REPORT ON THE IMPACT OF THE GERMAN FASHION INDUSTRY

GERMAN FASHION FOOTPRINT

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Cover/inside cover image: *Axl Jansen*

FOREWORD

Image: *Nela Koenig*

How much water is needed to keep Germany's fashion industry from being left high and dry? How much water are we polluting in the name of fashion? How much land is needed to clothe Germany – to produce "German" textiles? How much greenhouse gas is emitted during their production and transport?

In recent times, there has been much discussion and also much polemic with respect to assessing the ecological footprint of the German fashion industry. There has always been one thing lacking: substantiated facts. Without valid data, no truly accurate insights can be gained, nor can undoubtedly urgently needed measures be derived. Because one thing was and is certain: there is a need for action to enable a sustainable future for Germany's fashion industry, which is one of the largest in the world.

The now available study on the "German Fashion Footprint" initiated by Fashion Council Germany – in cooperation with studio MM04 – is an important step in the right direction. The survey, conducted by the renowned Oxford Economics, accompanied by the Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH and funded by the Federal Ministry for Economic Cooperation and Development (BMZ), provides a wealth of previously unavailable and summarised data.

Particular importance is attached to the global analysis. This analysis makes it clear that Germany, as one of the world's largest consumer markets for clothing, also has an enormous share in the global consumption of resources and in the environmental impact associated with fashion. German consumers purchased 76 billion euros worth of clothing and footwear in 2019, but only 5 per cent of that was made in domestic production facilities. In terms of greenhouse gas emissions alone, this has resulted in releasing a total of 38 million tonnes of CO_2 – two million tonnes of that in Germany.

These figures make clear what responsibility the people and institutions in Germany bear when it comes to introducing measures to reduce the large global ecological footprint.

Since its foundation in 2015, Fashion Council Germany has been committed to the cultural preservation and promotion of fashion on a creative and economic level. In addition, the Federal Ministry for Economic Cooperation and Development has long been committed to sustainability in the textile sector. The study on the status of German fashion presented in 2021, created an initial basis to conduct well-founded dialogues at political and business levels. The report on the German Fashion Footprint goes much further. We see it as a game-changing tool for reversing or stopping developments that have been proceeding in the wrong direction. It provides data and facts for discussions along with content for educational initiatives. It is about nothing less than making the world of fashion into a better place. Each and every one of us can contribute a little bit to this endeavour.

Scott Lipinski, Managing Director of Fashion Council Germany

EXECUTIVE SUMMARY

38 million tonnes

Total global greenhouse gas emissions from Germany's fashion industry in 2019 (CO_2-equivalent terms).

535,000

Terajoules: the German fashion industry's total global energy requirement in 2019.

Germany is one of the largest markets for fashion in the world and is home to several of the world's top fashion brands such as adidas, Puma and Hugo Boss. As such, trends and practices in the country's fashion industry have a significant environmental impact that reaches across the globe.

Following on from our recent study on the economic impact of the German fashion industry,[1] this report provides the first comprehensive look at the environmental impact of the industry. We look at its footprint through five important variables: greenhouse gas (GHG) emissions; energy use; air pollution; water use; and agricultural land use.

Building a detailed understanding of these existing impacts is an important step towards managing and mitigating them in the future. In this report, we assess the impact of the industry in 2019, before the effects of the COVID-19 pandemic, which severely reduced output across many sectors of the world economy.

In this report we have considered the impact of the operations of fashion brands and retailers within Germany, as well as the global impact of clothing and footwear sold in Germany but manufactured elsewhere. Not considered here is the impact created by the activities of German-owned companies manufacturing overseas and selling to customers abroad, for instance a German-owned or -contracted factory in China producing clothes to sell to the US.

GREENHOUSES GAS AND ENERGY USAGE FOOTPRINTS

We estimate that in 2019, **the German fashion industry's global greenhouse gas footprint was just over 38 million tonnes,** in CO2-equivalent (CO2e) terms.[2] This is equivalent to the average annual emissions of 1.9 million German households or 8.7 million trips around the Earth in a family car. It is also a similar magnitude to the total direct emissions of Slovakia in 2019 (42 million tonnes), or the business and government direct emissions of Sweden (47 million tonnes).

Due to the extent of off-shored production in the industry, more than 90% of the fashion industry's emissions—or 34.5 million tonnes—came from upstream activities such as materials production, preparation, and processing. China was the most prominent location for these emissions, at 9.2 million tonnes. Direct emissions by the industry in Germany itself amounted to only 2.0 million tonnes, while 1.7 million tonnes came indirectly from emissions linked to electricity purchased by the industry in Germany.

[1] Oxford Economics, The Status of German Fashion, 2021.

[2] An explanation of CO2-equivalence is given in Chapter 2.

Greenhouse gas emissions are closely tied to the amount of energy used by an industry. **We estimate that the German fashion industry required a total of 535,000 terajoules of energy across its direct and supply chain activities in 2019.** This is a similar magnitude to the direct electrical power usage for all purposes in the Netherlands, at 510,000 terajoules in 2018. The vast majority (83%) of the German fashion industry's power usage was supplied through fossil fuels, with the remainder split between nuclear power and renewable energy sources.

AIR POLLUTION EMISSIONS FOOTPRINT

We also estimate the global footprint of the industry in terms of five types of air pollution. In 2019, we estimate that the air pollution footprint of the German fashion industry and its global supply chains was:

- 410,000 tonnes of carbon monoxide (CO)
- 110,000 tonnes of volatile organic compounds (VOCs)
- 100,000 tonnes of nitrogen oxides (NOx)
- 90,000 tonnes of sulphur dioxide (SO2)
- 30,000 tonnes of particulate matter (PM10)

To put these figures into perspective, the German fashion industry's global carbon monoxide footprint was equivalent to 13% of all emissions of CO from within Germany from all sources. As the economic output of the domestic fashion sector is equivalent to approximate 1% of German gross domestic product (GDP), this highlights the extent to which the air pollution from fashion consumption in Germany is outsourced to other countries.

WATER AND AGRICULTURAL LAND USAGE FOOTPRINTS

We estimate that **the fashion industry had a total water footprint of 6.5 billion cubic metres in 2019.** Roughly two thirds (4.0 billion cubic metres) of this were "green water", or rainfall, used in growing crops. This is roughly equivalent to a large road tanker of water per resident of Germany per year. A further 1.6 billion cubic metres was "grey water", or water polluted and returned to the water supply. Finally, 900 million cubic metres of "blue water" were required: water taken from the public water supply for activities such as the water baths needed for adding dyes and other chemicals to fabric and the water required to wash machinery after its use.

740,000

Tonnes of five important air pollutants emitted globally by German's fashion industry in 2019.

6.5 billion

Cubic metres of water: the global water footprint of Germany's fashion industry in 2019.

2.5 million

Hectares of agricultural land used worldwide by Germany's fashion industry in 2019.

We also **estimate the agricultural land requirements for the German fashion and its global supply chains, at 2.5 million hectares worldwide.** This is equivalent to the majority of Belgium (3.0 million hectares), and reflects the land required to produce the cotton used in fashion items.[3]

CONCLUSION

The first step to reducing emissions is measuring and reporting footprints. This report provides an initial attempt at measuring the German fashion industry's environmental impact, providing an initial step towards identifying how and where to make changes.

German fashion industry companies and organisations, as well as the Federal government, have begun changing approaches and launching initiatives towards reducing environment impacts. However, ongoing government support will be needed to provide businesses with the necessary tools and knowledge to calculate environmental impacts, particularly small businesses that do not have significant resources to devote to the issue.

***Image:** Shutterstock*

[3] Although the majority of textiles are made from synthetic fibres rather than natural fibres, it has not been possible to assess land usage for these inputs due to data limitations.

Image: Axl Jansen

1. INTRODUCTION

1.1 GERMANY'S FASHION INDUSTRY TODAY

Germany is an important global market for fashion products, as one of the top five largest economies in the world and largest consumer market in Europe.[4] In 2019, consumers in Germany spent €76 billion on clothing and footwear, just behind the UK as the highest fashion spenders in Europe,[5] and sixth highest in the world.[6]

Germany's appetite for fashion requires sourcing a significant volume of products from elsewhere in the world: the country was the second-largest importer of clothing and footwear in the world in 2018.[7] This is a factor that has grown over the past few decades as the amount of domestically produced clothing has declined: economic output in the German clothing manufacturing sector fell by 91% in real terms between 1980 and 2020.[8] In fact, even ten years ago in 2011, it was reported that less than 5% of the clothing sold in the home market came from domestic factories.[9]

This activity generates a significant contribution to the economy. In a report published early in 2021,[10] Oxford Economics estimated that the German fashion industry directly contributed €28 billion to German GDP in 2019 (equivalent to roughly 1% of the national gross domestic product)[11] and supported employment for 770,000 people in Germany. Considering the effects of supply chain spending and workers spending their wages, we estimated that the German fashion sector supported a GDP contribution of €66 billion, and employment of nearly 1.3 million in the country.

[4] Eurostat, GDP and main components database for 2019, table nama_10_gdp.
[5] Eurostat, Final consumption expenditure of households by consumption purpose database .
[6] Figures from Oxford Economics' Global Economics database.
[7] United Nations Commodity Trade Statistics Database.
[8] Figures for earlier years including both the Federal Republic of Germany and the German Democratic Republic.
[9] Deutsche Bank Research, Textile and clothing industry, July 2011.
[10] Oxford Economics and Fashion Council Germany, The Status of German Fashion 2021.
[11] Oxford Economics, The State of Fashion, 2021.

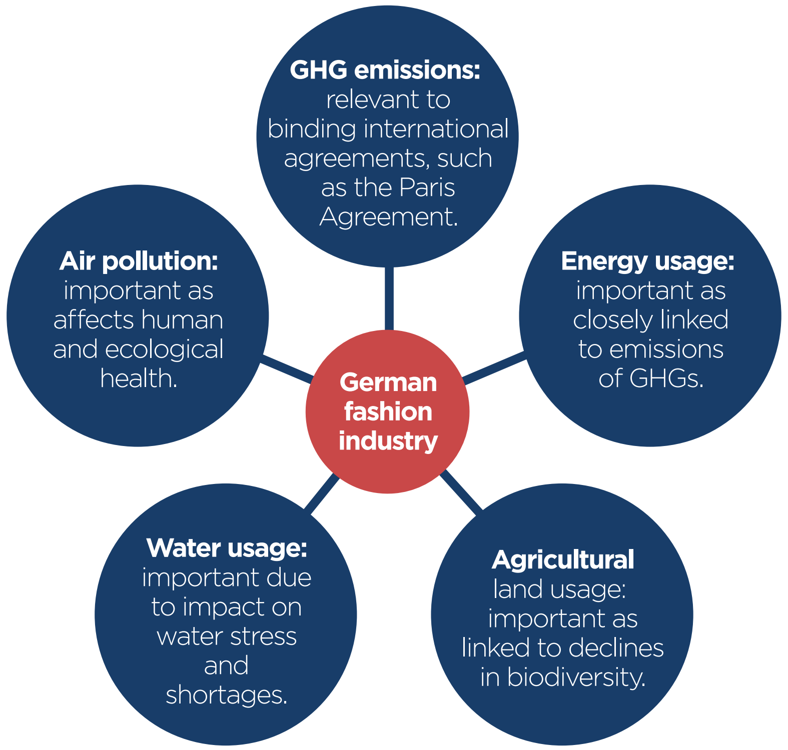
1.2 PURPOSE OF THIS REPORT

This economic activity also generates a complex environmental impact through many channels and across the entire value chain. For instance, the industry uses cotton, wool, leather and cellulose from the agricultural sector; metal ore from the mining sector to be turned into textile machinery; and oil and gas for synthetic fibres, transportation, energy, and other chemical and industrial processes. At each stage of a garment's journey from raw materials to a customer's wardrobe greenhouse gases are emitted, waste products are produced, and water and other inputs are consumed.

The purpose of this report is to investigate and estimate the environmental impact of the German fashion industry for the first time. Our analysis will firstly consider the impact of the industry's activity within Germany itself. However as discussed above, Germany's own fashion production sector is relatively small. As such, alongside this impact, we also consider the environmental impacts linked to the agriculture, manufacturing and other sectors around the world that produce the garments imported into Germany and the inputs of materials that are used to make them.

We measure the environmental impact of the German fashion industry across the five themes set out in the figure below. In our analysis across these themes, we consider the full value chain of the fashion industry starting with the production of both natural and synthetic raw materials,[12] through the manufacturing process, to the distribution to the end consumer.

Fig. 1: Measuring the environmental impact of the German fashion industry



Source: Oxford Economics.

[12] Synthetic fibres such as polyester made up more than 62% of global fibre production in 2018, compared to 6% for man-made cellulosic fibres, and 32% for plant-based and animal-based fibres. Textile Exchange, Fiber & Materials Market Report 2019.

The environmental impact of the German fashion industry
OXFORD ECONOMICS

A quantitative analysis of the social impact of the German fashion sector is not included in the scope of this report, however the social impact is discussed qualitatively in case studies provided by partners throughout this report.

The scope and reach of the German fashion sector are defined in this report is as follows:

- **Fashion manufacturing within Germany,** including manufacturing of clothing, footwear, accessories and jewellery. In this category we also include an estimate of the manufacturing of textiles that is used for fashion purposes, as opposed to other uses for textiles.
- **Retail and wholesale of all fashion products sold in Germany,** whether produced domestically or imported.
- **Manufacturing of clothing and footwear** elsewhere in the world and **imported into Germany.**

Our estimates do not include the impact of fashion manufacturing by German-owned fashion companies where the production occurs outside of Germany and the finished goods are sold in non-German markets. For instance, where a German-owned brand manufactures in China but sells in the US, the impact is not included in our estimates. This is due to limitations on the public availability of data necessary to consider this element comprehensively. However, this issue is discussed qualitatively in an analysis on page 22 based on figures published by major German fashion companies.

The COVID-19 global pandemic caused significant disruption to the overall economy and the fashion industry in particular from early 2020, as consumers had a significantly reduced need to buy new fashion items. Indeed, revenue in clothing stores in Germany in April 2020 was 78% lower than in the same period a year before in real terms.[13] Since then, there have been signs of recovery in revenues: clothing store turnover in June and July 2021 was 1% higher in real terms than the same months in 2019. However, to represent a more "typical" year for the industry and to reflect our recent economic impact study, we conduct our analysis and present results for 2019.

[13] Statistisches Bundesamt, Table 45212-0005, Turnover in retail trade.

MEASURING THE ENVIRONMENTAL IMPACT OF THE GERMAN FASHION INDUSTRY

In this study we base our assessment of the German fashion industry's environmental impact on the Greenhouse Gas Protocol, which provides a comprehensive international standard for measuring and managing GHGs.[14] The protocol provides a framework for companies or industries to assess their carbon footprint using three 'scopes', which are defined as follows.

- **Scope 1** refers to the direct emissions from the operation of an industry's own facilities and assets. In large part this refers to fuel combustion such as gas boilers on industry-operated sites, or petroleum products used to fuel the industry's own vehicle fleet.
- **Scope 2** refers to the indirect emissions that are made by other organisations that provide electricity and heat to the industry, i.e. the energy sector.
- **Scope 3 supply chain** refers to the indirect emissions that occur in the fashion industry's supply chain as a result of the goods and services it purchases. This can be thought of as the emissions 'embedded' in the industry's inputs of goods and services.

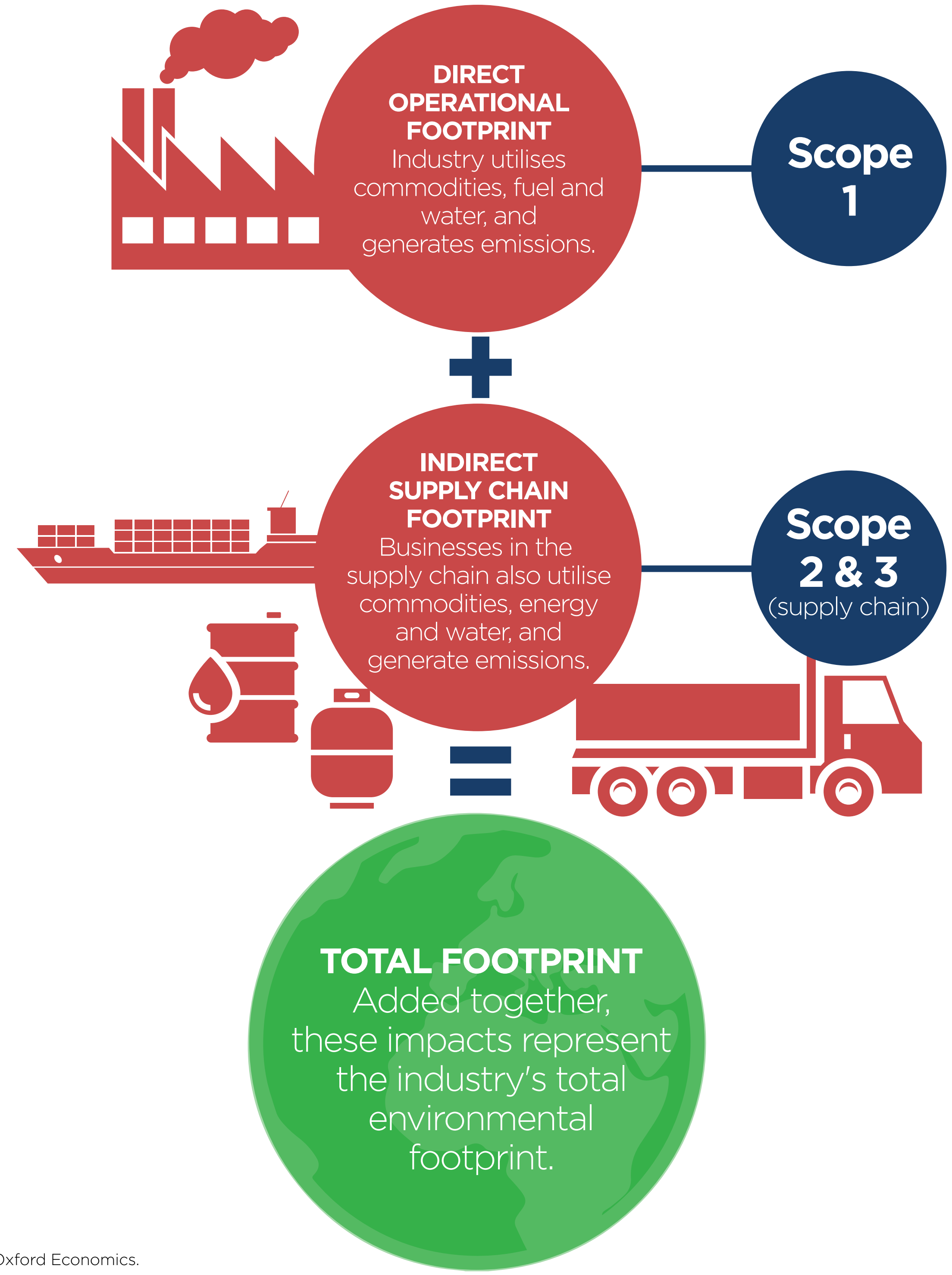
It should be noted our estimates relate specifically to the upstream supply chain aspect of Scope 3. As such, it does not include the impacts of other Scope 3 categories, such as the downstream use and disposal of the industry's products, or the impact of employees commuting to work. This is due to a lack of comprehensive data on these elements.

These three scopes are illustrated in the figure opposite. Although this framework is designed specifically for GHG emissions, it is also a useful approach for considering the industry's impact as measured by energy requirements and air pollution. Regarding water and land use, we consider the industry's direct requirements, plus the requirements embedded in the purchase of goods and services (analogous to Scope 3 in the emissions framework).

For further details on the methodology, see the Appendix.

[14] For more information, see the Greenhouse Gas Protocol's website: https://ghgprotocol.org/

Fig. 2: Measuring greenhouse gas footprints



Source: Oxford Economics.

GOVERNMENT-LED SUSTAINABLE FASHION INITIATIVES

Over the past decade the German Federal Ministry for Economic Cooperation and Development has introduced two initiatives aimed at increasing the sustainability of the textiles and fashion industry.

Partnership for Sustainable Textiles

Since its founding in 2014, the Partnership for Sustainable Textiles has been campaigning for social and ecological improvements in the textile and clothing industry along the entire textiles life cycle. The guiding principles for action are respect for human rights and doing business within planetary boundaries. The goals and procedures of the Partnership for Sustainable Textiles are based on international standards and guidelines for corporate due diligence from the UN, ILO, and OECD. As a multi-stakeholder initiative, the Partnership for Sustainable Textiles unites companies, associations, non-governmental organisations, standard organisations, trade unions, and the German Federal Government. They join forces and contribute their expertise and strengths. In addition, the Partnership for Sustainable Textiles cooperates with European and international initiatives to disseminate best practices, increase the leverage for its commitment and avoid duplication of efforts.

The Green Button Government-Run Textile Label

Since 2019, sustainable textiles can be easily recognised by the government-run textile certification label Green Button. The label demands responsible business practices from companies and sets requirements for sustainable production. In December 2021, around 80 companies offer products with the Green Button, over 150 million textiles have been sold since its launch, and 40% of people in Germany are familiar with the label. To protect people and the environment even more comprehensively, the requirements have been further developed since its introduction.

2. THE FASHION INDUSTRY'S GHG EMISSIONS FOOTPRINT

Image: *Mario Stumpf/Sascha Priesters/Neonyt*

The core of Germany's domestic fashion industry are design, manufacturing and administrative operations by brands located in Germany, as well as the retailers and wholesalers supplying fashion items to consumers. However, **the industry has a much bigger footprint across the world due to the nature of global supply chains, and in particular the extent of offshored clothing and footwear production.**

In this section, the greenhouse gas footprint of these various parts of the German fashion industry across the three scopes set out by the GHG Protocol is considered. Detail on how the estimates presented here were made is given in the Appendix.

CO_2 equivalency

The major greenhouse gases emitted by mankind are carbon dioxide, methane, nitrous oxide and fluorinated gases.

Emissions of these gases can be expressed in terms of CO2-equivalency (CO2e) based on their "global-warming potential", i.e. how many tonnes of CO2 it would take to have the same global warming effect as one tonne of each other gas.

For instance, the effect of one tonne of methane is equivalent to 25 tonnes of CO2; for nitrous oxide it is 298 tonnes of CO2, and for fluorinated gases it is up to 14,400 tonnes. This is due to how much infra-red radiation each gas can absorb, as well as how long each gas stays in the atmosphere.

2.1 SCOPE 1 EMISSIONS

Scope 1 of the GHG protocol covers the direct emissions of an industry through fossil-fuelled burning equipment that the industry owns, such as vehicles, heating systems and industrial equipment.

Using published industry-level emissions data, **we estimate that in 2019 the German fashion industry directly emitted 2 million tonnes of greenhouse gases** in CO2-equivalent terms, through the Scope 1 definition. Three quarters of these emissions came from the distribution side of the fashion industry (i.e. the wholesale and retail sector), for instance through the transport of fashion products between ports, warehouses and stores.

This puts the industry's direct emissions roughly in line with those of Germany's pharmaceutical manufacturing sector, or a little way below the country's rubber and plastic manufacturing sector.[15]

The fashion industry directly produces a relatively small share of Germany's overall emissions. By comparison, in 2019:

- the overall German manufacturing sector in total emitted nearly 170 million tonnes of CO2e;
- automobiles used by German households produced 110 million tonnes, and
- Germany as a whole produced a total of 850 million tonnes of greenhouse gases.

- Due to the majority of fashion products bought by German consumers being manufactured outside the country, Scope 1 emissions of the sector are lower than if production were predominantly domestic.

Fig. 3: Scope 1 GHG emissions of selected German industries, 2019

Source: Eurostat, Oxford Economics.

2.2 SCOPE 2 EMISSIONS

Scope 2 as set out by the GHG Protocol includes the emissions produced by the power sector, which generates the electricity and heat used by the fashion industry. As with Scope 1, the industry's Scope 2 footprint in Germany is relatively small due to the majority of the more energy-intensive manufacturing processes being conducted outside of the nation's borders.

We estimate that the German fashion industry's Scope 2 emissions in 2019 were 1.7 million tonnes of CO2e, mostly in the form of electricity purchased from energy suppliers. Across Scope 1 and Scope 2, this means the domestic German fashion sector is responsible for just 0.4% of the country's emissions.

The scale and intensity of Scope 2 emissions of any industry will be largely dependent on the mix of energy generation sources used in the country. At 40% of the total, Germany has a relatively high share of renewable energy in its mix of generation sources—compared to 35% across the EU28 in 2019, for instance. This means that the Scope 2 footprint of the fashion industry within Germany is smaller than it would be in countries with a lower share of renewables, but is likely to fall further in the future as the country's energy grid decarbonises.

[15] Eurostat Air Emissions Accounts database.

2.3 SCOPE 3 SUPPLY CHAIN EMISSIONS

Scope 3 supply chain emissions are much larger than Scopes 1 and 2 due to the extent of offshored production in the industry. More than 90% of the fashion industry's emissions—or 34.5 million tonnes of CO2e—came from upstream activities such as materials production, preparation, and processing. We split supply chain activities into two components:

1. Global supply chain purchases by Germany's domestic fashion industry. This would include textiles for domestic fashion manufacturing, products bought by the head offices of German brands, and the supply chains of the fashion distribution sector.
2. Fashion items produced abroad and imported into Germany, including the global supply chains supporting this activity.

By analysing the supply chains of the fashion industry within Germany, we estimate that the total Scope 3 GHG emissions generated by the global supply chain purchases of the domestic fashion sector equalled 8.7 million tonnes of CO2e in 2019. The largest component of this (3.7 million tonnes) came from within Germany itself, with a further 900,000 tonnes being produced in Russia, 700,000 tonnes in China, and the remainder split across many other countries including Bangladesh, Poland and India.

Secondly, we estimate the global Scope 3 emissions of the German fashion industry associated with overseas production, based on the volume of imports of clothing and footwear into Germany. We estimate that the business activity required to produce these imported fashion items generated some nearly 26 million tonnes of carbon dioxide equivalent in 2019, significantly adding to the GHG footprint of the German fashion industry. The geographic distribution of this footprint reflects trading relationships. For instance in 2019, China was Germany's largest import partner for clothing and footwear, followed by Bangladesh, Turkey and Vietnam.

FASHION SUPPLY CHAINS CONSIDERED IN THIS REPORT

In our analysis, we consider the impact of business activity across the full supply chain of any particular fashion item. This means that the impact is traced right back to where the natural resources are first extracted from the ground.

For example, the supply chain for a cotton garment would typically include the following stages, all of which are considered in our analysis:

1. Production of cotton from agricultural inputs such as seeds, fertilisers, fuels and farming equipment.
2. Production of textiles and hence clothing from manufacturing inputs such as cotton, chemicals, electricity and manufacturing equipment.
3. Distribution of fashion items to the end customer using distribution inputs such as the finished products themselves, vehicles and fuel, and everything required to fit out warehouses and fashion stores.

We also trace the supply chains that make these inputs back to their origin. For instance, farming and manufacturing equipment is made in other factories and requires raw materials such as steel, which ultimately requires iron ore to be mined.

For synthetic materials that don't result from agricultural inputs, we trace business activity back through the petrochemicals industry, starting with the oil extraction sector, through refining into plastic pellets and then into spinning into polyester threads, for instance.

Leather and animal products used in the fashion industry are often co-products of the food industry, meaning that the raising of cattle is done in some cases with the aim of producing both meat and leather. This will be captured in our supply chain analysis as the animal hides will be purchased by the leather production industry from the animal product processing sector, which in turn purchases from the agricultural industry.

2.4 TOTAL GREENHOUSE GAS IMPACT OF THE INDUSTRY

Across the Scope 1, Scope 2 and Scope 3 supply chain footprints, **we estimate that the German fashion industry's total global greenhouse gas emissions were just over 38 million tonnes of carbon dioxide equivalent in 2019.** Almost the entirety of this impact came from the industry's supply chain, with the majority of the Scope 3 impact arising via clothing and footwear produced outside of Germany.

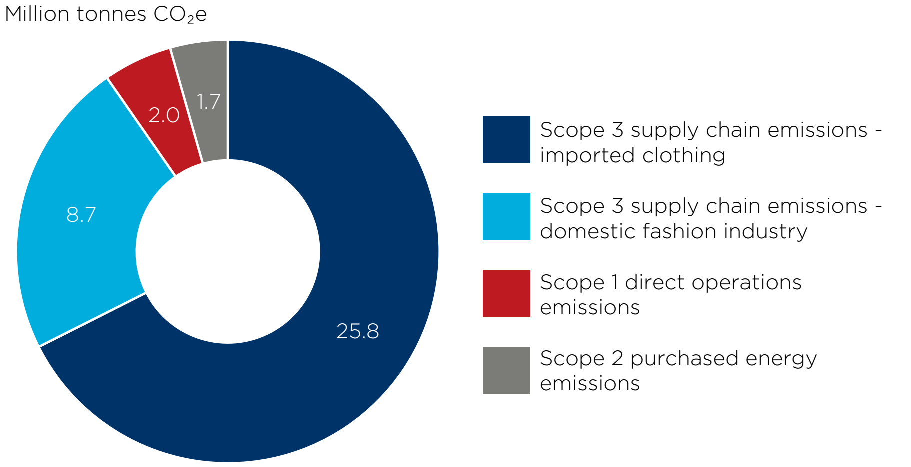
These 38 million CO2e tonnes emitted worldwide by the German fashion industry and its supply chains are equivalent to approximately 4.5% of all greenhouse gases emitted directly by German households, businesses and government. Similarly, this is equivalent to the average emissions of 1.9 million German households,[16] or 8.7 million circumnavigations of the Earth in a family car (more than enough for one trip for every resident of the state of Lower Saxony).[17] It is also a similar magnitude to the total direct emissions of Slovakia in 2019 (42 million tonnes), or the business and government direct emissions of Sweden (47 million tonnes).[18]

Breaking the headline result down by the country in which the greenhouse gases are emitted, the largest impact was in China at 9.2 million tonnes of CO2e. This reflects China's position as the largest source of clothing and footwear imports into Germany, as well as a major supplier to Germany's domestic fashion industry. The second largest impact at 7.6 million tonnes was Germany itself, due to the domestic Scope 1 and Scope 2 emissions as well as the emissions associated with supply chain purchases within the country.

The largest impacts by industry globally are seen in the agricultural sector, at 8.1 million tonnes across all three Scopes. This is due to the high importance of textile crops to the fashion industry, combined with the fact that agriculture is one of the most carbon intensive industries in the global economy.

The agricultural impact was followed by the impact of the carbon-intensive energy sector, as well as the textiles and clothing manufacturing sector itself.

Fig. 4: Total global GHG impact of the German fashion industry by scope of emissions, 2019



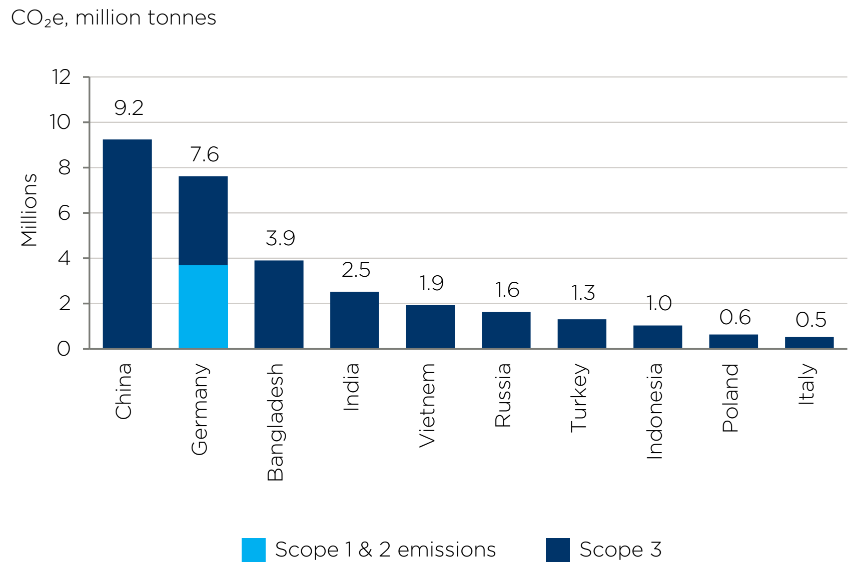
Source: Oxford Economics.

[16] Average household emissions of 20.6 tonnes, based on total GHG emissions in Germany of 850 million tonnes in 2019 and an estimated 41.5 million households.

[17] Based on Earth circumference of 40,000km and stated CO2 emissions of 0.1 kilograms per kilometre in a Volkswagen 2020 Golf.

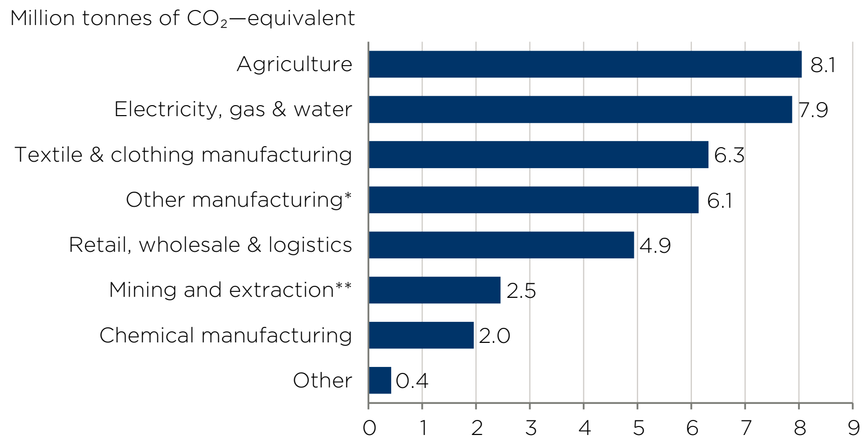
[18] Eurostat, air emissions accounts database, table reference env_ac_ainah_r2.

Fig. 5: Total GHG impact of the German fashion sector by 10 largest countries of emissions, 2019



Source: Oxford Economics.

Fig. 6: Total GHG impact of the German fashion sector by industry, 2019



* Predominantly metals and refined petroleum products

** includes extraction of crude oil and natural gas, as well as of metals used in textile machinery

Source: Oxford Economics.

THE GLOBAL IMPACT OF GERMAN-OWNED FASHION COMPANIES

In this report we have considered the impact of the operations of fashion brands and retailers within Germany, as well as the global impact of clothing and footwear sold in Germany but manufactured elsewhere. This all draws on publicly-available data from national statistics agencies and non-governmental organisations. However, one aspect not considered here is the impact created by the activities of German-owned companies manufacturing overseas and selling to customers abroad, for instance a German-owned or -contracted factory in China producing clothes to sell to the US.

The largest global German fashion brands such as Adidas, Puma, Hugo Boss and C&A[19] source the majority of production and generate the majority of sales outside of Germany itself, meaning we consider only a portion of their global impact within the scope of our study. However, it is possible to illustrate at a high level the global impact that the operations of these large fashion companies have by using the information published in corporate sustainability reports, which includes global production activity otherwise unlinked to Germany. This is given in Fig. 7.

The table highlights that more than 90% of emissions of many of Germany's largest fashion brands are through Scope 3 supply chain emissions, i.e. outsourced production. While production is carried out in many countries around the world, much is often done in lower-income countries such as Vietnam and Bangladesh that are often less able to produce in a low-carbon way. For instance, half of Vietnam's energy production was from coal in 2020[20] and Bangladesh's government was reportedly considering plans to increase the mix of coal in total electricity generation to 50% by 2030.[21]

Furthermore as shown in the table below, only a relatively small proportion of the global sales of these companies are within Europe (and it can be assumed that a still-smaller proportion is within Germany). As such, much of the impact shown below will be in addition to that captured within our analysis.

[19] Adidas' global sales at €23 billion in 2019 were more than the rest of the top ten largest German fashion brands combined.
[20] US Energy Information Administration, Vietnam's latest power development plan focuses on expanding renewable sources, 2021.
[21] US International Trade Administration, Bangladesh Power and Energy, 2020.

Fig. 7: Published environmental impacts of largest German fashion companies[22]

2019 figures	Adidas	Puma	Hugo Boss	C&A
Scope 1 emissions (tonnes CO_2e)	6,620	6,326	12,009	19,569
Scope 2 emissions (tonnes CO_2e)	21,690	11,533	20,384	98,767
Scope 3 supply chain emissions (t CO_2e)	NA	250,240	731,927	4,052,579
Share of Scope 3 in total emissions	NA	93%	96%	97%
Share of sales in Europe	26%	36%	63%	Not available
Share of sales in Americas	29%	35%	19%	Not available
Share of sales in Asia-Pacific	34%	28%	15%	Not available
Share of other sales	11%	0%	3%	Not available

Source: Oxford Economics.

[22] Figures taken from Adidas' Green Company Report and Annual Report, Puma's Annual Report, Hugo Boss's Sustainability Report, and C&A's Sustainability Report.

A CASE STUDY FROM GERMANY: THE GOAL IS 1.5°

Image: *ABOUT YOU*

The following is a case study provided by ABOUT YOU, a German e-commerce retailer, about the company's approach to addressing climate change objectives.

Written by Magnus Dorsch, Senior Project Manager Sustainability, ABOUT YOU.

ABOUT YOU is taking responsibility as a company and is therefore working on reducing Greenhouse Gas (GHG) emissions in line with the 1.5° goal of the Paris Agreement. Since 2020, ABOUT YOU, as one of the fastest-growing European fashion platforms, has been working on a dedicated GHG emission reduction strategy, set out here.

Based on our ESG (environmental, social and governance) approach we outlined three steps:

1. We continuously measure our GHG emissions and gradually improve our analysis.

2. We reduce our GHG emissions and coordinate with our partners.

3. We compensate for all GHG emissions that can not be reduced directly.

The environmental impact of the German fashion industry OXFORD ECONOMICS

From that, we derived our milestones:

- We achieved transparency on our corporate carbon footprint (CCF) by following the GHG Protocol accounting for all our e-commerce activities.[23] As a retailer with an asset-light business model, we have a high degree of Scope 3 emissions. Achievable with relatively low effort.
- Since Q4 2020, we are a carbon neutral company by offsetting all our corporate GHG emissions through tangible certified climate protection programs. Achievable with relatively low effort.
- Simultaneously, we kicked off our first new measures based on the CCF to reduce GHG emissions. Due to a high degree of Scope 3 emissions, a major share has to be realised with our partners. Our focus is on impact and visibility. This work continued and scaled since then. Achievable with a middling amount of effort to set up, but a high amount of effort to scale.
- We added the product carbon footprint of our products to the scope of the analysis. For this purpose we used a "screening approach", as opposed to the "inventory approach", of the CCF. Our screening approach is based on the quantity, weight, material and inbound transport distance of all products we acquire. Achievable with a middling amount of effort.
- To improve our GHG emission reduction trajectory we set science based targets (SBT) in Q1 2021.[24] This adds clear externally-verified goals to our GHG strategy that are tied to a universal standard. We will also report annually on the progress. Achievable with a high amount of effort.

Due to the high degree of Scope 3 emissions, we will also have to realise GHG emission reductions with our partners. Our approach here is to engage with partners to set SBT for themselves.

We have set ambitious targets until 2025 and have an internally aligned plan on how to get there. As part of our goals, we are also encouraging our partners who have not set SBT to do so.

Our recommendation for other companies wishing to work on their GHG footprint is to progress step by step in the order above.

For us, this is a work in progress, and we are already working on the next steps. Our biggest challenge has been that because we are a fast-growing e-commerce company, our GHG footprint has been growing in absolute terms due to the products we sell and the logistics service we use having associated non-reducible embedded emissions. As such, we also track our footprint in relative terms i.e. GHG emissions per order.

The most important key enabling factors for this process are access to data to base decisions on, the capacity of internal stakeholders to carry out these activities, and cooperation with our partners.

[23] Scopes 1 to 3, excluding products i.e. upstream production, third-party brand inbound transport impacts and downstream disposal. For details please refer to our 2020 Responsibility Report

[24] SBT are corporate GHG emission reduction targets aligned with up-to-date scientific methods to limit global warming to 1.5° or 2° as outlined in the Paris Agreement. The Science Based Targets initiative (SBTi) is a multi-stakeholder initiative approving SBT. The SBTi has created an industry changing momentum by enlisting over 1.000 companies globally also within the fashion industry. Read more at https://sciencebasedtargets.org/

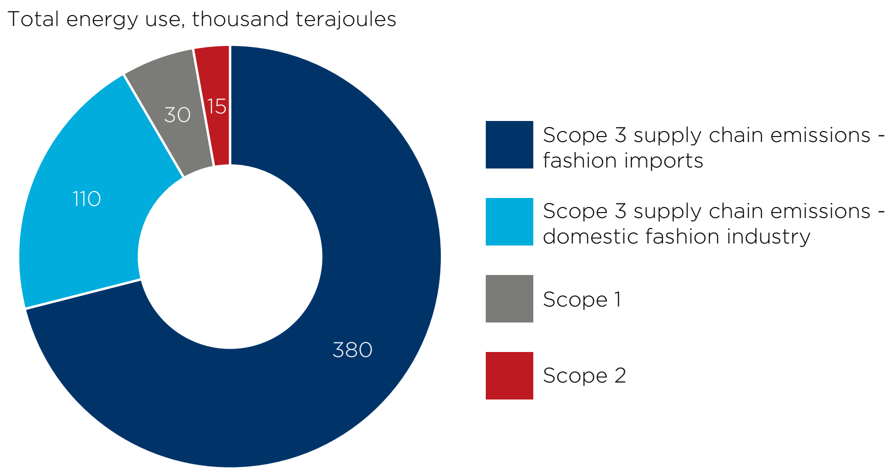
3. THE FASHION INDUSTRY'S ENERGY REQUIREMENTS

Total greenhouse gas emissions around the world are closely tied to the amount of energy used by the global population. One way that mankind uses energy is through the production of electricity, which more than doubled between 1990 and 2018.[25] However, energy is also used more directly through applications such as combusting fuels in engines, boilers and furnaces.

3.1 ENERGY USE BY THE GERMAN FASHION INDUSTRY

We estimate the energy use of the German fashion industry by looking at the business activity of the domestic sector and its global supply chains and applying average energy usage figures. From this, we estimate that the German fashion industry globally used approximately 535,000 terajoules[26] of energy in 2019 across all types, such as electricity and by directly burning fossil fuels in vehicles. Much of this energy usage is within the fashion manufacturing industry itself, through processes from the initial production of fibres, through to making textiles and finishing garments. Energy usage also comes through supporting activities such as transportation. This figure is only a little more than the entire electrical energy consumption of the Netherlands in 2018, which was 510,000 terajoules.[27] Countries such as China, Vietnam and India were major locations for this energy consumption.

Fig. 8: Energy use by German fashion sector split by scope, 2019



Source: Oxford Economics.

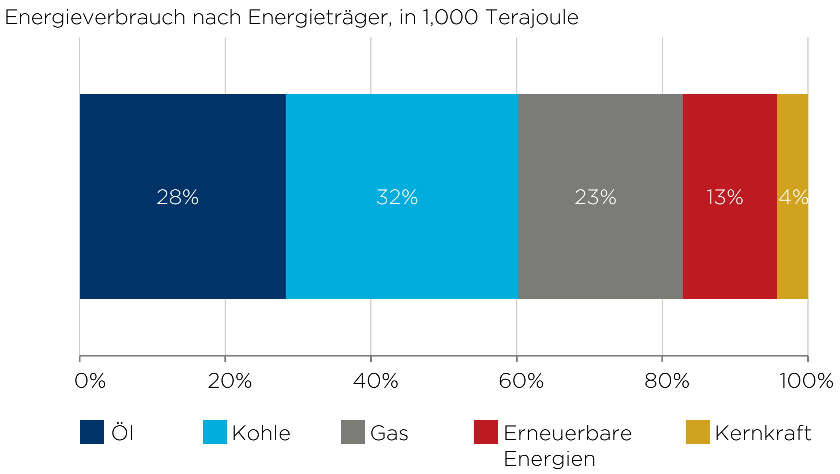
[25] International Energy Administration, Data and Statistics, Electricity Consumption indicator.

[26] A joule is a standard unit of energy usage. It can be linked to the units used as standard in electricity consumption as follows: one joule is equal to one watt per second, so one watt-hour is equivalent to 3,600 joules. A LED bulb is typically around 4-8 watts.

[27] Eurostat, Energy supply and use database, table env_ac_pefasu.

The largest sources of energy were petroleum products, such as fossil fuel-powered vehicles and oil-fired power stations, followed closely by coal. In total, fossil fuels were the source for 83% of the energy used globally by Germany's fashion sector. Renewable energy (such as hydroelectricity and wind power) and nuclear energy were the source for 13% and 4% of energy usage, respectively.

Fig. 9: Total global energy use by German fashion sector, split by energy type, 2019



Source: Oxford Economics.

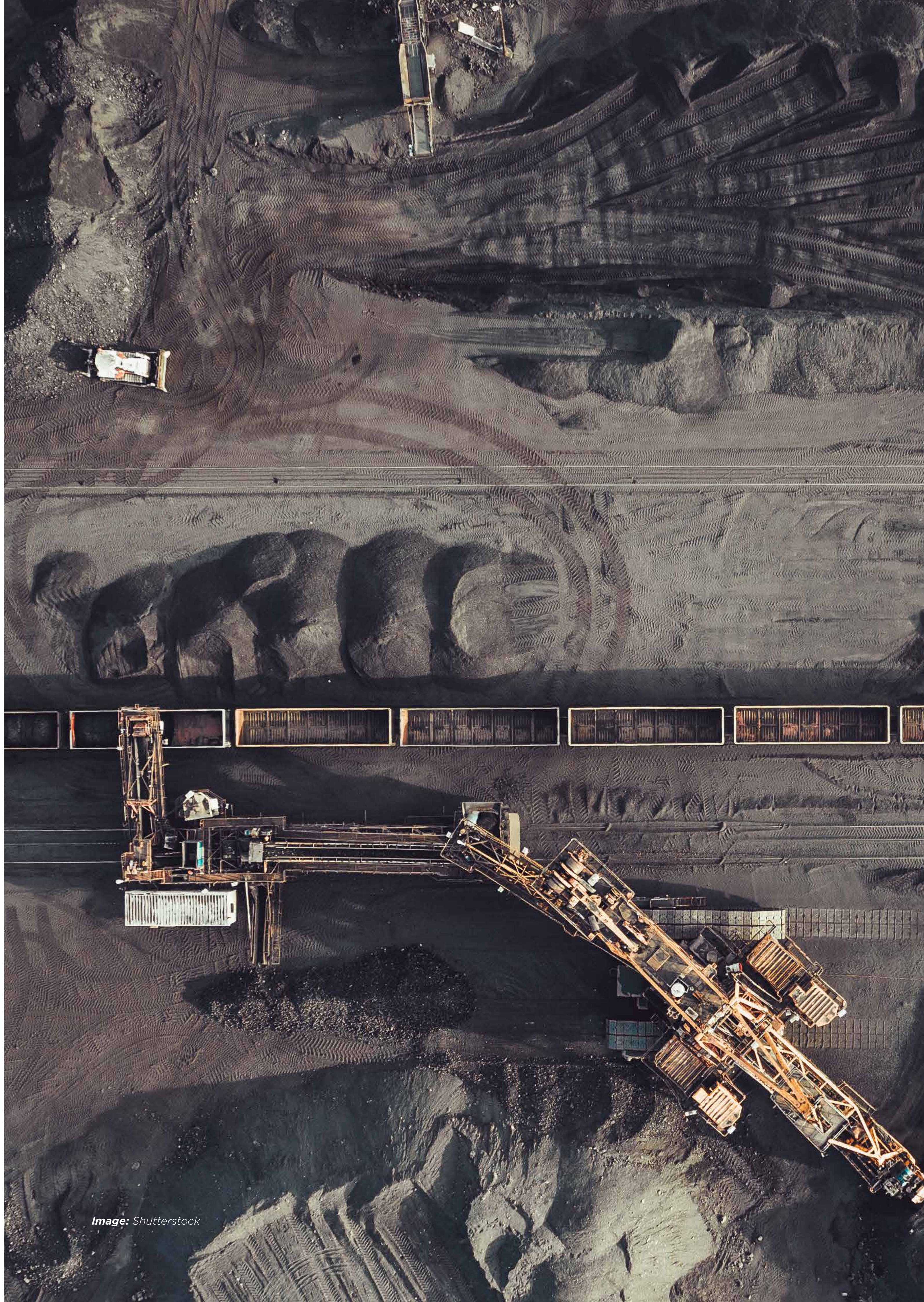


Image: Shutterstock

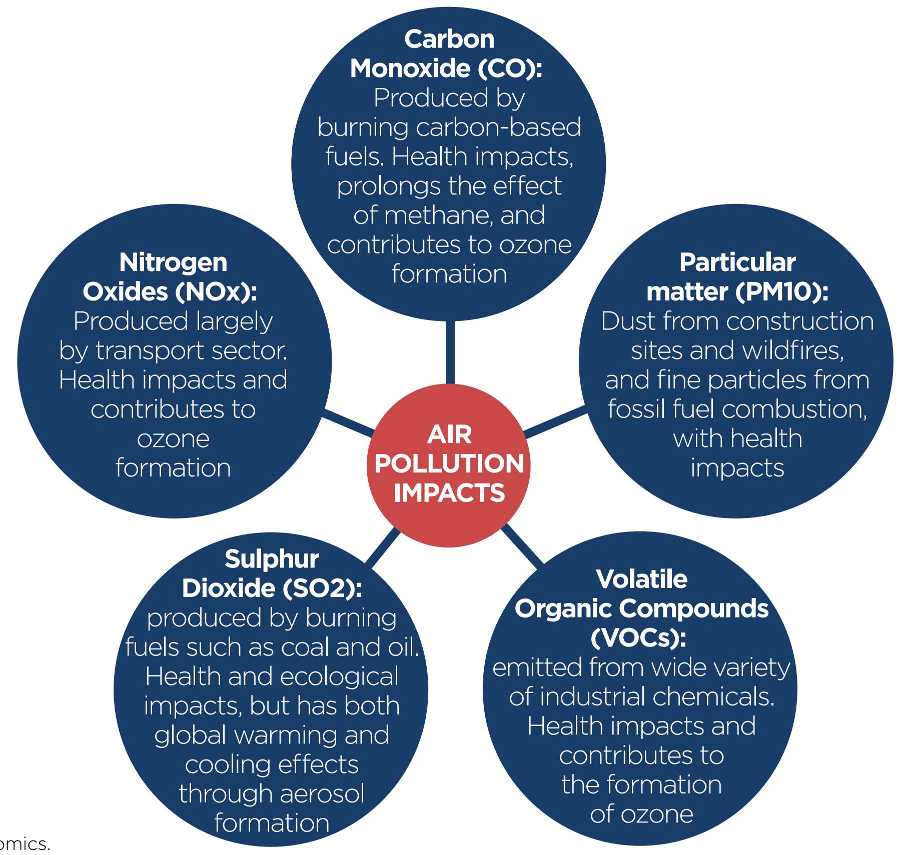
Image: Christian Wiediger via Unsplash

4. THE FASHION INDUSTRY'S AIR POLLUTION FOOTPRINT

Air pollution, whether produced by mankind or by natural sources such as volcanoes or wildfires, can have wide-ranging and significant impacts. This includes effects on human health: an estimated 7 million people worldwide face premature death each year due to air pollution.[28] The impact also includes ecological effects such as acidification of water and soil and the knock-on effects on ecosystems, and even air pollutants that are not considered typical greenhouse gases can have impacts on the global climate.

In this chapter we focus on five types of pollution frequently considered the most significant air pollutants, which all have harmful effects on human and ecological health.[29] Four of these are gases also known as "indirect" greenhouse gases due to the indirect effects they have on global warming (see descriptions below). The fifth pollutant is solid particulate matter, which has harmful respiratory health effects.

Fig. 10: Measured pollution types[30]



Source: Oxford Economics.

28 World Health Organization, Air Pollution.

29 Such as in UN, Towards a Pollution-Free Planet and British Lung Foundation, Types of air pollution.

30 More information on each of these pollutants is given in the Appendix.

A NOTE ON OZONE

When combined with one another and with sunlight, CO, NOx and VOCs form ozone (O3). While this gas has positive effects as the protective "ozone layer" in the higher atmosphere, when formed at ground level the gas has harmful effects on human health and ecological systems.[31] For instance, O3 reduces the yield and quality of agricultural output and is estimated to destroy enough food every year to feed 94 million people in the Indian subcontinent.[32]

Ground-level ozone is also identified by the Intergovernmental Panel on Climate Change as the third most important greenhouse gas after carbon dioxide and methane.[33] While we do not measure in this study the footprint of the German fashion industry in terms of ozone, it is worthwhile to note that a reduction in the emissions of NOx, CO and VOCs would help to reduce the formation of ozone pollution, hence reducing the overall volume of greenhouse gases produced.

[31] US Environmental Protection Agency, Ground-level ozone basics.
[32] US Research Applications Laboratory, Air pollution: a global problem, 2016.
[33] IPCC, Atmospheric Chemistry and Greenhouse Gases, 2018.

4.1 THE GERMAN FASHION INDUSTRY'S AIR POLLUTION FOOTPRINT

Germany itself is a relatively small direct emitter of air pollutants. The country's economy is the fourth largest in the world, accounted for 5% of global GDP in 2018,[34] yet directly emitted between just 1% (VOCs) and 0.4% (PM10) of the pollutants we are assessing.[35] This reflects both the industry mix in the national economy and the strength of environmental regulations in force in the country in comparison to lower income nations.

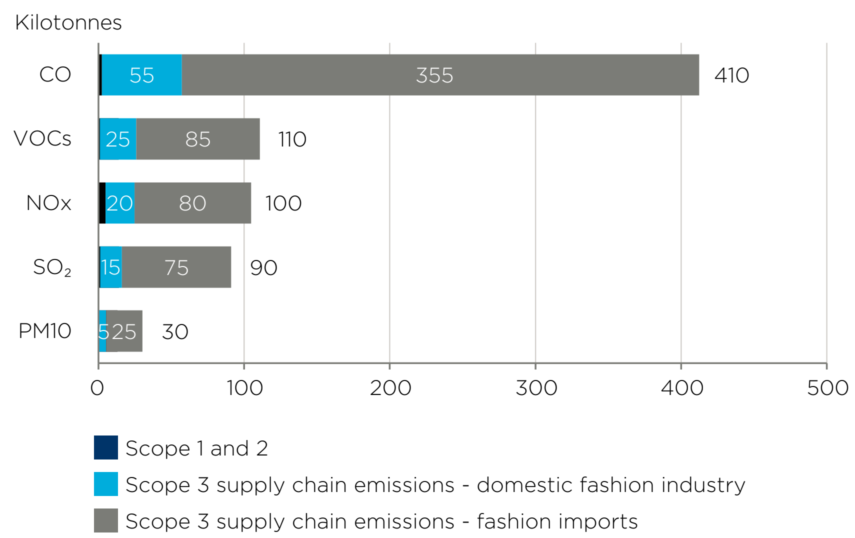
As such, the German fashion industry's Scope 1 air pollution emissions (by businesses in the industry) and Scope 2 emissions (through the generation of the electricity used by the industry) are relatively small.

The vast majority of the industry's air pollution impact comes through its supply chain. Within the fashion manufacturing industry, examples of processes that release air pollution include factory boilers heating water and releasing sulphur dioxide, and factory "sizing" operations (adding protective coatings to textiles) can release carbon monoxide.[36] By looking at the supply chain purchases of the German fashion industry in different industries and countries around the world, and applying average pollution emission intensity ratios, we can assess the industry's global air pollution footprint, as illustrated in the figure below.

In line with where German imports of fashion items and raw materials originate, the largest air pollution impacts for the German fashion sector were in countries such as China, Vietnam, India, Indonesia and Bangladesh. The largest pollution footprints were seen in the textiles, clothing and footwear sector itself, as well as agriculture, transportation and the energy sector.

To put these figures in context, the 410,000 kilotonnes of carbon monoxide that we estimate the German fashion industry emitted globally in 2019 are equivalent to 12% of all carbon monoxide emissions within Germany itself, from all sources. As the domestic German fashion industry is equivalent to only roughly 1% of the national gross domestic product (GDP),[37] this helps to highlight the extent to which Germany outsources polluting fashion industry activity.

Fig. 11: Total global air pollution footprint of the German fashion industry, split by air pollutant, 2019[38]



Source: Oxford Economics.

[34] IMF, World Economic Outlook database, April 2021.
[35] European Commission, Emissions Database for Global Atmospheric Research (EDGAR), April 2020.
[36] Parvin et al, A Study on the Solutions of Environment Pollutions and Worker's Health Problems Caused by Textile Manufacturing Operations, 2020.
[37] Oxford Economics, The State of Fashion, 2021.
[38] Scope 1 and 2 emissions are included for each pollutant, but in most cases are too minimal to be easily visible in this figure.

Image: *Max Muench/Neonyt*

5. THE FASHION INDUSTRY'S WATER USE FOOTPRINT

Water is an important input for the fashion industry, used everywhere from growing cotton and other plant-based fibres through industrial processes such as water baths to apply dyes or tan leather, to washing equipment after use. Each garment can require several thousand litres of water to produce from crop seed start to finished product,[39] and it has been previously estimated that the entire global textiles industry directly uses an estimated 93 billion cubic metres of water per year.[40] While much of the impact is through growing fibre crops, the synthetic fibres that comprise the majority of textile production have their own footprint: for instance, the footprint of producing a tonne of polyester has previously been estimated at 71,000 cubic metres of water.[41]

The water impact of an industry is important to measure. This is because the geographic location of where water is used by any industry and where the end users of those products live are increasingly separated. This means that water availability is no longer a local issue but one that must be thought of through the lens of global supply chains: billions of people live in areas that experience significant or critical water shortages every year, in part due to water being used in industrial processes and manufacturing leaving less available for human consumption.[42]

MEASURING WATER FOOTPRINTS

The concept of a water footprint has been codified by the Water Footprint Network.[43] Using the organisation's framework, a company or industry's water footprint is composed of three channels:

- The **green water** footprint is the volume of rainwater consumed through crop production.
- The **blue water** footprint is the volume of surface and groundwater consumed, such as from the rivers and reservoirs that feed the public water supply.
- The **grey water** footprint is a measure of water requirements related to water pollution: it is the amount of water required to dilute pollution back to safe background levels.

We use this framework in our analysis starting with water used directly by the fashion industry in Germany, followed by water used by the suppliers of goods and services to the industry, including imported fashion products.

39 A figure of 2,700 litres of water to grow a t-shirt's worth of cotton is widely cited, such as by Vogue, 6 ways to reduce your water footprint, 2020. However, it is not clear in these citations what the original source of the analysis is.

40 This includes textiles for all uses, not just for fashion products. One cubic metre is equivalent to 1,000 litres of water. Ellen MacArthur Foundation / McKinsey analysis, A new textiles economy: Redesigning fashion's future, 2017.

41 Water Footprint Network, Assessment of polyester and viscose, 2017.

42 3.2 billion in areas of "very high" or "high" water stress. FAO, Overcoming water challenges in agriculture, 2020.

43 For more information, see the organisation's website: https://waterfootprint.org/

5.1 GERMAN FASHION INDUSTRY'S WATER FOOTPRINT

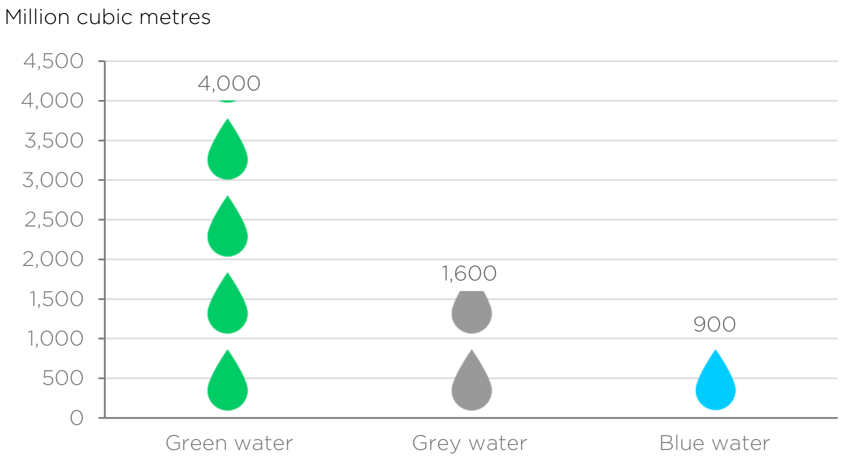
As in previous chapters, we look at the footprint of the German fashion industry's water usage by the domestic industry, the supply chains of the domestic industry and the water usage embedded in imported fashion items. However, for water usage, we also split these components further into the green, blue and grey water requirements detailed in the box above.

Across the world, the largest water requirement by the German fashion industry is the green water footprint, which represents rainwater used by agriculture.[44] We estimate a footprint of approximately 4 billion cubic metres of green water for the industry in 2019. With a national population of 83 million people, this means that on average, German residents are each linked to an estimated 50,000 litres of agricultural water requirements per year through the consumption of fashion products. This is approximately equivalent to the capacity of a large tanker lorry of rainwater per person per year and is an important issue to consider as some of the world's largest producers of cotton, such as India, are deemed to be at extremely high levels of water stress.[45]

We find that the industry has a grey water footprint of 1.6 billion cubic metres in 2019. This represents a conservative estimate of the amount of water polluted by the German fashion industry and its supply chains.[46] This means that on average, German residents are each linked to a conservative estimate of 20,000 litres of polluted water per year from the consumption of fashion products.

Lastly, we estimate a 900 million blue water requirement, which represents the water extracted from the water supply and consumed (mostly through evaporation) by industrial processes.

Fig. 12: German fashion industry's water footprint by type, 2019



Source: Oxford Economics.

[44] This includes water used to grow feedstock for livestock used in leather production.

[45] World Resources Institute, Water stress by country, 2013.

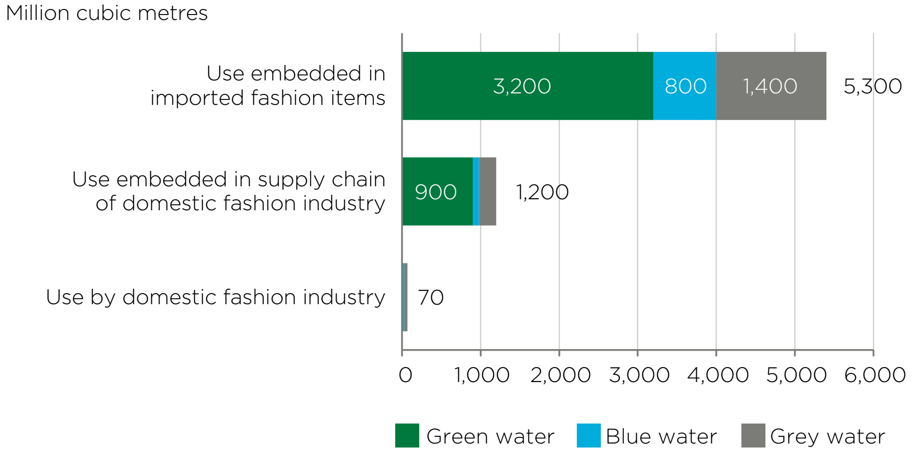
[46] It is a conservative estimate because it assumes that a litre of polluted water can be diluted back to safe levels with one extra litre of water. In reality, some pollutants require much more dilution. More detail on this is given in Appendix 1.

Splitting this by stage in the value chain, the domestic German fashion industry had a footprint of just 40 million cubic metres of grey water and 30 million cubic metres of blue water. This represents the water used and polluted by the domestic industry—and as Germany is not a producer of cotton, the domestic sector had no direct green water footprint.

As with the other environmental impacts discussed in this study, the largest footprint comes from the industry's supply chains. We estimate that the supply chains of the domestic fashion industry had a 1.2 billion cubic metre water footprint, in large part through the water required to grow the cotton for fashion production in Germany.

However, the largest impact comes through the water use embedded in fashion items imported into Germany, at an estimated 5.3 billion cubic metres—again in large part through the water required for growing cotton.

Fig. 13: Total global water footprint of the German fashion industry, 2019



Note: totals may not sum due to rounding

Source: Oxford Economics.

TRENDY VEGETABLES—WATER AND ITS SOCIAL IMPACT IN BANGLADESH

This case study provided by Amira Jehia, co-founder of Drip by Drip, an NGO focussed on addressing water issues in the fashion and textile industry.

Bangladesh is a water country, but it is also, regrettably, one of the countries that suffers the most from a lack of drinking water. The country's landscape is mainly characterised by the delta of the Brahmaputra, Ganges and Meghna rivers, with their extensive marshlands, and the Sundarbans, the largest mangrove forests in the world. Around 90% of the country is flat lowland; the capital Dhaka is only 6 metres above sea level. During the monsoon season in summer, the country often suffers from river floods and inundations. Due to its close location to the sea, more flooding can also be expected to occur in the future, triggered by rising sea levels. The results of salinisation of the arable soils due to the previous rise can already be seen today.[47] Furthermore, a considerable part of the groundwater in Bangladesh is contaminated with arsenic. As early as 2000, the WHO spoke of the "largest mass poisoning in history",[48] affecting around 20 million Bangladeshis.[49] Water is, in principle, available in abundance, but very little of it is suitable for supplying the 164.7 million inhabitants of this country.

Bangladesh's economy rests upon the production of textile goods. In 2017, this area accounted for 87% of total exports. Of these, 60% went to the EU, with German companies being the main clients.[50] The dominant sector in the textile industry, the ready-made garment sector, is estimated to be worth around USD 50 billion per year in the coming years. The fast fashion industry, in particular, benefits from the low wage level and the predominantly female workforce in Bangladesh.[51] Much is known about the working conditions in the factories, at least since the collapse of the Rana Plaza factory building in 2013, which killed over a thousand people. However, besides fair working conditions, one of the most critical factors for achieving social justice in the fashion industry remains a niche issue: water.

Access to safe drinking water is an internationally recognised human right. The 2030 Agenda for Sustainable Development, adopted by the United Nations in 2015, includes the Sustainable Development Goal number six, which aims to ensure all water and sanitation availability and sustainable management. This is a significant challenge for Bangladesh, which is further complicated by the water use and pollution of the textile industry. Although scientists have warned for years that access to clean fresh water will trigger the great wars of the future,[52] it still seems widely accepted that the textile industry continues to increase Bangladesh's water poverty by releasing its wastewater, unfiltered, back into nature.

According to the Department of Inspection for Factories and Establishments database, around 3,000 textile factories are operating in Dhaka. For two pairs of jeans, which corresponds to about one kilogram of fabric, an average of 120 litres of water are used for dyeing and washing the garments. In conversation with the local NGO Agroho, which specialises in solving the water problem, Ridwanul Haque, the NGO's director, said to Drip by Drip: "Factories using groundwater for washing and dyeing fabrics have been a major contributor to the fact that groundwater levels in the textile centres, Dhaka, Gazipur, Savar and Narayanganj, have dropped at an alarming rate." He goes on to explain: "Wastewater from the textile industry, which contains a variety of pollutants, was estimated at around 217 million cubic metres in 2016 and will reach 349 million cubic metres by 2022 if the textile industry continues to use conventional dyeing methods."

[47] Die Ziet, Klimawandel – Am schlimmsten ist die Versalzung, 2009.
[48] WHO, Arsenic – mass poisoning on an unprecedented scale, 2002.
[49] Süddeutsche Zeitung, The greatest mass poisoning in history, 2016.
[50] Bangladesh Bureau of Statistics, 2017 Statistical Year Book Bangladesh 37th EDITION.
[51] Taplin, Who is to blame? A re-examination of fast fashion after the 2013 factory disaster in Bangladesh, 2014.
[52] Der Tagesspiegel, Where water crises lead to conflict, 2020.

Near the industrial areas, industrial waste and wastewater contaminated with heavy metals such as vanadium, molybdenum, zinc, nickel, mercury, lead, copper, chromium, cadmium and arsenic are discharged unfiltered, back into nature. The contaminated river water is used to irrigate the rice and vegetable fields (spinach, tomatoes and cauliflower) in Gazipur and Keraniganj. Vegetable and fruit samples from Savar, Dhamrai and Tongi, show a variety of textile dyes.

One study showed a 16% higher disease incidence among people living in Hazaribagh. Marginalised groups, especially women and children, are particularly affected by using polluted water for washing and household chores. The result is acute, short-term suffering such as painful skin irritations, diarrhoea, food poisoning and other gastrointestinal ailments, as well as long-term, serious health consequences such as respiratory diseases or cancer. Even those parts of the population that do not live in the immediate vicinity of industrial areas are affected. Similar effects have even been detected in the cities where the contaminated vegetables are sold.[53]

As industrial wastewater is usually released into the natural water cycle, highly concentrated heavy metals have also been found in fish and micro-organisms in the river branches further away from the industrial areas. Many villages in Savar, Dhamrai, Gazipur and Tongi, suffer from depleted fish stocks and crop yields as soil fertility declines. The natural ecosystems are also threatened by the fact that the still-warm wastewater raises the temperature of the water bodies, putting additional strain on flora and fauna.

Bangladesh is just one example of many countries that have to live with the consequences of acute water shortages. Despite the awareness of the facts listed here, almost nothing has changed in the last few years in terms of the production conditions for which the German fashion and textile industry is partly responsible. This is why Drip by Drip advocates that water, nature conservation, and social consequences be introduced in design, sourcing, and production contracting as important factors and in the form of fixed criteria in the selection of partners in the value chain.

In particular, Drip by Drip recommends a focus on the following three approaches:

1. Binding requirements and financial support for factories to install and use Effluent Treatment Plants (ETPs) with so-called closed-loop processes that enable the reuse of industrial wastewater.

2. Investment in innovative technologies that minimise such ETPs' size and cost factors.

3. Investment in water treatment systems in areas with acute drinking water shortages to make the contaminated groundwater in Bangladesh usable again for humans and animals.

[53] Sakamoto et al, Water Pollution and the Textile Industry in Bangladesh: Flawed Corporate Practices or Restrictive Opportunities?, 2019.

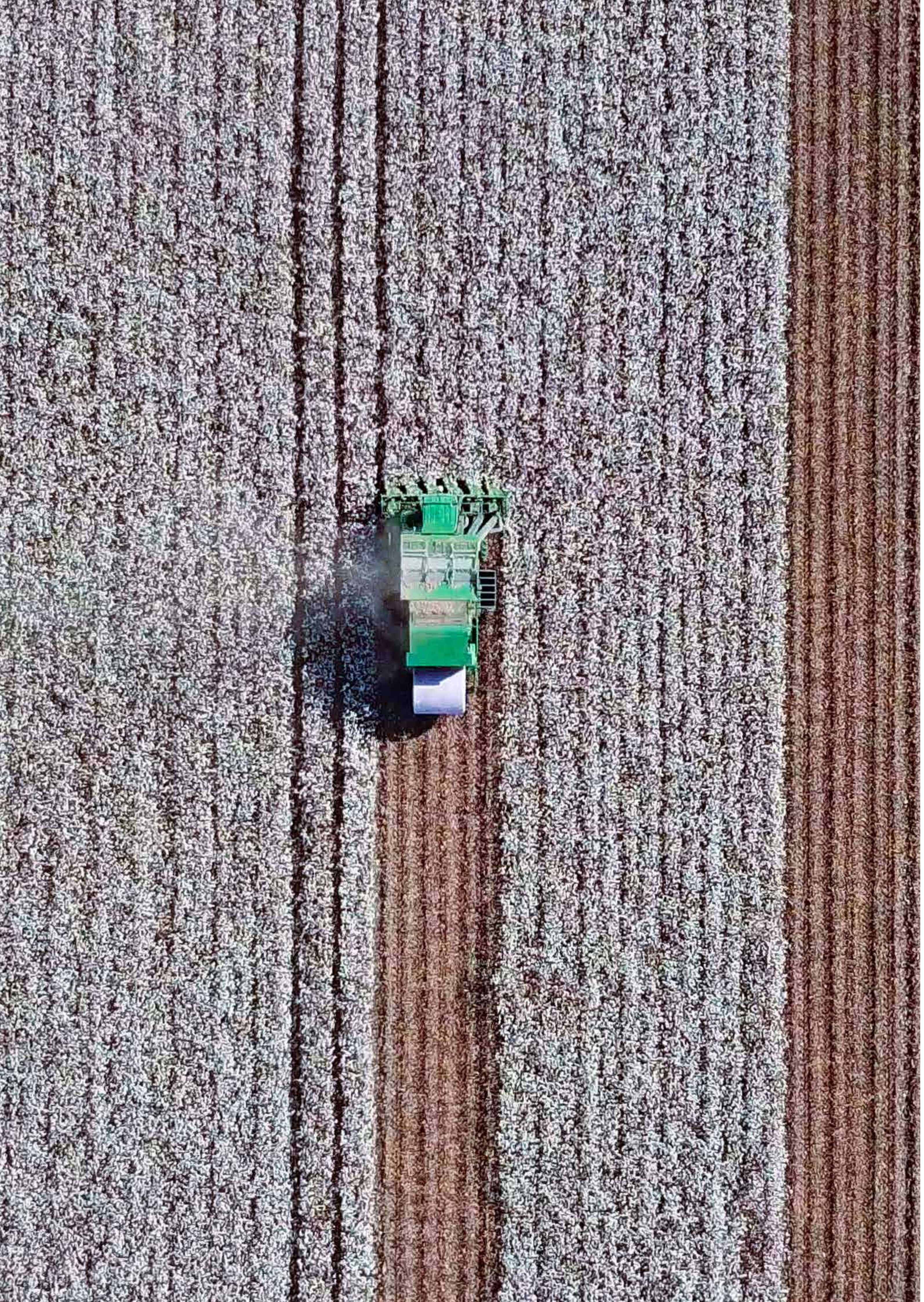


Image: Shutterstock

6. THE FASHION INDUSTRY'S LAND USAGE FOOTPRINT

Agriculture requires a significant amount of land globally. The Earth's total land area excluding Antarctica is nearly 14 billion hectares,[54] of which 5.3 billion hectares or 38% is land used for agriculture.

While the majority of this agricultural land is dedicated to food production, the area required for fashion production is still significant: globally, cotton production required 35 million hectares in 2019/20.[5] This land required to service the world's cotton demand is roughly equivalent to the land area of Germany itself.[56] This is important ecologically as land used for cotton farming may displace original habitats and ecosystems: for instance, in Burkina Faso (the world's 14th largest producer of cotton), overexploitation and conversion of land to cotton production was seen as the most important short-term threat to the country's forests.[57]

Other plant-based fibres such as jute, linen and hemp add to this land requirement, as does the production of cellulose for man-made cellulosic fibres. However these are much less widely- used than cotton so the associated footprint is much lower.[58] Leather and wool require further land, but as these are typically co-products of the food industry, it has not been possible within this project to allocate a set amount of grazing land to the fashion sector itself.

[54] Based on the 238 countries and territories in the UN FAOStat land use database.

[55] International Cotton Advisory Committee (ICAC), Data Portal.

[56] At 34.9 million hectares of land area in 2018. FAOStat.

[57] FAO, The state of the world's forests, 2020.

[58] Cotton had a market share of 24.4% of global fibre production in 2018/19, compared to 5.7% for jute, linen, hemp and other plant-based fibres combined. Textile Exchange, Market Report 2019.

6.1 GERMAN FASHION INDUSTRY'S LAND USE

We have assessed the amount of agricultural land that Germany's fashion industry requires worldwide.[59] Cotton and other fibre plants are not grown in sufficient quantity within Germany itself to be included in this analysis.[60] As such the German fashion industry's agricultural land usage footprint relates to the countries in the industry's supply chain in which fibre plants are grown.

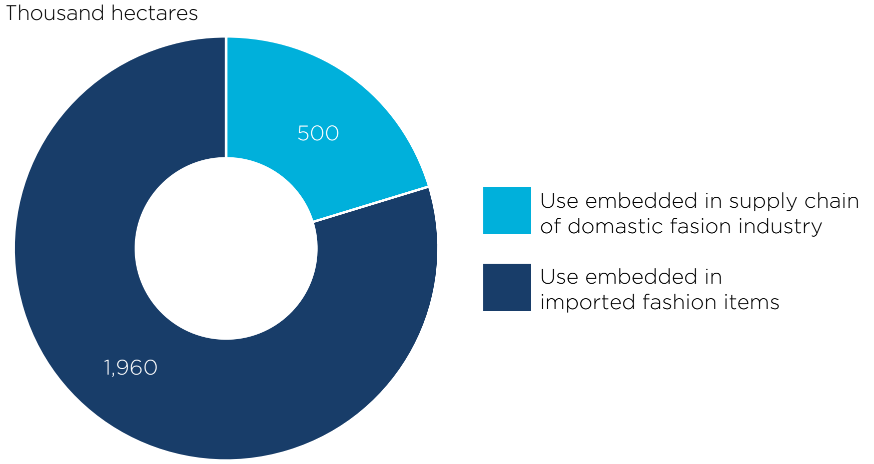
In total, we estimated that the industry requires approximately 2.5 million hectares worldwide, a land area similar to the areas of the German states of Brandenburg (2.9 million hectares) and Mecklenburg-Vorpommern (2.3 million hectares),[61] or the majority of the size of Belgium (3.0 million hectares).[62]

Across the 83 million residents of Germany, this means that on average each is associated with approximately 300 square metres of agricultural land to supply their fashion consumption each year, roughly equivalent to a tennis doubles court.

Most of this footprint (2.0 million hectares) comes through the supply chains of fashion production located in other countries. Our estimates of where this footprint is located is broadly in line with the largest global producers of cotton, which include India, China, the US, Brazil and Pakistan, as well as Pakistan, Australia and Turkey.

The remainder of the impact (500,000 hectares) is associated with the cotton grown overseas and imported for use in Germany's clothing and textile manufacturing industry. The cotton-farming countries where Germany directly imports the most cotton from include Turkey, India, Pakistan and China.[63]

Fig. 14: Agricultural land use globally by German fashion sector



Source: Oxford Economics.

[59] We look at agricultural land rather than all land types due to data availability: robust data exists on agricultural land usage across all countries, but it is much more difficult to identify other land uses split by industry.
[60] For instance, the ICAC database records zero land usage within Germany for cotton farming.
[61] German Federal Statistics Office.
[62] UN FAO.
[63] UN Comtrade database, using commodity code 52, which includes both raw cotton and cotton processed into textiles and fibres.

***Image:** Joachim Baldauf/Neonyt*

A CASE STUDY FROM BRAZIL: COTTON, POLYESTER OR VISCOSE? HOW FIBRE DECISIONS CARRY DIFFERENT SOCIAL IMPACTS

The following is provided by Melissa O de León and Larissa Roviezzo of REGENERATE Fashion, a consultancy that assists fashion companies and global textile producers to integrate sustainable practices.

Along with the environmental impacts, fibre choices have a social impact on the communities where raw materials are grown, processed, turned into garments and ultimately disposed of. This section will present the findings of social impacts associated with the production of cotton, polyester, and viscose in Brazil demonstrated in the report 'Fashion Threads: Systemic Perspectives for a Circular Fashion'[64] (hereafter referred to as 'Fashion Threads'), as well as to offer European countries a holistic insight endorsing the need of social impact analysis in different countries, using Brazil as a case study. Globally, the country is the fourth largest producer of cotton, the second largest cotton exporter[65] and is the fourth largest denim and twill producer in the world.[66] In 2018, 68% of all domestically-produced synthetic fibres were polyester,[67] and although the country does not produce viscose fibre internally, Brazil is a major exporter of soluble cellulose. This vast representation on the global market as both fibre producer and exporter makes Brazil an optimal model for German fashion companies planning their material sourcing strategies from countries in the southern hemisphere.

[64] MODEFICA, FGVces, REGENERATE, Fashion Threads: Systemic Perspectives for a Circular Fashion, 2020.
[65] National Supply Company (CONAB), Perspectives for agricultural crops, 2019 / 2020.
[66] Brazilian Textile and Apparel Industry Association (Abit), Industry Profile, 2018.
[67] Brazilian Association of Artificial and Synthetic Fibre Producers (Abrafas), Statistics, 2019.

Indicators for social impact

Unlike environmental impact analysis, social impact is often considered difficult to quantify due to the complexity of finding precise objectives and the challenges in determining which impact categories to include or how to measure some of them.[68] Social life cycle assessment (LCA) studies suggest analysing social impact by considering workers, local communities, consumers (stakeholders), and to evaluate human rights, working conditions, health and safety, and cultural heritage as impact categories.[69] Based on this, the report "Fashion Threads" developed a social impact framework with three social attributes to consider when selecting different textile materials. The production, processing, and commercialization of any selected fibre should support the local economy, create employment, and promote social justice. Within the social attributes, nine social impact indicators were developed to evaluate the studied textile fibres and how they directly impact different stakeholders along its value chain. The nine indicators within the social attributes are detailed in Fig. 15.

It is important to mention that the social impact attributes and indicators herein discussed were developed from Brazil's socio-economic context and studied under the lens of a "circular economy" potential. Given the country's relevance on the global textile industry, the social indicators proposed can be paralleled in other fibre-producing countries—particularly in the global south—and are applicable to traditional "linear" economic models.

Fibre choices: social Impact analysis of cotton, polyester, and viscose

As part of the report "Fashion Threads", a qualitative assessment was carried out (see table below) to identify how the three studied fibres can potentially have a positive impact towards the living conditions of people along their value chain. As the table demonstrates, cotton—being a natural fibre—has more potential to positively impact society than polyester. Viscose scored low on all indicators, since not enough information was publicly available; this low scoring makes it hard to compare with cotton or polyester. Some of the data considered for the social impact analysis of each of the fibres is described below.

[68] Valdivia et al, Social Life-Cycle Assessment: A Review by Bibliometric Analysis, 2020.
[69] Russo Garrido, Social Life-Cycle Assessment: An Introduction. Reference Module in Earth Systems and Environmental Sciences, 2017.

Cotton

The production of conventional cotton requires the use of dangerous pesticides which cause water pollution, loss of biodiversity, and impacts on human health.[70] An alternative to conventional cotton farming is the production of cotton from agroecological plantations. Organic cotton production represents about 0.7% of the world cotton supply and 98% of its production is concentrated in seven countries.[71] Public policy can play a decisive role in this regard as in Brazil for example small organic producers and family farms face challenges with public policies that favour usage of agrotoxic components.[72]

Brazil is currently facing challenges with public policies that favour agrotoxic components, such as Bill 4576/16, which proposes the increased usage of pesticides in cotton cultivation consequently threatening the work of small organic producers and family farms in the countryside. On the other hand, when it comes to the end of life for cotton products, the current National Solid Waste Policy (PNRS) can be a catalyst for recycling, especially of 100% cotton content products and textiles. Based on textile recycling information, there is potential for creating employment by generating jobs related to the separation of pre-consumer cotton waste from suppliers.

Fig. 15: Analysis of the fibre's potential to positive social impact[73]

Social Attributes	Social Impact Indicators	Cotton	Polyester	Viscose
Supports Local Economy	Policies that facilitate recycling	4	3	1
	Policies that facilitate organic farming	1	n/a	1
	Import/Export of raw material, fibre, textiles or finished product	3	1	1
	Potential for consumer adoption[74]	5	3	1
Creates Employment	Number and growth rate of new jobs based on circular economy practices	2	4	2
	Fibre's potential to obtain social certifications	5	0	0
Promotes Social Justice	Diversity and inclusion within the fiber's value chain (especially non-white women)	4	1	n/a
	Percentage of production in conflict areas	1	n/a	1
	Programs targeting informal employment	2	3	2

Potential to positively impact the indicators:
0= none | **1**= lowest | **2**= low | **3**= average | **4**= high | **5**= highest | **n/a**= not applicable for fiber type or not enough information available

Source: Oxford Economics.

[70] Sambuichi, A política nacional de agroecologia e produção orgânica no Brasil: uma trajetória de luta pelo desenvolvimento rural sustentável, 2017.
[71] Textile Exchange, Organic Cotton - Market Report, 2019.
[72] Costa et al., The issue of agrochemicals breaks the limits of the ethics of preservation of health and life, 2018.
[73] Adapted from Modefica et al, Fashion Threads, 2019.
[74] Measured by the volume and percentages of import and export ratio of the raw material, fibres, textiles or finished product, and the fibre's potential to be adopted by consumers.

For its agricultural characteristic, cotton is a very labour-intensive crop, and thus there are more social certifications available. Although each certification program has different criteria, certifications such as Fair Trade, GOTS, BCI and IBD can guarantee decent jobs for field workers. Such certifications are required since cotton is bound to land conflicts and population displacement, often caused by the decrease in work supply.[75] According to one study, "the Cerrado biome, the region with the highest concentration of cotton farms in Brazil (93.6%), has particularly suffered from territorial conflicts and constant deforestation for five decades, losing 50,000 square kilometres of native vegetation in the last 10 years."[76] Conflicts with cotton monoculture companies date back to the 1960s and affect rural workers, family farmers, indigenous communities and other stakeholders."[77]

Polyester

With annual production of around 55 million tons, polyester had a share of around 52% of the global fibre production in 2018. Of this total, the production of recycled polyester was 7.2 million tons, equivalent to about 13% of world's fibre production.[78] Despite coming from oil, a non-renewable and polluting source, an advantage identified by the fashion industry is that it is recyclable.[79] Recycled polyester is predominantly made from polyethylene terephthalate (PET) bottles that make up about 84% of global demand for PET resin.[80]

Similar to cotton, Brazil's PNRS can also facilitate the recycling of PET bottles for polyester fibres. Polyester has a high potential in creating employment, with jobs related to picking, classification, aggregation and pre-processing (removal of complicated parts, removal of printing, sanitisation/industrial washing, etc.) of PET bottles. However, from a global perspective, the Global Fashion Agenda has emphasized the need to recycle not from bottle to fibre but from fibre to fibre.[81] This would reduce the potential income source of PET recycling-related jobs and PET collectors in the informal sector, who are key players in sub-urban communities in countries of the global south such as Brazil.

[75] Oliveira, Território do agronegócio: expansão dos monocultivos do eucalipto e da produção de celulose na Bahia, 2014.
[76] Modefica et al, Fashion Threads, 2019.
[77] Fundação Oswaldo Cruz, Mapa de Conflitos envolvendo Injustiça Ambiental e Saúde no Brasil, 2010.
[78] Textile Exchange, Preferred Fiber & Materials Market Report, 2019.
[79] Modefica et al, Fashion Threads, 2019.
[80] Sarioglu & Kaynak, PET Bottle Recycling for Sustainable Textiles, 2016.
[81] Global Fashion Agenda, Final Report Circular Fashion System Commitment, 2020.

Viscose

Viscose represents 79% of the artificial fibres market,[82] and has characteristics similar to cotton fibre. Unfortunately, some manufacturers have not yet adopted the responsible practices for tracing raw materials and managing toxic and corrosive chemical products, making forestry and industrial production processes (soluble cellulose) highly impactful.[83]

When analysing the creation of employment, viscose is qualified as low given that eucalyptus farming offers only three jobs on a 500-hectare family farm compared to 200 jobs on a similar area in cotton farming.[84]

In 2019, the percentage of Brazilian pulp exports was 46 times the volume of imports of the same material (ABECE, 2020).[85] This points to the immense volumes of cellulose-based material production, many of which come from endangered forests or are related to land conflicts and pressure on communities. Pulp producing companies install their facilities in rural zones causing conflict with residents, destroying native vegetation, and creating precarious living conditions for local residents, who make their living from family farming.[86]

There are, however, initiatives such as Forest Stewardship Council and Canopy that seek to certify suppliers that properly manage natural resources and are committed to the non-predatory exploitation of forests, guaranteeing origin and traceability of the raw material.

Conclusion

Fibre choice is a critical variable when considering the social impact of fashion products. Textile fibres need to be analysed on a fibre-by-fibre basis since each has unique characteristics and represent different systems (i.e. cotton is a natural fibre, polyester is synthetic, and viscose is a manmade cellulosic). As the information presented in this case study demonstrates, it is important to understand the different trade-offs as fibres can have positive impacts on one social aspect, but compromise another.

However, the social indicators framework proposed in this case study can be tailored to analyse a brand's specific sourcing countries and regions. By finding parallels between the Brazilian case study and those sourcing regions, especially when sourcing from economies in the global south, it is possible to understand the social impacts associated with fibre sourcing, and build strategies to not only reduce unintended negative impacts, but promote people and communities' social development. In addition, the social impact of fibres can be dramatically improved by implementing public policies encouraging agroecological agriculture, robust waste management systems, technical jobs generation and developing country-level recycling systems.

Image: *Neonyt*

[82] Textile Exchange, Preferred Fiber & Materials Market Report, 2019.
[83] Changing Markets Foundation, Roadmap towards responsible viscose & modal fibre manufacturing, 2018.
[84] Oliveira, Território do agronegócio, 2014.
[85] ABECE, Importação Brasileira-Produtos Ordem Decrescente, 2020.
[86] Fundação Oswaldo Cruz, Mapa de Conflitos envolvendo Injustiça Ambiental e Saúde no Brasil, 2010.

The environmental impact of the German fashion industry
OXFORD ECONOMICS

A CASE STUDY FROM GERMANY: HESSNATUR'S IMPACT FOR A BETTER TOMORROW

The following is a case study provided by Jana Neumark, a Senior Sustainability Expert at hessnatur, a German retailer. The study looks at the company's approach to addressing social impact objectives.

How we create social impact in our supply chain

As a fair fashion pioneer, hessnatur stands for high social standards, long-lasting partnerships, high quality natural materials, and innovation. Our high social and ecological standards are part of our purchasing strategy. We cooperate with our suppliers on eye-level, we pay fair prices, and our production planning system supports reasonable working hours.

We adopted the requirements for socially responsible production defined in the Fair Wear Foundation (FWF) Code of Labour Practices. The eight core labour standards are based on the conventions of the International Labour Organization (ILO) and the UN's Declaration on Human Rights. They expressly regulate working conditions at our production sites. In 2005, hessnatur was the first German company to become a member of the Fair Wear Foundation. Audits are an integral part of the hessnatur monitoring system for social standards. In 2014, we even received the FWF leader status (the highest category). This accolade is the result of our efforts towards ensuring socially fair and safe working conditions and specific improvements made at our production sites. In 2017, we were nominated for the FWF Best Practice Award for our measures and projects to improve social standards. In cooperation with another fashion brand we succeeded in improving working conditions in a supplier factory through intensive training and restoring the destroyed trust between the union and management.

The pandemic has shown that strong, long-lasting partnerships and close collaboration are essential for creating resilient supply chains and securing peoples' livelihoods. Compliance with our social standards is monitored via regular on-site checks at every production site. During the pandemic they were mostly conducted online. In the business year 2020/2021, 97,89 percent of our partners were audited or visited. The intensity and focus of the monitoring depend on the production countries. FWF distinguishes between low-risk and high-risk countries. It defines different monitoring requirements respectively.

In this context, risk relates to compliance with local law and international standards. In so-called low-risk countries compliance with laws and standards is generally well regulated and monitored by legislative authorities. By contrast, in high-risk countries there is often a discrepancy between existing laws and standards and compliance with them. Accordingly, there is an increased need to work on social standards.

Suppliers are considered as our partners. That is why we value long-term partnerships: With many of our partners, we have been working together for over 10 years. At the same time, we must remain innovative and therefore it is necessary to take on new partners as well. But they are always taken on with the aim of a long-term cooperation. The focus of new production sites are Europe and low-risk countries.

Working together on improving social standards and labour conditions is a key element of our partnerships. Our stable business relationships give production locations a reason to improve working conditions. And investments can be made with a durable partnership in mind. Our long-term contracting with partners enables long-term contracts with workers. Whenever working conditions need to be improved, we inform our partners, share examples of best practice and develop individual solutions together.

We also arrange trainings and workshops for both workers and management in the production sites. The aim is to inform them about their rights and obligations, to strengthen internal dialogue and to address factory-specific topics. A functioning social dialogue is one of the key factors. Therefore, we intensively support it through specialised trainings and ongoing personal exchange. Apart from participation in FWF training programmes, we develop and conduct several own trainings and workshops.

We can't change the fashion industry alone

One key topic in the work of social standards and sustainability is collaboration. We believe that working with others will lead to more efficient and effective and hence better results. That is why we are a member of Fair Wear Foundation and the German Partnership of Sustainable Textiles. And that is why we are a licensee of the Global Organic Textile Standard (GOTS) and the Green Button. Together with our partners and in collaboration with other brands, we actively make the textile business more sustainable and altogether we create a positive impact.

In the past 45 years, we've achieved so much. Now we strive for a change in the whole fashion industry in collaboration with all relevant actors. Therefore, we support initiatives and projects like the Fashion Revolution Week and initiated the Fair Fashion Move. hessnatur has also supported the online petition #fairbylaw, together with Neonyt, and highly appreciates the adoption of the German Supply Chain law that binds brands to take over social and ecological responsibility for global supply chains.

The path we've chosen requires a lot of effort, commitment, and heart, but it can be done. It is a complex yet very exciting and fulfilling journey. Fashion can be sustainable.

The environmental impact of the German fashion industry
OXFORD ECONOMICS

A CASE STUDY FROM GERMANY: SOCIAL JUSTICE AND RESPONSIBILITY IN THE GERMAN FASHION INDUSTRY

This case study has been provided by Nora Milena Vehling of Fashion Revolution Germany.

Fashion Revolution was founded after the collapse of the dilapidated building which was home to the textile production factory Rana Plaza on the 24th April 2013 in Dhaka, Bangladesh.

1,134 people died in the incident and another 2,500 were seriously injured. With the hashtags #Whomademyclothes and #Imadeyourclothes, people in consuming and producing countries have been brought together and attention has been drawn to the problems in the textile industry. Every year, country coordinators around the world and several million people commemorate the Rana Plaza collapse.

As a globally networked initiative, Fashion Revolution advocates more transparency within the globalised textile industry. To this end, the global initiative collects, measures and publishes data in order to make actors within the textile industry more transparent and bring them together. With the Fashion Revolution Transparency Index, Fashion Revolution has been reviewing the world's top-selling fashion companies since 2017 on a total of 239 criteria, which are rated differently in five categories.

Many nations contribute to the added value of German textile products. When we speak of the industrial nation Germany with the fourth-highest production output of textiles, we mean a large number of actors who collectively create value for the German sales market worldwide. This sales market in Germany is one of the strongest sales markets worldwide. In 2019, sales of textiles in Germany totalled 76 billion euros, which was spent exclusively on clothing and shoes. As a relatively small country with just over 83 million people, Germany ranks sixth in global fashion consumption behind countries like the USA, China and India. Initiatives like Fashion Revolution point to the social and ecological responsibility which goes with consumption. This calls into question the conditions under which such high sales and extreme consumption behaviour can be tolerated as in Germany.

In the economy, social justice is expressed in wages and jobs. However, a look at the working conditions in the textile industry shows that the appreciation of work performance is disturbed in many ways. With the tragedy of the collapse of the textile factories in the Rana Plaza building in 2014, a lot of human rights violations related to financially strong, mainly European and American fashion companies became apparent. The widely ramified value chains of textile products are incomprehensible, making it unclear which service leads to which product. Or the other way around, which order leads to which effect.

Several textile factories were located in the eight-story Rana Plaza building. The working conditions there, with long hours and low wages in the dangerous working environment of the crumbling building, were known but suppressed. In addition, before the collapse of the Rana Plaza building the German certification company TÜV Rheinland performed a social audit at Phantom Apparel Ltd. and certified it, which allowed production to continue under the prevailing conditions. Sanctions against those responsible at TÜV Rheinland in Dhaka, Bangladesh have been avoided until today, although the complaints in Berlin, Germany were reported by the Rana Plaza Survivor Group with the support of German NGOs such as Femnet.

The Fashion Revolution Transparency Index 2021, with a differentiated look at the three levels of the textile industry, the so-called Tier 1 - Manufactories of needleworkers, Tier 2 - Processing and weaving mills and Tier 3 - Fibre production, shows that among the 250 world-leading fashion manufacturers there is no transparency beyond Tier 1. Since 2017, the index has consistently reported negative results with minimal improvements over the past few years: none of the 250 economically strongest textile processing companies in the world can present their own value chain transparently. Only 47% of fashion brands can claim transparency beyond Tier 1, only one in four companies to Tier 2 (27%) and 95% of all fashion companies do not have any transparency beyond Tier 3.

In order to make the social effects of German fashion consumption measurable, collaboration is required between all the actors who contribute to the added value of textile products. These actors are responsible for the production conditions. Fashion Revolution is against basing responsibility for production conditions exclusively on consumer decisions. Actively deciding based on the price whether or not to accept working conditions like those in Rana Plaza must be ruled out. A lack of transparency in value chains prevents consumers from making conscious decisions. Neither the price nor the information on the labels provides enough information to understand which type of production is being supported with a purchase decision. Fashion Revolution calls for people to be able to face this responsibility individually by demanding transparency from the market as consumers and workers with a question and an answer: Who makes my clothes? And: I make your clothes.

Image: *Ian Delu*

7. CONCLUSION

As the IMF notes in a guide to managing carbon emissions, the first step to reduction is measuring and reporting one's footprint.[87] This is what the analysis in this report provides—a first attempt at measuring the German fashion industry's environmental impact, providing an initial step towards identifying how and where to implement changes.

The German fashion industry and the Federal Government are aware of the need to increase the sustainability of the industry's operations and have been taking initial steps and providing support to begin doing so. This includes pledges from the largest fashion brands to reach net neutrality on carbon emissions across their supply chains by 2050, in line with recommendations from the United Nations and the Paris Agreement. Governmental support also comes in the form of multi-stakeholder initiatives such as the Partnership for Sustainable Textiles, and through helping consumers to make informed decisions through the use of the state-backed Green Button textile label.

Our research helps to establish a baseline for measuring the footprint of the industry, and a basis for monitoring future progress. It also highlights how much the German fashion industry is a global operation, with the largest impacts from purchases of clothing in Germany being seen around the world due to the prevalence of outsourced production.

An increasingly-important factor in the ability to measure the ongoing footprint of the industry is for businesses large and small to track and report their environmental impacts across a range of metrics, including greenhouse gas emissions and water usage. Many large companies are already doing this, but do not necessarily include their Scope 3, or supply chain spending, impacts—which, as highlighted in this report, can account for more than 90% of a business's total impact, particularly when production is outsourced.

Ongoing government support will be needed to provide businesses with the necessary tools and knowledge to calculate environmental impacts, particularly small businesses that do not have significant resources to devote to the issue.

[87] World Economic Forum, How technology can bridge the gap between climate talk and action, 2021.

EXAMPLES OF ORGANISATIONS AND INITIATIVES FOCUSSED ON SUSTAINABILITY IN THE GERMAN FASHION SECTOR

Beneficial Design Institute
The Beneficial Design Institute researches, develops and tests innovative concepts in fashion design, textiles and products, working from prototypes up to production. The Institute has a focus on closed loops and circular design systems, also known as a cradle-to-cradle philosophy, combining artistic design and scientific theory.

circular.fashion
An agency creating innovative software and systems for a circular economy in fashion and textiles. The agency provides services that encourage and enable fashion brands to incorporate circularity into the core of their business. Innovations include a digital platform for circular design and closed-loop recycling, including recyclable materials and design guidelines.

Clean Clothes Campaign
A global network of over 235 organisations in 45 countries, including labour unions and non-governmental organizations. The campaign focuses on the improvement of working conditions in the garment and sportswear industries

Drip by Drip
The world's first non-governmental organisation committed to tackling the water issues in the fashion and textile industry

FairWertung – the German Fair Recycling Federation
A network of 100 non-profit organisations and social enterprises focussed on promoting ethical standards and transparency in the collection and marketing of second-hand clothes. The collective also supports networking among social enterprises; provides information services and educational programmes for consumers, and develops guidelines for relief transport of second-hand goods in cooperation with NGOs overseas. FairWertung is also part of the Closed-loop Pilot Project initiated by circular.fashion to pilot and build a functioning reverse supply chain

Good Garment Collective
A production agency for apparel and fashion products focussed on sustainable and transparent production processes, working with brands from initial design ideas through to production.

Neonyt
An exhibition platform that highlights trends and future topics in the textile and fashion industry. Brands are included based on strict sustainability criteria

Plan A
Plan A has developed a science-driven certified software platform for automated carbon accounting, decarbonisation, ESG management and reporting, that serves customers across the globe.

Planetly
A producer of software for companies to analyse, reduce and offset their carbon footprint. The software analyses an organisation's footprint based on real data, supporting companies to find where they can reduce it in the most pragmatic way and then offset the rest.

Sqetch
Sqetch Agency is a leading online sourcing platform and a fashion consultancy providing a range of innovative products and services to the apparel and textile industry. With an experienced team of fashion professionals, Sqetch supports companies with sustainable service development and innovation. The company's mission is to accelerate sustainability and innovation within the fashion industry.

Retraced
Provider of supply chain transparency software that gives access to information about the products around us. The software enables fashion brands to visualise, verify and communicate their supply chains, manage their corporate social responsibility efforts, and gain customer trust. The blockchain-enabled platform connects companies' entire supplier networks and collects relevant data points regarding working conditions, materials, certifications, and environmental impact.

Systain
A sustainability consultancy in Germany for two decades, focussed on global sustainability challenges in the supply chain, including the environment and human rights.

These examples of organisations and initiatives were provided by Fashion Council Germany.

APPENDIX 1: METHODOLOGY DETAIL

In this Appendix, we set out in detail the approach taken to reach the estimates in this report.

ESTIMATING GREENHOUSE GAS EMISSIONS

Scope 1 emissions

Scope 1 greenhouse gas emissions refer to those produced directly by the German fashion industry through assets including gas-fired burners and vehicle fleets. These are published by Eurostat at the level of groups of two-digit standard industrial classification (SIC) codes.[88] We use a share of the emissions ascribed to the fashion manufacturing sectors Manufacturing of textiles, wearing apparel, leather and related products (representing clothing, footwear, accessories and textiles used for fashion products), Manufacture of computer, electronic and optical products (representing wrist-watches) and Manufacture of furniture and other manufacturing (representing jewellery), as well as the retail and wholesale sectors. The share taken of the published emissions of each group of SIC codes is taken from OE's study, The State of German Fashion 2021.

Scope 2 emissions

Scope 2 greenhouse gas emissions refer to those produced as a result of energy purchased and used by the industry. This is estimated using data published by Eurostat, which provides total energy usage by industries split by type of energy, such as electricity and heat energy purchased from the energy sector, and fuels such as natural gas, automotive fuels or coal used directly by an industry.[89] The figures are given for groups of two-digit SIC, such grouping together sectors 13 (manufacture of textiles), 14 (manufacture of wearing apparel) and 15 (manufacture of leather products).

To reach our estimates, as above we take a share of the published energy use of each group of SIC codes, based on previous work—specifically, electrical and heat energy. This energy usage (measured in joules) is converted to greenhouse gas emissions based on a standard conversion factor for Germany.[90]

Scope 3 emissions embedded in imported clothing

These emissions are those produced as a result of the clothing manufactured abroad and imported into Germany, as well as the supply chains feeding this activity. To calculate this impact, we first estimated the economic activity through these supply chains, based on the total value of clothing and footwear imported into Germany from all countries around the world. We then use Oxford Economics' global economic impact models to estimate economic activity in each country and industry within the supply chain. These models are based on "input-output" tables published by the OECD, which detail how much each country and industry purchases from which other domestic and foreign industries.

This economic activity is then converted into greenhouse gas emissions using emissions intensities, measured as emissions per dollar of gross value added. This information on emission intensities by country and industry is calculated by Oxford Economics using data provided by countries in Europe and several other OECD nations split by industry, and from country totals for all nations taken from the PRIMAP database produced by the Potsdam Institute for Climate Impact Research.

Scope 3 emissions embedded in all other supply chain activity

These emissions are produced as the result of global supply chain purchases by the domestic German fashion industry. The economic activity associated with these purchases is traced and estimated through the global economy using Oxford Economics' global economic modelling framework, carried out for The Status of German Fashion 2021.

These estimates of economic activity by country and industry are again converted into emissions based on the intensities worked out above.

[88] Eurostat, Air emissions accounts by NACE activity, table env_ac_ainah_r2.
[89] Eurostat, Energy supply and use by NACE activity, table env_ac_pefasu.
[90] German Environment Agency, CO2 emissions per kilowatt hour of electricity in further decline in 2019, 2020.

ESTIMATING AIR POLLUTION EMISSIONS

Before setting out how we estimated the emissions of the different air pollutants measured in this study, we set out more reference information on each of the pollutants of interest.

Carbon monoxide (CO): This gas is produced by burning carbon fuels, with major sources being cooking, heating and lighting buildings, as well as transport and industrial processes. In very high levels in enclosed spaces, exposure to CO can cause dizziness, unconsciousness and death. In outdoor spaces, exposure can be a risk to people with heart disease.[91] Carbon monoxide is also thought of as an indirect greenhouse gas. In combination with other ingredients, its presence leads to the formation of ozone, which is a greenhouse gas. However, its presence also has an effect on the lifetimes of other greenhouse gases,[92] effectively causing methane to remain in the atmosphere for longer, prolonging the warming effect of this gas.

Nitrogen Oxides (NOx): This group of gases refers to nitric oxide (NO) and nitrogen dioxide (NO2) and are primarily emitted by the transport sector. NOx and its constituent gases should not be confused with nitrous oxide (N2O), which is a greenhouse gas and emissions of which are included in our overall GHG estimates. High levels of NOx can irritate and inflame the lining of human airways, particularly in children and older people.[93] NOx gases are also thought of as indirect greenhouse gases, because like carbon monoxide, they lead to the formation of ozone.

Particular matter (PM10): This term refers to fine particles suspended in the air. In this report we focus on PM10, which means particles with a diameter of 10 micrometres or less—a human hair has a diameter of 50-70 micrometres. This pollution is composed of dust from construction sites and agriculture, wildfires and brush burning, and industrial sources, as well as finer particles from fossil fuel combustion.[94] Exposure to high concentrations of PM10 can have health consequences such as coughing, wheezing, asthma attacks and bronchitis.[95]

Sulphur Dioxide (SO_2): This gas is produced by burning sulphur-containing fuels such as coal and oil, and is largely emitted by the power generation, heavy industry and transport sectors. The effects of SO_2 on humans include irritation of the lining of the nose, throat and lungs, particularly for those with asthma.[96] Sulphur dioxide is not a direct greenhouse gas, but it can lead to both warming and cooling effects on the planet. This is because its presence in the atmosphere can lead to the formation of aerosols, which can either warm (through absorption of solar radiation on dark particles) or cool (from forming cloud droplets and reflecting radiation) the atmosphere.[97]

Volatile organic compounds (VOCs): these gases are emitted from certain solids and liquids, such as those used in the manufacture of paints, pharmaceuticals, refrigerants and solvents, but also a wide array of other products. Health effects from high exposure to VOCs include eye, nose and throat irritation; headaches, and damage to organs.[98] Specifically in this report we look at non-methane volatile organic compounds.[99]

[91] US Environmental Protection Agency, Basic Information about Carbon Monoxide Air Pollution.
[92] IPCC, Atmospheric Chemistry and Greenhouse Gases, 2018.
[93] UN, Towards a Pollution-Free Planet and British Lung Foundation, Types of air pollution.
[94] California Air Resources Board, Inhalable Particulate Matter and Health (PM2.5 and PM10).
[95] New Zealand Government, Health effects of PM10.
[96] UN, Towards a Pollution-Free Planet and British Lung Foundation, Types of air pollution.
[97] US National Atmospheric Emissions Inventory, Overview of Greenhouse Gases.
[98] US Environmental Protection Agency, Volatile Organic Compounds' Impact on Indoor Air Quality.
[99] Methane, which is a VOC, is typically excluded from this categorisation as "it has low reactivity and is not harmful" (UK Air Quality Expert Group).

Ozone (O3)
The primary pollutants outlined above also combine to form secondary pollutants, in particular ozone (O3). Ozone has benefits for humans when it is formed in the higher atmosphere (the stratosphere) to form the ozone layer that reduces the amount of harmful ultra-violet radiation from the sun reaching the surface. However, it is also formed at ground level (the troposphere) through the combination of heat, sunlight, CO and the VOCs and NOx described above.

When humans are exposed to particularly high levels of ground-level ozone, for instance on sunny days in urban areas, it can cause symptoms such as coughing, sore throats, difficulty breathing and increase susceptibility to lung infections, as well as aggravating diseases such as asthma and emphysema.[100]

Ozone also has negative impacts on plant life, reducing the yield and quality of agricultural output, with soybean, wheat and rice the most sensitive to the gas.[101] Indeed, in the Indian region, it is estimated that ground-level ozone destroys enough food to feed 94 million people every year.[102] Reduced agricultural yields means more land is required for the same amount of output, producing further carbon dioxide emissions.

Lastly, as well as human, animal and plant health effects, tropospheric ozone is identified by the Intergovernmental Panel on Climate Change as the third most important greenhouse gas after carbon dioxide and methane.[103]

While we don't measure here the footprint of the German fashion industry in terms of ozone, it is worthwhile to note that a reduction in the emissions of NOx, CO and VOCs would help to reduce the formation of ozone pollution.

Measuring Scope 1 air pollution emissions
As with greenhouse gas emissions, Eurostat publishes emissions split by groups of two-digit SIC codes of the other air pollutants assessed in this study: carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO2), particulate matter (PM10) and non-methane volatile organic compounds (VOCs).

Again, we take a share of the published emissions associated with the relevant groups of SIC codes.

Measuring Scope 2 air pollution emissions
To estimate the emissions associated with the energy purchased for the German fashion industry's direct use, we first use the published emissions produced by the energy sector of Germany (Electricity, gas, steam and air conditioning supply). We then estimate what share of German electrical production is used by the German fashion sector, based on the energy use described in the Scope 2 Greenhouse Gas Emissions paragraph above.

Scope 3 air pollution emissions embedded in supply chains
These are calculated in an analogous way to the Scope 3 Greenhouse Gas emissions described above. Economic activity associated with these supply chains is first calculated using Oxford Economics' global economic modelling framework. The economic activity estimated is then converted to air pollution emissions using intensity ratios derived by Oxford Economics. This was done by taking Eurostat emissions intensity data by industry for European countries and applying this relative distribution between industries to different country average intensities derived from emissions data published in the European Commission's Emissions Database for Global Atmospheric Research.[104]

[100] US Environmental Protection Agency, Ground-level ozone basics.
[101] UK Centre for Ecology and Hydrology, Agricultural and crop-effects of ozone.
[102] US Research Applications Laboratory, Air pollution: a global problem, 2016.
[103] IPCC, Atmospheric Chemistry and Greenhouse Gases, 2018.
[104] European Commission, Emissions Database for Global Atmospheric Research.

ESTIMATING ENERGY USAGE

Scope 1
Direct energy use by sector and type of energy is published by Eurostat at the level of groups of 2-digit SIC codes.[105] We take a share of these groups, as detailed in estimating greenhouse gas emissions.

Scope 2
As above, energy use by sector and type of energy, including electricity, is published by Eurostat. We split the electricity used by the fashion industry in Germany into different types of energy sources (such as fossil fuels, nuclear, renewables), in line with split of electricity production in Germany.

Scope 3 energy usage embedded in supply chains
The economic impact of supply chain purchases is first estimated using Oxford Economics' global impact modelling framework. The economic activity is then converted into energy requirements using energy intensities per unit of output, taken initially from the Eora Global Supply Chain Database.[106] The resulting country totals are then constrained to figures published in the published in the BP Statistical Review of World Energy.

ESTIMATING WATER USAGE

To estimate water usage by the German fashion industry, we begin with our estimates of the direct economic footprint of the industry, as well as the economic activity associated with supply chain purchases.

These are then converted into water requirements based on industrial intensities taken from the Eora Global Supply Chain Database, which are in turn based on total water requirements by country taken from the Water Footprint Network (WFN). More detail on how the water requirements are calculated by the WFN is given below.

Agricultural water usage[107]
Agricultural green water usage is based on bottom-up agricultural science modelling, using scientific literature detailing how much water healthy plants need per day, and multiplying by estimated numbers of different types of plants in each country.

Agricultural blue water usage is based on irrigated agricultural land and on bottom-up agricultural science modelling that looks at the differences in blue water requirements between scenarios of rainfall and no rainfall.

The Water Footprint Network's approach for estimating agricultural grey water footprints looks at water polluted by nitrogen fertiliser only. This is calculated by multiplying the fraction of nitrogen that leaches or runs off by the nitrogen application rate (kg/ha) and dividing this by the difference between the maximum acceptable concentration of nitrogen (kg/m3) and the natural concentration of nitrogen in the receiving water body (kg/m3) and by the actual crop yield (ton/ha). This provides a conservative estimate: the real estimate would be higher as nitrogen is only one of a number of agrochemicals that produce polluting effects.

[105] Eurostat, Energy supply and use by NACE activity, table env_ac_pefasu.
[106] KGM & Associates, Eora Global Supply Chain Database.
[107] Mekonnen and Hoestra, The green, blue and grey water footprint of crops and derived crop products, 2010.

Industrial and municipal blue water usage[108]
Industrial blue water usage estimates are calculated from industrial water withdrawal data sourced from the FAO's Aquastat database and from Eurostat. This data represents water self-supplied by the industry, rather than that supplied by the municipal public water supply, such as water for the cooling of nuclear or thermal electric power plants. The FAO estimates that up to 5% of this water extracted is consumed by the industry, for example through evaporation, and the rest is returned to the water supply.[109] Only this 5% consumed is considered as the footprint for this report.

Municipal blue water usage relates to water withdrawals by households and industry via the municipal public water network, again taken from figures published in the FAO's Aquastat database. The FAO estimates that between 5% and 15% of water extracted is consumed in urban areas, and between 10% and 50% in rural areas.[110] The Water Footprint Network data assumes a midpoint average of 10% of water withdrawn by municipal networks is actually consumed (e.g. through evaporation).

Industrial and municipal grey water footprint[111]
This relates to the water returned to the water supply after being extracted, i.e. 95% of all industrial water extracted and 90% of all municipal water extracted.

However, it is assumed that for locations connected to water treatment networks, the grey water is treated to become clean water before returning to the water supply and as such, is removed from the grey water footprint. The amount that is cleaned in this way is based on data on the share of urban populations covered by water treatment networks, taken from the FAO. Rural populations are assumed to not be connected to water treatment networks, and so all of the water returned to the water supply by rural populations is deemed to be grey water.

Like with agriculture, this approach provides very conservative figures for grey water footprints, due to the fact that the above assumes any pollutants in the water will be diluted back to background levels using just the volume of water returned to the water supply. In reality, industrial pollutants added to the water supply will often pollute much more water than this amount as they may require a much greater dilution ratio to return the water to safe levels. However, for the purposes of this report we have not sought to go beyond this conservative assumption due to a lack of available data or closely-related prior research on the topic.

ESTIMATING AGRICULTURAL LAND USAGE

To estimate the agricultural land requirements of the German fashion industry, we begin with data from the United Nations' Food and Agricultural Organisation,[112] which provides estimates of total agricultural land in each country of the world. We then use data from Oxford Economics' databanks on total economic output in the agricultural sector of each major country. Taking these two datasets together allows us to estimate land use intensities for the agricultural sector of each major country, i.e. how many hectares are required by thousand dollars of output.

We then use our economic modelling results to identify the demand from the German fashion sector's global supply chains for agricultural output in each major country around the world. Combining these demand figures with the intensities described above gives us estimates in each country for agricultural land use demand by the German fashion sector and its global supply chains.

These results are then sense-checked against cotton farming figures from the International Cotton Advisory Committee, which provides cotton farming areas and yields for each country in the world.[113]

[108] Mekonnen and Hoestra, National water footprint accounts: The green, blue and grey water footprint of production and consumption, 2011.
[109] FAO Aquastat, Industrial Water Withdrawal Metadata.
[110] FAO Aquastat, Municipal Water Withdrawal Metadata.
[111] Mekonnen and Hoestra, National water footprint accounts, 2011.
[112] UN FAO, Land Use database.
[113] International Cotton Advisory Committee, Data Portal.

Image: *Neonyt*

APPENDIX 2: FURTHER REFERENCE DATA

This chapter provides further data as reference material for understanding the scale, scope and detail of the German fashion industry's global impact.

Fig. 16: Value of clothing and footwear imports into Germany by country, 2019[114]

Country	€ millions
China	10,893
Bangladesh	5,666
Turkey	3,308
Vietnam	3,207
Italy	3,003
India	1,828
Netherlands	1,562
Cambodia	1,485
Poland	1,401
Indonesia	1,158
Pakistan	1,002
Myanmar	995
France	907
Portugal	844
United Kingdom	794
Romania	768
Tunisia	590
Morocco	525
Bulgaria	522
Spain	488
Rest of the world	5,413
Total	46,360

Source: Oxford Economics.

[114] German statistics office, table 51000-0007.

Fig. 17: Total greenhouse gas emissions (industry plus households) by EU28 country, 2019, million tonnes of CO2 equivalent[115]

Country	GHG emissions
Germany	853,700,000
United Kingdom	501,500,000
France	450,400,000
Italy	431,100,000
Poland	396,700,000
Spain	323,200,000
Netherlands	203,000,000
Czechia	122,500,000
Belgium	120,800,000
Romania	114,500,000
Denmark	87,000,000
Greece	85,200,000
Austria	76,700,000
Ireland	75,900,000
Hungary	65,700,000
Portugal	62,900,000
Finland	56,700,000
Bulgaria	56,300,000
Sweden	55,500,000
Slovakia	41,700,000
German fashion sector global emissions	39,000,000
Lithuania	26,500,000
Croatia	24,600,000
Slovenia	18,800,000
Estonia	15,500,000
Latvia	14,100,000
Luxembourg	10,300,000
Cyprus	9,100,000
Malta	4,600,000

Source: Oxford Economics.

[115] Eurostat air emissions accounts database, table env_ac_ainah_r2.

Fig. 18: Total EU28 greenhouse gas emissions by industry, 2019, million tonnes of CO_2e[116]

Industry	GHG emissions
Electricity, gas and steam	906,500,000
Households	886,000,000
Manufacturing	859,200,000
Transportation & storage	525,200,000
Agriculture	525,100,000
Water and waste	168,700,000
Wholesale & retail	102,100,000
Mining & quarrying	76,800,000
Construction	66,500,000
German fashion sector global emissions	39,000,000
Health and social work	33,500,000
Public administration & defence	30,600,000
Administrative & support services	22,900,000
Professional & technical services	21,400,000
Hotels & restaurants	19,400,000
Education	17,600,000
Other service activities	11,900,000
Information & communication	8,800,000
Arts & recreation	8,700,000
Real estate activities	6,800,000
Financial and insurance activities	6,500,000

Source: Oxford Economics.

Image: *Shutterstock*

[116] Eurostat air emissions accounts database, table env_ac_ainah_r2.

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