Sustain the World: The Case for Flexible Packaging
In 2018, the FPA commissioned PTIS, LLC to provide a holistic view on the sustainability benefits that flexible packaging offers. The resulting report, *A Holistic View of the Role of Flexible Packaging in a Sustainable World*, achieved this goal while also providing foresight into future sustainability implications of these versatile materials. Included in the report were six Life Cycle Assessment (LCA) case studies comparing flexible packaging to other packaging formats across a range of products. An LCA is a method for characterizing impacts associated with the sourcing, manufacturing, distributing, using, and disposing of a product or product system.

This brochure presents all six LCA case studies in abbreviated form, each of which evaluates common packaging formats for their environmental impacts with a cradle-to-grave boundary. The products used in the case studies span multiple market segments, including coffee, motor oil, baby food, laundry detergent, cat litter, and juice.

To view the full report or individual case studies in their entirety, please visit [www.flexpack.org](http://www.flexpack.org).
FLEXIBLE PACKAGING SUSTAINABILITY BENEFITS

Flexible packaging offers a number of sustainability benefits throughout the entire life cycle of the package when compared to other package formats including:

- **Lightweight/Source Reduction**
- **Transportation Benefits** due to inbound format and lightweight nature
- **High Product-to-Package Ratio**
- **Beneficial Life Cycle Metrics**
- **Material/Resource Efficiency**
- **Food Shelf Life Extension**
- **Reduced Materials to Landfill**
## COFFEE PACKAGING

### WATER CONSUMPTION

A traditional steel can uses **16x** as much water as the stand-up flexible pouch, mostly because of the material development stage.

The HDPE plastic canister consumes **2x** as much water as the stand-up flexible pouch.

<table>
<thead>
<tr>
<th>Material</th>
<th>Water Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE canister</td>
<td>17,238 liters</td>
</tr>
<tr>
<td>Flexible pouch</td>
<td>1,011 liters</td>
</tr>
<tr>
<td>Steel can</td>
<td>3,164 liters</td>
</tr>
</tbody>
</table>

### GREENHOUSE GAS EMISSIONS

The HDPE canister and steel can respectively emit **4x** and **7x** more GHG emissions than the flexible pouch.

<table>
<thead>
<tr>
<th>Material</th>
<th>GHG Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE canister</td>
<td>111 KG-CO₂ EQUIV</td>
</tr>
<tr>
<td>Flexible pouch</td>
<td>13.7 GRAMS of material</td>
</tr>
<tr>
<td>Steel can</td>
<td>63.7 GRAMS of material</td>
</tr>
<tr>
<td></td>
<td>1,678 KG-CO₂ EQUIV</td>
</tr>
</tbody>
</table>

### FOSSIL FUEL CONSUMPTION

A steel can and HDPE canister respectively use **453%** and **518%** more fossil fuel than a stand-up flexible pouch.

<table>
<thead>
<tr>
<th>Material</th>
<th>Fossil Fuel Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE canister</td>
<td>36,809 MJ-EQUIV</td>
</tr>
<tr>
<td>Flexible pouch</td>
<td>6,654 MJ-EQUIV</td>
</tr>
<tr>
<td>Steel can</td>
<td>41,130 MJ-EQUIV</td>
</tr>
</tbody>
</table>
END OF USE SUMMARY

SOURCE REDUCTION BENEFITS

According to the U.S. EPA Waste Hierarchy, the most preferred method for waste management is source reduction and reuse.

High product-to-package ratios associated with flexible packaging enable packaging efficiency.

High product-to-package ratio:

<table>
<thead>
<tr>
<th>Product</th>
<th>Weight</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE Canister</td>
<td>96%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Steel Can</td>
<td>83%</td>
<td>17%</td>
</tr>
<tr>
<td>LDPE Lid</td>
<td>67%</td>
<td>33%</td>
</tr>
</tbody>
</table>

Low product-to-package ratio:

<table>
<thead>
<tr>
<th>Product</th>
<th>Weight</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-up Flexible Pouch</td>
<td>96 : 4</td>
<td>40,294</td>
</tr>
<tr>
<td>Plastic (HDPE) Canister</td>
<td>83 : 17</td>
<td>142,063 (+252%)</td>
</tr>
<tr>
<td>Steel Can</td>
<td>67 : 33</td>
<td>163,122 (+304%)</td>
</tr>
</tbody>
</table>

ALTERNATIVE MATERIAL RECOVERY DOWNFALLS

For the HDPE canister to have the same net discards as the flexible pouch package, the recycling rate for the HDPE canister would need to jump from 34% to 84% with a 70% recovery rate for the lid.

The recycling rate for the steel can would need to increase from 71% to 93% and the LDPE lid would need to go from 21% to 75% for the steel can to have the same amount of landfilled material as the stand-up flexible pouch.

HDPE CANISTER

STEEL CAN

3x
net rate of landfilled material vs stand-up flexible pouch
MOTOR OIL PACKAGING

WATER CONSUMPTION
An HDPE bottle consumes 6x more water than a stand-up pouch.

GREENHOUSE GAS EMISSIONS
The rigid HDPE bottle has a greenhouse gas emission about 1.5x that of the flexible stand-up pouch with fitment.

Even though rigid HDPE bottles are recycled at a rate of 34.4%, 2x as much material still ends up as municipal solid waste in landfills compared to the stand-up pouch, leading to a larger end-of-life impact.

FOSSIL FUEL CONSUMPTION
The rigid HDPE bottle weighs about 3x more than the flexible stand-up pouch and uses 173% more fossil fuel resources.
**END OF USE SUMMARY**

**SOURCE REDUCTION BENEFITS**

While both the rigid HDPE bottle and flexible stand-up pouch enable packaging efficiency through high product-to-package ratios, the flexible stand-up pouch comes out ahead.

High product-to-package ratio:

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>PRODUCT-TO-PACKAGE RATIO (%)</th>
<th>PKG LANDFILLED ((G)/1000 KG MOTOR OIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBLE STAND-UP POUCH W/ FITMENT</td>
<td>38.0:1 97.4%:2.6%</td>
<td>26,301</td>
</tr>
<tr>
<td>RIGID HDPE BOTTLE</td>
<td>14.8:1 93.7%:6.3%</td>
<td>45,501 (+73%)</td>
</tr>
</tbody>
</table>

Low product-to-package ratio:

**ALTERNATIVE MATERIAL RECOVERY DOWNFALLS**

Compared to the flexible stand-up pouch:

- The rigid HDPE bottle results in almost 2x the amount of material ending up as municipal solid waste.
- The rigid HDPE bottle’s recycling rate would need to increase from 34.4% to 64% to equal the amount of discarded material associated with a flexible stand-up pouch.

**FORMAT**

- **PRODUCT-TO-PACKAGE RATIO (%)**
- **PKG LANDFILLED ((G)/1000 KG MOTOR OIL)**
# BABY FOOD PACKAGING

## WATER CONSUMPTION

The water consumption impact of a glass jar is 1,294% more than that of a flexible stand-up pouch.

<table>
<thead>
<tr>
<th></th>
<th>Water Consumption Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Jar</td>
<td>1.05 liters</td>
</tr>
<tr>
<td>Flexible Stand-up Pouch</td>
<td>0.08 liters</td>
</tr>
<tr>
<td>Thermoformed Tub</td>
<td>0.05 liters</td>
</tr>
</tbody>
</table>

## GREENHOUSE GAS EMISSIONS

The glass jar uses approximately 10x more material than the other two packaging formats.

The glass jar has a carbon impact 3x higher than the low carbon impact of the flexible stand-up pouch with fitment.

<table>
<thead>
<tr>
<th></th>
<th>Greenhouse Gas Emissions Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Jar</td>
<td>89.20 grams, 0.12 kg CO₂ equiv</td>
</tr>
<tr>
<td>Flexible Stand-up Pouch</td>
<td>10.10 grams, 0.03 kg CO₂ equiv</td>
</tr>
<tr>
<td>Thermoformed Tub</td>
<td>7.70 grams, 0.03 kg CO₂ equiv</td>
</tr>
</tbody>
</table>

## FOSSIL FUEL CONSUMPTION

The thermoformed tub uses less overall fossil fuel/energy than the glass jar because it’s much lighter, but neither format can match the reduction in fossil fuel seen with the flexible stand-up pouch.

The glass jar has a fossil fuel usage roughly 2x that of both the flexible stand-up pouch with fitment and thermoformed tub.

<table>
<thead>
<tr>
<th></th>
<th>Fossil Fuel Contraction Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Jar</td>
<td>1.46 MJ-Equiv</td>
</tr>
<tr>
<td>Flexible Stand-up Pouch</td>
<td>0.78 MJ-Equiv</td>
</tr>
<tr>
<td>Thermoformed Tub</td>
<td>0.73 MJ-Equiv</td>
</tr>
</tbody>
</table>
END OF USE SUMMARY

SOURCE REDUCTION BENEFITS
When comparing product-to-package ratios, a high ratio like that of the flexible stand-up pouch with fitment is a good measure of source reduction and packaging efficiency.

High product-to-package ratio:

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>PRODUCT-TO-PACKAGE RATIO (%)</th>
<th>PKG LANDFILLED ((G)/1000 KG BABY FOOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBLE STAND-UP POUCH W/ FITMENT</td>
<td>93.6 : 6.4</td>
<td>68,142</td>
</tr>
<tr>
<td>THERMOFORMED TUB</td>
<td>91.8 : 8.2</td>
<td>89,381 (+31%)</td>
</tr>
<tr>
<td>GLASS JAR</td>
<td>55.9 : 44.1</td>
<td>513,699 (+654%)</td>
</tr>
</tbody>
</table>

ALTERNATIVE MATERIAL RECOVERY DOWNFALLS
Thermoformed tubs contain a barrier layer that is difficult to process, which results in a 0% recycling rate. Because of this, thermoformed tubs contribute to about 30% more material in municipal solid waste than flexible stand-up pouches.

Even though glass containers are recycled at a rate of just over 30%, 7x more material ends up in municipal solid waste than the flexible stand-up pouch with fitment.

Low product-to-package ratio:
LAUNDRY DETERGENT PODS PACKAGING

WATER CONSUMPTION
A rigid PET container’s water footprint is +660% larger than a flexible stand-up pouch.

GREENHOUSE GAS EMISSIONS
The injection molding for the rigid PET container results in additional energy used in the process, leading to higher overall emissions (+726%).

FOSSIL FUEL CONSUMPTION
The rigid PET container has a fossil fuel usage nearly 504% greater than that of the flexible stand-up pouch with zipper, and the package weight is 6x heavier.
END OF USE SUMMARY

SOURCE REDUCTION BENEFITS
The flexible stand-up pouch with a zipper aligns with the Sustainable Materials Management framework that looks to maximize the use of resources in packaging as well as the U.S. EPA Waste Hierarchy that cites source reduction and reuse as preferred methods to reduce overall waste.

High product-to-package ratio:

<table>
<thead>
<tr>
<th>Format</th>
<th>Product-to-package ratio (%)</th>
<th>PKG LANDFILLED (G/1000 KG PODS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-up flexible pouch</td>
<td>47.2 : 1 97.9 : 2.1</td>
<td>21,209</td>
</tr>
<tr>
<td>Rigid PET container</td>
<td>8.5 : 1 89.4 : 10.6</td>
<td>82,604 (+289%)</td>
</tr>
</tbody>
</table>

ALTERNATIVE MATERIAL RECOVERY DOWNFALLS
When taking current recycling rates into consideration, the rigid PET container results in nearly 4x more material ending up in municipal solid waste than the flexible stand-up pouch.

In order for the PET container to have the same level of municipal solid waste as the flexible stand-up pouch, the recycling rate of both the rigid PET container and cap would need to increase from the current rate of 30% to more than 80%.

RIGID PET CONTAINER

4x amount of material ending up as municipal solid waste
CAT LITTER PACKAGING

WATER CONSUMPTION

The rigid pail has a water footprint 1,370% higher than the flexible stand-up bag. A barrier carton has a water consumption impact 3,573% more than that of a flexible stand-up bag.

GREENHOUSE GAS EMISSIONS

Compared to the flexible stand-up bag’s greenhouse gas emissions, the rigid pail emits 996% more while the barrier carton produces 331% more emissions.

FOSSIL FUEL CONSUMPTION

The rigid pail requires 11x as much material as the flexible stand-up bag and uses 1,429% more fossil fuel in manufacturing than the flexible stand-up bag.

The weight of the barrier carton and energy needed in the paper making process leads to 69.6% more fossil fuel in manufacturing than the flexible stand-up bag.
END OF USE SUMMARY

SOURCE REDUCTION BENEFITS
The stand-up bag offers a higher product-to-package ratio compared to the barrier carton and rigid pail formats.

High product-to-package ratio:

<table>
<thead>
<tr>
<th>Format</th>
<th>Product-to-package ratio (%</th>
<th>PKG LANDFILLED (G)/1000 KG CAT LITTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBLE STAND-UP BAG</td>
<td>99.1 : 0.9</td>
<td>8,941</td>
</tr>
<tr>
<td>RIGID PAIL</td>
<td>88.9 : 11.1</td>
<td>111,610 (+1,148%)</td>
</tr>
<tr>
<td>BARRIER CARTON</td>
<td>92.5 : 7.5</td>
<td>82,015 (+817%)</td>
</tr>
</tbody>
</table>

ALTERNATIVE MATERIAL RECOVERY DOWNFALLS
The rigid pail and lid recycling rate would need to increase from 11.1% to 90% to have the same weight of material ending up in municipal solid waste as the flexible stand-up bag.

The flexible stand-up bag results in about 9x less material ending up in municipal solid waste than the barrier carton, and about 12x less material by weight ending up in municipal solid waste than the rigid pail, even considering the recycling rate of the pail.
SINGLE SERVE JUICE FLAVORED BEVERAGES

WATER CONSUMPTION
The flexible drink pouch, by far, has lower water consumption than the glass bottle because of the small amount of water required for the laminating process.

- **WATER CONSUMPTION**
  - Flexible drink pouch: 12,108 liters
  - Glass bottle: 209,809 liters

GREENHOUSE GAS EMISSIONS
The flexible drink pouch has lower overall greenhouse gas emissions because of its lightweight and overall efficient material and manufacturing process.

- **GREENHOUSE GAS EMISSIONS**
  - Flexible drink pouch (PKG WT.:G/1,000 KG DRINK): 27,734 kg-CO$_2$ equiv
  - Glass bottle (PKG WT.:G/1,000 KG DRINK): 531,362 kg-CO$_2$ equiv

FOSSIL FUEL CONSUMPTION
The flexible drink pouch comes out with more favorable results in fossil fuel consumption.

- **FOSSIL FUEL CONSUMPTION**
  - Flexible drink pouch: 88,736 MJ-eq
  - Glass bottle: 326,690 MJ-eq
END OF USE SUMMARY

SOURCE REDUCTION BENEFITS
The flexible drink pouch is far more efficient with a product-to-package ratio of 97.3% : 2.7%.

High product-to-package ratio:

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>PRODUCT-TO-PACKAGE RATIO (%)</th>
<th>PKG LANDFILLED ((G)/1000 KG JUICE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBLE DRINK POUCH</td>
<td>97.3 : 2.7</td>
<td>27,734</td>
</tr>
<tr>
<td>GLASS BOTTLE</td>
<td>65.3 : 34.7</td>
<td>364,169 (+1,213%)</td>
</tr>
</tbody>
</table>

ALTERNATIVE MATERIAL RECOVERY DOWNFALLS
When considering the amount of packaging that ends up as municipal solid waste based on current recycling rates, the glass bottle results in more material ending up in municipal solid waste than the flexible drink pouch (1,213%).
KEY DRIVERS SHAPING THE FUTURE OF PACKAGING PROGRAMS

EMERGING MARKETS: Development of mobile and global middle class in fast-growth economies

RETAIL IMPACTS: Increased connections facilitate dialogue and interactions among retailers and consumers

HOLISTIC DESIGN THINKING: Design for functional and emotional needs to differentiate among competitors

SUSTAINABILITY: Complex technologies to address sustainability beyond recycling and material reduction

CONSUMER/SOCIAL MEDIA/PERSONAL TECHNOLOGY: Instant feedback from consumers through social media and online shopping

SCIENCE AND TECHNOLOGY: Smart packaging innovations enable personalization and address issues like food waste

LAWS AND REGULATIONS: Legislation influences the design of packaging

ANTICIPATORY ISSUES AND DISRUPTORS: Collection of data and research to anticipate issues or changes in the industry
HOW THE INDUSTRY IS EVOLVING TO ADDRESS FLEXIBLE PACKAGING CHALLENGES

INDUSTRY CHALLENGES

Consumer participation in material collection and recycling

Lack of end-of-life alternatives and recycling options for multi-material laminated packaging

Social concerns provoking legislation for marine debris and single-use packaging

INDUSTRY SOLUTION

Educate consumers on which materials can be recycled and drive collection and recycling of flexible materials through collaborations (Wrap Recycling Action Program & How2Recycle labels)

Enhance processing technologies and auto-sortation of multi-material flexibles (waste to energy, Materials Recovery For the Future)

Promote development of waste management infrastructure to address marine debris and litter issues. Additionally, investigate new materials including compostable or bio-based structures.
Flexible packaging offers exceptional environmental benefits to converters, manufacturers, retailers, and consumers alike. As shown in the case studies in this brochure, flexible packaging generally uses less energy and fewer resources over its life cycle.

It produces less CO\textsubscript{2} emissions, improves product-to-package ratio, requires fewer trucks on the road for transport, and provides numerous safety and consumer convenience features. Flexible packaging is an excellent, sustainable choice, creating more value and a smaller footprint.

The path forward for flexible packaging will require industry collaboration, which will help develop next-generation technologies that can bolster sustainability. From bio-based materials and consumer education, to mono-material recyclable structures and recycling infrastructure, we look forward to the fruits of these collaborations and the wider adoption of flexible packaging across the globe.
For more information and methodologies of assessments, please visit [www.flexpack.org](http://www.flexpack.org).

**SOURCE**

*A Holistic View of the Role of Flexible Packaging in a Sustainable World*, PTIS, 2018