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Final report

Ecodesign for Sustainable Products Regulation: requirements for the ecodesign of textiles and the possible transfer to an ecodesign label

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Abstract: Ecodesign for Sustainable Products Regulation: requirements for the ecodesign of textiles and the possible transfer to an ecodesign label

The Ecodesign for Sustainable Products Regulation (EU) 2024/1781 (ESPR) is a step towards establishing sustainable products as the norm within the European Union. Textiles are a priority product group due to their significant environmental impact. Commissioned by the German Environment Agency (UBA) and conducted by Oeko-Institut in collaboration with the universities of applied Sciences Hochschule Niederrhein and Hochschule Hof, this study supports the development of ecodesign requirements for textiles and explores how these can be communicated through an ecodesign label. The study's methodology involved a literature review, expert consultation, market analysis, and stakeholder workshops. These were used to develop requirements relating to durability, repairability, recyclability, recycled content, substances of concern and environmental impacts for three product examples: T-shirts, jeans and functional jackets.

Kurzbeschreibung: Die neue Ökodesign-Verordnung: Anforderungen an das Ökodesign von Textilien und die mögliche Überführung in ein Ökodesign-Label

Die Ökodesign-Verordnung (EU) 2024/1781 (ESPR) ist ein Schritt auf dem Weg, nachhaltige Produkte zur Norm in der Europäischen Union zu machen, wobei Textilien aufgrund ihrer erheblichen Umweltauswirkungen eine priorisiert Produktgruppe darstellen. Die Studie wurde vom Umweltbundesamt in Auftrag gegeben und vom Öko-Institut in Zusammenarbeit mit der Hochschule Niederrhein und der Hochschule Hof durchgeführt, um mögliche Ökodesign-anforderungen für Textilien zu erarbeiten und in ein potenzielles Kennzeichnungslabel zu überführen. Das methodische Vorgehen kombinierte Literaturrecherche, Expertenbefragung, Marktanalyse und Stakeholder-Workshops, um Anforderungen für drei Produktbeispiele (T-Shirts, Jeans und Funktionsjacken) in Bezug auf die priorisierten Produktaspekte Haltbarkeit, Reparierbarkeit, Recyclingfähigkeit, Rezyklatanteil, besorgniserregende Stoffe und Umweltauswirkungen zu entwickeln.

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Abbreviation	Explanation
A&FW	Apparel and Footwear
A.I.S.E.	Association Internationale de la Savonnerie et de la Détergence
AATCC	American Association of Textile Chemists and Colorists
ADEME	Agence de la Transition Écologique
AFIRM	Apparel and Footwear International RSL Management
BAT	Best Available Technique
BMUKN	Bundesministerium für Umwelt, Klimaschutz, Naturschutz und nukleare Sicherheit
BMZ	Bundesministeriums für wirtschaftliche Zusammenarbeit und Entwicklung
BREF	Best Available Techniques Reference Document
CAGR	Compound Annual Growth Rate
CAS	Chemical Abstract Service
CCS	Carbon Capture & Storage
CE	Conformité Européenne
CEAP	Circular Economy Action Plan
CIL	Chemical Inventory List
CLP	Regulation (EC) 1272/2008 on the Classification, Labelling and Packaging of substances and mixtures
CMR	Carcinogenic, Mutagenic, or toxic for Reproduction
CN	Combined Nomenclature
CO_2	Carbon dioxide
CoC	Chain of Custody
CPA	Classification of Products by Activity
CSDDD	Corporate Sustainability Due Diligence and Amending Directive
CSRD	Corporate Sustainability Reporting Directive
CTL	Center Textile Logistics
DIN	Deutsches Institut für Normung
DITF	Institute of Textile and Fibre Research Denkendorf
DKE	Deutsche Kommission Elektrotechnik, Elektronik und Informationstechnik

Abbreviation	Explanation
DPP	Digital Product Passport
DQR	Data Quality Ratings
DTB	Dialog Textil Bekleidung e. V.
DWR	Durable Water Repellent
EC	European Commission
ECHA	European Chemicals Agency
EEA	European Environment Agency
EF	Environmental Footprint
EINEC	European Inventory of Existing Commercial Chemical Substances
ELINCS	European List of Notified Chemical Substances
EMF	Ellen MacArthur Foundation
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility
ERP	Enterprise Resource Planning
ERTS	Ecological & Recycled Textile Standard
ESPR	Ecodesign for Sustainable Products Regulation
ESRS	European Sustainability Reporting Standards
EU	European Union
EURIC	European Recycling Industries' Confederation
GHG	Greenhouse gas
GHS	Globally Harmonised System
GOTS	Global Organic Textile Standard
GRI	Global Reporting Initiative
GRS	Global Recycled Standard
GVM	Gesellschaft für Verpackungsmarktforschung
HS	Harmonized System
ILO	International Labour Organization
IML	Institut für Materialfluss und Logistik
ISCC	International Sustainability and Carbon Certification
IUPAC	International Union of Pure and Applied Chemistry

Abbreviation	Explanation
JRC	Joint Research Centre
LCA	Life Cycle Assessment
MEErP	Methodology for Ecodesign of Energy-related Products
MMCF	Man Made Cellulose Fibre
MRSL	Manufacturing Restricted Substances List
n.a.	Not Applicable
NACE	Nomenclature of European Activities
Ne	English unit to express the fineness of yarn (how many 840 yards per pound of yarn)
NFC	Near-Field Communication
NIR	Near-Infrared
NLP	No Longer Polymer
Nm	Number of meters of yarn that weigh one gram.
NPE	Nonylphenolethoxylate
OBP	Ocean Bound Plastic
OVAM	Openbare Vlaamse Afvalstoffenmaatschappij
PA	Polyamide
PCW / PCR	Post-consumer waste / recycled material from post-consumer waste
PE	Polyester
PEF	Product Environmental Footprint
PEFCR	Product Environmental Footprint Category Rules
PES	Polyester
PET / rPET	Polyethylene Terephthalate / recycled Polyethylene Therephthalate
PFAS	Per- and Polyfluoroalkyl Substances
PIW / PIR	Post-Industrial Waste / Post-Industrial Recycled material
PLM	Product Lifecycle Management
POP	Persistent Organic Pollutants
PPWR	Packaging and Packaging Waste Regulation
PTFE	Polytetrafluorethylen

Abbreviation	Explanation
PU	Polyurethane
PVC	Polyvinylchlorid
RCS	Recycled Claim Standard
REACH	Regulation (EC) 1907/2006 on the Registration, Evaluation, Authorisation and restriction of Chemicals
RFID	Radio-Frequency Identification
RP	Representative Product
RSB	Roundtable on Sustainable Biomaterials
RSL	Restricted Substance Lists
SCIP	Substances of Concern In articles as such or in complex objects (Products)
SCS	Scientific Certification Systems
SDS	Safety Data Sheet
SME	Small and Medium-Sized Enterprises
SMR	Secondary Material Rate
SoC	Substances of Concern
SUPD	Single-Use Plastics Directive
SVHC	Substances of Very High Concern
TEGEWA	Verband der Hersteller von Prozess- und Performance-Chemikalien
THK	Textil-Hilfsmittel-Katalog
TI	Technical (application) Information
TITK	Thüringisches Institut für Textil- und Kunststoff-Forschung Rudolstadt
TMC	The Microfibre Consortium
TV	Television
UBA	Umweltbundesamt
	United Kingdom
UN	United Nations
VDI	Verein Deutscher Ingenieure e.V.
VSME	Voluntary reporting standard for SMEs
WCO	World Customs Organisation

Abbreviation	Explanation
WFD	Waste Framework Directive
WRAP	Waste & Resources Action Programme
ZDHC	Zero Discharge of Hazardous Chemicals

Summary

The new Ecodesign for Sustainable Products Regulation (EU) 2024/1781 (ESPR) establishes a comprehensive legal framework within the EU that aims to make sustainable products the norm. It introduces measures such as ecodesign requirements, digital product passports, and physical labels, with the intention of encouraging sustainable choices and market surveillance. Textiles are among the first product groups to be targeted with these requirements due to their environmental impact, and an ongoing preparatory study is being conducted by the Joint Research Centre (JRC). This study at hand was commissioned by the German Environment Agency (UBA) and was conducted by the Oeko-Institut in collaboration with two universities of applied sciences: the Hochschule Niederrhein and the Hochschule Hof. The study aims to support the development of ecodesign requirements for textiles and to explore how these requirements can be communicated effectively through an ecodesign label.

Methodology for developing ecodesign requirements for selected product examples

The initial step in this study in terms of **methodology**, was to prioritise product aspects based on literature reviews and previous work by UBA and the EU Commission. A categorisation of textile products was developed by analysing existing classifications and consulting experts. Product examples representing high-volume items and covering the prioritised product aspects were then selected based on different market analyses. The core work of this study involved developing ecodesign requirements for the selected product examples. This process entailed conducting iterative literature and desktop research to establish a baseline for each product aspect, as well as identifying trade-offs and conflicts between aspects. This research was supplemented by stakeholder consultation in various formats. A key element of this was a series of three national workshops attended by a fairly consistent group of around 40 participants from various stakeholder groups. The modular workshop format encouraged increasingly in-depth discussions. Further stakeholder consultation activities involved questionnaires, semi-structured interviews and written feedback. The findings of the Commission's JRC's ongoing preparatory study were critically reflected upon.

The **prioritisation of product aspects** concluded to address durability, repairability, recyclability, recycled content, the presence of substances of concern (SoC), and environmental impacts. Resource (energy and water) use and efficiency were generally subsumed under environmental impacts. The categorisation system developed in this study is based on the Combined Nomenclature (CN), as is the ESPR with regard to the prohibition of the destruction of unsold apparel. The **categorisation system** considers the use of materials by differentiating superordinate application categories, such as fashion (non-functional) clothing, functional clothing, underwear, and clothing for babies and children. Further categories include fabric structure (knitted/crocheted versus non-knitted/crocheted), accompanied by an indication of whether the garment is worn on the upper or lower body, or as on top garment. The categorisation system focuses on everyday clothing and proposes excluding a list of products, for example textile accessories.

Three **product examples** were selected for the development of ecodesign requirements based on market analyses: 1.) A classic 100 % cotton T-shirt and a functional 100 % polyester T-shirt, due to their very high sales volumes and the relevance of durability, recycled content, recyclability, and mono- versus multi-fibre materials; 2.) Jeans from 95 % cotton and 5 % elastane, due to their high sales volumes and the availability of trims, as well as their relevance for many product aspects, such as durability, repairability, recycled content, recyclability and mono- versus multi-fibre materials; 3.) A functional jacket made from 100 % polyester or

polyamide, due to its high relevance for the presence of SoC, multi-fibre materials, and the availability of wear parts, as well as its relevance for durability, repairability, and recycled content.

The detailed analytical work for each prioritised product aspect was guided by the unified methodological framework, while also allowing for additions tailored to the specific characteristics of each product aspect.

Results and discussion of the developed ecodesign requirements

Product aspect: durability

Analysis of the status quo showed that extending the service life of textiles could significantly reduce environmental impact by decreasing resource use and waste generation. However, the concept of durability lacks a unified, legally binding definition, and the way in which durability is tested in the textile industry varies considerably depending on the product category, material, and price segment. These requirements are usually incorporated into companies' quality management systems and adapted to their specific product portfolios. Industries such as babywear and outdoor clothing tend to apply higher standards or more stringent testing protocols due to safety regulations. Although textiles are subject to a legally binding two-year consumer guarantee, as it does to all products placed on the European market, there is no standardised, industry-wide method to verify compliance before products are brought to market. This legal guarantee period could serve as a baseline for establishing clothing longevity and for introducing objective durability standards under the ESPR, which would clarify the burden of proof for compliance.

The following key findings can be derived from the analysis performed in this study:

- **Performance:** Physical durability is defined by intrinsic properties that can be measured using existing textile testing standards. However, it is only by considering performance that one can arrive at realistic propositions about the durability of an item of clothing.
- **Adaptation of standards:** Currently, performance cannot be reliably determined, as existing test procedures do not simulate realistic stresses throughout the entire product lifecycle. Introducing washing tests at this stage would require a considerable amount of effort, particularly with regard to compliance testing. Standards must be adapted to simulate realistic stresses and research must be conducted to ensure that the testing effort remains reasonable.
- **Values for new items as a starting point:** Although the predictability of how intrinsic properties develop over the course of a product's life is unreliable with regard to all aspects of durability, testing new items is currently the most effective way for establishing a minimum durability for textiles.
- **Dynamic adjustment:** A comparison of the requirements derived after 30 wash-dry cycles and the characteristics of new T-shirts currently available on the market according to the JRC showed that these values are nearly identical. Consequently, the properties of new items would likely be insufficient to guarantee adequate durability for at least two years. Purposeful requirements for new items must factor in loss of intrinsic properties due to wear and tear to the threshold values. Therefore, durability requirements should evolve dynamically in line with research and standardization to more accurately reflect actual product performance in the long term.

- **Predictability:** To keep testing efforts reasonable for companies and testing bodies, predictability of ageing must be achieved.

In science, a distinction is made between physical durability and emotional durability. While the emotional dimension can significantly contribute to the service lifespan and reduce environmental impact, it is difficult to measure objectively. For this reason, this study focused on the physical durability of textiles, which represent technical, measurable characteristics. Physical durability encompasses both intrinsic properties, such as material composition, construction, and resistance to wear or colour fading, and extrinsic factors, such as user behaviour and care practices, providing a holistic view of how long a textile product remains functional and appealing. The interaction between these two dimensions determines the 'performance' of an item of clothing, offering a more comprehensive understanding of durability.

To establish minimum durability requirements for T-shirts, jeans and functional jackets, a triangulation of qualitative and quantitative data was applied. Data for the analysis was provided by literature research, industry surveys, workshops, expert interviews, and experimental tests (only for the 100 % cotton T-shirts).

The intrinsic properties of an item of clothing determine its prerequisites for durability and resistance to wear and tear. According to the literature, the causes of wear and tear are product-specific. Most of these properties can be quantified using textile testing standards (e.g. tensile strength, dimensional stability, colourfastness and abrasion resistance). Literature research and industry surveys show that the most relevant aspects of physical durability vary depending on the product, its material composition, and the intended use (see Table S-1). Therefore, minimum requirements should be set considering parameters relevant to the specific product.

Table S-1: Most relevant durability aspects for T-shirts, jeans and functional jackets

T-Shirt (100 % cotton)	Jeans (95 % cotton and 5 % elastane)	Functional jacket (100 % polyester or polyamide)
• Dimensional stability to washing	• Dimensional stability to washing	• Abrasion resistance
• Bursting resistance	• Tensile strength and Elongation	• Dimensional stability to washing
• Colourfastness to domestic laundering	• Abrasion resistance	• Colourfastness to artificial light
• Colourfastness to artificial light	• Colourfastness to domestic laundering	• Water repellency
• Pilling resistance	• Colourfastness to rubbing	• Water proofness
• Spirality after laundering	• Elasticity of fabric	• Water vapor permeability
	• Spirality after laundering	

Minimum values were set for these most relevant durability aspects based on the findings in the literature and consultation with industry representatives. Analysis of existing testing standards indicated that, while they correspond to the relevant aspects and are well established, their application and threshold values vary. Internal company standards often exceed the minimum values stated in the literature in order to prevent customer complaints. However, for regulatory purposes, workshop participants called for more achievable baseline levels. Discussions with the surveyed experts revealed that the physical durability and suitability of the minimum requirements can only be fully assessed if external factors are also considered.

For **extrinsic factors** that are harder to quantify due to individual variability, such as wearing and washing habits, the literature and expert input showed that wash-dry cycles are the most practical and comparable method for simulating use and resulting product ageing for most products. To investigate the durability of 100 % cotton T-shirts, a performance test involving 30 wash-dry cycles at 40°C was conducted in a household washing machine. Interviews revealed that standardised washing tests, such as the ISO 6330 standard, do not accurately simulate household washing, particularly with regard to parameters such as temperature, washing mechanics, detergent, and load size. Therefore, standardisation of realistic and efficient ageing simulations is needed to better verify the physical durability over an appropriate service lifespan.

Performance analysis in the form of experimental tests on 100% cotton T-shirts, considering the internal properties (i.e. textile testing standards with set minimum values) as well as external factors (i.e. wash-dry cycles), revealed that some requirements (e.g. dimensional stability, bursting resistance, colourfastness and pilling resistance) were often met. However, after applying maximum stress (30 wash-dry cycles), none of the T-shirts met all six relevant aspects with their corresponding values simultaneously.

In addition to the most relevant durability aspects identified in the literature and in practice, the expert interviews and the experimental tests revealed further product-specific findings that must be taken into account:

Table S-2: Additional product-specific findings

T-Shirt (100 % cotton)	Jeans (95 % cotton and 5 % elastane)	Functional jacket (100 % polyester or polyamide)
• Relevance of appearance-related properties	• Relevance of appearance-related properties	• Maintenance of key functions
	• Durability of fasteners	• Appropriateness of functional requirements to intended use
	• Validation of colourfastness standards	

Conclusion & recommendation

In conclusion**, minimum durability requirements** were identified for each example product. However, the testing efforts required for this (as performed in the experimental test for the 100 % cotton T-shirts, involving testing 16 T-shirts for over 250 hours) would currently be disproportionate to the benefit. Therefore, these requirements serve as a starting point and have been set for the new item. In future, it will be necessary to predict ageing in order to set even more realistic and manageable minimum durability requirements.

Product aspect: Repairability

In the context of the Ecodesign Regulation, repairability aims to extend product lifetimes, conserve resources and reduce waste. This perspective goes beyond the two-year legal guarantee period, as repairs should be easier, more attractive, and preferred to replacing products with new ones or purchasing new items. Emerging EU regulatory frameworks, such as the 'right to repair", could play an important future role in the textile industry. To this end, suitable indicators are required to describe and promote the repairability of textiles.

The analysis of the current state and the evaluation of repairability, based on a literature review, interviews, product analysis and stakeholder consultations, reveals the following key findings:

- **Common failures:** The most frequently repairable garment issues include broken zippers, loose buttons, holes, and seam defects. Problems such as pilling and fading, however, are more related to durability than repairability.
- **Challenges identified:** Garment repairability is hindered by complex constructions that make accessing damaged components difficult, as well as by high repair costs relative to generally low garment prices. Other barriers include consumers' insufficient repair skills, the limited availability of original spare parts, and the inadequate repair service infrastructure.
- **Impact of design:** Product design and manufacturing practices influence repairability, particularly for components such as zippers.
- **Transferable indicators:** These can be transferred from the electronic sector and include ease of disassembly, spare-part availability, repair documentation, and access to repair services.
- **Repairability at product level:** Product-specific criteria are not relevant to all products. Where they do apply, repairability assessments require precise, product group-specific indicators to ensure a fair evaluation of complex designs.
- **Feedback:** Stakeholders generally consider repair tools, spare parts, and user-friendly instructions to be important, but they reject economic criteria and express concerns that mandatory standardised parts could compromise quality, functionality, and brand aesthetics.

In conclusion, minimum requirements for garment repairability were proposed. Scenario 1 establishes a mandatory baseline for market entry applicable to all product groups.

Scenario 1: The mandatory baseline consists of three criteria: 1) Availability of spare parts, such as buttons, zippers, belt buckles, threads, and any other components needed to repair the product. These parts must either be standardized **or** designed in such a way that they can be replaced with commercially available spare parts without compromising the design or functionality. 2) Documentation should include information on self-repair and access to professional repair service providers. 3) Repair services refer to the various ways in which a company can provide repair services.

The two further scenarios provide options for the future to support a smooth transition if the following models become more relevant: a repairability score or more detailed criteria at the product level.

Scenario 2: Information requirements relating to a repairability score: Products are assessed on how many of the minimum criteria in Scenario 1 they meet. Scores are calculated using either a simple or a weighted system, resulting in an absolute or a percentage-based repairability score.

Scenario 3: Information requirements for 'repairability performance' at product level: Product-level requirements must be tailored to each product group, using specific indicators and a point-based scoring system to assess repairability. Sub-criteria such as part replaceability, fixation type, and number of seams can be rated on a scale, with higher scores indicating better repair performance. This has been demonstrated for jeans in the present study.

If product-specific repairability requirements become relevant, a selection scheme based on product complexity and design impact has been proposed. Products with few components, no repair-relevant parts, no need for special tools, and minimum design influence, such as T-shirts, can be assessed using the mandatory baseline as generic repairability requirements. In contrast, complex items such as jeans and functional jackets need additional product-specific requirements because they have multiple components, frequent failures, and require special tools, as well as being strongly affected by design choices.

Conclusion & recommendation

Although repairability can have a positive environmental impact, its effect on the challenges of fast fashion is relatively limited. The key obstacles remain consumer willingness to use products for longer and repair costs compared to the cost of new items. For complex or higher-priced products, however, ease of repair can have a positive impact. Therefore, a balanced approach could combine targeted, binding information requirements for companies (Scenario 1) with voluntary, product group-specific design guidelines. These should be tailored specifically to product groups in order to enhance and operationalise existing repair-oriented design frameworks within the textile sector strategically.

Product aspects: Recyclability and recycled content

Both recyclability and recycled content should strengthen the circular economy. The feasibility of a recycled content and the effectiveness of textile recyclability depend on textile waste management in the EU and the technical capabilities of textile recycling processes. The currently dominant fibre-to-fibre recycling method is mechanical recycling. Although this method is available on an industrial scale, it results in reduced fibre quality and has high input requirements. Processes such as solvent-based methods and depolymerisation are capable of producing higher-quality outputs. However, these methods are still in development and face challenges in terms of scaling up and input streams. Interviews with stakeholders across the textile recycling value chain revealed that to increasing fibre-to-fibre recycling and recycled content faces challenges including heterogeneous textile waste, immature sorting technologies, a lack of traceability, quality losses, and economic barriers such as low incentives and high costs compared to virgin materials. Overcoming these technical, economic and systemic hurdles is essential for scaling up high-quality recycling.

Recyclability refers to a product's ability to be recovered and reused as secondary raw materials after its initial use. In design terms, this means creating conditions that enable the high-quality, technically, ecologically, and economically feasible recovery of materials. In the case of textiles, factors such as fibre composition, material purity, the presence of coatings or blends, disassembly ease, and the availability of suitable recycling processes and infrastructure all influence recyclability. Improving recyclability requires high initial product quality, materials that are easily separable and clearly labelled, and reduced material diversity.

An analysis of the current state and an evaluation of recyclability, based on a literature review, interviews, product analysis, and stakeholder consultations, yields the following **key findings**:

There is a discrepancy between generic product design guidelines, which prioritise material purity, mono-material use, and easy disassembly, and the more specific, process-dependent input requirements of recyclers, such as fibre type purity and minimal contamination. This highlights the need for stronger collaboration and standardized recyclability criteria. Although industry initiatives and draft regulations increasingly recommend mono-materials and minimal non-textile components, there is currently no harmonised assessment methodology. Feedback from stakeholders at various consultation stages raised, among other things, the issue of structural design factors that are currently not included due to a lack of standardised, validated data from recyclers, particularly with regard to specific disruptive factors and system limitations. Other concerns relate to the trade-off between recyclability, durability, and function.

The proposed minimum requirements for textile recyclability focus **on restricting the use of heterogeneous materials**, ensuring that multi-material products consist of no more than two different materials in one surface layer (excluding all other product components). To maximise the main fibre content, further restrictions are based on the current state of automatic detection technologies for fibre materials, which can only reliably detect material types from a percentage share of around 5 to 10 %. This requirement, named the **'material utilisation rate"**, stipulates that minor parts must contain a minimum of 10 % fibre material relative to all other materials. Elastane was given special attention as its presence in a share of greater than 10 % affects mechanical recycling and in a share of greater than 3 to 5 % affects chemical recycling. In order to facilitate identification via automated sorting technologies while also allowing for recyclability, the proposed limitation of elastane content is set within the range of 5 to 10 %.

In addition to these concrete performance requirements, information requirements on the preferable recycling process were also proposed because not every product is suitable for every process in terms of fibre-to-fibre recycling. Examples of recycling processes and criteria are provided. These information requirements could be integrated when implementing the digital product passport.

The requirements for the use of heterogeneous materials, as well as for the material utilisation rate, were considered applicable to all product categories., Specific product groups should be excluded from the elastane restriction, for example clothing for babies and children, that is excessively elastic to ensure comfort when dressing and wearing it, as well as certain jeans and sport leggings. It is not recommended to exclude functional jackets from recyclability requirements, as these requirements apply at the surface level and allow different surfaces to be combined without affecting compliance. In the categorisation, general exclusions from ecodesign requirements were proposed for accessories, underwear and swimwear, for example. While the elastane content in functional T-shirts must be reduced to meet the requirements, fashion clothing can generally comply with limited elastane use and design adjustments without impairing functionality or comfort. Therefore, no further exclusions were considered necessary. However, ongoing validation of the technical feasibility of product functions and recycling technologies in terms of input requirements is recommended.

Conclusion & recommendation

The requirements for the use of heterogeneous materials as well as for the material utilisation rate, were considered applicable to all product categories. However, specific product groups should be excluded from the elastane restriction. It is recommended that the technical feasibility of product functions and recycling technologies, in terms of input requirements, should be validated on an ongoing basis.

Recycled content, as defined by EN ISO 14021, includes pre-consumer materials (i.e. post-industrial and unsold goods) and post-consumer materials. Recycled content is calculated as the proportion of recycled material by mass in a product. Accurate verification requires tracing material flows throughout the supply chain, often using chain of custody models such as segregation, controlled blending or mass balance. As there is no physical test to distinguish between recycled and primary content, third-party audits and certifications covering input, process, and output are essential to ensure transparency and prevent false claims, particularly at the recycling and blending stages.

The analysis of the current status of textile recycling and the use of recyclates, as well as the derivation of requirements, is based on literature review, expert interviews, and stakeholder consultations. This analysis yields the following **key findings**:

The status quo analysis reveals that the global market share of recycled fibres is low, at less than 1 %, particularly for closed-loop, fibre-to-fibre recycling. Most recycled polyester is sourced from PET bottles rather than post-consumer textiles, and the recycled content of products varies widely, often lacking transparency or reliable certification. Most certification schemes do not reliably differentiate between fibre and non-fibre waste, nor do they provide verifiable fibre-to-fibre recycled content. Only the 'UL Closed Loop" certification scheme offers robust proof, albeit with stricter requirements than are necessary for all products. Consequently, despite the growing strategic importance of recycled content for brands, the current lack of systematic data, standardised verification, and transparent market information makes it difficult to set credible minimum recycled content targets for textiles. However, mandatory recycled content requirements are widely supported as an effective policy tool to stimulate demand for recycled fibres and incentivise investment in recycling infrastructure. Most studies recommend setting low, product-specific targets that can be increased over time as technical capacity grows. As there is a lack of comprehensive data on the availability of high-quality recycled fibres, the proposed quotas are based on theoretical availability and current market trends, with T-shirts and jeans being used as feasible examples.

In order to derive minimum requirements for recycled content, it is necessary to clarify the **framework conditions**:

Firstly, a decision must be made whether the recycled content is required at **product level or batch level**. Secondly, it must be decided whether the recycled content must **originate from fibre-to-fibre recycling**, although the materials used in the recycling process can be post-industrial recyclates (PIR) and post-consumer recyclates (PCR). Thirdly, the method of **calculating** the recycled content must be decided, as well as how to deal with **multi-material** products (e.g. by using a simplified approach whereby only the fibre with the highest content must contain recycled materials. It is also necessary to decide what kind of certification scheme is recognised, and whether, in Chain of Custody **(CoC) models**, only **'identity preservation', 'segregation' and 'controlled blending'** are permitted. It is also recommended **that certified sustainable natural fibres be exempt** from recycled content requirements and accepted as an alternative to mechanically recycled natural fibres in cases where durability requirements conflict.

The study proposes the following recycled content targets for T-shirts and jeans by 2030: 10 % for cotton; 3 % for polyester; 5 % for polyamide and manmade cellulosic fibres; and 15 % for wool. Examining studies on the effect of the recycled content on textile quality leads to the conclusion that no durability impairment can be assumed for the relatively low recycled content proposed here. Therefore, the study team believes that the proposed recycled content for T-shirts and jeans is within a range that makes it technically possible to manufacture products that fulfil the proposed durability requirements.

Conclusion & recommendation

Implementing minimum recycled content requirements under the ESPR necessitates clarifying certain prerequisites. Studies show that it is possible to use low recycled content and still meet quality requirements. Furthermore, mandatory recycled content requirements are widely supported as an effective policy tool for stimulating demand for recycled fibres and incentivising investment in recycling infrastructure. Therefore, the study's authors recommend setting low, product- and fibre-specific targets (here, for T-shirts and jeans), which can be increased over time as technical capacity grows.

Product aspect: Substances of Concern

The ESPR defines Substances of Concern (SoC) based on EU chemical regulations and on hazardous classification properties under the European chemicals legislation REACH, POP and CLP, and adds a criterion for substances that hinder recycling or reuse. Thousands of chemicals fall under these definitions, but the exact number used in textiles is unknown.

Analysis of the current situation and evaluation of SoC, based on a literature review, interviews and stakeholder consultations, reveals the following **key findings**:

Safety data sheets (SDSs) are designed to be the primary tool for communicating information on hazardous chemicals to ensure their safe usage, storage, transport and disposal. In practice, the effectiveness and reliability of SDSs is often limited, especially within the complex and global textile supply chain. It is standard practice for chemical suppliers to also provide a technical information on how to use their chemicals. Both documents are primarily intended for sharing between chemical suppliers and textile dyeing or finishing producers. However, due to increasing awareness of the use of hazardous substances in textile production, the documents are also used by brands, retailers or importers to some extent. In the case of product regulations such as the ESPR, the content of these documents is relevant to all market operators. The various stakeholder consultation activities in the study also revealed that competence gaps are an important consideration. Many companies, particularly small and medium-sized enterprises (SMEs), lack the expertise to correctly interpret and use SDSs for effective chemical management. Furthermore, the lack of harmonised regulations and stricter enforcement outside the EU, as well as technical barriers such as digital systems like Product Lifecycle Management (PLM) and Enterprise Resource Planning (ERP) systems, which are often not designed to support detailed chemical tracking or SDS integration, mean that SoC cannot be tracked throughout product lifecycles. Current approaches in the textile industry largely rely on restricted substance lists that are passed on in the supply chain or verified by third-party certification standards.

The use of Chemical Inventory Lists (CILs) forms part of the Best Available Techniques (BAT) for chemical management in the textile sector and is included in the European BAT Reference Document (BREF). However, CILs are more frequently used by large manufacturers, particularly those subject to EU regulations or those participating in voluntary sustainability initiatives. Within a functioning chemical management system, SDSs, technical information and CILs play a crucial role.

Considering the final aspect of the SoC definition – substances that hinder reuse or recycling – it should be noted that the number of substances that may fall under this definition in the future is unknown. The connection between fibre materials (e.g. polyester), the chemicals used in processing (e.g. water-repellent chemicals) and the respective recycling processes (e.g. thermo-mechanical processes) has not been investigated in all its conceivable combinations. It is known that the use of chemicals affects many other aspects of ESPR, such as durability and recyclability, and that the impact on recycling processes is mostly due to chemicals remaining on the textile – the so-called 'effect chemicals'. These are substances that are intentionally used in textile production to impart specific properties to the final product and are therefore present in the textile.

Two information requirements are proposed as minimum requirements:

- Integration of the SVHC information requirements (identity, concentration and occurrence in articles and their parts, as well as accessories, as defined by REACH) in the public section of the Digital Product Passport (DPP), making the information accessible to end consumers. This would relieve industry of the need to respond to individual consumer requests regarding the presence of SVHCs. As the DPP system is being developed to be interoperable with existing databases, it would be necessary for the DPP to be interoperable with the SCIP database to avoid entering data into more than one system.
- Information requirement on effect chemicals (e.g. dyes and finishes): This information should cover the group of effect chemicals and be included in the product's technical specification to ensure that design considerations regarding product functionality, wear comfort and ease of care are informed by the necessary group of effect chemicals. This would also improve considerations regarding the durability of the effect chemicals, as some are known to last only a few wash-dry cycles.

It is proposed that the information on effect chemicals be limited to groups rather than single substances. Group-level communication of effect chemicals is recommended for practical reasons, as it is considered more feasible for suppliers and manufacturers, particularly when dealing with complex mixtures or proprietary formulations. However, this approach may serve as an interim solution. As DPPs and supply chain transparency advance, this group-level reporting can progressively expand towards full material disclosure. For now, group-level communication remains the most realistic and effective option, albeit one that still requires a functioning digital data system.

Finally, information about effect chemicals would contribute to a better understanding of chemicals that have an adverse effect on the reuse and recycling of materials in textile products. Different sorting and recycling processes are expected to drive technological innovation, for example in automated sorting. Therefore, the chosen approach for SoC here is to improve information transfer and strengthen durability considerations in order to keep textiles in use for as long as possible.

Conclusion & recommendation

For SoC, the following cautious approach to marking effect chemicals in the technical specification is proposed: As an initial step to addressing information requirements, it is recommended that effect chemicals intentionally present in the product (e.g. water repellents) are identified first. Information about these chemicals should be included in product specifications and passed along the supply chain, but not necessarily to end consumers. This will gradually improve chemical transparency over time. Information requirements on SVHCs (identity, concentration and occurrence in articles and their parts, as well as accessories, in accordance with REACH) should be integrated into the public part of the DPP, making this information available to end consumers.

Product aspect: Environmental impacts

The environmental impacts aspect encompasses energy use and energy efficiency, water use and water efficiency, and resource use and resource efficiency. The JRC preparatory study also came to a similar conclusion. Textile production and consumption are widely recognised in literature as having wide-ranging and substantial environmental impacts, including water use, pollution, climate change, energy demand, and microplastics. The European Commission recommends using Environmental Footprint methods in policies and schemes that measure or communicate the life cycle environmental performance of products and organisations. The Product Environmental Footprint (PEF) is a general method for measuring and communicating the potential life cycle environmental impact of a product. The suitability of the Product Environmental Footprint Category Rules (PEFCRs) for Apparel and Footwear was evaluated through a workshop and a review of the final version 3.1. PEFCRs, which revealed several significant data, methodological, and practical challenges, particularly for SMEs. These limitations have been analysed in a separate step and are summarized below. The following practical challenges were identified during the stakeholder exchange:

- Expertise and cost barriers: Calculating a PEF-profile requires specialist knowledge of Life Cycle Assessment (LCA) and textile production. SMEs often lack the capacity to carry out this work in-house, and outsourcing is expensive, particularly since external communication of results requires verification and validation.
- Verification challenges: Comprehensive verification of company data is not feasible, and companies may use default values selectively when it is to their advantage, which undermines reliability.
- Materiality principle issues: Distributors often lack access to primary data on raw materials and downstream processes, which makes compliance problematic.

At present, this study does not recommend mandatory PEF calculations until these issues are addressed and the cost-benefit analysis is clearer.

Instead, alternatives to the PEF that can be implemented by all economic operators placing textiles on the EU market with reasonable effort have been researched further. The analysis focused on ensuring that these requirements are harmonised with other reporting obligations. Additionally, these alternatives should steer the market or at least provide a basis for future benchmarking. Various options for reporting environmental impact obligations have been discussed in workshops as part of this study, and this has been supplemented with literature and desktop research, as well as selected expert interviews.

Energy and water use in textile manufacturing varies significantly by process and product; typically, data is collected at the production site rather than at the product level. While improved site-level reporting, especially for wet processes and main materials, could facilitate benchmarking, transparency of the supply chain and availability of data remain limited. European reporting standards do not adequately address water use in the supply chain, despite it being an environmental hotspot. Current manufacturer reporting focuses on annual consumption at production sites. However, these data risk being unverified for an information requirement, and demanding verification would create a disproportionate amount of effort. Implementing product-level reporting would impose a high administrative burden without providing any additional benefit over and above existing company-level obligations.

Overall, it was not recommended that a reporting obligation be placed on microplastics/microfibres, as it would require companies to conduct excessive testing in order to provide product-specific information on their entire portfolio. However, the idea of a stepwise introduction was suggested during the study, initially applying to products sold in large quantities. This proposal would allow for the determination of microplastic emissions to be requested, as testing a manageable number of products would be required.

Conclusion & recommendation

- No information requirements have been proposed for water and energy consumption, since companies usually only collect annual, site-wide data rather than product-specific figures. This data depends on various site parameters and product ranges, so it would not be suitable for future benchmarking.
- No general information requirement is proposed for microplastics/microfibres, as testing all products would be too excessive. However, information on shedding rates could be required for selected basic products.

Although reducing the environmental impact of production is a high priority in principle, this project concluded that the product policy framework of the ESPR is not suitable for this purpose. Instead, this must be addressed or regulated at company level, as set out in the Corporate Sustainability Reporting Directive and the Corporate Sustainability Due Diligence Directive. However, recent changes to the European Commission's omnibus package have significantly reduced its scope and data requirements, which will likely limit its effectiveness. Therefore, the long-term integration of environmental impacts into product-level frameworks may be necessary to achieve a reduction in environmental impacts. Future steps might include developing guidelines for allocating process-specific data, such as water use, to products, and gradually introducing fibre fragment emission testing to improve data and enable benchmarks.

Overall Conclusions

The overall conclusions are based on a synthesis of the results obtained from analysing the product aspects:

- The synthesis of all product aspects clearly indicates that **durability** is **crucial** for extending the lifespan of textiles. Textiles that are designed and manufactured for repeated use and washing have the potential to last longer. This can reduce overall textile consumption. Thus, durability can directly minimise resource use and the environmental impacts associated with production.
- The **scope** of the developed requirements **depends on the product aspect**: Durability requirements have been found to vary significantly depending on the specific product category. In contrast, requirements for other aspects, such as recyclability, can be formulated more broadly and applied across multiple product categories.
- The **timeline** for introducing the requirements is influenced by the availability of prerequisites, such as standardised methods and political decisions, and the complexity or number of requirements involved. Some aspects, such as durability, may allow for shorter transition periods (e.g., two years for basic products), while others, such as recycled content, may require longer periods to meet specific targets (e.g. by 2030).

- The **need for standardised test methods**, verification schemes, or other supporting frameworks was identified as critical to ensuring the effective implementation of performance requirements. In some cases, existing standards were found to be sufficient; in others, such as for recycled content, new or adapted frameworks are necessary.
- The requirements for the product examples can be determined by the technical specifications during the design phase.
- **Conformity assessment procedures** were considered crucial for reducing administrative burden and verification costs. Both the technical specification and the conformity assessment were confirmed to be integral tools in a company's quality management system for product development.
- A **stepwise introduction**, supported by measures such as capacity building for SMEs, was favoured by workshop participants in this study. They recommended trial runs on selected product categories to refine procedures and improve sustainability. The prioritisation criteria for selecting products or product categories for the stepwise introduction were market share and consumption volumes, as these would have the greatest impact. Basic products that are frequently used, such as cotton T-shirts, were suggested as a starting point.

Mapping and systematically comparing all relevant product aspects showed that improving one aspect often comes at the expense of another. The following conclusions were drawn to prioritise durability amid trade-offs: Conflict between durability and recycled content: Higher recycled content can reduce durability, particularly in the case of mechanically recycled fibres. To address this, fibre-specific recycled content requirements must be balanced with durability requirements for each product group. The low recycled content recommended for T-shirt and jeans can be assumed not to compromise compliance with durability requirements. Durability and recyclability conflict, particularly for functional products, due to complex material mixes. Therefore, specific exemptions are proposed for requirements relating to heterogeneous material, e.g. for swim wear, and the limited elastane range, e.g. for children's clothing. Durability can also be influenced by effect chemicals. This interlinkage was one of the reasons for proposing the requirement to provide information on effect chemicals to reflect their impact on durability.

Potential transfer of the requirements to an ecodesign label

This analysis is based on a comparative evaluation of the energy label and considers the potential transfer of the requirements to an ecodesign label. The ESPR foresees such a physical label on the product to help consumers make sustainable choices by providing clear, comparable information. It has been proven that the energy label is effective in reducing household energy use, with a 28 % reduction achieved by 2020. It is widely recognised and has been shown to strongly influence purchasing decisions. Studies on labels have found that graduated labels are the most effective means of promoting sustainable purchasing decisions, and that consumers find alphabetical scales (A–G) easier to understand than numerical ones. Therefore, this study used the energy label as a model to explore the potential of using performance classes and icons to display absolute information on textile labels.

The conclusions and recommendations for each product aspect are as follows:

- The development of performance classes for **durability** is challenging because it would require multiple test parameters to be aggregated into one score. Additionally, unlike energy efficiency, the test parameters do not behave linearly over time. For washable textiles, the number of washing cycles could be a clear indicator. The workshop discussion of stakeholders also recommended indicating washing cycles as absolute information. However, washing processes that reflect household laundry need to be standardised.

- For **repairability**, a simple point system (e.g. 1–5 points) based on indicators such as ease of disassembly and required tools could be used to differentiate repairability at the product level. This would result in the display of performance classes. Workshop participants favoured qualitative information, such as details of repair services.
- For **recyclability**, displaying performance classes could promote the use of mono-materials and discourage mixed materials. The proposed classes are based on major/minor material ratios, but further validation is needed as technology evolves. However, workshop discussions resulted in the proposal of a complex score that deviated from the system proposed as minimum requirements.
- For **recycled content**, it is recommended that the exact percentage of recycled content is displayed as absolute information. Most workshop participants also supported this approach. This would eliminate the need for performance classes, which would require further assessments to determine class distinctions. Displaying the exact percentage would also require definitions of the calculation and verification methods.
- For **SoC**, performance classes were not considered feasible. The SVHC information proposed as part of the minimum requirements should only be provided via the DPP, not on the label, to avoid consumer confusion. This is because it was not considered an aspect to be displayed on the label for advertising purposes. This decision was also supported by the workshop participants.
- As no minimum requirements are proposed for **environmental impacts**, no performance classes can be developed either. Mandatory product-specific environmental footprint calculations (i.e. PEFCRs) have not been considered proportionate or meaningful for product comparison. One option proposed was that the label could recognise existing environmental certifications. However, this would require the environmental certifications to be externally validated.

Conclusion & recommendation

In principle, it is possible to convert ecodesign requirements into an ecodesign label. However, as establishing meaningful performance classes for durability is considered complex; it is recommended that the number of washing cycles is displayed as absolute information to provide easily understandable and comparable data. As durability was considered the most important product feature, it should be displayed prominently. In comparison, the other product aspects should be displayed less prominently, only providing additional differentiation.

PEFCR Apparel & Footwear analysis

Following an analysis of how biodiversity and microfibre emissions were taken into account by the PEFCR, an in-depth analysis of the required input data and the significance of the PEF results was performed.

The impact on biodiversity and the effect of releasing microplastics and microfibres is considered in the form of additional environmental information. These are not considered as a stand-alone impact category and are therefore not included in the calculation of the total PEF score. The use of organic, certified materials must be reported, further efforts related to **biodiversity** can be reported but this information does not affect the product's overall score. Despite its substantial positive effects on biodiversity and other environmental impacts, there is currently no specific dataset for organic cotton in the PEFCR. Consequently, products made from organic cotton may appear less environmentally favourable than they truly are, and company efforts to promote biodiversity are not reflected in product scores. For the inclusion of **microplastics**, the PEFCR only considers fibre fragment release during domestic washing, using data from The Microfibre Consortium (TMC). While the TMC database is the best available, it has limitations. Overall, the TMC-method is essentially suited to demonstrating the intrinsic tendency of fibres to shed fibre fragments during washing; however, it does not accurately reflect emissions during actual household laundry. Furthermore, significant emissions result from the production, finishing and wearing of textiles, as well as the end-of-life phase, and these are not considered by the TMC approach. Also, the emission of fibre fragments into the air is not addressed, though studies show that this can be a major pathway. The PEFCR proposes characterisation factors for calculating the impact of fibre fragment release on marine fauna and sediments, but these are still associated with high uncertainty, especially for natural fibres.

Regarding **data input**, since most textile value chain processes are not performed by the company compiling the PEF profile, **company-specific data** is often limited. If supply chain data is unavailable or expertise to create a company-specific dataset is lacking, which is often the case with SMEs in particular, options to influence the PEF result are restricted. The available background datasets are not considered reliable enough due to outdated or opaque data, which is problematic given the wide variability in textile processes. While adaptations are possible, such as choosing a specific electricity mix, other factors (e.g. chemicals and energy use) would require the creation of detailed, EF-compliant datasets. Durability is included in the environmental assessment using an **Intrinsic Durability Multiplier** (IDM). The intrinsic durability tests are not mandatory, they are highly recommended. While the PEFCR test protocols are more detailed and tailored than those in the JRC preparatory study, they require fewer washing cycles, which raises concerns about the accuracy of the results. Nevertheless, harmonising the PEFCR and ESPR test requirements would reduce the compliance burden on companies overall.

Conclusion & recommendation

Although PEF studies are considered suitable for product-level comparisons and align with other EU initiatives, they are not yet a required minimum standard for textiles. Notable challenges to making PEF-calculations mandatory for all textiles include incomplete coverage of relevant impact categories (e.g. biodiversity and microplastics), limited and opaque data sets, and high costs and complexity for companies, especially SMEs. There is also a potential for misleading comparisons within product categories. Once the EF Database 4.0 is released, a renewed analysis of the suitability of the data basis with regard to a mandatory requirement should be carried out.

Zusammenfassung

Die neue Ökodesign-Verordnung für nachhaltige Produkte (EU) 2024/1781 (ESPR) schafft einen umfassenden Rechtsrahmen innerhalb der EU, der darauf abzielt, nachhaltige Produkte zur Norm zu machen. Sie führt Maßnahmen wie Ökodesign-Anforderungen, den digitalen Produktpass und das Etikett ein, um nachhaltige Entscheidungen und die Marktüberwachung zu fördern. Textilien gehören aufgrund ihrer Umweltwirkungen zu einer der ersten Produktgruppen, die mit diesen Anforderungen adressiert werden. Dazu wird eine Vorstudie vom Joint Research Centre (JRC) erarbeitet. Das Umweltbundesamt (UBA) hat die vorliegende Studie in Auftrag gegeben, die vom Öko-Institut in Zusammenarbeit mit der Hochschule Niederrhein und der Hochschule Hof durchgeführt wurde. Ziel der Studie ist es, die Entwicklung von Ökodesign-Anforderungen für Textilien zu unterstützen sowie zu untersuchen, wie diese Anforderungen über ein Ökodesign-Label effektiv kommuniziert werden können.

Methodik zur Entwicklung von Ökodesign-Anforderungen für ausgewählte Produktbeispiele

In einem ersten methodischen Schritt wurden Produktaspekte auf Basis von Literaturrecherchen und früheren Arbeiten des UBA und der Europäischen Kommission priorisiert. Eine Kategorisierung von Textilprodukten wurde durch die Analyse bestehender Klassifikationen und Expertenkonsultationen entwickelt. Auf Basis verschiedener Marktanalysen wurden solche Produktbeispiele mit hohem Absatzvolumen ausgewählt, die die priorisierten Produktaspekte abdecken. Die Kernarbeit der Studie bestand in der Entwicklung von Ökodesign-Anforderungen für die ausgewählten Produktbeispiele. Dazu wurden iterativ Literatur- und Desktoprecherchen durchgeführt, um eine Ausgangsbasis für jeden Produktaspekt zu schaffen und Zielkonflikte zu identifizieren. Die Forschung wurde durch Stakeholder-Konsultationen in verschiedenen Formaten ergänzt. Dabei bestand ein zentrales Element in einer Serie von drei nationalen Workshops mit einer relativ konstanten Gruppe von etwa 40 Teilnehmer*innen aus unterschiedlichen Interessengruppen. Das modulare Workshop-Format ermöglichte zunehmend vertiefende Diskussionen. Weitere Stakeholder-Konsultationen umfassten Fragebögen, halbstrukturierte Interviews und schriftliches Feedback. Die Ergebnisse der laufenden Vorstudie der Kommission des JRC wurden kritisch einbezogen.

Die Priorisierung der Produktaspekte ergab, dass Haltbarkeit, Reparierbarkeit, Recyclingfähigkeit, Rezyklatanteil, das Vorhandensein besorgniserregender Stoffe (Substances of Concern, SoC) und Umweltwirkungen adressiert werden sollten. Der Ressourcenverbrauch (sowie Energie und Wasser) wurde unter Umweltwirkungen subsumiert. Das entwickelte Kategorisierungssystem basiert auf der Kombinierten Nomenklatur (CN), wie auch in der Ökodesign-Verordnung für das Verbot der Vernichtung unverkaufter Kleidung. Das Kategorisierungssystem berücksichtigt die Materialverwendung durch die Unterscheidung übergeordneter Anwendungskategorien wie Modebekleidung (nicht-funktional), Funktionskleidung, Unterwäsche sowie Kleidung für Babys und Kinder. Weitere Kategorien umfassen die Gewebestruktur (gestrickt vs. nicht gestrickt) sowie die Angabe, ob das Kleidungsstück am Ober- oder Unterkörper oder als Oberbekleidung getragen wird. Das System konzentriert sich auf Alltagskleidung und schlägt vor, beispielsweise Textilaccessoires auszuschließen.

Drei Produktbeispiele wurden für die Entwicklung von Ökodesign-Anforderungen auf Basis von Marktanalysen ausgewählt: Ein klassisches T-Shirt aus 100 % Baumwolle und ein funktionales T-Shirt aus 100 % Polyester, aufgrund ihres sehr hohen Absatzvolumens und der Relevanz von Haltbarkeit, Rezyklatanteil, Recyclingfähigkeit sowie Mono- vs. Multifasermaterialien; Jeans aus 95 % Baumwolle und 5 % Elasthan, aufgrund ihres hohen Absatzvolumens, der Verfügbarkeit

von Besätzen sowie ihrer Relevanz für viele Produktaspekte wie Haltbarkeit, Reparierbarkeit, Rezyklatanteil, Recyclingfähigkeit und Mono- vs. Multifasermaterialien; und eine Funktionsjacke aus 100 % Polyester oder Polyamid, aufgrund ihrer hohen Relevanz für das Vorhandensein von SoC, Multifasermaterialien und die Verfügbarkeit von Verschleißteilen sowie ihrer Bedeutung für Haltbarkeit, Reparierbarkeit und Rezyklatanteil.

Ergebnisse und Diskussion der entwickelten Ökodesign-Anforderungen

Produktaspekt: Haltbarkeit

Die Analyse des Status quo zeigte, dass eine Verlängerung der Nutzungsdauer von Textilien die Umweltwirkungen erheblich reduzieren kann, indem Ressourcenverbrauch und Abfallaufkommen gesenkt werden. Allerdings fehlt es am Begriff der Haltbarkeit an einer einheitlichen, rechtlich verbindlichen Definition, und die Art und Weise, wie Haltbarkeit in der Textilindustrie geprüft wird, variiert je nach Produktkategorie, Material und Preissegment. Die Anforderungen sind üblicherweise Bestandteil von Qualitätsmanagementsystemen der Unternehmen und werden an deren spezifische Produktportfolios angepasst. Branchen wie Baby- und Outdoorbekleidung wenden aufgrund von Sicherheitsvorschriften oft höhere Standards oder strengere Prüfprotokolle an. Obwohl Textilien einer gesetzlich verbindlichen zweijährigen Gewährleistungspflicht unterliegen, gibt es keine standardisierte, branchenweite Methode zur Überprüfung der Einhaltung vor dem Inverkehrbringen. Diese Gewährleistung könnte als Ausgangspunkt für die Festlegung von Langlebigkeitsstandards und für die Einführung objektiver Haltbarkeitsstandards unter der Ökodesign-Verordnung dienen, was die Beweislast für die Einhaltung klären würde.

Die wesentlichen Erkenntnisse der Status quo-Analyse waren:

- **Leistung:** Die physische Haltbarkeit wird durch intrinsische Eigenschaften bestimmt, die mit bestehenden Textilprüfnormen messbar sind.
- **Anpassung von Standards:** Derzeit kann die Leistung nicht zuverlässig bestimmt werden, da bestehende Prüfverfahren keine realistischen Belastungen über den gesamten Produktlebenszyklus simulieren. Die Einführung von Waschtests würde einen erheblichen Aufwand erfordern, insbesondere im Hinblick auf die Konformitätsprüfung. Standards müssen angepasst werden, um realistische Belastungen zu simulieren, und es muss geforscht werden, damit der Prüfaufwand angemessen bleibt.
- **Neuware als Ausgangspunkt:** Obwohl die Vorhersagbarkeit der Entwicklung intrinsischer Eigenschaften im Lebenszyklus eines Produkts in Bezug auf alle Haltbarkeitsaspekte unzuverlässig ist, ist die Prüfung neuer Artikel derzeit der effektivste Weg, um eine Mindesthaltbarkeit für Textilien festzulegen.
- **Dynamische Anpassung**: Der Vergleich der ermittelten Anforderungen nach 30 Wasch-/Trocknungszyklen mit den Eigenschaften aktuell auf dem Markt erhältlichen T-Shirts, die das JRC in seiner Arbeit darlegt, ergibt, dass diese Werte nahezu identisch sind. Daher wären die Eigenschaften neuer Artikel wahrscheinlich nicht ausreichend, um eine Haltbarkeit von mindestens zwei Jahren zu gewährleisten. Zweckmäßige Anforderungen für Neuwaren müssen den Verlust intrinsischer Eigenschaften durch Abnutzung in die Schwellenwerte einbeziehen. Haltbarkeitsanforderungen sollten sich daher dynamisch im Einklang mit Forschung und Normung weiterentwickeln, um die tatsächliche Produktleistung langfristig besser widerzuspiegeln.

- **Vorhersagbarkeit:** Um den Prüfaufwand für Unternehmen und Prüfinstitute angemessen zu halten, muss die Alterung vorhersagbar werden.

In der Wissenschaft wird zwischen der physischen und der emotionalen Lebensdauer unterschieden. Zwar kann die emotionale Dimension erheblich zur Lebensdauer beitragen und die Umweltbelastung verringern, sie ist jedoch schwer objektiv zu messen. Aus diesem Grund konzentrierte sich diese Studie auf die physische Haltbarkeit von Textilien, die sich in technischen, messbaren Eigenschaften ausdrückt. Sie umfasst sowohl intrinsische Eigenschaften wie Materialzusammensetzung, Konstruktion und Widerstandsfähigkeit gegen Abnutzung oder Verblassen der Farben als auch extrinsische Faktoren wie das Nutzerverhalten und Pflegepraktiken. Somit ermöglicht sie einen ganzheitlichen Blick darauf, wie lange ein Textilprodukt funktional und ansprechend bleibt. Die Wechselwirkung zwischen diesen beiden Dimensionen bestimmt die „Leistung" eines Kleidungsstücks und bietet ein umfassenderes Verständnis von Haltbarkeit.

Um die Mindestanforderungen an die Haltbarkeit von T-Shirts, Jeans und Funktionsjacken zu ermitteln, wurde eine Triangulation aus qualitativen und quantitativen Daten angewandt. Die Daten für die Analyse stammten aus Literaturrecherchen, Branchenumfragen, Workshops, Expertenbefragungen und experimentellen Tests (nur für T-Shirts aus 100 % Baumwolle).

Die **intrinsischen Eigenschaften** eines Bekleidungsstücks sind entscheidend für seine Haltbarkeit und Beständigkeit gegen Verschleiß. Die Ursachen für die Abnutzung sind laut Literatur produktspezifisch. Die meisten dieser Eigenschaften lassen sich mithilfe von Textilprüfnormen quantifizieren (zum Beispiel Zugfestigkeit, Formbeständigkeit, Farbechtheit und Abriebfestigkeit). Literatursuchen und Erhebungen in der Industrie zeigen, dass die wichtigsten Aspekte der physikalischen Haltbarkeit je nach Produkt, Materialzusammensetzung und Verwendungszweck variieren (siehe Tabelle 1). Daher sollten die Mindestanforderungen unter Berücksichtigung der für das jeweilige Produkt relevanten Parameter festgelegt werden.

Tabelle Z-1: Relevanteste Haltbarkeitsaspekte für T-Shirts, Jeans und Funktionsjacken

T-Shirt (100 % Baumwolle)	Jeans (95 % Baumwolle and 5 % Elastan)	Functional jacket (100 % Polyester oder Polyamid)
• Änderung der Abmessung während des Waschens und Trocknens	• Änderung der Abmessung während des Waschens und Trocknens	• Abriebfestigkeit
• Berstfestigkeit	• Zugfestigkeit und Dehnung	• Änderung der Abmessung während des Waschens und Trocknens
• Farbechtheit bei Haushaltswäsche	• Abriebfestigkeit	• Farbechtheit gegenüber künstlichem Licht
• Farbechtheit gegenüber künstlichem Licht	• Farbechtheit gegenüber künstlichem Licht	• Farbechtheit bei Haushaltswäsche
• Pillbeständigkeit	• Farbechtheit beim Reiben	• Wasserabweisung
• Verdrehen nach einer Waschbehandlung	• Elastizität des Gewebes	• Wasserdichtigkeit

T-Shirt (100 % Baumwolle)	Jeans (95 % Baumwolle and 5 % Elastan)	Functional jacket (100 % Polyester oder Polyamid)
	• Verdrehen nach einer Waschbehandlung	• Wasserdampfdurchlässigkeit

Für diese wichtigsten Aspekte der Haltbarkeit wurden auf der Grundlage der Erkenntnisse aus der Literatur und der Abstimmung mit Industrievertretern Mindestwerte festgelegt. Die Analyse bestehender Prüfnormen ergab, dass sie zwar den relevanten Aspekten entsprechen und gut etabliert sind, ihre Anwendung und ihre Grenzwerte jedoch variieren. Unternehmensinterne Standards gehen oft über die in der Literatur angegebenen Mindestwerte hinaus, um Kundenreklamationen zu vermeiden. Für regulatorische Zwecke forderten die Workshop-Teilnehmer*innen jedoch besser erreichbare Basiswerte. Die Diskussionen mit den befragten Expert*innen ergaben, dass die physische Haltbarkeit und die Eignung der Mindestanforderungen nur dann vollständig beurteilt werden können, wenn auch externe Faktoren berücksichtigt werden.

In Bezug auf **extrinsische Faktoren**, die aufgrund individueller Schwankungen schwieriger zu quantifizieren sind – wie beispielsweise Trage- und Waschgewohnheiten –, haben Literatur und Expertenbeiträge gezeigt, dass Wasch-Trocken-Zyklen für die meisten Produkte die praktischste und vergleichbarste Methode zur Simulation von Gebrauch und der daraus resultierenden Alterung sind. Um die Haltbarkeit von T-Shirts aus 100-prozentiger Baumwolle zu untersuchen, wurde ein Leistungstest mit 30 Wasch-Trocken-Zyklen bei 40 °C in einer Haushaltswaschmaschine durchgeführt. Befragungen ergaben, dass standardisierte Waschtests wie die ISO-Norm 6330 das Waschen im Haushalt nicht genau simulieren, insbesondere im Hinblick auf Parameter wie Temperatur, Waschmechanik, Waschmittel und Beladungsmenge. Daher ist eine Standardisierung realistischer und effizienter Alterungssimulationen erforderlich, um die physikalische Beständigkeit über eine angemessene Nutzungsdauer besser überprüfen zu können.

Die Leistungsanalyse in Form von experimentellen Tests an T-Shirts aus 100 % Baumwolle unter Berücksichtigung der intrinsischen Eigenschaften (d. h. Textilprüfnormen mit festgelegten Mindestwerten) sowie der extrinsischen Faktoren (d. h. Wasch-Trocken-Zyklen) ergab, dass einige Anforderungen (z. B. Maßbeständigkeit, Berstfestigkeit, Farbechtheit und Pillbeständigkeit) häufig erfüllt wurden. Nach maximaler Beanspruchung (30 Wasch-Trocken-Zyklen) erfüllte jedoch keines der T-Shirts alle sechs relevanten Aspekte mit den entsprechenden Werten gleichzeitig.

Neben den in der Literatur und in der Praxis identifizierten relevantesten Aspekten der Haltbarkeit ergaben die Experteninterviews und die experimentellen Tests weitere produktspezifische Erkenntnisse, die es zu berücksichtigen gilt:

Tabelle Z-2: Zusätzliche produktspezifische Erkenntnisse

T-Shirt (100 % cotton)	Jeans (95 % cotton and 5 % elastane)	Functional jacket (100 % polyester or polyamide)
• Relevanz optischer Eigenschaften	• Relevanz optischer Eigenschaften	• Erhalt der Schlüsselfunktionen
	• Haltbarkeit von Verschlüssen	• Angemessenheit funktionaler Anforderungen
	• Validierung von Farbechtheitsstandards	

Schlussfolgerung und Empfehlung

Abschließend wurden für jedes Produktbeispiel Mindestanforderungen an die Haltbarkeit festgelegt. Der dafür erforderliche Prüfaufwand (wie im Versuch für die T-Shirts aus 100 % Baumwolle, bei dem 16 T-Shirts über 250 Stunden lang getestet wurden) stünde derzeit jedoch in keinem Verhältnis zum Nutzen. Diese Anforderungen dienen daher vorerst als Ausgangspunkt für neue Artikel. In Zukunft wird es notwendig sein, die Alterung vorherzusagen, um noch realistischere und handhabbare Mindesthaltbarkeitsanforderungen festzulegen.

Produktaspekt: Reparierbarkeit

Im Kontext der Ökodesign-Verordnung zielt die Reparierbarkeit darauf ab, die Lebensdauer von Produkten zu verlängern, Ressourcen zu schonen und Abfälle zu reduzieren. Dieser Ansatz geht über die zweijährige gesetzliche Gewährleistungsfrist hinaus, da Reparaturen einfacher, attraktiver und gegenüber dem Austausch oder Neukauf von Produkten bevorzugt werden sollen. Aufkommende EU-Regelwerke wie das „Recht auf Reparatur“ könnten künftig eine wichtige Rolle in der Textilindustrie spielen. Hierfür sind geeignete Indikatoren erforderlich, um die Reparierbarkeit von Textilien zu beschreiben und zu fördern.

Die Analyse des Status quo und die Bewertung der Reparierbarkeit – basierend auf einer Literaturauswertung, Interviews, Produktanalysen und Stakeholder-Konsultationen – ergeben folgende zentrale Erkenntnisse:

- **Häufige Schäden:** Am häufigsten reparierbare Kleidungsdefekte sind kaputte Reißverschlüsse, lose Knöpfe, Löcher und gerissene Nähte. Probleme wie Pilling und Verblassen betreffen hingegen eher die Haltbarkeit als die Reparierbarkeit.
- **Identifizierte Herausforderungen:** Die Reparierbarkeit von Kleidung wird durch komplexe Konstruktionen erschwert, die den Zugang zu beschädigten Teilen behindern, sowie durch hohe Reparaturkosten im Verhältnis zu den meist niedrigen Preisen von Kleidungsstücken. Weitere Hürden sind mangelnde Reparaturkenntnisse der Verbraucher*innen, die begrenzte Verfügbarkeit von Original-Ersatzteilen und eine unzureichende Reparaturdienst-Infrastruktur.
- **Einfluss des Designs:** Das Produktdesign und die Verarbeitungstechnik beeinflussen die Reparierbarkeit, insbesondere bei Komponenten wie Reißverschlüssen.
- **Übertragbare Indikatoren:** Mögliche Reparierbarkeitsindikatoren aus dem Elektroniksektor umfassen die Demontagefreundlichkeit, Verfügbarkeit von Ersatzteilen, Reparaturdokumentation und Zugang zu Reparaturdiensten.

- **Reparierbarkeit auf Produktebene:** Produktspezifische Kriterien sind nicht für alle Produkte relevant. Wo sie Anwendung finden, erfordern Reparaturbewertungen präzise, produktgruppenspezifische Indikatoren, um eine faire Bewertung komplexer Designs zu gewährleisten.
- **Feedback:** Stakeholder halten Reparaturwerkzeuge, Ersatzteile und benutzerfreundliche Anleitungen für wichtig, lehnen jedoch wirtschaftliche Kriterien ab und äußern Bedenken, dass verpflichtende standardisierte Teile Qualität, Funktionalität und Markenästhetik beeinträchtigen könnten.

Abschließend wurden Mindestanforderungen für die Reparierbarkeit von Kleidung vorgeschlagen. Szenario 1 legt eine verpflichtende Baseline für die Marktzulassung fest, die für alle Produktgruppen gilt.

Szenario 1: Die verpflichtende Baseline besteht aus drei Kriterien: 1) *Verfügbarkeit von Ersatzteilen* wie Knöpfen, Reißverschlüssen, Gürtelschnallen, Garnen und allen weiteren zur Reparatur benötigten Komponenten. Diese Teile müssen standardisiert **ODER** so beschaffen sein, dass sie mit marktüblichen Ersatzteilen ausgetauscht werden können und keine ästhetischen oder funktionalen Beeinträchtigungen verursachen. 2) Die *Dokumentation* muss Informationen zur Selbstreparatur und zum Zugang zu professionellen Reparaturdienstleistern enthalten. 3) *Reparatur-Service* beziehen sich auf die verschiedenen Möglichkeiten, wie ein Unternehmen Reparaturleistungen anbieten kann.

Die beiden weiteren Szenarien bieten Optionen für die Zukunft, um einen reibungslosen Übergang zu unterstützen, falls folgende Modelle an Bedeutung gewinnen: ein Reparierbarkeits-Score oder detailliertere Kriterien auf Produktebene.

Szenario 2: Informationsanforderungen bezüglich eines Reparierbarkeits-Scores: Produkte werden danach bewertet, wie viele der Mindestkriterien aus Szenario 1 sie erfüllen. Die Bewertung erfolgt anhand eines einfachen oder gewichteten Systems und ergibt einen absoluten oder prozentualen Reparierbarkeits-Score.

Szenario 3: Informationsanforderungen bezüglich einer „Reparierbarkeits-Performance" auf Produktebene: Produktspezifische Anforderungen müssen für jede Produktgruppe maßgeschneidert werden, wobei spezifische Indikatoren und ein punktbasiertes Bewertungssystem zur Anwendung kommen. Subkriterien wie Teileaustauschbarkeit, Befestigungsart und Anzahl der Nähte können auf einer Skala bewertet werden, wobei höhere Punktzahlen eine bessere Reparaturleistung anzeigen. Dies wurde in der vorliegenden Studie am Beispiel Jeans demonstriert.

Sollten produktspezifische Reparierbarkeitsanforderungen relevant werden, wurde ein Auswahlverfahren vorgeschlagen, das auf Produktkomplexität und Designeinfluss basiert. Produkte mit wenigen Komponenten, ohne reparaturrelevante Teile, ohne Bedarf an Spezialwerkzeugen und mit minimalem Design-Einfluss – wie T-Shirts – können anhand generischer Reparierbarkeitsanforderungen – der verpflichtenden Baseline - bewertet werden. Im Gegensatz dazu benötigen komplexere Artikel wie Jeans und Funktionsjacken zusätzliche produktspezifische Anforderungen, da sie mehr Komponenten enthalten, häufiger von Defekten betroffen sind, den Einsatz von Spezialwerkzeugen voraussetzen und durch Designentscheidungen beeinflusst werden.

Schlussfolgerung und Empfehlung

Obwohl sich eine Reparierbarkeit positiv auf die Umwelt auswirken kann, ist ihre Wirkung auf die Herausforderungen durch Fast Fashion relativ begrenzt. Die größten Hindernisse sind nach wie vor die mangelnde Bereitschaft der Verbraucher*innen, Produkte länger zu nutzen, sowie die im Vergleich zu den Kosten für neue Artikel hohen Reparaturkosten. Bei komplexen oder hochpreisigen Produkten kann sich eine hohe Reparaturfreundlichkeit jedoch positiv auswirken. Ein ausgewogener Ansatz könnte daher gezielte, verbindliche Informationspflichten für Unternehmen (Szenario 1) mit freiwilligen, produktgruppenspezifischen Gestaltungsrichtlinien kombinieren. Diese sollten produktgruppenspezifisch zugeschnitten sein, um bestehende reparaturorientierte Gestaltungs-Leitfäden im Textilsektor strategisch zu ergänzen und zu operationalisieren.

Produktaspekte: Recyclingfähigkeit und Rezyklatanteil

Beide Aspekte, Recyclingfähigkeit wie auch der Rezyklatanteil, sollen die Kreislaufwirtschaft stärken. Die Umsetzbarkeit eines Rezyklatanteils und die Wirksamkeit der Textilrezyklierbarkeit hängen vom Textilabfallmanagement in der EU und den technischen Möglichkeiten der Textilrecyclingverfahren ab. Das derzeit vorherrschende Faser-zu-Faser-Recyclingverfahren ist das mechanische Recycling. Obwohl dieses Verfahren im industriellen Maßstab verfügbar ist, führt es zu einer verminderten Faserqualität und hat hohe Anforderungen an das Inputmaterial. Verfahren wie lösungsmittelbasierte Aufbereitung und Depolymerisation können hochwertigere Ergebnisse liefern, befinden sich jedoch noch in der Entwicklung und stehen vor Herausforderungen hinsichtlich Skalierbarkeit und Inputströmen. Interviews mit Akteuren entlang der Textilrecycling-Wertschöpfungskette zeigten, dass der Ausbau von Faser-zu-Faser-Recycling und eine Steigerung des Rezyklatanteils durch Herausforderungen wie heterogene Textilabfälle, unausgereifte Sortiertechnologien, mangelnde Rückverfolgbarkeit, Qualitätsverluste und wirtschaftliche Hürden wie geringe Anreize und hohe Kosten im Vergleich zu Neuware erschwert wird. Die Überwindung dieser technischen, wirtschaftlichen und systemischen Hindernisse ist entscheidend für den Ausbau eines hochwertigen Recyclings.

Recyclingfähigkeit bezeichnet die Fähigkeit eines Produkts, nach seiner ersten Nutzung als Sekundärrohstoff zurückgewonnen und wiederverwendet zu werden. Aus Designperspektive bedeutet dies, Bedingungen zu schaffen, die eine hochwertige, technisch, ökologisch und wirtschaftlich machbare Rückgewinnung der Materialien ermöglichen. Bei Textilien beeinflussen Faktoren wie Faserzusammensetzung, Materialreinheit, Vorhandensein von Beschichtungen oder Mischungen, Demontagefreundlichkeit sowie die Verfügbarkeit geeigneter Recyclingverfahren und -infrastrukturen die Recyclingfähigkeit. Um diese zu verbessern, sind eine hohe Ausgangsproduktqualität, leicht trennbare und klar gekennzeichnete Materialien sowie eine reduzierte Materialvielfalt erforderlich.

Die Analyse des Status quo und die Bewertung der Recyclingfähigkeit basieren auf Literaturrecherche, Interviews, Produktanalysen und Stakeholder-Konsultationen und ergaben folgende **zentrale Erkenntnisse**:

- Es besteht eine Diskrepanz zwischen generischen Produktdesign-Leitlinien, die Materialreinheit, Monomaterialien und leichte Demontage priorisieren, und den spezifischeren, prozessabhängigen Inputanforderungen der Recycler, wie Faserartenreinheit und minimale Verunreinigungen.
- Dies unterstreicht den Bedarf an stärkerer Zusammenarbeit und standardisierten Kriterien zu Recyclingfähigkeit. Obwohl Brancheninitiativen und Gesetzesentwürfe zunehmend

Monomaterialien und minimale nicht-textile Komponenten empfehlen, gibt es derzeit keine harmonisierte Bewertungsmethodik.

- Rückmeldungen von Stakeholdern in verschiedenen Konsultationsphasen thematisierten u. a. strukturelle Designfaktoren, die derzeit wegen fehlender standardisierter, validierter Daten von Recyclern – insbesondere zu spezifischen Störfaktoren und Systemgrenzen – nicht einbezogen werden. Weitere Bedenken betreffen den Zielkonflikt zwischen Rezyklierbarkeit, Haltbarkeit und Funktion.

Die vorgeschlagenen **Mindestanforderungen** für die Textilrecyclingfähigkeit konzentrieren sich auf die **Beschränkung für den Einsatz heterogener Materialien** und verlangen, dass Multimaterial-Produkte auf maximal zwei andersartige Materialien in einer Flächenebene (exklusive aller anderen Produktbestandteile) beschränkt werden. Um den Anteil der Hauptfaser zu maximieren, basieren weitere Einschränkungen auf dem aktuellen Stand der automatischen Fasererkennungstechnologien, die Materialarten erst ab einem Anteil von etwa 5 bis 10 % zuverlässig erkennen können. Diese Anforderung, „**Materialeinsatzquote**" genannt, legt fest, dass Nebenbestandteile mindestens 10 % Faseranteil im Verhältnis zu allen anderen Materialien enthalten müssen. Elastan wurde besonders berücksichtigt, da sein Anteil von über 10 % das mechanische Recycling und von über 3 bis 5 % das chemische Recycling beeinträchtigt. Um die Identifizierung durch automatisierte Sortiertechnologien zu erleichtern und gleichzeitig die Rezyklierbarkeit zu ermöglichen, wird eine Begrenzung des Elastananteils im Bereich von 5 bis 10 % vorgeschlagen.

Zusätzlich zu diesen konkreten Leistungsanforderungen wurden auch **Informationsanforderungen zum bevorzugten Recyclingverfahren** vorgeschlagen, da nicht jedes Produkt für jedes Faser-zu-Faser-Recyclingverfahren geeignet ist. Beispiele für Recyclingverfahren und Kriterien werden bereitgestellt. Diese Informationsanforderungen könnten bei der Einführung des digitalen Produktpasses integriert werden.

Die Anforderungen an die Verwendung heterogener Materialien sowie an die Materialeinsatzquote wurden als auf alle Produktkategorien anwendbar erachtet. Bestimmte Produktgruppen sollten jedoch von der Elastanbeschränkung ausgenommen werden, zum Beispiel Baby- und Kinderkleidung, die besonders elastisch sein muss, um das An- und Ausziehen sowie das Tragen angenehm zu gestalten, sowie bestimmte Jeans und Sportleggings. Es wird nicht empfohlen, Funktionsjacken von den Anforderungen an Recyclingfähigkeit auszunehmen, da diese Anforderungen auf der Flächenebene gelten und die Kombination verschiedener Flächen zulassen, ohne die Konformität zu beeinträchtigen. In der Kategorisierung wurden allgemeine Ausnahmen von Ökodesign-Anforderungen beispielsweise für Accessoires, Unterwäsche und Bademode vorgeschlagen. Während der Elastananteil in Funktions-T-Shirts reduziert werden muss, um die Anforderungen zu erfüllen, kann Modebekleidung im Allgemeinen mit begrenztem Elastaneinsatz und Designanpassungen konform gehen, ohne Funktionalität oder Komfort zu beeinträchtigen. Daher wurden keine weiteren Ausnahmen für notwendig erachtet.

Schlussfolgerung und Empfehlung

Die Anforderungen an die Verwendung heterogener Materialien sowie an die Materialeinsatzquote wurden als auf alle Produktkategorien anwendbar erachtet. Bestimmte Produktgruppen sollten jedoch von der Beschränkung für Elastan ausgenommen werden. Es wird empfohlen, die technische Realisierbarkeit von Produktfunktionen und Recyclingtechnologien im Hinblick auf den Inputbedarf laufend zu bewerten.

Der **Rezyklatanteil**, wie in EN ISO 14021 definiert, umfasst sowohl Pre-Consumer-Materialien (d. h. postindustrielle und unverkaufte Waren) als auch Post-Consumer-Materialien. Der Rezyklatanteil wird als Anteil des recycelten Materials an der Masse eines Produkts berechnet. Eine genaue Überprüfung erfordert die Nachverfolgung der Materialflüsse entlang der gesamten Lieferkette, häufig mithilfe von Chain-of-Custody-Modellen wie Trennung („Segregation"), kontrollierter Mischung („Controlled Blending") oder Massenbilanzierung („Mass Balance"). Da es keinen zuverlässigen physikalischen Test zur Unterscheidung von recyceltem und Primärmaterial gibt, sind unabhängige Audits und Zertifizierungen, die Input, Prozess und Output abdecken, unerlässlich, um Transparenz zu gewährleisten und falsche Angaben – insbesondere in den Recycling- und Mischungsstufen – zu verhindern.

Die Analyse des aktuellen Stands des Textilrecyclings und des Einsatzes von Rezyklaten sowie die Ableitung von Anforderungen basiert auf Literaturrecherche, Experteninterviews und Stakeholder-Konsultationen. Daraus ergeben sich folgende **zentrale Erkenntnisse**:

- Die Status-quo-Analyse zeigt, dass der weltweite Marktanteil recycelter Fasern, insbesondere beim geschlossenen Faser-zu-Faser-Kreislauf, mit weniger als 1 % sehr gering ist. Die meisten recycelten Polyesterfasern stammen aus PET-Flaschen und nicht aus Post-Consumer-Textilien, und der Rezyklatanteil in Produkten variiert stark, wobei es häufig an Transparenz oder verlässlicher Zertifizierung mangelt.
- Die meisten Zertifizierungssysteme unterscheiden nicht zuverlässig zwischen Faser- und Nichtfaserabfällen und bieten keinen überprüfbaren Nachweis für Faser-zu-Faser-Rezyklatanteile. Lediglich das „UL Closed Loop"-Zertifizierungssystem bietet einen belastbaren Nachweis, allerdings mit strengeren Anforderungen, als für alle Produkte notwendig wären.
- Trotz der wachsenden strategischen Bedeutung des Rezyklatanteils für Unternehmen erschweren das Fehlen systematischer Daten, standardisierter Prüfverfahren und transparenter Marktinformationen die Festlegung sinnvoller und nachvollziehbarer Mindestziele für den Rezyklatanteil von Textilien.
- Verbindliche Anforderungen an den Rezyklatanteil werden jedoch weithin als wirksames politisches Instrument angesehen, um die Nachfrage nach recycelten Fasern zu stärken und Investitionen in Recyclinginfrastrukturen zu fördern. Die meisten Studien empfehlen, niedrige, produktspezifische Ziele zu setzen, die mit zunehmender technischer Kapazität schrittweise erhöht werden können.
- Da es an umfassenden Daten zur Verfügbarkeit hochwertiger Recyclingfasern mangelt, basieren die vorgeschlagenen Quoten auf theoretischer Verfügbarkeit und aktuellen Marktentwicklungen, wobei T-Shirts und Jeans als realistische Beispiele für eine Umsetzung herangezogen werden.

Um Mindestanforderungen für den Rezyklatanteil abzuleiten, müssen folgende **Rahmenbedingungen** geklärt werden:

1. Es muss entschieden werden, ob der Rezyklatanteil auf Produktebene oder Chargenebene gefordert wird.
2. Es ist festzulegen, ob der Rezyklatanteil aus Faser-zu-Faser-Recycling stammen muss, wobei sowohl postindustrielle (PIR) als auch Post-Consumer-Rezyklate (PCR) im Recyclingprozess verwendet werden können.

3. Die Methode zur Berechnung des Rezyklatanteil sowie der Umgang mit Multimaterial-Produkten müssen festgelegt werden (z. B. durch einen vereinfachten Ansatz, bei dem nur die Faser mit dem höchsten Anteil recyceltes Material enthalten muss).
4. Es ist zu entscheiden, welches Zertifizierungssystem anerkannt wird und ob in Chain-of-Custody-Modellen nur Rückverfolgbarkeitsverfahren wie „Identity Preservation" „Segregation" und „Controlled Blending" zulässig sind.
5. Es wird empfohlen, zertifizierte nachhaltige Naturfasern von den Anforderungen an den Rezyklatanteil auszunehmen und sie als Alternative zu mechanisch recycelten Naturfasern zu akzeptieren, wenn es einen Konflikt mit den Haltbarkeitsanforderungen geben sollte.

Die Studie schlägt für T-Shirts und Jeans bis 2030 folgende Rezyklatanteile vor: 10 % für Baumwolle, 3 % für Polyester, 5 % für Polyamid und zellulosische Chemiefasern sowie 15 % für Wolle. Die Auswertung von Studien zur Auswirkung des Rezyklatanteils auf die Textilqualität lässt den Schluss zu, dass bei den hier vorgeschlagenen, vergleichsweise niedrigen Rezyklatanteilen keine Schwierigkeiten mit der Einhaltung der Haltbarkeitsanforderungen zu erwarten sind. Daher ist das Studienteam der Ansicht, dass der vorgeschlagene Rezyklatanteil für T-Shirts und Jeans in einem Bereich liegt, der es technisch möglich macht, Produkte herzustellen, die die vorgeschlagenen Anforderungen an die Haltbarkeit erfüllen.

Schlussfolgerung und Empfehlung

Die Umsetzung der Mindestanforderungen an den Rezyklatanteil im Rahmen der Ökodesign-Verordnung setzt die Klärung bestimmter Rahmenbedingungen voraus. Studien zeigen, dass es bei geringen Rezyklatanteilen möglich ist, die Haltbarkeitsanforderungen zu erfüllen. Darüber hinaus wird der verbindliche Rezyklatgehalt weithin als wirksames politisches Instrument zur Ankurbelung der Nachfrage nach Recyclingfasern und als Anreiz für Investitionen in die Recyclinginfrastruktur unterstützt. Die Autor*innen der Studie empfehlen daher, niedrige, produkt- und faserspezifische Zielvorgaben festzulegen – beispielsweise für T-Shirts und Jeans –, die im Laufe der Zeit erhöht werden können, wenn die technischen Kapazitäten wachsen.

Produktaspekt: Besorgniserregende Stoffe (Substances of Concern, SoC)

Die Ökodesign-Verordnung definiert SoC auf Basis der EU-Chemikaliengesetzgebung und der Gefahrenklassifizierung gemäß REACH, POP und CLP sowie durch ein zusätzliches Kriterium für Stoffe, die Recycling oder Wiederverwendung behindern. Unter diese Definitionen fallen tausende Chemikalien, jedoch ist die genaue Anzahl der in Textilien eingesetzten Stoffe unbekannt.

Die Analyse des Status quo basieren auf Literaturrecherche, Interviews und Stakeholder-Konsultationen und ergaben folgende **zentrale Erkenntnisse**:

► **Sicherheitsdatenblätter (SDS)** sind als Hauptinstrument zur Kommunikation von Informationen über gefährliche Chemikalien vorgesehen, um deren sicheren Umgang, Lagerung, Transport und Entsorgung zu gewährleisten. In der Praxis ist ihre Wirksamkeit und Zuverlässigkeit jedoch oft begrenzt, insbesondere in der komplexen und globalen Textillieferkette. Üblicherweise stellen Chemikalienlieferanten auch technische Informationen zur Anwendung ihrer Produkte bereit. Beide Dokumente sind in erster Linie für den Austausch zwischen Chemikalienlieferanten und Textilfärbereien oder -veredlern gedacht. Mit wachsendem Bewusstsein für den Einsatz gefährlicher Stoffe in der Textilproduktion werden diese Unterlagen jedoch auch von Marken, Händlern oder

Importeuren genutzt. Im Kontext von Produktregulierungen wie der Ökodesign-Verordnung sind die Inhalte dieser Dokumente für alle Marktakteure relevant.

- Die verschiedenen Stakeholder-Konsultationen der Studie offenbarten zudem Kompetenzlücken: Viele Unternehmen, insbesondere kleine und mittlere Unternehmen (KMU), verfügen nicht über das nötige Fachwissen, um SDS korrekt zu interpretieren und für ein wirksames Chemikalienmanagement zu nutzen.
- Hinzu kommt das Fehlen harmonisierter Vorschriften und strengerer Durchsetzung außerhalb der EU sowie technische Hürden, etwa durch digitale Systeme wie „Product Lifecycle Management“ und „Enterprise Resource Planning“, die oft nicht für detailliertes Chemikalientracking oder SDS-Integration ausgelegt sind. Dadurch können SoC im Produktlebenszyklus nicht lückenlos nachverfolgt werden.
- Aktuelle Ansätze der Textilindustrie beruhen weitgehend auf sogenannten „Restricted Substance Lists“ (RSL), die in der Lieferkette weitergegeben oder durch Dritte zertifiziert werden.

Der Einsatz von Chemical Inventory Lists (CILs) ist Teil der besten verfügbaren Techniken (BAT) für das Chemikalienmanagement im Textilsektor und im europäischen BAT-Referenzdokument (BREF) enthalten. CILs werden jedoch häufiger von großen Herstellern genutzt, insbesondere von solchen, die EU-Vorschriften unterliegen oder an freiwilligen Nachhaltigkeitsinitiativen teilnehmen. In einem funktionierenden Chemikalienmanagementsystem spielen SDS, technische Informationen und CILs eine zentrale Rolle.

Bezüglich des letzten Aspekts der SoC-Definition – Stoffe, die Wiederverwendung oder Recycling behindern – ist zu beachten, dass die Anzahl der künftig darunterfallenden Stoffe unbekannt ist. Die Verbindung zwischen Faserstoffen (z. B. Polyester), eingesetzten Chemikalien (z. B. wasserabweisende Chemikalien) und den jeweiligen Recyclingverfahren (z. B. thermomechanische Verfahren) wurde in ihrer gesamten Bandbreite noch nicht untersucht. Es ist bekannt, dass der Chemikalieneinsatz viele weitere Aspekte der Ökodesign-Verordnung beeinflusst, etwa Haltbarkeit und Recyclingfähigkeit, und dass die Auswirkungen auf Recyclingprozesse meist auf Chemikalien zurückzuführen sind, die im Textil verbleiben – sogenannte „Effektchemikalien“. Diese werden gezielt eingesetzt, um dem Endprodukt bestimmte Eigenschaften zu verleihen, und sind daher im Textil enthalten.

Als Mindestanforderungen werden **zwei Informationspflichten** vorgeschlagen:

1. **Integration der SVHC-Informationspflichten** (Identität und Konzentration und in Erzeugnissen und deren Teilen sowie Zubehör gemäß REACH) in den öffentlich einsehbaren Teil des Digitalen Produktpasses (DPP), sodass diese Informationen für Endverbrauchende zugänglich sind. Dies würde die Industrie von der Beantwortung individueller Verbrauchenden-Anfragen zum Vorkommen von SVHCs entlasten. Da das DPP-System interoperabel mit bestehenden Datenbanken entwickelt wird, sollte es kompatibel mit der SCIP-Datenbank sein, um Mehrfacheingaben zu vermeiden.
2. **Informationspflicht zu Effektchemikalien** (z. B. Farbstoffe und Ausrüstungen): Diese Informationen sollten die Gruppe der Effektchemikalien abdecken und in die technische Produktspezifikation aufgenommen werden, um sicherzustellen, dass Designüberlegungen zu Funktionalität, Tragekomfort und Pflegeleichtigkeit auf der notwendigen Chemikaliengruppe basieren. Dies verbessert auch die Berücksichtigung der Haltbarkeit von Effektchemikalien, da einige nur wenige Wasch-Trockenzyklen überdauern.

Es wird vorgeschlagen, die Informationen zu Effektchemikalien auf Gruppenebene und nicht für einzelne Stoffe bereitzustellen. Die Kommunikation auf Gruppenebene wird aus praktischen Gründen empfohlen, da sie für Lieferanten und Hersteller – insbesondere bei komplexen Mischungen oder geschützten Rezepturen – besser umsetzbar ist. Dieser Ansatz kann als Übergangslösung dienen. Mit zunehmender Entwicklung von DPPs und mehr Transparenz in der Lieferkette kann die Berichterstattung schrittweise auf eine vollständige Materialoffenlegung ausgeweitet werden. Bis dahin bleibt die Kommunikation auf Gruppenebene die realistischste und effektivste Option, erfordert aber dennoch ein funktionierendes digitales Datensystem.

Abschließend würde die Information über Effektchemikalien zu einem besseren Verständnis jener Chemikalien beitragen, die sich nachteilig auf die Wiederverwendung und das Recycling von Materialien in Textilprodukten auswirken. Verschiedene Sortier- und Recyclingverfahren dürften technologische Innovationen, etwa bei der automatisierten Sortierung, vorantreiben. Der hier gewählte Ansatz für SoC zielt daher darauf ab, den Informationstransfer zu verbessern und die Berücksichtigung der Haltbarkeit zu stärken, um Textilien möglichst lange im Nutzungskreislauf zu halten.

Schlussfolgerung und Empfehlung

Für SoC wird der folgende vorsichtige Ansatz zur Kennzeichnung chemischer Wirkstoffe in der technischen Spezifikation vorgeschlagen: Als ersten Schritt zur Erfüllung der Informationsanforderungen wird die Identifizierung der absichtlich im Produkt vorhandenen Effektchemikalien (z. B. wasserabweisende Stoffe) empfohlen. Informationen über diese Chemikalien sollten in die Produktspezifikationen aufgenommen und entlang der Lieferkette weitergegeben werden – allerdings nicht an die Endverbraucher*innen. Dadurch verbessert sich die Transparenz der Chemikalien schrittweise im Laufe der Zeit. Die Informationsanforderungen zu SVHC (Identität und Konzentration in Erzeugnissen und ihren Teilen sowie in Zubehörteilen gemäß REACH) sollten hingegen in den öffentlichen Teil des DPP aufgenommen werden, sodass diese Informationen interessierten Endverbraucher*innen zur Verfügung stehen.

Produktaspekt: Umweltwirkungen

Der Aspekt der Umweltwirkungen umfasst Energieverbrauch und Energieeffizienz, Wasserverbrauch und Wassereffizienz sowie Ressourcennutzung und Ressourceneffizienz. Eine solche Zusammenlegung findet sich auch in der vorbereitenden Studie des JRC. In der Literatur ist anerkannt, dass die Produktion und der Konsum von Textilien weitreichende und erhebliche Umweltwirkungen haben, darunter Wasserverbrauch, Umweltverschmutzung, Klimawandel, Energiebedarf und Mikroplastik. Die Europäische Kommission empfiehlt, Methoden des „Environmental Footprint“ in politischen Maßnahmen und Systemen zu verwenden, die die Umweltleistung von Produkten und Organisationen über den Lebenszyklus messen oder kommunizieren. Der Product Environmental Footprint (PEF) ist eine allgemeine Methode zur Messung und Kommunikation der potenziellen Umweltwirkungen eines Produkts über dessen Lebenszyklus.

Die Eignung der Product Environmental Footprint Category Rules (PEFCRs) für Bekleidung und Schuhe wurde in einem Workshop und durch eine Überprüfung der finalen Version 3.1 bewertet. Dabei wurden mehrere wesentliche Daten-, Methoden- und Praxisprobleme festgestellt, insbesondere für KMU. Diese Einschränkungen wurden in einem separaten Schritt analysiert und lassen sich wie folgt zusammenfassen:

- **Fachkenntnis- und Kostenbarrieren:** Die Berechnung eines PEF-Profils erfordert spezielles Wissen über Lebenszyklusanalysen (LCA) und Textilproduktion. KMU verfügen oft nicht über die Kapazitäten, diese Arbeit intern zu leisten, und eine Auslagerung ist teuer, zumal die externe Kommunikation der Ergebnisse eine Überprüfung und Validierung voraussetzt.
- **Herausforderungen bei der Verifizierung:** Eine umfassende Überprüfung von Unternehmensdaten ist nicht praktikabel, und Unternehmen könnten Standardwerte selektiv zu ihrem Vorteil nutzen, was die Zuverlässigkeit untergräbt.
- **Probleme mit dem Wesentlichkeitsprinzip:** Händler haben oft keinen Zugang zu Primärdaten über Rohstoffe und nachgelagerte Prozesse, was die Einhaltung der Vorgaben erschwert.

Derzeit empfiehlt die Studie keine verpflichtenden PEF-Berechnungen, solange diese Probleme nicht gelöst und die Kosten-Nutzen-Analyse klarer sind.

Stattdessen wurden Alternativen zum PEF recherchiert, die von allen Wirtschaftsakteuren, die Textilien auf dem EU-Markt in Verkehr bringen, mit vertretbarem Aufwand umgesetzt werden können. Die Analyse konzentrierte sich darauf, sicherzustellen, dass diese Anforderungen mit anderen Berichtspflichten harmonisiert sind. Außerdem sollten diese Alternativen den Markt steuern oder zumindest eine Grundlage für zukünftige Benchmarks bieten. Verschiedene Optionen für die Berichterstattung über Umweltwirkungen wurden in Workshops im Rahmen der Studie diskutiert und durch Literatur- und Desktoprecherchen sowie ausgewählte Experteninterviews ergänzt.

Der Energie- und Wasserverbrauch in der Textilherstellung variiert erheblich je nach Prozess und Produkt; typischerweise werden die Daten allerdings auf Standortebene und nicht auf Produktebene erhoben. Während eine verbesserte Berichterstattung auf Standortebene – insbesondere für Nassprozesse und Hauptmaterialien – das Benchmarking erleichtern könnte, bleiben Transparenz und Datenverfügbarkeit in der Lieferkette begrenzt. Europäische Berichtsstandards berücksichtigen den Wasserverbrauch in der Lieferkette bislang nicht ausreichend, obwohl dieser ein bedeutender Umwelt-Hotspot ist. Die aktuelle Berichterstattung der Hersteller konzentriert sich auf den jährlichen Verbrauch an den Produktionsstandorten. Diese Daten sind jedoch für eine Informationspflicht oft nicht verifiziert, und eine verpflichtende Verifizierung würde einen unverhältnismäßigen Aufwand bedeuten. Die Einführung einer Berichterstattung auf Produktebene würde einen hohen Verwaltungsaufwand verursachen, ohne einen zusätzlichen Nutzen gegenüber bestehenden unternehmensbezogenen Pflichten zu bieten.

Insgesamt wurde nicht empfohlen, eine Berichtspflicht zu Mikroplastik/Mikrofasern einzuführen, da dies von Unternehmen umfangreiche Tests verlangen würde, um produktspezifische Informationen für ihr gesamtes Portfolio bereitzustellen. Während der Studie wurde jedoch die Idee einer schrittweisen Einführung diskutiert, die zunächst für Produkte mit hohen Verkaufszahlen gelten könnte. Dieser Vorschlag würde es ermöglichen, die Ermittlung von Mikroplastikemissionen zu verlangen, da hierfür nur eine überschaubare Anzahl von Produkten getestet werden müsste.

Schlussfolgerung und Empfehlung

- Für den Wasser- und Energieverbrauch wurden keine Informationsanforderungen vorgeschlagen, da die Unternehmen in der Regel nur jährliche, standortbezogene Daten und keine produktspezifischen Zahlen erheben. Diese Daten hängen von verschiedenen Standortparametern und der Produktpalette ab, so dass sie für ein künftiges Benchmarking nicht geeignet wären.

- Für Mikroplastik/Mikrofasern wird keine allgemeine Informationspflicht vorgeschlagen, da die Prüfung aller Produkte zu aufwändig wäre. Für ausgewählte Basisprodukte könnten jedoch Informationen über den Faserverlust (Shedding Rate) verlangt werden.

Obwohl die Verringerung der Umweltauswirkungen der Produktion grundsätzlich eine hohe Priorität hat, kam dieses Projekt zu dem Schluss, dass der produktpolitische Rahmen der Ökodesign-Verordnung für diesen Zweck nicht geeignet ist. Stattdessen muss dies auf Unternehmensebene angegangen bzw. geregelt werden, wie es in der Richtlinie hinsichtlich der Nachhaltigkeitsberichterstattung von Unternehmen und der Richtlinie über unternehmerische Sorgfaltspflichten für nachhaltige Lieferketten festgelegt ist. Die jüngsten Änderungen durch das Omnibus-Paket der Europäischen Kommission haben jedoch den Anwendungsbereich und die Datenanforderungen erheblich reduziert, was die Wirksamkeit der Richtlinien einschränken wird. Daher könnte die langfristige Integration von Umweltauswirkungen in Rahmenwerke auf Produktebene notwendig sein, um eine Reduzierung der Umweltauswirkungen zu erreichen. Künftige Schritte könnten die Entwicklung von Leitlinien für die Zuordnung prozessspezifischer Daten, wie z. B. des Wasserverbrauchs, zu Produkten und die schrittweise Einführung von Tests zu Faserfragment-Emissionen umfassen, um die Daten zu verbessern und Benchmarks zu ermöglichen.

Gesamtschlussfolgerungen

Die Gesamtschlussfolgerungen basieren auf einer Synthese der Ergebnisse aus der Analyse der Produktaspekte:

- Die Synthese aller Produktaspekte zeigt deutlich, dass die Haltbarkeit entscheidend für die Verlängerung der Lebensdauer von Textilien ist. Textilien, die für wiederholte Nutzung und Wäsche ausgelegt und hergestellt wurde, können länger genutzt werden, so dass dies den Gesamtverbrauch von Textilien senken kann. Somit kann die Haltbarkeit den Ressourcenverbrauch und die mit der Produktion verbundenen Umweltwirkungen direkt verringern.
- Der Umfang der entwickelten Anforderungen hängt vom jeweiligen Produktaspekt ab: Es wurde festgestellt, dass sich Haltbarkeitsanforderungen je nach spezifischer Produktkategorie erheblich unterscheiden. Im Gegensatz dazu können Anforderungen für andere Aspekte, wie beispielsweise die Recyclingfähigkeit, breiter formuliert und auf mehrere Produktkategorien angewendet werden.
- Der Zeitplan für die Einführung der Anforderungen wird durch die Verfügbarkeit von Voraussetzungen wie standardisierten Methoden und politischen Entscheidungen sowie durch die Komplexität oder Anzahl der Anforderungen beeinflusst. Einige Aspekte, wie die Haltbarkeit, ermöglichen kürzere Übergangsfristen (z. B. zwei Jahre für Basisprodukte), während andere Aspekte, wie der Rezyklatanteil, längere Zeiträume zur Erreichung spezifischer Ziele erfordern (z. B. bis 2030).
- Der Bedarf an standardisierten Prüfmethoden, Verifizierungssystemen oder anderen unterstützenden Rahmenwerken wurde als entscheidend für die wirksame Umsetzung von Leistungsanforderungen identifiziert. In einigen Fällen wurden bestehende Normen als

ausreichend bewertet; in anderen, wie beim Rezyklatanteil, sind neue oder angepasste Rahmenwerke notwendig.

- Die Anforderungen für die Produktbeispiele können durch die technischen Spezifikationen in der Designphase festgelegt werden.
- Konformitätsbewertungsverfahren wurden als entscheidend für die Reduzierung des Verwaltungsaufwands und der Verifizierungskosten angesehen. Sowohl die technische Spezifikation als auch die Konformitätsbewertung wurden als integrale Werkzeuge im Qualitätsmanagementsystem eines Unternehmens für die Produktentwicklung bestätigt.
- Eine schrittweise Einführung, unterstützt durch Maßnahmen wie Kapazitätsaufbau für KMU, wurde von den Workshop-Teilnehmenden bevorzugt. Sie empfahlen Testläufe mit ausgewählten Produktkategorien, um Verfahren zu verfeinern und die Nachhaltigkeit zu verbessern. Die Priorisierungskriterien für die Auswahl von Produkten oder Produktkategorien für die schrittweise Einführung waren Marktanteil und Verbrauchsmengen, da diese die größte Wirkung entfalten. Als Ausgangspunkt wurden häufig genutzte Basisprodukte wie Baumwoll-T-Shirts vorgeschlagen.

Die systematische Erfassung und der Vergleich aller relevanten Produktaspekte zeigten, dass die Verbesserung eines Aspekts zum Nachteil eines anderen Aspekts gereichen kann. Daraus wurden folgende Schlussfolgerungen zur Priorisierung der Haltbarkeit bei Zielkonflikten gezogen:

- **Konflikt zwischen Haltbarkeit und Rezyklatanteil:** Ein höherer Rezyklatanteil kann die Haltbarkeit beeinträchtigen, insbesondere bei mechanisch recycelter Baumwolle. Daher müssen faserspezifische Recyclingquoten mit den Haltbarkeitsanforderungen jeder Produktgruppe in Einklang gebracht werden. Der für T-Shirts und Jeans empfohlene niedrige Rezyklatanteil dürfte die Einhaltung der Haltbarkeitsanforderungen nicht beeinträchtigen.
- **Haltbarkeit und Recyclingfähigkeit stehen insbesondere bei Funktionsprodukten im Konflikt,** da diese oft komplexe Materialmischungen aufweisen. Deshalb werden spezifische Ausnahmen für Anforderungen an heterogene Materialien (z. B. bei Bademode) und den begrenzten Elastananteil (z. B. bei Kinderkleidung) vorgeschlagen.
- **Die Haltbarkeit kann auch durch Effektchemikalien beeinflusst werden.** Diese Verknüpfung war einer der Gründe für die vorgeschlagene Informationspflicht zu Effektchemikalien, um deren Einfluss auf die Haltbarkeit zu berücksichtigen.

Potenzielle Übertragung der Anforderungen auf ein Ökodesign-Label

Diese Analyse basiert auf einer vergleichenden Bewertung des Energielabels und untersucht das Potenzial, die Anforderungen auf ein Ökodesign-Label zu übertragen. Die Ökodesign-Verordnung sieht ein solches physisches Label am Produkt vor, um Verbraucher*innen bei nachhaltigen Kaufentscheidungen zu unterstützen, indem klare und vergleichbare Informationen bereitgestellt werden. Es ist nachgewiesen, dass das Energielabel wirksam den Energieverbrauch privater Haushalte senkt – bis 2020 wurde eine Reduktion um 28 % erreicht. Das Label ist weithin anerkannt und hat nachweislich einen starken Einfluss auf Kaufentscheidungen. Studien zeigen, dass gestufte Labels am effektivsten nachhaltige Kaufentscheidungen fördern und dass Verbraucher*innen alphabetische Skalen (A–G) leichter verstehen als numerische. Daher wurde in dieser Studie das Energielabel als Vorbild genutzt, um das Potenzial von Leistungsklassen und Icons für die Darstellung absoluter Informationen auf Textilkennzeichnungen zu untersuchen.

Die Schlussfolgerungen und Empfehlungen für die einzelnen Produktaspekte lauten wie folgt:

- **Haltbarkeit:** Die Entwicklung von Leistungsklassen für die Haltbarkeit ist herausfordernd, da hierfür mehrere Prüfparameter zu einem Wert zusammengefasst werden müssten. Zudem verhalten sich die Prüfparameter – anders als bei der Energieeffizienz – nicht linear über die Zeit. Für waschbare Textilien könnte die Anzahl der Wasch-Trockenzyklen ein klarer Indikator sein. Auch die Stakeholder im Workshop empfahlen, die Anzahl der Wasch-Trockenzyklen als absolute Information anzugeben. Allerdings müssen die Waschverfahren, die den Haushaltsgebrauch abbilden, standardisiert werden.
- **Reparierbarkeit:** Ein einfaches Punktesystem (z. B. 1–5 Punkte) auf Basis von Indikatoren wie Demontagefreundlichkeit und benötigte Werkzeuge könnte genutzt werden, um die Reparierbarkeit auf Produktebene zu differenzieren. Dies würde zur Anzeige von Leistungsklassen führen. Die Workshop-Teilnehmer*innen bevorzugten qualitative Informationen, etwa zu Reparaturservices.
- **Recyclingfähigkeit**: Die Darstellung von Leistungsklassen könnte die Nutzung von Monomaterialien fördern und Materialmischungen entgegenwirken. Die vorgeschlagenen Klassen basieren auf Haupt-/Nebenmaterial-Verhältnissen, benötigen aber weitere Validierung, da sich die Technologie weiterentwickelt. In den Workshops wurde stattdessen ein komplexeres Bewertungssystem vorgeschlagen, das von den als Mindestanforderung vorgeschlagenen Systemen abweicht.
- **Rezyklatanteil:** Es wird empfohlen, den exakten Prozentsatz des Rezyklatanteil als absolute Information anzugeben. Die Mehrheit der Workshop-Teilnehmenden unterstützte diesen Ansatz. Damit entfiele die Notwendigkeit von Leistungsklassen, für die weitere Bewertungen zur Klasseneinteilung erforderlich wären. Die Angabe des genauen Prozentsatzes setzt jedoch die Definition von Berechnungs- und Verifizierungsmethoden voraus.
- **Besorgniserregende Stoffe (SoC):** Leistungsklassen wurden als nicht praktikabel angesehen. Die vorgeschlagenen SVHC-Informationen sollten ausschließlich über den DPP bereitgestellt werden, nicht auf dem Label, um Verbraucher*innen nicht zu verwirren. Dies wurde auch von den Workshop-Teilnehmenden unterstützt.
- **Umweltwirkungen:** Da keine Mindestanforderungen vorgeschlagen wurden, können auch keine Leistungsklassen entwickelt werden. Verpflichtende produktspezifische Umweltfußabdruck-Berechnungen wurden nicht als verhältnismäßig oder sinnvoll für Produktvergleiche angesehen. Eine Option wäre, dass das Label bestehende Umweltzertifizierungen anerkennt – dafür müssten diese Zertifikate jedoch extern validiert sein.

Schlussfolgerung und Empfehlung

Grundsätzlich ist es möglich, die Ökodesign-Anforderungen in ein Ökodesign-Label umzuwandeln. Da die Festlegung aussagekräftiger Leistungsklassen für die Haltbarkeit jedoch als komplex erachtet wird, wird empfohlen, die Anzahl der Wasch-Trockenzyklen als absolute Information anzugeben. So lassen sich leicht verständliche und vergleichbare Daten liefern. Da die Haltbarkeit als das wichtigste Produktmerkmal angesehen wird, sollte sie an prominenter Stelle angegeben werden. Die anderen Produktaspekte sollten im Vergleich dazu weniger auffällig dargestellt werden, um lediglich eine zusätzliche Differenzierung zu ermöglichen.

Analyse der PEFCR für Bekleidung und Schuhe

Nach einer Analyse, inwieweit Biodiversität und Mikrofaseremissionen im PEFCR berücksichtigt wurden, wurde eine eingehende Analyse der erforderlichen Eingangsdaten und der Aussagekraft der PEF-Ergebnisse durchgeführt.

Die Auswirkungen auf die **Biodiversität** und die Freisetzung von Mikroplastik und Mikrofasern werden in der Form von zusätzlichen Umweltinformationen berichtet, jedoch nicht als eigenständige Wirkungskategorien berücksichtigt. Sie fließen daher nicht in die Berechnung des Gesamt-PEF-Scores ein. Die Verwendung von zertifizierter Bio-Baumwolle muss angegeben werden, weitere Bemühungen im Zusammenhang mit der biologischen Vielfalt können angegeben werden, diese Informationen haben jedoch keinen Einfluss auf die Gesamtbewertung des Produkts. Trotz der nachweislich positiven Effekte von Bio-Baumwolle auf Biodiversität und andere Umweltwirkungen existiert derzeit kein spezifischer Datensatz für Bio-Baumwolle in der EF 3.1 Datenbank. Produkte aus Bio-Baumwolle erscheinen daher möglicherweise weniger umweltfreundlich, als sie tatsächlich sind, und unternehmensseitige Biodiversitätsbemühungen spiegeln sich nicht in den Produktbewertungen wider. Die PEFCR berücksichtigt bei **Mikroplastik** ausschließlich die Freisetzung von Faserfragmenten beim häuslichen Waschen unter Verwendung von Daten des Microfibre Consortium (TMC). Obwohl diese Datenbank aktuell die beste verfügbare Quelle darstellt, weist sie Einschränkungen auf. Die TMC-Methode eignet sich zwar, um die grundsätzliche Neigung von Fasern zur Freisetzung von Faserfragmenten beim Waschen zu demonstrieren, bildet aber die tatsächlichen Emissionen beim Haushaltswaschen nicht exakt ab. Bedeutende Emissionen entstehen zudem bei der Produktion, Veredlung, Nutzung und Entsorgung von Textilien – diese Phasen werden jedoch nicht berücksichtigt. Auch die Freisetzung von Faserfragmenten in die Luft bleibt unbeachtet, obwohl Studien zeigen, dass dies ein bedeutender Emissionspfad sein kann. Die PEFCR schlägt zwar Charakterisierungsfaktoren zur Bewertung der Auswirkungen von Faserfragmenten auf Meereslebewesen und Sedimente vor, diese sind jedoch insbesondere für Naturfasern mit hoher Unsicherheit behaftet.

Dateneingabe und Einflussmöglichkeiten: Da die meisten Prozesse der textilen Wertschöpfungskette nicht vom Unternehmen, das das PEF-Profil erstellt, durchgeführt werden, sind unternehmensspezifische Daten meist begrenzt. Fehlen Lieferkettendaten oder das Know-how zur Erstellung eigener Datensätze – was bei KMU häufig der Fall ist – sind die Möglichkeiten, das PEF-Ergebnis zu beeinflussen, eingeschränkt. Die verfügbaren Hintergrunddatensätze gelten als nicht ausreichend zuverlässig, da sie veraltet oder intransparent sind, was angesichts der großen Prozessvielfalt im Textilbereich problematisch ist. Anpassungen sind teilweise möglich, etwa bei der Wahl des Strommixes; andere Faktoren (z. B. Chemikalien- und Energieeinsatz) erfordern jedoch die Erstellung detaillierter, EF-konformer Datensätze.

Haltbarkeit: Die Haltbarkeit wird in der Umweltbewertung über einen Intrinsic Durability Multiplier (IDM) berücksichtigt. Die entsprechenden Haltbarkeitstests sind zwar nicht verpflichtend, werden aber ausdrücklich empfohlen. Die PEFCR-Testprotokolle sind detaillierter und passgenauer als jene der JRC-Vorstudie, verlangen aber weniger Waschgänge, was Fragen zur Aussagekraft der Ergebnisse aufwirft. Eine Harmonisierung der PEFCR- und ESPR-Testanforderungen würde jedoch insgesamt die Umsetzungsaufwände für Unternehmen reduzieren.

Schlussfolgerung und Empfehlung

Obwohl PEF-Studien grundsätzlich für Produktvergleiche geeignet sind und mit anderen EU-Initiativen harmonieren, sind sie bislang kein verpflichtender Mindeststandard für Textilien. Zu den wichtigsten Herausforderungen für eine verpflichtende Anwendung zählen die unvollständige Abdeckung relevanter Wirkungskategorien (wie Biodiversität und Mikroplastik), begrenzte und intransparente Datensätze sowie hohe Kosten und Komplexität für Unternehmen, insbesondere KMU. Zudem besteht die Gefahr irreführender Vergleiche innerhalb von Produktkategorien. Nach Veröffentlichung der EF-Datenbank 4.0 sollte die Eignung der Datenbasis für eine verpflichtende Anwendung erneut bewertet werden.

1 Objective and background

The European Green Deal (European Commission 2019) and one of its key components, the Circular Economy Action Plan (CEAP) (European Commission 2020b) set out various legislative and non-legislative initiatives to promote circular economy processes and encourage sustainable consumption. These initiatives also target product design, with the aim of preventing waste by keeping resources in use for as long as possible.

In this context, the Ecodesign for Sustainable Products Regulation (ESPR or Ecodesign Regulation) (European Parliament; European Council 2024b) is the basis of the Commission's strategy for promoting more environmentally sustainable and circular products. The ESPR establishes a legal framework for making sustainable products the norm in the EU. To achieve this aim, the ESPR puts in place a set of measures. The approach of ecodesign requirements to improve the sustainability and circularity of products is one core element of the ESPR. Other important elements are the digital product passport for making information available to the relevant actors along the value chain and ecodesign labels for allowing for the effective comparison of products to drive consumers towards sustainable choices. Other measures address the prevention of the destruction of unsold consumer products, enhance green public procurement and strengthen market surveillance.

The scope of the ESPR is significantly broader than that of its successor, the Ecodesign Directive (Directive 2009/125/EC), which it has repealed. It basically covers all material goods that are placed on the European market or put into service. Prioritized products for which ecodesign requirements will be developed are listed in a working plan. The first ESPR and Energy Labelling Working Plan was adopted and published in April 2025 and covers five years with a review in 2028 (European Commission 2025a).

Ecodesign requirements

Textiles are among the first product groups for which ecodesign requirements for sustainable products are developed as textiles have been among the prioritized product groups through the EU Strategy for sustainable and circular textiles (European Commission 2022b). With this strategy, the European Commission provided a framework and a vision for a sustainable and circular textile sector and announced to address fast fashion and textile waste and to make textiles more durable, reparable, reusable and recyclable. To support the implementation of these commitments, the European Commission has launched a preparatory study by the Commission's Joint Research Centre (JRC) in 2023 which is – by autumn-2025 – ongoing.[1] According to the ESPR legal text, such a preparatory study follows the 'Methodology for Ecodesign of Energy-related Products' (MEErP)[2] and aims to provide a basis to consider the introduction of ecodesign requirements (Gama Caldas et al. 2024)

The ESPR is intended to enable ambitious requirements to be set for relevant aspects of products.[3] This means that manufacturers should only offer products on the EU market that are designed to last as long as possible, can be repaired and are manufactured in an environmentally friendly way that uses resources efficiently. Thereby, worst-performing products are removed

[1] Homepage of the Preparatory Study on Textile Products: https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/467/home, last accessed 26.06.2025.

[2] The MEErP was developed under the successor Ecodesign Directive and has been revised: (https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/521/home; last accessed 26.06.2025)

[3] Article 5 of the ESPR lists the product aspects for which ecodesign requirements may be set in order to improve the product aspects, if relevant for the product group under consideration.

from the market. The product group specific requirements will be published in a so-called delegated act.[4] This future delegated act on ecodesign requirements for textiles will be referred to as the 'future delegated act' throughout this study.

Ecodesign label

The Ecodesign Regulation provides for labels as a non-digital form of information transmission in addition to the digital product passport. These physical labels on the product are intended to encourage consumers to make sustainable choices by providing clear and easily understandable information and enabling an effective comparison of products, e.g. by indicating performance classes, according to recital (46) of the Ecodesign Regulation.

For energy-related products, the Energy label already exists. It is a legal instrument that works synergistically with the minimum ecodesign requirements. This interaction is described as 'Push & Pull 'interaction: Ecodesign minimum requirements are intended to push products with the worst performance out of the EU market. The label is intended to steer consumers' purchasing decisions towards the most efficient products. The label is also intended to stimulate competition among manufacturers to continuously improve the design of their products to appear in the highest classes and achieve the best values for all parameters indicated on the label. The ecodesign label is not intended to replace the energy label but is to be used in cases where the information provided by the energy label is not sufficient to represent the performance of products. This is the case for textiles.

The German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) and the German Environment Agency (UBA) commissioned the study here at hand to actively participate in the development of ecodesign requirements for textiles and strengthen the consideration of material efficiency, lifespan and recyclability of textile products under the new ESPR and to examine the transfer of requirements into an ecodesign label.

The study is being conducted by the Oeko-Institut in cooperation with two Universities of Applied Sciences with textile faculties, the Hochschule Niederrhein University of Applied Sciences and the Hochschule Hof University of Applied Sciences.

Editorial note

Care has been taken to minimise redundancies in the report. However, some repetition has been included to enable the chapters to be read separately.

The analyses and recommendations presented in this study are based on research and evaluations carried out up to May 2025.

[4] The empowerments to adopt delegated acts is specified in Article 4 of the ESPR.

2 Methodological approach

2.1 Prioritisation of product aspects

As this study started in autumn 2023, the list of product aspects from the proposal of the European Commission (COM(2022) 142 final) was the basis to prioritize the product aspects. From this list, a selection was made based on the results of a literature review and of previous work by the UBA and the European Commission (EC). The additions in the list of product aspects made in the institutional agreements and the final list of Article 5 of the ESPR have been considered.

2.2 Product categorisation and selection of product examples

The development of specific ecodesign requirements was carried out in this study on selected product examples of the textile mass market (clothing and home textiles). The selection of the product examples was based on a categorisation carried out in a first step.

In view of the wide range of product types, materials and material combinations that are available on the textile market, in a first step a categorisation of the product diversity was done. Here, statistical classifications of textiles were researched to identify a suitable categorisation for textiles that could provide a framework for the development of ecodesign requirements. To validate the findings of the desk research, the findings were presented to various experts from industry, associations, and research institutes in a second step. These expert groups consist of different textile experts from industry, associations and research institutes. The extracted national (German) and international categorisation systems were then analysed with the help of a comparative analysis regarding the structure and the depth of the respective systems, the coverage of product functions and clear product allocation. Finally, restructuring and a new division were developed to address the needs in the frame of the ecodesign regulation.

The product examples were defined to represent products that are sold in large quantities and include examples made from mono-fibre materials as well as multi fibre-material and multi-component products, latter one represented by a complex product with trims. In addition, the product examples should also demonstrate relevance with regards to the prioritised product aspects, not only as potential for a long service life (durability) and the possibility of repair (repairability) but also reflect products where recycled fibres are already used or the presence of substances of concern (SoC) is relevant. Against these criteria, three product examples were chosen for the development of ecodesign requirements. A market analysis was performed to determine the material composition predominantly available on the market.

2.3 Methodological approach for the development of ecodesign requirements

The methodology for the development of ecodesign requirements for each product aspect followed the same approach presented below. If additional tools for further in-depth analysis were applied, these are described in the specific product aspect section.

The following steps were taken:

Literature and desktop research

Literature and desktop research formed the basis to understand the initial situation of each product aspect, supported by the results of previous and ongoing research projects of all project partners and the UBA. Additional literature research was carried out iteratively for selected areas in order to deepen understanding or critically examine results. This was the case for trade-offs and target conflicts between product aspects, for example.

Workshop series

A national workshop series was conceptualized, conducted, and evaluated to gather additional relevant data and background information that cannot be obtained through desktop research and to obtain a critical discussion and feedback on the study team's interim findings.

The workshop series consisted of three workshops, where about 40 experts participated. As the aim was to focus on technical feasibility, the workshop series was conducted under Chatham House Rules with a largely fixed group of participants attending the modular workshops. Additional experts, e.g. from recycling companies and spinning mills, were brought in after the first workshop. The expert group comprised representatives from quality management and sustainability departments of textile manufacturing and retailing companies, sorting and recycling companies and textile and chemical associations, testing institutes, textile labelling institutions and academia. The fixed number of participants was chosen to enable the workshops to be built up in a modular way, to ensure that introductory presentations were kept short, and to facilitate continuous, increasingly in-depth discussions. The modular structure was designed in the following way:

- The first workshop presented initial results on categorising textile clothing products and selecting product categories for developing specific ecodesign requirements. The status quo, challenges and initial solution proposals for the prioritised product aspects were presented and discussed with the experts.
- The second workshop focused on presenting and discussing in depth initial proposals for possible minimum requirements for product aspects such as durability, repairability, fibre-to-fibre recyclability, recycled content, presence of SoC, and environmental impact/other resource consumption in working groups.
- The third workshop presented the final proposals for the individual product aspects in an overall view. The experts had the opportunity to comment on the minimum requirements. Additionally, the potential for transferring the ecodesign requirements into an ecodesign label was discussed.

Further stakeholder consultations

Further consultation formats were implemented to address individual aspects. In this context, information on the project was presented on several occasions, conferences or annual meetings of associations to share information and to identify and recruit additional stakeholders, e.g. at the TEGEWA Annual Technical Conference or Conference of the Association for the Future of Textiles (Gemeinschaft für textile Zukunft, GftZ)) on 'Extended producer responsibility for textiles' both in November 2024.

Different methods were applied depending on the data needs. Questionnaires were used to increase the number of stakeholders to obtain a reliable overview, while semi-structured interviews were conducted to gain particular insights in an in-depth analysis:

- **Questionnaire:** For the product aspects of durability and presence of SoC, questionnaires have been developed that are documented in the Annex B.1 and B.4.

- **Interviews:**
  - Semi-structured interviews were conducted with repair service providers: The focus was on understanding how repairs are carried out, on common defects, and typical repair barriers. Most of these interviews were conducted on site. The corresponding interview guideline is also provided in the Annex B.2 as the original German version.
  - Semi-structured interviews were conducted to analyse the recycled content aspect: Selected companies and institutions representing important stages of the supply chain were approached and invited to answer a set of general questions. Additionally, specific questions were addressed to targeted groups such as collectors and sorters, recycling companies, fibre and yarn manufacturers, and brands. The interviews were conducted online / by telephone and followed the questionnaire documented in the Annex B.3.
- The **stakeholders** participating in the workshop series were invited to contribute **written statements** to the final proposals of minimum ecodesign requirements aiming to include external perspectives. The workshop participants were asked to provide answers to the following guiding questions:
  - Which of these requirements can be implemented immediately?
  - Which requirements do you foresee difficulties with, and why?
  - What timeframe would be required for implementation?
  - Are there any product groups that you would exclude from ecodesign requirements, and if so, why?

  The feedback was carefully summarised and analysed as a basis for the study's final conclusions (see Chapter 9). Furthermore, the feedback was incorporated into the concluding discussions for each product aspect.

Experimental case study

In order to explore product durability and repairability, selected products were analysed through product assessments and physical testing. These analyses are described in detail in the respective chapters (4.2.4 and 5.2.2).

Consideration of the JRC Preparatory Study

The development of the **preparatory study by the Commission's JRC** was followed and its results were **critically and comparatively taken into account**. By finalizing the study at hand, the following documents have been published by the JRC:

- the 1st milestone report on scope, market and user behaviour (task 1 to 3 according to MEErP) (Delre et al. 2024b),
- the report on task 4 of the MEErP-Methodology, on technologies (Delre et al. 2024c) and
- the 2nd milestone report that covers the task 4 of the MEErP-Methodology, on technologies and also the revised 1st milestone report on scope, market and user behaviour (task 1 to 3 according to MEErP) (Delre et al. 2024a).

The task 4 report and the 2nd milestone report are also both referred to as the JRC preparatory study.

2.4 Steps in checking the transfer of requirements to an ecodesign label

An introductory survey among the participants of the workshop series in November 2024 formed the start of the check on the transfer of requirements to an ecodesign label. The survey was intended to understand the current knowledge and concepts of an ecodesign label as well as expectations towards such a label. Literature was reviewed with a focus on results in relation to the energy label. For the further analysis, the energy label was used as an orientation template to discuss the transfer of ecodesign requirements for textiles into a label. Working groups within the workshop series discussed the guiding questions on:

- What specific information /data can be used to represent the product aspect on a label?
- Is categorisation into performance classes or presentation with absolute information possible and meaningful? If so, how many performance classes are there?

3 Prioritisation of product aspects and selection of product examples

3.1 Prioritisation of product aspects

When the study started in autumn 2023, the list of product aspects from the proposal of the European Commission for the Ecodesign Regulation (European Commission 2022a) was the basis to prioritize the product aspects. This proposal contained 14 product aspects as listed in the table here below. In the list of product aspects in Article 5 of the ESPR, one more aspect have been taken up during the interinstitutional negotiations within the legislative process, namely water use and water efficiency and the aspect (k) on the possibility of remanufacturing and recyclability was separated.

Due to their potential to reduce the burden on the environment, the following product aspects have been prioritised as being particularly relevant for the textiles product group: durability, repairability, fibre-to-fibre recyclability and recycled content, presence of SoC and 'environmental impact, including CO_2e and environmental footprint', which includes energy use or energy efficiency and resource use or resource efficiency. The following table shows the considerations and conclusions on the product aspects.

Table 1: Considerations for the prioritization of product aspects

Product aspects	Considerations	Conclusion
(a) durability	- Various studies concluded that extending the service life or increasing the utilisation cycles of textile products can lead to significant environmental benefits (Gärtner et al. 2022a; Gärtner et al. 2022c; Gärtner et al. 2022b; Sandin et al. 2019b; Wrap 2017). - Product lifespan or durability is specifically named in the EU Textile Strategy (European Commission 2022b). - According to the JRC report on new product priorities for ecodesign (Faraca et al. 2023), durability is considered a horizontal measure, which means that provisions are defined for product groups with common characteristics. The possible determination of durability described by Faraca et al. (2023) is still strongly characterised by parameters that are relevant for energy-consuming products, such as reliability. For textiles, rather aspects help to describe the durability of textiles such as resistance to stress or aging mechanisms (wear and tear) and durability of specific functions (e.g. for water repellence) or of specific textile parameters, such as colour fastness, dimensional stability.	**Prioritized**
(b) reliability	The reliability of products is defined as the extent to which a given function is fulfilled within a specified timeframe (European Commission 2022a). This concept can basically be applied to specific functions of textiles (e.g. water repellence) but rather contributes to durability and will in this study be considered under durability.	Not prioritized.
(c) reusability	The reusability of textiles is determined by their durability and repairability. Also, appropriate textile care is a prerequisite for reusability. Certain items are generally reused less frequently or not at all (e.g. underwear or hosiery) (Re_fashion 2025e).	Not prioritized.

Product aspects	Considerations	Conclusion
(d) upgradability	According to the European Commission (2022a), upgrading means enhancing the functionality, performance, capacity or aesthetics of a product. This concept is applicable to technical, e.g. electronic equipment; however, it is concluded not to be applicable to textiles in a comparable way.	Not priori-tized.
(e) repairability	For items that can only be dry-cleaned, the most frequently cited problem was that buttons or zips broke (Cooper et al. 2013); repair services have so far been offered in the outdoor sector; for repairability requirements such as the provision of spare parts (buttons, zips) are discussed. Faraca et al. (2023): See the requirement for repairability as a horizontal provision and suggest the following requirements: - Introduction of a repairability scoring index/label - Availability of repair (+upgrade) information and maintenance instructions - Availability of spare parts and delivery times - Disassembly in general or related to tools, fasteners, working environment and skill level - Specification of components and materials used - Modular design, convertibility; removable or adjustable elements	**Prioritized.**
(f) possibility of maintenance and refurbishment	According to the European Commission (2022a), refurbishment means preparing or modifying an object that is waste or a product to restore its performance or functionality within the intended use, range of performance and maintenance originally conceived at the design stage, or to meet applicable technical standards or regulatory requirements, with the result of making a fully functional product and maintenance means an action carried out to keep a product in a condition where it is able to function as required. For this study, maintenance was subsumed under durability, as an extrinsic factor that influences the physical durability of textiles. Furthermore, repairability was also considered important for maintenance of textiles. In contrast refurbishment is rather considered to apply for products with safety provisions, e.g. electronics of vehicle component; for textiles, the concept is concluded to be covered by repairability.	Not priori-tized.
(g) presence of substances of concern	This is an important product aspect for fulfilling the EU Commission's ‘Zero Pollution Action Plan” (European Commission 2021). 5 % of the chemicals produced worldwide are consumed by the clothing industry (Jungmichel et al. 2020). A methodology for identifying substances that negatively impact the reuse and recycling of materials in products is not yet available. There are conflicting objectives between chemical finishing to improve durability and environmental and health protection (Gimkiewicz 2022).	**Prioritized.**
(h) energy use or energy efficiency	Energy use is relevant in the manufacturing process (Faraca et al. 2023; Jungmichel et al. 2020) and will be addressed under the aspects of environmental impacts.	Subsumed under environmen-tal impact.

Product aspects	Considerations	Conclusion
	Energy use and energy efficiency is critical for products directly consuming energy during their use such as electronic equipment for example. However, when it comes to textiles, they do not directly consume energy during their use, therefore energy use and energy efficiency is not taken up a particular product aspect.	
(i) resource use or resource efficiency	- Textile consumption is the third largest source of water and land use, with natural fibres requiring high levels of land use/consumption (EEA 2022a). - Water consumption: Cotton cultivation accounts for 2.6% of global water consumption (Faraca et al. 2023): 92% of water consumption in textile production takes place outside the EU. - Use of pesticides: Just under 6% of the pesticides and 16% of the insecticides sold worldwide each year are used in cotton cultivation and the cultivation of textile fibres accounts for 4% of the total fertiliser applied annually (Jungmichel et al. 2020). - Faraca et al. (2023) proposes performance requirements, e.g. maximum values for water or chemical consumption in the production of one kilogramme or one unit of the product (see Box 10 in the Factsheet for Textiles and Footwear in Faraca et al. (2023).	Subsumed under environmen-tal impact.
(j) recycled content	Despite the large volume of waste, used textiles are rarely recycled into new products. This is why mandatory recycled content in textiles is considered to have significant environmental benefits (Faraca et al. 2023). Faraca et al. (2023) categorises the requirement for recycled content as a horizontal measure, defined as a minimum percentage of post-consumer recycled content in relation to the recycled fibre used (e.g. cotton, wool, viscose or polyester, depending on the product composition). Teufel et al. (2024b) concluded that recycled content must be determined on a fibre-specific basis. Using recycled fibres can lead to trade-offs and conflicts with other product aspects, particularly durability (Faraca et al. 2023; Gimkiewicz 2022).	**Prioritized.**
(k) possibility of remanufactur-ing and recycling	According to the EU textile strategy (European Commission 2022b), there should be an increased focus on fibre-to-fibre recycling. Faraca et al. (2023) propose recyclability as a horizontal measure that can be covered by the following provisions: - Ability to easily separate the product into different materials (e.g. metal, plastic, textile) - Material selection and substance restrictions (e.g. selection and combination of polymers; homogeneous fibres) - Access to product data relevant for recycling, including dismantling information - Information on recyclability	**Prioritized** partly.
(l) possibility of recovery of materials	The most important recovery route for textiles is covered by the product aspect of recycling.	Not prioritized.
(m) environmental impacts, including carbon and	- Globally, the textile sector accounts for over 1% of greenhouse gas (GHG) emissions (Jungmichel et al. 2020).	**Prioritized.**

Product aspects	Considerations	Conclusion
environmental footprint	- The consumption of textiles throughout the life cycle of products is, on average, the fourth largest source of negative environmental and climate impacts (EEA 2022a). Faraca et al. (2023) argue that the use phase of textiles has the largest environmental impact in the life cycle of clothing due to the water and chemicals used for washing and the release of microfibres into the water. - High energy consumption is involved in the production of synthetic fibres. Faraca et al. (2023) suggest introducing performance requirements, e.g. in terms of greenhouse gas emissions per kg of product or garment produced.	
(n) expected generation of waste materials	Since textiles are largely imported from third countries, waste materials generated in the EU are mostly used textiles.	Not prioritized.

Source: List of product aspects according to European Commission (2022a), considerations based on the literature cited in the table cells.

The preparatory study of the JRC applied a different approach in defining relevant product aspects by successively excluding product aspects which were not relevant for textile apparel (possibility of recovery of materials), grouping product aspects that could potentially be addressed with the same requirements. Delre et al. (2024c) arrived at almost the same list of product aspects:

- The product aspects of durability, reliability and reusability were grouped and named **physical durability** to focus on intrinsic measurable properties of the product.
- **Maintenance** was addressed separately because of the importance of providing information to users.
- **Repairability** also includes upgradability, possibility of refurbishment and remanufacturing.
- **Recyclability and recycled content** were addressed as one product aspect arguing that recycled material should come from recyclable textile products, thus affected by the same process techniques and business models.
- The product aspect addressing **environmental impacts** was described to include the assessment of use (and efficiency) of water, energy and resources, which are the fundamental elements affecting the environment. This was also concluded by the study here at hand.
- Although Delre et al. (2024c) concluded that the **presence of SoC** was strongly interlinked with other product aspects, they still suggested that it should be addressed separately. The reason behind is that this product aspect mainly refers to information requirements that must be reported by economic operators who place or make the product available on the market.
- Only the expected **generation of waste** was considered as an additional product aspect compared to the study here at hand. The expected generation of waste was considered by the JRC to provide the feedstock for the recycling system.

3.2 Categorisation of textile products[5]

As base for the categorisation system, the combined nomenclature (CN) is recommended to which ESPR and the targeted amendment of the Waste Frame-work Directive (COM/2023/420) also refer to. The CN is based on the Harmonised Commodity Description and Coding System (HS), commonly referred to as the Harmonised System, which is an international system to classify goods developed by the World Customs Organisation (WCO).

Within a product structure, in addition to the product type, the use of materials and the fabric structure (pre-dominantly knitted, woven) must be considered, at least to a certain extent, so that product-specific and applicable requirements can be defined. Additionally, ecodesign requirements, especially for product aspects such as durability and recycled content, must consider the function and use of the textile product due to the relativity for different levels of use.

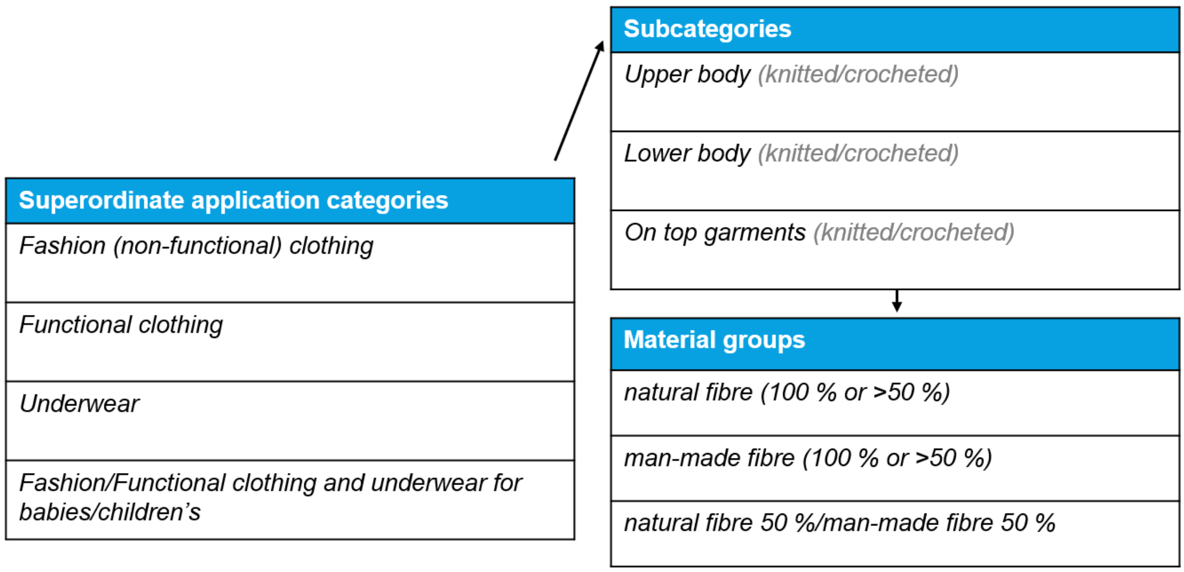
The proposal for the definition of product categories is published in a separate document (Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published). This developed categorisation follows shortly summarised the following categorisation steps (Figure 1 shows the steps in the categorisation scheme):

1. **Superordinate application categories:** Fashion (non-functional) clothing, Functional clothing, Underwear, Fashion/Functional clothing and underwear for babies/children's. This is explained in more detail further below (chapter 3.2.1).
2. **Subcategories:** Here, a distinction is made between knitted/crocheted and not knitted/crocheted. These designations have been taken from the descriptions of the Harmonized System (HS) of the (World Customs Organization) and are intended to ensure recognisability: Upper body knitted/crocheted, Upper body not knitted/crocheted, Lower body knitted/crocheted, Lower body not knitted/crocheted, on top garments knitted/crocheted, on top garments not knitted/crocheted (see in more details chapter 3.2.2)
3. **Product categories system:** The first four digits of the HS nomenclature are assigned to the subcategories. It should be noted that the HS codes cover a wide variety of products that do not all belong to the same product type in the proposed categories. Therefore, the HS codes can occur more than once within the structure, but the allocation to application categories (1.) and subcategories (2.) allows a specific assignment to be made. This is shown in detail in chapter 3.2.3.
4. **Material groups:** In order to incorporate the different material uses for appropriate requirements into the product categories and the differentiation between mono- and multi-material, each subcategory (2.) is divided into use of natural fibre (100% or >50%), man-made fibre (100% or >50%) or natural 50%/man-made fibre 50% (in total five material groups). This procedure is similar to the product categories within the study but takes the textile technological perspective into account in order to be able to set realistic average requirements. In addition, this product category scheme requires only minor additions from economic operators for a later integration, as it was developed based on the previous data queries for customs tariff numbers. This structure allows the product categories to be flexibly adapted to the scope during the development of the product requirements (see Figure 3 in chapter 3.2.4).

[5] This chapter was written by Sabrina Mauter and Markus Muschkiet of the Center Textile Logistics (CTL) at the Hochschule Niederrhein, University of Applied Sciences, in Mönchengladbach.

The product groups and definitions have been specifically constructed considering the different requirements for product groups (based on the different ESPR product aspects) so that they can be applied to all product aspects. Among other things, this facilitates the bureaucratic effort that would be involved if all product aspects were subject to different product category structures. As part of this structure and methodology, the durability requirements for different products can also be defined in a structured manner.

Figure 1: Categorisation scheme



Source: Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published

3.2.1 Details on the superordinate application categories

Superordinate application categories of clothing based on their area of application are proposed as follows:

- Fashion (non-functional) clothing;
- Functional clothing;
- Underwear;
- Fashion/Functional clothing and underwear for babies/children’s.

The application category of **fashion clothing** includes clothing/apparel products that are worn as everyday clothing and for special occasions but have not undergone any additional finishing or functionalisation. A differentiation between men's and women's clothing is not recommended.

The application categories of **functional clothing** include clothing products that are finished and therefore have an additional function. Due to their specific function, durability requirements cannot be equated with defined apparel articles. The chemical finish also influences the recyclability, for example, which is why general requirements in a common product group with fashion/apparel products cannot include these specific product features. For these reasons, product requirements must be defined specifically for this type of product. In particular, track-suits and outdoor clothing and/or clothing in the sports sector are assigned to this category. Swimwear garments are excluded.

The **underwear** application category includes clothing products that are worn close to the body. For the most part, these products have different structures, fineness's, functional areas and therefore cannot be included in the other categories. In addition, specific requirements should also be set with regard to increased washing cycles. Products that are made of fine knit are therefore excluded: tights, stockings and other hosiery as well as lingerie. Products with a correspondingly different surface structure behave differently in terms of durability, recycling and repair requirements and must be considered separately in order to be able to set appropriate requirements. It is proposed not to include this type of product in the reference framework of textile products for the time being, or to create a further specific class for it in the future.

Babies and children's clothing should also be subject to different durability requirements, as they are exposed to greater stress, particularly during washing. In addition, requirements for chemicals are specifically defined, e.g. stricter thresholds for chemical residues. In the HS nomenclature, baby articles are defined as 'body height not exceeding 86 cm' (World Customs Organization 2022). For the addition of children, children's sizes could be drawn as a boundary to adult clothing. In addition, the categories of fashion clothing and underwear are combined for babies and children, as the quantitative ratio of differentiated underwear products for babies and toddlers differs from that of adult underwear.

3.2.2 Subcategories

At the level of the subcategories, a distinction is made between knitted/crocheted and not knitted/crocheted (woven) on the basis of different manufacturing processes, as is also done in the HS system: The chapter numbers (the first two digits of the HS nomenclature) 61 cover exclusively knitted and crocheted products, while; the chapter numbers 62 covers products that are not knitted or crocheted but predominantly woven. The following two digits indicate the product category within the respective chapter of the customs system and thus distinguish, for example, between knitted or crocheted shirts for men or boys (6105) and knitted or crocheted blouses, shirts and shirt-blouses for women and girls (6106).

The reason for this further differentiation is the fact that different product aspects, for example for durability, have to be worked out for knitted/crocheted or woven goods due to their specific properties. For example, the dimensional stability of knitted or crocheted goods is different from that of woven goods. For woven fabrics, a change in dimensional stability is mainly the shrinkage of the fabric. For knitted or crocheted fabrics, however, non-reversible stretching can also occur.

The JRC's product system differentiates between which part of the body the product covers. The background to this analysis is, in particular, that it makes it possible to create generally valid requirements, as the products have a similar product structure. Requirements for on top garments, for example, which are pulled over a T-shirt or sweater, i.e. for the most part various jackets, can therefore be evaluated in a standardized manner and are consciously differentiated from requirements for T-shirts (upper body) and pants (lower body), for example. Then, other parameters must be applied. The following subcategories are applicable to each of the superordinate application categories:

- *Upper body* knitted/crocheted;
- *Upper body* not knitted/crocheted;

- *Lower body* knitted/crocheted;
- *Lower body* not knitted/crocheted;
- *On top garments* knitted/crocheted;
- *On top garments* not knitted/crocheted.

3.2.3 Product categories system

The proposed system can be easily integrated into the HS system. It should be noted that the existing HS nomenclature (specification of chapter numbers and product category positions) is less differentiated. The HS code numbers cover a variety of products that do not all belong to the same product type in the proposed categorisation system. In Figure 2, the HS code numbers appear several times in the categorisation system (example: HS code number 6104 covers suits, costumes, jackets, blazers, dresses, etc. for women and girls. This number is therefore assigned both in the subdivision 'fashion clothing' and in the subdivision 'fashion clothing and underwear for babies/children' as subcategories 'upper body" and 'lower body").

The proposed complete categorisation system (No. 1-28) is presented below. For this purpose, the defined application categories, subcategories, product types and the four digits of the HS nomenclature are linked.

Figure 2: Organisation of the developed systematic categorisation system for clothing products

No.	Sub-divisions	Subcategories	HS-codes
1.	Fashion clothing	*On top garments* knitted/crocheted	6101, 6102, 6103, 6104, 6114
2.		*On top garments* not knitted/crocheted	6201, 6202, 6203, 6204
3.		*Upper body* knitted/crocheted	6104, 6105, 6106, 6109, 6110, 6114
4.		*Upper body* not knitted/crocheted	6204, 6205, 6206
5.		*Lower body* knitted/crocheted	6103, 6104, 6114
6.		*Lower body* not knitted/crocheted	6203, 6204
7.	Underwear	*Upper body knitted/crocheted*	6107, 6108, 6114
8.		*Upper body* not knitted/crocheted	6207, 6208
9.		*Lower body* knitted/crocheted	6107, 6108, 6114
10.		*Lower body* not knitted/crocheted	6207, 6208

No.	Sub-divisions	Subcategories	HS-codes
11.	Functional clothing	*On top garments* knitted/crocheted	6101, 6102, 6103, 6104, 6112, 6114
12.		*On top garments* not knitted/crocheted	6201, 6202, 6203, 6204, 6211
13.		*Upper body* knitted/crocheted	6104, 6105, 6106, 6109, 6110, 6112, 6114
14.		*Upper body* not knitted/crocheted	6204, 6205, 6206, 6211
15.		*Lower body* knitted/crocheted	6103, 6104, 6112, 6114
16.		*Lower body* not knitted/crocheted	6203, 6204, 6211
17.	Fashion clothing and underwear for babies/children	*On top garments* knitted/crocheted	6101, 6102, 6103, 6104, 6107, 6108, 6111, 6114
18.		*On top garments* not knitted/crocheted	6201, 6202, 6203, 6204, 6207, 6208, 6209
19.		*Upper body* knitted/crocheted	6104, 6105, 6106, 6107, 6108, 6109, 6110, 6111, 6114
20.		*Upper body* not knitted/crocheted	6204, 6205, 6206, 6207, 6208, 6209
21.		*Lower body* knitted/crocheted	6103, 6104, 6107, 6108, 6111, 6114
22.		*Lower body* not knitted/crocheted	6203, 6204, 6207, 6208, 6209
23.	Functional clothing for babies/children	*On top garments* knitted/crocheted	6101, 6102, 6103, 6104, 6111, 6112, 6114
24.		*On top garments* not knitted/crocheted	6201, 6202, 6203, 6204, 6209, 6211
25.		*Upper body* knitted/crocheted	6104, 6105, 6106, 6109, 6110, 6111, 6112, 6114
26.		*Upper body* not knitted/crocheted	6204, 6205, 6206, 6209, 6211
27.		*Lower body* knitted/crocheted	6103, 6104, 6111, 6112, 6114
28.		*Lower body* not knitted/crocheted	6203, 6204, 6209, 6211

Source: Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published

3.2.4 Material groups

In order to best integrate the differentiated use of materials within the classification system, all 28 categorisation systems can additionally be segmented into the following material groups. The term chemical fibre refers to both artificial (regenerated fibres from natural raw materials – 'man-made') and synthetic fibres (produced from crude oil). At first glance, this additional segmentation increases the complexity of the system. However, it may be that ecodesign requirements refer to material groups e.g. in the context of recyclability or for durability requirements.

Figure 3: Supplement to the organisation of the categorisation system based on material groups

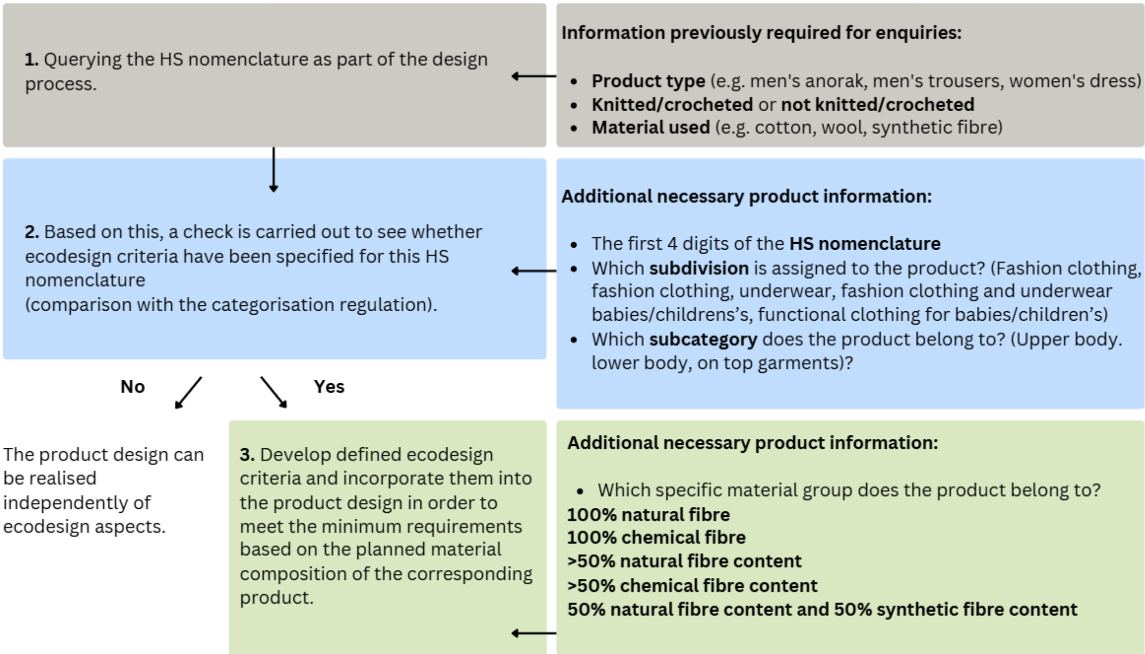
1.	100% natural fibre content	**Mono-material**
2.	100% man-made fibre content	
3.	>50% man-made fibre content	**Multi-material**
4.	>50% natural fibre content	
5.	50% natural fibre content and 50% man-made fibre content	

Source: Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published

3.2.5 Procedural approach

The proposed system is intended to enable the specific allocation of ecodesign requirements to products or product groups. Figure 4 shows the procedure for applying the system presented in three successive steps to obtain the ecodesign requirements for a product in the design process. Most of the required knowledge and information is already available today, as the HS nomenclature is integrated in the proposed system. Currently, computer software is used to determine to which HS code number a product belongs. This requires information on the material used (cotton, wool, man-made fibre) and the surface technology used (knitted/crocheted; non-knitted/crocheted). To determine the ecodesign requirements for a specific product, it is now also necessary to assign it to the (new) sub-ordinate application category, the (new) subcategories and the (new) more specific material group. Both systems, the HS nomenclature and the (future) ecodesign product requirements, can therefore be applied in parallel without the need to change the customs tariff scheme.

Figure 4: Processual procedure for the integration of future ecodesign criteria based on the proposed categorisation system



Source: Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published

3.2.6 Products excluded from the system

For this report, products that can be categorised as everyday clothing are selected, as the quantity of textiles placed on the market and the quantity of textile products on the waste market are predominantly categorised as clothing. Sorting analyses of waste textiles carried out by the Centre Textile Logistics from Niederrhein University of Applied Sciences and Fraunhofer IML in 2020 and 2021 show that inferior product qualities are mainly found in everyday clothing and that a tendency towards higher product quality can be assumed for household and home textiles, for example (Jarmer and Brieger 2021). The reason for this lies on the one hand in the differentiated product surface and on the other hand in the differentiated functionality of these textile products. (Maes et al. 2021)

The figure below lists the product groups excluded from the categorisation system with their reasons for exclusion and HS nomenclature. As far as possible, product examples have been supplemented by listing them within the product group codes (see Figure 5):

Figure 5: Products proposed to be excluded from ecodesign requirements

Excluded product groups	Product examples	Reason	HS codes
Technical and medical textiles	-	Very different functionality/product presentation compared to everyday clothing products.	-
Workwear/PSA	-	Different functionality/product presentation compared to the majority of everyday clothing products.	62
Leather, fur and feather articles	-	Different product presentation compared to the majority of everyday clothing products. Feature: Inclusion possible through separate functional category.	43
House and home textiles	e.g. bed inserts, towelling, bed sheets, fitted sheets, pillowcases, neck pillowcases, bed linen sets, duvet covers, tablecloths, serviettes	Different functionality compared to the majority of everyday clothing products.	63
Textile outdoor equipment	e.g. tents, sleeping bags, insulating mats	Very different functionality/product presentation compared to everyday clothing products.	-
Occasion wear	e.g. bridal fashions, carnival costumes, religious vestments	Different functionality/product presentation compared to the majority of everyday clothing products. Feature: Inclusion possible through separate functional category.	61, 62, 63
Shoes (with textile inserts and leather shoes)	-	Different product category and functionality/product presentation compared to everyday clothing products. Existing quantitative difference in the use of differentiated materials.	64
Textile accessories	e.g. ties, hats, caps, headbands, hairbands, caps, scarves, handkerchiefs, breathing masks, gloves, belts, umbrellas, rucksacks, bags	Different product category and functionality/product presentation compared to the majority of everyday clothing products.	6116, 6117, 6212, 6213, 6214, 6215, 6216, 6217, 66
Laundry and underwear (partial)	e.g. tights, stockings, other hosiery, lingerie	Different product presentation (fine knit) compared to the majority of everyday clothing products.	6115

Source: Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published

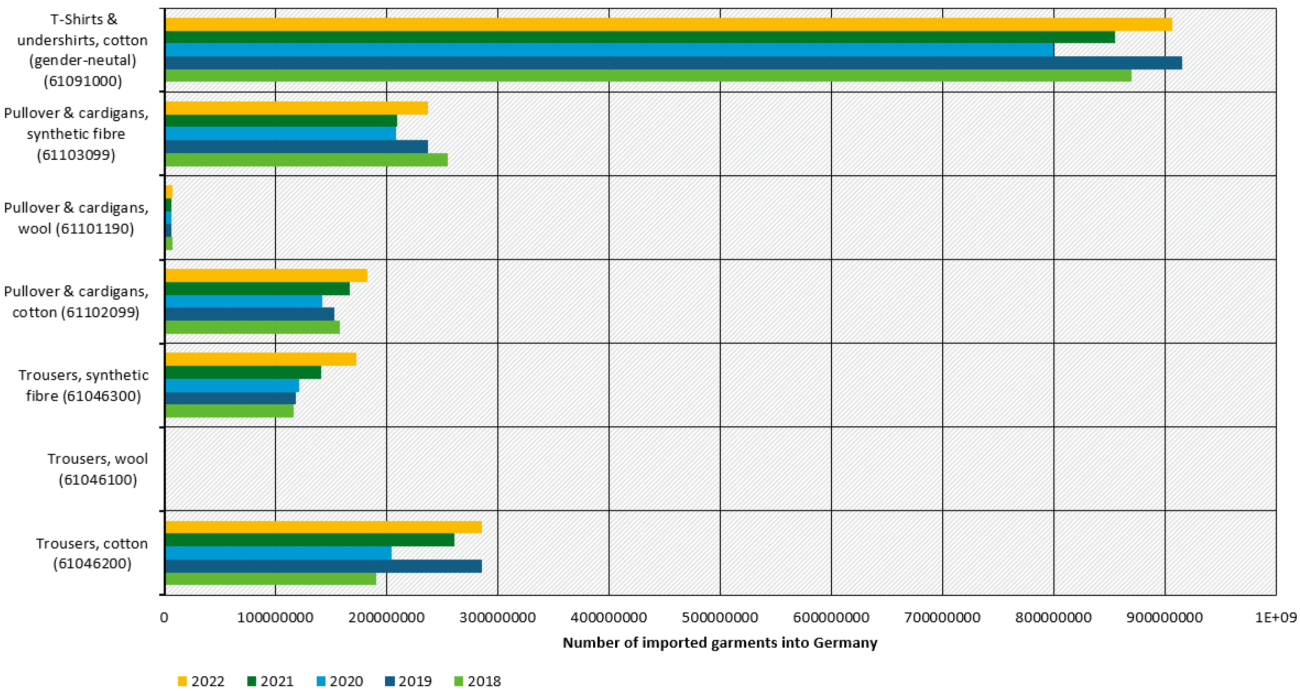
3.3 Selection of product examples

Practical experience gathered during a workshop with industry participants (Oeko-Institut e.V. 2023) indicated that the development of ecodesign requirements is best started with selected pilot projects. Therefore, the selection of product examples was carried out in line with the approach taken in the European Ecodesign Directive for energy-related products to address products relevant in terms of a significant volume of sales taking into account information on the material composition.

The product examples in this study were selected by the following approach to ensure market relevance and the comprehensive coverage of the prioritised product aspects: The selection criteria included large sales volumes and the coverage of the prioritised product aspects. Particular attention was given to mono-fibre versus multi-fibre materials, as material composition affects key product aspects such as durability, recyclability, and repairability.

To identify products with large sales volumes, statistical import data of garments were provided by a German textile association, based on data from the Federal Statistical Office of Germany DESTATIS (Destatis 2023; export and European production is not included here; see figure below). Also, information on fibre content on the market can be derived from import data. The following Figure 6 shows that gender neutral garments like T-shirts made from cotton constitute the most important product group. Within product groups, synthetic fibres are particularly important for pullover and cardigans, while cotton is predominant for trousers. Only a very small number of imported garments in the two categories trousers and pullover and cardigans were made from wool.

Figure 6: Import numbers of garments (product categories according to HS nomenclature indicated in brackets)



Source: According to Destatis (2023)

Additional data gathered during this study confirmed the high level of T-shirt consumption: in 2024, across Europe, T-shirts are in second place volume-wise (first are socks and stockings) with 0.8 billion units for men and 1.6 billion units for women (statista GmbH 2024). Likewise, in the JRC preparatory study, it was concluded that T-shirts are highly relevant in terms of volume for the EU market, with consumption amounting to around 600 million kilograms and a market value of €9.91 billion (Delre et al. 2024a). Given the growing market share of sportswear respectively activewear, it was considered appropriate to include functional T-shirts alongside classic T-shirts to reflect current market and material developments (see market trends by e.g. Grand View Horizon Databooks). As a close-to-body garment, T-shirts are washed particularly frequently in relation to how often it is worn – more often than, for example, sweaters or jeans (WRAP – Waste & Resources Action Programme 2017). Therefore, it can be concluded that the intensive use combined with high market availability at low prices results in especially quick replacement and thereby contributes to waste to a larger extent than other items of clothing.

With regards to trousers, those made of cotton predominantly represent jeans, which are a staple product in the market. Thus, jeans were included in the further analysis due to their market relevance.

To check whether the prioritised product aspects are comprehensively covered, the products with high sales volumes were mapped against the prioritised products aspects and the additional aspects for estimations on the relevance; the assessment of the relevance of the criteria for the product groups was carried out by the study team members from the universities of applied science (see the table directly below). It was found that multi-fibre materials as well as the presence of SoC and wear parts would not be exhaustively covered by product examples such as T-shirts, jeans and pullovers. Therefore, functional jackets were additionally included in the mapping to cover these product aspects and as a representative product example for a complex product with small parts that can easily wear out if the quality or workmanship is poor (e.g. zip) and where the presence of SoC have a high relevance. In the mapping presented in the table below, the products were each assigned one of three relevance values (X indicates low relevance to XXX for a high relevance). This revealed that T-shirts and jeans are more suitable product examples to investigate the relevant product aspects than pullovers. The functional jacket also proved its suitability as a product example.

Table 2: Selection of specific products according to relevant criteria

Criterion	T-Shirt (Knitwear)	Jeans	Pullover	Functional jacket
Relevance of sales volume	XXX	XXX	XXX	XX
Durability (Potential Long service life)	X	XX	X	XX
Potential Repairability	X	XX	X	XX
Recycled content	XX	XX	X	XX
Mono-fibre materials	XX	XX	X	X
Multi-fibre materials	XX	XX	XX	XXX
Potential recyclability	XX	XX	XX	X
Presence of SoC	X	X	X	XXX
Wear parts	X	XXX	X	XXX

Comment: The relevance score ranges from X, which indicates a low relevance to XXX for a high relevance.

A market analysis was conducted to identify the most abundant material compositions for T-shirts and functional jackets, as HS codes do not allow for detailed data on the synthetic fibres used. In a first step, companies with large market shares and high popularity in Germany were analysed to identify typical material compositions that are widely available on the market.

According to consumer survey results on the most popular clothing shops and key suppliers (statista GmbH 2025a; 2025b), the top companies for T-shirts and functional jackets has been compiled as shown in the Table 3 below. Jeans were not analysed separately, as the material composition within this classic product group varies very little. Denim is characterized by a predominantly cotton-based fabric, with variations mainly resulting from small amounts of elastane that are added to enhance wearing comfort. To take into account potential challenges for meeting ecodesign requirements due to elastane content, a model with 5% elastane was selected as a product example.

Table 3: Selection of companies

Product	Selected companies and respective links
Classic T-shirt	C&A; https://www.c-and-a.com/de/de/shop Hennes & Mauritz (H&M); https://www2.hm.com/de_de/index.html Peek & Cloppenburg; https://www.peek-und-cloppenburg.de/ KiK; https://www.kik.de/ Ernsting's family; https://www.ernstings-family.de/ otto.de; https://www.otto.de/ Zalando; https://www.zalando.de/ Adidas; https://www.adidas.de/ ASOS; https://www.asos.com/de/
Functional T-shirt	Adidas; https://www.adidas.de/ Nike; https://www.nike.com/de/ Puma; https://eu.puma.com/de/de/ Fila; https://www.fila.de/ Reebok; https://www.reebok.eu/de-de/ Asics; https://www.asics.com/de/de-de/ Jack Wolfskin; https://www.jack-wolfskin.de/ The North Face; https://www.thenorthface.de/ Mammut; https://www.mammut.com/de/de Schöffel; https://www.schoeffel.com/ Fjällräven; https://www.fjallraven.com/ Hennes & Mauritz (H&M); https://www2.hm.com/de_de/index.html
Functional jacket	H&M; https://www2.hm.com/de_de/ Jack Wolfskin; https://www.jack-wolfskin.de/ Mammut; https://www.mammut.com/de/de Salomon; https://www.salomon.com/de-de Schöffel; https://www.schoeffel.com/ SHEIN; https://de.shein.com/ The North Face; https://www.thenorthface.de/ Timberland; https://www.timberland.de/ Zara; https://www.zara.com/de/

The portfolio of these companies has been analysed:

- The analysis of 88 classic T-shirts of these companies showed that 55% of the T-shirts consist of 100% cotton and 13% consist of 95% cotton and 5% elastane and 6% of 50% cotton and 50% modal or lyocell or polyester. The remaining share consists of other blends.

  The analysis of 130 functional T-shirts showed that 43% of the T-shirts consist of 100% polyester and 6.2% consist of 100% cotton (mostly for hiking) followed by 4.6% of polyester/elastane or cotton/polyester blends. The remaining share consists of other blends.

These results indicate a high market share of mono-fibre T-shirts made of 100% cotton or 100% polyester. In addition, such mono-material T-shirts represent a less complex type of clothing and therefore provide a suitable starting point for developing ecodesign requirements.

- The analysis of 42 functional jackets showed 17 different types, such as softshell jackets, windbreakers, outdoor jackets and rain jackets[6]. The description of the jackets of all these types were checked for the advertised functionalities (e.g. waterproof, water-repellent, windproof, thermal insulation and breathable). It was found that waterproof and water repellent are mostly used together. The functions 'water-repellent", 'windproof' and 'breathable" always occur in combination with at least one other function.
Material compositions of functional jackets are rarely specified online: while technologies are advertised, the exact fiber content is often unclear. Nonetheless, jackets with water-repellent or waterproof properties appear to be predominantly made of mono-materials such as polyester or polyamide, depending on the price range. Therefore, this study includes both types of mono-fiber materials. Based on this analysis, the product under consideration was defined as a functional jacket having a polyester or polyamide main material and the following functions: waterproof/water-repellent, windproof and breathable.

Upon reviewing the sales volumes and coverage of the prioritised product aspects, it was found that the three sample products – T-shirt, jeans and functional jacket – were suitable. The portfolio analysis provided information about the typical material composition of these product examples. In the end, the following product examples with the following material composition were selected for this study:

- T-shirts: Classic T-shirt 100% cotton; functional T-shirt 100% PES
- Jeans: 95% cotton, 5% elastane
- Functional jacket: 100% polyester or polyamide

[6] Down jackets; Waterproof jackets; Ski & snowboard jackets; Insulation jackets; Softshell jackets; Windbreaker; 3-in-1 jackets; Winter jackets; Shell jackets; Outdoor jackets; Transition jackets; Mountaineering jackets; Hunting jackets; Cycling jackets; Nuptse & puffer jackets; Trekking jackets; Rain jackets

4 Durability[7]

The product aspect of durability is not a new concept for more sustainable clothing but was a central element of sustainable resource use until the 20th century. Since the 1970s, the relocation of textile production to low-wage countries and the rise of 'fast fashion" have led to mass production and rapid consumption - the importance of durability has largely been lost. Today's prevailing linear 'make-take-dispose" economic model leads to drastically shortened life cycles of clothing and a massive increase in the volume of used clothing in the European Union (EU), with considerable negative effects on the environment (Duhoux et al. 2022; European Commission 2022b; Gimkiewicz 2022).

With the ESPR, the product aspect of durability is once again becoming the centre of attention and is experiencing a renaissance in the current sustainability debate. In Article 2, the ESPR defines durability as '*the ability of a product to maintain over time its function and performance under specified conditions of use, maintenance and repair* (European Parliament; European Council 2024b)". In line with this renewed focus, the ESPR names textiles as a prioritized product group. Most likely textiles will be addressed as one of the first products groups in a delegated act. Furthermore, a ban on the destruction of unsold apparel, clothing accessories, and footwear is already included in the legal text.

To drive the aim of the EU Strategy for Sustainable and Circular Textiles of extending the product lifetime of apparel (European Commission 2022b), a delegated act must define measurable requirements in the future. In order to set minimum requirements for durability, however, the question arises as to how durability can be defined for clothing, which criteria can be used to measure whether relevant functions are fulfilled, and which thresholds are appropriate.

4.1 Description of the starting point and the status quo

To address these questions, Chapter 4.1 provides an overview of the current approaches to assessing durability in the scientific literature (4.1. (Duhoux et al. 2022)1) and textile industry (4.1.2). The conceptual understanding of this study is then presented based on a definition of the concept of durability (4.1.3).

4.1.1 Product aspect durability: environmental potential, definition and influencing factors used in science

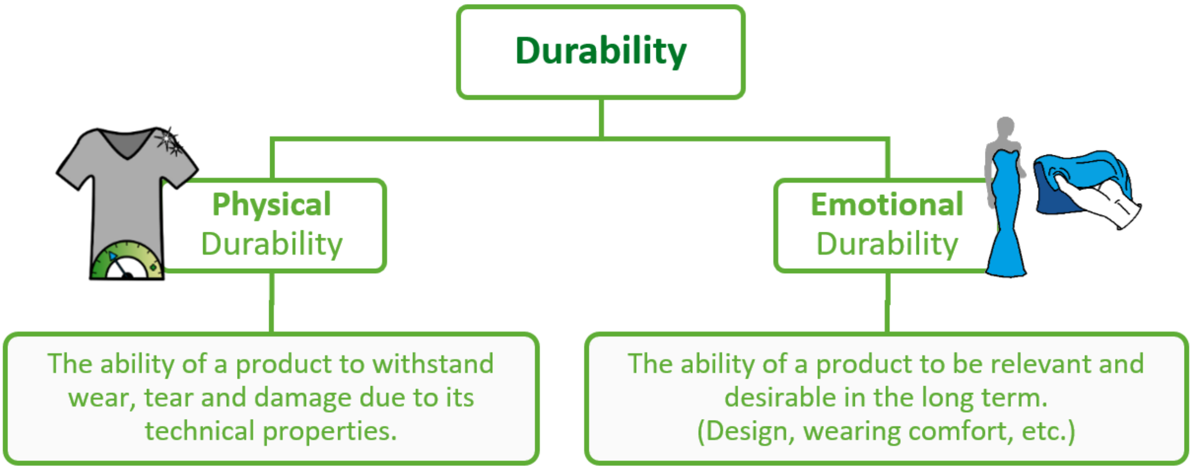
The EU textile strategy regards extending the lifespan of textiles as the most effective lever for reducing their environmental impact (European Commission 2022b). Several studies have also come to this conclusion. For example, Schmidt et al. (2016) found that extending the lifespan of a product can have a 6- to 50-fold climate benefit compared to recycling the same product - depending on the fibre type and recycling process (Schmidt et al. 2020; Schmidt et al. 2016). Cooper et al. (2013) estimated that extending the lifespan by an additional nine months can reduce the carbon, water and waste footprint by 20–30 % (Cooper et al. 2013). Even an extension of just three months leads to a reduction of eight to ten percentage points (Bauer et al. 2018; Gray 2017). Given the average lifespan of clothing is three to almost four years (Wrap 2017; Drycleaning Institute of Australia Ltd 2015), three months represents a modest increase. This data proves that durability makes a significant contribution to the ecological sustainability

7 This chapter was written by Marie Christine Reuters, Malina Lumpp and Maike Rabe from the Institute for Textile and Clothing (FTB) of Hochschule Niederrhein, University of Applied Sciences, Mönchengladbach.

of the textile industry - and thus becomes a key lever for future ecodesign requirements (Köhler et al. 2021).

In science, a distinction is made between two types of durability (Wrap 2017; Drycleaning Institute of Australia Ltd 2015): *physical durability* (also known as material, technical or functional durability), and *emotional durability*. The following figure shows the definitions.

Figure 7: Dimensions of durability



Source: Own work, Hochschule Niederrhein, based on (Wrap 2017).

Physical durability of textiles refers to the measurable resilience of materials and product construction, typically assessed through standardized tests (e.g. abrasion resistance, colour fastness). *Emotional durability*, in contrast, refers to the subjective, often unpredictable longevity of emotional attachment between user and garment. It influences whether and how long a garment is used, independent of its physical condition.

Fundamentally, the conditions for durability are established at the beginning of a product's life cycle. Yet, available data show large variations in actual use duration - not only between product types (e.g., underwear vs. jackets), but also across user groups, countries, and demographics. Consequently, there is no uniform benchmark in literature for what constitutes a 'reasonable" lifespan for textile products.

Regarding reasons for clothing disposal at the 'end of life", the often-cited wardrobe study *Making Clothing Last* by Laitala et al. (2015), which involved 16 Norwegian households, identified seven overarching reasons for clothing disposal: changes in garment, issues with size and fit, taste related unsuitability, situational factors, functional shortcomings, changes in fashion or style, and other reasons. In the 2nd milestone report, the JRC preparatory study (Delre et al. 2024a) distinguishes three main reasons, based on scientific research findings:

1. The loss of intrinsic product performance over time,
2. A change in the perceived value of the garment, and
3. Changes in the user's body shape over time, resulting in an improper fit.

However, the relevance of product wear and tear compared to changes in fashion, style or size and fit issues varies depending on the study group (Laitala 2014). Therefore, studies arrive at a different weighting for reasons for disposal as to why a product is discarded at the end of its product life cycle. Ungerth and Carlsson (2011) estimate that around 60% of discarded items of clothing are thrown away due to quality defects.

While the assumption that increased physical durability leads to longer use is widely accepted in the scientific literature, explicit empirical evidence supporting this relationship is limited. Workshop participants have critically noted this gap, emphasizing that many garments are discarded before their physical end-of-life is reached and that there is no proven link between improved physical durability and longer usage by consumers.
Addressing this issue, Bauer et al. (2018) suggest that increased quality could support reuse and the European Commission (2014b) assumed that reuse can lead to a 50% extension in service lifespan.

Nevertheless, in order to unlock the environmental potential of durability it is essential that physically durable clothing actually is used to the full extent of its service lifespan - either by the original user or others. In a circular textile economy, as envisioned by the European Commission, this also means garments must be suitable and attractive to multiple users beyond the initial owner (Bauer et al. 2018). The key enabler for this is the preservation of both physical durability (i.e. the garment is still intact and wearable) and emotional durability (i.e. it is still considered desirable). Yet the rise of fast fashion is driving consumer habits in the opposite direction, indicating an increasing intensity of use over the last years (Gimkiewicz 2022). This highlights the importance of emotional durability, as it is considered key to addressing the subjective factors that lead to clothing disposal.

Conclusion

Durability is a complex concept that includes both physical and emotional dimensions. Due to the wide range of items of clothing and use cases, combined with the subjective nature of consumer behaviour, a single benchmark for measuring durability is not feasible.

The next chapter 4.1.2 therefore focuses on practices and challenges from a practical perspective.

4.1.2 Durability in the textile industry: Practices and challenges

Although a legally binding two-year legal guarantee for conformity applies to textiles - as it does for all products placed on the European market (European Parliament; European Council 2019a) - this guaranteed period does not reflect the technical lifetime or actual useful service lifespan of clothing. Currently, there is no standardized or industry-wide method to verify this legally binding guarantee period before the product is brought to market. As noted by Gimkiewicz (2022) in a study for the German Environment Agency (UBA), the lack of sector-wide standardization for textile durability contributes significantly to the inconsistent understanding and application of the concept across the industry. The two-year legal guarantee period could serve as a starting point for the longevity of clothing. Clear durability requirements under the ESPR could close this gap by clarifying the concept of durability (i.e., equivalently, the absence of defects) for the first time across the EU: Minimum durability parameters would define when a product is considered durable, and any new item failing to meet these thresholds could be classified as deficient. In the context of the legal guarantee of conformity, objective standards would make the burden of proof clearer, benefiting both companies and consumers.

The concept of 'durability" itself is interpreted very differently across textile companies and product categories (Wrap 2015). A unified and legally binding definition, that clarifies whether durability refers to technical, functional, or aesthetic longevity, is still missing. This conceptual vagueness is an obstacle to regulation and comparability.

Despite the lack of binding regulations, quality assurance is generally considered important within the textile industry. In practice, however, durability-related requirements are rarely mandatory and differ significantly across companies and product segments. These requirements are usually embedded in internal quality management systems and defined through voluntary self-regulation (Gimkiewicz 2022).

The scope and rigor of these measures depend largely on the market segment and business model. For instance, higher standards are often applied in babywear or outdoor clothing due to functional demands and consumer expectations. In contrast, everyday fashion - especially fast fashion - typically prioritizes rapid product turnover over product longevity. In such cases, quality assurance may be reduced or bypassed entirely (Marian 2013), and products are sometimes sold despite failing internal quality tests. Cooper et al. (2014) found that early wear and tear is frequently attributed to consumer misuse rather than manufacturing flaws (Cooper et al. 2016).

Legal durability requirements exist primarily in safety-relevant sectors, such as personal protective equipment. In these cases, minimum standards must be met before market entry. Similarly, some segments - such as workwear or outdoor apparel - actively communicate durability claims, even though these are not always legally mandated.

Sustainability-oriented brands distinguish themselves by deliberately focusing on product longevity. Their strategies include the use of high-quality materials, offering repair services, and transparent communication around expected lifespans (Gimkiewicz 2022). While promising, such approaches remain the exception in a market still dominated by trend-driven consumption. Nonetheless, pilot projects show the innovation potential of circular product concepts, even though they are not yet widely established.

According to the literature review, the implementation of binding durability requirements faces several structural challenges, that are summarised in the following table:

Table 4: Challenges of the implementation of binding durability requirements

Challenge	Description
Lack of a clear definition of ‘durability”	A unified, legally recognized definition is missing - it remains unclear whether technical, functional, or aesthetic aspects are meant.
Absence of mandatory standards	Various test methods exist, but their application is voluntary.
Product and material diversity	Different materials and product categories require specific durability definitions and testing methods.
Complex supply chains	The multitude of actors and lack of transparency make consistent quality assurance difficult.
Market logic and business models	In trend-driven markets, durable products are not always economically prioritized.

Challenge	Description
Unclear consumer expectations	Varying usage demands, care behaviour, and price expectations complicate the comparability of durability claims.
Regulatory uncertainty	Without binding requirements, companies lack clear guidance on implementation.

Source: Own work, Hochschule Niederrhein, based on (Gimkiewicz 2022; Oeko-Institut e.V. 2023).

Despite these challenges, existing industry standards and ecolabels already provide useful reference points for developing measurable durability criteria, for example:

- **Quality standards** from trade and industry associations such as the Dialog Textil-Bekleidung (DTB) (2006), the Dutch trade association for fashion, interior design, carpets and textiles (Modint) and GermanFashion Modeverband Deutschland e.V. (2018) contain product group and partly material-specific 'minimum quality requirements" with test standards and concrete minimum requirements. Despite or perhaps because of its age, the DTB standard is still widely used as a reference. The Association Internationale de la Savonnerie, de la Détergence et des Produits d'Entretien, A.I.S.E. (2023) has issued recommendations for realistic testing of washing processes, which also includes requirements for colour fastness testing.
- **Ecolabels** such as the Blue Angel (RAL gGmbH 2023a) and the EU Ecolabel (Europäische Kommission 2014) set mandatory, measurable requirements for the 'fitness for use" of textiles. In their criteria, they prescribe specific limit values and test standards for durability aspects such as dimensional changes, colour fastness, pilling resistance or durability of function.
- According to the German Standardization Roadmap Circular Economy (DIN e.V.; DKE; VDI 2023), existing standards currently largely relate to new products or the source material and only partially take aging into account.

Conclusion

Although pioneering examples and voluntary standards already exist, there remains a clear need for binding, measurable, and product-specific durability requirements for textiles. Only on this basis an effective regulation can be established - complemented by transparent communication from manufacturers. Against this background, the present study defines a specific scope that focuses on physical durability, as outlined in the following chapter.

4.1.3 Key dimensions of physical durability in this study

Due to the difficulty of standardizing emotional durability, this study focuses on physical durability. It relates to technical product properties and can generally be quantified using existing test methods - an essential key prerequisite for defining minimum requirements within the framework of the EU textile strategy. Even though emotional durability can make a significant contribution to service lifespan (Bauer et al. 2018b). Therefore, it is essential for the full development of the environmental potential of durability, but it can hardly be measured objectively due to its subjective, psychological nature. According to current studies, it should rather be regulated via information requirements than performance requirements (Gimkiewicz 2022, pp. 41–42; Bauer et al. 2018b).

The European Parliament has therefore called for the research gap on emotional durability and its measurability to be closed, as an EU textile strategy must take longevity into account holistically (Europäisches Parlament 2023). An integration of emotional durability into a future delegated act is therefore not completely ruled out.

The approaches described for quantifying physical durability already indicate that the service lifespan of clothing textiles is influenced by many factors that are related to the specific type of clothing, the inherent physical properties of the product and the behaviour of the user (Delre et al. 2024a).

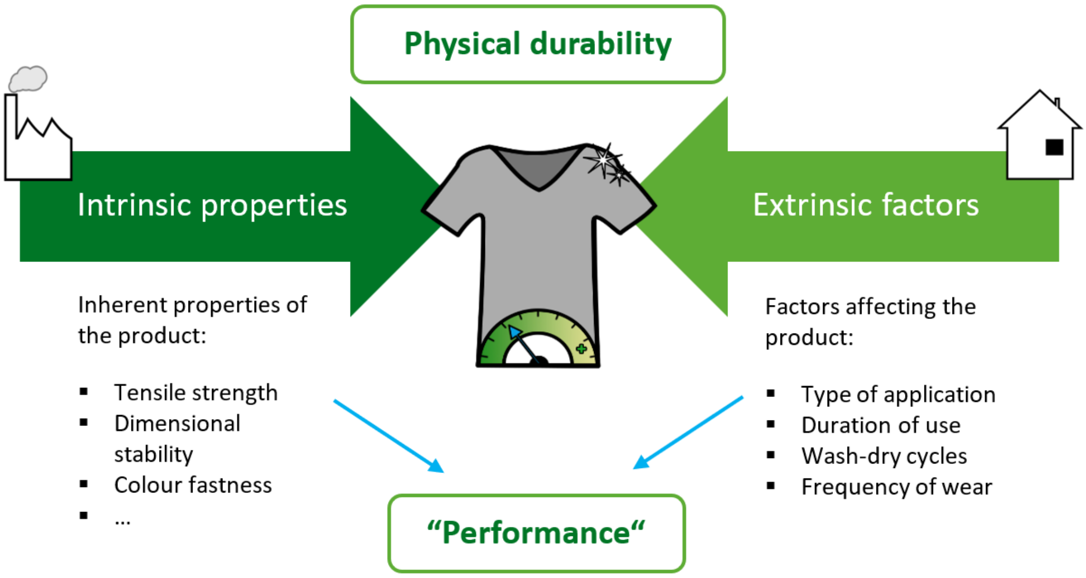
In general clothing aims to fulfil following functions for the wearer (Eberle et al. 2014):

- Suitability
- Appearance
- Stability
- Comfort
- Aftercare

The extent to which clothing maintains the fulfilment of these requirements over time depends not only on the subjective perception of the wearer but also on the properties of the clothing itself and the external influences during use.

For a uniform understanding of the term in the context of this study, the physical durability of a product is considered as ‘performance”. The term performance includes on the one hand, the *intrinsic properties*, and on the other hand, the *extrinsic factors* resulting from the use phase (see Figure 8). The combination of these two dimensions offers a more comprehensive view of physical durability, especially given the current lack of standardized methods for testing their interrelation and fully assessing durability.

Figure 8: Physical durability



Source: Own work, Hochschule Niederrhein.

Intrinsic properties refer to the physical and measurable inherent properties of the product, such as wear resistance or colour fastness. These properties result from aspects like material composition, textile production processes, and garment construction and define the prerequisites for durability. Thus, intrinsic properties are directly related to resistance to wear and tear. Extrinsic factors, on the other hand, refer to stresses placed on the product during its use.

The JRC also differentiates between intrinsic and extrinsic dimensions of durability. However, the latter is primarily understood as the emotional attachment of consumers (Delre et al. 2024a). A reference to the understanding of this study is that, according to the JRC preparatory study, laundry care also influences the 'perceived quality". As with this study, the emotional dimension of durability is outside the scope of the ESPR for the JRC, but is considered in the JRC's analysis of the product aspect of environmental impact due to its importance to longevity (Delre et al. 2024a).

Conclusion

This study differentiates between intrinsic properties and extrinsic factors which together give a holistic picture of durability - the performance of a product. However, there is a difference to be made between the technical lifetime of a product and the actual useful life. An absolute durability does not exist as it is influenced by many factors. Thereby also the actual useful life of two similar products can vary greatly. Therefore, this study is focussing on a relative durability to achieve a good approximation.

As there are no standardized procedures for the development of target-oriented minimum durability requirements, a new procedure must be developed. For this reason, the procedure used in this study to include intrinsic properties and extrinsic factors of physical durability in the definition of the product aspect of durability is presented in Chapter 4.2.

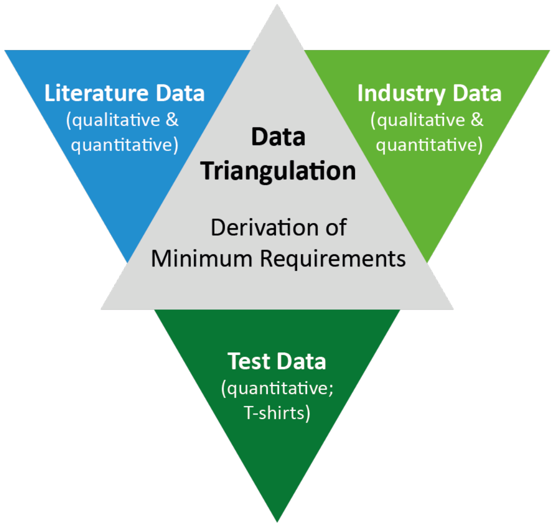
4.2 Considerations in relation to the product aspect and derivation of the requirement

Chapter 4.2 outlines the key considerations of this study in addressing the challenges of fully describing physical durability. The following section first explains the underlying methodological approach. Building on this, the subsections (4.2.1 and 4.2.2) present the findings related to intrinsic properties and extrinsic factors, as well as aspects of comfort (Chapter 4.2.3) and performance testing (Chapter 4.2.4).

Methodological approach

Based on the overarching methodology and the status quo described in Chapter 4.1 the methodological approach for assessing intrinsic properties, extrinsic factors, and performance was selected. The overarching methodology, a data triangulation combining qualitative and quantitative methods (see Figure 9), was then applied to these aspects and adapted as described below. This methodology allows for an analysis of the product aspect of durability that incorporates multiple perspectives and enables validation of the results.

Figure 9: Data triangulation for deriving minimum requirements



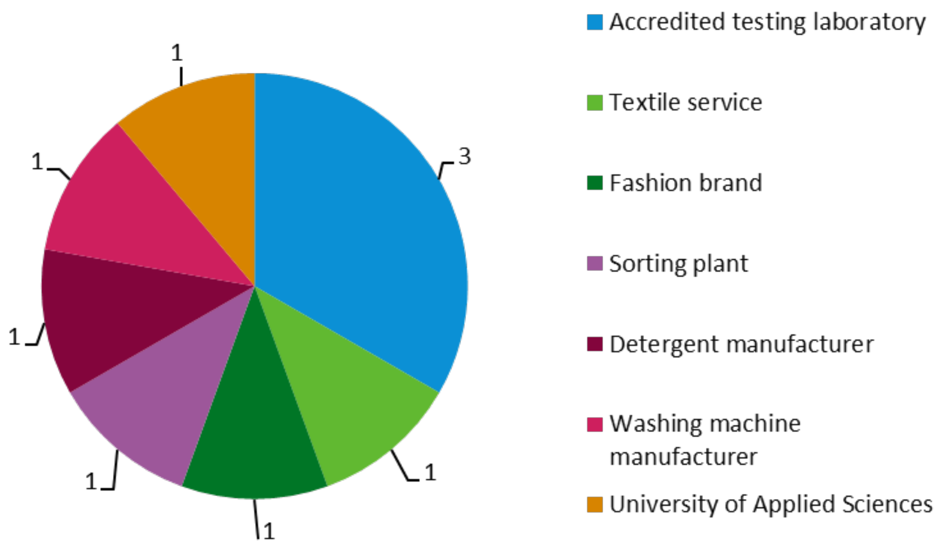
Source: Own work, Hochschule Niederrhein, based on Lumpp (2025), p. 22.

a) Intrinsic properties

Literature research was carried out on test methods and corresponding value corridors. The resulting literature data was systemised in the form of a table (see the results in Annex A.2), which was used to create a questionnaire

In addition to the workshop series, industry surveys were conducted using the prior prepared questionnaire to collect industry data (Annex B.1). To further refine and prioritise the most relevant intrinsic properties, expert interviews were conducted to discuss and validate the survey findings. The experts were selected considering different stakeholder perspectives, as the questionnaire was primarily aimed at fashion brands. Figure 10 provides an overview of the stakeholder groups to which the interviewed experts are assigned.

Figure 10: Overview of the interviewed experts (n=9)



Source: Own work, Hochschule Niederrhein.

b) Extrinsic factors

Literature research was carried out to compile additional literature data on customers' usage and washing behaviour. In addition, industry data were collected through discussions on extrinsic factors during the workshop series and through interviews with the same experts who had contributed to the assessment of intrinsic properties, focusing on washing parameters.

c) Performance testing

Based on the consolidated findings from the literature review and expert input, suitable test methods for assessing product performance were selected for experimental investigation, with the aim of generating test data. To account for extrinsic factors, washing cycles were used to simulate the use phase.

From the product examples defined for this study, classic T-shirts made of 100% cotton were chosen for the experimental investigation of the product aspect of durability.

For the classic T-shirt, performance requirements were derived by triangulating experimental results with literature and industry survey data, ensuring validation of the findings. In contrast, performance requirements for jeans and functional jackets were based on literature, industry survey and workshop results, and expert input, supplemented by insights transferred from the experimental T-shirt analysis. While intrinsic properties and extrinsic factors were considered for these products, no experimental testing was conducted to validate the derived requirements.

4.2.1 Intrinsic properties

According to the literature, most intrinsic properties, such as tensile strength, dimensional stability or colour fastness, can be quantified and tested using existing standardized textile testing methods (Gimkiewicz 2022; Van de Burgt et al. 2023; Maes et al. 2021; Bauer et al. 2018). Intrinsic properties of the textiles in these test methods depend on:

- Fiber characteristics (type, fineness, strength) and material composition

- Yarn structure
- Fabric construction and mass per unit area
- Finishing
- Confectioning

Although the status quo indicates that most reasons for no longer using the product are highly subjective and wearer-dependent, physical defects in garments can be objectively addressed by improving their durability. In this context, Cooper and Claxton (2022) analysed the most frequent causes wear and tear on 1,476 used garments donated to UK charities that were deemed unsuitable for resale in the UK. Their findings indicate that pilling and colour changes exert a considerable influence across all product categories (see Table 5). This data also shows that the causes of wear and tear vary by product category, potentially reflecting associated differences in typical fabric structures.

Table 5: Main types of garment failure

Category of wear and tear	Type of garment failure	Frequency of problems recorded (% of 1,476 items)	Affected product groups
Fabric surface-related	Pilling	55	Cardigans, T-shirts
Colour-related	Colour fading	53	Cardigans, T-shirts, shirts, jeans, jackets
Fabric surface-related	Fabric breakdown	29	Shirts, formal trousers
Fabric surface-related	Accidental damage	29	Jeans
Fabric surface-related	Loss of dimensional stability	20	Cardigans, T-shirts
Logo-related	Logo failure	16	T-shirts
Colour-related	Discolouration	15	Shirts
Fabric surface-related	Hole(s) in seams	14	Jeans, formal trousers, jackets
Fabric surface-related	Trim failure	8	No specific product group assigned

Source: Own work, Hochschule Niederrhein, based on Cooper and Claxton (2022).

According to the French MTE Regulation (MTE 2022), the OVAM[8] study (Maes et al. 2021), and the workshop held by Oeko-Institut e.V. (2023), the following aspects play a key role in durability:

Table 6: Most relevant aspects of physical durability according to the literature

Product example	Test criteria	Relevant Aspects
T-shirts	Shape retention	Dimensional stability to washing
T-shirts	Colour fastness	Colour fastness to washing and perspiration
T-shirts	Wear resistance	Pilling resistance, bursting resistance (for very lightweight fabrics, if applicable)

[8] The Openbare Vlaamse Afvalstoffenmaatschappij Flanders (OVAM) is the public waste management authority for the Flanders region (Belgium).

Product example	Test criteria	Relevant Aspects
T-shirts	Appearance	Spirality after laundering
Jeans	Shape retention	Dimensional stability to washing
Jeans	Colour fastness	Colour fastness to light
Jeans	Wear resistance	Abrasion resistance (Martindale), tear strength (trouser tear test), seam strength
Jeans	Functional durability	Strength of zippers, tear-out resistance of eyelets and buttons
Jeans	Appearance	Visual condition after washing and drying
Functional jackets	Wear resistance	Abrasion and pilling resistance (for delicate fabrics)
Functional jackets	Functional durability	Water repellency / protection against rain (for rain jackets)
Functional jackets	Appearance	Visual condition after washing and drying

Source: Own work, Hochschule Niederrhein, based on Oeko-Institut 2023; MTE 2022; Maes et al. 2021.

The comparison of this data with the empirical findings of Cooper and Claxton (2022) demonstrates that end-of-life data aligns well with the recommendations from the literature. Therefore, the results of the literature research can serve as indicators for defining priorities in product-specific intrinsic properties. Building on this, existing test standards were analysed to identify the most relevant corresponding test methods and their respective minimum value for the three product examples.

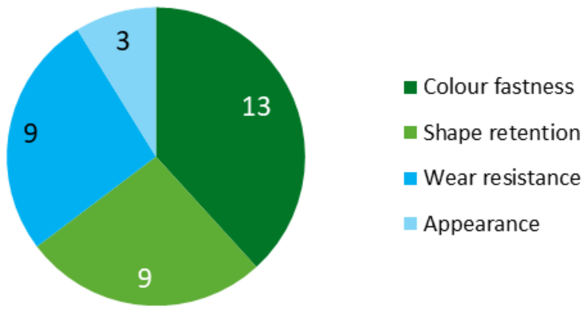
Existing test standards identified in the literature

The literature provides a total of 76 different test standards that relate to the intrinsic properties of textiles and could therefore be suitable for measuring durability (Lumpp 2025), see Annex A.2). These standards can be divided into six main categories:

- Shape retention
- Colour fastness
- Wear resistance
- Appearance
- Functional durability
- Odour

An analysis of the distribution of test standards reported in the literature for T-shirts (see Figure 11) reveals a strong focus on colour fastness, whereas appearance-related tests are currently underrepresented.

Figure 11: Distribution of existing test standards to sub-aspects of the physical durability of T-shirts (n=34)

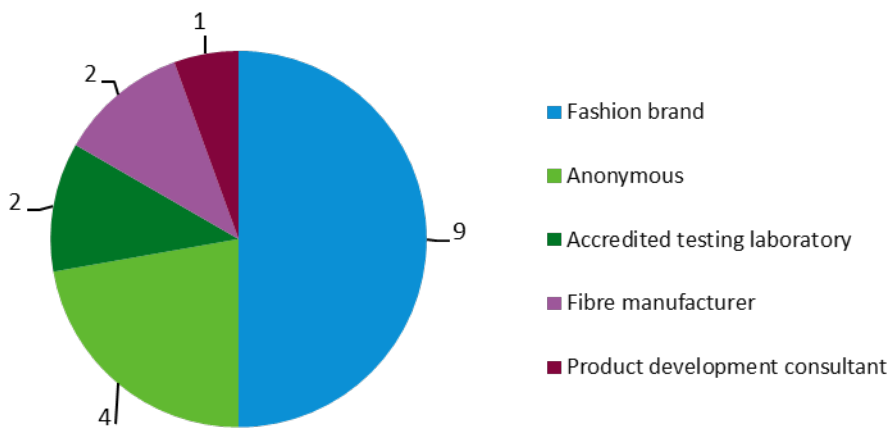


Source: Lumpp (2025), p. 55.

Established testing standards in the textile industry

The following results derive from a questionnaire distributed to a total of 350 member companies of the GermanFashion association, as well as to the participants of the workshops conducted within this study. The questionnaire, developed based on the findings of the product-specific literature review for the three product examples (T-shirt, jeans, and functional jacket), included a tabular overview of durability aspects and corresponding minimum requirements, presented as specific values or value ranges identified in the literature. The aim was to assess their relevance and applicability from an industry perspective (rating). In addition, participants were asked to rank the most relevant test methods (ranking; see questionnaire in Annex B.1). In total 18 participants filled in the questionnaires, with 16 responding to the T-shirt survey, 14 to the jeans survey, and 11 to the functional jacket survey, depending on their area of expertise (see Figure 12).

Figure 12: Overview of the survey participants (n=18)



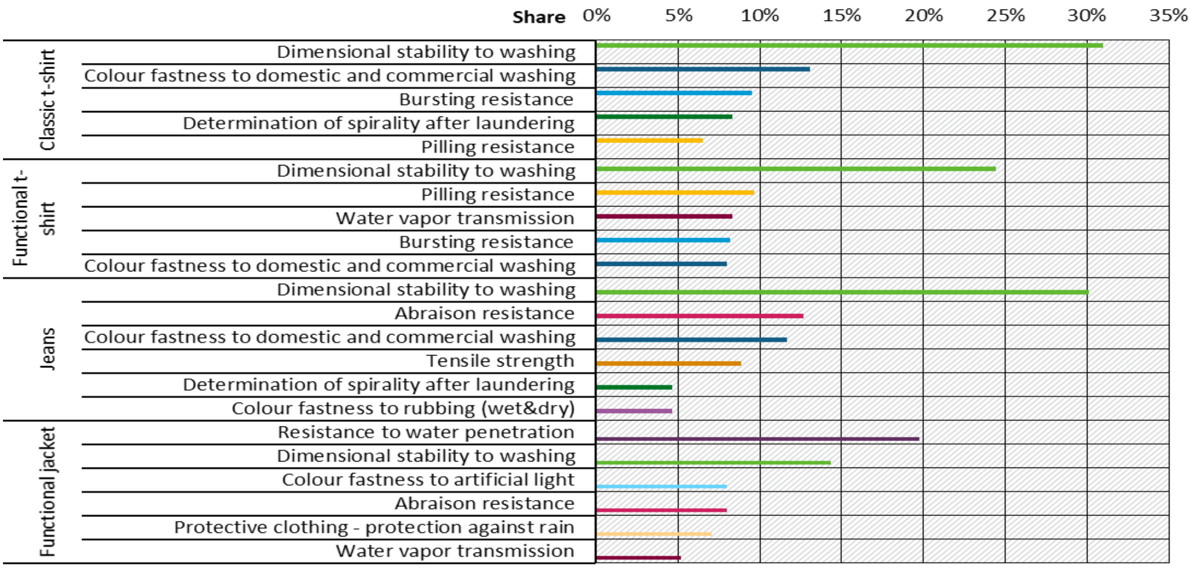
Source: Own work, Hochschule Niederrhein.

Since some participants just answered to the rating and others only to the ranking, the number of participants may differ from the total number of participants. Due to the low number of respondents, the results cannot be considered representative; however, the wide range of perspectives still contributed to meaningful insights.

The results from the industry survey show that nearly all testing standards (71 out of 76) identified in the literature are applied in practice by the surveyed brands and testing institutes. The frequency varies but basically reflects the distribution of the test standards across the sub-aspects: while colour fastness tests are widespread, visual appearance seems to play a secondary role in quality assurance.

Figure 13 presents an overview of the most relevant aspects for each product group, based on the survey results. The percentages indicate the relative importance of the durability aspects as ranked by the participants (classic T-shirt n=14, functional T-shirt n=13, jeans n=14, functional jacket n=11). The aspects were weighted according to their assigned rank and calculated as a proportion of the total number of ranking points given.

Figure 13: Most relevant aspects of physical durability for four different product types (Classic T-shirt n=14, functional T-shirt n=13, jeans n=14, functional jacket n=11)



Source: Own work, Hochschule Niederrhein.

The survey confirms that the participants have different perceptions of durability and of the most important criteria. After the top-ranked criteria (each named by 20–30% of participants), the number of mentions drops significantly. Despite differences, the comparison of key aspects indicates alignment between literature and practical data across all three product types:

- **T-shirts:** For the classic T-shirt, there is a high level of agreement; the only inconsistencies concern light fastness (rank 6) and bursting resistance. While bursting resistance was ranked highly, it was frequently mentioned as irrelevant in the comments. For the functional T-shirt, the results are less distinct: after dimensional stability to washing, no single aspect clearly stands out. However, the comparison between the two may confirm that fibre type and usage scenario influence the relevance of durability aspects - even within the same product group.

- **Jeans:** Spirality after laundering is not mentioned in the literature but considered relevant by the survey participants. Colour fastness to light, did not make it into the top five and is considered less important by the participants, whereas colour fastness to rubbing shares fifth place with spirality after laundering. For visual appearance, bleeding wasn't ranked as a minimum requirement, since it is characteristic of jeans.

- **Functional jacket:** As for all functional products, functional durability (e.g. rain resistance) is key in order to maintain the fitness for its purpose. Dimensional stability to washing is considered relevant by the survey participants, though not reflected in the literature.

In comparison with the findings of Cooper and Claxton (2022) (see Table 5), it becomes clear that quality assurance often targets product-specific causes of wear and tear to prevent complaints. This suggests that the surveyed durability aspects directly address frequent weak points in specific products and could effectively contribute to extending product lifespans. Accordingly, the highest-ranked aspects were integrated into the proposal for minimum requirements, despite differing assessments of their relevance among the survey participants. An exception is the occurrence of holes in seams in jeans and jackets, as recorded by Cooper and Claxton. Even though seam strength is emphasised by the JRC preparatory study for these product groups, this aspect was neither highlighted in the literature nor confirmed by the survey results. As a result, it was excluded from the proposal for minimum requirements. An exception is the occurrence of holes in seams found in discarded garments: These were not considered more relevant than the aspects listed above, neither in the literature nor in practical application. Even though seam strength is emphasised by the JRC preparatory study for jeans and jackets (Delre et al. 2024a), this was not confirmed by the survey results based on literature and practical data.

Regarding the results of the ranking, the survey as well as workshop participants emphasize that the identified aspects should not be assessed in isolation or interpreted as a strict hierarchy. Rather, durability is understood as the outcome of the interaction between various intrinsic characteristics. According to the experts, the following three general groups of properties should be considered to measure the intrinsic properties of clothing:

1. Physical properties
2. Colour properties
3. Specific appearance-related properties

Since the ranked aspects for each product example cover all of these groups, this further supports their relevance for measuring physical durability.

Minimum requirement level and thresholds

The selection of appropriate test methods for the identified durability aspects was based on their use in the textile industry, as indicated by the survey results. This approach ensures that the selected standards are not only suitable for quantifying the respective aspects, but also easy to implement in industry practice, as they seem to be already established.- Nevertheless, the presence of multiple standards addressing the same durability aspect will pose a challenge for the introduction of a unified industry standard within the framework of a future delegated act.

The following tables summarize the survey participants' assessments of the literature-based minimum requirements for the most relevant product-specific aspects of durability (see Table 7, Table 8, Table 9). The aspects are ordered according to their relevance as indicated by the ratings (T-shirts n=15, jeans n=12, functional jacket n=11). The first two columns show the test methods and the corresponding requirement levels found in the literature (literature data), while the third column presents the participants' ratings (industry data). The ratings were summed for each aspect, with the total indicated in the respective cells. A rating of 0 indicates that the proposed value is considered sufficient; + respectively ++ indicate the value should be stricter; and - respectively -indicate the value should be less strict.

T-shirts

Table 7: Survey results for the most relevant durability aspects for T-shirts (classic: 100% cotton, functional: 100% polyester)

Durability aspect Test standard	**Requirements according to literature**	**Rating from a practical perspective (n=15)**					
	T-shirts	**- -**	**-**	**0**	**+**	**++**	**Without rating***
Dimensional stability to washing DIN EN ISO 5077:2008-04	Classic T-shirt: –6% to +5%; Functional T-shirt: ±5%	0	2	6	6	0	1
Colour fastness to domestic laundering DIN EN ISO 105-C06:2010-08	≥ Grade 3.5 (Staining) ≥ Grade 4 (Colour change), ≥ Grade 2.5 for staining in dark colours (Acetate, polyamide), ≥ Grade 4.5 to 5 for strong colour contrasts *Does not apply to products that are neither dyed nor printed.*	0	0	8	4	1	2
Colour fastness to artificial light DIN EN ISO 105-B02:2014-11	≥ Grade 4 to 5 *Exclusion of undyed or unprinted products possible.*	0	1	6	3	0	5
Pilling resistance DIN EN ISO 12945-2:2021-04	125 cycles: ≥ grade 3.5 to 4, 500 cycles: ≥ grade 3 to 3.5, 1,000 cycles: ≥ grade 2.5 to3, 2,000 cycles: – *or* ≥ grade 3, 5,000 cycles: – *or* ≥ grade 2.5, 7,000 cycles: – *or* ≥ grade 2.5	0	1	2	4	1	7
Bursting resistance DIN EN ISO 13938-2:2020-03	Classic T-shirt: ≥ 200 kPa Functional T-shirt: ≥ 200 to 330 kPa *7.3 cm² perforated plate*	1	1	5	1	0	7
Spirality after laundering ISO 16322-3:2021-04	≤ 5%	0	0	7	1	0	7

* Here, it was stated that the aspect or standard is applied in practice, but no assessment of the associated minimum literature requirements was carried out in the survey.

Source: Lumpp (2025), p. 69-72.

Jeans

Table 8: Survey results for the most relevant durability aspects for jeans (95% cotton, 5% elastane)

Durability aspect Test standard	**Requirements according to literature**	**Rating from a practical perspective (n=12)**					
	jeans	**- -**	**-**	**0**	**+**	**++**	**Without rating***
Dimensional stability to washing DIN EN ISO 5077:2008-04	±3%, –5% to +2% for ≥ 60% viscose	0	1	8	1	0	2
Abrasion resistance DIN EN ISO 12947-2:2017-03	-– *or* ≥ 20,000 to 30,000 cycles regardless of mass per unit area *9 kPa nominal pressure*	0	1	3	1	0	7
Abrasion resistance DIN EN ISO 12947-2:2017-03	– *or* Mass per unit area > 340 g/m²: ≥ 30,000 cycles, Mass per unit area < 340 g/m²: ≥ 18,000 cycles	0	0	1	0	1	10
Colour fastness to domestic laundering DIN EN ISO 105-C06:2010-08	– *or* ≥ Grade 3.5 (Staining), ≥ Grade 4 (Colour change), ≥ Grade 4.5 for strong colour contrasts	0	1	7	0	1	3
Tensile strength and Elongation DIN EN ISO 13934-1:2013-08	Full fit: ≥ 250 N, 12.5% to 55%, Tight fit: ≥ 300 N, 12.5% to 35%	0	1	2	0	1	8
Colour fastness to dry rubbing ISO 105-X12:2016-11	≥ Grade 3 to 4 (Staining and colour change) *Does not apply to products that are neither dyed nor printed.*	0	1	6	2	0	3
Colour fastness to wet rubbing ISO 105-X12:2016-11	– *or* ≥ Grade 2 to 3 (Staining), ≥ Grade 4 (Colour change)	0	0	3	2	0	7
Elasticity of fabric DIN EN ISO 20932-1:2022-02	[No proposed requirements]	0	0	0	0	0	12
Spirality after laundering ISO 16322-3:2021-04	≤ 5%	0	1	3	3	1	4

* Here, it was stated that the aspect or standard is applied in practice, but no assessment of the associated minimum literature requirements was carried out in the survey.

Source: Own work, Hochschule Niederrhein.

Functional jacket

Table 9: Survey results for the most relevant durability aspects for functional jackets (100% polyester or polyamide)

Durability aspect Test standard	**Requirements according to literature**	**Rating from a practical perspective (n=11)**					
	functional jacket	**- -**	**-**	**0**	**+**	**++**	**Without rating***
Water repellency DIN EN ISO 4920:2012-12	≥ Grade 3 to 4 after five domestic wash-dry cycles at 40 °C and indication of care instructions to maintain function	0	0	4	0	1	6
Water repellency DIN EN ISO 4920:2012-12	≥ Grade 4 ((90) ISO 4)	0	0	4	1	0	6
Water repellency DIN EN ISO 4920:2012-12	New product: ≥ Grade 5 ((100) ISO 5), After laundry care: ≥ Grade 3 ((80) ISO 3)	0	0	4	1	0	6
Water proofness ISO 811:2018-08	≥ 80 to 130 mBar, *or* ≥ 1,300 mm water column	0	2	1	2	3	3
Water proofness EN 343:2019-06	≥ 80 mBar bis 130 mBar	0	0	0	1	1	9
Dimensional stability to washing DIN EN ISO 5077:2008-04	*– or* ±3%, for ≥ 60% viscose: –5% to +2%	0	0	8	1	1	1
Colour fastness to artificial light DIN EN ISO 105-B02:2014-11	≥ Grade 4 to 5, ≥ Grade 3 for neon colours, Linings: ≥ grade 4	0	1	8	1	0	1
Abrasion resistance DIN EN ISO 12947-2:2017-03	*– or* ≥ 16,000 to 25,000 cycles, Linings: ≥ 10,000 cycles *9 kPa nominal pressure*	0	0	2	2	1	6
Water vapor permeability ASTM E 96:2024	*– or* > 3,000 g/m²/24h	0	1	3	0	1	6
Tensile strength and elongation DIN EN ISO 13934-1:2013-08	Jackets: ≥ 200 N, 12.5% to 40%, Coats: ≥ 200 N, 12.5% to 55%, Anoraks/sportswear:** ≥ 250 N, 12.5% to 55%, Linings: ≥ 180 N (close-to-body) to 220 N (twill), 7.5% to 32.5%	0	0	1	1	2	7

*: Here, it was stated that the aspect or standard is applied in practice, but no assessment of the associated minimum literature requirements was carried out in the survey.

Durability aspect Test standard	Requirements according to literature	Rating from a practical perspective (n=11)
**: The requirements are taken from the DTB standard. Here it is not clearly defined which category functional jackets fall into. Therefore, all three categories were included in the questionnaire and evaluated by the respondents.		

Source: Own work, Hochschule Niederrhein.

As shown in Table 7, Table 8 and Table 9 the evaluation suggests that internal company standards for quality assurance are generally set higher than the minimum values recommended in the literature. Insights from the workshop indicate that this is primarily intended to prevent customer complaints and to reliably meet label specifications. However, there is general agreement among the workshop participants that minimum requirements under a future delegated act should initially be set at a lower level to guarantee feasibility.

Conclusion

The analysis shows that durability requirements must not only be product group-specific, but also be tailored to the individual product and its use scenario. For products frequently worn close to the body, like T-shirts and jeans, dimensional stability during washing and drying is considered essential. For functional clothing, such as rain jackets or performance T-shirts, the maintenance of functional properties is critical to durability, as their loss often marks the end of use - even if the product remains physically intact. Workshop and survey participants, as well as the interviewed experts, also emphasize the importance of material-related influences on intrinsic properties and propose differentiated requirements based on fibre type (e.g. viscose), fabric construction (knitted vs. woven), or fabric weight (e.g. for jeans). This differentiation between fibre type is also considered in the proposed categorisation (see Chapter 3.2).

According to experts' opinion and the durability definition used in this study (see Chapter 4.3.1), the physical durability and suitability of the minimum requirements can only be fully assessed when extrinsic factors are taken into account. The following chapter therefore details the considerations for including these extrinsic factors in the minimum durability requirements.

4.2.2 Extrinsic factors

In contrast to intrinsic properties, the extrinsic factors are more difficult to quantify as they strongly depend on the individual behaviour of the user. The status quo showed that the following extrinsic factors influence both the selection of durability measurements and the associated minimum values:

- Product groups
- Intended use / function
- Individual usage and laundry care habits

Table 10 presents literature data on aspects such as service lifespan, total days of wear, wash-dry cycles or days of wear per wash. This data indicates that there is no consensus on how long products actually last and what constitutes an appropriate benchmark for a 'durable" item of clothing.

Table 10: Extrinsic factors in the literature for T-shirts (t), jeans (j) and functional jackets (f)

Unit	Gray et al. (2022)	Laitala and Klepp (2020)	Laitala et al. (2018)	Wrap (2017)	Drycleaning Institute of Australia Ltd (2015)
Service life (in years)	t: 4.0 j: 4.1 f: 6.1 (non-padded jacket), 5.4 (padded jacket)	t: 4.6 j: 3.5 f: 6.8	t: 3.3-6.8 (average 4.6) j: 2.5-4.3 f: 4.0-11.5 (average 6.8)	t: 4.5 j: 4.0 f: –	t: – j: 2.0-3.0 f: 2.0-3.0
Total days of wear (number)	–	–	–	t: 112.5 j: 300.0 f: –	–
Washing cycles (number)	–	–	–	t: 56 j: 30 f: –	–
Days of wear per wash (number)	t: 2.6 wears j: 5.5 wears f: 14.1 wears (non padded jacket), 16.7 wears (padded jacket)	–	t: 1.5 wears j: 5.5 wears f: –	t: 2.0 wears j: 10.0 wears f: –	–

– no data available.

Source: Own work, Hochschule Niederrhein.

The term *extrinsic factors* is often used to describe influences beyond the material or construction of a garment, such as washing habits, frequency of use, or perceived quality. However, a study by Laitala et al. (2018) shows that consumer behaviour regarding the use phase of clothing can vary significantly between member states of the European Union. As a result, many extrinsic factors are highly individual and cannot be reliably controlled or standardized. Therefore, it is advisable to focus on clearly identifiable and testable factors, like washing frequency or washing parameters. The workshop and survey participants also prefer these more specific terms, as they consider the general label *extrinsic* to be imprecise and potentially misleading, since it may blur the line between behavioural influences and measurable aging effects.

The results of the literature research in Table 10 show that only if the service factors are linked with one another they give an indication of the use of a product. For example, the service life alone does not give any indication of the durability of a product as it does not define the intensity of use. On the other hand, only looking at the total days of wear and not knowing the use frequency or service life does not give an indication of how long the product can be of use. As the intensity and ways of wearing and washing is very subjective and varies between the European countries it is difficult to use these figures as a parameter of comparison.

Regarding aging simulation, both the WRAP[9] (Wrap 2015) and ECOS[10] (Botta and Cabral 2021) emphasize that test procedures must realistically reflect product stress over their entire lifespan to adequately assess actual product performance. In both, the scientific literature and the textile industry, tests simulating washing and wearing cycles are generally considered an appropriate approach. These tests examine whether key intrinsic properties - such as pilling, colour fastness, and dimensional stability - are retained after defined levels of stress have been applied to the product. Moreover, standards addressing the intrinsic properties of a textile, such as abrasion resistance, also in a way simulate the wear process.

WRAP (2017) recommends extended procedures based on industry-established wash-wear cycles (e.g. 50 wash cycles for T-shirts, 40 for jeans, and a minimum of 200 hours for wearer trials) (Wrap 2017). Workshop discussions highlighted that wearer trials are especially relevant for garments worn close to the skin, as workshop participants reported that sweat and skincare products, such as sunscreen, can significantly accelerate material aging. At the same time, the participants criticized the applicability of minimum durability requirements for garments worn close to the skin, e.g., T-shirts, underwear, and socks, since individual perspiration can significantly affect material degradation, resulting in a naturally shorter lifespan for these items.

Among the interviewed experts, washing is seen as the most realistic aging process. In contrast, wearer trials are strongly influenced by individual use habits and are also highly time-consuming, which limits their comparability and practical feasibility in testing. Hence, only the wash-dry cycles can be used as an approximate comparable parameter for the extrinsic factors. Further studies also consider washing, more precisely the stress and strain caused by washing, and number of wash cycles within a certain amount of time as relevant parameters for the simulation of use or aging. This is particularly appropriate for T-shirts, where washing frequency is disproportionately high compared to total days of wear (see Table 10), which makes washing the dominant extrinsic factor. It can therefore be assumed that, in everyday use, T-shirts are subjected to more stress from laundering than from wear itself. Thus, wash-dry cycles were selected for further elaborations.

Appropriate number of wash-dry cycles

As wash-dry cycles were identified to be a key extrinsic factor in this test set up, a further literature review was performed to determine suitable numbers of wash-dry cycles and to identify typical parameters influencing the washing process (e.g., time, temperature, chemistry, and mechanical action). Additionally, different test methods simulating textile aging were examined regarding their specified number of wash-dry cycles. The numbers for assessing aging effects in T-shirts, as reported in the literature and supplemented by input from an expert in the textile service sector, are summarised in the following table.

[9] The Waste and Resources Action Programme (WRAP) is a UK-based NGO that promotes circular living, resource efficiency, and sustainable waste management across industries and communities.

[10] The Environmental Coalition on Standards (ECOS) is an international NGO that promotes the integration of environmental aspects into technical standards and political processes.

Table 11: Tests after number of wash-dry cycles for T-shirts

Durability aspect	MTE (2022)/ EU Ecolabel for textiles (Europäische Kommission 2014)/ Blue Angel for textiles (RAL gGmbH 2023a)	Wrap (2014)	Van de Burgt et al. (2023)	Expert (textile service)
No aspect specified	–	T-shirt: 56 jeans: 30 functional jacket: –	–	–
Dimensional stability	3	–	–	1, 2, 3, 5, 10, 15, 20, 30
Bursting resistance	–	–	–	0, 5, 30 (max)
Colour fastness to washing	1	–	40-50	0
Colour fastness to artificial light	0	–	–	0
Spirality after laundry	0	–	20-30/ 40-50	1, 2, 3, 5, 10, 15, 20, 30
Pilling resistance	0, 1	–	20-30/ 40-50	0, 5, 30 (max)

Source: Own work, Hochschule Niederrhein.

Discussions with experts and the workshop results confirm that many manufacturers already test materials and products in their original condition, as well as after 5 and 10 wash cycles. Product testing is commonly based on just 1–10 wash-dry cycles, whereas a realistic assessment of performance requires 20–56 cycles (see Table 11). This gap highlights that established quality or 'fitness for use" (e.g. EU Ecolabel) assessments primarily address short-term usability rather than durability over the service lifespan. Accordingly, the requirements for intrinsic properties vary significantly depending on the number of cycles used as pre-treatment.

Van de Burgt et al. (2023) even differentiate between products of a 'short cycle" (usage up to two years) and those of a 'long cycle" (usage longer than two years), correlating the number of washing cycles to these categories to simulate use (short cycle: assessment with 20–30 wash cycles; long cycle: assessment with 40–50 wash cycles). Similarly, the JRC preparatory study (2024) and WRAP (2017) differentiate between different product categories which are assigned 20 respectively 30 wash cycles as a simulation of ageing (Delre et al. 2024a; Wrap 2017). The interviewed experts consider the use of washing cycles to assess durability an appropriate general approach. However, practical insights suggest that consumer expectations remain high regardless of material choice or intended lifespan. Experts therefore recommend testing up to 30 wash-dry cycles to realistically capture aging effects. Fewer cycles are not recommended, as material changes can still occur between 20 and 30 washes. Additionally, workshop participants have pointed out that defining what constitutes a short or long cycle requires a clear, context-specific definition, which is difficult to establish for apparel. For example, a pair of sweatpants may be used as a fast-fashion item or as long-term activewear, which makes a general categorisation difficult. For assessing potential reuse beyond the first user, differentiating based on intended use cycles is seen as impractical. An expert in textile sorting, who participated in the interviews, aligns with WRAP (2014) and states that at least 50 wash-dry cycles should be required for a T-shirt to be considered durable.

Due to limited textile testing capacities, both internal (e.g. within companies or quality assurance departments) and external (e.g. accredited testing institutes), testing 50 or more wash-dry cycles is currently difficult to implement. Therefore, 30 wash-dry cycles are considered a practical compromise, as this number allows for the assessment of aging effects on cotton T-shirts resulting from long-term washing. However, this test protocol only simulates a limited product lifespan of approximately 1.2–2.4 years [11], aiming to initially cover the two-year legal guarantee period as a starting point.

Washing parameters

Reported in literature, most testing set ups for the parameters of the washing are chosen according to the care label in combination with ISO 6330 (MTE 2022), EU Ecolabel for textiles (Europäische Kommission 2014), Blue Angel for textiles (RAL gGmbH 2023a), ISO 15487:2010). The JRC approach also recommends conducting household-like pre-treatment of garments in accordance with the care label and ISO 6330 (Delre et al. 2024a). Table 12 provides a summary of the pros and cons of care label-based washing protocols, identified in workshop discussions.

Table 12: Pros and cons of following the label instructions for performing test washing

Pros	Cons
Globally standardised symbols	Eco-program for washing machines
Standardised specification	Huge variety between manufacturer information
High level of awareness	Loss of label
Responsibility of manufacturer for the product – legal guarantee and liability	Down labelling
	Variety of washing programs
	Further complexity
	Extended testing effort

Source: Own work, Hochschule Niederrhein.

According to the workshop participants, testing based on care labelling is also widespread in industry as part of quality assurance, which is why many of them prefer this approach. The method proposed by the JRC would therefore be in line with industry practice. In addition, care-

[11] As a reference value, WRAP's (2017) estimate of 25 wears per year was used:
1 wear per wash * 30 washes = 30 wears.
30 wears / 25 wears per year = 1.2 years (or 2.4 years if each wash corresponds to two wears).

labelling considers material-specific requirements that contribute to long-lasting durability. However, care labelling is not yet sufficiently harmonised within the EU. The declared washing programs on care labels are currently a recommendation at the discretion of the fashion brand and may therefore vary between products with identical properties depending on the brand. This creates a risk that manufacturers might deliberately declare or apply milder washing programs or machines to intentionally reduce mechanical stress during testing. Such practices could strategically undermine minimum requirements and would be difficult for consumers to understand.

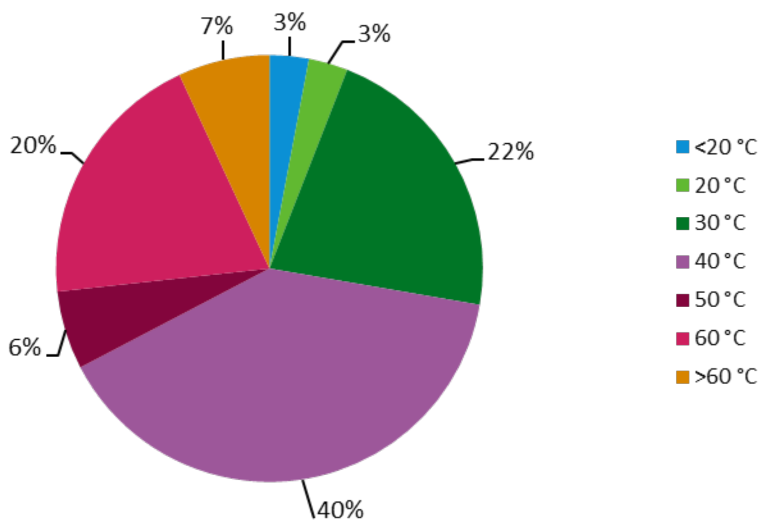
Additionally, consumers' washing habits do not always align with the instructions provided on the care labels. Feedback from workshop participants suggests that this is particularly the case for less delicate items of clothing, e.g., T-shirts and jeans made from cotton. Some workshop participants have therefore highlighted the potential benefits of introducing a standardized washing pre-treatment, preferably harmonized with well-established and accepted test methods. Washing temperature must be precisely specified due to its significant influence on material degradation.

If such a standardized washing pre-treatment is introduced under a future delegated act, workshop participants called for transparent communication regarding the washing approach. This is to ensure that consumers understand that the number of washing cycles applied during testing may not directly reflect real-life service life, particularly when washing habits or washing machines differ from the test conditions.

Furthermore, some standards, such as the French MTE law (MTE 2022) Klicken oder tippen Sie hier, um Text einzugeben., do not specify whether the ISO 6330 standard washing machine or a household machine should be used for washing pre-treatment. In addition, key washing parameters, such as drum capacity, load size, or detergent type, are often not defined. According to the interviewed experts, the washing mechanics differ significantly between the ISO 6330 standard washing machine and even among household washing machines. Currently the eco 40-60 programme, which is mandatory for all washing machines placed on the market since 2021, is the only washing programme standardized across washing machine manufacturers. However, this programme primarily represents soiled cotton laundry and automatically adjusts washing temperature and water consumption based on load size (Commission Regulation 2019). Consequently, the eco 40-60 programme sequence does not allow a fully standardized procedure to achieve true comparability.

To assess the practical relevance of laundry pre-treatment based on care labels and ISO 6330 for a 100% cotton T-shirt, literature on actual consumer washing behaviour and commonly used washing programs for this product type was reviewed. According to the European detergents and maintenance products industry association A.I.S.E., the average washing temperature is 42.4°C. Figure 14 shows the shares allocated to the different washing temperatures. Only 28% of laundry loads are washed at 30 °C or below (A.I.S.E. 2020).

Figure 14: Distribution of washing temperatures used in domestic laundry [%]



Source: Own work, Hochschule Niederrhein, based on A.I.S.E. (2020).

Kruschwitz et al. (2014) stated that the wash load in Germany varied from 2.1 ±1.1 kg (wool) to 3.4 ± 1.2 kg (cotton) and the washing temperature varied from 20 °C (silk) to 47.1 °C (cotton). According to Gooijer and Stamminger (2016), in Germany the average wash load and temperature for the different washing programs vary from 2.36 kg (delicate) to 3.18 kg (cotton) and from 25 °C (wool) to 49.7 °C (cotton).

According to data provided by a washing machine manufacturer, washing temperature for cotton is still predominantly set at 40 °C, despite the availability of innovative detergents that are effective at lower temperatures between 20–30 °C. The most frequently used program is the 'Mixed Program" (approx. 1 hour, possibly 36 minutes, 1,200 rpm, 40 °C), accounting for 26% of usage, followed by the 'Cotton Program" with 20%, which also operates at 40 °C. Around 82% of the recorded wash cycles ran with a washing load below the manufacturer's recommendation.

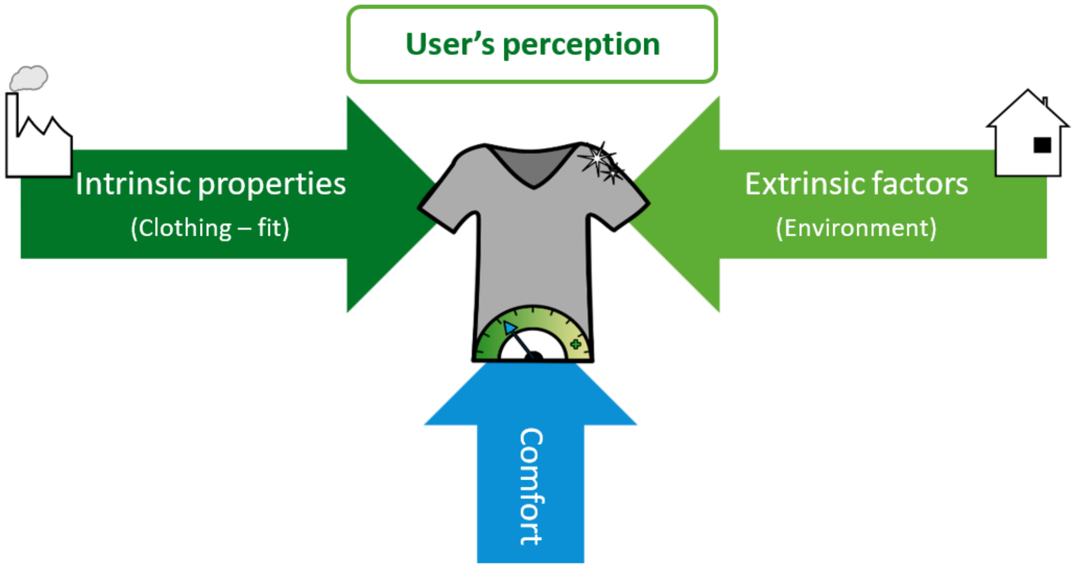
Conclusion

The basic idea of aging simulation is that clothing can be considered durable if it meets the relevant product-specific minimum requirements even after exposure to defined stresses. Given the high subjectivity of individual usage and laundry care habits across Europe, a defined number of wash-dry cycles has emerged as the most practical and comparable indicator for simulating aging effects over a product's service lifespan, such as 30 wash-dry cycles for 100% cotton T-shirts. However, research shows that existing standards do not sufficiently define key washing parameters, e.g., machine type, program settings, or temperature, which makes it difficult to reproducibly approximate extrinsic influences. Clearly defining these parameters is essential to ensure comparability between tests and to avoid underestimating material stress during performance assessments.

4.2.3 Wearing comfort and clothing physiology

In this study washing was selected to be the factor simulating the usage phase of the product, as wearer trials are very individual and hard to simulate and quantify. Nevertheless, especially the aspects ‘wearing comfort” and ‘clothing physiology” are important parameters regarding the service lifespan. The intrinsic properties as well as the extrinsic factors influence the individual perception of the user (see Figure 15).

Figure 15: Factors influencing the user’s perception of clothing physiology



Source: Own work, Hochschule Niederrhein, based on (Motlogelwa 2018).

In literature, wearing comfort and clothing physiology is often referred as elements of overall user requirements (Motlogelwa 2018; Eberle et al. 2014). In the industry, different modelling approaches in terms of moisture or heat formation can be found. However, these are mostly used with regards to product groups like sportswear or outdoor clothing. For functional products these aspects are more likely to be analysed looking at their intrinsic properties. Tests like water vapor permeability or water repellence already address these aspects (Hohenstein 2020).

The WRAP study (Wrap 2022) describes wearing comfort and clothing physiology as part of emotional durability. However, as also shown in Figure 15, these aspects not only contribute to an emotional durability, but they also to the dimensions of physical durability. This could offer a possibility to partly or indirectly include emotional durability in a physical durability assessment in order to support the emotional durability of products within ecodesign requirements.

To further analyse the aspects of wearing comfort and clothing physiology, two professors from the area of garment manufacturing and quality management from the Niederrhein University of Applied Sciences were interviewed on these topics. These experts named following key aspects as the most relevant for items of clothing:

- Fit
- Skin sensation
- Heat regulation

- Moisture management.

These found key aspects were further discussed in the workshops. The parameters named by the workshop participants show that material properties and their processing heavily influence wearing comfort and clothing physiology (see Figure 13).

Table 13: Key aspects and parameters of comfort and clothing physiology (Müller et al. 2021; Hohenstein 2020)

Key aspects	Parameters
Fit	Dimensional stability Twist
Skin sensation	Fibre type
Heat regulation	Fibre type Textile construction
Moisture management	Fibre type Water vapor permeability Water repellency Water column Air permeability

Source: Own work, Hochschule Niederrhein, based on interviews and the workshop results.

The analysis of the key aspects of wearing comfort and clothing physiology shows that relevant measurable parameters can be found. Although these parameters can be quantified, the interpretation of the resulting values is closely connected to the individual perception of the wearer. Accordingly, workshop participants regard wearer trials as appropriate method to assess the perception of the wearer and aspects like body temperature or sweat formation which are difficult to quantify. However, the perception of these aspects is highly individual and cannot be generalized. In the context of a delegated act and the establishment of minimum requirements a quantification is needed. Only when a systematic correlation between perception and measurable results can be found, it can be included in an assessment for durability. Therefore, wearing comfort and clothing physiology aspects were excluded from the further elaborations of this study.

Nevertheless, wearing comfort and clothing physiology should be included in the long run as they influence the service lifespan of a product. Additional investigations are needed to use wearing comfort and clothing physiology to more accurately define minimum durability requirements.

Conclusion

Material properties and their processing heavily influence central aspects of wearing comfort and clothing physiology. These can in parts already be assessed by specific testing methods for single parameters. However, there is a need to further gather and categorise these aspects to be able to build a system evaluating the wearing comfort or physiological performance of the product while systematically portraying and thereby gathering the perception of the wearer.

4.2.4 Performance testing

In order to apply the developed parameters and put them to a test, the performance of classic T-shirts (100% cotton) was evaluated. This is not only due to the market relevance already described in chapter 3.3, but also because the product example of T-shirts is washed most frequently and therefore aging simulation through washing seems most appropriate. Experimental tests were conducted on T-shirts by considering both intrinsic properties and extrinsic factors in an external study at Hochschule Niederrhein (Lumpp 2025).

Market analysis

Firstly, another market analysis was performed to select the classic T-shirts to be tested, with the aim of capturing the performance of market-standard T-shirts. Therefore, key players in Germany were analysed (see Table 14). The results of the analysis are general descriptive market data in the market overview as well as explorative market data in form of sustainability claims of the suppliers. This objective market data forms the basis for defining selection criteria according to which a sample of T-shirts representative of the market is selected.

Table 14: Key players in Germany

Market	Brand
International brands	H&M*°’, Zara*’, SHEIN*, New Balance*, Alpha Industries*, Uniqlo*, Tommy Hilfiger*, Primark*’
German brands	Tom Tailor*’, C&A’, KIK’, Takko’, NKD’, s. Oliver’
Online retailers	Zalando°, Bonprix°, About You°, Asos°

Source: Lumpp (2025), p. 86 based on

*Key Players for T-shirts in Germany measured by their share of turnover

° Highest selling online retailers 2021

’ Most popular apparel stores and textile department stores 2018-2020.

Cotton, as the dominant fibre in EU apparel products (accounting for approximately 2.8 million tonnes in 2015) (Gray 2017), was selected as reference fibre for the analysis. Although detailed data for the T-shirt segment is lacking, cotton’s skin-friendliness, favourable processing characteristics, and widespread use in everyday clothing indicate that it plays a leading role in this category as well. Additionally, the rising demand for organic cotton in Europe highlights its ongoing market relevance (Euratex 2024; Teufel et al. 2024). While fibre blends are also common in the apparel industry, garments made from 100% cotton remain popular. Given cotton’s significant contribution to the CO_2, water, and waste footprints of textile consumption, investigating the durability of cotton T-shirts is particularly relevant for developing strategies to reduce the environmental impact of the European textile sector. For these reasons, and due to limited testing capacity, functional T-shirts were not included in the performance testing.

Test design

A representative sample of 16 classic T-shirt models from 14 different brands is used for the experimental material tests. The sample consists of black men's T-shirts in size L (large), with regular, loose, or oversized fit, made from 100% cotton knitwear. To analyse differences in durability, half of the sample consists of T-shirts made from conventional cotton only, while the other half contains 20% to 100% recycled cotton fibres (see Figure 16). The selected T-shirt models cover mostly low-price (< €10.00) to mid-range (€10.00–€25.00) and a few high-end products (> €25.00). The selection is based on criteria of market relevance, consumer preferences and sustainability aspects resulting from the market analysis.

Based on the elaborations of the extrinsic factors, the washing program is selected as follows: Temperature 40 °C, cotton-program (2:58 h), spin speed 1,200 rpm, customary liquid laundry detergent for colours, wash load 4.1 kg. Based on current data, a washing temperature of 40 °C remains a typical scenario in domestic laundry for 100% cotton T-shirts. Even if consumers are increasingly being encouraged to wash at lower temperatures for the benefit of the environment, data shows that consumers are still washing at higher temperatures. The interviewed experts agree that cotton T-shirts should withstand washing at 40 °C, making this temperature an appropriate benchmark for assessing the durability of cotton fibres during washing pre-treatments. Between washes, the T-shirts were dried indoors on a clothesline. Only wash-dry cycles were used here to represent the extrinsic factors. As no wearer trials were included, the washing programme was to be used under regular conditions and not in the short programme, to adequately recreate the stress of a use phase solely through laundry.

Regarding the other product examples, it is important to note that while aging simulations should reflect realistic washing habits, actual consumer practices cannot be regarded as a universally valid reference. Such practices may differ significantly from recommended care procedures. According to workshop participants' feedback, this should be considered for products or materials requiring special care, such as functional jackets. For performance testing, pre-treatment parameters should realistically represent typical usage conditions while also taking the maximum permissible stress for each material into account. Ultimately, to ensure garment longevity, pre-treatment must be tailored to the specific product and its material composition.

The complete experimental series was set up as follows:

Figure 16: Test design for performance tests on classic T-shirts (100% cotton)

Dimensional stability	Spirality	NEW	Pilling resistance	Bursting resistance	Fastness to washing	artificial light
Dimensional stability	Spirality	1st cycle	Pilling resistance	Bursting resistance		
Dimensional stability	Spirality	2nd cycle				
Dimensional stability	Spirality	3rd cycle				
Dimensional stability	Spirality	5th cycle	Pilling resistance	Bursting resistance	Fastness to washing	
Dimensional stability	Spirality	10th cycle				
Dimensional stability	Spirality	15th cycle				
Dimensional stability	Spirality	20th cycle			Fastness to washing	
Dimensional stability	Spirality	30th cycle	Pilling resistance	Bursting resistance	Fastness to washing	

Source: Own work, Hochschule Niederrhein, based on Lumpp (2025), p. 92-94 and p. 98-100.

The applied procedure for performance testing includes assessing the most relevant intrinsic properties (according to data from literature research and the industry survey) using standardized test methods throughout the simulated aging process, such as 30 wash-dry cycles under defined washing conditions or standardized stress tests for colour fastness to washing and artificial light.
The detailed implementation of the experimental investigation on the durability of cotton T-

shirts, the test results, and the performance of the 16 T-shirts can be found in the external study (Lumpp 2025).

Conclusion

By defining the test design based on the intrinsic properties as well as extrinsic factors a scientifically sound basis was created for the experimental performance testing of the defined initial minimum requirements and its practical suitability and appropriateness for the cotton T-shirt.

Building on the experimental testing and the industry survey, minimum requirements for the product aspect durability will be formulated in the following chapter.

4.3 Proposal for minimum requirements

The investigation of the sample products has shown that there are very different product-specific requirements for increasing longevity.

Chapter 4.3 presents the final proposals for minimum durability requirements for the selected product examples. In the case of the cotton T-shirt (Chapter 4.3.1), the results of the experimental study were also included - a first step towards validating the requirements with regard to the aspect of durability. The study emphasises that experimental tests on representative products are essential to make a well-founded assessment of the practical suitability of the minimum requirements. Such a study has yet to be carried out for the validation of the proposals for jeans (Chapter 4.3.2) and functional jackets (Chapter 4.3.3).

The following requirements were developed based on testing conditions that reflect real-life use. As a disclaimer, it is important to acknowledge that the effect of durability requirements highly depends on several conditions. A detailed discussion of methodological prerequisites, testing limitations, and existing standardization gaps can be found in the Chapter 4.4 on *Possible Implications*.

Based on this study, the relevance of aspects of physical durability should not be understood as a ranking. Instead, their interaction is crucial to overall performance. Accordingly, the product-specific minimum requirements are presented in three groups: physical, colour, and appearance-related properties, as listed in the first column. The second column specifies the corresponding durability aspects and test standards. The order of these groups or aspects does not imply any prioritization. The third column contains the *proposed minimum requirements* derived from this study (criteria that must be met for market entry), while the final column outlines the *characteristics of new items* as defined by the JRC, which are intended as indicative reference values (Delre et al. 2024a).

4.3.1 T-shirts

Table 15 lists the final proposal for product-specific minimum durability requirements for a classic T-shirt made from 100% cotton. This specific product is allocated to category No. 3 and the respective material group No. 1 of the categorization (see Chapter 3.2).

Table 15: Proposal for minimum requirements for T-shirts (100% cotton, black)

Property	**Durability aspect** Test standard*	**Requirements after maximum stress° based on the tested T-shirts (Lumpp 2025)**	**JRC Characteristics of a new T-shirt (Delre et al. 2024a)**
Physical property	**Dimensional stability to washing** DIN EN ISO 5077:2008-04 (✓) in combination with DIN EN ISO 6330:2022-03 (~)	-5.5% to +4.5%	±5% (ISO 3759:2011)
Physical property	**Bursting resistance** DIN EN ISO 13938-2:2020-03 (✓)	≥ 130 kPa (50 cm^2)	≥ 160 kPa (50 cm^2) (ISO 13938-2:2020-03)
Colour property	**Colour fastness to domestic laundering** DIN EN ISO 105-C06:2010-08 (X)	≥ Grade 3.5 (Staining) ≥ Grade 4 (Colour change)	≥ Grade 4 (Colour change) ≥ Grade 5 (Self-staining; ISO 15487:2018)
Colour property	**Colour fastness to artificial light** DIN EN ISO 105-B02:2014-11 (~)	≥ Grade 4	–
Specific appearance-related property	**Pilling resistance** DIN EN ISO 12945-2:2021-04 (✓)	≥ Grade 3.5 (2,000 cycles)	≥ Grade 4 (ISO 12945 1:2020; 14,400 cycles)
Specific appearance-related property	**Spirality after laundering** ISO 16322-3:2021-04 (~)	≤ 5%	–
Specific appearance-related property	**Haptics and appearance** Manual and visual assessment according to DIN EN ISO 15487:2018-12 (~)	Acceptable overall impression after 30 wash-dry cycles: - Uniformity of colour change - Pleasant feel, especially at the neckline - No/minimal ‘wash pilling”	Visual inspection for: - Colour change: ≥ Grade 4 - Pilling: ≥ Grade 4 - Trimmings aspect: Grade 5 - Self-staining: Grade 5 (ISO 15487:2018)

*Applicability: (✓) Standard applicable; (~) Standard only suitable to a limited extent - adaptation recommended, (X) Standard found to be unsuitable - adaptation necessary.
For information on the applicability and necessary adaptation of individual standards, see Table 16.
° 30 realistic wash-dry cycles in domestic laundry; Except lightfastness: performance after exposure cycle A1, method 3.
JRC: – *no data available.* In parts the JRC chooses different standards, as indicated in brackets.

The experimental investigation of the T-shirts, which was conducted in an external study at Hochschule Niederrhein, has shown that the challenge lies in fulfilling the combined requirements. Except for seam twisting, the individual requirements were met by at least half of the T-shirts tested, but none of the T-shirts met all six initial criteria. As some T-shirts also failed to meet the minimum requirements when they are new or within the first 5 wash-dry cycles, this indicates that commercially available T-shirts are not currently designed for durability as defined by the ESPR (Lumpp 2025).

The tests have also shown that some of the specified requirements are set too low in terms of the impact on the overall appearance. For example, pilling resistance and colour fastness are set realistically high with scores of 3.5 to 4 out of 5 - because washing has a demonstrable impact on these properties and these thresholds ensure that the wearers expectation of a good visual appearance is adequately maintained after multiple washes. For the same reason, a visual assessment of the aspect 'haptics and appearance' was added, as the visual impression of the T-shirts after 30 wash-dry cycles was not fully captured by the numerical test data. More detailed insight into the data and justifications for the proposals can be found in (Lumpp 2025).

Regarding the functional T-shirt made from 100% polyester fibres, further evaluation is necessary before proposing minimum requirements, as neither the available literature nor the industry survey provides sufficiently reliable data. While the industry survey suggested that air permeability should be included, some of the interviewed experts argued that this test is unnecessary, as knitted fabrics are typically breathable due to their surface structure. Additionally, the need for functional performance criteria depends strongly on the intended use case. One expert suggested that pilling resistance could be replaced by abrasion resistance, as the latter may be more relevant for performance garments. Overall, this industry feedback proves a clear need to further specify durability requirements not only per product group, as it is currently the case for the JRC's product categorisation under the 2nd milestone report of the durability assessment (Delre et al. 2024a).

When evaluating functional T-shirts, the washing pre-treatment must be adjusted: garments made from polyester fibres are typically washed using easy-care programs, which involve lower mechanical stress. This must be taken into account when defining durability thresholds.

Concerns were raised by workshop participants that minimum durability requirements might disadvantage natural fibres, as man-made fibres intrinsically perform better in certain aspects. This could be the case, if requirements stay fibre-unspecific as it is the case for the current JRC approach. To address this, two possible approaches are being considered:

Raise minimum requirements for specific durability aspects in which man-made fibres generally perform better, such as colour fastness. This could reflect realistic usage scenarios for functional T-shirts, which are typically exposed to greater mechanical and environmental stress. However, the scope for increasing such thresholds is limited, as both the physical properties and scale systems for colour fastness have practical boundaries.

Increase the number of wash-dry cycles during pre-treatment to simulate higher stress levels during usage and to consider that T-shirts worn during sport activities are likely to be washed after every use. This option could help offset the milder conditions of easy-care programs and ensure a more comparable stress profile across different fibre types.

Excursus: Findings on the simulation of the aging process

The performance-evaluation of the durability aspects for cotton-T-shirts shows that 30 wash-dry cycles represent an appropriate assessment point to evaluate durability aspects. The test data indicates that many of the performance differences typically manifest from 20 wash-dry cycles onwards.

Based on the recent investigation, it appears unlikely that standard market cotton T-shirts are currently physically durable enough to still show distinguishable performance differences after 50 wash-dry cycles or more - a benchmark often proposed from a sustainability perspective to ensure extended product lifespans (see Table 16). Some tested T-shirts in their initial condition did not even meet the assumed characteristics of a new product as defined by the JRC. Raising the benchmark to 50 wash-dry cycles would therefore only be meaningful if improved material and manufacturing qualities are present. Performance requirements under a future delegated act should therefore be designed in such a way that they can be developed dynamically as also suggested by Bauer et al. (2018).

Despite the generally weak overall fulfilment levels across the tested T-shirts, this does not suggest that the requirements are unreasonably high. On the contrary, for a true extension of a T-shirts lifespan, even stricter minimum requirements may be necessary for certain individual aspects. At the same time, the results point to a clear need for further development and harmonization of test methods, particularly regarding to realistic simulation and complementary visual assessment.

The experimental tests showed that a reliable prediction of clothing durability based on the initial condition (new product) or a short-term simulation (e.g., 5 wash-dry cycles) is only partially possible. Individual samples deviated significantly from the mean in some cases. Nevertheless, initial trends can be identified as summarised in Table 16.

Table 16: Considerations on the reliability of durability tests under short-term testing conditions

Durability aspect Test standard	**Reliability under short term testing?**
Dimensional stability to washing DIN EN ISO 5077:2008-04 (✓) in combination with DIN EN ISO 6330:2022-03 (~)	Given to a limited extent; significant changes observed during the simulated service lifespan. (~) The current laundry standard is not designed for assessing the durability of T-shirts and is therefore only partially suitable. Neither the mechanics of the standardized washing machine nor the defined washing parameters adequately reflect typical household laundry conditions. The standard must be adapted to include a pre-treatment process based on real-life usage scenarios. The laundry pre-treatment method developed in this study provides an initial approach (see chapter 4.3.2). For a Europe-wide representative procedure, standardized washing procedures should be developed that correspond to the average usage behaviour of private households in the EU. This area represents a key gap where standardization is urgently needed to enable effective implementation of minimum requirements in line with the EU Textile Strategy.
Bursting resistance DIN EN ISO 13938-2:2020-03 (✓)	Reliable, for example with a burst pressure exceeding the requirement by +20% after 30 wash-dry cycles; the initial quality appears to be more decisive than the changes over time. A minimum requirement for the new condition could be defined by adding a margin based on the most negative changes observed.
Colour fastness to domestic laundering DIN EN ISO 105-C06:2010-08 (X)	Unreliable; significant variability and a requirement for standardization. (X) The current standard does not adequately reflect the actual colour changes in T-shirts that have been washed 30 times. The test condition 'A1M" only simulates around 5 wash-dry cycles and does not

Durability aspect Test standard	**Reliability under short term testing?**
	reveal the real aging effects or the uniformity of the colour change - an aspect that has proven to be essential for perceived durability. In addition, the test area is too small to make representative statements about uniformity. The advantage of the standard lies in the isolated test, which excludes the transfer of dyes from other textiles. However, to enable a more realistic assessment, either an adjustment of the test intensity or a standard for colour measurement on actually washed T-shirts is necessary.
Colour fastness to artificial light DIN EN ISO 105-B02:2014-11 (~)	Unreliable; significant changes due to exposure. (~) Lack of correlation of the artificial radiation dose with real-life stress conditions. Current standard test parameters require adjustment. The low lightfastness of the tested models, combined with industry practice - where grade 4 is often considered acceptable by dye suppliers - suggests that method 3 is comparatively strict. A rough estimate based on data provided by Atlas indicates that this method simulates significantly greater light exposure than what T-shirts typically experience over a lifespan of 30 wash-dry cycles. However, the lack of reliable data on actual solar radiation exposure of T-shirts in everyday use makes it difficult to conclusively assess the method's appropriateness. Ultimately, its relevance depends on the expected light exposure during real-life wear.
Pilling resistance DIN EN ISO 12945-2:2021-04 (✓)	Reliable, for example with an initial rating of ≥ grade 4.5; fluctuations are present but usually limited to a maximum of one grade.
Spirality after laundering ISO 16322-3:2021-04 (~)	Given to a limited extent; greatest change until around 5 wash-dry cycles, accompanied by fluctuations across the whole test span. (~) As with dimensional stability to washing, a realistic and efficient assessment of seam twisting is difficult to achieve, since current test standards rely on washing procedures that do not adequately reflect real-life conditions. Moreover, the handling of garments during line drying is not sufficiently defined.
Haptics and appearance Manual/visual assessment DIN EN ISO 15487:2018-12 (~)	Reliability requires further evaluation; significant changes observed during the simulated service lifespan. (~) The standard provides a solid basis for visual assessment; however, there are currently no standards addressing haptics, which can also significantly influence perceived durability. It is therefore recommended that tactile properties be included in the evaluation of perceived durability and that corresponding standardization measures be developed.

Source: Own work, Hochschule Niederrhein, based on Lumpp (2025).

A comparison of the requirements derived after 30 wash-dry cycles and the characteristics of new T-shirts currently available on the market according to the JRC showed that these values are nearly identical (see Table 16). However, the experimental investigation with commercially available T-shirts showed that 5 of the 16 T-shirts did not even meet the JRC criteria when new (Lumpp 2025). Furthermore, the comparison shows that the properties of new items would likely be insufficient to guarantee adequate durability over a minimum of two years of use. To establish purposeful requirements for new items, loss of intrinsic properties due to wear and tear must be factored into the threshold values. Therefore, durability requirements should be designed to evolve dynamically in line with the state of research and standardization, in order to reflect actual product performance more accurately in the long term.

Conclusion

These findings indicate that testing under minimum stress (new item up to 5 wash-dry cycles) is only advisable as a transitional solution until both, the durability of new items and the standards for assessing durability, have been improved. The research and development of a realistic yet efficient simulation of an appropriate service lifespan is crucial to truly prolong clothing product lifecycles. A transition period of two years, starting with requirements for new items, could be used for data collection and validation while standardization of aging simulation and testing capacities are established. It is recommended to start where compliance is already feasible and to further develop the legal framework of a future delegated act dynamically to support a long-term, continuous reduction of environmental impacts.

A simulation for products that are washed less frequently:
Some products (such as evening gowns, jackets, or those made from delicate materials like silk or wool) are washed relatively infrequently. This raises the question of how wear-related stress during actual use can be meaningfully incorporated into testing protocols.

4.3.2 Jeans

Table 17 shows product-specific minimum durability requirements for basic jeans with a material composition of 95% cotton and 5% elastane. This specific product is allocated to category No.6 and the respective material group No.4 of the categorization (see Chapter 3.2).

Table 17: Proposal for minimum requirements for jeans (95% cotton, 5% elastane)

Property	Durability aspect Test standard*	Requirements after maximum stress° (based on literature data and industry data)	JRC Characteristics of a new jeans (Delre et al. 2024a)
Physical property	**Dimensional stability to washing** DIN EN ISO 5077:2008-04 (✓) in combination with DIN EN ISO 6330:2022-03 (~)	±3%	±3% (ISO 3759:2011)
Physical property	**Tensile strength and Elongation** DIN EN ISO 13934-1:2013-08 (-)	Full fit: ≥ 250 N, 12.5% to 55%, Tight fit: ≥ 300 N, 12.5% to 35%	Longitudinal: ≥ 160 N Transversal: ≥ 120 N (ISO 13934-1:2013-08)

Property	Durability aspect Test standard*	Requirements after maximum stress° (based on literature data and industry data)	JRC Characteristics of a new jeans (Delre et al. 2024a)
Physical property	**Abrasion resistance** DIN EN ISO 12947-2:2017-03 (Martindale method) (-)	≥ 20,000 to 30,000 cycles regardless of mass per unit area *9 kPa nominal pressure* *or* Mass per unit area > 340 g/m²: ≥ 30,000 cycles, Mass per unit area < 340 g/m²: ≥ 20,000 cycles	–
Colour property	**Colour fastness to domestic laundering** DIN EN ISO 105-C06:2010-08 (X)	≥ Grade 4 (Colour change) Staining: information requirement for separate washing during first washes	≥ Grade 5 (Self-staining; ISO 15487:2018)
Colour property	**Colour fastness to rubbing** DIN EN ISO 105-X12:2016-11 (-)	Dry rubbing: ≥ Grade 3 to 4 (Staining and colour change)	–
Specific appearance-related property	**Elasticity of fabric** DIN EN ISO 20932-1:2022-02 (Strip test) (-)	No reliable data found in literature; data from experts needs to be tested while considering the elastane content and fit	–
Specific appearance-related property	**Spirality after laundering** ISO 16322-3:2021-04 (~)	≤ 5%	–
Specific appearance-related property	**Haptics and appearance** Manual and visual assessment according to DIN EN ISO 15487:2018-12 (~)	Acceptable overall impression after 30 wash-dry cycles: - Intensity of colour change - Pleasant feel	Visual inspection for: - Pilling: ≥ Grade 4 - Trimmings aspect: Grade 5 - Self-staining: Grade 5 (ISO 15487:2018)

* Applicability: (✓) Standard applicable; (~) Standard only suitable to a limited extent - adaptation recommended, (X) Standard found to be unsuitable - adaptation necessary; (-) Scenario-dependent.
For information on the applicability and necessary adaptation of individual standards, see Table 16.
° Realistic wash-dry cycles in domestic laundry; experimental tests are required as a basis for defining the number of cycles and suitable washing programs and parameters.

JRC: – *no data available.* In parts the JRC chooses different standards, as indicated in brackets.

Jeans are a widely used clothing textile causing a high resource consumption during their production. Therefore, it is necessary to establish minimum requirements within a future delegated act. The industry survey on jeans indicated that product weight and elastane content can have a significant impact on durability and should be considered when defining the minimum standards (see Table 17). Further studies are still needed in this area.

Even without performance tests, it can be assumed that fasteners have a significant influence on the durability of jeans. Repairing or replacing zippers is very costly, and especially for low-priced jeans. It is unlikely that consumers undertake such measures. As a result, defective fasteners would likely lead to the end of use, even if the textile materials and workmanship are still intact. Therefore, trimmings and accessories must be considered for the future delegated act for textiles.

A particular challenge is the assessment of colour fastness: bleeding is characteristic for jeans but must not be too severe. Fading is characteristic of jeans and, according to the workshop and survey participants, should not be defined as wear and tear. Against this background, a minimum requirement for colour fastness to washing should be critically reviewed and validated by testing.

4.3.3 Functional jacket

The Table 18 lists the final proposal for product-specific minimum durability requirements for a waterproof, windproof, and breathable rain jacket with an outer material made of 100% polyester or polyamide. This specific product is allocated to category No.12 and the respective material group No.2 of the categorization (see Chapter 3.2).

The product-specific functional properties are determined according to the characterisation of the product. The fulfilment of all functional requirements is not mandatory; instead, the selection and level of performance should be appropriate to the intended use scenario. For example, requirements for water repellency or waterproofness may vary depending on whether the garment is designed for everyday use or for demanding outdoor expeditions.

Table 18: Proposal for minimum requirements for functional jackets (100% polyester or 100% polyamide)

Property	**Durability aspect** Test standard*	**Requirements after maximum stress° (based on literature data and industry data)**	**JRC Characteristics of a new jacket (Delre et al. 2024a)**
Physical property	**Abrasion resistance** DIN EN ISO 12947-2:2017-03 (-) (Martindale method)	≥ 16,000 to 30,000 cycles, Linings: ≥ 12,000 cycles *9 kPa nominal pressure*	≥ 20,000 cycles (ISO 12947-2:2017-03)
Physical property	**Dimensional stability to washing** DIN EN ISO 5077:2008-04 (✓) in combination with DIN EN ISO 6330:2022-03 (X)	±3%	±3% (ISO 3759:2011)

Property	**Durability aspect** Test standard*	**Requirements after maximum stress° (based on literature data and industry data)**	**JRC Characteristics of a new jacket (Delre et al. 2024a)**
Colour property	**Colour fastness to artificial light** DIN EN ISO 105-B02:2014-11 (~)	≥ Grade 4 to 5, ≥ Grade 3 for neon colours, Linings: ≥ Grade 4	Colour change: ≥ Grade 4 (ISO 15487:2018)
Specific functional property	**Water repellency** DIN EN ISO 4920:2012-12 (-) (Spray test) in combination with DIN EN ISO 6330:2022-03 (~)	≥ Grade 3 to 4 after five domestic wash-dry cycles at 40 °C + *information requirements: care instructions to maintain function*	– (no functional apparel listed)
Specific functional property	**Water proofness** ISO 811:2018-08 (-)	≥ 1,300 mm water column	– (no functional apparel listed)
Specific functional property	**Water vapor permeability** ASTM E 96/E 96Ma:2024 (-)	> 3,000 g/m²/24h	– (no functional apparel listed)

* Applicability: (✓) Standard applicable; (~) Standard only suitable to a limited extent - adaptation recommended, (X) Standard found to be unsuitable - adaptation necessary; (-) Scenario-dependent.
For information on the applicability and necessary adaptation of individual standards, see Table 16.
° New item or realistic wash-dry cycles in domestic laundry; experimental tests are required as a basis for defining the number of cycles and suitable washing programs and parameters. Except lightfastness: performance after exposure cycle A1, method 3.
JRC: – *no data available.* In parts the JRC chooses different standards, as indicated in brackets.

Functional jackets are not typical items of a 'make-take-dispose" clothing model and are more complex, as the investigation has shown. In addition, there is a considerable quality gap between products from fashion retailers and those from outdoor brands. Therefore, it should be carefully considered whether minimum requirements in the form of performance standards for this product group are truly effective in the context of the ESPR - or whether information requirements, such as on the appropriate use contexts for functional jackets (e.g. everyday wear, hiking, sports) and proper care of the equipment, might be more suitable.

The survey results offer initial insights into durability aspects that could form minimum requirements (see Table 18); however, the added value of regulation must first be clearly demonstrated. If performance requirements for functional jackets are to be considered, a reasonable starting point could be to ensure that promised functions are reliably present in new items and maintained over time. One example is water resistance: if it is no longer present, the jacket is no longer suitable for its intended use, and other aspects of physical durability become irrelevant. Since jackets in general are washed less frequently (see Table 18), an evaluation of a representative aging simulation is needed, before requirements under maximum stress can be finalised. Similar to the case of jeans, the durability of fasteners is an important aspect and could be added to the list of minimum requirements.

Proof of compliance

The proposed minimum requirements were considered feasible by some workshop participants - in some cases even immediately implementable, as they are based on established testing methods. However, according to the participants' feedback, the overall feasibility largely depends on the documentation and verification process. Excessive bureaucratic effort could lead to implementation delays due to the high administrative burden.

There are basically two possible approaches to proofing compliance with durability minimum requirements: The first is internal verification, where each company must individually prove that the requirements are met. To reduce the testing effort, a distinction can be made between product-specific and indirect proof. For example, suppliers could test textile surface properties such as bursting resistance or colour fastness, while more complex product-specific tests (e.g. such as those for dimensional stability or seam distortion) would only be conducted when necessary. Additionally, internal material databases can be used so that materials already tested and approved for previous products can be accepted as proof for new products without retesting. This significantly reduces the testing burden.

The second option involves random checks conducted by external bodies. According to the feedback of workshop participants, this approach is preferred because laboratory capacities are limited, and comprehensive internal verification poses a major challenge for many companies. Under this system, companies are not required to provide proof for every individual item but are instead subject to random inspections. This approach is seen as more practical, better accepted within the industry, and would allow a quicker implementation.

Conclusion

The results of the study described in chapter 4.2 show that the definition of minimum requirements for the durability of a textile product consists of several small parts. To quickly introduce first requirements to start extending the service lifespan of clothing, testing efforts should be feasible. A distinction can be made between the methods of assessing or measuring durability, and the extent to which these measurements are required to demonstrate compliance, or whether random testing is sufficient enough. The costs and benefits need to be considered. Thereby it becomes clear that it is not realistic yet to define minimum durability requirements for every existing item of clothing but rather to start with specific products having the biggest market shares (e.g. classic T-shirts) to generate a big leverage effect. Moreover, a transition period of two years could be used to start with requirements for new items while working on data collection and validation as well as standardization of aging simulation and testing capacities are established. Nevertheless, important learnings can be derived from research done on the product examples.

The next chapter presents the key learnings on durability requirements in the context of a future delegated act and outlines the conditions that need to be considered.

4.4 Possible implications and potential impacts

The investigation of the product aspect of durability, along with the experimental analysis of 100% cotton T-shirts, demonstrated that the applied methodology offers an initial, yet reliable, approach to measuring physical durability. Building on these findings, the measurable minimum requirements developed for 100% cotton T-shirts represent a valid starting point for assessing durability for further product categories within the framework of a future delegated act. To ensure that these requirements are both effective and practically applicable in the near term, they must be further refined along the following dimensions:

- The definition of durability aspects and minimum requirements for T-shirts confirms that physical durability requirements for clothing must be defined not only by product group. Instead, when defining minimum thresholds for intrinsic properties and pre-treatments for aging simulation, **a product-specific approach is mandatory** that considers fibre type, fabric construction and mass per unit area.

  Workshop and survey participants support such a product-specific approach to minimum durability requirements within the framework of a future delegated act. The proposed minimum requirements were generally considered feasible. However, there was no consensus among the workshop participants on the appropriateness, number, and level of the proposed minimum requirements. Some are in favour, even stating that a short time implementation is feasible, others were against the minimum requirements, highlighting that the number of durability aspects for each product sample pushes testing effort and the thresholds are too high. According to this feedback, a distinction should be made between fibre types, especially with regard to colour properties. A distinction based on weight per unit area or fit was also requested, as consumers prefer different weights per unit area (e.g., summer vs. winter season). It was agreed that a final assessment of feasibility is currently not possible, as both clearly defined standards and a clear definition of the materials to be tested (e.g. main materials, components, processing elements such as bindings, linings, or appliqués) are still missing.

- The study shows that existing standards (typically between one to ten wash-dry cycles) do not adequately reflect real-life usage. Demonstrating durability in line with the ESPR requires **application-oriented performance testing protocols** with a higher number of wash-dry cycles that closely simulate household conditions. Wash-dry cycles proved to be a suitable aging simulation for cotton T-shirts. However, T-shirts made of silk or wool, or product groups such as jeans and functional jackets, for example, are washed less frequently, so the mechanical stress caused by washing and drying alone could be less suitable for simulating aging.

  Some workshop participants raised concerns about an aging simulation based solely on wash-dry cycles does not reflect wearing comfort or human factors affecting physical durability, such as perspiration, and therefore called for wearer trials. At the same time the same workshop participants criticized the increased testing effort associated with a higher number of wash-dry cycles. To establish appropriate minimum durability requirements, the applicability of durability test protocols to other products must be evaluated by the help of further experiments.

- The T-shirt study of Lumpp (2025) clearly demonstrates that **current quality assurance systems and relevant established standards need to be adapted** as they are not geared towards durability as defined by the ESPR. This applies particularly to the established ISO 6330 standard for washing pre-treatment. To ensure a procedure that is representative at the European level, standardized washing methods (i.e. washing programs as well as parameters) should be developed to reflect the typical usage behaviour of private households within the EU. This approach enhances both the comparability and efficiency of testing. For stakeholder acceptance, it is essential to use established test procedures wherever they yield robust results.

To facilitate the early introduction of minimum durability requirements, initial assessments based on established test methods applied to new products could serve as a pragmatic starting point and help foster industry acceptance (Lumpp 2025).

In the case of T-shirts, burst strength and pilling resistance can already be assessed using standardized methods, as test results on new products provide reliable predictions of performance after 30 wash-dry cycles. Colour fastness could also be introduced mid-term, provided that existing test parameters are adapted to reflect more realistic stress levels. For dimensional stability and spirality after washing, the underlying washing processes must first be sufficiently standardized. Currently, the conditions used in test protocols do not reflect common household washing practices and therefore lead to results of limited relevance.

- For minimum requirements to be effective, they must be supported by a clear **process for proof of compliance**. Workshop participants regard the effort required for compliance testing as a key challenge that significantly affects the implementation timeline. The efficiency of the verification process largely depends on the type of minimum requirements defined and whether compliance is demonstrated at the product or material level. To assess what constitutes a reasonable compliance burden, testing should start with less complex products such as T-shirts. During a two-year transition period, data could be collected to evaluate the environmental benefit and practical viability of the regulation.

- Workshop participants suggested a system similar to CE marking: random sampling by official test bodies is considered acceptable, whereas mandatory testing for each ready-made product is seen as disproportionate. In view of serious competitiveness concerns, the testing burden must be clearly justified. Feedback from testing institutes also highlighted that current capacities are insufficient to handle the number of aspects and wash-dry cycles to be tested for every product placed on the market. A substantiated demonstration of the environmental added value of minimum requirements remains outstanding and is urgently needed. The advantage of minimum durability requirements under the ESPR for the burden of proof in the context of legal guarantee is ultimately also a question of the obligation to provide evidence.

- With regard to the **scalability of minimum requirements,** a more detailed product categorisation is needed. Such differentiation is currently lacking in the JRC's consideration (Delre et al. 2024a) of physical durability. To support seamless integration into existing quality assurance systems, the HS codes could be expanded to include standardized durability requirements. This would contribute to a consistent understanding of durability and enable clear differentiation of product- and material-specific specifications. Therefore, a proposal for a suitable categorisation has also been developed in this study (see Chapter 3.2).

  Regarding scalability within product groups, scaling durability classes based on intrinsic properties is limited due to restricted rating scales and varying durability-relevant characteristics. A classification based on the number of wash-dry cycles would be less complex and more understandable for both companies and consumers. While workshop participants found this approach promising, they also noted the increased testing effort. Moreover, durability grading should not be based solely on expected use duration but should also consider circularity and potential reuse by multiple users.

A particular challenge lies in the inclusion of more sustainable materials: While requirements should not be lowered for these materials - since consumers expect equivalent performance and service lifespans - it is already evident that fibre quality in conventional cotton T-shirts can impair durability. It is therefore to be expected that meeting minimum requirements will become even more difficult for products with recycled content. One consideration is to account for the recycled content within an overall assessment, e.g. through an ecodesign label (see Chapter 11).

- To unlock the full potential of clothing durability, **consumers play an important role**. In this context, workshop participants criticized that current requirements focus solely on physical durability. An integration of emotional durability aspects and wearing comfort into a future delegated act - e.g. through information requirements such as care recommendations or repair tips - should therefore be considered to make sure that consumers actually use garments for longer.

  In the feedback of the workshop participants it was proposed to examine in greater detail the approach to integrating emotional durability according to the French Product Environmental Footprint (PEF) method 'Ecobalyse n.d." in which it is taken into account by means of a price factor (Ecobalyse n.d.). In connection with the idea of grading durability through wash-dry cycles, workshop participants emphasised the need to clearly communicate that the number of cycles is not equivalent to actual usage, since real-life stress depends on wearing habits, machine types, and load conditions.

Conclusion

Durability is a key lever in the ecodesign of clothing. Although the study confirmed that durability is established as a sustainability strategy in literature and in the context of quality assurance in the textile industry, the lack of a definition leads to different understandings of what constitutes appropriate service lifespans and testing scopes. Existing standards are insufficient, especially regarding realistic usage scenarios and material. However, minimum requirements can only be effective if aging simulations reflect real-life use - currently best achieved through household-like wash-dry cycles.

To ensure that durable clothing remains attractive, the minimum durability requirements must not compromise the general wearer requirements (suitability, appearance, stability, comfort, aftercare). Otherwise, consumers may opt for less durable alternatives. T-shirts made of 100% cotton are well suited as a pilot product to collect practical experience, validate test approaches, and gather regulatory impact data during the two-year transition period of the future delegated act. Initial requirements could be introduced swiftly, and a phased approach avoids overregulation and preserves competitiveness.

In the long term, well-implemented durability requirements could significantly extend the useful life of key textile products and measurably reduce their environmental footprint.

5 Repairability[12]

5.1 Description of the starting point and the status quo

5.1.1 General definition and legal framework

Within the context of strategies for circularity, the product aspect 'repairability" is part of the measures to extend the product lifetime during the use phase (see Potting et al. (2017)).

- According to Article 2(20) of the ESPR (European Parliament; European Council 2024b)), the term 'repair' means one or more actions carried out to return a defective product or waste to a condition where it fulfils its intended purpose.
- Regarding clothing repairs, a study conducted by the European Environment Agency (EEA) in 2022 provides a precise definition (Manoochehri et al. 2022). Accordingly, textile repair is understood as the process by which a garment is restored by replacing a damaged part or joining torn or broken areas. Thus, this definition encompasses both the repair of the material from which the garment is made and its construction, i.e., the way in which it was sewn or otherwise assembled.

Repair helps conserve resources by extending product lifetimes. Additionally, it also helps reduce waste, as products are not immediately disposed of entirely when a component breaks, e.g., a zipper- or button failure in an otherwise intact garment (Bauer et al. 2018).

Beyond conserving resources, the repair of a garment can also reduce the CO_2 emissions associated with the article over its useful life. As a hypothetical example, the Ellen MacArthur Foundation (2021) estimates that a torn dress, upon being repaired, can be worn 75% longer than if it was disposed of and replaced by a new dress, effectively reducing its associated CO_2-emissions by around 30%. It should be noted that objective data on the frequency of repair, as well as the wear of repaired garments, is currently insufficient. Therefore, only tenuous connections between the CO_2 efficiency and garment repair can be drawn (Zhang and Hale 2022).

This makes repair an important measure for achieving the overarching goals of the EU Green Deal. Besides the ESPR, other EU regulations, such as the '*Directive on common rules promoting the repair of goods'* (Directive (EU) 2024/1799 2024) and '*Directive on Empowering consumers for the green transition*" (Directive 2024/825 2024)) include repairability as well.

The promotion of repair and the strengthening of demand for repair is one key goal outlined in the '*Directive on common rules promoting the repair of goods"*, published on July 1, 2024, to be implemented into national law by July 31, 2026. Repairing a faulty product should be more accessible and affordable for consumers than replacing it. To this end, certain product groups – initially, only electronics like washing machines or smartphones – are to come with an extensive right for repair, as per the directive.

During the legal guarantee period, repairs are provided free of charge and allow consumers, should they make use of their right to repair, to extend their guarantee claims by an additional twelve months. Once the legal guarantee period expires, consumers essentially retain the right to claim repair services, though manufacturers/importers are no longer obligated to provide

[12] This chapter was written by Benita Rau and Maike Rabe from the Institute for Textile and Clothing (FTB) of Hochschule Niederrhein, University of Applied Sciences, Mönchengladbach.

these repairs for free. This right is currently not universally applicable, however, and is limited to certain product groups and only under the provision that repair is possible. Any incurred repair costs must be borne by the consumer, though they must be proportionate and disclosed to the consumer beforehand (Europäisches Parlament 2022).

In the consequence, repair requirements must be defined in order to ensure the repairability of the selected products. One example for a rulebook in this vein are the *EU Ecodesign and Energy Labelling rules on mobile phones and tablets (European Commission 2024d)*, published August 31, 2024. These rules stipulate that the devices it cites must be developed in such a way that it prolongs their product lifetime and facilitates repair. One crucial goal is to make spare parts and technical repair information available to both independent repair service providers and consumers, for at least seven years after the initial purchase of the device. Additionally, producers are obligated to provide software updates for at least five years after the initial purchase to ensure the long-term usability of the device. The overall repairability should be indicated on the product via a repairability index. (Ganapini 2023; European Commission 2024d)

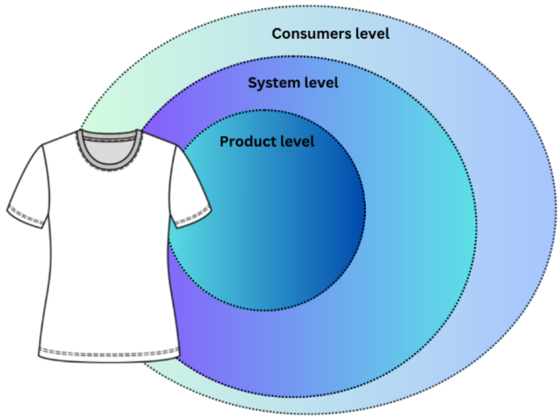
As of the drafting of ecodesign requirements in this study, there is no comparable regulatory framework for textiles, apart from the mandatory two-year legal guarantee period. Within the scope of this legal guarantee, repair is considered a legal remedy for specific deficiencies that do not fall under normal wear and tear, or defects caused by improper use, thereby granting consumers the right to a repair or a replacement free of defects. Whether a repair is chosen depends on how its cost compares to that of a replacement. Particularly for low-cost clothing, where repairs are generally feasible, the question of cost proportionality becomes relevant.

If the *'right to repair"* is extended to additional product groups and textiles in line with the Ecodesign Regulation, repairability will exceed the scope of legal guarantee obligations. The aim is to reduce environmental impacts and conserve resources. In this context, repairs should be easier to carry out and, regardless of how the damage occurred, constitute a more attractive alternative to replacement services or the purchase of new products.

To this end, indicators for the repairability of garments must be determined, which shall define the conditions a product may fulfil to be considered particularly repair-friendly, and conversely, the conditions under which it may be deemed difficult to repair.

Factors influencing the repairability of garments extend beyond the product level and can be analysed on different levels:

Figure 17: The dimensions of clothing repair: product, system, and consumer levels



Source: Own work, Hochschule Niederrhein

Product level

The product level includes all product-specific factors, such as materials, as well as design- and construction-aspects. On this level, frequent breakages and/or reasons for repair must be determined, and their influence on the repairability of the garment evaluated.

System level

The system level focusses on the repair process. To assess the effectiveness of repair services, the available repair approaches and the parties performing the repairs must be analysed.

Consumer level

This level considers consumer behaviour towards clothing repair. It is crucial to understand consumer attitudes, as well as their handling of garment repair.

Analysing these levels allows for the identification of potential barriers for repair, which can be considered when developing requirements for the improvement of product repairability.

5.1.2 Product level: Recurring failures and types of repairs

When defining repairability, it is useful to examine which potential product failures are possible, especially when they are observed to be recurring in nature. This can contribute to a better understanding of the problems that occur during the product's use phase.

Cooper and Claxton (2022) examined garments at the end of their life cycle regarding their damages and breakages that frequently led to their disposal. A systematic screening of **1,476 cast-off garments** that were given to UK charities but deemed unfit for resale serves a as the basis for this study. The random samples were taken from women's, men's, and children's clothes in equal parts, and covered a variety of product groups, e.g., tops (T-shirts, shirts, blouses) for 30% of total samples, trousers for 18%, knitwear (sweaters, cardigans) for 15%, sleepwear and underwear for 15%, outerwear (jackets, coats) for 12%, dresses, skirts and shorts for 6%, and school uniforms for 3%.

The analysis showed that pilling and colour changes – especially fading – are the most common types of failures and can occur in almost every product group. Other common damages were, e.g., thinned fabric at the inseam of a pair of trousers, or frayed fabric at hems. Further physical defects included unintentional damages to the product (e.g., stains and tears), dimensional changes, faulty logo prints, discolourations, and holes near seams. Broken fastenings like zippers and buttons only made up 8% of all recorded damages (see Table 19). It should be noted, however, that the number of products that featured potentially breakable trims was lower than the total number of samples. Out of the analysed products, 18% of pants could potentially suffer from button or zipper failures, as well as 12% of outerwear.

Table 19: Type of failures of discarded, used garments (n= 1.476 garments, multiple options possible)

Type of defect	%
Pilling	55
Colour fading	53
Fabric breakdown (thinning, fraying)	29
Accidental damage (stains, holes, tears)	29
Loss of dimensional stability	20
Change of the print/logo	16
Discolouration	15
Seam defects (e.g. holes)	14
Trim failure (e.g. zips, buttons)	8

Source: Cooper and Claxton (2022)

The types of failures that could potentially be repaired belong primarily in the categories *Accidental damage (stains, holes, tears)*, *Seam defects* and *Trim failure*. All other failures are directly related to the physical durability of a product and are therefore addressed by the product aspect durability. It must be examined to what extent these performance requirements can prevent or delay material-related failures from occurring. If the base material is of lesser quality, repairability is negatively impacted by it (Sauerwein 2023).

As the study focusses on products that were already at the end of their useful life and unmendable, it is crucial to shift the focus to the use phase and analyse the most frequent failures and repairs. Although the amount of literature available on this topic is relatively limited, a literature review shows that the following failures are mentioned particularly often (see e.g. Laitala and Boks 2012; Laitala and Klepp 2018; epa 2021).

- Broken zippers
- Loose/fallen-off buttons
- Holes
- Dissolved seams

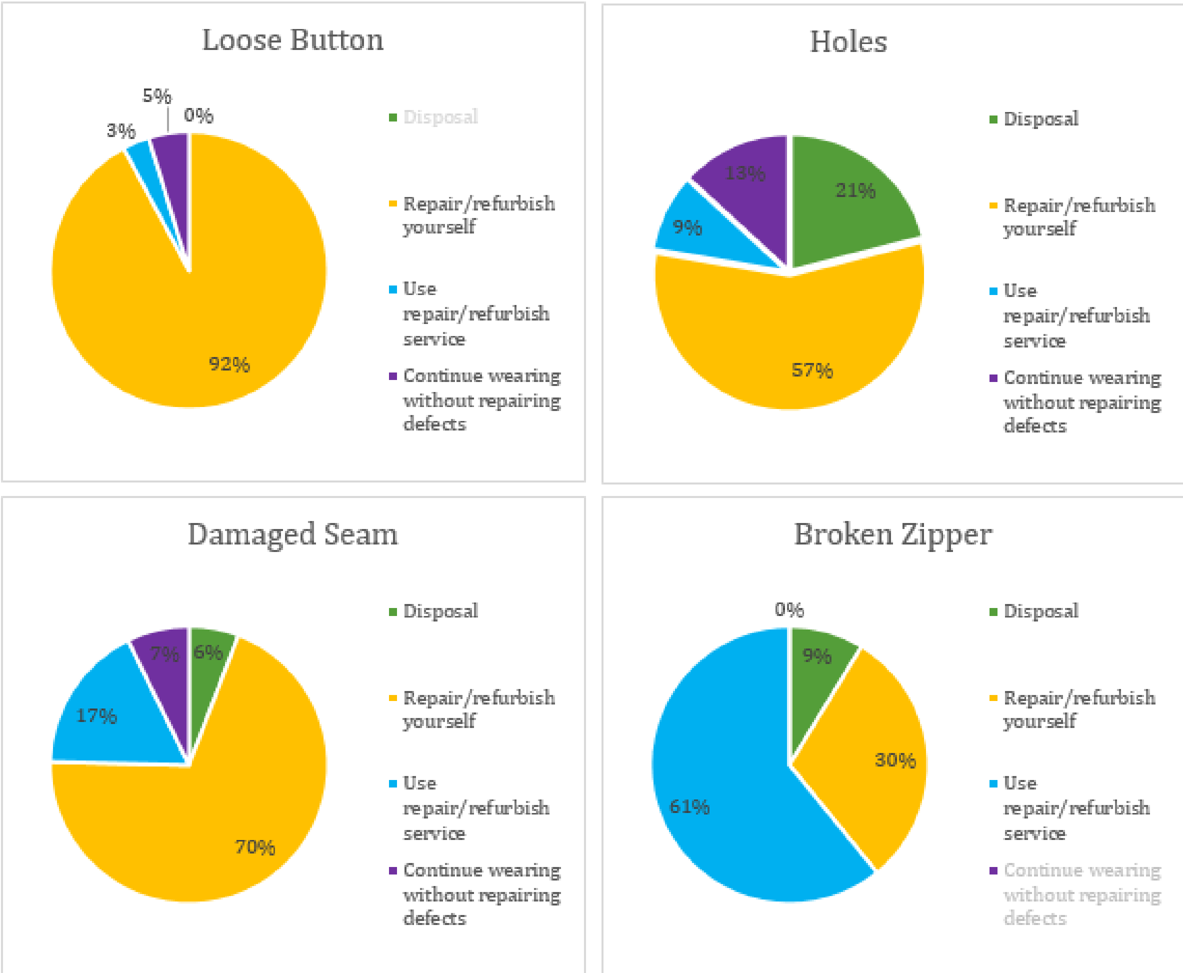
The relevance of these failures is corroborated by the results of a consumer survey with 61 participants, conducted by Fohrer et al. (2024). The most commonly occurring failures cited by the participants are the detaching of fasteners such as zippers and buttons, faults with the stitching and seams, stains, damaged material, dimensional changes, as well as print- and dye abrasion.

5.1.3 System level: Performing of repairs

Generally, consumers can either carry out repairs themselves or have them carried out by professional repair service providers. Self-repair can be conducted either in private or with support from a community in so called 'repair-cafés'. Professional repairs, meanwhile, have long since been provided by smaller tailor shops (Manoochehri et al. 2022). Nowadays, some enterprises are also offering to their customers their own repair services. To this end, enterprises may choose to cooperate with small third-party tailor shops, or to establish an in-house repair shop. The latter is becoming particularly popular in the activewear- and outdoor sector. Business models dedicated to repair in the textile and clothing sector also exist, e.g., repair rebels, who handle all communications and transactions related to repair for consumers and have the repairs carried out by small tailor shops.

A study by Laitala et al. (2021) shows that repairs can be performed successfully in most cases. Notably, out of the 625 participants, 270 participants perform repairs on their own, while only 107 participants have them performed by professional repair service providers. The extent to which self-repair is possible depends largely on the specific type of repair required. A consumer survey conducted as part of the project Re3Tex by Fohrer et al. (2023) provides concrete data on this topic. 61 participants took part in the survey, aged 18 to 65, with the 26 to 35 age group being the most represented. The survey results show that self-repair of a loose button is possible for 92% of participants. If a zipper is damaged 61% of participants would bring their garment to a professional repair service provider to get it fixed (see Figure 18)

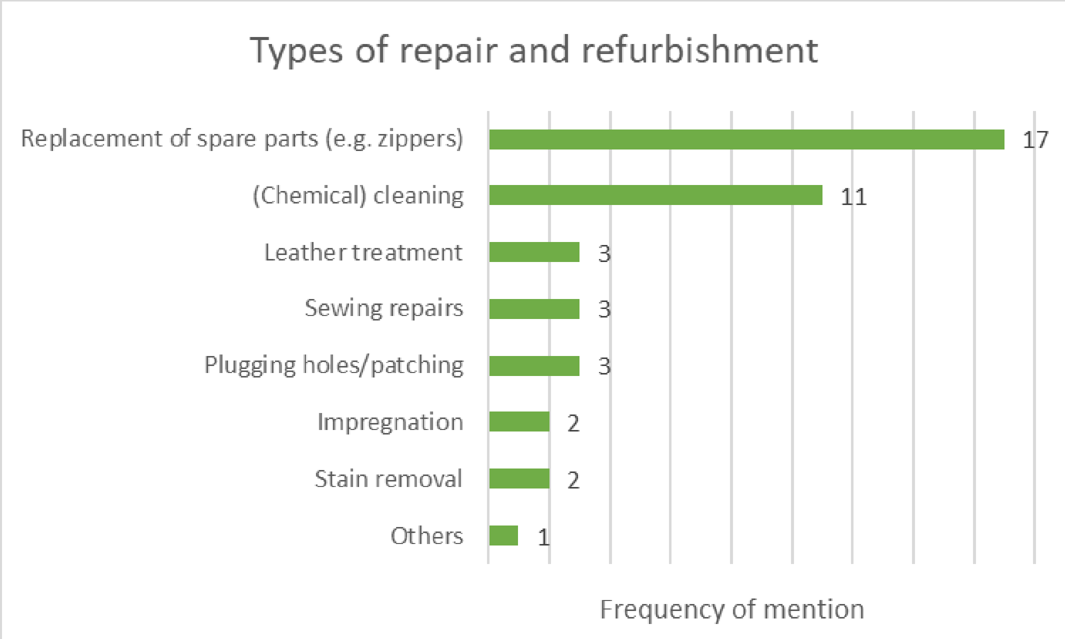
Figure 18: Clothing repairs carried out by consumers depending on the type of damage (n= 61 participants)



Source: Fohrer et al. (2023)

According to the survey 22 of the 61 participants also stated that they had already used repair or refurbishment services from professional providers. Figure 18 shows that the replacement of zippers represents the most frequently performed repair service by professional providers. The second most common measure is (chemical) cleaning, which was also included in the survey as a type of refurbishment. In contrast, repair services such as sewing or patching holes were utilized considerably less often.

Figure 19: Types of repair and refurbishment carried out by professional service providers (n= 22 participants, multiple options possible)



Source: Fohrer et al. (2023)

5.1.4 Consumer level: Consumer behaviour

The study *'The role of longevity and useful lifetime for the sustainable handling of clothing"* by Gimkiewicz et al. (2022), provides additional insights from a consumer perspective, as it also examined consumer behaviour regarding clothing repair. More than 70% of participants in a survey are quoted as saying that they would be comfortable with performing minor repairs, e.g., reattaching buttons or removing stains, on their own. Meanwhile, less than 20% of participants would feel comfortable performing more significant repairs, e.g., dimensional changes or swapping out a broken pocket or zipper (Gimkiewicz 2022).

According to the '*National Survey 2021 on Textiles: Attitudes & Behaviors"* by the EPA Circular Economy Programme and B&A (2021) (epa 2021), 48% of participants expressed a desire to repair their own clothing, but did not feel equipped to do so, either for lack of tools or skills (epa 2021). However, the desire to learn repair skills is comparably low. According to Gimkiewicz (2022) less than 20% of all participants answered with an affirmative on this topic.

Generally, this reluctance to perform repairs could be offset via professional repair services. A willingness to pay for repairs exists among consumers, as shown by a survey conducted by Ribeiro et al. (2023). 65.6% of the participants were receptive to the idea of paid repairs. This willingness, however, depends heavily on the price of the repair service being rendered. According to the ADEME study, the psychological threshold at which consumers decide to repair an item is 33% of the original price (ADEME 2022).

The (ultra-) fast fashion industry exacerbates this issue further. The low-price level often leads to garments in flawless condition being discarded and replaced. Additionally, consumers' emotional and non-material attachment to their clothing has strongly declined. Many people do not feel the need to repair damaged garments anymore, which in turn means that they have little motivation to bring their fast fashion pieces to repair services (Harris et al. 2016).

France aims to overcome this challenge by offering a bonus for repairs. Through this bonus, consumers can receive a subsidy of up to €25 for the repair of clothing and footwear. Certified repair workshops across various regions of the country provide their services, and the subsidised rebate is deducted directly from the invoice (Meyer 2024). A similar programme was launched in Berlin on January 18, 2025, albeit only for electronics up until now (Senatverwaltung für Mobilität, Verkehr, Klimaschutz und Umwelt 25 Jun 2025). Nevertheless, these initiatives will go on to show whether financial incentives can stimulate consumers' willingness to have products repaired.

The limited access to, and the lack of awareness for the available repair services for garments still pose a barrier for repair (Laitala et al. 2021). According to the survey by Fohrer et al. (2023), 31% of participants stated that they do not use repair services at all because of a lack of availability of such services. 19% do not use them because it is too much effort. A lack of confidence in the quality of the repairs and the result also factors into the lack of use of repair services, particularly when repairs need to be as subtle as possible and visible mending is undesirable (e.g., sewn-on patches).

5.1.5 Challenges in the context of repairability

Based on an initial literature review, the challenges that currently hamper the repairability of garments can be ascribed to the three established levels and summarised as follows:

Product level
Low base quality decreases a product's repairability

System level
Lacking availability of repair services
Repairs are personnel intensive and thus expensive (high costs)

Consumer level
Declining emotional attachment to clothing and shorter product use
Low price of new garments vs. repair costs
Inconvenience of repair as a barrier
Decrease of sewing skills among the population
Lack of information / repair guides
Limited access to repair services
Lack of trust in repair and results (functionality and aesthetics)

Most of the challenges for repair occur on the consumer level. This level is significantly influenced by pricing and the consumers' willingness to pay for repairs in the first place; a willingness which is, in turn, influenced by the monetary value (objective) as well as the emotional value (subjective) of the garment. The visibility of repairs is also a crucial factor for the consumers' acceptance.

On the flipside, factors which are influenced by the repair service providers can be deemed relatively insignificant for the repairability of a garment. Most repairs are currently easy to perform on a technical level; the biggest barriers therefore remain pricing and the consumers' acceptance of repair services. The complexity of a product does, however, directly influence the effort required to perform a repair: the more complex the product, the more time it takes to repair, and consequently, the repair becomes more cost-intensive. It is therefore necessary to examine which factors can facilitate repairs and contribute to the economic viability of repair services on a product level.

5.2 Considerations in relation to the product aspect and derivation of the requirements

In order to develop (minimum) requirements for the repairability of garments, a comprehensive approach was adopted, emphasizing the following key steps:

- Concepts and Criteria within the context of repairability: The literature review especially focused on existing concepts and approaches for the description and definition of repairability, as well as on the evaluation of products for their repair-friendliness. The purpose of this analysis was to gauge the extent to which the relevant evaluation criteria and methodologies used in non-textile-related systems could be applied to the garment sector.
- Case study: An experimental product analysis was undertaken to determine requirements for repair. This analysis was supported further by interviews conducted with repair service providers. This qualitative and quantitative analysis provided important insights to frequent barriers and potentials for garment repair. The purpose of the analysis was to develop realistic product-based performance requirements.
- Evaluation/verification: In order to assess the suitability of the previously developed performance requirements for the garment sector, interim results were presented and analysed at two separate workshops. The interdisciplinary working group 'repairability" was composed of experts from different fields, which allowed for inputs from designers, researchers, and companies in the garment- and workwear industry to be acknowledged and considered.

This approach formed the basis for the further development of performance requirements for the repairability of garments.

5.2.1 Concepts and criteria within the context of repairability

Various concepts and approaches for the description and evaluation of repairability already exist. The following Table 20 lists a selection of the analysed studies.

Table 20: Type of studies addressing the criteria repairability

Type of study	Study
Completed/ ongoing studies	e.g. Ecos Report (Botta and Cabral 2021), OVAM (Maes et al. 2021), Laitala et al. (2021), Wrap (2015), TAUW-report (Van de Burgt et al. 2023), JRC (Delre et al. 2024a)
EU initiative / directives / EU regulations / national laws	e.g. ESPR and Digital Product Passport (European Parliament; European Council 2024a), Directive on common rules promoting the repair of goods (Directive (EU) 2024/1799 2024)

Type of study	Study
Norms, standards, labels	e.g. DIN EN 45554:2020-10. EU Ecolabel for textiles (European Commission 2014a), Nordic Swan for textiles (Nordic Ecolabelling 2022), Blue Angel for textiles (DE-UZ 154) (RAL gGmbH 2025), LONGTIME® (Longtime 2022)
Repair-indices and -scores	e.g. Indice de Réparabilité (Ministère de la transition écologique aménagement du territoire transports ville et logement 2024), iFixit-Repair-Score (Souvanen et al. 2023)
Design-Guidelines, Design-Tools	e.g. Circular Design Kit (circular.fashion 2018), iFixit, bestseller (Bestseller 2022), Nike (Nike Inc.), re:fashion (Global Fashion Agenda 2020)

Sources: Own compilation, Hochschule Niederrhein

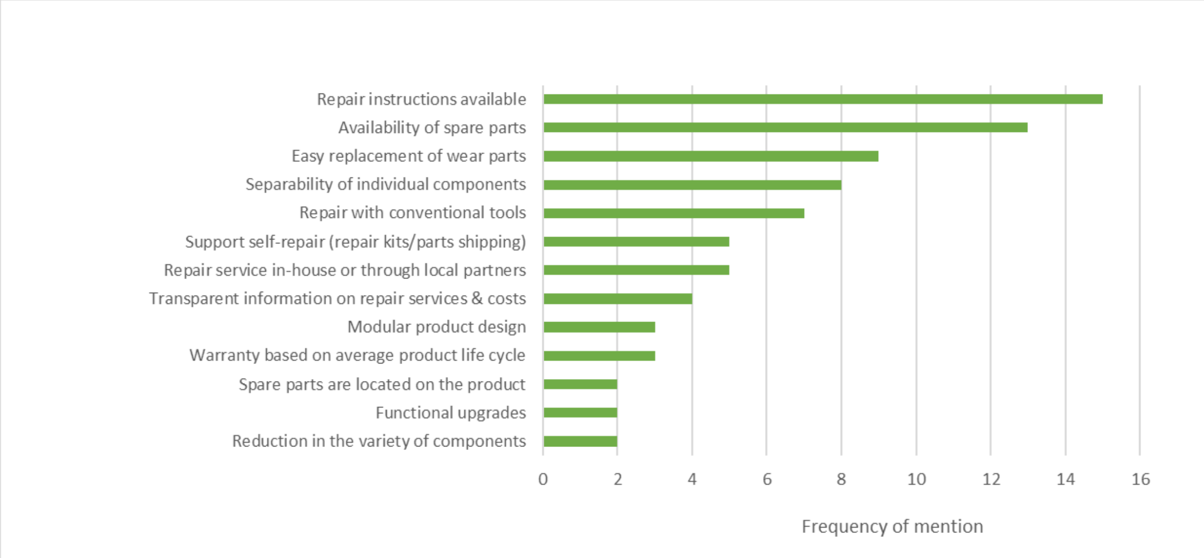
Throughout the garment sector, there already exist design guidelines and -tools, e.g., circular.fashion's Circular Design Kit, or re:fashion's Circular Design Toolbox, which include repair-friendly design approaches as a part of circular product design. Some companies also publish their design guidelines, e.g., Nike or H&M, whose guidelines include more generic approaches, or Vaude, whose in-house so called Reparaturindex serves as a system for the evaluation of the repairability of outdoor clothing in the design phase. An official system for the evaluation of the repairability of garments does so far not exist. For electronics, meanwhile, specific evaluation systems already exist, e.g., the French Repairability Index. In order to conform to the Ecodesign-Directive 2009/125/EG for energy-related products, which was a precursor to the current Ecodesign Regulation, several specific approaches were developed.

The existing approaches for electronics were analysed with a focus on possible indicators that a translation of their assessment-methodologies for the repairability of garments was feasible.

5.2.1.1 Criteria within the context of repairability

Based on the literature review of the studies listed in Table 20, recurring criteria and terms related to repairability were identified. Figure 20 shows how often these criteria were mentioned in the reviewed literature. The criteria were either explicitly named or described in textual form.

Figure 20: Recurring criteria in the context of repairability (n= 21, multiple options possible)

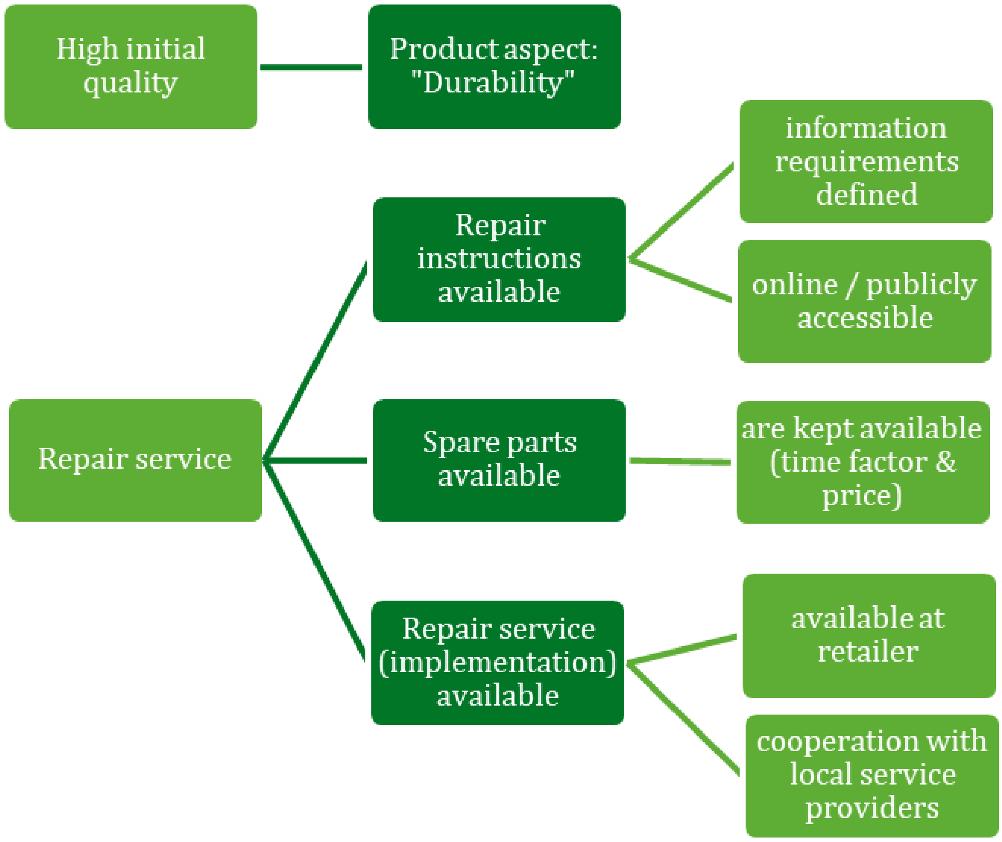


Source: Own work, Hochschule Niederrhein

The criteria identified in this first step served as a preliminary basis for the determination of key criteria and the derivation of requirements for the product aspect of repairability as it relates to clothing.

During the first workshop, the criteria cited in Figure 21 were discussed by the working group 'repairability" and elaborated on their relevance. In summary, a consensus was reached that the following key criteria were of particular relevance, and they were tentatively structured as follows:

Figure 21: Key criteria for repairability discussed in the working group 'repairability" during the 1st workshop



Source: Own work, Hochschule Niederrhein

The focused criteria primarily address aspects at the system level. However, key criteria such as the availability of repair services, repair instructions, and affordable spare parts also affect the consumer level. Criteria on a product-level were not yet integrated into the structure at this point. Nevertheless, the working group-participants agreed that the criterion '*ease of replacement of wearing parts*" in connection with the criterion '*ease of disassembly*" was of crucial importance as the manufacturing techniques used, e.g., when sewing a zipper into a garment, significantly impact its overall repairability.

Meanwhile, modular product design was a more divisive topic, with particular emphasis being placed on the fact that the criterion was only relevant for specific product groups, such as functional jackets.

5.2.1.2 Existing approaches for the evaluation of repairability

For the transfer from electronics related evaluation concepts onto garments are general, non-product specific evaluation concepts; in this case, product-specificity, complicates the transfer, as the repair of garments fundamentally differs from that of electronics. For the development of performance requirements for the repairability of garments, the following two concepts were examined:

The French Repairability Index

The French Repairability Index was introduced in 2021 as a measure in line with the '*Law on the fight against waste and the circular economy*' (LOI n° 2020-105 2020) and rates the repairability of electronics in different product categories (Runder Tisch Reparatur e.V. 2021; Zentrum für Europäischen Verbraucherschutz e.V. 2023). Currently, it covers the following product groups: washing machines, smartphones, laptops, TVs, lawnmowers, dishwashers, vacuum cleaners, and pressure washers. The Repairability Index shall, however, be expanded to cover more product groups in the future.

The evaluation method is applied analogously across all product categories. Five main criteria are ranked on a scale of 1-10, with several, differently weighted (sub-)criteria making up the main criteria's scores. The final score for each product is calculated by summing up the criteria's scores, then dividing the sum by 10. The final score must be displayed on the product. When describing and evaluating individual sub-criteria, some of them distinguish (wear) parts as 'particularly important" (List 1) and 'vulnerable" (List 2) parts; these distinctions are specific to each product category.

- **Documentation**
  The criterion being evaluated here is the availability of information for repair (e.g., repair instructions, technical manual, instructions leaflet, maintenance notice), as well as the duration for which it remains available. Another factor in the evaluation of the documentation for whom the information is provided: if a company, e.g., provides dedicated information for both repair service providers and consumers, the company will receive a higher score than if it would provide information only for one of these parties.

- **Ease of disassembly**
  Three sub-criteria are used to evaluate the ease of disassembly: a) ease of disassembly, measured by the number of steps required to replace typical, product-specific wear parts or parts that are important for the product's functionality, b) which tools are required to perform non-destructive disassembly (e.g., special tools or basic tools), and c) the types of fixations used to join the wear parts and/or important parts with the product, while also considering whether the parts can be reused upon reassembly.

- **Availability of spare parts**
  The evaluation considers vulnerable and function-critical parts in terms of (1) how many years they remain available after the product's market launch, and (2) the number of days between ordering a spare part and its delivery to the relevant actor.

- **Price of spare parts**
  The relative price of the most expensive spare part vis-à-vis the product's market price at the time of the calculation is evaluated for this criterion. Additionally, the average price of all wear parts (as detailed in the product specific list that is part of the Index) in relation to the product's original price.

- **Product specific criteria and specifications**
  Product specific evaluation criteria can be included in this criterion, e.g., the availability of software updates for laptops.

Joint Research Centre (JRC) Science for Policy Report

The European Commissions' JRCs' grading system for repairability aims to systematically evaluate the repairability of electronics, particularly smartphones and tablets. It is based on the standard EN 45554:2020 and supports the aims of the EU's Circular Economy Action Plan. The system combines a **three-step process** that follows a detailed methodology to ensure an objective appraisal of the products (Spiliotopoulos et al. 2022).

The individual process steps are:

1. Development of product-specific evaluation methods
   - Definition of the product properties to be evaluated and disassembly of the device to identify barriers for repair.
   - Methodological basis: prioritised parts and evaluation criteria are defined.
2. Calibration of the evaluation methods
   - Verification and adjustment of the evaluation-scheme based on actual devices and repair procedures.
   - Methodological basis: to ensure comparability, the identified key criteria are weighted according to their relative importance.
3. Validation of the rating-system
   - Verification of applicability and practicality by conducting real repair tests.
   - Methodological basis: a finalised rating system that is applicable for different product types can now be developed.

The methodological key elements of the rating system include:

Table 21: Methodological key elements of the rating system for electronic products

Aspect	Description
1. Definition of prioritised parts	Identification and weighting of critical and most failure-prone components.
Identification of critical parts	Determination of components with a high likelihood of failure (e.g., battery, display).
Evaluation of relevance	These parts are considered crucial for repairability and are regarded as especially important.
2. Selection of key criteria	Evaluation of crucial factors that determine the repairability of a product.
Access to information on repair	Availability of instructions, exploded diagrams, and lists of spare parts for both consumers and repair service providers.
Ease of disassembly	Number of steps required for the removal of critical parts without damaging the product or its fixations (e.g., screws vs. glue).
Required tools	Type and number of standard- and specialised tools required for repair.

Aspect	Description
Availability of spare parts	Timeframe during which spare parts remain available to independent repair service providers and consumers.
Software support	Provision of software- and security updates over a specific timeframe.
3. Development of a rating system	Combination of the criteria into a uniform scoring system for the quantitative evaluation of repairability.
Scoring system	Rating on a scale of 1 (difficult to repair) to 5 (easy to repair) after weighting all criteria.
Repair categories	Categorisation into classes from A (easy to repair) to E (difficult to repair) for the final results.

Source: Spiliotopoulos et al. (2022)

Thanks to the clear methodology used and the three-step evaluation process, a standardised evaluation process is possible. This process can be easily transferred for the evaluation of other devices or other products. The internal weighting of criteria varies between product groups and can be adjusted depending on the products' complexity and typical wear parts.

5.2.1.3 Derivation of potential indicators for repairability from existing approaches

The two approaches presented in Chapter 5.2.1.2. form the basis for potential indicators for repairability, as well as the base-structure for a rating system. Both systems show similarities in their descriptions of key criteria and factors for evaluation, though the French Repairability Index is more specific in its definitions in places. A noteworthy trait shared between the two approaches is their differentiation of 'prioritised," 'vulnerable," and 'functionally important" parts. Still, the systems vary in how different criteria are weighted and subsequently rated overall, both in terms of their structure and the product aspects they emphasise. The criterion 'ease of disassembly" takes a central role in both approaches, highlighting its significant importance, which is reflected in its relative weighting.

The importance of the disassembly further emphasises the need for an in-depth analysis on a product-level, namely to define especially vulnerable/prioritisation-worthy product sections and components of garments, and to identify which factors influence the ease of disassembly.

For the derivation of possible indicators for the repairability of garments as well as the structure for a rating system, the French Repairability Index served as the de facto basis, as it offers in-depth descriptions for the different criteria. The relevant aspects may be found in the draft for the list of performance requirements for the repairability of garments in Chapter 5.2.4. An in-depth comparison of the criteria that served as the basis for the case study may be found in the Annex A of this report.

5.2.2 Suitability test for textiles based on a case study

The suitability test for textiles conducted in this project follows a two-part approach in order to assess repairability from both a general and a product-centered perspective.

The first part focuses on the repair context itself and examines how repairs are carried out in practice, which types of damages are most common, and which factors influence repairability from the viewpoint of professional repair service providers. Therefore, repair service providers in the textile sector were interviewed according to a semi-structured questionnaire.

The second part addresses repairability on a product level. For this purpose, selected garments from the case study (jeans, classic T-shirt, and functional jacket) were examined in detail in order to identify product-specific repair requirements and barriers. The analysis focused on aspects such as construction methods, material combinations, accessibility of components, and fastening techniques, all of which may affect the feasibility and complexity of repairs.

By combining insights from repair actors with a technical product analysis, the case study aims to provide a comprehensive understanding of repairability: both as it is perceived and experienced in practice, and as it is reflected in the construction of the products themselves. The following sections describe the methodological approach and findings of both parts in detail.

5.2.2.1 Interview's approach

The questionnaire used in the interviews was developed based on the repairability criteria and discussion points addressed throughout the project. In addition, aspects that are currently being discussed in the context of the digital product passport were incorporated.

It focused on several key aspects: frequent damages, the types of repairs offered and the most frequently performed repairs, as well as the products most commonly brought for repair. Additionally, the service providers were asked for their personal definition of repairability, as well as the factors that, in their opinion, have the greatest influence on a product's repairability. The complexity of repairs and how to define it was addressed as well. Another question focused on the type of information that might facilitate repairs, e.g., the product type, technical drawings, and repair instructions. Further questions addressed their customers' willingness to pay and their price ranges, as well as the availability of spare parts. The questionnaire is attached in the Annex B.2.

Participants were selected to represent different types of repair actors within the textile sector. Accordingly, the sample included local tailoring and repair workshops in the Mönchengladbach region with one to two employees as well as larger national companies in the outdoor and sportswear sector with internal repair services and several repair workshops in different locations. This ensured that both small-scale and industrial-level repair practices were represented.

In total 25 perspectives were analysed. The interviews were conducted primarily in person and on-site, with a few carried out in written form or through video conferencing.

The responses were evaluated using a qualitative content-based approach, by identifying recurring themes and statements across all interviews. The findings serve as a practice-oriented perspective on repairability and form the basis for comparison with the product-specific analysis presented in Chapter 5.2.2.2.

In the following the most important findings are presented:

Frequency of repairs by product type

- Primarily trousers and jackets; also, T-shirts, shirts, and eveningwear.

Most frequent damages caused by wear and tear

- For trousers, an abraded inseam and holes at the knees,
- Zipper-repairs,
- Holes and torn seams,

- Damages to the membrane or tapings in outdoor clothing.

Relevant factors for the repairability of a garment

- Accessibility of the breakage; a multitude of seams impedes repair efforts and requires more work, driving up the price. This is especially common with zipper-repairs. Glued or welded seams make non-destructive repair almost impossible.
- The extent of the breakage, which is often related to how soon after the initial breakage the piece is brought in for repair.
- The fabric/material in relation to its quality, thickness, and fibre composition. Multifibre fabrics are often more difficult to repair because, e.g., the surface properties make holes harder to mend.

Availability of spare parts

- It is very difficult to acquire the original spare parts, but compatible replacements (though not the manufacturers' original spare parts) are usually available so long as a standard size was used.
- For original spare parts, long shipping times pose a challenge.
- Standardised spare parts with reduced variance would help increase repairability (e.g., using only standard sizes for zippers).

Helpful information for repair

- Repair service providers would rather benefit from information on matters of customer communications, e.g., when asking whether they would be willing to accept replacement (non-original) spare parts, or spare parts that do not perfectly match the product's colour.
- Information relating to the product itself are deemed less important. This includes, for example, product type, model-/style- and lot-number, technical drawings, seam types used, tech pack with material composition and list of accessories, technical manuals with repair instructions, and information on tools required for repair.

Out of these product-related types of information, only the material composition and the list of accessories was occasionally deemed to be of middling importance. The repair service providers considered all other suggested types of information to be of little to no help to them, as their professional expertise suffices to make decisions on these matters.

Customers' willingness to pay

- The decision to get a garment repaired is a highly individual one and frequently depends on the owner's emotional attachment to the textile.
- Overall, customers' willingness to pay for repairs, as well as the rates they are willing to pay, has decreased significantly.
- For more expensive items, customers are willing to pay around 25-30% of the garment's original retail price to get it repaired.

5.2.2.2 Product analysis

One of the most cited barriers for repair in the questionnaires is the lack of easy access to broken fasteners or fabric areas. Generally, it can be said that the complexity of a garment's construction and its manufacturing greatly influence how easy it is to repair. Across product groups, complex fabric layering, the joining of multiple product components in close proximity to each other, and non-functional seams (e.g., decorative stitching) create barriers when it comes to repairability.

Fasteners, trims and accessories add complexity to a garment. Each added element also poses increased potential for material failures – in this case, of the component itself. Especially functional and often indispensable fasteners like zippers compromise the usefulness and/or wearability of a garment upon breaking, yet they tend to be difficult to access and replace.

In line with the base assumption that simplicity facilitates repair, and under consideration of common garment failures cited in the questionnaire, several sample products from the focus groups (classic T-shirt, jeans, functional jacket) have been examined to determine where breakages can occur and what manufacturing practices may impede their repair. The following Table 22 shows the analysis using jeans as an example.

Very basic fabric breakages like tears or holes can occur in any product group. Similarly, seam failures are a universal breakage that may occur in any sewn garment, e.g., as a torn or dissolved seam. As these failures are often the result of abrasion, they are especially common in parts that are subjected to high physical stress, e.g., the inseam of a pair of denim trousers or the armpits of a T-shirt.

Though the ease of repair of material damages is beneficial, the construction of the garment cannot influence the repairability in a significant manner. Rather, fabric and seam failures (as well as the ease of repair) depend on the durability of the chosen materials, and therefore, they should be considered part of the product aspect of durability.

In more complex garments, such as the jeans and the functional jacket, potential failures become more specific to the product group. This specificity stems from typical features associated with the products, e.g., one may expect a jeans to have a zipper, two front pockets, two patch pockets on the back, several rivets, french seams, etc. In addition to these 'expected' features introducing a new level of complexity to the product, the repairability of the components can be further impeded by manufacturing choices made for each model.

Table 22: Excerpt from the analysis of the manufacturing of jeans

Manufacturing of overlay				
				
Description of zipper-manufacturing (Overlay)				
Zipper is attached to overlay-facing	Zipper sewn below elaborate shaped	Zipper is attached to overlay-facing	Zipper is attached to overlay-facing	Zipper is attached to overlay-facing

with two lockstitch-seams; facing also caught in J-stitching	waistband; zipper is attached to overlay-facing with two lockstitch-seams; facing also caught in J-stitching	with two lockstitch-seams; facing also caught in J-stitching; facing turned over with pocket lining and secured with additional stitching	with two lockstitch-seams; facing also caught in J-stitching	with two lockstitch-seams; facing also caught in J-stitching
Barriers for repair created by manufacturing				
no significant barriers	Multi-layered, complex shaped waistband with buttonholes impedes easy separation of waistband from zipper/zipper-facing	Secured turnover of pocket lining with zipper-facing impedes access to the zipper and requires more seams to be torn	no significant barriers	no significant barriers

Source: Photos by Hochschule Niederrhein (2024)

Table 23: Excerpt from the results of the analysis for jeans

Type of failure	Possible barriers for repair (esp. manufacturing techniques)	Possible approaches to facilitate repair (manufacturing and construction)
Zipper: broken or fallen-off zipper, broken coil/teeth, detached zipper tape	Elaborate turnover of the zipper-facing with the waistband Turnover of the zipper-facing with the pockets Layering of connecting seams over each other and/or overlock-seams Neatening of the edge of the facing after zipper-insertion, which potentially catches the zipper tape in the overlock-seam Use of special stitches for waistband manufacturing (e.g., elaborate chain stitches)	Not turning production pieces directly connected to the zipper over with other pieces (e.g., pockets) Wider seam allowances to avoid unintentionally catching the zipper with other seams (e.g., overlock seams) Wider seam allowances where bar tacks or overlock-seams may catch, e.g., the crotch seam For broken or fallen-off zippers: replacement zippers or easily re-threadable zippers Other zipper components kept in stock
Button: torn-out button, fallen-off button, loose button, fraying	(Torn-out buttons create a hole/tear; the material damage may be mendable) Elaborate manufacturing (riveting) used to put button in denim pants, making professional repair necessary to achieve good results Possible fraying of riveting-hole, especially after button-replacement	Easily replaceable buttons (also by laymen) Washers on the buttons' underside to prevent fraying

Source: Own work, Hochschule Niederrhein

Using the example of the zipper in jeans, analysis shows how barriers for repair can occur for a variety of reasons. Complicated turnover of the waistband and the facing behind the zipper may make the removal of the zipper difficult, while the pocket linings being turned over with the facing may necessitate additional seams to be opened to access the zipper at all. Some barriers may also be caused by the order in which manufacturing steps are performed: e.g., if the facing behind the zipper is neatened only after the zipper is sewn onto the facing, there is a chance that the overlock-seam may catch the zipper tape as well. When replacing the zipper, the overlock-seam would have to be undone and subsequently redone, increasing the steps required to repair the garment. It should be borne in mind that any layering of double-lockstitch- or chainstitch-seams over overlock-seams can impede intentional seam ripping and can lead to pulled or broken overlock-threads.

Though a functional jacket features a zipper as well, barriers for repair of this functionally similar component differ greatly from those of the denim trousers. Rather than being sewn onto an over-/underlay, the zipper in a functional jacket is typically turned over between two layers of fabric. As most functional jackets are also fully lined on the inside, access to the zipper is difficult without separating a sizeable portion of the lining from the shell fabric. Additional elements like flaps or dividing seams make the separation of all layers involved in the zipper's joining to the garment more difficult. On top of this, zippers in a functional jacket are frequently glued or taped onto the fabric, making the non-destructive separation of the zipper from the garment significantly more difficult.

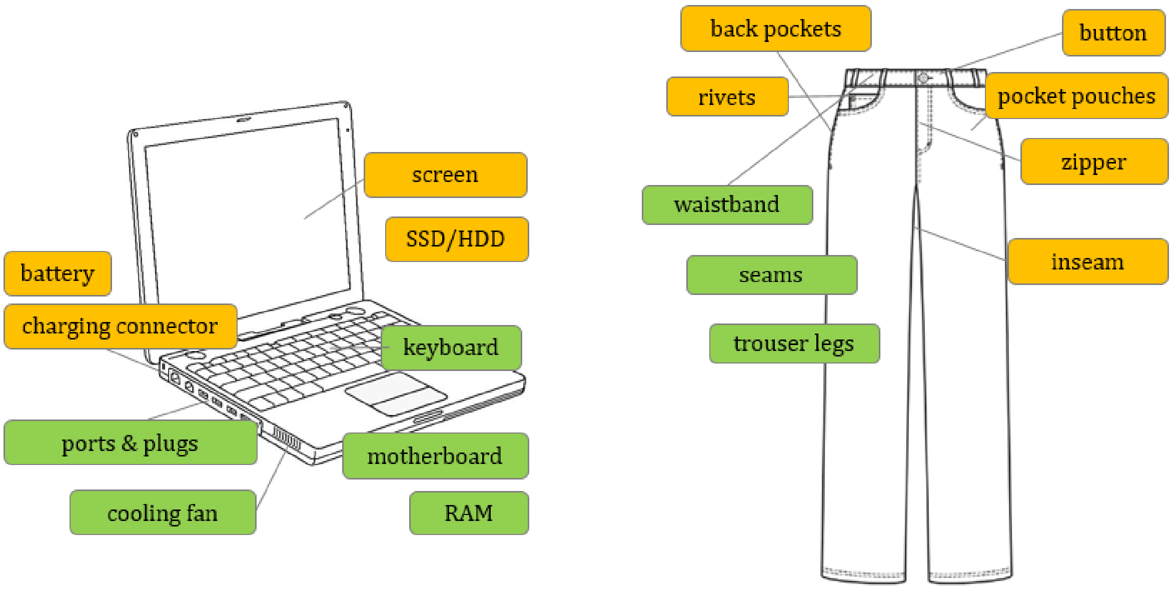
The differences between barriers for zipper repair in different product groups emphasise that repair must be considered fundamentally on a product group basis, which is a major challenge. The production of individual models can vary greatly, whether due to the manufacturer's preferred practices and/or for design reasons. The latter plays a far greater role for clothing than it does for electronic devices.

Another possibility to create an objective evaluation method for the complexity of repair could be – analogous to the French Repairability Index' number of steps required for disassembly – the number of seams that need to be opened before the repair can be undertaken. This approach would provide flexibility to account for design- and manufacturing-variations; when replacing a zipper, more complex processing typically translates to a higher number of seams that must be ripped and resewn, whereas a simpler manufacturing technique can often do with fewer seams. Additionally, the stitch type could be factored in as well: a simple, single-thread chainstitch, is easier to undo than an overlock seam, which is usually made up of a three- to four-thread system.

In order to implement this approach, however, it is necessary to clearly define the important and vulnerable parts for the respective product groups. Furthermore, a representative base number of seams would have to be determined, while an increasing number of seams would get rated worse and worse in predefined increments.

The French Repairability Index distinguishes between important and vulnerable points for electronic items (Runder Tisch Reparatur e.V. 2021). The following figure may serve to illustrate how the important and vulnerable parts of a laptop, as defined in the index, can be translated for jeans (see Figure 22).

Figure 22: Transfer of the important/vulnerable part-classification from a laptop to a jeans. Important parts are highlighted in green, while vulnerable parts are highlighted in orange.



Source: Own work, Hochschule Niederrhein; Picture of Laptop: VectorPortal, https://vectorportal.com/vector/laptop-vector-image-outline/10119

The insufficiency of this classification for garments becomes apparent when looking at how many of the vulnerable parts (highlighted in orange) double as important parts for the garment to be functional. Generally, any non-decorative part of a garment could be considered an important part, as the garment would not be functional without them. However, it makes sense to look at the vulnerable points.

The vulnerable parts of the product groups examined in this study may, for example, be determined as specified in Table 24 and Table 25.

Table 24: Type of failure (components)

Type of failure: (components)	Vulnerable parts: jeans	Vulnerable parts: classic T-shirt	Vulnerable parts: functional jacket
Zipper-failures, e.g., broken zipper	Front zipper, decorative zippers (if applicable)	/	Centre front zipper, pocket-zippers, hood-zipper, etc.
Torn out buttonholes or torn off buttons	Button(s) on waistband, decorative buttons (if applicable)	/	Press buttons (if applicable)
Torn out or dropped off rivets and eyelets	Rivets in the back pockets, coin pocket, or internal pockets	/	Eyelets (e.g., for drawstrings), press buttons

Source: Own work, Hochschule Niederrhein

Table 25: Type of failure (material)

Type of failure: (material)	**Vulnerable parts:** jeans	**Vulnerable parts:** classic T-shirt	**Vulnerable parts:** functional jacket
Tears and holes in stress-prone areas	Crotch seam, inseam, seat seam	Neckline, armpits, waist-area	Armpits, shoulders, cuffs
Unravelled hems	Trouser hems	Sleeve hems, shirt hem	Cuffs, hem of the jacket
Torn out patch pockets	Back pockets, especially around bar tacks/rivets	/	Pockets on the front of the jacket (if applicable)
Torn out internal pockets	Pocket openings or pocket pouches in the front trouser	/	Pocket openings or pocket pouches in the front panel
Tears and holes in the lining	/	/	Inner lining, especially close to hems

Source: Own work, Hochschule Niederrhein

As mentioned before, it may be useful to differentiate between fabric/material failures and component breakages, as material failures are a concern of durability and cannot be influenced through design or manufacture. It is therefore recommended to focus on the replacement of defective fasteners and other non-textile components and to ensure easy accessibility to these components.

5.2.3 Transfer of existing approaches onto garments

The structure and the potentially relevant repair-indicators featured in the French Repairability Index were transferred to form the basis for the list of performance requirements for the repairability of garments. The criteria were adjusted to match the garment sector and a tentative basis for a rating system was defined (see Table 26). Additionally, to address consumers' low willingness to engage with and pay for repair services, the criterion 'repair services" was added to the list. Workshop participants reviewed the individual criteria further at the second workshop, where they were evaluated for their suitability and feasibility.

Table 26: Transfer of French Repairability Index onto Garments – potential minimum criteria

Criterion	Sub-Criterion	Potential value corridors
1. Ease of disassembly	1.1 Ease of disassembly of the parts included in the list of vulnerable parts	
	1.1.1. Evaluation of ease of access to critical sections of the product -> accessibility of the relevant part judged by the number of seams that need ripping (notes required effort). Optionally, stitch type can be factored in as well (simple chainstitch = 1 thread, double lockstitch = 2 threads, overlock seams = usually 3-4 threads, cover stitch = usually 3-4 threads; welded seams => rated the worst)	*e.g., evaluation grid (1-3; 4-7, 8-more seams, via number of seams)*
	1.1.2. Type of fixations used for parts from the list of vulnerable parts -> possibility of non-destructive disassembly to remove broken part (e.g., rivets, welded seams, glue).	*e.g., Yes / No-rating*
	1.2 Tools required for disassembling the parts included in the list of vulnerable parts	
	Evaluation of availability/accessibility of tools required for repair, e.g., reattaching a loose button or mending a simple broken seam can be done with basic tools, while zipper-repair requires special tools.	*Repair is possible with basic tools* (rated better)/special tools** (rated worse)*
2. Availability of spare parts	2.1 Provision of original spare parts from the list of vulnerable parts	
	2.1.1. Evaluation of spare parts: are they standardised and accessible, and if not, can generic spare parts replace them without causing aesthetic or functional issues?	*e.g., Yes / No-rating*
	2.1.2. Evaluation whether spare parts for the original components are provided by the producer (if generic spare parts would lead to aesthetic or functional issues).	*e.g., Yes / No-rating*
	2.2 Availability period of spare parts from the list of vulnerable parts	
	Evaluation of the period (in years) for which producers keep original components on stock for spare parts.	*e.g., relative to overall product lifetime (cf. durability)*
	2.3 Shipping time for spare parts from the list of vulnerable parts	
	Evaluation of the delivery time and provision of the spare parts (in working days that pass between the initial placement of the order until the spare parts arrive at the repairing party's address).	*e.g., 5 days as a basis, anything longer than that is rated worse*

Criterion	Sub-Criterion	Potential value corridors
3. Documentation	3.1 Provision of information for repair for repair service providers	
	3.1.1 Clear identification of the product (product type, model-, style-, and lot-number).	*e.g., Yes / No-rating*
	3.1.2 Product data sheet/tech pack – overview of all elements of the garment and all information necessary to identify parts precisely, incl. technical drawings of the product's makeup.	*e.g., Yes / No-rating*
	3.1.3 Technical manual with repair instructions.	*e.g., Yes / No-rating*
	3.2 Provision of repair instructions for consumers	
	3.2.1 Instructions and tips for repair at home (recommended step, directions for safety and repair, required tools).	*e.g., Yes / No-rating*
	3.2.2 Information on access to professional repair services.	*e.g., Yes / No-rating*
4. Repair service	4.1 Access to professional repair services	
	Cooperation agreement with professional repair service providers exists, or the producer provides their own repair services.	*e.g., Yes / No-rating*
	4.2 Repair- and service handling	
	4.2.1 Repair is subsidized beyond the legal guarantee period.	*e.g., Yes / No-rating, or rating in predefined percentages (10%, 5%, no subsidies)*
	4.2.2 Handling services (shipping/logistics services) are subsidized.	*e.g., Yes / No-rating, or rating in predefined percentages (10%, 5%, no subsidies)*
5. Cost of repair	5.1 Relation of price for spare parts to original price	
	The lower the price for spare parts from the list of vulnerable parts in comparison to the product's original price, the more points are given for this criterion.	(e.g., less than 10% = high rating)
	5.2 Relation of price for repair services to original price	
	The relative price for repair costs when compared to the original market price of the product.	(e.g. < 30% = high score, < 60% medium

Criterion	Sub-Criterion	Potential value corridors
		score, < 90% low score)

Source: Own work, Hochschule Niederrhein

5.2.4 Discussion of repairability criteria: workshop insights and comparison with the JRC-study

The following section summarizes the outcomes of the workshop discussions on repairability criteria and relates them to the findings of the ongoing JRC study.

5.2.4.1 Workshop-based evaluation of repairability criteria

In the workshop series, participants evaluated the transferability of the French Repairability Index to the textile sector. The discussion focused on the suitability and feasibility of the proposed criteria, the definition of potential minimum requirements, and possible scoring ranges.

The criteria listed in Table 26 were presented on large-format posters and served as the basis for discussion. Participants first commented on the criteria individually using adhesive notes, before all items were jointly reviewed in a plenary session. Criteria considered unsuitable for the textile context were marked for removal, while relevant criteria were confirmed and, where necessary, reformulated. Additional refinements emerged through the group discussion.

The results summarized in the following section reflect a consolidated synthesis of the workshop outcomes. Verbatim participants wording was retained where appropriate; in other cases, statements were condensed to represent the dominant positions. The summary captures the main areas of agreement and debate, while individual remarks that were not broadly shared have not been included.

1. Ease of disassembly

The proposal to use *accessibility of the broken part judged by the number of seams that need ripping (evaluates required effort)* as a basis for assessment was generally acknowledged as a possibility to denote the complexity of repair. Nevertheless, it was also discussed critically for the following reasons:

- Assessing repairability on this basis would lead to a conflict of goals: repairability vs. high quality manufacturing. A higher number of seams is often required to construct a more durable / high quality garment (e.g., functional jackets). On this basis, such a product would receive a lower score. In this context, concerns regarding customer communications were expressed, particularly about the impression this evaluation method might give consumers.
- An evaluation of repairability by the time required to perform repairs was proposed as an alternative: e.g., less than 10 minutes would be considered easy to repair, 10 - 30 minutes would be considered moderately complex, and 30+ minutes would be considered very complicated to repair. For companies, the effort required to collect the necessary data on a product-basis would be untenable, however.
- A possibly more suitable basis for assessment for the ease of disassembly could be the criterion ‘tools required for repair”, wherein basic tools should be rated better than specialised tools (e.g., a sewing machine) and/or the need for an expert to repair it.

2. Availability of spare parts

The availability of spare parts was accepted as a key factor for repair. A simple yes/no-rating for the availability of standardised spare parts was deemed implementable. Meanwhile, the proposal to provide replacements for the original components was rejected on the grounds that providing comparable spare parts is sufficient. The period for which producers keep spare components on stock should be based on the expected useful life of the product, e.g., 5 years for a functional jacket.

3. Documentation

The provision of information for repair was viewed critically. While repair information and guides for consumers were considered worthwhile, the work group did not see the need to provide professional repair service providers with, e.g., technical drawings or manuals, seeing as the service providers already possess the necessary skills and expertise. A proposal to introduce the criteria '*sufficient information is provided*" and '*no information is provided*" to rate repair instructions was brought forward.

4. Repair services

Access to professional repair services was viewed favourably and its availability should be considered via a yes/no-rating. This could include cooperation agreements with professional, third-party repair service providers or a company-owned repair service. Boni/subsidies for repair and handling were rejected as they were deemed too complicated to implement. They could also be seen as an interference with a company's internal decision making.

5. Costs of repair

Discussing whether repair costs in relation to the original market price of the product could serve as an assessment criterion ultimately resulted in the criterion being scrapped. Reasons given for this decision were the difficulty of comparing costs, as well as the possibility of consumers being discouraged from having their products repaired, e.g., because they might avoid high repair costs for low-priced products. Discussing the proposed three-tiered rating system (repair costs < 30% of the original purchase price = high score, < 60% = medium score, < 90% = low score) therefore became redundant.

The criteria and bases for assessment for which the work group reached an agreement are summarised in the table below. Additionally, a direct comparison with the JRC Preparatory Study for product policy instruments is included. Task 4 of the study (Delre et al. 2024c), which included its current status, was published at the same time as the workshop. This task also includes indicators for repair to describe the repairability of garments. It should be noted that that this part of the study does not yet include the weighting of the individual indicators, nor does it clearly state how to apply the rating-structure or how to verify it. Besides defining the key criteria (cited here as 'criteria"), the study also describes which aspects lead to a '*relatively easy repair*" and a '*relatively difficult repair*".

Table 27: Repair indicators after the 2nd workshop and comparison with the JRC-study (Delre et al. 2024a)

Criterion	Sub-criterion	Assessment standard	JRC-study
1. Ease of disassembly	Necessary tools for the removal of components from the list of vulnerable parts.	Possible with basic tools / specialised	Considers the seam type, number of layers, and

Criterion	Sub-criterion	Assessment standard	JRC-study
		tools / expertise from a professional	accessibility of connecting elements. The evaluation of tools is an own criterion. Here, the type and availability of tools is rated.
2. Availability of spare parts	Standardised spare parts for the respective product are made available according to the respective product's lifetime.	Yes / No-rating	The basis for evaluation is whether standard fastenings are used and if they are readily available.
3. Documentation	3.1 Instructions for self-repair are available and sufficient. (The instructions include at least details on the necessary steps for repair, directions for safety and repair, required tools)	Yes / No-rating	The criterion is part of 'resources to support repair" and evaluates the availability of both, repair instructions and services.
	3.2 Availability of information on access to professional repair services.	Yes / No-rating	The criterion of availability of information on repair services is not considered in the JRC-study.
4. Repair service	Cooperation agreement with professional repair service providers exists, or the company offers an in-house repair service.	Yes / No-rating	The criterion is part of 'resources to support repair" (see above). It focusses on the regional availability of such offers.

5.2.4.2 Discussion and synthesis in relation to the JRC-study

The overview above shows that the indicators for repair cited in the JRC-study broadly match the work group's prioritised indicators. A notable difference between the two results is the criterion *'ease of disassembly*", which is a much bigger focus point in the JRC-study. It describes the '*complexity of disassembly*" based on three major features:

1. Types of connections

   Seams and seam-types are the basis for this assessment.

2. Fabric layering

   It is assumed that garments made up of only a single pattern piece are easier to disassemble and repair than multipiece and/or multilayered garments. Both modularity and the number of fabric layers are considered for this point.

3. Access points

   Visible access points that facilitate the replacement of parts or alterations are considered repair-friendly aspects.

Indicators on the product level

The description of product-complexity based on *'type of connection*" and different seam- and stitch types featured in the JRC-study is similar to the initial proposal of this study. The initial proposal, however, is still more in-depth than the JRC's approach: by considering the number of seams, the steps become quantifiable, which allows for a more precise evaluation. The visibility of access points mentioned in the JRC-study was not considered in this report, though it could be a useful inclusion in complex products.

Evaluation based on the number of '*fabric layers*" as proposed in the JRC-study is deemed less relevant. Instead, the types of connections between layers, as well as the manufacturing techniques used in their joining are crucial to consider. As the product analysis has shown, when repairing, e.g., a faulty zipper in a pair of denim trousers, if and how it is connected or turned over with other cut pieces (e.g., waistband, pockets) is a crucial factor in determining its repairability. Ease of replacement depends a lot on how the zipper is sewn into the trousers, and how many cut pieces its seams are integrated into. Even if the number of parts that make up the garment is the same, different manufacturing techniques can impede repair.

After considering the contributions of workshop participants, the remaining product level indicators are much fewer than in the initial proposal or in the JRC-study. The product's complexity is only defined via the '*necessary tools*". The type and availability of tools is considered as a separate indicator in the JRC-study (Delre et al. 2024a).

Depending on how the evaluation matrix is structured, a problem mentioned by the workshop participants regarding this aspect remains; namely, that a variety of (complex) products would either receive a worse score on principle or be excluded. E.g., a broken zipper in a jeans or a functional jacket, for example, cannot be repaired with basic sewing tools. This indicates of how repair-friendly a product actually is, particularly as an expensive garment (like a functional jacket) is more likely to be brought to a professional repair service provider.

- ► If future legislation should focus on the product level and the comparability of different products with each other, a precise evaluation methodology becomes necessary. Differentiated and specific indicators for individual product groups would then become a necessity. This way, it can be ensured that complicated products such as functional jackets would be able to receive a high repairability score in their respective product category.
- ► As this approach is very demanding, gradually introducing these indicators as 'should"-criteria next to the more generic requirements may be a sensitive strategy.

Economic indicators

In the initial proposal, the criteria '*repair service*" and '*cost of repair*" were included to represent the influence of prices on consumers' willingness to get their garments repaired (professionally). The inclusion of these economic indicators was rejected by the stakeholders due to the mentioned reasons, however. The JRC-study does not include any economic indicators either, but points out that an important precondition for repairability is that the cost of repair should be acceptable for consumers, especially when comparing it with the price for a new product.

- ► It can be assumed that spare parts for garments have a lower impact in terms of overall repair costs compared to electronics. The majority of costs are incurred through the rendering of the repair service itself. The more complex a product is constructed and manufactured, the higher the effort required to repair it. Through this, the indicator 'ease of disassembly" already becomes part of the pricing. If a product would have a repairability score, this could motivate producers to push for repair-friendly designs. This would also have a positive influence on repair costs.

Initiatives such as the introduction of repair bonuses – such as the ones already established in France and the ones being piloted in German cities like Berlin – offer promising approaches that may increase consumers' willingness to pay for repairs. By introducing economic incentives of this nature, the challenge posed by high repair costs can be tackled and does not necessarily have to be included as part of the minimum requirements set for products.

5.3 Proposal for minimum requirements

For setting minimum requirements for the repair of garments, different scenarios are possible. A decisive factor is the way in which they shall be displayed – whether they remain, e.g., solely information requirements or if a repairability score is shown on/next to the product.

5.3.1 Possible scenarios for requirements for repairability

Scenario 1 is intended as the mandatory baseline for market entry, ensuring that all products meet a minimum level of repairability. **Scenarios 2 and 3 are presented as preparatory and forward-looking options,** designed to support a smooth transition should future policy developments require stricter or more comprehensive repairability criteria. The requirements were developed based on the derivation's findings, as well as the inputs and new perspectives gained during the discussions.

5.3.1.1 Scenario 1: Information requirements as mandatory requirements for market entry

The following Table 28 shows a proposal for minimum requirements for garments that can be applied to all product groups as mandatory minimum requirements. These requirements are information requirements that enterprises must make publicly available. It is conceivable that the relevant information is provided both on the company's website and within the digital product passport. This way, conformity with these requirements can easily be verified by the relevant authorities in a random sample.

Table 28: Mandatory minimum information requirements ('generic requirements")

Criterion	Sub-criterion
1. Availability of spare parts*	1.1 Standardised spare parts ** are used <u>or</u> using compatible, generic spare parts does not lead to aesthetic or functional deficits. 1.2 Spare parts are readily available for purchase in public stores (online/offline). Non-standardised spare parts (that cannot be replaced by generic spare parts) are kept on stock for at least the duration of the legal guarantee period.
2. Documentation	2.1 Sufficient instructions for self-repair exist. They include at minimum a detailed description of the necessary steps for repair, directions for safety and repair, and the required sewing tools for generic damages. 2.2 Information on access to professional repair service providers exists.

Criterion	Sub-criterion
3. Repair service	Cooperation agreements with professional repair service providers exist, or the enterprise offers a company-owned repair service, or the company demonstrably refers to high-quality repair options that are easily accessible to customers (e.g. local tailors, repair networks) and actively supports their use – for example, by referring customers or providing information.

*Spare parts: e.g. buttons, zippers, belt buckles etc., threads, and/or any other components that are needed to repair the product.

**Standardised spare parts: e.g. standard sizes and diameters of (press) buttons, hook fasteners and eyelets, standardised zip lengths, teeth, sliders, etc.

This scenario establishes base conditions for the evaluation of repair. Especially the standardisation of spare parts and the availability of repair services for both, consumers and professional repair service providers, can be improved significantly compared to the current status quo. This scenario does not, however, lend itself to the comparison of different products with each other, nor for the calculation of a displayable repairability score. Feasibly, products could be labeled with icons indicating, e.g., 'repair instructions available" or 'spare parts available" instead of a repairability score.

5.3.1.2 Scenario 2: Information requirements in relation to a repairability-score

Instead of 'mandatory criteria", products are evaluated based on the degree to which they fulfil the requirements. The more criteria they fulfil, the better the overall evaluation. The evaluation can either be based on a simple scoring system or weigh each criterion according to its relative importance. In the end, the repairability score can then be calculated as either an absolute value, or a percentage. Table 29 presents a possible weighting of criteria:

Table 29: Information requirements in relation to a repairability-score

Criterion	Sub-criterion	Assessment standard
1. Availability of spare parts	1.1 Standardised spare parts are used <u>or</u> using compatible, generic spare parts does not lead to aesthetic or functional deficits. (20%) 1.2 Spare parts are readily available for purchase in public stores (online/offline). Non-standardised spare parts (that cannot be replaced by generic spare parts) are kept on stock for at least the duration of the legal guarantee period. (20%)	*40%*
2. Documentation	2.1 Sufficient instructions for self-repair exist. They include at minimum a detailed description of the necessary steps for repair, directions for safety and repair, and the required sewing tools for generic damages. (15%) 2.2 Information on access to professional repair service providers exists. (15%)	*30%*
3. Repair service	Cooperation agreements with professional repair service providers exist, or the enterprise offers a company-owned repair service, **or** the company demonstrably refers to high-quality repair options that are easily accessible to customers (e.g. local tailors, repair networks) and	*30%*

Criterion	Sub-criterion	Assessment standard
	actively supports their use – for example, by referring customers **or** providing information.	

The greater weight attributed to the criterion '*availability of spare parts*" is due to it being a prerequisite for the implementation of all other criteria.

For this scenario using an absolute repairability score, a scoring-system could be used; here, each sub-criterion could be awarded with one point, making the maximum repairability-score 5.

In this case, verification would not differ from the first scenario, which is an advantage in terms of its workability. The major issue with this variant is that it may not significantly incentivise repair-friendly design, as products can easily reach a score that would categorise them as repairable.

5.3.1.3 Scenario 3: Information requirements for 'repairability performance" on a product level

As shown in Chapter 5.2.4, requirements on a product level are not applicable across product groups. It is necessary to set more nuanced and specific indicators for different product groups.

When introducing indicators at product level, it is advisable to assign points to each sub-criterion to derive a total repairability-score at the end (see Table 30). The sub-criteria here cover the replaceability of parts, the type of fixation and the number of seams. A 5-point scoring-system may be a possibility here as well. In this case, the assigned score should express the repair-performance: 5 points for a sub-criterion mean '*good repairability*", 3 points mean '*limited repairability*", and 1 point means '*low repairability*".

For denim trousers, it may be applied as follows:

Table 30: 'Repairability performance" on a product level

Criterion	Sub-criterion	Score
Ease of disassembly	4. 1 **Parts** from the list of vulnerable parts can be replaced with basic tools (scissors, needle, thread).	*5*
	Parts from the list of vulnerable parts can be replaced with specialised tools.	***3***
	Parts from the list of vulnerable parts cannot be replaced.	*1*
	4.2 The **type of fixation** allows for easy, non-destructive access to vulnerable parts (use of simple chain- and double-lockstitches, replaceable trims).	***5***
	The **type of fixation** allows for non-destructive access to vulnerable parts (use of more complicated seam-types, replaceable trims).	*3*
	The **type of fixation** allows for destructive access to vulnerable parts only and/or includes non-replaceable trims.	*1*

	4.3 The product's construction, when measured by the **number of seams** that must be undone, allows for quick access to a faulty zipper (e.g., 13 seams for basic zipper-processing). Number of seams is lower than / equal to 13	*5*
	Number of seams is between 13 and 20	***3***
	Number of seams is greater than 20	*1*
Repairability score	Average score (x/3 sub-criteria) = repairability score x/5	

The repairability score in the example given above is: (3+5+3) / 3 = 3.7/5

The final repairability value depends on how the generic indicators are incorporated into the assessment. There are two possibilities:

- The generic indicators continue to represent 'must' criteria, and the repairability value is derived solely from the score at the product level.
- The generic indicators are included in the calculation of the repairability value at the product level without their fulfilment being mandatory. However, if generic indicators 1 to 3 are not met, a specified factor may be deducted from the determined repairability value at the product level.

Compared to the previous scenarios, approaching the repair score on a product level makes verification much more complicated. Typically, product information is not provided to the extent required to use this approach, be it on the product itself or in advertising.

One possible way to verify repairability claims could, e.g., be a technical drawing of the product, including how it is manufactured and what components are included. This type of information is usually included in so called tech packs (a document in the communication between designer and manufacturer). Enterprises must keep this information on hand and provide it in case they are asked to verify their claims. This variant therefore places the declaration of the repairability-score in the enterprises' hands.

5.3.2 Selection scheme for product-specific requirements

Product-specific requirements for repairability are not appropriate for all textile products. If product-specific requirements are to be introduced in the future, a selection scheme will be necessary to identify the relevant products (or product groups). The complexity of a product, as well as the design's impact on repairability play a major role in this decision. The following proposal shows a possible system that considers these factors. The selection of characteristics is based on the previous analytical work, including the evaluation and discussion product-related criteria. If one or more of the following characteristics apply, the inclusion of product-specific requirements is recommended.

1. **Number and variety of components**

- ≤ 2 main components -> generic requirements only
- >2 main components -> product-specific requirements

Examples

- T-shirt -> 1 main component (fabric)

- Jeans -> several components (e.g. buttons, zippers, rivets, different layers of fabric)

2. Repair-relevant components

Does the product have components that typically fail?

- No -> generic requirements only
- Yes -> product-specific requirements

Examples

- Jeans -> e.g. front zipper, buttons
- Functional jacket -> e.g. zipper, press buttons, eyelets, functional finishes (e.g. durable water repellent)

3. Repair tool requirement

- Repair without tools or with standard tools -> generic requirements only
- Special tools required -> product-specific requirements

Examples

- T-shirt -> only needles/thread required
- Jeans -> e.g. sewing machine, riveting tool

4. Influence of design on repairability

- The product can hardly be designed variably -> generic requirements only
- Design decisions can make repairs more difficult or easier -> product-specific requirements

Examples

- T-shirt -> Only few design options to improve repairability.
- Functional jacket -> Processing and connection of components significantly affects repairability.

Table 31: The final classification for the example products considered would therefore be

Characteristic	T-shirt	Jeans	Functional jacket
More than two main components	No	Yes	Yes
Contains components that often break	No	Yes	Yes
Requires special tools for repair	No	Yes	Yes

Design influences ease of repair	No	Yes	Yes

This classification suggests that only the T-shirt can be adequately assessed using generic parameters, whereas the jeans and functional jacket exhibit a level of complexity that warrants the inclusion of product-specific parameters.

5.4 Possible implications / and potential impacts

The previously described scenarios serve as a foundation for the further development of requirements related to the repairability of clothing. To enable viable and practical solutions, it is necessary to continue evaluating their effectiveness and feasibility, considering potential interactions with other product aspects (see chapter 10.1) as well as the perspectives of relevant industry stakeholders.

In this context, stakeholder feedback from the statements has been considered and summarised below to highlight key concerns and suggestions regarding the practical implementation of the final requirements presented.

- **Standardised spare parts** were critically discussed. While the idea aims to facilitate repairability, industry representatives emphasised the need for a clear definition and flexible implementation. Uniformity in components such as buttons or zippers may compromise product quality, technical functionality, and brand aesthetics. In addition, the use of standard parts must not lead to significant deviations in product appearance or performance.
  - The proposed requirement does not intend to enforce strict uniformity of components across all products, but rather to ensure that essential parts - such as buttons, press fasteners, or zippers -are selected in such a way that functional repairs remain feasible. For instance, choosing zip lengths or closure types that are widely available on the market helps avoid situations where replacement becomes impossible, ultimately reducing the product's repairability.
  - Standardisation, in this context, refers to avoiding the exclusive use of highly specific or proprietary components that hinder repair. The aim is to allow for the use of compatible, non-identical spare parts without compromising core functions or aesthetics. Examples include using zippers with common lengths and slider types, or widely available fastener formats. Minimum criteria could reflect such considerations while leaving room for product-specific adaptations. Functionality and durability should take precedence while preserving design freedom and brand-specific features.
- **Spare part storage** was seen as ecologically and economically challenging, particularly for SMEs. The requirement to maintain stock of non-standardised components risks generating waste and high logistics burdens, which may run counter to sustainability goals. Suggestions included limiting obligations to certain product categories or time frames or linking them to voluntary commitments.
  - The proposed criterion for standardized spare parts addresses this concern by explicitly allowing the use of generic and compatible spare parts. As a result, the storage requirement applies only to components that cannot be replaced by commonly available standard parts – effectively limiting obligations to exceptional cases. Moreover, it is expected that truly non-substitutable parts represent only a small fraction of all potential

replacements. A more detailed assessment of common defects and component types would help determine the actual relevance of spare part stockkeeping in practice. Linking the storage period to the legal guarantee timeframe is considered proportionate, as it ensures availability during the period in which consumers are legally entitled to repairs.

- Regarding **repair documentation**, stakeholders noted the high administrative and technical effort involved in providing detailed, product-specific repair instructions, especially given the diversity of textile products and limited repair skills or tools available to consumers. Instead, stakeholders advocated for more general, product-group-level guidance and flexibility, possibly integrated into digital tools like the Digital Product Passport.

  - The proposed criterion for repair documentation does not require product-specific instructions for every individual item. Instead, companies may provide generic guidance addressing typical types of damage - such as reattaching buttons or replacing zipper sliders - applicable across product groups. Where appropriate, links to high-quality external resources (e.g. iFixit) may be included. For more complex or safety-relevant repairs, such as full zipper replacements, companies are encouraged to clearly indicate the need for professional repair and, where feasible, link to appropriate service options.

- The requirement for in-house or contracted **repair services** was considered infeasible for many companies. While the objective of enabling repairs is widely supported, stakeholders raised concerns about the lack of available service infrastructure, the economic viability of formal cooperation agreements, and the risk of disadvantaging more accessible and often more sustainable local repair options. Several stakeholders emphasised the need for inclusive approaches that do not penalise companies for referring customers to qualified local solutions.

  - In response to this feedback, the minimum criterion was broadened to also recognize the referral to high-quality, climate-friendly, and accessible repair options - such as local tailoring services or repair networks - as a valid alternative, if companies actively support their use (e.g. through referral mechanisms or provision of information). Looking ahead, companies could also meet this requirement by referring to a centralized, publicly accessible directory of qualified textile repair providers, should such a platform be established in Germany in the future - similar to Refashion's 'Bonus Réparation map" introduced under the repair bonus scheme in France (Re_fashion 2025c).

- Regarding product disassembly, views highlighted potential conflicts between ease of repair and overall product durability. For instance, standardizing seam designs for the sake of dismantling might compromise the robustness of outdoor or technical garments. Stakeholders advocate more differentiated, product-specific considerations rather than general requirements.

  - To ensure that design-for-repair approaches do not undermine functional product lifespan, durability should remain the primary design priority. Should future product-specific requirements be introduced, this potential conflict must be carefully addressed by integrating further analysis of typical use cases, material stress factors, and consumer expectations into their development.

Overall, the stakeholder feedback underlines the importance of **practicability**, **proportionality**, and **flexibility** in the design of repairability requirements. There is broad agreement that future regulation should allow for differentiated approaches, depending on product type, usage context, and repair potential.

A balanced approach could consist of a combination of targeted, binding information requirements for companies (see 5.3.1.1 for the minimum requirements), complemented by voluntary design guidelines. These guidelines should be specifically tailored to product groups in order to strategically enhance and operationalize existing repair-oriented design frameworks within the textile sector.

6 (Fibre-to-fibre) recyclability and recycled content

6.1 Status Quo in relation to textile recycling

6.1.1 Textile recycling and management of textile waste in the EU-27

Generally, waste fractions are divided into pre- and post-consumer material (see definitions in chapter 6.3.1). While the Waste Framework Directive (Directive 2008/98/EC 2008; WFD) requires Member States to generally prevent waste generation, it does not contain specific provisions for post-consumer waste in general. Though, through the revision of the WFD, Extended Producer Responsibility (EPR) for post-consumer textile waste will need to be established in all Member States. Furthermore, the Waste Shipment Regulation (European Union 2024a) regulates the management of post-consumer waste in EU and its potential shipment within the EU and from the EU to third countries.

The pre-consumer textile waste category can be subdivided into post-industrial waste and unsold goods. In the textile production chain, post-industrial waste is mainly yarn and fabric waste (such as cutting waste and selvedge). Furthermore, post-industrial waste includes stock fabrics that are wasted due to limited storage capacities and suppliers enlarging their inventories to tackle demand fluctuations (Delre et al. 2024c). Thus, this waste is generated in the countries where the textile production takes place. In the countries that import textiles, on the other hand, a different type of pre-consumer waste is generated, unsold goods. It refers to textile products that have already been displayed in department stores and shops, but have been rejected in favour of other collections or online-shopped clothing that is sent back for whatever reason (Huygens et al. 2023). Pre-consumer textile waste is addressed through the ESPR which prohibits the destruction of unsold apparel and footwear products in the EU unless certain derogations apply. Delre et al. (2024c) note that 'the ESPR only addresses unsold products in the EU, while it does not address pre-consumer textile waste generated at manufacturing stage in third countries."

Huygens et al. (2023) estimated the total textile waste in the EU-27 at 12.6 Mt/year, of which post-consumer waste was the dominant fraction, accounting for 87% of all textile waste. Post-industrial waste makes up about 11%, and unsold goods about 3% of the total textile waste. Currently, only about 38% of the textile waste in the EU-27 is collected separately. Consequently, 62% of the textile waste is incinerated or landfilled. The majority of separately collected textile waste is exported unsorted (around 40%) or pre-sorted (about 35%) outside the EU, particularly to Africa and Asia. About 10% of the sorted used textiles are reused within the EU, which corresponds to about 7% of the collected used textiles. Approximately 32% of the collected used textiles are subjected to a recycling process.

According to Huygens et al. (2023), the European market for the recycling of textile waste has an overall capacity of 0.7–0.8 Mt/year, with about two-thirds of the capacity dedicated to open-loop recycling into cleaning rags or non-woven products. 0.2–0.3 Mt/year are processed in closed-loop recycling processes aimed at reusing the recycled fibres in the apparel sector. This capacity is distributed among 11 larger recyclers with a throughput of over 5 kt/year and 36 entities with smaller or unknown capacities. At least 50% of the input stream for recyclers consists of post-industrial and pre-consumer waste (Huygens et al. 2023), with some companies indicating that they are increasingly shifting to or planning to use post-consumer waste. Within Europe, there is a concentration of recycling companies in Italy and Spain (Fashion for Good; Circle Economy 2022; Delre et al. 2024a).

The recycling processes currently applied are mostly open-loop processes. The majority of processed used textiles are mechanically processed by cutting, grinding, or shredding and turned into cleaning cloths, insulation materials, or nonwovens, for example, for the automotive industry. Only about 30% of the used textiles available for recycling in the EU are recycled with the aim of the recycled material being used in a textile application. For technical reasons, with mechanical recycling being the dominant recycling pathway, only about 16% of spinnable fibres can be obtained from this input stream, which corresponds to 5% of the used textiles designated for recycling and 1–2% of the separately collected used textiles (Huygens et al. 2023).

Generally, a distinction can be made between material recycling and feedstock recycling processes, also referred to as thermo-chemical recycling, e.g. in Duhoux et al. (2022). Due to the increased energy demand of feedstock processes, material recycling processes are prioritized. The following material recycling processes can be distinguished:

- **Mechanical recycling** is currently the dominant process with a market share of 65-87% (Huygens et al. 2023). The process uses mechanical means, such as tearing, to extract the fibres from the textile waste. It is characterized by low energy requirements and is available on an industrial scale. However, there are high input stream requirements and regarding the output there is a quality reduction of fibres, particularly the fibre length. Due to the loss of fibre quality, fibre-to-fibre recycling of the same textile can probably only be carried out up to three times (Huygens et al. 2023).
- **Solvent-based processing** describes processes where one or more target materials are selectively dissolved out of waste mixtures and composites. Dyes and other undesirable substances can also be removed by choosing the appropriate solvent. In theory, the cellulose recovery process can be repeated multiple times, but the polymer chain deteriorates with each cycle (Duhoux et al. 2021). From the processes listed by Duhoux et al. (2022), this encompasses solvent-based dissolution of polymer cotton blends and pulping of cotton textiles.
- In contrast to feedstock recycling processes, **depolymerisation** produces defined, separable outputs that are simpler to handle in the further processing, both technically and energetically. In these processes selected, well-sorted fibre types are broken down into monomers that can be reused in industrial production. Typical reactions include hydrolytic or glycolytic reactions, which occur in aqueous or organic solvents. These reactions can be supported by microwaves or catalysts. The monomers can be used to create new, virgin-quality polymers. As a result, there is no quality degradation during the recycling process. From the processes listed by Duhoux et al. (2022), this encompasses hydro-thermal approach for polymer-cotton blends and monomer recycling of PA6 and PET fibres.
- For fibre blends, there are often **process combinations** where one component of the fibre blend is depolymerized/decomposed and the other is filtered/dissolved, such as decomposition of cotton to glucose and filtration of polyester fibres or depolymerisation of PET and solvent-based processing of cellulose (Duhoux et al. 2021).
- **Solvent-based processes** and **depolymerisation processes** can produce recyclates without significant quality losses, and the separation of mixed fabrics is also possible with certain process (combinations). However, they are still in the development or scaling phase and are partly associated with high energy and chemical requirements. Depending on the

process, the requirements for the input stream are also high, so only a limited portion of the used textiles stream can potentially be used.

- An additional process is the **enzymatic approach** for polymer cotton blend, which involves the use of biological catalysts (enzymes, such as cellulase) to selectively break down specific components. The enzymes are typically targeting the cotton component, breaking it down into glucose and cellulose powder while leaving the polyester fibres intact for further processing. According to Duhoux et al. (2021) less additives, solvents and chemicals are needed for the depolymerisation process compared to other depolymerisation processes. However, the effort for the repolymerisation of the monomers remains the same (Duhoux et al. 2021).

6.1.2 Barriers and challenges of fibre-to-fibre-recycling

There are still many challenges associated with the recycling of textiles. It is one aim of the ESPR to help to meet and overcome these challenges and to improve recyclability, increase recycled content and enable high-quality recycling (among others)[13].

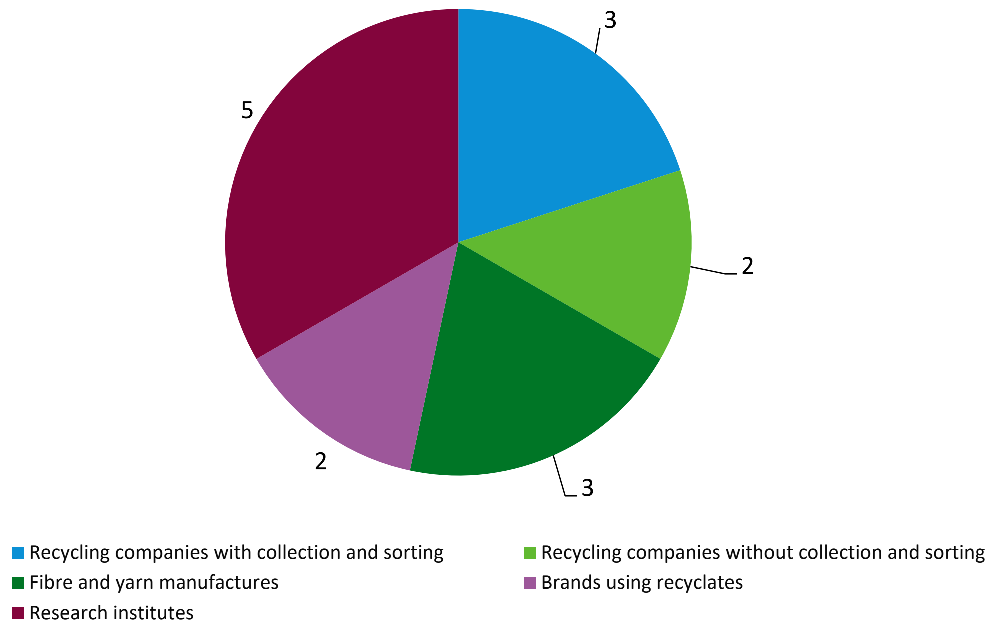
In order to describe the challenges in more detail and to take them into account when developing specific ecodesign requirements, interviews were conducted as part of this study. The aim of the survey was to gain insight into the current state of fibre-to-fibre recycling and to identify current barriers and challenges that hinder an increase in recyclability and in recycled content. The experts were interviewed in the form of semi-structured interviews (see questionnaire in B.3) in addition to the literature review conducted. To capture the diversity of actors in the recycling context and specifically include both the supply and demand sides for recyclates, companies/institutions from the following areas were approached:

- Collectors and sorters
- Recycling companies (both mechanical and chemical material recyclers)
- Fibre and yarn manufacturers
- Brands using recyclates in their products
- Research institutes

A total of 60 companies or institutions from the mentioned areas were invited for a telephone interview. The contacted companies were mainly located in Europe with some of the companies having branches outside the EU. 15 companies/institutions agreed to participate in an interview (see Figure 23).

[13] Recital 6 of the ESPR

Figure 23: Overview of the interviewed companies/institutions (n=15)



Source: Own work, Öko-Institut

The questionnaire for the interviews was adjusted depending on the focus of the interview partners. In addition to overarching questions posed to everyone, there were specific questions for collectors and sorters, recycling companies, fibre and yarn manufacturers, and brands (see the questionnaire in Annex B.3). The questionnaire was provided in English and German. The interviews conducted and especially the answers on the overarching questions led to insights regarding potential recycled content depending on the fibre used (see Chapter 6.3.4). Additionally, challenges associated with fibre-to-fibre recycling were identified and summarised from the different perspectives of the interviewees. These were clustered into the following three different areas:

Input-side challenges

- The large heterogeneity of used textiles (different qualities, different colours, mixed fabrics, product constructions etc.) complicates pre-sorting into the quality needed by recyclers. (More detailed consideration in Chapter 6.2.1)
- Automatic sorting technologies that could sort the textiles by fibres are not yet technically mature enough; the error tolerance regarding the detection of fibre content is still too high. That means that the output from automated sorting is still not of the quality needed by recyclers.
- So far, there are no widely used approaches applied in the textile market that could ensure the full traceability of material composition. Wilting and van Duijn (2020) found in a study that only 59% of the fibre labels on the analysed garments were correct.

Challenges at the recycling level or in the use of recycled material

- There is a large variability in the chemical finishes, dyes, or coatings used in textile manufacturing, as well as material blends that can hinder the recycling process. The need to remove these contaminants, if possible at all, increases the energy consumption and costs of recycling.

- Particularly in the mechanical recycling of waste textiles that were produced a long time ago, there is a risk that the recycled materials contain undesirable substances that are not REACH-compliant. However, due to the dilution effect, the risk of contamination is considered to be relatively low.
- Currently, only mechanical recycling is available at an industrial level. Fibre-to-fibre recycling accounts for only a small share, with the majority being reused in other applications (such as cleaning cloths or non-woven fabrics). The use of mechanical recycled fibres is mostly not compatible with the quality requirements of manufacturers for the production of fine textile products (e.g., blouses).
- Mechanical recycling and some solvent-based recycling processes shorten the fibre length, which negatively affects the quality and durability of yarns spun from recycled fibres. To achieve the qualities desired by clothing brands, recycled fibres must be mixed with virgin fibres.

System-related challenges

- So far, there is a lack of economic or regulatory incentives to increase the use of recycled materials in textile products. This negatively impacts efforts to increase collection rates and expand recycling capacities.
- New textile products are often cheaper than their (partially) recycled counterparts due to low raw material prices, especially due to low crude oil prices, for demand reasons, and – to a lesser extent – mature business models.
- Sorting currently has to be done mostly manually and is largely carried out in low-labour cost countries. The collection and sorting of used textiles is primarily financed through sales of higher-value textiles for reuse. The sorting and recycling of low-value post-consumer textiles alone is not a viable business model.
- Supply and demand from fibre-to-fibre recycling fluctuate, and no breakthrough has been achieved yet to increase the supply of yarns from fibre-to-fibre recycling. Most of the currently available recycled polyester comes from PET bottles rather than textile recycling.
- Since the recycled content cannot be physically detected, a suitable traceability or verification system must be implemented or developed throughout the entire value chain.
- Some companies have relocated sorting to non-European countries (e.g., Turkey, Pakistan, Morocco) for cost reasons. Since used textiles are declared as ‘waste’ in cross-border transports due to regulatory requirements, special permits must be obtained, and sometimes country-specific bilateral agreements must be made. [14]
- There is often a lack of efficient networking among sorters, recyclers, and yarn producers, which could enable cost reduction through economies of scale.

[14] From May 2027 onwards, the Basel Convention on the control of transboundary movement of hazardous waste restricts the export of waste textiles to non-OECD countries. Importing countries need to provide and proof that the management of textile waste is carried out in accordance with the waste hierarchy. While the aim of this regulation is the proper disposal of waste, this will have an impact on material flows and the possible locations for sorting outside the EU.

Among all these challenges, input-side challenges were mentioned most frequently, and by all interviewed stakeholder groups. System-related aspects such as the lack of economic viability in sorting and the additional costs of recycled fibres were the second most frequently mentioned, while aspects such as regulatory obstacles and the lack of quality in recycled fibres were mentioned less often.

Charnley et al. (2024) also conducted interviews with various stakeholders from each stage of the textile value chain and reached similar conclusions regarding the barriers to scaling fibre-to-fibre recycling: The authors point out that the viability of collecting and sorting post-consumer textiles is currently heavily dependent on volunteer labour and donations, and there are not yet adequate revenue generation mechanisms for collecting low-value used textiles. Additionally, it is difficult to find investors for scaling fibre-to-fibre recycling technologies and from the perspective of a brand, there is currently a lack of incentive to incorporate recycled fibres in their products as environmental or social externalities are not considered in the costs of virgin fibres. It was also emphasised that international trade rules and an unspecific classification of post-consumer textiles can hinder the establishment of a circular business model as the trading (especially for reuse) is crucial for its viability. For the implementation of robust trade regulatory frameworks, the improvement of the digital traceability of the material composition is needed.

Köhler et al. (2021) clustered the barriers to fibre-to-fibre-recycling in product design issues (blended fibres and materials, missing or incorrect product labelling etc.), economic, market- and regulatory-related (lack of traceability, lack of incentives etc.), and systemic problems (e.g. lack of communication between textile supplier and brands). They conclude that an increased coordination between actors in the textile value chain is a main precondition to foster the circular economy.

The introduction of mandatory ecodesign requirements addresses the lack of incentives for using recycled materials in products and designing them in a way that their circularity is fostered. By increasing the demand for recyclates and recyclable textiles, the development of necessary technologies, such as automatic sorting systems and the advancement and scaling of recycling technologies, is also being simulated.

6.1.3 Examples of business activities related to recycling

Besides the barriers, some brands are actively involved in developing fibre-to-fibre recycling processes.

The brand PUMA is notable for its textile-to-textile recycling program called 'RE:FIBRE.' This initiative shifts the focus from sourcing recycled polyester from plastic bottles to producing fabric from non-reusable polyester textiles. By doing so, the company successfully derives recycled material from both post-industrial and post-consumer waste. Products marketed under the 'RE:FIBRE' label, according to PUMA, contain a minimum of 95% recycled polyester. The project's feasibility has been demonstrated through the use of RE:FIBRE jerseys at events such as the recent Women's World Cup, the 2024 European Championship, and the 2024 Copa América (Puma 2025).

A similar concept is pursued by H&M in collaboration with the company Syre. H&M aims to source polyester recyclate from old polyester textiles in the future, rather than from old plastic bottles (H&M Group Media Relations 2024).

Inditex, the parent company of ZARA and other brands, has two recycling programs. The company's efforts are focused on the material Cycora, which is derived from recycling polyester residues and was developed by the Los Angeles-based startup Ambercycle. ZARA announced that it will become the main purchaser of Ambercycle's material for three years, investing over 70 million euros in the recycled raw material (Inditex 2023). Additionally, Inditex, along with other companies, supported the creation of a jacket made entirely of Loopamid®, a material from recycled Polyamide 6, based on textile donations from Caritas (Schramm 2024).

Nike also recycles post-industrial, pre-consumer and post-consumer waste from its footwear line as well as post-industrial waste from apparel production. The 'Nike Grind' program transforms the resulting recyclate into various new products, such as skateboards or sports facilities, primarily through open-loop recycling (Nike Inc. 2023).

6.2 Recyclability[15]

6.2.1 Definition and status quo

Recyclability generally refers to the suitability of a product to be subjected to material recovery after the end of its use phase, allowing the processed materials to be reused as secondary raw materials (Ellen MacArthur Foundation 2017). In the context of design, recyclability means that already during product development, specific conditions are created to enable high-quality material recovery in a technically, ecologically, and economically feasible way (European Commission 2020b).

- According to the Waste Framework Directive (Directive 2008/98/EC) the term 'recycling" is defined as: *'any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations."*
- According to Annex I of the ESPR the term 'design for recycling" is defined as: 'design for recycling, ease and quality of recycling as expressed through use of easily recyclable materials, safe, easy and non-destructive access to recyclable components and materials or components and materials containing hazardous substances and material composition and homogeneity, possibility for high-purity sorting, number of materials and components used, use of standard components, use of component and material coding standards for the identification of components and materials, number and complexity of processes and tools needed, ease of non-destructive disassembly and re-assembly, conditions for access to product data, conditions for access to or use of hardware and software needed;"

Recyclability specifically in context of textile products describes the suitability of a textile product for material recycling after use, whereby recycling can be carried out in an economically, ecologically and technically sensible manner. It depends on the fibre composition, material purity, the presence of coatings or blends, disassembly, and the availability of suitable recycling processes and infrastructure (Ellen MacArthur Foundation 2017; Roos et al. 2019; Sandin and Peters 2018). The recyclability of textile products is significantly determined by the actors involved throughout the entire supply and recovery chain. The textile value chain comprises a large number of stakeholders whose decisions affect material recovery (chapter 6.1.2).

Already at the stage of raw material suppliers responsible for the production of primary fibres, fundamental choices regarding materials and additives are made, laying the groundwork for

[15] This chapter was written by Sabrina Mauter and Markus Muschkiet of the Center Textile Logistics (CTL) at Hochschule Niederrhein, University of Applied Sciences, in Mönchengladbach.

subsequent recyclability (Ellen MacArthur Foundation, 2017). Yarn and textile manufacturers further influence the potential for recycling through dyeing, finishing, and treatment processes, for example, by using blended fabrics or coatings that are difficult to remove (Palm et al. 2014). In the manufacturing phase, textile intermediates are processed into final products. Here, design decisions – such as combining different materials or adding buttons, zippers, or decorative elements – directly impact the separability and sortability at the end of the product life cycle (Sandin and Peters 2018). Brands and retailers play a central role, as their product specifications, design requirements, and marketing strategies influence material choices and complexity, thereby indirectly determining the resources needed for processing (Zamani et al. 2018).

Another important actor is the consumer. The way products are used, cared for, and disposed of has a considerable influence on the quality of collected post-consumer textiles and thus on the feasibility of material recycling (European Commission, 2019). After use, textiles are collected and sorted by specialized operators who perform the crucial task of preparing used products for reuse or recycling. The sortability of textiles largely depends on clear material labelling and low contamination (Palm et al., 2014). Recycling companies are responsible for the actual recovery process. They apply e.g. mechanical or chemical methods to extract fibres, with material purity, contamination levels, and fibre quality being critical determinants of recycling yields (Sandin and Peters 2018). Waste management operators dispose of non-recyclable textiles by thermal treatment or landfilling, which is regarded as the least preferable option from an ecological sustainability perspective (Ellen MacArthur Foundation 2017).

In order to determine factors for a potentially improved recyclability of products in the course of design requirements, it is first necessary to include the **different product presentations and constructions** of the (clothing) products on the market. This includes:

- Product structure (e.g. single-/multi-layer; type of material composite).
- Product construction/fabric structure (e.g. knitted, not knitted/crocheted; type of yarn, yarn twist, yarn count).
- Colours used, dyes used and dyeing technology.
- Specific use of chemicals incl. equipment.
- Non-textile components (e.g. zip, buttons/rivets/eyelets, logos/patches, prints).
- Material composition (e.g. mono- or multi-materials); materials used and percentage of use.

Whether factors in this list are to be classified as recycling-supporting or as a specific disruptive factor or as recycling-inhibiting for differentiated recycling processes depends on the fibre-to-fibre process to be used (see Chapter 6.1.1) and therefore cannot be generalised. It should also be mentioned at this point that these factors relate to the product level. Overarching systematic or process-specific problems have already been addressed in Chapter 6.1.2.

To move towards a comprehensive approach that also enables universal support for differently orientated processes in the course of improved recyclability, the following **factors** can be classified as **fundamentally positive for the recyclability** of heterogeneous products (Re_fashion 2025a):

- High initial quality at fibre, yarn, fabric and product level.
- Use of easily separable materials.

- Reduction of composite materials.
- Low material diversity at yarn, fabric and product level.
- Specific and accurate material labelling.

In order to evaluate the aspect of recyclability, additional specific methods were used to supplement the general methodological approach described in Chapter 2. These included interviews with global recyclers who are specifically involved in the process of developing and optimising fibre-to-fibre processes (see Chapter 6.1.2). Within this framework, practical assessments were incorporated into the evaluation of both the product aspect of recyclability and the recycled content. Following this, research was conducted into existing product requirements on the part of clothing manufacturers. This also made it possible to specifically address and incorporate practical approaches and the feasibility of product development. In this context, it was assessed that, as a first step, the perspectives of both - recyclers and distributors - are particularly relevant in terms of defining product requirements. This is justified by both the benefits of changed design requirements for recycling processes and the practicality of product development, which is the responsibility of the manufacturer or brand.

6.2.1.1 Requirements criteria from a product development perspective

As described in the previous chapter, the perspective of companies, manufacturers were taken into account when evaluating potential requirements, particularly those that had already dealt with recyclability criteria. In addition to this, the various design guidelines were consulted and compared. A summary of the aspects stated therein is listed below in Table 32. Product design refers to the primary manufacture of a textile clothing product in the first cycle using primary materials. This does not include the manufacture of a product using recycled materials/secondary raw materials.

Table 32: Summary of requirements profiles from a product development perspective for improving recyclability

Related area	Summary of requirement profiles from manufacturer's perspective
General design principles for recyclability	• Products should be designed for easy disassembly (e.g. with screwable buttons). • Goal: Separate materials for pure recycling streams. • Challenge: Manual disassembly is currently inefficient at scale and may compromise quality. • Use as few seams and components as possible. • Minimize or eliminate decorations and trims (e.g. use bar-tacks instead of rivets). • Prints reduce recyclate quality and hinder recycling. • Alternative: creative fabric techniques (e.g. laser engraving, embroidery) instead of chemical printing.
Material selection and mono-materials	• Mono-materials with at least 98% purity are considered highly recyclable. • Ideally, the entire product (including lining, zippers, padding, etc.) should be made from a single fibre type. • Cotton, polyester, wool, nylon 6, linen, silk, and hemp are currently the most recyclable materials. • For cotton, nylon, linen, hemp, silk, or wool: ≥ 90% content. For polyester: ≥ 85% content.

Related area	Summary of requirement profiles from manufacturer’s perspective
	• Materials should ideally already be recycled and recyclable again. • Novel material combinations may be considered for long-lasting products (> 5 years), as recycling technologies are still evolving.
Recycling disruptors	• External Disruptors (Removable): • Zippers, buttons, eyelets, elastics, foam, sequins, electronics, etc. • Recommendation: Use sparingly and concentrate them in one area for easy removal (ReFashion). • Internal Disruptors (Non-removable): • 5% elastane, metallic yarns, stretch fabrics, full-fabric prints, adhesives, chemical finishes. • Multi-materials and all-over decoration are problematic. • Technological Status: • Recyclability varies between facilities and sorting technologies. • Elastane should be kept below 3–5%, as higher amounts are not widely recyclable. • Mixed fibres are often only partially recovered – focus is usually on reclaiming the dominant fibre.
Recycling technologies and their limitations	• Mechanical recycling shortens fibres, reducing quality and durability. • Mixed materials are rarely recyclable in full. • Prints (especially on cellulosic fabrics) complicate recycling. • Multi-layered garments are hard to sort. • Emerging technologies may enable processing of mixed fibre materials. • For long-life products, forward-looking materials may be considered, though they carry risks.
Transparency and product information	• Material list (‘Bill of Materials”) with composition, purity levels, and mass proportions ≥ 1% should be mandatory. • Chemical list (‘Bill of Chemicals”) to eliminate harmful substances from recycling streams should be mandatory. • Digital product passport (e.g. RFID, NFC, fibre-tracking tech) to support sorting and recycling should be mandatory. • ≥ 98% purity qualifies for ‘100% recyclable” label. • Materials should be aligned with the same recycling loop (e.g., polyester with polyester).
Product types and lifespan	• Short-Lived Products: • Should align with current recycling technologies. • Design should be as recyclable and mono-material as possible. • Long-Lasting Products: • May use new materials anticipating future technologies. • Trade-off exists between aesthetics/durability and recyclability.

Sources: Bestseller (2022); circular.fashion (2018); Global Fashion Agenda (2020); Re_fashion (2025a); H&M Group (2023); Maes et al. (2021); sympatex (2025)

The examples listed above show that, from a product development perspective, the list mainly contains basic approaches to product recyclability that are consistent with the assumptions made in the previous chapter. For the most part, no distinctions are made between different types of products. In individual cases, a distinction is made between products with a short and long service life, among other things in order to integrate prospective developments regarding suitable material combinations into the design for recycling (Bestseller 2022).

It is also apparent that the availability of detailed product information is considered indispensable for the classification of specific recyclability. In this context, digital product data is mentioned as a solution for the sortability of products as an upstream process step in the recycling process. Product ingredients should include material combinations, mass fractions and chemicals used. In the future, the bill of materials and chemicals can also be used and/or integrated (Maes et al. 2021; H&M Group 2023).

Specific material usage rates are specified in individual cases for the material types of polyester, cotton and other natural fibres. Mono-materials should consist of at least 98% of the same fibre type, either including or excluding labels, yarn, lining, etc. (H&M Group 2023). In addition, in individual cases, a distinction is made between external and internal disruptive factors with regard to recyclability. External disruptive factors include those that can be removed before the recycling process. Internal disruptive factors, on the other hand, are inseparably linked to the main material and therefore represent a comparatively higher disruptive potential (Re_fashion 2025a).

About the specific indication of disruptive materials in relation to the use of fibre types, elastane is mentioned. According to this, current recycling technologies can process products with a maximum of 5% elastane fibre content (Re_fashion 2025a; H&M Group 2023). The conflict of objectives regarding the durability of textile fabrics containing recycled fibres, in particular mechanically recycled fibres due to fibre shortening, is also addressed (H&M Group 2023).

6.2.1.2 Requirements criteria from a textile recycling perspective

In addition to the above consideration of potential requirements with a focus on product development, this chapter discusses the perspective of recyclers and individual processes. The background to this is the comparison of respective requirements to ensure efficiency on the part of the recycling process and the possibility of implementation and handling with regard to product design. This includes the entire textile recycling process chain, consisting of collection, sorting and recycling.

It is important to note that the majority of recycling processes in fibre-to-fibre textile recycling is currently under development. Only a few recycling processes exist globally that are established on an industrial scale. As recycling processes are still at an early stage and process details are often subject to confidentiality, there is little published information on specific requirements for differentiated recycling processes. The information listed below is mainly derived from interviews conducted with recycling companies (see Chapter 6.1.2). These specifications primarily cover mechanical, and thermo-mechanical recycling processes as well as 'chemical" recycling processes[16] (Chapter 6.1.1). The reason for this is the relevance of the processes for fibre-to-fibre recycling.

Table 33: Summary of requirement profiles from a textile recycling perspective for improving recyclability of the input stream

Related recycling process	Summary of the requirement profiles for the input stream
Mechanical Recycling	Fibre **types**: • Basically, all fibre types and blends are possible, but quality is higher with homogeneous and high-quality materials.

[16] Chemical recycling is an umbrella term for depolymerisation, solvent-based processes and pyrolysis.

Related recycling process	Summary of the requirement profiles for the input stream
	• The structure of the fabric (knitwear, woven fabric) may have an influence on the mechanical tearing process. • The structure of the used yarn including the fibre (open-end, ring-spung) and its properties (e.g., yarn count, number of twists, mean fibre length) may have an influence on the mechanical tearing process. • The more uniform, untreated, undamaged, and uncontaminated the input is, the higher the amount and quality of the fibre output. **Minimum fibre content:** • Cotton: at least 80% cotton for high-quality recycling. • Acrylic/Wool: at least 95% of the respective material. **Condition & foreign parts**: • All hard accessories (zippers, metal/plastic buttons, leather) must be removed manually beforehand or are eliminated during the tearing process and its periphery (especially metal components). • No coated, laminated, welded textiles or composites. • Elastane content > 10% is problematic. **Colour**: • Plays a major role – sorted, single-coloured textiles are ideal. **Chemicals**: • Additives and chemicals remain in the output fibres. **Fibre quality**: • Fiber length is reduced (about 5–20% of natural fibres remain spinnable, 25 to 55% for synthetic fibres as input). • Fresh fibres (up to 80%) must be mixed in to improve yarn quality.
‘Chemical Recycling’	**Fibre types**: • Particularly suitable for polyester (PES), polyamide (PA) and cotton. **Minimum fibre content**: • Polyester: ≥ 95% polyester, max. 5% other components. • Cotton: ≥ 95% cotton, max. 5% other components, no protein-based fibres. • Polycotton: ≥ 60% polyester, max. 5% other components, no protein-based fibres. **Condition & foreign parts**: • Removal of hard/metallic parts required. • Accessories such as zippers and buttons must be removed. **Colour**: • Of minor importance, if the procedures are capable of decolourization/bleaching. **Purity**: • Synthetic fibres should have at least 80–90% purity. **Contaminants**: • Small amounts of foreign fibres (e.g., nylon, wool, acrylic, elastane) are tolerated.
Thermo-mechanical Recycling	**Fibre types**: • Suitable only for thermoplastic single-polymer materials (e.g., polyester, polyamide, polypropylene). **Minimum requirements**: • Input should be as pure as possible to produce high-quality regranulate. • Post-industrial waste (pure materials) is ideal. **Foreign substances**: • Additives and dyes remain in the material (may change during processing).

Related recycling process	Summary of the requirement profiles for the input stream
	Blends: • Mixed materials are unsuitable (except for thermochemical pyrolysis).

Sources: Tischberger-Aldrian et al. (2023); Keßler et al. (2021); Palm et al. (2014); Duhoux et al. (2021); Re_fashion (2025d); Re_fashion (2025b); Re_fashion (2024); interviews conducted with recycling companies (see Chapter 6.1.2)

The content of Table 33 is described in more detail in the following chapter, the sources used are the same as indicated for the table, additionally Löw et al. (2024) was used as reference.

The quality and composition of the input stream play a critical role in determining the feasibility and efficiency of textile recycling technologies. Each recycling process has distinct requirements and tolerances for material types, purity, and contaminants. Based on existing findings, comparisons regarding similarities and differences can be summarised as follows.

All three recycling methods require a degree of manual or automated sorting before processing. This includes the (part) removal of accessories (zippers, buttons, labels), separation by fibre type, and exclusion of coated or composite textiles. Without this pre-treatment, the risk of process failure or reduced output quality increases (Duhoux et al. 2021; Re_fashion 2025d).

Regardless of the recycling method, chemical 'contamination" (e.g. pesticides, flame retardants, dyes, finishing agents) is a concern. Although chemical recycling can reduce or remove some of these, all systems must deal with the potential risks associated with legacy substances, especially from post-consumer textiles. Each recycling method is strongly dependent on the purity and composition of the input stream. Poorly sorted or degraded materials can result in lower process yield, inferior product quality, or increased environmental burden due to inefficiencies (Duhoux et al. 2021; Tischberger-Aldrian et al. 2023).

Mechanical recycling exhibits the highest flexibility regarding fibre types, allowing the processing of various natural and synthetic fibres, including blends. However, homogeneous streams, such as 100% cotton or wool, yield significantly better results in terms of fibre length and reusability. In contrast, chemical recycling is highly selective, requiring a specific fibre composition, typically ≥ 95% polyester or cotton (or specific multi-material mixtures), for effective depolymerisation or regeneration (Palm et al. 2014; Keßler et al. 2021).

Thermal recycling, particularly thermomechanical processes, is limited to pure polymer streams such as PET or PA. Only thermochemical approaches, such as pyrolysis, can process mixed or complex materials. Blended textiles present a major challenge across all methods. Mechanical recycling tolerates limited amounts of elastane or other additives (usually below 10%) before the fibre quality degrades substantially (Tischberger-Aldrian et al. 2023; Duhoux et al. 2021).

Chemical recycling can accommodate small fractions (typically ≤ 5%) of foreign fibres but struggles with high elastane content or multi-fibre blends. Thermal recycling is the most robust in this regard. Thermochemical processes can handle heavily contaminated or composite materials, including non-textile content, although the output is usually downcycled (Keßler et al. 2021; Tischberger-Aldrian et al. 2023).

Colour sorting is essential in mechanical recycling, as dyes are retained in the recovered fibres and limit their reuse potential. This necessitates input streams that are either colour-separated or uniformly dyed. In contrast, chemical recycling includes decolourization or bleaching steps, rendering the original colour irrelevant. Thermal recycling processes typically do not remove dyes, and the high temperatures involved may lead to dye degradation, resulting in discolouration or unstable material properties (Palm et al. 2014; Re_fashion 2025b).

Mechanical and thermomechanical recycling do not remove chemical finishes, flame retardants, or other additives. These remain embedded in the recycled product and may impact health, safety, or performance. Chemical recycling offers an advantage in this regard, as many processes involve steps that isolate or eliminate unwanted substances, thereby improving the quality and safety of the output material. Thermal recycling generally transforms or destroys additives through combustion or heat-induced reactions (Tischberger-Aldrian et al. 2023; Keßler et al. 2021).

Mechanical recycling is affected by the structural form of the input (e.g., woven vs. knitted textiles), as it influences tearing behaviour and resulting fibre length. Chemical and thermal processes, on the other hand, are largely independent of fabric structure, since the textile is either dissolved or melted, not mechanically disintegrated. Mechanical recycling retains the original fibre identity (e.g., cotton remains cotton), but with a reduction in fibre length and quality. Chemical recycling involves e.g. the complete depolymerisation of the input fibres and re-synthesis into new polymers, which may differ in identity or properties. No depolymerisation takes place during solvent-based processing. Thermal recycling does not preserve fibre identity; the fibres are either melted into plastic granulates or converted into energy or gas, depending on the process type (Palm et al. 2014; Keßler et al. 2021).

Conclusion

In summary, it can be said that the information provided by recyclers on the requirements for the input stream of different recycling processes is predominantly limited to or focused on specific types of material. In particular, the minimum fibre content and the specific proportion of elastane are discussed. It is also clear that specific requirements for specific processes will need to be further adapted and evaluated in the future so that textile products can be developed in the best possible way for recycling processes. This applies in particular to specific information on equipment, including the use of chemicals, specific fabric finishes, yarn twist and counts. Certain information can support or hinder specific processes. Fundamentally and across all processes, it should be noted that as soon as spinnable fibres are to be produced as the output of the recycling process, different fibre mixtures limit their use (especially in the clothing sector).

6.2.2 Consideration in relation to the product aspect and derivation of the requirement

The analysis compares current recyclability requirements from two key perspectives: product development and recycling processes (mechanical, chemical, thermal). On the one hand, product design guidelines, mainly derived from industry stakeholders through literature and interviews, emphasize material purity, mono-material usage, reduction of disruptive components (e.g., elastane), and availability of digital product data. These principles are intended to facilitate future recyclability, even though they are still relatively generic and rarely tailored to specific recycling technologies. This is based on the information listed in the previous chapters.

On the other hand, recyclers outline more specific and process-dependent input requirements, primarily based on interviews and limited published data due to industrial confidentiality. Key factors include fibre type purity, separation of accessories, absence of certain chemical contaminants, and minimization of composite materials. All recycling technologies, in focus mechanical, chemical, and thermal, require varying degrees of pre-sorting, but diverge significantly in their tolerance toward mixed materials and contaminants. Product design often lacks detailed specifications that directly match the operational thresholds of existing recycling technologies. For example, while guidelines recommend mono-materials, the exact thresholds and tolerable levels of elastane or additives often differ between what is recommended for design and what is feasible in practice.

While there is growing awareness in product development regarding recyclability requirements, a clear gap remains between recyclers' technical input needs and the level of detail currently addressed in product design guidelines. The alignment is strongest in basic aspects such as material purity, mono-material usage, and the need for accessory removal. However, discrepancies persist in critical thresholds, treatment of chemical finishes, and practical sorting capabilities. Furthermore, most product development recommendations remain general and forward-looking, whereas recycling technologies demand precise, technically defined input streams today. To close this gap, stronger collaboration between designers and recyclers is essential, alongside the development of standardized recyclability criteria that account for current process capabilities. Enhanced material transparency (e.g., digital product passports, bills of materials), combined with fibre-specific design strategies, can support better integration between design and recycling, ultimately enabling scalable fibre-to-fibre recycling (Tischberger-Aldrian et al. 2023; Duhoux et al. 2021; Keßler et al. 2021; Re_fashion 2025b; 2025d).

In addition to material composition and design-related factors, contamination introduced during the use phase significantly affects the recyclability of textile products. Textiles can accumulate a variety of substances during their lifecycle, including body oils, sweat, food residues, detergents, cosmetics, and environmental pollutants such as particulate matter, heavy metals, or microplastics. These contaminants are particularly relevant in post-consumer textiles, which represent a growing share of the recycling feedstock. Unlike pre-consumer waste, which typically consists of clean production offcuts, post-consumer textiles pose greater challenges for processing due to unpredictable contamination levels (Tischberger-Aldrian et al. 2023; Palm et al. 2014; Re_fashion 2024; Keßler et al. 2021).

6.2.2.1 Requirements within the context of recyclability

Based on the preceding analysis, literature review and expert interviews, the following is a list of potential criteria that could have a positive impact on the recyclability of clothing products. These criteria include specific suggestions for product design aspects. This list of criteria was discussed during the workshop series one and two. For the time being, no distinction is made between different types of products; instead, generally applicable criteria that affect the majority of the product market are listed.

Prioritize mono-materials
Design garments using a single fibre type. Mono-materials are significantly easier to sort and recycle relating to all types of recycling methods. Use threads, labels, and accessories made from the same material as the main textile or ensure they can be easily removed. The durability of the product should not be compromised, for example, by replacing the sewing thread.

Specific material use and fibre purity
To ensure the technological feasibility and efficiency of a process, the percentage of fibre material used should be set to a minimum stake. This also helps to reduce the mixing of materials with many different fibre material inputs.

Products with a high elastane content are seen as a barrier to recycling by recycling-companies. Limiting the elastane content improves recyclability.

This should include revising the EU regulation on the labelling of textiles. Current EU Regulation No. 1007/2011 determines for 'textile products consisting exclusively of one fibre" as follows: Tolerances in fibre composition 2% foreign fibres in the product (5% for products which have undergone a carding process, wool 0.3%). The maximum permissible deviation from the specified blend ratio is 3%[17].

Integrate detailed product information and traceability

Digital product information (e.g. with information on materials, yarn specifications, fabric structure, chemicals, recycling options) can be used to control and simplify the recycling process (including collection, sorting and recovery) in a more targeted manner.

In this context, it is essential that the information on material use is specified correctly. Digital technologies can be used to determine the material within the sorting process. The limitations of these technologies must be taken into account.

Enable easy disassembly

Elements such as zips, buttons, labels and lining fabrics should be designed to be easily removable or detachable. Design for disassembly can simplify the process of sorting materials for recycling.

The type and material of elements that are particularly problematic must be further investigated. For example, the material chosen for the element can determine whether or not it is still suitable for a recycling process.

Avoid disruptive materials and coatings

Avoid metallic fibres, polyurethane coatings, PVC prints or composites. These are considered 'internal contaminants' that cannot be removed and hinder or prevent the recycling process.

Other contaminants must be further investigated and defined in the future in connection with specific recycling processes.

Do not use chemicals that inhibit recycling

Limit the use of finishes that are difficult to remove, such as water-repellent or flame-retardant finishes. Instead, use easily degradable, declared chemicals in accordance with standard catalogues.

The exact specification of chemicals with recycling-inhibiting properties must be further investigated.

It can be said that, with regard to the potential criteria mentioned for improving recyclability, there is a need to evaluate and establish more detailed specifications and precise quantitative values/information within these criteria. This includes, in particular, the definition of material specifications, elements and chemicals that inhibit recycling. With a precise indication of feasible

[17] If these are technically unavoidable in good manufacturing practice and are not the result of systematic addition.

percentage contributions on the part of the recycling companies. In addition, the limitations of automatic detection technologies for use in upstream sorting and preparation processes, as well as the integration of the revision of the European Textile Labelling Regulation (European Union 2011).

6.2.2.2 Existing Approaches for the evaluation of recyclability

Following on from the list of potential design criteria for increasing recyclability, the following chapter presents an examination of existing proposals for evaluating recyclability. In addition to the design-for-recycling guidelines from brands and organisations discussed in chapter 6.2.1, initial approaches to assessing recyclability have been developed by industry initiatives. These include The European initiative ReHubs, launched by EURATEX, which is committed to promoting the industrial scaling of textile-to-textile recycling in Europe. It formulates criteria for the sorting, material purity and processability of recycled materials from the recycler's perspective. One sub-goal is to evaluate input materials based on their compatibility with currently available recycling processes. It should be noted at this point that the study referred to is not publicly available (ReHubs 2022).

The Make Fashion Circular initiative from Ellen MacArthur Foundation focuses, among other things, on design guidelines for recyclability, such as the Jeans Redesign programme, which promotes specific product designs that facilitate reuse and recycling. The study of Ellen MacArthur Foundation outlines key design principles to enhance the recyclability of clothing products. These include using mono-materials to simplify recycling, avoiding harmful chemicals and complex fibre blends, and designing garments for easy disassembly. It also emphasizes the importance of durability, material transparency, and safe, recyclable inputs. Digital product passports and standardized labelling can further support sorting and processing at end-of-life. The focus is on establishing central principles for circular design rather than specific assessment approaches (EMF 2020; 2021).

The Fashion Positive 'Circular Materials Guidelines 1.0' report focuses on guidelines for recycled content and the recyclability of fibres and blends. A specific requirement for fibre recyclability potential emphasises that a key problem at present is the lack of large-scale separation of blends of protein or cellulose fibres from synthetic fibres. Therefore, garments should consist of at least 95% (better) or ideally 98% (best) protein or cellulose fibres, with the remaining fibres also being recyclable (Fashion Positive 2020).

Initial tools (some developed internally by brands or by consortia) enable qualitative or semi-quantitative assessments of clothing based on basic criteria (e.g. material purity, elastane content, separability). Predominantly the focus is on key principles rather than on establishing concrete and quantitatively measurable data.

In the draft ‚Preparatory study on textiles for product policy instruments' by the JRC (Delre et al. 2024a), requirements for recyclability are described as follows. To enhance the recyclability of textile products, the document proposes an integrated and dynamic approach that considers the entire recycling system — from collection to fibre reuse. A textile item is considered recyclable only if it meets all five of the following criteria at the point it becomes waste:

1. It can be effectively collected;
2. It can be sorted, i.e. segregated from other textile waste and sent to the subsequent suitable recycling pathways;
3. It can be pre-treated before recycling, or can be sent directly to recycling without specific pre-treatment;

4. Its fibre content can be fully used as feedstock for one or more recycling techniques to produce recycled fibres usable in textile products;
5. It has no elements or substances in amounts that disrupt the collection, sorting, preparation for recycling and recycling, or that limit the use of the recycled fibre.

Further product design-related recommendations include:

- Use of homogeneous materials (e.g., pure cotton or pure polyester) to ease recycling.
- Avoidance of fibre blends, especially those combining synthetic and natural fibres, which are difficult to separate.
- Minimizing or eliminating non-textile components such as zippers, labels, or buttons that complicate sorting and processing.
- Ensuring transparency of fibre composition, ideally through product labelling or digital product passports, to support proper sorting and recycling.
- Designing products with end-of-life management in mind, aligning with ecodesign principles.

This system is technology-neutral and does not prescribe specific recycling methods, in order to allow innovation in collection, sorting, and processing technologies. The goal is to close the loop in the textile industry by making products easier to recycle and reuse.

In summary, it can be said that the assessment of the recyclability of textile clothing products is still in its infancy. While industry-specific guidelines and tools offer initial guidance, there is currently no internationally harmonised assessment methodology. The development of uniform, scientifically sound criteria for assessing recyclability is essential in order to better coordinate product design, material selection and recycling technologies.

6.2.2.3 Derivation of potential indicators for recyclability

To summarise, it can be said that there are requirements both from the perspective of the recyclers and from the perspective of product design, which in this thematic context is equivalent to requirements that must necessarily be integrated into product development in order to meet the recyclers' requirements and support high-quality fibre-to-fibre recycling. Below is a summary of the respectively five most relevant aspects.

From the Recycler's Perspective (Collectors, Sorters, Recyclers)
to enable textile (fibre-to-fibre-) recycling, products should fulfil these operational criteria:

- Products must be available in sufficient quantity and quality to be processed economically. Standardized product groups are more easily recycled than individualized, difficult-to-classify specialty products.
- Differentiation between product types in terms of type, function, presentation and materiality is necessary for the integration of recycling requirements into product design.
- Products must be easily identifiable by fibre type (and possibly further criteria) using existing and future (semi-)automatic sorting technologies. Fibre content must be detectable or already known to direct items into appropriate recycling streams.

- The fibres used should retain their strength and length during processing so that they can be reused for textile applications. Avoid fibre types or combinations that break down or lose strength during mechanical and/or chemical processing.
- Textiles should be free of harmful substances or foreign materials that hinder recycling processes.

From the Product Development Perspective
to ensure (fibre-to-fibre-) recyclability products should be designed to meet the following criteria:

- Use fibres from one type of material whenever possible (e.g., 100% cotton or polyester). Avoid fibre blends, especially combinations that are difficult to separate unless established recycling processes exist.
- No interfering substances or materials, e.g. metallic fibres, PU foam, coatings. Minimize non-textile components (buttons, zippers, etc.) or design them to be easily disassembled ('Design for Disassembly').
- Seams, labels etc. can differ from the material type of the textile fabric but should ideally be made of one material (e.g. the material of the outer fabric).
- Certain products (e.g., underwear, socks) are currently not produced without stretch content. However, elastane, in particular, should be kept to a minimum and be detectable.
- Avoid complex material layers or difficult to identify product structures.

Furthermore, based on the interviews and expert discussions conducted, as well as the literature research, the majority of relevant criteria do not define any measurable restrictions. The reason for this is the current state of development of the experience and the associated secrecy of technological requirements, as well as the necessary further process evaluations to be able to define fact-based, process-specific requirement profiles. Especially regarding aspects such as contamination during the use phase and its impact on identification and recyclability, further evaluation is required to provide concrete recommendations for action. The same applies to finishes and colourants, which must be examined process-specifically to determine whether there is an obstacle to recycling. At this point, the relevance of gradually introducing product requirements is emphasised. Nevertheless, based on the consideration of the different perspectives, it is possible to derive potential and measurable requirement criteria. These are continuously explained and discussed.

Based on the above criteria, a further reference is now made to the discussion with the stakeholders of the second workshop. The current chapter defines (on the current state of technology) the aspects of **'material diversity'** and **'separability'** as primary key factors for the material recycling of textile products. This refers to the comparatively greatest relevance of different factors across different recycling processes. The underlying focus was on the evaluation of (eco-)design aspects that can be applied as uniformly as possible and that include the widest possible range of products available on the market. In addition, the question of whether a differentiation between different product types is fundamentally necessary in this context was addressed in the workshops with stakeholders. In particular in connection with functional products and the currently limited recyclability (based on existing processes), the exclusion of product types to be defined was analysed.

The discussion with participants of the workshop series regarding the listed focus aspect of material diversity was initially related to yarns, fabrics and/or products. Most experts stated that a reduction in the variety of materials within a product would be desirable, but probably not realisable, as this would result in the loss of important functions and properties. However, a reduction in the variety of materials was considered feasible from a product development perspective. An initial approach should be to produce seams and labels (care labels, etc.) from a single material. Without certain synthetic fibre materials, particularly in the area of seams, industrial processing would not be possible. It was also shown that recycling technologies, and in particular chemical recycling, are still 'at the beginning of development', so that further improvements can be expected in the future. It is important that impurities and thus the overall variety of materials are reduced.

Identified hurdles in relation to the defined key factors included the determination and concentration of recycling requirements for differently oriented recycling approaches. Corresponding processes usually require a different requirement profile for the textile products as input material, which is why the first step in defining potential design criteria is to define requirements that are as generic as possible. These criteria should subsequently be supplemented with the requirements that are characteristically necessary for the processes. The conflicting - objectives relating to the product aspect of durability were addressed in connection with the key factor of separability.

As with the first focus aspect, the experts' discussion of the second focus aspect, separability, also related to yarns, fabrics and/or products. Separability can also be built up in a supplementary preliminary stage through modularity. This would make separability (almost) obsolete in many cases. The suggestion that there should be (technical) design instructions for designers that enable better separability is also aimed at this aspect. Detachable yarns were brought into the discussion as a technical solution. However, reference was made to the conflict of objectives in conjunction with durability. In addition, the different types of detachable yarns should be considered: from loosening due to thermal effects to easily mechanically separable seams.

Conclusion

Separability conflicts with durability. For example, easily removable seams are desirable for mechanical separation, but can compromise the durability of the product during the wear cycle.

Does a potential separation will take place within the design process in the form of preparation or at the beginning of the textile recycling chain as an upstream step of the recycling process; motivation and incentives are still undefined.

Durability conflicts with recyclability. Fibre blends can enhance durability but impair recyclability; a partial solution may need to be defined at this time. High quality (durability) due to high areal density/yarn twist makes mechanical recycling more difficult. Functional finishing chemicals can be beneficial to durability, but they impair recyclability.

Limiting the elastane content can have a positive effect on durability. A high elastane content can lead to faster wear.

A limited variety of materials can promote repairability in specific cases. In repair processes, it is advantageous to use specific (mono-)materials for the application and adhesion of patches.

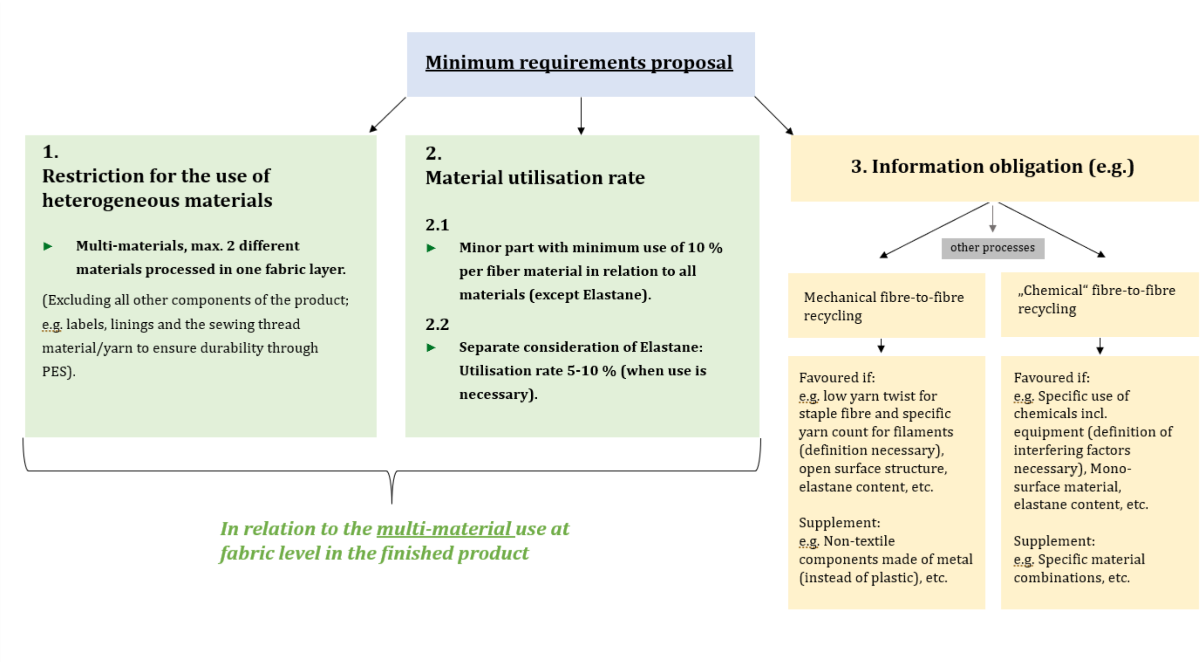
With reference to the discussion aspects presented, the primary focus within the further development of this study was on the key factor of **material diversity**. The aspect of separability was excluded from the definition of minimum requirements for the product aspect of recyclability due to the conflicting goals of 'separability vs. durability'. Possible solutions to this conflict of objectives, for example regarding product presentation, should continue to be addressed and discussed in further studies due to the relevance identified. Within a gradual implementation of requirements, this criterion should therefore be included in the long term; a link to the product aspect of repairability may also be suitable for this purpose.

6.2.3 Proposal for minimum requirements

Based on the previous discussion, the fundamental decision was made for the further course of this study to only include criteria in the selection of proposals that have already been evaluated and have a demonstrably positive influence on usability. However, it is important to supplement or adapt these criteria if new findings become available and procedural methods have developed further.

The proposed minimum requirements for the recyclability of textile products, as illustrated in Figure 24, include two specific criteria that relate to the use of materials at fabric level in the finished product. The overall consideration at fabric level serves to inclusion of both, mono-material products and mono-material mixed products (e.g. multi-layer products whose fabrics are made of mono-material). In addition, further requirements are proposed which are intended to determine the appropriate recycling process.

Figure 24: Proposal for minimum requirements for the product aspect of recyclability



Source: Own illustration, Hochschule Niederrhein

On the one hand, the diversity of materials should be channelled by limiting the use of heterogeneous materials (minimum requirement 1.). The fewer different materials are processed within a product, the higher the recyclability of the product and the output quality of the secondary raw materials. It should therefore be prioritised to avoid material mixtures or to limit and, if possible, avoid the use of different materials. This also addresses how the material of the sewing thread used (and in future, for example, the material of the care label) should be handled and whether the corresponding material should be included in this limitation in terms of durability and against the background of limited alternatives. In this context, it is proposed to limit the use of heterogeneous materials to two different fibre materials in one fabric layer (excluding all other components of the product).

On the other hand, the relatively low use of material types in multi-material fabrics should be addressed (minimum requirement 2.). The proposed restriction (of minimum requirement 2.1) is based on the current state of automatic detection technologies for fibre materials. According to the current state of the art, material types can only be reliably detected from a percentage share of around 5-10% (Re_fashion 2025d). In the future, the use of such methods will play an important role in upstream process steps for high-quality fibre-to-fibre recycling within upstream process steps, as the reliable identification of the materials used in the product plays an essential role in determining the input streams based on inherent material properties, especially in chemical recycling processes. In addition, not only the technological feasibility but also the economic viability of recycling processes is supported when specific fibre content accounts for a high proportion. The lower the percentage of fibres, the lower the economic viability, especially for processes based on a specific fibre material (Duhoux et al. 2021). The aim is therefore to set the major material of the mixture as high as possible. The material major part of a multi-material describes the higher percentage of the fabric, the minor material the lower percentage. With an equal percentage distribution (50%/50%), it can be chosen which material represents the major or minor part.

The material type elastane (criterion 2.2) must be given special consideration in this context, as depending on the recycling process, high-quality recycling with approx. > 10% elastane (mechanical) (Tischberger-Aldrian et al. 2023; Duhoux et al. 2021) and > 3-5% (chemical) (Re_fashion 2025d; H&M Group 2023) is largely not feasible with the current state of the art. The required recycling rate for elastane should therefore be defined separately (minimum requirement 2.2). However, in order to ensure (spectroscopic) detection of the elastane content, an application rate of at least 5% should be aimed for. This means that if elastane is processed within a fabric, it should make up 5-10% of the fabric. Basically, the lowest possible proportion of elastane is preferable from a recycling point of view. In connection with the need for identification technologies to ensure the occurrence within the product and to determine the suitability for a specific recycling process, the evaluation of the proportion should be prioritized in the first instance. Depending on the percentage of elastane used, a decision must be made as to whether the product is basically still suitable for chemical recycling or should be processed mechanically in order to achieve the highest possible recyclate quality. As soon as the recyclers are able to specify in perspective which elastane fractions the processes can handle, this specification should be adjusted accordingly. The same applies to the improvement of spectroscopic methods with regard to the minimum proportion of a fibre type for detection.

The requirements under minimum requirement 2. are based on the assumption that the existing tolerances of the Textile Labelling Regulation (European Union 2011) are adjusted, in particular with regard to the use of elastane. Chapter 6.2.3.1 goes into further detail on the requirements under 1., 2. and includes product group-specific exceptions.

In addition to the proposed concrete minimum requirements, criteria for the obligation to provide information are defined (minimum requirement 3.). A corresponding indication of the information enables the determination of the recycling process suitable for the product and thus supports the recyclability of the product. Specific product criteria and design aspects should define the decision between different recycling processes, as not every product is suitable for every process in terms of fibre-to-fibre recycling, even if the products comply with the proposed requirements. In parallel to the further development of the processes, it must be continuously evaluated and supplemented which product criteria are favoured for specific processes and therefore do not restrict recyclability and/or represent disruptive factors. A prospective integration of these information requirements could be realised in the course of implementing the digital product passport. Products that are not suitable for high-quality textile recycling according to this information could be assigned to other recycling as further utilisation in the open loop, e.g. for use in other branches of industry. The recycling processes and criteria listed in the following overview serve as examples. A concrete list of requirements is not provided at this time in order to avoid prematurely prioritizing specific processes while others are still under development. In the future, however, any mandatory information requirement must be backed up with specific, verifiable and standardized values that are subject to the reporting obligation. Corresponding product information can be stored perspectively, for example, along the supply chain by the Digital Product Passport (DPP). Until the introduction of product requirements for the recyclable kit, a specific cascade is therefore needed to determine which recycling process should be used in which given product data constellation.

The majority of the experts and workshop participants (from the fields of product development and textile recycling) suggested during the discussion of these proposed minimum requirements that a restriction to, for example, two heterogeneous materials within a fabric would be feasible and that a corresponding limitation would also have a significantly positive effect on recyclability. A correspondingly formulated requirement would be an appropriate compromise between durability and recyclability. With regard to specific requirements for the use of elastane (and other materials), it was also expressed that further requirements could also be placed on specific fibre materials in the future. At the current point of time, an elastane utilisation rate of between 5-10% would support near-infrared (NIR) technologies, for example, in the context of large-scale automatic sorting projects.

6.2.3.1 Supplementary explanation

In order to provide more detailed information on the current market share of elastane in clothing products, as well as the average number of different materials within a blend, additional information is provided below based on an analysis of old textiles and used to validate the above requirements. Table 34 summarizes the above information on (elastane) tolerances of different recycling processes, as well as the limits of spectroscopy measurements.

Table 34: Comparison of the influence of the disruptor elastane on the recyclability with different processes in connection with spectroscopic material recognition

Assessment of the disturbance factor grade of the disruptor Elastane			
Spectroscopic detection (Material recognition)	Mechanical recycling	Thermo-mechanical recycling	Chemical recycling
High (if < 5 %)	High (if > 10%)	Middle (unspecific percentage)	High (if > 3-5%)

Source: Hochschule Niederrhein based on Re_fashion (2025d) and Duhoux et al. (2021).

Considering requirements for recycling processes as well as the technological possibilities for material identification result in a preferred elastane usage rate of minimum 5% and maximum 10%. In this way, suitability (with regard to the disruptor elastane) can be evaluated, as optical identification technologies recognize a potential elastane use. The selection of a suitable recycling process can then be ensured without the need for credible textile labelling. The sorting processes are relieved and at the same time become more efficient and specifically aligned to the process specifications of the different recycling processes. The purity of the input streams can thus be supported and leads to an increase in efficiency as well as ensuring the economic viability of the process methods, as disruptive factors in the input stream can be reduced.

Based on an analysis of used textiles (post-consumer) carried out as part of a research project from the Hochschule Niederrhein, the average use of elastane in specific product categories was determined using a mixed used textile stream with 550 individual products and refers exclusively to products consisting of two different materials. The figures in the study presented refer exclusively to products with one layer. The elastane content is based on the information on the care label.

Table 35: Listing of average elastane usage rate and the proportion of products with an elastane content < 5 % based on product subcategories

Product subcategories	Average elastane usage rate [%] (relative frequency based on usage in product within product classes)	Proportion of products with elastane content <5 % [%] (relative frequency based on the number of products within product classes)
On top garments	7	39
Upper body	5	53
Lower body	11	50

Source: Hochschule Niederrhein, Center Textile Logistics (2025)

The derivation from the analysis shows that with an elastane usage rate of < 5%, on average 47% of the products would not have been detected via spectroscopy within these three product subcategories[18]. In relation to the proposal presented (criterion 2.2), it can be deduced from this that if an elastane content of at least 5% is necessary, around half of the products that currently have a lower content based on the old textiles can also be identified without a care label. With reference to the total evaluation quantity of products with two material blends (approx. 1,770, pieces), it was also found that blends with elastane content occur similarly frequently (31%) as blends of cotton and polyester (36%)[19]. Due to the frequency of occurrence, this also shows the relevance of the specific inclusion of elastane components within product requirements for recyclability.

In addition, the average number of heterogeneous materials within multi-materials was analysed within this used textile sorting analysis. For this purpose, 2,077 individual products were analysed on the basis of the care label.

[18] Information from the project R(h)einTex – Recycling durch Innovation in der Textilwirtschaft am Niederrhein (Hochschule Niederrhein, Center Textile Logistics 2025).

[19] The cotton and polyester content is also determined from the information on the care label mixed with information from an NIR measurement if no care label was available. The specification of the elastane content is based exclusively on the information on the care label, as an NIR measurement is not accurate enough if the content is too low for the reasons discussed.

Table 36: Use of heterogeneous materials within multi-materials in one layer (relative frequency based on distribution within product classes)

	2 materials [%]	3 materials [%]	4 and 5 materials [%]
On top garments	4	2	9
Upper body	60	55	68
Lower body	36	43	23
Average of total	75	22	3

Source: Hochschule Niederrhein, Center Textile Logistics (2025)

The table above indicates that currently, 75% of products contain a maximum of two heterogeneous materials. This means that 25% of products contain more than two materials. If the number of materials were limited to a maximum of two, these 25% of products would also be more suitable for recycling as they would be less complex.

In addition, the percentage use of main and secondary material within a multi-material mixture with a maximum of two heterogeneous materials was also investigated within this study. Based on an analysis of 1,160 individual products, an average use of the main material of 78% was determined. On average, 22% of the minor material is used. In the following table 37, the average percentage use of the minor material is broken down into the different types of material. For example, on average, the minor material content in on top garments products using elastane is 8%.

Table 37: Percentage use of minor material in multi-materials in relation to type of materials (relative frequency based on the total fabric)

[%]	Elastane	Nylon	Polyamide	Wool	Polyester	Cotton	Acrylic/ Polyacrylic
On top garments	8	-	-	-	42	33	59
Upper body	5	22	30	33	32	32	40
Lower body	11	34	32	32	32	41	41
Average	8	28	31	33	35	35	47

Source: Hochschule Niederrhein, Center Textile Logistics (2025)

In connection with the proposed criterion 2.1, it can be determined that a reduction of the minor material is required against the background of a requirement for a minimum fibre content of 10% in the minor material. Based on the analysis, an average of 22% of the minor material is currently used. When looking at specific fibre materials, the proportion of minor parts increases.

The analysis also shows that (except for elastane) the majority of the low material usage rates (e.g. 1-5%) are attributable to multi-materials with more than 2 heterogeneous materials. The proposed requirement (1.) already counteracts this. The desired mixing ratio (in addition to a mono-material) is 90/10 (major/minor material) and can lead to a better classification within a potential ecodesign label structure. The mixing ratios 80/20, 70/30, 60/40 and 50/50 (and other gradations) would lead to a poorer classification within the classes. Chapter 11 further explains how changing the proportion of a fibre material can lead to a different classification.

At this point, it should be noted that in the medium term, additional and further analyses using the improved techniques will be required to further validate all of the mentioned values.

6.2.3.2 Application to defined product groups

With reference to the categorization system presented in Chapter 3.2, the transferability of minimum requirements 1, 2.1 and 2.2 to differentiated product groups is discussed below. Based on the listed groups 1. - 28. (see Figure 2) it was checked whether product groups may have to be excluded from the proposed criteria for the improvement and support of recyclability to ensure the technical feasibility of the product while maintaining the functionality of the product. This estimation also takes the discussions with experts during the workshops into account.

- Minimum requirement 1 no product group exclusivity necessary, therefore applicable to all listed subcategories.
- Minimum requirement 2.1 no product group exclusivity necessary, therefore applicable to all listed subcategories.
- For minimum requirement 2.2, specific product groups should be categorically excluded from compliance with the proposed requirements.
    - This includes No. 17-28. (concerns the subdivisions ‘Fashion clothing and underwear for babies/children’, ‘Functional clothing for babies/children’). The reason for this is the need for elasticity of the products to maintain their function. Clothing for babies/children must necessarily continue to be excessively elastic in order to ensure comfort during dressing and wearing.
    - It is recommended that No. 6 ‘Fashion clothing, lower body not knitted/crocheted’ is also excluded from this requirement. Subcategory No. 6 includes jeans pants which may require an elastane content of < 5% in order not to restrict the function and to be able to continue to offer elastic jeans. 5% or more may be too much elastane for this type of product.
    - It is recommended that **No. 15** ‘Functional clothing, lower body knitted/crocheted’ is also excluded from this requirement. Subcategory No. 15 includes sport leggings. Usually, the elastane content is > 10%, which is why reducing the elastane content to a maximum of 10% may result in too high a restriction in terms of function.

In addition, other product groups were reviewed for possible exclusion. Excluding **functional jackets** from the requirements due to product complexity is not recommended, as all three proposed requirements already refer to the fabric level. It is still possible to combine different fabrics within a product, and this does not affect compliance with the requirements. **Functional T-shirts** may traditionally have an elastane content of > 10%, so this content must be reduced in order to comply with the requirement. It is considered technologically feasible for this specific product type. Within the **underwear subcategory**, the necessary use of > 10% elastane to maintain functionality mainly refers to the product type lingerie. The specific products ‘laundry and underwear’ has already been categorically excluded from this product group within the categorization system due to its different fabric structure (fine knit) (see Chapter 2.2). For the **fashion clothing subcategory**, it can be assumed that limited use of elastane in combination with changes to the pattern/cut and fabric construction will not impair the functionality and primary wearing comfort of the products. The analysis has shown that, for the reasons mentioned above, no exclusion of these specific product groups is necessary.

At this point, it is important to mention that the above assessments must be continuously validated and examined to ensure that the requirements can be implemented in practice. This requires further analysis and testing procedures. In doing so, it is fundamental to include product groups that have already been proven to make a positive contribution to the objectives of the overarching goals of the regulation from individual requirements.

6.2.4 Possible implications / Potential impacts

The scenarios described above serve as a basis for further developing the requirements for the recyclability of clothing. To enable practical and feasible solutions, it is necessary to further evaluate their effectiveness and feasibility, considering possible interactions with other product aspects (see Chapter 10.2) and the perspectives of relevant industry stakeholders. Due to transparency and documentation, the contents of the preparatory documents were less extensive than the current documentation. In this context, subsequent and formal feedback from stakeholders was taken into account and summarised below to highlight key concerns and suggestions regarding the practical implementation of the final requirements presented.

Inclusion of all textile waste types and focus on post-consumer textiles

A common discussion is that all types of textile waste – post-industrial, pre-consumer, and particularly post-consumer – should be counted toward mandatory recycled content targets. Post-consumer textiles are the most challenging to process due to contamination, heterogeneity, and collection issues, and therefore require specific incentives.

- This project specifically focuses on criteria for post-consumer clothing, aiming to enable fibre-to-fibre recycling and reintegration into new garments. This approach aligns with the goals of the ESPR, which prioritizes circularity and high-quality recycling for consumer end products. In addition, post-consumer items exhibit the highest complexity in terms of missing product information, influences of the wear cycle, and contamination. Nevertheless, the possibility of making other waste streams recyclable and use them as input stream should not be ruled out. However, if clear regulations for end products are defined, this will also have a positive impact on the recyclability of post-industrial waste and pre-consumer products.

Technology-neutral and adaptive requirement development

Technological advances in recycling necessitate a dynamic and adaptable set of requirements. Overreliance on a few established technologies may prematurely exclude emerging solutions and create market distortions.

- All proposed requirements are based on the current state of the art and designed to include as many recycling pathways as possible. The framework is deliberately technology-neutral, avoiding early prioritization of any one method. Requirements will be updated as new processes become industrially viable and their performance validated. The system is designed to evolve in line with technological progress and increasingly complex waste streams.

Neglecting constructive influencing factors

A key discussion point is that recyclability is typically assessed based on material composition at the fabric level, while structural design aspects (e.g., stitching density, laminates, or processing methods) also significantly affect recyclability but are less involved in the proposal.

- ► At this stage, these structural influences cannot yet be fully integrated into the requirements due to a lack of standardized, validated data from recyclers, especially regarding specific disruptive factors and system limitations. However, the proposed framework includes an option to incorporate such parameters later, once reliable information becomes available. These factors can then be used to guide sorting decisions and select the most suitable recycling route for each product.

Functionality and multi-materials in performance products

For technical and outdoor apparel, mixing different materials is often essential to deliver required performance attributes like weather resistance, durability, or flexibility. Blanket restrictions on material heterogeneity could undermine functionality and inhibit innovation. At the same time, harmonized baseline requirements are necessary to avoid competitive disadvantages and ensure a level playing field.

- ► To address this, the project allows certain product types to be categorically exempted from minimum requirements via a product categorization system. Initial exclusions have already been defined, and further categories will be established through continued analysis. The aim is to enforce a general recyclability standard without compromising key functional characteristics, especially in performance-driven segments.

Differentiated regulation on the use of elastane

Elastane is widely used for fit and comfort but poses recycling challenges. Some recyclers call for minimal content, yet scientific consensus is lacking on the optimal threshold (e.g., whether 5% is meaningfully better than 10%). Poorly set limits could negatively impact garment durability and lead to faster product replacement. If the amount of elastane used is too low, the durability of textiles can suffer. Without sufficient elastane content, fit and comfort often suffer. The requirements for the sample products are considered realistic, but their transferability to other product groups must be examined. For another manufacturer, a maximum elastane content of 10% instead of 15% would be recommended because of experiences with recyclers. Based on feedback from recyclers, the elastane content should be as low as possible, not at least 5%.

- ► The proposed elastane limit regulation is based on the information currently available. If further information becomes available, an adjustment may/must also be made here. The currently proposed limit of minimum 5% also results from the link with identification technologies for the validated detection of elastane content in upstream recycling process steps, to ensure single-variety materials and suitable input streams. If these technologies continue to develop in the future, the limit for a minimum elastane content may also be adjusted. Measurable validation of the materials present in the product, even without a care label (in absence of or assumed inaccuracy of a care label, as well as currently permitted deviations due to the Textile Labelling Regulation), should currently be a priority. Products for which the proposed elastane content is not technically feasible without compromising functionality and comfort have already been recommended for exclusion from the requirements. This list can be further expanded if the need arises.

Balancing recyclability with durability and function

Critics warn that focusing too much on recyclability may conflict with other ecological goals like longevity, repairability, and functionality. Design for Recycling must not be equated with simplified bans on material combinations. The balance between different sustainability parameters is product-specific and must be carefully managed. Concerns have been raised, particularly in the areas of accessories and underwear. Polyester-polyamide-elastane blends are often used in swimwear. There is currently no alternative to this. The market must first develop in the direction of recyclability. For the three examples discussed (T-shirt, jeans, functional jacket), the requirements are considered feasible, especially since we are talking about flat fabrics.

- Therefore, the proposed minimum requirements aim to address only minimal product requirements to create a 'new/adapted" basis in the market. Even more stringent design requirements (to improve recyclability) can only be imposed if it is ensured that the durability of this specific product should be assessed for validated reasons of recyclability. This possibility is offered, for example, by the addition of a comprehensive label structure, in which product groups can be specifically separated on the basis of conflicting objectives and a distinction can be made as to which criteria should be given priority for which products in order to promote the overall sustainability of the product (in the sense of the ESPR). Functional products in particular should be considered separately due to their durability and limited recyclability. In particular, the proposed reduction of heterogeneous materials should be further specified in perspective if test runs show that technical implementation is not feasible from a product development perspective. To this aim, the requirements (in accordance with ESPR) are gradually being further specified and adapted. In this specific case, product(s) or product groups may be excluded from the requirements. However, efforts to investigate technical feasibility should not be restricted from the outset by exclusions. A further consideration of product group-specific market shares and consumption volumes can contribute to this in parallel, to ensure that requirements exist for the majority of products available on the market. Products that are not suitable for compliance with recycling requirements have already been categorically excluded during the categorization process. These include accessories, underwear, swimwear, and other items (see Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published).

Recycling must be technically and economically viable

'Suitable recycling process" means not only technically feasible, but also economically viable and available. It is of little help if a suitable process is so specialized that it can only be carried out on a laboratory scale with the corresponding effort. In chemical recycling, according to the state of the art, the number of materials is not particularly decisive and a restriction to two materials is not necessary. Such a restriction should therefore not be mandatory, especially for performance products. Based on feedback from recyclers, the proportion of the second component should be ≤ 20%. A minimum proportion for a specific fibre type instead of a maximum proportion is counterproductive for recycling, as there is often a target component.

- Based on predominantly feedback from recyclers, a contribution is made to ensuring economic feasibility, in particular by preferring the highest possible fibre content. The target components of recycling processes should account for as high a proportion as possible. Regarding chemical recycling, in addition to the (assumed) technical feasibility, economic profitability must also be considered when discussing multi-materials with >2 materials. The more heterogeneous materials the fabric has, the lower the proportions of the primary target components. As much of the material as possible should be reused for reintegration rather than simply being dissolved, separated, and rendered unusable for reuse. However, this often requires the recycling process to be tailored to these specific material mixtures. A minimum proportion of minor material of 10% implies a requirement for a proportion of minor material of ≤ 20%. Minimum or maximum proportions for specific fibre types (except elastane) are not addressed in the proposed requirements in order not to restrict or specify the target components of different recycling processes in the interests of technological openness.

Role of information requirements for sorting and recycling

Information requirements regarding suitable recycling processes are considered impractical, as recyclers determine the appropriate method. In practice, sorter make this decision themselves, as they are most familiar with the current specifications of the recyclers.

- The information requirements and measurable factors should be based on the recyclers' specifications to ensure that the information is sufficient to determine the appropriate recycling process and to ensure the purity of the material according to the parameters for the process. For this reason, only examples are currently given, as most recyclers do not yet provide quantitative information and are unable to do so, largely because the processes are still being tested and evaluated in bigger scales. The current specifications of recyclers for sorting companies are mainly based on recycling processes that do not target fibre-to-fiber recycling. Therefore, the sorting requirements and criteria must also be changed and adapted in the future to ensure that the sorting categories reflect the specific requirements of recyclers for high-quality recycling. The information listed in the information request also serves to aid decision-making with regard to the appropriate high-quality recycling process, as it is foreseeable that a variety of different processes will be needed to recycle the wide range of different product packaging on the market in such a way that it can be reused in clothing products (in accordance with ESPR).

Role of accepting voluntary recycling standards

It is suggested that recognized recycling standards must be clearly specified.

- Existing certifications (e.g. Cradle to Cradle, EU Ecolabel, Bluesign) assess recyclability to varying degrees but are not harmonized across the industry. They typically address recycled content, process transparency, and traceability rather than recyclability of the full product. These standards are currently not used to determine compliance with the proposed recyclability requirements. However, their integration may become relevant if certification schemes are adapted to cover the specific product-level criteria defined in the project. Recognition of such standards could then serve as verification tools or evidence for conformity.

Restriction to two materials per product

A hard limit of two materials per product is viewed as overly restrictive. Many functional or innovative textiles, especially those using recycled inputs, rely on more complex compositions. Limiting the number of fibres may hinder innovation and prevent integration of new recycled materials.

- The positive influence of material mixtures, especially of >2 heterogeneous materials, must be validated. If the addition of small percentages does not make a significant contribution, e.g., to the durability of the product, the necessity for most of the products must be questioned. Innovative material combinations could continue to be implemented as long as it is ensured that, for example, spectroscopic detectability for sorting processes is guaranteed and that there are existing industrial recycling processes that can recycle these material combinations to a high standard. With regard to the inclusion of recycled materials (in multi-loop cycles) in relation to the proposed limitation of heterogeneous materials within a mixture, it should be noted that special regulations may have to be applied to materials made from recycled materials. However, it is necessary to wait and see how the product aspect of the mandatory recycled content is designed. If this is to apply exclusively to specific types of materials, special regulations could be implemented for these materials within the proposed restriction.

Definition of 'Material composition' scope

The requirements based on the material usage for the recyclability of textiles, could be implemented to a large extent for many product groups and by some of the stakeholders surveyed, but this would in turn entail higher costs. It would be necessary to define whether the material requirements apply only to the outer fabrics and main fabrics or also include other textile components.

► The reference framework is established within the proposal. The material requirements refer to the multi-material of each fabric within the end product. Multi-layer products with more than one main fabric/outer fabric can therefore still be produced, if the individual fabrics meet the requirements.

Furthermore, in order to ensure practical transfer and implementation, it is expressly recommended that a gradual implementation of requirements be endeavoured, for example to integrate the differentiated development stages of recycling processes into the ongoing definition of product criteria.

In summary, based on formal feedback from stakeholder participating in the 3rd workshop, no direct adjustment of the proposed minimum requirements is necessary to enable practical implementation. Nevertheless, as explained above, innovations in technology development should subsequently be incorporated into a requirements profile with regard to the requirements for input material and possible output qualities. This goes hand in hand with standardised, validated data from recycling companies, which must be made available on an ongoing basis to ensure that the minimum requirements listed for products support high-quality material recycling. In order to ensure practical transfer and implementation, it is also expressly recommended that a step-by-step implementation of the requirements be pursued, for example for the integration of the differentiated development stages of recycling processes into the ongoing definition of product criteria.

6.3 Recycled content[20]

6.3.1 Recycled content and its verification in general

Different definitions of what can count as recycled material exist. According to EN ISO 14021:2016-07, recycled material can be differentiated into two categories: Recycled material from pre-consumer and from post-consumer recycled material (PCR). The EN ISO 14021 is not textiles specific but applicable to all waste streams. For the two types of pre-consumer textile waste (see Table 38), the EN ISO 14021 does not distinguish these two sub-categories.

[20] This chapter was written by Clara Löw, Johannes Klinge, Hannah Lorösch and Katja Moch from Öko-Institut.

Table 38: Definitions used to differentiate recycled material (not textile specific)

Term	Definition according to EN ISO 14021
Recycled content	Proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content, consistent with the following usage of terms. (clause 7.8.1.1 a)
Pre-consumer material (also called post-industrial material)	Material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it (clause 7.8.1.1 a) 1).
Post-consumer material	Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain (clause 7.8.1.1 a) 2).

Source: DIN EN ISO 14021:2021-10

The information on the material flows is primarily available from the recyclers and product manufacturers. In order to avoid having to rely solely on the self-reporting of the actors involved, the processes and companies can be certified. Generally, the recycled content can only be verified by tracing the material flows via the supply chain or the input and output data. This is due to the fact that there is no physical or chemical evidence that could determine the exact proportion of recyclate in practice (Betz et al. 2022).

Most of the existing certificates, especially for the textile sector, are awarded for the end product (see Chapter 6.3.2.4). However, the entire supply chain of the material flow to be certified (in this case the recyclates) must be traced. The various existing certificates differ in their approach and methods.

The following characteristics are relevant:

- Calculation, e.g., point of calculation, dealing with different outputs/by-products, minimum content vs. exact recycled content information,
- Methodology of verification, e.g.:
- Inclusion of the entire supply chain
- Approval of waste sources (e.g., PET beverage bottles or textile waste; PCR vs. PIR)
- Approval of recycling processes (e.g., mechanical vs. chemical recycling)
- Chain of Custody according to ISO 22095:2020-10 (from 'Identity Preservation' to 'Book and Claim')
- Surveillance/monitoring (e.g., self-declaration/audits/accreditation etc.)

6.3.1.1 Calculation

There are several ways to calculate the recycled content. A formula for the calculation of recycled content based on percentage by mass is given in section 6 of EN 15343:2007 and section 7.8.4.1 in ISO 14021:2016:

$$\text{Percentage of recycled content in the product} = \frac{\text{mass of recycled materials used for the product OR product category}}{\text{total mass of the final product OR product category}} \, x\, 100$$

This formula, however, can only be applied at a point whereafter no loss of recycled materials is expected during production of the final product. This usually is not the case, as there are several points early in the process chain where secondary materials can enter the process, whereafter still significant losses due to short fibres or cutting waste occur. For textiles, this includes for example spinning, knitting, dyeing and finishing.

Another possibility is a mass balance based on input/output streams based on the EN 45557:2020:

$$\text{Output} = \text{Input} \vdash \text{Inventory change} - \text{Internal conversions} - \text{Waste}$$

This latter calculation method leads to the same result as the former calculation method but should allow for an actually correct calculation. For the formula, which is entirely based on the masses of the final product, the actual mass of the recycled material in the product is needed. This is nearly impossible to calculate, as all the losses have to be accounted for. If the mass of the recycled input were used for this value, the calculation would be wrong, as many losses occur during manufacturing, all of which would be attributed to the primary material instead of both material flows.

Based on the idea of an input stream, the following formula is proposed, taking into account possible losses during the process:

$$\text{Percentage of recycled content in the (intermediate) product} = \frac{\text{mass of recycled material in the input}}{\text{total mass of this material in the input}} \, x\, 100$$

The formular is used by the Global Reporting Initiative (GRI) Standard, more specifically GRI 301: Materials 2016, Disclosure 301-2 'Recycled input material used" (GRI 2016).

The formula should be applicable for every step of the production chain to be able to calculate the recycled content of an intermediate product as well, as every step of a value chain, a new stakeholder or a new location could be involved. Therefore, it is defined for intermediate products (yarn, fabrics, etc.) and for the final product, like a jeans, which is placed on the EU market.

These reflections are considered in the Content Claim Standard (CCS) for all Textile Exchange's Standards: 'The CCS is intended to maintain the integrity of the claimed material's attributes from the original input source to the final product" (Textile Exchange 2022a, p. 5). Additional information including calculation examples can be found in the CCS User Manual (Textile Exchange 2022b).

6.3.1.2 Chain of custody models

The ISO 22095:2020-10 'General terminology and models' provides different models to trace back certified material streams using a 'Chain of custody' (CoC). In this context, certain CoC main concepts are proposed, such as depicted in table:

Table 39: Chain of custody models given by ISO 22095:2020-10

Chain of custody model	Description
Identity Preservation	Supply chain is kept entirely separate and isolated.
Segregation	Difference to identity preservation: it allows aggregation of content in an end product from multiple certified sources.
Controlled Blending	Certified and non-certified material are blended together in known proportions and the ratio is known and can be verified.
Mass Balance	Material is blended together at any point in the supply chain. Overall proportion of certified content is known, but not necessarily for a given product. Allocation of recycled content to a certain output stream is allowed.
Book and Claim	The lowest level of transparency, involving tradeable certifications that entirely decouple the production from the end user.

Source: ISO 22095:2020-10

Usually, recycled content schemes use ‘segregation’ and ‘controlled blending’, sometimes also ‘mass balance’, as possible CoC types. This still allows the manufacturer of a product some flexibility, while ensuring that recycled content is not just a tradable certification that is no longer tied to a specific product or company. While for ‘controlled blending’, there is still a physical connection between the given recycled content and the actual recycled content in the product, depending on the exact criteria, ‘mass balancing’ allows for a certain allocation of recycled content from one product to another. This can lead to products with a certified recycled content claim and no actual recycled content in them. For the applicability of CoC types under Ecodesign, see Chapter 6.3.3.

6.3.1.3 Monitoring the supply chain

The producers of a final textile product in most cases buy the materials like fabrics, yarn and components such as buttons from another company. As a result, the producers are not the ones declaring a certain recycled content per material since they simply obtain intermediate products with a certain ratio of secondary material from others. Producers of final textile products have, however, the possibility of mixing various fabrics and materials from different sources. Actually, in many textile products, different materials are used for design or functionality reasons.

This means that the importers and textile product manufacturers are not the most important step at which the recycled content has to be verified. The blending of primary and secondary material usually happens earlier in the production chain, mainly, in the production and spinning of the yarn.

Apart from knowledge about all the suppliers of secondary materials in the supply chain, also the mass ratio of input streams must be recorded, which differs from due diligence schemes wherein only the source itself matters. Another difference is that only secondary material has to be monitored, as the rest only counts to the uncertified primary material part.

Since it makes no sense to personally audit a manufacturer of final textile products without examining the supply chain, the application and auditing of a management system could help, where the auditing and mass balance for every supplier of secondary material are included.

Conclusion

- In order to verify a certain recycled content of a textile product, during all steps of the supply chain the textile product involving the recyclate has to be monitored for recycled content and material flows (addition and loss of recycled fibres during the processing).
- A third-party audit is required at the sites where the recycled materials are recovered from the textiles waste and later processed together with primary material. This excludes all steps where only primary material is involved, as this does not need to be monitored for recycled content.
- As soon as primary material and secondary material are combined, the quantities and material flows need to be tracked.
- A management system for the textiles product manufacturer could ensure audits for recycled content in the whole supply chain.

6.3.1.4 Auditing the recycled content

The starting point for auditing the recycled content in textile products, as already mentioned, is the inspection of a recycling plant's premises by a notified body, as this serves as certification of the source of recycled material. Without certification, it would be easy to sell primary material as recycled. Certification includes auditing the production site and the reports addressing input and output flows to certify that the recycler is actually able to produce the claimed amount of recycled material. The output is then certified by the notified body that it is actual secondary material, which can also be pre-treated scraps that have to be processed further by another company.

The auditing of recyclers also should include the differentiation between different sources of secondary material. This is not only necessary to differentiate between fibres and, e.g., plastic bottles, but can also differ between PCR and PIR. This leads to more transparency and giving labels or certificates for recycled content based on the initial audit the possibility to differentiate between them.

To give an example of how such a process could look like, the following exemplary process is depicted:

- Auditor selection: The recycler selects an accredited auditor.
- On-site auditing: The recycling plant is inspected by the chosen auditor on-site.
- Information exchange and report: A report is written and additional information is exchanged between the recycler and the auditor.
- Third party checks: A third party – an anonymous auditor (also accredited) – checks the report to ensure uniformity and rigour in all the new reports. There are also spot-checks on monitoring reports.
- Certification: After a successful audit, a certification valid for a certain period of time (maximum one year) is issued.
- On-site monitoring audit: Before the certification period ends, a new audit takes place on site, which is not as detailed, but checks all relevant points to ensure continuity of the earlier findings.

- Unannounced audits: In certain cases, a 'surprise' audit can take place to ensure that the recycler is complying with the requirements.

There are several types of audits, all of which are scheduled and pre-arranged with the recycler:

- Initial Certification; estimated on-site time of 1 day
- Monitoring Certification; estimated on-site time of 0.5 day
- Change of Recycling Process Certification; estimated on-site time of 0.5 days

A recycler will need to request a 'Change of Recycling Process' audit when, during the period of certification, significant changes are made to its recycling process. Changes considered as significant are:

- When the equipment capacity is changed by more than 50%,
- When input waste type is changed,
- When recycled output is changed.

There can be different levels of traceability concerning recyclers:

- Control of input material:
  - The input of material can be strongly monitored (controls for each incoming batch of input material with complete traceability) or more loosely monitored (documented on a monthly basis).
  - There can be a requirement to keep each batch of input material separate and identifiable in the stock area.
- Control of the recyclates production process:
  - There can be a requirement for the recycling process to be fed with individual batches of material or blends of batches of known composition to be able to gain full traceability from the input batches to the output batches. The other end of the traceability scale would be again to trace back the output of recycling to the input only by monthly averages.
  - For the stricter way, recording process variables per batch can be required.
  - In general, details of the date and time of production should be recorded, and quality controls have to be carried out on recycled outputs.
- Controls on output material:
  - On the higher level of traceability, recyclers should be able to provide to the end user the characteristics of each batch of recycled output produced (in line with relevant measures in the EU regulation).
  - Recycled content of the output stream: This can be calculated using a dedicated formula (which requires a known blend of recycled and primary / other material; see Chapter 6.3.1.1).
- Record keeping: Records are kept of all of the above-mentioned data.

The recycler's audit offers the possibility to ensure other specifications (e.g. monitoring of input sources for a carbon footprint calculation) and the coherence of the recycling plant with the measures of other regulations and is therefore recommended anyway. However, combining too many aspects in one audit could also lead to excessive expectations of the auditor, as he or she must have knowledge and experience in each area of the aspects to be audited (e.g. recycled content vs. human rights violations).

From this point on, every step and every facility involved in processing the materials and involving the blending of secondary and primary materials must be audited in-person by a notified body to verify the resulting recycled content. It may be noted that deceptive practices cannot always be noted by an auditor; even with an in-person audit, there still can be ways to circumvent the requirements, as the auditors can only look into the past and audit what is there (see 'challenges and concerns' below). The above-mentioned example of the audit of a recycler can be used for other steps in the value chain as well such as yarn and fabric producers. The standard EN 45557:2020 'General method for assessing the proportion of recycled material content in energy-related products' can serve as an additional basis for this.

The audit must verify not only the technical aspects of production, but also the traceability of the input and output flows involved in the recycled material, including weighing certificates and documentation of each material flow. The longer such a production chain is, the more on-site audits by third parties have to be carried out. While such audits involve serious effort, auditing is nevertheless the safest way to achieve transparency. The value chain for textiles is very complex. Therefore, certificates of the suppliers should be usable as a basis for every audit, so that not every auditor has to visit all supplying companies. This, however, is only possible if all audits can be held to the same high standards.

Conclusion

- The on-site audit processes of the recyclers serve as a basis for the recycled content but have to be complemented by on-site audits for every company that blends secondary and primary material.
- A management process for the economic operator who places the textile product on the European market, supported by an audit, could include the requirements for the supply chain, as the ESPR only commits the economic operator that places the product on the European market.

6.3.1.5 Recycled content provisions in different legislations

At the time of writing (mid-2025), legal recycled content requirements exist in the Batteries Regulation for various battery raw materials, in the Packaging and Packaging Waste Regulation (PPWR) and the Single-Use Plastics Directive (SUPD) for recycled plastics in beverage bottles.

Table 40 displays the wording of the different recycled content provisions in these legal documents. The SUPD specifies the recycled content of PET / beverage bottles to be 'calculated as an average for all […] bottles placed on the market on the territory of that Member State'. In contrast, the recycled content is calculated per year and per manufacturing plant in provisions in the PPWR and the Batteries Regulation.

Table 40: Wording of the legal text for recycled content provisions in the Single-Use Plastics Directive (SUPD), the Packaging and Packaging Waste Regulation (PPWR) and the Batteries Regulation

Docu-ment	Legal text
SUPD Article 6	5. With regard to beverage bottles listed in Part F of the Annex, each Member State shall ensure that: a) from 2025, beverage bottles listed in Part F of the Annex which are manufactured from polyethylene terephthalate as the major component ('PET bottles') contain at least 25% recycled plastic, calculated as an average for all PET bottles placed on the market on the territory of that Member State; and b) from 2030, beverage bottles listed in Part F of the Annex contain at least 30% recycled plastic, calculated as an average for all such beverage bottles placed on the market on the territory of that Member State.
PPWR Article 7	1. By 1 January 2030 or 3 years from the date of entry into force of the implementing act referred to in paragraph 8 of this Article, whichever is the latest, any plastic part of packaging placed on the market shall contain the following minimum percentage of recycled content recovered from post-consumer plastic waste, per packaging type and format as referred to in Table 1 of Annex II, **calculated as an average per manufacturing plant and year**: a) 30% for contact-sensitive packaging made from polyethylene terephthalate (PET) as the major component, except single-use plastic beverage bottles; b) 10% for contact-sensitive packaging made from plastic materials other than PET, except single-use plastic beverage bottles; c) 30% for single-use plastic beverage bottles; d) 35% for plastic packaging other than those referred to in points (a), (b) and (c) of this paragraph.
Batteries Regulation Article 8	1. From 18 August 2028 or 24 months after the date of entry into force of the delegated act referred to in the third subparagraph, whichever is the latest, industrial batteries with a capacity greater than 2 kWh, except those with exclusively external storage, electric vehicle batteries and SLI batteries that contain cobalt, lead, lithium or nickel in active materials, shall be accompanied by documentation containing information about the percentage share of cobalt, lithium or nickel that is present in active materials and that has been recovered from battery manufacturing waste or post-consumer waste, and the percentage share of lead that is present in the battery and that has been recovered from waste, **for each battery model per year and per manufacturing plant.**

Sources: SUPD (Directive (EU) 2019/904), PPWR (European Parliament; European Council 2025), Batteries Regulation (European Parliament; European Council 2023)

6.3.2 Status quo (recycled content)

This chapter covers information on the market of recycled fibres, recycled content in products on the current market as well as companies' claims and business strategies in relation to recycled content. Furthermore, it gives a summary of the status quo of the verification of recycled content. An interim conclusion describes the extent to which the status quo provides a good starting point and solid basis for a mandatory recycled content requirement in textiles.

6.3.2.1 Market of recycled fibres

Table 41 shows the share of recycled fibres in the respective fibre production. The shares in the table refer to the entire fibre market, regardless of the subsequent area of use for the fibres. In addition to clothing, the fibres are also used for home textiles, technical textiles, or other industrial applications, such as in the automotive or construction industries. Furthermore, for the production of recycled fibres, material streams from other industrial sectors are often used, e.g. packaging. The share of recycled fibres originating from closed-loop recycling globally was less than 1% in 2023 (Textile Exchange 2024). Looking at the trends, the recycled fibre market has remained consistently low over the past five years.

Table 41: Estimated global share [%] of recycled fibres in the respective fibre production

Fibre	2020	2021	2022	2023
Polyester*	15	15	14	12
Polyamide	2	2	2	2
Polypropylene	0.6***	0.2	0.2	0.3
Elastane	see above	3	3	3
Cotton**	0.96	1	1	1
Manmade cellulosic fibres (MMCF)	0.4	0.5	0.5	0.7
Wool	6	6	7	6
Down	1	1	1	1

*98% of recycled polyester is based on PET bottles. Other sources include ocean waste (Ocean Bound Plastic (OBP) certification), packaging waste, industrial plastic waste, or old textiles;
**recycled cotton refers exclusively to mechanically recycled cotton. In the chemical recycling of cotton, the result is a regenerated cellulose fibre.
***The share includes polypropylene, elastane and acrylics.
Source: Textile Exchange (2021; 2022c; 2023; 2024)

The fibres considered most significant for establishing a recycled content requirement, based on their global market share, are polyester (57.2%), cotton (19.9%), polyamide (5.3%), and viscose (5%). Although wool only holds a minor role in the global fibre market with 0.9%, it should still be considered in the development of recycled content quotas, as there are already established recycling processes on a larger scale (Textile Exchange 2024).

The relatively high share of recycled polyester in fibre production is currently covered by using materials from the packaging industry, particularly recycled PET (rPET) from bottles. Generally, approximately 75% of globally rPET from PET bottles is diverted for other product lines, such as the production of textile fibres (Cobbing et al. 2023). For Germany, GVM (2022) concludes that by 2025, instead of 88 kt, a maximum of only 24 kt (i.e., less than 30%) of rPET can be used for fibres, as its use in beverage bottles is increasing due to legal requirements and commitments from the packaging industry. The reduction in the amounts of rPET available for fibres from bottle collection is likely to be generalized due to the Europe-wide quotas of the PPWR and the commitments of globally operating companies beyond these quotas.

The use of rPET from bottles in polyester textiles is not only a problem of decreasing availability. It is also problematic because 31% of fibres from post-consumer textiles are blends, making fibre-to-fibre recycling difficult (van Duijn et al. 2022). As a result, PET bottles are removed from a closed loop and downcycled as it is not possible to obtain recycled polyester from post-consumer textiles that can be used as an input to PET bottle production again. Furthermore, the use of rPET from bottle recycling does not contribute to prevent textile waste. Some bring forward the argument that its use is hindering solving the issue that most textiles are not recycled at the end of their use and thus become waste, which is either incinerated or landfilled.

6.3.2.2 Recycled content in products on the textile market today

There are already garments on the market with ambitious recycled contents. Van de Burgt et al. (2023) estimates an average of up to 20%. There are individual products with very high recycled content such as the 'Monovest" by Neumühle Switzerland GmbH made of 100% rPA (Bundespreis ecodesign 2023) or the sleeping suit 'Sleep 'til Infinna" by Armed Angels fully made of recycled cellulosic fibres from post-consumer textiles (Bundespreis ecodesign 2024) both winners of the German Ecodesign Prize in 2023/4.

In the market research conducted for the product selection (see Chapter 3.3) the recycled content in T-shirts was analysed[21]. There was a wide variation in indicated recycled content, if any quantitative information was provided. Among cotton T-shirts claimed to contain recycled cotton, the stated recycled content varied from 20% and 100%. The majority of cotton T-shirts that had a share of recycled fibres contained 20% recycled cotton (around 55%) (see Table 62Table 62: Results of the market analysis on recycled content in T-shirts made from cotton and polyester, Annex A.1). For polyester T-shirts that were claimed to contain recycled material, the stated recycled content varied from 30% and 100%, while the majority (around 65%) stated a recycled content of 100%. Few certificates were provided to confirm the declared recycled content. The most common certificates are the Global Recycled Standard (GRS) and Recycled Claim Standard (RCS). However, these certificates do not require the disclosure of the absolute recycled content of the product. Furthermore the certificates do mostly not clearly regulate, whether the recycled content has to refer to the article or only to the fibre content (e.g., 50% of the cotton in a 50/50 polycotton blend corresponds to a 25% share in the article) (GRS 2014). See Chapter 6.3.2.4 for more details on the verification of recycled content in textiles today.

In general, it can be stated that there are not only a few products that contain recycled content on the market. Also, exemplary products containing recycled content can be found for the fibres with the highest market shares, i.e. polyester, cotton, polyamide and viscose. However, a systematic market analysis is difficult as the information on recycled content is not transparent, and there is a lack of a solid data foundation on the product- and fibre-specific use of recycled fibres.

6.3.2.3 Claims and business strategies related to recycled content

In a survey conducted by McKinsey & Company (2021) with global sourcing executives, 21% of the respondents stated that they aim to replace at least 30% of virgin cotton with recycled cotton by 2025. Furthermore, 25% indicated that they want to use polyester from fibre-to-fibre recycling in at least 30% of their polyester products, and another quarter of the companies expressed the same for their viscose products. According to Köhler et al. (2021), the uptake of recycled content is one of the main circular strategies of businesses.

As part of this study, ten brands[22] were examined regarding their goals for using recycled materials. This is to show that the topic is part of business strategies and can therefore be considered relevant. Of the ten brands analysed, four have set specific short-term goals for using

[21] The ten fashion platforms in Germany with the highest turnover were filtered for T-shirts with recycled content made from 100% cotton or 100% polyester. Not all fashion platforms allowed filtering by recycled content. In total, 64 T-shirts made from 100% cotton and 61 T-shirts made from 100% polyester were analysed, where a recycled content was specified. Blends were not considered for simplicity.

[22] The analysed brands/online retailers were: PUMA, Adidas, Nike, Zara, H&M, Shein, C&A, Asos, Tommy Hilfiger, Otto Group.

recycled materials by 2025 (the year of publication of this study). It is noticeable that these short-term goals all relate to recycled polyester:

- PUMA plans to increase the share of recycled polyester from textile waste in both its clothing and accessories to 75%, measured by the weight of each item (Puma 2025b).
- ADIDAS aims to use only recycled polyester by 2024, which includes material sourced from ocean-threatening plastic (adidas 2025).
- Nike uses recycled plastic bottles for polyester production and nylon from post-consumer waste, such as fishing nets. Additionally, since 2020, the majority of the cotton raw material input comes from organic, recycled, or third-party certified cotton (Nike Inc. 2023).
- ZARA targets using 100% recycled polyester and sustainable 'lower-impact"[23] linen by the end of 2025 (Inditex 2024).

Mid-term, e.g., by 2030, and long-term goals, e.g. by 2050, are found to be more ambitious in numbers, but less concrete in relation to fibre-specific goals. For example, C&A plans to use 100% more sustainable sources for materials by 2028 (C&A Mode GmbH & Co. KG 2022) and ASOS intends to make all its products sustainable or based on recycling by 2030 (Wightman-Stone 2021). ZARA and ADIDAS plan to further increase the proportion of recycled textiles in the long-term: ADIDAS aims for climate neutrality by 2050 (ISPO 2022), while ZARA intends to use 40% recycled materials and 25% sustainable plant fibres by 2030 (Market Screener 2023). SHEIN aims to replace 31% of the polyester used in its products with recycled material by 2030 (SHEIN). H&M has adjusted its goal from using 30% recycled textiles by 2025 to 50% by 2030 (Fachverband Textilrecycling 2024).

In general, the brands' claims suggest that they often consider recycled or otherwise sustainable materials as equivalent for achieving their goals (e.g., organic cotton or recycled cotton instead of conventional cotton).

6.3.2.4 Existing verification schemes for recycled content in textiles today

Based on the general considerations for the verification of recycled content (see Chapter 6.3.1), the certificates listed in the following table were analysed to determine the extent to which they contain verification for recycled content and can be used for the minimum requirements for recycled content in textiles. The objectives, independence and transparency aspects of the certification, the permitted raw material sources and environmental and social compatibility were analysed; however, this is only a broad analysis and cannot vouch for the eligibility of a certification scheme.

To claim a certain recycled content under ESPR, there have to be certain criteria fulfilled. In this study, the authors conclude, that schemes are not applicable, if

- they do not differentiate between recycled and bio-based material,
- they do not differentiate between fibre- and non-fibre-based waste, and

[23] Inditex defines 4 sustainability metrics for the classification of lower-impact raw materials: Impact analysis, traceability, standards and certifications and fibre suppliers assessment (Inditex 2024).

- if there is no possibility to know the actual recycled content in the end-product, as the scheme uses the chain-of-custody model 'mass balance' or 'book-and-claim'[24].

The differentiation between fibre- and non-fibre waste as source for the recycled content is central to the identification of the fibre-to-fibre recycled content. Therefore, the source of waste has to be known and audited and the scheme has to differentiate between fibre waste or other waste (e.g. PET beverage bottles). This is particularly relevant for synthetic fibres, as various types of waste are suitable as source material for recycled textile fibres. However, apart from one specific certification scheme, this is not part of any of the certificates analysed. Many of the certificates also do not differentiate between PCR and PIR. Even if they do, the evidence is often questionable, as the origin of the recyclates is often based on self-declaration and the first certified link in the chain is the recycler.

Table 42 summarises the most important findings of the evaluation of the existing certification.

Table 42: Certificates and considerations for suitability as proof of recyclate in textiles

Label (alphabetic order)	Considerations	Number of certified products/companies, Status as of 19 March 2025
Blue Angel for Textiles	Refers to other certificates in the case of recycling (RAL gGmbH 2023b): • RCS (Recycled Claim Standard), • GRS (Global Recycled Standard) (Textile Exchange 2025b), • International Sustainability and Carbon Certification (ISCC+) (ISCC System GmbH 2025), • Roundtable on Sustainable Biomaterials (RSB) (RSB 2025b), • RedCert (only in Europe) (REDcert 2025) As the named certificates do not suit as proof for fibre-to-fibre recycled content (see individual entries in this table), this does not as well.	4 companies; 11 products (Blauer Engel 2025)
Bluesign	No certification of recycled content (bluesign technologies ag 2020)	12 companies (selling to the end consumer), 78,244 products (bluesign technologies ag 2025)
Cradle2cradle	Recycled raw materials are recognised/calculated together with renewable raw materials and not reported individually (Cradle to Cradle Products Innovation Institute 2025).	68 products (Cradle to Cradle Products Innovation Institute Inc. 2025)
Ecological & Recycled Textile Standard (ERTS)	No differentiation between sources of waste (fibre and non-fibre-waste) (ECOCERT Greenlife 2018)	n.a.
EU Ecolabel for textiles	Recycled content plays a minor role, certain fibre types must have a minimum recycled content (e.g. nylon 20%). No differentiation between sources of waste (fibre and	97 licences; 10,204 products

[24] For different CoC models, see 6.3.1, for the rationale of excluding the two models, see 6.3.3.

Label (alphabetic order)	Considerations	Number of certified products/companies, Status as of 19 March 2025
	non-fibre-waste like PET-bottles), no definition of a certain chain-of-custody model (European Commission 2022c).	(European Commission 2024c)
Fairtrade textile	No certification of recycled content (Fairtrade Labelling Organizations International e.V. 2016)	30 textile producers (Fairtrade America 2025)
Global organic textile Standard (GOTS)	Do not focus on recycled content, but allow it up to a certain share (e.g. certain recycled synthetic plastic fibres from pre- or post-consumer waste up to a maximum of 20%) (Global Standard gemeinnützige GmbH 2023)	11,311 companies (Global Standard gemeinnützige GmbH 2025)
GreenCircle Certified - Recycled content	No differentiation between fibre and non-fibre waste, virtual audits possible, no clear definition of the applicable chain-of-custody standard (only 'mass balanced' is named without definition what is meant) (GreenCircle Certified 2024)	451 products (GreenCircle 2025)
Grüner Knopf	Do not focus on recycled content, but allow it on presentation of recognised labels such as GRS or RCS (BMZ 2024)	65 companies (Grüner Knopf 2025)
International Sustainability & Carbon Certification (ISCC) PLUS Standard	Mass balancing across the entire chain is permitted. It is therefore no longer possible to guarantee a correlation between the stated recycled content and the actual recycled content; no differentiation between sources of waste (fibre and non-fibre-waste) (ISCC System GmbH 2025)	5 companies (not specific for textiles) (ISCC System GmbH 2025)
Intertek Recycled Content Verification	No differentiation between sources of waste (fibre and non-fibre-waste) (Intertek Group plc 2025)	n.a.
OEKO-TEX STANDARD 100	Not clear which proof for recycled content is accepted as recycled content is not the focus of the label and labelling recycled content is optional (Oeko-Tex Service GmbH 2025b)	1,642 companies for finished articles (Oeko-Tex Service GmbH 2025)
OEKO-TEX STeP Standard	see OEKO-TEX STANDARD 100 (Oeko-Tex Service GmbH 2025c)	1,421 companies (Oeko-Tex Service GmbH 2025a)
OEKO-TEX Made in Green Standard	see OEKO-TEX STANDARD 100 (Oeko-Tex Service GmbH 2024)	745 companies (Oeko-Tex Service GmbH 2025a)
QA-CER Recycled Content	No differentiation between sources of waste (fibre and non-fibre-waste) (Simoens 2021)	n.a.
RedCert	Mass balancing across the entire chain is permitted. It is therefore no longer possible to guarantee a correlation between the stated recycled content and the actual content; no differentiation between sources of waste (fibre and non-fibre-waste) (REDcert 2025)	473 companies (not specific for textiles) (REDcert 2025)

Label (alphabetic order)	Considerations	Number of certified products/companies, Status as of 19 March 2025
Roundtable on Sustainable Biomaterials (RSB) Standard for Advanced Products	No differentiation between sources of waste (fibre and non-fibre-waste) (RSB 2025a)	44 companies (RSB 2025)
SCS Recycled Content Certification	No mandatory audits on site, mass balance allowed (actual share of recycled content in the end product unknown), no differentiation between sources of waste (fibre and non-fibre-waste) (SCS Global Services Headquarters 2025b).	11 companies, 44 products (SCS Global Services Headquarters 2025a)
Textile Exchange - Global Recycled Standard (GRS)	Mass balancing is permitted for continuous processes (aim to avoid this as far as possible); the supply chain is not covered in its entirety (start from recycler, further up the supply chain: self-declaration and random inspections of about 2% of suppliers); the exact amount of recycled material in the product does not have to be declared (certificate is awarded if a minimum recycled content is reached); no differentiation between sources of waste (fibre and non-fibre-waste) (Textile Exchange 2025b) and expert information.	6,809 companies [2019] (Textile Exchange 2020)
Textile Exchange - Content Claim Standard (CCS)	Support of self-declaration of product claims, not directly connected to recycled content (Textile Exchange 2025a)	20 companies (Textile Exchange 2025)
Textile Exchange - Recycled Claim Standard (RCS)	See GRS	2.499 companies [2019] (Textile Exchange 2020)
'UL Solutions" Recycled Content Verification Validation	Different schemes, only the 'Closed Loop Recycled Materials' scheme assures fibre-to-fibre recycled content by requesting a closed loop recycling (same product as source of waste). This goes beyond the necessary requirements for a recycled content scheme but could nevertheless assure that products fulfilling this scheme also comply with the ESPR regulation (UL Solutions 2025).	n.a.

Source: Own compilation, Öko-Institut

Some of the certification schemes and labels for textiles do not include recycled content. For certificates that validate recycled content, it was found that at least one, often more than one of the exclusion criteria mentioned above applied. This means that none of the certificates listed are suitable for reliably verifying a fibre-to-fibre recycled content for textiles. There is one exception: The 'Closed Loop Recycled Materials' scheme under the UL Recycled Content Verification Validation allows only for a closed loop recycling (same product waste as the product itself). It can be therefore used to prove a certain fibre-based recycled content in a specific fibre product. However, the criteria are more strict than necessary and therefore this scheme would not be applicable for all products that need to fulfil the ESPR recycled content criteria.

Interim conclusion

It was found that recycled fibres are available for all common fibre types, but in recent years there has been little change in their market shares. Products on the market also increasingly contain recycled materials, but platforms do not systematically indicate this and information on the recycled content in products on the market is not transparent, e.g., not specified or not comprehensible due to unknown calculation methodology. Of a longlist of certificates and labels for textiles, only one certificate reliably proves a fibre-to-fibre recycled content for textiles in a way that ESPR requirements could be certified. Nevertheless, for large companies and brands, recycled content is an important part of their sustainability strategies.

These findings make it difficult to assess how far the market has come in terms of recycled content in textiles. Against the background of the lack of a comprehensive market overview, it is not possible to derive a minimum recycled content target based on its market penetration.

6.3.3 Considerations and proposals by others

This chapter refers to studies and summarises proposals that have already been made for mandatory recycled content requirements. Some stakeholders, including participants in the workshop series conducted as part of this project (see Chapter 2.3), raised concerns with regards to recycled content requirements. Their arguments are evaluated below.

(Mandatory) recycled content targets are not only one of the important strategic policy goals of the EU textile strategy (European Commission 2022b), but they are also found to be beneficial or recommended by publications and stakeholders:

Duhoux et al. (2021) find that 'to stimulate the demand and incentivise investments, the EU may consider the introduction of mandatory recycled content for certain textile products and put measures in place that level the playing field for recycled fibres'. According to EEA (2022a), 'recycled content requirements ensure that producers buy SRMs[25] regardless of price' which as a result – and as brought forward by Duhoux et al. (2021) - increases the demand of recycled fibres and thus supports investment in recycling. With the objective to 'decouple production from the use of virgin resources, and to send a demand signal for solutions that deliver ease of disassembly and recyclability by design', the EMF (2024) sets recycled content targets in relation to EPR policy. It could be calculated as 'the minimum percentage of non-reusable textiles that are sent to textile-to-textile recycling relative to the total amount of non-reusable textiles, with the percentage increasing year-on-year as textile recycling capacity scales up'. Among the stakeholders that participated in the study by Duhoux et al. (2021), there was overall little disagreement about the introduction of low targets for recycled content by 2024. They perceived a mandatory recycled content 'as a useful policy incentive to stimulate demand for recycled fibres" and specified that 'it could start with few carefully selected product groups and low targets that are in line with technical feasibility."

In contrast to the stakeholder survey as part of the study of Duhoux et al. (2021), the participants of the workshop series have raised concerns regarding the requirement for a minimum recycled content target. Some of the arguments refer to the (technical) barriers and challenges of fibre-to-fibre recycling (see Chapter 6.1.2), e.g., the input material available for fibre-to-fibre recycling is either of too small quantity or of too low quality. In addition, the aim of promoting recycling in Europe is viewed critically, since, mainly recycled fibres from Asia are used. Then there are several arguments that relate to supposedly immature knowledge base

[25] SRM = secondary raw materials

including missing life cycle assessment data for evaluating the sustainability of different recycling routes, certification schemes, or in consequence of a missing link between ESPR and REACH regulation e.g., in relation to exemptions. In addition, some stakeholders mention different preferences for instruments to support textile waste recycling, e.g., they propose to create incentives through a modulated fee structure in EPR schemes, to promote the setup of networks to connect actors in the value chain, or a 'secondary raw material strategy" which, according to a participant in the workshop series, 'establishes the most efficient recycling routes and also allows for cross-industry (open-loop recycling)".

To find a 'realistic initial level" against the background of currently low capacities, Duhoux et al. (2021) propose to '[...] start with very low targets in the single-digit percentage range, with differentiated targets for the different product groups addressed" and 'make the targets dynamic and adapt them over time [...]', i.e. aligning targets to what is technically possible. Furthermore, product groups for which recycling technologies are available on the market should be carefully selected and defined. To start, around half of stakeholders asked in the stakeholder survey[26] on textile recycling in the EU named T-shirts and jeans as the textile products for which mandatory recycled content could be introduced by 2024 (Ecologic Institute 2021).

Bauer et al. (2018) conclude that the use of recycled fibres in (fast fashion) products with a short lifetime[27] is more relevant than in products designed for durability, e.g. bed linen, towels and underwear. These considerations are also reflected in the quantitative proposals by Van de Burgt et al. (2023) (see Table 43), but this study comes to a different conclusion for home textiles: Because home textiles are often made of a single material, it is easier to incorporate recycled fibres into the design.

The quantitative proposals by Van de Burgt et al. (2023) can be interpreted as in line with expectations of recyclers – at least in the long term (2035). In 2022, the European Recycling Industries' Confederation (EuRIC) suggested that '[...] all new textile products should contain 10% recycled textile content from post-consumer textiles by 2025 and 25% recycled textile content from post-consumer textiles by 2035' (EuRic 2022). For different products, proposals by Van de Burgt et al. (2023) vary between 21% and 29% in 2035.

No further quantitative proposals for recycled content requirements for textiles from others are known except for this study.

Table 43: Proposal for recycled content requirements by Van de Burgt et al. (2023)

Product	Source	Requirement	By 2035
Home textiles	PCR	5% per item from 2027 onwards, increase of 3% per year	29%
Everyday clothing (short lifetime)	PCR	5% per item from 2027 onwards, increase of 3% per year	29%
Everyday clothing (long lifetime)	PIR, PCR	5% per item from 2027 onwards, increase of 2% per year	21%

[26] ‚For Which Textile Products Could Mandatory Recycled Content be Introduced by 2024?' Answers (n=69): T-shirts 35, Jeans 34, Textiles for furniture 29, bed linen 22, sport wear 20, socks 17, medical robes 13, outdoor wear 13, other 9, I don't know 14.

[27] Here, short lifetime means < 2 years and long lifetime > 2 years.

Product	Source	Requirement	By 2035
Workwear (short lifetime)*	PCR	5% per item from 2027 onwards, increase of 3% per year	29%
Workwear (long lifetime)*	PIR, PCR	5% per item from 2027 onwards, increase of 2% per year	21%

* Personal protective equipment excluded.
Note: Here, short lifetime means < 2 years and long lifetime > 2 years.
Source: Van de Burgt et al. (2023)

According to article 5.1(k) of the ESPR, recycled content is an ecodesign requirement to be considered in product-specific delegated acts if relevant to the product group concerned. Article 2.7 of the ESPR defines ecodesign requirement as '[...] a performance requirement or an information requirement aimed at making a product, including processes taking place throughout the product's value chain, more environmentally sustainable'. Based on the definition of a product (ESPR, article 2.1: product means '[...] any physical goods that are placed on the market or put into service"), ecodesign requirements apply to every product, i.e. physical good on the EU market. In contrast to the recycled content provisions in other EU legislations, for recycled content requirements in ESPR, the requirement must not be calculated as an average per Member State or per manufacturing plant with consequences for producers as well as certification. Instead, this results in specific requirements on the chosen certification scheme to verify the recycled content. Considering the different chain-of-custody schemes in ISO 22095:2020-10 (see Chapter 6.3.1.2) only 'identity preservation', 'segregation' and 'controlled blending' could be permitted, as the proportions of the recycled content in the final product are known in these schemes. This is in contrast with stakeholder opinion raised during the workshop series conducted as part of this study. It was asked whether it would be possible to move away from the product-related approach. However, the product-related approach is assumed to be in the nature of the product policy instrument of the ESPR. Therefore, it is concluded there, that a batch- or sector-specific recycled content quota (similar to the Single-Use Plastics Directive (SUPD) or Battery Directive) could not be regulated via the ESPR (see Chapter 6.3.1.5 that displays the wording of the different recycled content provisions in these legal documents). The SUPD specifies the recycled content of PET / beverage bottles to be 'calculated as an average for all [...] bottles placed on the market on the territory of that Member State'. In contrast, the recycled content is calculated per year and per manufacturing plant in provisions in the PPWR and the Batteries Regulation.

6.3.4 Proposal for a minimum requirement

6.3.4.1 The proposed recycled content targets and conditions

At this point, the recyclate quotas developed in this study will be presented, including the conditions and examples of how they apply.

Reference to the product categorisation

According to Delre et al. (2024c), the recycled content of a textile apparel is 'specific to the function that the item must provide' (p. 134). E.g. 'when constructing fabrics, knitted products are generally better suited for incorporating mechanically recycled fibres due to their more flexible structure compared to woven fabrics' with the exception of denim trousers (Delre et al. 2024c, p. 136). This means that the recycled content is defined specifically for a product category. In this study, recycled contents were developed with specific products in mind, i.e., T-shirts and jeans. According to the categorisation system developed in this project (Center Textile Logistics (CTL) at the Hochschule Niederrhein to be published), the proposed recycled target values refer to categories No. 3 (upper body knitted/crocheted) and No. 6 (lower body not knitted/crocheted).

In contrast to Van de Burgt et al. (2023), this study does not suggest to differentiate the recycled content target between products with shorter and longer lifetime. In the opinion of the authors, all products should be designed to be long-lasting if possible.

Conclusion

Because different manufacturing techniques and fibres, e.g., in terms of fibre length, are used for the products in different product categories, which technically allow for different amounts of recycled content, the recycled content must be specified for individual product categories; here, T-shirts (category No. 3 Upper body knitted/crocheted according to Center Textile Logistics (CTL) at the Hochschule Niederrhein (to be published)) and jeans (category No. 6 Lower body not knitted/crocheted according to Center Textile Logistics (CTL) at the Hochschule Niederrhein (to be published).

Minimum recycled content for different fibres

For five fibre types, target values for recycled content targets are derived from information displayed in previous chapters. The presented figures are developed based on availability, not technical possibilities:

The share of recycled **cotton** in the global cotton production is considered low at 1% (Textile Exchange 2024). Recycled cotton can only be obtained through the mechanical recycling process; in chemical recycling, from cotton inputs, a cellulosic regenerated fibre is obtained. Through mechanical recycling, the original fibre structure is retained, which also means that any impurities such as dyes and chemicals cannot be removed (Huygens et al. 2023). However, compliance with the REACH regulation was largely considered uncritical by the recycling experts interviewed for this study, as individual impurities can be offset by mixing with uncontaminated fibres (see 6.1.2). During the tearing process in mechanical recycling, the fibre length is shortened, so currently only about up to 20% of the cotton input stream can be converted into high-quality spinnable fibres (Huygens et al. 2023).

According to Textile Exchange (2024), there are still large amounts of material available for recycling. It is estimated that in Bangladesh alone, approximately 330,000 tons per year of post-industrial textile waste from pure cotton or cotton-elastane blends are generated, which would be well-suited for mechanical fibre-to-fibre recycling. Of these only 5-7% are currently recycled (Syrett et al. 2021). Instead, most of this textile waste is used directly by production companies as fuel (Syrett et al. 2021). An increase in demand for recycled fibres would provide these companies with an incentive to sell these material quantities to textile recyclers.

The interviewed experts from the recycling sector and research institutes provided a range from 1% to 80%[28] for a possible minimum requirement for the recycled content of the cotton fibre. Most of the respondents considered a recycled content of 10-20% for recyclates from post-

[28] 1% was indicated as the minimum value, which should be gradually increased. 80% referred to a pure input stream with a known composition, such as material from public procurement.

consumer textiles to be realistic, while for post-industrial textiles, higher values could be demanded due to the higher purity of the input stream.

Conclusion

Considering these assessments and the currently low share of recycled cotton, it is suggested to start with a minimum recycled content of 10% for cotton fibres, which can be gradually increased over the next few years.

The share of recycled **polyester** in global fibre production has decreased from 15% in 2020 to 12% in 2023 (see Chapter 6.3.2.1). The reduction in the share of recycled polyester is due to an increase in the production of virgin polyester while recycling volumes have stagnated. So far, the largest share of recycled polyester is obtained through mechanical recycling from PET bottles (about 98%, Textile Exchange 2024). Due to current developments in the field of chemical recycling of polyester, i.e. many start-ups in the research and development phase, the market share of chemically recycled polyester is expected to increase (Textile Exchange 2024). Depending on the process used, the quality of recycled polyester is either worse (mechanical or solvent-based recycling) or comparable (depolymerisation) to virgin polyester (see chapter 6.1.1).
Despite the currently underrepresented fibre-to-fibre recycling for polyester (2% of recycled fibres, Textile Exchange 2024), the experts surveyed in this study indicated that a similar minimum recycled content requirement as for cotton could be demanded for polyester.

Conclusion

As fibre-to-fibre recycling for polyester has not yet reached an industrial scale, but there are significant advancements in chemical material recycling, it is proposed to begin with a minimum recycled content of 3% for polyester fibres.

Polyamide can be recycled through both (thermo-)mechanical and chemical recycling processes (depolymerisation). For depolymerisation, only polyamide PA6 is currently feasible as an input (Duhoux et al. 2021), but not other types of polyamide. Unlike the mechanical process, depolymerisation does not result in a loss of fibre quality (Duhoux et al. 2021). Similar to polyester recycling, input materials often do not originate from the apparel sector, however, include fibre-based waste. For example, the company Aquafil uses fishing nets, fabric scraps, carpet flooring, and industrial plastic as input for their chemical recycling process (Aquafil 2025). According to the definition of textile products in the Textile Labelling Regulation (European Union 2011)29, materials such as carpets, fabric scraps and fishing nets can be classified as textile products. Thus, in terms of fibre-to-fibre recycling, they can be used to fulfil a fibre-to-fibre recycling quota.

Conclusion

In 2023, 0.1 million tons of recycled polyamide were produced globally, accounting for 2% of global polyamide production (Textile Exchange 2024). Compared to polyester, there is a bigger

[29] According to European Union 2011, ‘textile product’ means any raw, semi-worked, worked, semi-manufactured, manufactured, semi-made-up or made-up product which is composed for at least 80% of textile fibres, regardless of the mixing or assembly process employed.

share of already established fibre-to-fibre recycling processes. Therefore, a minimum recycled content of 5% for polyamide fibres is proposed.

In 2023, the share of recycled **manmade cellulosic fibres (MMCF)** in total MMCF production was 0.7%, representing an increase of 0.2 percentage points from the previous year (Textile Exchange 2024). Recycled MMCF result from the chemical recycling of cellulose-rich materials (cotton textiles or textiles made from MMCF). This process is already being used on a commercial scale. The pulp obtained from recycling is usually mixed with wood pulp for yarn production (Duhoux et al. 2021). So far, mostly post-industrial textiles are used, but according to recycling companies, the share of post-consumer textiles as input is expected to increase (Textile Exchange 2024; Fashion for Good; Circle Economy 2022). Similar to synthetic fibres, an increase in recycling potential is expected due to current advancements in chemical recycling (Textile Exchange 2024). The quality of recycled MMCF varies depending on the input stream, but generally the polymer chain degrades with each repetition of the recycling process. Nevertheless, a sufficient quality for the further processing to yarns can be reached (Duhoux et al. 2021).

Conclusion

Due to the already established recycling process and the expected developments in chemical recycling, a minimum recycled content of 5% is set for MMCF.

In contrast to other textile recycling activities, **wool** recycling has a long tradition. In 2023, approximately 73 kt of recycled wool were produced which accounts for 6% of the global wool production. The largest European producer is the Italian district of Prato, where alone 30,000 t of recycled wool are manufactured (Textile Exchange 2024). In interviews conducted with various stakeholders from the textile chain, wool recycling was assessed as a mature recycling system, where collection and sorting processes already function well, as wool is economically a profitable fibre. Wool is mechanically recycled, which leads to the challenge of shortened fibre lengths. A scientific Coursework of Ayla Bernkopf commissioned by Roy Robson in 2024 concluded that a yarn containing 27% recycled wool resulted in higher pilling and decreased tensile strength and recommended as an initial indication a recycled content of 15% as an acceptable compromise between quality and saving primary material.[30] However, according to Glasper et al. (2024) the tensile strength of wool fibres (or cashmere) is only slightly affected by the recycling process. In general, wool fibres with a shorter average fibre length, such as high-quality merino fibres, are more suitable for recycling. With appropriate process settings, yarns containing up to 85% recycled wool fibres can currently be spun, meeting the quality requirements of brands (Glasper et al. 2024).

Conclusion

Considering these points, a recycled content rate of 15% is proposed for wool.

Consequences of fibre-specific targets for the recycled content in final products

In line with Delre et al. (2024c), authors of this study suggest that the recycled content shall be fibre-specific. Moreover, a calculation formular should be used (see Chapter 6.3.1.1) that

[30] It is stated that the results should not be used for general judgements, as only two qualities were compared with each other and no specific quality requirements were previously placed on the fabric producer for the material with recycled wool content. Further analyses of other fabric and yarn qualities are required in order to be able to make overarching statements on how high-quality standards and ecological benefits can be reconciled when using recycled wool.

accounts for final products being made of different materials. This results in the fact that products from the same type, e.g. T-shirts, can actually have different proportion of recycled content in the final product (T-shirt) based on the fibre composition:

- If all parts of a textile product are made only from a single-fibre fabric (mono-material), e.g. 100% polyester or 100% cotton, then the proportion of recycled material in the fibre is identical to the proportion of recycled material in the product.
- If all parts of a textile product are made from a fabric with the same composition of fibres, e.g. a 50/50 cotton-polyester blend, or, if different parts of a textile product are made from different single-fibre fabric, then the individually proposed recycled content targets apply to each of the materials. For the blend, with the recycled content targets for cotton and polyester suggested in this study, this means that 5% of the final product is made from recycled cotton (10% of the 50% cotton content) and 1.5% of the final product is made from recycled polyester (3% of the 50% polyester content) – in total, 6.5% of the final product is from recycled fibres. With the same assumptions, a final product made of a 40/60 cotton-polyester blend contains 5.8% recycled content (4% recycled cotton and 1.8% recycled polyester).
- If different parts of a textile product are made of different material compositions, the calculation must also be adapted according to the composition and recycled content targets.

A somewhat simpler suggestion for multi-material products could also look like this:

- If the product is made of multi-material > 50% man-made fibre content, then suggested recycled content targets apply for the man-made fibre with the highest share (polyester, polyamide or MMCF).
- If the product is made of multi-material > 50% natural fibre content, then suggested recycled content targets apply for the natural fibre with the highest share (cotton and wool).
- If the product is made of multi-material of 50% natural fibres and 50% man-made fibres, then suggested recycled content targets apply for one of the natural fibres (cotton / wool) **or** one of the man-made fibres (polyester / polyamide / MMCF).

However, this approach could indirectly encourage the use of multi-material, as fewer recyclates would then have to be used in relation to the total weight. In the case of a shirt made of 60% polyester and 40% cotton, recyclates would then only have to be used for the polyester part, i.e. 3% of the 60%, which corresponds to 1.8% of the total weight. If one follows the approach presented first, recycled fibres would have to be used for each type of fibre used, in this case an additional 10% of the 40% cotton content. This would result in a total use of recycled fibres of 5.8% for the product.

Conclusion

Products from the same type, e.g. T-shirts, can have different proportion of recycled content in the final product (T-shirt) based on the fibre composition.

Certified fibres from organic farming or recycled fibres?

Stakeholder – during this study – brought forward the question whether the same amount of certified organic material could be used instead of meeting the recycled content requirement.

When comparing the environmental impacts of recycled and virgin fibres, various LCA studies conclude that the greenhouse gas potential of textiles can be reduced by using recycled fibres (Suresh et al. 2021; Duhoux et al. 2021; Rubik et al. 2024; Huygens et al. 2023). For a comprehensive view, other environmental impact categories such as water and resource use or eutrophication potential should also be considered. Under certain conditions, such as the depolymerisation of blends, energy recovery from textiles can perform better in terms of specific environmental impacts than the recycling process (Huygens et al. 2023). However, this might not be a general conclusion. A comprehensive assessment of chemical recycling processes, including depolymerisation, is currently not possible due to a lack of reliable and publicly available life cycle assessments, as many technological developments are ongoing.

Furthermore, the question arises whether the replacement of virgin fibres with organic fibres, for example concerning cotton fibres, has an equally positive effect on environmental impacts as the use of recycled cotton.

To do that, it is first necessary to look at the comparison between cotton from conventional and certified organic cultivation: In controlled organic cotton farming, the use of mineral fertilizers, pesticides, and other chemical aids is avoided, which has positive effects on biodiversity as well as on greenhouse gas potential and eutrophication potential. On the other hand, organic farming methods are often attributed to greater land use due to lower yields (Teufel et al. 2024a). However, various studies state that yield differences are influenced more by site-specific climatic factors, soil type, and specific production methods than by the choice of a conventional or organic farming system (Sandin et al. 2019a; Nordic Ecolabelling 2020; Suresh et al. 2021; Singh et al. 2018). Regarding water consumption, there is a wide variance in the statements of different life cycle assessments, which is due to the fact that water use in organic farming is not explicitly regulated, leading to significant location- and production-dependent differences (Teufel et al. 2024a). In summary, the use of organic cotton can clearly have a positive effect on some environmental impacts, while for other impact categories such as land and water use, no general statements can be made.

Conclusion

Thus, while tendencies regarding environmental impacts can be derived, a concrete quantitative comparison of the benefits of different fibres (virgin, recycled, organic) does not seem feasible at this time due to the data situation, the influence of specific production systems or recycling processes, and regional/climatic differences. The use of organic natural fibres, despite its lower environmental impacts, is still associated with the use of raw materials.

However, the compromise of using fibres from certified organic cultivation instead of recycled fibres offers the opportunity to compensate for the fact that some yarn production techniques, such as ring spinning, are not optimally suitable for using recycled fibres. Companies that use products made with yarns from such techniques would have the option of using certified organic fibres.

PIR vs. PCR

According to Delre et al. (2024c) recycled content should only originate from post-consumer waste. While the recycled content of post-consumer waste is 'the gold standard", in this case, it is suggested not to limit the use to post-consumer waste only. Post-industrial waste 'ranges from 25-45% of all fabric used in the production" (Delre et al. 2024c, line 3274) and that 'cutting operations are the largest contributor to [post-industrial] waste" (ibid., line 3334). In contrast to other waste streams (e.g., plastics), the post-industrial waste from textile production, namely cutting waste of the confectioner, is currently in most cases incinerated rather than re-processed. If, for example, in the production of plastic packaging by injection moulding, the post-industrial waste can actually be put back into the machine, then it is right not to declare the material as recycled content. However, the confection process of textile products is not one in which cutting waste can be mixed with the input. Therefore, the recycling of cutting waste decreases textile waste that would otherwise be incinerated and contributes to the efficient use of primary resources.

Conclusion

Therefore, the source of material to be used for fulfilling the provision of recycled content should be broadened and allow textile pre-consumer waste (also called post-industrial waste) according to the DIN EN ISO 14021:2021-10 definition. Unsold goods, which are sometimes also referred to as textile pre-consumer waste should be explicitly excluded as input material.

Certification and verification of recycled content in ESPR for textiles

Certification of the value chain from the source of waste over a recycler to the product by a third person audit is the basis for certification of recycled content in a product. A certification of a recycler itself provides verification of the origin of secondary material but alone cannot serve as certification of a recycled content in an intermediate product such as yarn, or even an end-product. For this, a product certification scheme is necessary, as there is no reliably realizable possibility of physical testing a product to find out its recycled content (Gesamtverband der deutschen Textil- und Modeindustrie e. V. 2025). The claim of a certain recycled content has to be supported by a paper trail and a certification process, including audits of every step of the value chain for the recyclates, following a certain chain of custody model.

As described in Chapter 6.3.3, certain requirements apply to chain of custody models for the certification of recycled content under ESPR based on the definitions. Considering the different chain-of-custody schemes in ISO 22095 (see Table 39), only ‘identity preservation’, ‘segregation’ and ‘controlled blending’ could be permitted, as the proportions of the recycled content in the final product are known in these schemes.

A brief evaluation of the existing certification systems has also been carried out in this study (see Chapter 6.3.2.4): There are several certification schemes for recycled content in textiles, but with varying criteria, most of them are not sufficient to claim a certain recycled content based on fibre-to-fibre recycling.

Conclusion

The exact definitions, chain of custody schemes and calculation method would be binding on all market participants and would need to be set out in a delegated act.

The main concerns regarding verification when introducing a mandatory recycled content requirement are the complexity of verification along with doubts about the ability to fulfil the main targets. Even if such processes already exist for other materials, they are completely new for textiles. The complexity of verification is not easily resolved. In-person audits by a notified body along the whole supply chain seem to be the most reliable way to verify the recycled content of a textile product, a process which would entail additional costs. However, such an audit could be combined with a management system for the economic operator. Furthermore, the other ESPR requirements that require action by notified bodies could also benefit from a management system. Also, the audit of recyclers might be necessary for other (future) policies concerning recycling, such as general recycling efficiency and material-specific recovery targets. These audits could be brought together into a single management system.

Conclusion

A reasonable transition period between publication of the rules and the mandatory target for recycled content should be given to be able to implement standards and certification schemes. Another way of first testing such a verification system could be through a voluntary declaration of recycled content based on the official calculation rules, e.g., introduced through a delegated act. This would lead to several different schemes for each company on how they can prove and survey their supply chain and would result in a learning curve. It should also be ensured that the implementation is practical and cost-efficient, including for Small and Medium-sized Enterprises (SMEs).

Summary

Firstly, it should be noted that there is no comprehensive data available on the quantities of recyclate that are of sufficient quality to be used in textiles. The proposed recyclate quotas were developed based on the quantities theoretically available for recycling and current market developments with regard to the further development of chemical recycling processes (see Chapter 6.3.4.2). These quotas do not take into account the technical feasibility of integrating recycled fibres for each product group. The focus of this study was on the product examples of T-shirts and jeans, for which the implementation of these recycled fibre contents was classified as technically feasible. It is recommended to review the feasibility of recyclate quotas individually for the product groups proposed in the categorisation system.

The implementation of minimum requirements for recycled content within the framework of the ESPR is tied to various conditions. Our proposal for the formulation of these conditions is summarised in Figure 25. Our thoughts on the framework conditions are summarised above in this chapter. Each of these conditions involve trade-offs that should be taken into account and weighted against other alternatives in the political decision-making process.

For instance, the implementation of recyclate quotas as part of the ESPR means that mass balancing according to the definition of ISO 22095 (both on a product or on a portfolio-level) to verify the recyclate content is not possible, as long as the definition for product requirements is not changed. As part of the stakeholder consultations carried out in this project, it was pointed out several times that the mass balancing approach on a company level is important for the efficient management of the use of recycled fibres. This would give companies more freedom to achieve the absolute recycling target. Another example is the definition of possible input sources for the fulfilment of a recyclate quota. In principle, it is also possible to allow non-fibre-based sources. In order to exclude the use of PET bottles (see Chapter 6.1.1) and to focus on reducing waste volumes within the textile industry, we suggest only allowing inputs from fibre-to-fibre recycling. In some of the stakeholder statements received, a transitional period for the use of PET bottles is proposed, with the clear goal of switching to input from fibre-to-fibre recycling at a later date to be determined. This would both provide incentives for the expansion of fibre-to-fibre recycling and at the same time allow for the restructuring of recycling processes towards fibre-based input sources. Furthermore, it was pointed out that alternative material sources from biomass or carbon capture utilization should also be taken into account. This condition is also linked to the design of the recyclate certificate, which has yet to be developed. Depending on the design of the certification system, some framework conditions may need to be adapted.

Figure 25: Proposed recycled content targets for T-shirts and jeans in 2030

The presented figures are developed based on quantities theoretically available for recycling, screening of recycling technologies and capabilities, literature review and feedback from interviews conducted in the study.

Fibre	Target for 2030*	Conditions
Cotton	10%	General conditions: 1. Targets have to be specified for individual product categories; here values refer to T-shirts and jeans* 2. Products of the same type can have different shares recycled content based on their fibre composition (see Chapter 6.3.4.1); 3. Recycled content must originate from fibre-to-fibre recycling, but inputs into the recycling can be PIR and PCR (see Chapter 6.3.4.1); 4. Before entering into force, a calculation methodology and a certification scheme must be in place, e.g., through a delegated act (see Chapter 6.3.3; 6.3.4.1); 5. There must be a sufficiently long transition period between the publication of the certification system with calculation methodology and the entry into force of the mandatory rules (see Chapter 6.3.4.1). 6. For CoC models, only 'identity preservation', 'segregation' and 'controlled blending' can be permitted as recycled content must be product-specific in order to be implemented under ESPR (based on the definition of 'product requirement' under ESPR) (see Chapter 6.3.3; 6.3.4.1); 7. We recommend that fibres that are certified sustainable (natural) fibres are exempt from recycled content requirements and accepted as an alternative to meet the recycled content (further information further up in Chapter 6.3.4.1). In case of multi-material products, a simplified approach could be applied, whereby only one of the fibres (the one with the highest content) has to contain recycled materials (see Chapter 6.3.4.1).
Polyester	3%	
Polyamide(**)	5%	
MMCF	5%	
Wool(**)	15%	

(*) Here for T-shirt (categories No. 3 upper body knitted/crocheted) and jeans (category No. 6 lower body not knitted/crocheted), see validation calculations using the example of T-shirts in Chapter 6.3.4.2;

(**) Wool or Polyamide are not typical fibres for T-shirts or jeans, but due to the status quo of the use of recycled materials, a requirement can be made for them.

Source: This study.

6.3.4.2 Validation of the proposed recycled content quotas

To estimate whether a requirement in the form of a mandatory recyclate content can potentially be met, it is necessary to compare the expected demand for recycled fibres with the current and potentially available supply of recycled fibres from fibre-to-fibre recycling.

For this, the input side was first considered: Huygens et al. (2023) surveyed the fibre-to-fibre recycling capacities per year in the EU and determined the Compound Annual Growth Rate (CAGR) of the textile recycling sector in the EU based on a cross-evaluation of various studies with subsequent verification by stakeholders. The identified capacities for recycling are 0.7-0.85 million tons of textiles per year in 2023 and a forecast of 1.3 million tons per year in 2035. These amounts can theoretically be processed in existing or planned facilities in the EU. However, this does not mean that these amounts will actually be implemented. Furthermore, it is not specified that the recycled fibres must necessarily be recycled with the aim of use in the textile sector. Currently, non-woven applications of recycled textile fibres, for example in the automotive or construction sector, are common. Considering exclusively closed-loop recycling processes that recycle fibres with the aim of application in the clothing sector, the estimated recycling capacities in 2023 are 0.2–0.3 Mt/year and 0.3–0.4 Mt/year in 2030. McKinsey, on the other hand, assume that up to 70% of the textile waste available for recycling in the EU could be recycled for use in the clothing sector by 2030 (McKinsey & Company 2022). Although figures on the production of recycled fibres are available at a global level (see Table 41 in chapter 6.3.2.1), neither the initial source nor the subsequent area of application of the fibres is specified. Accordingly, it is currently not possible to estimate the availability of recycled fibres from closed-loop recycling outside the EU. The following analysis therefore refers to figures for the EU-27.

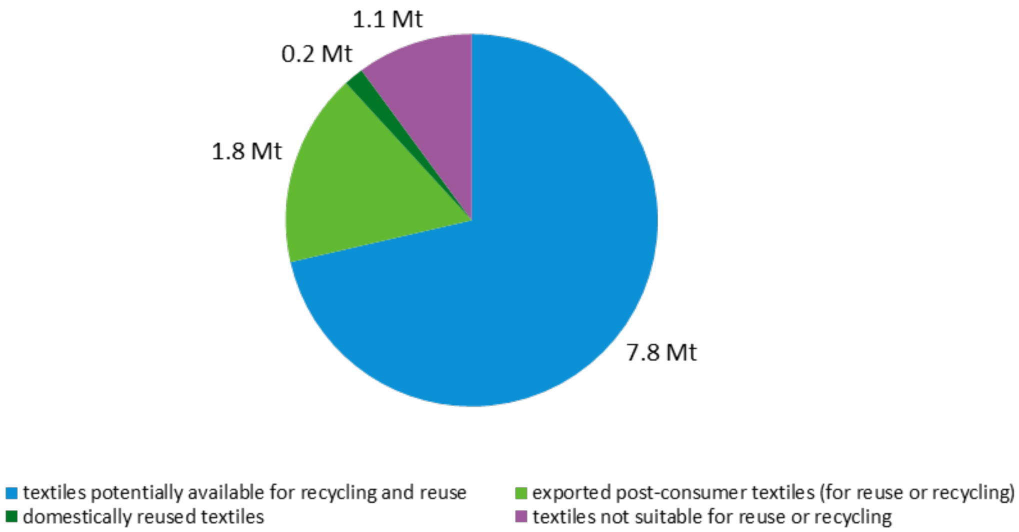
In this study, the recycling capacities were compared with the amounts of post-consumer textiles potentially available for recycling in the EU to check whether there are sufficient quantities of textile input for recycling activities.

The calculation was proceeded as follows:

$$\begin{aligned}&\text{Potential availability of recycling \& reuse in the EU}\\&\quad = \text{discarded post consumer textiles in the EU}\\&\quad - \text{exported post consumer textiles (for reuse or recycling)}\\&\quad - \text{domestically reused waste textiles} - \text{non recyclable portion}\end{aligned}$$

In the EU, the amount of post-consumer textiles in 2019 was 10.9 million tons per year, of which the largest part is currently energetically recovered or landfilled on average in the EU (see figure below).

Figure 26: Distribution of disposal routes for post-consumer textiles



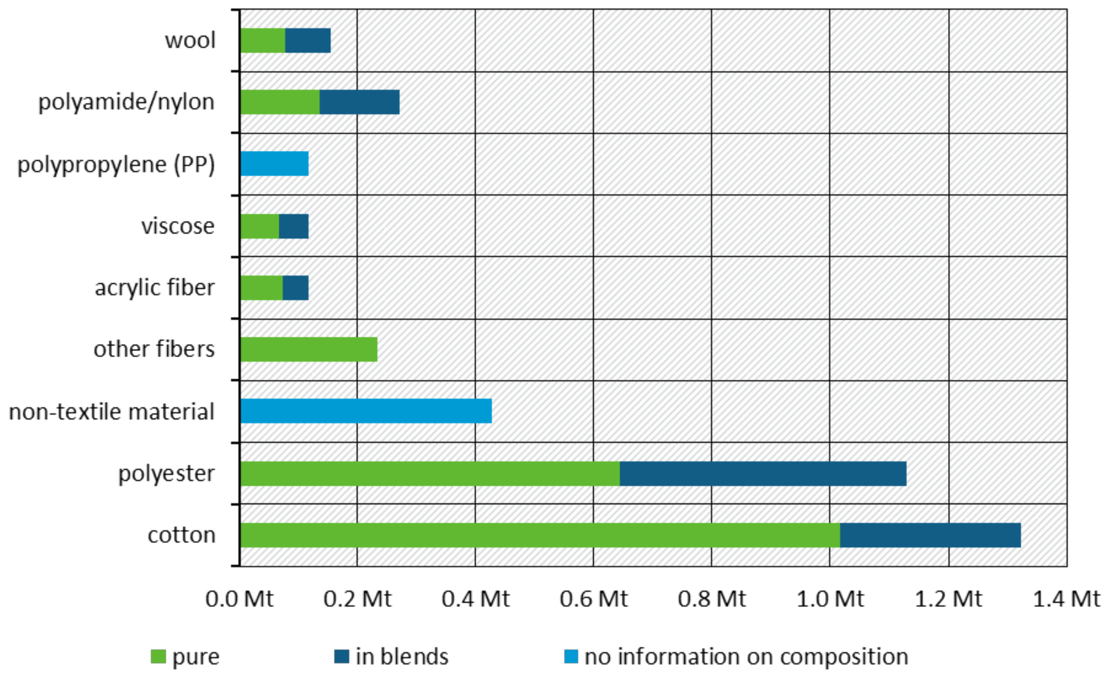
Assumption: Amounts that are currently energetically recovered or landfilled would instead be available for reuse or recycling in equal parts. Figures for the year 2019, reference area EU-27, amounts displayed include apparel, home textiles and technical textiles.

Source: Huygens et al. 2023.

Subtracting the share that is currently directly reused within or outside the EU or is not recyclable, there are still nearly 8 million tons potentially available for reuse and recycling. Assuming an increase in reuse if that of the 8 million tons 50% will additionally be reused, nearly 4 million tons are still available for recycling. To tap this potential and reduce the share of energetic recovery and landfilling, more separate collection must be implemented. It is expected that this will be achieved with the EU-wide separate collection obligation from January 2025. In addition to these quantities which result from post-consumer textiles, there are quantities available from post-industrial waste and pre-consumer waste. These amounted to approximately 1.67 Mt in 2019 and are another potential input source for recycling.

Figure 27 translates this potentially available amount for recycling into the different fibre types based on the typical fibre composition of post-consumer textiles. According to van Duijn et al. (2022), 31% of the fibres from post-consumer textiles are in blends, which are currently not or only partially suitable for fibre-to-fibre recycling. Consequently, the actually usable fibre amounts for recycling are lower. Nevertheless, the total amount of material potentially available for recycling significantly exceeds the current and projected recycling capacities.

Figure 27: Yearly amounts of fibres potentially available for recycling



Source: Own elaboration based on average composition of textile post-consumer waste (Huygens et al. 2023) and the calculated amount of post-consumer waste that can be used for recycling activities of 4 Mt/year. Information on the share of pure fibres and fibres in blends are based on van Duijn et al. (2022).

The annual demand for recycled fibres in the EU resulting from the proposed recycled content targets is calculated by multiplying the annual consumption quantities of clothing in the EU by the fibre-specific share of those consumption quantities (e.g. 34% for cotton, 29% for polyester) and the proposed fibre-specific recycled content target (e.g. 10% for cotton, 3% for polyester):

$$\begin{aligned}&\text{Annual demand for recycled fibres (EU)}\\&= \text{annual consumption quantities of clothing (EU)}^{31}\\&\quad\times \text{ fibre specific share of consumption quantities}^{32}\\&\quad\times \text{ proposed fibre specific recycled content target}\end{aligned}$$

The following Table 44 summarizes the results by fibre type:

[31] Based on average per capita consumption values in kg/capita for the consumption of apparel in the EU from the year 2020 ((Duhoux et al. 2022)), multiplied by the EU population (Statistics | Eurostat, dataset: demo_gind).

[32] Based on the fibre composition of textile post-consumer waste (Huygens et al. 2023).

Table 44: Results of the calculation of the demand for recycled fibres for apparel and for the product example of T-shirts in the EU

Fibre	Proposed recyclate quota (%)	Fibre-specific consumption quantities clothing EU (Mt/year)*	Demand for recycled fibres for clothing EU (Mt/year)	Demand for recycled fibres for T-shirts ** (Mt/year)
cotton	10	0.9	0.091	0.033
polyester	3	0.8	0.023	0.0033***
viscose / other MMCF	5	0.1	0.004	0.0014
polyamide / nylon	5	0.2	0.009	-
wool	15	0.1	0.016	-
Total	**-**	**2.7**	**0.145**	**0.038**

*Fibre-specific breakdown of the average per capita consumption values in kg/capita for the consumption of apparel in the EU from the year 2020 (Duhoux et al. 2022), multiplied by the EU population (Statistics | Eurostat, dataset: demo_gind). Due to a lack of current data on the fibre composition of textiles, the average fibre composition of collected post-consumer textiles is used as the data basis. Collected post-consumer textiles are dominated by clothing at 48%, 36% are home textiles, and 16% are technical textiles. (Huygens et al. 2023).
**Calculation for T-shirts: Apparent consumption of the year 2023 based on eurostat (2025) for PRODCOM Code 14.14.30.00. Material composition and average weight (0.17 kg per product) based on Quantis Switzerland (2024).
*** Values for the polyester portion per product include aramid, copolyester, elastodiene, elastolefin, polyethylene, rubber synthetic (Quantis Switzerland 2024).
Source: This study.

The resulting total demand for recycled fibres from this estimate is around 0.15 Mt/year resulting from the consumption of apparel. For T-shirts specifically in total around 0.038 Mt/year of recyclates are required. Already, 0.2–0.3 Mt/year of capacities for closed-loop recycling are available, with the prospect of significant expansion in the coming years. However, according to Huygens et al. (2023) at the current state only a small share of about 15 % of the amount going into closed-loop-recycling is recovered as spinnable fibres for the use in the clothing sector. This would amount to 0.03–0.05 Mt/year. Therefore, with the currently established recycling capacities, the volume of recycled fibres produced in good quality is clearly not sufficient to meet the demand which would result from a recycled quota for all apparel product groups on the market, if this demand is to be met by the European market alone. Even for the T-shirt and jeans product groups alone, the supply of good quality recycled fibres from the EU would not be sufficient with the current recycling capacities. Especially for polyester, further development and scaling of chemical material recycling processes are necessary to achieve the required recyclate quota. However, a significant increase especially in the polyester recycling is expected: Carbios, a French recycling company, is planning to commission a commercial plant for the enzymatic depolymerisation of PET waste with a capacity of 50 kt/year in 2026. A significant proportion of the input stream is expected to come from post-consumer textile waste (Carbios 2024). Furthermore, one chemical recycler expects the chemical recycling technologies to scale up to industrial levels by 2030 with several projects targeting a combined capacity of > 320 kt per year[33].

One way of taking this market situation into account, but at the same time providing a strong incentive for the expansion of closed-loop recycling plants, would be to initially limit the requirements to certain product groups with high market significance, such as T-shirts and jeans. With the expected increase in capacities, the requirements can be successively extended to other product groups.

6.3.4.3 Supportive measures

In the workshop series, the following supporting measures were mentioned: Capacity building in market surveillance, incentives and support for infrastructure investments and the introduction of tax advantages or advantages in CO_2 accounting when implementing recycled content. It was suggested to combine the recycled content target (*push* instrument) with incentives (*pull* instruments). Duhoux et al. (2021) add from their stakeholder consultation the importance of regulating unsubstantiated claims regarding recycled content. In addition, industry-initiated standardisation processes are proposed: 'Together with industry, central terms and rules could be defined to ensure the establishment of high-quality recycling streams' (Duhoux et al. 2021).

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6.3.5 Possible implications / Potential impacts

The intended effect of the quotas for the use of recycled materials, as developed in this study, is to strengthen the market for recycled materials and thus encourage recycling, specifically fibre-to-fibre recycling. The aim is for the formulated conditions, e.g., that recycled content must originate from fibre-to-fibre recycling, to contribute to achieving this effect.

Unintended consequences should be carefully monitored and addressed. These might be a decrease in the quality, rising prices for recycled materials and thus, for the products made from them. A redirection of existing recycled materials, here e.g. PET beverage bottles, textiles (EEA 2022a) is not considered probable taking into account the formulated conditions targeting a fibre-to-fibre-recycling.

The properties of mechanical recycled fibres are different to virgin fibres and the use of recycled fibres can lead to a decrease of durability. The trade-off is discussed in more detail below in Chapter 6.3.5.2.

Mechanically recycled fibres often have limited recyclability due to their already decreased quality in terms of fibre length and yarn evenness (Huygens et al. 2023; Oeko-Institut 2023). As a result, the overall recyclability of textile products may decline over time, since fibre quality tends to decrease with each recycling cycle. This poses a significant challenge to achieving genuinely circular textile systems.

[33] Statement of a participant of the workshops conducted in this project.

There were also concerns expressed regarding compliance with the European chemicals regulation REACH; this is analysed in the chapter on substances of concern in Chapter 7.1.4.

Finally, a global perspective on fibre availability and existing recycling technologies is necessary in order to anticipate possible impacts on markets and pricing. High demand combined with limited supply of recyclates could lead to significant price increases and financial risks especially for SMEs. There is also a risk of new dependencies on other economic powers, for example if large recycling capacities are primarily established in countries such as China.

6.3.5.1 Stakeholder feedback on the proposals for recycled content

The majority of stakeholder statements point out that there is a lack of reliable data on material availability, technical feasibility, quality-related restrictions and a holistic assessment of the impact and benefits of using recycled materials. Some stakeholders see a better understanding of current market availability and possible rebound effects from the use of recyclates as a prerequisite for setting minimum requirements.

Some of the stakeholders consider the proposed percentages to be feasible; in the case of synthetic fibres, more ambitious targets were also proposed as an important instrument to enable the scaling of existing technologies and to have a steering effect on innovation, infrastructure development and market transformation. Furthermore, chemical recycling is associated with fewer quality problems, which in turn could have a negative impact on the durability of the products. One chemical recycler suggested a minimum recycled content of 10-15% for polyester fibres by 2030. This proposal was based on the expectation that chemical recycling technologies are now scaling up to industrial levels (with several projects targeting a combined capacity of > 320 kt per year) and therefore should be considered alongside mechanical recycling in policy frameworks. This stakeholder urged for an immediate demand for recycled polyester content of at least 5% before 2030, in order to stimulate investment; this immediate start must be linked to the gradual phase-out of r-PET from bottles and a binding revision should be introduced to allow for adjustments to realised capacities.

For natural fibres in contrast, it was suggested by a textile association that no recycled content requirements should be imposed for the time being. They generally refer to the loss of quality due to mechanical recycling as the reason for this. This conflict of objectives is discussed in more detail further down.

A general concern of some stakeholders is the definition of the recycled content at product level. This is perceived as too inflexible and too time-consuming in the subsequent verification of product-specific recyclates. As an alternative, a recycled content at company or portfolio level was proposed.

Some of the stakeholders reject the specification of recycled content at the present time; sorting and collection structures and recycling capacities should first be promoted via other instruments (e.g. EPR, tax incentives or advantages in CO_2 accounting, environmentally friendly public procurement). Only when recycled fibres match those of virgin fibres in terms of price, availability and quality can a mandatory recycled content be seriously discussed. Otherwise, the global competitiveness of companies will be weakened, and they will be exposed to the financial risks of fluctuating and expensive recyclate prices.

Furthermore, the certification requirements and the administrative efforts were claimed to be a competitive disadvantage for European companies in the global market, especially for SMEs.

6.3.5.2 Zoom-In: Trade-off between recycled content and durability

To date, mechanical recycling of textile fibres is by far the most commonly used recycling process (Huygens et al. 2023). This requires tearing the textiles into individual fibres, which damages the fibres. Specifically, this results in shorter fibre lengths and lower fibre length uniformity of the recycled fibres compared to virgin fibres. The proportion of short fibres, the average fibre length and the longest fibres are in turn decisive for the further spinning process and the yarn quality (Baumann et al. 2023). Stakeholders report that the fabric of material made from recycled cotton appears significantly rougher and shows greater signs of wear, which can result in a different colour impression (Oeko-Institut e.V. 2023). An investigation of recycled wool revealed that the yarns were 'hairier" due to the higher short fibre content, which led to poorer pilling values for the fabric. The tensile strength of products containing recycled wool was also lower than that of products made from virgin wool[34].

The spinning technology chosen influences the subsequent durability of the yarns: according to Abbas et al. (2025) ring-spun yarns are characterised by higher bursting strength and lower pilling tendency compared to rotor-spun yarns, as the fibres are better integrated into the yarn structure during ring spinning. According to stakeholder feedback, to compensate for the lower quality of mechanically recycled wool fibres, practices such as using more (virgin) fibre material or adding elastane are also applied to achieve the desired quality. This, in turn, can lead to negative interactions with other product aspects, such as environmental impacts due to increased material consumption or reduced recyclability due to the use of elastane.

However, research projects are addressing ways to improve the quality of mechanically recycled fibres. For instance, the German Institute of Textile and Fibre Research Denkendorf (DITF) has achieved a reduction in fibre shortening by adjusting the tearing parameters in the recycling process. This has enabled the production of yarns made entirely from recycled aramid fibres for use in clothing production. Nevertheless, they emphasised that yarns made from recycled fibres are not suitable for producing all types of apparel . Will and Çağdaş (2023) have introduced a recycling toolbox for spinning cotton ring yarns with a high share of recycled fibres. They tested a fibre blend of 50% recycled cotton and 50% virgin cotton for a yarn count of Ne 30. They used pre-carding, an additional cleaning step to remove yarn pieces and reduce neps and thick places. This is followed by combing, which reduces the proportion of short fibres and allows a larger proportion of recycled material to be used. However, combing also combs out a larger proportion of the recycled fibres due to their decreased fibre length, which is why the proportion of virgin fibres in the fibre blend increases by 8-11% depending on the set noil level[35]. The higher the noil level is set, the better the tenacity of the yarn, but a larger proportion of fibres is also combed out. These combed out fibres can be used to produce recycled rotor yarns with yarn counts of Ne 12 to Ne 16. However, these are not sufficient for many applications due to their lower tenacity. As a third step, the fibre mixture is compacted, which makes the yarn more tear-resistant and reduces hairiness. By applying these process steps, a recycled yarn with a recycled cotton content of 40% after the combing process could be produced, which had a comparable quality to a carded cotton yarn made from 100% virgin cotton.

Textile Exchange (2025c) has compiled an overview for cotton and wool of technically possible yarn counts depending on the spinning process used and the proportion of mechanically recycled fibres. According to this, ratios of 5–60% mechanically recycled cotton from pre- or

[34] Unpublished scientific Coursework of Ayla Bernkopf / HS Niederrhein, conducted for ROY ROBSON, 2024.

[35] The noil level describes the percentage of short fibres and impurities removed during the combing process of textile fibres.

post-consumer waste are feasible for the spinning of yarn counts of Ne 24 to Ne 34[36]. In case of very good input material from post-industrial yarn hard waste with a fibre length of up to 26 mm even yarn counts of Ne 30 to Ne 40 can be reached with a ratio of 5–25% mechanically recycled cotton. Säntis, a Swiss textile recycling company, even states that it can produce cotton yarns up to Ne 30 with a content of 100% mechanically recycled cotton from post-industrial and post-consumer textile waste (Säntis Textiles 2025).

For wool yarn counts of up to Nm 20[37] can be reached using open end spinning and a ratio of 85-90% mechanically recycled wool. By creating a ring carded yarn, yarn counts of up to Nm 15 can be reached with a ratio of 75-80% of mechanically recycled wool (Textile Exchange 2025c).

Conclusion

Mechanically recycled fibres have a quality disadvantage compared to virgin fibres. However, the proportion of recycled material that can be used while still meeting the desired quality requirements has not yet been systematically investigated. In addition, quality requirements vary depending on the area of application and the manufacturing process of the product. It is therefore necessary that the minimum requirements for the recycled content are adapted to the minimum requirements for durability on a product group-specific basis to the extent that it must be technically and economically possible for both requirements to be met.

A different picture emerges when considering the quality of recycled fibres from chemical recycling processes such as depolymerisation. Here, it is possible to produce fibres with virgin-like properties (Huygens et al. 2023). Recently, the Thuringian Institute of Textile and Plastics Research (TITK) has demonstrated that not only is it possible to achieve 100% recycling of cellulose fibres, but the process can even be repeated three times in succession without compromising key properties such as a pleasant, soft feel, a subtle sheen and excellent, uniform dyeability. The results of this project are now being transferred to the recycling of polycotton textiles (Beikirch 2025). However it has to be stressed that chemical recycling processes are associated with a higher energy demand compared to mechanical recycling (Huygens et al. 2023).

Examining the individual studies summarised above leads to the conclusion that no impairment of durability can be assumed for the relatively low recycled content proposed here. Therefore, from the study team's point of view, the proposed recycled content for T-shirts and jeans is within a range that, from a technical point of view, makes it possible to manufacture products that fulfil the proposed durability requirements.

[36] Ne (English Cotton Count) is a unit to express the fineness of yarn, especially in the cotton industry. The higher the Ne number, the finer/thinner the yarn.

[37] Nm (Nummer metrisch) or Metric count indicates the yarn fineness, especially in Europe and for wool. Nm expresses the number of meters of yarn that weigh one gram.

7 The presence of substances of concern (SoC)[38]

The term of substances of concern (SoC) has firstly been introduced in 2020 in the Chemicals Strategy for Sustainability of the European Commission (2020b). The final definition in the ESPR will firstly be introduced in this chapter which is then followed by an analysis on how the criteria have been dealt with in the textile industry so far.

SoC are defined in Article 2(27) of the ESPR and includes four letters that define independent criteria for a concern (see Figure 28): The definition refers on the one hand to the hazardous properties of substances as defined in the European chemicals legislation, namely the regulations REACH (European Parliament; European Council 2006), CLP (European Parliament; European Council 2008) and POP (European Parliament; European Council 2019b). In addition to the substances of very high concern under REACH (SVHC or candidate list substances), further hazard classes are listed, e.g. substances classified as carcinogenic, mutagenic, or toxic for reproduction (CMR substances) of category 2, substances of so-called new hazard classes (e.g. endocrine disruptors with effects on human health or the environment, or persistent, mobile and toxic properties) or sensitising substances, all which are listed in Annex VI of the CLP regulation. Parts of the hazard classes, listed in Article 2(27)(b) under (iv), (v), (vi) and (vii) of the SoC definition are specific to EU legislation and do not exist in the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) classification schemes (United Nations 2023).

The European Commission (2024b) estimates that the number of substances falling under the SoC definition of the ESPR can be counted as follows:

- ~450 substances (individual SVHC under REACH);
- ~5,000 substances (relevant harmonized classification under CLP);
- several hundred substances under the POPs Regulation.

No overview is available today how many of those substances with a harmonized classification are used in textile production. To get an estimation a detailed search for each substance and their possible usage in textile chemicals would be necessary.

In addition to these substances classified as hazardous to the environment or human health, the last criterion for SoC mentions adverse effects on the reuse and recycling of materials in the product in which they are contained.

[38] This chapter was written by Anett Matthäi, Hochschule Hof, and Katja Moch, Öko-Institut.

Figure 28: Definition of substances of concern in Article 2(27) of the ESPR

(27) 'substance of concern' means a substance that:

(a) meets the criteria laid down in Article 57 of Regulation (EC) No 1907/2006 and is identified in accordance with Article 59(1) of that Regulation;

(b) is classified in Part 3 of Annex VI to Regulation (EC) No 1272/2008 in one of the following hazard classes or hazard categories:

(i) carcinogenicity categories 1 and 2;

(ii) germ cell mutagenicity categories 1 and 2;

(iii) reproductive toxicity categories 1 and 2;

(iv) endocrine disruption for human health categories 1 and 2;

(v) endocrine disruption for the environment categories 1 and 2;

(vi) persistent, mobile and toxic or very persistent, very mobile properties;

(vii) persistent, bioaccumulative and toxic or very persistent, very bioaccumulative properties;

(viii) respiratory sensitisation category 1;

(ix) skin sensitisation category 1;

(x) hazardous to the aquatic environment — categories chronic 1 to 4;

(xi) hazardous to the ozone layer;

(xii) specific target organ toxicity — repeated exposure categories 1 and 2;

(xiii) specific target organ toxicity — single exposure categories 1 and 2;

(c) is regulated under Regulation (EU) 2019/1021; or

(d) negatively affects the reuse and recycling of materials in the product in which it is present;

Source: Article 2(27) of the ESPR; https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401781

According to Article 5 (14) for any substance defined under Article 2 (27) of the ESPR in a textile product group it should be considered if

> *'(a) based on standard technologies, the substances make the reuse, or recycling process more complicated, costly, environmentally impactful, or energy- or resource-demanding;*
>
> *(b) the substances impair the technical properties or functionalities, the usefulness or the value of the recycled material coming from the product or products manufactured from that recycled material;*
>
> *(c) the substances negatively impact aesthetic or olfactory properties of the recycled material."*

According to Article 7 (5) of the ESPR, the information requirements shall make it possible to track the SoC, throughout the life cycle of the products concerned. The information required shall include a unique substance identification[39] as well as information on e.g. the concentration

[39] „(a) the name or numerical code of the substances of concern present in the product, as follows: (i) name in the International Union of Pure and Applied Chemistry (IUPAC) nomenclature, or another international name when IUPAC name is not available; (ii)

in the final product and information relevant for among others recycling and the environmentally sound management of the product at end-of-life.

Additionally, Annex I of the ESPR on product parameters addresses improvements regarding the presence of substances of concern (SoC). It states that the use of these substances—whether used on their own, as parts of other substances, or in mixtures—should be carefully considered. This applies to their use during the production process, as well as to any situation where they end up in products, including when these products become waste.

To conclude, the ESPR sets an ambitious level with regard to data collection and communication of SoC used in the manufacturing process. For complex and international textile supply chains, the scope of European chemical regulation is limited mostly to product compliance, hence an implementation is challenging. To track individual substances, based on CAS-number identity, expertise about the substances and their possible usage in processing would be needed among all actors in the supply chain on individual product level.

Information was gathered through a literature review of grey literature (reports from the EU Commission/authorities) and scientific publications on the impact of (hazardous) substances on recycling. Academic textbooks on textile industrial chemicals were also consulted. Additionally, interviews were conducted with experts and a survey was carried out among experts from the textile industry. The feedback from participants in the workshop series was also used as a source of information.

7.1 Status quo in the textile industry

A large number of chemicals are used in the various stages of textile production. There are merely estimations on the total number of chemicals, e.g. that 15,000 substances are used. Many of which are not disclosed for reasons of confidentiality (Bour et al. 2023), which is also cited be the JRC preparatory study (Delre et al. 2024b). Estimates by workshop participants, which also included chemical suppliers, are lower, at around 5,000 substances.

The usage of the substances can be grouped into functional performance (effect) chemicals and auxiliary (process) chemicals. Effect chemicals, such as colourants and finishing agents, are supposed to remain on the textile and create a certain effect like colour or an easy-care effect. Process chemicals are needed to aid in the processing but are not intended to remain on the textile. A differentiation of both groups with regards to the ESPR requirements could be important, as knowledge about the effect chemicals is expected to be present to a greater extend among the actors in the supply chain.

Current requirements under the European chemicals legislation REACH exist regarding the duty to communicate substances of very high concern (SVHC) along the supply chain. In addition, certain chemicals in textile products are subject to restrictions under REACH, Annex XVII or the POP regulation. According to EU legislation, information about hazard classes as well as known SVHC substances (> 0.1%) present in a textile chemical product has to be provided in Safety Data Sheets. This requirement does not exist outside of EU, where no or a different legal framework for chemicals exist.

other names, including usual name, trade name, abbreviation; (iii) European Community (EC) number, as indicated in the European Inventory of Existing Commercial Chemical Substances (EINECS), the European List of Notified Chemical Substances (ELINCS) or the No Longer Polymer (NLP) list or the number assigned by the European Chemicals Agency (ECHA), if available and appropriate; (iv) the Chemical Abstract Service (CAS) name and number, if available.“

7.1.1 Chemical management from a product development perspective

With regard to current practices to deal with SVHCs and other restricted chemicals, participants in the workshop series of this study described that this is predominantly followed by approaches via restricted substances lists. Here, the Manufacturing Restricted Substances List (MRSL) of the multi-stakeholder organisation 'Zero Discharge of Hazardous Chemicals" (ZDHC) (Stichting ZDHC Foundation 2025) was often mentioned as well as the Restricted Substances List (RSL) of the Apparel and Footwear International RSL Management (AFIRM) group (AG n.d.) or other voluntary standard RLSs or MRSLs. These (M)RSLs are lists of substances that have been identified as being hazardous to human health and the environment. These substances are therefore restricted above a certain concentration limit, either in the textile article (RSL) or during the production process, e.g. in the chemical inputs or in waste water (MRSL) (Patra and Pariti 2022).

Some participants in the workshop series explained that they set up contractual requirements that SVHCs may not be used, and suppliers have to provide certificates of clearance for the article. It was explained that the restricted substances approach in textile products is then used as the basis for risk-based testing on final articles. Some participants described the use of chemical positive lists via selected environmental labels, e.g. Global Organic Textile Standard (GOTS) (Gots 2023), different standards of OEKO-TEX® (Oeko-Tex Service GmbH 2025b; 2025c) or bluesign (bluesign® 2021; bluesign technologies ag 2025). In the workshop series, it was highlighted that the most common way to ensure compliance with restricted substances requirements is through the transfer of documentation. One workshop participant reported that they would check and compare the chemical inventory lists (CIL) of the concerned factories.

The set up a CIL is part of the Best Available Techniques (BAT) with regards to chemicals. The European BAT Reference Document for the textile industry (Roth et al. 2023) describes the chemical management system as part of the environmental management system. The conclusions of the reference document have been transferred into an implementing decision (European Commission 2023a) and are therefore binding within the EU for large-scale plants where the processing capacity exceeds 10 tons per day. However, the Best Available Techniques Reference Document (BREF) serve as reference and benchmark not only within the EU but worldwide and therefore have a global impact. The chemical management system described in the BREF (Roth et al. 2023) includes the technical and organisational measures to limit the environmental impact of the use of chemicals. Examples are an overarching policy to reduce the use and risks associated with process chemicals, a procurement policy to select less harmful process chemicals and their suppliers, a CIL of process chemicals and criteria for selecting process chemicals and their suppliers. There was consensus that communication and knowledge about chemical management system and inventories between the actors is rare. To the participants' knowledge, the CIL compiled and collected over the last decade as part of the Detox measures, a Greenpeace campaign to eliminate the use of dangerous chemicals in textile manufacturing (Greenpeace e.V. 2021), are not being used for the purpose of managing textile chemicals in products.

In the workshop series, participants noted that the duty to provide information does often not take place in the supply chain and that knowledge on the chemicals used decreases significantly from the stage of area production onwards. Confidentiality of information was highlighted as an obstacle to communication: Both information on chemical substances from chemical suppliers and information on application processes from the wet processing mill are often not shared voluntarily due to the highly competitive nature of the industry. Participants described the knowledge in textile companies about the use of specific chemical products and substances used in finishing to achieve a certain performance or usability as rather limited, especially in international supply chains. Rather, the process was described as follows: The company communicates its technical performance requirements to the finisher and the finisher implements these requirements on the raw material (e.g. yarn, fabric). It was highlighted that communication of information about chemicals is not integrated in currently used digital tools. Existing Product Lifecycle Management systems (PLM) and Enterprise Resource Planning (ERP) systems today do not offer options to set specific requirements for chemical usage during wet processing. This expertise lies solely with the finisher. Information on substances, performance and applications is provided by chemical manufacturers in the EU through REACH compliant Safety Data Sheets (SDS) and technical application information (TI) to the direct customers, which are the finishers. Outside of EU similar procedures and documentation are applicable. Knowledge of individual substances present in the textile chemical mixtures and chemical products used to achieve usability is rarely available to the textile company.

The workshops participants agreed that usually communication involves excluding restricted substances from being present in the product. Occasionally, especially when a specific effect is to be marketed, the textile company is aware of the high-level finishing agents used (e.g. biocidal or water-repellent finishing).

7.1.2 Chemical management from a chemical production and application perspective

The possibility to alter raw materials according to the demand of the market was described by the workshop participants from chemical industry. A large variety of finishes can be applied to increase durability and usability (Lee Wayland 2011; Fischer 2011a; 2011b). The German Association of Manufacturers of Process and Performance Chemicals (TEGEWA) provided a mapping of groups of chemicals and their functionalities, which was compared to literature (Schindler and Hauser 2004a; 2004b) and combined with feedback from participants during the workshops (see Table 46). The following notes are important for the table:

Firstly, similar substances can be used for different applications as functional ingredients to create an effect on the textile article.

Secondly, it can be concluded that the same effect can be achieved in applications by different chemicals or other processes, for example the anti-felting treatment of wool fibres, which makes wool garments machine washable and thereby increasing the useability of the garment. The effect can be achieved by additives or by subtractive chemical processes. The last example given in Table 45 is water, stain and oil repellent finishing. The different effects can be achieved by different chemical substances classes, which today are classified in PFAS and PFAS-free chemical finishings. Combined water and oil repellence or water/stain/oil repellence can currently only be achieved by PFAS chemistry as well as oil and blood repellence, which no longer play a role in clothing textiles. Differentiation of the two classes of finishings is important with regards to the reuse as well as the recycling of textile waste from different sources, as some PFAS chemicals fall under the definition of SoC under ESPR. No exhaustive comparison was made between possible hazard classification and substances, but two examples of SoC are provided to show the conflicts between the different aspects of ESPR.

Thirdly, some chemical finishes serve more than one purpose, once it is applied. For example, a softener may have an effect on the wearing comfort, but it may also improve sewability, thereby reducing the amount of wasted and damaged goods due to yarn breakage.

Table 45: Functional modifications by effect chemicals impacting durability and usability (non-exhaustive list of examples)

Functionality	Finished with / substance group:	Effect
Tough-cotton	Polyethylene (PE) in combination with isocyanate crosslinkers	Sewability improvement
Bio-polishing	Enzymes (e.g. cellulases)	Possible reduction of pilling
Non-iron finishing / 'Easy Care"	Resins (e.g. glyoxal based)	Easier to iron Antipilling Improved dimensional stability Colour tones: higher wash stability Reduction of mechanical properties (fibres get brittle, this can be partly compensated by addition of polyethylene dispersion).
Hydrophilizing agents/ Anti-static finishing	Fatty acid esters and others	Moisture management Improvement of wearing comfort e.g. for PES and PA textiles (sportswear) Soil-release effect Improvement of cleaning ability in home laundry
Seam slip resistance	Silica sol	Increase of seam shear strength
Antipilling/ Antisnagging	Polymer dispersions in general (e.g. polyacrylates, polyurethanes, styrene acrylates, vinyl acetates, etc.)	Tear/seam and abrasion resistance, rubbing fastness, abrasion resistance Increased elasticity and recovery
Felt-free finishing of wool	Oxidising treatment e.g. Chlorine-Hercosett process to remove scales (subtractive treatment) Treatment with resins cover scales (additive treatment)	Wool garments made machine washable
Water, stain and oil repellents	Special fluorine-free polymers and waxes, sometimes in combination with silicone polymers or PFAS containing polymers in accordance with derogations defined within REACH restrictions and POP regulation (e.g. for personal protection, medical uses, etc.)	Water repellence, Durable Water Repellence (DWR) or Stain repellence or Oil repellence or Combined water/oil or water/stain/oil repellence with PFAS Protection Fabric is washed less often, therefore lasts longer

The use of chemicals has an impact on other product aspects of the ESPR and there may be conflict of objectives. For durability, but also for the impact on recycling and reuse it is important to know how long, i.e. how many wash-dry cycles, a chemical finishing will last on the garment. Textile chemicals can be classified as non-permanent, semi-permanent and permanent, an exact definition is however not available (Fischer 2011a). Data on wash-dry cycles of some example finishings as shown in Table 46 were provided by TEGEWA. The durability depends on the respective finishing effect and the individual chemical. Thus, an individual information from the chemical supplier must usually be requested. Variations from few wash-dry cycles to 100 wash-dry cycles (permanent) are possible (see Table 46). With a synthetic resin finish, the cotton forms a covalent bond with the glyoxal resin and is therefore permanent. A fluorine-free, stain-repellent finish, the permanence can be improved by using a cross-linking agent (~5-20 washes). Reactive systems that are covalently bonded to the fibres, withstand an unlimited number of wash-dry cycles.

One important example for the impact of the choice of the chemical finishing agent is the antistatic finishing of garments made from synthetic fibres. Due to their low humidity, fabrics made from synthetic fibre, such as Polyester, builds up static charges, which lead to clinging of the garment and thus a reduction in wearing comfort. Further soil and dust particles are easily adsorbed onto the fabric, reducing the aesthetic appearance. Both permanent and non-permanent antistatic finishing agents are available (Bechtold and Pham 2023). Using a non-permanent finishing agent may lead to an early disposal of the garment, due to the loss of the antistatic property of the garment. Considering the number of garments made from synthetic fibres, such as polyester, the choice of the antistatic agent is of importance for the ecodesign.

Chemical suppliers have provided individual durability figures for the finishes shown in the Table 46 below. It can be concluded that brands and producers, which want to ensure durability, performance as well as knowledge about the presence of SoC for their product under the ESPR should be able to specify requirements about the chemicals to be used accordingly in the product specification. In order to ensure durability of the finishing on the final garment, the expected wash-dry cycles have to be determined during the design phase in the technical product specification. Also, chemical suppliers would need to actively provide this data to their customers.

Table 46: How many washes will the finish last on the garment? (examples)

Finishes with	Number of wash-dry cycles possible
Resins on-iron finishing / ‘Easy Care”	Permanent
Anti-pilling and softener finish	~5-20 washes
Fluorine-free, stain-repellent finish using a cross-linking agent	~5-20 washes
‘Tough cotton”	> 20
Silica sol	up to 5
Hydrophilization / Anti-static finishing	> 20 or non-permanent
Polyurethanes and other polymers	> 20

Source: TEGEWA

The wash resistance of the chemical finishing agent has to be considered. Knowledge of the combination of fibre material, production processes and chemical treatments is crucial to make a valid assumption about the physical durability, not only after production, but also during the use phase of the textile product and during sorting and preparation for recycling. Further, it can be expected that the number of shorter fibres will increase as a side effect when using mechanically recycled fibre content for new products. Consequently, it is possible that for preparation for recycling and for manufacturing mechanically recycled fibres a higher amount as well as different and new finishing agents will be used.

Minimum physical durability requirements for a textile product may be achieved by different production methods. Therefore, durability can be achieved either by using high quality material (e.g. defined by fibre length, strength and fineness and suitable for ring spun yarn processing) or, in the case of lower quality fibres and yarns, by additional treatment of the yarn with a chemical finishing agent compensating low raw material quality. The results of testing the physical durability (such as pilling or rubbing fastness) of textile products made from low quality fibres with certain finishes and high-quality fibres immediately after production could be comparable and both would meet the same minimum physical durability requirements. In addition to the functional modifications in Table 46, TEGEWA gave the following examples for finishing agents and treatments, which can compensate for a lower fibre quality:

- Polyethylenes, waxes and silicones improve the sewability and prevent seam damage during manufacture and later use;
- Softeners: reduce fabric roughness, improve handle (e.g. of open end yarns) and abrasion resistance;
- Shine effect via calender (mechanical);
- Mercerization of cotton

7.1.3 Conflict between SoC and other product aspects

Some chemicals which today are SoC due to their classification have explicitly been developed to reduce environmental impact in textile manufacturing. To show the conflicts between the different aspects of ESPR, two examples were chosen: enzymes and reactive dyestuffs.

7.1.3.1 Enzymes used in textile wet processing

The example of Bio-polishing with enzymes was chosen. Bio-polishing is today well known in production of knitted goods as well as denim goods with a ‘stone-wash’ design (Sheikh and Bramhecha 2019). Enzymes, such as cellulase (CAS number 9012-54-8), are widely used in processing of cellulosic fibres, such as cotton or viscose to achieve a smooth and soft surface of the fabric and reduce pilling. Also, new biotechnological recycling processes are carried out with enzymes (Ribul et al. 2021). The advantage of enzymes is a low processing temperature, which leads to energy savings. From an environmental perspective the usage of enzymes is preferable (Ribul et al. 2021).

Furthermore, enzymes, such as cellulase, are often readily biodegradable. Data can be found in the REACH registration dossiers (European Parliament; European Council 2006). Cellulase, like all enzymes, is affected by any information or performance requirement of ESPR, as it falls under the definition of SoC. It carries a harmonized classification as Resp.Sens. 1 (H334: Respiratory sensitization category 1) (CLP Annex VI - EU Harmonised Classification). In 2022 an industry guideline on the safe handling of enzymes in the textile industry has been published to share information on the state-of-the-art technology in production (Bachler et al. 2022). Once cellulases have been processed, they will not remain on the textile, they will be deactivated and removed. Hence, the risk due to the health hazard is important to manage during the production of the enzymes as well as during textile processing. For the final product and the consumer, no risks can be identified. A sound chemical management system which is implemented by the chemical enzyme producer as well as in the textile production facility is important to control the risks (Bachler et al. 2022).

7.1.3.2 Reactive dyestuffs used in wet processing

The second example is the group of reactive dyestuffs for dying of cellulosic (e.g. cotton or man-made cellulosic fibres) and to a lesser extent also protein fibres (e.g. wool). Reactive dyestuffs are among the most relevant class of synthetic dyestuffs for the mentioned fibres, which is common knowledge in the processing industry. It is unknown whether textile designers share this knowledge, too. The mentioned dyestuff class has a positive impact on durability, they have a very good wash, perspiration, and light fastness due to covalent bonding to fibre. Bright colours and shades can be achieved, often without heavy metals contained in the molecule. From a technical perspective reactive dyestuffs have many advantages in dyeing of cellulosic materials, compared with other groups of synthetic dyestuffs like sulphur or direct dyes. Some reactive dyestuffs exhibit very good fixing properties, leading to less after washing as well as less discharge to effluent treatment (Roth et al. 2023).

Like other reactive dyestuffs, the reactive dyestuff Tetrasodium 4-amino-5-hydroxy-3,6-bis[[4-[[2-(sulphonatooxy)ethyl]sulphonyl]phenyl]azo]naphthalene-2,7-disulphonate, also known as Reactive Black 5, holds a harmonized classification under (CLP Annex VI - EU Harmonised Classification). It is classified as Resp. Sens. 1A (H334) as well as Skin Sens. 1 (H317). During processing the dyestuff reacts with the fibres, hence exposure to the dyestuff preparation in form of a powder, granulate or a liquid mixture in the wet processing has to be managed to minimize health risks in production (ETAD 2023). After bonding to the fibre, the dyestuff is not reactive anymore.

Verification of the usage of a reactive dyestuff on the final textile product is possible, as chemical analysis to identify the respective dyestuff class exist. The methods today are not established in the general testing laboratories. This makes it difficult to determine if a product, for example a black shirt, has been dyed with direct, a reactive or a sulphur dyestuff. All dyestuff classes could be used for dyeing of cellulosic materials, each class having more favourable and less favourable aspects like fastness to light, washing or perspiration to be considered.

7.1.3.3 Communication of substances with a harmonized classification and safety data sheet

These two examples lead to the question of how to achieve consistent communication on chemicals in textile products in the sense of the ESPR. The workshop participants stressed that the communication requirements were perceived as highly complex and data intensive. They described the current information situation as uncertain, as required information is not forwarded by the suppliers or information is incomplete. Along the further supply chain, it is not possible to obtain a complete picture of all effect and process chemicals used during production.

So far, there is a lack of personnel who are able to read and understand the content of documentation such as SDSs. The connection between the chemical products, the concentration of classified substances within the chemical products and the resulting classification, the desired performance on the textile product and the exposition and effect of the chemicals on humans or the environment is not known. Thus, it is difficult to substitute a single substance solely on the basis of their classification. Moreover, the definition of SoC refers to harmonized hazard classes of the CLP Regulation, Annex VI, which is the European implementation of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS). A list of all substances with a harmonized classification can be downloaded free of charge from the ECHA website (CLP Annex VI - EU Harmonised Classification). This makes it possible to identify the substances, which carry a harmonized classification in the European Union. However, it should be noted that some of the hazard classes do not exist outside the European Union.

Within the EU it is legally binding for chemical supplier to prepare a SDS in order to communicate hazardous substances above a certain concentration in any chemical product. A 16-chapter format, identification and emergency contact of the supplier, local language as well as up-to-date regulatory data are some of the most important criteria for a SDS (Table 47). The SDS must be prepared by a 'competent person", which is further defined in REACH (European Parliament; European Council 2006), Annex II. Also, international certifications, such as GOTS or bluesign rely on the information in the SDS and further data. A legally binding basis, such as the SDS in EU for communication of hazardous substances can be acknowledged as a mandatory foundation to fulfilling ESPR requirements. Competent persons for reading and verifying the information in a SDS would need to be employed at all stages of product design to production, which today is not the case. Given the crucial role of SDSs, there have been calls within the industry for higher quality and greater content harmonisation to facilitate compliance with ESPR requirements.

Table 47: Content and norms of SDS

Chapters considered in the SDSs	International norms according to which SDSs are prepared (not exhaustive)
1: Identification of the substance/mixture and of the company/undertaking 2: Hazards identification 3: Composition/information on ingredients 4: First aid 5: Firefighting measures 6: Accidental release measures 7: Handling and storage 8: Exposure controls/personal protection 9: Physical and chemical properties 10: Stability and reactivity 11: Toxicological information 12: Ecological information 13: Disposal considerations 14: Transport information 15: Regulatory information 16: Other information	European Parliament; European Council 2006 – Annex II UN GHS (United Nations 2023) – Annex 4 ISO 11014:2009-03 GB/T 16483-2008 and GB/T 17519-2013

Sources: see the right-hand column.

However, the GHS is not implemented in all countries in national frameworks (Persson et al. 2017). According to the Secretariat of the GHS Sub-Committee, textile producing countries such as India or Pakistan are not listed as having implemented the GHS. Furthermore, GHS is implemented in a different way to the CLP Regulation, e.g. in China, so the classification of substances would not be comparable.[40] At least certain hazard classes, which are also addressed under the ESPR criteria, are only existent in the European CLP system, but not in UN GHS. In addition, when it comes to usage, handling, storing and disposing chemical products, ILO convention C170 (Chemicals Convention, 1990) as well as the ILO recommendation R177 (Chemicals Recommendation, 1990) should be acknowledged. Only 24 countries have ratified the convention so far, last ratification was done by Ukraine in 2023. Many of the countries relevant in textile production have not ratified the convention.

[40] Information about the status of implementation of the GHS by country can be found here: https://unece.org/transport/documents/2021/01/ghs-implementation-implementation-country (UNECE 2021).

- As a result, in the case of production outside the EU, especially in countries that have no or no comparable chemicals legislation, it is more difficult for EU brands and retailers to transfer information and enforce transparency in production for individual substances that are not always identified by name and identification number (e.g. CAS number). The example of cellulase (CAS number 9012-54-8), given above, also shows that cellulase in the REACH registration dossier can be identified by more than ten different CAS numbers. To implement such a communication system more chemical knowledge would be needed within brands and retailers. From other international production chains, it is known that information on the use of chemicals in the manufacturing usually ends once an article is produced. Thus, information on chemicals used in the yarn production or in the fabric production are not further transferred to other production sites. Also, company knowledge about a substances' identity most likely will be handled confidential and as a business secret and not shared with potential competitors.

- Lastly, the workshop participants have the concern that communication requirements for new individual substances could lead to a misuse. They expressed their concerns that once a substance is identified by CAS number and communicated, the substance would be voluntarily restricted for the production by brands or retailers. Some workshop participants described this practice as a 'race to the highest number of restricted substances and the lowest limit values`, often without the knowledge on application and chemical functionality. The original intention of collecting data about used hazardous substances in a form of a 'watch list" to be enabled to make a sound decision about possible substitutions, was not reached according to the participants. The intention to protect consumers and the environment from the effect of hazardous substances was supported by all workshop participants. Therefore, different approaches to implement feasible solutions were developed.

  For substances that react during the process or are bound to the product in such a way that they no longer react, such as cellulase or reactive dyes, careful consideration should be given to whether the effort required for communication based on their CAS number and classification is reasonable for a product regulation such as ESPR, and which stakeholders should have access to this information. Surely communication between the chemical producer and the wet processor must be ensured to fulfil occupational health and environmental safety requirements on site.

- With regards to environmental safety the approach focusing exclusively on a CLP classification neglects harmful constituents of textile chemicals, which are not classified, such as content of Nitrogen and Phosphorous, leading to eutrophication. Nitrogen and Phosphorous are considered as well in the already mentioned chemical management approach described in the BREF. Impact on the possibility to protect vulnerable consumer groups like people with allergies and sensitivities to chemical substances was discussed during the workshops. There was an agreement that protection cannot be achieved by solely relying on the hazard classification of the chemical inputs as they not always exist in this form in the final textile article. Thus, it cannot not be verified in a test-based product conformity assessment.

A broader chemical management system approach, which considers conflicts and dependencies for each textile product category could be a solution reflecting the complexity of textile garment production and products.

7.1.4 Chemical and restricted substances management from a recycling perspective

The last criterion for SoC regarding negative impacts on the reuse and recycling of materials has not yet been further specified in the ESPR. There is a demand to reduce hazardous substances to achieve what is known as 'toxic-free recycling".

Further, substances can impair the reuse and recycling of textiles at various levels and in different recycling processes (chemical, thermo-mechanical, mechanical, biochemical and others). Previous research results show that knowledge about substances that threaten existing textile recycling technologies is limited (Duhoux et al. 2022; Bauer et al. 2018). Different substances are identified as potential 'technical impurities' in the various recycling processes. Hence, there is a strong dependence at the international level of (1) fibre material and composition, (2) effect chemicals remaining on the textile article and the respective mechanical, (bio)chemical or physical recycling process, in which the textile waste material is processed. Depending on the process, certain SoC could also be separated from the recycling mass. It was highlighted during the workshop that a range of recycling processes will be necessary to handle the different qualities and quantities of textile waste.

It was then mentioned during the second workshop that detailed and substance specific knowledge for the respective material recycler would be helpful to optimize the feedstock and process conditions for the recycling process. Participants with a degree in chemistry or related fields stated that the physical and chemical characteristics of the substances, such as solubility, melting point or molecular weight are important to known to purify them from a textile material. The participants were of the opinion that information about single substances, which may or may not hinder individual recycling processes will not be transferred from product design phase to the end of life of the product via a physical or digital product passport or label reliably. Therefore, the investment in sorting and identification technology was considered as important and more promising than investment in communication of chemical substance information.

Some examples were given by the workshop participants where certain substances or classes of substances can influence individual mechanical or chemical recycling processes in different ways, which are also mentioned in ESPR Art. 5 (14). It was stated by the workshop participants that most chemicals used in the pre-treatment of textile materials can be neglected in post-consumer recycling as they do not remain on the final textile. An overlap to chapter 6.2 can be found, where materials affecting the recyclability of materials were described.

- Dyeing with dyestuffs and pigments (different dye classes according to fibre type, fastness, pigments, etc.): One obvious influence is the colour of the dyed fibres and textiles. For some fibre and material types, this can now be compensated for very well in mechanical recycling by detailed and intelligent colour sorting and colourimetric recombination of the fibres (example: successful commercial wool recycling industry in Italy) (Textile Exchange 2023).
- Finishing: Desired, permanent effects are usually achieved by chemical changes to the fibre substrate, e.g. permanent easy-care finishing of cellulose fibre, which makes the fibre more brittle and easier to break in a mechanical process or felt-free finishing of wool, which makes the fibres easier to separate from the yarn without entangling during recycling. Mechanical recyclability can be negatively or positively influenced, as these two examples show.
- Permanent wash finishes can further influence the recyclability -e.g. by influencing the fibre/ yarn strength or disrupting spinning and weaving processes. In addition, a new colouration

of the recycled product can be impaired, and new or additional effect finishes on the recycled products can be negatively affected.

- Possible interfering substances could be: Post-treatment agents, fastness improvers, silicones, polyethylenes, PFAS-containing repellents, PFAS-free repellents, easy-care finishing, polymer dispersions, possibly also biocides. Residues from various dyeing and finishing agents could also influence recyclability, for example: synthetic resin, coatings, plasticizers, dyes/pigments as well as laminates and composite materials.

Conclusion

Setting requirements for substances under the SoC definition of ESPR have to consider many aspects, such as the fate of the chemical in the production process and the end use of the recycled product. Further a detailed specification of the recycling process will be important in this context (mechanical, physio-chemical, chemical). The dynamic development of recycling technologies must be considered. A substance which today may hinder one recycling process or will lead to a longer purification process of the waste before the actual recycling, might not be a problem any more in a few years. Alternatively, another recycling process might be available for which the specific substance does not have a hindering effect.

For recycling processes where chemical substances remain on the textiles/fibres during recycling, future changes in legislation (e.g. changes to Annex XVII of the REACH Regulation or the definition of substances under ESPR) must be taken into account. For example, textiles with a long service life may contain substances that are restricted or prohibited under new EU legislation at the time of recycling, but which were not subject to any legal requirements when the original textiles were manufactured. This circumstance could prevent the desired recycling and thus a key objective of the ESPR. REACH Annex XVII already takes this into account for certain substances. Entry 46a, number 2b on Nonylphenol ethoxylates (NPE) specifically excludes ‘second- hand textile articles or of new textile articles produced, without the use of NPE, exclusively from recycled textiles” from the restriction of NPE in textile articles, which can be expected to be washed (Entry 46a of Annex XVII in Regulation (EC) No 1907/2006). Regarding the undesirable recycling of PFAS, the European Chemicals Agency (ECHA) announced updates to the EU PFAS restriction proposal for REACH Annex XVII in August 2025, proposing a 13.5-year transition period for textile articles (exempt toys) containing recovered materials (European Chemicals Agency 2025). Knowing that certain substances might be contained in the waste feedstock which already is available today, makes it more important to invest in sorting and purification processes. At the same time, it has to be ensured that future waste contains a fibre composition that enables recycling in the first place and provides enough feedstock for high quality recycling processes. A full material disclosure covering also the effect and process chemicals used during production could be a vision for the future development of ESPR, yet not a first step.

7.2 Considerations in relation to the product aspect and derivation of the information requirements

Based on existing chemicals legislation and feedback from workshop participants, Table 48 summarises the results on how substances falling under the definition of SoC could be identified and communicated.

The discussion of Article 2 Definitions 27 of the ESPR with workshop participants produced the following results: The workshop participants developed a **proposal to define information requirements,** but not performance requirements:

- **ESPR Article 2 Definitions 27(a):** The handling of the specified SVHCs as well as the restricted substances according to REACH (EC) No 1907/2006 Annex XVII, is usually accompanied by communication of a restricted substance list in company contracts and agreements. In particular, the exclusion of SVHCs (> 0.1%) in final textile articles and their components is usually specified. This procedure is implemented within EU supply chains, as well as outside of them. Risk-based testing of final articles to ensure compliance has been reported for textile products imported into the EU (Fransson and Molander 2013). A performance requirement under ESPR for substances of concern could be, for example, a restriction of SVHCs. However, SVHCs are clearly part of the REACH regulation, and multiple regulations should be avoided. Furthermore, communicating the presence of SVHCs in products at concentrations above 0.1% to other parties in the supply chain, as well as to end users upon request, is already an obligation under REACH. Articles containing SVHCs above this threshold must be notified in the SCIP database[41] (European Chemicals Agency) established under the WFD. One way of incorporating SVHC requirements within the ESPR would be to require this information to be included in the DPP, which would be made available to the end consumer. While it is unclear how the SCIP database is used by end consumers, the SVHC information on the DPP would provide easy access. Participants in the workshop agreed to this proposal on the condition that no double reporting would be required. Information on the DPP (European Commission 2023b) indicates that the interoperability with existing databases will be exploited. Therefore, if this information requirement is adopted, it is expected that only one data collection will be necessary for the DPP and SCIP. Participants even suggested that the communication of SVHC (identity, concentration and occurrence in sub-components) via the DPP would make the industries task easier, as it would eliminate the need to respond to individual consumer requests. According to the feedback from the workshop participants, SVHCs are more likely to be found in (non-textile) accessories and trimmings than in textile fabrics.
- **ESPR Article 2 Definitions 27(b):** Further requirements that cover SoC referring to specific harmonized classifications of the CLP regulation (EC) No 1272/2008 were discussed controversially, but a consensus was reached. So far, the textile industry has not implemented a requirement to pass on information regarding all substances and textile chemicals, whether classified or not, across the textile supply chains, but only in individual cases. Approximately 5,000 substances will be affected by harmonized classification according to the hazard phrases as mentioned in the SoC definition. The number of substances relevant to textile production remains unknown. In many producing countries, legislation comparable to the European Union's REACH and CLP regulations for identifying substances and their classification does not exist. Even if countries implement the GHS, classification of substances with the same effect can differ (Yazid et al. 2020). This makes it difficult to implement in the international supply chains the requirement through corporate contracts and agreements. Even well-known ecolabels do not fully reflect the hazard phrases mentioned in the ESPR with regard to chemical management. The approach of achieving

[41] SCIP is a database of the European Chemicals Agency (ECHA) of information on substances of very high concern (SVHC) in articles that are present in a concentration above 0.1% by mass. SCIP stands for 'Substances of Concern in articles as such or in complex objects (Products)'. Manufacturers, importers and suppliers are obliged to provide information about these products (https://echa.europa.eu/de/scip).

compliance by testing of chemical substances and residues in textile articles was also discussed. It can be concluded that the approach of testing final articles for certain classified substances is not feasible, since not all the substances used in textile production that are classified are known. Some of these substances chemically react during processing and some are washed out. Furthermore, there are no testing procedures available to detect these substances in final textile articles with individual or common limit values.

- **ESPR Article 2 Definitions 27(c):** Substances falling under the POP (EU) 2019/1021 Regulation, which are considered SoC under the ESPR Regulation, were not discussed in detail. During the workshop, it was agreed that these substances are restricted, and therefore contractual agreements, as well as risk-based chemical residue testing, would ensure that they are not present in textile products.
- **ESPR Article 2 Definitions 27(d):** So far, the handling of substances that negatively affect recycling or reuse has only been addressed in very specific cases, rather than systematically, due to an overall knowledge gap.

Table 48: Feasibility of identification of SoC in EU and non-EU textile production

'Substance of concern' means a substance that:	Potential number of single substances	Feasibility for EU manufacturers to identify and communicate SoC	Feasibility for importers and non-EU manufacturers to identify and communicate SoC
(a) meets the criteria laid down in Article 57 of Regulation (EC) No 1907/2006 and is identified in accordance with Article 59(1) of that Regulation	~450 substances	Possible, according to legal framework (SVHC in Safety Data Sheet (SDS) of the chemical product)	Possible, through company contracts and agreements
(b) is classified in Part 3 of Annex VI to Regulation (EC) No 1272/2008 in certain defined hazard classes or categories	~5,000 substances	Possible, according to legal framework (harmonized CLP classification in SDS)	• Challenging to impossible, due to the high number of substances and no comparable legislation to CLP for identifying classification in many production countries • No legally binding SDS • implementation possible with expert knowledge + Mostly not reflected in (international) ecolabels
(c) is regulated under Regulation (EU) 2019/1021	several hundred substances	Possible, according to legal framework	Possible, through company contracts and agreements (limited number of substances relevant in textile production)

'Substance of concern' means a substance that:	Potential number of single substances	Feasibility for EU manufacturers to identify and communicate SoC	Feasibility for importers and non-EU manufacturers to identify and communicate SoC
(d) negatively affects the reuse and recycling of materials in the product in which it is present	unknown	Feasibility unknown, currently knowledge about positive or negative impact on recycling of substances is limited and needs further research	Feasibility unknown, currently knowledge about positive or negative impact on recycling of substances is limited and needs further research

Derivations based on best available techniques (BAT) in chemical management systems for textiles in supply chains

Due to the obstacles described and the limited impact of communicating the presence of individual substances within the supply chain on the final product, the existing pillars of chemical management systems developed over the last few decades were analysed. As mentioned by the workshop participants, these systems were both voluntary and mandatory.

Ideally, when implementing an information requirement for textile chemicals, the economic operator placing textile products on the EU market should define all the textile chemicals needed to achieve the desired properties in the technical product specification, e.g. an easy-care finish, a durable water-repellent finish, or an antipilling finish, including the wash-dry cycles. This information must then be shared with producers in the supply chain to enable them to produce the desired effect and performance level of the material. Ideally, the information would be reported back from the processor to the operator. Some workshop participants explained that it is standard practice to identify and specify chemicals that remain on the product. However, other participants explained that no such information is currently provided during product design, and that providing it would significantly increase the effort required for companies, particularly within international supply chains.

During the workshops, it was therefore proposed that the chemical management tools currently used in supply chains be linked. It is standard practice for textile producers to keep and maintain a CIL. Improving communication about effect chemicals between retailers/brands and wet processors leads to a better understanding of, and more consistent definition for, the different chemicals classes used (Schäfer and Herter 2021; ZDHC CIL 2021). During the workshop series, participants agreed that communication about the classes of effect and process chemical used within the supply chain could be limited to effect chemicals. This is because process chemicals usually do not remain on textiles, meaning they do not impact recycling processes or reuse. Table 50 provides an overview of the main groups of effect and process chemicals currently used in CILs during production. It should be noted that, while CIL now includes information about hazard classes according to CLP for chemical products, it remains difficult to gather this information from non-EU chemical suppliers, as previously described.

Table 49: Groups of effect and process chemicals

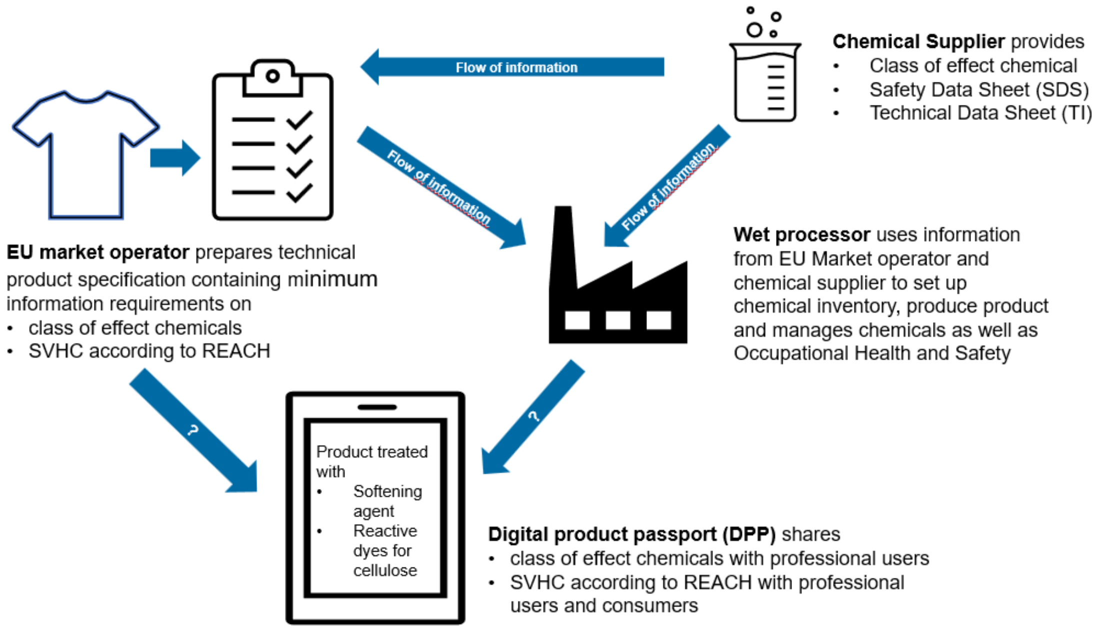
Effect chemicals	Process chemicals
Finishing auxiliaries	Spinning/ weaving / knitting
Coating (including membranes and laminating agents)	Sizing agents
Dyes and pigments	Pre-treatment auxiliaries
Dyeing/ printing/ coating auxiliaries (remaining on the textile)	Dyeing/ Printing auxiliaries
Optical brightening agents	Commodity or bulk chemicals
	Utility / Ancillary chemicals

Source: based on ZDHC CIL (2021) glossary

Effect chemicals mainly belong to the groups of dyes and pigments, and to agents for dyeing, printing, coating, laminating, and finishing. Membrane materials used in lamination should also be considered here; however, membranes are materials and are not considered to be a part of the group of effect chemicals. As explained in Chapter 7.1.4 the impact of the listed effect chemicals and materials on recyclability is well understood and almost identical to the list of effect chemicals in Table 49, which was extracted from the ZDHC CIL (2021) glossary. Since membranes cannot be applied without the use of textile chemicals, membrane materials have also been included.

It was suggested that information on the usage of textile effect chemicals could be included in the technical product specification during the design phase to improve knowledge of textile chemicals usage and facilitate communication of requirements within the supply chain. Thus, the technical product specification helps to gather information on chemicals that could impact durability, reuse or recycling. Information about chemical product groups, together with further specifications of performance requirements (e.g. the number of wash-dry cycles that a textile chemical is expected to withstand), would contribute to the ecodesign approach. The figure below illustrates the potential processing of information from the design phase through to production and into a DPP. It was highlighted that incorporating the described data into existing systems would currently present a challenge.

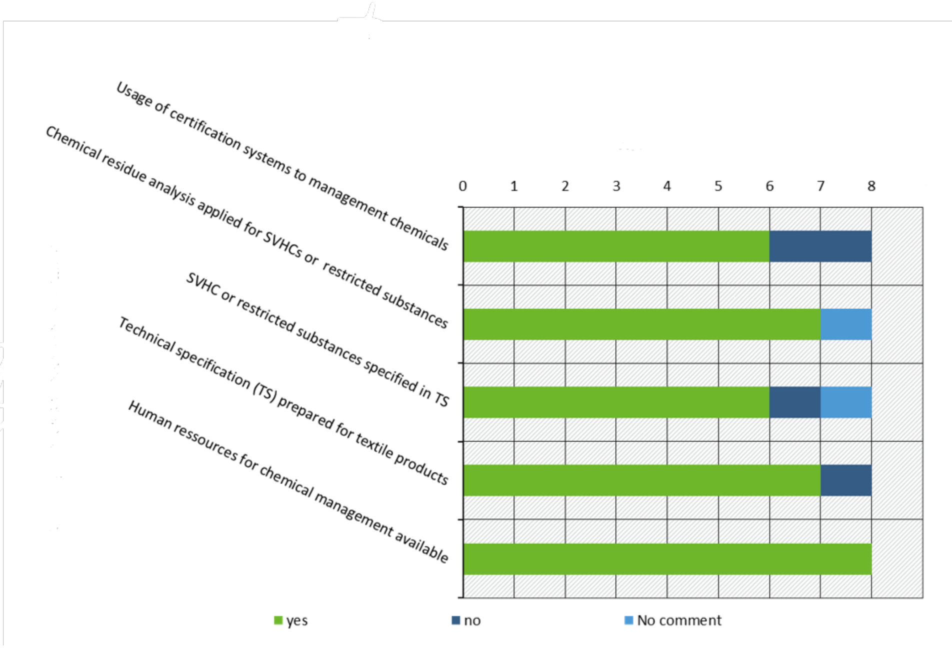
Figure 29: Linking chemical management between technical product specification and chemical inventory (CIL) in production



Source: Own work, Hochschule Hof

A questionnaire was provided to industry participants to gain insight into how companies manage regulated chemicals (such as SVHC) as well as the effect and process chemicals in their products. The questionnaire was distributed in the same way as the questionnaires on standard physical durability tests. Only eight questionnaires were returned. This could be explained by the aforementioned lack of knowledge about textile chemicals, as mentioned during the workshops. It can therefore be assumed that only companies that can be considered best practice responded. It was found that all of the companies that responded to the questionnaire had a person responsible for chemicals management. Seven out of eight companies said that they prepare a technical specification for their textile products, which contains requirements regarding regulated substances, such as SVHCs. Six out of eight companies stated that they use certification schemes to manage regulated substances in their products (see Figure 30).

Figure 30: Responses to the questionnaire on the chemical management in textile product development (number of questionnaires received = 8)



Source: Own work, Hochschule Hof

The second part of the questionnaire began with a question about whether companies specify certain textile chemical classes for their products as part of the technical product development. 50 % answered in the affirmative. It was mentioned that chemicals, which are approved for ecolabels were requested for use. While the responses to the questionnaire were not considered representative of the entire textile industry, it can be concluded that chemical management is being implemented and utilised by some companies during product development.

Implementing a chemical management system according to BAT requires of information to be exchanged between chemical suppliers and wet processors in order to manage and inventorise all chemical products. During the workshops, it was confirmed that textile operators who already interact with and exchange information with both chemical suppliers and wet processors have a better understanding of the chemical products and their constituents (e.g. active substances and their concentrations in the chemical mixtures), the application conditions (e.g. water and energy consumption), the performance of the final article (e.g. washing fastness or water repellence), and the management of restricted substances in the final textile. Improving knowledge of the effect chemicals can be seen as a first and most crucial step in improving the knowledge of chemical use throughout the product life cycle. The inventory can also support the identification of possible conflicts of interest in achieving a high durability and functionality.

Analysis of the requirements confirms that a single measure cannot implement an information requirement on the different categories of SoC. A stepwise approach could be taken, starting with the communication of **information about effect chemicals as a group** that are directly linked to the final product, and that might impact reuse and recycling.

A second step could involve linking this information about effect chemicals to a data set that is more substance- and performance-related. Table 50 shows an example based on the information from the International Textile Auxiliaries Buyers' Guide (THK) 2006/2007. THK was last updated and published in 2006/2007 (Redaktion melliand in Zusammenarbeit mit TEGEWA e.V.

2006). Nevertheless, it illustrates how a link could be established between substance-specific and general chemical product categories. It should be noted that the THK was guidance used by wet processors and provided by the textile chemicals industry association (TEGEWA) and a publishing house specialising in the textile industry (Melliand). Today, comparable information is provided in the technical information (TI) by the chemical supplier. To ensure the communication of relevant data, a certain quality level of TI should be ensured for all chemical suppliers. For example, performance aspects of finishing agents could also be stated here. The reliability of TI and SDS is considered an important pillar.

Table 50: Example from THK 2006/07 CD-ROM of information about chemical products (translated from German into English; supplier anonymized)

Parameter	Product 1	Product 2
Product Category	finishing agents	finishing agents
Product Subcategory	water repellents	water/ oil repellents
Producer	XY GmbH	AB GmbH
Application	Universally applicable hydrophobic agent for water-repellent finishing of textiles; resistant to the synthetic resins and additives commonly used in high-end finishing.	Oil and water repellent finish for all fibre types, preferably synthetics and blends with a predominantly synthetic content.
Ionicity	cationic	cationic
Chemical characterisation	paraffines	fluorocarbon resin

The third step could then focus on a full material disclosure approach, considering individual textile product groups and fibre compositions. Further preparatory work is necessary to achieve this, such as identifying and overcoming existing traceability barriers for chemicals, aligning with chemicals regulations to avoid duplication of work, determining the scope of the data, and agreeing on data ownership and access rights.

It should be emphasised that the aforementioned knowledge gap concerning textile chemicals, their classification, and their field of application must be considered. Market operators have shown to rely on voluntary certifications to manage chemical substances. More transparency about the process of assessing and approving chemicals would help to clarify how certification deals with the aforementioned obstacles regarding the quality of SDSs and further information about individual substances. Additionally, harmonising chemical requirements in voluntary certifications could reduce complexity for market operators.

7.3 Proposal for a minimum requirement

The stakeholders' contributions showed that knowledge of chemical usage and management, as well as awareness of the presence of chemicals remaining on the textile articles, ranged from very low to excellent. Therefore, when proposing minimum requirements, it must be considered that some market participants will find those requirements infeasible at the current time, while others will find them easily adoptable.

- **Integration of the information requirements on SVHC** (identity, concentration and occurrence in articles and their parts, including accessories, as defined by REACH) **in the public part of the DPP** and make the information available to the end consumer.

This would relieve industry of the need to respond to individual consumer requests regarding the presence of SVHCs. As the DPP system is being developed to be interoperable with existing databases, it will be necessary to ensure interoperability between the DPP and the SCIP database, in order to avoid the need to enter data into more than one system.

It is not feasible to introduce an information requirement for chemicals in the supply chain that are SoC based on a classification under the CLP Regulation, since CLP and the respective hazard classes are only mandatory for chemicals used in EU Member States. Furthermore, not all substances used in textile processing that are classified under CLP are present in the final product (i.e. textile articles). The following alternative, step-by-step approach is therefore proposed to focus on gaining information about chemicals that could impact reuse and recycling. This approach links knowledge about textile chemical usage during the design phase of textile articles to chemical management systems within the supply chain:

- **Communication about effect chemical groups** should be prioritised within a step-by-step approach because these chemicals are intended to remain in the product to fulfil a function. Information about the required effect chemicals should be passed on between all operators in the supply chain, but not to end consumers. To this end, retailers and other operators should include a description of the relevant effect (functional) chemicals (e.g. the often-mentioned water repellents) in the technical product specification during the design phase of the product and pass this information on to the producer responsible for the production or wet processing. In wet processing, any information about required effect chemicals should be integrated into the relevant production recipes. The required chemical products are usually maintained in the CIL during production. Information on the chemical properties (such as toxicity or reactivity) is extracted from the SDSs, which are provided by the chemical suppliers. This approach allocates responsibility for the product's impact at the design stage. Over time, knowledge about the chemicals used to make a product will increase, knowledge which was reported during the workshops to be lacking in brand and retail enterprises today. The transfer of information can be arranged in two scenarios. In the first scenario, market participants have knowledge of chemical products and the requirements can be shared with the supply chain. In the second scenario, market participants have little knowledge of chemical products and can request that information about classes of textile chemicals used be communicated from the producer back to the EU market participant. In both scenarios, it is not expected that the confidentiality of information will hinder the transfer of the requested information. It should be noted that this group-based approach does not involve passing on information about the identity individual substances with hazard classification, which could be interpreted as the intention of the SoC requirements in the ESPR. Nevertheless, the group approach can be justified by the fact that knowledge about substances that hinder reuse or recycling is currently inadequate and that the non-binding CLP hazard classification outside the EU can lead to competitive disadvantages for European manufacturers. Acquiring knowledge about the use of textile chemicals is a prerequisite for gradually introducing further requirements for SoC in the future.

The following definition is proposed (KEMI Swedish Chemicals Agency 2014): 'Functional or effect chemicals' are those that are intended to remain in the final article and are expected to be present at certain concentrations in order to achieve the desired function.[42]

The following categories listed in the table below, which are well established in the industry, are recommended for communication purposes. In addition to textile chemicals, the information requirements should also cover the usage of certain additional materials, such as membranes.

Table 51: Suggested non-exhaustive groups of effect chemicals and additional materials which should be passed on as an information requirement within the supply chain

Effect chemicals group	Effect chemicals subgroup
Dyes and pigments	As a minimum requirement the colourant class should be stated • Reactive dyes for cellulose • Reactive dyes for wool • Disperse dyes • Acid dyes • Metal complex dyes • Basic dyes • Vat dyes • Sulphur dyes • Direct dyes • Azoic dyes • Indigo dye • Digital printing inks • Natural dyes
Optical brightening agents	• Optical brightening agents
Printing chemicals	As a minimum requirement the printing process should be stated, preferable with the chemical basis (e.g. PVC or PU) • Discharge Printing • Pigment Printing • Plastisol Printing • Ink jet Printing • Transfer Printing • Foam Printing And further applied printing methods
Finishing chemicals	As a minimum requirement the finishing agent should be stated • Cross linking agent for crease recovery or resin finish • Stiffening agent • Weight filling agent • Delustering agent

[42] In contrast to this, auxiliary (process) chemicals are involved in some step of textile processing but are not intended to remain in the product.

Effect chemicals group	Effect chemicals subgroup
	• Softening agent • Water repellent finish • Oil repellent finish • Water repellent finish • Handle imparting agent • Soil or Stain release agent • Anti felting agent • Non-slip, anti-snag agent • Flame retardant finish • Anti- microbial finish • Bonding agent for fibres • Additive to increase depth of shade • Microencapsulated fragrance finish • Spotting agent • Dry cleaning agent • Anti-pilling agent
Coating chemicals	As a minimum requirement the coating type should be stated • Laminating agent • PU resin for coating • PVC resin for coating • Silicone resin for solvent coating • Cross linking agent for coating
Membranes	At a minimum requirement the membrane material should be stated • Polyester (PES) • Polyurethane (PU) • Polytetrafluoroethylene (PTFE) • And further materials used as membranes

Source: based on ZDHC CIL (2021) and input from workshop participants, modified by Hochschule Hof.

No additional specific requirement can currently be set for SoC that negatively affect the reuse or recycling of materials in the product. However, the proposed recyclability requirement to restrict the use of heterogeneous materials (a maximum of two different materials processed in one fabric layer, see in chapter 6.2.3) is supported from a chemical perspective, as it is assumed that fewer chemical substances are used if only one material is used. Different materials usually require different types of dye and process chemicals.

Another aspect that was highlighted earlier, is the impact of textile chemicals on the durability of items of clothing, which can be achieved through different production methods, either mechanical or chemical. One example is the pilling behaviour of a ready-made garment. A good pilling rating can be achieved either by using a certain quality of fibre/yarn (for example, ring spun), or by using a different quality of fibre/yarn (for example, open end) and by applying anti-pilling chemical treatments. In both cases, the final product would fulfil minimum requirements for durability before home laundry. However, differences in appearance and durability may become apparent after several washing cycles and. the recyclability of the garment in chemical or mechanical recycling processes could be impacted in different ways. Implementing the proposed information requirement within the supply chain is expected to make knowledge of the interactions between fibre material, chemical use, and their impact on durability and recyclability, as well as on health and the environment, more transparent in the future. SDS and technical information provided by the chemical suppliers are core elements of a chemical management system. The approach can provide the necessary baseline information to conduct more research on the interactions of materials, chemicals and different recycling processes, before further ecodesign requirements can be defined. Eventually, when durability and recyclability are be considered the most important aspects of ESPR for textiles, this will impact the use of textile chemicals. Therefore, the industry needs persons with interdisciplinary knowledge of the identity of chemicals and concentration, production processes, and article performance testing, as well as design and construction. It should be noted that aspects such as physical durability are core competencies of garment technologists and engineers, and designers are also educated in this area to some extent. To implement SoC requirements, it is recommended that the respective competencies are included in the curricula of future textile engineers and designers, as well as comparable degree programs.

7.4 Possible implications / Potential impacts

- Double regulation of chemicals in products under REACH, POP, CLP, CSRD and ESPR could place an excessive burden on companies, the relevant authorities, market surveillance bodies and consumers. Workshop participants have raised this concern, particularly with regard to the chemicals regulation, where specific chemicals are restricted and threshold values are in place. However, another stakeholder requested that a standardised MRSL be defined and implemented. This request is generally interpreted as a call for a requirement that can be met by wet processors without the level of knowledge intended by the information requirement regarding effect chemicals during the design phase.

- If requirements are set that only apply to chemical products marketed in the EU, such as the CLP classification, there is a risk of creating an uneven playing field between EU and non-EU producers. It was recommended that market surveillance, particularly with regard to Asian e-commerce platforms, should be strengthened to prevent substances prohibited under REACH or POP from entering recycling cycles. This is also intended to avoid competitive disadvantages for companies that comply with the aforementioned legal requirements. In the written statements, however, initiatives like AFIRM were mentioned, where indeed the communication of all SoC, including CLP-classified substances with a threshold of 0.1 % is proposed. The proposed information requirements would prevent such a non-level playing field being created by the communication of the CLP classification.

- It is important to note that the Corporate Sustainability Reporting Directive (Directive (EU) 2022/2464); CSRD) also sets out information requirements regarding SoC. This reporting should adhere to the European Sustainability Reporting Standards (ESRS), which were adopted by the European Commission (Commission Delegated Regulation (EU) 2023/2772 2023). ESRS E2 on pollution contains the following Disclosure Requirement E2-5 on SoC and SVHCs:

  > 32. The undertaking shall disclose information on the production, use, distribution, commercialisation and import/export of substances of concern and substances of very high concern, on their own, in mixtures or in articles.
  >
  > 33. The objective of this Disclosure Requirement is to enable an understanding of the impact of the undertaking on health and the environment through substances of concern and through substances of very high concern on their own. It is also to enable an understanding of the undertaking’s material risks and opportunities, including exposure to those substances and risks arising from changes in regulations.

> 34. The disclosure required by paragraph 32 shall include the total amounts of substances of concern that are generated or used during the production or that are procured, and the total amounts of substances of concern that leave its facilities as emissions, as products, or as part of products or services split into main hazard classes of substances of concern.
>
> 35. The undertaking shall present separately the information for substances of very high concern.

- Most stakeholders who provided feedback on the proposed information requirement for SVHCs in particular, considered this to be a as a sensible and practicable first step in the proposed SoC process.
- Several stakeholders referred to the SoC criterion (d)[43] in their feedback and explained the limitations of any initiative in this regard. However, as this study concluded that there was insufficient evidence to suggest that a substance hindered recycling, this stakeholder feedback is not summarised here. Regarding the proposed information requirement for effect chemicals, stakeholders were divided. Some rejected the proposal, arguing that effect chemicals, such as water-repellent or antibacterial finishes, are being equated with SoC in a blanket manner, which is both technically and legally unjustified. This would result in information obligations for substances that do not fall under the definition of SoC. It was also highlighted that this approach would not guarantee consumers access to information about 'pollutant-free' textile articles. Others expressed support for this 'proportionate, step-by-step implementation' of the disclosure obligations for SoC, stating that the proposed information requirements could be implemented for new products within the medium term. Against the backdrop of some stakeholders emphasising in their feedback that companies leave the choice of chemicals entirely to textile manufacturers, who only communicate certain requirements/functions that the material should fulfil, there is a risk that some operators will require a high level of investment to acquire technical and chemical product expertise. Voluntary industry standards such as ZDHC, GOTS and bluesign or other could help to increase the knowledge in the sector. Two main types of investment could be identified:
- Investment in human resources: Many companies today lack specialists in textile chemistry and its application to different categories of textile garments. Due to the unavailability of such specialists, it may take some time to implement a system that includes information about effect chemicals in technical product specifications. Implementing this step by step, based on the categorisation proposed earlier in the report, could help reduce failure in this field. It is suggested that the process starts with a limited number of highly relevant products (such as rain/outdoor jackets, women's shirts made from synthetic fibre, and men's shirts made from cotton).
- Investment in software applications: Digital solutions and tools for communicating information about textile chemicals in the supply chain are not available or not currently included in all procurement processes. Chapter 10.1 also highlights the need for raw data processing, possible interfaces between different software solutions, and integration of raw data.
- Requirements on durability or recyclability may conflict with the use of textile chemicals identified as SoC. Setting individual requirements in the delegated act for the specific textile

[43] Article 2 (27) of the ESPR says that a 'substance of concern' means a substance that [...] (d) negatively affects the reuse and recycling of materials in the product in which it is present.

product categories and the chemicals used in their production is expected to require considerable effort from legislators and market operators alike.

- The harmonisation approach to the global usage of definitions related to textile chemicals has had a positive impact. Agreement on definitions for the respective groups of textile effect chemicals is a step towards transparency, which is essential for communication of reliable information between different stakeholders.
- Monitoring reporting under the CSRD could provide further insights into how companies fulfil their disclosure obligations and implement their sustainable responsibility with regard to chemical management.

8 Environmental impacts[44]

The ESPR product aspects 'energy use and energy efficiency', 'water use and water efficiency' and 'resource use and resource efficiency' were subsumed under environmental impacts in the beginning of this study when prioritising the product aspects of Article 5. In the literature, climate change and water use are highlighted as the main environmental impacts of textile production, considering energy and resource use. Emissions to air and water including all kind of pollutants, such as also chemicals and microplastic, are another main environmental impact that is more likely to be captured in environmental impact categories such as impacts on water, air, soil and biodiversity in some approaches. The JRC also came to the same conclusion in the preparatory study (Delre et al. 2024c) saying that ‘the product aspect addressing environmental impacts includes the assessment of use (and efficiency) of water, energy and resources, which are the fundamental elements affecting the environment.”

8.1 Status quo

The Circular Economy Action Plan and the EU Textiles Strategy (European Commission 2020b; 2022b) have already identified textiles as a key product value chain for the transition to a sustainable and circular production. The JRC report on product priorities (Faraca et al. 2023) also prioritised textiles due to a high environmental relevance with regards to water effects, waste generation, climate change, energy consumption and material efficiency in the various production stages. In the following, a short summary of the literature in this field is provided.

8.1.1 Environmental impacts of textiles

When considering the various areas of private consumption, such as housing, mobility, or food consumption, and ranking them in descending order according to their negative environmental impacts, textile consumption in Europe ranks fourth. If only the water footprint or land use is considered, textile consumption in Europe even moves up to third place (Duhoux et al. 2022).

In addition to the environmental impact categories of climate change and water use, other relevant emission categories include particulate matter, acidification, and especially the cumulative energy demand (or demand for fossil resources) as negative environmental impacts in the life cycle of textiles. Furthermore approximately 20% of global clean water pollution is caused by textile production (EEA 2019).

Certain production methods, specifically dyeing or finishing of clothes or the use of fertilizers in cotton cultivation are also associated with high eco- and human toxicity potentials (Teufel et al. 2024a; Gonzalez et al. 2023). Typically, the extraction and processing of raw materials, as well as subsequent processes for yarn production or the creation of textile fabrics, such as spinning, weaving or knitting, dyeing, and finishing, contribute the largest shares to the greenhouse gas emissions of textile products (Teufel et al. 2024a). The ranking of the contributors can vary depending on the environmental impact category (Teufel et al. 2024a; Rubik et al. 2024). For textiles that are characterized by a long lifespan, the overall environmental footprint is generally reduced (Gärtner et al. 2022a; Sandin et al. 2019b).

Another environmental impact of textile products, which is currently not adequately reflected in environmental impact categories is the emission of fibre fragments and specifically microplastic

[44] This chapter was written by Katja Moch and Hannah Lorösch of Öko-Institut and Anett Matthäi of Hochschule Hof.

fibres. According to EEA (2022b) approximately 16-35% of the microplastics released to oceans originate from synthetic textiles.

8.1.2 Product Environmental Footprint Category Rules Apparel & Footwear

In 2021, the European Commission has published a recommendation to promote the use of Environmental Footprint methods in relevant policies and schemes related to the measurement and/or communication of the life cycle environmental performance of all kinds of products, including both goods and services, and of organisations (Commission Recommendation (EU) 2021/2279 2021). The Product Environmental Footprint (PEF) is defined as a general method to measure and communicate the potential life cycle environmental impact of a product. Details on the method are further laid down in Annex 1 of Commission Recommendation (EU) 2021/2279 2021 (2021). The PEF is based on the internationally standardised Life Cycle Assessment methodology. In a pilot phase launched in 2013, so-called Product Environmental Footprint Category Rules (PEFCRs) were developed for 24 different product groups, including the product group 'T-shirts', which has been further developed for the now broader product group 'Apparel & Footwear'.[45] The PEFCRs specify and substantiate the general requirements for calculating the environmental footprint in order to achieve comparability of the environmental performance of products. In June 2025, the Commission launched the PEFCR for ‘Apparel & Footwear’ (Quantis Switzerland 2025b). A detailed assessment of this PEFCR can be found in Chapter 12.

In this final version, apparel and footwear are classified in 13 subcategories, which can be assigned to a specific subcategory based on their CPA/NACE[46] codes. The sub-categories shown below have so far not been further sub-divided, e.g. into fashion clothing and functional clothing.

1. T-shirts
2. Shirts and blouses
3. Sweaters and midlayers
4. Jackets and coats
5. Pants and shorts
6. Dresses, skirts and jumpsuits
7. Leggings, stockings, tights and socks
8. Underwear
9. Swimwear
10. Apparel accessories
11. Open-toed shoes
12. Closed-toed shoes
13. Boots

The technical secretariat responsible for the development of the PEFCR has conducted calculations for 13 representative products (one per subcategory). The characterised as well as the normalized and weighted results have been published per impact category. Those benchmark values can be used as reference points for products within the same subcategory.

The ESPR mentions the PEF as a recommended method according to the Commission Recommendation (EU) 2021/2279 2021 for calculating the environmental footprint of

[45] https://pefapparelandfootwear.eu/

[46] Both CPA (Classification of Products by Activity) and NACE (Nomenclature of European Activities) are European systems which are used to classify products and industries across Europe.

products.[47] Also, various stakeholders refer to the PEF in the context of ecodesign to report the environmental impacts of textiles. For example, the Dutch study of Van de Burgt et al. (2023) propose that the environmental impact should be an information requirement that should be incorporated in the product passport. Furthermore, Van de Burgt et al. (2023) propose that a sustainability index for textiles based on the PEF should be displayed on the label showing sustainability scores such as an A, B, C, D or E score. This proposal is made to increase transparency on the environmental impact of textile products and allow consumers to make conscious decisions. Van de Burgt et al. (2023) do not elaborate this proposal further (This should be seen in the context of the fact that the PEFCRs for clothing and footwear had not yet been published at that time) and state that 'The label should be based on the PEF for textiles that will be published in 2024. The label should be understandable for consumers and differentiate between different types of garments, such as underwear, household textiles, and coats."

France recently developed a regulatory framework (Ministry for the Ecological Transition, Biodiversity, Forestry, the Sea and Fisheries 2025) for the voluntary displaying of the environmental cost of clothing, which is based on the PEF methodology, but contains some significant differences in the methodology in order to address problems of fast fashion, which is now available as Ecobalyse:

- Two new impact categories have been added: Each kilogram of clothing that is not reused after being exported from the EU is assigned with considerable impact points. Additionally, impact points are allocated for the emission of microfibres based on the material of the reference product.
- The regulation introduces a durability coefficient, which is modulating the average number of wearing days during the use phase. It is composed of three criteria: the maximum number of different product variations or models that the brand offers in the market segment of the considered product; the incentive to repair (ratio between the average cost of repair and the selling price, plus the offer of a repair service) and the visibly display of the geographical traceability of the production stages. This approach is a simplified version of the Intrinsic Durability Multiplier and Repairability Multiplier of the PEFCR Apparel & Footwear (see Chapter 12.4.1).

It is important to stress that this French initiative is an offer to manufacturers to voluntarily label their products. It is considered likely that the label will used by high performing manufacturers. This differs from the requirements under the ESPR, which aim for mandatory minimum requirements.

8.2 Assessment of the suitability of the PEF-methodology for a product specific quantification of environmental impacts

In a first step, the suitability of the PEFCR for Apparel and Footwear (PEFCR A&FW) was assessed. The workshop series was used for an exchange of experiences with the PEF-methodology. The feedback from the participants was supplemented by results from the review

[47] E.g. Recital 28 of the ESPR states that „To improve the environmental sustainability of products, information requirements should relate to a selected product parameter relevant to a product aspect, such as the product's environmental footprint, carbon footprint and durability. They should require the manufacturer to make available information on the product's performance in relation to a selected product parameter or other information that may influence the way the product is handled by parties other than the manufacturer in order to improve performance in relation to such a parameter. Such information requirements should be set either in addition to, or instead of, performance requirements concerning the same product parameter, as appropriate. […]"

of the final version of the 'PEFCR for Apparel & Footwear'[48], version 3.1 (Quantis Switzerland 2025b). The detailed analysis can be found in Chapter 12.

There was a consensus between the workshop participants that the calculation of a PEF study for every textile product in form of an information requirement in the ESPR should not be recommended. The main reasons listed included:

- The availability of generic background data sets is insufficient. For many textile processes, especially in fibre production and further processing steps, there is little or no data available, and existing data is often outdated (Quantis Switzerland 2024; Eunomia 2022; Quantis Switzerland 2025b). For example, there is no specific dataset for organic cotton production; in which case one would have to rely on the generic dataset for conventional cotton production. Organic cotton outperforms conventional cotton in most environmental impact categories and also regarding biodiversity impacts (Teufel et al. 2024a). However, due to a lack of specific data, this is not reflected in the PEFCR A&FW. It is therefore questionable to what extent a PEF-profile calculated according to the PEFCR A&FW can reliably indicate the environmental footprint of a 100% cotton T-shirt A compared to a 100% cotton T-shirt B.

- The calculation of a PEF-profile for a textile product requires profound methodological knowledge in LCA and profound textile expertise. SMEs state that they cannot build this in-house and that an outsourcing would result in high costs. The costs might further be increased as according to Commission Recommendation (EU) 2021/2279 2021 (2021) a verification and validation of the PEF study are always required when the study or any part of the information contained therein is used for any external communication (i.e., communication to interested parties other than the client or the user of the PEF method of the study).
  Even during a critical review of conducted PEFs, a comprehensive verification of the company's specifications would not be feasible. For example, data availability cannot be verified. In principle, it is therefore possible that for example, a company may claim that data is not available in situations where the default value provided by the PEFCR A&FW is advantageous.

The analysis of the PEFCR A&FW also reveals the following main limitations, which are explained in detail in Chapter 12.5:

- Scope of the environmental impact categories: Certain relevant environmental impacts[49] cannot yet be adequately represented with the PEFCR A&FW. Both biodiversity and the impact of fibre fragment release are not considered in the calculation of the total score of the product.

- Lack of availability of suitable secondary data sets and lack of transparency in the data set description.

[48] The final version of the PEFCR was launched on 25 June 2025. At this time, the recommendations for the product aspects had already been developed (see disclaimer in chapter 1). As the PEFCR A&FW was evaluated in a separate work package (see Chapter 12) and the relationship to the environmental impacts is of central importance here, the results of the final evaluation were nevertheless used for the considerations in relation to the environmental impacts. The final version of the PEFCR A&FW was not taken into account for the assessment of the other product aspects.

[49] 16 environmental impact categories are calculated, namely: Climate change, total; Ozone depletion; Human toxicity, cancer; Human toxicity, non-cancer; Particulate matter; Ionising radiation, human health; Photochemical ozone formation, human health; Acidification; Eutrophication, terrestrial; Eutrophication, freshwater; Eutrophication, marine; Ecotoxicity, freshwater; Land use; Water use; Resource use, minerals and metals; Resource use, fossils

- Comparability of results is limited as the range of products with different functions within one subcategory group is too high.
- Possibility to modify secondary data sets with company specific activity data is limited, creation of new Environmental Footprint (EF)-compliant datasets[50] is associated with high effort, which is unproportionate especially for SMEs.
- Compliance with the materiality principle[51] seems questionable as primary data on raw material provision and downstream processing steps are typically not available to the distributor of a textile product.

Conclusion

First, a cost-benefit analysis should be conducted in order to understand if calculating a PEF-study represents added value in terms of a pull effect towards a reduced environmental impact. At this point in time the authors of this study do not recommend making the PEF calculation mandatory for all textile products placed on the European market. This assessment may be re-evaluated with future adaptations of the PEFCR Apparel & Footwear as well as with an updated database EF 4.0.

8.3 Alternatives to the PEF

Though basically the PEF is recognised as an overall effort to provide a robust and comprehensive framework for the verification of environmental claims, that can help to increase the integrity and confidence in the validity of environmental claims and expose misleading or exaggerated claims about the environmental performance of products. Here, often arguments are raised that this could help to reduce greenwashing while strengthening substantiated green marketing (Antony et al. 2024). This means that often the debate on the applicability of the PEF is related to voluntary environmental claims. Benefits brought forward are the (additional) information value for consumers to make environmental choices (Antony et al. 2024).

Thus, in the course of this study, possibilities were developed to identify information requirements in the field of environmental impacts that...

- ...can be implemented by all economic operators placing textiles on the EU market with a reasonable effort. The requirement should be harmonized with other (reporting) requirements.
- ...makes sense in terms of steering effect AND/OR provides a basis for a future benchmarking.

In search of alternative requirements to the PEF, the participants in the workshop series reflected that water and energy are important resources that should be tracked in order to create transparency in the supply chain. Besides, microplastic emissions were proposed to be evaluated as an alternative requirement to the PEF. The following chapters reflect the analysis of both topics.

[50] Datasets need to be compliant with specific data quality requirements to be integrated in the Environmental Footprint-database. The requirements are defined in Eynard et al. (2025).

[51] Materiality principle means 'act where it matters'.

8.3.1 Water and energy use

Generally, it can be assumed that the environmental management, thus also the energy and water use, of companies that produce textiles and their intermediates can vary considerably: Roth et al. (2023) lists water and energy consumption values for various processes in the production of textiles and usually report value ranges; in some cases very wide ranges were indicated as this is the case for the water use for some finishing step e.g. for printing or batch dyeing. Roth et al. (2023) explicitly indicated the ranges because the values from individual factories cannot be compared directly because consumption differences between the individual factories are due to the fact that different products are processed (e.g. clothing versus technical textiles or speciality textiles).

However, production sites produce a variety of products. For the ESPR as a product regulation, reporting should be done at the product level. In perspective, the values should not only be related to the output of the production site, but preferably to the product or product category.

The workshop discussions led to a proposal of starting with relevant reporting processes as this could be a first feasible step to address product-related environmental impacts and resource consumption. For water consumption, wet processes were proposed as first and relevant stage in the supply chain. In the workshop series, a step-by-step plan for reporting was discussed on the energy and water consumption of textile finishing companies. The distributor of the textile product must then compile information on the average energy and water consumption per kg of textile (based on one year) for all finishing plants. This would create a database that could be used to define specific performance classes. Although this would only cover the finishing process, it would then be possible to do so with better data than a PEF would provide.

With regard to water consumption, questions from participants indicated that the following system boundaries should be specified:

- For which material should water consumption be measured? Here, participants pointed out that the requirement should not apply to ingredients or sewing thread. Rather, the discussion showed that the information requirements should relate to the main material, where an 80% rule was suggested as a first step.
- For which processes should water consumption be measured? The term ‘wet processes’ was suggested as a specification.
- Part of the discussion also revolved around the fact that the water consumption data collected in this way is suitable for benchmarking for companies, but not for communication to end users.
- Regarding energy consumption, participants pointed out that energy consumption is higher in the production of durable textiles. It was suggested that energy consumption should be expressed in relation to the lifetime of the textiles (kJ/kg textile/year of lifetime).

Whereas some clothing manufacturers, e.g. Inditex (2025), set an own benchmarking for the various processes, other do not gather detailed water consumption from the supply chain. The manufacturing companies in the workshop series confirmed that annual consumption figures are collected, but not consumption figures for individual products. However, to distributors /retailers, information of the downstream processes in the production of textile surfaces is usually not available. Furthermore, many manufacturers do not have strong supplier relationships this far along the textile chain, or do not even know the suppliers at the beginning of the textile chain. European legislators have emphasised the importance of creating transparency in the supply chain in order to identify, prevent and mitigate the adverse impacts of their operations, namely by the Corporate Sustainability Reporting (Directive (EU) 2022/2464, CSRD) and the Corporate Sustainability Due Diligence Directive (EU) 2024/1760 (Directive (EU) 2024/1760 2024, CSDDD). Companies that are subject to the CSRD have to report according to European Sustainability Reporting Standards (ESRS) developed by the EFRAG and adopted as Commission Delegated Regulation (EU) 2023/2772 2023. Before the ESRS have been developed, textile companies often oriented the reporting at the standards of the Global Reporting Initiative (GRI).

The Voluntary reporting standard for SMEs (VSME) developed by EFRAG (2024) is intended for those SMEs that do not have to report according to the CSRD with the aim to provide a simple reporting tool to face growing sustainability data requests from business counterparties (i.e. banks, investors or larger companies for which non-listed SMEs are suppliers) in an efficient and proportionate manner.[52] Table 52 compares the information requirements of the CSRD, the VSME and the CSDDD that is already applied by many textile companies with regards to water and energy use to understand the level at which this data is already being collected and whether there are opportunities to link it to ecodesign requirements.

From the following table it can be concluded that the ESRS basically addresses the uses for the own undertaking, which means that e.g. water use in the supply chain is not addressed, in textile production the hotspot for water use. The due diligence approach pursued in the CSDDD is not considered to be formulated specific enough with regards to adverse environmental impacts, so that water consumption would not be taken into account, for example.

[52] https://www.efrag.org/en/projects/voluntary-reporting-standard-for-smes-vsme/concluded

Table 52: Overview on the reporting provisions of the ESRS, VSME and the CSDDD

	European Sustainability Reporting Standards (ESRS)	Voluntary reporting standard for SMEs (VSME)	Obligations under the CSDDD
Water	Disclosure Requirement E3-1 – Policies related to water and marine resources 9. The undertaking shall describe its policies adopted to manage its material impacts, risks and opportunities related to water and marine resources. […] 12. The undertaking shall indicate whether and how its policies address the following matters where material: (a) water management including: i. the use and sourcing of water and marine resources in its own operations; ii. water treatment as a step towards more sustainable sourcing of water; and iii. the prevention and abatement of water pollution resulting from its activities. (b) product and service design in view of addressing water-related issues and the preservation of marine resources; and (c) commitment to reduce material water consumption in areas at water risk in its own operations and along the upstream and downstream value chain. Disclosure Requirement E3-2 – Actions and resources related to water and marine resources 15. The undertaking shall disclose its water and marine resources-related actions and the resources allocated to their implementation. Disclosure Requirement E3-3 – Targets related to water and marine resources 20. The undertaking shall disclose the water and marine resources-related targets it has set. Disclosure Requirement E3-4 – Water consumption 26. The undertaking shall disclose information on its water consumption performance related to its material impacts, risks and opportunities. 27. The objective of this Disclosure Requirement is to provide an understanding of the undertaking's water consumption and any progress by the undertaking in relation to its targets. 28. The disclosure required by paragraph 26 relates to own operations and shall include:	Basic Module – Environment metrics B6 – Water 35. The undertaking shall disclose its total water withdrawal, i.e. the amount of water drawn into the boundaries of the organisation (or facility); in addition, the undertaking shall separately present the amount of water withdrawn at sites located in areas of high water-stress. 36. If the undertaking has production processes in place which significantly consume water (e.g. thermal energy processes like drying or power production, production of goods, agricultural irrigation, etc.), it shall disclose its water consumption calculated as the difference between its water withdrawal and water discharge from its production processes.	Recital 32 […] Due diligence should further encompass adverse environmental impacts resulting from the violation of one of the prohibitions and obligations listed in Part II of the Annex to this Directive, as well as adverse impacts resulting from the breach of one of the prohibitions listed in Part I, points 15 and 16, of the Annex to this Directive taking into account national legislation linked to the provisions of the instruments listed in the Annex. Annex Part I 15. The prohibition of causing any measurable environmental degradation, such as harmful soil change, water or air pollution, harmful emissions, excessive water consumption, degradation of land, or other impact on natural resources, such as deforestation, that: (a) substantially impairs the natural bases for the preservation and production of food; (b) denies a person access to safe and clean drinking water; (c) makes it difficult for a person to access sanitary facilities or destroys them; (d) harms a person's health, safety, normal use of land or lawfully acquired possessions; (e) substantially adversely affects ecosystem services through which an ecosystem contributes directly or indirectly to human wellbeing; interpreted in line with Article 6(1) of the International Covenant on Civil and Political Rights and Articles 11 and 12 of the International Covenant on Economic, Social and Cultural Rights; […]

	European Sustainability Reporting Standards (ESRS)	Voluntary reporting standard for SMEs (VSME)	Obligations under the CSDDD
	(a) total water consumption in m^3; (b) total water consumption in m^3 in areas at water risk, including areas of high-water stress; (c) total water recycled and reused in m^3; (d) total water stored and changes in storage in m3; and (e) any contextual information necessary regarding points (a) to (d), including the water basins' water quality and quantity, how the data have been compiled, such as any standards, methodologies, and assumptions used, including whether the information is calculated, estimated, modelled, or sourced from direct measurements, and the approach taken for this, such as the use of any sector-specific factors. 29. The undertaking shall provide information on its water intensity: total water consumption in its own operations in m^3 per million EUR net revenue.		
Energy	Disclosure Requirement E1-2 – Policies related to climate change mitigation and adaptation […] 25. The undertaking shall indicate whether and how its policies address the following areas: (a) climate change mitigation; (b) climate change adaptation; (c) energy efficiency; (d) renewable energy deployment; and (e) other […] 30. The undertaking shall disclose the climate-related targets it has set. […] 33. For the disclosure required by paragraph 30, the undertaking shall disclose whether and how it has set GHG emissions reduction targets and/or any other targets to manage material climate-related impacts, risks and opportunities, for example, renewable energy deployment, energy efficiency, climate change adaptation, and physical or transition risk mitigation. 34. If the undertaking has set GHG emission reduction targets(32), ESRS 2 MDR-T and the following requirements shall apply: (a) GHG emission reduction targets shall be disclosed in absolute value (either in tonnes of CO2eq or as a percentage of the emissions of a base year) and, where relevant, in intensity value;	Basic Module – Environment metrics B3 – Energy and greenhouse gas emissions 29. The undertaking shall disclose its total energy consumption in MWh, with a breakdown as per the table below, if it can obtain the necessary information to provide such a breakdown: Renewable, Non-renewable, Total Electricity (as reflected in utility billings), Fuels, Total 30. The undertaking shall disclose its estimated gross greenhouse gas (GHG) emissions in tons of CO2 equivalent (tCO2eq) considering the content of the GHG Protocol Corporate Standard (version 2004), including: (a) the Scope 1 GHG emissions in tCO2eq (from owned or controlled sources); and (b) the location-based Scope 2 emissions in tCO2eq (i.e. emissions from the generation of purchased energy, such as electricity, heat, steam or cooling). 31. The undertaking shall disclose its GHG intensity calculated by dividing 'gross greenhouse gas (GHG) emissions' disclosed under paragraph 30 by 'turnover (in Euro)' disclosed under paragraph 24(e)(iv)5. Comprehensive Module - Environmental Metrics Consideration when reporting on GHG emissions under B3 (Basic Module) 50. Depending on the type of activities carried out by the undertaking, disclosing a quantification of its Scope 3 GHG emissions can be appropriate (see paragraph 10 of this Standard)	Article 22 Combating climate change 1. Member States shall ensure that companies referred to in Article 2(1), points (a), (b) and (c), and Article 2(2), points (a), (b) and (c), adopt and put into effect a transition plan for climate change mitigation which aims to ensure, through best efforts, that the business model and strategy of the company are compatible with the transition to a sustainable economy and with the limiting of global warming to 1,5°C in line with the Paris Agreement and the objective of achieving climate neutrality as established in Regulation (EU) 2021/1119, including its intermediate and 2050 climate neutrality targets, and where relevant, the exposure of the company to coal-, oil- and gas-related activities. The design of the transition plan for climate change mitigation referred to in the first subparagraph shall contain: (a) time-bound targets related to climate change for 2030 and in five-year steps up to 2050 based on conclusive scientific evidence and, where appropriate, absolute emission reduction targets for greenhouse gas for scope 1, scope 2 and scope 3 greenhouse gas emissions for each significant category; (b) a description of decarbonisation levers identified and key actions planned to reach the targets referred to in point (a), including, where appropriate, changes in the product and service portfolio of the company and the adoption of new technologies; (c) an explanation and quantification of the investments and funding supporting the implementation of the transition plan for climate change mitigation; and

	European Sustainability Reporting Standards (ESRS)	Voluntary reporting standard for SMEs (VSME)	Obligations under the CSDDD
	(b) GHG emission reduction targets shall be disclosed for Scope 1, 2, and 3 GHG emissions, either separately or combined. The undertaking shall specify, in case of combined GHG emission reduction targets, which GHG emission Scopes (1, 2 and/or 3) are covered by the target, the share related to each respective GHG emission Scope and which GHGs are covered. The undertaking shall explain how the consistency of these targets with its GHG inventory boundaries is ensured (as required by Disclosure Requirement E1-6). The GHG emission reduction targets shall be gross targets, meaning that the undertaking shall not include GHG removals, carbon credits or avoided emissions as a means of achieving the GHG emission reduction targets; Disclosure Requirement E1-6 – Gross Scopes 1, 2, 3 and Total GHG emissions 44. The undertaking shall disclose in metric tonnes of CO2eq its (38): (a) gross Scope 1 GHG emissions; (b) gross Scope 2 GHG emissions; (c) gross Scope 3 GHG emissions; and (d) total GHG emissions.	to yield relevant information on the undertaking's value chain impacts on climate change. 51. Scope 3 emissions are indirect GHG emissions (other than Scope 2) that derive from an undertaking's value chain. They include the activities that are upstream of the undertaking's operations (e.g. purchased goods and services, purchased capital goods, transportation of purchased goods, etc.) and activities that are downstream of the undertaking's operations (e.g. transport and distribution of the undertaking's products, use of sold products, investments, etc.). 52. If the undertaking decides to provide this metric, it should refer to the 15 types of Scope 3 GHG emissions identified by the GHG Protocol Corporate Standard and detailed by the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard. When it reports on Scope 3 GHG emissions, the undertaking shall include significant Scope 3 categories (as per the Corporate Value Chain (Scope 3) Accounting and Reporting Standard) based on its own assessment of relevant Scope 3 categories. Undertakings can find further guidance on specific calculation methods for each category in the GHG Protocol's Technical guidance for Calculating Scope 3 Emissions. 53. When reporting its Scope 1 and Scope 2 emissions, if the undertaking discloses entity-specific information on its Scope 3 emissions, it shall present it together with the information required under B3 – Energy and greenhouse gas emissions. C3 – GHG reduction targets and climate transition 54. If the undertaking has established GHG emission reduction targets, it shall disclose its targets in absolute values for Scope 1 and Scope 2 emissions. In line with paragraphs 50 to 53 above and if it has set Scope 3 reduction targets, the undertaking shall also provide targets for significant Scope 3 emissions. In particular, it shall provide: (a) the target year and target year value; (b) the base year and base year value; (c) the units used for targets; (d) the share of Scope 1, Scope 2 and, if disclosed, Scope 3 that the target concerns; and (e) a list of main actions it seeks to implement to achieve its targets	(d) a description of the role of the administrative, management and supervisory bodies with regard to the transition plan for climate change mitigation. […]

Source: Compilation from CSRD, VSME and CSDDD

To gain an insight into how these reporting obligations are fulfilled related to energy and water consumption, wastewater treatment as well as microplastics, the sustainability reports of 10 textile brands/online retailers[53] were analysed. The following information was provided by the companies:

Water consumption in the supply chain

- Monitoring of water consumption: All brands aim to reduce the water consumption in their supply chain. Almost all of them report that they at least monitor or have some form of overview of water use in their supply chain. The monitoring is mostly done by audits and regular reporting, monitoring tools or the adoption of standards such as ZDHC or HIGG Index, which address the water use. Only C&A is just getting started with monitoring the water consumption along their supply chain (C&A Mode GmbH & Co. KG 2023).
- Setting of targets and measures to reduce water consumption: Most companies have set concrete goals or programs to reduce water use in the supply chain. Puma, for example, reports initiatives to recycle industrial wastewater at key supplier sites and provides training to suppliers to improve water management (Puma 2024). Adidas aims to improve water efficiency at supplier sites on tier 2 level by providing suppliers with customised technical advice and assistance in improving their water management. By that a reduction of the water consumption in the water-intensive Tier 2 suppliers by 40% by 2025 is targeted (adidas 2024).
- Approach to wastewater treatment: Almost all companies monitor the quality of wastewater of selected or main tier 1 and tier 2 suppliers. The ZDHC Wastewater Guidelines are usually used as a reference for wastewater quality. Adidas, for example, has set the target that 90% of its suppliers will achieve the 'Foundational Level' of the ZDHC Wastewater Guidelines for their wastewater quality by 2025 (adidas 2024). Some of the companies set compliance with the ZDHC standard as a requirement for all of their tier 1 and 2 suppliers (e.g. H&M, Tommy Hilfinger, ZARA for wet processing facilities) (H&M Group Media Relations 2024; PVH 2023; Inditex 2024). The level of monitoring of supplier wastewater quality data varies between the companies, while some conduct a monitoring on a regular level, others do not address the topic systematically.

Most companies are at a similar stage regarding water use in their supply chain: they monitor consumption, set targets, and verify implementation through audits, tools, and standards. Differences are mainly in the level of transparency and detail in reporting, rather than in the fundamental approach. Concerning the wastewater treatment there are bigger differences in the ambition level of the companies, there is a range between clear requirements and only limited action or a voluntary approach.

Energy use / Energy efficiency

- Almost all of the companies analysed mention concrete targets or measures for reducing energy use in their supply chain. This includes setting reduction goals or implementing efficiency programs. Most companies set both targets for energy reduction and switching to renewables. Only a few focus exclusively on one approach.

[53] The same brands/online retailers as for the analysis of the recycled content claims were selected, namely: PUMA, Adidas, Nike, Zara, H&M, Shein, C&A, Asos, Tommy Hilfiger, Otto Group; see also chapter 6.3.2.3

- Some companies are endeavouring to collect energy efficiency data from their supply chain via monitoring tools or questionnaires and interviews. Only few companies (e.g. Adidas, Nike) report to have a comprehensive overview of the energy consumption of their suppliers (adidas 2024; Nike Inc. 2023)

Companies are addressing energy consumption in their supply chain, often focusing more on switching to renewables to reduce GHG emissions. However, most companies do not have comprehensive information on energy consumption in the supply chain.

To summarise, it can be said that companies are addressing the energy and water consumption of their supply chain. Then, data are collected that are to some extent production site specific, but the available data are far from being product specific. In the vast majority of the analysed reports, there is no comprehensive overview of the entire supply chain, and in some cases, they only start collecting data using questionnaires or monitoring tools. Clear requirements for the supply chain are only made regarding wastewater treatment and only by some companies. The availability of data is far away of being product specific.

8.3.2 Emissions of fibre fragments

Textile microplastic accounts for 8% of the total emissions of primary microplastics to water with an estimated 13,000 tonnes in Europe (EEA 2022b). Thus, tackling microplastics pollution has already been highlighted in the EU Textile strategy as one key action for sustainable and circular textiles.

Studies showed that fibre fragment release is highest during the first washes and decreases with subsequent washes. Particularly for textiles with a short lifespan, the initial washes are responsible for a significant portion of the emissions of fibrous microplastics during laundering. In Europe a large portion (95 to 99.9%) of the fibre fragments is retained in wastewater treatment plants, although some are released back into the environment through the application of sewage sludge (Bendt et al. 2021; Cross Industry Agreement 2020; Napper et al. 2023). Additionally, a considerable portion of fibre fragments (especially natural fibres) is released into the air during wear (Cross Industry Agreement 2020; Napper et al. 2023). The use phase is not the only source of textile microplastics. Fibre fragments are also emitted into the air and water during the production, transportation, and disposal of textiles: Studies by TextileMission have shown that during water-based finishing processes, a significantly larger amount of fibre fragments is released compared to household washing. As wastewater systems in textile producing countries are often less developed than in Europe, large quantities of fibre fragments are discharged into surface waters (Bendt et al. 2021). Abbas et al. (2025) investigated fibre loss after laundering recycled polyester, recycled acrylic and recycled wool. There is a direct correlation between the mechanical properties of the recycled fibres and the emission of fibre fragments: Fibres with shorter staple lengths, low uniformity and high yarn unevenness had higher fibre loss. Fibre loss was greatest in recycled wool, but recycled polyester also had a 50% higher fibre loss compared to virgin polyester. Akyildiz et al. (2024) also concluded that recycled polyester emits more microfibres than virgin polyester. In contrast, Gao et al. (2024) did not find any statistically significant difference in their comparison of fibre losses from virgin and recycled polyester textiles. The fabric structure, i.e. whether filament or staple yarns were used and whether surface treatment was carried out, had a greater influence here.

One major actor in gaining data on the fibre fragmentation of textiles is The Microfibre Consortium (TMC)[54]. TMC is a non-profit organisation with the aim to reduce the impact of fibre fragmentation from textiles to zero until 2030. One of their measures to reach this goal is building up a database on fibre fragmentation of textiles. By that they want to gain insights how different fibres, production methods and ways of confectioning influence the fibre fragmentation. Each participating company (61 brands/retailers in 2024) must conduct a minimum number of tests per year according to the TMC test method. The database contains over 13,000 data points from 1,431 textiles (status April 2025), out of which a median fabric shedding rate of 0.402 g/kg was calculated (TMC 2025a).

The PEF proposes that the emission of microfibres should be provided as additional information. The PEFCR for A&FW proposes characterisation factors for the calculation of the impacts of fibre fragment release on marine fauna and sediments, which, however, is still associated with very high uncertainties (Eunomia 2022; Quantis Switzerland 2025b). For the fibre-specific average amount of microfibres emitted per kg of the specific fabric per use, reference is made to 'The Microfibre Consortium'.

Thus, the TMC database is currently considered the most comprehensive approach. However, it remains a challenge to establish benchmarks for fibre fragmentation from textiles. Furthermore, there is a recognized need to promote research on ways to influence fibre fragment emissions. For instance, optimizing knitting parameters, cutting technologies, or finishing processes can reduce the release of fibre fragments. Besides, measures such as pre-drying or pre-washing have been proposed to intercept the generally high fibre fragment release found in the first washes, but currently there is a lack of data to compare the environmental impacts of these pre-treatments with those of fibre fragment emissions.

As for a definition, textile microplastics usually refer to particles (of synthetic or regenerated natural polymers) less than 5 mm in length that are unintentionally released into the environment during the production, maintenance, use, and disposal of a fabric. However, natural fibres (e.g., cotton) may also be poorly biodegradable due to finishing agents and may therefore have similar environmental impacts as synthetic fibre fragments (Bendt et al. 2021)(Blue Lakes 2021). Yet, there is no internationally accepted and applied definition of textile microplastics and fibre fragments. According to DIN EN ISO 24187 2024-04, microplastic is every solid, water-insoluble plastic particle of any size between 1 µm and 5 mm. The Microfibre Consortium (TMC) glossary distinguishes between Microplastic, Microfibres and Fibre Fragmentation (TMC 2025b, pp. 3–4):

- Microplastic: ‘A small piece of plastic debris measuring 5mm or less, found in the environment from the disposal or breakdown of consumer products and industrial waste. These particles can take various shapes, including spheres, pellets, foam, and irregular fragments. Therefore, also include synthetic fibre fragment.”
- Microfibre: ‘The textile industry definition of a microfibre is a synthetic fibre with a linear density of less than 1 denier. There is a different understanding of this term in the context of unintended release of fibres and thus subsequent microfibre pollution. The Microfibre Consortium, in this context does not determine the size nor the type. To avoid such confusion, fibre fragment / fibre fragmentation is the preferred terminology.”

[54] https://www.microfibreconsortium.com/

- Fibre Fragmentation: 'The process of fibre loss from a textile product during its life cycle and/or through its subsequent breakage in the natural environment. This is also referred to as fibre shedding."

To address microplastic emissions to reduce the overall environmental impact of textiles, the Dutch study of Van de Burgt et al. (2023) proposes that the potential for the product to release microplastics should be disclosed as information requirement. The aim is to 'differentiate between products that release many microplastics and those that release less microplastics".

The CSRD provides for a reporting obligation on microplastics, according to which companies must disclose the microplastics they use or produce. According to the disclosure requirement on pollution of air, water and soil:

> '26. The undertaking shall disclose the pollutants that it emits through its own operations, as well as the microplastics it generates or uses.
>
> 27. The objective of this Disclosure Requirement is to provide an understanding of the emissions that the undertaking generates to air, water and soil in its own operations, and of its generation and use of microplastics.
>
> 28. The undertaking shall disclose the amounts of [...]
>
> (b) microplastics generated or used by the undertaking."

In the Appendix[55], it is further stated that 'the information to be provided on microplastics under paragraph 28(b) shall include microplastics that have been generated or used during production processes or that are procured, and that leave the undertaking's facilities as emissions, as products, or as part of products or services. Microplastics may be unintentionally produced when larger pieces of plastics like car tires or synthetic textiles wear and tear or may be deliberately manufactured and added to products for specific purposes (e.g., exfoliating beads in facial or body scrubs)."

In the VSME standards, there is no specific disclosure obligation for microplastic foreseen, but pollution of air, water and soil is quite generally addressed by stating: '32. If the undertaking is already required by law or other national regulations to report to competent authorities its emissions of pollutants, or if it voluntarily reports on them according to an Environmental Management System, it shall disclose the pollutants it emits to air, water and soil in its own operations, with the respective amount for each pollutant. If this information is already publicly available, the undertaking may alternatively refer to the document where it is reported, for example, by providing the relevant URL link or embedding a hyperlink."

The analysis of the reporting of the retailers and brands on microplastics / microfibres shows that only a minority of companies mention clear targets and actions on microplastic/microfibre release. Most other companies either do not address the topic or do so only superficially. The companies that refer to the topic are part of The Microfibre Consortium (TMC) (adidas, C&A, PUMA; Tommy Hilfiger, ZARA) and state that a better understanding of the factors influencing the release of microfibres is needed. Inditex (ZARA), for example, is doing research on several ways to reduce or prevent microfibre shedding, e.g. by innovative dyeing solutions or the implementation of AirFiberWasher, which aims to prevent the release of microfibres in domestic washing by removing a large share of the microfibres prior to selling (Inditex 2024).

[55] The status of the Appendix is explained as such: „This Appendix is an integral part of ESRS E2. It supports the application of the disclosure requirements set out in this standard and has the same authority as the other parts of the Standard."

The topic of microfibres is not as widespread as monitoring the water and energy consumption. Nevertheless, this topic has arrived in the textile industry, even if it is still clearly emphasised that more research is needed to better understand the causes of fibre release in order to take this knowledge into account when selecting materials, for example, or to be able to introduce effective measures to reduce it. Furthermore, none of the companies refers only to microplastics, the scope includes all microfibres.

A prerequisite for setting an information requirement is the availability of a realistic and standardized method for detecting fibre fragment emissions. Since 2023, a standardized method for determining material loss from textile fabrics during washing has been available through the quick test according to DIN EN ISO 4484-1. Other, comparable testing methods are the TMC test method and the test method TM212[56] of the American Association of Textile Chemists and Colorists (AATCC). All of them are suitable for evaluating textiles in terms of their intrinsic tendency to release fibre fragments and in relation to the effects of raw materials and production steps. However, Bendt et al. (2021) concluded that the quick test does not always reflect emissions during household washing when comparing results from the quick test and household washing. In addition, Heller et al. (2023) concluded, that for comparable test results standardized washing processes needs to be developed which reflect the conditions of household laundry.

Conclusion

To conclude on the findings above, there is currently insufficient data to set any performance requirement to prevent microplastic/-fibre release like for example a certain pre-treatment of textiles. An information requirement for textile microplastic emissions for the purpose to improve the data situation and possibly set a limit value in the future is currently not recommended as an overall information requirement as it was not considered feasible to require companies to generate product specific information for a whole product portfolio. Rather aggregated information requirement of the activities of the economic operator was considered feasible, like e.g. an overall information which products from the portfolio have been tested so far. However, as not only the textile composition but also further aspects influence the shedding rate, the information would not be suitable to generate a limit value.

8.4 Proposal for a minimum requirement

An initial in-depth review of the PEFCR A&FW concluded that mandatory reporting on the environmental impact of individual products as a minimum requirement is not recommended for the following reasons:

- The calculation of a PEF profile following the PEFCR A&FW requires profound methodological knowledge in LCA and profound textile expertise. SMEs state that they cannot build this in-house and that an outsourcing would results in high costs.
- The use of company specific primary data, especially from raw material provision and downstream processing steps in the production of textile surfaces, should preferably be used to determine possible differences between two products. However, such detailed information from the supply chain is typically not available to the distributor of a textile product. This means that at the data points where it matters, the requirements for data

[56] TM212 is a Test Method for Fiber Fragment Release During Home Laundering (AATCC 2021).

quality are not met, as is fundamentally required by the PEF under the principle of materiality.

- In order to facilitate the use of the PEFCR A&FW, particularly for SMEs, it is intended that as many generic datasets as possible will be made available. The current generic background data sets are considered insufficient. For many textile processes, especially in fibre production and further processing steps, there is little or no data available, and existing data is often outdated (Quantis Switzerland 2024; Eunomia 2022; Quantis Switzerland 2025b). There is no consistent transparency in these available secondary data e.g. in the form of adequate documentation.
- Impacts on biodiversity cannot be adequately represented with the PEFCR A&FW. Biodiversity impacts are currently only recorded on a voluntary basis as additional information based on reporting the mass-based proportion of fibres certified by an organic certification system (Quantis Switzerland 2025b).

Various option for reporting obligations on environmental impacts have been discussed in the workshops of this study and complemented with literature and desktop research and selected expert interviews. The final conclusion of this analysis was not to propose an information requirement for environmental impacts, as no product specificity can be achieved. The considerations and background for this decision are summarised below for the different options:

- Reporting obligations on water and energy would require information from the production process to record the stages in the manufacturing process that are water and/or energy intensive. Current efforts of textile manufacturers address production sites in the supply chain that result in information on the annual consumption. The consumption strongly depends on the different processes that are applied in the facilities. Besides, different products (with different yarns, materials, colour shades etc.) also result in different consumption. Therefore, the annual consumption of production sites cannot be compared without further knowledge of the processes and the produced goods.
- For example, to fulfil a data requirement on water consumption, it would currently be possible to specify the annual consumption of the production site that manufactures a large number of different products, which would be anything but product specific.
- The reported data also risk in not being verified by e.g. audits or other standards; demanding a verification in this framework would introduce disproportionate effort.
- Thus, collecting these data under a product regulation would create a high and disproportional administrative burden. The information that could be gained would not provide a benefit compared to the reporting obligations on company level.

Overall, a reporting obligation on microplastics/microfibres has not been recommended, as it would require excessive testing if companies had to provide product-specific information on their entire portfolio. However, the proposal of a stepwise introduction arose during the course of the study, which would initially apply to products brought on the market in high volumes. This proposal opens up the opportunity of requesting the determination of microplastic emissions, as testing a manageable number of products would be required.

8.5 Possible implications / Potential impacts

Same stakeholders provided feedback in their written statement on the unsuitability of the PEFCR for A&FW and pointed out that this methodology was developed as a voluntary and indicative framework for environmental product claims and not as a product specific requirement under the ESPR. Stakeholders also expressed agreement that reducing the environmental impact of textile manufacturing must be addressed primarily at company level, for example within the framework of the CSRD or the CSDDD.

However, the so-called omnibus package launched by the European Commission (European Commission 2025c) introduces major simplifications to the CSRD; it has recently been adopted by the European Parliament (European Parliament 2025). The most significant change is the drastic reduction in the scope of the CSRD. Only companies with more than 1,000 employees will now be required to report, which excludes around 80% of companies that were previously within the scope, including many listed SMEs. Furthermore, the proposal commits to revising the ESRS with the aim of reducing the number of required data points substantially. It is therefore considered unlikely that the CSRD will have the expected effect of improving environmental impact at company level.

Therefore, it is considered necessary that in the long term the integration of the environmental impacts of the textile value chain into a product-related framework, such as the ESPR, has to be reconsidered. The workshop participants in this study suggested the introduction of a mass balancing of water and energy consumption as well as waste management, i.e. the conversion of overall company consumption to the product. This would not allow for a direct comparison of the associated water and energy consumption between different products. Even comparing the overall company consumption of different companies would not provide meaningful results, as consumption is strongly dependent on a company's product and process portfolio.

In order to gain real insight into product-related water and energy consumption, the data must be collected in a process-specific manner and allocated to products using appropriate allocation factors, which would need to be defined for each process. As this information is not currently available, the next step could be to develop a guideline for allocating company-level data to different products depending on the processes employed.

Furthermore, proposing a stepwise introduction of testing for fibre fragment emissions, alongside an information requirement on fibre composition, manufacturing processes and finishing techniques, would increase the database and knowledge about fibre fragment emissions related to the domestic washing step. This could eventually lead to the development of fibre-specific benchmarks for the release of fibre fragments via the laundry pathway. However, this approach does not take into account fibre fragment emissions during wet finishing processes or via the air during the use of textiles.

9 Stakeholder feedback to the proposed requirements

Stakeholders were requested to provide additional written feedback following the workshop series. In total 19 stakeholders provided statements from the following stakeholder groups: individual companies, associations, testing institutes and ecolabel institutions.

The workshop participants were asked to provide feedback to the following guiding questions:

- Which of these requirements can be implemented immediately?
- Which requirements do you foresee difficulties with, and why?
- What timeframe would be required for implementation?
- Are there any product groups that you would exclude from ecodesign requirements, and if so, why?

When answering the questions, stakeholders mainly referred to the individual product aspects, and in some cases only to selected aspects. Overall, the product aspects received a similar amount of feedback, which differed in detail between the statements. Durability and recyclability were addressed in 12 statements each and repairability in 11 statements, while recycled content and the presence of SoC were addressed in 14 and 13 statements, respectively. The feedback on the product aspects is taken up, discussed and considered in the product aspect chapters under 'Possible implications / Potential impacts" (Chapter 4.4; 5.4; 6.2.4; 6.3.5; 7.4; 8.5).

Some comments were made repeatedly in the responses and should therefore be summarised first:

- Stakeholders across all groups stressed the need for a clearly defined, standardised and comprehensible categorisation of product groups across all sectors. Especially, the need to differentiate between fashion / street and outdoor / sport / functional clothes was repeatedly highlighted.
  This demand is covered by the categorisation developed in this study, that explicitly recommends among others a differentiation between fashion and functional clothes.
- Overall, stakeholders proposed the introduction of ecodesign requirements using a stepwise or staggered approach. It was proposed that this should start with prioritised products or product categories. The proposed prioritisation criteria were market share and consumption volumes as these would have the greatest leverage. Basic products that are frequently used, such as cotton T-shirts, were suggested as a starting point. It was recommended as essential to regularly review the legislation on ecodesign requirements to ensure its long-term effectiveness and practicability.
  This suggestion will be taken up in the next chapter.
- It was emphasised in various ways, that the European textile industry largely consists of SMEs, that should not be disadvantaged by the requirements and the administrative burden. The European Commission recognizes the specific situation of SMEs and is searching for supporting measures (European Commission 2024a).
  The present study exchanges in the workshop series on the business practices and finally decided to limit the requirements to those that can be included and determined in the design phase. As one consequence, no requirements regarding environmental impacts have been finally proposed as these would heavily rely on information from the supply chain (see Chapter 8 for further information).

- There are concerns that no level playing field would be created by ecodesign requirements and that European manufacturers would be disadvantaged.
  This concern was raised despite the briefings given in the workshop series on the ESPR being a product regulation addressing all product placed on the EU market. It is therefore assumed that hereby online marketplaces etc. are meant where regulation and surveillance is challenging. Against the background that insufficient market surveillance has continuously been cited as a major shortcoming in the implementation of the Ecodesign and Energy Labelling Directives due to lack of effective coordination, limited resources and the large range of product groups that must be checked, strengthening market surveillance and custom controls is explicitly addressed in the ESPR and a strong focus is set on controls of regulated products (European Commission 2024a). As these issues are beyond the scope of this study, it will not be taken up further.
- It was raised several times that the requirements should apply only to new products and not to those that are already produced and stored to avoid destruction of goods. Here, it was referred to experiences from the toy's legislation. The comparability with clothing was not further explored in these statements.
  Though storage periods for apparel is assumed to be shorter than the shortest transition period of 18 months, a reminder will be introduced when transition periods are discussed.

9.1 What timeframe would be required for implementation?

Eleven responses were provided here. The estimations varied between 36 months and 'at least ten years". The explanations provided for the estimates show that the variation between the estimates depend on the perspective: Individual companies due to their agility or high-quality standards (established quality management and quality assurance measures) rather provide estimations at the lower end. This shows that a rapid implementation of basic requirements is basically possible. Ecolabel institutions considering the need for e.g. standardisation processes rather came to a long-term estimate. An overall consideration was that a stepwise/graded/staggered introduction of the requirements and /or product(s) (groups) covered was mentioned to be helpful and also the possibility to rely on existing systems, e.g. information on SVHCs. Moreover, overall practical transitional solutions and clear guidelines and planning security are essential for successful implementation.

The feedback from **individual companies** varied between two years, 36 months and four years and one feedback explained that an estimation would not yet possible due to the many unresolved issues, another added that the estimation provided strongly depends on the final requirements. According to the companies' statements, it is understood that they have slightly different planning lead times, which seem to depend on the price segment they serve. For the transition, it was explained that the time is needed to adapt existing ordering and production processes and to implement systematically the new requirements and for internal organisational and technical preparation.

One stakeholder assigned different implementation times according to the product aspects: For durability, a realisation period of 2 years; repairability within 3 years, for recyclability, the implementation period was seen different for 'standard items' (3 years) and special cases (5-10 years); for SoC, in a range of at least 5 years.

Associations estimated two years as ambitious and generally referred to a period of 18 months from product development to market launch or rather four to six years. Feedback from **ecolabel institutions** estimated the need of at least ten years for a full implementation, including the necessary framework conditions such as standardisation processes, data systems, testing institutions and recycling infrastructure. **Testing institutions** rather estimated that the transition would vary between the product aspects where repairability was given the shortest transition need and durability three years.

9.2 Products to be excluded

Twelve responses were received to the question about which product groups would need to be excluded from the ecodesign requirements. The responses mainly covered proposals for complete exemptions from requirements. However, some responses also suggested that less stringent requirements should apply in certain cases, or that certain product aspects should not apply.

The following list[57] shows the products that stakeholders proposed to be exempt from ecodesign requirements followed by the explanations given:

- Fine hosiery, corsetry, lace goods, lingerie (especially bras): Due to their delicate materials and low recyclability.
- Textiles that are rarely worn, such as festive clothing (evening dresses, silk blouses and lingerie) or rarely washed (blazers, suits) and generally non-washable clothing.
- Accessories: Due to their small surface area and complex material combinations, testing is often not possible or sensible.
- Workwear, protective clothing, cleanroom textiles and hygiene-related clothing: These products already meet high standards in terms of durability and practicality and are subject to strict, industry-specific requirements.

These stakeholders' proposals were quite consistent with those from the categorisation system (see chapter 3.2.6). Among others, textile accessories are proposed to be excluded due to their different functionality and product presentation compared to the everyday clothing products. The JRC in its preparatory study (Delre et al. 2024a) came to the same conclusion regarding accessories.

In the following the proposals are listed where less stringent requirements should apply or where a certain products aspect should not apply:

- Less durability requirements for materials made from animal/natural fibres, e.g. wool, silk, linen and leather: Natural fibres require special care and are susceptible to shrinkage.
- No recyclability requirement for products consisting of many different components by their nature (e.g. functional clothing, including corsetry and performance clothing); swimwear where polyester-polyamide-elastane blends are used (by some manufacturers).
- Exemptions from specific requirements, such as recyclability or recycled content, for products made from certified natural fibres, due to their biodegradability, low environmental impact, and independent sustainability certifications.
- Less (durability) requirements for low-value and lightweight products; here no further explanation or specification was given.

[57] The input is summarised and products that are out of scope of this study such as e. g. shoes have not been taken up.

10 Conclusion and proposals for ecodesign requirements for T-shirt, jeans, and functional jacket

The following chapters provides an overview on the results of this study and the proposals of the **minimum requirements** developed in this study.

- The **prioritisation of product aspects** based on available recommendations in the literature concluded to address durability, repairability, recyclability, recycled content, presence of SoC and environmental impact, where generally any resource use was subsumed.
- The **categorisation system** developed in this study (see chapter 3.2) bases on the CN[58] as does the ESPR with regards to the prohibition of the destruction of unsold apparel and the proposals on the introduction of an EPR system for textiles (COM/2023/420). The categorisation system considers the use of materials to a certain extent and the fabric structure (pre-dominantly knitted and woven), in addition to the product type, and the function and use of the textile product.

  The categorisation system proposes to focus on everyday clothing so that a list of products can be excluded (see Figure 5).
- For the **selection of product examples**, a prioritisation was developed. These considerations can also support to define a stepwise introduction of ecodesign requirements, e.g. to start with basic products with high market share and consumption volumes.

The product examples selected reflected the various relevance criteria:

- T-shirt (classic 100% cotton and functional 100% polyester): Highly relevant due to sales volumes on the market and relevance of durability, recycled content, recyclability and mono- versus multi-fibre material.
- Jeans (95% cotton, 5% elastane): Highly relevant due to sales volumes on the market and availability of trims, and relevance for many product aspects, namely durability, repairability, recycled content, recyclability and mono- versus multi-fibre material.
- Functional jacket (100% polyester or polyamide): Highly relevant for the presence of SoC, multi-fibre material and the availability of wear parts as well as relevance for durability, repairability and recycled content.

For these product examples, minimum requirements have been developed. The detailed analytical work on the prioritised product aspects and the derivation of recommendations are carefully documented in the previous chapters. The text fields below provide brief pitches of each product aspect that should provide the background information necessary to understand the table.

- The **development of ecodesign requirements for the different product aspects** based on the same general methodological approach. Nevertheless, product aspect specific additions were allowed, led to different conclusions regarding the application range of the developed

[58] The Combined Nomenclature is based on the Harmonised Commodity Description and Coding System (HS), commonly referred to as the Harmonised System, which is an international system to classify goods developed by the World Customs Organisation (WCO).

requirements, the identification of e.g. standardisation needs and the timeline for implementation:

- The **possible application range of the requirements**: For example, whereas the proposed requirements for durability has been found to be product category-specific, generic requirements for repairability have been formulated that are applicable across all product categories.
- For the verification of performance requirements, standardised test methods or other appropriate schemes needs to available. It was found that some product aspects require **prerequisites that have yet to be defined in the political context**. This was overall the case for recycled content, where it needs to be determined whether the recycled content is product-specific which would then need identity preserved or segregated chain-of-custody verification schemes or can be achieved by a mass balance approach.
  With regards to durability, a need for the adaptation of some standardised test methods was found to better determine durability in the use phase.
- The **transition period** respectively **timeline for implementation** was found to be influenced not only by the prerequisites still to be decided, but might also depend on the amount of requirements.
  For durability, a transition period of two years was proposed given that ecodesign only addresses selected basic products.
  For example, for recycled content, the fulfilment of product specific target was proposed for 2030 which means that five years are estimated.
- Overall, the minimum requirements were specified in a way that they can be addressed in the technical product specification during the design phase.

Requirements for durability

- The proposal includes minimum requirements for the example product T-shirt, which were developed based on a performance testing involving 30 wash-dry cycles. The requirements for the product example jeans and functional jacket are only based on a literature review and industry survey and were not tested during practical trials.
- In the case of the T-shirts washing and drying is a sufficient method to simulate the aging of the product. For other products like T-shirts made from silk or wool or products like jeans and functional jackets being washed less frequently wash-dry cycles alone might not be the most suitable solution to simulate aging.
- Standardization needs become especially apparent for the simulation of aging. Existing standards (typically between one to ten wash-dry cycles) do not adequately reflect real-life usage. Furthermore, a standardized washing pre-treatment is needed to ensure comparability.
- Therefore, it is suggested to first set the requirement to the new condition of the T-shirt, for which the testing effort is estimated to be feasible.
- A transition period of two years could be used to start with requirements for new items while working on data collection and validation while standardization of aging simulation and testing capacities are established.

- For a stepwise extension of requirements to other products and product groups, the HS-codes can be of great help. The suggested categorization provides the necessary framework for this.
- The reliable verification or proof of compliance is to be designed in a feasible way. Here the approach of CE-marking could be used as a role model.

Generic requirements for repairability across all product groups

- The proposal includes **general requirements** as minimum criteria that support repairability independent of specific product groups. The requirements include: 1. Availability of spare parts, 2. Documentation and 3. Repair services.
- These requirements represent a combination of performance requirements (e.g. ensuring interchangeable trims, where applicable) and information requirements (e.g. information on repair services) that companies must make publicly available.
- It is conceivable that the relevant information is provided both on the company's website and/or within the digital product passport. This way, conformity with these requirements can easily be verified by the relevant authorities in a spot check.
- The requirements can be introduced as either mandatory or scoring-based (optional) requirements.
- If **product-specific requirements** are to be introduced in the future to assess the repairability performance of different products (e.g. repair-score, label), it will be necessary to define more nuanced and targeted indicators for each relevant product group.
- Verification of repairability claims on product level could be supported through a technical drawing of the product, showing its construction and components (e.g. via tech pack). Companies should retain this documentation and provide it upon request to substantiate their claims.

Proposal for recyclability provides an overall framework

- Two performance requirements are proposed: 1. Restriction for the use of heterogeneous material (max. 2 different materials processed in one fabric layer); 2. Material utilisation rate (minor part with minimum use of 10% per fibre material in relation to all materials with exemption for elastane).
- Separate consideration of elastane with a utilisation rate of 5-10%, when the use is necessary.
- The requirements specifically address the material composition at the fabric level of the finished product, not the entire product or all components.
- The proposal is based on current capabilities of automatic detection technologies, which can reliably identify fibre types only if they make up at least 5-10% of the material; the proposal is deliberately technology-neutral, avoiding early prioritization of a particular method.
- The requirements are designed to be particularly compatible with mechanical, thermo-mechanical and chemical recycling processes, considering their current technological and economic limitations.

- Restrictions (e.g., on elastane content) are set in a way that does not unduly compromise the durability, comfort, or function of specific product groups. Therefore, certain product groups (No. 6, 15 and 17-28 according to the proposed product categorisation[59]) are exempt from the elastane restriction to maintain necessary properties.
- Product information (e.g., material composition) should be documented and made available, potentially via a digital product passport, to enable correct sorting and selection of recycling processes.

Requirements for recycled content depend on several prerequisites and restrictions

- The proposal for minimum recycled content sets **fibre-specific targets for the specific product examples T-shirts and jeans**: cotton: 10%; polyester: 3%; polyamide: 5%; MMCF: 5%; wool: 15%.
- The proposed recycled content values refer to **inputs from fibre-to-fibre recycling only**. Post-consumer and pre-consumer (also called post-industrial in this study) textile waste according to DIN EN ISO 14021:2021-10 is recommended as allowed input material. In principle, non-fibre-based sources could be permitted. However, the EU textile strategy aims at inputs from fibre-to-fibre recycling (not, for instance, from PET bottles), to incentivize closed-loop systems within the textile sector.
- The recycled content in products with multiple fibre types must be **calculated fibre-specifically**, applying the target to each fibre in the blend.
- Reliable **verification** is only possible via a robust certification and **chain-of-custody system**, not by physical testing. Audits along the value chain are necessary. The proposed requirements for recycled content have been developed based on the understanding that the ESPR is a **product regulation** and that recycled content must be product-specific. Therefore, only the chain-of-custody systems ‘identity preservation’, ‘segregation’ or ‘controlled blending’ are permissible. However, this issue will need to be addressed during the political decision-making process. An alternative approach is mass balancing where the ratio of primary and secondary raw materials is calculated but not assessed in the finished product. To achieve this, the system boundaries for mass balancing must be defined, i.e. whether the balance relates to the entire company or individual product lines. In the workshop series, stakeholders emphasised that mass balancing enables companies to more easily achieve the absolute recycling target by 'efficiently' distributing the recycled content.
- **Certified sustainable (e.g. organic) fibres** may be allowed as an **alternative** to recycled content in cases where recycled fibres are not technically feasible.
- The minimum requirements are set to be compatible with durability standards.
- The targets are set for 2030.
- There must be a sufficiently long transition period between the publication of the certification system with calculation methodology and the entry into force of the mandatory rules.

[59] No. 6: ‘Fashion clothing, lower body not knitted/crocheted’, esp. jeans pants, which may require an elastane content < 5%; No. 15: ‘Functional clothing, lower body knitted/crocheted‘, esp. sport leggings; No. 17-28: ‘Fashion clothing and underwear for babies/children’, ‘Functional clothing for babies/children’

Minimum requirements on SoC: cautious approach towards marking the effect chemicals in the technical specification

There are two information requirements proposed:

- The **integration of the information requirements on SVHC** (identity, concentration and occurrence in articles and their parts, also accessories according to REACH) **in the public part of the DPP** and make the information available to the end consumer. This requirement is already in place under REACH.
  This would relieve industry from the need to respond to individual consumer requests on the presence of SVHC. As the development of the DPP system is aimed at achieving interoperability with existing databases; here, interoperability of the DPP and the SCIP database is needed to avoid the need to enter data into more than one system.

- Stepwise approach for further information requirements: It is suggested to start with effect (functional) chemicals that are intentionally present in the product (e.g., water repellents). Information about these chemicals should be included in product specifications and passed along the supply chain, but not necessarily to end consumers. This builds capacity over time and gradually improves chemical transparency.

For the environmental impact, no minimum requirements are proposed.

The 'Product Environmental Footprint Category Rules for Apparel and Footwear'[60] are not recommended to be applied as a minimum product specific requirement for various reasons that are discussed in chapter 8. Alternative information requirements regarding water or energy consumption in the supply chain or microplastic/microfibre emissions, were examined:

- No information requirement is proposed for water and energy consumption as data (if they are collected by companies) is not product-specific but are annual consumption figures from production sites. As this data depends on various production site parameters, including processes and the range of products or materials produced, it could not be used for future benchmarking either.

- No information requirement is proposed for microplastic/microfibre as a general requirement as the testing effort for the whole product portfolio would be excessive. However, if ecodesign for textiles starts with selected basic products, information on their shedding rates could be introduced.

While reducing the environmental impact of production should in principle be a high priority, it was concluded during this project that the product policy framework of the Ecodesign Regulation is not suitable for this purpose. Instead, this must be addressed or regulated at company level, as set out in the CSRD and CSDDD.

10.1 Technical product specification and conformity assessment

The process of ensuring and verifying conformity was addressed during the workshop series, as stakeholders were interested in how an implementation into procurement processes might work. It was pointed out that this aspect was not a part of the research project. Nevertheless,

[60] Product Environmental Footprint Category Rules (PEFCRs) have been developed for apparel and footwear (https://pefapparelandfootwear.eu/).

due to the importance of an actual implementation, the relevant chapters of the Ecodesign Regulation were introduced and discussed briefly, which is reflected in the following points:

- The obligations of economic operators (ESPR, chapter VII) to design and manufacture a product in accordance with the requirements describe the duties of the operators to draw up a technical documentation and carry out a conformity assessment for the products before they are placed onto the market.

  Both the technical specification and the conformity assessment were confirmed to be tools that are already an integral part of product development within the quality management system of a company.

- Further chapters cover conformity of products (ESPR, chapter VIII), notification of conformity assessment bodies (ESPR, chapter IX), and market surveillance (ESPR, chapter XII). The regulation stipulates that suitable measurement and testing methods on the product should confirm conformity as part of a conformity assessment. A declaration of conformity must be prepared for this purpose.

- Workshop participants raised the question of who should inspect the products and at what level of detail (colour, design, quantity, etc.). The regulation currently states that there should be notified bodies to assess conformity and bodies to carry out market surveillance in the member states. The regulation refers in many respects to the delegated act which will be provided for this purpose.

- There was an agreement among the participants involved in the discussion that in general a conformity assessment process would be possible but that two aspects should be considered: First, many data points might be relevant to be integrated later in the DPP. Hence the data points as well as the system in which they are collected should be able to import/export data to build an interface. It was highlighted that the systems which are used today in order to draw up a specification do not yet completely contain those data fields, which would be necessary to cover all aspects of ESPR. Second, the high number of different product categories as well as the different software solutions used, would demand an intelligent and stepwise approach to avoid overloading the companies.

Once more, stakeholders favoured the idea to start implementation based on production/import volume of textile article, based on mono-fibre and multi-fibre composition of textile articles or depending on the complexity of the textile article.

The industry would highly appreciate a trial run with a few product categories to gain experience. This test would improve the chances of developing a solution that would lead to improvements in the sustainability of products and be understood by market participants.

The authors of this study consider the conformity assessment as one area where supporting measures for SMEs are important, e.g., through capacity building and training. Once the DPP will take shape, capacity building and training should focus on the digitalization of the information.

10.2 Conflicting objectives and trade-offs between product aspects

When developing minimum requirements, there are interlinkages between the various product aspects. The following Table 53 provides a mapping of the possible trade-offs between the product aspects that were identified in this study. These trade-offs and conflicting objectives are addressed through the following decisions and recommendations:

- Recycled content and durability: The conflict between recycled content and durability was often raised by stakeholders mutually arguing against a product-specific minimum requirement of recycled content. Chapter 6.3.5.2 summarizes the findings of the quantitative results of especially cotton yarn. Although mechanically recycled fibres currently have a quality disadvantage compared to virgin fibres, it has not been systematically investigated which proportion of recycled material influences the varying quality requirements.
  Therefore, it was concluded necessary that the fibre-specific minimum requirements for the recycled content are adapted to the minimum requirements for durability on a product group-specific basis to the extent that it must be technically and economically possible for both requirements to be met. The analysis of the individual studies led to the conclusion that no impairment of durability can be assumed for the relatively low recycled content proposed here.

- Recyclability and durability:

  - Functional products in particular should be considered separately due to their durability and the fact that they are usually difficult to recycle, as well as to ensure that they remain functional. The study therefore proposed further specifying the reduction of heterogeneous materials and the use of elastane for functional products. This includes, for example, sports leggings.

  - For products in the 'fashion" category, such as jeans, consideration could also be given to excluding the requirements for elastane use in order to continue to be able to implement conventional and necessary designs in accordance with function and wearing comfort. Against a similar background, products in the 'babies/children" category should also be exempted from the requirements for elastane use in particular.

  - Products that are not suitable for compliance with recycling requirements include swimwear, which often uses polyester-polyamide-elastane blends. In addition, specific products in the underwear category, which have a fundamentally different fabric finish (fine knit) and a different usage cycle, are also not suitable for more generalised requirements.

- SoC and other product aspects: Although it was concluded that no specific requirements can currently be set for SoC that negatively affect the reuse or recycling of materials in the product in which they are present, the proposed recyclability requirement provides synergy. This is because restricting the use of heterogeneous materials to a maximum of two different materials, processed in one fabric layer, is assumed to reduce the number of different chemical substances (different materials typically require different types of dye and processing chemicals).

- Textile chemicals can have an impact on the durability of a textile item. E.g. the application of anti-pilling chemical treatments to a quality of fibre/yarn (for example open end) contributes to the fulfilment of the minimum requirements for durability. However, it can be expected that differences in appearance and durability would become obvious after several washing cycles. This interlinkage was one of the reasons to propose the information requirement for effect chemicals.

To better balance the trade-offs between different product aspects in order to maximise environmental benefits through an ecodesign approach, the study team sees an opportunity in the ecodesign label, where a higher fulfilment of e.g. the recycled content with constant fulfilment of the durability requirements can be highlighted. In the next chapter, the possible transfer to an ecodesign label will be analysed.

Table 53: Trade-offs between the product aspects

Product aspect	Repairability	Recyclability	Recycled content	Substances of concern	Environmental impacts
Durability	Easy material separability improves repairability but can reduce durability, as unbound seams may open more quickly. Non-glued surfaces (e.g. in outdoor products) can limit the functionality of the product.	Easy separability of the materials is an advantage for repairability and recyclability. This can reduce durability, as, for example, seams that are not bound/welded, open more quickly. Fibre blends (e.g. addition of polyester or elastane) can be beneficial to comfort and durability but reduce recyclability. High quality (durability) due to high fabric density/yarn twist makes mechanical recycling more difficult. Functional finishing chemicals can be beneficial to	The use of recycled fibres can reduce durability: Mechanical recycling leads to a shortening of the fibre length, which results in a deterioration of the tensile and tear strength as well as the pilling values. As cotton and wool can only be recycled mechanically, the fibre length of the recycled fibres is always shortened. Chemical recycling, e.g. solvent-based dissolution, can also lead to a reduction in the quality of the recyclates. However, depolymerisation processes usually produce virgin like quality of the fibres.	Poor fibre quality can be compensated for with finishes such as anti-pilling and softening finishes or Easy Care finishes for simplified care. Their durability depends on the respective finishing effect and the individual chemical; variations from 1-2 washes to 100 washes possible. Examples: Synthetic resin finish: Cotton forms a covalent bond with the glyoxal resin and is therefore permanent. Anti-pilling and softener finish: Permanence is limited and highly dependent on the product (~5-20 washes). Fluorine-free, stain-repellent finish: Permanence can be improved by using a cross-linking agent (~5-20 washes).	The use/blending of synthetic fibres can increase durability, however, potentially leads to a higher release of microfibres (both in the wet finishing and in the use phase). The use of functional chemicals / chemical finishes can increase the durability of a textile and ensure its functionality (e.g. rain protection). This can lead to the release of substances with negative effects on the environment and human health (e.g. PFAS).

Product aspect	Repairability	Recyclability	Recycled content	Substances of concern	Environmental impacts
		durability but impair recyclability.			
Repairability		A repair may impair recycling due to the use of other materials (e.g. patches).	The lower quality of a textile due to its recycled content may mean that repairs are not worthwhile.		If spare parts are required to be made available on the product, unused parts could contribute to a waste of resources. The same applies to spare parts that must be kept in stock by manufacturers and may not be used.
Recyclability			Mechanically recycling is limited in terms of recycling loops (multi-loop problem) due to the reduction in fibre length. Due to the lower quality of mechanically recycled fibres, other fibres are often mixed in. The use of mixed fibres reduces recyclability.	Chemical finishes often hinder the recycling process and must be removed using separation processes.	There are studies which confirm the positive environmental impact of recycling compared to other end-of-life scenarios such as energy recovery. However, there is not yet reliable and comprehensive data on the environmental impact of all recycling processes. For a comprehensive assessment, environmental impact categories such as water and resource consumption should be considered in addition to greenhouse gas potential.
Recycled content				Recycled content can be a potential source of pollutants, as there are still substances present that are or may be banned (e.g. PFAS) There might be process auxiliaries from (chemical) recycling that have not yet been considered in the context of the textile process chain,	No comprehensive data is yet available on the environmental impact of all recycling processes. The use of recycled fibres may lead to an increase in the emission of fibre fragments. The use of recyclates can lead to a reduced quality being offset by the use of primary fibres, which limits the resource savings.

Product aspect	Repairability	Recyclability	Recycled content	Substances of concern	Environmental impacts
				problematic with regard to residues (e.g. certain machine oils, chemical auxiliaries, etc.)	
SoC					The use of chemical finishes and auxiliaries can lead to the release of substances with negative effects on the environment and human health (e.g. PFAS). Fragments of natural fibres with finishes can be difficult to degrade in nature.

Source: Own compilation

11 The possible transfer to an ecodesign label

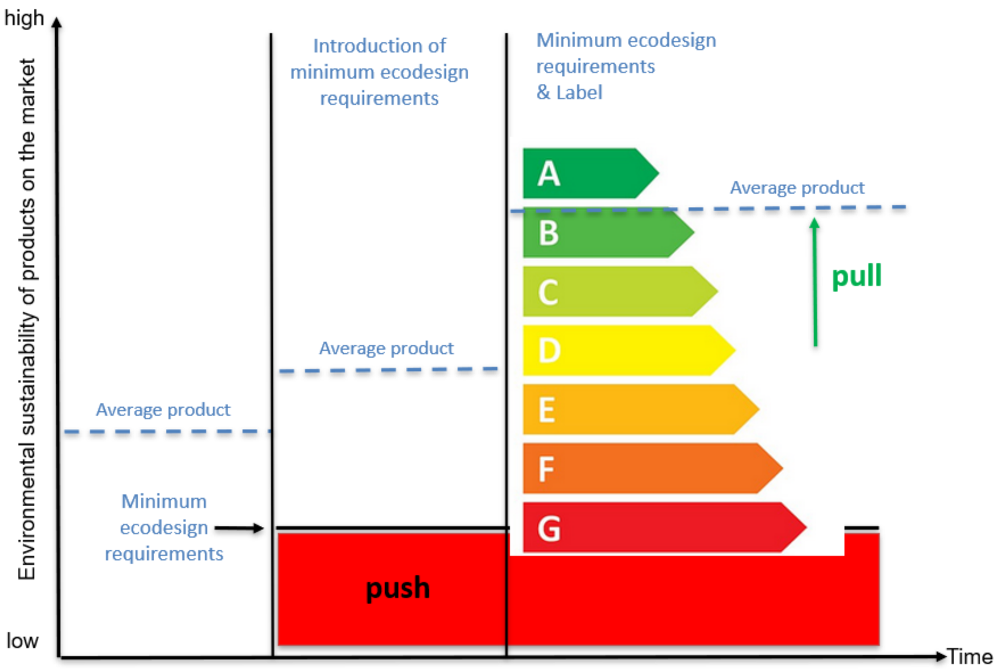
The ESPR places a strong emphasis on product information. In addition to the DPP, which will serve as a digital identity card for product group specific information, the ESPR also provides for physical labels on the product. According to recital (46) of the ESPR, this ecodesign label is intended to encourage consumers to make sustainable choices by providing clear and easily understandable information and enabling an effective comparison of products, e.g. by indicating performance classes.

11.1 Status quo

For energy-related products, the Energy Label already exists that displays ecodesign requirements. Here, (European Parliament; European Council 2017) sets the framework for energy labelling with 'clear and detailed rules which preclude divergent transposition by Member States and thus ensures a higher degree of harmonisation across the Union". The ecodesign label will not replace the energy label, which will continue to apply to energy-related products alongside the ESPR. The ecodesign label will only be established instead of the energy label in cases where relevant information on a product's performance in relation to a product parameter cannot be included as supplementary information on the energy label and is considered more relevant and comprehensive than the information covered by the energy label. This also applies to textiles. Moreover, it will specifically support the Directive on Empowering Consumers for the Green Transition (Directive 2024/825 2024). This directive aims to enhance product information at the point of sale, particularly with regard to durability and repairability. It also seeks to prevent greenwashing and premature obsolescence.

The energy label is a legal instrument intended to interact synergistically with minimum ecodesign requirements. This interaction is described as a 'push and pull' mechanism (European Union 2019) (see figure here below). The minimum ecodesign requirements aim to remove the least efficient products from the EU market. The label aims to influence consumers' purchasing decisions, encouraging them to choose the most efficient products. The energy label is also intended to stimulate competition among manufacturers by encouraging them to continuously improve their product designs to achieve the best values for all the parameters indicated on the label, thereby enabling them to appear in the highest classes.

Figure 31: Push & pull mechanism of ecodesign requirements and ecodesign label



Source: Based on Figure 2 in European Union (2019)

The first mandatory EU-wide Energy Labelling Framework for selected household appliances was adopted in 1990. Since then, the Energy Labelling was further developed and spread to a large range of energy-related products in 2010. Together with the Ecodesign Directive which is addressing energy efficiency and sustainability since its first introduction in 2008, Energy Labelling has proven to be a successful lever to shift towards more sustainable products:

- The environmental benefits become clear when the energy savings achieved by the two legal instruments are considered. Wierda and Zanuttini (2024) estimated that, thanks to the introduction of the product specific Ecodesign and Energy Labelling regulations, an average EU household saved 1,011 kWh/a in 2020, which corresponds to 28% of the total energy consumption of an average household. For the calculation the business-as-usual scenario was compared with a scenario with measures under the Ecodesign and Energy Labelling regulations. The main energy savings are reached by measures to refrigerators, electronics, lighting and cleaning (washing machines, dishwashers, vacuum cleaners).
- The energy label is widely recognised: According to a 2024 Eurobarometer survey on energy, 93% of EU consumers recognised the label, with 75% stating that it had influenced their purchasing decisions in the previous five years (European Union 2024b).
- Studies on the effect of the energy label design on the purchase decisions can be used to derive conclusions for the design of an ecodesign label:
- The JRC conducted a study investigating the relative effects of three labelling concepts — positive and negative labelling, as well as graduated labelling[61] — on purchasing decisions (Dessart et al. 2021). An online choice experiment involving smartphones and microwave

[61] The labels each referred to one aspect of sustainability, such as the environmental performance, lifespan or the ethical performance. In case of positive labelling a green check mark label identified the product with the best performance regarding the respective sustainability aspect. Similarly, the negative label marked the product with the worst performance with a red cross. Graduated labels ranked all products on a scale from A to E.

ovens was conducted with over 1,200 consumers in three EU member states. In settings where products had graduated labelling, the most sustainable products achieved a higher purchase share than in settings with positive or negative labelling. The results suggest that tiered labelling is more effective than positive or negative labelling in promoting sustainable purchasing decisions.

- The main finding of the 'Behavioural Study on Consumers' Engagement in the Circular Economy', commissioned by the EU Commission in 2017, was that providing information on durability[62] and repairability effectively shifts purchasing decisions towards more durable and repairable products (Consumers et al. 2018). This effect was stronger when the information on durability and repairability was presented together; durability was found to be more influential than repairability. Furthermore, it could be seen that the effect can be further increased by giving the consumers information about the benefits of buying durable/repairable products. The Behavioural Study comprised an online consumer survey with about 12,000 participants and a behavioural experiment involving 6,000 participants. Furthermore, it revealed that a decision in favour of a repair depends heavily on the effort involved. In general, the interest in buying durable and repairable goods was higher for large and expensive products whereas for fashion items such as clothes the willingness to buy second hand was higher.

- The London Economics (2014) analysed how different designs of energy labels influence consumer understanding and purchasing decisions. The study focused on various label formats, such as alphabetical scales (A-G or A+++ to D), numeric scales (1-5 or 1-8), continuous[63] vs. categorical scales, and the inclusion of benchmark markers indicating the best- and worst-performing comparable devices. The findings are based on a literature review and an online behavioural experiment with about 5,000 participants and a bricks-and-mortar[64] experiment with 500 participants across several EU countries. The following key findings were made:

    - Alphabetical scales (A-G or A+++-D) are generally easier for consumers to understand than numerical scales. As a result, consumers are more likely to opt for energy-efficient products with alphabetical scales than with numerical scales.

    - There is no statistically significant difference in understanding of the various alphabetical scales. However, the results suggest that consumers are more likely to choose energy-efficient products for TVs with an A to G scale than for those with an A+++ to D scale.

    - There is no clear advantage to using different numeric scales (e.g. ascending or descending, continuous or categorical); consumers' understanding of them is mixed. For open-ended scales, understanding improves significantly when the meaning is explained in advance. For the other labels prior information did not change the level of understanding significantly.

[62] Durability was defined as: The period in which the manufacturer promises to replace or repair the product free of charge.

[63] Continuous scales are mostly visualised with a horizontal or vertical bar and have no fixed classes, instead the product is placed at the representative point along the scale. The inclusion of benchmark markers is typical.

[64] The experiment was conducted in retail stores as well as centralised locations. The participants were asked to decide which of three products (all with the same type of label) they would hypothetically purchase.

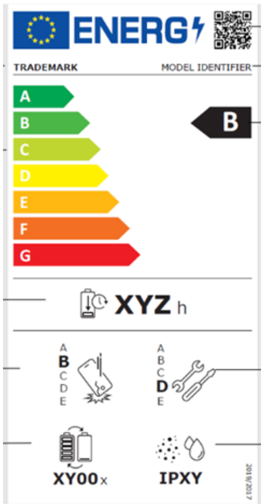
- The majority of consumers understand the inclusion of a benchmark marker, but confusion can arise if its meaning is not clearly explained.
- In general, the design of the label has a greater impact on those consumers who do not consider energy efficiency a key factor in their purchase decision.

11.2 Considerations

In view of the results of the behavioural studies, the design of the energy label can be regarded as quite optimal in terms of providing appropriate information for consumers. In the current project, the energy label was therefore used as a template to discuss how ecodesign requirements for textiles could be transferred into a label.

The energy label for example for smart phones comprises several components: On the one hand, there is the graduated energy consumption scale ranging from A to G. On the other hand, there are icons or classifications for other performance parameters. Smartphones are the first product group for which energy labelling provisions include performance classes and icons for material efficiency aspects, such as battery life, reliability class for free fall, repairability class, battery life in cycles and protection class for water ingress (see Figure 32 here below). Thus, the possibility of performance classes and icons with an absolute information (like for smartphones the battery endurance per cycle in the end device in hours and minutes per full battery charge or the battery endurance in cycles) have been assessed as possibilities for textiles.

Figure 32: Energy label with additional icons indicating the material efficiency of smartphones.



Source: Commission Delegated Regulation (EU) 2023/1669

11.2.1 Survey among the workshop participants

The workshops participants were asked to take part in a survey on the ecodesign label following the 2nd workshop. The aim of the survey was to obtain initial input from stakeholders from the textile industry about their understanding of an ecodesign label and suggestions as to what it should cover. A total of 21 stakeholders participated in the survey. The results are summarised in detail in Annex C and briefly in the following:

The majority of participants understand the ecodesign label to serve for end consumers as the target group and agreed that the ecodesign label should therefore be an aid to purchasing decisions, 'non-performers" should be clearly disclosed. The label should allow a comparison between products and be clear and easy to understand for a simple and quick orientation. It was however also raised to manage all information via the DPP rather than displaying it on an ecodesign label.

For the product aspects 'environmental impact', 'durability' and 'recyclability", a presentation of performance classes was mostly considered being useful, but a quarter of respondents would not visualise any of the product aspects using performance classes.

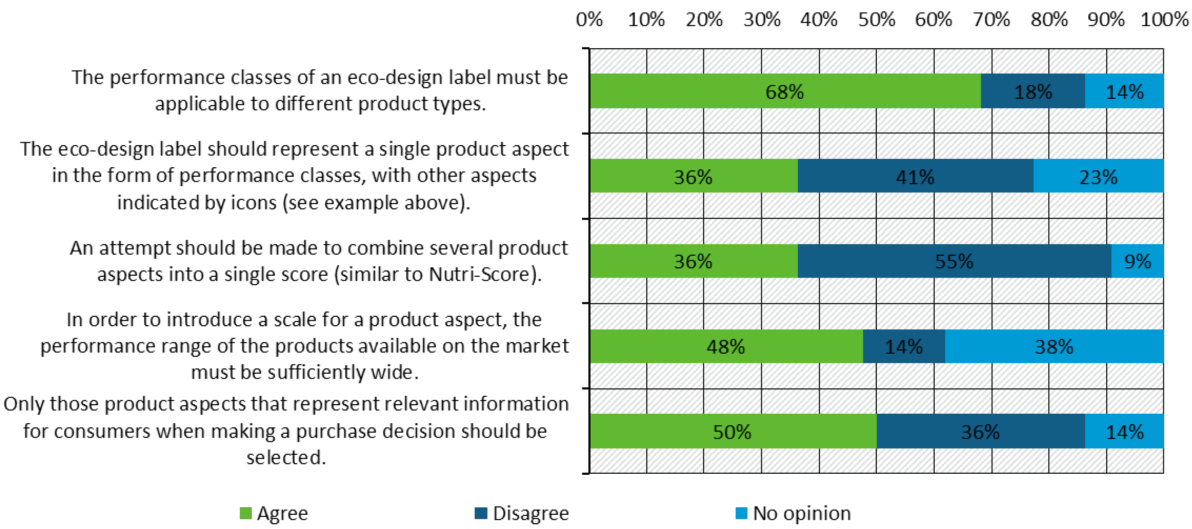
Asked for additional information to be included in an ecodesign label, the participants referred basically to the information of the current textile labelling and voluntary environmental and social certifications, as well as country of manufacture and correct disposal. However, several respondents suggested not to overload the label.

There were several suggestions on which parameters should be used to visualise the environmental impact: Water consumption was favoured here, as well as energy consumption, followed by CO_2eq, the proportion of new materials used and the degradability of the product in the waste stream.

With regards to a prioritisation of product aspects, durability was clearly prioritised. Environmental impact was the next most important aspect, followed by recyclability and SoC, whereas repairability and recycled content were ranked lowest on average.

The feedback to five statements is shown in Figure 33 below. There was a high level of agreement that the performance classes of an ecodesign label should be applicable to different product types. There was comparably high disagreement about combining several aspects into one score. Regarding the specific design of the ecodesign label, the answers did not demonstrate a comparable preference.

Figure 33: Opinion of the survey participants on five questions regarding the ecodesign label



Source: Own work, Öko-Institut.

11.2.2 Results from the workshop discussion

The example of the energy label containing several building blocks (graduated scale from A to G for energy efficiency as the main parameter, additional icons on further performance parameters) was discussed whether or to which extent it can be used as a model for an ecodesign label for textiles. Working groups within the workshop series discussed the guiding questions for each product aspect:

- What value can be used to represent the product aspect on a label?
- Is it possible and meaningful to categorise into performance classes or present absolute information? If performance classes are considered possible, how many distinct performance classes can be clearly identified?

Durability

For durability, the participants generally agreed on an added value to show this aspect on an ecodesign label. However, they did not consider a further gradation of the test values used for the minimum requirement to be suitable to set out different performance classes. Because the various durability aspects with their specific test methods behave differently, a generalised gradation using percentages, for example, would not be realistic.

The number of washing cycles was mentioned as a possible unit or indicator, which can be depicted as an absolute information to indicate durability. Here, the current restriction was seen that there must be a comparable washing process. For such a comparable washing process, the testing effort should not be too great but allows to easily carry out a large number of washing cycles and it should be resource efficient. At best, this could be based on a standardized quick test procedure. As examples, Durawash was brought forward in the workshop, in order to be able to work with ready-made garments.

Repairability

For the product aspect of repairability, the participants saw no added value in the expansion of performance classes. Instead, there should be repairability indicators. The participants understood the possibility of absolute information on the label in this case in a way, that information should be provided that facilitate the repair or indicates a repair offer.

Overall, the participants warned that there was a risk that a poor-quality product could be upgraded by offering a repair service, for example.

Recyclability

For recyclability, it was brought forward that the information provided must be understandable to consumers. The participants agreed that the assessment recyclability could not be based on one indicator, but that several relevant recyclability indicators would be aggregated into one score for recyclability. The participants proposed the following indicators:

- Material heterogeneity
- Ingredients (non-textile components).
- The high value/quality of the recycled material
- The inclusion of the energy input of the recycling process (with no direct reference to the recyclability of the material).

Biodegradability was also proposed as an alternative to recyclability, but biological waste treatment is not an option for textile waste. Specific indicators and concrete considerations for calculating an overall recyclability index score could not be defined during the workshop. The above indicators are therefore to be understood as suggestions only, and their actual suitability for calculating a recyclability index or for presentation on the label would need further examination.

To enable recognition of compliance with other certifications by the Ecodesign label, existing labels and certifications, such as GRS and GOTS, should align with the Ecodesign label criteria. It was proposed that reference be made to DIN EN ISO 14021:2021-10 to verify recyclability criteria. This standard covers environmental labelling, including information on recyclability, and applies to various products, including textiles.

Recycled content

The majority of participants favoured displaying the recycled content on the label. Though unlike durability, for example, recycled content does not offer consumers any direct added value, it was generally assumed in the workshop discussion that recycled content would be of fundamental interest to consumers. The participants here came to a different conclusion to that of the survey, in which recycled content was ranked lowest on average. One participant raised that the use of recycled fibres would have a deterrent effect on consumers, which is why the recycled content should either not be shown at all or included only in an overall score on the label.

The most obvious option was to present the data as a percentage value. However, the reference point used to calculate the percentage must first be defined whether it is e.g. according to product weight or fibre content. It was suggested that the reference point could be either the main material or the total weight of the product, including the inner lining and other features. It was also recommended that the Global Recycled Standard (GRS) criteria be referred to.

Two options were basically considered possible for indicating the percentage of recycled material:

1) Absolute value: specification of percentage ranges (e.g. contains 20–30% recycled material).

2) Classification into quality classes. However, it would be necessary to specify exactly how the grading would take place, as well as how many quality classes could be formed as a result.

Substances of concern

The SVHC, a subgroup of SoC, was examined from different perspectives. The usefulness or misleading nature of information on the content and concentration of SVHCs was discussed. It was noted that enquiries received by consumer associations relate to the negative effects of chemicals, such as triggering allergic reactions, but do not refer to specific chemical levels. It was agreed that a label with SVHC values or quality classes does not offer consumers any added value, as it requires specialist knowledge and does not fully meet individuals' needs but rather poses a risk to misleading information if it is confused with information on sensitizing chemicals.

However, information on SVHCs as part of the digital product passport (DPP) was viewed positively by the participants, provided that the DPP would be the sole means of communicating such information (in accordance with REACH (1907/2006, Articles 7.2 and 33)).

The analytical determination of chemicals using restricted substance lists (RSLs), and the possibility of detecting individual substances according to the definition of Substances of Concern (SoC) (CLP, Table 3.1, Annex VI), were discussed in detail. Semi-quantitative detection methods for migration were also discussed. The majority of the workshop participants agreed that providing information on the label or in the DPP about other classified chemicals and their analytical detection in the end product would create effort not being proportionate. Examples were given of manufacturing companies that are already choosing not to produce goods for the EU market, partly because the chemical requirements are perceived as too complex.

Overarching comments on the structure of an ecodesign label

The participants advised against highlighting one product feature on a label, as is the case on the energy label highlighting energy efficiency. In light of the conflicting objectives between various product aspects in the case of textiles — for example, the use of recycled fibres can reduce durability — there is a fear that such a presentation would oversimplify matters. The participants believed most consumers would only consider the highlighted scale displayed for the main product aspect when making a purchase decision, without paying attention to the other icons. Against this background, the following options were proposed by the workshop participants for the structure of the label:

- Focusing on an overall aggregated score that takes into account the various product aspects, which could also be represented by individual icons. Regarding the calculation, it was noted that the individual product aspects should be weighted differently. It was suggested that a variation of this weighting depending on the product category under consideration would be appropriate.
- It is also possible to display only the individual product features using icons, thus avoiding the multi-coloured, multi-level label. These could be displayed as quality classes or as absolute values. In this case, there would be no overall score. Consumers can then look specifically at the product aspects that are relevant to them and use these as a basis for their purchase decision.

The feedback of the workshop participants indicates that it is important to consider existing labelling obligations, such as the currently revised EU Textile Labelling Regulation (Regulation (EU) No 1007/2011), but also other voluntary certificates.

Stakeholder reflections from the written statements

In the additional written feedback following the workshop series, eight stakeholders also commented on the label and mostly expressed an overall reluctance for the following reasons:

- The exchange on the label was deemed premature in light of the ongoing preparatory study. Therefore, minimum requirements have not yet been defined, but they are an important baseline. Due to this situation, some stakeholders explained that they were unable to formulate a clear position.
- An additional physical label was refused referring to the binding textile labelling regulation where a physical label on the product has to show the fibre composition.
- Referring to the DPP, there were concerns about bureaucratic duplication. However, other stakeholders suggested that the DPP and the label could complement each other. In this scenario, the label would serve as a quick visual aid for making decisions, while the DPP would provide interested consumers with more information.
- It was noted by individual stakeholders, that the minimum requirements that are proposed in this study for durability would allow little scope for defining best classes. To link the mere fulfilment of the minimum requirements with the worst rating (e.g. label level G in red) would devalue these compliant products in the public perception without creating any real added value for sustainability.

- Further feedback on durability was that standardised test procedures for durability measured by washing cycles were found to be interesting in principle, as this aspect was considered tangible for customers. Whereas bursting resistance was not considered to be understandable for the end consumer.

Individual feedback welcomed the opportunity to communicate sustainability information about products, which was said to be hindered by the Green Claims Directive proposal. Examples of criteria to be labelled as 'sustainable', such as the use of organically grown raw materials with established standards that have a proven positive impact, were mentioned, e.g. GOTS.

11.3 Conclusion on the transfer

The following table shows the considerations with regards to performance classes versus an absolute information for each product aspect.

Table 54: Considerations on performance classes versus absolute information for various product aspects

Product aspect	Performance classes	Absolute information
Durability	This study proposes a number of test parameters to specify durability. To determine performance classes would be an aggregated score over the various test parameters. However, the different parameters do not behave linear over time like energy efficiency does. Furthermore, their results are not (necessarily) proportional to each other. The development of meaningful performance classes would need testing of each product group. When comparing a grading-based test method with a numerical based test method it becomes clear, that a change of for example 20% describes a varying degree of change. In a 5-level grading system, 20% would mean a change of one grade. For numerical based tests like bursting resistance a 20% change depends on the initial value and therefore will behave differently depending on the value in the initial condition of a product. Furthermore, for the grading-based tests the limit of acceptable values is quickly exhausted and would limit the possibility of setting performance classes. For washable textiles, the number of washing cycles could be used as a parameter to form performance classes. However, the washing process would need to be standardised first.	For washable textiles, the number of washing cycles would be an information that is easily understood by consumers. This needs the standardisation of washing processes for durability tests on clothing. The current washing processes do not reflect real household laundry. The standardised continuous washing process is resource efficient, but does not represent a realistic or consumer-oriented laundry. The mechanical influence in particular is higher than in household laundry. To ensure comparability and a consumer-oriented test set up the need for standardization is further detailed in the Annex at C.2. The number of washing cycles indicated on the label would require care instructions to clarify the conditions under which they can be achieved.
Repair-ability	Performance classes are only useful at product level. These could be set to differentiate a product that is very easy to repair and those that only have a limited repairability. A 3-stage point system is possible, where specific indicators are assessed as follows: 5 points for 'good repairability,' 3 points for 'limited repairability,' and 1 point for 'low repairability.' An indicator at product level is, for example, 'ease of disassembly", which can be evaluated based on how easily vulnerable parts (e.g., zippers, rivets, buttons, seams) can be replaced. This is assessed using further sub-criteria, which are defined specifically for a product group. Based on a 3-stage system, one such sub-criterion – 'required tools" for replacing vulnerable parts – could be structured as follows: Basic tools required (5 points)	Overall information on repairability can be translated into a score. When deriving a repairability value based on information requirements, each requirement can be assigned an absolute value. Products are then evaluated according to the number of indicators they fulfil. Each fulfilled criterion contributes to the total score, resulting in an absolute repairability value. For example: each sub-criterion could be awarded with one point, making the maximum repairability-score 5.

Product aspect	Performance classes	Absolute information
	Special tools required (3 points) Not replaceable (1 point) The company is responsible for providing technical drawings and tech packs as proof, which must be made available upon request.	
Recycla-bility	Performance classes for recyclability could be introduced to promote the use of mono-materials and to declassify mixing ratios where high-quality recycling is not possible for knitwear and clothing, but only recycling into fabrics or downcycling for the production of nonwovens. Limiting the proportion of the minor material in a mixture should ensure that the fibre material and material composition can be identified by spectroscopy. In addition, not only the technological feasibility but also the economic viability of recycling processes is supported when the proportion of certain fibres is high. The lower the fibre content to which the recycling process is targeted, the lower the economic viability, especially for processes based on a specific fibre material. The desired mixing ratio (apart from a mono material) is 90/10 (major/minor material) and can lead to a better classification within a potential ecodesign label structure. Based on the factors that the minimum criteria of max. 2 heterogeneous materials (criterion 1) and with the minor proportion not <10% are met (criterion 2.1), this can result in the following distribution following the scaling from A to G, for example: [Legend: major/minor material] Class A = mono-material Class B = 90/10 (in the case of elastane minor material 5-10 -> major 90-95) Class C = 82-89/11-18 Class D = 74-81/19-26 Class E = 66-73/27-34 Class F = 58-65/35-42 Class G = 50-57/43-50	As it is assumed that recyclability is difficult for consumers to understand and assess, absolute information is not considered suitable, but rather a rating scale in the form of performance classes.

Product aspect	Performance classes	Absolute information
	If the number of classes is to be reduced, the division must be adjusted with new increments at a greater distance. An adjustment is also necessary when technologies evolve and system boundaries shift (for example, when spectroscopic detection becomes more accurate or more detailed information on boundaries within recycling processes is published). In addition, the impact of such specific classifications on the effectiveness of recycling processes must be validated. It has not been conclusively clarified whether correspondingly small percentage differences have a positive influence. The proposed classification merely presents a basic idea. In the future, criteria such as contaminants and multi-layer combinations should also be included in the classification system to ensure a comprehensive assessment of recyclability based on differentiated factors.	
Recycled Content	Performance classes based on the amount of recycled content would help strengthen the fibre-to-fibre recycling. All prerequisite to display and classify a product specific recycled content, e.g. reference point and certification to be clearly defined, are described in chapter 6.3.4. According to the current state, an increase in the proportion of recycled content stemming from mechanical recycling conflicts with durability requirements. However, there are other factors that influence how many recycled fibres can be used, such as the spinning process applied, the yarn count and the average length of the recycled fibres used. In addition, the ratio of recycled fibres can be increased by adding polyester or using effect chemicals. Dynamic developments are also expected in recycling processes. In this respect, it will be necessary to specify revisions when establishing performance classes for recycled content.	Given that the prerequisites are defined such as reference for calculation and certification, the exact percentage of the recycled content can be used as an absolute information. As the absolute information by the percentage does not need the complex derivation of performance classes it can therefore easier be implemented. One disadvantage is that consumers may find it difficult to determine whether a certain amount is large or small, which could lead to misinterpretation or a lack of incentive to purchase. This would favour performance classes again.
SoC	Performance classes are currently not feasible due to the overall lacking information in the use of chemicals in the manufacturing process.	It is **not** recommended to indicate Substances of Very High Concern (SVHCs) on the label, e.g. with a 'yes/no" option, as this could lead consumers to an incorrectly assumption that no other hazardous chemicals are present. Feedback from workshop participants pointed to the fact that enquiries that associations receive from consumers relate to the negative effects of chemicals, such as the triggering of allergic reactions. In contrast, it is recommended that information on SVHCs should be provided in the DPP in accordance with REACH,

Product aspect	Performance classes	Absolute information
		Articles 7.2 and 33, given that the DPP is the only medium through which companies communicate such information. There the information is available to interested consumers.
Environ-mental impact	There are no minimum requirements proposed for environmental impact. Therefore, no performance classes are proposed either.	The analysis of the Product Environmental Footprint Category Rules (PEFCR) for Apparel and Footwear as a minimum requirement concluded that a mandatory product specific application of the PEFCR was considered not being proportionate and also not meaningful to ensure a product comparison. Currently, the only way to display information on environmental impacts is to highlight the voluntary initiatives of manufacturers, e.g. environmental product labels that require for example a chemicals management that ensure that substances of concern based on hazard classification are not used and that cover requirements on wastewater management. However, a recognition of these labels would need an approval procedure to ensure that a necessary minimum ambition level is met. Such an approval procedure is for example done by the German initiatives Siegelklarheit and the Green Button (Grüner Knopf 2024; 2025). It is understood that an approach of a substantiation of environmental claims is essentially part of the Green Claims Directive (COM/2023/166 final 2023). Possible links could be examined based on this Directive and its implementation. Then the ecodesign label could integrate (certain) voluntary product labels (as an excellent class). Recognising these labels would encourage companies to follow these sustainable practices.

Source: Own compilation.

To conclude, there is potential for a transfer of ecodesign requirements into an ecodesign label. However, the difficulties are currently seen in deriving performance classes. This is especially the case for durability as shown in the table above so that rather an absolute information is proposed, which is still another value in comparison to the testing parameters proposed for the minimum requirements. But the number of washing cycles provides suitable information that can be easily understood and allows products to be easily compared. However, this would need two prerequisites, namely that care instructions have to be made mandatory to clarify to consumers under which conditions the indicated number of washing cycles can be achieved. Furthermore, a standardised washing procedure must be developed that is comparable to household laundry. Alternatively, for the currently available standard washing processes, conversion factors could be agreed to reflect household laundry conditions.

For recycled content, an absolute information can be easily implemented: The recycled content could be displayed by a percentage value. This needs the same prerequisites as formulated for the minimum requirements, namely a reference for calculation and a certification. The percentage of recycled content is valuable when products can be compared directly. Without these comparisons, consumers may find it difficult to interpret these values, which can lead to confusion and reduced incentive to purchase. In such cases, performance classes are preferable as they provide clearer guidance on the amount of recycled content in a product.

For repairability and recyclability, a possibility is seen to derive performance classes:

- For repairability, performance classes are considered to be only useful at product level. These could be set to differentiate a product that is very easy to repair and those that only have a limited repairability, where a 3-stage point system is possible.
- Performance classes for recyclability could be introduced to promote the use of mono-materials and to declassify mixing ratios where high-quality recycling is not possible.

With these proposals, the ecodesign label could be used to emphasise and highlight certain product aspects. Thereby, the ecodesign label is also a possibility to deal with the trade-offs or conflicts between product aspects: For example, a company that focuses on the highest possible durability beyond the minimum requirement may, as a result, use lower amounts of recycled fibres or achieve lower recyclability. Conversely, a company that focuses on recyclability and the use of recycled materials might only cover the minimum durability requirements.

Thus, the pull-push mechanism, which has already been described for the energy label, can also be applied to the ecodesign label. The performance requirements push all products from the market that cannot fulfil the minimum requirements per product aspect. The ecodesign label allows companies to demonstrate their additional commitment. This allows them to set themselves apart from other products on the market and influence customers' purchasing decisions, thereby creating a pull effect towards more sustainable products.

12 Analysis PEFCR Apparel & Footwear[65]

Following the publication of the PEF method in 2013 (European Commission)[66], a pilot phase was launched in which Product Environmental Footprint Category Rules (PEFCRs) were developed for an initial 25 different product groups. The main objective of the pilot phase was to test and further develop the process for developing PEFCRs, to examine approaches for verifying PEF results, and to test various communication tools for communicating the PEF results (Antony et al. 2024). In the subsequent transition phase starting in 2019, some of the PEFCRs are being revised based on the methodological developments already made, and new PEFCRs have been and are being developed (European Commission 2025b). The PEFCR for the product group 'T-shirt' from the pilot phase was further developed into a PEFCR Apparel & Footwear (A&FW), with the final version published in June 2025 (Quantis Switzerland 2025b).

The following chapter summarises the results of an analysis of the PEFCR A&FW: In addition to a general introduction to the composition of the Technical Secretariat, the functional unit, product subcategories and key environmental impact categories, the focus is on the consideration of biodiversity and microfibre emissions, as well as a more in-depth analysis of the required input data and the significance of the PEF results. Finally, the relevance of the PEFCR A&FW for application within the ESPR is discussed.

12.1 Technical Secretariat and public consultations

PEFCRs are developed by a technical secretariat (TS). The development process of the PEFCR Apparel & Footwear differs from other PEFCRs by dividing the TS in voting members, non-voting members and observers. Whether a member is classified as a voting member depends on the financial contributions made. Therefore, smaller brands or some non-industry stakeholders may be restricted to non-voting memberships due to the lack of financial resources (Eunomia 2022). Similar to the process of development of other PEFCRs, the TS is mainly composed of industry players, in this case large apparel and footwear brands or industry associations. This bias towards industry stakeholders becomes even more striking when considering the breakdown by type of membership: all voting members (14 stakeholders) are industry bodies, and even among the non-voting members, only two out of eight members are non-industry bodies. The high proportion of participants from industry is also due to the requirement that 51% of the EU market in terms of yearly turnover or production must be represented by the participants (European Commission 2017; Commission Recommendation (EU) 2021/2279 2021). However, this requirement regarding the representativeness of the PEFCR could not be fulfilled for the PEFCR A&FW. In this case it is formulated that 'the Commission needs to actively participate in the work of the Technical Secretariat" (Damiani et al. 2022).Therefore the EU Commission EF Team was involved as an observer of the development process of the PEFCR A&FW.

Beside the obligation regarding the market representation, there are mechanisms in place that aim to ensure that various interest groups have the chance to involve themselves in the development of the PEFCR. These include public consultations, which were very actively used with contributions from over 80 organisations in the first consultation and over 250 organisations in the second consultation (Quantis Switzerland 2025b). However, participation by brands and industry associations, particularly from the natural fibre industry, dominated

[65] This chapter was written by Hannah Lorösch, Katja Moch and Florian Antony from Öko-Institut.

[66] Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations (2013/179/EU)

here as well. On a positive note, many SMEs also contributed to the public consultations. Nevertheless, it should be noted that the opportunity to contribute to the development of the PEFCR through public consultation was limited in the case of the PEFCR A&FW. This was partly because the initial consultation was based on an incomplete version of the PEFCR, making it difficult to comment on its content. Relevant methodological and data-specific questions remained unresolved even for the second consultation. Furthermore, it is difficult to ascertain how stakeholder input was incorporated into the final revision of the PEFCR, given that, unlike in the development of previous PEFCRs, no document containing responses to the comments received has been made available. In terms of stakeholder participation, the PEFCR A&FW represents a step backwards and there is space to further improve transparency and integrity of the process in future.

Finally, each PEFCR must undergo a review and approval process by independent experts and member state representatives. The reviewers of PEFCR A&FW[67] were unable to identify any major objectives and concluded that the PEF studies conducted in accordance with this PEFCR lead to reproducible results, which can therefore be used for comparisons under the specified conditions[68].

12.2 Product sub-categories, functional unit & most relevant impact categories and life cycle stages

The PEFCR distinguishes the following main product sub-categories for apparel:

1. T-shirts
2. Shirts and blouses
3. Sweaters and midlayers
4. Jackets and coats
5. Pants and shorts
6. Dresses, skirts, and jumpsuits
7. Leggings, stockings, tights, and socks
8. Underwear
9. Swimwear
10. Apparel accessories

Each subcategory is further described and mapped to CPA/NACE codes.

The functional unit of the PEF-studies conducted according to the PEFCR 'is to provide an apparel or footwear product to **meet the user's specific needs** for **one use**, as defined per sub-category" (Quantis Switzerland 2025b). The consumer's need is described per subcategory, for the first subcategory (T-shirts), it is defined as a 'Garment to cover the upper body to the elbow". Furthermore, a level of quality is defined, which excludes the presence of defects that would lead the consumer to discard the product. The quality aspect is covered by the Intrinsic Durability Multiplier (IDM) (see chapter 12.4.1). One use 'is defined as a 24-hour period, regardless of how many hours the apparel or footwear product is worn within this 24-hour period. A use may not always include a washing step as some products only require washing after a few uses" (Quantis

[67] The review panel is constituted as follows: Ugo Pretato from Studio Fieschi & soci (Chair – LCA expert), Laurent Maeder from Maeder Conseils (Industry expert) and Sonia Valdivia from World Resource Forum (NGO representative).

[68] Those conditions are namely comparison only between products from the same sub-category. In doing so, "comparison and comparative assertions of products of the same sub-category should acknowledge the vast variety of products and their functions within that sub-category." Furthermore it is not allowed to use single score results for making comparative assertions, at least the first four most relevant indicators have to be used (Quantis Switzerland 2025b).

Switzerland 2025b). The average amount of uses per product duration of service (DoS)[69] is based on Cascale (2024) and can be modified by the IDM and the repairability multiplier (RM)[70]. To derive the reference flow for fulfilling the functional unit, the total amount of products needed in the life cycle is divided by the amount of uses in the products DoS.

Using a T-shirt as an example, this would look like this:

$$Reference\ flow_{T-shirt} = \frac{Total\ Life\ Cycle\ Impact_{\ T-shirt}}{DoS_{T-shirt}} \text{ with } DoS_{T-shirt} = 45\ uses * IDM * RM$$

A representative product was selected for each product subcategory and for those representative products PEF studies were conducted using the PEFCR A&FW. Based on these results, a hotspot analysis was carried out to identify the most relevant impact categories, life cycle stages and processes. The hotspot analysis is presented in Table 55 and Table 56 for the apparel subcategories. The most relevant processes depend strongly on the representative product and are therefore not described in detail here.

Table 55: Hotspot analysis identifying the most relevant impact categories for the apparel sub-categories

Impact Category (6 most relevant ones)	Average relevance of the impact category for all apparel sub-categories (RP1-RP10) in % (weighted results)
Climate Change	19.6
Particulate Matter	17.9
Resource use, minerals and metals	11.2
Water use	9.7
Resource use, fossils	6.9
Acidification	5.5

Source: Own calculation, based on Quantis Switzerland (2025b), Table 12

Table 56: Hotspot analysis identifying the most relevant life cycle stages for the apparel sub-categories in terms of their contribution to the most relevant impact categories

Life Cycle Stage	Average relevance of the life cycle stages for all apparel sub-categories (RP1-RP10), qualitative assessment
Raw Material Production	High
Manufacturing	Medium-High; less important for Acidification, partly important for water use
Use Phase	Low-Medium for most RPs; important for RP8 (Underwear) and RP9 (Swimwear)
End of Life	Low, not listed as most relevant life cycle stage for any RP

[69] The product duration of service covers the first use as well as all kind of reuses after the product has been discarded/donated/resold by the first user.

[70] The Repairability Multiplier is a factor that is calculated based on four criteria: the Repair cost ratio (RC), the availability of spare parts, the provision of a repair service and the availability of information on repair. The RC is the criteria having the highest impact on the RM; it is calculated by the repair cost divided by the product selling price. The RM has a minimum value of 1 (no impact on the duration of service) and a maximum of 1.15 (Extension of the duration of service by 15%).

Life Cycle Stage	Average relevance of the life cycle stages for all apparel sub-categories (RP1-RP10), qualitative assessment
Distribution	Low, not listed as most relevant life cycle stage for any RP

Source: Own analysis, based on Quantis Switzerland (2025b), Table 13.

12.3 Comment on consideration of biodiversity and microplastic

The consideration of both the impact on the biodiversity and the effect of the release of microplastic or microfibres[71] takes place in form of additional environmental information. As such both aspects are not considered as stand-alone impact category and are therefore not included in the calculation of the total PEF score either.

12.3.1 Microfibres

The calculation of the fibre fragment impacts is currently limited to the impact on marine biota and sediments. Furthermore, for now only the fibre fragments coming from the care cycle in terms of the fibre release during domestic laundering are considered using secondary data from the most recent Microfibre Data Portal Insights of The Microfibre Consortium (TMC) (TMC 2025a). Microfibre release during the production of raw materials, manufacturing of the textile, inclusive dyeing and finishing processes, during the use phase (in terms of wearing) of the textile product and during the end-of-life (treatment) is not included.

This is particularly problematic as studies by TextileMission (Bendt et al. 2021) have shown that water-based finishing processes release a significantly larger amount of fibre fragments than household laundry. In addition, wastewater treatment in the manufacturing countries is often poorer compared to the EU, which means that a larger proportion of the released fibre fragments can actually end up in the environment. Accordingly, emissions of fibre fragments are even more problematic in this case (Bendt et al. 2021). Furthermore, the analysis focuses purely on emissions into water. There are not yet many studies on the emissions of fibre fragments into the air. However, it is already clear from the existing studies that a not insignificant proportion of the emissions occur via the air: According to Falco et al. (2020) emissions via the air are of a similar order of magnitude compared to emissions into wastewater. Napper et al. (2023) even come to the conclusion that the atmospheric deposition of synthetic microfibres is the dominant emission pathway, which is much larger than the release via treated wastewater. In addition, especially for natural fibres, a considerable proportion of fibre fragments are released into the air during wear (Napper et al. 2023; Cross Industry Agreement 2020). The emission path through the air is also not subject to any treatment method, which means that these fibre fragments can accumulate directly in the environment. Accordingly, the analysis can only be interpreted as a first step that does not yet allow any comprehensive conclusions to be drawn about the actual environmental impact of fibre fragmentation.

Still the database of TMC is the best currently available. By now 1,431 fabrics have been tested. There is a bias in the testing frequency with 35.5% of the tested fabrics consisting of 100% polyester, compared to 6.5% consisting of 100% cotton. The most common yarn type submitted to the portal is filament, the most common structure type is weft knit (TMC 2025a). The median fibre fragment loss has to be selected according to the used fabric structure and yarn type; values for 2025 can be seen in Table 57. Here you can also see the difference in the underlying

[71] The PEFCR A&FW is following the approach of 'The Microfibre Consortium' in taken into account all fibre fragments, both from synthetic and from natural fibres (2025b).

number of tests. Accordingly, the uncertainty of the data statement is to be classified as high, especially for woven, warp knit and staple fibres. In addition, it is not possible to differentiate directly by fibre type and natural fibres are underrepresented in the average median values. In addition, the high standard deviation values show that there is a large variance within the fibre fragment releases of the individual categories. Another limitation in the significance of the data is the underlying test method. The TMC-method, which is comparable to the quick test described in DIN EN ISO 4484-1:2023, is well suited to demonstrating the intrinsic tendency of fibres to shed fibre fragments during washing. However, Bendt et al. (2021) concluded that test methods such as the one proposed by the TMC do not always reflect emissions during the actual household laundry.

Table 57: Data on fibre fragment release from the TMC Microfibre Data Portal, 2025

Fabric structure		Filament	Staple
Weft knit	Median fibre fragment loss (g/kg)	0.399	0.619
Weft knit	Standard deviation	0.839	2.044
Weft knit	No. tested fabrics	469	169
Warp knit	Median fibre fragment loss (g/kg)	0.238	0.610
Warp knit	Standard deviation	2.031	0.441
Warp knit	No. tested fabrics	126	9
Woven	Median fibre fragment loss (g/kg)	0.314	0.510
Woven	Standard deviation	0.598	0.729
Woven	No. tested fabrics	252	134

Source: Figure from TMC (2025a).

TMC also records the dyeing and finishing methods that were applied to the fabrics tested. However, with regard to the indicators for the calculation according to the PEFCR A&FW, no distinction can be made according to the treatment method. This is also due to the currently available characterisation factors (CFs) that quantify the influence of fibre fragment release on marine biota and sediment. The characterisation factors are based on generic properties of the microplastic particles (e.g. density, size, shape, polymer type), not on chemical or physical modifications by additives used in dyeing or finishing processes. Furthermore, the ecotoxicity of additives attached to or contained in fibre fragments is not considered here, as it is still not well understood and requires further investigation. There are characterisation factors for 17 different fibre types. Due to insufficient data on the exposure and effect of cellulosic fibres in water and sediments, for natural and semi-synthetic fibres the values of the exposure and effect factors (EEFs)[72] were taken as 50% of the EEFs of synthetic fibres. Considering the potential effect on sediments in the CFs additionally to the one on marine water, strongly increases the CFs of high-density materials, as they quickly sink to the bottom of the sea (Saadi et al. 2025).

[72]For the calculation of characterisation factors exposure and effect factors are combined. Exposure factors describe the extent to which ecosystems are exposed to the released substance by taking into account the distribution, the persistence and how it is taken up by organism. The effect factors quantify the severity or probability of damage caused, e.g. by the uptake of fibre fragments in marine biota.

In summary, it can be said that both the fibre shedding rates from the TMC database and the CFs are still associated with a high degree of uncertainty. Against this background, it seems sensible not to include the results of the impact calculation of fibre fragment release in the calculation of the single score results at this stage. This also means that the consideration of fibre releases in the current PEFCR, at least for the time being, could be seen inadequate. Based on the current methodological and data-specific foundations, it cannot be concluded that the environmental issue of microfibre release is adequately addressed[73]. In order to reduce the uncertainties in the data, further combinations of different fibres, yarn types, fabric structures and treatment processes should be tested. To systematically improve the database and not be dependent on the results of voluntary tests, it is conceivable to integrate a test requirement or information obligation for fibre release within the framework of ESPR. To avoid disproportionate testing costs, it would be possible to start with a certain percentage of the product portfolio or with products with a high market presence (see Chapter 8.4). In order to fully account for the emission of fibre fragments, further research is also needed to include emissions into the air during the use phase and emissions during the manufacture of textiles.

12.3.2 Biodiversity

Even though biodiversity is considered as relevant for all the textile sub-categories, no attempt is made to present the impact on biodiversity as a separate impact category. The influence of a company on biodiversity has to be indicated as additional environmental information using the mass-related proportion of organic certified materials in the total product. However, this information does not influence the overall score of the product (Quantis Switzerland 2025b). Furthermore, companies can provide information on other biodiversity-promoting projects they have carried out or other product- and/or company-related information about their participation in other certifications, such as ZDHC's Manufacturing Restricted Substance List (MRSL) (Stichting ZDHC Foundation 2025). Insofar as they are environmental claims, the information must be substantiated with evidence and verified in accordance with the Directive on Empowering Consumers for Green Transition (Directive 2024/825 2024) adopted in February 2024 and the Green Claims Directive, which is still in the process of being adopted.

The lack of quantifiable consideration for biodiversity is also reflected in the selection options for background data sets; for example, there is no specific data set for organic certified cotton (Quantis Switzerland 2025b). The cultivation of certified organic cotton avoids the use of mineral fertilizers, pesticides, and other chemical additives, which not only has a positive effect on biodiversity but also on other environmental impact categories such as greenhouse gas potential and eutrophication potential (Teufel et al. 2024a).

The lack of data for organic cotton is particularly relevant because cotton cultivation has a very significant impact on some environmental impact categories and also has a considerable influence on the overall PEF-score. Taking the T-shirt (representative product RP 1) as an example, cotton cultivation accounts for around one third of the weighted total environmental impact (see Table 58). Individual environmental impact categories such as water use or eutrophication are almost exclusively influenced by cotton cultivation. Accordingly, adjustments

[73] In the proposal for the Green Claims Directive, it is stated that "category rules for specific products or traders can be used to support the substantiation of claims in line with the requirements of this Directive. [...] However, in case the Product Environmental Footprint method does not yet cover an impact category, which is relevant for a product group, the adoption of PEFCR may take place only once these new relevant environmental impact categories have been added. [...] As regards textiles, the PEFCR should for example reflect the microplastics release, before the adoption of PEFCR could be considered." ((European Commission 2023a).

in cotton cultivation, such as reducing the use of pesticides and fertilisers, not only have an unquantified impact on biodiversity in this case, but also on the overall PEF score.

Table 58: Contribution of cotton cultivation per impact category for RP 1 (T-shirt)

Impact category	Contribution of cotton cultivation* in %
Climate change	18%
Particulate matter	26%
Acidification	34%
Eutrophication	68%
Water use	86%
Resource use, minerals and metals	11%
Resource use, fossils	11%
Single overall score	31%

*namely following process: Cotton fibre {GLO} | technology mix | production mix, at farm | 'as is' delinted product | LCI result

Source: Quantis Switzerland (2025c), Annex I-LCI_v3.1.

To wrap up, it can be said that according to the PEFCR A&FW, these positive effects of organic certified cotton are not taken into account in the calculations and therefore not in the product score. As a result, products made from organically certified cotton fibres are presented in a comparatively worse light than they actually are, and the efforts of companies are not reflected in the product score.

12.4 Data input and significance of the results

The PEFCR A&FW sets out clear rules on which activity data must be recorded. This selection is intended to cover the most important information having a significant impact on the environmental impact of the product. But the challenge is that most of the processes along the value chain of a textile are not carried out directly by the company that conducts the PEF-profile. Therefore, the company-specific data that must be collected is limited to information that is widely considered to be readily available across the industry (see Table 59, middle column). Information on some of the mandatory data points may be more difficult to access, such as the proportion of unsold goods or air cargo distances at company level. However, these have been retained as mandatory data points due to their significance for environmental impact (Quantis Switzerland 2025b).

Table 59: Requirement of the PEFCR A&FW regarding mandatory and mandatory, if available, company-specific data per life cycle stage

Life cycle stage	Mandatory company-specific data	Mandatory, if available
LCS1: Raw materials acquisition and pre-processing	• At least 95% of the product's Bill of Materials (BOM) by weight, covering 100% of the main fabrics, lining, padding, and electronic parts and metals • If the BOM isn't available, product weight and reference size	• Raw materials transport distances, modes, share of raw material mass transported for each transport leg, and utilisation rates for trucks

Life cycle stage	Mandatory company-specific data	Mandatory, if available
	• Raw materials mass transported	
LCS2: Manufacturing	If the BOM isn't available, assembly loss rate for the product studied	• Manufacturing technologies • Other processing loss rates • Energy mix of the manufacturing steps for the product studied –exempted for SMEs • Intermediate product transport distances, modes, share of semifinished product mass transported for each origin and utilisation rates for trucks
LCS3: Distribution	• Air cargo distances at company level • Air cargo share of product mass transported for each origin at company level • Product weight (if not collected in LCS1)	• Product transport distances, modes, share of product mass transported for each origin and utilisation rates for trucks
LCS4: Use	• Apparel: Product type, if delicate product or sportswear	N/A
LCS 5: End of Life	N/A	N/A
General	• Share (% product) of unsold consumer products at product sub-category or product category (apparel and footwear) level	• Highly recommended but **not mandatory** – intrinsic durability tests and repairability information (product selling price in the EU, and repair documentation)

Source: Quantis Switzerland (2025b), Table 15.

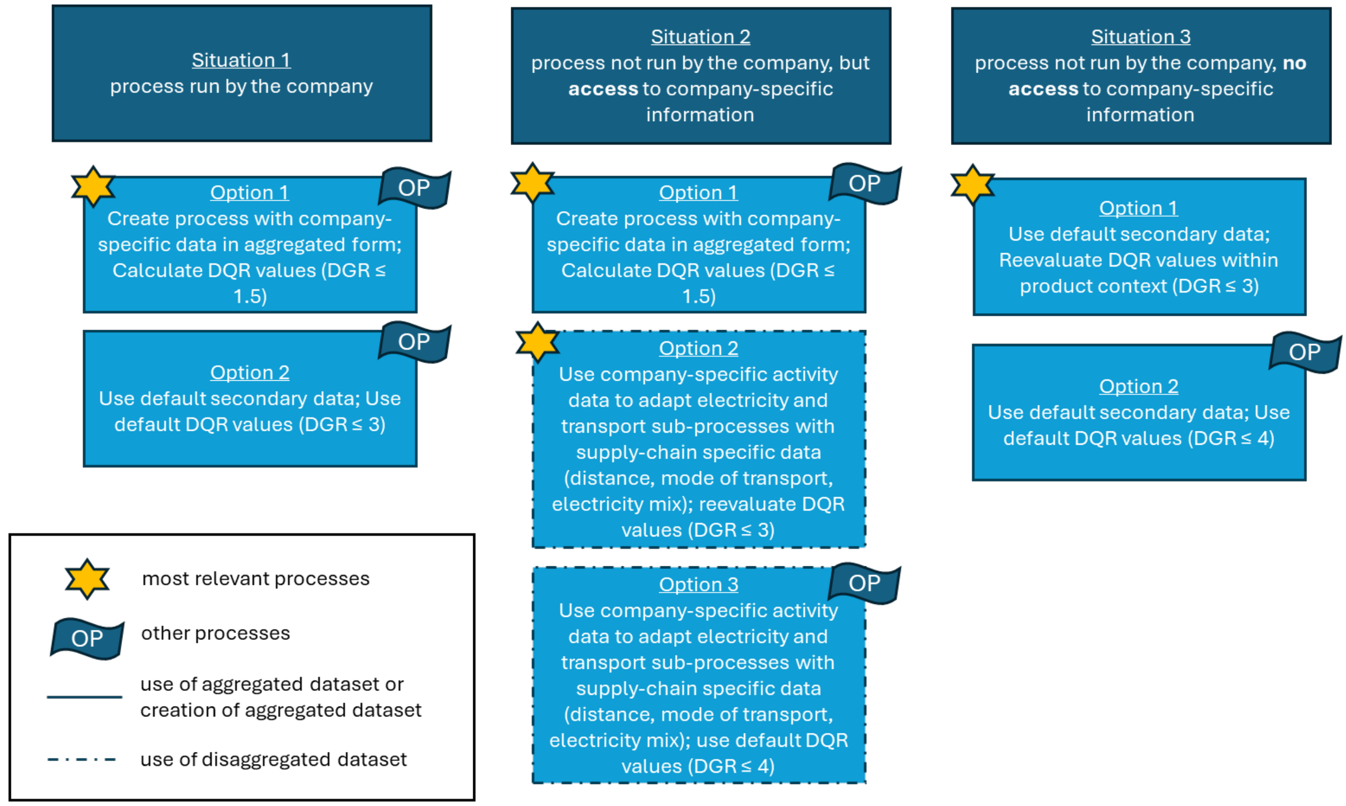
There are several other data inputs that are mandatory if the company has the relevant information available. These include, for example, the allocation of the appropriate manufacturing technologies, the adjustment of processing loss rates or the energy mix in the manufacturing processes.

For all data entries that are not already specified as mandatory, the PEFCR A&FW uses the Data Needs Matrix to define a scheme that shows the options available to the creator of a PEF profile when selecting data.

In principle, a distinction is always made here between the most relevant processes and other processes. Most relevant processes are those that account for at least 80% of a product's overall environmental impact. They are identified in the PEF-RP study (representative product study) and reported for each product subcategory (Quantis Switzerland 2025c). It should be noted that the representative products do not represent a real product from a manufacturer, but rather an average product with a BoM based on European market shares. For products that are manufactured in a particularly sustainable manner or that use materials that are not common on the market, there may therefore be a deviation in the most relevant processes for this specific product. The most relevant processes are subject to stricter data quality requirements, which must also be re-evaluated in relation to the product-specific context.

Figure 34 illustrates the data selection process.

Figure 34: Procedure for data selection based on the data needs matrix



[74]

Source: Own compilation based on Quantis Switzerland (2025b)

As already mentioned earlier, in the case of a textile manufacturer, situations 2 or 3 will probably apply to most data sets, as in most cases all or a large part of the processes from raw material extraction to the manufacture of the end product are not carried out by the company itself.

If no company-specific information is available from the supply chain, or if it is available but the expertise to develop an own EF-compliant data set[75] cannot be built up internally or commissioned (which is particularly likely in the case of SMEs), the possibilities for influencing the PEF result are limited. If we play out this scenario using the example of ring spinning 1 kg of yarn, the creator of the PEF can adapt the electricity mix to the mix of the manufacturing country or to the supplier-specific mix, for example if certified green electricity is purchased; however, the auxiliary chemicals used or the amount of energy consumed can only be influenced by creating an EF-compliant data set. This illustrates how important it is to have a comprehensive

[74] Let's explain the data needs matrix with an example: A company does not run the process of dyeing, but they receive specific information from the supplier of the dyed goods, e.g. from an internal LCA analysis carried out by the supplier (= situation 2). Now they have to check whether dyeing is a relevant process for the product under consideration. If it is a relevant process, they have two options: 1. Creation of a completely new data set 2. Use of the available disaggregated background data set, in which case the transport distances and transport types as well as the electricity mix (e.g. 100% electricity from the country of manufacture instead of a global mix as in the secondary data set) are subsequently adjusted. Depending on the option selected, different data quality requirements must be met.

[75] EF-compliant datasets should follow the scope of primary data collected in the corresponding dataset in the EF database. Beside a complete documentation compliant with the ILCD format and a calculation of the data quality rating, a review by a qualified reviewer and a separate review report is needed. Therefore, the effort is equivalent to a PEF study, but without a study report with results analysis etc.

selection of background data sets[76] that map a wide variety of processes and that these are kept up to date. At present, however, these are often based on (older) literature data or data from a specific company. Given the wide variation in energy consumption and auxiliary materials used in textile processes, as revealed by the analysis of Roth et al. (2023) of best available techniques in the textile industry, the transferability of the assumptions made in the background data sets must be questioned.

Furthermore, for the most relevant processes the PEFCR demand a re-evaluation of the data quality ranking (DQR) values, both for modified datasets and when using secondary datasets. The DQR values are averaged over four data quality criteria: technological representativeness (TeR), geographical representativeness (GeR), time-related representativeness (TiR) and precision (P). For all criteria, values between 1 (Excellent data quality) and 5 (Poor data quality) are possible. The methodology of determining the data quality level of a dataset varies slightly between newly created company-specific datasets and the re-evaluation of secondary datasets or modified secondary datasets. The main difference is that in the case of the creation of a new dataset all criteria have to be calculated at a level-1 disaggregation, before an aggregated weighted DQR for the whole process is calculated based on the most relevant sub-processes and elementary flows. In contrast, in the context-specific re-evaluation of already existing DQR, the original value for the criteria precision is kept, whereas the criteria TeR, TiR and GeR have to be assessed in the product-context again. If the dataset is modified with a specific electricity mix of the company-specific manufacturing places (only applicable for Situation 2, Option 2), additionally the GeR criterion is lowered by 30% (Commission Recommendation (EU) 2021/2279 2021; Quantis Switzerland 2025b).

In many cases, however, an adequate re-evaluation of the data sets is made difficult by a lack of transparency regarding the sources and assumptions underlying the data set. In some cases, there are only rudimentary descriptions of the technologies included in the data sets, and it is not possible to determine from the aggregated data sets, for example, which operating resources were taken into account and to what extent. Quite apart from this, it can be assumed that a technical assessment of specific raw material extraction processes or specific manufacturing processes poses a challenge for the creators of PEF profiles, whose expertise does not normally extend to the processes of their suppliers. As a result, the assessment of data quality itself is subject to considerable uncertainty. This creates the risk that apparently favourable Data Quality Ratings (DQR) may obscure actual uncertainties and deficiencies in the underlying data quality.

Furthermore, it is also possible that the only distinguishing features between two products in the same subcategory lie in the mandatory activity data, if the default secondary data is used for all other data. In this case, the result is largely determined by the materials used (the BoM). Since cotton cultivation in particular has a major impact on the overall score (e.g. 31% for the RP T-shirt) (Quantis Switzerland 2025c), the possibility of a product-specific adjustment, e.g. of the amounts of fertiliser and pesticides used, via the selection of a data set for organic cotton would be very helpful here.

On the positive side, however, there is already a relatively large selection of data sets in some areas. For example, the data set for ring-spun spinning processes can be selected specifically for the fabric structure (knit or woven), specifically for the yarn fineness to be achieved, and specifically for the processing of cotton.

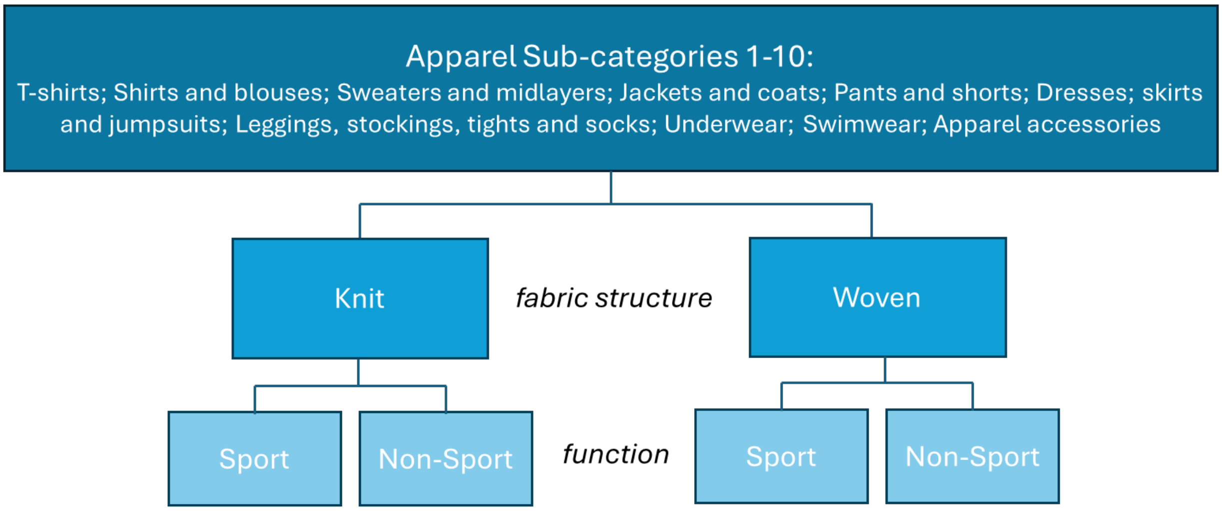
[76] Organisations conducting a PEF-study have to use EF-compliant datasets, which are provided free of charge by the EU Commission with the EF 3.1 database. The database was not developed by the EU Commission itself, but consists of various individual databases, either publicly available data or commercial databases, such as ecoinvent.

12.4.1 Comment on Intrinsic Durability Multiplier

The IDM (Intrinsic Durability Multiplier) in the PEFCR A& FW is a factor that takes into account the durability of a product in the environmental assessment. It reflects how durable an item of clothing or a pair of shoes[77] is compared to the average reference product. Products that are demonstrably more durable (due to the physical durability tests) receive an IDM > 1. This reduces their environmental impact per use in the PEF profile because they can be used for longer. The IDM can reach a minimum of 0.67 (lowest durability) and a maximum of 1.45 (highest durability). This can be translated up to a 50% higher environmental impact per use for a product with low durability and up to a 30% lower environmental impact per use for a product with high durability, whereas an IDM of 1 means that just the default lifetime value of the product is used. The IDM factor was deliberately limited to this range, as there is currently only limited knowledge about the extent to which the physical durability of a product actually extends its service life.

The intrinsic durability tests are not mandatory, but highly recommended. In case no intrinsic durability tests are conducted for a product, a default intrinsic durability multiplier of 0.67 is used. For the test protocol the sub-categories are further segmented based on the fabric structure (knitted/woven) and the function (sport/non-sport) (see Figure 35):

Figure 35: Apparel sub-categories for identifying the relevant durability tests



Source: Own compilation based on Quantis Switzerland (2025b), Figure 3

When durability tests are conducted, they have to be carried out per product, whereby a product is defined by its individual specific material composition, material construction, fabric weight, dyeing method, fabric treatment and finishes used. If there is a deviation in any of these areas, the tests must be repeated. For products that are available in different colours, the tests must be carried out at least with the product in the darkest colour[78]; additional tests with other colours are also possible, in which case the average of the results is used. In principle, testing on a product level is preferred and mandatory for tests that require prior washing. However, testing

[77] The PEFCR A&FW formulates criteria both for clothing and footwear. Footwear was excluded in the preparatory study for the ESPR for textiles as the heterogeneity between footwear and apparel was considered to be too high for setting common ecodesign requirements (Delre et al. 2024a). Therefore, the following analysis focuses on durability criteria for apparel.

[78] Since this requirement refers only to the colour tone and not to a specific dye, this could result in a loophole. Manufacturers could initially use a high-quality dye to conduct the tests and then switch to another, cheaper dye with the same colour tone without having to conduct new tests.

may be carried out at material level if permitted by the test method, provided that the material is not subjected to any further treatment afterwards. For each durability test that has to be carried out, the test results are assigned to one of three levels (basic level = 5 points, moderate level = 10 points, aspirational level = 15 points). If the test results are below basic, the test score is 0. Some of the tests are clustered into related test groups, e.g. for knitted T-shirts both testing of the abrasion resistance and the bursting properties are assigned to the test group 'fabric strength". If one of the tests in the group is categorised as critical for the intrinsic durability, at least the basic level must be achieved here, otherwise the other tests in this group are also given 0 points. Furthermore, the tests are weighted according to their relevance for durability, whereby the selection of relevant tests and their weighting is specific to the respective apparel sub-categories. For the overall score, the individual test scores are added together based on the specific weighting. The Intrinsic Durability Product Score (IDPS) calculated in this way will be between 0 and 15. Products with an IDPS ≤ 2.5 will receive the lowest IDM of 0.67. If the IDPS is > 2.5, the IDM is calculated as follows:

$IDM = 0.514 + (0.0624 \times IDPS)$

The durability tables do not apply to genuine fur or genuine leather apparel products, to menstrual underwear and to small series[79]. In these cases, the IDM equals 1. For small series, durability testing is optional.

The test methods for the IDPS are only to a certain extent comparable to the test methods proposed in the JRC's preparatory study (Delre et al. 2024a). Both refer to the care label in combination with the ISO 6330 standard for the simulation of the washing process. However, for the PEFCR, the products must undergo fewer washing cycles[80] compared to the suggestions of 30 washing cycles for T-shirts in Delre et al. (2024a) (2nd milestone report). In the author's opinion the amount of washing cycles demanded by the PEFCR is too low to derive meaningful results for the durability of the product's lifespan. Apart from that, the PEFCR test protocols are more detailed, taking the design and functionality of the product into account by dividing requirements after fabric construction and intensity of use. The required test methods vary accordingly: For example, knitted T-shirts must be tested for pilling and bursting strength, whereas woven T-shirts are not tested for these properties; instead, test methods for tear and tensile properties are required. In contrast, the test methods proposed in the JRC's preparatory study seem to focus on knitted T-shirts.

Still, there are many overlaps between the testing methods selected for ESPR and those of the PEFCR, such as the use of ISO 15487 for most of the tests regarding colour or fabric changes after washing. However, not all test results that must be determined for compliance with ESPR can be used one-to-one for the calculation of the IDPS. Another difference is that according to the PEFCR for products of the same collection that just vary in their colour average, results can be either based on the product with the darkest colour only or on average results of different colours. In the preparatory study such simplification of the test procedure has not yet been addressed (Quantis Switzerland 2025a; Delre et al. 2024a). In principle, greater harmonisation of PEFCR and ESPR requirements makes sense in order to reduce the compliance burden on companies.

[79] A small series is when fewer than 1,000 units of a specific model-material combination (e.g. a specific T-shirt) are produced worldwide per year, and the brand does not make more than 500 such unique combinations (product references) in the same product category each year.

[80] Namely 5 washing cycles for dimensional stability and spirality tests and 15 washing cycles for appearance tests (exception for products with hand wash symbol, then 5 washing cycles).

Table 60: Comparison of the required normative tests for T-shirts and polos (JRC) and T-shirts, Segment: Knit, Non-sport (PEFCR A&FW)

Required test categories	Preparatory study JRC: Normative test and value for new product	PEFCR A&FW: Normative test and basic level value	Weighting according to the PEFCR A&FW
Dimensional change	ISO 3759 (Basic standard for many test procedures); washing according ISO 6330: ±5%	•ISO 6330/ISO 5077 (dimensional change): 5 < x ≤ 7%; •ISO 16322-3 (Spirality): 6 < x ≤ 8%;	12% 12%
Bursting resistance	ISO 13938-2: ≥ 160 kPa	ISO 13938-1 (or 2): 200 < x ≤ 300	12%
Pilling resistance	ISO 12945-1: Grade ≥ 4	ISO 12945-1: X = 2/3	4%
Abrasion resistance	-	EN ISO 12947-2: 8,000 < x ≤ 10,000	8%
Appearance assessment	ISO 15487 for: • Colour change: Grade ≥ 4 • Pilling: Grade ≥ 4 • Trimmings aspect: Grade 5 • Self-staining: Grade 5	ISO 15487 for: • Colour change (Prints & embroideries): Grade 3 • Colour change (Main fabric): Grade 3 • Pilling: Grade 2/3 • Trimmings aspect: Grade 3 • Functional accessories: Grade 2-3 • Holes and broken yarn: either aspirational level (no holes) or below basic level (presence of defect)	4% 12% 8% 4% 12% 12%

Source: Own compilation based on Delre et al. (2024a), Table 44 and Quantis Switzerland (2025a), Table 6
The values of the preparatory study refer to characteristics of a new product before washing. For the base case, which might be the most equivalent to the basic level of the PEFCR, the JRC defines a performance decrease between 30% and 50% after the washing cycles. For the dimensional change the value for the base case after washing would be then ±6.5%–7%. The values of the PEFCR A&FW refer to values after defined washing cycles: 5 washing cycles for dimensional stability and spirality tests and 15 washing cycles for appearance tests (exception for products with hand wash symbol, then 5 washing cycles).

Besides the physical intrinsic durability, there are other factors with a great impact on the lifetime of a product: namely design for good fit and extrinsic factors such as the business model of the brands as represented, for example, by the Renewal Rate[81]. About 28% of the products are discarded due to poor fit, 35% due to a low perceived value. The causal relationship between extrinsic factors and the lifetime of a product, as well as the relative importance of the individual factors, cannot currently be scientifically substantiated. For this reason, the PEFCR focused on physical intrinsic properties and the repairability multiplier. Extrinsic factors will be taken into account in the next revision of the PEFCR (Quantis Switzerland 2025b).

[81] The Renewal Rate is defined as the collection renewal frequency. A high renewal rate can both increase the perceived value of products by signalling exclusivity and decrease it as products are quickly replaced by new trends, encouraging more purchases overall.

12.4.2 Comment on the use of chemicals and auxiliary materials in manufacturing processes

As mentioned previously, it is not possible to modify the chemicals used in the manufacturing processes. If a company does not create its own dataset, its ability to influence is limited to selecting the dataset that best reflects the actual process. What does this mean in the case of the dyeing process? It is worth noting positively that the EF 3.1 database represents a wide, yet not exhaustive range of dyeing processes (see Table 61). However, even for the disaggregated datasets, it is often difficult to ascertain which chemicals and auxiliaries are used specifically, as well as how the production of these chemicals is itself modelled. For example, it would not be possible to display the difference if chemicals from renewable resources would have been used or chemicals from fossil sources. Due to the considerable variance in possible dyeing processes, some datasets aggregate different dye classes within a single dataset. For example, the dataset 'dyeing, continuous, direct, sulfur, vat or reactive dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric' can be used for four different dye classes. This simplified aggregation of different processes means that certain dye-specific details are not represented. In the dataset description explicit reference is only made for two of the dyes. Furthermore, for reactive and direct dyes, cationic aftertreatment agents—which are often used for dye fixation—are absent. Additionally, the inclusion of a liquor ratio in the dataset description for a continuous dyeing process is misleading, as a pick-up rate would typically be specified in this context. Generally, all dyeing processes cover only a shade depth of around 2%. As a result, variations in dye consumption for lighter or darker shades are not represented. The aim to differentiate products with a lower environmental footprint from products with a higher footprint with the generic data could not be fulfilled.

In order to assess the effect of this generalisation or simplification in certain datasets, it would be advisable to model the processes as accurately as possible using primary data from various companies, or alternatively, to conduct sensitivity analyses, for example by applying a different dye shade. This would make it possible to estimate the range of results, that is, to understand the extent to which changes in the dyeing process affect the environmental impacts of the final product. Based on this, it could be determined whether further differentiation of dyeing processes is necessary.

Table 61: Background datasets for dyeing processes in the EF 3.1 database

Process type	Dye (classes)	Dataset name
Waterless	Not specified	dyeing, waterless; Dyeing; production mix, at plant; textile service for 1 kg of fabric
Solution	Blue pigment	dyeing, solution (dope); Dyeing; production mix, at plant; textile service for 1 kg of fabric
Continuous	Disperse, cationic	dyeing, continuous, disperse or cationic dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric
Continuous	Direct, sulfur, vat, reactive	dyeing, continuous, disperse or cationic dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric

Process type	Dye (classes)	Dataset name
Continuous	Acid	dyeing, continuous, acid dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric
Batch	Unspecified	dyeing, batch, warp-beam; Dyeing; production mix, at plant; textile service for 1 kg of fabric
Batch	Disperse, cationic	dyeing, batch (incl. piece, jet, jig, kier, yarn), disperse or cationic dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric
Batch	Acid dyes	dyeing, batch (incl. piece, jet, jig, kier, yarn), acid dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric
Batch	Direct, sulfur, vat, reactive	dyeing, batch (incl. piece, jet, jig, kier [fibre], paddle, pad-batch, yarn), direct, sulfur, vat or reactive dyes; Dyeing; production mix, at plant; textile service for 1 kg of fabric

Source: Datasets from EF 3.1 Apparel_1_public made available by ecoinvent (2025).

12.5 Relevance of the PEFCR for the ESPR

Some EU-level policy processes and regulations refer to recognised life cycle analysis methods for calculating environmental impacts: In some cases, the PEF method is recommended directly (e.g. in the draft Green Claims Directive), or the role of PEF methods is indicated (e.g. in the Circular Economy Action Plan, the EU Taxonomy Regulation, the European Sustainability Reporting Standardsand the ESPR). However, none of these regulations stipulate the calculation of a PEF as a mandatory requirement. However, the Battery Regulation, which came into force in 2024, requires the calculation and communication of a battery's CO_2 footprint in accordance with the PEFCR Batteries specifications. Subsequently, the EU Commission will define performance classes for batteries based on the information collected through the carbon footprint declarations, and conduct an impact assessment to establish carbon footprint thresholds that must be met by batteries placed on the European market (European Parliament; European Council 2023).

Due to its product focus, the PEF method is generally suitable for cross-application or use in connection with product regulations such as the ESPR. The recently developed PEFCR for A&FW provides product group-specific methodological approaches for calculating a PEF. This provides the fundamental prerequisite for the comparability of product results calculated according to the PEFCR. In the preparatory study for the ESPR, explicit attention was also paid to aligning the product groups with those proposed in the PEFCR. However, the calculation of a PEF has not yet been mentioned as a possible mandatory minimum requirement in the JRC's preparatory study (Delre et al. 2024a). Furthermore, there is currently no complete alignment of the assessment of the durability between the PEFCR A&FW and the suggestions in the preparatory study.

In view of the limitations and challenges associated with calculating a PEF according to the PEFCR A&FW analysed in the previous chapters, the authors of this study do not recommend (at this point in time) making PEF calculation mandatory for all textiles placed on the European market. The primary reasons and concerns are outlined below:

- **Scope of environmental impact categories**: With its approach of assessing 16 environmental impact categories, the PEF already covers a wide range. However, there are some environmental impact categories that have not yet been taken into account or have only been considered for informational purposes. These include the impact on biodiversity and microplastics (see chapter 12.3291), but also on animal welfare. In principle, it seems sensible to focus on the impact categories that are most relevant from a political perspective within the framework of a mandatory requirement. These impact categories do not necessarily have to correspond to the set of environmental impact categories according to the PEF method, especially as some of them are associated with significant methodological uncertainties.
- **Availability of suitable secondary data sets and lack of transparency**: The sources, assumptions and system boundaries underlying the secondary data sets are mostly not comprehensively traceable, making it difficult to select and assess the suitability of a data set for a product-specific context. In addition, secondary data sets are sometimes missing for processes that significantly impact the environmental footprint of textiles (e.g. data set for organic cotton).
- **Cost-benefit analysis**: Calculating a PEF for all products entering the European market involves a great deal of effort for companies, given the sometimes very extensive and rapidly changing product range. Calculating a PEF is particularly complex if you do not want to rely solely on secondary data sets, for example because you already source from suppliers who produce in an efficient and environmentally friendly manner and you want these efforts to be reflected in the results. This effort is probably not affordable or disproportionate, especially for SMEs. Accordingly, a cost-benefit analysis should first be carried out to show that calculating a PEF-study represents added value, particularly in terms of information gain and as a basis for consumer decision-making, and to examine whether this results in a pull effect towards a reduction in environmental impact (Antony et al. 2024). In addition, it should be evaluated whether this added value can be achieved with reasonable additional effort and a comparison should be made to determine whether the added value can also be achieved with less effort through other product policy or more company-related regulations, such as the Corporate Sustainability Reporting Directive (CSRD). Furthermore, it should be noted that, due to its product focus, the PEF method is not suitable for assessing the environmental impact of a company or the textile sector. System-related problems at a higher level, such as the problems of overconsumption and fast fashion, can only be addressed indirectly using such a method.
- **Comparability of results**: According to the PEFCR A&FW, a comparison of the PEF results of products in the same subcategory and with the RP of the subcategory is permitted, provided that the comparison does not only use the single score result. However, it is already highlighted that, even within a subcategory, there is a wide range of products with different functions. Light summer jackets, winter jackets and rain jackets, for example, all fall into the same subcategory. Without further restrictions on comparative statements within a subcategory, it would be possible to make misleading statements. A manufacturer, for instance, could claim that its product has a lower environmental impact than the market average (represented by the RP), when in fact the difference lies less in more sustainable production and more in lower requirements for the product's functionality and thus possibly lower material requirements or a lower need for technical equipment.

- **Uncertainties in the further process**: The PEFCR A&FW is valid until the end of 2027, after which a review will be necessary. Although the process for further method adaptation has been decided at an administrative level, it is not financially or legally binding. The voluntary participation of stakeholders from the respective industries is therefore necessary to enable the creation of new PEFCRs and the updating of existing PEFCRs. Furthermore, although an independent review of PEF studies is required and minimum requirements for verifiers in the PEF method are defined, there is currently no guarantee of a suitable pool of verifiers or a review body similar to market surveillance authorities.

  The data of the current EF database 3.1 is supposed to be used until end of 2025. In the interim until the new database EF 4.0 is launched (probably in 2027), companies will have to purchase EF-compliant datasets for those datasets that will not be extended (PEF Apparel Footwear 2025).

Despite the aforementioned restrictions on the application of the PEFCR in the product policy context of the ESPR, there are also some advantages to the systematic approach based on the PEFCR A&FW. These include the following points:

- Issues such as fast fashion and declining clothing quality are indirectly addressed via the IDM and RM: less durable and less repairable products are 'penalised' by increasing their environmental impact per use (see chapter 12.4.1). Through the sub-group-specific selection of test methods and further differentiation according to fabric structure and function, the test requirements according to the PEF cover the physical durability of textiles in a very specific way. Extrinsic factors, such as the perceived value of a product, cannot currently be taken into account, but the aim is to include these factors in the next revision.
- The PEFCR requires verification of all PEF profiles created. Accordingly, at least 100% of the 'mandatory' and 70% of the 'mandatory, if available' data (by number of data points) must be verified. In addition, it must be verified that sufficient efforts have been made to obtain data from suppliers. To this end, the creator of the PEF profile must explain why a data point is not available and, upon request, provide evidence of their efforts to obtain information. The mandatory verification process contributes to the mitigation of greenwashing practices.
- Tools offered to simplify the calculation of a PEF profile must be pre-verified. This involves a first verifying by recalculating the RP models and then a full verification of the first PEF study created with the tool. Subsequently, a randomised verification of five PEF studies per semester that were created using the tool must be carried out. The precise specifications for the verification of tools simplify the implementation of a PEF study. SMEs in particular rely on the availability of easy-to-understand tools that guide them through the process and accompany data collection, with mandatory data points already prepared as required input fields.
- The EU Commission is currently working on the EF 4.0 database. It is supposed to have an improved data accessibility and particular attention is paid to data quality and consistency. The expected launch is in 2027 (European Commission 24 Jan 2025). With the new database the suitability of an application of the PEFCR in the product policy context will have to be reevaluated.

In summary, it can be concluded that the mandatory requirement to conduct PEF studies for the entire product portfolio entering the European market should not be enforced without further support measures (especially for SMEs), an improvement in the available data sets and a cost-benefit analysis of the resulting additional benefits. In order to still make use of the comprehensive methodological work from the PEFCR to A&FW, the data and information gained from conducting PEF studies on a voluntary basis could initially be used as a basis for further improving the PEFCR A&FW: For less relevant processes, data collection could be simplified by requiring fewer mandatory company-specific data points. This mostly includes distribution, which was identified as a non-relevant life cycle stage. Other potentially relevant aspects (such as emotional durability) could be included instead. The impact of textiles on biodiversity and the environmental impact of the release of fibre fragments should also gain importance in the overall assessment of environmental impacts. Alternatively, PEF studies could initially be required only for the most relevant product groups in terms of quantity, and SMEs could be exempted from the requirements for the time being. Another option would be to initially require larger companies to contribute to the development of a better data basis by requesting and verifying certain company-specific data from suppliers.

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A Detailed results of certain analytical steps [some in German]

A.1 Results of market analysis on recycled content in T-Shirts

Table 62: Results of the market analysis on recycled content in T-shirts made from cotton and polyester

Fibre type	material composition	Frequency of material composition	Proportion of the material composition of all analysed T-shirts	Proportion of the material composition per fibre type, considering only T-Shirts containing recycled fibres
Cotton	100CO	64	51%	-
Cotton	100rCO	4	3%	6%
Cotton	20rCO	35	28%	55%
Cotton	24rCO	1	1%	2%
Cotton	25rCO	3	2%	5%
Cotton	30rCO	11	9%	17%
Cotton	50rCO	6	5%	9%
Cotton	75rCO	3	2%	5%
Cotton	?rCO	1	1%	2%
Polyester	100PES	61	49%	-
Polyester	100rPES	39	31%	64%
Polyester	30rPES	2	2%	3%
Polyester	50rPES	3	2%	5%
Polyester	51rPES	1	1%	2%
Polyester	52rPES	1	1%	2%
Polyester	53rPES	1	1%	2%
Polyester	70rPES	3	2%	5%
Polyester	75rPES	3	2%	5%
Polyester	90rPES	2	2%	3%
Polyester	96rPES	1	1%	2%
Polyester	?rPES	5	4%	8%
	Overall result	125	100%	-

Source: Own compilation, Hochschule Niederrhein

A.2 Overall evaluation of literature-based requirement sources for durability

Table 63: Evaluation of existing requirements for durability in the literature (in German language) ([A], [B], [C] etc. stand for different sources. Please see the next table 64)

			Textile apparel		Technical textile apparel	
Main Category	Durability aspect	Standard / Test	Basic-T-shirt (100% CO)	Basic-Jeans (95% CO, 5% EL)	Functional-T-shirt (100% PES)	Rain jacket (100% PES or 100% PA)
Formbeständigkeit	Änderung der Abmessung während des Waschens und Trocknens	ISO 5077 in Kombination mit ISO 6330	[A] Zwischen minus X % und plus X % für Webwaren und dauerhafte Vliesstoffe, andere Maschenwaren. [B] Die Dimensionsstabilität des fertigen Produkts muss ≤ +/- 5 % betragen. [C] Nach dem Waschen und Trocknen gemäß der Pflegehinweise dürfen sich die Abmessungen am fertigen Textil um +/- 5 % ändern. [E] Die Maßänderung darf -6% - +2% in Länge und Breite nicht unterschreiten [F] Die Dimensionsstabilität für Strickwaren muss -3% bis +5% betragen. [I] T-Shirts: Anzahl der vor der Prüfung durchzuführenden Wäschen: 56, ± 5%	[A] Zwischen minus X % und plus X % für Webwaren und dauerhafte Vliesstoffe, andere Maschenwaren. [B] Die Dimensionsstabilität des fertigen Produkts muss ≤ +/- 3 % betragen. [C] Nach dem Waschen und Trocknen gemäß der Pflegehinweise dürfen sich die Abmessungen am fertigen Textil um +/- 3 % ändern. [D] Gewebe: Baumwolle oder Baumwollgemisch ± 3,0 % [E] Die Maßänderung darf -2% in Länge und Breite nicht unterschreiten. [F] Die Dimensionsstabilität muss +0% bis -3% betragen. [G] Jeans 98%CO 2%EL: ISO 6330, ISO 5077 Mischgewebe: Kein Trockner; Bestimmung der Maßänderung von durch Bügeln mit feuchtem Bügeltuch und beheizter	[A] Zwischen minus X % und plus X % für Webwaren und dauerhafte Vliesstoffe, andere Maschenwaren. [B] Die Dimensionsstabilität des fertigen Produkts muss ≤ +/- 5 % betragen. [C] Nach dem Waschen und Trocknen gemäß der Pflegehinweise dürfen sich die Abmessungen am fertigen Textil um +/- 5 % ändern. [D] Die Maßänderung darf -3% in Länge und Breite nicht unterschreiten. F] Die Dimensionsstabilität für Strickwaren muss -3% bis +5% betragen. [G] T-Shirt 100% PES: Insbesondere für PES ist die Bestimmung der Maßänderung von textilen Flächengebilden durch Bügeln mit feuchtem Bügeltuch und beheizter Metallplatte wichtig. [I] T-Shirts: Anzahl der vor der Prüfung durchzuführenden	[A] Zwischen minus X % und plus X % für Webwaren und dauerhafte Vliesstoffe, andere Maschenwaren. [B] Keine Angaben für (Funktions)Jacken [C] Nach dem Waschen und Trocknen gemäß der Pflegehinweise dürfen sich die Abmessungen am fertigen Textil um +/- 3 % ändern. [D] Gewebe: Synthetische Fasern ± 2,0 % [E] Die Maßänderung darf für Mäntel -2 % und für Anoraks/Skikleidung/Sportswear -3% in Länge und Breite nicht unterschreiten. Keine Angabe für Jacken. [F] Die Dimensionsstabilität muss +0% bis -3% betragen.

			Textile apparel		**Technical textile apparel**	
				Metallplatte nicht relevant. [I] Jeans: Anzahl der vor dem Test durchzuführenden Wäschen: 30, ± 3%	Wäschen: 56, ± 5%	
Formbeständigkeit	Beurteilung der Eignung von Textilien und Kleidungsstücken für die Reinigung	ISO 3175-1	[E] Die Maßänderung nach der Chemischreinigung darf in Länge und Breitete - 2,5% nicht überschreiten. [F] Die Dimensionsstabilität für Strickwaren muss -3% bis +5% betragen.	[E] Die Maßänderung nach der Chemischreinigung darf in Länge und Breitete - 1,5% nicht überschreiten. [F] Die Dimensionsstabilität muss +0% bis -3% betragen.	[E] Die Maßänderung nach der Chemischreinigung darf in Länge und Breitete - 2,5% nicht überschreiten. [F] Die Dimensionsstabilität für Strickwaren muss -3% bis +5% betragen.	[E] Die Maßänderung nach der Chemischreinigung darf in Länge und Breitete - 1,5% nicht überschreiten. [F] Die Dimensionsstabilität muss +0% bis -3% betragen.
	Elastizität und Dehnbarkeit ausgewählter Kleidung	DIN EN ISO 20932-1 (Elastizität textile Flächen), NF EN ISO 20932-1 (Streifenprüfungen), NF EN ISO 20932-3 (Schmaltextilien)	[H] Jeans oder textile Flächen mit definiertem Elasthan-Gehalt.	[H] Jeans oder textile Flächen mit definiertem Elasthan-Gehalt.	[H] Jeans oder textile Flächen mit definiertem Elasthan-Gehalt.	[H] Jeans oder textile Flächen mit definiertem Elasthan-Gehalt.
		DIN EN ISO 14704-1[82] (Elastizität Fasern)	[-]	[-]	[-]	[-]
Farbechtheit	Farbechtheit beim Waschen	ISO 105-C06	[A] Die Farbechtheit beim Waschen muss mindestens X (Prüfwert) für die Farbveränderung und mindestens X (Prüfwert) für die Fleckenbildung betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Schwellenwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit beim Waschen entsprechend der	[A] Die Farbechtheit beim Waschen muss mindestens X (Prüfwert) für die Farbveränderung und mindestens X (Prüfwert) für die Fleckenbildung betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Schwellenwert könnte für dunkle Farben strenger sein) [C] - (Die Farbechtheit beim Waschen gilt nicht für mit	[A] Die Farbechtheit beim Waschen muss mindestens X (Prüfwert) für die Farbveränderung und mindestens X (Prüfwert) für die Fleckenbildung betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Schwellenwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit beim Waschen entsprechend der	[A] Die Farbechtheit beim Waschen muss mindestens X (Prüfwert) für die Farbveränderung und mindestens X (Prüfwert) für die Fleckenbildung betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Schwellenwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit beim Waschen entsprechend der

[82] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist DIN EN ISO 20932-1:2022-02.

			Textile apparel		Technical textile apparel	
			Pflegeanleitung muss jeweils mindestens Note 3-4 auf dem Graumaßstab betragen. (gilt nicht für Endprodukte, die weder gefärbt noch bedruckt werden) [D] Die Farbbeständigkeit beim Waschen und die Abfärbebeständigkeit müssen mindestens 3-4 betragen. (gilt nicht für Erzeugnisse, die mit dem Hinweis 'nur für Trockenreinigung' gekennzeichnet sind, sowie nicht für Weißwaren, nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. (Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten) [F] Der vorgeschlagene Grenzwert kann für die Fleckenbildung und Farbveränderung auf 4 festgelegt werden. Bei mehrfarbigen Kleidungsstücken mit hohem Farbkontrast, könnte die Fleckenbildung auf 5 festgelegt werden. (gilt für	Indigo gefärbtes Denim.) [D] Die Farbbeständigkeit beim Waschen und die Abfärbebeständigkeit müssen mindestens 3-4 betragen. (gilt nicht für Erzeugnisse, die mit dem Hinweis 'nur für Trockenreinigung' gekennzeichnet sind, sowie nicht für Weißwaren, nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten. [F] Der vorgeschlagene Grenzwert kann für die Fleckenbildung und Farbveränderung auf 4 festgelegt werden. Bei mehrfarbigen Kleidungsstücken mit hohem Farbkontrast, könnte die Fleckenbildung auf 5 festgelegt werden. (gilt für alle Farbechtheitsprüfungen, bei denen es um Fleckenbildung geht) [I] Anzahl der vor dem Test	Pflegeanleitung muss jeweils mindestens Note 3-4 auf dem Graumaßstab betragen. (gilt nicht für Endprodukte, die weder gefärbt noch bedruckt werden) [D] Die Farbbeständigkeit beim Waschen und die Abfärbebeständigkeit müssen mindestens 3-4 betragen. (gilt nicht für Erzeugnisse, die mit dem Hinweis 'nur für Trockenreinigung' gekennzeichnet sind, sowie nicht für Weißwaren, nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. (Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten) [F] Der vorgeschlagene Grenzwert kann für die Fleckenbildung und Farbveränderung auf 4 festgelegt werden. Bei mehrfarbigen Kleidungsstücken mit hohem Farbkontrast, könnte die Fleckenbildung auf 5 festgelegt werden. (gilt für alle Farbechtheitsprüfungen, bei denen es um Fleckenbildung geht) [G] 100% PES: PES hat aber allgemein die Fähigkeit, wenig zu verblassen. Outdoor: Polyester	Pflegeanleitung muss jeweils mindestens Note 3-4 auf dem Graumaßstab betragen. (gilt nicht für Endprodukte, die weder gefärbt noch bedruckt werden) [D] Die Farbbeständigkeit beim Waschen und die Abfärbebeständigkeit müssen mindestens 3-4 betragen. (gilt nicht für Erzeugnisse, die mit dem Hinweis 'nur für Trockenreinigung' gekennzeichnet sind, sowie nicht für Weißwaren, nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. (Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten) [F] Der vorgeschlagene Grenzwert kann für die Fleckenbildung und Farbveränderung auf 4 festgelegt werden. Bei mehrfarbigen Kleidungsstücken mit hohem Farbkontrast, könnte die Fleckenbildung auf 5 festgelegt werden. (gilt für alle Farbechtheitsprüfungen, bei denen es um Fleckenbildung geht)

			Textile apparel		Technical textile apparel	
			alle Farbechtheitsprüfungen, bei denen es um Fleckenbildung geht) [I] Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4	durchzuführenden Waschvorgänge: 30, 4	wird durchgefärbt eingesetzt. [I] Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4	
Farbechtheit	Farbechtheit beim Waschen	ISO 105-C08 (+ phosphatfreies Testwaschmittel und Bleichaktivator für niedrige Temperaturen)	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.
		ISO 105-C09 (+oxidative Bleiche)	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung und das Anbluten nach dem Waschen dürfen mindestens 4 betragen. Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten.
	Farbechtheit gegenüber Wasser	ISO 105-E01	[I] Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	[I] Anzahl der vor dem Test durchzuführenden Waschvorgänge: 30, 4.	[I] Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	[-]
	Farbechtheit gegen künstliche Bewetterung	ISO 105-B04			[E] Änderung der Farbe unter Einfluss von künstlichen Wetterbedingungen	[E] Änderung der Farbe unter Einfluss von künstlichen Wetterbedingungen

			Textile apparel		Technical textile apparel	
					Qualitäts-Mindestanforderungen: Blaumaßstab Skala von 1-8 (1 am schlechtesten) Anoraks/Skikleidung/Sportswear: 5	Qualitäts-Mindestanforderungen: Blaumaßstab Skala von 1-8 (1 am schlechtesten) Jacken / Mäntel / Anoraks/Skikleidung/Sportswear: 5, Futterstoffe: 4
	Farbechtheit beim Bügeln	ISO 105-X11	[E] Die Farbänderung und das Anbluten nach dem Bügeln oder Dämpfen dürfen mindestens 4 betragen.	[E] Die Farbänderung und das Anbluten nach dem Bügeln oder Dämpfen dürfen mindestens 4 betragen.	[E] Die Farbänderung und das Anbluten nach dem Bügeln oder Dämpfen dürfen mindestens 4 betragen.	[E] Die Farbänderung und das Anbluten nach dem Bügeln oder Dämpfen dürfen mindestens 4 betragen (Ausnahme Futterstoffe: 3-4).
Farbechtheit	Farbechtheit gegen Schweiß	ISO 105-E04	[A] Die Farbechtheit muss mindestens X betragen (Prüfwert für Farbwechsel und Fleckenbildung). (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Schwellenwert könnte für dunkle Farben strenger sein) [D] Die Farbbeständigkeit gegenüber (saurer und alkalischer) Transpiration muss mindestens 3-4 betragen (Farbänderung und Abfärben). Eine Beständigkeit von 3 ist annehmbar, wenn die Gewebe zum einen dunkel gefärbt (Standardtiefe > 1/1) sind und zum anderen aus regenerierter Wolle bestehen. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden)	[D] Die Farbbeständigkeit gegenüber (saurer und alkalischer) Transpiration muss mindestens 3-4 betragen (Farbänderung und Abfärben). Eine Beständigkeit von 3 ist annehmbar, wenn die Gewebe zum einen dunkel gefärbt (Standardtiefe > 1/1) sind und zum anderen aus regenerierter Wolle bestehen. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Farbänderung oder Anbluten von gefärbtem oder bedrucktem Material unter dem Einfluss von Schweiß Qualitäts-Mindestanforderungen: Graumaßstab Hosen: 4 [F] Der Grenzwert könnte bei	[A] Die Farbechtheit muss mindestens X betragen (Prüfwert für Farbwechsel und Fleckenbildung). (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Schwellenwert könnte für dunkle Farben strenger sein) [E] Farbänderung oder Anbluten von gefärbtem oder bedrucktem Material unter dem Einfluss von Schweiß Qualitäts-Mindestanforderungen: Graumaßstab Anoraks/Skikleidung/Sportswear: 4, Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note 4-5 nicht unterschreiten. [F] Der Grenzwert könnte bei mindestens 4 liegen, sowohl für Farbveränderungen als auch für Flecken. [I] T-Shirt: Anzahl der vor dem	[D] Die Farbbeständigkeit gegenüber (saurer und alkalischer) Transpiration muss mindestens 3-4 betragen (Farbänderung und Abfärben). Eine Beständigkeit von 3 ist annehmbar, wenn die Gewebe zum einen dunkel gefärbt (Standardtiefe > 1/1) sind und zum anderen aus regenerierter Wolle bestehen. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Farbänderung oder Anbluten von gefärbtem oder bedrucktem Material unter dem Einfluss von Schweiß Qualitäts-Mindestanforderungen: Graumaßstab: Jacken: 4, Mäntel: 4 Anoraks/Skikleidung/Sportswear: 4, Futterstoffe: 3-4 Ausnahme: sehr kontrastreiche Kleidungsstücke sollten die Note

			Textile apparel		Technical textile apparel	
			[E] Farbänderung oder Anbluten von gefärbtem oder bedrucktem Material unter dem Einfluss von Schweiß Qualitäts-Mindestanforderungen: Strickware: 4 [F] Der Grenzwert könnte bei mindestens 4 liegen, sowohl für Farbveränderungen als auch für Flecken. [G] T-Shirts 100% CO: Eher anspruchsvoll – siehe Farbechtheit; Beim Waschen nur die Farbveränderung betrachten [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	mindestens 4 liegen, sowohl für Farbveränderungen als auch für Flecken. [I] Jeans: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 30, 4.	Test durchzuführenden Waschvorgänge: 56, 4.	4-5 nicht unterschreiten. [F] Der Grenzwert könnte bei mindestens 4 liegen, sowohl für Farbveränderungen als auch für Flecken. Bei Futterstoffen könnte eine Veränderung von 3-4 akzeptabel sein, da sie weniger sichtbar ist. Ist der Grenzwert für die Anfärbung eines Futterstoffes zu niedrig, könnte er auf den Oberstoff abfärben und sichtbare Flecken verursachen, was das Ende der Lebensdauer des Kleidungsstücks bedeuten würde.
	Farbechtheit gegen Meerwasser	NF EN ISO 105-E02				
	Farbechtheit gegen gechlortes Wasser	NF EN ISO 105-E03				
Farbechtheit	Farbechtheit gegen Flecken: Wasser (Wassertropfenechtheit)	ISO 105-E07	[E] Qualitäts-Mindestanforderungen: Die Farbänderung durch Kontakt mit einem Wassertropfen muss mindestens 4 betragen. [F] entspricht [E]	[E] Qualitäts-Mindestanforderungen: Die Farbänderung durch Kontakt mit einem Wassertropfen muss mindestens 4 betragen. [F] entspricht [E]	[E] Qualitäts-Mindestanforderungen: Die Farbänderung durch Kontakt mit einem Wassertropfen muss mindestens 4 betragen. [F] entspricht [E]	[E] Qualitäts-Mindestanforderungen: Die Farbänderung durch Kontakt mit einem Wassertropfen muss mindestens 4 betragen. Futterstoffe: 3-4. [F] entspricht [E]
	Farbechtheit gegen Licht von mit künstlichem Schweiß angefeuchteten Textilien	ISO 105-B07	[-]	[-]	[G] 100% PES: Wegen Funktion	[-]

			Textile apparel		Technical textile apparel	
Farbechtheit	Farbechtheit gegenüber Reiben (nass)	ISO 105-X12	[A] Die Farbechtheit gegenüber nassem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben nass muss mindestens Note 2-3, bei dunklen Farben mindestens Note 2 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Die Farbbeständigkeit gegenüber Feuchtscheuern muss mindestens 2-3 betragen. (gilt nicht für Weißwaren oder Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in nassem Zustand darf mindestens 3-4 betragen. [F] Der Grenzwert könnte ein Minimum von 3-4 für die Farbechtheit beim Nassabrieb sein. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	[A] Die Farbechtheit gegenüber nassem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben nass muss mindestens Note 2-3, bei dunklen Farben mindestens Note 2 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Für mit Indigo gefärbtes Denim ist die Beständigkeit 2 zulässig. (gilt nicht für Weißwaren oder Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in nassem Zustand darf mindestens 3-4 betragen. [F] Der Grenzwert könnte ein Minimum von 3-4 für die Farbechtheit beim Nassabrieb sein. Wenn diese Mindestanforderung allgemein angewandt wird, ist es möglich, dass viele Denim-Produkte nicht konform sind, da es für dieses Produkt typisch ist, seine Farbstoffe leicht	[A] Die Farbechtheit gegenüber nassem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben nass muss mindestens Note 2-3, bei dunklen Farben mindestens Note 2 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Die Farbbeständigkeit gegenüber Feuchtscheuern muss mindestens 2-3 betragen. (gilt nicht für Weißwaren oder Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in nassem Zustand darf mindestens 3-4 betragen. [F] Der Grenzwert könnte ein Minimum von 3-4 für die Farbechtheit beim Nassabrieb sein. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	[A] Die Farbechtheit gegenüber nassem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben nass muss mindestens Note 2-3, bei dunklen Farben mindestens Note 2 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Die Farbbeständigkeit gegenüber Feuchtscheuern muss mindestens 2-3 betragen. (gilt nicht für Weißwaren oder Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in nassem Zustand darf mindestens 3-4 betragen. [F] Der Grenzwert könnte ein Minimum von 3-4 für die Farbechtheit beim Nassabrieb sein.

			Textile apparel		Technical textile apparel	
				abzugeben. [I] Jeans: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 30, 4.		
Farbechtheit	Farbechtheit gegenüber Reiben (trocken)	ISO 105-X12	[A] Die Farbechtheit gegenüber trockenem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben trocken muss für dunkle Farben mindestens Note 3-4 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Die Farbbeständigkeit gegenüber Trockenscheuern muss mindestens 4 betragen. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in trockenem Zustand darf mindestens 4 betragen. [F] Der Grenzwert könnte ein Minimum von 4 für die Farbechtheit beim Trockenreiben sein.	[A] Die Farbechtheit gegenüber Trockenscheuern muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben und insbesondere für indigo-gefärbten Denim strenger sein. Hier könnte es jedoch zu einem potenziellen Konflikt mit der Ästhetik kommen. Die Annehmbarkeit könnte bei einigen Artikeln wie Jeans eingeschränkt sein, die als Teil ihrer ästhetischen Qualität verblassen sollen). [C] Die Farbechtheit gegenüber Reiben trocken muss für Denim mindestens Note 3 gemäß Graumaßstab betragen. [D] Für mit Indigo gefärbtes Denim ist die Beständigkeit 3-4 zulässig. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen:	[A] Die Farbechtheit gegenüber trockenem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben trocken muss für dunkle Farben mindestens Note 3-4 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Die Farbbeständigkeit gegenüber Trockenscheuern muss mindestens 4 betragen. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in trockenem Zustand darf mindestens 4 betragen. [F] Der Grenzwert könnte ein Minimum von 4 für die Farbechtheit beim Trockenreiben sein. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	[A] Die Farbechtheit gegenüber trockenem Reiben muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbechtheit gegenüber Reiben trocken muss für dunkle Farben mindestens Note 3-4 gemäß Graumaßstab betragen. (gilt nicht für ungefärbte und unbedruckte Endprodukte) [D] Die Farbbeständigkeit gegenüber Trockenscheuern muss mindestens 4 betragen. (gilt nicht für Weißwaren und nicht für Erzeugnisse, die weder gefärbt noch bedruckt werden) [E] Qualitäts-Mindestanforderungen: Graumaßstab; Das Anbluten in trockenem Zustand darf mindestens 4 betragen. [F] Der Grenzwert könnte ein Minimum von 4 für die Farbechtheit beim Trockenreiben sein.

			Textile apparel		Technical textile apparel	
			[I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	Graumaßstab; Das Anbluten in trockenem Zustand darf mindestens 4 betragen. [F] Der Grenzwert könnte ein Minimum von 4 für die Farbechtheit beim Trockenreiben sein. Wenn diese Mindestanforderung allgemein angewandt wird, ist es möglich, dass viele Denim-Produkte nicht konform sind, da es für dieses Produkt typisch ist, seine Farbstoffe leicht abzugeben. [I] Jeans: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 30, 4. Durability aspects, on which the sources provide very contradictory statements!		
Farbechtheit	Farbechtheit gegenüber Licht	ISO 105-B02	[A] Die Farbechtheit gegenüber Licht muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbbeständigkeit gegenüber Licht muss mindestens Note 4 betragen (gilt nicht für Unterwäsche) [D] Die Farbbeständigkeit gegenüber Licht muss mindestens 4 betragen. (gilt	[A] Die Farbechtheit gegenüber Licht muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben und insbesondere für indigo-gefärbten Denim strenger sein. Hier könnte es jedoch zu einem potenziellen Konflikt mit der Ästhetik kommen. Die Annehmbarkeit könnte bei einigen Artikeln wie Jeans eingeschränkt sein, die als	[A] Die Farbechtheit gegenüber Licht muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbbeständigkeit gegenüber Licht muss mindestens Note 4 betragen. [D] Die Farbbeständigkeit gegenüber Licht muss mindestens 4 betragen. (gilt nicht für Matratzenüberzüge, Matratzenschutz oder Unterwäsche)	[A] Die Farbechtheit gegenüber Licht muss mindestens X (Testwert) betragen. (Produkte, die weder gefärbt noch bedruckt sind, sind ausgeschlossen; der Grenzwert könnte für dunkle Farben strenger sein) [C] Die Farbbeständigkeit gegenüber Licht muss mindestens Note 4 betragen. [D] Die Farbbeständigkeit gegenüber Licht muss mindestens 4 betragen. (gilt nicht für Matratzenüberzüge, Matratzenschutz oder Unterwäsche)

			Textile apparel		Technical textile apparel	
			nicht für Matratzenüberzüge, Matratzenschutz oder Unterwäsche) [E] Qualitäts-Mindestanforderungen Skala von 1-8 für die Farbänderung (1 am schlechtesten): Strickware: 5 [F] Die Farbänderung durch Lichteinwirkung ist eine wichtige Anforderung, und der Mindestwert kann 5 betragen. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	Teil ihrer ästhetischen Qualität verblassen sollen) [C] Die Farbbeständigkeit gegenüber Licht muss mindestens Note 4 betragen. [D] Die Farbbeständigkeit gegenüber Licht muss mindestens 4 betragen. (gilt nicht für Matratzenüberzüge, Matratzenschutz oder Unterwäsche) [E] Qualitäts-Mindestanforderungen Skala von 1-8 für die Farbänderung (1 am schlechtesten): Hosen: 5 [F] Die Farbänderung durch Lichteinwirkung ist eine wichtige Anforderung, und der Mindestwert kann 5 betragen. [I] - (Jeans: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 30, k.A.)	[E] Qualitäts-Mindestanforderungen Skala von 1-8 für die Farbänderung (1 am schlechtesten): Sportswear: 5 [F] Die Farbänderung durch Lichteinwirkung ist eine wichtige Anforderung, und der Mindestwert kann 5 betragen. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	[E] Qualitäts-Mindestanforderungen Skala von 1-8 für die Farbänderung (1 am schlechtesten): Jacken /Mäntel / Anoraks/Skikleidung/Sportswear: 5 [F] Die Farbänderung durch Lichteinwirkung ist eine wichtige Anforderung, und der Mindestwert kann 5 betragen. Für Futterstoffe ist ein niedrigerer Mindestwert von 4 akzeptabel.
	Farblässigkeit gegenüber Speichel, Schweiß (Babykleidung)	§64 LFGB[83], BVL B 82.10-1[84]				
Farbechtheit	Farbechtheit gegenüber der chemischen Reinigung (Trockenreinigung)	ISO 105-D01	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung durch die	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung durch die	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung durch die Chemischreinigung	[E] Qualitäts-Mindestanforderungen: Graumaßstab; Die Farbänderung durch die Chemischreinigung

[83] §64 LFGB (deutsches Lebensmittel-, Bedarfsgegenstände und Futtermittelgesetzbuch).

[84] Technische Regel zur Übernahme der gleichnamigen Deutschen Norm DIN 53160:1974.

			Textile apparel		Technical textile apparel	
			Chemischreinigung darf mindestens 4 betragen. [F] Für diese Farbechtheit könnte die Mindestanforderung sowohl für die Veränderung als auch gegebenenfalls für die Färbung 4 sein. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	Chemischreinigung darf mindestens 4 betragen. [F] Für diese Farbechtheit könnte die Mindestanforderung sowohl für die Veränderung als auch gegebenenfalls für die Färbung 4 sein. [I] Jeans: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 30, 4.	darf mindestens 4 betragen. [F] Für diese Farbechtheit könnte die Mindestanforderung sowohl für die Veränderung als auch gegebenenfalls für die Färbung 4 sein. [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, 4.	darf mindestens 4 betragen. [F] Für diese Farbechtheit könnte die Mindestanforderung sowohl für die Veränderung als auch gegebenenfalls für die Färbung 4 sein.
	Farbechtheit von Färbungen und Drucken gegen das Sublimieren beim Lagern	DIN 54056	[G] [H] Bei Polyester- und Polyamidfaser bzw. Artikeln mit starken Kontrasten Prüfung der Farbechtheit von Färbungen und Drucken gegen das Sublimieren beim Lagern.		[G] [H] Bei Polyester- und Polyamidfaser bzw. Artikeln mit starken Kontrasten Prüfung der Farbechtheit von Färbungen und Drucken gegen das Sublimieren beim Lagern.	
	Farbechtheit bei künstlicher Bewitterung	ISO 105-B10				[-]
Strapazierfähigkeit	Pillbeständigkeit und Abriebfestigkeit von textilen Oberflächen	ISO 12945-1 (Verfahren mit dem Pilling-Prüfkasten)	[A] Die Stoffe müssen mindestens X (Testwert) Pilling frei sein. [B] Die Pillingbeständigkeit nach einmaligem Waschen muss mindestens ≥ 4 sein. [C] Gestrickte Kleidungsstücke müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [D] Non-woven-Materialien und gestrickte Kleidungsstücke müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [I] T-Shirt: Anzahl der vor der		[A] Die Stoffe müssen mindestens X (Testwert) Pilling frei sein. [B] Die Pillingbeständigkeit nach einmaligem Waschen muss mindestens ≥ 4 sein. [C] Gestrickte Kleidungsstücke müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [D] Non-woven-Materialien und gestrickte Kleidungsstücke müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [I] T-Shirt: Anzahl der vor der Prüfung durchzuführenden Waschvorgänge: 56, 4.	[A] Die Stoffe müssen mindestens X (Testwert) Pilling frei sein. [C] Nonwoven-Materialien und gestrickte Kleidungsstücke, müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [E] Non-woven-Materialien und gestrickte Kleidungsstücke müssen eine Pillbeständigkeit von mindestens 3 aufweisen.

			Textile apparel		Technical textile apparel	
			Prüfung durchzuführenden Waschvorgänge: 56, 4.			
Strapazierfähigkeit	Pillbeständigkeit und Abriebfestigkeit von textilen Oberflächen	ISO 12945-2 (Martindale-Verfahren)	[A] Die Stoffe müssen mindestens X (Testwert) pillingfrei sein. [E] Qualitäts-Mindestanforderungen: Maschenwaren: nach 125 Touren: 3-4 nach 500 Touren: 3 nach 1000 Touren: 2-3 [F] Qualitäts-Mindestanforderungen: Maschenwaren: nach 125 Touren: 4 nach 500 Touren: 3-4 nach 1000 Touren: 3 nach 2000 Touren: 3 nach 5000 Touren: 2-3 nach 7000 Touren: 2-3 Qualitäts-Mindestanforderungen Premium: Maschenwaren: nach 125 Touren: 4-5 nach 500 Touren: 4 nach 1000 Touren: 3-4 nach 2000 Touren: 3-4 nach 5000 Touren: 3 nach 7000 Touren: 2-3	[B] Die Pillingbeständigkeit nach einmaligem Waschen muss nach 5.000 Scheuerzyklen ≥ 3-4 sein. (Test am Endprodukt und/oder an Rohstoffen) [C] Für Kleidungsstücke verwendete Baumwollmischgewebe müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [D] Für Kleidungsstücke verwendete Baumwollgewebe müssen eine Pillbeständigkeit von mindestens 3 aufweisen. [E] Qualitäts-Mindestanforderungen: Gewebe mit glatter, ebener Oberfläche: nach 125 Touren: 4 nach 500 Touren: 4 nach 1000 Touren: 4 nach 2000 Touren: 4 [F] Qualitäts-Mindestanforderungen: Gewebe mit glatter, ebener Oberfläche: entsprechend [E] Note 4 Qualitäts-Mindestanforderungen Premium: Gewebe mit glatter, ebener Oberfläche: Note 4-5 [I] - (Jeans: Anzahl der vor	[A] Die Stoffe müssen mindestens X (Testwert) Pilling frei sein. [E] Qualitäts-Mindestanforderungen: Maschenwaren: nach 125 Touren: 3-4 nach 500 Touren: 3 nach 1000 Touren: 2-3 [F] Qualitäts-Mindestanforderungen: Maschenwaren: nach 125 Touren: 4 nach 500 Touren: 3-4 nach 1000 Touren: 3 nach 2000 Touren: 3 nach 5000 Touren: 2-3 nach 7000 Touren: 2-3 Qualitäts-Mindestanforderungen Premium: Maschenwaren: nach 125 Touren: 4-5 nach 500 Touren: 4 nach 1000 Touren: 3-4 nach 2000 Touren: 3-4 nach 5000 Touren: 3 nach 7000 Touren: 2-3	[E] Qualitäts-Mindestanforderungen: Gewebe mit glatter, ebener Oberfläche: nach 125 Touren: 4 nach 500 Touren: 4 nach 1000 Touren: 4 nach 2000 Touren: 4 Gewebe mit aufgerauter Oberfläche: nach 125 Touren: 3-4 nach 500 Touren: 3 nach 1000 Touren: 2-3 Maschenwaren: nach 125 Touren: 3-4 nach 500 Touren: 3 nach 1000 Touren: 2-3 [F] Qualitäts-Mindestanforderungen: glatte, ebene Gewebe-Oberfläche: wie [E] Note 4 Gewebe mit aufgerauter Oberfläche: nach 125 Touren: 4-5 nach 500 Touren: 4 nach 1000 Touren: 3-4 nach 2000 Touren: 3-4 nach 5000 Touren: 3 nach 7000 Touren: 2-3 Maschenwaren: nach 125 Touren: 4 nach 500 Touren: 3-4 nach 1000 Touren: 3 nach 2000 Touren: 3 nach 5000 Touren: 2-3 nach 7000 Touren: 2-3 Premium: glatte, ebene Gewebe-

			Textile apparel		Technical textile apparel	
				dem Test durchzuführenden Wäschen: 30, k.A.)		Oberfläche: wie [E] Note 4-5 Gewebe mit aufgerauter Oberfläche: nach 125 Touren: 4-5 nach 500 Touren: 4-5 nach 1000 Touren: 4 nach 2000 Touren: 4 nach 5000 Touren: 3-4 nach 7000 Touren: 3-4 Maschenwaren: nach 125 Touren: 4-5 nach 500 Touren: 4 nach 1000 Touren: 3-4 nach 2000 Touren: 3-4 nach 5000 Touren: 3 nach 7000 Touren: 2-3
Strapazierfähigkeit	Scheuerbeständigkeit	DIN EN ISO 12947-2 (Martindale)	[B] - keine Angabe für T-Shirts/Maschenwaren [C] - (Gilt nur im Falle von Berufsbekleidung). [E] Die Scheuerfestigkeit darf 8.000 Scheuertouren (abhängig vom Artikel (T-Shirt / Sweatshirt) ohne Lochbildung nicht unterschreiten. [F] Qualitäts-Mindestanforderungen (9 kPa): Strickware: 8.000 Zyklen (dies ist ein extrem niedriger Wert; abhängig vom Produkt muss er höher sein) Qualitäts-Mindestanforderungen Premium (9 kPa): Strickware: 26.000 Zyklen	[B] Die Abriebfestigkeit muss mehr als 30.000 Scheuerzyklen betragen. [C] - (Gilt nur im Falle von Berufsbekleidung). [E] Die Scheuerfestigkeit darf 20.000 Scheuertouren (abhängig vom Artikel (T-Shirt / Sweatshirt) ohne Lochbildung nicht unterschreiten. [F] Qualitäts-Mindestanforderungen (9 kPa): Hosen: 20.000 Zyklen Qualitäts-Mindestanforderungen Premium (9 kPa): Hosen: 40.000 Zyklen [G] T-Shirts 100% PES: Pilling + Recycled: problematisch	[B] - Keine Angabe für T-Shirts/Maschenwaren. [C] - (Gilt nur im Falle von Berufsbekleidung). [E] Die Scheuerfestigkeit darf 16.000 Scheuertouren ohne Lochbildung nicht unterschreiten. [F] Qualitäts-Mindestanforderungen (9 kPa): Sportswear: 16.000 Zyklen Qualitäts-Mindestanforderungen Premium (9 kPa): Sportswear: 26.000 Zyklen	[B] - keine Angabe für Jacken [C] - (Gilt nur im Falle von Berufsbekleidung). [E] Die Scheuerfestigkeit darf für Jacken / Mäntel / Anoraks/Skikleidung/Sportswear 16.000 Scheuertouren ohne Lochbildung nicht unterschreiten. Futterstoffe: 10.000 Touren. [F] Qualitäts-Mindestanforderungen (9 kPa): Jacken: 16.000 Zyklen, Mäntel: 16.000 Zyklen, Anoraks/Skikleidung/Sportswear: 16.000 Zyklen Qualitäts-Mindestanforderungen Premium (9 kPa): Jacken: 36.000 Zyklen, Mäntel: 36.000 Zyklen, Anoraks/Skikleidung/Sportswear: 26.000 Zyklen

			Textile apparel		Technical textile apparel	
		EN 13770 (gestrickte Fußbekleidung)				
	Faserverlust	interne Verfahren	[-]	[-]	[-]	[-]
	Gewebebindung	DIN ISO 9354	[-]	[-]	[-]	[-]
	Anzahl der Fäden je Längeneinheit	DIN EN 1049-2		[E] Qualitäts-Mindestanforderung: Nicht relevant für diese Anforderung. Toleranzen: 6% für kardierte Materialien, 4% für alle anderen Materialien.		[E] Qualitäts-Mindestanforderung: Nicht relevant für diese Anforderung. Toleranzen: 6% für kardierte Materialien, 4% für alle anderen Materialien.
	Dichte von Fäden in einem Gewebe	ISO 7211-5		[-]		[-]
Strapazierfähigkeit	Höchstzugkraft und Höchstzugkraft-Dehnung von Geweben	EN ISO 13934-1 (Höchzugkraft und -Dehnung, Streifenzugversuch)		[E] Qualitäts-Mindestanforderungen: Maximalkraft und Dehnung bei dieser Maximalkraft dürfen 25 daN und 12,5 - 55% (körperfern geschnitten) / 30 daN und 12,5 - 35% (körpernah geschnitten) nicht unterschreiten. [F] Qualitäts-Mindestanforderungen Premium: Hosen:450 N		[E] Qualitäts-Mindestanforderungen: Maximalkraft und Dehnung bei dieser Maximalkraft dürfen bei Jacken 20 daN und 12,5 - 40%, Mänteln 20 daN / 12,5 - 55% bei Anoraks/Skikleidung/Sportswear 25 daN und 12,5 - 55% (körperfern und körpernah geschnitten) nicht unterschreiten. Futterstoffe: 18 daN und 7,5 - 32,5% (körperfern geschnitten), bzw. 22 daN und 7,5 - 32,5% (körpernah geschnitten). [F] Qualitäts-Mindestanforderungen Premium: Jacken: 350 N, Mäntel: 350 N, Anoraks/Skikleidung/Sportswear: 450 N

			Textile apparel		Technical textile apparel	
		EN ISO 13934-2 (Höchzugkraft und - Dehnung, Grab Methode)		[E] Qualitäts-Mindestanforderungen: Die Maximalkraft darf 18 daN (körperfern geschnitten), bzw. 20 daN (körpernah geschnitten) nicht unterschreiten. [F] Qualitäts-Mindestanforderungen Premium: Hosen:300 N		[E] Qualitäts-Mindestanforderungen: Maximalkraft darf bei Jacken und Mänteln 15 daN und bei Anoraks/Skikleidung/Sportswear 18 daN (körperfern und körpernah geschnitten) nicht unterschreiten. Futterstoffe: 15 daN. [F] Qualitäts-Mindestanforderungen Premium: Jacken: 250 N, Mäntel: 250 N, Anoraks/Skikleidung/Sportswear: 280 N
	Weiterreißversuch an Geweben	EN ISO 13937-1		[E] Die Weiterreisfestigkeit darf 1,5 daN (körperfern geschnitten), bzw.1,6 daN, (körpernah geschnitten) nicht unterschreiten. Toleranzen: 7% Abweichung vom Vertragswert o. Wert des Referenzmusters (ausgenommen vertragliche Mindestwerte) [G] Jeans: Bei Belastung		[E] Die Weiterreisfestigkeit darf für Jacken / Mäntel / Anoraks/Skikleidung/Sportswear 1,2 daN (körperfern und körpernah geschnitten) nicht unterschreiten. Toleranzen: 7% Abweichung vom Vertragswert o. Wert des Referenzmusters (ausgenommen vertragliche Mindestwerte)
Strapazierfähigkeit	Weiterreißversuch an Geweben	EN ISO 13937-2 (Schenkelweiterreißversuch)		[B] Für Produkte mit weniger als 3% Elasthan, muss die Weiterreißfestigkeit mindestens 20 N betragen. (Test am Endprodukt und/oder an den Rohstoffen, wenn die Rohjeans nicht behandelt ist) [F] Qualitäts-Mindestanforderungen entsprechend [E] für 13937-1, Premium-Qualität: Hosen:		[F] Qualitäts-Mindestanforderungen entsprechend [E] für 13937-1, Premium-Qualität: Jacken: 20 N, Mäntel: 20 N, Anoraks/Skikleidung/Sportswear: 20 N

			Textile apparel		Technical textile apparel	
				25 N		
	Mit Kautschuk oder Kunststoff beschichtete Textilien - Bestimmung der Zugfestigkeit und der Bruchdehnung	EN ISO 1421				[F] Hinsichtlich beschichteter oder unbeschichteter Stoffe besteht kein Grund, niedrigere Mindestanforderungen für beschichtete Stoffe im Hinblick auf physische Mängel zu akzeptieren. Neben dieser Anforderung an die Verwendung könnten die Anforderungen dieser Norm implementiert werden, um Wasserdichtigkeit, Dichtheit der Nahtbänder und Membran oder Beschichtung sowie Atmungsaktivität abzudecken.
	Mit Kautschuk oder Kunststoff beschichtete Textilien - Bestimmung der Weiterreißfestigkeit (Verfahren mit konstanter Geschwindigkeit)	EN ISO 4674-1				
	Berstdruck	EN ISO 13938-1, EN ISO 13938-2	[F] Der Berstdruck muss bei einer Platte mit einem Loch von 7,3 cm² mindestens bei 200 kPa liegen.		[F] Der Berstdruck muss bei einer Platte mit einem Loch von 7,3 cm² mindestens bei 200 kPa liegen.	
	Prüfung von fixierten Einlagestoffen	DIN 54310		[-]		[-]
Strapazierfähigkeit	Prüfung der Nahtfestigkeit	EN ISO 13935-1, EN ISO 13935-2	[I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, min. 100 N.	[F] Die Qualitäts-Mindestanforderung könnte entsprechend der PSA-Produktnorm EN 343:2019 - 'Schutzkleidung - Schutz gegen Regen' 200 N betragen, außer für Materialien mit einer Dehnung von mehr als 50%. [I] - (Jeans: Anzahl der Waschvorgänge vor dem Test 30, k.A.)	[I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, min. 100 N.	[F] Die Qualitäts-Mindestanforderung könnte entsprechend der PSA-Produktnorm EN 343:2019 - 'Schutzkleidung - Schutz gegen Regen' 200 N betragen, außer für Materialien mit einer Dehnung von mehr als 50%.
	Nahtverschiebung /	EN ISO 13936-1		[E] Der Schiebewiderstand		[E] Der Schiebewiderstand darf

			Textile apparel		Technical textile apparel	
	Bestimmung des Schiebewiderstandes von Garnen in Gewebenähten			darf 14 daN (körperfern geschnitten), bzw. 16 daN (körpernah geschnitten) nicht unterschreiten. [F] Übernahme der in [E] genannten Werte.		für Jacken: 12 daN, Mäntel: 14 daN, Anoraks/Skikleidung/Sportswear: 14 daN (körperfern und körpernah geschnitten) nicht unterschreiten. Futterstoffe: 10 daN (körperfern geschnitten), bzw. 12 daN (körpernah geschnitten) [F] Übernahme der in [E] genannten Werte.
		EN ISO 13936-2	[I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, Nahtöffnung von max. 6 mm bei einer Belastung mit 80 N.	[E] Die Nahtöffnung bei einer Belastung mit 12 daN darf 3 mm (körperfern geschnitten), bzw. 2 mm (körpernah geschnitten) nicht überschreiten. [F] Übernahme der in [E] genannten Werte. [I] - (Jeans: Anzahl der Waschvorgänge vor dem Test 30, k.A.)	[I] T-Shirt: Anzahl der vor dem Test durchzuführenden Waschvorgänge: 56, Nahtöffnung von max. 6 mm bei einer Belastung mit 80 N.	[E] Die Nahtöffnung bei einer Belastung mit 12 daN darf 4 mm (körperfern geschnitten), bzw. 3 mm (körpernah geschnitten) nicht überschreiten. Futterstoffe: 3 mm (körperfern geschnitten), bzw. 2 mm (körpernah geschnitten) [F] Übernahme der in [E] genannten Werte.
Optik	Bestimmung des Knittererholungswinkels von Geweben	ISO 2313[85]		[E] Der Knittererholungswinkel von Geweben darf 110° - 120° nicht unterschreiten.		[E] Der Knittererholungswinkel von Geweben darf 110° - 120° nicht unterschreiten.
Optik	Bewertung der Knittererholung von Geweben; Verfahren zur Bewertung des Aussehens	ISO 9867 (Selbstglättungsverhalten)		[E] Die Knittererholung von Geweben darf 4 nicht unterschreiten.		[E] Die Knittererholung von Geweben darf 4 nicht unterschreiten. (gilt nicht für Futterstoffe)
	Bestimmung des Verdrehens	ISO 16322-1	[B] Das Verdrehen nach dem	[I] - (Jeans: Anzahl der vor	[B] Das Verdrehen nach dem	[B] - (nennen generell keine

[85] Diese Norm wurde zurückgezogen. Die Nachfolgedokumente sind ISO 2313-1 und ISO 2313-2.

			Textile apparel		Technical textile apparel	
	nach einer Waschbehandlung		Waschen gemäß Pflegekennzeichnung darf ≤ 4 % nicht überschreiten. [G] Nahtverdrehung nach der Wäsche: 100% CO: Vor allem bei Slim fit -> Firmenindividuelle Werte 100% PES: Je nach Art der Garne kardiert, gekämmt, ring gesponnen, open end gezwirnt [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Wäschen 56, 3%.	dem Test durchzuführenden Wäschen 30, k.A.)	Waschen gemäß Pflegekennzeichnung darf ≤ 4 % nicht überschreiten. [G] Gilt insbesondere bei Polyester. Nahtverdrehung nach der Wäsche: 100% CO: Vor allem bei Slim fit -> Firmenindividuelle Werte 100% PES: Je nach Art der Garne kardiert, gekämmt, ring gesponnen, open end gezwirnt [I] T-Shirt: Anzahl der vor dem Test durchzuführenden Wäschen 56, 3%.	Anforderungen an Jacken)
		ISO 16322-2	[B] Das Verdrehen nach dem Waschen gemäß Pflegekennzeichnung darf ≤ 4 % nicht überschreiten.	[-]	[B] Das Verdrehen nach dem Waschen gemäß Pflegekennzeichnung darf ≤ 4 % nicht überschreiten.	[B] - (nennen generell keine Anforderungen an Jacken)
	Fadenzieher-neigung von Textilien (Snagging)	ASTM D 3939/D 3939M (oder JIS L 1058)	[E] Die Neigung des Materials zu Snagging darf die Note 2-3 nicht unterschreiten.	[E] Die Neigung des Materials zu Snagging darf die Note 3 nicht unterschreiten.	[E] Die Neigung des Materials zu Snagging darf die Note 2-3 nicht unterschreiten.	[E] Die Neigung des Materials zu Snagging darf die Note 3 nicht unterschreiten.
Optik	Optische Veränderung nach dem Waschen / Pflegeeigenschaft und Selbstglättungsverhalten	EN ISO 15487	[B] Wenn das T-Shirt Drucke, Accessoires oder Kontrastfarben aufweist, darf sich das Aussehen nach der Wäsche nicht verändern: 1. Keine Veränderung des Aussehens ≥ 4 2. Farbverfall ≥ 4 3. Kein Kreuz Degorgieren [F] Eine Mindestanforderung könnte sein, dass die Kleidungsstücke nach 5 Waschgängen noch	[B] Das Aussehen darf sich nach der Wäsche nicht verändern: 1. Keine Veränderung des Aussehens ≥ 4 2. Farbverfall ≥ 4 3. Kein Kreuz Degorgieren [F] Eine Mindestanforderung könnte sein, dass die Kleidungsstücke nach 5 Waschgängen noch funktionsfähig sein sollten. [I] Gemäß Pflegeetikett	[B] Wenn das T-Shirt Drucke, Accessoires oder Kontrastfarben aufweist, darf sich das Aussehen nach der Wäsche nicht verändern: 1. Keine Veränderung des Aussehens ≥ 4 2. Farbverfall ≥ 4 3. Kein Kreuz Degorgieren [F] Eine Mindestanforderung könnte sein, dass die Kleidungsstücke nach 5 Waschgängen noch	[B] - keine Angaben für (Funktions)Jacken [F] Eine Mindestanforderung könnte sein, dass die Kleidungsstücke nach 5 Waschgängen noch funktionsfähig sein sollten.

			Textile apparel		Technical textile apparel	
			funktionsfähig sein sollten. [G] Je nach Einsatzzweck optional; Abhängig von Farbe & Färbemittel [I] Gemäß Pflegeetikett waschen mit visueller Beurteilung durch Expert*innen.	waschen mit visueller Beurteilung durch Expert*innen.	funktionsfähig sein sollten. [G] Je nach Einsatzzweck optional; Abhängig von Farbe & Färbemittel [I] Gemäß Pflegeetikett waschen mit visueller Beurteilung durch Expert*innen.	
	Bewertung der Knittererholung von Geweben - Verfahren zur Bewertung des Aussehens	ISO 9867		[-]		[-]
Funktionsbeständigkeit	Wasserabweisende Ausrüstung	ISO 6330 für Haushaltswaschzyklen in Kombination mit ISO 4920 (Sprühverfahren, nicht geeignet für die Regendichtigkeit, da es nicht die Wasserdurchlässigkeit, sondern nur die Vernetzung an der Oberfläche feststellt)				[C] Die Funktionsfähigkeit der wasserabweisenden Ausrüstung muss nach 5 Haushaltswasch- und Trockenzyklen bei 40 °C oder nach 5 Industriewasch- und Trockenzyklen bei mindestens 75 °C noch mindestens 80 von 90 betragen. Bei Industriewaschzyklen kann die Temperatur für Kleidungsstücke mit versiegelten Nähten auf 60 °C gesenkt werden. Es muss eine Pflegeanleitung zur Nachimprägnierung mit dem Textil mitgeliefert werden. [D] Die Funktionsfähigkeit der wasserabweisenden Ausrüstung muss nach 20 Haushaltswasch- und Trockenzyklen bei 40 °C oder nach 10 Industriewasch- und Trockenzyklen bei mindestens 75 °C noch mindestens 80 von 90 betragen. (ausgenommen sind Textilfasern, Gewebe und Membrane, die dem

			Textile apparel		Technical textile apparel	
						Enderzeugnis intrinsische funktionale Eigenschaften verleihen -> Nachweis über Vergleichbarkeit mit der Eigenschaft über Ausrüstungsmittel) Den Verbraucher*innen sind Pflegehinweise für die Erhaltung der Funktion zu geben. [E] Die Wasserabweisung textiler Flächen von neuen Mänteln / Anoraks, Skikleidung, Sportswear muss mindestens 5 und nach der Pflegebehandlung 3 betragen.
		DIN EN 29865 (Beregnungsversuch)				[-]
Funktionsbeständigkeit	Wasserabweisende Ausrüstung	ISO 811 (hydrostatischer Druckversuch) (alternativ Schutzkleidung - Schutz gegen Regen EN 343 -> DTB Qualitäts-Mindestanforderungen gleich)				[E] Die textile Fläche von Wetter-Schutzbekleidung (Mäntel, Regenkleidung / Anoraks, Skikleidung, Sportswear) muss eine Wasserdichtigkeit von mindestens 130 mBar aufweisen. Für ‘Fashion’ Artikel mindestens 80 mBar. Das Prüfverfahren wird für andere Artikelgruppen nicht angewendet.
	Schutzkleidung - Schutz gegen Regen	EN 343				[E] Die textile Fläche von Wetter-Schutzbekleidung (Mäntel, Regenkleidung / Anoraks, Skikleidung, Sportswear) muss eine Wasserdichtigkeit von mindestens 130 mBar aufweisen. Für ‘Fashion’ Artikel mindestens 80 mBar. Das Prüfverfahren wird für andere Artikelgruppen nicht

			Textile apparel		Technical textile apparel	
						angewendet. [F] Die Norm EN 343 (2019) - Schutzkleidung - Schutz gegen Regen könnte verwendet werden, um Wasserdichtigkeit, Dichtheit der Nahtbänder und Membran oder Beschichtung sowie Atmungsaktivität abzudecken, wobei die niedrigste Klasse als Mindestanforderung für normale, nicht-schützende Regenbekleidung festgelegt ist.
	Luftdurchlässigkeit	DIN EN ISO 9237			[E] Die Luftdurchlässigkeit textiler Flächen von Sportswear muss mindestens 25 mm/s (l/m²s) betragen.	[E] Die Luftdurchlässigkeit textiler Flächen von Mänteln, Regenkleidung, Anoraks/Skikleidung/Sportswear muss mindestens 25 mm/s (l/m²s) betragen.
	Langlebigkeit von Verschlüssen	D2061-03 ASTM		[A] Kleidungsstücke mit Verschlüssen: Die Verschlüsse müssen sich X-mal öffnen und schließen lassen, ohne zu versagen.		[A] Kleidungsstücke mit Verschlüssen: Die Verschlüsse müssen sich X-mal öffnen und schließen lassen, ohne zu versagen.
	Schließkraft von Druckknöpfen	ASTMD 4846		[-]		[-]
Funktionsbeständigkeit	Sicherheit der Befestigung von Druckknöpfen (Ausreisfestigkeit)	CEN/TS 17394-3		[F] Die Sicherheitsgrenze von 70 N oder 50 N, die mit den Produktsicherheitsstandards verknüpft ist, wird als zu niedrig für eine gute Qualität betrachtet. Die Diskussion darüber, welche Grenze angemessen wäre, muss unter Experten geführt werden.		[F] Die Sicherheitsgrenze von 70 N oder 50 N, die mit den Produktsicherheitsstandards verknüpft ist, wird als zu niedrig für eine gute Qualität betrachtet. Die Diskussion darüber, welche Grenze angemessen wäre, muss unter Experten geführt werden.

			Textile apparel		Technical textile apparel	
	Belastbarkeit von Klettverschlüssen	DIN 3415-1				[C] Klettverschlüsse müssen auf ihre Belastbarkeit untersucht werden und dabei die vorgegebenen Werte des Prüfstandards (s. Nachweis) einhalten.
	Belastbarkeit von Reißverschlüssen	DIN EN 16732		[C] Reißverschlüsse müssen auf ihre Belastbarkeit untersucht werden und dabei die vorgegebenen Werte des Prüfstandards (s. Nachweis) einhalten. [F] Einige sicherheitsrelevante Produktstandards fordern ein höheres Mindestlimit, da die Norm für die Sicherheit mancher Reißverschlusstypen ungeeignet ist. Dennoch kann diese Norm als Ausgangspunkt verwendet werden.		[C] Reißverschlüsse müssen auf ihre Belastbarkeit untersucht werden und dabei die vorgegebenen Werte des Prüfstandards (s. Nachweis) einhalten. [F] Einige sicherheitsrelevante Produktstandards fordern ein höheres Mindestlimit, da die Norm für die Sicherheit mancher Reißverschlusstypen ungeeignet ist. Dennoch kann diese Norm als Ausgangspunkt verwendet werden.
	Sicherheit der Befestigung von Knöpfen (Ausreisfestigkeit)	EN 17394-2		[F] Die Sicherheitsgrenze von 70 N oder 50 N, die mit den Produktsicherheitsstandards verknüpft ist, wird als zu niedrig für eine gute Qualität betrachtet. Die Diskussion darüber, welche Grenze angemessen wäre, muss unter Experten geführt werden.		[F] Die Sicherheitsgrenze von 70 N oder 50 N, die mit den Produktsicherheitsstandards verknüpft ist, wird als zu niedrig für eine gute Qualität betrachtet. Die Diskussion darüber, welche Grenze angemessen wäre, muss unter Experten geführt werden.
	Beständigkeit gegen Beschädigung durch Biegen	DIN EN ISO 7854 (Methode C)	[G] Weitere Anforderungen eines Unternehmens	[G] Weitere Anforderungen eines Unternehmens	[G] Weitere Anforderungen eines Unternehmens	[-]

			Textile apparel		Technical textile apparel	
	UV-Beständigkeit	keine Verfahren genannt			[G] Sollte bei T-Shirt keine Rolle spielen -> Marketing, nicht wirklich nützlich	[-]
Geruch	Bestimmung der Geruchsentwicklung von Ausrüstungen	SNR 195651			[-]	[-]
Pflege / Reinigung	Verbraucher*inneninformation zur Pflege	Vorgaben von GINETEX32 oder ISO 3758	[A] Dem Produkt müssen Informationen (oder Links zu Informationen) über empfohlene Pflege- und Wartungstipps beigefügt sein, die die Lebensdauer des Produkts verlängern (und die Auswirkungen der Nutzungsphase verringern). -> Clever Care Symbol, QR-Code			
Demontage / Reparatur	Gewährleistung einer einfachen Demontage / Design for dis-assembly	keine	[A] Das Produktlogo, Knöpfe und Reißverschlüsse sollten innerhalb von X Sekunden abnehmbar sein. Die Nähte sollten sich innerhalb von X Sekunden auftrennen lassen, ohne dass die Haltbarkeit bei normalem Gebrauch und normaler Pflege beeinträchtigt wird. Es sollte eine Anleitung gegeben werden, wie dies zu bewerkstelligen ist.			
	Gewährleistung einer einfachen Reparatur / Design for repairability	keine	[F] Anleitungen, wie Reparaturen einfach durchgeführt werden können, könnten im Geschäft, in der Verpackung oder online zugänglich gemacht werden. Wenn Selbstreparatur oder Änderung nicht angebracht ist, könnten Einzelhändler Reparaturdienstleistungen im Geschäft anbieten und Partnerschaften mit Reparatur- und Upcycling-Anbietern in lokalen Gemeinschaften eingehen.			
Demontage / Reparatur	Bereitstellung von Ersatzteilen oder Reparatur-Sets	Nachweis der Verfügbarkeit von Ersatzteilen nach Décret n° 2014-1482 du 9 décembre 2014[86]		[A] Der Hersteller muss Ersatzteile für x Jahre nach dem Verkauf des Produkts zur Verfügung stellen oder alternativ Ersatzteile mit		[A] Der Hersteller muss Ersatzteile für x Jahre nach dem Verkauf des Produkts zur Verfügung stellen oder alternativ Ersatzteile mit dem Produkt

[86] Décret n° 2014-1482 du 9 décembre 2014 relatif aux obligations d'information et de fourniture concernant les pièces détachées indispensables à l'utilisation d'un bien.

			Textile apparel		**Technical textile apparel**	
				dem Produkt liefern (d.h. zusätzliche Knöpfe, Garn in der richtigen Farbe, Ersatzreißverschlüsse usw.). [F] Diese Ökodesignanforderung wäre relevant für Produktgruppen von Kleidung und Heimtextilien mit Verschlüssen/Zubehör und könnte anhand des Nachweises der Verfügbarkeit von Ersatzteilen durch den Hersteller bewertet werden. Dieser Zugang zu Ersatzteilen könnte zusammen mit dem Produkt zum Zeitpunkt des Kaufs durch die Bereitstellung relevanter Ersatzteile, einschließlich (Näh-) Fäden oder Garn, bereitgestellt werden. [H] Um den Zugang zu erleichtern, kann Bekleidung direkt mit Reparatursets für zu Hause verkauft werden, die passendes Garn und Ersatzknöpfe sowie eine Anleitung, einen Link oder einen QR-Code zu Online-Informationen enthalten.		liefern (d.h. zusätzliche Knöpfe, Garn in der richtigen Farbe, Ersatzreißverschlüsse usw.). [F] Diese Ökodesignanforderung wäre relevant für Produktgruppen von Kleidung und Heimtextilien mit Verschlüssen/Zubehör und könnte anhand des Nachweises der Verfügbarkeit von Ersatzteilen durch den Hersteller bewertet werden. Dieser Zugang zu Ersatzteilen könnte zusammen mit dem Produkt zum Zeitpunkt des Kaufs durch die Bereitstellung relevanter Ersatzteile, einschließlich (Näh-) Fäden oder Garn, bereitgestellt werden. [H] Um den Zugang zu erleichtern, kann Bekleidung direkt mit Reparatursets für zu Hause verkauft werden, die passendes Garn und Ersatzknöpfe sowie eine Anleitung, einen Link oder einen QR-Code zu Online-Informationen enthalten.
Variabilität / Modularität	keine	keine	[A] Für Produktgruppen ohne Verschleißteile wie Verschlüsse ist das modulare Design ein wichtiger Aspekt, der eine einfachere Reparatur und funktionelle Verbesserungen ermöglicht. Dies könnte bei Kleidung genutzt werden, indem Elemente wie Ellbogen oder Knie, die eher verschleißen, entfernt und ersetzt werden können. Es kann jedoch schwierig sein, Ökodesign-Anforderungen zu formulieren, die eine solche Modularität für Kleidung und Textilien vorschreiben. [H] Kleidung, die sich anpassen lässt, wirkt sich positiv auf eine lange Nutzungsdauer aus. [I] Natürlich gibt es einige feste Maße, die die Größe und Passform beeinflussen, z. B. die Oberweite oder den Taillenumfang. Es gibt			

			Textile apparel	Technical textile apparel
			jedoch keine Standardgrößen für den Menschen, und auch die Verbraucher*innen haben nicht alle die gleichen Vorlieben in Bezug auf Komfort und Passform eines Kleidungsstücks. Eine Möglichkeit, dies zu umgehen und die Haltbarkeit zu maximieren, besteht darin, Kleidung so zu entwerfen, dass sie eine Größenanpassung ermöglicht, um vernünftige Variationen der individuellen Form (und Vorlieben) zu ermöglichen. Dies könnte z. B. durch die Verwendung strategischer Verschlüsse geschehen, mit denen die Größe/Länge an Seitennähten oder Säumen vergrößert/verkleinert werden kann.	
Tragekomfort	keine	keine	[A] Die Ökodesign-VO ist nicht das richtige Instrument, um subjektive Aspekte des Stils zu behandeln. Sie sollte in erster Linie dazu verwendet werden, Eigenschaften zu fordern, die leicht geprüft und dokumentiert werden können. Allerdings können die Ökodesign-Anforderungen potenziell genutzt werden, um das Verhalten über informationsbasierte Kennzeichnungen zu beeinflussen. [H] In [dem Bericht 'A new textiles economy' der Ellen MacArthur Foundation] wird die individuelle Anpassung von Kleidung mit einem erhöhten Tragekomfort in Zusammenhang gebracht. Das kann bei Verbraucher*innen zu einer längeren Nutzung der Kleidung führen. Zudem wird darauf hingewiesen, dass die auch in den vorherigen Berichten genannte emotionale Langlebigkeit durch das Einbeziehen der Verbraucher*innen in den Herstellungsprozess gefördert werden kann.	
Design / Passform	keine	keine	[A] Die Ökodesign-VO ist nicht das richtige Instrument, um subjektive Aspekte des Stils zu behandeln. Sie sollte in erster Linie dazu verwendet werden, Eigenschaften zu fordern, die leicht geprüft und dokumentiert werden können. Allerdings können die Ökodesign-Anforderungen potenziell genutzt werden, um das Verhalten über informationsbasierte Kennzeichnungen zu beeinflussen. Entsorgungsgründe wie die Veränderung des Geschmacks können teilweise durch die Verwendung von klassischem Design behoben werden. [H] 'Ein wichtiger Faktor beim Design für die Langlebigkeit eines Kleidungsstücks ist der Schnitt (Cooper et al. 2013, 15). Hervorgehoben werden können diesbezüglich maßgeschneiderte Kleidungsstücke, die wirklich gut passen und daher lange getragen werden. Auch Kleidung, die sich anpassen lässt, wirkt sich positiv auf eine lange Nutzungsdauer aus. […] Neben dem Schnitt ist auch ein zeitloses Design von Bekleidung ein die Langlebigkeit fördernder Aspekt. Durch die Unabhängigkeit von Modetrends kann diese Kleidung länger getragen werden. Hier geht es sowohl um klassische Formen der Kleidung als auch um eine bestimmte Farbauswahl. Die bessere Planbarkeit und größere Erfahrung bei der Herstellung solcher Kleidungsstücke könnte zudem zu einer Reduktion der Produktionskosten führen (Cooper et al. 2013, 15).' [I] Farben und Stile: Zwar wird es immer einen höheren Umsatz bei Modeartikeln geben, doch können Designer die Lebensdauer vieler Kleidungsstücke verlängern, indem sie 'klassische' oder zeitlose Stile und Farben verwenden, die weniger schnell aus der Mode kommen. Größe und Passform; einer der Hauptgründe für das Wegwerfen von unbeschädigten Kleidungsstücken ist, dass sie nicht mehr passen. Durch die Gestaltung von Kleidungsstücken, die leicht angepasst werden können, um vernünftige Variationen in der individuellen Form zu ermöglichen, können Designer dazu beitragen, die Haltbarkeit zu erhöhen;	

Source: Lumpp 2025

Table 64: Abbreviation for the requirement sources of table 63

Code	Source
[A]	Nordischer Ministerrat (2018) Potential Ecodesign Requirements for Textiles and Furniture.
[B]	MTE (2023) Arrêté du 23 novembre 2022 portant cahiers des charges des éco-organismes et des systèmes individuels de la filière à responsabilité élargie du producteur des textiles, chaussures et linge de maison (TLC)
[C]	Blauer Engel (2023) V2
[D]	EUCOM (2014) BESCHLUSS DER KOMMISSION vom 5. Juni 2014 zur Festlegung der Umweltkriterien für die Vergabe des EU-Umweltzeichens für Textilerzeugnisse (Bekanntgegeben unter Aktenzeichen C(2014) 3677)
[E]	EURATEX (2006) TCG Recommendations Proposal/ DTB (2006) Informationen zu Eigenschaften und Fehlern in Textilen Flächengebilden für Bekleidung -> Beim DTB Dokument handelt es sich um die deutsche Übersetzung der TCG Recommendations
[F]	OVAM (2021) Ecodesign Criteria for Consumer Textiles
[G]	Öko-Institut e.V. (2023) Dokumentation der Workshops zur Erarbeitung von konkreten Vorschlägen für verbindliche produktspezifische Ökodesignanforderungen für zwei ausgewählte Textilprodukte: T-Shirt und Jeans
[H]	Gimkiewicz (2022) Die Rolle der Langlebigkeit und der Nutzungsdauer für einen nachhaltigen Umgang mit Bekleidung
[I]	WRAP (2015) Clothing Durability Report
Added later to the value ranges in the questionnaires	Modint und GermanFashion Modeverband Deutschland e.V. (2018) International Quality Testing List (IQTL), Version April 2018 TAUW (2023) Performance requirements for textiles Input on EU sustainable design criteria for textiles
[-]	The requirement sources suggest the durability aspect/standard, but do not specify any values for minimum durability requirements.

B Documentation of stakeholder consultation approaches [some in German]

The additional stakeholder consultation approaches are documented here in the original format, with some in German for this reason.

B.1 Questionnaire on durability (in German language)

Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology

Hochschule Niederrhein University of Applied Sciences

Hochschule Hof

Fragebögen

Produktspezifische Haltbarkeitsaspekte

Hintergrund

Das Umweltbundesamt hat ein Forschungsvorhaben ausgeschrieben, in dem – parallel zu den laufenden Arbeiten der Europäischen Union – mögliche Ökodesignanforderungen für Textilien erarbeitet und in ein mögliches Kennzeichnungslabel überführt werden. Außerdem dient das Vorhaben dazu, die europäischen Prozesse zur neuen Ökodesign-Verordnung für die Produktgruppe der Textilien zu begleiten.

Das Projekt wird bearbeitet durch das Öko-Institut e.V., die Hochschule Niederrhein sowie die Hochschule für angewandte Wissenschaften Hof. Die Projektleitung liegt beim Öko-Institut e.V..

Produktspezifische Haltbarkeitsaspekte

Für die Entwicklung von textilen Haltbarkeitsaspekten wurde im Forschungsvorhaben eine Literaturrecherche zu bestehenden Prüfnormen und Mindestanforderungen hinsichtlich der Qualität und Haltbarkeit textiler Produkte durchgeführt. Auf dieser Basis wurden die Haltbarkeitsaspekte mit den korrespondierenden Prüfnormen sowie Mindestanforderungen für Beispielprodukte, die im europäischen Markt in großen Volumina verkauft werden (T-Shirt, Jeans und Funktionsjacke), abgleitet und in Form von Fragebögen zusammengefasst. Diese Fragebögen spiegeln ausschließlich den aktuellen Stand der Literatur wider.

Das Ziel der vorliegenden Fragebögen ist es, Ihre praktische Perspektive zu den Ergebnissen der Literaturrecherche zu ergänzen. Damit sollen im Forschungsprojekt einerseits die Unterschiede zwischen Praxis und Literatur deutlich gemacht werden und andererseits die relevantesten Aspekte der Haltbarkeit sowie entsprechende Prüfnormen und Mindestanforderungen abgeleitet werden.

Eine Anleitung zum Ausfüllen des Fragebogens finden Sie auf der nächsten Seite. Ihre Daten werden vertraulich behandelt und nicht an Dritte weitergegeben.
Bei Fragen wenden Sie sich bitte an marie.reuters@hs-niederrhein.de.

Wir bedanken uns für Ihre Zuarbeit.

1

Ausfüllen der Fragebögen

1. **Angabe von Hintergrunddaten**

   Bitte wählen Sie für Ihre Organisation und Zielgruppe jeweils eine Option für die **Anzahl der Kollektionen pro Jahr**, das **Preisgenre** und den **Modegrad** aus.

2. **Ausfüllen des Fragebogens pro Beispielprodukt**

   a) **Abfrage über die Anwendung der Norm**

      Für jedes Prüfkriterium sind mehrere Normen aufgeführt. Kreuzen Sie bitte die Normen mit „Ja" an, die Sie in der Praxis anwenden.

   b) **Bewertung bestehender Mindestanforderungen in der Literatur**

      Den Normen aus a) sind in der nächsten Spalte Wertekorridoren zugeordnet. Bewerten Sie diese Wertekorridore mittels der fünf-stufigen Skala. (Falls die Literatur keinen Wert nennt, ergänzen Sie optional einen Vorschlag für geeignete Mindestwerte)

   c) **Eventuelle Anmerkungen** und d) **Sonstige Vorschläge**

      In der rechten Anmerkungsspalte können Sie Ergänzungen eintragen, wie bspw. praxisrelevante Wertekorridore (c). Ergänzungen zu weiteren produktspezifisch relevanten Haltbarkeitsaspekten, die Ihrer Meinung nach in der Literatur fehlen, können Sie in der letzten Tabellenzeile eintragen (d).

   e) **Ranking der Haltbarkeitsaspekte**

      Nennen Sie uns bitte die Prüfkriterien oder Unteraspekte, die produktspezifisch für Sie am wichtigsten sind (max. 5 Aspekte).

Tabellenlegende:

	Der Unteraspekt ist aus der Literatur als nicht relevant für die Haltbarkeit des Beispielprodukts hervorgegangen.
[keine Werte vorhanden]	Die Anforderungsquellen schlagen den Unteraspekt / die Prüfnorm vor, nennen aber keine Werte für Haltbarkeits-Mindestanforderungen.
- *oder*	Mindestens eine Anforderungsquelle betrachtet den Unteraspekt als nicht relevant für die Haltbarkeit des Beispielprodukts (N.A.).

Bewertung:

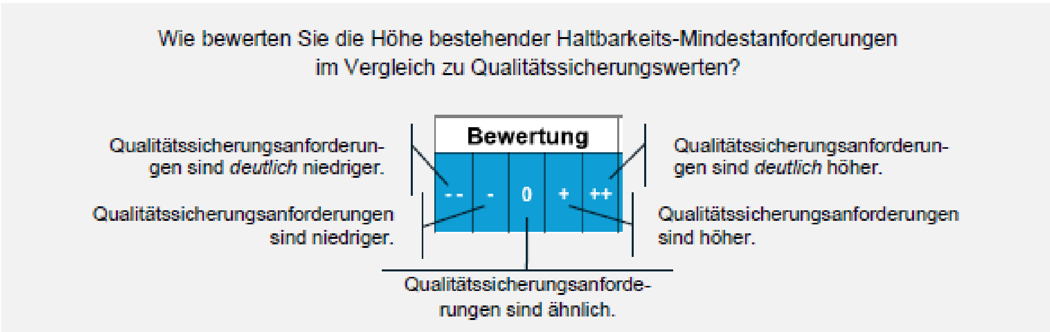

Abbildung 1 Erläuterung der Bewertungsskala
Quelle: Eigene Darstellung

2

Hintergrunddaten

Anzahl Kollektionen pro Jahr	Preisgenre	Modegrad
☐ 2-4 ☐ 8-12 ☐ > 12	☐ Preismarkt ☐ Markt der Mitte ☐ gehobener Markt	☐ trendy ☐ modern ☐ klassisch/konservativ

T-Shirts

Tabelle 1 führt bestehende, produktspezifische Haltbarkeits-Mindestanforderungen für ein klassisches T-Shirt aus 100% Baumwolle mit Druck und ein Funktions-T-Shirt aus 100% Polyester mit atmungsaktiver Flächenkonstruktion (entsprechend „quick dry" Technologie) auf.

Tabelle 1 Fragebogen zur Bewertung bestehender Prüfnormen und Haltbarkeits-Mindestanforderungen für T-Shirts

Bestehende Haltbarkeitsaspekte			a) Anwendung	Mindestanforderungen		b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm / Verfahren	*Wird die Norm für T-Shirts angewendet?*	Klassisches T-Shirt	Funktions-T-Shirt	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
1. Formbeständigkeit	1.1. Änderung der Abmessung während des Waschens und Trocknens	ISO 5077:2007 in Kombination mit ISO 6330:2021	☐ Ja ☐ Nein, weil____	-6% bis +5%	±5%	☐ ☐ ☐ ☐ ☐	
	1.2. Bestimmung des Verdrehens nach einer Waschbehandlung	ISO 16322-1:2005, ISO 16322-2:2021, ISO 16322-3:2021	☐ Ja ☐ Nein, weil____	≤ 3% bis 5% (ISO 16322-1) ≤ 4% bis 5% (ISO 16322-2) ≤ 5% (ISO 16322-3)		☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	1.3. Beurteilung der Eignung von Textilien und Kleidungsstücken für die Reinigung	ISO 3175-1:2017	☐ Ja ☐ Nein, weil____	- oder -3% bis +5%	-3% bis +5%	☐ ☐ ☐ ☐ ☐	
	1.4. Formbeständigkeit beim Dampfpressen von nicht waschbaren Materialien	DIN 53894-2:2018	☐ Ja ☐ Nein, weil____		≤ 2%	☐ ☐ ☐ ☐ ☐	
	1.5. Elastizität und Dehnbarkeit ausgewählter Kleidung	DIN EN ISO 20932-1:2022 (Elastizität textile Flächen), NF EN ISO 20932-1:2020 (Streifenprüfungen), NF EN ISO 20932-3:2020 (Schmaltextilien)	☐ Ja ☐ Nein, weil____	[keine Werte vorhanden]		Geeigneter Wert:_	
		DIN EN ISO 14704-1:2005[1] (Elastizität Fasern)	☐ Ja ☐ Nein, weil____	Dehnung 25%, Erholung 95% (Belastung 30 N, 5 Dehnungszyklen Erholungszeit: 30 Minuten)		☐ ☐ ☐ ☐ ☐	[1] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist DIN EN ISO 20932-1:2022-02.
2. Farbechtheit	2.1. Farbechtheit beim Waschen (Farbänderung und Anblutung)	ISO 105-C06:2010	☐ Ja ☐ Nein, weil____	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid), ≥ Note 4,5 bis 5 bei starken Farbkontrasten *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*		☐ ☐ ☐ ☐ ☐	
		ISO 105-C08:2010 (+ phosphatfreies Testwaschmittel und Bleichaktivator für niedrige Temperaturen)	☐ Ja ☐ Nein, weil____	≥ Note 4, ≥ Note 4,5 bis 5 bei starken Farbkontrasten		☐ ☐ ☐ ☐ ☐	
		ISO 105-C09:2001 (+oxidative Bleiche)	☐ Ja ☐ Nein, weil____	≥ Note 4, ≥ Note 4,5 bis 5 bei starken Farbkontrasten		☐ ☐ ☐ ☐ ☐	
	2.2. Farbechtheit gegenüber Wasser	ISO 105-E01:2013	☐ Ja ☐ Nein, weil____	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid), ≥ Note 4,5 bei starken Farbkontrasten		☐ ☐ ☐ ☐ ☐	
	2.3. Farbechtheit gegen künstliche Bewetterung	ISO 105-B04:1994	☐ Ja ☐ Nein, weil____		≥ Note 5	☐ ☐ ☐ ☐ ☐	
	2.4. Farbechtheit beim Bügeln (oder Dämpfen)	ISO 105-X11:2018	☐ Ja ☐ Nein, weil____	- oder ≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung)	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung)	☐ ☐ ☐ ☐ ☐	
	2.5. Farbechtheit gegen Schweiß (Farbänderung und Anbluten)	ISO 105-E04:2013	☐ Ja ☐ Nein, weil____	≥ Note 3* bis 4, ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid), ≥ Note 4,5 bis 5 bei starken Farbkontrasten *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.* ** annehmbar bei Standardtiefe > 1/1*		☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Mindestanforderungen		b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm / Verfahren	*Wird die Norm für T-Shirts angewendet?*	Klassisches T-Shirt	Funktions-T-Shirt	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
2. Farbechtheit	2.6. Farbechtheit gegen Flecken: Wasser	ISO 105-E07:2010 (Wassertropfenechtheit)	☐ Ja ☐ Nein, weil___	≥ Note 4		☐ ☐ ☐ ☐ ☐	
	2.7. Farbechtheit gegenüber Reiben (nass)	ISO 105-X12:2016	☐ Ja ☐ Nein, weil___	≥ Note 2,5 bis 4 für alle Farben, ≥ Note 2 für dunkle oder Pigment Farben *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*		☐ ☐ ☐ ☐ ☐	
	2.8. Farbechtheit gegenüber Reiben (trocken)	ISO 105-X12:2016	☐ Ja ☐ Nein, weil___	≥ Note 4 für alle Farben, ≥ Note 3 bis 3,5 für dunkle und Pigment Farben *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*		☐ ☐ ☐ ☐ ☐	
	2.9. Farbechtheit gegenüber Licht	ISO 105-B02:2014	☐ Ja ☐ Nein, weil___	≥ Note 4 bis 5, ≥ Note 3 bei Neonfarben *Ausschluss von ungefärbten oder unbedruckten Produkten möglich.*		☐ ☐ ☐ ☐ ☐	
	2.10. Farbechtheit gegenüber der chemischen Reinigung	ISO 105-D01:2010	☐ Ja ☐ Nein, weil___	- oder ≥ Note 4	≥ Note 4	☐ ☐ ☐ ☐ ☐	
	2.11. Farbechtheit von Färbungen und Drucken gegen das Sublimieren beim Lagern	DIN 54056:2017	☐ Ja ☐ Nein, weil___	[keine Werte vorhanden]		Geeigneter Wert:_	
	2.12. Farbechtheit gegen Licht von mit künstlichem Schweiß angefeuchteten Textilien	ISO 105-B07:2009	☐ Ja ☐ Nein, weil___		[keine Werte vorhanden]	Geeigneter Wert:_	
	2.13. Bestimmung der Möglichkeit der Vergilbung durch Phenole	ISO 105-X18:2007	☐ Ja ☐ Nein, weil___	- oder ≥ Note 4		☐ ☐ ☐ ☐ ☐	
	2.14. Farbechtheit gegenüber Farbabweichungen bei wechselnden Leuchtmitteln	EN ISO 105-J05:2007	☐ Ja ☐ Nein, weil___		Im Vergleich zum Muster: ΔE 1,2, Kante/Mitte des Stücks/Kante: ΔE0,5, Anfang des Stücks/Ende des Stücks: ΔE 0,5, Stück zu Stück: Δ1,2	☐ ☐ ☐ ☐ ☐	
3. Strapazierfähigkeit	3.1. Pillbeständigkeit und Abriebfestigkeit von textilen Oberflächen	ISO 12945-1:2020 (Verfahren mit dem Pilling-Prüfkasten)	☐ Ja ☐ Nein, weil___	≥ Note 3 bis 4		☐ ☐ ☐ ☐ ☐	
		ISO 12945-2:2020 (Martindale-Verfahren)	☐ Ja ☐ Nein, weil___	nach 125 Touren: ≥ Note 3,5 bis 4, nach 500 Touren: ≥ Note 3 bis 3,5, nach 1000 Touren: ≥ Note 2,5 bis 3, nach 2000 Touren: - oder ≥ Note 3, nach 5000 Touren: - oder ≥ Note 2,5, nach 7000 Touren: - oder ≥ Note 2,5		☐ ☐ ☐ ☐ ☐	
	3.2. Scheuerbeständigkeit	DIN EN ISO 12947-2:2016 (Martindale-Verfahren)	☐ Ja ☐ Nein, weil___	- oder ≥ 8.000 bis 10.000 Touren (9 kPa) unabhängig von der Flächenmasse	- oder ≥ 10.000 bis 16.000 Touren (9 kPa) unabhängig von der Flächenmasse	☐ ☐ ☐ ☐ ☐	
	3.3. Berstdruck	EN ISO 13938-1:2019, EN ISO 13938-2:2019	☐ Ja ☐ Nein, weil___	≥ 200 kPa (7,3 cm² Lochplatte)	≥ 200 bis 330 kPa (7,3 cm² Lochplatte)	☐ ☐ ☐ ☐ ☐	
	3.4. Prüfung der Nahtfestigkeit	EN ISO 13935-1:2014, EN ISO 13935-2:2014	☐ Ja ☐ Nein, weil___	≥ 100 N		☐ ☐ ☐ ☐ ☐	
	3.5. Nahtverschiebung / Bestimmung des Schiebewiderstandes von Garnen in Gewebenähten	EN ISO 13936-2:2004 (Nahtöffnung bei definierter Belastung)	☐ Ja ☐ Nein, weil___	≤ 6 mm (Belastung mit 80 N)		☐ ☐ ☐ ☐ ☐	
	3.6. Faserverlust	Interne Verfahren	☐ Ja ☐ Nein, weil___	[keine Werte vorhanden]		Geeigneter Wert:_	
	3.7. Masse pro m²	EN 12127:1997	☐ Ja ☐ Nein, weil___	5% Toleranz		☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Mindestanforderungen		b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm / Verfahren	*Wird die Norm für T-Shirts angewendet?*	Klassisches T-Shirt	Funktions-T-Shirt	-- / - / o / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
4. Optik	4.1. Fadenziehemeigung von Textilien (Snagging)	ASTM D 3939/D 3939M:2013 (oder JIS L 1058:2021)	☐ Ja ☐ Nein, weil______	≥ Note 2,5 bis 3		☐ ☐ ☐ ☐ ☐	
	4.2. Optische Veränderung nach dem Waschen / Pflegeeigenschaft und Selbstglättungsverhalten	EN ISO 15487:2018	☐ Ja ☐ Nein, weil______	Erhalt der Funktion nach ≥ 5 Wäschen, oder keine Veränderung des Aussehens (Waschen gemäß Pflegeetikett, visuelle Beurteilung durch Expert*in), oder bei Drucken, Accessoires oder Kontrastfarben darf sich das Aussehen nach der Wäsche nicht oder nur geringfügig verändern: 1. keine Veränderung des Aussehens ≥ Note 4 2. Farbveränderung ≥ Note 4 3. Kein Anbluten		☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
5. Funktionsbeständigkeit	5.1. Luftdurchlässigkeit	DIN EN ISO 9237:1995	☐ Ja ☐ Nein, weil______		≥ 25 mm/s (l/m^2s; textile Fläche), oder <5 l/m^2s	☐ ☐ ☐ ☐ ☐	
	5.2. Atmungsaktivität	ASTM E 96:2000[2]	☐ Ja ☐ Nein, weil______		> 3000 $g/m^2/24h$	☐ ☐ ☐ ☐ ☐	[2] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist ASTM E 96/E 96M:2023.
	5.3. UV-Beständigkeit	[keine Verfahren genannt]	☐ Ja ☐ Nein, weil______		[keine Werte vorhanden]	Geeigneter Wert:_	
6. Geruch	6.1. Bestimmung der Geruchsentwicklung von Ausrüstungen	SNR 195651:2015	☐ Ja ☐ Nein, weil______		[keine Werte vorhanden]	Geeigneter Wert:_	
d) Sonstige Vorschläge	*Haben Sie Vorschläge für weitere Haltbarkeitsaspekte?*						

Quelle: Eigene Darstellung

Bitte ergänzen Sie die Ihrer Ansicht nach 3 – 5 wichtigsten Haltbarkeits- oder Unteraspekte für T-Shirts mit absteigender Relevanz:

	Klassisches T-Shirt			Funktions-T-Shirt
e) Ranking	*1*		*1*	
	2		*2*	
	3		*3*	
	4		*4*	
	5		*5*	

Jeans

Tabelle 2 führt bestehende, produktspezifische Haltbarkeits-Mindestanforderungen für eine Basic-Jeans mit einer Materialzusammensetzung aus 95% Baumwolle und 5% Elastan.

Tabelle 2 Fragebogen zur Bewertung bestehender Prüfnormen und Haltbarkeits-Mindestanforderungen für Jeans

Bestehende Haltbarkeitsaspekte			a) Anwendung	Modebekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	**Titel / Unteraspekt**	**Norm/ Verfahren**	*Wird die Norm für Jeans angewendet?*	**Basic-Jeans**	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
1. Formbeständigkeit	1.1. Änderung der Abmessung während des Waschens und Trocknens	ISO 5077:2007 in Kombination mit ISO 6330:2021	☐ Ja ☐ Nein, weil ____	±3%, -5% bis +2% für ≥ 60% Viskose	☐ ☐ ☐ ☐ ☐	
1. Formbeständigkeit	1.2. Bestimmung des Verdrehens nach einer Waschbehandlung	ISO 16322-2:2021	☐ Ja ☐ Nein, weil ____	≤ 5%	☐ ☐ ☐ ☐ ☐	
1. Formbeständigkeit	1.3. Beurteilung der Eignung von Textilien und Kleidungsstücken für die Reinigung	ISO 3175-1:2017	☐ Ja ☐ Nein, weil ____	-3% bis +2%	☐ ☐ ☐ ☐ ☐	
1. Formbeständigkeit	1.3. Beurteilung der Eignung von Textilien und Kleidungsstücken für die Reinigung	ISO 3175-2:2017, ISO 3175-3:2020, ISO 3175-4:2018	☐ Ja ☐ Nein, weil ____	±2%	☐ ☐ ☐ ☐ ☐	
1. Formbeständigkeit	1.4. Formbeständigkeit beim Dampfpressen von nicht waschbaren Materialien	DIN 53894-2:2018	☐ Ja ☐ Nein, weil ____	≤ 2%	☐ ☐ ☐ ☐ ☐	
1. Formbeständigkeit	1.5. Elastizität und Dehnbarkeit ausgewählter Kleidung	DIN EN ISO 20932-1:2022 (Elastizität textile Flächen), NF EN ISO 20932-1:2020 (Streifenprüfungen), NF EN ISO 20932-3:2020 (Schmaltextilien)	☐ Ja ☐ Nein, weil ____	[keine Werte vorhanden]	Geeigneter Wert:_	
1. Formbeständigkeit	1.5. Elastizität und Dehnbarkeit ausgewählter Kleidung	DIN EN ISO 14704-1:2005[a] (Elastizität Fasern)	☐ Ja ☐ Nein, weil ____	Dehnung 25%, Erholung 95% (Belastung 30 N, 5 Dehnungszyklen Erholungszeit: 30 Minuten)	☐ ☐ ☐ ☐ ☐	[a] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist DIN EN ISO 20932-1:2022-02.
2. Farbechtheit	2.1. Farbechtheit beim Waschen (Farbänderung und Anblutung)	ISO 105-C06:2010	☐ Ja ☐ Nein, weil ____	- oder ≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 4,5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.1. Farbechtheit beim Waschen (Farbänderung und Anblutung)	ISO 105-C08:2010 (+ phosphatfreies Waschmittel, Bleichaktivator, niedrige Temperaturen)	☐ Ja ☐ Nein, weil ____	≥ Note 4, ≥ Note 4,5 bis 5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.1. Farbechtheit beim Waschen (Farbänderung und Anblutung)	ISO 105-C09:2001 (+oxidative Bleiche)	☐ Ja ☐ Nein, weil ____	≥ Note 4, ≥ Note 4,5 bis 5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.2. Farbechtheit gegenüber Wasser	ISO 105-E01:2013	☐ Ja ☐ Nein, weil ____	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung) ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid) ≥ Note 4,5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.3. Farbechtheit beim Bügeln (oder Dämpfen)	ISO 105-X11:2018	☐ Ja ☐ Nein, weil ____	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung)	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.4. Farbechtheit gegen Schweiß (Farbänderung und Anbluten)	ISO 105-E04:2013	☐ Ja ☐ Nein, weil ____	≥ Note 3 bis 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 4,5 bis 5 bei starken Farbkontrasten *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.5. Farbechtheit gegen Flecken: Wasser	ISO 105-E07:2010 (Wassertropfenechtheit)	☐ Ja ☐ Nein, weil ____	≥ Note 4	☐ ☐ ☐ ☐ ☐	
2. Farbechtheit	2.6. Farbechtheit gegenüber Reiben (nass)	ISO 105-X12:2016	☐ Ja ☐ Nein, weil ____	- oder ≥ Note 2 bis 3 (Anblutung) bis Note 4 (Farbänderung)	☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Modebekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	**Titel / Unteraspekt**	**Norm/ Verfahren**	*Wird die Norm für Jeans angewendet?*	**Basic-Jeans**	-- - 0 + ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
2. Farbechtheit	2.7. Farbechtheit gegenüber Reiben (trocken)	ISO 105-X12:2016	☐ Ja ☐ Nein, weil______	≥ Note 3 bis 4 *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*	☐ ☐ ☐ ☐ ☐	
	2.8. Farbechtheit gegenüber Licht	ISO 105-B02:2014	☐ Ja ☐ Nein, weil______	≥ Note 4 bis 5, ≥ Note 3 bei Neonfarben	☐ ☐ ☐ ☐ ☐	
	2.9. Farbechtheit gegenüber der chemischen Reinigung	ISO 105-D01:2010	☐ Ja ☐ Nein, weil______	≥ Note 4	☐ ☐ ☐ ☐ ☐	
	2.10. Bestimmung der Möglichkeit der Vergilbung durch Phenole	ISO 105-X18:2007	☐ Ja ☐ Nein, weil______	≥ Note 4 (Anblutung)	☐ ☐ ☐ ☐ ☐	
	2.11. Farbechtheit gegenüber Farbabweichungen bei wechselnden Leuchtmitteln	EN ISO 105-J05:2007	☐ Ja ☐ Nein, weil______	Im Vergleich zum Muster: ΔE 1,2, Kante/Mitte des Stücks/Kante: ΔE 0,5, Anfang des Stücks/Ende des Stücks: ΔE 0,5, Stück zu Stück: Δ 1,2	☐ ☐ ☐ ☐ ☐	
3. Strapazierfähigkeit	3.1. Pillbeständigkeit und Abriebfestigkeit von textilen Oberflächen	ISO 12945-2:2020 (Martindale-Verfahren)	☐ Ja ☐ Nein, weil______	Baumwollmischgewebe: ≥ Note 3 ohne Tourenzahl-Vorgabe, oder nach 125 Touren ≥ Note 3,5, nach 500 Touren ≥ Note 3,5, nach 1.000 Touren ≥ Note 3,5, nach 2.000 Touren ≥ Note 3,5, nach 5.000 Touren ≥ - oder Note 3,5, oder Gewebe mit glatter Oberfläche: nach 125 bis 2.000 oder 7.000 Touren ≥ Note 4, Gewebe mit aufgerauter Oberfläche: nach 125 Touren ≥ Note 3,5, nach 500 Touren ≥ Note 3, nach 1.000 Touren ≥ Note 2,5 *Möglicherweise nicht relevant für Jeans.*	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.2. Scheuerbeständigkeit	DIN EN ISO 12947-2:2016 (Martindale-Verfahren)	☐ Ja ☐ Nein, weil______	- oder ≥ 20.000 bis 30.000 Touren unabhängig von der Flächenmasse (9 kPa Nenndruck), oder Masse > 340 g/m² ≥ 30.000 Touren Masse < 340 g/m² ≥ 18.000 Touren	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.3. Faserverlust	Interne Verfahren	☐ Ja ☐ Nein, weil______	[keine Werte vorhanden]	Geeigneter Wert:_	
	3.4. Anzahl der Fäden je Längeneinheit	DIN EN 1049-2:1994	☐ Ja ☐ Nein, weil______	6% Toleranz für kardierte Materialien, 4% Toleranz für alle anderen	☐ ☐ ☐ ☐ ☐	
	3.5. Dichte von Fäden in einem Gewebe	ISO 7211-5:2020	☐ Ja ☐ Nein, weil______	[keine Werte vorhanden]	Geeigneter Wert:_	
	3.6. Höchstzugkraft und Höchstzugkraft-Dehnung von Geweben	EN ISO 13934-1:2013 (Streifenzugversuch)	☐ Ja ☐ Nein, weil______	≥ 250 N und 12,5% bis 55%, wenn körperfern geschnitten, ≥ 300 N und 12,5% bis 35%, wenn körpernah geschnitten	☐ ☐ ☐ ☐ ☐	
		EN ISO 13934-2:2014 (Grab Methode)	☐ Ja ☐ Nein, weil______	≥ 180 N, wenn körperfern geschnitten, ≥ 200 N, wenn körpernah geschnitten, oder Masse > 340 g/m² ≥ 300 N, Masse > 200 g/m² bis < 340 g/m² ≥ 230 N, Masse < 200 g/m² ≥ 200 N, Futterstoffe ≥ 140 N	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.7. Weiterreißfestigkeit von Geweben	EN ISO 13937-1:2000 (ballistisches Pendel)	☐ Ja ☐ Nein, weil______	≥ 15 N, wenn körperfern geschnitten, ≥ 16 N, wenn körpernah geschnitten, *7% Toleranz zum Referenzmuster* oder Masse > 340 g/m² ≥ 20 N, Masse > 200 g/m² < 340 g/m² ≥ 15 N, Masse < 200 g/m² ≥ 12 N, Futterstoffe ≥ 8 N	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
		EN ISO 13937-2:2000 (Schenkelweiterreißversuch)	☐ Ja ☐ Nein, weil______	≥ 15 N, wenn körperfern geschnitten, ≥ 16 N, wenn körpernah geschnitten, ≥ 20 N für Materialien mit < 3% Elastan	☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Modebekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm/ Verfahren	*Wird die Norm für Jeans angewendet?*	Basic-Jeans	-- - 0 + ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
3. Strapazierfähigkeit	3.8. Prüfung von fixierten Einlagestoffen	DIN 54310:1980	☐ Ja ☐ Nein, weil ____	[keine Werte vorhanden]	Geeigneter Wert_	
	3.9. Prüfung der Nahtfestigkeit	EN ISO 13935-1:2014	☐ Ja ☐ Nein, weil ____	- oder ≥ 200 N für Materialien mit einer Dehnung von weniger als 50%	☐ ☐ ☐ ☐ ☐	
		EN ISO 13935-2:2014	☐ Ja ☐ Nein, weil ____	- oder ≥ 200 N für Materialien mit einer Dehnung von weniger als 50%, oder Masse > 340 g/m² ≥ 260 N, Masse > 200 g/m² < 340 g/m² ≥ 200 N, Masse < 200 g/m² ≥ 140 N, Futterstoffe ≥ 80 N	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.10. Nahtverschiebung / Bestimmung des Schiebewiderstandes von Garnen in Gewebenähten	EN ISO 13936-1:2004 (Schiebewiderstand)	☐ Ja ☐ Nein, weil ____	- oder ≥ 140 N, wenn körperfern geschnitten, ≥ 160 N, wenn körpernah geschnitten	☐ ☐ ☐ ☐ ☐	
		EN ISO 13936-2:2004 (Nahtöffnung bei definierter Belastung)	☐ Ja ☐ Nein, weil ____	≤ 3 mm, wenn körperfern geschnitten, ≤ 2 mm, wenn körpernah geschnitten Futterstoffe: ≤ 3 mm, wenn körperfern geschnitten, ≤ 2 mm, wenn körpernah geschnitten (Belastung mit 120 N), oder Masse > 340 g/m² Öffnung ≤ 6 mm (Belastung mit 160 N), Masse > 200 g/m² <340 g/m² Öffnung ≤ 6 mm (Belastung mit 120 N), Masse < 200 g/m² Öffnung ≤ 6 mm (Belastung mit 100 N), Futterstoffe: Öffnung ≤ 6 mm (Belastung mit 80 N)	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.11. Masse pro m²	EN 12127:1997	☐ Ja ☐ Nein, weil ____	5% Toleranz	☐ ☐ ☐ ☐ ☐	
4. Optik	4.1. Bestimmung des Knittererholungswinkels von Geweben	ISO 2313:1972[4]	☐ Ja ☐ Nein, weil ____	≥ 110° bis 120°	☐ ☐ ☐ ☐ ☐	[4] Diese Norm wurde zurückgezogen. Die Nachfolgedokumente sind ISO 2313-1:2021 und ISO 2313-2:2021.
	4.2. Bewertung der Knittererholung von Geweben - Verfahren zur Bewertung des Aussehens	ISO 9867:2022 (Selbstglättungsverhalten)	☐ Ja ☐ Nein, weil ____	≥ Note 4	☐ ☐ ☐ ☐ ☐	
	4.3. Fadenziehemeigung von Textilien (Snagging)	ASTM D 3939/D 3939M:2013 (oder JIS L 1058:2021)	☐ Ja ☐ Nein, weil ____	≥ Note 3	☐ ☐ ☐ ☐ ☐	
	4.4. Optische Veränderung nach dem Waschen / Pflegeeigenschaft und Selbstglättungsverhalten	EN ISO 15487:2018	☐ Ja ☐ Nein, weil ____	Erhalt der Funktion nach ≥ 5 Wäschen, oder gemäß Pflegeetikett waschen mit visueller Beurteilung durch Expert*in -> keine Veränderung des Aussehens oder bei Drucken, Accessoires oder Kontrastfarben darf sich das Aussehen nach der Wäsche nicht verändern: 1. keine Veränderung des Aussehens ≥ Note 4 2. Farbveränderung ≥ Note 4 3. Kein Anbluten	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
5. Funktionsbeständigkeit	5.1. Langlebigkeit von Verschlüssen	D2061-03 ASTM:2003	☐ Ja ☐ Nein, weil ____	[keine Werte vorhanden]	Geeigneter Wert_	
	5.2. Schließkraft von Druckknöpfen	ASTM D 4846:1996	☐ Ja ☐ Nein, weil ____	[keine Werte vorhanden]	Geeigneter Wert_	
	5.3. Sicherheit der Befestigung von (Druck-) Knöpfen	EN 17394-2:2020, CEN/TS 17394-3:2021 (Ausreißfestigkeit)	☐ Ja ☐ Nein, weil ____	> 50 N bis 70 N, *d.h. höher als die Grenzwerte der Produktsicherheitsstandards.*	☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Modebekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm/ Verfahren	*Wird die Norm für Jeans angewendet?*	Basic-Jeans	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
5. Funktionsbeständigkeit	5.4. Belastbarkeit von Reißverschlüssen	DIN EN 16732:2016	☐ Ja ☐ Nein, weil__________	*Sollten über den Qualitäts-Mindestanforderungen der DIN 16732 liegen.*	☐ ☐ ☐ ☐ ☐	
	5.5. Beständigkeit gegen Beschädigung durch Biegen	DIN EN ISO 7854:1997 (Methode C)	☐ Ja ☐ Nein, weil__________	[keine Werte vorhanden]	Geeigneter Wert:_	
d) Sonstige Vorschläge	*Haben Sie Vorschläge für weitere Haltbarkeitsaspekte?*					

Quelle: Eigene Darstellung

Bitte ergänzen Sie die Ihrer Ansicht nach 3 – 5 wichtigsten Haltbarkeits- oder Unteraspekte für Jeans mit absteigender Relevanz:

		Jeans
e) Ranking	1	
	2	
	3	
	4	
	5	

Funktionsjacke

Tabelle 3 führt bestehende, produktspezifische Haltbarkeits-Mindestanforderungen für eine wasser-, winddichte und atmungsaktive Regenjacke mit einem Obermaterial aus 100% Polyester oder Polyamid auf.

Tabelle 3 Fragebogen zur Bewertung bestehender und Haltbarkeits-Mindestanforderungen an Funktionsjacken

Bestehende Haltbarkeitsaspekte			a) Anwendung	Funktionsbekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm / Verfahren	*Wird die Norm für Regenjacken angewendet?*	Regenjacke	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
1. Formbeständigkeit	1.1. Änderung der Abmessung während des Waschens und Trocknens	ISO 5077:2007 in Kombination mit ISO 6330:2021	☐ Ja ☐ Nein, weil________	- oder ±3%, -5% bis +2% für ≥ 60% Viskose	☐ ☐ ☐ ☐ ☐	
	1.2. Bestimmung des Verdrehens nach einer Waschbehandlung	ISO 16322-2:2021	☐ Ja ☐ Nein, weil________	≤ 5%	☐ ☐ ☐ ☐ ☐	
	1.3. Beurteilung der Eignung von Textilen und Kleidungsstücken für die Reinigung	ISO 3175-1:2017	☐ Ja ☐ Nein, weil________	-3% bis +2%	☐ ☐ ☐ ☐ ☐	
	1.4. Formbeständigkeit beim Dampfpressen von nicht waschbaren Materialien	DIN 53894-2:2018	☐ Ja ☐ Nein, weil________	≤ 2%	☐ ☐ ☐ ☐ ☐	
	1.5. Elastizität und Dehnbarkeit ausgewählter Kleidung	DIN EN ISO 20932-1:2022 (Elastizität textile Flächen), NF EN ISO 20932-1:2020 (Streifenprüfungen), NF EN ISO 20932-3:2020 (Schmaltextilien)	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	
		DIN EN ISO 14704-1:2005[a] (Elastizität Fasern)	☐ Ja ☐ Nein, weil________	Dehnung 25%, Erholung 95% (Belastung 30 N, 5 Dehnungszyklen Erholungszeit: 30 Minuten)	☐ ☐ ☐ ☐ ☐	[a] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist DIN EN ISO 20932-1:2022-02.
2. Farbechtheit	2.1. Farbechtheit beim Waschen (Farbänderung und Anblutung)	ISO 105-C06:2010	☐ Ja ☐ Nein, weil________	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung) ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid) ≥ Note 4,5 bis 5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
		ISO 105-C08:2010 (+ phosphatfreies Testwaschmittel und Bleichaktivator für niedrige Temperaturen)	☐ Ja ☐ Nein, weil________	≥ Note 4, ≥ Note 4,5 bis 5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
		ISO 105-C09:2001 (+oxidative Bleiche)	☐ Ja ☐ Nein, weil________	≥ Note 4, ≥ Note 4,5 bis 5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
	2.2. Farbechtheit gegenüber Wasser	ISO 105-E01:2013	☐ Ja ☐ Nein, weil________	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid), ≥ Note 4,5 bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
	2.3. Farbechtheit gegen künstliche Bewetterung	ISO 105-B04:1994	☐ Ja ☐ Nein, weil________	≥ Note 5, ≥ Note 4 für Futterstoffe	☐ ☐ ☐ ☐ ☐	
	2.4. Farbechtheit beim Bügeln (oder Dämpfen)	ISO 105-X11:2018	☐ Ja ☐ Nein, weil________	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 3,5 für Futterstoffe	☐ ☐ ☐ ☐ ☐	
	2.5. Farbechtheit gegen Schweiß (Farbänderung und Anbluten)	ISO 105-E04:2013	☐ Ja ☐ Nein, weil________	≥ Note 3 bis 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 4,5 bis 5 bei starken Farbkontrasten, ≥ Note 2-3 für das Anbluten bei dunklen Farben (Acetat, Polyamid), *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*	☐ ☐ ☐ ☐ ☐	
	2.6. Farbechtheit gegen Flecken: Wasser	ISO 105-E07:2010 (Wassertropfenechtheit)	☐ Ja ☐ Nein, weil________	≥ Note 4, ≥ Note 3,5 für Futterstoffe	☐ ☐ ☐ ☐ ☐	
	2.7. Farbechtheit gegen Licht von mit künstlichem Schweiß angefeuchteten Textilien	ISO 105-B07:2009	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Funktionsbekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm / Verfahren	*Wird die Norm für Regenjacken angewendet?*	Regenjacke	-- - 0 + ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
2. Farbechtheit	2.8. Farbechtheit gegenüber Reiben (nass)	ISO 105-X12:2016	☐ Ja ☐ Nein, weil ___	≥ Note 2 für dunkle Farben und ≥ 2,5 bis 3,5 für alle Farben	☐ ☐ ☐ ☐ ☐	
	2.9. Farbechtheit gegenüber Reiben (trocken)	ISO 105-X12:2016	☐ Ja ☐ Nein, weil ___	≥ Note 4 für alle Farben, oder ≥ Note 3 bis 3,5 für dunkle Farben *Gilt nicht für Produkte, die weder gefärbt noch bedruckt sind.*	☐ ☐ ☐ ☐ ☐	
	2.10. Farbechtheit gegenüber Licht	ISO 105-B02:2014	☐ Ja ☐ Nein, weil ___	≥ Note 4 bis 5, ≥ Note 4 für Futterstoffe, ≥ Note 3 bei Neonfarben	☐ ☐ ☐ ☐ ☐	
	2.11. Farbechtheit gegenüber der chemischen Reinigung	ISO 105-D01:2010	☐ Ja ☐ Nein, weil ___	≥ Note 4	☐ ☐ ☐ ☐ ☐	
	2.12. Farbechtheit bei künstlicher Bewitterung	ISO 105-B10:2011	☐ Ja ☐ Nein, weil ___	[keine Werte vorhanden]	Geeigneter Wert: _	
	2.13. Bestimmung der Möglichkeit der Vergilbung durch Phenole	ISO 105-X18:2007	☐ Ja ☐ Nein, weil ___	≥ Note 4 (Anblutung)	☐ ☐ ☐ ☐ ☐	
	2.14. Farbechtheit gegenüber Farbabweichungen bei wechselnden Leuchtmitteln	EN ISO 105-J05:2007	☐ Ja ☐ Nein, weil ___	Im Vergleich zum Muster: ΔE 1,2, Kante/Mitte des Stücks/Kante: ΔE 0,5, Anfang des Stücks/Ende des Stücks: ΔE 0,5, Stück zu Stück: Δ 1,2	☐ ☐ ☐ ☐ ☐	
	2.15. Farbechtheit gegen Meerwasser	EN ISO 105-E02:2013	☐ Ja ☐ Nein, weil ___	≥ Note 3,5 (Anblutung) bis Note 4 (Farbänderung), ≥ Note 2,5 für das Anbluten bei dunklen Farben (Acetat, Polyamid), ≥ Note 4,5 für die Farbänderung bei starken Farbkontrasten	☐ ☐ ☐ ☐ ☐	
3. Strapazierfähigkeit	3.1. Pillbeständigkeit und Abriebfestigkeit von textilen Oberflächen	ISO 12945-1:2020 (Verfahren mit dem Pilling-Prüfkasten)	☐ Ja ☐ Nein, weil ___	≥ Note 3	☐ ☐ ☐ ☐ ☐	
		ISO 12945-2:2020:2020 (Martindale-Verfahren)	☐ Ja ☐ Nein, weil ___	Gewebe mit glatter Oberfläche: nach 125 bis 2.000 oder 7.000 Touren ≥ Note 3,5 bis 4 oder Gewebe mit aufgerauter Oberfläche: nach 125 Touren: ≥ Note 3,5 bis 4,5, nach 500 Touren: ≥ Note 3 bis 4, nach 1.000 Touren: ≥ Note 2,5 bis 3,5, nach 2.000 Touren: - oder ≥ Note 3,5, nach 5.000 Touren: - oder ≥ Note 3, nach 7.000 Touren: - oder ≥ Note 2,5,	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.2. Scheuerbeständigkeit	DIN EN ISO 12947-2:2016 (Martindale-Verfahren)	☐ Ja ☐ Nein, weil ___	- oder ≥ 16.000 bis 25.000 Touren, ≥ 10.000 Touren für Futterstoffe (9 kPa Nenndruck)	☐ ☐ ☐ ☐ ☐	
	3.3. Faserverlust	Interne Verfahren	☐ Ja ☐ Nein, weil ___	[keine Werte vorhanden]	Geeigneter Wert: _	
	3.4. Anzahl der Fäden je Längeneinheit	DIN EN 1049-2:1994	☐ Ja ☐ Nein, weil ___	6% Toleranz für kardierte Materialien, 4% Toleranz für alle anderen	☐ ☐ ☐ ☐ ☐	
	3.5. Dichte von Fäden in einem Gewebe	ISO 7211-5:2020	☐ Ja ☐ Nein, weil ___	[keine Werte vorhanden]	Geeigneter Wert: _	
	3.6. Höchstzugkraft und Höchstzugkraft-Dehnung von Geweben	EN ISO 13934-1:2013 (Streifenzugversuch)	☐ Ja ☐ Nein, weil ___	≥ 200 N, 12,5% bis 40% für Jacken, ≥ 200 N, 12,5% bis 55% für Mäntel, ≥ 250 N, 12,5% bis 55% für Anoraks/ Skikleidung/Sportswear ≥ 180 N (körpernah) bis 220 N (köperfern), 7,5% bis 32,5%, für Futterstoffe	☐ ☐ ☐ ☐ ☐	
		EN ISO 13934-2:2014 (Grab Methode)	☐ Ja ☐ Nein, weil ___	≥ 150 N bis 180 N für Jacken/Mäntel, oder Masse > 340 g/m² ≥ 300 N, Masse > 200 g/m² < 340 g/m² ≥ 230 N, Masse < 200 g/m² ≥ 200 N für Anoraks/Skikleidung/Sportswear, ≥ 140 N bis 50 N für Futterstoffe	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Funktionsbekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	**Titel / Unteraspekt**	**Norm / Verfahren**	*Wird die Norm für Regenjacken angewendet?*	**Regenjacke**	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
3. Strapazierfähigkeit	3.7. Weiterreißfestigkeit von Geweben	EN ISO 13937-1:2000 (ballistisches Pendel)	☐ Ja ☐ Nein, weil___	≥ 10 N bis 12 N für Anoraks, Masse > 340 g/m² ≥ 20 N, Masse > 200 g/m² < 340 g/m² ≥ 15 N, Masse < 200 g/m² ≥ 12 N für Sportbekleidung, ≥ 8 N für Futterstoffe *7% Toleranz zum Referenzmuster.*	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
		EN ISO 13937-2:2000 (Schenkelweiterreißversuch)	☐ Ja ☐ Nein, weil___	≥ 12 N	☐ ☐ ☐ ☐ ☐	
	3.8. Mit Kautschuk oder Kunststoff beschichtete Textilien - Bestimmung der Zugfestigkeit und der Bruchdehnung	EN ISO 1421:2016	☐ Ja ☐ Nein, weil___	*Entsprechend den Anforderungen an unbeschichtete Textilien.*	☐ ☐ ☐ ☐ ☐	
	3.9. Mit Kautschuk oder Kunststoff beschichtete Textilien - Bestimmung der Weiterreißfestigkeit	EN ISO 4674-1:2016 (Verfahren mit konstanter Geschwindigkeit)	☐ Ja ☐ Nein, weil___	*Entsprechend den Anforderungen an unbeschichtete Textilien.*	☐ ☐ ☐ ☐ ☐	
	3.10. Prüfung von fixierten Einlagestoffen	DIN 54310:1980	☐ Ja ☐ Nein, weil___	[keine Werte vorhanden]	Geeigneter Wert:_	
	3.11. Prüfung der Nahtfestigkeit	EN ISO 13935-1:2014	☐ Ja ☐ Nein, weil___	≥ 140 N und 120 N nur für Futterstoffe, oder ≥ 200 N für Materialien mit einer Dehnung von weniger als 50%	☐ ☐ ☐ ☐ ☐	
		EN ISO 13935-2:2014	☐ Ja ☐ Nein, weil___	≥ 140 N und 120 N für Futterstoffe, oder ≥ 200 N für Materialien mit einer Dehnung von weniger als 50% oder Masse > 340 g/m² ≥ 260 N, Masse > 200 g/m² < 340 g/m² ≥ 200 N, Masse < 200 g/m² ≥ 140 N, ≥ 80 N für Futterstoffe	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.12. Nahtverschiebung / Bestimmung des Schiebewiderstandes von Garnen in Gewebenähten	EN ISO 13936-1:2004 (Schiebewiderstand)	☐ Ja ☐ Nein, weil___	≥ 120 N für Jacken, ≥ 140 N für Mäntel, Anoraks/Skikleidung/Sportswear Futterstoffe: ≥ 100 N, wenn körperfern geschnitten ≥ 120 N, wenn körpernah geschnitten	☐ ☐ ☐ ☐ ☐	
		EN ISO 13936-2:2004 (Nahtöffnung bei definierter Belastung)	☐ Ja ☐ Nein, weil___	≤ 4 mm, wenn körperfern geschnitten, ≤ 3 mm, wenn körpernah geschnitten, Futterstoffe: ≤ 3 mm, wenn körperfern geschnitten, ≤ 2 mm, wenn körpernah geschnitten (Belastung mit 120 N), oder ≤ 6 mm (Belastung mit 120 N) für Anoraks, oder Masse > 340 g/m² Öffnung ≤ 6 mm (Belastung mit 160 N), Masse > 200 g/m² <340 g/m² Öffnung ≤ 6 mm (Belastung mit 120 N), Masse < 200 g/m² Öffnung ≤ 6 mm (Belastung mit 100 N) für Sportbekleidung, Öffnung ≤ 6 mm für Futterstoffe (Belastung mit 80 N)	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	3.13. Masse pro m²	EN 12127:1997	☐ Ja ☐ Nein, weil___	5% Toleranz	☐ ☐ ☐ ☐ ☐	
4. Optik	4.1. Bestimmung des Knittererholungswinkels von Geweben	ISO 2313:1972*	☐ Ja ☐ Nein, weil___	≥ 110° bis 120°	☐ ☐ ☐ ☐ ☐	* Diese Norm wurde zurückgezogen. Die Nachfolgedokumente sind ISO 2313-1 und ISO 2313-2.
	4.2. Bewertung der Knittererholung von Geweben - Verfahren zur Bewertung des Aussehens	ISO 9867:2022 (Selbstglättungsverhalten)	☐ Ja ☐ Nein, weil___	≥ Note 4, - für Futterstoffe	☐ ☐ ☐ ☐ ☐	
	4.3. Fadenziehemeigung von Textilien (Snagging)	ASTM D 3939/D 3939M:2013 (oder JIS L 1058:2021)	☐ Ja ☐ Nein, weil___	≥ Note 3	☐ ☐ ☐ ☐ ☐	
	4.4. Optische Veränderung nach dem Waschen / Pflegeeigenschaft und Selbstglättungsverhalten	EN ISO 15487:2018	☐ Ja ☐ Nein, weil___	- oder Erhalt der Funktion nach ≥ 5 Wäschen, oder keine Veränderung	☐ ☐ ☐ ☐ ☐	

Bestehende Haltbarkeitsaspekte			a) Anwendung	Funktionsbekleidung	b) Bewertung	c) Anmerkungen
Prüfkriterium	Titel / Unteraspekt	Norm / Verfahren	*Wird die Norm für Regenjacken angewendet?*	Regenjacke	-- / - / 0 / + / ++	*Haben Sie Anmerkungen zu den jeweiligen Werten?*
5. Funktionsbeständigkeit	5.1. Wasserabweisung	ISO 4920:2012 in Kombination mit ISO 6330:2021 (Sprühverfahren)	☐ Ja ☐ Nein, weil________	≥ Note 3 bis 4 nach 5 Haushaltswasch- und Trockenzyklen bei 40 °C sowie Angabe von Pflegehinweisen für die Erhaltung der Funktion, oder ≥ Note 4 ((90) ISO 4), oder ≥ Note 5 im Neuzustand ((100) ISO 5), ≥ Note 3 nach der Wäschepflege ((80) ISO 3)	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
		DIN EN 29865:1993 (Beregnungsversuch)	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	
	5.2. Wasserdichtheit	ISO 811:2018 (hydrostatischer Druckversuch)	☐ Ja ☐ Nein, weil________	≥ 80 mBar bis 130 mBar, oder ≥ 1300 mm Wassersäule	☐ ☐ ☐ ☐ ☐	
		EN 343:2003[7] (Schutzkleidung)	☐ Ja ☐ Nein, weil________	≥ 80 mBar bis 130 mBar	☐ ☐ ☐ ☐ ☐	[7] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist EN 343+A1:2007.
	5.3. Luftdurchlässigkeit	DIN EN ISO 9237:1995	☐ Ja ☐ Nein, weil________	≥ 25 mm/s (l/m²s; textile Fläche), oder <5 l/m²s	☐ ☐ ☐ ☐ ☐	
	5.4. Atmungsaktivität	ASTM E 96:2000	☐ Ja ☐ Nein, weil________	- oder > 3000 g/m²/24h	☐ ☐ ☐ ☐ ☐	
	5.5. Langlebigkeit von Verschlüssen	D2061-03 ASTM:2003	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	
	5.6. Schließkraft von Druckknöpfen	ASTM D 4846:1996	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	
	5.7. Sicherheit der Befestigung von (Druck-) Knöpfen	EN 17394-2:2020, CEN/TS 17394-3:2021 (Ausreisfestigkeit)	☐ Ja ☐ Nein, weil________	> 50 N bis 70 N, *d.h. höher als die Grenzwerte der Produktsicherheitsstandards.*	☐ ☐ ☐ ☐ ☐	
	5.8. Belastbarkeit von Klettverschlüssen	DIN 3415-1:1990	☐ Ja ☐ Nein, weil________	*Entsprechend den Anforderungen der DIN 3415-1.*	☐ ☐ ☐ ☐ ☐	
	5.9. Belastbarkeit von Reißverschlüssen	DIN EN 16732:2016	☐ Ja ☐ Nein, weil________	*Anforderungen sollten über den Qualitäts-Mindestanforderungen der DIN 16732 liegen.*	☐ ☐ ☐ ☐ ☐	
	5.10. Beständigkeit gegen Beschädigung durch Biegen	DIN EN ISO 7854:1997 (Methode C)	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	
	5.11. UV-Beständigkeit	[keine Verfahren genannt]	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	
	5.12. Bestimmung der Entflammbarkeit von Bekleidungstextilien	ASTM D 1230:2022[7]	☐ Ja ☐ Nein, weil________	> 4 Sekunden bis zum Auslösen des Fadens bei 127 mm	☐ ☐ ☐ ☐ ☐	[7] Diese Norm wurde zurückgezogen. Das Nachfolgedokument ist ASTM D 1230a:2022.
	5.13. Bestimmung elektrischer Widerstandsgrößen	DIN 54345-1:1992, EN 1149-1:2006	☐ Ja ☐ Nein, weil________	< 10^9Ω	☐ ☐ ☐ ☐ ☐	
6. Geruch	6.1. Bestimmung der Geruchsentwicklung von Ausrüstungen	SNR 195651:2015	☐ Ja ☐ Nein, weil________	[keine Werte vorhanden]	Geeigneter Wert:_	

d) Sonstige Vorschläge	*Haben Sie Vorschläge für weitere Haltbarkeitsaspekte?*	

Quelle: Eigene Darstellung

Bitte ergänzen Sie die Ihrer Ansicht nach 3 – 5 wichtigsten Haltbarkeits- oder Unteraspekte für Regenjacken mit absteigender Relevanz:

Regenjacke		
e) Ranking	*1*	
	2	
	3	
	4	
	5	

B.2 Questionnaire for repairability (in German language)

Fragebogen Interview Reparierbarkeit

Die neue Ökodesign-Verordnung: Anforderungen an das Ökodesign von Textilien und die mögliche Überführung in ein Ökodesign-Label
Ziel des Forschungsprojektes ist es zum einen, mögliche abgestufte Ökodesignanforderungen für Textilien zu erarbeiten, diese in ein Ökodesign-Label zu überführen sowie die europäischen Prozesse im Rahmen der neuen europäischen Ökodesign-für-nachhaltige-Produkte-Verordnung für die Produktgruppe Textilien zu begleiten. In diesem Zuge erarbeiten wir derzeit konkrete Ökodesign-Anforderungen für Textilien, u. a. an die Haltbarkeit, Recyclingfähigkeit oder Reparierbarkeit von Bekleidung und Textilien.
Ziel des Interviews ist es, eine Einschätzung aus der Praxis der durchführenden Reparateure zur Reparierbarkeit von Bekleidung zu erhalten.

Durchführende Institution:	Hochschule Niederrhein, Webschulstraße 41-43, 41065 Mönchengladbach
Interviewer*in:	
Interviewpartner*in:	
Ort und Datum:	
Kurzportrait des Unternehmens	
Unternehmensgröße (z. B. Mitarbeiter*innen)	
Standorte:	
Zielgruppe:	

Fragestellungen

Welche Nutzungsschäden treten am häufigsten auf?

Welche Reparaturleistungen können Sie durchführen? Welche führen Sie am häufigsten durch?

Welche Art von Produkten bringen Kunden*Kundinnen am häufigsten zur Reparatur?

Wie würden Sie selbst Reparierbarkeit definieren? Was macht ein Produkt besonders reparierbar und welche Einflussfaktoren spielen hierbei eine Rolle?

Wie könnte man Ihrer Meinung nach die Komplexität der Reparaturarbeiten beschreiben/bewerten? Z. B. nach Zugang zu kritischen Stellen (Anzahl der zu trennenden Nähten)?

Welche Informationen wären für Sie bei einem Reparaturauftrag hilfreich? (i. V. m. Tabelle)

Informationsart	Relevanz
Produkttyp, Modell-/Style- und ggf. Chargennummer)	

Fragebogen Interview Reparierbarkeit	
Technische Zeichnung, verwendete Nähte, Produktdatenblatt mit Materialzusammensetzung und Zutatenliste	
Technisches Handbuch mit Reparaturanweisungen	
Liste der notwendigen Reparaturwerkzeuge	
Versuchen Ihre Kunden*Kundinnen auch manchmal, Dinge selbst zu reparieren? Wie schätzen Sie den Schwierigkeitsgrad der am häufigsten vorkommenden Mängel ein? Könnten diese Reparaturen auch durch die Kunden*Kundinnen selbst durchgeführt werden?	
Welchen Preis (prozentual vom Neukauf) sind Ihre Kunden*Kundinnen bereit für eine Reparatur zu bezahlen?	
Führen Sie mehr Reparaturen oder Passformänderungen durch? Wie ist das Verhältnis?	
Erhalten Sie auch Anfragen für Upcycling bzw. führen dies durch?	
Wie bewerten Sie die Verfügbarkeit von notwendigen/passenden Ersatzteilen?	

B.3 Questions for the interviews on recyclability, recycling and recycled content

Overarching questions

1. Is it realistic to demand a minimum recycled content in textiles (focus: clothing textiles and home textiles: bed linen, towels, tablecloths, curtains - but not carpets, technical textiles, shoes or backpacks)? Should this be developed for specific fibres? Why or why not? If not, do you think a requirement for a minimum recycled content is realistic in the next 10 to 15 years?
2. Are there products/materials for which a mandatory recycled content should not apply? If so, why?
3. If we are talking about specific fibres, what minimum recycled content could be required for the following fibres:
4. Cotton
5. Polyester
6. Polyamide
7. Manmade cellulose fibres (MMCFs)
8. Wool
9. In your opinion, what would be an ambitious target for the share of recycled material (if necessary, name specific fibres, see fibres mentioned above) in textiles?
10. Does it make sense to introduce fibre-specific 'classes' (e.g. high recycled content / medium recycled content / low recycled content) as part of an ecodesign-label for textiles?
11. What is the biggest challenge in fibre-to-fibre recycling? What are possible solutions to this problem?
12. What technical requirements or further developments are needed to increase the proportion of recycled material? What are the current obstacles to increasing the proportion of recycled material?
13. How do you assess the quality of recycled textile fibres (in terms of fibre-to-fibre recycling)? What quality losses are there? Are there prospective solutions to remedy the quality losses?
14. PROSPECTIVE DEVELOPMENT --> What will happen from 2025 when the separate collection of used textiles in the EU becomes mandatory? What will happen if the destruction of unsold goods is banned? What impact do you expect this to have on your industry?

Collection and logistics (questions for collectors and sorters)

15. Do you have any idea how old the textiles are that you collect? (Background to the question: Potentially increased pollutant content in older textiles that have not yet been produced in accordance with the current REACH requirements).
16. How do you deal with the materials that are not suitable for fibre-to-fibre recycling?
17. Do you plan to increase the collection rate in the coming years? Why (not)?
18. Have you noticed a decline in the quality of textiles compared to the past?
19. Which are the 5 to 10 most common criteria you use to sort collected textiles? What sorting technologies/techniques do you use? How do you assess the use of automatic sorting systems? (perspective usage scenarios)

Recycling processes and technologies (questions for recycling companies)

20. How do you assess the recyclate quality of the recycled fibres you produce? Which tests do you carry out and according to which parameters?
21. How do you document/verify the recycled content in the fibres you produce?
22. In your opinion, what would be the best procedure to prove compliance with a certain recycled content?
23. Which materials (substances/chemicals) are problematic in the recycling process? Why are they problematic? How do you deal with the problematic materials?
24. Do you see problems in complying with the requirements of REACH, Annex XVII regarding restricted substances through the use of recycled material?
25. Do you test waste or the recycled material obtained from it for the presence of restricted substances (e.g. Annex 17, Entry 72 or Entry 46a)?
26. What can you tell us about the maturity of current fibre-to-fibre recycling technologies?
27. Are the purchased fractions cleaned before they are fed into the recycling process?
28. Can you give us a ratio of starting materials to regenerated fibres (possibly depending on the application)? In other words: How much material is lost in the recycling process?
29. What price increases are associated with the use of recycled fibres? Possibly in stages currently, in 5 years, in 10 years?

Recycling processes and technologies (questions for yarn manufacturers)

30. How do you document/verify the recycled content in the yarns you produce?
31. In your opinion, what would be the best procedure to prove compliance with a certain recycled content?
32. Do you see problems in complying with the requirements of REACH, Annex XVII regarding restricted substances through the use of recycled material?
33. Do you test waste or the recycled material obtained from it for the presence of restricted substances (e.g. Annex 17, Entry 72 or Entry 46a)?
34. Can you give us a ratio of textile waste to yarn? In other words, from how much textile waste do you produce how much yarn?
35. What price increases are associated with the use of recycled yarns? Possibly in stages currently, in 5 years, in 10 years?

Questions for clothing brands

36. How high is the share of recycled material in your products and for which fibre material? Which products do you make from it?
37. For which product types have you experienced difficulties in the production with recycled material?
38. Can you cover your demand for recycled fibres through the market? If not, why?
39. Is there a price difference compared to virgin fibres/non-recycled yarns?
40. Do you see any problems in complying with the requirements of REACH, Annex XVII regarding restricted substances by using recycled material?
41. Do you test waste or the recycled material derived from it for the presence of restricted substances (e.g. Annex 17, Entry 72 or Entry 46a)?
42. Do you work with pure fabric producers or do you already source the yarns and carry out the fabric production yourself? What are your incentives to use yarns/fabrics with recycled content?
43. How do you document/verify the proportion of recycled material in the products you manufacture?

44. Which other eco-design measures (repairability, durability, recyclability) have you implemented or will you implement?

B.4 Questionnaire on Substances of Concern (in German language)

Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology | Hochschule Niederrhein University of Applied Sciences | Hochschule Hof

Fragebogen

Besorgniserregende Stoffe (Substances of Concern, SoCs)

Hintergrund

Das Umweltbundesamt hat ein Forschungsvorhaben ausgeschrieben, in dem – parallel zu den laufenden Arbeiten der Europäischen Union – mögliche Ökodesign-Anforderungen für Textilien erarbeitet und in ein mögliches Kennzeichnungslabel überführt werden. Außerdem dient das Vorhaben dazu, die europäischen Prozesse zur neuen Ökodesign-Verordnung für die Produktgruppe der Textilien zu begleiten.

Das Projekt wird bearbeitet durch das Öko-Institut e.V., die Hochschule Niederrhein sowie die Hochschule für angewandte Wissenschaften Hof. Die Projektleitung liegt beim Öko-Institut e.V..

Besorgniserregende Stoffe

Besorgniserregende Stoffe im Sinne der Ökodesign-Verordnung sind Chemikalien, die aufgrund ihrer umweltschädlichen oder gesundheitsschädlichen Eigenschaften, aber auch aufgrund ihres negativen Einflusses auf das Recycling, besondere Aufmerksamkeit erfordern. Die Ökodesign-Verordnung fördert eine nachhaltigere und sicherere Produktgestaltung, wozu Transparenz über den Einsatz besorgniserregender Stoffe zählt.

Ausfüllen des Fragebogens

1. Angabe von Hintergrunddaten

Bitte wählen Sie für Ihre Organisation und Zielgruppe jeweils eine Option für die **Anzahl der Kollektionen pro Jahr**, das **Preisgenre** und den **Modegrad** aus.

Anzahl Kollektionen pro Jahr	Preisgenre	Modegrad
☐ 2-4	☐ Preismarkt	☐ trendy
☐ 8-12	☐ Markt der Mitte	☐ modern
☐ > 12	☐ gehobener Markt	☐ klassisch/konservativ

2. Ausfüllen des Fragebogens für Ihre Produkte

Bitte beantworten Sie die Fragen produktübergreifend. Wichtig für uns ist es, einen Einblick in das Chemikalien- und Ausrüstungsmanagement Ihres Unternehmens zu erhalten, um dies bei der Entwicklung der Anforderungen an die Informationsweitergabe, sowie Leistungs-anforderungen im Sinne der Ökodesign-Verordnung von Daten zu besorgniserregenden Stoffen zu berücksichtigen.

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2.1. SVHC (Besonders besorgniserregende Stoffe) und beschränkte Stoffe

SVHC und beschränkte Stoffe	Antwort	Kommentar
Gibt es in Ihrem Unternehmen eine Person oder Abteilung, die speziell für das Chemikalienmanagement verantwortlich ist?	☐ ja ☐ nein ☐ keine Angabe	
Erstellen Sie in der Regel für Produkte eine technische Produktbeschreibung/ Spezifikation?	☐ ja ☐ nein ☐ keine Angabe	
Wenn ja: Machen Sie im Rahmen ihrer technischen Produktbeschreibung Vorgaben zum Vorhandensein besonders besorgniserregender Stoffe (SVHC) und beschränkter Stoffe (REACH Annex 17) oder weiterer Stoffe?	☐ ja ☐ nein ☐ keine Angabe	
Wenn ja: Wie gehen Sie mit dem Vorhandensein von SVHCs in Produkten und deren Komponenten > 0,1 % um?	☐ SVHC > 0,1 % verboten ☐ SVHC > 0,1 % müssen genannt werden ☐ keine Angabe	
Lassen Sie chemische Analysen zum Vorhandensein von SVHCs in Ihren Produkten, oder deren Komponenten, im Rahmen der Qualitätssicherung durchführen?	☐ ja ☐ nein ☐ keine Angabe	
Haben Sie schon Produkte, oder deren Komponenten, aufgrund von einem SVHC-Gehalt > 0,1 % in die SCIP-Datenbank eingetragen?	☐ ja ☐ nein ☐ keine Angabe	
Nutzen Sie Zertifizierungssysteme, um das Vorhandensein von SVHCs und beschränkten Stoffen auszuschließen?	☐ ja ☐ nein ☐ keine Angabe	

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2.2. Eingesetzte Chemikalien und Ausrüstungen

Eingesetzte Chemikalien und Ausrüstungen	Antwort	Kommentar
Machen Sie Vorgaben zum Einsatz bestimmter Textilchemikalien für Ihre Produkte im Rahmen der technischen Produktentwicklung?	☐ ja ☐ nein ☐ keine Angabe	
Wenn ja: Zu welchen Gruppen von Textilchemikalien machen Sie Vorgaben für den Einsatz?	☐ Spinn-präparationen ☐ Vorbehandlung ☐ Färben ☐ Drucken ☐ Laminieren, Beschichten, Membranen ☐ Ausrüstung/ Hochveredlung ☐ Garment-veredelung ☐ andere	
Wenn ja: Welche Vorgaben machen Sie?	☐ qualitative Vorgaben (z.B. DIN Norm muss erfüllt sein) ☐ Produkt von bestimmtem Hersteller/ bestimmter Marke muss verwendet werden ☐ nach Ökolabeln zertifizierte Produkte/ Chemikalien müssen verwendet werden ☐ andere Vorgaben	

Vielen Dank für Ihre Angaben!

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C Additional information for the ecodesign label section

C.1 Detailed result of the survey on the ecodesign label

What objectives should be pursued with the ecodesign label for textiles?

The majority of participants named the end consumer as the target group. The ecodesign label should therefore

- Be an aid to purchasing decisions & clearly disclose 'non-performers'
- Enable a comparison between products
- Be clear and easy to understand in order to enable simple and quick orientation

It was also noted that comparability is only possible in categories with similar quality of the data on which the label is based.

One of the participating stakeholders would prefer processing entirely via the digital product passport and refrain from presenting it in an ecodesign label.

For which product aspect do you consider performance classes to be useful?

Multiple answers were possible for this question. In particular for the product aspects 'environmental impact', 'durability' and recyclability, a presentation with performance classes is considered useful. Around a quarter of respondents would not visualise any of the product aspects using performance classes.

What additional information should be included in an ecodesign label?

Several of the responses were in favour of not overloading the label. The following additional information was also suggested:

- Type of materials used and further information on the use of materials, such as eco-certifications
- (controlled) social standards; animal welfare; correct disposal
- country of manufacture

Suggestions were also made as to which parameters should be used to visualise the environmental impact. Water consumption was mentioned several times, as well as energy consumption, CO_2eq, the proportion of new materials used and the degradability of the product in the waste stream.

It is clear from the responses that one challenge or task in the creation of the ecodesign label is a sensible consideration and differentiation from existing labelling obligations and other certificates. For example, the material composition is already regulated by the EU Textile Labelling Regulation (European Union 2011), which is currently being revised by the European Commission.

In what order should the six product aspects considered be categorised?

The answers (see the table below) show that durability is clearly the top priority, being ranked first most often. Environmental impact is the next most important aspect, followed by recyclability and Substances of Concern, which are close together in the middle. Repairability and recycled content are ranked lowest on average.

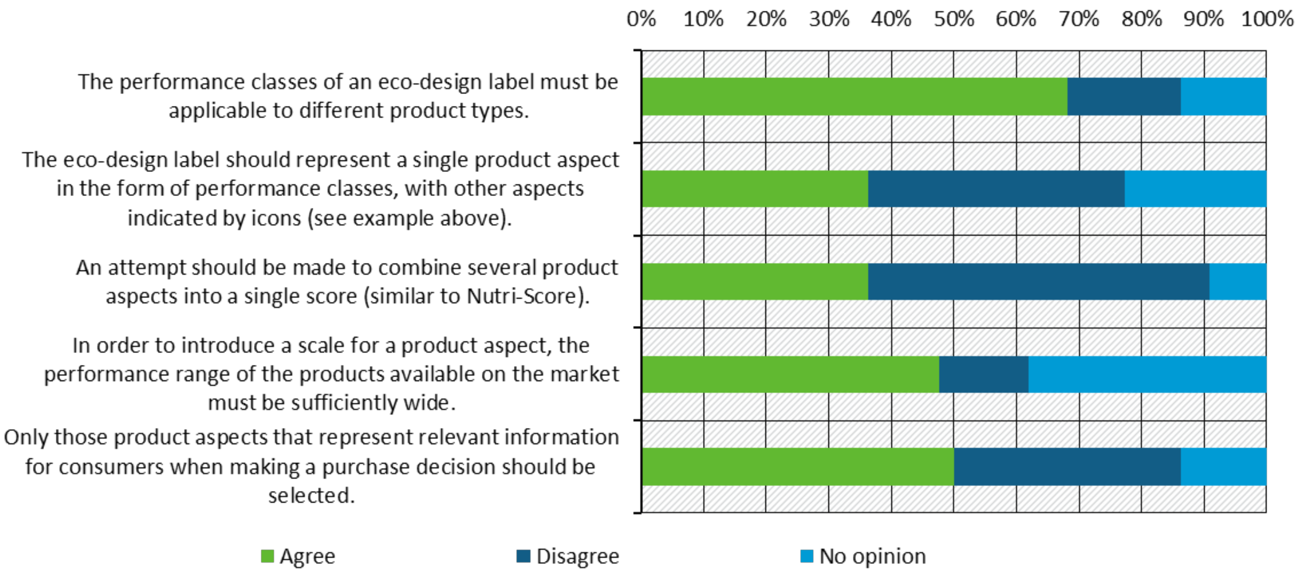
Table 65: Results of survey question on ranking of the importance of the six product aspects

Product aspect	Average rank	Frequency rank
Durability	1.73	11
Environmental impact	3.27	5
Recyclability	3.73	0
Substances of Concern	3.82	3
Repairability	4.00	0
Recycled content	4.45	3

Source: This study.

The participants were also asked for their opinion on five statements (see Figure 36).

Figure 36: Opinion of the survey participants on five questions regarding the ecodesign label



Source: This study.

It can be seen from this that a majority are of the opinion that the quality classes of an ecodesign label must be applicable to different product types. Furthermore, the performance bandwidth should be sufficiently wide for the introduction of quality classes to make sense. The participants were divided on the specific design of the ecodesign label: a slight absolute majority were against both the proposal to emphasise one product aspect with quality classes and to supplement the others with icons (in the style of the EU energy label) and the presentation with a single score that combines all product aspects.

Although a majority of participants consider consumers to be the target group of the ecodesign label, just over a third of participants are still in favour of not only selecting the product aspects that represent relevant information for consumers when making purchasing decisions.

C.2 Standardisation needs in order to indicate durability by washing cycles

The development of a standardised washing process as well as a suitable test device that realistically simulates the use phase (i.e. a household washing machine) is necessary in the medium term, as it was done for standardised washing programmes. Apart from the Eco 500 wash program, the load on the laundry in a programme can vary depending on the model and/or provider of the household washing machine (e.g. 'easy-care' programmes can differ between models).

The following table summarizes available or currently applied procedures and provides estimations on their suitability for their suitability to be applied for testing durability.

Table 66: Overview of common procedures and assessment of their suitability in the context of durability tests for clothing in private use

Procedure / standard (test device)	Application within the industry	Comments
EN ISO 6330: Textiles - Domestic washing and drying procedures for textile testing (Wascator) (DIN EN ISO 6330)	Established standard for textile testing for non-commercial washing and drying processes	Increased mechanical stress due to the wascator -> Limited suitability for simulating normal household Not realistic enough, large scope for implementation
Washing according to the care label (household washing machine / Wascator)	Common in the clothing industry, often in combination with ISO 6330 (see EU Ecolabel, JRC Preparatory Study)	Comparability difficult, as not clear which device was used for testing Care label does not sufficiently specify the washing parameters - scope for implementation is currently large
ISO 15797: Textiles - Industrial washing and finishing procedures for testing of workwear (industrial washing machines)	Established in textile service	Not suitable for private household conditions Clothing for private use does not have to meet the demands of industrial processes It may provide valuable input for the standardisation / definition of washing parameters
Accelerated continuous washing process (test devices e.g. 'Durawash' from Atlas or 'Dynawash' from James Heal)	Currently not widely used; recommended in guidelines for the safety of children's clothing (DIN EN TR 16792, BS 7907) or for testing the durability of ingredients/prints (e.g. M&S P5, M&S C15)	Efficient procedure, but according to experts not realistic in terms of mechanical stress; limited suitability for simulation of household laundry

Source: This study.