



Research Paper/ Business Plan

Table of Contents

Introduction.....	3
Climate Change.....	3
Overview.....	3
Impacts.....	3
Greenhouse Gasses & Atmospheric Chemistry.....	4
Landfills and Waste Disposal.....	8
Traditional Composting.....	9
Overview.....	9
Evaluation as a Waste Disposal Strategy.....	9
In-Vessel Composting.....	10
Overview.....	10
Aerobic vs. Anaerobic.....	11
Executive Summary.....	13
Market Opportunities and Analysis.....	15
Composting Ordinances.....	18
S.W.O.T. Analysis.....	20
Strengths.....	20
Weaknesses.....	21
Opportunities.....	21
Threats.....	21
Organization Description.....	22
Marketing Plan.....	23
Target Consumers.....	23
Unique Selling Proposition.....	23
Distribution Plan.....	24
Market Materials.....	25
Partnerships.....	25
Retention Strategy.....	27
Financial Projections.....	27
Comparative Analysis.....	30
Bibliography.....	32

Introduction

Food waste directly contributes to the levels of greenhouse gases within our atmosphere, which decreases air quality and causes shifts in the global climate. This seemingly trivial issue has a huge impact on our world. Composting is a sustainable method that removes these negative emissions, and converts unused food into nutrient-filled soil.

Climate Change

Overview

Current trends in global temperatures and CO₂ levels (parts per million) have led to a relative scientific consensus about man-made climate change. Since the industrial revolution carbon dioxide and methane levels have increased within our atmosphere by an exponential amount. These compounds raise the global temperature, because many of them are extremely dense, and therefore sit lower in the atmosphere and trap heat closer to the earth's surface. (EPA, Overview of Greenhouse Gases)

Impacts

A raise in the overall global temperature by as much as 2 degrees Celsius could potentially cause cataclysmic natural disasters, which would continue even if the amount of greenhouse gasses being added to the atmosphere was decreased. (NASA). Ice caps melt, which raises sea levels, destroying shore side infrastructure and property, and in extreme cases causing a significant loss of life. Small island nations are the first

casualties of rising sea levels. Climate change has the potential to destroy human society, by causing devastating droughts that destroy agriculture and crops and massive floods that make submerge entire cities underwater. We can already see the early impacts of climate change today. Studies indicate the amount of hurricanes has been increasing along with constantly climbing temperatures and some of the hottest years on record. In the United States, California experienced a massive drought that affected a large percent of the population. Any measure to decrease global emissions is important for the future of our world.

Greenhouse Gases and Atmospheric Chemistry

Earth's atmosphere primarily contains oxygen gas and nitrogen gas, which collectively contribute to 99% of atmospheric composition (NC State University, 2013). The remaining 1% varies considerably depending on historical land uses, nearby emissions sources, and local carbon sinks. Despite their relative diffusion, greenhouse gases and other pollutants significantly impact atmospheric chemistry and climate conditions (NASA, *n.d.*). In small quantities, gases like carbon dioxide and methane provide a protective layer around the Earth, trapping heat and warming the planet to a degree suitable for life. However, rising greenhouse gas emissions from human activities cause higher temperatures, rising sea levels, and more frequent extreme weather events, destabilizing the climate system and endangering biodiversity. The most prevalent greenhouse gases - carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons - are emitted from agriculture, deforestation, industrial activities, transportation, and residential and commercial buildings (EPA, 2015).

Carbon dioxide (CO₂) is the most prevalent and impactful greenhouse gas, currently present in the atmosphere in concentrations of 405 parts per million (NASA, 2017). Carbon dioxide concentrations have risen exponentially in the past three centuries, contributing to a corresponding rise in global average temperature (Figure 1). Last year, global emissions of carbon dioxide totaled 9.8 gigatons, with the United States responsible for approximately 21% of emissions (CO₂.earth, 2017). Carbon dioxide also reacts with oxygen gas to create two other harmful gases - carbon monoxide (CO) and ground-level ozone (O₃).

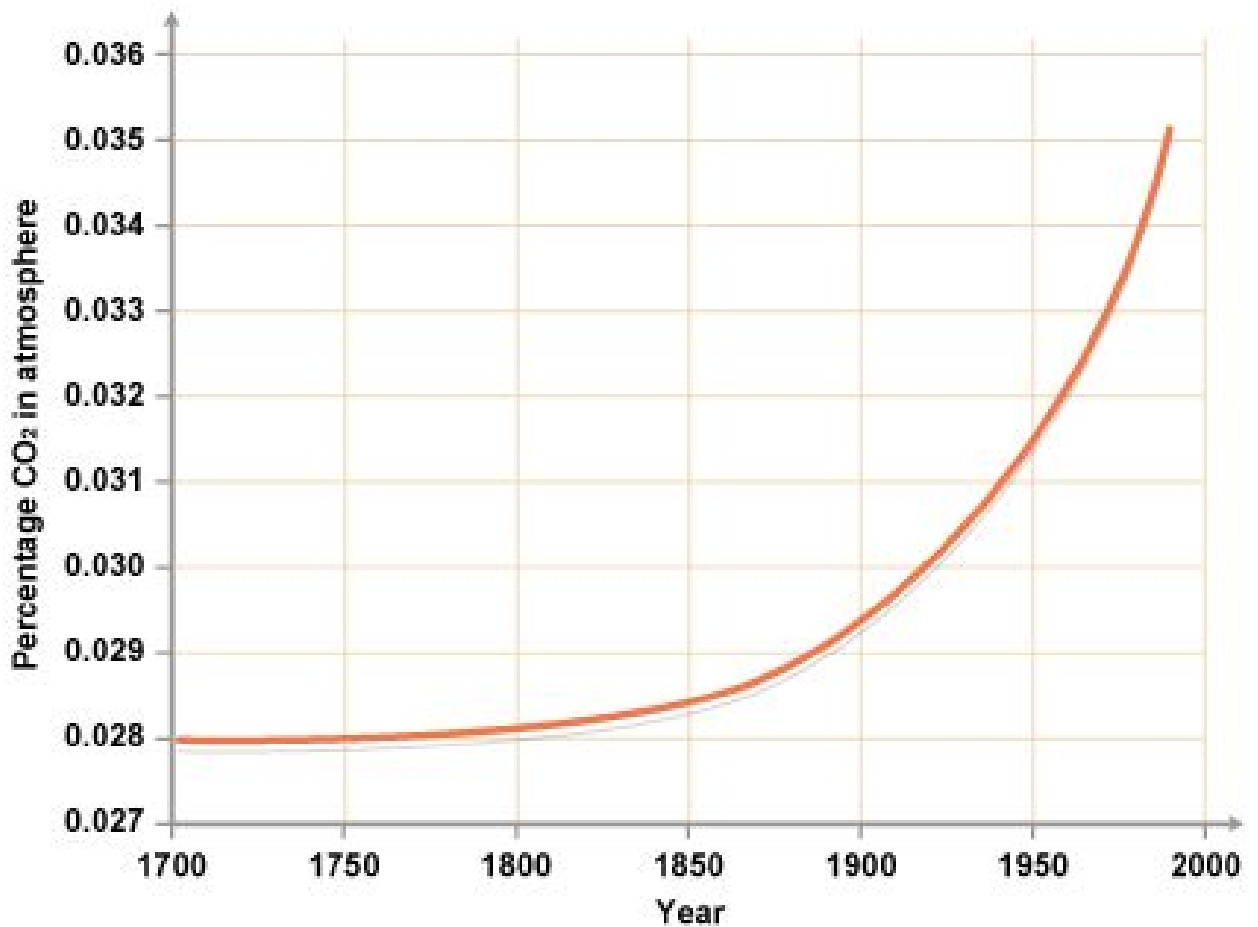


Figure 1 (BBC, *n.d.*)

Methane gas (CH_4) reacts with atmospheric oxygen gas (O_2) to form carbon dioxide (CO_2) and water vapor (H_2O). Water vapor isn't toxic or dangerous, but the increase in CO_2 is dangerous because it is denser than water vapor and sits lower in the atmosphere. This traps sunlight and warms our planet. However, the dangers of methane aren't limited to the greenhouse effect.

Carbon monoxide is toxic to humans. This colorless, odorless, and tasteless gas can cause seizures, induce comas, and is fatal in large quantities. It reacts with hemoglobin to form carboxyhemoglobin, and takes space away from oxygen typically carried throughout the body via this hemoglobin. While these severe health impacts are caused by large concentrations of CO inhaled over a brief period of time, even trace amounts in the atmosphere can lead to negative health impacts for large populations.

(EPA, Overview of Greenhouse Gases)

Ozone gas (O_3) exists in nature and has certain positive impacts for our planet. However, all of these O_3 is located in the stratosphere, and therefore called stratospheric ozone. This means the ozone gas exists somewhere between 6 and 30 miles above the Earth's surface. This very dense molecule shields the planet from harmful UV radiation. However, the amount of O_3 gas needed for this role is very small.

The second type of O_3 doesn't naturally occur. This type is called tropospheric ozone, as it sits in the troposphere, much closer to Earth's surface. This gas is commonly called smog, and hangs over cities with large industrial sectors. This gas is so dense that it traps heat and contributes to declining air quality and increase in lung disorders and

other breathing conditions..

While carbon dioxide is an important greenhouse gas, methane poses a much more significant threat to Earth's environment and human populations. Methane breaks down significantly faster than carbon dioxide, which is harmful because it leads to the creation of CO and O₃ gases. Methane's lifetime, on average, is about a decade but carbon dioxide's lifetime can be centuries long. (EPA, Importance of Methane)

Methane is commonly overlooked because of the focus on carbon dioxide. However, methane is more influential and damaging than carbon dioxide. A methane molecule is composed of one carbon atom covalently bonded with four hydrogen atoms and thus has a chemical formula of CH₄. Methane is a greenhouse gas (GHG) and generates 75% of natural gas. CH₄ also accounts for about 20% of global emissions. (EPA, Understanding Global Warming and its Potentials)

Methane is produced less and has an inferior concentration in the atmosphere compared to carbon dioxide. However, methane is considered more dangerous. It is widely agreed, "Methane is more than 25 times as potent as carbon dioxide at trapping heat in the atmosphere". (EPA, Importance of Methane) Some of the heat that would usually be reflected back into space becomes trapped in the Earth's atmosphere. This additional heat leads to global warming/climate change. Carbon dioxide has a much longer lifetime than methane, and therefore more gradually affects climate change.

Methane poses other dangers besides the effects on the atmosphere. Methane is an extremely flammable gas as well as an explosion hazard in enclosed areas. If ignited poisonous gases will be produced in the fire. During these fires, there is also the

possibility of their containers exploding. Chemical burns are hazardous to human health. Additionally, methane is an asphyxiant and depletes oxygen in enclosed areas causing “suffocation with symptoms of headache, dizziness, weakness, nausea, vomiting, loss of coordination and judgment, increased breathing rate and loss of consciousness”.

Methane can be emitted from a variety of anthropogenic and natural sources. An anthropogenic source is one that is human-influenced, like landfills. In the United States landfills accounted for approximately 20.2% of the United States, total anthropogenic methane. (EPA, Importance of Methane) At this percent, methane emissions exclusively from landfills are the third largest source of CH₄ emissions in the United States. Methane is basically produced through the decomposition of organic waste under anaerobic conditions. Inventory of U.S. Greenhouse Gas Emissions and Sinks provide a more detailed explanation of this process: 1990 – 2014 “After being placed in a landfill, organic waste (such as paper, food scraps, and yard trimmings) is initially decomposed by aerobic bacteria. (EPA, Overview of Greenhouse Gases) After the oxygen has been depleted, the remaining waste is available for consumption by anaerobic bacteria, which break down organic matter into substances such as cellulose, amino acids, and sugars. These substances are further broken down through fermentation into gases and short-chain organic compounds that form the substrates for the growth of methanogenic bacteria. These methane (CH₄) producing anaerobic bacteria convert the fermentation products into stabilized organic materials and biogas consisting of approximately 50 percent biogenic carbon dioxide (CO₂) and 50 percent CH₄, by volume.” (EPA, Importance of Methane)

Landfills and Waste Disposal

Landfills pose a significant problem for the environment, especially relating to how they affect the decomposition of natural material. Food in landfills is subjected to anaerobic composting which is significantly worse for the environment. This rotting food produces large methane emissions, which could be avoided by using sustainable aerobic composting. Waste disposal in landfills is already harmful because it often causes pollutants to seep into soil beds and negatively affect communities. This is sadly most unavoidable for waste that cannot be recycled or composted, but increasing the mass of landfills with compostable food waste is much more unnecessary and harmful to ecosystems and the Earth as a whole.

Traditional Composting

Overview

Composting is an organic form of decomposition for animal and plant matter, typically intended for human consumption. Individuals commonly compost this unconsumed nourishment, called food waste. From a fiscal standpoint, it provides free new soil and only requires water, space, and time. From an environmental standpoint, composting is beneficial because it reduces the volume of food waste in landfills.

Organic matter typically isn't an environmental hazard because it breaks down in a series of chemical reactions, which produce harmless chemical products (nutrient dense soil, H₂O, and water molecules).

Evaluation of Composting as a Waste Disposal Strategy

While composting only works for organic material, a large amount of landfill mass is compostable. Most recyclable products, specifically those made of wood, paper, and cardboard are easily compostable with the proper enzymes. Wood waste and other plant and animal matter decompose naturally over differing amounts of time, and these are the most commonly composted materials. This is because the process happens naturally and doesn't require anything more than space, water, and time. However, composting does require a specific environment that isn't achievable everywhere.

Rotting food attracts a variety of animal life that can flock to compost piles. While the space requirement also sounds easy to achieve, over one billion tons of food are thrown away each year in the U.S. alone. This is a massive amount of food waste for society as a whole, and while individuals can compost their own waste, industrial composting is much more difficult.

In-Vessel Composting

Overview

In-vessel composting refers to the process of composting organic material in a controlled, contained, and enclosed environment. Factors that are controlled during the

composting process include temperature, moisture, and airborne emissions. Through in-vessel composting, mechanical processes, such as rotating the contents of the vessel, can rapidly increase the efficacy the composting process. Unlike tradition composting methods, in-vessel composting allows organic material to decompose faster. By constantly controlling the surrounding environment, invariability such as weather conditions no longer have an effect on the decomposing material. Time efficiency is not the only benefit to composting in a contained vessel. In-vessel composting takes up very little space, and can be implemented virtually anywhere.

Aerobic and Anaerobic Composting

Aerobic composting is one of the two types of composting. Aerobic composting refers to the biological process of organic matter decaying due to microorganisms that consume the material. These microorganisms require exposure to air in order to survive and decompose compost. In nature, most composting is done through aerobic composting, but it's also more efficient for man-made food waste composting. In order to increase time efficiency for the composting process, rotating the contents allows it to be exposed to more air. Adding water also speeds up the composting process.

Anaerobic composting is the decomposition of organic material due to microorganisms that do not require exposure to air to survive. In nature, this type of decomposition mostly happens underground. Anaerobic composting differs from aerobic composting because different microorganisms are used during the decay of food, and it undergoes this process in a different environment than the organic material in aerobic composting. Anaerobic composting creates a more acidic environment. Although

anaerobic can compost the same materials that aerobic can, certain materials take longer. Examples of these materials include weed seeds and pathogens found in compost.

There are many disadvantages to anaerobically composting. Firstly, anaerobic composting takes a significantly longer time to fully decompose in comparison to aerobic composting. This is not the only disadvantage. Anaerobic composting also creates a stronger smell, and attracts more insects and animals. Thirdly, unlike aerobic composting, anaerobic composting creates an acidic environment that produces high levels of pH. The acidity of the compost prevents the immediate use of the new soil created. If the soil were used, the acid contained in it would kill the plants that came into contact with it. Because of this, the soil created through anaerobic composting must neutralize. This process takes about one month, which only adds to the amount of time it takes to get the end product of usable soil. In conclusion, anaerobic composting takes longer, creates a stronger odor, and attracts more pests than aerobic composting.

Finally, aerobic composting is preferential to anaerobic composting because it produces less methane gas. Without oxygen to react with, the broken down carbon and hydrogen bond together to form CH_4 . However, in aerobic composting oxygen gas (O_2) reacts to form CO_2 gas and liquid H_2O .

Executive Summary

Landfills produce deadly emissions and greenhouse gases that destroy our ozone layer and pollute the air we breathe. One of the deadliest of these gases is methane. Each year, billions of tons of food waste are added to landfills. It is estimated that 32 percent of food produced is not consumed and wasted (Lipinski, Hanson and Waite). Normally, when food waste is left over a long period of time, it will naturally break down and turn into soil, via a process known as biodegradation. However, when food waste is added to landfill, it can no longer safely biodegrade. Instead, it becomes inseparable from the other trash, and releases methane into our atmosphere. However, there is a solution. Composting is an extremely effective tool in combatting food waste and greenhouse gas emissions.

When food waste is composted, it is kept separate from inorganic trash. This allows it to be safely converted into nutritious soil. The benefits to composting are huge. It's eco-friendly, provides free soil, and saves money on trash services. However, composting is traditionally only done in suburban and rural areas across the country, despite the fact that most of our food waste comes from cities. This is student the Engineer and Science University Magnet School started Wasteless.

Wasteless is a company committed to increasing the access of city residents to composting. We have created an in-vessel compost unit, with the basic exterior of a dumpster. This composter has been created to meet the needs of our consumers: city restaurants and companies. Food is internally shredded, tilled, and watered until fresh soil is produced at the end of the process. The food waste is safe from rodents and other

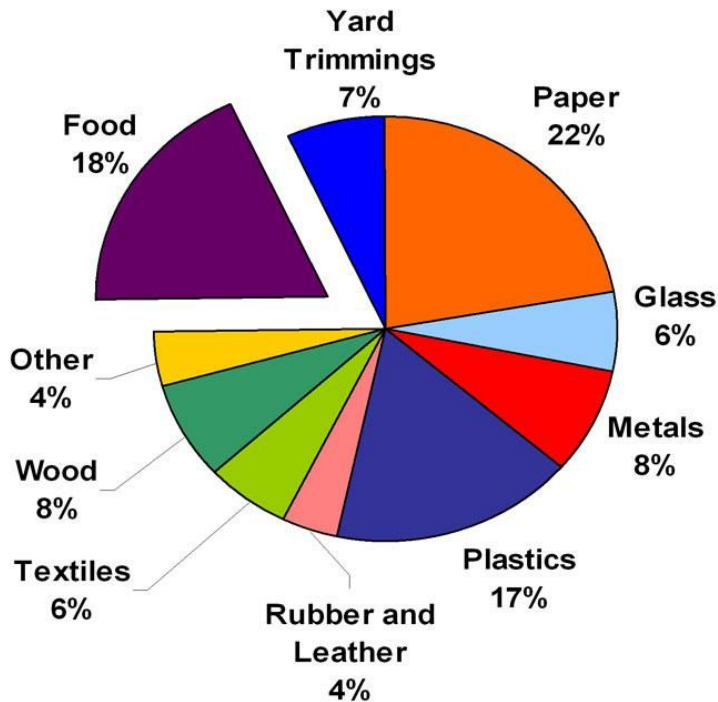
infestations, and doesn't release a pungent smell like traditional compost piles.

Our team is producing 3D models, animations, commercials, and PSAs to spread awareness about the lack of composting in cities. We have created a comprehensive business plan that shows the growing opportunity for a product. Our product is poised to have a massive impact across cities throughout the United States, and we intend to diligently work to make this a reality, and establish a brighter greener society for future generations.

Marketing Opportunities and Analysis

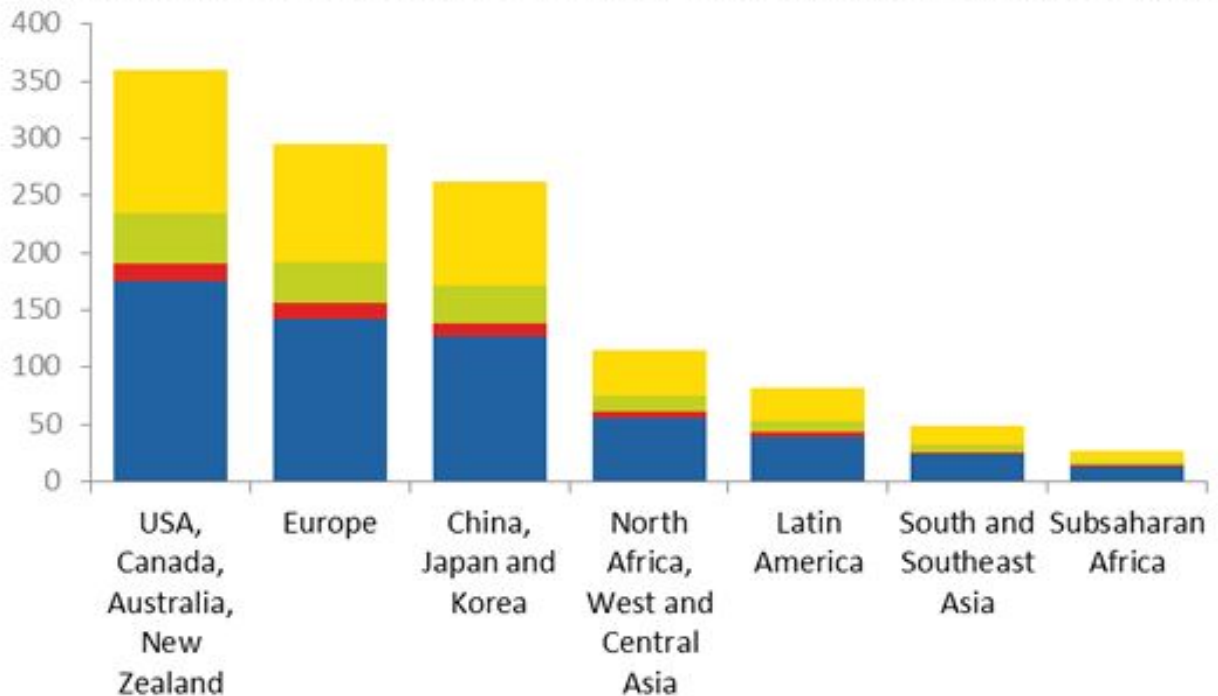
The United States produces roughly \$143 billion in crops and \$153 billion in meat products from livestock. This is an extremely large amount of food, and leads to much of it getting wasted. Americans waste nearly 141 trillion calories worth of food every twenty-four hours (Elton). Not only that, but food waste makes up 18% of the content in landfills (Environmental Protection Agency). As these trends continue to reoccur annually, many people are beginning to be more environmental concerned. Legislation and mandatory ordinances have also been enacted in a legal attempt to reduce greenhouse emissions due to organic waste in the United States.

Municipal Solid Waste Sent to Landfill, 2007



Source: Environmental Protection Agency (2007)

Consumer food waste footprints (kg CO₂e/person)



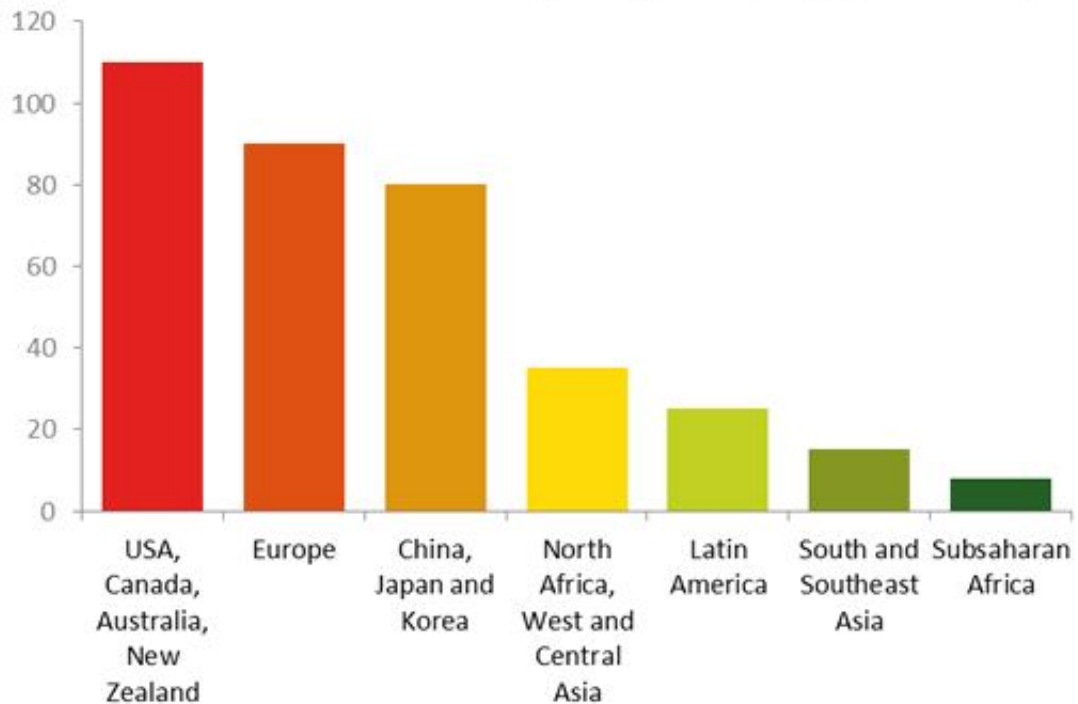
Note: This chart is produced using the global average carbon intensity of food production or all regions. **It is for a descriptive purpose**, and should not be considered an accurate estimate of food waste emissions, as it assumes homogenous production of food across the globe.

Source: Vermeulen et al (2012), Gustavsson et al (2011)



Despite these ordinances being enacted in urban areas, many people and business owners continue to ignore composting. This is because composting is very time consuming to do. Not only that, but composting can't be done year-round in areas where there are colder climates. These are not the concerns for people who don't compost. Many ordinances in cities require that peoples compost does not produce a smell or attract pests of any kind (rats, mice, insects, etc.). These conditions are near impossible for businesses and people, thus deterring efforts to compost.

Annual food waste by region (kg/person)



Note: Figures are consumer waste per capita based on data from 2007 in the FAO report 'Global Food Losses and Food Waste'. Globally consumer food waste amounts to roughly 350 Mt each year which equates to about 50 kg per person or 10% of total food supply.

Source: Gustavsson et al (2011), FAO



Wasteless has an extremely large market to sell our product. Over 10 percent of United States citizens live in major cities. Not only this, but it is expected that the population in the United States is expected to be 685 million people (World Population Review). These numbers not only show that many people live in cities, but they also show that the number of people in cities will only increase as time continues.

Composting Laws and Ordinances

Due to existing and emerging laws and ordinances that require small businesses and restaurants to compost food and organic material, there is a very high demand for an efficient way to compost. Urban areas like San Francisco and Chicago are leaders in creating and enforcing composting ordinances. Many cities are also creating composting programs that connect small businesses and community gardens and urban farms. Farm to Table is a large trend in restaurants. Using compost created from food scraps and organic material, restaurants can use their compost and utilize it as soil for their personal gardens.

San Francisco

The city's Mandatory Recycling and Composting Ordinance (No. 100-09), enacted in 2009, requires that all citizens and businesses of San Francisco separate their compost and recyclables from waste that goes to landfills. Currently, people and businesses are supplied with three disposal bins where they separate their waste. The Food Service Waste Reduction Ordinance (No. 295-06), effective in June 1, 2007, requires restaurants and food vendors to use service ware that is compostable such as cardboard. This has decreased the amount of materials such as Styrofoam ending up in San Francisco's landfills and adding to the carbon emissions that they produce. Similarly, the Plastic Bag Reduction Ordinance, adopted in October of 2009, requires businesses and restaurants to use compostable or reusable bags during checkout.

Vermont

According to the Vermont Agency of Natural Resources, Vermont residences produce 3.15 pounds of waste daily. In 2012, the state of Vermont passed the universal Recycling Law (Act 1480). This law requires that all residences of Vermont separate and recycle three types of waste that are compostable. The three types of waste that must be separated are food waste, clean wood, and paper based goods such as cardboard. If residences and small businesses do not follow the required ordinances Through these ordinances, Vermont hopes to achieve its zero-food waste in landfills by 2020. Also, businesses that generate over 104 tons of food scraps annually are required to donate it to local farms for livestock or compost.

Chicago

Chicago requires businesses and food distributors to compost their food scraps that are produced. By doing this, Chicago hopes to diminish the amount of food that goes into landfills. Chicago has also continued to expand their urban farm programs. In 2011, Mayor Emanuel passed the Urban Farm Ordinance. The ordinance's goal was to incentivize more people to start urban gardens by lowering startup costs, and reducing fencing and parking requirements. Chicago continued their efforts in sustainable urban gardens by introducing an ordinance that expands the permitted materials an individual can compost for urban farms. This ordinance now allows food scraps to be used as

compost for soil production in city farms. Through this ordinance, businesses and farms can create connections for sustainable farming. The produce is then used as ingredients in local restaurants.

S.W.O.T. Analysis

Strengths:

- The size of our unit is significantly smaller than comparable in-vessel composters, allowing it to be easily integrated into cities
- The shredding and tilling process decrease the overall composting time by months
- Repurpose dumpsters, thus helping environment
- Our design has the outer appearance of a dumpster, making it inconspicuous
- All energy is obtained via solar panel
- Decreases the amount of food waste in landfills, and therefore also decreases CO₂ and methane emissions
- Has capabilities to compost bone, unlike other units currently on the market
- A single unit has enough space to be used by multiple businesses
- Incentivizes composting by increasing the efficiency of the process
- Efficient to use via app that is connected to composting unit
- Can be used to compost year-round
- Large market for compost unit in a city environment
- People are becoming more environmentally aware in the United States
- Create incentive for more people to compost food waste
- Easy to use because of app that controls unit

Weaknesses:

- There are other in-vessel composting units on the market
- The composting material will still need to sit for several weeks outside of the unit
- Not made for individual consumers
- Will be sold to businesses located in cities only

Opportunities:

- Legislation in major cities, like San Francisco, are mandating that restaurants dispose of their food waste in environmentally friendly ways like composting
- *Farm-to-Table* restaurants are increasing in popularity nation-wide, and would benefit from a *Waste-less* compost unit
- The current push for renewable energy and decreasing the amount of food in landfill will make finding partners and sponsors much easier
- Several cities have laws that prohibit composting if it produces a notable odor, which our unit does not do
- Cities also require the compost to not attract pests, which our unit does not do
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Threats:

- Safety: sharp parts (shredder) pose a hazard to humans and animals

- Cost: the price of each unit must be affordable for local governments or business owners located in urban areas
- People may not care about composting or reducing greenhouse gas emissions
- It is not guaranteed that other areas of the United States will continue to create mandatory composting laws

Organization Description

Our company started in 2016 with the goal to create a in vessel composter that utilizes aerobic composting processes to reduce the amount of food waste that is contributed in landfills. We hope to make people more aware about the issue of greenhouse gases and create a more efficient composting process for businesses and food distributors in urban environments. We will distribute our product through major cities in the United States, and spread awareness about climate change through our social media, website, and 3D models. Our video game will also create an educational and entertaining platform for people to learn about how to compost correctly.

Marketing Plan

Target Consumers

According to the New York Tourism Board, there are over 18,696 restaurants and food distributed in New York City alone. There is an overwhelming amount of food based businesses all over the country located in cities. This leaves an endless market for Wasteless to sell and profit from our design. Cities are in desperate need of an efficient way to compost their food scraps due to the emerging and existing ordinances that require a certain percentage of organic waste to be distributed. Our company has lots of leverage in selling our product because of the legislation like this.

Due to the continuing of greenhouse gas emissions being produced, it is predicted that these types of laws will only continue to be created. This provides a long-term market for Wasteless to continue to sell our composting unit and gain profit. Wasteless will start selling in major cities such as New York City, Seattle, Chicago, San Antonio, Toronto, and Portland. Once we initially target these major cities, we can later distribute our product to smaller cities such as New Haven.

Although Wasteless is a product focusing on urban composting units, we have the capabilities to later design a composting unit that would be more appropriate for a residential area. Many people do personal composting, and could use a cheaper, smaller

scale model of our original design.

Unique Selling Proposition (USP)

Wasteless has multiple unique ways of advertising our product to potential consumers. Firstly, our company has developed a mobile game that allows players about what types of items can be composted. Not only does our mobile app advertise our product, but it also creates an entertaining platform for people to learn about composting. Our game is a unique way to advertise Wasteless that no other company like us has done.

One other unique aspect of our project is through our websites 3D models and animations. By highlighting our product through engaging visuals and scale models, we can more effectively educate consumers about the anatomy of our composting unit. One important element in selling a product is making sure the consumer understands what your product is and how it works. By allowing business owners to have a better understanding of our unit, we believe this will result in more people purchasing our urban composting unit.

Distribution Plan

Our main distribution model for our company is through our website. The Wasteless website includes information about our mission, 3D models of our product, commercials, and our social media accounts. People can also find an array of research on our website about the effects of greenhouse gas emissions, how composting works, types

of composting, laws pertaining to composting, and the chemistry behind our composting process.

We also plan to spread awareness about our product by attending public events and conventions. By having a booth space where people can interact with the technology in our composting unit, we can also spread awareness about our company. Public functions will be another essential way we make the public more aware about our company.

Marketing Materials

Marketing materials that we will use in to promote ourselves will heavily rely on digital platforms. By continuing to update our website, we can have a strong base for an online presence. We will also continue to post to our social media accounts. Twitter and Instagram provides an easy way to share media publicly. Social media is also an effective tool in getting involved in online composting and farm to table communities.

Physical items are also necessary to market our company. Business cards, brochures, and branded items such as pens, pencils, and water bottles will all be used during events such as conventions.

Partnerships

Farm to Table Restaurants:

One of the main focuses of our company has been to partner with restaurants that are “farm to table”. Farm to table refers to the act of restaurants and food distributors

planting their own produce and then use it as ingredients in their food. By collaborating with these restaurants, we can create connections in urban farming communities.

Biology Professionals:

The reason that food decomposes is because of microorganisms that consume the organic material contained in compost. Through biological processes, food decomposes. By having qualified professionals review our product, it would legitimize the science behind our product. Also, consumers would be more likely to buy our product if biologists backed it up because it appeals to ethos. Ethos is a tool of persuasion theorized by Aristotle that supports the fact that when someone qualified approves of something, it is more likely to be accepted. Having this tool would help us in selling our product. Professionals could include university professors, graduate students, or microbiologists.

Solar Panel Manufacturers:

One of the parts of our composting unit is the solar panel application. Because solar panels are needed in manufacturing our product, it is important that we partner with companies that manufacture solar panels. By collaborating with these companies, we could obtain these solar panels at a cheaper price.

Industrial Shredder Manufacturers:

The shredder is another vital component to our design. By partnering with companies that manufacture shredders, we could also obtain the necessary materials to

fully construct our composting unit. Wasteless has already collaborated with JWC Environmental, and they have provided us with information about their product and shown support of our design.

Municipalities:

Because Wasteless repurposes dumpsters, by collaborating with local cities, we would be able to obtain unwanted, old, or damaged trash containers. Collaboration with local governments in major cities would provide a doorway for us to save money by reusing existing shells instead of having to manufacture a brand-new dumpster.

Welding and Machine Shops:

Welding and machine shops are a strategical partnership because it would provide us with the ability to repair broken dumpsters and construct frames for our unit. These shops have the necessary tools to effectively construct our product during the production phase.

Retention Strategy

Because our composting unit is a product that you purchase once and use over a long period of time, no major retention strategy is needed. However, by advertising online and posting regularly to social media, we can effectively grow the amount of people investing in our composting units.

Financial Projections

The financial projections of our product can be estimated once you consider net income, liquidity, and solvency. Net income refers to the surplus of revenues that your company makes over initial expenses. Liquidity refers to the money that you use to pay off bills. Lastly, solvency refers to the relationship between your company's assets and liabilities.

Our company would first need a startup cost that would cover the production of our units and the shipping of our products. It is projected that these costs would be roughly \$30,00 for a prototype unit. In the early years of our company, we would start with a small office space and require technology to continue keeping up with our website and social media. As our company continues to sell composting units, we will be able to obtain more money and expand the reach of our services. By expanding to the West Coast in cities like Los Angeles and Seattle, we will increase our market, and continue to make money. All throughout this process, we would continue to create partnerships and spread awareness about our product.

First, we would need to consider the cost of the shredder piece of our unit. As stated previously, we have recently been in contact with JWC, a shredder manufacturing company. They have told us that their smallest current model, the (1-SHRED-H-0800), could be sold to us at roughly \$13 thousand dollars. Even with their smallest model, our design could still use a smaller shredder to still perform optimally. In response, JWC said that they may have an even smaller model in the future. Using this information, it is

estimated that our designs shredding component will cost roughly \$10-13 thousand dollars.

The next part of our unit is the solar panels that would power the shredder and drum. To perform these functions, a 265-watt solar panel with 60 cells or more would work. Using this information, we have found that this would cost roughly \$2000 dollars. Solar panels at this price can be found on company websites such as Larson Electronics LLC. This company also sells frames for solar panels at about \$500.

Dumpster Shells are also something that our company needs to obtain to produce our product. Because we are reusing dumpsters, we can obtain them for extremely low prices through partnerships with local city governments. It is estimated that we could purchase a used dumpster at roughly \$1000. There is also the option that we do salvaging in dumps to try to obtain the dumpster shells for free, saving the company even more money.

The welding process of our dumpster shell is another expense that needs to be taken into consideration. Because the amount of money spent on welding will be case by case depending on how damaged the dumpster is, the welding could cost anywhere between \$1500 and \$6000. By creating partnerships with welding shops and providing regular business for them, we could decrease these prices.

Lastly, the battery must be considered. On the market, batteries that would be used in our units cost about \$4000 to \$5000. Because it is powering a rotating drum, the battery needs to have the capabilities to store a large amount of energy that is produced from the solar panels.

Comparative Analysis

The purpose of having a comparative analysis is to highlight the advantages that our company has over existing companies and or products. Wasteless has multiple components to our design that provide consumers with a unique and effective product that is like nothing else on the current market.

Currently on the market, there are many composting units that utilize in-vessel composting. Firstly, companies such as Mantis have developed small in-vessel composting units for people's personal use. Because the target demographic is different in that their composters are for people and not businesses, they pose no threat to our company. This also goes for other personal composter providers and companies.

There are also existing companies that produce in-vessel composters on a larger scale for businesses. Companies such as FOR Solutions create industrial level composters that utilize turning drums to increase efficiency. However, our product has multiple benefits that the competitors does not. Firstly, our design also shreds the compost, which results in even faster composting. Other designs on the market do not use a shredder. Secondly, many current products are extremely large in geometry, resulting in them being unable to be sold to businesses in major cities where space is limited in allies. Our compact design is more suited for cities. Thirdly, our design has the capabilities of being controlled via an app on the consumers smart phone or tablet. This function makes it more efficient for people to use our product versus others that can be found that are being sold. Lastly, our company repurposes dumpsters and turns them into the shells of our composting unit. This creates an inconspicuous design that makes it less likely to be tampered with. This selling point is extremely unique, and gives our company an edge when selling our product.

In conclusion, our product has multiple benefits that other industrial level in-vessel composters do not. Our design is more compact, making it easy for use in urban areas. It also is more efficient because of the shredder component. With the use of app control and the re-using of old dumpsters as a kind of camouflage for our unit, we have many reasons why a consumer would prefer our product over others.

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