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Foreword

The project "Textile flows in Finland – Update on the survey of 2013" was financed by the Ministry of the Environment Finland (MoE), together with Finnish Textile and Fashion (STJM), Muoti- ja urheilukauppa ry, Suomen Kiertovoima ry (KIVO) and the Finnish Environment Institute (SYKE)[1]. The project was carried out by SYKE in co-operation with Turku University of Applied Sciences (Turku UAS) and the South-West Finland Waste Management company (LSJH). The project group consisted of Helena Dahlbo (coordinator, SYKE), Aija Rautiainen (SYKE), Hannu Savolainen (SYKE), Pauliina Oksanen (Turku UAS), Piia Nurmi (Turku UAS, from 1 Jan. 2021), Henna Knuutila (Turku UAS, until 15 Dec. 2020), Oskari Pokela (LSJH) and Sini Ilmonen LSJH). The steering group consisted of Sarianne Tikkanen (MoE), Sirje Sten (MoE), Satumaija Mäki (STJM), Veli-Matti Kankaanpää (Muoti- ja urheilukauppa ry), Heli Haapea (KIVO, until 19 Apr. 2021), Iira Niemeläinen (KIVO, from 20 Apr.2021) and Timo Hämäläinen (KIVO).

The survey followed the methodology developed in several previous Nordic studies, the most recent of them being "Mapping of textile flows in Denmark" by Watson et al. (2018). In the beginning of the project, we were given valuable help and information on the details of the methodology and data sources by David Watson from PlanMiljö, Denmark. The data sources used for the survey included various statistics, with which guidance was received from Juha Espo from Statistics Finland. In addition to statistics, data and information was gathered from a variety of operators within the textile value chain by questionnaires and interviews.

The authors wish to thank everyone who contributed by helping us to obtain the data required for this survey or by other means.

Executive summary

Introduction

In Europe and globally, the consumption of textiles has been growing. The amount of textile waste is increasing along with environmental problems. Since the high environmental impacts connected to the textile systems have been recognized, textiles are raised high on environmental policy agendas.

For developing the textile systems and launching business models for textiles' circularity, reliable up-to-date data on the volumes and management of textile flows is required. The previous survey on the Finnish textile flows was carried out in 2013 and was based on data from 2012. The Finnish textile field has changed, and in addition to presumably grown volumes of textiles consumption and waste generation, new operators have entered the field.

The textile field needs to be prepared for the requirement of implementing the separate collection textile waste beginning 2023 given in the currently revised Finnish Waste Act. Hence, knowledge is needed on the consumption of textiles and the discarded volumes that can be expected to enter the textile waste collection while it's in full operation.

The objective of this mapping of new and used (i.e. end-of-life) textiles is to generate information needed for developing the separate collection, reuse and recycling of textiles and textile wastes in Finland to respond to the requirements from legislation, strategies and plans. The information will be useful also in developing the overall sustainability of textile systems.

Methods

The mapping covers the supply and use of textiles and the flows of end-of-life textiles through various collection routes to reuse, recycling or incineration in Finland, including imports and exports. The methodology used for the mapping follows the one used in other recent surveys on textile flows in Nordic and Baltic countries for clothing and household textiles.

However, for Finland, the product list is expanded. We cover all the products in the Classification of Products by Activity (CPA 2008) categories 13 textiles and 14 wearing apparel, excluding product groups 13900 Carpets and rugs and 133 Textile finishing services. The former is excluded because of high share of the mass is of other material than textiles and the latter because this product group solely includes services with little or no mass effect.

The data gathered for mapping the flows of textiles is primarily from 2019. However, in some cases, even older data was used.

The flows of textile materials and products are reported in mass units (kilograms and tonnes) rather than their economic value (euros) whenever possible.

Results

The overall textile flows in 2019 (Figure 2) show that the Finnish economy is highly linked with foreign trade. Two thirds of the net supply of new textile products and garments are imported. 25% of the net supply is exported. Households are responsible for a little over 50% of domestic use. Foreign trade has its role also in end-of-life textiles. The volume of exported used clothes is over 3-fold compared to reuse by households (C2C exchange excluded) (Figure 3). 60% of all end-of-life textiles are recovered as energy through incineration.

Import covers 67% of the net supply of new textiles (import + domestic supply - textile use in the Finnish textile industry) and the rest of the supply is domestic products. The total net supply is 174 457 tonnes, which is allocated to export (25%) and domestic use (75%)(Figure 2).

62 342 tonnes of new clothes and household and similar textiles were supplied to Finland in 2019. Most of the supply was new clothes (79%) and a smaller percentage was household textiles (21%). The total consumption of new textile products, both public and households, is 11.3 kg/capita.

Household consumption dominates the use of clothes and household textiles and similar textiles. Households' share of the consumption is approximately 51 906 tonnes (83%) (Figure 4) of the overall supply. This shows that within one year, an average Finn purchased 7.4 kg of clothes and 2 kg of household textiles, equaling to 9.4 kg of new textiles for private use.

The rest of the use (10 436 tonnes equaling to 17%) belongs to the public sector and enterprises. The largest consumers in this sector are human health care and social work activities, laundries, defense forces, hotels and restaurants and cleaning services.

About 44% of the textiles consumed by households were separately collected as end-of-life textiles in 2019; most of

the rest went to mixed MSW. The textiles separately collected by private collectors, charity organizations and municipal waste companies add up to almost 23 000 tonnes in 2019. A total of 213 tonnes of post-consumer textiles were collected in Finland by municipal waste management companies in 2019.

All in all, 9 990 tonnes of used textiles from households were being reused in 2019, which is around 1.8 kg per capita. The share includes both online hubs, flea markets and charity organizations as well as textiles that are exchanged via friends and family. Approximately over 40 000 tonnes of textiles were discarded from households in mixed MSW.

The total amount of end-of-life textiles from laundry companies in 2019 was about 1 330 tonnes. 265 tonnes of end-of-life textiles were generated by other public sectors and enterprises than laundries in 2019. The majority (1 132 tonnes, 71%) of the end-of-life textiles that originated from the public sector and enterprises went to energy recovery by incineration. The rest was recycled as material recovery (426 tonnes, 26.7%), reused (29 tonnes, 1.8%) or exported (6 tonnes, 0.4%).

Discussion

The previous mapping of textile flows in Finland was done for the year 2012 (Dahlbo et al. 2015; 2017). However, the total volumes of textile flows estimated in this study are not comparable to the 2012 study as such, since the total volumes for 2019 include all textiles, also semi-manufactured products, which were not included in the 2012 flows. For this reason, only the part of the flows that describe the supply and use of clothing and home textiles in households and public sector and enterprises, are comparable to the 2012 study.

The consumption of garments and home textiles has remained quite constant between these two mappings, being 11 kg/capita in 2012 and 11.3 kg/capita in 2019., although in view of global trends it was assumed that the consumption would have grown.

The data gathered on consumer to consumer (C2C) exchanges of reusable clothes does not provide a full picture of used textile flows that would include all kinds of C2C exchanges in Finland. No records were available on e.g. exchanges between friends, within family or non-economic exchanges between strangers via swap markets and online swapping platforms. Further studies of C2C flows are necessary in order to get a better picture of the volumes and of the prevalence of C2C exchange in Finland.

The collected volumes of end-of-life textiles have grown from 2012 to 2019. In 2019, municipal waste management companies started a separate collection of end-of-life textiles in order to prepare for the separate collection requirement taking place in 2023. Products that should not be included in the collection have been found in the separately collected textiles, which emphasizes the need for continuous consumer education on the sorting criteria to ensure efficient operation of the recycling chain.

Charity organizations also reported increase in collected volumes and the amounts of donations each year. However, the quality of donated clothes is getting worse which means higher amounts and costs of wastes for the businesses.

From 2012 to 2019, the recovery of textiles as material has remained on quite a low level and resources for material identification and separations in the bigger scene have been lacking. However, since 2019 and within the following few years significant improvement is foreseen along with the separate collection of end-of-life textiles by municipal waste management companies. This collection will most probably also decrease the flow of textile waste into the collections of charity organizations.

Improvements in data quality and coverage is needed

The data acquisition behind this report shows several data gaps concerning textile flows. Especially data on end-of-life textile flows is severely gapped and incomplete. A more detailed assessment and accounting of intermediate use of textiles would need separate data collection in Statistics Finland and several surveys to enterprises.

Needs for further research and development

In order to be able to regularly generate comparable data on end-of-life textile flows, a reporting system with guidance on how to measure and report the textile volumes should be generated for the value chain operators. Additionally, a system for following and reporting the exchanges through online and offline hubs could be included in the reporting system. In addition to the textile volumes, the development of material recovery solutions requires data on the textile waste quality, i.e., the fiber types included in the material.

Contents

1. Introduction

1.1 Background

The environmental impacts of textiles production and consumption are widespread and substantial (Niinimäki et al. 2020, Manshoven et al. 2019). Manshoven et al. (2019) have shown that clothing, footwear and household textiles is the fourth highest category consuming water and primary raw materials in the EU, after food, housing and transport. It also causes the second highest pressure on land use (after food), and a considerable amount of chemical and water pollution. The same study showed that the production of clothing, footwear and household textiles for Europeans caused an estimated 654 kg of CO_2 equivalent emissions per person, making textiles the fifth largest source of CO_2 emissions linked to private consumption. About three quarters of these emissions took place outside of the EU.

The knowledge of the high environmental impacts connected to textile systems has resulted in textiles being raised high on environment policy agendas. In 2020, in the New Circular Economy Action Plan, the European Commission identified textiles as one of the priority product categories for a sustainable product policy legislative initiative (European Commission 2020). The European Commission has also prepared a proposal for a comprehensive EU strategy for textiles-based industry and stakeholder input to respond to the challenges caused by textile production and consumption. The strategy would boost the EU market for sustainable and circular textiles, including the market for textile reuse, address fast fashion and drive new business models. (European Commission 2021). Information on the volumes and flows of new and used textiles in Finland is needed when implementing the EU strategy on textiles and prioritizing flows and actions for the implementation.

In Europe and globally, the consumption of textiles has been growing. The fast fashion trend has resulted in shortened use time of garments, lower quality of textiles and increasing volumes of textile waste (Niinimäki et al. 2020). The recycling rate of textile waste is very low both in Europe and globally (Ellen MacArthur Foundation 2017). The negative impacts of textile production and consumption can be reduced by introducing and adopting circular business models focusing on textile design, sharing, recycling and reuse of textiles. In Finland there has been and is active research and development on the collection, sorting, separating and recycling of textiles and the whole textile system. The Telaketju project (Telaketju 2021) and its co-operation network brought together operators from along the whole textile value chain to co-develop functioning solutions for various steps in the chain (Heikkilä et al. 2020). The ongoing Finix project (Sustainable textile systems: Co-creating resource-wise business for Finland in global textile networks) produces new scientific research on sustainability aspects of textile systems and helps in co-creating a resource-wise textile business in Finland in ways that promote global sustainable development (Aalto 2021).

For developing the textile systems and launching business models for textiles' circularity, reliable up-to-date data on the volumes and management of textile flows is required. The previous survey on the Finnish textile flows was carried out in 2013 and was based on data from 2012 (Dahlbo et al. 2015, 2017). Since this survey, the Finnish end-of-life textile field has changed and new operators have entered the field. For example, many clothes shops have started to take back both reusable and recyclable textiles from consumers. Online marketplaces for used textiles have increased. Operated by South-West Finland Waste Management (LSJH) a pilot plant for sorting, separating, and opening fibers collected from consumers as textile waste will start operating in 2021. Some regional waste operators have been collecting textile waste from consumers already during 2020 to provide material for the pilot plant. From the pilot phase to the near commercial scale, new technologies have been developed to convert cotton-rich textile waste into new sustainable textile fibers. All this prepares the textile field to increase textiles circularity. The textile field needs to be prepared for the requirement of implementing the separate collection of textile waste beginning in 2023 given in the currently revised Finnish Waste Act. Hence, knowledge on the consumption of textiles and the end-of-life volumes that can be expected to

enter the textile waste collection while it's in full operation, is needed. This mapping will provide basic information for the development of the nationwide separate collection, reuse and recycling of used textiles and for the development of the overall sustainability of textile systems.

1.2 Objectives

The general objective of the mapping of new and used textiles is to generate information needed for developing the separate collection, reuse and recycling of textiles and textile wastes in Finland to respond to the requirements from legislation, strategies and plans.

The project has the following specific objectives:

- To map all textile flows on as a detailed level as possible including semi-manufactured products such as fabrics.

- To provide an overview of the yearly supply and use of all textile and wearing apparel products.

- To provide an overview of the yearly supply of new textile products (clothes and household textiles) to households, the public sector and private enterprises.

- To calculate and estimate the yearly flows of used (or unsold) textile products from households, the public sector and private enterprises via various collection routes and evaluate percentages that are reused, recycled and incinerated in Finland.

2. Methodology and approach

2.1 General principles

2.1.1 Boundaries of the study: scope, data and year

Scope of the study

The mapping covers the supply and use of textiles and the flows of end-of-life textiles through various collection routes to reuse, material recovery or energy recovery in Finland, including imports and exports. The methodology used for the mapping follows the one used in other recent surveys on textile flows in Nordic and Baltic countries for clothing and household textiles. However, for Finland, the product list is expanded. We cover all the products in Classification of Products by Activity (CPA 2008) categories 13 (textiles) and 14 (wearing apparel), excluding product groups 13900 Carpets and rugs and 133 Textile finishing services. The former is excluded because of high share of the mass is of other material than textiles and the latter because this product group includes solely services with little or no effect on mass.

We utilize the hierarchy of CPA classification: the most aggregated level is the total mass of all product groups, the second includes six product groups (131 Textile yarn and thread, 132 Woven textiles, 139 Other textiles, 141 Wearing apparel, except fur apparel, 142 Articles of fur, 143 Knitted and crocheted apparel), the third 20 product groups and the most detailed level 110 product groups (a complete list of product groups is in Appendix 1).

Data year

At the time of carrying out this project, the latest data available on imports, exports and domestic production covered the year 2019. Therefore, also the data gathered for mapping the flows of end-of-life textiles e.g., through separate textile collections is from 2019. However, if the most recent data originated from 2018, as described in the following sections, the validity of this data for year 2019 was estimated and, when relevant, applied for 2019. Additionally, we have used background data on textile use shares (intermediate use, household consumption) from the years 2017 and 2008.

Units

The flows of textile materials and products are reported in mass units (kilograms and tonnes) rather than in economic value (euros) whenever possible. Some of the data sources used do not include mass data, so the economic value data had to be converted into kilograms. Expert estimations were used to identify the conversion method best suitable for each case. These methods are described in more detail in the following sections.

2.1.2 A short note on definitions

In the following, the key terms applied in the project are defined for the purposes of this report.

Consumer to consumer exchange or C2C exchange is the business model that facilitates commerce between private individuals without a middleman.

Discarded textiles or textile wastes are end-of-life textiles from households and industries that cannot be utilized as clothing or as fabric in a new product (but can be recovered as material or fibers in new products).

End-of-life textiles are textiles that have become redundant for the owner. They include both textile products, i.e., used and wearable textiles as well as textile waste from households and industries. Textile products can still fill their original intended use. (Telaketju 2021). In this report, used textiles donated to charities and other collection organizations are considered end-of-life textiles, which are sorted into reusable textiles, recyclable textile waste or waste to be recovered as energy by the receiver or another operator.

Industry/industries is the term used in the statistical classification (e.g., national accounts). Economic units (e.g., enterprises) are divided into industry classes based on their main economic activity.

Mixed municipal solid waste, mixed MSW – mixed waste generated in households and waste comparable to household waste generated in production, especially in the service industries (Statistics Finland 2021a).

Online/offline hubs – consumer-to-consumer exchanges that happen via online sites such as Tori.fi, Huuto.net and through social media platforms (e.g., Facebook groups). Offline hubs mean exchanges that can happen via physical flea markets and swap markets.

Public sector and enterprises, operators from public administration and private businesses that are of interest in terms of consumption of textiles, such as the Police, the Defense Forces, the Rescue Services, Customs, laundries, hospitals, hotels and restaurants. The public sector includes industry classes in Nace classification code 84.

Recycling or material recovery is an activity where waste is reprocessed into a product or raw material for its original or another purpose.

Reuse means utilizing a used product or parts of it for the same purpose they were originally intended, i.e., as clothing or as fabric in a new product.

Separate collection means collection of end-of-life textiles so that they are kept separate from other types of wastes to enable their reuse, recycling or other recovery.

Supply, use and consumption are used in this report in the spirit of national accounts. Supply includes the import and domestic production of textile products. Use includes domestic use and export. Consumption equals the final use in Finland, for example household use of garments.

Wearing apparel, clothing, garments are in this report used as synonyms for clothes, as a distinction to other textile products, such as household textiles.

2.2 Estimation of the supply and use of textiles

2.2.1 Supply

In this study, the total supply of textiles consisted of CPA product categories 13 and 14: garments, home textiles and similar textiles used in the public sector and enterprises – as in Watson et al. (2018) – and industrial textiles. Since we used various data sources, different product categories and classifications (CN, Prodcom, COICOP) were linked with the CPA classification with correspondence tables. The supply includes both imports and domestic production.

In the Finnish Customs' national import and export Uljas Statistical Database (Finnish Customs 2021) the products are classified with an 8-digit CN code (Combined Nomenclature, a European classification of goods used for foreign trade statistics). It includes the monetary values and amounts of products, which are usually reported as mass units (kilograms). In some cases, amounts might be pairs or square meters

which were converted into mass units. All CN products linked with CPA classes 13 and 14 and 381 textile waste were included.

There is no monetary data for international online purchases of clothing and home textiles available as open access. However, we were able to get estimates of the market value shares of clothing and home textiles that households bought in 2019 (Kankaanpää 2021). From the data, market shares of domestically bought clothes and home textiles were compared to the amounts that were bought online in the EU and other countries.

For our calculations, the shares of internationally bought clothes were 10.5% and home textiles 0.7% of the total market share of these groups. On the grounds of this information, we were able to estimate that our

calculations of the household supply cover 88.8% of the total supply of clothes and home textiles and then adding the international online shares adds it up to 100%.

The domestic production is reported in 8-digit Prodcom codes (the classification of goods used for statistics on industrial production in the EU), which was mapped with CPA and CN codes. The data on the domestic production was gathered from Industrial Output statistics from the Official Statistics of Finland database (Official Statistics of Finland 2021a). The Prodcom data includes monetary values and amount information (usually mass units, but other units as well). Missing mass information were estimated from other amount units or monetary values based on the export data. Kg/€-coefficients were used when available, but in some specific cases other coefficients (e.g., kg/pair) were used. This conversion increases the uncertainty in the volumes of the domestic production. In addition, uncertainty in the domestic production data is caused by the small operators not being included in the statistics. To overcome this, the monetary values of domestic manufacture of textiles and wearing apparel were scaled up based on the comparison of Industrial Output statistics and input-output tables from the year 2017, which was the most recent year available during the analysis phase.

In the detailed analysis we concentrated on a certain part of textiles and garments. Mapping the flows of new textile products (considered clothing, home textiles and similar textiles used in the public sector and enterprises) and their final destinations was performed following the methodology of Watson et al. (2018) which is in line with Tojo et al. (2012) and Carlsson et al. (2011), which have also been used in the previous textile flow mapping in Finland in 2012 by Dahlbo et al. (2015; 2017).

These product groups follow the CN 2-digit codes 61, 62 and 63 (See Appendix 2 for more details) (Finnish Customs 2021, Uljas Statistical Database). CN codes 6309 and 6310 were also used for imports and exports on end-of-life textiles. These codes are described to be worn clothes, accessories and home textiles and miscellaneous types of used textiles such as rags, scrap twine, cordage and rope. These codes were looked at separately, since obviously there are no corresponding codes for used textiles in domestic production data. Used textile imports is one flow to the used textile supply. Exports of these codes are the only reported exported used textile flows.

In addition, some final textile products were excluded due to the fact that a major part of the material used in the products are not textiles. Product types that were excluded are heavy products such as shoes, bags, carpets, duvets, pillows and upholstery on furniture, in which most of the mass originates from non-textile material. Including these could bias the overall results. In line with Watson et al. (2018), we also did not consider leather products as final textile products.

2.2.2 Use

The use of textiles and garments can be divided into domestic use and export. Domestic use includes intermediate use of industries and final use (household consumption, public consumption and investments). Domestic final use can be called domestic consumption, too.

In an accounting framework, supply equals use. After estimating the total supply and removing the mass of exports, we could estimate the domestic use of textiles following the identity:

Domestic use = Supply – Export.

The export data of textile products were obtained from Customs' foreign trade data, like import data. The missing amount data of exports were estimated based on domestic production data.

Domestic use was divided between final use categories and intermediate use in several steps. First, the monetary value of household consumption of textiles and garments were estimated by Household consumption expenditure reported in the COICOP classification (Classification of Individual Consumption According to Purpose). The consumption expenditure was converted from purchasers' prices to basic prices (excluding the margins of trade and logis-

tics) using the average margin share of CPA product groups 13–15 from the years 2015–2017. The basic price consumption expenditure in the COICOP classification was mapped to the CPA classification of 20 product groups. Hereafter, the household consumption was balanced to ensure that no CPA classes of intermediate use were negative (using the equation *domestic use – household consumption = intermediate use of industries*). The rest of the domestic final use were either zero or on very low level of 0–1% of the total use textile products (public consumption or changes in inventories). These final use categories were omitted.

Secondly, household consumption expenditure was converted into mass units, using shares of imports and domestic production, CPA productwise kg/euro-coefficients. These figures were compared to detailed level euro and mass data of CN products (codes 61, 62 and 63), which were divided between households and intermediate use (including all industries, i.e., public sector and different enterprises) using 2008 shares at CPA 20 product group level to ensure, once again, that intermediate use of products is at a feasible level (and at least non-negative). In CN code group

6210 (Garments made up of fabrics), some products were allocated 100% to intermediate use.

Thirdly, the intermediate use was split between manufacture of textiles and wearing apparel and other industries. This was based on the monetary input-output tables from the years 2008 (20 product group level of CPA) and 2017 (3-digit CPA level, six product groups). The shares of imports and domestic products were estimated for both groups of enterprises and monetary values were converted into mass units using product-wise coefficients separately for both imports and domestic production. In material flow accounting, it is of high importance to estimate the net production of domestic manufacturing to avoid double calculation.

Finally, the textile product use of household consumption, manufacture of textile and wearing apparel and other industries were aggregated at total mass level for each category to compare the shares of total use. This checking revealed that shares were close to that of 2017, since no detailed information of use in 2019 was available.

2.2.3 Mass balance

Mass balance is an application of conservation of mass. In an ideal situation all textile inputs (supply of new and used textiles) and outputs (material recovery, energy recovery, exports of new and used textiles and losses) are accounted and equal. Flows that circulate within the system (textiles collected or passed on and then reused in Finland) do not leave the system and therefore should not be calculated as inputs or outputs of the system (Watson et al. 2018). Mass balance between textile inputs and outputs is challenging to achieve. One reason for this is that estimates of the different textile flows always include uncertainties and biases. (These are described in more detail in chapter 2.4). There are also minor flows of textiles that come and go to the system through other routes that are difficult to estimate. These routes include e.g., textile exchanges through tourism and from black markets. Finnish households import textiles bought in other countries e.g., during holidays and shopping trips. Vice versa tourists in Finland buy textiles and export them out of the system. In this regard, if these two flows were equal, the mass balance

would in equilibrium. When textiles are bought from illegal sources, they are not accounted in statistics and therefore are unknown to the system. A study by Oxford Economics (2018) has estimated that 10.7% of clothing consumption in Finland would originate from illicit trade, which is less than in other Nordic countries (average 11.8%).

There are additional challenges when trying to provide a mass balance for the one-year scope in textile flows. If consumption of new textiles and the number of textiles stored would remain constant, the mass balance would be in equilibrium. However, this is not usually the case and therefore the mass balance for a single year won't hold because the amount of discarded textiles changes due the accumulation in storages in one year and increasing disposal in other years (Watson et al. 2018).

2.3 Estimation of the end-of-life textile flows

End-of-life textiles in the Finnish economy include several flows for which different data sources were used. The data-gathering method used in Watson et al. (2018) and Tojo et al. (2012) was applied for collecting data on the end-of-life textile flows from households, the public sector and enterprises. However, the method was adjusted to Finland. Primary data was obtained from questionnaires on the flows of separately collected end-of-life textiles and from the most recent data from municipal waste management companies on textile waste in mixed MSW. Secondary data was used when estimating the share of end-of-life textiles from households that are exchanged with friends and families or via online and offline hubs. End-of-life textiles from households can have several destinations. Foreign trade statistics include information of used garments and textile products and textile waste exported from Finland. The methods used for estimating the flows and quantity of end-of-life textiles from households are described below.

2.3.1 Industries

Flows of separate textile wastes from industries were obtained from Waste Statistics (Statistics Finland 2021b) from the year 2018. The waste flows for 2019 were estimated based on the economic output of 2019 and waste/output coefficients from 2018. Textile waste flows were reported separately for textile and wearing apparel manufacturing and other industries. Data for the service sector was excluded due to detailed survey data obtained during the study (see chapter 2.3.6). For the textile waste generated in industries other than service sector companies, the treatment shares based on the data from 2018 were used: material recovery (92%) and energy recovery (8%). The estimation of textile waste in mixed MSW from industries is presented in chapter 2.3.5.

2.3.2 Estimating consumer to consumer exchanges

The most informal flow includes direct consumer to consumer (C2C) exchanges between friends and family. There is no recorded data in Finland for these exchanges because of their non-economic nature. These flows could be estimated by carrying out surveys for households, but no such survey was performed in this project. Due to lack of Finnish data, we estimated the volumes of C2C exchanges via friends and family based on Watson et al. (2018).

The more formal flows of end-of-life textiles from households consist of exchanges via online and offline hubs because they take place in various platforms where economic value is often present. These online and offline hubs include, for example, social media, internet business platforms and flea markets. We combined two types of data for estimating these quantities as comprehensively as possible. First, data was gathered through surveys from charities that collect, sort, resell or/and export used textiles (See section 2.3.3 for details on charities). Secondly, we used estimates from Eskelinen et al. (2018) for textile reuse in different Finnish platforms and hubs. To avoid data overlapping we selected the platforms and hubs not included in the receivers of our questionnaires.

We used the estimates of Eskelinen et al. (2018) for C2C exchanges on popular Finnish online platforms such as huuto.net, tori.fi, nettimarkkina.com and one Facebook group called "Haaga kierrättää". Additionally, estimates for local recycling centers and flea markets were used.

In Eskelinen et al. (2018), clothes and shoes were combined. For this reason, we had to make estimates based on their study that about 70% were clothes and 30% shoes. To derive figures representing solely textiles, we estimated a 70% share for clothes the rest being shoes. This was based on a finding of Eskelinen et al. (2018) concerning peer-to-peer online platform exchanges, where clothes represented 70% of the mass of the combined category clothes and shoes.

The four regional estimates from Eskelinen et al. (2018) on C2C exchanges (kg/person/year) via online platforms, hubs and local flea markets were scaled up to regions with similar population densities multiplying the kg/person/year estimate with the population of these regions. These were summed up to generate national estimates for Finland in 2019 (Official Statistics of Finland 2021b).

2.3.3 Mapping the separate collection of end-of-life textiles (charities, private collectors, brand stores)

There are no national statistics of the end-of-life textiles originating from private households or institutions. Therefore, the quantitative data on end-of-life textiles was collected through questionnaires sent out to several operators including charities, brand store trade associations, brand stores, laundries, and the public sector organizations. The work wear company Image Wear Oy was also interviewed concerning the textile flows of the Police, the Defense Forces, the Rescue Service and Customs from the public sector. Restaurant and hotel chains were interviewed, as well.

Based on the data from 2012 on textile flows in Finland (Dahlbo et al. 2015), the majority of separately collected end-of-life textiles are collected by charity organizations. The six largest charity organizations were asked about the volumes and destinations of the collected textiles (Appendix 4). These six biggest charities are U-landshjälp från Folk till Folk i Finland sr (UFF), the Salvation Army (Pelastusarmeija), Finnish Red Cross (SPR, Suomen Punainen Risti), SPR Kontti (recycling department store chain that works under SPR), Fida and the Metropolitan Area Recycling Center. Since SPR Kontti operates in a different way compared to SPR, it is handled separately in this re-

port. The textile collection of the largest charity UFF covers almost the entire area of Finland, with service coverage of approximately 5.4 million people. The figures for the Salvation Army were estimated based on economic activity data.

Most of the textiles that these charities receive and collect are from households. Under 1% comes from small companies, clothing stores, brand stores, hospitals and others. The collection is carried out with drop-off boxes, by receiving donations in local stores or by using both options (depending on the charity, see Table 1).

The biggest charity organization UFF together with the Metropolitan Area Recycling Center weigh the textiles collected or received, whilst SPR and Fida uses both evaluation and weighing. Fida weighs 80% of all the incoming textiles, and the rest is evaluated. SPR Kontti and Salvation army use only evaluation and do not weigh the textiles. The weight of shoes and other products out of our scope was extracted from the total textile weights by each charity organization's own estimation of the proportion, thus adding to the uncertainty of the data through evaluation errors.

Table 1. Collection points for end-of-life textiles and method for generating the data on textile volumes used by the different organizations carrying out separate collection of end-of-life textiles.

Organization	Collection points for end-of-life textiles			Method for generating the data on textile volumes	
	In the stores or logistic centers	External drop-off stations	Door to door collection	Weighing	Estimation
UFF	YES	YES	NO	YES	NO
Salvation Army	YES	YES	YES	NO	YES
SPR	YES	NO	NO	YES	YES
SPR Kontti	YES	NO	NO	NO	YES
Fida	YES	YES	YES	YES	YES
Metropolitan Area Recycling Center	YES	NO	YES	YES	NO

The volumes of the textiles discarded by brand stores were obtained from an inquiry and estimation made by the brand store trade association Muoti- ja urheilukauppa ry. The survey covered about 15% of the Finnish market, and the survey data on the volumes was scaled to cover the whole Finnish market area. Muoti- ja urheilukauppa ry evaluated that its members cover about 70% of the overall clothing and home textile market in Finland (Kankaanpää 2021).

2.3.4 Mapping the separate collection of textile waste

In 2019, end-of-life textiles from households were separately collected within the area of two waste management companies (Lounais-Suomen jätehuolto (LSJH) and Rauma regional waste management facility). The companies reported total mass volumes and treatment shares. Since post-consumer collection of separate textile waste in not yet compulsory, these waste management companies represent the piloting phase of collecting.

2.3.5 Estimating the textile waste in mixed municipal solid waste

Estimates of the share of textile waste within mixed municipal solid waste from households and the service sector (trade, services etc.) were based on statistical data on the volume of MSW and national average of the composition of mixed MSW. During 2015–2019, six sorting studies have been carried out to find out the composition of mixed household waste. According to these, approx. 6.3% of mixed waste collected from households is textiles, shoes, and bags. When shoes and bags were removed from this figure, according to expert estimation, mixed MSW from households in Finland contains on average 5.0% by weight of textiles, that is clothing and other textiles. (Suomen Kiertovoima ry 2020). 71% of the overall volume of mixed MSW generated in Finland in 2019 was estimated to originate from households (Salmenperä et al, 2016). The remaining 29% originated from trade, manufacturing and services and was estimated to have a slightly lower content of textiles, namely ca. 2% (Suomen Kiertovoima ry 2020).

When mixed with e.g., biowaste, textiles easily collect moisture and dirt which increase their weight. Hence the weight of textiles within mixed waste was multiplied with a correcting factor to derive an estimate for the dry weight. The factor was derived from a Swedish study (Fråne et al. 2015) assessing different packaging materials and the amount of moisture they caught when mingled with e.g., biowaste. We estimated that the factor obtained for cardboard mixed in waste containing 20–30% biowaste was closest from the factors available, since no factor was found for textiles. We used the correction coefficient 0.74 for households (28.2% biowaste in mixed MSW) and 0.69 for the service sector (38.2% biowaste in mixed MSW).

2.3.6 Mapping the flows of end-of-life textiles from public sector and enterprises

Laundries were key operators for the evaluation of the volumes of end-of-life textiles from the health care sector (hospitals, health centers, nursing homes) and the hospitality sector (hotels and restaurants). Since there are no statistics kept on used textiles of institutions either, the quantitative data on used textiles by these sectors was collected by questionnaires (Appendix 4) that was sent to the five biggest laundry companies. Puhdaspalvelu Fi Oy is a nationwide textile sales and marketing company founded by laundries. It includes eight textile service companies from all over Finland that offer textile rental services for most of the Finnish hospitals. Concerning the textiles discarded by institutions the questionnaire was targeted for the three largest laundries of Puhdaspalvelu Oy: Puro tekstiilipalvelut Oy (earlier Uudenmaan sairaalapesula Oy), Sakupe Oy and Oulun keskuspesula Oy. The questionnaire was also sent to Lindström Oy and its subsidiary Comforta Oy, both of which cover a large share of the textile rental services provided for the hospitality sector (hotels and restaurants), and work clothes for many companies and institutes.

Most of the laundry companies evaluated the volumes of end-of-life textiles and only one company weighed the textiles, thus adding the uncertainty of the data through evaluation errors. Most of the laundry companies could specify whether the end-of-life textiles went to reuse, material recovery or energy recovery.

Regarding accommodation and food service activities, this report includes only the end-of-life textile volumes that are managed by the textile rental service companies and excludes the textiles that are discarded by restaurants themselves.

Volumes of end-of-life textiles from public sector operators such as Police, Customs and the Rescue Service, were obtained directly from the operators and were confirmed by their contractor supplier Image Wear Oy (a work wear manufacturer). The textile quantities were calculated using a formula in which the number of garments delivered was multiplied by the average weight calculated for each type of clothing in each sector. The volumes of the end-of-life textiles from the Finnish Defense Forces were derived from a report (Uusi-Uitto 2019). This report includes the volumes from 2018, but the Finnish Defense Forces confirmed that the volumes are not much different for 2019.

The textiles discarded by the brand stores in Finland include model items and faulty products from wholesale but exclude removals from the actual clothing stores. These figures were obtained from the brand store statistics (Kankaanpää 2021).

2.4 Uncertainties

Material flow accounting such as this study on textiles relies on the quality and coverage of the used data sources. In the following we consider various aspects of uncertainty in the different stages of the textile flow mapping. These sources of uncertainties need to be kept in mind when utilizing the results. Uncertainties of the used data are illustrated in Figure 1, which presents the structure of the flows of new and end-of-life textiles in the Finnish economy. Data quality describes whether the data on textile flows was in mass units or monetary units converted to mass units, and whether the data was from statistics, surveys or literature. Data coverage describes to what degree the data source (statistics or survey) covers the population or includes only a population sample. Obvious data gaps are considered as well. The colors of the elements of accounting in Figure 1 (different supply, use and treatment classes) describe the quality and the coverage of the data source as follows: green – data is mostly in mass units and comprehensive; yellow – data in euros, notable estimation of figures or data coverage is low; red – figures are based on literature, include several gaps or were estimated in several steps.

Flows of new textiles

The most reliable data is foreign trade statistics on import and export (Uljas Statistical Database by the Finnish Customs). Yet, the Finnish Customs make some statistical corrections over the years. The data is comprehensive and only a couple of CN product groups were missing mass unit data, which was estimated based on domestic production. Imports of the new textiles include online shopping, which was estimated. The amount is ca. 5% of all imports.

The data on domestic production of textiles and garments includes some uncertainties. The monetary values were converted into mass units, which is a source of error. The textile industry's own use of textiles (to prevent double counting) was estimated using input-output data from 2017. In this process, average kg/euro coefficients for products were used, which is possibly a source of a moderate bias. Statistics of industrial output is a sample survey, which omits small companies. Therefore, estimates of the actual volume of domestic production were generated by scaling up the values in statistics. This adds some uncertainty to the data. The elements described above give rise to the uncertainty of figures in total supply of new textiles – even though it is dominated by imports.

Dividing the use of textiles and garments between households and industries (intermediate use) is based on input-output data from 2017 (and in some cases from 2008). Hence monetary values from the national accounts may not fully apply for 2019. The most severe source of uncertainty in this division deals the price assumption. We have used the same basic price kg/euro coefficients for different industries and household consumption.

DOMESTIC TEXTILE AND GARMENT PRODUCTION

OWN USE

IMPORTS (new)

IMPORTS (used)

IMPORTS (textile waste)

SUPPLY (new)

SUPPLY (used)

OTHER INDUSTRIES

HOUSEHOLDS

C2C

END-OF-LIFE TEXTILES

EXPORTS

ENERGY RECOVERY

MATERIAL RECOVERY

REUSE

Data is mostly in mass units and comprehensive.

Data in euros, notable estimation of figures or data coverage is low.

Figures are based on literature, include several gaps or were estimated in several steps.

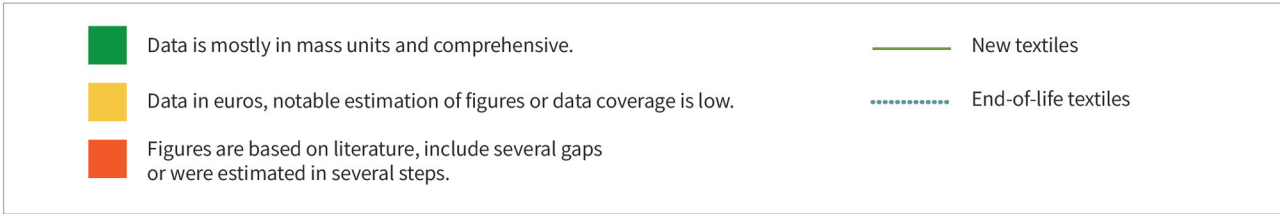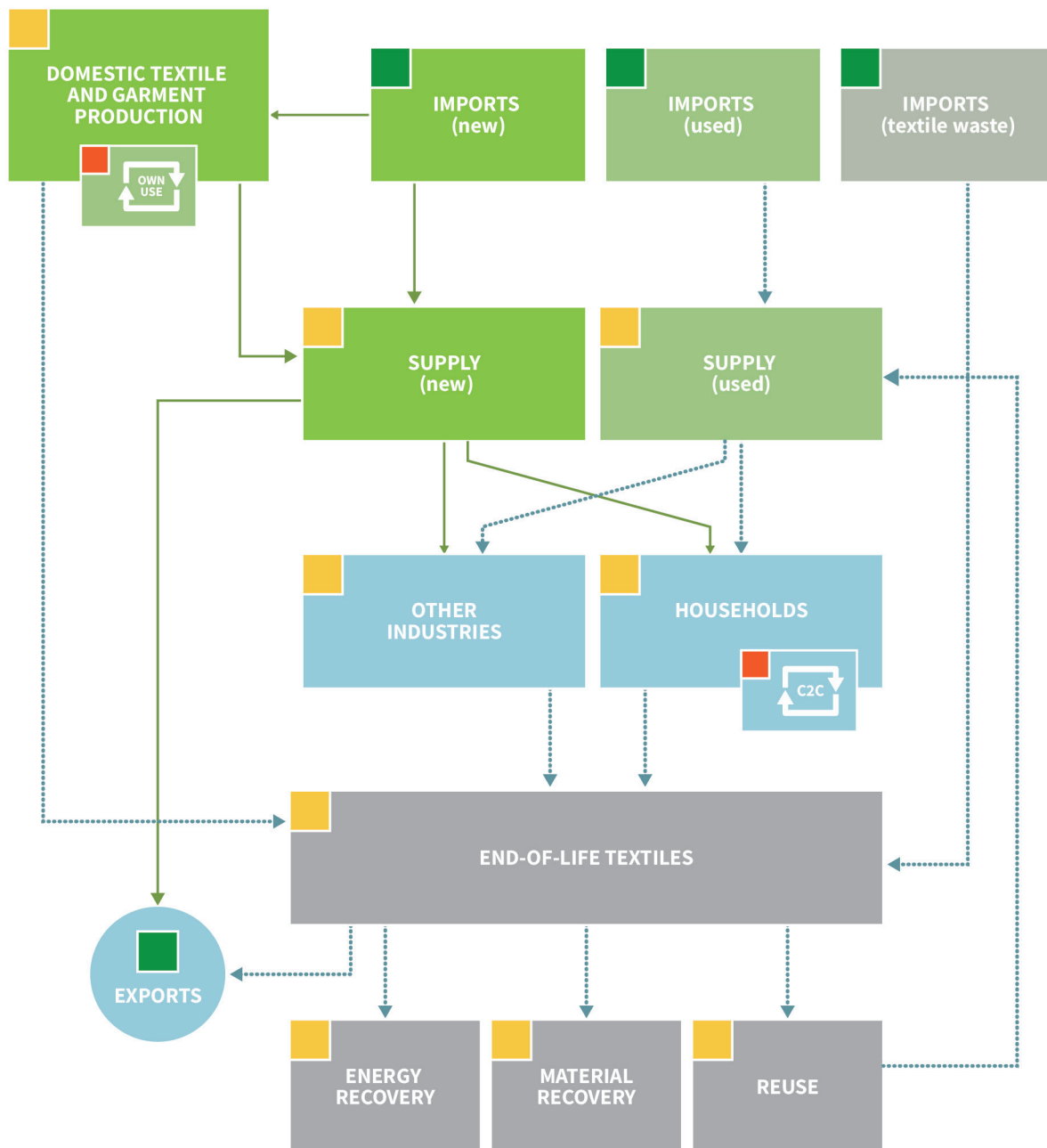New textiles

End-of-life textiles

Figure 1. Uncertainties (quality and coverage) of the data sources used for mapping the flows of new and end-of-life textiles in the Finnish economy.

In general, converting monetary data into physical mass-based volumes involves assumptions of homogeneous prices for each textile item within the product and material categories, even though in reality there is variation. This results in biases in textile use of industries and households.

Flows of used textiles

Supply of used textiles is a combination of import data and surveyed reuse of end-of-life textiles. The latter data increases the uncertainty of these flows. The volume of consumer to consumer (C2C) exchange is based on earlier studies concentrating on Finland and Denmark. These figures contain significant uncertainty.

Textile waste flows from industries are based on Waste Statistics, which doesn't include comprehensive data of waste flows. The data used here represents only a fraction of real separate textile flows (Espo, 2021). The textile waste in mixed MSW (both household and service sector) is estimated with latest composition studies. The reported shares might not hold in every municipality in Finland.

When mapping the flows of used textiles, it is not easy or even possible to keep the chosen product scope. The concept of textiles varies in the used data sources, such as reports and surveys. Collectors of used textiles, for example, include shoes and bags in their reports. Hence, all charities had to extract the weight of products that were out of our scope (shoes, handbags, leather products, toys and rugs with rubber lining) from their data. Additionally, most of the charities that answered our questionnaire estimated the weights of textiles rather than weighed them. Only two organizations weigh the textiles collected or received, one uses both evaluation and weighing and three uses evaluations. All these elements add to the uncertainty of the data.

When mapping the flows of used textiles from charities, it needs to be considered that we were able to include only the biggest organizations (UFF, the Salvation Army, Fida, SPR, SPR Kontti, the Metropolitan Area Recycling Center). One of these biggest charities (the Salvation Army) does not keep a record on the goods they collect and receive anymore, and hence their share was evaluated based on the data from previous years on: the number of donations, turnover and volumes of collected textiles.

The terms concerning end-of-life or discarded textiles are not yet fully established. For example, the meaning and differences of reuse, recycling and material recovery are not clear to all stakeholders and they are not always used consistently. This might have caused misunderstandings concerning the questions in the questionnaire, and false categorization of textile flows to reuse and recycling.

When mapping the flows of end-of-life textiles from laundry companies, only the biggest companies operating in Finland were included. The volumes for the small laundry companies were estimated by the project. Most of the responding companies estimated the weights of end-of-life textile, and only one company weighed the textiles. This adds uncertainty to the data received.

For mapping the flows of used textiles from the public sector (the Police, the Defense Forces, the Rescue Service and Customs) the textile volumes were calculated by multiplying the number of garments discarded by an average weight used for all types clothing within one sector. The average weight was specific for each sector (Police 500 g, the Rescue Service 450 g and Customs 320 g). Each sector uses different types of garments and thus by using only the average weight of garment adds some uncertainty to the volumes given in mass units.

The treatments of textile waste and export volumes are taken from foreign trade statistics, waste statistics, literature or reported in surveys. These figures include uncertainties.

Since we might have data on some textile flows only from the supply or use side, it is impossible to assess the quality of the statistics, reporting or data. Only in a handful of cases we might have two figures concerning the same flow. Additionally, we don't have estimates on lint losses, stolen drop box textiles etc. Our methodology relies strongly on mass balance principle and basic supply-use equations. Therefore, textile flow volumes and routes include uncertainties.

3. Textile flows in Finland in 2019

3.1 Overall supply and use of textiles and flows of end-of-life textiles

Overall textile flows (including all textile product groups) in Finland in 2019 are presented in Figure 2 and Table 2 (figures might differ due to rounding). Import covers 67% of the net supply of new textiles (import + domestic supply less textile own use in Finnish textile industry) and the rest of the supply is domestic products. The total net supply is 174 457 tonnes, which is allocated to export (25%) and domestic use (75%). In Table 2, supply categories represent gross volumes and the textile use of the domestic textile industry is reported separately in the Use section.

Domestic use is divided between intermediate use by industries (47%) and households (53%). Textiles used in other industries (besides domestic textile and garment production) are spread widely in the economy. They are used in manufacturing processes, as raw material in products and as work clothes, for instance. The most important industries in textile use (based

on monetary values) are construction (12% of intermediate use, excl. textile industry), human health activities (7%), business support activities (e.g., cleaning services, 6%), manufacture of furniture and other manufacturing (6%), waste management (6%) and water transport (6%).

Household consumption comprises both new textiles and garments and used textiles. Some 6 699 tonnes of used textiles circulate between households via C2C exchange. Additionally, flows of used clothes from charities and flea markets and abroad (import) end up to households.

Overall, the mass balance of new textiles (supply and use) is in equilibrium, as Table 2 shows. In Table 3, detailed categories of new textiles are presented. The main categories of imports are other textiles and garments. The biggest volumes in domestic production

Table 2. Supply and use of new and used textiles and textile waste flows, tonnes.

	Category	New textiles	End-of-life textiles
Supply	Domestic	63 971	85 773
	Imports	117 530	1 035
	Total	**181 501**	**86 808**
Use	Textile industry	7 044	0
	Other industries	61 097	960
	Households	69 714	3 719
	Treatment: energy recovery	-	52 014
	Treatment: material recovery	-	15 012
	Treatment: reuse	-	29
	Total use in Finland	**137 855**	**71 735**
	Exports	43 646	14 043
	Total use	**181 501**	**85 778**
	Supply – Use	**0**	**1 030**

(net) are in other textiles (the most important product group being Non-wovens and articles made from non-wovens). The negative value in Textile yarn and thread under domestic production is a result from domestic textile industry using these products more than domestic production supplies them. The most important category in export is other textiles, followed by wearing apparel. Domestic use is following the same pattern, but with more volume in garments.

End-of-life textile flows originate mainly from households. This is due to the higher share of use of new textiles and the nature and data of intermediate use in other industries. Part of the textiles in intermediate use are embedded into other products. Besides that, the textile waste data is of poor quality, and some part of textile wastes might be categorized in other classes than textile waste or mixed MSW. The textile use volume in households exceeds the end-of-life flow implicating the growing stock of textiles in households in year 2019. Most of the end-of-life textiles end up being incinerated and utilized in energy recovery. This treatment is followed by material recovery, export and reuse. Reuse is mostly directed to households, but 29 tonnes of reuse was recognized, for which no data of potential users was available.

Table 2 shows an imbalance of 1 030 tonnes of end-of-life textiles. This amount is explained by the fact that export volumes of used textiles and textile wastes in foreign trade statistics differ from the figures collected from different data sources during the project (indicating export of 15 042 tonnes). Since the collected data included estimation, we decided to present the figures from foreign trade statistics, which are more comprehensive and checked. Using the collected data would result in 30 tonnes of excess supply. This example reveals the difficulty in linking various data sources and estimated figures together in material flow accounting.

A detailed examination of end-of-life textiles offers more insight. Households discard textiles and clothes as two main flows: textiles waste (mixed MSW and separate textile waste, 64%) and reusable textiles (36%) (Figure 3). Industries discard textiles in mixed MSW and separate textile waste. Most of the end-of-life textiles are treated in mixed MSW, all of which is incinerated. The most part of the separate textile waste is recovered as material. Over 66 % of collected reusable textiles are exported. Over 16% are incinerated indicating a poor quality of home textiles and clothes. 16% of reusable textiles return to households.

Textile waste imports are mainly staple fiber waste from Poland and cotton thread waste from Denmark. Import of used textiles (Figure 2) consists of used clothes (69 tonnes) mainly from Germany, United States, Turkey and United Kingdom, and rags (960 tonnes) mainly from the Netherlands, Belorussia, Germany and Poland. Export includes 14 tonnes of textile waste, almost completely staple fiber waste to Indonesia.

Table 3. Supply and use of new textiles in detailed product classification, tonnes.

	Import	Domestic supply (net)	Total supply	Export	Domestic use
Textile yarn and thread	2 624	-700	1 924	101	1 822
Woven textiles	5 127	1 922	7 049	2 585	4 464
Other textiles	56 754	53 009	109 763	35 034	74 729
Wearing apparel (except fur apparel)	45 493	1 035	46 527	5 414	41 114
Articles of fur	34	16	50	12	38
Knitted and crocheted apparel	7 499	1 645	9 143	500	8 643
Total	117 530	56 927	174 457	43 646	130 811

DOMESTIC TEXTILE AND GARMENT PRODUCTION
56 927 (net)

OWN USE
7 044

IMPORTS (new)
117 530

IMPORTS (used)
1 029

IMPORTS (textile waste)
6

SUPPLY (new)
174 457

SUPPLY (used)
4 680

3 651

43 646
25%

61 097
35%

69 713
40%

960
21%

3 719
79%

OTHER INDUSTRIES
62 057

HOUSEHOLDS
73 433

C2C
6 699

5 441

17 211

63 115

END-OF-LIFE TEXTILES
85 773

14 043
16%

61%

18%

4%

EXPORTS
57 690

ENERGY RECOVERY
52 014

MATERIAL RECOVERY
15 012

REUSE
3 680

New textiles
End-of-life textiles

Figure 2. Textile flows in Finland in 2019, tonnes. The overall supply of textiles consists of clothing, home textiles and similar textiles used in the public sector and enterprises, and industrial textiles. Figures might not sum up due to rounding.

DOMESTIC TEXTILE AND GARMENT PRODUCTION

IMPORTS (textile waste)

OTHER INDUSTRIES

HOUSEHOLDS

3 651

5 441

17 211

40 589

22 526

6

END-OF-LIFE TEXTILES

Textiles in mixed MSW	45 789
Enterprises	5 413
Households	40 376
Treatments	
energy recovery	100 %

Separately collected textile waste	17 458
Enterprises	17 239
Households	213
Import	6
Treatments	
energy recovery	14.3 %
material recovery	85.4 %
reuse	0.2 %
export	0.1 %

Reusable textiles	22 523
Charity organizations	21 782
Brand stores	741
Treatments	
energy recovery	16.6 %
material recovery	0.4 %
reuse	16.2 %
export	66.8 %

14

14 029

EXPORTS 14 043

ENERGY RECOVERY 52 014

MATERIAL RECOVERY 15 012

REUSE 3 680

- - - Reusable textiles
——— Textile waste

Figure 3. End-of-life textile flows in Finland in 2019, tonnes.

3.2 Supply and use of clothes and home textiles by households, public sector and enterprises

This section of the results presents the overall supply of final clothing, household textiles and similar textiles used in the public sector and enterprises (comparable to Watson et al. 2018). The focus is on the narrower product group classes than in chapter 3.1.

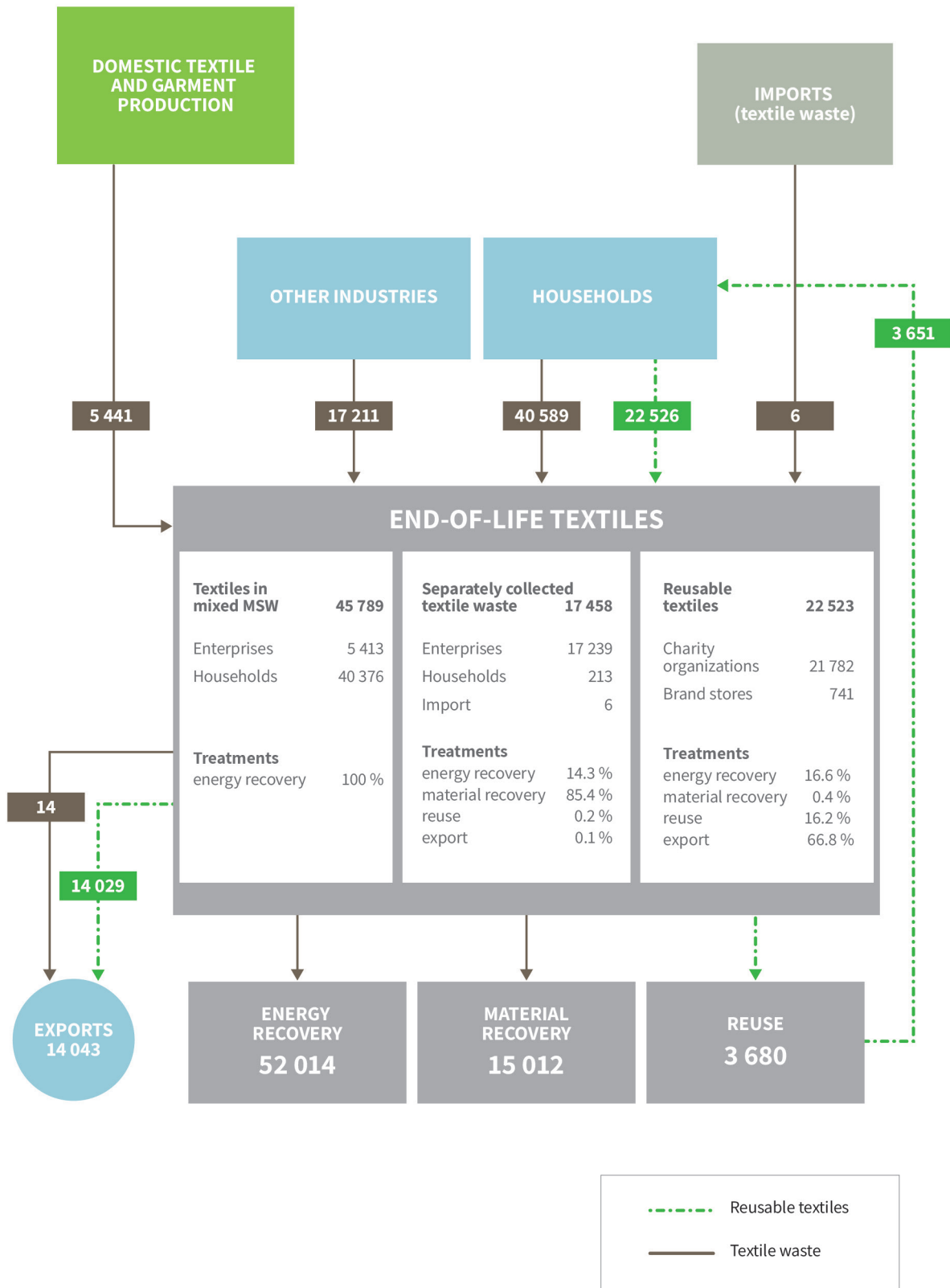62 342 tonnes of new clothes and household and similar textiles were supplied in Finland in 2019 (Table 4). Most of the supply was new clothes (79%) and a smaller percentage was household textiles (21%). Total consumption of new textile products in households, public sector and enterprises is 11.3 kg/capita. (A more detailed version of new final textile products and their approximate consumption, both private and public, divided from different product groups can be found in Appendix 3).

Household consumption dominates the overall use. Households' share of the use is approximately 51 906 tonnes which equals 83% of the overall supply (Table 4). This shows that within one year, an average Finn purchased 7.4 kg of clothes and 2 kg of household textiles equaling 9.4 kg of new textiles for private use. The rest of the supply (10 436 tonnes equaling 17%) is used in the public sector and enterprises (Table 4). The largest consumers in this sector are human health activities and social work activities, laundries, defense forces, hotels and restaurants and cleaning services (Appendix 3).

Table 4. Supply of new final textile products and their approximate consumption both private and public (2019).

	Total supply (tonnes)	Household consumption (tonnes)	Public sector & enterprises (tonnes)	Total supply (kg/capita)	Household consumption (kg/capita)
Garments	**44 061**	**36 016**	**8 045**	**8.0**	**6.5**
Garments bought from international online shops	5 468	5 468	–	1.0	0.9
Household textiles	**12 466**	**10 075**	**2 391**	**2.3**	**1.9**
Household textiles bought from international online shops	347	347	–	0.1	0.1
Sum of all new textile products	**62 342** **100%**	**51 906** **83%**	**10 436** **17%**	**11.3**	**9.4**

3.3 Flows of end-of-life textiles from households

The flows of textiles to and from private households are described in Figure 4. Due to the uncertainties connected to the data used for the mapping (see chapters 2.3 and 4) and the issues connected to mass balance calculations in general (see chapter 2.2.3), the supply flow of new textiles does not match with the sum of flows leaving the households. Inputs to the system consist of imports of new and used textiles (46 091 and 69 tonnes) and international online purchases (5 815 tonnes) which sum up to 51 975 tonnes. Outputs from the system consist of material recovery (198 tonnes), energy recovery (44 219 tonnes) and exports (15 036 tonnes) which sum up

to 59 453 tonnes. End-of-life textiles directed to reuse keep circulating within the system.

According to our mapping, 7 478 tonnes more end-of-life textiles were discarded from households than were purchased as new textiles in 2019. Estimations of the losses from the system were not obtained in this study. However, estimations from the Denmark study indicate that around 1.4% is lost from the system due to thefts from containers and lint loss during textile usage (Watson et al. 2018). The flows leaving the households are described in more detail in the following chapters.
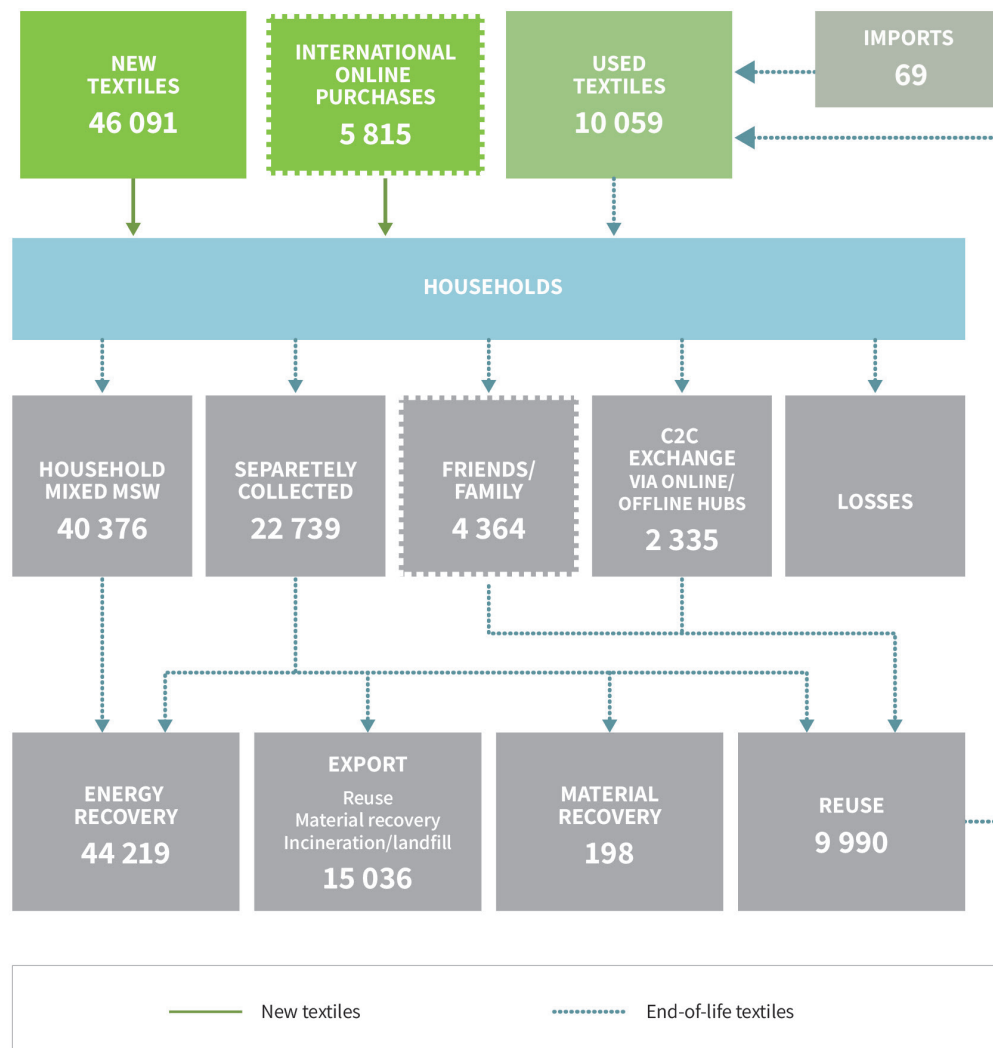

Figure 4. Overview of flows of textiles to and from private households in Finland (in tonnes). The supply of new textiles does not match with the sum of flows leaving the households. Reasons for this mismatch are discussed in Chapter 4.

3.3.1 Consumer to consumer exchanges

Exchanges of reusable clothing and other textiles can take place between consumers in many ways. The most common way is to pass baby and children's clothes from an elder sibling to a younger one. Clothes and other textiles can also be passed on or sold to friends and family. In recent years, non-economic exchanges of clothing between strangers via swap markets and online swapping platforms have been increasing (Watson et al. 2018). These informal flows of reusable clothes and other C2C clothes exchanges are difficult to measure and obtain data from. For this reason, it has not been possible to generate a full picture of used textile flows that would include all kinds of C2C exchanges in Finland.

Watson et al. (2018) estimated that from the new textiles purchases about 7% is reused via exchanges between friends and family annually. Based on our results this could be converted to about 4 364 tonnes of textile exchanges via friends and family each year.

However, the estimate of Watson et al. (2018) was based on a UK study, the applicability of which to Finland is uncertain. However, the estimate was used in our report.

The more formal volume of reuse of used textile exchanges between households was estimated from online and offline hubs. Based on Eskelinen et al. (2018), we calculated that 954 tonnes of used clothes are exchanged C2C via online platforms such as Facebook groups, tori.fi and huuto.net. Also, from Eskelinen et al. (2018), we estimated that for local fleamarkets in other parts of Finland (excluding the Metropolitan area recycling center from the data, because it's cov-ered in our questionnaire too), we estimated the reuse flow via local self-service fleamarkets at about 1 381 tonnes. These together combines 2 335 tonnes of used textiles that are exchanged between consumers via online and offline hubs.

3.3.2 Separately collected end-of-life textiles

The textiles separately collected by private collectors, charity organizations and municipal waste companies add up to almost 23 000 tonnes in 2019 (Table 5). This means that around 44% of textiles purchased by Finnish households in 2019 are separately collected after households no longer have use for them. Most of the separately collected end-of-life textiles, about 15 036 tonnes (66%), are exported to other countries. Charity organizations send most of the collected end-of-life textiles for reuse abroad. However, the final destinations of these end-of-life textiles is not known and thus not included in this study. In Finland, 3 651 tonnes (16%) of the collected textiles were directed to reuse and slightly highere amount 3 843 tonnes (17%) was recovered as energy by incineration. Smallest share, 198 tonnes (1%) of the collected textiles was recycled. Only UFF and The Metropolitan Area Recycling Center weigh the textiles they receive and treat, hence some of the amounts in Table 5 are estimates of weights.

In 2019 there were at least six brand store chains operating in Finland which received used textiles from private consumers in their stores. Five of these collected altogether 741 104 kg of used textiles in 2019

(Ahokas and Kokko 2019). This volume excludes the amount of used textiles collected by one brand store chain and therefore, the total volume of used textiles collected by brand stores is slightly bigger in reality.

The responses given to the questionnaires by the charity organizations show that all these organizations are responsible for the sorting of the textiles they collect or receive. All respondents collected used textiles in their shops. Three of the six (UFF, Salvation Army and Fida) charities have drop-off containers. Three (Salvation Army, Fida and the Metropolitan Area Recycling Center) also have door-to-door collection. Other collection methods mentioned were events and direct fetching from donators. All charities also sell part of the donated textiles in their stores. Generally, the charities indicated that recycling of textile material in Finland is difficult due to the sorting requirements of recycling operators. In some cases, the processing capacity of Finnish recycling operators was found to be too small, and due to these two reasons, a significant part of the textile used as a material was sold to foreign textile operators.

Table 5. Separate collection of used textiles from households by private collectors, charities and waste management operators in 2019 (tonnes).

	Total collection	Reuse	Material recovery	Energy recovery	Export
Charity organizations	**21 785**	**3 291**	**15**	**3 704**	**14 767**
UFF	14 742	693	–	767	13 283
Salvation Army	2 785	836	3	1 821	125
SPR	204	59	2	20	122
SPR Kontti	1 706	699	–	512	487
Fida	1 500	495	–	255	750
Metropolitan Area Recycling Center	848	509	10	329	–
Municipal Waste management	**213**	*****	**100**	**111**	**–**
LSJH	169	–	85	85	–
Rauma	44	*	15	26	–
Other	**741**	**360**	**84**	**28**	**269**
Brand stores	741	360	84	28	269
Sum	**22 739** **100%**	**3 651** **16%**	**198** **1%**	**3 843** **17%**	**15 036** **66%**

(*) Reused textiles from Rauma regional waste management's collection (2.5 tonnes) are included in the number of reused textiles from one charity organization due their exchanges. (Note, all num-bers do not sum up due to rounding of numbers or due to the fact that the collected data is not fully comprehensive).

To obtain a full picture of the sources of used textiles, we asked the charity organizations which donators they had in addition to households. One of the respondents (Metropolitan Area Recycling Center received used textiles from the municipal waste management company (HSY). All received occasionally some textiles from private businesses, clothing stores and brands. These amounts were generally small except for Fida, who said that they had received large donations from one brand during the years of 2018–2019 (about 60 tonnes of textiles). Two out of four charities received some small amounts occasionally from public organizations, e.g., hospitals.

Separately collected textiles were directed from charity organizations further to partners via wholesale in Finland and to other EU countries, Baltia and Russia for reuse. One charity organization exported most of the collected and received textiles (60%) as international help. Part of the textiles exported to the EU were further directed to fiber recycling. Part of the textiles was also further donated to other charity organizations for reuse in Finland (e.g., Hope ry, Vailla vakinaista asuntoa ry, SPR). Additionally, textiles were given for reuse as material, for example, to craftsmen, schools, car repair shops and animal shelters in Finland.

Currently, about 15 tonnes (0.1%) of the end-of-life textiles collected separately by the charity organizations are sold for recycling in Finland. Some of the recycling operators were mentioned, but the flows to different operators are not recorded and known on a more detailed level. Dafecor Oy is one of the receivers, a company which operates by mechanically recycling textiles to produce technical fabrics. In addition to Dafecor Oy, there are e.g., the following companies in Finland utilizing end-of-life textiles as raw material for new products: Globe Hope Oy, Infinited Fiber Company, Pure Waste and Touch Point.

Textiles directed to energy recovery via incineration were of the lowest quality textiles or materials that are not suitable for recycling. Primarily they were broken, stained, moist or mold or had a bad smell on them. Some textiles, although clean and undamaged, were discarded to waste due to their non-existing market value (bad quality, such as shabby, over worn or having color errors).

End-of-life textiles are collected in several brand stores (e.g., H&M, KappAhl, Finlayson). The estimated volume of this collection was 741 tonnes (Ahokas and Kokko 2021). The stores reported that 49% of the textiles are directed to reuse, 11% to recycling, 4% are recovered as energy and 36% exported.

3.3.3 Summary of reusable textiles circulation

The volume of reuse of end-of-life textiles from households was estimated for three routes, namely online hubs, local flea markets and charity organizations that also have national flea market operations that sell reused textiles in Finland. 954 tonnes of used clothes are exchanged via online platforms and 1 381 tonnes of used textiles are exchanged via offline hubs between consumers. 3 291 tonnes of charity organizations' collection of used textiles are sold in Finland

to reuse. When adding the number of reused textiles that are exchanged via friends and family (4 364 tonnes), all in all, this equals to 9 990 tonnes of used textiles from households being reused in 2019, which is around 1.8 kg per capita. This represents around 19% of textiles purchased by Finnish households in 2019. Also, a small amount, 69 tonnes, of used textiles is imported to Finland for reuse (Figure 4).

3.3.4 Separately collected textile waste

The separate collection obligation for post-consumer textiles will take place in the EU in 2025. In Finland, the obligation will enter into force already in 2023 (proposal on the Waste Act from Government to the Parliament 25 March 2021). In Finland, post-consumer textiles from residents fall under the responsibility of municipalities. In practice the responsibilities of municipalities are dealt with by 31 municipal waste management companies. Piloting the collection of post-consumer end-of-life textiles began in the LSJH area in 2016.

In the data year of this mapping, 2019, a total of 213 tonnes of post-consumer textiles were collected in Finland by regional waste management companies (LSJH and Rauma, Table 5). 100 tonnes ended up

being reused or mechanically recycled. The rest was recovered as energy.

A total of 169 tonnes were collected in the LSJH operational area in the southwestern Finland. The post-consumer textiles were mainly collected at the waste company's sorting stations, but other collection points were also in use. Of the amount collected, 84.5 tonnes ended up being reused or recycled mechanically. The rest, i.e., also 84.5 tonnes, was recovered as energy by incineration.

In the Rauma area 44 tonnes of post-consumer textiles were collected in 2019. Of this, 15 tonnes ended up for recycling, 2.5 tonnes were donated for reuse, and 26 tonnes were recovered as energy by incineration.

3.3.5 Textiles in mixed waste

Approximately over 40 000 tonnes of textiles were discarded from households in mixed MSW. The amount was estimated using the total amount and average composition shares of mixed MSW from households. This waste flow is currently incinerated,

since no post-consumer waste man-agement facility for mixed MSW is sorting textile waste.

3.4 Flows of end-of-life textiles from the public sector and enterprises

Textile users, such as hotels, restaurants and hospitals, belonging to the public sector and businesses, use primarily textile rental services provided by laundries, which means that the worn-out textiles are discarded by the laundry companies. Table 6 presents the results of interviews with four laundry companies of their estimations on the shares of end-of-life textiles that are directed to reuse, recycling or incineration. None of the interviewed laundry companies exported their textiles. The total amount of end-of-life textiles from laundry companies in 2019 was about 1 330 tonnes. Most of the end-of-life textiles (67%) were incinerated in Finland. Approximately one third (32%) was recycled and only a small amount (1%) was reused.

Table 6. Distribution of end-of-life textiles from laundry companies to reuse, recycling or incineration in 2019, in tonnes.

	Reused	Material recovery	Energy recovery	Total
The four interviewed laundry companies	6	336	705	1 047
Rest of the laundries (estimated)	2	90	190	281
Sum	**8** **1%**	**426** **32%**	**895** **67%**	**1 328** **100%**

Image Wear Oy operates as a workwear contract supplier for the Police, the Rescue Departments, Customs and other smaller operators. In 2019 Image Wear supplied 9 720 kg of workwear textiles to the Police, 6 386 kg to the Rescue Departments and 1 560 kg to Customs. The exact volumes of end-of-life textiles were not available, but it is assumed that the purchased amounts correspond to discarded amounts, since usually new workwear is purchased to replace old ones. Information from the Police of Finland confirmed that the purchases of new textiles equal the number of textiles that are discarded. Workwear such as police uniforms are difficult to recycle due to the different tags (badges, names) that prior to recycling need to be removed and disposed of due to safety issues. Uniforms also contain several zippers and buttons that hinder effective recycling. Hence, police uniforms are currently incinerated. However, other options are under consideration for the future, e.g., with Kuusakoski Oy being involved as part of the solution.

The Finnish Defense Forces has its own system for purchasing and handling textiles. Used textiles go through the Defense Forces' clothing repair centers located in Säkylä and Mikkeli which take care of wash-ing, repairing and discarding the textiles. Roughly 66 760 kg of textiles were discarded in 2019. About 53 408 kg (80%) of end-of-life textiles including uniforms and other textiles were incinerated as energy recovery (Table 7). The reasons leading to incineration of the textiles are similar as with the police uniforms. Materials used in the uniforms are considered difficult to recycle. The textiles also include hazardous chemicals and colorants complicating recycling. The rest of end-of-life textiles, 13 352 kg (20%), including all used sheets, bedspreads and some of the clothing (t-shirts, jackets, sportswear etc.) were reused as cleaning cloths and for training materials. (Uusi-Uitto 2019).

The estimated volume of the textiles discarded by all the brand stores in Finland was evaluated to be 180 750 kg in 2019. This includes model items and faulty products from wholesale but excludes removals from the actual clothing stores (Kankaanpää 2021).

A study made by Hyvönen and Keinonen (2020) on the cutting waste and surplus textiles generated by the clothing industry aimed at finding out the flows of surplus textiles from companies and at coming up with solutions for the utilization of surplus tex-

tiles and the reduction of losses. A questionnaire was sent to 182 recipients and 38 responses were received (Hyvönen and Keinonen, 2020). Most respondents (73.7%) were entrepreneurs and/or managers assumingly mainly from small companies. According to this study, 50% of respondents currently dispose of the surplus textiles either as energy waste or by donation, 34% dispose of them in some other way, 32% sell the textiles and 11% dispose of them as mixed waste. 52% of the respondents already direct their surplus textiles to companies that utilize the textiles in their produc-

tion and 30% was interested to co-operate with these companies in the future (Hyvönen and Keinonen, 2020). However, the volumes of the flows were not estimated in the study.

To summarize, 265 tonnes of end-of-life textiles were generated by other public sector operators and private enterprises than laundries in 2019. Most of these were recovered as energy (89%), 8% was reused and the rest 2% was exported (Table 7).

Table 7. End-of-life textiles from public sector operators and brand stores, tonnes.

	Generated	Reuse	Energy recovery	Export
Police	10	—	10	—
Rescue Departments	6	—	6	—
Customs	2	—	2	—
Defence Forces	67	13	53	—
Brand stores	180	8	237	6(*)
Sum	265 100%	22 8%	237 89%	6 2%

(*) Expert estimate based on the information concerning end-of-life textiles collected by brand stores from consumers.

4. Discussion and conclusions

The overall textile flows in 2019 show that Finnish economy is highly linked with foreign trade. Two thirds of the net supply of new textile products and garments are imported. 25% of the net supply is exported. Households are responsible for a little over 50% of domestic use. Foreign trade has its role also in end-of-life textiles. The volume of exported used clothes is over 3-fold compared to reuse by households (C2C exchange excluded). 60% of all end-of-life textiles are recovered as energy through incineration.

The use of clothing and household textiles and removal of them from use by households, public sector and enterprises

Our results show that in 2019, the consumption of new garments and household textiles (in the narrower product list) was 62 342 tonnes which equals to 11.3 kg/capita textiles used in Finland in 2019. The share of household consumption was 51 906 tons equaling to 9.4 kg purchase of new textiles per an average Finn in one year. The rest of the consumption (10 436 tons) was by the public sector and enterprises. About 44% of household consumption was separately collected in 2019 and most of the rest were collected within the mixed MSW. Some minor flows probably are also lost from the system, such as lint loss during the use phase of the textiles. Other types of textile losses, e.g. illegal disposal and theft from the containers of charity organizations, have been raised by Watson et al. (2018). In their estimation, 1% of household end-of-life textile losses come from thefts from containers and lint loss. However, losses were not studied in our project and hence we cannot provide comprehensive estimates on these.

The previous mapping of textile flows in Finland was made for the year 2012 (Dahlbo et al. 2015; 2017). However, the total volumes of textile flows estimated in this study (Figure 2, chapter 3.1) are not as such comparable to the 2012 study, since the total volumes for 2019 include all textiles, also semi-manufactured products, which were not included in the 2012 flows. For this reason, only the part of the flows that describe the supply and use of clothing and home textiles in households and the public sector and enterprises are comparable to the 2012 study. The consumption (supply) of garments and home textiles has remained quite constant between these two mappings, being 11 kg/capita in 2012 and 11.3 kg/capita in 2019. However, even within this comparable part of the studies, some differences can be found. In the earlier mapping, the domestic production was not scaled up to cover the missing data of small enterprises in industrial output statistics. For this reason, the actual volume of domestic production in 2012 should have been estimated to a higher level and similarly the average consumption per capita should have been higher. (The detailed assessment of the extent of the mentioned error is beyond this report.) In addition, the textiles' online purchases from international retailers by private users were not estimated in the earlier study. If they were included, the overall consumption would have been even higher. However, online purchases were not as significant in 2012 as in 2019, which can be seen from the share of the international online shopping having over quadrupled between 2013 and 2019 (from 2.7% to 11.2%) (Kankaanpää 2021).

In addition, it must be noted that the masses of clothing have changed over the years due to the increase of use of synthetic fabrics such as polyester, nylon and acrylics over natural fibers such as cotton and wool. In average, synthetic fabrics weigh less than natural fibers. In nine years, between 2010 and 2019, global consumption of synthetic fibers has increased about 3% over natural fibers (FAO-ICAC-Survey 2013; Statista 2021). This may have affected the overall mass of the textile flows.

When looking at the household consumption expenditure (monetary data), we can notice a slight increase of 8% between 2012 and 2019. During the same period, the consumption of home textiles has decreased 2%. It must be noted that consumption expenditure is in purchasers' prices including margins of trade and logistics. Not to mention that possible conversion to mass units would give rise to a bias. All in all, no definitive data is available to conclude that textile consumption in Finland would have changed drastically between 2012 and 2019.

In 2012, separate collection of end-of-life textiles from households was about 16 415 tonnes, which has increased in seven years by 39% to 22 736 tonnes.

The flow of end-of-life textiles from the public sector and enterprises through laundry operators has over doubled in seven years from 568 to 1 328 tonnes.

In 2012, a 7% share of separately collected textiles was added to the volumes reported by the main charity organizations. This share was not based on actual volume data but was estimated to include flows such as C2C exchange, local small flea markets and donations to emergency aid. For 2019 we have tried to specify these flows by quantifying C2C exchange, small flea markets' activities and collection by brand stores. The

separate collection started by municipal waste management companies is additional to 2012 and enables to divert textile waste from energy recovery to material recovery or even reuse.

The major flow of end-of-life textiles originating from the public sector and enterprises come from laundry companies. Other smaller but still significant end-of-life textile flows are generated by the Police, the Rescue Services, Customs and the Defense Forces (Figure 5).Altogether, in 2019, the majority (1 132 tonnes, 71%) of the end-of-life textiles that originated from the public sector and enterprises went to energy recovery by incineration. The rest was recycled as material recovery (426 tonnes), reused (29 tonnes) or exported (6 tonnes).

Laundry companies **1 400 tons** Hotels Restaurants Health care Institutes

Other operators **300 tons** Police Rescue department Customs Defence forces Brand stores

Figure 5. Illustration of the amount of end-of-life textiles from public sector and enterprises through laundry companies and other operators in 2019.

Textile consumption and separate collection in Finland compared to other countries

In recent years, several EU countries have performed mapping of textile flows using an approach similar to the one used in this project for the flows of final textile products (clothes and home textiles). Annual consumption of these products and shares of separately collected end-of-life household textiles in several EU countries are presented in Table 8. Our estimate of the Finnish consumption (11.3kg/capita) is on the same scale with the Swedish (12.8 kg/capita) (Tojo 2019). Norway and Denmark have slightly higher consumption rates (both 15 kg/capita). The separate collection rate for end-of-life household textiles is notably similar (about 44%) in Finland, Sweden, Norway, Denmark and the Netherlands. Separate collection in the

Baltic countries is significantly lower and similarly the consumption of new textiles is lower (Watson et al. 2018, 2020a, 2020b, 2020c). According to the European Environment Agency (2019), an average European consumes a higher amount, 26 kg of textiles per person per year, than the mappings for individual countries show. However, the European average includes all textile products (shoes, carpets etc.) whereas the results presented in Table 8 exclude products such as shoes and carpets (as described in Chapter 2.4 of this report). It is important to note that textile consumption rates reported in different studies may not be fully comparable due to different scopes and methods used.

Table 8. Annual consumption of new textiles (kg/capita/year) and share of separate collection of end-of-life textiles from households in European countries, where the mapping has been performed with identical methodologies (Watson et al. 2018, 2020a, 2020b, 2020c; Tojo 2019).

Country (year)	Finland (2019)	Estonia (2018)	Latvia (2018)	Lithuania (2018)	Sweden (2016)	Norway (2018)	Denmark (2018)	Netherlands (2018)
Consumption of new textiles kg/capita	11.3	12.4	6.1	7.0	12.8	15	15	17.7
Separate collection rate	44%	30%	5%	11%	42%	45%	48%	45%

Circulation of reusable textiles through C2C exchanges needs to be studied deeper

The data gathered on C2C exchanges of reusable clothes does not provide a full picture of used textile flows that would include all kinds of C2C exchanges in Finland. No records were available on e.g., exchanges between friends, within family or non-economic exchanges between strangers via swap markets and online swapping platforms. We estimated this by applying Watson et al. (2018) who refer to a UK study. However, when comparing our estimate with information from studies with a different perspective to the same issue, we can find support for the fact that textile exchanges via friends and family are almost as common as buying used clothes from flea markets, online platforms and from charity organizations.

A consumer-based survey about the sharing economy by Statistics Finland (2019) showed that 30% of Finns have passed clothes, shoes, children's supplies and other similar items to a second user for good or for loan. 53% of households have bought clothes from traditional flea markets, online or other secondhand marketplaces (Statistics Finland 2019). A survey carried out in Flanders, Belgium, shows that friends and family is the most common channel for purchasing used textiles, with a proportion of 28.5% of used textiles purchases in 2019 (Figure 6) (Delanoeije & Bachus 2020). Our results show a similar proportion for the volume of textile exchanges between friends and family (4 364 tonnes) compared to other channels where used clothes are bought (6 104 tonnes).
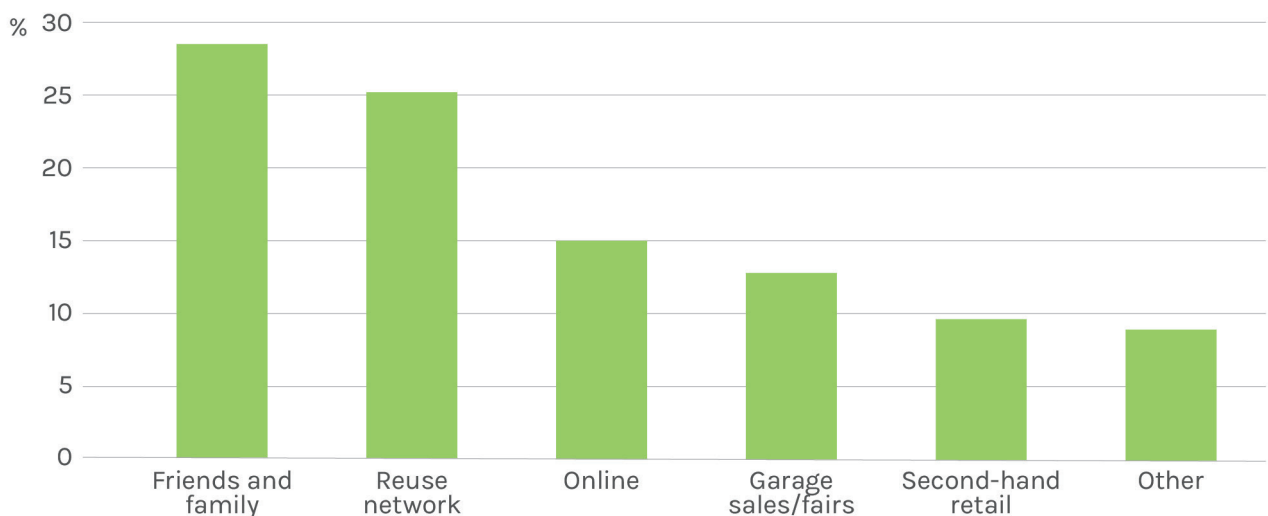

Figure 6. Proportion of used textiles purchased via different channels, based on a survey carried out on 508 Flemish citizens in Flanders in 2019 (Delanoeije & Bachus 2020). The reuse network in Flanders includes recycling centers and charities similar to Finland.

Further studies of the C2C flows are necessary to get a better picture of the volumes and of the prevalence of C2C exchange in Finland. Because the garment and apparel industry is one of the largest industries globally, the yearly growing volumes of clothing production and consumption affects both in first-hand and secondhand cycles. The trend of buying secondhand and vintage clothing is growing in global North due the widespread concerns of clothing production and the complicated value chains that have globally negative effects both sociologically and environmentally (Tranberg Hasen & Le Zotte 2019). This change in secondhand economies can be noticed in Finland as well. According to UFF (2020), the popularity of vintage clothing has increased notable within the last five years.

Charities collected most of the end-of-life textiles from households, but received unwanted flows as well

We estimated that in 2019 about 22 736 tonnes of end-of-life textiles were separately collected from households. This represents about 44% of the new textiles that are purchased by Finnish households yearly. Most of the collected end-of-life textiles go to charity organizations (around 96%) (Figure 7). From the total collection of end-of-life textiles, only 15% are directed to reuse in Finland by the charities. These results and the responses to the questionnaire indicate that consumers have perceived the charity organization's collections as the main place to dispose of their end-of-life clothes, even though they would not be reusable anymore but rather recyclable. This is understandable, since previously there has not been any organized separate collection available for non-reusable end-of-life textiles. However, this also indicates that there is a need for additional collection for end-of-life textiles.

Separate collection from households

- 3.3%
- 0.9%
- 95.8%

Legend:
- Charity organizations
- Brand stores
- Municipal Waste management

Distribution of charity organizations collected textiles

- 15.1%
- 0.1%
- 17.0%
- 67.8%

Legend:
- Reuse
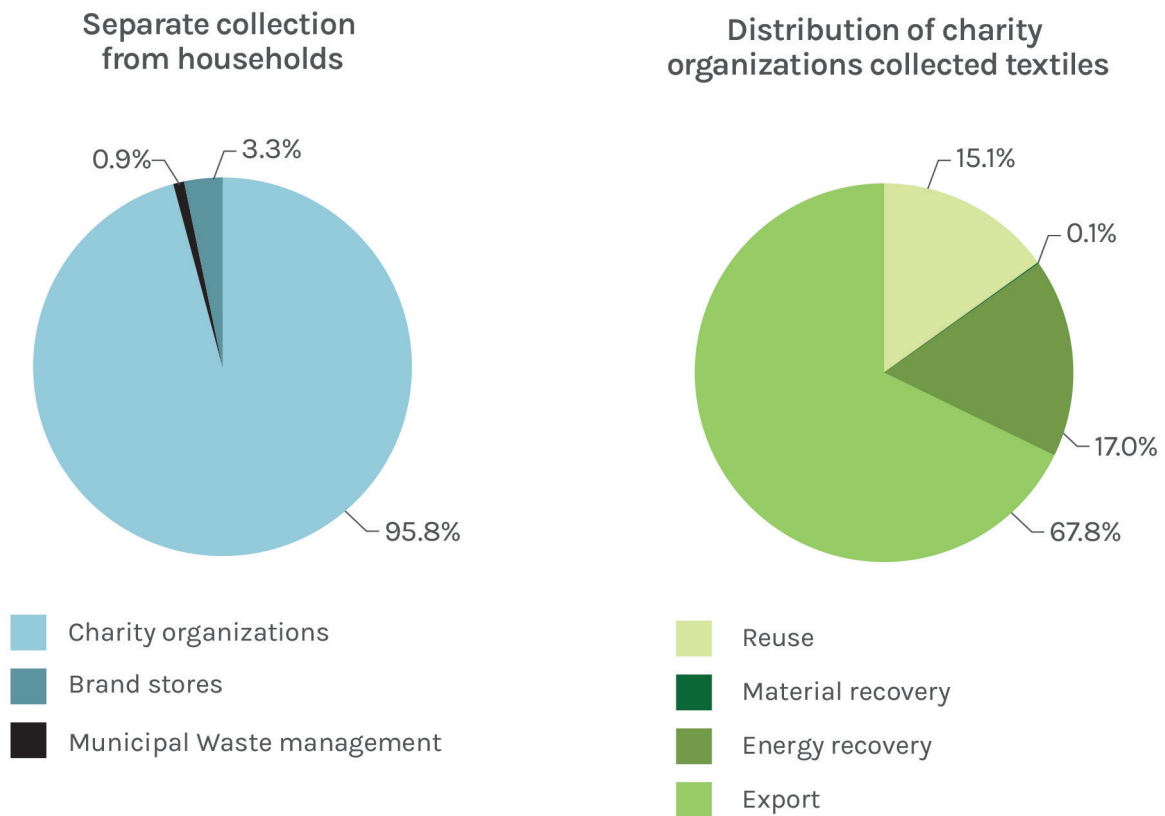- Material recovery
- Energy recovery
- Export

Figure 7. Separate collection from households and distribution of charity organizations' collected textiles.

In 2019, 1% of the end-of-life textiles were collected by the municipal waste management companies and 3% by other operators such as brand stores that receive end-of-life clothes from customers. However, the separate collection by municipal waste management companies is expanding step-by-step to become nation-wide and the situation is changing.

The collection and volumes were small in 2019, but they are steadily growing as the collection becomes established (Figure 8) and new waste management companies start the collection. This collection will most probably decrease the flow of textile waste into the collections of charity organizations.
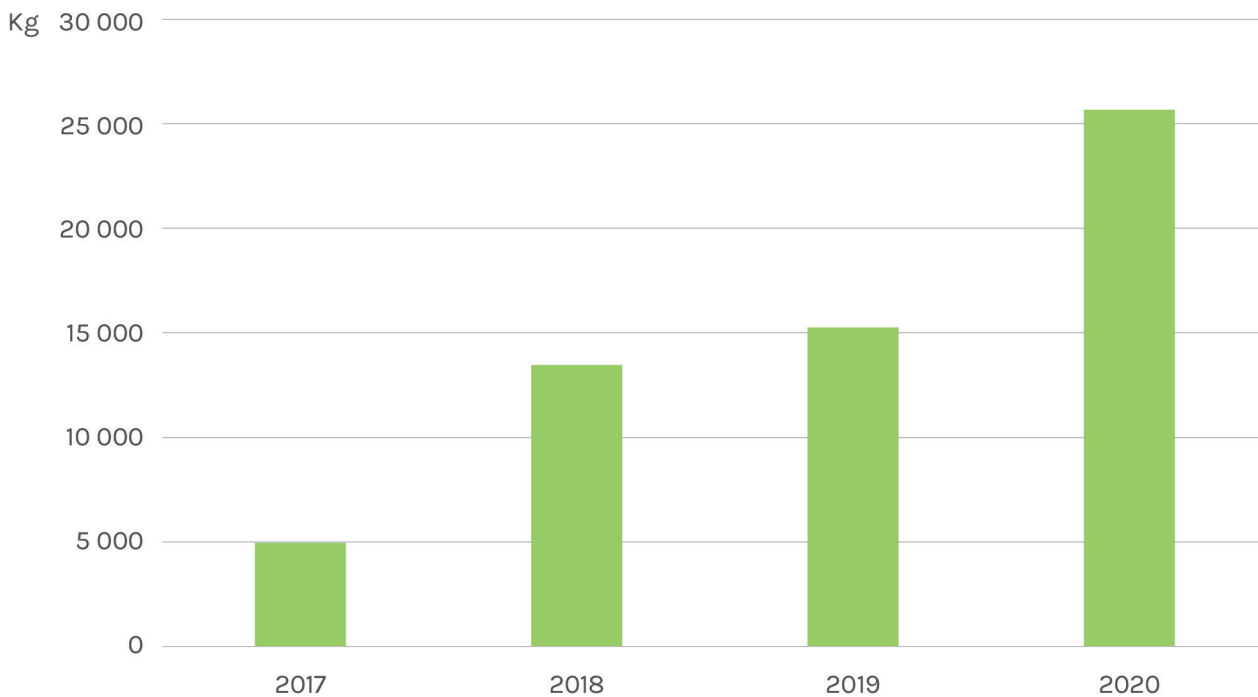

Figure 8. End-of-life textiles collected by Rauma regional waste management facility in 2017–2020.

Exports of separately collected end-of-life textiles have increased, while imports have remained quite constant

The exported flows of end-of-life textiles reported to us by the charity organizations are almost identical to the exported flows in the Customs statistics, indicating that for this flow the statistics provide us with reliable data. From the statistics we can see the development of exports and imports during 2012–2020. The volume of end-of-life textiles exported from Finland has in recent years been on average eleven times higher than imported volumes (Figure 9). Used clothes dominate the exported textiles, whereas most of the imported end-of-life textiles are rags, scrap twine compared to clothes. The number of imported clothes has declined significantly after 2013.

Between the reporting years 2012 and 2019, the volumes of end-of-life textile imports have been stable whereas the exports have doubled from around 7 000 tonnes to 14 000 tonnes. In 2020 exports decreased, which may be due to the COVID-19 pandemic reducing activities all around the world. It may also be due to the expanding of the separate collection of end-of-life textiles in Finland. Used clothes are exported to 71 countries, the majority of volumes being small. Estonia (31%), Lithuania (23%) and Oman (20%) are the most important export destinations in volumes (Figure 10).
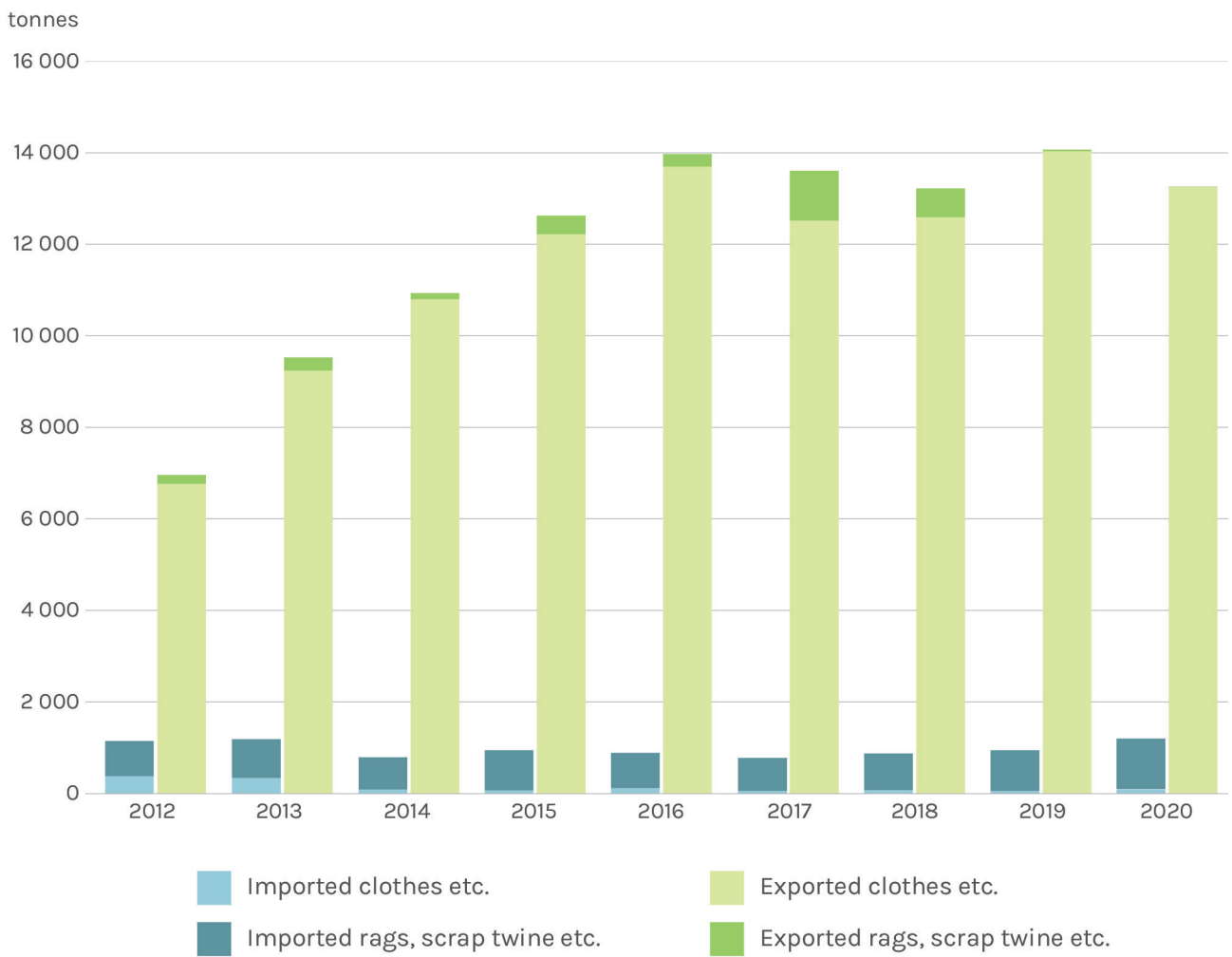
Figure 9. End-of-life textile imports and exports to/from Finland in 2012–2020, tonnes.
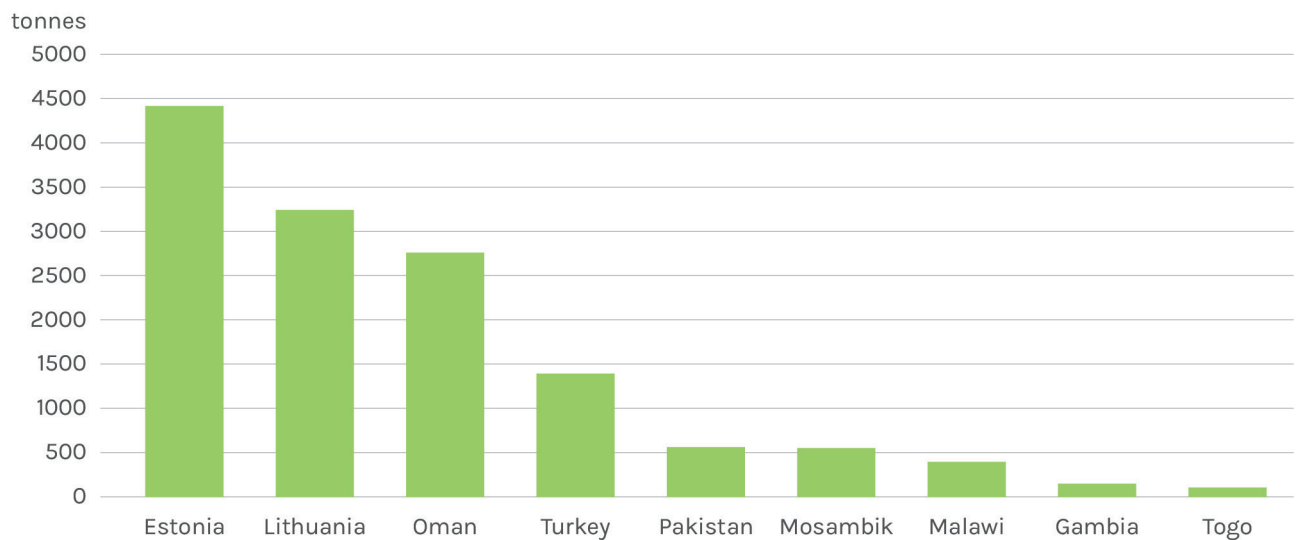

Figure 10. Export destinations of used clothes from Finland in 2019, tonnes.

Circulation of end-of-life textiles has increased after 2019 and will increase further in the next years

The collected volumes of end-of-life textiles have grown from 2012 to 2019. In 2019, municipal waste management companies started separate collection of end-of-life textiles to prepare for the separate collection requirement taking place in 2023. The collection has already expanded from 2019 and is constantly growing as can be seen from the report from Rauma regional waste management facility (Figure 8). In 2020, the total amount of post-consumer textiles separately collected by municipal waste management companies increased to 416 tonnes from 213 tonnes in 2019. The 2020 volume includes collections by LSJH (170 tonnes), Rauma (52 tonnes), HSY (127 tonnes), and Loimi-Häme (56 tonnes). Additionally, Helsinki Metropolitan Area Recycling Centre delivered 132 tonnes of post-consumer textiles to LSJH under HSY in 2020 (see Table 9 for the population served by these companies). For example, in the HSY collection around 30% of products should not have been included in the collection (e.g., underwear, shoes, blankets) or spoiled textiles. This highlights the continuous need for consumer education on the criteria for end-of-life textiles that can be included in the collection.

Table 9. Population served by the municipal waste management companies that have started textile waste collection in 2020 (JLY 2021).

Municipal waste management company	Population (2021)
South-West Finland Waste Management company (LSJH)	422 608
Helsinki region environmental services (HSY)	1 237 207
Rauma regional waste management facility	48 492
Loimi-Hämeen Jätehuolto Oy (LHJ)	108 279

Also, the charity organizations reported an increase in the collected volumes and the amounts of donations each year. The growing consumer interest in buying secondhand clothing and the increasing awareness of the environmental impacts of fashion have had a positive effect on sales of secondhand retailers. However, the quality of donated clothes is getting worse which means higher amounts and costs of wastes for the businesses.

From 2012 to 2019, the recovery of textiles as material has remained on quite a low level and resources for material identification and separations in the bigger scene have been lacking. However, since 2019 and within the following few years, significant improvement is foreseen. Municipal waste management companies have started (from 2019) a separate collection of end-of-life textiles to prepare for the separate collection requirement taking place in 2023. In addition, pilots performed within the Telaketju network have generated experience on how to organize the collection (Telaketju 2021). By the end of 2020, the collection was arranged in the area of five waste management companies (LSJH, Rauma regional waste management facility, Helsinki region environmental services (HSY), Loimi-Hämeen Jätehuolto and Pirkanmaan Jätehuolto). In 2021, the collection is expected to begin in at least five new waste management company areas and phase by phase become national.

LSJH is planning a refining plant for treating the collected end-of-life textiles and enabling their recycling. In 2021 testing of the refinement will start in a pilot plant located in Paimio Green Field Hub. Rester Oy activities on the processing of end-of-life textiles from companies will also be located under the same roof. LSJH and Rester Oy will process end-of-life textiles and fibers mechanically into recycled fibers which companies can utilize as raw materials for their products. The final aim of LSJH is to launch in Topinpuisto, Turku a facility that could cover the demand for refining capacity for the total collected volume of end-of-life textiles after 2023. Services would be offered also to other Baltic Sea countries. (LSJH 2021).

Different operators of the textile system are also looking for possibilities to improve the circulation of textiles. From the responses we received to the end-of-life textile questionnaire, we also learned that charity organizations, laundries and other operators dealing with end-of-life textiles have promoted recycling of textile waste after the year 2019. Co-operation with companies utilizing end-of-life textiles as raw material has increased, and the volumes of textiles recovered as energy have declined since 2019. For example, the Metropolitan Area Recycling Center directed most of the textile waste it received (329 tonnes) to energy recovery, but since June 2020, the textile waste has been directed to LSJH Paimio pilot plant. Charity organizations announced their interest in finding new recycling solutions for the non-reusable textiles they receive. Different alternatives have been considered, and some collaborations have started during 2020 e.g., with LSJH. As one big obstacle they identified the lack of domestic operators able to accept large amounts of textiles at once. Presorting small batches of textiles requires too many resources to make it profitable for the charity organizations.

Three of the four interviewed laundry companies pointed out that since 2019, the volume of end-of-life textiles directed to recycling has increased. Most of the end-of-life textiles (88%) came from Lindström Oy, the biggest textile rental service and laundry company in Finland, and its subsidiary Comforta Oy. In 2019, 70% (650 tonnes) of their discarded textiles were directed to energy recovery. In 2021, Comforta Oy directs almost 97% of the discarded textiles to recycling and only 3% to energy recovery. In 2021, Lindström Oy directs most of the work clothes, res-

taurant textiles and hand towel rolls to recycling. In 2020, the laundry company Sakupe Oy delivered 50% (25 tonnes) of its previously incinerated waste textiles for recycling.

Image Wear Oy operates as a workwear contract supplier for the Police, the Rescue Departments, Customs and other smaller operators. In 2019, Image Wear purchased and manufactured a total of 213 tonnes of garments for its partners. In recent years, Image Wear has started to provide its customers with take-back services for end-of-life garments. Take-back end-of-life textiles are reused or recycled. In 2019, Image Wear repurchased 24.5 tonnes of textiles, which equals to 11% of the total purchased amount. Image Wear participates in the Telaketju project in 2021 to further promote circular economy within its business, having a goal of directing 50% of all the returned items to recycling in 2022. (Image Wear 2019).

The discarded uniforms of the Police, the Rescue Departments and Customs are considered difficult to recycle e.g., due to tags, zippers and buttons that need special treatment prior to recycling. Hence, uniforms are currently mainly incinerated. However, for the future, new options are under consideration, with Kuusakoski Oy being involved as part of the solutions. The Finnish Defense Forces has textile recycling as part of their environmental strategy for 2021–2032. An interview with the Headquarters of the Defense Forces Logistics disclosed that utilization of end-of-life textiles is being developed and a tender for the post-processing of end-of-life textiles in line with circular economy thinking is currently being prepared.

Improvements in data quality and coverage is needed

The data acquisition behind this report shows several data gaps concerning textile flows. Especially data on end-of-life textile flows is severely gapped and incomplete. A more detailed assessment and accounting of intermediate use of textiles would need separate data collection in Statistics Finland and several surveys to enterprises.

The diversity of textile products and their complex streams from producers to users and various routes as end-of-life textiles makes it challenging to capture all these flows completely. Methods used in several previous Nordic studies provide a practice that nar-

rows the flows in the scope down to the main textile products (clothes and household textiles) and the central flows from users to the next destinations. The more specific product scope prevents the counting of other heavier materials that are often used in textile products (e.g rubber in shoes and carpets). However, the shares of specific product groups are more difficult to estimate for example from the mixed MSW. Additionally, the mass of materials other than textiles cannot be excluded accurately, which overestimates some weights. Although a wider product scope would provide valuable information in more detail, a simple and easily repeatable method is necessary to make

international comparisons streamlined and results comparable.

However, despite of the methodology used, data quality and coverage differ within countries. In Finland, most of the monetary data used in this study is open access data. Values for private purchases through international online shops and some of the domestic production data is not publicly available making them more difficult to obtain and estimate. Due to the growing use of e-commerce, especially the data from online purchases should be more available. Additionally, connecting data from different sources is hindered by the different product classifications, values and units used.

Needs for further research and development

In order to be able to regularly generate comparable data on end-of-life textile flows, a reporting system with guidance on how to measure and report the textile volumes should be generated for the value chain operators. Volumes should be based on weighing and the products included should be identical for all operators. The methodology followed in this mapping has been used for several national textile flow studies, and if followed systematically in future mappings, would produce a solid basis for information on textile flows e.g. on the European level.

The estimates produced on C2C exchanges via informal and formal routes were based on previous domestic or international studies and include uncertainty. Information on e.g., flows exchanged between friends and families could be studies through specific questionnaires. Additionally, a system for following and reporting the more formal exchanges through online and offline hubs could be included in the reporting system mentioned above.

In addition to the textile volumes, the development of material recovery solutions requires data on the textile waste quality, i.e., the fiber types included in the material. There are ongoing studies (e.g. in the Finix project, Aalto 2021) on adding this type of data into textiles and if these solutions are taken in general use, they will provide a valuable addition to the system. While these are not yet in use, data on fiber types could be produced by the operators within the end-of-life textile value chain.

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Appendices

Appendix 1. The list of textile and wearing apparel products

CPA 6-digit code	Description	Comment
131010	Wool grease (including lanolin)	
131021	Raw silk (not thrown)	
131022	Wool, degreased or carbonised, not carded or combed	
131023	Noils of wool or of fine animal hair	
131024	Wool and fine or coarse animal hair, carded or combed	
131025	Cotton, carded or combed	
131026	Jute and other textile fibres (except flax, true hemp and ramie), processed but not spun	
131029	Other vegetable textile fibres, processed but not spun	
131031	Synthetic staple fibres, carded, combed or otherwise processed for spinning	
131032	Artificial staple fibres, carded, combed or otherwise processed for spinning	
131040	Silk yarn and yarn spun from silk waste	
131050	Yarn of wool put up or not put up for retail store	
131061	Cotton yarn (other than sewing thread)	
131062	Cotton sewing thread	
131071	Flax yarn	
131072	Yarn of jute or of other textile bast fibres	
131081	Yarn of man made filaments, multiple or cabled (other than sewing thread, high tenacity yarn of polyamides, polyesters or viscose rayon), not put up for retail sale	
131082	Yarn other than sewing thread of synthetic staple fibres, containing >= 85% by weight of such fibres	
131083	Yarn (other than sewing thread) of synthetic staple fibres, containing < 85% by weight of such fibres	
131084	Yarn (other than sewing thread) of artificial staple fibres	
131085	Sewing thread and yarn of artificial and synthetic filaments and fibres	
131091	Garnetted stock of wool or of fine or coarse animal hair	
131092	Garnetted stock and other cotton waste	
131093	Preparation services of natural textile fibres	
131099	Sub-contracted operations as part of manufacturing of textile yarn and thread	Excluded
132011	Woven fabrics of silk or of silk waste	
132012	Woven fabrics carded or combed wool or fine animal hair or of coarse animal hair or of horsehair	
132013	Woven fabrics of flax	
132014	Woven fabrics of jute and other textile bast fibres (except flax, true hemp and ram-ie)	
132019	Woven fabrics of other vegetable textile fibres	
132020	Woven fabrics of cotton	
132031	Woven fabrics of synthetic filament yarn and artificial filament yarn	
132032	Woven fabrics of synthetic staple fibres	
132033	Woven fabrics of artificial staple fibres	
132041	Woven pile fabrics and chenille fabrics (other than terry towelling and narrow fab-rics)	

132042	Terry towelling and similar woven terry fabrics (other than narrow fabrics) of cotton	
132043	Other terry towelling and similar woven terry fabrics (other than narrow fabrics)	
132044	Gauze (other than narrow fabrics)	
132045	Tufted textile fabrics, other than carpets	
132046	Woven fabrics (including narrow fabrics) of glass fibres	
132050	Imitation fur by weaving	
132099	Sub-contracted operations as part of manufacturing of textile fabrics	Excluded
133011	Bleaching and dyeing services of textile fibres and yarns	Excluded
133012	Bleaching services of fabrics and textile articles (including wearing apparel)	Excluded
133013	Dyeing services of fabrics and textile articles (including wearing apparel)	Excluded
133014	Printing services of fabrics and textile articles (including wearing apparel)	Excluded
133019	Other finishing services of textiles and textile articles (including wearing apparel)	Excluded
139111	Pile fabrics, terry fabrics, knitted or crocheted	
139119	Other knitted or crocheted fabrics, including imitation fur by knitting	
139199	Sub-contracted operations as part of manufacturing of knitted or crocheted fabrics	Excluded
139211	Blankets and travelling rugs, except electric blankets	
139212	Bed linen	
139213	Table linen	
139214	Toilet and kitchen linen	
139215	Curtains (including drapes) and interior blinds	
139216	Furnishing articles n.e.c.	
139221	Sacks and bags, of a kind used for the packing of goods	
139222	Tarpaulins, awnings and sunblinds	
139223	Parachutes (including dirigible parachutes) and rotochutes	
139224	Quilts, eiderdowns, cushions, pouffes, pillows, sleeping bags and the like, fitted with springs or stuffed or internally fitted with any material or of cellular rubber or plas-tics	
139229	Other made-up textile articles (including floor cloths, dish-cloths, dusters and similar cleaning cloths, life-jackets and life-belts)	
139299	Sub-contracted operations as part of manufacturing of made-up textile articles, except apparel	Excluded
139311	Carpets and other textile floor coverings, knotted	Excluded
139312	Carpets and other textile floor coverings, woven, not tufted or flocked	Excluded
139313	Carpets and other textile floor coverings, tufted	Excluded
139319	Other carpets and textile floor coverings (including those of felt)	Excluded
139399	Sub-contracted operations as part of manufacturing of carpets and rugs	Excluded
139411	Twine, cordage, rope and cables, of jute or other textile bast fibres	
139412	Knotted netting of twine, cordage or rope, made up nets of textile materials	
139420	Rags, scrap twine, cordage, rope and cables and worn out articles of textile materials	
139499	Sub-contracted operations as part of manufacturing of cordage, rope, twine and netting	Excluded
139510	Non-wovens and articles made from non-wovens, except apparel	
139599	Sub-contracted operations as part of manufacturing of non-wovens and articles made from non-wovens, except apparel	Excluded
139611	Metallised yarn or metallised gimped yarn	
139612	Woven fabrics of metal thread and woven fabrics of metallised yarn n.e.c.	
139613	Rubber thread and cord, textile covered	

139614	Textile fabrics, impregnated, coated or covered n.e.c.	
139615	Tyre cord fabric of high tenacity yarn of nylon or other polyamides, polyesters or viscose rayon	
139616	Textile products and articles for technical uses (including wicks, gas mantles, hose piping, transmission or conveyor belts, bolting cloth and straining cloth)	
139617	Narrow woven fabrics	
139699	Sub-contracted operations as part of manufacturing of technical and industrial textiles	
139911	Tulles and other net fabrics, except woven, knitted or crocheted fabrics	
139912	Embroidery in the piece, in strips or in motifs	
139913	Felt, coated, covered or laminated	
139914	Textile fibres ≤ 5 mm in length (flock), textile dust and mill neps	
139915	Gimped yarn and strip	
139916	Quilted textile products in the piece	
139919	Other textiles and textile products n.e.c.	
139999	Sub-contracted operations as part of manufacturing of other textiles n.e.c.	Excluded
141110	Apparel of leather or of composition of leather	
141199	Sub-contracted operations as part of manufacturing of leather clothes	
141211	Men's ensembles, jackets and blazers, industrial and occupational	
141212	Men's trousers, bib and brace overalls, breeches and shorts, industrial and occupational	
141221	Women' s ensembles, jackets and blazers, industrial and occupational	
141222	Women's trousers, bib and brace overalls, breeches and sorts, industrial and occupational	
141230	Other workwear	
141299	Sub-contracted operations as part of manufacturing of workwear	Excluded
141311	Men's or boys' overcoats, car coats, capes, cloaks, anoraks, windcheaters, wind-jackets and similar articles, knitted or crocheted	
141312	Men's or boys' suits, ensembles, jackets, blazers, trousers, bib and brace overalls, breeches and shorts, knitted or crocheted	
141313	Women's or girls' overcoats, car coats, capes, cloaks, anoraks, windcheaters, wind-jackets and similar articles, knitted or crocheted	
141314	Women's or girls' suits, ensembles, jackets, blazers, dresses, skirts, divided skirts, trousers, bib and brace overalls, breeches and shorts, knitted or crocheted	
141321	Men's or boys' overcoats, raincoats, car coats, capes, cloaks, anoraks, wind-cheaters, wind-jackets and similar articles of textile fabrics, not knitted or crocheted	
141322	Men's or boys' suits and ensembles of textile fabrics, not knitted or crocheted	
141323	Men's or boys' jackets and blazers, of textile fabrics, not knitted or crocheted	
141324	Men's or boys' trousers, bib and brace overalls, breeches and shorts of textile fab-rics, not knitted or crocheted	
141331	Women's or girls' overcoats, car coats, capes, cloaks, anoraks, wind-cheaters, wind-jackets and similar articles of textile fabrics, not knitted or crocheted	
141332	Women's or girls' suits and ensembles of textile fabrics, not knitted or crocheted	
141333	Women's or girls' jackets and blazers of textile fabrics, not knitted or crocheted	
141334	Women's or girls' dresses, skirts and divided skirts of textile fabrics, not knitted or crocheted	
141335	Women's or girls' trousers, bib and brace overalls, breeches and shorts of textile fabrics, not knitted or crocheted	
141340	Worn clothing and other worn articles	

141399	Sub-contracted operations as part of manufacturing of outerwear	Excluded
141411	Men's or boys' shirts, knitted or crocheted	
141412	Men's or boys' underpants, briefs, nightshirts, pyjamas, bathrobes, dressing gowns and similar articles, knitted or crocheted	
141413	Women's or girls' blouses, shirts and shirt-blouses, knitted or crocheted	
141414	Women's or girls' slips, petticoats, briefs, panties, nightdresses, pyjamas, dressing gowns, negligees, bathrobes and similar articles, knitted or crocheted	
141421	Men's or boys' shirts, of textile fabric not knitted or crocheted	
141422	Men's or boys' singlets and other vests, underpants, briefs, nightshirts, pyjamas, bathrobes, dressing gowns, of textile fabric not knitted or crocheted	
141423	Women's or girls' blouses, shirts and shirt-blouses, of textile fabric not knitted or crocheted	
141424	Women's and girls' singlets and other vests, slips, petticoats, briefs, panties, night-dresses, pyjamas, negligees, bathrobes, dressing gowns and similar articles, of textile fabric not knitted or crocheted	
141425	Brassieres, girdles, corsets, braces, suspenders, garters and similar articles and parts thereof, whether or not knitted or crocheted	
141430	T-shirts, singlets and other vests, knitted or crocheted	
141499	Sub-contracted operations as part of manufacturing of underwear	Excluded
141911	Babies' garments and clothing accessories, knitted or crocheted	
141912	Tracksuits, ski suits, swimwear and other garments, knitted or crocheted	
141913	Gloves, mittens and mitts, knitted or crocheted	
141919	Other made-up clothing accessories and parts of garments or of clothing accesso-ries, knitted or crocheted	
141921	Babies' garments and clothing accessories, of textile fabric, not knitted or crocheted	
141922	Tracksuits, ski suits and swimwear	
141923	Handkerchiefs, shawls, scarves, veils, ties, cravats, gloves and other made-up cloth-ing accessories	
141931	Clothing accessories of leather or of composition leather, except sports gloves	
141932	Garments made up of felt or non-wovens, textile fabrics impregnated or coated	
141941	Hat forms, hat bodies and hoods of felt	
141942	Hats and other headgear, of felt, or plaited or made by assembling strips of any ma-terial, or knitted or crocheted or made up from lace or other textile fabric in the piece	
141943	Other headgear, except headgear of rubber or of plastics, safety headgear and asbestos headgear	
141999	Sub-contracted operations as part of manufacturing of other wearing apparel and accessories	Excluded
142010	Articles of apparel, clothing accessories and other articles of fur skin, except head-gear	
142099	Sub-contracted operations as part of manufacturing of articles of fur	
143110	Panty hose, tights, stockings, socks and other hosiery, knitted or crocheted	
143199	Sub-contracted operations as part of manufacturing of knitted and crocheted hosi-ery	
143910	Jerseys, pullovers, cardigans, waistcoats and similar articles, knitted or crocheted	
143999	Sub-contracted operations as part of manufacturing of other knitted and crocheted apparel	Excluded
381156	Textile waste	

Source: Eurostat 2021.

Appendix 2. Grouping used for the final textile products.

CN 4 digit code	Product group
6101 + 6102 + 6201 + 6202	Overcoats, car coats, capes, cloaks, anoraks, incl. ski jackets etc.
61031-3 + 61041-3 + 62031-3 + 62041-3	Suits, ensembles, jackets, blazers
61034 + 61046 + 62034 + 62046	Trousers, bib and brace overalls and shorts
61044-5 + 62044-5	Dresses and skirts
6105 + 6106 + 6205 + 6206	Shirts, blouses and tops
6107 + 6108 + 6212 + 6115 + 6215	Underwear, nightshirts, pyjamas, bathrobes, dressing gowns plus bras, corsets etc. plus Pantyhose, tights, stockings and socks
6109 + 6207 + 6208	T-shirts, singlets and other vests
6110	Sweaters, cardigans, waistcoats
6111 + 6209	Babies clothing
6112 + 6211 + 6114	Tracksuits, ski-suits and swimwear plus professional wear
6113	Garments covered or impregnated with plastics
6117 + 6213 + 6214 + 6217 + 6116 + 6216	Handkerchiefs, ties, scarves, gloves and other
6210	Non-woven garments
6301	Blankets and travelling rugs
63021-3	Bed linen
63024-5	Tablecloths
63026 + 63029	Towels, tea towels and cloths
6303 + 6304	Curtains and drapes and other interior furnishings

Source: Watson et al. 2018

Appendix 3. Supply of new textiles in Finland in 2019

Supply of new textiles (clothing and household textiles) and their approximate consumption both private and public divided into different product groups in 2019.

	Total supply (tonnes)	Household consumption (tonnes)	Public sector & enterprises (tonnes)	Total supply (kg/capita)	Household consumption (kg/capita)
Garments	49 530	41 485	8 045	9.0	7.5
Overcoats, anoraks	3 793	3 170	623	0.7	0.6
Suits and blazers	1 248	635	613	0.2	0.1
Trousers and shorts	9 085	6 822	2 263	1.6	1.2
Dresses and skirts	1 866	1 561	305	0.3	0.3
Shirts, blouses, tops	2 389	2 377	13	0.4	0.4
Underwear, socks and nightclothes	6 917	6 806	111	1.3	1.2
T-shirts and vests	5 572	5 544	28	1.0	1.0
Sweaters and cardigans	4 602	4 400	202	0.8	0.8
Baby clothes	812	617	195	0.1	0.1
Sportwear and swimwear	2 398	803	1 594	0.4	0.1
Garments impregnated with plastic	125	83	42	0.0	0.0
Handkerchiefs, ties, scarves, gloves and other	2 424	1 822	602	0.4	0.3
Non-woven garments	2 828	1 377	1 452	0.5	0.2
Garments bought at international online shops*	5 468	5 468		1.0	0.9
Household textiles	12 812	10 421	2 391	2.3	1.9
Blankets and rugs	940	754	186	0.2	0.1
Bed linen	5 038	4 086	952	0.9	0.7
Table cloths	596	482	114	0.1	0.1
Towels, tea towels, cloths	2 585	2 083	501	0.5	0.4
Curtains, drapes, other furnishings	3 308	2 670	638	0.6	0.5
Household textiles bought at international online shops*	347	347		0.1	0.1
Sum of all new textiles	62 342	51 906	10 436	11.3	9.4

*Note: textiles bought from international online shop could not be divided into different product groups due the lack of detailed data.

Appendix 4. Questionnaires to end-of-life textile collectors and laundries

The following questionnaires were used for acquiring data on the flows of used textiles from 1) charities and other operators collecting used textiles and 2) laundries. The survey and questions were modified for the Finnish textiles market from Watson et al. (2020).

Questions on textile flows for Charity collectors

1. What quantity of used textiles did your organization collect in 2019 (or 2018)?

2. Additional questions on the reported collected quantity.
   a) Is this quantity based on measured weights or is it an estimate?
   b) Does the quantity include bags, toys, leather products, shoes or floor carpets with rubber underlay?

3. If the reported quantity contains the goods listed above that are outlined from this report, do you have an estimate of what percentage of the total that this represents?

4. How do you collect used textiles?
   a) In your stores
   b) In drop-off containers
   c) Via door-to-door collection
   d) Other
   e) How many stores and drop-off containers does your organization have?
      Where are the drop-off containers placed?

5. Do you also receive textiles from municipal waste companies? If yes, what quantity did you receive from them in 2019 (or 2018)? Were these quantities included in the quantity you reported under question 1?

6. Do you also get donations from private businesses, clothing stores or brand stores?
   For example new and/or used textiles, uniforms, work clothes from some sectors and/or unsold clothing collections from retail / brands etc.?
   If yes, what quantity did you receive in 2019 (or 2018) and from what types of businesses?
   Were these donations included in the quantity you reported under question 1?

7. Did you received donations from public (state or municipal-owned) organizations
   e.g. hospitals, schools etc. of new and/or used textiles?
   What quantity did you received in 2019 (or 2018) and from what types of organizations?
   Were these donations included in the quantity you reported under question 1?

8. What happened to the textiles you received from these sources?
   a) Sold them unsorted to a local wholesaler/sorting organisation? (Who?)
   b) Exported them unsorted to a wholesaler inside of EU? (Who?)
   c) Exported them unsorted to a wholesaler outside of EU? (Who?)
   d) Skim off the best textiles for sale in your shops?
   e) Fully sort them by yourselves in your own sorting plants?

9. **If you answered d) in the previous question (i.e. you skim off the best textiles for sale in your shops):**
    a) What share of your total collected textiles do you skim off for sale in your shops (% or total quantity in 2019 (or 2018)?
    b) What do you do with the remaining textiles?
    (More than one of the options below could be correct. In that case indicate the shares that end in each route, and describe each in detail):
        i. Donate reusable items locally to people in need (describe)
        ii. Sell/give to wholesaler/sorter (who?)
        iii. Recycle into other products (including upcycling). What kind of recycling are we talking about? What kinds of products? Is it local or exported for recycling elsewhere?
        iv. Send for incineration (where?)
        v. Other?

10. **Concerning the quantity that is sent for incineration:**
    a) Have you tried to reuse or recycle it? If so, what did you attempt?
    What obstacles did you meet? What collaborations did you investigate?
    b) What local recycling solutions exist today that have potential?
    c) Do you have to pay waste fees to get rid of it? How much?
    d) What type of products/fiber types does it comprise?

11. **Concerning general economic conditions for used textile collection:**
    a) How has this developed in recent years in Finland?
    b) What has caused these developments?
    c) Does the import of used textiles from other countries affect the economics of your operations?

12. **What other obstacles do you have in increasing the collection and resell of used textiles?**
    a) Regulative and legal (e.g. waste definitions)
    b) Lack of markets
    c) Lack of technology
    d) Lack of quality
    e) High level of contamination
    f) other

13. **How could government assist in overcoming these obstacles you identified in the two previous questions?**

14. **Would you be willing to participate in the co-operative development of the textile sector, for example in work-shops / joint events involving public decision-makers as well as various actors in the textile sector?**

In order to be able to put material flow and volumes to the right scale at the national level,
we asked each company to give the following company information:

    1. Classification of the company
    2. Business ID of the company
    3. How much the company covers from entire industry, % or own estimate
    4. Total turnover of the company in 2019
    5. Company's turnover from the textile business in 2019

Questions on textile flows for Laundry

1. How many tonnes / kilos did you wash textile in 2019 (or 2018)?

2. How many tonnes / kilos of textiles processed by your company were removed from use in 2019 (or 2018)?

3. Is the amount of removal textile your own estimate or weighed amount?

4. If known, please complete in the table below which fabric type is removed each year?

Fabric type	Kilos, kg
100% Cotton	
100% Polyester	
100% Viscose	
100% Wool	
100% Acrylic	
Other pure fibers	
Other mixed fibers	
+80% wool mix	
Cotton/ poly –mix fibers	

5. How does your organization dispose removal textiles currently? You can choose more than one answer.

Table 1.

	Yes(/No)	Kilos, kg
Energy waste (incineration, mixed waste)		
By selling it		
Textile is re-used in the Finnish market		
Textile in exported inside the EU-area		
Textile in exported outside the EU-area		
By donating it		
Other means, what?		

6. If your removal textiles went to one of the operators in Table 1 above, who will the textile go?
    a) What happens to textiles in the hands of the operator?

7. What waste management service providers does your organization use?

Table 2.

	Yes(/No)	Kilos, kg
Lassila & Tikanoja		
Delete		
Local waste management company, private		
Local waste management company, communal		
Urbaser		
Remeo		

8. If your removal textiles went to one of the operators in Table 2 above, what happens to the textiles in the hands of the operator?

9. Do you sell textile maintenance services to service companies, such as restaurants and hotels?
   a) If so, for which companies?
   b) Does your textile service include the for operators:
      i. work clothes
      ii. bed linen and towels
      iii. tablecloths
      iv. other textiles, what?
   c) Do you know how to estimate your market share?

10. Do you sell textile supply services to public sectors
    (hospitals, health centers, service houses or national defense etc.)?
    a) If so, to which parties?
    b) If you answered yes to this question, does your textile service include:
       i. work clothes
       ii. bed linen and towels
       iii. both of the above
       iv. other textiles, what?
    c) Can you estimate your market share of that business area in Finland?

11. If you answered yes to questions 2 and 3:
    a) Does your company or customer own the textiles?
    d) Who takes care of the removal of poor textiles, you or your customer?

In order to be able to put material flow and volumes to the right scale at the national level, we asked each company to give the following company information.

   1) Industry classification of the company (TOL2008):
   2) Business ID of the company
   3) How much the company covers from entire industry, % or own estimate
   4) Total turnover of the company in 2019
   5) Company's turnover from the textile business in 2019

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