REDUCING GREENHOUSE GAS EMISSIONS THROUGH MATERIALS INNOVATION IN THE APPAREL INDUSTRY

PROJECT MOTIVATION
The apparel industry accounts for 6.7% of global greenhouse gas (GHG) emissions. In response, apparel companies are focusing on reducing their carbon footprints by setting aggressive GHG reduction goals, such as carbon neutrality and science-based targets.

Through a company-wide carbon footprint assessment for fiscal year 2017, Patagonia found that textile production accounts for 85% of total company GHG emissions. Patagonia’s 2017 Carbon Footprint

85%

While 85% of GHG emissions came from all five stages of textile production, the project focused on raw material source and dyeing and coloration. These stages were chosen because innovations in the apparel industry typically are made in these categories. Patagonia also has greater control to select technologies in these two stages.

RESEARCH QUESTIONS
To investigate how Patagonia can feasibly set and attain GHG reduction targets, the project was structured in these two stages.

1. What are the GHG intensities of alternative materials and dyes?
2. How much can Patagonia reduce its GHG emissions by implementing less impactful materials and dyes?
3. How can a growing company like Patagonia feasibly reduce absolute GHG emissions?

APPROACH

61 changes in raw material source, dye technology, or a combination of the two were identified for various products in Patagonia’s portfolio. The graphic below illustrates how these product swaps work.

RESULTS

The graphs above show changes in GHG intensity (kg CO₂e/kg material) for material* (left) and dye (right) technologies. Decreases in GHG intensity are below the x-axis and increases are above. Changes in raw materials led to the reduction of GHG intensities in 39 product swaps. Changes in dye technologies led to the reduction of GHG intensities in 16 product swaps.

*Due to scale, PSI 1.2.1.2; 3.2.4; 4.3.5 with GHG intensity changes -48.19; -46.67; +30.99 kg CO₂e/kg material, respectively, were excluded.

The GHG intensities (kg CO₂e/kg material) of conventional and alternative technologies: raw materials (left) and dyes (right).

While 51 product swaps decreased GHG intensity, 10 product swaps made the impacted products more GHG intensive.

The GHG intensities (kg CO₂e/kg material) x Product Mass (kg material) = GHG Emissions (kg CO₂e)

Changes in GHG intensity, multiplied by the mass of products impacted in each product swap, determine changes in GHG emissions. All product masses increase exponentially with company growth.

For each product swap, the GHG intensity of an existing material or dye technology was swapped for the alternative GHG intensity, and the resulting change in GHG emissions was calculated. The GHG intensity is the ratio of GHG emissions per unit of material. By multiplying the GHG intensity by the mass of the products, the result is GHG emissions.

GHG (kg CO₂e/kg material) x Product Mass (kg material) = GHG Emissions (kg CO₂e)

KEY FINDINGS

Patagonia and other apparel companies can proactively address environmental impacts during the design phase of products by using alternative material and dye technologies.

There is a tension between assumed company growth (orange) and the GHG savings rate (teal), which poses a challenge to reducing net GHG emissions.

Limiting company growth was analyzed as a way to address this tension. To supplement the GHG savings from adopting the product swaps from the recommended strategy, Patagonia would need to restrict annual growth to 1.5% to keep emissions at 2019 levels by the end of 2034.

RECOMMENDATIONS

The recommended strategy for emissions reductions includes 31 product swaps. This result in approximately a 15% reduction in overall GHG emissions aggregated over the 15-year timeframe, compared to business as usual.

Implementing the recommended strategy decreases the GHG intensity of Patagonia’s entire product portfolio as the 31 product swaps occur over the 15-year timeframe (left). When the GHG intensities are applied to the mass of products (right), GHG emissions are consistently lower but continue to rise with annual growth.

In order to understand the full scope of environmental impacts from apparel production, other categories, such as water scarcity and eutrophication, should be analyzed. Considering these other impacts may yield different recommendations for product changes.

ACKNOWLEDGEMENTS AND REFERENCES

We would like to thank our advisors Dr. Roland Geyer, Jason Maier, Dr. Sangeun Suh, and Dr. Lisa Leimbren, as well as our clients Elissa Foster, Elena Egorova, and Steph Karba.


More information about the project can be found at https://sustainapparel.wixsite.com/groupproject or by contacting gp-sustainapparel@bren.ucsb.edu.