

Reusable Campus Bag



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ENVS 4100: Appropriate Technology and Sustainability

The Campus as a Living, Learning Laboratory

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I. Executive Summary

The problem we are investigating is the lack of student connection to the current reusable campus bag offered at WMU, the lack of a sustainability-driven purpose surrounding this bag, and the rampant use of HDPE bags on campus. Plastic HDPE bags have been on environmental and sustainability radars for a while, yet they still remain a problem today. While a reusable bag is passed out at Bronco Bash for free, we feel that it does not foster any student investment that would encourage them to reuse the bag over and over again. The main problem is the rampant use of plastic HDPE bags on campus, and the current solution (the reusable bag passed out at Bronco Bash) does not adequately encourage students to use the bag multiple times, thereby lowering its GWP below that of plastic HDPE bags. This renders the current reusable bag offered at Bronco Bash as ineffective.

A survey was conducted to gauge current student use and attitude towards reusable bags. We also researched the life cycle analysis of various reusable bags, including NWPP (non-woven polypropylene), LDPE (low-density polyethylene), and cotton bags, as well as traditionally "single-use" bags, HDPE and paper bags. We found the NWPP bags have a high potential as a solution to HDPE bags, given that they only need to be used 11 times to lower their Global Warming Potential (GWP) below HDPE bags. Additionally, we contacted a variety of local stores; The People's Food Co-Op, Sawall's Health Foods, and Water Street Coffee Joint all expressed an interest in sponsoring a design contest for a campus reusable bag. Other support came from members of WSA, including the President, Vice President, and Sustainability Chair.

To bring this project to fruition, a Registered Student Organization (RSO) responsible for picking up the campus bag project needs to be created (see Appendix IV) or an existing RSO needs to take on the project to obtain funding from the Western Student Association (WSA). WSA is a key participant in this project, given that they are at the heart of student affairs and would be monumental to generating student support and interest in the project, in addition to funding. Also, a Student Sustainability Grant (SSG) application should be filled out to fund either the design contest or the production of the end campus bag product.

II. Introduction

Western Michigan University takes the mission of being a sustainable campus very seriously. Yet our campus is lacking in one of the easiest problems to fix: there is no connection and/or awareness to the reusable bags currently available on our campus. The absence of knowledge surrounding where to get the bags and the lack of student interaction involved with the construction of the bag forces these bags to become completely unnoticed and most importantly, unused.

By now, we all are aware of the damaging effects plastic bags have by being thrown to sit in a landfill. They often end up in bodies of water or out on public land, where they take decades to decompose. Because of this, reusable bags are becoming more popular than ever, and WMU has caught on to the trend. Or at least we thought they did, until we took a closer look into previous 4100 reports addressing issues involved with reusable bags through the use of survey data from our fellow classmates. It is safe to say there are not enough students using the WMU reusable bag, let alone any bag, to make an actual, positive environmental impact. We wanted to come up with a method to change the way students think about plastic and reusable bags. A goal of ours was to organize some type of solution to make reusable bags more prevalent throughout the student body by creating a product that would be more connected to WMU students. By making that connection, students would be more likely to use the bag frequently, which was another problem we were trying to tackle.

Anyone can create a reusable bag; there are countless websites allowing you to do so. But we wanted to do more than just create a bag that would probably get tossed in a corner a few hours after we handed them out to students. This goal needed to be completed on multiple levels, which began with what kind of material would be used to make the bag. We decided to take a further look into the life cycles of some common materials used in the production of reusable bags in order to determine which materials would be the most ecologically and environmentally sustainable for our proposal. Through our research we have found that not all bags are created equal, and even though the reusable bags through the bookstore and WMU freebies reduce the use of plastic bags, they may not be much better on account of their total, environmental lifecycle impact. We have come to the conclusion that using NWPP, or non-woven polypropylene, will create the smallest environmental impact while still allowing students to gain easy access to them.

The main goal of creating this bag is to involve as many Western students as possible by providing them with a connection to the bag, which will allow them to remember to use the bags and in return decrease their ecological footprint.

III. Methodology and Data

This project was built around the aforementioned problem we investigated: the lack of student connection to the current reusable campus bag offered at WMU, the lack of sustainability-driven purpose surrounding this bag, and the rampant use of HDPE bags in campus stores—such as the campus bookstore. Our group hypothesized that a reusable bag featuring

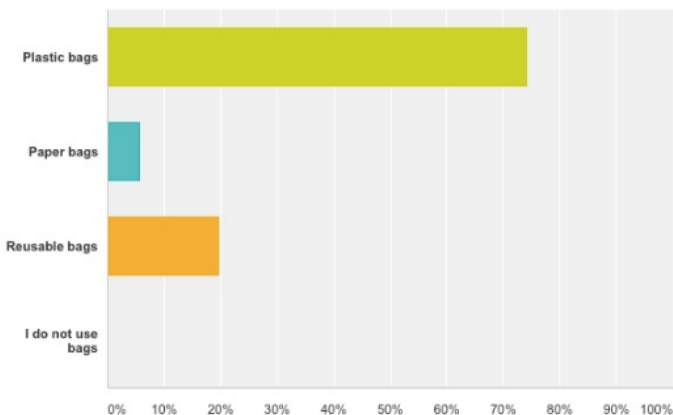
- a) a sustainability-driven purpose, and
- b) a feeling of investment by students

would lead to a potential solution to the overuse of HDPE plastic bags and the lack of use surrounding the current reusable bag offered at Bronco Bash annually.

This project began with a 10-question survey. The questions asked in this survey inquired about students' current ownership of reusable bags and their preferred method of bagging groceries. This particular survey also inquired as to whether students would be more likely to use a campus reusable bag if given a discount at local stores. A survey allowed for the measurement of student interest in a campus reusable bag and allowed us to gauge whether the bag would need incentivizing for frequent use. Had the results of the survey indicated students were not interested in reusable bags, the project recommendations at the conclusion of this report would likely look different.

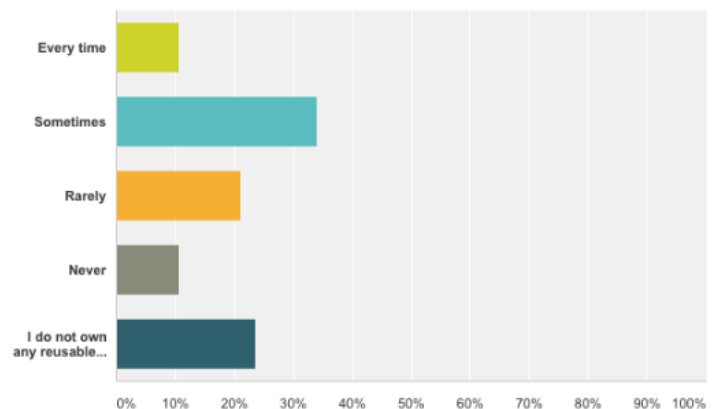
What is your most common method of bagging groceries when shopping at local stores?

Answered: 86 Skipped: 0



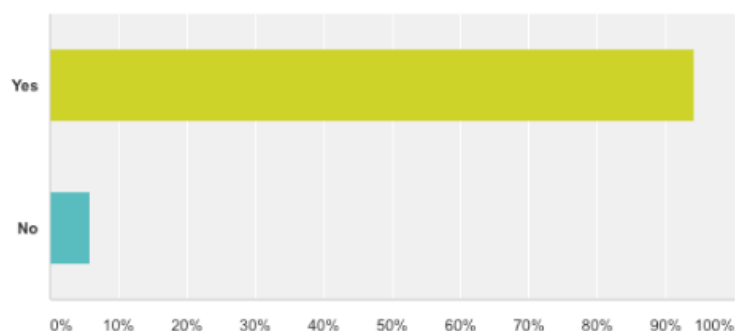
If you do own and use reusable bags, how often do you actually use them when you shop?

Answered: 85 Skipped: 1



If WMU was to come up with a campus reusable bag, would you be interested in obtaining one?

Answered: 86 Skipped: 0



Following the initial survey, we began research regarding best practice on other campuses as well as the life cycle analysis of various bag types (both reusable and non-reusable). Research of best practice on other campuses was conducted to determine what, if any, reusable bag programs were currently in place or what efforts were being undertaken to reduce HDPE bag use on campuses. The latter research includes reusable bags types: NWPP (non-woven polypropylene), LDPE (low-density polyethylene), and cotton bags as well as non-reusable bag types: HDPE and paper bags. This research enabled comparison between the bag types, factoring in raw material extraction, manufacture, shipping, and end-of-life disposal practices. Other factors considered when comparing these bag types included the number of times the various bag types would need to be used to reduce their Global Warming Potential (GWP)¹ below that of traditional HDPE bags.

Type of carrier	HDPE bag (No secondary reuse)	HDPE bag (40.3% reused as bin liners)	HDPE bag (100% reused as bin liners)	HDPE bag (Used 3 times)
Paper bag	3	4	7	9
LDPE bag	4	5	9	12
Non-woven PP bag	11	14	26	33
Cotton bag	131	173	327	393

The amount of primary use required to take reusable bags below the global warming potential of HDPE bags with and without secondary reuse

This group additionally met with a variety of contacts through the course of this project, including: Judy Gipper, members of the Western Student Association, and a variety of stores near WMU's campus. Meeting with various stores gave an idea of whether stores would be interested in potentially sponsoring a design competition for the bag. WSA provided us with their interest and potential future support for the reusable bag project. Our group also conferred with Isaac Green, Office for Sustainability employee, which enabled us to reorient ourselves

¹ GWP is defined as the amount of greenhouse gas that is estimated to contribute to global warming by accumulating in the atmosphere and absorbing infrared radiation.

IV. Examples of Best Practices on Campus

There are currently several practices related to bag use on campus. According to the 2013 ENVS 4100 report on reusable bags by Clough et al, the WMU Bookstore ordered about 75,000 plastic bags for the 2013-2014 school year, which added up to about \$19,500 in plastic bags. The bags that were ordered are 100% biodegradable, which the 2013 ENVS 4100 group deemed to be a "more ecofriendly option than the average plastic bag" (4). However, based on one research study, biodegradable bags are actually slightly more taxing to the environment. This is based on the on their eutrophication potential—which is heightened because of fertilizing the crops that are used as the basis for the polymer found in biodegradable bags (Edwards 65). Additionally, biodegradable bags tend to have higher methane emissions when they break down in a landfill as a result of their starch content. Because of this finding, more research should be conducted on the total life cycle analysis of biodegradable plastic bags and overall environmental impact.

We also talked to Judy Gipper, who informed us that the reusable bag program that Dining Services put into effect for late night carry out in 2010—replacing the plastic and paper bags that used to be handed out to students to-go—was an overall ineffective program. The 2012 Reusable Bag report by Gumpert and Sullivan mentions that Gipper thought this reusable bag program to be a success; however, Gipper's current view is that the program is not very successful and Dining Services will not be continuing it in the future. Gipper feels that the reason for the overall failure of this program is due to students bringing their own reusable bags (if they bring a reusable bag at all) to carryout, rather than the bag issued by Dining Services to incoming freshmen.

Bronco Bash is currently the main supplier of WMU Reusable bags on campus. Of the 5,000 reusable bags purchased by the bookstore every other year, about 4,000 are given away at Bronco Bash in September over the course of two years. Then the leftover 1,000 bags are sold at WMU Bookstores throughout the school years as well (Gumpert 13). Despite ease of access to these free/cheap bags, they are rarely reused and lack the ability to develop a sense of connection that would foster reuse among students.

V. Examples of Best Practices on Other Campuses

Syracuse University

Syracuse University, located in New York state, consists of about 15,000 undergraduate and 5,000 graduate students. This university is releasing a new pilot reusable bag program beginning July 1st, 2017. This reusable bag program arose from a student's capstone course project requirement and the desire to reduce the plastic waste generated by one-time plastic bag use.

Syracuse University uses an average of 153,300 bags per year (which comes out to almost eight plastic bags per student per year), and has given out a five-year total of 766,500 plastic bags. In an effort to reduce the large amount of waste generated from these bags, Syracuse will be significantly reducing their plastic use in the bookstores, featuring a variety of reusable bags in their stores, as well as holding a student design contest for the design of the reusable bags that will sold starting Fall of 2017. Although this program is in its infancy—the pathway for which has been laid out, but will not be implemented until July 1st, 2017—it is a prime example of a student-led initiative to reduce plastic bag waste that arose from a class project. Additionally, multiple offices are working together to reduce waste, including the Syracuse University Bookstore, the Student Association, Students for Sustainability, and the Energy Systems and Sustainability Management Department. An incentive program will also be announced soon for students who choose to use the new reusable bags on campus.

University of California, Davis

The University of California, Davis is approaching the issue of the over usage of plastic bags on campus with an artistic twist. In order to bring awareness to more students on campus, an associate professor of design created a plastic bag tornado sculpture made out of 1,000 plastic bags. The number of bags represents the average amount of plastic bags a California couple uses each year. We found it significant that this awareness to the plastic bag issue was brought upon by a professor outside the sphere of environmental and sustainability. This is allowing a whole other department on campus to get involved with an issue that would originally be outside their element. This fact alone is why we found UC Davis's practice on reducing plastic bags so effective and a great example to learn from. Bringing together a whole community of individuals over a certain issue can be extremely powerful, especially in a closed in community like a college campus. Having a variety of different thinking minds come together to work on a single goal is the true meaning of a community.



The plastic bag tornado sculpture is a visual that leaves a lasting impression. Having something like this in the middle of Western Michigan's campus for every student to see would be the easiest way to start a campus wide conversation about how many plastic bags each of us really uses. It is quite literally a different spin on a growing old problem.



The picture below the plastic bag tornado are the bags created by students of the artist/associate professor, Ann Savageau. The students in the sustainable design class created bags out of reclaimed materials such as, used fabric swatches and vinyl banners.

University of Georgia

The University of Georgia has created a very ambitious reusable bag imitative program on their campus that reaches out to the citizens of Athens, Georgia as well. The students received a \$4000 grant from the school's office of sustainability, and took that money to help educate their fellow students and community about the environmental impact plastic bags have. The students have taken their forces to the local government and are asking for the city to impose a small fee on the use of plastic bags in local stores. They have also made an impact on UGA's college campus by installing multiple recycling bins specifically for recycling plastic bags. According to their "Bag the Bag" website, they have been able to divert over 3000 plastic bags from landfills. Similar to UGA's program, with the help of our proposed bag design competition, we will be able to educate students at Western Michigan about the harmful effects plastic bags have. Eventually with the corporation of local Kalamazoo business's we will be able to get the community involved with lowering their daily usage of plastic bags and turning to the WMU student created bag instead.

VI. Discussion

Incentivizing

This project began with the idea of incentivizing a campus bag with discounts at local stores to encourage students to use the bag multiple times. However, after further reflection, it would most likely be very difficult to get a variety of stores to offer discounts for a campus bag before details about the bag and funding for the project were actually secured. If a campus bag program can be carried out, we could then look into incentivizing the bags to increase student use.

Stores may also need incentivizing to provide funding for the project. This could be achieved by either a) charging stores a flat rate to put their logo on the back of the bag, or b) adding their logo to the back of the bag should they choose to sponsor the campus design contest. As the end goal is to distribute the campus bag to a large number of students, it would benefit stores greatly for their logo to appear on a bag promoting WMU and sustainability.

We brainstormed different ideas on how the consumer would be more likely to remember to use the reusable bag, in order for sustainability ability to be at its full potential. We thought that some sort of sticker program would be impactful, viewing it as a reward system so the consumer would be more apt to bring in at least one reusable bag. The system, we imagine would be worked out with the local stores who have agreed to allow the bags into their business, once the bag is presented at the cashier will provide a sticker to place on the bag, after ten stickers have been collected by the consumer a discount of some sort (either money off or free item depending on store's compliance). By including multiple incentives to go along with deciding to shop with a reusable bag over a typical plastic one, we hope it will slowly shift customer's habits into a normalcy of not using plastic bags.

Life Cycle Analysis

Plastic HDPE have a variety of detrimental effects through the course of their life cycle. Reusable bags, likewise, have the potential for negative impact on the environment. User behavior is key to reducing the GWP of any reusable bag type to below HDPE plastic bags. This project proposes the creation of a reusable bag with a mechanism to catalyze student investment and involvement in a campus reusable bag—a student design contest.

After talking with a variety of stores—including Sawall's Health Foods, The People's Food Co-Op of Kalamazoo, Water Street Coffee Joint, Fourth Coast, and Earth Fare, we found that three of the five stores were very interested in sponsoring—either through a monetary donation or gift card—a design contest for a reusable campus bag. Sawall's Health Foods, The People's Food Co-Op, and Water Street Coffee Joint, were the three stores to show a high level of interest in sponsorship. Fourth Coast did not respond to our inquiries, and Earth Fare is a corporate chain, which made it difficult to secure concrete support and interest in sponsoring a campus reusable bag without more concrete steps and details (I.e. an RSO to take on the project, a distribution and design contest timeline, an official supplier, etc.).

For this project, we not only wanted to make sure the bag and design contest brought the university to gather around a single sustainable solution, but to ensure the product being produced is truly having as little of an environmental impact as possible. To do so, we researched the most commonly used materials for reusable bags and dove into understanding the life cycles of these materials and what how their production is impacting the environment. A major issue with the rise of retailers promoting reusable bags over plastic, how many times does a consumer have to use the bag in order for it to actually have an environmental benefit. As more larger stores are selling their own reusable bag the issue becomes more relevant, with such a large amount of reusable bags being produced – can this still be considered sustainable? We thought this question served to be extremely important with

our project, being that, if this competition follows through and the student designed bag gets passed out to thousands of students what would the ecological footprint of this large consumption look like. In creation of the bag, how many nonrenewable resources are used and at what amount? These were the types of questions we found to be important in selecting the most sustainable material.

LDPE bag (low-density polyethylene) vs. HDPE bag (high-density polyethylene)

LDPE is commonly seen in the material used to make sandwich baggies, and HDPE is typically seen in the production of plastic grocery bags; this is shown in the image below on the right. LDPE bags contain polymer chains that are more highly branched when compared to HDPE bags (Sullivan 2012). This high level of branching leads to a reduction of the intermolecular forces of attraction because the chains neatly stack beside each other, making the plastic softer and more flexible. However, in these LDPE bags, a softer, flexible material leads to a lower tensile strength, which is the maximum amount of load a material can support without breaking when it is stretched divided by the original cross-sectional area of the starting material (The Editors of the Encyclopedia Britannica 1998). Although LDPE bags are flexible and soft, they are extremely weak when it comes to holding materials. The tensile strength in HDPE bags, however, is much greater because their polymer chains are extremely linear. Linear polymer chains increase intermolecular forces and the formation of a crystalline structure, which is much less flexible but extremely durable. The lifecycle impact of LDPE bags mostly stems from the transport of materials to the manufacturer and the distribution of bags to supermarkets; these processes greatly affect human toxicity, acidification, and eutrophication, which can be seen in the third image below (Edwards & Fry 2011). The end-of-life processing for LDPE bags, unfortunately, is similar to that of HDPE bags because they are designed and modeled in the same fashion. Also, LDPE bags are much more expensive than HDPE bags because more material is required to make polymer branches (Island Plastic Bags 2013). Despite these facts, LDPE bags have a much lower transportation impact than HDPE bags; mainly because most HDPE bags are produced in China while the LDPE bags in the 2011 study were made in Turkey. Also, when it comes to the environmental impact of LDPE bags, they only have to be reused 4 times to put them below the global warming potential of HDPE bags (Edwards & Fry 2011).



Image courtesy of the University of Oregon Chemistry Department (2012)

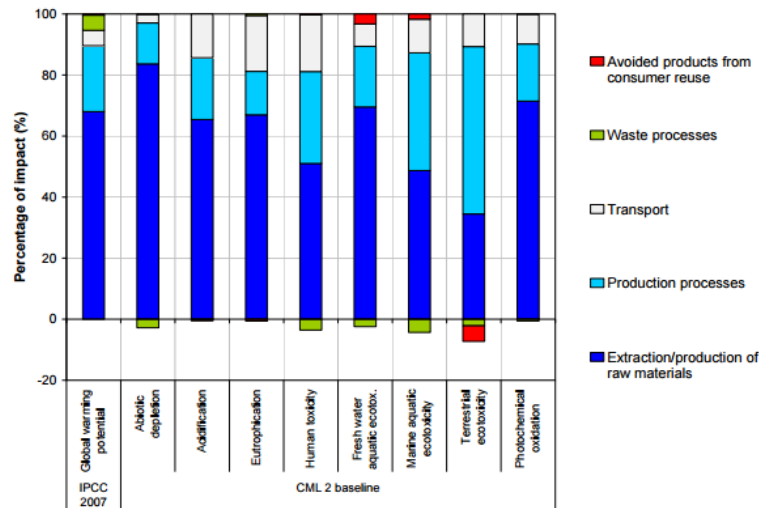


Figure 5.7 The lifecycle impacts of the LDPE bag.

NWPP bags (non-woven polypropylene “bag for life”)

NWPP (non-woven polypropylene) bags are the typical, cheap reusable bags seen in many grocery stores (see image). They contain thermoplastic polymers, which are petroleum-based (ECOBAGS 2017). To make NWPP bags, polypropylene beads are melted, spun, extruded, and pressed into rolls, and the final rollers have a distinct pattern to create the fabric-like texture that feels like canvas (1 Bag at a Time 2017). NWPP bags are also referred to as “bags for life” because they are thought to be something that people can reuse for the rest of their lives. They have ideal material qualities: they are extremely reusable, washable, recyclable, and creative in terms of design. Many retailers can be creative when it comes to designing NWPP bags; they come in many different shapes, sizes, and colors, and stores are able to put their own logos, designs, catchphrases, and slogans on the bags at a relatively inexpensive cost (Kimmel, Cooksey, & Littman 2014). Many of these bags are given away as promotions, because having a logo on the bag helps customers remember where they acquired it and continue to shop there.



Image courtesy of Bag Maverick (2017)

However, despite these benefits of NWPP bags, they have major drawbacks that need to be addressed. The vast majority of NWPP bags are made in China, where labor is very cheap. There are also high emissions associated with the transportation of these bags from China to the United States (Morris & Seasholes 2014). The true cost of these bags, however, stems from their lifecycle impact on the environment. They cannot be recycled easily because customized logos and designs usually feature bright colors, which cannot be broken down easily. Also, the actual bag and its handles are made of a fabric-like material that can easily become caught and jammed in sorting machines, which can sometimes break them (Kimmel, Cooksey, & Littman 2014). As far as the environmental impact, NWPP bags have extremely high impacts on abiotic depletion, acidification, freshwater eco-toxicity, photochemical oxidation, and eutrophication, which all stem from the material extraction and production stages of its lifecycle (Edwards & Fry 2011). The fiber used in the non-woven bag comes from cotton cultivation, which releases nitrogen causing large amounts of eutrophication. There is also a unique industrial furnace used in the process of making NWPP bags that burns heavy fuel oil and emits nickel and vanadium, which contributes greatly to eco-toxicity.

Overall, NWPP bags are great for businesses that are trying to gain a head start and spread word of their company quickly and inexpensively, but the environmental impact of the bags should be considered before mass production. A single NWPP bag need to be used 11 times more than the traditional HDPE bag in order to put them below the global warming potential of HDPE bags (Edwards & Fry 2011). As discussed in the rest of this report, customers need to have an incentive and connection to the bag that will keep them from forgetting their bags at home when they go shopping. If companies spent more time thinking of creative and unique designs for their bags, less money on over-seas transportation, and gave customers a reason to remember their bags when they decide to visit, NWPP bags could easily surpass HDPE bags in terms of lifecycle impact.

Paper

Although paper bags only need to be reused 3 times to take them below the global warming potential of HDPE bags, the benefits of using paper are out-weighted by the costs and environmental hazards involved in the production process. There are many more resources required to produce a paper bag than a plastic bag, which suggests that paper bags might actually be worse than plastic bags. The process of moving from old-growth trees to the paper bags we see in many grocery stores consists of a few steps, which include:

1. Making pulp:

Tumbling logs and drums remove the bark that is broken down to a pulp and boiled at high pressure in a sodium hydroxide solution. Then filtered once again where bleach and color is added.

2. Beating

This process involves pounding and squeezing pulp, and includes the addition of filler materials—such as chalks, clays, or titanium oxide.

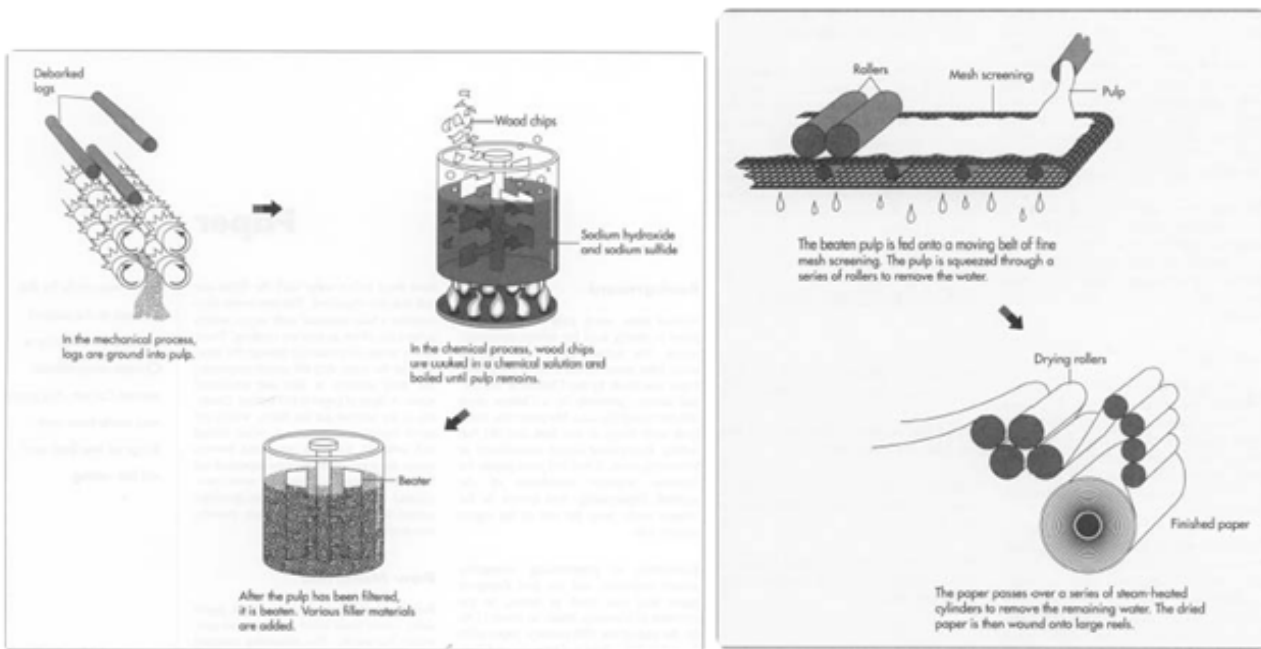
3. Turning pulp into paper

This process involves pulp being fed into giant machines (typically called Fourdrinier machines) where moving belts of fine mesh screening squeeze the pulp, drain excess water, and watermarks are added.

4. Finishing

Tumbling logs in drums remove the bark, then is broken down to a pulp and boiled at high pressure in sodium hydroxide. Then filtered once again where bleach and color is added.

Lastly, the dried paper is wound into large reels, where it is then smoothed and compacted by metal rollers, which are called calendars; the calendars also impart a finish, and coatings can also be added based on the preferred size of the paper (How Products are Made 2017).



Images courtesy of How Products are Made (2017)

The environmental impacts associated with the process of making paper bags exceed those associated with plastic bags. On top of the large amount of trees and vegetation cut down, there are many chemicals used that can be harmful to the environment if they are released into water supplies. Dyes, inks, and bleach are just some of these chemicals that can get released into waterways used for agriculture and sometimes into the production of drinking

water. Many paper companies try to say they plant as many trees as they chop down, but environmentalists say new growth trees, which are smaller and younger than those removed, cannot replace the value of the older trees.

Paper bags are also less likely to be reused as much as plastic bags, typically because of their lack of durability and flexibility. Many people use paper bags once for their groceries and maybe twice for yard waste or recycling material. The paper bags are then thrown away and typically take more time to break down than expected because of all the chemicals associated in the production process. Paper bags also weigh five to seven times more than plastic bags, which adds five to seven more times the weight to the waste stream for municipalities to manage (The Canadian Plastics Industry Association 2012). It also takes at least a gallon of water to produce one paper bag, which is more than 20 times the amount used to make an HDPE bag (Smith-Heisters 2008).

Overall, it is fairly difficult to find accurate information behind the production of paper bags and their environmental impact, usually because those presenting the information are on one side or the other of the paper vs. plastic debate. However, it can be concluded that the environmental costs associated with the production of paper bags outweigh the environmental impact of plastic bags after they have been used, which is shown in the graph below (Edwards & Fry 2011). Paper bags would definitely not be an option for our proposal, based on their limited use, durability, and environmental cost.

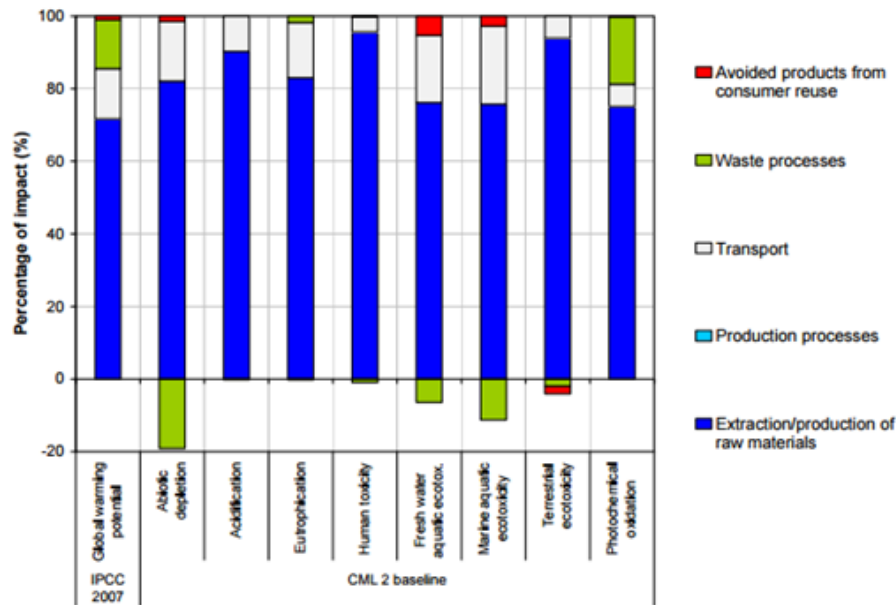


Figure 5.6 The lifecycle impacts of the paper bag.

Image courtesy of Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006 (2011)

Cotton

Cotton is one of the more commonly-used materials to produce reusable bags. Cotton has many benefits in regards to creating an appealing design, and it is very durable and machine washable. There are many websites where cotton bags can be designed and purchased in bulk for various organizations. They are more expensive than NWPP bags, but they do have greater durability and last much longer because they can be washed. Also, when they are washed, the color and design is less likely to fade than what is typically seen in NWPP bags.

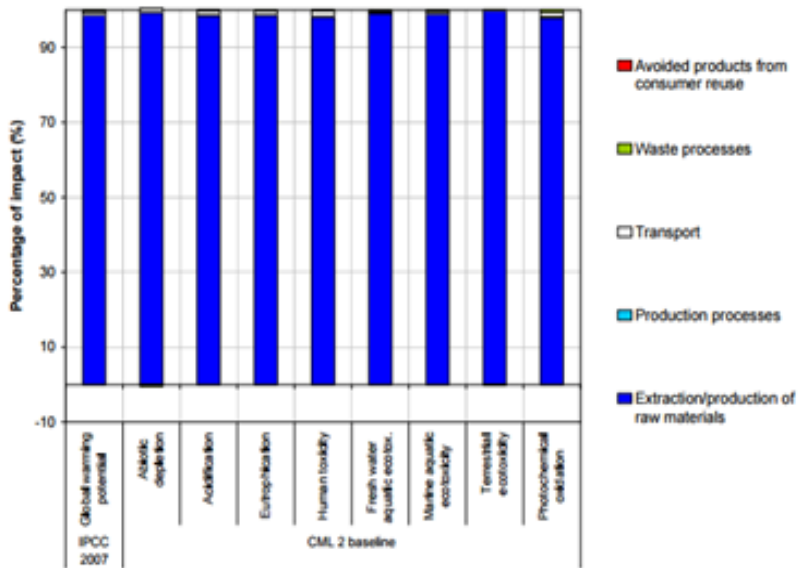


Image courtesy of Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006 (2011)

However, the costs associated with cotton bags are tremendous. The extraction and production of raw materials accounts for almost 100% of their lifecycle impacts, which is seen below. Agricultural production of cotton usually occurs on arid land where a large amount of water is required for irrigation (Lohse 2013). The use of pesticides also increases the carbon footprint and pollution associated with growing cotton, and traditional cotton production accounts for 165 of the world's pesticide use (The Canadian Plastics Industry Association 2012). Cotton bags are not water-resistant (unless extra chemicals are added to the process), cost much more to ship because of their weight, and must be washed regularly in order to avoid cross contamination. This creates another contribution of water use and chemicals used to make laundry detergent

to the growing list of concerns with the production of cotton bags.

Cotton bags have the worst environmental impact in regards to a smaller global warming potential than HDPE bags; they need to be reused 131 times for this to occur (Edwards & Fry 2011). This fact alone demonstrates the idea that the design and possibly environmental impacts associated with cotton bags leads many people to not use their cotton bags to their full potential. Many people will receive cotton bags for free, or pay a small price or them, but after a few uses they usually are forgotten in the back of closet. Many people do not take full advantage of something that is cheap or free, which leads to all the labor that went into producing the bag to go to waste. The message we are trying to convey is to reuse fewer bags, not purchase more and never use them. In conclusion, cotton bags might be a decent option for this proposal, based on the ease involved with creating a design online and their durability, but based on the agricultural costs of producing cotton, there are much better options that will have a smaller life cycle impact.

Hemp

Hemp is an extremely controversial material, typically because it comes from the same plant as marijuana, *cannabis sativa* L. Hemp is different than marijuana for a variety of reasons: to begin, the female parts of hemp bare the seeds and strong fibers used in hemp, while the female parts of marijuana bare the buds and flowers that are typically used for smoking. It is practically impossible to get high from hemp, because marijuana contains anywhere from 5%-20% THC while hemp only contains 0.3%-1.5% THC (HERB 2015). The only hemp products that are legal to sell, buy, consume, and ship must have less than 0.3% THC in order to be considered industrial (Price 2015). Hemp has many amazing benefits: there is no need for pesticides, herbicides, or fungicides because hemp produces these on its own, it is drought-resistant so there is no need for water-intensive irrigation, and it can be harvested three to four times annually because of how fast it grows (Hands on Hemp 2011). Hemp produces twice the amount of



fiber as cotton and 320 times more fiber than typical trees do, and it is machine washable and a great canvas for custom printing (Green Issues 2013). Hemp is also much stronger than cotton and is less wrinkly, so it lasts much longer, making it almost perfect as far as lifecycle impacts and the cost of production.

Unfortunately, there is still stigma around hemp because of its relationship to the marijuana plant. This stigma has led to acts that ban the use of hemp; for example, congress passed the Controlled Substances Act of 1970 to only allow the cultivation of hemp with a special permit and imported hemp products must test THC-free, which is essentially impossible. The Agricultural Act of 2014, however, loosened some of these restrictions by allowing cultivation for research purposes in states that have permit-issuing regimes for industrial hemp (Seidman 2016). This permit is usually very difficult to acquire, though. There isn't much research into making the plant have less THC, most hemp is imported from other countries where it is not as restricted, which leads to an increased in global warming impacts associated with transportation.

Hemp would be a perfect candidate for the reusable bag's desired material, based on its small environmental impact and cultivation requirements, but until the stigma around marijuana is lessened, it will be difficult to import the material required to make enough bags for the students at WMU's campus. There is a positive side, as more states allow marijuana to become legal, such as Colorado, the production of hemp will also become easier. Maybe in future years students could lead the way in becoming the first campus to distribute eco-friendly, reusable hemp bags.

VII. Limitations of the Analysis and Proposed Future Work

This project needed a source of funding to become a viable solution to the current reusable bags distributed on campus and the rampant use of HDPE plastic bags. Originally, this was a major limitation, as we were not sure if WMU, WSA, stores, or another source would be able and willing to sponsor a campus bag given our time frame. The deadline for an SSG passed the Thursday before Spring Break, which did not allow our group time to apply and secure potential funding for the spring semester. We were unable to find other grants that might apply to our project at WMU. However, we did receive significant interest and support from the Western Student Association (WSA). That said, we would either need to be a part of an RSO or have an RSO take on this project in order to receive funding from WSA. To get around this limitation, we wrote an RSO constitution for the formation of a future RSO.

Future work would need to include either a) an RSO being created that could take on the campus bag project and receive funding from WSA, or b) the securing of an RSO willing to take on the project to receive funding from WSA. Additionally, an SSG would likely need to be applied for to further fund the project, including a graphic design competition to generate student excitement and investment in a campus bag, as well as to fund the bag manufacturing. If a future group takes on this project, the stores that expressed interest in funding a design competition would need to be contacted and the actual donation would need to be secured. Other future work includes creating the final draft of the design contest poster and nailing down an exact manufacturer and bag type for the campus bag.

The life cycle analysis that was researched was limited by the bag types thoroughly investigated. For instance, many scholarly articles did not go into an in-depth analysis of bags that were made from jute material, so we were not able to fully compare these bags to other reusable bag types, such as Non-Woven PP. Because of this, our recommendation may not be fully comprehensive and may need to be altered based upon further investigation and knowledge.

VIII. Conclusions/recommendations

To summarize, we believe NWPP bags would be the best material to use for our proposal. This material would be able to hold a design created by students, yet still be affordable so that the university could buy them in bulk without overcharging students. NWPP bags only need to be used 11 times to lower themselves below the GWP of HDPE plastic bags. The only caveat with NWPP bags is their overseas production, but if future students could find a company that produces NWPP bags in the USA, the environmental impacts associated with transportation and fossil fuel emission could lessen dramatically. Another excellent choice

In regard to campus involvement, the best way to tackle the issue is to team up with the student body government (WSA) and use their resources to allow us to reach as many students as possible. The end goal is to see a design competition come to life and bring excitement and student interest to campus. When we discussed our ideas with WSA, the Vice President, Logan Brown, was very enthusiastic about engaging the WMU student body and also mentioned the idea of involving our new WMU President to be a guest judge for the design competition. The Sustainability Chair and President also expressed interest in the project, suggesting it could potentially be carried out in the fall if an RSO took it on for funding.

By having the highest ranking faculty member become a major figure of the competition will help promote the legitimacy of the event as well as show the university following through with their commitment to sustainability.

The top recommendation for this project is for a future group of students, potentially in the fall semester, to pick up this project and finalize the funding for the design competition and actual production of the bag. We have done all of the research needed and contacted the necessary individuals to make this bag project successful with the proper funding. This is essentially a how-to guide for students to follow and continue, with nearly everything they would need to have a successfully end product by Bronco Bash of 2018. We suggest that the future group create a Registered Student Organization; a rough draft of an RSO constitution is included in Appendix (NUMBER). Creating an RSO allows WSA—who is only allowed to give out money to RSO's with a specific cause--to provide funds.

In lieu of another student group from ENV5 4100 not picking up this project, we would suggest an already established RSO at Western to finish through to our end goal. Being that an existing RSO is already established, it would have the immediate ability to obtain funding from WSA. A group of students or an organization could also write and apply for a Student Sustainability Grant (due the Thursday before Thanksgiving for the Fall allocation) as another possible way to fund this project.

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X. Appendices

Appendix I. ENVS 4100 Group Contact List

Name	Email	Phone Number
Alyson Melnik	alyson.r.melnik@wmich.edu	(313)719-1951
Hunter Ward	hunter.n.ward@wmich.edu	(269)312-6852
Sara Holgate	sara.e.holgate@wmich.edu	(517)215-9378

Appendix II. Project Contact List (External)

Name	Position	Email	Phone Number
Albarran, Gerardo	Store Manager, Sawall Health Food Store	_____	(269)343-3619
Brown, Logan	Vice President, WSA	logan.r13.brown@wmich.edu	_____
Butler, Emily	Head of Marketing, Earth Fare	_____	(828)281-4800
Decker, Mitchell	Sustainability Chair, WSA	mitchell.r.decker@wmich.edu	_____
Gipper, Judy	Director, WMU Dining Services	judy.gipper@wmich.edu	_____
Glasser, Harold	Executive Director for Campus Sustainability, WMU Office for Sustainability	harold.glasser@wmich.edu	_____
Green, Isaac	Employee, WMU Office for Sustainability	isaac.s.green@wmich.edu	_____
Hurst, Katie	Marketing Director, Water Street Coffee Joint	katie@waterstreetcoffeejoint.com	(269) 870-6283
Langley, Anthony	Manager, Earth Fare	_____	(269)343-4160
Lymon, Chiante	President, WSA	Chiante.n.lymon@wmich.edu	_____
Nabors, Erik	Front End Manager, Kalamazoo People's Food Co-Op	Frontend@pfckalamazoo.coop	(269)342-5686

Appendix III. Contact Log

Strait, Lynnae. Meeting. 17 March 2017.

In attendance: Hunter Ward

Location: Kalamazoo Book Arts Center, Park Trades Center, Kalamazoo, MI

Discussed prospect of creating a WMU-themed design incorporating sustainability for a reusable bag.

Contact inquired as to whether position was paid. No funds were available for design and contact was doing too much freelance work to pick up project.

Green, Isaac. Meeting. 28 March 2017.

In Attendance: Alyson Melnik, Hunter Ward, Sara Holgate

Location: WMU Office for Sustainability

Discussed overall campus bag project. Isaac mentioned that we should contact the People's Food Co-Op and Sawall's Health Foods about some type of partnership with a WMU Reusable bag and to research these stores' bagging practices. Isaac mentioned that our group should pursue our idea of creating a graphic design contest for the reusable bag to get students invested and involved in the project. Other ideas talked about included using this project as an exposé of plastic and various types of reusable bags, contacting an RSO for potential support of project, or creating an RSO designed solely for distribution of sustainable projects (I.e. reusable bag, EcoMug, etc.).

Hudson, Terence. Email. 1 April 2017.

Contact Position: Director, WMU Bookstore

Sent by: Hunter Ward

Inquired about meeting to discuss plastic bag use and reusable bag use in WMU bookstore.

Albarran, Gerardo. Interview. 1 April 2017.

In Attendance: Alyson Melnik, Hunter Ward, Sara Holgate

Location: Sawall's Health Foods, Kalamazoo, MI

Discussed Sawall's bagging practices at checkout. Talked about reusable bags currently offered at Sawall's and reusable bag incentive program currently offered at Sawall's. Inquired about possible financial support (via cash prize or gift card) for a student reusable bag design competition for a WMU campus bag and potential discount for students who use bag in store.

Nabors, Erik. Interview. 1 April 2017.

In Attendance: Alyson Melnik, Hunter Ward, Sara Holgate

Location: People's Food Co-Op, Kalamazoo, MI

Discussed Co-Op's bagging practices at checkout. Talked about reusable bags currently offered at Co-Op and reusable bag incentive currently offered at the Co-Op. Inquired about potential financial support (via cash prize or gift card) for a student reusable bag design competition for a WMU campus bag and potential discount for students who use bag in store.

Decker, Mitchell. Email. 3 April 2017.

Contact Position: Sustainability Chair, WSA

Sent by: Alyson Melnik

Discussed prospect of funding and support from WSA for bringing a reusable bag to campus and/or for graphic design competition funds. Also discussed potential creation of RSO for distributing sustainable products and whether that would enable WSA support in the future.

Gipper, Judy. Interview. 6 April 2017.

In Attendance: Alyson Melnik, Hunter Ward

Location: Dining Services Office, Room 161, Bernhard Center

Discussed carryout reusable bag program initiated by Dining Services that replaced plastic and paper bags previously offered at carryout. Gipper mentioned that the reusable bag program was not successful overall.

Decker, Mitchell, Logan Brown & Chiantie Lymon. Meeting. 5 April 2017.

In Attendance: Alyson Melnik

Location: Bernhard Center

Discussed the possible interest WSA would have in this project and the steps to take to be able to receive the funding for the bag. Also discussed ideas for spreading the bag competition campus wide, suggestion of getting the new president involved was brought up in order to publicize the event.

Hurst, Katie. Email. 14 April 2017.

Contact Position: Media Director, Water Street Coffee Joint

Sent by: Aly Melnik

Inquired interest in a possible sponsor for the actual bag and bag competition. Katie showed interest in the project and was willing to set up a discussion into the next steps for us to acquire funding from Water Street. She explained that it usually takes at least a month ahead of time to go through the paper work and confirmations needed.

Langley, Anthony. Interview. 17 April 2017.

In Attendance: Hunter ward

Location: Earth Fare, Portage, MI

Discussed Earth Fare's current bag use. Anthony said that Earth Fare does not have a reusable bag incentive program (like Sawall's and People's Food Co-Op, who do have these programs). Anthony said that any sponsorship from Earth Fare for the design contest would need to come from corporate. He provided corporate contact information.