Environmental Footprint Reduction

Produced by The Humble Shoe Company Executive Team

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The Humble Shoe Company
33 Fifth Avenue
New York, NY 10003

Introduction

Given that the fashion industry produces 10% of all man-made carbon emissions, which is greater than all international flights and maritime shipping combined, and is the second largest consumer of the world's freshwater supply, paving a new path for sustainability through manufacturing processes and material sourcing is of great importance. The dyeing process of textiles is estimated to be the second leading cause of water pollution as well, with 20% of all industrial water pollution emanating from the fashion industry leading to pollution of rivers, waters and streams.

Product waste is also of major concern, with industry trends in recent decades pointing to far greater waste than ever seen previously. While clothing production has doubled since 2000 and the average consumer purchasing 60% more clothing items, most apparel items are only kept for half as long compared to two decades ago, thus resulting in the equivalent of one garbage truck of clothes being dumped or burned in a landfill, per second. This can partly be attributed to increased consumer purchasing, but responsibility also lies with apparel companies, as reduced product quality leads to increased raw material, energy and environmental impact, since lower quality products have a shorter average shelf life.

While taking into account population and income growth, the apparel industry's resource consumption is projected to triple by 2050 as compared with the year 2000 as the indexed value.

Material input selection plays a pivotal role in reducing negative environmental, community and human impacts of the fashion industry, while enabling a more inclusive economy that supports workers and communities across the global supply chain. The Higg Materials Sustainability Index (MSI) (created in partnership with the Sustainable Apparel Coalition), which was developed in attempts to standardize measurement of environmental impact across the fashion and textile industries, measures various inputs environmental impacts in terms of water usage, global warming, eutrophication (excess nutrients in waterways leading to dead zones and pollution), and abiotic resource depletion (depletion of natural resources).

While issues with eco-synthetic and bio-based alternatives remain, such as microplastic pollution, cow leather and silk rank highest for cradle-to-gate[1] environmental impact, with cotton in third and bast fiber and wool, followed by synthetic leather rounding out the top 6. Additionally, worker and community impact is of major concern, particularly in industries such as leather production, due to required usage of pollutant chemicals and resulting hazardous waste, with higher cancer rates being found in regions of high tannery workers. Leather alternatives, which historically have come in the form of plastics, have ongoing negative environmental impacts including micro pollution of our oceans and more. Given the pollution issues associated with plastic, its inability to naturally biodegrade for hundreds of years, and the high energy usage required for production, we are focused on producing products with lower plastic contents and higher recycled products, in order to reduce the impacts of plastic.

[1] Cradle to gate refers to the product life cycle from resource extraction (cradle) to the factory gate, before it is distributed to customers.

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New York, NY 10003

Through improved material selection and our partnership with leading suppliers that are creating new innovations in material selection and production processes, **our aim is to become the leading luxury footwear brand that is inspiring a more sustainable future, for all workers involved in the global supply chain, for the environment and the future of human life on Earth**.

Impact and Environmental Performance Report

To see our latest edition of our impact and environmental performance report, which includes environmental impacts of production and distribution and associated 110% offset carried out, you can find our latest report on our website.

Relative Importance of Manufacturing on Environmental Footprint (Input Extraction and Production vs Assembly Production)

While efficiencies emanating from innovations in the manufacturing and assembly process in the luxury footwear market is an important aspect of our goal of reducing our negative environmental footprint to near zero, selection and manufacturing of input materials, packaging and distribution remain of far greater importance with regards to this goal based on data from our Life Cycle Assessment studies.

The relative impact of the manufacturing process for THSC's footwear products on Global Warming Potential (GWP) is substantially lower compared to impacts of manufacturing on GWP for synthetic sneakers, as shown in a 2013 MIT study[2]. However, in the luxury footwear market, as opposed to the synthetic athletic footwear market, materials often serve as the key driver of carbon and overall environmental impact. As co-author Elsa Olivetti of the 2013 MIT study, *Footwear's (carbon) Footprint*, stated in comparing athletic shoes to luxury shoes:

"*What stood out was this manufacturing burden being on par with materials, which we hadn't seen in similar products. Part of that is because it's a synthetic product. If we were looking at a leather shoe, it would be much more materials-driven because of the carbon intensity of leather production.*"

Given that a great number of luxury footwear products use animal leather (mainly from cows) as a primary material, due to the extensive environmental impact associated with cow leather as described by the Higg MSI Index, the input selection and manufacturing processes are weighted as of greater importance in the luxury shoe market as it stands today[3]. Additionally, the smaller

[2] Conducted in 2013 at MIT by the Materials Systems Laboratory, Kirchain and Olivetti found the manufacturing process was responsible for more than the-thirds of a running shoe's carbon impact (measured in our tables and figures by the impact indicator GWP). The research team concluded that the reliance on coal as the dominant energy source in most shoe manufacturing facilities is a primary reason for such high carbon emissions figures associated with the manufacturing process. https://news.mit.edu/2013/footwear-carbon-footprint-0522

[3] More details regarding the Higg MSI Index individual scores for different shoe inputs can be seen in Appendix Figure 1. Cow leather has the greatest overall aggregate impact across all five Higg categories (global warming, eutrophication, water scarcity, resource depletion/fossil fuels and chemistry/ecotoxicity).

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33 Fifth Avenue
New York, NY 10003

number of separate parts that must be manufactured to produce an end luxury shoe product compared to synthetic sneaker products also leads to a reduction in the relative impact of manufacturing on overall environmental impact compared to input material selection and manufacturing.[4]

Based on data from our three Life Cycle Assessments (LCAs) to date[5], we are able to more clearly understand the relative impacts (as a percentage) of the different phases of our footwear products on various environmental variables. The major categories that make up our footwear products include raw material processing, transport, manufacturing, packaging, and distribution, as shown in Appendix Table 1. The major environmental impact variables used in LCAs include Global Warming Potential (GWP), Ozone Depletion Potential (ODP), Acidification Potential (AP), Eutrophication Potential (EP), Smog Creation Potential (POCP) and Fossil Fuel Depletion (FFD). Further details about each impact indicator are described in Appendix Table 2.

Table 1 below shows the relative contribution of the five major categories that encompass our footwear production on various environmental impact indicators. Given that the figures in Table 1 assume 100% of product distribution via air freight, which is our sole mode of distribution from the factories to our distribution center at this time[6], distribution maintains the highest percent relative impact on four of the six impact indicators and contributes the greatest average percentage of environmental impact. As our sales volumes increase, we will be shifting our distribution to ocean freight, both for environmental harm reduction and associated cost savings.

Packaging contributes the second most average environmental impact, including the highest environmental impact on ODP and EP. Raw material extraction, processing and production is the third most impactful, with manufacturing of our products being the fourth most environmentally impactful. The values in Table 1 represent the average percent contribution for each stage of production across the main six impact indicators for all footwear styles produced to date.

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[4] For example, our luxury shoes contain up to 17 distinct component parts that are then manufactured to produce a final shoe product. In the 2013 MIT Study (see footnote #1), an average of 65 component parts is cited as the average for synthetic sneakers.

[5] The three Life Cycle Assessments were carried out on May 28, 2019, September 11, 2019 and April 7, 2021. A new LCA is conducted upon a new product line being manufactured, to have clear measurements of the life cycle impact of each of our products, or upon a substantial change in the input material selection or production process of any given existing product line. The LCAs then serve as our baseline figures that are used for THSC's 110% offset programs. All LCAs and associated environmental claims validation studies can be seen on our website at the following link: https://aeranewyork.com/pages/lca

[6] For more details regarding transportation and distribution, as described in our LCAs, see page 14, section 2.13 of the "Final LCA Report 1 May 28 2019.pdf" from our website here: https://aeranewyork.com/pages/lca

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33 Fifth Avenue
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Table 1. Contribution Analysis Across Major Categories of Our Footwear Products.

Impact Indicator	Raw Material Extraction	Transport	Manufacturing	Packaging	Distribution
GWP (kg COz eq)	12.72%	0.08%	17.69%	15.09%	57.31%
ODP (kg CFC-Il eq)	1.92%	0.02%	3.59%	79.25%	18.38%
AP (kg SO2 eq)	13.81%	0.08%	13.22%	16.97%	59.16%
EP (kg N eq)	24.56%	0.05%	14.23%	38.34%	25.81%
POCP (kg 03 eq)	8.19%	0.11%	7.17%	8.63%	79.00%
FFD (MJ eq.)	13.67%	0.09%	15.37%	7.29%	66.81%
Average Impact Across All Indicators	12.48%	0.07%	11.88%	27.60%	51.08%

**Key assumption: 100% of product transported from factory to distribution center via air freight (as opposed to ocean freight).*

The key assumption of 100% product distribution via air freight has a substantial and significant effect on the percentage impact across the 5 main stages of our footwear. For reference, see Figures A2 and A3 in the appendix, which further illustrates the differential outcomes associated with ocean freight vs. air freight.

Material Selection, Manufacturing and Associated Environmental Impact

Higg Materials Sustainability Index (MSI) Methodology

Given that the input materials selected, and the associated production and manufacturing processes of such inputs, represent the category of greatest environmental impact associated with luxury shoe production[7], the Higg MSI (Material Sustainability Index) provides additional insight into differing impacts of the main materials used in our shoe production compared to industry standards.

Figure 1 describes the relative negative environmental impact associated with Polyurethane (PU) synthetic leather vs. cow leather, as determined by the Higg MSI. PU synthetic leather, which represents the largest share of many of our shoe lines as a function of total weight in grams (excluding packaging), is most notably substantially lower compared to cow leather with regards to water usage (water scarcity) and eutrophication.

Based on Higg data, the use of PU synthetic leather, which for our products primarily come through its use in the outer material and lining components, reduces freshwater usage by 95.8%, while PU synthetic leather also has a lower environmental impact on all other impact indicators. Eutrophication, for example, which is caused by excess nutrients that often emanate

[7] As shown in Appendix Figures A2 and A3, when ocean freight is used as the primary mode of transport, input material extraction, processing and production become the greatest environmental contributor.

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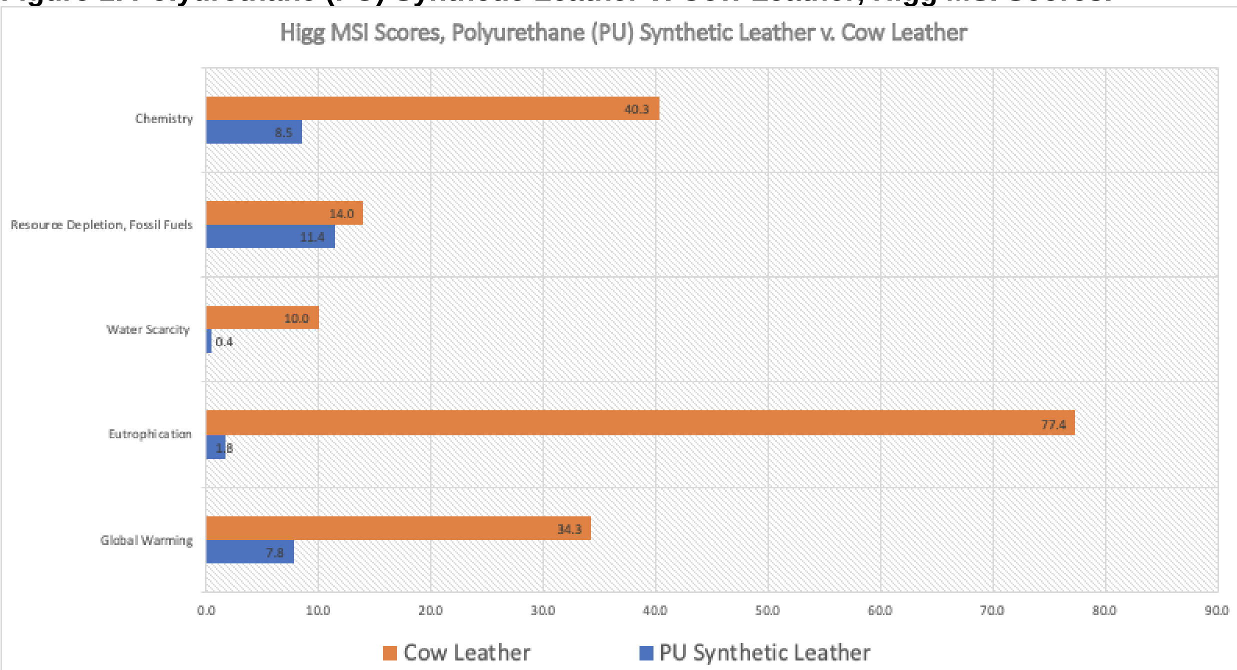
from manure associated with animal feed operations[8], is reduced by 97.7% through the strategic replacement of traditional cow leather with PU synthetic leather.

Additionally, Global Warming Potential is reduced by 77.2%, chemistry (ecotoxicity[9]) is reduced by 78.8% and fossil fuel depletion by 18.6%.

Figure 1. Polyurethane (PU) Synthetic Leather v. Cow Leather, Higg MSI Scores.



**All values calculated from the Higg Materials Sustainability Index product tool.*

Waste

While leather industry estimates of waste associated with the natural imperfections of animal leather ranges around 15% (known as cutting loss), other research suggests a far more substantial figure. Sivaram and Barik, (Energy from Toxic Organic Waste for Heat and Power Generation, 2019, Pages 55-67) in their study of waste in animal leather conclude only 20% of raw material leather yields a finished leather product, with more than 60% of the raw material being returned as solid and liquid waste, including the highly carcinogenic heavy metal, chromium. With a minimum of 60% of raw material animal leather inputs being wasted, coupled with the heavy metal pollution associated with such waste, the strategic use of synthetic leather alternatives, particularly ones where a greater percentage of material is obtained from renewable sources, the differential waste produced is substantial.

For synthetic leathers, such as PU synthetic leather, given the uniformity of the product, far less waste is generated during the production processes as compared to other leathers such as cow

[8] See: https://www.wri.org/our-work/project/eutrophication-and-hypoxia/sources-eutrophication
[9] For greater details regarding the Higg MSI's chemistry impact framework, see page 42 of the "Higg Materials Sustainability Index (MSI) Methodology " published version from July 31, 2020.

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leather[10]. On average, based on data provided to us from our shoe manufacturing partners, we estimate 8% material used to make our shoes is wasted.

Our shoe manufacturing partner, VP Shoes, a leading manufacturer of luxury footwear based in Veneto, Italy, has also stated that THSC's shoe manufacturing process creates far less waste compared to luxury footwear standards. Corporate administrator of VP Shoes, Valter Poletto, states *"due to the uniformity of these man-made materials (non leather, 100% vegan materials sourced in Italy) we immediately noticed that the materials waste for these shoes was on average 10%, which is at least 50% less than the typical waste for cow leather-based materials."*

Poletto continues by stating *"in cooperation with THSC, we have implemented certain production process changes – such as the cutting of the material, and the use of smaller pieces left over from the cutting – that have resulted in a decrease of the average material waste by 20%. Thus, on average, today we estimate that only 8% of the material used to make the AERA shoes is wasted, compared to an industry average for cow leather material waste of 20-25%."*

Renewable Energy

Given the energy demand required for shoe production, we strategically chose a primary supplier partner (which produces our primary material supplier for bio-based eco-synthetic leather and associated products used in our outer materials and lining) that leverages green, renewable energy. Coronet SpA, based in Milan, Italy, has installed four photovoltaic plants, which produces 1.4 million kWh of solar energy per year, leading to a CO2 emissions reduction of 1.02 million kg on an annual basis.

[10] Our Life Cycle Assessments include information on average Non-hazardous waste disposed per pair of shoes for every shoe line, which can be viewed at the following link: https://aeranewyork.com/pages/lca

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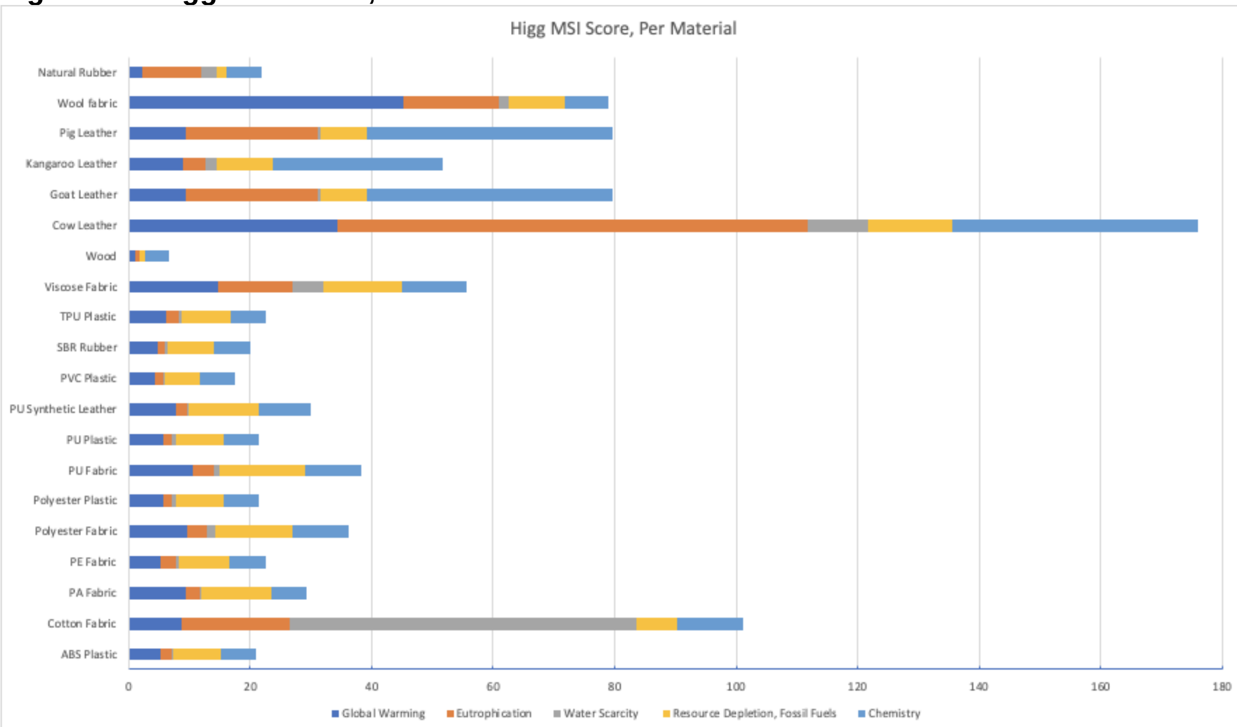
Appendix

Figure A1. Higg MSI Score, Per Material



Cow leather maintains the highest total [Higg MSI score](#) when the five major categories are aggregated. Cow leather, a primary input material to most luxury shoes with an average of 1.7 square feet of leather being used per pair of shoes, scores particularly high with regards to negative impacts on Global Warming Potential, Eutrophication, Water Scarcity and Chemistry. Eutrophication is the category where cow leather has the greatest negative differential effect on the environment compared to other input materials, with a Higg score of 77.4. For comparison, the next closest scores are 21.6 for pig/goat leather and 17.6 for cotton fabric.

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Table A1. Modules and unit processes included in scope for THSC footwear production.

Module	Module description	Unit Processes Included in Scope
Raw Materials Processing (Sourcing/Extraction) stage	Extraction and processing of raw materials; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Extraction and processing of raw materials for the footwear product components.
Transport stage	Transport (to the manufacturer)	Transport of component materials to the manufacturing facilities
Manufacturing stage	Manufacturing, including ancillary material production	Manufacturing of AERA footwear (incl. upstream unit processes*)
Packaging stage	Extraction and processing of packaging materials and transport to manufacturer	Extraction and processing of packaging materials; transport to manufacturer
Product Distribution	Transport (product distribution; product returns)	Transport of product (including packaging) to consumer; transport of returned product

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Table A2. Impact Indicators and Mechanisms

Category Indicator	Impact Category and Environmental Mechanism
Global Warming Potential of GHGs over 100 years (GWP)	Anthropogenic emissions of greenhouse gases and short-lived climate forcers have led to increased radiative forcing, which has in turn increased the global mean temperature by 0.8°C since pre-industrial times. This is projected to increase to 1.5°C by 2035, 2.0°C by 2050, and 4.0°C by 2100. As global mean temperatures continue to climb, global climate change will result. Some of the predicted impacts include reductions in food and food supplies, water supplies, and sea level rise.
Ozone Layer Depletion (ODP Steady State) (ODP)	Emissions of ozone depleting substances such as chlorofluorocarbons contribute to a thinning of the stratospheric ozone layer. This can lead to increased cases of skin cancer, and effects on crops, other plants, marine life, and human-built materials. All chlorinated and brominated compounds stable enough to reach the stratosphere can have an effect. CFCs, halons and HCFCs are the major causes of ozone depletion. Damage to the ozone layer reduces its ability to prevent ultraviolet (UV) light entering the earth's atmosphere, increasing the amount of carcinogenic UVB light reaching the earth's surface. Due to the international ban on ozone depleting chemicals, the stratospheric ozone layer has begun to recover; U.S. EPA projects that the ozone layer will recover within about 50 years.
Photochemical Oxidant Creation Potential (POCP)	Photochemical ozone, also called "ground level ozone", is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. If ozone concentrations reach above certain critical thresholds, health effects in humans can result, including bronchitis, asthma, and emphysema. The impact category depends largely on the amounts of carbon monoxide (CO), sulphur dioxide (SO2), nitrogen oxide (NO), ammonium and NMVOC (non-methane volatile organic compounds).
Acidification Potential (AP)	Acidification is the increasing concentration of hydrogen ion (H+) within the local environmental and occurs as a result of adding acids such as nitric acid and sulphuric acids into the environment. Acid precursor emissions transport in the atmosphere and deposit as acids. These acids may deposit in soils which are sensitive, or insensitive, to the increased acid burden; sensitivity can depend on a number of factors. In acid-sensitive soils, the deposition can decrease the soil pH (acidification) and increase the mobility of heavy metals in the environment, such as aluminum. This acidification can affect the pH of local soils and freshwater bodies, by increasing local hydrogen ion concentrations, causing endpoints such as tree die-offs and dead lakes. Emissions of sulphur dioxide and nitrogen oxides from the combustion of fossil fuels have been the greatest contributor to acid rain.
Eutrophication Potential (EP)	Eutrophication is the build-up of a concentration of chemical nutrients in an ecosystem which leads to abnormal productivity. In some regions, emissions of excess nutrients (including phosphorus and nitrogen) into water can lead to increased algal blooms. These blooms can reach such a severity that waterways become choked, with no other plant life able to establish itself. If algal blooms are intense enough, the decaying algae consumes dissolved oxygen in the water column starving other organisms of needed oxygen. Whereas phosphorous is mainly responsible for eutrophication in freshwater systems, nitrogen is mainly responsible for eutrophication in ocean water bodies. Emissions of ammonia, nitrates, nitrogen oxides and phosphorous to air or water all have an impact on eutrophication.
Fossil Fuel Depletion (FFD)	This impact category reflects the relative abundance and depletion of feedstock reserves resulting from the net consumption of fossil energy resources used for electric power generation, operations and transport, and for incorporation into materials such as plastics. This indicator takes into account the amount of resources used for the function under study, the availability of economically recoverable reserves, the degree to which such resources may be replenished, the relative efficiency of power generation systems and fuel systems, and whether the resource is available for reuse at end of life (e.g., recycling). All fossil fuel resources which are consumed in a non-renewable fashion are included.

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33 Fifth Avenue
New York, NY 10003

Figure A2. Impact Indicators for Each Stage Of Production, with Ocean Freight.

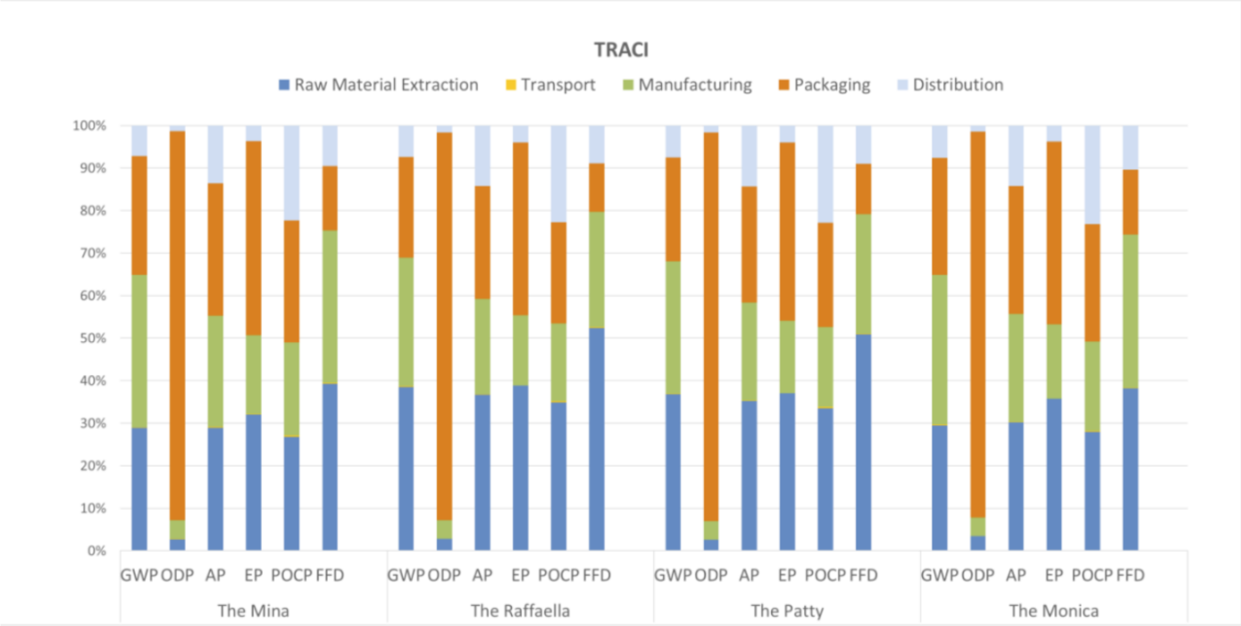
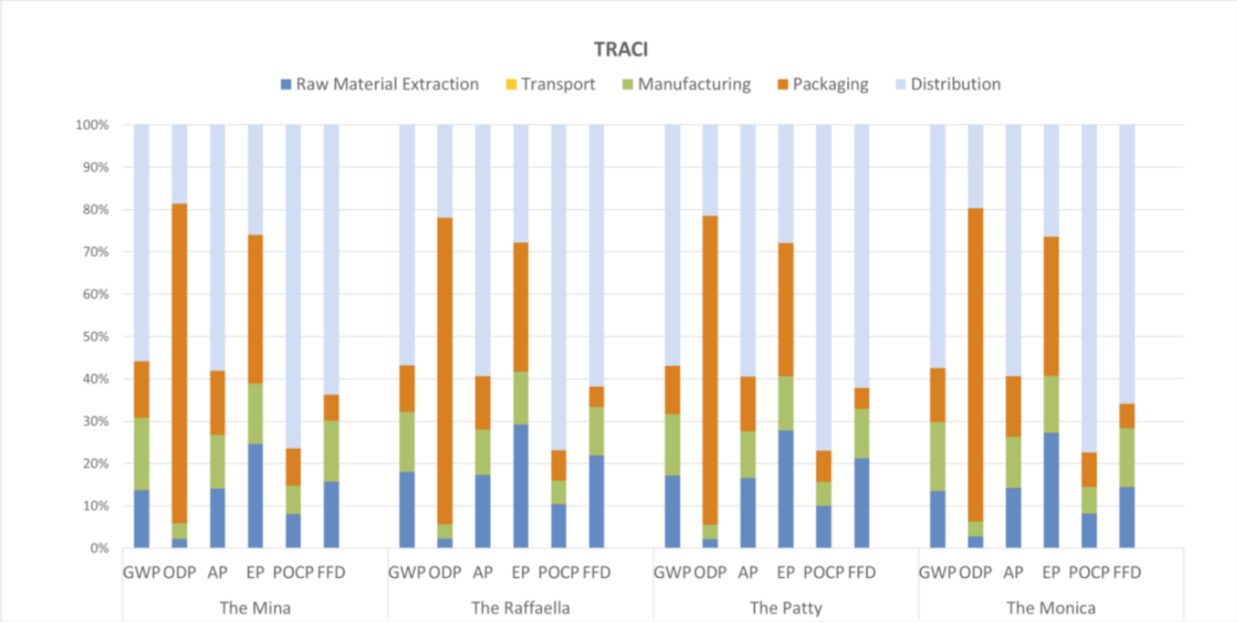


Figure A3. Impact Indicators for Each Stage Of Production, with Air Freight.



As shown in Figures A2 and A3, air freight drastically increases the relative environmental impact contribution of distribution across all impact categories. When ocean freight is used as the primary distribution mechanism, raw material extraction, processing and production becomes the greatest contributing factor to the various environmental impact indicators, on average. Values in Figure A2 and Figure A3 are taken from our April 7, 2021 Life Cycle Assessment carried out by SCS Global Services. As volume of shoe production increases, and as ocean freight shipping logistical challenges associated with the Covid19 pandemic and

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33 Fifth Avenue
New York, NY 10003

associated maritime shipping backlogs reduce, we plan to shift to ocean freight as our primary mode of distribution.

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33 Fifth Avenue
New York, NY 10003