An Exploration of Environmental Impacts and Consumer Perceptions of Soft Drink Packaging

Ryerson University
Graphic Communications Management

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Research Question:
How does Coca Cola's present North American plastic, glass and aluminum beverage packaging impact the environment, and how do the results compare with consumers' environmental impact perception regarding those materials?

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Table of Contents

Abstract

There is an increased concern with how packaging impacts the environment. This thesis investigates the environmental impacts of The Coca Cola Company's plastic, glass and aluminum beverage packaging systems, including their secondary packages. As well, consumer environmental impact perception will be explored. A Life Cycle Assessment (LCA) methodology was used to evaluate the packaging systems. An LCA provides a holistic view and identifies a connection between the packaging's life cycle and potential environmental impacts involving it. A survey was conducted with 160 responses asking consumers to rate each packaging on a numerical scale to provide insight on their environmental impact perception. The LCA results concluded that Coca Cola's plastic bottle packaging with plastic shrink wrap had the least environmental impact, followed by the aluminum can with paperboard box and lastly, glass bottle with paperboard carrier had the greatest environmental impact. The survey results contrasted the LCA findings, with consumers believing that Coca Cola's glass packaging has the least environmental impact, followed by aluminum and lastly, plastic bottles have the greatest environmental impact. Further analysis of the results suggests that plastic packaging has a negative connotation due to historical malpractices and the existence of single-use plastic. For there to be a shift in consumer perception, companies can implement more recycled plastic into their packaging, spread awareness around this topic and enhance their packaging designs to reflect these changes. However, there is also a need for more efficient recycling systems, a reduction in the use and manufacturing of single-use plastics, a movement towards creating circular economies and helping consumers understand how to recycle packaging properly.

Introduction

There has been an increasing need for environmental attention, especially in the food and beverage industry (Del Rosso, 2020). The consumer market has influenced the rise of increasing environmental packages that contain less polluting materials, are manufactured in more ecological ways, and a focus on recyclability has been very prominent (Del Rosso, 2020).

Though profit is the primary focus of many food and beverage companies, consumers and their willingness to purchase goods that do not indicate ecological consciousness decreases Whelan, & Kronthal-Sacco, 2019). In 2018, products that visibly claimed to be sustainable accounted for 16.6% of the consumer packaged goods market compared to 14.3% in 2013 Whelan, & Kronthal-Sacco, 2019). In addition, products that were marketed as sustainable showed a 5.6% faster growth rate than their competitors, who were not (Whelan, & Kronthal-Sacco, 2019).

The Coca Cola Company is one of the largest beverage manufacturing companies in the world. With earnings of $37 billion in the past year, Coca Cola has sold billions of beverage packages ranging from plastic bottles, glass bottles, aluminum cans and paper cartons (The Coca Cola Company, 2019a). The Coca Cola Company has also made strides in becoming more sustainable and environmentally conscious.

With a rise in environmental consciousness and sustainability prevalent in the world today, it is important to utilize packaging in an effective and efficient manner that contributes to decreasing environmental impacts. It is also important to study consumers' perception of the packaging and how they respond to the environmental impacts of packaging options. This thesis aims to investigate the environmental impacts of The Coca Cola Company's classic Coca Cola beverage packaging. A focus will be on the North American market, and an evaluation of plastic, glass and aluminum beverage packaging will be pursued in addition to their secondary packages. The findings will also be compared with consumers' environmental impact perception regarding those packaging materials. This thesis will be using a Life Cycle Assessment (LCA) to explore the impacts of those materials on the environment and a Cradle-to-Cradle system boundary will be used to examine the materials.

Literature Review

A literature review evaluates the current landscape of knowledge relevant to theories and methodologies in a topic (McCombes, 2019). This literature review aims to provide an overview of the beverage packaging industry and discuss its impact on the environment. This literature review will also explore consumer environmental impact perception and its implications concerning beverage packaging materials. To further explore this goal, research studies that examined these particular areas were analyzed.

Niero M., Hauschild M.Z., Hoffmeyer, S.B., & Olsen, S.I (2017) evaluates the use of the Life Cycle Assessment (LCA) methodology concerning the beverage industry, eco-efficiency, and eco-effectiveness. An LCA is used to identify a connection between the packaging's life cycle and potential environmental impacts involving it. The packaging life cycle describes creating a package from its raw material extraction, manufacturing, transportation, end-use and disposal phases. Companies in the beverage packaging field had paved the way for implementing environmental sustainability strategies into their businesses. The use of an LCA to approach packaging and sustainability is common. It is a useful tool to quantify eco-efficiency improvements, meaning increasing the value of a package while reducing resource use and environmental impact. An LCA supports the integration of sustainability factors related to design, innovation, and product evaluations. There is a focus on reducing packaging material but maintaining the protective function of a package. Using an LCA allows for opportunities to pinpoint areas to reduce environmental impacts through comparisons. A Cradle-to-Cradle methodology, in particular, aims to provide a positive increase in the footprint of packaging materials. Combining the LCA methodology and Cradle to Cradle scope can offer more information on beverage packaging materials and their impact on the environment.

Saleh, Y. (2016) researched the environmental impacts of beverage packaging materials in Palestine. The materials chosen consisted of glass, aluminum, and PET packaging. Saleh used an LCA methodology to evaluate and compare the materials.

The environmental impacts that are concerned with include "water consumption, non-renewable energy, solid waste, human toxicity, terrestrial acidification, global warming potential, and respiratory effects." Saleh concluded that PET beverage packaging has the least environmental impact. Aluminum and glass packaging material followed afterward. As this study was generally broad in its chosen materials, an evaluation of secondary and tertiary packaging was not conducted.

Simon B, Amor M.B. & Földényi, R. (2016) concluded that packaging materials significantly contribute to ththe beverage value chain's overall impact. Recycling has a significant effect on greenhouse gas emissions, specifically with aluminum cans and glass bottles. There is an emphasis on convincing consumers to recycle, explicitly using "kerbside" bag collection. Simon, Amor, and Földényi conducted an LCA to evaluate beverage packaging materials' impacts on the environment. The research used a functional unit of 1000 L to equalize the varying volumes of their beverages. The study also used a "Cradle to Grave" system boundary to define the LCA evaluation. An investigation of global warming potential, greenhouse gas emissions (GHG), human toxicity air emissions, and transportation impact was carried out. These aspects covered a wide range of factors impacting the environment; however, an evaluation of water usage and human impact was not explored. When the whole life cycle of packaging materials is considered, glass and aluminum beverage cans have the highest GHG impact. However, aluminum cans' GHG impact may decrease more than PET bottles if a closed-loop recycling method was implemented. From this research, it is clear that proper recycling system implementation to recycle materials such as glass bottles, aluminum cans, and PET bottles has a significant impact on the environment.

Dam Y. (1996) conveys the significance of incorporating consumer beliefs into environmentally responsible packaging decisions. According to Dam, packaging needs to be environmentally perceived by the consumer, or else the producer of the package loses a competitive advantage. Marketing ecologically responsible packaging to consumers requires information concerning consumer beliefs. Concerning materials, consumers perceive glass as the most environmentally friendly packaging material by

consumers. Paper is second to glass, followed by tin cans and cardboard beverage containers come after. Lastly, plastic packaging is perceived to have the most significant environmental impact.

This literature review analyzed detailed research conducted in the beverage packaging industry regarding its impact on the environment. It also investigated consumers' environmental impact perception. The largest commonality present between these research studies lies in using a Life Cycle Assessment (LCA) to compare various beverage packaging material types. Using an LCA allows for an analysis of the material, from raw extraction to end of life. However, as many of the studies discussed the broad topic of beverage materials, a closer perspective into a specific company and a look into secondary packaging and how that impacts the environment would be useful in this field. In addition, there is research that separately investigates the environmental impacts of packaging materials and research that separately investigates consumer environmental impact perception. However, there is a lack of intersection between the two areas. The research that will be conducted in this thesis will be combining the results of an LCA methodology and information from consumers.

Packaging Information

This thesis will primarily investigate the following three primary packaging materials; Polyethylene Terephthalate (PET) Bottle Grade Plastic, Container Glass and Aluminum. Secondary packaging will also be considered, and these materials consist of Solid Unbleached Board (SUB) and Low-Density Polyethylene (LDPE).

The Plastic Bottle

Primary Package

The Coca Cola Company produces a Polyethylene Terephthalate (PET) bottle (*Figure 1*). And it will be assumed in this research that Coca Cola uses a bottle cap composed of High-Density Polyethylene (HDPE).

PET, a type of thermoplastic, is commonly used in packaging (Emblem & Emblem, 2012). It has high gas barrier properties, and roughly 90% of PET is used to package mineral water and carbonated beverages. The use of recycled PET (rPET) is increasingly popular for food and non-food products (Emblem & Emblem, 2012).

HDPE is a rigid and high tensile strength plastic (Emblem & Emblem, 2012). It is normally used to manufacture bottles for milk and household cleaner. It is also used for screw caps, such as for milk containers and soft drink bottles (Emblem & Emblem, 2012).

Figure 1: Photo of Coca Cola's Plastic Bottle Primary Packaging

Secondary Package

The Coca Cola company uses a plastic shrink film to secure their primary packaging (*Figure 2*). It will be assumed in this research that Coca Cola uses Low-Density Polyethylene (LDPE) as their choice material for secondary packaging of their PET primary packaging.

LDPE is commonly used as a collation shrink film for secondary packaging. It is a soft and flexible material that stretches before breakage occurs (Emblem & Emblem, 2012).

Figure 2: Photos of Coca Cola's Plastic Bottle Secondary Packaging

The Glass Bottle

Primary Packaging

The Coca-Cola Company uses glass to create their glass bottles, and it will be assumed that aluminum is used for its crimped crown cork closure (*Figure 3*).

Commercial glass is made of silica, which is a component in sand (Emblem & Emblem, 2012). Soda-lime glass, which is a mix of limestone and soda ash, is often the type used in packaging. Metals and calcium compounds can also be added to the glass mixture to strengthen specific qualities. An essential component of glass is cullet, which is recycled glass. Cullet reduces the energy needs of glass manufacturing by enhancing

the melting rate. Glass container production follows three primary methods: blow-and-blow, press-and-blow and narrow neck press-and-blow (Emblem & Emblem, 2012).

A crimped crown cork acts as the glass bottle's closure (Emblem & Emblem, 2012). They seal carbonate beverages and withstand internal pressure from the liquid it contains (Emblem & Emblem, 2012). For this LCA, it will be assumed that Coca Cola uses closures composed of aluminum with a coating.

Figure 3: Photo of Coca Cola's Glass Bottle Primary Packaging

Secondary Package

A paperboard carrier is used as secondary packaging for the glass bottles (*Figure 4*). In this LCA, it will be assumed that Coca Cola uses Solid Unbleached Board (SUB), also known as Coated Unbleached Kraft Paperboard (CUK). This paperboard type is composed of wood fibres, and a clay-coated layer is applied on top to provide a smooth white printing surface (North American Packaging Association, 2019). It also has excellent strength and tear resistance (North American Packaging Association, 2019).

Figure 4: Photo of Coca Cola's Glass Bottle Secondary Packaging

Metal Cans

Primary Packaging

The Coca Cola Company uses aluminum to create their metal cans (*Figure 5*). A two-piece can design consists of a seamless cylindrical body where a flat disk is drawn up and formed into a tall can (Emblem & Emblem, 2012). Metal cans are thermally stable, strong and readily recyclable. Metal cans are relatively low cost, thermally stable, strong, rigid, opaque, easy to process on high-speed lines and readily recyclable. As a packaging material, metal offers a total barrier to gas, moisture and light. These attributes make metal packaging particularly appropriate for long-term storage of perishable products at ambient conditions (Emblem & Emblem, 2012). Pre-cut aluminum closures are sealed onto the tops of the metal cans, and a pull tab is fitted over a rivet pin (Emblem & Emblem, 2012).

Figure 5: Photo of Coca Cola's Aluminum Can Primary Packaging

Secondary Packaging

A paperboard rectangular box is used as secondary packaging for the aluminum cans (*Figure 6*). In this LCA, it will be assumed that Coca Cola uses Solid Unbleached Board (SUB), also known as Coated Unbleached Kraft Paperboard (CUK), similarly to the glass's secondary packaging.

Figure 6: Photo of Coca Cola's Aluminum Can Secondary Packaging

Life Cycle Assessment Information

A Life Cycle Assessment (LCA) will be used in this thesis to determine the environmental impacts of Coca Cola's beverage packaging options. An LCA is used to identify a connection between the packaging's life cycle and potential environmental impacts involving it. The packaging life cycle describes the process of the creation of a package from its raw material extraction, manufacturing, transportation, end-use and disposal phases. The environmental impact categories that will be measured are fossil fuel usage (MJ), greenhouse gas emissions (kg CO2 eq.), water use (kl) and daily human impact (DALY). Trayak's EcoImpact-COMPASS software was chosen to collect this data.

System Boundary

A system boundary defines the range in which the life cycle of a package is evaluated. A cradle to cradle methodological approach is implemented in the LCA. This approach captures the process of the life cycle of a package from raw material extraction to the end of life disposal phase. However, the end of life stage extends to the recycling processes, which aids in creating a conscientious environmental approach. The primary and secondary packaging of each package will be evaluated. For this LCA, the transportation phase will not be considered. A visual representation of the system boundaries can be seen in *Figure 7*.

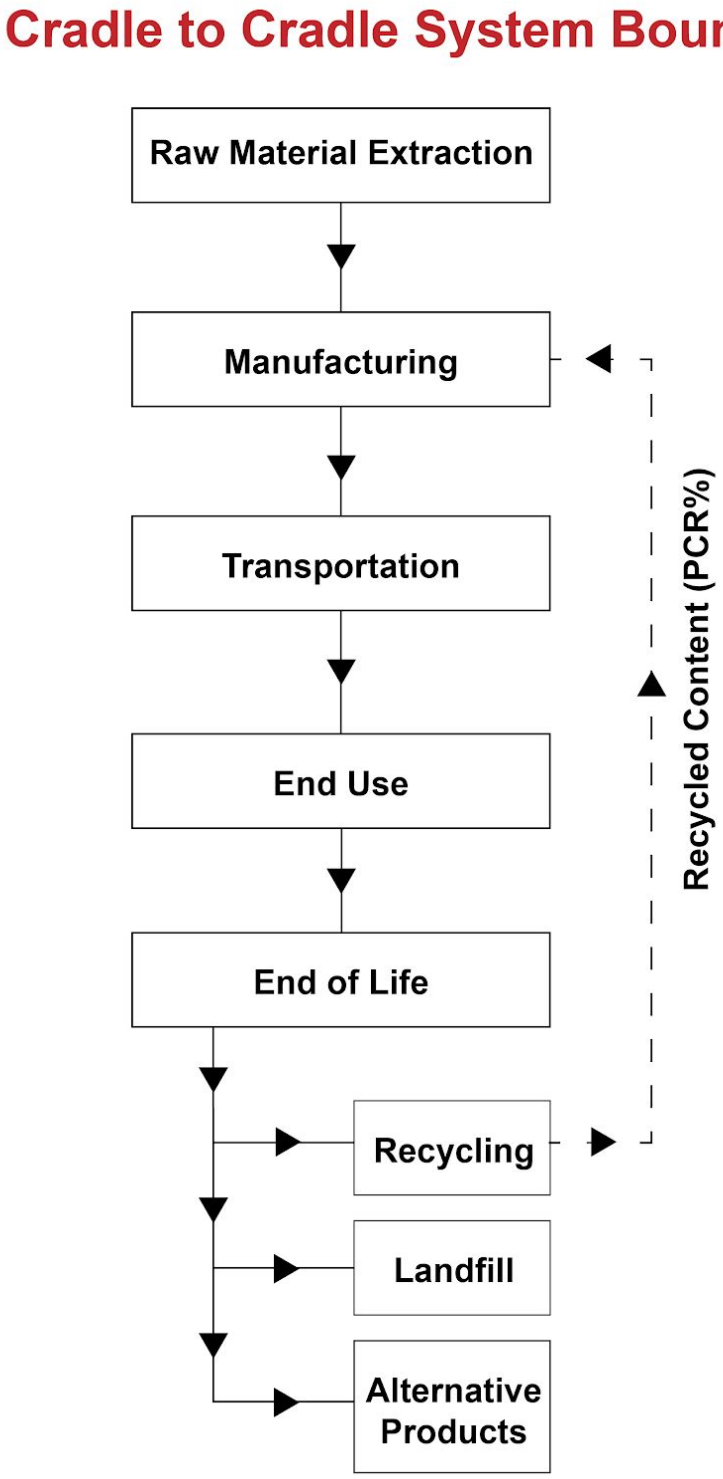

Figure 7: Cradle to Cradle System Boundary Diagram

Functional Unit

A functional unit is a number that allows for equal comparison of several different items. This thesis examines three separate primary packages with varying volumetric capacities and their secondary packages. A functional unit allows for an equal comparison of each package by setting a reference point. The functional unit of this LCA is packaging materials used to contain and protect 1000L of soft drink within the system boundary. Simply put, for each primary package, how many bottles will it take to contain 1000L of carbonated drink. And for each secondary packaging, how many secondary packages will be required to hold 1000L worth of carbonated drinks.

Assumptions and Limitations

An LCA consists of many assumptions and limitations that must be discussed before performing the LCA.

The post-consumer recycling percentage (PCR%) of each primary packaging option and their secondary packages will be assumed in some capacity. The information about PCR% Coca Cola's packaging was not available on their website nor on external sources. However, whilst investigating Coca Cola's European website, some information on their PCR% was discovered. And thus, it will be assumed that the PCR% of the packaging materials are relatively the same in Europe as they are in North America for this LCA. These PCR% are 25% for PET plastic bottles, 47% for glass bottles, and 42% for aluminum can packaging (The Coca Cola Company, 2020b). In addition to that, it will be assumed that PCR% for the Solid Unbleached Board (SUB) also known as Coated Unbleached Kraft Paperboard (CUK) consists of a PCR% of 20% (American Forest & Paper Association, n.d.). However, the LDPE secondary package used for plastic bottles will have a PCR% of 0%.

Manufacturing processes will also be assumed for this LCA. The manufacturing processes for each packaging material were estimated based on industry practices.

Transportation information relating to Coca Cola's services was limited, and thus transportation was omitted from the system boundaries of the LCA. As well, as this thesis focuses on the primary and secondary packaging materials specifically, the omission of the

transportation phase did not play a pivotal role as it was omitted from every single packaging system.

Lastly, due to limitations of the LCA software regarding the functional unit, a convergent factor was manually calculated in order to determine the appropriate weight and number of packages required to hold 1000L of Coca Cola. See (Appendix A) for calculations.

Characteristics of Products Input into the LCA

Table 1: Characteristics of the Primary and Secondary Packaging of Plastic Bottles

Primary Packaging	Material	Mass (g)	PCR %	Process	Packaging Type	Pedigree Score
Cap	High-Density Polyethylene (HDPE)	2816g	0%	Injection Molding	Other	(1, 3, 1, 5, 3,1)
Bottle	Polyethylene Terephthalate	36608g	25%	Blow Molding	Soft Drink Bottles	(1, 1, 1, 2, 3,1)

Secondary Packaging	Material	Mass (g)	PCR %	Process	Packaging Type	Pedigree Score
Shrink Wrap	Low-Density Polyethene (LDPE)	3744g	0%	Thermoforming Plastic Sheet	Other plastic packaging	(1, 3, 1, 5, 3, 1)

Table 2: Characteristics of the Primary and Secondary Packaging of Glass Bottles

Primary Packaging	Material	Mass (g)	PCR %	Process	Packaging Type	Pedigree Score
Crimped Crown Closure	Aluminum	8438g	42%	Aluminum Sheet Rolling	Foil and Closures	(1, 3, 1, 5, 5,1)
Bottle	Glass Container	624412g	47%	Production of Glass Production	Beer and Soft Drink Bottles	(1, 1, 1, 2, 1,1)

Secondary Packaging	Material	Mass (g)	PCR %	Process	Packaging Type	Pedigree Score
Paperboard Carrier	Solid Unbleached Board (SUB)	40071g	20%	Production of Carton (Offset)	Folding Carton	(1, 3, 1, 3, 3,1)

Table 3: Characteristics of the Primary and Secondary Packaging of Aluminum Cans

Primary Packaging	Material	Mass (g)	PCR %	Process	Packaging Type	Pedigree Score
Aluminum Closure	Aluminum	2816g	42%	Production of Aluminum Can	Foils and Closures	(1, 1, 1, 2, 1,1)
Can	Aluminum	33792g	42%	Production of Aluminum Can	Beer and Soft Can Drinks	(1, 1, 1, 2, 1,1)

Secondary Packaging	Material	Mass (g)	PCR %	Process	Packaging Type	Pedigree Score
Paperboard Rectangular Box	Solid Unbleached Board (SUB)	21528	20%	Production of Carton (Offset Printing)	Folding Carton	(1, 3, 1, 3, 3,1)

Methodology

This research focuses on the environmental impacts of Coca Cola's North American plastic, glass and aluminum beverage packaging and investigates environmental impact insights of consumers. Methodologies that would yield quantitative data to evaluate the impacts of packaging on the environment was most suitable. However, some qualitative data was collected to gauge consumers' environmental impact perception. All data was collected through primary research methods.

Life Cycle Assessment

To evaluate Coca Cola's packaging, and its impacts on the environment, a life cycle assessment (LCA) was used. Trayak's EcoImpact-COMPASS software was chosen to collect this data. An LCA methodology provided a holistic approach in the investigation of evaluating environmental impacts. This form of research provides a perspective of the entire life cycle of a package ranging from raw material extraction to its end of life. This software required information such as weight (See Appendix B), types of packaging materials and the characterizations of manufacturing processes. The use of secondary research was used to assume the manufacturing processes of the packages (*Table 1, 2 & 3)*. The manufacturing processes were assumed as Coca Cola does not directly reveal information pertaining to their manufacturing procedures. As well, post-consumer recyclability percentages about each packaging material was gathered through secondary sources. The PCR% used in the LCA for plastic, aluminum and glass materials were 25%, 42% and 47%, respectively. It was assumed that Coca Cola's European market uses the same PCR% as North America. This was because the information about North America's PCR% was not readily available. To perform the LCA, a functional unit of 1000L was used to equalize the volumetric differences in packages. A limitation of the LCA software is the calculation of the functional unit. Therefore, to problem solve this limitation, a convergent factor was used in the calculations of the weights of each primary package and secondary package in relation to the functional unit (See Appendix A). Transportation was omitted from the LCA due to the limited information present about Coca Cola's transportation system. As well, since

this thesis focuses on the primary and secondary packaging materials, an omission of transportation was not pivotal. Once the LCA was conducted, the results of each package were compared and graphed against each other. The LCA provided insights on 4 main categories, Fossil Fuel Use (MJ), GHG Emissions (kg CO2 eq.), Water Use (kl) and Human Impact (DALY). Trayak's EcoImpact-COMPASS provided graphs and charts that displayed the results and no further processing of the data was required. An LCA is an industry-standard, found in numerous studies conducting research on the impacts of the beverage packaging field. As well, an LCA provided automatically calculated findings according to industry standards. Thus, using an LCA was a clear decision to evaluate Coca Cola's packaging.

Consumer Survey

To investigate the insights of consumers' environmental impact perception on Coca Cola's packaging, a survey was conducted (See Appendix C). The use of Google Forms was chosen to collect this data. Google Forms was an accessible methodology that allowed many participants to provide insights by answering both quantitative and qualitative questions. The survey received 160 responses and was active from October 25, 2020 to Nov 7, 2020. The survey primarily received responses from those who were in the age range of 18 - 24 living in Canada. The questionnaire had the participants answer questions on their opinions on Coca Cola's plastic, glass and aluminum beverage packaging systems by rating each package based on a numerical system. Participants were asked to rate each primary and secondary package on their environmental impact. A scale from 1 to 10 was used to quantify their opinions, 1 indicating that the package has the least environmental impact and 10 being the package has greatest environmental impact. The questionnaire also investigated recycling, beverage washout practices and consumer purchase behaviour. Google forms was used as it was relatively easy to set up, it allowed the use of images, and their display of results was helpful. Following the collection of the results, they were transferred into Microsoft Excel to have further processing done. The use of an ANOVA single factor analysis was used to compare the mean of each package and to identify the p-value. Lastly, graphs were created to visualize the data.

LCA Results of Coca Cola's Beverage Packaging Systems (Primary + Secondary Package)

Fossil Fuel Use (MJ Deprived)

The LCA software Trayak's EcoImpact-COMPASS calculates the total quantity of fossil fuel consumed throughout the life cycle reported in megajoules (MJ) equivalents deprived. This calculation uses the IMPACT World+ method and assumes that fossil fuels are primarily used for energy purposes such as coal, petroleum, and natural gas.

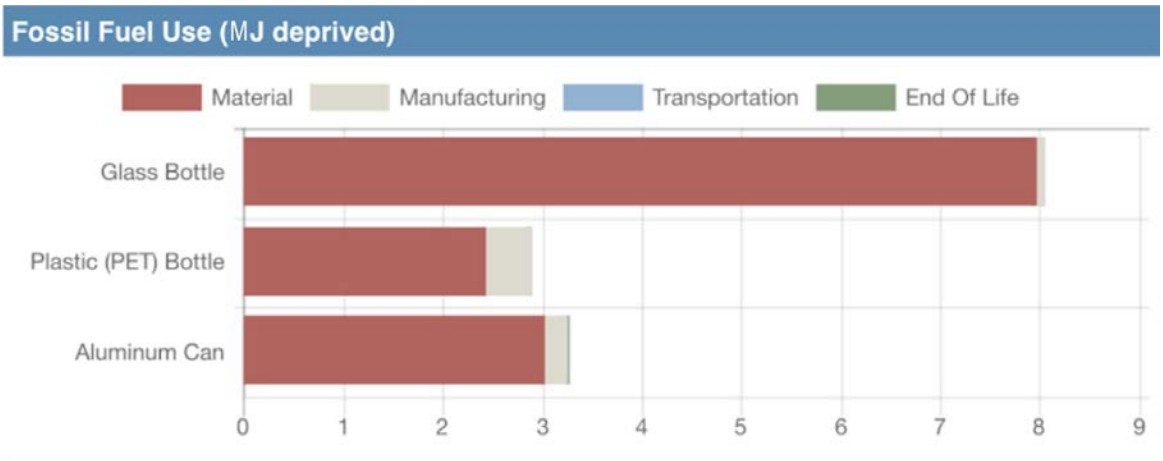

Figure 8: Graph displaying the LCA results of Fossil Fuel Usage (MJ Deprived)

Table 4: Comparative Numerical LCA Results of Fossil Fuel Usage (MJ Deprived)

Package Type	Material	Manufacturing	End of Life	Total Impact (MJ Deprived)
Plastic Bottle Packaging	2.40	0.4479	0.004437	2.85
Glass Bottle Packaging	7.93	0.07918	0.006499	8.02
Aluminum Can Packaging	2.99	0.2391	0.005402	3.23

When comparing the three various packaging types, the total impact of fossil fuel usage was significantly higher in Coca Cola's glass bottle packaging (with paperboard carrier) than the plastic bottle (with plastic shrink wrap) packaging and aluminum can (with paperboard box) packaging. Overall, Coca Cola's plastic bottle packaging uses

64.41% fewer fossil fuels than their glass packaging, and aluminum can packaging uses 59.69% fewer fossil fuels than their glass packaging (*Figure 8 & Table 4*). The most notable difference in fossil fuel usage is seen in the Material phase. In addition, the manufacturing of the glass bottle packaging (with paperboard carrier) uses the least amount of fossil fuel compared to aluminum can production and plastic bottle packaging manufacturing. However, due to the material phase, Coca Cola's glass packaging overall has the highest fossil fuel usage.

GHG Emissions (kg CO2 eq.)

The LCA software Trayak's EcoImpact-COMPASS calculates the total quantity of greenhouse gases (GHG) emitted throughout the life cycle reported in kilograms of CO2 equivalents. It uses the IPCC 2013 method and considers climate feedback loops.

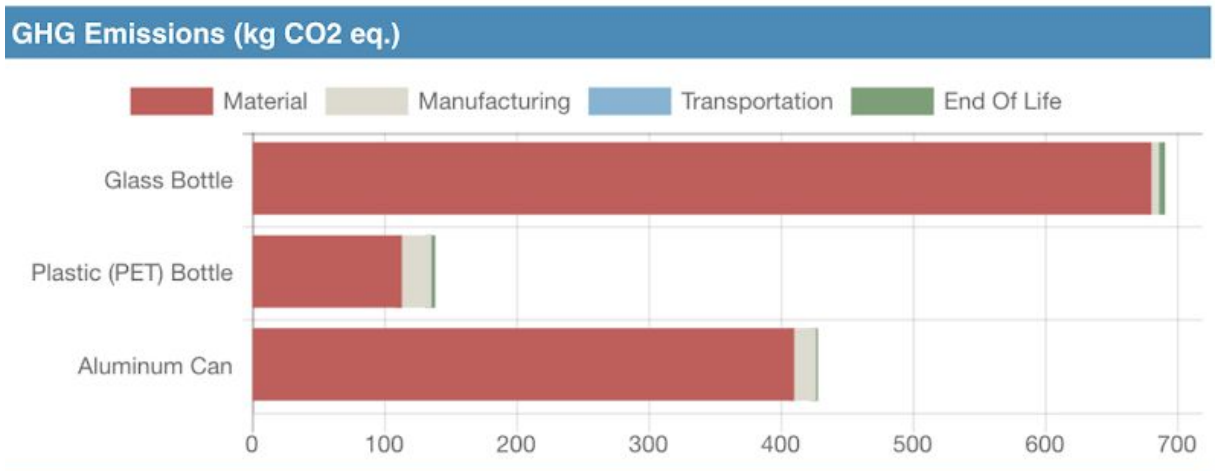

Figure 9: Graph displaying the LCA results of GHG Emissions (kg CO2 eq.)

Table 5: Comparative Numerical LCA Results of GHG Emissions (kg CO2 eq.)

Package Type	Material	Manufacturing	End of Life	Total Impact (kg CO2 eq)
PET Bottle	109.73	21.99	4.14	135.85
Glass Bottle	688.16	5.83	4.01	688.16
Aluminum Can	407.67	16.41	1.32	425.40

When comparing the three various packaging types, the total GHG emissions impact of Coca Cola's glass bottle packaging (with paperboard carrier) was significantly higher than the plastic bottle (with plastic shrink wrap) packaging and moderately higher than aluminum can (with paperboard box) packaging. Overall, Coca Cola's plastic bottle packaging emits 80.26% less GHG than their glass packaging, and aluminum can packaging emits 38.18% less GHG than their glass packaging (*Figure 9 & Table 5*). The most notable difference in GHG emission is seen in the Material phase. In addition, the manufacturing of the glass bottle packaging (with paperboard carrier) emits the least amount of GHG compared to aluminum can production and plastic bottle packaging manufacturing. As well, the aluminum cans emit the least amount of GHG at the end of life stage among the three packaging options.

Water Use (Kiloliters)

The LCA software Trayak's EcoImpact-COMPASS calculates the relative available water remaining per area in a watershed after the demand of humans, aquatic ecosystems, and manufacturing process has been met. A consideration for water scarcity and the results represents the relative value in comparison with the average liters consumed in the world.

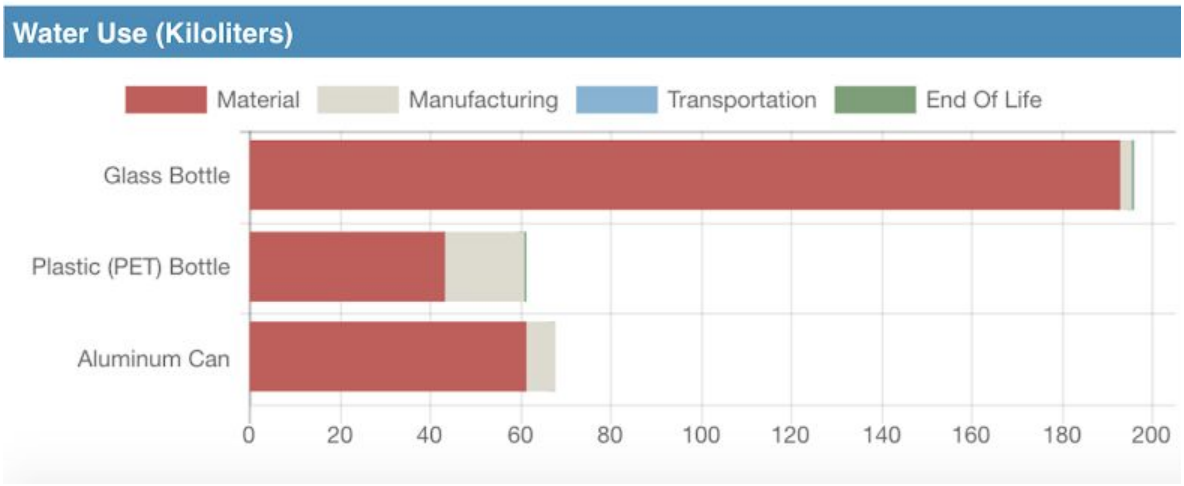

Figure 10: Graph displaying the LCA results of Water Usage (kl)

Table 6: Comparative Numerical LCA Results of Water Usage (kl)

Package Type	Material	Manufacturing	End of Life	Total Impact (kl)
PET Bottle	42.62	17.67	0.2022	60.49
Glass Bottle	192.41	2.54	0.2617	195.21
Aluminum Can	60.58	6.20	0.2040	66.99

When comparing the three various packaging types, the total water use impact of Coca Cola's glass bottle packaging (with paperboard carrier) was significantly higher than the plastic bottle (with plastic shrink wrap) packaging and significantly higher than aluminum can (with paperboard box) packaging. Overall, Coca Cola's plastic bottle packaging uses 69.01% less water than their glass packaging and aluminum can packaging uses 65.68% less water than their glass packaging (*Figure 10 & Table 6*). The most notable difference in water usage is seen in the Material phase.

In addition, the manufacturing of the glass bottle packaging (with paperboard carrier) uses the least amount of water compared to aluminum can production and plastic bottle packaging manufacturing. As well, the difference in water usage in the end of life stage is very minimal among the three packaging options. However, due to the material phase, Coca Cola's glass packaging overall has the highest water usage impact.

Human Impact (DALY)

The LCA software Trayak's EcoImpact-COMPASS calculates the number of environmental emissions resulting in particulate, cancer & toxic non-cancer impacts to humans released throughout the lifecycle. The results convey these three measurements in Disability Adjusted Life Years (DALY). The guide of Impact World+ is used and considerations of severity factors are included.

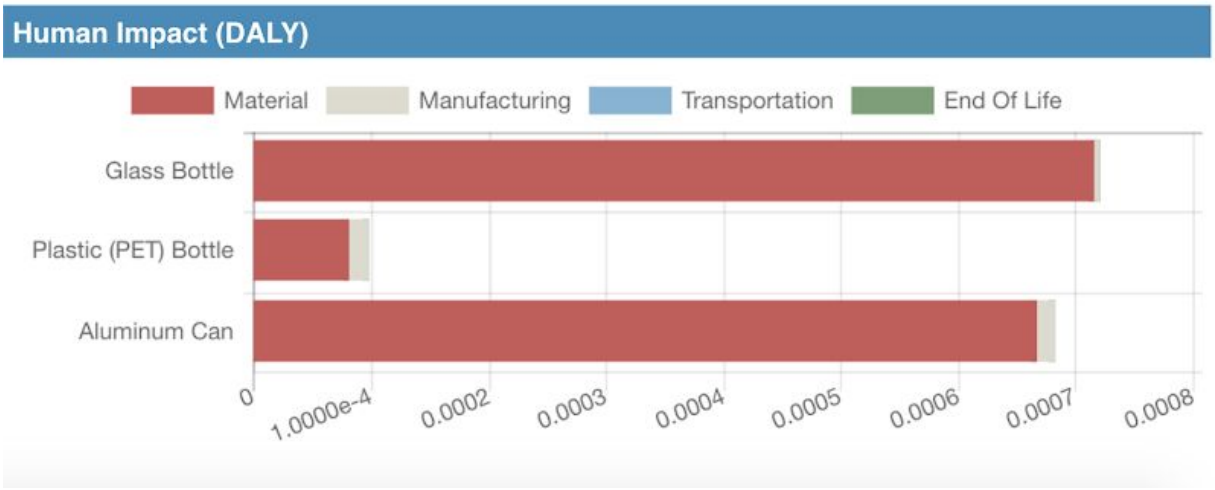

Figure 11: Graph displaying the LCA results of Human Impact (DALY)

Table 7: Comparative Numerical LCA Results of Human Impact (DALY)

Package Type	Material	Manufacturing	End of Life	Total Impact (DALY)
PET Bottle	7.7861e-5	1.7136e-5	4.3184e-7	9.5430e-5
Glass Bottle	0.0007130	5.4353e-6	4.2746e-7	0.0007189
Aluminum Can	0.0006648	1.3857e-5	3.6965e-7	0.0006790

When comparing the three various packaging types, the total DALY impact of Coca Cola's glass bottle packaging (with paperboard carrier) was significantly higher than the plastic bottle (with plastic shrink wrap) packaging and relatively similar to aluminum can (with paperboard box) packaging. Overall, Coca Cola's plastic bottle packaging impacts 84.94% less DALY than their glass packaging. In contrast, Coca Cola's Aluminum packaging impacts 12.44% more DALY than their glass packaging

(*Figure 11 & Table 7*). The most notable difference in DALY is seen in the Material phase. In addition, the manufacturing of the glass bottle packaging (with paperboard carrier) impacts with the least amount of DALY compared to aluminum can production and plastic bottle packaging manufacturing. As well, the difference in DALY impact at the end of life stage is very minimal among the three packaging options. However, due to the material phase, Coca Cola's glass packaging overall has the highest DALY impact.

Survey Results

The following information showcases the results from the survey that was conducted. To reiterate, the questionnaire had the participants answer questions on their opinions on Coca Cola's plastic, glass and aluminum beverage packaging systems by rating each package based on a numerical system. Participants were asked to rate each primary and secondary package on their environmental impact. A scale from 1 to 10 was used to quantify their opinions, 1 indicating that the package has the least environmental impact and 10 being the package has greatest environmental impact. The questionnaire also investigated recycling, beverage washing practices and consumer purchase behaviour.

Environmental Impact Rating of Each Beverage Packaging

The Null Hypothesis (Ho) states that the μa = μb = μc. In other words, the average of the values in each group are equal.

The alternative hypothesis (Ha) states that there is at least one inequality (ALOI). Meaning that at least one of the groups is different from another group.

The P-Value indicates whether the null hypothesis is not rejected, or in other words, if the alternative hypothesis should be accepted. This analysis was based on an alpha of 0.05.

Table 8: ANOVA: Single Factor for Primary Packaging

Group	Primary Packaging Material	Number of Responses	Sum of Environmental Impact Ratings	Average	Variance
a	Plastic Bottle	160	1242	7.76	2.87
b	Glass Bottle	160	805	5.03	3.64
c	Aluminum Can	160	969	6.06	4.61

Source of Variation	SS	df	MS	F	P-Value	F crit
Between Packaging Materials	609.15	2	304.58	82.16	2.19e-31	3.01
Within Packaging Materials	1768.31	477	3.71			
Total	2377.47	479				

Table 8 showcases the ANOVA single factor analysis for data referencing questions on the survey pertaining to primary packaging. In this situation, the p-value was calculated as 2.19e-31. When comparing the p-value to an alpha of 0.05, because the p-value calculated is less than the alpha, this indicates that the null hypothesis should be rejected. Meaning that the alternative hypothesis is accepted instead and there is at least one inequality between the different groups.

This indicates that the results obtained from the survey about Coca Cola's primary packaging have noticeable differences and thus we can determine that consumers' environmental impact and sustainability perceptions vary from packaging material to packaging material.

Table 9: ANOVA: Single Factor for Secondary Packaging

Group	Secondary Packaging Material	# of participants	Sum of Environmental Impact Ratings	Average	Variance
a	Plastic Wrap	160	1327	8.29	3.29
b	Paperboard Carrier	160	690	4.31	4.69
c	Paperboard Box	160	725	4.53	4.52

Source of Variation	SS	df	MS	F	P-Value	F crit
Between Packaging Materials	1602.91	2	801.46	192.17	6.15e-62	3.01
Within Packaging Materials	1989.41	477	4.17			
Total	3592.33	479				

Table 9 showcases the ANOVA single factor analysis for data referencing questions on the survey pertaining to secondary packaging. In this situation, the p-value was calculated as 6.15e-62. When comparing the p-value to an alpha of 0.05, because the p-value calculated is less than the alpha, this indicates that the null hypothesis should be rejected. Meaning, that the alternative hypothesis is accepted instead and there is at least one inequality between the different groups.

This indicates that the results obtained from the survey about Coca Cola's secondary packaging have noticeable differences and thus we can determine that consumers' environmental impact and sustainability perceptions vary from packaging material to packaging material.

As the alternative hypothesis has been accepted in both situations, the average environmental impact rating can be assessed. *Figure 12* displays the averages pertaining to plastic, glass and aluminum beverage packaging. Participants were asked to rate each package on their environmental impact. A scale from 1 to 10 was used to

quantify their opinions, 1 indicating that the package has the least environmental impact and 10 being the package has greatest environmental impact.

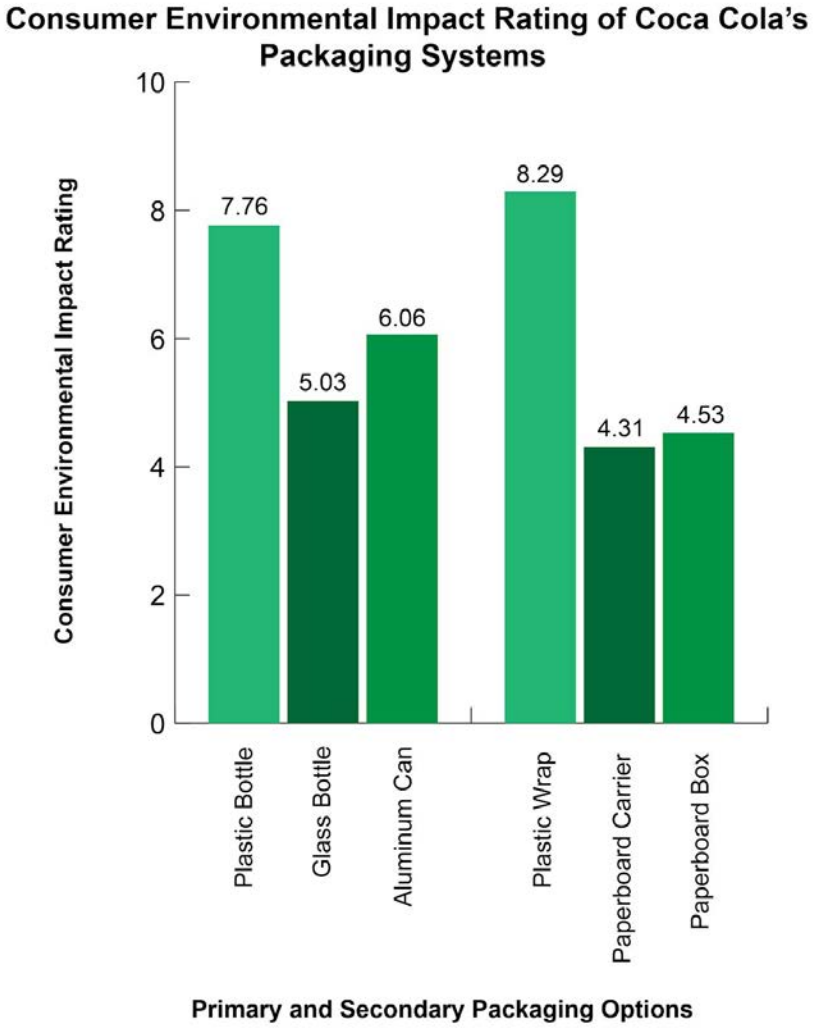

Figure 12: Graph of Average Ratings of Each Primary Soft Drink Packaging

Plastic bottles were rated the highest with an average rating of 7.76, aluminum cans were rated second highest with an average rating of 6.06 and glass bottles were rated the lowest with an average rating of 5.03 (*Figure 12*). These results indicate that consumers believe that plastic bottles have a greater environmental impact than aluminum and glass beverage containers.

This trend is similarly seen in the results pertaining to Coca Cola's secondary packaging. The plastic wrap packaged around the plastic bottles had the highest average rating of 8.29. Whereas the paperboard box rated second highest with an average rating of 4.53 and the paperboard carrier rated lowest with an average rating of 4.31 (*Figure 12*).

Recycling and Wash Habits of Consumers

Plastic Bottles

Figures 13 and *14* describe the recycling habits and wash out practices of respondents who purchase plastic bottles. 89.4% of respondents actively try to recycle their plastic soft drink bottles however, only 42.5% of respondents tend to rinse out their plastic soft drink bottles before recycling them.

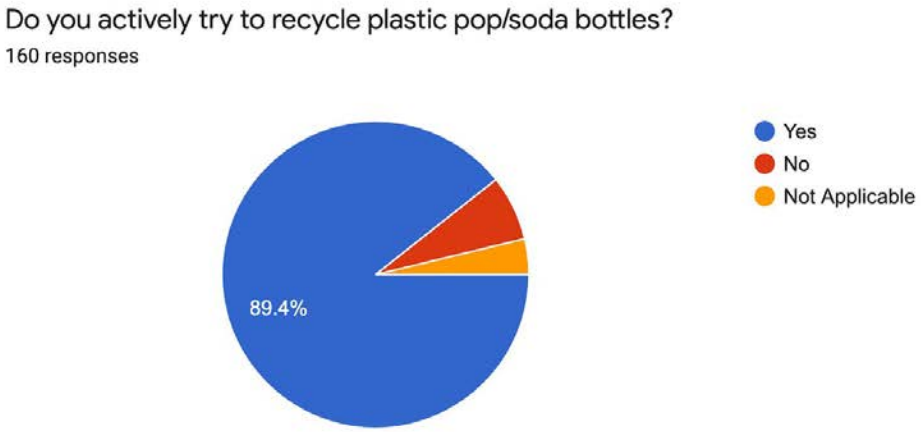

Figure 13: Chart displaying the percentage of respondents who actively try to recycle their plastic soft drink bottles

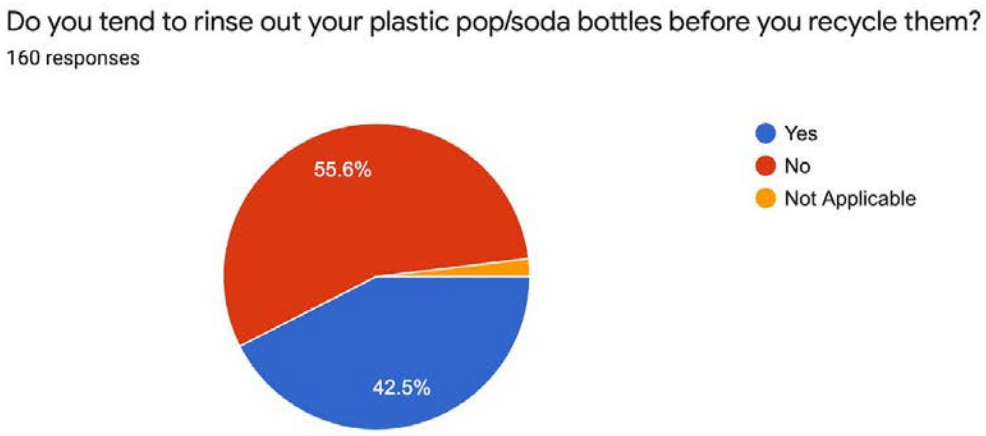

Figure 14: Chart displaying the percentage of respondents who tend to rinse out their plastic soft drink bottles

Glass Bottles

Figures 15 and *16* describe the recycling habits and washout practices of respondents who purchase glass bottles. 78.8% of respondents actively try to recycle their glass soft drink bottles; however, only 49.4% of respondents tend to rinse out their glass soft drink bottles before recycling them. The recycling rate of glass bottles is slightly lower than that of plastics. However, this is partly because some respondents answered “Not Applicable” which indicates that some do not purchase or have ever interacted with glass soft drink beverage packaging. The washout habits of consumers are higher in glass bottles than in plastic.

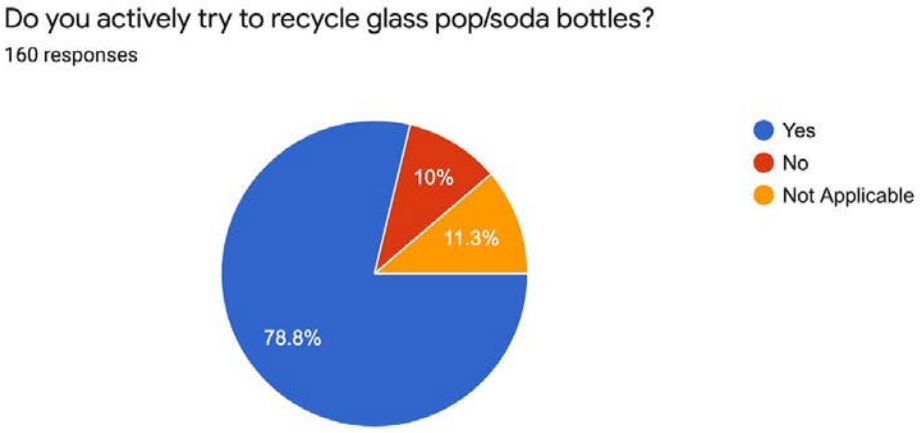

Figure 15: Chart displaying the percentage of respondents who actively try to recycle their glass soft drink bottles

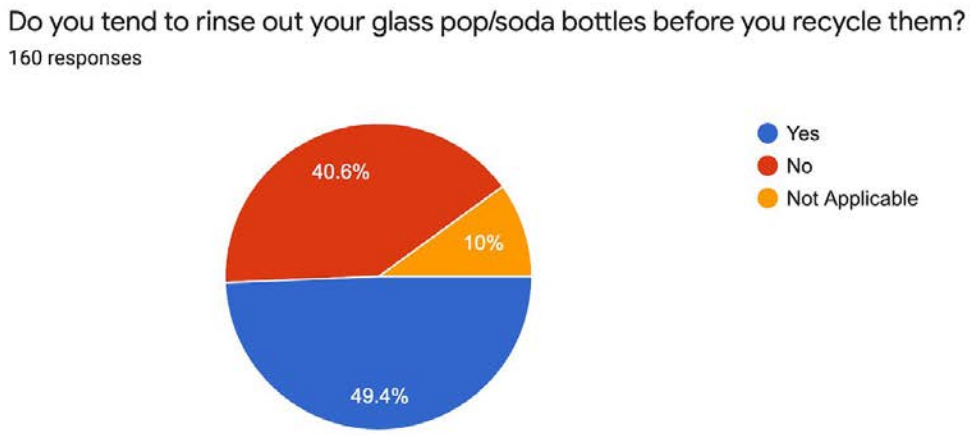

Figure 16: Chart displaying the percentage of respondents who tend to rinse out their glass soft drink bottles

Aluminum Cans

Figure 17 and *Figure 18* describe the recycling habits and wash out practices of respondents who purchase aluminum cans. 86.3% of respondents actively try to recycle their aluminum cans; however, only 30% of respondents tend to rinse out their aluminum cans before recycling them. This is the lowest washout habit percentage compared to plastic bottles and glass bottles. The recycling rate of aluminum cans is slightly lower than that of plastic bottles and higher than glass bottles.

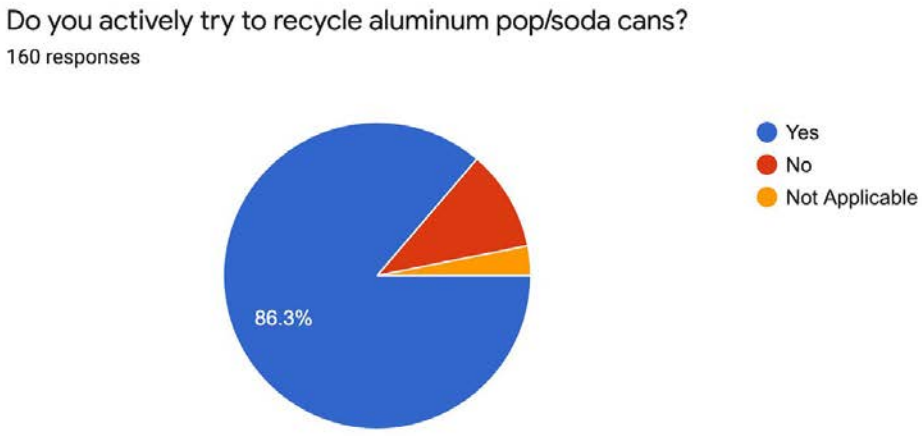

Figure 17: Chart displaying the percentage of respondents who actively try to recycle their aluminum soft drink cans

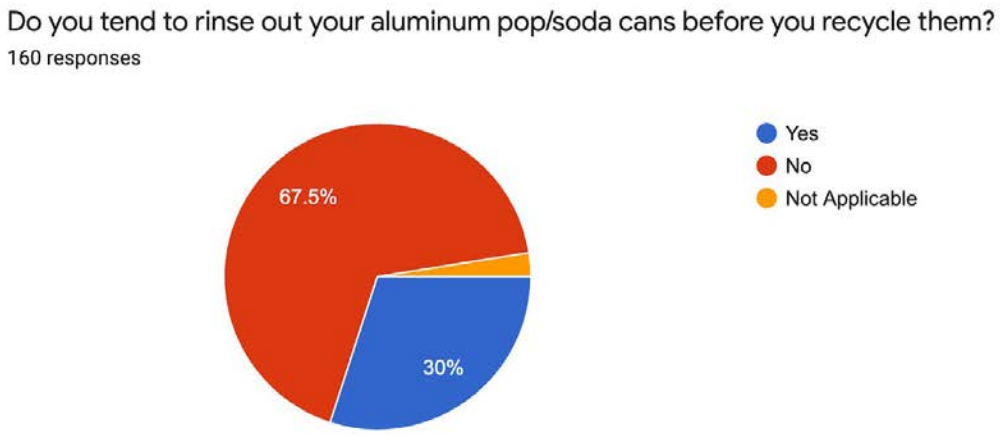

Figure 18: Chart displaying the percentage of respondents who tend to rinse out their aluminum soft drink cans

Consumer Buy Decision

Figure 19 showcases the results pertaining to consumer buy decisions. Respondents were asked to assume that each packaging option contains equal amounts of soft drink. In this instance, of the three packaging options, which option would they often find themselves purchasing? 61.3% of the respondents often purchase aluminum cans, 22.5% of the respondents often purchase glass bottles and 16.3% of consumers purchase plastic bottles.

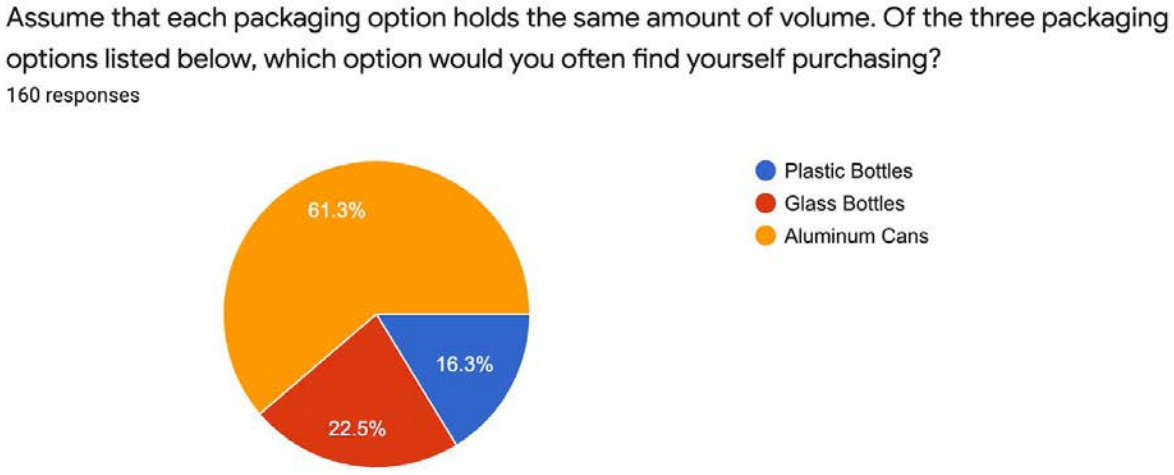

Figure 19: Chart displaying the percentage of respondents' most frequently purchased beverage packaging format

Discussion

When comparing the results from the LCA and survey, the findings are quite polarizing. The conducted LCA concludes that overall, Coca Cola's plastic bottle beverage packaging (with plastic wrap) has the least environmental impact of all three packaging options. These findings contrast with the survey results that concluded that the majority of consumers who responded to the survey believe that Coca Cola's plastic bottle beverage packaging has the greatest environmental impact.

Concerning the LCA, although there was an overall trend of glass packaging having a greater environmental impact than plastic packaging and aluminum packaging, the manufacturing area of glass packaging's life cycle often had a lower environmental impact than plastic and aluminum. Similarly, the end-of-life stage displayed similar results between each environmental impact measured, excluding GHG emissions where Aluminum cans emit less GHG in their end-of-life stage.

To go more into depth with this idea, the Material phase, also known as the Raw Material Extraction phase of each package's life cycle, had the most considerable role on the final environmental impact results. However, excluding the Material phase would result in varying outcomes. Looking at the Manufacturing stage and end of life phase, the manufacturing of glass bottles displayed the lowest usage of fossil fuels, GHG emissions, use of water, and DALY impact. This is most likely due to the production of glass and use of cullet. The recycling of glass bottles is a practice that is highly recommended as it can result in the reduction of energy consumption in the production of glass (Saleh, 2016). The addition of cullet into the manufacturing process of glass adds to its efficiency (Saleh, 2016).

A similar trend can be seen with the manufacturing of aluminum cans, where this packaging type had the second-lowest overall environmental impact across the four categories that were analyzed. Therefore, the manufacturing of plastic bottles has the greatest environmental impact as it uses the most fossil fuels, emits the most GHG, uses the most water, and uses the most DALY compared to glass and aluminum manufacturing. The PCR% of each package plays a significant role in this aspect. As Coca Cola uses a PCR% of 47% for their glass bottles, and aluminum cans use a

PCR% of 42%, this factor influences the manufacturing process and the End-of-Life phase.

Regarding the End-of-Life phase, all three packaging options have similar results on the four categories analyzed. The most notable difference is that aluminum cans emit significantly less GHG in the End-of-Life stage.

For packaging options such as glass and aluminum to decrease their overall environmental impact in the Material phase, a push towards more recycling efforts and increasing the recycling rate of glass bottles and aluminum cans can reduce the energy needed to extract the raw materials from its sources (Saleh, 2016). This, in theory, would lower the fossil fuel usage and emission of GHG, as less energy would be used and therefore impact those environmental categories.

In addition, after reviewing the recycling habits of consumers who responded to the survey, more than 80% of consumers responded that they actively try to recycle soda/pop bottles. However, when evaluating respondents' washout practices, 42.5% of people actively wash their plastic bottles before recycling them (*Figure 14*), 40.6% of people actively wash their glass bottles before recycling them *(Figure 16*), and a striking 30% of people actively wash their aluminum cans before recycling them (*Figure 18*). Recycling and washing habits of beverage packaging is an important consideration. Washing out jars, bottles or containers before recycling them is an important step that mitigates contamination as well as reduces the cost of processing the recyclables (Patel, 2018). Food or drink substances that are left inside these packages can contaminate paper fibres and other recyclable items in the mix (Patel, 2018). This jeopardizes the entire collection of recyclables and can potentially lead to the items being disposed of rather than recycled. Rinsing out packages in general before recycling can reduce the environmental harm of sorting and processing systems. This aspect may shed light on the findings of the End-of-Life stage of the packages' life cycle. The three packaging options had very similar results. An element that might contribute to this relation is that most consumers actively recycle these beverage packaging options. However, the survey's wash habits portion reveals that close to half of the respondents do not wash out their containers, which impacts their recyclability, which affects the End-of-Life stage.

Although glass and aluminum beverage packaging may have resulted in higher environmental impact numbers than plastic, there are positives to both materials that cannot be fully captured through the LCA. For example, glass can be recycled, melted down, and reformed without losing strength or quality without producing harmful by-products (Emblem & Emblem, 2012).

Aluminum cans are recycled on an atomic level. They are re-melted, and the recycled metal can be re-melted an infinite amount of times without losing its properties. These aspects help in the Manufacturing phase of the LCA and the End-of-Life stage (Emblem & Emblem, 2012).

To bring this all to a greater context, the contrast in scientific data versus consumers' environmental perception is quite interesting. From the survey results, it is clear that consumers believe that Coca Cola's plastic bottle packaging has the greatest impact on the environment. With consumers rating plastic bottles' environmental impact as 7.76 (*Figure 12*). In comparison to aluminum cans' average environmental impact rating of 6.06 and glass bottles' average rating of 5.03 (*Figure 12*). Some potential reasonings that might lead to consumers considering that plastic is more environmentally impactful than glass and aluminum beverage packaging is the shift towards more sustainable packaging. Plastic is often presently viewed as harmful material. The Coca Cola Company is making strides in becoming more environmentally conscious, intending to make 100% of their packaging recyclable globally by 2025 and to use at least 50% recycled materials in their packaging by 2030 (The Coca Cola Company, 2019c).

This trend can also be seen in the secondary packages used. With respondents rating the plastic shrink wrap protecting the plastic bottles, an average environmental impact rating of 8.29 out of 10 (*Figure 12*). Whereas the paperboard carrier for the glass packaging had an average rating of 4.31 and the paperboard packaging for the aluminum cans had an average rating of 4.51 (*Figure 12*). There is a consensus that overall, plastic has a greater environmental impact than any other material such as paperboard. Thus, consumer perception of plastic does not only pertain to primary packaging but any other forms of secondary packaging as well.

Also, 61.3% of respondents have revealed that they most likely find themselves purchasing aluminum cans, 22.5% have stated that they find themselves buying glass, and 16.3% responded by saying they often purchase plastic (*Figure 19*). These results reveal that consumers' beliefs do, in fact, impact purchasing decisions. As most respondents believed that plastic bottles have the highest environmental impact, many respondents do not decide to purchase plastic packaged beverages. However, a concerning aspect regards the wash habits of these consumers. 61.3% of respondents choose to buy aluminum can packaging (*Figure 19)*; however, only 30% of overall consumers wash out their beverage cans (*Figure 18*). This causes an issue in the easiness of recycling these aluminum cans as consumers themselves are not doing their part to contribute to being more environmentally conscious.

Also, there is an immense problem with single-use plastics. Single-use plastics are primarily made from petrochemicals and are intended to be thrown away after one use (Lindwall, 2020).

Straws, plastic bags, takeout containers, wrappers, and plastic bottles are examples of convenient plastic items that add to the environmental price that the planet is currently facing. Single-use plastics devastate oceans, wildlife and impact human health. 300 million tons of plastic are produced each year worldwide, and 50% of that is used for single-use items (Lindwall, 2020).

With this perspective in mind, it is inferred that many respondents had this idea in mind when answering questions about Coca Cola's plastic bottle packaging. Thus, believing that Coca Cola's plastic bottle has the greatest environmental impact compared to Coca Cola's glass and aluminum beverage packaging.

Recycling plastic more frequently would reduce its carbon footprint. PET is commonly recycled and can be turned into other products such as polyester fabrics and automotive parts. This can explain why Coca Cola's plastic bottle made of PET overall impacts the environment the least. However, in practice, 91% of all plastic is not recycled and ends up in landfills or in the environment (Lindwall, 2020). There is a significant need for an increased effort in recycling and properly recycling plastic packages.

Although there have been several developments in recycled PET such as Coca Cola's plastic bottles, historical practices, and treatment of plastic products have perpetuated the negative narrative of plastic PET bottles. This research highlights that consumers will continue to associate plastic products with being harmful to the environment because of single-use plastics. Single-use plastics have to be omitted to shift consumers' minds, and the implementation and narrative of recycled plastic must be pushed.

The Coca Cola company has currently implemented 100% recycled PET bottles in 16 markets (The Coca Cola Company, 2019c). However, the North American market has not yet reached that place. Using 100% recycled PET bottles would eliminate the use of 3500 tons of virgin plastics resulting in a reduction of Co2 emission by 25% (The Coca Cola Company, 2019c). Coca Cola has also developed a "PlantBottle" that incorporates 30% plant-based material into its PET bottles (The Coca Cola Company, 2019c).

Shifting the North American market towards this trend would require infrastructure to meet those recycling and manufacturing demands. However, there is an ethical responsibility for companies to move towards sustainability and innovate to create more sustainable packaging. Packaging will not be going away any time soon; but there is an ethical and social responsibility for these companies to make sure that their products impact the environment as little as possible. Not only does this pertain to the packaging they use, but also recycling and collection of the packaging materials.

Overall, pushing the world towards a circular economy where the components of a package can be recycled and used again in the manufacturing process or can be manufactured into other products would be an ideal situation. Although this LCA has shown that plastic packaging overall has the least impact on the environment, this should not be the stopping point. Instead, it should be a motivating factor to influence change towards better implementation of material creation, manufacturing, recycling as well as consumer practices.

Conclusion

To conclude, environmental consciousness and sustainability has been an increasing factor in today's society. With packaging being a prominent area of concern, consumers have instilled an ethical and social responsibility for companies such as The Coca Cola Company to innovate and create packaging that provides the least amount of harm to the environment.

Through an LCA methodology, three primary and three secondary packages were evaluated. These were Coca Cola's plastic bottle with plastic shrink wrap, their glass bottle with a paperboard carrier and their aluminum cans and a paperboard rectangular box. The results of the LCA suggested that Coca Cola's packaging system for their plastic bottles overall showed the least environmental impact followed by their aluminum cans and lastly their glass bottle packaging systems. These packages were evaluated on four categories, fossil fuel usage, greenhouse gas emissions, water usage and human impact. A survey was conducted to evaluate consumers' environmental impact perception on Coca Cola's packaging. Respondents rated each primary and secondary packaging based on a scale of 1 to 10, 1 being the package has the least environmental impact, and 10 being the package has the greatest environmental impact. The results of this survey expressed the opposite of the LCA results. Respondents believed that overall, Coca Cola's plastic bottle packaging and its plastic shrink wrap has the greatest environmental impact. The recycling habits, wash out practices, and consumer buy preferences were also surveyed.

Further analysis of the results suggests that plastic packaging has a negative connotation due to historical malpractices and the existence of single-use plastic. For there to be a shift in consumer perception, companies can implement more recycled plastic into their packaging, spread awareness around this topic and enhance their packaging designs to reflect these changes. However, there is also a need for more efficient recycling systems, a reduction in the use and manufacturing of single-use plastics, a movement towards creating circular economies and helping consumers understand how to recycle packaging properly.

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Appendices

Appendix A

Convergent Factor and Functional Unit Calculations

Table 10: Convergent Factor Calculations of Primary Packages

Packaging Component	Functional Unit (ml)	Volume Capacity of Primary Package	Convergent Factor (# of bottles to fill 1000L and # of closures to seal X number of bottles)	Weight of Primary Packaging Component (g)	Net Weight of Primary Packages to fill 1000L (g)
Plastic Bottle	1000000	710	1408	26	36608
Plastic Cap	1000000		1408	2	2816
Glass Bottle	1000000	237	4219	148	624412
Aluminum Crimped Crown	1000000		4219	2	8438
Aluminum Can	1000000	355	2816	12	33792
Aluminum Tab	1000000		2816	1	2816

Table 11: Convergent Factor Calculations of Secondary Packages

Packaging Component	Convergent Factor	# of Primary Packages in one Secondary Package	Convergent Factor (# of secondary packages to package X amount of primary bottles)	Weight of Secondary Packaging Component (g)	Net Weight of Secondary Packages to package 1000L (g)
Plastic Wrap	1408	6	234	16	3744
Paperboard Carrier	4219	6	703	57	40071
Paperboard Box	2816	12	234	92	21528

Appendix B

Weights and Dimensions of Packages

Table 12: Weight of Coca Cola's Classic PET Plastic Bottle (710mL)

	Primary Packaging [Non-Filled Single Plastic Bottle with cap & label]	Primary Packaging [Non-Filled Plastic Bottle]	Primary Packaging [Polypropyl-ene Cap]	Primary Packaging [PET? Label]	Secondary Packaging [PET? Shrink Wrap]	Primary Packaging +Secondary Packaging [6 Filled Bottles]
Weight of the Package (g)	29g	26g	2g	1g	16g	4639g

Table 13: Dimensions of Coca Cola's Classic PET Plastic Bottle Packaging

	Primary Package [Single Plastic Bottle with Cap and Label]	Secondary Package [6 Primary Packages]
Dimensions of the Package (inches)	2.75" x 2.75" x 10.25"	6" x 9" x 10.375"

Table 14: Weight of Coca Cola's Classic Glass Bottle Packaging (237mL)

	Primary Packaging [Non-Filled Single Glass Bottle with cap]	Primary Packaging [Non-Filled Single Glass Bottle]	Primary Packaging [Aluminum Crown]	Secondary Packaging [Paperboard]	Primary Packaging +Secondary Packaging [6 Filled Bottles]
Weight of the Package (g)	150g	148g	2g	57g	2447g

Table 15: Dimensions of Coca Cola's Classic Glass Bottle Packaging

	Primary Package [Single Glass Bottle with Crown]	Secondary Package [6 Primary Packages]
Dimensions of the Package (inches)	2.125" x 2.125" x 7.25"	4.625" x 7.875" x 7.875"

Table 16: Weight of Coca Cola's Classic Aluminum Can Packaging (355mL)

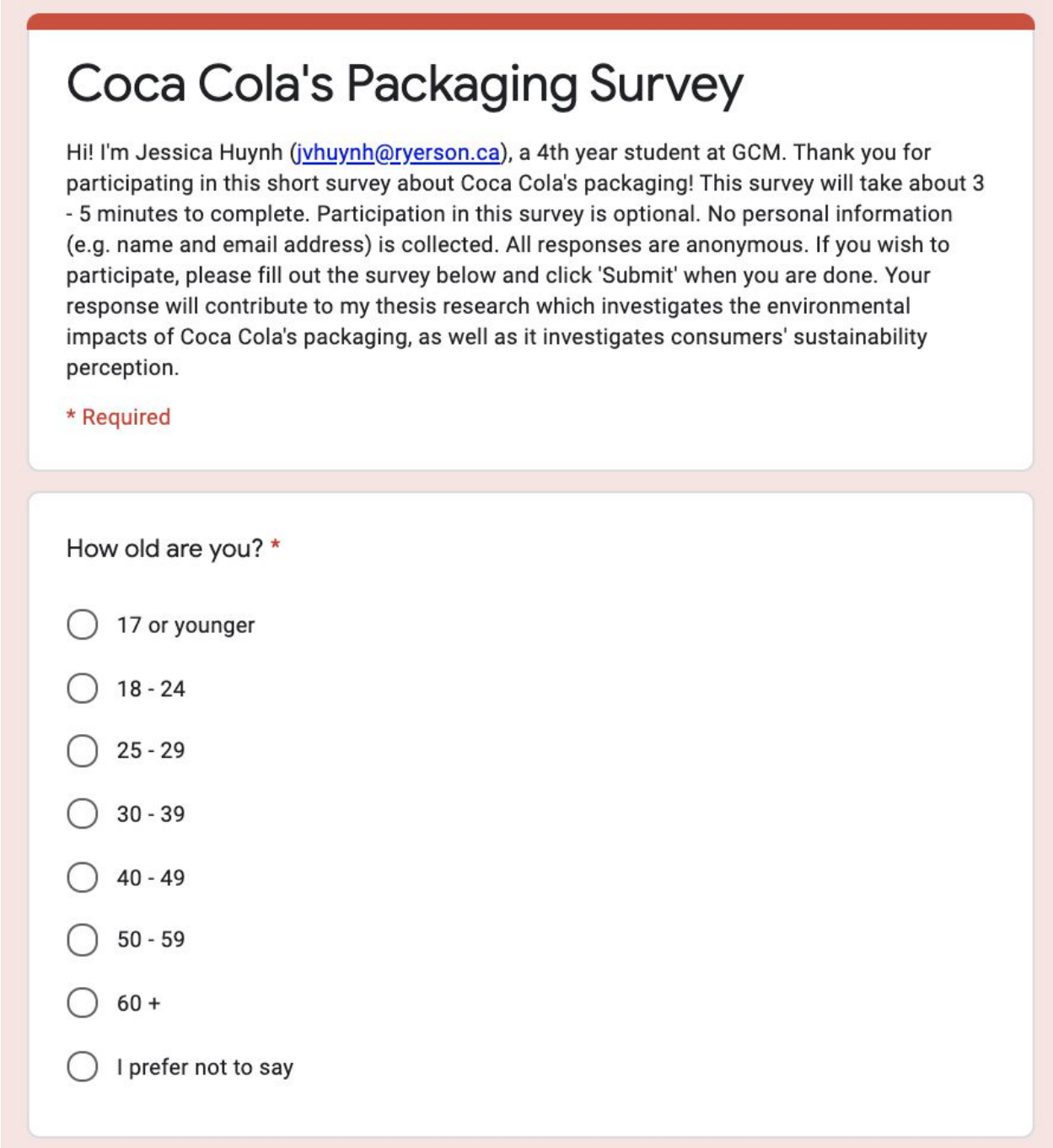
	Primary Packaging [Non-Filled Single Aluminum Can with Closure]	Primary Packaging [Non-Filled Single Aluminum Can]	Primary Packaging [Aluminum Closure]	Secondary Packaging [Paperboard Rectangle]	Primary Packaging +Secondary Packaging [12 Filled Cans]
Weight of the Package (g)	13g	12g	1g	92g	4695g

Table 17: Dimensions of Coca Cola's Classic Aluminum Can Packaging

	Primary Package [Single Aluminum Can]	Secondary Package [12 Primary Packages]
Dimensions of the Package (inches)	2.5" x 2.5" x 5"	5.25" x 15.625" x 4.875"

Appendix C

Survey



Coca Cola's Packaging Survey

Hi! I'm Jessica Huynh (jvhuynh@ryerson.ca), a 4th year student at GCM. Thank you for participating in this short survey about Coca Cola's packaging! This survey will take about 3 - 5 minutes to complete. Participation in this survey is optional. No personal information (e.g. name and email address) is collected. All responses are anonymous. If you wish to participate, please fill out the survey below and click 'Submit' when you are done. Your response will contribute to my thesis research which investigates the environmental impacts of Coca Cola's packaging, as well as it investigates consumers' sustainability perception.

* Required

How old are you? *

- ◯ 17 or younger
- ◯ 18 - 24
- ◯ 25 - 29
- ◯ 30 - 39
- ◯ 40 - 49
- ◯ 50 - 59
- ◯ 60 +
- ◯ I prefer not to say

On a scale of 1 to 10, please rate the environmental impacts of Coca Cola's plastic bottle packaging sold in North America. *

1 2 3 4 5 6 7 8 9 10

Least environmental impacts ○○○○○○○○○○ Greatest environmental impacts

Do you actively try to recycle plastic pop/soda bottles? *

- ○ Yes
- ○ No
- ○ Not Applicable

Do you tend to rinse out your plastic pop/soda bottles before you recycle them? *

- ◯ Yes
- ◯ No
- ◯ Not Applicable

On a scale of 1 to 10, please rate the environmental impacts of Coca Cola's plastic wrap packaging sold in North America. *

	1	2	3	4	5	6	7	8	9	10	
Least environmental impacts	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Greatest environmental impacts

On a scale of 1 to 10, please rate the environmental impacts of Coca Cola's glass bottle packaging sold in North America. *

1 2 3 4 5 6 7 8 9 10

Least environmental impacts ○○○○○○○○○○ Greatest environmental impacts

Do you actively try to recycle glass pop/soda bottles? *

- ○ Yes
- ○ No
- ○ Not Applicable

Do you tend to rinse out your glass pop/soda bottles before you recycle them? *

- ◯ Yes
- ◯ No
- ◯ Not Applicable

On a scale of 1 to 10, please rate the environmental impacts of Coca Cola's paperboard carrier packaging sold in North America. *

1 2 3 4 5 6 7 8 9 10

Least environmental impacts ◯◯◯◯◯◯◯◯◯◯ Greatest environmental impacts

On a scale of 1 to 10, please rate the environmental impacts of Coca Cola's aluminum can packaging sold in North America. *

1 2 3 4 5 6 7 8 9 10

Least environmental impacts ○○○○○○○○○○ Greatest environmental impacts

Do you actively try to recycle aluminum pop/soda cans? *

- ○ Yes
- ○ No
- ○ Not Applicable

Do you tend to rinse out your aluminum pop/soda cans before you recycle them? *

- ◯ Yes
- ◯ No
- ◯ Not Applicable

On a scale of 1 to 10, please rate the environmental impacts of Coca Cola's paperboard rectangular packaging sold in North America. *

	1	2	3	4	5	6	7	8	9	10	
Least environmental impacts	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Greatest environmental impacts

Assume that each packaging option holds the same amount of volume. Of the three packaging options listed below, which one of these do you believe has the greatest environmental impact? *

- ◯ Plastic Bottles
- ◯ Glass Bottles
- ◯ Aluminum Cans

Assume that each packaging option holds the same amount of volume. Of the three packaging options listed below, which option would you often find yourself purchasing? *

- ◯ Plastic Bottles
- ◯ Glass Bottles
- ◯ Aluminum Cans