A Streamlined Life Cycle Assessment Comparison of Pet Food Packages

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June 2024

Project Overview & Goals

The Flexible Packaging Association (FPA) commissioned PTIS, LLC to look at providing a streamlined life cycle assessment (LCA) and report with descriptions of key environmental indicators based on a selection of different pet product package formats currently available on the market. The pet products evaluated across a range of package formats include pet food, flea collars, dog treats, and dog dental sticks.

The purpose of this LCA was to better understand the environmental impacts of the various package options. The packages selected represent a range of product options and compare LCA factors of other packaging formats to the flexible packaging option. It is important to remember that the environmental attributes of an LCA are only one consideration when selecting a package format. A package developer must also take a holistic perspective around consumer usage, brand equity, convenience, product protection/shelf life, and distribution as well as environmental attributes when designing a package.

These LCAs considered the primary packaging only as information on distribution for secondary packaging, pallet load, or transportation is not readily available.

For this report, the different package product formats evaluated include:

Each of the product samples used in the assessment was purchased at a pet supply or mass merchandiser retailer. The packages were then deconstructed, and each component was weighed. For the flexible packaging options, an outside expert was utilized to determine the most likely construction of the package. The density of each material and the weight allocated to each material was then determined and used for the assessment.

Streamlined LCA Tool

The streamlined LCA software tool used for the project was EcoImpact-COMPASS® from Trayak. The tool was originally developed through the Sustainable Packaging Coalition (SPC) and is widely used and accepted in the packaging industry for quick LCA package comparisons. It is now maintained and updated regularly by Trayak.

For the comparison, a product weight for each package was used that was as close as possible between the different package formats. In many cases, a different product weight had to be used, but the EcoImpact-COMPASS® tool normalizes the data by weight, allowing for a comparison between packages of different weights.

The environmental indicators that were measured through EcoImpact-COMPASS® include:

- Fossil fuel use
- Global warming potential (GWP)
- Water consumption

Other metrics considered include:

- Material efficiency (g of pkg/fl. oz of product)
- Material discarded

Recycling rate assumptions (based on U.S. EPA data and default in the EcoImpact-COMPASS® software):

- Flexible pouches – 0%
- Retort tub – 0%
- Blister pack – 0%
- PP tub – 3%
- Aluminum pet food can – 35%
- Paperboard folding carton – 21%
- Corrugated box – 96%

Other assumptions used in the calculations:

- The energy profile for the U.S. was used for all calculations.
- For the pet food comparison, all packages underwent a retort process.

- For the aluminum can, 65% post-consumer recycled content was assumed; with 45% post-consumer recycled content and 20% pre-consumer recycled content based on consultation with an industry expert.
- For the corrugated box, 52% PCR content was used, as that is the average amount of recycled content in corrugated boxes in the U.S.

Streamlined Life Cycle Assessment and Case Studies

Streamlined Life Cycle Assessment Tool – EcoImpact-COMPASS®

EcoImpact-COMPASS® was used for the life cycle assessment (LCA) package comparison in this report as it is a widely accepted tool within the packaging community. It is known as a streamlined LCA as it uses industry average data, rather than inputs specific to a particular company and is much faster than a full LCA. The tool has been continuously revamped as new manufacturing and converting information is available. The EcoImpact-COMPASS® tool also uses data from ecoinvent, the U.S. Life Cycle Inventory Database (part of the National Renewable Energy Laboratory), and other LCA databases that are widely used. EcoImpact-COMPASS® allows for a cradle-to-grave boundary as it can also incorporate transportation and end-of-life (recycling or landfill) impacts. The tool is administered and updated regularly by software provider, Trayak.

EcoImpact-COMPASS® output includes metrics for several environmental impact categories, which can be used by packaging developers to gain a better understanding of the impacts of different materials, conversion processes, and packages, while in the package development phase.

The output from the tool allows for easy comparison across the environmental impacts, incorporating data from material formation, package manufacturing, transportation, and end-of-life.

EcoImpact-COMPASS® Limitations:

As with all life cycle assessments, several assumptions are made, using industry averages. As such, the output from the EcoImpact-COMPASS® can help show general comparisons between different package options. The tool does not include all materials and processes but does tend to include most materials widely used in packaging.

Environmental Indicator Metrics Results

Additionally, it must be understood that in most cases, some package formats and materials will perform better in some environmental indicators (such as global warming potential (GWP) and fossil fuel use) and may not perform as well around others, such as water-based indicators. There are generally tradeoffs that need to be considered with any package option. This does not mean one package is necessarily better than another but does lead to a discussion about which environmental indicators are most important as package developers and brand owners attempt to understand these tradeoffs and decide which indicators most reflect their internal goals while balancing product protection, shelf life, consumer use, brand equity, and environmental indicators among many other factors when selecting a package structure and format.

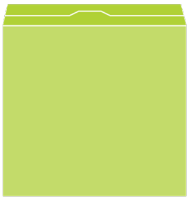
The charts on the following pages highlight results across several environmental indicators. Package developers may reference these indicators when considering the environmental impact of different package options.

Dog Treats Comparison – Primary Package

Dog treats are sold in a variety of package formats. For this comparison, three of the most common formats are used: Stand-up Pouch, Carton, and PET jar. An attempt to utilize products that are similar in size was made though was not possible in this case. The stand-up pouch is used as the standard to which other options are compared.

The following packs were utilized in the comparison:

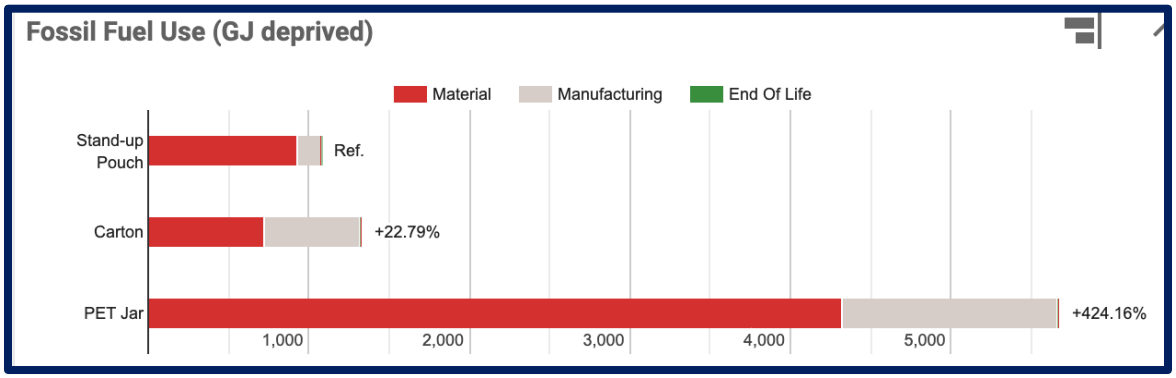
Table 1-A. Dog Treats Comparison – Package Details

Stand-up Pouch (SUP) – 12 oz.	**Wt. (g)**	
PET	2.0g	
Metallized PET	2.0g	
LLDPE	7.8g	
Total Weight	**11.8g**	
Carton – 19 oz.	Wt. (g)	
SUS Board (0% PCR)/SFI Certified	59.7g	
Total Weight	**59.7g**	
PET Jar – 25 oz.	Wt. (g)	
PET Jar	100.3g	
PP Closure	14.9g	
Paper/Aluminum/LLDPE – Induction Lidding	2.3g	
Kraft Paper Label	1.6g	
Total Weight	**119.1g**	

FOSSIL FUEL USE (MJ DEPRIVED)

The charts below and on the following pages highlight the results of fossil fuel use, global warming potential (GWP, which is a measure of carbon emissions), and water use for each of the package formats evaluated. These are some of the primary indicators that package developers consider when appraising the environmental impacts of a particular package. The EcoImpact-COMPASS® software "normalizes" the data based on the functional unit such as weight or number of uses to allow comparison between package formats which may not be the exact same size.

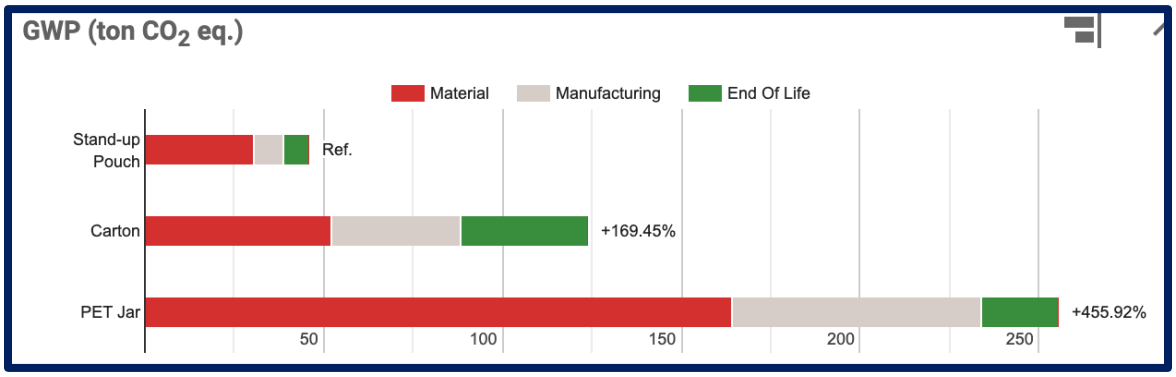
Figure 1-1. Dog Treats – Primary Package – Use



The fossil fuel use chart above shows the stand-up pouch (SUP) results in a reduction in fossil fuel use of 23% compared to the carton. The PET jar package utilizes 425% more fossil fuel than the SUP. Much of this is driven by the weight of the jar. The SUP weighs under 12g (for 12 oz. of product), while the carton weighs nearly 60g (for 19 oz. of product) and the PET jar comes in at 119g (for 25 oz. of product). Thus, the SUP is much more efficient in the amount of product it holds when compared to the other formats. Additionally, the SUP and PET jar are both made entirely of plastic materials, so would utilize more fossil fuel in the material phase (red part of the graphic) than packages made from other materials.

GLOBAL WARMING POTENTIAL (GWP) EMISSIONS (KG CO2 EQ.)

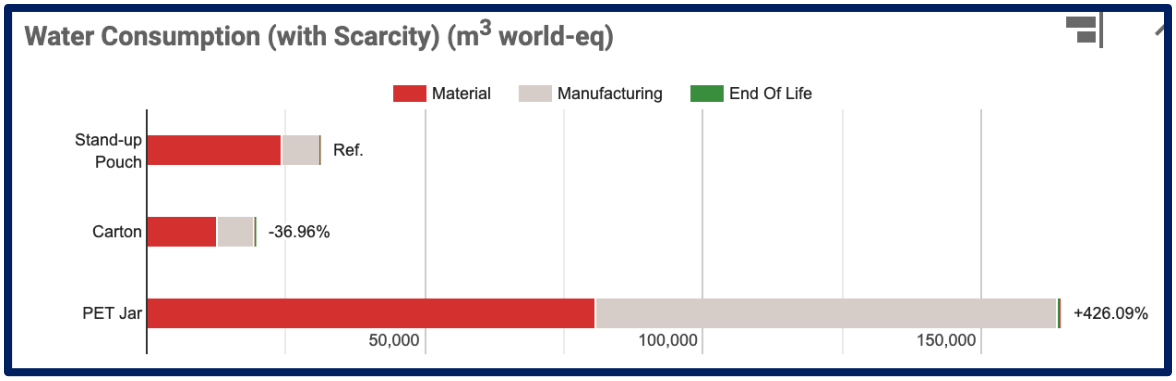
Figure 1-2. Dog Treats – Global Warming Potential (GWP) Emissions (kg CO_2 eq.)



Global warming potential (GWP) is the greenhouse gas emissions in CO_2 equivalents for the different package formats. The chart above shows that the SUP offers substantially lower emissions than the alternative packaging types. This is driven by the overall weight of the SUP coming in considerably lower than the alternative packages (shown in the red part of the graph under material), as well as lower impacts in the manufacturing and end-of-life phases. Even though the carton is recycled at a rate of 21% and the PET jar at 29%, and the current multi-material pouch is not recyclable, the much higher weights of the other package formats result in a higher impact at the end-of-life phase.

WATER CONSUMPTION (WITH SCARCITY) (M^3 WORLD-EQ)

Figure 1-3. Dog Treats – Primary Package – Water Consumption



The water consumption attribute considers the relative water remaining per area in a watershed. This is meant to consider the impacts of water consumption in areas with high water scarcity with a factor utilized for areas of high scarcity. This attribute is measured in cubic meters of water.

In this metric, the carton actually comes in with the lowest amount of water usage, over one-third lower than the SUP. This is driven by paper manufacturers, including carton producers, recycling and reusing more of the water used in their material (red part of the graph) and manufacturing (gray part of the graph), and driving overall water efficiency in their production processes. The PET jar has considerably higher water consumption in both the material phase (driven by overall package weight) as well as manufacturing phase, which is driven by water used to cool the molds for the jar and closure.

END-OF-USE RESULTS AND SUMMARY – PRIMARY PACKAGE

The charts previously shown compare environmental impacts including fossil fuel use, global warming potential (CO_2 emissions), and water consumption in this scenario for different dog treat package formats. Table 1-B (on the following page) considers the impacts of a package that is recycled or discarded as well to ensure that the package aligns with circular economy or sustainable materials management goals. The table shows the results when current recycling rates are considered, as well as the material efficiency ratio, which is a measure of the resource efficiency of the materials to package a gram of product.

The results in Table 1-B show that the SUP has a considerably better material efficiency value. This is largely driven by the pouches utilizing considerably less material (especially on a weight per ounce of product) to contain the dog treats. The SUP uses less than 1 gram to contain an ounce of product, while the carton and PET jar use considerably (three to almost five times) more material to protect the product.

Additionally, the SUP options result in substantially less material being discarded at the end-of-life than the competitive packs. This is despite the multi-layer SUP having no current recycling readily available, while the carton is recycled at a rate of 21% and the PET jar at a 29% rate.

The table on the following page summarizes a variety of environmental attributes for different primary package options that were evaluated.

SUMMARY COMPARISON

Table 1-B. Dog Treats – Primary Packaging Comparison Summary

Format	Weight	Fossil Fuel Use (GJ deprived)	GWP (tons-CO_2 eq.)	Water Consumption (m^3 world-eq.)	Material Efficiency (g of pkg/oz. of product)	End-of-Life Total Mass discarded (1MM packs)
Stand-up Pouch (12 oz.)	11.8g	1,082 ----	46 ----	31,208 ----	0.98g/oz.	11.8 tons
Carton (19 oz.)	59.7g	1,329 +22.79%	123.84 +169.46%	19,673 -36.96%	3.14 g/oz	29.79 tons (+152%)
PET Jar (25 oz.)	119.1g	5,673 +424.16%	256 +455.92%	164,186 +426.09%	4.76g/oz.	42.99 tons (+264%)

Notes:

- *A normalized product weight (common value divisible by all package formats) was used for fossil fuel, GWP, and water consumption calculations. The values shown above are for 1MM primary packs for the stand-up pouch (631,579 cartons and 480,000 PET jars).*
- *All percentages cited are for other formats compared to the stand-up pouch package.*
- *For all percentage comparisons in EcoImpact-COMPASS®, the tool uses percent change. The formula is ((Standard flexible pkg value – comparative pkg value)/standard flexible pkg value) *100 = percent change.*
- *End-of-life total mass discarded values are based on the amount of packaging sent to municipal solid waste after recycling, based on 1,000,000 packs of the flexible product used as the basis for both comparisons. (Note: the equivalent of 631,579 cartons and 480,000 PET jars.)*
- *Recycling rates utilized: 0% – stand-up pouch; 21% – carton; 29% – PET jar.*

Cat Flea Collar Comparison – Primary Package

Pet flea collars are a common item that many pet owners purchase to protect their pets. For this comparison, two widely used package formats are compared: a flexible pouch (hanging on a retail peg rack) and a carton (hanging on a retail peg rack), which included a lightweight flexible pouch inside the carton to provide a barrier for the aroma and extend the shelf life of the flea collar. The flexible pouch is used as the standard to which the other option is compared.

The following packs were utilized in the comparison:

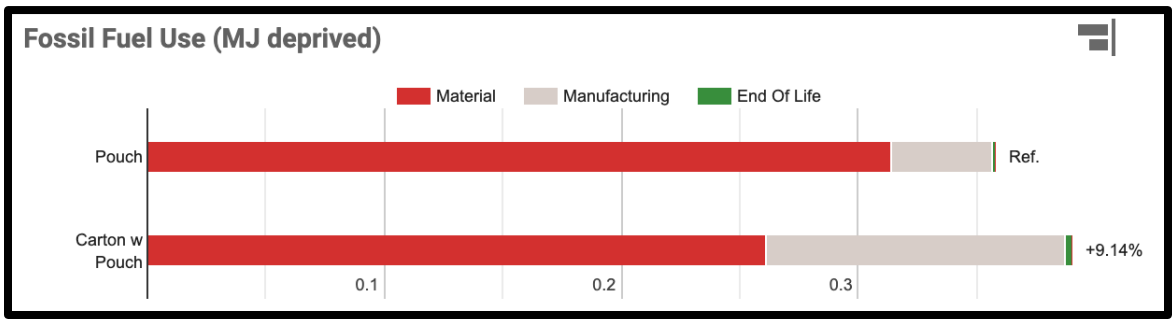
Table 2-A. Cat Flea Collar Comparison – Package Details

Flexible Pouch – 1 Collar	Wt. (g)	
PET	0.76g	
LLDPE	3.24g	
Total Weight	**4.00g**	
Carton with Pouch – 1 Collar	**Wt. (g)**	
SBS Board	9.6g	
Pouch – OPP/Metallized OPP	0.8g	
Total Weight	**10.4g**	

FOSSIL FUEL USE (MJ DEPRIVED)

The charts below and on the following pages highlight the results of fossil fuel use, global warming potential (GWP, which is a measure of carbon emissions), and water use for each of the package formats evaluated. These are some of the primary indicators that package developers consider when appraising the environmental impacts of a particular package. The EcoImpact-COMPASS® software "normalizes" the data based on the functional unit such as weight or number of uses to allow comparison between package formats which may not be the exact same size. In this case, a single flea collar was the unit of measure between the two package formats.

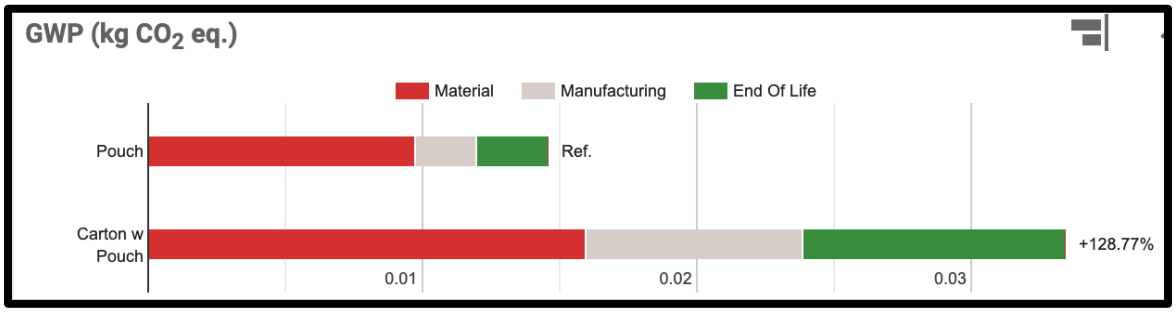
Figure 2-1. Cat Flea Collar – Primary Package – Fossil Fuel Use



The fossil fuel use chart above shows that the carton (with pouch inside) uses about 9% more fossil fuel than the flexible pouch option. The material component (red part of the graph) is larger for the flexible pouch since it uses more plastic material (4.0g vs. 0.8g), however, the manufacturing or conversion process (gray part of the graph) is larger for the carton due to the processing energy needed for both a carton and the lightweight flexible pouch inside. There is still fossil fuel used in the production of paper as an energy source, which shows up in the material phase of the graph.

GLOBAL WARMING POTENTIAL (GWP) EMISSIONS (KG CO_2 EQ.)

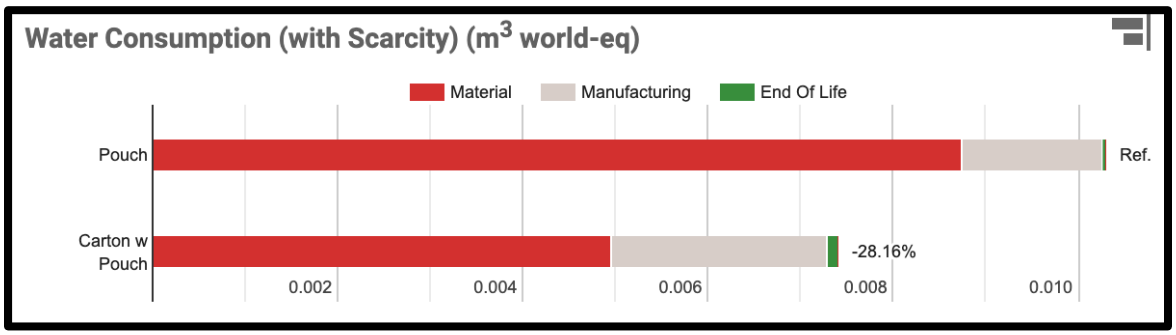
Figure 2-2. Cat Flea Collar – Primary Package – GWP



Global warming potential (GWP) is the greenhouse gas emissions in CO_2 equivalents for the different package formats. The chart above shows the carton option has a GWP nearly 130% higher than the flexible pouch option. This is largely driven by the overall weight of the carton option (10.4g vs. 4.0g). The carton option is higher in the material, manufacturing, and end-of-life phases. Even though the carton is recycled at a rate of 21%, it still has substantially more material that ends up being discarded by consumers than the flexible pouch option, which drives its end-of-life GWP impact.

WATER CONSUMPTION (WITH SCARCITY) (M^3 WORLD-EQ)

Figure 2-3. Cat Flea Collar – Primary Package – Water Consumption



The water consumption attribute considers the relative water remaining per area in a watershed. This is meant to consider the impacts of water consumption in areas with high water scarcity with a factor utilized to show increased impact if there is high scarcity. This attribute is measured in cubic meters of water.

In this metric, the carton actually comes in with a lower amount of water usage, nearly 30% lower than the pouch. This is driven by paper producers increasingly recycling and reusing any water used in their process. This resulted in paper-based packaging increasingly using less water throughout their material (red part of the graph) and manufacturing (gray part of the graph) processes.

END-OF-USE RESULTS AND SUMMARY – PRIMARY PACKAGE

The charts previously shown compare environmental impacts including fossil fuel use, global warming potential (CO_2 emissions), and water consumption in this scenario for different flea collar package formats. Table 2-B (on the following page) considers the impacts of a package that is recycled or discarded as well to ensure that the package aligns with circular economy or sustainable materials management goals. The table shows the results when current recycling rates are considered, as well as the material efficiency ratio, which is a measure of the resource efficiency of the materials to package a flea collar.

The results in Table 2-B show that the flexible pouch has a considerably better material efficiency value, using 4.0g of material vs. 10.4g with the carton option to contain a flea collar.

Additionally, the pouch option results in substantially less material being discarded at the end-of-life than the competitive pack. This is despite the multi-layer pouch currently not being recyclable, while the carton is recycled at a rate of 21%.

The following table summarizes a variety of environmental attributes for different primary package options that were evaluated.

SUMMARY COMPARISON

Table 2-B. Cat Flea Collar – Primary Packaging Comparison Summary

Format	Weight	Fossil Fuel Use (GJ deprived)	GWP (tons-CO_2 eq.)	Water Consumption (m^3 world-eq.)	Material Efficiency (g of pkg/item product)	End-of-Life Total Mass discarded (1MM packs)
Pouch (1 flea collar)	4.0g	357.74 ----	14.61 ----	10,301 ----	4.0g/collar	4 tons
Carton with Pouch (1 flea collar)	10.4g	390.36 +9.12%	33.41 +128.68%	7.404 -28.16%	10.4g/ collar	8.38 tons (+109.5%)

Notes:

- *A normalized product weight (common value divisible by all package formats) of 1 flea collar was used for fossil fuel, GWP, and water consumption calculations. The values shown above are for 1MM primary packs for the flexible pouch.*
- *All percentages cited are for other formats compared to the stand-up pouch package.*
- *For all percentage comparisons in EcoImpact-COMPASS®, the tool uses percent change. The formula is ((Standard flexible pkg value – comparative pkg value)/standard flexible pkg value) *100 = percent change.*
- *Package landfilled values are based on the amount of packaging sent to municipal solid waste after recycling, based on 1 million packs used as the basis for both comparisons.*
- *Recycling rates utilized: 0% – pouch; 21% – carton.*

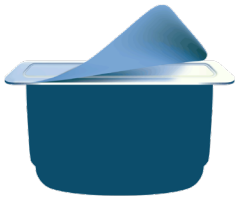
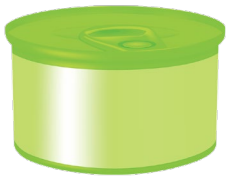
Pet Food Comparison – Primary Package

Pet food is sold in a variety of package formats. For this comparison, several package options for single-serve (or small-serving) pet food were considered. Five of the most common formats used for both dog and cat single food were utilized in this assessment: (1) a foil-based retort pouch for dog food; (2) a clear retort pouch for cat food; (3) dog food in a thermoformed cup with foil lid stock; (4) cat food in a thermoformed cup with a clear lid stock and wrap around paperboard sleeve; and (5) an aluminum can. (Pet food cans can be made of aluminum, stainless steel, or tinplate. This particular can was confirmed to be aluminum-based).

An attempt to utilize products that are similar in size was made though not possible in this case. The dog food foil retort pouch is used as the standard to which other options are compared.

The packs on the following page were utilized in the comparison.

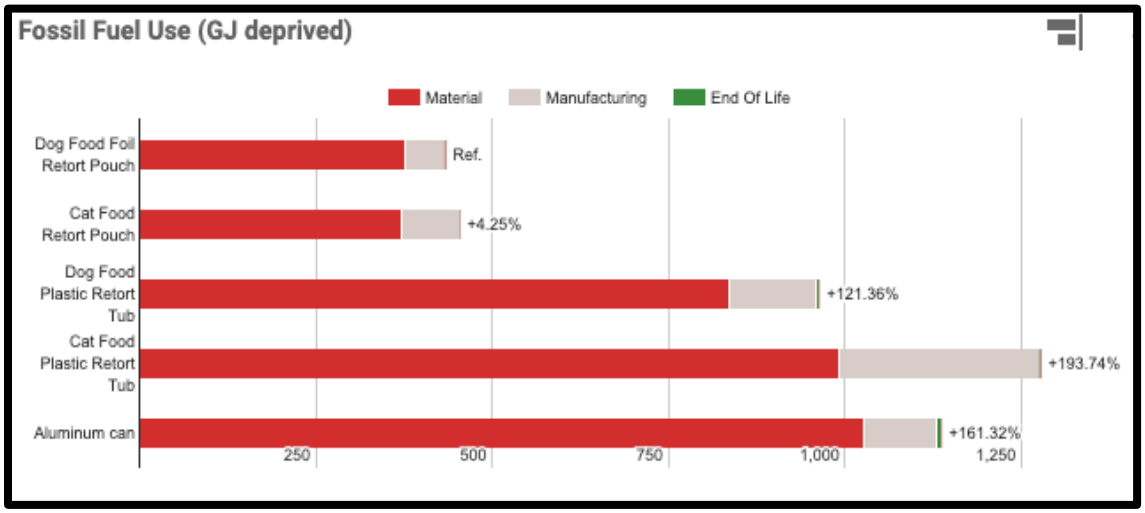
Table 3-A. Pet Food Comparison – Package Details

Dog Food Foil Retort Pouch – 3 oz.	Wt. (g)	
PET	0.44g	
Aluminum Foil	0.53g	
Nylon	0.46g	
CPP	1.77g	
Total Weight	**3.2g**	
Cat Food Clear Retort Pouch – 2.47 oz.	**Wt. (g)**	
PET	0.45g	
AlOx Coated PET	0.45g	
Nylon	0.47g	
CPP	1.83g	
Total Weight	**3.2g**	
Dog Retort Plastic Container – 3.5 oz.	**Wt. (g)**	
Cup – PP (5% EVOH)	8.1g	
Paper Label	0.5g	
Foil Lid Stock	1.4g	
Total Weight	**10.0g**	
Cat Retort Plastic Container – 2.12 oz.	**Wt. (g)**	
Cup – PP	6.4g	
Paperboard Overwrap – SUS	4.7g	
Clear Lid Stock – BON/CPP	0.8g	
Total Weight	**11.9g**	
Aluminum Can – 5.5oz.	**Wt. (g)**	
Aluminum Can (45% PCR/20% PIR)	15.5g	
Paper Label	0.8g	
Total Weight	**16.3g**	

FOSSIL FUEL USE (GJ DEPRIVED)

The charts below and on the following pages highlight the results of fossil fuel use, global warming potential (GWP, which is a measure of carbon emissions), and water use for each of the package formats evaluated. These are some of the primary indicators that package developers consider when appraising the environmental impacts of a particular package. The EcoImpact-COMPASS® software "normalizes" the data based on the functional unit such as weight or number of uses to allow comparison between package formats which may not be the exact same size.

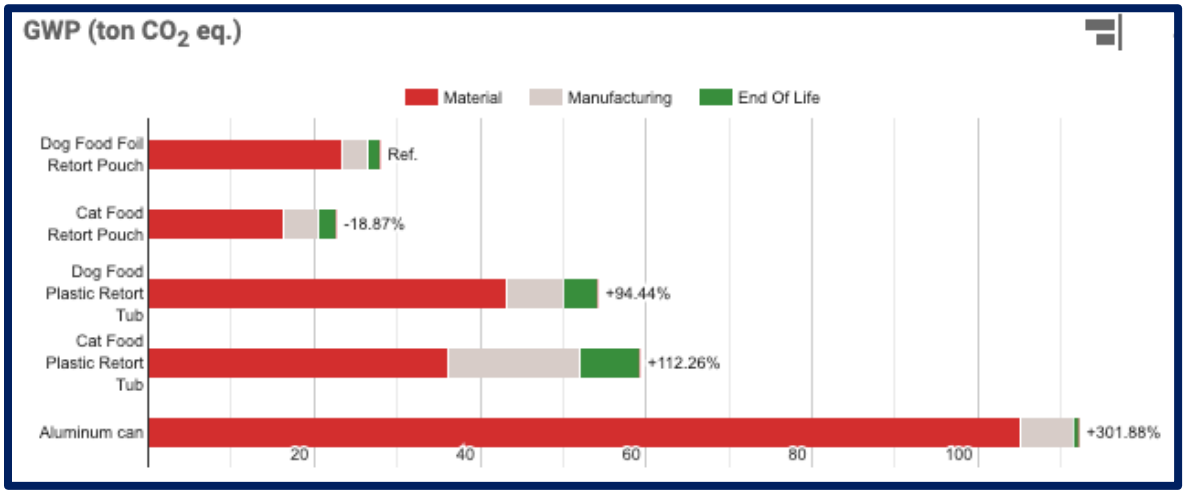
Figure 3-1. Pet Food – Primary Package – Fossil Fuel Use



The fossil fuel use chart above shows that the two pouch options yield the lowest fossil fuel use of the package formats and are quite close with both packs within 4% of each other. The dog and cat retort tubs have greater fossil fuel use over 120% and 190% respectively, largely generated from the heavier package formats. The aluminum can, credited with a 35% recycling rate and containing 65% recycled content in the can, had over 160% greater use of fossil fuel than the dog food pouch, largely based on the energy usage required in the production of aluminum.

GLOBAL WARMING POTENTIAL (GWP) EMISSIONS (KG CO_2 EQ.)

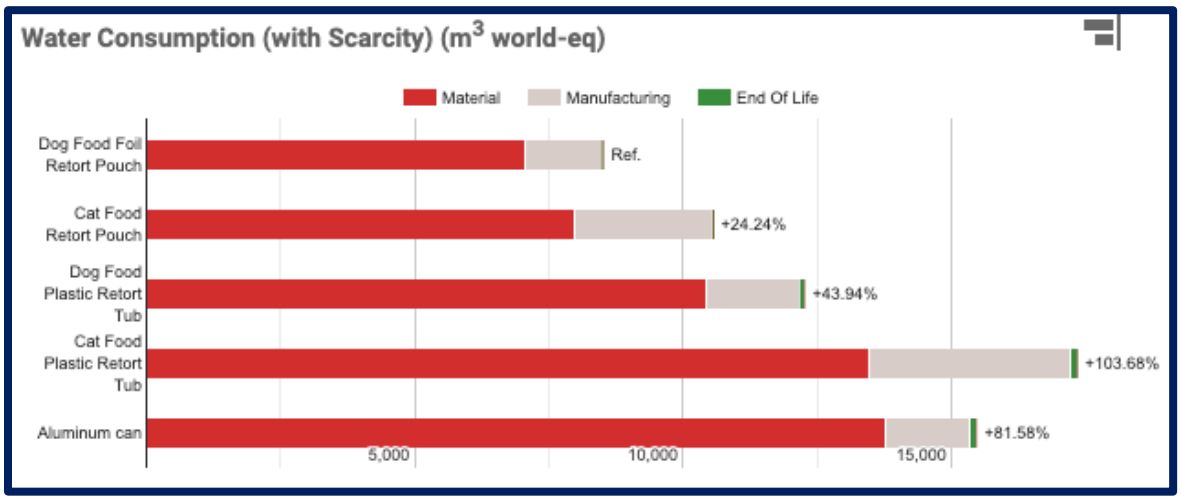
Figure 3-2. Pet Food – Primary Package – GWP



Global warming potential (GWP) is the greenhouse gas emissions in CO_2 equivalents for the different package formats. The above chart again shows the two flexible pouch options as having the lowest GWP. The cat food pouch GWP is nearly 20% lower than the dog food pouch. This is due to the dog food pouch using an aluminum foil layer, while the cat food pouch instead uses an aluminum oxide coating (modeled as plastic metallization in COMPASS®). The other formats all have considerably higher GWP, driven largely by the amount of material used. The two pouch options each use 3.2g of material, while the other three options utilize anywhere from 10g-16.3g of material, though the can has a higher product weight of 5.5 oz., which is about 80% more than the 3.0 oz. of product for the dog food pouch. This product weight difference is considered in all EcoImpact-COMPASS® calculations. The aluminum can GWP is about three times that of the dog pouch even when accounting for the higher product content in the can. Most of the impact for aluminum is in the material phase (red part of the graph) due to the high energy use in the production of aluminum.

WATER CONSUMPTION (WITH SCARCITY) (M^3 WORLD-EQ)

Figure 3-3. Pet Food – Primary Package – Water Consumption



The water consumption attribute considers the relative water remaining per area in a watershed. This is meant to acknowledge the impacts of water consumption in areas with high water scarcity with a factor utilized for areas where scarcity is a major concern. This attribute is measured in cubic meters of water.

In this metric, the two pouch options again come in with the lowest amount of water consumed among the options evaluated. The cat food pouch is about 24% higher in water usage, largely due to the pouch containing less food (2.47 oz. vs. 3.0 oz.) while utilizing the same 3.2g of material. The two plastic tub options have rates of approximately 40% and 100% for the dog and cat options, respectively, driven by the material efficiency (amount of packaging per ounce of pet food). The larger impact on water consumption for the cat food tub versus the dog food tub is led by the cat food having a lower amount of product (2.12 oz. vs. 3.5 oz. for the dog food). The aluminum can, again, was considerably higher due to the amount of water consumption needed in making bauxite to produce aluminum in the production process.

END-OF-USE RESULTS AND SUMMARY – PRIMARY PACKAGE

The charts previously shown compare environmental impacts including fossil fuel use and global warming potential (CO_2 emissions), and water consumption in this scenario for different dog treat package formats. Table 3-B (on the following page) considers the impacts of a package that is recycled or discarded to ensure that the package aligns with circular economy or sustainable materials management goals. The table shows the results when current recycling rates are considered, as well as the material efficiency ratio, which is a measure of the resource efficiency of the materials to package a gram of product.

The results in Table 3-B show that the two pouch options had substantially lower environmental attributes when considering fossil fuel usage, GWP, and water consumption. Additionally, the two pouch options were the most efficient when considering the amount of material used to protect and transport the product. The dog food pouch used just over a gram of material for each ounce of product (1.07g or pkg/oz. of dog food), while the cat food in a PP retort container with a paperboard sleeve used over 5.6 grams of packaging material per ounce of cat food.

Finally, when looking at the amount of material discarded at the end-of-life for the package, the two flexible pouches resulted in the least amount of material being discarded.

The table on the following page summarizes a variety of environmental attributes for different primary package options that were evaluated.

SUMMARY COMPARISON

Table 3-B. Pet Food – Primary Packaging Comparison Summary

Format	Weight	Fossil Fuel Use (GJ deprived)	GWP (tons-CO_2 eq.)	Water Consumption (m^3 world-eq.)	Material Efficiency (g of pkg/oz. of product)	End -of-Life Total Mass discarded (1MM packs)
Dog Food Retort Pouch (3 oz.)	3.2g	435.19 ----	27.91 ----	8,515.52 ----	1.07g/oz.	3.2 tons
Cat Food Retort Pouch (2.47 oz.)	3.2g	453.67 +4.25%	22.64 -18.87%	10,579.47 +24.24%	1.30g/oz.	3.89 tons (+21.5%)
Dog Food Retort Tub (3.5 oz.)	10.0g	963.34 +121.36%	54.27 +95.84%	12,256.90 +43.94%	2.86g/oz.	8.02 tons (+150.6%)
Cat Food Retort Tub (2.12 oz.)	11.9g	1,278.3 +193.74%	59.25 +112.26%	17,344.36 +103.68%	5.61g/oz.	11.59 tons (+262.2%)
Aluminum Can (5.5 oz.)	16.3g	1,137.21 +161.32%	112.17 +301.88%	15,462.42 +81.58%	2.96g/oz.	5.84 tons (+82.2%)

Notes:

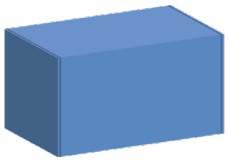
- *A normalized product weight (common value divisible by all package formats) was used for fossil fuel use, GWP, and water consumption calculations. The values shown above are for 1MM primary packs for the dog food retort pouch (1,214,575 cat food retort pouches; 857,143 dog food retort tubs; 1,415,094 cat food plastic retort tubs; and 545,455 aluminum cans).*
- *All percentages cited are for other formats compared to the stand-up pouch package.*
- *For all percentage comparisons in EcoImpact-COMPASS®, the tool uses percent change. The formula is ((Standard flexible pkg value – comparative pkg value)/standard flexible pkg value) *100 = percent change.*
- *End-of-life total mass discarded values are based on the amount of packaging sent to municipal solid waste after recycling, based on 1,000,000 packs of the flexible product used as the basis for both comparisons. (Note: the equivalent of 1,214,575 cat food retort pouches; 857,143 dog food retort tubs; 1,415,094 cat food plastic retort tubs; and 545,455 aluminum cans.)*
- *Recycling rates utilized: 0% – retort pouches; 8% – PP retort tubs; 21% – paperboard sleeve; 35% – aluminum pet food cans.*

Dog Dental Sticks Comparison – Primary Package

Dog dental sticks are a common treat and health product. They are sold in a variety of package formats. For this comparison, three of the most common formats are used: a SUP, a rigid tub, and a corrugated case. An attempt to utilize products that are similar in size was made though was not possible in this case. The stand-up pouch is used as the standard to which other options are compared.

The following packs were utilized in the comparison:

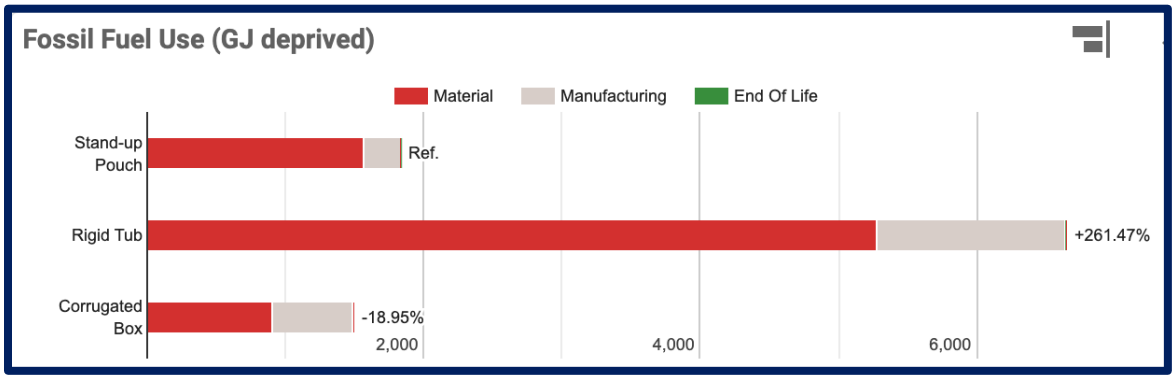
Table 4-A. Dog Dental Sticks Comparison – Package Details

Stand-up Pouch (SUP) – 18.9 oz.	Wt. (g)	
PET	3.0g	
LLDPE	11.77g	
PET (with metallization)	3.01g	
LLDPE	1.05g	
LLDPE	1.05g	
Total Weight	**19.88g**	
Rigid Tub – 29.6 oz.	**Wt. (g)**	
PP Tub	62.0g	
PP Lid	38.5g	
Total Weight	**100.5g**	
Corrugated Box – 46.4 oz.	**Wt. (g)**	
Bleached Corrugated (52% PCR)	162.2g	
Total Weight	**162.2g**	

FOSSIL FUEL USE (MJ DEPRIVED)

The charts below and on the following pages highlight the results of fossil fuel use, global warming potential (GWP, which is a measure of carbon emissions), and water use for each of the package formats evaluated. These are some of the primary indicators that package developers consider when appraising the environmental impacts of a particular package. The EcoImpact-COMPASS® software "normalizes" the data based on the functional unit such as weight or number of uses to allow comparison between package formats which may not be the exact same size.

Figure 4-1. Dog Dental Sticks – Primary Package – Fossil Fuel Use

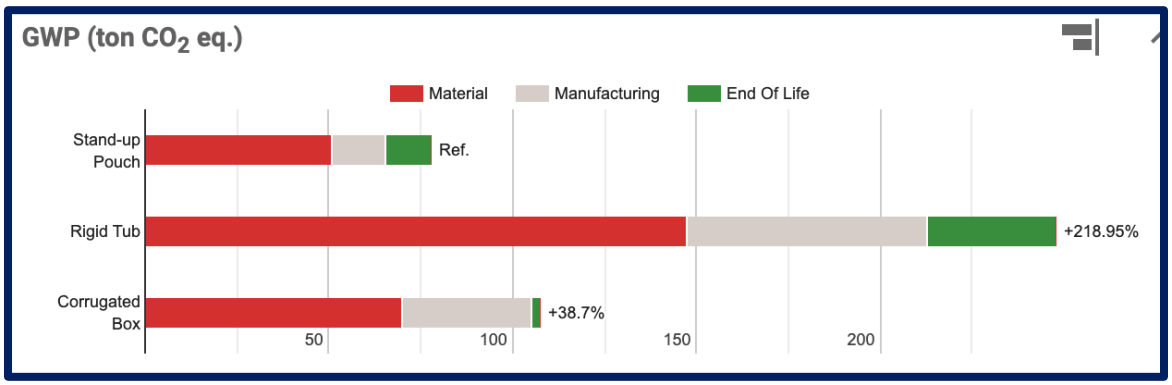


The fossil fuel use chart above shows that the rigid tub fossil fuel consumption is over 250% higher than the SUP. Much of this is driven by the weight of the tub and material efficiency, where the polypropylene (PP) tub uses about three times the amount of packaging as the pouch (3.4g/oz. of dental sticks compared to 1.05g/oz. for the SUP).

The corrugated box, however, uses about 19% less fossil fuel even though the SUP is again about three times more efficient than the corrugated box (1.05g/oz. of dental sticks vs. 3.5g/oz. for the corrugated box) in material usage. The reason is that more corrugated production facilities are using biomass as their energy source for production, thus leading to less use of fossil-based sources for energy usage. The large amount of product within the corrugated box also figures positively in this assessment as the box contains nearly 2.5 times as much product as the pouch. Larger package formats generally use less material per amount of product than smaller package sizes.

GLOBAL WARMING POTENTIAL (GWP) EMISSIONS (TON CO_2 EQ.)

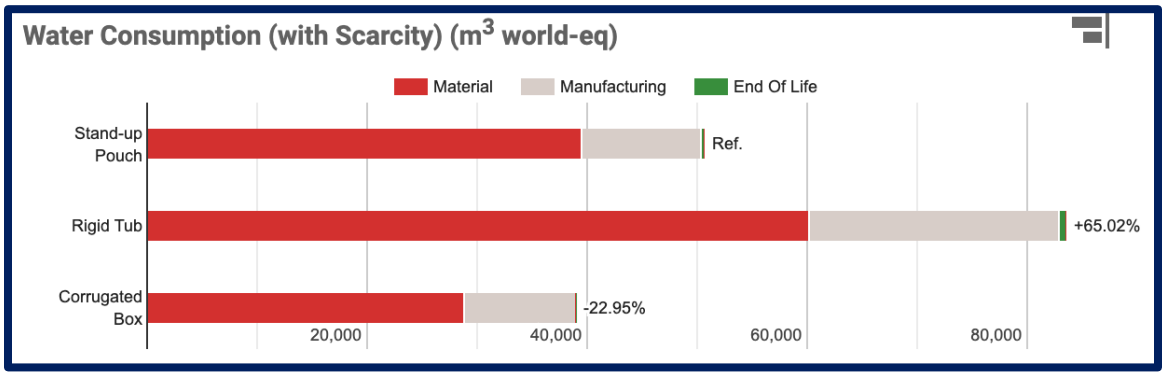
Figure 4-2. Dog Dental Sticks – Primary Package – GWP



Global warming potential (GWP) is the greenhouse gas emissions in CO_2 equivalents for the different package formats. The chart above shows that the SUP results in lower emissions than the competitive packs. This is driven again by the material efficiency of the SUP. The rigid tub results in over 200% more GWP than the pouch. Both the SUP and rigid tub packs consist entirely of plastic materials, but the pouch has much higher material efficiency. The corrugated box results in about a 35% increase over the SUP despite the higher weight and less efficient material usage. Being paper-based, the corrugated box does not have as much CO_2 allocated in the materials phase (red part of the bar chart) as may be expected for a package format that weighs over three times as much per amount of product. This is likely due to the use of biomass for energy in the material production phase.

WATER CONSUMPTION (WITH SCARCITY) (M^3 WORLD-EQ)

Figure 4-3. Dog Dental Sticks – Primary Package – Water Consumption



The water consumption attribute considers the relative water remaining per area in a watershed. This is meant to address the impacts of water consumption in areas with high water scarcity with a factor utilized for areas of high scarcity. This attribute is measured in cubic meters of water. Water usage is expected to be an increasingly important metric, particularly in parts of the world with low water tables and high scarcity.

In this metric, the corrugated box actually comes in with the lowest amount of water usage, about 23% lower than the stand-up pouch. This is guided by paper and corrugated producers in North America increasingly recycling and reusing water in their process, thus reducing the overall amount of water consumed in their material (red part of the graph) and manufacturing (gray part of the graph). The rigid PP tub has considerably higher water consumption in both the material phase (driven by overall package weight) as well as manufacturing phase, which is driven by water used to cool the molds in the production of the tub and lid.

END-OF-USE RESULTS AND SUMMARY – PRIMARY PACKAGE

The charts previously shown compare environmental impacts, including fossil fuel use, global warming potential (CO_2 emissions), and water consumption in this scenario for different dog treat package formats. Table 4-B (on the following page) considers the impacts of a package that is recycled or discarded to ensure that the package aligns with circular economy or sustainable materials management (SMM) goals. The U.S. EPA says that SMM is "a systematic approach to using and reusing materials more productively over their entire life cycles." It also talks about the "use of materials in the most productive way with an emphasis on using less." The table shows the results when current recycling rates are considered, as well as the material efficiency ratio, which is a measure of the resource efficiency of the materials to package a gram of product.

The results in Table 4-B show that the SUP has a considerably better material efficiency value than the rigid PP tub and the corrugated box, both of which use about three times as much material per ounce of product. The corrugated box, however, actually comes out with lower fossil fuel use and water consumption attributes, as well as material discarded at the end-of-life. The corrugated box is credited with a very high recycling rate of 96%, which is the highest rate for all materials collected and recycled in the U.S.

Meanwhile, the table shows the SUP coming out ahead of the corrugated box in two areas measured – global warming potential and material efficiency. This is a good example where a packaging developer must consider the different environmental tradeoffs between the two formats from a holistic perspective around consumer usage, brand equity, convenience, product protection/shelf life, and distribution environment in determining the appropriate package.

The SUP comes out ahead of the rigid PP tub in all metrics shown on the following page, largely due to its much more efficient use of materials, while both structures consist entirely of plastic materials.

The table on the following page summarizes a variety of environmental attributes for different primary package options that were evaluated.

SUMMARY COMPARISON

Table 4-B. Dog Dental Sticks – Primary Packaging Comparison Summary

Format	Weight	Fossil Fuel Use (GJ deprived)	GWP (tons-CO_2 eq.)	Water Consumption (m^3 world-eq.)	Material efficiency (g of pkg/oz. of product)	End-of-Life Total Mass discarded (1MM packs)
Stand-up Pouch (18.9 oz.)	19.88g	1,840.52 ----	77.72 ----	50,617.03 ----	1.05g/oz.	19.88 tons
Rigid PP Tub (29.6 oz.)	104.5g	6,652.84 +261.47%	247.90 +218.95%	83,526.34 +65.02%	3.40g/oz.	60.27 tons (+203%)
Corrugated Box (46.4 oz.)	162.2g	1,491.78 -18.95%	107.80 +38.70%	39,002.23 -22.95%	3.50g/oz.	2.64 tons (-87%)

Notes:

- *A normalized product weight (common value divisible by all package formats) was used for fossil fuel use, GWP, and water consumption calculations. The values shown above are for 1MM primary packs for the stand-up pouch (638,514 rigid PP tubs and 407,328 corrugated boxes).*
- *All percentages cited are for other formats compared to the stand-up pouch package.*
- *For all percentage comparisons in EcoImpact-COMPASS®, the tool uses percent change. The formula is ((Standard flexible pkg value – comparative pkg value)/standard flexible pkg value) *100 = percent change.*
- *End-of-life total mass discarded values are based on the amount of packaging sent to municipal solid waste after recycling, based on 1,000,000 packs of the flexible product used as the basis for both comparisons.*
- *Recycling rates utilized: 0% – stand-up pouch; 3% – PP lid; 8% – PP tub; 96% – corrugated case.*

APPENDIX

Fossil Fuel Use (GJ equivalents deprived)

This indicator considers the total quantity of fossil fuel consumed throughout the life cycle reported in megajoules (MJ) equivalents deprived/kg dissipated, which is based on an extraction/consumption/competition/adaptation approach. This indicator uses the Impact World+ method, uses the primary energy content, and assumes fossil fuel resources are mainly used for energy purposes. Fossil fuels include coal, petroleum, and natural gas.

Global Warming Potential (GWP) (tons of CO_2 equivalents)

Global warming potential (GWP) considers the total quantity of greenhouse gases (GHG) emitted throughout the life cycle reported in kilograms of CO_2 equivalents. This calculation follows the IPCC Sixth Assessment Report (AR6) 2021 100a w/o CO_2 Uptake method and considers climate feedback loops. It considers global warming potential for a 100-year timeframe.

Water Consumption – with Scarcity (m^3 – world-equivalents)

This indicator considers the relative available water remaining per area in a watershed after the demand of humans, aquatic ecosystems, and the manufacturing process has been met, compared to the world average. The AWARE method is used to calculate the water scarcity footprint, which looks at the potential to deprive another freshwater user by consuming freshwater in a given region. The water scarcity footprint is the water consumption inventory multiplied by a characterization factor, which is based on the availability and demand of fresh water in a given region. The characterization factors have a range of 0.1 to 100, with higher numbers associated with more water-scarce regions and are dimensionless (m3 world eq./m3). The water scarcity footprint results are typically reported in m3 world-eq. but may be reported in liters world-eq. if there is a small quantity of water being considered in the analysis by EcoImpact-COMPASS.

Acronyms

Adh:	Adhesive
Alum:	Aluminum
Coex:	Coextruded Film
HDPE:	High-density Polyethylene
LLDPE:	Linear Low-density Polypropylene
OPP:	Oriented Polypropylene
PE:	Polyethylene
PCR:	Post-consumer Recycled
PET:	Polyethylene Terephthalate
PP:	Polypropylene

About the Flexible Packaging Association

The Flexible Packaging Association is the voice of the U.S. manufacturers of flexible packaging and their suppliers. The association's mission is connecting, advancing, and leading the flexible packaging industry. Flexible packaging represents over $42.9 billion in annual sales in the U.S. and is the second largest and one of the fastest-growing segments of the packaging industry. Flexible packaging is produced from paper, plastic, film, aluminum foil, or any combination of those materials, and includes bags, pouches, labels, liners, wraps, rollstock, and other flexible products.

About PTIS, LLC

PTIS, LLC is a leading business and technology management company focused on Creating Value Through Packaging© and helping clients throughout the packaging value chain develop long-term packaging strategies and programs. PTIS, recognized for foresight and thought leadership, and the success of their 20-year Future of Packaging program, helps companies achieve and incorporate these elements into their innovation programs, e-commerce, holistic productivity, sustainability, holistic design, and consumer/retail insights related to packaging.