# Industrial Fabric Waste Flow

## A tentative Analysis for Vietnam

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

FABRIC Asia

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| | |
|---|---|
| **ASEAN** | The Association of Southeast Asian Nations |
| **CPTPP** | Comprehensive and Progressive Agreement for Trans-Pacific Partnership |
| **DOIT** | Department of Industry and Trade |
| **DONRE** | Department of Natural Resources and Environment |
| **EPR** | Extended Producer Responsibility |
| **EU** | The European Union |
| **EVFTA** | European Union- Vietnam Free Trade Agreement |
| **FTA** | Free Trade Agreement |
| **GDP** | Gross Domestic Product |
| **GIZ** | German Corporation for International Cooperation |
| **GOV** | Government |
| **GRS** | Global Recycling Standard |
| **IDH** | The Sustainable Trade Initiative |
| **IFC** | International Finance Corporation |
| **ISWM** | Integrated Management of Solid Waste |
| **LEP** | The Law on Environment Protection 2020 |
| **MCG** | MCG Energy and Real Estate JSC |
| **MOIT** | Ministry of Industrial and Trade |
| **MONRE** | Ministry of Natural Resources and Environment |
| **MPI** | Ministry of Planning and Investment |
| **RCEP** | Regional Comprehensive Economic Partnership |
| **RCS** | Recycled Claim Standard |
| **RMG** | Readymade Garment |
| **UNDP** | United Nations Development Programme |
| **US** | The United States |
| **VCCI** | Vietnam Chamber of Commerce and Industry |
| **VCOSA** | Vietnam Cotton & Spinning Association |
| **VITAS** | The Vietnam Textile and Apparel Association |
| **WTO** | World Trade Organization |

The report is part of the project 'Fostering and Advancing Sustainable Business and Responsible Industrial Practices in the Clothing Industry in Asia' (FABRIC) , implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

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**Disclaimer:**
The research is continuous research – within the limited data availability and the impacts of informal waste market. The information and the data in the research have been conducted on the basis of publicly available information; internal data and other sources believed to be true and are for general guidance only but which may have not been verified independently. While every effort is made to ensure the accuracy and completeness of information contained, the company takes no responsibility and assumes no liability for any error/omission or accuracy of the information. Recipients of this material should rely on their own judgments and conclusions from relevant sources before making any decisions.

# Executive Summary

**The textile industry in Vietnam generates massive amounts of fabric waste, which this study aims to address by analyzing the fabric waste stream with a strong focus on local ground reality.**

Fabric waste at the cutting table can be divided into two categories: fabric end-rolls (or deadbolts) and fabric scraps, which are leftovers from the cutting process.
Within the scope of tracking fabric waste from factory to landfill (formal and informal approaches) in Vietnam, this report applies a circular economy perspective to post-industrial fabric waste. The waste stream analysis focuses on the down-stream situation, including current waste management at Cut-Make-Trim (CMT) manufacturers, waste handling and end-of-life disposal. Further, the framework of current government regulations and the key stakeholders in accelerating the recycled textile market in Vietnam are analyzed.
The goal of the study is to realize the potential for post-industrial textile-to-textile recycling by analyzing the current local circumstances of the fabric waste flow in Vietnam.

## At a glance: The fabric waste situation in Vietnam

The textile sector is the second largest industry, according to the yearly export volumes in Vietnam, with more than 7,000 enterprises. Based on the estimation, that 12-15% of the total production volume becomes waste, it accounts to 937,500 tons of textile waste yearly for Vietnam. *(The total production volume of fabric is assumed to be 6,250,000 tons. It is calculated based on domestic production volume of fabric 2,500,000 tons[21] plus 60% import).* These volumes are around 367 truck loads per day and represent enough feedstock to establish a textile-to-textile recycling economy. However, in current practice, there is a high risk of unethical non-hazardous waste disposal treatments and a large informal economy around the recyclable waste. Further, CMT-manufacturers lack capability and knowledge to separate the fabric waste to provide a high-quality feedstock. Additionally, the local waste sector often complies poorly with social and environmental regulations.

In Vietnam, some recycling approaches has been identified and shown in table 1.

Since the recycling output remains low or is used for producing other products a textile-to-textile recycling approach is currently not given.

The Government of Vietnam recognizes the need to address issues of solid waste and requires a better management system in order to adopt the principles of a circular economy. Among recently published national strategies, in particular, the law of environmental protection, solid waste management is an urgent environmental challenge to tackle. Nevertheless, fabric waste has neither been recognized as a challenge for solid waste management nor as a potential economic opportunity. Since the recycling flow is primarily private, there are no specific regulatory obstacles to establishing a recycling system.

**TABLE 1: CURRENT RECYCLING APPROACHES IN VIETNAM**

| Waste category | Treatment process | Treatment category | Final destination |
|---|---|---|---|
| **100% polyester** | Mechanical recycling | Physical treatment | Produce pellets to quality which meets requirements for lower-end household, furniture products and to produce polyester fibres |
| **100% cotton** | Mechanical recycling | Physical treatment | Processing of shredded fabric scrap into fibre to be used for yarn production |
| **Blended cotton (minimum 60%, no spandex)** | Mechanical recycling | Physical treatment | Processing of shredded fabric scrap into fiber to be used for yarn production |

## Research findings: Towards textile-to-textile recycling in Vietnam

The study identifies five main findings of current handling of industrial fabric waste in Vietnam towards a textile-to-textile recycling economy.

**Regulation and management:** Fabric scrap management falls under general industrial solid waste management but not under specific regulations or any central management system for the material itself which hamper the access to accurate feedstock data and the adequate handling and treatment of fabric waste.

**Current availability of textile-to-textile recycling feedstock:** 100% cotton and 100% polyester are high-demand feedstocks for textile-to-textile recycling in Vietnam which is largely run by Chinese textile supply chains in Vietnam. Moreover, 100% polyester is recycled into pellets and produced for different output products.

**Fabric waste sortation at manufacturer level:** Overall, the fabric sorting cost is about 10-30% of the production cost for the recycler. Sorting at the cutting table directly would reduce the cost of feedstock material for the downstream recycling process. While interested in increasing sustainable performance, most manufacturers do not sort fabric scraps at source as they do not know what is worth sorting.

**Information and knowledge:** There is a lack of data and knowledge available for the relevant stakeholders, including policy makers, waste producers, recyclers and potential investors, in order to make informed decisions. Specifically, there is insufficient data available on the quantity and quality of the feedstock to allow textile-to-textile recycling.

Furthermore, there exists only limited know-how about the technical feasibility of recycling approaches as well as the current state of Research&Development of recycling processes, which could already provide output that can compete with virgin materials, is missing.

**Market Demand:** The market demand for recycled material plays a major role in shaping and promoting the flow of recyclable fabric scraps toward a closed loop system. It includes clear standards and acceptance quality to enable the economic viability for the recycled material production.

The following barriers and good practices can be summarized.

**TABLE 2: GOOD PRACTICES AND BARRIERS**

| Good practices | Barriers |
|---|---|
| • Gradual investments in equipment for better waste sortation at factory level<br>• Polyester fabric is used as feedstock for plastic recycling<br>• Sustainable performance such as HIGG FEM, required by brands, incentivize manufacturers to improve their waste management | • Lack of data about feedstock compositions<br>• Limited knowledge about possible recycling technology and feedstock requirements<br>• Missing legislation about fabric waste management<br>• Lack of brands' demand for recycled material made from fabric waste<br>• Low environmental and social compliance of waste handling and sorting |

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# Chapter 1: introduction

## 1.1 Objectives of the study

In order to assess the potential for textile-to-textile recycling in Vietnam and its contribution to a so-called 'circular economy', it is essential to understand the current circumstances and practices 'on the ground'. Therefore, the primary objective of this study is to map and analyse the fabric waste streams, the stakeholders involved and the regulatory frameworks in Vietnam.

The study focuses on the fabric waste generated at the cutting table by garment manufacturers (Tier 1). Herein, fabric waste can be divided into two categories: fabric end-rolls (or deadbolts) and fabric scraps, which are leftovers from the cutting process. Broadly speaking, the amount of textile scrap produced is heavily influenced by the volume of apparel produced and exported. Even though there are no precise data on post-industrial fabric waste available, it can be assumed that a 12% to 15% of fabric waste depending on the style, design and material, is generated from the total production volume. Since textiles forms one of the major manufacturing sectors in Vietnam with over 7,000 textile manufacturing companies in operation, the volume of fabric waste generation is estimated to be very high. Fabric waste has become one of the major negative environmental impacts of the fashion industry, since most of the waste is dumped or burned, causing severe air pollution and releasing microplastics and toxins. To address the issue and define further action, it is essential to understand and assess the current waste flow.

### SPECIFIC OBJECTIVES

- Providing assessment of industrial fabric waste streams and disposal methods
- Providing analysis of relevant formal and informal stakeholders
- Providing assessment of legal and regulatory frameworks

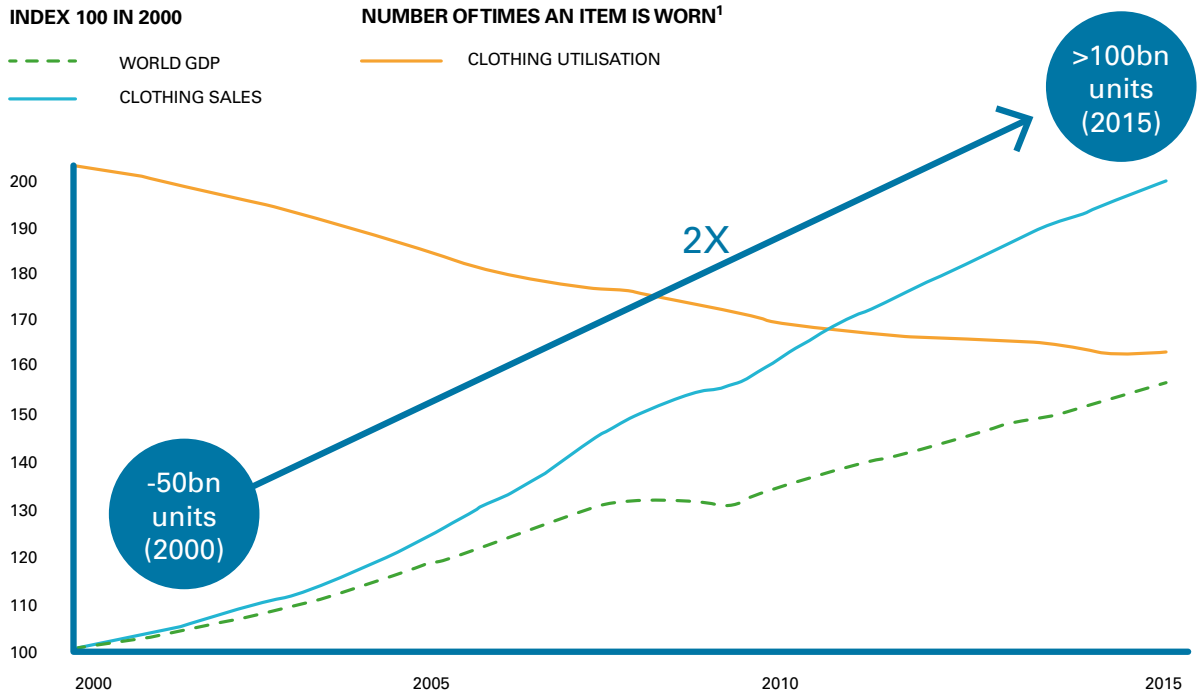
## 1.2 General background

### 1.2.1 Global overview

Globally, the US$1.3 trillion clothing industry employs more than 300 million people along the value chain, and the production of cotton alone accounts for almost 7% of all employment in some low-income countries. Clothing accounts for more than 60% of the total textiles used, and in according to the graph, clothing production has approximately doubled, driven by a growing middle-class population across the globe and increased per-capita sales in mature economies. At the same time, clothing utilisation has declined by almost 40%. Both developments are mainly due to the 'fast fashion' phenomenon, with a quicker turnaround of new styles, increased number of collections offered per year, and often, lower prices.

The current system for producing, distributing, and using clothing operates in a linear fashion. Non-renewable resources are used to produce clothes which are often used for a short period, after which the materials are lost to landfill or incineration. More than half of fast fashion is estimated to be disposed of in under a year. This linear system leaves economic opportunities untapped, puts pressure on resources, pollutes and degrades the natural environment and its ecosystems, and creates significant negative societal impacts at local, regional, and global scales.

**FIGURE 1: CURRENT TREND IN CLOTHING SALES AND UTILISATION**




[1] *Average number of times a garment is worn before it ceases to be used*

*Source: Euromonitor international Apparel & Footwear 2016 Edition (volume sales trends 2005-2015); World Bank, World development indicators - GD (2017)*

### 1.2.2 The circular economy

The circular economy is one of the prime approaches to counter the linear model, closing the production/waste loop and bringing material value back into the supply chain. It is a regenerative system in which resource inputs, waste, emissions, and energy leakage are minimized by slowing, closing, and narrowing energy and material loops. This can be achieved via long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, recycling, and upcycling.

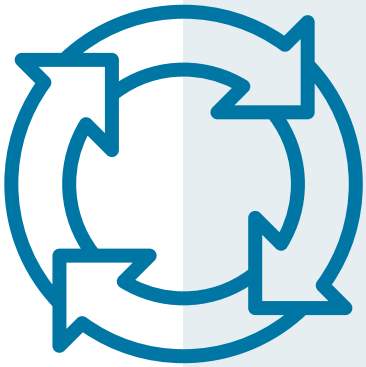
**There are three core elements of the circular economy:**

(1) Prioritizing regenerative resources by utilizing renewable, reusable, non-toxic resources as materials and energy in an efficient way.

(2) Maximizing the product lifespan to keep products in-use as long as possible

(3) Using waste as a resource by utilizing waste streams as a source of secondary material and recovering waste for reuse and recycling.[1]

This study analyzes the current textile flow in Vietnam and seeks to shed light on the importance of circularity and the potential for textile-to-textile recycling, in which waste becomes a new resource (as in Circular Economy core element 3).



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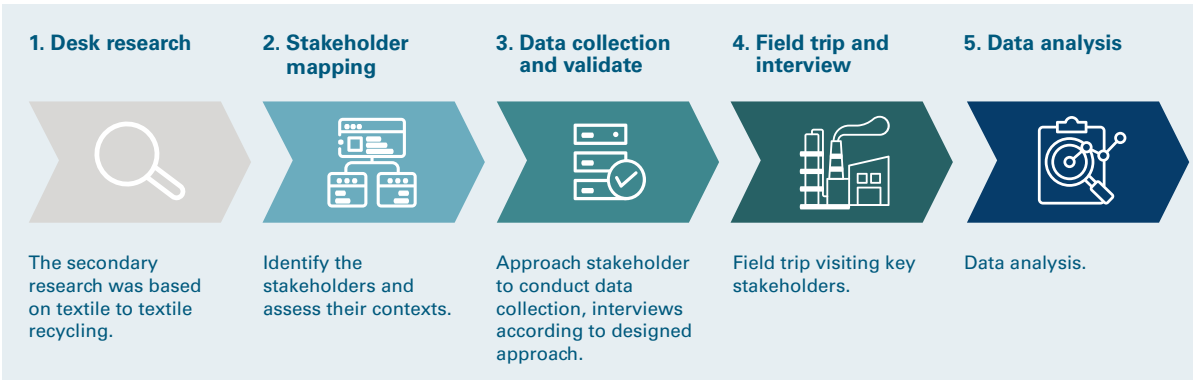
# Chapter 2: Methodology

## 2.1 Methodology and technical approach

The project brought a strong focus on local ground reality, taking into account the different stakeholders and state of development in Vietnam.

**FIGURE 2: METHODOLOGY**




**Desk research:** The secondary research was based on the current state-of-the-art developments in fabric recycling, general market conditions, and legal regulations.

**Stakeholder mapping and approach:** Considering the complexity and lack of transparency of the waste sector, the research team developed a specific approach for each stakeholder group. The mapping and the approach per stakeholder is described in Table 3.

**TABLE 3: TECHNICAL APPROACH**

| Stakeholder categories | Stakeholder group | Approach |
|---|---|---|
| **Government, policy maker** | Ministry | • Designated questionaire and interview regarding project goals |
| | Local authorities | |
| **Private sector** | Fashion brands & manufacturer group | • Questionnaires probing the circular goals and roles, strategies and action plan of fashion brands for production countries |
| | Tier 1 manufacturer | • Employ the Reverse Resources platform for data collection<br>• Follow up with field trip visit for 5 selected manufacturers |
| | Tier 3 manufacturer | • In-depth interview<br>• Informal investigation |
| | Waste handlers | • In-depth interview<br>• Informal investigation |
| | Waste buyers | • In-depth interview<br>• Informal investigation |
| | Recyclers | • In-depth interview<br>• Informal investigation |
| **Civil organisation, International technical agencies and donor** | Business Association and local NGOs | • Designated questionnaire and interview regarding project goals |
| | International Technical agencies, International organisation | • Designated questionaire and interview regarding project goals |

## PROJECT SCOPE:

Textile production waste contains various materials such as fibre waste (including dust and fluff), yarn residues, textile fabrics, cutting waste, feathers, leather, laminating fabric, defective products and other non-fabric waste, such as paper, cardboards, films, wood, etc. The material composition of the fabric waste comprises nearly all kinds of known natural and synthetic fibres. However, the scope of the research was developed based on the waste materials of non-laminating fabric waste at the cutting table to best explore the potential of textile-to-textile recycling in Vietnam. The studied waste materials used under the term 'fabric waste' are:

- Fabric scrap at cutting tables
- Fabric end-rolls

Hence, the research team focused on the Apparel Tier 1 – Cut-Make-Trim manufacturers as the specific research group of interest and on several Tier 3 producers– Yarn manufacturers that use fabric scraps as production input material.

In total, the study reached 72 stakeholders including nine fashion brands, 46 manufacturers, 10 waste handlers, five recyclers of which two are Tier 3 manufacturers/recyclers and three other actors.

## 2.2 Data collection

### 2.2.1 Primary data collection

**Primary data were collected from different stakeholders in four batches. In every batch, factory representatives, waste collectors, waste exporters/recycles, brand representatives, and representatives of industry associations and goverment bodies were interviewed. Interview questions were prepared to collect information from different stakeholders. After the analysis of the first batch of responses, the interview questions were modified. Primary data were collected in two ways.**

**1. Onsite visit & interview:**
Consultants visited manufacturers, waste collectors, waste exporters, industry association representatives, and government and non- government authorities in order to collect data relevant to the project. Formal interviews were conducted to understand the current scenario, challenges, and improvement opportunities.

**TABLE 4: DATA COLLECTION**

| Skateholder category | Executive interviews |
|---|---|
| Manufacturer | 25 |
| Waste collector | 7 |
| Waste processor/ Exporter/Importer | 4 |
| Manufacturer/NGO/ Governmental authority | 3 |
| Brand/Supplier | 5 |

**2. Offsite interview:**
Owing to COVID-19, it was not possible to interview every potential manufacturer. Hence, some interviews were conducted over the phone, and some information was collected via e-mail communication.

### 2.2.2 Secondary data collection

**1. Desk research:**

Many secondary pieces of research were reviewed to validate primary data and collect additional information

**2. Data collection from industry associations**

## 2.3 Limitations of the study

**1. The data associated with this report were obtained from publicly available sources, including:**

- Academic literature
- Laws, regulations, policies, standards and guidance published by central or local governments
- Industrial research reports Industrial database
- Corporate annual and sustainability reports
- Interviews

**2. The reported data are considered 'generalised' owing to the following multiple factors:**

- Interviewed stakeholders were pre-selected rather than be randomly selected. Conclusions were drawn based on feedback from the stakeholders' interview
- Stakeholders were not very open to discussing all matters of interest and also not very willing to share data
- Data on fabric consumption and waste generation according to fabric type were unavailable

**3. The reported findings are limited owing to multiple factors, including:**

- Lack of available secondary information and knowledge of the fabric waste sector and lack of data availability of waste volume and its end-of-life disposal method for each type of waste
- Lack of compliance, interest and transparencywithin the waste sector, especially regarding waste handling

**4. The cutting waste volume can vary owing to the factors mentioned below, i.e. the volume cannot be confirmed without robust country-specific analysis:**

- Product categories
- Product design or style
- Factory's cutting techniques Order frequency
- Seasonal orders

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# Chapter 3: Vietnam

## 3.1 Overview of the circular economy in Vietnam

After 35 years of the New Economy, Vietnam has grown tremendously, sustaining 7% growth in the past decade.[2] The country has shifted toward industrial services, with manufacturing contributing 25.1% of the total GDP in 2021.[3] Although the country went through 19 lockdowns in 2020 and 2021, it was one of the few economies that sustained growth during the pandemic. The UNIDO Competitive Industrial Performance Index (CIP) shows that Vietnam's manufacturing sector is making significant progress in the global context, rising 27 spots from 69th to 42nd in the global rankings in the period 2006-2016, and that this was the most significant leap among the Association of Southeast Asian Nations (ASEAN) countries over this time interval. The CIP differences among the top five in the region (Singapore, Malaysia, Thailand, Indonesia, and the Philippines) have been smaller than ever, and the Party Central Committee Resolution No. 23 NQ/TW goal for Vietnam, that of being one of ASEAN's top three competitors by 2030, is attainable if the current momentum is maintained.[4]

This economic growth also generates challenges for the environment. Vietnam is facing environmental risks, including depletion of natural resources, pollution, climate change, and so on. According to the World Bank, Vietnam is ranked among those countries most vulnerable to climate change, and environmental pollution is forecast to cost more than 3.5% of the GDP by 2030.[5] In response to these challenges, the government (GOV) has made great efforts to integrate sustainable development into economic growth. The circular economy has been highlighted in several environmental and economic policies as a way for the nation to reach sustainable targets. Vietnam is one of the first ASEAN countries to institutionalise circular economy regulations. Article 142, the Law on Environmental Protection (LEP) 2020 on the circular economy has defined policy tools necessary to promote the implementation of the circular economy at different stages of natural resource exploitation, production, manufacturing, distribution, consumption, and end-of-life handling.[6] These circular economy strategies and action plans, as well as ongoing development, are expected to be published in the near future with details on how the nation will adopt the circular economy concept.

## 3.2 Textile industry in Vietnam

Textile forms one of the major manufacturing sectors of Vietnam. Globally, it is one of the biggest textile manufacturers, with over 7000 textile manufacturing companies in operation, and these numbers are expected to grow rapidly.[7] The sector employs over three million people,7. labour costs are low and the labour force is growing. This has helped make textiles the second and third (footwear and apparel, respectively) largest export segments after electrical goods, contributing 16% of the country's GDP.[7]
Roughly 70% of business is centred around assembly manufacturing, and the textile trade is an industry driven by exports to the US (42%), Asian neighbours Japan and South Korea, and EU nations.[7] In 2021, apparel and footwear exports total led over 41.05 billion USD, up 15.36% compared to the same period in 2020 and 1.45 times higher than the set target.[7] Vietnam's potential textile growth is expected to increase in the coming year. Owing to the trade war, Vietnam has also been a significant investment and manufacturing location for the China +1 strategies of many manufacturers and brands. Therefore, Vietnamese textiles are expected to benefit from shifting orders when Chinese textiles are subjected to a 25% tax rate. More opportunities arise from recent free trade agreements (FTAs), including the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), Regional Comprehensive Economic Partnership (RCEP), European Union–Vietnam Free Trade Agreement (EVFTA), and UK-Vietnam Free Trade Agreement (UKVFTA). These FTAs will support an increase in export value, especially to explore other markets.

While Vietnam is a key player in the textile sector, more clothes, shoes, and other finished textile goods are manufactured in Vietnam than actual textile fibres or materials. This has led Vietnam to import large quantities of raw material and fabrics to supply the 'Cut-Make-Trim'(CMT) industry, which is dependent on the availability and cost of raw materials from abroad. Its dependence on raw material imports, from China in particular, impacted the Vietnamese market in 2020 owing to the COVID-19 pandemic. Around 70% of textile and garment manufacturers depend on imported materials, and Vietnam experienced a 3% drop in raw material imports from China as international restrictions were imposed.[8] In 2019, out of US$13.3 billion of total textile-related imports, $11.5 billion was spent on Chinese imports.[9]

The textile industry is somewhat vulnerable owing to a lack of easily available material. Vietnam is not a cotton-producing country, and the oil refining industry is also underdeveloped, resulting in a lack of synthetic material sources for the textile industry. These factors have contributed to a situation in which Vietnam imports an enormous amount of fibre and fabric for CMT manufacturing. Owing to the expected rise in raw material prices, importing fibre and fabrics will become costlier. The local production and recycling of fibres and fabric offer an opportunity to add value domestically and lower material import dependency.[10] Vietnam has the potential to close the loop of textile material and accelerate the circular economy of textiles, aiming for more sustainable sources of material and reducing the risk of being dependent on the import of raw materials.[11]

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## TOWARDS CIRCULAR ECONOMY

As the top economic industry, the textile industry has set sustainable targets and pushed the private sector to aim toward sustainability to meet brand expectations. At the international seminar in 2020 *"Vietnam's textile, garment and footwear industry one year COVID-19 and sustainable development",* 57.6% of textile enterprises adjusted their long–term strategies toward green technology and automation. According to MCG consulting (2018), 15 initiatives directly and indirectly supported the textile sector in improving water, energy, and climate performance, which were led by international organisations, bilateral/multilateral donors, NGOs, and brands over the past 15 years.[12]

From 2018 to 2021, several other initiatives have been implemented, such as the Vietnam Climate Action workshop implemented by FABRIC – GIZ in 2019, and the ongoing *Greening textile sector* implemented by the World Wide Fund for Nature (WWF) Additionally, technical and human resource management training and consultation toward efficiency and increasing the competitive advantages for leather and wet processing in the Vietnamese textile industry by the Industrial University of Ho Chi Minh City IUH and VIA in 2021 have played a role. Many other programs have been established to leverage the capabilities of enterprises and relevant stakeholders in the textile industry toward more sustainability.

Solid waste –especially fabric scraps from the initial stage of textile manufacturing– is a part of ecological industrial park (EIP) symbiosis; however, there are no specific records from the industrial symbiosis of fabric scraps or the textile industry, generally. From 2020, more activities related to textile solid waste management have been recorded, from initial interest to adopting the circular economy approach to the textile industry and fabric scraps. In 2020, IDH launched a study titled 'Scoping IDH's impact potential in valorising fabric-scrap in Vietnam'. The study results show the possibility of adapting the circular economy concept to fabric scraps. However, this move still faces many challenges.[13] Accelerating the circular economy of textiles by promoting a system for textile-to-textile recycling will potentially provide more sustainable sources of material and reduce the risk of dependency on the importation of raw materials.

In 2022, with the launch of the Circular Economy Hub with the Ministry of Natural Resources and Environment (MONRE), the United Nations Development Programme (UNDP) is to host the business forum *"Meet-up connecting businesses to Close the Loop"* with representatives of the Vietnam Garment and Apparel Association (VITAS), manufacturers, and brands. IKEA has expressed interest in adopting a circular economy and interest in the closed- loop-value chain in several feedstocks such as plastic and polyester fabric. Several programs have been developed based on major brands' interests. IFC–circular economy for textile supply chain and the soon-to-be-launched program of the Footwear Distributors and Retailers of America (FDRA) with selected brands for shoe manufacturer waste programs are expected to push for zero manufacturing waste-to-landfill and incineration.

It can be said that the circular economy in the textile industry has received more attention in recent years from civil organisations. However, most of the program is still in the initial phase of mapping impact areas, hotspots, communication, and targeting a small group of stakeholders concerned with waste management and material. There is not yet a shared approach for the circular economy of textiles in Vietnam.

## FABRIC SCRAP THROUGH THE LENS OF INDUSTRIAL SOLID WASTE

Vietnam's industrial sector has been rapidly growing over the past 35 years. For decades, the manufacturing industry has continued to contribute significantly to the country's economy with a growth rate of 13%, and has accounted for over 80% of Vietnam's total exports in recent years.[14] However, accompanying the growth of this sector has been increasing volumes of industrial solid waste.
As of 2019, the country has more than 335 industrial parks and export processing zones,forming a system of industrial parks distributed in all provinces and cities. In particular, Vietnam has developed several industries critical to the economy, such as oil and gas exploitation and processing,

electronics, telecommunications, information technology, metallurgy, and iron and steel. Textiles and footwear also form an important industrial sector. Besides positive economic growth, the process of industrialisation, along with the explosion of commercial and service activities, has caused significant environmental impacts. Environmental pollution is becoming increasingly serious, especially in industrial zones and densely populated areas. The MONRE report on the Current National Environment Status (2016-2020) indicates that the amount of solid waste generated from industrial production activities is estimated at 25 million tonnes/year and about 8.1 million tonnes from industrial zones alone.15 However, the volume of regular industrial solid waste generated is much higher because the amount of waste generated from traditional craft villages or businesses located outside the industrial park is yet to be formally quantified.[15]

Non-hazardous industrial waste is often considered high-value recycling feedstock, and is legally traded as scraps. There is a lack of data on the volume of non-hazardous industrial waste being recycled and disposed owing to low compliance of waste stakeholders and the involvement of different micro-enterprises. This has created a large, informal economy around recyclable waste material. The actual flow of material in the industrial sector cannot easily be traced. Vietnam's regulations on non-hazardous materials are well developed. However, the country shares the same challenges as other developing countries–implementing regulations remains challenging owing to weak enforcement. Consequently, the environmental impacts of leaked and unmanaged industrial waste are difficult to measure as data only surface occasionally. For example, as reported by VTC news in 2020, Hai Duong City citizens filed a complaint about the illegal dumping and burning of industrial waste.[16]

The GOV encourages businesses to recycle and recover non-hazardous waste wherever possible. With textiles being the second-largest industrial sector of Vietnam, textile non-hazardous waste also shares the same management and practices applicable to industrial non-hazardous solid waste, including handling, trading, economic opportunities, and potential impacts of leakage and unmanaged disposal situations.

## 3.3 Laws and regulation

### DEVELOPMENT OF REGULATIONS AND RELEVANT POLICIES

In the past decades, the environmental regulatory framework has developed quickly to adapt to economic growth and meet sustainable development commitments.
In general, Vietnam does not have specific legislation regarding fabrics scraps. Fabric scrap can either defined as scrap or recyclable non-hazardous waste.

While scrap often has high monetary value and can be traded like a regular product, non-hazardous waste can be recyclable but often has lower economic value. The lower monetary value of several recyclable solid wastes might not motivate the recycling industry to proactively purchase, trade, and collect these materials. High-value scraps include iron, steel, copper, plastic, etc., while recyclable waste can be of mixed material such as blended fabric and blended material. As per LEP 2020, scrap is defined as materials that can be recovered, classified, and sorted from other materials and products discarded in production, business, service, or consumption, and then can be used as raw materials for another production process.

Scrap is not referred to in regulation as scrap from industrial waste but the term primarly refers to import- and export scraps as material and in the context of relevant businesses. Domestically, no specific regulations identify scrap management, but scrap can be traded as a regular product if manufacturers segregate it appropriately.

## FIGURE 3: THE DEVELOPMENT OF ENVIRONMENTAL REGULATIONS

### 2005 - 2010

| | |
|---|---|
| The Law on Enviroment Protection No. 52/**2005**/QH11 | The Law on Enviroment Protection (LEP) mentioned the first time about the content of Extended Producer Responsability (EPR). |
| Decision No. 36/**2008**/QD-TTg | Strategic Development of Vietnam Textile and Garment Industry 2015-2030. |

### 2010 - 2015

| | |
|---|---|
| Decision No. 577/**2013**/QD-TTg | The Prime Minister dated 11 April 2023 approving the Master program for enviromental protection in craft villages towards 2020 and vision toward 2030. |
| The Law on Enviroment Protection No. 55/**2014**/QH13 | The Law on Environment Protection (LEP) is updated from LEP 2005. It stipulated about the good behaviour for protecting enviroment. |
| Decree No. 38/**2015**/ND-CP | Regulation on waste and scrap management. |
| Circular No. 36/**2015**/TT-BTNMT | The MONRE dated 30 June 2015 on the management of hazardous waste. |

### 2015 - 2020

| | |
|---|---|
| Decree No. 155/**2016**/ND-CP | Treatment of legal violations in environmental protection, forms, levels, competence and procedures/remedies. |
| Decision No. 491/**2018**/QD-TTg | Approving the adjusted national strategy on integrated managment of solid waste up to 2025, with a vision toward 2050. |
| The New Law on Enviroment Protection No. 72/**2020**/QH414 | The New Environment Protection Law 2020 is updated from LEP 2014. In January 2022, the revised Law on Envoironment Protection (LEP) 2020 came into effect. |
| The Law on Inestment No. 61/**2020**/QH14 | List of several numbers of investment priority business. One of them is the regulation about the collecting, treating, reusing and recycling activities. |
| Decision No. 28/**2020**/QD-TTg | Categories of scrap to be imported as production materials. |

### 2020 - 2022

| | |
|---|---|
| National Strategy on Integrated Managment of Solid Waste (ISWM) to 2025, vision to 2050 | Responsibility of the entire sociaty, though the State plays a key role in mobilizing resources and increasing investment. |
| Decree No. 55/**2021**/ND-CP | Detailing some articles of Decree No. 155/2016/ND-CP about the treatment of legal violations in environmental protection, forms, levels, competence and procedures/remedies. |
| Decision No. /**2021**/0D-TTg | Ministry of Industry and Trade (MOIT) has launched a Master Plan for Vietnam Textile Industrial Development 2021-2030 in HCMC. |
| Decree No. 08/**2022**/ND-CP | Detailing some articles of the New Environmental Protection Law 2020. |
| Circular No. 02/**2022**/TT-BTNMT | Detailing some articles of the New Environmental Protection Law. |
| Annex 1 Circular No. 02/**2022**/TT-BTNMT | Mentioned the waste code for the textile industry. But it mostly focused on wet processing. |

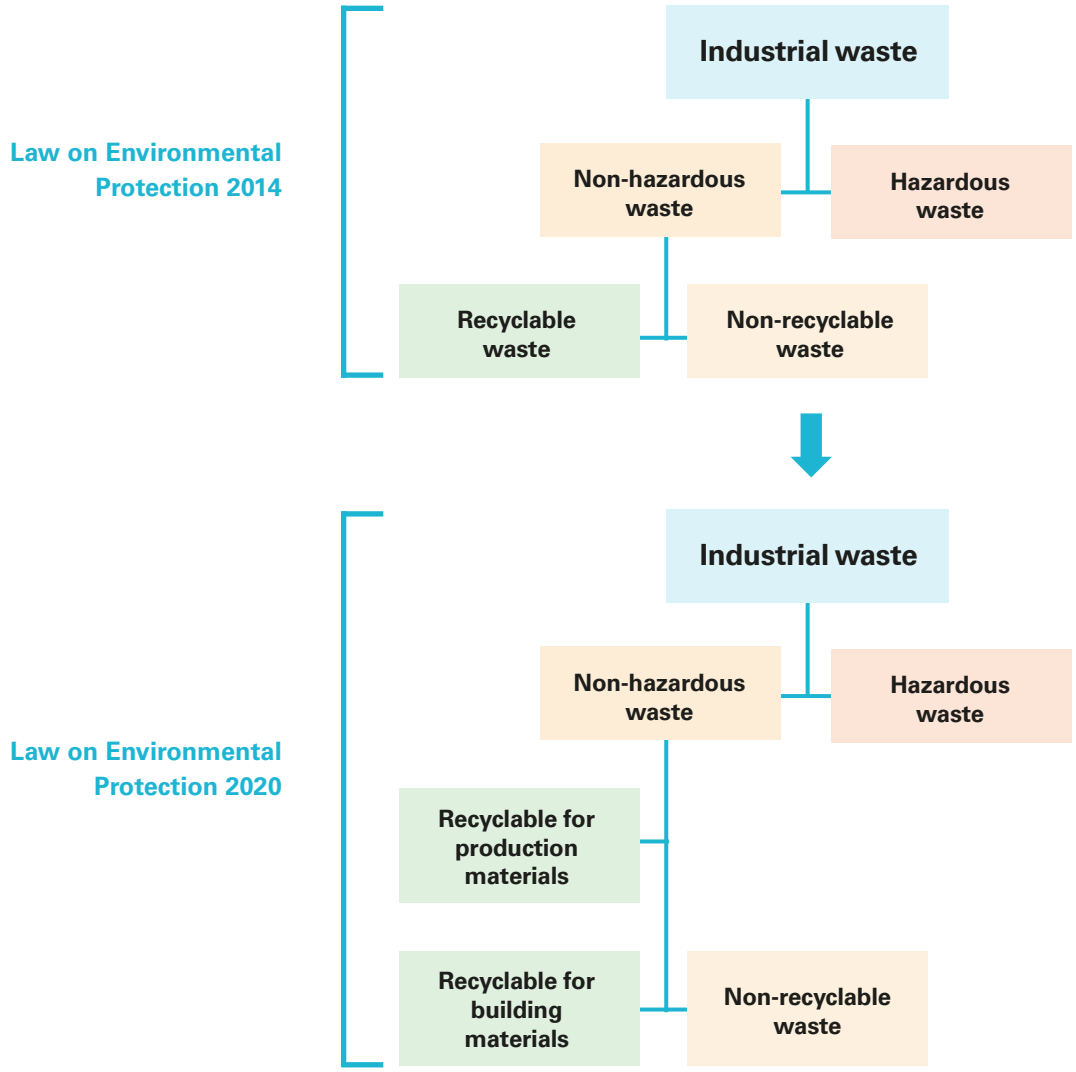
Fabric scraps can be grouped under non-hazardous waste. According to No. 2, article 3 of Decree 38/2015/ND-CP, fabric scraps and deadbolts can be identified as non-hazardous industrial waste if the material's hazard value remains under defined hazard limits and it is stored separately from hazardous waste.

No 3, article 82, chapter VI of The New Environmental Law, 2020 requires manufacturers to separate non-hazardous waste into three types: (1) recyclable for production material, (2) recyclable for building material, and (3) non-recyclable waste. The LEP 2020 shows the efforts of the GOV toward waste separation at source so as to maximise the recycled waste volume. However, the regulations have not yet defined which material will be recyclable into production or building material.

Circular 02/2022/TT defines the solid waste material code. The manufacturer shall separate the waste to label, then store, transfer and report the waste volume per waste transaction accordingly. In detail:

- Hazardous waste is denoted 'NH'
- Industrial waste that must be controlled is denoted 'KS'
- Non-hazardous industrial solid waste is denoted 'TT'
- The label 'R' will be added to waste groups that can be recovered and collected as recycling feedstock for production.

**FIGURE 4: OVERVIEW OF THE LEP 2020 UPDATE OF INDUSTRIAL WASTE SEPARATION**



Circular 02/2022/TT- BTNMT provides details of waste code numbers for several sectors. While waste codes had been only applied for hazardous waste before 2022, as per new regulations, GOV has stressed on better solid waste management to increase transparency, traceability, and availability.

However, there is no specific waste code for fabric scraps yet. The solid waste code for the textile industry is only available for waste in wet-processing dyeing and fabric production waste types owing to its potentially hazardous waste volume and impacts. Policymakers have not yet identified and recognised Tier 1–CMT manufacturing waste volume and characteristics. Fabric scraps can be declared under code 19 03 03 belonging to group 19 03, which covers off- specification batches and unused products. The specific data for fabric scraps in terms of volume and economical value for recyclable or production/recyclable material classified as building material or non-recyclable material might not be available in the coming years owing to a lack of traceability method. With sustainability commitments and the National Circular Economy Action Plan on the way, the recyclable waste in significant sectors will expectedly be identified, as also fabric scrap in the textile industry.

Implementing the government's direction in Resolution No. 09/ NQ-CP dated February 3, 2019, which assigns the MONRE as the focal point for the unified state management of solid waste, is a challenge. The Center for Environmental Information and Data under the Vietnam Environment Administration, the Ministry of Natural Resources and Environment, is assigned to build a Solid Waste Information System to update information on solid waste management in 63 provinces and cities nationwide, according to Official Letter No. 825/BTNMT-TCMT dated February 27, 2019, on reporting on solid waste management in provinces and centrally- run cities. However, implementing the Solid Waste Information System faces many challenges, especially in data collection. Currently, manufacturers report solid waste data manually in the Environmental Protection Annual Report to DONRE.

## FABRIC SCRAP COLLECTION AND HANDLING

LEP 2020 has also updated the regulation for industrial waste collection and handling to maximise the volume of recyclable industrial waste and reduce non-hazardous waste that must be treated.
According to article 82, waste producers of non-hazardous waste shall directly work with the following entities to handle non- hazardous waste.

- Waste recyclers who use the material as recycling feedstock for production or use waste as building material which has been approved by local authorities
- Material co-processing facilities
- Non-hazardous waste treatment facilities
- Industrial solid waste collection companies contracted with the above-mentioned businesses

Manufacturers shall ensure that non-hazardous waste is separated and the waste is transferred and handled by approved waste treatment facilities. The waste producer can move and deliver non-hazardous waste, including fabric scraps, directly to suitable waste treatment facilities, or have the waste treatment facilities pick up waste. In this case, the waste vehicle shall accordingly be registered under the waste producer or waste treatment facility.

In common practice, a waste collection company can play the role of the middleman if it has a direct contract with all relevant treatment companies. The updated regulations will also force the waste contractor to be more transparent about waste handling.

## REGULATIONS FOR NON-HAZARDOUS WASTE TRANSFER AND END-OF-LIFE TREATMENT

As mentioned, the end-of-life of fabric scrap can be (1) recycled, (2) co-processed, or (3) moved to non-hazardous waste treatment facilities such as incinerators or sanitary landfills.

According to Decree 08/2022/ ND-CP List of production and economic activities that create environmental impact lists, non-hazardous waste recycling plants with medium-to-large capacity must have relevant compliances to ensure better regulation. That is, fabric scrap recyclers or those using fabric scraps as input material for production must have approved environmental impact assessments to operate in Vietnam. Depending on the production impacts, businesses shall clarify how and when they provide suitable environmental protection solutions to minimise the impacts of their manufacturing activities. Recycling manufacturing units shall strictly report to local authorities annually on environmental protection performance according to potential pollution to ensure that their activities have limited impact. To attract investment for recycling projects, the government shall provide tax incentives and support in the form of land endowment and so on, via the Environmental Protection Fund.

Overall, regulations for industrial recyclable waste are fairly open, allowing for fabric scraps to be traded as normal products and encouraging the maximum possible recovery of recyclable material. However, current management practices might not allow for or encourage tracing of material volume and the methods of material recycling. There is no identification specified for which fabric material can be recycled, and which is non- recyclable; moreover, there are no suggested disposal practices for each type of material.

## 3.4. Stakeholder analysis

The circular textile economy is still in its infancy in Vietnam, and thus the following stakeholder groups are critical to drive solid fabric waste management and circular economy in Vietnam:

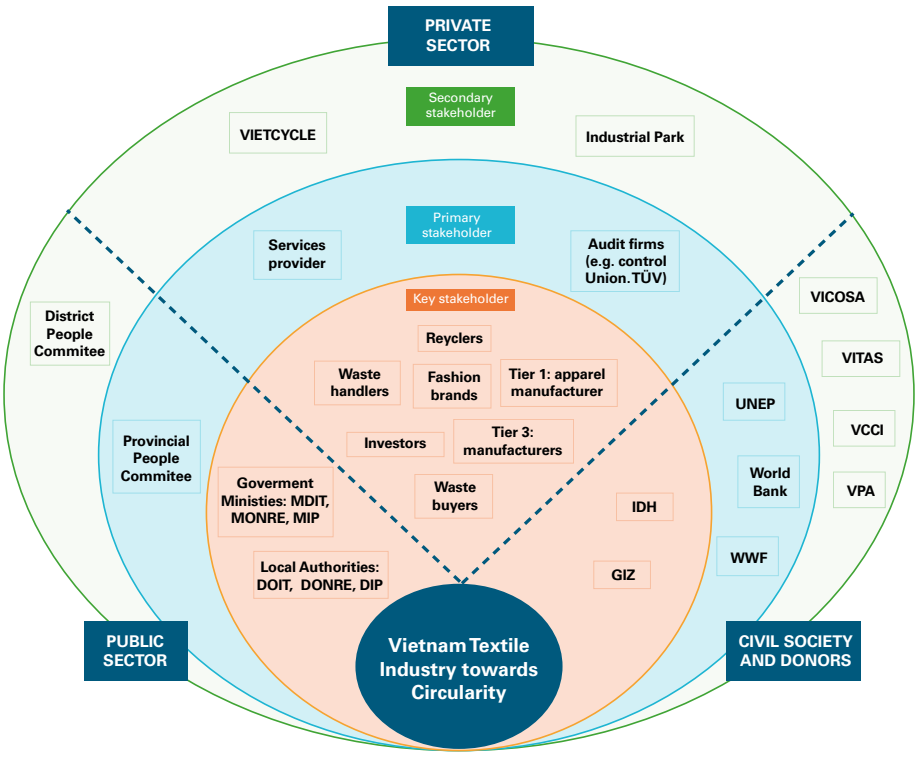
- **Government and policymakers:** government ministry, local authorities
- **Private sector:** Fashion brands, manufacturing groups, Tier 1 and 3 manufacturers, waste handlers, waste buyers, recyclers, service providers, investors
- **Civil organisations:** international technical agencies and donors, business associations and local NGOs, international technical agencies and organisations

### STAKEHOLDER MAPPING

The stakeholder map (below) identifies and helps to visualise the relevant actors in textile-to-textile recycling to understand their interest and influence and the potential group of stakeholders to accelerate the recycled textile market. The stakeholders are structured in 'onion-like' multiple layers (key, primary, secondary) and exist across different segments by their nature (public, private, civil society). They include:

- **Key stakeholders**: those who directly impact and influence the textile-to-textile recycling value chain, including waste producers–Tier 1 manufacturing, waste contractors, recyclers, and fashion brands. They can significantly affect the textile sector through their resources, competence, mandates, or position of power, to exert considerable influence.
- **Primary stakeholders:** those who directly affect, either positively or negatively, and engage with the textile sector either as subcontractors and cooperation partners or designated beneficiaries, or because they stand to gain (or lose) power and privilege, or because they are negatively or positively affected by a strategy change of key stakeholders.
- **Secondary stakeholders:** Persons or organisations who indirectly influence textile-to-textile recycling and are negatively or positively affected by a strategy change of key stakeholders.

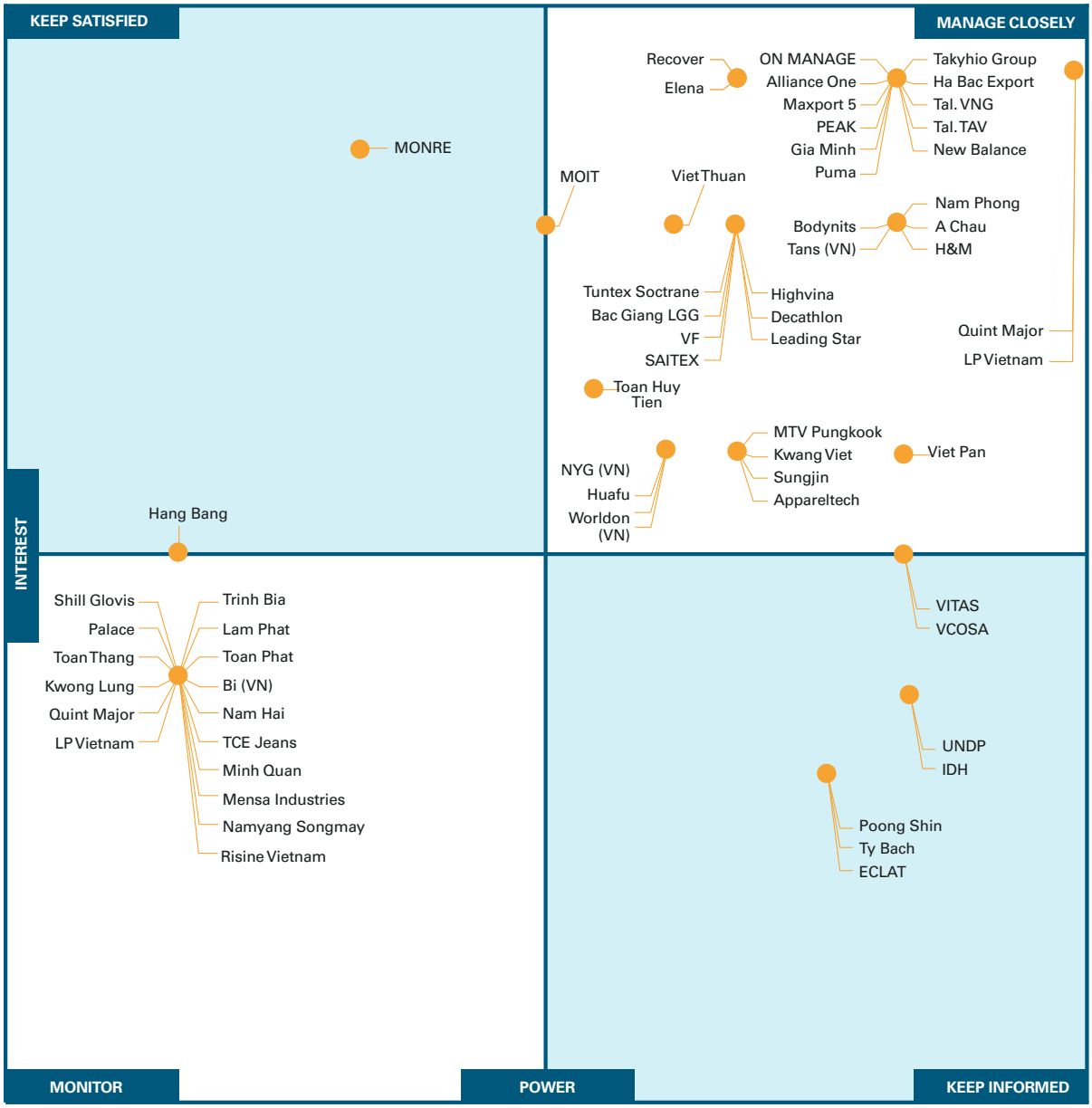
**FIGURE 5: STAKEHOLDER MAPPING**



## STAKEHOLDER POSITION

The Figure 6 below shows the stakeholders' position compared within their influence and interests.

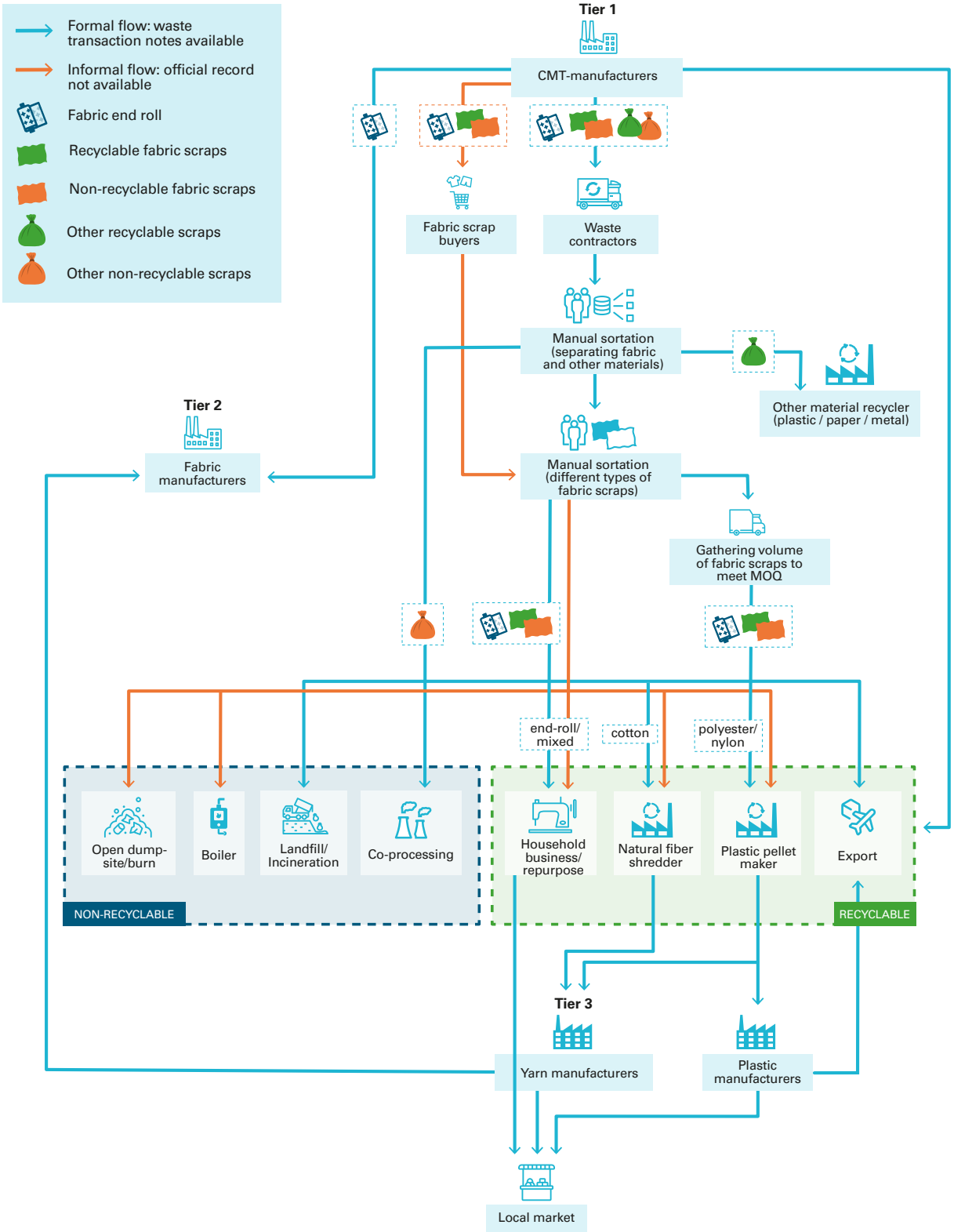
### FIGURE 6: STAKEHOLDERS' INFLUENCE IN RELATION TO THEIR INTERESTS



## 3.5 Fabric waste flow

Textile-to-textile recycling is already in place in Vietnam. However, currently recycled products remain low-value, and recycling is largely run by low-compliance operators with opaque manufacturing practices. The figure below provides an overview of the flow of fabric cutting scrap.

**FIGURE 7: FABRIC WASTE FLOW VIETNAM**



## 3.5.1 Fabric waste managment

### SOLID WASTE MANAGEMENT AT TIER 1 APPAREL MANUFACTURING UNITS

**Solid waste management policy:** The policy briefly describes solid waste management and sorting for three types of manufacturing waste: Hazardous and non-hazardous waste and recyclables/scrap. The compliance or the health and safety department is responsible for solid waste management.

**Waste storage regulations:** Regulations apply to waste storage, including firefighting, waste separation, and safe handling. They are applicable mostly to hazardous waste-dealing companies, ensuring the implementation of clear signage and regulations at the waste storage facility.

**Solid waste tracking records:** The records used to track recyclable, non-recyclable, and hazardous waste monthly. While fabric scraps are recyclable or non-recyclable, most manufacturers do not record these data separately as there is no sortation at the source. In various waste programs, the manufacturer uses the waste tracking platform to input monthly volume per separated waste type. The manufacturer implementing sortation at source is able to provide figures for the volumes of 100% cotton and 100% polyester volume each month.

**Waste delivery notes:** This refers to the waste delivery notes of waste volume per pick-up with the waste collection company. Most companies generate and take note of hazardous and domestic waste. However, no details are usually available for fabric scraps or non-hazardous waste.

**Annual environmental protection report:** Annual report to local authorities containing all the environmental protection items of the manufacturer. On checking several yearly reports and manufacturing reports, we found records of hazardous solid waste and domestic waste volume, but non-hazardous waste or scrap is barely mentioned.

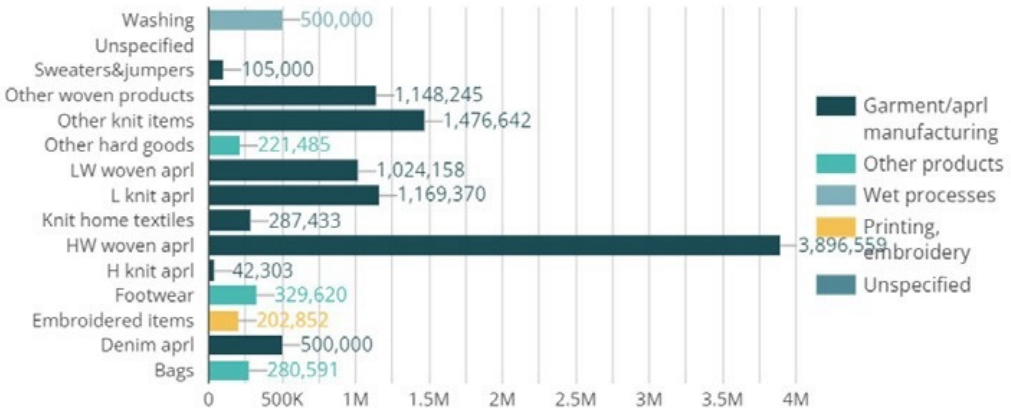
**Contract with waste collector/ scrap buyer:** This depends on waste type and function of the waste contractor. Each manufacturer can have different contractors for various waste types, or a single contractor provides all solid waste collection services and scrap buying. The fabric waste management on the manufacturer side remains at the compliance level, and there are no targets or specific KPIs related to fabric-scrap sortation or reduction. Several manufacturers have joined brand waste management programs, and show a more detailed management record of fabric scraps. Among 30 manufacturers, 14 are targeting solid waste management performance under HIGG FEM.

**Fabric scrap generation characteristics:** Composition and volume: Over 30 manufacturers have signed up to the the Reverse Resources platform with 24 apparel manufacturers and five other Tier 1 manufacturers, as stated by respondents in the home textile-bedding, backpack, and footwear manufacturing sub-sectors.

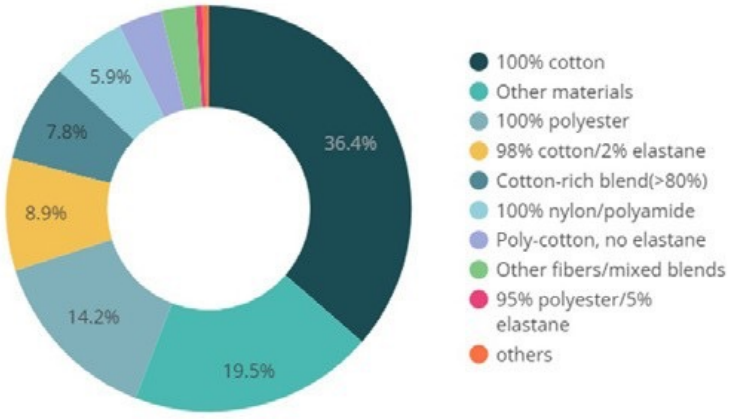
## FIGURE 8: FABRIC WASTE DATA OF 30 MANUFACTURERS
(registered on the Reverse Resources platform)

| Number of facilities profiled | Total volume of production (kg/month) | Total volume of waste (kg/month) | Number of facilities segregating textile waste | Number of facilities with Higg Index certificate | Average % of waste stated by respondents |
|---|---|---|---|---|---|
| 30 | 11,184,258 | 864,159 | 26 | 14 | 8% |

### Production breakdown by product type and type of suppliers



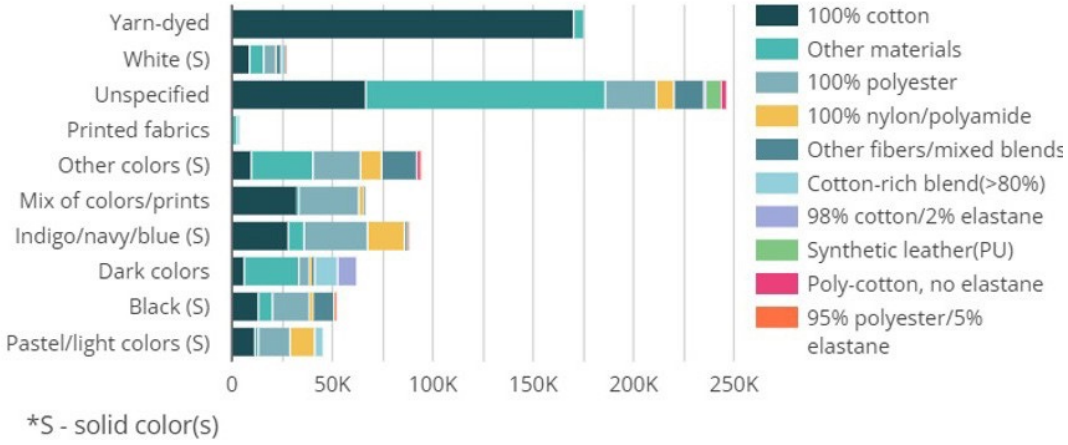

### Production by composition




*The data input is the average monthly volume of production activities during November 2021, December 2021 and January 2022.*

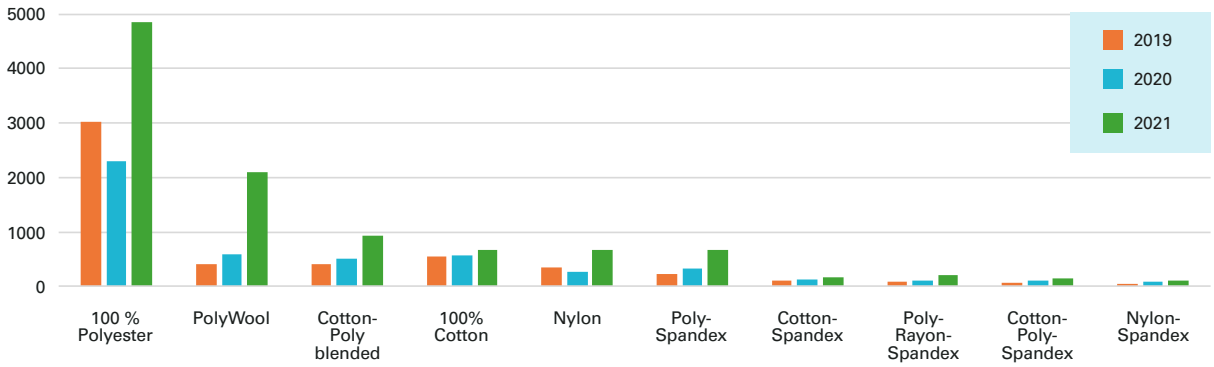
The total waste volume from 30 manufacturers is 11,184,258 kg/month, with an average loss of 9% as reported by the Reverse Resources platform. As per details of loss claims by manufacturing, several CMT manufacturers have claimed that their wastage is 1%-5%, which the manufacturer cannot explain as an accurate calculation of wastage. It is recognised that many manufacturers have little awareness of how to calculate waste and loss as a percentage of production, or are unwilling to declare the actual loss. According to Reverse Resources, the 7% efficiency marker is already impressive, and hardly any manufacturer achieves below 7% loss in CMT manufacturing. Therfore, the prediction for Vietnam to achieve 9% on average is inaccurate.

**FIGURE 9: FABRIC WASTE COMPOSITION AND COLOUR CLASSIFICATION**
(based on Reverse Resources platform)




According to the data collected, cotton represents the biggest share of waste by composition (Figure 9). Corresponding to over 40% of the total waste mapping, cotton-rich waste amounts to 346,678 kgs per month. The proportion of 'other material' corresponds to other types of waste such as metal pieces, buckets, and magnetics, which are not included in the list of 40 materials present in the Reverse Resources platform. According to the data, the average waste of 100% polyester is 157,109 kg/month, making it the second-most generated fabric waste after cotton. This estimate is questionable, as in 2021, Vietnam imported over 10,000 million metres of polyester fabric and only imported 806 million metres of cotton fabric (Figure 10).

**FIGURE 10: TOP 10 FABRIC COMPOSITION IMPORT TO VIETNAM 2019-2021**




*Source: STS Vietnam 2022*

The cutting department's responsibility involves planning the cutting of the fabric rolls according to the design patterns. Next, the rolls are sent to the sewing department. The cutting departments of all participating manufacturers aim to reduce material loss in order to minimise the production cost.

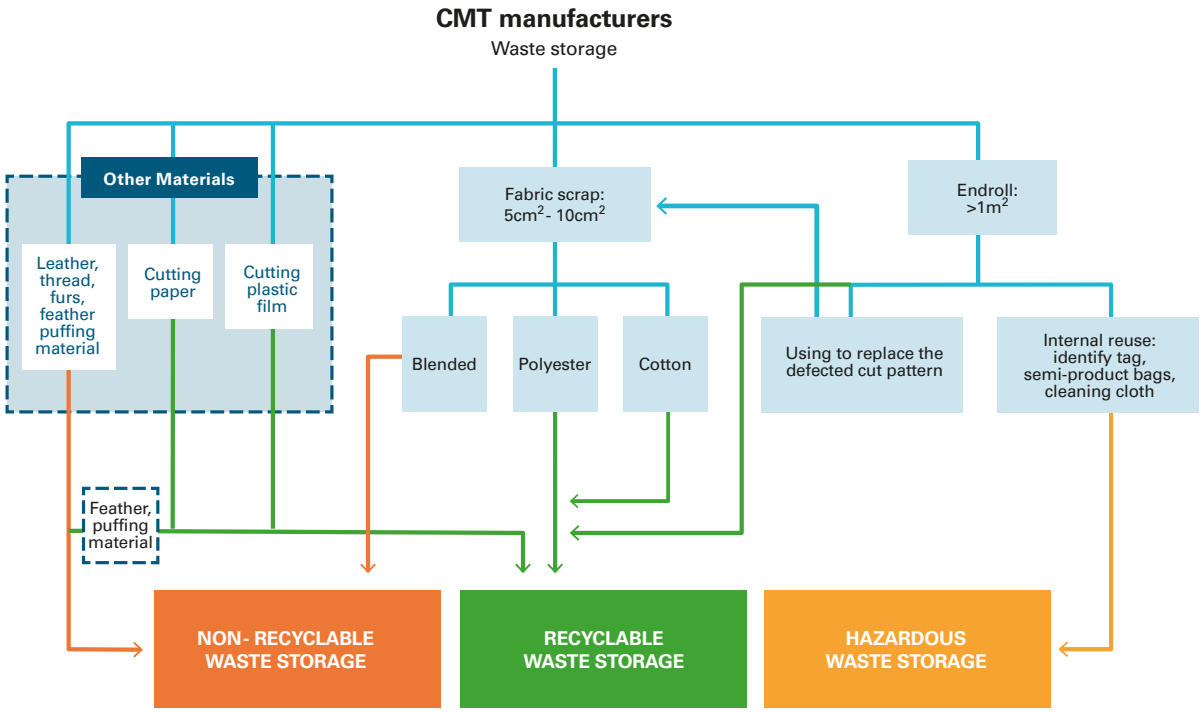
The loss rate at the cutting table does not depend on the material composition, but instead depends on:
(1) Product categories
(2) Product design
(3) Manufacturer cutting technique

Other than the personnel skills and operational efficiency level at Tier 1 manufacturing units, the generated waste composition depends on seasonal orders and product group categories (outerwear, sportswear, women's or children's wear, etc.)

We visited five manufacturers, and each shared a different profile of wastes and products. This implies different loss rates at the cutting table and is based on the material characteristics. There is no standard loss rate at the cutting table for apparel manufacturers. A production manager shared her challenges in reducing the loss rate of football uniform products: 'The overall loss rate is 15-17%, while for several pattern design products, the loss rate can reach 35%-40%, based on pattern and size'.

There is a definite need to communicate and educate manufacturers about how waste flows through various stages and how to set standard calculations. Moreover, there is a need to ensure that the Reverse Resources platform collects data continuously to accurately estimate the percentage loss and waste composition.

**FIGURE 11: FABRIC WASTE FLOW AT CMT MANUFACTURERS**



## FABRIC CUTTING WASTE AND END-ROLLS AT THE CUTTING TABLE

**Handling cutting waste and end-rolls at the cutting table**

Over 90% of manufacturers who participated in the research reported that they do not separate the cutting fabric waste at the cutting table because there are too many different compositions and types, and they do not know what is worth sorting.

**End-roll fabric**

The most common use of fabric end-rolls is replacing defective cutting patterns. The defective pattern is marked and replaced by fabric end-rolls. The left-over material is classified as fabric cutting scrap. The fabric end-roll is internally reused and also repurposed as packaging for semi-finished products, cleaning cloths, semi-finished product fasteners, etc. At the end of their life cycle, these products are also handled as either non-hazardous or hazardous waste.

Several manufacturing units sell fabric end-rolls to scrap buyers at higher prices (two to three times higher than fabric scrap prices). There are no available data on the end-roll volume at the cutting table, according to current internal reuse practices.

**Fabric scraps at the cutting table**

The fabric scrap size from the cutting table ranges from 5 to 30 $cm^2$. The size and loss rate of fabric scraps depends on the cutting pattern design. The sortation activities at the cutting table differ between manual or machine cutting process.

**FIGURE 12: FABRIC END - ROLL: INTERNAL REUSE**

Bag/ packaging for semi products

Reuse fabric for fastening semi- product

**Manual cutting**

In a manual cutting process, a worker uses a cutting machine to cut each pattern. There is hardly any sortation at the manual cutting table. All mixed waste, including textile and non-textile (paper) is moved to the waste bin and collected by the cleaning team. In our study, manufacturers shared the following major challenge in separating the fabric waste from other waste components such as paper: The workload at the manual cutting table is high, which means the worker needs to be highly focused on the cutting process- separation. The focus on extra waste separation would distract the worker from the main task.

**FIGURE 13: MIXED WASTE AT MANUAL CUTTING LINE**

**Machine cutting**

Besides paper and fabric, plastic film is used to prevent unwanted material movement during machine cutting. In this process, the waste bin is located at the end of the cutting line, where workers often separate the waste into fabric, plastic and paper.

**FIGURE 14: WASTE SEPARATION AT MACHINE CUTTING LINE**


Worker separates paper and plastic film at cutting line

## MOTIVATION FOR WASTE SORTATION AT SOURCE

The separation and compliance standards mostly come from buyers/brands, compliance and sustainability requirements, or waste handlers' suggestions of what is worth sorting, including paper and cartons, plastic films, thread cores and other plastic waste, metals, etc.

The cleaning team is often responsible for waste separation into recyclable and non-recyclable waste. Several manufacturing units reported that scrap buyers send their people to sort, organize, and manage non–hazardous waste to maximise the volume of recyclable waste being sorted at source, as the manufacturer does not have the workforce required for waste segregation.

Overall, most manufacturers pay little attention to sorting at the cutting table due to the following reasons:

**(1) Manufacturers do not know what is worth sorting**
As fabric comes in many compositions and colours, manufacturers do not know what to sort. The additional workload of separating all kinds of fabric compositions is not comprehensible for production managers, who also do need to understand the value and reason behind it.

**(2) Management does not want workers to spend too much time on waste separation**
While they do not know which material is worth sorting, manufacturers are also concerned about the time and effort workers must sacrifice from their work for waste separation. They are concerned about how waste separation at the source will affect their workers' time and efficiency.

**FIGURE 15: OTHER RECYCLABLE WASTE IN CMT MANUFACTURES (TIER 1)**


Fabric carton tube


Carton paper


Plastic film


Stuffing material
And non woven fabric


Plastic thread core


Other recyclable waste

Waste sortation at the cutting table, if any, is mostly only at the automatic cutting line or sorted by the cleaning team afterwards. Even though manufacturers are interested in profiting from selling fabric scraps, this revenue is not their biggest motivation, because it is a very small add-on for their business. The main incentives for manufacturers to sort and adopt better solid waste management is to achieve a better HIGG FEM ranking, and better sustainable performance, required by the brands/ buyers.

**FIGURE 16: EXAMPLES OF FABRIC WASTE STORAGE**

According to best practice, all fabric scraps are sorted separately from paper and plastic and are collected and labelled in one bin bag per cutting load. However, very few manufacturers follow this practice. Sometimes, the waste is separated into three composition types: 100% cotton, 100% polyester, and blended. Such manufacturers usually apply best practice and proactively aim for sustainable development. Currently, manufacturers are looking to apply automated sortation approaches to separate fabric scraps, plastic and paper directly at the cutting table without an additional workload for labours.

## GOOD PRACTICES IN WASTE SEPARATION AND MANAGEMENT

Realising the importance of waste management at the source (including sortation and optimisation of the management system), the Board of Directors of Far Eastern New Century (FENC) has invested in the most modern machinery and equipment in the production process and solid waste management system. FENC applies waste management technology by barcode. Waste is separated into different coloured bags and provided with an identification barcode before being transferred to a functional treatment unit. The manufacturer's internal tracking system records the sorted waste types and volume.

The company efficiently manages the quantity of each kind of waste and ensures the maximum recyclable fabric waste volume.

The company conducts regular training and testing, diligently guiding workers to correctly and efficiently perform sortation. The Far Eastern Group is also researching technology for recycling fabric waste from the production process into new materials in order to exploit waste resources.

**FIGURE 17: EXAMPLE OF SOLID WASTE MANAGMENT**
at the company "Far Eastern Apparel Vietnam Co., Ltd"

Upcycle – end-roll fabric scrap to be reusable bag

Digital scale and tracking system per waste type

Separate and identify clearly waste type

Safe and separate waste storage

## CONTRACT TYPES FOR FABRIC SCRAPS

The research team identified four common types of waste contract related to CMT manufacturers. The waste management activities are combined into one or more contracts depending on the contractor and manufacturer.

**Hazardous waste collection and disposal contract:**
This contract clearly states the price, hazardous waste type, disposal method, and the disposing party. In this case, hazardous waste is not scrutinised further as this is beyond the scope of the contract.

**Non-hazardous waste collection:**
Here, the manufacturer pays a fee for non-hazardous waste disposal. However, most non-hazardous waste collection contracts do not charge a waste collection and disposal fee per kilogram of waste; rather, this is billed as a monthly cost. This type of contract also covers scrap selling contracts.

**Domestic waste collection:**
The manufacturer shall pay a monthly fee for domestic waste collection and disposal. Here within, the disposing party is the municipal waste collection company or waste collection company that is assigned by the industrial park.

**Economic contract:**
Scrap is traded as a commodity, and so the manufacturer sells this as a standard product.

In practice, manufacturers do not have to pay non-hazardous waste collection and disposal fees. The waste contractor negotiates the recyclable waste price and then offers the non-hazardous waste treatment as a 'side' service to access high-value recyclable waste. The waste contract value and price per material are not fixed or published, but depend on the following criteria:

(i) Potential volume and quality of high-value scrap
(ii) Frequency of pickup
(iii) Distance from manufacturing unit to waste storage location.

Hence, the fabric scrap price in the contract differs for each manufacturer.

The most common recyclable waste in the contract is plastic, carton paper, metals, and fabric scraps. The scrap price spans a wide range, especially fabric scrap (from 400 VND/kg to >5000 VND/kg), and sometimes, the recyclable waste value is ambiguous if the contract agreement is in the form of a tender. In this case, manufacturers are scarcely aware of their actual volume of recyclable and non-recyclable fabric scraps. Ethical waste contractors often clearly state the recyclable waste type, price, and fee for non-hazardous waste disposal. Per waste pick-up, the details of the scrap price and non-hazardous waste are identified to prepare the final bill for the collection. But often, the manufacturer has extra income from solid waste. On reviewing different contracts from various manufacturers, we found that manufacturers frquently make a minimum of 10,000,000 VND/ month from selling scrap without paying any money for non-hazardous waste disposal.

The details of the types of contracts are listed in Table 12.

**TABLE 5: OVERVIEW OF DIFFERENT RECORDED CONTRACTS FOR SOLID WASTE HANDLING**

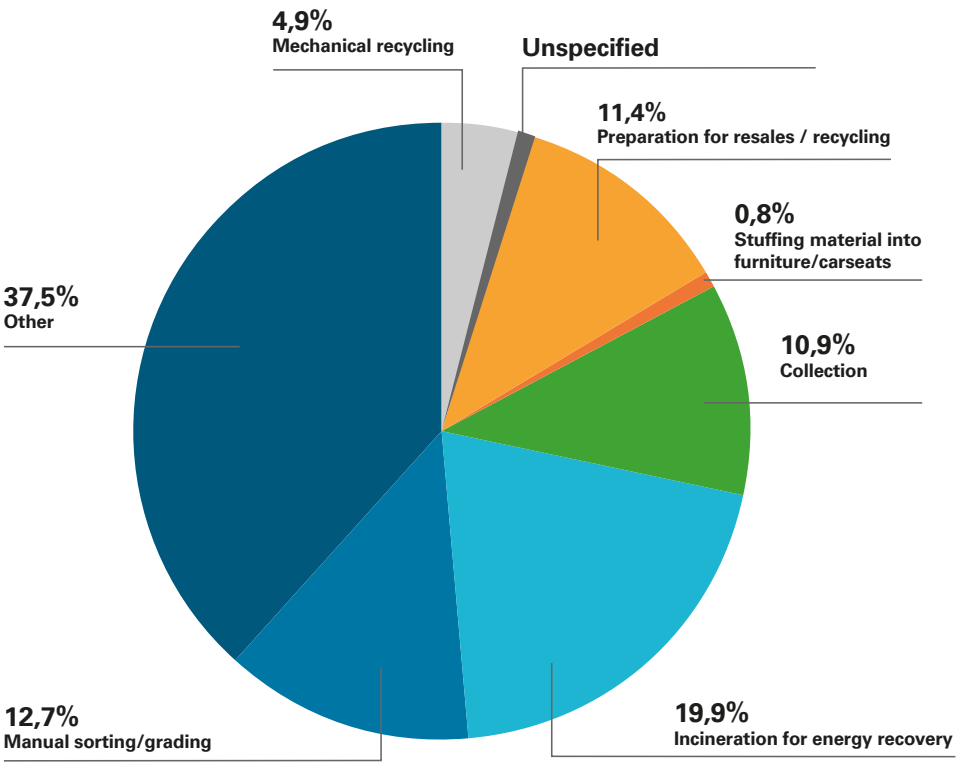
| Waste collection company | Waste contract | Business register | Terms of agreement about waste material | Price |
|---|---|---|---|---|
| **Lam Phat Environ-mental Co. Ltd,** | One contract for both non-hazardous and recyclable waste | Non-hazardous and hazardous waste treatment, collection company | Fabric scraps | 5,000 VND/kg |
| | | | Testing fabric at QA stage and printing room | 7,000 VND/kg |
| | | | Fabric end-rolls | 13,000 VND/kg |
| | | | Paper | 4,000 VND/kg |
| | | | Plastic film packaging | 14,000 VND/kg |
| | | | Plastic bottle, plastic drum | 6,000 VND/kg |
| | | | Non-hazardous waste collection and treatment | 0 |

| Waste collection company | Waste contract | Business register | Terms of agreement about waste material | Price |
|---|---|---|---|---|
| **T.H.L Hoang Long co. ltd.** | One contract for both non-hazardous and recyclable waste | Non-hazardous and hazardous waste treatment, collection company | Fabric scraps | 1,700 VND/kg |
| | | | Waste carton paper | 4,000 VND/kg |
| | | | Waste paper | 1,500 VND/kg |
| | | | Waste plastic (HDPE) | 9,500 VND/kg |
| | | | Metals: iron | 7,000 VND/kg |
| | | | Plastic thread core | 6,000 VND/kg |
| | | | Non-hazardous waste collection and treatment | 0 |
| **Hoang Vu Co., Ltd** | One contract for both non-hazardous and recyclable waste | Non-hazardous waste treatment, collection company | Tender package for buying all scraps and recyclable waste from manufacturer, also responsible for collecting and disposing all non-hazardous waste legally | 10 million VND per month |
| **Huu Thien Environ-mental treatment company** | One contract each for non-hazardous waste and recyclable waste but from one contractor | Non-hazardous waste treatment, collection company | Tender package for buying all scrap and non-hazardous waste, also responsible for collecting and disposing all non-hazardous waste legally | 110 million VND per year |
| | | | Collection and disposal of non-hazardous waste and domestic waste | 1 million VND per 2.5 ton truck and 2 million VND per 5 ton truck |

Currently, the waste volume, quality, and quantity are impossible to track owing to a lack of transparency along the fabric waste flow. Most manufacturers do not know where or how the waste is being handled, especially of recyclable waste. Our research team made five random calls to check the fabric scrap price. We found that the scrap buyer offers a commission per transaction to the manufacturer representative to become the designated waste contractor. The waste businesses often bribe manufacturing employees to gain access to high-value recyclable waste such as overstock, metals, and electrical devices. These high-value scraps drive the main margins for the scrap buyer. Hence, these contractors often do not separately disclose the non-hazardous waste treatment fee and instead offer a commission to the manufacturer's solid waste management representative to access higher value scrap.

The manufacturers aiming for sustainable development and expecting the correct disposal of non-hazardous waste require the waste contractor to provide a non-hazardous waste transaction note to the waste treatment facilities. However, this only proves that the waste contractor has legally treated the waste; there is no way to estimate the exact volume of non-hazardous and recyclable waste since the waste contractor handles waste from multiple manufacturers and does not track the volume per waste type. Most waste contractors are often not willing to declare such data as they make the most profit from undeclared recyclable waste under the tender package contract. This lack of transparency and traceability leads to a high risk of unethical non-hazardous waste disposal approaches, such as unmanaged dumpsites and open burning.

**FIGURE 18: FABRIC WASTE END-OF-LIFE DISPOSAL METHOD**
(based on the 25 manufacturers registered on the Reverse Resources platform)



## END-OF-LIFE HANDLING OF FABRIC SCRAPS

The most acknowledged disposal method for fabric scraps as per 25 manufacturers is co-processing. However, in-depth interviews showed that most manufacturers are unsure how the fabric scrap is disposed of after being collected. As co-processing is the only disposal method considered environmentally friendly, many manufacturers request that waste contractors use co-processing for disposal. However, as mentioned above, there is a lack of transparency and an unwillingness amongst these contractors to declare the actual volume of recyclable waste and the fabric scrap volume being disposed correctly. The new regulations support the development of co-processing technologies as an eco-friendly post-industrial waste disposal solution. However, the price of waste disposal by co-processing is relatively high in comparison to Co-processing by INSEE-Ecocycle is now available in Dong Nai, Ho Chi Minh, and Binh Duong, and by Thanh Cong JCS in Hai Duong Province. Vincem, one of the biggest cement production companies, has been planning three co-processing plants in Hai Duong, Ha Nam, and Ho Chi Minh in 2020. INSEE Ecocycle –one of the biggest coprocessing service providers in Vietnam– is one of the non-hazardous disposal companies preferred by many fashion brands and manufacturers. The company also partners with other waste handlers to maximise recyclable waste and co-process non- recyclable waste of up to 8,000 tons/ month.

Fabric scraps have been used in garment manufacturing as boiler material. However, this has been banned by several provincial governments and brands due to the production of potentially hazardous emissions. We found that low-value fabric scraps are still being used as burning material for industrial boilers in several industrial zones while meeting standard QCVN30/2012-TNMT for boilers. However, in several rural areas and remote industrial zones, ensuring that emissions stay within permissible levels remains a challenge.

There is no available assessment of the environmental impacts of industrial waste at the disposal stage in Vietnam, including leakage potential through open burning and unmanaged dumpsites.

## FABRIC COLLECTION AND HANDLING

**Fabric scrap handling:** Waste handlers provide fabric scrap collection and preparation services to deliver the right quality and waste type to suitable recyclers. The value chain of waste handling in fabric scrap includes waste collection, buying, selling, delivery and transfer, waste storage, sorting, producing material in bales, and trading. This process can be divided into two types of business: formal and informal, according to size and location.

**The formal waste handlers:** Such a business meets the minimum regulation compliance, including business and approved environmental protection licencing and planning. Formal waste handlers are often located in large and well-developed industrial provinces. The businesses range from small to medium (more than ten employees) and they can be environmental service provider companies or scrap buyers.

**Environmental services/waste services providers:** These provide hazardous and non-hazardous waste collection services and buy and trade scraps for profit. Often, the waste collection services do not provide the best margins; hence, recyclable waste traders optimise their practices for profit.

Scraps buyers can register as a scrap trading business (the main job is to buy, sort, and resell scrap). Mostly, they only accept high-value, well-sorted scraps. However, to access the scraps, they also offer waste collection services by partnering with a collection company to be able to provide all relevant documents.

Environmental service companies often have approved operation permits to sign contracts with manufacturers for scraps and non- hazardous and hazardous waste collection. Popular ones are Viet Uc Environmental Company, A Chau Environmental Company, Thanh Liem Environmental, and Tan Phat Tai co., Ltd.

Several fashion brands suggest these companies to their suppliers for partnering as these waste handlers meet the relevant environmental compliances. These companies also have more transparency and collaborate in developing better management systems.

**FIGURE 19: DIFFERENT OPERATION ACTIVITIES AT WASTE HANDLERS**

Waste collection

Waste storage

Waste separation

Bale

Storage

Waste separation guideline
At a waste handler

Many other waste handlers also have good documentation that meets local operational regulations. However, these waste handlers have poor infrastructure, storage conditions, and compliance with safety and environmental laws, that do not satisfy the requirements of many recyclers. Several waste handlers take advantage of weak regulation enforcement to maximise their profit through unethical practices. Others aggressively force and threaten manufacturers to sign long-term contracts, allocate areas of operation, and harass or blackmail other business competitors, leaving manufacturers in the area no choice but to go with them. A manufacturer in Dong Nai said that it is impossible for them to switch to another waste contractor as they were being threatened by the current one.

The informal business sector mostly includes micro-enterprises, household businesses, or craft villages. These are not registered but are reasonably compliant with the local regulations, including business registration and tax-paying. They operate in precarious and difficult conditions and generate low incomes. Informal scrap buyers are located around small industrial zones, while informal waste sortation and recycling facilities are located in craft villages in small cities or remote areas. The leading supplier of the formal private sector is the informal sector itself. These informal operators are sub-contracted to the formal waste business and form one of their marginal suppliers. Some formal waste handlers often outsource waste sortation to informal household businesses since they do not have sortation facilities in several remote provinces. Moreover, fabric sortation requires skill and experience in fabric composition and structure identification.

**FIGURE 20: FABRIC WASTE SORTATION AT WASTE HANDLERS**

Waste at informal waste collector

Mixed incoming waste

Sorted waste

This skilled labour is not always available and it takes time to train personnel; several informal waste sortation businesses provide these skills and workers.

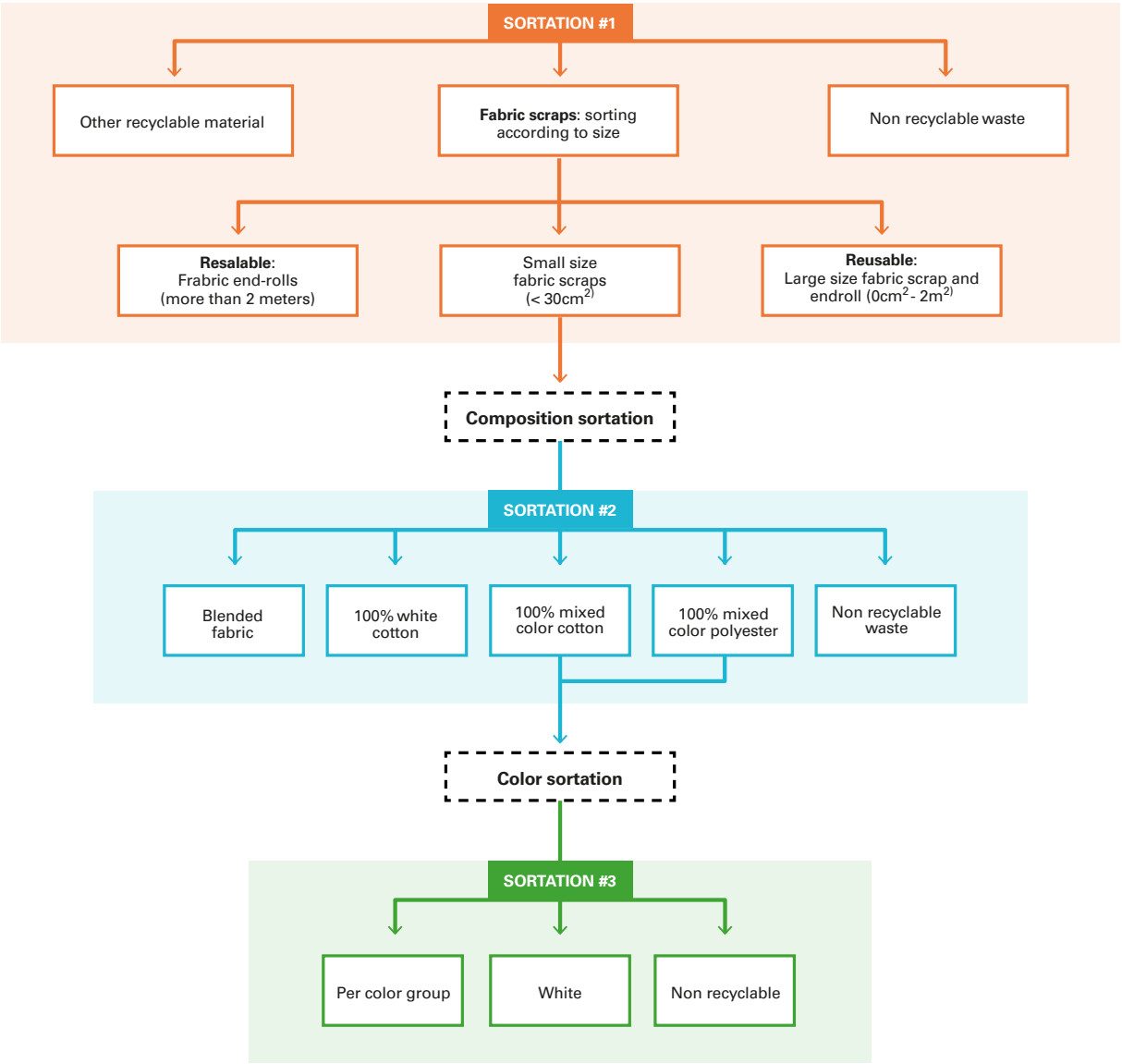
The incoming waste arriving at informal waste handling sites is often mixed with other material such as plastic film and cutting paper. Informal waste handlers sort all the material into different types, fabric composition, and colour groups. There is little information or data about the informal sector in Vietnam. According to ILO, measuring the informal economy is problematic since it operates on the fringes of the economy.[17]

In 2013, the informal economy accounted for half of all industrial jobs and contributed to 20% of the GDP although it was not known what share was already included in the national accounts.[17]

The fabric scrap sector is impacted in the same manner as the informal economy of Vietnam. In recent years, the informal economy has been slowly integrated into the formal economy owing to the economic and social development and the efforts of the GOV in tackling environmental and social issues, especially in the waste sector.

The fabric scrap stream follows the common flow of industrial recyclable waste in Vietnam. After the material is collected by the waste contractor and delivered to the waste storage facility for separation into different recyclables and non-recyclables, material such as fabric scraps is further sorted based on composition, size, quality, and colour group onsite or elsewhere by other waste handlers, who then sell to the recycler.

**FIGURE 21: SORTING STAGES FOR FABRIC WASTE**



Depending on the workforce and the availability of infrastructure, one or more waste handlers sort fabric scraps. The fabric scraps go through three levels of sortation:

1. Sortation by size for reselling to the local market, or reuse and repurpose to other product types, with fabric scrap being sent for recycling. Owing to the limited workforce and poor awareness of fabric composition recognition, not all scrap buyers can provide further sortation. Hence, the scrap fabric is often subcontracted out to sort or sell to the fabric scrap buyer.

2. The fabric scrap is sorted across different compositions into high-demand types. The most in-demand composition is 100% cotton, followed by polyester and cotton blend with a minimum of 70% cotton. Polyester is well-sorted but not always in demand. Often, waste buyers base their buying on the recycler's demands regarding sortation type.

3. Depending on negotiations between the recycler and waste handler, the waste handler delivers the waste by composition to the recycler or separates the waste into different colour groups. The common colour groups are white, light blue, red, black, and dark blue.

After sorting, the fabric scraps often go to one or more waste handlers to ensure that there is enough volume to meet the minimum order quantity of the recycler. Thereof, the fabric delivered to the recycler is sorted by composition and colour and available in an adequate volume. These waste handlers purchase scrap from thousands of sources daily to meet the required volumes. Fabric scrap sortation requires skill and experience in recognising the material by touch and the elasticity of the fabric. Some waste handlers also burn the material to detect blended material that is classified as non-recyclable. Fabric scrap sortation in Vietnam is manual and relies on low-cost labour.

### 3.5.2 Fabric waste grey market

It is common knowledge that the scrap market in Vietnam is a market-driven sector with huge price volatility. There are no available data on the market value of domestic scrap owing to the large-scale involvement of informal players. Scrap prices are subject to global market forces and can fluctuate daily, hourly, or even by the minute. Prices are set by the marketplace and reflect domestic manufacturing demands and the availability of virgin commodities. In the case of fabric scrap, the price and demand for material rely heavily on Chinese recyclers.

The prices of several compositions of fabric scrap are posted online to attract manufacturers. However, when we asked for details, waste buyers requested that we visit the manufacturing sites to check out prices, and most buyers were only interested in overstock fabric rolls or large -volume end-roll fabric, not fabric scraps.

**TABLE 6: FABRIC WASTE PRICE PUBLISHED BY SEVERAL ONLINE SCRAP BUYERS**

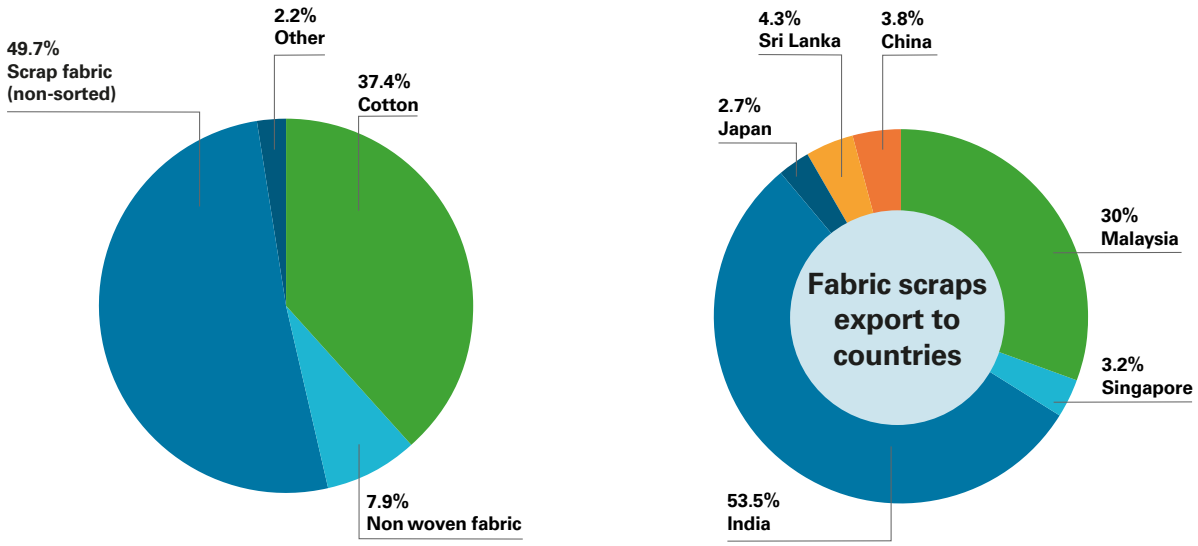
| Types of fabric | Composition | Average price |
|---|---|---|
| **Fabric scraps** | Mixed fabrics waste material | 3,000 - 18,000 Price |
| **End-roll** | Blended and mixed | 10,000 - 50,000 |
| | 100% cotton | 10,000 - 40,000 |
| | 100% cotton | 10,000 – 200,000 |
| | Spandex | 15,000 – 100,000 |
| | Tole | 50,000 – 200,000 |
| | Chiffon | 50,000 - 200,000 |
| | Denim | 10,000 - 100,000 |
| | Khaki | 10,000 - 120,000 |
| | Mesh | 30,000 - 200,000 |
| | Blended fabric (65% cotton and 35% polyester) | 20,000 – 200,000 |

The waste handlers also stated that the price of blended and mixed fabric scraps has dropped owing to the low demand for scraps since 2019. The exit of several Chinese recyclers and the waste import ban on China was reported as the reason for the reduced demand.

A large volume of fabric scraps is exported to other countries. In 2021, Vietnam exported over 1,550 tons of fabric scraps, with India being the leading destination country.

Nam Phong is the biggest fabric scrap trader in Vietnam, with a capacity of 3600 tons per year. Mostly, Nam Phong exports fabric scrap to European countries and covers an equivalent of around 5% of the total textile waste in Vietnam. However, COVID-19 in 2020-2021 disrupted the business, mainly due to increased shipping fees, thus putting all shipments to Europe on hold. The fabric scrap prices increased by at least three times along with the increased shipping fee. The import-export of fabric scraps and recycled textile products is speculated to be larger as small-quota export to Cambodia, China, and neighbouring countries is not formally recorded.

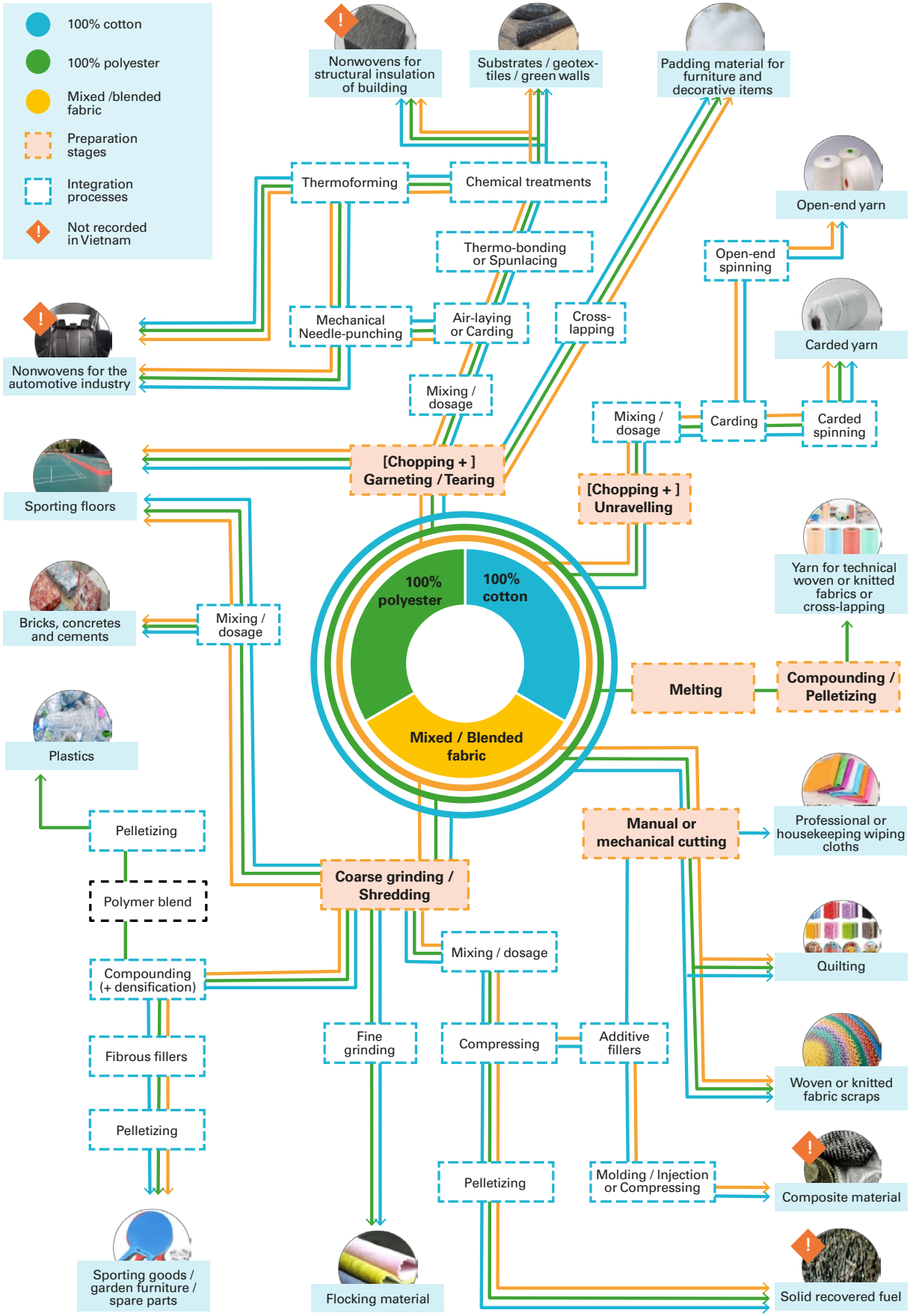
**FIGURE 22: FABRIC WASTE EXPORT FROM VIETNAM 2020-2021**




## 3.5.3 Fabric waste recycling

From the mapping of products (including recycled textiles) by Re_Fashion, we found that Vietnam's textile recycling is mainly mechanical and confined to three main types of material: (1) Natural fibre, (2) synthetic fibre, and (3) blended material. The overall recycling process is shown in Figure 23:

## FIGURE 23: CURRENT RECYCLING PROCESS AND END PRODUCTS FROM FABRIC WASTE



In regards to the textile-to-textile concept, two fabric waste processes have been identified:

**Natural fibre recycling:**
100% white cotton and cotton-polyester blend (minimum 70% cotton) form the highest-demand mechanically recycled fabric scrap. The quality of recycled yarn relies on the length and elongation of recycled fibres, which is the output of the shredding process. Often, Tier 3 yarn producers invest in a shredding line to shred fabric scrap into fibre for yarn production.

A yarn producer who is a supplier of various international brands reported looking for a scrap supplier of 200 tons of GRS-certified cotton scrap per month. The producer generates 30% recycled textile and 70% conventional cotton yarn sizes from 14 to 16.

**FIGURE 24: EXAMPLE OF 100% COTTON RECYCLING**

Gia Minh Ltd. is a Vietnamese yarn manufacturer that has produced around 200 tons of recycled textile yarn from fabric scraps since 2018. The company produces recycled open-ended yarn in various sizes (6 to 14) with a maximum of 30% recycled fibre and 70% conventional cotton. Even with sorted incoming feedstock, the cost of internal sortation is around 10-15% of the production. Hence, Gia Minh is planning to invest in sortation equipment and upgrading the shredding line to produce higher output quality.

**Synthetic fibre recycling:**
100% polyester scrap is bought by plastic recyclers to produce plastic pellets. The most popular plastic is low-value plastic for household products. A waste handler also claims that a Chinese plastic recycler in the Tien Giang province is producing polyester filament yarn from recycled polyester fabric. However, most recognised polyester recyclers are plastic recyclers, and they produce pellets of a quality suitable only to meet lower-end household and furniture product needs.

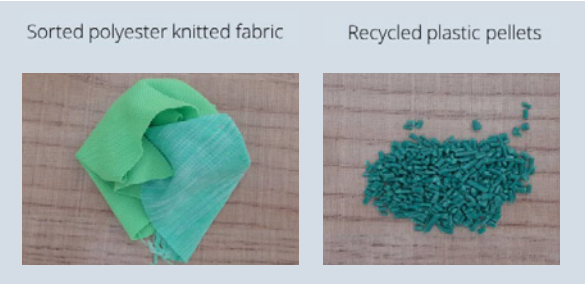
Using polyester fabric as feedstock for plastic recycling requires high-quality filters to remove all organic contamination. Knowledge of synthetic fibre recycling is still limited as recyclers say that output from woven polyester cannot be formed into plastic pellets. Hence, they are only able to process knitted polyester fabric. However, recyclers also do not know why woven fabric cannot be used to produce similar quality. Many recyclers only provide shredding and plastic granulation services and lack an understanding of fabric and textile material to provide higher-quality recycled output.

Vietnam has limited thermomechanical recycling of polyester textiles, and its implementation is limited by the capabilities of the recyclers as well as by the technological limitations of this method for several reasons:

Fabric scrap contains many contaminants such as organic material, sand, and soil. A washing step is needed to remove organic contamination, but this consumes energy and water and often the equipment, know-how, and willingness to perform this process are not present in Vietnam.

After the fabric is washed, the next challenge is to remove solid contamination through filtration. To produce rPET that can be re-spun into fibres, fairly high-level filtration is needed (e.g. down to 16 micrometres), and most of the time, local Vietnamese recyclers do not have such high-quality filtering equipment. Often the equipment available in Vietnam cannot create the right conditions to maintain the viscosity of rPET, which leads to reduced molecular chain length and lower quality. Colours cannot be removed, and so the outgoing colour is typically dark or black, which further limits its use.

**FIGURE 25: EXAMPLE OF 100% POLYESTER RECYCLING**

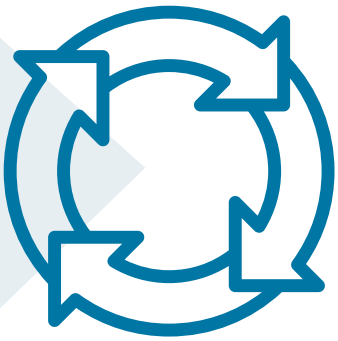



Even minor contamination with non-polyester components can derail the extrusion process, and small amounts of spin-finish are known to cause this issue. Relatively low percentages of elastane, acrylic, or nylon can also destabilise the process, yielding rPET of such low quality that it cannot be reused.
Therefore, to obtain high output quality of the polyester fabric, the recycling process must be controlled carefully to remove all potential contamination. The recycler needs to have information on the fabric composition, coating, dye auxiliaries, and finishing chemicals, which potentially impact the quality of the recycling process. The recycler also needs to have the correct equipment to produce a re-sellable rPET.

Vietnam has textile-to-textile recycling capability, however, the technology is nascent and output values remain low. Vietnamese recyclers primarily provide a very low-level mechanical recycling technique without incorporating techniques to achieve higher output quality. Adopting the closed-loop concept means providing material that can return to the textile value chain; it requires the recycler to understand textile material and fibre-yarn production.

One recycler pointed out that there is no clear demand market for recycled textile material in Vietnam and that it might also not be economically viable. The costs of textile recycling primarily derive from the significant losses made in the sortation and recycling processes, and the current market does not guarantee volumes and fair price for the recycler to make investment efforts. In 2020, the recycled cotton market share was around 0.96%, and the government is committed to bringing it up to 1.5% by 2025 via the 2025 Sustainable Cotton Challenge.[43] And while the market for recycled polyester from PET bottles is strong, the fashion industry has not yet made such a strong commitment to obtaining recycled material from textile scraps.

However, there is a possibility that the brand and EU product requirements for the recycled material share in the endproduct will further foster the demand for a textile-to-textile recycling approach.



## GROWTH POTENTIAL OF TEXTILE-TO-TEXTILE RECYCLING IN VIETNAM

Recognising the potential of a huge volume of feedstock in Vietnam, many players have expressed increasing interest in textile recycling. Several local recyclers also plan on investing in better technology and techniques. They are encouraged by the changed perception of the recycling industry over the past year. 'Recycling was a "dirty" and overlooked sector for many years in Vietnam. Now the government is promoting and encouraging recycling', says one recycler. Foreign investment is available, and brands have evinced interest around recycled textile material.

Recover™ is a leading materials science company and global producer of low-impact, high-quality recycled cotton fibre and cotton fibre blends. Its premium, environmentally friendly, cost- competitive products are created in partnership with the supply chain for global retailers and brands, offering a sustainable solution to close the loop on fashion.

The company is investing strongly to scale recycled fibre production to meet surging demand. To achieve this, it is opening new manufacturing facilities worldwide, including a new facility in southern Vietnam to support the Southeast Asian market. Recover's expansion plans have carefully considered its hub location, with the new facility in Vietnam being situated close to fabric waste or textile manufacturing units, thereby being close to supply and demand. The location also helps reduce the company's carbon footprint, as transporting the raw waste material has a significant carbon impact. South Asia is one of the largest cotton waste-producing regions, and by establishing a presence in these countries, Recover™ can take another big step in closing the loop on fashion.

## 3.6 Key findings

Vietnam offers some textile-to-textile recycling, and key stakeholders are interested in creating a more structured and efficient approach to maximising the volume and quality of recyclable fabric scraps.

The consolidated findings are as follows:

**Regulation and management:** Fabric scraps come under general industrial solid waste management but there are no specific regulations or central management systems for the material itself. There is currently no central tracking and tracing method to capture the market size and impact of fabric scraps on the economy and waste management in Vietnam.

**Current availability of textile-to-textile recycling feedstock:** 100% cotton and 100% polyester are high-demand feedstocks for textile-to-textile recycling. These are largely run by the Chinese textile supply chain in Vietnam. Moreover, 100% polyester is recycled into pellets and produced for different output products. Ensuring the quality of recycled 100% polyester textile for its return to the textile supply chain is a primary challenge that remains unmet.

**Fabric waste sortation at factory level:** Overall, the fabric sorting cost is about 10-30% of the production cost for the recycler. Sorting at the cutting table directly would reduce the cost of feedstock material for the downstream recycling process. While interested in increasing sustainable performance, most manufacturers do not sort fabric scraps at source because they do not know what is worth sorting. Consequently, recyclable and non-recyclable fabric scraps are often mixed at the manufacturing site. Manufacturers have a limited understanding of waste material and how to handle it to maximise the volume of sorted recyclable waste.

**Information and knowledge:** There is a lack of sufficient data and knowledge for relevant stakeholders, including policymakers, waste producers, recyclers and potential investors, to make informed decisions. The limitation lies in data regarding the quantity and quality of the feedstock to facilitate textile-to-textile recycling. Furthermore, there is limited technical know-how about the technical feasibility of recycling approaches as well as the current state of Research&Development of recycling processes, which could already provide output that can compete with virgin materials, is missing.

**Market demand:** The market demand for recycled material plays a major role in shaping and promoting the flow of recyclable fabric scraps toward a closed-loop value. It includes a clear standard and acceptable quality to enable the economic viability of recycled material production.

If tackling the barriers, the stakeholders can tap into ample opportunities of a more circular textile economy. Textile-to-textile recycling also delivers an answer to a raw material shortage which is expected in the long-run. Current and upcoming regulations will require a higher share of recycled materials in the apparel production. Furthermore, public awareness is needed to transform the linear model to a more material-efficient system. Therefore, it seems clear that tapping into this under-utilised waste flow as a valuable resource can create new business opportunities. While mechanical recycling technologies are simple and practical, efficient material sortation is the main technical challenge. Even though sortation technologies are still in development, manual sorting also increases employment opportunities for low-skilled labour in Vietnam. In light of the rapid growth of textile-related industries, material efficiency and recycling offer opportunities to increase local value economically and sustainably.

# Final recommendations

Regulatory framework addressing fabric waste management

Establishment of a tracking and tracing system to capture the market size, feedstock composition and value of fabric waste in the economy

Capacity development for fabric waste sortartion and segregation, especially at the factory level

Development of a business case and establishing collaboration between all actors in the waste supply chain to create a favourable eco-system for textile recycling:

- Incentivize manufacturers to provide high-quality feedstock
- Inclusion and linking waste handlers with manufacturers and recyclers
- Establishing capacity and infrastructure for recycling technologies

Increasing mandatory requirements and voluntary brands` commitments for recyled material

Higher investments in recycling units and technologies

# Annex

## Glossary

### Blended

Blended fabrics are created by  combining different fibres, resulting in a new fabric with unique properties.

### Carded yarn

A yarn formed by twisting together two or more plied yarns.

### Chemical recycling

Chemical textile recycling adopts a series of chemical processes to depolymerise/dissolve the fibre form of the fabric into a monomer/ solvent form either to make new fibre compounds or extract one compound from a mix.

### Circular Economy

Looking beyond the current 'take, make, and dispose' extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system- wide innovation, it aims to redefine products and services to design waste out while minimising negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital.

### Closed loop recycling

Closed loop is a production process in which waste (pre-consumer and/or post-consumer) is recycled into new materials and products.[5]

### Deadbolt

Fabric end-roll cutting waste. The left- over at the end of fabric at cutting table, which often is bigger in size than waste scraps.

### Down cycling

Reprocessing discarded textiles to create new consumer or industrial products in a process that is usually mechanical. Down-cycling processes result in a lower value or lower quality output than the originating product.

### Fabric scraps at cutting table

Fabric scraps at the cutting table are small, ranging in size from 5 $cm^2$ to 30 $cm^2$.

### Open-end yarn

Produced by continuously pulling a yarn extended into the rotor. This yarn, which is produced by evaluating even the shortest fibers of cotton, is very economical. In order to ensure integrity, the number of twists must be higher than the ring system. This causes it to have a harder structure.

## Recycled content

Includes products and packages that contain reused, reconditioned, or remanufactured materials, as well as recycled raw material.

## Recycler

A business, facility or manufacturer that engages in the process of converting waste materials into new materials and objects.

## Textile scrap

Cut-and-sew waste is textile scraps generated during garment manufacturing.

## Textile to textile recycling

Recycling process of textiles where the output is the input material for fabric production.

## Tier 1

Cut – Make –Trim, apparel manufacturing.

## Tier 2

Fabric manufacturing.

## Tier 3

Yarn manufacturing.

## Upcycling

The process of converting an industrial nutrient (material) into something of similar or greater value, in its second life. Aluminium and glass, for example, can usually be upcycled into the same quality of aluminium and glass as the original products.

## Waste handler

Business or services provider who provides waste collection, primary handling, waste sortation, storage,and transfers stations for waste.

## 3 R

Reduce, reuse, and recycle.

## 5R

Refuse, reduce, reuse, repurpose, and then recycle.

# Appendices

## List of relevant local regulations

| No. | Regulation | Overview |
|---|---|---|
| | | **NATIONAL STRATEGY** |
| 1 | National Strategy on Integrated Management of Solid Waste (ISWM) to 2025, vision to 2050 | The national strategy defines key role in mobilizing resources and increasing investment for solid waste management. Industrial waste solid management also contains the prevention/ reduction of waste generation and sorting of waste at source as a priority task of industrial solid waste management as well as promotion of reuse and recycling to minimize the amount of landfilled waste. |
| | | **LAW** |
| 2 | The Law on Environment Protection (LEP) 2020 No.72/2020/ QH14 | The New Environmental Protection Law 2020 is updated from LEP 2014. In January 2022, the revised Law on Environmental Protection (LEP) 2020 came into effect. In general, the law highlights the responsibilities of ministries and localities to integrate circular economy in planning strategies, development plans, waste management, and waste recycling.<br><br>The following updates on solid industrial waste, including<br>• The solid waste management and register will be a part of the environmental license.<br>• Industrial non-hazardous waste is separated into 3 types: Recyclable waste as material for production; Recyclable waste as building material and Non- recyclable waste. |
| 3 | The Law on Investment 2020 No. 61/2020/ QH14 | This law provides for business investment activities in Vietnam and business investment activities from Vietnam to abroad. Inside that, there is a regulation about sectors, occupations, and geographical areas for collecting, treating, recycling, and reusing waste eligible for investment incentives. |
| | | **DECISION** |
| 4 | Decision No. 577/2013/QD-TTg | The Prime Minister dated 11 April 2013 approving the Master program for environmental protection in craft villages towards 2020 and vision towards 2030. |
| 5 | Decision No. 491/2018/QD-TTg | Approving the adjusted national strategy on integrated management of solid waste up to 2025, with a vision toward 2050. |
| 6 | Decision No. 28/2020/QD-TTg | Categories of scrap to be imported as production materials. |

## Regulation category

| No. | Regulation | Overview |
|---|---|---|
| | **DECREE** | |
| **7** | Decree No. 38/2015/ND-CP | Regulation on waste and scrap management. |
| **8** | Decree No. 155/2016/ND-CP | Treatment of legal violations in environmental protection, forms, levels, competence, and procedures/remedies. |
| **9** | Decree No. 40/2019/ND-CP | Amending and supplementing some articles of decrees details programs and instructions for implementation of environment protection law. |
| **10** | Decree No. 55/2021/ND-CP | Amending and supplementing some articles of Decree No. 155/2016/ND-CP on 18th November 2016 about the treatment of legal violations in environmental protection, forms, levels, competence, and procedures/remedies. |
| **11** | Decree No. 8/2022/ND-CP | Detailing some articles of The New Environmental Protection Law 2020. |
| | **CIRCULAR** | |
| **12** | Circular No. 36/2015/TT-BTNMT | The MONRE dated 30 June 2015 on the management of hazardous wastes. |
| **13** | Circular No. 02/2022/TT-BTNMT | Belongs to The Law on Environmental Protection 2020 and Decree No. 8/2022/ND-CP, detailing some articles of The New Environmental Protection Law. |
| | **VIETNAMESE STANDARD** | |
| **14** | TCVN 6705:2009 | The classification of the non-hazardous solid waste. |
| **15** | TCVN 6706:2009 | The classification of the hazardous waste. |
| **16** | TCVN 6707:2009 | The warning signs of the hazardous waste. |

## Waste code list for the textile industry

| Waste Code | Waste Type | EC Code | Basel Code (A) | Basel Code (Y) | Hazardous Characteristic | Stage | Clasifi-cation Sign |
|---|---|---|---|---|---|---|---|
| 10 02 | Wastes from textile industry | 04 02 | | | | | |
| 10 02 01 | Wastes from finishing containing organic solvents | 04 02 14 | A3140 A3150 | Y41 Y42 | Toxic, flammable | Liquid | KS |
| 10 02 02 | Dyestuffs and pigments containing hazardous substances | 04 02 16 | A1040 | Y12 | Toxic, ecologically toxic | Solid/ Liquid | KS |
| 10 02 03 | Sludges from on-site effluent treatment containing hazardous substances | 04 02 19 | | | | | |
| 10 02 04 | Solutions containing hazardous substances from dyeing process | | A4070 | A 4070 | Toxic, ecologically toxic | Liquid | KS |
| 10 02 05 | Wastes from composite materials (impregnated textile, elastomer, plastomer) | 04 02 09 | | | | Solid | TT |
| 10 02 06 | Organic matter from natural products (for example grease, wax) | 04 02 10 | | | | Solid/ Mud | TT |
| 10 02 07 | Wastes from finishing other than those mentioned above | 04 02 15 | | | | Solid/ Mud | TT |
| 10 02 08 | Dyestuffs and pigments other than those mentioned above | 04 02 17 | | | | Solid/ Mud | TT |
| 10 02 09 | Sludges from on-site effluent treatment other than those mentioned above | 04 02 20 | | | | Mud | TT |
| 10 02 10 | Wastes from unprocessed or processed textile fibers | 04 02 21 04 02 22 | | | | Solid/ Mud | TT-R |

*Note: KS – Need to control; TT – Non-hazardous waste; TT-R – Recyclable non-hazardous waste*
*Source: Annex III, Circular 02/2022/TT-BTNMT*

## Other waste category

| Waste Code | Waste Type | EC Code | Basel Code (A) | Basel Code (Y) | Hazardous Characteristic | Stage | Clasifi-cation Sign |
|---|---|---|---|---|---|---|---|
| 19 03 | Off-specification batches and unused products | 16 03 | | | | | |
| 19 03 01 | Inorganic wastes containing hazardous substances | 16 03 03 | A4140 | | Toxic, ecologically toxic | Solid/ Liquid | KS |
| 19 03 02 | Organic wastes containing hazardous substances | 16 03 05 | A4140 | | Toxic, ecologically toxic | Solid/ Liquid | KS |
| 19 03 03 | Inorganic wastes other than those mentioned above | 16 03 04 | | | | Solid/ Mud | TT-R |
| 19 03 04 | Organic wastes other than those mentioned above | 16 03 06 | | | | Solid/ Mud | TT-R |

*Note: KS – Need to control; TT-R – Recyclable non-hazardous waste*
*Source: Annex III, Circular 02/2022/TT-BTNMT*

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