Clothing Consumption: Analyzing the Apparel Industry's Current and Future Impact on Greenhouse Gas Emissions

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The central aim of the Paris Agreement is to keep global temperatures below 2°C from pre-industrial levels. According to the Intergovernmental Panel on Climate Change (IPCC) this will require a reduction in total greenhouse gas emissions of 41-72% from 2010 levels by 2050. Furthermore the IPCC identified population and economic growth as primary drivers of carbon dioxide emissions. In particular, the apparel industry has come under criticism because it is considered one of the most highly pollutive with significant challenges exacerbated by projected population and economic growth (Edenhofer et al., 2014). Recent trends that have allowed consumers to “spend less, buy more” are expected to continue for decades, including in developing countries where over one billion new consumers will arise by 2030 (Gordon & Hodgson, 2015). Under the industry’s current operating model, these trends will cause a significant rise in greenhouse gas (GHG) emissions. While select reports have made estimates on the industry’s carbon impact, they have opted to focus on the production phase where the majority of GHG emissions tend to occur for large fashion retailers. Moreover, few studies have considered where GHG emissions stemming from the apparel industry might occur in the future between developed and developing countries as the dynamics of population growth and economic development influence regional GHG mitigation targets.

This research presents a comprehensive dynamic model that allows for quantifying and evaluating the apparel industry’s GHG emissions against 2030 and 2050 climate mitigation targets under different scenarios of production, consumption, and post-consumption. The model is built using population, economic, demographic, consumer, transportation, and industry-specific data from dozens of publicly available sources. Users of the model will be able to ascertain answers to a variety of questions associated with the apparel industry’s impact on GHG emissions at a global level and in both developed and developing countries.

During the study, the model was run to evaluate GHG emissions under four scenarios of varying production, consumption, and post-consumption activities, including a separate baseline “business as usual” scenario from which a sensitivity analysis was conducted to determine which variables had the greatest impact on emissions. The sensitivity results showed that consumption rates in both developed and developing countries had the largest impact on apparel emissions, but for different reasons. For developing countries, this result was due to the multiplication effect of rapidly rising population against the carbon intensity of materials. For developed countries, it was strictly related to overconsumption. Furthermore, the baseline scenario indicated that the apparel industry will represent more than 20% of the remaining 2018 carbon budget under the IPCC’s 1.5°C pathway, and up to 72% of the remaining budget when prudently accounting for Earth-system feedbacks (Figure 1). It also indicated that developed

countries will need to reduce their consumption rates by 95% to proportionally align their apparel-related emissions with their populations.

This research demonstrated that up to 85% of emissions from apparel occur in the production stage (Table 1), indicating a need to rapidly reduce the carbon intensity of materials and divert finished garments from landfill. If population growth and corresponding demand for apparel cannot be decoupled from the carbon intensity of production, it will be difficult to remain within 2°C of warming, much less 1.5°C, especially when considering the inertia that is inherent in the human and planetary systems involved.

The oral presentation of this study will demonstrate the dynamic nature of the model and suggest how companies can use the model for decision making strategies that can impact GHG emissions.

Figure 1. Remaining carbon budget scenarios based on 2018 carbon budget.

Table 1. Baseline scenario global warming potential by life cycle stage, 2015 - 2050.

Phase	Stage	GWP (MT CO ₂ -eq)			% of Total Emissions	% of Total Captured & Saved
		Developing Countries	Developed Countries	Total		
1	Material Production	52,809,841,110	20,592,190,882	73,402,031,992	79.09%	
1	Manufacturing Scrap (production)	2,792,792,766	1,206,325,667	3,999,118,434	4.31%	
1	Mfg Scrap (landfill, incineration w/out energy recovery)	393,928,603	170,179,403	564,108,005	0.61%	
1	Mfg Scrap (incineration w/ energy recovery, reuse, recycling)	(4,357,868)	(1,867,153)	(6,225,021)		0.2%
1	Distribution (transportation of newly manufactured clothing)	1,118,720,628	857,802,517	1,976,523,145	2.13%	
2	Washing	831,590,938	495,626,285	1,327,217,223	1.43%	
2	Drying	497,638,203	351,223,227	848,861,430	0.91%	
2	Detergent	927,564,171	746,075,085	1,673,639,256	1.80%	
3	Distribution (transportation of imported used clothing)	139,426,958	36,828,798	176,255,755	0.19%	
3	Est. Collection and Sorting Emissions	143,172,519	55,801,349	198,973,869	0.21%	
3	Landfill	6,169,909,459	2,475,624,977	8,645,534,436	9.32%	
3	Incineration (with energy recovery)	(4,939,811)	(8,131,671)	(13,071,482)		0.4%
3	Incineration (without energy recovery)	22,675	47,868	70,543	0.00%	
3	Reuse	(14,583,820)	(4,653,243)	(19,237,063)		0.6%
3	Recycling	(2,546,990,505)	(845,067,516)	(3,392,058,021)		98.9%
Total MT CO₂-eq Emissions		65,824,608,031	26,987,726,057	92,812,334,087		
Total MT CO₂-eq Captured and Saved		(2,570,872,004)	(859,719,584)	(3,430,591,588)		

Total MT CO ₂ -eq Emitted by Phase	Developing Countries		Developed Countries		Total	
Phase 1 - Production	57,115,283,106	86.77%	22,826,498,469	84.58%	79,941,781,575	86.13%
Phase 2 - Consumption	2,256,793,313	3.43%	1,592,924,596	5.90%	3,849,717,909	4.15%
Phase 3 - Post-Consumption	6,452,531,612	9.80%	2,568,302,992	9.52%	9,020,834,603	9.72%

References

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