A Streamlined Life Cycle Assessment Comparison for Glenroy® Stand-up Pouch Options vs. Rigid HDPE Canister

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Prepared for:

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Project Overview & Goals

Glenroy approached PTIS to look at providing a streamlined life cycle assessment (LCA) and report with descriptions on key environmental indicators based comparing three separate Stand-Up Pouch (SUP) to a rigid package equivalent currently on the market for protein powders. The purpose of this LCA was to use the results as an educational tool and better understand the environmental impacts of the SUP options when compared to the rigid canister package.

For this report, three separate SUP options were compared to the rigid canister:

- Traditional Stand-up Pouch
- Post Consumer Recycled (PCR) Stand-up Pouch
- Store Drop-off Recyclable (PE based) Stand-up Pouch

Traditional SUP	**Wt (g)**
PET	2.01g
Metalized PET	2.0g
LLDPE	8.33g
Adhesive	0.78g
Zipper – LDPE	1.92g
Ink	0.28g
PP – Scoop	5.4g
Total Weight	20.72g

PCR SUP	Wt (g)
.48mil PCR PET	1.96g
.48 mil PCR Metalized PET	1.96g
3.0 mil PCR (42%) LLDPE/ HDPE	8.47g
Adhesive	0.78g
Zipper – LDPE	1.92g
Ink	0.28g
PP – Scoop	5.4g
Total Weight	20.84g

Recyclable (all-PE) SUP	Wt. (g)
1.5 mil HDPE	4.31g
4.5 mil HDPE/ EVOH	12.62g
Zipper – LDPE	1.92g
Adhesive	0.39g
Ink	0.28g
PP - Scoop	5.4g
Total Weight	24.92g

Rigid Canister	Wt. (g)
HDPE Cansiter	69.4g
PP – Closure	26.0g
OPP – label	3.1g
Paper/Alum foil/paper lidstock	4.4g
Scoop	5.4g
Total Weight	108.3g

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 type of package comparisons. It is now maintained and updated by Trayak.

For the comparison, a product weight of 584g was used for all products. This was based on the sales weight for the protein powder and provided an appropriate fill height for the pouch options. Note that only the primary package was modeled in the comparison.

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

1. Fossil Fuel Use
2. GHG Emissions
3. Water Use

Other metrics considered include:

- Product:package ratio
- Material discarded (grams of packaging per 1000 kg of product)

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

- HDPE bottle – 18%
- PP closure/ cap – 3%
- PE based pouch – 13% (note that 3% was used in the discard calculation)
- All other materials – 0%

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 for a particular company, and is much quicker 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, U.S. Life Cycle Inventory Database (part of the National Renewable Energy Laboratory), and other LCA databases which are widely used. EcoImpact-COMPASS® allows for a Cradle to Grave boundary as it can also incorporate in 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 impacts of different materials, conversion processes, and packages, while in the package development phase.

The output from the tool allows for an 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, a number of assumptions are made, using industry averages. As such, the output from the EcoImpact-COMPASS® can help show general comparisons between different flexible package and rigid options. Additionally, it must be understood that in most cases, some package formats and materials will perform better in some environmental indicators (such as greenhouse gas emissions and fossil fuel usage) 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 discussion about which environmental indicators are most important for brands to attempt to minimize their overall impacts.

Environmental Indicator Metrics Results

The charts on the following pages will highlight results across a number of environmental indicators. Package developers may reference these indicators when considering the environmental impact of different package options. Note that there are generally tradeoffs between the different indicators and no one package will typically come out ahead in all indicators. This means that package developers and companies must decide which indicators most reflect their internal goals and balance product protection, consumer usage, brand equity, and environmental indicators among many other factors when selecting a package structure and format.

Protein Powder Packaging Comparison

Protein powders are often sold in a rigid package, but can also be found sold in flexible packaging formats such as the Stand-up Pouch (SUP). For this comparison, 3 separate SUPs were evaluated with the rigid HDPE canister as the standard to which other packages are compared. A product weight of 584g was used for the comparison.

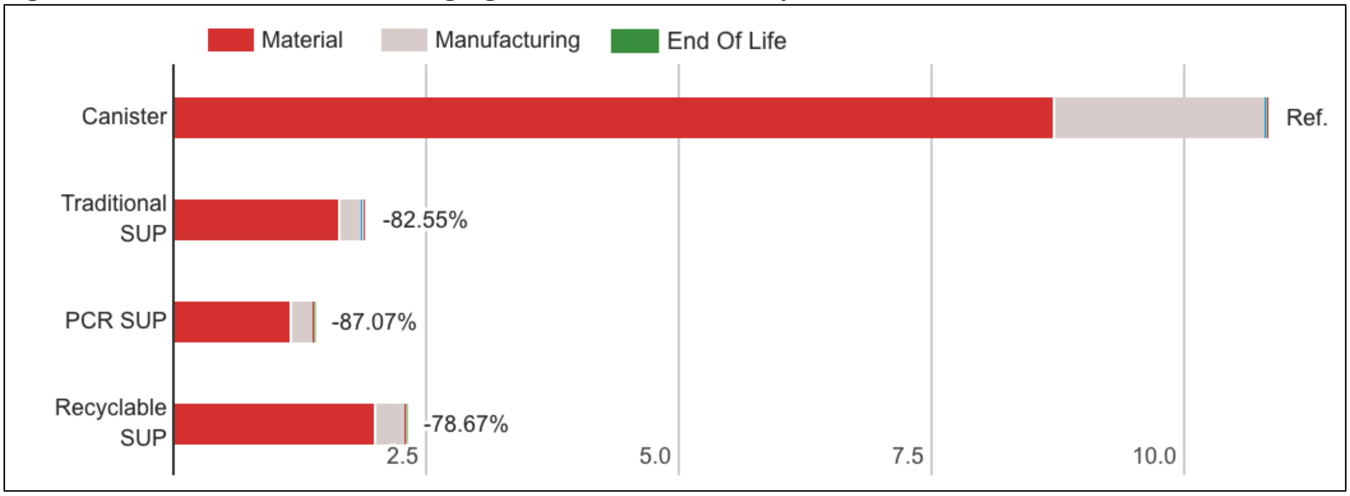
Table 1-A. Protein Powder Packaging Evaluation Comparison

Package Type/Product Weight	Structure (package weight)	Photo
Rigid Canister (584g)		
HDPE Canister and Label	HDPE canister – 69.4g OPP label – 3.1g	
Closure	PP – 26.0g	
Tamper Evident Seal	Paper/Foil/Poly – 4.4g	
Scoop	PP – 5.4g	
	TOTAL = 108.3g	
Traditional Stand-up Pouch (584g)		
Traditional Stand-up Pouch	PET/Met PET/ LDPE/LDPE zipper/ ink/ adhesive – 15.33g	
Scoop	PP – 5.4g	
	TOTAL = 20.73g	
Post-consumer Recycled (PCR) SUP (584g)		
PCR Stand-up Pouch	PCR PET/ PCT Met PET/ LLDPE/HDPE/ Zipper/ Ink/ Adhesive – 15.43g	
Scoop	PP – 5.4g	
	TOTAL = 20.84g	
Store Drop-off Recyclable (all-PE) SUP (584g)		
Store Drop-off Recyclable SUP	HDPE/HDPE/LDPE zipper/ Ink/ Adhesive – 19.52g	
Scoop	PP – 5.4g	
	TOTAL = 24.92g	

Fossil Fuel Use

The charts on the following pages will highlight results of the fossil fuel usage, greenhouse gas (GHG) 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, though in this case the same product weight of 584g was used across all package formats evaluated.

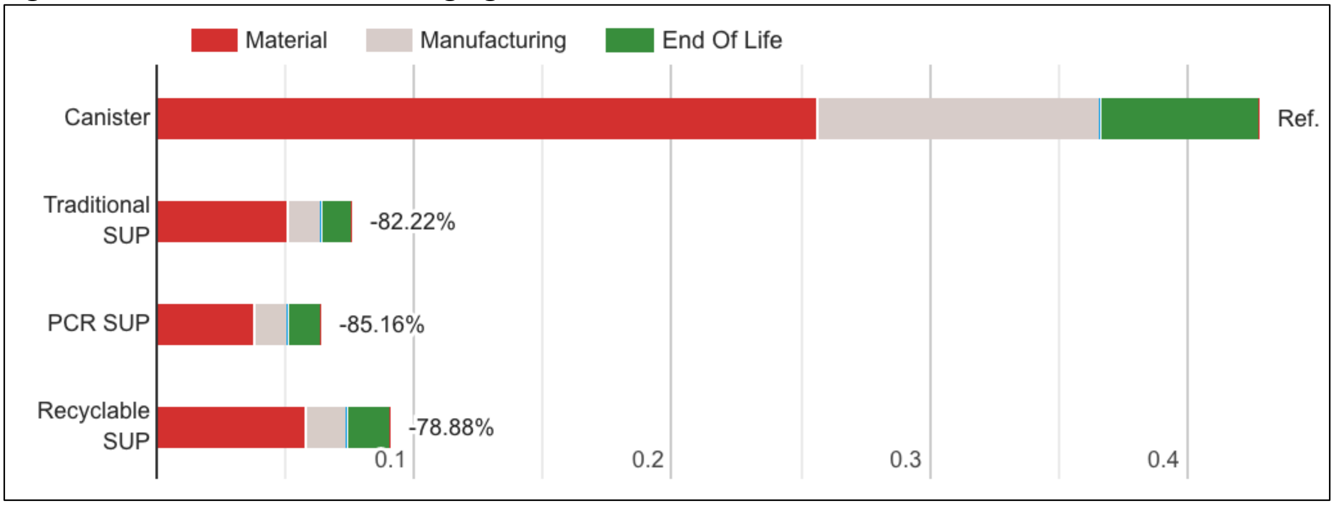
Figure 1-1. Protein Powder Packaging – Fossil Fuel Consumption



The fossil fuel use chart above shows that the pouch options result in a significant reduction in fossil fuel use compared to the current canister. This is largely driven by the overall package weight, with the canister weighing 4-5 times (108.3g vs. 20.73g/ 24.92g) that of the pouches and all options being primarily made up of plastic structures. The recyclable pouch uses more fossil fuel than the PCR or traditional SUP since it is a heavier structure (24.92g vs. 20.73g) to get the necessary performance. The PCR structure has a further reduction over the traditional SUP since it is utilizes a large overall percentage of PCR material (53%), which then requires less overall fossil fuel in the material production (red bar) stage.

Greenhouse Gas (GHG) Emissions

Figure 1-2. Protein Powder Packaging – GHG Emissions

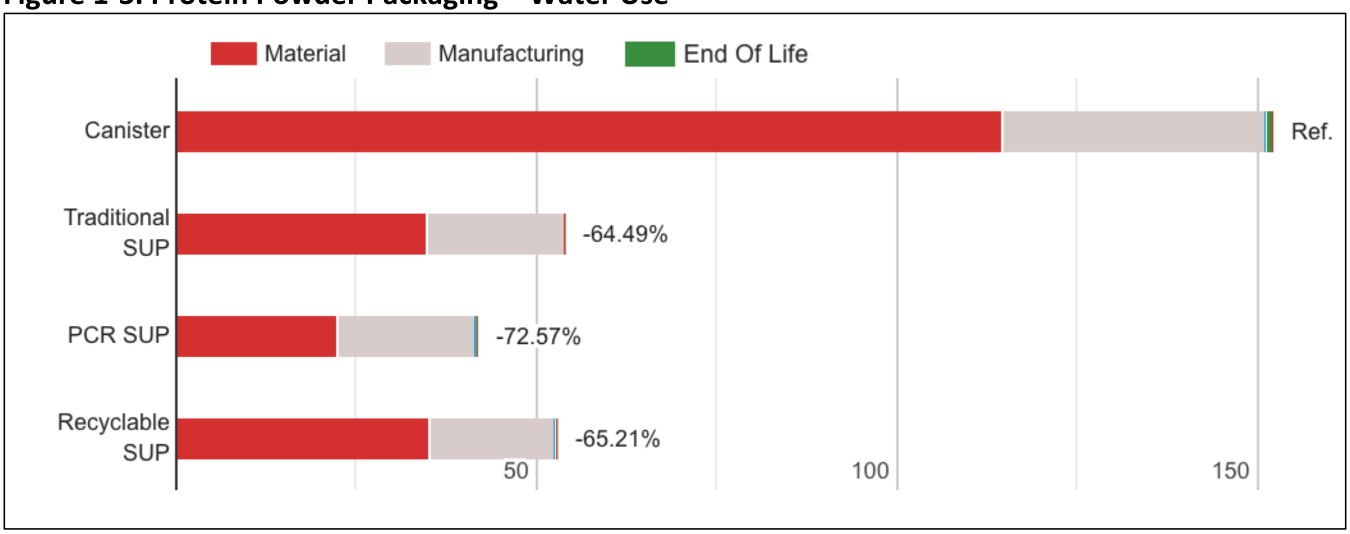


The values for Greenhouse Gas (GHG) emissions shown above track very similarly to the fossil fuel usage graph, with all pouches resulting in far less GHG emissions than the canister across the material manufacture, conversion (manufacturing) and end of life phases.

Again, the use of PCR results in an additional emission savings vs. the traditional pouch. This is generally the case when PCR utilized in any application.

Water Use

Figure 1-3. Protein Powder Packaging – Water Use



Again, similar to the previous charts, the pouch variables result in substantial reduction in water use vs. the rigid canister. This is most apparent in the material production (red part of the graph), since less far less material is being used, it would make sense that water use would also be reduced. The PCR pouch results in the least amount of water used due to the use of cleaning PCR flakes, which is less intensive than using water in the initial material production phase.

End of Use Results and Wrap-up / Summary

The charts previously shown indicate that the stand-up pouches variations all have lower environmental impacts including fossil fuel usage, GHG emissions, and water usage in this scenario than the rigid HDPE container. In this section, the impacts of a material that is recycled or discarded are considered to ensure that the package aligns with Circular Economy or Sustainable Materials Management goals. Table 1-B (below) shows the results when current recycling rates are considered, as well the product-to-package ratio, which is a measure of the resource efficiency of the materials used. For this measure, a high product and a low package number are desired.

The results in Table 1-B show that the stand-up pouches have a higher overall product weight percentage (95.9-96.6%) than the rigid PET container (84.4%), showcasing the material efficiency of the flexible pouch.

Additionally, the rigid HDPE canister results in substantially more material being discarded at the end of life (162,442g vs. 35,219g-42,394g of packaging for 1000 kg of product) when taking into consideration estimated current recycling rates for HDPE canisters (18%), vs. the PE-based stand-up pouch (3% recycling rate used). With the movement toward greater investment in recycling systems, potential EPR legislation and brand owner goals driving toward a circular economy, it is likely that investment in the recovery system to drive higher recycling rates and better integrated packaging into a circular economy model will occur over the next decade.

The table below summarizes a variety of environmental attributes for the stand-up pouch options. In all of the attributes evaluated below, the stand-up pouch variables hold an advantage vs. the rigid HDPE package.

In the end, it is up to the packaging developer and other stakeholders to determine which indictors and other sustainability-based metrics are to be prioritized (such as weight of material used, weight of material sent to landfill or recycled). Package developers also need to consider customer needs (ease of use, shipping environment, breakage) that must be balanced along with the environmental indicators. Most companies prioritize 2-3 main indicators for their focused sustainability strategy and messaging. This can help companies and package developers concentrate on package formats that most closely align with company goals.

SUMMARY COMPARISON

Table 1-B. Protein Powder Packaging Comparison Summary

Format	Fossil Fuel Use (MJ-Equiv)	GHG Emissions (kg-CO2 equiv)	Water Use (l)	Product-to-Package Ratio	Pkg Landfilled (g)/1000 kg Product
HDPE Canister	10.83	0.428	152.22	84.4%:15.6%	162,442
Traditional SUP	1.89 (-82.55%)	0.0761 (-82.22%)	54.05 (-64.49%)	96.6%:3.4%	35,219 (-78.3%)
PCR Based SUP	1.40 (-87.07%)	0.0635 (-85.16%)	41.75 (-72.57%)	96.6%:3.4%	35,390 (-78.2%)
Recyclable SUP	2.31 (-78.67%)	0.0904 (-78.88%)	52.95 (-65.21%)	95.9%:4.1%	42,394 (-73.9%)

Notes:

- *A normalized product weight (common value divisible by all package formats) of 584g was used for Fossil Fuel, GHG and Water Consumption calculations.*
- *All percentages cited are for other formats compared to the rigid package.*
- *A higher number for product-to-package ratio (first number) cited means a higher percentage of weight is attributed to product, and less to packaging, resulting in more efficient use of packaging resources.*
- *For all percentage comparisons in EcoImpact-COMPASS®, the tool uses percent change. The formula is: ((Rigid pkg value – flexible pkg value)/ rigid pkg value) *100 = percent change.*
- *Package landfilled values are based on the of amount of packaging sent to municipal solid waste after recycling, based on 1000 kg of protein powder used as the basis for both comparisons.*
- *For recycling rates – HDPE modeled at 18%, PP fitments/caps - 3%,PE based STANDCAP pouch – 13%, all other materials – 0%*

APPENDIX

Fossil Fuel Use

Fossil Fuel Use measures the total quantity of fossil fuel consumed throughout the life cycle, reported in mega joules (MJ) equivalent deprived. This calculation uses the IMPACT World+ method and assumes fossil resources are used for energy purposes. Fossil fuels include coal, petroleum, and natural gas. Inputs for nuclear fuel as uranium are accounted for in the Mineral Consumption metric.

GHG Emissions

GHG Emissions measure the total quantity of greenhouse gases (GHG) emitted throughout the lifecycle reported in kilogram CO2 equivalents. This calculation follows the latest IPCC 2013 method and considers climate feedback loops.

Water Use

Water Use measures the relative water remaining per area in a watershed after the demand of humans, aquatic ecosystems and manufacturing processes have been met. This metric accounts for water scarcity and the result represents the relative value in comparison to the average liters consumed in the world. Essentially, the total water consumed to make the package is multiplied by the regions scarcity factor which with either increase or decrease the water usage value based on the scarcity or excess availability of water in a specific region, respectively. This metric uses the AWARE (Available Water Remaining) methodology.

Acronyms

Coex:	Coextruded film
HDPE:	High Density Polyethylene
MDPE:	Medium Density Polyethylene
LLDPE:	Linear Low-Density Polypropylene
PE:	Polyethylene
PCR:	Post-Consumer Recycled
PET:	Polyethylene Terephthalate
PP:	Polypropylene

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