Preferred Fiber Product Mapping and Climate Impact Assessment

A project submitted in partial fulfillment of the requirements for the degree of Master of Science (Environment and Sustainability) in the University of Michigan

University of Michigan
School for Environment and Sustainability
April 2022

Master's Project Client: prAna Living LLC
Authors: Greg Allinson, Jess Halter, Amy Schatz, Annie Zaro

Faculty Advisor: Dr. Ravi Anupindi
Professor of Operations Research and Management
UM Stephen M. Ross School of Business

Table of Contents Outline

Abstract

According to a report published in 2020, approximately four percent of global manmade greenhouse gas emissions are attributable to the fashion industry.[1] The majority of these emissions can be categorized as Scope 3 emissions, encompassing all indirect emissions across the value chain, with the exception of indirect emissions from purchased energy (i.e., Scope 2). Fashion brands and retailers are increasingly focusing on investing in strategies to reduce the carbon impact of their products.

Our project team of University of Michigan dual-degree Masters of Environment & Sustainability and Masters of Business Administration candidates worked with Sustainability team members at prAna, an active lifestyle apparel and accessory brand with a history of incorporating responsible social and environmental practices into their operations, to determine how prAna's 2025 goal to transition 100% of their product fibers to more sustainable options ('preferred fibers') could reduce carbon emissions of their products.[2] Using a baseline year of 2019, our team analyzed internal product data from prAna with industry-standard fiber emissions factors from the Higg MSI database to estimate the total CO_2e reduction expected in 2025 assuming the same portfolio of products were made with only preferred fibers.

The findings of this project affirmed that with investment in transitioning prAna's existing fiber selections to more preferred versions, prAna can significantly reduce their carbon footprint emissions and make progress towards a manufacturing emissions reduction target of 30% by 2030, set by both prAna and its parent company, Columbia Sportswear Company.

---

[1] *Fashion on climate full report - how the fashion industry can urgently act to reduce its greenhouse gas emissions*. McKinsey. (2020). Retrieved March 27, 2022, from https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf

[2] The project team defines sustainable fibers in terms of carbon intensity. For example, a more sustainable fiber is one in which the CO_2e is lower than the standard fiber.

Project Introduction

Background on Apparel Industry

Clothing has been a mainstay of human culture for at least the past 100,000 years, with people creating the first garments from natural materials like furs, grass, and leaves.[3] Today, the clothing industry makes up a substantial proportion of the global economy, employing some 300 million people and generating $1.3 trillion.[4] Given the scale of the industry, it is unsurprising that the resources used and pollutants emitted over the course of a product's lifecycle are significant. As the global economy expands, more people enter the middle class, and clothing trends such as fast fashion persist, the environmental impacts associated with the clothing industry will worsen if today's design paradigms hold fast.

The clothing industry annually emits more greenhouse gas (GHG) than maritime shipping and all international flights combined. It has been calculated that while in 2015 the industry emits 2% of the carbon budget needed to adhere to a 2°C pathway, the clothing industry could make up 26% of the global carbon budget by 2050. Additionally, the industry consumes 93 billion cubic meters of water and uses 98 million tonnes of non-renewable resources, including oil, fertilizers, and dyes.[5]

Once manufactured, clothing continues to leave its mark on the environment through energy and water usage through transport, washing, and end-of-life emissions. In 2018, 87% of the 13 million tons of clothing disposed of in the U.S. were either incinerated or sent to landfill, contributing to GHG emissions and pollution.[6] Differences in the production of textiles is dependent on the fiber(s) used in production, which can result in dramatically different environmental impact. For example, conventional cotton requires 22,000 kilograms of water to produce 1 kilogram of fiber, whereas polyester requires only 62 kilograms of water to produce the same amount of fiber.[7] In addition to strictly environmental impacts, apparel production has been associated with contributing to a

---

[3] Bellis, M. (2019, June 29). *History of clothing*. ThoughtCo. Retrieved March 27, 2022, from https://www.thoughtco.com/history-of-clothing-1991476

[4] Ellen MacArthur Foundation. (2017). *A new textiles economy - redesigning fashion's future*. https://www.ellenmacarthurfoundation.org/publications

[5] Ibid.

[6] *Nondurable Goods: Product-Specific Data*. (2021, December 14). US EPA. Retrieved March 27, 2022, from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/nondurable-goods-product-specific-data#ClothingandFootwear

[7] Muthu, S. S., Li, Y., Hu, J., & Mok, P. (2012). Quantification of environmental impact and ecological sustainability for textile fibres. *Ecological Indicators*, *13*(1), 66–74. https://doi.org/10.1016/j.ecolind.2011.05.008

myriad of detrimental social impacts such as low wages, hazardous working environments, and discharging of pollutants into local waterways.[8]

Background on prAna

prAna is a $150M active lifestyle apparel and accessory brand and operates under the parent brand, Columbia Sportswear Company (CSC), a company with $3B in annual sales as of 2021. CSC was founded in 1938 and sells outdoor, active and lifestyle apparel, footwear, and accessories through the following brands: Columbia®, SOREL®, Mountain Hardwear®, and prAna®.[9] Acquired by CSC in 2014, prAna has long woven sustainability into its business ethos, which is exemplified by producing the first Fair Trade Certified™ piece of apparel in North America in 2011, widely using recycled fibers, and eliminating plastic from its direct to consumer product packaging.[10]

Per CSC's 2020 Corporate Responsibility Report, 97% of its GHG emissions are Scope 3, meaning the majority of their emissions are not directly emitted from sources that are owned by the organization (Scope 1) or indirectly emitted through the purchase of electricity, steam, heat, or cooling (Scope 2). As shown in Figure 1 below, the bulk of CSC's Scope 3 emissions are due to material inputs and material processing.[11]

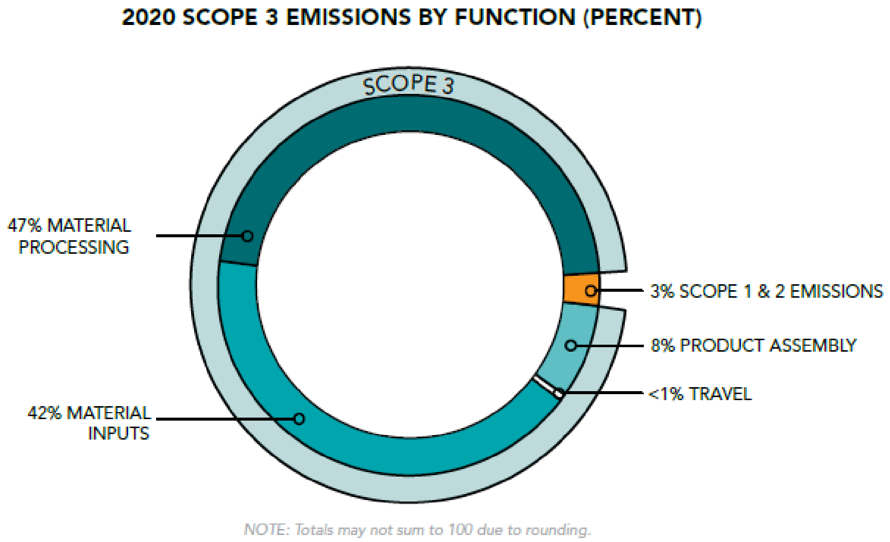


Figure 1: CSC GHG Emissions Breakdown[12]

---

[8] Ellen MacArthur Foundation. (2017). *A new textiles economy - redesigning fashion's future*. https://www.ellenmacarthurfoundation.org/publications

[9] Columbia Sportswear Company (2021). Form 10-K.

[10] *Our sustainability movement*. (n.d.). prAna. Retrieved March 27, 2022, from https://www.prana.com/sustainability.html

[11] Columbia Sportswear Company (2020). Corporate Responsibility Report.

[12] Ibid.

To reduce its Scope 3 emissions, CSC set a 2030 target to reduce manufacturing emissions by 30% from a 2019 baseline. In addition to the overall manufacturing emissions reduction goal of the parent company, prAna has set brand-specific goals for itself. Most relevant to this project is prAna's 2025 goal to use only preferred fibers in 100% of their products main materials. CSC defines a preferred material as 'a material that has a demonstrated significant improved impact over a standard version of that material in at least one of the following impact categories: 1) Animal-Welfare, 2) Biodiversity, 3) Chemicals, 4) Energy, 5) Greenhouse Gas Emissions, 6) Land Use Intensity, 7) Social Impact, 8) Waste, 9) Water.'[13] For the purposes of this project, our team more narrowly defined preferred fiber as a fiber with improved GHG emissions impact.

At the time this project initiated in 2021, prAna had developed an internal preferred fiber index that it used to directionally prioritize which fibers to use in production and increase the environmental sustainability of their product lines.[14] These fibers had been defined as more sustainable by prAna based on an internal review of Life Cycle Assessment (LCA) data from the Higg Index, Textile Exchange, and other scientific reports. The Sustainability team at prAna speculated that shifting their product lines to use more preferred fibers could help them achieve their manufacturing carbon emission reduction targets of 30% by 2030, but they had not yet performed the analysis to verify the impact based on their product lines, nor did they have a process or tool to forecast their impact or evaluate their previous work.[15]

Defining the Project Objectives and Research Needs

This project was designed to enable prAna to strategically plan and act on shifting the fibers used in their product lines to leverage more preferred fibers and to estimate the environmental impact, specially CO_2e emissions, of making this shift.

There were four objectives for the project. The primary objective was to calculate the environmental impact of complete product fiber conversion to preferred fibers either by total emission reduction season over season or by weight of product purchased. This primary goal was emphasized by our client - Rachel Lincoln, Director of Sustainability and Product Operations - as her top priority for the project. Additional objectives include

---

[13] Ibid.

[14] prAna leverages its own proprietary tool that consolidates data from various life cycle assessments to determine which fibers are deemed "preferred fibers"; for internal use only, although the term "preferred fibers" is used industry-wide

[15] *Climate action*. (n.d.). prAna. Retrieved March 27, 2022, from https://www.prana.com/sustainability/climate-action.html

mapping out options to convert prAna's existing product line to preferred fibers to maximize CO_2e emissions reduction while maintaining quality, style, performance, and price, creating recommendations to complete conversion to 100% preferred fibers by 2025, and outlining opportunities for continuous assessment and integration of new preferred fibers.

Our hypothesis was that there will be a significant reduction in environmental impact in prAna's manufacturing if they are to evolve all their product lines to only using preferred fibers. Prior to our engagement, the client had begun to transition the fibers used in their existing product lines to preferred fibers and were only using preferred fibers in new material launches. Our team anticipated that while some unconverted fibers appeared to have a preferred fiber equivalent, those preferred fiber alternatives may not meet design and performance specifications. As a result, our team flagged these as potential barriers to reach prAna's overall goal. Our team also hypothesized that apparel brands are interpreting preferred fibers in several different ways so determining a clear definition of what a preferred fiber is would be important to agree upon. Each of these challenges were also opportunities for prAna to stand out as a leader in the apparel industry and for prAna to engage the industry to create universal solutions for these barriers to utilizing more climate positive fibers and mitigate fashion's climate impact.

Our goal for this project was to evaluate the resulting environmental impact that converting 100% of prAna's product fibers to preferred fibers could have on the company's 2030 manufacturing carbon emissions reduction target.

Research questions the team asked during the project for the primary objective of evaluating preferred fibers include:
- What components of an LCA measurement should be included in the preferred fiber evaluation?
- How is prAna defining a preferred fiber?
- How will our team and prAna navigate scenarios when a preferred fiber supplement does not exist for an existing product?

Research questions for the other objectives that are more focused on creating and implementing a preferred fiber strategy recommendation include:
- What would prAna need to integrate preferred fiber evaluations into the existing product development process?
- How are other apparel brands evaluating their fiber base - is there an industry standard?
- How frequently should it be recommended that prAna reevaluate their preferred fibers?

Defining the Project Deliverables & Success

At the mid-point of our project, our team gave a presentation to the prAna Sustainability team that estimated the impact transitioning to preferred fibers could have on product manufacturing emissions and barriers to accessing complete and accurate data. The presentation provided prAna with directional insight into the impact converting their existing product lines to using preferred fibers and mobilized increasing accuracy of the data our team had access to.

The final deliverables for prAna from our team included:

- Presentation to prAna Sustainability: The presentation outlined scenarios to convert prAna's product lines to preferred fibers while maintaining quality, style, and price to maximize sustainability impact and the resulting carbon emissions of each scenario. The presentation also covered how industry peers are conducting their preferred fiber carbon emissions analysis to benchmark our project's analysis and inform prAna's strategic fiber conversation plan. The presentation concluded with recommendations for how to move forward with converting prAna's product fibers to preferred fibers and ensure consistent measurement and reevaluation of their product emissions.
- Emissions Calculation Guide: A guide was developed to support prAna's Sustainability team's efforts to continuously monitor and track the carbon emissions of its product lines holistically based on our team's manual, Excel-based methodology. The guide also included recommendations for how to manually maintain an internal preferred fiber index and how to transition the calculations to a digital platform such as a Product Lifecycle Management system (a tool used during design, product development, and ordering stages of a product's life cycle) to increase adoption and efficiency and ease the process of data maintenance.
- Internal Product Fiber Emissions Calculator: An Excel-based calculator was created with the intention of being utilized by internal prAna teams, such as Design team members to determine associated environmental impacts by adjusting the fibers used in specific products prior to solidifying design and product development decisions. The tool was designed to be integrated into prAna's internal processes and could be adapted to a digital system in the long term.

The way prAna measured success for this project was by:

- Receiving a thorough analysis of the arbon emission impact of transitioning their existing product lines to use 100% preferred fibers

- Receiving a few scenarios of this analysis to identify multiple preferred fiber transition opportunities for their product lines

The way our team measured success for the project was by:

- Ensuring that our project's standards for calculating carbon emissions of fibers aligned with the fashion industry's standards and acceptable by CSC and prAna
- Ensuring that prAna's Sustainability team found our team's preferred fiber recommendations and roadmap as actionable

Research Methods & Analysis

Our team addressed the four project objectives through interviews with internal prAna and Columbia stakeholders, interviews with external preferred fiber experts, benchmarking other apparel retailers through online research via their websites and primary interviews, and performing both industry and academic research. The industry research involved leveraging resources such as the Sustainable Apparel Coalition's Higg Index and Textile Exchange. The academic research consisted of reviewing academic journals with articles that discussed preferred fiber LCA. prAna already had a preferred fiber index developed from 2019, so part of our analysis included reviewing the sources cited by the original developer of the index, who still works at prAna and agreed to serve as a resource for the project.

Literature Review Data Collection Approach

Based on prAna's goal to calculate the CO_2e environmental impact of complete fiber conversion to preferred fibers, our team collected data from three main data sources. The data was collected from the Higg Materials Sustainability Index (MSI) database, the Textile Exchange database, and academic LCA literature on the environmental impact of various fibers. The three main sources used for the research and their corresponding strengths and weaknesses are outlined below.

Higg MSI Data

The Higg MSI methodology was originally developed by the Sustainable Apparel Coalition to enable brands, retailers, and facilities to measure a product's sustainability performance. [16] Today, the Sustainable Apparel Coalition is the sole licensee of the Higg Index and the Higg Index, which houses the Higg MSI, is a public benefit technology company.[17] The Higg MSI includes the Global Warming Potential, Nutrient

---

[16] Sustainable Apparel Coalition. (2020, August 11). The SAC. Retrieved March 29, 2022, from https://apparelcoalition.org/the-sac/

[17] Sustainable Apparel Coalition. (2021a, June 12). *The higg index*. Retrieved March 27, 2022, from https://apparelcoalition.org/the-higg-index/

Pollution in Water (Eutrophication), Water Scarcity, Fossil Fuel Depletion, and Chemistry information of materials.[18] The Higg MSI data comes from data that is submitted by industry and LCAs that have been done by various partners in the industry.[19] The Sustainable Apparel Coalition criticizes the Higg MSI Index's use of a Single Score system as well as a claim that the tool's methodology is biased towards synthetic fibers.[20] In the *False Promises of Certification* report, the authors cite concerns around a reliance on self-reporting from factories and brands as well as lack of transparency with the tool. The authors also cite concerns around the Better Cotton Initiative (BCI)'s reliance on toxic chemicals and genetically modified (GMO) seeds as being misleading in its representation of its positive environmental impact.[21] Despite the concerns, the Higg MSI Index is being used by many fashion brands.

Textile Exchange Data

The Textile Exchange collects and publishes industry data and insights for clothing brands and retailers to measure environmental impact and track use of preferred fibers. The data on the platform includes data on the carbon footprint, soil health, water, and biodiversity of materials. The organization also has multiple certification standards including the Organic Content Standard, the Global Recycled Standard, the Recycled Claim Standard, the Responsible Down Standard, the Responsible Wool Standard, the Responsible Mohair Standard, and the Content Claim Standard.[22] The Textile Exchange has collected data on preferred fibers including organic cotton, other more sustainable cotton, recycled polyester, preferred man-made cellulosics, bio-synthetics, and responsibly produced animal fibers and materials.[23] The data is collected by voluntary participation of over 170 companies including Adidas, C&A, Gucci, IKEA,

---

[18] Sustainable Apparel Coalition. (2020, August 11). *Higg brand tool*. Retrieved March 27, 2022, from https://apparelcoalition.org/higg-brand-tool/

[19] Sustainable Apparel Coalition. (2021c, June 21). *Higg product tools*. Retrieved March 27, 2022, from https://apparelcoalition.org/higg-product-tools/#:%7E:text=The%20Higg%20Materials%20Sustainability%20Index,-The%20Higg%20Materials&text=The%20Higg%20MSI%20uses%20data,of%20possible%20material%20manufacturing%20variations

[20] Roshitsh, K. (2020, November 3). *SAC to retire "criticized" higg msi score early next year*. WWD. Retrieved March 27, 2022, from https://wwd.com/sustainability/materials/sac-drops-criticized-higg-msi-1234651722/

[21] Changing Markets Foundation. (2018, May). *The false promise of certification*. https://changingmarkets.org/wp-content/uploads/2018/05/False-promise_full-report-ENG.pdf

[22] *About us*. (2022, February 16). Textile Exchange. Retrieved March 27, 2022, from https://textileexchange.org/about-us/

[23] *Materials*. (n.d.). Textile Exchange. Retrieved March 27, 2022, from https://textileexchange.org/materials/

Inditex, Nike, Patagonia and Tchibo. The disclosure allows the companies to better understand their supply chain and open it up to criticism and independent review by third parties.[24] Like the Higg MSI Index, the data included in the Textile Exchange database is self-reported by various industry partners.

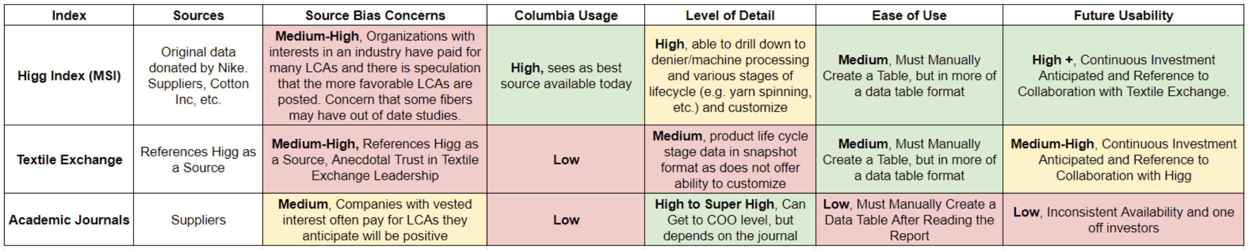
Academic Literature of LCA Data

Research was conducted on academic LCA studies that were authored by independent researchers or by authors that were sponsored by companies or industry trade groups.

Selection of Environmental Impact Data Source for Analysis

Our team did extensive due diligence on which data source to use for our analysis. After talking with six sustainability experts in the apparel industry to discuss the pros and cons of using each of these sources as the basis of analysis, their logic led us to understand why it is an industry standard to rely on the Higg Index for the data at present. The Higg MSI compiles datasets from multiple sources and is updated semi-annually with the most up-to-date sources from multiple sources so, while there is room for improvement in the data included in the database, it is the best source that the industry currently has access to. Furthermore, using Higg MSI impact data to analyze impact of the prAna portfolio is in alignment with the method CSC uses to calculate emissions of its portfolio.

The chart below (Figure 2) demonstrates how the team analyzed the three available data sources.



Index	Sources	Source Bias Concerns	Columbia Usage	Level of Detail	Ease of Use	Future Usability
Higg Index (MSI)	Original data donated by Nike. Suppliers, Cotton Inc, etc.	**Medium-High**, Organizations with interests in an industry have paid for many LCAs and there is speculation that the more favorable LCAs are posted. Concern that some fibers may have out of date studies.	**High,** sees as best source available today	**High**, able to drill down to denier/machine processing and various stages of lifecycle (e.g. yarn spinning, etc.) and customize	**Medium**, Must Manually Create a Table, but in more of a data table format	**High +**, Continuous Investment Anticipated and Reference to Collaboration with Textile Exchange.
Textile Exchange	References Higg as a Source	**Medium-High,** References Higg as a Source, Anecdotal Trust in Textile Exchange Leadership	**Low**	**Medium**, product life cycle stage data in snapshot format as does not offer ability to customize	**Medium**, Must Manually Create a Table, but in more of a data table format	**Medium-High**, Continuous Investment Anticipated and Reference to Collaboration with Higg
Academic Journals	Suppliers	**Medium**, Companies with vested interest often pay for LCAs they anticipate will be positive	**Low**	**High to Super High**, Can Get to COO level, but depends on the journal	**Low**, Must Manually Create a Data Table After Reading the Report	**Low**, Inconsistent Availability and one off investors

Figure 2: Pros and Cons Analysis of Three Available Data Sources

---

[24] Makower, J. (2020, January 20). *How the textile exchange's new index aims to make a material difference*. Greenbiz. Retrieved March 27, 2022, from https://www.greenbiz.com/article/how-textile-exchanges-new-index-aims-make-material-difference

Analytic Methods

Phase 1: Benchmarking Environmental Footprint of Preferred Fibers

The following Research Flow Diagram (Figure 3) provides an overview of the data analysis process for calculating the reduction in prAna's switch to 100% preferred fibers prior to 2020.

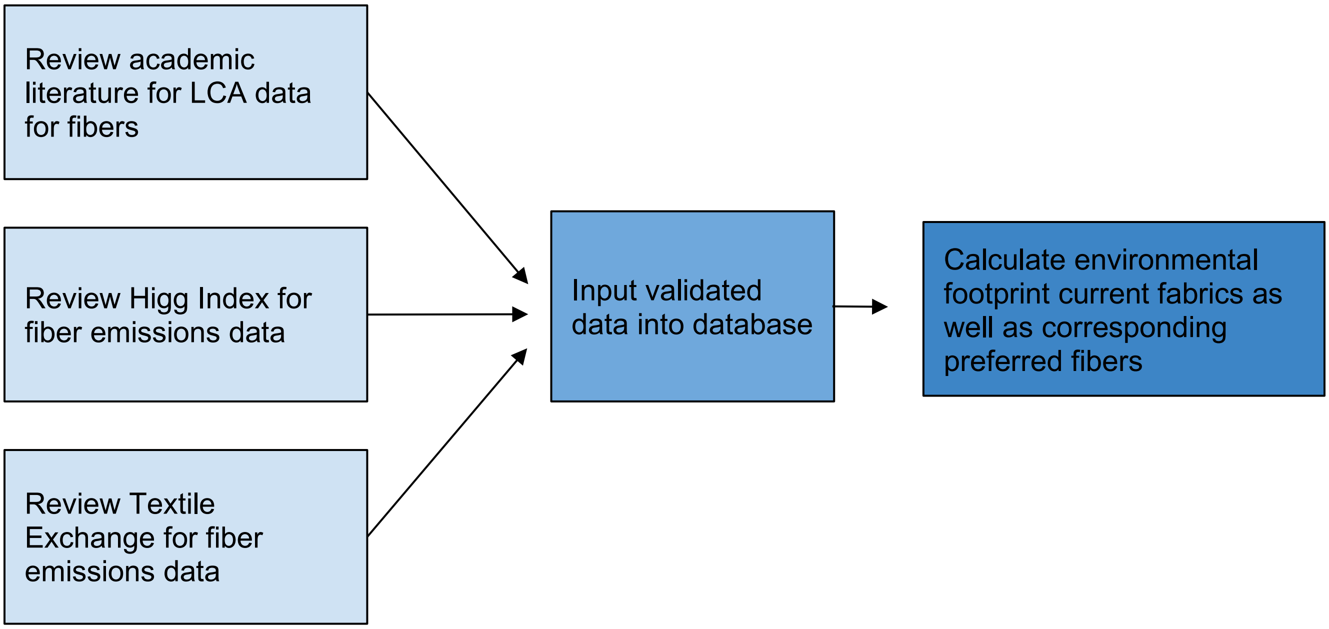


Figure 3: Research Sources Used to Validate Database and Calculate Footprint

Our team did research to assess the environmental impact of preferred fiber and material indexing methodology performed in 2020 and determine the need to update the existing emissions data prAna was leveraging. Our team reviewed the previous LCA methodology used by Oliver Ambros, a Sourcing Analyst at prAna, who cataloged research from 2019 and validated using existing data on the environmental performance. Given the proliferation of new data sources since 2019 and the fashion industry's increased focus on reducing its environmental impact, our team conducted additional research to validate the need to update prAna's existing fiber emissions data. Our team conducted this analysis by reviewing current data in the Higg MSI Index, the Textile Exchange database, and current academic articles with Life Cycle Assessment results and then mapping it back to the existing database created by prAna. Our research affirmed that the database required an update and that the numbers across the various indexes and journals were similar enough to affirm our decision to continue to use the Higg MSI for our preferred fiber transition analysis. [25] The mapping methodology to validate the data included in the Higg Index followed current research methodologies used by leading retail brands through online research and interviews.

---

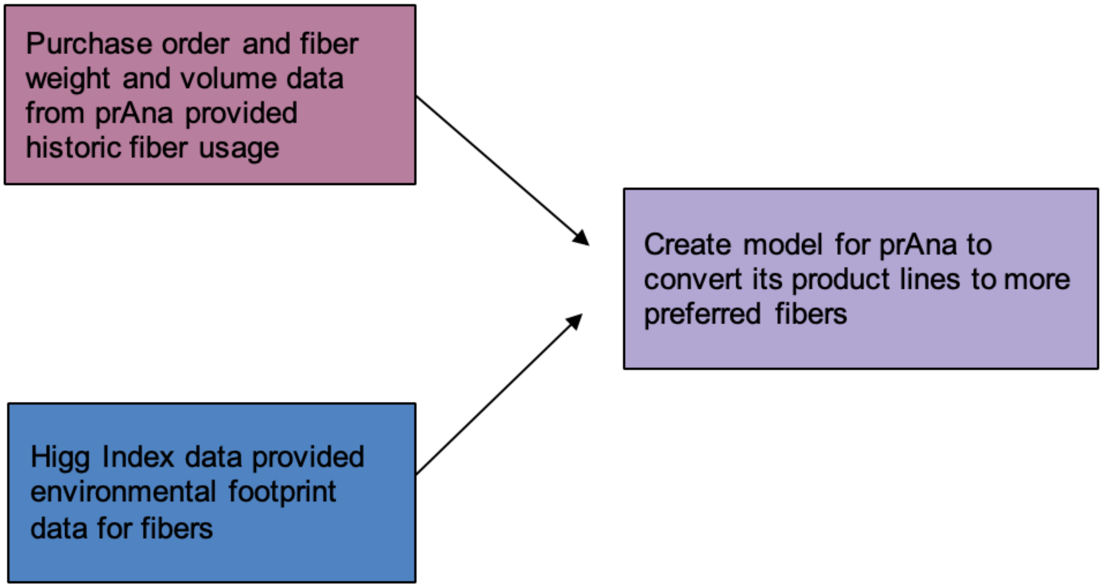
[25] Ibid.

Once the data in the Higg MSI was validated and prAna approved of our team's ability to use the Higg MSI for our GHG emissions analysis of their fibers and preferred fiber alternatives, our team began to develop an internal database to enable us to evaluate the emissions of each fiber type. Our team also utilized analyses of the social, environmental, and health category impacts of various fibers based on data in the Higg Index to map out how fibers compare against each other on various factors. While our team focused on evaluating and gathering GHG impact of each fiber, when available, our team collected additional data from the Higg MSI on water usage, eutrophication, and chemical use of each fiber per prAna's request for additional consideration.

Throughout this phase of the research, our team partnered with the prAna Sustainability team to understand the development of their internal preferred fiber index to identify what aspects are influenced by the LCA based rankings and what are not (e.g., is origin of the fiber included in the assessment to factor in transport or grid emissions). Our team also worked with the prAna Sustainability team to understand current thresholds of determining what is called a "preferred fiber" or not to evaluate that threshold and propose strategies to raise that threshold over time.

Phase 2: Analyze Options for Converting Product Line to Preferred Fibers

The second goal with this project was to map out how to convert prAna's existing product line to preferred fibers to maximize carbon emission reduction while maintaining quality, style, performance, and price. The following research flow diagram (Figure 4) provides the process overview for this step.



Purchase order and fiber weight and volume data from prAna provided historic fiber usage

Higg Index data provided environmental footprint data for fibers

Create model for prAna to convert its product lines to more preferred fibers

Figure 4: Data Sources Used to Calculate prAna's Preferred Fiber Emission Reductions

Our team used GHG data gathered referred to in Phase 1 and combined it with historical purchase order and estimated product weight data from prAna to contribute to a model to calculate the impact of transitioning to 100% preferred fiber-based product lines. Our team partnered with prAna product line specialists and Sustainability team to analyze current prAna product lines and materials to identify fibers to prioritize transitioning and their prospective alternative preferred fibers with equal or better performance and quality and lower emissions.

Phase 3: Creation of Strategic Plan for Conversion to 100% Preferred Fibers

The third goal was to create a supplemental project plan to complete conversion to 100% preferred fibers by 2025. The following Research Flow Diagram (Figure 5) overviews the process for this step.

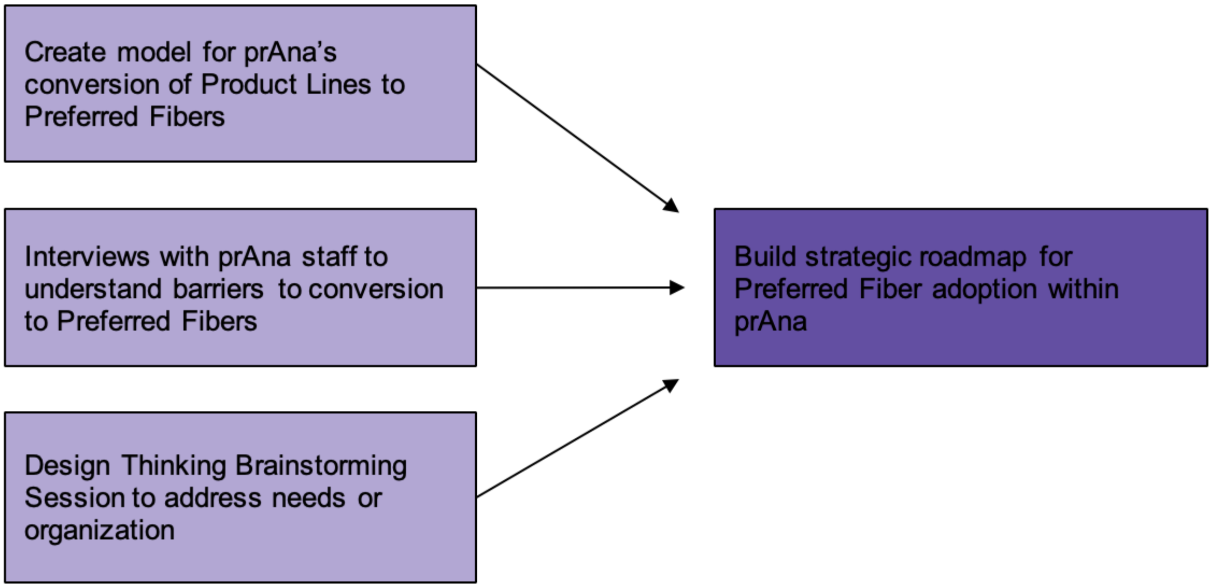


Figure 5: Workflow to Provide Final Recommendations for Project Adoption

After creating a model to assess the impact of converting prAna's product lines to 100% preferred fibers, our team followed up with prAna Sustainability team members, a member of the CSC team who conducts product emissions analysis for CSC, and other responsible sourcing and sustainability brand leaders to identify best practices to sustain continued fiber emissions evaluation and increase likelihood of adopting the transition plan. These interviews combined with the interviews conducted during the first two phases of the project with internal prAna stakeholders, influenced the development of a guide to maintain the calculations along with other recommendations.

Our team also developed a tool to support the prAna Design team in relation to this objective is an Excel-based calculator that can be used to determine the associated environmental impacts that result from using specific fibers in the products during the design and product development phase. The calculator can help prAna prioritize integration of preferred fibers that can be then filtered into a Wear Test to ensure consistent quality and performance. The Wear Test may be needed to identify if there are any performance issues with switching one of the non-preferred fibers to a preferred fiber for a particular garment style.

Calculation Methodology and Findings

Calculation Methodology

To calculate the CO_2e impact from each prAna product, our team multiplied the fiber GHG emissions factor by the fiber weight and item quantity to identify the total carbon emissions for each fiber material, as shown in Figure 6.

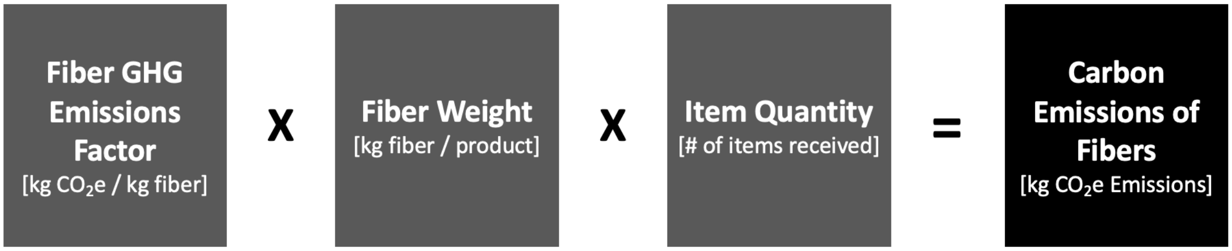


Figure 6: Carbon Emission Calculation

Our team used a variety of resources that informed our calculation methodology. First, to determine the fiber CO_2e for each fiber, our team extracted the fiber GHG emissions factor from the Higg MSI.[26] As mentioned on page 12 of the *Literature Review Data Collection Approach* section, our team confirmed using Higg MSI emissions factors to calculate product CO_2e emissions was aligned with CSC's fiber emissions calculation methodology as well as most of the fashion industry. Our team relied on internal prAna data such as item receipts, fiber breakdowns, product weights, and preferred fiber options to make the above calculation for all products as mentioned on pages 14 and 15 under our *Analytic Methods* section.

Emissions Calculations Boundaries

System boundaries for LCA typically come in two cases: 'cradle-to-gate' (raw materials up to the factory gate) and 'cradle-to-grave' (raw materials through end of life). Higg MSI uses the 'cradle-to-gate' approach.[27]

---

[26] Sustainable Apparel Coalition. (2021a, June 12). *The higg index*. Retrieved March 27, 2022, from https://apparelcoalition.org/the-higg-index/

[27] *FAQ – user resources: How to higg*. (n.d.). How to Higg. Retrieved March 27, 2022, from https://howtohigg.org/higg-msi/faq/

For a typical material in the Higg MSI, impact data for the following processing steps are included:

- Raw Material Source
- Yarn Formation Method
- Textile Formation
- Preparation
- Coloration
- Additional Coloration and Finishing
- Chemistry Certifications

Each processing step has associated impact categories (e.g., global warming, eutrophication). Within the MSI, each of the steps have a range of options that can be selected for each base fiber. For example, for cotton, the raw material source includes options such as conventional, recycled, organic, and others. In our analysis, the only variable that was changed for a given fiber was the Raw Material Source. This approach was selected taking into account a combination of limitations on product information granularity and ease of future calculation by prAna team members due to the manual nature of performing the calculations.

The Higg MSI includes loss rates between the process steps listed above. For example, material is lost between the production of raw material and fiber spinning steps, so the loss rate captures the emissions factor associated with the material that is disposed of and not used. Additionally, impacts associated with the transportation between steps are accounted for in the MSI. The default scenario for transportation within the MSI is 200km between process steps via Large Freight Truck. Loss rates and transportation modes and distances were left as the default values for our analysis. Apparel ‘trim,’ such as zippers and buttons, were excluded from the calculation.

Analysis

Our team first calculated the current fiber CO_2e impact for both 2019 and 2020, before projecting the impact of converting the fibers to 100% preferred fiber alternatives. Data from 2019 provided a baseline calculation that was used for comparison for the projected emissions in 2025, while 2020 demonstrated the progress that prAna already made after 2019 in their preferred fibers conversion and resulting carbon emissions reduction.

Through this analysis, our team was able to identify the fibers that have the most impact on reducing carbon emissions and positively impact the company’s 30% manufacturing emissions reduction target. The chart below (Figure 7) shows the breakdown of preferred fiber usage in 2019 and 2020 and highlights where the biggest opportunity lies in the use of non-preferred fibers. From the chart, one can see Polyester, Nylon, and Spandex + Lycra are the largest volume of purchased non-preferred fibers being used, with Nylon appearing as the largest conversion opportunity based on purchase volume.

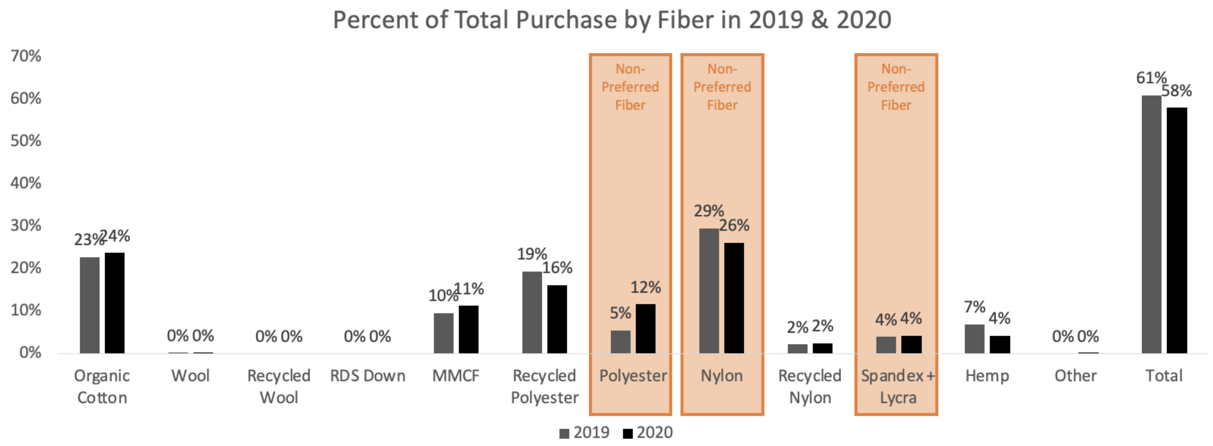


Figure 7: Percent of Purchased Fiber Type for 2019 and 2020

To calculate the projected carbon emissions reduction for 2025, our team broke down the calculation into three scenarios and identified two tiers of preferred fiber alternatives that accounted for multiple fiber options and resulting carbon emissions.

The two tiers of preferred fibers were based on the identification of two alternative preferred fibers by prAna internal team members as prospective fibers to convert existing fibers to that were prioritized based on carbon emissions (Tier 1 preferred fibers had lower carbon emissions than Tier 2 preferred fibers). It should be noted that there were some instances in which a Tier 1 fiber would have lower carbon emissions than a Tier 2 fiber, but the Tier 2 fiber would have lower water usage or eutrophication levels. See *Appendix* C for a full breakdown of the Tier 1 and Tier 2 fibers.

The first scenario considered for the 2025 carbon emissions reduction involved measuring the conversion of all existing fibers to Tier 1 fibers, fibers that presented the highest carbon emissions reduction for prAna and would therefore be the most optimal fiber conversion. The second consisted of converting all existing fibers to Tier 2 fibers, fibers that presented the second highest carbon emissions reduction for prAna. The third scenario consisted of converting all existing fibers, except Spandex, to use Tier 1 fibers, recognizing that it is currently a significant challenge for the industry to use alternative fibers to Spandex to achieve the same performance quality the virgin fiber provides. By breaking down these scenarios, our team was able to highlight fibers that would have a higher reduction potential and allow prAna to consider the nuances within the fibers (i.e., mechanical vs recycled nylon) and weigh their performance qualities and feasibility of internal and customer adoption.

Results

Carbon Emissions Reduction Calculation

The following results are all on an intensity basis, meaning that they represent CO_2e emissions per unit weight of product. This approach takes into account that prAna is a growing apparel brand and that as sales grow, there is a potential for increased emissions output on an absolute basis. Using 2019 as a baseline, having already begun the fiber conversion process, prAna reduced its carbon emissions from the fiber creation process of the product life cycle by 2.59% in 2020. Based on the above-mentioned analysis and using 2019 as the baseline, by converting all fibers, including spandex, to Tier 1 preferred fibers prAna can realize a 27.53% intensity-based reduction in carbon emissions. Spandex, however, is a harder fiber to convert due to its performance qualities, and therefore may take longer to integrate a comparable preferred fiber. Excluding spandex from conversion will lead to minor decrease in reduction by 0.3% to 27.23 because spandex only makes up a small percentage of use across prAna's overall product mix. Converting all current non-preferred fibers to Tier 2 preferred fibers, including transitioning Spandex, results in a 17.63% reduction in carbon emissions. These conversion impacts on carbon emissions intensity for prAna's product portfolio are illustrated Figure 8 below.

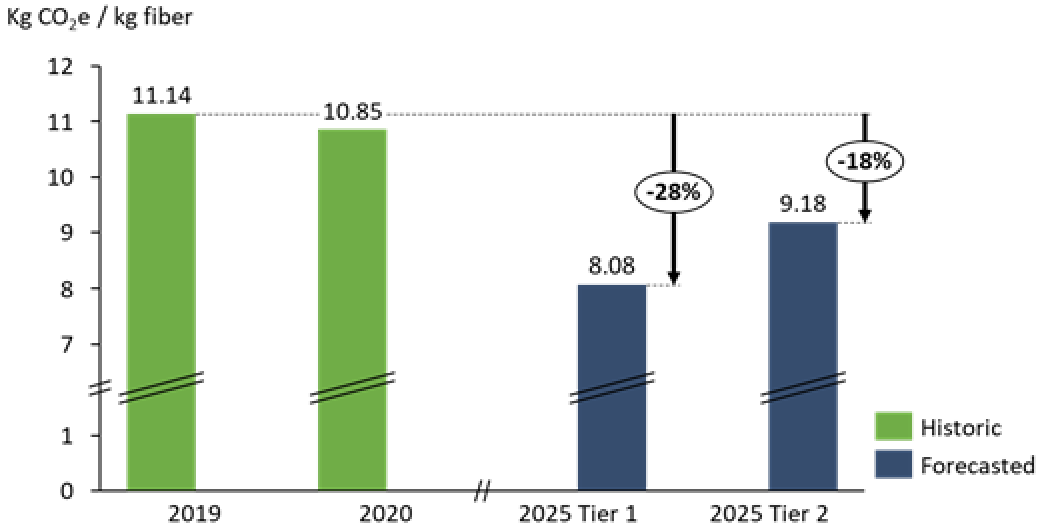


Figure 8: prAna CO_2e Emissions Intensity

Our team also considered the impact of the preferred fiber conversion in the context of the broader product lifecycle. Based on industry benchmark data (see Table 1 below), Scope 3 emissions attributed to raw materials and material manufacture made up between 64% to 91% of carbon emissions. The use phase is excluded from the total range and in our calculations due to various external factors that are out of the company's control, including how often a consumer washes the product, etc.

Carbon Emissions from Product Lifecycle: Industry Scope 3 Benchmark

Industry Scope 3 Benchmarking	**Scope 3 emissions attributed to raw materials and material manufacture (use phase *excluded* from total Scope 3)**
McKinsey Industry-wide Report	87%
Quantis industry-wide report	91%
H&M Group	69%
Patagonia	86%
Levi's	64%
Total Range	***64% - 91%***

Table 1: Apparel Industry Scope 3 Benchmarking[28]

Based on the 64-91% range that makes up Scope 3 emissions and factoring in the Tier 1 preferred fiber conversion of 27.3%, the overall projected Scope 3 emissions reduction possible from swapping to these preferred fibers equals 18%-25% (see

---

[28] *Fashion on climate full report - how the fashion industry can urgently act to reduce its greenhouse gas emissions*. McKinsey. (2020). Retrieved March 27, 2022, from https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf

H&M Group. (2020). *Sustainability performance report 2020*. https://hmgroup.com/wp-content/uploads/2021/03/HM-Group-Sustainability-Performance-Report-2020.pdf

The climate crisis is our business. (n.d.). Patagonia. Retrieved March 27, 2022, from https://www.patagonia.com/climate-goals/

Levi Strauss & Co. (2018, August). *Climate action strategy 2025*. https://www.levistrauss.com/wp-content/uploads/2018/07/LSCO_Climate_Action_Strategy_2025.pdf

Quantis. (2018). *Measuring fashion - environmental impact of the global apparel and footwear industries study*. https://quantis-intl.com/wp-content/uploads/2018/03/measuringfashion_globalimpactstudy_full-report_quantis_cwf_2018a.pdf

Science Based Targets & World Resources Institute. (n.d.). *Apparel and footwear sector science-based targets guidance*. Science Based Targets. https://sciencebasedtargets.org/resources/files/SBT_App_Guide_final_0718.pdf

Table. As such, given prAna's 30% carbon emissions reduction goal, from just switching to preferred fibers, prAna, at a minimum, can achieve 60% (17% out of 30%) progress towards the goal. In order to reach the remainder emissions reduction, prAna will need to seek out other methods.

Carbon Emissions from Product Lifecycle: Industry Scope 3 Benchmark

Tier 1 Preferred Fiber Conversion CO_2e Emission Reduction		**Scope 3 emissions attributed to raw materials and material manufacture (use phase *excluded* from total Scope 3)**		**Total Emissions**
27.3%	x	64% (lower range)	=	18%*
27.3%	x	91% (upper range)	=	25%

Table 1: Calculations of Impact of Scope 3 Emissions

**Values rounded to 18%.*

While our team's calculations primarily focused on carbon emissions to align with prAna's carbon emissions reduction goal, the following figures demonstrate the impact that Tier 1 vs Tier 2 preferred fiber conversions have on eutrophication, water scarcity, and resource depletion (fossil fuels). These are also important to monitor as the conversion of certain fibers, like cotton, don't impact carbon emissions as much as the other environmental impacts, like water scarcity. See Appendix A for breakdown of impacts of the preferred fiber conversion on eutrophication, water intensity, and resource depletion.

Recommendations

Our team makes the following recommendations. First, prAna should prioritize fiber transition by weight and carbon emissions volume. See Appendix B for a list of fibers used for this calculation and refer to the Higg Index database for the full values. By doing so and working directly with the design team to transition such preferred fibers will allow prAna to balance the carbon emissions reduction with quality and performance of their current product mix. Through continuous improvement, prAna can consider phasing out specific fibers or products that are above a "carbon emissions" threshold. Furthermore, tying performance metrics, such as sales, and product performance metrics to emissions reductions goals provides incentives for each of the respective teams to work towards fully transitioning to Tier 1 preferred fibers.

Next, because the calculations above rely on using a singular data source, the Higg Index, our team recommends that prAna supports funding of life cycle assessments of preferred fibers that have very few sources in the Higg Index, such as hemp, to add to the robustness of the data available. Fibers such as Hemp, for example, are not as thoroughly researched and therefore may not have recent and/or accurate studies that may impact the types of fibers that prAna will use.

Additionally, prAna should integrate fiber emissions factor data in its internal systems. Integrating emissions of various fibers into prAna's internal system creates visibility for the design team when building out various products. The integration also improves the feasibility of calculating year-end emissions associated with the current product portfolio. As such, prAna should evaluate the costs and benefits associated with linking the Higg MSI internal applications to prAna's internal system or exploring other third-party tool integrations. Currently there are few systems that allow for easy systems linkage, so continuous reevaluation is necessary to determine if/when this opportunity makes sense for prAna.

Lastly, our team recommends that an analyst should be added to the prAna Sustainability team to support ongoing analysis of preferred fiber conversion and associated carbon emissions. Based on the amount of time it took our team of four to complete this project, about 1/10th of a full-time employee's time is needed to support the calculations and data maintenance. A further 1/10th would be used to calculate additional environmental impact measures, such as product last mile transportation, to continue to identify other opportunities for carbon emissions reduction.

Limitations of Analysis

Throughout the analysis phase of the project, our team relied on internal prAna data to understand the current fiber makeup of the products, including fiber percentages, fiber weights, and item quantities. As this data heavily influenced our resulting calculations, an important aspect of this project focused on data validation before performing our calculation.

During the data gathering phase, several products had incomplete associated data. Approximately only 90% of the 2019 and 2020 styles were able to be measured. While the results may change with a complete data set, the level of data completion mirrored an industry benchmark, giving us confidence that our analysis is at least as accurate as that conducted by prAna's industry peers. To increase the accuracy of the dataset in the future, our team recommended that prAna's Sustainability team integrate quality assurance checkpoints into internal systems to safeguard against missing or inaccurate data challenges in the future.

Due to time constraints and data completion limitations, our team leveraged the default emissions values from the Higg MSI rather than leveraging details about the textile and product manufacturing process to increase the accuracy of the emissions calculations. Through primary research benchmarking conversations with industry peers, our team was able to verify that many brands and retailers leverage the default values for similar reasons. Our team created recommendations for prAna based on emissions associated with various fiber types (See Appendix B) to design their product and fabric data management system to increase the feasibility of leveraging more accurate values in the Higg Index in the future. An additional limitation of the Higg Index values is that it is unable to adjust emissions calculations based on country of origin of the raw materials, mill, or manufacturing, further contributing to potential under or over valuation of the emissions from fibers.

Due to time constraints and data confidentiality, our team was not able to partner with prAna Materials and Production teams to understand the current quoted prices for fibers, yarns, and fabrics, including and not including shipping costs, to perform cost-benefit modeling in the short and long term. Such an analysis would have provided key insights to consider when prioritizing certain fibers over others in the conversion process.

Implications for Retail Industry

This project's conclusions affirm that fiber selection does have a material impact on the carbon emissions, as well as on other environmental factors, of the apparel industry as it not only alters the emissions calculations for the raw material sourcing, but all subsequent processing, manufacturing, usage, and disposal of a product. The study should mobilize other brands to follow prAna's lead in striving to convert their products to using more preferred fibers to reduce their brand and the broader fashion industry's impact on the environment. The study also affirms there is a growing marketplace of preferred fibers as brands are likely to want to purchase raw materials that have lower emissions, but similar price points and performance qualities. Lastly, this study highlights a growing need for LCAs to continue to increase the accuracy of the data available in databases like the Higg Index for brands to leverage to make informed decisions about which fibers to prioritize transitioning out of and which to transition into.

Team Composition

University of Michigan Research Team

From left to right

Amy Schatz, MBA/MS 2023

Amy is a dual MBA/MS student at the University of Michigan. Prior to graduate school, Amy worked for a healthcare consulting firm, focused on identifying lost revenue and recommending solutions to mitigate future losses for hospitals across the U.S. She is passionate about working in the apparel space where environmental and social impacts intersect to promote responsible production and consumption of goods. Amy holds a B.S. in Business Economics from the University of California, Davis.

Annie Zaro, MBA/MS 2023

Annie is a dual MBA/MS student at the University of Michigan. Prior to school, she worked in management consulting at Huron Consulting Group and in strategic sourcing at Stitch Fix. Since starting her graduate program she has interned and worked part time for retail brands and nonprofits including Carhartt, Good Business Lab, Retrievr, StockX, Ten Thousand Villages and thredUP. Annie is passionate about transforming the retail industry into a more socially responsible and climate positive industry. She holds a B.S. in Human & Organizational Development from Vanderbilt University.

Jess Halter, MBA/MS 2023

Jess is a dual MBA/MS student at the University of Michigan. Prior to graduate school, she worked in consumer insights at IPG Media Lab in the AdTech space and in environmental Consulting at Cascadia Consulting Group in the Zero Waste space. Jess is passionate about designing sustainable foods that include sustainably sourced ingredients, efficient production and transportation, and messaging that resonates with consumers, all while being nutritious and delicious. She holds a B.A. in Behavioral Neuroscience from Colgate University.

Greg Allinson, MBA/MS 2023

Greg is a dual MBA/MS student at the University of Michigan. Prior to graduate school, he worked in a variety of engineering roles at Chevron, where he managed projects primarily in Texas and the Gulf of Mexico. Greg is passionate about the energy industry *and the ways it can be decarbonized through technological and market approaches. He holds a B.S. in Mechanical Engineering from the University of California, Santa Barbara.*

Faculty Advisor
Dr. Ravi Anupindi, Faculty Advisor
Ravi Anupindi is Colonel William G. and Ann C. Svetlich Professor of Operations Research and Management at the Stephen M. Ross School of Business; founding Faculty Director of the Center for Value Chain Innovation (2017-2020); co-Director of the Technology and Business Innovation Forum (2015-18) at Ross and Chair of (UM) President's Advisory Committee on Labor Standards and Human Rights (2013-). His main research areas include technology and business innovation, global supply chain management, health care delivery in low and middle-income countries, economic development, and environmental & social sustainability.

Client Team
Rachel Lincoln, Director of Sustainability & Social Responsibility
Ellen Johnson, Sr. Social Responsibility and Sustainability Specialist

Acknowledgements

The research team would like to acknowledge our clients, advisors, and industry experts for the support they provided during this project. Thank you, Lulu Michell, Rachel "Rockie" Goldbaum, and Oliver Ambros at prAna for the time and knowledge you gave us in the initial stages of our project. Thank you, Lex Agapinan, for ensuring alignment with prAna's parent company, Columbia Sportswear. And lastly, thank you Linda Greer, Senior, Global Fellow at Institute for Public and Environmental Affairs for your insights on carbon emissions in the garment manufacturing industry. Without their input, guidance, and feedback this project would not have been possible.

Thank you to University of Michigan faculty Dr. Olivier Jolliet and Dr. Gregory Keoleian for providing feedback on lifecycle assessments in the early stages of the project. A special thank you to Rachel Lincoln and Ellen Johnson, for their considerable time and effort spent with our team over the last year and a half. Thank you to Dr. Ravi Anupindi for serving as our academic advisor.

Appendix A

Other Environmental Impact of Preferred Fiber Conversion

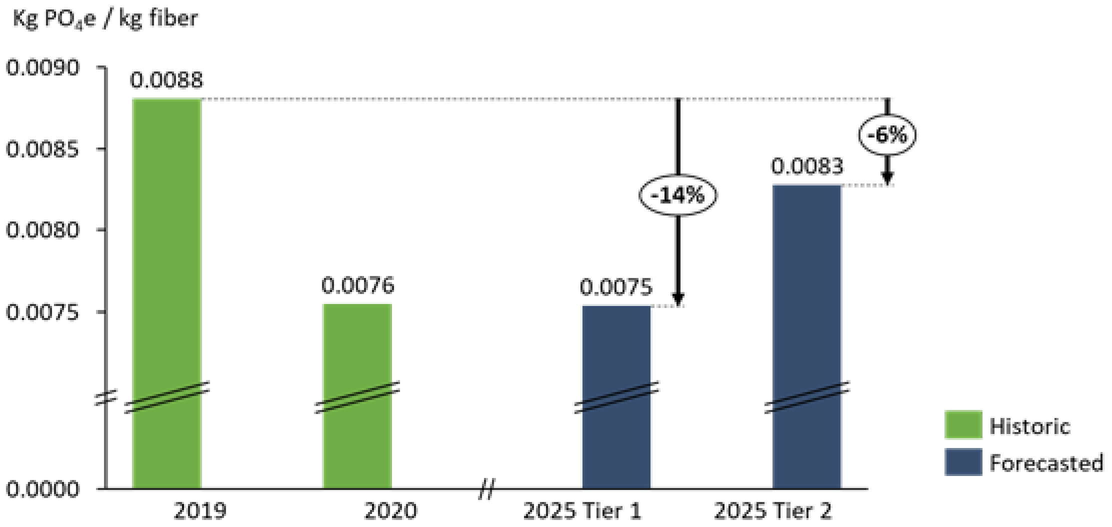


Figure 9: prAna Eutrophication Potential Intensity, excluding Spandex

Figure 9 shows the impact of the transition to preferred fibers on eutrophication expressed in Phosphate (PO4)-equivalents per kilogram of fiber used by prAna. According to Space4Water, the eutrophication impact covers the “the impacts on terrestrial and aquatic environments due to over-fertilization or excess supply of nutrients, particularly focusing on the most important substances nitrogen (N) and phosphorus (P).”[29]

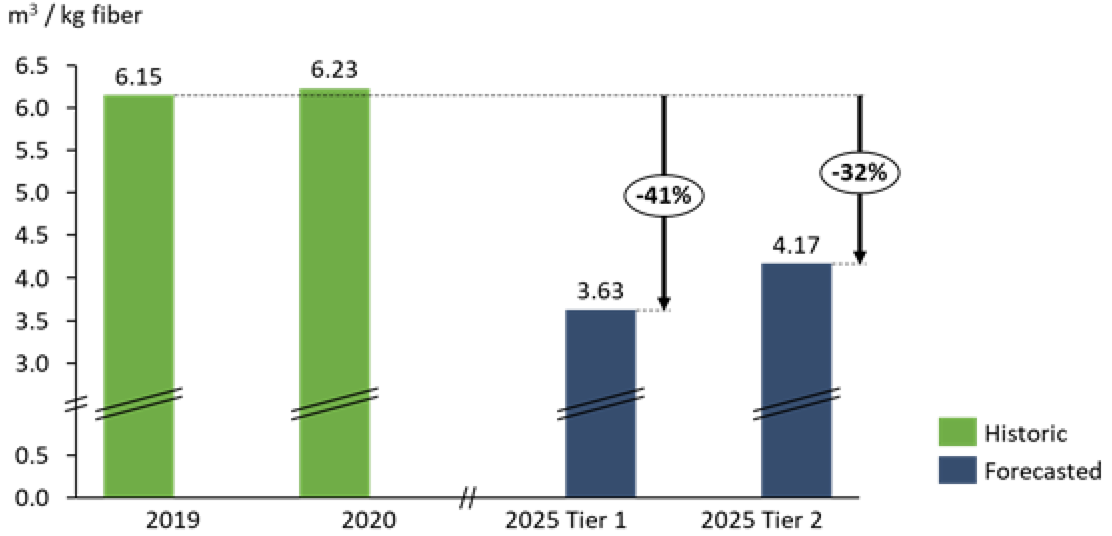


Figure 10: prAna Water Scarcity Intensity, excluding Spandex

Figure 10 shows the impact of the transition to preferred fibers on water scarcity expressed in the cubic meters of water per kilogram of fiber used by prAna.

---

[29] Eutrophication potential. Eutrophication Potential | Space4Water Portal. (n.d.). Retrieved March 31, 2022, from https://www.space4water.org/water/eutrophication-potential

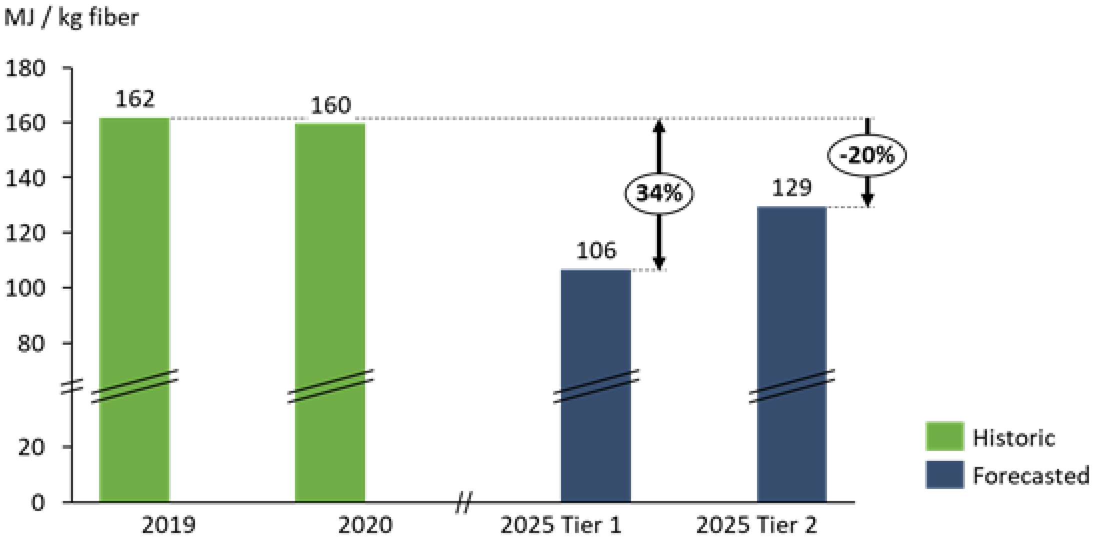


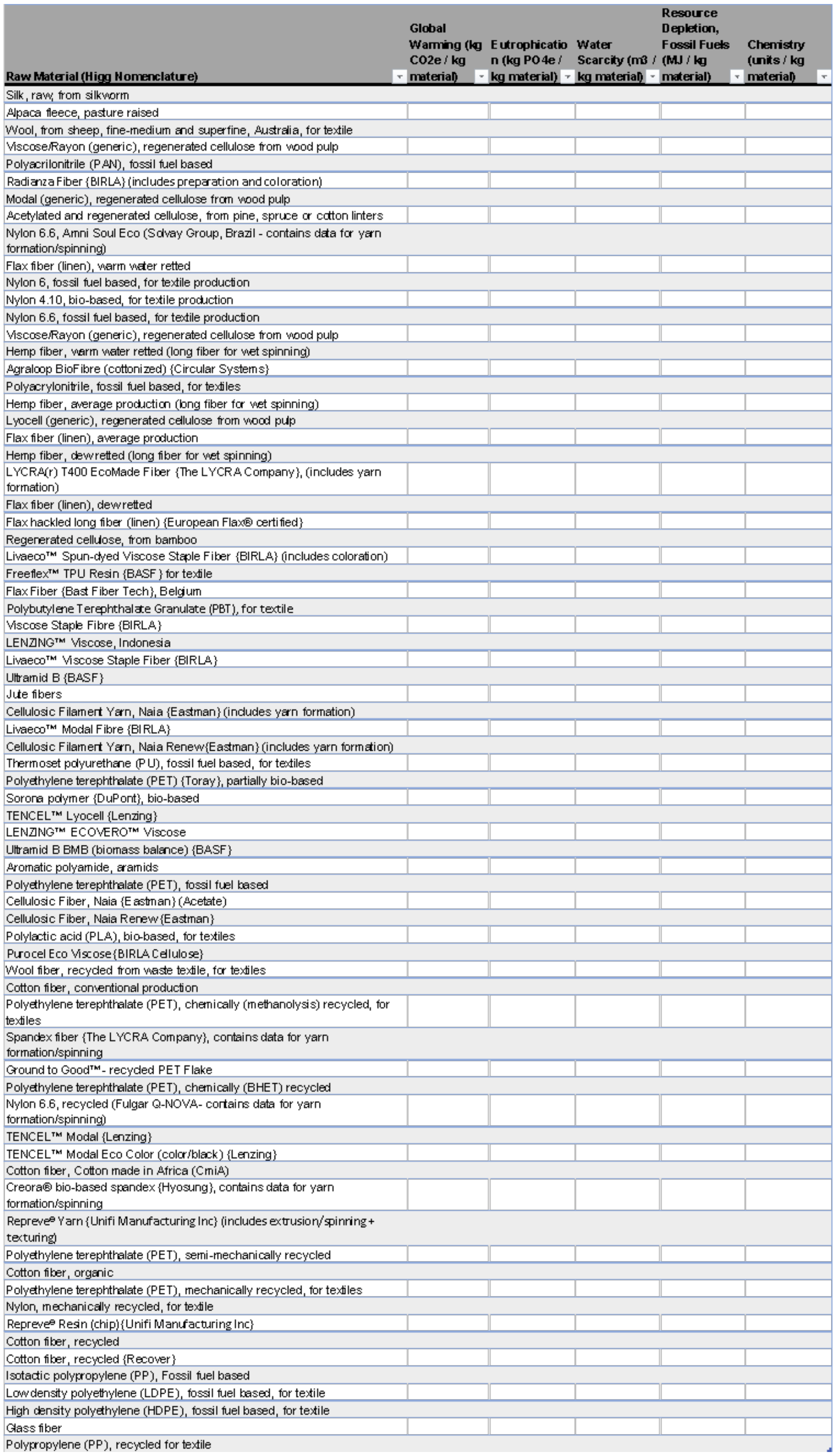
Figure 11: prAna Resource Depletion, Fossil Fuels Intensity, excluding Spandex

Figure 11 shows the impact of the transition to preferred fibers on resource depletion expressed in energy content in megajoules per kilogram of fiber used by prAna.

Appendix B

Environmental Impact of Fibers Ordered by CO_2e per kilogram of fiber

The table below represents the type of data used from the Higg Database for the calculations. Due to the proprietary nature of the data, please refer to the Higg Database for the full values based on the most up-to-date LCA data.



Raw Material (Higg Nomenclature)	Global Warming (kg CO2e / kg material)	Eutrophication (kg PO4e / kg material)	Water Scarcity (m3 / kg material)	Resource Depletion, Fossil Fuels (MJ / kg material)	Chemistry (units / kg material)
Silk, raw, from silkworm					
Alpaca fleece, pasture raised					
Wool, from sheep, fine-medium and superfine, Australia, for textile					
Viscose/Rayon (generic), regenerated cellulose from wood pulp					
Polyacrilonitrile (PAN), fossil fuel based					
Radianza Fiber {BIRLA} (includes preparation and coloration)					
Modal (generic), regenerated cellulose from wood pulp					
Acetylated and regenerated cellulose, from pine, spruce or cotton linters					
Nylon 6.6, Amni Soul Eco (Solvay Group, Brazil - contains data for yarn formation/spinning)					
Flax fiber (linen), warm water retted					
Nylon 6, fossil fuel based, for textile production					
Nylon 4.10, bio-based, for textile production					
Nylon 6.6, fossil fuel based, for textile production					
Viscose/Rayon (generic), regenerated cellulose from wood pulp					
Hemp fiber, warm water retted (long fiber for wet spinning)					
Agraloop BioFibre (cottonized) {Circular Systems}					
Polyacrylonitrile, fossil fuel based, for textiles					
Hemp fiber, average production (long fiber for wet spinning)					
Lyocell (generic), regenerated cellulose from wood pulp					
Flax fiber (linen), average production					
Hemp fiber, dew retted (long fiber for wet spinning)					
LYCRA(r) T400 EcoMade Fiber {The LYCRA Company}, (includes yarn formation)					
Flax fiber (linen), dew retted					
Flax hackled long fiber (linen) {European Flax® certified}					
Regenerated cellulose, from bamboo					
Livaeco™ Spun-dyed Viscose Staple Fiber {BIRLA} (includes coloration)					
Freeflex™ TPU Resin {BASF} for textile					
Flax Fiber {Bast Fiber Tech}, Belgium					
Polybutylene Terephthalate Granulate (PBT), for textile					
Viscose Staple Fibre {BIRLA}					
LENZING™ Viscose, Indonesia					
Livaeco™ Viscose Staple Fiber {BIRLA}					
Ultramid B {BASF}					
Jute fibers					
Cellulosic Filament Yarn, Naia {Eastman} (includes yarn formation)					
Livaeco™ Modal Fibre {BIRLA}					
Cellulosic Filament Yarn, Naia Renew{Eastman} (includes yarn formation)					
Thermoset polyurethane (PU), fossil fuel based, for textiles					
Polyethylene terephthalate (PET) {Toray}, partially bio-based					
Sorona polymer {DuPont}, bio-based					
TENCEL™ Lyocell {Lenzing}					
LENZING™ ECOVERO™ Viscose					
Ultramid B BMB (biomass balance) {BASF}					
Aromatic polyamide, aramids					
Polyethylene terephthalate (PET), fossil fuel based					
Cellulosic Fiber, Naia {Eastman} (Acetate)					
Cellulosic Fiber, Naia Renew {Eastman}					
Polylactic acid (PLA), bio-based, for textiles					
Purocel Eco Viscose {BIRLA Cellulose}					
Wool fiber, recycled from waste textile, for textiles					
Cotton fiber, conventional production					
Polyethylene terephthalate (PET), chemically (methanolysis) recycled, for textiles					
Spandex fiber {The LYCRA Company}, contains data for yarn formation/spinning					
Ground to Good™ - recycled PET Flake					
Polyethylene terephthalate (PET), chemically (BHET) recycled					
Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)					
TENCEL™ Modal {Lenzing}					
TENCEL™ Modal Eco Color (color/black) {Lenzing}					
Cotton fiber, Cotton made in Africa (CmiA)					
Creora® bio-based spandex {Hyosung}, contains data for yarn formation/spinning					
Repreve® Yarn {Unifi Manufacturing Inc} (includes extrusion/spinning + texturing)					
Polyethylene terephthalate (PET), semi-mechanically recycled					
Cotton fiber, organic					
Polyethylene terephthalate (PET), mechanically recycled, for textiles					
Nylon, mechanically recycled, for textile					
Repreve® Resin (chip) {Unifi Manufacturing Inc}					
Cotton fiber, recycled					
Cotton fiber, recycled {Recover}					
Isotactic polypropylene (PP), Fossil fuel based					
Low density polyethylene (LDPE), fossil fuel based, for textile					
High density polyethylene (HDPE), fossil fuel based, for textile					
Glass fiber					
Polypropylene (PP), recycled for textile					

Appendix C

Breakdown of prAna’s Tier 1 and Tier 2 fibers.

prAna internal fiber names represent fibers used in 2019. Tier 1 and Tier 2 fibers are the recommendations from our team.

prAna Internal Fiber Names	HIGG Fiber Names	TIER 1 PREFERRED prAna 2025 HIGG Fiber Names	TIER 2 PREFERRED prAna 2025 HIGG Fiber Names
Nylon 6	Nylon 6, fossil fuel based, for textile production	Nylon, mechanically recycled, for textile	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)
Supplex Nylon	Nylon 6, fossil fuel based, for textile production	Nylon, mechanically recycled, for textile	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)
Organic Cotton	Cotton fiber, organic	Cotton fiber, recycled (Recover)	Cotton fiber, recycled
Nylon	Nylon 6, fossil fuel based, for textile production	Nylon, mechanically recycled, for textile	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)
Polyester	Polyethylene terephthalate (PET), fossil fuel based	Polyethylene terephthalate (PET), mechanically recycled, for textiles	Polyethylene terephthalate (PET), chemically (BHET) recycled
Wool	Wool, from sheep, fine-medium and superfine, Australia, for textile	Wool fiber, recycled from waste textile, for textiles	Wool, from sheep, fine-medium and superfine, Australia, for textile
Recycled Nylon	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)	Nylon, mechanically recycled, for textile	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)
Spandex	Spandex fiber (The LYCRA Company), contains data for yarn formation/spinning	Creora® bio-based spandex (Hyosung), contains data for yarn formation/spinning	LYCRA(r) T400 EcoMade Fiber (The LYCRA Company), (includes yarn formation)
Lycra	Spandex fiber (The LYCRA Company), contains data for yarn formation/spinning	Creora® bio-based spandex (Hyosung), contains data for yarn formation/spinning	LYCRA(r) T400 EcoMade Fiber (The LYCRA Company), (includes yarn formation)
Cordura Nylon	Nylon 6.6, fossil fuel based, for textile production	Nylon, mechanically recycled, for textile	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)
Sorona Polyester	Sorona polymer (DuPont), bio-based	Polyethylene terephthalate (PET), mechanically recycled, for textiles	Polyethylene terephthalate (PET), chemically (BHET) recycled
Recycled Polyester	Polyethylene terephthalate (PET), chemically (BHET) recycled	Polyethylene terephthalate (PET), mechanically recycled, for textiles	Polyethylene terephthalate (PET), chemically (BHET) recycled
Elastane	Spandex fiber (The LYCRA Company), contains data for yarn formation/spinning	Creora® bio-based spandex (Hyosung), contains data for yarn formation/spinning	LYCRA(r) T400 EcoMade Fiber (The LYCRA Company), (includes yarn formation)
Acrylic	Polyacrylonitrile, fossil fuel based, for textiles	Polyethylene terephthalate (PET), mechanically recycled, for textiles	Cotton fiber, organic
Alpaca	Alpaca fleece, pasture raised	Wool fiber, recycled from waste textile, for textiles	Wool, from sheep, fine-medium and superfine, Australia, for textile
Hemp	Hemp fiber, dew retted (long fiber for wet spinning)	Hemp fiber, dew retted (long fiber for wet spinning)	Hemp fiber, dew retted (long fiber for wet spinning)
Modal	TENCEL™ Modal (Lenzing)	TENCEL™ Modal (Lenzing)	TENCEL™ Modal (Lenzing)
Nylon 6,6	Nylon 6.6, fossil fuel based, for textile production	Nylon, mechanically recycled, for textile	Nylon 6.6, recycled (Fulgar Q-NOVA- contains data for yarn formation/spinning)
Recycled Polyester (Mechanical)	Polyethylene terephthalate (PET), mechanically recycled, for textiles	Polyethylene terephthalate (PET), mechanically recycled, for textiles	Polyethylene terephthalate (PET), chemically (BHET) recycled
Tencel Lyocell	TENCEL™ Lyocell (Lenzing)	TENCEL™ Lyocell (Lenzing)	TENCEL™ Lyocell (Lenzing)
Tencel Modal	TENCEL™ Modal (Lenzing)	TENCEL™ Modal (Lenzing)	TENCEL™ Modal (Lenzing)

Appendix D

Final Report Presentation

Report starts on the next page.

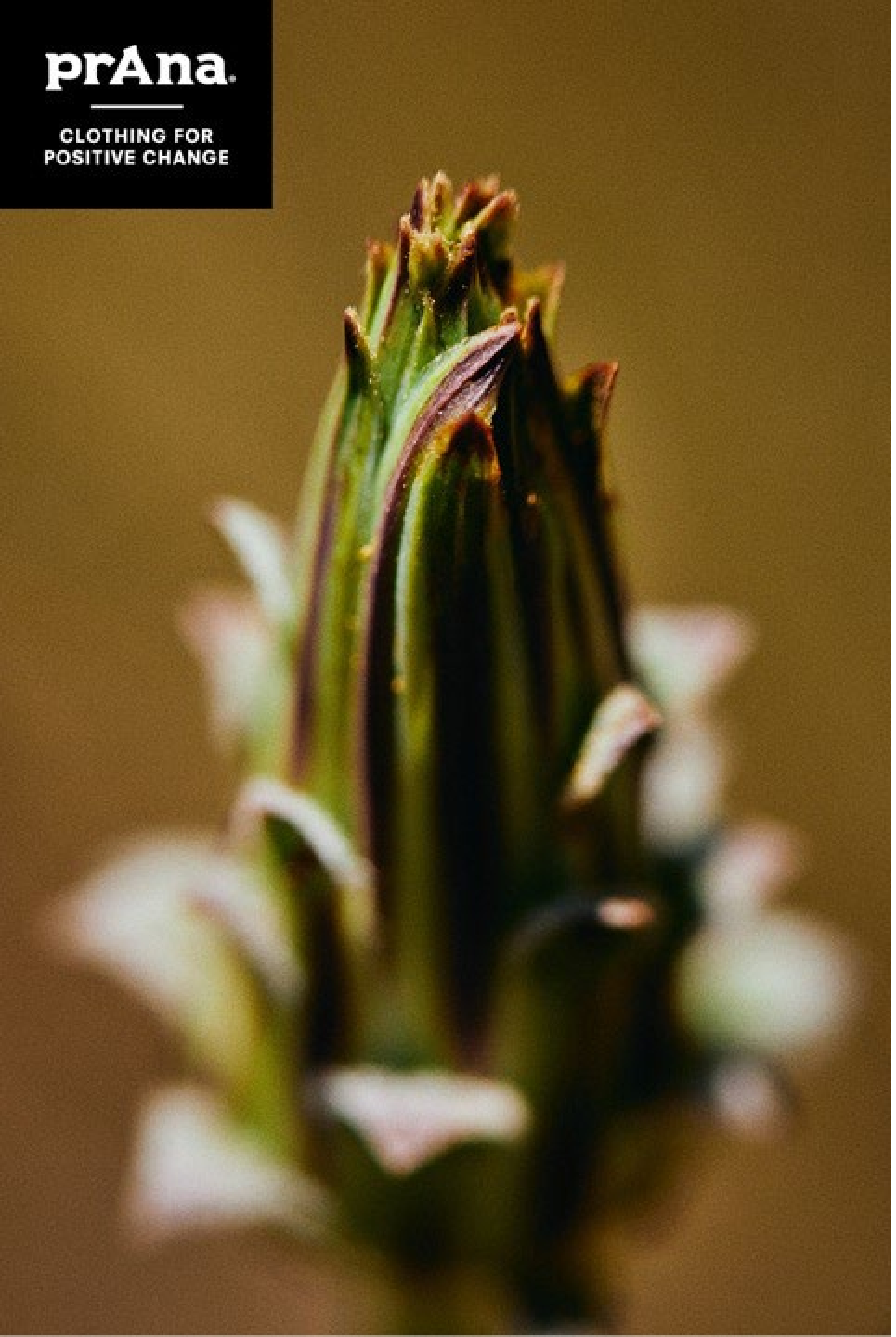
Preferred Fiber Product Mapping and Climate Impact Assessment

---

In Collaboration with University of Michigan

SEAS Master's Project

Greg Allinson, Jess Halter, Amy Schatz, Annie Zaro



Agenda

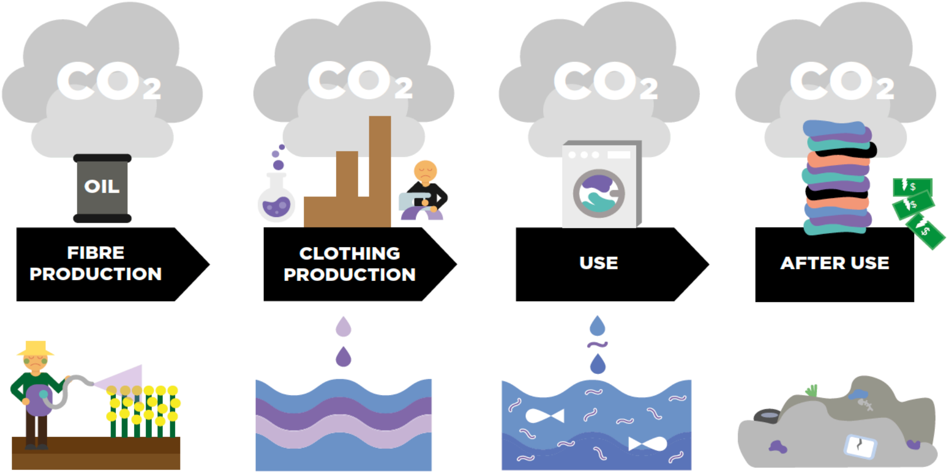
- Background on the retail industry
- prAna's progress on preferred fibers
- Importance of calculating emission reduction
- Calculation methodology
- CO_2e emission calculation
- Transitioning to Preferred Fibers
- Next steps

Background on the Retail Industry

Background on Retail Industry Environmental Impact

- The clothing industry annually emits more greenhouse gas (GHG) than maritime shipping and all international flights combined
- The clothing industry emits 2% of the carbon budget needed to adhere to a 2°C pathway as of 2015 and could make up 26% of the global carbon budget by 2050.
- As of 2015, the clothing industry consumes 93 billion cubic meters of water and uses 98 million tonnes of non-renewable resources

FIGURE 2: TODAY'S CLOTHING SYSTEM PUTS PRESSURE ON RESOURCES, POLLUTES THE ENVIRONMENT, AND CREATES NEGATIVE SOCIETAL IMPACTS



https://www.ellenmacarthurfoundation.org/publications

Preferred Fiber Definition

Columbia Sportswear defines a preferred material as ‘a material that has a demonstrated significant improved impact over a standard version of that material in at least one of the following impact categories: 1) Animal-Welfare, 2) Biodiversity, 3) Chemicals, 4) Energy, 5) Greenhouse Gas Emissions, 6) Land Use Intensity, 7) Social Impact, 8) Waste, 9) Water.’

For the purposes of this project, the project team more narrowly defined preferred fiber as: a fiber with improved GHG emissions impact.

Columbia Sportswear Company (2020). Corporate Responsibility Report.

prAna's Preferred Fiber Progress

Who is prAna

- $150M active lifestyle apparel and accessory brand
- Brand at the forefront of the sustainability movement
- Doing the right thing for:
  - Animal Welfare
  - Circularity
  - Climate Action
  - Fibers and Materials
  - Social Responsibility
  - Supply Chain
  - and so much more^

Source: prana.com

^https://www.prana.com/sustainability.html

A Few of prAna's Sustainability Milestones

2004

First used organic cotton and hemp

2011

FAIR TRADE CERTIFIED

Brought first-ever Fair Trade Certified piece of clothing to market

2012

FAIR TRADE CERTIFIED FACTORY

Sponsored first-ever Fair Trade Certified Factory for apparel

2016

Converted all down to Responsible Down Standard

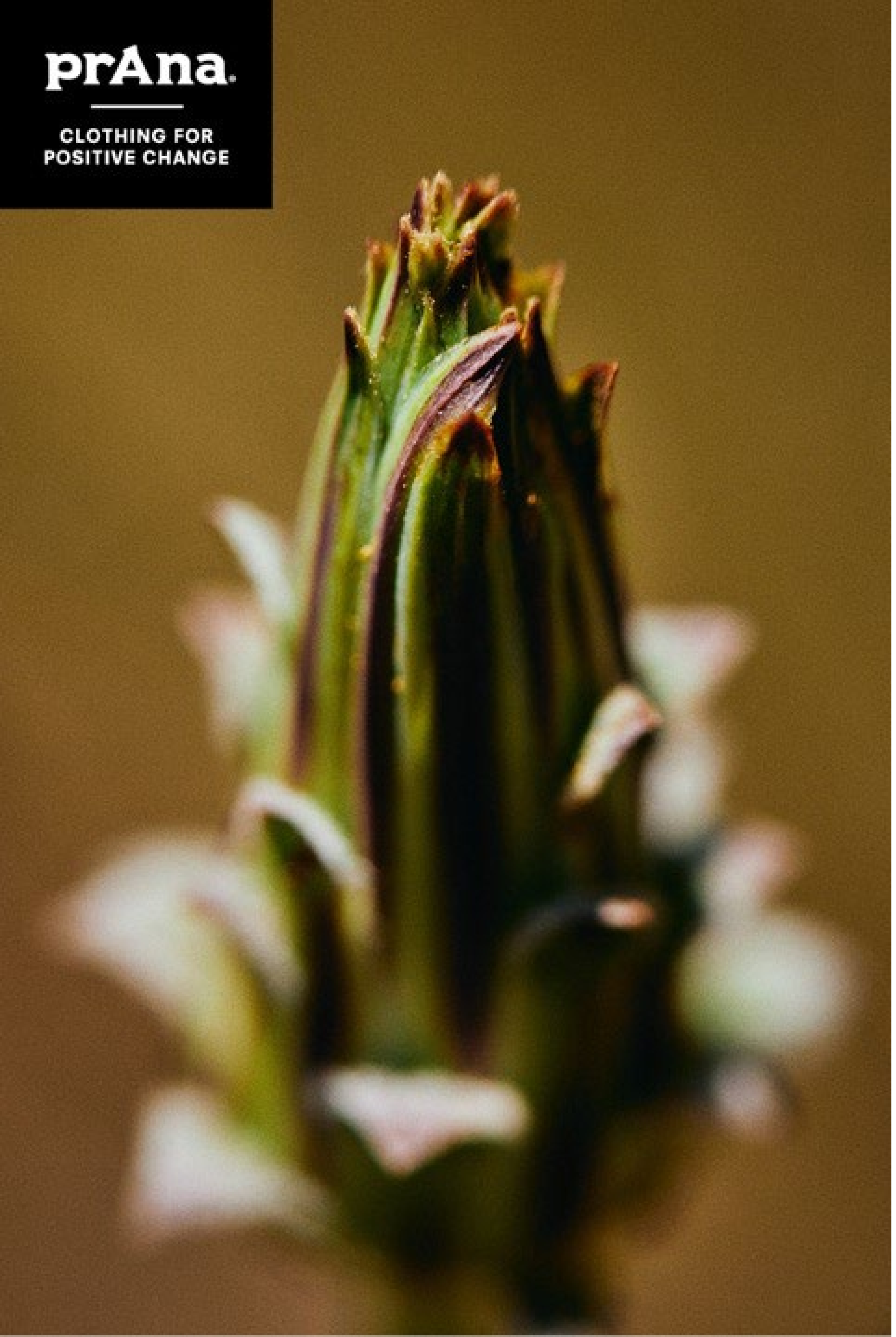
RESPONSIBLE DOWN STANDARD R·D·S CERTIFIED

2018

Converted all cotton to 100% organic

2021

Shifted to 100% plastic fee packaging



prAna.
CLOTHING FOR
POSITIVE CHANGE

prAna’s Goal

100% of products to be made with preferred fibers and materials by 2025*

**excluding spandex*
https://www.prana.com/sustainability/preferred-fibers-and-materials.html

UM School for Environment & Sustainability Project Goals

1\.

Calculate change in CO_2e emissions from 2019 baseline to 2020

2\.

Calculate percent of CO_2e emissions prAna could reduce if all non-preferred fibers are switched to preferred options by 2025

prAna.

CLOTHING FOR
POSITIVE CHANGE

Summary of Findings

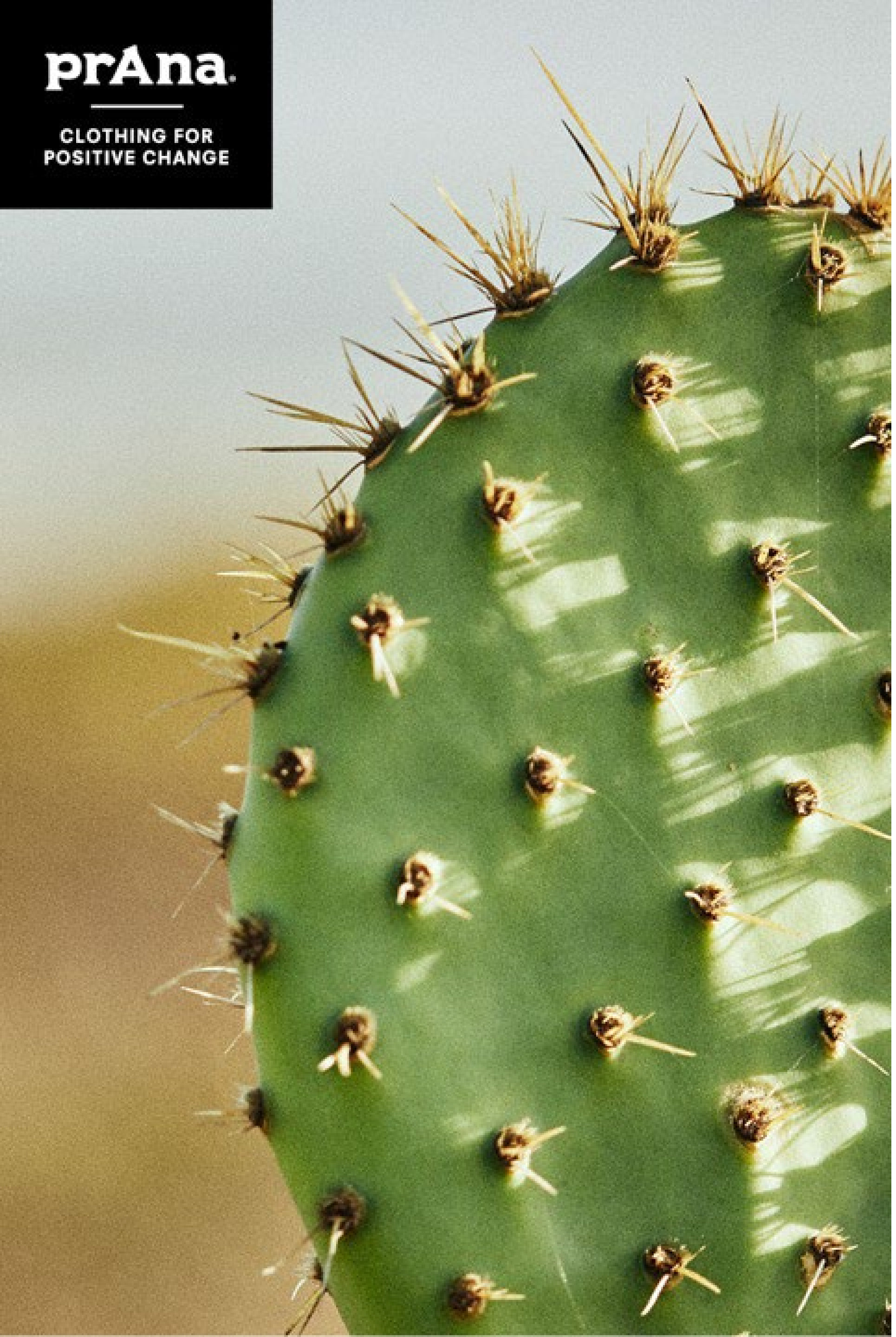
- Switching to 100% preferred fibers by 2025 (including transitioning spandex) will reduce CO_2e emissions from fibers by 27.5%

- Based on industry benchmarks, raw materials and fabric production make up 64-91% of Scope 3 emissions
    - *Using this assumption, preferred fiber conversion will result in 18-25% reduction of Scope 3 emissions for prAna (not including use phase)*

- Current CO_2e emissions calculations are performed using Higg Default values, aligning with industry

prAna.

CLOTHING FOR POSITIVE CHANGE



Carbon Emission Analysis Methodology

Calculation Methodology & Inputs

Fiber CO_2e Database

Data Inputs

Fiber Impact (kg CO_2e / kg fiber)

Use Default Fiber CO_2e Values

Methodology Benchmark

Methodology

Evaluate products

Use Higg Index MSI

Internal Resources

Data Inputs

Item Receipts

Fiber Breakdown

Product Weights

Preferred Fiber Options

prAna

CLOTHING FOR POSITIVE CHANGE

Boundaries of Fiber Analysis

Aligns with Higg MSI material processes:

- Raw material source
- Yarn formation method
- Textile formation
- Preparation
- Coloration
- **Includes emissions related to transportation between the above processes*

Calculation Methodology

Fiber GHG Emissions Factor
[kg CO_2e / kg fiber]

X

Fiber Weight
[kg fiber / product]

X

Item Quantity
[# of items received]

=

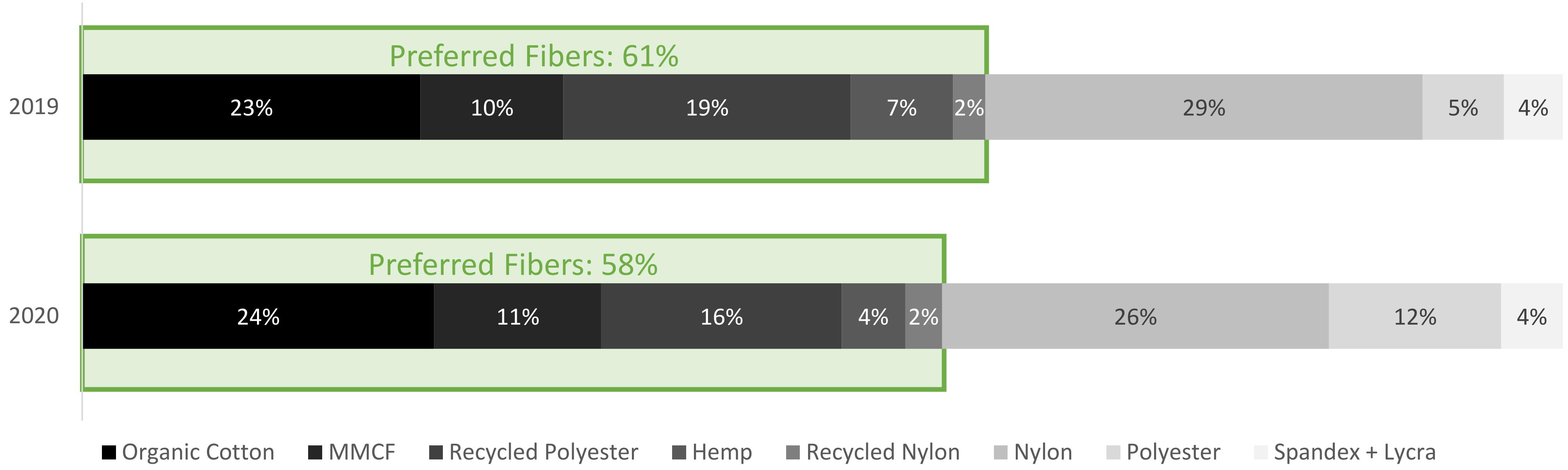
Carbon Emissions of Fibers
[kg CO_2e Emissions]

**Additional details in appendix*

CO_2e Fiber Analysis Results

Where prAna Stands: 2019 & 2020 Preferred Fibers Usage

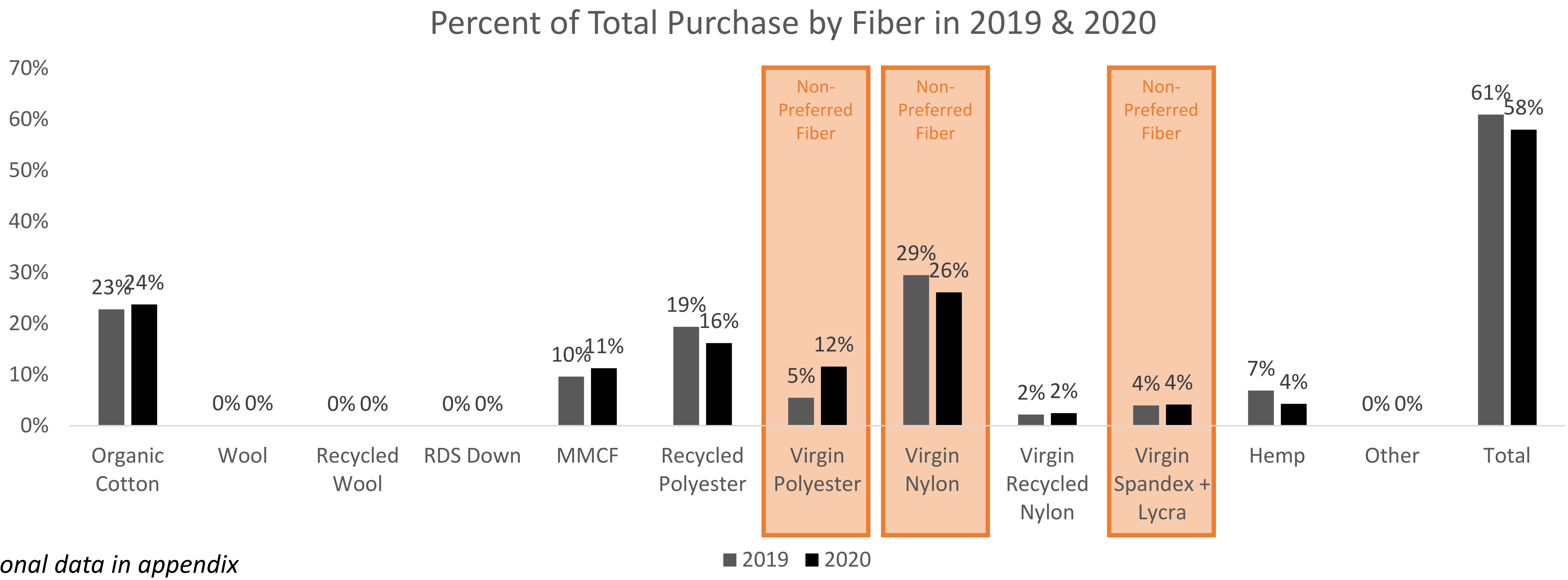
Amount of preferred fibers decreased in 2020 by 3%^.



^Driven by shifts in purchase orders by prAna
**Additional data in appendix*

Where prAna Stands: 2019 & 2020 Preferred Fibers Usage

Opportunity lies in the 39% on nonpreferred fibers used (virgin polyester, nylon, and lycra)



**Additional data in appendix*

prAna.
CLOTHING FOR POSITIVE CHANGE

Tier 1 vs Tier 2 Preferred Fibers

Collaborated with prAna team to identify Tier 1 and Tier 2 Preferred Fibers based on current conversion plan:

- Tier 1 Preferred Fibers: Optimal* fiber choice for fiber conversion
- Tier 2 Preferred Fibers: Second optimal* fiber choice for fiber conversion

This analysis accomplishes two things:

1. *Identifies fibers where Tier 1 has much higher reduction potential than Tier2*
2. *Captures the CO_2e reduction for fibers nuances (i.e. different types of recycling)*

Opportunity for 2025 (except transitioning spandex)

Assuming sales are at 2019 level in 2025 and **all fibers (except spandex)** are converted to identified **Tier 1**^ preferred alternatives, prAna will realize a 27.23% decline in CO_2e emissions on a per kilogram of fiber basis (intensity basis)

Year	% Reduction kg CO_2e/kg fiber from 2019
2019 (Baseline)	-
2020	2.59%
2025 Projection	27.23%

^ Tier 1 preferred fibers are most optimal preferred fibers in Higg MSI; determined by prAna team

Opportunity for 2025 (including transitioning spandex)

Assuming sales are at 2019 level in 2025 and **all fibers (including spandex)** are converted to identified preferred alternatives (Tier 1^), prAna will realize a 27.53% decline in CO_2e emissions on a per kilogram of fiber basis (intensity basis)

Year	% Reduction kg CO_2e/kg fiber from 2019
2019 (Baseline)	-
2020	2.59%
2025 Projection	27.53%

^ Tier 1 preferred fibers are most optimal preferred fibers in Higg MSI; determined by prAna team

Opportunity for 2025: Tier 1 vs Tier 2 (Including Spandex)

Assuming sales are at 2019 level in 2025 and **all fibers (including spandex)** are converted to identified Tier 2^ preferred alternatives, prAna will realize a 17.63% decline in CO_2e emissions on a per kilogram of fiber basis (intensity basis)

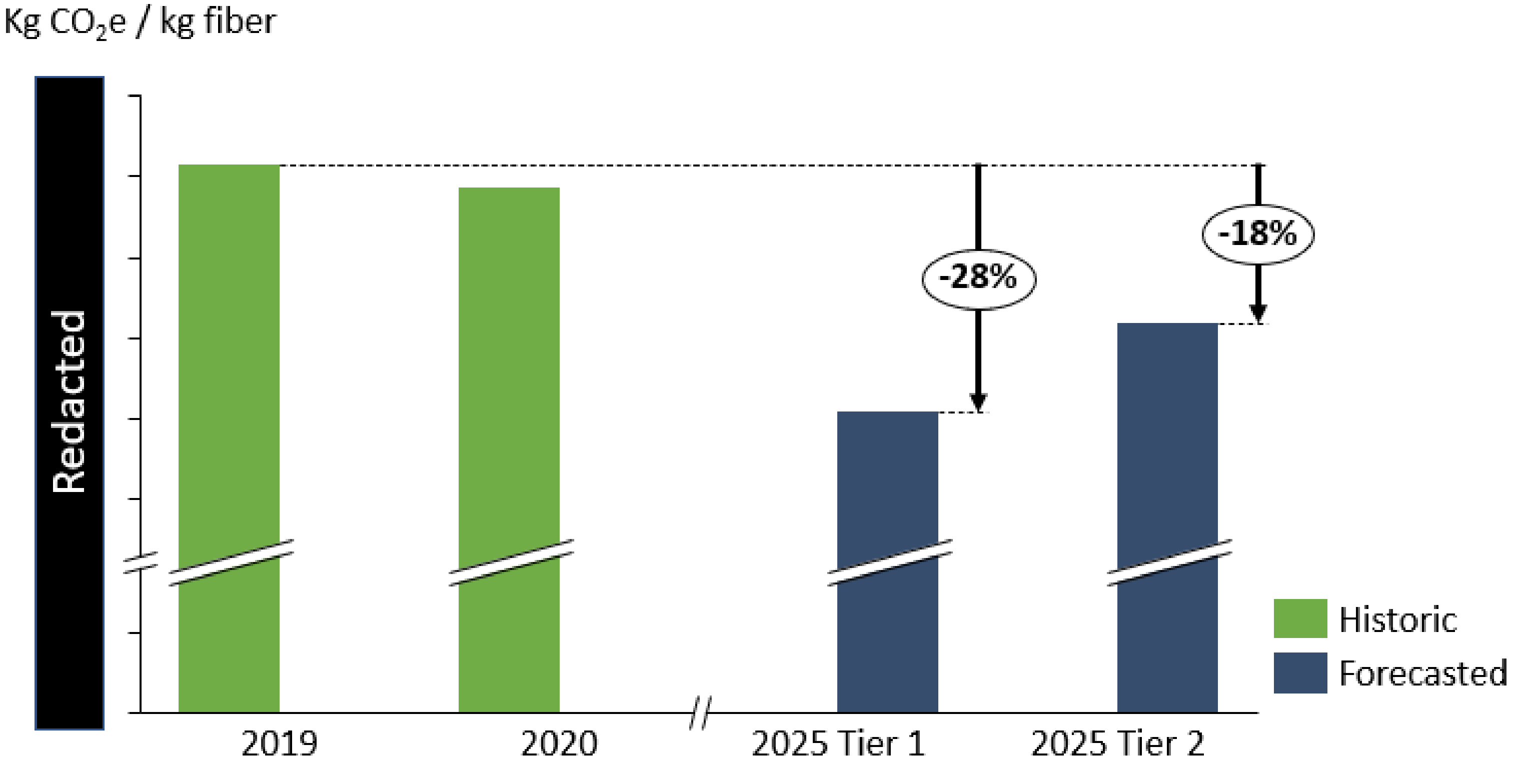
Year	% Reduction kg CO_2e/kg fiber from 2019
(Tier 1) 2025 Projection	27.53%
(Tier 2) 2025 Projection	17.63%

**Additional data in appendix*

^ Tier 2 preferred fibers are second most optimal preferred fibers in Higg MSI; determined by prAna team

20-30% Forecasted Reduction in CO_2e Emissions

Global Warming Potential



Additional Impacts of 100% Preferred Fibers Transition

6-14% ↓

Eutrophication Potential

32-41% ↓

Water Scarcity

20-34% ↓

Resource Depletion, Fossil Fuels

Note: Range represents Tier 1 and Tier 2 selections

Carbon Emissions from Product Lifecycle

Industry Scope 3 Benchmarking	Scope 3 emissions attributed to raw materials and material manufacture (use phase ***excluded*** from total Scope 3)*
McKinsey industry-wide report	87%
Quantis industry-wide report	91%
H&M Group	69%
Patagonia	86%
Levi’s	64%
Total Range	***64% - 91%***

Note: Sources in appendix

**Scope 3 emissions including use phase in appendix*

prAna

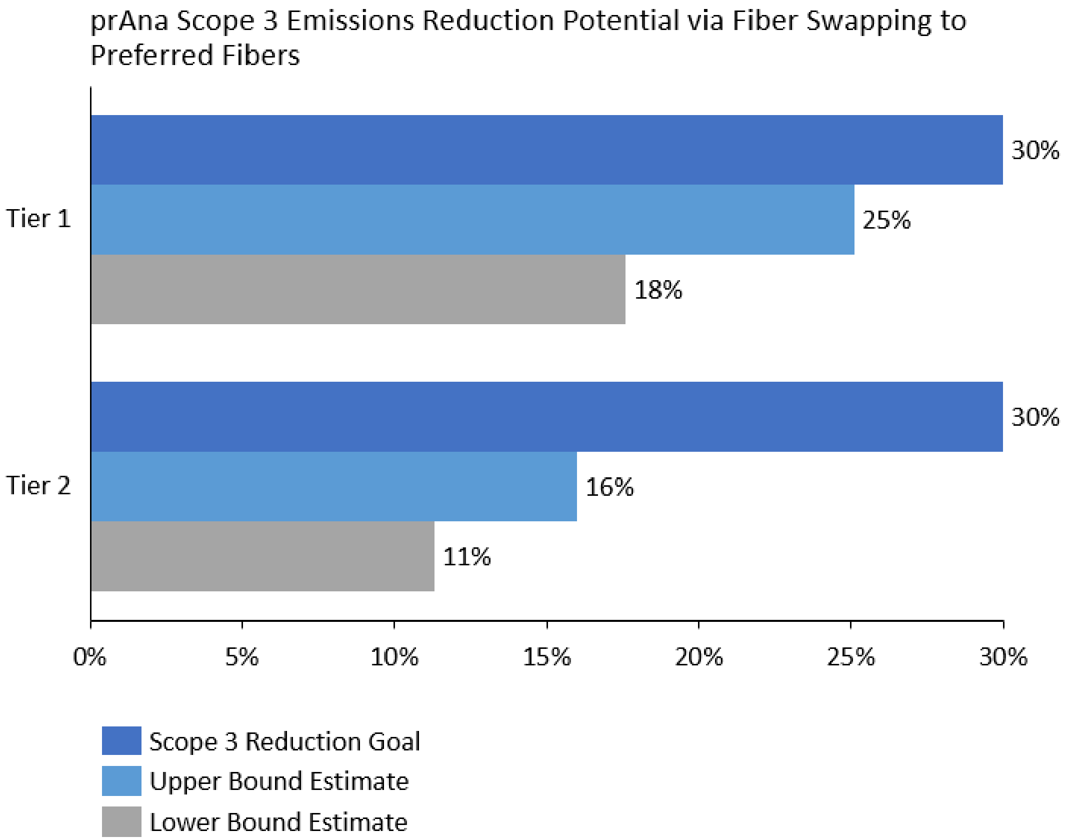
CLOTHING FOR POSITIVE CHANGE

Carbon Emissions from Product Lifecycle

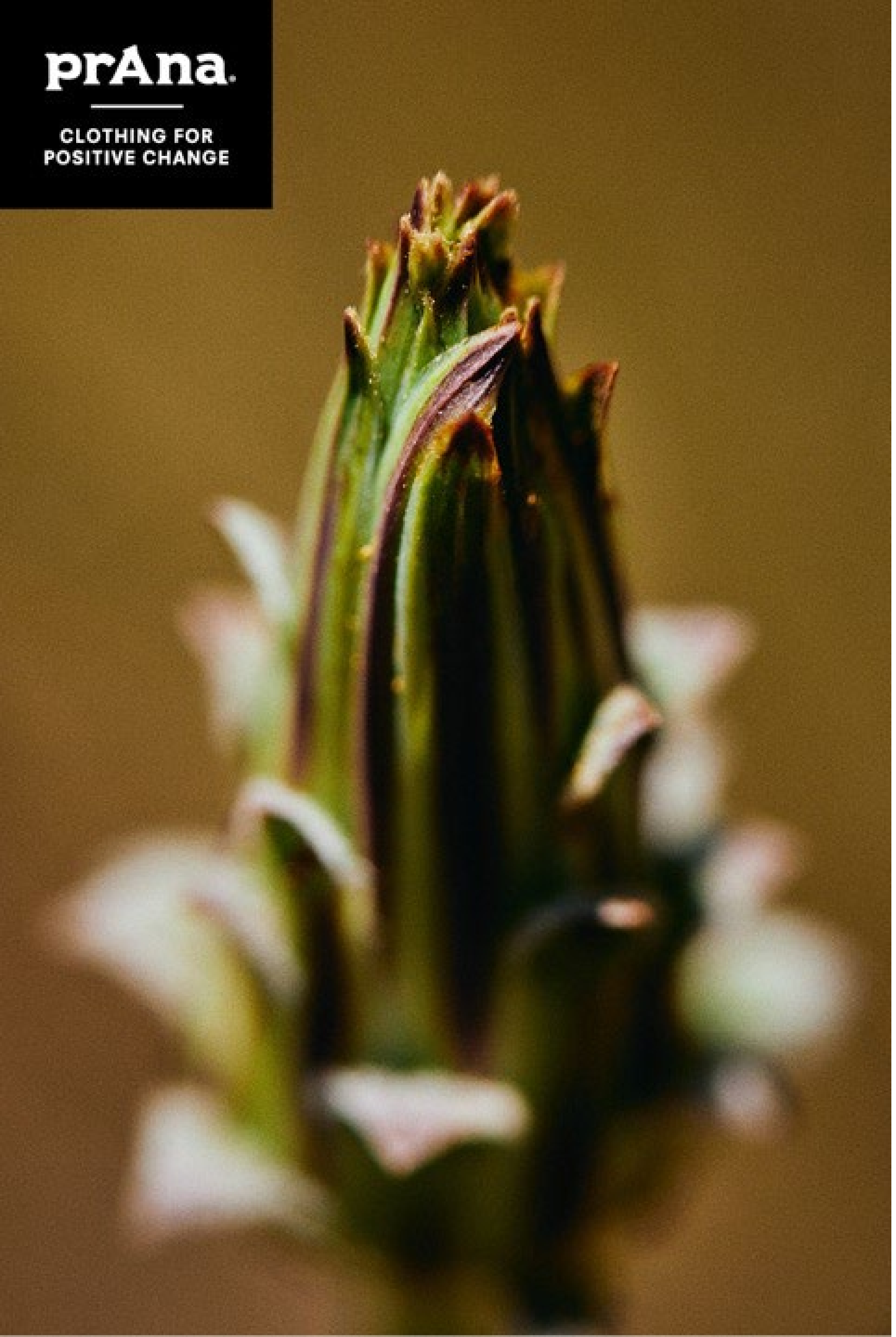
prAna Scope 3 Reduction Potential

- Tier 1 Intensity reduction from prAna swapping to preferred fibers (including spandex): 27.53%
- Proportion of apparel industry Scope 3 emissions due to raw materials and material manufacturing (excluding use phase): 64% - 91%

Projected Scope 3 emissions reduction possible from transitioning to preferred fibers: 18% - 25%*



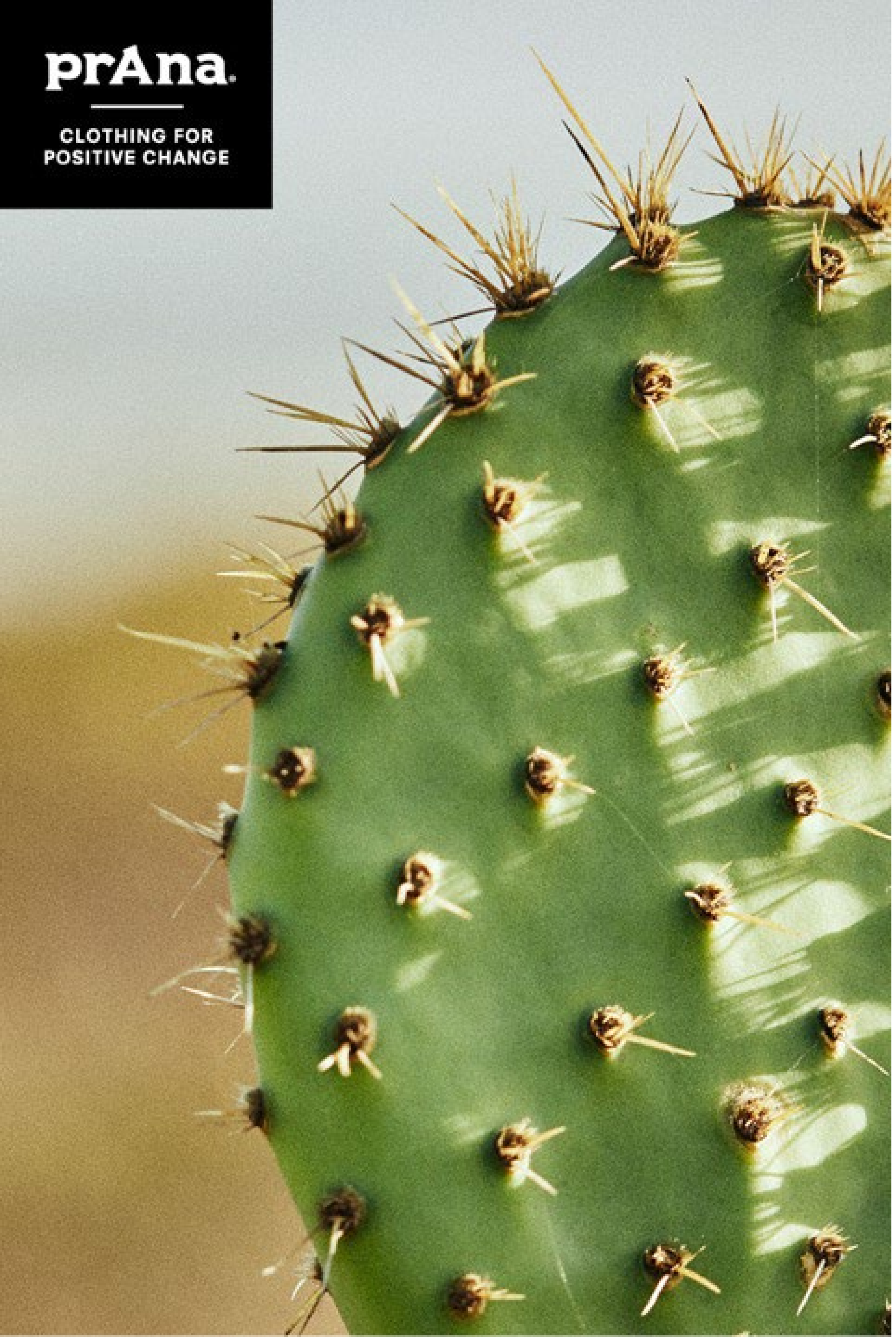
**Changes <1% if spandex is excluded*



Key Takeaways from Analysis

- Current opportunity of full transition to Tier 1 preferred fibers will reduce emissions associated with fibers by 27.53%
- Opportunity to transition to Tier 2 preferred fibers will reduce emissions associated with fibers by 17.63%
- Fiber raw materials and fabric production represent 64-91% of apparel industry Scope 3 emissions. *Total emission reduction potential of 18-25% of Scope 3 emissions.*
- Prioritize fiber transition by weight and CO_2 emission volumes*

prAna.
CLOTHING FOR POSITIVE CHANGE



Appendix

Carbon Emissions from Product Lifecycle

Industry Scope 3 Benchmarking	Scope 3 emissions attributed to raw materials and material manufacture (use phase included in total Scope 3)	Scope 3 emissions attributed to raw materials and material manufacture (use phase excluded from total Scope 3)
McKinsey industry-wide report	69%	87%
Quantis industry-wide report	--	91%
H&M Group	60%	69%
Patagonia	--	86%
Levi’s	41%	64%
Total Range	***41% - 69%***	***64% - 91%***

Per the *Apparel and Footwear Sector Science-based Targets Guidance*, it is recommended but not required for companies to include indirect use-phase energy in their inventories and targets. **To date, no apparel company has set targets for use phase.**

Sources: Industry Scope 3 Benchmark

- McKinsey & Company. *Fashion on climate, how the fashion industry can urgently act to reduce its greenhouse gas emissions.* Retrieved from https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/fashion%20on%20climate/fashion-on-climate-full-report.pdf
- H&M Group. *Sustainability performance report 2020.* Retrieved from https://hmgroup.com/wp-content/uploads/2021/03/HM-Group-Sustainability-Performance-Report-2020.pdf
- Patagonia. *The climate crisis is our business.* Retrieved from https://www.patagonia.com/climate-goals/
- Levi Strauss & Co. *Climate action strategy 2025.* Retrieved from https://www.levistrauss.com/wp-content/uploads/2018/07/LSCO_Climate_Action_Strategy_2025.pdf
- Quantis. *Measuring fashion, environmental impact of the global apparel and footwear industries study.* Retrieved from https://quantis-intl.com/wp-content/uploads/2018/03/measuringfashion_globalimpactstudy_full-report_quantis_cwf_2018a.pdf
- World Resources Institute. *Apparel and footwear sector science-based targets guidance*. Retrieved from https://sciencebasedtargets.org/resources/files/SBT_App_Guide_final_0718.pdf