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Efficiency and Innovation: Navigating Waste Management in Fashion and Textile Industries

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Efficiency and Innovation: Navigating Waste Management in Fashion and Textile Industries

Amidst the growing global focus on sustainability, countries worldwide are prioritizing policies to curb the volume of waste destined for landfills, which poses significant environmental threats. Rapid changes in lifestyles and technological advancements have led to a lack of effective waste disposal methods, exacerbating the challenge, particularly in the textile and fashion industry—a sector known for its dynamism but also for its substantial waste generation and environmental impact.

A notable disparity exists between producer and consumer countries regarding policies and innovations aimed at addressing textile and fashion waste. Nevertheless, it's essential to recognize the collective efforts undertaken by the global textile industry to confront this pressing issue.

One must revisit the promises made during the most famous Copenhagen summit where many brands participate. Every year the summit raises awareness of the harm the industry is doing to the environment, but the 2017 summit saw significant commitments made by the industry towards innovation for sustainable textiles. The commitments included:

- To effectuate the system of circularity
- Augment the number of garments collected.
- Increase the number of garments re-sold.
- Increase the number of garments made from recycled post-consumer textile waste.

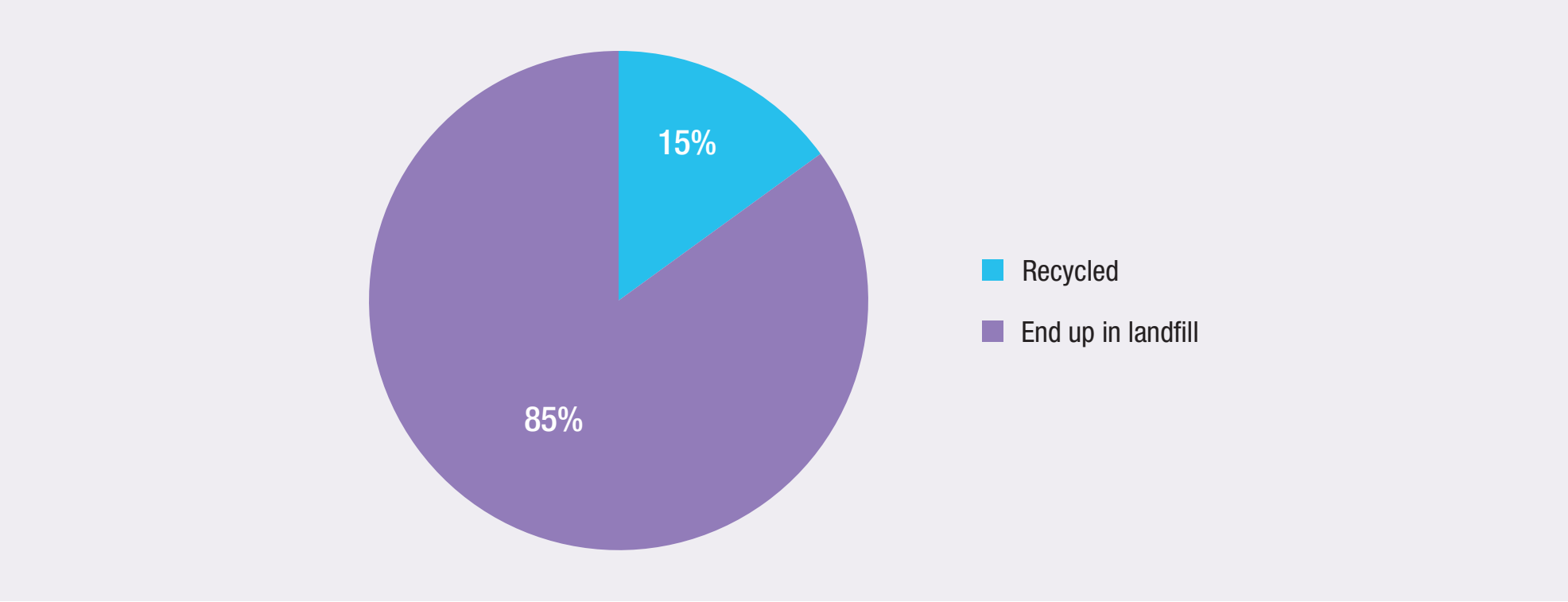
However, the commitments made 7 years ago didn't bear fruit. As of today, there is only 1 per cent of textile waste recycled globally. All the remaining textile waste is dumped into the landfill. To make the problems worse, the issue is spreading on a global level to countries like Africa and Asia.

What do the waste statistics say

The textile industry is the second largest industrial polluter in the world. The per capita consumption of apparel is increasing as we have entered the era of fast fashion. In 2021 according to Fashion United, people globally consumed around 16.7 units of approximately per capita. Globally, clothing and textiles make up 7 per cent of the total waste in the landfill. Clothing in the landfills emit methane which is harmful to the environment.

If we consider the global condition of the clothes that are discarded, only 15 per cent are collected for recycling, and from that, only 1 per cent is recycled into new clothing. Global textile consumption will increase by around 120 million tonnes by the year 2030 if we continue to adopt the lifestyle of fast fashion. Figure 1 shows the condition of the clothing which is discarded. The current scenario gives a grim picture of the global textile and fashion industry in terms of recycling.

Figure 1: Global textile and apparel disposal statistics

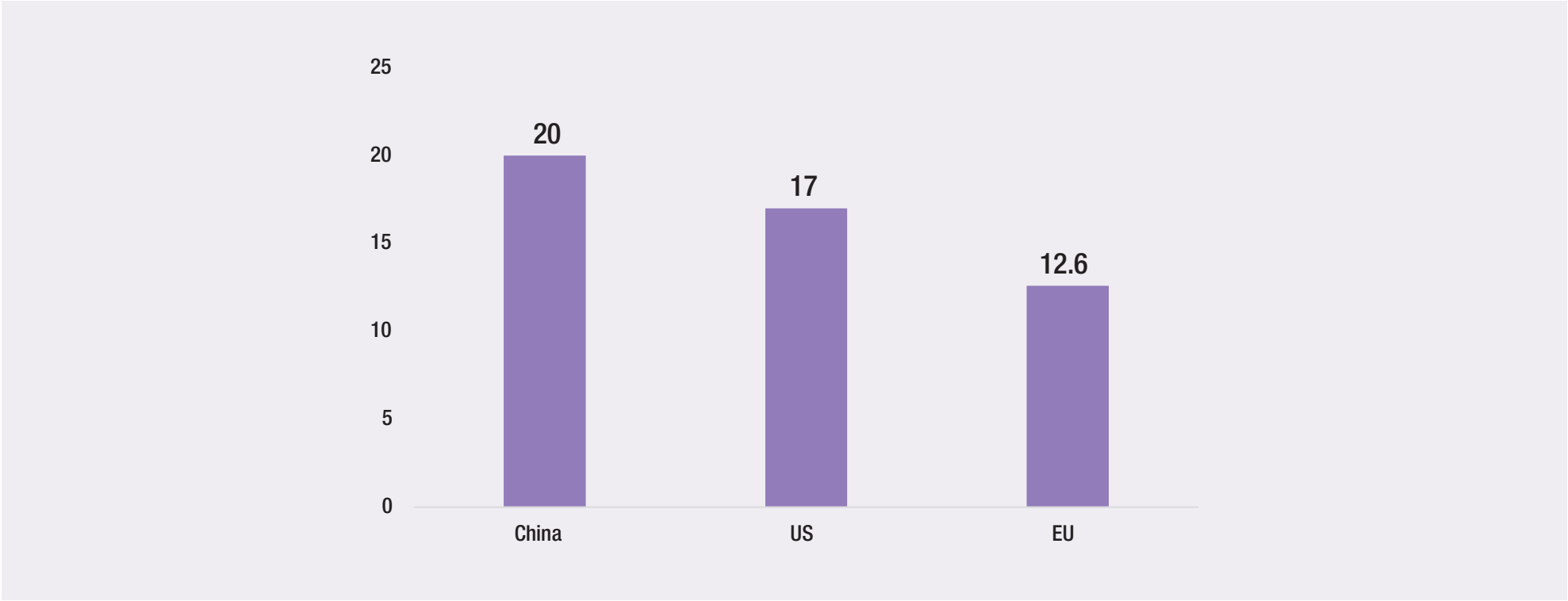


Source – Sustainable Ninja

Textile production is responsible for 20 per cent of clean water pollution and is the third largest sector responsible for the pollution of land resources in the year 2020 according to the European Parliament. The industry is responsible for 7 per cent of the overall CO_2 emissions. The industry emits around 1.7 billion tons of CO_2 annually. Globally, the US and the EU are the only countries that are adopting laws binding to the entire textile and apparel value chain. The McKinsey's State of Fashion Report 2024,' the US and the EU are framing policies that are meant to increase the accountability of the companies involved in the apparel production via the policies like the Extended Producers Responsibility Act (EPR Act) and Third-Party certification for the process of production and the apparel production along with standardized matrices for pollution. Globally almost $500 billion is lost due to the underutilisation of apparel and failure to recycle clothes.

If looked at from the country perspective; US, EU, China, and India are some of the largest countries in terms of textiles. If seen from a country perspective, China the US, and the EU are some of the countries with the largest textile waste disposed of so far. China has disposed of around 20 million tons of waste followed by the US and the EU.

Figure 2: Textile waste in countries (in million tons)



Source – Down to Earth, EU Parliament, The Roundup

Country-wise stats

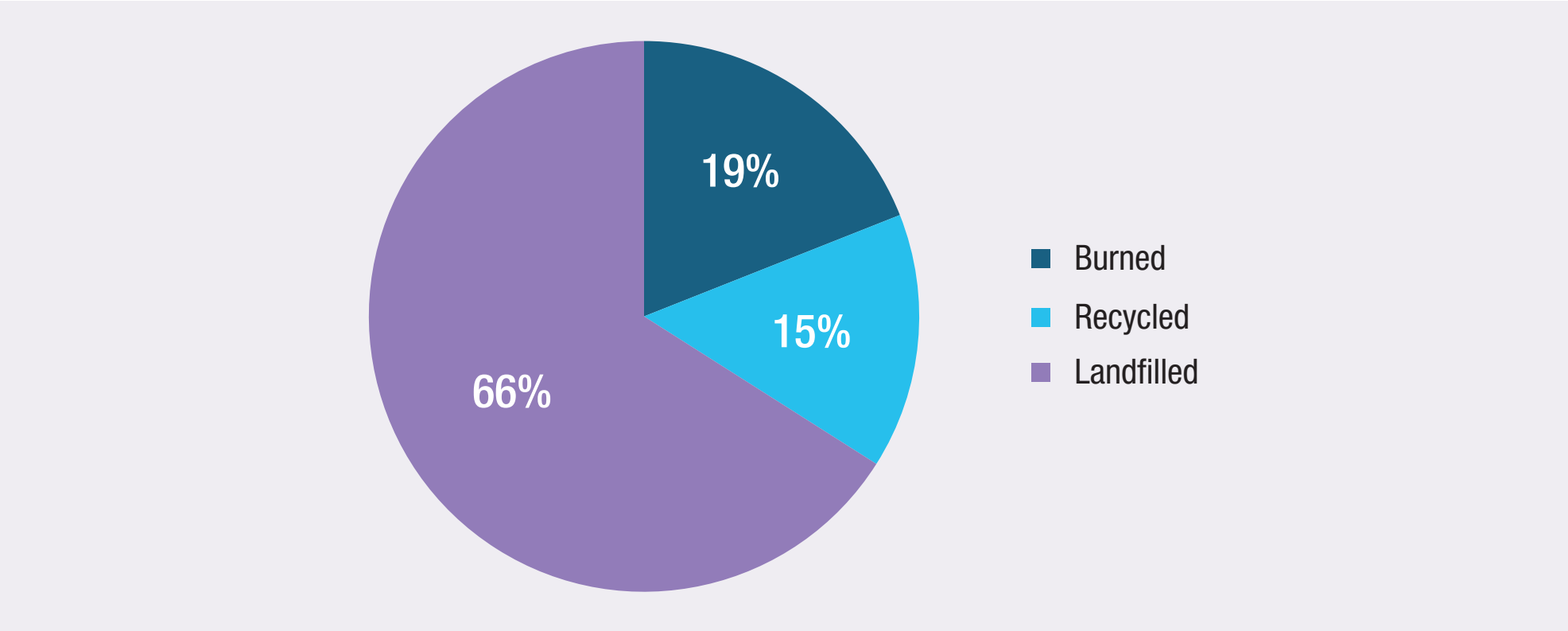
We know very well that the US and the EU are two of the largest importers of apparel and these countries are the ones which are trying to implement policies to ensure that the apparel that is imported as well as produced within their borders is more in the line of sustainability and the producers take the full responsibility of the apparel manufactured. For now, we consider two consumer countries US and the EU. Although the countries have their textile industry, these are some of the major importers of textile and apparel products from Asia. The countries considered here are the US and the EU.

Waste Statistics for the US and the technological scenario

The US is one of the largest consumers in the world when it comes to textiles and apparel. The country disposes of almost 17 million tons of textile waste. And out of it only 15 per cent is sent for recycling, followed by 19 per cent burned, and a majority 66 per cent of the apparel is sent to landfills. With a high return rate of apparel in the US the clothes that are disposed of in the US are made with technologies and materials that are difficult to recycle. The low recycling rate in the US is leading to the US Congress

introducing the New York Fashion Act; to induce sustainability. It is important to ensure the implementation of the laws and stricter regulation of textile waste as it has increased by 76 per cent from the year 2000 to 2017.

Figure 3: The composition of the US textile waste in percentage (%)



Source: The Round Up

One of the most startling facts for a technologically developed country like the US is that the country still utilises recycling technologies on a small scale, and this is the small-scale use of fibre recycling technologies. Even though there is the availability of mechanical and chemical recycling of the fibres, the technological development has been only in terms of chemical recycling, and a significant fact about the same is the methods introduced so far are not made open for the consumers and therefore the methods are not used widely. Several startups have been established in the US but are still unable to bring the process to use less energy completely. The quality of the clothes being recycled and what is to be done to improve the quality of the same is to be found out through the process. To understand the condition better, it will be useful to take an example of one of the states of the US that is involved in the Textile Industry and the efforts taken to align to the sustainability goals.

California

Being one of the top fashion capitals in the US, the state is also home to the sewing factories in the US, it is one of the first states in the US to implement the textile waste ban which mandates that households do not dispose of any textile items in the landfills or incinerators. Being one of the largest manufacturers in the US, the state has contributed almost 15 per cent to US manufacturing. The law is important to be implemented as according to the McKinsey Report, from 5,10,000 tons of apparel used by the people in California, only 5,000 clothes are recycled. This makes it barely just one per cent of all the clothes that are used in the state.

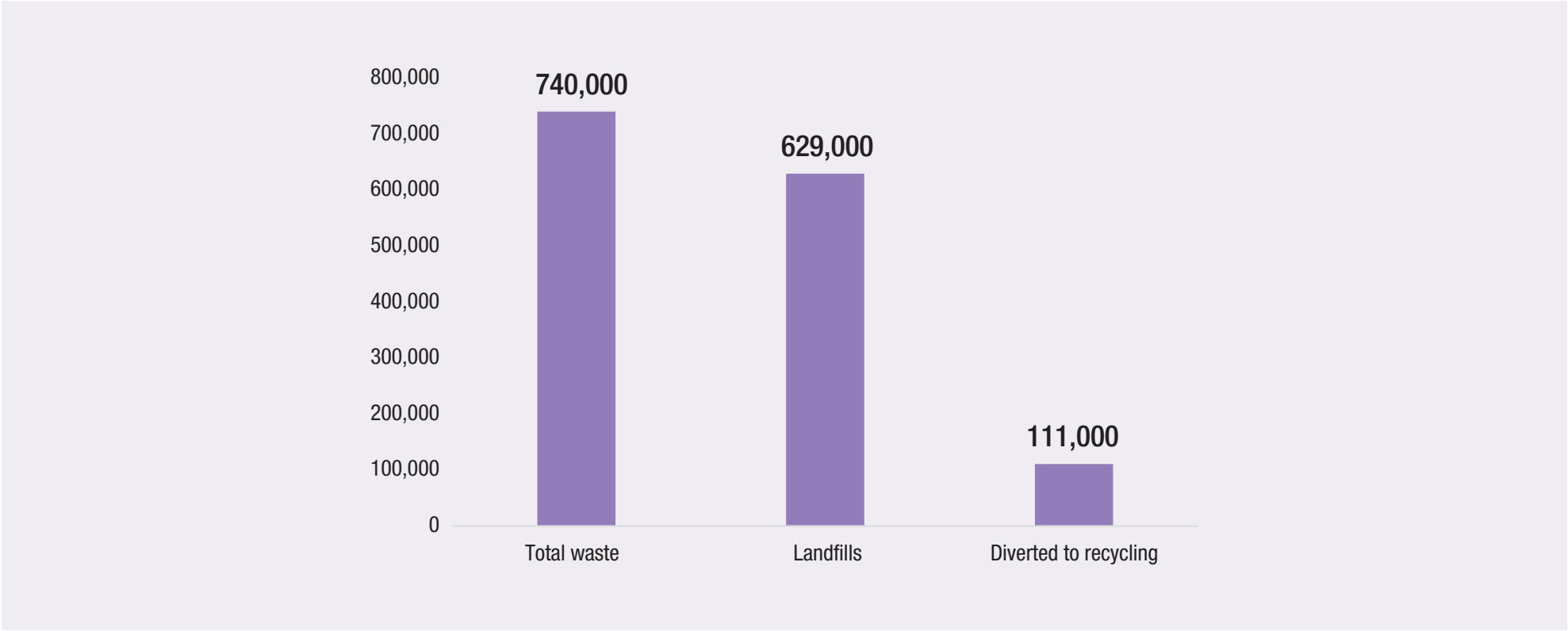
There is barely less than one per cent that goes to textile-to-textile recycling. The main issue with the upcycling of textiles is fewer firms adopt textile-to-textile recycling. Almost all the firms have adopted textile recycling on a pilot basis. The closed-loop recycling method has been encouraged to be adopted in almost all the states in the US. But considering California is important due to Los Angeles – the second fashion capital of the US. The issue of textile waste in California is an issue as it is a burning issue in the state. Although there are some steps taken to resolve the issue, the reach of the capacities and the companies is still low. There are 30 or so firms in California that work to recycle the companies' textile waste.

California specifically has the largest concentration of garment workers in the US and therefore, with such prowess, the issue of textile waste becomes one of the harrowing issues for the state. So far, the state has seen very limited efforts, investments, and the reach of such technologies to the textile industries, and therefore there is a need to ensure that the clothes used, produced, consumed, and then further disposed of are fully recycled.

The textile waste statistics are harrowing. Being no different as compared to the other nations in the word, the amount of clothes recycled is less than one per cent as compared to the total textile waste disposed of. Yearly almost 6 per cent of the waste is incinerated of the total textile waste.

Almost 7,40,000 tons of used clothing is expected to be disposed of. And if went by the stats, almost 6,60,000 tons of textile waste may go to the landfills and the remaining 10 per cent is diverted to recycling.

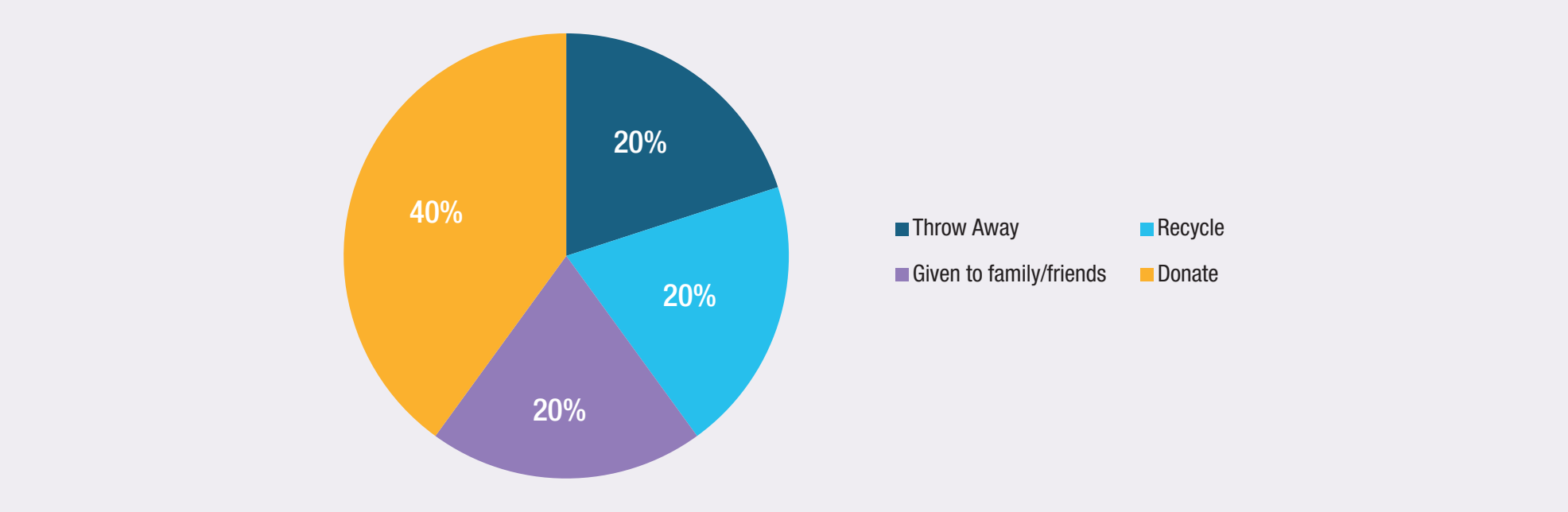
Figure 4: Clothing waste in California (in tons)



Source: McKinsey and F2F analysis

From the 1,10,000 tons of apparel diverted from the landfills in California, only about 5,000 tons are sent to actual recycling. This means a mere 5 per cent of the diverted waste is converted into apparel. This also means that the remaining is either sold out as second-hand clothes, exported to other countries, or downcycled. This shows the dire need to invest in recycling technologies. If one considers the consumer preferences for purchasing apparel made from different materials, only a mere 20 per cent of the households have given used clothing directly for recycling purposes. And the majority who donate the clothing, the system is hard as of now to track what happens to the clothing after it is donated.

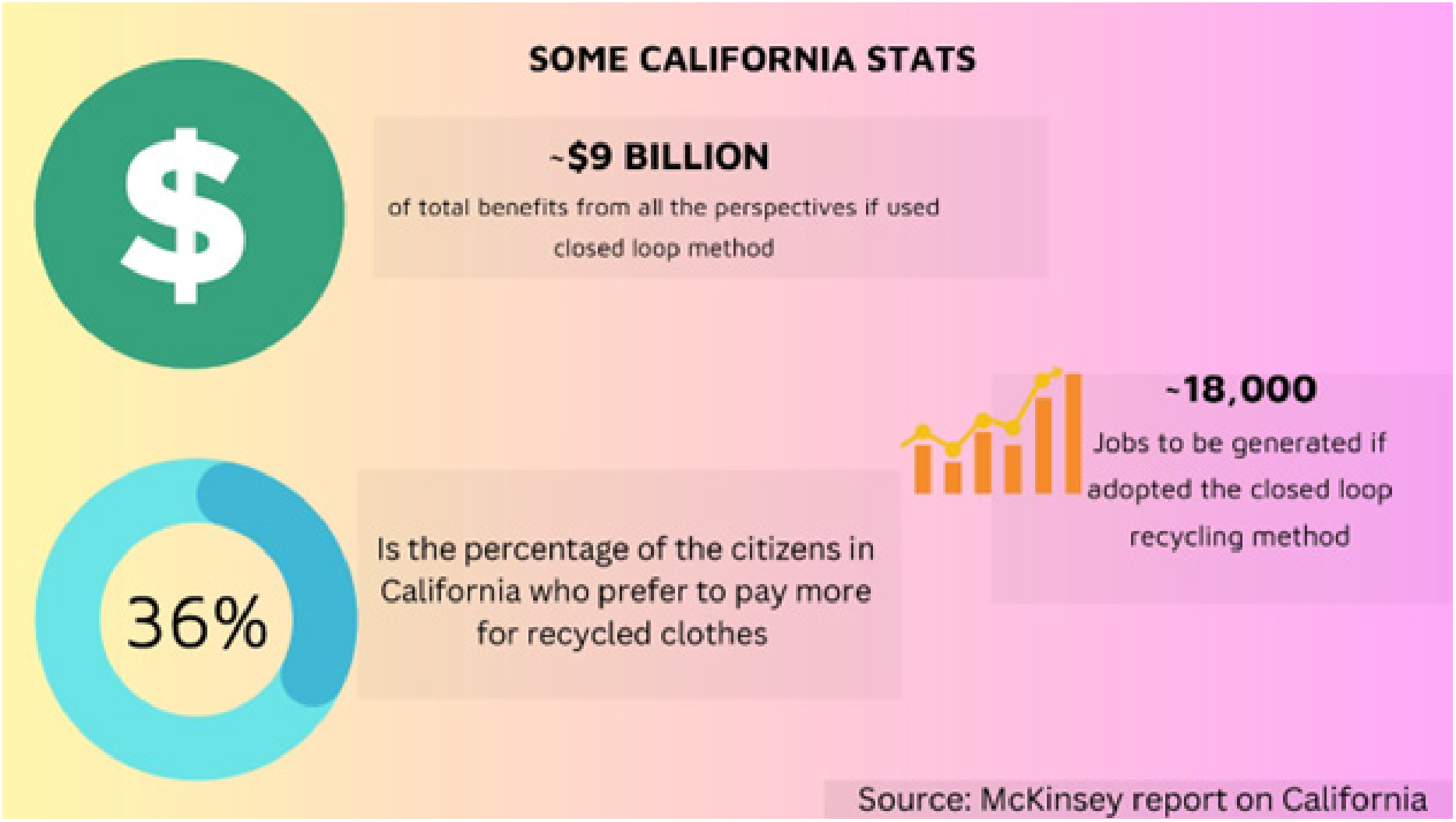
Figure 5: Consumer's preferred destinations for giving away used clothing (in %)



Source: McKinsey Report

The same is the case for the kind of clothing that the consumers prefer. A survey taken by McKinsey revealed a high preference for clothing made from natural fibres like organic cotton and a mere 36 per cent for recycled clothes.

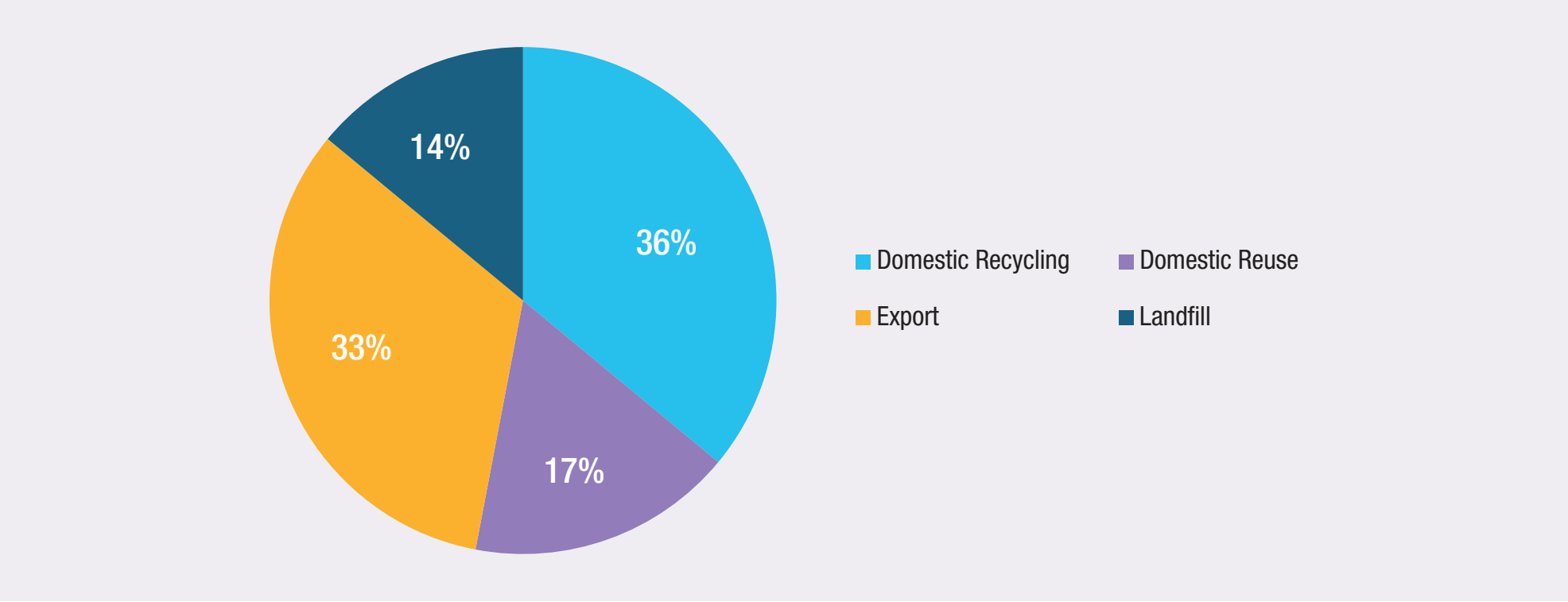
However, if a method of recycling for used and disposing of textiles is adopted, it will have a lot of benefits for the country, in terms of the social but also for the economy. Adopting a closed-loop method for the recycling of clothes will lead to the generation of jobs along with huge benefits in terms of the environment. There are multiple brands worldwide that have attempted to adopt on a pilot basis the circular method of recycling used apparel using the closed loop method. Although this is the case for the US, the same case persists in the other corners of the world. Take the EU for example.



Australia

Being the world's second-largest consumer of apparel in the world, even Australia exports a major chunk of the apparel to other countries as second-hand clothing. And the majority is sent to domestic recycling. The charitable groups in Australia receive around 12.1 kg of textiles per person. The charities must pay a hefty cost of sending the unused apparel to the landfills; and due to the lack of proper regulation on textile waste; the charities must educate the citizens to dispose of only those clothing materials that are in good condition for reuse or recycle.

Figure 6: Textile waste management in Australia



Source: Science Direct

Australia is taking proactive steps to imbibe circularity in the value chain. There is a multistakeholder collaboration in the country; which led to initiatives like the Waste and Resources Action Programme (WRAP), Universities and charities to design an action plan to tackle the issue of the textile waste generated in the country by keeping a financial buffer to help manage the end of life cost of the product; by sharing the burden and helping to minimise the environmental and health impact of the product.

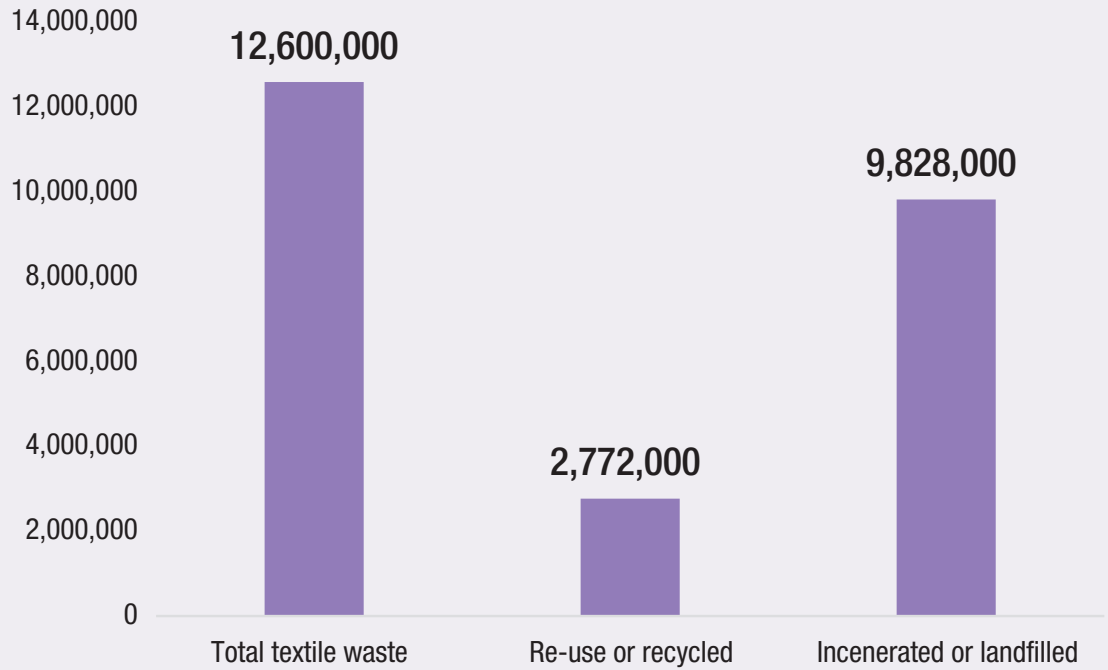
Apart from this, the country is also taking very basic steps towards imbibing sustainability like introducing the same in school, sustainable procurement, utilising sustainable practices in the workplace and including sustainability and innovation in the fashion and textile courses etc. Apart from this, the retailers are also doing their part by accepting clothes which are partially torn and used which helps to divert clothes from the landfills. A lot of fashion brands use the collected waste partially in the production of new garments. A lot of brands are aiming to increase the component of recycled materials in the production of apparel by the year 2030.

Initiatives like the SWOP clothing exchange shops, Suitcase rummage, Garage sale trail, and the Brisbane revive festivals showcase the discarded clothing in novel ways. Thus, although the country has fewer municipal collection infrastructure and regulatory regulations for textile waste management, the initiatives are helping the country to move towards a more sustainable future. The country still has to tackle issues like having a cost-effective method of collection of textiles, a proper law for textile waste collection and disposal, a waste collection law and proper government initiatives to ensure the continuous process of sustainable textile production and disposal.

The EU

The EU also has the same condition when it comes to clothing waste. EU generates around 12.6 million of textile waste every year and from those a mere 22 per cent is recycled or re-used and the remaining is either incinerated or is landfilled.

Figure 7: EU's composition of the textile waste disposal methods (in Mn tons)



Source: EU Parliament

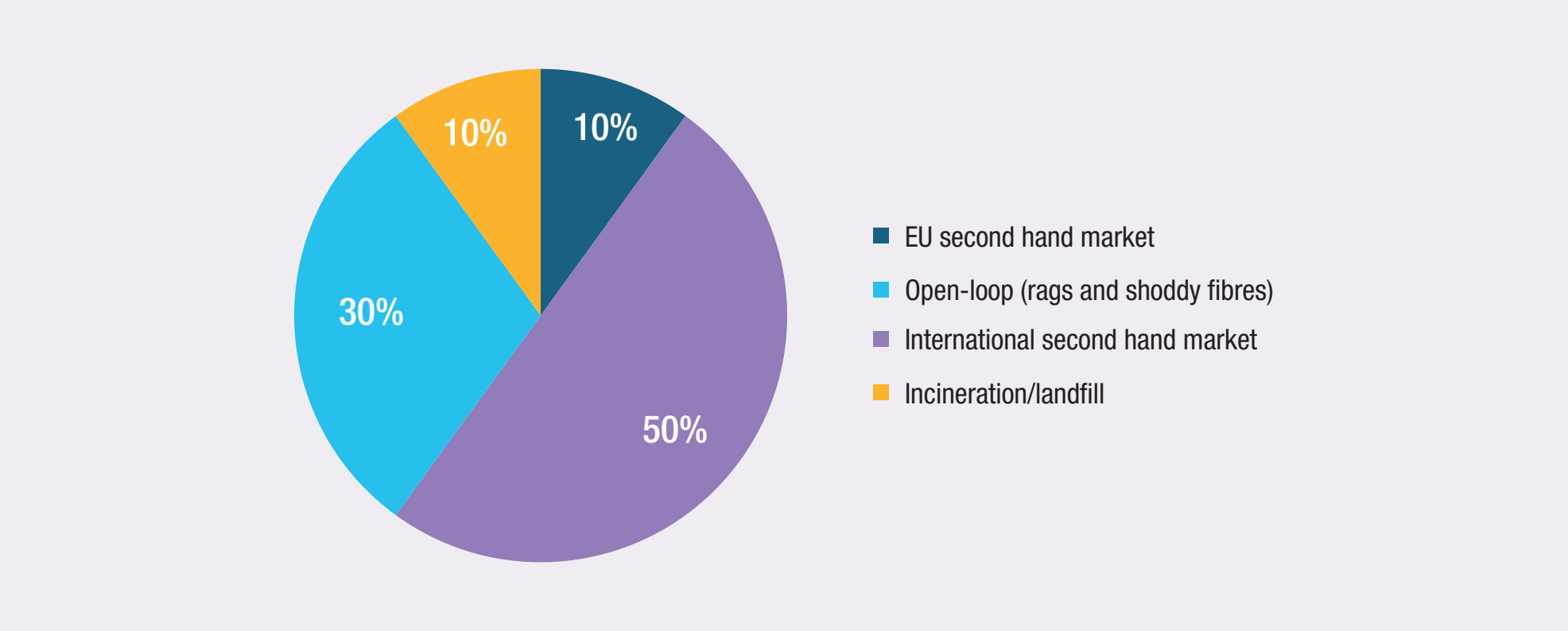
According to a report from McKinsey, around 85 per cent of textile waste comes from post-consumer waste disposed by households. That is estimated to increase by the year 2030 if the same trend of fast fashion without any measures to tackle the problem of textile waste continues, thus proliferating the already existing problem into a crisis. The policy of the EU to tackle textile waste along with pro-active participation in promoting the adoption of textile waste recycling as the EU has been relying too much on exporting used clothing to African countries and some countries in Asia also has led to some environmental problems arising due to an improper infrastructure to handle the landfills.

The data from the McKinsey report indicates that 50 per cent of textile waste collected and sorted by textile collectors and sorters is sold in second-hand and international markets, making it the second largest revenue source after the EU second-hand markets. Notably, nearly 60 per cent of the total textiles/clothing collected and sorted are exported to second-hand markets within the EU.

Given these figures, it becomes crucial for the EU to champion recycling methods across all member countries. McKinsey's report on the circular economy in Europe suggests that an initial investment of approximately $6.5 billion is necessary to effectively initiate circularity initiatives within the bloc. These initiatives would involve policies mandating producers to take responsibility for the apparel they manufacture.

Out of the second-hand clothing exported by the EU, almost 46 per cent of the used clothing gets exported to the African regions, and that itself is a major issue. With the obligation for all the textile waste to be collected separately in the EU by 2025, higher is the possibility that the textile waste will increase. Countries like France have tabled a ban in the Parliament to ban the exportation of second-hand apparel from the bloc to countries like Kenya, and Ghana as the exports are hurting the country's ecological balance as well; along with stunting the growth of the domestic textile industries there.

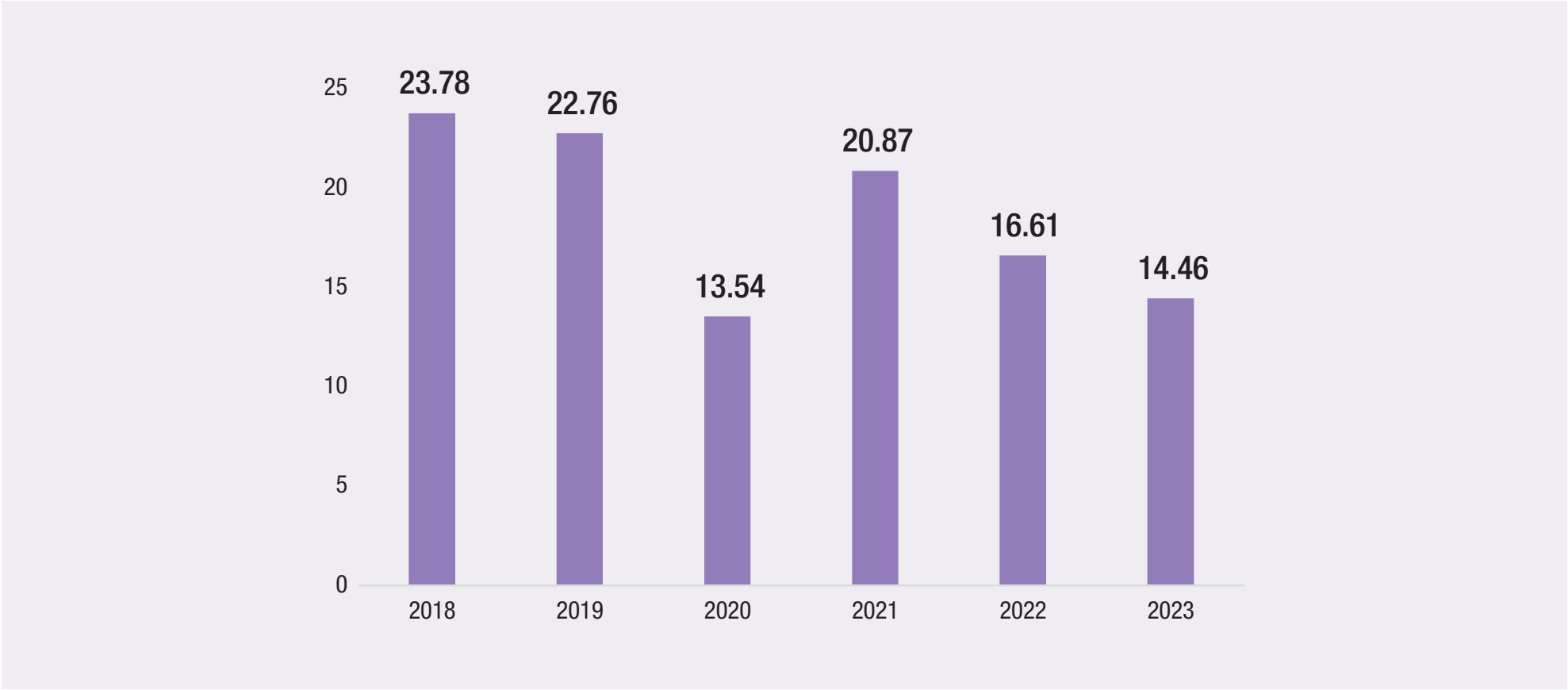
Figure 8: Destination of the textiles collected by the collectors in the EU (in %)



Source: McKinsey

The figures given below give a rough scenario of the total exports of second-hand clothing from the EU to Kenya and Ghana. To Kenya, if looked at the overall exports of the EU to the countries have been reducing, although half of the same also can be attributed to the economic uncertainty which reduced the overall exports to other regions.

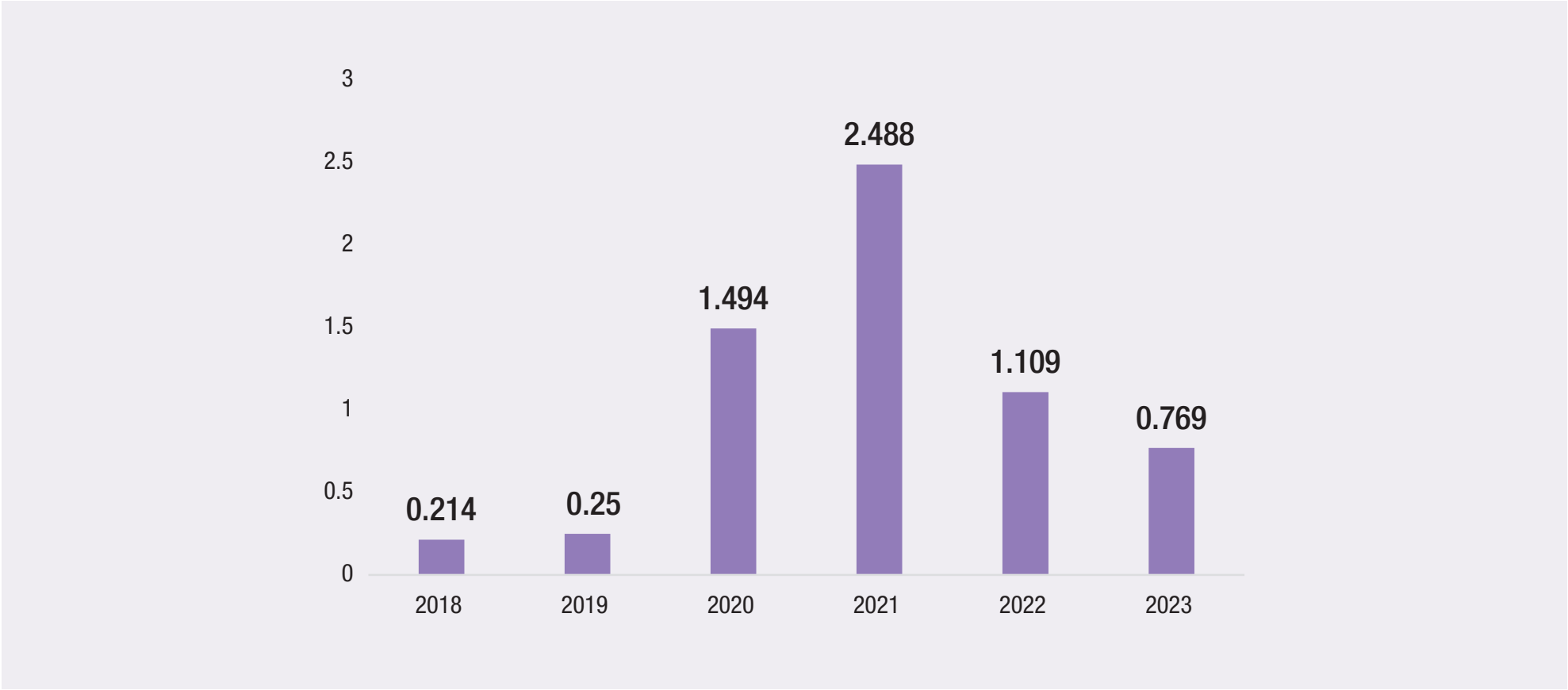
Figure 9: Export of the second-hand clothing to Kenya (in $Mn)



Source: ITC Trade map

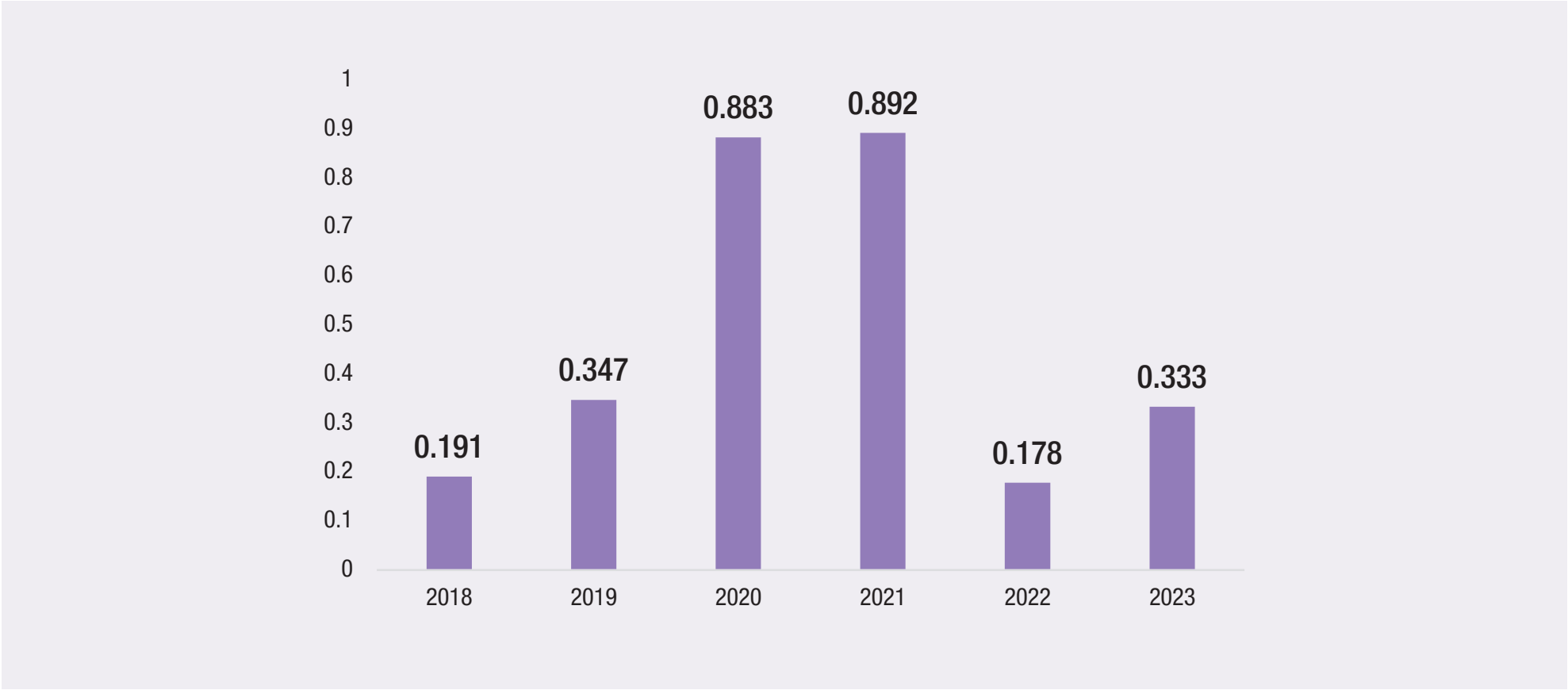
Similar challenges are evident in the export of second-hand apparel to countries like Ghana. While overall exports may be declining, the environmental impact on recipient nations remains substantial. In response, recent policy initiatives by the EU, such as the Extended Producer Responsibility Act and efforts to curtail the export of second-hand clothing to African countries, are poised to stimulate innovation in recycling technologies within the bloc itself.

Figure 10: Exports of Second-hand clothing (textile materials including dress patterns) to Kenya: (In $Mn)



Source: ITC Trade map

Figure 11: Exports of Second-hand clothing (textile materials including dress patterns) to Ghana (In $Mn)



Source: ITC Trade Map

The Technologies introduced to recycle disposed of clothes

To date, disposed clothing has primarily been exported as second-hand garments or downcycled due to the challenges posed by the diverse array of fibre types used in apparel production. The development of technologies for recycling clothing into new garments is still in progress.

One promising approach that many nations are considering is Closed-loop recycling, which aligns with the global push towards a circular economy, particularly within the textile industry. In a circular economy, products are recycled, reused, upcycled, or downcycled to maximize resource efficiency. However, the industry's capacity for circular practices remains largely untapped due to insufficient investment and government support.

Nevertheless, some companies and organizations worldwide have begun piloting circular textile recycling initiatives. For instance, organizations in Los Angeles are implementing circular economy principles through staff training and tailored programs developed with consultant support. Other apparel companies are also exploring similar approaches, with the efficiency of these methods being assessed through life cycle analyses. Here's a brief overview of the methods adopted by these companies.

What is a closed-loop recycling method

Closed-loop recycling is a sustainable production approach that emphasizes using materials and components sourced from recycling collections or take-back schemes. Maintaining the quality of the apparel is crucial in closed-loop recycling, ensuring that garments recycled produce output equivalent in quality to the original input.

While successful pilots have been conducted primarily for polyester garments, which constitute a significant portion of global fibre composition, challenges remain in achieving fully recycled garments. Some brands utilize post-consumer waste components to recycle them into new garments. However, to date, no individual company or country has developed a foolproof solution for achieving completely recycled garments.

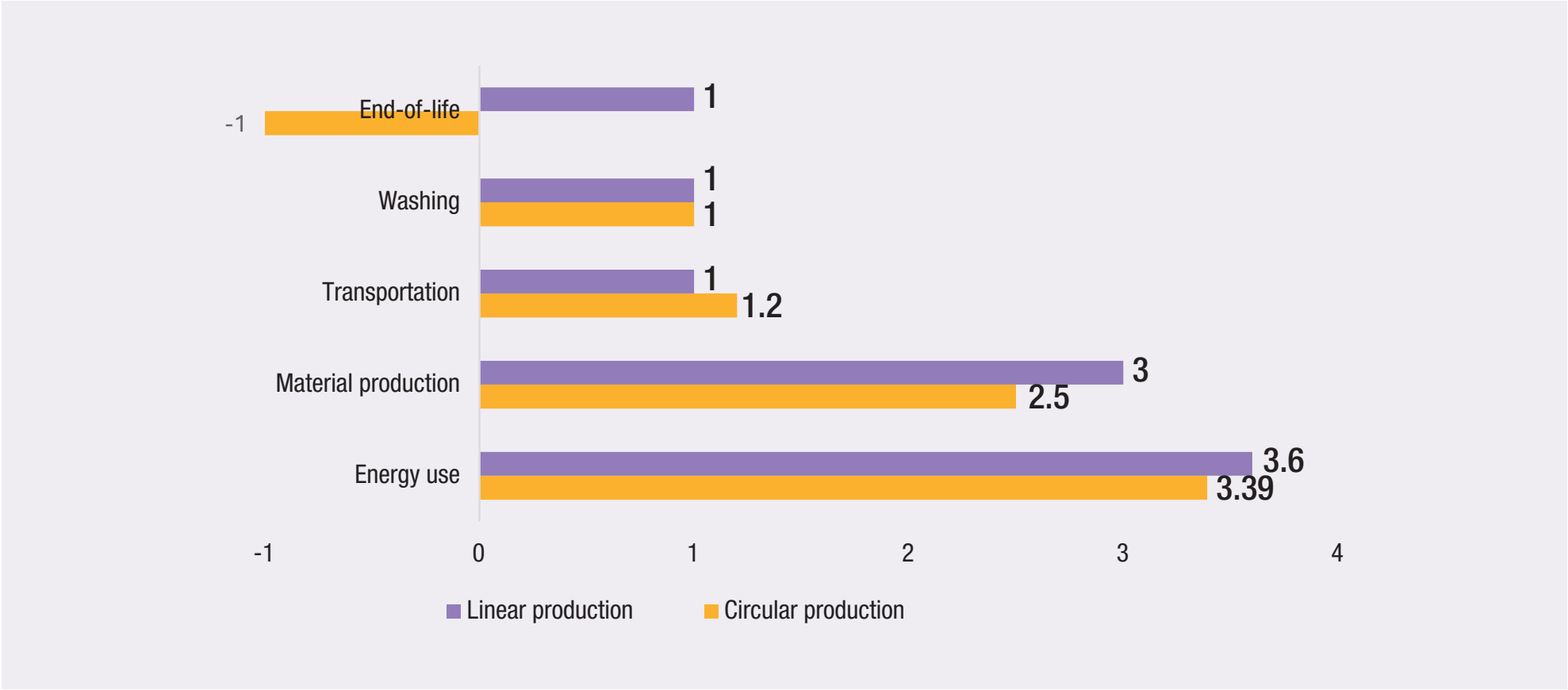
Wear2wear loop method

The initiative involves the top brands of Europe collaborating across the textile value chain to produce apparel from recycled textile materials. The technology involves all the principles of sustainability including transparency, and traceability. The clothes can be completely recycled at the end of their life cycle; thus, ensuring their cyclical nature. the process involves all the eight components of the textile value chain- right from the fibre to the washing and the disposal.

A life cycle analysis of the method revealed that the production method adopted by the W2W is little different from the linear production of apparel. As the production involves recycling the PET bottles in the first stage, the linear method involves the direct use of petroleum for the use of the polyester fibre. Although a direct comparison is not possible when it comes to the production systems; the environmental impact is clear. The current method reduces environmental pollution by 25 per cent as compared to the linear method and has more than 50 per cent effects on human health. Land use is reduced by 20 per cent and water use is reduced to 45 per cent of the original method's use.

The Greenhouse emissions are also lower due to the recycled materials used in the process, which reduces the wastage and the emissions released while using virgin materials. In all the stages of the W2W, it was observed that the emissions are lesser as compared to the linear system of garment production. Methods used by Wear2wear reduce GHG emissions by 33 per cent, reduce the risk to human health by a staggering 51 per cent and reduce the pressure on land resources by approximately 15 per cent. The overall analysis of the W2W revealed a significantly lesser usage of raw materials and energy usage. However, it was also mentioned that the overall energy usage and the impact on the environment depends upon the kind of fibre that is recycled and the apparel.

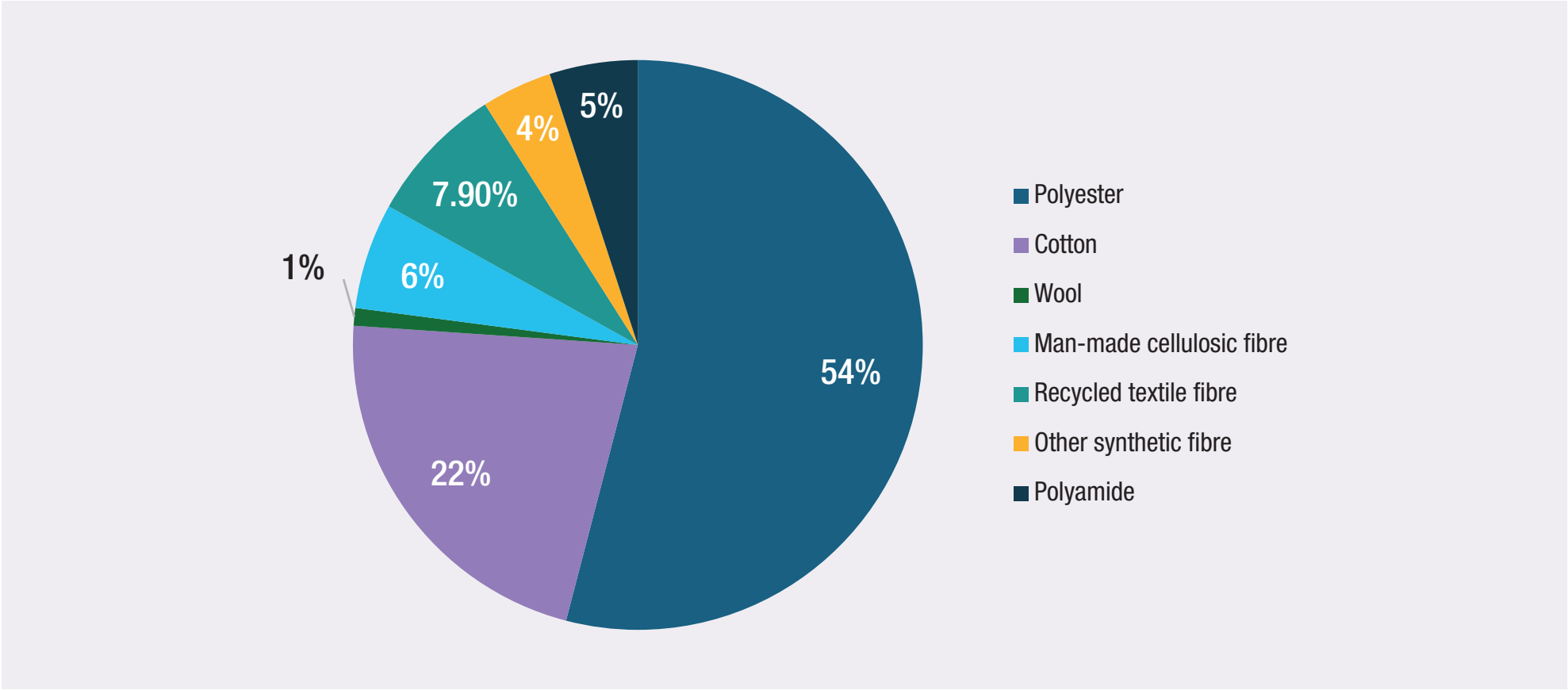
Figure 12: Comparison between the W2W and the linear method of production of garments



Source: Wear2Wear

The conclusion which comes from the analysis of the system is that it will turn more efficient as there will be more research on the kind of materials used and how will it impact the recycling process of the apparel. The recycling methods need to be assessed individually process by process; comparing it to the linear method of production will turn out to be ambiguous after some time as every stage of production will be different.

Figure 13: Global fibre composition (in %)



Source: Textile Exchange Materials Market Report 2023

Currently, the focus of recycling methods has predominantly been on polyester and cotton fibres, with significant research and investment directed towards both producing polyester fibre sustainably and improving recycling methods. Despite these efforts, the overall share of recycled fibre has decreased by 7.9 percent from 9 percent.

Nevertheless, ongoing research and pilot projects aim to explore how circularity can be achieved in apparel production while minimizing waste. One notable initiative is the HKRITA, for example, which is actively involved in advancing sustainable practices in the textile industry.

Garment to Garment Processing

The Popular G2G or the Garment to Garment made by HKRITA, Hong Kong is sweeping the industry off its feet by introducing a mobile used clothes recycling factory. Currently, this mini-40-foot container factory is in Hong Kong and has opened for public use since September 2021. Although it does not undertake mass recycling of clothes, this innovation is one of its kind. Although the main purpose is to educate the consumers on how the recycling of used apparel is done, the initiative is a perfect example of transparency and traceability – which is a hard task for companies to achieve. The Hong Kong Research Institute of Textiles and Apparels (HKRITA), has multiple projects which aim at achieving goals of sustainability across the value chains. The company has already taken a step towards using less water by making the entire process of dyeing using supercritical carbon-di-oxide- which all the companies claim to use for the same. But the G2G has the added benefit of – allowing the customers to see how the entire process works.

The process explained by the HKRITA is simple and one which can be understood by a layman. By graphically explaining how the clothes will be recycled and made into a new piece of garments. However, traceability is still an issue and recycling comes with standard terms and conditions applied. The process cannot take fibres like Lycra, spandex down, leather and clothes with special coating. The most important drawback of this entire process is that it can only take in t-shirts and sweaters to recycle and make into apparel. Mixing the cloth with virgin cotton and lyocell is the next step to make the garment strong.

But how sustainable is it? How one can determine the source of those raw materials is still a question. With many clothes having some component of spandex, this limits the recycling process only up to a certain type of clothes. With many countries still not having this kind of facilities will further enhance the trade of used clothes to the places where these facilities are available. Therefore, more study and collaborative efforts are required to ensure the same closed-loop method is applied to all the clothes.

The innovations in the textile sector will continue unless and until there is a more promising and everlasting solution found to ensure that the circular economy is in place. But before the roadway to make the textile industry more circular is ensured, there must be a regulating policy on a global level to monitor the transparency of the entire value chain, which seems to be an uphill task as the stakeholders with different bargaining powers are involved. Green tagging and exporting the used clothes to the LDCs at the cost of their economy is not a solution for the companies to become green. In the end accountability, transparency and traceability are still absent from the entire chain of recycling the garments. More scrutiny and tighter regulations are required to ensure all three main aspects of sustainable production are fulfilled.

How effective are all of these?

Although there are methods and techniques introduced to imbibe circularity in the textile value chain, a lot of factors are yet to be studied. In a lot of countries, there are no proper municipal laws in place to dispose of textile waste and sort it further. And some counties even today heavily rely on the landfill method to dispose of the used apparel and textile waste, not knowing the long-term effects of the same.

There are a lot of companies that have tried to adopt the circular loop method of recycling, but a lot of companies are unable to close the loop in recycling. Therefore, a lot of research is still to be done on reducing the impact of the garments made using the linear method of production and further how to recycle them into new garments using the technologies that are being tested. So far, a lot of innovation has happened for polyester garments and fibre; however, the real issue comes when garments made from the blends of the fibres are to be recycled. Apart from this, the garments reach the end of the cycle where they cannot be re-used. Thus, further analysis is required just to think about how to recycle the same clothing using advanced technology.

The closed-loop system is not efficient yet. Although some companies are involved in fibre-to-fibre recycling there are very less companies which are involved in textile-to-textile recycling. The available technologies for recycling apparel make it very hard the recycle garments made using linear production techniques. Therefore, the fashion industry needs to focus on the availability of circular products right from the start of the production process. In each step of the manufacturing like the input, design, and production; there has to be a planned use of only those products that are cyclical and for the further stage of recycling and re-use appropriate technologies and infrastructure have to be considered and invested into accordingly.

Although the efforts done by the components of the supply chain are appropriate enough, there are the following shortcomings in the entire system:

Collection

The collection efforts are fragmented across the value chain. The household textile waste collection is fragmented across the countries. Australia, the EU and the US have now started to recently frame laws regarding the collection of textile waste in the countries. There has been not only a lack of policy actions but also there has been a lack of incentives to collect textile waste. Therefore, a lot of take-back programmes or used apparel re-collection programmes close after a certain period. A lot of charities must dump the collected textiles and apparel into the waste due to the lack of proper sorting facilities and infrastructure. Therefore, a properly structured system needs to be in place for the collection of used apparel.

Sorting

Sorting apparel for recycling presents a multifaceted challenge in the circularity chain. There's an ongoing debate on whether sorting should prioritize fibre type, damage assessment, or employ a composite method. The sorting process demands substantial capacity, infrastructure, and a robust transportation system to move garments from collection points to sorting facilities and eventually to recycling centres.

Despite dedicated sorting systems in place, inadequate infrastructure often hampers the transportation of sorted clothing to recycling facilities. Moreover, the labour-intensive nature of sorting underscores the importance of garment labels, which play a crucial role in identifying materials and directing items to the appropriate recycling centres. Consequently, establishing pre-conditions for apparel sorting becomes imperative to streamline the recycling process effectively.

Recycling

The recycling model does not often guarantee a closed-loop recycling for the apparel. The types of fibres to be recycled and the life of apparel manufactured using the traditional method are yet to be found. Also, closed-loop recycling products have not achieved the desired sales due to the high cost and doubtable quality of the products. Mechanical recycling for example is one of the most expensive methods of recycling apparel as it requires mono-material apparel that is undyed and therefore the sorting and sourcing of such materials is expensive for the recyclers. The method is known to reduce the strength of the fibres and therefore apparel in the end. Further, the garment produced also has virgin fibres; thus, making the production of the apparel expensive and not sustainable enough. The closed-loop recycling also produces mostly polyester fibres and other fibres and tends to cover the limitations of mechanical recycling. However, the method is highly expensive and requires a large investment and capacity for its long-term sustenance.

The Way Forward

There are existing methods for recycling apparel, but significant bottlenecks hinder the effectiveness of the recycling loop. To address this, a robust system of municipal laws must be established to incentivize proper disposal and sorting of apparel. Additionally, governments should offer incentives and financial benefits to companies to establish recycling systems, thereby reducing emissions.

Currently, recycling methods are fragmented across different regions, lacking centralized government intervention. Municipalities initiate efforts, and then companies take further action. However, to enhance efficiency and drive innovation, a global initiative is necessary. Governments and companies should collaborate to develop a comprehensive plan for apparel recycling and waste reduction. This approach will ensure long-term efficiency gains and cost reductions in the recycling process.

Increased participation from various stakeholders will foster innovation and drive down recycling costs, incentivizing more firms to engage in recycling initiatives. This alignment of interests will enhance coordination throughout the supply chain. Ultimately, adopting this approach aligns with basic economic principles and can catalyse the circularity process.

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