ONE OCEAN FOUNDATION

Ocean Disclousure Initiative

TEXTILE AND APPAREL INDUSTRY REVIEW

SDA Bocconi SCHOOL OF MANAGEMENT
SUSTAINABILITY LAB

McKinsey & Company

CSIC
Consejo Superior de Investigaciones Científicas

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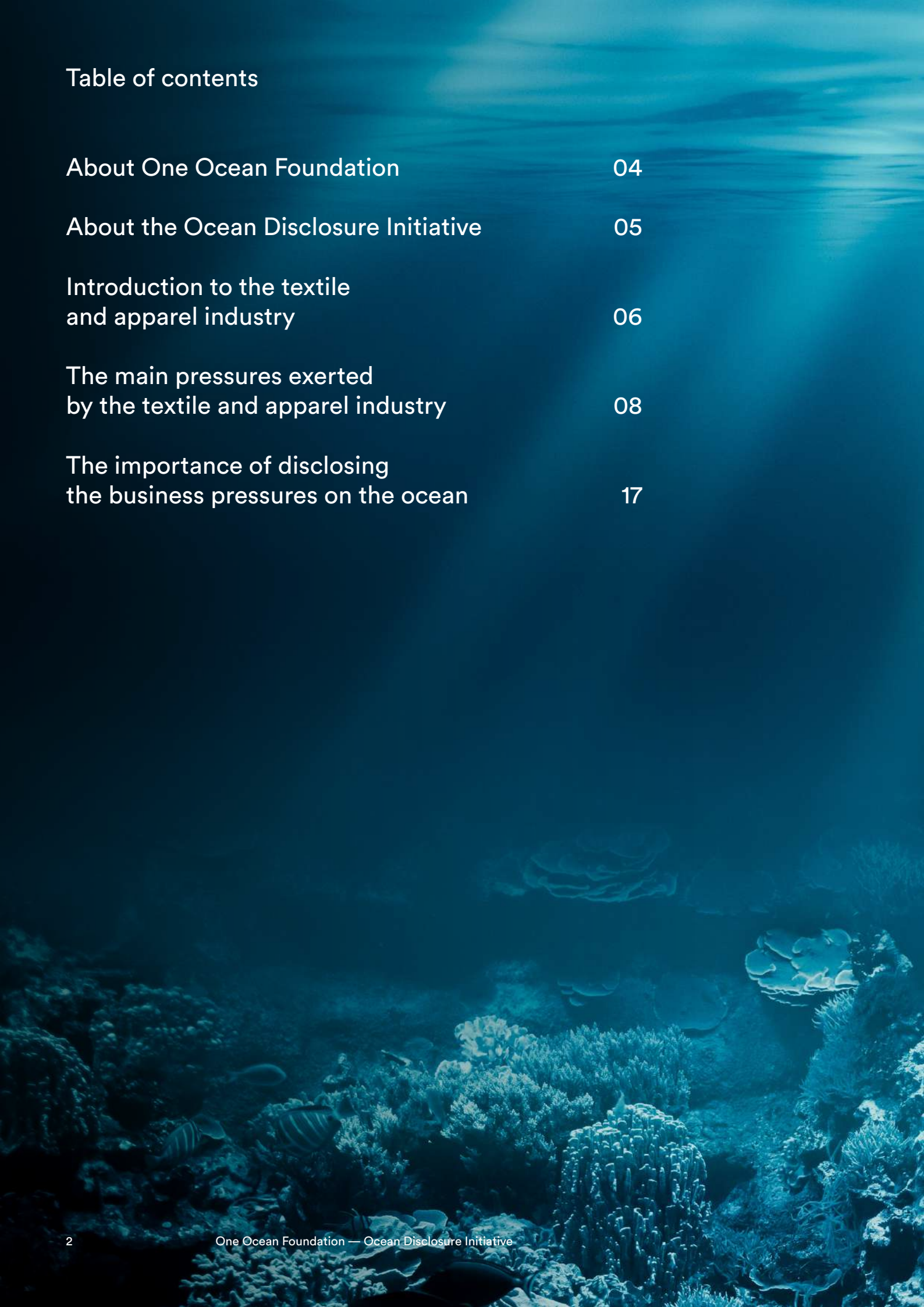

About One Ocean Foundation

This research is an initiative of the One Ocean Foundation as part of its commitment to the diffusion of ocean literacy.

The mission of the Foundation is to accelerate solutions to ocean issues by inspiring international leaders, institutions, companies, and people, promoting a blue economy and enhancing ocean knowledge through ocean literacy. The Foundation intends to develop a leading platform bringing together and strengthening the voices speaking out on behalf of the ocean around the world.

The distinctive feature of the One Ocean Foundation is its scientific scope and, at the same time, its strong educational drive, in order to increase awareness and establish constructive relationships between all stakeholders engaged in marine preservation at different levels.

Thanks to its relevant network of partners, the One Ocean Foundation is engaged in numerous unique, innovative, and high-added-value projects related to its mission of ocean protection in three main areas: education, environmental research, and blue economy.

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About the Ocean Disclosure Initiative

The Ocean Disclosure Initiative project is part of the multi-year research “Business for Ocean Sustainability” promoted by the One Ocean Foundation (OOF) in collaboration with SDA Bocconi School of Management Sustainability Lab, McKinsey & Company and CSIC (Consejo Superior de Investigaciones Científicas) and aimed at building knowledge about the relationship between the business and the ocean.

The project started in 2019 with the goal of investigating the role of companies in addressing ocean challenges, focusing on the pressures on marine ecosystems, the level of awareness within the business community and the main (technological and organisational) responses implemented.

The Ocean Disclosure Initiative is the first science-based framework and methodology aimed at supporting businesses from all industries in taking action on ocean-related issues, promoting prevention and/or mitigation responses and favouring disclosure and reporting.

To know more please visit www.oceandisclosureinitiative.org

Introduction to the textile and apparel industry

The textile and apparel sector is considered one of the world's biggest manufacturing industries. In 2022 alone, the global market's revenue was calculated to be around 1.53 trillion USD[1] and is expected to increase to more than 1.7 trillion USD in 2023[2]. The industry, which encompasses everything from textile and apparel brands to wholesalers, importers, and retailers, plays a fundamental role in social and cultural life. Today fashion is an expression of values, status and identity and an essential part of social communication.

THE TEXTILE AND APPAREL SECTOR IS CONSIDERED ONE OF THE WORLD'S BIGGEST MANUFACTURING INDUSTRIES. TODAY FASHION IS AN EXPRESSION OF VALUES, STATUS AND IDENTITY AND AN ESSENTIAL PART OF SOCIAL COMMUNICATION

From the environmental point of view, the sector presents critical issues that still need to be fully identified. For this reason and its impact on marine ecosystems, it has been selected as one of the principal sectors analysed in the framework of the Ocean Disclosure Initiative. This review was elaborated by analysing relevant scientific materials and sectoral publications related to the fashion industry's environmental pressures on the ocean to create a baseline for the industry-specific edition of the ODI tool.

If the United Nations' estimates of the global population reaching 9.6 billion by 2050 is accurate, an equivalent of three planet Earths[3] will be needed to have enough resources to continue with current demographic and lifestyle habits. In terms of the clothing industry, overall consumption will rise from 62 million metric tons in 2019 to 102 million metric tons in 2030[4]. This trend is attributed to mass-market brands and retailers offering competitive pricing and being more open to different styles, cultural influences, and production techniques, making clothing more accessible to people.

CLOTHING CONSUMPTION IS PROJECTED TO RISE FROM 62 MILLION METRIC TONS IN 2019 TO 102 MILLION METRIC TONS IN 2030

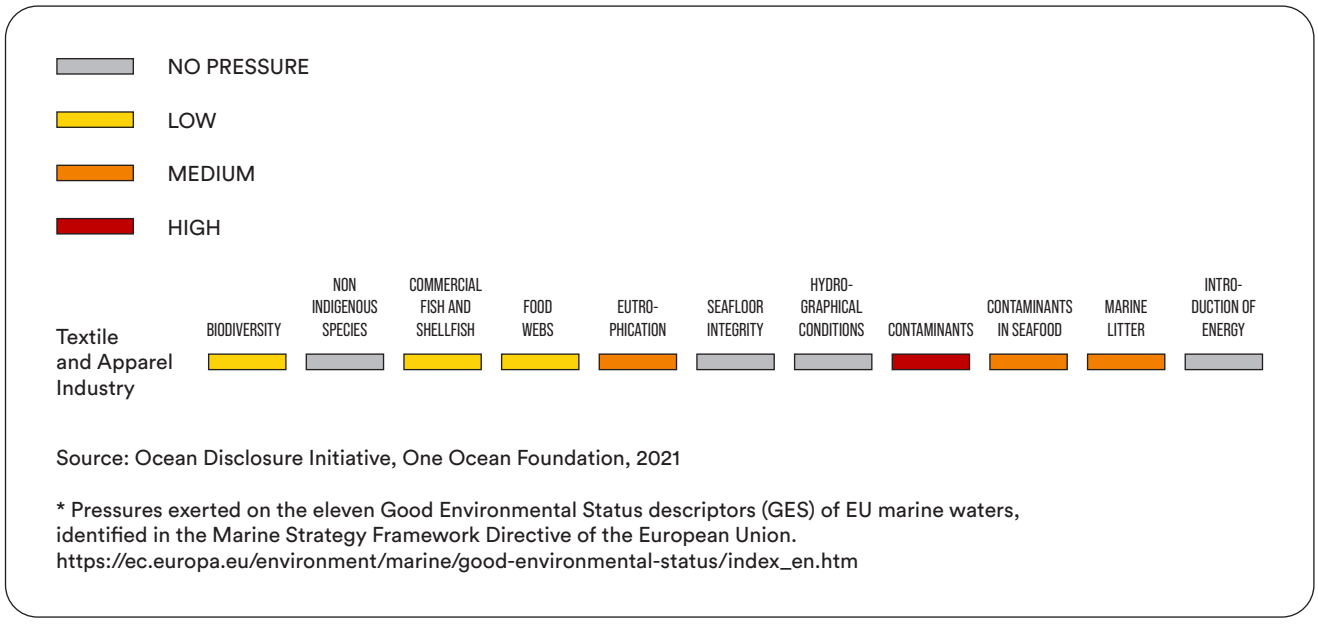
1. Smith, P. (2023) "Global apparel market - statistics & facts. Statistica" [online]. Available at https://www.statista.com/topics/5091/apparel-market-worldwide/#topicOverview (Accessed: 23 March 2023)
2. Ibidem.
3. United Nations (N.D) "Sustainable Development Goals, Goal 12: Ensure sustainable consumption and production patterns" [online] Available at https://www.un.org/sustainabledevelopment/sustainable-consumption-production/ (Accessed: 28 July 2023)
4. World Bank (2019) "How much do our wardrobes cost the environment?" [online] Available here (Accessed: 28 July 2023)

Moreover, the sector's environmental impact is exacerbated by business models such as "fast fashion". This model reduces the time required to produce new collections and frequently introduces new fashion lines, even multiple times, within a single clothing season[5]. While this has made fashion more accessible to a wider population, it has also resulted in increased use of raw materials, chemicals, and water to produce more garments and meet market demands. Additionally, the rapid pace at which fashion trends change and new collections are restocked creates quick obsolescence of products, with only a small fraction of purchased clothing being recycled for raw material recovery.

Thus, in the framework of the research led by One Ocean Foundation on the relationship between business and the ocean, the scientific review has uncovered the most significant pressures exerted by the textile and apparel industry on the marine ecosystem, which are the following:

— Introduction of marine litter
— Introduction of contaminants
— Eutrophication of seawater

FIGURE 1: Review of the negative pressures of the textile and apparel industry*



Source: Ocean Disclosure Initiative, One Ocean Foundation, 2021

* Pressures exerted on the eleven Good Environmental Status descriptors (GES) of EU marine waters, identified in the Marine Strategy Framework Directive of the European Union. https://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm

5. One Ocean Foundation, et al. (2021) "Business for Ocean Sustainability: Focus-Fashion Industry" [online] Available at https://www.1ocean.org/blue-economy/b4os-2021-fashion-industry (Accessed: 28 July 2023)

The main pressures exerted by the textile and apparel industry

WATER POLLUTION FROM CONTAMINANTS AND MICROPLASTICS REPRESENT THE FASHION INDUSTRY'S MAIN PRESSURES EXERTED ON MARINE ECOSYSTEMS

The environmental stresses caused by the textile and apparel sector broadly impact marine ecosystems and their biodiversity. In particular, ocean pollution may occur when released chemicals, such as dyes and other solvents, reach waterbodies causing eutrophication and water toxicity. Furthermore, increased plastic pollution due to microplastics released from clothing washes during pre-and-post-production processes could impact marine species, accumulating within organisms along the entire food chain.

More generally, one of the industry's major environmental problems is the overconsumption of hydric resources, which starts during the cultivation of crops for materials such as cotton and finishes with the manufacturing of end products through the various phases of weaving, dyeing, washing, and finishing. To give an estimate, the production of jeans requires approximately 3,800[6] to 7,500[7] litres of water, while to produce one t-shirt, it is necessary to use about 2,700 litres[8]. All these production phases require enormous quantities of water, often in countries characterised by chronic water scarcity, thereby overexploiting freshwater resources, often to the detriment of the local population.

The following is an in-depth description of the main pressures on the ocean identified for the textile and apparel industry.

6. World Bank (2019) "How much do our wardrobes cost the environment?" [online]. Available here (Accessed: 28 July 2023)
7. United Nations (2019) "UN launches drive to highlight environmental cost of staying fashionable" [online]. Available at: https://news.un.org/en/story/2019/03/1035161 (Accessed: 28 July 2023)
8. McKinsey & Company (2020) "Biodiversity: The next frontier in sustainable fashion" [online] Available at: https://www.mckinsey.com/industries/retail/our-insights/biodiversity-the-next-frontier-in-sustainable-fashion (Accessed: 13 April 2023)

1. Marine litter

EACH YEAR ROUGHLY 200,000 TO 500,000 TONNES OF MICROPLASTICS ARE RELEASED INTO THE MARINE ENVIRONMENT, HEAVILY CONTRIBUTING TO OCEAN POLLUTION. THESE PARTICLES ARE MOSTLY GENERATED BY WASH TREATMENTS OF SYNTHETIC AND NATURAL FIBRES IMPREGNATED WITH CHEMICALS.

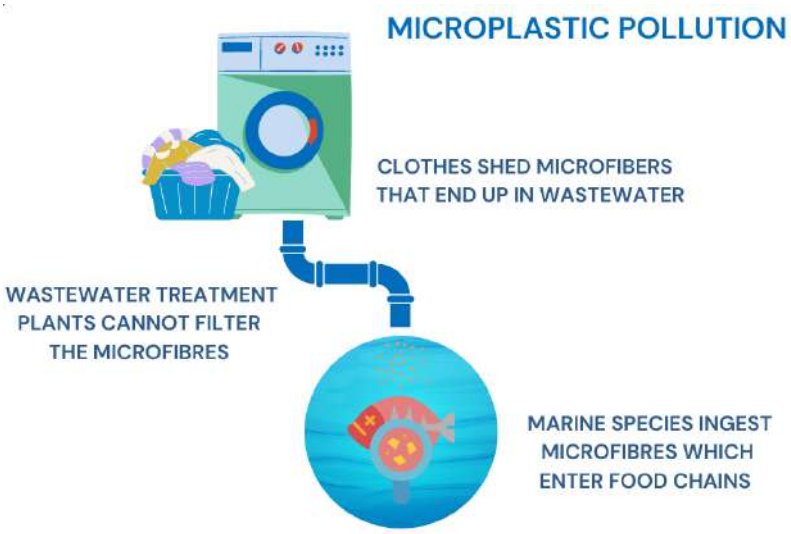
Out of the 32 billion garments produced for fashion each year, around 64% end up in landfill waste, potentially entering the ocean through leachates[9]. Currently, most clothing is manufactured using synthetic materials made from plastic fibres, usually treated with chemical substances that do not decompose and can break down into microplastic particles. These tiny plastic threads are released during washing before and after production, significantly contributing to ocean pollution annually, introducing around 200,000 to 500,000 tons of particles into the marine environment[10]. Although 35% of primary microplastics that enter the ocean come from synthetic textiles[11], they could also be generated by natural fibres, such as cotton and linen, and other manufactured fibres, such as rayon, which have been impregnated with chemicals and can also emit microplastics that do not biodegrade naturally.

The regular use of laundry machines further enhances the microplastic problem, as it is estimated that half a million tonnes of microfibers plastic are released yearly into the ocean during this process. Research shows that one machine load of washing can shed more than 700,000 microfibers[12]. This is mainly because, on average, water treatment plants let up to 40% of the microfibers they receive into lakes, rivers, and seas[13], as only a part of the population is connected to wastewater treatment plants[14]. Unfortunately, the effects of microfiber ingestion on marine life are highly harmful as they may cause starvation, endocrine disruption, stunted growth, and break down the digestive systems of organisms[15], ultimately affecting the entire food chain.

9. Fashion Network. (2022). Two-thirds of garments made globally each year go to landfill-report. Access on 03 April 2023. Available at https://uk.fashionnetwork.com/news/Two-thirds-of-garments-made-globally-each-year-go-to-landfill-report,1375047.html.
10. European Environmental Agency (2022) "Microplastics from textiles: towards a circular economy for textiles in Europe" [online]. Available at: Available at https://www.eea.europa.eu/publications/microplastics-from-textiles-towards-a (Accessed on 11 April 2023)
11. International Union for Conservation of Nature (2017) "Primary Microplastics in the Ocean Report" [online]. Available at: https://portals.iucn.org/library/sites/library/files/documents/2017-002-En.pdf (Accessed: 28 July 2023)
12. Reuters. (2020) "Fashion 'slow to act on ocean plastic pollution from microfibres" [online]. Available at https://www.reutersevents.com/sustainability/fashion-slow-act-ocean-plastic-pollution-microfibres (Accessed: 13 April 2023)
13. UN Environment Programme (2019) "Fashion's tiny secret" [online]. Available at: https://www.unep.org/news-and-stories/story/fashions-tiny-hidden-secret (Accessed: 13 April 2023)
14. For example, in 2018, Austria had the highest % of the population connected to wastewater treatment plants in the EU (95.94%) and Slovenia the lowest (67.50%) according to OECD data available at Water - Wastewater treatment - OECD Data
15. UN Environment Programme (2019) "Fashion's tiny secret" [online]. Available at https://www.unenvironment.org/news-and-stories/story/fashions-tiny-hidden-secret (Accessed: 13 April 2023)

For instance, it has been reported that 63% of shrimps in the North Sea now contain microfibers[16], and 73% of fish caught at mid-ocean depths in the Northwest Atlantic had microplastics in their stomach[17].

FIGURE 2: Microplastic pollution



Source: Author's elaboration

Finally, the lack of recycling methods for single-use plastic widely used in the packaging of clothes and footwear can also impact the marine environment since plastic materials, if mismanaged, could end up in the ocean, increasing water pollution.

Best practices. Effective actions are taken from a holistic point of view, tackling the problem along the entire value chain, from product design to production (e.g., fabric manufacturing), usage and cleaning (e.g., use of washing machines) and disposal. For instance, some companies have integrated into their product portfolio sustainable solutions to foster correct behaviours among consumers and minimise the impact of their garments on the ocean during washing.

16. OECD data available at Water - Waste water treatment - OECD Data
17. Hartline, N. et al. (2016) "Microfibre Masses Recovered from Conventional Machine Washing of New or Aged Garments" [online]. Available at: https://doi.org/10.1021/acs.est.6b03045 (Accessed: 31 July 2023)

Key examples include developing and selling microfiber-reducing laundry bags and laundry machine filter systems, which could prevent microfiber from breaking off clothes. Selling these solutions directly at the point of sale (physical or digital) makes them more impactful, as customers are simultaneously educated on the issue and presented with a potential solution during their shopping journey. Indeed, another critical pillar is represented by educational campaigns for customers, aimed at informing the final consumer of the environmental impact of products and giving instructions and guidelines for their sustainable use. For example, virtuous fashion companies provide a series of written instructions and engaging video tutorials that explain how to take care of garments at home, including correct washing, to make them last longer and contribute to reducing their water use and carbon footprint. This material may be positioned in the store, on the company's website and e-commerce, on social media and on the product packaging.

Finally, some companies are integrating responsible alternatives to virgin plastic to help protect the world's oceans from plastic pollution. One of these alternatives includes the production of plastic to be utilised in the supply chains from discarded fishing nets, one of the issues of most serious concern concerning marine pollution. Turning this product into a raw material reduces the need for new plastic and dependence on petroleum, gives value to existing waste and prevents plastic pollution from entering the ocean. Moreover, using recycled polyester, coming from different sources such as bottles, containers thrown away by consumers and recycled ocean plastics, allows companies to use fewer resources, discard less and promote new recycling streams for polyester clothing that is no longer wearable.

2. Introduction of contaminants and eutrophication

As mentioned above, clothes fabrication involves utilising materials that require a significant amount of chemicals. The use of chemicals takes place from the production of raw materials used to make clothes up to the finished and packaged product.

In terms of raw material, the case of cotton is exemplary. Although the widespread use of cotton has been reduced over the past years due to increasing demand for fossil-fuel-based textiles (e.g., polyester, polyamide, etc.)[18], it is still considered one of the preferred plant-based textiles, mainly due to its versatility, performance, and comfort. Unfortunately, using conventional cotton requires not only vast quantities of water but also pesticides and insecticides to protect crops from insects. These substances may reach water bodies through runoffs and rain depositions, eventually resulting in marine environmental pollution[19]. Aside from the use of pesticides, farmers frequently use nitrogen-based fertilisers to replenish soil nutrients and boost crop growth, which may affect water bodies through leaching, contributing to the process known as eutrophication[20].

Additional nutrients can also come from wastewater treatments and industrial discharges, especially in developing countries from Latin America, Asia, and Africa, where factories and sewage facilities are less regulated. Eutrophication has an impact on both freshwater and marine ecosystems, resulting in the overgrowth of macrophytes, algae or cyanobacteria that lead to depletion of oxygen and, ultimately, death of marine life[21].

18. Textile Exchange (2022) Preferred Fiber & Materials Market Report [online]. Available on: https://textileexchange.org/app/uploads/2022/10/Textile-Exchange_PFMR_2022.pdf (Accessed: 28 July 2023)
19. FAO. (2018) "More people, more food, less water? A global review of water pollution from agriculture"
20. One Ocean Foundation, et al. (2021) "Business for Ocean Sustainability: Focus-Fashion Industry" [online] Available at https://www.1ocean.org/blue-economy/b4os-2021-fashion-industry (Accessed: 28 July 2023)
21. European Commission and World Health Organization Regional Office for Europe (2002) "Eutrophication and Health" [online]. Available at: https://ypen.gov.gr/wpcontent/uploads/legacy/Files/Ydatikoi%20Poroi/Nitrorypansi/eutrophication%20and%20Health.pdf (Accessed: 28 July 2023)

EXTENSIVE USE OF POTENTIALLY HARMFUL CHEMICAL SUBSTANCES ALONG THE FASHION SUPPLY CHAIN, FROM RAW MATERIALS EXTRACTION TO DYING AND PRINTING OF GARMENTS, MAY HAVE SEVERAL IMPACTS ON THE MARINE ENVIRONMENT SUCH AS EUTROPHICATION AND WATER POLLUTION

In addition, contamination along the supply chain can also occur when chemicals, like dyes and solvents, are released into wastewater systems without treatment. The main substances utilised are colourants and metals employed in the dyeing process, phosphates used for dyeing and initial operations, and non-biodegradable materials related to compound agents[22].

The improper disposal of these chemicals can lead to water pollution. Many processing procedures, such as dyeing fabrics, use water baths and aqueous systems, which can contaminate freshwater bodies if not treated properly. This pollution can eventually reach the ocean and negatively impact marine life and biodiversity. Marine species can absorb chemical substances that bioaccumulate in their tissues over time. This can result in biomagnification, where the accumulation of contaminants increases as you move up the food chain, resulting in a higher concentration in Apex predators.

Numerous countries have raised concerns regarding the excessive use of chemicals and dyes in clothing manufacturing. In particular, the European Union has identified 165 of the 1,900 chemicals[23] utilised in clothing production as hazardous and has banned certain components, including trichloroethane (TCE) and nonylphenol ethoxylates (NPEs)[24]. Despite this, some of these solvents and dyes are essential during the preparatory, dyeing, printing, and finishing phases since they contribute to the functionality of garments (e.g., waterproofness or resistance to shrinkage) and their aesthetics (e.g., colour and colour-fastness).

Best practices. Technology and innovation are essential to diminish the use of contaminants in the production of garments. Several companies focus on changing existing methods and investing time and resources to assess and revamp existing practices. A way to do this is by introducing on-site treatment plants to process wastewater or using natural dyes that could significantly reduce water pollution from the processing phase.

22. Fibre2Fashion. (2006) "Textile Effluent Treatment- A Solution to the Environmental Pollution" [online]. Available here (Accessed: 13 April 2023)
23. European Parliamentary Research Service (2019) "Environmental impact of the textile and clothing industry" [online]. Available at: https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2019)633143 (Accessed: 28 July 2023)
24. Common Objective (2021) "The Issue: Chemicals. Access" [online]. Available at: https://www.commonobjective.co/article/the-issues-chemicals (Accessed: 13 April 2023)

It is also essential to collaborate among supply chain partners by involving all stakeholders in sustainable chemical practices and gathering data from direct and indirect suppliers to ensure correct chemical management practices to identify where methods should be changed.

Lastly, to reduce human-induced eutrophication in the fashion industry, it is necessary to act against the nitrogen and phosphorous load in the ocean. One way of doing this is by changing to different agricultural practices, introducing more sustainable techniques, such as regenerative agriculture that avoid using synthetic fertilisers and pesticides and planting crops that grow year-round to enrich the soil and prevent erosion.

3. GHG emissions

According to a recent report, in 2022, the fashion industry has been responsible for about 5 to 6% of the annual global GHG emissions[25]. The industry's extensive supply chain and energy-intensive production methods are the primary sources of these emissions. This includes growers and processors of raw textiles, weavers, knitters, dyers, finishers, product manufacturers, and distributors[26]. The main sources of GHG emissions come from the sector's dependency on fossil fuels for producing synthetic fibres from oil and fracked gas and factories and fashion manufacturers' reliance on non-renewable sources for electricity and transportation[27].

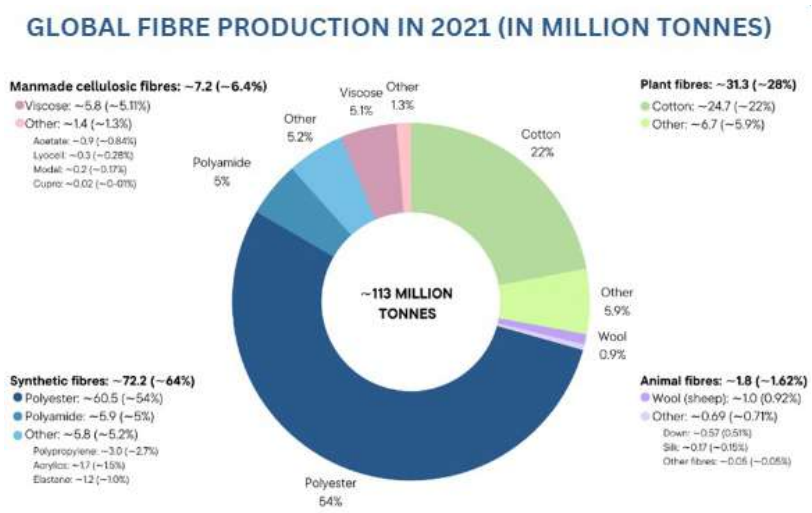
GHG EMISSIONS FROM THE FASHION INDUSTRY ARE MOSTLY CONNECTED TO THE PRODUCTION OF SYNTHETIC FIBERS DERIVED FROM FOSSIL FUELS. THESE EMISSIONS ARE A MAJOR CONTRIBUTOR TO GLOBAL WARMING AND OCEAN ACIDIFICATION

Particularly referring to fibre production, as seen in the graph below, synthetic fibres accounted for approximately 64% of production in 2021, meaning that fossil-fuel-based fabrics are predilected over more sustainable and naturally grown materials. This number will only keep growing, as synthetics are mostly preferred for their affordability in a world dominated by fast fashion markets. Being derived from crude oil and natural gas, the output of these clothes is massive in terms of GHG emissions when gas and oil are extracted and throughout the conversion process to fabrics[28].

25. Stand Earth (2022) "Major Fashion Brands Increased Emissions in 2022" [online] Available at: https://stand.earth/press-releases/major-fashion-brands-increase-emissions-in-2022/ (Accessed: 28 July 2023)
26. Filho, L. et al. (2022) "An overview of the contribution of the textiles sector to climate change" [online]. Available at: https://doi.org/10.3389/fenvs.2022.973102 (Accessed: 31 July 2023)
27. Stand Earth. (2022) "Major Fashion Brands Increased Emissions in 2022" [online]. Available at: https://stand.earth/press-releases/major-fashion-brands-increase-emissions-in-2022/ (Accessed 13 April 2023)
28. Changing Market. (2021) "Fossil Fashion. The hidden reliance of fast fashion on fossil fuels" [online]. Available at: https://changingmarkets.org/wp-content/uploads/2021/01/FOSSIL-FASHION_Web-compressed.pdf (Accessed 31 July 2023)

The graph below (figure 3) indicates the most preferred fibres used in the industry.

FIGURE 3: Global fabric production in 2021



Source: Elaboration of the authors from Textile Exchange (2022) Preferred Fiber & Materials Market Report 2022

Ultimately, these GHG emissions contribute to global warming, directly affecting the ocean's temperatures as it absorbs the excess heat from the atmosphere. Rising temperatures in the ocean create enormous pressures on the marine environment as it leads to deoxygenation, resulting in a high mortality level for aquatic species, loss of breeding grounds and mass migration. Moreover, elevated carbon dioxide levels contribute to ocean acidification, negatively affecting marine species and ecosystems, especially those relying on calcium carbonate structures like coral reefs.

Best practices. There are several ways in which the fashion industry can reduce its GHG emissions. One approach involves modifying its production systems by transitioning from intensive fossil fuel farming to organic and low-tillage methods that aid in cultivating healthy soil and storing carbon in the ground. Another solution is to decrease emissions from brand operations by embracing decarbonisation initiatives, such as utilising a higher percentage of recycled fibres or selecting more sustainable fibres for clothing production[29].

Furthermore, companies need to minimise the impact generated by the transportation of products, whether by sea, truck, rail, or air. Some leading companies in the sustainability field are starting to prioritise transportation by trains, as they have the lowest carbon footprint, allowing significant quantities of goods to be moved at once and are not associated with risks to ocean life.

29. McKinsey (2020) "Fashion on climate report" [online]. Available at: https://www.mckinsey.com/industries/retail/our-insights/fashion-on-climate (Accessed: 04 April 2023)

The importance of disclosing the business pressures on the ocean

The industry-specific edition of the Ocean Disclosure Initiative tool dedicated to the fashion sector, developed by One Ocean Foundation in collaboration with its partners, reflects the main pressures exerted by this sector to support companies in becoming aware of their impacts on marine ecosystems, assessing the related risks, and disclosing critical information and strategic responses on the significant issues related to the fashion industry. As identified in our research and reflected in the industry-specific tool, these pressures include i) use of potentially contaminating chemicals; ii) waste and pollution from fibres, plastics and microplastics; iii) GHG emissions.

The importance of the Ocean Disclosure Initiative is related to the fact that, for the first time, companies, scientific and financial communities, and civil society can rely on a common language to measure, address, and mitigate the most relevant pressures that humanity exerts on the marine environment, sector by sector, with significant advantages for the health of the ocean.

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