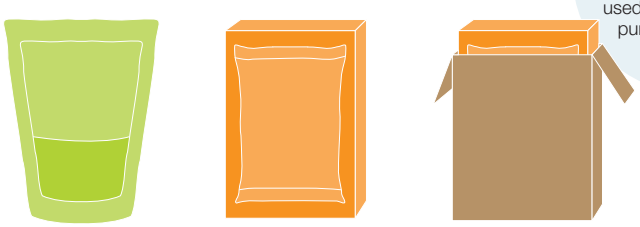
STREAMLINED LIFE CYCLE ASSESSMENT*

E-COMMERCE CEREAL PACKAGING CASE STUDY

CEREAL PACKAGE COMPARISON

This life cycle scenario looked at two popular package formats for cereal with a cradle-to-grave boundary: a stand-up pouch — the standard against which all other formats were measured — and a traditional bag-in-box, both packed as part of a six-pack in a corrugated box. Two scenarios were run for the bag-in-box option: one including an overbox and one without.**



STAND-UP POUCH | BAG-IN-BOX | BAG-IN-BOX WITH OVERBOX

An "overbox" or "box in a box" is a corrugated case that holds another corrugated case and is used for e-commerce purposes as extra protection.

FOSSIL FUEL CONSUMPTION

The stand-up pouch and e-commerce case use considerably less fossil fuel than the bag-in-box options.

The bag-in-box carton as shipped (1,031.6 g) uses nearly **4X** the amount of packaging as the stand-up pouch system (277.6 g), largely due to the two separate corrugated cases. Even when the overbox is eliminated, the bag-in-box option (536.6 g) still uses more than **twice** the amount of packaging (277.6 g) than the stand-up pouch e-commerce option.

1.22 MJ-EQUIV | **2.70** MJ-EQUIV | **3.94** MJ-EQUIV

GREENHOUSE GAS (GHG) EMISSIONS

GHG emissions are often closely aligned with the amount of packaging used. Both bag-in-box cereal options result in considerably higher overall GHG emissions than the stand-up pouch scenario.

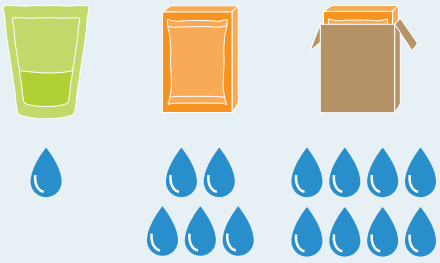
Even the bag-in-box option without the overbox results in **+290%** more GHG, which is driven largely by the amount of packaging. The nesting of the pouches within the case ensures a very tight pack, with minimal amount of corrugated material needed for the shipping case.

.07557 kg-CO2 equiv | **.2951** kg-CO2 equiv | **.4117** kg-CO2 equiv

WATER CONSUMPTION

The stand-up pouch format, which is formed by laminating multiple thin layers of film together, uses much less water in its manufacturing and conversion processes compared to the bag-in-box options. Production of any paper-based substrate, including cartons and corrugated, results in much higher water use than plastic production.

The bag-in-box option shipped with the overbox uses **+708%** more water compared to the stand-up pouch scenario. And even without the overbox, overall water impact remains higher **(+421%)**.



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*All environmental impact metrics were developed using the streamlined life cycle assessment tool, EcoImpact-COMPASS®
**In this case the cereal bag-in-box option was shipped with an additional overbox around the shipping case. That would not likely be the case for many bag-in-box shipments, so the scenario in which the overbox was eliminated was also considered. This scenario was also run in the event that the shipping case could undergo certification for the Amazon Ship In Own Case (SIOC) program.

END OF USE SUMMARY

SOURCE REDUCTION BENEFITS

Flexible packaging offers the ability to source reduce, which is one of the most preferred methods of waste management, according to the U.S. EPA Waste Hierarchy.

As a result, a major benefit of flexible packaging is the high product-to-package ratio that it offers.

HIGH product-to-package ratio:

88.0% Product weight

12.0% Package weight

LOW product-to-package ratio:

75.1% Product weight

24.9% Package weight

62.2% Product weight

37.8% Package weight

RECOVERY BENEFITS

STAND-UP POUCH **1x**

amount of material ending up as municipal solid waste

BAG-IN-BOX **4x**

amount of material ending up as municipal solid waste

BAG-IN-BOX WITH OVERBOX **7x**

amount of material ending up as municipal solid waste

Using available recycling rates, the stand-up pouch results in less material discarded (**12,619 g** for 1,000 kg of cereal), while the current bag-in-box option would result in over **7X** that amount and about **4X** the amount of material discarded without the overbox.

While many multi-material flexible packages are not yet recovered and recycled in significant amounts, the packaging components for the corrugated boxes and paperboard cartons can be recycled in most curbside programs. In addition, the cereal liner and the stand-up pouch can be part of the How2Recycle® store drop-off programs.

IMPLICATIONS

In an e-commerce application, the stand-up pouches nested in the shipping case result in a significant reduction in environmental impacts across a number of key attributes vs. the bag-in-box system, including fossil fuel, greenhouse gas emissions, water and material discarded. The advantages are driven by the pouch using anywhere from 1/4 to 1/2 of the materials as the other options, while still offering excellent product protection and consumer features, such as a press-to-close zipper system.

FORMAT	FOSSIL FUEL CONSUMPTION (MJ-EQUIV)	GHG EMISSIONS (KG-CO^2 EQUIV)	WATER USE (L)	PRODUCT-TO-PACKAGE RATIO AND PERCENT WT.	PKG LANDFILLED (G)/1,000 KG CEREAL
STAND-UP POUCH	1.22	.07557	12.50	7.4:1 88.0%:12.0%	12,619
BAG-IN-BOX WITHOUT OVERBOX	2.70 (+122%)	.2951 (+290%)	65.10 (+421%)	3.0:1 75.1%:24.9%	50,532 (+300%)
BAG-IN-BOX WITH OVERBOX	3.94 (+224%)	.4117 (+445%)	100.98 (+708%)	1.65:1 62.2%:37.8%	91,034 (+621%)

For more information and methodologies of assessments, please visit www.flexpack.org to download the "Sustainability and Life Cycle Impacts of Flexible Packaging in E-commerce" report. For additional findings on the impact of flexible packaging on dimensional weight and shipping costs, visit www.flexpack.org/resources/sustainability-resources.

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Disclaimer: The products selected in this case study were all purchased online from standard e-commerce sites. They were meant to be representative of packages in a particular category, though results may vary based on a specific package that was purchased.