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"How circular economy can affect the pattern of textile system, with particular focus on fashion and carpet industry."

BY

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Abstract

The circular economy is a sustainable model of production and consumption, where life cycle of product is extended to the maximum and waste is reduced to the minimum.
The thesis aims to analyse the impact of this new regenerative system for a textile industry, with particular focus on fashion and carpet segments. The dissertation will illustrate the current situation of the market, challenges and new possible solutions for the industry in adaptation of circular model.

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Literature Review

To conduct a study on this dissertation many kind of sources have been used. The concept of a circular economy gained interest lately and a lot of modern channels are recently devoted to this topic. But that field has also fundaments in some academic books especially in terms of more technical issues being part of this concept as recycling.

The best analytical framework for the currently happening circular change in the textile industry is given by concrete companies from the fashion and carpet segment, who make the researches on theirs own, resulting in the private reports, which were used many times as a reference in this thesis.

To best achieve the goal of analysing how circular economy is influencing the textile industry, we have described case studies – real examples of new sustainable approach of the companies in carpet and fashion industries to the problem of waste. Moreover, as the circular economy is not a standard yet, thus many entities have released guidelines and suggestions for the private sector on which we based some potential strategy.

Due to the fact that the application of circularity in the textile industry is very popular topic nowadays, websites, webinars, workshops and social campaigns were also crucial part of this research.

Furthermore, this study will help us find characteristics of circular economy as European concept for existing and future regulations, based on the European initiatives documents as well as already implemented laws.

Acronyms

EU European Union

CEAP Circular Economy Action Plan

SDG Sustainable Development Goals

EPR Extended Producer Responsibility

EPCIS Electronic Product Code Information System

KPI Key Performance Indicators

API Application Programming Interfaces

REACH Registration, Evaluation, and Authorisation of Chemicals

ECHA European Chemicals Agency

BREF Best Available Techniques Reference Document

GPP Green Public Procurement

CSR Corporate Social Responsibility

ECRA European Carpet and Rug Association

VOC Volatile organic compounds

C2C Cradle to Cradle

CPR Construction Products Regulation

LEED Leadership in Energy and Environmental Design

UN United Nations

OECD Organisation for Economic Co-operation and Development

GO Guarantees of Origin

ECAP European Clothing Action Plan

Introduction

Circular economy is a recent economic regenerative model, that has emerged as a response to alarming state of the raw materials, in order to benefit the society and our planet. Since the industrial revolution, the linear model of production and consumption – as a opposition to circular one - was in use constantly. Today, when the pollutions are reaching its limits almost every day, we are facing the moment where there is not enough resources for keeping this kind of economic model. Circular economy concept gives a solution proposing production, consumption and recycling changes in order to generate less polluting waste. Moreover, the idea of circularity is to use and re-use the waste, creating a close circle of production, consumption and waste. Long lasting products generate less waste and that is the reason why one of the key points for the circular concept is prolonging the usage of goods. Looking with hope into the future, more and more entities within textile industry are getting involved in transformation into the circular economy. It is the result of many factors as the policies, especially European ones and new standards which we will analyse in the first chapter, innovation and development within the fashion and carpet segment will be described in chapter two and three, as well as sustainable examples driven by other companies contributing to the success which will be illustrated in the chapter four. Currently, textile industry is beginning to take serious measures in this regard and implementation process within its production has started on different levels. For this moment the actions taken by fashion or carpet companies are voluntary and readily exposed in theirs marketing as a sign of awareness and modernity. The new circular economy approach is a challenge for both industries but at the same time it opens new innovative solutions developing new possibilities described in the last chapter. Climate changes, pollutions, pandemics and many more problems we face are forcing us to change and act right now. Fortunately we can observe that awareness of this fact is risen amongst the entrepreneurs and consumers within the textile industry and not only. This dissertation will examine how circular economy affects the pattern of textile industry, explaining the foundations, changes, possibilities and challenges that has already arisen and which can arise in the future.

1. Circular economy and textile industry

1.1 Textiles as a circular economy priority for EU

Textiles play a fundamental role in our society, providing us with the basic use things as clothing, shoes, carpets, curtains, furniture, etc. They are strictly connected, as raw materials, with many companies from the private to the public sector, creating together a lot of workplaces for people and being the important part of the economy. The textile industry is highly globalised and employs vast amount of people worldwide, making it one of the largest world's manufacturing industry. Production of textiles and its consumption is causing nowadays significant environmental, climate and social harm. To produce clothes, footwear, carpets or household textiles, the manufacturers use resources as water, land and chemicals, at the same time emitting massive amount of greenhouse gases and pollutions. Unfortunately, the whole way which textile material go until the final consumption and waste, includes these days little or no reuse or recycling at all.

Textile sector is a resource-intensive sector with a intense climate and environmental impact. The consumption of textiles is the fourth highest pressure category in the EU after food, housing and transport in terms of the use of primary raw materials and water, fifth for its emissions of greenhouse gases (GHG). Despite a growing awareness in the EU textile and fashion industry, average European consume on about 26 kg of textiles per year - a vast share of these coming from third countries, where sustainability and labour rights are not considered as a priority. Each item is used for a very short period of time and most of them ends up discarded or incinerated.[1] Data from 2017 - published by the European Environment Agency- estimates that the textile industry consumes 1.3 tons of raw materials and 104 cubic meters of water per person/ per year. Moreover, other highly harmful impact of textiles to the environment is fact that clothing, footwear and household or commercial textiles represent the second highest pressure category in terms of land use, following directly food consumed in the EU. The most used fibres are synthetic ones, as polyester, which production requires carbon-intensive processes with the usage of more than 70 million barrels of oil each year. Taking a closer look into more „natural" materials

[1] European Parliament (2020). *The impact of textile production and waste on the environment.*

such as cotton, opens a discussion because “natural” doesn't mean that is this kind of fibre is much better for the environment than others. Unfortunately, the consumption of soil and water is still very high to produce one cotton ball. [2] Moreover, during the plantation of cotton, the water is dramatically overused according to data and it is more than half of global cotton production that takes place in areas under high or extreme water stress and relies on the irrigation, mainly wasteful.[3] According to those facts, there is a high need for the market to work with new, less harmful materials, which are produced in sustainable way.

The textile industry employs over 1.5 million people in more than 160.000 companies in the EU, most of which are small and medium-sized enterprises (SMEs). Annual turnover of the EU textiles business is approx. EUR 162 billion (as of the date of 2019). While discussing about textiles and its influence to the environment, our attention should go firstly to the main market which is fashion but also carpet segment of the industry. Cannot be forgotten that Europe is one of the world’s largest carpet producer. That is why the European Commission identified textiles (apparel and fabrics) as a product category „priority” for the new circular economy actions. Overall around 65% of EU demand for carpets is fulfilled by EU-based manufactures, with its own production standards.[4]

The EU Commission is undertaking a range of actions to support the Europe’s move into a more circular economy, where the life cycle of a product is extended and when product reaches the end of its life, materials from which it was made, are kept within a market the longest as possible, creating further value**.**[5] The newest plan adopted by the European Commission in March 2020 is called The New Circular Economy Action Plan (CEAP) and is one of the main building blocks of the European Green Deal - a ambitious set of policy initiatives, with main aim of reaching the carbon neutrality by 2050. In line with the Green Deal and proposed new industrial strategy, the New Circular Economy Action Plan, which at the same time includes proposals on more sustainable product design and waste management, are focused on bringing resource intensive sectors, such

[2] Young S. (2021). *The fabrics with the worst environmental impact revealed, from polyester to fur*.
[3] Textile Exchange (2017). *Organic Cotton Market Report 2017 and USDA (2017) Cotton:* World Markets and Trade Foreign Agricultural Service.
[4] European Parliament (2020). *The impact of textile production and waste on the environment.*
[5] European Parliament (2015). *Circular economy: definition, importance and benefits.*

as electronics, constructions, plastics and textiles on board into the circular transformation.[6]

1.2 New circular economic model in EU

The 'take-make-use-dispose' linear economic model has been called into question many years ago and all industries has been taking into consideration that field. The main approach taken on the European level, to mitigate the risks connected with todays current wasteful and polluting system of production and consumption, is the circular economy. With the European Green Deal even more, due to the fact that circularity of the product is one of its most important pillars. European Union is working collectively on the transition towards carbon neutral continent, which economies principals are based on circularity. This circular approach towards products manufactured in EU holds enormous potential when it comes to sustainability, where not only environment benefits but also people's and the countries' prosperity is a ambitious aim. a change in the production systems - from a linear to more circular and regenerative – is a challenge but also an opportunity to support and create more innovative processes that make greater resource efficiency mark.[7] More sustainable and cleaner production represents potential gains in economic, environmental as well as cultural fields. Over the globe the competition for resources is growing rapidly, making at the same time big harm on our natural environment. The biggest organisations globally are reacting in order to make a shift into more sustainable of production, consumption and living. The UN has adopted Sustainable Development Goals (SDGs) and implemented the Paris Agreement on Climate Change, which every Member State in the EU has fully committed to and will fulfil. The change into more sustainable continent is a priority for Europe. For this reason the European Commission adopted an ambitious Circular Economy package which touches the whole chain starting from production, through consumption of the goods, its waste and secondary raw materials management. The Circular Economy has high economic potential; it is a driver for a modernised economy with important environmental responsibility, at the same time contributing to the SDGs. As really great future change,

[6] European Commission (2020). *Circular Economy Action Plan.*

[7] Ellen MacArthur Foundation (2017). a *new textiles economy: Redesigning fashion's future.*

this shift needs research in the field of bests adjustments of technology and innovation supported by this concept.

The Ellen MacArthur Foundation defines the circular economy as: '*An industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.'* (Ellen MacArthur Foundation, 2013). Products manufactured and used in a circular way have a long lifetime, due to qualitative and durable design. According to circular concept, when the product is broken – it is not thrown away but repaired. When a consumer doesn't need longer the product – then it is passed on and reused by another consumer. Ideally, the product is finally discarded and then starts its another life cycle or if its not possible, due to technical reasons, its parts (materials) are recycled with a minimum of remaining new resources ending up in energy recovery. During the production process the minimum amount resources as water or energy is used. The idea of circular economical production also covers the field of emissions, as the main idea of Green Deal is to minimize them and make Europe carbon neutral. The emissions and its impact to the environment must be limited across the whole life of the product.

With help to achieve it comes different kind of regulations as for example EcoDesign Directive which sets out requirements for the energy efficiency of concrete products in order to help prevent creation of barriers to trade, improve product quality and to protect the environment. The biggest environmental impacts of products are determined at the initial, design stage. That it why EU pays attention to the design of the product so it will encourage its longevity or facility to be recycle later on. The Ecodesign directive not only have established a framework under which manufacturers are obliged to reduce the energy consumption during production but also other negative environmental impacts occurring throughout the production process and whole life cycle of the product as putting in one place requirements on the dismantling of the product and its components for possible recycling and further identification of hazardous materials, with a view to facilitating recycling of the products at the end of life. The EU Ecodesign Directive has real potential to guideline the designers, manufacturers or society as a whole in terms of taking the material efficiency considerations along with other environmental

impacts into account when creating products. Unfortunately in the currents shape it is focused mostly on energy related issued. Not much of the focus was given on the material use. Material and resource efficiency inspirations and guidelines can be found in ecolabels criteria or as well in the Green Public Procurement Criteria for products.[8] There the criteria for textiles address product durability to a certain degree, but they do not mention in details about the recyclability field, reparability nor about the conditions which specify and enhance the concept on repairing and recycling. [9] The result of the circular approach to the production and consumption means less use of resources, less waste, more jobs in repair and recycling sectors. This is as well the way how consumers can save more money, while maintaining the services provided by products.

While the Europe is facing vast amounts of waste, all producers should find the end-of-life management of the products that they put on the market. The policy approach under Extended Producer Responsibility (EPR) schemes can be a useful instrument in this field. At this moment Member States are not obliged to set up an EPR for textiles but often it was served as a scheme for producers to guideline them. This policy could help raise resources for the collection, organise transport issues, make sorting more precise, manage re-use treatment and ease the recycling of products at end-of-life.

Extended Producer Responsibility (EPR) is a policy approach under which producers are taking significant responsibility such as financial responsibility or/and physical one for the managing disposal of the post-consumer products. Assigning such responsibility could provide manufacturers with the incentives to prevent waste increase, promote product design for the environment and support the achievement of recycling.

Moreover, end-of-waste criteria for textile should go in line with already existed Waste Framework Directive, which sets the basic concepts and actions to take related to waste management. During the circular transformation we should not forget about the already existing tools and policies which can be very helpful as a base and starting point.

A circular economy requires a global rethink on how we create, produce, package, transport and recycle goods. We need to recreate our idea of designing multi-use products

[8] Kofoworola O., Konstantas A., Wolf O., Wilde D., Garcia R., Hidalgo C.(2020). *EU Green Public Procurement (GPP) Criteria for Textile Products and Services.*

[9] Ecodesign Directive of the European Parliament and of the Council (2009). Official Journal of the European Union.

with endless future life cycles that could offer easy reuse and recycle, adding at the same time the value to the business.

The current linear usage of textile products operate with vast amount of resources and has negative impact on the environment. It cause high level of pollution and exploitation of resources. Chemicals and other substances which are hazardous for environment and peoples' health (textile workers as the owners of for example new clothes). Moreover, some non eco-friendly textiles currently often used, such as polyester, overuses large quantities of non-renewable resources and energy to be produced, or cotton requires a lot of water and pesticides to be used. The aforementioned materials and others most commonly used in the textile industry are causing various detrimental impact on the environment and people's health, what cannot be forgotten.

A lot of measures on a EU policy was already taken to confront the detrimental influence of textiles production. Many initiatives are still in process, waiting for the confirmation and final implementation. The harmonized regulations are the key towards the circular shift, some of them will be discussed later on while analysing concrete problems.

1.3 Recycling as a key towards circularity

Recycling plays crucial role in textile industry shift towards circular economy through its role in turning post-consumer materials into valuable substances or products, putting used materials back into the value chain. Global waste crisis is a current problem which points recycling as a first area of intervention within a broader European circular economy strategy. Less than 1% of material is used again after recycled to produce new clothing and overall one full garbage truck filled with textiles is landfilled or incinerated every second in the global context.[10] If recycling process is implemented then only 13% of the total material input is in some way fully recycled after the garment is used. Most of the recycled content ends up into lower-value applications: they are used as a mattress stuffing or insulations material etc. This leads to the situation where the real value of the

[10] Ellen MacArthur Foundation (2017). *a new textiles economy: Redesigning fashion's future.*

textiles is missed and later the materials are difficult to be recollected, therefore at the end they are usually discarded.[11]

There are voices coming from stakeholders to strengthen recycling industries so they can be ready to play its integral role in the circular economy and be a example to follow by others. It would present a great opportunity for the Member States to introduce the circular concept into theirs production chain. Strengthening of recycling industries also needs help from EU where the incentivized system for recycling companies should be implemented. The recycled materials extracted from the textile products need to be safe for both the environment and humans. They should be reprocessed by a professional company and reused. At the same time the materials and components - divided and extracted- should be traceable to make sure where they come from and if they do not contain by chance any hazardous chemicals which are prohibited in EU.

At the same time Waste Framework Directive introduced its revision on obligation for separate collection of textiles by 2025. During the public consultations, stakeholders from textile industry shows the need to have a harmonised approach to maximise effectiveness while minimising fragmentation of the internal market during the recycle implementations programs.

Every sustainable industrial development of recycling needs strong and efficient policies as well as institutional frameworks. This would ensure the security and sustainable future plans for other commercial actor as manufacturers of textiles. Sometimes lack of this kind of policies is justified as low economic development of the countries but this new sustainable approach is the way which can help countries to grow also in economic sense.

The question is how, besides financial support, to encourage the textile industries player to follow up with the requirements of circular economy? The sector's ability to self-regulate and self-transition by holding all players accountable to time-limited green targets will be challenging. This policy framework will be likely in need of some additional policies with adequate sanctions for producers or distributors who fail to meet the requirement of circularity. Many EU policies contribute to the shift into circular economy by giving guidelines how products should be designed, produced, used or

[11] Ibid.

treated until theirs end of use. a lot of regulations are needed due to the diversity on technologies and services used in production or recycling of different kind of products, also in a textile industry which is not only consisted out of clothes. a basic precondition for recycling is to enable the system to detect the primary waste in order to separate it later on the largest scale as possible. This can be achieved by organising the clear, understandable for all actors on the markets and economically possible to perform model of production, supported by developed infrastructure and adequate policies.

As was mentioned before, recycling is the key step in the shift into circular economy. The recycle companies are responsible on the market for turning the waste into new resource and re-introducing them into the production. But someone has to be eager to buy the new-resources from them. Theirs products cannot only be characterised by the fact that they are more "greener" than other competing non-recyclable products as for example yarns extracted from used clothes vs. new yarn made from the raw materials. The producers have to encouraged to choose the recycled materials, not only by moral guidelines but also by price or strict European law. The question then is if it will not be a limitation of free trade and if it will not weaken the manufacturers whose business profile is oriented only on producing raw not-recycled materials. Research and the brands opinions says that recycled content fabrics currently cost around 5-15 percent more than the fabrics from virgin fibres. Strengthening the recycling industries as well as incentivizing the manufacturers of products where textiles are used, who are willing to support new approach into using the recycled primary materials is a key step for implementing a circular economy on the textile market.[12]This requires a lot of technological advancements especially in the production chain as well developments in new sorting and recycling technologies. Existing recycling technologies for common materials needs dramatical improvements in theirs economics and high quality results accomplished, in order to capture the full value of the materials in recovered garments or other textile products.[13]

There is also another problem, more logistic in its nature, which is the classification of non-renewable used textiles as 'waste' and associated trade restrictions posed by

[12] Interreg. Fibersort (2019). *Policy recommendations towards a zero waste textile industry.*
[13] Ellen MacArthur Foundation (2017). a *new textiles economy: Redesigning fashion's future.*

international trade law. End-of-waste criteria are currently regulated by the European Commission for a number of specific recyclable materials but there is no criteria which will define used textiles and this is crucial to ensure that they can be later traded as a feedstock for recycling and stay on the market as with a certain value. [14]

Reparability also plays a crucial role in circular economy and was considered as highly important in the Circular Economy Action Plan. Some initiatives are taken on a EU level on the field of for instance clothing industry. The Commission Staff Working Document "Sustainable garment value chains through EU development action" emphasize the priorities for future EU development action: women's economic empowerment and theirs right, decent wages, as well as transparency and traceability in the value chain. Environmentally friendly technologies which process textiles and recycle them, have been developed under the EU funding schemes. As a example we can present the finalist of the RegioStars Awards 2018 – company Tekide, which focus on the textile fibre recycling or pilots taken place within European Clothing Action Plan (ECAP) and many of other projects co-funded by EU. We can also mention about the Partnership for Sustainable Textiles Initiative, the EU funded SwitchAsia programme and several others European funding projects cooperated with different clothing brands shows us that textile industry is on the eye of EU entities seeing its contribution in various ways.

1.4 Green Deal Friendly Textiles

This EU sectoral plan for a circular economy in the field of textiles will take an integrated product policy approach. The new regulations will address all environmental aspects throughout the product lifecycle within its value chain. The shift into circular economy for textiles will be based on the fundaments of sustainable production and consumption, access to higher quality goods, what will prolong the life of the products, circularity principles will also be build on the ground of remanufacturing and recycling.

[14] Interreg. Fibersort (2019). *Policy recommendations towards a zero waste textile industry.*

The sustainable approach in production covers the concept of minimizing the use of non-renewable resources, zero-waste procedures, extending the life of the products made from textiles and discharging the hazardous chemicals in the entire value chain. [15]

Higher quality products are top concept of the circular economy as it is estimated that prolonging the life of for example clothes by a additional 9 months of use, could reduce up to even 30% of carbon, water, and waste footprints.[16] Only in terms of fashion industry, it is estimated that by increasing the duration of first use, reuse and repair of our garments, we could lead to a 5% reduction of production the new garments and thanks to this we would deliver a sustainability benefit equivalent to 20.000 kg of CO_2 emissions.[17]

Before the European Green Deal initiative, the textile industry indicated as well the need for more sustainable and environmentally friendly processes in the fibres production. This has led to visible changes from traditional textile processing (negative environmentally) to mild enzyme-based textile processes with decreased consumptions in energy, lowered water, and harmful chemicals.[18] Polyester is very common use plastic based fabric, currently it is the fibre with the largest market share. The share of recycled polyester is increasing but low prices of fossil-based polyester is making the business situation harder for the eco-polyester. Most of recycled polyester is based for a production of plastic bottles and it is highly needed to move forward this trend for textile-to-textile recycling.[19]

Another, greatly developed and impactful for the fashion and carpet market is material called polyamide, which is the second most used synthetic fibre. Comparing to aforementioned recycled polyester, the market share of preferred (eco-friendly) polyamide is still low. Polyamide can be transitioned into the recycled and biobased polyamide. Currently, recycled polyamide is made from pre-consumer waste, exist also a polyamide made from discarded fishing nets, which will be described as one of the case study in the further chapters.[20]

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[15] Fair and Sustainable Textiles - Civil Society Coalition (2020). *European Strategy for Sustainable Textile, Garments, Leather and Footwear.*

[16] Waste & Resources Action (2016). *Textiles Market Situation Report.*

[17] European Commission, Commission staff working document (2019*). Sustainable Products in a Circular Economy- Towards an EU Product Policy Framework contributing to the Circular Economy.*

[18] Ellen MacArthur Foundation (2017). a *new textiles economy: Redesigning fashion's future.*

[19] Ibid.

[20] Textile Exchange (2020). *Preferred Fiber and Materials Market Report*.

Conventional wool still takes the floor on the market but the due to the adoption of non-mulesing and eco-wool programs, such as the Responsible Wool Standard, the more sustainable solutions of acquiring this fibre are increasing. More sustainable wools means improvements on the field of the animal welfare, land use, and biodiversity.

Cotton production is very important for textile industry since it covers approx. 23 percent of global fibre production The sustainable, preferred cotton's production is the most advanced among other beforementioned materials. The recycling of cotton is one approach towards a more circular textile industry. This process can be managed either mechanically or chemically. It is worth to remember that chemically recycled cotton is nothing else than manmade cellulosic. Cellulose is the polymer (material made of long, repeating units), which you can find in nature, that makes up the living cells of all vegetation. There are three types of the most popular regenerated cellulosic fibres : rayon (viscose), acetate, and triacetate which are derived from the cell walls of short cotton fibres called liners. Acetate and triacetate are often known as a cheap version of silk due to its drape and lustre structure.[21] Lately we see a lot of development in the regenerated fibres. They are more environmentally friendly by transition the production of the fibre into using less fossil fuels and by moderating the manufacturing process making it more closed-loop – where the waste created in the fabric factory is reused in the production process.

Currently the textiles production is covered by the Registration, Evaluation, and Authorisation of Chemicals (REACH). This entity regulates and sets particular requirements for the chemicals, used during textile production, as well as the Industrial Emissions Directive (IED) and the Best Available Techniques Reference Document (BREF) on the textile industry- which is currently under review. Emissions are also under control and theirs allowances is regulated under EU Emission Trading System. At the same time EU Ecolabel is meant for textiles and it offers a reference point of environmental excellence at European level for this kind of products. Also the EU Green Public Procurement (GPP) criteria can served as a guidelines in the field of on sustainability when producing or purchasing textiles.

[21] Textile School (2019). *Manmade Regenerated Cellulose Fibers.*

However, we need to indicate that there is no minimum criteria for sustainable performance of textiles in EU law. [22]

What happens after the product of textiles is produced is highly important for the circularity concept. But we cannot forget about the impactful process for the environment which is actually the production at the first stage. That is why, implementing best environmentally friendly practices are crucial. This will also help in using the garment for more time. The biggest climate impact happened while dyeing the yarns during the wet process. It is when the biggest amount of energy is required to heat the water, which is waisted and ended up contaminated. To avoid the water waste in the fashion as carpet segments, the best way to do it is to completely quit wet dyeing. This can be done by so called dope dyeing (solution dyeing), which is adding the colour pigmentation to the already manufactured fibres. Solution or dope dyeing is made by adding a masterbatch colorant to the polymer melt in spinning or extrusion. That means that this way of colouring can by applied only to fibres which are extruded (polyester, nylon, viscose). This results in full impregnation of fibres and filaments, with a pigment coming out of the spinnerets in a one step process. Such dry dyeing technique is already available on the market, as it is use successfully today by some clothing and carpet companies.[23] As a comparison, traditional fibre dyeing requires a two-step process. In the first one, fibres are produced and later are being coloured - in the second step. The colour is applied directly to the surface of the fibre. With dope dyeing (solution dyeing), whole one step is eliminated, which gives us water consumption reduction by 80%, soluble substance usage reduction by more than 20%, moreover the use of other chemical as for example important for restating the strength of the fibre - alkaline - is slowed by 80%. Electricity usage is also decreased, not at the spectacular level but by 7% comparing to non-dope dyeing.[24]

New eco-friendly materials and new aforementioned production processes as solution dyeing, can reduce at the same time the number of plastic microfibers which is shed by for example our clothing. Microfibers which are released into the environment while washing are very big concern for environmentalists as it is estimated that each year

[22] European Commission, Commission staff working document (2019*). Sustainable Products in a Circular Economy - Towards an EU Product Policy Framework contributing to the Circular Economy.*
[23] Wennberg M.V., Östlund A. (2019). *The Outlook Report Mistra Future Fashion Final Program Report.*
[24] IKEA (2015). *Textile dyeing*.

globally, around half a million tonnes of plastic microfibers are released into the ocean. This amount is equivalent of more than 50 billion plastic bottles. By solution dyeing process of colouring the yarns, this harmful brushing is reduced, ultrasound cutting is applied in the cut & sew process and some microparticles on fabrics are withdrew already during the production stage. There is no support nor scientific proof for the assumption that fabrics made from recycled polymers shed more than fabrics made of virgin polymers. This theory might find the source in the fact that textile is already washed and used many times so the pigment might stay less, but it is not proved any way. Another common shared myth is that by eco-friendly textile ultrasonic cutting method we use the energy more when we compare this process with the regular scissors cutting of the fabrics. The ultrasonic cutting reduce shedding of the textiles for about 50% and indeed the energy while cutting is used during the actual welding time. The ultrasonic cutting officially is considered to be an environmentally friendly process, due to low energy consumption (comparing to other non-traditional scissors) but also due to the fact that it does not require any consumables such as adhesives or hot glue, avoiding contamination at the same time. No adhesives also improves the further recyclability of the products complying with the circular concept.[25]

In fact there is no unified path of action for the governments and to fulfil the circular economy concept. The countries and especially manufacturers needs to make theirs individual decisions by for example choosing eco-friendly materials to theirs production. Moreover, right technology implemented on the national level is needed due to the wide range of materials that could be sorted and made available as feedstock for recycling.

As was previously mentioned, the textiles on the European market must comply with REACH regulations where included are the restrictions on hazardous chemical content. Responsible for the enforcement of the Directive REACH are the governments of the Member States collaborating with European Chemicals Agency (ECHA). With the mechanical recycling procedure, the material input which involve some hazardous chemicals might be transported over the post-consumer output. At the same time the feedstock which is not complying with REACH could be sold on the European market as REACH requirements do not apply to non-EU producers. Examining the feedstock before

[25] Wennberg M.V., Östlund A. (2019). *The Outlook Report Mistra Future Fashion Final Program Report.*

recycling is expensive and non-exhaustive. For that moment no precedent case is known for non-REACH recycled content and legal consequences for the retailers who bought contaminated recycled materials, but if this technique will gain ground, then this kind of challenges for the Europe might arise in future. This possible problem and risky change into recycled materials usage, cause already concerns amongst the brands and manufacturers. The EU should take a closer look into that challenge and provide guidance for protocols to prevent and manage this risks.[26] To tackle this challenge the European Union has released the traceability concept, where the origins of the material would be trackable and all specifics of the fibres would be recorded and easily derived, for instance through the use of material passports showing the specifications for every individual garment sold on the European market. The traceability concept will be more broadly covered in the next chapter.

How can we describe the textiles which are "Green Deal Friendly"? There is no specific classification in the EU regulation. But what we can deduce is that during the production of sustainable textiles, the emissions must be lowered, preferably to level zero, the discharge must be minimised and used chemicals must comply with REACH. The perfect production of them has to follow the circular path, so the production system should be closed-looped. The use of water must be lowered to the level of absolutely needed and freshwater withdrawal should be radically reduced.

Aforementioned guidelines are essential in driving immediate improvements and shift into more eco-friendly textiles in manufacturing practices. Nevertheless the sector must continue to strive beyond today's best practices. In order to comply with the circular economy concept, there is a need to rethink the materials which are commonly used in the textile industry and try to phase out the materials that are the most hazardous for the environment and peoples health. To strengthen this idea, the design of new eco-friendly materials which are or biodegradable or not shed microfibers has to develop constantly. With the increased awareness of the manufacturers, consumers and policy makers, there are many opportunities for a deeper research and development on this field, so that new

[26] Ibid.

materials will be less detrimental for environment and will be able to comply with the green principles of the EU future and hopefully the rest of the world.

1.5 Traceability as a step towards circularity of the products

Traceability is the ability to trace the movement of a good, in our case made of textiles, from the moment of production to the moment of successful recycle, which goes through the specified stages of the extended supply chain. Digital technology assists the visibility data which can provide important details about the traceable assets regarding where they are in time and why, and especially through which stages it has been processed.

Key factor into the shift to circular world within the garment supply chain is digital development in the field of the traceability. The traceability and transparency in textile value chains means information gathered by entities in order to support business processes and record events for sustainable trade. For effective traceability process, it is needed to provide manufacturers, distributors or other intermediaries answer to five question: who, what, when, where, why (includes how). Aforementioned questions should refer to the final product or the raw materials from which it was made. Concept of traceability envisage that value chain partners will store this information, and will be retrieving it from a common place such as an electronic product code information system (EPCIS) database, a blockchain or a cloud application. When this data is traceable, it is possible to retrieve some additional information, for example regarding the sustainability: where the product has ended up and if there are the chances to recycle it after a specific period of time. There are different traceability models which can be useful depending of the type of the product. The most suitable model can also be changed along the value chain. Can happen also that in the value chains implementation of more than one traceability model will be needed. There are 3 examples of traceability models: segregation, mass balance, and book&claim.[27]

[27] United Nations. Economic and Social Council (2021*). Recommendation No. 46: Enhancing Traceability and Transparency of Sustainable Value Chains in the Garment and Footwear Sector.*

The implementation of a traceability system based on product identification within the segregation model can be created in more advances supply chains, where the assets need to be tagged, traced, and the information have to be available in electronic format. Products which comply with particular sustainability standards are strictly tagged and differentiate from other products.

Product segregation method has two approaches within it. The first one is called "identity preservation of the product" requires in this situation differentiation of the certified material from the non-certified materials throughout the whole supply chain. At the same time the mixing of materials from different producer is not possible, because otherwise the traceability all the way back from the final consumer to a specific source (for example a cotton farm) would not be clear enough. Within the second segregation model there is "bulk commodity" approach, where the principal is very similar to the product identification but it allows the mixing of certified materials from different manufacturers. All producers must achieve the accordance with the certification standards. This model is popular within the organic raw materials industry (for example organic cotton).

The mass balance approach (a moderately demanding method) makes products from non-sustainable and sustainable possible to be mixed, but theirs exact amount must be kept. There is requirement that proportion of sustainable content indicated in the claim, must be exactly the same to the calculation of sustainable products or materials, which were used. By claim we mean the high-level statement about a specific characteristic of a product, or about a process or an organization associated with that product. This approach is good alternative for products where the sustainable segregation is more problematic such as for example cotton. The last approach called "book and claim" is applied to products which are impossible to segregate. Under this model we cannot indicate to any physical relationship between the amount of sustainable inputs in a specific product and the amount of sustainable content which is being claimed. The manufacturer of the goods is given a sustainability certificates to show the amount of actual sustainable input in the product and the amount that the producer want to claim. This kind of certificates served later as the basis to reward farmers who are producing the equivalent amount of sustainable inputs and who can prove it. Subsequently this input is going to be used for a production of other goods. [28]

[28] United Nations. Economic and Social Council (2021*). Recommendation No. 46: Enhancing*

The concept of traceability will encounter a lot of challenges for the textile industry. First of all, this market is characterized by voluntary guidelines, where lack precise European standards and regulatory inspections compared to for example food industry. Supply chain for textiles, especially for garments, is very complex where the transparency is hard to achieve. Textile industry is labour very intensive, in the sense that this industry gives job to many people and countries. At the same time many retailers do not have theirs own yarn or production lines and depends on cooperation with other companies, from poorer sides of the world where ethical principals which are part of circular shift, are often not a priority. That is why the unified, technological solutions are needed since the distance between the raw material and the final product is very often distanced not only geographically but also discontinuous with many intermediaries on all the production chain.[29] This imposes additional constraints on any traceability system. Digital technology would be obviously needed for Europe to achieve the circular plans. We cannot forget that not all the companies are that much technologically developed. The policies has to make sure that the traceability concept matches to the capabilities of all the stakeholders. Smaller stakeholders will have to gradually scale up theirs capacities so they can comply with the stricter sets of rules in the traceability system. The types of the information needed to make a systemic change into the circular economy using the traceability concept can be divided into two: basic information records and more detailed information. It is recommended that basics will be consisted with: the use of optional elements, references and codes. Moreover, the granularity of the information depends on the demands of a value chain phase. It could be a producer, trader, regulator, retailer or the consumer. The detailed information will be more concrete and advanced. Key performance indicators (KPIs) might be requested by business partners. Additionally, the certificates of achieving some standards, results of inspections or reference values, may be demanded as well.[30]

Traceability and Transparency of Sustainable Value Chains in the Garment and Footwear Sector.

[29] Mahmood S., Koski E., Järveläinen M., Vehmas K., Szuba T., *Traceability in a circular supply chain - Digitally Circular.*

[30] United Nations Economic and Social Council (2021*). Recommendation No. 46: Enhancing Traceability and Transparency of Sustainable Value Chains in the Garment and Footwear*

All the aforementioned examples which might be requested by information entities, should be designed to be technology independent. The technology gives to the industry already some solutions; blockchain technology, electronic product code information system (EPCIS) and application programming interfaces (APIs) or the latest technologies for the identification of relevant objects can be effectively used in the textile industry. The difficulty appears in choosing the best tracking methods. There is a wide range of software options available that enable direct communication between final consumers and stakeholders in the whole supply chain. The same would apply to communications between brands (retailers, distributors) and workers or farmers. The State of Sustainability Initiatives report (2014) sees traceability systems as the linkage between the eco-friendly initiatives and considers traceability systems as potential help, which could ensure the integrity of claims by providing accountability between standard-approved products. [31]

As a example of developed traceability system implemented into real business life, we can indicate the Indian company Birla Cellulose and its block-chain based traceability software made for its LivaEco natural based yarns and other fibres. Firs of all, we need to explain the block-chain concept, which can be described as a shared, immutable ledger which facilitates the process of recording, tracking and tracing the transactions of goods in a business network.[32] In the case of Birla Cellulose the tracer used was a molecular tracer, which is a method enabling identifying the fibre way of the final garment and its origin from the principal fibre stage. This is a globally known and accepted model, where we can see the source of a fibre and its verification can be done at any stage of the fibres journey. This blockchain-based traceability system enabled share of secured information, facilitated product quality control, operation control, exact-time data acquisition, transparency and visibility throughout the whole supply chain from the fibre production to the final garment.

The effectiveness of the traceability concept will depends on the scale, because good traceability means costs; only if more companies will join and more products will be

[31] Potts J., Lynch M., Wilkings A., Huppé G., Cunningham M., Voora V. (2014*). The State of Sustainability Initiatives - Standards and the Green Economy.*

[32] Agrawal, Kumar, Pal, Wang, Chen (2021). *Blockchain-based framework for supply chain traceability: a case example of textile and clothing industry*. Computers & Industrial Engineering.

involved, then this will lead to lower costs. Full disclosure of data might be dangerous and could alleviate the problems associated with illegal or migrant labour, at the same time the large amount of data collected and later analysed might be discouraging for the companies.[33] The data will include information on every stage from the manufacturing and ending at the final consumer: textile fibre origins and production methods, textile processing, chemicals used, sewing threads, accessories as for example buttons, environmental footprint, social conditions and distribution information.

The challenges indicated in this chapter and the research made by DAI Europe, shows how traceability concept is complex especially for the garment value chain which is very extended and developed. There is little consensus with different organizations, stakeholders, regarding the adoption of a single system (or standardized) that would satisfy all.[34]

[33] Richero R., Ferrigno S. (2016*). a background analysis on transparency and traceability in the garment value chain. Directorate General for International Cooperation and Development, European Commission.*

[34] Ibid.

2. Fashion Industry - realising the vision of circular economy

2.1 Fast fashion problem

Fast fashion is a considerable environmental and ethical concern due to the way and the conditions under which the clothes manufactured and consumed are treated. Fast fashion concept describes low-cost, mass-produced clothes, which appeal to consumers because they are affordable and trendy at the same time. But because of theirs weak construction, they are not designed to last for long, quickly going out of style, these clothes are shortly after the use discarded ending up in the landfills. With such consumers need for fast fashion and ability to buy due to low prices, fashion companies have moved from designing clothes seasonally to releasing many more collections per year. The well-known common fast fashion brand includes of for example such as Zara, H&M, UNIQLO, Forever 21, or TopShop.[35] With the ability to buy more and often, average consumer is more likely to throw away cheap, trendy clothes than more expensive, timeless garments. According to the alarming data from Environmental Protection Agency (EPA), globally 17 million tons of textile waste were generated in 2018, of which only 2.5 million tons were recycled. Each year, the consumers are missing out around 460 USD billion of value by throwing away the clothes which they decided not to wear anymore, not because the garment got broken but just because they decided to buy a new, more fresh clothes from new collections.[36] It is estimated that more than the half of clothes from fast fashion brands are manufactured and disposed in under one year. In the last 15 years, globally, clothing production has approx. doubled. The reason is fast fashion, with its quick turnround of new collections, and easy achievability due to its low prices.

They are bold voices for example from the European Federation of Sustainable Business that fast fashion marketing should be discouraged, by for example restricting fashion sales to 2 weeks per year. The question then is if it will not be an unfair trade limitation forbidden by the law. The antonym and sustainable alternative to fast fashion is slow fashion, which is more thoughtful shopping, buying ethical, sustainable and better

[35] DiLonardo M. (2021). *What is the Fashion and why it is a problem?*

[36] Ellen MacArthur Foundation (2017). a *new textiles economy: Redesigning fashion's future.*

quality garments.[37] It is a movement focused on sustainable production and shopping, challenging at the same time social cultures surrounding the industry and encouraging manufacturers, retailers and final consumers to take a more ethical and reasonable approach to trends in fashion industry.

Nowadays slow fashion has to be considered as a future for the textile and clothing sector in order to save our environment and comply with the circular economy concept. We already should follow the slow fashion guidelines by paying more attention to the quality and timelessness over current trends. At the same time we should be aware of the sustainable and fair labour practices and pay attention to this while choosing a brand we trust. But the most sustainable action consumers of good as clothes can do is switched into buying a second-hand items instead of new clothes.

It's the consumers who think broadly and are aware of the change needed in leaving the fast fashion patterns, who think about the impact of their shopping decisions on the environment and society before making a purchase, will be the major influence in the fashion industry. These customers who pre-consider shopping new garments will lead the way towards more circular fashion industry.[38]

2.2 Circular Fashion

Nowadays the fashion industry based on take-make-dispose is not sustainable in its current form. The Co2 emissions are increasing, the environmental footprint is accelerating due to raw material consumption, further pollution and final waste. The need for a more circular system, where garments and materials are reused, is needed.

As we already know the principles of circular economy, we should take now a closer look into a specific fashion industry and its adjustment to the new circular economy future of textiles. Radically improving recycling would allow the industry to capture the material value of clothes that can no longer be used. Especially now when material recycling schemes have become more popular and new technologies are emerging to ease the process for the consumers as for the retailers. Using recycled materials rather than virgin

[37] DiLonardo M. (2021). *What is the Fashion and why it is a problem?*

[38] Ellen MacArthur Foundation (2017). a *new textiles economy: Redesigning fashion's future.*

once also offers an opportunity to decrease non-renewable resource inputs and the negative impacts of the industry on the environment.[39]

Taking action is required to capture the opportunity to introduce clothing recycling at scale. To do this we need cooperation and involvement at all of the value chain stages starting from designers, manufacturers, retailers, textile collectors (including public entities such the municipalities), recycling companies, as well as innovators but also consumers. There is few areas of action which could start the process of capturing that value of the garments and reusing its value in new product, complying at the same time with the circular economy. First of all the fibres used for creation of the garment must be eco-friendly and clothing design has to be made in a way that the clothing once bought will last long. Moreover, the traceability of the garment must be available so that the recycled materials can be back to its origins in order to be remade into new garments and also so the consumer would know from where its purchase is coming from. Transparency on the materials flowing through the system is the key principal to improve recycling rates. One of the most important points in the whole process of circularity in the field of fashion is recycling, which should be made a new norm in order to circular fashion design and sale. Socio cultural/physical barriers might be a problem as we do not want to wear clothes, which were used by someone else in the past. To deal with these problem the engagements of brands is needed. The customer engagement might be boosted by new service value propositions by implementing take back and/or repair schemes. Good communication also plays a important role with the consumers cooperation. Targets and goals of specific brands should be clear to the consumers so they feel the engagements on a personal level – for that the shift in the marketing could help. More clear specifications on material grades suitable for recycling process will make brand more available.

Currently globally, 87% of material used for clothing production is landfilled or incinerated after its final use.[40] There is many reasons why. First of all recycling of all kind of fibres is not possible due to technological limitations. For example, mechanical recycling processes are shredding some materials trying to recapture the fibres, which

[39] Ibid.
[40] Ibid.

made its quality worse in comparison to virgin materials. On the other hand, chemical recycling technologies which could return fibres to virgin quality, are not yet technologically or economically advanced enough. We face lack of large-scale systems designed to collect and sort used clothes, either connected with manufacturers or brands or independent one. Poor waste management is concerning and leads to a loss of the value in the material and eventually this value ends up landfilled, occupying the landfill space. We cannot forget that clothes discarded that way still cause negative impact on the environment, because natural fibres while decomposing do generate gas methane. Plastic based fabrics as polyester which can survive over 200 years, stays in the environment for decades. Optimising the materials palette for the recycling would be helpful, as there exist a lot of not eco-friendly materials which are hardly recyclable after use. The cooperation between the policy makers, designers, material experts, and recyclers is needed to identify them and slowly extract them from the manufacturing or finding new innovative alternatives of recycling. Those measurements should be fully supported by brands and the collective politics actions.

Couple types of recycling exist in the fashion industry; fabric recycling takes pieces of complete fabric and re-sews them to create (partially) new garment. The second type considers yarn recycling, which has to be more precise. To be able to unravel a piece of garment, the clothing made out of that yarn must be knit in a way that makes it possible to get the yarn back in the pieces. This type of recycling its not possible with every kind of the yarn, only for specific garments, which means it has to be collected separately. Then for fibre recycling, we used often called "mechanical recycling" by sorting out garments by its colours and material, later then shredded and processed them back into fibres. The fibres are shortened through the shredding and at the same time they loose the previous quality. Due to that fact, later a supplement for new yarns are needed as for example recycled polyester or virgin cotton to fill the emerged gaps.[41]

[41] Ibid.

2.3 New innovative business models

There has never been a better time for fashion retailers to support the circular fashion. We are living in the moment where the consumers preferences are often shifting, the technological developments were never this much advances, infrastructure possibilities for improvements are growing and the new circular design practices are widely discussed and the knowledge on that field is constantly is enlarging.

Some progress has been made into the more circular fashion and we can see it for example through constantly emerging start-ups, which are implementing a wide range of circular models. New business models are needed and they must be designed with wise sustainability oriented way and enhance the potential environmental benefits. Accenture Strategy and Fashion for Good have collaborated in order creating the report, exploring the financial viability of new possible fashion circular business models. The focus was putted on 3 circular business models; Rental, Subscription-Rental and Recommerce. They all can be financially feasible for fashion retailers who already exist on the market. New opportunities can emerge from the models and they could drive a higher margin per circular clothe compared to the current linear model. [42]

"Rental" is the model where the focus will be put on short term period sharing a garment. One off rental of the clothes will be time-limited and without possibility to purchase, so that the clothe will circulate among others after wearing by one person. Rental is nowadays under transformation from an outdated model to an innovative one thanks to fashion tech companies who are constantly developing new innovations in the fields of optimizing processes for returns, inventory management, all data collection etc. in this sector. Rental is a great solution for customers which previously were not able to afford expensive garments for a special occasion. The opportunity for this model is challenging in value market due to fact that the high variable costs for rent comparing to the low price-point for purchase the garment. Based od the survey carried out by Westfield depict that nearly half - 46 per cent- of the respondents said that they would use rental shopping

[42] Fashion for good (2019*). Circular Fashion - Assessing the viability of circular business models.*. Collaborative report by Accenture Strategy and Fashion for Good.

because of the choice in order to live in more environmental friendly way. This model would best in the luxury clothing market. Beyond Luxury, making rental workable seems challenging, especially in the Value Market, where the maintenance cost, packaging, sending packages etc are extremely exceeding the possible revenue for renting a garment. Une of the world's leading sustainable fashion retailers -Filippa K- made his own sustainable more and has allowed its customer to lease the brands' clothes for four days with the reduction in price of 80%. This case study was made to see the consumers behaviours and has illustrate that rental must be designed with the customer at the focus, as they will play the most important part of the circular shift.

The second model is called "Subscription – Rental" where the concept is based on a monthly paid access to 3- 4 garments. These garments can be exchanged by the consumers at any time. In this type of a model the purchase will be possible by a consumer at a reduced price. But if the consumer is not sure if he or she want to buy the item, this Subscription models is a great way for the consumer try new clothes and later decide about the purchase in a very low risk way." Subscription-Rental" is definitely attractive for younger generations, who value experiences over things. This model might be also a important source of new information such as the customers individual preferences. Retailers can have insights on how customers experience the usage and if they finally like them enough to make a final choice of purchase. This deeper knowledge can inform manufacturing and product future design and at the same time optimize production of new garments and help in reducing waste.

The third model to discuss is "Recommerce" and its principles are built on the recovery and resale of the clothes, which were previously sold by the original retailer.
This model is becoming easier to implement on the market thanks to technology, optimised collection, increased merchandising and curation platforms. Moreover, incentivizing system for participation pays important role in the process. This will be a challenge for retailers to encourage and convince the customers to return the garments to theirs origins as a distributor/producer. Especially when the every day men, has a lot of other possibilities nowadays to resale its purchases on many different platforms as eBay, Vinted etc. Retailers will have to put a lot of effort and finances into marketing

promoting this desired behaviour from the costumers and also they have to make sure that the customers are sufficiently motivated and incentivized to return garments to the brand where they have bought it. The other challenge is to encourage people to buy previously used clothes. The newest studies gives hope, given the information that perception of previously owned garments has changed recently. They are no longer perceived as dirty or outdated. The new vintage trends are emerging. Recommerce definitely provides a great opportunity to engage first time at this level, customers with a retailer.[43]

We should take a closer look into how new business models can become financially viable, doable and successful in the future. They should not require big, unfeasible financial outlays and at the same time try to embed the new circular principles in order to improve the clothing quality to prolong theirs usage. To do so we need important change in consumers perception of affordable fashion.

2.4 Consumers attitude towards new circular economy in fashion

For young generations of consumers who were born into the sharing economy and got used to it, by sharing the drives or apartments, adopting circularity is a natural step. New generations are more socially and environmentally responsible, and at the same time they have higher expectations of fashion in terms of environmental influence and ethical aspects in their production processes. for fashion brands that means that if they want to attract young consumers, they need to evolve towards new business models based on ethical, sustainable, and circularity in the fashion. The problem of not understanding the need for sharing and the environmental aspect of it are the older consumers. Changing theirs mindset may require education and encouragement. Some consumers still see the hygiene issue with used clothes, which you can find in for example second hands, they still consider them as "worse quality" due to the fact that they were used. Others do not understand the sustainable values, because they were never fully acknowledged to them. Nowadays even in the kinder gardens the recycling need is broadly explained, but 30 years ago this topic was not often covered in the schools.

[43] Ibid.

Latest studies shows that consumers' interest towards recycling and sustainable solutions is increasing.[44] The idea of recycling textile waste is appreciated and there is the assumption, more broadly popularized, that circular products should become "the new normal". Consumers are asking questions and want to obtain more visible and concrete information about circular clothing. That clearly shows that they are willing to be a part of circular economy. They also want to know how their behaviour can contribute to the environmental aspects of textile production. One of the most important factor in the purchasing of garments process is price. The eco-reason purchase alone will not be enough to make the necessary changes in consumers' clothing choices. [45]

It is because clothing sustainability is too complex and broad, consumers are too diverse in their ethical believes, and clothing is not any kind of altruistic purchase; sustainability is not popular enough and is not considered as a priority when it comes to garments purchases. Studies also found that unfortunately young consumers do not put sustainable fashion as a priority, separating at the same time fashion from sustainability even if they support the idea circular fashion. They are more interested in their own personal fashion needs. The lack of information about the product they are buying is also crucial factor. If the client of a shop think that there is no actually choice -since most of the garments are produced in developing countries- it is harder for the potential consumer to put additional effort into looking for more sustainable clothes, while most of the clothes which are more affordable, are at theirs fingertips. Most people lack knowledge of how the parts of theirs clothing are made, or what the environmental negative consequences of artificial fibres such as polyester and intensive cotton (natural) production really is.

The clothing brands has to participate actively in encouraging consumers to buy second-hand and sustainable clothing and recycle used clothing through appropriate communication and well founded marketing. No doubt, there a lot of space for marketing professionals to explore this sustainable field of advertising in the future. Social interactions, was never easier as it is now. The web has become the main channel for sustainability initiatives. Social media, such as Facebook, Instagram, Twitter, Youtube, blogs, wiki, vlogs and the many other social platforms, has proliferated in past years,

[44] Rodríguez, P.H (2017). Circular Economy: Application in the textile industry.

[45] K., Raudaskoski A., Heikkilä P., Harlin, Mensonen A. (2018). Consumer attitudes and communication in circular fashion. Journal of Fashion Marketing and Management.

allowing businesses to create a real social media sustainable strategies to exploit the great potential provided by these channels. Social media are used on everyday basis, to reach a wider audience and make companies to participate and contact consumers who are showing interest in sustainability issues.

To make this circular change, fashion brands need to develop the efforts in the few areas: first of all the consumers must be acknowledged better about all the sustainability issues. They have to know much more about the concept as about the production process, explained in an accessible and understandable way. The traceability is a priority in that case. Moreover, to encourage consumers to repair or return used clothes, the brand should create some kind of financial strategy in order to drive consumers' uptake, while the cost for brands will be offset by retaining materials for reuse.

The rental of clothes, which was mentioned in previous points rase out, should be very much promoted as it is a important route to a sustainable future for that industry. Promotion in order to broaden the appeal for renting garments, should take place especially in the segments of people not that young, who were not raised in the environmental awareness.[46]

All researches shows that growing attention among the consumers and, in particular the younger generations, in terms of to necessity to be more sustainable and for the concept of circular economy, is in fact reflected in the new strategies as well as new business models of fashion companies, leading to a transformation of sectorial boundaries. This positive perspective can help develop further some other interesting research perspectives for management scholars, in particular for marketing and business strategy studies.[47]

[46] Internationale Nederlanden Groep (2020). Learning from Consumers: How Shifting Demands Are Shaping Companies' Circular Economy Transition.

[47] Gazzola P., Pavione E., Pezzetti R., Grechi D. (2020). Trends in the Fashion Industry. The Perception of Sustainability and Circular Economy: a Gender/Generation Quantitative Approach. Sustainability.

3. Carpet Industry – realising the vision of circular economy

3.1 Circular Carpets

By word “carpets” comes very different connotations but mainly we associate with this word the piece of material laying in our rooms, decorating the interiors. But carpet plays important role in whole floor industry as it includes wide range of different types of flooring: loose lays rugs, wall-to-wall floor coverings, carpet tiles, exhibition and event carpet which are used for both residential and commercial buildings. The carpet recycling, despite growing awareness of manufacturers and consumers about environmental issues, is still low. With the new Circular Economy Action Plan (CEAP) in play, the recycling abilities in this industry need to be strengthen and the focus should now be put on improving technologies in order to maximise the value of the end product. We have to bare in mind that recycling of the products such as carpets, which very often are mixed of textiles and other materials, is more complicated and the volumes of the carpet which are available for recycling should be increased. Currently we see a positive development in new innovations for carpet recycling particularly regarding fibre extraction, reduction of contaminant elements, purification of output. All in all, this shows a promising increase in circularity concept of carpet products and materials used to create them. Post-consumer waste stream play important role in adjusting carpets to circular concept. Collecting and sorting schemes (as the carpet that must be kept dry, uncontaminated and able to sort) has to be more structured and harmonized among all countries so that the product's potential value is maintained properly.[48]

The circular approach of the carpet market, based on the report of European Carpet and Rug Association (ECRA) is integrated, multidimensional, cross sectorial and value chain driven. The aim is to have the full potential for circular economy by 2030, which is ensured by a long-term stability, healthy competitiveness where the economic growth on the market come together with the environmental awareness and protection.

[48] European Carpet and Rug Association (2021). *Leading the carpet industry towards circular economy- a 2030 strategic approach.*

Similarly as within the fashion industry, the carpet industry has to implement the initiatives for the long life cycle of products, starting from its design, through production until the consumption, later focus on recycling process (collection and sorting) not forgetting about the reducing carbon and material footprint. The quality and content of materials is also very important and transformation should address the more common use of eco friendly materials. Vast part of the manufacturers are reluctant in changing the materials usage due to lack of the experience with new one. That is why more research of eco-available materials and theirs treatment is needed. Moreover, the implementation of restriction on single-use carpets for instance used for the short time events could be a good start for minimizing the waste with the ambition of target zero waste to landfill. To mobilize the potential of product traceability the innovations are very needed as well to support better management of natural resources including renewables ones during the production process. [49]

Four key pillars provides the foundation for a circular shift in carpet industry: standardization, innovation, permanent use of circular materials and sustainable products on the market adhered to circular principles. Carpet associations already has taken closer step into the materials quality assessments and its compliance with health standards and effective recycling, even before they were targeted by National or EU Regulations. The industry put as a priority reducing product-related VOC emissions (type of harmful gases) and already has phased out or put a ban on substances of very high concerns.

3.2 Sustainable solutions - recycling of carpets

Already some initiatives has taken place in order to produce carpets designed for better recycling. Those carpets where it is possible to separate the yarn from the backing are easing the separation into two (mono)-material streams. In this case the product as a whole will be not fully circular but the raw materials will. There are two types of new approach towards recycling in the industry: mechanical one and chemical. To understand each of them, we need to know a structure of the different kind of a carpet. The vast majority of textile fibres, from which carpets are made as well, are made of polymers.

[49] Ibid.

Polymers, whether artificial (such as the plastic) or natural (as wool), are made of repeating chains of smaller chemical units, which are bonded one to another.

Mechanical methods for carpet recycling have been utilized to separate the components of the product. The extracted components are further recycled into products that generally compete with products produced from virgin polymers.[50] But in some cases, this mechanical process face some problems; coloured yarns can be challenging for mechanical recycling because during the process of extraction they might change the colour putting at the same time obstacles to creating a steady supply of coloured secondary raw materials (as yarns) for new products. Oxidative degradation from mechanical recycling processes, is later responsible for a further decline of mechanical features. For the second recycling approach for chemical-based textiles as for example viscose polypropylene or nylon, the industry has implemented a chemical recycling strategy to get back the chemicals from certain materials so they can be reused. Sometimes mechanical and chemical recycling is cooperating together as in case of nylon recycling when waste carpets are primarily collected, later on sorted and then subjected to a mechanical shredding process before chemical depolymerization – which is, simply saying, breaking the polymers into monomers (smaller parts).

To understand better the possible recycles routes for carpet materials, below the graph:

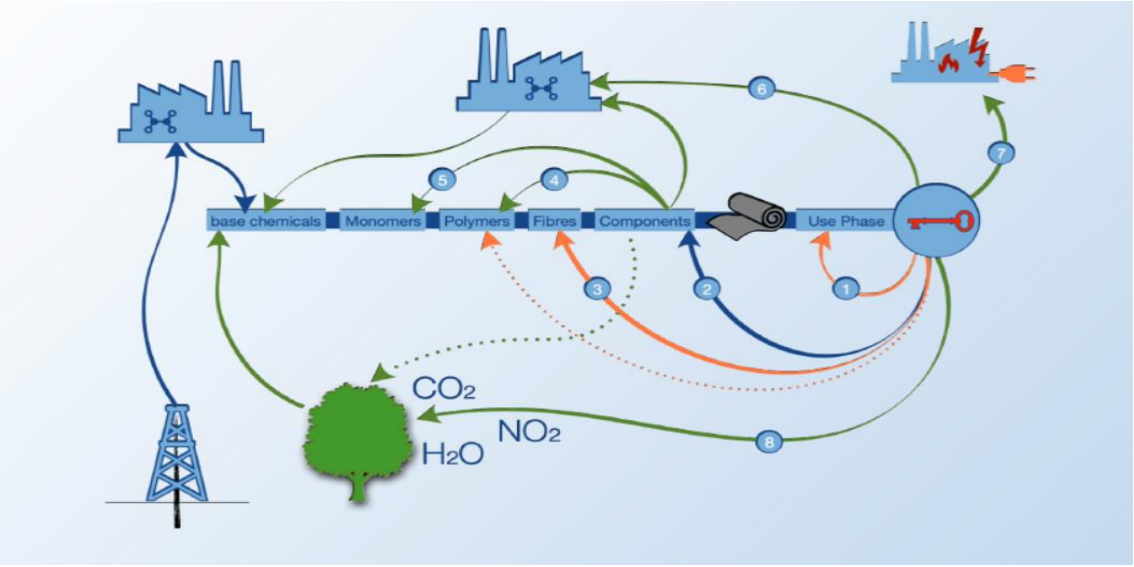

Figure 1.
Source graph: European Carpet and Rug Association (ECRA)

[50] Wang, Y. (2006). *Recycling in textiles*, Woodhead Publishing, Cambridge.

In the figure 1, the route number 1 illustrates the reuse of carpets, wherever is feasible, route number 2 associate the way back for main components: separation from use-layer and the backing (as for example bitumen one). Further route number 3 illustrates the direct reuse of fibres where possible. Route 4 means that extracted polymers from mono-material (easier to recycle) components can be reused in a certain way. Further route 5 shows the possible chemical recycling of mono-material components. Route 6 illustrates the chemical based carpets from polymer mixtures that cannot directly be recycled to monomers (from which polymers are originally made). Route 7 shows the combination of recycling and energy recovery- carpets are diverted from landfill. Route 8 illustrates the full biodegradation of materials, which are coming from sustainable sources.

We cannot forget that new sustainable solutions (for the production and recycling) have to create proper output with a concrete economical value and guarantee the same level of quality and performance as non-sustainable one. The price of the production cannot exceed the standards since it can discourage manufacturers to take part in the circular change. Shift to a full circular economy needs the cooperation of all players in the value chain but as well the politics involvement. Consumers of course play one of the most important roles. They have to be acknowledged about more sustainable solutions while purchasing, consuming and dismantling theirs carpet products. Change in how the carpet are created, manufactured, consumed and handled at the end of life requires the cooperation across the industrial value chain and society as a whole.

3.3 Cradle to Cradle design

Cradle to Cradle, sometimes shortly described as C2C, is a approach to the regenerative design of products and systems that shapes industry on nature's processes, where materials from which the product is made are seen as nutrients circulating in healthy, safe metabolisms. The product, which adhere to this concept, obtain a Cradle to Cradle Certified™ - globally recognized standard for safer and more sustainable products applying to the circular economy concept – acknowledged by Cradle to Cradle Products Innovation Institute. The Institute develop the vision of the world where safe materials and products are designed and manufactured in a prosperous way, adhering to the circular

economy principles in order to maximize health and wellbeing for people and planet. Wide range of goods, from cosmetics to flooring, t-shirts and jeans to water bottles and house appliances- thousands of products have C2C Certification. With reference to the ideal cycle of product, end-of-life carpets should serve as a ingredient for new manufactured products or as a nutrients in the biological cycle, limiting the waste.[51] Designers responsible for the idea of final product as well as manufacturers during the production process and brands around the world rely on the Cradle to Cradle Certified product standards as a transformative, modern pathway for creating products with a positive impact on people and planet. To obtain the certification, which is needed to be renewed every two years, products are strictly assessed for environmental and social performance across five categories to check if they match with the sustainable prerequisites. Those conditions are filling the field of: material health, material reuse, renewable energy and carbon management, water stewardship, and social fairness.

Material health consider ensuring that manufactured goods are made using raw materials that are as safe as much for people as well as for the environment. Material reuse condition illustrates the concept of elimination of waste by helping to ensure that products remain in the cycle of use and are further reused. Renewable Energy & Carbon Management prerequisite help to make sure that chosen product is manufactured using renewable energy to reduce or eliminate the influence on climate change by decreasing its greenhouse gases emitted during to the manufacturing process. Water stewardship means that watersheds are protected and used only when it is necessary for the production, it ensures that much of the water, as recognized as a valuable resource, is saved for people and all other organisms. Later social fairness is not left without recognition. Social Fairness assessment ensures that while producing the good, some progress is being made towards sustaining business operations through protecting all parts of the value chain and at the same time, its actions are contributing to all stakeholder interests; including possible suppliers, employees, customers/consumers, community members, and of course the environment.

[51] Cradle to Cradle. https://www.c2ccertified.org/

The aim is to design business that honour all people and natural systems which are somehow connected with the manufacturing of products. All products accredited with the C2C certificate are easily to find on the official website of the institute, which may influence the purchase decisions of the consumers. The Cradle to Cradle Certificate gives a mark and score on different levels on a concrete product in terms of theirs compliance with sustainability principals. That further helps architects and specifiers have a confirmation about the environmentally friendly attributes of a product as a whole.
Cradle to Cradle Certified products means that the product is optimized for human and environmental health, or that products' materials have been assessed in terms of not carrying any chemicals, hazardous ingredients which might cause the risk for humans or environment, based on strict standards. Carpet, as floor coverings are treated as building materials, which are subject to EU Construction Products Regulation (CPR). They are used very often as floor covering in commercial buildings, where the sustainability concept is well appreciated, gaining more interest. The level of sustainable solutions used while constructing a commercial building can be rated in different levels and by different institutes, resulting in prestigious eco certificates, which can further attract the possible tenants. C2C certified products used in, for example office building, can contribute to gain credits under LEED (Leadership in Energy and Environmental Design) green building rating system. It is the most widely used green building rating system in the world. The building gets the points for eco-friendly solutions, as C2C certified products for theirs interiors, creating simultaneously healthier, modern spaces with cleaner and free from harmful chemicals air. At the same time, LEED helps investors to implement eco-practices, where as a priority the building efficiency is placed, decreasing operational costs is visible also the value of asset is increased together with the productivity, comfort, health and wellbeing for occupants is maintained and very much taken into account. LEED is suitable for both, new and already existing buildings, to start the sustainable change and become more greener and high performing buildings.

When taking into account carpet industry, the C2C certification plays important role in terms of sustainability shift. We can see growing awareness in manufacturers approaches and the sustainability seems to be something to prestigious to boost about, gaining more and more interest in the market. Within the interest of industrial ecology, flooring

companies such as Interface, Desso, Balta Group and are currently implementing a "Cradle to Cradle" concept, using the materials which are reprocessed and reused to become new product, once they have exhausted their first useful life. Taking a closer look into Desso company – carpet manufacturer- which has become the first carpet tile manufacturer in the world to achieve Cradle to Cradle gold level certification for one of theirs carpet tiles collection. This collection characterized with an EcoBase backing, that was contained with upcycled re-engineered calcium carbonate (chalk) from local drinking water companies, which is 100 percent recyclable in Desso's own production process. Moreover, the collection contained ECONYL yarn, which is a 100% regenerated nylon. What is the difference between a carpet made with ECONYL and any other carpet material? ECONYL carpet are made with a special yarn, which is obtained from the regeneration of pre and post-consumer waste. As a example of waste used in the process we can mention; fluff, fishing nets taken from the see or other used textiles extracted from products as garments. The positive side of ECONYL carpets is that theirs performance is the same as those made from yarn coming from fossil raw material but production of those is having much less environmental impact than traditional nylon. The hope, for companies such as Desso and other beforementioned, is that eventually they will reach the stage where not only specific collection will be sustainable at high level, but maybe all theirs raw materials will one day come from already existed products.[52] This kind of examples can lead us to the idea of "forever carpets" – in essence, certain volume of materials to needed to become floor covering would be kept in reuse forever, giving the product life after life in closed loop material flows. This illustrate a perfect shift from linear model to circular one in integrated carpet system, where everything has its proper use.

We have to point out that it is often very difficult for a single one enterprise to achieve this cradle to cradle ideal. The circular shift would be definitely more effective when applied to multiple enterprises, so that waste from one organization/manufacturer becomes the raw material for another. In that kind of ideal system there would not be a need for extensive transformation of production system.[53]

[52] Innovation for Sustainable Development Network (2019). *Implementing Cradle-to-Cradle concept to create products with the right purity that can be recycled at high levels.*

[53] Ness D., Field M., (2004). *Cradle to Cradle Carpets and Cities.* CSIRO Sustainability Network.

3.4 Environmental Due Diligence

Due diligence is an very important concept in environmental regulation and compliance. Environmental due diligence is a form of proactive environmental management within a business world, which can take different forms of assessment and be accomplished through several methods. The objective is always clear and principal: confirmation that your organisation adhered to environmental regulation and is safeguarded against environmental accidents such as water contamination (for example during dyeing the textiles needed to manufacture a product).

European Commission has already taken some steps for creating binding legislation in that field, including publishing researches and conducting public consultations, towards a possible legislative initiative on mandatory due diligence for companies. Its 2021 work programme is including a proposal for a Directive on Sustainable Corporate Governance that would bring up the subject of environmental due diligence.[54] Some voluntary measures has been implemented so far. As a example we can mention about the German Partnership for Sustainable Textiles. This initiative has shown that enterprises are willing and eager of making the change and are able to meet theirs due diligence obligations along the supply chains. Unfortunately, the researches has revealed that voluntary actions have its limits. It is worth mention bout two documents- UN Guiding Principles on Business and Human Rights and OECD Guidelines for Multinational Enterprises - which make strong statement, that businesses have a responsibility to respect human rights and the environment and should undertake effective due diligence.[55]

Now, the EU has decided that adequate time has come to introduce a binding framework for companies of generally applicable minimum mandatory requirements for corporate due diligence obligations, including environmental issues on which this dissertation is predominantly focused on. New legislation will influence a lot on the carpet industry, as vast amount of carpet manufacturers is based in Europe. The EU Textile Strategy, which include carpet, must explicitly recognise that textiles has to be considered as a high-risk

[54] European Parliament (2020). *Towards a mandatory EU system of due diligence for supply chains.*

[55] Organisation for Economic Co-operation and Development (2020). *Global Forum on Responsible Business Conduct: Partner Side Session, Building environmental resilience and responding to global crises through supply chain due diligence.*

sector with regard to this kind of obligations. It is almost certain that more complex supply chain of carpet industry, due to non European suppliers of materials or long list of distributors, will require specific binding procedures to address the challenges.

The new strategy of EU includes binding obligations that would be required from the companies to identify, prevent, address and remedy their environmental risks and impacts across their entire value chain. Moreover, the transparency in actions plays also important role as organisations will have to report publicly on these processes. This will help consumers and enforcement bodies to verify compliance. The commercial flooring, as carpet in rolls or carpet tiles, are very often subject of public tenders as for interior finishing of the commercial building. Going further, if the compliment of the environmental due diligence would be mandatory – then this kind of requirements might be subjected to the descriptions of the public tender. This idea in practice, would imply not really a direct punishment for the manufacturers who do not adhered to the environmental due diligence concept, but it would actually prevent them for offering non compliance products in the commercial spaces.

The EU-wide due diligence law has to be applicable to all kind of business enterprises domiciled or based in the EU as well as to companies which imports goods into the EU (as distributors), including those in the carpet industry.

To be more effective, the European Commission cannot forget about the Textiles Strategy and has to cooperate strictly with already existing policies withing companies in a sector of high risk for possible environmental harm, as carpet industry.[56]

[56] Fair and Sustainable Textiles - Civil Society Coalition (2020). *European Strategy for Sustainable Textile, Garments, Leather and Footwear.*

4. Case study- practical examples of the circularity in the textile industry.

4.1 Aquafil & regenerated yarn

Company Aquafil is a leading manufacturer of filaments for textile floorings in Europe. For more than 30 years of existence on the market, Aquafil is placing the circular economy as a principal value in order to save the resources, give new life to the materials which are confirmed as a waste, and to increase the efficiency along the value chain. Currently, Aquafil is the biggest supplier for carpet manufacturers operating in the following market areas: residential as houses, commercial buildings as hotels, offices and others, automotive as car mats and upholstery. The field of theirs work is mainly knows for creation of the ECONYL carpet yarn, which can be provided within the manufactory in 176 solution dyed colours that are available.

For manufacturing the regenerated yarn called ECONYL, Aquafil uses the valuable waste. Each year, 640,000 tons of fishing gear are left or abandoned in the global waters: seas and oceans. Todays researches show that discarded fishing nets are highly contributing to the nylon waste in our oceans that makes up globally 40% of all plastic pollution. Leavings of fishing industry which are left in the sees are threating the marine life as whales, turtles, seals. For this fact Aquafil is a co-founder of the initiative "Healthy Seas, a Journey from Waste to Wear". This organization works with volunteers who collects end-of-life nets, which further might be mixed with other nylon-type waste (as unwanted carpets), later cleaned, shredded, depolymerised to extract nylon, then polymerised to be fully converted into the regenerated nylon called ECONYL in order to become a new commercial textile products. Regenerated this way nylon is exactly the same as brand new nylon. Moreover, can be recycled, recreated and remoulded endlessly. That means you can create products and buy new textile goods without having to use new resources. The product made from regenerated nylon is absolutely the same in terms of characteristics as its petroleum-based traditional version, but made entirely from the waste, where any new raw material from the planet are taken**.** There are two different types of fishing nets which are extracted from the waters and used for new sustainable yarn: the one directly taken from the oceans - rescued by volunteer divers - and nets coming from industries dealing with fishery and aquaculture. The fishing nets are first

cleaned and sorted out, further sent to Aquafil's Slovenian regeneration plant, where all recycling process is activated.

Later, this kind of sustainably remanufactured yarn serves as a base for a new products such as carpets or garment nylon-type goods. Aquafil as a leader in sustainable solutions, is trying to fully embrace the environmental mission. That is why while processing the yarn, is using almost 100% of electricity from renewable sources for its recycling activities. This great output was possible to make thanks to the purchase of Certificates of Origin (GO), works as a guarantor that the electricity purchased comes from renewable energy sources. Moreover, to self-produced energy, the company used theirs owned obtained photovoltaic panels. It is worth saying that ECONYL carpet fibres are eligible for LEED points for eco-friendly buildings – more information on that system is given in chapter 3. At the same time, ECONYL created new possibilities for architects and designers for more sustainable interiors. Investors, tenants can equip the interior with good quality carpets wall to wall, carpet tiles and rugs while being part of a circular change using the innovative sustainability solution. ECONYL (nylon), made by Aquafil is one of the most sought-after materials, used by more than 1,000 brands worldwide from different market segments, including BMW, Stella McCartney, Prada, Gucci and Adidas.

International companies which uses regenerated nylon, made by Aquafil are the once who are a example of circular economy pioneers. This way of doing business is sustainable by minimizing the waste together with ecological impact and maximising at the same time the value of a product over a longer period of time and using fewer resources for its production. The key is to ensure manufacturers as well as future consumers, that waste has its value on the market, and its regenerative. Only this way we can achieve greater circularity. Thus ECONY is not just a yarn. It fully represents companies' vision and new way of thinking and approach to sustainability. It puts together the desire for innovation, the need for constant improvement and full commitment in order to protect the environment.[57]

[57] Aquafil. https://www.aquafil.com/sustainability/econyl/

4.2. We Fashion & recycled fibres

In 2018 the Dutch company „We Fashion" with clothes shop chain in various Northern European countries presented the pullovers with recycled content. Usually the development of new yarns and fabrics are not part of the procurement process within this company, but due to the aim of the project of European Clothing Action Plan (ECAP) they also have created a sustainable fibres.

WE Fashion participated in this project during the period of 2011-2013 and showed that recycled fibres from textile material can be reused to create new clothes. The company decided to use two old uniforms to produce two knitting styles for men. Two type of yarn were involved into the project. They were developed, subsequently produced in bulk by the spinner, and ultimately supplied to the producer- in this case We Fashion company.[58] The composition of one yarn comprises a mix of approximately 50-50% recycled cotton from denims and Tencel - a modal cellulosic fibre produced by environmentally responsible processes from the sustainably sourced natural raw material as wood. To the second yarn, the mix of recycled cotton from T-shirt and Tencel, We Fashion added also few per cent of polyester in the production process. The production needed also a colour added to both yarns. This has happened shortly after creating the yarn, which means that less water was saved as if the yarn would be coloured during the production process. There exists other options for sustainable colouring. As a example, the viscose fibres can be coloured in the production process, which does not require any additional water.
WE Fashion researched if fashion company can set up a process with post-consumer recycled yarns with the current suppliers for clothes. They have started with discarded denims and white T-shirts to measure the volume of possible recycling.
The yarn was jointly developed, subsequently produced in bulk by the spinner, and supplied to the knitter/pullover producer. The development of the yarn and finding the spinner was cooperated with the open centre for textile recycling Texperium [59],company whose main aim is to help the consumers, governments and private businesses in the transformation into the circular economy.

[58] Fibre to Fibre.
http://www.ecap.eu.com/wp content/uploads/2019/07/Fibre_to_Fibre_Pilot_Case_Study_WE_Fashion.pdf
[59] www.texperium.eu

We Fashion decided to launch in the Netherlands new, made from recycle fibres, pullovers which were hanged with the special tags, where it was explicitly emphasized that product was made in order to indicate the environmental problems and impact. The pullovers were promoted on social media as well as in the official website of the company. The results of the project were very promising in terms of creation recyclable fashion. It has been shown that it is highly possible to develop specific yarns with post- consumer recycled content for the products which will fit into a standard process of production and consumption. But at the same time, it has to be emphasized that the ultimate purchase price for the final garment was higher due to different type of yarn production and has required additional work.

This project aimed to perform waste prevention, reduction in water and energy use and reduction in CO2 emissions in the textile production. ECAPs projects support businesses in their engagement to produce or invest into more circular textiles This project intended to deepen the knowledge of the recycled textile material usage in clothing industry and measure the consumers reception of the recycle pullovers concept. For WE Fashion, this project was a trial and impulse at the same time to take the further steps step to high-quality recycling of textile.

4.3 JBC and recycled clothes

Similarly as the case study described above, JBC project was supported by ECAP funds. JBC company is a family-owned fashion retail company, having its headquarter in Belgium, established in the year of 1975. The company owns about 145 shops across Belgium, Luxembourg and Germany. Constantly growing its online business as well. The company has shown the interest in being a part of sustainable change years ago and the subject of this case study will be a full collection called I AM (started in 2018), filled with sustainably manufactured trousers for kids, men and women.

JBC vision was to offer sustainable fashion at honest, reasonable price level. JBC has already been focused on the development of sustainable fashion, even before the ECAP founded project. Innovative materials solutions such as Lyocell, bio-cotton, recycled polyester and bamboo are used in the creation of some of its collections those days and

in the past as well. The idea of a JBC project was to produce several circular denim products featuring as many post-consumer textile waste as possible at an reasonable price. The items had to fit into the collection for all kind of consumers (kids, men and women). Previously, the project was about to be connected with the production of the t-shirts but, due to limited availability of high-quality post-consumer yarns, the idea was substitute by creating a line of eco-made trousers. They were made from 20% post-consumer recycled content combined with the fabric complemented with bio-cotton. Moreover, jeans pockets were made of 100% recycled cotton. The jeans' pockets and zippers were designed slightly higher than normal in order to be easier to recycle later on. By positioning the trouser pockets and the zipper higher than normal, large sections of the jeans could be recycled again at a later stage. Belt label, size label and hang tag cord were made of 100% recycled polyester.

The project was not easy and came across to some difficulties as: reliable supplier of used denim was hard to find or research of the new material treatment needed to be improved. It turned out that the company could not be self sufficient, because it is not possible (hopefully yet) to use denims that the company has collected by itself. Costs for fabrics with recycled content is much higher than the one from traditional materials processed in non eco-way, what results in higher retail price.

The study shows that companies in order to be a part of circular change should start from small steps, starting from limited products manufactured in sustainable way. This project proved that circularity in the supply chain is possible. Management of marketing and sales plays a important role and needs to be researched before in order to be well prepared for new kind of products. It has also shown that combination of pre and post-consumer recycled material is the most effective. The JBC company put a lot of work into the well-researched communications with theirs customers, providing them with a lot of knowledge about the new eco collections on many different social channels taking part at the same time in raising social awareness which is one of the key points towards circular change.[60]

[60] Fibre to Fibre. http://www.ecap.eu.com/wp-content/uploads/2019/07/Fibre_to_Fibre_Pilot_Case_Study_JBC.pdf

4.4 Newhey and carpet backing from recycled bottles PET

UK manufacturer of carpet, Newhey is producing a very sophisticated, sustainable backing for theirs carpets, using to its creation plastic bottles PET. The environment has always been a priority for Newhey. In 2013 the company launched a innovative carpet secondary backing system called ‘Evobac’, made from post consumer recycled bottles. Through a innovative production/recycling technique, used plastic bottles are firstly transformed into plastic flakes and then into the soft fibres - part of the felt backing. Moreover, as the backing is made from waste, the felt has the eco-friendly quality of being regenerable over and over again. That means that after use, the part of felt- backing can be depolymerized (broken into smaller parts) to its original chemical formula and become part of new PET products, not necessarily carpet but for instance: vehicle interiors and noise-reducing materials. Today, all of Newheys’ products are consisted with this very sustainable backing system. Due to that company’s carbon footprint is definitely reduced and it marks a major milestone towards a more eco-friendly, sustainable and circular process of carpet production. This innovative solution for carpets is using the post-consumer waste in order to benefit the product itself and save the environment at the same time. The carpets on this kind of backing means less risk of scuffing of skirtings and paintwork, the comfort of walking is higher, the cut is as well easier to proceed - the wear on blades are reduced. a unique eco-friendly hot melt, energy efficient laminating process makes a strong connection between the primary fabric and secondary backing, ensuring at the same time that finished carpet product has at least three times more of the strength than conventional latex backed product. Moreover, the products where the Evobac backing is used, comply in 100% with all highest standards for European regulations in terms of flammability. It is also important to mention that Evobac has more benefits, not only for consumer but also for installers. They are easy of handling, which is guaranteed through decreased risk of scuffing skirtings and paintwork. But of course if installers prefer more traditional way to install these products, they are ensured that Ecobac backing carpets are compatible with all traditional installation methods as well.

To understand better the structure of this eco-backing, beneath in presented the simplifying scheme:

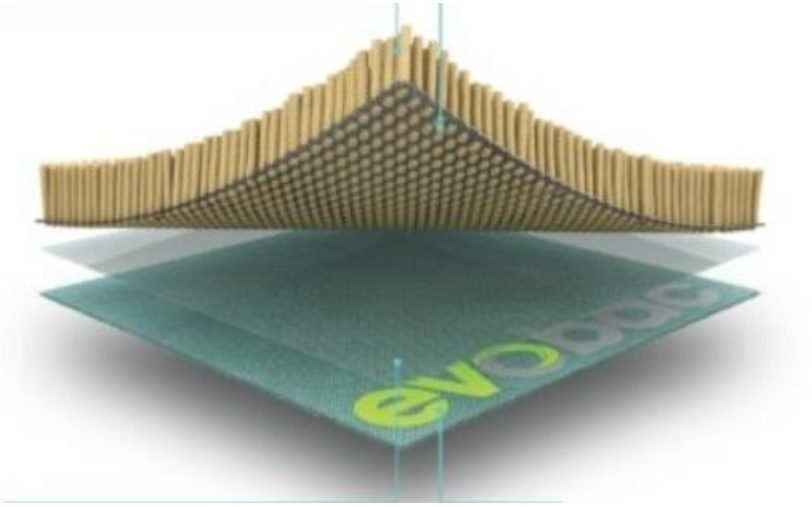

Figure 2.

Source: https://www.egecarpets.com/carpets/carpet-backings/ecotrust

The company is taking theirs clients into a sustainable journey towards more circular production. The environmental efforts are ongoing at Newhey. It operates in an ethical way, in order to benefit society, the environment and the economy.[61]

[61] Newhey. https://www.newheycarpets.co.uk/news/newhey-carpets-revolutionary-backing-made-from-100-recycled-material/

5. Challenges for the textile industry in adoption of circular economy

5.1 Barriers and potential problems

The circular system is not easy in implementation. It costs money, time, human resources, investments and change in the society mindsets.

Still, majority of the people, especially on higher positions, what is followed often with the higher age, are reluctant to environmentally friendly solutions as they do not see the problem of the pollutions nor CO2 emissions- the environment is not a priority in that case. Fortunately we can see growing awareness in the society and most of the SMEs are willing to implement sustainable measures. But the main success of these measures will depend of the final recipient, which is customer and on the sector in which the company will operate.[62]

Later on, finances are vast obstacle. The new measurement taken in any company are always a challenge and investment. Especially in the textile industry, new innovative environmentally friendly solutions on a big scale can cost a lot. Not all of the companies are financial able to do so. Without the economical profits the company cannot operate so it is crucial to be productive and sustainable at one time.[63]

Lack of adequate policies and supportive governments will make the transformation impossible. The countries need to work together and textile companies need to cooperate in the whole supply chain. Many times the products materials are coming from different country, or the final product is created somewhere and later distributed even further.

The circular economy opens new possibilities and benefits. Some of the companies are not aware of that, and are followed by fear which is based on lack of the information, what makes them resistant for making a change. While the investment at the beginning in the first year is significant further, in the long run, means great financial and environmental benefits. Moreover, the sustainable approach is currently a new trend in business and it can create a good image for the consumers who are aware of the importance of the environment.

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[62] Rodríguez P.H. (2017). *Circular Economy: Application in the textile industry*.
[63] Ibid.

Unfortunately for many manufacturers it is easy to depend on a system, which is already known- this way is easier and cheaper. The revolution in production system is scary, unknown and for this reason many manufacturers do not want to evaluate into more advance technology, which could provide the system with reduction of waste.[64]
Moreover, in order to reduce the costs, many fashion companies are provided with raw materials or even labour work in the countries where environmental issues does not play a crucial role, where the poor working conditions or child exploitation are taking place. This condition is mainly visible within the fast fashion approach, we have already discussed. There the sustainability might be a part of the companies image but it will be only marketing. The concept of sustainability, which is the core of circular economy, is composed of three key points: economic, environmental, and social and as well should benefit the people. If we pretend not to see the major problems of the production process in the third world countries as aforementioned, then we cannot say that we fully comply to the sustainable approach.

Consumers are the biggest challenge as are the hope. More conscious consumption will be a sign of a new way of life and approach for textile goods. People will choose what is cheaper, this is a economic truth. However, focusing only on a cheap price and choosing the less expensive textiles items as clothes or carpets for your home or office, can actually in a long run come at a cost. Consistently choosing the cheaper option, which is mainly lower quality will not only cost the organization more money in stages but it also degrades its value overtime. Price and sustainability are inherently connected and it is us, society and our purchase decisions which will be impactful in the future.[65]

Corporate social responsibility (CSR) is becoming more and more important for the companies due to the fact that consumers are heading in that direction, forcing industry to change. Now, especially young generations of consumers wants

[64] Ibid.
[65] Rodríguez, P.H (2017*). Circular Economy: Application in the textile industry.*

companies to make their products in a sustainable way that allows them to uphold their value and help to save our world.[66]

The market sees the challenges and there is a strong demand from stakeholders in recent years to develop a sustainable textiles approach at EU level rather than at national level or a global one. Being realistic, it is more likely for a harmonization in a institution as European Union rather than a country where national or regional ruling parties are constantly changing and the circular economy transformation needs stable and strong strategy.

5.2 Possible solutions and strategy

In order to address aforementioned challenges, the cooperation on many fields is needed. Coordinated and harmonised response from the market and authorities will be essential to address structural weaknesses regarding textile waste collection, sorting processes and recycling. Harmonization within the policies is much more possible on the EU level, rather than globally. But we have to remember that textile sector is highly globalized. Fragmented actions at national or only local levels will not be sufficient to transform the industry into circular system. The coordination is needed at all supply chain stages, including the raw materials providers, the manufacturer and distributors included some of them who can be based outside the EU.

Legislative action that derives from EU strategy for textiles, which is under creation and will be released very soon, in accordance with the Better Regulation Guidelines, can be efficient. Financial challenges have been discussed as one of the most important. With regard to financial obstacles, which make manufacturers reluctant to change the production chain into more sustainable in order to comply with circular economy concept, the help could come from EU. Some sustainable projects are being incentivized and as Europe prioritize the eco-transition, then the financial support will be needed for the companies who try to be part of it. The manufacturers concerns about the new innovative

[66] Boiten V.J., Li-Chou Han S. Tyler D., (2017). *Circular economy stakeholder perspectives: Textile collection strategies to support material circularity.*

technologies as traceability systems, should be resolved with the help of information strategy where companies can find reliable information about new technologies and possibly get in contact with the companies specializing in that field.

In terms of communication and information the national bodies or local ones should put more effort into familiarizing the society with the environmental alarming situation and possible steps on every day basis which textiles consumers might take. New business models are appearing, new waste disposals are emerging and society needs to be aware of it. Sustainability can work to improve efficiency by changing the process in which products are designed. If the manufacturers or distributors will hear that long lasting products are gaining interest on the market, this will make them to change the production, because the profits from sales will be key point for the business. If a consumer will voice the textile companies through feedbacks or purchase decisions that he/she value more sustainable products that are long lasting and are good quality, then to satisfy the needs of the market, they will naturally change production toward more sustainable.[67] The stakeholders consultations play important role in a circular change. They lead to many new ideas such as additional tax on retailers who use virgin materials and non-recyclable products. The taxes would play somehow a role as a punishment for a non sustainable manufacturers. Other idea is to increase the costs for waste incinerations or create landfill taxes. Going further there are voices to make a schemes which will oblige all public and commercial actors that make vast textile waste to manage their material streams and ensure that theirs textile goods aim at leading to the most effective reuse, recycling or remanufacturing circle of theirs products. To effectively create a incentive system for closed-loop value chain approach the key is to promote and encourage companies to recycling and acknowledge them with available solutions, which will be financially harmless for the production.[68] With regards to the materials, it is obvious that new solutions of eco-friendly textiles should be implemented. But it is needed to increase the industry knowledge on chemical content in some of the most popular materials. Unfortunately only a few large-scale studies have been conducted currently on the chemical contents in collected for recycling textiles. Understanding among textile

[67] Rodríguez, P.H (2017*). Circular Economy: Application in the textile industry.*

[68] Boiten V.J., Li-Chou Han S. Tyler D., (2017). *Circular economy stakeholder perspectives: Textile collection strategies to support material circularity.*

industries as fashion&carpet segments, with the policymakers together that research is crucial to safely recyclable textiles, is a key. This could be a good start by industry, but coordination on a bigger scale with the support of the government is needed to understand the complete picture of this challenge.[69]

Conclusions

As we have seen, the linear economic model based on infinite life cycle of a product generate waste and is highly detrimental for our environment. That is why in the current policies, especially on a EU level, we discuss recently the circular transition. The implementation of circular economy model into the market, where waste is introduced again in the productive cycle, will be filled with challenges for the textile industry. This will require a change of the society approach, where currently we see a positive signs which shows that the social and environmental awareness is increasing and it has a great influence on a market activities.

In the fashion and carpet sector we are experiencing a great development of new sustainable solutions and responsible policies as the circular systems implementations in terms of products design and production innovations in some private companies. There is still long way to reach the ideal point of 100% circular production which is intended.

Many unanswered questions are arising while analysing how the circular economy is influencing and will influence in the future the textile market. Will the transformation be possible without strong policies, filled with financial penalties for non-compliance with the new law? How to close the loop while the certain product is operate between many distributors? How to effectively trace the product after its use and how to force the user to return used item back to the place where its value will be reintroduced to the market? When taking a closer look, some companies as HM or OVS has carried out projects where the customers could bring back theirs clothes to the shop, where later on they were re-made into new garments. The projects where successful but efficient only on small scale. In terms

[69] H&M Group's contribution to the European Commission's request for feedback on the roadmap on the EU strategy for sustainable textiles (2021).

of commercial carpet industry it is almost impossible to return large amounts of the square meters to the manufacturer by a client. The question is then who will be responsible for the process of bringing it back in order to recycle. Manufacturer, distributor or maybe the consumer? The case studies has shown us that even though we use the waste for the new garment creation, or backing for the carpet tile it is almost always a part of the product which comes from non regenerated raw materials. We are facing the biggest challenge how to close the loop in the production process and create 100% recycled textile good and make them not a project but a daily basis, new normal for the customers.

The circular economy has a good prognosis and we already see some steps forward towards the circular transformation in the textile industry. The market is more aware of the environmental concerns for the world. The eco-friendly goods are gaining interest and are perceived very positively by consumers. New technologies and innovative solutions are appearing and the main challenge now is to implement them while not increasing the prices for the goods. Creation of the close loop system for a production will encounter obstacles and to make the change effective, the textile recycling technologies have to be economically, technologically and logistically viable in the current market situation. With a good strategy, the textile industry will implement the circular economy system, what will significantly reduce greenhouse gas emissions through better waste management and reduce use of resources, raw materials in manufacturing, having a positive impacts on the climate. This circular concept is a global priority, where Europe with the environmental policies takes the lead and can be example to follow by others. This transition will seriously reshape the textile sector having the influence not only on a market but as well on the society. The organisational alignment, cross-value chain collaboration and innovation-friendly policies on the EU, national as local level will have to be strongly emphasized and supported. The transition comes with barriers and difficulties, but also offers opportunities for the market, environment and people's future life on the planet, where consumption and waste processes need to be rethink more than never.

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