The Pennsylvania State University
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ArcelorMittal
Waste Stream Reuse and Recycling

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Section 001

Design Team #7
Team Lions
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# TABLE OF CONTENTS

## SECTION 1. EXECUTIVE SUMMARY

## SECTION 2. INTRODUCTION
2.1 PROJECT OBJECTIVES
2.2 PROJECT BACKGROUND
2.3 SPONSOR BACKGROUND
2.4 PROJECT CATEGORIES
2.5 PROBLEM STATEMENT

## SECTION 3. METHODOLOGY
3.1 SUSTAINABILITY
3.2 RATIONALE FOR SELECTION
3.3 DESCRIPTION OF ALTERNATE CONCEPTS
3.4 REGULATORY ISSUES
3.5 STAKEHOLDERS
3.6 ASSESSMENT OF AMOUNT OF WASTE DIVERTED FROM LANDFILL
3.7 ECONOMIC ASSESSMENT
3.8 SYSTEM DIAGRAM/MODEL
3.9 ENVIRONMENTAL IMPACTS
3.10 PRODUCT DEVELOPMENT AND MARKETING

## SECTION 4. SUMMARY

## SECTION 5. REFERENCES
After careful consideration and research, Design Team Lions determined that the most worthwhile material to recycle would be the steel drums. These drums, which before would just have gone to waste, could instead be made into industrial trash cans to be sold as new products. Although the cleaning and manufacturing process may initially seem long and arduous, the benefits of recycling these used drums will greatly outweigh the costs. The cleaning process of the drums, the necessary safety regulations, and the manufacturing process of the non-hazardous trash cans will be explained in later portions of this report.
SECTION 2  INTRODUCTION

2.1 PROJECT OBJECTIVES. Reduce ArcelorMittal’s waste stream at one of its facilities by designing an opportunity to reuse and/or recycle one or more of the largest sources of refuse: pallets from incoming material delivery, empty drums or totes received from delivery of fluids, and waste refractory brick.

2.2 PROJECT BACKGROUND. Steel is one of the most common materials used by modern societies. It is also a good example of a resource with large known reserves that are finite. As with most of the finite resources we utilize, our industries that use iron and steel initially developed a linear production cycle (see figure below, from www.storyofstuff.org), often referred to as “Cradle-to-grave.” Given that iron is seemingly abundant in the Earth, it was common for steel to be disposed of like everything else: in a landfill. Imagine, then, that, in this project, we are contributing to taking the linear cradle-to-grave process and making it a cyclical “cradle-to-cradle” process. By recycling most of our materials over and over again, we greatly reduce the strain on resources and on waste disposal. For the greatest impact, this must be combined with lowering growth in consumption, eventually reaching a steady-state or even shrinking consumption. Use of recycled steel has been a part of the steel industry since its beginnings, with major efforts made in wartimes when resources were scarce. While steel is often recycled effectively, some of the byproducts of production are not. Many steel companies are able to sell the slag produced in the process of making liquid steel for roadbed filler, and some also sell the iron oxide mill scale byproduct. Arcelor Mittal espouses company values of Sustainability, Quality, and Leadership. In support of the value of sustainability, we look to reduce our overall waste stream to improve the sustainability of our processes. Also, reducing the amount of waste will, in turn, reduce disposal costs, and improving profitability also helps the long-term sustainability of a business unit.

2.3 SPONSOR BACKGROUND. ArcelorMittal USA is the largest steel producer in North America and the largest integrated steel producer in the United States. In addition to being the leader in all major global steel markets, including automotive, construction, household appliances, and packaging, it is the world’s largest and most global steel company by both revenue and production, with over 285,000 employees in 60 countries. ArcelorMittal operates in three divisions in the USA: flat carbon, long carbon, and tubular. The Steelton, PA, plant is in the long carbon division. Similar to the other long carbon plants, the Steelton plant manufactures steel from recycled scrap metals. This plant has a liquid steelmaking capacity of about 1.1 million net tons of steel per year. Product lines include cast and rolled blooms for the forging and rerolling industries; rails for railroad, transit, and crane application; rolled billets, squares, and flats; construction equipment sections; and large diameter specialty ingots.

2.4 PROJECT CATEGORIES.
1. Identify an opportunity for re-use or recycling of waste materials.
2. Examine your opportunity as a system and examine all inputs and outputs.
   a. Consider the connections to the plant, city, region, state, country if need be
3. Design the opportunity and explain how it will help ArcelorMittal reduce its waste footprint.
4. Investigate behavior—how will stakeholders share the vision you are proposing?
5. Ensure that the solution meets all applicable requirements, satisfies relevant regulatory codes, and is economically viable.

2.5 **PROBLEM STATEMENT.** After much research and deliberation, Design Team Lions chose to take on the task of repurposing ArcelorMittal’s abundance of currently unutilized steel drums, so as to prevent these drums from being sent to a landfill.
SECTION 3 METHODOLOGY

3.1 SUSTAINABILITY. A sustainable product, in the eyes of a producer, may be defined as any product which does no harm to the environment and does not further deplete any natural resources. In larger terms, sustainability is extremely important in ensuring that the global environment is maintained for years to come. Thus, in this project, the Lions want to make sure that the conversion process of these drums to trash cans will not be harmful to the environment and that these products will withstand the test of time.

3.2 RATIONALE FOR SELECTION. After completing background research on all three of the material choices, Design Team Lions decided that repurposing the steel drums in a unique way would likely have the biggest impact, both environmentally and economically. When considering the refractory brick and wooden pallets, our design team felt that the repurposing of these materials would be neither cost nor time effective for ArcelorMittal to pursue.

3.3 DESIGN CONCEPT. Although the design concept for the drums itself is rather simple, the production process must be approached very carefully. Because these drums contain materials used in the steelmaking process, it is expected that they may be filled with any number of different hazardous chemicals and wastes, thus making them unsafe for use immediately after being emptied. Although certain restrictions are placed on the type and amount of toxic material that may be housed in each drum, it is still absolutely vital that these drums be properly cleaned before repurposing. Although this process can be very difficult, it must be taken extremely seriously; this process will be discussed more in the next section. After the drum is cleaned, it must be prepared to be used as a garbage can. Should ArcelorMittal choose to pursue this option, they would likely find great economic benefit from then selling these garbage cans to consumers, perhaps including schools, businesses or other industrial plants.

There were a number of other options that were considered. Beyond the cleaning of the drums, each option became vastly different. We considered melting the clean drums down to be recycled, but that option seemed far too costly. We also considered the possibility that these drums could be burned as a heat source to perhaps fuel some sort of mechanism, but this option seemed detrimental to the environment and likely unsafe. However, as long as all the drums are thoroughly and properly cleaned, ArcelorMittal should have no issues in converting the drums to trash cans for resale, an option that would not only bring economic benefit to ArcelorMittal but also minimize ill effects to the environment.
3.4 REGULATORY ISSUES. In designing a solution to this problem, our team discovered that there are likely a few environmental and legal concerns that must be dealt with before the steel drum to garbage can production process can be completed. The drums must first be cleaned in accordance with individual safety regulations based on the chemicals they contained. In other words, a different cleaning process exists for a drum previously filled with a solid waste versus that of a non-solid waste, in the same way that the process would differ from one toxic chemical to another. In order to ensure that the proper cleaning process is utilized, each drum should first be marked with what material was stored inside of it. This will allow those who are performing the cleaning to be entirely certain that each drum is properly cleaned and that the proper safety procedures are put in place before cleaning. Should these procedures be ignored or compromised in any way, the product would likely be unsafe for resale, might cause damage to the environment (in the case of improper handling and disposal of chemicals), and could pose further legal issues for ArcelorMittal.

3.5 STAKEHOLDERS. ArcelorMittal, the major company that will implement the production process described in this report, would benefit greatly from this project. First and foremost, this solution has proven to be a more environmentally friendly option than merely discarding the drums as waste, thus making this option beneficial to the environment and those responsible for treating and managing waste. Further, this solution has the potential to be highly profitable for the ArcelorMittal company as they produce and market these trash cans to consumers. And finally, this solution would likely expand the ArcelorMittal name, as they would be expected to establish a new branch of their company devoted to the production and distribution of these new products. This new branch could bring economic prosperity to the company, its employees, and its stakeholders. Should this solution prove to be as successful as we, the design team, expect it to be, ArcelorMittal could very well become a leader in their industry, encouraging other similar companies to take the same steps in reducing their own waste in creative ways.

3.6 ASSESSMENT OF AMOUNT OF WASTE DIVERTED FROM LANDFILLS. This solution has the potential to prevent a significant amount of useable material from ending up in a landfill. On average, one of these steel drums will weigh anywhere between 33 and 48 pounds. Even taking the more conservative of these two numbers, we can see that given even 100,000 steel drums per year (a very moderate number considering the size of the ArcelorMittal plant), the company stands to keep 3.3 million pounds of steel out of landfills. Consider the fact that many of these drums weigh considerably more than the minimum and the fact that this company is likely going through far more drums per year, and it is easy to see just what an enormous impact this solution could have in reducing waste generated from the ArcelorMittal plant.

3.7 ECONOMIC ASSESSMENT. In order to make an informed conclusion about the economic efficiency of this solution, our team first examined the cost that this solution would impose on ArcelorMittal. Based on extensive research, we found that the average cost of cleaning (here meaning rinsing, leak testing, and inspecting) and repurposing a steel drum which previously contained hazardous material is roughly $30. Assume, then, that the
ArcelorMittal company repurposes these drums and then sells them for $35. Using the conservative figures from the previous section regarding diversion of waste, we then assume that ArcelorMittal converts only 100,000 steel drums per year. This estimate leads us to find that our solution could result in roughly $500,000 in revenue for the company. With these conservative calculations, it is clear to see that the ArcelorMittal company could likely make far more revenue should more steel drums be converted, perhaps reaching anywhere from 1-2 million dollars per year based on resale of these drums alone.
Should these drums merely be left for waste (in a factory or in a landfill), they could eventually pose a toxic threat to the environment and those working around them.

In order to ensure that this product is safe for use, the drums must be thoroughly cleaned in accordance with numerous rules and regulations before being repurposed.

After being thorough cleaning and inspection, the drums can then be used in the ArcelorMittal warehouse if so desired or marketed to potential consumers and shipped out to buyers.
3.9 ENVIRONMENT IMPACTS. If left to waste, steel drums such as those currently being underutilized in the ArcelorMittal plant can pose a significant threat to the environment. First and foremost, steel itself is not biodegradable. Should these drums be disposed of in a landfill, they will never decompose and will remain as permanent waste unless otherwise recycled. Alternatively, should they be left inside a warehouse, they would soon occupy an enormous amount of space due to sheer size. This wasted space could be detrimental to the productivity, and thus revenue, of a company. These effects alone should be enough motivation for a company like ArcelorMittal to pursue more sustainable options. However, because these drums contain hazardous material, they pose an even greater threat to the environment. Should they be disposed of before proper cleaning can take place, they could leak hazardous material into a landfill, contaminating the groundwater, and thus the life, in the surrounding area. If left in a warehouse, this material could be potentially hazardous to those working near it and could pose an even greater threat in the instance of a disaster such as a fire occurring in the plant.

3.10 PRODUCT DEVELOPMENT AND MARKETING. In order to maximize the cost efficiency of this endeavor, ArcelorMittal should first and foremost look for opportunities to use these repurposed steel drum garbage cans in their own factory, thereby saving them the money they would have spent purchasing these products from another company. If it is determined that there is not a need for these garbage cans in the ArcelorMittal plant, the company can then turn to potential consumers of the garbage cans. The most likely consumers would be industrial plants, which often are in need of large, durable trash receptacles. Other potential customers might include large businesses looking to buy products in bulk that would be difficult to find at retail stores or perhaps even schools. These garbage cans could be sold for any price ArcelorMittal sees fit, but, from our research alone, it seems that the minimum price in order to generate considerable profit would be $35 per drum.
Our concept design for the ArcelorMittal company involves taking the currently underutilized steel drums and repurposing them to be used as industrial sized trash cans. This solution would likely generate great prosperity by creating an environmentally friendly and sustainable product from materials previously going to waste. First and foremost, this solution could save the ArcelorMittal company a significant amount of money, whether due to money which would otherwise be spent on purchasing trash cans for the company itself or recycling the unused drums. Although recycling the drums is another environmentally friendly option, it is also a rather costly and labor intensive process. Our solution, on the other hand, bypasses the costly recycling process completely, instead generating products directly from underutilized materials. In addition to saving money, this solution also has the potential to generate a considerable profit for the ArcelorMittal company due to the sales of these repurposed trash cans to other companies. Further, this design concept has proven to be a more environmentally friendly option than that currently being used in the ArcelorMittal plant. Melting down the drums releases carbon admissions into the atmosphere and this in turn hurts the environment. By repurposing the drums without melting them down, ArcelorMittal avoids these unnecessary carbon emissions.

However, despite the numerous benefits our concept design offers, its major shortcoming is that the cleaning process must be carried out with zero mistakes. The cleaning process includes multiple rinses and an inspection, each step requiring thorough inspection and attention to detail. If this cleaning process is compromised in any way, the repurposed garbage cans could pose potential health or environmental threats.

Should ArcelorMittal choose to pursue this design concept, the process could be easily implemented into the company’s fiscal plan for the upcoming year. They could begin implementing the repurposing process at one or a few of their plants and then slowly expand the process to other plants. Should this endeavor prove as successful as our team believes it will, ArcelorMittal may even choose to establish an entire branch of their company specifically designed to produce the garbage cans.

Given the information presented in this design report, it is clear that ArcelorMittal is currently housing underutilized materials in the form of steel drums. The repurposing process we have presented clearly offers numerous environmental and economic benefits, therefore making it the obvious solution to ArcelorMittal’s current dilemma. Should the company choose to pursue this solution, they should contact Design Team Lions for further guidance and research.
SECTION 5 REFERENCES


