European Environment Agency

Resource efficiency

Plastic in textiles: towards a circular economy for synthetic textiles in Europe

Plastic-based — or ‘synthetic’— textiles are woven into our daily lives in Europe. They are in the clothes we wear, the towels we use and the bed sheets we sleep in. They are in the carpets, curtains and cushions we decorate our homes and offices with. And they are in safety belts, and car tyres, workwear and sportswear. Synthetic textile fibres are produced from fossil fuel resources, such as oil and natural gas. Their production, consumption and related waste handling generate greenhouse gas emissions, use non-renewable resources and can release microplastics. This briefing provides an overview of the synthetic textile economy in Europe, analyses environmental and climate impacts, and highlights the potential for developing a circular economy value chain.

Key messages

In 2017, European households consumed about 13 million tonnes of textile products (clothing, footwear and household textiles). Synthetic fibres, such as polyester and nylon, make up about 60% of clothing and 70 % of household textiles.

Synthetic textiles affect the environment and climate throughout their life cycle through resource use, and the emission of greenhouse gases and pollutants. In addition, between 200 000 and 500 000 tonnes of microplastics from textiles enter the marine environment each year.

In contrast to cotton, the production of synthetic fibres does not use agricultural resources, toxic pesticides or fertilisers.

EU consumers discard about 5.8 million tonnes of textiles annually – around 11 kg per person - of which about two thirds consist of synthetic fibres. In Europe, about one third of textile waste is collected separately, and a large part is exported.

Promoting sustainable fibre choices and control of microplastic emissions, and improving separate collection, reuse and recycling, have the potential to improve the sustainability and circularity of synthetic textiles in a circular economy.

An underpinning report on "Plastic in textiles: potentials for circularity and reduced environmental and climate impacts" by the EEA's European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE) is available.

Consumption and production of synthetic textiles in Europe

> Since the late 1990s, polyester has surpassed cotton as the fibre most commonly used in textiles.

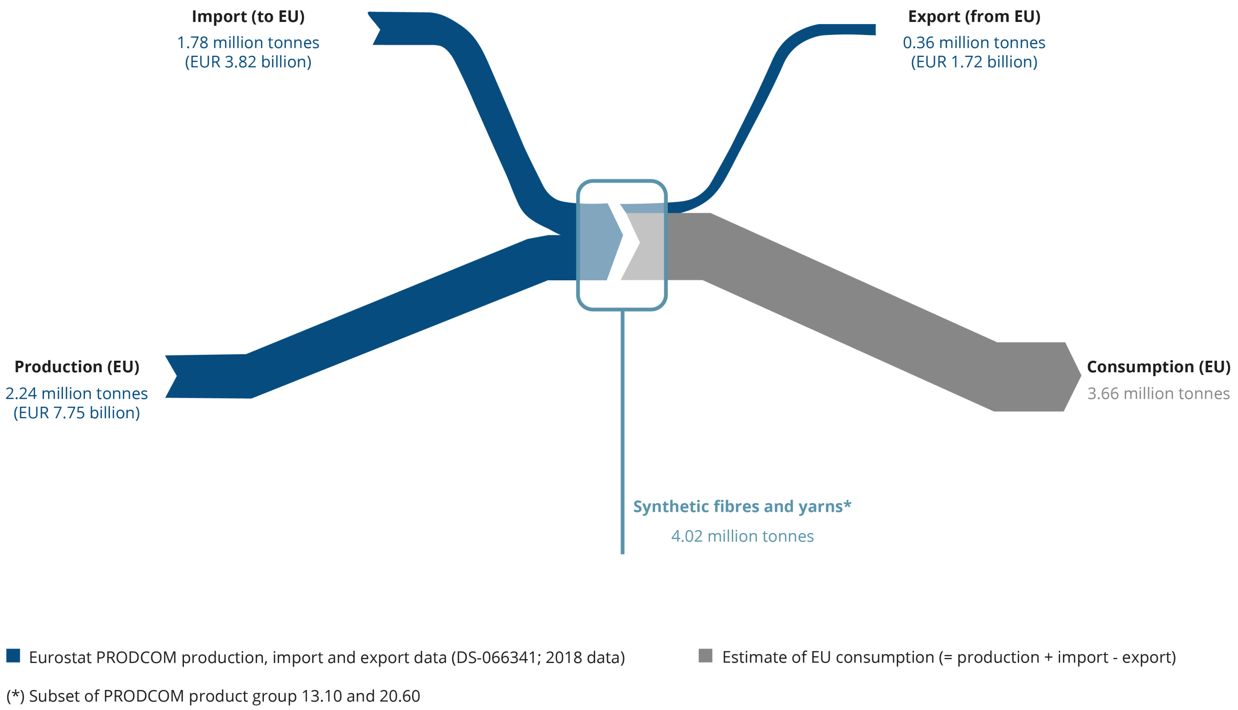
The global consumption of synthetic fibres increased from a few thousand tonnes in 1940 to more than 60 million tonnes in 2018, and it continues to rise. Since the late 1990s, polyester has surpassed cotton as the fibre most commonly used in textiles. While the majority of synthetic textile fibres are produced in Asia, Europe stands out as the world's largest importer of synthetic fibres by trade value (Birkbeck, 2020), and also produces and exports such fibres.

Estimates of textile consumption per person in Europe are uncertain, ranging from 9 to 27 kg per person (Beton, et al., 2014; Watson, et al., 2018; ETC/WMGE, et al., 2019; Šajn, 2019). It is estimated that, in 2017, European households consumed about 13 million tonnes of textile products (clothing, footwear and household textiles) (Stadler, et al., 2018).

Over 70 % of synthetic textile fibres are processed into clothing and household textiles. The remainder is used for technical textiles (e.g. safety wear) and industrial uses (e.g. vehicles and machinery) (Ryberg, et al., 2017). Synthetic fibres are cheap and versatile, enabling the production of cheap, fast fashion and high-performance textiles for durable clothing.

The EU production of synthetic fibres totalled 2.24 million tonnes in 2018: 1.78 million tonnes were imported, 0.36 million tonnes exported and 3.66 million tonnes consumed (Figure 1).

Figure 1. EU production, consumption and trade of synthetic fibers, 2018



Source: Based on Eurostat and ETC/WMGE data.
Note: Synthetic fibers and yarns are a subset of PRODCOM product groups 13.10 and 20.60

At a global level, the production of synthetic fibres currently consumes approximately 1 % of crude oil production (48 million tonnes per year) (Ellen MacArthur Foundation, 2017; EIA, 2020), and is expected to increase.

Production and use of bio-based synthetic fibres is currently negligible (European Bioplastics 2020).

Resource efficiency and waste

More than half of the global fibre production is polyester, making it the most common synthetic fibre (55 million tonnes in 2018) (Textile Exchange, 2019). Polyester is a strong fibre and produced at a low price. It is used in a multitude of applications. Clothing accounts for a large share of its use, as a cheaper and thinner alternative to cotton. After polyester, nylon is the most common synthetic fibre. It is a strong fibre that is widely used in tights, carpets and umbrellas. In 2018, over 5 million tonnes of nylon fibre was produced (Textile Exchange, 2019).

> It is estimated that EU consumers discard about 5.8 million tonnes of textiles annually — about 11 kg per person – of which roughly two thirds are synthetic (Beasley, and Georgeson, 2014).

In Europe, about one third of textile waste is collected separately, and a large part is exported for reuse or recycling abroad. While percentages vary between countries, about 60-70 % of all collected textiles are reused (locally or abroad), 10-30 % are recycled and 10-20 % are incinerated for energy recovery or landfilled (Watson, et al., 2020). Textiles that are not separately collected end up in mixed waste. Globally, it is estimated that only 0.06 % of all textile waste (typically cotton-rich products) is recycled into fibres for use in new textile products (Textile Exchange, 2020). Recycling of synthetic fibres is not observed at scale.An estimated 42 million tonnes of plastic textile waste was generated globally in 2015. This accounts for 13 % of all plastic waste, making textiles the third largest contributor to plastic waste generation (Geyer, et al., 2017). The total amount of textile waste generated annually in the EU is unknown.

Environmental and climate impacts of synthetic fibres and textiles

The production and consumption of textiles generate environmental pressures and impacts such as greenhouse gas (GHG) emissions; air and water pollution; land, water and other resource use; and impacts related to the use of chemicals. The range of impacts depends on the fibre type (ETC/WMGE, et al., 2019).

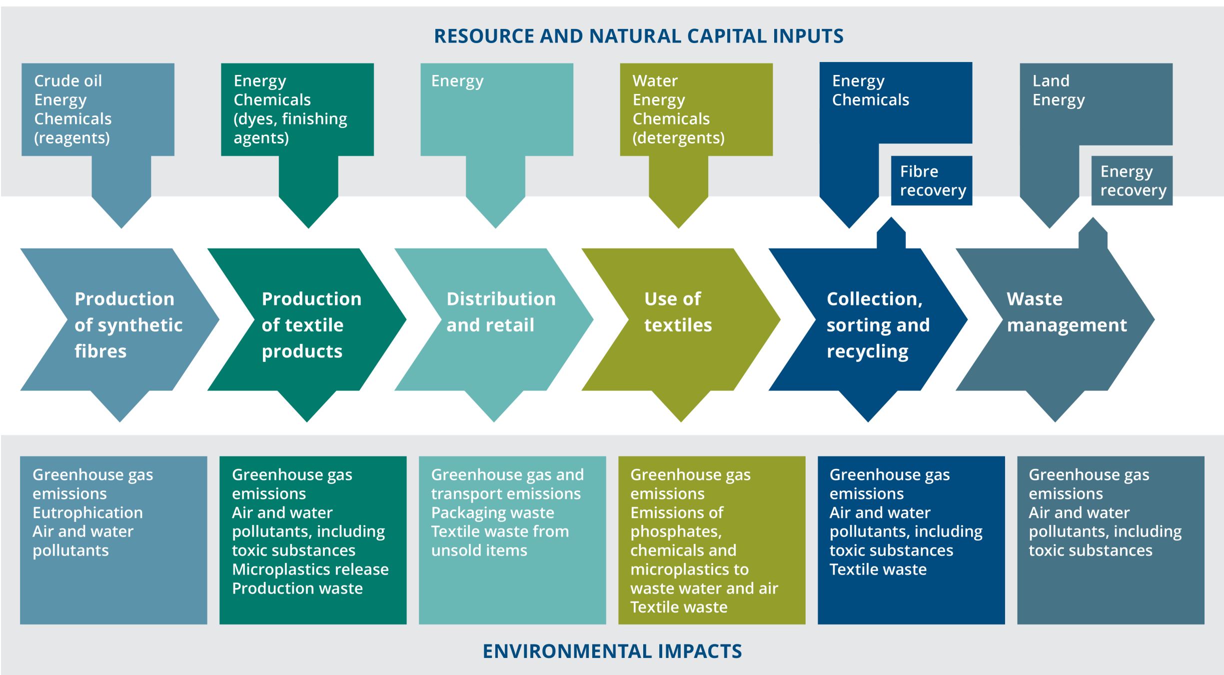
Resource efficiency and waste

> The production of synthetic fibres requires large amounts of energy and is a significant contributor to climate change and the depletion of fossil fuel resources.

The production of synthetic fibres requires large amounts of energy and is a significant contributor to climate change and the depletion of fossil fuel resources. However, in contrast to cotton — the most common natural fibre — producing synthetic fibres does not require agricultural resources or the use of toxic pesticides or fertilisers (Sandin, et al., 2019).

Thus, if a comparative assessment of overall impact on the environment and climate is extended beyond resource depletion and GHG emissions to include land use, water use and ecosystem impacts, it is not possible to make a straightforward comparison of different fibre types in terms of their overall environmental performance (Beton, et al., 2014). Different fibres clearly have different environmental and climate impacts, so which textile is deemed more advantageous depends on which impact one focuses on. Figure 2 below provides an overview of the environmental and climate impacts of textiles.

Figure 2. Environmental impacts across the life cycle of synthetic textiles

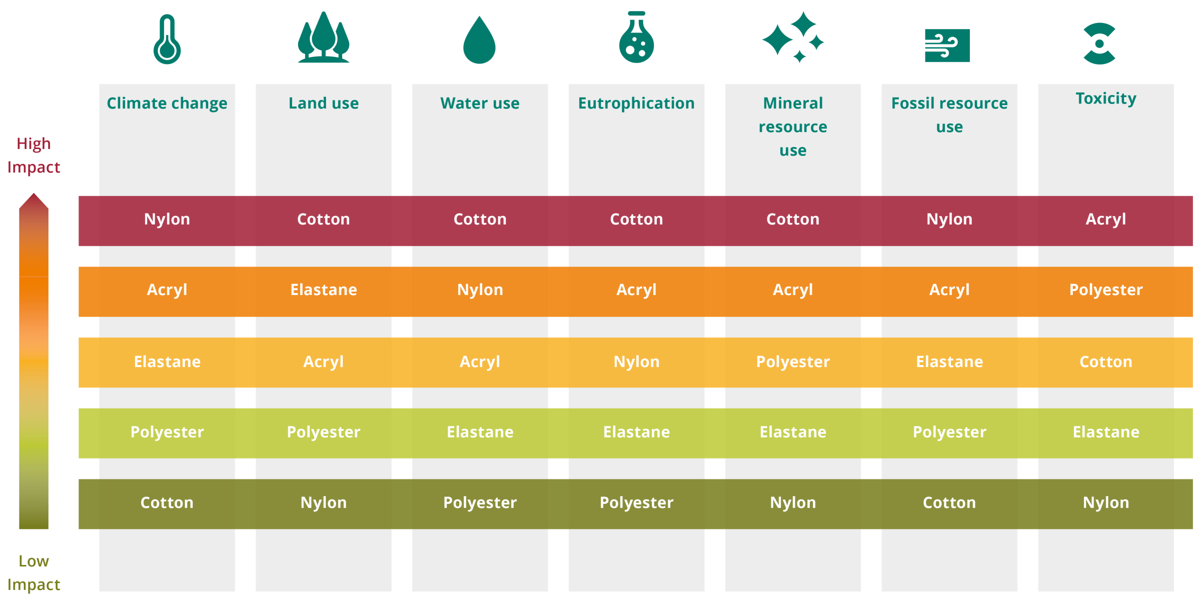


Sources: EEA and ETC/WMGE; Illustration by CSCP.

The specific relative environmental and climate impacts of the most common synthetic fibres and cotton can be compared, per kilogram of dyed, woven fabric, as shown in Figure 3. The synthetic fibre nylon has the highest impact per kilogram for climate change and fossil fuel use. For land use, water use, eutrophication and mineral resource scarcity, cotton has the highest impact per kilogram. A similar comparison can be made between polyester and cotton: the full life cycle of 1 kg of polyester fabric is estimated to be responsible for the release of more than 30 kg of carbon dioxide equivalent, while only around 20 kg are associated with cotton (Beton, et al., 2014).

It is important to keep in mind that impacts also depend on the production volumes of the fibres and fabrics. For example, while the manufacturing of polyester uses less energy than nylon, its annual production rate is much higher resulting in higher overall impacts.

Figure 3. Comparison of the environmental impacts for the manufacturing of 1 kg of dyed, woven fabric



Sources: EEA and ETC/WMGE; Illustration by CSCP.

Environmental effects are not only generated during the production of textiles. During use, the main environmental impacts are generated by domestic and/or industrial washing, drying and ironing. While these caretaking activities require a lot of energy and contribute to climate change, they also enable longer and more intensive product use, adding to the product's lifespan.

Resource efficiency and waste

The importance of considering the entire life cycle becomes obvious when looking at the example of microplastics shed from synthetic textiles throughout their lifespan. Microplastics are a fairly recent issue of concern. They are a new topic of research and not included in typical life cycle analysis. Much is still to be learned about the magnitude of their impact on human health and the environment.

> It is estimated that between 200 000 and 500 000 tonnes of microplastic fibres from textiles enter the marine environment each year (Sherrington, 2016; Ellen MacArthur Foundation, 2017).

Microplastics are shed from synthetic textiles throughout their life cycles: from fibre and fabric manufacturing, through use and washing to their final disposal, whether by landfilling, incineration or recycling. It is estimated that between 200 000 and 500 000 tonnes of microplastic fibres from textiles enter the marine environment each year (Sherrington, 2016; Ellen MacArthur Foundation, 2017).

Towards a circular economy for synthetic fibres and textiles

> **In the 2020 circular economy action plan, the European Commission identified textiles as a priority product category with significant potential for circularity.**

In the 2020 circular economy action plan, the European Commission identified textiles as a priority product category with significant potential for circularity. The action plan recognises that ‘textiles are the fourth highest pressure category for the use of primary raw materials and water, after food, housing and transport, and the fifth for greenhouse gas emissions’ (EEA, 2019; EC, 2020b). The action plan envisages a comprehensive EU strategy for textiles aiming to ‘strengthen industrial competitiveness and innovation in the sector, boosting the EU market for sustainable and circular textiles, including the market for textile reuse, addressing fast fashion and driving new business models’. In 2019, the first Product Environmental Footprint Category Rules (PEFCR) for textile products (T-shirts) were developed (Elsen, et al., 2019; Pesnel, and Payet, 2019).

In line with the 2020 circular economy action plan, this EEA briefing and its underpinning ETC/WMGE report highlight some pathways to make synthetic textile production and consumption more circular and sustainable. These are sustainable fibre choices, control of microplastic emissions and improved separate collection, reuse and recycling.

Sustainable fibre choices: the choice of fibres not only defines textile product properties and performance but also determines the environmental impact of the resulting product and will influence the fate of synthetic textiles throughout the rest of their life cycles. While a shift to natural or bio-based fibres may reduce the impacts from the use of fossil fuel resources and greenhouse gas emissions, these fibres do not always have equivalent properties and are not necessarily more sustainable over the entire life cycle. The guiding principle is that the choice of fibre should match the textile product's application, the properties required, and the expected lifespan and end-of-life processes. At the design stage, important choices are made on the fibre types to be used for a particular product or application. The importance of fit-for-purpose fibre selection implies that there is no use in ruling out certain fibre types — e.g. synthetic ones — and that there is no go-to fibre type that by itself constitutes a sustainable textiles industry.

Control of microplastic emissions: several initiatives have been set up to study the factors that influence microplastic emissions — including those from synthetic textiles — and assess their effect on human health and the environment. At the same time, many strategies, such as adapted textile construction and filters in washing machines, are being explored to reduce the emissions of microplastics to water and air during a textile's life cycle. In implementing the EU plastics strategy, efforts will not only focus on building the knowledge base related to the risk and the occurrence of microplastics in the environment, and improving and harmonising measuring methods, but also be targeted at increasing the capture of microplastics in practice, e.g. by filters(EC, 2020a).

Improved separate collection, reuse and recycling: reuse and recycling are critical to reducing the demand for virgin fibres and achieving a circular economy. Fibre recycling is especially challenging in the case of synthetic textiles, for both technical and economic reasons. Improved separate textile collection, accurate automated sorting and high-quality textile reuse and recycling have significant potential to reduce environmental impacts. However, many technical, economic and social challenges will have to be overcome to facilitate and encourage reuse and make fibre-to-fibre recycling technically and economically viable. Under the EU Waste Framework Directive, separate collection of textile waste will be obligatory in all Member States by 1 January 2025. This calls for prior installation of sufficient sorting and recycling capacity.

The COVID-19 crisis has led to a sudden but rapid decrease in consumer demand for textiles and consequential cash-flow problems and unemployment in the textiles sector. There are risks that these factors could slow down the shift to a more circular and sustainable textiles sector. At the same time, the crisis demonstrates the fragility of the current way of working and offers the momentum to fundamentally change the textiles system towards greater circularity, with positive economic and environmental outcomes.

To achieve a circular and more sustainable textile system, while supporting economic recovery, a number of textile and clothing organisations have proposed a list of measures (Euratex, 2020; Policy Hub, and Boston Consulting Group, 2020).

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