Executive Summary

This project was sponsored by the Automotive Recyclers of Massachusetts (ARM) with the goal of assessing the environmental impact of recyclers in the state of Mass. The team was tasked with quantifying the number of vehicles, types of parts sold, types of hazardous waste and the overall amount of carbon saved by recycling. The team started with a literature review of the industry. Due to a lack of source material about the metal compositions of parts and the cost of mining, refining, and producing the metal the team had to calculate those numbers themselves. The team calculated the total amount of metal required to produce the 2015 domestic car production. This was done by using a variety of sources to accurately approximate the fuel and energy cost of mining. The smelting cost for refining of raw and scrap metal. And the production cost to assemble all of the cars. The final number was given as a range due to a variance in the refining process. Refining can take many different forms and techniques and can ultimately take different amounts of energy. The key point to understand in this portion of the process is the massive reduction in energy required to refine scrap instead of virgin metal. The third process is the general production of the cars. This was done by using the largest factory in America and approximating the cost to produce all the cars at that facility. All of the fuel and kWh were then converted to carbon tons using the EPA free software. The final answer being between 78,095,147 and 158,623,481 tons of carbon.

The second step in the process was to acquire information of the industry and operations. This was done via surveys and site visits. The team visited several ARM facilities in order to understand the operations through observation and through conversation with the owners. The second portion was a survey sent to the ARM to acquire data from other members for later usage. This data helped answer questions about the overall system of operations and how many cars and parts were processed in Massachusetts. This data was processed in two ways. As a range of answers due to the wide variance in responses due to differences in size, employees, and business models. Second it was averaged due to the request of the ARM for an averaged answer.

The results of the data and four questions by the ARM were answered accordingly. The number of vehicles scrapped in Massachusetts is approximately 165,500. This was done by averaging the number of cars processed annually by each operation and multiplying it by the total number of ARM members in the state.

Second the variance of parts sold in Massachusetts was calculated by surveying the top sellers at each facility. The common parts that appeared in almost every survey were: wheels, doors, engines, transmission, tail lights and mirrors. These parts were then counted and following the same method as part one were averaged to approximate the yearly sales of each part.

Third was the classification and disposal methods of hazardous chemicals. The team found all facilities in compliance with state regulations and that each facility was wisely disposing of materials. They were selling antifreeze and refrigerants, using the gasoline, and burning excess oils.

Fourth was the environmental impact of recycling. The team used the calculations in the background and with the answer to question one for total cars to tabulate the amount of metal. The carbon cost per ton was then calculate for virgin and scrap tons. The difference between the

two was the amount of savings in tons of carbon per year for the ARM, which was approximately 2.2 million tons a year.

Using the information provided for the most common parts, the project team asses the carbon footprint of the production of these parts using the software Sustainable Minds. This was done by creating a bill of materials for each part and the process required to create those parts. The software provided was with the equivalent amount of carbon dioxide in kilograms required to produce a single part from virgin materials. The analysis consisted of four items, which were the transmission, engine, alloy wheels, and tires. The production of these parts creates 921 kg, 1620 kg, 109 kg, and 36.6 kg of carbon dioxide respectively. From these results it can be noted that the largest positive impact to the environment are made by reusing transmissions and engines. Considering the large number of wheels and tires that are recycled, the comparatively small savings are not negligible.

Assessing the Environmental Impact of Automotive Recyclers of Massachusetts

A Major Qualifying Project

Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the degree in Bachelor of Science in Mechanical Engineering

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Date: April 27 2017

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