Addressing microplastics release from apparel

Recommendations for the delegated act on ecodesign for apparel

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Acronym list	
Digital Product Passport	DPP
Ecodesign for Sustainable Products Regulation	ESPR
Effluent Treatment Plants	ETPs
Extended Producer Responsibility	EPR
Life cycle Assessment	LCA
Persistent, Bioaccumulative and Toxic Chemicals	PBTC
Persistent Organic Pollutants	POPs
Polychlorinated biphenyls	PCB
Polycyclic Aromatic Hydrocarbons	PAH
Product Environmental Footprint	PEF
Product Environmental Footprint Category Rules	PEFCRs
Registration, Evaluation, Authorisation and Restriction of Chemicals (Regulation)	REACH

Executive summary

Textiles are among the most significant sources of environmental microplastic pollution in the EU. Textiles consistently release thousands of microplastic fibres at every stage of their life cycle, from industrial manufacturing and pre-consumer handling to laundering, but also through wear and tear and end-of-life processing.

The Ecodesign for Sustainable Products Regulation (ESPR) offers an opportunity to address the growing environmental concern of microplastics by enabling the European Commission to introduce **mandatory ecodesign requirements on microplastics release**. This policy brief outlines a tiered set of ecodesign requirements to progressively reduce textile-derived microplastics loss in Europe. The brief draws on published standardised methodologies (ISO 4484 series).

In the **short term**, we call for product information transparency, including the development of an EU-wide pictogram for textiles made fully or in part of synthetic fibres and disclosure of substances of concern, following ESPR article 7. In the **medium term**, we recommend mandatory pre-washing, with documented effluent capture, and setting maximum shedding thresholds for products. In the **long term**, manufacturing techniques linked to higher microplastic shedding should be phased out or limited. The full list of recommendations can be found at the end of the paper.

Combined, these measures offer a comprehensive, evidence-based pathway to reduce textile derived microplastic pollution, while ensuring circularity, environmental sustainability and economic feasibility under EU markets. Some of the recommendations may need to be implemented by stakeholders that are not directly placing products on the EU market. To ensure a just transition, it is of the utmost importance that brands and operators that buy products from manufacturers contribute to the effort of reducing microplastics emissions in the supply chain, including financially, and that the burden of the costs linked to ecodesign implementation is not merely passed down the supply chain.

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Microplastic release from synthetic textiles: Why is it a concern?

Microplastics are pervasive across all environmental compartments, being found from the depths of the Mariana Trench to the top of Mt. Everest.[1] They have been detected in over 1,300 species, as well as in multiple human tissues.[1] Microplastics have been associated with oxidative stress, inflammation and endocrine disruption.[2] Their ecological consequences include physical harm to biota,[3] chemical vectoring of persistent and bioaccumulative toxic chemicals (PBTC),[4] and invasive species dispersion via the plastisphere.[5] The socio-economic consequences are associated with loss of days at sea due to entangled propellers,[6] and loss of direct tourism revenue.[7] All of these are environmental and socio-economic impacts of the presence of plastics and microplastics in the environment. Despite the cumulative weight of approximately nearly 7,000 peer-reviewed studies, translating this evidence into enforceable regulation remains a challenge.[8]

Microplastics can be defined as "any synthetic, solid particle or polymeric matrix with regular or irregular shape, with a size ranging between 1 µm and 5 mm, of either primary or secondary origin, that are insoluble in water".[9]

Synthetic textiles are one of the six main sources of environmental microplastic pollution, together with pellets, personal care products, paint, tyres and macroplastics.[1]

Synthetic fibres are estimated to contribute between 2 to 13 million tonnes annually to environmental deposition.[10] Figure 1 shows the release and fates of microplastic fibres from textiles to the environment. Shedding, particularly during manufacturing[11, 12] or due to washing[1] or wear and tear of textiles, is recognised as a key emission pathway (Figure 1). Evidence suggests that a single domestic wash of polyester garments can release hundreds of thousands of fibres per cycle, and with one study reporting over 700,000 fibres per load.[13]

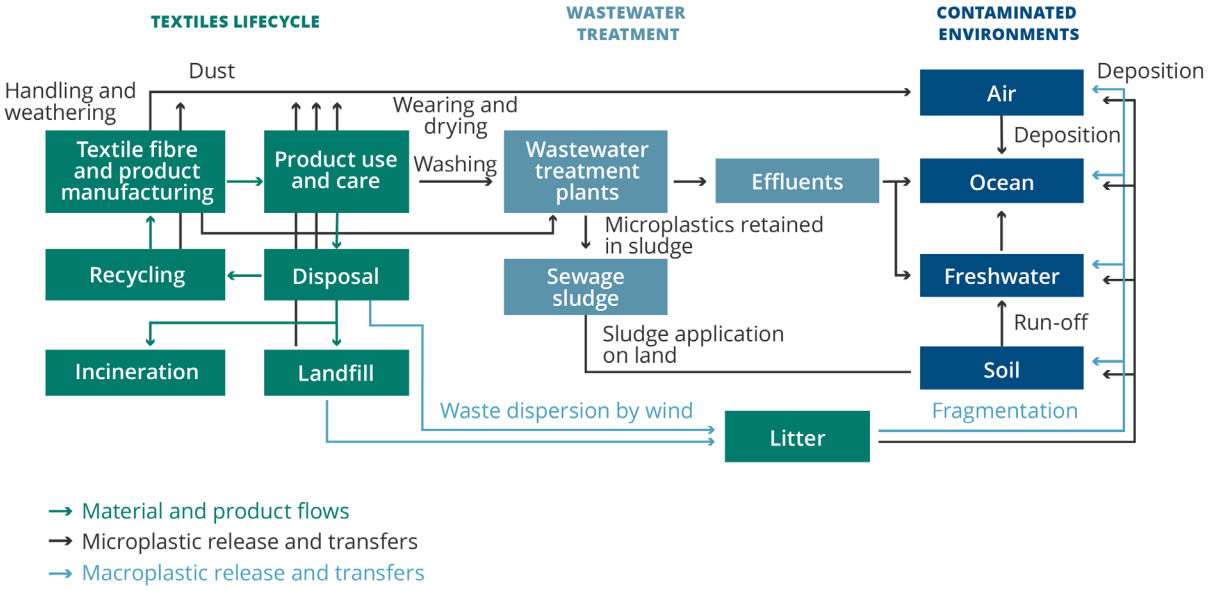

Figure 1 – Release and fates of microplastic fibres from textiles

Source: ETC/CE for the EEA

Global fibre production has been rapidly growing since the 2000s and has more than doubled since 2000.[14] It reached 132 million tonnes in 2024 and it is projected to increase up to 169 million tonnes in 2030, in a business-as-usual scenario.[14] **Synthetic fibres** represent the category of fibres that is mainly responsible for driving this increase. In 2024, it **represented 69% of global fibre production and trends point to a future increase**, rather than reduction, of total global production of synthetic fibres.[14]

According to the European Environment Agency (EEA), the **average consumption of textiles** in 2022 was approximately **19 kg of clothing, footwear and household items**, corresponding to a cumulative consumption of ~8.5 million tonnes of household textiles (excluding carpets) in the EU-27.[15, 16] **Textile waste generation in the EU reached 16 kg per capita** in 2020, with only about 25% (~4.4. kg) being separated for reuse or recycling.[17] The remainder entered mixed municipal waste disposal streams.

The combined scale of production, consumption and disposal of synthetic textiles causes a continuous and diffuse release of microplastics into the environment. Given their persistence and practical irreversibility of retrieval once released into the environment, policy intervention on synthetic textiles is urgently necessary. **Reducing the volume of production and consumption of textiles**, in particular clothing, **is an important and necessary action that will contribute to reducing the overall release of microplastics from synthetic textiles**.[i] The focus of this paper is, on the other hand, on policy intervention addressing products' shedding and manufacturing.

Ecodesign policy options

In the **EU's Strategy for Sustainable and Circular Textiles**,[18] the Commission acknowledged the serious concerns over microplastics pollution and committed to addressing the issue by adopting a series of preventive and reduction measures targeting the different life cycle stages at which synthetic fibres are shed into the environment. These measures were to be introduced under the **Ecodesign for Sustainable Products Regulation** (ESPR) (EU 2024/1781), and in *ad hoc* commission initiative to address the unintentional release of microplastics in the environment. The ESPR entered into force in July 2024, however, the *ad hoc* initiative, unfortunately, was never adopted.

In 2023, the **European Parliament adopted a resolution** on the EU Textile Strategy.[19] MEPs called on the Commission to take legislative action, emphasising the importance of tackling the problem at source and covering the whole life cycle. Among the recommendations, the European Parliament asked to adopt clear targets and measures to prevent and minimise the release of microplastics into the environment.

Always in 2023, the **Commission** published a **brochure, titled "EU action against microplastics"**,[20] where they gave an overview of the EU policies and initiatives aimed at addressing microplastics pollution. When it comes to synthetic textiles, the Commission reiterated their intention to set requirements under the ESPR. It also added the possibility to assess the use of filters in washing machines and dryers, mandatory information to consumers via the revision of the Textile Labelling Regulation and the inclusion of microplastics impacts in Product Life Cycle Assessment (LCA), in particular the Product Environmental Footprint Category Rules (PEFCRs) for apparel and footwear.

The ESPR is the main horizontal instrument for regulating sustainability across products. Its aim is to improve the environmental sustainability of products by design, and to reduce the overall environmental footprint of products over their life cycle.

[i] ECOS policy recommendations to address overproduction and overconsumption can be found in the report: Less is more: Taking a sufficiency approach in EU textiles policy

Given the high environmental and climate impacts associated with the sector, **apparel is one of the priority product groups for which ecodesign requirements will be introduced.**

The ESPR offers a once-in-a-decade opportunity to address the growing environmental impacts of microplastics by enabling the European Commission to introduce **mandatory ecodesign requirements on microplastics release**. The design stage of textiles is potentially one of the most important stages of product development, as it includes relevant aspects that determine downstream impacts, such as fibre composition, shedding behaviour, robustness, and recyclability.

In the context of the adoption of mandatory ecodesign requirements for apparel, we recommend the introduction of the following policy measures.

Ecodesign measures to reduce emissions from apparel

Pictogram of plastic content in synthetic textiles

Recommendation 1: All items made fully or partly of synthetic fibres must display a mandatory pictogram informing consumers that the product contains plastic materials and that microplastics can be released during use, washing or wear and tear. The pictogram should be present on an ESPR label, on the textile label and on a digital label.

To ensure information transparency on the presence of plastics in textile products, **all items made fully or partly of synthetic fibres must display a mandatory pictogram on an ESPR label**, physically attached to the product, at the moment of sale, as well as present on the textile label. This pictogram, similar to the Single Use Plastic (SUP) marking,[21] must inform the consumer that the product contains plastic materials in its composition and that microplastics can be released during use, washing or wear and tear. In addition to apparel, this pictogram should also be expanded to household fabrics, carpets and shoes.

The development of such EU-wide pictogram does not require the development of new methodologies, since its inclusion would only be dependent on the material composition of the product. A relevant precedent was already applied in French legislation, where a similar label informing users about microplastics pollution risks was introduced for textiles made of at least 50% of synthetic materials.[22] A 2023 report[23] from the Inspection générale de l'Environnement et du Développement durable, an advisory body under the authority of the French ministry in charge of the environment, later recommended lowering such threshold of synthetic material content to 5%, stating that 50% is too high. Using this as an example, a similar label could be expanded at the EU-level, under a harmonised pictogram, to prevent internal market fragmentation and ensure transparency. The precise thresholds for the synthetic fibre content necessary to trigger the obligation to affix the pictogram should be set within the range from 5% to 50%.

Microplastics loss during washing: performance and information requirements, and ecomodulation of EPR fees

Recommendation 2: Introduce performance-based limits on microplastics loss, supported by standardised test methods in ISO standard 4484 series (Parts 1, 2, and 3). The results of these tests should then be uploaded to the DPP.

Recommendation 3: Set up Extended Producer Responsibility schemes, with modulation of the fees based on microplastics shedding.

Fibres are inevitably released during washing.[24] Release during industrial washing and domestic laundering is one of the most significant pathways of how synthetic textiles contribute to microplastic pollution.[1,10] Ecodesign requirements should introduce **performance-based limits on microplastics loss**, supported by standardised test methods as the ones included in ISO 4484 series.

Standardised testing should be mandated under the delegated act in order to undertake a market assessment of shedding rates. A recent review of 55 peer-reviewed studies on microplastics from household washing machines, over a 4-year period (2020-2024), highlighted a lack of harmonised and/or standardised methods to test synthetic microfibre release during washing.[25] While there is a wide range of settings and conditions for household and industrial washing (beyond the materials of the garments), the settings and conditions of the appliances can be controlled variables while testing, given that most appliances follow CEN/CENELEC standards, e.g. CLC/TC 59X series, particularly WG01. Moreover, ISO also published a series of standards under the 4484 series: ISO 4484-1 (Determination of material loss from fabrics during washing), ISO 4484-2 (Qualitative and quantitative analysis of microplastics), and ISO 4484-3 (Measurement of collected material mass released from textile end products by domestic washing method). These standards set methods to determine fibre loss during washing as well as analyse the samples collected at various stages of the life cycle to determine the number, morphology and type of fragments found in the sample. **The combination of these standards is suitable to undertake a market assessment of shedding rates and establish emission limits and thresholds, including maximum allowable shedding limits.** These product performance requirements should be subject to periodic revision based on the best available evidence to phase out the worst-performing textiles.

The results of these tests should be uploaded to the Digital Product Passport (DPP) as information requirement. While we acknowledge that testing using ISO 4484 part 2 will incur additional costs, it is necessary to precisely identify and determine the concentration, morphology, and type of microplastics emitted from textiles. Otherwise, we recommend applying ISO standard 4484 Part 1 only to apparel made of synthetic materials beyond a certain fibre content, e.g. 20%. Even though we are conscious that the scope of the current delegated act is limited to apparel, we recommend expanding these limits beyond apparel, e.g. household textiles or carpets for a fully encompassing circular approach.

In addition, Extended Producer Responsibility (EPR) schemes offer an important incentive to improve the performance of textiles products. Following the adoption of the targeted revision of the Waste Framework Directive in 2025, EU Member States have now an obligation to set up EPR schemes for textiles. The fee that producers have to pay for each textile product they place on the market can vary based on relevant criteria that have yet to be defined. We recommend **including microplastics shedding as a criterion to modulate the fee of EPR schemes for textiles**.

Care instructions to minimise fibre loss during washing

Recommendation 4: **Provide consumers with care instructions in the DPP on how to minimise microplastics shedding, coupled with an awareness campaign.**
Recommendation 5: **Introduce an obligation to install microplastic filters in washing machines in the context of ecodesign for washing machines.**

Available scientific evidence suggests that microplastics release varies significantly depending on washing temperature, detergent formulation, and fabric structure. One study in particular suggests that lower temperatures, lower mechanical agitation, and gentler wash cycles consistently reduce shedding.[25]

Controlled experiments show that **washing at lower temperatures, using liquid detergents, and avoiding heavy agitation cycles can reduce shedding** across a wide range of fibre types.[26]
To minimise fibre loss, ecodesign requirements should **provide specific information to consumers**, and that information should be available in the DPP. Such information should:

- Promote the use of liquid detergents instead of powders, to reduce friction.
- Promote washing at lower temperatures to reduce mechanical stress and shedding.
- Promote washing full loads to reduce garment-to-garment abrasion.
- Promote, when or if possible, natural drying instead of tumble-drying.
- Promote the use of microplastic collection tools, including laundry bags.

A consumer awareness campaign should support the dissemination and uptake of practices that minimise microplastic release during the washing.

Innovative technical and technological solutions play significant mitigation roles, beyond consumer behaviour guidance.[27] Ecodesign requirements for washing machines should introduce mandatory filters to recover microplastics that prevent their discharge in wastewater. Collaborations between brands have previously explored technical and commercial feasibility of in-machine and external microfibre filters[27, 28] capable of capturing a substantial proportion of synthetic fibres during washing. This has been done through appliance brands collaborating with detergent brands, or by innovation filtering techniques being incorporated into washing appliances.

A legal provision already exists in France, where recent legislation in place states that all new domestic **washing machines** placed on the French market from 1 January 2025, **must be equipped with filters capable of capturing synthetic microplastic fibres.**[29] Such legislation signals the market that evidence-based research will contribute to reducing microplastic fibre emission, while also reducing pressure to wastewater treatment plants.

Addressing microplastics pollution during textile manufacturing

Textile manufacturing releases large quantities of both airborne microplastics and microplastics into grey and wastewaters.[30] Industrial machines usually operate at higher speeds, larger loads and with continuous mechanical stress, releasing substantially higher quantities of fibres than household washing machines on a per-cycle basis. Large industrial facilities process hundreds of kilograms of textile materials per day, resulting in shedding and release levels that can equal or exceed the total microfibre loss during the use phase of a garment or textile product.

Scientific studies show that mechanical and thermal stresses applied during manufacturing generate fine microfibres that enter wastewater treatment plants and their sludge, as well as factory air streams, long before the products reach consumers.[31] These studies highlight that surface finishes or mechanical treatments can increase microfibre release rates. These findings align with earlier works in this field[30] and with the European Environmental Agency (EEA) 2022 assessment, which emphasises that **upstream fibre loss occurs across the entire textile value chain**, and that **pre-consumer emissions represent a substantial and preventable source of microplastics.**[32,33]

The following recommendations need to be implemented most of the time by stakeholders that are not directly placing products on the EU market. It is of the utmost importance that brands and operators that buy products from manufacturers contribute to the effort of reducing microplastics emissions in the supply chain, including financially, and that the burden of the costs linked to ecodesign implementation is not merely passed on other actors in the supply chain.

Mandatory pre-washing at industrial level

Recommendation 6: Mandate controlled industrial pre-washing conditions for apparel before they are placed on the EU market.

Controlled industrial pre-washing conditions should be implemented prior to market placement.

Although a review of studies on microplastics from household washing machines highlighted high variability in microplastics emissions,[24] textiles shed the most during the early washes due to the release of loose fibres.[32,33] Shedding then decreases over time to then finally increase again as the garments ages because of the excessive wearing out of the fabric.[32,33] The high shedding during the first washes of textiles supports the introduction of mandatory pre-washing for all garments sold in EU markets.

Reducing emissions can be achieved if manufacturing facilities are required to have advanced effluent treatment plants (ETPs) on site to:

- Document the mass of captured fibres.
- Report on pre-washing conditions and microfibre capture efficiency.

Mandatory air filtration in cutting and garment-assembly stages

Recommendation 7: Mandate the installation and continuous operation of local exhaust ventilation systems that capture particles above 0.5 µm.

Mechanical cutting operations, including manual scissors cutting and automated knife or laser cutting, constitute one of the most intensive point sources of airborne microplastic generation across in the textile manufacturing value chain.[34] Scientific evidence shows that airborne synthetic fibre concentration in unventilated textile cutting environments can substantially exceed ambient atmospheric background levels, and that occupational inhalation of synthetic particles can carry documented risks of chronic respiratory tract inflammation and pulmonary fibre deposition.[35] These occupational hazards disproportionately affect workers in manufacturing countries. Local exhaust ventilation and capture of airborne particles are necessary to mitigate these risks.

Assess microplastics release during textile manufacturing and track substances of concern

Recommendation 8: Require monitoring of the microplastics released in wastewater and air during manufacturing using ISO 4484 Part 2.
Recommendation 9: All substances of concern, including process chemicals, are clearly listed in the DPP, and toxicological data on these chemicals are available.

Monitoring of microplastic fibre emissions can be achieved by following the protocol in ISO 4484 Part 2. Manufacturers should periodically measure microplastic concentrations in wastewater and relevant air-filtration systems, demonstrate that they have emission-control technologies in place, and report that information. This also enables a further refinement of the understanding of microplastics shedding during manufacturing.

Furthermore, traceability metrics (raw material origin, weaving, dying and tailoring country, etc.) should be collected and reported in the DPP. This information enables consumers and waste managers to make safer and better decisions, either when acquiring new products or when disposing of them.

Traceability information is particularly important in relation to **substances of concern**. Synthetic textile fibres contain a broad range of chemical additives, including dyes, pigments, plasticisers, optical brighteners, flame retardants, and finishing agents, which are incorporated during manufacturing to improve performance, aesthetics and durability. Depending on the additive, they might be progressively released during washing, wear, and end-of-life processing, entering aquatic, terrestrial and atmospheric environments alongside the fibres themselves. Despite this, most additives used in the textile industry remain without harmonised threshold limits or standardised test methods to assess their release from fibres or their combined ecotoxicological effects on biota and human health.[36, 37]

The use of chemical finishes is often marketed as treatments that reduce shedding; however, the **toxicology trade-offs** of these substances need to be understood and considered. When substances of concern are used to finish products, **it should be mandatory to provide toxicological data about the chemical used in the DPP**, alongside information about other substances of concern used in the manufacturing of the product. If a chemical finishing substance prevents the circularity of the product or if it poses a significant risks to human health or the environment, then it is imperative that the ESPR restrict that substance; moreover, these substances must be evaluated and assessed under REACH, if not already reviewed, and restrictions must follow if the substance is harmful to human health or the environment.

The colour of microplastics can potentially influence ecological interactions.[38] The current state-of-the-art evidence on microplastic effects is sufficient to justify precautionary regulatory action in the case of pigments and dyes that might have human health or environmental impacts.

Requirements on fibres and fabrics to minimise shedding

> Recommendation 10: **Phase out or limit the use of manufacturing techniques linked to higher microplastic emission.**

Ecodesign principles should apply during the whole life cycle of garments, from design to disposal. Reducing synthetic fibre emissions at the design and manufacturing stages is the most effective long-term strategy for achieving low-shedding textile products. Further development of ecodesign requirements should consider **specific design requirements for fibre manufacturing, weaving and finishing processes**, based on an assessment of manufacturing techniques utilising the existing ISO standard 4484 Part 2, as well as Parts 1 and 3 if necessary. Abrasive techniques such as brushing, sanding or heavy mechanical softening should also be carefully assessed and potentially phased out or restricted.

Inclusion of microplastic release in LCAs

> Recommendation 11: **Incorporate metrics and indicators in LCA methodologies to account for the impacts of microplastics emissions as a standalone category.**

Product LCA is a common tool used to assess several metrics and indicators of productivity and market sustainability. **Most LCAs currently do not include or account for microplastics release as a standalone impact category,** despite growing evidence that microplastics from textiles represent a persistent environmental pollutant.

The Product Environmental Footprint (PEF) is a method developed by the Commission that helps quantify the environmental effects of products across their life cycle, from raw material extraction to end-of-life disposal.[39] The need to improve the scope of impacts covered by LCA at the European level is recognised. **Traditional LCA models underestimate the environmental footprint of synthetic garments, including toxicity and ecotoxicity assessments of pigments, dyes and other additives introduced during product manufacture.**[4,36] We urge the Commission to incorporate these metrics in the PEF methodology as well as in the PEFCRs for apparel and footwear.

Microplastic metrics and indicators should account for:

- Upstream emissions during production and pre-washing
- Emissions during the washing and use phase
- Shedding and emissions during recycling and end-of-life operations
- Fate and transport of fibres in marine, freshwater and terrestrial compartments

Ecotoxicity considerations of microplastics release

Recommendation 12: Develop harmonised ecotoxicity tests and standards for textile microplastics

Plastic production includes a wide range of additives, such as polymerisation and processing additives (catalysts, initiators, modifiers, and processing aids), stabilisers (heat, ultraviolet and light stabilisers, antioxidants), plasticisers, fillers, antimicrobials, antifouling agents, biocides, anti-static, minerals, pigments and dyes. There are at least 16.000 known plastic chemicals that are potentially used or present in plastics.[4] About 25% of these chemicals are potentially hazardous to human health or the environment.[4] Only 6% of all plastic chemicals are regulated internationally, with additional national regulations applying to 1.000 chemicals.[4] **The need to incorporate (eco)toxicological assessments of combined effects is essential in future-proofing ecodesign requirements**.

The European Chemicals Agency (ECHA) work on the REACH microplastics restriction highlighted that currently there is no harmonised test method capable of quantifying the ecotoxicity of textile-derived microfibres across environmental compartments. Nonetheless, there are several dozens of references to test methods under peer-reviewed scientific journals that could be incorporated into methods and procedures for a diversity of Persistent Bioaccumulative and Toxic Chemicals (PBTCs), including Persistent Organic Pollutants (POPs), [such as Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs)] or heavy metals. The current technologies available already allow for the quantification of PBTCs in tissues and environmental matrices and therefore should be considered and/or adapted into harmonised and standardised into methods for textiles.

Recommendations

Below is the summary of the recommendations in this paper organised by suggested implementation time frame.

Table 1 – Recommendations to support ecodesign principles for textiles

Short-term up to 5 years from today	Medium-term 5-8 years from today	Long-term (> 8 years from today)
Introduction of an EU-wide pictogram for all textile products made fully or in part of synthetic fibres. The pictogram should be on the ESPR label, the physical textile label and a digital label.	Controlled industrial pre-washing is implemented before the product is placed on the market.	Adopt metrics and indicators across the value chain, including mandatory monitoring of microplastic emissions in production facilities.
Adopt metrics and indicators to quantitatively and qualitatively assess fibre shedding using standardised methods available in ISO 4484 series and report it in the DPP.	Set maximum shedding thresholds for products, based on the metrics and assessment tests from ISO 4484 series.	Mandate the installation and continuous operation of local exhaust ventilation systems that capture particles above 0.5 µm.
Modulate EPR fees for textiles based on microplastics shedding.	Under ESPR and REACH, restrict the use of substances of concern used in textile production if the substance is harmful to human health or the environment or prevents circularity	Phase out or limit the use of manufacturing techniques linked to higher microplastic shedding.
Consumer information and guidance regarding product care, use to minimise microplastic shedding.	Develop harmonised ecotoxicity tests and standards for textile microplastics.	
Mandatory reporting about the presence or use of substances of concern in the DPP, including toxicological data.	Global standardisation and international cooperation to reduce environmental and human impacts on microplastics.	
Incorporate microplastics release as a standalone category in LCA and PEF methodologies to assess the impact of microplastic emissions.		
Introduce an obligation to install microplastic filters in washing machines, under ecodesign requirements.		

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Figures