recycling)*

30. Designtex. (n.d.). *A New Life for Recycled Wool*. Accessed April 10, 2025, from https://designtex.com/stories/a-new-life-for-recycled-wool/ *(IT Prato Recycling)*

31. Arco Lab. (2019). *Circular Economy and industrial symbiosis: The role of the municipality of Prato...* Accessed April 10, 2025, from https://www.arcolab.org/wordpress/wp-content/uploads/2019/07/ISDRS18EconomiaCircolare.pdf *(IT Prato Infrastructure/GIDA)*

32. Next Technology Tecnotessile (NTT). (n.d.). *Home (NEW)*. Accessed April 10, 2025, from https://www.tecnotex.it/en/ *(IT R&D)*

33. Prato Circular City. (n.d.). *Homepage*. Accessed April 10, 2025, from https://www.pratocircularcity.it/en/ *(IT Initiative)*

34. ISPRA. (2023). *Report on Municipal Waste 2022*. Accessed April 10, 2025, from https://www.isprambiente.gov.it/files2023/pubblicazioni/rapporti/rapportorifiutiurbani_ed-2022_n-381-bis_versionedati-di-sintesi_en_05_04_2023-1.pdf *(IT Waste Data)*

35. My Compliance. (n.d.). *IT - Italy Textiles - EPR compliance*. Accessed April 10, 2025, from https://www.my-compliance.eu/news/it-italy-textiles/ *(IT EPR Status)*

36. AICEP. (n.d.). *Textile industry in Portugal*. Accessed April 10, 2025, from https://www.portugalglobal.pt/media/ucsads3k/textiles-clothing-industry-report.pdf *(PT Econ Data)*

37. ATP - Associação Têxtil e Vestuário de Portugal. (n.d.). *Description*. Accessed April 10, 2025, from https://atp.pt/en/statistics/description/ *(PT Industry Association)*

38. CITEVE. (n.d.). *Homepage PT*. Accessed April 10, 2025, from https://www.citeve.pt/ *(PT RTO)*

39. Universidade do Minho. (n.d.). *2C2T - Center for Textile Science and Technology*. Accessed April 10, 2025, from https://2c2t.uminho.pt/ *(PT R&D)*

40. CCDR-N. (n.d.). *Plano de Ação Regional para a Economia Circular*. Accessed April 10, 2025, from https://www.ccdr-n.pt/storage/app/media/uploaded-files/PLANO%20DE%20A%C3%87%C3%83O_REGIONAL_EC_12_09_2022.pdf *(PT Regional Strategy)*

41. CITEVE. (n.d.). *BE@T - Bioeconomia no Têxtil e Vestuário*. Accessed April 10, 2025, from https://bcsdportugal.org/bet-bioeconomia-no-textil-e-vestuario/ *(PT Project Example)*

42. Interreg Sudoe. (n.d.). *FASHION FORWARD*. Accessed April 10, 2025, from https://interreg-sudoe.eu/en/proyecto-interreg/fashion-forward/ *(PT Project Example)*

43. Macau Business. (2021). *Portugal: Almost 11M clothing items weighing 2700 t recycled in 2021*. Accessed April 10, 2025, from https://www.macaubusiness.com/portugal-almost-11m-clothing-items-weighing-2700-t-recycled-in-2021-association/ *(PT Collection Estimate)*

44. Gabarró, J., et al. (2023) *Reference for Guimarães study on textile waste composition. (Need specific reference from previous draft - likely Ref 5)*

45. Catalonia.com. (n.d.). *Fashion & Design ecosystem in Catalonia*. Accessed April 10, 2025, from https://catalonia.com/key-industries-technologies/fashion-design-ecosystem-in-catalonia *(ES Context)*

46. Tèxtils.CAT. (n.d.). *Homepage*. Accessed April 10, 2025, from https://www.textils.cat/en/home/ *(ES Cluster)*

47. Leitat Technological Center. (n.d.). *LIFE-CIRTECHTEX*. Accessed April 10, 2025, from https://leitat.org/en/blog/lifecirtechtex/ *(ES RTO/Project)*

48. Eurecat Centre Tecnològic. (n.d.). *Homepage*. Accessed April 10, 2025, from https://eurecat.org/home/en/ *(ES RTO)*

49. University of Borås. (n.d.). *Textiles and Fashion*. Accessed April 10, 2025, from https://www.hb.se/en/research/research-portal/research-areas/textiles-and-fashion/ *(SE R&D)*

50. Science Park Borås. (n.d.). *Textile*. Accessed April 10, 2025, from https://scienceparkboras.se/en/textil-och-mode/ *(SE Hub)*

51. RISE - Research Institutes of Sweden. (n.d.). *Test bed for textile recycling*. Accessed April 10, 2025, from https://www.ri.se/en/expertise-areas/test-demo/test-bed-for-textile-recycling *(SE R&D/Pilot)*

52. Wargön Innovation. (n.d.). *AI for circular fashion*. Accessed April 10, 2025, from https://wargoninnovation.se/en/projekt/ai-for-cirkulart-mode/ *(SE Sorting Tech)*

53. TEKO. (n.d.). *In English*. Accessed April 10, 2025, from https://www.teko.se/in-english/ *(SE Association)*

54. Västra Götalandsregionen. (n.d.). *Textile Movement*. Accessed April 10, 2025, from https://www.vgregion.se/regional-utveckling/regional-utvecklingsstrategi/kraftsamlingar/cirkulara-affarsmodeller/textile-movement/ *(SE Initiative)*

55. Naturvårdsverket. (2016). *Förslag om hantering av textilier – redovisning av regeringsuppdrag*. Accessed April 10, 2025, from https://www.naturvardsverket.se/4ac469/globalassets/amnen/textil/dokument/redovisning-regeringsuppdrag-hantering-textilier-2016-09-26.pdf *(SE Waste/Policy)*

56. Avfall Sverige. (2023). *Swedish Waste Management 2023*. Accessed April 10, 2025, from https://www.avfallsverige.se/media/cwibhsx2/svensk_avfallshantering_2023_en.pdf *(SE Waste Data)*

57. Naturvårdsverket. (n.d.). *Statistics on textiles. (Representing orig refs 31, 38 - requires specific link consolidation) (SE Waste Data)*

58. Västra Götalandsregionen. (n.d.). *Cirkulära affärsmodeller*. Accessed April 10, 2025, from https://www.vgregion.se/regional-utveckling/regional-utvecklingsstrategi/kraftsamlingar/cirkulara-affarsmodeller/ *(SE Policy)*

59. Circular City Funding Guide. (n.d.). *Prato: building on existing local circular practices*. Accessed April 10, 2025, from https://www.circularcityfundingguide.eu/case-studies/prato-building-on-existing-local-circular-practices/ *(Benchmarking - Prato)*

60. Interreg Europe. (n.d.). *Textile recycling valley*. Accessed April 10, 2025, from https://www.interregeurope.eu/good-practices/textile-recycling-valley *(Benchmarking - Nord France)*

61. Vlaanderen Circulair. (n.d.). *Homepage*. Accessed April 10, 2025, from https://vlaanderen-circulair.be/en *(Benchmarking - Flanders)*

62. Source Intelligence. (n.d.). *SB 707: California's Textile EPR Law Explained*. Accessed April 10, 2025, from https://www.anthesisgroup.com/insights/sb-707-californias-textile-epr-law-explained/ *(EPR Context - External)*