

# MEASURING FASHION

Insights from the Environmental Impact of the Global  
Apparel and Footwear Industries study

2018

Quantis

 ClimateWorks  
FOUNDATION



# GUIDING INSIGHTS FOR THE FASHION INDUSTRY

Based on a full study of the environmental impact of the global apparel and footwear industries, this summary provides metrics-based guidance for companies committed to making viable changes to reduce their impacts.



## IT'S TIME FOR FASHION TO SET BOLD GOALS

The role of the global apparel and footwear industries has shifted far beyond meeting a basic human need. The relationship with fashion in our modern lives has had a significant collateral impact on our planet's resources. As we face urgent environmental and social challenges caused by climate change and resource depletion, **the efficacy of solutions will depend on the creativity, innovation and boldness so characteristic of the fashion industry. It's time for players to change the trajectory.** Together, ClimateWorks Foundation and Quantis encourage actors in the industry **to set ambitious, evidence-based environmental impact reduction goals to drive meaningful change** to secure a more sustainable future for fashion.



## GUIDED BY THE FIRST SCIENCE-DRIVEN STUDY OF FASHION'S GLOBAL IMPACT

Committed to driving bold, science-based climate action, ClimateWorks commissioned Quantis to conduct the first comprehensive study that measures the environmental impact of the apparel and footwear industries across the entire value chain. **This groundbreaking analysis reveals the industry's environmental hotspots – life cycle phases of activity where focused efforts can render significant impact reductions.** The study is based on the World Apparel and Footwear Life Cycle Database (WALDB) and provides impact results for climate change, water, and human health, among other indicators.



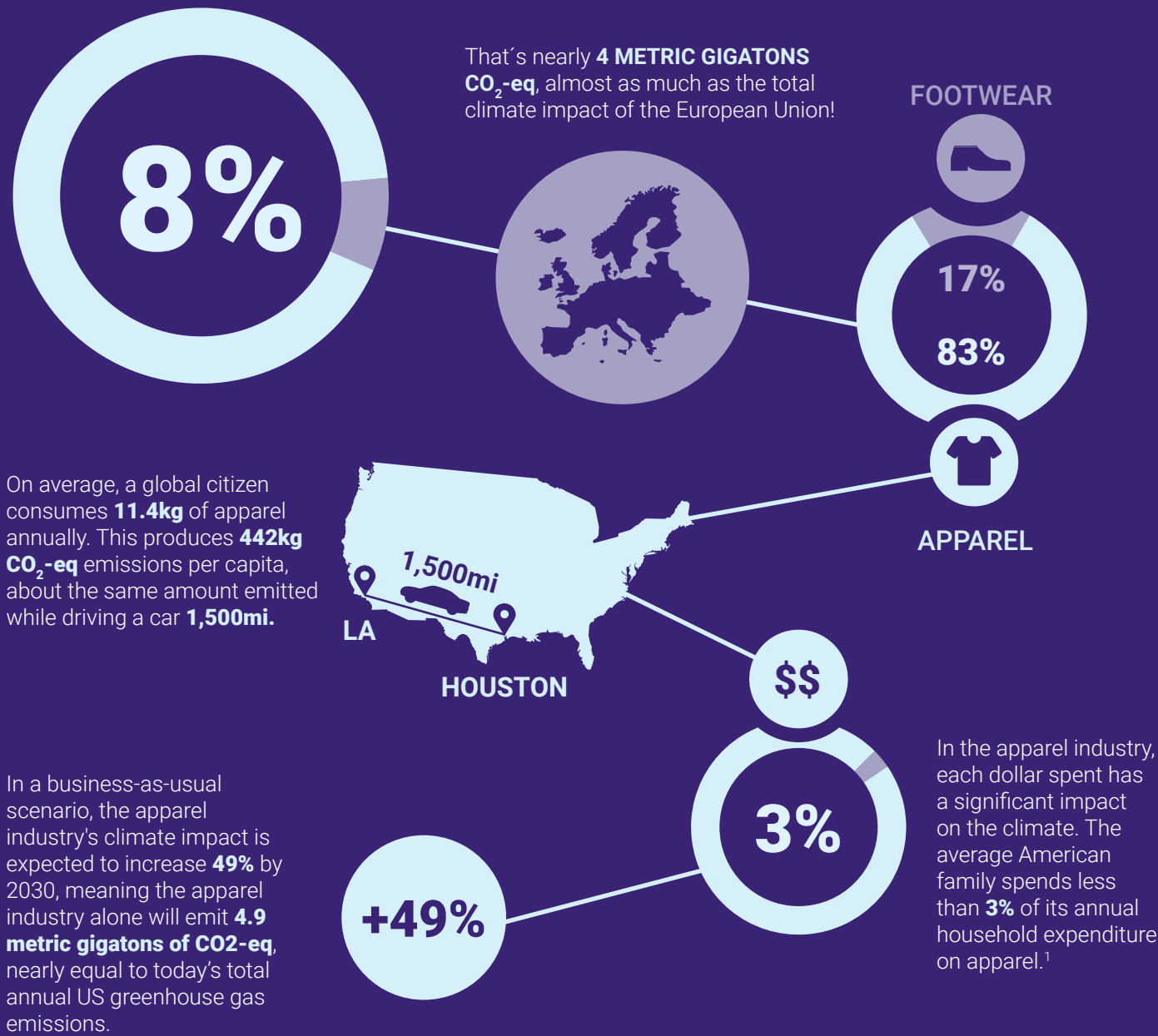
## USING ROBUST DATA TO DRIVE CLEAR ACTIONS

The objective of the study is two-fold: to deliver comprehensive data that gives a credible and current snapshot of the industries' environmental performance to help businesses make fact-based decisions, and **to provide actionable data to support alignment with the Science Based Targets initiative (SBTi), or other 2°C scenario frameworks.** The benefit of acting now to build a **truly resilient business model** is clear. It's time for stakeholders in apparel and footwear to set, drive and support ambitious and effective sustainability programs.

Access the [full study](#) for detailed information on the scope, methodology and results.

# APPAREL AND FOOTWEAR HAVE A MAJOR IMPACT ON CLIMATE

Combined, the global apparel and footwear industries account for an estimated 8% of the world's greenhouse gas emissions.



<sup>1</sup> Source: bls.gov, consumer expenditures, 2016

# APPAREL'S IMPACT ON CLIMATE

The *Environmental Impact of the Global Apparel and Footwear Industries* study used a life cycle approach investigating 7 different stages in the life of garments. The following results illustrate the greenhouse gas (GHG) emissions for each life cycle stage. **The apparel industry alone represents 6.7% of global GHG emissions**, equivalent to about 3.3 billion metric tons of CO<sub>2</sub>-eq. **More than 50% of emissions come from three stages: Dyeing & Finishing, Yarn Preparation, and Fiber Production.** With global manufacturing concentrated in Asia, GHG emissions in these stages are driven by apparel production's reliance on hard coal and natural gas to generate electricity and heat.

## 7 LIFE CYCLE STAGES OF APPAREL

- 1 FIBER PRODUCTION**  
Raw material extraction and processing of synthetic, cellulosic, cotton, and natural fibers

### ! NOTE:

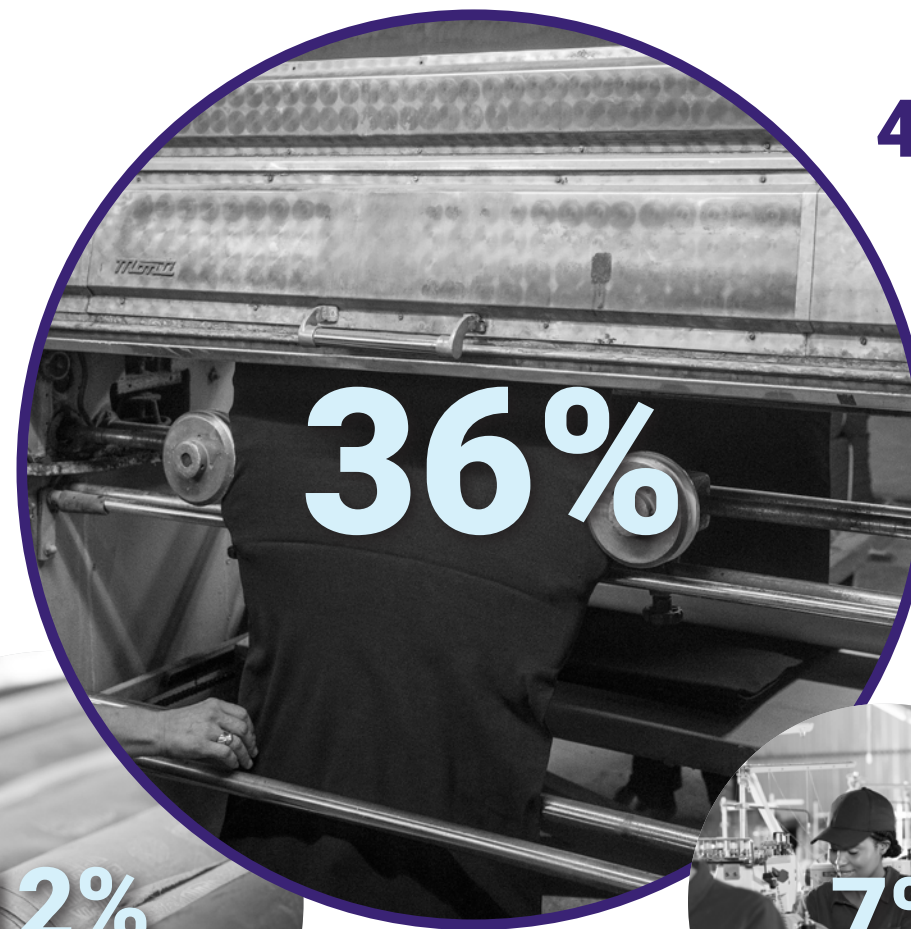
Percentages represent the climate change impact (measured in CO<sub>2</sub>-eq) of each life cycle stage relative to the total apparel impact



- 2 YARN PREPARATION**  
Spinning of yarn from filament and staple fibers



- 3 FABRIC PREPARATION**  
Knitting and weaving of yarn into fabric



- 4 DYEING & FINISHING**  
Bleaching and dyeing of fabric as well as fabric finishing  
The most energy intensive stage, dyeing has a high energy demand due to wet processes which require large amounts of heated water.

- 5 ASSEMBLY**  
Cutting and sewing fabric into apparel products



- 6 DISTRIBUTION**  
Transportation from assembly location to retail stores  
A low impact stage today but could increase if companies switch to aircraft transport.



- 7 END OF LIFE**  
Collection and management of apparel products at the end of their useful life (incineration and landfilling)

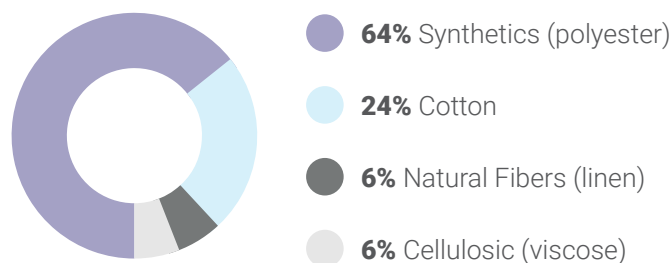


### ! NOTE:

#### EXCLUSION OF USE PHASE

This typically high impact stage was not included as the study focused on the apparel value chain and manufacturing processes

## TOTAL SHARE OF FIBERS (VOLUME MEASURED)




## METHODOLOGICAL CONSIDERATIONS

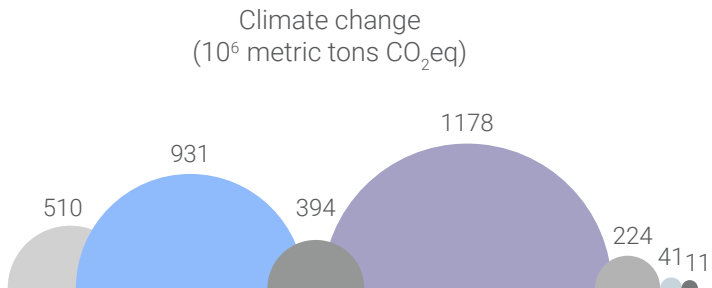
The functional unit used is the global apparel annual production for 2016. The impact of each stage includes all system inputs and outputs such as raw materials, water use, energy use, as well as environmental emissions. Transportation and material losses between stages were also considered. Where possible, different technologies were taken into account (e.g., for spinning, cotton and wet spinning; for knitting, circular and flat knitting). Most of the data is based on The Fiber Year Report 2017 and The Fabric Year Report 2017. As production impacts vary based on location and energy mix, this study aggregates geographically specific data to give global numbers. For more details on the sources, refer to the [full study](#).




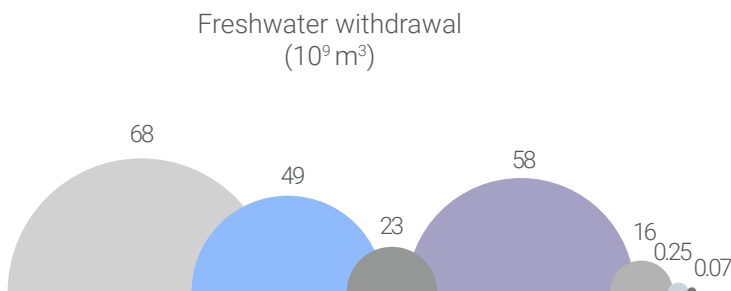
# 5 KEY INDICATORS MEASURED


The study analyzed the environmental impact of the apparel industry across 5 indicators: Climate Change (GHG emissions or CO<sub>2</sub>-eq), Resources (non-renewable energy use), Freshwater Withdrawal (water use), Ecosystem Quality (water & land ecotoxicity, acidification), Human Health (human toxicity, respiratory effects, etc.). Here are the 3 key indicators (see [full study](#) for more details).

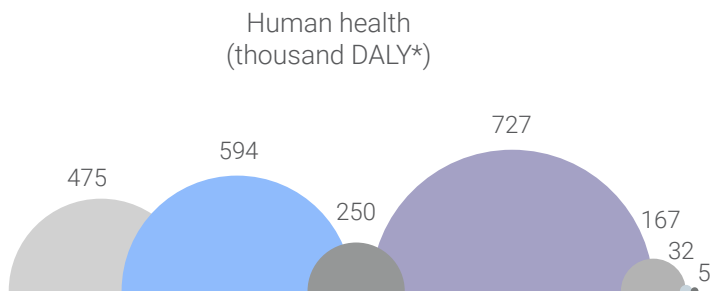
**CLIMATE CHANGE**  
**Key Stages:** Dyeing & Finishing, followed by Yarn Preparation  
**Impact Drivers:** Hard coal and natural gas have a 60% - 70% share of climate change impact in the Dyeing & Finishing stage, a result of global manufacturing concentrated in Asia.



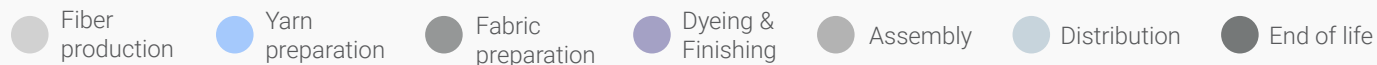
**FRESHWATER WITHDRAWAL**  
**Key Stages:** Fiber production followed by Dyeing & Finishing, Yarn preparation  
**Impact Drivers:** Water usage mainly driven by production of fibers, especially cotton, then from dyeing and wet spinning yarn.



**HUMAN HEALTH**  
**Key Stages:** Dyeing & Finishing, followed by Yarn Preparation, Fiber Production  
**Impact Drivers:** Human health is most impacted by pollution from fossil fuels used to generate heat and energy during industrial processes.



\*DALY stands for disability-adjusted life years, which combine estimations of morbidity and mortality from a number of causes.



The other 2 indicators showed similar results, with Resources closely aligned with the key stages and drivers of Climate Change and Ecosystem Quality mirroring those of Freshwater Withdrawal. See [full study](#) for complete analysis.

# APPAREL IMPACT GROWTH TRENDS

To get a comprehensive view of the apparel industry’s historical evolution and future impact trajectory, the study compared 2016 baseline data to past levels in 2005 and 2010, then assessed against 2020 and 2030 projections.

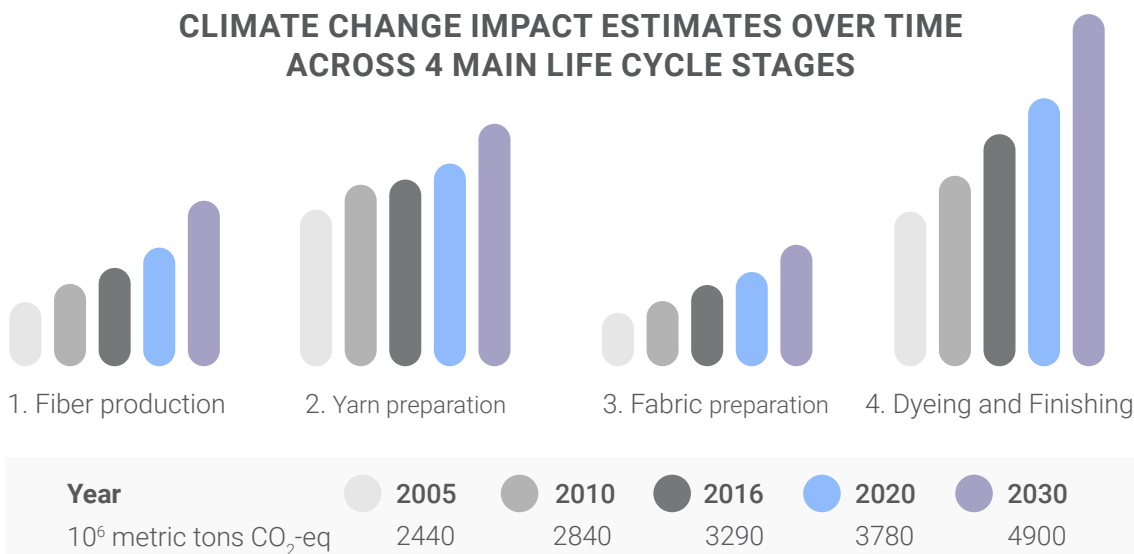


The study showed the industry’s climate change impact increased by 35% between 2005 and 2016, driven by shifts in materials used, consumption habits and production locations.

**If a business-as-usual scenario prevails, the apparel industry’s impact will steadily rise over the next 15 years, reaching a projected 49% increase in climate change impact by 2030.** That means the apparel industry will emit 4.9 metric gigatons of CO<sub>2</sub>-eq, nearly equal to today’s total annual US greenhouse gas emissions. Further shifts in material use (from cotton to synthetics) and increasing per capita global consumption fuel this continued impact growth.

While all 5 environmental indicators studied (see left side) show increased environmental impacts, Climate Change and Human Health are expected to register the highest increases.

## CLIMATE CHANGE IMPACT ESTIMATES OVER TIME ACROSS 4 MAIN LIFE CYCLE STAGES



The increase in climate change impact is visible across all apparel life cycle stages, although there is a greater rate of increase in the fiber production phase, driven by the growth in synthetic material usage.





# 1.4% FOOTWEAR'S IMPACT ON CLIMATE

The *Environmental Impact of the Global Apparel and Footwear Industries* study used a life cycle approach investigating 7 different stages in the life of shoes. The following results illustrate the greenhouse gas (GHG) emissions for each life cycle stage. The footwear industry is responsible for 1.4% of global GHG emissions, equivalent to 700 million tons of CO<sub>2</sub>-eq. **More than 60% of emissions come from two stages: Manufacturing and Raw Material Extraction.**

## 7 LIFE CYCLE STAGES OF FOOTWEAR

**1 RAW MATERIAL EXTRACTION**  
Obtaining the raw materials for shoes



**2 RAW MATERIAL PROCESSING**  
Spinning, weaving, and tanning



**3 MANUFACTURING**  
Producing the shoe components through cutting and linking processes



**4 ASSEMBLY**  
Sewing and assembling the footwear



**5 PACKAGING PRODUCTION**  
Manufacturing of shoe boxes



**6 TRANSPORT**  
Transportation from assembly location to retail stores



**7 DISPOSAL**  
Collection and management of footwear products at the end of their useful life (incineration and landfilling)



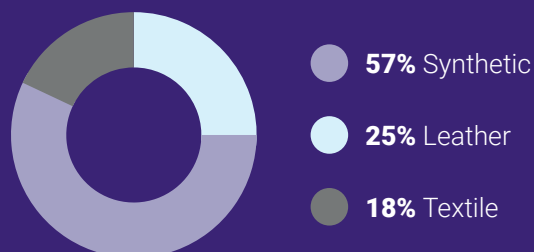
### ! NOTE:

Percentages represent the climate change impact (measured in CO<sub>2</sub>-eq) of each life cycle stage relative to the total footwear impact

### ! NOTE: EXCLUSION OF USE PHASE

This typically high impact stage was not included as the study focused on the footwear value chain and manufacturing processes

## TOTAL MATERIAL SHARE OF FOOTWEAR



## LIFE CYCLE HOT SPOTS VARY DEPENDING ON THE MATERIAL USED

For synthetic and textile shoes, the manufacturing stage represents the biggest impact area. However, for leather shoes, the raw material extraction and processing (tanning) stages account for over 50% of their climate impact.

## METHODOLOGICAL CONSIDERATIONS

The functional unit used is the global annual footwear production. The impact of each stage includes all system inputs and outputs such as raw materials, water use, energy use, as well as environmental emissions. Transportation was considered for Raw Material Extraction and Packaging Production. The data is based on the 2012 World Footwear Yearbook, which studied 23 billion pairs of shoes. As production impacts vary based on location and energy mix, this study aggregates geographically specific data to give global numbers. For more details on the sources, refer to the [full study](#).



# EXPLORING SOLUTIONS FOR A MORE SUSTAINABLE FUTURE OF FASHION

The study also tested different scenarios to identify viable actions for impact reduction that manufacturers could take to achieve industry-wide emissions targets. This is particularly relevant for setting and achieving science-based targets. The following recommendations were identified to propel the apparel and footwear industries into a more sustainable future through significant emissions reductions.

## 3 LEVERS FOR ACTION

After exploring 3 different scenarios, including switching to renewable energy, promoting energy efficiency/productivity, and implementing the circular economy (re-looping recycled fiber into the system), the study revealed a significant reduction in environmental impacts will only be possible with a multi-faceted strategy that incorporates several distinct actions across the value chain. These different approaches vary in consideration: cost effectiveness; the end benefit for climate, water and/or health; and which part of the apparel life cycle will incur the biggest reduction.



### 1 RETHINK ENERGY: MAXIMIZE EFFICIENCY AND SHIFT TO RENEWABLES

The study revealed the major climate impacts in the fashion life cycle are driven by power generated by coal and natural gas (to supply electricity and heat, particularly in Asia). To significantly lower emissions and achieve an industry wide science-based target, fossil fuel dependency needs to be massively reduced while boosting energy efficiency throughout the value chain. In fact, the scenario analysis showed an 80% overall greenhouse gas emission reduction in the apparel industry alone may be achieved by shifting to 60% renewable energy and setting a 60% energy efficiency target by 2030. Increasing use of renewable energy also has positive effects on human health and freshwater consumption. Additional reduction opportunities could come from changing production to regions with positive renewable energy forecasts.



### 2 DISRUPT TO REDUCE: DIGITALIZATION AND NEW CONSUMPTION MODELS

New trends hold the power to yield notable sustainability benefits in the apparel and footwear industries. Benefits can come from both the supply side (in the form of disruptive technologies) and the demand side (as new consumption models). On the supply side, digitalization can lead to process efficiency improvements by reducing raw materials and waste. New technologies can also improve energy efficiency to further reduce emissions in key life cycle stages like Dyeing and Finishing and Yarn Preparation. On the demand side, smart(er) consumption models, such as garment and accessory leasing or take-back programs, can extend the use phase of the article, reducing demand for new products.



### 3 DESIGN FOR THE FUTURE: PREFERRED AND RECYCLED FIBERS

Material selection is also key for reducing the climate impact of apparel and footwear. More sustainable choices include preferred fibers with a lower environmental impact (such as cotton using regenerative organic agriculture practices), emerging materials that use less energy intensive processes, and recycled fibers available thanks to new chemical recycling processes. This goes hand in hand with energy efficiency considerations and circular economy concepts by understanding how fiber materials can be collected and looped back into the system. However, garment recycling is only sustainable when combined with a reduction in consumption of fast fashion and must take into account global equity considerations (evidenced by increasing bans on imports of second-hand clothing in developing nations).



### IS SHIFTING TO A CIRCULAR ECONOMY ENOUGH?

Circular material flow alone is not enough to ensure the apparel sector greatly reduces its impacts by 2030, as such solutions (that focus primarily on increasing rates of clothing recycling and recycled fiber content) do not alter the impacts of key production stages, such as dyeing and finishing. **In particular, analysis indicates fiber recapture and reuse alone would at best achieve only a 10% sector-wide emissions reduction within the broader apparel value chain.** Even by reaching the ambitious target of recycling 40% of fibers in clothing by 2030, the study estimates the sector would reduce emissions by only 3-6%. For this reason, tackling impact areas common to both circular and conventional linear manufacturing, such as the heavy reliance on coal to produce steam for fabric dyeing and finishing, must remain a crucial component of efforts to reduce sector-wide impacts. **The scale of impact reduction this industry must achieve in the coming decade will only be possible with a combination of increased circular material flow, rapid transition to renewable energy sources, a significant increase in manufacturing process efficiencies, and smart design.**





## IN SUPPORT OF THE STUDY

*"This unique study provides robust data on the environmental impacts of each step of the apparel supply chain. It directs focus to areas that matter the most so you don't waste time on the small stuff. It empowers companies to step up and set ambitious, achievable science-based targets to reduce their climate impact."* - **Linda Greer, Senior Scientist, NRDC**

*"What we know is only valuable when it rubs up against what other people know. This report is an invaluable resource for making change."*  
- **Debera Johnson, Executive Director, Brooklyn Fashion + Design accelerator, Pratt Center for Sustainable Design Strategies**

*"You have to have good information to make sound decisions. This report provides a great perspective on ways that we, as a textile community, can take action. We can't allow ourselves to be overwhelmed to paralysis; every small decision and individual action adds up. This will require new business thinking and engagement. Let's make the wisest choices!"* - **La Rhea Pepper, Managing Director, Textile Exchange**

## THANK YOU TO THE STEERING COMMITTEE

The steering committee provided valuable feedback and input throughout the study; members included: Jason Kibbey, CEO, Sustainable Apparel Coalition; Debera Johnson, Executive Director, Brooklyn Fashion + Design Accelerator, Pratt Center for Sustainable Design Strategies; Megan McGill, Program Manager, C&A Foundation; La Rhea Pepper, Managing Director, Textile Exchange; Linda Greer, Senior Scientist, NRDC



**C&A Foundation**



To read the full study findings & methodology, please visit  
[www.climateworks.org/report/measuring-fashion-global-study/](http://www.climateworks.org/report/measuring-fashion-global-study/)

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