Flexible Packaging Provides Sustainable Solutions for E-Commerce Applications

FPA Flexible Packaging Association
Connecting. Advancing. Leading.

Less Resources. Less Footprint. More Value.™ Flexible Packaging

According to the United States Department of Commerce, e-commerce is a growing economic segment, experiencing a 32.4% surge from 2020 in the U.S.[1] With an annual growth rate of approximately 20% expected to continue through 2024[2], the demand for highly efficient, cost-effective e-commerce packaging is more critical than ever.

Several real-world application case studies show that flexible packaging, when compared to other package formats, has significantly better environmental attributes for fossil fuel usage, greenhouse gas emissions, and water usage. The Flexible Packaging Association's (FPA) "Sustainability Life Cycle and Economic Impacts of Flexible Packaging in E-commerce" report highlights five Streamlined Life Cycle Assessment (LCA) case studies using EcoImpact-COMPASS® LCA software to quantify the environmental and economic shipping impacts of different flexible and non-flexible e-commerce packaging.

For full case studies, please visit **www.flexpack.org**.

[1] Fareeha, Ali and Young, Jessica, "US E-commerce Grows 32.4% in 2020," Digital Commerce 360, January 29, 2021, Digitalcommerce360.com

[2] Insider Intelligence Editors, "US E-commerce Forecast Revised Upward, 18% Growth Expected in 2021," Intelligence Insider, June 9, 2021, Emarketer.com

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LIFE CYCLE ASSESSMENT

PEANUT BUTTER PACKAGING CASE STUDY

Fossil Fuel (MJ-EQUIV)		Greenhouse Gas Emissions (kg-CO2 EQUIV)		Water Consumption (Liters)	
Stand-up Pouch with Fitment:	**1.29**	Stand-up Pouch with Fitment:	**.08491**	Stand-up Pouch with Fitment:	**22.01**
Stand-up Pouch with Overbox:	**1.76**	Stand-up Pouch with Overbox:	**.1255**	Stand-up Pouch with Overbox:	**28.08**
PET Jar:	**1.46**	PET Jar:	**.08461**	PET Jar:	**25.21**

FOSSIL FUEL USAGE

The FPA report shows that the stand-up pouch with a fitment uses the least amount of fossil fuel, 1.29 MJ-EQUIV, when compared to the PET jar pack and stand-up pouch with overbox. The PET jar pack uses **13%** more fossil fuel, and the pouch with fitment and overbox resulted in nearly **36%** more fossil fuel used. The primary cause of increased fossil fuel usage is due to the overbox, which doubled the total amount of packaging used.

GREENHOUSE GAS EMISSIONS

The stand-up pouch with a fitment and PET jar pack had similarly low overall levels of GHG (greenhouse gas) emissions. The PET jar pack reported slightly lower GHG emissions because it contained less “dead space” compared to the stand-up pouch. The stand-up pouch with fitment and overbox again proved to be the least efficient when comparing each package’s GHG emissions.

WATER CONSUMPTION

The stand-up pouch with a fitment reported the lowest overall water usage at 22.01 liters. The PET jar pack used **14%** more water, while the water-intensive process of paper and corrugated production resulted in the stand-up pouch with overbox using **27.5%** more water than the stand-up pouch with a fitment.

LIFE CYCLE ASSESSMENT

CEREAL PACKAGING CASE STUDY

Fossil Fuel (MJ-EQUIV)		Greenhouse Gas Emissions (kg-CO2 EQUIV)		Water Consumption (Liters)	
Stand-up Pouch:	**1.22**	Stand-up Pouch:	**.07557**	Stand-up Pouch:	**12.50**
Bag-in-Box:	**2.70**	Bag-in-Box:	**.2951**	Bag-in-Box:	**65.10**
Bag-in-Box with Overbox:	**3.94**	Bag-in-Box with Overbox:	**.4117**	Bag-in-Box with Overbox:	**100.98**

FOSSIL FUEL USAGE

The FPA report shows that the stand-up pouch used considerably less fossil fuel than both bag-in-box options. The bag-in-box option with overbox used nearly four times the amount of packaging and **224%** more fossil fuel than the stand-up pouch format, largely due to the use of two separate corrugated cases. Even with the overbox eliminated, the bag-in-box option uses more than twice the amount of packaging than the stand-up pouch and **122%** more fossil fuel.

GREENHOUSE GAS EMISSIONS

The bag-in-box cereal options resulted in considerably higher GHG emissions in comparison to the stand-up pouch alone. Similar to the fossil fuel results, the extra packaging caused the bag-in-box option without an overbox to emit **290%** more GHG emissions, and the option with the overbox resulted in **445%** more when compared to the stand-up pouch.

WATER CONSUMPTION

Due to the vast amount of water usage during the production of paper-based products, the bag-in-box options used significantly more water than the stand-up pouch. The additional overbox caused the traditional bag-in-box option to use **708%** more water than the stand-up pouch, and even with the overbox removed the bag-in-box option still used **421%** more water.

LIFE CYCLE ASSESSMENT

SHOE PACKAGING CASE STUDY

Fossil Fuel (MJ-EQUIV)		Greenhouse Gas Emissions (kg-CO2 EQUIV)		Water Consumption (Liters)	
Shoe Box with Flexible Pouch:	**6.26**	Shoe Box with Flexible Pouch:	**.3943**	Shoe Box with Flexible Pouch:	**94.23**
Shoe Box with Outer Overbox:	**7.15**	Shoe Box with Outer Overbox:	**.6529**	Shoe Box with Outer Overbox:	**92.68**

FOSSIL FUEL USAGE

The shoe box with an overbox used approximately **14%** more fossil fuel than the shoe box with a flexible pouch. This is due to the flexible pouch using less than half of the amount of packaging material for e-commerce delivery.

GREENHOUSE GAS EMISSIONS

The shoe box with the flexible pouch resulted in the least amount of GHG emissions, while the shoebox with an overbox, in comparison, reported an increase of approximately **66%**. The material impact alone for the overbox is greater than the material, manufacturing, transportation, and end-of-life GHG impacts combined for the flexible pouch.

WATER CONSUMPTION

The water consumption for the shoe box with an overbox and the flexible pouch are similar. The production of LDPE is more water intensive on a per gram basis than corrugated packaging, even though far less material is used.

LIFE CYCLE ASSESSMENT

LAUNDRY DETERGENT PACKAGING CASE STUDY

Fossil Fuel (MJ-EQUIV)		Greenhouse Gas Emissions (kg-CO2 EQUIV)		Water Consumption (Liters)	
Liquid in a Stand-up Pouch with Fitment:	**4.07**	Liquid in a Stand-up Pouch with Fitment:	**.2613**	Liquid in a Stand-up Pouch with Fitment:	**69.61**
Liquid in a HDPE Detergent Bottle:	**7.80**	Liquid in a HDPE Detergent Bottle:	**.4309**	Liquid in a HDPE Detergent Bottle:	**91.16**
Pods in Flexible Pouch:	**3.46**	Pods in Flexible Pouch:	**.2479**	Pods in Flexible Pouch:	**73.19**
Pods in a Flexible Pouch without Overbox	**2.55**	Pods in a Flexible Pouch without Overbox	**.1634**	Pods in a Flexible Pouch without Overbox	**60.11**

FOSSIL FUEL USAGE

The packages that primarily used a flexible structure versus a rigid structure resulted in significantly lower fossil fuel usage. Laundry pods in a flexible pouch without an overbox proved to use the least fossil fuel at 2.55 MJ-EQUIV. Due to its weight, the package format that used the most fossil fuel was the HDPE bottle, which resulted in **91.5%** more fossil fuel than the liquid detergent in a flexible pouch with a fitment.

GREENHOUSE GAS EMISSIONS

The report shows that flexible packaging options resulted in less GHG emissions than heavier, more rigid packages. The laundry pods in a flexible pouch without an overbox reported the lowest GHG emissions when compared to liquid detergent in stand-up pouch, while the highest level of emissions, **64.9%**, were tied to the rigid HDPE bottle.

WATER CONSUMPTION

The HDPE bottle and rigid PET containers used the most water when compared to the laundry pods in a flexible pouch. This is due to the additional water needed to cool molds during injection molding or blow molding processes of the rigid containers.

LIFE CYCLE ASSESSMENT

MAILER PACKAGING CASE STUDY

Fossil Fuel (MJ-deprived)		Greenhouse Gas Emissions (kg-CO2 EQUIV)		Water Consumption (Liters)	
Poly Mailer:	**1.49**	Poly Mailer:	**.06467**	Poly Mailer:	**24.70**
Bubble Mailer:	**2.60**	Bubble Mailer:	**.1092**	Bubble Mailer:	**36.68**
Paper Cushion:	**2.34**	Paper Cushion:	**.3425**	Paper Cushion:	**195.68**
Paperboard:	**3.51**	Paperboard:	**.4494**	Paperboard:	**124.56**

FOSSIL FUEL USAGE

The poly mailer reported the lowest overall fossil fuel usage due to having the lowest weight. The paperboard mailer resulted in the highest fossil fuel used, **135%**, because is it nearly eight times the weight of the poly mailer.

GREENHOUSE GAS EMISSIONS

The poly mailer also was most efficient in GHG emissions, with the other lighter options following behind. The paper-based options were the heaviest and therefore had the most GHG emissions. When compared to the poly mailer, the paper cushion mailer resulted in **430%** more GHG emissions, while the paperboard mailer reported the most GHG emissions at **595%**.

WATER CONSUMPTION

The poly mailer and the bubble mailer used the least water when compared to paper-based products, as most plastic products use less water in the material production process. Compared to the poly mailer, the paperboard mailer used **404%** more water, and the paper cushion mailer resulted in the most water use at **692%**.

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