TECHNICAL UNIVERSITY OF CRETE

SCHOOL OF PRODUCTION ENGINEERING AND MANAGEMENT

MASTER OF TECHNOLOGY AND INNOVATION MANAGEMENT (MTIM)

Business model for the circular economy for fashion -The influence of digital modeling

Student: Moutsou Marianna

Thesis Supervisor: Nikos Bilalis

Summary

Introduction

The impact of the fashion industry on the environment is very big and this is understood by everyone worldwide. It is vital that consumers and fashion stakeholders assess the current situation and align themselves with the principles of the Circular Economy (CE) and sustainability. CE can serve as a guiding framework for the fashion industry by promoting sustainable product development, incorporating cleaner technologies and embracing green and recyclable materials.

To transition to a circular model, the fashion industry needs to redefine several aspects, including design, material selection, dyeing processes, manufacturing techniques, distribution, sales, ownership, use and disposal of fashion items. This transformation can be made possible through the adoption of new technologies, innovative business models and alternative materials. The adoption of circular policies in the fashion industry will enable it to serve the ever-growing global population, while operating within the limits of our planet and ensuring a sustainable long-term business model. Furthermore, the adoption of circularity offers additional benefits such as reducing material costs, accessing new markets, strengthening customer relationships and mitigating the risks of resource depletion.

The Circular Economy (CE) represents an alternative to the traditional linear economy, aiming at maximizing the value extracted from resources during their use phase and promoting the recovery and regeneration of materials and products at the end of their life cycle. CE relies on renewable energy sources such as solar, wind and hydroelectric power to drive its operations. Furthermore, the integration of digital modelling combined with cyclical business models has emerged as a revolutionary force in today's rapidly changing fashion design and manufacturing scene, redefining conventional norms of creativity, innovation and consumer engagement. Digital fashion modelling has ushered in a new era of precision and efficiency in the creative process, encompassing a wide range of technologies such as 3D rendering, virtual prototyping and computer-aided design. With the help of this paradigm shift, designers can explore an infinite number of fabric, texture and silhouette options with a level of precision not previously known. Still, by eliminating the need for unnecessary physical prototypes,

digital modeling not only speeds up the design process but also opens the door to more environmentally friendly processes.

This paper aims to present the business models of fast fashion companies in terms of the circular economy and how digital technology and new innovations influence and reduce environmental impacts, the negative impacts of the fashion industry and how over the years indicators have been developed that help to measure aspects of sustainability. By applying cyclical principles throughout the production and consumption system, the textile industry can reduce pollution and protect the environment, ultimately preserving human life. Two well-known fast fashion companies that have in recent years intensified their efforts to move towards a more cyclical and sustainable environment will also be presented. The 21st century has witnessed a growing concern about environmental issues caused by pollution resulting from linear methods used by companies.

1. Sustainability

What is Sustainability

Many times, the concept of sustainability is confused with recycling, the use of renewable energy sources and the preservation of natural areas such as forests and coral reefs. But what is sustainability really? Sustainability is the ability to endure or continue. When an activity is called sustainable it means that it can be reused, reflected or repeated in some way because not all the resources or energy used to create it were used up. In a broader sense we could say that sustainability is the ability of a thing to be maintained.

Wetlands, forests, ecosystems in general are strong examples of sustainability because for very long periods of time they are productive and have varieties. Thus, sustainability concerns the preservation of resources as well as their energy on a long-term level despite their rapid depletion to cover needs or goals on a short-term level. Sustainability was first mentioned in the 1800s in forestry studies done in Germany. The forest rangers managed the harvested timber as in continuous use. A German forestry researcher, George Hartig, described sustainability "as the use of forests to the maximum extent possible but in such a way that future generations will have as much benefit as the existing one bravely" (George Hartig, 1804). This is how Hartig's definition remains the best definition of sustainability today. While today there are many different definitions of sustainability, Hartig's definition remains relevant and points to the need to preserve physical spaces and use resources wisely so that they are preserved in a fair way for all, both for today and for the future.

Sustainability lies in the constant search for new ways of coping between social development and environmental degradation, in such a way that would enable human societies and economies to develop without destroying the environment and without overexploiting it. Another definition given for sustainability in 1987 by the Prime Minister of Norway, Gro Harlem Brundtland, is that sustainability is "meeting the needs of the present without compromising the ability of future generations to meet their own needs". An example of sustainability is aluminum soda cans. In the past, these soda cans were thrown away after use. Their method of disposal was clearly unsustainable.

Sources of aluminum are quite limited and landfills were overflowing with trash. Thus began the recycling of aluminum by governments and private companies and the recycling industry gained great profits creating value, jobs, profit for workers and resources are reused reducing the impact on the environment.

Today the textile industry is at the same point where aluminum was at its beginning many years ago. The fashion industry is strongly dominated by the so-called Fast Fashion. The fast fashion has caused a lot of damage to the environment. Less than 1% of clothing is recycled. Circularity and sustainability were unknown words in the fashion industry. The continuous and massive production and sale of clothes, the low prices burdened the environment day by day more. Garment landfills pollute the environment due to harmful chemicals, the presence of polyester, etc. The volume of water used for cotton in clothes as well as fertilizers and pesticides for the production of cotton is enormous. Garment factory waste is also dumped in sanitary landfills. Despite the progress fast fashion companies have made in sustainability, they still have a long way to go.

1.1 Goals for Sustainability

By the term sustainability we mean the continuous support and maintenance of a process over the years. The purpose of sustainability is to prevent the depletion of natural resources so that they continue to exist for years. How does it work?

The impact of political or business practices on people, ecosystems and the wider economy in the future are things those sustainable policies emphasize. Green technology and sustainable business practices are booming.

Three pillars of Sustainability

Sustainability can be analyzed in three pillars: **economic, environmental and social.**

Economic sustainability is based on the capacity of entities to contribute to economic growth and prosperity. Environmental protection must be promoted and encouraged by limiting the risks involved in their production. Product recycling and the use of renewable energy sources are fundamental aspects of the development of the economic pillar.

Environmental sustainability is concerned with life support systems such as the atmosphere and soil with the aim of sustaining economic production and human life.

Social sustainability refers to values that promote equality and respect for individual rights. The social impact of the company's social activity is then assessed according to these issues, such as gender equality. Social sustainability is concerned with the effects of economic systems on humans and efforts to eradicate poverty. The principles on which this pillar is based are combating social exclusion and discrimination, promoting solidarity and contributing to the well-being of stakeholders, such as developing social dialogue, encouraging the exchange of information, etc.

Corporate sustainability

There are two ways of measuring sustainable business practices. One measures the impact that a business has on the environment and the other measures the impact of the business on society. Their goal is that sustainable practice helps in at least one of these sectors. Moves towards sustainability can include reducing emissions, reducing energy use, sourcing products from fair trade organizations and ensuring their natural waste is disposed of properly and with a smaller carbon footprint. (Mollenkamp, D. T. (2023) of Investopedia)

Challenges related to sustainability

The Santa Fe Institute refers to three important obstacles that businesses face in trying to improve their environmental impact. Firstly, it is difficult for each business to understand its real impact, secondly, there is difficulty in classifying the environmental impact on business activities and thirdly, there is no possibility of predicting or it is difficult how the economic factors respond to the changing drivers.

1.2 UN Sustainable Development Agenda

The UN Sustainable Development Agenda includes 17 Sustainable Development Goals and 169 sub-targets. These goals were set at the 70th UN General Assembly on September 25, 2015. They have a time horizon of implementation and application until 2030 and concern all countries of global independent development, national policies

and priorities. The 2030 Agenda includes sustainable development in 3 main components: social, environmental and economic.

Figure(1) Sustainable Development Goals

Source: https://www.un.org/en/sustainable-development-goals

Goal 1: Zero Poverty - End all forms of poverty, everywhere

A key goal of the sustainable development agenda is the eradication of poverty by 2030. The COVID19 pandemic has contributed to the increase of the global poverty rate to 9.2% in 2020 and has reversed the steady progress of its reduction. It was the first large increase in the extreme poverty rate since 1998. Thus, it delayed the reduction of poverty by about 3 years.

Goal 2: Zero Hunger - End hunger, improving nutrition and sustainable agriculture

Sustainable Development Goal 2 is about zero hunger by 2030. The war in Ukraine has disrupted food supply chains and created one of the biggest food crises since World War II.

The pandemic has also worsened the situation. Redefining how food is grown shared and consumed. Correct utilization of agriculture, forestry and fishing in order to produce nutritious food for all, to create new incomes and at the same time to protect the environment. Today the land, the fresh water, the oceans, the forests, the biodiversity have been degraded to a significant extent. Climate change is here with several disasters in important resources for humans. Many people from the regions are forced to move to cities as they can no longer get by on their land.

Goal 3: Good Health and Well-being - Ensure a healthy life - Promote well-being for everyone, at all ages In order for sustainable development to occur, healthy living conditions must be ensured as well as the well-being of all ages must be promoted.

The life expectancy on earth has increased due to important steps in science. What has to do with maternal and child mortality shows a decrease. Increased access to clean water, sanitation facilities have led to a reduction in malaria, tuberculosis, polio and the spread of HIV/AIDS. The pandemic has also disrupted basic health services, increased anxiety and depression, reduced life expectancy, affected progress in ending HIV, tuberculosis and malaria. Two-tenths of universal health coverage has been disrupted. from malaria and tuberculosis.

Goal 4: Quality Education - Ensuring free, equal and quality education -Promotion of opportunities for lifelong learning.

Human improvement and sustainable development will be achieved through quality education. In recent years, access to education has increased. Basic knowledge has also improved.

Goal 5: Gender Equality - Gender equality and the empowerment of all women and girls

Although the world has progressed in the issues of equality and the emancipation of women, they still continue to be discriminated against and subjected to gender-based violence throughout the world. The foundation for a peaceful and sustainable way is the equality of the two races. Women should have equal access to education, health care, work and an active role in political and economic decisions.

Goal 6: Clean Water and Sanitation - Ensure the availability and sustainable management of water and sanitation for all

Access to clean water is essential for everyone. There is still enough fresh water on the planet. Many diseases come from the lack of water, drainage, hygiene and are responsible for the death of a large number of people and especially children. Food security is threatened by water scarcity and poor drinking water. Until 2050, 1 in 4 people will live in countries that will have a problem with the sufficiency of fresh water.

Goal 7: Cheap and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy for all

Energy is very important for indoor activities. Access to energy is required for the performance of work, the achievement of safety, climate change, and food production. Sustainable energy will change lives, the economy and the planet.

Goal 8: Decent Work and Economic Development - Promote sustained, sustainable and inclusive economic growth and full and productive employment - Decent work for all

About 50% of the world's population lives on an average of $2 a day. Sustainable economic development aims at creating conditions that will enable people to secure quality jobs for them, that will strengthen and stimulate the economy and at the same time will not harm the environment. All these should be ensured for all ages of the workforce.

Goal 9: Industry, Innovation and Infrastructure - Build resilient infrastructure, promote open and sustainable industrialization and encourage innovation

The development of transportation, irrigation, energy, information and communication technologies will play an important role in sustainable development. Investments in these shoes are imperative. Access to sustainable and industrial development creates income that contributes to the rapid increase in living standards. And also, through technology it gives solutions for a sustainable industrialization. COVID-19 has highlighted that innovation in healthcare, education

Goal 10: Less Inequalities - Reduce inequality within and between countries

Equality causes great concern within and between countries. Although the gap of some inequalities, such as income inequality, is decreasing, in some countries they continue to exist. COVID19 has exacerbated inequalities and reinforced them in poorer and more vulnerable societies. Together with the social, political and economic one's inequalities amplified the effects of the pandemic. The COVID-19 pandemic has greatly increased unemployment and reduced the income of workers. The pandemic has also set back progress on gender equality and women's rights.

Goal 11: Sustainable Cities and Communities - Creating safe, adaptive, sustainable and inclusive cities and human settlements

This goal is about making cities and human settlements inclusive, resilient and sustainable. 7 out of 10 people will live in urban centers by 2050. Cities have a significant contribution to global GDP because they are drivers of economic development. Indeed, greenhouse gas emissions exceed 70%. The many successive crises at a social, economic, political and health level show how important sustainable urban development is. The shielding of cities is very important for dealing with future crises.

Goal 12: Responsible Consumption and Production - Ensure sustainable consumption and production methods

Ensuring sustainable consumption and production patterns is a key aspect of this goal. Many criticisms of climate change, biodiversity loss and pollution have come from unsustainable consumption and production patterns. Environmental degradation combined with these crises is major threats to human well-being and the goals set for sustainable development. The cooperation between governments and citizens will give impetus to the improvement of resource efficiency, reduction of waste and pollution, with the aim of forming a circular economy.

Goal 13: Climate Action - Take immediate action to combat climate change and its consequences

Goal 13 is about taking urgent action to combat climate change and its devastating effects. The effects of climate change are already visible and include floods and droughts, displacement of millions of people, plunging them into poverty and hunger, denial of access to basic services such as health and education, widening inequalities, suppression of economic growth and even causing conflicts.

Goal 14: Life in Water - Protection and sustainable use of the oceans, seas and marine resources for sustainable development

The conservation and sustainable use of the oceans, seas and marine resources is the purpose of goal 14. In order for life to continue to exist on earth, it is necessary for the seas and oceans to be healthy. 70% of the earth is covered by water and provides food, energy and water. 1/4 of annual carbon dioxide (CO_2) emissions at global level are absorbed by the ocean, thus reducing the effects of climate change.

Goal 15: Life on Land - Promote the sustainable use of terrestrial ecosystems and forests combating desertification, reversing land degradation and biodiversity

This goal concerns the maintenance of life on land. It includes restoring terrestrial ecosystems, sustainable forest management, combating desertification and halting and reversing land degradation and halting biodiversity loss. Sources of food, water, medicine, shelter and other material goods are healthy ecosystems and their biological diversity. Yet an ecosystem is capable of purifying air and water.

Goal 16: Peace, Justice and Strong Institutions - Promoting peaceful and inclusive

Societies, providing access to justice for all and building effective institutions at all levels

Promotion of peaceful and inclusive societies so as to achieve sustainable development. Creation of participatory, effective and responsible institutions at all

Goal 17: Cooperation for the Goals - Strengthening and renewing the means of implementation Revitalization of the global corporate relationship for sustainable development set's goal 17. The 2030 agenda concerns all countries and calls them to take action so that no one is left behind. It aims at the collaboration of governments, the private sector and society.(*THE 17 GOALS | Sustainable Development*, n.d.)

1.3 Institutional framework of sustainability

UN Sustainable Development Institutional Framework

In the year 2002 in the city of Johannesburg, Africa, the JPI (Johannesburg implementation plan) for sustainable development was drawn up at the World Summit.

The provided a framework for the implementation of sustainable development goals and described specific commitments and actions that should be undertaken by governments, international organizations and other interested parties. The JPI emphasized the need for everyone's cooperation and a more integrated approach to sustainable development where it will be spread across social, environmental and economic levels.

Institutional framework and dimensions of sustainable development

The institutional framework of sustainability is a complex system that includes multiple components and bodies. All these together interact with each other in different ways and their effectiveness depends on how good their cooperation is. It includes the policies, regulations and organizations that contribute to the promotion of sustainable development. All these have been designed in such a way as to strengthen and ensure the 3 dimensions of sustainable development, economic development, social development and environmental protection. The institutional framework for sustainable development should integrate all 3 dimensions in a balanced way. The framework must be inclusive, transparent and effective in order to find common solutions related to global challenges for sustainable development. The institutional framework is of vital importance as without it many different actors pursue their own interests without considering the long-term consequences of their actions. The institutional framework includes:

- the promotion of the balanced integration of the 3 dimensions of sustainable development, the underlining of the importance of the connections between the main issues and challenges and the systematic approach at all relevant levels, strengthening coherence and increasing efficiency and transparency through coordination and cooperation ,promoting the participation of all countries in the decision-making process , involvement of high-level political leaders with the aim of providing political guidance and determining actions for the effective implementation of sustainable development, scientific and political collaborations, strengthening the participation of citizens as well as their effective engagement in the relevant international forums ,promote transparency and broad public participation and partnerships in the implementation of sustainable development and promote the recording of progress on sustainable development actions and commitments to redefine the goals.

Institutional framework and strengthening of intergovernmental arrangements

Strengthening intergovernmental regulations for sustainable development is part of the JPI. The objective of this unit is to improve the effectiveness and coherence of intergovernmental regulations for sustainable development. This unit emphasizes how necessary intergovernmental organizations and their further development are in promoting sustainable development. The cooperation and coordination of them as well as the rest of the stakeholders is very important in the promotion.

The measures to be taken to strengthen intergovernmental arrangements concern

- Improving the coherence and effectiveness of intergovernmental regulations by improving coordination and promoting the exchange of information.

- Strengthening the role of the United Nations in promoting sustainable development through financial support and technical means.

- Strengthening the role of regional organizations in promoting sustainable development by supporting efforts and strengthening their effectiveness.

- More generally, the teamwork and coordination of intergovernmental organizations and the utilization of their strengths will give a great boost to sustainable development.

Institutional framework and Environmental pillar

The environmental pillar is an important dimension of sustainable development. This recognizes the importance of the natural environment in supporting human well-being and emphasizes the preservation and protection of natural resources for future generations.

This section of the Plan focuses on the necessary integration of environmental considerations into all aspects of sustainable development and describes specific measures to achieve this goal.

The measures described in this section to achieve the integration of environmental parameters also refer to sustainable development The environmental pillar, by addressing environmental issues and promoting the sustainable use and management of

natural resources, can contribute to the achievement of the broader goals of sustainable development.

Institutional framework and International financial organizations and operational activities of the United Nations

This unit addresses the role of international financial institutions and the operational activities of the United Nations in promoting sustainable development. This calls for greater cooperation and coordination of these agencies to promote sustainable development. The measures described in this section to strengthen the role of IFIs and UN operational activities towards sustainable development include:

- The alignment of the activities of the IFIs with the World Bank and the International Monetary Fund, with the goals of sustainable development and the promotion of the integration of environmental and social parameters in their activities.

- Increasing operational transparency and accountability in the operations of the IFIs and the operational activities of the United Nations, including through the use of performance indicators and monitoring mechanisms.

Institutional framework and Regional, national, sub national and local level

The final focus of this unit is the critical role of regional, national, sub-national and local levels in the implementation of sustainable development strategies. The emphasis here is that sustainable development must be pursued at all levels, from the global to the local, and that effective implementation requires the participation and cooperation of all levels of government and stakeholders. It says how important it is to build partnerships and networks between different levels of government, civil society organizations and other stakeholders.

The measures described in this section relate to:

- The development and implementation of national sustainable development strategies to address social, economic and environmental concerns and involve all levels of governance and stakeholders.

- Building the capacity of sub-national and local governments and stakeholders to be able to implement sustainable development strategies and participate in decision-making processes.

- The promotion of regional cooperation and integration to address common sustainable development challenges and the exchange of knowledge and best practices.

- Promoting partnerships between different levels of government and stakeholders to promote sustainable development and ensure that local needs and concerns are reflected in decision-making processes.

By developing national sustainable development strategies, building capacity at sub-national and local levels, promoting regional cooperation and integration and fostering partnerships between different levels of government and stakeholders, regional, national, sub-national and local levels can contribute to the achievement of broader goals of sustainable development.

The institutional framework for sustainability consists of many different elements such as International agreements: There are many international agreements and protocols that set the framework for sustainable development, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement and the Sustainable Development Goals (SDGs), national policies and laws: Governments around the world have developed policies and laws to promote sustainability, such as renewable energy targets, carbon pricing mechanisms and environmental protection laws, regulatory bodies, such as environmental agencies and energy regulators, play a critical role in enforcing sustainability policies and regulations, civil society organizations: non-governmental organizations (NGOs) and civil society groups play an important role in advocating for sustainable development and in taking responsibility from governments and businesses, business practices Companies can also play a role in promoting sustainability through sustainable business practices, such as reducing their carbon footprint, implementing sustainable supply chains and participating in corporate social responsibility initiatives.

The institutional framework of sustainability is crucial because it provides a coordinated and integrated approach to addressing environmental, social and economic issues. Without such a framework, different actors may pursue their own interests without considering the long-term consequences of their actions. The institutional framework of sustainability is not a static entity, but rather a dynamic process. It evolves over time to reflect changing social, economic and environmental conditions.

The institutional framework of sustainability is not without challenges. One of the key challenges is the lack of political will to implement sustainability policies and regulations. Governments may face resistance from powerful interest groups, such as the fossil fuel industry, which can lobby against environmental regulations. Finally, the institutional framework of sustainability is a critical tool for achieving sustainable development. It ensures that environmental, social and economic factors are integrated into decision-making processes at all levels. However, the framework also faces significant challenges and there is a need for continued support and political will to ensure its effective implementation.

2.Fashion

Fashion is a global industry that predicts what we will wear and how we intend to appear to others. Fashion is a cultural and social phenomenon, not just a business. Fashion brings change and the desire for the new. Fashion can be found in a dominant mode of expression such as custom, style of dress, speech or other.

Fashion implies a dominant style of dress. The style of clothing helped people to express their feelings or solidarity with other people. It shows individuality. A person's dressing style gives an idea to those around him about who he is. It is often used as an indicator of social class or status. Fashion varies according to age, social class, generation, profession and geography.

The term modern or not refers to whether one fits the current popular mode of expression. Cultural changes brought about the evolution of fashion. New trends in clothing spring from the fashion industry. The rapid changes in fashion trends have forced the consumer to spend part of their income on new clothes that they may not need. Nowadays, fashion trends have reached a point where they change every 2 to 3 weeks. The internet and social networks quickly bring new trends to the eyes of consumers.

2.1 What is fast fashion

Fast fashion according to researcher, K. Saxon 2023, is a business model that copies high-end designs and celebrity looks and then proceeds to mass-produce them (cheaply and quickly) to capitalize on consumers' desire for the latest fashion trends. The fast

fashion model poses many issues such as the creation of waste, the exploitation of workers (many of whom are young children), the depletion of resources and the theft of designs. All this negatively affects the environment, local communities, workers and fashion designers.

85% of the textiles produced annually on an international level end up in landfills.
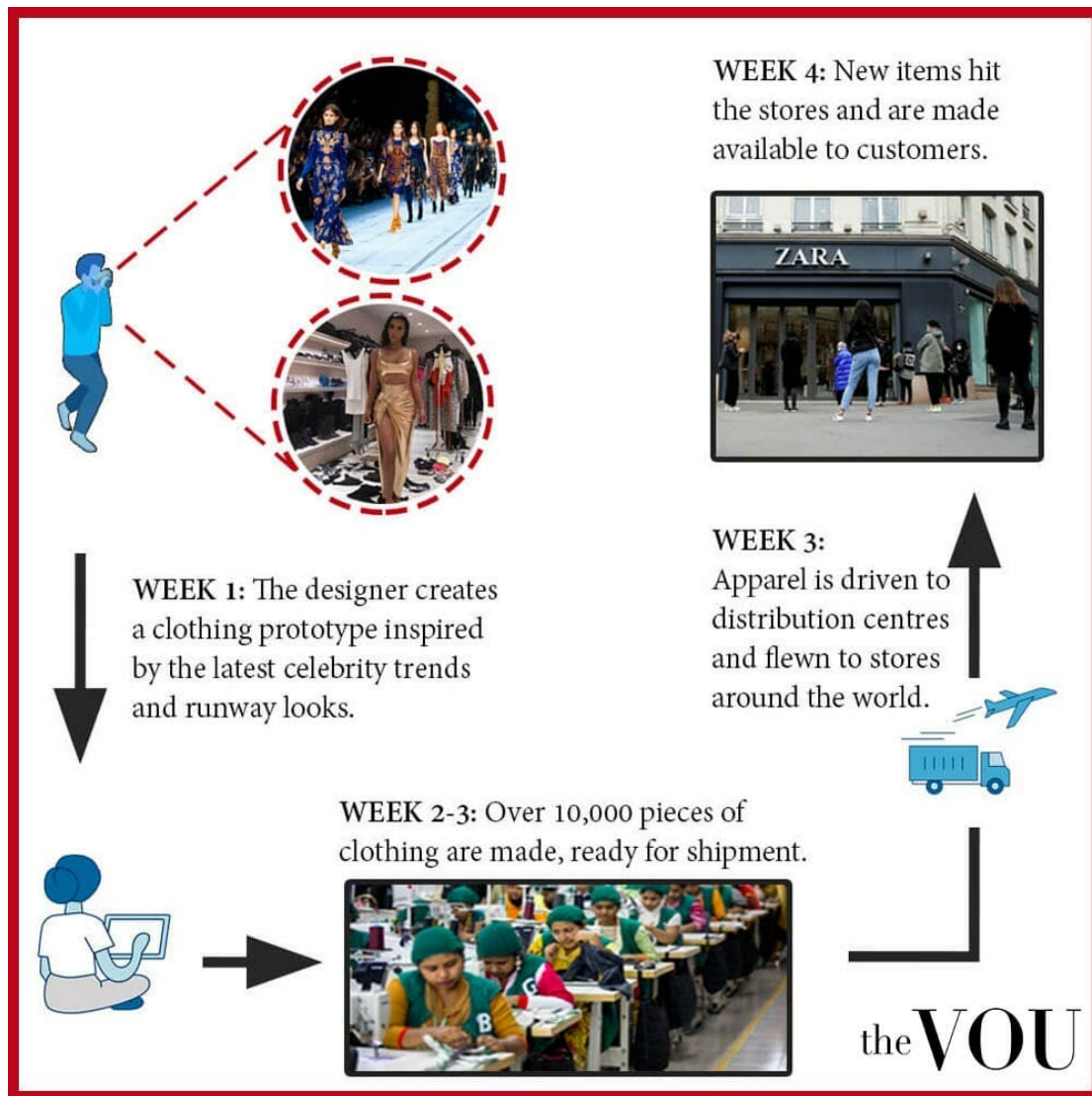
Figure (2) Issues of immorality of the fast fashion model are raised

Source: https://thevou.com/fashion/fast-fashion/

- Copyright issues

Design theft is the basis of fast fashion. Fast fashion companies that are extremely popular steal styles and designs from top and up-and-coming fashion designers. Fast fashion brands have "spies" everywhere and at all hours so that the copying is done immediately. In less than a week the design is replicated by minors usually factory workers in China or Bangladesh using cheaper materials and sent to all the fast fashion retailers. A brand-name company usually needs five to six months to launch a new collection. Fast fashion companies do it in a week at most.

-Pollution and waste issues

Fast fashion companies cause huge ecological problems. They ignore environmental law; they use cheap and toxic dyed fabrics, making them the second most polluting industry in the world. Many organizations such as Greenpeace have been urging them to avoid chemicals for years, with little success. The polyester with which many types of clothing and footwear are manufactured comes from fossil fuels, textile products have an impact on the overheating of the planet due to carbon emissions and the release of microfibers into the water due to washing and pollute the oceans. Deforestation is taking place to create cotton fields.

-Issues of cheap labor and contemporary slavery

According to journalist Lucy Siegle (movie" True Cost", 2015) "Fast fashion is not a gift. Someone somewhere is paying». Fast-paced companies are making millions of dollars off the backs of workers they work for less than minimum wage. In 2013, a garment manufacturing complex, Rain Plaza, collapsed in Bangladesh and killed over 1000 workers. Workers work without the power of their human rights in areas of dubious origin for a very low salary. To keep manufacturing costs low, fast fashion brands have moved their production factories to developing countries. Harmful chemicals are used which cause various types of cancer and respiratory diseases. If the workers do not die from exposure to the chemicals, they risk dying from the mental and physical abuse of thousands of hours.

-Throwaway culture issues

Compared to 20 years ago, 2 times more clothes are bought and kept for a much shorter period of time. Fast fashion brands convince buyers that they are out of trend month after month. 20% of garments on the production line are rejected as defective and 90% of them are discarded by consumers in less than a year. Consumers throw away clothes too quickly, creating unnecessary waste, this process is now known as the throwaway culture.

Microplastics in fashion items

The polluting particles that are found in clothing and footwear when they are either discarded or washed are a huge problem and require changes in the choice of materials, the manufacturing of the products. Plastic beads and threads wash up on beaches. The pollution created by the tiny particles is enormous, many of these particles are found in food and even in human blood. Fashion companies have focused more on what the

consumer can do and not on how they can help on the design side to reduce pollution. By using more environmentally friendly materials, the problem will become smaller. Clothing releases over half a million metric tons of tiny plastic fibers into the environment every year. Many companies, especially large ones, have focused on production and in fact producing series of products that are friendlier to the environment. Several sellers also have ecological bags available. ZARA and BASF have created a special detergent that, according to them, reduces waste by up to 80%. Samsung and Patagonia have created a washing machine that they claim reduces microplastics released into the water from washing by up to 54%. The problem should not lie only with the consumer; the companies should also take their share of responsibility. First, the yarns, the threads and generally the materials used in the construction should be examined. Polyester clothing, which has increased over the last two decades, makes the fashion industry responsible for 35% of annual microplastic emissions. The textile industry releases 120,000 metric tons of synthetic microfibers annually, compared to 530,000 metric tons in the consumer use phase, according to a 2021 report released by environmental organization The Nature Conservancy and consulting firm Bain & Company, meaning that for every 500 tons shirts are made, one is lost as microfiber pollution.

2.2 Facts and numbers in fashion

Facts about the global fashion industry

- ❖ China and the US have the largest apparel and footwear markets in 2021. For China and the US, respectively, the market size in 2021 was US$427,153.9 million and US$364,136.6 million.
- ❖ Globally, China is the largest supplier of clothing and textiles, while the EU is the largest buyer of these goods.
- ❖ The world's largest apparel manufacturer and retailer is Spain's Inditex, with sales of $31.01 billion, ahead of H&M ($20.83 billion) and Fast Retailing ($18.45 billion).
- ❖ Each year, this sector produces between 100 and 150 billion individual pieces. Every year, around 80 billion of these are purchased as spare parts.
- ❖ 36% of Generation Z members buy new clothes at least once every month.

- ❖ 84% of consumers are willing to pay more for personalized products and are interested in doing so. Personalized clothing and personalized colour preferences are particularly popular (45%). Personalization of top high fashion products (26%), seasonal fashion products (31%) and personalized everyday clothing (41%) are also on the wish list.

- ❖ With more than 2,300 index points, France leads Italy (1,866 points) and the US (697 points) as the world's largest fashion market. Taking into account the comparative market power of all fashion brands in a nation, the actual market value of their market.

- ❖ The average wardrobe contains about 148 items.

- ❖ The market for women's clothing generates much more money than that for men's or children's clothing. More than half (53%) of global fashion retail spending in 2018 was on women's clothing. Men's and children's apparel purchases accounted for 31% and 16%, respectively, of total spending.

- ❖ More than 100 to 150 billion pieces of clothing are produced annually by global fashion businesses.

- ❖ Consumption of clothing has skyrocketed recently.

- ❖ Over the past 20 years, the demand for clothing has skyrocketed. Consumers of fashion purchase more than 80 billion new garments annually. That's a 400% increase from what we were eating just 20 years ago.

- ❖ 14.5 billion pairs of shoes and nearly 107 billion articles of clothes were bought globally in 2016. This indicates that each person on the earth purchases around 13 articles of clothing and 2 pairs of shoes annually.

Shopping and distribution and Fashion

- ❖ The biggest opportunity for fashion businesses, according to 32% of respondents, is digitalization. This is followed by sustainability (12%) and customer engagement (11%).

- ❖ Among the goods with the highest levels of inflation, clothing comes in sixth place. As a result, 44% of customers are cutting back in this market, more than in any other, except for restaurants.

Internet and Fashion

- ❖ The top five e-commerce-generating nations are China, the US, Japan, the UK, and Germany.

- ❖ Nearly 25% of all retail sales worldwide in 2025 will be made online.

- ❖ One third of sales, or 33.6%, are made through digital sales platforms. Mobile devices account for 61.4% of this share.

- ❖ Luxury clothing has the highest shopping cart abandonment rate at 87.78% (the industry average is 84.43%).

- ❖ JD.com ($14.5 billion in net sales) is the most lucrative online retailer in the apparel industry, followed by shein.com ($1.5 billion) and zara.com ($1.1 billion).

- ❖ Online retailing accounts for 20.8% of all apparel retailing worldwide, excluding general online stores. Africa has the smallest share (6.5%; market volume: USD 1.56 trillion) and Asia the largest share (39.7%; market volume: USD 172.4 trillion).

Second Hand and Fashion

- ❖ 62% of millennials and members of Generation Z prefer to buy used clothes over new.

- ❖ Clothing-related shopping is becoming increasingly popular.

- ❖ Real reached $167 million in global sales in 2021, followed by Poshmark with $126 million.

- ❖ North America is expected to have the fastest growth in the used market through 2026. In this case, the market can expand 8 times faster than the conventional apparel market. Even twice as fast in Europe.

Sustainability and fashion

- ❖ 50 percent of consumers are aware of the harmful effects of fast fashion on the environment. 59 percent of consumers say it is a challenge to break the habit.

- ❖ In terms of the amount of textile waste generated, Copenhagen is the most environmentally friendly fashion capital in Europe. Dublin and Antwerp are in second and third place respectively.

- ❖ In a YouGov survey for Changing Markets, 34.3% of respondents reported that they buy certified clothing at least occasionally, while 44.4% reported that they never to never do so.

Resource consumption and fashion

❖ Polyester is used to make 52% of all textiles processed worldwide. The second largest share, 24.2%, belongs to cotton.

❖ From the creation of the raw materials to the sale in the clothing store, around 140 producers and companies are involved in the production of a white shirt worldwide.

❖ Up to 15 000 litres of water (2 700 litres on average) are needed to produce one kilogram of cotton. A T-shirt is made from one kilogram of raw cotton and about one kilogram of hazardous chemicals, which in turn contribute to water pollution.

❖ Every second, a truckload of clothing (2,625 kilograms) is burned or otherwise disposed of. With that, the Empire State Building could be filled 1.5 times a day. In one year (82.78 million pounds), that would be enough to fill the entire Port of Sydney.

Fast fashion

❖ Since 2000, the number of collections provided each year by fast fashion merchants has increased. The average number of collections offered each year in Europe was 2, but market leaders such as H&M and Zara can release up to 24.

The world's largest fast fashion groups, Inditex, H&M and Fast Retailing, WERE increasing their revenue from 2020 to 2021. (*Fashion Statistics 2022/3*, 2023)

2.3 Measuring the Sustainability in the Fashion Sector

Measuring sustainability in the fashion sector has become increasingly important in recent times. Given the industry's significant impact on the environment and society, it is important to assess and understand how sustainable fashion brands and practices are. Custom indicators designed specifically for the fashion sector provide a more comprehensive framework for assessing various aspects, including resource use, greenhouse gas emissions, supply chain transparency, working conditions and product

life cycle. These indicators make it possible to determine the extent to which fashion companies prioritize sustainability, promote ethical practices and reduce their ecological footprint. By measuring sustainability in the fashion sector, stakeholders are held accountable for their practices, positive changes are promoted and everyone works towards a future where the industry is more sustainable and responsible.

2.4 The Higg Index

The Higg index was created by Sustainable Apparel Coalition (SAC) in 2011.The SAC is a non-profit coalition that operates on a global scale and includes various stakeholders from the consumer goods industry.

It acts as an independent organization working to achieve a positive environmental impact of the industry. The aim of the company was to develop a collaborative approach involving multiple stakeholders to effectively measure, enhance and communicate performance in sustainable practices.

It was created in 2009, by Walmart and Patagonia who recognized the lack of standardization in the industry and to address this issue, they joined forces and brought together peers and competitors from across the industry. They aimed to develop a universal framework for measuring sustainability performance and encourage collective action.

SAC today brings together more than 280 leading global brands, retailers, manufacturers, NGOs, academics and industry associations across the supply chain. SAC is deeply committed to promoting a more sustainable, equitable and just world for all. They believe in the power of collective action to promote positive social and environmental change on a large scale.

In 2011, SAC introduced the Higg Index, a comprehensive tool created in collaboration with its members. The purpose of the Higg Index is to establish a global approach to the efficient and effective production of clothing and footwear.

The Higg Index is a set of 5 distinct tools that collect and quantify reliable data on textile and footwear production and standardize how sustainability is measured across a company's entire value chain. By bringing this information together in one place, the

Higg Index enables brands, retailers and manufacturers in the apparel and footwear industry to assess, improve and communicate their social and environmental performance using a common 'language of sustainability'. It aims to revolutionize the way businesses impact the environment.

To achieve this significant change, companies and organizations need to speak a common language and have a common platform for monitoring and evaluating their social and environmental impacts. The Higg Index will be that common language which will enable brands, retailers and manufacturers to use verified data to measure, improve and share their performance.

It took a decade to develop the Higg Index methodologies. Throughout this process, SAC members, consultants, stakeholders and industry experts have participated and collaborated. The evolution of these methodologies continues and incorporates the latest scientific research and data. Currently, more than 21,000 organizations worldwide make use of the Higg index, enabling SAC to drive transformational change in the industry. Since its release in 2011, it has become the leading tool for assessing environmental and social impacts in the apparel industry, measuring the entire value chain as a whole.

The Higg Index includes 5 tools that collectively assess the social and environmental performance of the value chain and the environmental impacts of products. These tools include the Higg Facility Environmental Module (FEM), Higg Facility Social & Labor Module (FSLM), Higg Brand & Retail Module (BRM), Higg Materials Sustainability Index (MSI) and Higg Product Module (PM).

Figure (3) Higg Index-Suite of tools

Source: https://www.leadership-sustainability.com/2017/06/26/how-does-the-sacs-higg-index-fit-your-sustainability-strategy/

Over the past decade, SAC and its members have accumulated a significant amount of verified data. This data allows the industry to identify areas of concern, continuously improve sustainability performance and meet the growing demand for transparency in environmental and social practices from consumers.

Various stakeholders, including consumer goods brands, retailers, manufacturers, governments, NGOs and consumers, can use the Higg Index in areas such as water use, carbon emissions and working conditions. It informs their individual sustainability strategies and leads to collective transformation within the industry.

Higg Product tools are tools for life cycle assessment and shed light on the impact of the production of materials and products on the environment. The Higg Product Tools evaluate a product's effects on environmental sustainability, taking into account everything from the materials a designer decides to use in a t-shirt to the volume of water used to color that worn-out pair of jeans.

The tools included in the product category: The MSI (Materials Sustainability Index) and PM (Product Module) of Higg. These tools enable manufacturers, merchants, brands, and designers to leverage life cycle assessment data to build more sustainable products.

Their purpose is: When designing a product to understand how different production options affect the environment.

Who uses them: Sustainability experts, product and material developers.

What they measure: 5 environmental impacts

- Global Warming Potential

- Nutrient Pollution in Water (Eutrophication)

- Water Scarity

- Fossil Fuel Depletion

- Chemistry

➢ **The MSI (Materials Sustainability Index)**

The MSI is the most reliable method for measuring and assessing the environmental impact of materials in the clothing sector. Product designers and developers in the apparel, footwear and textile industries can use the Higg MSI to assess and analyze the cradle-to-gate impacts of various materials, including fabrics, plastics, metals and leather. In other words, it measures the impact of a material from the point of resource extraction (the cradle) to the factory door. Post-market and end-of-life effects are not taken into account, so the entire life cycle of each material is not considered.

The Higg MSI calculates environmental impacts and converts them into comparable Higg MSI scores using information provided by industry and life cycle assessment databases. The Higg MSI can determine the impacts of many variations in material manufacturing.

The Higg MSI features 90+ example materials

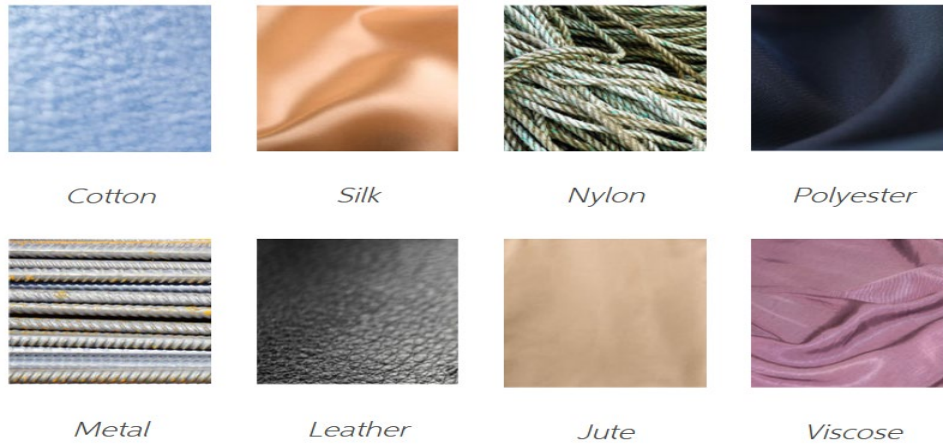These examples represent materials commonly used in the industry.

Cotton · Silk · Nylon · Polyester

Metal · Leather · Jute · Viscose

Figure (4) Higg MSI Materials

Source: https://apparelcoalition.org/higg-product-tools/

The Higg MSI was created specifically for the textile sector after extensive consultation with the industry. Prior to the Higg MSI there was no instrument in the clothing sector establishing standardized criteria for life cycle assessments, methodology and procedures. The Higg MSI is being used to create more environmentally friendly products.

➢ **PM (Product Module)**

What role can a T-shirt play in global warming? What is the environmental impact of a pair of jeans over its life cycle? The Higg PM will help us learn.

From the point of resource extraction through the impacts of manufacturing, to product lifetime, care and end-of-life, Higg PM now analyses the environmental impact of a product from cradle-to-grave.

Higg PM is the only tool on the market that allows companies to upgrade the environmental impact of their products beyond carbon emissions. Finally, Higg PM offers reliable information that helps businesses understand the sustainability performance of their product portfolios and facilitates progress towards cyclicality goals. The product tool was created to help businesses prepare for upcoming legislation.

Higg PM will adapt to and comply with new laws as they emerge, in particular the forthcoming EU PEF Apparel & Footwear approach.

Higg Facility Tools are assessments that shed light on the social and environmental performance of a facility. Thousands of institutions around the world manufacture consumer goods. Each facility is essential to the overall sustainability of the industry. Higg Facility Tools provide standardized social and environmental assessments that encourage dialogue among value chain participants to socially and environmentally enhance each link in the value chain.

The tools included in the facility category: Higg Facility Environmental Module (FEM); Higg Facility Social & Labor Module (FSLM).

Their purpose is: Identify opportunities for facilities and continuously improve their sustainability.

Who uses them: Manufacturers

What they measure: 7 environmental and 9 social management categories.

➢ **Higg Facility Environmental Module (FEM)**

The production and consumption of clothing has a significant environmental impact. It takes up to 2,000 litres of water and 400 megajoules of energy to make a typical pair of jeans. The same pair of jeans is maintained throughout their lifetime after purchase, and can produce more than 30 kilograms of carbon dioxide. That's the same as covering 78 miles in a car.

By providing manufacturers, brands and retailers with information on the environmental performance of each specific facility, the Higg Facility Environmental Module (Higg FEM) allows them to scale sustainable improvements. Facilities gain a clear picture of their environmental impact thanks to the Higg FEM. It helps identify and prioritize performance improvement opportunities.

The Higg FEM assesses:

- Environmental Management Systems

- Energy Use and Greenhouse Gas Emissions

- Water Use

- Waste water

- Emissions to Air (If Applicable)

- Waste Management

- Chemical Management

➢ Higg Facility Social & Labor Module (FSLM)

The Higg Facility Social and Labor Module (Higg FSLM) is a program that can be used to analyze the social and labor conditions of workers in the value chain worldwide. The scored assessment can be used by facilities to understand hotspots and reduce audit fatigue. Instead of focusing on compliance, they can devote time and resources to making lasting systemic changes.

The SLCP Aggregated Assessment Framework is fully integrated into the Higg certified FSLM, helping the industry shift from proprietary assessments to convergence. By using this tool, companies are supporting an industry-wide initiative to reduce duplication of controls, which will allow greater focus on significant improvements in social and labor conditions in global supply chains.

The Higg Facility Social & Labor Module, saves facilities time and money that would otherwise be used for individual audits. Resources can be redirected to better support staff using the Higg indicator. Communication is made easier with business partners around the world and collaboration more productive for industry improvement thanks to the digital Higg Index platform.

The Higg FSLM assesses:

- Recruitment and Hiring

- Working Hours

- Wages and Benefits

- Employee Treatment

- Employee Involvement

- Health and Safety

- Termination

- Management Systems

- Empowering People Communities

Higg Brand & Retail Tool shed light on how well retailers and brands are behaving in terms of social and environmental responsibility. By comparing their organization's sustainability performance against the most significant environmental, social and management challenges in the market, companies of all sizes can use the Higg BRM to obtain an in-depth assessment.

The tools included in the brand & retail category: Higg Brand and Retail Module (BRM).

Their purpose is: Continuously improve sustainability in business operations by identifying opportunities.

Who uses them: Brands and retailers are the users.

What they measure: 11 environmental and 16 social management categories

Businesses can use the BRM to measure their performance against similar industry peers year on year, assess their ESG performance and identify areas for continuous improvement. The industry-created Higg BRM complies with relevant industry standards and laws, including the EU Corporate Sustainability Reporting Directive, the ZDHC Brands to Zero initiative and the Textile Exchange's Material Change Index. This reduces the reporting burden and accelerates the adoption of industry best practices, while helping brands and retailers develop strong corporate sustainability plans to better meet their ESG goals and industry needs.

Conscious organizations can track, measure and share their sustainability progress with their value chain partners using Higg BRM. Higg BRM helps establish a common language across the industry, enabling brands and retailers to interact and communicate with business partners across the value chain.

Businesses can more effectively and transparently share their ESG progress and activities with internal and external stakeholders using BRM. It enables businesses to offer transparent, clear and consistent scoring that provides internal and external stakeholders - including senior management and customers - with reliable information on sustainable goals and achievements.

In June 2022 and despite its ten-year lifetime, the Higg index is challenged as inefficient, complex and biased towards fossil fuel-based synthetic materials over natural fabrics. New York Times journalist Hiroco Tabuchi, in an article entitled "It's

Soft. It's Vegan. It looks just like leather. It's also made from fossil fuels" and thus expresses her displeasure with the huge explosion in the use of cheap oil-based materials and their embellishment with words like "pleather" or for marketing purposes like "vegan leather".

It then mentions the Higg Index evaluation system which influenced companies in the sector and evaluated all types of fabrics and materials. It points out that the Higg Index largely favours synthetic materials made from fossil fuels over natural materials such as cotton, wool, or leather. These assessments are now heavily criticized by independent experts and by representatives of the natural fibre industry who say that using the Higg index to reflect the increasing use of synthetics is environmentally desirable despite questions about the environmental costs of synthetics. **It is also reported that many people believe that the index comes from research funded by members of the synthetic industry.**

Although most of **the world's polyester is produced in Asia, often using a dirtier energy grid and under less stringent environmental regulations**, the index rates polyester as one of the most sustainable fabrics in the world, for example, using data on European polyester production provided by a plastics industry group. The Higg score for elastane, more commonly known as spandex or Lycra, is based on research conducted by Invista, a division of Koch Industries and then the world's largest producer of elastane. In 2019, Invista sold its Lycra division.

It claims that the index's creation coincided with an increase in consumer emphasis on sustainability, environmental and animal welfare issues and in the use of cheap fabrics. It is also stressed that the board of directors of the company that has created the Higg Index includes major companies that have benefited from the two major trends based on the Higg Index: fast fashion and sporting activity. Most of these brands use polyester and thus benefit from the Higg Index and have a better score. The Material Sustainability Index (MSI) is the only tool that is not behind a paywall and is the index most often used by the largest and richest fashion companies to measure the global impact of their fibre and fabric choices, including Nike, H&M Group, Inditex and others.

Another blow to the Higg Index in 2022 was the banning of the use of the Higg Material Sustainability Index (MSI) by the Norwegian Consumer Authority because it found that

the marketing claims derived from the index are inaccurate, inadequate in terms of environmental claims and the index measurements are based on average environmental impact figures for textiles. Norrona and H&M are in the Authority's focus. Norrona's advertisements are based on the Higg MSI tool, which measures the environmental impact of different textile products e.g., it uses MSI to present the environmental benefits of organic cotton T-shirts on its website. Norrona's marketing suggests that the T-shirt has a much lower environmental impact because it is made from organic cotton rather than 'normal' cotton. This claim by Norrona is not substantiated, in the opinion of the Norwegian Consumer Protection Agency.

The main reason for this is that the MSI does not list the environmental characteristics of a specific product but only provides information on the typical environmental impact of a specific material. According to Ronningen, this average may not always be applicable to the specific product advertised as having a positive environmental impact.

Depending on where the organic cotton is grown and used in the product in question, the actual environmental impact of cotton, for example, may change. In addition, Forbrukertilsynet noted that the study data on which the Higg MSI is based is partly outdated and is not intended for the comparisons that the Higg MSI makes.

According to these data, the Authority concluded that the use of the Higg MSI in this case is misleading and, therefore, prohibited. The promotion of environmental benefits based on the Higg MSI was requested by Norrona to be changed or removed.

H&M also uses the Higg MSI to communicate the positive environmental benefits of its products to consumers. Therefore, the Authority is sending them a letter informing them that the use of the Higg MSI will be misleading and prohibited for them to use as a basis for their environmental claims. H&M was asked to do the same which was communicated to Norrøna and they were given a deadline of 1 September 2022 to align with them and the standards given.

MSI was deficient in its assessment of a material in environmental and social impact. One of the main shortcomings of the Index is that the data used to calculate fibre ratings is limited in scope, often outdated and based on surveys that do not adequately represent the entire fibre industry. Next, these records are widely used and are assumed to reflect a type of fibre that cannot in fact be disconnected from its local ecological and social context.

Higg MSI uses life cycle analyses to calculate the impact on fibres. However, the Higg MSI does not fully capture the life cycle of a product. A methodology that takes into account the environmental, economic and social costs of a product would be necessary to accurately assess the life cycle of a product.

The MSI Higg has several limitations:

 -Instead of using a comprehensive "cradle to grave" or "cradle to cradle" approach, it focuses exclusively on a "cradle to gate" perspective.). **Cradle to Grave**, also known as Life Cycle Assessment (LCA), is a system used to assess the physical consequences associated with each stage of a product's existence, from the acquisition of raw materials to processing, manufacturing, distribution, use, maintenance and repair, as well as sale or reuse. The **cradle-to-cradle** process describes a production method where products are created for closed-loop systems where each ingredient is safe and beneficial, either to biodegrade naturally and replenish the soil (referred to as a biological nutrient) or to be fully recycled into high quality materials for subsequent generations of products (referred to as a technical nutrient).

-It focuses exclusively on assessing environmental impacts and fails to consider the broader picture of sustainability, which includes environmental, economic and social factors associated with the production of goods.

-The methodology still fails to provide consistent comparisons of environmental costs between different materials. Consequently, some animal fibre products, such as wool, silk and alpaca, receive lower scores compared to preferred materials such as cotton and synthetic fibres preferred by large clothing companies.

Two important terms in life cycle assessments are the terms "cradle to gate" and "cradle to grave". MSI Higg uses the cradle-to-gate approach, which focuses on assessing the environmental impact of a product from the production phase to the point of entry into the store. On the other hand, the "cradle-to-cradle" assessment evaluates the environmental impacts throughout a product's life cycle, including raw material extraction, processing, manufacturing, use and eventual disposal or recycling. The cradle-to-cradle approach provides a more comprehensive understanding of the environmental impacts of a material.

Higg MSI's reliance on the cradle-to-gate methodology overlooks important negative impacts associated with the life cycle of synthetic fabrics. This includes the

environmental impacts of fossil coal mining and transportation and the release of microplastics into ecosystems. In addition, the methodology does not consider factors such as the renewability, repairability and biodegradability of products. Consequently, there is an inherent bias towards synthetic fibre types, neglecting the more harmful aspects of their life cycle and ignoring the important advantages of natural fibres. These advantages include the need for less frequent washing, increased durability, and the ability to safely biodegrade after a long period of use.

2.5 The Fashion Transparency Index

In 2013, after the collapse of the Rana Plaza garment factory in Bangladesh, a non-profit global movement Fashion Revolution was founded by Carry Sommers and Orsola de Castro. Its purpose was to campaign for reform of the fashion industry by focusing on transparency and the fashion supply chain. In 2014, understanding that transparency is fundamental to achieving systemic change in the fashion industry landscape, they created the Fashion Transparency Index (FTI) tool. The FTI is a report that is conducted annually and includes 250 of the world's largest fashion brands and retailers based on how much information they disclose about their supply chains, their internal operations and their human rights and environmental policies. Because of the greatest impact on workers and the environment, the index focuses on the largest and most profitable brands as the ones most in need of change. Transparency is the foundation for transformational change but unfortunately many parts of the supply chain are still opaque, giving companies room for unregulated abuse. Transparency need not be linked to sustainability. It will not be possible to create a fair, responsible and sustainable fashion sector without transparency. The FTI analyses 246 variables from 5 major sectors to assess how the information disclosed to the public by brands relates to environmental and human rights issues.

The 5 areas are

1. Policies & Commitments

2. Governance

3. Supply Chain Traceability

4. Know, Show & Fix

5. Spotlight Issues, which this year (2022) are decent work, covering forced labour, living wages, purchasing practices, unionization and collective bargaining, gender and racial equality, sustainable sourcing and materials, overconsumption and business models, waste and circularity, water and chemicals, climate change and biodiversity.

Through the transparency index, businesses will be able to:

-providing incentives for big brands and retailers to capitalize on their competitive trends and be encouraged to publish more accurate and comparable statistics and information year on year.

-compare the degree of transparency on human rights and environmental issues among the world's largest and most powerful companies and fashion retailers through trend analysis.

-create a tool that will allow a wide range of stakeholders to better understand the data and information published by the world's largest companies and use the results to guide future action.

-use this study to inform people's actions and collectively mobilize people in their ongoing efforts, to educate the public about the social and environmental concerns facing the global fashion industry.

The Fashion Transparency Index does not seek to measure transparency per se alone. Its aim is to encourage the disclosure of information so that people, activists, experts, employee representatives, environmental groups, policy makers, investors and even brands themselves can use it to examine what the big players are doing, hold them accountable, highlight best practices and work to achieve change.

Transparency involves not only providing information to the public, but also presenting that information in a way that makes it easy to find, understand and, if necessary, challenge. Pages filled with hyperbole and meaningless phrases mask the lack of detail and accessibility in the review.

How brands and retailers are selected by the index

The Fashion Transparency Index evaluates and ranks 250 of the world's largest and most influential fashion brands and retailers. The brands are selected based on

- Annual turnover of more than USD 400 million

- Valuations based on publicly available data on the brand, which may indicate investment interest or media attention when the companies are private.

-Diverse market segments from Europe, North America, South America, Asia and Africa, including high-end apparel, luxury apparel, sportswear, accessories, footwear and jeans.

The companies considered in this index are the largest and most dominant consumer brands in the clothing sector. They have the greatest negative impacts on human rights and the environment and bear a disproportionate burden of responsibility for bringing about revolutionary change. These brands are incredibly successful and popular. With some of the world's wealthiest owners and CEOs at the helm, these companies have the means and the moral obligation to take significant action, not only for transparency but also to enhance human rights and environmental impacts at the core of their business models. Because the public is more familiar with brands, the report quoted in the index refers to brand names and not to names of parent companies or controlling groups.

By using the Fashion Revolution technique, participating companies often earn higher scores, as they may be able to identify relevant disclosures that their researchers may have overlooked or provide more detail during the review period in an effort to earn higher scores.

What does participation brands mean

Each year, at the beginning of the Fashion Transparency Index study cycle, usually in November, Fashion Revolution contacts all 250 brands. At this point, they are informed of the changes in approach and invited to participate. They are asked to respond with a yes or no. As businesses know their rules better than we do, participation means that brands will evaluate their pre-populated questionnaires to fill in any gaps that Fashion Revolution's research team might have overlooked during the initial evaluation.

Fashion Transparency Index researchers write comments on the questionnaire form asking brands for clarification on certain disclosures or for updated disclosures. This questioning helps brands develop their capabilities.

Fashion Transparency Index researchers then inform brands of the reasons why a disclosure is or is not acceptable under the methodology, when brands submit

comments and/or disclose more information in accordance with the questionnaire. In this way, participation adds value.

A-Z OF BRANDS

● = participated in brand questionarire

Abercrombie & Fitch (Ambercrombie & Fitch) ●
adidas (Adidas AG) ●
Aeropostale (Authentic Brands Group LLC)
AJIO (Reliance Retail)
ALDI Nord (ALDI Einkauf GmbH & Co. oHG) ●
ALDI SOUTH (ALDI Einkauf GmbH & Co. oHG) ●
ALDO (The Aldo Group Inc.) ●
Amazon (Amazon.com, Inc.) ●
American Eagle ●
ANTA
Anthropologie (URBN) ●
Aritzia ●
Armani (Giorgio Armani S.p.A) ●
Asda (George.) (TDR Capital) ●
ASICS ●
ASOS ●
Balenciaga (Kering) ●
Bally (JAB Holding Company) ●
Banana Republic (Gap Inc.) ●
BCBGMAXAZRIA (Marquee Brands)
Beanpole (Samsung C&T)
Belle
Bershka (Inditex) ●
Big Bazaar – ffb (Future Group)
Big W (Woolworths Group) ●
Billabong (Boardriders) ●
Bloomingdale's (Macy's Inc.)
Bonprix (Otto Group) ●
boohoo (boohoo group plc) ●
Bosideng
Bottega Veneta (Kering) ●
Brooks Sports (Berkshire Hathaway) ●
Brunello Cucinelli
Buckle
Burberry ●
Burlington ●
C&A ●
Calvin Klein (PVH) ●
Calzedonia (Calzedonia Group) ●
Canada Goose
Carhartt ●
Carolina Herrera (Puig) ●
CAROLL (Vivarte)
Carrefour ●
Carter's (Carter's Inc) ●
CELINE (LVMH) ●
celio
Champion (HanesBrands Inc.) ●
Chanel
Chico's
Chloé (Richemont) ●

Clarks ●
COACH (Tapestry, Inc.) ●
Cole Haan
Columbia Sportswear ●
Converse (Nike, Inc.) ●
Cortefiel (Tendam) ●
Costco
Cotton On (Cotton On Group) ●
Decathlon (Association Familiale Mulliez) ●
Deichmann
Desigual ●
Dick's Sporting Goods ●
Diesel (OTB Group)
Dillard's
Dior (LVMH) ●
Disney (The Walt Disney Company)
DKNY (G-III Apparel Group)
Dolce & Gabbana
Dr. Martens (Permira) ●
Dressmann (VARNER) ●
DSW (Designer Brands)
Eddie Bauer (Authentic Brands Group LLC)
El Corte Inglés ●
Elie Tahari
Ermenegildo Zegna ●
Esprit ●
Express
Falabella
Famous Footwear (Caleres)
Fanatics (Kynetic)
Fashion Nova
Fendi (LVMH) ●
Fila ●
Fjällräven (Fenix Outdoor) ●
Foot Locker
Foschini (TFG) ●
Fossil (Fossil Group, Inc.) ●
Free People (URBN) ●
Fruit of the Loom (Fruit of the Loom) ●
Furla
G-Star RAW ●
Gap (Gap Inc.) ●
Gerry Weber
Gildan ●
GU (Fast Retailing) ●
Gucci (Kering) ●
GUESS ●
H&M (H&M Group) ●
Hanes (HanesBrands Inc.) ●
Heilan Home
Helly Hansen (Canadian Tire Corporation) ●

HEMA ●
Hermès
Hollister Co. (Abercrombie & Fitch) ●
Hudson's Bay (Hudson's Bay Company)
Hugo Boss ●
Intimissimi (Calzedonia Group) ●
Ito-Yokado (Seven & i Holdings Co)
Jack & Jones (BESTSELLER) ●
Jack Wolfskin (Calloway Golf Company)
JD Sports ●
Jil Sander (Onward Holdings)
Jockey
Joe Fresh (Loblaw Companies Limited) ●
John Lewis ●
Jordan (Nike, Inc.) ●
Justfab (TechStyle Fashion Group) ●
K-Way
Kate Spade (Tapestry, Inc.) ●
Kathmandu ●
Kaufland
Kiabi ●
KiK ●
Kmart (Sear Holdings)
Kmart Australia (Westfarmers) ●
Kohl's
KOOVS
La Redoute (Galeries Lafayette Group) ●
Lacoste (Maus Frères) ●
Lands' End ●
LC Waikiki
Levi Strauss & Co ●
Li-Ning
Lidl ●
Lindex (Stockmann Group) ●
LL Bean
Longchamp
Louis Vuitton (LVMH) ●
Lululemon ●
Macy's (Macy's Inc.)
Mammut (Telemos Capital Limited) ●
Mango ●
Marc Jacobs (LVMH) ●
Marks & Spencer ●
Marni (OTB Group) ●
Massimo Dutti (Inditex) ●
Matalan ●
Max (Landmark Group)
Max Mara
Merrell (Wolverine World Wide, Inc.)
Metersbonwe
Mexx

Michael Kors (Capri Holdings)
Miu Miu (Prada Group) ●
Mizuno ●
Moncler
Monoprix (Groupe Casino)
Morrisons (Nutmeg) ●
MRP
Muji (Ryohin Keikaku Co.) ●
New Balance ●
New Look ●
New Yorker
Next ●
Nike (Nike, Inc.) ●
Nine West (Authentic Brands Group LLC)
Nordstrom ●
Old Navy (Gap Inc.) ●
Otto (Otto Group) ●
OVS ●
Paris (Cencosud) ●
Patagonia ●
Pepe Jeans
Pimkie ●
Prada (Prada Group) ●
PrettyLittleThing (boohoo group plc) ●
Primark (Associated British Foods plc) ●
Prisma (S Group) ●
Pull&Bear (Inditex) ●
Puma ●
Quiksilver (Boardriders) ●
Ralph Lauren ●
Reebok * (Authentic Brands Group LLC) ●
REI
Reliance Trends (Reliance Retail)
Reserved (LPP) ●
REVOLVE
River Island ●
Romwe (Shenzen Globalegrow E-Commerce Co, Ltd)
Ross Dress for Less
Roxy (Boardriders) ●
Russell Athletic (Fruit of the Loom) ●
s.Oliver ●
Sainsbury's (Tu Clothing) ●
SAINT LAURENT (Kering) ●
Saks Fifth Avenue (Hudson's Bay Company)
Salvatore Ferragamo ●
Sandro (SMCP)
Semir (Semir Group)
SHEIN
Shimamura (Shimamura Co., Ltd.)
Skechers
Speedo (Pentland Group) ●

Splash (Landmark Group)
Sports Direct (Frasers Group)
Steve Madden
Stradivarius (Inditex) ●
Superdry ●
Takko
Target ●
Target Australia (Westfarmers) ●
Tchibo ●
Ted Baker ●
Tesco ●
Tezenis (Calzedonia Group) ●
The Children's Place
The North Face (VF Corporation) ●
The Warehouse
Timberland (VF Corporation) ●
TJ Maxx (TJX)
Tod's
Tom Ford
Tom Tailor ●
Tommy Bahama (Oxford Industries, Inc.)
Tommy Hilfiger (PVH) ●
TOPVALU COLLECTION (AEON)
Tory Burch
Triumph
Truworths
UGG (Deckers Brands) ●
Under Armour
Uniqlo (Fast Retailing) ●
United Arrows ●
United Colors of Benetton ●
Urban Outfitters (URBN) ●
Valentino
Van Heusen ** (Authentic Brands Group LLC)
Vans (VF Corporation) ●
Vero Moda (BESTSELLER) ●
Versace (Capri Holdings)
Very (The Very Group) ●
Victoria's Secret (L Brands) ●
Walmart (Walmart Inc.)
Woolworths South Africa (Woolworths
Holdings Limited) ●
Wrangler (Kontoor) ●
Youngor
Zalando ●
Zara (Inditex) ●
Zeeman ●

*Reebok is no longer part of adidas as of 2022 and is now part of Authentic Brands Group. Quantitative KPIs included in adidas' 2021 Annual Financial Report do not apply to Reebok. Supply chain data applies to Reebok as adidas and Reebok share common suppliers. **Van Heusen is no longer part of PVH Group, as of June 2021 and is now part of Authentic Brands Group.

Figure (5) Companies which participated in the questionnaire in 2022 by FIT

In general, participating companies score better year on year, as the Fashion Transparency Index research team can encourage them to disclose more information in line with industry best practice.

In 2022, 23 brands participated for the first time in the Index for the year resulting in a 7% increase in participation points, from 55% to 62%. The participation rate of the Index is increasing year on year.

How it works

The purpose of the FIT is to emphasize transparency through open disclosure. Multiple stakeholders, including representatives of employees, environmental groups, investors, consumers and the brands themselves, can make use of the information and data disclosed by brands if it is publicly available, comprehensive and specific enough to influence positive change on human rights and environmental issues. The Index encourages major brands to achieve this. Public accountability is fuelled by disclosure. The Index deliberately leaves out everything that brands and retailers claim to perform in their operations and supply chains on an internal and behind-the-scenes basis. Moreover, this is why more of the brands' practices are sought to be publicly disclosed.

What it measures

The Fashion Transparency Index looks at what companies know and openly disclose about the human rights and environmental impacts of their value chains.

-Credit for major brands' policies, practices, performance and developments on human rights and environmental issues along the value chain is given only to information/data that has been made public.

-Only information or data that has been made public on the brand's own or parent company's website (or directly linked to it; see below) is eligible for points.

What does not measure?

The Fashion Transparency Index looks at public disclosure, not impact.

-Although it is outside the scope of their research, stakeholders are encouraged to use it to hold companies accountable for their promises. Verification of the claims of brands and retailers is outside the scope of their investigation.

-Ethics and sustainability are not factors measured by the Fashion Transparency Index. No brand in the Index is recommended by us and we do not advise customers to purchase specific brands based on the Index's ranking. It is not a buying guide.

Information/data must be publicly available from one of the following places

-On the brand or parent company's website,

-Small sustainability/CR websites, with the key requirement that there is a web link to them from the main brand or parent company website.

-In annual reports or annual sustainability reports (counted only if dated January 2019 or later) published on the brand or parent company's website; In any other documents that are publicly available and freely downloadable from the brand or parent company's websites.

-Through external, third-party websites, but only where there is a direct web link from the brand or parent company website to the third-party website (e.g. Bangladesh Accord, Better Work, CDP, FLA, ETI, BSCI/Amfori) where specific disclosures can be found.

Don't measure the following information sources

-Clothing labels and hang tags on products in the store or other physical locations.

-Smartphones, Social media channels.

-A third party website or document where there is no web link from the brand website, including press articles.

-Documents that can be downloaded where the web link cannot be found on the brand's website

The methodology

The 2022 index includes 62,250 data points from 246 different variables across 250 brands. A four-month consultation process with a wide range of industry professionals and stakeholders from academia, the trade union movement, civil society organizations, socially responsible investment, business advisory services and the media was used to develop the methodology in 2017. In collaboration with the Fashion Revolution Advisory Committee, which in 2022 consisted of more than 20 experts and organizations, the process was updated.

A serious effort has been made to align the methodology with current international frameworks and standards, including Open Data Standard, the UN Guiding Principles, the SDGs, the OECD Due Diligence Guidelines and relevant ILO conventions, as well as other benchmarks and initiatives such as ACT, CHRB, Know the Chain, Transparency Pledge and several others. Through the Wiki rate open research platform, we also collaborate to share research with other benchmarks. In addition, in order to improve clarity and comply with best practices, the language of some of the indications was revised.

Restrictions

-Data are up to date as of 30 April 2022.

-Brands may have published or withheld information or links to evidence may have changed location or ceased operations after this date.

In addition, changes in methodology in 2022 may make it difficult to compare results year on year. Verification of brand claims is outside the scope of this research; only rights holders and experts can hold brands accountable when their practices and impacts do not live up to their promises. Office research depends on people, which makes human error possible; when it comes to disclosing information that can be used to take action by large companies, we are confident that the process is thorough and reliable.

Calculation of results

For the purposes of this report, all scores were calculated to two decimal places (in the data set) and rounded to the nearest whole percentage point. The scores given to each brand for each of the five parts were summed to determine the total score for each brand. Since some parts are worth more points than others, each part is given a different weight:

Section 1 has a value of 33/250.

Section 2 has a value of 11/250.

Section 3 has a value of 73/250.

Section 4 has a value of 50/250.

Section 5 has a value of 83/250.

By averaging the individual final scores of each brand, the overall average score for all 250 brands is determined. Instead of the percentage change, the differences in scores from year to year are expressed as a change in percentage points. Unless otherwise stated, this is accurate; for example, instead of stating that a brand increased by 50% of the percentage change (45/30=1.5) if it received a score of 30% one year and 45% the next, it will usually be stated that the brand increased by 15 percentage points (45-30=15). Calculate the change from year to year using the rounded values rather than the exact decimal places in cases where a score may have been rounded to the nearest percentage point in previous editions. For example, the average score in a module is rounded to 18% when it was 17.74%. If the average score for that section in last year's report was 12.41%, we rounded it to 12% in the current report. Thus, the annual difference is 5.33 percentage points but if we go by the nearest rounded figures it is 6 percentage points.

Weightings of the scores

Policies and Commitments-13.2%

This section examines the social and environmental policies of brands, focusing on their application to both internal employees and workers in their supply chains. It examines the implementation of these policies, the existence of related goals and objectives, and whether brands provide in its annual reports progress on the achievement of these goals. In 2021, the available points in this section were halved to focus on outcomes and impact. Although there were no changes to the indicators in 2022, stricter guidelines were given on acceptable disclosure, which may explain why some brands received lower scores compared to the previous year. For example, when assessing whether brands have a vendor policy on overtime pay, simply stating that "overtime is paid at a premium" is not sufficient. Disclosure of the percentage by which overtime pay exceeds the minimum wage is required; ambiguous language may be used to avoid liability, and it was intended that the language used

Governance-4.4%

In the governance section, the executive board members responsible for social and environmental performance are examined. It assesses how these responsibilities are put into practice and also includes the link between social and environmental improvements and the performance of employees, directors and suppliers. In addition, the accessibility

of the relevant department to the public and whether there is employee representation on the board of directors shall be assessed. Finally, it is assessed whether brands publish a responsible fiscal strategy and whether there is employee representation on the executive board. The weights for this section are 13.2% for executive board accountability, 4.4% for performance linkage and 3% for employee representation.

Traceability-29.2%

In the traceability section, brands are expected to disclose their supplier lists at three levels: production, processing and milling facilities, and raw materials. Additional data such as supplier addresses, workforce size, gender breakdown, presence of migrant workers, union representation and last date of list update are also requested. A new requirement for is to ensure that brand catalogues are publicly available and aligned with the Open Data Standard for the apparel sector, facilitating accessibility for trade unions and NGOs. In addition, it is verified whether brands actively contribute to the Open Apparel Register, promoting collaboration and simplified data access for relevant stakeholders. The weighting for this section is 29.2%.

Know, show and Fix-20%

The Know, Show & Fix section looks at the information brands disclose about their human rights and environmental due diligence processes. This includes methods for evaluating suppliers against their policies, the results of audits and assessments, how brands address identified issues, the channels available to employees to make complaints, and how these complaints are addressed. For the first time, we separate human rights and environmental due diligence into separate subsections to shed light on potential gaps in environmental due diligence disclosure. Previous indicators have focused primarily on human rights due diligence. The weighting for this section is 20%.

Spotlight Issues-33.2%

In 2021, the weighting for the Spotlight Issues section increased significantly compared to previous versions (from 19.6% in 2020). This is part of an effort to encourage greater publicity of the most pressing and challenging issues facing the industry. There have been no changes to the weighting of this section for 2022. In this section, we examine the information brands disclose on a range of issues, including forced labour, living wages, purchasing practices, unionization race and gender equality, overproduction,

waste and cyclicality, sustainable materials, water and chemicals, climate and deforestation.

Guide to the final score

0-5%

Brands scoring between 0-5% have either not disclosed any information or have disclosed a very limited number of policies. Typically, these policies focus on the brand's recruitment practices or engagement with the local community. In cases of minimal disclosure, disclosed information often includes reports that are required by law, such as modern slavery statements or gender pay gap reports. Mandatory transparency legislation can be effective in forcing brands to disclose information that they would not otherwise share voluntarily.

6-10%

Brands scoring between 6-10% are expected to have published certain policies relating to their employees and suppliers. Brands approaching 10% are more likely to have a basic supplier code of conduct, provide some details about their processes, and offer limited information about their supplier evaluation process.

11-20%

Brands scoring between 11-20% are expected to have published numerous policies regarding both their employees and suppliers. They are likely to provide some processes and offer information about their supplier evaluation and remediation processes. However, these brands are unlikely to make their supplier lists public and may not share important information, if any, on Spotlight issues including decent work and purchasing practices, gender and racial equality, sustainable sourcing and materials, overconsumption, waste and cyclicality, water and chemicals, and climate.

21-30%

Brands scoring between 21-30% are expected to provide significantly more comprehensive information on policies, procedures, governance, social and environmental objectives, and supplier assessment and remediation processes. These brands may disclose a basic list of manufacturers that includes only the name and address of the factory. However, they are unlikely to share information about the results

of their supplier evaluations or the existence of complaint channels. While these brands may not disclose information on all the issues at stake, they may address some of them.

31-40%

Brands scoring between 31-40% generally provide transparency by disclosing their main manufacturers and offering detailed information on policies, procedures, social and environmental objectives, governance, supplier evaluation and remediation processes. These brands also tend to be more inclined to disclose individual information on certain Spotlight Issues, such as carbon emissions, gender equality, sustainable sourcing and materials and energy use.

41-50%

Brands scoring between 41-50% are expected to provide more extensive supplier lists, including processing facilities along with manufacturers. They are likely to disclose detailed information on their policies, procedures, social and environmental objectives, governance, supplier assessments, remediation processes and some findings from supplier assessments. These brands also tend to be more inclined to address certain Spotlight Issues, such as carbon emissions, gender equality, sustainable sourcing and materials, energy use, waste and cyclicality, carbon, water and chemical discharge.

51-60%

Brands scoring between 51-60% are expected to disclose all of the above information and are likely to provide detailed supplier lists. These brands will disclose the majority of their human rights and environmental policies, procedures, social and environmental objectives, as well as information on governance and due diligence processes. They are also likely to share detailed information on the findings of their supplier assessments. In addition, these brands will address many of the cutting-edge issues such as carbon emissions, gender equality, sustainable sourcing and materials, energy use, waste and circularity, carbon, water and chemical free, living wages, waste and circularity.

61-70%

Brands scoring between 61-70% are expected to disclose all the above information and will provide detailed lists of suppliers including manufacturers, processing facilities and some suppliers of raw materials such as cotton, wool or viscose. These brands will also address the majority of the Spotlight Issues mentioned in previous series, as well

as focus on racial equity, forced labor, overconsumption, deforestation and regeneration, purchasing practices, unionization, and collective bargaining.

71-80%

Brands scoring between 71-80% are expected to disclose all of the above information and will provide detailed supplier lists for manufacturers, processing facilities and suppliers of raw materials such as cotton, wool or viscose. These brands will publish detailed information on due diligence processes and results, supplier assessments and remediation findings. Compared to other brands in the Index, these brands will share more comprehensive and detailed information and data on the issues at hand. However, they may still have some gaps in disclosure of results and impacts.

81-90% & 91-100%

No brands are currently achieving scores above 80%. However, if they did reach this level, these brands would disclose all of the information previously mentioned and would also provide detailed information on the findings of supplier assessment and remediation for specific facilities. They would share comprehensive supplier lists for at least 95% of all suppliers, from production to raw materials. These brands would integrate social and environmental impacts into their economic business model and disclose full details on the use of sustainable materials. They would provide a gender breakdown of labour roles in their own operations and throughout the supply chain. They would make available detailed information on the company's purchasing practices and its progress towards implementing living wages for supply chain workers. These brands would disclose their carbon emissions, renewable energy use and water footprint across their operations and supply chains, including raw material levels.

2.6 The Business of Fashion Sustainability Index

More and more large companies in the fashion industry are addressing environmental and social responsibility. The Business of Fashion site dedicated to fashion, every year presents an annual report on the progress of fashion in relation to the critical sustainability goals of the Business of Fashion Sustainability Index. The index is an excellent benchmark to set new standards for the sustainability performance of fashion companies. The index looks at 6 areas of waste, water and chemicals, workers' rights, materials, emissions and transparency. These need to become the focus of fashion

change so that the fashion industry can begin to radically change. In order to measure performance objectively and quantitatively each of the above areas is divided into a series of measurements, where questions are asked with binary "yes" or "no" answers. Each series starts at a basic level, moving on to detailed questions that explore the implementation of best policies and practices. Together, they are intended to represent a comprehensive path to achieving each goal. Companies receive a point when they provide enough public information to show that they meet the criteria for meeting a particular metric. A company's score for a category represents the percentage of metrics in each category's goal set where the company earned a point. The total score for each company is derived from the average of the scores for each company's six categories. A brief overview of the six categories is given below.

1. Transparency

The fashion industry remains opaque in many areas such as supply chains.Many of the raw materials used by companies are not known to them where they come from. This gives rise to the possibility of human rights violations, makes it difficult to measure pollution and mitigation and other environmental disasters. Companies can also adopt new technologies that will help them to increase transparency and streamline their supply chains so as to facilitate their monitoring and management. Target by 2022 full supply chain mapping and supplier disclosure and analysis and disclosure of data on environmental and social impacts.

2. Emissions

The fashion industry, as we have mentioned before, is one of the biggest polluters in the world. Greenhouse gas emissions are between 4-10% of the global total and unless there is no intervention this will continue to escalate over the coming years and contribute to climate crisis. The states need to set laws and encourage these companies to switch to greener energy sources. Target by 2030 a 45% reduction in total greenhouse gas emissions by 2030.

3. Water and Chemicals

Waste and pollution of water and hazardous chemicals are key concerns of the fashion industry. The manufacture of fabrics requires large quantities of water and the use of hazardous and toxic chemicals which are responsible for pollution, drought and desertification. Fashion companies need to change their attitude towards water and

chemicals and follow more sophisticated approaches with cleaner green chemistry and methods that use less water. active participation of companies in industry efforts to minimize microfiber pollution is recommended. Target by 2030 to reduce water use to levels that can be naturally renewed, eliminate harmful pollution, and eliminate hazardous chemical use.

4. Materials

The materials of the fashion industry are based on a mining model. The manufacture of most garments is made using fossil fuels. Oil-based polyester is the most commonly used fabric in world fashion. Reuse and recycling are not yet taking place on a large scale. interest in it is certainly growing and regenerative agriculture seeks to restore soil health and biodiversity. It still offers the potential for long-term ways of dealing with it. Target by 2022 to source 100% of materials from preferred sources. by 2030 to source 100% of all-natural fibers from regenerative and socially responsible sources and to eliminate the use of virgin polyester and other oil-based synthetic materials.

5. Worker's Rights

The fashion industry continues in large part to be an ally of systemic inequality and social injustice. The modern fashion industry's obsession with the speed of the mass market and the globalization of the fashion system has created in the supply chain space an unequal environment for workers who are subjected to modern slavery with exhausting hours. The corona virus pandemic has further exacerbated these conditions. Fashion needs a big change, a social contract that empowers workers and regulates and ensures fair working conditions. The protection of human rights must be integrated into corporate strategy. Aim by 2022 to have full alignment of purchasing practices with commitments to ethical working conditions. And by 2025 to ensure that

6. Waste

The fashion industry fuels a culture of over-consumption and waste generation. Fashion trends today change almost every two weeks, resulting in consumers buying more clothes and wearing them for shorter periods of time. Thus almost 40 million tons of textile waste is land filled or incinerated every year. But there are ways to turn this

waste into valuable resources. The alternative business cycle models of resale, rental and development of recycled materials are here to change the landscape in the fashion industry. The goal by 2025 is to eliminate landfill waste and virgin plastic packaging and disposable packaging. The goal by 2030 is to establish waste-free production. Target by 2025 to establish a circular business model.

The results of the index for 2022 include more than 9000 data points, in 200 exclusive measurements applied to 30 companies. These companies represent the largest listed companies and provide the largest amount of information on their performance and activities. The index allows the comparison and assessment of the progress of sustainability by the companies' executives.

BoF INSIGHTS | The BoF Sustainability Index 2022

		Overall Index Score: 28	Emissions: 38	Transparency: 35	Water & Chemicals: 26	Materials: 25	Workers' Rights: 25	Waste: 19
● Puma	↑9	49	64	74	56	30	47	22
● Kering	↑5	47	43	74	51	48	40	24
● Levi Strauss	↑8	44	79	56	49	30	32	22
● H&M Group	↑5	42	36	48	47	43	40	38
● Burberry		41	57	44	42	48	33	24
● VF	↑6	41	64	52	42	30	30	30
● PVH	↑6	41	57	52	40	35	39	24
● Nike	↓2	41	43	70	44	17	33	35
● Inditex	↑6	40	50	52	33	39	44	22
● Adidas	↑1	37	50	37	35	43	32	24
● Lululemon		36	43	44	37	30	35	24
● LVMH	↑8	36	50	52	33	30	19	30
● Next		34	50	52	35	30	25	11
● Gap Inc.	↓2	33	50	48	30	22	26	19
● Ralph Lauren		32	43	33	33	39	23	22
● Hermès	↑9	32	36	48	26	22	28	32
● Fast Retailing	↑11	30	43	41	26	22	30	19
● Asics		29	50	26	19	35	19	24
● Tapestry		22	29	26	16	26	21	16
● AEO		21	50	11	19	22	12	11
● Richemont	↑8	20	43	15	7	13	25	16
● A&F Co.		18	21	22	9	30	21	5
● Capri		18	29	15	23	13	14	14
● Prada Group		16	36	15	5	9	16	16
● Under Armour	↑6	13	29	11	9	4	21	5
● URBN		8	0	0	5	13	11	22
● Skechers		7	0	7	5	4	18	8
● Fila Holdings		7	7	7	0	9	12	5
● Anta Sports		4	0	4	5	4	7	5
● HLA Group		0	0	0	0	0	0	0

Legend

● Luxury
● High Street
● Sportswear
↑↓ YoY Change

Note: The 2022 Index is based on public information published on or before Dec. 31, 2021. Scores are calculated as percentages, with the totals representing the mean for each company. Companies and categories are ordered by overall performance.

BoF INSIGHTS © 2022

Figure(6) The BOF Sustainability Index 2022

Source: **https://shop.businessoffashion.com/products/the-bof-sustainability-index-2022**

In the picture below you can see that Puma has received the best rating for 2022. It was the best performing company, scoring 49 points out of 100. Fast Retailing in 2022 went up 11 points compared to 2021 with a score of 30 points. Almost one-third of the companies in the Index have accumulated a score of less than 20. The Index shows very limited progress and the average score of the companies in the Index is 28 out of 100.

The conclusion of the Index is that there is widespread inertia among companies. no company will achieve the targets set for 2030 if progress continues at such a slow pace.

3. Strategy EU for the sustainable and circular textile products

According to the European Union, by 2050 human consumption will be for three planets. In order to prevent the loss of biodiversity and the pressure on water resources due to extraction and processing, the European Union set a specific strategy for a neutral, resource-efficient, and competitive economy. The circular economy will decouple economic growth from resource use by 2050 in line with the European Union's plan. Manufacturing companies in Europe consume 40% in materials. The "closed" models of the circular economy will help them increase their profitability by protecting them from fluctuation of resource prices. Today, the prevailing trend is for clothing and footwear to be used for short periods of time and then discarded.

The circular economy will provide citizens with safe and high-quality products that are affordable, longer lasting and designed to be reused, repaired and recycled. Textile products are the fourth category which is related to the use of primary materials and water, food, transport and greenhouse gas emissions. Only 1% of these worldwide are recycled. The aim of the European Union is to strengthen industrial competitiveness and innovation, the promotion of sustainable and textile products, new business models as well as reuse models.

The European Union has defined a comprehensive strategy to address the impact of the textile industry. Some key elements of this strategy concern

- The promotion of sustainable production where the aim of the EU is to encourage the use of sustainable materials and production methods (Sustainable materials include organic cotton, recycled polyester and production methods and low-impact dyeing processes). Improving resource efficiency and energy efficiency as well as reducing the use of hazardous substances.

- Supporting circularity by promoting circular business models for textile products (product rental, resale, recycling) and improving design so that they are more durable, repairable and recyclable.

- Through information campaigns and labeling systems, increasing consumer awareness of sustainable and circular textile products. Promoting sustainable second-hand market patterns and reducing textile waste through sorting and recycling.

- Support programs for research and innovation in the EU in order to develop sustainable and circular textile technologies (biodegradable and compostable fibers, digital tools for traceability and circularity). Among the basic elements, we see that the measures that the EU has taken to implement this strategy also follow.

The measures EU take to achieve them:

- Relate to the new requirements for the design of textile products. It sets the minimum limits of recycled fibers that will be included in the products, with the aim of increasing their lifespan and making it easier to repair and recycle them. Among the actions for seen will be the prohibition of the destruction of unsold products and those that were not sold or that were returned.

- Textile products should have a digital passport with information about circularity and basic environmental aspects.

- Strict controls will be conducted regarding false ecological identities in order to protect consumers.

- Tackling the release of micro plastics contained in textile products through the design and pre-washing in the industrial units.

- EU rules on producer responsibility.

- Support and investment in research and innovation programs to develop green and digital transition skills.

- Stopping the export of textile waste products.

- Determining a future course to achieve goals up to 2030 through the transition course for the textile ecosystem.

Even the EU, in order to achieve its strategy, has set and continues to set regulations and rules in the field of textiles. Below are basic rules and how they are connected to its strategy.

- **REACH (REGISTRATION - EVALUATION - AUTHORIZATION - RESTRICTION OF CHEMICALS)**

  REACH is a regulation set by the Union and aims to ensure that the chemicals used in all products, including those in the textile industry, are for human health and the environment. It is valid for all products circulating in the EU, whether produced in Europe or imported. Businesses based in Europe that manufacture, import or use chemicals in their products must register them with the European Chemicals Agency (ECHA) and provide information on their properties, risks and safe use. There is a small loophole that allows the use of certain dangerous substances only if their benefits outweigh the risks and restricts the use of the most dangerous substances.

- **GPSD (General Product Safety Directive)**

  The European Union's General Safety Directive concerns the required general product safety directives. It is valid for all consumer products sold in the European Union whether they are imported or produced. Manufacturers or importers must provide assurance that the products are safe and do not endanger the health of consumers.

- **Regulation for textile products**

  According to this regulation all products sold in the European Union must be labeled with information on fiber content, country of origin and care instructions. The fiber content must state the percentage by weight and must also state if a product is produced entirely in a country. The regulation also prohibits the use of any hazardous substances in textile products.

- **Waste Framework Directive (WFD)**

  This directive defines the requirements for waste management. It applies to all waste produced in the EU. According to this directive, the waste produced in the Union must be reduced and the recycling, the reuse of products and the safe disposal of hazardous waste must be promoted.
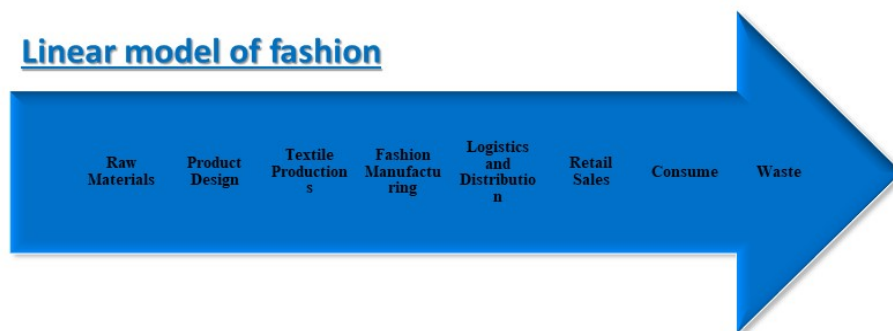
- **Eco label**

  The ecological flag of the European Union is a voluntary flag that is awarded to products that meet strict environmental criteria. The product must meet strict

environmental conditions throughout its life cycle. Reduced water and energy consumption reduced hazardous substances and recycled content is one of them.

4.Business Models in fashion

Business models help to better understand the work processes in a business. A business model is how a company manages its business activities with a proper business strategy in order to achieve a competitive advantage. However, the rapid changes in fashion require the change of business models and their adaptation to the new changes. Nowadays the fashion industry traditionally follows a linear business model. In the linear business model, the value chain starts from the production of the raw materials until the point where it is sold to the consumer and then it uses it until it breaks down or it no longer wants it and discards it and gets a new one. This model is characterized by high consumption of resources, high production of waste and great environmental pollution. However, in recent years there have been an increasing number of fashion companies as well as industry partners that have adopted and integrated circular business models. Circular business models differ from linear ones in that the value of materials and resources is preserved as much as possible in the form of functional products.

In the linear model as we see in figure (7), fashion companies produce large volumes of clothing at low cost and cheap labor and materials. Products usually have a short shelf life. A large amount of water, energy and raw materials are usually wasted during the production process. The clothes are then sold through retail stores and after use they are discarded, incinerated, or sent to sanitary landfills. The result of this process is the

Linear model of fashion

Raw Materials | Product Design | Textile Productions | Fashion Manufacturing | Logistics and Distribution | Retail Sales | Consume | Waste

significant amount of waste, the pollution of the environment and the creation of social and economic issues.

Figure (7) Linear Model of fashion (Traditionally the linear model of fashion starting with design through to consumption and disposal.) Source: https://www.facebook.com/photo.php?fbid=233970239156049&set=pb.100076292239403.-2207520000&type=3

On the other hand, now in the circular business model the main aim is to create a **closed loop model** with the aim of eliminating waste and maximizing the efficiency of resources. The circular model includes several strategies such as design for circularity,

resource recovery and closed loop recycling. Circularity aims to create products that are easy to disassemble, recycle using recyclable or biodegradable materials and the application of circular business practices throughout the supply chain. In figure (8) we see how the circular model works from the manufacture of raw materials, production to disposal by the consumer.
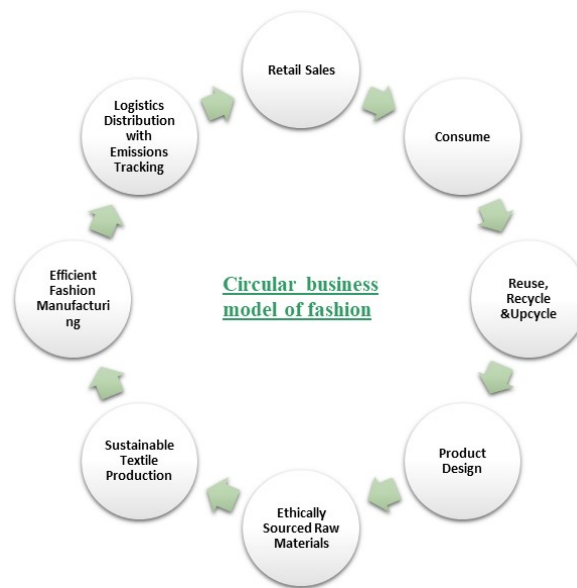

Figure (8) Circular Business Model of fashion (The circular model of fashion closes the loop.) Source: https://www.mdpi.com/2071-1050/15/1/262

Circular models can be integrated in different stages of the life cycle of the design, the manufacture of durable products, the collection and resale after the use of the products or their recycling. Although textile products lose their value during their use, circular models come to prevent this by keeping the products in circulation and generating income.

However, linear models still offer low production costs and attract a large share of consumers. In contrast, circular business models currently address a specialized segment of consumers who are aware of the environment and know the dangers of overproduction of textile products.

However, the circular fashion business model has several advantages over the linear one. Because it reduces the impact on the environment by minimizing waste and resource consumption, while linear contributes to the increase in waste and the depletion of resources. The circular model creates new economic opportunities through the recovery and reuse of materials and promotes economic and social sustainability while the linear model promotes social inequality. The transition from a linear production model to a circular one can be made if all parties involved in the fashion industry are oriented towards sustainability.

4.1 Principles of the Circular Economy

Rapid advances in technology since the industrial revolution have given wide access to products from around the world. However, the current linear economic model, characterized by the take-do-waste approach, is reaching its limits. The model involves using the Earth's resources to manufacture products, using them temporarily and ultimately disposing of them. Fortunately, with the help of technology, we now have the knowledge and tools to create an economy that is aligned with the demands of the 21st century.

The Ellen MacArthur Foundation identifies three fundamental principles of circular economy, by design, namely designing waste and pollution out of the system, keeping products and materials in use, and regenerating natural systems. These principles offer several benefits, including a projected 48% reduction in carbon dioxide emissions by 2030, a €3,000 increase in disposable income per year for households in the European Union, and savings of CNY70 billion for Chinese companies and households. In addition, Chinese cities expect a 47% reduction in traffic congestion by 2040, along with annual savings of $700 million in material costs in the fast-growing consumer goods sector.

The circular economy is based on three fundamental principles. First, the preservation and enhancement of the environment. When additional resources are needed, reuse cycles should be designed and technologies using renewable resources should be adopted. Secondly, optimizing resource efficiency which involves maximizing the use of materials, designing products for reconstruction, renovation and recycling, and thus maintaining the circulation of materials.

Thirdly, the negative externalities which must be eliminated through effective design systems. This minimizes damage to key human sectors such as food, mobility, housing, education and health, while promoting the use of renewable energy sources.

Given the numerous unsustainable practices exhibited by companies, the circular economy seeks to address the issues of environmental costs. Each production system must address its inefficiencies to minimize

 its environmental damage, known as 'negative externalities'. These externalities come from decisions related to consumption, production, input exchange, inputs, factors of production and investment. By reducing negative externalities, family businesses can mitigate their environmental impacts and maintain their long-term objectives.

4.1.1 Circular Economy and Fashion

The fashion industry has a profound impact on the environment, with global consequences. In light of this, consumers and fashion stakeholders need to assess the current situation according to the principles of circular economy and sustainability. By encouraging the development of sustainable products, such as those incorporating cleaner technologies and recyclable materials, the circular economy can serve as a guideline for the fashion industry.

To embrace circularity, the fashion industry needs to revisit its approaches to design, material selection, dyeing, cutting, sewing, shipping, selling, owning, using and disposing of fashion. This transformation can be made possible through the adoption of new technologies, business models and materials. Shifting to a circular model allows the fashion industry to produce clothing for a growing global population while operating within the confines of our planet, thus ensuring a sustainable long-term business. The adoption of circular fashion also offers additional benefits to the industry, such as reduced material costs, access to new markets, improved customer relationships and reduced risks of resource depletion.

This model highlights the importance of decision-makers within family businesses actively seeking to reduce these externalities. Moving from a linear model to a circular economy facilitates the mitigation of adverse impacts.

The circular economy presents an alternative to the linear economy by prolonging the use of resources, maximizing their lifetime value and recovering and regenerating

materials and products at the end of their life cycle. In addition, the circular economy is based on renewable energy sources such as solar, wind and hydroelectricity.

4.2 Circular business models

Circular business models can be categorized in various ways.

The most well-known categorization according to Fontell and Heikkila (2017) is the list of basic CBM presented by Accenture (2014):

-Circular procurement through environmentally friendly production and organic or recycled material inputs.

-Recovery of resources and energy from available products or by-products.

-Extending product life by repairing, reusing parts and reselling.

-Sharing platforms that allow an increased rate of product utilization (consumer to consumer).

-Product as a service or B2B/ B2C lease where the retailer retains ownership.

In the fashion industry today, we encounter **six main circular business models.**

These are

-**Of rent** where it is related to peer-to-peer rentals, subscription models. In the rental model, customers rent clothes for a set period of time instead of buying them outright. After the end of the lease, the object is returned by the customer to each company. Thanks to this model, waste is reduced and the lifespan of each type of clothing is extended and the need for consumers to buy new items is reduced. Digitization has greatly affected the rental model. The appearance of online platforms and the rise of technology offered consumers the possibility to rent clothes and accessories without having to visit a physical store. Through these platforms' companies have the ability to collect data on consumer preferences, sizes and styles for a more personalized proposition and improve the customer experience. The use of digital technology has made it possible to test flows through virtual rooms.

-**Resale,** involving the peer-to-peer sale of second-hand clothing and footwear either online or offline and third-party resale purchases. In this model, companies buy or

accept used clothing or footwear products and resell them in physical or online stores. Thus, their lifespan is extended and waste is reduced. In this model, digitization also played a very important role. Online platforms for buying and selling used clothes, such as ThredUp, Poshmark and Depop, are becoming increasingly popular. These platforms use algorithms and machine learning to personalize recommendations and improve search results. They also give sellers data and insights about their products so they can make informed decisions about pricing, inventory management and marketing.

-**Of repair,** where it is the process by which a defective or damaged product can be used again. The repair model aims to extend the life of products as much as possible through repair and maintenance, minimize waste and radically redefine the relationship between consumer and fashion. The repair of clothing and footwear reduces waste but also brings to the fore the need for quality and durable, time-resistant products. The COVID-19 pandemic played a particular role in feeding this trend as people found more time to repair items in their closets. In 2023, people may increasingly seek to breathe new life into existing items in their wardrobe, recognizing the value and sustainability of garments with a history.

-**Up cycling**, where a product is created from already existing products or parts. Companies take old or discarded clothes and turn them into new ones, thus creating new products of higher value. This may include cutting fabrics or accessories and placing them on new products. This is how waste is reduced and old objects are given life. The use of digital technology has enabled this model to become more efficient and scalable. Using 3D scanning and printing, fashion brands can create digital versions of garments that can be customized and altered to create new designs. Block chain technology has also allowed the up-cycling model to become more transparent and traceable. Through the use of block chain, the entire supply chain of a product can be tracked, from the origin of raw materials to the finished product. This ensures that products are produced sustainably and ethically.

-**Closed loop model,** clothing and footwear products from their design, sale to use and use are created with the aim of being recycled or reused. The products here are created through a closed-loop system, where the product can be recycled or reused at the end of its life. It includes using sustainable materials and designing products in a way that

makes them easy to disassemble and recycle. For example, Patagonia's Worn Wear program allows customers to send in used Patagonia products for repair, reuse or recycling. Digitization has also played an important role here. By using RFID (Radio frequency identification) technology, fashion brands are able to track products throughout the supply chain, from production to disposal. This helps them better manage their inventory, reduce waste and ensure that products are made sustainably and ethically. Furthermore, 3D printing has also enabled fashion companies to create products to order, reducing waste and   the need for overproduction. XYZ bags for example is a bag company that uses 3D to design bags. It enables customers to buy customized products using the make to order technique. Once the order is submitted, the final product is manufactured. Although there is a longer wait for the product, this method is more environmentally friendly compared to buying from store shelves.3D printing methods do not waste resources or energy.

-**Made-to-order model,** first order and then product creation. In the make-to-order model, companies produce items only after they have been ordered by customers, rather than producing products in bulk and hoping they will sell. This reduces waste by minimizing overproduction and allows for greater customization and personalization. For example, some companies like Shoes of Prey offer custom shoes. In the shoes of pray women can create their own shoes with the global, multi-channel retail brand Shoes of Prey. Jodie Fox, Mike Knapp and Michael Fox (all former Google employees) came up with the idea for Shoes of Prey in 2009 after realizing they couldn't locate what they were looking for so they created a platform where customers create the shoes they want. Digitization has made the made-to-order model more accessible. Online platforms allow customers to design and order custom clothing and shoes, while also using digital tools to optimize the production process and minimize waste. 3D printing technology has also made it possible to create products to order, reducing the need for large-scale production and overstocking.

When we talk about a circular business model, it means that products are not produced and become waste and their raw materials are released for use. Most fast fashion companies operate on a ``take-make-dispose' pattern. This fashion allows consumers to buy clothing, footwear and accessories at low prices. These companies aim to maintain the production price as much as possible. The quality of these products is questionable

and the working conditions of their creators in human. The above procedure results in the clothes not being valuable to anyone other than the retailer.

The good news is that in recent years we see a shift by companies toward sustainability and a more circular system or a shift in the use of closed-loop fabrics such as viscose or tencel and by consumers to more sustainable brands. The fast fashion companies that made fashion so accessible to consumers must now use their power to turn the tide. The sustainability and circulation of their products must become attractive or even better. Large companies in the fast fashion space such as HM have entered the "cycle" and are incorporating business models of circularity into the culture.(*Rethinking Business Models for a Thriving Fashion Industry*, n.d.)

Another option for Circular business models according to the Ellen MacArthur Foundation are models of

-More use if used

This model's design should allow the user to wear a product for more and longer time and clothes should last longer. Creating products that are both physically and psychologically durable, offering services that encourage long-term use and providing customers with the tools to use their products longer and for longer H&M Group offers a customization service and publishes advice and recommendations. M.IN. T Care, an H&M Group project offering repair, mending and washing services, was also presented. The platform also offers "do it yourself" tips, encouraging users to extend the life of clothes with useful reworking and repair methods.

-More users per product

They are designed in such a way as to facilitate the movement of the products from user to user, so that the products can used more. A company that implements this is Ganni, which has a rental platform called Ganni Repeat.

-Beyond physical products

Business models here have to do with alternatives such as digital clothing or services that replace, reinforce and complement customers' fashion needs and aspirations, according to the ellenmacarthour foundation. They have the potential to increase environmental opportunities in circular business models. According to the Ellen MacArthur(2021), the production of a digital product versus a physical product

eliminates material waste, reduces gas emissions by 97% and reduces water use by 3300 liters. It also contributes to the reduction of clothing transports, resulting in savings.

DressX is an example of such a company where it provides users with digital clothes that they can buy and wear directly digitally. It works like this by taking a photo of the purchased garment that can be worn an infinite number of times. It is a solution for creating content on through social networking without the need for someone to have the physical product.

And The Fabricant is also such a platform that works with Napapijri and Tommy Hilfiger to digitize their campaigns so the two companies don't need to create clothes for their campaigns. (https://www.thefabricant.com/)

The combination of business models of these categories could create great possibilities. The combination of resale, which falls into the category of more users if a product, and repair, whenever the category of more use if used, would help users to maintain a used product for longer period of time. The combination of this model with a digital one, (category beyond physical products) could help the future buyer to test the product before buying it so as to ensure its use by the buyer. (Ellen Macarthur Foundation,2021)

4.3 Butterfly diagram

The circular economy can be illustrated with a diagram (Figure 9), which is called a butterfly diagram. This diagram shows the continuous flow of materials in a circular economy. The diagram includes 2 cycles, the technical cycle and the biological cycle.

In the technical cycle, materials are in circulation through reuse, repair, reconstruction, and recycling. Here the products are used and not consumed. In the technical cycle diagram, the smaller inner loops are surrounded by the larger inner loops.
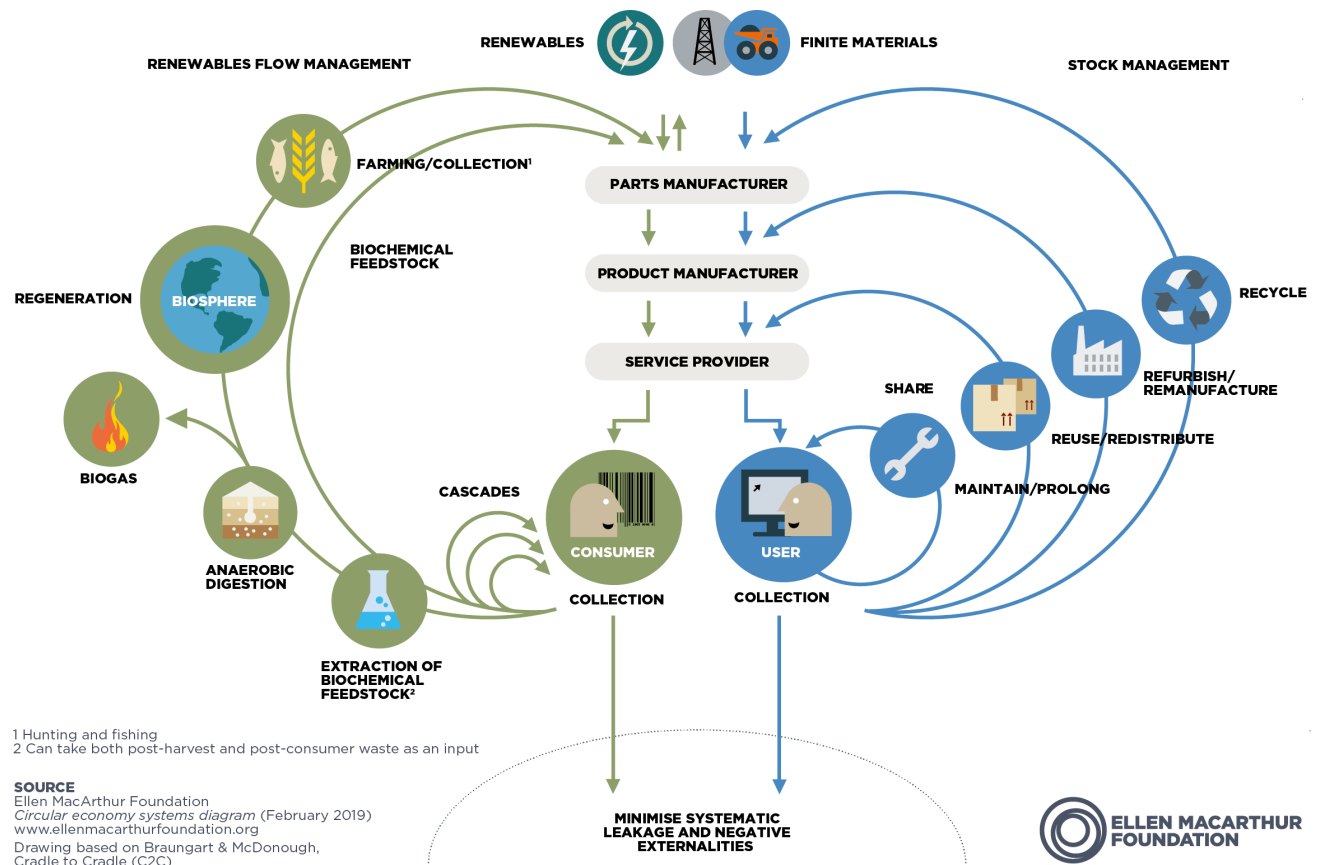
Figure (9) Butterfly diagram of circular economy

Source: https://ellenmacarthurfoundation.org/circular-economy-diagram

Sharing

Sharing is the first inner door to the technical cycle, but it is not suitable for all products in the economy. It can dramatically increase the usage of many products. An example of this is tools like the average electric drill which is used for only 13 minutes in its lifetime. This is terribly underutilized but many still have one. Why not share it. In Toronto there are community tool libraries, where users pay a subscription and gain access to higher quality tools than they would buy for themselves, while also de-cluttering their home. Sharing can be applied to different types of products. Another example is that many platforms around the world allow users to wear clothes from shared closets. Other examples are car sharing systems in cities around the world,

platforms like Airbnb that allow people to share spaces. Insurance companies solve the problem of potential loss concern by providing micro-insurance for those who want to earn extra money by listing their products on peer-to-peer platforms.

Maintaining

Another way to maximize the value of a product is to extend its useful life. Maintenance helps keep products in high quality and prevent them from failing or falling.

Reusing

The next loop in the technical cycle of the butterfly diagram is reuse. It keeps the products in use in their original form and for their original purpose. Reuse occurs throughout the economy, especially in packaging. Reusable packaging is one of the most effective ways to deal with packaging waste. The clothing industry has also gotten into the reuse game. Many people sell clothes they no longer need.

Redistribution

Redistribution is the way to keep products in use and stop them from becoming waste. For example, a fashion brand could redistribute unsold clothing from one of its stores to another.

Renovation

Returning a product to good working order is a way to regain value. It can include repairing or replacing parts, updating specifications and improving the cosmetic appearance. Refurbishing can be done by individuals on their own products or by professionals.

Reconstruction

In the next stage of the technical cycle, the products are remanufactured. This is because they cannot be circulated in their current state and requires more intensive work to be used again. It involves redesigning products and components to a new condition with the same or improved level of performance as a newly manufactured one.

Recycling

The last door of the technical cycle is recycling. When a product cannot be renovated or reconstructed, it cannot be used. Here we have the preservation of the product's materials so that they do not become waste and their transformation into new materials.

In the biological cycle, through biodegradable material, nutrients return to the earth to regenerate nature. Regarding products that are consumed. Many biodegradable materials come from the technical cycle such as cotton or wood when they reach a point where they can no longer be used.

Renaissance

The regeneration helped to not continuously degrade nature, as is done in the linear economy, in the circular economy natural capital is created. Agricultural practices are used that enable nature to regenerate its soil and increase biodiversity. Organic food materials are returned to the soil.

Cultivation

Good management of farms, forests and fish farms and other sources of biological resources can have positive effects on nature. Such as healthy and stable soils improved local biodiversity, improved air and water quality and more carbon storage in the soil. Methods of achieving the above can be regenerative agriculture, restorative aquaculture, agro ecology, agro forestry and conservation agriculture. After consumption food can be harvested and nutrients from organic waste streams can be returned to the soil through processes such as composting and anaerobic digestion.

Composting and anaerobic digestion

Composting is the microbial breakdown of organic matter in the presence of oxygen. It is used to convert food by-products and other biodegradable materials into compost, which can be used as a soil conditioner, returning valuable materials to farmland instead of artificial fertilizers. The process is biological and involves natural microorganisms such as bacteria and fungi. Anaerobic digestion is another way of recovering the materials incorporated in organic waste. The process involves microorganisms, but unlike composting, it is done in the absence of oxygen. Anaerobic digestion produces biogas and a solid residue or 'digested residue'. This digested residue can be applied directly to the land or composted and used as a soil conditioner.

Waterfalls

Loops of the biological cycle where products and materials that are already in the economy are used. Such as using food by-products to make other materials, such as

fabrics from orange peels, or designing new food products using ingredients that are usually considered waste, such as ketchup from banana peels.

Extraction of biochemical raw material

Biological materials are the raw material both after harvest and after consumption; here we have the use of biorefineries for the production of low volume but high value chemical products. Biorefineries can produce a number of other valuable products from organic materials through a series of steps such as high value biochemicals and nutrients, followed by bulk biochemicals.

5. Evolution of digital fashion

In 2020, the transition from physical to digital mentality is starting to become more intense for both consumers and companies. A big change in consumer behavior is observed. According to the article of Rubin (2021) in the Keisei magazine the fashion industry in Europe produces 20% of the world's wastewater and 85% of textile products (21 billion tons) are buried in the soil. This overconsumption has prompted social media to examine the ethics and morals of society and call for change that is more necessary than ever. Many companies have already started to focus on sustainability since the previous years but now the need is more urgent than ever. Technology and innovation are coming to give transparency and traceability to products. Fashion Revolution is one such brand. The buyer of a product can instead scan the QR that exists on the label of the garment with his mobile phone and see information about the care of the garment so as to increase the longevity of the garment and see information of the supply chain. According to the company R-Collective, there cannot be a sustainable fashion industry and work to improve it, unless we can trace and monitor the supply chain.

Fabrics are evolving, the textile industry is undergoing tremendous development. A start up based in California, Bolt Threads, uses the weaving method to convert industrial silk proteins into fibers. Another company that innovates in the textile industry is Ananas Ana. Ananas Ana produces leather fabric from pineapple leaves. It was used by Puma as a vegan shoe label and thus showing the company's turn to sustainability. Even in the design part, 3D printing comes to provide a solution to sustainable

construction, as we have no fabric waste at all. Adidas in 2018 collaborated with a 3D printing start-up CARBON to create 3D printed midsoles called Future Carft 4D.

Digital collections and virtual accessories

The ever-increasing need to reduce or eliminate textile waste has led several luxury brands to create digital clothes instead of physical ones. According to the Keisei magazine "Gucci in 2019 launched the ACE sneaker line in 2019 where customers can try ACE sneaker in an augmented reality AR application". Another company that pioneered Taylor Stitch where customers could digitally pre-order clothes before they were produced.

Instagram promoted sustainable production. Digital clothing helps create content for social networking platforms.

The COVID 19 pandemic has turned supply chains upside down. The sad truth behind the ethics of the branded companies came to the surface and revealed many aspects of the exploitation of the workers. The reforms had already begun. The sustainability movement gained more followers who wanted ethics and change. The issues that concerned the movement were climate change, class differences, clothing production, etc. Social media was the connection of all of them.

Many companies during lockdown have developed a direct dialogue with the consumer via the internet. This allowed companies to expand and better understand consumer needs. Many companies during lockdown have developed a direct dialogue with the consumer via the internet. This allowed companies to expand and better understand consumer needs. Their digital strategies revolved around video campaigns and live streams. The competition is getting even bigger.

During the pandemic, many fashions week events have been canceled, postponed or held virtually. The digital future of fashion has just begun. London fashion week, after Paris and Milan, took place digitally. Digital technology will help sustainable trends accelerate and companies adopt a digital business plan that aims to **bring change** and **do more with less.** (*About Us | Sustainable Brand | the R Collective*, n.d.)

6. Circular fashion models based on digitization

Digital technology is coming to change data today to create new and more flexible business models linked to sustainability and real-time information flow. One of the main innovations introduced by digitization has been less dependence of business

activities on physical assets. In fact, emerging business models are increasingly based on digital infrastructures (Warner and Wager, 2019) and new forms of business are developing as digital platforms that serve as a hub between buyers and sellers in the exchange of goods and services. Products are becoming smarter and are reframing the corporate fashion ecosystem and creating cyber-physical systems with sensors on a case-by-case basis and enhanced data analysis. Efforts are being made to apply newer design tools with improved digitization, more environmentally friendly textile designs so that the fashion industry turns to new more sustainable business models. The transformation strategies of the circular economy are based on strategies based on the flow of materials, services and the use of resources based on efficiency. There are three basic circular economy models that are based on digital technology:

-the circular supply chain model based in block chain

-the product as a service model and

-the circular pull demand- model.

The specific digital models provide a very promising solution to the sustainability challenges faced by the fashion industry. The three models will be analyzed below.

6.1 The circular supply chain model based in blockchain

This model is based on providing information to track and trace trading activities of clothing products. Here in the Blockchain transaction activities are recorded during the value chain process. Providing product sustainability metrics to consumers such as (eg garment components, carbon emissions, production process, logistics) and also helping the Internet of Things by connecting objects and enabling blockchain activities. Increasing the possibilities of reuse, repair and recycling is done with a circular economy QR code that is scanned and provides transaction data. What is intended here is the creation of a Closed Loop System where there is continuous circulation of resources and minimization of waste. In a closed loop system, companies have the possibility to manage the entire life cycle of their products from the procurement of raw materials to the disposal or recycling of the final product.

Blockchain technology enables transparency and traceability in the fashion supply chain. This is done by creating a tamper-proof record of every transaction in the supply chain. The blockchain system concerns the creation of a common database where

information is stored for each stage of the supply chain from raw materials to final products. This database is common and accessible to all interested parties such as producers, suppliers and gives the possibility to them of tracking the product's route. Blockchain, spreading throughout the supply chain, enables customers to obtain information related to the origin of the product and the journey it has taken through the help of an embedded chip. This helps them with the necessary information needed to reject counterfeit products or those from dubious ethical production units. It also allows them to know if the product is authentic. The creation of smart contracts of blockchain technology another very important piece of technology smart contracts are computer programs or protocols for automated transactions stored in a block chain and executed in response to certain conditions, they give the possibility to automate the supply chain process from the supply of raw materials until the delivery of the final products. In this way, the need for intermediaries is reduced and the risk of failures and delays is eliminated. The blockchain-based circular supply chain model enables the creation of circular business models where products are designed to be reused, repaired and recycled.

A major challenge faced in the application of blockchain technology is the cost of this technology. Blockchain technology needs a fairly large investment in hardware, software and personnel. Thus, small and medium-sized businesses in the fashion industry may not have the necessary resources to support blockchain technology.

Another important part of this circular model is the cooperation between the stakeholders in the supply chain. The blockchain-based supply chain requires collaboration and coordination between producers, suppliers, manufacturers, retailers and consumers. This coordination and cooperation are a difficult undertaking because each interested party has different priorities and interests.

But despite the challenges, the specific circular model seems to have significant opportunities in the fashion industry. It enhances transparency and traceability, promotes sustainable and ethical practices, reduces waste and increases efficiency. It is a very promising model for transforming the fashion industry into a more sustainable and ethical industry.

The circular blockchain-based Supply Chain model presents significant opportunities for the fashion industry. By enhancing transparency and traceability, the model can

promote ethical and sustainable practices, which can lead to increased consumer trust and loyalty. In addition, the model can help reduce waste and increase resource efficiency, which can lead to cost savings for businesses.

The block chain-based supply chain model presents a noticeable difference compared to the traditional supply chain model in the transparency and security provided by block chain technology. In the traditional logistics model, each participant in the process maintains its own transaction records in relation to other participants, these records may contain errors and inaccuracies that lead to ineffective monitoring of the circulation of goods. On the contrary, now the model based on blockchain technology uses a decentralized and secure digital ledger to record and verify transactions between participants. Thus, each transaction is recorded as a block of data that comes to be added to a chain of previous blocks, offering an immutable and transparent file that concerns the entire process of the supply chain. (Bhardwaj, 2021)

6.2 The model based in service

This model is based on extending the life cycle of clothes and increasing their use, on the creation of a digital platform hosting functional activities and services, on the offer to consumers of clothing rental, repair, used clothing for more economical, sustainable solutions and on the Internet of Things with connecting objects and enabling service activities Block chain by improving the clothes sorting process.

It is an emerging business model that has been gaining ground in the fashion industry in recent years. The platforms offer subscription-based models that allow customers to access a variety of products for a set monthly fee. This model allows customers to continually update their wardrobes without the financial commitment of purchasing individual items. Companies instead of selling products provide services, they switch from selling physical products to providing services. Here the customers do not buy the same product as a product but for the use and the experience. The goal of this model is to create a more sustainable and circular fashion industry by reducing waste, increasing product life and providing consumers with a more personalized and flexible experience.

Increasing the product life cycle plays a primary role here. The model allows for flexibility in product use and ownership. Customers can use product services for a certain period of time, allowing them to access the product without having to purchase

and own it. This can lead to a more cost-effective and convenient experience for consumers and a more sustainable solution. Also, the sale of services and products instead of the sale of the products themselves reduces the financial risk of businesses.

The success of this model also lies in the huge development of online platforms. The infrastructures of these platforms allow the provision of service in a more efficient manner. Through online platforms, service providers can connect with customers, collect data and optimize their services to meet customer needs. They enable customers to rent clothes for a specific occasion, wear them and return them, instead of buying them outright. This reduces the amount of clothing waste generated by fast fashion and enables customers to enjoy designer clothing without the high cost.

However, there are challenges associated with the service-based model on online platforms. One of the biggest challenges is maintaining quality control of the products offered. Since these platforms rely on third-party vendors to provide products, it can be difficult to ensure that each item meets the platform's quality standards. Another challenge is managing the logistics of the platform. With so many different products and sellers, it can be difficult to ensure that products are delivered on time and in good condition. This can lead to disappointed customers and damage the platform's reputation.

Another success factor of this model is the development of the Internet of Things. The Internet of Things (IoT) is a technology that connects devices and allows them to exchange data with each other by creating a network of connected devices. In the fashion industry, IoT can be integrated into the service-based model to enhance the customer experience and improve operational efficiency. One application of IoT to the service-based model is smart clothing. Smart clothes are items of clothing that are connected to electronic devices, sensors and software. Their smart clothes collect data and provide various functions. For example, smart clothing can monitor the wearer's physical activity, monitor vital signs and provide real-time feedback on performance. In the supply chain, the Internet of Things can monitor the movement of products in real time and monitor various parameters such as temperature, humidity and pressure. This enables companies to ensure that products are delivered in optimal conditions and reduce waste due to spoilage or damage.

The Internet of Things also presents challenges. One of the major challenges is ensuring the security and privacy of customer data. As more data is collected and stored, there is an increased risk of data breaches and cyber-attacks. Fashion companies must invest in strong cybersecurity measures and comply with data privacy regulations to ensure the safety of their customers' information.

Another challenge is the complexity of implementing IoT technology in the supply chain. Many fashion companies still rely on traditional supply chain practices and may not have the resources or expertise to seamlessly integrate IoT. In addition, IoT devices and sensors require energy to operate, and the additional energy demand can contribute to environmental concerns.

Overall, the service-based model has the potential to revolutionize the fashion industry by creating a more sustainable and efficient way to deliver fashion products to customers. With the right technology and business strategies in place, companies can overcome the challenges and reap the benefits of this innovative model.

6.3 The pull-demand model

In this model we have the transition from mass production based on six-nine-month market forecasts to real-time demand-driven production to reduce overproduction, 3D design with virtual drawings and prototypes that can be modified in the online system, simplifying physical designs with 3D virtual designs to reduce false samples and reduce product development time. The avatar-based 3D model by measuring and modifying designs according to consumer avatars, providing personalized solutions to consumers to customize clothing designs with higher quality and better fitness to reduce excess demand, the digital platform with communication and interaction between end users and designers and business partners, 3D printing ME production of clothing directly based on 3D virtual designs and automation of production to reduce labor costs and increase more precise manufacturing of clothing and the use of AI and automation for automated production without human participation.

The attraction model in fashion is quite an innovative approach and provides solutions to reduce waste and increase sustainability. In this model, production is based on actual customer demand rather than forecasted demand. Using advanced technologies such as

3D printing, fashion brands can create custom-made products more efficiently and sustainably.

Using 3D printing in the pull demand model allows for more flexible and efficient manufacturing processes. With 3D printing, it is possible to create prototypes and produce small quantities of products quickly and economically. This technology also enables greater customization and personalization of products, which is increasingly important to consumers.

Artificial intelligence can also play a critical role in the pull demand model. By analyzing customer data and behavior, AI can help fashion brands better understand their customers' preferences and anticipate their needs. This can lead to more accurate demand forecasting and more efficient use of resources.

In addition, artificial intelligence can help optimize the production process by analyzing production data and identifying areas for improvement. This can lead to a more sustainable and efficient supply chain, improved quality control and faster market time.

While the pull demand model offers many advantages, it also comes with its own challenges. One of the main challenges is the ability to accurately forecast demand. This can be especially difficult in the fast-paced fashion industry, where trends and consumer preferences can change quickly.

Another challenge is how the supply chain can be managed to meet demand in a timely and efficient manner. This requires coordination and cooperation between different stakeholders in the supply chain, including manufacturers, suppliers and retailers.

In addition, implementing a pull demand model may require significant changes to the traditional supply chain model, which can be costly and time-consuming. Companies may need to invest in new technologies, such as real-time inventory management systems and agile manufacturing processes, in order to effectively implement this model.

Ultimately, the pull demand model has the potential to revolutionize the fashion industry by reducing waste, increasing efficiency and improving customer satisfaction. As technology continues to advance, there may be new opportunities to overcome these challenges and further optimize this model.

In the following chapters we will see how these models work in well-known fashion retail companies and a comparison will be made of how it works in each business and what differences and similarities they present between them.

7.H&M (Hennes & Mauritz)

H&M was founded in 1947 in Vasteras, Sweden by Erling Persson. In 1952 the first store was opened in Stockholm. It started its operation as a shop selling women's clothing under the name of Hennes. In 1968 it added Mauritz Widforss, a shop selling hunting and fishing equipment, to its portfolio and added men's and children's clothing to its collection. The company was renamed Hennes & Mauritz (H&M). In 1969 the company had 42 stores in Norway, Denmark, the United Kingdom and Switzerland. In 1974 it entered the Stockholm stock exchange. In 1980 it began to expand worldwide and opened its first stores in Germany and the Netherlands. In 1998 it starts to offer online markets, the first online market being Sweden. It also opens the first H&M store in Paris. In 2000, it expands across the Atlantic by opening a store on New York's Fifth Avenue. In 2002 publishes its first Corporate Social Responsibility Report, starting the journey towards sustainability. 2004 The company launches designer collaborations with Karl Lagerfeld. In 2007 opens its first Asian stores in Shanghai and Hong Kong. In 2010 the company launches its first collection of sustainable materials. In 2013, the non-profit H&M foundation is established by the company and the clothing collection program is launched where thousands of tons of old fabrics are collected for reuse and recycling. In 2015 the company launches the Global Change Award. The GCA is a challenge designed to encourage innovations that can accelerate the transition from a linear to a circular fashion industry. In 2019, it becomes the first major fashion brand to provide detailed product-level information on materials and supply chain. In 2021 introduces two new business ventures Singular Society and Creator Studio. H&M Innovation Stories is launched and includes a series of themed collections dedicated to promoting more sustainable materials, technologies and production processes. The project goes hand-in-hand with H&M's fashion rental service, launched in 2019. In 2022, climate targets and annual sustainability reports are incorporated into the company's goals. HM has under its wing 8 brands H&M, H&M Home, H&M Move, COS, Weekday, & Other Stories, ARKET and Monki.

7.1 H&M's sustainability Commitments

-All their products to be made from recyclable or sustainable materials by 2030

-By 2025, all packaging they use and plastic will be reusable, recyclable or compostable.

-Reduction of greenhouse gas emissions by 56 percent by 2030, compared to the 2019 baseline, with a long-term goal of reaching zero emissions by 2040.

7.2 The business model

H&M follows a customer-centric approach. The company's aim is for its brands and business ventures to empower people around the world to express themselves through sustainable fashion and design. The company makes extensive use of two of the three digital models of the service-based model and the pull demand model.

The initial concept of the company starts from creating what the customers want and what that will start based on design. So here we see a broad application of the pull-demand model. Designers take action based on predictions and analyses of customer preference trends. To achieve this they make use of tools such as three-dimensional design, virtual showrooms, etc. By using these tools, the need to manufacture and ship physical samples is reduced and thus time and resources are saved, thus reducing the environmental impact. The use of artificial intelligence by designers gives the possibility of predicting how many products to produce, where to sell and when. The company aims to align supply and customer demand. This venture offers the potential for a more cyclical economy and a reduction in its environmental impact. Circular business practices are finding a foothold throughout the value chain of the company.

Wanting to ensure its further development, HM turns to the idea that its products are used more and for a longer period of time and that their materials are eventually recovered. For the protection of the owner, there is no other solution than the introduction of circular business models in the group in order to reduce their impact on the environment. The circular business models will also help them in the future in relation to the environmental obligations set by the European Union. The sequence of a linear business model is getting, make, waste according to HM. Circular business

models are coming to change this habit. Repair, resale, reconstruction and recycling are words and actions that are embraced more as a group. They have set a goal of reducing their carbon footprint and doubling their revenue from circular business models-clothing can generate income beyond a one-time sale or resale. HM is launching several circular business models with the aim of learning what works best and better responding to the needs of its customers. HM's CBMs fall into three broad categories. Access, use, care and collection.

Their circular ecosystem consists of three elements which, when combined, allow them to reach net zero and have a net beneficial effect on biodiversity.

Circular products

Manufacturing durable objects that can be reused many times over, using materials that are safe, recycled, regenerated or otherwise provided in a more sustainable way.

Circular supply chains

Manufacturing scalable systems using low-impact production techniques such as printing, finishing and painting that circulate goods and materials for repair, reuse and recycling.

Circular costumer journeys

Providing convenient solutions for customers to join a circular economy where things are used more before being repaired, reused and recycled.

The figure below shows how all three elements are combined

Figure (10) Circular fashion ecosystem

Source: https://hmgroup.com/wp-content/uploads/2023/03/HM-Group-Sustainability-Disclosure-2022.pdf

Through **access**, HM tries to keep the products in circulation as long as possible.

7.2.1 Circular Products

Design

The design influences every phase of production. The materials chosen in processing determine the recycling and durability capabilities of the product. The design is based on circularity. The company aims to have all its products designed for cyclicality by 2025. They have created a tool to help them design better. Circular design, which focuses on creating clothes that are made to be recycled, will be supported by **The Circulator** which will promote use, care and recycling. Any brand, designer or product group can use, benefit and progress from this tool.

How it works

First, one has to envision the product and think about the target market and the product that one wants to manufacture. Second, one has to define the purpose category of the product. If one has a specific object in mind, it is time to determine its purpose. Will it be available for rent or purchase? A cocktail dress or a simple t-shirt? The tool categorizes the item into one of three product purpose categories - light, medium or extended - based on data about how, for how long and how often it will be used. Because it will influence future decisions about materials and design approaches, this classification is important. Third, it selects the components of the product all hidden in the details. The program evaluates each component of the product, including the fabric, lining and buttons, and assigns each component a score based on durability, recyclability and environmental impact. Depending on the purpose category of the product, the tool also ranks the components accordingly; fourth, the design tactics are determined. The product must be categorized, the components selected and then the design techniques chosen. For example, one may want to design a product for increased consumption, waste reduction or physical durability. This tool contains six design strategies and many of them can be combined to create a product. Finally, the circular product score is available. the tool identifies the product's Circular Graph once all design decisions have been completed. Circulator provides internal teams, as well as other business and design teams, with the tools they need to plan for circularity and

make the transition to a circular business model. A real impact will result from changing the way goods are designed. The score based on how durable, recyclable, and environmentally friendly it is.

The aim of HM's brands and business ventures is to allow people from around the world to express themselves through sustainable fashion and design. All brands under the HM umbrella emphasize design and buying processes by closely following fashion trends and creating inspiring and relevant collections. Leveraging their extensive experience, customer-centric approach and creativity, they strive to deliver value beyond the price customers pay.

The team of in-house designers, each with different backgrounds and skills, collaborate to develop collections based on trend forecasts and analysis of customer preferences. The pull demand driven model in combination with the other cyclical models is evident throughout the supply chain of the business.

The company makes use of technologies such as 3D design and virtual showrooms, thus reducing the need for physical samples, saving time and resources and minimizing environmental impact. Through artificial intelligence (AI), production quantities, sales channels and timing are further optimized. They also developed more artificial intelligence models to program supply and demand before each session. Through the Assortment Quantification initiative, they introduced a machine learning model that predicts the return rate of online orders based on an article and replaced the traditional logic of predicting returns by department. The company has introduced its own **AI tool, Movebox**, which makes it easier to redistribute products to locations where there is greater demand.

Customers are playing a role in the design piece and the company is implementing a pilot program from which it is collecting timely feedback from customers on the design and automation of purchases for long-life products. This alignment of supply with customer demand benefits not only their customers but also benefits the business and the environment. They are also testing bespoke business models. The Monki brand a digital print-on-demand shop and the production by H&M of the first customizable jacket on demand. All of this supports the transition to a more circular business model across the value chain, including product design, development, production and use, reuse and recycling by the customer. By harnessing artificial intelligence, 3D tools and

customer feedback, they have the potential to combine supply and demand to reduce waste and improve inventory productivity.

Design plays a key role in creating products that offer maximum value to customers. The aim in the design process is to select materials and processes with reduced negative impacts, promoting the longevity of the product through multiple users before it is reintroduced into the supply chain for recycling into new fibres. The design influences every phase of production, from material selection to processing, and determines the potential for recycling and durability. It is therefore vital to optimize resource use and facilitate circular business models that support progress towards in climate and nature goals. Tools and methods are being tested and developed to achieve this. One of these is the Circulator, which guides commercial product teams and is supported by the Ellen MacArthur Foundation (EMF).

In addition to the Circulator, designers adhere to standards of material and quality categorization. The choice of materials is very important as it can have an impact on various aspects such as climate, nature and people. All products are subjected to rigorous washing tests and factors such as colour fastness, tear resistance, tensile strength, abrasion and seam slip are evaluated. It is of great importance to select, create and innovate materials that have the least negative impact. This includes reducing overall resource use and striving for materials with a lower environmental footprint. Priority is given to closed-loop recycled post-consumer materials that have the potential to be reused and recycled again, to regenerative materials where basic virgin raw materials are produced through regenerative agricultural practices and contribute to improving soil health and enhancing livelihoods and ecosystems.

-The Circulator Academy was also developed, which is an internal training programme that introduces circular economy principles and provides guidance on circular design.

-Through the Seam application, data is collected on the use of clothes by customers. The application can also inform the categorization of the purpose of products.
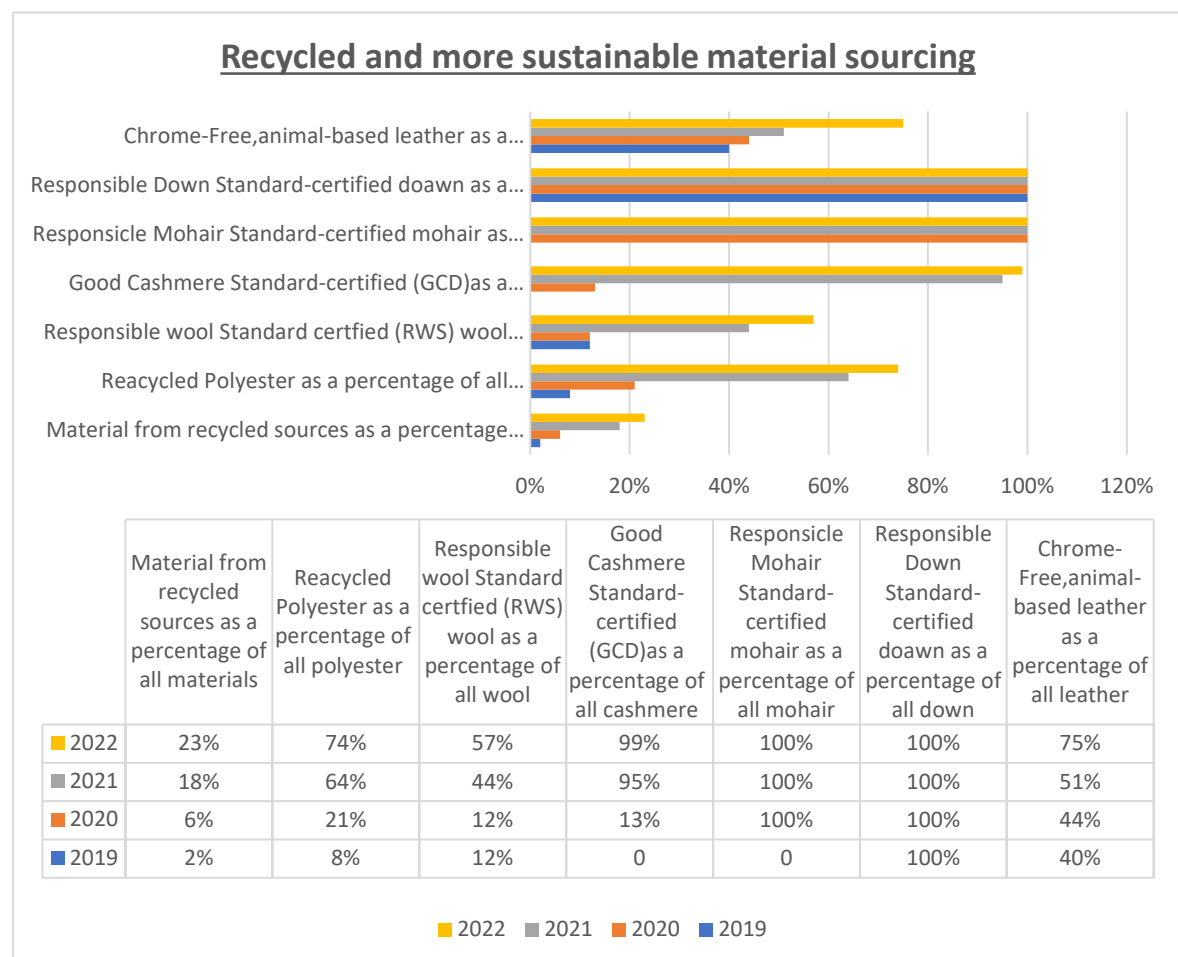
-Development of an internal tool to assess the circular potential of different fabrics during early-stage product development.

-Introduction of quality scorecards and product quality control charts to monitor and improve quality aspects of collections.

In addition, efforts on circular design aim to reduce environmental impacts and create a more circular business through accurate planning, data-driven decision making and demand-driven approaches.

Material Choice

The fashion industry is highly dependent on materials, which is why the selection, demand creation and innovation of materials with a lower negative impact are critical aspects of the strategy. H&M's objective is to reduce the overall use of resources and decouple them from the development of the business. All material choices, whether they are natural fibres such as wool and cotton or synthetic materials such as polyester or polyamide, have an impact on the climate, nature and people. Their targets are to have 100% of materials either recycled or from more sustainable materials by 2030 and

Recycled and more sustainable material sourcing

	Material from recycled sources as a percentage of all materials	Reacycled Polyester as a percentage of all polyester	Responsible wool Standard certfied (RWS) wool as a percentage of all wool	Good Cashmere Standard-certified (GCD)as a percentage of all cashmere	Responsicle Mohair Standard-certified mohair as a percentage of all mohair	Responsible Down Standard-certified doawn as a percentage of all down	Chrome-Free,animal-based leather as a percentage of all leather
2022	23%	74%	57%	99%	100%	100%	75%
2021	18%	64%	44%	95%	100%	100%	51%
2020	6%	21%	12%	13%	100%	100%	44%
2019	2%	8%	12%	0	0	100%	40%

to achieve 30% recycled materials by 2025. The company's material choices are based on the Sustainable Apparel Coalition and Textile Exchange and third-party life cycle assessments (LCAs) where applicable. An effort is being made to improve

Chart (1) Evolution of recycled and more sustainable materials from 2019

traceability in all key materials. Their vision is based on three pillars: recycled, regenerative and responsible. Priority is given to the use of closed-loop recycled post-consumer materials that can be reused and recycled again. Also, the use of basic virgin raw materials produced through regenerative agricultural practices that enhance soil health, livelihoods and ecosystems. In addition, responsible sourcing is fundamental to their material choices, with the aim of reducing environmental impact, respecting human rights and protecting animal welfare. In general, in recent years the company has increased the use of recycled materials. The graph below shows how the use of recycled and more sustainable materials has evolved from 2019 to 2022.

We see in 2022 an increase of 23% against 18% in 2021 of materials from recycled sources. The target is for 30% of total materials to come from recycled sources by 2025.

To highlight the potential for recycling mixed fibres, a Reverse Supply Chain operation has been introduced, which involves recovering garments from their customers and materials from their suppliers and reintegrating them into their supply chain as valuable resources, using the Up-cycling model. As a demonstration of this concept, the Green Machine installation, developed by the Hong Kong Research Institute of Textiles and Apparel Industry and Technology (HKRITA), was supported.

The pioneering Green Machine, developed by HKRITA with the support of the H&M Foundation, is a revolutionary technology capable of efficiently separating mixed fabrics on a large scale without compromising quality. The most remarkable aspect is that it is available to companies in the industry at a cost price, with the aim of driving significant changes across the fashion industry. Adoption of Green Machines is expanding rapidly, with the first commercial order from Kahatex, Indonesia's largest textile manufacturer, in 2020. In 2021, ISKO, the world's largest denim manufacturer, also ordered one for its factory in Turkey.

Although many garments are made from mixed materials, finding a recycling method that can separate and recycle fibres efficiently has long been a challenge. In 2016, the H&M Foundation launched the Recycling Revolution project in collaboration with the Hong Kong Research Institute of Textiles and Apparel Technology (HKRITA) to identify a commercially viable method to address this issue within a four-year timeframe.

A breakthrough occurred just one year into the project, when Professor Kanji Kanjiwara and his team at Shinshu University's School of Textile Science and Technology discovered a hydrothermal method that had the potential to revolutionize the industry. This innovation, known as the Green Machine, has several key features: it uses heat, water, pressure and a biodegradable green chemical. It is time and cost effective. It can be customized to fit any factory or facility due to its modular design. It operates as a closed loop system without creating secondary pollution as the water, heat and chemicals are continuously reused and its production includes polyester fibres and cellulose powder. The separated polyester fibres can be recycled and used to produce new materials, while the exported cotton is converted into cellulose powder, offering multiple applications such as the manufacture of new garments. Through initiatives such as the Planet First programme, in partnership with the H&M Foundation and HKRITA, cellulose powder is used in projects such as Absorboost, which aims to enhance cotton farming practices and eliminate the need for irrigation.

The company's recycled material efforts present another innovation as it produces different collections of recycled materials such as recycled sequins, recycled mulberry silk from cutting waste, recycled silk to produce a capsule collection, recycled sterling silver collected from household goods in Denmark through urban mining. The company's brands in recent years have presented many collections made from recycled materials. For example, H&M incorporated recycled sequins, while & Other Stories used recycled mulberry silk sourced from cutting waste for a capsule collection. In addition, & Other Stories incorporated recycled silver obtained from household waste through urban mining - a process that recovers precious metals from discarded materials and turns them into new items.

Innovative materials were also tested including:

-**Newlight Air Carbon**: Microorganisms living in the ocean consume carbon dioxide and methane every day and convert them into PHB, a biomaterial. PHB can be used in
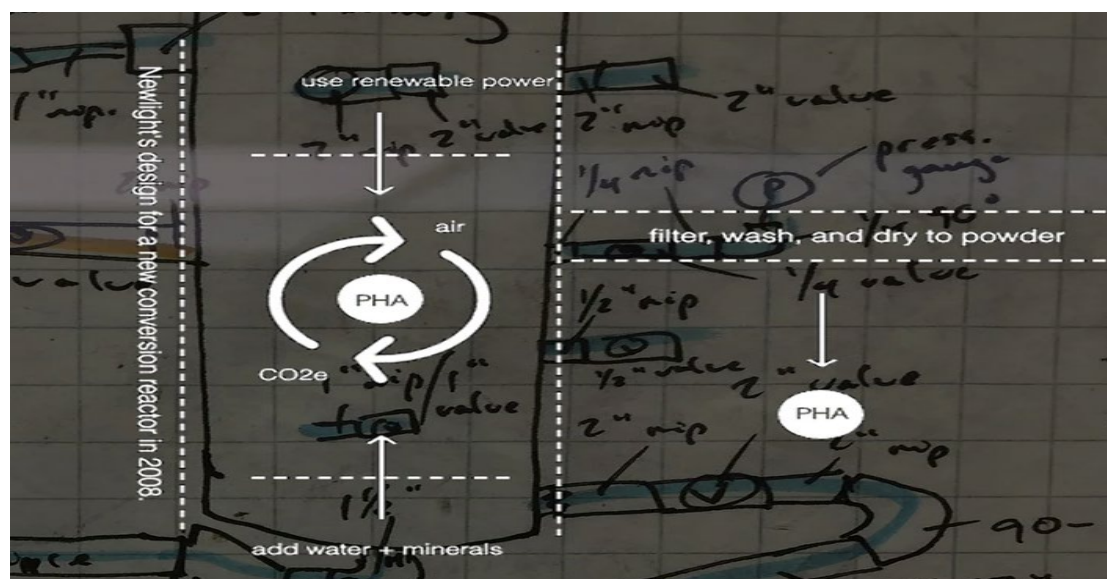
place of plastic, fibres and leather because it is fusible.

Figure (11) Newlights Design

Source: https://www.newlight.com/technology

-**Bananatex**: The world's first durable, technological fabric, Bananatex® is created only from naturally grown Abaca banana plants. The plant is self-sufficient and needs no pesticides, fertilizers or more water because it is grown in the highlands of the Philippines in a natural environment of sustainable mixed farming and forestry. These characteristics have allowed it to improve biodiversity and the economic well-being of its farmers, while helping to reforest areas once destroyed by palm monoculture, used by COS.

-**Kapok**: A cotton-like fibre derived from the fruit of the Kapok tree, used by ARKET.

-**Resortecs Smart Stitch**: a soluble sewing thread used by H&M. Garments sewn with Smart Stitch, heat-dissolvable sewing threads, can be disassembled on an industrial scale thanks to Smart Disassembly, low-emission thermal disassembly systems. The combination of the two innovations enables up to 90% fabric recovery.

H&M CO: LAB supported the launch of new products in partnership with Ambercycl (recycled fabrics) and Sheerte ("unbreakable" socks), and also made an initial investment in Fairbrics, a company using a new process to produce polyester

components from CO2 waste. In addition, the Circular Innovation Lab engaged in proof-of-concept projects with Keel Labs following an investment from H&M CO: LAB.

The company is also committed to the phasing out of virgin polyester and is focusing on the exclusive supply of recycled polyester by 2025. As shown in the Chart (1) above, 74% of the polyester used in 2022 came from recycled sources, which significantly reduced the greenhouse gas emissions footprint compared to traditional sources. From 2019 to 2022 we have a very large increase in the use of recycled polyester. The company is working with Textile Genesis to enhance the traceability of recycled polyester, ensuring a more transparent and responsible supply chain for this material.

The use of Responsible Wool Standard (RWS) reached 57% in 2022 against 44% in 2021.The company's goal is to exclusively source virgin wool only from certified farms by 2025. In 2022, cashmere that met the Good Cashmere Standard (GCS) requirements reached 99% utilization, almost reaching the 2025 target where the company will exclusively source pure cashmere from GCS certified farms. With regard to the use of Responsible Mohair Standard (RMS), the company has kept its commitment to purchase only from RMS certified farms.100% of 2021 mohair meets the standard, in line with the previous year and remains at the same percentage without reduction. Since 2016, they have only sourced Responsible Down Standard (RDS) virgin down, with 100% compliance through 2021. Their commitment to exclusively sourcing from RDS certified farms remains unchanged. For leather, they have enhanced traceability and greater accountability throughout the leather supply chain, from tanneries to upstream farms.75% of leather products are made from chrome-free tanned leather, which includes vegetable-dyed leather and metal-free leather. This represents a significant increase from 51% in 2021. By 2025, the goal is for all of their new leathers to be chrome-free. Finally, in relation to materials, a roadmap on MAN-MADE CELLULOSIC FIBRES (MMCF) has been developed. This map focuses on scaling up the use of next generation raw materials, especially recycled raw materials from textiles and improving the recycling infrastructure. By the end of 2025, their goal is to exclusively source MMCF from FSC-certified sources. Alternatively, we will seek to replace them with next-generation fibres derived from agricultural residues and pre- and post-consumer textiles. This complements the existing requirement that MMCF producers must be verified as low risk through the Canopy Style audit.

Examples of innovative companies in which they have invested include Renewcell, Infinited Fiber Company, Spinnova, Materra. The ability to recycle resources over and over again, maintaining quality and minimizing impact, is a key step towards achieving a circular fashion industry. This is why supporting new recycling technologies is a strategic continuation of initiative to collect in stores used clothing and household fabrics, from any brand and in any condition, for reuse and recycling. All this has been done through the company's innovative Circular Innovation Lab and HM: COLAB, which works in partnership with some of the start-ups mentioned above and will be presented and some facts about them will be mentioned below.

Renewcell

Another innovative company is the Renewcell with the aim of circularity and sustainability. The process in this company is that cellulose from cotton waste is dissolved and transformed into a new material called Circulose. The clothes that are not used more and what remains from the cutting of the fabrics used by the producers come for processing and the parts of the clothing that do not belong to fiber such as zippers and buttons are removed to be recycled later.
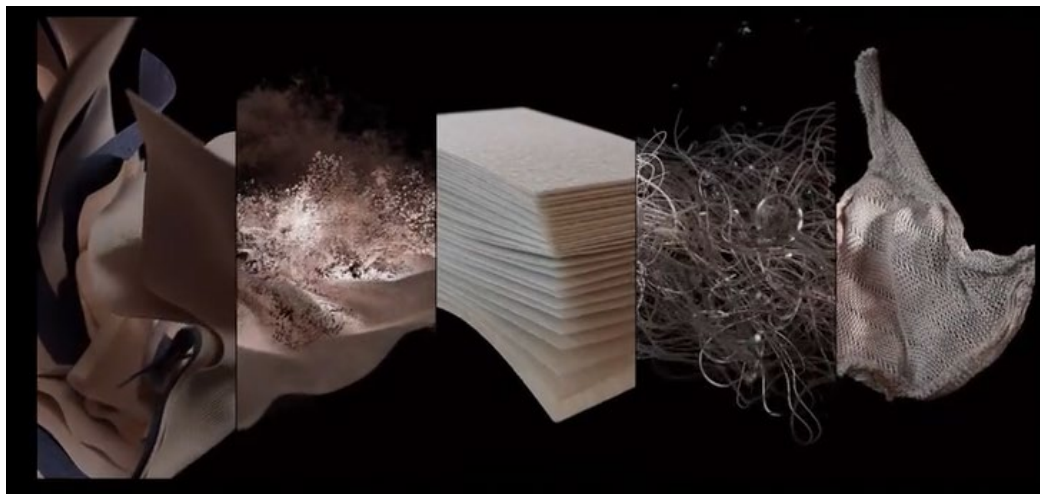

Figure (12) Renewcell

Source: https://www.zara.com/gr/el/sustainability-infinited-fiber-mkt5242.html?v1=2159420
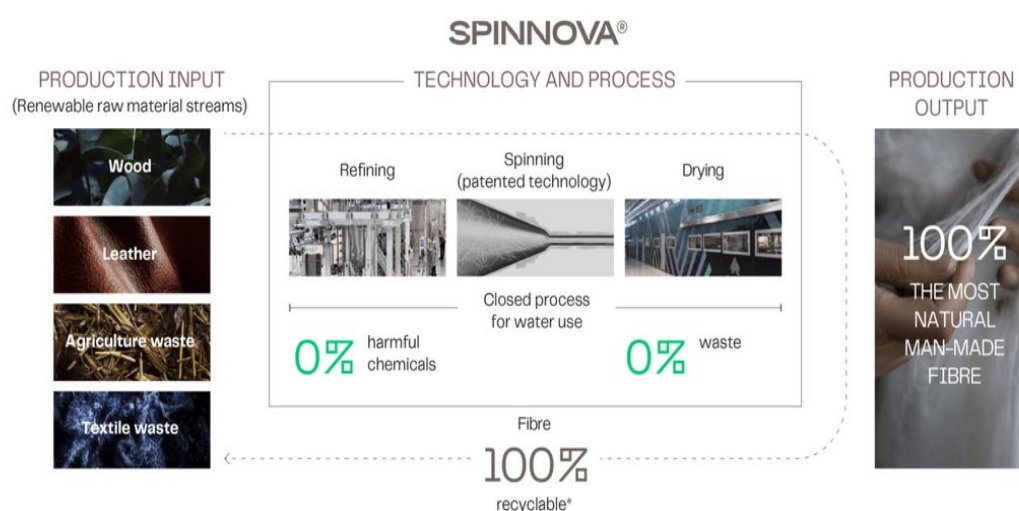
The fibers of the fabrics are discolored and the polyester, elastin and other components are separated and the pure cellulose from cotton is recovered. The resulting pulp is dehydrated and pressed into Circulose sheets. It is then sent to viscose producers where the Circulose sheets are dissolved and mixed with new virgin wood pulp that meets the

company's forest protection criteria, and the final viscose fiber is created. Thus, by using a resource that has been used before, the consumption of virgin raw material wood is reduced and consequently the wood consumption of the forests is reduced.

Spinnova

Spinnova is a Finnish company that has created a cellulose base fibre from FSC certified wood, and in the future plans to eventually use other raw materials, such as cellulose from agricultural and biological waste. Unlike other cellulosic fibres, Spinnova does not use hazardous chemicals or dissolving to turn the pulp into textile fibre. The process is based on mechanical processing of the pulp, fiber suspension flows and rheology.

Spinnova uses 99% less water during the process compared to cotton manufacturing. The only by-product of this closed process, which has no waste streams, is the

evaporated water, which is then recycled back into the main operation.

Figure (13) Process of Spinnova

Source: https://spinnova.com/

The fibre is made up of white, strong, fluffy wool that is as warm as lamb's wool. Its elasticity and tensile strength are very similar to cotton. They can modify the fibre to be either water-repellent or absorbent, depending on the use. Before wet spinning has even begun, the mass of the fibre can be coloured. It can be used just as it is for knitting, weaving or spinning yarns and fabrics elsewhere; they are currently working with many retail brands to create the fiber product to match specific commercial footwear, clothing

and nonwovens. Fibria, Lenzing, Marimekko and Fashion for Good are some of their current business partners. microfiber cellulose (MFC), an extremely thin, pasty material is created mechanically from the pulp that enters their process. A by-product of the pulping process is MFC. For low-volume products, such as cosmetics, it is traditionally produced on a small scale.

The finely milled pulp material is passed through a special nozzle where the rotating and aligned fibres and fibrils form a network of strong and elastic fibres. The fibre is then spun and cured. The most important aspects of the process are covered by a number of international patents granted and pending by Spinnova in nine different patent families.

Materra

Materra has developed a technology for the cultivation of cotton that has the potential to increase yields and fibre quality, while minimizing the use of water and pesticides. The Cyclic Innovation Lab has partnered with Materra to set up a pilot project in India, with the first crop to be harvested in late 2022 and used in COS collections.

Microfibers

At the stage of textile production and washing, there is a risk of fibre fragmentation, which leads to the release of small microfiber, both natural and synthetic, into water bodies, causing pollution of various habitats. There is widespread and growing concern about the pollution caused by microfibers and the company is trying to take measures to address this.

They have initiated a process to create a comprehensive microfibers Roadmap across the organization. This roadmap includes the following actions:

-Selection and design of yarns and fabrics that minimize the shedding of microfibers.

-Conduct research to investigate new production processes and requirements that can effectively reduce shedding.

-Providing customers with laundry bags that help reduce the release of microplastics during washing and we also support the development of laundry filter systems.

-Promote improvements in technologies that facilitate the reuse and recycling of fabrics to minimize waste.

The company is also fully aligned with the 2030 Commitment of the Microfiber Consortium (TMC). TCM is a global initiative focused on achieving zero impact on nature caused by the fragmentation of textile fibers by the year 2030. They have developed a position paper highlighting the importance of a holistic and collaborative approach based on scientific evidence. The paper stresses the need for comprehensive legislation that covers all stages of the product life cycle, recognizes ongoing industry research and adopts a risk-based step-by-step approach with a common methodology. Three research projects have been initiated in collaboration with the Hong Kong Research Institute of Textiles and Apparel Industry and Technology (HKRITA) which focus on understanding the levels of fibre fragmentation for different materials during production, developing methods to remove microfibers from wastewater using sound waves and investigating the use of bacteria to degrade microfibers in wastewater treatment plants. ARKET and H&M are actively promoting and selling laundry bags to customers, allowing them to reduce the shedding of microfibers during washing.

7.2.2 Circular supply chain

Resource optimization & Recirculation

To achieve a truly circular ecosystem, resources must be optimized, recirculated and waste and impacts minimized. Waste generated during production and unused or damaged clothing are no longer considered valuable resources. Efforts are being made by the company to focus on developing reverse supply chains that return used products and production waste back into circulation. These resources can be reused, recycled or converted into valuable raw materials within the production system. The waste management and resource recycling strategy extend to all operations, supply chains and products. The objectives are to comply with regulations and laws and to minimize waste and maximize value through reduction, repair, reuse of products or materials and recycling.

To optimize and efficiently circulate resources, they aim to:

-Through guidance and the creation of systems and networks, they work with suppliers to minimize waste and optimize the movement of resources through the supply chain.

-Optimize supply in line with demand, return used products to circulation through second-hand sales or recycling and ensure that products are used to their highest resource value.

-Giving a new life to defective products, giving priority to reusing or recycling defective products to avoid waste.

They have already produced guidelines for clothing suppliers on the responsible handling, disposal and management of production waste, enabling them to minimize waste and maximize value. In collaboration with Reverse Resources, a digital tool is being used to enable the traceability of waste production, allowing them to incorporate it as a resource in their products. Participation in the SWITCH2CE initiative, which aims to facilitate a just transition to a circular economy through environmentally sustainable initiatives and green innovation. In continuation of their commitment to innovation and collaboration, they have invested in Smartex. Smartex uses innovative AI technology to identify production errors. Smartex is an established and innovative company specializing in hardware-based software solutions for the modern textile factory. Focused on AI-based technology, Smartex is committed to optimizing operations, improving quality control, enhancing sustainability and streamlining supply chain processes in the textile industry. Their comprehensive suite of tools, including Smartex CORE and Smartex LOOP, is revolutionizing the way manufacturers operate and excel in an increasingly competitive environment. At the core of the Smartex system is Smartex CORE, a fundamental tool that leverages artificial intelligence and machine learning algorithms to identify various types of defects produced by Circular Knitting Machines (both open width and tubular). Seamlessly integrating with existing textile machinery, the system uses a suite of cameras and sensors. In addition, Smartex CORE integrates with a comprehensive software platform for managing factory operations, articles, digital twin textile rolls and more. Smartex's mission is to digitize the textile industry by providing technical tools that enhance efficiency, productivity and sustainability. This enables to minimize the production of defective yarn and fabric, thus improving resource efficiency.

COS launched the Beyond One Life capsule collection, using leftover fabrics from previous collections. To promote the recycling of product resources, it aims to maximize product use and value, establish a reverse supply chain team, working with I:CO to collect and sort garments, and participate in initiatives such as Fashion for

Good's Sorting for Circularity project. In terms of defective products, priority is given to reuse and recycling, and internal communication and routines to identify and address product defects are continuously strengthened.

Production

At the **production stage**, the company aims to provide unrivalled value through a combination of fashion, quality, price and sustainability. Through long-term investments and by cultivating strong partnerships with suppliers, they have created an efficient and demand-driven supply chain that can respond quickly to changing trends and customer demands. This ensures that the best possible customer experience is offered across all sales channels at the right time. By leveraging artificial intelligence and data from across the supply chain, they are able to improve accuracy in quantification, allocation, pricing, personalization and local relevance, thus promoting leaner production and sustainable use of resources.

The use of energy, chemicals and water in various processes such as washing, dyeing and printing is a common practice. However, efforts are being made to adopt an integrated approach to improve the processing of materials, in collaboration with others to minimize the overall environmental impact. Their aim is to establish tools that effectively measure the impact of production processes, while promoting the adoption of less harmful alternatives.

The focus revolves around 5 key areas:

Chemical: Aim to reduce chemical use, promote reuse or regeneration, and incorporate third-party risk-assessed chemistry such as Screened Chemistry.

Energy: Improving energy efficiency and minimizing greenhouse gas (GHG) emissions is a priority for us.

People: Ensuring that employees use personal protective equipment appropriately to protect their health and safety.

Production waste: Reduce waste and enhance recovery, reuse and recycling practices.

Water: Strive to minimize water consumption, promote reuse and recycling of water and reduce overall water use and improve water quality.

A printing roadmap has been developed for production processes that describes efforts to maximize the use of processes that significantly reduce water, energy and chemical consumption compared to conventional practices.

A significant part of the environmental footprint comes from the supply chain, particularly in textile manufacturing and processes such as dyeing and washing, which often consume significant energy and water resources. In 2022, they launched the 2030 Water Strategy, developed in collaboration with brands, NGOs, water experts and key suppliers from each region. The strategy focuses on reducing absolute water use and decoupling development from resource consumption, rather than solely measuring water efficiency. Investments have also been made in **Colorifix** and **Alchemie** two start-ups that have developed dyeing processes that require less water, chemicals and energy compared to conventional methods. These innovative processes have already been used in some of the collections.

Colorifix

Three like-minded people who were creating biological sensors to monitor heavy metal contamination in drinking water in rural Nepal created Colorifix. Colorifix is the first company to create, deposit and fix dyes in textiles using only biological processes. Over 5 trillion litres of water, petrochemical dyes and a variety of poisonous and highly polluting chemicals are used annually to produce the 100 billion garments produced. Colorifix has created a synthetic biology method to produce colour from living microorganisms in order to reduce this number. Their method is 100% natural and non-toxic and also uses up to ten times less water than standard dyeing techniques. They have an ever-growing colour library derived from the extremely diverse colour palette found in nature and have shown the company that quality and cost do not necessarily have to be compromised. the river water back in Kathmandu was quite contaminated with garbage mainly from the death of textiles.
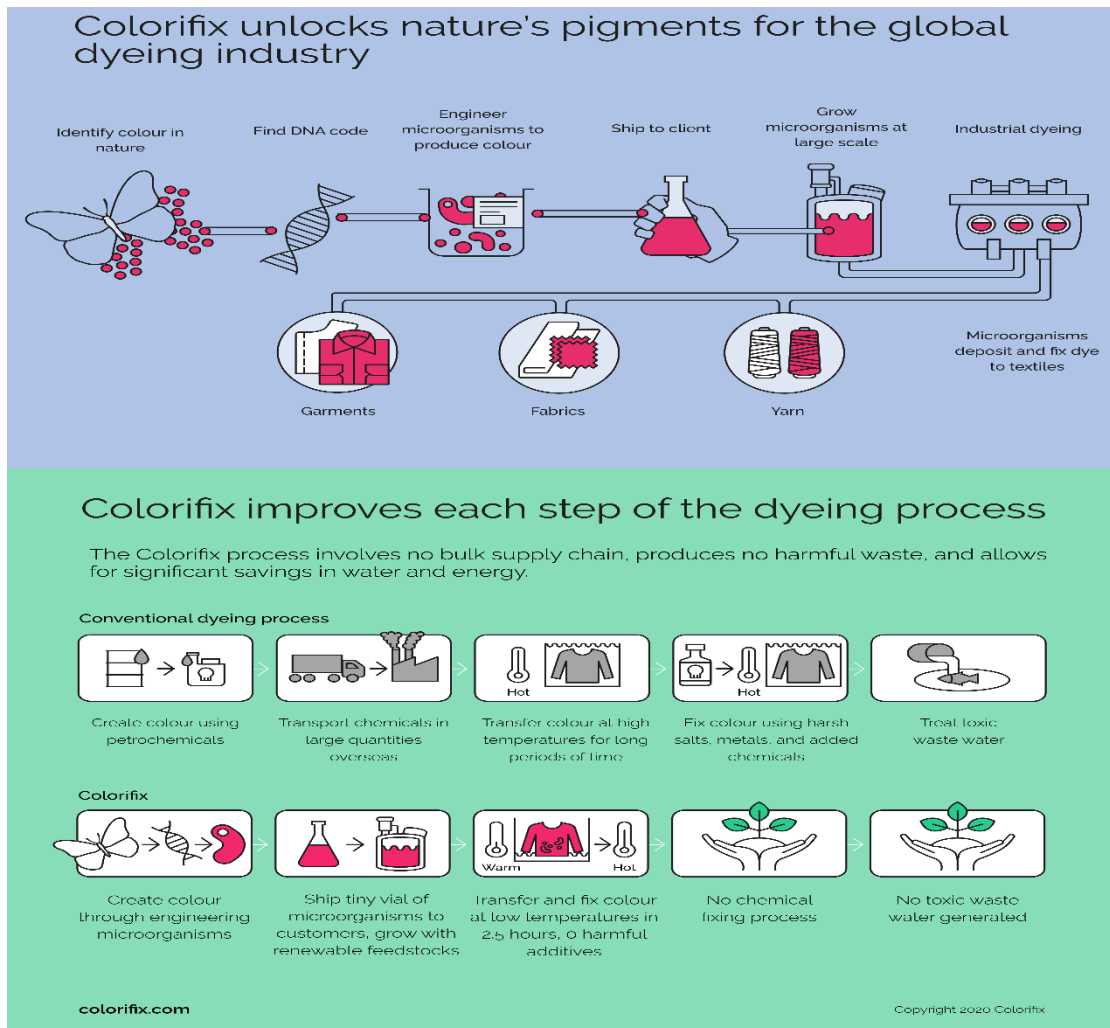
Figure (14) Colorifix

Source: https://www.ukft.org/colorfix-pvjuly22/

So, the peers chose to explore a biological solution when they realized how much damage the textile and fashion industry had done to the water. They discovered a method using a bacterium. Finding a colour produced by a living organism, such as an animal, plant or microbe, is the first step; deciphering the information that encodes how a pigment is produced by sequencing DNA and then translating that message to the designed microbes used to grow and transport the colour. The colour is produced in the laboratory and then a small number of live bacteria is then deposited with local fermentation partners who develop the colour using waste from the sugar production business, just as beer is produced. The microorganisms are then distributed locally and used directly in place of the dyeing liquid, requiring only a tenth of the water and no additional specialized machinery or hazardous chemicals. With the help of technology, natural and synthetic fibers can be dyed at a temperature of 37 degrees.

Alchemie

Alchemie Technology from Cambridge, UK has developed an innovative pigment application technique that combines the advantages of inkjet printing with the reliability of spray systems. A series of individually controlled rollers carry the fabric through the machine; Endeavour, Alchemies' waterless dyeing system, uses 85% less energy and virtually no waste. Typically, 4.5 liters of water and 0.17 kg of CO_2 are used to dye a polyester garment. In the Endeavour, only 0.2 liters of water and 0.03 kg of CO_2 are used.

Figure (15) Alchemie

Source: https://www.textiletoday.com.bd/alchemie-technology-endeavor-smart-waterless-dyeing
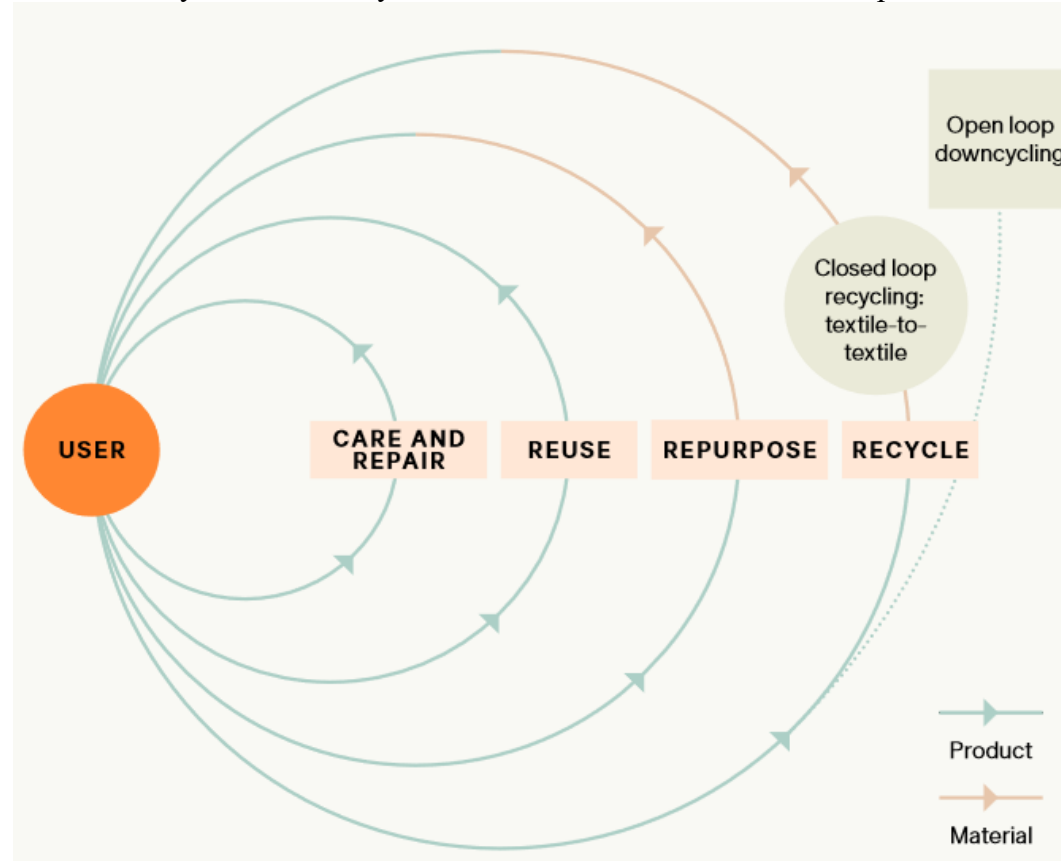
The 1440 nozzles per side of fabric used in the innovative design allow for precise and fast colour dispensing. The variety of nozzles ensures that the surface is dyed evenly. The border size can be digitally modified and the machine can and automatically detects the width of the fabric. The nozzles themselves are significantly larger in diameter than the nozzles used in inkjet printers, which eliminates clogging problems and chemical limitations. It is not necessary to purchase specific dyes for the Endeavour system; it works with current common dye chemicals. An infrared array is placed on each side of the fabric after dyeing. As a result, water is removed and dye stabilization begins.

Approximately 10% of the water in the fabric is still present when it comes out of the Endeavour machine. Digital textile printing techniques can only achieve coloration at the surface level. The method used by Alchemie pulls the color into the fabric, penetrating it at 50 to 70 percent. Endeavor is a two-sided dyeing technique that uses rollers to turn the fabric inside the machine before dyeing the back side of the fabric with a different set of nozzles. The machine can be used exclusively for one-sided dyeing. This can help to consume less chemistry and energy.

7.2.3 Circular Customer Journey

Scaling customer-facing circular business models

Maximizing the use of products and applying circular business models addressed to customers are the foundations for a resilient and customer-centric business. The main goal is to introduce customers to circular tactics through repair, rental and resale services. Reducing dependence on resources and maximizing the use of products in order to decouple their development from resource consumption. In order for these models to drive the necessary industry-wide change and affect changes in customer behavior, they must be firmly embedded in the mainstream. It is important to note that

products or services accessed through these models should replace those traditionally **sold through a linear model.**

Figure(16) Customer facing circular business model

Source: https://hmgroup.com/wp-content/uploads/2023/03/HM-Group-Sustainability-Disclosure-2022.pdf

They focus on three key areas to maximize product usage:

Use, care and repair

Encouraging customers to explore their personal style and extend the life of their clothes through care and repair initiatives. On HM's website online there is a section called sustainability and there is an HM Take Care initiative where inside there is information on how to wash, clean different fabrics and the treatment that can be done to some clothes. There are videos and instructions for lots of different clothes. H&M Take Care, which is now available in all global online markets. Additionally, through their digital closet service called My Closet, they are piloting a "digital wardrobe" in India, providing users with an overview of their purchases at H&M over the past ten years. This service helps customers get the most out of their existing wardrobe and increase the use of clothing. Repair services were also expanded with H&M repair stations and now operate in seven key cities in five markets. Defective customer returns are repaired at their distribution center in Milton Keynes, allowing them to be resold. Brands such as COS, Monki, ARKET and & Other Stories have also implemented repair projects for specific product lines.

Access

Providing a range of rental and reuse services that allow customers to experience fashion while facilitating the circulation of products. The aim is to boost the desire for second-hand fashion. Some stores have used clothing departments. These sections may include second-hand H&M clothing or collections of vintage and designer pieces. By providing a platform to sell used clothing, H&M promotes reuse and extends the life cycle of its products. As part of in-store circularity, H&M operates a global clothing collection program in its stores, allowing customers to bring in their unwanted clothing for recycling. This program encourages customers to recycle their clothes instead of throwing them away, promoting responsible disposal and diverting textiles from

landfills. It works in partnership with Sellpy, where customers in Sweden and Germany can buy second-hand clothes on HM's website. Sellpy is one of Sweden's leading e-commerce companies for used products. HM owns the majority of its shareholders. This start-up picks up merchandise from sellers' homes, photographs it, sells it, and ships it. According to an article in the Business of fashion magazine, since its launch in 2014 it has sold more than 6 million items and due to growing demand it will double its stock in Sweden. Customers on Sellpy have the opportunity to buy quality, reliable used items. Through the company's purchases and sales, millions of tons of water are saved and emissions are reduced due to reduced product life. The products sold on them are subject to strict controls. They operate like any other online store. Anything not sold is donated to charity or recycled. The cost of quality control, photography, description, product storage and exchange from sale to return is fully covered by the company. In return, he charges a commission on the sale price of the item. Her customers receive 40% of the price for items sold under €50 and 70% if the item is over €50 - minus a €1 surcharge per item.HM customers can buy clothes in 24 markets through Sellpy, and customers in four markets can sell on Sellpy. With the motto "when an old favorite is sold, it becomes a new favorite", HM created the REWEAR platform in partnership with REFLAUNT in Canada, where users can sell and buy used clothes from any brand. HM's rewear platform is powered by REFLAUNT's resale-as-a-Service technology. It is based on C2C (consumer-to-consumer) sales.

H&M has also invested in clothing rental services in selected markets. Customers can rent clothes for a certain period instead of buying them. This rental model encourages sharing and reduces the environmental impact associated with disposable clothing. In Amsterdam, Berlin and Stockholm, the company can rent specific collections. On the digital side, HM through Hurr Collective sells clothing and accessories online. Forbes says Hurr is the Airbnb of fashion. Hurr is a technology-based platform with thousands of renters and clothing borrowers. Hurr has no inventory. It is the middleman between the transactors and receives a commission from both sides of the transaction. It works with companies that follow the green standard. It stocks mid-level fashion pieces and showcases current trends and up-and-coming designers. One of its founders says it saves money from your closet. Users register for free and after checking in can book an outfit up to six months in advance.

Collect

The in-store clothing collection program is available worldwide, allowing customers to return their used clothing. In their stores one will find special recycling bins so that products can be collected and repaired, recycled or reused. Efforts are made so that the collected products are sorted in the most appropriate way, whether it is reuse as products, reuse as materials or as recyclables. They have created partnerships and initiatives to support this effort, such as COS Full Circle, where select garments are repaired for resale under the Restore label. In addition, the brands Monki, ARKET and & Other Stories have implemented projects to sort and refurbish returned items.

7.2.4 Circular Products, Supply Chain & Customer Journey

Packaging

Protecting products throughout their journey, from suppliers to distribution centers and from stores to customers, thus preventing any damage or waste. With the clear aim of reducing the environmental impact of packaging, a Circular Packaging Strategy has been developed based on the principles established by the Ellen MacArthur Foundation (EMF). These principles revolve around the elimination of waste and pollution, the circulation of products and materials at their highest value, and the regeneration of nature. The focus is on areas such as reducing unnecessary and problematic packaging such as hangers and plastic bags.

By 2025 (using 2018 as a base), the goal is an absolute 25% reduction in plastic packaging. All packaging is created to be reusable and/or recyclable by 2025. By 2030, 100% of packaging will be made from recycled or more sustainable materials, with a preference for post-consumer recycled materials. In addition, Canopy's Pack4Good initiative is supported, which emphasizes the responsible sourcing of wood-based packaging, including recycled pulp, next-generation fibers and FSC-certified source paper. Regarding hangers, they are committed to eliminating and replacing all polystyrene hangers by the end of 2023. Through partnerships with suppliers and collectors, the industry is actively shifting to a circular model, applying the return-to-source model in most markets.

Stores, distribution centers and offices

The shops, offices and distribution centers used by the company are also part of the company's commitment to sustainability. They are constructed, maintained and furnished in accordance with the cyclicality and climate objectives. The built environment strategy contributes to reducing the climate footprint. They have set a target to reduce GHG emissions from activities by 56% by 2030, design 100% of indoor spaces to be reusable, repairable or recyclable and use only recycled or other more sustainable materials by 2030. Reuse, repair or recycle all interiors by 2030.

To achieve these goals, work with business partners and building owners, striving for progress in many areas. They have identified six key raw materials for interiors, such as stone, steel and wood, that help reduce greenhouse gas emissions through reuse. Their circular built environment strategy has been extended to distribution centers and offices. A significant percentage of offices worldwide are now lit with LEDs, with an ultimate goal of 100%.

The circular design instruction for the built environment has been instructed to be aligned with the commercial circular product design tool Circulator. In collaboration with Really to recycle textiles into interior products, although challenges are faced with minimum quantities ordered per colour and the possibility of using standard colors is being considered.

A Redesign project has been launched to reuse, repair and recycle materials from closed stores. The online sharing tool facilitates the reuse of redundant shop interiors and a reuse tool has been developed to integrate reuse opportunities into the design phase of new projects. COS is committed to using no new concrete products in the interiors and is testing a flooring system that can be easily installed and removed for reuse.

Optimizing office space and reusing or selling internal products instead of recycling them has not only saved resources and reduced greenhouse gas emissions, but has also proven to be a profitable business case.

In collaboration with the Swedish Environmental Research Institute IVL, a climate impact analysis model for indoor products is being developed. This model will help to understand the impact on CO2 and resource reduction of materials throughout their life cycle, from extraction and processing of raw materials to their use in indoor production, including logistics. They will continue to reduce office space per person and increase the proportion of indoor space that is reused.

The stores serve customers around the world on a daily basis, acting as a shopping and fashion hub. They offer a physical space where individuals can find inspiration, explore brands and enjoy a hands-on experience. Building relationships and providing services to them is a very important part.

Over time, the role of stores has evolved, leading to continuous optimization of the store portfolio. This is ensured by a constant presence with the right stores in the right locations, in formats that meet the diverse needs of customers. Emphasis is also placed on enhancing the digitalization of the in-store experience and providing omni-channel services. In addition, stores play a critical role in the supply chain, in particular in providing last mile options. Customers can conveniently combine their purchases with omni-channel services such as click and collect, in-store pick-up and online returns. By leveraging stores and integrating different service offerings, they provide a seamless and flexible shopping experience that meets evolving customer expectations. With sustainability in mind, they take a responsible approach to the construction, furnishing and operation of stores. They focus on reducing energy consumption and equip the majority of stores with LED lighting. Priority is also given to smart design and construction, incorporating circular principles for careful selection of sustainable materials and reduction, reuse, repair and recycling.

As they continue to expand and integrate physical and digital channels, they are adjusting the number and types of stores in each market to maintain a healthy store portfolio. The contracts they have established allow them to renegotiate or exit approximately one-third of their leases each year. In 2022, they opened 91 new stores and closed 427 stores, resulting in a net closure of approximately 336 stores.

Online and physical stores work together at the same time, enhancing the offer to customers. In addition to integrating these channels to provide a seamless experience, they are constantly improving their online platform to engage customers in meaningful ways. For example, in some markets, they have introduced new digital experiences that allow customers to explore and navigate their range in inspiring ways. They can also create and share their own style boards, further engaging products. In addition, H&M has extended its online offering to customers in certain markets to include products from other brands.

The growing focus on artificial intelligence (AI) and technology is instrumental in becoming a more data-driven business. In 2022, they launched a competition in partnership with Kaggle, an online community of data scientists, to design algorithms for online product recommendations that improve the customer experience.

In the context of sustainability and improved customer experience, there are ongoing initiatives some of which are piloted in certain markets and some of which are operating in most of the stores of the house

-H&M customer loyalty programme: Members are provided with personalized offers and digital services. Members also receive sustainability rewards either when they deliver clothes to the clothing collection or when they choose a preferred delivery option when shopping online and when they go to the store for collection, they bring their own bag to the store.

-More payment options: Members have the option to pay immediately or later via the H&M app, whether they are shopping in store or online.

-Digital receipts: Receipts can be obtained by customers digitally on the H&M app for the majority of purchases.

-Find in-store: If customers see an item online, they can use their mobile phone to find it quickly and easily in the

Using the Internet, they can quickly and easily find the size they want in the physical store.

-Scan & Purchase: By scanning an OR product code in the store there is the possibility of finding and buying a product online in the

A product can be found by locating and locating a product on the internet in the size and color that the customer wants.

-With the Click & Collect function, customers receive online purchases in the store.

Repair and manufacturing services to customers is another activity towards the viability of the company. These services enable customers to repair, modify or adapt damaged or unsuitable clothing. By offering repair options, the longevity of the product is promoted and customers are encouraged to extend the use of their clothes. The use and care and repair model are about extending the life of clothes.

The circular business models embedded in H&M's stores and online operations promote sustainable practices such as reuse and responsible consumption. By embracing circularity, H&M aims to reduce waste, extend the life of its products and contribute to a more sustainable fashion industry.

8.Inditex

Business overview

The Inditex includes 8 brands (Zara, Pull and Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home and Uterque). These Brands respond to all tastes.

The beginning of the foundation of Inditex took place in 1963, where Armancio Ortega opened a small tailoring workshop, Confecciones GOA. In 1975, the first Zara retail store was opened. In 1985, Inditex was officially founded, bringing together all the companies. In the years 1988-1990 Zara opens stores in Porto, New York and Paris. At1991, Massimo Dutti, Bershka and Stradivarius joined the group.

In 2001, Inditex was listed on the Madrid stock exchange. In that year, it also issued a Code of Ethics for manufacturers and suppliers. It is also included in the Dow Jonew Sustainability Index (DJSI). With an implementation schedule until the end of 2010, in 2006 it starts the engines for the first environmental strategic plan called Sustainable Inditex. Between 2007 and 2017 she started her journey in online commerce. Zara Home is indeed the company's first online store and by 2010 it had expanded online to 16 European markets. In 2011 all the brands joined the online trade and started selling in USA and Japan. Zara's first ecological stores appeared in 2008 and 2012 in Athens and London respectively. In 2016, the Dow Jonew Sustainability Index made it a leader in the retail trade and it is characterized as exemplary regarding the disposal of hazardous chemical substances during production. According to GlobalData.com in 2021 it listed 6477 stores.

In 2021, it is included in the 100 most sustainable businesses in the world among 7000 businesses, occupying the 73rd position in the general index and the second in its branch where it was evaluated in the indicators of the economy, the environment, society and governance. The FTSE –which is an indicator of good sustainability–rates it with 4.9 out of 5. The specific index, which is a stock market sustainability index, shows the businesses on a global level with the strongest commitment to sustainability in mental,

social and corporate governance. Until 2016, the company was based on a fast fashion model and a linear process, take - make - consume - eliminate. And although the company had already taken some steps towards sustainability since 2009, in the last 7 years it made a big turn towards sustainability. According to Inditex, its business model is characterized by flexibility, efficiency, continuous innovation, creativity of teams and sustainability in all processes. Inditex knows the customer very well and the network of its people is very well organized with agility on a global level so that it listens to the needs of its customers at all times.

8.1 Inditex's sustainability commitments

They are as follows:

For the year

- 2022, facilities such as offices, logistics centers, factories and shops are to be powered 100% by renewable energy sources. A goal that was planned for 2025 but happened earlier. Over 50% of articles to carry the Join Life label.
- 2023 the cotton to be 100% from sustainable sources, the fibers from 100% artificial cellular fibers from sustainable sources, the elimination of single-use plastic, the collection of all packaging materials for recycling or reuse in the supply chain and zero waste from all their facilities.
- 2025, the polyester used and the white items to be from 100% sustainable sources and to reduce by 25% the water consumption in the supply chain.
- 2040, it is committed to net zero emissions.

8.1.1 Inditex's Sustainable Development Goals (SDGs)

1. End of poverty

2. Zero hunger

3. Good health and well-being

4. Quality Education

5. Gender equality

6. Clean water and drainage

7. Affordable and clean energy

8. Decent Work and Economic Development

9. Industry, Innovation and Infrastructure

10. Reduced inequalities

11. Sustainable cities and communities

12. Responsible consumption and production

13. Climate action

14. Life under water

15. Life on earth

16. Peace, justice and strong institutions

17. Partnerships for the goals

Figure (17) Key milestones of 2022

The key milestones of 2022 were the above goals

SDG 3

The core of Inditex's activities is to support health, safety and well-being in the workplace. This is stated in the revised Health and Safety Policy 2022. This commitment extends to all employees throughout the supply chain. Therefore, under the strategy "Workers at the heart of 2019-2022", several projects have been implemented in this area. Through partnerships with Médecins Sans Frontières, Medicus Mundi and Every Mother Counts, they help improve the health and well-being of more than one million vulnerable people around the world.

SDG 5

The empowerment of women and gender equality are core values of the group. For this reason, workplaces are inclusive and free of any form of prejudice. The Global Policy for the Prevention of Sexual Harassment and Harassment based on Gender or Gender Identity in the Workplace was subsequently adopted in 2022. In addition, it achieved the target of 45.45% of women on the board in 2022.

SDG8

Inditex attaches great importance to promoting enriched, safe and secure working environments. Equal opportunities and professional development for all stakeholders, including all their employees and those working in their supply chain. In line with this commitment, the Workers at the Centre 2019-2022 strategy was successfully implemented in 2022. Over the past four years, this strategy has positively impacted 2.5 million workers through various projects and initiatives carried out in partnership with local and international organizations.

SDG 12

As a fundamental element of the business model, sustainability implies supporting responsible consumption and production practices. In 2022, a three-year partnership was established with Infinited Fiber Company, with an investment of over €100 million to supply 30% of Infinna's future production. In addition, the use of preferred raw

materials continued to increase, accounting for 60% of total raw material consumption in 2022.

SDG13

Inditex demonstrates its commitment to fighting climate change. In 2022, it committed to supporting the United Nations Fashion Industry Charter for Climate Action by adopting its new goals. This comprehensive framework encompasses several areas, including emissions and the use of sustainable raw materials. In addition, all the electricity consumed at its facilities in 2022 came from renewable sources, achieving the milestone of 100% renewable energy consumption.

SDG17

Collaborative efforts and alliances play a vital role in achieving the Sustainable Development Goals and progressing towards a sustainable revolution in the fashion industry. There is a persistent emphasis on collaboration by undertaking ventures and efforts in partnership with various local and global stakeholders such as organizations, labor unions, governments and academic institutions, among others. Notable are the collaborations with notable partners such as the International Labour Organization, IndustriALL, UNI Global Union, ACT (Action, Collaboration, Transformation), the Fashion Pact and Cáritas, among many others.

8.2 Inditex's business model

Inditex's business model is customer centric. Its business model covers all stages from the design of the products to their sale on online platforms and in stores. The main pillars on which Inditex business model is based are **sustainability, innovation** and **working together**.
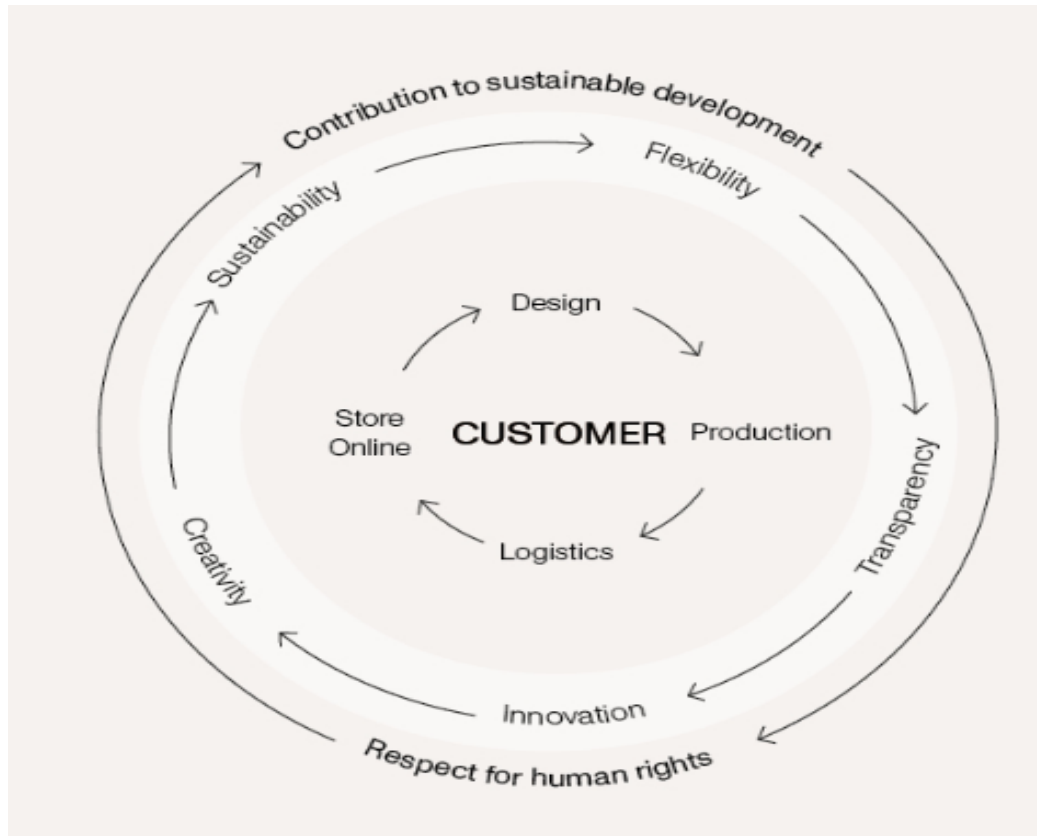

Figure (18) Inditex's Business Model

Source: https://static.inditex.com/annual_report_2022/pdf/Inditex-group-annual-report-2022.pdf

The Inditex model is unique as it includes products that combine design, quality and affordable prices. The company's goal is to reduce waste and keep resources in circulation for as long as possible. Its linear model is slowly being deprecated and the closed loop model is gaining ground in the company's resource conservation model. The digital element supports Inditex in all aspects of its processes. From design, production, fast distribution to the circular economy, digital technologies are seen as an ally of the company. The business model of Inditex in relation to the digital part is in line with contemporary trends, combining online and physical sales channels. The company's e-commerce platforms are quite powerful. An important part of the company's income comes from them. According to the company's data, in 2021 the

company's websites received 6.2 billion visits, which is equivalent to 17 million visits per day. The company has developed strong interactive platforms in its brands. Inditex has included circularity in all the stages of its products from the beginning to the end and in the value chain. Circularity, according to Inditex, is an opportunity for the entire industry as it benefits people, the environment and the economy. Below will be analyzed the business model of the company, which consists of 4 cycles. One node of the cycle will be analyzed and the correlation between them will be shown. In the middle of the circles, we meet Customers. Customers are the center of the company. Every procedure focuses on customers and their needs.
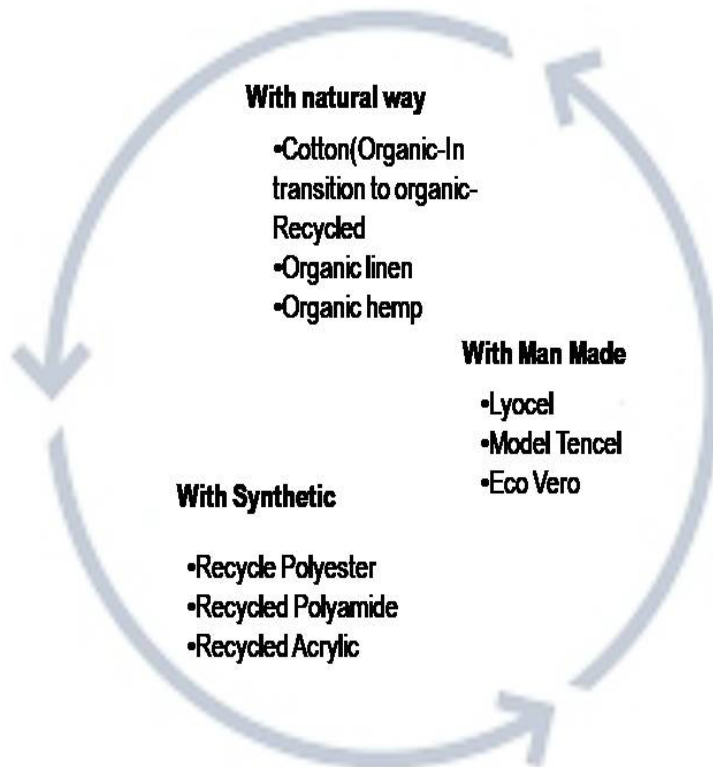
Design and Production: As we started from the middle of the circles to the outside, in the second circle we met Design and Production. One of its main processes is Design. According to the company's data, in 2021 it counted over 700 designers in its potential. The online presence such as social media and the company's e-commerce websites and apps provide a large volume of useful data to analyze. In this way, they give the company the possibility to identify in real time the trends and tastes of the customers at any moment, to respond immediately to the request and through all this the company achieves the reduction of waste and resources. The company's designers are fully in tune with the company's orientation towards sustainability. This is also evident from the constantly new clothing and footwear collections of the company, where they constantly incorporate new innovations.

In the new designs that are conceived, the people working in the design department take into account the new products to be of high quality, healthy, safe, sustainable and their life cycle as long as possible so that their durability is extended and the future is easy recycling them. Here the training of individuals in the culture of the company and in the turn towards sustainability is a very important work of the company. The training takes place above issues of sustainable raw materials, synchronous production processes, and circular design. **The production of products at Inditex starts from the design part.** The selection of raw materials and their processing are very important processes for the company because it complies with the safety standard (Safetowear). According to this standard, the supplier will receive clear instructions and with every detail regarding the manufacturing of the products up to the final product.

The company prefers materials that are friendly to the environment. Organic cotton and recycled polyester are just a few of the materials used by the company to keep its

commitments to the environment. It innovates in the development of new more sustainable fibers, in new production techniques, in the development of new recycling techniques, in the promotion of a product traceability system. Thanks to these new processes, it aims to reduce greenhouse gases, to reduce the use of natural resources, to take a circular approach and to monitor its species. In the picture below we can see the materials that company uses. The products it sells must be produced in a sustainable manner.

Raw Materials

With natural way
- Cotton(Organic-In transition to organic-Recycled
- Organic linen
- Organic hemp

With Man Made
- Lyocel
- Model Tencel
- Eco Vero

With Synthetic
- Recycle Polyester
- Recycled Polyamide
- Recycled Acrylic

Figure(19) Raw Materials

Source : https://www.inditex.com/itxcomweb/en/home

Inditex's raw materials

According to commitments announced by the company in 2023, the cotton used in their products will be organic, recyclable and 50% of the company's clothes will carry the Join Life label. According to the data of the same company, below we will see the percentage change in the use of sustainable materials from 2018 to 2021.

Sustainable raw materials increase from 2018 to 2021

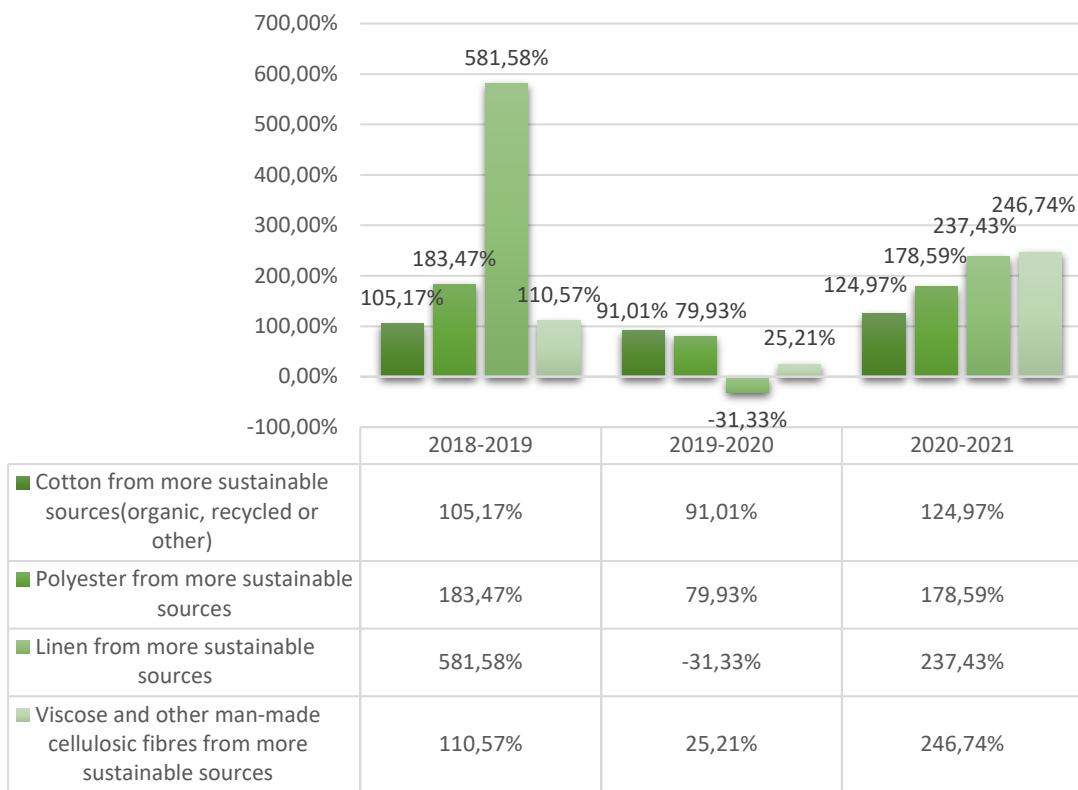|	2018-2019	2019-2020	2020-2021
■ Cotton from more sustainable sources(organic, recycled or other)	105,17%	91,01%	124,97%
■ Polyester from more sustainable sources	183,47%	79,93%	178,59%
■ Linen from more sustainable sources	581,58%	-31,33%	237,43%
■ Viscose and other man-made cellulosic fibres from more sustainable sources	110,57%	25,21%	246,74%

Chart (2) Increase of sustainable raw Materials in Inditex from 2018

As we see in the graph from 2018 to 2019, we have a huge increase in the use of sustainable materials and this increase intensifies until the year 2021. Here we see that the company starts from its base and fulfills the commitments for more sustainable materials. In 2019, it intensifies its efforts to include sustainable materials in its production process in relation to 2018 and the use of **organic cotton** increases by **105.17% polyester from sustainable materials 183.47%, linen from sustainable materials 581.58 % and viscose 110.57%.**

Another innovation of the company is the **Sustainability Innovation Hub**. It is a supportive platform where new technologies, materials and processes are used with the aim of reducing environmental impacts and transitioning to circularity. The Innovation Hub was created to identify and test innovative initiatives and integrate them into the supply chain and textile industry. It works to examine and evaluate the extent to which start-ups and their new initiatives are developed. First, they receive and analyze

quantitative data of the life cycle of these initiatives and qualitatively examine the social impact, well-being, biodiversity of animals. It promotes startups and supports them with all means so that they reach the best possible point of their technology.

In order to adopt and integrate startup ideas into the company, they follow 4 basic steps

1. Exploration: The Company at this stage is looking for startups and technologies that will make the company's products more sustainable and reduce their impact on the environment. These initiatives are related to materials, processes, use, life cycle and traceability. Technological development levels (TRL) can be at different stages of maturity.

2. Hatching: Here a deep analysis of each initiative takes place. The preliminary analysis of the innovation life cycle is evaluated. Discussions are also held with startups so that their ideas can be further developed.

3. Tests: In this stage pilot applications of the technology are made in the supply chain to analyze, develop and test if each innovation works

4. Development at scale: The final stage and here the initiative has reached its main stage is that the company helps the successful innovations to the level that they can be adopted by the commercial side and especially as a business to be active in the textile sector or to commit them to products' market.

Below, it will be presented the technological innovations and corporation of the company with other companies in terms of the materials and processes used for the production of its products.

➢ **Evrnu-Lyocel**

The creation of the innovation company Evrnu took place in 2014 in Seattle. This company has created a technology, Nucycl, which is innovative. According to the company's data, cotton fabric waste before and after consumer use is converted into cellulose that can be used for fabric production. Traditional wood-based pulp is replaced by Nucycl pulp, thus reducing the extraction of wood for the production of cellulose fibers in fabrics. When the clothes arrive at the Evrnu Company, they are grouped, separated and classified and the remaining cotton fabrics are exported. The waste that is rich in cotton is processed and turned into a pulp. Lyocel Nucycl fiber is created through this pulp. What remains of cotton fabrics are shredded, liquefied,

cleaned and depolymerized and what is obtained is repolymerized and extruded into new R-Lyocel fibers.

➢ **Infinite Fiber - Infinna**

The above Fashion and Technology Textile Group do the same innovation of converting materials that are rich in cellulose such as worn clothes into textiles that have the feel of cotton. The company's collection is made up of 60% recycled scraps that actually come from Zara's clothing collection program. The fiber production process is as follows and here the waste fabrics rich in cotton are collected and sorted. The materials of the clothing that do not belong to the part of the fabric, such as buttons, zippers, are thrown away and the fabrics become very thin strips. Then the cellulose powder turns into a liquid that looks like honey and the remaining impurities are filtered out. According to the company's article the cellulose in the cotton is collected to be processed and activated to create stable and soluble carbamide cellulose slurry. At the end the cellulose crystallizes and new strands of fibers called Infinna are created. The technology developed by Infinite Fiber is quite innovative because the fiber produced is completely circular, thus contributing to the progress of recycling. The company's factory will be fully operational in 2025 and Zara, seeing that this technology will change the industry, has signed a 3-year commitment to purchase 30% of Infinited Fiber's annual production.
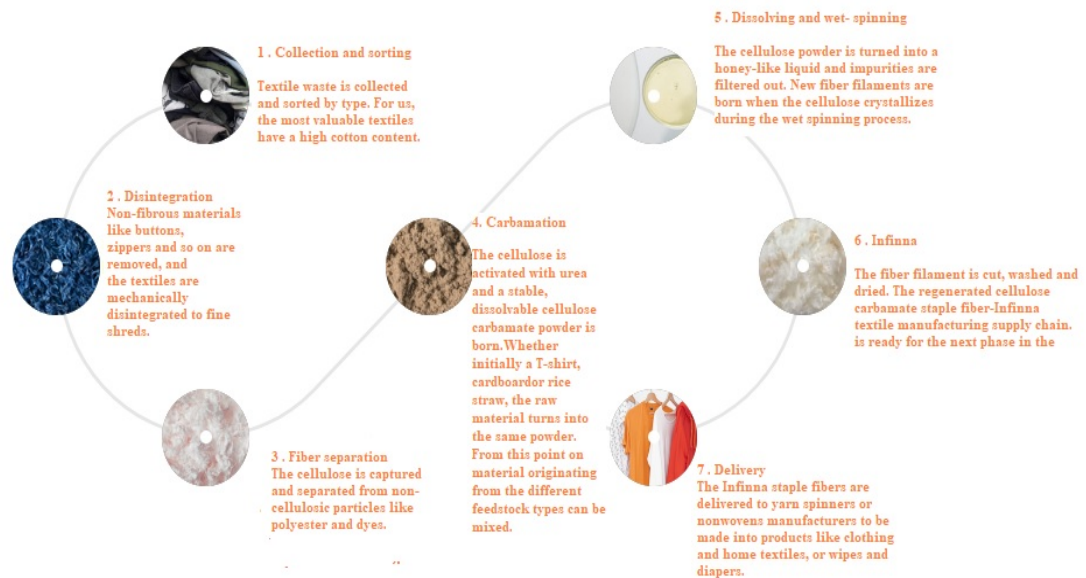
Figure (20) Infinna process

Source: https://infinitedfiber.com/our-technology/

➢ **Ananas Anam - Pinatex**

Ananas Anamis a certified company for the positive impact it has on the environment by the B-Corp organization. The innovation of this company is that it transforms pineapple leaf waste into a new material, Pinatex. Of which 72% of its fiber sare from pineapple leaves. Here we have an example of company in terms of circular economy. Every part of the plant is used. During the pineapple harvest, instead of the leaves falling, they are collected by the farmers. Then from these leaves are extracted. This fiber is processed and mixed with corn polylactic acid and Pinafelt is frozen. Then on top of that a coating of polyurethane resin is applied and that's how Pinatex was created. A piece of agricultural waste ceases to be waste and becomes a new material.
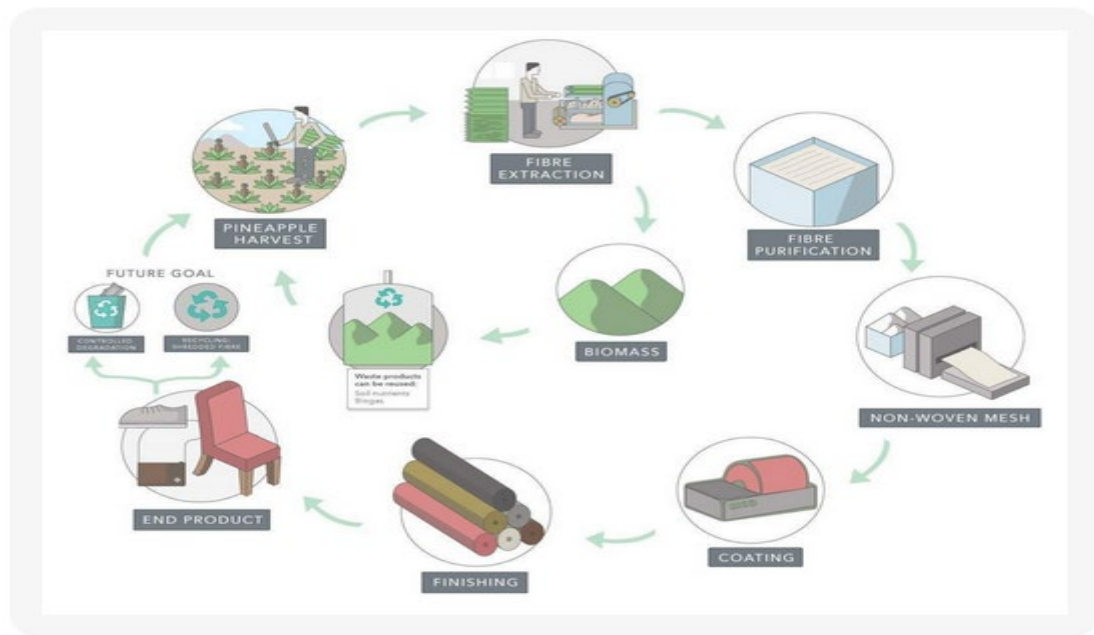
Figure (21) The life circle of Pinatex

Source: https://www.ananas-anam.com/about-us/

➢ **Lanzatech**

Another very successful collaboration of the company is with the Lanzatech Company. Lanzatech is a start-up company that presents an innovation in carbon sequestration and conversion to ethanol, from which a new material such as polyester can be produced. Sequestering carbon emissions during industrial processes firstly helps to reduce atmospheric pollution and secondly limits the use of virgin mineral resources. This technology captures Co2 from industrial, agricultural or domestic
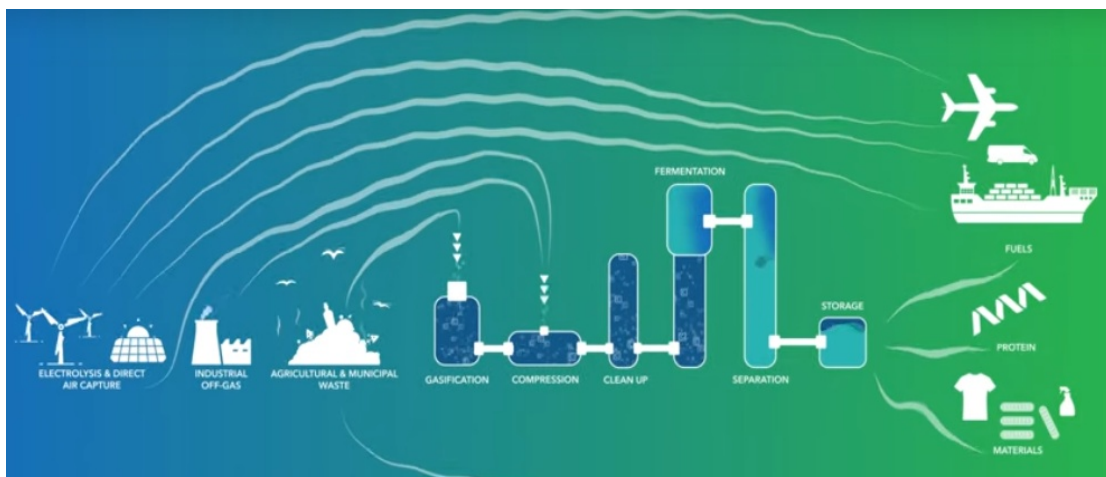

Figure (22) The Lanzatech Process

waste work and through fermentation; these gases are converted into ethanol. The final product includes 20% MonoethyleneGlycol which comes from CO_2 emissions and 80% pure Terephthalic acid. The fibers produce dresemble virgin polyester.

Logistics

Another very important point in the supply chain that contributes to the company's speed and plays a decisive role in its success is Logistics. We see that the company operates with a system of vertical integration, having full control in all phases. Its supply chain, in relation to a traditional supply chain, provides information simultaneously to all areas inside and outside the enterprise. The entire supply chain of the business presents great innovation in cooperation with technology and a turn towards sustainability, logistics could not be an exception. Through logistics, it enhances production, optimizes costs and creates a lower percentage of waste in the supply chain. The logistics and distribution system enables the electronic and physical stores to be continuously supplied by the logistics centers all the time. Under the parent company Inditex are many logistics subsidiaries. Each store has its own logistics company.

At this stage, Inditex is quite flexible and constantly adapts to new data. Logistics was an important help so that it expanded to 200 markets. The distribution to the stores and the keeping of the stock is done by each brand of the company separately. Each one has central nodes. The efficient storage, transport and distribution of the supply chain are due to the inventory management system which is implemented using radio frequencies of each garment (Radio Frequency Identification). RFID is a type of wireless communication that uses radio waves. It uses radio frequencies to read various information. It contains a tag with an integrated antenna and a microchip of a reading device that communicate between them. Customers of each brand have the option of buying online or in a physical store. The innovations that the company still offers are the reduction of the safety stock in each store. A retail tool has been developed which gives the possibility of adjusting the product display according to the request, through notifications or using information of comparable items. Also, another procedure of the company is the movement of products that do not have the expected demand in the stores to the online store. In the warehouse management part, they use an IOT (Internet

of Things) model with an emphasis on warehouse management control to ensure availability so that there is complete control of logistics and distribution.

Two other important achievements of the company in inventory management and immediate availability are the autonomous portable robots and the automated sorter induction. The use of AMR is aimed at automating the inventory on Zara's website. According to the company's data, 500 autonomous robots based on AMR technologies are used by operators in tasks related to the receipt, storage, selection and control of stocks. The robots are used to move 13500 shelves and store 4.5 million products. The use of AMR is aimed at automating the inventory on Zara's website. According to the company's data, 500 autonomous robots based on AMR technologies are used by operators in tasks related to the receipt, storage, selection and control of stocks. The robots are used to move 13500 shelves and store 4.5 million products. The robots reliably transport the products when they receive an order from the warehouse management system. Thus, the people working there travel less distance to perform their work and the productivity, experience and quality of their role is enhanced. Another innovation of the company in warehouse management is the Automated Sorter Induction project. The company is piloting a program for folded clothes and packaging sorting. Essentially, the garments to be entered into the system are classified and identified using artificial intelligence systems.

Below will also be an analysis of the storage and distribution tools mentioned earlier in the text

The main tools used by the company are:

-RFID (Radio-frequency identification)

The company uses RFID technology to track its products throughout the supply chain. RFID tags are placed on each product and can thus be scanned at any point in the supply chain to provide real-time inventory level and product movement data.

-AS/AR (Automated storage and retrieval systems)

The use of AS/RS technology automates the storage and retrieval of products. This allows the company to store and move products in the shortest possible time and to minimize the work required to transport products in and out of the warehouse.

- WMS (Warehouse management systems)

The WMS software used by the company gives the possibility to control in real time the levels of the stocks and the movement of the products. This optimizes the flow of products in the supply chain.

- TMS (Transportation management systems)

The transportation management systems help the company in the planning and execution of missions, in the optimization of routes and monitoring of missions in real time.

The company's logistics model is based on a combination of just-in-time production, a centralized distribution system and a focus on sustainability.

The main elements of this model are:

- Just-in-time manufacturing, i.e. in accordance with real-time demand data, small batches of products are designed, produced and delivered to stores. This allows the company to respond quickly to consumer demand and trends and at the same time to minimize inventory costs.

- Central distribution system. The company has a large network of distribution centers worldwide. Its largest center is in Spain at Arteixo, but it also has centers in other countries. So, it can control the entire supply chain and respond immediately to changes in demand.

- Fast and flexible logistics

Its logistics are designed in such a way to be fast and flexible, which is a great advantage in the fast fashion industry. The use of air transport, the maintenance of close relations with suppliers, the utilization of its technologies helps in the timely delivery of its products.

- Sustainable logistics

The company's model is based on sustainability and has undertaken several initiatives to reduce its impact on the environment. It has implemented a recycling program in physical stores as well as in distribution centers and has also established a very important program of donating products that are not sold at social events.

The logistics model is based on just-in-time production, centralized distribution system, fast and flexible logistics and all in relation to sustainability. In this way, it responds directly to changes in demand and at the same time reduces the environmental impact.

The centers of the company are located in different parts of the world. It is responsible for receiving and distributing the products.

The main headquarters of the company are the following:

- Arteixo Distribution Center

Arteixo Distribution Center is located in Spain and is the company's largest center. It is located on an area of 700,000 square meters. It is the central artery of the logistics of the enterprise.

- Meco Distribution Center

And its center is located in Spain in the city of Meco. It covers an area of 160,000 square meters and processes and distributes the company's products in Spain, Portugal and France.

- Stradella Distribution Center

It is located in the city of Stradella in Italy. It covers an area of 110,000 square meters and it has received processing and distribution of products in Italy and in Italy.

- Cabanillas Distribution Center

It is located in Spain, has an area of 97,000 square meters and serves the stores of northern Spain, France, Belgium, the Netherlands and Luxembourg.

-Shanghai Distribution Center

It is located in Shanghai, China and has an area of 86,000 square meters. It distributes and processes products in its stores in China, Japan and Korea.

Store/online

As mentioned above, the company has 8 companies under its umbrella: Zara, Zara Home, Pull Bear, Massimo Dutti, Bershka, Stradivarius, Oysho and Uterqüe. All these companies have a different style from each other. They each have their own design team. Their sales model is based on physical and online stores with direct handling. The shopping areas of both physical and online stores are characterized by quality. Their

physical stores are always in the most central streets of the cities. That's why the company does not spend a lot of money on advertising; they believe that the best advertising is in the most central points of the cities. The design of the stores is characterized by aesthetics and the stores themselves have technological tools for better customer service. The companies' online sales platforms aim to extend the fashion experience to every occasion and location through mobile devices. Customers are given the opportunity to receive the products they have ordered in the place they want. In this way, the barriers that arise between the physical and virtual worlds are overcome and the products reach both areas as efficiently as possible.

The application of Zara has several digital tools, most of them are innovative. They provide a real-time 360° view of the stock both online and in the nearest store. The application supports the following:

Scanning objects

The consumer can scan the code of any product in the store and have the possibility to check the availability of the size and color if it is available in a store in its area. No other retailer in the whole world has achieved what Zara has achieved during the pandemic.

Click and go, Click and find

By pressing the store mode function of the application, one can see the inventory of the products, which have been registered as favorites or in the basket of the application, in the store that is located in real time. In this way, a consumer can buy products through the store mode function, have them collected and ready after 30 minutes and receive them from the store on the same day. The application also provides a map of the deck where someone can see in which point of the store, the product he is looking for is found without engaging any employee.

Click and try

The possibility of closing a test room during a discount period is really an incredible idea and one understands how organized the company is.

Digital receipt

In an effort to improve sustainability and reduce paper, the company gives the consumer, if he has the application on his mobile phone, the possibility to send him the

receipt in the application simply by scanning a QR CODE. In this way, the consumer can find the receipt stored on his mobile phone at any time and by extension the reduction of paper is reduced.

Preowned Zara

In the context of closing the loop, the brand Zara has created an online platform which is currently piloting in the United Kingdom and is called Preowned Zara. **Preowned Zara** is a platform where you can repair, requests for a Zara product, sell or buy used products of the same brand, as well as donate for a small fee.

Its business model covers all stages from the design of the products to their sale on online platforms and in stores. Around the basic operations of the company that we saw above, we see in the second cycle of its business model sustainability, flexibility, transparency, innovation, and creativity. These principles are embedded throughout the supply chain. The company at all stages tries to operate with these principles.

9.H&M vs INDITEX

As we saw above, H&M and Inditex are two top companies in the world of fast fashion retailing. As industry leaders we have seen that they have made significant strides in integrating sustainability into their operations, the road is of course still a long one. By comparing their strategies, we can gain insights into supply chain transparency, material sustainability, recycling, circular economy principles and workers' rights. While both companies share the goal of reducing their environmental impact and promoting ethical practices, their approaches differ. H&M has placed a strong emphasis on circular economy principles, actively promoting initiatives such as garment care, rental services and resale platforms to extend the life of their products.

Both companies are committed to making their operations and stores greener by reducing energy use, switching to renewable sources for electricity and significantly reducing waste. However, the majority of environmental damage, whether it is air pollution, CO_2 emissions, water consumption, land use, chemicals used for dyeing, or deforestation, comes from the garment materials and associated production processes. Both H&M and Inditex recognize the problem of sustainable clothing and set targets to address this problem as well. The sustainability ambitions of both companies are

strikingly similar. The table below summarizes selected key sustainability measures of the H&M group and Inditex, together with the timetables for achieving them.

Key sustainability measure	H&M	Inditex
Packaging	By 2025 100% of packaging will be reusable, recyclable or composted.In 2022 they have reached 87%	2023 target to eliminate single-use packaging completely plastic to customers
	44% total reduction in 2022 of plastic packaging compared to 2018, achieving the the plastic reduction target earlier than the target deadline	2020 completely eliminated plastic from the packaging delivered to costumers to stores and in online orders
	100% of materials to be either recycled or sourced in a more sustainable way by 2030,including 30% recycled materials by 2025	In 2021, the charging of recycled paper bags in shops began. By the end of 2022 this initiative was taken up by countries in 59 markets worldwide
	By the end of 2025, all wood and wood- based material used in products and packaging will come from either responsibly managed forests certified to FSC or made of recycled materials	In 2022, the Green to Pack boxes used to ship and distribute products contained more than 75% of post consumer recycled cardboard
Collection of used garments	In 2020, they collected 18.800 tonnes of unwanted clothes and textiles through Garment Collecting programme. That's the equivalent of 94 million	In stores collection boxes in 100% of stores(Zara clothes Collecting-Join Life)
Renewable energy	100% of energy from renewable sources (2030)	In 2021, 91% of the energy consumed in their own facilities was produced from renewable energy sources
	In 2023 they will start building a solar park to provide renewable energy at a fixed price	
Digital Innovations for sustainability	On December 8, 2022, they released the first H&M Innovation Metaverse Design collection, which presents clothes digitally that in their natural form are made with circular methods	In 2022, store sales grew 23% reflecting incremental footfall and increasing store productivity. This higher level of store sales has been achieved with 10% less stores and 6% less commercial space than in 2021.Ongoing store optimisation and digitalisation programme continues to be key
Sustainable cotton	By 2022 all cotton was organic (14%), recycled (11%) or sourced from Better Cotton (75%)	By 2023 all cotton wii be organic , recycled cotton or Better Cotton.In 2021 65% of the cotton used by the Group is from more sustainable cotton
Sustainable polyester	In 2022, 74% of o polyester was from recycled sources	By 2025 alla polyester tah used my company will be
Zero discharge of hazardous chemicals	In 2020, they stopped dumping hazardous chemicals	In 2022, they continued to provide training and awareness to their staff. In total, more than 13,000 workers received environmental aviation training. In 2020, they stopped dumping hazardous chemicals
Greenhouse gas GHG emmisions	H&M reported 50.8 thousand tonnes of CO_2 equivalents in total GHG emissions (Scope 1 and 2) in 2021, a 33.5% drop over 2020.Scope 1, 2, and 3 emissions are the most common categories for GHG emissions. Direct GHG emissions from company-owned or -controlled sources, such as refrigerant leaks, owned trucks, and on-site fuel use, are included in scope 1. Scope 2 includes emissions that are produced as a result of the company's use of heat, steam, or electricity that was acquired. Scope 3 emissions come from resources that the company does not own or control but that nonetheless have an impact on the value chain.The majority of H&M's total GHG emissions in 2021 will come from Scope 2 emissions, which will amount about 37.37 thousand tonnes of CO_2 equivalent (74.7% of the total).With about 37.37 thousand tonnes of CO_2 equivalent (or 74.7% of all GHG emissions) in 2021, Scope 2 emissions will make up the majority of H&M's overall GHG emissions, down 39.4% from 2020. Scope 1 emissions for the corporation (13.59 thousand tonnes of CO_2 equivalent) down 6.6% from 2020 levels. Here, only Scope 1 and 2 are included in the total GHG emissions. In 2021, H&M's scope 3 emissions were 7,742 thousand tonnes of CO_2 equivalent. The company has set a target to reduce absolute Scope 1, 2, and 3 emissions by 56% by 2030 from a 2019 baseline	In 2021, Inditex's total GHG emissions (Scope 1 and 2) were 62.35 thousand tonnes of CO_2 equivalents, down 43.6% from 2020.Scope 1, 2, and 3 emissions are the most common categories for GHG emissions. Direct GHG emissions from sources that the corporation owns or controls are included in scope 1. Scope 2 includes emissions that are produced indirectly as a result of the company's energy purchases, such as electricity. The emissions produced by Inditex's complete value chain are included in Scope 3 along with additional indirect emissions from the manufacture and delivery of capital goods and other activities.With about 47.77 thousand tonnes of CO_2 equivalent (76.62% of the total GHG emissions) and a drop of 51.6% from 2020, Scope 2 emissions make up the majority of Inditex's overall GHG emissions in 2021. Scope 1 emissions for the corporation (14.58 thousand tonnes of CO_2 equivalent) rose by 22.9% from 2020 to 2019. Here, only Scope 1 and 2 are included in the total GHG emissions. Scope 3 emissions in 2021 were 17,097,8 thousand tonnes of CO_2 equivalent, a 28.2% increase over 2020.By 2040, Inditex commits to achieving net zero GHG emissions

Figure(23)Key sustainability measures

10.Conclusion

The circular business model of fashion combined with innovation and digital technology promises big changes in the fashion industry's approach to sustainability. Responsible production, consumption and waste management are critical issues that will be of concern to fashion businesses in the coming years.

By redesigning the entire life cycle of fashion, the circular model seeks to create a regenerative system where resources are saved, waste is minimized and products have an extended life cycle. This approach aligns with the broader goals of sustainability, not only by reducing the industry's ecological footprint, but also by promoting ethical practices and fostering a more conscious consumer culture.

The integration of digital technologies into all phases of the supply chain further enhances the efficiency and scalability of circular practices in fashion. From sustainable material sourcing options to digital manufacturing and extended product lifecycles through resale platforms, digital solutions offer innovative ways to engage consumers, optimize operations and optimize resource use.

In this dynamic landscape, fashion companies need to adopt a proactive approach to embrace circularity and digitization. H&M and Inditex are two companies that invest in research and development, in collaboration with technological partners and foster a culture of innovation. These companies are capable of unlocking new possibilities and overcoming challenges on the way to a circular and digitally enabled future.

The successful adoption of the circular business model in fashion, enhanced by digital technologies, has the potential to foster a harmonious relationship between fashion, the environment and society. It offers a unique opportunity for the industry to overcome the limitations of the past, reinvent itself and embrace a future that values creativity, ethical practices and environmental stewardship.

In conclusion, the journey towards a circular fashion industry influenced by the digital age may be challenging, but it is a journey that promises a more sustainable and responsible future for fashion that respects the planet's non-infinite resources, empowers consumers with informed choices and fosters a culture of innovation and collaboration in the industry.

References

[1]Christian Weisser. (2014, December 20). *What Is Sustainability? Video*YouTube.https://www.youtube.com/watch?v=rmQby7adocM

[2] Mollenkamp, D.T.(2023). What is Sustainability? How Sustainabilities Work,

https://www.investopedia.com/terms/s/sustainability.asp

[3] Neshovski, R. (2023, May 12). *Home - United Nations Sustainable Development*. United Nations Sustainable Development. https://www.un.org/sustainabledevelopment

[4]

https://sustainabledevelopment.un.org/index.php?page=view&type=2002&nr=31&menu=35

[5] Fashion - New World Encyclopedia. (n.d.).https://www.newworldencyclopedia.org/entry/fashion

[6] Saxon, K. (2023, January 27). What Is Fast Fashion? Definitions, Problems, Examples (In 2022). *The VOU*. https://thevou.com/fashion/fast-fashion/

[7]Deeley, R. (2023, May 25). Fashion's Microplastics Problem Is a Design Challenge. *The Business of Fashion*. https://www.businessoffashion.com/articles/sustainability/sustainability-microfibres-microplastics-microfibers-design-challenge/

[8] Kent, S. (2022, October 10). Fashion's Plastic Addiction Is Harder to Shake Than it Seems. *The Business of Fashion*. https://www.businessoffashion.com/articles/sustainability/recycled-polyester-plastic-materials-sustainability-bottles-textile/

[9] *EUR-Lex - 32008L0098 - EN - EUR-Lex*. (n.d.). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

[10] *Consumer product safety*. (2021, June 30). European Commission. https://commission.europa.eu/business-economy-euro/product-safety-and-requirements/product-safety/consumer-product-safety_en

[11] *Textiles and clothing industries*. (n.d.). Internal Market, Industry, Entrepreneurship and SMEs. https://single-market-economy.ec.europa.eu/sectors/fashion/textiles-and-clothing-industries_en

[12] *Understanding REACH - ECHA*. (n.d.). https://echa.europa.eu/regulations/reach/understanding-reach

[13] *Waste Framework Directive*. (n.d.). Environment. https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en

[14] *Legislation*. (n.d.). Internal Market, Industry, Entrepreneurship and SMEs. https://single-market-economy.ec.europa.eu/sectors/fashion/textiles-and-clothing-industries/legislation_en

[15] *Other legislation related to textiles and clothing*. (n.d.). Internal Market, Industry, Entrepreneurship and SMEs. https://single-market-economy.ec.europa.eu/sectors/fashion/textiles-and-clothing-industries/legislation/other-legislation-related-textiles-and-clothing_en

[16] *Textiles strategy*. (n.d.). Environment. https://environment.ec.europa.eu/publications/textiles-strategy_el?etrans=el

[17] *Rethinking business models for a thriving fashion industry*. (n.d.). https://ellenmacarthurfoundation.org/fashion-business-models/overview

[18] Stanton, A. (2023, February 3). *What Is A Closed Loop System? - The Good Trade*. The Good Trade. https://www.thegoodtrade.com/features/what-is-a-closed-loop-system/

[19] Aus, R., Moora, H., Vihma, M., Unt, R., Kiisa, M., & Kapur, S. (2021). Designing for circular fashion: integrating upcycling into conventional garment

manufacturing   processes.   *Fashion   and   Textiles*,   *8*(1).
https://doi.org/10.1186/s40691-021-00262-9

[20]Hawkins, L. (2022). Made-to-order fashion is giving garment waste the chop.
wallpaper.com.   https://www.wallpaper.com/fashion/made-to-order-fashion-
explained

[21]The Economist. (2022, November 18). Repairing clothes is becoming more
fashionable.   *The   Economist*.   https://www.economist.com/the-world-
ahead/2022/11/18/repairing-clothes-is-becoming-more-fashionable

[22]*A   digital-only,   multi-brand   fashion   platform: DRESSX*.   (n.d.).
https://ellenmacarthurfoundation.org/circular-examples/dressx

[23] *Scale a wider range of circular business models*. (n.d.).

[24]*DRESSX*. (n.d.). DRESSX / More Dash Inc. Dba DRESSX. https://dressx.com/

[25]Garik. (2022). The Higg Index: True Sustainability or a Way for the Fashion
Industry to |. *Eco-Stylist*. https://www.eco-stylist.com/the-higg-index-true-
sustainability-or-a-way-for-the-fashion-industry-to-keep-polluting/

[26]Tabuchi, H. (2022, June 12). 'Vegan Leather': How Fashion Giants Recast Plastic
as   Good   for   the   Planet.   *The   New   York   Times*.
https://www.nytimes.com/2022/06/12/climate/vegan-leather-synthetics-
fashion-industry.html

[27]Tabuchi, H. (2022b, June 12). 'Vegan Leather': How Fashion Giants Recast Plastic
as   Good   for   the   Planet.   *The   New   York   Times*.
https://www.nytimes.com/2022/06/12/climate/vegan-leather-synthetics-
fashion-industry.html

[28]Fibershed. (2022). Why You Should Be Paying Attention to What's Happening with the Higg Material Sustainability Index. *Fibershed*. https://fibershed.org/2022/08/17/why-you-should-be-paying-attention-to-whats-happening-with-the-higg-index/

[29]Reuterdahl, A. (2022). Villeder om miljøvennlige klær. *Forbrukertilsynet*. https://www.forbrukertilsynet.no/villeder-om-miljovennlige-klaer

[30]*Zara logistics case study*. (n.d.). https://www.slideshare.net/sakiskarajohn/zara-logistics-case-study-33289479

[31]Admin. (2019). Inditex's centralized logistics. A successful model for reaching the entire world. *MAPFRE Global Risks*. https://www.mapfreglobalrisks.com/en/risks-insurance-management/article/inditexs-centralized-logistics-a-successful-model-for-reaching-the-entire-world/

[32]Spinney, R. (2021). From Origin to Owner; is blockchain fulfilling its promise of bringing transparency to the fashion industry? *Good Brand Guru*. https://www.goodbrand.guru/from-origin-to-owner-is-blockchain-fulfilling-its-promise-of-bringing-transparency-to-the-fashion-industry/

[33]Bhardwaj, C. (2021, July 9). *How Blockchain Technology is Transforming the Fashion Industry?* Appinventiv. https://appinventiv.com/blog/blockchain-in-fashion-industry/

[34]*The technical cycle of the butterfly diagram*. (n.d.). https://ellenmacarthurfoundation.org/articles/the-technical-cycle-of-the-butterfly-diagram

[35]*Sustainability, the basis for transformation*. (n.d.). Inditex Memoria 2021. https://static.inditex.com/annual_report_2021/en/unique-model/sustainability-basis-transformation.html

[36]Reuters. (2021, November 19). H&M's Online Secondhand Shop Sellpy Launches Internationally. *The Business of Fashion*. https://www.businessoffashion.com/articles/retail/hms-online-secondhand-shop-sellpy-launches-internationally/

[37]*The Trends: "We need to make shopping second hand as easy as possible."* (n.d.). the-spin-off.com. https://www.the-spin-off.com/news/stories/The-Trends-We-need-to-make-shopping-second-hand-as-easy-as-possible-16231

[38]Shendruk, A. (2022, July 20). The controversial way fashion brands gauge sustainability is being suspended. *Quartz*. https://qz.com/2180322/the-controversial-higg-sustainability-index-is-being-suspended

[39]*Why we should be constructive about the Higg Index, not shame it*. (n.d.). FASHINFIDELITY. https://www.fashinfidelity.com/blog/why-we-should-be-constructive-about-the-higg-index-not-shame-it

[40]Garik. (2022b). The Higg Index: True Sustainability or a Way for the Fashion Industry to |. *Eco-Stylist*. https://www.eco-stylist.com/the-higg-index-true-sustainability-or-a-way-for-the-fashion-industry-to-keep-polluting/

[41]Tabuchi, H. (2022c, June 12). 'Vegan Leather': How Fashion Giants Recast Plastic as Good for the Planet. *The New York Times*. https://www.nytimes.com/2022/06/12/climate/vegan-leather-synthetics-fashion-industry.html

[42]Fibershed. (2022b). Why You Should Be Paying Attention to What's Happening with the Higg Material Sustainability Index. *Fibershed*. https://fibershed.org/2022/08/17/why-you-should-be-paying-attention-to-whats-happening-with-the-higg-index/

[43]Reuterdahl, A. (2022b). Villeder om miljøvennlige klær. *Forbrukertilsynet*. https://www.forbrukertilsynet.no/villeder-om-miljovennlige-klaer

[44]Rubin, R. (2021). The Evolution Of Digital Fashion And The Impact On Sustainability. *KeiSei Magazine*. https://keiseimagazine.com/the-evolution-of-digital-fashion-and-the-impact-on-sustainability/

[45]Arrigo, E. (2021). Digital platforms in fashion rental: a business model analysis. *Journal of Fashion Marketing and Management*, *26*(1), 1–20. https://doi.org/10.1108/jfmm-03-2020-0044

[46]Russell, M. (2023, January 19). Is the Internet of Things (IoT) the new fashion and retail disruptor? *Just Style*. https://www.just-style.com/features/is-the-internet-of-things-iot-the-new-fashion-and-retail-disruptor/

[47]Arrigo, E. (2021b). Digital platforms in fashion rental: a business model analysis. *Journal of Fashion Marketing and Management*, *26*(1), 1–20. https://doi.org/10.1108/jfmm-03-2020-0044

[48]Stephenson, B. (2021, October 26). What Are Smart Clothes? *Lifewire*.

https://www.lifewire.com/what-are-smart-clothes-4176103

[49] *Fashion on demand*. (2019, February 19). McKinsey & Company. https://www.mckinsey.com/industries/retail/our-insights/fashion-on-demand

[50] *Spinnova. Cleanest process. Disruptive circularity.* (n.d.). Spinnova. https://spinnova.com/

[51] *Fashion Statistics 2022/3*. (2023, June 2). wunderlabel.com. https://wunderlabel.com/lab/fashion-statistics/

[52] *Global fashion industry statistics*. (n.d.). FashionUnited. https://fashionunited.com/global-fashion-industry-statistics

.