Report

From local strategies to global sustainability

A macroeconomic analysis of Extended Producer Responsibility scenarios for the Norwegian consumer textiles sector

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SUMMARY
This report looks at the macroeconomic effects of different scenarios of Extended Producer Responsibility for consumer textiles in Norway. It quantifies not only the effects on the textile consumption, but also the ripple effects on the Norwegian economy and in global value chains of a reduction in household consumption of textiles driven by higher prices, of the investment of collected eco-fees in the textile waste management, and of the consumption shift to other goods and services. We find that, on the medium and long term, the total economic effects, employment, and carbon emissions are highly dependent on what consumers spend the income saved by avoided clothing consumption.

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Preface

This report is part of the project Wasted Textiles, financed by the Research Council of Norway (project number 318862) and led by the Consumption Research Norway (SIFO), at the Oslo Metropolitan University (OsloMet). The Wasted Textiles project aims to reduce the amount of textile waste and the proportion of synthetic textiles that goes to waste. Here, we report the results from Work Package 4 – Evaluating Circular Strategies.

We thank the colleagues from the project for the discussions and feedback on the modelling and report. In particular, we thank Ingun Grimstad Klepp, Tone Skårdal Tobiasson, Jens Måge, Nina Simon, Kristiane Rabben and Kerli Kant Hvass for their discussion and comments on the report.

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1 Introduction

The textile value chain is highly globalised. The production of textiles depends on goods and services provided by different countries. From raw material extraction to final consumer products, the consumption of clothing and home textiles in Norway depends almost entirely on imports (Rubach et al., 2023), and this value chain is very linear, with very little reuse or recycling.

In 2022, textiles accounted for the 7th most traded product worldwide, reaching 941 billion USD, more than double of the trade value two decades ago (OEC, 2024). This value includes trade in fibres, fabric, textile products, and used textiles. The textiles and apparel market is expected to rise even more in the next years as global population and expendable income rises, especially in emerging markets. Textiles are used by a variety of industries, such as automotive, healthcare, agriculture, fishing, home textiles, and apparel industries. Consumer textiles, which include apparel and home textiles, make up most of the global textile market.

The value chain for textile products starts with raw material and fibre production. Global fibre production increased from 58 million tonnes in 2000 to 124 million tonnes in 2023, mostly driven by the growth of synthetic fibres. Synthetic fibres correspond to around 67% of global fibre production in 2023, most of it made up by polyester. Plant fibres correspond to around 25% of global fibre production, with cotton corresponding to around 80% of all plant fibre production. Manmade cellulosic fibres, dominated by viscose (rayon), accounted for around 6% of global fibre production. Animal fibres, mostly made up of wool, accounts for around 1% of total fibre production (Textile Exchange, 2024). These fibres are produced in different countries. Almost three quarters of all synthetic fibres are produced in China (Statista, 2024). China, India, Brazil, the United States, and Pakistan are the main producers of raw cotton, accounting together for over three quarters of global production (U.S. Department of Agriculture, 2024). China, Chile, India, Austria, and Indonesia account for nearly 95% of global viscose production (Canopy, 2018), and around half of global wool production originates from China, Australia, New Zealand, and Türkiye (FAO, 2024).

These fibres are then shipped for yarn and fabric production, transformed into final textile products such as garments and home textiles. Clothing exports amounted to 544 billion USD in 2022, with Asian countries responsible for two thirds of global exports (OEC, 2024). In particular, China, Bangladesh and Viet Nam accounted, together, for over 45% of global clothing exports. These final products are then shipped to different countries where they are distributed and sold to final consumers.

The textile industry is a resource-intensive industry, with large social and environmental impacts which are fuelled by patterns of overproduction and overconsumption. The production of clothing and footwear requires large quantities of resources and energy, which results in large emissions of greenhouse gases (GHG) and local pollutants such as particulate matter. The production of textiles, from fibre to final products, is very water intensive (Kumar & Pavithra, 2019), and the increasingly larger share of synthetic textiles in final textile products leads to the release of microplastics in every stage in the life cycle, from manufacturing, use, to final disposal (Kounina et al., 2024). In recent years, the use of organic and recycled materials by the wearing apparel industry has increased. Most recycled fibres are made from recycled polyester, with over 12% of polyester fibre production sourced from recycled materials. However, 98% of this recycled polyester is derived from PET bottles (Textile Exchange, 2024), creating competition for these bottles and disrupting the closed-loop recycling system for plastic packaging, ultimately leading to recycled PET being incinerated, sent to landfills, or downcycled at the end of the life cycle of textile products.

Circular strategies for consumer textiles are becoming increasingly popular as countries aim to reduce waste, promote sustainable production and consumption, and encourage a shift from linear to circular economies. In Europe, the EU's Circular Economy Action Plan targets textiles as a priority sector, emphasizing eco-design standards, resource-efficient production, and increased recycling rates, and the Waste Framework Directive has established a separate textile collection from 2025 and is proposing rules for extended producer responsibility (EPR) for textiles for all European countries. In Norway, the separate textile collection will start in the entire country from 1st January 2025, and there are recommendations on how a Norwegian Extended Producer Responsibilities for textiles can look like. In this report, we investigate the societal and economic impacts of an EPR scheme for Norway, following the recommendations proposed by main stakeholders of the Norwegian textile and waste management industry (Virke et al., 2023) and the recommendations for a scheme based on discarded textiles flows, fate and composition, which are a focus of the Wasted Textiles project.

This report is structured as follows:

- Section 2 presents an overview of the Norwegian clothing sector, which includes the Norwegian domestic textile value chain, the upstream value chain of imported textiles, and the downstream value chain of discarded textiles.
- Section 3 presents a summary of the circular economy roadmap for textiles in Europe and in Norway.
- Section 4 presents a summary of the methods and the scenarios for circular strategies for the Norwegian clothing sector. A detailed and more technical method description is available in the Annex.
- Section 5 presents the modelling results and analysis of the effects of the circular economy strategies in the Norwegian clothing sector and in the upstream global value chains.
- Finally, section 6 presents a conclusion.

2 The Norwegian consumer textiles sector

The value chain for consumer textiles includes manufacturing industries involved in the production of fibres and textile products, to sale, services to households such as repair and washing, to collection, reselling, exports, and waste treatment of discarded textiles.

In 2022, there were over 7 500 Norwegian companies in the consumer textiles value chain, which employed over 44 000 people and had a turnover of 93 billion kroner. Retail sale of consumer textiles accounted for 50% of all companies in the value chain, 70% of all employed people, and 52% of turnover and value creation. Retail sale of wearing apparel corresponded to the lion share, being alone responsible for 57% of total employment in the Norwegian textile value chain and 42% of all value creation. Statistics for the end-of-life management of discarded waste, including those collected by charities, is not available due to lack of data. The key statistics for companies in different segments are summarised in Table 1.

Table 1 Key statistics for Norwegian businesses in the textiles value chain in 2022, adapted from SSB (2024c)

Industries		Number of units	Employed persons	Turnover (NOK million)	Value added (NOK million)
Manufacturing	Production of man-made fibres	1	16	N.A. [1]	N.A. [1]
	Production of textiles and textile fibres	590	3 272	8 565	2 899
	Production of wearing apparel	1 244	1 753	3 152	1 088
	Production of leather and leather products	92	146	168	66
Trade services	Wholesale of textiles	246	696	2 529	569
	Wholesale of clothing and footwear	725	3 873	26 383	4 555
	Retail sale of textiles and home textiles	583	4 188	5 353	1 764
	Retail sale of clothing and footwear	2 211	24 964	37 151	10 135
	Retail sale of textiles, clothes, footwear, travel accessories and leather goods via mail order houses or via Internet	931	1 335	5 442	558
	Retail sale of second-hand clothes	55	464	457	151
HH services	Repair of footwear and leather goods	101	143	111	59
	Repair of other personal and household goods [2]	527	465	405	202
	Washing and (dry-)cleaning of textile and fur products	199	2 833	3 684	2 210
EOL	Textile collection, sorting, handling, and waste treatment	N.A. [3]			

[1] Not available due to confidentiality; [2] Clothing and other textile products fit into the category of other personal and household goods, but there is no detail of how much of it is dedicated to textiles; [3] The only division for waste streams for collection, sorting, and treatment is between hazardous and non-hazardous waste.

In addition, in 2022 there were 13 636 agricultural holdings (SSB, 2024b), with sheep husbandry, using a total of 13.7 million hours as labour input (SSB, 2024a), which corresponds to over 7 0000 full-time equivalent employment. There is, however, no data for the economic turnover or value added for sheep husbandry.

According to a recent study (Rubach et al., 2023), the vast majority of the consumer textiles sold in Norway is imported. Out of 106 000 tons of new textiles put in the Norwegian market in 2022, only around 1 000 ton was produced domestically, and nearly 80% of all imported textiles were comprised of clothing and footwear. Therefore, changes in consumption of consumer textiles, especially of wearing apparel, can have important economic impacts in Norwegian industries, but the main impacts – on value creation, jobs, or on the environment – will happen elsewhere, in the upstream value chain of imported textile products.

2.1 Imported consumer textiles and their upstream value chain

The volume of consumer textiles[1] imported to Norway doubled between 1988 and 2022, as shown in Figure 1, going from around 50 to 100 million tons of textile products (SSB, 2023b), while Norwegian population grew by 29% (World Bank, 2024).

Looking at the import statistics, we can identify the following trends. Between 1988 (earliest data available) up until 2008 there was a growth in imports nearly every year. This growth was faster after 2001, when middle-income countries went through trade liberalisation and increased exports to high-income countries, especially of products which are labour-intensive such as textiles. This outsourcing of manufacturing to middle-income countries also decreased the costs of consumer goods, mostly due to lower labour and production costs. The global financial crisis in 2008-2009 led to a sharp decrease of imports in 2009, of 8% in volume compared to 2008. From 2013 to 2019 there was a small decline in annual imports, a trend that was interrupted with the Covid-19 economic crisis. After both economic crisis of 2008-2009 and 2019-2020, we see a sharp increase in imports as the economy recovered. Between 2022 and 2023 there was a sharp decline in imports, of around 17%, similar to the decline in 2012 after the post-economic crisis import peak. It is important to note that we do not know the future trend in the consumption of textile products, which is strongly linked to the volume imported. The next years could see a sharp decline following the changes between 2022 and 2023, or a slow decline or a plateau in consumption following the trend in the period before the economic crisis due to the Covid-19 pandemic, or see another trend of increased volume.

[1] In this report, consumer textiles include clothing and wearing apparel, footwear, and household textiles such as linens and curtains. See Table 4 in Section 4.3.1 to see all import product codes included in **Error! Reference source not found.**.

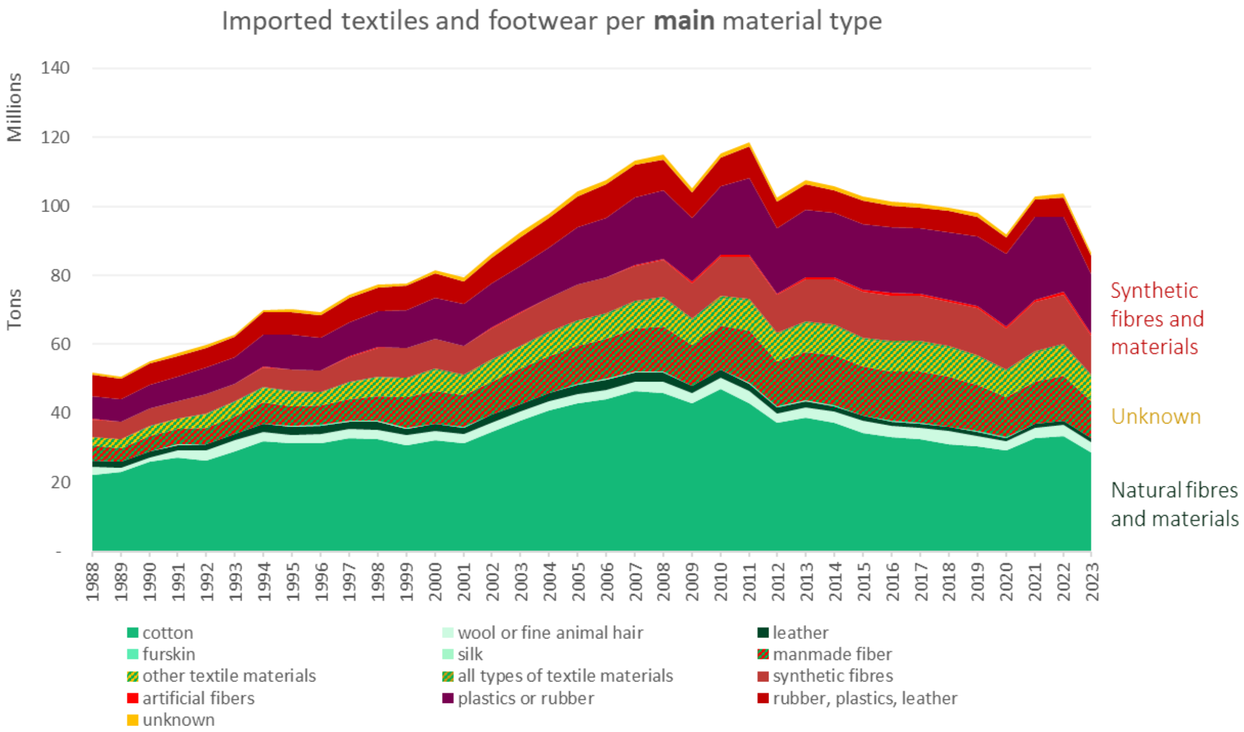

Figure 1 Volume in million tons of consumer textiles imported yearly between 1988 and 2023, by main material type, based on SSB (2023b)

We take 2022 as the year to describe the changes in consumption, as we do not know whether the strong decrease in 2023 is only short term or the start of a lasting consumption trend. The largest growth in textile consumption in the period, as shown in Figure 2, is of textiles made of mainly synthetic and artificial fibres and of unknown fibres, both of which tripled between 1988 and 2022. Unknown fibres are those which cannot be easily categorised between natural or artificial due to lack of detailed information. Those include, from the custom tariff codes, “manmade fibres”, “other textile materials”, “all types of textile materials” and “unknown”. The imports of textile consumer products made of mainly plastic and rubber doubled, while the consumption of products made up of mainly cotton and wool increased by around 50%, and products made of mainly leather and other natural fibres reduced by 30%. The distribution of fibres in imported textiles did not change between 2022 and 2023.

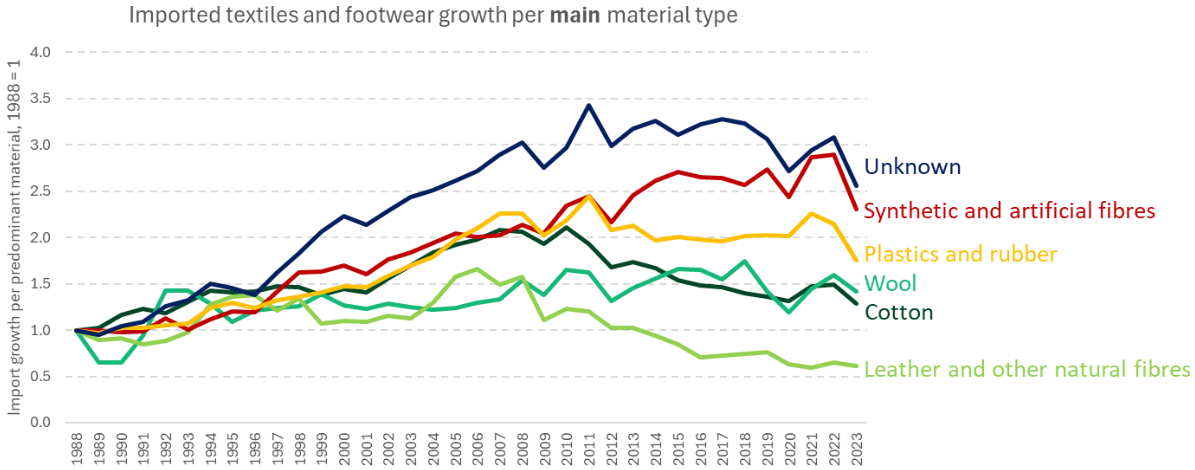

Figure 2 Growth between 1988 and 2023 in the volume of imports of textile products by main material type, where the volume of textiles of different material types in 1988 equals 1. Based on SSB (2023b)

However, this distribution is based on the main material reported in the customs tariff codes. A product reported as mainly cotton could be either made of 100% cotton, or a blend of fibres where the fibre with highest share is cotton. A product containing a blend of 55% cotton and 45% synthetic would count as cotton in the statistics. More detailed product codes (e.g. blends vs monofibre) are needed to provide a better overview of the types of fibres in textile products. Likewise, detail on the different types of manmade fibres (e.g. synthetic, viscose) is also needed to estimate the proportion of natural and synthetic materials. Products mostly composed of manmade fibres accounted for 12.5% of all textiles imported in 2022 and 2023.

The trends of imports changes considerably, however, when looking at monetary value instead of physical volume. Figure 3 shows that there has not been a decrease on monetary imports of textiles after the 2008-2009 financial crisis or after the economic crisis caused by the Covid-19 pandemic. Instead, the value imported increased. When looking at corrected value to 2019 prices, using the consumer price index for textiles and footwear (Figure 3, grey line), we see a more stable trend until 2010, after which the trends are similar to the current value. It is important to note here that import value is not the same as the consumer expenditure on imported products, i.e. how much Norwegian consumers spend in textile products. As most products are sold through physical or online stores, there are also different costs added to the import value, such as transport and freight, warehousing, labour costs, energy, rent for physical stores, profit margins, taxes, and other costs to maintain and operate retail businesses.

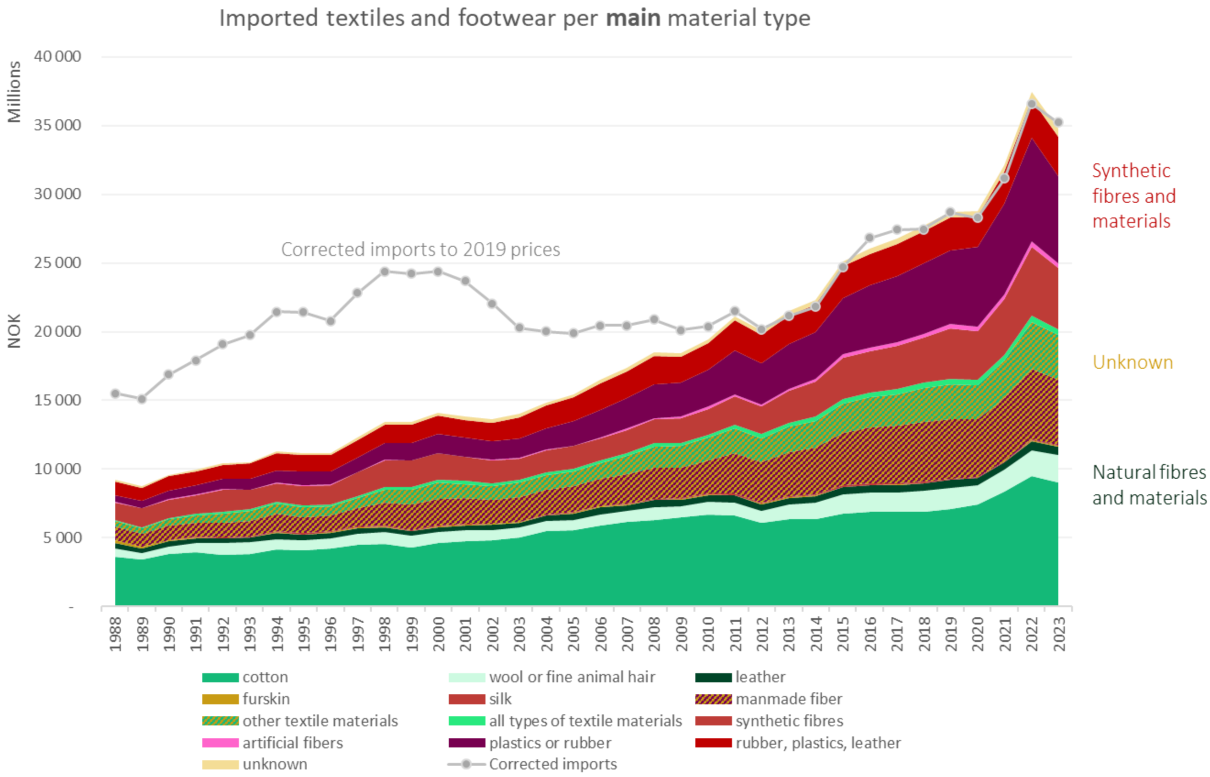

Figure 3 Annual Imports in current million NOK of consumer textiles between 1988 and 2023, by main material type, based on SSB (2023b)**. "Corrected imports to 2019 prices" are adjusted by the Consumer Prices Index for textiles and footwear from** SSB (2023a)**.**

When looking at the source of these imported textiles[2], we see that most of them originate from Asia (Figure 4, in shades of red) and Europe (Figure 4, in shades of blue). The imports of textiles originating from Asia nearly quadrupled between 1995 and 2022, going from 30% in 1995 to half of all imported textile and footwear products into Norway in 2022.

[2] The numbers from Figure 3 and Figure 4 do not match due to three reasons: different currencies (NOK vs USD), different product classification (Figure 4 includes textile fibres, not included in Figure 3), and different data sources (SSB statistics vs BACI database for bilateral trade data).

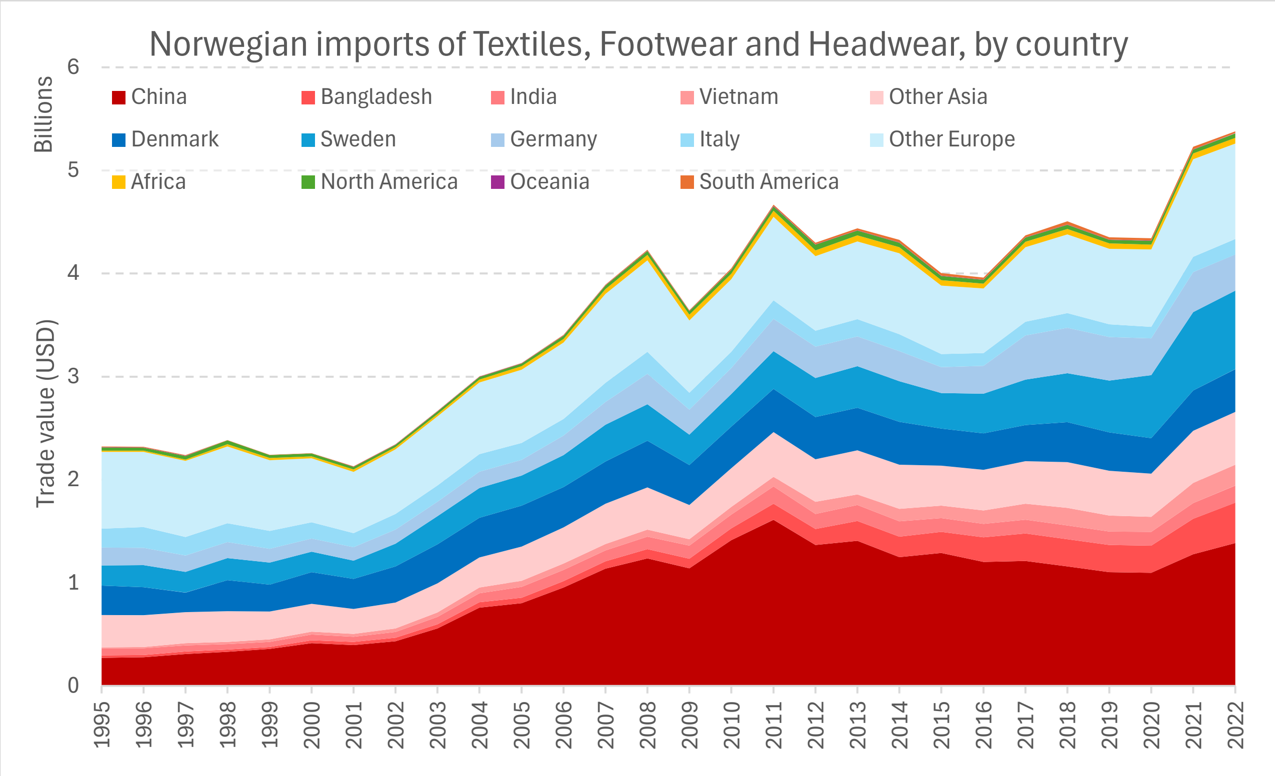

Figure 4 Norwegian imports of textiles footwear and headwear, in current USD, between 1995 and 2022 by country. Based on (OEC, 2024).

The global garment industry offers employment and income to almost 100 million workers globally, 75% of those in Asia, and it is estimated that over 40 million women are employed in the Asian garment value chain (ILO, 2023a). However, this industry is also often accompanied by exploitative working conditions such as forced and coerced labour, child labour, verbal abuse, sexual harassment, excessive overtime, and low salaries leading to working poverty (ILO, 2016). The collapse of the Rana Plaza building in Bangladesh, in 2013, killing over 1100 garment workers brought into attention the poor working conditions and human rights of garment workers in the fast fashion value chain (ILO, 2023b). The concern on the social impacts of imported textile products is even higher in a time when *fast fashion* is giving space to what has been referred to "*ultra-fast fashion*", with online companies like Shein adding thousands of new individual pieces and styles to its app each day, fuelling the increasing overproduction and overconsumption of cheap clothing items (Rajvanshi, 2023).

2.2 Unwanted and discarded textiles and their downstream value chain

Overproduction and overconsumption of textile products results in wardrobes with more items, with many consumers across the world acknowledging they own more clothes than what they need (Greenpeace International, 2017). Globally, clothing is increasingly underutilised, and the times a piece is used on average before it gets discarded has decreased by over one third since the early 2000 – and in countries with high garment consumption such as the US and China, clothes are worn much less (Ellen MacArthur Foundation, 2017).

It was estimated that, in 2020, the EU generated an estimated amount of 6.95 million tonnes of textile waste, approximately 16 kg per person. However, only around one third was collected separately for reuse and recycling, and the remaining ended up in mixed household waste (EEA, 2024b). In Norway, over 80 thousand tonnes of textiles were discarded in 2022, amounting to around 14.7 kg per person. Similarly to the EU, around one third was collected through separate textile collection, mostly by charities (89.5%), and nearly 51 thousand tonnes of textile products were discarded in household mixed waste and ended up being incinerated (Rubach et al., 2023).

Understanding discarded textiles in Norway

Some tools for understanding the discarded textiles are waste audits and wardrobe studies. These tools can give us information on the types of discarded garments and on aspects such as their age, reusability, and fibre composition. Here, we summarise the main findings on textile conditions and fibre content from the waste audits and wardrobe studies that have been completed in the Wasted Textiles project.

In the Summer of 2023, a small-scale waste audit was completed, where over 3 000 items of clothing, totalling over 1 000 kg, was mainly collected from a pilot-scale textile collection system in Trondheim (Sunde et al., 2023). This analysis characterised the discarded textiles by data on the label, regarding its fibre composition, brand, country of production, and, when available, production date. In addition, the analysis also characterised the items by their condition, from grade 1 (not usable) to grade 5 (perfect conditions, like new). The production year is not available for most discarded items, and estimating the year of production is very uncertain. However, assessing the physical condition of the items, although subjective, is more straightforward as it is based on factors such as presence of stains, pilling, discolouration, damaged zippers, missing buttons, holes, and other signs of use. In total, 60% of the items discarded had a high potential for reusability, with 42% of the items showing minor modifications that can be fixed by consumers (such as change a button), and 18% in perfect condition, some of these still with price tags on. Some of these items were discarded either in mixed waste or in bags for damaged textiles. There was virtually no difference between these discarded items in good condition regarding whether they were made of a majority of synthetic or non-synthetic fibres. Only 7% of the items discarded were completely damaged beyond the point of being able to be fixed.

A deep dive into the characteristics of textiles waste was published in the end of 2023, consisting of the results from 19 different waste audits in three different areas of Norway, between 2021 and 2023. The authors examined approximately 13 000 items, corresponding to 4 375 kg[3], consisting of clothing and accessories, shoes, and other household textiles (Syversen et al., 2023). These items came from three collection streams: mixed household waste, delivery to mixed waste bins in recycling stations, and donation boxes, and were registered according to type, proportion of synthetic fibres and wool, and the condition of the product when it was discarded. Around 50% of the household textiles were made entirely of non-synthetic fibres, and nearly 40% is made of entirely of synthetic fibres. For clothes and accessories, about half consisted of a blend of synthetic and non-synthetic fibres. Over 70% of the discarded textiles are still usable, i.e. not damaged. Textiles in donation boxes had the higher proportion of reusable items, of around 80%. However, it was noted that over 60% of textiles thrown away in mixed waste are still usable, which shows that consumers throw away a large amount of clothes, shoes, and other textiles in good conditions, instead of (at least attempting to) extending their use by donating to charities for reuse. Only less than 40% of the discarded textiles in Norway are put in donation boxes.

While waste audits give us insight into what is in the waste and reuse collection streams, wardrobe studies investigate the textile waste generated by households, understanding why different textiles go into waste, and what their characteristics are. In the Wasted Textiles project, a wardrobe study with 28 households in three different Norwegian municipalities gave an overview of how much and what kind of textile was discarded by the participants for six months. The study looked at 2 307 pieces discarded[4], weighting 389.5 kg, and registered the number of items, weight, condition (whether it was like new, with minor or major changes, or unusable), time owned, number of times used, and why these pieces had been discarded. About two thirds of the discarded textiles were clothing items. The study showed that around 10% of the items (by weight) were like new, 27% had minor changes in condition, and only 16% of the discarded textiles were not usable anymore. Around one quarter of the textiles were owned for only 1-2 years, and 8% were owned for less than one year before discarded. The age of the discarded textiles varied a lot whether an assessment was done by weight or by number of items, as small items such as underwear, socks, and baby clothes are discarded with less use than heavier items such as sweaters and jackets. About one third of the textiles contained 100% synthetic fibres, and one third contained a blend of synthetic and non-synthetic fibres (Sigaard, 2023). Table 2 summarises the findings for textile condition and fibre content for these three studies.

[3] The results in the report are based on a sample of 3 111 kg that could be analysed in detail. Some of the collected textiles had to be removed from the analysis, for example, due to clothes being soiled from the mixed waste and impossible to assess the condition before being discarded.

[4] For the study, over 3 000 pieces have been collected, but had not been processed yet by the time of the publication of the preliminary results. The study will be concluded in 2025.

Table 2 Summary of the discarded textiles condition and fibre content in the Wasted Textiles waste audits and wardrobe study

Publication	Amount	Textile types	Textile condition	Fibres
REdu waste audit (Sunde et al., 2023)	3 024 items 1 028 kg	90% clothes, accessories and shoes 10% other textiles (based on number of items)	18% in perfect condition 42% with minor modification 33% with moderate modification 7% damaged	8% entirely synthetic fibres 25% entirely non-synthetic fibres 67% mixed
Wasted Textiles waste audit (Syversen et al., 2023)	12 936 items 4 375 kg (3 111 kg for detailed analysis)	58% clothes and accessories 12% shoes 29% Other textiles (based on weight)	76% good condition for reuse 65% of textiles discarded in household waste were considered reusable	44% synthetic fibres For clothes and accessories, over half was a blend of synthetic and non-synthetic fibres
Wasted Textiles wardrobe study (Sigaard, 2023)	2 307 items 389.5 kg	72% clothes, accessories and shoes 28% other textiles (based on weight)	10% in perfect condition 27% with minor modification 26% with moderate modification 29% damaged	39% entirely synthetic fibres 28% entirely non-synthetic fibres 33% mixed

If we take the largest Wasted Textiles waste audit as representative of the Norwegian textile waste, then out of the 79 000 tons of discarded textiles in 2021 (Syversen et al., 2023), 56 000 tons would still be useable, but 32 000 of these (around 20 000 tons of clothing and accessories and shoes) would be thrown away in mixed waste, never reaching the reuse collection stream. However, being collected for reuse does not mean that the clothes will be reused.

What happens to collected textiles?

The market for used clothes in Norway is extremely low[5]. In 2022, only 909 kg –3% of textiles separately collected – were put for sale in second-hand stores in Norway (Rubach et al., 2023). Many of the discarded items have minor imperfection or damage that could be solved through simple household repairs (Sunde et al., 2023).

In 2022, 97% of textile items collected separately were exported from Norway (Rubach et al., 2023), and 91% of these exports (in monetary value) was destined to Europe (OEC, 2024), mostly to Sweden (20%), Poland (31%), Germany (9%), Bulgaria (6%), and Lithuania (4%), as shown in Figure 5. Not all exported textile

[5] Not accounting for reselling used clothes in consumer platforms such as Finn.no due to lack of data.

was sorted (Rubach et al., 2023), and textile waste can be exported under the classification of *textiles for reuse*.

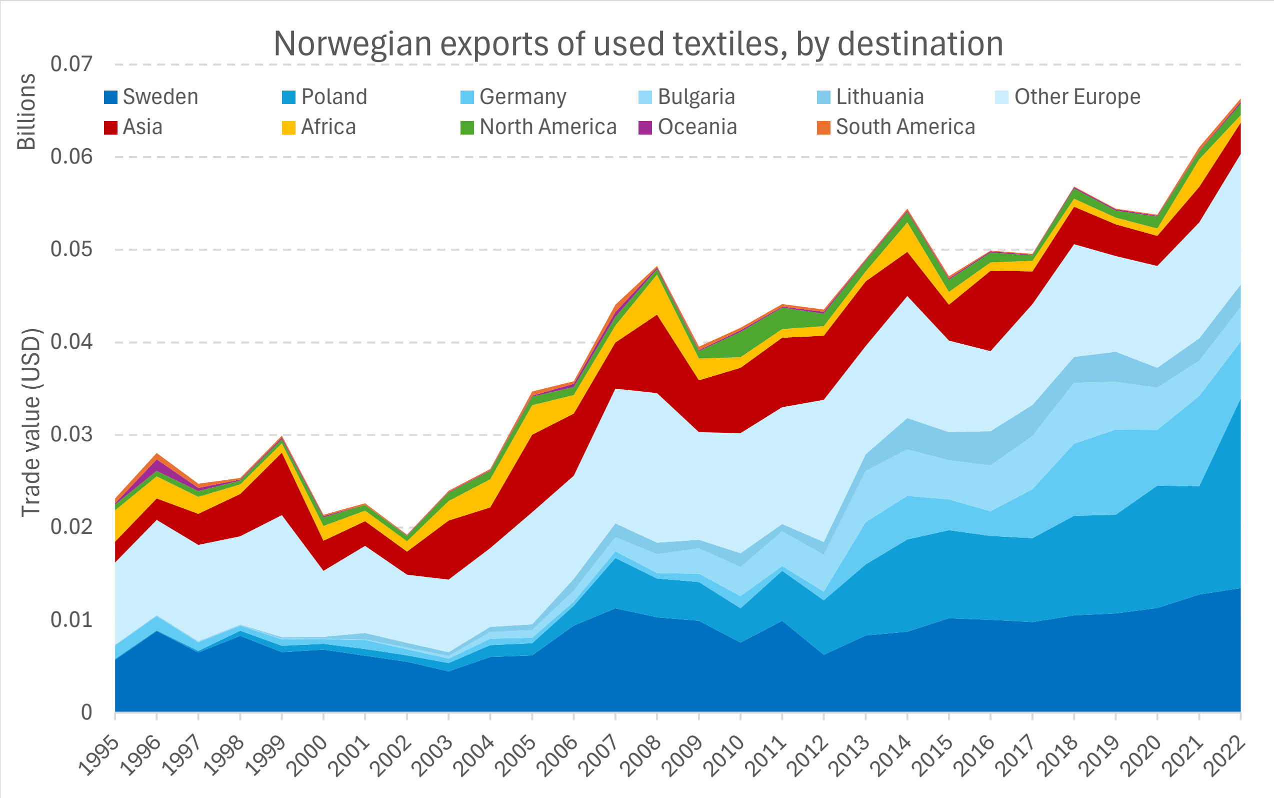

Figure 5 Norwegian exports of used textiles, in current USD, between 1995 and 2022 by country. Based on (OEC, 2024).

However, these exports are not destined to places where clothes will be reused. First, these textile products need to be stored and sorted. As sorting is very labour-intensive as ii is done manually, this process often takes place in countries with lower labour cost. Poland, the Netherlands, France, Germany, Estonia, Hungary, and Lithuania offer most of the operating sorting capacity in Europe (EEA, 2024a). After being exported from Norway to other European countries, these used textiles can either be sorted there or be re-exported and sorted elsewhere. Around three-quarters of the textile items that are not suitable for reuse are destined to recycling and backfilling, 15% are incinerated with energy recovery, and about 10% are landfilled. Out of the textiles that are suitable for reuse, about 10% are considered high-quality and resold in Europe. The remaining are exported, mostly to Africa and Asia (EEA, 2023). Figure 6 illustrates the flows of collected used textiles in the European Union.

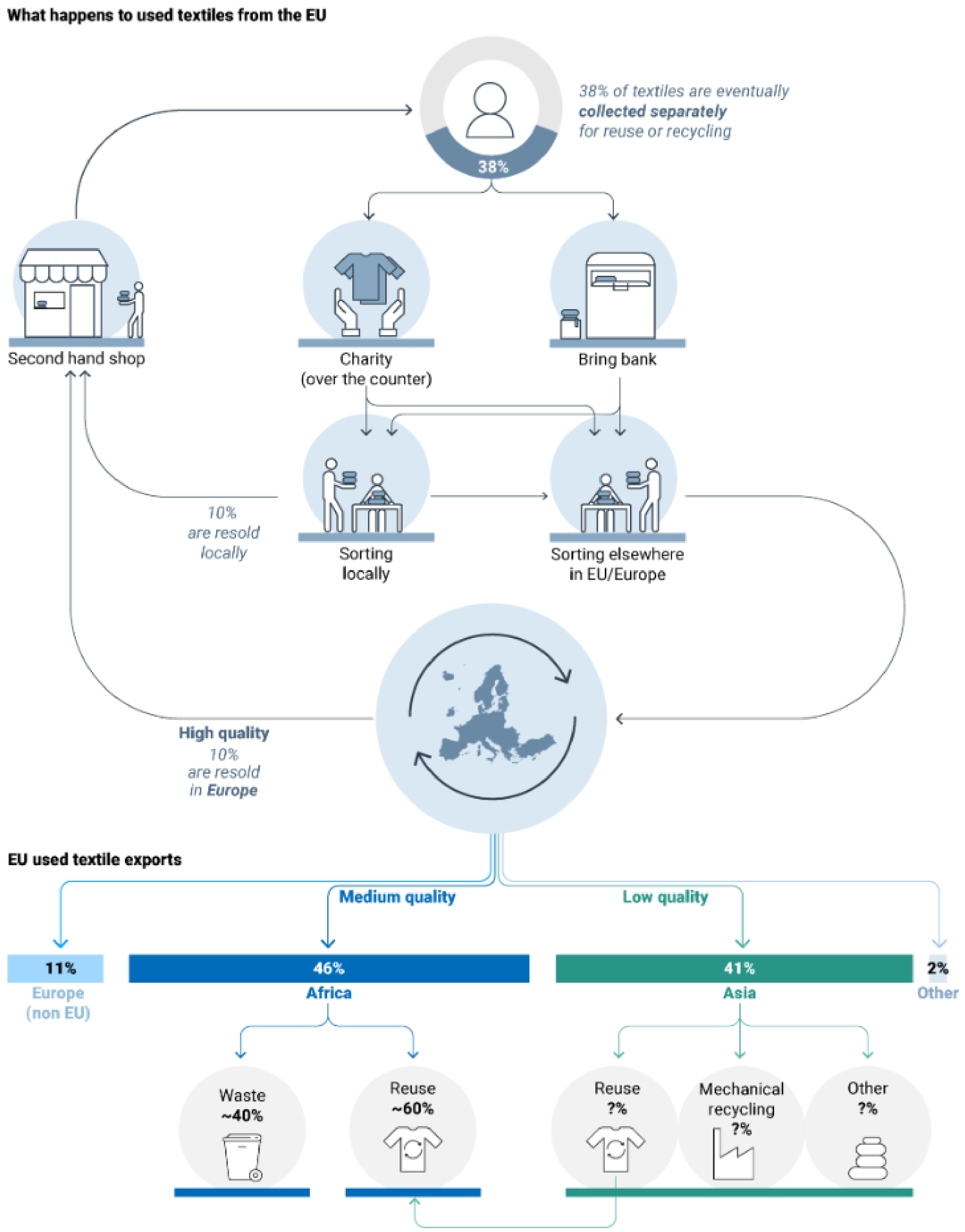

Figure 6 Flows of used textiles collected in the European Union. Source: (EEA, 2023)

The fate of used textiles exported from Europe is highly uncertain. A study from 2019 estimated that 46% of the textiles exported from Europe ended up in Africa for local reuse, and about 41% ended up in sorting centres in Asia, and are further sent for downcycling into industrial rags or filling, re-exported for (mostly open loop) recycling in other Asian countries, or for reuse in Africa (EEA, 2023).

A large share of used clothes exported to Africa are not deemed fit for reselling and ends up in open landfills and informal waste streams. In second-hand clothing markets, resellers purchase bales of used clothes without knowing what is inside of them. In Accra's Kantamanto Second-hand Clothing Market, it is estimated that resellers pay upfront 1.58$ per garment before they open the bale. On average, 40% of the clothes purchased in the bales ends up being damaged or unable to be sold. Allied to the increasingly lower quality garments arriving to these markets, it has become increasingly hard for resellers to make a profit (The Or Foundation, 2023b).

The Or Foundation (The Or Foundation, 2023b, 2023a) argues that increasing exports of fast fashion clothes from the Global North to African countries is not only a transfer of textile waste management – waste colonialism – but it actually results in African countries paying for managing textile waste from developed economies. This includes resellers who lose money to buy used textiles that cannot be sold, costs to governments and municipalities to operate waste management and landfills, as well as clean up textile waste that is disposed in illegal dumpsites and end up polluting the environment and waters. And the increasing amount of synthetic textiles in these products lead to persistent plastic and microplastic pollution.

Some discarded items can be in perfect conditions, never used, but if no one is willing to buy them, they have little or no economic value (Syversen et al., 2023). Therefore, a significant amount of discarded clothing from fast fashion, even if they are in perfect condition for reuse and delivered to donation boxes, will never be worn again.

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3 Towards a circular economy for textiles in Europe and Norway

The textiles value chain in Europe remains far from being considered circular. A recent report from the Joint Research Centre of the European Union mapped the flows of used and discarded textiles in the European Union (EU) (Huygens et al., 2023). It estimated that only 22% of post-consumer textile waste is collected separately in the EU, while most of the remaining is either landfilled or incinerated for energy recovery. Less than 75% of these collected textiles are sorted within the EU before being exported, and only 7.7% of everything that is separately collected (1.7% of all post-consumer textile waste) are resold in European markets. Around 6% of all textile waste (including pre-consumer waste) is sent to recycling in Europe, and around 95% of textile materials are recovered through open-loop recycling, being transformed into cleaning wipes and non-woven materials such as insulation. Additionally, around 25% of all textile exports end up in landfills or incineration plants outside of Europe, instead of recycling or reuse markets (Huygens et al., 2023).

The EU has set ambitious policies to transition the European textile industry towards a more circular economy, aiming to reduce textile waste, promote circular businesses, lower environmental impacts of textile production, use, and disposal, and promote more sustainable practices in the textile industry. As part of the EU Green Deal (European Commission, 2019) and the Circular Economy Action Plan (European Commission, 2020), the EU Strategy for Sustainable and Circular Textiles (European Commission, 2022) was introduced in 2022. This strategy covers the entire life cycle of textiles in Europe aiming at that, by 2030, all textile products sold in Europe are long-lived and recyclable largely made of recycled fibres, free of hazardous substances, and produced with lower environmental and social impacts. This strategy aspires to "*make fast fashion out of fashion*" and establish circular businesses for reuse and repair services economically profitable. It relies on proposed key actions including eco-design requirements, digital product passports, a ban on the destruction of unsold textiles, and initiatives to tackle microplastic pollution. Furthermore, the EU's Waste Framework Directive (European Commission, 2023) mandates separate collection of textile waste by 2025, aiming to improve reuse and recycling rates by isolating textiles from general waste streams.

A key component of the EU policy on circular textiles is the introduction of extended producer responsibility (EPR) rules, which assign producers financially and logistically responsible for the end-of-life (EOL) management of their textile products. The EPR scheme aims to support textile waste management by funding collection, sorting, and recycling infrastructure, encouraging producers to take more environmental responsibility for their products.

3.1 Extended producer responsibility

Extended Producer Responsibility (EPR) is a policy that mandates producers and importers to bear the cost of managing the environmental impacts of their products' lifecycle, aligning with the "polluter pays" principle. Under EPR, textile producers are responsible for covering the entire waste management value chain, including collection, transport, sorting, and treatment, as well as related administrative costs, which are managed by a Producer Responsibility Organization (PRO) (Long et al., 2022). The goal of the policy is to decouple textile waste generation from the economic growth of the textiles sector and improve separate collection of textile waste and promote reuse and recycling (European Commission, 2022).

EPR costs are typically integrated into product prices, indirectly transferring waste management expenses to consumers. Whether these price increases reduce overconsumption depends on the level of increase and the consumers' willingness to pay. In general, however, EPR primary funds waste management, and many stakeholders argue that additional policies are needed to address overproduction and overconsumption of fast fashion (Long et al., 2022; Virke et al., 2023).

EPR fees apply to all textiles sold, whether domestically produced or imported, and can be reduced through eco-modulation, which incentivises sustainable practices, such as enhanced product durability, use of recycled materials, and recyclability (Long et al., 2022). France, the Netherlands, and Hungary currently have textile-specific EPR initiatives, with similar programs emerging across Europe (WRAP, 2024), including in Norway (Virke et al., 2023). In 2023, the European Union submitted the proposal to amend the Waste Directive with the introduction of mandatory and harmonised EPR schemes for textiles for all EU Member States (European Commission, 2023).

France established the first textile EPR in 2008, covering clothing, household linens and footwear, and is managed by its only PRO, *Refashion*. The EPR fees, or eco-fees, are invested on collection, sorting, and processing of textiles and footwear, funds for repair and reuse, bonuses for eco-modulations, stakeholder support, R&D, and communication, in addition to operating expenses and administrative fees (Refashion, 2024). In 2024, fees for individual items ranged from 0.0177–0.1597 € for clothing, 0.0257–0.1797 € for household linens, and 0.0517–0.1767 € for footwear. Producers can receive eco-modulation bonuses for durability[6], environmental certifications, and recycled content. Bonuses for durability and certifications decrease considerably for each item put into the market after a certain amount, penalising producers that sell large volumes of the same type of item, and bonuses for closed-loop recycled content (fibre-to-fibre recycling) are twice as high as for open-loop recycled content (e.g. recycled polyester from PET bottles). Recycled material that comes from production scrap or from unsold items are not eligible for bonus (Refashion, 2024). However, these fees cover only part of the EOL management costs, and low fees have limited impact on encouraging durability or recycling (Long et al., 2022). In 2021 the average fee paid by producers was only 0.0168 € per piece, with an average contribution of 0.0714 € per kg of textiles placed in the market, of which around half was destined to sorting and waste management (Refashion, 2023).

In the Netherlands, the PRO *UPV Textiles Foundation* set a fee of 0.10 € per kg of textiles put into the market in 2024, 40% higher than the 0.071 € per kg average fee reported by *Refashion* for 2021, and estimate that this fee will increase to 0.20 € in 2025 (Stichting UPV Textiel, 2024). Unlike France, the Dutch scheme applies a flat rate across all textiles and excludes accessories and certain textile products and accessories like footwear, bags, and curtains. The Dutch EPR fees applies to return items that have previously been sold, but

[6] In the French EPR scheme, physical durability is defined by the laboratory-scale testing of the physical durability of the clothes, such as maintaining their characteristics (size, colour, appearance) after washing, and resistance to abrasions, tears, seam slippage, and pilling (Ministère de la Transition Écologique, 2022). It does not account for actual time used, which is becoming shorter due to the nature of fast fashion.

it does not apply to unsold items. Hungary's 2023 EPR policy also applies a flat rate of 0.42 € per kg for textiles, making it the highest EPR fee among active schemes (WRAP, 2024).

Table 3 summarises the active EPR regulations in different European countries as of December 2024. In addition, there are upcoming or planned EPR schemes for textiles in Sweden, Spain, Bulgaria, Italy, the United Kingdom, and Norway (WRAP, 2024).

Table 3 Active EPR schemes in other European countries, based on: (Refashion, 2024; Stichting UPV Textiel, 2024; WRAP, 2024)

Country	EPR fees	Scope
France **Active since 2008**	0.0177-0.1597 € for clothing items 0.0257-0.1797 € for household linens 0.0517-0.1767 € for footwear	Scope: Clothing, footwear and household textiles. Eco-modulation: Bonus based on durability, environmental certification, and recycled raw materials. Bonuses are paid back to producers for the total volume of eligible items put into the market in each year, after validation in the following year.
Netherlands **Active since 2024, mandatory from 2025**	0.10 € per kg in 2024 0.20 € per kg in 2025, estimated	Scope: Consumer clothing, workwear and household textiles (does not apply to footwear, accessories, and some household textiles). No eco-modulation as of December 2024.
Hungary **Active since 2023**	0.42 € per kg (HUF 145)	Scope: Clothing, footwear, household textiles, accessories, and carpets.

3.2 Proposal for a Norwegian extended producer responsibility scheme

In September 2022, the Norwegian Ministry of Climate and Environment commissioned a working group to develop recommendations for a Norwegian EPR scheme for textiles. This group included stakeholders from the retail, waste management, and environmental sectors, led by the Federation of Norwegian Enterprise (Virke), with the participation of members from the Confederation of Norwegian Enterprise (NHO), the Norwegian Waste Management & Recycling Association (AvfallNorge), Samfunnsbedriftene (The Association of Municipal Enterprises), Fretex, Future in our hands (Framtiden i våre hender), and Friends of the Earth Norway (Naturvernforbundet). The recommendations build on EU Waste Framework Directive requirements and prior guidance from the Norwegian Environment Agency. This section summarizes the report's (Virke et al., 2023) key points relevant to our analysis.

The report recommends defining textiles broadly within the EPR to include all products predominantly made of textile fibre or leather. This includes clothing, footwear, bags, uniforms and work-related textiles, and household textiles, while excluding items with minimal textile content, such as furniture and mattresses. The report advises aligning product definitions with customs tariff codes, including the potential establishment of new codes to accurately categorize different textile products, such as those made with recycled fibres. Recommended tariff codes are outlined in Table 4 in section 4.3.1.

The proposed EPR scheme would require all entities bringing new textiles to the Norwegian market, including online retailers and shopping platforms, to contribute fees. Initially, fees would be based on weight, with a potential shift to per-item fees as the scheme matures. The report also recommends a basic eco-modulation fee structure based on costs for waste treatment and potential for recyclability, with higher fees for products that are made of mainly synthetic fibres, textiles that need additional handling such as those that include electronics, and those that are difficult to recycle, such as mixed-material household textiles. Future fee adjustments could be informed by compositional surveys, such as waste audits, and closed-loop recycling experiences.

EPR fees should cover all waste management costs, including collection, transport, sorting, treatment, and preparation for reuse, as well as administrative and operational expenses of the PRO, such as reporting, communication, and research. Additionally, the EPR framework should incorporate quantitative targets consistent with EU regulations, such as increased reuse and recycling rates. The working group held differing views on certain aspects, like setting reduction targets for textile imports and including non-EU waste management costs for exported used textiles. There is a need to ensure that exported used textiles do not create environmental issues abroad and suggests discussing stricter export guidelines and potential collaboration with non-EU countries to establish sustainable waste management practices for used textiles.

3.3 Targeted producer responsibility

The goal of EPR is to hold producers and importers accountable for managing their products' EOL management once they enter waste streams. While charging a fee per item or per weight of products put into the market would mean that companies introducing large volumes of new products would bear a greater share of waste management costs (Virke et al., 2023), EPR cannot address fast fashion's overproduction issues if the fees are too small (Klepp, Tobiasson, et al., 2023). Some working group members propose implementing a more sophisticated model after EPR is established, coupled with improved systems for used and waste textile collection and sorting. One of the advanced model possibilities, proposed by the Wasted Textiles consortium, is the Targeted Producer Responsibility (TPR).

TPR aims to assign producer fees based not only on the volume and type of products introduced to the market but also on the products' lifespan and post-consumer fate. Under TPR, producers of short-lived clothing that frequently ends up in waste or donation streams would face higher fees, while producers of clothes with long lifespan would pay reduced fees or even nothing at all (Klepp, Tobiasson, et al., 2023). This model could incentivise businesses importing smaller volumes of long-lasting textiles and penalize those responsible for high-volume, short-use garments that are often discarded with little or no use, or which are discarded before even being sold.

TPR would rely on data from detailed waste audits, which assess aspects like fibre content, the usability of discarded textiles, and how many years the product has been in use. For instance, items discarded within a year of purchase but still wearable would incur higher fees than products with a five-to-ten-year lifespan. Similarly, low-quality garments that fail after minimal wear, like jeans or sweaters that wear out quickly, would also attract higher fees. As such data is currently limited, initial EPR fees could help fund the necessary analyses for an eventual TPR model. Improved documentation, like market entry dates on labels or digital product passports, would also be necessary, along with data from organizations involved in textile collection, sorting, and reuse.

The primary distinction between TPR and EPR lies in how the fees are calculated. TPR extends the concept of EPR by considering the actual use, reuse, and recyclability of garments discarded (Tobiasson et al., 2023). However, for TPR to effectively counter fast fashion's overproduction, consumption, and rapid disposal, fees must be impactful enough to influence producer practices, business models, and downstream decisions. High TPR fees would not only deter fast fashion by raising costs but also support various initiatives, including covering operational costs for waste audits, proper handling of collected textiles, funding for charities and the reuse market, reduction of synthetic textiles to mitigate microplastic pollution, municipal development of collection and processing facilities, partnerships with entities in the Global South to manage textile waste, and fostering technological innovation, research, and investment in a truly circular textile industry (Klepp, Tobiasson, et al., 2023).

In summary, the TPR framework as proposed in the context of the Wasted Textiles project proposes a focused approach to managing the impacts of textile overproduction and waste. Unlike generalized recycling mandates, TPR emphasizes waste reduction and product longevity, especially of synthetic fibres, advocating a reduction in the quantity of textiles entering the market, and products that are quickly discarded after being bought, "used, but not used up" (Klepp, Laitala, et al., 2023; Klepp, Tobiasson, et al., 2023). Rather than promoting more recycling, TPR focuses on the waste hierarchy, prioritising waste prevention and re-use.

The TPR fees would be based on two parameters: 1) the lifespan of the textile product, i.e. how long it has been used; and 2) how much it costs to process the used and discarded textiles into reusable products, following the waste hierarchy. The shorter the service life of the textile products, and the more expensive the waste treatment, the more the producers will have to pay (Klepp, Tobiasson, et al., 2023).

4 Modelling the effects on the Norwegian consumer textile sector and across national and global value chains

The implementation of different policies, such as EPR and other circular economy strategies can create indirect effects across multiple industries within both local and global value chains. In this report, we perform a value chain analysis in two levels. First, we examine how implementing Norwegian circular economy strategies for consumer textiles affects the Norwegian economy, specially focusing on their impacts on value creation, employment, and emissions. Then, we analyse the broader effects of these policies on other countries, evaluating their effects on value creation, employment, and GHG emissions in global value chains (GVC). A summary of the method is illustrated in Figure 7.

This section summarises the methods, data sources, and scenarios used in the analysis in this report. A detailed and technical description of the models and data are available in the Annex.

Figure 7 Illustration of the method used in this report for modelling the effects of eco-fees on Norwegian textiles on national and global value chains

4.1 Macroeconomic input-output modelling for value chain analysis

Circular economy policies aimed at decreasing consumption of textiles and increasing investments on circular businesses have indirect economic effects across different industries. These effects are due to the shifts in demand for goods and services from the industries directly affected by these policies, with ripple effects extending through their suppliers, the suppliers of their suppliers, and further along the supply chain. Such change in economic activity, whether increase or decrease, can impact employment and energy use, which will also impact emissions. Assessing these impacts is necessary to maximise the potential benefits of a circular economy and minimise potential negative economic, social, and environmental implications.

In this report, we apply a macro-econometric trajectory model for the Norwegian economy (Perez-Valdes et al., 2024; Wiebe et al., 2023) to quantify these ripple effects of circular economy strategies for consumer textiles. Specifically, we use the Supply-and-Use Model for Sustainability Analysis for Norway (SUMS-Norway), which assesses both direct and indirect effects on Norwegian value chains due to year-by-year changes in production and demand. SUMS-Norway is based on the Norwegian Supply and Use tables (SUTs) compiled by Statistics Norway (SSB, 2021), and provides projections from 2019[7], the base year of the macroeconomic model, to 2035. Economic growth is modelled based on historical statistical data from 2019 to 2023, while predictions from 2024 until 2035 are based on forecasted data.

SUTs show an annual snapshot of the total goods and services supplied and consumed in the economy, quantifying the transactions in products between industries, purchases by final consumers, and to and from international trade. The supply tables describe what industries produce and how much of each product is imported. It also includes the trade and transport margins and taxes less subsidies on products, which represent the difference between the production (basic) prices and the final consumer (purchase) prices. Furthermore, the use tables describe all products used by industries in the country, as well as products purchased by final consumers and exported, and gross value added (VA) generated by industries.

SUMS-Norway enables us to simulate the impacts of various policies on the economy, by estimating the changes in economic output and value added across all industries in the Norwegian economy. By linking economic output to GHG emissions and employment, the model also quantifies the shifts in GHG emissions and labour demand. It is important to note that SUMS-Norway is not an economic forecasting model, but a tool to inform about possible effects of "*what-if*" scenarios on emissions and labour demand by industries, given that the remaining structure of the economy remains constant.

The model results show how changes in individual economic activities influence the broader economic structure, capturing direct, indirect, and induced effects. Here, we consider a linear relationship between economic output and environmental and socioeconomic impacts in each industry, therefore it does not account for labour market dynamics in the assessment of the demand for jobs.

A technical description of the model is available in the Annex A1.

[7] The latest available year for the Norwegian Supply and Use tables from SSB is 2021. However, the value chains in Norway and in the world (imports, exports, industrial output, final consumption) was highly affected in 2020 due to Covid-19, and still under supply chain disruptions in 2021. Therefore, the chosen production and consumption structure for SUMS-Norway is based on that of 2019, before the effects of the Covid-19 pandemic. An updated model based on the 2022 tables will be developed in 2025.

4.2 Local policies, global effects

As part of the European Green Deal, Europe has an ambition to implement a more sustainable and circular value chain for consumer textiles. Nevertheless, sustainability impacts in the textile value chain go far beyond European or Norwegian borders. The increase in the demand for consumer textiles generates environmental, social, and economic impacts worldwide.

Multi-regional input-output (MRIO) analysis can quantify these cross-border impacts, tracing where imported goods and services are being produced, and where in the world the inputs to these products originate. MRIO analysis also links to where economic value is created, where the demand for labour arises along the global value chain, and where environmental impacts such as GHG emissions happen. Over the past two decades, GVC analysis has been increasingly utilized across various topics (Wiedmann & Lenzen, 2018). MRIO databases represents the flow of goods and services, in economic terms, between industries and to final consumers throughout the global economy. They are built using economic flows statistics from national accounts and bilateral trade data. This field advanced significantly around 10 to 15 years ago with the release of the first global MRIO databases (Lenzen et al., 2012; Nakano et al., 2009; Timmer et al., 2015; Tukker et al., 2013; Wiebe et al., 2012).

GVC analysis using MRIO databases is particularly suitable for examining globalised value chains, such as those of consumer textiles. While modelling the impacts of circular economy strategies in Norway can give insights into effects on Norwegian industries, most of the upstream impacts for consumer textiles sold in Norway occur outside Norwegian borders. Therefore, we use the Inter-Country Input-Output Database (ICIO) (OECD, 2024) to calculate the share of impacts from Norwegian consumer textiles demand that happen abroad, identifying where globally these impacts on economic value creation, jobs, and GHG emissions occur.

4.3 Scenarios for circular economy for consumer textiles

We explore two scenarios for creating a more sustainable textiles value chain. These scenarios are not intended to be predictions of the future of the textiles industry and consumption in Norway. We rather should treat the scenarios as **what-if** questions. The main question we ask here is: *"What are the potential impacts on the Norwegian economy of various policies for a more circular textile industry, and how might these changes affect socioeconomic and environmental indicators, both in Norway and in other countries through the upstream value chain?"*

The scenarios in Wasted Textiles are inspired by strategies for circular textiles value chains discussed in the recommendations for a Norwegian textiles EPR scheme (Virke et al., 2023) and for a TPR framework (Klepp, Tobiasson, et al., 2023; Tobiasson et al., 2023). The two scenarios analysed in this report are the following:

1. Implementation of Extended Producer Responsibility
2. Eco-modulation based on wasted textile streams, accounting for lifespan and unsold textiles

The effects that we examine with our scenarios are:

- The impacts of added fees on the consumption of textiles, based on price elasticities.
- The total revenue from additional fees that could be used to boost circular waste management and circular business models.
- The impacts of decreased textiles consumption of Norwegian households on value added, employment, and emissions, both domestically and globally.

4.3.1 Scenario 1: Implementation of Extended Producer Responsibility (EPR)

This scenario models the implementation of an EPR scheme for Norway, based on the framework proposed by the working group for the recommendations for the Norwegian textiles EPR scheme (Virke et al., 2023), as summarised in Section 3.1.

Under this scenario, fees would be applied to new clothing, household textiles, and footwear products entering the Norwegian market annually, regardless of whether they are sold. We model a basic EPR scheme with the option of one simple eco-modulation based on the main category for fibre type, non-synthetic or synthetic, using the import custom tariffs declaration (SSB, 2023b). Due to lack of data on domestic production, we only apply fees for the imported items[8] within the specific tariff codes listed in Table 4, as recommended by the working group (Virke et al., 2023).

Currently, there is no recommended fee for the Norwegian EPR scheme, due to the high uncertainties in costs associated with collection, sorting and appropriate treatment of discarded textiles and textile waste. Costs linked to material recovery are also very uncertain, due to limited capacity for textile recycling in Norway today, and even more limited capacity for fibre-to-fibre recycling in Europe or in the Nordics. In addition, the market demand of used clothes and recycled fibres are unknown.

[8] National production accounts for less than 1% of the total weight of textiles put into the market in 2022 (Rubach et al., 2023). Therefore, we assume this simplification is valid. There is also a current gap in the data for imports of clothing items directly to consumers due to exemption of customs declaration for shipments below 350 NOK (Rubach et al., 2023; Virke et al., 2023), which we are not be able to include in this model.

Table 4 Custom tariff codes for imported products where EPR fees would be incident, from Virke et al. (2023)

Custom tariff codes	Description
39.26.2000	Articles of apparel and clothing accessories (including gloves, mittens and mitts) made of plastic
42.03.xxxx	Articles of apparel and clothing accessories, of leather or of composition leather
43.03.xxxx	Articles of apparel, clothing accessories and other articles of furskin
43.04.xxxx	Artificial fur and articles thereof
61.xx.xxxx	Articles of apparel and clothing accessories, knitted or crocheted
62.xx.xxxx	Articles of apparel and clothing accessories, not knitted or crocheted
63.01.xxxx	Blankets and travelling rugs
63.02.xxxx	Bed linen, table linen, toilet linen and kitchen linen
63.04.xxxx	Other furnishing articles made up of textiles, excluding those of heading 94.04
64.xx.xxxx (except for 64.06.xxxx)	Footwear, gaiters and the like; parts of such articles (except for 64.06.xxxx - Parts of footwear)
65.04.xxxx	Hats and other headgear, plaited or made by assembling strips of any material, whether or not lined or trimmed
65.06.xxxx	Other headgear, whether or not lined or trimmed

We perform an assessment using fees from two established European EPR schemes, the French and Dutch, see Table 5. The French EPR schemes uses item-based fees with high level of detail (72 categories for clothing items, 15 for household textiles, and 17 for footwear). The fees for the Dutch EPR scheme, in contrast, applies a flat rate per kilogram of textile products put into the market. We also introduce a basic eco-modulation, increasing fees for synthetic (or mostly synthetic) textiles by 30%, based on relevant custom tariff codes. This is based on the rational that synthetic fibres are cheaper to produce, contribute significantly for the overproduction, are less attractive in a second-hand market and become waste more quickly (Virke et al., 2023). The products for which the custom tariff does not specify whether the fibre is synthetic or not (e.g. of other textile materials), we apply the fees for mainly synthetic textiles. The different sub-scenarios are described in Table 5. We use the average 2023 currency exchange between euro and Norwegian krone. A detailed description on the data and assumptions used is available in the Annex A.2.

The two types of sub-scenarios – fee per item and fee per weight – are also two types of fees suggested (Virke et al., 2023), each with pros and cons. A fee set per product can provide greater incentives for eco-design, and most importantly, avoids penalizing heavier products (e.g. a thick woollen sweater) more than lighter products (e.g. a synthetic t-shirt made with lighter materials), which would occur if fees were based solely on weight. However, since waste management and sorting facilities work with weight, calculating waste management costs (including transport, sorting, preparation for reuse, material recovery, and energy recovery) would be more practical by weight. Due to easier availability of textile weight data, both in imports and waste management, the working group recommends an initial fee based on weight, and then progress to a system based on fee per item.

Table 5 Fees used in the EPR scenarios

Sub-scenario	Fees used
Scenario 1.1 **Fees per item, basic model without eco-modulation**	Fees for the French textile EPR for 2024 per type of product, ranging from 0.0157 to 0.1797 € (0.1793 to 2.0522 NOK) per item (Refashion, 2024)
Scenario 1.2 **Fees per item, basic model with eco-modulation per main fibre material**	Based on the fees for the French EPR for 2024, with a 30% higher fee for products made from mainly synthetic fibres
Scenario 1.3 **Fees per weight, basic model without eco-modulation**	Fee for the Dutch EPR for 2025, as a flat rate for textiles regardless of category, of 0.2 € (2.284 NOK) per kg (Stichting UPV Textiel, 2024).
Scenario 1.4 **Fees per weight, basic model with eco-modulation per main fibre material**	Based on the fee for the Dutch EPR for 2025, as a flat rate for textiles regardless of category, with a 30% higher fee for products made with mainly synthetic fibres

In this scenario, the EPR fees are allocated across several areas, with investments loosely based on the distribution of fees from Refashion (Refashion, 2023) and the categories proposed by Eunomia (Long et al., 2022):

- 75% invested in management of textile waste, which involves activities such as collection, transport and storage, sorting, preparation for reuse and recycle, material recovery, and incineration of textile waste which is not sent to reuse or recycling. As there are no estimates on the actual costs for collection, sorting, preparation for reuse and recycling, and actual recycling in Norway, we do not differentiate of what part of the fees go towards each activity.
- 10% invested in administrative fees for covering operational costs of the Producer Responsibility Organization (PRO), including activities such as government fees, reporting, and communications.
- 5% invested in communications towards consumers and producers, including communication campaigns on environmental and social impacts of textile production and waste and behavioural changes from consumers to achieve a circular economy for textiles.
- 5% invested in a repair fund, to facilitate repair services.
- 5% invested in research and development.

The annual changes in household expenditure compared to the baseline are modelled as follows. First, additional expenditure on textile products due to price increases are assumed to be taken from spending in arts, entertainment, and recreational services. Over time, however, there are savings due to reduced consumption of textile products, and households would have income that is not spent in textile products.

This additional income would be spent in service activities[9], in the same distribution as in the base-year of the model.

4.3.2 Scenario 2: Eco-modulation based on wasted textile streams, accounting for lifespan and unsold textiles

This scenario is based on textiles reaching waste and reuse collection streams. As shown in Section 2.2, most textile waste ends up in mixed waste and is incinerated, while textiles intended for reuse are typically collected mostly through donations to charity boxes. With the introduction of a dedicated textile collection stream from 2025, less wasted textiles should be discarded in mixed waste (Mepex & NF&TA, 2023), allowing for more reuse and recycling of end-of-life textiles.

In this scenario, we explore a scenario where an eco-modulation could be applied on the analysis of textile waste streams, based on the amount of textile that is discarded by consumers, its fate, and whether they are fit for reuse. Here, the total eco-fees collected based on textile waste are assumed to be paid for by the textile producers and importers in Norway and consequently incorporated in the price of textile products to new consumers.

With this scenario, we do not aim to answer how these fees would be collected – whether they would be added to imports/production taking place in the same year or added to the fees collected for the products put in the market the following year. Our assessment would instead answer the following question: *What would be the effects of the total additional fees collected for an eco-modulation scheme based on textile waste streams, under different magnitudes of eco-modulation fees, considering what we currently know about estimates from waste accounts and waste audits?*

For this scenario, we look at post-consumer textiles, which are those discarded by households and businesses either in mixed waste, delivered to mixed waste bins in recycling stations, or donated to charities. Here, we use the estimates from the Norion and Norsus report (Rubach et al., 2023) and the recently published Wasted Textiles waste audits (Syversen et al., 2023), summarised in Table 6. For this scenario, we assume that the waste composition, handling, and reusable share in these assessments are representative of the average Norwegian pattern of consumption and discard of textiles[10].

To estimate eco-modulations based on the lifespan of textiles, we assume that the ownership duration observed in the Wasted Textiles wardrobe study is representative. According to this study, one-third of textiles are discarded within two years of ownership, while one-quarter are kept for over 10 years (Sigaard,

[9] Excluding rent, wholesale and retail trade, transport of goods, business and financial services, education, and health.

[10] This is a limitation of this scenario due to lack of data. Further work with textiles collection and picking analysis throughout Norway would be needed to refine the results in this report. It can be that, in other Norwegian municipalities, there is a different composition of discarded textiles based on their use. However, since the textile markets is so dominated by big international companies (Klepp, Tobiasson, et al., 2023), the estimates of the share of textiles that end in the waste per type, age and fibres could be representative.

2023). Due to limited data, we assume that the handling and proportion of reusable textiles remain consistent regardless of their age.

The assumptions for volume, handling, lifespan and reusable share for scenario 2 are summarised in Table 6.

Table 6 Assumptions for handling, reusable share, and lifespan of post-consumer textiles in this scenario, based on: (Rubach et al., 2023; Sigaard, 2023; Syversen et al., 2023)

Flow	Amount	Handling	Share*	Reusable share	Ownership time		
					<2 years	2-10 years	>10 years
Post-consumer textiles	79 000 tons	Sent to incineration	65%	65%	35%	37%	28%
		Sent to material recovery	0.10%	81%			
		Reuse market in Norway	1.20%				
		Export to sorting facilities	33%				

A smaller, yet notable flow of discarded textiles, comes from discarding unsold textiles. The destruction of unsold consumer products, before they are used for their intended purpose, results in unnecessary social and environmental impacts in the different stages in the production value chain. We assume that imposing high fees on unsold products and their disposal would negatively impact businesses, discouraging overproduction and overstocking by distributors and retailers. There has recently been implemented a ban on the destruction of unsold products (EEA, 2024c). However, it is not only the destruction of unsold textiles that should be targeted, however, but any handling of unsold textiles, including donation to charities which are often exported to developing countries. Implementing high destruction fees while maintaining low or no fees for donations may not sufficiently address oversupply issues, potentially leading to more clothing and footwear being shipped out of Europe. The analysis in this scenario incorporates estimates of unsold textiles from Samfunnsøkonomisk analyse (Jordell & Norberg-Schulz, 2022) and data on how unsold textiles are managed, as reported by surveys from Norsus and Norion (Rubach et al., 2023), described in Table 7.

Table 7 Assumptions for handling and reusable share of unsold textiles in this scenario

Flow	Amount	Handling	Share*	Reusable share
Unsold textiles	825 tons	Sent to incineration	5%	100%
		Sent to material recovery	28%	
		Reuse market in Norway	0%	
		Export to sorting facilities	34%	
		Other handling (unknown)	33%	

Shares displayed in this table may not add to 100% because of rounding

We start with a base fee for textiles that were discarded but were still reusable. Then, we have discounts based on whether they are destined to reuse in Norway or exported. Here, discarded textiles owned for more than 10 years (regardless of whether reusable or not) would not have any additional eco-fee.

We look at three different sub-scenarios for fees incorporating wasted textiles into an eco-modulation. Scenario 2.1 takes as a base eco-modulation fee the same as the average of EPR fees calculated in scenario 1. As these fees are an eco-modulation added on top of the original EPR fees, this would effectively result in a fee twice as high as the original for each textile product that is sold and discarded while still being able to be reused, and which is not destined to any reuse market. Scenario 2.2 assumes a fee of 0.50 USD fee per item, which is recommended by The Or Foundation as the floor of eco-fees that would account for the entire global value chain of waste management, including cleaning up textile waste in developing countries which import used textiles (The Or Foundation, 2023b). Scenario 2.3 assumed the ceiling of the recommended eco-fee by The Or Foundation, which is 2.50 USD. We assume an average weight of 0.284 kg per item (Syversen et al., 2023) to calculate fees per kg for scenarios 2.2 and 2.3.

These fees would have discounts proportional to the clothes that are destined to reused textiles markets. Used clothes that are exported to international reuse markets would have a discount of half of the base eco-modulation fee in scenario 2.1, while for scenarios 2.2 and 2.3, the discount would correspond to the average of the original EPR fees, resulting in that the original EPR fee plus the eco-modulation would result in the recommended fees by The Or Foundation. Finally, for used textiles that are resold in Norway would not be subject to additional eco-modulation (i.e. the discounts would be equal to the base eco-modulation fee). The discounts for reuse for unsold textiles would be half of those for used textiles, as a way of removing incentives for overproduction.

The eco-modulation fees used in scenario 2 are summarised in Table 8.

Table 8 Eco-modulation fees used in scenario 2, according to reusability and handling of discarded textiles

Condition and handling	Fees/Discounts, Scenario 2.1	Fees/Discounts, Scenario 2.2	Fees/Discounts, Scenario 2.3
Discarded, owned for 10 years of more	No fees	No fees	No fees
Discarded, but reusable, including unsold textiles (owned for less than 10 years)	0.61 NOK per item / 2.36 NOK per kg	5.28 NOK (0.50 USD) per item / 18.59 NOK (1.76 USD) per kg	26.40 NOK (2.5 USD) per item / 92.93 NOK (8.80 USD) per kg
Discount for textile products that are exported to sorting facilities outside of Norway, where these would go to reuse or recycling (owned for under 10 years), not including unsold textiles	0.305 NOK per item / 1.18 NOK per kg	0.61 NOK per item / 2.36 NOK per kg	0.61 NOK per item / 2.36 NOK per kg
Discount for textile products that go to the reuse market in Norway (owned for under 10 years), not including unsold textiles	0.61 NOK per item / 2.36 NOK per kg	5.28 NOK (0.50 USD) per item / 18.59 NOK (1.76 USD) per kg	26.40 NOK (2.5 USD) per item / 92.93 NOK (8.80 USD) per kg
Discount for unsold textile products that are exported to sorting facilities outside of Norway, where these would go to reuse or recycling	0.15 NOK per item / 0.59 NOK per kg	0.305 NOK per item / 1.18 NOK per kg	0.305 NOK per item / 1.18 NOK per kg
Discount for unsold textile products that go to the reuse market in Norway	0.305 NOK per item / 1.18 NOK per kg	2.64 NOK (0.25 USD) per item / 9.29 NOK (0.88 USD) per kg	13.20 NOK (1.25 USD) per item / 46.46 NOK (4.40 USD) per kg

In this scenario, the EPR fees (calculated as average of scenarios 1.1-1.4) are allocated according to scenario 1, and the eco-modulation fees are applied in the following way:

- 50% invested in management of textile waste in Norway, which would include waste audits.
- 50% invested in management of textile waste in European countries that receive Norwegian textiles and in Asian and African countries that import used textiles from Europe.

In the proposal for a TPR scheme, brands that have short average lifespan of textiles would have higher fees. Our model, however, covers the supply and consumption of consumer textiles in Norway as a whole, and we cannot model the effects of fees only paid for by specific brands. Therefore, the eco-fees in this scenario would be incident to the total consumer textile expenditure. Similarly, bonuses and discounts have the effect of decreasing the total eco-fees collected in the scenarios, and we do not discuss how the payment of bonuses would happen in practice.

4.4 Price elasticities and consumer demand

Price elasticity[11] of demand measures how responsive the quantity demanded of a good is to price changes. Own-price elasticity reflects the percentage change in demand resulting from a 1% change in price. In our analysis, we applied an average own-price elasticity of -0.83 for clothing and footwear in Norway based on a recent estimate of demand elasticities for different categories of consumer goods in OECD countries (Clements et al., 2020) to proxy the sensitivity of consumer purchases to price changes**.** This indicates relatively inelastic demand, meaning a 1% price increase leads to only a 0.83% drop in demand, in which consumers are somewhat responsive, but their demand doesn't decrease significantly with price rises.

In this study, we applied the elasticity concept to estimate the change in the quantity of clothing purchased resulting from price increases caused by eco-fees. By multiplying the percentage price change from eco-fees by the elasticity value of -0.83, we calculated the proportional decrease in the quantity of clothing purchased (more details of the calculation steps are provided in Annex A2.1). This approach allowed us to evaluate how price adjustments introduced through eco-fees schemes impact consumer behaviour and contribute to potential reductions in textile waste.

The use of price elasticities to analyse aggregate consumer demand is common in economic analysis (Britz et al., 2020). While the application of a single elasticity across a whole consumption category can provide a general estimate on the effects of prices on household consumption, applying a single average elasticity across all textiles category comes with limitations. Firstly, demand elasticity varies widely within textile categories. For example, essentials like socks and underwear are less elastic as necessities, while fashion items like shirts tend to be more elastic, with demand more sensitive to price. A single elasticity measure overlooks these distinctions, leading to possible inaccuracies when estimating demand for specific items. Furthermore, elasticity differs even within the same category due to demographic and socioeconomic status, brand loyalty, style, season, and trends. High-end brands often see more inelastic demand from brand-loyal consumers, while seasonal items like jackets tend to be more inelastic in winter and elastic in summer. Additionally, short-term demand could be generally more inelastic, as consumers can delay but not avoid essentials, while long-term demand tends to be more elastic, as consumers adjust by finding substitutes or opting for second-hand clothing. These time-based and category-specific factors are not fully captured by a single elasticity figure.

[11] Elasticity is generally categorized as elastic (elasticity < -1, demand highly responsive to price), inelastic (between -1 and 0, demand less responsive), and unit elastic (elasticity = -1, demand changes proportionally with price). These classifications help assess consumer reactions to price adjustments.

Despite these limitations, using price elasticity in our analysis offers a practical way to estimate consumer demand sensitivity, providing a baseline that reflects general consumer behaviour in textiles purchase. While simplified, this measure gives more informed pricing and consumer demand analysis, helping us to anticipate overall demand shifts in response to price changes in the textiles market in Norway.

5 The sustainability effects of Extended Producer Responsibility scenarios

In this section, we report the effects in the Norwegian economy and in the global value chains of the two scenarios described in the Section 4.3.

5.1 Effects of eco-fees and eco-modulations on the consumption of textiles

5.1.1 Prices

The introduction of eco-fees in our scenarios results in varied price impacts for textiles, depending on the fee structure and material type. Figure 8 illustrates the absolute price levels after the application of eco-fees, shown both per kg and per item, and the percentage differences between these new prices and the original prices. This analysis is based on 2023 imports prices, values and quantities. Although minor outliers are observed in these figures, they do not meaningfully affect the overall trends, or the conclusions drawn from the data.

In the EPR scenarios (1.1 to 1.4), the price effects are relatively moderate. Scenario 1.1 applies the French EPR fee across textiles products per product type, and scenario 1.2 introduces a 30% surcharge for synthetic textiles. Scenario 1.3 adopts the Dutch EPR fee, applying a flat rate per kg to all textiles, regardless of product and material type, and scenario 1.4 includes a 30% surcharge for synthetic textiles. The large spread of price difference of scenarios 1.1 and 1.2 is because those scenarios are based on the French EPR fee, which differentiates different types of textile products, while scenarios 1.3 and 1.4 do not, resulting in more uniform price increases. Synthetic textiles face higher price levels and sharper percentage differences in both scenarios 1.2 and 1.4.

In the scenarios with eco-modulation based on discarded textiles (scenarios 2.1-2.3), the effects of eco-modulation are more pronounced due to higher fees linked to waste generation and product lifespan. Scenario 2.1 builds on eco-modulations based on the average fees from scenario 1 of 0.61 NOK per discarded item, producing similar price levels with slightly greater increases for synthetic textiles. Scenarios 2.2 and 2.3 have much higher base eco-modulation fees, of 0.50 USD (5.28 NOK) and 2.50 USD (26.40 NOK), respectively, per discarded item. This leads to more significant price increases. Eco-modulation fees were distributed according to prices and volumes sold in 2023, so that these fees wouldn't disproportionally affect products of different prices.

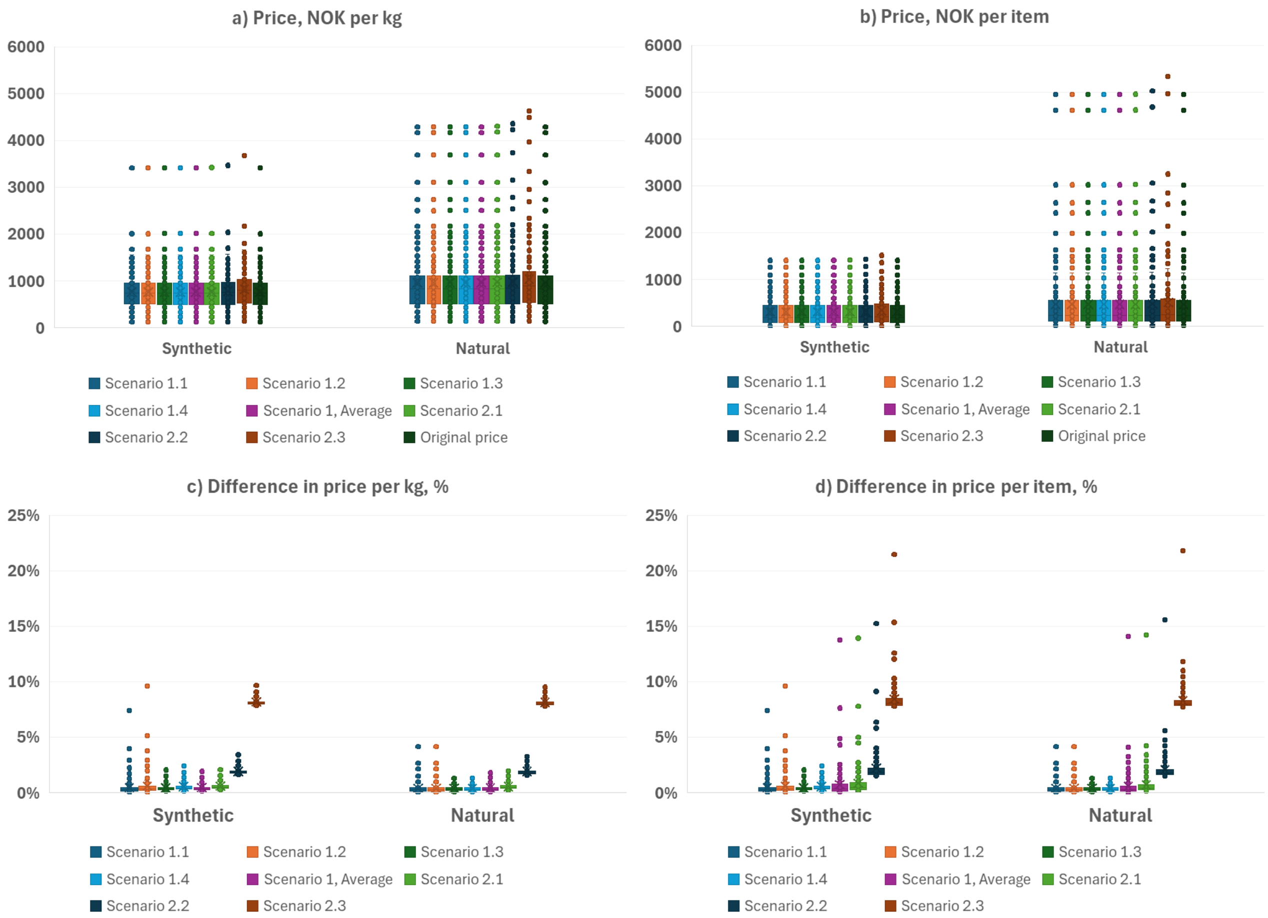

Figure 8 Current and new estimated price levels with eco-fees on clothing items (a and b) and difference between current and new estimated prices with eco-fees on clothing items (c and d)

We can also see, from Figure 8, that prices of imported products made of predominantly synthetic materials in 2023 was, on average and in terms of range, lower than for products made of predominantly natural materials. This difference was even more noticeable when looking at price per item compared to price per kg.

Table 9 summarises average eco-fees and price changes for each scenario, not differentiated by main material type. These price effects under the different scenarios underscore the critical role of fee design in shaping the outcomes of eco-fees. While eco-modulation through material surcharges or waste-based fees effectively drives price differentiation, the impacts observed in some scenarios may be too modest to meaningfully incentivise sustainability effects. By contrast, higher fees create more substantial effects, enhancing the likelihood of behavioural and market shifts toward sustainable practices and decreased textile overproduction and overconsumption.

Table 9 Average eco-fees and price changes in the different scenarios

	Average eco-fee		Average price change	
	NOK per item	NOK per kg	%, per item	%, per kg
Scenario 1.1	0.55	2.13	0.9%	0.6%
Scenario 1.2	0.63	2.42	1.1%	0.7%
Scenario 1.3	0.59	2.28	0.6%	0.5%
Scenario 1.4	0.68	2.62	0.7%	0.6%
Scenario 1, Average	0.61	2.36	1.6%	0.6%
Scenario 2.1	0.86	3.25	2.6%	0.7%
Scenario 2.2	3.16	11.34	4.3%	2.0%
Scenario 2.3	13.83	48.91	10.7%	8.3%

5.1.2 Consumption of textile products and household expenditure

The effects of the price increase introduced by the eco-fees on the consumption of textiles, calculated based on 2023 imports, is shown in Table 10.

Table 10 Estimated reduction in annual textile consumption due to price increase introduced by eco-fees, in number of items and in kg, based on 2023 imports

	Estimated reduction in items purchased			Estimated reduction in kg purchased		
	Mainly natural	Mainly synthetic / unknown	All materials	Mainly natural	Mainly synthetic / unknown	All materials
Scenario 1.1	-0.6%	-1.1%	-0.8%	-0.5%	-0.5%	-0.5%
Scenario 1.2	-0.6%	-1.4%	-1.0%	-0.5%	-0.7%	-0.6%
Scenario 1.3	-0.5%	-0.6%	-0.6%	-0.5%	-0.5%	-0.5%
Scenario 1.4	-0.5%	-0.8%	-0.6%	-0.5%	-0.6%	-0.5%
Scenario 2.1	-1.2%	-2.1%	-2.4%	-0.6%	-0.6%	-0.6%
Scenario 2.2	-2.3%	-3.2%	-3.7%	-1.7%	-1.7%	-1.7%
Scenario 2.3	-7.5%	-8.4%	-9.1%	-6.9%	-6.9%	-6.9%

The implementation of an EPR scenario leads to a reduction in household consumption of 0.6% to 1.0% in the number of items purchased, and a reduction of 0.5% to 0.6% in the weight of products purchased. The reduction in the number of items purchased is around twice as high for products made of synthetic materials than for those made of mainly natural materials for scenarios 1.1 and 1.2, where we apply an eco-fee differentiated between product types. As expected, the reduction is even higher in scenario 1.2, where we apply a 30% higher fee for products made of mainly synthetic materials. For scenarios 1.3 and 1.4, where we apply a flat rate regardless of product type, the difference in the reduction of natural and synthetic materials is not as high. When looking at reduction in weight, there is a minor difference in the reduction of products made of natural and synthetic materials. This can be because synthetic fibres have, in general, lower weight than natural fibres.

In the scenarios with eco-modulation, the reduction in textile consumption is considerably higher. Scenario 2.1, with a low eco-modulation, shows a decrease in item consumption over twice as high as for the EPR scenarios, of 2.4%, even if the reduction in weight is similar. This can be because the distribution of the eco-modulation fees between products according to volume and price, where products with higher prices and volumes would be allocated a higher share of the eco-modulation based on waste streams, might affect lighter items made with synthetic materials the most. Scenario 2.2, with a medium eco-modulation, sees a reduction in consumption of items of 3.7%, and scenario 2.3, with a high eco-modulation, leads to a reduction of 9.1% in item consumption. Scenarios 2.2 and 2.3 result in a higher reduction in the consumption of products made with synthetic materials compared to mostly natural materials, but this difference is not as high as for the EPR scenarios or for scenario 2.1.

These annual reduction in the purchase of textile products do not translate into a reduction of consumer expenditure on textile products of the same magnitude due to higher prices, which lead to higher expenditure for the purchase of the same number of items. Similarly, the annual reduction in consumption is based on the estimated consumption in the baseline scenario, and not on current consumption. It is important to note here that the consumer expenditure is based on constant prices of the base-year of the model (2019), and the increased trend of expenditure does not include inflation. In interpreting the results of the baseline scenario, a higher expenditure translates into higher physical consumption. Figure 9 shows historical trends and household expenditure in the scenarios for SUMS-Norway[12].

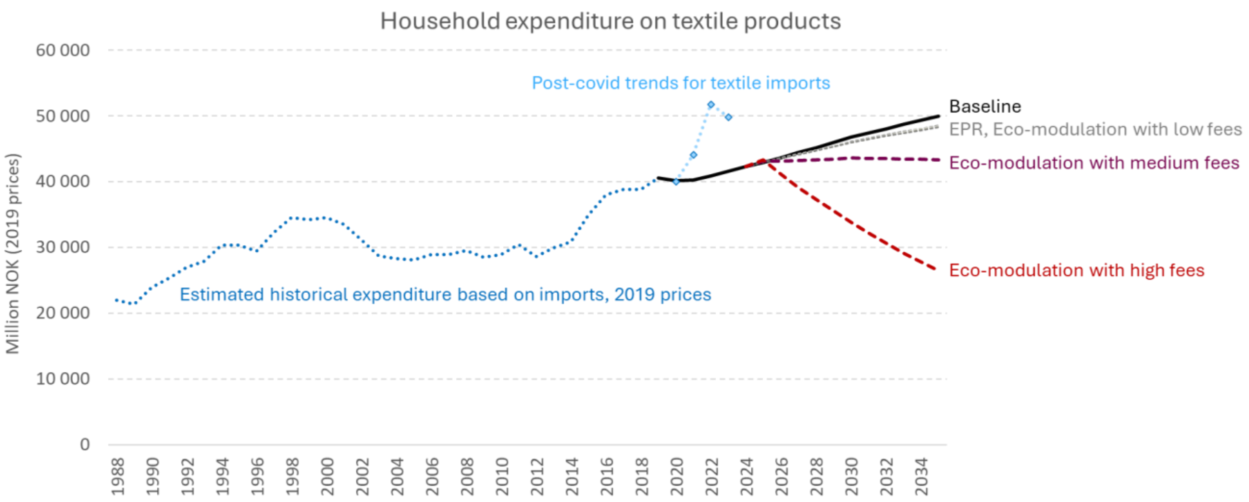

Figure 9 Historical trends and scenarios for household expenditure on textile products

[12] Historical expenditure is estimated based on the growth rate of import value, adjusted for the consumer price index for textiles and footwear, as shown in Figure 3.

The baseline scenario sees the household textile consumption following historical trends and income growth, increasing from 40,593 million NOK in 2019 to 49,990 million NOK in 2035. On average, every household in Norway spent over 16,000 NOK (in 2019 prices) in consumer textiles between 2019 and 2023. Between 2023 and 2035, household expenditure on textiles grows by 30% in the baseline scenario[13], higher than estimated population growth of 5% in the same period (NAV, 2019).

Table 11 summarises household expenditure on textiles in 2019, 2030 and 2035 in each scenario. The EPR scenarios (1.1 to 1.4) lead to a small decrease in the household expenditure on textiles of 3% in 2035 compared to the baseline scenario. Scenario 2.1, with eco-modulations based on the original EPR fees, also leads to a small decrease of around 4% in expenditure. If there is a purpose of reducing consumption of textiles, eco-fees should be higher. In scenario 2.2, with eco-modulations reaching 0.5 USD per item (the floor of the proposed EPR fees by The Or Foundation) that is discarded within 10 years while still being reusable, there is a plateau on household expenditure, with a 14% reduction in expenditure compared to baseline and, by 2035, household expenditure on consumer textiles is similar to that of 2024 in the scenario[14]. A much higher fee, of 2.5 USD per item (the ceiling of the proposed EPR fees by The Or Foundation) discarded within 10 years while still being reusable, leads to a substantial decline in consumption of textile products by households, halving household textile consumption compared to the baseline scenario. Considering an increase of 5% in households by 2035, annual household expenditure in textile products would go down from around 18,000 NOK to 9,600 NOK (in 2019 prices).

Table 11 Household expenditure on consumer textiles in the baseline and scenarios in 2019, 2030 and 2035, in million NOK

Scenario description		2019	2030	2035
Baseline	Follow historical trends	40 593	46 744	49 990
Scenario 1	Extended producer responsibility		45 953 - 46 099	48 278 - 48 591
Scenario 2.1	Eco-modulation with low fees		45 944	47 872
Scenario 2.2	Eco-modulation with medium fees		43 574	43 008
Scenario 2.3	Eco-modulation with high fees		33 843	26 436

[13] The demand growth for textiles in the baseline scenario follows historical expenditure, and builds on previous years' consumption, GDP and income growth, and price and income elasticities.

[14] As shown in Figure 3, the post-Covid trends for textile imports are much higher than historical trend. These peaks are not captured in the current version of SUMS-Norway.

5.2 Effects on Norwegian industries, employment, and GHG emissions

This section presents the scenario results obtained from the macro-econometric trajectory model for the Norwegian economy, SUMS-Norway. The scenarios are analysed in terms of their impact on the economy (value added), society (employment), and environment (GHG emissions). All results are presented here as the difference between the baseline and the scenario outcomes for 2035. Results from scenario 1 examines the effects of introducing basic EPR fees on imported textiles[15], while scenarios 2.1 to 2.3 analyse the additional impacts of eco-modulation mechanisms, where fees are adjusted based on waste generation, product lifespan, and reuse potential.

Extended Producer Responsibility

A scenario with EPR fees following the French scheme, with a simple eco-modulation on higher fees for textiles made of mainly synthetic materials, is driven by the following characteristics:

- A 1% reduction per year in the consumption of textile products in items, compared to the baseline scenario, resulting in a household expenditure of 3.6% lower in textile products than in the baseline scenario by 2035.
- This 3.6% lower expenditure totals around 1.6 billion NOK in 2035, correspondent to 0.09% of total household expenditure in 2035, and is spent instead in services such as accommodation and food services, arts and entertainment, sports, restaurants, and travel services.
- The total eco-fees collected in 2035 amount to 192 million NOK, which is spent in the management of waste textiles, operational costs of the PRO, communication activities, research and development, and repair.

Under this scenario, in 2035, the Norwegian economy would have an additional value added of 1.9 billion NOK and 2.2 thousand additional jobs. These outcomes come from direct investments funded by EPR fees and the broader economic ripple effects of redistributed household spending. The additional economic activity would also lead to increased emissions of around 94 ktons of CO_2-eq[16]. The main reason for the higher economic activity and jobs in the scenario is that the Norwegian value chain of services generates more value added and jobs than the textile value chain. In addition, these services have higher ripple effects in the Norwegian economy, as the vast majority of textile products are imported, and thus the upstream value chains are located outside of Norway.

[15] Given the minor differences observed between the EPR scenarios, we selected scenario 1.2 as the representative case for further analysis in the macroeconomic modelling using SUMS-Norway. This scenario best captures the impacts of eco-modulation, particularly with the surcharge on synthetic textiles, while simplifying comparisons with scenarios 2.1 to 2.3.

[16] For reference, Norwegian GHG emissions in 2023 were of 63.3 million tonnes CO_2-eq.

Table 12 further provides sectoral breakdown, showing how the changes in value added, employment, and GHG emissions are distributed across economic sectors and selected industries in the Norwegian economy. The main changes are in the service sector. Leisure and household services emerge as the largest contributor, adding 707 million NOK to value added and creating 1 228 jobs. This is mainly driven by the redistribution of household textile expenditure to services, including leisure-related categories. The labour-intensive nature of these activities explains their significant employment contribution. The allocation of 5% of the collected eco-fees to a repair fund, which incentivises repair and reuse activities, leads to a small economic effect, which is likely underestimated in the model. Waste management and recycling sectors contribute 74 million NOK to value added and create 61 jobs, supported by the allocation of 75% of EPR fees to collection, sorting, preparation for reuse, and recycling. The Norwegian textile industries lose 78 million NOK in value added, and 105 jobs compared to baseline. This includes not only the domestic manufacturing industries such as the production of fibres, textiles, ad wearing apparel, but also retail. As the reduction of household textile consumption happens mostly on imported items, then most of these losses on value added and employment in the Norwegian textile industry happen on retail businesses.

Table 12 Changes in value added, employment, and GHG emissions in scenario 1.2 compared to the baseline scenario for broad economic sectors, selected industries (*in italic*), and for the entire Norwegian economy[17]

	Value Added (GDP, million NOK)	Employment (Persons)	GHG Emissions (ktons CO_2-eq)
Primary sectors	**95**	**22**	**6.3**
All industry, incl. utilities	**153**	**72**	**27**
Textile industry	*-78*	*-105*	*-5.3*
Waste management and recycling	*74*	*61*	*6.1*
All service sectors	**1 718**	**2 084**	**61**
Leisure and household services	*707*	*1 228*	*17*
Repair services	*7*	*10*	*0.1*
Total economy	**1 965**	**2 178**	**94**
Direct household emissions			**28**

Assessing the effects on jobs in textile waste management, however, is highly uncertain. This is because the employment coefficients in SUMS-Norway are based on the current waste management sector, for which there is no detail except for hazardous and non-hazardous waste, as mentioned in Section 2. The waste

[17] There are large uncertainties with these values, and these numbers should not be cited out of context. For uncertainties related to the model, see Perez-Valdes et al. (2024). In addition, these values are sensitive to the assumptions on new household demand due to reduced expenditure in textile products, see sub-section "*The rebound effect: the impacts of consumption choices due to savings from textile consumption*", at the end of this section 5.2.

sector is dominated by the collection, sorting, transport and treatment of other types of waste, such as waste from households (especially mixed waste), construction, and industries. Textile collection and sorting is very labour-intensive (van Dujin et al., 2022), and those activities are expected to increase with increased collection of textiles in separate waste streams from 2025. Investing collected eco-fees in better sorting activities for textile reuse and recycling could potentially create even more jobs.

The eco-fees collected in the EPR scenarios in 2025 amount to 150-185 million NOK, with 113-139 million NOK spent in textile waste management, as shown in Table 13. If textile waste in 2025 was similar to 2022, and separate collection rate remained the same, this would amount to 1.41-1.74 NOK per kg of all discarded textiles, or 3.82-4.70 NOK per kg of textiles collected separately from mixed waste.

Table 13 Eco-fees collected in the EPR scenarios in 2025

	Eco-fees collected in 2025	Eco-fees spent in textile waste management in 2025		
	Total collected, million NOK	Total spent in waste management, million NOK	NOK/kg, based on total textile waste in 2022	NOK/kg, based on separate collection of textile waste in 2022
Scenario 1.1	150.8	113.1	1.41	3.82
Scenario 1.2	170.8	128.1	1.60	4.33
Scenario 1.3	162.0	121.5	1.52	4.11
Scenario 1.4	185.7	139.3	1.74	4.70

Eco-modulations based on discarded textiles

The scenarios with eco-modulations based on discarded textiles are driven by the following characteristics:

- This scenario builds on top of the EPR scenario. In addition to the eco-fees, there is an additional eco-modulation, which is invested in textile waste management.
- The reduction of textiles consumed per year depends on the size eco-modulated fee. Low/medium/high eco-modulation fees lead to a 2.4% / 3.7% / 9.1% annual decrease in number of items consumed, respectively. This results in household textile expenditures in 2035 lower than baseline by 4.2% / 14% / 47.1% respectively.
- This reduced expenditure totals around 2.1 / 7.0 / 23.6 billion NOK in 2035, correspondent to 0.1% / 0.4% / 1.4% of total household expenditure in 2035, and is spent instead in services such as accommodation and food services, arts and entertainment, sports, restaurants, and travel services.
- The total eco-fees collected in 2035 amount to 257 / 799 / 1 976 million NOK, which is spent in the management of waste textiles, operational costs of the PRO, communication activities, research and development, and repair, as well as invested in waste management systems outside of Norway.

In a scenario with low eco-modulation fees (scenario 2.1), the additional value added in the Norwegian economy in 2035 would be of 2.6 billion NOK, and 2.9 thousand additional jobs, together with additional 125 ktons of CO_2-eq. In this scenario, the textile industries lose 105 million NOK and 141 jobs compared to baseline, as shown in Table 14.

Table 14 Changes in value added, employment, and GHG emissions in scenario 2.1 compared to the baseline scenario for broad economic sectors, selected industries (*in italic*), and for the entire Norwegian economy

	Value Added (GDP, million NOK)	Employment (Persons)	GHG Emissions (ktons CO_2-eq)
Primary sectors	**126**	**29**	**8.3**
All industry, incl. utilities	**197**	**90**	**35**
Textile industry	*-105*	*-141*	*-7.0*
Waste management and recycling	*95*	*78*	*7.8*
All service sectors	**2 272**	**2 766**	**81**
Leisure and household services	*941*	*1 641*	*22*
Repair services	*9*	*12*	*0.1*
Total economy	**2 594**	**2 886**	**125**
Direct household emissions			**37**

In a scenario with medium eco-modulation fees (scenario 2.2), the additional value added in the Norwegian economy in 2035 would be of 8.3 billion NOK, and 9.3 thousand additional jobs, together with additional 400 ktons of CO_2-eq. In this scenario, the textile industries lose 343 million NOK in value added and 462 jobs compared to baseline, as shown in Table 15.

Table 15 Changes in value added, employment, and GHG emissions in scenario 2.2 compared to the baseline scenario for broad economic sectors, selected industries (*in italic*), and for the entire Norwegian economy

	Value Added (GDP, million NOK)	Employment (Persons)	GHG Emissions (ktons CO_2-eq)
Primary sectors	**402**	**94**	**27**
All industry, incl. utilities	**591**	**250**	**110**
Textile industry	*-343*	*-462*	*-23*
Waste management and recycling	*273*	*227*	*23*
All service sectors	**7 320**	**8 959**	**264**
Leisure and household services	*3 083*	*5 381*	*73*
Repair services	*24*	*31*	*0.3*
Total economy	**8 313**	**9 304**	**400**
Direct household emissions			**118**

In a scenario with high eco-modulation fees (scenario 2.3), the additional value added in the Norwegian economy in 2035 would be of 28.7 billion NOK, and over 31 thousand additional jobs, together with additional 1.3 million tons of CO_2-eq. This scenario has a high economic impact in the textile industries, with losses of over 1 billion NOK in value added and over 1 500 jobs compared to baseline, as shown in Table 16. In this scenario, there is a very high additional economic value added and employment, as well as GHG emissions, in the Norwegian economy. That's because there is a large amount of household income that is used for service activities instead, with high economic benefits to the economy, but also higher GHG emissions. In this scenario, households decrease their annual expenditure in textile products by almost half.

Table 16 Changes in value added, employment, and GHG emissions in scenario 2.3 compared to the baseline scenario for broad economic sectors, selected industries (*in italic*), and for the entire Norwegian economy

	Value Added (GDP, million NOK)	Employment (Persons)	GHG Emissions (ktons CO_2-eq)
Primary sectors	**1 394**	**324**	**92**
All industry, incl. utilities	**2 229**	**1 059**	**394**
Textile industry	*-1 123*	*-1 514*	*-75*
Waste management and recycling	*1 056*	*876*	*87*
All service sectors	**25 092**	**30 482**	**895**
Leisure and household services	*10 481*	*18 136*	*252*
Repair services	*73*	*97*	*0.9*
Total economy	**28 715**	**31 865**	**1 380**
Direct household emissions			**408**

These eco-modulation fees are spent both in textile waste management in Norway and in textile waste management in other countries that receive used textiles from Norway and from Europe, shown in Table 17.

Table 17 Eco-fees collected in the eco-modulation scenarios in 2025

	Total eco-fees collected, million NOK	Total eco-fees spent in waste management in Norway, million NOK	NOK/kg, based on total textile waste in 2022	NOK/kg, based on separate collection of textile waste in 2022	Eco-fees exported for waste management in other countries, million NOK
Scenario 2.1	231	157	1.97	5.32	32
Scenario 2.2	800	442	5.52	14.92	317
Scenario 2.3	3 239	1 659	20.73	56.03	1 542

The eco-fees collected in the eco-modulation scenarios in 2025 amount to 231 million NOK in the low eco-fees scenario, up to 3.2 billion NOK in the high eco-fees scenario. The eco-fees used in the Norwegian textile management would amount to nearly 2 NOK/kg of discarded textiles in scenario 3.1, 5.52 NOK/kg in scenario 3.2, and 20.73 NOK/kg in scenario 3.3. Additionally, this scenario includes transfer of investments to waste management systems outside of Norway. In scenario 3.1, this would be only of 32 million NOK, amounting to 0.62 NOK per kg of used textile exported in 2022. In scenario 3.2, the value invested in waste management outside of Norway would be of over 300 million NOK, around 6.22 NOK per kg of used textile exported in 2022. Finally, scenario 3.3 would lead to almost half of all eco-fees collected to be used for waste management in other countries, amounting to around 30 NOK per kg of used textile exported.

The rebound effect: the impacts of consumption choices due to savings from textile consumption

The reduction in household expenditure in one product leads to redirection of household expenditure to savings or to the consumption of other goods and services. This will have different effects on the economy, society, and environment. The reduction in consumption of textile products will lead to different effects depending on what households will spend their saved income (Andersson & Nässén, 2023). These indirect impacts are the largest share of impacts, in Norway, of reduction in textile consumption. This is because most of the textile products consumed by the Norwegian households are imported, and the reduction in consumption mostly leads to a reduction of imports, impacting few Norwegian industries. On the other hand, household consumption of goods and services supplied by many other Norwegian businesses lead to higher spillovers in the domestic value chain, having a larger effect on the local economy.

In this report we assumed that households save part of their income due to lower expenditure on textile products and will spend on services instead. This leads to high increase in value added and employment, as the service industry is characterised by high labour inputs and strong interlinkages with the domestic economy.

However, what would be the effects in the Norwegian economy if the savings are spent not only on services, but represent a more equal distribution to current household consumption, including food products, products from the manufacturing industries, and services not included in the first assessment such as rent and financial services? Figure 10 shows the differences on the total impacts in the economy if we assume that households spend their savings in services only (dark green) or in a mix of goods and services based on the current distribution of household expenditure (light green). The impacts represent the differences in total value added, GHG emissions and employment in Norway in 2035 compared to the baseline scenario. There are virtually no differences in total value added in the entire economy in the two cases. However, by assuming additional expenditure in services only, we might underestimate impacts on GHG emissions (from additional 0.7% to 1% higher emissions in scenario 3.3, a difference of 885 ktons CO2-eq), and overestimate impacts on employment (from additional 1% to 0.7% higher employment in scenario 3.3, a difference of 9.8 thousand jobs).

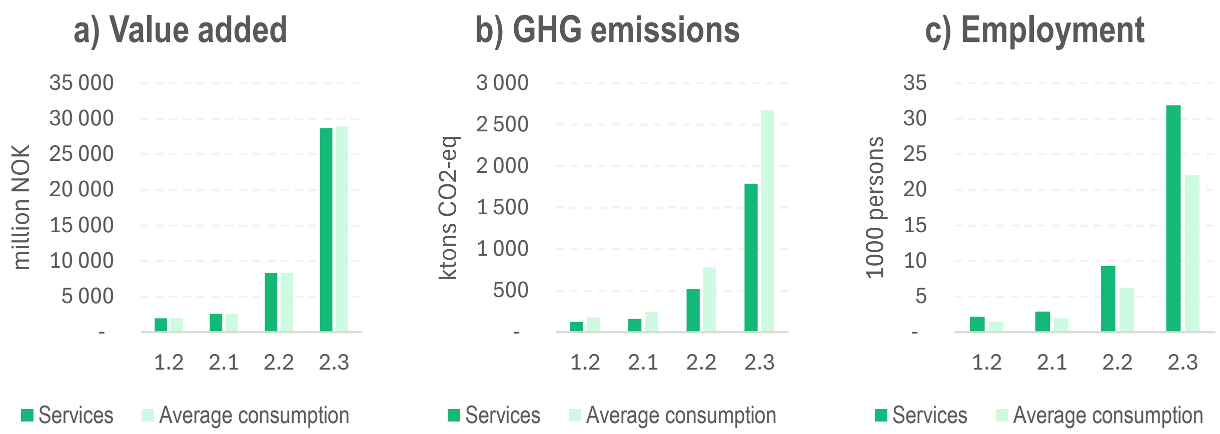

Figure 10 Differences between baseline scenario and scenarios for EPR (1.2) and eco-modulation (3.1-3.3) for value added, greenhouse gas emissions, and employment in 2035, based on whether households spend their savings on services only (dark green) or on current distribution of household expenditure (light green)

5.3 Effects on global value chains

The effects of the scenarios described above in the Norwegian industries showed that decreased consumption of textiles leads to high positive economic impacts in the Norwegian economy, due to the shift in household expenditure towards services. The main reason is because the economic and employment effects in Norway of textiles consumption is much lower than that of services. But how much of upstream impacts of Norwegian textiles consumption happen in Norway, and where in the world will the impacts of Norwegian strategies for decreasing textile products consumption will be felt?

In this section, we look at where are the upstream impacts of Norwegian textiles consumption in the world. Figure 11 shows where value added, employment, and GHG emissions in the upstream value chain of textiles and footwear purchased by final consumers in Norway. 12% of all value added is generated by companies in Norway, but only 2% of all employment and 3% of all GHG emissions. This could be because of high labour productivity and low emissions intensity of Norwegian industries, but this could also be due to outsourcing by the Norwegian textile industries. It is not uncommon for products to be designed in Europe or North America by local brands but made in Asia with cheaper labour costs. This can also be because a large share of the purchase of textile products by households happen in local retail businesses (physical stores or online), leading to high value added created in retail businesses, while the majority of the environmental impacts happen in the upstream value chain in other countries.

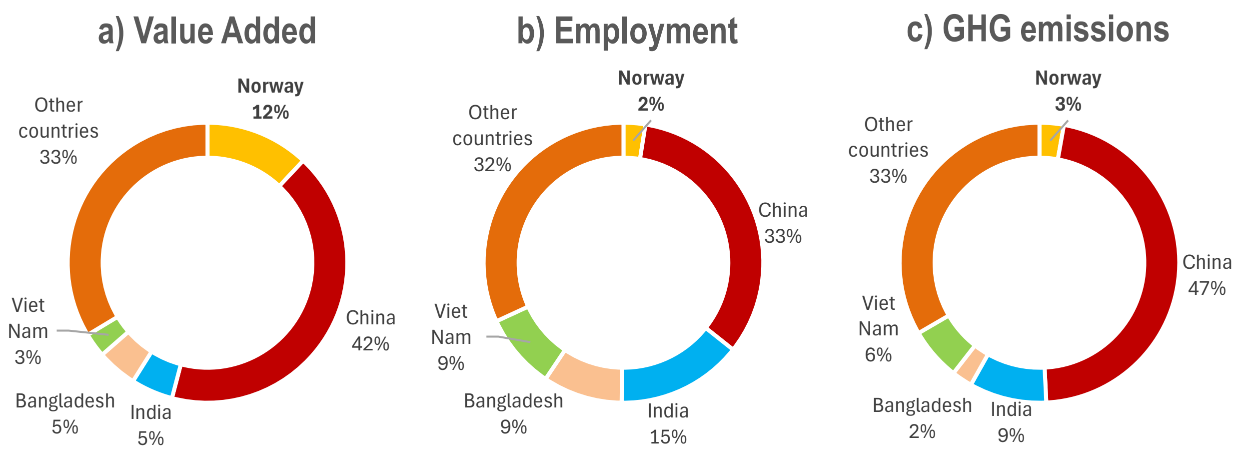

Figure 11 Country of origin of value added, employment, and greenhouse gas emissions of textile products purchased in Norway in 2020

The impacts of changes in consumption of textile products in Norway are mostly felt in Asia, especially in China. Over half of all value added and two thirds of employment and GHG emissions in the value chain of Norwegian textiles happen in China, India, Bangladesh, and Viet Nam.

Figure 12 shows the impacts of scenario 1.2, with a 1% decrease in consumer textiles consumption[18]. It shows impacts in the textile industry (in red), in the waste management industry (in blue), and spillovers in the rest of the economy (in yellow). This analysis considers only the reduction in consumption and EPR fees collected estimated for the first year of the analysis, which would correspond to 2025, and quantifies only immediate impacts of the introduction of the EPR fees. It does not consider the redirection of consumer expenditure towards services as presented in section 5.2. It shows that half of the losses in value added occur in the upstream value chain of textile industries, and not in the production of textiles (which includes from fibre production to final products) themselves, while most GHG emissions come from other industries, mainly the energy industries. The positive impacts in value added and employment in Norway come mostly from the direct investment in the waste management industry.

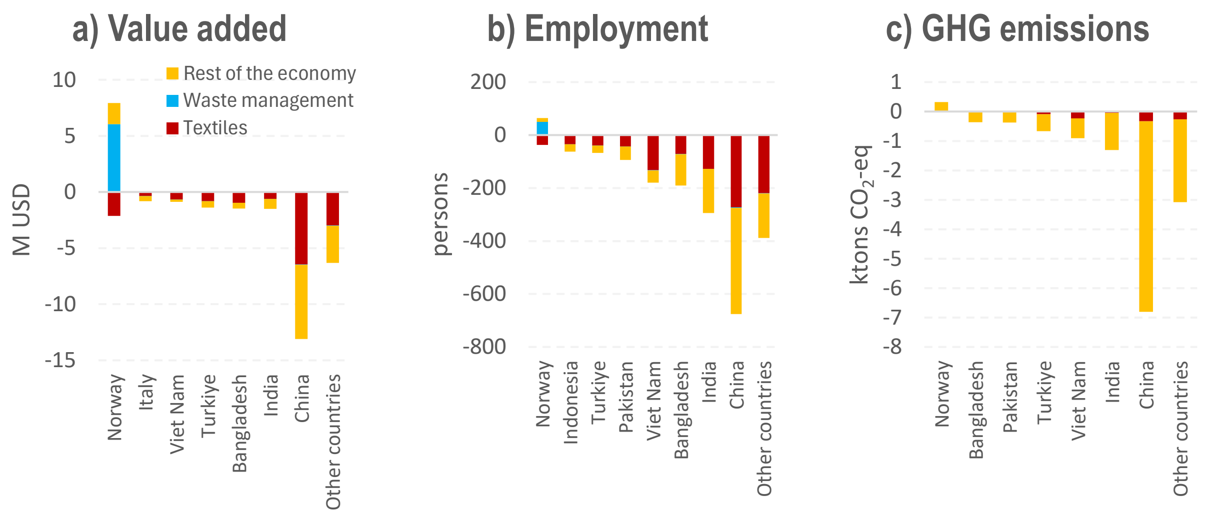

Figure 12 Impacts in the global value chain of scenario 1.2, with EPR fees and investments in waste management in Norway

On scenario 3.3, with high eco-modulation fees and large investments in waste management outside of Norway, we see much larger effects, and more balance between positive and negative impacts in other countries, as seen in Figure 13. Impacts are, overall, about 10 times higher in scenario 2.3 compared to scenario 1.2. Positive impacts on the economy and employment are driven by investments in the waste management industry. In this scenario, we consider that 50% of eco-modulation fees are invested in waste manage industries abroad: 50% in European countries that imported used textiles from Norway in 2020 as

[18] Here, we model textile consumption changes in global value chains based on physical quantities, not expenditure, due to comparing scenarios in a static input-output table. We choose to model change in consumption based on number of items as shown in Table 10. The numbers for Norway are not directly comparable to results in section 5.2, since the models use different data.

seen in Figure 5, and 50% on Asian and African countries based on exports of used textiles from Europe in 2019, from EEA (2023). In both EPR and eco-modulation scenarios, global GHG emissions decrease.

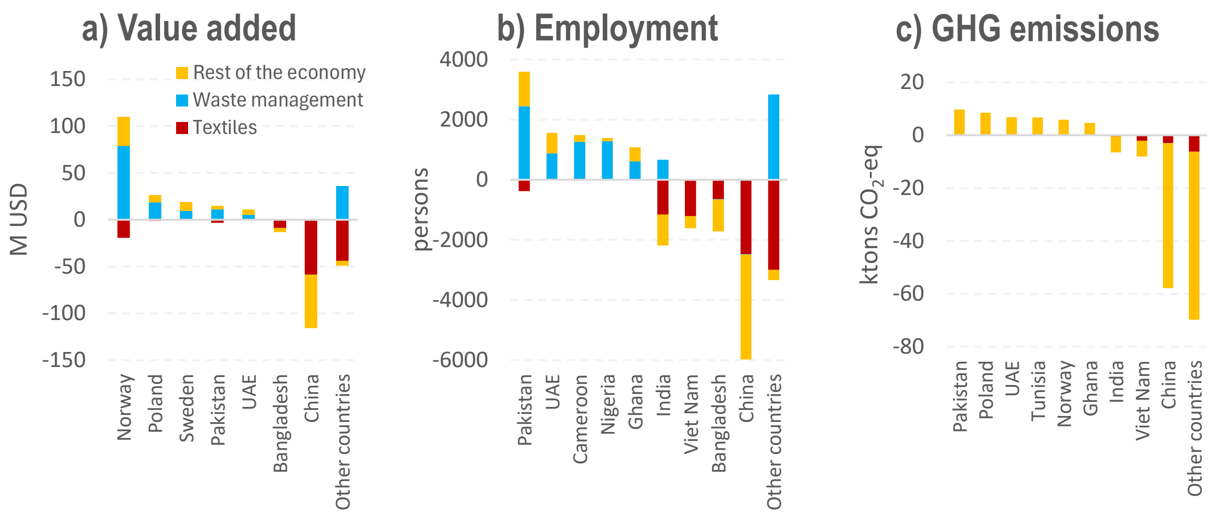

Figure 13 Impacts in the global value chain of scenario 2.3, with high eco-modulations and investments in waste management in Norway and abroad

6 Conclusion

In this report, we looked at the effects of different scenarios of implementation of an Extended Producer Responsibility (EPR) scheme for consumer textiles in Norway. We assessed the effects of price changes, their effect on household textile consumption, and the effects of redistribution of consumer expenditure on the generation of value added, employment, and greenhouse gas emissions. For this assessment, we used a input-output trajectory model of the Norwegian economy, looking at changes up until 2035 compared to a baseline scenario with no changes in textile consumption.

The scenarios are based on suggestions for the implementation of a Norwegian EPR scheme, with the suggestion of an eco-modulation based on principles suggested by the Wasted Textiles project for a Targeted Producer Responsibility (TPR) scheme. We show that eco-fees that distinguish for item instead of weight lead to a higher decrease of synthetic textile products compared to those made of predominantly natural fibres. Scenarios that increase the eco-fee based on predominantly synthetic fibres also lead to significantly higher reduction in the consumption of synthetic textile products and can have important effects on other impacts, such as microplastic pollution and plastic waste in landfills in developing countries.

The largest effects are due to the redistribution of consumer expenditure to the purchase of other goods and services. This is because the majority of consumer textiles are imported, generating few interlinkages in the Norwegian economy. Therefore, the reduction of textile consumption affects few Norwegian industries, with most impacts felt in the retail industry. When reducing the consumption of textiles and shifting towards the consumption of other goods and services, there are positive impacts in both value creation and employment in the Norwegian economy, which replace the jobs and value added lost in the textile manufacturing and retail sectors. However, there are many aspects which are not captured in this analysis, such as the high labour demand for textile sorting, which could be underestimating the labour effects of textile waste management, and labour and income of second-hand stores due to increased reuse in Norway.

We also looked at the effects of the changes in consumer textiles in global value chains, pointing at the total impacts beyond Norwegian borders. Most of the impacts of reduced textile consumption happen in the upstream value chain in other countries, not only in the textile production industry but also due to spillovers to other industries in countries in the textile value chain, which spans from production of raw materials and fibres to the production of finished garments and other textile products.

A Norwegian EPR scheme will be aligned with European Union initiatives. This report highlights the importance of integrating local strategies with global sustainability objectives, ensuring Norway contributes to broader environmental and social outcomes. For long-term success, further collaboration with stakeholders across production, retail, and waste management in Norway and abroad will be necessary to refine strategies and achieve sustainability goals. However, the transition towards a more circular and sustainable textile industry cannot happen without tackling overproduction and overconsumption of textile products. For this, fees that target synthetic textiles and short-lived products are needed, and they should be high enough to lead to a reduction in consumer demand. The revenues from the eco-fees should fund local collection, sorting, repair industries, preparation for reuse, recycling capacity, and waste audits both in Norway and in countries that receive a large amount of used textiles from Europe.

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Annex

A.1 SUMS-Norway

The SUMS-Norway model is a an economic "what-if" scenario analysis framework developed to analyse the effects of various scenarios, such as climate policies, on emissions and labour demand. It operates within a Supply and Use Tables (SUT) framework using constant 2019 prices, providing a detailed view of interactions between industries and products. By combining macro-economic equations with an industry-by-commodity, demand-driven approach, the model links product demand to industry output in a structured, data-driven manner.

The SUMS-Norway model is driven by both exogenous and endogenous factors. Exogenous inputs, including population growth, export demand, and scenario-specific investments, shape the structure and assumptions of each simulation. Endogenous responses adjust dynamically within the model, influenced by macroeconomic factors such as household demand, GDP growth, and inter-industry dependencies.

Macro-economic equations

SUMS-Norway's core macro-economic equations calculate GDP and its components for each year t. These components, household consumption, government spending, investment, and trade, are linked to overall GDP to reflect their interactions within the economy. GDP is calculated as the sum of economic components, with imports subtracted:

$$GDP_t = HHE_t + GOV_t + GFCF_t + CIES_t + EXP_t - IMP_t$$

where HHE_t represents household consumption expenditures, GOV_t denotes government spending, $GFCF_t$ is gross fixed capital formation (investment), $CIES_t$ is changes in inventories, and EXP_t and IMP_t are exports and imports, respectively. Below we give a detail descriptions of these variables.

Household consumption expenditure (HHE_t) is the aggregate household expenditure for the entire economy in year t. It is calculated within the macroeconomic model and contributes to total GDP. In SUMS-Norway, the total household consumption HHE_t is further broken down by individual products to capture detailed consumption patterns. At the product level, household expenditure, $HHE_{prod,t}$ for each product $prod$ in year t is calculated using a demand system that incorporates the lagged household expenditure

($HHEprod_{t-1}$), income elasticity (eI), own-price elasticity (eop), and cross-price elasticity (ecp) for each product with:

$$HHEprod_t = HHEprod_{t-1} + (eI \times \Delta GDP) + (eop \times \Delta OwnPrice) + (ecp \times \Delta OtherPrices)$$

where ΔGDP, $\Delta OwnPrice$, and $\Delta OtherPrices$ denote percentage changes in GDP, the product's own price, and the prices of other goods, respectively. Here, elasticities are taken from the USDA international food comparison programme (Meade et al., 2014; Muhammad et al., 2015).

Furthermore, government expenditure (GOV_t) is modeled as a function of population growth and GDP, with a one-year lag reflecting delayed budget adjustments. Here, population is assumed to follow the medium fertility scenario from UN DESA's world population prospects (UN, 2019) and government consumption data is based on time series data from the system of national accounts. Investment (Gross fixed capital formation, $GFCF_t$) grows based on past GDP changes influenced by historical GDP data. Changes in inventories ($CIES_t$) are assumed to trend toward zero over time. And finally, exports (EXP_t) grow with global GDP and imports (IMP_t) are modelled as a constant share of GDP.

The product-demand-driven supply-and-use model

SUMS-Norway uses an industry-by-commodity commodity-demand-driven model that relies on three main matrices to capture interdependencies across industries and products. The industry output g is calculated by adjusting the final demand vector y_p, as follows

$$g = D(I - BD)^{-1} y_p$$

where I is the identity matrix, B represents the use coefficient matrix, which indicates the proportion of each product consumed by industries, and D represents the market share matrix that allocates each product's output across industries. The matrix B is derived from the use matrix, U, calculated as:

$$B = U\, diag\left(\frac{1}{g_1}, \frac{1}{g_2}, \dots, \frac{1}{g_n}\right)$$

where g_i represents the total output of each industry. The matrix D is derived from the make matrix V as:

$$D = V\, diag\left(\frac{1}{q_1}, \frac{1}{q_2}, \dots, \frac{1}{q_n}\right)$$

where q_i represents the total output of each product. The product final demand vector y_p represents total demand across various final uses, including household consumption, government spending, investment, changes in inventories, and exports for each product:

$$y_p = yHHE + yGOV + yGFCF + yCIES + yEXP$$

The model iterates each year until the change in final household demand between iterations falls below a threshold, ensuring convergence. The next year is then initialized with endogenous variables set to the current year's solution, and exogenous variables, along with scenario inputs, advance to the next year's values.

A.2 Data treatment and assumptions for scenarios: Calculations of eco-fees based on import data

We use import data for textiles and footwear from Statistics Norway (SSB, 2024) to approximate changes in household consumer expenditures on textiles, which forms the basis of our scenario analysis. The import data, collected from customs, is classified under specific custom tariff codes and is available for several years. Relevant clothing items, as presented in Table 3, were selected for further processing into our scenario data. The selected items were first categorized into product types and material types. The later was used to apply eco-modulation of the items, distinguishing between natural and synthetic items.

We categorized the items further to align with the French EPR categories:

i. The French EPR system includes 56 item categories, with non-unisex clothing items (e.g., accessories and baby items), while the rest was split across men's, women's, and children's categories.

ii. Import data mapping was performed using 343 selected custom tariff codes (***Tolltariffen***) from 2023 and aligned to 28 Re_fashion item categories as it is depicted in Figure 14. The mapping process included the following steps:

- 216 codes were mapped to the correct gender categories (male, female, or unisex).
- 74 codes with unknown gender classification were assigned an average male/female fee.
- 13 codes were classified as baby items.
- 40 codes were mapped to household textiles.
- Curtains were excluded as they are not included in the Re_fashion categories.
- 15 codes for clothing items that could not be allocated to any specific category were assigned an average fee for all clothing items.

For Dutch EPR fees categories, no additional alignment was needed, as the same rate applies uniformly across all product categories.

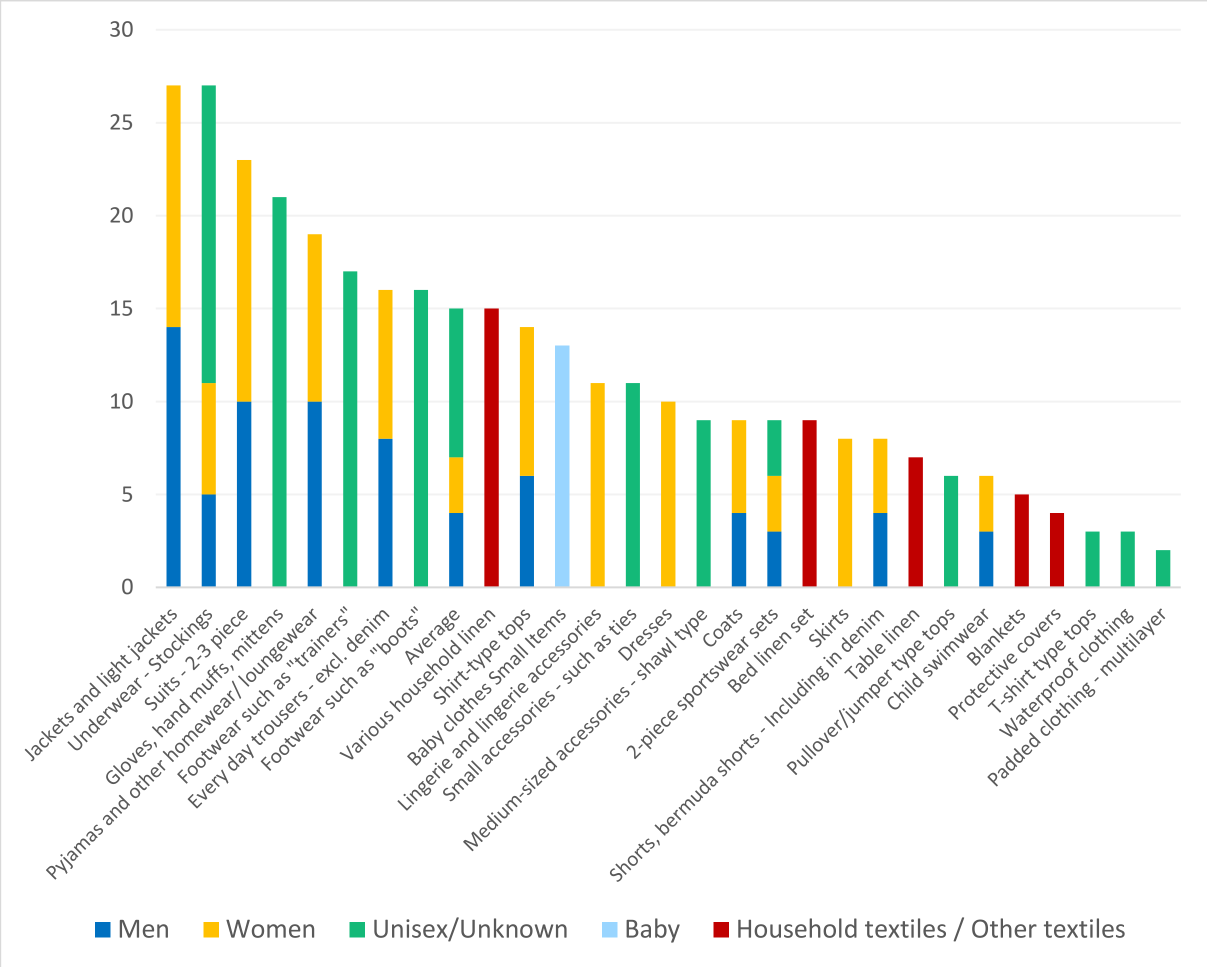

Figure 14 Correspondence between *Tolltariffen* codes and Re_fashion categories

We then followed the below steps for calculation of the EPR fees:

i. The purchaser price of imported items was estimated as:

Purchaser Price (NOK) = Import Value (NOK) × (1+TTM+TLS)

where, TTM (Trade and Transport Margins) and TLS (Taxes Less Subsidies) are assumed to account for approximately 50% of the basic import price. Eco-fees were then added on top of these prices. The assumption here is that the import value serves as an approximation for household expenditures on textiles. To better reflect the final price paid by consumers, we added the TTM and TLS to the import values based on our own calculation using data obtained from Norway's SUT for the year 2019 (SSB, 2021). A limitation of this approach is that it may not fully capture domestic markups or additional costs within the supply chain, which could cause slight discrepancies between the estimated purchaser price and actual market prices.

ii. For applying French EPR fees, when number of items was not available, we used the average weight per item category obtained from picking analysis (Syversen et al., 2023) as provided in Table 18.

Table 18 Product category by estimated average weight (kg)

Produkt Kategorier	Product Category	Average Weight (kg)
Klær og tilbehør tekstil	Clothing and Textile Accessories	0.218
Barn og baby	Children and Baby	0.201
Overdeler A (tynn)	Tops A (thin)	0.223
Overdeler B (tykk)	Tops B (thick)	0.514
Sport/fritid/overall/arbeidstøy	Sports/Leisure/Overalls/Workwear	0.401
Underdeler	Bottoms	0.476
Yttertøy	Outerwear	1.068
Klær annet	Other Clothing	0.071
Sko (vekt pr. sko)	Shoes (weight per shoe)	0.549
Sko (vekt pr. sko)	Shoes	0.549
Tekstil ikke-klær	Non-Clothing Textiles	0.388
Husholdning	Household	0.421
Ikke-klær annet	Other Non-Clothing	0.332
Gjennomsnitt	Average	0.284

iii. The new price of imported items, which includes the purchaser price and eco-fees, is calculated as:

New Price (NOK)=Purchaser Price (NOK)+Eco-Fees (NOK)

Here, eco-fees are applied based on the French and Dutch EPR fees rates, which include eco-modulation adjustments according to the scenarios, which differentiate fees based on material types. For the Dutch EPR fees, a uniform flat rate per kilogram of textile products is applied to all items, requiring no further adjustments.

iv. The new quantity of textiles purchased reflects the reduction in demand caused by higher prices due to eco-fees. This is calculated using own-price elasticity of demand as:

New Quantity = Old Quantity × (1 + Price Change (%) × Elasticity)

where, Old Quantity is the current import volume to approximate the quantity of textiles purchased by consumers, Price Change (%) is the percentage increase in prices due to eco-fees and Elasticity is -0.83 (own-price elasticity for clothing and footwear in Norway).

v. We then calculated the oversupply of textiles as the difference between the Old Quantity and New Quantity, which represents the volume of unsold items resulting from reduced consumer demand. The oversupply occurs because EPR fees are applied to the entire volume of textiles placed on the market, regardless of whether they are sold or remain unsold. When prices increase due to eco-fees, consumers purchase fewer items, leaving a portion of the textiles unsold. These unsold items remain within the market supply but still incur EPR fees, highlighting inefficiencies in aligning production with reduced consumer demand. As importers would still pay EPR fees on these unsold items, and the revenue would be reinvested into circular economy initiatives such as collection, sorting, preparation for reuse, recycling, communication, and research and development (R&D).

vi. The decreased demand for textiles was applied to estimate the percentage reduction in consumption as:

$$\textbf{Decreased Quantity (\%)} = 100 \times (1 - \text{Old Quantity}/\text{New Quantity})$$

vii. The increased household expenditure on textiles, despite the reduction in purchased volume, was calculated as:

$$\text{New Household Expenditure (NOK)} = \text{New Price (NOK)} \times \text{New Quantity}$$

The additional expenditures on textiles were assumed to be reallocated from recreational services.

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