

Diane Moore HC'20

Spring 2020: Praxis Sustainability Seminar, Sustainable Supply Chains

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Course description: This course explores the sustainability of global supply chains by analyzing the environmental costs associated with the manufacturing of flip flops. Topics covered include the circular economy and carbon footprinting with a specific focus on carbon dioxide emissions associated with transportation. In addition, other sustainability issues are explored through biweekly meetings and discussions with the faculty supervisor and other Praxis students working on projects with environmental focuses.

Understanding the carbon footprint of a product throughout its life cycle is a research area that has gained substantial interest over the past few years in a wide variety of industries. For my Praxis project, I analyze the carbon footprint of three brands of flip flops. Specifically, I look at Rainbow Sandals, Havaianas, and Pips which are manufactured in China, Brazil, and the U.S., respectively. Importantly, Pips is a hypothetical brand of flip flops that would be composed of high quality recycled material. In stark contrast to the traditional “cradle-to-grave” design model where products are used once and then disposed of, a second and third generation of flip flops could be produced from the material of the original pair of Pips flip flops. A prototype of Pips flip flops is displayed in Figure 1.



Figure 1: Prototype of Pips flip flops

Carbon dioxide emissions occur during four distinct stages of the life cycle of a product: processing and refining its raw materials, manufacturing it in a factory, delivering it to a customer, and using it until its disposal (Figure 2). For the sake of my work, the fourth category plays a minimal role. Research has shown that the first two stages of this cycle—materials and manufacturing—produce the greatest quantity of carbon emissions in the footwear industry.¹ However, due to limited data availability and the classified nature of much of this information, my research focuses on calculating the carbon dioxide emissions from transportation.



Figure 3: Transportation route of Rainbow Sandals

emissions to be 0.04 pounds per pair of flip flops using a shipping calculator created by Orient Overseas Container Line, a major container shipping firm.

In total, I find the transportation carbon footprint of a pair of Rainbow Sandals flip flops to be 0.25 pounds of carbon dioxide. Notably, although the distance traveled by ship is about three times the distance traveled by truck, the carbon emissions per flip flop from sea transportation is only 20% of the total emissions with the other 80% coming from ground transportation. This illustrates that shipping by sea is a relatively environmentally friendly way of transporting goods. Moreover, minimizing the distance traveled via ground transportation, as would be the case with a domestically produced Pips brand, has the greatest impact on minimizing the carbon footprint associated with transporting goods. In comparison, Havaianas and Pips have a shipping footprint of 0.16 and 0.06 lbs per pair of flip flops, respectively, which reflects their smaller reliance on ground transportation compared to Rainbow Sandals. After a hypothetical third generation of Pips, its carbon footprint from transportation represents a 140% decrease compared to shipping three pairs of Rainbow Sandals and 60% compared to transporting three pairs of Havaianas. Areas of future research include refining this model to include smaller quantities of flip flops per shipment as well as including data on the first two stages to make this comparative analysis more comprehensive.

To show the process of assessing the environmental cost of shipping, I include the transport route for Rainbow Sandals as an example (Figure 3). Under my model, these flip flops travel from a factory in Dongguan, China to an REI store in Illinois. To calculate the carbon dioxide emissions

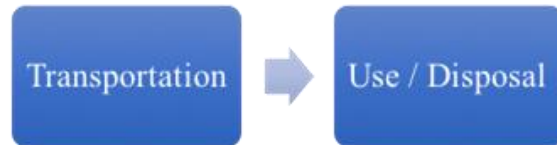


Figure 2: Stages of a product's life

from ground transportation, I compute the miles traveled assuming one 40' high cube is transported and filled with the maximum quantity of flip flops. I find that the carbon emissions from ground transportation is 0.21 pounds per pair of flip flops. From sea shipping, I calculate the

1. Jennifer Chu. "Footwear's (carbon) footprint." May 22, 2013. <http://news.mit.edu/2013/footwear-carbon-footprint-0522>